STORMWATER MANAGEMENT REPORT

Village Retail & Bridges by Epoch at Meadow Walk

Sudbury, Massachusetts

PREPARED FOR

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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.

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature

COMMONWEALTH OF MASSACHUSETTS
KAREN F. STAFFIER
CIVIL
No. 45865
REGISTERED
PROFESSIONAL ENGINEER

Karen F. Staffier 10/14/2016

Signature and Date

Checklist

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

☐ New development

☒ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

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

☒ No disturbance to any Wetland Resource Areas

☐ Site Design Practices (e.g. clustered development, reduced frontage setbacks)

☒ Reduced Impervious Area (Redevelopment Only)

☒ Minimizing disturbance to existing trees and shrubs

☐ LID Site Design Credit Requested:

- ☐ Credit 1
- ☐ Credit 2
- ☐ Credit 3

☐ Use of “country drainage” versus curb and gutter conveyance and pipe

☒ Bioretention Cells (includes Rain Gardens)

☐ Constructed Stormwater Wetlands (includes Gravel Wetlands designs)

☐ Treebox Filter

☐ Water Quality Swale

☐ Grass Channel

☐ Green Roof

☐ Other (describe): ______________________

Standard 1: No New Untreated Discharges

☒ No new untreated discharges

☐ Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth

☐ Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.

Checklist (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 (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.

Massachusetts Department of Environmental Protection
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Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

- ☒ The ½" or $\boxed{1"}$ 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.

The Village Retail area is a LUHPPL while the Bridges is not.

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 (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 (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. DRAFT
- ☐ 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 Management Report is prepared to support the village retail and assisted living portions of the multi-phased, mixed-use redevelopment project proposed at 526-528 Boston Post Road, Sudbury, MA. The village retail and assisted living portion includes the construction of approximately 35,000-gsf of retail space in four separate buildings and a 48 unit assisted living facility with associated drive aisles, parking, and landscape areas.

Due to the nature of the phased development on the Site, VHB developed a Preliminary Stormwater Management Master Plan for the full-build project to evaluate the existing and anticipated proposed full-build hydrologic conditions on the site. The Preliminary Master Plan demonstrates that the overall project will not increase pre-construction peak rates or volumes of stormwater discharging from the site in the 1-inch, 2-year, 10-year, 25-year, and 100-year design storms.

As detailed herein, this Stormwater Management Report:

- Demonstrates compliance with the Massachusetts Department of Environmental Protection (DEP) Stormwater Management Standards;
- Demonstrates compliance with the Town of Sudbury Article V (F) Stormwater Management Regulations;
- Confirms that the design included herein for the village retail and assisted living facility portion of the redevelopment plan is consistent with the overall Preliminary Stormwater Management Master Plan developed for the Project;
- Details construction-phase erosion and sedimentation controls, inspection requirements and maintenance requirements to protect downstream receiving waters; and,
- Presents a detailed long term operation and maintenance plan for the stormwater management system and the site.

Project Description

The Applicant, BPR Sudbury Development LLC, is proposing to construct the retail and assisted living facility portion (The Project) of the Full Build Redevelopment at 526-528 Boston Post Road, Sudbury, MA (the Site). The Project involves the construction of approximately 35,000-gsf of retail space in four separate buildings and a 48 unit assisted living facility with associated parking, access roadway, landscape, and utilities. Stormwater management BMPs and conveyances are proposed to support the village retail and assisted living facility construction.

Existing Drainage Conditions

The existing conditions in The Project area of the Site consists predominately of impervious surfaces, including portions of two large buildings with paved parking and drives. Topography is relatively flat and slopes southeasterly. Runoff from the village retail area of the Site is directly tributary to the off-Site closed drainage system. The assisted living facility area is tributary to a centrally located retention pond via a closed drainage system. Outflows from the retention pond combine with the closed drainage system located on the southeastern portion of the Site (which collects the village retail area) through an existing piping network, which ultimately discharges to a wetland on the southern side of Boston Post Road, east of the Sudbury Plaza.

The existing Site contains a stormwater management system that was constructed prior to the current DEP Stormwater Management Standards and as such is a "grandfathered" existing condition. Raytheon recently undertook a significant maintenance effort, with approval of the Sudbury Conservation Commission, to re-establish and enhance the functional characteristics of the on-site stormwater management system. While the system is compliant as an existing condition, the water quality treatment is not consistent with current state or local stormwater management standards.

For a more detailed discussion of the existing hydrologic conditions at the Site, refer to the Preliminary Stormwater Management Master Plan revised April 2016, prepared by VHB.

Proposed Drainage Conditions

The village retail and assisted living facility portions of the redevelopment project provides opportunity to enhance the existing on-Site stormwater management system by (1) implementing a series of stormwater water quality and infiltrative BMPs at the Site and (2) reducing the amount of impervious cover at the Site. These improvements will help to restore elements of a natural hydrologic cycle in the Project areas which will benefit the underlying aquifer by increasing both the amount and quality of runoff that is infiltrated.

The stormwater treatment methods for The Project area are shown in Figure 3. Several different treatment trains are proposed for stormwater runoff from paved areas, including:

- Runoff discharges via overland flow to surface bio-retention areas;
- Runoff is collected by deep-sump hooded catch basins, directed through an isolator row, and then infiltrated via a subsurface system; or,

- Runoff is collected by deep-sump hooded catch basins and then directed through a water quality unit (when other options proved impractical/infeasible).

All stormwater treatment BMPs (bio-retention areas, subsurface infiltration systems, and water quality units) are sized to treat the 1-inch water quality volume, or its equivalent flow rate. Additionally, stormwater from proposed buildings will be discharged to underground perforated pipes or a subsurface infiltration basin, to maximize recharge to the underlying aquifer. The systems will be sized to infiltrate the first 1-inch of runoff from the rooftops. All stormwater treatment BMPs and the roof drainage systems will overflow into the closed drainage system and discharge to existing stormwater outfalls.

The Site is in the watershed of Hop Brook, which is classified as in impaired waterway requiring a TMDL for impairments including dissolved oxygen saturation, excess algal growth, dissolved oxygen, and total phosphorous. Since a TMDL has not been determined for Hop Brook, there are no required performance standards for discharges in the watershed. The proposed suite of BMPs, as discussed in the next paragraph, and the reduction of impervious area on the Site will provide improvements to these impairments relative to the no-build conditions. Recharge is generally considered the best way to remove phosphorous from stromwater and has a beneficial impact on stormwater temperatures.

VHB considered a wide range of stormwater BMPs during the preliminary design of the Project. Through a careful design approach a majority of the impervious areas in this phase of the project are tributary to an infiltrative BMP sized to infiltrate an inch of runoff, which will create a substantial benefit to the underlying aquifer. Where the topography on the site and the relatively shallow depth to groundwater limited the use of recharge BMPs, the design relies on other methods.

VHB is proposing the use of subsurface infiltration basins as part of the village retail area to provide water quality treatment, and also to maximize recharge into the underlying aquifer. Additionally, the use of overland flow and bio-retention areas in the assisted living facility area is deliberate to provide some vegetated stormwater features while also maximizing separation from groundwater. Soil permeability rates and groundwater depths were determined in support of the BMP design in the village retail area. In the Bridges by Epoch at Meadow Walk area, where an occupied building prevents access for soil sampling, nearby test pits and groundwater elevations were interpolated. In these two areas, confirmatory geotechnical explorations are required to confirm that the required two feet of separation between infiltrating BMPs and groundwater is provided in the design. Should the additional data indicate that the minimum separation is not available, infiltrative BMPs will be removed from the design and runoff form the tributary impervious areas will be treated by water quality units.

Fortunately, both in the interim and the full build conditions, impervious cover will be reduced on-Site, which in addition to the proposed stormwater management system will provide an improvement to water quality and will increase groundwater recharge on the Site, benefitting the underlying aquifer. As previously described stormwater runoff from roofs in The Project area will discharge to perorated pipes or a subsurface infiltration basin.

The comprehensive stormwater management system has been developed in accordance with the Massachusetts Stormwater Handbook. The bio-retention areas, subsurface infiltration basins, and water quality unit sizing have been sized to treat the one inch water quality volume and equivalent flow rate, respectively. Additionally, the stormwater management system provides 44% pretreatment prior to infiltration. The one inch water quality volume is required by the Town of Sudbury Stormwater Regulations, the Massachusetts DEP Zone II (a critical area) and the fact that the village retail portion of The Project area parking is considered a LUHPPL.

A detailed discussion of the proposed Full Build Redevelopment hydrologic conditions are summarized in the Preliminary Stormwater Management Master Plan. The Project area comprises the village retail and assisted living facility portions of the mixed-use redevelopment project, and in the interim condition will reflect less impervious cover than is proposed at full build, as summarized in the table below. The proposed impervious areas summarized in Table 1 below includes up to 7,000 square feet of impervious area for the future central park area design, 100 percent imperviousness in the future patio areas in the retail areas, and assumes the future Bridges by Epoch at Meadow Walk courtyard garden areas are 50-percent impervious. As such, there will be no increase in peak rates or volumes of runoff from the Site for the design storms.

Table 1 below summarizes the composition of the drainage areas and illustrates consistency with the Preliminary Stormwater Management Master Plan.

Table 1
Proposed Conditions Impervious Cover Comparison

Drainage Area	*Discharge Location*	*Design Point*	*Existing Impervious Area (acres)*	*Preliminary Master Plan Proposed Impervious Area (acres)*	*Currently Proposed Impervious Area* (acres)*
S-1A	48" RCP Across Boston Post Road	DP-1	7.1	5.3	6.2
S-1B	Ex Pond at Center of Prop	DP-1	6.6	5.6	5.0**
S-1C	Ex Pond at Center of Prop	DP-1	11.3	10.8	10.8
S-1D	Ex Pond at Center of Prop	DP-1	1.6	1.4	1.4
S-1E	Ex Pond at Center of Prop	DP-1	3.4	2.3	1.7
S-1F	SW Wetland at Western Prop Line	DP-1	9.9	9.9	9.9
S-1G	48" RCP Across Boston Post Road	DP-1	N/A	2.3	1.8
S-2	Overland Flow to Boston Post Rd	DP-2	0.0	0.0	0.0
S-3	Wetland at Northeast Corner	DP-3	0.0	0.0	0.0
			39.9	37.6	36.2

*Currently Proposed Impervious Area includes all proposed work associated with the "Grocery Store at Meadow Walk" and "Avalon Sudbury" projects as previously approved by the Town of Sudbury, all work described herein proposed as part of the "Village Retail & Bridges by Epoch at Meadow Walk" project, and all other existing impervious areas to remain.
** Includes 2.4 acres of impervious area from future active adult phase

Additional stormwater improvements associated with this phase of the redevelopment project include the replacement of the outfall pipe from the existing central retention pond, which is necessary due to the age and condition of the pipe as well as its conflicting location with the Bridges by Epoch at Meadow Walk building. The central pond will also see some minor enhancements including a modification to one of the openings on its outlet control structure as well as some re-grading of its perimeter on the Bridges by Epoch at Meadow Walk building. None of these improvements result in a disturbance of wetlands and are proposed so the pond may continue to function as intended in the proposed condition, and support the overall site in the long-term.

The final stormwater improvements associated with this phase of the redevelopment project is collecting a small portion of the Avalon Sudbury site driveway and the future central green and routing it through the central retention pond to Design Point 1 rather than sending it directly to Design Point 1. The small portion of the driveway area was previously approved under the Avalon Sudbury Notice of Intent and Comprehensive Permit plans to be collected and routed to Design Point 1 through a water quality unit to provide water quality treatment. The proposed change to route this runoff through the central retention pond maintains the use of a water quality unit for stormwater treatment and further clarifies the intent of managing stormwater in this location as presented in the stormwater master plan.

To document the result of these minor changes on the functioning of the central pond, this report includes an updated hydrologic model (see Appendix F). The model demonstrates that with the addition of the numerous infiltrative BMPs proposed in association with the Avalon, Grocery Store, Bridges by Epoch at Meadow Walk and Village Retail portions of the project, the peak flows and volume of runoff to the central pond are reduced. This Project proposes to reduce the opening in the pond's outlet control structure from 36" by 18" to 24" by 18" with the installation / bolting of a plate on the existing concrete box structure. The flows will leave the pond more slowly, further reducing peak rates of runoff from the Overall Site from the previous condition.

During peer review of stormwater reports associated with prior phases of the Overall Project there was some discussion about the peak surface elevation of water within the pond during larger storm events (100 year). Previous analysis and hydrologic modeling did not include any infiltration or detention occurring on the adjacent property to the west, which drains towards this site. In essence, this provided the most conservative approach to stormwater design with the goal of evaluating peak rates of runoff. The modeling was not conducted to overcome the presumption of accuracy of the FEMA flood maps, which do not show any floodplain / BLSF on the property. In this Phase of the project, VHB has now updated this existing model to more accurately reflect the connected pockets of storage in the wetlands adjacent to the central pond, while retaining the conservative approach for the off-site area to the west. The revised proposed hydrologic model takes into account the associated grading along the pond proposed in the Bridges by Epoch at Meadow Walk area, and the substantial introduction of infiltrating BMPs on the site within previously permitted phases of the Overall Project. These all result in a 0.15' reduction in the peak water surface elevation in the pond, even with the introduction of a smaller outlet control structure as summarized in Table 2 below. This peak water surface elevation will be contained within the wetland and vegetated upland area surrounding the pond, whereas today it extends into the adjacent parking lot. This analysis also assumes that the 152 contour on the east side of wetland 1 (in the future age-qualified housing portion of the Overall Project) will be modified to be fully within the existing vegetated area immediately adjacent to the existing parking lot.

Table 2
Central Pond Peak Water Surface Elevation

	Central Pond Peak Water Surface Elevation (ft) *(xx inch / 100-year storm)*
Existing Conditions (April 2016)	151.69
Existing Conditions (October 2016)	151.62
Proposed Conditions (October 2016)	151.46

An additional benefit of the reduction in impervious area associated with the Overall Project and the BMPs and improvements proposed on the site, is the reduction of rates and volumes to Design Point 1 (the pipe discharge under Route 20) which will help to offset an increase in impervious area associated with the roadway widening along the Project's frontage. In conjunction with the revised hydrologic model included herein, a new proposed subcatchment S-4 has been added to the hydrologic model to reflect the 1 acre off-site impervious area also discharging to Design Point 1. While the specific details of the off-site roadway stormwater design will be the subject of a future Notice of Intent filing with the Sudbury Conservation Commission, this report demonstrates that the runoff from widening can be included in the discharge to Design Point 1 without increasing peak rates or volumes in the design storms.

Best Management Practices (BMPs) and Low Impact Development (LID) Techniques

The proposed stormwater management system incorporates low impact development (LID) techniques and Best Management Practices (BMPs) including a reduction of impervious area, minimized disturbance to existing trees and vegetation, and a vegetated drainage channel. The following LID techniques used in the Project are described hereon.

Bio-Retention Basin
Runoff from portions of the site is directed to bio-retention basins via sheet flow. The bio-retention basins use soils, plants, and microbes to treat stormwater before it is discharged. The bio-retention cells are shallow depressions filled with sandy soil topped with a thick layer of mulch and planted vegetation.

Deep Sump Hooded Catch Basins
Catch basins at the Site are to be constructed with sumps (minimum 4-feet) and oil/debris traps to prevent the discharge of sediments and floating contaminants.

Subsurface Infiltration Basin
The subsurface infiltration systems consists of underground Stormtech Chambers. The system has an "Isolator Row", which is the entrance row wrapped in geosynthetic material which collects sediment and can be easily cleaned through the manhole structures located at each end. The design of the chambers includes a permeable bottom that allows for maximum exfiltration of runoff from the system to the groundwater.

Water Quality Units
The proposed hydrodynamic water quality units proposed on Site separate and trap trash, debris, sediment and hydrocarbons from stormwater runoff.

Rooftop Recharge Systems
Runoff from the assisted living facility will discharge to perforated pipe set in stone to recharge the uncontaminated runoff to the underlying aquifer. Runoff from the village retail buildings will discharge to subsurface infiltration basins as described above. If the roof runoff does not mix with site runoff from impervious areas an "Isolator Row" as described above will not be needed.

0 150 300 Feet

LEGEND

P-1	POND
DP-1	DESIGN POINT
S-1	DRAINAGE AREA DESIGNATION
	DRAINAGE AREA BOUNDARY
	TIME OF CONCENTRATION FLOW LINE
	SOIL TYPEBOUNDARY

SCS SOIL CLASSIFICATIONS

656	UDORTHENTS – URBAN LAND HSG – UNKNOWN
44A	BIRDSALL MUCKY SILT LOAM HSG – C/D
255A	WINDSOR LOAMY SAND HSG – A
256A	DEERFIELD LOAMY SAND 3% HSG – B
256B	DEERFIELD LOAMY SAND 8% HSG – B

MEADOW WALK
SUDBURY

vhb

Figure #1
Master Plan Existing Drainage Conditions
Village Retail & Bridges by Epoch at October 2016
Meadow Walk Sudbury, MA

\\vhb\proj\Wat-LD\13125.00\cad\ld\Eng\Area Take-offs\Stormwater - HydroCAD\Retail-Bridges - Drainage Figures\PR-Drainage Figure-MP April 2016.dwg

0 150 300 Feet

MEADOW WALK
SUDBURY

vhb

Figure #2
Master Plan Proposed Drainage Conditions
April 2016

Sudbury, MA

\\vhb\proj\Wat-LD\13125.00\cad\ld\Eng\Area Take-offs\Stormwater - HydroCAD\Retail-Bridges - Drainage Figures\PR-Drainage Figure-Retail_Bridges.dwg

MEADOW WALK
SUDBURY

vhb

Figure #3
Master Plan Proposed Drainage Conditions
Village Retail & Bridges by Epoch at Meadow Walk Sudbury, MA

October 2016

\\vhb\proj\Wat-LD\13125.00\cad\ld\Eng\Area Take-offs\Stormwater - HydroCAD\Retail-Bridges - Drainage Figures\Retail-Bridge Treatment.dwg

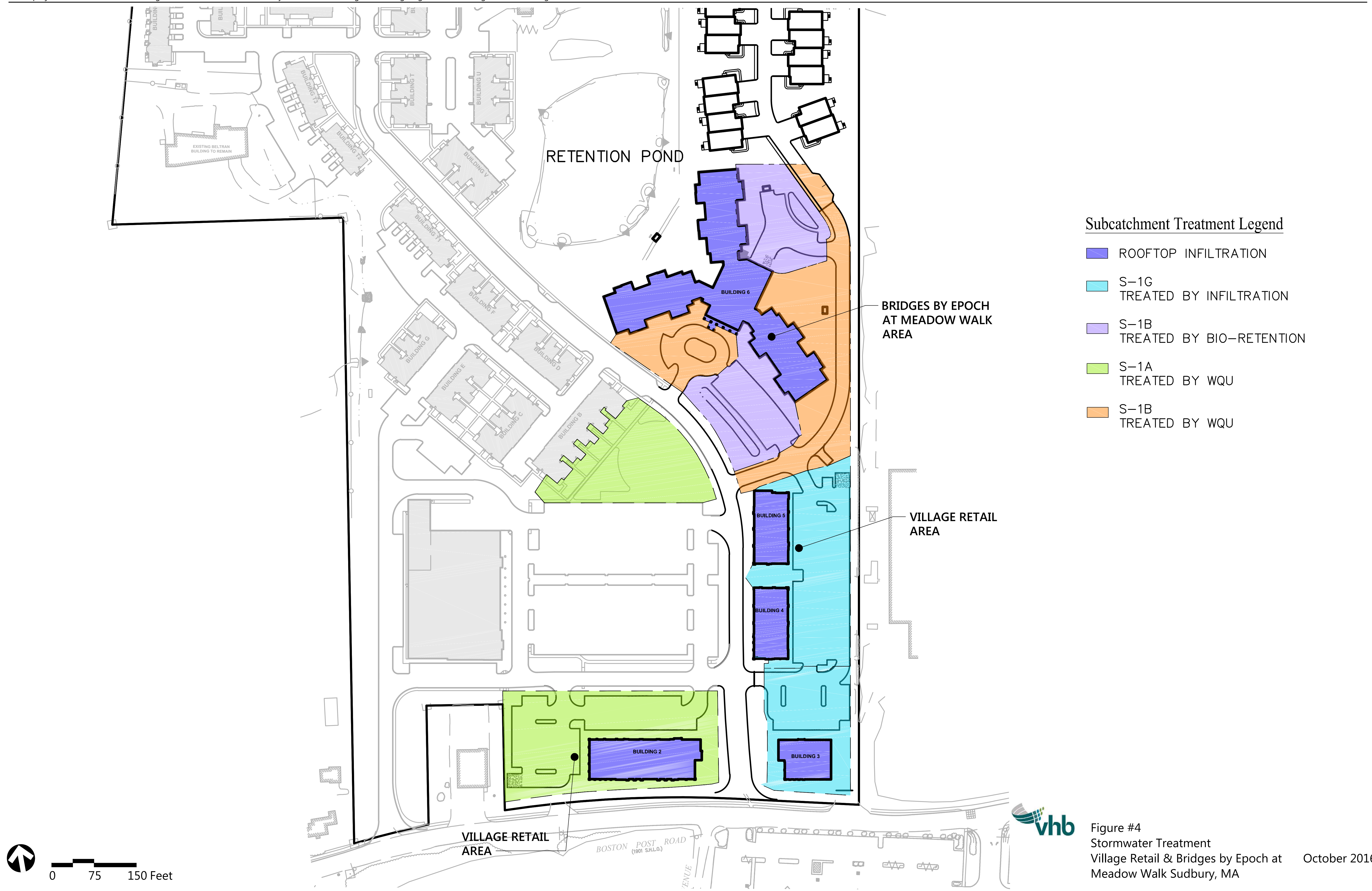


Figure #4
Stormwater Treatment
Village Retail & Bridges by Epoch at Meadow Walk Sudbury, MA
October 2016

Regulatory Compliance

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

Standard 1: No New Untreated Discharges or Erosion to Wetlands

The Project has been designed to 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.

The Project proposes to discharge all stormwater to existing closed drainage systems and does not propose any new outfalls to wetlands.

Standard 2: Peak Rate Attenuation

The Project has been designed to comply with Standard 2.

As noted herein, this phase of construction is consistent with the Preliminary Master Hydrologic Analysis for the Project, and will not increase peak rates or total volume of runoff from the Site for the design storms.

The updated hydrologic model included in Appendix F has been provided to demonstrate how the Site will function hydrologically once the stormwater BMPs are constructed throughout the Site, the outfall pipe is reconstructed, the pond perimeter along the Bridges by Epoch at Meadow Walk area is re-graded, and the outlet control structure is adjusted. The updated hydrologic model also demonstrates how the increase in runoff associated with the Route 20 roadway widening – which will be the subject of a future Notice of Intent with the Sudbury Conservation Commission – is offset by the combined benefit of the on-site BMPs to control peak rates and volumes of runoff to the discharge point from the site.

Standard 3: Stormwater Recharge

The Project has been designed to comply with Standard 3.

As noted herein the project will result in a decrease in impervious coverage on the Site, both in the interim condition and in the full-build condition, and will consequently result in an increase in recharge on the property.

Computations and supporting information are included in Appendix A.

Standard 4: Water Quality

The Project has been designed to 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 all proposed impervious surfaces as well as 44% pretreatment prior to infiltration BMPs.

Computations and supporting information are included in Appendix B.

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

The village retail portion of the Project area will generate more than 1,000 vehicle trips per day and the proposed parking area is therefore considered a LUHPPL. As such, the Project stormwater management system has been designed with suitable BMPs sized to treat the one inch Water Quality Volume from all on-site impervious roadway and parking lot areas. Proposed source controls and pollution prevention measures have been identified in the Operation and Maintenance Plan included in Appendix C.

For computations and supporting information regarding the sizing of BMPs suitable for treatment of runoff from a LUHPPL, see Appendix B.

Standard 6: Critical Areas

The Project will discharge treated storm water to a critical area (Zone II) and therefore has been designed with suitable BMPs sized to treat the one inch Water Quality Volume. Proposed source controls and pollution prevention measures have been identified in the Operation and Maintenance Plan included in Appendix C.

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

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

The Project is a redevelopment. The Project has been designed to comply with the Stormwater Management Standards as noted above and below. As permitted for a redevelopment, the BMP selection criteria associated with standards 4, 5 and 6 are met only to the extent practical, given practical limitations associated with groundwater elevations, end-user considerations, and topographic constraints.

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

The Project will disturb more than 1 acre 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 draft Stormwater Pollution Prevention Plan (SWPPP) has been included in Appendix E. The draft SWPPP includes recommended construction period pollution prevention and erosion and sedimentation controls.

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 C.

Standard 10: Prohibition of Illicit Discharges

Sanitary sewer and storm drainage structures remaining from the 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. No statement is made with regard to the drainage system in portions of the site not included in the redevelopment project area.

Appendix A
Standard 3 Computations and Supporting Information

- Exploration Location Plan
- Test Pit Logs

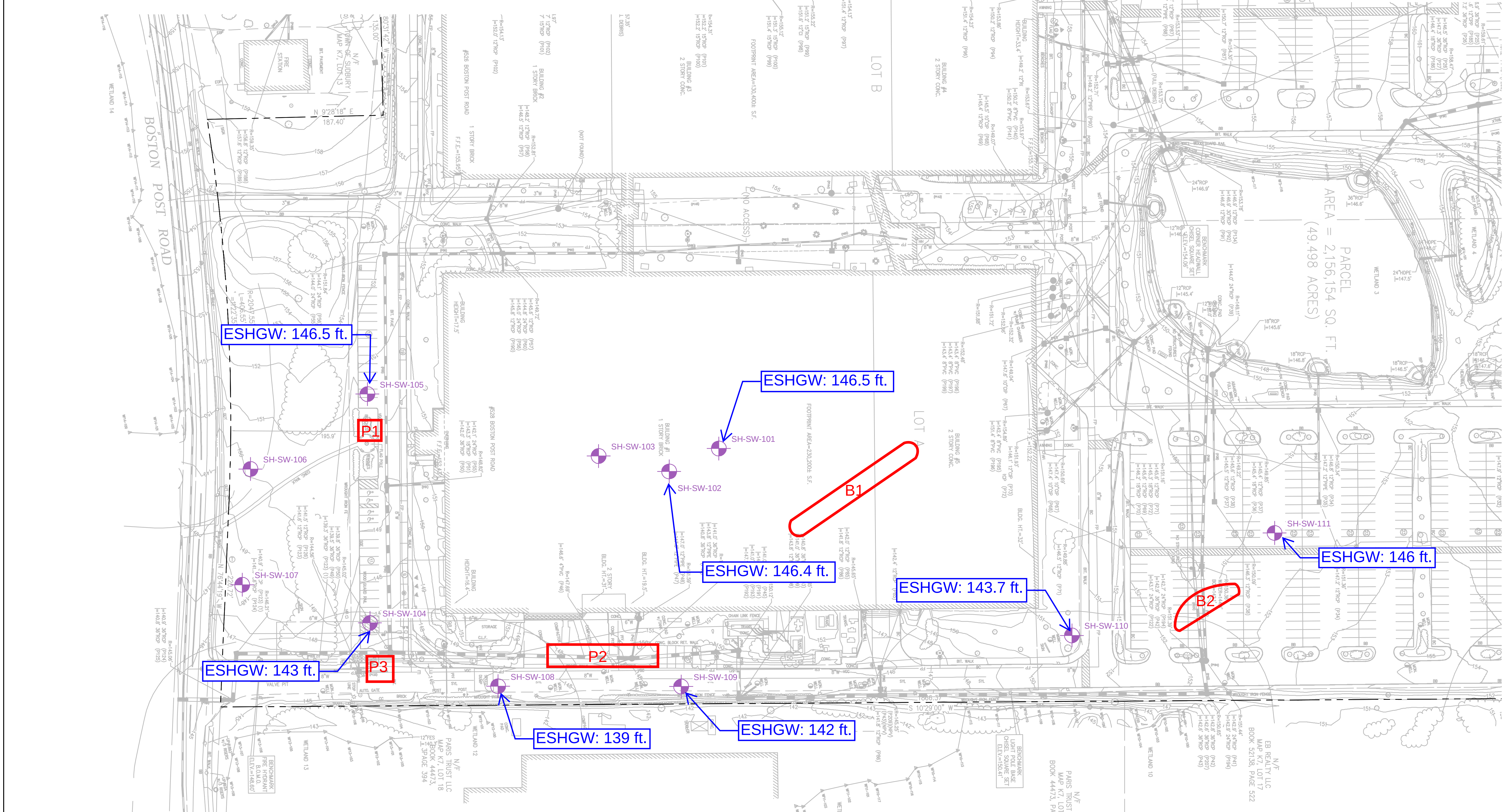
Exploration Location Plan

NOTES:

1. THE BASE MAP WAS DRAWN FROM A PLAN ENTITLED, "EXISTING CONDITIONS PLAN OF LAND", PREPARED BY VANASSE HANGEN BRUSTLIN, INC. (VHB) OF WATERTOWN, MA, DATED OCTOBER 12, 2015 WITH AN ORIGINAL SCALE OF 1" = 40'.

LEGEND:

SH-SW-101 — APPROXIMATE LOCATION OF PROPOSED STORMWATER BORING



SANBORN | HEAD

GRAPHICAL SCALE

50' 25' 0' 50' 100'

DRAFT

NO.	DATE	DESCRIPTION	BY

DRAWN BY: C.GREEN
DESIGNED BY: L.NORTON
REVIEWED BY: S.SADKOWSKI
PROJECT MGR: L.NORTON
PIC: K.STETSON
DATE: SEPTEMBER 2016

GEOTECHNICAL CONSULTING SERVICES
528 BOSTON POST ROAD
SUDBURY, MASSACHUSETTS

PRELIMINARY EXPLORATION LOCATION PLAN

PROJECT NUMBER: 3888.02

SHEET NUMBER: 1

Test Pit Logs

SANBORN HEAD

Sanborn, Head & Associates, Inc.

Project: Meadow Walk Sudbury - WFM
Location: Sudbury, MA
Project No.: 3888.01

Log of Boring SH-SW-101

Ground Elevation: 152 ± feet
Datum: NAVD 1988

Drilling Method: Hand Auger

Sampling Method: Hand Auger

Drilling Company: Soil Exploration Corp.
Foreman: T. Flores
Date Started: 08/22/16 **Date Finished: 08/22/16**
Logged By: E. Briggs **Checked By: L. Norton**

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Depth of Hole	Stab. Time
08/22/16	---	8'	Ground Surface		8'	5 Minutes

Depth (ft)	Sample No.	Sample Depth (ft)	Pen/Rec (ft)	Field Testing Data	Stratum Description	Geologic Description	Remarks
0					-----0'----- CONCRETE -----0.4'-----	(0 to 0.4'): Concrete slab.	
	G-1	0.4 - 2.8	---	PID: ND	FILL	G-1 (0.4 to 2.8'): Brown, fine to coarse SAND, some Gravel, little Cobbles, trace Silt. Moist. FILL.	
2					-----2.8'-----		
	G-2	2.8 - 3.5	---	PID: ND	SAND	G-2 (2.8 to 3.5'): Brown, fine to coarse SAND, trace Gravel, trace Silt. Moist.	
	G-3	3.5 - 4	---	PID: ND		G-3 (3.5 to 4'): Orange/brown, fine to coarse SAND, trace Gravel, trace Silt. Moist.	
4	G-4	4 - 4.5	---	PID: ND		G-4 (4 to 4.5'): Orange/brown, fine to coarse SAND, trace Gravel, trace Silt. Moist.	
	G-5	4.5 - 5	---	PID: ND		G-5 (4.5 to 5'): Orange, fine to coarse SAND, trace Gravel, trace Silt. Moist.	
	G-6	5 - 5.5	---	PID: ND		G-6 (5 to 5.5'): Orange, fine to coarse SAND, trace Gravel, trace Silt. Moist.	
	G-7	5.5 - 6	---	PID: ND		G-7 (5.5 to 6'): Red, fine to coarse SAND, trace Gravel, trace Silt. Moist.	Redoximorphic features were observed at an approximate depth of 5.5 feet and interpreted as estimated seasonal high groundwater.
6	G-8	6 - 6.5	---	PID: ND		G-8 (6 to 6.5'): Orange, fine to coarse SAND, trace Gravel, trace Silt. Moist.	
	G-9	6.5 - 7	---	PID: ND		G-9 (6.5 to 7'): Orange/brown, fine to medium SAND, trace Silt, little Silt. Moist.	
	G-10	7 - 7.5	---	PID: ND		G-10 (7 to 7.5'): Orange/brown, fine to medium SAND, trace Silt, little Silt. Moist.	
	G-11	7.5 - 8	---	PID: ND		G-11 (7.5 to 8'): Gray/brown, fine to medium SAND, trace Silt, little Silt. Moist.	
8					-----8'-----	Boring terminated at 8 feet due to repeated collapse.	Repeated collapse of borehole at a depth of appproximately 8 feet interpreted as groundwater.
10							
12							

NOTES:

1. Soil samples were screened for volatile organic compounds (VOCs) using a MiniRAE 2000 Photoionization Detector (PID) with a 10.6 eV lamp, calibrated to a 100 parts per million by volume (ppmv) isobutylene-in-air standard using a response factor of 1.0. Results are presented in ppmv; the typical detection limit is 1 ppmv. ND indicates not detected. NA indicates not available. The PID measures relative levels of VOCs. Although PID screening cannot be used directly to quantify VOC concentrations or identify individual compounds, the results can serve as a relative indicator for the presence of VOCs.

SANBORN HEAD

Sanborn, Head & Associates, Inc.

Project: Meadow Walk Sudbury - WFM
Location: Sudbury, MA
Project No.: 3888.01

Log of Boring SH-SW-102

Ground Elevation: 152 ± feet
Datum: NAVD 1988

Drilling Method: Hand Auger

Sampling Method: Hand Auger

Drilling Company: Soil Exploration Corp.
Foreman: T. Flores
Date Started: 08/24/16 **Date Finished:** 08/24/16
Logged By: E. Briggs **Checked By:** L. Norton

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Depth of Hole	Stab. Time
08/24/16	---	8.5'	Ground Surface		8.5'	5 Minutes

Depth (ft)	Sample No.	Depth (ft)	Pen/ Rec (ft)	Field Testing Data	Stratum Description	Geologic Description	Remarks
0					-----0'----- CONCRETE -----0.5'-----	(0 to 0.5'): Concrete Slab.	
	G-1	0.5 - 4	---	PID: ND	FILL	G-1 (0.5 to 4'): Brown, fine to coarse SAND, some Gravel, little Cobbles, trace Silt. Moist. FILL.	
2							
4	G-2	4 - 4.5	---	PID: ND	-----4'----- SAND	G-2 (4 to 4.5'): Brown, fine to coarse SAND, trace Gravel, trace Silt. Moist.	
	G-3	4.5 - 5	---	PID: ND		G-3 (4.5 to 5'): Brown, fine to coarse SAND, trace Gravel, trace Silt. Moist.	
	G-4	5 - 5.5	---	PID: ND		G-4 (5 to 5.5'): Light brown, fine to coarse SAND, trace Gravel, trace Silt. Moist.	
	G-5	5.5 - 6	---	PID: ND		G-5 (5.5 to 6'): Orange/brown, fine to coarse SAND, trace Gravel, trace Silt. Moist.	Redoximorphic features were observed at an approximate depth of 5.6 feet and interpreted as estimated seasonal high groundwater.
6	G-6	6 - 6.5	---	PID: ND		G-6 (6 to 6.5'): Orange, fine to coarse SAND, trace Gravel, trace Silt. Moist.	
	G-7	6.5 - 7	---	PID: ND		G-7 (6.5 to 7'): Orange/brown, fine to medium SAND, little Silt. Moist.	
	G-8	7 - 7.5	---	PID: ND		G-8 (7 to 7.5'): Orange/brown, fine to medium SAND, little Silt. Moist.	
	G-9	7.5 - 8	---	PID: ND		G-9 (7.5 to 8'): Gray/orange, fine to medium SAND, little Silt. Moist.	
8	G-10	8 - 8.5	---	PID: ND	-----8.5'-----	G-10 (8 to 8.5'): Gray/brown, fine to medium SAND, little Silt. Moist.	
						Boring terminated at 8.5 feet due to repeated collapse.	Repeated collapse of borehole at a depth of appproximately 8.5 feet interpreted as groundwater.
10							
12							

NOTES:

1. Soil samples were screened for volatile organic compounds (VOCs) using a MiniRAE 2000 Photoionization Detector (PID) with a 10.6 eV lamp, calibrated to a 100 parts per million by volume (ppmv) isobutylene-in-air standard using a response factor of 1.0. Results are presented in ppmv; the typical detection limit is 1 ppmv. ND indicates not detected. NA indicates not available. The PID measures relative levels of VOCs. Although PID screening cannot be used directly to quantify VOC concentrations or identify individual compounds, the results can serve as a relative indicator for the presence of VOCs.

BORING LOG P:\3800S\3888.01\WORK\LOGS\3888.01 LOGS.GPJ 2010 SANBORN HEAD V1.GLB 2010 SANBORN HEAD V1.GDT 9/9/16

SANBORN HEAD

Sanborn, Head & Associates, Inc.

Project: Meadow Walk Sudbury - WFM
Location: Sudbury, MA
Project No.: 3888.01

Log of Boring SH-SW-103

Ground Elevation: 152 ± feet
Datum: NAVD 1988

Drilling Method: Hand Auger

Sampling Method: Hand Auger

Drilling Company: Soil Exploration Corp.
Foreman: T. Flores
Date Started: 08/22/16 **Date Finished: 08/22/16**
Logged By: E. Briggs **Checked By: L. Norton**

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Depth of Hole	Stab. Time
08/22/16	---	8'	Ground Surface		8'	5 Minutes

Depth (ft)	Sample No.	Depth (ft)	Pen/ Rec (ft)	Field Testing Data	Stratum Description	Geologic Description	Remarks
0					-----0'----- CONCRETE -----0.4'-----	(0 to 0.4'): Concrete Slab.	
	G-1	0.4 - 1.5	---	PID: ND	FILL -----1.5'-----	G-1 (0.4 to 1.5'): Brown, fine to coarse SAND, some Gravel, trace Silt. Moist. FILL.	
2							
	G-2	3 - 3.6	---	PID: ND		G-2 (3 to 3.6'): Orange/brown, fine to coarse SAND, trace Gravel, trace Silt. Moist.	
	G-3	3.6 - 4	---	PID: ND		G-3 (3.6 to 4'): Orange/brown, fine to coarse SAND, trace Gravel, trace Silt. Moist.	
4	G-4	4 - 5.5	---	PID: ND	SAND	G-4 (4 to 5.5'): Brown, fine to coarse SAND, trace Gravel, trace Silt. Moist.	
	G-5	5.5 - 6.5	---	PID: ND		G-5 (5.5 to 6.5'): Brown/orange, fine to medium SAND, trace Silt. Moist.	
6							Redoximorphic features were observed at an approximate depth of 6 feet and interpreted as estimated seasonal high groundwater.
	G-6	6.5 - 7	---	PID: ND		G-6 (6.5 to 7'): Red, fine to medium SAND, trace Silt. Moist.	
	G-7	7 - 8	---	PID: ND		G-7 (7 to 8'): Orange/brown, fine to medium SAND, trace Silt. Moist.	
8					-----8'-----	Boring terminated at 8 feet due to repeated collapse.	Repeated collapse of borehole at a depth of appproximately 8 feet interpreted as groundwater.
10							
12							

NOTES:

1. Soil samples were screened for volatile organic compounds (VOCs) using a MiniRAE 2000 Photoionization Detector (PID) with a 10.6 eV lamp, calibrated to a 100 parts per million by volume (ppmv) isobutylene-in-air standard using a response factor of 1.0. Results are presented in ppmv; the typical detection limit is 1 ppmv. ND indicates not detected. NA indicates not available. The PID measures relative levels of VOCs. Although PID screening cannot be used directly to quantify VOC concentrations or identify individual compounds, the results can serve as a relative indicator for the presence of VOCs.

BORING LOG P:\3800S\3888.01\WORK\LOGS\3888.01 LOGS.GPJ 2010 SANBORN HEAD V1.GLB 2010 SANBORN HEAD V1.GDT 9/9/16

SANBORN HEAD

Sanborn, Head & Associates, Inc.

Project: Meadow Walk Sudbury
Location: Sudbury, MA
Project No.: 3888.07

Log of Boring SH-SW-104

Ground Elevation: 147.0 ± feet
Datum: NAVD 1988

Drilling Method: Rubber-tired ATV with 4-1/4" ID HSA

Sampling Method: 2" O.D. Split Spoon, Automatic Hammer

Drilling Company: Soil Exploration Corp.
Foreman: P. Goodale
Date Started: 09/29/16 **Date Finished: 09/29/16**
Logged By: E. Briggs **Checked By: L. Norton**

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Depth of Hole	Stab. Time
09/29/16	---	8'	Ground Surface	10'	12'	<5 Minutes

Depth (ft)	Sample Information: Sample No.	Depth (ft)	Spoon Blows per 6 in	Pen/ Rec (in)	Field Testing Data	Stratum: Log	Description	Geologic Description	Remarks
0	S-1	0 - 2	7 6 6 5	24/16			-----0'----- ASPHALT -----0.4'-----	(0 to 0.4'): ASPHALT. S-1 (0.4 to 2'): Medium dense, brown, fine to coarse SAND, trace Gravel, trace Silt. Moist. FILL.	
2	S-2	2 - 4	7 16 16 10	24/6			FILL	S-2 (2 to 4'): Dense, brown, fine to coarse SAND, trace Gravel, trace Silt. Moist. FILL.	
4	S-3	4 - 6	4 3 2 3	24/20			-----4'-----	S-3 (4 to 6'): Loose, dark brown, fine to coarse SAND, trace Silt. Moist.	Redoximorphic features observed at approximately 4 feet and interpreted as seasonal high groundwater.
6	S-4	6 - 8	4 5 7 9	24/24				S-4A (6 to 7.2'): Medium dense, dark brown, fine to coarse SAND, trace Silt. Moist. S-4B (7.2 to 8'): Medium dense, brown, fine SAND and Silt. Moist.	
8	S-5	8 - 10	4 5 5 7	24/13			SAND	S-5 (8 to 10'): Loose, gray, fine to medium SAND, some Silt. Wet.	
10	S-6	10 - 12	3 5 6 6	24/16				S-6 (10 to 12'): Medium dense, gray, fine SAND and Silt. Wet.	
12							-----12'-----	Boring terminated at 12 feet. No refusal encountered.	
14									
16									
18									
20									
22									
24									

BORING LOG P:\3800S\3888.07\WORK\LOGS\3888.07 LOGS.GPJ 2010 SANBORN HEAD V1.GLB 2010 SANBORN HEAD V1.GDT 10/4/16

SANBORN | HEAD

Sanborn, Head & Associates, Inc.

Project: Meadow Walk Sudbury
Location: Sudbury, MA
Project No.: 3888.07

Log of Boring SH-SW-105

Ground Elevation: 150.5 ± feet
Datum: NAVD 1988

Drilling Method: Rubber-tired ATV with 4-1/4" ID HSA

Sampling Method: 2" O.D. Split Spoon, Automatic Hammer

Drilling Company: Soil Exploration Corp.
Foreman: P. Goodale
Date Started: 09/29/16 **Date Finished: 09/29/16**
Logged By: E. Briggs **Checked By: L. Norton**

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Depth of Hole	Stab. Time
09/29/16	---	6'	Ground Surface	10'	10'	<5 Minutes

Depth (ft)	Sample No.	Depth (ft)	Spoon Blows per 6 in	Pen/ Rec (in)	Field Testing Data	Stratum Log	Stratum Description	Geologic Description	Remarks
0	S-1	0 - 2	9 29 14 9	24/6			-----0'----- ASPHALT -----0.4'-----	(0 to 0.4'): ASPHALT.	
								S-1 (0.4 to 2'): Dense, brown, fine to coarse SAND, some Gravel, trace Silt. Moist. FILL.	
2	S-2	2 - 4	11 11 47 17	24/6			FILL	S-2 (2 to 4'): Very dense, brown, fine to coarse SAND, some Gravel, trace Silt. Moist. FILL.	
4	S-3	4 - 6	37 18 12 15	24/18			-----5'-----	S-3A (4 to 5'): Dense, brown, fine to coarse SAND, some Gravel, trace Silt. Moist. FILL.	Redoximorphic features observed at approximately 4 feet and interpreted as seasonal high groundwater.
								S-3B (5 to 6'): Dense, gray, fine to coarse SAND, trace Silt. Moist.	
6	S-4	6 - 8	19 13 13 13	24/16				S-4 (6 to 8'): Medium dense, gray, fine to coarse SAND, trace Silt. Wet.	
8	S-5	8 - 10	6 5 9 8	24/15			SAND	S-5 (8 to 10'): Medium dense, gray, fine to medium SAND and Silt. Wet.	
10							-----10'-----	Boring terminated at 10 feet. No refusal encountered.	
12									
14									
16									
18									
20									
22									
24									

SANBORN HEAD

Sanborn, Head & Associates, Inc.

Project: Meadow Walk Sudbury
Location: Sudbury, MA
Project No.: 3888.07

Log of Boring SH-SW-106

Ground Elevation: 150.0 ± feet
Datum: NAVD 1988

Drilling Method: Rubber-tired ATV with 4-1/4" ID HSA

Sampling Method: 2" O.D. Split Spoon, Automatic Hammer

Drilling Company: Soil Exploration Corp.
Foreman: P. Goodale
Date Started: 09/29/16 **Date Finished: 09/29/16**
Logged By: E. Briggs **Checked By: L. Norton**

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Depth of Hole	Stab. Time
09/29/16	---	6'	Ground Surface	10'	10'	<5 Minutes

Depth (ft)	Sample No.	Depth (ft)	Spoon Blows per 6 in	Pen/ Rec (in)	Field Testing Data	Stratum Description	Geologic Description	Remarks
0	S-1	0 - 2	2 1 3 4	24/12		-----0'----- TOPSOIL	S-1A (0 to 1.7'): Loose, dark brown, fine to coarse SAND, trace Gravel, trace Silt, few Root particles. Moist. TOPSOIL.	
2	S-2	2 - 4	3 1 3 4	24/15		-----1.7'-----	S-1B (1.7 to 2'): Loose, brown, fine to coarse SAND, trace Silt. Moist. S-2 (2 to 4'): Loose, brown, fine to medium SAND, trace Silt. Moist.	
4	S-3	4 - 6	4 6 5 5	24/18			S-3 (4 to 6'): Medium dense, gray, fine to medium SAND, trace Silt. Moist to wet.	Redoximorphic features observed at approximately 4 feet and interpreted as seasonal high groundwater.
6	S-4	6 - 8	6 6 7 7	24/24		SAND	S-4 (6 to 8'): Medium dense, gray, fine to medium SAND, some Silt. Wet.	
8	S-5	8 - 10	3 3 3 4	24/18			S-5 (8 to 10'): Loose, gray, fine to medium SAND, some Silt. Wet.	
10						-----10'-----	Boring terminated at 10 feet. No refusal encountered.	
12								
14								
16								
18								
20								
22								
24								

SANBORN HEAD

Sanborn, Head & Associates, Inc.

Project: Meadow Walk Sudbury
Location: Sudbury, MA
Project No.: 3888.07

Log of Boring SH-SW-107

Ground Elevation: 148.0 ± feet
Datum: NAVD 1988

Drilling Method: Rubber-tired ATV with 4-1/4" ID HSA

Sampling Method: 2" O.D. Split Spoon, Automatic Hammer

Drilling Company: Soil Exploration Corp.
Foreman: P. Goodale
Date Started: 09/29/16 **Date Finished: 09/29/16**
Logged By: E. Briggs **Checked By: L. Norton**

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Depth of Hole	Stab. Time
09/29/16	---	8'	Ground Surface	10'	12'	<5 Minutes

Depth (ft)	Sample Information: Sample No.	Depth (ft)	Spoon Blows per 6 in	Pen/ Rec (in)	Field Testing Data	Stratum: Log	Description	Geologic Description	Remarks
0	S-1	0 - 2	1 4 8 12	24/18			-----0'----- TOPSOIL -----1'-----	S-1A (0 to 1'): Medium dense, dark brown, fine to coarse SAND, trace Silt. Moist. TOPSOIL. S-1B (1 to 2'): Medium dense, brown, fine to coarse SAND, little Silt. Moist.	
2	S-2	2 - 4	7 7 5 5	24/12				S-2 (2 to 4'): Medium dense, brown, fine to coarse SAND, little Silt. Moist.	
4	S-3	4 - 6	3 3 2 3	24/18				S-3 (4 to 6'): Loose, brown, fine to coarse SAND, little Silt. Moist.	Redoximorphic features observed at approximately 5 feet and interpreted as seasonal high groundwater.
6	S-4	6 - 8	4 4 4 6	24/22			SAND	S-4A (6 to 7.5'): Loose, orange/brown, fine to coarse SAND, little Silt. Moist. S-4B (7.5 to 8'): Loose, gray, fine to medium SAND and Silt. Moist.	
8	S-5	8 - 10	5 8 6 7	24/20				S-5 (8 to 10'): Medium dense, gray, fine to medium SAND, little Silt. Wet.	
10	S-6	10 - 12	5 5 4 5	24/12				S-6 (10 to 12'): Loose, gray, fine to medium SAND, little Silt. Wet.	
12							-----12'-----	Boring terminated at 12 feet. No refusal encountered.	
14									
16									
18									
20									
22									
24									

SANBORN HEAD

Sanborn, Head & Associates, Inc.

Project: Meadow Walk Sudbury
Location: Sudbury, MA
Project No.: 3888.07

Log of Boring SH-SW-108

Ground Elevation: 147.0 ± feet
Datum: NAVD 1988

Drilling Method: Rubber-tired ATV with 4-1/4" ID HSA

Sampling Method: 2" O.D. Split Spoon, Automatic Hammer

Drilling Company: Soil Exploration Corp.
Foreman: P. Goodale
Date Started: 09/29/16 Date Finished: 09/29/16
Logged By: E. Briggs Checked By: L. Norton

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Depth of Hole	Stab. Time
09/29/16	---	8'	Ground Surface	10'	12'	<5 Minutes

Depth (ft)	Sample No.	Depth (ft)	Spoon Blows per 6 in	Pen/ Rec (in)	Field Testing Data	Stratum Log	Stratum Description	Geologic Description	Remarks
0	S-1	0 - 2	10 14 33 18	24/12			0' ASPHALT 0.3'	(0 to 0.3'): ASPHALT. S-1 (0.3 to 2'): Dense, brown, fine to coarse SAND, some Gravel, trace Silt, few Asphalt fragments. Moist. FILL.	
2	S-2	2 - 4	27 27 29 29	24/16			FILL	S-2 (2 to 4'): Very dense, brown, fine to coarse SAND, some Gravel, trace Silt. Moist. FILL.	
4	S-3	4 - 6	32 24 31 36	24/17				S-3 (4 to 6'): Very dense, brown, fine to coarse SAND, some Gravel, trace Silt. Moist. FILL.	
6	S-4	6 - 8	25 14 25 39	24/10			6'	S-4 (6 to 8'): Dense, orange/brown, fine to coarse SAND, little Silt. Moist.	
8	S-5	8 - 10	7 8 7 9	24/14			SAND	S-5 (8 to 10'): Medium dense, gray, fine to coarse SAND, little Silt. Wet.	Redoximorphic features observed at approximately 8 feet and interpreted as seasonal high groundwater.
10	S-6	10 - 12	8 8 10 9	24/24				S-6 (10 to 12'): Medium dense, gray, fine to coarse SAND, trace Silt. Wet.	
12							12'	Boring terminated at 12 feet. No refusal encountered.	
14									
16									
18									
20									
22									
24									

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SANBORN HEAD

Sanborn, Head & Associates, Inc.

Project: Meadow Walk Sudbury
Location: Sudbury, MA
Project No.: 3888.07

Log of Boring SH-SW-109

Ground Elevation: 148.0 ± feet
Datum: NAVD 1988

Drilling Method: Rubber-tired ATV with 4-1/4" ID HSA

Sampling Method: 2" O.D. Split Spoon, Automatic Hammer

Drilling Company: Soil Exploration Corp.
Foreman: P. Goodale
Date Started: 09/29/16 Date Finished: 09/29/16
Logged By: E. Briggs Checked By: L. Norton

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Depth of Hole	Stab. Time
09/29/16	---	10'	Ground Surface	10'	14'	<5 Minutes

Depth (ft)	Sample No.	Depth (ft)	Spoon Blows per 6 in	Pen/Rec (in)	Field Testing Data	Stratum Description	Geologic Description	Remarks
0	S-1	0 - 2	11 16 17 26	24/10		0' ASPHALT -----0.2'-----	(0 to 0.2'): ASPHALT. S-1 (0.2 to 2'): Dense, brown, fine to coarse SAND, some Gravel, little Silt. Moist. FILL.	
2	S-2	2 - 4	37 19 22 36	24/12			S-2 (2 to 4'): Dense, pink/brown, fine to coarse SAND, some Gravel, little Silt. Moist. FILL.	
4	S-3	4 - 6	11 25 25 35	24/14		FILL	S-3 (4 to 6'): Very dense, brown, fine to coarse SAND, some Gravel, little Silt. Moist. FILL.	
6	S-4	6 - 8	42 26 22 17	24/14		-----7.6'-----	S-4A (6 to 7.6'): Dense, brown, fine to coarse SAND, some Gravel, little Silt. Moist. S-4B (7.6 to 8'): Dense, brown, fine to coarse SAND, trace Silt. Moist.	Redoximorphic features observed at approximately 6 feet and interpreted as seasonal high groundwater.
8	S-5	8 - 10	5 39 100/4"	16/0			S-5 (8 to 10'): Very dense, No Recovery.	
10	S-6	10 - 12	14 10 10 10	24/15		SAND	S-6 (10 to 12'): Medium dense, brown, fine to medium SAND, little Silt. Wet.	
12	S-7	12 - 14	13 13 13 10	24/24			S-7 (12 to 14'): Medium dense, brown, fine to medium SAND, little Silt. Wet.	
14						-----14'-----	Boring terminated at 14 feet. No refusal encountered.	
16								
18								
20								
22								
24								

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SANBORN | HEAD

Sanborn, Head & Associates, Inc.

Project: Meadow Walk Sudbury
Location: Sudbury, MA
Project No.: 3888.07

Log of Boring SH-SW-110

Ground Elevation: 151.0 ± feet
Datum: NAVD 1988

Drilling Method: Rubber-tired ATV with 4-1/4" ID HSA

Sampling Method: 2" O.D. Split Spoon, Automatic Hammer

Drilling Company: Soil Exploration Corp.
Foreman: P. Goodale
Date Started: 09/30/16 **Date Finished: 09/30/16**
Logged By: L. Norton **Checked By: L. Norton**

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Depth of Hole	Stab. Time
09/30/16	07:45	10'	Ground Surface	12'	14'	15 Minutes

Depth (ft)	Sample No.	Depth (ft)	Spoon Blows per 6 in	Pen/ Rec (in)	Field Testing Data	Stratum Description	Geologic Description	Remarks
0	S-1	0 - 2	2 3 2 11	24/10		-----0'----- TOPSOIL -----0.7'-----	S-1A (0 to 0.7'): Loose, dark brown, fine to coarse SAND, little Silt, trace Gravel, very few Roots. Moist. TOPSOIL. S-1B (0.7 to 2'): Loose, tan, fine to medium SAND, trace Silt. Moist. FILL.	Root in tip.
2	S-2	2 - 4	11 12 13 20	24/14			S-2A (2 to 3.6'): Medium dense, brown, fine to coarse SAND, little Gravel, trace Silt. Moist. FILL. S-2B (3.6 to 4'): Medium dense, dark brown, fine to coarse SAND, little Gravel, trace Silt. Moist. FILL.	
4	S-3	4 - 6	11 12 9 6	24/15		FILL	S-3 (4 to 6'): Medium dense, brown, fine to coarse SAND, some Silt, little Gravel. Moist. FILL.	
6	S-4	6 - 8	4 3 3 3	24/11			S-4 (6 to 8'): Loose, brown, fine to coarse SAND, some Silt, little Gravel. Moist. FILL.	
8	S-5	8 - 10	5 9 10 11	24/5			S-5 (8 to 10'): Medium dense, brown, fine to coarse SAND, some Silt, little Gravel. Moist. FILL.	Redoximorphic features observed at approximately 7.3 feet and interpreted as seasonal high groundwater.
10	S-6	10 - 12	11 10 17 9	24/16		-----10'-----	S-6 (10 to 12'): Medium dense, gray, fine to medium SAND, little Silt. Wet.	
12	S-7	12 - 14	8 8 7 9	24/18		SAND	S-7 (12 to 14'): Medium dense, gray, fine to medium SAND, some Silt. Wet.	
14						-----14'-----	Boring terminated at 14 feet. No refusal encountered.	
16								
18								
20								
22								
24								

SANBORN ||| HEAD

Sanborn, Head & Associates, Inc.

Project: Meadow Walk Sudbury
Location: Sudbury, MA
Project No.: 3888.07

Log of Boring SH-SW-111

Ground Elevation: 151.5 ± feet
Datum: NAVD 1988

Drilling Method: Rubber-tired ATV with 4-1/4" ID HSA

Sampling Method: 2" O.D. Split Spoon, Automatic Hammer

Drilling Company: Soil Exploration Corp.
Foreman: P. Goodale
Date Started: 09/30/16 **Date Finished: 09/30/16**
Logged By: L. Norton **Checked By: L. Norton**

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Depth of Hole	Stab. Time
09/30/16	08:30	6.5'	Ground Surface	10'	12'	<5 Minutes

Depth (ft)	Sample No.	Depth (ft)	Spoon Blows per 6 in	Pen/ Rec (in)	Field Testing Data	Stratum Log	Stratum Description	Geologic Description	Remarks
0	S-1	0 - 2	5 5 7	24/12			0' ASPHALT 0.3'	(0 to 0.3'): ASPHALT. S-1 (0.5 to 2'): Medium dense, brown, fine to coarse SAND, trace Gravel, trace Silt. Moist. FILL.	
2	S-2	2 - 4	12 25 17 13	24/14			FILL	S-2A (2 to 3.5'): Dense, brown, fine to coarse SAND, trace Gravel, trace Silt. Moist. FILL. S-2B (3.5 to 4'): Dense, brown/black, fine to coarse SAND, little Gravel, trace Silt, few Asphalt particles. Moist. FILL.	
4	S-3	4 - 6	14 13 14 14	24/21			4' TOPSOIL 4.3'	S-3A (4 to 4.3'): Medium dense, brown, fine to coarse SAND, little Silt, trace Gravel, very few Organics. Moist. BURIED TOPSOIL. S-3B (4.3 to 6'): Medium dense, tan, fine to medium SAND, trace Silt. Moist.	
6	S-4	6 - 8	10 13 9 10	24/18				S-4 (6 to 8'): Medium dense, tan with orange, fine to medium SAND, some Silt. Wet.	Redoximorphic features observed at approximately 5.5 feet and interpreted as seasonal high groundwater.
8	S-5	8 - 10	7 7 8 7	24/15			SAND	S-5 (8 to 10'): Medium dense, tan with orange, fine to medium SAND, some Silt. Wet.	
10	S-6	10 - 12	9 4 6 5	24/10				S-6 (10 to 12'): Loose, gray, fine to medium SAND, little Silt. Wet.	
12							12'	Boring terminated at 12 feet. No refusal encountered.	
14									
16									
18									
20									
22									
24									

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Appendix B
Standard 4 Computations and Supporting Information

- TSS Removal Worksheets
- Bio-retention Basin Water Quality Volume Calculations
- Subsurface Infiltration Basin Water Quality Volume Calculations
- Roof Runoff Water Quality Volume Calculations
- WQU Unit Sizing Calculations
- MASTEP CDS Reports

TSS Removal Worksheets

TSS Removal Calculation Worksheet

VHB, Inc..
101 Walnut Street
Post Office Box 9151
Watertown, MA 02471
P 617.924.1770

Project Name:	**Retail & The Bridges**	Sheet:	**1 of 5**
Project Number:	**13125.00**	Date:	**26-Sep-2016**
Location:	**Sudbury, MA**	Computed by:	**CWF**
Discharge Point:	**DP1**	Checked by:	
Drainage Area(s):	**S-1A-2**		

A	B	C	D	E
BMP*	TSS Removal Rate*	Starting TSS Load**	Amount Removed (C*D)	Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	**25%**	**1.00**	**0.25**	**0.75**
Water Quality Unit	**74%**	**0.75**	**0.55**	**0.20**
	0%	**0.20**	**0.00**	**0.20**
	0%	**0.20**	**0.00**	**0.20**
	0%	**0.20**	**0.00**	**0.20**

Treatment Train TSS Removal = **80%**

* 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.

** Equals remaining load from previous BMP (E)

TSS Removal Calculation Worksheet

vhb
101 Walnut Street
Post Office Box 9151
Watertown, MA 02471
P 617.924.1770

Project Name: **Retail & The Bridges**
Project Number: **13125.00**
Location: **Sudbury, MA**
Discharge Point: **DP1**
Drainage Area(s): **S-1G-1**

Date: **26-Sep-2016**
Computed by: **CWF**
Checked by:

1. Pre-Treatment prior to Infiltration

BMP*	TSS Removal Rate*	Starting TSS Load**	Amount Removed (C*D)	Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	25%	100%	25%	75%
Isolator Row	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 (C*D)	Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	25%	100%	25%	75%
Subsurface Infiltration Structure	80%	75%	60%	15%
	0%	15%	0%	15%
	0%	15%	0%	15%
			Treatment Train TSS Removal =	85%

* BMP and TSS Removal Rate Values from the MassDEP Stormwater Handbook Vol. 1.
** Equals remaining load from previous BMP (E)

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TSS Removal Calculation Worksheet

Project Name:	**Retail & The Bridges**	Sheet:	**3 of 4**
Project Number:	**13125.00**	Date:	**26-Sep-2016**
Location:	**Sudbury, MA**	Computed by:	**CWF**
Discharge Point:	**DP1**	Checked by:	
Drainage Area(s):	**S-1G-2**		

1. Pre-Treatment prior to Infiltration

BMP*	TSS Removal Rate*	Starting TSS Load**	Amount Removed (C*D)	Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	**25%**	**100%**	**25%**	**75%**
Isolator Row	**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 (C*D)	Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	**25%**	**100%**	**25%**	**75%**
Subsurface Infiltration Structure	**80%**	**75%**	**60%**	**15%**
	0%	**15%**	**0%**	**15%**
	0%	**15%**	**0%**	**15%**

Treatment Train TSS Removal = **85%**

* BMP and TSS Removal Rate Values from the MassDEP Stormwater Handbook Vol. 1.
** Equals remaining load from previous BMP (E)

TSS Removal Calculation Worksheet

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Watertown, MA 02471
(617) 924-1770

Project Name: **Retail & The Bridges**
Project Number: **13125.00**
Location: **Sudbury, MA**
Discharge Point: **DP1**
Drainage Area(s): **S-1B-1 portion**

Date: **26-Sep-2016**
Computed by: **CWF**
Checked by:

A	B	C	D	E
BMP*	TSS Removal Rate*	Starting TSS Load**	Amount Removed (C*D)	Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	**25%**	**1.00**	**0.25**	**0.75**
Water Quality Unit	**74%**	**0.75**	**0.55**	**0.20**
	0%	**0.20**	**0.00**	**0.20**
	0%	**0.20**	**0.00**	**0.20**
	0%	**0.20**	**0.00**	**0.20**

* 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.
** Equals remaining load from previous BMP (E)

Treatment Train TSS Removal = **80%**

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TSS Removal Calculation Worksheet

Project Name:	**Retail & The Bridges**	Sheet:	**5 of 5**
Project Number:	**13125.00**	Date:	**26-Sep-2016**
Location:	**Sudbury, MA**	Computed by:	**CWF**
Discharge Point:	**DP1**	Checked by:	
Drainage Area(s):	**S-1B-1 portion**		

A	B	C	D	E
BMP*	TSS Removal Rate*	Starting TSS Load**	Amount Removed (C*D)	Remaining Load (D-E)
Bioretention Area	**90%**	**1.00**	**0.90**	**0.10**
	0%	**0.10**	**0.00**	**0.10**
	0%	**0.10**	**0.00**	**0.10**
	0%	**0.10**	**0.00**	**0.10**
	0%	**0.10**	**0.00**	**0.10**

* BMP and TSS Removal Rate Values from the MassDEP Stormwater Handbook Vol. 1.
** Equals remaining load from previous BMP (E)

Treatment Train TSS Removal = **90%**

Bio-Retention Basin Water Quality Volume Calculations

Summary for Pond B-3: Bridges Bio Reten 1

Inflow Area = 0.268 ac,100.00% Impervious, Inflow Depth > 1.00" for WQV event
Inflow = 0.55 cfs @ 12.07 hrs, Volume= 0.022 af
Outflow = 0.08 cfs @ 12.55 hrs, Volume= 0.011 af, Atten= 85%, Lag= 28.6 min
Discarded = 0.08 cfs @ 12.55 hrs, Volume= 0.011 af
Primary = 0.00 cfs @ 11.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 11.00-13.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 149.41' @ 12.55 hrs Surf.Area= 1,462 sf Storage= 540 cf

Plug-Flow detention time= 22.3 min calculated for 0.011 af (48% of inflow)
Center-of-Mass det. time= 5.2 min (728.9 - 723.7)

Volume	Invert	Avail.Storage	Storage Description
#1	149.00'	2,850 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
149.00	1,161	254.0	0	0	1,161
150.00	1,951	272.0	1,539	1,539	1,959
150.50	3,354	354.0	1,311	2,850	6,047

Device	Routing	Invert	Outlet Devices
#1	Discarded	149.00'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	148.35'	**12.0" Round Culvert** L= 473.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 148.35' / 145.40' S= 0.0062 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#3	Device 2	150.00'	**24.0" Horiz. Orifice/Grate X 2.00** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.08 cfs @ 12.55 hrs HW=149.41' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.08 cfs)

Primary OutFlow Max=0.00 cfs @ 11.00 hrs HW=149.00' (Free Discharge)
└─**2=Culvert** (Passes 0.00 cfs of 1.48 cfs potential flow)
  └─**3=Orifice/Grate** (Controls 0.00 cfs)

Hydrograph for Pond B-3: Bridges Bio Reten 1

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)	Discarded (cfs)	Primary (cfs)
11.00	0.04	0	149.00	0.00	0.00	**0.00**
11.05	0.04	5	149.00	0.02	0.02	0.00
11.10	0.04	7	149.01	0.03	0.03	0.00
11.15	0.04	9	149.01	0.03	0.03	0.00
11.20	0.04	10	149.01	0.04	0.04	0.00
11.25	0.05	11	149.01	0.04	0.04	0.00
11.30	0.05	12	149.01	0.04	0.04	0.00
11.35	0.05	13	149.01	0.05	0.05	0.00
11.40	0.05	13	149.01	0.05	0.05	0.00
11.45	0.06	14	149.01	0.05	0.05	0.00
11.50	0.06	15	149.01	0.05	0.05	0.00
11.55	0.06	15	149.01	0.06	0.06	0.00
11.60	0.08	17	149.01	0.06	0.06	0.00
11.65	0.10	21	149.02	0.07	0.07	0.00
11.70	0.12	28	149.02	0.07	0.07	0.00
11.75	0.14	40	149.03	0.07	0.07	0.00
11.80	0.17	56	149.05	0.07	0.07	0.00
11.85	0.19	76	149.06	0.07	0.07	0.00
11.90	0.22	101	149.08	0.07	0.07	0.00
11.95	0.25	130	149.11	0.07	0.07	0.00
12.00	0.37	172	149.14	0.07	0.07	0.00
12.05	**0.53**	241	149.20	0.07	0.07	0.00
12.10	**0.51**	325	149.26	0.08	0.08	0.00
12.15	0.37	391	149.31	0.08	0.08	0.00
12.20	0.27	433	149.34	0.08	0.08	0.00
12.25	0.23	463	149.36	0.08	0.08	0.00
12.30	0.20	488	149.38	0.08	0.08	0.00
12.35	0.18	507	149.39	0.08	0.08	0.00
12.40	0.15	522	149.40	0.08	0.08	0.00
12.45	0.13	532	149.41	0.08	0.08	0.00
12.50	0.10	539	149.41	0.08	0.08	0.00
12.55	0.08	**540**	**149.41**	**0.08**	**0.08**	0.00
12.60	0.07	539	149.41	0.08	0.08	0.00
12.65	0.06	536	149.41	0.08	0.08	0.00
12.70	0.06	532	149.41	0.08	0.08	0.00
12.75	0.06	528	149.40	0.08	0.08	0.00
12.80	0.05	523	149.40	0.08	0.08	0.00
12.85	0.05	518	149.40	0.08	0.08	0.00
12.90	0.05	513	149.39	0.08	0.08	0.00
12.95	0.05	507	149.39	0.08	0.08	0.00
13.00	0.04	501	149.39	0.08	0.08	0.00

Summary for Pond B-4: Bridges Bio Reten 2

Inflow Area = 0.209 ac,100.00% Impervious, Inflow Depth > 1.00" for WQV event
Inflow = 0.43 cfs @ 12.07 hrs, Volume= 0.017 af
Outflow = 0.06 cfs @ 12.57 hrs, Volume= 0.008 af, Atten= 87%, Lag= 29.9 min
Discarded = 0.06 cfs @ 12.57 hrs, Volume= 0.008 af
Primary = 0.00 cfs @ 11.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 11.00-13.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 148.48' @ 12.57 hrs Surf.Area= 1,037 sf Storage= 443 cf

Plug-Flow detention time= 23.7 min calculated for 0.008 af (45% of inflow)
Center-of-Mass det. time= 4.9 min (728.6 - 723.7)

Volume	Invert	Avail.Storage	Storage Description
#1	148.00'	2,767 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
148.00	819	152.0	0	0	819
149.00	1,305	171.0	1,053	1,053	1,333
150.00	2,159	200.0	1,714	2,767	2,209

Device	Routing	Invert	Outlet Devices
#1	Discarded	148.00'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	146.65'	**12.0" Round Culvert** L= 56.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 146.65' / 146.36' S= 0.0052 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#3	Device 2	149.00'	**24.0" Horiz. Orifice/Grate X 2.00** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.06 cfs @ 12.57 hrs HW=148.48' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.06 cfs)

Primary OutFlow Max=0.00 cfs @ 11.00 hrs HW=148.00' (Free Discharge)
└─**2=Culvert** (Passes 0.00 cfs of 3.04 cfs potential flow)
  └─**3=Orifice/Grate** (Controls 0.00 cfs)

Hydrograph for Pond B-4: Bridges Bio Reten 2

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)	Discarded (cfs)	Primary (cfs)
11.00	0.03	0	148.00	0.00	0.00	**0.00**
11.05	0.03	4	148.01	0.01	0.01	0.00
11.10	0.03	7	148.01	0.02	0.02	0.00
11.15	0.03	8	148.01	0.02	0.02	0.00
11.20	0.03	10	148.01	0.03	0.03	0.00
11.25	0.04	11	148.01	0.03	0.03	0.00
11.30	0.04	12	148.01	0.03	0.03	0.00
11.35	0.04	13	148.02	0.04	0.04	0.00
11.40	0.04	13	148.02	0.04	0.04	0.00
11.45	0.04	14	148.02	0.04	0.04	0.00
11.50	0.05	15	148.02	0.04	0.04	0.00
11.55	0.05	16	148.02	0.04	0.04	0.00
11.60	0.06	17	148.02	0.05	0.05	0.00
11.65	0.08	21	148.03	0.05	0.05	0.00
11.70	0.09	28	148.03	0.05	0.05	0.00
11.75	0.11	38	148.05	0.05	0.05	0.00
11.80	0.13	51	148.06	0.05	0.05	0.00
11.85	0.15	68	148.08	0.05	0.05	0.00
11.90	0.17	88	148.10	0.05	0.05	0.00
11.95	0.20	111	148.13	0.05	0.05	0.00
12.00	0.29	145	148.17	0.05	0.05	0.00
12.05	**0.41**	199	148.23	0.05	0.05	0.00
12.10	**0.40**	266	148.30	0.05	0.05	0.00
12.15	0.29	318	148.35	0.05	0.05	0.00
12.20	0.21	352	148.39	0.06	0.06	0.00
12.25	0.18	376	148.41	0.06	0.06	0.00
12.30	0.16	396	148.43	0.06	0.06	0.00
12.35	0.14	412	148.45	0.06	0.06	0.00
12.40	0.12	425	148.46	0.06	0.06	0.00
12.45	0.10	434	148.47	0.06	0.06	0.00
12.50	0.08	440	148.48	0.06	0.06	0.00
12.55	0.06	**443**	**148.48**	**0.06**	**0.06**	0.00
12.60	0.05	**442**	**148.48**	**0.06**	**0.06**	0.00
12.65	0.05	441	148.48	0.06	0.06	0.00
12.70	0.05	439	148.47	0.06	0.06	0.00
12.75	0.04	437	148.47	0.06	0.06	0.00
12.80	0.04	434	148.47	0.06	0.06	0.00
12.85	0.04	432	148.47	0.06	0.06	0.00
12.90	0.04	428	148.46	0.06	0.06	0.00
12.95	0.04	425	148.46	0.06	0.06	0.00
13.00	0.03	421	148.46	0.06	0.06	0.00

Subsurface Infiltration Basin Water Quality Volume Calculations

Summary for Pond 1P: Bldg 4&5 Subsurface Infiltration System

Inflow Area = 1.241 ac,100.00% Impervious, Inflow Depth > 1.00" for WQV-DYN event
Inflow = 2.54 cfs @ 12.07 hrs, Volume= 0.103 af
Outflow = 0.22 cfs @ 11.96 hrs, Volume= 0.034 af, Atten= 91%, Lag= 0.0 min
Discarded = 0.22 cfs @ 11.96 hrs, Volume= 0.034 af
Primary = 0.00 cfs @ 11.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 11.00-13.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 146.19' @ 12.93 hrs Surf.Area= 3,943 sf Storage= 3,022 cf

Plug-Flow detention time= 24.8 min calculated for 0.034 af (33% of inflow)
Center-of-Mass det. time= 0.5 min (724.2 - 723.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	145.00'	3,494 cf	**30.00'W x 130.60'L x 3.50'H Field A** 13,713 cf Overall - 4,978 cf Embedded = 8,734 cf x 40.0% Voids
#2A	145.50'	4,978 cf	**ADS_StormTech SC-740** x 108 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap Row Length Adjustment= +0.44' x 6.45 sf x 6 rows
#3	145.50'	126 cf	**4.00'D x 5.00'H Vertical Cone/Cylinder** x 2
		8,598 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	145.00'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	144.50'	**12.0" Round Culvert X 2.00** L= 20.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 144.50' / 144.00' S= 0.0250 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#3	Device 2	148.00'	**4.0' long Sharp-Crested Rectangular Weir X 2.00** 2 End Contraction(s) 2.5' Crest Height
#4	Device 2	146.20'	**10.0" Vert. Orifice/Grate X 2.00** C= 0.600

Discarded OutFlow Max=0.22 cfs @ 11.96 hrs HW=145.50' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.22 cfs)

Primary OutFlow Max=0.00 cfs @ 11.00 hrs HW=145.00' (Free Discharge)
└─**2=Culvert** (Passes 0.00 cfs of 1.90 cfs potential flow)
  ├─**3=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)
  └─**4=Orifice/Grate** (Controls 0.00 cfs)

Pond 1P: Bldg 4&5 Subsurface Infiltration System - Chamber Wizard Field A

Chamber Model = ADS_StormTechSC-740 (ADS StormTech®SC-740 without end caps)
Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap
Row Length Adjustment= +0.44' x 6.45 sf x 6 rows

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

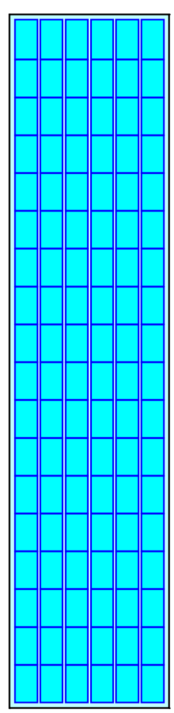
18 Chambers/Row x 7.12' Long +0.44' Row Adjustment = 128.60' Row Length +12.0" End Stone x 2 = 130.60' Base Length
6 Rows x 51.0" Wide + 6.0" Spacing x 5 + 12.0" Side Stone x 2 = 30.00' Base Width
6.0" Base + 30.0" Chamber Height + 6.0" Cover = 3.50' Field Height

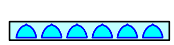
108 Chambers x 45.9 cf +0.44' Row Adjustment x 6.45 sf x 6 Rows = 4,978.5 cf Chamber Storage

13,712.8 cf Field - 4,978.5 cf Chambers = 8,734.3 cf Stone x 40.0% Voids = 3,493.7 cf Stone Storage

Chamber Storage + Stone Storage = 8,472.2 cf = 0.194 af
Overall Storage Efficiency = 61.8%
Overall System Size = 130.60' x 30.00' x 3.50'

108 Chambers
507.9 cy Field
323.5 cy Stone





Hydrograph for Pond 1P: Bldg 4&5 Subsurface Infiltration System

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)	Discarded (cfs)	Primary (cfs)
11.00	0.17	1	145.00	0.00	0.00	**0.00**
11.05	0.17	25	145.02	0.06	0.06	0.00
11.10	0.18	41	145.03	0.10	0.10	0.00
11.15	0.19	53	145.03	0.13	0.13	0.00
11.20	0.20	61	145.04	0.16	0.16	0.00
11.25	0.21	69	145.04	0.17	0.17	0.00
11.30	0.22	75	145.05	0.19	0.19	0.00
11.35	0.23	81	145.05	0.20	0.20	0.00
11.40	0.25	86	145.05	0.22	0.22	0.00
11.45	0.26	92	145.06	0.22	0.22	0.00
11.50	0.27	100	145.06	0.22	0.22	0.00
11.55	0.29	110	145.07	0.22	0.22	0.00
11.60	0.35	127	145.08	0.22	0.22	0.00
11.65	0.45	159	145.10	0.22	0.22	0.00
11.70	0.55	210	145.13	0.22	0.22	0.00
11.75	0.66	280	145.18	0.22	0.22	0.00
11.80	0.77	369	145.24	0.22	0.22	0.00
11.85	0.88	479	145.31	0.22	0.22	0.00
11.90	1.00	609	145.39	0.22	0.22	0.00
11.95	1.16	761	145.49	**0.22**	**0.22**	0.00
12.00	1.71	973	145.56	**0.22**	**0.22**	0.00
12.05	**2.45**	1,310	145.66	0.22	0.22	0.00
12.10	**2.37**	1,719	145.78	0.22	0.22	0.00
12.15	1.69	2,046	145.88	0.22	0.22	0.00
12.20	1.25	2,265	145.95	0.22	0.22	0.00
12.25	1.06	2,432	146.00	0.22	0.22	0.00
12.30	0.93	2,570	146.05	0.22	0.22	0.00
12.35	0.81	2,687	146.08	0.22	0.22	0.00
12.40	0.70	2,783	146.11	0.22	0.22	0.00
12.45	0.59	2,860	146.14	0.22	0.22	0.00
12.50	0.48	2,916	146.15	0.22	0.22	0.00
12.55	0.37	2,952	146.17	0.22	0.22	0.00
12.60	0.31	2,973	146.17	0.22	0.22	0.00
12.65	0.29	2,988	146.18	0.22	0.22	0.00
12.70	0.28	2,999	146.18	0.22	0.22	0.00
12.75	0.26	3,008	146.18	0.22	0.22	0.00
12.80	0.25	3,014	146.19	0.22	0.22	0.00
12.85	0.24	3,019	146.19	0.22	0.22	0.00
12.90	0.23	**3,021**	**146.19**	0.22	0.22	0.00
12.95	0.22	**3,022**	**146.19**	0.22	0.22	0.00
13.00	0.20	3,020	146.19	0.22	0.22	0.00

Summary for Pond 4P: Bldg 3 Subsurface Infiltration System

Inflow Area = 0.460 ac,100.00% Impervious, Inflow Depth > 1.00" for WQV-DYN event
Inflow = 0.94 cfs @ 12.07 hrs, Volume= 0.038 af
Outflow = 0.02 cfs @ 11.07 hrs, Volume= 0.003 af, Atten= 98%, Lag= 0.0 min
Discarded = 0.02 cfs @ 11.07 hrs, Volume= 0.003 af
Primary = 0.00 cfs @ 11.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 11.00-13.00 hrs, dt= 0.01 hrs
Peak Elev= 147.73' @ 13.00 hrs Surf.Area= 0.020 ac Storage= 0.035 af

Plug-Flow detention time= 44.8 min calculated for 0.003 af (9% of inflow)
Center-of-Mass det. time= (not calculated: outflow precedes inflow)

Volume	Invert	Avail.Storage	Storage Description
#1A	145.00'	0.019 af	**34.75'W x 24.98'L x 3.50'H Field A** 0.070 af Overall - 0.022 af Embedded = 0.048 af x 40.0% Voids
#2A	145.50'	0.022 af	**ADS_StormTech SC-740 +Cap** x 21 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 7 Rows of 3 Chambers
		0.041 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	145.00'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	145.00'	**12.0" Round Culvert** L= 16.0' Ke= 0.500 Inlet / Outlet Invert= 145.00' / 144.60' S= 0.0250 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#3	Device 2	147.75'	**4.0' long Sharp-Crested Rectangular Weir X 0.00** 2 End Contraction(s)

Discarded OutFlow Max=0.02 cfs @ 11.07 hrs HW=145.04' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=0.00 cfs @ 11.00 hrs HW=145.00' (Free Discharge)
└─**2=Culvert** (Passes 0.00 cfs of 0.00 cfs potential flow)
  └─**3=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 4P: Bldg 3 Subsurface Infiltration System - Chamber Wizard Field A

Chamber Model = ADS_StormTechSC-740 +Cap (ADS StormTech®SC-740 with cap length)
Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

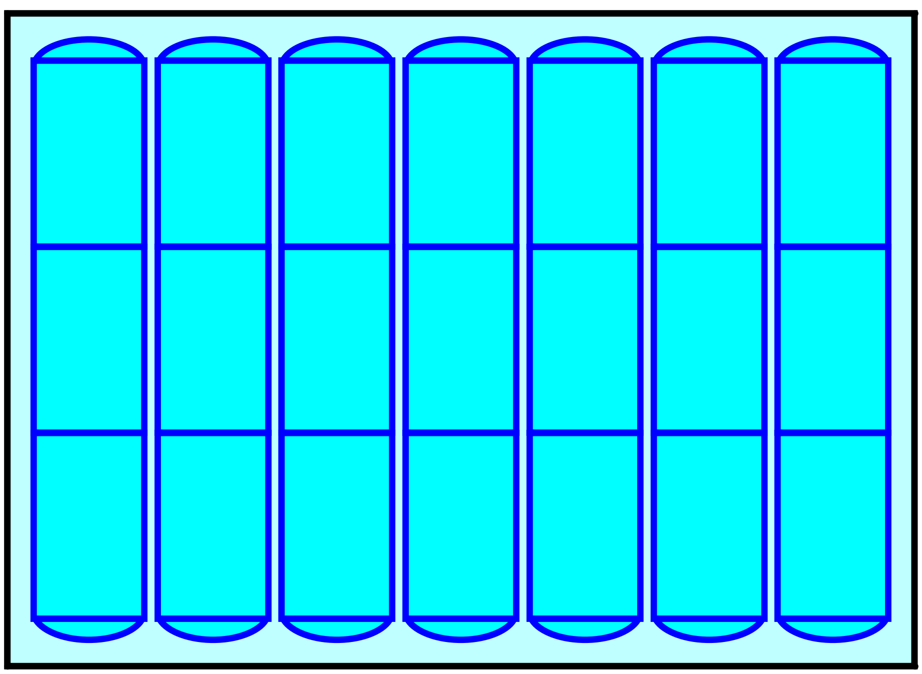
3 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 22.98' Row Length +12.0" End Stone x 2 = 24.98' Base Length
7 Rows x 51.0" Wide + 6.0" Spacing x 6 + 12.0" Side Stone x 2 = 34.75' Base Width
6.0" Base + 30.0" Chamber Height + 6.0" Cover = 3.50' Field Height

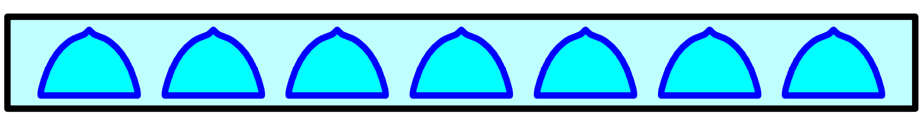
21 Chambers x 45.9 cf = 964.7 cf Chamber Storage

3,037.8 cf Field - 964.7 cf Chambers = 2,073.0 cf Stone x 40.0% Voids = 829.2 cf Stone Storage

Chamber Storage + Stone Storage = 1,794.0 cf = 0.041 af
Overall Storage Efficiency = 59.1%
Overall System Size = 24.98' x 34.75' x 3.50'

21 Chambers
112.5 cy Field
76.8 cy Stone





Hydrograph for Pond 4P: Bldg 3 Subsurface Infiltration System

Time (hours)	Inflow (cfs)	Storage (acre-feet)	Elevation (feet)	Outflow (cfs)	Discarded (cfs)	Primary (cfs)
11.00	0.06	0.000	145.00	0.00	0.00	**0.00**
11.05	0.06	0.000	145.03	**0.02**	**0.02**	0.00
11.10	0.07	0.000	145.05	**0.02**	**0.02**	0.00
11.15	0.07	0.001	145.08	0.02	0.02	0.00
11.20	0.07	0.001	145.10	0.02	0.02	0.00
11.25	0.08	0.001	145.13	0.02	0.02	0.00
11.30	0.08	0.001	145.16	0.02	0.02	0.00
11.35	0.09	0.002	145.20	0.02	0.02	0.00
11.40	0.09	0.002	145.23	0.02	0.02	0.00
11.45	0.10	0.002	145.27	0.02	0.02	0.00
11.50	0.10	0.002	145.31	0.02	0.02	0.00
11.55	0.11	0.003	145.35	0.02	0.02	0.00
11.60	0.13	0.003	145.40	0.02	0.02	0.00
11.65	0.17	0.004	145.47	0.02	0.02	0.00
11.70	0.20	0.004	145.53	0.02	0.02	0.00
11.75	0.25	0.005	145.58	0.02	0.02	0.00
11.80	0.29	0.006	145.65	0.02	0.02	0.00
11.85	0.33	0.007	145.72	0.02	0.02	0.00
11.90	0.37	0.009	145.81	0.02	0.02	0.00
11.95	0.43	0.010	145.91	0.02	0.02	0.00
12.00	0.63	0.012	146.04	0.02	0.02	0.00
12.05	**0.91**	0.016	146.25	0.02	0.02	0.00
12.10	**0.88**	0.019	146.51	0.02	0.02	0.00
12.15	0.63	0.022	146.72	0.02	0.02	0.00
12.20	0.46	0.024	146.87	0.02	0.02	0.00
12.25	0.39	0.026	147.00	0.02	0.02	0.00
12.30	0.34	0.028	147.10	0.02	0.02	0.00
12.35	0.30	0.029	147.20	0.02	0.02	0.00
12.40	0.26	0.030	147.29	0.02	0.02	0.00
12.45	0.22	0.031	147.36	0.02	0.02	0.00
12.50	0.18	0.031	147.42	0.02	0.02	0.00
12.55	0.14	0.032	147.47	0.02	0.02	0.00
12.60	0.12	0.032	147.51	0.02	0.02	0.00
12.65	0.11	0.033	147.54	0.02	0.02	0.00
12.70	0.10	0.033	147.57	0.02	0.02	0.00
12.75	0.10	0.033	147.60	0.02	0.02	0.00
12.80	0.09	0.034	147.63	0.02	0.02	0.00
12.85	0.09	0.034	147.66	0.02	0.02	0.00
12.90	0.08	0.034	147.68	0.02	0.02	0.00
12.95	0.08	0.035	147.71	0.02	0.02	0.00
13.00	0.08	**0.035**	**147.73**	0.02	0.02	0.00

Roof Runoff Water Quality Volume Calculations

Summary for Pond 2P: Bldg 2 Subsurface Infiltation System

Inflow Area = 0.312 ac,100.00% Impervious, Inflow Depth > 1.00" for WQV-DYN event
Inflow = 0.64 cfs @ 12.07 hrs, Volume= 0.026 af
Outflow = 0.12 cfs @ 12.50 hrs, Volume= 0.016 af, Atten= 81%, Lag= 25.9 min
Discarded = 0.12 cfs @ 11.68 hrs, Volume= 0.016 af
Primary = 0.00 cfs @ 12.50 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 11.00-13.00 hrs, dt= 0.01 hrs
Peak Elev= 149.92' @ 12.50 hrs Surf.Area= 0.014 ac Storage= 0.012 af

Plug-Flow detention time= 17.8 min calculated for 0.016 af (62% of inflow)
Center-of-Mass det. time= 4.9 min (728.6 - 723.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	148.50'	0.010 af	**24.83'W x 24.56'L x 2.33'H Field A** 0.033 af Overall - 0.007 af Embedded = 0.026 af x 40.0% Voids
#2A	149.00'	0.007 af	**ADS_StormTech RC-310 +Cap** x 21 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap 7 Rows of 3 Chambers
		0.017 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	148.50'	**8.270 in/hr Exfiltration over Surface area**
#2	Primary	149.90'	**12.0" Round Culvert** L= 34.0' Ke= 0.500 Inlet / Outlet Invert= 149.90' / 149.00' S= 0.0265 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Discarded OutFlow Max=0.12 cfs @ 11.68 hrs HW=148.53' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.12 cfs)

Primary OutFlow Max=0.00 cfs @ 12.50 hrs HW=149.92' (Free Discharge)
└─**2=Culvert** (Inlet Controls 0.00 cfs @ 0.50 fps)

Pond 2P: Bldg 2 Subsurface Infiltation System - Chamber Wizard Field A

Chamber Model = ADS_StormTechRC-310 +Cap (ADS StormTech®RC-310 with cap length)
Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf
Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap

34.0" Wide + 6.0" Spacing = 40.0" C-C Row Spacing

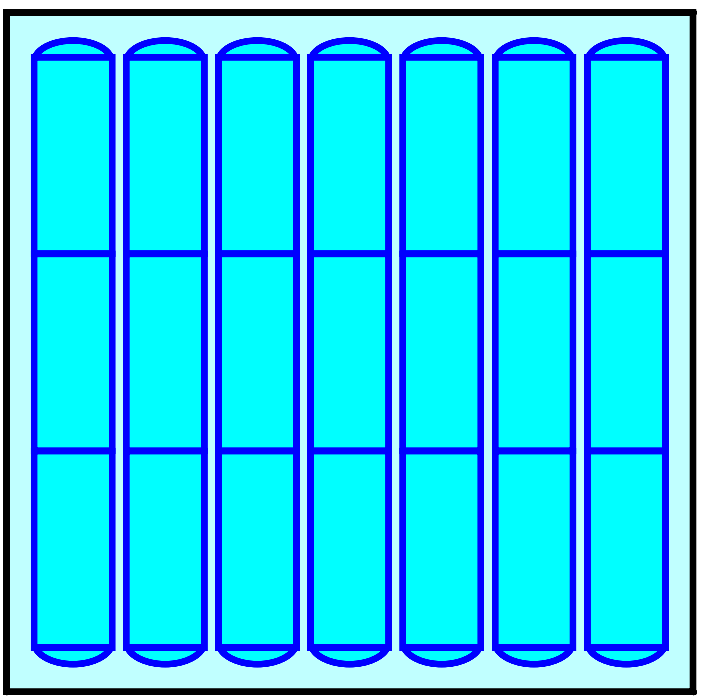
3 Chambers/Row x 7.12' Long +0.60' Cap Length x 2 = 22.56' Row Length +12.0" End Stone x 2 = 24.56' Base Length
7 Rows x 34.0" Wide + 6.0" Spacing x 6 + 12.0" Side Stone x 2 = 24.83' Base Width
6.0" Base + 16.0" Chamber Height + 6.0" Cover = 2.33' Field Height

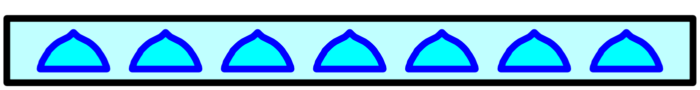
21 Chambers x 14.7 cf = 309.6 cf Chamber Storage

1,423.1 cf Field - 309.6 cf Chambers = 1,113.5 cf Stone x 40.0% Voids = 445.4 cf Stone Storage

Chamber Storage + Stone Storage = 755.0 cf = 0.017 af
Overall Storage Efficiency = 53.1%
Overall System Size = 24.56' x 24.83' x 2.33'

21 Chambers
52.7 cy Field
41.2 cy Stone





Hydrograph for Pond 2P: Bldg 2 Subsurface Infiltation System

Time (hours)	Inflow (cfs)	Storage (acre-feet)	Elevation (feet)	Outflow (cfs)	Discarded (cfs)	Primary (cfs)
11.00	0.04	0.000	148.50	0.01	0.01	0.00
11.05	0.04	0.000	148.51	0.04	0.04	0.00
11.10	0.04	0.000	148.51	0.04	0.04	0.00
11.15	0.05	0.000	148.51	0.05	0.05	0.00
11.20	0.05	0.000	148.51	0.05	0.05	0.00
11.25	0.05	0.000	148.51	0.05	0.05	0.00
11.30	0.06	0.000	148.51	0.06	0.06	0.00
11.35	0.06	0.000	148.51	0.06	0.06	0.00
11.40	0.06	0.000	148.51	0.06	0.06	0.00
11.45	0.06	0.000	148.51	0.06	0.06	0.00
11.50	0.07	0.000	148.51	0.07	0.07	0.00
11.55	0.07	0.000	148.51	0.07	0.07	0.00
11.60	0.09	0.000	148.52	0.08	0.08	0.00
11.65	0.11	0.000	148.52	0.11	**0.11**	0.00
11.70	0.14	0.000	148.53	0.12	**0.12**	0.00
11.75	0.17	0.000	148.56	0.12	0.12	0.00
11.80	0.19	0.001	148.60	0.12	0.12	0.00
11.85	0.22	0.001	148.67	0.12	0.12	0.00
11.90	0.25	0.001	148.76	0.12	0.12	0.00
11.95	0.29	0.002	148.87	0.12	0.12	0.00
12.00	0.43	0.003	149.02	0.12	0.12	0.00
12.05	**0.62**	0.005	149.19	0.12	0.12	0.00
12.10	**0.60**	0.007	149.39	0.12	0.12	0.00
12.15	0.43	0.008	149.56	0.12	0.12	0.00
12.20	0.31	0.010	149.67	0.12	0.12	0.00
12.25	0.27	0.010	149.75	0.12	0.12	0.00
12.30	0.23	0.011	149.81	0.12	0.12	0.00
12.35	0.20	0.011	149.86	0.12	0.12	0.00
12.40	0.18	0.011	149.89	0.12	0.12	0.00
12.45	0.15	0.012	149.91	0.12	0.12	0.00
12.50	0.12	**0.012**	**149.92**	**0.12**	0.12	**0.00**
12.55	0.09	0.012	149.92	0.12	0.12	0.00
12.60	0.08	0.012	149.90	0.12	0.12	0.00
12.65	0.07	0.011	149.88	0.12	0.12	0.00
12.70	0.07	0.011	149.86	0.12	0.12	0.00
12.75	0.07	0.011	149.83	0.12	0.12	0.00
12.80	0.06	0.011	149.81	0.12	0.12	0.00
12.85	0.06	0.011	149.78	0.12	0.12	0.00
12.90	0.06	0.010	149.76	0.12	0.12	0.00
12.95	0.05	0.010	149.73	0.12	0.12	0.00
13.00	0.05	0.010	149.70	0.12	0.12	0.00

Summary for Pond P-Roof 2: Bridges Perf Pipe System

Inflow Area = 1.018 ac,100.00% Impervious, Inflow Depth > 1.00" for WQV-DYN event
Inflow = 2.09 cfs @ 12.07 hrs, Volume= 0.085 af
Outflow = 0.22 cfs @ 11.55 hrs, Volume= 0.034 af, Atten= 89%, Lag= 0.0 min
Discarded = 0.22 cfs @ 11.55 hrs, Volume= 0.034 af
Primary = 0.00 cfs @ 11.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 11.00-13.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 151.24' @ 12.71 hrs Surf.Area= 4,000 sf Storage= 2,224 cf

Plug-Flow detention time= 21.0 min calculated for 0.034 af (40% of inflow)
Center-of-Mass det. time= 0.4 min (724.1 - 723.7)

Volume	Invert	Avail.Storage	Storage Description
#1	150.00'	3,043 cf	**2.00'W x 2,000.00'L x 2.00'H Prismatoid** 8,000 cf Overall - 393 cf Embedded = 7,607 cf x 40.0% Voids
#2	150.50'	393 cf	**6.0" Round Pipe Storage** Inside #1 L= 2,000.0'
		3,436 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	150.00'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	151.50'	**0.5' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Discarded OutFlow Max=0.22 cfs @ 11.55 hrs HW=150.02' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.22 cfs)

Primary OutFlow Max=0.00 cfs @ 11.00 hrs HW=150.00' (Free Discharge)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Hydrograph for Pond P-Roof 2: Bridges Perf Pipe System

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)	Discarded (cfs)	Primary (cfs)
11.00	0.14	1	150.00	0.01	0.01	**0.00**
11.05	0.14	14	150.01	0.10	0.10	0.00
11.10	0.15	19	150.01	0.13	0.13	0.00
11.15	0.15	21	150.01	0.15	0.15	0.00
11.20	0.16	22	150.01	0.16	0.16	0.00
11.25	0.17	24	150.01	0.17	0.17	0.00
11.30	0.18	25	150.02	0.18	0.18	0.00
11.35	0.19	26	150.02	0.18	0.18	0.00
11.40	0.20	28	150.02	0.19	0.19	0.00
11.45	0.21	29	150.02	0.20	0.20	0.00
11.50	0.22	31	150.02	0.21	0.21	0.00
11.55	0.23	32	150.02	**0.22**	**0.22**	0.00
11.60	0.29	38	150.02	0.22	0.22	0.00
11.65	0.37	57	150.04	0.22	0.22	0.00
11.70	0.45	90	150.06	0.22	0.22	0.00
11.75	0.54	140	150.09	0.22	0.22	0.00
11.80	0.63	205	150.13	0.22	0.22	0.00
11.85	0.73	287	150.18	0.22	0.22	0.00
11.90	0.82	386	150.24	0.22	0.22	0.00
11.95	0.95	503	150.31	0.22	0.22	0.00
12.00	1.40	669	150.42	0.22	0.22	0.00
12.05	**2.01**	938	150.57	0.22	0.22	0.00
12.10	**1.94**	1,266	150.73	0.22	0.22	0.00
12.15	1.39	1,526	150.85	0.22	0.22	0.00
12.20	1.02	1,699	150.93	0.22	0.22	0.00
12.25	0.87	1,827	151.00	0.22	0.22	0.00
12.30	0.76	1,933	151.06	0.22	0.22	0.00
12.35	0.67	2,021	151.12	0.22	0.22	0.00
12.40	0.57	2,093	151.16	0.22	0.22	0.00
12.45	0.48	2,148	151.20	0.22	0.22	0.00
12.50	0.39	2,186	151.22	0.22	0.22	0.00
12.55	0.30	2,208	151.23	0.22	0.22	0.00
12.60	0.26	2,218	151.24	0.22	0.22	0.00
12.65	0.24	2,222	151.24	0.22	0.22	0.00
12.70	0.23	**2,223**	**151.24**	0.22	0.22	0.00
12.75	0.22	**2,223**	**151.24**	0.22	0.22	0.00
12.80	0.21	2,221	151.24	0.22	0.22	0.00
12.85	0.20	2,217	151.24	0.22	0.22	0.00
12.90	0.19	2,211	151.23	0.22	0.22	0.00
12.95	0.18	2,204	151.23	0.22	0.22	0.00
13.00	0.17	2,195	151.22	0.22	0.22	0.00

WQU Unit Sizing Calculations

Project: Village Retail & Bridges at Meadow Walk
Location: Sudbury, MA
Prepared For: VHB

CONTECH ENGINEERED SOLUTIONS

Purpose: To calculate the water quality flow rate (WQF) over a given site area. In this situation the WQF is derived from the first 1.0" of runoff.

Reference: Massachusetts Dept. of Environmental Protection Wetlands Program / United States Department of Agriculture Natural Resources Conservation Service TR-55 Manual

Given:

Structure Name	Impv. (acres)	A (miles^2)	t_c (min)	t_c (hr)	WQV (in)
WQU 201	0.90	0.0014063	6.0	0.100	1.00
WQU 501	0.73	0.0011406	6.0	0.100	1.00
WQU 510	0.21	0.0003281	6.0	0.100	1.00

Procedure:

Determine unit peak discharge using Figure 1 or 2. Figure 2 is in tabular form so is preferred. Using the tc, read the unit peak discharge (qu) from Figure 1 or Table in Figure 2. qu is expressed in the following units: cfs/mi^2/watershed inches (csm/in).

Structure Name	qu (csm/in.)
WQU 201	774.00
WQU 501	774.00
WQU 510	774.00

1. Compute Q Rate using the following equation:

$$Q_1 = (qu)\ (A)\ (WQV)$$

where:

Q_1 = flow fate associated with first 1.0" of runoff
qu = the unit peak discharge, in csm/in.
A = impervious surface drainage area (in square miles)
WQV = water quality volume in watershed inches (1.0" in this case)

Structure Name	Q_1 (cfs)
WQU 201	1.09
WQU 501	0.88
WQU 510	0.25

CDS ESTIMATED NET ANNUAL TSS REDUCTION
BASED ON THE RATIONAL RAINFALL METHOD

VILLAGE RETAIL & BRIDGES AT MEADOW WALK
SUDBURY, MA
for SYSTEM: WQU 201

Area	0.9	acres	CDS Model	
Weighted C	0.90		2015-4	
Tc	6	minutes	CDS Treatment Capacity	
			1.4	cfs

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Removal Efficiency (%)	Incremental Removal (%)
0.02	10.2%	10.2%	0.02	0.02	96.4	9.8
0.04	9.6%	19.8%	0.03	0.03	95.6	9.2
0.06	9.4%	29.3%	0.05	0.05	94.9	9.0
0.08	7.7%	37.0%	0.06	0.06	94.1	7.3
0.10	8.6%	45.6%	0.08	0.08	93.3	8.0
0.12	6.3%	51.9%	0.10	0.10	92.5	5.8
0.14	4.7%	56.5%	0.11	0.11	91.7	4.3
0.16	4.6%	61.2%	0.13	0.13	90.9	4.2
0.18	3.5%	64.7%	0.15	0.15	90.1	3.2
0.20	4.3%	69.1%	0.16	0.16	89.3	3.9
0.25	8.0%	77.1%	0.20	0.20	87.4	7.0
0.30	5.6%	82.7%	0.24	0.24	85.4	4.8
0.35	4.4%	87.0%	0.28	0.28	83.4	3.6
0.40	2.5%	89.5%	0.32	0.32	81.5	2.1
0.45	2.5%	92.1%	0.36	0.36	79.5	2.0
0.50	1.4%	93.5%	0.41	0.41	77.5	1.1
0.75	5.0%	98.5%	0.61	0.61	67.7	3.4
1.00	1.0%	99.5%	0.81	0.81	57.8	0.6
1.50	0.0%	99.5%	1.22	1.22	38.1	0.0
2.00	0.0%	99.5%	1.62	1.40	25.1	0.0
3.00	0.5%	100.0%	2.43	1.40	16.8	0.1
						89.3
					Removal Efficiency Adjustment[2] =	6.5%
					Predicted % Annual Rainfall Treated =	93.3%
					Predicted Net Annual Load Removal Efficiency =	**82.8%**

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

CDS ESTIMATED NET ANNUAL TSS REDUCTION
BASED ON THE RATIONAL RAINFALL METHOD

VILLAGE RETAIL & BRIDGES AT MEADOW WALK
SUDBURY, MA
for SYSTEM: WQU 501

Area	0.73	acres	CDS Model	
Weighted C	0.90		2015-4	
Tc	6	minutes	CDS Treatment Capacity	
			1.4	cfs

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Removal Efficiency (%)	Incremental Removal (%)
0.02	10.2%	10.2%	0.01	0.01	96.6	9.8
0.04	9.6%	19.8%	0.03	0.03	95.9	9.3
0.06	9.4%	29.3%	0.04	0.04	95.3	9.0
0.08	7.7%	37.0%	0.05	0.05	94.7	7.3
0.10	8.6%	45.6%	0.07	0.07	94.0	8.1
0.12	6.3%	51.9%	0.08	0.08	93.4	5.9
0.14	4.7%	56.5%	0.09	0.09	92.7	4.3
0.16	4.6%	61.2%	0.11	0.11	92.1	4.3
0.18	3.5%	64.7%	0.12	0.12	91.5	3.2
0.20	4.3%	69.1%	0.13	0.13	90.8	3.9
0.25	8.0%	77.1%	0.16	0.16	89.2	7.1
0.30	5.6%	82.7%	0.20	0.20	87.6	4.9
0.35	4.4%	87.0%	0.23	0.23	86.0	3.8
0.40	2.5%	89.5%	0.26	0.26	84.4	2.1
0.45	2.5%	92.1%	0.30	0.30	82.8	2.1
0.50	1.4%	93.5%	0.33	0.33	81.2	1.1
0.75	5.0%	98.5%	0.49	0.49	73.2	3.7
1.00	1.0%	99.5%	0.66	0.66	65.3	0.7
1.50	0.0%	99.5%	0.99	0.99	49.3	0.0
2.00	0.0%	99.5%	1.31	1.31	33.3	0.0
3.00	0.5%	100.0%	1.97	1.40	20.7	0.1
						90.7
					Removal Efficiency Adjustment[2] =	6.5%
					Predicted % Annual Rainfall Treated =	93.4%
					Predicted Net Annual Load Removal Efficiency =	**84.3%**

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.

CDS ESTIMATED NET ANNUAL TSS REDUCTION
BASED ON THE RATIONAL RAINFALL METHOD

CDS

VILLAGE RETAIL & BRIDGES AT MEADOW WALK
SUDBURY, MA
for SYSTEM: WQU 510

CONTECH ENGINEERED SOLUTIONS

Area	0.21	acres	CDS Model	
Weighted C	0.90		2015-4	
Tc	6	minutes	CDS Treatment Capacity	
			1.4	cfs

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Removal Efficiency (%)	Incremental Removal (%)
0.02	10.2%	10.2%	0.00	0.00	97.0	9.9
0.04	9.6%	19.8%	0.01	0.01	96.8	9.3
0.06	9.4%	29.3%	0.01	0.01	96.7	9.1
0.08	7.7%	37.0%	0.02	0.02	96.5	7.5
0.10	8.6%	45.6%	0.02	0.02	96.3	8.3
0.12	6.3%	51.9%	0.02	0.02	96.1	6.1
0.14	4.7%	56.5%	0.03	0.03	95.9	4.5
0.16	4.6%	61.2%	0.03	0.03	95.7	4.4
0.18	3.5%	64.7%	0.03	0.03	95.6	3.4
0.20	4.3%	69.1%	0.04	0.04	95.4	4.1
0.25	8.0%	77.1%	0.05	0.05	94.9	7.6
0.30	5.6%	82.7%	0.06	0.06	94.5	5.3
0.35	4.4%	87.0%	0.07	0.07	94.0	4.1
0.40	2.5%	89.5%	0.08	0.08	93.5	2.4
0.45	2.5%	92.1%	0.09	0.09	93.1	2.4
0.50	1.4%	93.5%	0.09	0.09	92.6	1.3
0.75	5.0%	98.5%	0.14	0.14	90.3	4.6
1.00	1.0%	99.5%	0.19	0.19	88.0	0.9
1.50	0.0%	99.5%	0.28	0.28	83.4	0.0
2.00	0.0%	99.5%	0.38	0.38	78.8	0.0
3.00	0.5%	100.0%	0.57	0.57	69.6	0.3
						95.3

Removal Efficiency Adjustment[2] = 6.5%

Predicted % Annual Rainfall Treated = 93.5%

Predicted Net Annual Load Removal Efficiency = 88.9%

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.

MASTEP CDS Reports

UNIVERSITY OF MASSACHUSETTS
AT AMHERST
Water Resources Research Center
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Amherst, MA 01003

Massachusetts Stormwater Evaluation Project

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www.mastep.net

MASTEP Technology Review

Technology Name: CDS (Continuous Deflective Separator) - Contech Stormwater Solutions, Inc.

Studies Reviewed:
- Independent Review of CDS 2015 Product Evaluation, FB Environmental Associates, 2009.
- NJCAT Technology Verification Addendum Report High Efficiency Continuous Deflective Separators CDS Technologies Inc. December 2004
- Continuous Deflection Separation (CDS) Unit For Sediment Control In Brevard County, Florida January, 2000

Date: 12/16/2009
Reviewer: Jerry Schoen

Rating: 2

Brief rationale for rating: MASTEP rating is based primarily on FB Environmental 2009 laboratory study. This study generally followed NJDEP-recommended laboratory test protocols, with some exceptions: no evidence of a Quality Assurance Project Plan, little discussion of quality control, higher than recommended particle size distribution, limited range of influent sediment concentration, sediments analyzed by SSC method but not TSS.

The Florida field study monitored 5 storm events and encountered sampling/equipment problems in four of them. The NJCAT lab study was conducted on a unit that was specially modified for testing in New Jersey, and is now being sold in NJ and NY.

Other Comments:

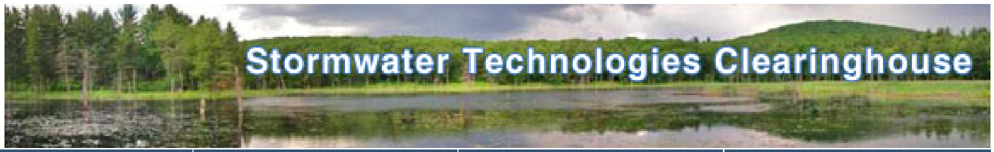
FB Environmental Associates study:
- OK-110 sediment mix used. This is recommended by Maine DEP, but produces sediments somewhat larger than those recommended by New Jersey DEP.
- Sediment analysis conducted with whole sample; essentially SSC method. SSC is generally regarded as more accurate than TSS method, but comparisons with other studies or products that use TSS data are problematic.
- Full range of flows were tested.
- Only one target sediment concentration was tested; average influent SSC was 313 mg/l, slightly outside of recommended 100-300 mg/l range.
- Scour test was performed; system produced no scour at flows up to 137% of capacity.

NJCAT Study
- Expectations of sediment removal performance comparable to this study should be confined to units that contain the sediment weir and a 2400 micron screen.
- The study did not include a scour test.
- A particularly fine sediment mix (Sil-Col-Sil 106, pre-washed to remove all particles > 100 microns), which makes sediment removal more difficult. Higher removal efficiencies may be obtained if sediment particle size range is larger.

- A narrow range of influent sediment (164 – 203 mg/l, average 184), was tested but this is within the NJDEP-recommended 100-300 mg/l range.
- TSS analysis appears to have been performed by a non- standardized method.
- No discussion of quality control.

Brevard County FL study

- This study was performed before release of the TARP Tier II Protocols and does not conform to them.
- The study states that "testing under higher flow conditions would be desirable."
- TSS, BOD, COD, pH, total phosphorus, and turbidity were monitored.



Test Report Details

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CDS Inline Unit :: A product from CONTECH STORMWATER SOLUTIONS, INC. ::

General Information:

This report describes a laboratory study that evaluated the performance of a CDS model PMSU20_20_6 with a special configuration, involving an enlarged pipe diameter and a sediment weir. This is an inverted oil baffle that extends several inches above the outlet invert. This reconfigured unit is sold in NJ and NY. Anyone considering this unit with expectations of sediment removal performance comparable to this study should ensure that a unit with the sediment weir, and with a 2400 micron screen is obtained. A 4700 screen is also available – solids removal would be adversely affected with the larger mesh screen. A particularly fine sediment mix (Sil-Col-Sil 106, pre-washed to remove all particles > 100 microns), which created rigorous testing conditions for sediment removal. It tested a rather narrow range of influent sediment concentration (164 – 203 mg/l, average 184), but this is within the NJDEP-recommended 100-300 mg/l range. For the most part, the study tested NJ-recommended operating rates; except that no tests at 125% operating rate were conducted. 0% credit for sediment removal at this rate was given when calculating the overall performance of 73.7% removal. The report states that this figure may be conservative because of the 0% credit at 125% operating rate. However, this assertion cannot be substantiated, because no scour tests were conducted. No discussion of quality control. MASTEP Rating 3: This study has some scientific merit. Significant caveats exist regarding use of the study information.

Report title	Author	Agency conducting study	Funding source for study
NJCAT Technology Verification Addendum Report High Efficiency Continuous Deflective Separators	-	Portland State U, for NJCAT	-

Report date	Date system installed	Study start date	Study end date
12/01/2004	-	-	-

Name, location of test site	Watershed where test site exists	% impervious surface in test watershed	Size of BMP drainage area (acres)
-	-	-	-

Performance claims statement used for this study:

A 500 GPM unit (Model PMSU20_20_5) with a 2400 micron screen opening and a reconfigured outlet for best sediment control, operating with an average influent TSS concentration of 184 mg/L and zero initial sediment loading, has been shown to have a total mass TSS removal efficiency of 73.7% (per NJDEP treatment efficiency calculation methodology) for silica sand particles < 100 microns (d50 particle size of 63 microns) in laboratory studies using simulated stormwater.

Rating /Verification given by agency conducting study:

Based on the evaluation of the results from the Portland State University sub-100 micron particle testing studies, sufficient data is available to support the CDS Technologies Claim: A 500 GPM unit (Model PMSU20_20_5) with a 2400 micron screen opening and a reconfigured outlet for best sediment control, operating with an average influent TSS concentration of 184mg/l and zero initial sediment loading, has been shown to have a total mass TSS removal efficiency of 73.7% (per NJDEP treatment efficiency calculation methodology) for silica sand particles <100 microns (d50 particle size of 63 microns) in laboratory studies using simulated stormwater.

Average annual number of storms in test watershed	Average annual rainfall at test site (inches)	Average monthly rainfall during test period (inches)
-	-	-

% of total annual rainfall monitored during study	Number of storms that occurred during study period	Number of storm events that were monitored during the study

-	-	-

Dates, precipitation amounts of storm events occurring during study	Dates of storm events that were monitored during study
-	-

Qualifying event minimum storm depth (inches)	Maximum event recurrence interval (years)	Was bypass monitored?
-	-	No

Type of samples collected	Parameters measured	Analytical methods used	Statistical methods used	Pollution removal efficiency calculation methods
-	-	-	-	9

Return to the Home Page

Appendix C
Stormwater Management System Operation and Maintenance Manual

STORMWATER OPERATIONS AND MAINTENANCE MANUAL

Village Retail & Bridges by Epoch at Meadow Walk

Sudbury, Massachusetts

PREPARED FOR

BPR Sudbury Development LLC
c/o National Development
2310 Washington Street
Newton Lower Falls, MA 02462

PREPARED BY

101 Walnut Street
PO Box 9151
Watertown, MA 02471
617.924.1770

Issued: October 2016

Table of Contents

Operations & Maintenance Manual Introduction

This Stormwater Management Operations and Maintenance Manual (O&M Manual) has been prepared to support the village retail and assisted living facility portions of the multi-phase redevelopment proposed for 526-528 Boston Post Road, Sudbury, MA. This O&M Manual figures incorporate stormwater management features within this portion of the redevelopment, however this plan supplements the current O&M plan for previously permitted portions of the overall project and is consistent with the overall approach to O&M throughout the overall project. Refer to Stormwater O&M figures prepared by VHB under separate cover for O&M of infrastructure proposed by other phases on-site as well as the required O&M of all existing stormwater management features which are to remain. Where applicable, this O&M Manual reflects the requirements incorporated for the site in the "Operations and Maintenance Plan" dated July 20, 2012 prepared by Paul Finger Associates, approved as part of the Order of Conditions MassDEP File #301-1083 issued on August 21, 2012 related to the stormwater system elements that are to remain in the future, including the central retention pond and the drainage swales on the property.

Project Information

Site

Village Retail & Bridges by Epoch at Meadow Walk
Sudbury, Massachusetts

Developer

BPR Sudbury Development LLC
c/o National Development
2310 Washington Street
Newton Lower Falls, MA 02462

Site Supervisor

TBD

Site Contact

Name: ______________________________

Telephone: ___________________________

Cell phone: ___________________________

Email: ______________________________

Section A - Source Control

A. Source Control

A comprehensive source control program will be implemented at the Site, which includes the following components:

- Regular pavement sweeping
- Catch basin cleaning
- Clearing litter from the pavement and landscape areas
- Enclosure and regular maintenance of all dumpsters
- Spill Prevention training

Section B - Spill Prevention

B. Spill Prevention

Spill prevention equipment and training will be provided by the property management company.

B.1 Initial Notification

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

Facility Manager (name): ____

Facility Manager (phone): ____

Construction Manager (name): ____________________________________

Construction Manager (phone): ___________________________________

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.

B.2 Further Notification

Based on the assessment from the Fire Chief, additional notification to a cleanup contractor may be made. The Massachusetts Department of Environmental Protection (DEP) and the EPA may be notified depending upon the nature and severity of the spill. The Fire Chief will be responsible for determining the level of cleanup and notification required. 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: ______________ ALTERNATE CONTACT: NAME: ______________		PHONE: ______________ BEEPER/CELL: ______________, ______________ HOME PHONE: ______________ PHONE: ______________ BEEPER/CELL: ______________, ______________ HOME PHONE: ______________
2.	FIRE & POLICE DEPARTMENT		EMERGENCY: **911**
3.	CLEANUP CONTRACTOR: ______________________ ADDRESS: ______________________ ______________________		PHONE: ______________
4.	MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION (DEP)		EMERGENCY PHONE: **(888) 304-1133**
5.	NATIONAL RESPONSE CENTER ALTERNATE: U.S. ENVIRONMENTAL PROTECTION AGENCY		PHONE: (800) 424-8802 EMERGENCY: (800) 424-8802 BUSINESS: (888) 372-7341
6.	SUDBURY HEALTH DEPARTMENT SUDBURY CONSERVATION COMMISSION:		PHONE: (978) 440-5479 PHONE: (978) 440-5471

Hazardous Waste / Oil Spill Report

Date: ____/____/________ Time: ______ AM / PM

Exact location ____

Type of equipment:__________________________ Make:______________ Size:_____________

License or 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 clean up

______________ 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: ____

____

B.3 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**
Sudbury Health Department:	**(978) 440-5479**
Sudbury Conservation Commission:	**(978) 440-5471**

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, 26
➤ SORBENT PADS	**50**	feet of sock, 50 pads, and five pounds of absorbent
➤ LITE-DRI® ABSORBENT	**5 POUNDS**	(or equivalent)
➤ SHOVEL	**1**	http://www.forestry-suppliers.com
➤ PRY BAR	**1**	Item # 43210 — Manhole cover pick (or equivalent)
➤ GOGGLES	**1 PAIR**	Item # 33934 — Shovel (or equivalent)
➤ GLOVES – HEAVY	**1 PAIR**	Item # 90926 — Gloves (or equivalent)
		Item # 23334 — Goggles (or equivalent)

Section C - Snow Management

C. Snow Management

Snow storage areas are shown on Figure B-1 included herein.

- Snow storage areas will be managed to prevent blockage of storm drain catch basins, stormwater drainage channels, and on-street parking. Snow combined with sand and debris may block a storm drainage system, diminishing the infiltration capacity of the system and causing localized flooding.
- Sand and debris deposited on vegetated or paved areas shall be cleared from the site and properly disposed of at the end of the snow season, no later than May 15.
- Snow shall not be dumped into any waterbody, pond, or wetland resource area.
- All sand shall be removed from the top of bank and on the banks of all wetlands immediately following spring snow melt each year.
- Only calcium or magnesium-based de-icing chemicals shall be used on surfaces where runoff/drainage will discharge into any wetland resources, or the 100' adjacent upland resource area.

Section D - Maintenance of Stormwater Management Systems

Maintenance of Stormwater Management Systems

D.1 Pavement Systems

D.1.1 Standard Asphalt Pavement

- Sweep or vacuum standard asphalt pavement areas with a rotary brush sweeper and properly dispose of removed material.
- Recommended sweeping schedule:
  - Oct/Nov
  - Apr/May
  - More frequent sweeping of paved surfaces will result in less accumulation in catch basins, less cleaning of subsurface structures, and less disposal costs.
- Check loading docks and dumpster areas frequently for spillage and/or pavement staining and clean as necessary.
- No coal-tar, petroleum-based, or other parking lot "sealants" are permitted to be used on-site. Normal maintenance activities intended to extend the life expectancy of the pavement surfaces including the use of bitumen asphalt to seal developing cracks, asphalt repair are not subject to this special condition.

D.2 Structural Stormwater Management Devices

D.2.1 Catch Basins & Landscape Drains

The proper removal of sediments and associated pollutants and trash occurs only when catch basin inlets and sumps are cleaned out regularly. The more frequent the cleaning, the less likely sediments will be re-suspended and subsequently discharged. In addition, frequent cleaning also results in more volume available for future deposition and enhances the overall performance. As noted in the pavement Operation and Maintenance (O&M) section, more frequent sweeping of paved surfaces will result in less accumulation in catch basins, less cleaning of subsurface structures, and less disposal costs.

Catch basins installed as part the redevelopment are constructed with sumps (minimum 4 feet) and hooded outlets to trap debris, sediments, and floating contaminants. Disposal of sediments from all catch basins must be in accordance with applicable local, state, and federal guidelines. Catch basin and landscape drain locations are shown on Figure A-1 included herein.

Inspections and Cleaning

- Catch basins with hoods shall be cleaned and inspected according to manufacturer recommendations.
- All catch basins shall be inspected at least four times per year and cleaned a minimum of at least once per year or when the depth of deposits is greater than one half of the depth from the bottom of the sump to the invert of the lowest connecting pipe.
- Sediment 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 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.

D.2.2 Structural Water Quality Devices

The stormwater drainage system includes structural water quality devices. They are Contech CDS units, which efficiently remove sediment and hydrocarbons from stormwater runoff. The locations of the water quality devices are shown on Figure A-1 included herein.

- All water quality units are to be inspected at least twice per year and cleaned a minimum of at least once per year or when sediment reaches 75% of the sump 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 in Section F - Project Literature.

D.2.3 Subsurface Infiltration Basins

The subsurface infiltration/detention basins are used to detain and infiltrate roadway and rooftop runoff. The Project proposes to install Stormtech subsurface infiltration chambers. The subsurface basin has a water quality pre-treatment device in the form of a sediment removal row to protect the infiltration bed from clogging. The sediment removal row is an integral part of the underground infiltration system. The location of the subsurface infiltration system is shown on Figure A-1 included herein.

Inspections and Cleaning

- The subsurface infiltration system will be inspected at least once each year by removing the manhole/access port covers and determining the thickness of sediment that has accumulated in the sediment removal row.

- If sediment is more than six inches deep, it must be suspended via flushing with clean water and removed using a vactor truck.
- Manufacturer's specifications and instructions for cleaning the sediment removal row are provided in Section G – Project 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.

D.2.4 Stormwater Outfalls, Filter Berms and Sediment Forebays

The stormwater drainage system contains many outfall locations, where treated stormwater is discharged to surface wetlands or existing drainage pipes. Outfall locations are shown on Figure A-1 included herein.

- At a minimum, inspect outfalls annually.
- At a minimum, inspect sediment forebays quarterly and clean them out annually. When mowing grasses, keep the grass height no greater than 6-inches. Set mower blades no lower than 3 to 4 inches. 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.
- Replace vegetation damaged during the clean-out by either reseeding or resodding. When reseeding, incorporate practices such as hydroseeding with a tackifier, blanket, or similar practice to ensure no scour occurs in the forebay, while the seeds germinate and develop roots

D.2.5 Roof Drain Leaders and Rooftop Recharge Systems

Roof runoff is directed to the rooftop recharge system via roof drain leaders. The rooftop recharge system uses perforated pipe to infiltrate clean runoff.

Inspections and Cleaning

- Perform routine roof drain leader and recharge system inspections and cleanings annually.
- Keep roofs clean and free of debris.
- Keep roof drainage systems clear.
- Keep roof access limited to authorized personnel.
- Clean inlets once per year.

D.3 Vegetated Stormwater Management Devices

D.3.1 Bioretention Basins

The bioretention basins are excavated shallow surface depressions planted with specially-selected native vegetation to treat and capture runoff. Each rain garden also has an overflow structure leading to the larger stormwater collection system.

The vegetation in the bioretention basisns serves to filter runoff — improving water quality and reducing runoff quantity — and the root systems can enhance infiltration. The soil medium filters out pollutants and allows storage and infiltration of stormwater runoff. Properly designed bioretention basisns may mimic natural forest ecosystems through species diversity, density and distribution of vegetation, and the use of native species, resulting in a system that is resistant to insects, disease, pollution, and climatic stresses.

Bioretention basins require routine maintenance (similar to conventional landscaping maintenance) to ensure that the system both functions well as a stormwater management practice while also maintaining an aesthetic quality compatible with the surrounding land uses.

Replacement of mulch is an important part of bioretnetion basin maintenance. Mulch keeps the soil moist, allowing for easy infiltration of rain water. Un-mulched surfaces may develop into a hardpan, a condition in which the soil surface becomes cemented together, forming a hard, impervious layer. Mulching also protects plants and reduces weed growth.

Initial Post-Construction Inspection

- Bio-retention basins should be inspected after every major storm for the first few months to ensure proper stabilization and function.
- During the initial period of vegetation establishment pruning and weeding are required twice in first year by contractor.
- Any dead vegetation found after the first year must be replaced.
- Proper mulching is mandatory and regular watering may be required initially to ensure proper establishment of new vegetation.

Long-Term Maintenance

- Weeds and invasive plant species shall be removed by hand.
- Leaf litter and other detritus shall be removed twice per year.
- If needed to maintain aesthetic appearance, perennial plantings may be trimmed at the end of the growing season.
- Trees and shrubs should be inspected twice per year to evaluate health and attended to as necessary.
- Re-mulch bioretention basins with well-aged hardwood mulch to a depth of 3 inches each spring or whenever erosion is evident. The entire area may require

mulch replacement once every two to three years. Mulch depth shall not exceed 3 inches and the depth of the depression shall not be compromised by the accumulation of vegetation or old mulch.

- Seeded ground cover or grass areas shall not receive mulching.
- Fertilizers should not be used in the bioretention basins as excessive nutrients in the bioretention basins may migrate to the underdrain and be discharged to adjacent surface waters.
- Test pH of the soils in the planting bed annually. If the pH is below 5.2, limestone should be applied to increase it. If the pH is above 8.0, iron sulfate plus sulfur should be added to reduce it.
- Bioretention basisns may require watering during periods of extended drought.

D.3.2 Vegetated Areas Maintenance

Although not a structural component of the drainage system, the maintenance of vegetated areas may affect the functioning of the stormwater management system. This includes the health/density of vegetative cover and activities such as the application and disposal of lawn and garden care products, disposal of leaves and yard trimmings and proper aeration of soils.

- 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.
- No pesticides or herbicides are allowed within the 100' adjacent upland resource area property without prior approval of the Conservation Commission.
- Fertilizer usage should be avoided. If deemed necessary, fertilizer may only be of the low nitrogen and phosphorous variety. 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.
- Fertilizer applications shall be limited to the spring and early fall, and applied per the manufacturers' specifications. Nitrogen content shall not exceed 25% with ratios for Nitrogen, Phosphorus, and Potassium at 3-1-2 or 3-1-1. It is also recommended at least 30%-50% of total nitrogen be slow release.
- Annual application of compost amendments and aeration are recommended.

D.3.3 Vegetated Drainage Systems

The vegetated drainage system shall include the Retention Basin (Constructed Stormwater Wetland) and the Modified Treatment Swale. The swale and retention basin shall be inspected annually. All sediment and debris shall be removed and disposed according to local, state and federal regulations.

Regular maintenance includes mowing and pruning, and weed control. Mow swales at least once per year. Do not cut the grass shorter than three to four inches, otherwise the effectiveness of the vegetation in reducing flow velocity and removing pollutants may be reduced. Do not let grass height exceed 6 inches. Manually remove sediment and debris at least once per year, and periodically re-seed during the spring or fall growing seasons, if necessary, to maintain a dense growth of vegetation. Take care to protect water quality swales from snow removal and disposal practices and off-street parking.

The vegetated drainage systems require small-scale maintenance at regular intervals to evaluate the health and composition of the plant species. During these inspections, record and map the following information:

- Notable changes in the general extent of standing water; changes in the general configuration and scale of standing water within the drainage system can signal that hydraulic conditions in the outfall or outlet channel areas, or in downstream BMP's are occurring. If significant changes in standing water are observed, follow-up activities should include identification of the source of the change.
- Stability of embankments, channels, and outfall areas; where minor erosion is observed in any area it should be noted and logged for future monitoring. Where significant erosion or instability of embankments or other earth structures are noted, they should be logged and corrective action should be scheduled.
- Accumulation of sediment; accumulated sediment at inlet locations should be removed by hand excavation (or mechanical excavation if such activity will not diminish the structural integrity of the inlet area) once per year. Sediment that has been deposited in the interior portions of an open drainage system should be removed by hand excavation or vacuum extraction when, in the opinion of the Site Manager, the accumulation has a detrimental effect on the drainage system in terms of plant health and/or retention volume in channels or ponded areas.

Section E - Operations and Maintenance Summary

Operations & Maintenance Plan Summary

This Operation and Maintenance Plan has been prepared in accordance with the Stormwater Management Policy developed by the DEP and local regulations. It specifies operational practices and drainage system maintenance requirements for the village retail and assisted living facility of multi-phased mixed-use redevelopment. Requirements should be adjusted by the site manager as necessary to ensure successful functioning of system components.

E.1 Routine Maintenance Checklists

Routine required maintenance is described in Sections A – D. The following checklists are to be used by the property manager to implement and document the required maintenance and inspection tasks.

E.2 Reporting and Documentation

The site supervisor shall be responsible for ensuring that the scheduled tasks as described in this plan are appropriately completed and recorded in the Maintenance Log. Accurate records of all inspections, routine maintenance and repairs shall be documented and these records shall be available for inspection by members of the Sudbury Conservation Commission, or their designated agent, upon request.

The Maintenance Log shall:

- Document the completion of required maintenance tasks.
- Identify the person responsible for the completion of tasks.
- Identify any outstanding problems, malfunctions or inconsistencies identified during the course of routine maintenance.
- Document specific repairs or replacements.

E.3 Long Term Maintenance/ Evaluation Checklist

Village Retail & Bridges by Epoch at Meadow Walk– Sudbury, Massachusetts

These checklists are provided for the maintenance crew to photocopy and use when conducting inspections and cleaning activities to the stormwater management systems.

Date:____________________Name of Inspector:____

Catch Basins and Landscape Drains – Inspect 4 times per year, clean when sediment depth >1/2 depth of sump or at least once per year					
Structure	Inspected (Y/N)	Sediment Depth (inches)	Cleaning needed (Y/N)	Date Cleaned	Comments (Trash, Oil, Pet Waste, Lawn Debris, Damaged)
				/ /	
				/ /	
				/ /	
				/ /	
				/ /	
				/ /	
				/ /	
				/ /	
				/ /	
				/ /	
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				/ /	
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				/ /	
				/ /	

Date: ____________________Name of Inspector: ______________________________________

Water Quality/Pretreatment Devices – Inspect 2 times per year, clean at least once per year or when sediment reaches a depth of 75% of the sump					
Device	Inspected (Y/N)	Sediment Depth (inches)	Cleaning needed (Y/N)	Date Cleaned	Comments
WQU-				/ /	
Manhole baffle intact?				/ /	
WQU-				/ /	
Manhole baffle intact?				/ /	
WQU-				/ /	
Manhole baffle intact?				/ /	
WQU-				/ /	
Manhole baffle intact?				/ /	
WQU-				/ /	
Manhole baffle intact?				/ /	
WQU-				/ /	
Manhole baffle intact?				/ /	

Date: ____________________Name of Inspector: ____

Roof Runoff Systems – Inspect once per year and remove all debris at least once per year					
Building Number	Inspected (Y/N)	Sediment Depth (inches)	Cleaning needed (Y/N)	Date Cleaned	Comments (Trash, Oil, Pet waste, Lawn Debris, Damage)
				/ /	
				/ /	
				/ /	
				/ /	
				/ /	
				/ /	
				/ /	
				/ /	
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				/ /	

Date: ____________________Name of Inspector: ____

Stormwater Outfalls – Inspect outfalls once per year, clean as needed.					
Outfall	Inspected (Y/N)	Sediment Depth (inches)	Cleaning needed (Y/N)	Date Cleaned	Comments (Trash, Oil, Pet waste, Lawn Debris, Damage)
				/ /	
				/ /	
				/ /	
				/ /	
				/ /	
				/ /	
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				/ /	

Date: ____________________Name of Inspector: ____

Subsurface Infiltration Systems – Inspect once per year					
System/Inspection Item	Inspected (Y/N)	Sediment Depth (inches)	Cleaning needed (Y/N)	Date Cleaned	Comments
P				/ /	
Proper drainage/ function				/ /	
Sediment carryover				/ /	
Major rainfall inspection				/ /	
Immediate oil/hazardous material removal				/ /	
Integrity/ function of structures				/ /	
Other maintenance as necessary				/ /	
P				/ /	
Proper drainage/ function				/ /	
Sediment carryover				/ /	
Major rainfall inspection				/ /	
Immediate oil/hazardous material removal				/ /	
Integrity/ function of structures				/ /	
Other maintenance as necessary				/ /	

Date: ____________________ Name of Inspector: ____

Surface Infiltration/Bio-retention Basins – Inspect twice per year. If sediment build-up is found, core aeration or cultivating of unvegetated areas may be required to ensure adequate filtration.					
Surface Infiltration/Detention Basin	Inspected (Y/N)	Sediment Depth (inches)	Cleaning needed (Y/N)	Date Cleaned	Comments (Trash, Oil, Pet waste, Lawn Debris, Damage)
P				/ /	
Sediment buildup and erosion				/ /	
Monthly trash/debris removal				/ /	
Bi-annual pruning and vegetation maintenance				/ /	
Major rainfall inspection				/ /	
Immediate oil/hazardous material removal				/ /	
Integrity/function of structures				/ /	
Other maintenance as necessary				/ /	
P				/ /	
Sediment buildup and erosion				/ /	
Monthly trash/debris removal				/ /	
Bi-annual pruning and vegetation maintenance				/ /	
Major rainfall inspection				/ /	
Immediate oil/hazardous material removal				/ /	
Integrity/function of structures				/ /	
Other maintenance as necessary				/ /	

E.3a Construction Practices Maintenance/ Evaluation Checklist

Village Retail & Bridges by Epoch at Meadow Walk – Sudbury, Massachusetts

Best Management Practice	Inspection Frequency	Date Inspected	Inspector Initials	Minimum Maintenance and Key Items to Check	Cleaning or Repair Needed Yes/No (List Items)	Date of Cleaning or Repair	Performed by:
Hay Bales/Silt Fencing	Weekly or bi-weekly and after a ¼" rainfall event	/ /		Sediment build up, broken bales or stakes			
Gravel Construction Entrance	Weekly or bi-weekly and after a ¼" rainfall event	/ /		Filled voids, runoff/sediments into street			
Catch Basin Protection	Weekly or bi-weekly and after a ¼" rainfall event	/ /		Clogged or sediment build-up at surface or in basin			
Diversion Channels	Weekly or bi-weekly and after a ¼" rainfall event	/ /		Maintained, moved as necessary to correct locations, Check for erosion or breakout			
Temporary Sedimentation Basins	Weekly or bi-weekly and after a ¼" rainfall event	/ /		Cracking, erosion, breakout, sediment buildup, contaminants			

Date of Inspection: ______________________________

Stormwater Control Manager: ______________________

Inspector (list title/qualifications):____________________

Weather: __________________________________ Weather since last inspection: ____________________________________

Comments:____

____

____

E.3b Construction Stormwater Management System Evaluation Checklist

Village Retail & Bridges by Epoch at Meadow Walk – Sudbury, Massachusetts

Date:______________________________

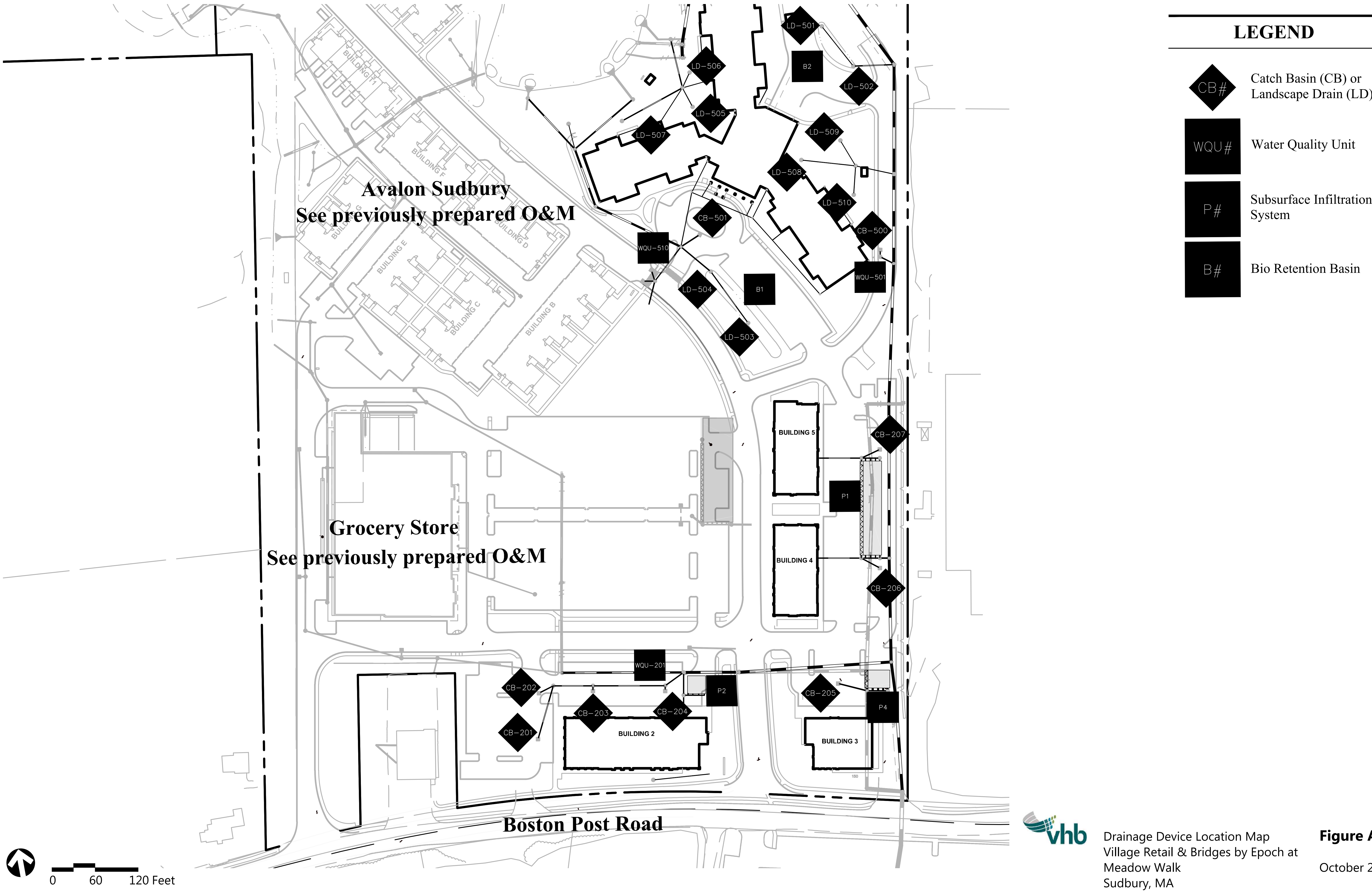
Name:______________________________ Title/Qualifications:______________________________

Stormwater Management Component/Location Evaluated:____

Notes (Please note any variations from approved construction specifications; compliance with construction plans; violations, etc):

Figure A-1 –
Device Location Map

\\vhb\proj\Wat-LD\13125.00\cad\ld\Eng\StormwaterO&MFigs\Retail-Bridges\13125.00 - Drainage Device Location Map_Retail-Bridges.dwg



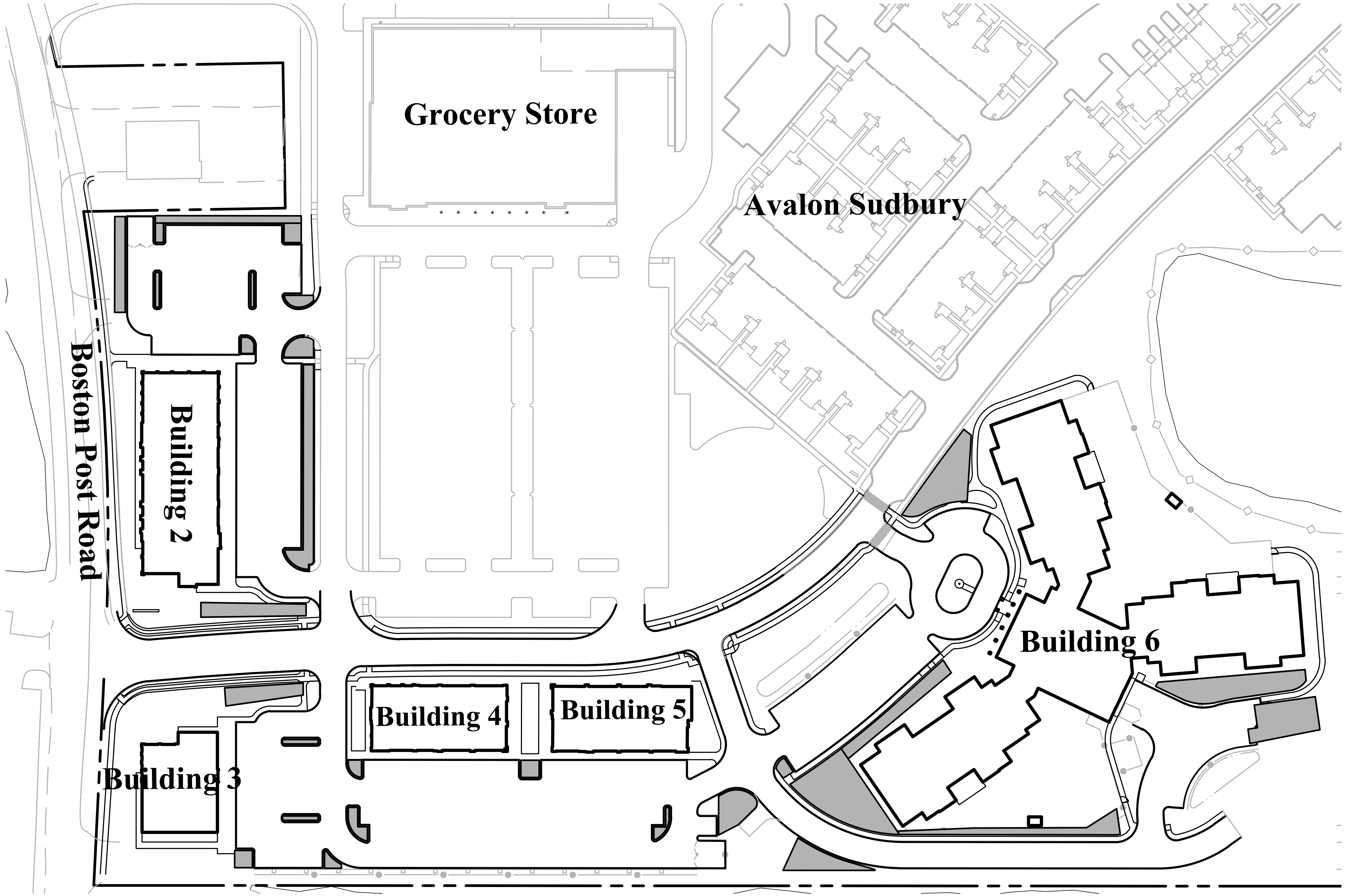
Drainage Device Location Map
Village Retail & Bridges by Epoch at
Meadow Walk
Sudbury, MA

Figure A-1

October 2016

Figure B-1 –
Snow Storage Plan

\\vhb\proj\Wat-LD\13125.00\cad\ld\Eng\StormwaterO&MFigs\Retail-Bridges\13125.00 - Snow Storage-Bridges.dwg



Legend

Approximate Snow Storage Area

Notes

1. The Retail area has approximately 2.3 acres of paved vehicular area and sidewalk. The Bridges area has approximately 1.8 acres of paved area and sidewalk. The plan does not include snow storage for the roof or pervious areas.

2. The plan depicts approximately 24,800 SF of area available for snow storage within the retail and Bridges area. This area is estimated to accommodate an approximate 1.5' snowfall, assuming 5:1 compaction and an average snow pile height of 2'. Additional snow storage is available in pervious areas throughout the project area such as in between buildings and sidewalks along the roadway.

3. Under no circumstance shall snow be stored in any wetland resource area or proposed stormwater best management practice.

4. Snow storage will be implemented to avoid hydrants, fences, landscaping, and other permanent features.

0 50 100 Feet

vhb

Snow Storage Plan
Village Retail & Bridges by Epoch at Meadow Walk
Sudbury, MA

Figure B-1

October 2016

Section F – MA Stormwater Handbook BMP and Product Literature

CONTECH ENGINEERED SOLUTIONS

CDS® Inspection and Maintenance Guide

CDS TECHNOLOGIES

Maintenance

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

Inspection

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

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

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

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

Cleaning

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

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

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

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

Table 1: CDS Maintenance Indicators and Sediment Storage Capacities

Support

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

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

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CDS Inspection & Maintenance Log

CDS Model: ______________________ Location: ______________________

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

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

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

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Save Valuable Land and Protect Water Resources

Isolator® Row O&M Manual

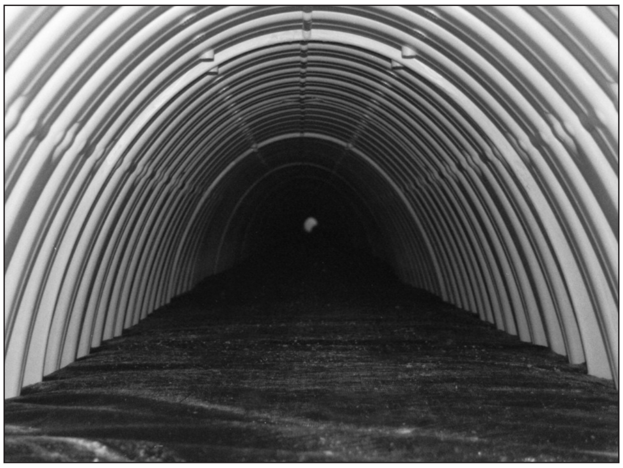
StormTech® Chamber System for Stormwater Management

U.S. GREEN BUILDING COUNCIL MEMBER

1.0 The Isolator® Row

1.1 INTRODUCTION

An important component of any Stormwater Pollution Prevention Plan is inspection and maintenance. The StormTech Isolator Row is a patented technique to inexpensively enhance Total Suspended Solids (TSS) removal and provide easy access for inspection and maintenance.



Looking down the Isolator Row from the manhole opening, woven geotextile is shown between the chamber and stone base.

1.2 THE ISOLATOR ROW

The Isolator Row is a row of StormTech chambers, either SC-310, SC-310-3, SC-740, DC-780, MC-3500 or MC-4500 models, that is surrounded with filter fabric and connected to a closely located manhole for easy access. The fabric-wrapped chambers provide for settling and filtration of sediment as storm water rises in the Isolator Row and ultimately passes through the filter fabric. The open bottom chambers and perforated sidewalls (SC-310, SC-310-3 and SC-740 models) allow storm water to flow both vertically and horizontally out of the chambers. Sediments are captured in the Isolator Row protecting the storage areas of the adjacent stone and chambers from sediment accumulation.

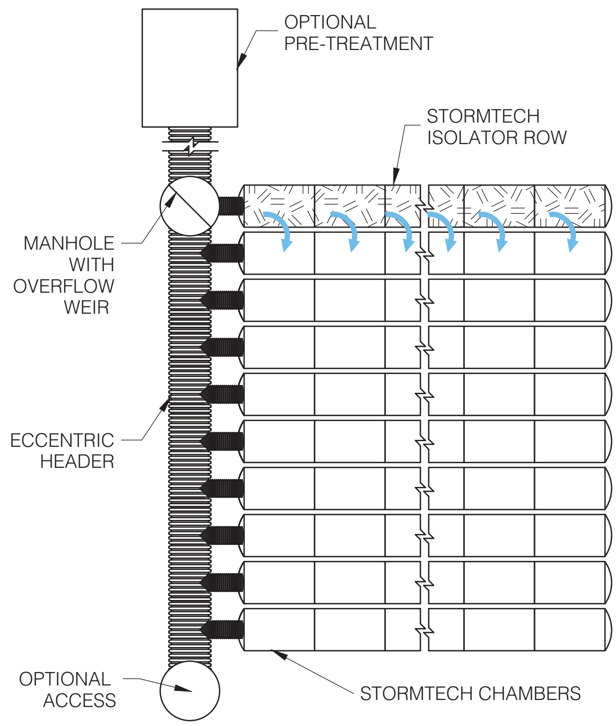
Two different fabrics are used for the Isolator Row. A woven geotextile fabric is placed between the stone and the Isolator Row chambers. The tough geotextile provides a media for storm water filtration and provides a durable surface for maintenance operations. It is also designed to prevent scour of the underlying stone and remain intact during high pressure jetting. A non-woven fabric is placed over the chambers to provide a filter media for flows passing through the perforations in the sidewall of the chamber. The non-woven fabric is not required over the DC-780, MC-3500 or MC-4500 models as these chambers do not have perforated side walls.

The Isolator Row is typically designed to capture the "first flush" and offers the versatility to be sized on a volume basis or flow rate basis. An upstream manhole not only provides access to the Isolator Row but typically includes a high flow weir such that storm water flowrates or volumes that exceed the capacity of the Isolator Row overtop the over flow weir and discharge through a manifold to the other chambers.

The Isolator Row may also be part of a treatment train. By treating storm water prior to entry into the chamber system, the service life can be extended and pollutants such as hydrocarbons can be captured. Pre-treatment best management practices can be as simple as deep sump catch basins, oil-water separators or can be innovative storm water treatment devices. The design of the treatment train and selection of pretreatment devices by the design engineer is often driven by regulatory requirements. Whether pretreatment is used or not, the Isolator Row is recommended by StormTech as an effective means to minimize maintenance requirements and maintenance costs.

Note: See the StormTech Design Manual for detailed information on designing inlets for a StormTech system, including the Isolator Row.

StormTech Isolator Row with Overflow Spillway
(not to scale)



2.0 Isolator Row Inspection/Maintenance

2.1 INSPECTION

The frequency of Inspection and Maintenance varies by location. A routine inspection schedule needs to be established for each individual location based upon site specific variables. The type of land use (i.e. industrial, commercial, residential), anticipated pollutant load, percent imperviousness, climate, etc. all play a critical role in determining the actual frequency of inspection and maintenance practices.

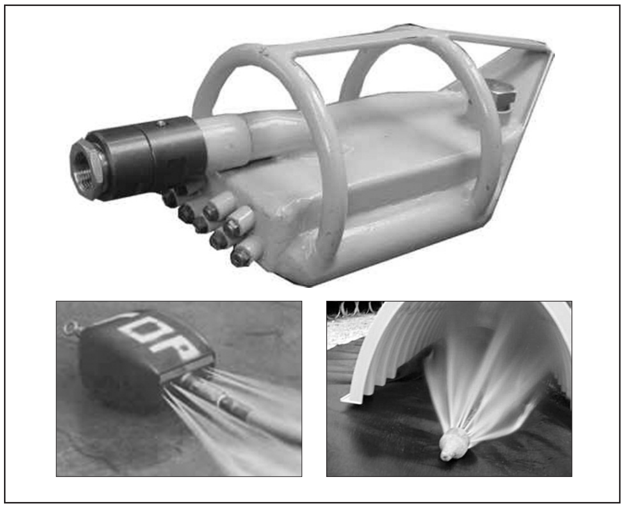
At a minimum, StormTech recommends annual inspections. Initially, the Isolator Row should be inspected every 6 months for the first year of operation. For subsequent years, the inspection should be adjusted based upon previous observation of sediment deposition.

The Isolator Row incorporates a combination of standard manhole(s) and strategically located inspection ports (as needed). The inspection ports allow for easy access to the system from the surface, eliminating the need to perform a confined space entry for inspection purposes.

If upon visual inspection it is found that sediment has accumulated, a stadia rod should be inserted to determine the depth of sediment. When the average depth of sediment exceeds 3 inches throughout the length of the Isolator Row, clean-out should be performed.

2.2 MAINTENANCE

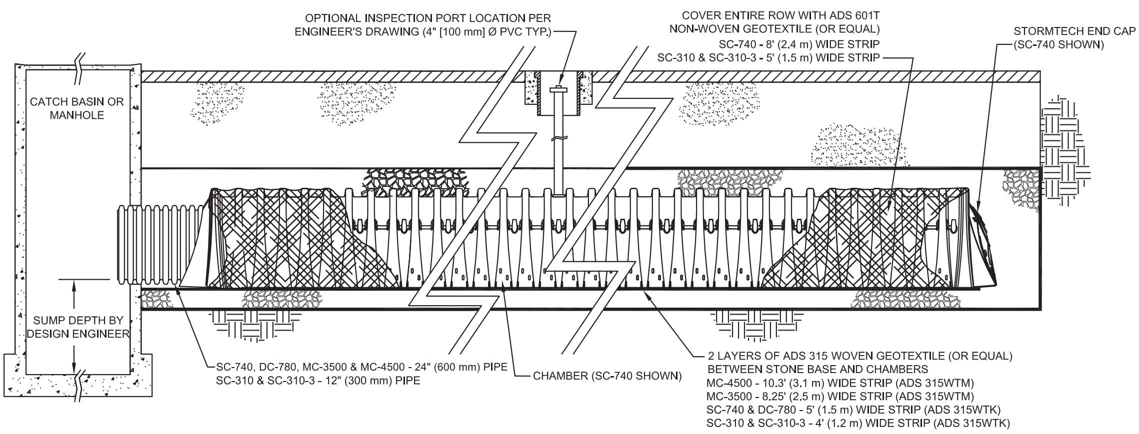
The Isolator Row was designed to reduce the cost of periodic maintenance. By “isolating” sediments to just one row, costs are dramatically reduced by eliminating the need to clean out each row of the entire storage bed. If inspection indicates the potential need for maintenance, access is provided via a manhole(s) located on the end(s) of the row for cleanout. If entry into the manhole is required, please follow local and OSHA rules for a confined space entries.



Examples of culvert cleaning nozzles appropriate for Isolator Row maintenance. (These are not StormTech products.)

Maintenance is accomplished with the JetVac process. The JetVac process utilizes a high pressure water nozzle to propel itself down the Isolator Row while scouring and suspending sediments. As the nozzle is retrieved, the captured pollutants are flushed back into the manhole for vacuuming. Most sewer and pipe maintenance companies have vacuum/JetVac combination vehicles. Selection of an appropriate JetVac nozzle will improve maintenance efficiency. Fixed nozzles designed for culverts or large diameter pipe cleaning are preferable. Rear facing jets with an effective spread of at least 45” are best. Most JetVac reels have 400 feet of hose allowing maintenance of an Isolator Row up to 50 chambers long. **The JetVac process shall only be performed on StormTech Isolator Rows that have AASHTO class 1 woven geotextile (as specified by StormTech) over their angular base stone.**

StormTech Isolator Row (not to scale)

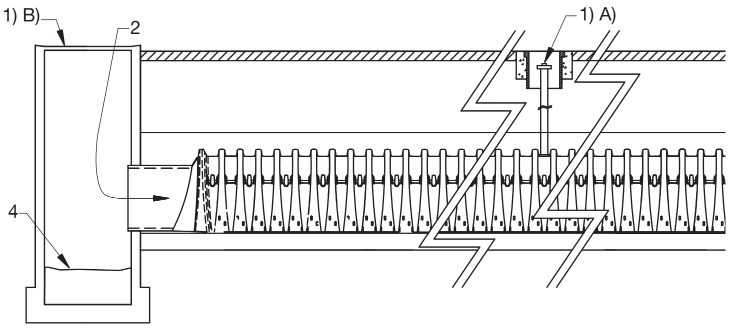


NOTE: NON-WOVEN FABRIC IS ONLY REQUIRED OVER THE INLET PIPE CONNECTION INTO THE END CAP FOR DC-780, MC-3500 AND MC-4500 CHAMBER MODELS AND IS NOT REQUIRED OVER THE ENTIRE ISOLATOR ROW.

3.0 Isolator Row Step By Step Maintenance Procedures

Step 1) Inspect Isolator Row for sediment
- A) Inspection ports (if present)
  - i. Remove lid from floor box frame
  - ii. Remove cap from inspection riser
  - iii. Using a flashlight and stadia rod, measure depth of sediment and record results on maintenance log.
  - iv. If sediment is at, or above, 3 inch depth proceed to Step 2. If not proceed to step 3.
- B) All Isolator Rows
  - i. Remove cover from manhole at upstream end of Isolator Row
  - ii. Using a flashlight, inspect down Isolator Row through outlet pipe
    1. Mirrors on poles or cameras may be used to avoid a confined space entry
    2. Follow OSHA regulations for confined space entry if entering manhole
  - iii. If sediment is at or above the lower row of sidewall holes (approximately 3 inches) proceed to Step 2. If not proceed to Step 3.

StormTech Isolator Row (not to scale)



Step 2) Clean out Isolator Row using the JetVac process
- A) A fixed culvert cleaning nozzle with rear facing nozzle spread of 45 inches or more is preferable
- B) Apply multiple passes of JetVac until backflush water is clean
- C) Vacuum manhole sump as required

Step 3) Replace all caps, lids and covers, record observations and actions

Step 4) Inspect & clean catch basins and manholes upstream of the StormTech system

Sample Maintenance Log

Date	Stadia Rod Readings		Sediment Depth (1) - (2)	Observations/Actions	Inspector
	Fixed point to chamber bottom (1)	Fixed point to top of sediment (2)			
3/15/01	6.3 ft.	none		New installation. Fixed point is CI frame at grade	djm
9/24/01		6.2	0.1 ft.	Some grit felt	sm
6/20/03		5.8	0.5 ft.	Mucky feel, debris visible in manhole and in Isolator row, maintenance due	rv
7/7/03	6.3 ft.		0	System jetted and vacuumed	djm

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Bioretention Areas & Rain Gardens

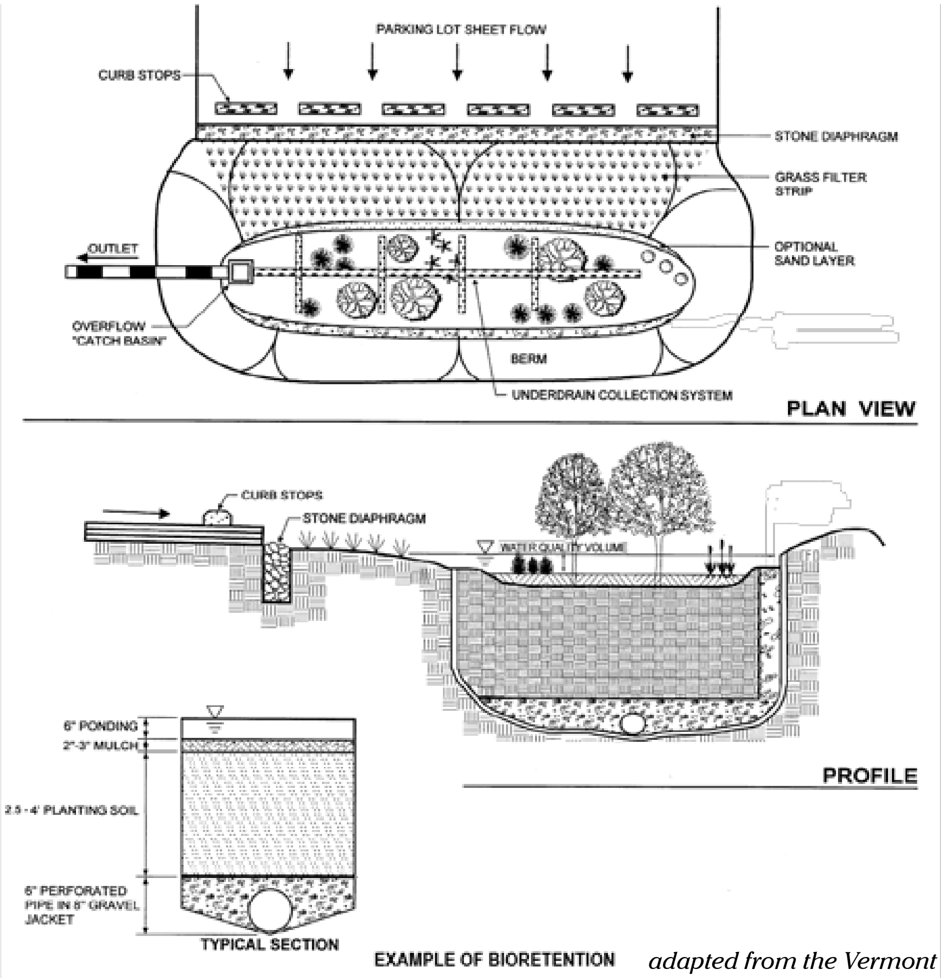
Description: Bioretention is a technique that uses soils, plants, and microbes to treat stormwater before it is infiltrated and/or discharged. Bioretention cells (also called rain gardens in residential applications) are shallow depressions filled with sandy soil topped with a thick layer of mulch and planted with dense native vegetation. Stormwater runoff is directed into the cell via piped or sheet flow. The runoff percolates through the soil media that acts as a filter.
There are two types of bioretention cells: those that are designed solely as an organic filter filtering bioretention areas and those configured to recharge groundwater in addition to acting as a filter exfiltrating bioretention areas. A filtering bioretention area includes an impermeable liner and underdrain that intercepts the runoff before it reaches the water table so that it may be conveyed to a discharge outlet, other best management practices, or the municipal storm drain system. An exfiltrating bioretention area has an underdrain that is designed to enhance exfiltration of runoff into the groundwater.

Ability to meet specific standards

Standard	Description
2 - Peak Flow	N/A
3 - Recharge	An exfiltrating bioretention area provides groundwater recharge.
4 - TSS Removal	90% TSS removal credit with adequate pretreatment
5 - Higher Pollutant Loading	Can be used for certain land uses with higher potential pollutant loads if lined and sealed until adequate pretreatment is provided. Adequate pretreatment must include 44% TSS removal prior to infiltration. For land uses that have the potential to generate runoff with high concentrations of oil and grease such as high intensity use parking lots and gas stations, adequate pretreatment may also include an oil grit separator, sand filter or equivalent. In lieu of an oil grit separator or sand filter, a filtering bioretention area also may be used as a pretreatment device for infiltration practices exfiltrating runoff from land uses with a potential to generate runoff with high concentrations of oil and grease.
6 - Discharges near or to Critical Areas	Good option for discharges near cold-water fisheries. Should not be used near bathing beaches and shellfish growing areas.
7 - Redevelopment	Suitable with appropriate pretreatment

Pollutant Removal Efficiencies

• Total Suspended Solids (TSS)	90% with vegetated filter strip or equivalent
• Total Nitrogen	30% to 50% if soil media at least 30 inches
• Total Phosphorus	30% to 90%
• Metals (copper, lead, zinc, cadmium)	40% to 90%
• Pathogens (coliform, e coli)	Insufficient data



adapted from the Vermont Stormwater Manual

Special Features:
- Can be lined and sealed to prevent recharge where appropriate
- Adequate pretreatment is essential
- Not recommended in areas with steep slope
- Depth of soil media depends on type of vegetation that is proposed
- Soil media must be 30 inches deep to achieve removal of nitrogen

Advantages/Benefits:
- Can be designed to provide groundwater recharge and preserves the natural water balance of the site
- Can be designed to prevent recharge where appropriate
- Supplies shade, absorbs noise, and provides windbreaks
- Can remove other pollutants besides TSS including phosphorus, nitrogen and metals
- Can be used as a stormwater retrofit by modifying existing landscape or if a parking lot is being resurfaced
- Can be used on small lots with space constraints
- Small rain gardens are mosquito death traps
- Little or no hazard for amphibians or other small animals

Disadvantages/Limitations:
- Requires careful landscaping and maintenance
- Not suitable for large drainage areas

Maintenance

Activity	Frequency
Inspect and remove trash	Monthly
Mow	2 to 12 times per year
Mulch	Annually
Fertilize	Annually
Remove dead vegetation	Annually
Prune	Annually

Bioretention Areas & Rain Gardens

Not all bioretention cells are designed to exfiltrate. Only the infiltration requirements are applicable to bioretention cells intended to exfiltrate.

Applicability

Bioretention areas can provide excellent pollutant removal for the "first flush" of stormwater runoff. Properly designed and maintained cells remove suspended solids, metals, and nutrients, and can infiltrate an inch or more of rainfall. Distributed around a property, vegetated bioretention areas can enhance site aesthetics. In residential developments they are often described as "rain gardens" and marketed as property amenities. Routine maintenance is simple and can be handled by homeowners or conventional landscaping companies, with proper direction.

Bioretention systems can be applied to a wide range of commercial, residential, and industrial developments in many geologic conditions; they work well on small sites and on large sites divided into multiple small drainage areas. Bioretention systems are often well suited for ultra-urban settings where little pervious area exists. Although they require significant space (approximately 5% to 7% of the area that drains to them), they can be integrated into parking lots, parking lot islands, median strips, and traffic islands. Sites can be retrofitted with bioretention areas by replacing existing parking lot islands or by re-configuring a parking lot during resurfacing. On residential sites, they are commonly used for rooftop and driveway runoff.

Effectiveness

Bioretention areas remove pollutants through filtration, microbe activity, and uptake by plants; contact with soil and roots provides water quality treatment better than conventional infiltration structures. Studies indicate that bioretention areas can remove from 80% to 90% of TSS. If properly designed and installed, bioretention areas remove phosphorus, nitrogen, metals, organics, and bacteria to varying degrees.

Bioretention areas help reduce stress in watersheds that experience severe low flows due to excessive impervious cover. Low-tech, decentralized bioretention areas are also less costly to design, install, and maintain than conventional stormwater technologies that treat runoff at the end of the pipe.

Decentralized bioretention cells can also reduce the size of storm drain pipes, a major component of stormwater treatment costs. Bioretention areas enhance the landscape in a variety of ways: they improve the appearance of developed sites, provide windbreaks, absorb noise, provide wildlife habitat, and reduce the urban heat island effect.

Planning Considerations

Filtering bioretention areas are designed with an impermeable liner and underdrain so that the stormwater may be transported to additional BMPs for treatment and/or discharge. Exfiltrating bioretention areas are designed so that following treatment by the bioretention area the stormwater may recharge the groundwater.

Both types of bioretention areas may be used to treat runoff from land uses with higher potential pollutant loads. However, exfiltrating bioretention areas may be used to treat runoff from land uses with higher potential pollutant loads, only if pretreatment has been provided to achieve TSS removal of at least 44%. If the land use has the potential to generate runoff with high concentrations of oil and grease, other types of pretreatment, i.e., a deep sump catch basin and oil grit separator or a sand filter, is required prior to discharge of runoff to an exfiltrating bioretention area. A filtering bioretention area may also be used as a pretreatment device for an exfiltrating bioretention area or other infiltration practice that exfiltrates runoff from land uses with a potential to generate runoff with high concentrations of oil and grease.

To receive 90% TSS removal credit, adequate pretreatment must be provided. If the flow is piped to the bioretention area a deep sump catch catch basin and sediment forebay should be used to provide pretreatment. For sheet flow, there are a number or pretreatment options. These options include:

- A vegetated filter strip, grass channel or water quality swale designed in accordance with the specifications set forth in Chapter 2.
- A grass and gravel combination. This should consist of at least 8 inches of gravel followed by 3 to 5 feet of sod. (source: North Carolina Stormwater Manual, 2007, http://h2o.enr.state.nc.us/su/documents/Ch12-Bioretention_001.pdf)
- Pea diaphragm combined with a vegetated filter strip specially designed to provide pretreatment for a bioretention area as set forth in the following table. (source: Georgia Stormwater Manual and Claytor and Schuler 1996)

Dimensions for Filter Strip Designed Specially to Provide Pretreatment for Bioretention Area

Parameter	Impervious Area				Pervious Areas (lawns, etc.)			
Maximum inflow approach length (feet)	35		75		75		100	
Filter strip slope (max=6%)	<2%	>2%	<2%	>2%	<2%	>2%	<2%	>2%
Filter strip minimum length (feet)	10	15	20	25	10	12	15	18

Bioretention areas must not be located on slopes greater than 20%. When the bioretention area is designed to exfiltrate, the design must ensure vertical separation of at least 2 feet from the seasonal high groundwater table to the bottom of the bioretention cell.

For residential rain gardens, pick a low spot on the property, and route water from a downspout or sump pump into it. It is best to choose a location with full sun, but if that is not possible, make sure it gets at least a half-day of sunlight.

Do not excavate an extensive rain garden under large trees. Digging up shallow feeder roots can weaken or kill a tree. If the tree is not a species that prefers moisture, the additional groundwater could damage it. Size the bioretention area using the methodology set forth in Volume 3.

Design

Size the bioretention area to be 5% to 7% of the area draining to it. Determine the infiltrative capacity of the underlying native soil by performing a soil evaluation in accordance with Volume 3. Do not use a standard septic system (i.e., Title 5) percolation test to determine soil permeability.

The depth of the soil media must be between 2 and 4 feet. This range reflects the fact that most of the pollutant removal occurs within the first 2 feet of soil and that excavations deeper than 4 feet become expensive. The depth selected should accommodate the vegetation. If the minimum depth is used, only shallow rooted plants and grasses my be used. If there is a Total Maximum Daily Load that requires nitrogen to be removed from the stormwater dischrges, the bioretention area should have a soil media with a depth of at least 30 inches, because nitrogen removal takes place 30 inches below the ground surface. If trees and shrubs are to be planted, the soil media should be at least 3 feet.

Size the cells (based on void space and ponding area) at a minimum to capture and treat the required water quality volume (the first 0.5 inch or 1 inch of runoff) if intended to be used for water quality treatment (Stormwater Standard No. 4), the required recharge volume if used for recharge (Stormwater Standard No. 3), or the larger of the two volumes if used to achieve compliance with both Stormwater Standards 3 and 4.

Cover the bottom of the excavation with coarse gravel, over pea gravel, over sand. Earlier designs used filter fabric as a bottom blanket, but more recent experiences show that filter fabric is prone to clogging. Consequently, do not use fabric filters or sand curtains. Use the Engineered Soil Mix below.

Engineered Soil Mix for Bioretention Systems Designed to Exfiltrate

- The soil mix for bioretention areas should be a mixture of sand compost and soil.
  - o 40 % sand,
  - o 20-30% topsoil, and
  - o 30-40% compost.

- The soil mix must be uniform, free of stones, stumps, roots or similar objects larger than 2 inches. Clay content should not exceed 5%.
- Soil pH should generally be between 5.5-6.5, a range that is optimal for microbial activity and adsorption of nitrogen, phosphorus, and other pollutants.
- Use soils with 1.5% to 3% organic content and maximum 500-ppm soluble salts.
- The sand component should be gravelly sand that meets ASTM D 422.

Sieve Size	Percent Passing
2-inch	100
¾-inch	70-100
¼-inch	50-80
U.S. No. 40	15-40
U.S. No. 200	0-3

- The topsoil component shall be a sandy loam, loamy sand or loam texture.
- The compost component must be processed from yard waste in accordance with MassDEP Guidelines (see http://www.mass.gov/dep/recycle/reduce/leafguid.doc). The compost shall not contain biosolids.

On-site soil mixing or placement is not allowed if soil is saturated or subject to water within 48 hours. Cover and store soil to prevent wetting or saturation.

Test soil for fertility and micro-nutrients and, only if necessary, amend mixture to create optimum conditions for plant establishment and early growth.

Grade the area to allow a ponding depth of 6 to 8 inches; depending on site conditions, more or less ponding may be appropriate.

Cover the soil with 2 to 3 inches of fine-shredded hardwood mulch.

The planting plan shall include a mix of herbaceous perennials, shrubs, and (if conditions permit) understory trees that can tolerate intermittent ponding, occasional saline conditions due to road salt, and extended dry periods. A list of plants that are suitable for bioretention areas can be found at the end of this section. To avoid a monoculture, it is a good practice to include one tree or shrub per 50 square feet of bioretention area, and at least 3 species each of herbaceous perennials and shrubs. Invasive and exotic species are prohibited. The planting plan should also meet any applicable local landscaping requirements.

All exfiltrating bioretention areas must be designed to drain within 72 hours. However, rain gardens are typically designed to drain water within a day and are thus unlikely to breed mosquitoes.

Bioretention cells, including rain gardens, require pretreatment, such as a vegetated filter strip. A stone or pea gravel diaphragm or, even better, a concrete level spreader upstream of a filter strip will enhance sheet flow and sediment removal.
Bioretention cells can be dosed with sheet flow, a surface inlet, or pipe flow. When using a surface inlet, first direct the flow to a sediment forebay. Alternatively, piped flow may be introduced to the bioretention system via an underdrain.

For bioretention cells dosed via sheet flow or surface inlets, include a ponding area to allow water to pond and be stored temporarily while stormwater is exfiltrating through the cell. Where bioretention areas are adjacent to parking areas, allow three inches of freeboard above the ponding depth to prevent flooding.

Most bioretention cells have an overflow drain that allows ponded water above the selected ponding depth to be dosed to an underdrain. If the bioretention system is designed to exfiltrate, the underdrain is not connected to an outlet, but instead terminates in the bioretention cell. If the bioretention area is not designed to exfiltrate, the underdrain is connected to an outlet for discharge or conveyance to additional best management practices.

Construction

During construction, avoid excessively compacting soils around the bioretention areas and accumulating silt around the drain field. To minimize sediment loading in the treatment area, direct runoff to the bioretention area only from areas that are stabilized; always divert construction runoff elsewhere.

To avoid compaction of the parent material, work from the edge of the area proposed as the location of an exfiltrationg bioretention cell. Never direct runoff to the cell until the cell and the contributing drainage areas are fully stabilized.

Place planting soils in 1-foot to 2-foot lifts and compact them with minimal pressure until the desired elevation is reached. Some engineers suggest flooding the cell between each lift placement in lieu of compaction.

Maintenance

Premature failure of bioretention areas is a significant issue caused by lack of regular maintenance. Ensuring long-term maintenance involves sustained public education and deed restrictions or covenants for privately owned cells. Bioretention areas require careful attention while plants are being established

Bioretention Maintenance Schedule

Activity	*Time of Year*	*Frequency*
Inspect & remove trash	Year round	Monthly
Mulch	Spring	Annually
Remove dead vegetation	Fall or Spring	Annually
Replace dead vegetation	Spring	Annually
Prune	Spring or Fall	Annually
Replace entire media & all vegetation	Late Spring/early Summer	As needed*

** Paying careful attention to pretreatment and operation & maintenance can extend the life of the soil media* and seasonal landscaping maintenance thereafter.

In many cases, a landscaping contractor working elsewhere on the site can complete maintenance tasks. Inspect pretreatment devices and bioretention cells regularly for sediment build-up, structural damage, and standing water.

Inspect soil and repair eroded areas monthly. Re-mulch void areas as needed. Remove litter and debris monthly. Treat diseased vegetation as needed. Remove and replace dead vegetation twice per year (spring and fall).

Proper selection of plant species and support during establishment of vegetation should minimize—if not eliminate—the need for fertilizers and pesticides. Remove invasive species as needed to prevent these species from spreading into the bioretention area. Replace mulch every two years, in the early spring. Upon failure, excavate bioretention area, scarify bottom and sides, replace filter fabric and soil, replant, and mulch. A summary of maintenance activities can be found on the previous page.

Because the soil medium filters contaminants from runoff, the cation exchange capacity of the soil media will eventually be exhausted. When the cation exchange capacity of the soil media decreases, change the soil media to prevent contaminants from migrating to the groundwater, or from being discharged via an underdrain outlet. Using small shrubs and plants instead of larger trees will make it easier to replace the media with clean material when needed.

Plant maintenance is critical. Concentrated salts in roadway runoff may kill plants, necessitating removal of dead vegetation each spring and replanting. The operation and maintenance plan must include measures to make sure the plants are maintained. This is particularly true in residential subdivisions, where the operation and maintenance plan may assign each homeowner the legal responsibility to maintain a bioretention cell or rain garden on his or her property. Including the requirement in the property deed for new subdivisions may alert residential property owners to their legal responsibilities regarding the bioretention cells constructed on their lot.

Cold Climate Considerations

Never store snow in bioretention areas. The Operation and Maintenance plan must specify where on-site snow will be stored. All snow dumps must comply with MassDEP's guidance. When bioretention areas are located along roads, care must be taken during plowing operations to prevent snow from being plowed into the bioretention areas. If snow is plowed into the cells, runoff may bypass the cell and drain into downgradient wetlands without first receiving the required water quality treatment, and without recharging the groundwater.

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Plant Species Suitable for Use in Bioretention - Herbaceous Species

Species	Moisture Regime		Tolerance						Morphology			General Characteristics		Comments
Scientific Name Common Name	Indicator Status	Habitat	Ponding (days)	Salt	Oil/ Grease	Metals	Insects/ Disease	Exposure	Form	Height	Root System	Native	Wildlife	
Agrostis alba redtop	FAC	Mesic-Xeric	1-2	H	–	H	H	Shade	Grass	2-3'	Fiberous Shallow	Yes	High	–
Andropogon gerardi bluejoint	FAC	Dry Mesic-Mesic	1-2	–	–	–	–	Sun	Grass	2-3'	Fiberous Shallow	Yes	High	–
Andropogon virginicus broomsedge	–	Wet meadow	1-2	L	–			Full sun	Grass	1-3'		Yes	High	Tolerant of fluctuating water levels and drought.
Carex vulpinoidea fox sedge	OBL	Freshwater marsh	2-4	L	–			Sun to partial sun	Grass	2-3.5'	Rhizome	Yes	High	–
Chelone glabra														
Deschampsia caespitosa tufted hairgrass	FACW	Mesic to wet Mesic	2-4	H	–	H	H	Sun	Grass	2-3'	Fiberous Shallow	Yes	High	May become invasive.
Glyceria striata fowl mannagrass, nerved mannagrass	OBL	Freshwater marsh, seeps	1-2	L	–			Partial shade to full shade	Grass	2-4'	Rhizome	Yes	High	–
Hedera helix English Ivy	FACU	Mesic	1-2	–	–	–	H	Sun	Evergreen ground cover	–	Fiberous Shallow	No	Low	–
Hibiscus palustris														
Iris kaempferi														

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Species	Moisture Regime		Tolerance						Morphology			General Characteristics		Comments
Scientific Name **Common Name**	**Indicator Status**	**Habitat**	**Ponding (days)**	**Salt**	**Oil/ Grease**	**Metals**	**Insects/ Disease**	**Exposure**	**Form**	**Height**	**Root System**	**Native**	**Wildlife**	
Lobelia siphilitica														
Lotus Corniculatus birdsfoot-trefoil	FAC	Mesic-Xeric	1-2	H	L	H	H	Sun	Grass	2-3'	Fiberous Shallow	Yes	High	Member of the legume family.
Onoclea sensibilis sensitive fern, beadfern	FACW							Shade		1-3.5'			H	
Pachysandra terminalis Japanese pachysandra	FACU	Mesic	1-2	–	–	–	M	Shade	Evergreen ground cover	–	Fiberous Shallow	No	Low	–
Panicum virgatum switch grass	FAC to FACU	Mesic	2-4	H	–	–	H	Sun or Shade	Grass	4-5'	Fiberous Shallow	Yes	High	Can spread fast and reach height of 6'.
Vinca major large periwinkle	FACU	Mesic	1-2	–	–	–	H	Shade	Evergreen ground cover	–	Fiberous Shallow	No	Low	Sensitive to soil compaction and pH changes.
Vinca minor common periwinkle	FACU	Mesic	1-2	–	–	–	H	Shade	Evergreen ground cover	–	Fiberous Shallow	No	Low	–
Indian grass														
Little bluestem														
Deer tongue														
Green coneflower														

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Aronia arbutifolia *(Pyrus arbutifolia)* red chokeberry	FACW	Mesic	1-2	H	–	H	M	Sun to partial sun	Deciduous shrub	6-12'	–	Yes	High	Good bank stabilizer. Tolerates drought.
Clethra alnifolia sweet pepperbush	FAC	Mesic to wet Mesic	2-4	H	–	–	H	Sun to partial sun	Ovoid shrub	6-12'	Shallow	Yes	Med	Coastal plain species.
Cornus Stolonifera *(Cornus sericea)* red osier dogwood	FACW	Mesic-Hydric	2-4	H	H	H	M	Sun or shade	Arching, spreading shrub	8-10'	Shallow	Yes	High	Needs more consistent moisture levels.
Cornus amomum silky dogwood	FAC	Mesic	1-2	L	–	–	M	Sun to partial sun	Broad-leaved	6-12'	–	Yes	High	Good bank stabilizer
Euonymous europaeus spindle-tree	FAC	Mesic	1-2	M	M	M	M	Sun to partial sun	Upright dense oval shrub	10-12'	Shallow	No	No	–
Hamamelis virginiana witch hazel	FAC	Mesic	2-4	M	M	M	M	Sun or shade	Vase-like compact shrub	4-6'	Shallow	Yes	Low	–
Hypericum densiflorum common St. John's wort	FAC	Mesic	2-4	H	M	M	H	Sun	Ovoid shrub	3-6'	Shallow	Yes	Med	–
Ilex glabra inkberry	FACW	Mesic to wet Mesic	2-4	H	H	–	H	Sun to partial sun	Upright dense shrub	6-12'	Shallow	Yes	High	Coastal plain species.
Ilex verticillata winterberry	FACW	Mesic to wet Mesic	2-4	L	M	–	H	Sun to partial sun	Spreading shrub	6-12'	Shallow	Yes	High	–

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Scientific Name **Common Name**	**Indicator Status**	**Habitat**	**Ponding (days)**	**Salt**	**Oil/ Grease**	**Metals**	**Insects/ Disease**	**Exposure**	**Form**	**Height**	**Root System**	**Native**	**Wildlife**	
Itea virginica tassel-white, Virginia sweetspire	OBL	Mesic	1-2	M	–	–	M	Sun or shade	Broad-leaved, deciduous shrub	6-12'	–	Yes	Low	–
Juniperus communis "compressa" common juniper	FAC	Dry Mesic-Mesic	1-2	M	H	H	M-H	Sun	Mounded shrub	3-6'	Deep taproot	No	High	Evergreen
Juniperus horizontalis "Bar Harbor" creeping juniper	FAC	Dry Mesic-Mesic	1-2	M	H	H	M-H	Sun	Matted shrub	0-3'	Deep taproot	No	High	Evergreen
Lindera benzoin spicebush	FACW	Mesic to wet Mesic	2-4	H	–	–	H	Sun	Upright shrub	6-12'	Deep	Yes	High	–
Myrica pennsylvanica bayberry	FAC	Mesic	2-4	H	M	M	H	Sun to partial sun	Rounded, compact shrub	6-8'	Shallow	Yes	High	Coastal plain species.
Physocarpus opulifolius ninebark	FAC	Dry Mesic to wet Mesic	2-4	M	–	–	H	Sun	Upright shrub	6-12'	Shallow	Yes	Med	May be difficult to locate.
Viburnum cassinoides northern wild raisin	FACW	Mesic	2-4	H	H	H	H	Sun to partial sun	Rounded, compacted shrub	6-8'	Shallow	Yes	High	–
Viburnum dentatum arrow-wood	FAC	Mesic to wet	2-4	H	H	H	H	Sun to partial sun	Upright, multi-stemmed shrub	8-10'	Shallow	Yes	High	–
Viburnum lentago nannyberry	FAC	Mesic	2-4	H	H	H	H	Sun to partial sun	Upright, mlti-stemmed shrub	8-10'	Shallow	Yes	High	–

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Scientific Name Common Name	Indicator Status	Habitat	Ponding (days)	Salt	Oil/ Grease	Metals	Insects/ Disease	Exposure	Form	Height	Root System	Native	Wildlife	
Acer rubrum red maple	FAC	Mesic-Hydric	4-6	H	H	H	H	Partial sun	Single to multi-stem tree	50-70'	Shallow	Yes	High	–
Amelanchier canadensis shadbush	FAC	Mesic	2-4	H	M	–	H	Partial sun	Single to multi-stem tree	35-50'	Shallow	Yes	High	Not recommended for full sun.
Betula nigra river birch	FACW	Mesic-Hydric	4-6	–	M	M	H	Partial sun	Single to multi-stem tree	50-75'	Shallow	Yes	High	Not susceptible to bronze birch borer.
Betula populifolia gray birch	FAC	Xeric-Hydric	4-6	H	H	M	H	Partial sun	Single to multi-stem tree	35-50'	Shallow to deep	No	High	Native to New England area.
Fraxinus americana white ash	FAC	Mesic	2-4	M	H	H	H	Sun	Large tree	50-80'	Deep	Yes	Low	–
Fraxinus Pennsylvanica green ash	FACW	Mesic	4-6	M	H	H	H	Partial sun	Large tree	40-65'	Shallow to deep	Yes	Low	–
Ginko biloba Maidenhair tree	FAC	Mesic	2-4	H	H	H	H	Sun	Large tree	50-80'	Shallow to deep	No	Low	Avoid female species-offensive odor from fruit.
Gleditsia triacanthos honeylocust	FAC	Mesic	2-4	H	M	–	M	Sun	Small caopled large tree	50-75'	Shallow to deep variable taproot	Yes	Low	Select thornless variety.
Juniperus virginiana eastern red cedar	FACU	Mesic-Xeric	2-4	H	H	–	H	Sun	Dense single stem tree	50-75'	Taproot	Yes	Very high	Evergreen
Liquidambar styraciflua sweet gum	FAC	Mesic	4-6	H	H	H	M	Sun	Large tree	50-70'	Deep taproot	Yes	High	Edge and perimeter; fruit is a maintenance problem.
Nyssa sylvatica black gum	FACW	Mesic-Hydric	4-6	H	H	H	H	Sun	Large tree	40-70'	Shallow to deep taproot	Yes	High	–

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Scientific Name Common Name	Indicator Status	Habitat	Ponding (days)	Salt	Oil/ Grease	Metals	Insects/ Disease	Exposure	Form	Height	Root System	Native	Wildlife	
Platanus acerifolia London plane-tree	FACW	Mesic	2-4	H	–	–	M	Sun	Large tree	70-80'	Shallow	No	Low	Tree roots can heave sidewalks.
Platanus occidentalis sycamore	FACW	Mesic-Hydric	4-6	M	M	M	M	Sun	Large tree	70-80'	Shallow	Yes	Med	Edge and perimeter; fruit is a maintenance problem; tree is also prone to windthrow.
Populus deltoides eastern cottonnwood	FAC	Xeric-Mesic	4-6	H	H	H	L	Sun	Large tree with spreading branches	75-100'	Shallow	Yes	High	Short lived.
Quercus bicolor Swamp white oak	FACW	Mesic to wet Mesic	4-6	H	–	H	H	Sun to partial sun	Large tree	75-100'	Shallow	Yes	High	One of the faster growing oaks.
Quercus coccinea scarlet oak	FAC	Mesic	1-2	H	M	M	M	Sun	Large tree	50-75'	Shallow to deep	Yes	High	–
Quercus macrocarpa bur oak	FAC	Mesic to wet Mesic	2-4	H	H	H	M	Sun	Large spreading tree	75-100"	Taproot	No	High	Native to Midwest.
Quercus palustris pin oak	FACW	Mesic-Hydric	4-6	H	H	H	M	Sun	Large tree	60-80'	Shallow to deep taproot	Yes	High	–
Quercus phellos willow oak	FACW	Mesic to wet Mesic	4-6	H	–	–	H	Sun	Large tree	55-75'	Shallow	Yes	High	Fast growing oak.
Quercus rubra red oak	FAC	Mesic	2-4	M	H	M	M	Sun to partial sun	Large spreading tree	60-80'	Deep taproot	Yes	High	–
Quercus shumardii Shumard's red oak	FAC	Mesic	2-4	H	H	H	M	Sun to partial sun	Large spreading tree	60-80'	Deep taproot	No	High	Native to Southeast.

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Scientific Name Common Name	Indicator Status	Habitat	Ponding (days)	Salt	Oil/ Grease	Metals	Insects/ Disease	Exposure	Form	Height	Root System	Native	Wildlife	
Sophora japonica Japanese pagoda tree	FAC	Mesic	1-2	M	M	_	M	Sun	Shade tree	40-70'	Shallow	No	Low	Fruit stains sidewalk.
Taxodium distichum bald cypress	FACW	Mesic-Hydric	4-6	_	_	M	H	Sun to partial sun	Typically single stem tree	75-100'	Shallow	Yes	Low	Not well documented for planting in urban areas.
Thuja occidentalis arborvitae	FACW	Mesic to wet Mesic	2-4	M	M	M	H	Sun to partial sun	Dense single stem tree	50-75'	Shallow	No	Low	Evergreen
Zelkova serrata Japanese zelkova	FACU	Mesic	1-2	M	M	_	H	Sun	Dense shade tree	60-70'	Shallow	No	Low	Branches can split easily in storms.

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Deep Sump Catch Basin

Description: Deep sump catch basins, also known as oil and grease or hooded catch basins, are underground retention systems designed to remove trash, debris, and coarse sediment from stormwater runoff, and serve as temporary spill containment devices for floatables such as oils and greases.

Ability to meet specific standards

Standard	Description
2 - Peak Flow	Provides no peak flow attenuation
3 - Recharge	Provides no groundwater recharge
4 - TSS Removal	25% TSS removal credit when used for pretreatment. Because of their limited effectiveness and storage capacity, deep sump catch basins receive credit for removing TSS only if they are used for pretreatment and designed as off-line systems.
5 - Higher Pollutant Loading	Recommended as pretreatment BMP. Although provides some spill control capability, a deep sump catch basin may not be used in place of an oil grit separator or sand filter for land uses that have the potential to generate runoff with high concentrations of oil and grease such as: high-intensity-use parking lots, gas stations, fleet storage areas, vehicle and/or equipment maintenance and service areas.
6 - Discharges near or to Critical Areas	May be used as pretreatment BMP. not an adequate spill control device for discharges near or to critical areas.
7 - Redevelopment	Highly suitable.

Advantages/Benefits:

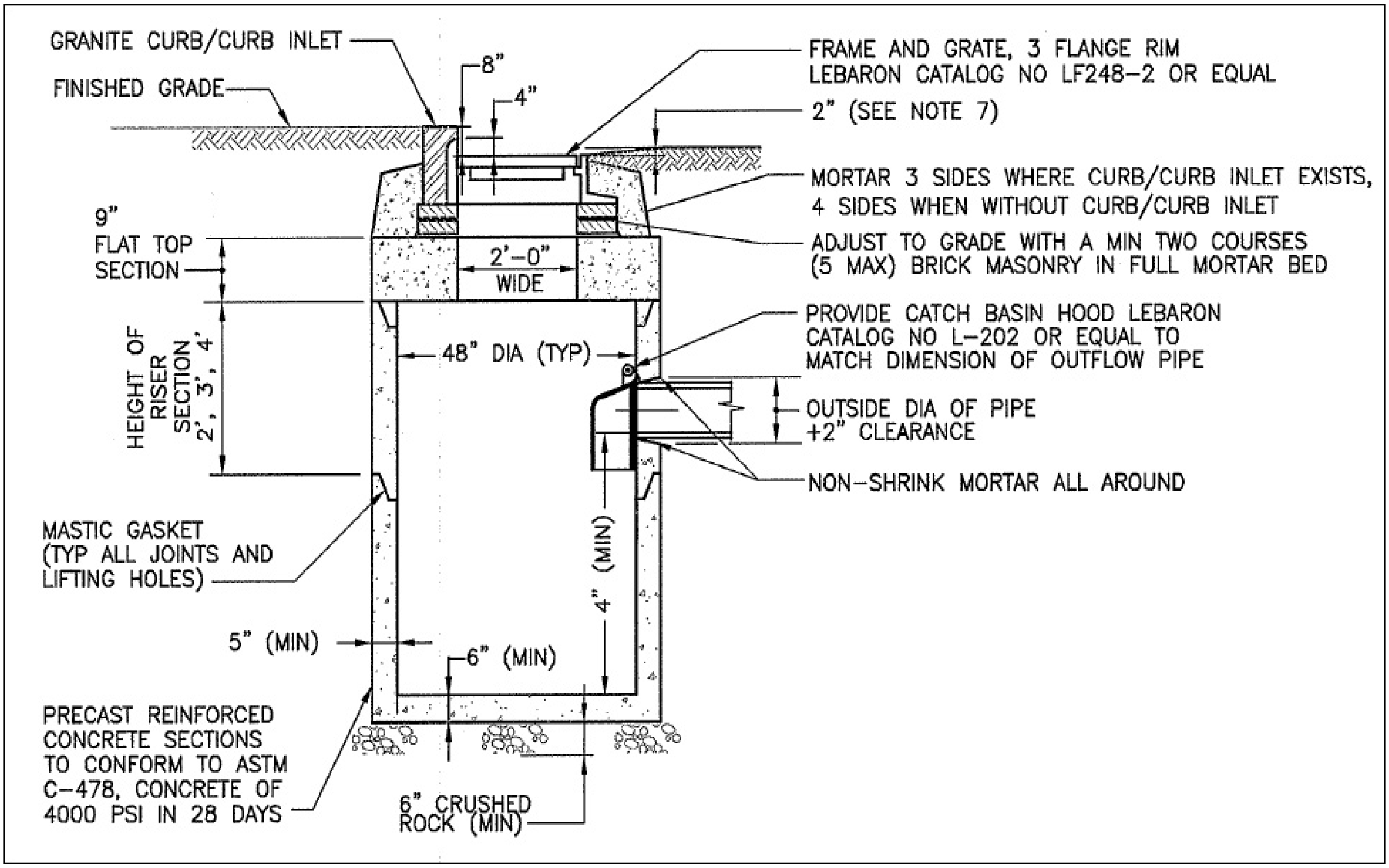
- Located underground, so limited lot size is not a deterrent.
- Compatible with subsurface storm drain systems.
- Can be used for retrofitting small urban lots where larger BMPs are not feasible.
- Provide pretreatment of runoff before it is delivered to other BMPs.
- Easily accessed for maintenance.
- Longevity is high with proper maintenance.

Disadvantages/Limitations:

- Limited pollutant removal.
- Expensive to install and maintain, resulting in high cost per unit area treated.
- No ability to control volume of stormwater
- Frequent maintenance is essential
- Requires proper disposal of trapped sediment and oil and grease
- Entrapment hazard for amphibians and other small animals

Pollutant Removal Efficiencies

- Total Suspended Solids (TSS) - 25% (for regulatory purposes)
- Nutrients (Nitrogen, phosphorus) - Insufficient data
- Metals (copper, lead, zinc, cadmium) - Insufficient data
- Pathogens (coliform, e coli) - Insufficient data



adapted from the University of New Hampshire

Maintenance

Activity	Frequency
Inspect units	Four times per year
Clean units	Four times per year or whenever the depth of deposits is greater than or equal to one half the depth from the bottom of the invert of the lowest pipe in the basin.

Special Features

All deep sump catch basins must include hoods. For MassHighway projects, consult the Stormwater Handbook for Highways and Bridges for hood requirements.

LID Alternative

Reduce Impervious Surface
Disconnect rooftop and non-rooftop runoff
Vegetated Filter Strip

Deep Sump Catch Basin

Suitable Applications

- Pretreatment
- Residential subdivisions
- Office
- Retail

Design Considerations

- The contributing drainage area to any deep sump catch basin should not exceed ¼ acre of impervious cover.
- Design and construct deep sump catch basins as off-line systems.
- Size the drainage area so that the flow rate does not exceed the capacity of the inlet grate.
- Divert excess flows to another BMP intended to meet the water quantity requirements (peak rate attenuation) or to a storm drain system. An off-line design enhances pollutant removal efficiency, because it prevents the resuspension of sediments in large storms.

Make the sump depth (distance from the bottom of the outlet pipe to the bottom of the basin) at least four feet times the diameter of the outlet pipe and more if the contributing drainage area has a high sediment load. The minimum sump depth is 4 feet. Double catch basins, those with 2 inlet grates, may require deeper sumps. Install the invert of the outlet pipe at least 4 feet from the bottom of the catch basin grate.

The inlet grate serves to prevent larger debris from entering the sump. To be effective, the grate must have a separation between the grates of one square inch or less. The inlet openings must not allow flows greater than 3 cfs to enter the deep sump catch basin. If the inlet grate is designed with a curb cut, the grate must reach the back of the curb cut to prevent bypassing. The inlet grate must be constructed of a durable material and fit tightly into the frame so it won't be dislodged by automobile traffic. The inlet grate must not be welded to the frame so that sediments may be easily removed. To facilitate maintenance, the inlet grate must be placed along the road shoulder or curb line rather than a traffic lane.

Note that within parking garages, the State Plumbing Code regulates inlet grates and other stormwater management controls. Inlet grates inside parking garages are currently required to have much smaller openings than those described herein.

To receive the 25% removal credit, hoods must be used in deep sump catch basins. Hoods also help contain oil spills. MassHighway may install catch basins without hoods provided they are designed, constructed, operated, and maintained in accordance with the Mass Highway Stormwater Handbook.

Install the weep hole above the outlet pipe. Never install the weep hole in the bottom of the catch basin barrel.

Site Constraints

A proponent may not be able to install a deep sump catch basin because of:

- Depth to bedrock;
- High groundwater;
- Presence of utilities; or
- Other site conditions that limit depth of excavation because of stability.

Maintenance

Regular maintenance is essential. Deep sump catch basins remain effective at removing pollutants only if they are cleaned out frequently. One study found that once 50% of the sump volume is filled, the catch basin is not able to retain additional sediments.

Inspect or clean deep sump basins at least four times per year and at the end of the foliage and snow-removal seasons. Sediments must also be removed four times per year or whenever the depth of deposits is greater than or equal to one half the depth from the bottom of the invert of the lowest pipe in the basin. If handling runoff from land uses with higher potential pollutant loads or discharging runoff near or to a critical area, more frequent cleaning may be necessary.

Clamshell buckets are typically used to remove sediment in Massachusetts. However, vacuum trucks are preferable, because they remove more trapped sediment and supernatant than clamshells. Vacuuming is also a speedier process and is less likely to snap the cast iron hood within the deep sump catch basin.

Always consider the safety of the staff cleaning deep sump catch basins. Cleaning a deep sump catch basin within a road with active traffic or even within a parking lot is dangerous, and a police detail may be necessary to safeguard workers.

Although catch basin debris often contains concentrations of oil and hazardous materials such as petroleum hydrocarbons and metals, MassDEP classifies them as solid waste. Unless there is evidence that they have been contaminated by a spill or other means, MassDEP does not routinely require catch basin cleanings to be tested before disposal. Contaminated catch basin cleanings must be evaluated in accordance with the Hazardous Waste Regulations, 310 CMR 30.000, and handled as hazardous waste.

In the absence of evidence of contamination, catch basin cleanings may be taken to a landfill or other facility permitted by MassDEP to accept solid waste, without any prior approval by MassDEP. However, some landfills require catch basin cleanings to be tested before they are accepted.

With prior MassDEP approval, catch basin cleanings may be used as grading and shaping materials at landfills undergoing closure (see Revised Guidelines for Determining Closure Activities at Inactive Unlined Landfill Sites) or as daily cover at active landfills. MassDEP also encourages the beneficial reuse of catch basin cleanings whenever possible. A Beneficial Reuse Determination is required for such use.

MassDEP regulations prohibit landfills from accepting materials that contain free-draining liquids. One way to remove liquids is to use a hydraulic lift truck during cleaning operations so that the material can be decanted at the site. After loading material from several catch basins into a truck, elevate the truck so that any free-draining liquid can flow back into the structure. If there is no free water in the truck, the material may be deemed to be sufficiently dry. Otherwise the catch basin cleanings must undergo a Paint Filter Liquids Test. Go to www. Mass.gov/dep/recycle/laws/cafacts.doc for information on all of the MassDEP requirements pertaining to the disposal of catch basin cleanings.

Appendix D
StormCAD

- 25-year Storm Drain Calculations

25-Year Storm Drain Calculations

Storm Drainage Computations

vhb
101 Walnut Street
Post Office Box 9151
Watertown, MA 02471
P 617.924.1770

Project: Village Retail & Bridges
Location: Sudbury, MA
Calculated By: RLG
Title: 25-Year Hydraulic Calculations per StormCAD using NRCC IDF Curve

Project #: 13125.00
Sheet: 1 of 1
Date: 10/17/2016

Start Node	Stop Node	Upstream Invert (ft)	Downstream Invert (ft)	Slope (ft/ft)	Manning's n	Diameter (in)	Length (ft)	System Intensity (in/hr)	Upstream Inlet Area (sf)	Upstream Inlet C (acres)	Flow (cfs)	Capacity (cfs)	Average Velocity (ft/s)	Elevation Ground Start (ft)	Cover Start (ft)	Elevation Ground Stop (ft)	Cover Stop (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)
CB-500	WQU-501	144.4	144.21	0.02	0.012	18	9.7	8.447	0.666	0.9	5.1	15.94	2.89	148	2.1	148.1	2.39	148.12	148.1
CB-201	DMH-201	147.8	146.6	0.016	0.012	12	76.8	8.447	0.259	0.81	1.79	4.82	2.27	152.8	4	153.5	5.9	151.91	151.75
Bldg 2 Roof	DMH-203	150.2	149.9	0.01	0.012	12	31.2	8.453	(N/A)	(N/A)	1.9	3.8	4.84	153.5	2.3	152.9	2	150.79	150.61
LD-511	DMH-508	149	148	0.028	0.01	6	36	8.453	(N/A)	(N/A)	0.5	1.22	2.55	152	2.5	152.3	3.8	150.43	150.26
LD-502	DMH-502	146.65	146.36	0.005	0.012	12	56.7	8.453	(N/A)	(N/A)	1.9	2.76	2.42	149	1.35	151.3	3.94	149.32	149.18
Bridges Roof-North	DMH-510	150	149	0.022	0.01	6	44.6	8.453	(N/A)	(N/A)	1	1.09	5.09	152.5	2	153.46	3.96	151.15	150.31
Bridges Roof-West	DMH-510	150	149	0.022	0.01	6	46.4	8.453	(N/A)	(N/A)	1.1	1.07	5.6	152.4	1.9	153.46	3.96	151.36	150.31
LD-506	DMH-510	150	149	0.027	0.01	6	37.3	8.453	(N/A)	(N/A)	0.6	1.19	3.06	152	1.5	153.46	3.96	150.56	150.31
LD-505	DMH-510	150	149	0.028	0.01	6	36.1	8.453	(N/A)	(N/A)	0.6	1.21	3.06	151.8	1.3	153.46	3.96	150.55	150.31
CB-204	WQU-201	144.2	144.1	0.014	0.012	12	7.4	8.447	0.172	0.9	1.32	4.5	1.68	152.5	7.3	152.7	7.6	148.96	148.96
CB-203	DMH-202	145.8	145.7	0.014	0.012	12	7.2	8.447	0.179	0.9	1.37	4.54	1.75	152.5	5.7	152.7	6	151.01	151
CB-202	DMH-201	147	147	0.018	0.012	12	22.3	8.447	0	0.78	1.83	5.17	2.33	152.6	4.6	153.5	5.9	151.8	151.75
Bldg 3 Roof	DMH-205	147	146.45	0.014	0.012	12	39.7	8.447	0.145	0.9	1.11	4.54	1.41	148.89	0.89	149.9	2.45	148.33	148.3
CB-205	DMH-205	146.9	146.45	0.011	0.012	12	41.5	8.447	0.459	0.84	3.28	4.02	4.18	149.4	1.5	149.9	2.45	148.6	148.3
DMH-205A	DMH-206A	145	144.6	0.025	0.012	12	16.1	8.453	(N/A)	(N/A)	4.2	6.08	5.35	150.49	4.49	149.4	3.8	146.58	146.39
CB-16	DMH-209	144.5	144	0.039	0.012	18	12.9	8.453	(N/A)	(N/A)	5.1	22.39	2.89	151.5	5.5	151.7	6.2	148.49	148.47
CB-206	DMH-208A	147.5	147	0.016	0.012	12	31.1	8.447	0.47	0.9	3.6	4.89	4.59	151.2	2.7	152	4	149.63	149.36
Bldg 4 Roof	DMH-208A	146.2	146	0.011	0.012	12	61.2	8.447	0	0.9	1.32	4.13	1.68	153.5	6.3	152	5.5	149.43	149.36
Bldg 5 Roof	DMH-210	146.2	145.5	0.011	0.012	12	60.9	8.447	0.172	0.9	1.32	4.14	4.68	153.5	6.3	152	5.5	147.13	147.06
CB-207	DMH-210	147.5	147	0.016	0.012	12	30.3	8.447	0	0.9	3.6	4.95	6.88	151.2	2.7	152	4	148.31	147.65
Bridges Roof East	WQU-502	148.9	148.28	0.007	0.012	12	83.2	8.453	(N/A)	(N/A)	3.1	3.32	3.95	152.2	2.3	151.4	2.12	151.38	150.84
LD-504	WQU-502	148.35	148	0.007	0.012	12	53.3	8.453	(N/A)	(N/A)	2.2	3.13	2.8	150	0.65	151.4	2.4	151.01	150.84
CB-503	DMH-513	150	150	0.021	0.012	12	16.6	8.453	(N/A)	(N/A)	1.1	5.61	1.4	153.5	2.5	153.5	2.85	151.12	151.11
CB-502	DMH-513	150	149.68	0.02	0.012	12	15.9	8.453	(N/A)	(N/A)	1.1	5.46	1.4	153.5	2.5	153.5	2.82	151.12	151.11
CB-501	WQU-502	148.1	148	0.005	0.012	12	36.9	8.447	0	0.6	2.23	2.84	2.84	150.9	1.8	151.4	2.5	150.96	150.84
LD-507	DMH-510	150	149	0.012	0.01	6	83.9	8.453	(N/A)	(N/A)	0.6	0.8	3.06	152	1.5	153.46	3.96	150.87	150.31
WQU-3	DMH-204A	145.3	145	0.002	0.012	24	24.1	8.453	(N/A)	(N/A)	19.82	10.88	6.31	151.3	4	154.49	7.49	149.64	148.64
DMH-207	OFF-SITE CB	140.8	139	0.024	0.012	48	21.5	8.395	(N/A)	(N/A)	72.67	241.08	16.79	145.06	0.26	145.49	2.49	143.38	140.74
DMH-209	DMH-206	141.59	141.3	0.002	0.012	36	147.9	8.4	(N/A)	(N/A)	34.27	31.99	4.85	151.7	7.11	151.5	7.2	148.21	147.88
DMH-501	DMH-212	142.4	142	0.002	0.012	36	195.3	8.409	(N/A)	(N/A)	29.18	32.7	4.13	148.6	3.2	152.3	7.3	149.26	148.94
DMH-514	O-1	146.65	146.4	0.018	0.013	12	13.9	8.44	(N/A)	(N/A)	4.6	4.77	5.86	152.5	4.85	147.49	0.09	148.23	148
WQU-501	DMH-501	144.1	144	0.014	0.012	18	21	8.447	(N/A)	(N/A)	5.1	13.69	2.89	148.1	2.5	148.6	3.42	148.77	148.7
DMH-512	DMH-501	142.65	142	0.002	0.012	36	124.3	8.412	(N/A)	(N/A)	24.1	32.22	3.41	148.9	3.25	148.6	3.2	148.84	148.7
DMH-206A	DMH-207	141.19	140.93	0.002	0.012	36	128.9	8.397	(N/A)	(N/A)	72.67	32.22	10.28	149.4	5.21	145.06	1.13	145.24	143.94
DMH-205	ISO ROW	145.5	145	0.001	0.012	24	3.8	8.445	(N/A)	(N/A)	4.39	6.32	1.4	149.9	2.4	149.9	4.9	148.28	148.23
DMH-204	DMH-204A	142.98	143	0.005	0.012	36	77	8.441	(N/A)	(N/A)	14.42	53.09	2.04	154.2	8.22	154.49	8.92	148.68	148.64
DMH-515	O-3	145.4	146	-0.006	0.013	18	31.3	8.453	(N/A)	(N/A)	3.9	8.39	2.21	150.5	3.6	146.6	-0.5	148.04	148
DMH-513	WQU-502	149	148	0.017	0.012	12	53.6	8.453	(N/A)	(N/A)	2.2	5	2.8	153.5	3.5	151.4	2.3	151.01	150.84
DMH-502	DMH-512	142.95	143	0.002	0.012	36	152.3	8.453	(N/A)	(N/A)	22.7	32.22	3.21	151.3	5.35	148.9	3.25	149.05	148.9

Storm Drainage Computations

101 Walnut Street
Post Office Box 9151
Watertown, MA 02471
P 617.924.1770

Project: Village Retail & Bridges
Location: Sudbury, MA
Calculated By: RLG
Title: 25-Year Hydraulic Calculations per StormCAD using NRCC IDF Curve

Project #: 13125.00
Sheet: 1 of 1
Date: 10/17/2016

Start Node	Stop Node	Upstream Invert (ft)	Downstream Invert (ft)	Slope (ft/ft)	Manning's n	Diameter (in)	Length (ft)	System Intensity (in/hr)	Upstream Inlet Area (sf)	Upstream Inlet C (acres)	Flow (cfs)	Capacity (cfs)	Average Velocity (ft/s)	Elevation Ground Start (ft)	Cover Start (ft)	Elevation Ground Stop (ft)	Cover Stop (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)
WQU-502	DMH-509	147.8	147.28	0.004	0.012	24	130.9	8.446	(N/A)	(N/A)	9.73	15.45	3.1	151.4	1.6	152.4	3.12	150.69	150.48
DMH-511	DMH-512	146.59	145.5	0.02	0.012	12	54.4	8.415	0.33	0.5	1.4	5.46	1.78	151.5	3.91	148.9	2.4	148.97	148.9
DMH-206	DMH-206A	141.3	141	0.002	0.012	36	51.6	8.397	(N/A)	(N/A)	68.48	32.59	9.69	151.5	7.21	149.4	5.21	146.86	146.39
DMH-508	DMH-507	146.94	146	0.007	0.012	15	106.1	8.44	(N/A)	(N/A)	5.62	5.84	4.58	152.3	4.11	152.3	4.85	149.93	149.25
DMH-508	DMH-514	146.94	147	0.002	0.012	18	96.2	8.44	(N/A)	(N/A)	4.6	5.06	0	152.3	3.86	152.5	4.25	149.03	148.87
DMH-3	DMH-204	144	143	0.005	0.012	24	169.6	8.453	(N/A)	(N/A)	6.22	18.01	1.98	151.84	5.84	154.2	9.12	148.85	148.74
DMH-208A	ISO-ROW	145.5	145	0.001	0.012	12	5.8	8.444	(N/A)	(N/A)	4.92	1	6.26	152	5.5	152	5.6	148.81	146.31
DMH-210	ISO ROW	145.55	145	0.019	0.012	12	5.2	8.446	(N/A)	(N/A)	4.92	5.38	7.76	152	5.45	152	5.55	146.46	146.29
DMH-212	DMH-209	142	142	0.002	0.012	36	210.8	8.404	(N/A)	(N/A)	29.18	31.95	4.13	152.3	7.3	151.7	7.11	148.81	148.47
DMH-507	O-2	146.2	145	0.016	0.013	12	50.1	8.438	(N/A)	(N/A)	5.62	4.5	7.16	152.3	5.1	146.73	0.33	149.25	148
DMH-509	DMH-508	147.28	146.94	0.004	0.012	24	84.9	8.442	(N/A)	(N/A)	9.73	15.51	3.1	152.4	3.12	152.3	3.36	150.39	150.26
DMH-202	WQU-201	145.6	144.1	0.015	0.012	12	100.3	8.443	(N/A)	(N/A)	4.98	4.72	6.34	152.7	6.1	152.7	7.6	150.63	148.96
WQU-201	DMH-204	144	143.5	0.016	0.012	18	31.7	8.442	(N/A)	(N/A)	6.3	14.3	3.56	152.7	7.2	154.2	9.2	148.84	148.74
DMH-203	DMH-204	149.9	149	0.028	0.012	12	31.7	8.453	(N/A)	(N/A)	1.9	6.5	7.19	152.9	2	154.2	4.2	150.49	149.38
DMH-510	DMH-515	148.99	147.9	0.015	0.012	12	72.7	8.453	(N/A)	(N/A)	3.9	4.73	6.73	153.46	3.47	150.5	1.6	149.83	148.59
DMH-201	DMH-202	146.5	145.7	0.014	0.012	12	55.2	8.444	(N/A)	(N/A)	3.61	4.64	4.6	153.5	6	152.7	6	151.49	151
DMH-204A	DMH-206	142.46	141.3	0.005	0.012	36	211.9	8.438	(N/A)	(N/A)	34.24	53.46	4.84	154.49	9.03	151.5	7.2	148.35	147.88

Appendix E
Construction Phase Erosion and Sedimentation Control Draft SWPPP

Village Retail & Bridges by Epoch at Meadow Walk Sudbury

526-528 Boston Post Road
Sudbury, Massachusetts

CONSTRUCTION ACTIVITIES AT: 526-528 Boston Post Road
Sudbury, Massachusetts

PROPERTY OWNER: BPR Sudbury Development LLC
c/o National Development
2310 Washington Street
Newton Lower Falls, MA 02462

PREPARED ON BEHALF OF: BPR Development LLC
c/o National Development
2310 Washington Street
Newton Lower Falls, MA 02462

PREPARED BY: **Vanasse Hangen Brustlin, Inc.**
101 Walnut Street
Watertown, Massachusetts 02471
T (617) 924-1770

SWPPP Preparation Date: October 2016
Estimated Project Start Date:
Estimated Project End Date:

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Table of Contents

List of Attachments

List of Tables

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Introduction and Instruction to Contractor

This Stormwater Pollution Prevention Plan (SWPPP) has been prepared in accordance with the guidelines for the National Pollutant Discharge Elimination System (NPDES) Construction General Permit for Stormwater Discharges from Construction Activity (2012, USEPA).

A copy of the Construction General Permit (CGP) for which this SWPPP was prepared is attached hereto. The CGP authorizes the discharge of stormwater from construction activities in accordance with specified terms and conditions. All construction projects that propose to disturb one (1) or more acres of land must comply with the CGP. A construction project that is part of a larger common plan that will ultimately disturb one or more acres of land must also comply.

Compliance with the CGP is achieved by:

- Developing and implementing a SWPPP;
- Completing, certifying and submitting a Notice of Intent (NOI) to the Environmental Protection Agency (EPA); and
- Reading and complying with the requirements contained in the CGP and the Order of Conditions.

Compliance with the CGP and its Standard Permit Conditions is the responsibility of the site Operator. An Operator is any party associated with a construction project that meets either of the following two criteria:

- The party has operational control over construction plans and specifications, including the ability to make modifications to those plans and specifications; or
- The party has day-to-day operational control of those activities at a project, which are necessary to ensure compliance with a SWPPP for the site or other permit conditions (e.g., they are authorized to direct workers at a site to carry out activities required by the SWPPP or comply with other permit conditions).

The Operators have been identified under Section 1.1 Operator(s) / Subcontractor(s). Each Operator shall identify at least one person from each respective organization that will be responsible for complying with the CGP and SWPPP.

The NPDES CGP, SWPPP, and the EPA-issued authorization must be kept on file at the Project field office. The SWPPP shall be kept current and shall be amended according to the conditions described in the CGP.

This manual provides the following information, as required by the NPDES Permit:

- Contact Information and Responsible Parties
- Site Evaluation, Assessment, and Planning
  - Site Description
  - Development Description
  - Wetland Characteristics
  - Drainage Characteristics
  - Rare and Endangered Species Data
  - Historic Preservation Data
- Documentation of Compliance with Other Federal Reglulations
- Erosion and Sediment Controls
- Pollution Prevention Standards
- Inspections and Corrective Actions
- Training
- Certifications and Notification
- Site Plans
- The text of the 2012 CGP
- The EPA-issued authorization
- Underground Injection Control Forms

The SWPPP must be prepared prior to filing of the Notice of Intent (NOI). The NOI must be filed electronically, on the U.S. EPA website (www.epa.gov) at least fourteen (14) days prior to the start of construction.

In order to complete the pre-construction SWPPP, the General Contractor must complete the following to finalize the SWPPP:

- Certify that they have read and understand the terms of the NPDES Permit. (Attachment H).
- Review this manual, fill out relevant information in the spaces provided (or attach additional pages as necessary) and update and/or revise as necessary.
- Provide the names and contact information for all parties responsible for preparing, finalizing, amending, and implementing the SWPPP (Section 1).

- Install a sign or other notice posted conspicuously at a safe, publicly accessible location, in close proximity to the project site. At a minimum, the notice shall include the NPDES Permit tracking number and a contact name and phone number for obtaining additional project information.
- Review local by-laws or ordinances.

The SWPPP is a dynamic document, and must be continually updated by the contractor throughout construction. However, this manual does not comprise a complete SWPPP. It is the responsibility of the contractor to update and complete this manual by including the following information (and additional information, if necessary) as required by the terms of the CGP:

- Designate and Provide Contact Information for the Responsible Parties. See Section 1. Also see Attachments H, J, and K.
- Provide documentation confirming EPA authorization of the Project. Insert into Attachment D.
- Provide documentation of correspondence with Massachusets Historical Commission. Submit the Project Notification Form (PNF) (See Attachment L) to Massachusetts Historic Commission and fill out Section 3.2.
- Document compliance with DEP regulations 310 CMR 27.00. See Section 3.3.
- Provide a construction schedule including dates of major earthwork, stabilization and/or erosion control installations. See Table 5 and Appendix I.
- Document the installation and maintenance of Erosion and Sediment Controls. Update location and types of sedimentation and erosion control materials as necessary. See Section 4.
- Identify any chemical treatments that may be applied to the site and describe dosage, application techniques, and training for personnel. See Section 4.12, Section 7 and Attachment J.
- Identify potential sources of pollution. See Section 5.1 and Table 8.
- Provide information for Spill Notification Procedures. See Section 5.2 and Attachment N.
- Identify personnel responsible for Inspections and Corrective Actions. See Section 6, Attachment F.
- Provide an inspection Schedule. See Section 6.1.
- Document any spills and incorporate documentation into the SWPPP .
- Document off-site sedimentation resulting from this construction.

The contractor-completed SWPPP must be updated throughout construction, until a Notice of Termination (NOT) Form has been submitted to the EPA. From the date of submital of the NOT form, the SWPPP documents must be maintained by the Site operator for a period of three years.

1

Contact Information and Responsible Parties

1.1 Operator(s) / Subcontractor(s)

Operator(s):

Company or Organization Name: ______________________

Name: ______________________

Address: ______________________

City, State, Zip: ______________________

Telephone: ______________________

Fax/Email: ______________________

Area of responsibility: ______________________

Subcontractor(s):

Company or Organization Name: ______________________

Name: ______________________

Address: ______________________

City, State, Zip: ______________________

Telephone: ______________________

Fax/Email: ______________________

Area of responsibility: ______________________

Insert pages for additional subcontractors as necessary.

Emergency 24-hour Contact:

Company or Organization Name: ______________________

Name: ______________________

Address: ______________________

City, State, Zip: ______________________

Telephone: ______________________

Email: ______________________

1.2 Stormwater Team

The duties of these personnel include one or more of the following:

1. Prepare the Draft SWPPP
2. Finalize the SWPPP
3. Implement the SWPPP
4. Oversee maintenance practices identified as BMPs in the SWPPP
5. Conduct or provide for inspection and monitoring activities
6. Identify other potential pollutant sources and make sure that they are added to the plan
7. Identify any amendments to the SWPPP necessitated by field conditions and make sure they are implemented
8. Ensure that any design changes during construction are addressed in the SWPPP

Role or Responsibility:	1
Company:	Vanasse Hangen Brustlin, Inc. (VHB) 101 Walnut Street, Watertown, MA 02471
Name:	Karen Staffier, P.E.
Telephone:	(617) 607.0088
Email:	karenstaffier@vhb.com

Role or Responsibility:	2, 3, 4, 5, 6, 7, 8
Company:	
Name:	
Telephone:	
Fax/Email:	

Role or Responsibility: ______________________

Position: ______________________

Name: ______________________

Telephone: ______________________

Fax/Email: ______________________

Role or Responsibility: ______________________

Position: ______________________

Name: ______________________

Telephone: ______________________

Fax/Email: ______________________

Additional information if necessary

2

Site Evaluation, Assessment and Planning

2.1 Project/Site Information

Project Name and Address

Project/Site Name:	**Village Retail & Bridges by Epoch at Meadow Walk Sudbury**
Project Street/Location:	526-528 Boston Post Road
City:	Sudbury
State:	Massachusetts
Zip Code:	01776
County	Middlesex County

Project Latitude/Longitude

Latitude:

1. _ _ _ _ ' _ _" N (degrees, minutes, seconds)
2. _ _ º _ _ . _ _' N (degrees, minutes, decimal)
3. 42.360492º N (decimal)

Longitude:

1. _ _ _ _ ' _ _" W (degrees, minutes, seconds)
2. _ _ º _ _ . _ _' W (degrees, minutes, decimal)
3. 71.429708º W (decimal)

Method for determining latitude/longitude:

☐ USGS topographic map (specify scale: ___________)

☐ EPA Web site

☐ GPS

☒ Other (please specify): Maps.google.com

Horizontal Reference Datum:

☐ NAD 27 ☐ NAD 83 or WGS 84 ☒ Unknown

If you used a U.S.G.S topographic map, what was the scale?
____

Additional Project Information

Is the project/site located on Indian country lands, or located on a property of religious or cultural significance to an Indian tribe?	☐ Yes ☒ No
*Contractor must submit a Project Notification Form to Massachusetts Historic Commission to confirm. See Attachment L for documentation.	
If yes, provide the name of the Indian tribe associated with the area of Indian country (including the name of Indian reservation if applicable), or if not in Indian country, provide the name of the Indian tribe associated with the property:	n/a
If you are conducting earth-disturbing activities in response to a public emergency, document the cause of the public emergency *(e.g., natural disaster, extreme flooding conditions)*, information substantiating its occurrence *(e.g., state disaster declaration)*, and a description of the construction necessary to reestablish effective public services:	n/a
Are you applying for permit coverage as a "federal operator" as defined in Appendix A of the 2012 CGP?	☐ Yes ☒ No

2.2 Discharge Information

Does your project/site discharge stormwater into a Municipal Separate Storm Sewer System (MS4)?	☐ Yes	☒ No
Are there any surface waters that are located within 50 feet of your construction disturbances?	☒ Yes	☐ No

Table 1. Names of Receiving Waters

Name(s) of the first surface water that receives stormwater directly from your site and/or from the MS4 (note: multiple rows provided where your site has more than one point of discharge that flows to different surface waters)

1. On-site unnamed wetlands
2. Off-site unnamed wetlands, tributary to Hop Brook
3.
4.
5.
6.

Table 2. Impaired Waters/TMDLs

(Answer the following for each surface water listed in Table 1 above)

	Is this surface water listed as "impaired"?	If you answered yes, then answer the following: What pollutant(s) are causing the impairment?	Has a TMDL been completed?	Title of the TMDL document	Pollutant(s) for which there is a TMDL
1.	☐ YES ☒ NO		☐ YES ☒ NO		
2.	☐ YES ☒ NO	Dissolved Oxygen, Dissolved Oxygen Saturation, Excess Algal Growth, Total Phosphorus	☐ YES ☒ NO		
3.	☐ YES ☐ NO		☐ YES ☐ NO		
4.	☐ YES ☐ NO		☐ YES ☐ NO		
5.	☐ YES ☐ NO		☐ YES ☐ NO		
6.	☐ YES ☐ NO		☐ YES ☐ NO		

Describe the method(s) you used to determine whether or not your project/site discharges to an impaired water: VHB used the US EPA Impaired Waterbodies database found online at http://iaspub.epa.gov/tmdl/attains_state.control?p_state=MA&p_cycle=&p_report_type=T.

Table 3. Tier 2, 2.5, or 3 Waters

(Answer the following for each surface water listed in Table 1 above)

	Is this surface water designated as a Tier 2, Tier 2.5, or Tier 3 water? (see Appendix F)	If you answered yes, specify which Tier (2, 2.5, or 3) the surface water is designated as?
1.	☐ YES ☒ NO	
2.	☐ YES ☒ NO	
3.	☐ YES ☐ NO	
5.	☐ YES ☐ NO	
6.	☐ YES ☐ NO	

Source: http://www.mass.gov/eea/docs/dep/water/laws/i-thru-z/tblfig.pdf

2.3 Nature of the Construction Activity

General Description of Project

Provide a general description of the construction project:

The Applicant, BPR Development LLC, is proposing to construct 34,700-gsf of retail space in four separate buildings and a 48 unit assisted living facility on the existing 50 acre parcel located at 526-528 Boston Post Road in Sudbury, MA (the Project). See Figure 1, Site Location Map.

As proposed, the Project includes 34,700-gsf of retail space in four separate buildings and a 48 unit assisted living facility with associated drive aisles, parking, and landscape areas and utility and stormwater improvements to support this use.

The Project Site lies within the SuAsCo surface watershed and there are several wetland resources on the Site. The National Resources Conservation Service (NRCS) has classified surface soils on the Site as predominantly Udorthents-Urban Land complex.

Size of Construction Project

What is the size of the property (in acres), the total area expected to be disturbed by the construction activities (in acres), and the maximum area expected to be disturbed at any one time?

- Total Property Size: 50 acres
- Total Area of Construction Disturbances: approximately 8.5 acres
- Maximum area to be disturbed at any one time: up to approximately 8.5 acres

Construction Support Activities (only provide if applicable)

Describe any construction support activities for the project (e.g., concrete or asphalt batch plants, equipment staging yards, material storage areas, excavated material disposal areas, borrow areas).

Table 4. Construction Support Activities

The contractor will describe construction support activities here (insert additional sheets as necessary)

2.4 Sequence and Estimated Dates of Construction Activities

For each phase of construction, include the following information:

- Installation of stormwater controls, and when they will be made operational;
- Commencement and duration of earth-disturbing activities, including clearing and grubbing, mass grading, site preparation (i.e., excavating, cutting and filling), final grading, and creation of soil and vegetation stockpiles requiring stabilization;
- Cessation, temporarily or permanently, of construction activities on the site, or in designated portions of the site;
- Final or temporary stabilization of areas of exposed soil. The dates for stabilization must reflect the applicable deadlines to which you are subject to in Part 2.2.1; and
- Removal of temporary stormwater conveyances/channels and other stormwater control measures, removal of construction equipment and vehicles, and cessation of any pollutant-generating activities.

The construction sequence must reflect the following requirements:

- Part 2.1.1.1 (area of disturbance);
- Part 2.1.1.3.a (installation of stormwater controls); and
- Parts 2.2.1.1, 2.2.1.2, 2.2.1.3 (stabilization deadlines).

Table 5. Construction Schedule

Date	Activity

2.5 Allowable Non-Stormwater Discharges

Table 6. Allowable Non-Stormwater Discharges Present at the Site

Type of Allowable Non-Stormwater Discharges Present at the Site	Likely to be Present at the Site	
	Yes	No
Discharges from emergency fire-fighting activities	x	
Fire hydrant flushings	x	
Landscape irrigation	x	
Waters used to wash vehicles and equipment	x	
Water used to control dust	x	
Potable water including uncontaminated water line flushings	x	
Routine external building wash down	x	
Pavement wash waters	x	
Uncontaminated air conditioning or compressor condensate	x	
Uncontaminated, non-turbid discharges of ground water or spring water	x	
Foundation or footing drains	x	
Construction dewatering water	x	

2.6 Site Maps

Attachment A contains the Project Plans for this project.
Attachment C contains Site Maps including the:

- Site Location Map
- FEMA Flood Insurance Rate Map
- Soil Map
- SWPPP Erosion and Sedimentation Control Measures

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3

Documentation of Compliance with Other Federal Requirements

3.1 Endangered Species Protection

Eligibility Criterion

Under which criterion listed in Appendix D of the Construction General Permit are you eligible for coverage under this permit?

The proponent will be consulting with the Massachusetts Natural Heritage & Endangered Spexies Program (NHESP) prior to submitting the NOI.

☒ A ☐ B ☐ C ☐ D ☐ E

- **Criterion A.** No federally listed threatened or endangered species or their designated critical habitat(s) are likely to occur in your site's "action area" as defined in Appendix A of this permit.
- **Criterion B.** The construction site's discharges and discharge-related activities were already addressed in another operator's valid certification of eligibility for your action area under eligibility Criterion A, C, D, E, or F and there is no reason to believe that federally-listed species or federally-designated critical habitat not considered in the prior certification may be present or located in the "action area". To certify your eligibility under this Criterion, there must be no lapse of NPDES permit coverage in the other operator's certification. By certifying eligibility under this Criterion, you agree to comply with any effluent limitations or conditions upon which the other operator's certification was based. You must include in your NOI the tracking number from the other operator's notification of authorization under this permit. If your certification is based on another operator's certification under Criterion C, you must provide EPA with the relevant supporting information required of existing dischargers in Criterion C in your NOI form.

- **Criterion C.** Federally listed threatened or endangered species or their designated critical habitat(s) are likely to occur in or near your site's "action area," and your site's discharges and discharge-related activities are not likely to adversely affect listed threatened or endangered species or critical habitat. This determination may include consideration of any stormwater controls and/or management practices you will adopt to ensure that your discharges and discharge-related activities are not likely to adversely affect listed species and critical habitat. To make this certification, you must include the following in your NOI: 1) any federally listed species and/or designated habitat located in your "action area"; and 2) the distance between your site and the listed species or designated critical habitat (in miles). You must also include a copy of your site map with your NOI.
- **Criterion D.** Coordination between you and the Services has been concluded. The coordination must have addressed the effects of your site's discharges and discharge-related activities on federally-listed threatened or endangered species and federally designated critical habitat, and must have resulted in a written concurrence from the relevant Service(s) that your site's discharges and discharge-related activities are not likely to adversely affect listed species or critical habitat. You must include copies of the correspondence between yourself and the Services in your SWPPP and your NOI.
- **Criterion E.** Consultation between a Federal Agency and the U.S. Fish and Wildlife Service and/or the National Marine Fisheries Service under section 7 of the ESA has been concluded. The consultation must have addressed the effects of the construction site's discharges and discharge-related activities on federally listed threatened or endangered species and federally-designated critical habitat. The result of this consultation must be either:

  i. a biological opinion that concludes that the action in question (taking into account the effects of your site's discharges and discharge-related activities) is not likely to jeopardize the continued existence of listed species, nor the destruction or adverse modification of critical habitat; or

  ii. written concurrence from the applicable Service(s) with a finding that the site's discharges and discharge-related activities are not likely to adversely affect federally-listed species or federally designated habitat.

  You must include copies of the correspondence between yourself and the Services in your SWPPP and your NOI.
- **Criterion F.** Your construction activities are authorized through the issuance of a permit under section 10 of the ESA, and this authorization addresses the effects of the site's discharges and discharge-related activities on federally-listed species and federally designated critical habitat. You must include copies of the correspondence between yourself and the Services in your SWPPP and your NOI.

For reference purposes, the eligibility criteria listed in Appendix D of the Construction General Permit are as follows:

Supporting Documentation

Provide documentation for the applicable eligibility criterion you select in Appendix D of the Construction General Permit, as follows:

For criterion A, indicate the basis for your determination that no federally-listed threatened or endangered species or their designated critical habitat(s) are likely to occur in your site's action area (as defined in Appendix A of the permit). Check the applicable source of information you relied upon:

☐ Specific communication with staff of the U.S. Fish & Wildlife Service or National Marine Fisheries Service.

☐ Publicly available species list.

☒ Other source: The proponent has consulted with the Massachusetts Natural Heritage & Endangered Species Program (NHESP) and has received confirmation from NHESP that there are no federally-listed threatened or endangered species likely to occur in our action area. Refer to the submission to NHESP and the response letter included in Attachment M.

For criterion B, provide the Tracking Number from the other operator's notification of permit authorization:

Provide a brief summary of the basis used by the other operator for selecting criterion A, B, C, D, E, or F:

For criterion C, provide the following information:

- Any federal ylisted species and/or designated habitat located in your "action area":

- The distance between your site and the listed species or designated critical habitat (in miles). You must also include a copy of your site with your NOI.

For criterion D, E, or F, attach copies of any letters or other communication between you and the U.S. Fish & Wildlife Service or National Marine Fisheries Service concluding consultation or coordination activities.

3.2 Historic Preservation

The Operator responsible for finalizing this SWPPP must:

- Fill out the answers to the questions below for
  - Appendix E, Step 2

- Appendix E, Step 3
- Appendix E, Step 4

➢ Insert copies of any correspondence with the Massachusetts Historical Commission into Attachment L.

Appendix E, Step 1

Do you plan on installing any of the following stormwater controls at your site? Check all that apply below, and proceed to Appendix E, Step 2.

☐ Dike
☒ Berm
☒ Catch Basin
☒ Pond (Bioretention Basin)
☒ Stormwater Conveyance Channel (e.g., ditch, trench, perimeter drain, swale, etc.)
☐ Culvert
☒ Other type of ground-disturbing stormwater control: Subsurface infiltration structures

(Note: If you will not be installing any ground-disturbing stormwater controls, no further documentation is required for Section 3.2 of the Template.)

Appendix E, Step 2

If you answered yes in Step 1, have prior surveys or evaluations conducted on the site already determined that historic properties do not exist, or that prior disturbances at the site have precluded the existence of historic properties?

☒ YES, prior disturbances at the site have precluded the existence of historic properties ☐ NO

If yes, no further documentation is required for Section 3.2 of the Template. If no, proceed to Appendix E, Step 3.

Appendix E, Step 3

If you answered no in Step 2, have you determined that your installation of subsurface earth-disturbing stormwater controls will have no effect on historic properties?

☐ YES ☐ NO

If yes, provide documentation of the basis for your determination. If no, proceed to Appendix E, Step 4.

Appendix E, Step 4

If you answered no in Step 3, did the State Historic Preservation Officer (SHPO), Tribal Historic Preservation Office (THPO), or other tribal representative (whichever applies) respond to you within 15 calendar days to indicate whether the subsurface earth disturbances caused by the installation of stormwater controls affect historic properties?

☐ YES ☐ NO

If no, no further documentation is required for Section 3.2 of the Template.

If yes, describe the nature of their response:

☐ Written indication that adverse effects to historic properties from the installation of stormwater controls can be mitigated by agreed upon actions. *INSERT COPIES OF LETTERS, EMAILS, OR OTHER COMMUNICATION BETWEEN YOU AND THE APPLICABLE SHPO, THPO, OR OTHER TRIBAL REPRESENTATIVE*

☐ No agreement has been reached regarding measures to mitigate effects to historic properties from the installation of stormwater controls. *INSERT COPIES OF LETTERS, EMAILS, OR OTHER COMMUNICATION BETWEEN YOU AND THE APPLICABLE SHPO, THPO, OR OTHER TRIBAL REPRESENTATIVE*

☐ Other:

3.3 Safe Drinking Water Act Underground Injection Control Requirements

Do you plan to install any of the following controls? Check all that apply below.

☐ Infiltration trenches (if stormwater is directed to any bored, drilled, driven shaft or dug hole that is deeper than its widest surface dimension, or has a subsurface fluid distribution system)

☐ Commercially manufactured pre-cast or pre-built proprietary subsurface detention vaults, chambers, or other devices designed to capture and infiltrate stormwater flow

☒ Drywells, seepage pits, or improved sinkholes (if stormwater is directed to any bored, drilled, driven shaft or dug hole that is deeper than its widest surface dimension, or has a subsurface fluid distribution system)

All stormwater structures meeting the definition of Underground Injection Wells shall be registered in accordance with DEP regulations 310 CMR 27.00. A copy of this application is included in Attachment O.

4

Erosion and Sediment Controls

The purpose of an erosion and sedimentation control program is to minimize the discharge of pollutants from earth-disturbing activities during the construction phase of the project. The program incorporates BMPs specified in guidelines developed by the DEP[1] and the U.S. Environmental Protection Agency[2] and complies with the requirements of the NPDES General Permit for Storm Water Discharges from Construction Activities.

Proper implementation of the erosion and sedimentation control program will:

- minimize exposed soil areas through temporary stabilization and construction sequencing;
- minimize sediment track-out from the site;
- minimize the generation of dust;
- minimize soil compaction;
- place structures to manage stormwater runoff and erosion; and
- establish permanent vegetative cover or other forms of stabilization in accordance with Part 2.2 of the Permit.

Installation of stormwater controls must be completed prior to the commencement of each phase of earth-disturbing activities. All manufactured control measures must be installed and maintained in accordance with the manufacturer's specifications. The site contractor must inspect all erosion and sediment controls in accordance with the applicable requirements in CGP Part 4.1, and document findings in accordance with Part 4.1.7 of the Permit.

1 Massachusetts Department of Environmental Protection, 1993. *Massachusetts Nonpoint Source Management Manual, The Megamanual: A Guidance Document for Municipal Officials.*
2 United States Environmental Protection Agency, 1992. *Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.*

The following sections describe the erosion and sedimentation controls that will be used on this site. The contractor will implement, modify, and add to these stormwater controls, when required.

4.1 Natural Buffers or Equivalent Sediment Controls

Buffer Compliance Alternatives

Are there any surface waters within 50 feet of your project's earth disturbances?

☒ YES ☐ NO
(Note: If no, no further documentation is required for the SWPPP Template.)

Check the compliance alternative that you have chosen:

☐ I will provide and maintain a 50-foot undisturbed natural buffer.
(Note (1): You must show the 50-foot boundary line of the natural buffer on your site map.)
(Note (2): You must show on your site map how all discharges from your construction disturbances through the natural buffer area will first be treated by the site's erosion and sediment controls. Also, show on the site map any velocity dissipation devices used to prevent erosion within the natural buffer area.)

☐ I will provide and maintain an undisturbed natural buffer that is less than 50 feet and is supplemented by additional erosion and sediment controls, which in combination achieves the sediment load reduction equivalent to a 50-foot undisturbed natural buffer.
(Note (1): You must show the boundary line of the natural buffer on your site map.)
(Note (2): You must show on your site map how all discharges from your construction disturbances through the natural buffer area will first be treated by the site's erosion and sediment controls. Also, show on the site map any velocity dissipation devices used to prevent erosion within the natural buffer area.)

☐ It is infeasible to provide and maintain an undisturbed natural buffer of any size, therefore I will implement erosion and sediment controls that achieve the sediment load reduction equivalent to a 50-foot undisturbed natural buffer.

☒ I qualify for one of the exceptions in Part 2.1.2.1.e. (If you have checked this box, provide information on the applicable buffer exception that applies, below.)

Buffer Exceptions

Which of the following exceptions to the buffer requirements applies to your site?

☒ There is no discharge of stormwater to surface waters through the area between the disturbed portions of the site and the surface waters located within 50 feet of disturbance.

Stormwater from construction disturbances will be directed to stormwater BMPs and not directly to the surface waters.
(Note: If this exception applies, no further documentation is required for Section 4.1 of the Template.)

☐ No natural buffer exists due to preexisting development disturbances that occurred prior to the initiation of planning for this project.
(Note (1): If this exception applies, no further documentation is required for Section 4.1 of the Template.)
(Note (2): Where some natural buffer exists but portions of the area within 50 feet of the surface water are occupied by preexisting development disturbances, you must still comply with the one of the CGP Part 2.1.2.1.a compliance alternatives.)

☐ For a "linear project" (defined in Appendix A), site constraints (e.g., limited right-of-way) make it infeasible for me to meet any of the CGP Part 2.1.2.1.a compliance alternatives.

☐ The project qualifies as "small residential lot" construction (defined in Part 2.1.2.1.e.iv and in Appendix A).

☐ Buffer disturbances are authorized under a CWA Section 404 permit.
(Note (1): If this exception applies, no further documentation is required for Section 4.1 of the Template.)
(Note (2): This exception only applies to the limits of disturbance authorized under the Section 404 permit, and does not apply to any upland portion of the construction project.)

☐ Buffer disturbances will occur for the construction of a water-dependent structure or water access area (e.g., pier, boat ramp, and trail).
(Note (1): If this exception applies, no further documentation is required for Section 4.1 of the Template.)

4.2 Perimeter Controls

General

Installation of perimeter controls must be completed prior to the commencement of earth-disturbing activities.

Specific Perimeter Controls

Straw Wattle

Straw wattles can be installed around the project work limits as perimeter controls. Straw wattles shall be as manufactured by *Earthsaver* or approved equivalent. Straw wattle size and compost fill material shall be in accordance with the manufacturer's recommendations. Straw wattles to be entrenched into the substrate approximately 3 inches to prevent underflow. Install in accordance with manufacturer recommendations.

Date of Perimeter Control Installation

Straw Wattle

Date Installed: ______________________

Maintenance Requirements

Straw wattles will be inspected in compliance with the inspection schedule specified in CGP Part 4.1.2 and maintained routinely throughout the duration of the project. In accordance with CGP Part 2.1.2.2.b, the contractor must remove sediment before it accumulates to one-half of the above-ground height of any perimeter control.

Perimeter Silt Fence and Strawbales

Staked silt fence and straw bales can be used separately or in conjunction as erosion control barriers. They are staked in a line around perimeters of disturbed areas, especially those adjacent to wetlands, waterways, roadways or at the base of slopes. Perimeter barriers intercept, filter, and reduce the velocity of stormwater run-off.

Date of Perimeter Control Installation

Silt Fence and Strawbales

Date Installed: ______________________

Maintenance Requirements

Staked Strawbales will be inspected before forecasted storm events, daily during prolonged rain events. Sediment will be removed when it reaches two-thirds the hight of the strawbale or when it accumulates to a depth of one foot adjacent to the silt fence. Bales that are no longer in a condition to operate effectively (e.g. rotted) will be replaced as necessary.

4.3 Sediment Track-out

General

A temporary crushed-stone construction entrance/exit will be constructed.

Specific Track-Out Controls

Stabilized Construction Exit

A cross slope will be placed in the construction 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.

Date of Track-Out Control Installation

Stabilized Construction Exit

Date of Installation: ____________________

Maintenance Requirements

The exit shall be maintained in a condition which shall prevent tracking or flowing of sediment onto public rights-of-way. This may require periodic top dressing with additional stone as conditions demand and repair or clean out or any measures used to trap sediment.

In the event that sediment is tracked-out of the site onto the surface of off-site streets, other paved areas, and sidewalks, the contractor will remove the deposited sediment by the end of the same work day. If track-out occurs on a non-work day, the contractor will remove the sediment by the end of the next work day. Sediment will be swept, shoveled, vacuumed or removed by similar means. Hosing or sweeping sediment directly into a stormwater conveyance, storm drain inlet, or surface water is prohibited.

Stabilized construction exit shall be removed prior to final finished materials being installed.

4.4 Stockpiled Sediment or Soil

General

Any areas of exposed soil or stockpiles that will remain inactive for more than 14 days will be temporarily stabilized with vegetative or non-vegetative stabilization practices.

Specific Stockpile Control

Vegetative Stabilization

Vegetative stabilization practices will include seeding exposed surfaces with a seed mix containing a blend of rapid germinating grasses that are indigenous to central Massachusetts. Once seeded, areas will be covered with a layer of straw mulch according to the recommendations provided by the manufacturer.

Non-Vegetative Stabilization

Non-vegetative stabilization practices will consist of applying a layer of straw mulch, or an erosion control blanket in accordance with manufacturer's specifications.

Date of Stockpile Control Installation

Vegetative Stabilization

Date Installed: ______________________________

Date Installed: ______________________________

Date Installed: ______________________________

Non-Vegetative Stabilization

Date Installed: ______________________________

Date Installed: ______________________________

Date Installed: ______________________________

Maintenance Requirements

In accordance with CGP Part 2.1.2.4, the contractor must comply with the following requirements for any stockpiles or land clearing debris composed, in whole or in part, of sediment or soil:

- Locate the piles outside of any natural buffers established under Part 2.1.2.1a and physically separated from other stormwater controls implemented in accordance with Part 2.1;
- Protect from contact with stormwater (including run-on) using a temporary perimeter sediment barrier;
- Where practicable, provide cover or appropriate temporary stabilization to avoid direct contact with precipitation or to minimize sediment discharge;
- Do not hose down or sweep soil or sediment accumulated on pavement or other impervious surfaces into any stormwater conveyance (unless connected to a sediment basin, sediment trap, or similarly effective control), storm drain inlet, or surface water; and
- Unless infeasible, contain and securely protect from wind.

4.5 Minimize Dust

General

When necessary larger areas of exposed soil will be wetted to prevent wind borne transport of fine grained sediment.

Specific Dust Controls

Soil Wetting

Enough water shall be applied to wet the upper 0.5 inch of soil. The water will be applied as a fine spray in order to prevent erosion.

Date of Dust Control Implementation

Soil Wetting

Date of Implementation: ________________________

Date of Implementation: ________________________

Date of Implementation: ________________________

Maintenance Requirements

Large areas of exposed soils will routinely be inspected to determine if soil wetting is required.

4.6 Minimize the Disturbance of Steep Slopes

General

Disturbances to steep slopes were minimized, to the maximum extent practicable, during the design phase of the project. Preservation of natural grading will occur where feasible and disturbances will be minimized through the implementation of erosion and sediment control practices designed for utilization on steep slopes.

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.

Specific Steep Slope Controls

Erosion Control Blanket

Erosion control blankets will be installed by anchoring the top of the blanket in a 6 inch deep trench. The trench shall be backfilled and compacted after the blanket is secured with staples. The erosion control blanket will be installed in the direction of potential flow. Edges of the blankets must be stapled with approximately 4 inches overlap where 2 or more strip widths are required.

Date of Steep Slope Control Installation

Erosion Control Blanket

Date of Installation: ____________________

Date of Installation: ____________________

Date of Installation: ____________________

Maintenance Requirement

Erosion control blankets will be inspected in compliance with the inspection schedule specified in CGP Part 4.1.2 and maintained routinely throughout the duration of the project.

4.7 Topsoil

General

Topsoil will be preserved throughout the site to the maximum extent practicable. Where it is infeasible to preserve topsoil in place it shall be repurposed throughout the site to the maximum extent practicable.

Specific Topsoil Controls

Topsoil Preservation/Repurpose

Topsoil will be repurposed throughout the project site and excess topsoil will be disposed of in accordance with local, state and federal regulations, as necessary.

Date of Topsoil Control Implementation

Topsoil Preservation/Repurpose

Date of Implementation: ________________________________

Date of Implementation: ________________________________

Date of Implementation: ________________________________

4.8 Soil Compaction

General

In order to avoid soil compaction the contractor will limit vehicle and equipment use in areas where final vegetative stabilization will occur or where infiltration practices will be installed.

Prior to seeding or planting of areas where final vegetative stabilization will occur or where infiltration practices will be installed techniques that condition soil, to support vegetative growth, will be implemented in the event exposed soils become compacted as a result of construction activities. Soil conditioning techniques shall be determined on an individual basis, if required.

Specific Soil Compaction Controls

Soil Conditioning Techniques

Date of Soil Compaction Control Implementation

Date of Implementation: ________________________________
Date of Implementation: ________________________________
Date of Implementation: ________________________________

Maintenance Requirement

4.9 Storm Drain Inlets

General

Prior to any earth-disturbing activities inlet protection measures will be installed.

Specific Storm Drain Inlet Controls

Siltsack Sediment Traps

Siltsack sediment traps will be installed at the inlets of existing and proposed catch basins throughout the site. Catch basin grates to be placed over siltsack.

Straw Bale and Non-Woven Filter Fabric

A straw bale barrier may be installed at the inlets or existing and proposed catch basins. If straw bales are used, a layer of non-woven filter fabric shall be placed beneath the grate of each catch basin.

Date of Storm Drain Inlet Control Installation

Siltsack Sediment Trap

Date of Installation: ______________________________

Date of Installation: ______________________________

Date of Installation: ______________________________

Straw Bale and Non-Woven Filter Fabric

Date of Installation: ______________________________

Date of Installation: ______________________________

Date of Installation: ______________________________

Maintenance Requirement

The contractor will clean, or remove and replace, the protection measures as sediment accumulates, the filter becomes clogged, and/or performance is compromised. Where there is evidence of sediment accumulation in or adjacent to the inlet protection measure, the contractor must remove the deposited sediment by the end of the same work day in which it is found or by the end of the following work day if removal by the same work day is not feasible. Sediment will be reused onsite or disposed of at a suitable off-site location.

4.10 Constructed Stormwater Conveyance Channels

General

Constructed Stormwater Conveyance Channels will be used to collect runoff from construction areas and discharge to either sedimentation basins or protected catch basin inlets.

Specific Constructed Stormwater Conveyance Channel Controls

Diversion Channels

Diversion channels will be used to collect runoff from construction areas and discharge to either sedimentation basins or protected catch basin inlets.

Date of Constructed Stormwater Conveyance Channel Controls Construction

Diversion Channels

Date of Installation: ______________________________

Date of Installation: ______________________________

Date of Installation: ______________________________

Maintenance Requirement

Diversion channel s will be inspected weekly and after any rainfall. If breakout or erosion is observed, the diversion channel shall be reinforced or protected by an erosion control blanket.

4.11 Sediment Basins

General

If the Site contractor discharges flows from the disturbed area into the rehabilitated retention pond, the rehabilitated retention pond will meet the requirements of CGP Part 2.1.3.2.

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.

Maintenance Requirements

(Note: At a minimum, you must comply with following requirement in CGP Part 2.1.3.2.b: "Keep in effective operating condition and remove accumulated sediment to maintain at least ½ of the design capacity of the sediment basin at all times.")

The sediment basins shall be inspected weekly and after any rainfall. If cracking, erosion, breakout, sediment build-up are observed, the basin shall be reinforced or cleaned out as needed. If accumulated sediment occupies at least ½ of the design capacity (or is deposited to a depth greater than 6 inches), whichever is smaller, the basin will be cleaned out and sediments will be disposed of properly. If contaminants are observed in the basin(s), they shall be identified and cleaned up in accordance with local, state, and federal requirements.

4.12 Chemical Treatment

Soil Types

List all the soil types (including soil types expected to be found in fill material) that are expected to be exposed during construction and that will be discharged to locations where chemicals will be applied:

Soils within existing developed areas are generally classified as Urban Land and Udorthents and a soil class determination (type A, B, C, or D) is not specified by the NRCS for the Site. The Site soils have been characterized as Class A & B soils based on a review of the NRCS maps for adjacent undisturbed parcels.

Treatment Chemicals

List all treatment chemicals that will be used at the site and explain why these chemicals are suited to the soil characteristics:

Table 7. List of Treatment Chemicals and Dosage/Use to be used on Site

Chemical	Dosage and Application Details

The contractor will comply with all treatment chemical usage requirements under Part 2.1.3.3 of the Permit by:

- utilizing conventional erosion and sediment controls prior to and after the application of any treatment chemical;

- selecting treatment chemicals suitable to the types of soils likely to be exposed during construction activities;
- minimizing discharge risk by storing chemicals in leak-proof containers;
- using chemicals in accordance with good engineering practices and specifications of the chemical provider;
- complying with state and local requirements;
- ensuring that all persons who handle and use treatment chemicals are provided with product-specific training and appropriate dosing requirements;
- complying with additional requirements for the pre-approved use of cationic chemicals; and
- providing proper SWPPP documentation of specific chemicals and chemical treatment systems to be used and compliance with CGP Part 2.1.3.3.

Special Controls for Cationic Treatment Chemicals

If you have been authorized by your applicable Regional Office to use cationic treatment chemicals, include the official EPA authorization letter or other communication, and identify the specific controls and implementation procedures you are required to implement to ensure that your use of cationic treatment chemicals will not lead to a violation of water quality standards:

Training

Describe the training that personnel who handle and apply chemicals have received prior to permit coverage, or will receive prior to the use of treatment chemicals:

Personnel will receive all necessary training prior to any treatment chemical application. Attachment J contains the training records.

4.13 Dewatering Practices

General

For the demolition of the existing buildings and the construction of the village retail and assisted living facility, we anticipate that dewatering will be needed, primarily for the installation of deeper utilities and construction of the footings. Existing Building Nos. 2, 3 and 4 and most of Building No. 1 are outside of the Massachusetts Contingency Plan (MCP) disposal site boundary and known groundwater contamination associated with Release Tracking Numbers (RTNs) 3-27243 and 3-3037. The proposed village retail and assisted living facility and associated parking lot are also outside of the MCP disposal site boundary. As such, groundwater encountered in deeper excavations during demolition activities and during new construction activities outside of the MCP disposal site boundary will be managed in accordance with the NPDES General Construction Permit, and guidelines included herein, or recharged on site after removal of sediment through the use of straw bale basins, dewatering filter bags, or settling basins. Groundwater sampling will be conducted as necessary in accordance with the applicable permit.

For construction activities within the MCP disposal site boundary, dewatering will be managed under the NPDES Remediation General Permit (anticipated to be renewed by EPA) or recharged on-site in accordance with the MCP (310 CMR 40.0045). Within the disposal site boundary, we anticipate dewatering will be required to construct the proposed pump station located in the northeastern corner of Phase I. Earthwork, including dewatering, will be performed under a Post-RAO Release Abatement Measure (RAM) Plan in accordance with the MCP (310 CMR 40.0440). Groundwater sampling will be performed prior to dewatering to evaluate the type of treatment required, if any, and effluent sampling will be performed in accordance with the applicable permit requirements for discharge.

Specific Dewatering Practices

Straw Bale Basin

The basins will consist of a ring of staked straw bales overlain by non-woven geotextile filter fabric and crushed stone. Discharge water will be pumped into the basin and allowed to drain through the fabric onto relatively-flat stabilized surfaces.

Dewatering Filter Bag

Dewatering filter bags may be used in place of straw bale basins. The bags will be placed on relatively flat terrain, free of brush and stumps, to avoid ruptures and punctures. A maximum of one six-inch discharge hose will be allowed per filter bag. To help prevent punctures, geotextile fabric will be placed beneath the filter bag when used in wooded locations. Unattended filter bags will be encircled with a straw bale and silt fence barrier.

Date of Dewatering Practice Installation

Treatment System

Date of Installation: ______________________________

Date of Installation: ______________________________

Date of Installation: ______________________________

Treatment System

Date of Installation: _______________________________

Date of Installation: ______________________________

Date of Installation: ______________________________

Maintenance Requirement

All dewatering structures will be placed as far away from wetland resources as practicable. Filter bags used during construction will be bundled and removed for proper disposal. Backwash water shall be returned to the beginning of the treatment process or hauled away for disposal. Filter media shall be cleaned and replaced in all dewatering devices when the pressure differential equals or exceeds the manufacturer's specifications.

4.14 Other Stormwater Controls

General

Additional erosion controls may be used in the event that excessive erosion occurs. Placement of temporary silt fence, straw bales or earthen berms may be used to control the movement of material within the site. If such controls are deemed necessary for adequate protection, they will be installed perpendicular to the flow direction to contain sediment. These measures will be installed to prevent perimeter erosion controls from becoming compromised.

Silt Socks

Silt Socks will be placed to trap sediment transported by runoff before it reaches the drainage system or leaves the construction site. Silt Socks will be set in accordance with the details in the Site Plans.

Catch Basin Protection

Newly constructed and existing catch basins will be protected with straw bale barriers (where appropriate) or silt sacks throughout construction.

4.15 Site Stabilization

General

Any areas of exposed soil or stockpiles that will remain inactive for more than 14 days will be temporarily stabilized with vegetative or non-vegetative stabilization practices.

Site Stabilization Practice

☐ Vegetative ☐ Non-Vegetative
☐ Temporary ☐ Permanent

Vegetative 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 Requirement

- 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 before it has accumulated to one-half the above-ground height of any perimeter control.
- Damaged or deteriorated items will be repaired immediately after identification.
- The underside of straw bales should be kept in close contact with the earth and reset as necessary.
- Sediment that is collected in structures shall be disposed of properly and covered if stored 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.

Site Stabilization Practice

☐ Vegetative	☐ Non-Vegetative
☐ Temporary	☐ Permanent

Non-Vegetative Stabilization

Non-vegetative stabilization practices will consist of applying a layer of straw mulch, at a rate of 90 pounds per 1,000 square feet. The mulch will be anchored with a tacking coat (non tar) applied by a hydroseeder. Steeper slopes (greater than 10 percent) will be covered with a bonded fiber matrix as described above.

In the event heavy rain is forecast (more than 2 inches over a 24 hour period), slopes that are not stabilized will be treated with a polyacrylamide (PAM) product such as Silt Stop® (or equivalent product). PAM is a non toxic substance that promotes soil bonding. PAM shall be applied in powder or liquid form in accordance with the recommendations provided by the manufacturer.

Date of Site Stabilization Practice Installation

Vegetative Stabilization

Date of Installation: ____________________________

Date of Installation: ____________________________

Date of Installation: ____________________________

Non-Vegetative Stabilization

Date of Installation: ____________________________

Date of Installation: ____________________________

Date of Installation: ____________________________

Mulching

- ☐ Vegetative
- ☐ Temporary
- ☐ Non-Vegetative
- ☐ Permanent

Installation

When construction will be temporarily or permanently ceased, mulching shall occur immediately over seeding, as required, for erosion control while vegetation is being established.

Maintenance Requirements

Periodic inspections shall occur once a week and after every rainstorm 0.25 inches or greater.

See BMP Manual Section 8.2 for specific controls, installation, and maintenance.

Erosion Control Mats and Blankets

☐ Vegetative ☐ Non-Vegetative
☐ Temporary ☐ Permanent

Description of Practice

Organic or synthetic materials applied to the soil surface as a continuous sheet. Used to protect disturbed areas from erosion and to enhance seed growth, typically where moving water is likely to wash out new vegetative plantings and mulches are ineffective.

Commonly used techniques include erosion control blankets which are made of mulch material surrounded by plastic netting, jute mats which are sheets of woven jute fiber, and turf reinforcement matting which is usually a geotextile matrix most effective for channels.

5

Pollution Prevention Standards

5.1 Potential Sources of Pollution

Table 8. Construction Site Pollutant

Pollutant-Generating Activity	**Pollutants or Pollutant Constituents** (that could be discharged if exposed to stormwater)	**Location on Site** (or reference SWPPP site map where this is shown)
Paving Operations	Concrete constituents	
Painting	Paint	
Vehicle/Building Cleaning	Cleaning solvents, detergents	
Landscape Plantings	Fertilizer	
Vehicle Maintenance	Petroleum-based products	
Cleared & Graded Areas	Soil erosion, fertilizer	
Portable Toilets	Sewage	
Fuel Tanks	Fuel oil, gasoline, other fuels	
Storage Areas	Soil erosion, fuel oil, gasoline, asphalt, concrete, vehicle fluids, paints, solvents, pesticides, fertilizer	

Add information as necessary.

5.2 Spill Prevention and Response

The following practices will be followed for spill control, notification and cleanup:

- The construction superintendent responsible for the daily operations will be the spill prevention and cleanup coordinator. He will designate at least three other site personnel to receive spill prevention and cleanup training. These individuals will each become responsible for a particular phase of prevention and cleanup. The names of the responsible spill personnel will be posted in the material storage area and in the on-site office trailer.

- Spills of toxic or hazardous material in excess of reportable quantities, as established in the CGP, will be reported to the Massachusetts Department of Environmental Protection Division of Hazardous Waste [(617) 292-5851 or (978) 661-7679] and the National Response Center [(800) 424-8802];

- All spills will be cleaned up immediately after discovery;

- The spill area will be kept well ventilated and personnel will wear protective clothing to prevent injury from contact with a hazardous substance; and

- Manufacturer's recommended methods for spill cleanup will be clearly posted and site personnel will be informed of the procedures and the location of the information and cleanup supplies;

- Materials and equipment necessary for spill cleanup will be kept in the material storage area on-site. Equipment and materials will include, but will not be limited to the emergency response equipment listed herein;

The following text is excerpted from the Project Stormwater Management System Operations and Maintenance Manual.

A comprehensive Spill Prevention Control and Countermeasure (SPCC) plan will be developed and implemented by the Project Owner and Tenant. At a minimum the SPCC, will discuss:

- Spill prevention equipment;
- Spill prevention supplies provided on-site; and
- Spill prevention training to be provided by the Owner and/or Tenant to designated employees.

Initial Notification

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

Facility Manager (name): ____

Facility Manager (phone): ____

Construction Manager (name): ____

Construction Manager (phone): ______________________________________

The supervisor will first contact the Fire Department and then notify the Police Department, the Board of Health and the Conservation Commission.

Further Notification

Based on the assessment from the Fire Chief, additional notification to a cleanup contractor may be made. The Massachusetts Department of Environmental Protection (DEP) and the EPA may be notified depending upon the nature and severity of the spill. The Fire Chief will be responsible for determining the level of cleanup and notification required. 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: ______________ ALTERNATE CONTACT: NAME: ______________	PHONE: ______________ BEEPER/CELL: ______________, ______________ HOME PHONE: ______________ PHONE: ______________ BEEPER/CELL: ______________, ______________ HOME PHONE: ______________
2. FIRE & POLICE DEPARTMENT	EMERGENCY: **911**
3. CLEANUP CONTRACTOR: ______________________ ADDRESS: ______________________ ______________________	PHONE: ______________
4. MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION (DEP)	EMERGENCY PHONE: (800) 340-1133
5. NATIONAL RESPONSE CENTER ALTERNATE: U.S. ENVIRONMENTAL PROTECTION AGENCY	PHONE: (800) 424-8802 EMERGENCY: (800) 424-8802 BUSINESS: (800) 424-8802
6. SUDBURY HEALTH DEPARTMENT SUDBURY CONSERVATION COMMISSION:	PHONE: (978)440-5479 PHONE: (978)440-5471

See **Attachment N** for a the Hazardous Waste Oil Spill Report

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**

Sudbury Health Department: **(978)440-5479**

Sudbury Conservation Commission: **(978)440-5471**

Emergency Response Equipment

The following is an example of an equipment and materials list that must be prepared by the Owner and Tenant. Equipment and Supplies on this list 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, 26 feet of sock, 50 pads, and five pounds of absorbent (or equivalent)
➤ SORBENT PADS	**50**	➤ http://www.forestry-suppliers.com
➤ LITE-DRI® ABSORBENT	**5 POUNDS**	➤ Item # 43210 — Manhole cover pick (or equivalent)
➤ SHOVEL	**1**	➤ Item # 33934 — Shovel (or equivalent)
➤ PRY BAR	**1**	➤ Item # 90926 — Gloves (or equivalent)
➤ GOGGLES	**1 PAIR**	➤ Item # 23334 — Goggles (or equivalent)
➤ GLOVES – HEAVY	**1 PAIR**	

5.3 Fueling and Maintenance of Equipment or Vehicles

When fueling or maintaining equipment or vehicles, the contractor will adhere to the following requirements (CGP 2.3.3.1):

- If applicable, comply with the Spill Prevention Control and Countermeasures (SPCC) requirements in 40 CFR 112 and Section 311 of the CWA;
- Ensure adequate supplies are available at all times to handle spills, leaks, and disposal of used liquids;
- Use drip pans and absorbents under or around leaky vehicles;
- Dispose of or recycle oil and oily wastes in accordance with other federal, state, tribal, or local requirements;
- Clean up spills or contaminated surfaces immediately, using dry clean up measures where possible, and eliminate the source of the spill to prevent a discharge or a furtherance of an ongoing discharge; and
- Do not clean surfaces by hosing the area down.

5.4 Washing of Equipment and Vehicles

As listed in CGP 2.3.3.2, the contractor must provide an effective means of minimizing the discharge of pollutants from equipment and vehicle washing, wheel wash water, and other types of washing. Effective controls include, but are not restricted to, locating activities away from surface waters and stormwater inlets or conveyances and directing wash waters to a sediment basin or sediments trap, using filtration devices, such as filter bags or sand filters, or using other similarly effective controls. For compliance with Part 2.3.1.4, for storage of soaps, detergents, or solvents, the contractor must provide either cover (e.g., plastic sheeting or temporary roofs) to prevent these detergents from coming into contact with rainwater, or a similarly effective means designed to prevent the discharge of pollutants from these areas.

As listed in CGP 2.3.3.4, the contractor must provide an effective means of eliminating the discharge of water from the washout and cleanout of concrete and other construction materials. For compliance with this requirement, the contractor must, at minimum, direct all washwater into a leak-proof pit, remove and dispose of hardened concrete waste consistent with CGP 2.3.3.3, and locate any washout or cleanout activities as far away as possible from surface waters and stormwater inlets or conveyances.

5.5 Storage, Handling, and Disposal of Construction Products, Materials, and Wastes

The following good housekeeping practices will be followed on-site during the construction period:

- An effort will be made to store only enough product required to do the job;
- All materials stored on-site will be stored in a neat, orderly manner in their appropriate containers, and (if possible) under a roof or other enclosure;
- Products will be kept in their original containers with the original manufacturer's label;
- Substances will not be mixed with one another unless recommended by the manufacturer;
- Whenever possible, all of a product will be used before disposing of the container;
- Manufacturer's recommendations for proper use and disposal will be followed; and
- The site superintendent will inspect the storage area daily to ensure proper use and disposal of materials on-site.

The following practices will reduce the risks associated with hazardous materials (e.g., petroleum products, solvents):

- A copy of all Material Safety Data Sheets (MSDS) for materials or products used during construction will be kept in the office trailer;
- Products will be kept in original containers unless they are not re-sealable;
- Original labels and material safety data (MSD sheets) will be retained; they contain important product information; and
- If surplus product must be disposed, manufacturer's or local- and state-recommended methods for proper disposal will be followed.

Building Products

All containers will be tightly sealed and covered with plastic sheeting or a temporary roof when not required for use. Excess materials will be properly disposed according to manufacturer's instructions or state and local regulations and shall not be discharged to the storm sewer system. No storage will occur within 100 feet of a wetland or waterway.

Pesticides, Herbicides, Insecticides

Pesticides, herbicides, and insecticides will not be used at the Project Site.

Diesel Fuel, Oil, Hydraulic Fluids, Other Petroleum Products, and Other Chemicals

All on-site vehicles will be monitored for leaks and will receive regular preventive maintenance to reduce the chance of leakage. Spills will be cleaned up immediately, using dry clean-up methods where possible. No vehicle maintenance or handling of petroleum products will occur within 100 feet of a wetland or waterway.

Any asphalt substances used on-site will be applied according to manufacturer's recommendations. No petroleum-based or asphalt substances will be stored within 100 feet of a wetland or waterway. All containers will be tightly sealed and covered with plastic sheeting or a temporary roof when not required for use.

Hazardous or Toxic Waste

In accordance with CGP Part 2.3.3.3.d, the contractor will:

- Separate hazardous or toxic waste from construction and domestic waste;
- Store waste in sealed containers, which are constructed of suitable materials to prevent leakage and corrosion, and which are labeled in accordance with

applicable Resource Conservation and Recovery Act (RCRA) requirements and all other applicable federal, state, tribal, or local requirements;

- Store all containers that will be stored outside within appropriately sized secondary containment (e.g., spill berms, decks, spill containment pallets) to prevent spills from being discharged, or provide a similarly effective means designed to prevent the discharge of pollutants from these areas (e.g., storing chemicals in covered area or having a spill kit available on site); and
- Clean up spills immediately, using dry clean-up methods where possible, and dispose of used materials properly.
- Hosing will not be utilized as a method to clean surfaces or spills.
- Eliminate the source of the spill to prevent a discharge or a furtherance of an ongoing discharge.

All hazardous waste materials (e.g., petroleum products, solvents) will be disposed in the manner specified by local and state regulation, or by the manufacturer. Site personnel will be instructed in these practices, and the site construction supervisor will be responsible for seeing that these procedures are followed.

Construction and Domestic Waste

The contractor will provide waste containers (e.g., dumpster or trash receptacle) of sufficient size and number to contain construction and domestic wastes. Daily loose trash removal will prevent litter, construction debris, and construction chemicals exposed to stormwater from becoming a pollutant source for stormwater discharges. All loose trash will be placed in appropriate storage containers until being disposed of properly off-site. Areas to be used for storing dumpsters, compactors or other raw or waste materials will be covered to prevent contact with stormwater.

Sanitary Waste

Portable toilets will be positioned so that they are secure and will not be tipped or knocked over. All sanitary waste will be collected from the portable units by a licensed contractor as required, and disposed in compliance with state and local regulation.

5.6 Washing of Applicators and Containers used for Paint, Concrete or Other Materials

In compliance with the prohibition in CGP Parts 2.3.1.1 and 2.3.1.2, the contractor must provide an effective means of eliminating the discharge of water from the washout and cleanout of stucco, paint, concrete, form release oils, curing compounds, and other construction materials. To comply with this requirement, the contractor must:

- Direct all washwater into a leak-proof container or leak-proof pit. The container or pit must be designed so that no overflows can occur due to inadequate sizing or precipitation;
- Handle washout or cleanout wastes as follows:
  - Do not dump liquid wastes in storm sewers;
  - Dispose of liquid wastes in accordance with applicable requirements in Part 2.3.3.3; and
  - Remove and dispose of hardened concrete waste consistent with handling of other construction wastes in Part 2.3.3.3.
- Locate any washout or cleanout activities as far away as possible from surface waters and stormwater inlets or conveyances, and, to the extent practicable, designate areas to be used for these activities and conduct such activities only in these areas.

5.7 Fertilizers

Only slow-release organic fertilizers will be used in landscaped areas. This protocol will limit the amount of potential nutrients that could enter the stormwater and wetland systems. Fertilizer use will be reduced once the proposed landscaping is established.

As included in CGP Part 2.3.5, the contractor must follow the requirements below when applying fertilizer products:

- Apply at a rate and in amounts consistent with manufacturer's specifications, or document departures from the manufacturer specifications where appropriate in Part 7.2.7.2 of the CGP;
- Apply at the appropriate time of year for the project location, and preferably timed to coincide as closely as possible to the period of maximum vegetation uptake and growth;
- Avoid applying before heavy rains that could cause excess nutrients to be discharged;

- Never apply to frozen ground;
- Never apply to stormwater conveyance channels with flowing water; and
- Follow all other federal, state, tribal, and local requirements regarding fertilizer application.

5.8 Other Pollution Prevention Practices

Pavement sweeping may be performed daily or as needed, when track-out has occurred. The sweeping program will remove sediments and contaminants directly from paved surfaces before their release into stormwater runoff. Pavement sweeping has been demonstrated to be an effective initial treatment for reducing pollutant loading into stormwater.

6

Inspection and Corrective Action

6.1 Inspection

Personnel Responsible for Inspections

Inspections are to be performed by "qualified personnel" as defined in Part 4.1.1 of the Permit and shall include all areas of the site disturbed by construction activity and areas used for materials storage that are exposed to precipitation. The Inspector must look for evidence of, or the potential for, pollutants entering the storm water system, inspect the BMPs installed as part of the Plan, inspect the site drainage outfalls, inspect the site egress points for tracking, and inspect material, waste, borrow, or equipment storage and maintenance areas. If, in the course of the inspection, the inspector identifies an eroded area or an area impacted by sedimentation, additional erosion and sedimentation controls will be implemented, the discharge will be documented, and the SWPPP will be revised to include these changes.

Inspection Personnel

Name: ______________________________

Title: ______________________________

Name: ______________________________

Title: ______________________________

Name: ______________________________

Title: ______________________________

Inspection Schedule

At least once every 7 calendar days OR

Once every 14 calendar days and within 24-hours of an event 0.25 inches or greater

To determine if a storm event of 0.25 inch or greater has occurred on the site, data will be obtained from the weather station at Hanscom Field in Bedford, Massachusetts.

For reduction in inspections due to frozen conditions: If the contractor is suspending earth-disturbing activities due to frozen conditions, the contractor may temporarily suspend inspections on the site until thawing conditions (as defined by the CGP as based on the historical likelihood of two or more days with daytime temperatures greater than 32˚F) begin to occur if:

- Runoff is unlikely due to continuous frozen conditions that are likely to continue at the site for at least 3 months based on historic seasonal averages. If unexpected weather conditions (such as above freezing temperatures or rain on snow events) make discharges likely, the contractor must immediately resume regular inspection frequency as described in Parts 4.1.2 or 4.1.3, if applicable;
- Land disturbances have been suspended; and
- All disturbed areas of the site have been temporarily or permanently stabilized in accordance with Part 2.2 of the CGP.

For reduction in inspections due to frozen conditions:

Beginning Date: ______________________________

End Date: ______________________________

Site Inspection Forms are provided in Attachment E, Corrective Action Forms are provided in Attachment F.

6.2 Corrective Action

The following personnel are responsible for completing corrective action forms:

Personnel Responsible for Corrective Actions

Name:

Name:

Position:

Address:

City, State, Zip Code:

Telephone Number:

Fax/Email:

Name:

Name:

Position:

Address:

City, State, Zip Code:

Telephone Number:

Fax/Email:

6.3 Delegation of Authority

The following representatives or positions have been granted the delegation of authority to sign inspection reports. A copy of the signed delegation form is provided in Attachment K.

Duly Authorized Representative(s) or Position(s):

Company Name: ______________________

Name: ______________________

Position: ______________________

Address: ______________________

City, State, Zip Code: ______________________

Telephone Number: ______________________

Fax/Email: ______________________

Duly Authorized Representative(s) or Position(s):

Company Name: ______________________

Name: ______________________

Position: ______________________

Address: ______________________

City, State, Zip Code: ______________________

Telephone Number: ______________________

Fax/Email: ______________________

7

Training

The following table provides a list of personnel and training completion date, which are responsible for the design, installation, maintenance and/or repair of stormwater controls, the application and storage of treatment chemicals, conducting inspections and completing inspection and corrective action forms.

Table 9. Documentation for Completion of Training

Name	Date Training Completed

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8

Certifications and Notification

The following certification statement must be signed and dated by a person who meets the requirements of Appendix I, Part I.11.b. This certification must be re-signed in the event of a SWPPP Modification.

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

OWNER REPRESENTATIVE	CONTRACTOR	SUBCONTRACTOR
Signature and Date	Signature and Date	Signature and Date
Title	Title	Title
Steve Senna BPR Sudbury Development LLC c/o National Development 2310 Washington Street Newton Lower Falls, MA 02462 T: (617) 559-5046 ssenna@natdev.com		
Company, Address, Telephone	Company, Address, Telephone	Company, Address, Telephone

SUBCONTRACTOR	SUBCONTRACTOR	SUBCONTRACTOR
Signature and Date	Signature and Date	Signature and Date
Title	Title	Title
Company, Address, Telephone	Company, Address, Telephone	Company, Address, Telephone

Add additional sheets as necessary.

8.1 Notice of Intent (NOI)

After completion of the SWPPP and the above certification, the NOI must be submitted by all site Operators, list above, at least 14 calendar days prior to commencing earth disturbing activities. The project is considered covered under the permit 14 calendar days after EPA has acknowledged receipt of the project NOI on the Agency's website (www.epa.gov/npdes/stormwater/cgpnoisearch), unless EPA notifies the Operator that the authorization has been delayed or denied. Copies of the NOI and the EPA Authorization Email shall be included in Attachment D.

8.2 Notice of Termination (NOT)

Until coverage is terminated under this permit, the Operators are required to continue to comply with all conditions and requirements in the permit. To terminate permit coverage, all Operators must submit to EPA a complete and accurate NOT, which certifies an Operator has met the requirements for termination as listed in Part 8 of the CGP. In addition, Operators must submit the NOT within 30 calendar days after any of the triggering conditions listed in Part 8.2 of the CGP. An Operator's authorization to discharge under the CGP terminates at midnight of the calendar day that a complete NOT is processed and posted on EPA's website.

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Attachment A
Site Plans

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Attachment B
2012 Construction General Permit

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Attachment C
Site Maps

- Site Location Map
- FEMA Flood Insurance Rate Map
- Soil Map
- SWPPP Erosion and Sedimentation Control Measures

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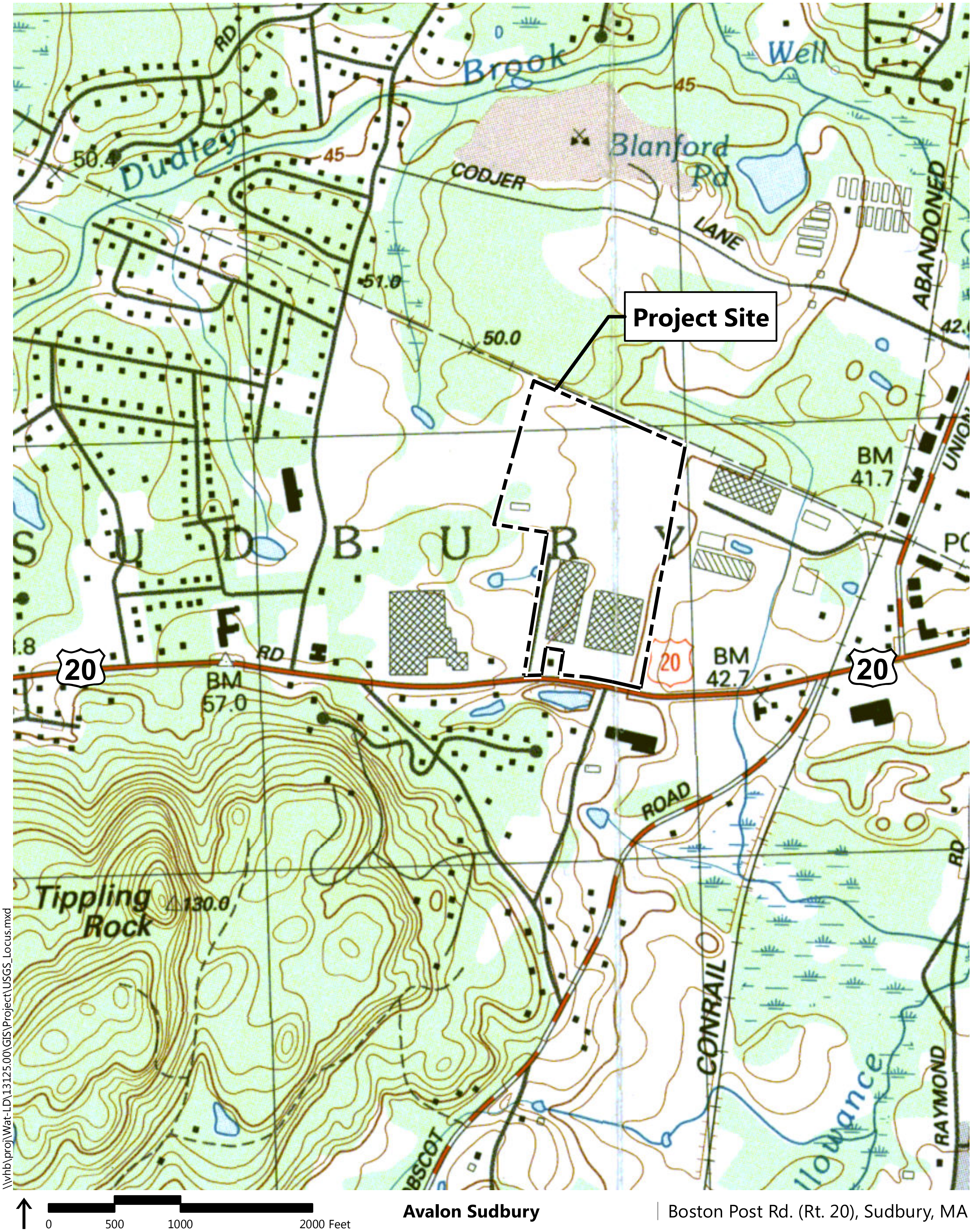

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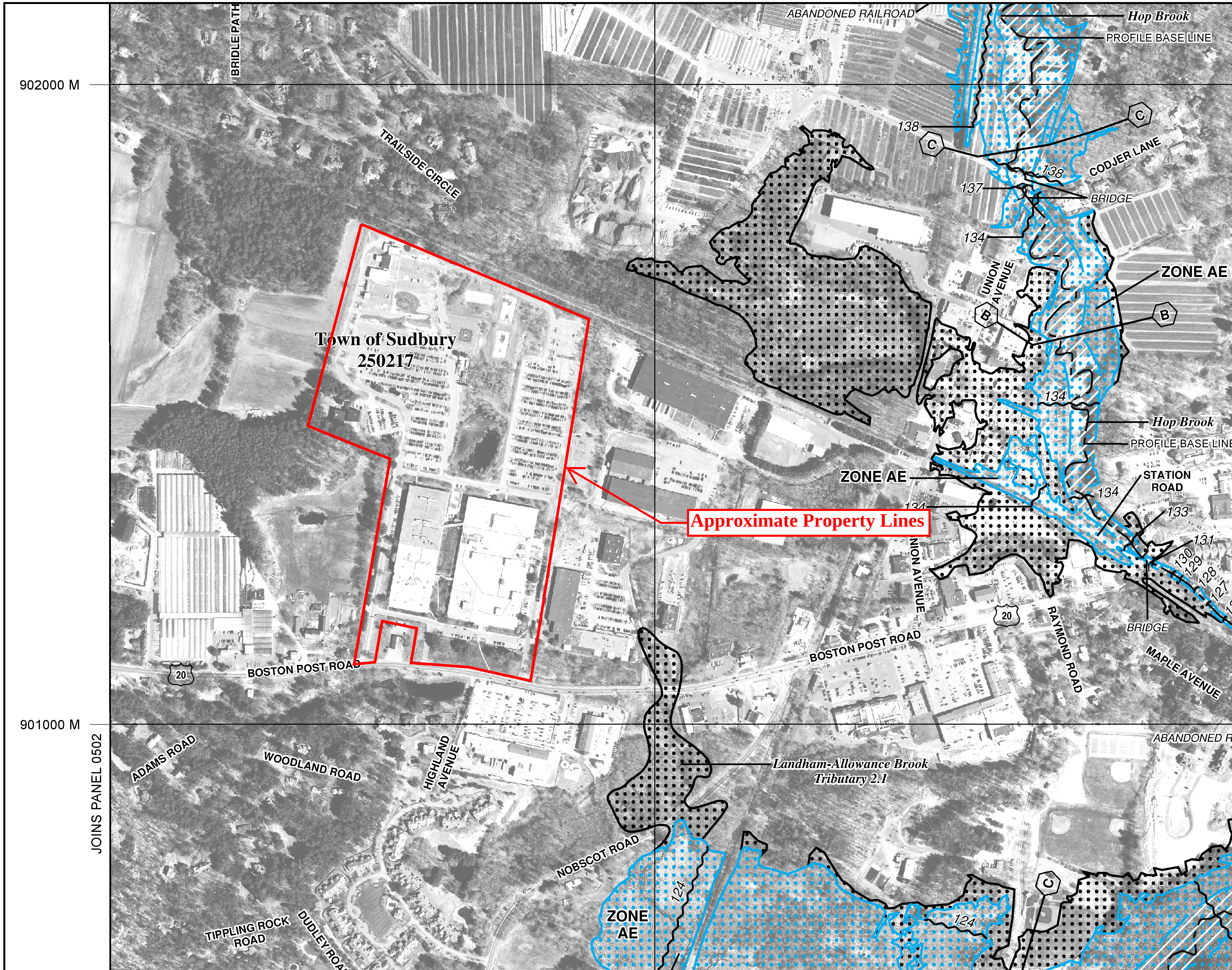
Avalon Sudbury | Boston Post Rd. (Rt. 20), Sudbury, MA

USGS Locus Map

Source: USGS 1987



MAP SCALE 1" = 500'

250 0 500 1000 FEET

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0506F

FIRM

FLOOD INSURANCE RATE MAP

MIDDLESEX COUNTY, MASSACHUSETTS
(ALL JURISDICTIONS)

PANEL 506 OF 656
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
FRAMINGHAM, TOWN OF	250193	0506	F
SUDBURY, TOWN OF	250217	0506	F

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

MAP NUMBER
25017C0506F

MAP REVISED
JULY 7, 2014

Federal Emergency Management Agency

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

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A No Base Flood Elevations determined.

ZONE AE Base Flood Elevations determined.

ZONE AH Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.

ZONE AO Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.

ZONE AR Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.

ZONE A99 Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.

ZONE V Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.

ZONE VE Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D Areas in which flood hazards are undetermined, but possible.

MAP SCALE 1" = 500'

250 0 500 1000 FEET

METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0506F

FIRM

FLOOD INSURANCE RATE MAP

MIDDLESEX COUNTY, MASSACHUSETTS

(ALL JURISDICTIONS)

PANEL 506 OF 656

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

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

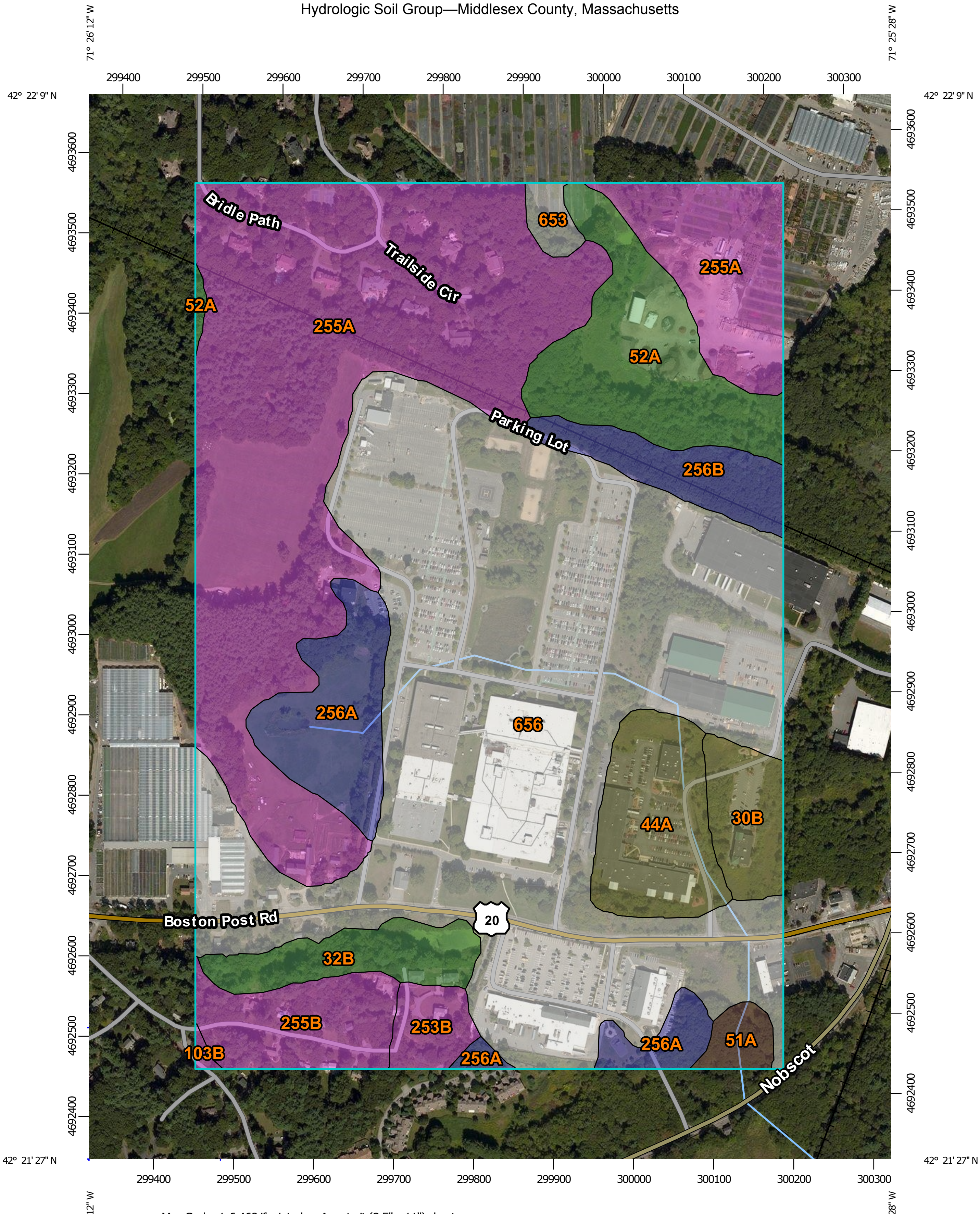
U.S. DEPARTMENT OF HOMELAND SECURITY

MAP NUMBER 25017C0506F

MAP REVISED JULY 7, 2014

Federal Emergency Management Agency

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



Map Scale: 1:6,460 if printed on A portrait (8.5" x 11") sheet.

Meters: 0, 50, 100, 200, 300

Feet: 0, 300, 600, 1200, 1800

N

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 1:25,000.

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

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

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

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

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

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

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

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

Date(s) aerial images were photographed: Sep 12, 2014—Sep 28, 2014

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

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Middlesex County, Massachusetts (MA017)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
30B	Raynham silt loam, 0 to 5 percent slopes	C/D	4.2	2.1%
32B	Wareham loamy fine sand, 0 to 5 percent slopes	A/D	5.0	2.5%
44A	Birdsall mucky silt loam, 0 to 1 percent slopes	C/D	8.5	4.2%
51A	Swansea muck, 0 to 1 percent slopes	B/D	1.5	0.8%
52A	Freetown muck, 0 to 1 percent slopes	A/D	12.5	6.2%
103B	Charlton-Hollis-Rock outcrop complex, 3 to 8 percent slopes	A	0.2	0.1%
253B	Hinckley loamy sand, 3 to 8 percent slopes	A	2.4	1.2%
255A	Windsor loamy sand, 0 to 3 percent slopes	A	60.8	30.3%
255B	Windsor loamy sand, 3 to 8 percent slopes	A	6.5	3.2%
256A	Deerfield loamy sand, 0 to 3 percent slopes	B	10.2	5.1%
256B	Deerfield loamy sand, 3 to 8 percent slopes	B	4.9	2.4%
653	Udorthents, sandy		1.2	0.6%
656	Udorthents-Urban land complex		83.1	41.4%
Totals for Area of Interest			**200.9**	**100.0%**

Description

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

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

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

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

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

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

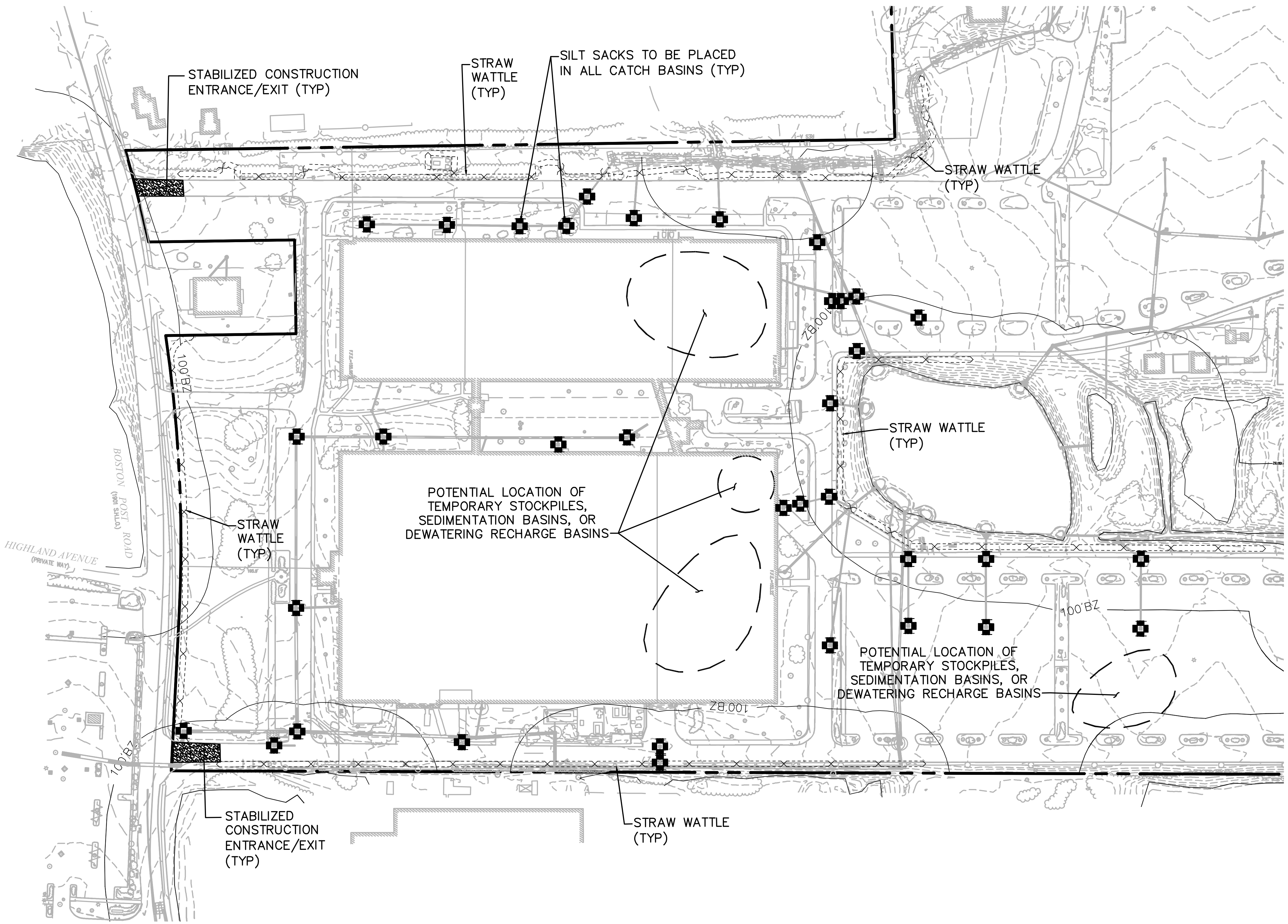
If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

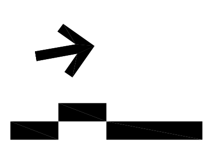
Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Higher





Notes

1. The locations of erosion/sedimentation control measures (including temporary sedimentation basins) shown on this plan are approximate. Final locations to be based on field conditions as determined by the Site Operator who is responsible to implement, inspect, maintain, repair, and modify erosion/sedimentation control measures (including temporary sedimentation basins) as necessary.
2. This plan presents a graphical interpretation of the minimum erosion and sedimentation requirements for the Project. Based on the phasing and timing of the work, the contractor will be responsible for determining whether additional controls are necessary to control erosion and sedimentation. Refer to the Site Plans prepared by VHB for the actual Project Plans.
3. If the Contractor does install a sedimentation basin, the basin shall provide at least 3,600 cubic feet of storage per acre draining to the basin. Sedimentation basin discharge shall be directed to an existing on-site catch basin equipped with a silt sack.

Figure 1 October 2016

Draft SWPPP Erosion and Sedimentation Control Measures
Village Retail & Bridges at Meadow Walk
Sudbury, MA

Attachment D
EPA eNOI, Local, and State Authorizations

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Attachment E
Inspection Forms

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Village Retail & Bridges by Epoch at Meadow Walk Sudbury

Site Inspection Form

Report No. ____
Page_1__of ___

Date / Time of Inspection: _______________ Weather Conditions:___________________________________

Recent Precipitation Event:____

Construction Activities Underway:____

____

Status of Existing BMPs

Erosion Control Measure	Status – Cleaning or Repair Needed	Comments/Notes
	☐yes ☐no	
	☐yes ☐no	
	☐yes ☐no	
	☐yes ☐no	
	☐yes ☐no	
	☐yes ☐no	
	☐yes ☐no	
	☐yes ☐no	
	☐yes ☐no	
	☐yes ☐no	

N/A – Not applicable

In the event of a spill refer to the Spill Response Procedure and contact appropriate agencies. Refer to Section 5.2 for Spill Prevention Plan and Response Procedures.

General Comments (Attached figures to show locations of concern):

Are additional Erosion Control Measures Needed?

☐ No ☐ Yes If yes, describe:____

____

Report No. .___

Are sediment/pollution discharges from the site present?

☐ No ☐ Yes If yes, describe:____

____

____

Describe any corrective action required at this time: ____

____

____

____

____

____

Notes:____

____

____

____

Attach additional sheets with notes, comments, illustrations and issues as needed. Use site plan to identify locations of work areas or issues noted above.

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Stormwater Control Manager:______________________ Date: ____________________________

Qualifications: ____

Attachment F
Corrective Action Form

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Stormwater Construction Corrective Action Form

General Information			
Project Name			
NPDES Tracking No.		**Location**	

Non Compliance

	BMP/activity	Date Observed	Date Corrected	Corrective Action Needed and Notes
1				
2				
3				
4				

Corrective Action

Describe how any incidents of non-compliance have been addressed:

CERTIFICATION STATEMENT

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

Print name and title:
____

Signature:____

Date:_____________________

Attachment G
SWPPP Amendment Log

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SWPPP Amendment Log

No.	Description of the Amendment	Date of Amendment	Amendment Prepared by [Name(s) and Title]

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Attachment H
Subcontractor Certifications/Agreements

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SUBCONTRACTOR CERTIFICATION
STORMWATER POLLUTION PREVENTION PLAN

Project Number: __________

Project Title: __________

Operator(s): __________

As a subcontractor, you are required to comply with the Stormwater Pollution Prevention Plan (SWPPP) for any work that you perform on-site. Any person or group who violates any condition of the SWPPP may be subject to substantial penalties or loss of contract. You are encouraged to advise each of your employees working on this project of the requirements of the SWPPP. A copy of the SWPPP is available for your review at the office trailer.

Each subcontractor engaged in activities at the construction site that could impact stormwater must be identified and sign the following certification statement:

I certify under the penalty of law that I have read and understand the terms and conditions of the SWPPP for the above designated project and agree to follow the practices described in the SWPPP.

This certification is hereby signed in reference to the above named project:

Company:	
Address:	
Telephone Number:	
Type of construction service to be provided:	
Signature:	
Title:	
Date:	

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Attachment I
Grading and Stabilization Activities Log

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Grading and Stabilization Activities Log

Date Grading Activity Initiated	Description of Grading Activity	Description of Stabilization Measure and Location	Date Grading Activity Ceased (Indicate Temporary or Permanent)	Date When Stabilization Measures Initiated

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Attachment J
Training Log

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Stormwater Pollution Prevention Training Log

Project Name: ______________________

Project Location: ______________________

Instructor's Name(s): ______________________

Instructor's Title(s): ______________________

Course Location/Date: ______________________

Course Length (hours): ______________________

Stormwater Training Topic

Stormwater Training Topic: *(check as appropriate)*

- ❑ Sediment and Erosion Controls
- ❑ Emergency Procedures
- ❑ Stabilization Controls
- ❑ Inspections/Corrective Actions
- ❑ Pollution Prevention Measures

Specific Training Objective: ______________________

Attendee Roster: *(attach additional pages as necessary)*

No.	Name of Attendee	Company
1		
2		
3		
4		
5		
6		
7		
8		

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Attachment K
Delegation of Authority

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Delegation of Authority

I, _______________________ (name), hereby designate the person or specifically described position below to be a duly authorized representative for the purpose of overseeing compliance with environmental requirements, including the Construction General Permit, at the ____________________________________ construction site. The designee is authorized to sign any reports, stormwater pollution prevention plans and all other documents required by the permit.

Name of person/position: ______________________________

Company: ______________________________

Address: ______________________________

City, State, zip ______________________________

Phone ______________________________

By signing this authorization, I confirm that I meet the requirements to make such a designation as set forth in Appendix I of EPA's Construction General Permit (CGP), and that the designee above meets the definition of a "duly authorized representative" as set forth in Appendix I.

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name: ______________________________

Company: ______________________________

Title: ______________________________

Signature: ______________________________

Date: ______________________________

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Attachment L
Historic Properties Documentation

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The Commonwealth of Massachusetts
Executive Office of Energy and Environmental Affairs
100 Cambridge Street, Suite 900
Boston, MA 02114

Charles D. Baker
GOVERNOR

Karyn E. Polito
LIEUTENANT GOVERNOR

Matthew A. Beaton
SECRETARY

Tel: (617) 626-1000
Fax: (617) 626-1181
http://www.mass.gov/envir

March 25, 2016

CERTIFICATE OF THE SECRETARY OF ENERGY AND ENVIRONMENTAL AFFAIRS
ON THE
ENVIRONMENTAL NOTIFICATION FORM

PROJECT NAME	: 526 & 528 Boston Post Road Redevelopment
PROJECT MUNICIPALITY	: Sudbury
PROJECT WATERSHED	: Concord (SuAsCo)
EEA NUMBER	: 15479
PROJECT PROPONENT	: Old Post Road Holdings, LLC
DATE NOTICED IN MONITOR	: February 24, 2016

Pursuant to the Massachusetts Environmental Policy Act (M.G. L. c. 30, ss. 61-62I) and Section 11.06 of the MEPA regulations (301 CMR 11.00), I hereby determine that this project **does not require** an Environmental Impact Report (EIR).

Project Description

As described in the Environmental Notification Form (ENF), the project consists of redevelopment of a 50-acre site in Sudbury currently and formerly occupied by office and research and development (R&D) buildings for the Raytheon Corporation (Raytheon). The redevelopment project entails demolition of five existing buildings and construction of a mixed-use village-style development that will include commercial/retail space, mixed-income residential apartment homes, age-restricted condominiums, and a memory care assisted living community. The project will also include upgrades and expansion of the existing privately-owned on-site wastewater treatment facility (WWTF), on-site and off-site roadway improvements and pedestrian and bicycle accommodations, enhanced stormwater management features, and expanded areas of open space and landscaping. Access to the site will be provided via connections to Boston Post Road (Route 20).

The proposed development program is summarized below:

- 250 residential apartment homes (2- to 3- story townhouse buildings (54 units) and 3-story walkup buildings (196 units)) with an ancillary 6,000 square foot (sf) leasing office and 1,500-sf maintenance shop;
- A 48-unit (54 bed) memory care assisted living community;
- A 60-unit active adult residential condominium community;
- Up to 80,000-sf of retail space
  - 45,000-sf grocery store (Whole Foods)
  - 35,000-sf of dry goods and restaurant space.

The apartment homes are proposed for development pursuant to M.G.L. Chapter 40B, Massachusetts' affordable housing statute.

Project Site

The 50-acre project site is located at 526 and 528 Boston Post Road and is bounded by a former railroad right-of-way to the north, commercial and agricultural properties to the east and west, and Boston Post Road to the south. The site currently contains approximately 563,000-sf of office and R&D space, portions of which have recently been vacated by Raytheon. The site contains two main office buildings fronting Boston Post Road, each of which are comprised of smaller, connected buildings: Buildings 2,3, and 4 to the west and Buildings 1 and 5 to the east. The northern portion of the site contains large paved parking lots for up to 2,040 vehicles, a central vegetated area and stormwater retention pond, the WWTF, and a helipad. A small, 7,000-sf structure referred to as the Beltran building is located on the westernmost property line and several small buildings and structures (e.g., radio tower) previously used for R& D are located in the northwest portion of the property.

The project site is within a designated Zone II area for public drinking water supplies. It is not identified as *Priority* or *Estimated Habitat* in the most recent Natural Heritage Atlas (13th edition) and there are no certified or potential vernal pools located on or adjacent to the site. It is not located in a 100-year or 500-year floodplain according to the most recent Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) (No. 25017C0506F, dated July 7, 2014). The project site does not contain any structures or locations that are listed in the *State Register of Historic Places* or the *Inventory of Historic and Archaeological Assets of the Commonwealth.* Finally, the project site is not located within a designated Area of Critical Environmental Concern (ACEC) nor does it contain an Outstanding Resource Water, as designated by MassDEP.

Jurisdiction and Permitting

The project is undergoing MEPA review and requires an ENF because it requires State Agency Actions and will generate more than 2,000 average daily trips (adt) on roadways providing access to a single location (301 CMR 11.03(6)(b)(13), includes the construction of one or more new sewer mains that will result in an expansion of flow to a wastewater treatment and/or disposal facility by 10 percent of existing capacity (301 CMR 11.03(5)(b)(3)(a), and includes new discharge or expansion in discharge to groundwater of more than 10,000 gallons per day (gpd) of sewage within an area, zone or district established, delineated or identified as necessary or appropriate to protect a public drinking water supply…(301 CMR 11.03(5)(b)(4)(c)(i)).

The project requires a Vehicular Access Permit from the Massachusetts Department of Transportation (MassDOT) and a Modification to a Groundwater Discharge Permit from the Massachusetts Department of Environmental Protection (MassDEP).

A group of citizens appealed the Order of Conditions (OOC) for demolition of Buildings 2, 3, and 4 issued by the Sudbury Conservation Commission; therefore, MassDEP must issue a Superseding Order of Conditions (SOC). Other portions of the redevelopment project will likely require an OOC from the Sudbury Conservation Commission, or in the case of an appeal, a SOC from MassDEP.

The project also requires a National Pollutant Discharge Elimination System (NPDES) Construction General Permit from the U.S. Environmental Protection Agency (EPA).

The Proponent will receive Financial Assistance from the Commonwealth in the form of bond financing from the Massachusetts Housing Partnership. Therefore, MEPA jurisdiction for this project is broad and extends to all aspects of the project that are likely, directly or indirectly, to cause Damage to the Environment as defined in the MEPA regulations.

Environmental Impacts and Mitigation

The project will decrease impervious area on-site by approximately 2.5 acres from 28.8 acres to 26.3 acres. Cumulative floor area within buildings will increase by 37,000 sf from 563,000 sf to 600,000 sf. The project will likely result in temporary impacts to adjacent Bordering Vegetated Wetlands (BVWs) along the Boston Post Road corridor. These impacts will be less than 5,000 sf and contingent upon final design approval from MassDOT. Additional site development work will be limited to the 100-foot buffer zone to BVW with no direct alteration of other wetlands proposed. Water use is expected to increase by approximately 47,800 gpd for a total of 90,000 gpd. An additional 35,000 gpd may be withdrawn on-site if the Proponent pursues the installation of irrigation wells, subject to local approval. Wastewater generation will increase by approximately 40,000 gpd, for a total of 90,000 gpd, to be treated on-site at the upgraded WWTF. On-site, privately-owned water and sewer mains will be extended 0.5 miles each to serve the new buildings. The amount of on-site parking will be reduced by 740 spaces from 2,040 to 1,300. Finally, the project is anticipated to generate an additional 2,810 average daily trips (adt), increasing traffic from approximately 5,110 adt to 7,920 adt (prior to adjustment for internal trip capture and pass-by trips).

Measures to avoid, minimize and mitigate environmental impacts include: installation of a new traffic signal at the primary site driveway, addition of bicycle and pedestrian accommodations, implementation of a transportation demand management (TDM) program to minimize single occupancy vehicle (SOV) trips, construction of a stormwater management system consistent with MassDEP regulations, and ongoing monitoring consistent with Massachusetts Contingency Plan (MCP) regulations, expansion and operation of a WWTF that meets MassDEP standards for treatment in a Zone II wellhead protection area, and implementation of construction period best management practices (BMPs).

Review of the ENF

The ENF described existing site conditions and the proposed project and its programmatic and physical elements. The ENF presented existing and proposed conditions plans and identified environmental resources and potential impacts.

Alternatives consistency with planning

The ENF identified several alternatives for the project site:

1. A No-Build Alternative that includes the as-of-right re-occupation of the existing 563,000-sf of office space by other office/R&D tenants. This alternative would not include upgrades to the stormwater management system or WWTF. Roadway improvements along Route Boston Post Road would also not be realized.
2. An As-of-Right Alternative that includes 80,000 sf of retail space, 260,000 sf of office space and 230,000 sf of R&D and warehouse space, consistent with the property's Limited Industrial zoning designation. This alternative would not require upgrades to the WWTF and would generate more traffic than the Preferred Alternative, particularly during peak hours. This alternative would reduce parking spaces from 2,040 to approximately 1,850 and would include upgrades to the stormwater management system to meet current MassDEP standards. This alternative is inconsistent with many of the Town's planning goals, described further below.
3. A Preferred Alternative.

The ENF described project consistency with local planning initiatives. Specifically, the project site was identified in the Sudbury Housing Production Plan (HPP) as a preferred location for development of affordable housing. The project site was also identified in the 2001 Sudbury Master Plan as a key location for potential redevelopment. The Town of Sudbury subsequently worked with Raytheon to identify goals and priorities for the project site, all of which will be achieved under the Preferred Alternative. The ENF also noted the project's consistency with a Route 20 Zoning Project (2012) undertaken on behalf of the Town by the Metropolitan Area Planning Council (MAPC) to assist in the development of land use controls for parcels along Route 20 and a 2015 Route 20 Corridor Study that evaluated potential zoning changes to commercial districts along Route 20. Finally, the ENF described how the project will meet many of the planning goals set forth at the regional and state-wide level (i.e., MAPC's Metro Future: Making a Greater Boston Region and Executive Order 385 – Planning for Growth.

Land Impacts

The project site has historically been altered in its entirety, as it features buildings, a large retention pond, parking areas, and a WWTF with open leaching pits. Limited areas of landscaping and trees are located along the property lines and along the site frontage on Boston Post Road. The project will reduce on-site impervious area and will not require extensive grading or earth removal to facilitate redevelopment. The project will provide enhanced open space areas around the retention pond to make it a central feature of the site with improved natural vegetated buffer and additional landscaping and tree plantings throughout.

Traffic and Transportation

The ENF included a transportation study in accordance with MassDOT/EEA *Transportation Impact Assessment (TIA) Guidelines* to evaluate project impacts on the State highway system. The TIA was prepared subsequent to peer review on behalf of the Town of Sudbury during the local review process and in consultation with MassDOT.[1] On October 25, 2015, MassDOT issued a response to a Transportation Scoping Letter (TSL) submitted by the Proponent. A TSL is often submitted prior to initiation of both the MEPA and MassDOT Access Permit review processes to assist a Proponent in the preparation of the TIA. In this TSL response memorandum from MassDOT, guidance was provided on a variety of issues, including but not limited to, the determination of trip generation rates, mode spilt assumptions, and identification of additional study area intersections. I note that the MassDOT memorandum indicated that this guidance is "preliminary and subject to change with the receipt of additional information during the MEPA review periods." MassDOT's comment letter on the ENF indicated that methodologies used in the TIA are generally acceptable to MassDOT and will be accurate in assessing the impact of the project during peak periods.

The transportation study area included the following intersections:

- Boston Post Road at Horse Pond Road;
- Boston Post Road at Dudley Road;
- Boston Post Road at Highland Avenue and Sudbury Plaza (west);
- Boston Post Road at Sudbury Plaza (east);
- Boston Post Road at Nobscot Road (signalized);
- Boston Post Road at Union Avenue (signalized);
- Boston Post Road at Raymond Road;
- Boston Post Road at Concord Road (signalized); and
- Boston Post Road at Landham Road (proposed for signalization by MassDOT)

The transportation study evaluated existing (2015), proposed No-Build (2022) and proposed Build (2022) conditions within the study area. The 2015 Existing Condition assumed re-occupancy of the 563,000-sf of office/R&D space. Traffic volume data collected within the

[1] The peer reviewer, Vanasse and Associates, Inc., (VAI) issued a letter to the Director of the Sudbury Planning and Community Development Department on February 26, 2016 indicated that they are, "satisfied that the Applicant's engineer has addressed the comment that were raised in our review letter." This aforementioned review letter was issued on January 21, 2016 by VAI. The Proponent incorporated VAI's recommendations into the revised TIA submitted as part of the ENF.

study area was used to determine the weekday morning and evening and Saturday midday peak hours. Given the recent vacancies within the Raytheon facility (less than 25 percent), existing traffic generated by the project site was determined using Institute of Transportation Engineers (ITE) land use codes (LUC) for office space (LUC 710), R&D (LUC 760) and Manufacturing (LUC 140) in lieu of extrapolated existing trip generation data. This methodology was vetted and approved by MassDOT. The current adt for the site was estimated at 5,110 adt (2,555 entering, 2,555 exiting).

Currently, there are limited accommodations for bicyclists and pedestrians within the TIA study area. Sidewalks are provided along the north side of Boston Post Road, but only intermittently along the south side. On-street bicycle accommodations are limited to varying width shoulders. The TIA noted future plans for two bicycle trails near the site, one located directly north (the Mass Central Rail Trail) and the Bruce Freeman Rail Trail (to the east of the site). While Sudbury is a member community of the MetroWest Regional Transit Authority (MWRTA), there is no MWRTA service along Boston Post Road.

In analyzing the proposed No-Build and Build 2022 Conditions, the evaluation considered future background growth and known projects, as well as anticipated roadway improvement projects. Specifically, the Boston Post Road/Landham Road intersection is slated for major upgrades, including signalization, by MassDOT. The 2022 conditions assume these upgrades will be constructed at this intersection. An estimation of adt generated by the project in the 2022 Build Condition was made also using ITE data. As is typical practice approved by MassDOT during the MEPA process, daily trip estimates were estimated using LUC 820 (shopping center) for the collective retail square footage, LUC 220 for the apartments, LUC 252 for age-restricted housing, and LUC 254 for the assisted living units.[2] Using this approved methodology, daily trips generated by the project were estimated at 7,920 adt, an increase of 2,810 adt.

More importantly, the TIA assessed peak hour trips to be generated by the project as peak hour impacts allow for an evaluation of worst-case intersection operations within the study area over the course of a given day. MassDOT requested in the TSL response memorandum that the Proponent evaluate an alternative methodology to determine peak hour trip generation rates. MassDOT requested that the Proponent use LUC 850 (supermarket) for the 45,000 Whole Foods and LUC 820 (shopping center) for the remaining 35,000 sf of retail space and compare these estimates with empirical data obtained from at least three comparable shopping centers with grocery stores to determine the most accurate portrayal of the land uses proposed.[3] Subsequent to the issuance of the TSL, but prior to preparation of the ENF TIA, the Proponent submitted these comparison data to MassDOT and received approval to use the empirical data to determine the 2022 Build Condition peak hour trip generation estimates.[4] These are the data presented in the ENF. These data also indicate that the proposed project will generate less entering traffic during the weekday morning peak hour, less exiting traffic during the weekday evening peak

[2] According to ITE, LUC 820 is appropriate for an "integrated group of commercial establishments that is planned, developed, owned and managed as a unit" Furthermore, this LUC considers outparcels that may include uses such as retail stores and restaurants.
[3] ITE considers the use of LUC 850 for free-standing stores only.
[4] Email from Vinod Kalikiri, VHB Inc., to Derek Valentine and Lionel Lucien, MassDOT, dated October 21-22, 2015 and provided to MEPA on March 21, 2016.

hour, and more traffic during the Saturday midday peak hour than the re-occupancy No-Build 2022 Condition (as is expected with a shift from office/R&D use to mixed uses).

Mixed-use developments also benefit from increased efficiencies between uses on-site that further minimize vehicle trips through internal capture or shared trips. The TIA described projected trip generation assumptions including a 15 percent residential trip internal capture rate during the weekday morning and evening peak hours and a 30 percent rate during the Saturday midday peak hour. Pass-by trip adjustments were applied consistent with MassDOT guidelines for the retail trips, consisting of a 42 percent rate for the weekday evening peak hour and a 37 percent rate for the weekday morning peak hour and the Saturday midday peak hour. These assumptions were deemed acceptable by both MassDOT and the Town of Sudbury's peer reviewer.

The TIA included the results of a signal warrant analysis for the Boston Post Road/primary site driveway intersection in the future build condition. This intersection will meet all three traffic volume-based warrants for the installation of a traffic signal. This mitigation measure is discussed later in this Certificate.

Capacity analysis were conducted for the weekday morning peak hour, weekday evening peak hour, and Saturday midday peak hour conditions for the Existing 2015, and the 2022 No-Build and Build Conditions. The 2022 Build Condition assumed the installation of a new traffic signal at the intersection of a relocated primary site driveway and Boston Post Road. The primary site driveway will be relocated opposite the westerly Sudbury Plaza driveway and Highland Avenue (private way) to create a new five-legged intersection. The TIA also noted that under the 2015 Existing Condition, the Raytheon primary site driveway is under police detail control during the weekday evening peak period. This police detail will not be included in the 2022 Build Condition.

The TIA concluded that under the 2022 Build Condition, all signalized intersections within the study area will operate at acceptable levels of service (LOS) (i.e., LOS D or better) with the exception of the following:

- Boston Post Road at Primary Site Driveway/Sudbury Plaza/Highland Avenue during the weekday evening peak period (LOS E); and
- Boston Post Road at Union Avenue/Shopping Plaza during the Saturday midday peak period (LOS E).

The TIA indicated that the proposed Boston Post Road at Primary Site Driveway/Sudbury Plaza/Highland Avenue intersection will include an exclusive phase for Highland Avenue due to its very low traffic volume (less than five trips during the peak hours). The TIA compared intersection LOS when the Highland Avenue phase activation (LOS E, as noted above) and without Highland Avenue phase activation (LOS F). As recommended by MassDOT, the Proponent should initiate discussions with the Sudbury Plaza and Highland Avenue property owners to discuss the feasibility of rerouting Highland Avenue traffic through the Sudbury Plaza west driveway to allow for the elimination of the proposed signal phase for Highland Avenue.

The TIA acknowledges that relatively long vehicle queues are estimated on Boston Post Road at the signalized site driveway despite the reduction in peak hour trip generation, as compared to the 2022 No-Build Condition. These queues will be ameliorated to some degree by proposed signal timing coordination as part of the mitigation package that will improve LOS at the Boston Post Road/Nobscot Road and Boston Post Road/Union Avenue intersections during the weekday evening and Saturday midday peak hours.

Unsignalized intersections between Boston Post Road and Horse Pond Road and Raymond road currently operate at LOS F and will continue to do so in the 2022 Build Condition. Boston Post Road at Landham Road, Sudbury Plaza Driveway (west) and the existing site driveway (east) currently operate poorly and will be placed under signal control under the 2022 Build Condition. Other unsignalized intersections will experience similar poor operating conditions (with the exception of certain movements during certain peak periods) between the 2022 No-Build Condition and the 2022 Build Condition.

Parking

The project will provide approximately 1,300 parking spaces. MassDOT and MAPC comment letters indicate that opportunities likely exist to further reduce overall parking on-site. I encourage the Proponent to evaluate means to minimize overall parking by considering potential parking management programs, banking parking until demand is demonstrated, and/or incentives to discourage the need for parking (e.g., unbundling parking cost from rent, etc.).

Transportation Mitigation

As noted previously, the key transportation mitigation measure will be the installation of a traffic signal at the primary site driveway/Sudbury Plaza west driveway/Boston Post Road/Highland Avenue intersection. The TIA included a conceptual plan for this improvement and improvements to Boston Post Road along the site's frontage. The Proponent will continue to work with the owners of the Sudbury Plaza to coordinate modifications to its west driveway in conjunction with the new traffic signal. These intersection improvements will also include new actuated pedestrian crosswalk and bicycle accommodations and bicycle detection systems.

The sidewalk on the north side of Boston Post Road along the project site frontage will be widened and the limits of the sidewalk on the south side of Boston Post Road will extended from the Sudbury Plaza east driveway to an area opposite the Sudbury Fire Station. The project may also include an addition of five-foot shoulder (which would become part of any future bike lanes) on either side of Boston Post Road within the limits of work. These shoulders will be subject to the availability of rights-of-way and local and State permit approvals.

The secondary site driveway will be maintained in its current location, but modified to accommodate truck turning maneuvers.

The Proponent also intends to install a pre-emption signal in front of the fire station located west of the project site. The proximity of this signal with that proposed at the primary site driveway will require that they be integrated. The Proponent should address this issue with the Town and MassDOT during final roadway improvement design and approval.

To improve traffic flow along Boston Post Road through the study area the Proponent will implement a time-based coordinated signal system between the primary site driveway, Nobscot Road, and Union Avenue intersections likely using either GPS timers or radio technology.

Finally, the Proponent will implement a TDM program consisting of the following elements:

- Designation of a Transportation Coordinator to manage the TDM program, inform residents, employees and customers of commuting options and coordinate with the Metrowest Transportation Management Association (TMA), MassRides and the MWRTA;
- Membership in the Metrowest TMA;
- Encourage participation by residents and employees in ridesharing programs such as carpools or vanpools;
- Provide accommodations to facilitate bicycle and pedestrian modes of travel including but not limited to, convenient secure bicycle parking on-site, sidewalk improvements along Boston Post Road, future connections to proposed nearby rail trails, and construction of an on-site pedestrian path network.

MassDOT has recommended additional TDM measures that may be feasible for the project. The Proponent should evaluate these recommendations and specifically address whether they will be implemented as part of the project during the MassDOT permitting process. The Proponent should continue to work with the MWRTA, abutters and the Town of Sudbury to explore possible bus service expansion along the Boston Post Road corridor to serve both the project site and adjacent retail/commercial destinations. The project should be designed in a manner that will not preclude on-site transit service.

The Proponent will be required to undertake a traffic monitoring program for a minimum of five years consistent with MassDOT's TIA guidelines. According to the Proponent, a traffic monitoring program will be developed in conjunction with requirements established by the Town of Sudbury and its peer reviewer and the MassDOT permitting process. I encourage the Proponent to establish mode share goals as a means to evaluate the success of the TDM program. These mode share goals should be presented to MassDOT for consideration during its permit review process.

Hazardous Materials

The ENF identified three sites currently or formerly regulated under the MCP:

- Release Tracking Number (RTN) 3-27243 and RTN 3-3037 – 528 Boston Post Road: related to the presence of chlorinated volatile organic compounds (CVOCs), primarily trichloroethylene (TCE) in groundwater in the northeast portion of the property. The presence of CVOCs was identified between 1990 and 1991 (RTN 3-3037) and achieved regulatory closure (Pending No Further Action status) with MassDEP in 1997. Raytheon continued groundwater monitoring on-site and while groundwater concentrations remained consistent with earlier data, Raytheon notified MassDEP in 2007 as a precautionary measure (RTN 3-27243). In 2008, Raytheon submitted a Class C Response Action Outcome (RAO), which concluded that a Temporary Solution has been achieved and active remediation was not required. Regulatory compliance is maintained through monitored natural attenuation and periodic groundwater monitoring. Raytheon has, and will continue, to be the responsible party for this periodic groundwater monitoring requirement (every five years). The Proponent continues to work with Raytheon to ensure ongoing access post-construction to those monitoring wells necessary to ensure compliance under the MCP.

- RTN 3-3037 – 528 Boston Post Road: related to a 1987 spill of approximately 35 gallons of number 2 heating oil within the former Boresite Building in the west-central portion of the site. Clean-up documentation was provided as part of RTN 3-3037 and included removal of the underground storage tank (UST) and impacted soils. The UST closure report indicated that there is not a significant risk to human health and environment related to this spill.

- RTN 3-17106 – 528 Boston Post Road: related to a 1998 spill of 15 to 20 gallons of hydraulic oil, resulting from an overturned crane. The spill was remediated with absorbent materials and removal of approximately 1.5 cubic yards of impacted soil. A Class A-2 RAO was filed with MassDEP demonstrating that a Permanent Solution (i.e., regulatory closure) had been achieved.

Each of these RTN's has achieved either Temporary or Permanent Solutions as defined by the MCP. No Activity and Use Limitation (AUL) has been established on any portion of the project site. According to the ENF, sampling has occurred on the project site for the past 20 years under the MCP. Forty groundwater monitoring wells were advanced by Raytheon on-site along with the collection of 43 soil samples. Data collected have not identified soil contamination that would pose a health risk to future users/residents. The most recent groundwater sampling was conducted in March 2015. These data indicated that currently three of the 40 groundwater monitoring wells contain concentrations of constituents above applicable MCP standards. No evidence of groundwater significantly impacting off-site receptors or the Town public water supply wells has been detected over the 20-year monitoring efforts on the property. Prior correspondence from MassDEP noted that "at this time there is no information that would suggest that redevelopment of the site should be restricted."[5]

Concentrations of TCE in excess of MCP standards were detected in two monitoring wells (GZ-10D and GZ-202) on the eastern portion of the site. As noted in the ENF, these wells are located below ground surface in deep groundwater (59-91 feet) and TCE was not detected above reporting limits in shallower groundwater at the site. Correspondence in the ENF from

[5] *MassDEP* correspondence from John Miano, Bureau of Waste Site Cleanup dated March 14, 2016, attached to comment submitted by Bob Haarde, dated March 15, 2016.

MassDEP noted that potential for exposures due to solvent vapor migration into buildings is generally not a concern for the proposed location of the residential buildings due to the depth of groundwater contamination.

Testing also detected the presence of Freon 7 at levels in excess of the applicable MCP standards (Method 2 GW-2 standards) in one groundwater well (GZ-106) located along the eastern property line. The ENF stated that Freon 7 levels at GZ-106 are lower than levels detected in 2013 and none of the surrounding wells contain levels that exceed Method 2 GW-2 standards. There are no buildings proposed in the vicinity of GZ-106, limiting the potential for vapor intrusion into occupied spaces. If the site layout is modified to include building near this monitoring well, the Proponent will be required to evaluate for the possibility of Freon vapor intrusion to indoor air.

Data indicate that contaminant concentrations in groundwater have been decreasing over time, with groundwater containing concentrations above the MCP standards representing approximately five percent of the total site area. Water supply will be provided via the public drinking water supply, with no potable water wells to be installed on-site. The Proponent indicated that the potential installation of an irrigation well is still under investigation. If an irrigation well is proposed, it will be located outside and up-gradient of the RTN and will likely be drilled 300 to 500 feet underground to ensure sufficient water pressure. The Proponent will study the location, design and pumping rates of the irrigation well to ensure that it will not draw in groundwater from the contaminated zone.[6]

Wastewater

The project site presently contains a private wastewater collection, treatment, and disposal system because the Town of Sudbury does not provide municipal wastewater service to the area. On-site wastewater is collected via gravity and force sewer mains prior to being treated at the WWTF. The WWTF's main components include a sequencing batch reactor (SBR), ultraviolet (UV) disinfection, and three open sand beds that filter the treated effluent. This facility has been upgraded in the past (1990 and 2009) and is currently permitted to discharge up to 50,000 gpd by MassDEP in accordance with its existing Groundwater Discharge Permit (GWDP).

The proposed development will be connected to the existing WWTF via a series of new gravity and force mains. The WWTF will be upgraded to process the additional flows anticipated from the expanded uses on-site. These upgrades will provide redundancy, improve system reliability, and increase recharge to the underlying aquifer. While the Proponent intends to modify the GWDP to allow for the treatment of up to 90,000 gpd, the proposed development program is projected to generate approximately 82,000 gpd, based on MassDEP Title V flow estimates. The Proponent also expects to reduce project-related wastewater flows on the order of 20 percent through the implementation of water conservation measures.

The ENF indicated that a hydrogeological evaluation is underway to determine: the capacity of the existing sand beds to accommodate the additional flow, if supplemental measures

[6] Email correspondence with Seth Lattrell, VHB, Inc., and Tricia Pinto, Sanborn Head & Associates, Inc., March 21 and March 22, 2016.

will be necessary to increase wastewater treatment capacity to 90,000 gpd, and which WWTF design upgrades may be needed dependent upon the projected capacity capabilities of the sand beds. These design upgrades will be required to maintain all suitable wastewater discharge standards to a Zone II wellhead protection area. The permit application to MassDEP should demonstrate that these standards will be met and address the potential relationship between increased groundwater discharge and possible impacts to areas subject to review and monitoring under the MCP. As requested by the Town of Sudbury, I encourage the Proponent to consider the feasibility of subsurface leaching beds in lieu of the open sand beds during the final design evaluation process as this may facilitate the creation of additional usable open space on-site.

The proposed development plan presented in the ENF includes a reserve area adjacent to the existing sand beds demonstrating that additional land is available if the final WWTF upgrade design indicates that an additional leaching bed is necessary. Finally, the ENF noted that, based on data collected, the proposed changes to the WWTF and disposal system will not affect the residual contamination due to its depth below ground surface and/or the size of the site.

Water

The project will continue to rely upon water from the Sudbury Water District via the existing 12-inch water main located in Boston Post Road. The project will also include the construction of redundant 8-inch water mains and fire hydrants throughout the site to meet domestic water flows up to 90,000 gpd. To minimize overall water usage, the Proponent will implement the following water conservation measures:

- Installation of low-flow plumbing fixtures and high-efficiency appliances;
- Metering and sub-metering of water usage (e.g., residents will be responsible for their own water usage);
- Installation of efficient water heating systems in multi-family units;
- Use of drought-tolerant plans and an irrigation system with efficiency measures such as rain sensors; and
- Limitation of the use of potable water for irrigation.

The Proponent will strive to reduce overall water demand by 20 percent via these conservation measures. I encourage the Proponent to continue to evaluate measures to reduce irrigation demand through reuse measures such as capture of roof runoff and cisterns or rain barrels.

Wetlands

The project site contains several types of wetland resource areas regulated by the Wetlands Protection Act (WPA), including BVW, inland Bank, and Isolated Land Subject to Flooding (ILSF). The ENF characterized these wetland resource areas, noting that several wetland areas drain to a large stormwater basin in the center of the site via underground pipes. Adjacent properties also contain wetland resource areas with 100-foot buffer zones that extend onto the project site. Upland areas in the 100-foot buffer zones are generally previously developed and consist of paved parking lots and driveways and the WWTF leaching beds. As noted previously, the project site layout limits direct wetland impacts to BVW (less than 5,000 sf) along the Route 20 and 100-foot buffer zone areas on-site (not a State-regulated resource area).

To limit potential impacts to wetland resource areas along Boston Post Road resulting from the widening of the roadway to meet MassDOT Complete Streets guidelines, the Proponent will use retaining walls to avoid placing fill in the wetlands. Unavoidable temporary impacts will be restored to preconstruction conditions upon completion of work. As noted in the ENF, if upon final roadway design approval from MassDOT direct wetland resource impacts cannot be avoided, the Proponent will be required to replicate these wetlands areas in accordance with the WPA regulations, subject to review and approval by the Sudbury Conservation Commission, or in the case of an appeal, MassDEP.

Stormwater

The project site is presently dominated by impervious surfaces (i.e., buildings, parking areas, driveways). The site contains a stomwater management system that predates the current MassDEP stormwater management standards (SMS). Currently, stormwater flows on-site to a centrally located retention pond or to an area that drains via closed pipe system to the municipal stormwater system. Stormwater swales and wetlands located in the southwestern part of the site collect and convey water to the retention pond. Outflows from the retention pond combine with the closed drainage system located in the southern portion of the site and ultimately discharge to a wetland on the south side of Boston Post Road.

The project will remove approximately 2.5 acres of impervious area, maintain the existing retention pond, and install additional stormwater management BMPs to collect, convey and treat stormwater in a manner consistent with the SMS. Specific BMPs will include grassed swales, deep-sump hooded catch basins, water quality units, subsurface infiltration equipped with isolator rows, and bioretention ponds. The stormwater management system will achieve a minimum removal of 80 percent of total suspended solids (TSS). Furthermore, consistent with requirements for BMPs in a Zone II wellhead protection area, BMPs will be sized for the first inch of water quality runoff volume and 44 percent pretreatment prior to infiltration. The proposed system will improve the attenuation of the post-development peak discharge rates compared to existing conditions, thereby resulting in a net reduction in stormwater discharge rates to the retention pond while the BMPs will improve the overall water quality of the runoff.

The ENF noted that while the project will meet the standards to be considered a redevelopment project under the SMS, it will be designed to be substantially compliant with the SMS for new development. Depths to groundwater in some locations on-site may impede compliance with the new development SMS standards in their entirety, in which case the Proponent will comply with the applicable redevelopment SMS standard. The Proponent should prepare a comprehensive drainage report and submit it to the Sudbury Conservation Commission as part of the NOI review for the project demonstrating consistency with all applicable SMS and wetland regulations at 310 CMR 10.00

Sustainable Design

The Town of Sudbury is a designated Green Community. As such, the project must be designed to meet the current Stretch Energy Code which requires projects to achieve additional energy reduction measures compared to the State's Energy Code. The ENF indicated that the Proponent is committed to achieving or exceeding Stretch Energy Code requirements applicable at the time of construction. I strongly encourage the Proponent to strive to achieve the maximum energy reductions feasible for all elements of the project, focusing not only on fixed measures (e.g., windows, insulation, HVAC systems), but also tenant-driven operational measures. Construction of energy efficient homes, particularly for affordable housing, can not only reduce a project's greenhouse gas emissions (GHG), but also reduce operating costs for owners or tenants. The Proponent should consider the feasibility of solar photovoltaic (PV) of solar hot water (SHW) in light of the available State and federal incentives that make these systems financially viable for projects of this scale.

Construction

All construction should be managed in accordance with applicable MassDEP Solid Waste and Air Pollution Control regulations pursuant to M.G.L. c.40, §54. The Proponent will implement a demolition and construction period waste management plan. Existing pavement will either be processed on-site for reuse as structural fill or shipped off-site to an asphalt recycling facility. Excess soil generated during construction will be subject to analytical testing prior to off-site disposal to ensure consistency with the applicable disposal regulations. Asbestos and hazardous materials abatement will be performed prior to demolition of the existing buildings consistent with local, State and federal regulations, as applicable. The Proponent should review the MassDEP comments on applicable recycling and construction period air pollution requirements to ensure compliance. The Proponent will prepare a Stormwater Pollution Prevention Plan (SWPPP) to meet EPA NPDES Construction General Permit requirements. I encourage the Proponent and its contractors to comply with MassDEP's Diesel Retrofit Program (DRP) and restrict on and off-road idling to the maximum extent practicable. All construction activities should be undertaken in compliance with the conditions of all State and local permits.

A Licensed Site Professional (LSP) will provide monitoring during the construction period to ensure that all work is performed in accordance with MCP requirements. In preparation for the construction process, the LSP will prepare a Release Abatement Measure (RAM) Plan that identifies the policies and procedures should additional contamination be encountered. The RAM Plan will include requirements for soil management, construction dewatering, duct control, and air monitoring. The Proponent should review recommendations in the MassDEP comment letter regarding potential indoor air impact during the demolition and construction process, installation of new utilities, and general consistency requirements with the MCP. Furthermore, as a conservative approach, the Proponent should consider evaluation of the soil beneath the buildings proposed for demolition if the redevelopment of the site creates the potential for exposure to untested soils.

Conclusion

The ENF has sufficiently defined the nature and general elements of the project for the purposes of MEPA review and demonstrated that the project's environmental impacts will be avoided, minimized and/or mitigated to the extent practicable. Based on review of the ENF and comments received, and in consultation with State Agencies, I have determined that no further MEPA review is required. Outstanding issues should be addressed during the local, State and federal permitting processes.

March 25, 2016
Date

Matthew A. Beaton

Comments Received:

3/11/2016	Joanne Lynch
3/14/2016	Town of Sudbury Planning and Community Development Department
3/15/2016	Massachusetts Department of Environmental Protection – Northeast Regional Office (MassDEP – NERO)
3/15/2016	Bob Haarde
3/15/2016	Bill Schineller
3/15/2016	Robert Abrams on behalf of 28 residents of the Town of Sudbury
3/15/2016	Massachusetts Department of Transportation
3/16/2016	Metropolitan Area Planning Council

MAB/HSJ/hsj

Johnson, Holly (EEA)

From: Joanne Lynch [jjmlynch@gmail.com]
Sent: Friday, March 11, 2016 11:56 AM
To: jjmlynch@gmail.com; Robert Abrams; Tamm, Peter; Dineen, Deborah; Steve Senna; Freed, Rachel (DEP); Johnson, Holly (EEA); Dan DePompei
Subject: Public Comment on Raytheon Sudbury Facility

Ms. Johnson,

I have several comments relating to the environmental conditions at the Raytheon Site Boston Post Road in Sudbury. I have been submitting my concerns to MA DEP since last year - starting with a PIP petition which was essentially denied with DEP stating that the Site was closed - albeit with a Temporary RAO. I have noted four issues below that I don't feel were adequately addressed in the Site characterization reports that I reviewed on the DEP website.

This item keeps popping up on the Agenda at the Town Board of Selectmen meetings and news items regarding proposed housing and the Whole Foods, but I am still concerned about the Site conditions as Raytheon is leaving them.

Specifically, I am concerned about Raytheon's:

- Impact to the Town of Sudbury Zone II Wellhead Protection Area for our main drinking water supply by GW-1 exceedances migrating off the Raytheon Site;
- Impact to the health and safety of town residents and construction workers during any demolition of the current facility by adverse impacts to air from building materials potentially containing asbestos. I have not seen any reports that document the building materials being tested for potential asbestos-containing materials;
- Impact to the health and safety of town residents, construction workers, and future Site users from any potential PCB-containing materials not properly disposed from the current facility. I have not seen any reports that document testing for PCBs at on-Site transformers or in building materials; and
- Impact to future Site residents and future workers in these proposed structures (commercial and residential buildings) from VOC impacts that remain on-Site and are not well-defined. (Please note my comments in emails to MADEP dated 2/3/16, 2/5/16, 2/9/16, and 3/8/16 that include pointing out an LSP statement that a "well-defined on-Site source of the CVOCs in groundwater has not been identified" and my observation that PID hits of VOCs, some in part per million range, were noted in the boring logs at six locations in Appendix E of the Phase II report.)

Thanks in advance for your response and attention to these matters.

Best Regards,
Joanne Lynch
201 Pratt's Mill Road, Sudbury, MA

Town of Sudbury

Planning and Community Development Department

Jody A. Kablack, Director

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March 14, 2016

Secretary Matthew A. Beaton
Executive Office of Energy and Environmental Affairs
Attn: MEPA Office
100 Cambridge Street, Suite 900
Boston MA 02114

RE: 526 & 528 Boston Post Road Redevelopment, Sudbury, MA
Project #13125.00

Dear Secretary Beaton:

This office provides technical review for all development applications presented to the Town of Sudbury through all the land use permitting boards, including the Zoning Board of Appeals, Planning Board and Board of Selectmen. I have been involved with the redevelopment efforts at the former Raytheon property for the last 19 months, and am very familiar with the proposal and the information submitted to date, including the Environmental Notification Form (ENF). Please accept these comments as you review the above application pursuant to the Massachusetts Environmental Policy Act.

The former Raytheon property has been a subject in many land use planning reports dating back to 2001 when Sudbury's most recent Master Plan was prepared. In that report, it was advised to create a plan for the future use of the Raytheon site if, or when, it was vacated. The 2001 Master Plan also stressed the need increase Sudbury's commercial tax base in a sustainable manner by balancing growth in all sectors, improving infrastructure, creating new bylaws to promote desirable development that does not adversely impact the character of the Town, and to find the right balance of development which provides goods and services the local population needs and wants. This redevelopment project embodies all of these strategies, and presents Sudbury with a unique opportunity to shape the future of its commercial business district.

Efforts over the last fourteen years have set the stage for this project. The Route 20 commercial corridor has been studied multiple times to determine what desirable development looks like, where it will be located, and how it will protect the groundwater which sits directly beneath the business district. New zoning bylaws have been adopted, and existing bylaws modified, to steer commercial development in a positive direction to meet goals identified in local and regional planning studies. In 2012 the former Raytheon property specifically was identified in the 495 MetroWest Development Compact Plan in 2012 as a local Priority development Area.

Fast forward to July of 2014 when Raytheon publicly announced its plans to close the Sudbury facility. Knowing the importance of being actively involved in the redevelopment scheme, the Board of Selectmen and Planning Board immediately mobilized to discuss the range of development options, ultimately unanimously voting to support a mixed use development that met several Town goals – redevelopment which acts as a catalyst for other economic development initiatives along the Route 20 corridor, the construction of rental housing to allow the Town to reach its 10% 40B goal, and the construction of age-restricted housing that minimize impacts on the school system and provides additional housing diversity for a growing senior population. This letter, dated February 25, 2015, was submitted in Appendix B of the ENF.

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Town of Sudbury

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kablackj@sudbury.ma.us

Since purchasing the property in December 2015, the project team of National Development and Avalon Bay have been working closely with the Town of Sudbury on the redevelopment plan. It is a large and complicated plan, and the Town, with the assistance, cooperation and financial support of the development team, has been carefully studying the potential impacts of the development. We have conducted a peer review of the proposed traffic signal on Route 20, and are satisfied with the draft design, particularly the reduced width of the cross section to be context sensitive along this narrow stretch of Route 20 and its proximity to groundwater supplies, farms and residences. We will be reviewing the developer's stormwater plan for compliance with DEP and local standards, and are confident that the proposed conditions will provide for significant environmental benefits over the existing use. We are writing a new mixed use overlay district zoning bylaw to allow certain aspects of the development that are currently not contemplated in the Zoning Bylaw. Public use of the property will be significantly improved and will include public parks areas, walking paths, and access to the proposed MassCentral Rail Trail. Negotiations are on-going regarding a development agreement between the parties which will mitigate identified impacts beyond the improvements planned for the property and adjacent areas.

The Town of Sudbury experiences severe wastewater disposal limitations in this sector of town which limit commercial growth, and other divisions of DEP are acutely aware of our long-standing efforts to sewer the commercial districts along Route 20. This property is unique with its own treatment plant. The opportunities to create a vibrant commercial center on this site should not be limited by the existing treatment plant capacity, but should be expanded to a safe level based on the treatment processes available and the physical limitations of the ground. My only request to your department in this regard is to investigate the installation of subsurface leaching beds (instead of open sand beds) for effluent disposal, which would provide for a much needed unstructured recreational use area within the large development.

In conclusion, the redevelopment plan is consistent with local and regional planning efforts, contemplates the redevelopment of an existing disturbed site, and proposes significant environmental benefits by bringing the new development into conformance with current environmental regulations.

Thank you for your consideration of these comments.

Sincerely,

Jody A. Kablack

Jody A. Kablack
Director of Planning and Community Development

cc: Steve Senna, National Development
Conservation Commission
Board of Selectmen
Planning Board

Commonwealth of Massachusetts
Executive Office of Energy & Environmental Affairs

Department of Environmental Protection

Northeast Regional Office • 205B Lowell Street, Wilmington MA 01887 • 978-694-3200

Charles D. Baker
Governor

Karyn E. Polito
Lieutenant Governor

Matthew A. Beaton
Secretary

Martin Suuberg
Commissioner

March 15, 2016

Matthew A. Beaton, Secretary
Executive Office of
Energy & Environmental Affairs
100 Cambridge Street
Boston MA, 02114

RE: Sudbury
526 & 528 Boston Post Road
Redevelopment
EEA # 15479

Attn: MEPA Unit

Dear Secretary Beaton:

The Massachusetts Department of Environmental Protection Northeast Regional Office (MassDEP-NERO) has reviewed the Environmental Notification Form (ENF) submitted by BPR Sudbury Development LLC to demolish the existing, 563,300 sf of buildings and paved parking areas in order to construct about a 600,000 square foot (sf) mixed-use project consisting of 80,000 sf of commercial/retail space including a 45,000 sf grocery, 250 residential apartments and up to 60 condominiums, and a memory care assisted living facility a 50 acre site in Sudbury (EEA #15479). MassDEP provides the following comments.

Wastewater

At this time, BPR Development Sudbury LLC holds a MassDEP Groundwater Discharge Permit 23-4M, which was transferred to them on December 28, 2015. This permit authorizes the discharge of up to 50,000 gallons per day of treated wastewater to the ground, subject to the effluent limits and terms and conditions of the permit. MassDEP also notes that BPR Development Sudbury LLC is now proceeding with field investigations related to hydrogeological work, pursuant to a MassDEP-approved scope of work. Successful completion of the field investigations, a hydrogeological report, and a subsequent Application for Modification of the MassDEP Groundwater Discharge Permit will be required in order to support a future wastewater design flow of 90,000 gallons per day included in the ENF. The proponent should continue to work with MassDEP to ensure all regulatory requirements are met for modification of the existing groundwater discharge permit.

Wetlands

The ENF includes a plan depicting the wetlands resource areas on and near the site, Figure 7, and it is reported the project will alter less than 5,000 sf of bordering vegetated wetlands (BVW) temporarily and about 330,000 sf of buffer zone to BVW. These impacts are expected for the proposed access that includes reconfiguration of a section of Boston Post Road to the south of the project site and work on existing stormwater inlets or outlets. There are reported to be BVW, bank, and isolated land subject to flooding wetland resource areas on site.

The Notice of Intent relating to the demolition of existing buildings was appealed to MassDEP, and a Superseding Order of Conditions (SOC) is being requested, DEP File # 301-1169. After completion of the MEPA review, MassDEP will issue a decision on the request for an SOC. In addition, a Notice of Intent will be needed for the redevelopment project and proposed roadway improvements.

Stormwater

The ENF indicates that the project will reduce imperviousness from 28.8 acres to 25.3 acres. Since the project is reported to reduce imperviousness, the stormwater management system is proposed under the redevelopment standards in the wetlands regulations, 310 CMR 10.05 (6)(k). The proposed stormwater management system includes catchbasins to capture runoff, water quality units, and subsurface infiltration with isolator rows. Grass swales and bioretention ponds also are identified. However, there is insufficient information to evaluate the stormwater management system for compliance with the applicable stormwater management standards.

The ENF acknowledges that the stormwater management system capturing runoff from parking areas will be designed for compliance with the standards for land uses of higher potential pollutant load. The project site also is within the Zone II for public drinking water supplies, which is a critical area under the Stormwater Management Standard 6. The ENF indicates that the stormwater system will be designed to capture and treat the one inch of runoff water quality volume and provide 44 percent pretreatment prior to infiltration. In addition, for compliance with the critical area standard, stormwater management systems must include shutoff/containment capabilities to avoid release of contaminants into the wetlands and groundwater.

MassDEP also notes that the ENF did not identify Hop Brook as an impaired waterbody. According to the *Massachusetts Year 2014 Integrated List of Waters*, Hop Brook is a Category 5 impaired waterbody, which requires a total maximum daily load for dissolved oxygen saturation, excess algal growth, dissolved oxygen, and total phosphorus.

Recycling

The project includes demolition and construction, which will generate a significant amount of construction and demolition (C&D) waste. MassDEP highly recommends that the proponent make a significant commitment to recycle C&D waste as a sustainable measure for the project, comparable to other similar projects. In addition, the proponent is advised that demolition activities must comply with both Solid Waste and Air Pollution Control regulations, pursuant to M.G.L. Chapter 40, Section 54, which provides:

> "Every city or town shall require, as a condition of issuing a building permit or license for the demolition, renovation, rehabilitation or other alteration of a building or structure, that the debris resulting from such demolition, renovation, rehabilitation or alteration be disposed of in a properly licensed solid waste disposal facility, as defined by Section one hundred and fifty A of Chapter one hundred and eleven. Any such permit or license shall indicate the location of the facility at which the debris is to be disposed. If for any reason, the debris will not be disposed as indicated, the permittee or licensee shall notify the issuing authority as to the location where the debris will be disposed. The issuing authority shall amend the permit or license to so indicate."

For the purposes of implementing the requirements of M.G.L. Chapter 40, Section 54, MassDEP considers an asphalt, brick, and concrete (ABC) rubble processing or recycling facility, (pursuant to the provisions of Section (3) under 310 CMR 16.05, the Site Assignment regulations for solid waste management facilities), to be conditionally exempt from the site assignment requirements, if the ABC rubble at such facilities is separated from other solid waste materials at the point of generation. In accordance with 310 CMR 16.05(3), ABC can be crushed on-site with a 30-day notification to MassDEP. However, the asphalt is limited to weathered bituminous concrete, (no roofing asphalt), and the brick and concrete must be uncoated or not impregnated with materials such as roofing epoxy. If the brick and concrete are not clean, the material is defined as construction and demolition (C&D) waste and requires either a Beneficial Use Determination (BUD) or a Site Assignment and permit before it can be crushed.

Pursuant to the requirements of 310 CMR 7.02 of the Air Pollution Control regulations, if the ABC crushing activities are projected to result in the emission of one ton or more of particulate matter to the ambient air per year, and/or if the crushing equipment employs a diesel oil fired engine with an energy input capacity of three million or more British thermal units per hour for either mechanical or electrical power which will remain on-site for twelve or more months, then a plan application must be submitted to MassDEP for written approval prior to installation and operation of the crushing equipment.

Asbestos removal notification on permit form BWP AQ04 (ANF 001) and building demolition notification on permit form BWP AQ06 must be submitted to MassDEP at least 10 working days prior to initiating work. If any asbestos-containing materials will need to be abated through non-traditional abatement methods, the proponent must apply for and obtain approval from MassDEP, through Application BWP AQ36 - Application for Non-Traditional Asbestos Abatement Work Practice Approval. Except for vinyl asbestos tile (VAT) and asphaltic-asbestos felt and shingles, the disposal of asbestos containing materials within the Commonwealth must be at a facility specifically approved by MassDEP, (310 CMR 19.061). No asbestos containing material including VAT, and/or asphaltic-asbestos felts or shingles may be disposed at a facility operating as a recycling facility, (310 CMR 16.05). In addition, the demolition project contain asbestos, the project proponent is advised that asbestos and asbestos-containing waste material are a special waste as defined in the Solid Waste Management regulations, (310 CMR 19.061). The disposal of the asbestos containing materials outside the jurisdictional boundaries of the Commonwealth must comply with all the applicable laws and regulations of the state receiving the material.

The demolition activity also must conform to current Massachusetts Air Pollution Control regulations governing nuisance conditions at 310 CMR 7.01, 7.09 and 7.10. As such, the proponent should propose measures to prevent and minimize dust, noise, and odor nuisance conditions, which may occur during the demolition. Again, MassDEP must be notified in writing, at least 10 days in advance of removing any asbestos, and at least 10 days prior to any demolition work. The removal of asbestos from the buildings must adhere to the special safeguards defined in the Air Pollution Control regulations, (310 CMR 7.15 (2)).

Waste Ban Regulation – 310 CMR 19.017

Section 310 CMR 19.017 *Waste Bans* of the Massachusetts Solid Waste regulations prohibit the disposal of certain wastes in Massachusetts. These wastes include, but are not limited to, recyclable paper (including cardboard). On October 1, 2014, the Massachusetts Organics Waste Ban on the disposal of commercial organic wastes by businesses and institutions takes effect. It prohibits the disposal of organic wastes from businesses and institutions that generate a ton or more of organic materials per week, which necessitates the composting, conversion (such as anaerobic digestion), recycling or reuse of organic the waste.

As the lead state agencies responsible for helping the Commonwealth achieve its waste diversion goals, MassDEP and EEA have strongly supported voluntary initiatives by the private sector to institutionalize source reduction and recycling into their operations. Adapting the design, infrastructure, and contractual requirements necessary to incorporate reduction, recycling and recycled products into existing large-scale developments has presented significant challenges to recycling proponents. Integrating those components into developments such as the Tyngsboro Crossing and Merrimac Commons project at the planning and design stage enables the project's management and occupants to establish and maintain effective waste diversion programs. For example, facilities with minimal obstructions to trash receptacles and easy access to main recycling areas and trash chutes allow for implementation of recycling programs and have been proven to reduce cleaning costs by 20 percent to 50 percent. Other designs that provide sufficient space and electrical services will support consolidating and compacting recyclable material and truck access for recycling material collection.

By incorporating recycling and source reduction into the design, the proponent has the opportunity to join a national movement toward sustainable design. Sustainable design was endorsed in 1993 by the American Institute of Architects with the signing of its *Declaration of Interdependence for a Sustainable Future.* The project proponent may be aware of organizations that provide additional information and technical assistance, including Reuse Marketplace (http://www.reusemarketplace.org/), USEPA's WasteWise Program (www.epa.gov/wastewise/), and MassRecycle (http://www.massrecycle.org/). The listed organizations and programs are notable for offering valuable and effective waste reduction and recycling assistance, web-based resources, case studies, and tools for C&D projects.

Massachusetts Contingency Plan (MCP)/M.G.L. c.21E

Contaminated Soil and Groundwater: The ENF indicates that the project has been regulated by MassDEP's Waste Site Cleanup Program under the MCP/MGL c21E, Release Tracking Numbers (RTNs) 3-3037, RTN 3-17106, and RTN 3-27243 have been assigned for three separate conditions. The proponent plans to implement a Release Abatement Measure (RAM) Plan during demolition and construction that will include a soil and groundwater management plan. MassDEP recently completed a review of the Waste Site Cleanup files for the project site. A summary of that review is provided in a memorandum from MassDEP, dated January 22, 2016, which is included in Attachment E with the ENF.

The project proponent is advised that excavating, removing and/or disposing of any contaminated soil, pumping of contaminated groundwater, or working in contaminated media must be done under the provisions of MGL c.21E (and, potentially, c.21C) and OSHA. If permits and approvals under these provisions are not obtained beforehand, considerable delays in the project may occur. The project proponent cannot manage contaminated media without prior submittal of appropriate plans to MassDEP, which describe the proposed contaminated soil and groundwater handling and disposal approach, and health and safety precautions. If contamination at the site is known or suspected, the appropriate tests should be conducted well in advance of the start of construction and professional environmental consulting services should be readily available to provide technical guidance to facilitate any necessary permits. If dewatering activities are to occur at a site with contaminated groundwater, or in proximity to contaminated groundwater where dewatering can draw in the contamination, a plan must be in place to properly manage the groundwater and ensure site conditions are not exacerbated by these activities. Dust and/or vapor monitoring and controls are often necessary for large-scale projects in contaminated areas. The need to conduct real-time air monitoring for contaminated dust and to implement dust suppression must be determined prior to excavation of soils. An evaluation of contaminant concentrations in soil should be completed to determine the concentration of contaminated dust that could pose a risk to health of on-site workers and nearby people. If this dust concentration, or action level, is reached during excavation, dust suppression should be implemented as needed, or earthwork should be halted.

Potential Indoor Air Impacts: Parties constructing and/or renovating buildings in contaminated areas should consider whether chemical or petroleum vapors in subsurface soils and/or groundwater could impact the indoor air quality of the buildings. All relevant site data, such as contaminant concentrations in soil and groundwater, depth to groundwater, and soil gas concentrations should be evaluated to determine the potential for indoor air impacts to existing or proposed building structures. Particular attention should be paid to the vapor intrusion pathway for sites with elevated levels of chlorinated volatile organic compounds such as tetrachloroethylene (PCE) and trichloroethylene (TCE). MassDEP has additional information about the vapor intrusion pathway on its website at http://www.mass.gov/dep/cleanup/laws/vifs.htm.

New Structures and Utilities: Construction activities conducted at a disposal site shall not prevent or impede the implementation of likely assessment or remedial response actions at the site. Construction of structures at a contaminated site may be conducted as a Release Abatement Measure if assessment and remedial activities prescribed at 310 CMR 40.0442(3) are completed within and adjacent to the footprint of the proposed structure prior to or concurrent with the construction activities. Excavation of contaminated soils to construct clean utility corridors should be conducted for all new utility installations.

Air Quality

Pre-installation approval from MassDEP, pursuant to regulation 310 CMR 7.02, is required if the project will include any boiler regulated under 310 CMR 7.26(30)-(37), inclusive. Natural gas or distillate fuel oil-fired boilers with an energy input capacity less than 10,000,000 British thermal units per hour (Btu/hr) are exempt from the above listed regulations. In addition, if the project will be equipped with emergency generators equal to or greater than 37 kW, then each of those emission units must comply with the regulatory requirements in 310 CMR 7.26(42).

The MassDEP Northeast Regional Office appreciates the opportunity to comment on this proposed project. Please contact at (978) 694- for further information on the issues. If you have any general questions regarding these comments, please contact Nancy.Baker@state.ma.us , MEPA Review Coordinator at (978) 694-3338.

Sincerely,

This final document copy is being provided to you electronically by the Department of Environmental Protection. A signed copy of this document is on file at the DEP office listed on the letterhead.

John D. Viola
Deputy Regional Director

cc: Brona Simon, Massachusetts Historical Commission
Eric Worrall, Rachel Freed, Kevin Brander, John Macauley, Jack Miano, Andrew Friedmann, MassDEP-NERO

Johnson, Holly (EEA)

From: Bob Haarde [rhaarde@comcast.net]
Sent: Tuesday, March 15, 2016 10:57 AM
To: Johnson, Holly (EEA)
Subject: FW: Sudbury, 528 Boston Post Rd, Raytheon, Letter & Memo, 3-3037, 3-17106, 3-27243

Ms. Johnson

Holly,

I am passing along my comments and comments from Sudbury citizens on the MEPA decision for the development of the Raytheon property in Sudbury. I believe today is the deadline. If you could please confirm that you received this email I would appreciate it?

Thank you.

I am a member of the board of selectmen but I am not speaking for the board. A letter was sent from Chuck Woodard, Chairman of the Board of Selectmen, to Raytheon last year when they were considering selling the property outlining some concerns including the statement: "With any project, we expect that all impacts will be fully mitigated, including but not limited to increases in the number of school-age children, potential environmental contamination, traffic and support service needs."

There was a group of citizens who petitioned for a PIP designation for this site but were unsuccessful and then asked if there was something I could do to help them.

These citizens asked that I pass along their concerns. I am not an expert in this area but I have reviewed these concerns and they did seem valid to me and worthy of consideration which are below. Below is also an email from the DEP which outlines some concerns as well.

- The developer plans to install deep irrigation wells which could cause human interaction with contaminants.
- Impacts to the Town of Sudbury Zone II Wellhead Protection Area for our main drinking water supply by GW-1 exceedances leaving the Raytheon Site.
- There were only six water and soil samples taken in 2015 and two samples of TCE and one sample of FREON were discovered and all were above the legal limit.
- The only analysis to date have been conducted by GZA, the LSP for Raytheon, and the LSPs for the developers, but not by an independent LSP representing the general public. During the 2/10 Sanborn Head planning board presentation, TCE was described as a "great industrial solvent." The harmful carcinogenic risks of TCE were not mentioned. An independent LSP who looks at TCE as a potential health risk and not a "great industrial solvent" should be hired.
- Most of the analysis on this site appears to have take place in the 1990s, with the exception of the six recent samples.
- According to the February 10th Planning Board Meeting presentation only 43 soil samples in over 20 years have been analyzed.
- The February 20th Planning Board presentation by National Development and Sanborn Head did not adequately cover the presence nor the plan to deal with PCBs, Asbestos and other harmful contaminants which could be released during demolition/construction and which are likely to be in buildings of this vintage. It appears, based on the 2/10 presentation, that the developers will rely on construction workers to report that something "looks funny or smells funny" in order to then engage a RAM process. There are concerns about this process as it may be too late to prevent contamination to construction workers and nearby residents. This area is very youth-centric with athletic facilities and day care centers directly adjacent to the east of this property.

- Impacts to the health and safety of town residents and construction workers during any demolition of the current facility by adverse impacts to air from building materials potentially containing asbestos. We have not seen any reports that document the building materials being tested for potential asbestos-containing materials;
- Impacts to the health and safety of town residents, construction workers, and future Site users from any potential PCB-containing materials not properly disposed from the current facility. We have not seen any reports that document testing for PCBs at on-Site transformers or in building materials; and
- Impacts to future Site residents and future workers in these proposed structures (commercial and residential buildings) from VOC impacts that remain on-Site and are not well-defined. A previous LSP statement that a "well-defined on-Site source of the CVOCs in groundwater has not been identified" and my observation that PID hits of VOCs, some in part per million range, were noted in the boring logs at six locations in Appendix E of the Phase II report.)

Thank you,

Bob Haarde

37 Belcher Drive

Sudbury, MA 01776

617-909-7477

From: Miano, John (DEP) [mailto:John.Miano@MassMail.State.MA.US]
Sent: Monday, March 14, 2016 9:31 AM
To: Bob Haarde
Cc: 'Joanne Lynch'; Johnson, Stephen (DEP); Worrall, Eric (DEP); Friedmann, Andrew (DEP); health@sudbury.ma.us; customerservice@sudburywater.com
Subject: Sudbury, 528 Boston Post Rd, Raytheon, Letter & Memo, 3-3037, 3-17106, 3-27243

Hi Bob,

Thank you for your email related to the former Raytheon site located at 528 Boston Post Road in Sudbury. Given that the Town of Sudbury will be making some decisions about the project in the near future, you are seeking guidance from MassDEP.

As you are aware, MassDEP has recently reviewed information in our 21E files to determine whether any risk would be posed by the proposed future redevelopment of the site. Based on our review, and the testing done to date, it is important to note that at this time there is no information that would suggest that redevelopment of the site should be restricted. This review included an evaluation of the Sanborn report you reference in your email.

The Sanborn "Phase I Environmental Site Assessment with Subsurface Investigation Report", prepared for ND Acquisitions LLC, dated August 2015, included a historical review of contamination at the site and documented their 2015 subsurface investigation program, which evaluated soil and groundwater at the Site. Groundwater and soil samples were tested from 6 locations in June 2015, for VOCs, petroleum, metals, polychlorinated biphenyls (PCBs) and cyanide. All soil and groundwater levels were below MassDEP's Reportable Concentrations. The Town of Sudbury website contains a Sanborn Head Letter dated February 4, 2016, to Avalon Bay Communities, Inc., and a Summary of Environmental Conditions Presentation to the Sudbury Planning Board, for 528 Boston Post Road, by Patricia M. Pinto, P.E., LSP. The conclusions presented in the Sanborn Phase 1 Report, the letter to Avalon Bay, and the Presentation to the Planning Board were each consistent with MassDEP's findings and recommendations, as presented in our January 22, 2016 letter.

A quick summary of MassDEP's findings and recommendations follows.

- Based on the presence of solvent contamination remaining in deep groundwater, at levels exceeding the MassDEP Drinking Water Standards, MassDEP recommends that if the project should propose to install drinking water wells in the contaminated areas, a Licensed Site Professional evaluate the possible need for treatment. This recommendation is based on the possibility of a change in MCP groundwater category, depending on whether future drinking water wells are installed.
- Buildings constructed near former groundwater monitoring well GZ-106, where Freon levels were present, should be evaluated for the possibility of Freon vapor intrusion to indoor air. This recommendation is based on the possibility of a newly created indoor air exposure pathway if a building is built in this area.
- Given the past uses of the facility and associated use of hazardous materials, further assessment is recommended to evaluate the soil beneath the buildings if redevelopment of the site creates the potential for exposure to untested soils. Although there is no information to indicate that elevated levels beneath the buildings are present, this recommendation is based on a conservative approach to land use change (to residential), and uncertainty about contaminant levels due to the prior presence of buildings.

In terms of next steps, the project is currently before MEPA and the public comment period closes on March 15, 2016. MEPA will issue its decision on the Environmental Notification Form by March 25, 2016. Once that process is complete, MassDEP will be able to finalize its' decision on the pending wetlands appeal through a Superseding Order of Conditions.

I hope this information is helpful. If you have any other questions, please let me know.
Thanks,
Jack

John F. Miano
Chief, Site Management Section
Bureau of Waste Site Clean-up
205B Lowell St., Wilmington MA 01887
Telephone 978-694-3357
Email john.miano@state.ma.us
MassDEP e-newsletter: mass.gov/dep/public/publications/enews.htm
MassDEP web site: mass.gov/dep

Johnson, Holly (EEA)

From: Bill Schineller [bschineller@yahoo.com]
Sent: Tuesday, March 15, 2016 8:10 AM
To: Johnson, Holly (EEA)
Cc: scac@sudbury.ma.us; KablackJ@sudbury.ma.us; BoardofSelectmen@sudbury.ma.us; rte20sewer@sudbury.ma.us; townmanager@sudbury.ma.us
Subject: Comment on Raytheon Redevelopment project in Sudbury w.r.t. Sewer and Overhead Wires

Hello Ms. Holly Johnson,

Regarding the Raytheon Redevelopment project in Sudbury, I understand that a filing under the Massachusetts Environmental Policy Act (MEPA) has been submitted to the Executive office of Energy and Environmental Affairs for the project and that Comments are due to EOEEA on this application by March 15, 2016.

I wish to comment that a project of this magnitude which will dramatically alter the Rt 20 business district in Sudbury, and place additional stresses on the known drinking water, wetland resources, flood zones, and environmental issues in that area. As such this project MUST provide for the installation of sewers for treatment elsewhere.
Furthermore, all utility lines along Rt. 20 should be buried so that there are no overhead wires.
The Raytheon Redevelopment project should be coordinated with other utility projects (such as the proposed Eversource Sudbury - Hudson power line project) to result in a more beautiful, vibrant, village-friendly downtown business district.

I think there is both a requirement and a tremendous opportunity here. Reference https://sudbury.ma.us/scac/route-20-zoning-recommendations-mapc/

Thank you for including my comments in the public record, and acting upon them.

Sincerely,
Bill Schineller
37 Jarman Road
Sudbury, MA 01776

Charles D. Baker, Governor
Karyn E. Polito, Lieutenant Governor
Stephanie Pollack, MassDOT Secretary & CEO

massDOT
Massachusetts Department of Transportation

March 15, 2016

Matthew Beaton, Secretary
Executive Office of Energy and Environmental Affairs
100 Cambridge Street, Suite 900
Boston, MA 02114-2150

RE: Sudbury – 526 & 528 Boston Post Road: ENF
(EEA #15479)

ATTN: MEPA Unit
Holly Johnson

Dear Secretary Beaton:

On behalf of the Massachusetts Department of Transportation, I am submitting comments regarding the proposed 526 & 528 Boston Post Road project in Sudbury, as prepared by the Office of Transportation Planning. If you have any questions regarding these comments, please contact J. Lionel Lucien, P.E., Manager of the Public/Private Development Unit, at (857) 368-8862.

Sincerely,

David J. Mohler
Executive Director
Office of Transportation Planning

DJM/jll

Ten Park Plaza, Suite 4150, Boston, MA 02116
Tel: 857-368-4636, TTY: 857-368-0655
www.mass.gov/massdot

cc: Thomas J. Tinlin, Administrator, Highway Division
Patricia Leavenworth, P.E., Chief Engineer, Highway Division
Jonathan Gulliver, District 3 Highway Director
Neil Boudreau, State Traffic Engineer
Sudbury Planning Board
PPDU Files

Charles D. Baker, Governor
Karyn E. Polito, Lieutenant Governor
Stephanie Pollack, MassDOT Secretary & CEO

massDOT
Massachusetts Department of Transportation

TO: David J. Mohler, Executive Director

FROM: J. Lionel Lucien, P.E, Manager, Public/Private Development Unit
Office of Transportation Planning

DATE: March 15, 2016

RE: Sudbury – 526 & 528 Boston Post Road: ENF
(EEA #15479)

The Public/Private Development Unit (PPDU) has reviewed the Environmental Notification Form (ENF) for the proposed 526 & 528 Boston Post Road project in the Town of Sudbury. The site is currently a multi-building, 563,300 square-foot research/development and office campus for the defense contractor Raytheon. The site totals 50 acres bordered by Boston Post Road (Route 20) to the south, commercial properties to the east, agricultural/open space to the west, and a former railroad right-of-way to the north.

The proposal is to redevelop the site as a mixed-use development with 250 residential apartment housing units, a 54-bed memory care assisted living facility, 60 active adult condominium units, and up to 80,000 square feet of retail space including restaurants and a grocery store. The site would include 1,300 parking spaces spread across the various land uses.

The site abuts and would be accessed via a state-controlled roadway, Boston Post Road (Route 20), and will therefore require a Vehicular Access Permit from MassDOT. The project also exceeds the Massachusetts Environmental Policy Act (MEPA) threshold for trip generation (1,000 or more new trips) and parking (300 or more new parking spaces). The ENF includes a "Traffic Impact Study" that generally conforms to the current (March 2014) MassDOT/EOEEA *Transportation Impact Assessment (TIA) Guidelines*.

Study Area

The study area for the ENF includes the following intersections and connecting roadway segments:

- Route 20 at Horse Pond Road;
- Route 20 at Dudley Road;
- Route 20 at Highland Avenue/Sudbury Plaza (West);
- Route 20 at Sudbury Plaza (East);
- Route 20 at Nobscot Road;
- Route 20 at Union Avenue;
- Route 20 at Raymond Road;
- Route 20 at Concord Road; and
- Route 20 at Landham Road.

The study area is generally acceptable and is adequate in capturing the impact of the project on area roadways.

Trip Generation

As presented in the ENF, ITE trip rates for Land Use Code (LUC) 820-Shopping Center, LUC 220-Apartments, LUC 252-Age-Restricted Housing, and LUC 254- Assisted Living were used to determine average weekday AM, weekday PM, and Saturday midday peak hour trip generation for the proposed uses. The Proponent has supplemented ITE data with empirical data at four other area retail plazas with supermarket anchors.

To estimate and take credits for the existing uses on site, the trip generation was calculated using LUC 710-Office Space, LUC 760- Research & Development, and LUC 140-Manufacturing. While we generally prefer the use of empirical data for existing uses, the site is currently less than 25% occupied and extrapolation would not provide the most accurate representation of site trip generation potential at 100% occupancy. The methodology used in the ENF is generally acceptable to MassDOT and will be accurate in assessing the impact of the project during peak periods.

When fully occupied, the project is expected to generate 2,810 net new trips on an average day; including a net decrease of 425 trips during the weekday AM peak hour, a net decrease of 35 trips during the weekday PM peak hour, but a net increase of 645 trips during the Saturday midday peak hour.

Safety

The transportation study includes a summary of crash rates derived from MassDOT and available local data for the continuous five-year period of 2009 through 2013 (most recent). The summary indicates that two study area intersections have crash rates that exceed the MassDOT District 3 average. The Route 20/Highland Avenue/Sudbury Plaza (West) intersection has a crash rate of 0.8 and the Route 20/Landham Road intersection has a rate of 0.94. The Landham Road intersection is currently being redesigned to address the safety and capacity issues.

The Proponent will be required to conduct a Roadway Safety Audit (RSA) at all locations exceeding the District crash average with specific mitigation aimed at improving safety, where necessary. An update must be provided based on the RSAs conducted prior to the issuance of a Highway Access Permit.

Traffic Operations

Capacity analyses were conducted for the weekday morning, weekday evening, and Saturday midday peak hours for existing, future No-Build, and future Build conditions. The analysis shows that all study area intersections would operate at a generally comparable level of service under both 2022 No-Build and 2022 Build conditions, suggesting that the area roadways have adequate capacity to support the project with the following improvements in place:

Site Access Improvements

The existing Raytheon driveway is currently unsignalized and is managed by providing police control during peak periods. The Proponent is proposing signalization at this location. A new site driveway would be constructed opposite Sudbury Plaza western driveway/Highland Avenue (private way). A designated left-turn lane would be added from Boston Post Road eastbound along with pedestrian crosswalks and bicycle accommodations. New sidewalks would be added within the limits of disturbance.

The Highland Avenue leg of the proposed intersection is expected to contribute low traffic volumes (on the order of fewer than five vehicle trips during peak hours). This prompted the Proponent to analyze operations at this location under two scenarios. Scenario 1 would be the typical condition without activation of the Highland Avenue phase and Scenario 2 represents activation of that phase when needed.

Under Scenario 2, this location is expected to operate at LOS "F" which is generally seen as unacceptable. The Proponent should continue to work with the MassDOT Traffic Operations Section and the Highway Division District 3 Office during the access permitting process to develop additional traffic signal timing and phasing schemes along Route 20 that could improve this condition. The Proponent should initiate a discussion with Sudbury Plaza and Highland Avenue property owners to reroute Highland Avenue through the Sudbury Plaza West Driveway to create a more typical intersection configuration. This would allow for the elimination of the proposed signal phase for Highland Avenue.

Fire Station Preemption Signal

The Sudbury Fire Department has expressed interest in having traffic signal preemption on Boston Post Road in front of the fire station located along the Proponent's site frontage. The Proponent would implement preemption, in consultation with MassDOT during the access permitting process.

Traffic Signal Coordination

The Proponent would implement a traffic signal coordination system comprised of the intersections of Route 20 with the site driveway, Nobscot Road, and Union Street. The coordinated system would be tailored with specific timing plans implemented during the peak periods. This improvement is expected to help to improve flow along Route 20 at these intersections and numerous other unsignalized intersections along this segment.

Conceptual Plans

The Proponent should provide sufficiently detailed conceptual plans (at least 80-scale) for proposed roadway improvements in order to verify the feasibility of constructing such improvement. These plans should clearly show proposed lane widths and offsets, layout lines and jurisdictions, and land uses (including driveways) adjacent to areas where improvements are proposed.

Any proposed mitigation within the state highway layout and all internal site circulation must be consistent with a Complete Streets design approach that provides adequate and safe accommodation for all roadway users, including pedestrians, bicyclists, and public transit riders. Guidance on Complete Streets design is included in the *MassDOT Project Development and Design Guide*. Where these criteria cannot be met, the Proponent should provide justification, and should work with the MassDOT Highway Division to obtain a design waiver.

Parking

According to the ENF, the project is expected to include approximately 1,300 parking spaces to serve the on-site uses. While the Proponent did not provide details on the parking calculations, the supply is high and does exceed ITE recommendations for the proposed land uses. While we acknowledge that the proposed is actually a reduction from the existing site parking supply, it is important to recognize that providing parking at a rate that is disproportionate to what is required by the specific land uses has the undesired effect of encouraging excessive single-occupant vehicle travel. Therefore, a comprehensive transportation demand management plan will be essential.

Multimodal Access and Facilities

The Town of Sudbury is served by MetroWest Regional Transit Authority (MWRTA) with the nearest service approximately three miles from the site. The MWRTA recently undertook a service assessment, which identified priority service expansion within the region. One location that was identified as having growth potential is the Route 20 corridor in the vicinity of the site. The Proponent should continue discussions with the MWRTA regarding this possible service and should explore how the project can be designed so not to preclude on-site transit service.

The Proponent has committed to the following pedestrian/bicycle improvements:

- Widening and reconstructing the sidewalks within the limits of work along both sides of Route 20;
- Provision of five-foot wide shoulders on both sides of Route 20 within the limits of construction to become part of future bicycle lanes;
- Construction of a fully actuated pedestrian crosswalk at the site driveway;
- Installation of bicycle detection at the site driveway intersection;
- A network of sidewalks throughout the site; and
- Future connections to the planned Mass Central Rail Trail.

Transportation Demand Management (TDM) Program

The Proponent has committed to providing a TDM plan including, but not limited to, the following measures:

- Designation of an on-site Transportation Coordinator;
- Membership in the MetroWest/495 Transportation Management Association;
- Ridesharing programs for employees; and
- Secure bicycle parking throughout the site.

In addition, the TDM plan should be expanded to include the following measures that have been successful at reducing single-occupant vehicle trips to similar mixed-use developments:

- Information on transportation options provided via a website that is accessible to all residents and visitors;
- Subsidized transit passes for residents, as appropriate;
- Supporting ride-matching/carpooling through the active promotion of NuRide, the Commonwealth's web-based trip planning and ride-matching system that allows users to earn rewards for taking greener trips;
- Providing a guaranteed ride home program for employees;
- Developing a relationship with a car-sharing program and providing an appropriate number of spaces for these car(s) on-site; and
- Providing preferential parking for carpool and vanpool users.

The Proponent should begin identifying the details of these measures as well as developing additional programs. The Proponent should also consult with MassRIDES, the Commonwealth's Travel Options provider, to help implement the TDM program.

The Proponent should continue consultation with appropriate MassDOT units, including PPDU and the District 3 Office, in advance of the issuance of a Vehicular Access Permit. If you have any questions regarding these comments, please contact me at (857) 368-8862 or Derek Valentine at (857) 368-8885.

March 22, 2016

Matthew A. Beaton, Secretary
Executive Office of Energy & Environmental Affairs
Attention: MEPA Office – Holly Johnson, MEPA #15479
100 Cambridge Street, Suite 900
Boston, MA 02114

RE: 526 & 528 Boston Post Road Redevelopment, MEPA #15479

Dear Secretary Beaton:

The Metropolitan Area Planning Council (MAPC) regularly reviews proposals deemed to have regional impacts. The Council reviews proposed projects for consistency with *MetroFuture*, the regional policy plan for the Boston metropolitan area, the Commonwealth's Sustainable Development Principles, the GreenDOT initiative, consistency with Complete Streets policies and design approaches, as well as other impacts on the environment.

Located on approximately 50 acres, 526 & 528 Boston Post Road (the Project) is bordered by Boston Post Road (Route 20) to the south, to the east by commercial properties, to the west by agricultural use and open space, and to the north by a former railroad right-of-way in Sudbury. BPR Sudbury Development, LLC (the Proponent) proposes a mixed-use development that will comprise approximately 80,000 square feet of mixed retail use[1] and a range of residential developments. Specifically, the proponent proposes 250 apartment units[2], 60 age-restricted (55 or older) condominium units, and a 54-bed assisted living/memory care facility. The Proponent proposes to demolish the existing buildings on the site, formerly owned by Raytheon, in phases.

The Project will modestly help to meet Sudbury's and the region's housing needs. We are somewhat disappointed that the Project continues a trend we see in much of the region, with most units directed to senior citizens and only a few to households with children. Since 114 of the units are directly or effectively age restricted, and since fully half of the 250 rental apartments are one-bedroom units, a significant majority of residents are likely to be senior citizens. We recognize that Sudbury has a need for increased senior housing, and that many of these units may help seniors who are selling their homes in Sudbury to remain in their community. The Project is consistent with Sudbury's 2012 Housing Production Plan, which specifically identifies the site as one of the top six preferred sites for development of affordable housing.

Nevertheless, the region – and certainly communities in this part of the region – have a serious deficit of affordable rental units for families, and developments of this kind represent a critical opportunity to address this deficit. Although the project has many positive aspects, we believe the Proponent will largely miss this important opportunity to diversify the housing stock of Sudbury, to advance Fair Housing goals and to help meet the housing needs of families.

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[1] The 80,000 square feet of retail use will comprise a 45,000 square foot grocery store and 35,000 square feet of restaurant/commercial use.

[2] The 250 apartment units will consist of approximately125 1-bedroom, 100 2-bedroom, and 25 3-bedroom units. 25% percent of the apartment homes permitted under M.G.L. Ch. 40B will be restricted to households earning no more than 80 percent of the Area Median Income.

Moving beyond the housing question, we note that this side has been identified as a Priority Development Area (PDA) locally as part of the 495/MetroWest Development Compact planning process, but it was not chosen as a regional priority by MAPC or as a state priority by the Executive Office of Housing & Economic Development. Sudbury's 2001 Master Plan also identified the site as a key location for redevelopment and expansion once vacated by Raytheon.

526 & 528 Boston Post Road proposes a total of 1,300 parking spaces. This Project is forecast to generate an estimated 7,920 daily vehicle trips, an increase of 2,810 trips compared to the office and research & development uses at the former Raytheon site. The weekday morning and evening peak hour traffic generation is estimated at 264 and 447 vehicle trips respectively. Due to the dispersed impacts of the mixed-use development, it is anticipated that vehicle trips will be distributed throughout the day and generate less traffic during the weekday morning and weekday evening peak hours as compared to the previous land use.

MAPC has a long-term interest in alleviating regional traffic and environmental impacts, consistent with the goals of *MetroFuture.* The Commonwealth also has established a mode shift goal of tripling the share of travel in Massachusetts by bicycling, transit, and walking by 2030. Additionally, the Commonwealth has a statutory obligation to reduce greenhouse gas emissions (GHG) by 25% from 1990 levels by 2020 and by 80% from 1990 levels by 2050. Despite the positive aspect of housing production, this largely auto-dependent development will make it more difficult to attain these goals. Therefore MAPC recommends robust traffic mitigation measures in order to realize the benefits of this mixed use development while minimizing any negative impacts.

MAPC has reviewed the Environmental Notification Form (ENF) and our recommendations primarily address providing bus access as part of the mitigation commitments, reducing the number of parking spaces, and developing mode share goals. Our intent is to encourage a greater shift of auto trips to transit, bicycling, and walking, which will reduce the adverse impacts of this project. MAPC respectfully requests that the Secretary incorporate these recommendations into the Certificate on the ENF.

Thank you for the opportunity to comment on this project.

Sincerely,

Marc D. Draisen
Executive Director

cc: Jody Kablack, Director of Planning and Community Development, Town of Sudbury
David Mohler, MassDOT

Public Transportation
Currently, there is no MetroWest Regional Transit Authority (MWRTA) service on Boston Post Road in Sudbury near the Project. The MWRTA bus routes closest to the Project are located at Hager Street in Marlborough to the west (Route 7C) and at the Nobscot Shopping Center in Framingham to the south (Routes 2 and 3). The closest stops to the Project along these routes are located at a distance of approximately three miles to the west and south, respectively.

A recently completed Comprehensive Service Assessment by the MWRTA[1] identifies service gaps and proposes recommendations for their resolution. The Service Assessment explicitly recommends extending the current weekday service along Route 7C in Marlborough to include Sudbury and Wayland along Boston Post Road. The route, when extended, would provide hourly weekday service along Boston Post Road between 6:00 AM and 8:00 PM. The estimated the cost for this service extension is $220,000 annually. This extension has been identified in the Service Assessment as a Phase 1 project that "increases service levels on the agency's routes with the highest ridership and fills unserved gaps in the system." The Service Assessment states that "MWRTA fully believes that additional resources targeted on these services will strengthen the system as a whole." (p.10)

While the Proponent has committed to a mitigation program for roadway improvements, mitigation for public transportation is not addressed. The Proponent should outline how they will coordinate with the MWRTA, specifically identifying how connections to and from the Project site can be enhanced for bus use. The Proponent should partner with the MWRTA by contributing to the operating costs of area bus lines in an amount that is reasonably related to the Project's additional demand. The Proponent should also collaborate with the owners of other sites along Boston Post Road who could also contribute to the operating costs of extending MWRTA bus lines. Additionally, the Proponent's site design should be able to accommodate MWRTA vehicles.

Overall Parking Supply
MAPC strongly encourages the Proponent to investigate measures to reduce the overall number of parking spaces to deter Single Occupancy Vehicle (SOV) trips. As there is a critical relationship between parking supply and transportation behavior, reducing the amount of parking can contribute towards an overall decrease in automotive traffic and trips related to this project. Although the ENF states there will be a total of 1,300 parking spaces, how the spaces are allocated among the various land uses is not indicated. The EIR should describe the allocation of parking spaces the various land uses. It should be noted that MassDOT's Transportation Scoping Letter (TSL) dated October 20, 2015, states that the Transportation Impact Assessment (TIA) "should explain the derivation of the proposed parking supply for the project. The number of proposed spaces should be compared to the amount required based on information contained in the most recent edition of ITE's Parking Generation as well as the requirements of local zoning codes."

Parking reserves and unbundling are innovative parking strategies that can facilitate the reduction of overall parking supply at this site:

<u>Parking Reserves</u>
Consider banking some of the parking spaces until and unless they are determined to be necessary based on monitoring. A parking reserve would require reducing the number of parking spaces initially built, but land would be held in reserve to provide additional parking spaces if – and only if – they are needed in the future. As long as the additional parking is not needed, the land can be landscaped or used for other amenities such as playgrounds, parks, or stormwater mitigation. MassDOT's TSL also recommended that the Proponent investigate this parking strategy. It should be noted that the Proponent can take advantage of the provision in the Town's Zoning Bylaw which allows for reserve parking spaces[2].

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[1] MWRTA, Comprehensive Service Assessment, December 2015.

[2] Town of Sudbury Bylaw, Article IX, 2014, Section 3113. Reserve Parking Spaces.

Unbundling
Unbundle parking from space rent or sales price. Unbundling parking allows renters or owners to purchase only as much parking as they need. It would give residents the opportunity to save money by using fewer parking spaces, and this reduced demand would also enable the developer to save money on parking construction. By changing parking from a required purchase to an optional amenity, vehicle ownership and parking demand can be reduced.

In addition to applying these two parking strategies, the Proponent should be required to implement the following Transportation Demand Management (TDM) measures intended to further reduce trip demand, which, in turn, is a rationale for reducing parking.

- Provide ride-matching/carpooling for residents; and
- Provide car-share vehicles and electric vehicle (EV) charging stations for use by residents, as demand warrants.

Pedestrian and Bicycle Accommodations
MAPC is pleased that the Proponent has identified roadway improvements that include pedestrian and bicycle accommodations as well as proposed pedestrian connections. To further enhance pedestrian and bicycle accommodations, the Proponent should implement the following:

- Ensure connectivity to the two bicycle trails planned within close proximity to Project's site, i.e., the Mass Central Trail along the northern edge of the property and the Bruce Freeman Rail Trail to the east of the site.
- While the ENF mentions that there will be secure bicycle parking at convenient locations on the site, the number and location of parking spaces is not provided. The EIR should specify the number and location of bicycle racks and covered parking throughout the Project site.

Mode Share Goals and Monitoring
MAPC is concerned that the ENF does not address mode share goals or a comprehensive monitoring program. The Proponent needs to clearly define mode share goals (vehicular, transit, bicycling and walking) and commit to conducting regular monitoring and reporting of transportation mode shares. Adoption of modes share goals along with a comprehensive monitoring program would allow the Proponent to adjust the project's TDM program as necessary.

Mode Share Goals
Developing and monitoring mode share goals is a central component of a Traffic Impact Assessment (TIA). The *EOEEA/MassDOT Guidelines for TIAs* states: "The TIA should include an assessment of the mode split assumptions, as well as the Proponent's plan to maximize travel choice, promote non-SOV modes, and achieve the assumed mode shares." (p. 17)

Consistent with these Guidelines, the TDM program should include specific, defined mode share goals that target the highest attainable rates of transit, bicycle, and pedestrian use. Data and analysis of existing modes (including public transportation, walking, and bicycling) should be employed to identify proposed physical improvements and supporting programs to increase these modes. MAPC also notes MassDOT's TSL states, "The Proponent will be expected to set specific mode shift goals, particularly for residents of the residential portion and employees of the retail portion of the project."

Monitoring Program
A monitoring program can help to determine if the defined mode share goals are being achieved. A monitoring program should evaluate achievement of the assumptions originally made in the transportation analysis and determine the effectiveness of the TDM program. With a monitoring program, the actual impacts of a project can be determined and additional mitigation measures identified, if necessary.

We ask the Secretary to require that the Proponent work closely with the Town of Sudbury and MassDOT to define clearly the project's intended mode split, to deploy specific practices intended to achieve that goal, and to develop a comprehensive monitoring program for all modes. The project site should be monitored for a minimum period of five years, as outlined in *MassDOT's TIA Guidelines*. (p. 44).

Attachment M
Endangered Species Documentation

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MESA Information Request Form

Please complete this form to request site-specific information from the Natural Heritage & Endangered Species Program (Please submit only one project per request form).

Please include a check for $50.00 made out to Comm. of MA – NHESP.*

Requestor Information

Name: Meredith Avery

Affiliation: VHB, Inc.

Address: 101 Walnut Street

City: Watertown State: MA Zip Code: 02471

Daytime Phone: 617-607-2604 Ext. Email address: mavery@vhb.com

Project Information

Project or Site Name: 526 and 528 Boston Post Road Redevelopment

Location: 526 and 528 Boston Post Road Town: Sudbury

Name of Landowner or Project Proponent: BPR Sudbury Development LLC

Acreage of the Property: ~50 acres

Description of Proposed Project and Current Site Conditions: (If necessary attach additional sheet)

The Project consists of redevelopment of the former Raytheon property to a new mixed use development including retail, active-adult residential community, a senior living complex, and an affordable residential community. (see attached for additional information)
Applicant requests information on any known Northern Long Eared Bat maternity roost trees or hibernaculum on or near (within ¼ mile) of the site.

- [x] Will this project be reviewed as a Notice of Intent by the local Conservation Commission?
- [x] Will this project be undergoing MEPA review for reasons other than rare species?
- [x] Have you enclosed the required copy of a USGS topographic map in the scale 1:24,000 or 1:25,000 (not copy reduced) with the site location clearly marked and centered on the copy page? (Copies of Natural Heritage Atlas pages are not accepted)

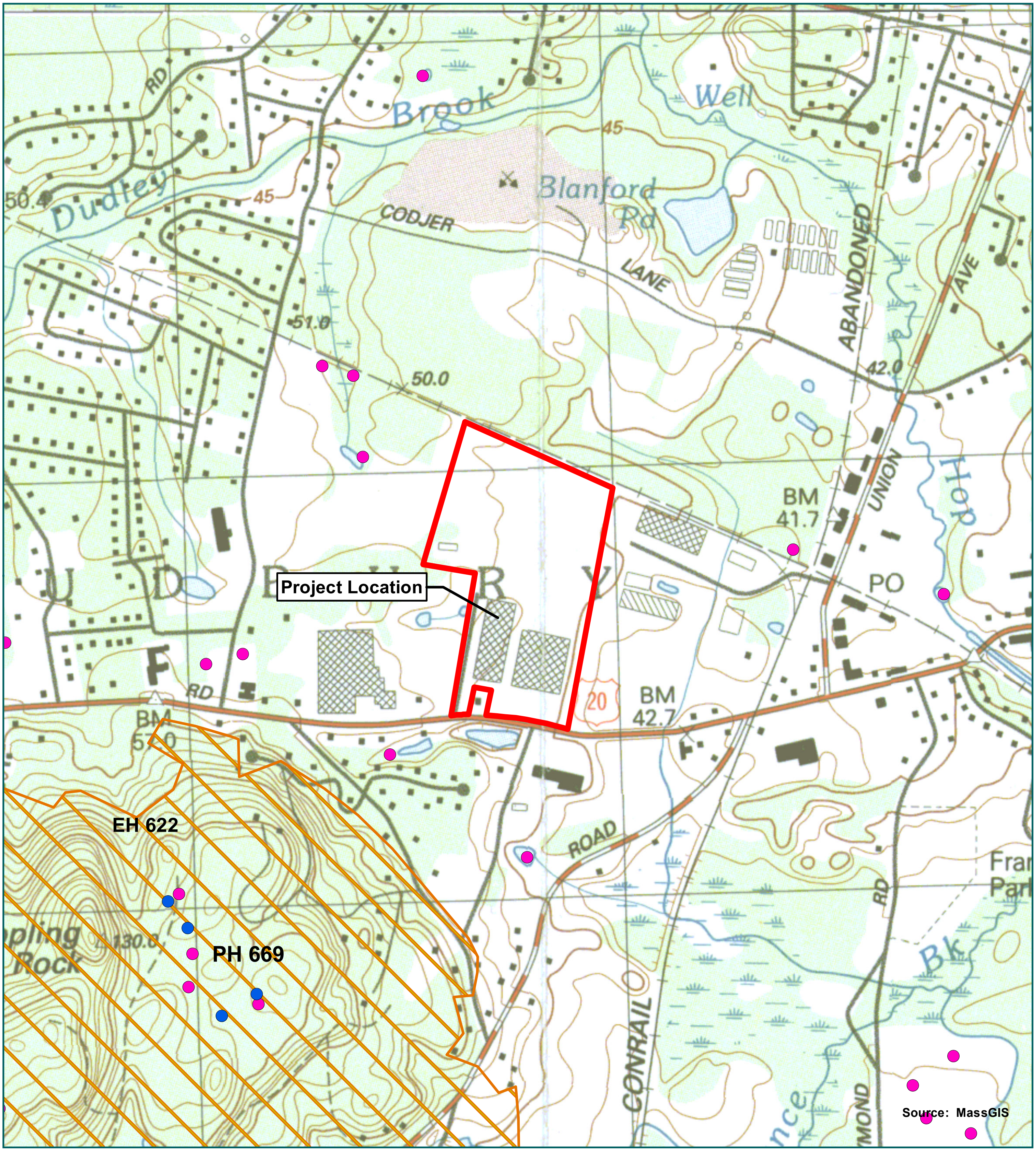
Please **mail** this completed form and topographic map to:

Regulatory Review
Natural Heritage and Endangered Species Program
MA Division of Fisheries and Wildlife
1 Rabbit Hill Road
Westborough, MA 01581

Questions regarding this form should be directed according to the county that the property is located:
Berkshire, Essex, Franklin, Hampshire, Hampden, Middlesex & Worcester Counties call: 508-389-6361
Barnstable, Bristol, Dukes, Nantucket, Norfolk, Plymouth & Suffolk Counties call: 508-389-6385

Persons requesting information will receive a written response within 30 days of receipt of all information required. Please do not ask for an expedited review. ***If you are requesting information for habitat management or conservation purposes and you are a non-profit conservation group, government agency or working with a government agency please fill out a Data Release Form.

Path: \\vhb\proj\Wat-LD\13125.00\GIS\Project\Demo NOI\Figure3_NHESP.mxd



- Certified Vernal Pool
- Potential Vernal Pools
- PropertyBoundary
- NHESP Priority & Estimated Habitat

0 1,000 2,000 Feet

Engineers | Scientists | Planners | Designers
101 Walnut Street, PO Box 9151, Watertown, MA 02471

Figure 1 – NHESP Polygon
526/528 Boston Post Road
Sudbury, Massachusetts

Source: MassGIS USGS Quadrangle

VANASSE HANGEN BRUSTLIN, INC.
101 WALNUT STREET • PO BOX 9151
WATERTOWN, MASSACHUSETTS 02471

CITIZENS BANK
MASSACHUSETTS
5-7017/2110

305153

CHECK DATE

February 11, 2016

Fifty and 00/100

AMOUNT

$50.00

Commonwealth of MA- NHESP
1 Rabbit Hill Rd
Westborough, MA 01581

AUTHORIZED SIGNATURE

⑈305153⑈ ⑆211070175⑆ 1130161371⑈

Security Check features included. Details on back.

EMILY BUSINESS FORMS 800.392.6018 VISION

VANASSE HANGEN BRUSTLIN, INC.
101 WALNUT STREET • PO BOX 9151
WATERTOWN, MASSACHUSETTS 02471

305153

Check Date: 2/11/2016

Invoice Number	Date	Voucher	Amount	Discounts	Previous Pay	Net Amount
Meredith Avery	2/10/2016	0001037	$50.00			$50.00
Commonwealth of MA- NHESP		TOTAL	$50.00			$50.00
Citizens	9	0013614				

Additional Sheet

BPR Sudbury Development LLC (BPR) is proposing a mixed-use redevelopment at Raytheon's former integrated defense systems facility in Sudbury, Massachusetts. The site is located at 526/528 Boston Road and is approximately 50 acres. The project is within range of the federally threatened northern long-eared bat (NLEB). No estimated or priority habitat is mapped by the Massachusetts Natural Heritage and Endangered Species Program.

The site is predominately composed of parking lots, building, and lawns. Roughly, 3.7 acres of the site are wooded or include a canopy associated with a stand of mature trees planted in support of the existing development. The largest of these is approximately 1.3 acres in size. Of the 3 acres of wooded area, the redevelopment will remove up to 1 acre of tree canopy area within the site. Landscaped trees to be cleared adjacent to buildings or singular trees within parking lot islands were not included in this analysis.

This Information Request is being submitted to determine if any maternity roost trees or hibernaculum are located in the proposed project area. Given potential habitat is minimal we anticipate no effect to NLEB.

March 30, 2016

Meredith Avery
Vanasse Hangen Brustlin, Inc.
PO Box 9151
101 Walnut St
Watertown MA 02471

RE: Project Location: 526 & 528 Boston Post Road Redevelopment
Town: SUDBURY
NHESP Tracking No.: 16-35389

To Whom It May Concern:

Thank you for contacting the Natural Heritage and Endangered Species Program of the MA Division of Fisheries & Wildlife (the "Division") for information regarding state-listed rare species in the vicinity of the above referenced site.

Based on the information provided, the Natural Heritage has determined that at this time the site is not mapped as Priority or Estimated Habitat. The NHESP database does not contain any state-listed species records in the immediate vicinity of this site.

This evaluation is based on the most recent information available in the Natural Heritage database, which is constantly being expanded and updated through ongoing research and inventory. If you have any questions regarding this letter please contact Lauren Glorioso, Endangered Species Review Assistant, at (508) 389-6361.

Sincerely,

Thomas W. French

Thomas W. French, Ph.D.
Assistant Director

Attachment N
Hazardous Waste Oil Spill Report

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Hazardous Waste / Oil Spill Report

Date: ____/____/______ Time: ______ AM / PM

Exact location ____

Type of equipment:__________________________ Make:______________ Size:_____________

License or 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 clean up

______________ 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: ____

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Attachment O
Stormwater Discharge Well Registration

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Massachusetts Department of Environmental Protection
Bureau of Resource Protection – Drinking Water Program

BRP WS 06 UIC Registration
Stormwater Discharge Well
Instructions and Supporting Materials

Introduction

Massachusetts Department of Environmental Protection (MassDEP) *Permit and Registration Applications*, as well as these *Instructions & Supporting Materials*, also are available for download from the MassDEP Web site at http://www.mass.gov/eea/agencies/massdep/service/approvals/ in two file formats: Microsoft Word™ and Adobe Acrobat PDF™. Either format allows documents to be printed.

Instructions & Supporting Materials files in Microsoft Word™ format contain a series of documents that provide guidance on how to prepare a permit application.

Permit Applications in Microsoft Word format must be downloaded separately. Users with Microsoft Word™ 97 or later may complete these forms electronically.

Permitting packages in Adobe Acrobat PDF format combine *Permit Applications* and *Instructions & Supporting Materials* in a single document. Adobe Acrobat PDF™ files may only be viewed and printed without alteration. *Permit Applications* in this format may not be completed electronically, but must be printed and completed using a typewriter or by hand.

Permit Name
Registration Stormwater Discharge Well

Permit Code	BRP WS06 (includes BRP WS06 categories as cited in the permit and fees regulations 310 CMR 4.00) (http://www.mass.gov/eea/agencies/massdep/service/regulations/310-cmr-4-00-timely-action-schedule-and-fee-provisions.html)
Purpose of Registration	Regulating the injection of fluids to the ground to prevent contamination of groundwater used as a source of drinking water.
For Assistance with this application	Contact MassDEP Bureau of Resource Protection, Underground Injection Control (UIC) Program: For all UIC types: (617) 292-5859. For email questions: ask.UIC@state.ma.us

Massachusetts Department of Environmental Protection

Bureau of Resource Protection – Drinking Water Program

BRP WS 06 UIC Registration
Stormwater Discharge Well
Instructions and Supporting Materials

Who must apply

Any party who has discharged, is discharging, or proposes to discharge to a Class V Stormwater Discharge Well as defined in 310 CMR 27.00 must apply unless exempted by 310 CMR 27.07 (http://www.mass.gov/eea/docs/dep/service/regulations/310cmr27.pdf). Also, any party that has a registered Class V stormwater discharge well with the UIC Program for which ownership, contents or type of discharge, physical location, number of wells, or construction details have or will change. Also any Class V water purification discharge well that was not previously registered and which is now being registered for Pre-Closure. The only types of Class V stormwater UIC wells not requiring UIC Registration are those associated with properties that are only used for **single unit** (family) residential use **OR** for which a permit has been obtained from the MassDEP Ground Water Discharge Program (314 CMR 5.00 http://www.mass.gov/eea/agencies/massdep/water/regulations/314-cmr-5-00-groundwater-discharge-permits.html). Typically the only types of Class V UIC wells that require a Ground Water Discharge Permit are those that are adding chemicals to the discharge to the UIC well.

If you are attempting to register a different type of UIC Class V well then see the UIC Program's main web page (http://www.mass.gov/eea/agencies/massdep/water/drinking/underground-injection-control.html) to obtain the applicable UIC Registration application form for your well type. Also see the "Class V Injection Well Category and Well Type Descriptions" link under the "Guidance" Section of this web page for descriptions of the various UIC Class V well types.

May I submit one application for multiple properties?

No. A separate BRP WS 06 UIC Registration application form must be submitted for each facility address. Multiple wells may only be registered under one application if all wells are on the same property. Also, all wells must be in the same municipality (with some limited exceptions).

What land use types must use this application

This application form applies to all types of land uses.

Fees

Depending upon the specific details concerning your application, your registration fee is $0, $110, $220, $290, $400, $585 or $695. See the discussion below under Section A, Registration Fee to determine the applicable registration fee.

Review timeline

If MassDEP fails to issue a determination for the registration of the UIC Class V well on an adequately prepared BRP WS-06 application within 48 days of receipt of the application and payment of the application fee, the Department will refund the entire fee and will continue with the review. The same applies if MassDEP fails to issue a determination for the application for pre-closure of a UIC Class V well within 30 days of receipt of the application and payment of the application fee.

What regulations apply?

Regulations that apply primarily include, but are not limited to:

- Underground Injection Control Program, 310 CMR 27.00 (http://www.mass.gov/eea/docs/dep/service/regulations/310cmr27.pdf).

These and other MassDEP Regulations are available online at:
http://www.mass.gov/eea/agencies/massdep/service/regulations/

Or, they may be purchased at

State Bookstore	State Bookstore West
Massachusetts State House Room 116 Boston, MA 02133 617-727-2834	436 Dwight Street, Room 102 Springfield, MA 01103 413-784-1376

What other requirements must be considered?

The installation and operation of Class V Water Purification discharge wells shall comply with the MassDEP *Standard Design Requirements for Shallow Injection Wells*.

You may only register one UIC Class V "well category" and "well type" combination with each BRP WS06 application. If your residence or facility includes multiple combinations of "well category" and "well type" then you must submit a separate BRP WS06 application with applicable payment transmittal form and fee for each unique combination. The requirement for separate applications applies whether for multiple single use wells or a single well that is used for more than one type of UIC Class V wastewater discharge.

If your application is for the conversion of a well that was not previously registered then you must submit two (2) separate BRP WS06 applications (with 2 separate payment transmittal forms) and pay the fees associated with each registration application. One application must be submitted for the proposed converted new use and one for the closure or partial closure of the unregistered well use.

In addition to the above UIC registration requirements, applicants should consider the need to obtain the following permits or sanctions that may apply:

- Wetlands requirements should be checked through the local Conservation Commission;
- Ground Water Discharge Permit Program (314 CMR 5.00 http://www.mass.gov/eea/agencies/massdep/water/regulations/314-cmr-5-00-groundwater-discharge-permits.html);
- A MassDEP Title 5 Permit (310 CMR 15.00 http://www.mass.gov/eea/agencies/massdep/water/regulations/310-cmr-15-00-septic-systems-title-5.html);
- Local Board of Health requirements may also apply; and,
- Local Plumbing Inspector requirements.

Note: The additional requirements listed above are examples intended to serve as a guide to the applicant. They do not necessarily include **all** possible additional requirements.

How long is the Registration valid?

UIC registrations for Class V wells currently do not have expiration dates provided that the Owner/Operator submits a UIC Modification Application when pertinent inventory information changes. Future changes in Massachusetts regulations may establish expiration/renewal dates for any and all UIC Class V well types.

How to Apply

To submit an application to MassDEP, follow the steps described below:

Step	Action
1.	Complete a MassDEP Transmittal Form for Permit Application and Payment. The transmittal form and required transmittal number can be obtained at : http://www.mass.gov/eea/agencies/massdep/service/approvals/transmittal-form-for-payment.html Submit payment and original signed transmittal form to the MassDEP address shown on the transmittal form. *Please note that if you are sending in payment for multiple application forms you must submit a separate transmittal form (each with a unique transmittal number) for each form that is submitted.*
2.	Complete the appropriate Application Form - BRP WS 06 UIC Registration Stormwater Discharge Well(s). Include all specified information. Use additional sheets if necessary.
3.	Submit a complete application package including a BRP WS-06 form, a copy of the Transmittal Form for Permit Application and Payment, and all specified attachments to: MassDEP, BRP UIC Program One Winter Street, 5th Floor Boston, MA 02108 **Please note that if that the PO box shown on the Transmittal Form for Permit Application and Payment is for the bank that MassDEP uses to deposit permit and registration fees. If you send the entire application package to the PO box rather than the One Winter Street address, the bank will discard everything other than the Payment Transmittal Form and check and you will be required to resubmit your application package to MassDEP.**
4.	Retain a copy of the complete application package for your files.

Instructions to assist with completing the application form:

A. Registration Category and Fee

Registration Category

Identifying the type of registration activity you are conducting

Registration Category:	Expanded Description
1.a. Registration of a Proposed or Existing Unregistered UIC Well(s)	Select this category for the first time registration of a proposed injection well(s) or an existing injection well unless the well is being registered for the purpose of closing, partially closing, or converting it to a new use.

1.b. Pre-Closure of an Unregistered or Registered UIC Well(s)	Select this category for the first time registration of an existing injection well(s) for the purpose of closing or partially closing it unless also converting it to a new use. Also select this category for the purpose of obtaining Pre-Closure approval for a well(s) that has already received a MassDEP UIC registration number where you also must modify any of the information that was submitted with the original UIC registration application for that well. If none of the original information must be changed then you should use the shorter BRP WS06d Pre-Closure application form for your convenience.
1.c. Pre-Closure of an Unregistered or Registered UIC Well(s)and Conversion to New Well Type	Select this category for the first time registration of an existing injection well(s) for the purpose of closing the initial use and converting it to a new use. **You must complete a separate BRP WS 06 application form for the use that the well is being converted to (if applicable).** Also select this category for the purpose of obtaining Pre-Closure approval for a well(s) that is being converted to a new use and that has already received a MassDEP UIC registration number where you also must modify any of the information that was submitted with the original UIC registration application for that well If none of the original information must be changed then you should use the shorter BRP WS06d Pre-Closure application form for your convenience.
1.d. Modification of a UIC Registration Application that is Still Under Review at MassDEP	Select this category if you must make modifications or corrections to a previously submitted BRP WS06 application form that is still pending MassDEP review and approval.
1.e. Modification of an Existing UIC Registration that Does Not Include Increasing the Number of Registered Wells (Minor Modification)	Select this category for modification to an existing MassDEP approved UIC registration that does not include increasing the number of registered wells.
1.f. Modification of an Existing UIC Registration that Includes Increasing the Number of Registered Wells (Major Modification)	Select this category for modification to an existing MassDEP approved UIC registration that includes increasing the number of registered wells.

For the above Pre-Closure categories (items 1.b. and 1.c.), if you are submitting for an UIC well(s) that has received a MassDEP issued UIC registration number complete Sections A, B, L, and M of this application form and for all other Sections only complete the data/information fields where you are entering new or revised information. For any of the above Modification categories (items 1.d., 1.e., and 1.f.) complete Sections A, B, and M of this application and for all other Sections only complete the data/information fields where you are entering new or revised information.

For Modifications, Pre-Closures, or Pre-Closures and Conversions of a UIC Registered Well(s) you must enter the UIC registration number that was previously issued by MassDEP. If you can't locate your UIC registration number then call the number or send an email to the address listed on page one of this form for assistance.

Basic Well Information

1. Descriptions of the well category and well type can be found on the UIC Class V Well Category and Well Type Descriptions web page (http://www.mass.gov/eea/agencies/massdep/water/approvals/uic-class-v-well-category-and-well-type-descriptions.html).

2. The fee structure and classification of an application is impacted by whether a well is being installed at a residential or non-residential site. In order to be classified as, fee exempt, residential well(s) must service 4 or fewer residential units AND only be used for residential purposes.
3. Some wells can be used for more than one purpose. For instance, a dry well may be used for both stormwater or water purification discharge and system bleed from an open-loop ground source heat pump well. If applicable, indicate the other well category and well type.

Registration Fee

For Registration of More than One Type of Discharge – This form may only be used to apply for UIC registration of stormwater discharge to one type of Stormwater Discharge Well(s) (from the selection in Basic Well Information Question #2). A separate BRP WS06 registration application, payment transmittal form (transmittal form not required if you answered "yes" to Basic Well Information question #3), and applicable fee shall be submitted for each additional type of discharge even if one discharge well(s) is used for more than one well category and well type combination.

For Conversion of Unregistered Wells - If your application is for the conversion of a well(s) that was not previously registered, you shall submit one application form, payment transmittal form, and applicable fee for the registration and closure or partial closure of each of the unregistered well uses. You shall also submit a separate registration application form, payment transmittal form, and applicable fee for each type of new UIC Class V discharge well.

For Conversion of Registered Wells - If your application is for the conversion of a Registered UIC well(s), you shall submit a separate registration application form, payment transmittal form, and applicable fee for each type of new UIC Class V discharge. In addition one BRP WS06d Pre-Closure application must be submitted for the closure of the previous well use.

Fee Table Instructions
Determine which fee applies to your well using the provided fee table in conjunction with the answers you provided for Questions 1 (registration category), 2 (well type), and 3 (residential status).
Step 1: Find the Registration Category in the first row (this will limit the number of columns you have to choose from to either 1 or 2).
Step 2: In the second row find the one column that matches your response to Question 3.
Step 3: Follow this column downward to the row that matches your well category (selected in Question 2).

Your Registration Category Selection (from Section A, question 1 above)		**1.a. or 1.f.**		**1.b. or 1.c.**		**1.d. or 1.e.**
Your Answer to Question 3		**Yes**	**No**	**Yes**	**No**	**Yes or No**
Your Well Type (from question 2 above)	No land uses with higher potential pollutant loads per MassDEP Stormwater Handbook	$0	$110	$0	$220	$0
	One or more land uses with higher potential pollutant loads per MassDEP Stormwater Handbook	$585	$585	$695	$695	
	Agricultural	$290	$290	$400	$400	
	Karst	$0	$0	$0	$110	

Exceptions: If the well(s) is owned by a local or regional government the fee is $0. If the well(s) is owned by the state then the entire fee indicated above applies.

B. Facility/Residential Information

Facility/Residential Property Name: Enter the common name of this facility if it is different than the legal name and the facilities (or residence's) street address and the town that the facility is located in. You may enter "private residence" under the "Facility/Residential Property Name" category if applicable.

Additional information (for facilities only): The remainder of the information discussed below under Section B does not apply to a property that is only used as a private residence. If the property is only used as a private residence then you may proceed to Section C.

Company Name: Enter the **legal** / corporate name (i.e., Acme Products, Inc.) or the name of the **legal** representative of the company if the company operates under an assumed business name (i.e., John Smith, dba Acme Products). The name must be a legal, active name registered with the state of Massachusetts, unless otherwise exempted by the Department of Commerce regulations.

Facility PWS ID number: If the facility is a Public Water System (PWS) or there is a PWS on the same site list the PWS ID number assigned by the MassDEP Drinking Water Program.

NAICS or SIC Code: Enter the Standard Industrial Classification (SIC) four-digit code **or** North American Industry Classification System five or six-digit code (NAICS) for the facility. These codes are used to describe the primary activity at the facility that generates the most money and may be found on fire marshal reports, insurance papers, or tax forms. The NAICS codes replaced the SIC system in 1997; however, it is usually easy to convert between the two systems so either code is acceptable. SIC or NAICS information is also available from the U.S. Census Bureau at 1-888-756-2427 or at http://www.naics.com/search.htm. Include a secondary code if applicable.

EPA Hazardous Waste Generator ID Number: If you store Hazardous Waste on site enter the appropriate EPA ID number(s). If you store Hazardous Waste on site and do not have an ID number contact your Regional MassDEP office and ask for the Hazardous Waste section to obtain an appropriate ID number. Find your region: http://www.mass.gov/eea/agencies/massdep/about/contacts/

Tenant Name and Tenant's EPA Hazardous Waste Generator ID Number: If the well will receive waste from a tenant or from an area occupied by a tenant on the property then list the name of the tenant and, if applicable, the EPA Hazardous Waste Generator ID Number that has been assigned to the tenant.

C. Current Status of Activity(ies) Being Registered

Designed but not yet constructed/modified/closed/converted: Construction/modification/closure/partial closure/conversion of the system has not started.

Proposed activity partially completed or completed but not active: Construction of the new well(s) or modification or conversion of a registered well(s) or conversion of an unregistered well(s) has begun or has been completed but the well(s) has not been placed into operation.

Discharge discontinued but closure activities not completed: All entry points to well(s) temporarily plugged or discharge discontinued but well closure activities are not yet completed.

Proposed activity completed and active or closure completed:
Construction/modification/conversion/closure/partial closure has been completed and the system has either been placed into operation and/or the closure activities have been completed and the well has been partially or permanently closed.

Enter the date that the well(s) was placed in service or the date that the closure activities were completed.

Is the applicant requesting a waiver of the 30-day review period for closure applications? If you answer "yes" you must include in a cover letter with your application the reason you are requesting a waiver of the 30-day review period.

D. Owner/Operator Information

Name and Address of Owner: Enter the legal/corporate name (i.e., Acme Products, Inc.) and address of the owner of the company if different than the facility name in Section A. The name must be a legal, active name registered with the state of Massachusetts, unless otherwise exempted by the Department of Commerce regulations. If this information is the same as the "Facility/Residential Property Name" or the "Company Name" from Section B you may enter in the "Name of Owner" space "same as facility name" or "same as company name".

Legal Contact: Give the name and phone numbers to whom you want all correspondence directed. The correspondence will otherwise be sent to the Operator's and Owner's addresses.

Name and address of the operator: (if not the same as the owner): In the case where the property is owned by one or more entities but the facility is operated by another company and the facility owner's name and address are different than in Section A, enter the **legal** / corporate name (i.e., *Acme Products, Inc.*) and address of the owner of the facility. The name must be a legal, active name registered with the state of Massachusetts, unless otherwise exempted by the Department of Commerce regulations. If applicable, under "Name of Operator" you may enter "same as owner" or "same as facility name" or "same as company name".

Ownership Type: Select the applicable category.

E. Designer

Enter the name and phone number of the person who has designed the proposed/existing UIC system and the company for which he/she works or the person who is overseeing the well closure activities. If designed by a Massachusetts licensed engineer, enter Massachusetts license number. An internet based Massachusetts Engineer lookup tool can be found here:
http://license.reg.state.ma.us/public/licque.asp?query=personal&color=red&board=EN. If designed by a Licensed Site Professional (LSP) enter the Massachusetts LSP license number. (An internet based LSP lookup tool can be found here: http://public.dep.state.ma.us/LSP/lspsearch.htm)

F. Installer

Enter the name and phone number of the person who will install or has installed the proposed/existing UIC system or who will conduct the well closure activities and the company for which he/she works.

G. Preparer Information

Enter the name, address, and phone number of the person who has completed the BRP WS06 registration application form and the company for which he/she works. If applicable, enter Massachusetts license number or the Massachusetts LSP license number. (An internet based LSP lookup tool can be found here: http://public.dep.state.ma.us/LSP/lspsearch.htm)

H. Registered Well Driller

If the UIC well installation involves the installation of a drilled well or the decommissioning of a drilled well, enter the driller's name, the name of the company that he/she works for, the driller's MassDEP Well Driller certification number, and a phone number where the driller can be reached. Per 310 CMR 46.00 (http://www.mass.gov/eea/agencies/massdep/water/regulations/310-cmr-46-00-3-certification-of-well-drillers-and-filing-of-well-completion-reports.html) drilled wells may only be installed or decommissioned by a MassDEP Certified Well Driller. A list of certified well drillers can be found here: http://www.mass.gov/eea/agencies/massdep/water/drinking/well-drillers-program.html

I. Site Information

Water Supply: Indicate whether the facility is supplied water from a Public Water System (PWS) or a private well. Note that in addition to large municipal water systems, most private water companies that have 15 or more service connections are considered a PWS.

Sewer: Indicate whether the facility is connected to a public sewer system or whether the property is serviced by an on-site sanitary wastewater disposal system (Title 5 or Groundwater Discharge Permit).

Other Discharges: List and locate on the site map all other discharges on the site, whether or not they are registered or permitted with MassDEP. Provide the information requested on the application form.

Sites with Activity and Use Limitations (AULs): The following web link provides a searchable database where one may look up properties in Massachusetts where an "Activity and Use Limitation" (AUL) has been recorded or registered: http://public.dep.state.ma.us/SearchableSites/Search.asp. An AUL provides notice to users of property of the presence of oil or hazardous material (OHM) contamination remaining at the location after a cleanup has been conducted pursuant to M.G.L. Chapter 21E and the Massachusetts Contingency Plan MCP). The AUL is a legal document that identifies activities and uses of the property that may and may not occur, as well as the property owner's obligation and maintenance conditions that must be followed to ensure the safe use of the property.

Location of Well(s): Enter the UIC Well latitude and longitude coordinates for each UIC well included in this application in decimal degrees to a minimum of five decimal places and fill out the information requested on how you obtained this data. Only enter the location of wells for the Well Category and Well Type that you are registering with this application.

In the far left column of the table provided in the form the applicant shall provide a unique name identifier for each well being registered. The identifier can be a combination of characters, symbols and numbers (i.e. storm-1, storm-2, etc.). The middle two columns are for entering latitude and longitude. Place a check mark or the letter "X" in the far right column for any well that is being either physically closed or for which all entry points for the well category and well type associated with this application are being closed or discontinued such that the well will no longer be receiving stormwater associated with this UIC well category and well type. If you are only closing some, but not all of the entry points associated with this UIC well category and well type you should leave this column blank (i.e. the well will continue to receive wastewater of this well category and well type after the proposed closure activities).

Where indicated, identify the method used for locating the latitude/longitude coordinates for the UIC Class V well(s) and the accuracy of the measurement.

If you would like to test whether your Latitude and Longitude data are correct, simply go to www.maps.google.com and type in the numbers in the following format and select the search icon (blue box with magnifying glass). A green arrow should appear on the location of the coordinates provided. [Format example: 42.37635 -71.06075]

If you do not have access to a GPS unit you may use Internet tools including the following:

1. Go to http://maps.google.com/
2. Select **Maps Labs** from the lower left corner of the web page.
3. A separate window will open up with various map tools available for use.
4. Scroll down and select Enable next to the "**LatLng Marker**" tool.
5. Select **Save Changes** (note: you may have to drag the window up in order to access the "save changes button).
6. Using Google Maps, navigate and zoom in to the well site.
7. Right click on the point closest to the well being located and select "**Drop LatLng Marker**."
8. Select and copy or note the lat/long provided in the marker tab.

Attachments:

All Plans and Maps Submitted Must Have a Title, North Arrow and a Bar Scale of Distance.

UIC Class V Well Stormwater Non-Exposure Form: The UIC Stormwater Non-Exposure Form is required for all original UIC Registration applications for stormwater wells and for any Modification UIC Registration applications where one or more proposed stormwater well is being added to the existing UIC Registration. The only exceptions are for registration applications for which **all** stormwater wells associated with this application or are being registered for Pre-Closure or if you answered "yes" to Question #3 in Section A (i.e. the land use is only for one to four residential units). The form and instructions can be found here: http://maps.massgis.state.ma.us/images/dep/omv/wspviewer.htm.

Topo or Orthophoto map of the facility: Provide a topographic map or maps of the area extending at least to **1/2 mile** beyond the property boundaries of the facility, which clearly show the following:

1) The site location;
2) All hazardous waste management and storage facilities;
3) All springs and surface water bodies in the area, plus all Public Water System (PWS) drinking water wells within ½ mile of the facility and the nearest private drinking water wells within ¼ mile of the facility that are identified in the public record or otherwise known to you.
4) All public source water protection areas including: Zone II's, Zone C's or Interim Wellhead Protection Area's (IWPA). (Water supply protection maps are available at http://maps.massgis.state.ma.us/images/dep/omv/wspviewer.htm.)

Scaled site plan of the facility with the following:

1) Location of buildings, property boundary lines, and abutting streets;
2) Plat and lot number (from local tax assessor record maps);
3) Location where groundwater table elevation, ledge test, percolation data, and soil profile data were collected (if applicable);
4) Location of all UIC Class V Wells associated with this application or UIC Registration Number;
5) Location of all other shallow or deep injection well(s) and all drains, drain lines, treatment devices, drywells, cesspools, septic systems and other on-site surface or subsurface discharges at the facility;
6) Location of drinking water well(s) and other types of water supply wells on the property, and any on abutting properties or public water supplies within 500 feet of the shallow injection well;
7) Boundary of any known oil or hazardous material contaminant soils or groundwater plume and any Activity Use Limitation areas that exist on the property; and,
8) Location of monitoring wells (if applicable).

Description of the shallow injection well system and its major components: The description **must** contain diagrams (**design sheets**) including the plan view and **cross sectional diagram** of the shallow injection well system, indicating piping, junction boxes, tanks, treatment devices, wells and drainfields. Dimensions of all major components and design calculations **must** be included.

Narrative Statement: Provide a narrative statement that indicates that this proposed well(s) and UIC Class V discharge will conform to the MassDEP *Standard Design Requirements for Shallow Injection Wells* (http://www.mass.gov/eea/agencies/massdep/water/drinking/standard-design-requirements-for-shallow-uic-class-v-.html) and provide explanations for any deviation(s) from these requirements.

Material Safety Data Sheets (MSDS) (if applicable) - for all chemical products stored or used at the facility which may discharge to the shallow injection well and or are known to be added to the effluent to the well.

Analytical Testing Data: Laboratory analytical results from soil samples may be required for an existing stormwater discharge well that has one or more land uses with higher potential pollutant loads in order to establish base-line conditions prior to the MassDEP issuance of the UIC registration approval. Typically water quality testing is not required to be submitted with the UIC application package but may be a condition of MassDEP's issuance of an approval to install or operate the well depending upon site specific concerns for water quality.

Equipment Specification Sheets - for all treatment equipment that will add chemicals to the proposed wastewater that is or will be discharged to the UIC Class V well. Specification sheets are not required for filtration equipment that will not add chemicals to the wastewater that is discharged to the UIC Class V well. Please note that chemical additives are not commonly used for Class V Stormwater wells. You should discuss the proposed use of any chemical additives with the MassDEP UIC Program prior to submitting your application form and payment.

Other Information: If the responsibility for operating and maintaining one or more of your stormwater wells will be transferred to another entity (e.g. municipality) after completion of your project, you shall attach a letter from the local municipality or other responsible party agreeing to committing to the long term maintenance of the **UIC system**, as described in the Certification statement that is signed by the Operator of the UIC well(s) in Section M of this application form. See the instructions for Section K for additional information that may be required as attachments to this application.

J. Injection Well Information

Number of wells, maximum well depth and month/year of installation: Indicate the number of wells being registered. Include a breakdown of the number of wells being proposed (not yet constructed) and the number of existing wells, the proposed well depth (enter maximum well depth if registering multiple wells), and the month and year installed (for existing wells). Only include the number of wells that are being included with this registration (i.e. only include the wells for the unique combination of "well category" and "well type" associated with this application).

Well construction: Check applicable well type(s). Enter type of well seal and the grout material used to create the well seal (if applicable). Well seals and grout are typically associated with **drilled** wells and not with shallow injections wells.

Will the Discharge Include any Well Additive(s)? If yes, submit *Proposal for Chemical Use (additive) in a UIC Class V Well* supplemental form.

Source of Injection Fluid and Potential Contaminants: Describe the types of fluids being discharged to the UIC well (e.g., backwash from water softening unit, reject water from reverse osmosis unit, stormwater run-off from parking lot or roof, non-contact cooling water, ground source heat pump or plate and frame heat exchanger, etc.). Identify all sources of injection fluid and for each, detail the potential contaminants that may be present in the injection fluid.

List Any Current or Proposed Treatment Devices: If applicable, list all treatment devices proposed or installed prior to the infiltration structure in order to prevent the contamination of underground sources of drinking water. The sampling point for the system must be after all treatment devices. Specifications and a detail sheet must be provided for all treatment devices. A statement from the device manufacturer or from the UIC system designer must be included stating that the devise(s) are rated to meet the standards of the UIC program.

Rate of Injection:

> **Maximum total rate of injection (gallons per minute):** Enter the maximum discharge rate that the well(s) is/are designed to accept in gallons per minute (for all wells combined).
>
> **Maximum total rate of injection (gallons per day):** Provide the maximum daily discharge rate in gallons per day that all wells combined are designed to accept.
>
> **Month/Year ceased using well(s) for previous use(s):** Enter this information for unregistered wells that are being registered for closure/partial closure or conversion (if applicable).

Number of entry points to the system: The number of entry points to a stormwater UIC Class V discharge well is the number of catch basins (including leaching catch basins which are considered both an entry point and a Class V UIC well), surface drainage structures (trench, grate, channel & certain Low Impact Development (LID) Best Management Practices (BMPs)) and roof drain downspouts that contribute stormwater discharge to the stormwater UIC well(s).. Enter the existing number of entry points and the proposed number of entry points. If the facility has multiple existing UIC registrations or if multiple UIC registrations are being applied for, only enter the number of entry points for the unique "well category" and "well type" associated with this application.

Well Setback Distances and Depth:

> **Distance to nearest wetland or water body (within 200 feet of the UIC well):** Water bodies include lakes, ponds, reservoirs, ocean, rivers, and streams. Note: If you are within 200 feet of a waterbody or wetland you must notify the local conservation commission.
>
> **Distance to nearest septic system (within 200 feet of the UIC well):** If not known check with local Board of Health. All on-site septic systems must be shown on the site plan.
>
> **Distance to nearest building foundation (within 25 feet of the UIC well):** If multiple wells, list the shortest distance between the wells and the building foundation.
>
> **Distance to nearest property line (within 25 feet of the UIC well):** If multiple wells, list the shortest distance between the wells and the property boundary.
>
> **Depth to Water Table and Depth to Bedrock:** If the UIC discharge is an existing system and the depths are not known provide the best information available. However, systems installed after 9/13/02 must provide these data. If water table and depth to bedrock are not available at the time of UIC registration application submittal, it will be a condition of MassDEP's issuance of an approval to install the well.

Depth to bedrock is only required to the depth of the bottom of the deepest proposed UIC Class V injection well or depth to water table, whichever is deeper. If no bedrock is encountered to that depth then the applicant should enter "greater than [insert depth] feet".
Soil Type: Use terms such as fill, sandy till, gravel, sand, etc.

Distance to Nearest Private Drinking Water Well (within 1,250 feet of the UIC well): If not known check with local Board of Health. All on-site wells must be shown on the site plan.

Distance to Nearest Public Water Supply Source (e.g. well or reservoir) (within 2,500 feet): If not known check at - http://maps.massgis.state.ma.us/images/dep/omv/wspviewer.htm. All on-site wells must be shown on the site plan. If you need assistance, check with the Customer Service Center at the Regional MassDEP office.

K. Additional Well-Type-Specific Information

Stormwater Well

Does the overflow from the UIC well(s) discharge to groundwater onto a different property or to a stormwater system that is owned/operated by another entity? Check the "yes" box if the overflow is connected to a groundwater discharge well or to a stormwater system that is not owned by the same entity that owns the property for which the UIC stormwater discharge registration is being sought.

If you checked the "yes" box for this question then you must attach a copy of the approval letter, permit, or Order of Conditions from the entity that owns the property that is receiving the overflow water or from the entity that controls the municipal stormwater system or from the local conservation commission (whichever is applicable).

Does the overflow from the UIC well(s) discharge to surface water or within a wetland or surface water buffer on-site or off-site? Check the applicable "yes" or "no" box.
If you checked the "yes" box for this question then you must attach the Order of Conditions from the local conservation commission.

L. Injection Well(s) or Activity(ies) Being Closed

<u>Is the closure being required by a federal, state, or local entity?</u> Check the "yes" box if the proposed closure is the result of a written notification by a federal, state, or local authority indicating that the well(s) must be closed. If you check off the "yes" box fill out the information requested to identify the issuing authority and any contact information that was provided to you for that authority.

<u>Number of Wells Being Closed with this Application</u>: Enter the number of stormwater discharge wells that will be completely closed that are associated with this UIC registration application or with the existing UIC registration number that was previously assigned by MassDEP. Completely closed means that all entry points associated with the stormwater discharge will no longer discharge to the well(s) after the proposed closure activities have been completed. If you are only closing some but not all of the stormwater entry points for a particular UIC well then you are only closing some of the entry points and not the well itself. Do not include in your answer any wells for which one or more stormwater entry points will continue to discharge to the well following the completion of the proposed closure activities.

Closure of a UIC well does not necessarily mean that the well itself will be physically decommissioned. Under many circumstances a well that is closed as a UIC well for one "well category" and "well type" may continue to be used for other types of UIC and/or non-UIC type uses. However, if the well will not be used for any other water supply or water discharge purposes it is considered an abandoned well per 310 CMR 46.00 (http://www.mass.gov/eea/docs/dep/service/regulations/310cmr46.pdf). An abandoned well shall be physically decommissioned before it falls into a state of disrepair. A drilled well shall be decommissioned by a MassDEP Certified Well Driller before it falls into a state of disrepair. Please note that an abandoned well that falls into a state of disrepair may be considered a potential hazard to public health or safety and become reclassified as an unauthorized UIC Class V well that will require subsequent UIC registration for the purposes of properly closing the well.

Will this proposed closure activity result in the complete closure of all wells associated with this registration application or with the existing UIC registration number? Only answer "yes" to this question if **all** of the stormwater discharges associated with the UIC well(s) included in this UIC registration application or with the existing UIC registration number that was previously assigned by MassDEP will discontinue upon completion of the proposed well closure activities. **It is important that this question be answered correctly because MassDEP will determine whether or not the UIC registration for stormwater discharge will be completely closed out upon the completion of the proposed closure activities. The consequences of answering "yes" will be that any further stormwater discharges associated with this UIC registration number will be unauthorized.**

If you check off the "no" box for this question, enter the number of wells associated with this UIC registration number that will continue to receive stormwater discharges of this well type.

Number of entry points to the system: There are three questions associated with the number of entry points. The number of entry points to a UIC stormwater well is the number of catch basins, and roof drain downspouts that are discharging to the well(s). Enter the number of entry points before closure, the number of entry points proposed for closure, and the number of entry points that will remain after the proposed closure activities have been completed. Only enter the number of entry points for the stormwater discharges associated with this UIC registration number.

Proposed or previously completed well closure activities (check all that apply):

Closure activities shall adhere to the Mass DEP Guidance Document #: BRP/DWM/DW/G04-3, *Massachusetts Closure Requirements for Underground Injection Control (UICs) Wells (including shallow injection wells)* (http://www.mass.gov/eea/docs/dep/water/laws/i-thru-z/uicclose.pdf). The discussion of required laboratory analytical testing parameters in that document is focused on motor vehicle – waste disposal wells. For other types of "well category" and "well type" combinations the sampling parameters chosen will depend upon the types of contaminants that were either known to have been discharged to the well or that had the potential to have been discharged into the well. If properly maintained and operated, many UIC Class V stormwater discharge wells will not require sampling of fluids/sediments in the bottom of the well or in the area surrounding the well. If uncertain as to what sampling and laboratory analyses should be completed, you are encouraged to contact the MassDEP UIC Program at ASK.UIC@state.ma.us prior to submitting your Pre-Closure application.

Check all boxes that describe the types of well closure activities associated with this UIC Pre-Closure application. You shall include both proposed closure activities and activities that will have already been completed at the time this application is submitted. The selection options include the following:

- Clean out well(s);
- Sample fluids/sediments in the bottom of the injection well;
- Remove well(s) and any contaminated soil – the selection of this option indicates that the well(s) will be physically removed (excavated) from the ground;
- Appropriate disposal of remaining fluids/sediments;
- Conversion to other well type;

- **Note:** Only select this option if the well is being converted to another UIC Class V well type. If you are converting to a non-UIC Class V well type (i.e. converting to an irrigation well, etc.) then you should not select this option and you should not select the following "well and all entry points physically decommissioned" option. If you select this option you will be asked to select the well category and type for the new purpose of the well. Note: a separate UIC registration application (BRP WS06) must be submitted for any conversion to a new well type). If you are converting to a non-UIC Class V well type (i.e. irrigation well) then you should indicate your intent in an attached narrative to your Pre-Closure application from;
- Well(s) and entry points abandoned (physically decommissioned). The selection of this option indicates that the well, or one or more of the UIC wells, associated with this UIC Registration Number will be physically removed/filled-in/destroyed and that all entry points to the well will either be removed and/or the piping to the UIC well will be permanently sealed so that no fluid may continue to be directed toward the closed well.;
- Partial Closure - Some of the current or past discharges will be discontinued. Other discharges of the well category and well type associated with this UIC Registration Number to the well(s) will continue;
- Sample fluids/sediments from the area surrounding the injection well (as applicable); or,
- Other (Describe).

Proposed Laboratory Analytical Parameters for Soil Sampling Activities:

The selection of soil or groundwater analytes shall be based upon the potential oil and/or hazardous materials that are known to have discharged to the UIC well or had the potential to be discharged to the UIC well. Laboratory analytical results from soil samples are often required for a stormwater discharge well that has one or more land uses with higher potential pollutant loads In many instances laboratory analyses are not required for the closure of the other types of UIC Class V stormwater discharge wells.

Go to http://www.mass.gov/eea/agencies/massdep/water/drinking/certified-laboratories.html for MassDEP's online searchable database of MassDEP Certified Laboratories.

Proposed Laboratory Analytical Parameters for Groundwater Sampling Activities:

See discussion above for proposed soil sampling activities.

M. Certifications for UIC Well(s) that is/are Being Registered for Continued Use or Proposed Future Use as a Stormwater Well

The certification statements in Section M shall be signed if one or more of the existing or proposed wells included in this application are being registered for continued or future use. If all of the wells included in this application are being registered for closure then the certification statements in Section M should be left blank and you shall complete the certification statements in Section N of this document.

Section M has two certification statements. One is for the operator of the existing or proposed UIC well(s) and one is for the owner of the property on which the existing or proposed UIC well(s) is, or will be, located. All applications are required to have the Operator certification statement signed by the operator. If the operator **is not** also the owner of the property then the property owner shall sign the Owner certification statement. The following are the only eligible persons who may sign for the operator or owner.

Any person who signs for the operator or owner must have authority to legally bind the business to perform the activities described in the applicable certification statement. That person must be one of the following:

- In a sole proprietorship, the company's sole proprietor.

- In a partnership, a general partner with authority to bind the partnership.
- In a corporation or a non-profit corporation, a corporate official with authority to bind the corporation, e.g., president, secretary, treasurer, or vice president of the corporation in charge of a principal business function, or any other person who performs similar policy-making or decision making functions of the corporation.
- In a municipality or other public agency, a principal executive officer or ranking elected official who is empowered to enter into contracts on behalf of the municipality or public agency.

N. Certifications for UIC Well(s) that is/are Being Registered for Complete Closure of all Future Use as a Stormwater Well

The certification statements in Section N shall be signed if all of the wells included in this application are being registered for closure. See the instructions above for Section M for the descriptions for the persons who are eligible to sign for the operator or owner.

Massachusetts Department of Environmental Protection
Bureau of Resource Protection – drinking water program

BRP WS 06 UIC Registration

Stormwater Discharge Well

Note: this application form only applies to Stormwater Discharge Wells.

Refer to the Instructions and Supporting Materials document that corresponds to this UIC Registration form for detailed instructions regarding the completion of this form and the required attachments.

Transmittal # (not required for 1- to 4-unit residential applications)

A. Registration Category and Fee

Registration Category

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

1. Identify the type of registration activity you are conducting (check one):

   a. Registration of a Proposed or Existing Unregistered UIC Well(s) ☐

   b. Pre-Closure of an Unregistered or Registered UIC Well(s) ☐

   c. Pre-Closure of an Unregistered or Registered UIC Well(s)and Conversion to New Well Type* ☐

   * **Note:** Conversion also requires submittal of a separate registration application for the new well type.

   d. Modification of a UIC Registration Application that is Still Under Review at MassDEP ☐

   e. Modification of an Existing UIC Registration that Does Not Include Increasing the Number of Registered Wells ☐

   f. Modification of an Existing UIC Registration that Includes Increasing the Number of Registered Wells ☐

   Note: For the above Pre-Closure categories (items b and c), if you are submitting for a UIC well(s) that has received a MassDEP issued UIC registration number complete Sections A, B, L, and M of this application and for all other Sections only complete the data/information fields where you are entering new or revised information. For any of the above Modification categories (items d, e, and f) complete Sections A, B, and M of this application and for all other Sections only complete the data/information fields where you are entering new or revised information.

   For Modifications, Pre-Closures, or Pre-Closures and Conversions of a UIC Registered Well:

   Enter UIC Registration Number (required): ______________________
   UIC Registration Number issued by MassDEP

Basic Well Information

2. Well Category, Well Type and registration fee

   Well Category: Stormwater

   Well Type (select one):

   ☐ No Land Uses with Higher Potential Pollutant Loads per MassDEP Stormwater Handbook

   ☐ One or more Land Uses with Higher Potential Pollutant Loads per MassDEP Stormwater Handbook

   ☐ Agricultural

   ☐ Karst

A. Registration Category and Fee (cont.)

3. Is the facility serviced by the well(s) **both**:
   a. For four (4) residential units or fewer; and,
   b. Only used for residential purposes? ☐ Yes ☐ No
4. Are any of the wells included in this registration application also being used for another type of UIC Class V discharge? ☐ Yes ☐ No
5. If you answered "yes" to the above question 4, enter the well category and well type for the other type of discharge (refer to the *Class V Injection Well Category, Well Type, and Fee Table* (see instructions document for web link)):

Well Category	Well Type

UIC Registration Fee

Notes:
For Registration of More than One Type of Discharge – This form may only be used to apply for UIC registration of discharge from one type of stormwater discharge well(s). A separate BRP WS06 registration application, payment transmittal form, and applicable fee shall be submitted for each additional type of discharge even if one discharge well is used for more than one well category and well type combination.

For Conversion of Unregistered Wells - If your application is for the conversion of a well(s) that was not previously registered, you shall submit one application form, payment transmittal form, and applicable fee for the registration and closure or partial closure of each of the unregistered well uses. You shall also submit a separate registration application form, payment transmittal form, and applicable fee for each type of new UIC Class V discharge well.

For Conversion of Registered Wells - If your application is for the conversion of a Registered UIC well(s), you shall submit a separate registration application form, payment transmittal form, and applicable fee for each type of new UIC Class V discharge. In addition one BRP WS06d Pre-Closure application must be submitted for the closure of the previous well use.

Fee Table Instructions:

Determine which fee applies to your well using the following fee table in conjunction with the answers you provided for questions 1 (registration category), 2 (well type), and 3 (residential status).
Step 1: Find the Registration Category in the first row (this will limit the number of columns you have to choose from to either 1 or 2).
Step 2: In the second row find the one column that matches your response to Question 3.
Step 3: Follow this column downward to the row that matches your well category (selected in Question 2).

Massachusetts Department of Environmental Protection
Bureau of Resource Protection – drinking water program

BRP WS 06 UIC Registration

Stormwater Discharge Well

A. Registration Category and Fee (cont.)

<table>
<tr><td>Your Registration Category Selection
(from question 1 above)</td><td colspan="2">1.a. or 1.f.</td><td colspan="2">1.b. or 1.c.</td><td>1.d. or 1.e.</td></tr>
<tr><td>Your Answer to Question 3</td><td>Yes</td><td>No</td><td>Yes</td><td>No</td><td>Yes or No</td></tr>
<tr><td>No land uses with higher potential pollutant loads per MassDEP Stormwater Handbook</td><td>$0</td><td>$110</td><td>$0</td><td>$220</td><td rowspan="4">$0</td></tr>
<tr><td>One or more land uses with higher potential pollutant loads per MassDEP Stormwater Handbook</td><td>$585</td><td>$585</td><td>$695</td><td>$695</td></tr>
<tr><td>Agricultural</td><td>$290</td><td>$290</td><td>$400</td><td>$400</td></tr>
<tr><td>Karst</td><td>$0</td><td>$0</td><td>$0</td><td>$110</td></tr>
</table>

Exceptions: If the well(s) is owned by a **local or regional government** the fee is **$0**. If the well(s) is owned by the **Commonwealth of Massachusetts**, the standard fees indicated above apply. If the fee would have exceeded $100 then the entire fee indicated above applies.

Enter fee here: **$** ____________

Annual Compliance Fee: There is no annual compliance fee associated with this Registration.

B. Residential/Facility Information

Facility/Residential Property Name

Facility/Residential Street Address

City/Town

State

Zip Code

Additional information (for facilities only):

Company Name

(MassDEP use only) Facility #

Facility Public Water Supplier (PWS) ID# (if applicable)

NAICS or SIC Code # (if applicable)

Facility Telephone #

Facility Mailing Address (if different from street address)

City/Town

State

Zip Code

EPA Hazardous Waste Generator ID # (if applicable)

EPA Hazardous Waste Generator ID # (if applicable)

Tenant Name (if applicable)

Tenant's EPA Haz. Waste Generator ID # (if applicable)

C. Current Status of Activity(ies) Being Registered (check one)

☐ Designed, but not yet constructed/modified/closed/converted
☐ Discharge discontinued but closure activities not completed
☐ Proposed activity completed and active or closure completed
☐ Proposed activity partially completed or completed but not active

Date placed in service (or date closure completed)

Is the applicant requesting a waiver of the 30-day waiting period for closure applications?
☐ Yes ☐ No
If you answered "yes" to this question, indicate your reasons for requesting the waiver in a cover letter attached to this application.

D. Owner/Operator Information

Name of Owner

Address of Owner (enter "same" if same as facility)

City/Town

State

Zip Code

Owner Email Address

Owner's Legal Contact

Legal Contact Phone #

Legal Contact Fax #

Legal Contact Email Address

Name of Operator (if different from owner)

Address of Operator (enter "same" if same as facility)

City/Town

State

Zip Code

Operator's Legal Contact

Legal Contact Phone #

Legal Contact Fax #

Legal Contact Email Address

Ownership Type (choose one):

Private: ☐ Industrial ☐ Commercial ☐ Non-profit ☐ Residential

Public: ☐ Local ☐ Regional ☐ State ☐ Federal

E. Designer

Name of Designer

Name of Company

Massachusetts Engineer License # (if applicable)

Designer Phone #

Email

LSP # (if applicable)

National 3rd party or manufacturer approval & ID # (if applicable)

F. Installer

Name of Installer ______ Name of Company ______

National 3rd party or manufacturer approval & ID # (if applicable) ______

Installer Phone # ______ Email ______

G. Preparer

Name of Preparer ______ Preparer Address ______

City/Town ______ State ______ Zip Code ______

Preparer Phone # ______ Email address ______

Massachusetts Engineer License # (if applicable) ______ LSP # (if applicable) ______

H. Registered Well Driller (if applicable)

MassDEP Well Driller Registration # ______

Name of Well Driller ______ Phone # ______

Name of Company ______ Email address ______

I. Site Information

Water Supply: ☐ Public ☐ Private

Sewer: ☐ Public ☐ Private

Other Discharges:

Are there other current or proposed discharges on site? ☐ Yes ☐ No

If yes, are they permitted with MassDEP? ☐ Yes ☐ No

If yes, permit #: ______ Permit #

If no, are they registered with MassDEP as UIC Class V wells? ☐ Yes ☐ No

If yes, registration #: ______ Registration #

Please list the type or types of other discharges:

______

______

Check any of the following that apply to this site:

a. ☐ Bureau of Waste Site Cleanup Priority Site ______ If yes, file number

b. ☐ Bureau of Waste Site Cleanup Waiver Site ______ If yes, file number

c. ☐ Superfund site ______ If yes, Federal ID #

I. Site Information (cont.)

If the site is currently being regulated by the Bureau of Waste Site Cleanup, check any of the following that apply:

☐ Incident Response ☐ Short Term Measure

☐ Activity and Use Limitations: ______________________________

Confirm that the applicant has checked that the site does not have any activity restrictions with respect to limiting discharges on the site.

☐ No restrictions ☐ Restrictions (please explain; attach additional sheets if necessary):

____

____

Location of Wells:

Only enter the location of wells for the one well type you are including in this registration.

Note: Latitude & Longitude are required data. Well ID# is assigned by you and each well should have a unique ID#. Please check the closure box for any well(s) being completely closed to the well category and well type associated with this registration application.

If you need additional well locations, please provide all information on a separate sheet.

If you do not have access to a GPS unit, see instructions to this form for Internet tools that may be used to select well locations.

Well ID (name and/or number)	**Latitude in Decimal Degrees (e.g., 42.355767)**	**Longitude in Decimal Degrees (e.g., -71.060996)**	**Check here if well is either being physically closed or if all entry points (discharges) associated with this well category and well type will be discontinued.**
			☐
			☐
			☐
			☐
			☐
			☐
			☐

I. Site Information (cont.)

Identify the method used for locating the latitude/longitude coordinates for the UIC Class V well(s) (check one):

Location Type:

☐ Approximate location of well

☐ Approximate center of area where discharge is located (i.e. center of drainfield or trench)

Accuracy – Estimated horizontal accuracy is less than (check one):

☐ +/-100 feet ☐ +/- 500 feet ☐ +/- 1000 feet

Provide a narrative description of the site and the feature to be permitted. As an example: "The site is on the west side of Main Street, the third building north of High Street. The disposal field lies 100 feet off the southwest corner of the building."

Attachments:

All of the following shall be attached to this application (unless submitted with a previous application and the information contained in the original submittal has not changed):

☐ UIC Class V Stormwater Non Exposure Form and Certification Statement (required for all registrations unless filing for Pre-Closure of all stormwater wells associated with this UIC registration application or you answered "yes" to Question #3 in Section A).

☐ Topographic or Orthophoto Map ☐ Design Sheets ☐ MSDS Sheets (if applicable)

☐ Site Plan (include bar scale, stormwater collection system, and delineation of drainage area contributing to the stormwater wells).

☐ Equipment Specification Sheets (if applicable) ☐ Narrative Statement

☐ Cross Sectional Diagram Depicting All Underground Components of the UIC System

☐ Analytical Testing Data ☐ Other information

J. Injection Well Information

Number of proposed new wells	Maximum well depth
Number of existing wells	Month/year of UIC wells construction (for existing wells)

J. Injection Well Information (cont.)

Total Number of Existing Plus Proposed Wells (do not include wells that are in a different UIC well category and well type (those must be registered under a separate UIC registration number)):

____

Well Construction (check all that apply):

☐ Drywell ☐ Drilled Well ☐ Manufactured System ☐ Dug Well

☐ Improved Sinkhole ☐ Drainfield/Leachfield ☐ Trench Drain

☐ Other (describe): ______________________________

Well Additives:

Are any well additives being used or proposed for use? ☐ Yes ☐ No

If you answered yes, attach a completed *Proposal for Chemical Use (additive) in a UIC Class V Well* supplemental form. **Please note that chemical additives are not typically allowed for UIC registered stormwater wells.**

Source of Injection Fluid and Potential Contaminants

Source of injection fluid #1	Potential contaminants for Source #1
Source of injection fluid #2	Potential contaminants for Source #2
Source of injection fluid #3	Potential contaminants for Source #3
Source of injection fluid #4	Potential contaminants for Source #4

Treatment Devices

If applicable, list any treatment devices prior to the injection point that will serve to remove contaminants from the water that is discharged into the stormwater well(s) (attach specification sheets & include on site plan and cross section):

____

____

____

Rate of Injection

Maximum total rate of injection (of all wells combined): ____________ Gallons per minute and ____________ Gallons per day

Month/Year ceased using well(s) for previous use(s) (only applies to wells being closed or converted if applicable): ____________

J. Injection Well Information (cont.)

Number of Entry Points

Note: The number of entry points equals the number of collection points to the stormwater system that are or will be discharging to the stormwater well(s). This includes catch basins (including leaching catch basins which are considered both an entry point and a Class V UIC well), surface drainage structures (trench, grate, channel & certain Low Impact Development (LID) Best Management Proctices (BMPs)) and roof drain downspouts.

______________________ # of entry points to existing system

______________________ Total # of entry points for proposed system (existing plus proposed)

Well setback distances and depths (all distances shall be provided in feet):

Distance to nearest wetland or water body (enter "NA" if distance is greater than 200 feet) ______________________

Distance to nearest septic system (enter "NA" if distance is greater than 200 feet) ______________________

Distance to nearest building foundation (existing or proposed) (enter "NA" if distance is greater than 25 feet) ______________________

Distance to nearest property line (enter "NA" if distance is greater than 25 feet) ______________________

Depth to water table (feet) (indicate "unknown" if unknown) ______________________

Depth to bedrock (feet) (indicate "unknown" if unknown) ______________________

______________________ Soil type(s) at site - e.g., fill, sandy till, gravel, sand

Distance to nearest private drinking water well (existing or proposed) (enter "NA" if distance is greater than 1,250 feet) ______________________

Distance to nearest Public Water Supply source (e.g., well or reservoir) (enter "NA" if distance is greater than 2,500 feet) ______________________

K. Additional Well-Type-Specific Information

In addition to completing the questions in this section, all registration applications for a new stormwater well(s) and for an existing stormwater well(s) that was not previously registered with the MassDEP UIC program must attach a completed ***UIC Stormwater Non Exposure Form*** (unless you answered "yes" to Question #3 in Section A). The non-exposure form is required for a Pre-Closure of unregistered wells unless all of the wells being registered with this application are also being closed. The non-exposure form is also required if filing a Modification of an existing UIC registration for the purpose of adding an additional stormwater well(s) or for all other modifications where any of the information previously submitted on the non exposure form has changed or needs to be corrected.

Does overflow from the UIC well(s) discharge to groundwater or surface water on a different property or to a stormwater system that is owned/operated by another entity?

☐ Yes ☐ No

If yes, the applicant must attach a copy of the approval letter/permit/Order of Conditions from the entity owning the property that is receiving the overflow water or from the entity that controls the municipal stormwater system or from the local conservation commission.

K. Additional Well-Type-Specific Information (cont.)

Does the overflow from the UIC well(s) discharge to surface water or within a wetland or surface water buffer on-site?

☐ Yes ☐ No

If yes, the applicant must attach a copy of the Order of Conditions from the local conservation commission allowing the discharge.

L. Injection Well(s) or Activity(ies) Being Closed

Note: Section L should only be filled in if you are closing a well(s).

Is the closure being required by a federal, state, or local entity? ☐ Yes ☐ No

If yes, which regulatory entity? ______________________
Name

______________________ ______________________
Contact name for regulatory entity Contact Phone #

Number of Wells Being Closed with this Application ______________________

Will this proposed closure activity result in the complete closure of all wells associated with this registration application or with the existing UIC registration number?

☐ Yes ☐ No

If you answered "no" to the above question, how many wells of this well category and well type will remain after the proposed closure activities have been completed?

____

The following three (3) data entry fields are only associated with the well type being registered with this application. Do not include the numbers of entry points associated with any converted new well type (if applicable).

Number of entry points to system before closure ______________________

Number of entry points proposed for closure ______________________

Number of entry points to system after closure ______________________

Proposed or previously completed well closure activities (check all that apply):

☐ Clean out well(s) ☐ Sample fluids/sediments in the bottom of the injection well(s)

☐ Remove well(s) and any contaminated soil ☐ Appropriate disposal of remaining fluids /sediments

☐ Conversion to other Well Category/Type ________ / ________
Well Category/Well Type

Note: a separate UIC registration application (BRP WS06) must be submitted for any conversion to a new well type.

☐ Well(s) and all entry points physically decommissioned

☐ Partial Closure (some but not all entry points eliminated or well(s) still in use for other types of discharge)

L. Injection Well(s) or Activity(ies) Being Closed (cont.)

☐ Sample fluids/sediments from the area surrounding the injection well(s) (as applicable)

☐ Other (specify): ____________________

Proposed Laboratory Analytical Parameters for Soil Sampling Activities:

Soil Sampling Parameter #1 ____________________ Soil Sampling Parameter #2 ____________________

Proposed Laboratory Analytical Parameters for Groundwater Sampling Activities:

Groundwater Sampling Parameter #1 ____________________ Groundwater Sampling Parameter #2 ____________________

M. Certifications for UIC Well(s) that is/are Being Registered for Continued Use or Proposed Future Use for the Stormwater Well Type Activity Selected for this Application (Applicant to fill in this information)

Operator:

The injection well(s) described above is used for placement or injection of fluids into the ground. I understand that this well(s) is subject to inventory requirements and compliance with the regulations under the Underground Injection Control Program established pursuant to the Safe Drinking Water Act, P.L. 93-523 and amendments, and UIC guidelines, and I hereby serve notice that the well(s) is proposed or in service.

I agree:

1. That the well(s) described herein will not be used for discharges other than those described above (unless I have applied for and received the required Massachusetts and local government approvals);

2. That I will notify the MassDEP Drinking Water Program/UIC Program (on forms provided by the UIC program) if any of the information (including ownership, location or type of discharge, and installation of additional wells,) for the above well(s) changes, but before the change occurs (30-day minimum notice on ownership/operator and 60-day notice on all other changes) (ownership changes not required after a UIC registration number has been completely closed (i.e. all wells associated with the approved registration application have been closed and closure has been approved by MassDEP));

3. That I will notify the MassDEP Drinking Water Program/UIC Program (on forms provided by the UIC program) if the well(s) becomes inactive;

4. That I will notify the MassDEP Drinking Water Program/UIC Program (on forms provided by the UIC program) when the above well(s) is no longer in use, but before physically decommissioning the well(s) and that I will file a Post-Closure Notification Form within seven days of completing the closure with the UIC program;

5. That I will maintain financial responsibility for the well(s) described above; and

6. That I will provide a sampling tap (approved by MassDEP) and allow sampling at the point of injection (not required for a closed well).

I certify under pains and penalties of law that I have personally examined and am familiar with the information submitted in this document and all attachments and based on my personal knowledge or inquiry of those agents immediately responsible for obtaining the information on my behalf, I believe the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including possible fines and imprisonment.

Signature of Operator	Date
Name of Operator	Position/Title

M. Certifications for UIC Well(s) that is/are Being Registered for Continued Use or Proposed Future Use for the Stormwater Well Type Activity Selected for this Application (cont.) (Applicant to fill in this information)

Owner (must be completed if owner has not signed above as operator)

I certify that I have personally examined and am familiar with the information submitted in this document and agree to the installation, conversion, or closure of the discharge well(s) described in this application. I also agree that I will assume the responsibilities of the operator in the event that the operator leaves the property and a replacement operator has not been established and reported to MassDEP (on forms provided by the UIC program).

Signature of Owner	Date
Printed Name	Position/Title

N. Certifications for UIC Well(s) that is/are Being Registered for Complete Closure of all Future Stormwater Activities Associated with the Well Type Selected for this Application: (Applicant to fill in this information)

Operator

I certify under pains and penalties of law that I have personally examined and am familiar with the information submitted in this document and all attachments and based on my personal knowledge or inquiry of those agents immediately responsible for obtaining the information on my behalf, I believe the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including possible fines and imprisonment.

Signature of Operator	Date
Name of Operator	Position/Title

Owner (must be completed if owner has not signed above as operator)

I certify that I have personally examined and am familiar with the information submitted in this document and agree to the conversion or closure of the discharge well(s) described in this application.

Signature of Owner	Date
Printed Name	Position/Title

Submit a signed and complete application package to:

MassDEP
Bureau of Resource Protection
UIC Program
One Winter Street, 5th Floor
Boston, MA 02108

Send duplicate copies of this form to:

Local Board of Health

Appendix F
Hydrologic Model

- Peak Rate and Volume Tables
- Existing Hydrologic Calculations
  - Node Diagram
  - 1-inch Storm Event
  - 2-Year Storm Event
  - 10-Year Storm Event
  - 25-Year Storm Event
  - 100-Year Storm Event
- Proposed Hydrologic Calculations
  - Node Diagram
  - 1-inch Storm Event
  - 2-Year Storm Event
  - 10-Year Storm Event
  - 25-Year Storm Event
  - 100-Year Storm Event

vhb

Peak Rate and Volume Tables

Peak Discharge Rates (cfs)

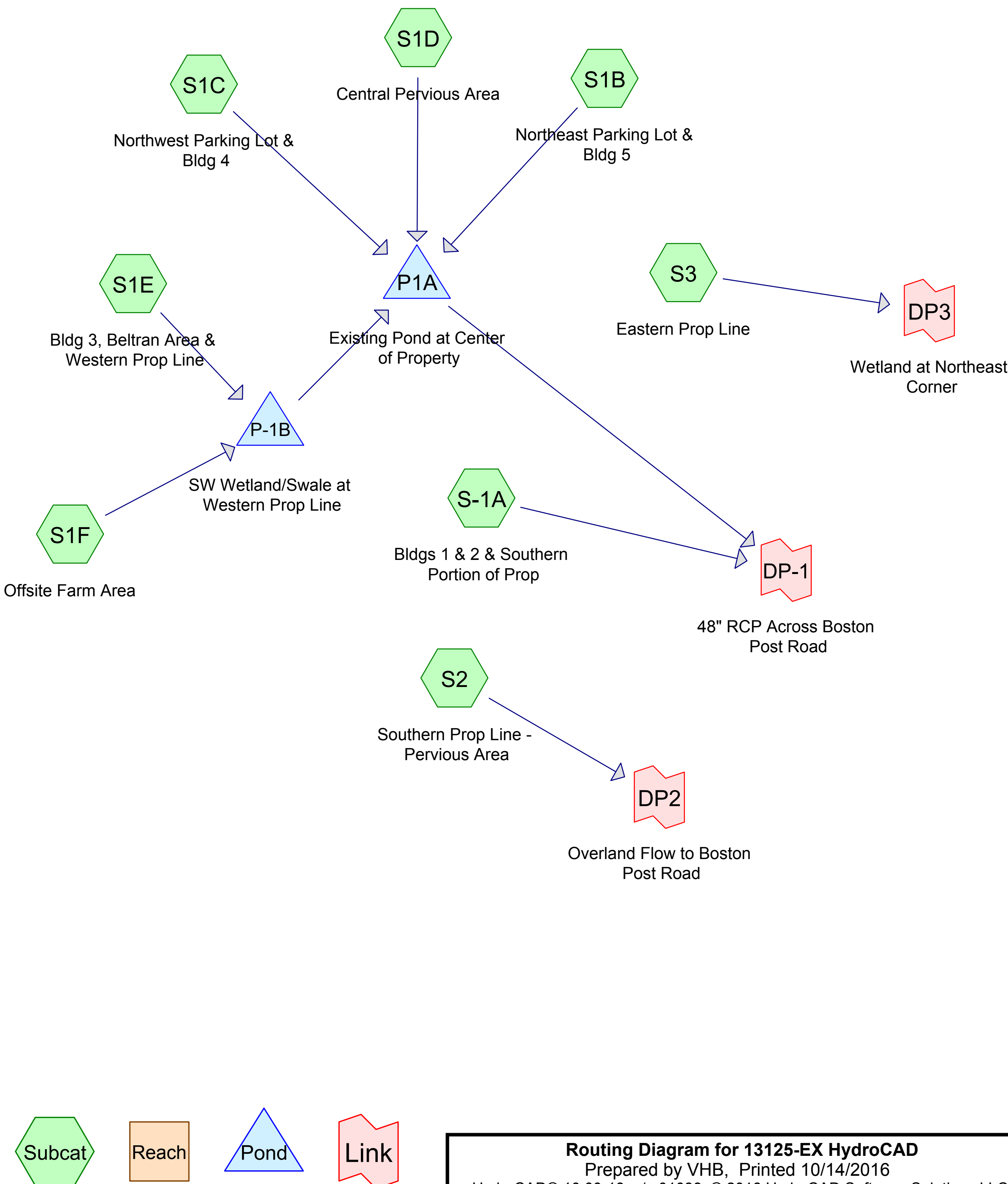
Design Point	*1-inch*	*2-year*	*10-year*	*25-year*	*100-year*
Design Point: DP-1 (48" Across Boston Post Rd)					
Existing (Oct 2016)	1.8	26.3	45.7	65.4	116.1
Proposed (April 2016 Master Plan)	1.7	20.5	44.8	59.0	110.2
Proposed (Oct 2016 with BMPs)	0.8	14.2	31.1	52.8	101.5
Proposed (Oct 2016 BMPs & Rte 20)	1.5	17.4	34.8	59.0	110.2
Design Point: DP-2 (Overland Flow to Boston Post Rd)					
Existing (Oct 2016)	0.0	0.4	1.4	2.3	4.6
Proposed (April 2016 Master Plan)	0.0	0.0	0.2	0.3	0.6
Proposed (Oct 2016 with BMPs)	0.0	0.0	0.0	0.0	0.1
Proposed (Oct 2016 BMPs & Rte 20)	0.0	0.0	0.0	0.0	0.1
Design Point: DP-3 (Wetland at Northeast Corner)					
Existing (Oct 2016)	0.0	0.2	0.9	1.5	3.1
Proposed (April 2016 Master Plan)	0.0	0.2	0.9	1.5	3.1
Proposed (Oct 2016 with BMPs)	0.0	0.2	0.9	1.5	3.1
Proposed (Oct 2016 BMPs & Rte 20)	0.0	0.2	0.9	1.5	3.1

Total Volume of Discharge (acre-ft)

Design Point	*1-inch*	*2-year*	*10-year*	*25-year*	*100-year*
Design Point: DP-1 (48" Across Boston Post Rd)					
Existing (Oct 2016)	0.5	6.6	13.5	19.5	33.9
Proposed (April 2016 Master Plan)	0.3	5.8	12.6	18.6	32.9
Proposed (Oct 2016 with BMPs)	0.1	3.8	9.6	15.0	28.3
Proposed (Oct 2016 BMPs & Rte 20)	0.2	4.0	10.0	15.5	29.0
Design Point: DP-2 (Overland Flow to Boston Post Rd)					
Existing (Oct 2016)	0.0	0.0	0.1	0.2	0.3
Proposed (April 2016 Master Plan)	0.0	0.0	0.0	0.0	0.0
Proposed (Oct 2016 with BMPs)	0.0	0.0	0.0	0.0	0.0
Proposed (Oct 2016 BMPs & Rte 20)	0.0	0.0	0.0	0.0	0.0
Design Point: DP-3 (Wetland at Northeast Corner)					
Existing (Oct 2016)	0.0	0.0	0.1	0.1	0.2
Proposed (April 2016 Master Plan)	0.0	0.0	0.1	0.1	0.2
Proposed (Oct 2016 with BMPs)	0.0	0.0	0.1	0.1	0.2
Proposed (Oct 2016 BMPs & Rte 20)	0.0	0.0	0.1	0.1	0.2

As shown above, implementing stormwater BMPs, increasing pervious area throughout the site and enhancing the overall stormwater management system maintains or reduces peak rates and total volume of discharge to the design points in the design storms with the additional increase in runoff associated with the Route 20 roadway widening.

HydroCAD Analysis: Existing Conditions



Routing Diagram for 13125-EX HydroCAD
Prepared by VHB, Printed 10/14/2016
HydroCAD® 10.00-18 s/n 01038 © 2016 HydroCAD Software Solutions LLC

1-inch Storm Event – Existing

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

SubcatchmentS-1A: Bldgs 1 & 2 & Runoff Area=482,099 sf 64.58% Impervious Runoff Depth=0.17"
Flow Length=1,239' Tc=5.1 min CN=85 Runoff=1.7 cfs 0.2 af

SubcatchmentS1B: Northeast Parking Runoff Area=362,836 sf 79.83% Impervious Runoff Depth=0.36"
Flow Length=375' Tc=5.0 min CN=91 Runoff=3.5 cfs 0.2 af

SubcatchmentS1C: Northwest Parking Runoff Area=696,274 sf 70.96% Impervious Runoff Depth=0.22"
Flow Length=1,845' Tc=12.2 min CN=87 Runoff=2.9 cfs 0.3 af

SubcatchmentS1D: Central Pervious Runoff Area=340,318 sf 20.22% Impervious Runoff Depth=0.00"
Tc=5.0 min CN=68 Runoff=0.0 cfs 0.0 af

SubcatchmentS1E: Bldg 3, Beltran Area Runoff Area=311,033 sf 48.01% Impervious Runoff Depth=0.02"
Flow Length=533' Tc=7.7 min CN=74 Runoff=0.0 cfs 0.0 af

SubcatchmentS1F: Offsite Farm Area Runoff Area=1,470,921 sf 29.23% Impervious Runoff Depth=0.00"
Flow Length=1,734' Tc=17.0 min UI Adjusted CN=51 Runoff=0.0 cfs 0.0 af

SubcatchmentS2: Southern Prop Line - Runoff Area=39,780 sf 4.56% Impervious Runoff Depth=0.00"
Flow Length=285' Slope=0.0280 '/' Tc=5.0 min CN=63 Runoff=0.0 cfs 0.0 af

SubcatchmentS3: Eastern Prop Line Runoff Area=28,484 sf 0.00% Impervious Runoff Depth=0.00"
Flow Length=20' Slope=0.0810 '/' Tc=5.0 min CN=61 Runoff=0.0 cfs 0.0 af

Pond P-1B: SW Wetland/Swale at Western Prop Peak Elev=151.00' Storage=0 cf Inflow=0.0 cfs 0.0 af
24.0" Round Culvert n=0.011 L=300.0' S=0.0093 '/' Outflow=0.0 cfs 0.0 af

Pond P1A: Existing Pond at Center of Property Peak Elev=145.00' Storage=47,837 cf Inflow=5.5 cfs 0.6 af
Outflow=0.3 cfs 0.4 af

Link DP-1: 48" RCP Across Boston Post Road Inflow=1.8 cfs 0.6 af
Primary=1.8 cfs 0.6 af

Link DP2: Overland Flow to Boston Post Road Inflow=0.0 cfs 0.0 af
Primary=0.0 cfs 0.0 af

Link DP3: Wetland at Northeast Corner Inflow=0.0 cfs 0.0 af
Primary=0.0 cfs 0.0 af

Total Runoff Area = 85.7 ac Runoff Volume = 0.7 af Average Runoff Depth = 0.10"
53.24% Pervious = 45.6 ac 46.76% Impervious = 40.1 ac

Summary for Subcatchment S-1A: Bldgs 1 & 2 & Southern Portion of Prop

Runoff = 1.7 cfs @ 12.10 hrs, Volume= 0.2 af, Depth= 0.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Inch Rainfall=1.00"

	Area (sf)	CN	Description
*	170,769	61	>75% Grass cover, Good, HSG B
*	99,171	98	Road & Sidewalk
*	212,159	98	Roofs
	482,099	85	Weighted Average
	170,769		35.42% Pervious Area
	311,330		64.58% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.20		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"
3.5	537	0.0160	2.57		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.9	652	0.0130	12.71	89.87	**Pipe Channel,** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.011 Concrete pipe, straight & clean
5.1	1,239	Total			

Summary for Subcatchment S1B: Northeast Parking Lot & Bldg 5

Runoff = 3.5 cfs @ 12.08 hrs, Volume= 0.2 af, Depth= 0.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Inch Rainfall=1.00"

	Area (sf)	CN	Description
*	62,603	98	Roofs
*	227,035	98	Road & Sidewalk
*	73,198	61	>75% Grass cover, Good, HSG B
	362,836	91	Weighted Average
	73,198		20.17% Pervious Area
	289,638		79.83% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.20		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"
1.2	175	0.0150	2.49		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.4	150	0.0150	6.57	5.16	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean

2.3 375 Total, Increased to minimum Tc = 5.0 min

Summary for Subcatchment S1C: Northwest Parking Lot & Bldg 4

Runoff = 2.9 cfs @ 12.19 hrs, Volume= 0.3 af, Depth= 0.22"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Inch Rainfall=1.00"

	Area (sf)	CN	Description
*	44,716	98	Roofs
*	449,394	98	Road & Sidewalk
*	202,164	61	>75% Grass cover, Good, HSG B
	696,274	87	Weighted Average
	202,164		29.04% Pervious Area
	494,110		70.96% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.0200	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
3.9	500	0.0180	2.16		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.2	471	0.0150	6.57	5.16	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
0.3	141	0.0150	8.60	15.20	**Pipe Channel,** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.011 Concrete pipe, straight & clean
0.3	188	0.0150	10.42	32.74	**Pipe Channel,** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.011 Concrete pipe, straight & clean
0.9	495	0.0070	9.33	65.95	**Pipe Channel,** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.011 Concrete pipe, straight & clean
12.2	1,845	Total			

Summary for Subcatchment S1D: Central Pervious Area

Runoff = 0.0 cfs @ 24.00 hrs, Volume= 0.0 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Inch Rainfall=1.00"

	Area (sf)	CN	Description
*	961	98	Roofs
*	16,841	98	Road & Sidewalk
*	271,522	61	>75% Grass cover, Good, HSG B
	50,994	98	Water Surface, HSG B
	340,318	68	Weighted Average
	271,522		79.78% Pervious Area
	68,796		20.22% Impervious Area

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

Summary for Subcatchment S1E: Bldg 3, Beltran Area & Western Prop Line

Runoff = 0.0 cfs @ 14.81 hrs, Volume= 0.0 af, Depth= 0.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Inch Rainfall=1.00"

	Area (sf)	CN	Description
*	68,971	98	Roofs
*	98,296	61	>75% Grass cover, Good, HSG B
*	63,425	39	>75% Grass cover, Good, HSG A
*	80,341	98	Road & Sidewalk
	311,033	74	Weighted Average
	161,721		51.99% Pervious Area
	149,312		48.01% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.0200	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
1.2	178	0.0220	2.39		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.9	305	0.0100	5.36	4.21	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
7.7	533	Total			

Summary for Subcatchment S1F: Offsite Farm Area

Runoff = 0.0 cfs @ 0.00 hrs, Volume= 0.0 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Inch Rainfall=1.00"

Area (sf)	CN	Adj	Description
10,003	98		Water Surface, HSG B
181,224	61		>75% Grass cover, Good, HSG B
859,788	30		Meadow, non-grazed, HSG A
301,859	98		Roofs, HSG B
118,047	98		Unconnected pavement, HSG B
1,470,921	54	51	Weighted Average, UI Adjusted
1,041,012			70.77% Pervious Area
429,909			29.23% Impervious Area
118,047			27.46% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.0210	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
0.6	264	0.1900	7.02		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.8	100	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
4.9	610	0.0050	2.08	1.64	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.020 Corrugated PE, corrugated interior
0.6	307	0.0100	8.51	26.74	**Pipe Channel,** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.011 Concrete pipe, straight & clean
0.3	140	0.0200	8.87	70.94	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=2.00' Z= 2.0 '/' Top.W=8.00' n= 0.022 Earth, clean & straight
4.1	172	0.0100	0.70		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	91	0.0100	6.27	50.16	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=2.00' Z= 2.0 '/' Top.W=8.00' n= 0.022 Earth, clean & straight
17.0	1,734	Total			

Summary for Subcatchment S2: Southern Prop Line - Pervious Area

Runoff = 0.0 cfs @ 0.00 hrs, Volume= 0.0 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Inch Rainfall=1.00"

	Area (sf)	CN	Description
*	37,965	61	>75% Grass cover, Good, HSG B
*	1,815	98	Road & Sidewalk
	39,780	63	Weighted Average
	37,965		95.44% Pervious Area
	1,815		4.56% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	25	0.0280	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
1.6	260	0.0280	2.69		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
4.4	285	Total, Increased to minimum Tc = 5.0 min			

Summary for Subcatchment S3: Eastern Prop Line

Runoff = 0.0 cfs @ 0.00 hrs, Volume= 0.0 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Inch Rainfall=1.00"

	Area (sf)	CN	Description
*	28,484	61	>75% Grass cover, Good, HSG B
	28,484		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.5	20	0.0810	0.22		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
1.5	20	Total, Increased to minimum Tc = 5.0 min			

Summary for Pond P-1B: SW Wetland/Swale at Western Prop Line

Inflow Area = 40.9 ac, 32.50% Impervious, Inflow Depth = 0.00" for 1-Inch event
Inflow = 0.0 cfs @ 14.81 hrs, Volume= 0.0 af
Outflow = 0.0 cfs @ 14.81 hrs, Volume= 0.0 af, Atten= 0%, Lag= 0.0 min
Primary = 0.0 cfs @ 14.81 hrs, Volume= 0.0 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 151.00' @ 14.81 hrs Surf.Area= 498 sf Storage= 0 cf

Plug-Flow detention time= 0.0 min calculated for 0.0 af (100% of inflow)
Center-of-Mass det. time= 0.0 min (1,060.7 - 1,060.7)

Volume	Invert	Avail.Storage	Storage Description
#1	151.00'	126,119 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
151.00	498	198.0	0	0	498
152.00	1,368	715.0	897	897	38,063
153.00	8,822	6,900.0	4,555	5,452	3,786,066
154.00	25,925	1,559.0	16,623	22,075	7,381,341
155.00	50,627	1,626.0	37,594	59,669	7,398,397
156.00	83,648	1,717.0	66,450	126,119	7,422,663

Device	Routing	Invert	Outlet Devices
#1	Primary	149.70'	**24.0" Round Culvert** L= 300.0' Ke= 0.500 Inlet / Outlet Invert= 149.70' / 146.90' S= 0.0093 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf

Primary OutFlow Max=8.4 cfs @ 14.81 hrs HW=151.00' (Free Discharge)
└─**1=Culvert** (Inlet Controls 8.4 cfs @ 3.88 fps)

Summary for Pond P1A: Existing Pond at Center of Property

Inflow Area = 73.0 ac, 45.00% Impervious, Inflow Depth = 0.09" for 1-Inch event
Inflow = 5.5 cfs @ 12.11 hrs, Volume= 0.6 af
Outflow = 0.3 cfs @ 16.64 hrs, Volume= 0.4 af, Atten= 94%, Lag= 271.3 min
Primary = 0.3 cfs @ 16.64 hrs, Volume= 0.4 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Starting Elev= 144.70' Surf.Area= 48,178 sf Storage= 33,047 cf
Peak Elev= 145.00' @ 16.64 hrs Surf.Area= 49,037 sf Storage= 47,837 cf (14,790 cf above start)
Flood Elev= 152.00' Surf.Area= 267,916 sf Storage= 692,409 cf (659,363 cf above start)

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= 420.9 min (1,300.0 - 879.1)

Volume	Invert	Avail.Storage	Storage Description
#1	144.00'	692,409 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
144.00	46,247	909.0	0	0	46,247
145.00	49,018	939.0	47,626	47,626	50,754
146.00	53,432	1,337.0	51,209	98,835	122,849
147.00	56,882	1,331.0	55,148	153,983	124,693
148.00	64,098	2,188.0	60,454	214,437	364,688
149.00	71,981	2,519.0	68,001	282,438	488,693
150.00	93,091	3,451.0	82,310	364,749	931,476
151.00	151,091	4,574.0	120,926	485,675	1,648,645
152.00	267,916	5,056.0	206,734	692,409	2,018,048

Device	Routing	Invert	Outlet Devices
#1	Device 4	144.70'	**12.0" Round Culvert** L= 382.0' Ke= 0.500 Inlet / Outlet Invert= 144.70' / 142.80' S= 0.0050 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Device 3	147.00'	**36.0" W x 18.0" H Vert. Orifice/Grate** C= 0.600
#3	Device 4	144.00'	**24.0" Round Culvert** L= 372.0' Ke= 0.500 Inlet / Outlet Invert= 144.00' / 142.80' S= 0.0032 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf
#4	Primary	142.60'	**36.0" Round Culvert** L= 1,295.0' Ke= 0.500 Inlet / Outlet Invert= 142.60' / 140.90' S= 0.0013 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 7.07 sf

Primary OutFlow Max=0.3 cfs @ 16.64 hrs HW=145.00' (Free Discharge)
└─**4=Culvert** (Passes 0.3 cfs of 19.9 cfs potential flow)
  ├─**1=Culvert** (Barrel Controls 0.3 cfs @ 2.47 fps)
  └─**3=Culvert** (Passes 0.0 cfs of 4.3 cfs potential flow)
    └─**2=Orifice/Grate** (Controls 0.0 cfs)

Summary for Link DP-1: 48" RCP Across Boston Post Road

Inflow Area = 84.1 ac, 47.58% Impervious, Inflow Depth > 0.08" for 1-Inch event
Inflow = 1.8 cfs @ 12.10 hrs, Volume= 0.6 af
Primary = 1.8 cfs @ 12.10 hrs, Volume= 0.6 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Link DP2: Overland Flow to Boston Post Road

Inflow Area = 0.9 ac, 4.56% Impervious, Inflow Depth = 0.00" for 1-Inch event
Inflow = 0.0 cfs @ 0.00 hrs, Volume= 0.0 af
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0.0 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Link DP3: Wetland at Northeast Corner

Inflow Area = 0.7 ac, 0.00% Impervious, Inflow Depth = 0.00" for 1-Inch event
Inflow = 0.0 cfs @ 0.00 hrs, Volume= 0.0 af
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0.0 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

2-Year Storm Event – Existing

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

SubcatchmentS-1A: Bldgs 1 & 2 & Runoff Area=482,099 sf 64.58% Impervious Runoff Depth=1.76"
Flow Length=1,239' Tc=5.1 min CN=85 Runoff=23.6 cfs 1.6 af

SubcatchmentS1B: Northeast Parking Runoff Area=362,836 sf 79.83% Impervious Runoff Depth=2.26"
Flow Length=375' Tc=5.0 min CN=91 Runoff=22.5 cfs 1.6 af

SubcatchmentS1C: Northwest Parking Runoff Area=696,274 sf 70.96% Impervious Runoff Depth=1.91"
Flow Length=1,845' Tc=12.2 min CN=87 Runoff=29.3 cfs 2.6 af

SubcatchmentS1D: Central Pervious Runoff Area=340,318 sf 20.22% Impervious Runoff Depth=0.73"
Tc=5.0 min CN=68 Runoff=6.0 cfs 0.5 af

SubcatchmentS1E: Bldg 3, Beltran Area Runoff Area=311,033 sf 48.01% Impervious Runoff Depth=1.04"
Flow Length=533' Tc=7.7 min CN=74 Runoff=7.7 cfs 0.6 af

SubcatchmentS1F: Offsite Farm Area Runoff Area=1,470,921 sf 29.23% Impervious Runoff Depth=0.15"
Flow Length=1,734' Tc=17.0 min UI Adjusted CN=51 Runoff=1.0 cfs 0.4 af

SubcatchmentS2: Southern Prop Line - Runoff Area=39,780 sf 4.56% Impervious Runoff Depth=0.52"
Flow Length=285' Slope=0.0280 '/' Tc=5.0 min CN=63 Runoff=0.4 cfs 0.0 af

SubcatchmentS3: Eastern Prop Line Runoff Area=28,484 sf 0.00% Impervious Runoff Depth=0.44"
Flow Length=20' Slope=0.0810 '/' Tc=5.0 min CN=61 Runoff=0.2 cfs 0.0 af

Pond P-1B: SW Wetland/Swale at Western Prop Peak Elev=151.04' Storage=22 cf Inflow=7.7 cfs 1.0 af
24.0" Round Culvert n=0.011 L=300.0' S=0.0093 '/' Outflow=7.7 cfs 1.0 af

Pond P1A: Existing Pond at Center of Peak Elev=147.23' Storage=167,363 cf Inflow=59.4 cfs 5.6 af
Outflow=4.8 cfs 5.3 af

Link DP-1: 48" RCP Across Boston Post Road Inflow=26.3 cfs 6.9 af
Primary=26.3 cfs 6.9 af

Link DP2: Overland Flow to Boston Post Road Inflow=0.4 cfs 0.0 af
Primary=0.4 cfs 0.0 af

Link DP3: Wetland at Northeast Corner Inflow=0.2 cfs 0.0 af
Primary=0.2 cfs 0.0 af

Total Runoff Area = 85.7 ac Runoff Volume = 7.3 af Average Runoff Depth = 1.03"
53.24% Pervious = 45.6 ac 46.76% Impervious = 40.1 ac

Summary for Subcatchment S-1A: Bldgs 1 & 2 & Southern Portion of Prop

Runoff = 23.6 cfs @ 12.08 hrs, Volume= 1.6 af, Depth= 1.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.20"

	Area (sf)	CN	Description
*	170,769	61	>75% Grass cover, Good, HSG B
*	99,171	98	Road & Sidewalk
*	212,159	98	Roofs
	482,099	85	Weighted Average
	170,769		35.42% Pervious Area
	311,330		64.58% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.20		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"
3.5	537	0.0160	2.57		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.9	652	0.0130	12.71	89.87	**Pipe Channel,** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.011 Concrete pipe, straight & clean
5.1	1,239	Total			

Summary for Subcatchment S1B: Northeast Parking Lot & Bldg 5

Runoff = 22.5 cfs @ 12.07 hrs, Volume= 1.6 af, Depth= 2.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.20"

	Area (sf)	CN	Description
*	62,603	98	Roofs
*	227,035	98	Road & Sidewalk
*	73,198	61	>75% Grass cover, Good, HSG B
	362,836	91	Weighted Average
	73,198		20.17% Pervious Area
	289,638		79.83% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.20		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"
1.2	175	0.0150	2.49		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.4	150	0.0150	6.57	5.16	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean

2.3	375	Total, Increased to minimum Tc = 5.0 min

Summary for Subcatchment S1C: Northwest Parking Lot & Bldg 4

Runoff = 29.3 cfs @ 12.17 hrs, Volume= 2.6 af, Depth= 1.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.20"

	Area (sf)	CN	Description
*	44,716	98	Roofs
*	449,394	98	Road & Sidewalk
*	202,164	61	>75% Grass cover, Good, HSG B
	696,274	87	Weighted Average
	202,164		29.04% Pervious Area
	494,110		70.96% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.0200	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
3.9	500	0.0180	2.16		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.2	471	0.0150	6.57	5.16	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
0.3	141	0.0150	8.60	15.20	**Pipe Channel,** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.011 Concrete pipe, straight & clean
0.3	188	0.0150	10.42	32.74	**Pipe Channel,** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.011 Concrete pipe, straight & clean
0.9	495	0.0070	9.33	65.95	**Pipe Channel,** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.011 Concrete pipe, straight & clean
12.2	1,845	Total			

Summary for Subcatchment S1D: Central Pervious Area

Runoff = 6.0 cfs @ 12.09 hrs, Volume= 0.5 af, Depth= 0.73"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.20"

	Area (sf)	CN	Description
*	961	98	Roofs
*	16,841	98	Road & Sidewalk
*	271,522	61	>75% Grass cover, Good, HSG B
	50,994	98	Water Surface, HSG B
	340,318	68	Weighted Average
	271,522		79.78% Pervious Area
	68,796		20.22% Impervious Area

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

Summary for Subcatchment S1E: Bldg 3, Beltran Area & Western Prop Line

Runoff = 7.7 cfs @ 12.12 hrs, Volume= 0.6 af, Depth= 1.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.20"

	Area (sf)	CN	Description
*	68,971	98	Roofs
*	98,296	61	>75% Grass cover, Good, HSG B
*	63,425	39	>75% Grass cover, Good, HSG A
*	80,341	98	Road & Sidewalk
	311,033	74	Weighted Average
	161,721		51.99% Pervious Area
	149,312		48.01% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.0200	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
1.2	178	0.0220	2.39		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.9	305	0.0100	5.36	4.21	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
7.7	533	Total			

Summary for Subcatchment S1F: Offsite Farm Area

Runoff = 1.0 cfs @ 12.60 hrs, Volume= 0.4 af, Depth= 0.15"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.20"

Area (sf)	CN	Adj	Description
10,003	98		Water Surface, HSG B
181,224	61		>75% Grass cover, Good, HSG B
859,788	30		Meadow, non-grazed, HSG A
301,859	98		Roofs, HSG B
118,047	98		Unconnected pavement, HSG B
1,470,921	54	51	Weighted Average, UI Adjusted
1,041,012			70.77% Pervious Area
429,909			29.23% Impervious Area
118,047			27.46% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.0210	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
0.6	264	0.1900	7.02		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.8	100	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
4.9	610	0.0050	2.08	1.64	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.020 Corrugated PE, corrugated interior
0.6	307	0.0100	8.51	26.74	**Pipe Channel,** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.011 Concrete pipe, straight & clean
0.3	140	0.0200	8.87	70.94	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=2.00' Z= 2.0 '/' Top.W=8.00' n= 0.022 Earth, clean & straight
4.1	172	0.0100	0.70		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	91	0.0100	6.27	50.16	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=2.00' Z= 2.0 '/' Top.W=8.00' n= 0.022 Earth, clean & straight
17.0	1,734	Total			

Summary for Subcatchment S2: Southern Prop Line - Pervious Area

Runoff = 0.4 cfs @ 12.10 hrs, Volume= 0.0 af, Depth= 0.52"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.20"

	Area (sf)	CN	Description
*	37,965	61	>75% Grass cover, Good, HSG B
*	1,815	98	Road & Sidewalk
	39,780	63	Weighted Average
	37,965		95.44% Pervious Area
	1,815		4.56% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	25	0.0280	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
1.6	260	0.0280	2.69		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
4.4	285	Total, Increased to minimum Tc = 5.0 min			

Summary for Subcatchment S3: Eastern Prop Line

Runoff = 0.2 cfs @ 12.11 hrs, Volume= 0.0 af, Depth= 0.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.20"

	Area (sf)	CN	Description
*	28,484	61	>75% Grass cover, Good, HSG B
	28,484		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.5	20	0.0810	0.22		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
1.5	20	Total, Increased to minimum Tc = 5.0 min			

Summary for Pond P-1B: SW Wetland/Swale at Western Prop Line

Inflow Area = 40.9 ac, 32.50% Impervious, Inflow Depth = 0.31" for 2-Year event
Inflow = 7.7 cfs @ 12.12 hrs, Volume= 1.0 af
Outflow = 7.7 cfs @ 12.12 hrs, Volume= 1.0 af, Atten= 0%, Lag= 0.0 min
Primary = 7.7 cfs @ 12.12 hrs, Volume= 1.0 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 151.04' @ 12.12 hrs Surf.Area= 527 sf Storage= 22 cf

Plug-Flow detention time= 0.0 min calculated for 1.0 af (100% of inflow)
Center-of-Mass det. time= 0.0 min (921.9 - 921.8)

Volume	Invert	Avail.Storage	Storage Description
#1	151.00'	126,119 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
151.00	498	198.0	0	0	498
152.00	1,368	715.0	897	897	38,063
153.00	8,822	6,900.0	4,555	5,452	3,786,066
154.00	25,925	1,559.0	16,623	22,075	7,381,341
155.00	50,627	1,626.0	37,594	59,669	7,398,397
156.00	83,648	1,717.0	66,450	126,119	7,422,663

Device	Routing	Invert	Outlet Devices
#1	Primary	149.70'	**24.0" Round Culvert** L= 300.0' Ke= 0.500 Inlet / Outlet Invert= 149.70' / 146.90' S= 0.0093 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf

Primary OutFlow Max=8.9 cfs @ 12.12 hrs HW=151.04' (Free Discharge)
1=Culvert (Inlet Controls 8.9 cfs @ 3.95 fps)

Summary for Pond P1A: Existing Pond at Center of Property

Inflow Area = 73.0 ac, 45.00% Impervious, Inflow Depth = 0.93" for 2-Year event
Inflow = 59.4 cfs @ 12.11 hrs, Volume= 5.6 af
Outflow = 4.8 cfs @ 14.60 hrs, Volume= 5.3 af, Atten= 92%, Lag= 149.2 min
Primary = 4.8 cfs @ 14.60 hrs, Volume= 5.3 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Starting Elev= 144.70' Surf.Area= 48,178 sf Storage= 33,047 cf
Peak Elev= 147.23' @ 14.60 hrs Surf.Area= 58,517 sf Storage= 167,363 cf (134,317 cf above start)
Flood Elev= 152.00' Surf.Area= 267,916 sf Storage= 692,409 cf (659,363 cf above start)

Plug-Flow detention time= 545.3 min calculated for 4.5 af (80% of inflow)
Center-of-Mass det. time= 388.9 min (1,229.9 - 841.0)

Volume	Invert	Avail.Storage	Storage Description
#1	144.00'	692,409 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
144.00	46,247	909.0	0	0	46,247
145.00	49,018	939.0	47,626	47,626	50,754
146.00	53,432	1,337.0	51,209	98,835	122,849
147.00	56,882	1,331.0	55,148	153,983	124,693
148.00	64,098	2,188.0	60,454	214,437	364,688
149.00	71,981	2,519.0	68,001	282,438	488,693
150.00	93,091	3,451.0	82,310	364,749	931,476
151.00	151,091	4,574.0	120,926	485,675	1,648,645
152.00	267,916	5,056.0	206,734	692,409	2,018,048

Device	Routing	Invert	Outlet Devices
#1	Device 4	144.70'	**12.0" Round Culvert** L= 382.0' Ke= 0.500 Inlet / Outlet Invert= 144.70' / 142.80' S= 0.0050 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Device 3	147.00'	**36.0" W x 18.0" H Vert. Orifice/Grate** C= 0.600
#3	Device 4	144.00'	**24.0" Round Culvert** L= 372.0' Ke= 0.500 Inlet / Outlet Invert= 144.00' / 142.80' S= 0.0032 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf
#4	Primary	142.60'	**36.0" Round Culvert** L= 1,295.0' Ke= 0.500 Inlet / Outlet Invert= 142.60' / 140.90' S= 0.0013 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 7.07 sf

Primary OutFlow Max=4.8 cfs @ 14.60 hrs HW=147.23' (Free Discharge)
└─**4=Culvert** (Passes 4.8 cfs of 36.1 cfs potential flow)
  ├─**1=Culvert** (Barrel Controls 3.7 cfs @ 4.68 fps)
  └─**3=Culvert** (Passes 1.1 cfs of 17.9 cfs potential flow)
    └─**2=Orifice/Grate** (Orifice Controls 1.1 cfs @ 1.55 fps)

Summary for Link DP-1: 48" RCP Across Boston Post Road

Inflow Area = 84.1 ac, 47.58% Impervious, Inflow Depth > 0.99" for 2-Year event
Inflow = 26.3 cfs @ 12.08 hrs, Volume= 6.9 af
Primary = 26.3 cfs @ 12.08 hrs, Volume= 6.9 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Link DP2: Overland Flow to Boston Post Road

Inflow Area = 0.9 ac, 4.56% Impervious, Inflow Depth = 0.52" for 2-Year event
Inflow = 0.4 cfs @ 12.10 hrs, Volume= 0.0 af
Primary = 0.4 cfs @ 12.10 hrs, Volume= 0.0 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Link DP3: Wetland at Northeast Corner

Inflow Area = 0.7 ac, 0.00% Impervious, Inflow Depth = 0.44" for 2-Year event
Inflow = 0.2 cfs @ 12.11 hrs, Volume= 0.0 af
Primary = 0.2 cfs @ 12.11 hrs, Volume= 0.0 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

10-Year Storm Event – Existing

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

SubcatchmentS-1A: Bldgs 1 & 2 & Runoff Area=482,099 sf 64.58% Impervious Runoff Depth=3.18"
Flow Length=1,239' Tc=5.1 min CN=85 Runoff=42.3 cfs 2.9 af

SubcatchmentS1B: Northeast Parking Runoff Area=362,836 sf 79.83% Impervious Runoff Depth=3.79"
Flow Length=375' Tc=5.0 min CN=91 Runoff=36.8 cfs 2.6 af

SubcatchmentS1C: Northwest Parking Runoff Area=696,274 sf 70.96% Impervious Runoff Depth=3.38"
Flow Length=1,845' Tc=12.2 min CN=87 Runoff=51.1 cfs 4.5 af

SubcatchmentS1D: Central Pervious Runoff Area=340,318 sf 20.22% Impervious Runoff Depth=1.74"
Tc=5.0 min CN=68 Runoff=16.0 cfs 1.1 af

SubcatchmentS1E: Bldg 3, Beltran Area Runoff Area=311,033 sf 48.01% Impervious Runoff Depth=2.21"
Flow Length=533' Tc=7.7 min CN=74 Runoff=17.3 cfs 1.3 af

SubcatchmentS1F: Offsite Farm Area Runoff Area=1,470,921 sf 29.23% Impervious Runoff Depth=0.66"
Flow Length=1,734' Tc=17.0 min UI Adjusted CN=51 Runoff=12.1 cfs 1.9 af

SubcatchmentS2: Southern Prop Line - Runoff Area=39,780 sf 4.56% Impervious Runoff Depth=1.38"
Flow Length=285' Slope=0.0280 '/' Tc=5.0 min CN=63 Runoff=1.4 cfs 0.1 af

SubcatchmentS3: Eastern Prop Line Runoff Area=28,484 sf 0.00% Impervious Runoff Depth=1.25"
Flow Length=20' Slope=0.0810 '/' Tc=5.0 min CN=61 Runoff=0.9 cfs 0.1 af

Pond P-1B: SW Wetland/Swale at Western Peak Elev=152.51' Storage=2,308 cf Inflow=21.8 cfs 3.2 af
24.0" Round Culvert n=0.011 L=300.0' S=0.0093 '/' Outflow=20.4 cfs 3.2 af

Pond P1A: Existing Pond at Center of Peak Elev=148.62' Storage=255,942 cf Inflow=110.3 cfs 11.4 af
Outflow=23.9 cfs 11.0 af

Link DP-1: 48" RCP Across Boston Post Road Inflow=45.7 cfs 13.9 af
Primary=45.7 cfs 13.9 af

Link DP2: Overland Flow to Boston Post Road Inflow=1.4 cfs 0.1 af
Primary=1.4 cfs 0.1 af

Link DP3: Wetland at Northeast Corner Inflow=0.9 cfs 0.1 af
Primary=0.9 cfs 0.1 af

Total Runoff Area = 85.7 ac Runoff Volume = 14.6 af Average Runoff Depth = 2.04"
53.24% Pervious = 45.6 ac 46.76% Impervious = 40.1 ac

Summary for Subcatchment S-1A: Bldgs 1 & 2 & Southern Portion of Prop

Runoff = 42.3 cfs @ 12.07 hrs, Volume= 2.9 af, Depth= 3.18"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (sf)	CN	Description
*	170,769	61	>75% Grass cover, Good, HSG B
*	99,171	98	Road & Sidewalk
*	212,159	98	Roofs
	482,099	85	Weighted Average
	170,769		35.42% Pervious Area
	311,330		64.58% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.20		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"
3.5	537	0.0160	2.57		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.9	652	0.0130	12.71	89.87	**Pipe Channel,** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.011 Concrete pipe, straight & clean
5.1	1,239	Total			

Summary for Subcatchment S1B: Northeast Parking Lot & Bldg 5

Runoff = 36.8 cfs @ 12.07 hrs, Volume= 2.6 af, Depth= 3.79"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (sf)	CN	Description
*	62,603	98	Roofs
*	227,035	98	Road & Sidewalk
*	73,198	61	>75% Grass cover, Good, HSG B
	362,836	91	Weighted Average
	73,198		20.17% Pervious Area
	289,638		79.83% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.20		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"
1.2	175	0.0150	2.49		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.4	150	0.0150	6.57	5.16	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean

2.3 375 Total, Increased to minimum Tc = 5.0 min

Summary for Subcatchment S1C: Northwest Parking Lot & Bldg 4

Runoff = 51.1 cfs @ 12.16 hrs, Volume= 4.5 af, Depth= 3.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (sf)	CN	Description
*	44,716	98	Roofs
*	449,394	98	Road & Sidewalk
*	202,164	61	>75% Grass cover, Good, HSG B
	696,274	87	Weighted Average
	202,164		29.04% Pervious Area
	494,110		70.96% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.0200	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
3.9	500	0.0180	2.16		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.2	471	0.0150	6.57	5.16	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
0.3	141	0.0150	8.60	15.20	**Pipe Channel,** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.011 Concrete pipe, straight & clean
0.3	188	0.0150	10.42	32.74	**Pipe Channel,** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.011 Concrete pipe, straight & clean
0.9	495	0.0070	9.33	65.95	**Pipe Channel,** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.011 Concrete pipe, straight & clean
12.2	1,845	Total			

Summary for Subcatchment S1D: Central Pervious Area

Runoff = 16.0 cfs @ 12.08 hrs, Volume= 1.1 af, Depth= 1.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (sf)	CN	Description
*	961	98	Roofs
*	16,841	98	Road & Sidewalk
*	271,522	61	>75% Grass cover, Good, HSG B
	50,994	98	Water Surface, HSG B
	340,318	68	Weighted Average
	271,522		79.78% Pervious Area
	68,796		20.22% Impervious Area

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

Summary for Subcatchment S1E: Bldg 3, Beltran Area & Western Prop Line

Runoff = 17.3 cfs @ 12.11 hrs, Volume= 1.3 af, Depth= 2.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (sf)	CN	Description
*	68,971	98	Roofs
*	98,296	61	>75% Grass cover, Good, HSG B
*	63,425	39	>75% Grass cover, Good, HSG A
*	80,341	98	Road & Sidewalk
	311,033	74	Weighted Average
	161,721		51.99% Pervious Area
	149,312		48.01% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.0200	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
1.2	178	0.0220	2.39		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.9	305	0.0100	5.36	4.21	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
7.7	533	Total			

Summary for Subcatchment S1F: Offsite Farm Area

Runoff = 12.1 cfs @ 12.34 hrs, Volume= 1.9 af, Depth= 0.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (sf)	CN	Adj	Description
10,003	98		Water Surface, HSG B
181,224	61		>75% Grass cover, Good, HSG B
859,788	30		Meadow, non-grazed, HSG A
301,859	98		Roofs, HSG B
118,047	98		Unconnected pavement, HSG B
1,470,921	54	51	Weighted Average, UI Adjusted
1,041,012			70.77% Pervious Area
429,909			29.23% Impervious Area
118,047			27.46% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.0210	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
0.6	264	0.1900	7.02		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.8	100	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
4.9	610	0.0050	2.08	1.64	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.020 Corrugated PE, corrugated interior
0.6	307	0.0100	8.51	26.74	**Pipe Channel,** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.011 Concrete pipe, straight & clean
0.3	140	0.0200	8.87	70.94	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=2.00' Z= 2.0 '/' Top.W=8.00' n= 0.022 Earth, clean & straight
4.1	172	0.0100	0.70		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	91	0.0100	6.27	50.16	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=2.00' Z= 2.0 '/' Top.W=8.00' n= 0.022 Earth, clean & straight
17.0	1,734	Total			

Summary for Subcatchment S2: Southern Prop Line - Pervious Area

Runoff = 1.4 cfs @ 12.08 hrs, Volume= 0.1 af, Depth= 1.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (sf)	CN	Description
*	37,965	61	>75% Grass cover, Good, HSG B
*	1,815	98	Road & Sidewalk
	39,780	63	Weighted Average
	37,965		95.44% Pervious Area
	1,815		4.56% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	25	0.0280	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
1.6	260	0.0280	2.69		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
4.4	285	Total, Increased to minimum Tc = 5.0 min			

Summary for Subcatchment S3: Eastern Prop Line

Runoff = 0.9 cfs @ 12.09 hrs, Volume= 0.1 af, Depth= 1.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (sf)	CN	Description
*	28,484	61	>75% Grass cover, Good, HSG B
	28,484		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.5	20	0.0810	0.22		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
1.5	20	Total, Increased to minimum Tc = 5.0 min			

Summary for Pond P-1B: SW Wetland/Swale at Western Prop Line

Inflow Area = 40.9 ac, 32.50% Impervious, Inflow Depth = 0.93" for 10-Year event
Inflow = 21.8 cfs @ 12.16 hrs, Volume= 3.2 af
Outflow = 20.4 cfs @ 12.34 hrs, Volume= 3.2 af, Atten= 7%, Lag= 10.8 min
Primary = 20.4 cfs @ 12.34 hrs, Volume= 3.2 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 152.51' @ 12.34 hrs Surf.Area= 4,397 sf Storage= 2,308 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 0.4 min (890.9 - 890.5)

Volume	Invert	Avail.Storage	Storage Description
#1	151.00'	126,119 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
151.00	498	198.0	0	0	498
152.00	1,368	715.0	897	897	38,063
153.00	8,822	6,900.0	4,555	5,452	3,786,066
154.00	25,925	1,559.0	16,623	22,075	7,381,341
155.00	50,627	1,626.0	37,594	59,669	7,398,397
156.00	83,648	1,717.0	66,450	126,119	7,422,663

Device	Routing	Invert	Outlet Devices
#1	Primary	149.70'	**24.0" Round Culvert** L= 300.0' Ke= 0.500 Inlet / Outlet Invert= 149.70' / 146.90' S= 0.0093 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf

Primary OutFlow Max=20.4 cfs @ 12.34 hrs HW=152.51' (Free Discharge)
└─**1=Culvert** (Inlet Controls 20.4 cfs @ 6.49 fps)

Summary for Pond P1A: Existing Pond at Center of Property

Inflow Area = 73.0 ac, 45.00% Impervious, Inflow Depth = 1.88" for 10-Year event
Inflow = 110.3 cfs @ 12.11 hrs, Volume= 11.4 af
Outflow = 23.9 cfs @ 12.75 hrs, Volume= 11.0 af, Atten= 78%, Lag= 38.2 min
Primary = 23.9 cfs @ 12.75 hrs, Volume= 11.0 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Starting Elev= 144.70' Surf.Area= 48,178 sf Storage= 33,047 cf
Peak Elev= 148.62' @ 12.75 hrs Surf.Area= 68,963 sf Storage= 255,942 cf (222,895 cf above start)
Flood Elev= 152.00' Surf.Area= 267,916 sf Storage= 692,409 cf (659,363 cf above start)

Plug-Flow detention time= 347.4 min calculated for 10.2 af (89% of inflow)
Center-of-Mass det. time= 267.0 min (1,098.1 - 831.0)

Volume	Invert	Avail.Storage	Storage Description
#1	144.00'	692,409 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
144.00	46,247	909.0	0	0	46,247
145.00	49,018	939.0	47,626	47,626	50,754
146.00	53,432	1,337.0	51,209	98,835	122,849
147.00	56,882	1,331.0	55,148	153,983	124,693
148.00	64,098	2,188.0	60,454	214,437	364,688
149.00	71,981	2,519.0	68,001	282,438	488,693
150.00	93,091	3,451.0	82,310	364,749	931,476
151.00	151,091	4,574.0	120,926	485,675	1,648,645
152.00	267,916	5,056.0	206,734	692,409	2,018,048

Device	Routing	Invert	Outlet Devices
#1	Device 4	144.70'	**12.0" Round Culvert** L= 382.0' Ke= 0.500 Inlet / Outlet Invert= 144.70' / 142.80' S= 0.0050 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Device 3	147.00'	**36.0" W x 18.0" H Vert. Orifice/Grate** C= 0.600
#3	Device 4	144.00'	**24.0" Round Culvert** L= 372.0' Ke= 0.500 Inlet / Outlet Invert= 144.00' / 142.80' S= 0.0032 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf
#4	Primary	142.60'	**36.0" Round Culvert** L= 1,295.0' Ke= 0.500 Inlet / Outlet Invert= 142.60' / 140.90' S= 0.0013 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 7.07 sf

Primary OutFlow Max=23.9 cfs @ 12.75 hrs HW=148.62' (Free Discharge)
└─**4=Culvert** (Passes 23.9 cfs of 43.0 cfs potential flow)
  ├─**1=Culvert** (Barrel Controls 4.4 cfs @ 5.55 fps)
  └─**3=Culvert** (Passes 19.5 cfs of 22.5 cfs potential flow)
    └─**2=Orifice/Grate** (Orifice Controls 19.5 cfs @ 4.34 fps)

Summary for Link DP-1: 48" RCP Across Boston Post Road

Inflow Area = 84.1 ac, 47.58% Impervious, Inflow Depth > 1.99" for 10-Year event
Inflow = 45.7 cfs @ 12.07 hrs, Volume= 13.9 af
Primary = 45.7 cfs @ 12.07 hrs, Volume= 13.9 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Link DP2: Overland Flow to Boston Post Road

Inflow Area = 0.9 ac, 4.56% Impervious, Inflow Depth = 1.38" for 10-Year event
Inflow = 1.4 cfs @ 12.08 hrs, Volume= 0.1 af
Primary = 1.4 cfs @ 12.08 hrs, Volume= 0.1 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Link DP3: Wetland at Northeast Corner

Inflow Area = 0.7 ac, 0.00% Impervious, Inflow Depth = 1.25" for 10-Year event
Inflow = 0.9 cfs @ 12.09 hrs, Volume= 0.1 af
Primary = 0.9 cfs @ 12.09 hrs, Volume= 0.1 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

25-Year Storm Event – Existing

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

SubcatchmentS-1A: Bldgs 1 & 2 & Runoff Area=482,099 sf 64.58% Impervious Runoff Depth=4.30"
Flow Length=1,239' Tc=5.1 min CN=85 Runoff=56.5 cfs 4.0 af

SubcatchmentS1B: Northeast Parking Runoff Area=362,836 sf 79.83% Impervious Runoff Depth=4.96"
Flow Length=375' Tc=5.0 min CN=91 Runoff=47.4 cfs 3.4 af

SubcatchmentS1C: Northwest Parking Runoff Area=696,274 sf 70.96% Impervious Runoff Depth=4.52"
Flow Length=1,845' Tc=12.2 min CN=87 Runoff=67.5 cfs 6.0 af

SubcatchmentS1D: Central Pervious Runoff Area=340,318 sf 20.22% Impervious Runoff Depth=2.62"
Tc=5.0 min CN=68 Runoff=24.6 cfs 1.7 af

SubcatchmentS1E: Bldg 3, Beltran Area Runoff Area=311,033 sf 48.01% Impervious Runoff Depth=3.18"
Flow Length=533' Tc=7.7 min CN=74 Runoff=25.1 cfs 1.9 af

SubcatchmentS1F: Offsite Farm Area Runoff Area=1,470,921 sf 29.23% Impervious Runoff Depth=1.22"
Flow Length=1,734' Tc=17.0 min UI Adjusted CN=51 Runoff=27.8 cfs 3.4 af

SubcatchmentS2: Southern Prop Line - Runoff Area=39,780 sf 4.56% Impervious Runoff Depth=2.18"
Flow Length=285' Slope=0.0280 '/' Tc=5.0 min CN=63 Runoff=2.3 cfs 0.2 af

SubcatchmentS3: Eastern Prop Line Runoff Area=28,484 sf 0.00% Impervious Runoff Depth=2.01"
Flow Length=20' Slope=0.0810 '/' Tc=5.0 min CN=61 Runoff=1.5 cfs 0.1 af

Pond P-1B: SW Wetland/Swaleat Western Peak Elev=153.97' Storage=21,385 cf Inflow=42.8 cfs 5.3 af
24.0" Round Culvert n=0.011 L=300.0' S=0.0093 '/' Outflow=27.4 cfs 5.3 af

Pond P1A: Existing Pond at Center of Peak Elev=149.84' Storage=350,392 cf Inflow=147.6 cfs 16.5 af
Outflow=30.7 cfs 16.0 af

Link DP-1: 48" RCP Across Boston Post Road Inflow=65.4 cfs 19.9 af
Primary=65.4 cfs 19.9 af

Link DP2: Overland Flow to Boston Post Road Inflow=2.3 cfs 0.2 af
Primary=2.3 cfs 0.2 af

Link DP3: Wetland at Northeast Corner Inflow=1.5 cfs 0.1 af
Primary=1.5 cfs 0.1 af

Total Runoff Area = 85.7 ac Runoff Volume = 20.7 af Average Runoff Depth = 2.90"
53.24% Pervious = 45.6 ac 46.76% Impervious = 40.1 ac

Summary for Subcatchment S-1A: Bldgs 1 & 2 & Southern Portion of Prop

Runoff = 56.5 cfs @ 12.07 hrs, Volume= 4.0 af, Depth= 4.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.00"

	Area (sf)	CN	Description
*	170,769	61	>75% Grass cover, Good, HSG B
*	99,171	98	Road & Sidewalk
*	212,159	98	Roofs
	482,099	85	Weighted Average
	170,769		35.42% Pervious Area
	311,330		64.58% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.20		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"
3.5	537	0.0160	2.57		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.9	652	0.0130	12.71	89.87	**Pipe Channel,** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.011 Concrete pipe, straight & clean
5.1	1,239	Total			

Summary for Subcatchment S1B: Northeast Parking Lot & Bldg 5

Runoff = 47.4 cfs @ 12.07 hrs, Volume= 3.4 af, Depth= 4.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.00"

	Area (sf)	CN	Description
*	62,603	98	Roofs
*	227,035	98	Road & Sidewalk
*	73,198	61	>75% Grass cover, Good, HSG B
	362,836	91	Weighted Average
	73,198		20.17% Pervious Area
	289,638		79.83% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.20		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"
1.2	175	0.0150	2.49		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.4	150	0.0150	6.57	5.16	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean

2.3 375 Total, Increased to minimum Tc = 5.0 min

Summary for Subcatchment S1C: Northwest Parking Lot & Bldg 4

Runoff = 67.5 cfs @ 12.16 hrs, Volume= 6.0 af, Depth= 4.52"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.00"

	Area (sf)	CN	Description
*	44,716	98	Roofs
*	449,394	98	Road & Sidewalk
*	202,164	61	>75% Grass cover, Good, HSG B
	696,274	87	Weighted Average
	202,164		29.04% Pervious Area
	494,110		70.96% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.0200	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
3.9	500	0.0180	2.16		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.2	471	0.0150	6.57	5.16	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
0.3	141	0.0150	8.60	15.20	**Pipe Channel,** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.011 Concrete pipe, straight & clean
0.3	188	0.0150	10.42	32.74	**Pipe Channel,** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.011 Concrete pipe, straight & clean
0.9	495	0.0070	9.33	65.95	**Pipe Channel,** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.011 Concrete pipe, straight & clean
12.2	1,845	Total			

Summary for Subcatchment S1D: Central Pervious Area

Runoff = 24.6 cfs @ 12.08 hrs, Volume= 1.7 af, Depth= 2.62"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.00"

	Area (sf)	CN	Description
*	961	98	Roofs
*	16,841	98	Road & Sidewalk
*	271,522	61	>75% Grass cover, Good, HSG B
	50,994	98	Water Surface, HSG B
	340,318	68	Weighted Average
	271,522		79.78% Pervious Area
	68,796		20.22% Impervious Area

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

Summary for Subcatchment S1E: Bldg 3, Beltran Area & Western Prop Line

Runoff = 25.1 cfs @ 12.11 hrs, Volume= 1.9 af, Depth= 3.18"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.00"

	Area (sf)	CN	Description
*	68,971	98	Roofs
*	98,296	61	>75% Grass cover, Good, HSG B
*	63,425	39	>75% Grass cover, Good, HSG A
*	80,341	98	Road & Sidewalk
	311,033	74	Weighted Average
	161,721		51.99% Pervious Area
	149,312		48.01% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.0200	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
1.2	178	0.0220	2.39		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.9	305	0.0100	5.36	4.21	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
7.7	533	Total			

Summary for Subcatchment S1F: Offsite Farm Area

Runoff = 27.8 cfs @ 12.28 hrs, Volume= 3.4 af, Depth= 1.22"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.00"

Area (sf)	CN	Adj	Description
10,003	98		Water Surface, HSG B
181,224	61		>75% Grass cover, Good, HSG B
859,788	30		Meadow, non-grazed, HSG A
301,859	98		Roofs, HSG B
118,047	98		Unconnected pavement, HSG B
1,470,921	54	51	Weighted Average, UI Adjusted
1,041,012			70.77% Pervious Area
429,909			29.23% Impervious Area
118,047			27.46% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.0210	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
0.6	264	0.1900	7.02		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.8	100	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
4.9	610	0.0050	2.08	1.64	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.020 Corrugated PE, corrugated interior
0.6	307	0.0100	8.51	26.74	**Pipe Channel,** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.011 Concrete pipe, straight & clean
0.3	140	0.0200	8.87	70.94	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=2.00' Z= 2.0 '/' Top.W=8.00' n= 0.022 Earth, clean & straight
4.1	172	0.0100	0.70		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	91	0.0100	6.27	50.16	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=2.00' Z= 2.0 '/' Top.W=8.00' n= 0.022 Earth, clean & straight
17.0	1,734	Total			

Summary for Subcatchment S2: Southern Prop Line - Pervious Area

Runoff = 2.3 cfs @ 12.08 hrs, Volume= 0.2 af, Depth= 2.18"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.00"

	Area (sf)	CN	Description
*	37,965	61	>75% Grass cover, Good, HSG B
*	1,815	98	Road & Sidewalk
	39,780	63	Weighted Average
	37,965		95.44% Pervious Area
	1,815		4.56% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	25	0.0280	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
1.6	260	0.0280	2.69		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
4.4	285	Total, Increased to minimum Tc = 5.0 min			

Summary for Subcatchment S3: Eastern Prop Line

Runoff = 1.5 cfs @ 12.08 hrs, Volume= 0.1 af, Depth= 2.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.00"

	Area (sf)	CN	Description
*	28,484	61	>75% Grass cover, Good, HSG B
	28,484		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.5	20	0.0810	0.22		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
1.5	20	Total, Increased to minimum Tc = 5.0 min			

Summary for Pond P-1B: SW Wetland/Swale at Western Prop Line

Inflow Area = 40.9 ac, 32.50% Impervious, Inflow Depth = 1.56" for 25-Year event
Inflow = 42.8 cfs @ 12.19 hrs, Volume= 5.3 af
Outflow = 27.4 cfs @ 12.52 hrs, Volume= 5.3 af, Atten= 36%, Lag= 19.2 min
Primary = 27.4 cfs @ 12.52 hrs, Volume= 5.3 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 153.97' @ 12.52 hrs Surf.Area= 25,346 sf Storage= 21,385 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 3.6 min (879.3 - 875.7)

Volume	Invert	Avail.Storage	Storage Description
#1	151.00'	126,119 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
151.00	498	198.0	0	0	498
152.00	1,368	715.0	897	897	38,063
153.00	8,822	6,900.0	4,555	5,452	3,786,066
154.00	25,925	1,559.0	16,623	22,075	7,381,341
155.00	50,627	1,626.0	37,594	59,669	7,398,397
156.00	83,648	1,717.0	66,450	126,119	7,422,663

Device	Routing	Invert	Outlet Devices
#1	Primary	149.70'	**24.0" Round Culvert** L= 300.0' Ke= 0.500 Inlet / Outlet Invert= 149.70' / 146.90' S= 0.0093 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf

Primary OutFlow Max=27.4 cfs @ 12.52 hrs HW=153.97' (Free Discharge)
└─**1=Culvert** (Inlet Controls 27.4 cfs @ 8.71 fps)

Summary for Pond P1A: Existing Pond at Center of Property

Inflow Area = 73.0 ac, 45.00% Impervious, Inflow Depth = 2.71" for 25-Year event
Inflow = 147.6 cfs @ 12.10 hrs, Volume= 16.5 af
Outflow = 30.7 cfs @ 13.09 hrs, Volume= 16.0 af, Atten= 79%, Lag= 59.0 min
Primary = 30.7 cfs @ 13.09 hrs, Volume= 16.0 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Starting Elev= 144.70' Surf.Area= 48,178 sf Storage= 33,047 cf
Peak Elev= 149.84' @ 13.09 hrs Surf.Area= 89,593 sf Storage= 350,392 cf (317,345 cf above start)
Flood Elev= 152.00' Surf.Area= 267,916 sf Storage= 692,409 cf (659,363 cf above start)

Plug-Flow detention time= 282.5 min calculated for 15.2 af (92% of inflow)
Center-of-Mass det. time= 224.3 min (1,050.2 - 825.9)

Volume	Invert	Avail.Storage	Storage Description
#1	144.00'	692,409 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
144.00	46,247	909.0	0	0	46,247
145.00	49,018	939.0	47,626	47,626	50,754
146.00	53,432	1,337.0	51,209	98,835	122,849
147.00	56,882	1,331.0	55,148	153,983	124,693
148.00	64,098	2,188.0	60,454	214,437	364,688
149.00	71,981	2,519.0	68,001	282,438	488,693
150.00	93,091	3,451.0	82,310	364,749	931,476
151.00	151,091	4,574.0	120,926	485,675	1,648,645
152.00	267,916	5,056.0	206,734	692,409	2,018,048

Device	Routing	Invert	Outlet Devices
#1	Device 4	144.70'	**12.0" Round Culvert** L= 382.0' Ke= 0.500 Inlet / Outlet Invert= 144.70' / 142.80' S= 0.0050 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Device 3	147.00'	**36.0" W x 18.0" H Vert. Orifice/Grate** C= 0.600
#3	Device 4	144.00'	**24.0" Round Culvert** L= 372.0' Ke= 0.500 Inlet / Outlet Invert= 144.00' / 142.80' S= 0.0032 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf
#4	Primary	142.60'	**36.0" Round Culvert** L= 1,295.0' Ke= 0.500 Inlet / Outlet Invert= 142.60' / 140.90' S= 0.0013 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 7.07 sf

Primary OutFlow Max=30.7 cfs @ 13.09 hrs HW=149.84' (Free Discharge)
└─**4=Culvert** (Passes 30.7 cfs of 48.2 cfs potential flow)
  ├─**1=Culvert** (Barrel Controls 4.9 cfs @ 6.21 fps)
  └─**3=Culvert** (Barrel Controls 25.8 cfs @ 8.21 fps)
    └─**2=Orifice/Grate** (Passes 25.8 cfs of 31.2 cfs potential flow)

Summary for Link DP-1: 48" RCP Across Boston Post Road

Inflow Area = 84.1 ac, 47.58% Impervious, Inflow Depth > 2.85" for 25-Year event
Inflow = 65.4 cfs @ 12.08 hrs, Volume= 19.9 af
Primary = 65.4 cfs @ 12.08 hrs, Volume= 19.9 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Link DP2: Overland Flow to Boston Post Road

Inflow Area = 0.9 ac, 4.56% Impervious, Inflow Depth = 2.18" for 25-Year event
Inflow = 2.3 cfs @ 12.08 hrs, Volume= 0.2 af
Primary = 2.3 cfs @ 12.08 hrs, Volume= 0.2 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Link DP3: Wetland at Northeast Corner

Inflow Area = 0.7 ac, 0.00% Impervious, Inflow Depth = 2.01" for 25-Year event
Inflow = 1.5 cfs @ 12.08 hrs, Volume= 0.1 af
Primary = 1.5 cfs @ 12.08 hrs, Volume= 0.1 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

100-Year Storm Event – Existing

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

SubcatchmentS-1A: Bldgs 1 & 2 & Runoff Area=482,099 sf 64.58% Impervious Runoff Depth=6.79"
Flow Length=1,239' Tc=5.1 min CN=85 Runoff=87.3 cfs 6.3 af

SubcatchmentS1B: Northeast Parking Runoff Area=362,836 sf 79.83% Impervious Runoff Depth=7.52"
Flow Length=375' Tc=5.0 min CN=91 Runoff=70.2 cfs 5.2 af

SubcatchmentS1C: Northwest Parking Runoff Area=696,274 sf 70.96% Impervious Runoff Depth=7.03"
Flow Length=1,845' Tc=12.2 min CN=87 Runoff=102.9 cfs 9.4 af

SubcatchmentS1D: Central Pervious Runoff Area=340,318 sf 20.22% Impervious Runoff Depth=4.74"
Tc=5.0 min CN=68 Runoff=45.1 cfs 3.1 af

SubcatchmentS1E: Bldg 3, Beltran Area Runoff Area=311,033 sf 48.01% Impervious Runoff Depth=5.47"
Flow Length=533' Tc=7.7 min CN=74 Runoff=43.0 cfs 3.3 af

SubcatchmentS1F: Offsite Farm Area Runoff Area=1,470,921 sf 29.23% Impervious Runoff Depth=2.74"
Flow Length=1,734' Tc=17.0 min UI Adjusted CN=51 Runoff=73.1 cfs 7.7 af

SubcatchmentS2: Southern Prop Line - Runoff Area=39,780 sf 4.56% Impervious Runoff Depth=4.15"
Flow Length=285' Slope=0.0280 '/' Tc=5.0 min CN=63 Runoff=4.6 cfs 0.3 af

SubcatchmentS3: Eastern Prop Line Runoff Area=28,484 sf 0.00% Impervious Runoff Depth=3.91"
Flow Length=20' Slope=0.0810 '/' Tc=5.0 min CN=61 Runoff=3.1 cfs 0.2 af

Pond P-1B: SW Wetland/Swale at Western Peak Elev=155.80' Storage=109,941 cf Inflow=99.6 cfs 11.0 af
24.0" Round Culvert n=0.011 L=300.0' S=0.0093 '/' Outflow=32.4 cfs 11.0 af

Pond P1A: Existing Pond at Center of Peak Elev=151.62' Storage=600,351 cf Inflow=224.4 cfs 28.6 af
Outflow=35.5 cfs 28.1 af

Link DP-1: 48" RCP Across Boston Post Road Inflow=116.1 cfs 34.3 af
Primary=116.1 cfs 34.3 af

Link DP2: Overland Flow to Boston Post Road Inflow=4.6 cfs 0.3 af
Primary=4.6 cfs 0.3 af

Link DP3: Wetland at Northeast Corner Inflow=3.1 cfs 0.2 af
Primary=3.1 cfs 0.2 af

Total Runoff Area = 85.7 ac Runoff Volume = 35.4 af Average Runoff Depth = 4.96"
53.24% Pervious = 45.6 ac 46.76% Impervious = 40.1 ac

Summary for Subcatchment S-1A: Bldgs 1 & 2 & Southern Portion of Prop

Runoff = 87.3 cfs @ 12.07 hrs, Volume= 6.3 af, Depth= 6.79"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.60"

	Area (sf)	CN	Description
*	170,769	61	>75% Grass cover, Good, HSG B
*	99,171	98	Road & Sidewalk
*	212,159	98	Roofs
	482,099	85	Weighted Average
	170,769		35.42% Pervious Area
	311,330		64.58% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.20		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"
3.5	537	0.0160	2.57		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.9	652	0.0130	12.71	89.87	**Pipe Channel,** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.011 Concrete pipe, straight & clean
5.1	1,239	Total			

Summary for Subcatchment S1B: Northeast Parking Lot & Bldg 5

Runoff = 70.2 cfs @ 12.07 hrs, Volume= 5.2 af, Depth= 7.52"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.60"

	Area (sf)	CN	Description
*	62,603	98	Roofs
*	227,035	98	Road & Sidewalk
*	73,198	61	>75% Grass cover, Good, HSG B
	362,836	91	Weighted Average
	73,198		20.17% Pervious Area
	289,638		79.83% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.20		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"
1.2	175	0.0150	2.49		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.4	150	0.0150	6.57	5.16	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean

2.3	375	Total, Increased to minimum Tc = 5.0 min

Summary for Subcatchment S1C: Northwest Parking Lot & Bldg 4

Runoff = 102.9 cfs @ 12.16 hrs, Volume= 9.4 af, Depth= 7.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.60"

	Area (sf)	CN	Description
*	44,716	98	Roofs
*	449,394	98	Road & Sidewalk
*	202,164	61	>75% Grass cover, Good, HSG B
	696,274	87	Weighted Average
	202,164		29.04% Pervious Area
	494,110		70.96% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.0200	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
3.9	500	0.0180	2.16		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.2	471	0.0150	6.57	5.16	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
0.3	141	0.0150	8.60	15.20	**Pipe Channel,** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.011 Concrete pipe, straight & clean
0.3	188	0.0150	10.42	32.74	**Pipe Channel,** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.011 Concrete pipe, straight & clean
0.9	495	0.0070	9.33	65.95	**Pipe Channel,** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.011 Concrete pipe, straight & clean
12.2	1,845	Total			

Summary for Subcatchment S1D: Central Pervious Area

Runoff = 45.1 cfs @ 12.07 hrs, Volume= 3.1 af, Depth= 4.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.60"

	Area (sf)	CN	Description
*	961	98	Roofs
*	16,841	98	Road & Sidewalk
*	271,522	61	>75% Grass cover, Good, HSG B
	50,994	98	Water Surface, HSG B
	340,318	68	Weighted Average
	271,522		79.78% Pervious Area
	68,796		20.22% Impervious Area

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

Summary for Subcatchment S1E: Bldg 3, Beltran Area & Western Prop Line

Runoff = 43.0 cfs @ 12.11 hrs, Volume= 3.3 af, Depth= 5.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.60"

	Area (sf)	CN	Description
*	68,971	98	Roofs
*	98,296	61	>75% Grass cover, Good, HSG B
*	63,425	39	>75% Grass cover, Good, HSG A
*	80,341	98	Road & Sidewalk
	311,033	74	Weighted Average
	161,721		51.99% Pervious Area
	149,312		48.01% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.0200	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
1.2	178	0.0220	2.39		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.9	305	0.0100	5.36	4.21	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
7.7	533	Total			

Summary for Subcatchment S1F: Offsite Farm Area

Runoff = 73.1 cfs @ 12.26 hrs, Volume= 7.7 af, Depth= 2.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.60"

Area (sf)	CN	Adj	Description
10,003	98		Water Surface, HSG B
181,224	61		>75% Grass cover, Good, HSG B
859,788	30		Meadow, non-grazed, HSG A
301,859	98		Roofs, HSG B
118,047	98		Unconnected pavement, HSG B
1,470,921	54	51	Weighted Average, UI Adjusted
1,041,012			70.77% Pervious Area
429,909			29.23% Impervious Area
118,047			27.46% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.0210	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
0.6	264	0.1900	7.02		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.8	100	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
4.9	610	0.0050	2.08	1.64	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.020 Corrugated PE, corrugated interior
0.6	307	0.0100	8.51	26.74	**Pipe Channel,** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.011 Concrete pipe, straight & clean
0.3	140	0.0200	8.87	70.94	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=2.00' Z= 2.0 '/' Top.W=8.00' n= 0.022 Earth, clean & straight
4.1	172	0.0100	0.70		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	91	0.0100	6.27	50.16	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=2.00' Z= 2.0 '/' Top.W=8.00' n= 0.022 Earth, clean & straight
17.0	1,734	Total			

Summary for Subcatchment S2: Southern Prop Line - Pervious Area

Runoff = 4.6 cfs @ 12.08 hrs, Volume= 0.3 af, Depth= 4.15"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.60"

	Area (sf)	CN	Description
*	37,965	61	>75% Grass cover, Good, HSG B
*	1,815	98	Road & Sidewalk
	39,780	63	Weighted Average
	37,965		95.44% Pervious Area
	1,815		4.56% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	25	0.0280	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
1.6	260	0.0280	2.69		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
4.4	285	Total, Increased to minimum Tc = 5.0 min			

Summary for Subcatchment S3: Eastern Prop Line

Runoff = 3.1 cfs @ 12.08 hrs, Volume= 0.2 af, Depth= 3.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.60"

	Area (sf)	CN	Description
*	28,484	61	>75% Grass cover, Good, HSG B
	28,484		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.5	20	0.0810	0.22		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
1.5	20	Total, Increased to minimum Tc = 5.0 min			

Summary for Pond P-1B: SW Wetland/Swale at Western Prop Line

Inflow Area = 40.9 ac, 32.50% Impervious, Inflow Depth = 3.21" for 100-Year event
Inflow = 99.6 cfs @ 12.20 hrs, Volume= 11.0 af
Outflow = 32.4 cfs @ 12.71 hrs, Volume= 11.0 af, Atten= 67%, Lag= 30.6 min
Primary = 32.4 cfs @ 12.71 hrs, Volume= 11.0 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 155.80' @ 12.71 hrs Surf.Area= 76,300 sf Storage= 109,941 cf

Plug-Flow detention time= 21.5 min calculated for 11.0 af (100% of inflow)
Center-of-Mass det. time= 21.5 min (877.5 - 856.0)

Volume	Invert	Avail.Storage	Storage Description
#1	151.00'	126,119 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
151.00	498	198.0	0	0	498
152.00	1,368	715.0	897	897	38,063
153.00	8,822	6,900.0	4,555	5,452	3,786,066
154.00	25,925	1,559.0	16,623	22,075	7,381,341
155.00	50,627	1,626.0	37,594	59,669	7,398,397
156.00	83,648	1,717.0	66,450	126,119	7,422,663

Device	Routing	Invert	Outlet Devices
#1	Primary	149.70'	**24.0" Round Culvert** L= 300.0' Ke= 0.500 Inlet / Outlet Invert= 149.70' / 146.90' S= 0.0093 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf

Primary OutFlow Max=32.4 cfs @ 12.71 hrs HW=155.80' (Free Discharge)
└─**1=Culvert** (Barrel Controls 32.4 cfs @ 10.31 fps)

Summary for Pond P1A: Existing Pond at Center of Property

Inflow Area = 73.0 ac, 45.00% Impervious, Inflow Depth = 4.71" for 100-Year event
Inflow = 224.4 cfs @ 12.10 hrs, Volume= 28.6 af
Outflow = 35.5 cfs @ 14.58 hrs, Volume= 28.1 af, Atten= 84%, Lag= 149.1 min
Primary = 35.5 cfs @ 14.58 hrs, Volume= 28.1 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Starting Elev= 144.70' Surf.Area= 48,178 sf Storage= 33,047 cf
Peak Elev= 151.62' @ 14.58 hrs Surf.Area= 219,838 sf Storage= 600,351 cf (567,304 cf above start)
Flood Elev= 152.00' Surf.Area= 267,916 sf Storage= 692,409 cf (659,363 cf above start)

Plug-Flow detention time= 264.6 min calculated for 27.3 af (95% of inflow)
Center-of-Mass det. time= 226.4 min (1,049.5 - 823.0)

Volume	Invert	Avail.Storage	Storage Description
#1	144.00'	692,409 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
144.00	46,247	909.0	0	0	46,247
145.00	49,018	939.0	47,626	47,626	50,754
146.00	53,432	1,337.0	51,209	98,835	122,849
147.00	56,882	1,331.0	55,148	153,983	124,693
148.00	64,098	2,188.0	60,454	214,437	364,688
149.00	71,981	2,519.0	68,001	282,438	488,693
150.00	93,091	3,451.0	82,310	364,749	931,476
151.00	151,091	4,574.0	120,926	485,675	1,648,645
152.00	267,916	5,056.0	206,734	692,409	2,018,048

Device	Routing	Invert	Outlet Devices
#1	Device 4	144.70'	**12.0" Round Culvert** L= 382.0' Ke= 0.500 Inlet / Outlet Invert= 144.70' / 142.80' S= 0.0050 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Device 3	147.00'	**36.0" W x 18.0" H Vert. Orifice/Grate** C= 0.600
#3	Device 4	144.00'	**24.0" Round Culvert** L= 372.0' Ke= 0.500 Inlet / Outlet Invert= 144.00' / 142.80' S= 0.0032 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf
#4	Primary	142.60'	**36.0" Round Culvert** L= 1,295.0' Ke= 0.500 Inlet / Outlet Invert= 142.60' / 140.90' S= 0.0013 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 7.07 sf

Primary OutFlow Max=35.5 cfs @ 14.58 hrs HW=151.62' (Free Discharge)
└─**4=Culvert** (Passes 35.5 cfs of 54.9 cfs potential flow)
  ├─**1=Culvert** (Barrel Controls 5.6 cfs @ 7.07 fps)
  └─**3=Culvert** (Barrel Controls 30.0 cfs @ 9.55 fps)
    └─**2=Orifice/Grate** (Passes 30.0 cfs of 42.6 cfs potential flow)

Summary for Link DP-1: 48" RCP Across Boston Post Road

Inflow Area = 84.1 ac, 47.58% Impervious, Inflow Depth > 4.90" for 100-Year event
Inflow = 116.1 cfs @ 12.07 hrs, Volume= 34.3 af
Primary = 116.1 cfs @ 12.07 hrs, Volume= 34.3 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Link DP2: Overland Flow to Boston Post Road

Inflow Area = 0.9 ac, 4.56% Impervious, Inflow Depth = 4.15" for 100-Year event
Inflow = 4.6 cfs @ 12.08 hrs, Volume= 0.3 af
Primary = 4.6 cfs @ 12.08 hrs, Volume= 0.3 af, Atten= 0%, Lag= 0.0 min

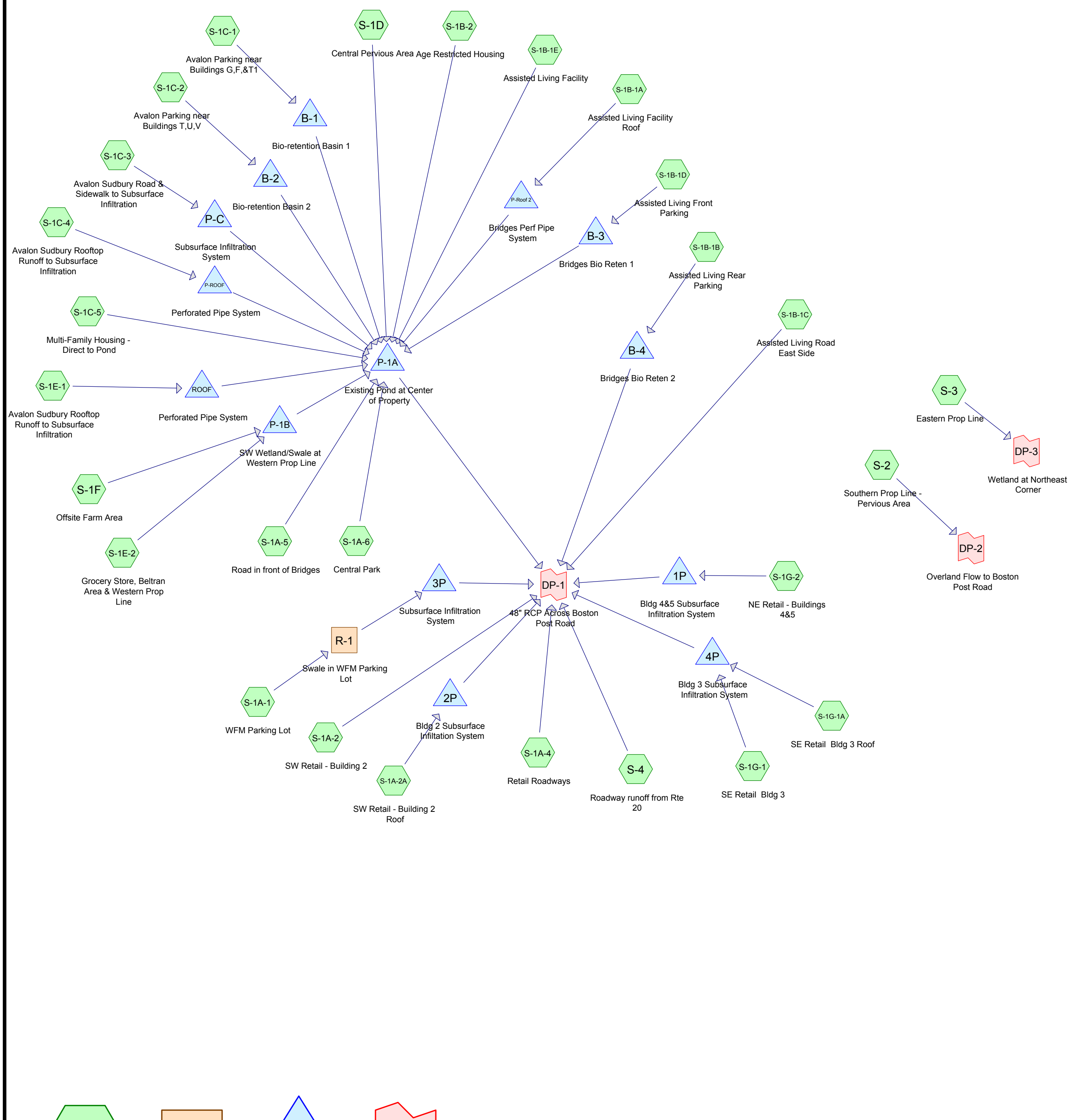
Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Link DP3: Wetland at Northeast Corner

Inflow Area = 0.7 ac, 0.00% Impervious, Inflow Depth = 3.91" for 100-Year event
Inflow = 3.1 cfs @ 12.08 hrs, Volume= 0.2 af
Primary = 3.1 cfs @ 12.08 hrs, Volume= 0.2 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

HydroCAD Analysis: Proposed Conditions



Routing Diagram for 13125-PR HydroCAD
Prepared by VHB, Printed 10/14/2016
HydroCAD® 10.00-18 s/n 01038 © 2016 HydroCAD Software Solutions LLC

1-inch Storm Event – Proposed

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

SubcatchmentS-1A-1: WFM Parking Lot Runoff Area=97,026 sf 90.11% Impervious Runoff Depth=0.50"
Tc=5.0 min CN=94 Runoff=1.4 cfs 0.1 af

SubcatchmentS-1A-2: SW Retail - Runoff Area=53,667 sf 73.74% Impervious Runoff Depth=0.25"
Flow Length=891' Tc=10.1 min CN=88 Runoff=0.3 cfs 0.0 af

SubcatchmentS-1A-2A: SW Retail - Runoff Area=13,612 sf 100.00% Impervious Runoff Depth=0.79"
Tc=5.0 min CN=98 Runoff=0.3 cfs 0.0 af

SubcatchmentS-1A-4: Retail Roadways Runoff Area=167,617 sf 62.93% Impervious Runoff Depth=0.15"
Tc=5.0 min CN=84 Runoff=0.5 cfs 0.0 af

SubcatchmentS-1A-5: Road in front of Runoff Area=16,532 sf 79.91% Impervious Runoff Depth=0.36"
Tc=5.0 min CN=91 Runoff=0.2 cfs 0.0 af

SubcatchmentS-1A-6: Central Park Runoff Area=35,240 sf 27.59% Impervious Runoff Depth=0.01"
Flow Length=819' Tc=17.8 min CN=71 Runoff=0.0 cfs 0.0 af

SubcatchmentS-1B-1A: Assisted Living Runoff Area=44,351 sf 100.00% Impervious Runoff Depth=0.79"
Tc=5.0 min CN=98 Runoff=0.9 cfs 0.1 af

SubcatchmentS-1B-1B: Assisted Living Runoff Area=24,236 sf 37.48% Impervious Runoff Depth=0.03"
Tc=5.0 min CN=75 Runoff=0.0 cfs 0.0 af

SubcatchmentS-1B-1C: Assisted Living Runoff Area=46,929 sf 61.74% Impervious Runoff Depth=0.15"
Flow Length=1,032' Tc=14.7 min CN=84 Runoff=0.1 cfs 0.0 af

SubcatchmentS-1B-1D: Assisted Living Runoff Area=27,332 sf 42.67% Impervious Runoff Depth=0.05"
Tc=5.0 min CN=77 Runoff=0.0 cfs 0.0 af

SubcatchmentS-1B-1E: Assisted Living Runoff Area=53,724 sf 31.75% Impervious Runoff Depth=0.02"
Tc=5.0 min CN=73 Runoff=0.0 cfs 0.0 af

SubcatchmentS-1B-2: Age Restricted Runoff Area=206,575 sf 50.94% Impervious Runoff Depth=0.08"
Flow Length=375' Tc=5.0 min CN=80 Runoff=0.2 cfs 0.0 af

SubcatchmentS-1C-1: Avalon Parking Runoff Area=28,905 sf 43.77% Impervious Runoff Depth=0.05"
Tc=5.0 min CN=77 Runoff=0.0 cfs 0.0 af

SubcatchmentS-1C-2: Avalon Parking Runoff Area=82,736 sf 61.44% Impervious Runoff Depth=0.15"
Tc=5.0 min CN=84 Runoff=0.2 cfs 0.0 af

SubcatchmentS-1C-3: Avalon Sudbury Runoff Area=187,450 sf 59.27% Impervious Runoff Depth=0.13"
Tc=5.0 min CN=83 Runoff=0.4 cfs 0.0 af

SubcatchmentS-1C-4: Avalon Sudbury Runoff Area=176,027 sf 100.00% Impervious Runoff Depth=0.79"
Tc=5.0 min CN=98 Runoff=3.7 cfs 0.3 af

SubcatchmentS-1C-5: Multi-Family Runoff Area=313,748 sf 37.45% Impervious Runoff Depth=0.00"
Flow Length=1,845' Tc=12.2 min CN=67 Runoff=0.0 cfs 0.0 af

SubcatchmentS-1D: Central Pervious Runoff Area=368,478 sf 16.57% Impervious Runoff Depth=0.00"
Tc=5.0 min CN=67 Runoff=0.0 cfs 0.0 af

SubcatchmentS-1E-1: Avalon Sudbury Runoff Area=25,470 sf 100.00% Impervious Runoff Depth=0.79"
Tc=5.0 min CN=98 Runoff=0.5 cfs 0.0 af

SubcatchmentS-1E-2: Grocery Store, Runoff Area=157,982 sf 30.11% Impervious Runoff Depth=0.00"
Flow Length=533' Tc=7.7 min CN=65 Runoff=0.0 cfs 0.0 af

SubcatchmentS-1F: Offsite Farm Area Runoff Area=1,470,921 sf 29.23% Impervious Runoff Depth=0.00"
Flow Length=1,734' Tc=17.0 min UI Adjusted CN=51 Runoff=0.0 cfs 0.0 af

SubcatchmentS-1G-1: SE Retail Bldg 3 Runoff Area=26,763 sf 74.84% Impervious Runoff Depth=0.28"
Tc=5.0 min CN=89 Runoff=0.2 cfs 0.0 af

SubcatchmentS-1G-1A: SE Retail Bldg 3 Runoff Area=6,137 sf 100.00% Impervious Runoff Depth=0.79"
Tc=5.0 min CN=98 Runoff=0.1 cfs 0.0 af

SubcatchmentS-1G-2: NE Retail - Runoff Area=59,109 sf 91.46% Impervious Runoff Depth=0.56"
Tc=5.0 min CN=95 Runoff=0.9 cfs 0.1 af

SubcatchmentS-2: Southern Prop Line - Runoff Area=520 sf 35.19% Impervious Runoff Depth=0.02"
Tc=5.0 min CN=74 Runoff=0.0 cfs 0.0 af

SubcatchmentS-3: Eastern Prop Line Runoff Area=29,000 sf 0.00% Impervious Runoff Depth=0.00"
Flow Length=20' Slope=0.0810 '/' Tc=5.0 min CN=61 Runoff=0.0 cfs 0.0 af

SubcatchmentS-4: Roadway runoff from Runoff Area=45,746 sf 95.22% Impervious Runoff Depth=0.63"
Tc=5.0 min CN=96 Runoff=0.8 cfs 0.1 af

Reach R-1: Swale in WFM Parking Lot Avg. Flow Depth=0.20' Max Vel=1.38 fps Inflow=1.4 cfs 0.1 af
n=0.040 L=200.0' S=0.0140 '/' Capacity=99.3 cfs Outflow=1.3 cfs 0.1 af

Pond 1P: Bldg 4&5 Subsurface Infiltration System Peak Elev=145.42' Storage=661 cf Inflow=0.9 cfs 0.1 af
Discarded=0.2 cfs 0.1 af Primary=0.0 cfs 0.0 af Outflow=0.2 cfs 0.1 af

Pond 2P: Bldg 2 Subsurface Infiltation System Peak Elev=149.37' Storage=292 cf Inflow=0.3 cfs 0.0 af
Discarded=0.0 cfs 0.0 af Primary=0.0 cfs 0.0 af Outflow=0.0 cfs 0.0 af

Pond 3P: Subsurface Infiltration System Peak Elev=149.09' Storage=187 cf Inflow=1.3 cfs 0.1 af
Discarded=1.0 cfs 0.1 af Primary=0.0 cfs 0.0 af Outflow=1.0 cfs 0.1 af

Pond 4P: Bldg 3 Subsurface Infiltration System Peak Elev=145.92' Storage=455 cf Inflow=0.3 cfs 0.0 af
Discarded=0.0 cfs 0.0 af Primary=0.0 cfs 0.0 af Outflow=0.0 cfs 0.0 af

Pond B-1: Bio-retention Basin 1 Peak Elev=154.00' Storage=0 cf Inflow=0.0 cfs 0.0 af
Discarded=0.0 cfs 0.0 af Primary=0.0 cfs 0.0 af Outflow=0.0 cfs 0.0 af

Pond B-2: Bio-retention Basin 2 Peak Elev=152.02' Storage=33 cf Inflow=0.2 cfs 0.0 af
Discarded=0.2 cfs 0.0 af Primary=0.0 cfs 0.0 af Outflow=0.2 cfs 0.0 af

Pond B-3: Bridges Bio Reten 1 Peak Elev=149.00' Storage=2 cf Inflow=0.0 cfs 0.0 af
Discarded=0.0 cfs 0.0 af Primary=0.0 cfs 0.0 af Outflow=0.0 cfs 0.0 af

Pond B-4: Bridges Bio Reten 2 Peak Elev=148.00' Storage=1 cf Inflow=0.0 cfs 0.0 af
Discarded=0.0 cfs 0.0 af Primary=0.0 cfs 0.0 af Outflow=0.0 cfs 0.0 af

Pond P-1A: Existing Pond at Center of Peak Elev=144.74' Storage=34,809 cf Inflow=0.3 cfs 0.0 af
Outflow=0.0 cfs 0.0 af

Pond P-1B: SW Wetland/Swale at Western Prop Peak Elev=151.00' Storage=0 cf Inflow=0.0 cfs 0.0 af
24.0" Round Culvert n=0.011 L=300.0' S=0.0093 '/' Outflow=0.0 cfs 0.0 af

Pond P-C: Subsurface Infiltration System Peak Elev=152.94' Storage=522 cf Inflow=0.4 cfs 0.0 af
Discarded=0.1 cfs 0.0 af Primary=0.0 cfs 0.0 af Outflow=0.1 cfs 0.0 af

Pond P-ROOF: Perforated Pipe System Peak Elev=150.50' Storage=2,869 cf Inflow=3.7 cfs 0.3 af
Discarded=0.8 cfs 0.3 af Primary=0.0 cfs 0.0 af Outflow=0.8 cfs 0.3 af

Pond P-Roof 2: Bridges Perf Pipe System Peak Elev=150.42' Storage=670 cf Inflow=0.9 cfs 0.1 af
Discarded=0.2 cfs 0.1 af Primary=0.0 cfs 0.0 af Outflow=0.2 cfs 0.1 af

Pond ROOF: Perforated Pipe System Peak Elev=153.76' Storage=308 cf Inflow=0.5 cfs 0.0 af
Discarded=0.2 cfs 0.0 af Primary=0.0 cfs 0.0 af Outflow=0.2 cfs 0.0 af

Link DP-1: 48" RCP Across Boston Post Road Inflow=1.5 cfs 0.2 af
Primary=1.5 cfs 0.2 af

Link DP-2: Overland Flow to Boston Post Road Inflow=0.0 cfs 0.0 af
Primary=0.0 cfs 0.0 af

Link DP-3: Wetland at Northeast Corner Inflow=0.0 cfs 0.0 af
Primary=0.0 cfs 0.0 af

Total Runoff Area = 86.5 ac Runoff Volume = 0.8 af Average Runoff Depth = 0.12"
56.41% Pervious = 48.8 ac 43.59% Impervious = 37.7 ac

Summary for Subcatchment S-1A-1: WFM Parking Lot

Runoff = 1.4 cfs @ 12.08 hrs, Volume= 0.1 af, Depth= 0.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Inch Rainfall=1.00"

Area (sf)	CN	Description
87,427	98	Unconnected pavement, HSG B
9,599	61	>75% Grass cover, Good, HSG B
97,026	94	Weighted Average
9,599		9.89% Pervious Area
87,427		90.11% Impervious Area
87,427		100.00% Unconnected

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

Summary for Subcatchment S-1A-2: SW Retail - Building 2

Runoff = 0.3 cfs @ 12.16 hrs, Volume= 0.0 af, Depth= 0.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Inch Rainfall=1.00"

	Area (sf)	CN	Description
*	39,573	98	Parking
	14,094	61	>75% Grass cover, Good, HSG B
	53,667	88	Weighted Average
	14,094		26.26% Pervious Area
	39,573		73.74% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.6	50	0.0240	0.11		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.5	103	0.0330	3.69		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.7	266	0.0150	6.57	5.16	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
0.2	76	0.0050	6.02	18.90	**Pipe Channel,** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.011 Concrete pipe, straight & clean
0.5	215	0.0050	7.89	55.74	**Pipe Channel,** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.011 Concrete pipe, straight & clean
0.6	181	0.0020	4.99	35.25	**Pipe Channel,** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.011 Concrete pipe, straight & clean

10.1 891 Total

Summary for Subcatchment S-1A-2A: SW Retail - Building 2 Roof

Runoff = 0.3 cfs @ 12.07 hrs, Volume= 0.0 af, Depth= 0.79"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Inch Rainfall=1.00"

	Area (sf)	CN	Description
*	13,612	98	Rooftop
	13,612		100.00% Impervious Area

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

Summary for Subcatchment S-1A-4: Retail Roadways

Runoff = 0.5 cfs @ 12.10 hrs, Volume= 0.0 af, Depth= 0.15"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Inch Rainfall=1.00"

Area (sf)	CN	Description
105,483	98	Roofs, HSG B
62,134	61	>75% Grass cover, Good, HSG B
167,617	84	Weighted Average
62,134		37.07% Pervious Area
105,483		62.93% Impervious Area

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

Summary for Subcatchment S-1A-5: Road in front of Bridges

Runoff = 0.2 cfs @ 12.08 hrs, Volume= 0.0 af, Depth= 0.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Inch Rainfall=1.00"

Area (sf)	CN	Description
13,211	98	Roofs, HSG B
3,321	61	>75% Grass cover, Good, HSG B
16,532	91	Weighted Average
3,321		20.09% Pervious Area
13,211		79.91% Impervious Area

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

Summary for Subcatchment S-1A-6: Central Park

Runoff = 0.0 cfs @ 17.15 hrs, Volume= 0.0 af, Depth= 0.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Inch Rainfall=1.00"

Area (sf)	CN	Description
9,723	98	Roofs, HSG B
25,517	61	>75% Grass cover, Good, HSG B
35,240	71	Weighted Average
25,517		72.41% Pervious Area
9,723		27.59% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.8	50	0.0100	0.08		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
3.8	159	0.0100	0.70		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.3	162	0.0050	2.02	0.40	**Pipe Channel,** 6.0" Round Area= 0.2 sf Perim= 1.6' r= 0.13' n= 0.013 Corrugated PE, smooth interior
0.3	94	0.0100	4.54	3.56	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
1.6	354	0.0050	3.79	2.98	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
17.8	819	Total			

Summary for Subcatchment S-1B-1A: Assisted Living Facility Roof

Runoff = 0.9 cfs @ 12.07 hrs, Volume= 0.1 af, Depth= 0.79"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Inch Rainfall=1.00"

	Area (sf)	CN	Description
*	44,351	98	Roofs & Parking
	44,351		100.00% Impervious Area

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

Summary for Subcatchment S-1B-1B: Assisted Living Rear Parking

Runoff = 0.0 cfs @ 13.75 hrs, Volume= 0.0 af, Depth= 0.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Inch Rainfall=1.00"

	Area (sf)	CN	Description
*	9,084	98	Roofs & Parking
	15,152	61	>75% Grass cover, Good, HSG B
	24,236	75	Weighted Average
	15,152		62.52% Pervious Area
	9,084		37.48% Impervious Area

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

Summary for Subcatchment S-1B-1C: Assisted Living Road East Side

Runoff = 0.1 cfs @ 12.27 hrs, Volume= 0.0 af, Depth= 0.15"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Inch Rainfall=1.00"

	Area (sf)	CN	Description
*	28,975	98	Roofs & Parking
	17,954	61	>75% Grass cover, Good, HSG B
	46,929	84	Weighted Average
	17,954		38.26% Pervious Area
	28,975		61.74% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.8	50	0.0100	0.08		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.6	27	0.0100	0.70		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.4	95	0.0200	4.04	0.79	**Pipe Channel,** 6.0" Round Area= 0.2 sf Perim= 1.6' r= 0.13' n= 0.013 Corrugated PE, smooth interior
2.9	860	0.0020	4.99	35.25	**Pipe Channel,** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.011 Concrete pipe, straight & clean
14.7	1,032	Total			

Summary for Subcatchment S-1B-1D: Assisted Living Front Parking

Runoff = 0.0 cfs @ 12.42 hrs, Volume= 0.0 af, Depth= 0.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Inch Rainfall=1.00"

	Area (sf)	CN	Description
*	11,662	98	Roofs & Parking
	15,670	61	>75% Grass cover, Good, HSG B
	27,332	77	Weighted Average
	15,670		57.33% Pervious Area
	11,662		42.67% Impervious Area

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

Summary for Subcatchment S-1B-1E: Assisted Living Facility

Runoff = 0.0 cfs @ 15.09 hrs, Volume= 0.0 af, Depth= 0.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Inch Rainfall=1.00"

	Area (sf)	CN	Description
*	17,055	98	Roofs & Parking
*	36,669	61	>75% Grass cover, Good, HSG B
	53,724	73	Weighted Average
	36,669		68.25% Pervious Area
	17,055		31.75% Impervious Area

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

Summary for Subcatchment S-1B-2: Age Restricted Housing

Runoff = 0.2 cfs @ 12.30 hrs, Volume= 0.0 af, Depth= 0.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Inch Rainfall=1.00"

	Area (sf)	CN	Description
*	105,219	98	Roofs & Parking
*	101,356	61	>75% Grass cover, Good, HSG B
	206,575	80	Weighted Average
	101,356		49.06% Pervious Area
	105,219		50.94% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.20		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"
1.2	175	0.0150	2.49		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.4	150	0.0150	6.57	5.16	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
2.3	375	Total, Increased to minimum Tc = 5.0 min			

Summary for Subcatchment S-1C-1: Avalon Parking near Buildings G,F,&T1

Runoff = 0.0 cfs @ 12.42 hrs, Volume= 0.0 af, Depth= 0.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Inch Rainfall=1.00"

Area (sf)	CN	Description
12,651	98	Unconnected pavement, HSG B
16,254	61	>75% Grass cover, Good, HSG B
28,905	77	Weighted Average
16,254		56.23% Pervious Area
12,651		43.77% Impervious Area
12,651		100.00% Unconnected

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

Summary for Subcatchment S-1C-2: Avalon Parking near Buildings T,U,V

Runoff = 0.2 cfs @ 12.10 hrs, Volume= 0.0 af, Depth= 0.15"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Inch Rainfall=1.00"

Area (sf)	CN	Description
50,831	98	Unconnected pavement, HSG B
31,905	61	>75% Grass cover, Good, HSG B
82,736	84	Weighted Average
31,905		38.56% Pervious Area
50,831		61.44% Impervious Area
50,831		100.00% Unconnected

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

Summary for Subcatchment S-1C-3: Avalon Sudbury Road & Sidewalk to Subsurface Infiltration

Runoff = 0.4 cfs @ 12.11 hrs, Volume= 0.0 af, Depth= 0.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Inch Rainfall=1.00"

Area (sf)	CN	Description
111,097	98	Unconnected pavement, HSG B
76,353	61	>75% Grass cover, Good, HSG B
187,450	83	Weighted Average
76,353		40.73% Pervious Area
111,097		59.27% Impervious Area
111,097		100.00% Unconnected

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

Summary for Subcatchment S-1C-4: Avalon Sudbury Rooftop Runoff to Subsurface Infiltration

Runoff = 3.7 cfs @ 12.07 hrs, Volume= 0.3 af, Depth= 0.79"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Inch Rainfall=1.00"

Area (sf)	CN	Description
176,027	98	Unconnected pavement, HSG B
176,027		100.00% Impervious Area
176,027		100.00% Unconnected

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

Summary for Subcatchment S-1C-5: Multi-Family Housing - Direct to Pond

Runoff = 0.0 cfs @ 24.03 hrs, Volume= 0.0 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Inch Rainfall=1.00"

	Area (sf)	CN	Description
*	117,511	98	Road & Sidewalk
*	89,299	61	>75% Grass cover, Good, HSG B
	106,938	39	>75% Grass cover, Good, HSG A
	313,748	67	Weighted Average
	196,237		62.55% Pervious Area
	117,511		37.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.0200	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
3.9	500	0.0180	2.16		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.2	471	0.0150	6.57	5.16	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
0.3	141	0.0150	8.60	15.20	**Pipe Channel,** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.011 Concrete pipe, straight & clean
0.3	188	0.0150	10.42	32.74	**Pipe Channel,** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.011 Concrete pipe, straight & clean
0.9	495	0.0070	9.33	65.95	**Pipe Channel,** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.011 Concrete pipe, straight & clean
12.2	1,845	Total			

Summary for Subcatchment S-1D: Central Pervious Area

Runoff = 0.0 cfs @ 24.01 hrs, Volume= 0.0 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Inch Rainfall=1.00"

	Area (sf)	CN	Description
*	10,045	98	Road & Sidewalk
	1,564	39	>75% Grass cover, Good, HSG A
*	305,875	61	>75% Grass cover, Good, HSG B
	50,994	98	Water Surface, HSG B
	368,478	67	Weighted Average
	307,439		83.43% Pervious Area
	61,039		16.57% Impervious Area

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

Summary for Subcatchment S-1E-1: Avalon Sudbury Rooftop Runoff to Subsurface Infiltration

Runoff = 0.5 cfs @ 12.07 hrs, Volume= 0.0 af, Depth= 0.79"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Inch Rainfall=1.00"

Area (sf)	CN	Description
25,470	98	Unconnected pavement, HSG B
25,470		100.00% Impervious Area
25,470		100.00% Unconnected

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

Summary for Subcatchment S-1E-2: Grocery Store, Beltran Area & Western Prop Line

Runoff = 0.0 cfs @ 0.00 hrs, Volume= 0.0 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Inch Rainfall=1.00"

	Area (sf)	CN	Description
*	47,568	98	Roofs
*	57,122	61	>75% Grass cover, Good, HSG B
*	53,292	39	>75% Grass cover, Good, HSG A
	157,982	65	Weighted Average
	110,414		69.89% Pervious Area
	47,568		30.11% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.0200	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
1.2	178	0.0220	2.39		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.9	305	0.0100	5.36	4.21	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
7.7	533	Total			

Summary for Subcatchment S-1F: Offsite Farm Area

Runoff = 0.0 cfs @ 0.00 hrs, Volume= 0.0 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Inch Rainfall=1.00"

Area (sf)	CN	Adj	Description
10,003	98		Water Surface, HSG B
181,224	61		>75% Grass cover, Good, HSG B
859,788	30		Meadow, non-grazed, HSG A
301,859	98		Roofs, HSG B
118,047	98		Unconnected pavement, HSG B
1,470,921	54	51	Weighted Average, UI Adjusted
1,041,012			70.77% Pervious Area
429,909			29.23% Impervious Area
118,047			27.46% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.0210	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
0.6	264	0.1900	7.02		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.8	100	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
4.9	610	0.0050	2.08	1.64	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.020 Corrugated PE, corrugated interior
0.6	307	0.0100	8.51	26.74	**Pipe Channel,** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.011 Concrete pipe, straight & clean
0.3	140	0.0200	8.87	70.94	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=2.00' Z= 2.0 '/' Top.W=8.00' n= 0.022 Earth, clean & straight
4.1	172	0.0100	0.70		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	91	0.0100	6.27	50.16	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=2.00' Z= 2.0 '/' Top.W=8.00' n= 0.022 Earth, clean & straight
17.0	1,734	Total			

Summary for Subcatchment S-1G-1: SE Retail Bldg 3

Runoff = 0.2 cfs @ 12.08 hrs, Volume= 0.0 af, Depth= 0.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Inch Rainfall=1.00"

	Area (sf)	CN	Description
*	20,029	98	Roof, Parking, Sidewalk
	6,734	61	>75% Grass cover, Good, HSG B
	26,763	89	Weighted Average
	6,734		25.16% Pervious Area
	20,029		74.84% Impervious Area

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

Summary for Subcatchment S-1G-1A: SE Retail Bldg 3 Roof

Runoff = 0.1 cfs @ 12.07 hrs, Volume= 0.0 af, Depth= 0.79"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Inch Rainfall=1.00"

	Area (sf)	CN	Description
*	6,137	98	Rooftop
	6,137		100.00% Impervious Area

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

Summary for Subcatchment S-1G-2: NE Retail - Buildings 4&5

Runoff = 0.9 cfs @ 12.07 hrs, Volume= 0.1 af, Depth= 0.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Inch Rainfall=1.00"

	Area (sf)	CN	Description
*	54,061	98	Parking and Rooftop
	5,048	61	>75% Grass cover, Good, HSG B
	59,109	95	Weighted Average
	5,048		8.54% Pervious Area
	54,061		91.46% Impervious Area

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

Summary for Subcatchment S-2: Southern Prop Line - Pervious Area

Runoff = 0.0 cfs @ 14.75 hrs, Volume= 0.0 af, Depth= 0.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Inch Rainfall=1.00"

	Area (sf)	CN	Description
*	337	61	>75% Grass cover, Good, HSG B
*	183	98	Road
	520	74	Weighted Average
	337		64.81% Pervious Area
	183		35.19% Impervious Area

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

Summary for Subcatchment S-3: Eastern Prop Line

Runoff = 0.0 cfs @ 0.00 hrs, Volume= 0.0 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Inch Rainfall=1.00"

	Area (sf)	CN	Description
*	29,000	61	>75% Grass cover, Good, HSG B
	29,000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.5	20	0.0810	0.22		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
1.5	20	Total, Increased to minimum Tc = 5.0 min			

Summary for Subcatchment S-4: Roadway runoff from Rte 20

Runoff = 0.8 cfs @ 12.07 hrs, Volume= 0.1 af, Depth= 0.63"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Inch Rainfall=1.00"

	Area (sf)	CN	Description
	2,186	61	>75% Grass cover, Good, HSG B
*	43,560	98	Road
	45,746	96	Weighted Average
	2,186		4.78% Pervious Area
	43,560		95.22% Impervious Area

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

Summary for Reach R-1: Swale in WFM Parking Lot

Inflow Area = 2.2 ac, 90.11% Impervious, Inflow Depth = 0.50" for 1-Inch event
Inflow = 1.4 cfs @ 12.08 hrs, Volume= 0.1 af
Outflow = 1.3 cfs @ 12.10 hrs, Volume= 0.1 af, Atten= 5%, Lag= 1.6 min

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Max. Velocity= 1.38 fps, Min. Travel Time= 2.4 min
Avg. Velocity = 0.42 fps, Avg. Travel Time= 8.0 min

Peak Storage= 186 cf @ 12.10 hrs
Average Depth at Peak Storage= 0.20'
Bank-Full Depth= 2.00' Flow Area= 20.0 sf, Capacity= 99.3 cfs

4.00' x 2.00' deep channel, n= 0.040 Earth, cobble bottom, clean sides
Side Slope Z-value= 3.0 '/' Top Width= 16.00'
Length= 200.0' Slope= 0.0140 '/'
Inlet Invert= 155.80', Outlet Invert= 153.00'

Summary for Pond 1P: Bldg 4&5 Subsurface Infiltration System

Inflow Area = 1.4 ac, 91.46% Impervious, Inflow Depth = 0.56" for 1-Inch event
Inflow = 0.9 cfs @ 12.07 hrs, Volume= 0.1 af
Outflow = 0.2 cfs @ 11.89 hrs, Volume= 0.1 af, Atten= 76%, Lag= 0.0 min
Discarded = 0.2 cfs @ 11.89 hrs, Volume= 0.1 af
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0.0 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 145.42' @ 12.48 hrs Surf.Area= 3,918 sf Storage= 661 cf

Plug-Flow detention time= 19.9 min calculated for 0.1 af (100% of inflow)
Center-of-Mass det. time= 19.9 min (843.0 - 823.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	145.00'	3,494 cf	**30.00'W x 130.60'L x 3.50'H Field A**
			13,713 cf Overall - 4,978 cf Embedded = 8,734 cf x 40.0% Voids
#2A	145.50'	4,978 cf	**ADS_StormTech SC-740** x 108 Inside #1
			Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
			Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap
			Row Length Adjustment= +0.44' x 6.45 sf x 6 rows
#3	145.50'	63 cf	**4.00'D x 5.00'H Vertical Cone/Cylinder**-Impervious
		8,535 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	145.00'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	144.50'	**15.0" Round Culvert**
			L= 20.0' RCP, sq.cut end projecting, Ke= 0.500
			Inlet / Outlet Invert= 144.50' / 144.00' S= 0.0250 '/' Cc= 0.900
			n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.23 sf
#3	Device 2	148.30'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#4	Device 2	146.50'	**8.0" Vert. Orifice/Grate** C= 0.600

Discarded OutFlow Max=0.2 cfs @ 11.89 hrs HW=145.06' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.2 cfs)

Primary OutFlow Max=0.0 cfs @ 0.00 hrs HW=145.00' (Free Discharge)
└─**2=Culvert** (Passes 0.0 cfs of 1.1 cfs potential flow)
  ├─**3=Sharp-Crested Rectangular Weir** (Controls 0.0 cfs)
  └─**4=Orifice/Grate** (Controls 0.0 cfs)

Summary for Pond 2P: Bldg 2 Subsurface Infiltation System

Inflow Area =	0.3 ac,100.00% Impervious,	Inflow Depth = 0.79"	for 1-Inch event
Inflow =	0.3 cfs @ 12.07 hrs,	Volume=	0.0 af
Outflow =	0.0 cfs @ 12.11 hrs,	Volume=	0.0 af, Atten= 88%, Lag= 2.3 min
Discarded =	0.0 cfs @ 12.11 hrs,	Volume=	0.0 af
Primary =	0.0 cfs @ 0.00 hrs,	Volume=	0.0 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 149.37' @ 12.63 hrs Surf.Area= 622 sf Storage= 292 cf

Plug-Flow detention time= 57.5 min calculated for 0.0 af (100% of inflow)
Center-of-Mass det. time= 57.5 min (844.5 - 786.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	148.50'	445 cf	**24.83'W x 24.56'L x 2.33'H Field A**
			1,423 cf Overall - 310 cf Embedded = 1,114 cf x 40.0% Voids
#2A	149.00'	310 cf	**ADS_StormTech RC-310 +Cap** x 21 Inside #1
			Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf
			Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap
			7 Rows of 3 Chambers
#3	149.10'	24 cf	**4.00'D x 1.90'H Vertical Cone/Cylinder**
		779 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	148.50'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	149.90'	**12.0" Round Culvert** L= 501.0' Ke= 0.500
			Inlet / Outlet Invert= 149.90' / 140.93' S= 0.0179 '/' Cc= 0.900
			n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Discarded OutFlow Max=0.0 cfs @ 12.11 hrs HW=149.11' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.0 cfs @ 0.00 hrs HW=148.50' (Free Discharge)
└─**2=Culvert** (Controls 0.0 cfs)

Summary for Pond 3P: Subsurface Infiltration System

Inflow Area = 2.2 ac, 90.11% Impervious, Inflow Depth = 0.50" for 1-Inch event
Inflow = 1.3 cfs @ 12.10 hrs, Volume= 0.1 af
Outflow = 1.0 cfs @ 12.08 hrs, Volume= 0.1 af, Atten= 24%, Lag= 0.0 min
Discarded = 1.0 cfs @ 12.08 hrs, Volume= 0.1 af
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0.0 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 149.09' @ 12.17 hrs Surf.Area= 5,124 sf Storage= 187 cf

Plug-Flow detention time= 2.0 min calculated for 0.1 af (100% of inflow)
Center-of-Mass det. time= 2.0 min (839.5 - 837.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	149.00'	3,575 cf	**41.50'W x 123.48'L x 2.33'H Field A** 11,957 cf Overall - 3,018 cf Embedded = 8,939 cf x 40.0% Voids
#2A	149.50'	3,018 cf	**ADS_StormTech SC-310** x 204 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap Row Length Adjustment= +0.44' x 2.07 sf x 12 rows
#3	149.00'	628 cf	**4.00'D x 5.00'H Vertical Cone/Cylinder** x 10 -Impervious
		7,222 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	149.00'	**8.270 in/hr Exfiltration over Surface area**
#2	Primary	149.00'	**18.0" Round Culvert** L= 27.0' Ke= 0.500 Inlet / Outlet Invert= 149.00' / 148.50' S= 0.0185 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#3	Device 2	150.80'	**4.0' long Sharp-Crested Rectangular Weir** 0 End Contraction(s) 3.5' Crest Height

Discarded OutFlow Max=1.0 cfs @ 12.08 hrs HW=149.05' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 1.0 cfs)

Primary OutFlow Max=0.0 cfs @ 0.00 hrs HW=149.00' (Free Discharge)
└─**2=Culvert** (Controls 0.0 cfs)
  └─**3=Sharp-Crested Rectangular Weir** (Controls 0.0 cfs)

Summary for Pond 4P: Bldg 3 Subsurface Infiltration System

Inflow Area = 0.8 ac, 79.53% Impervious, Inflow Depth = 0.38" for 1-Inch event
Inflow = 0.3 cfs @ 12.08 hrs, Volume= 0.0 af
Outflow = 0.0 cfs @ 11.67 hrs, Volume= 0.0 af, Atten= 94%, Lag= 0.0 min
Discarded = 0.0 cfs @ 11.67 hrs, Volume= 0.0 af
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0.0 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Peak Elev= 145.92' @ 14.55 hrs Surf.Area= 868 sf Storage= 455 cf

Plug-Flow detention time= 220.6 min calculated for 0.0 af (100% of inflow)
Center-of-Mass det. time= 220.5 min (1,057.6 - 837.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	145.00'	829 cf	**34.75'W x 24.98'L x 3.50'H Field A** 3,038 cf Overall - 965 cf Embedded = 2,073 cf x 40.0% Voids
#2A	145.50'	965 cf	**ADS_StormTech SC-740 +Cap** x 21 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 7 Rows of 3 Chambers
		1,794 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	145.00'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	145.00'	**12.0" Round Culvert** L= 16.0' Ke= 0.500 Inlet / Outlet Invert= 145.00' / 144.60' S= 0.0250 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#3	Device 2	147.75'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=0.0 cfs @ 11.67 hrs HW=145.04' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.0 cfs @ 0.00 hrs HW=145.00' (Free Discharge)
└─**2=Culvert** (Controls 0.0 cfs)
  └─**3=Sharp-Crested Rectangular Weir** (Controls 0.0 cfs)

Summary for Pond B-1: Bio-retention Basin 1

Inflow Area = 0.7 ac, 43.77% Impervious, Inflow Depth = 0.05" for 1-Inch event
Inflow = 0.0 cfs @ 12.42 hrs, Volume= 0.0 af
Outflow = 0.0 cfs @ 12.43 hrs, Volume= 0.0 af, Atten= 0%, Lag= 0.9 min
Discarded = 0.0 cfs @ 12.43 hrs, Volume= 0.0 af
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0.0 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 154.00' @ 12.43 hrs Surf.Area= 2,545 sf Storage= 0 cf
Flood Elev= 155.00' Surf.Area= 3,882 sf Storage= 3,214 cf

Plug-Flow detention time= 0.9 min calculated for 0.0 af (100% of inflow)
Center-of-Mass det. time= 0.9 min (995.0 - 994.2)

Volume	Invert	Avail.Storage	Storage Description
#1	154.00'	3,214 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
154.00	2,545	0	0
155.00	3,882	3,214	3,214

Device	Routing	Invert	Outlet Devices
#1	Primary	151.00'	**12.0" Round Culvert** L= 275.0' RCP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 151.00' / 146.90' S= 0.0149 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	154.50'	**24.0" Horiz. Orifice/Grate X 2.00** C= 0.600 Limited to weir flow at low heads
#3	Discarded	154.00'	**8.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.5 cfs @ 12.43 hrs HW=154.00' (Free Discharge)
└─**3=Exfiltration** (Exfiltration Controls 0.5 cfs)

Primary OutFlow Max=0.0 cfs @ 0.00 hrs HW=154.00' (Free Discharge)
└─**1=Culvert** (Passes 0.0 cfs of 4.9 cfs potential flow)
  └─**2=Orifice/Grate** (Controls 0.0 cfs)

Summary for Pond B-2: Bio-retention Basin 2

Inflow Area = 1.9 ac, 61.44% Impervious, Inflow Depth = 0.15" for 1-Inch event
Inflow = 0.2 cfs @ 12.10 hrs, Volume= 0.0 af
Outflow = 0.2 cfs @ 12.14 hrs, Volume= 0.0 af, Atten= 11%, Lag= 2.5 min
Discarded = 0.2 cfs @ 12.14 hrs, Volume= 0.0 af
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0.0 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 152.02' @ 12.14 hrs Surf.Area= 1,386 sf Storage= 33 cf
Flood Elev= 155.00' Surf.Area= 5,206 sf Storage= 6,908 cf

Plug-Flow detention time= 2.6 min calculated for 0.0 af (100% of inflow)
Center-of-Mass det. time= 2.6 min (910.5 - 907.9)

Volume	Invert	Avail.Storage	Storage Description
#1	152.00'	6,908 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
152.00	1,364	0	0
153.00	2,290	1,827	1,827
154.00	3,513	2,902	4,729
154.50	5,206	2,180	6,908

Device	Routing	Invert	Outlet Devices
#1	Primary	150.00'	**18.0" Round Culvert** L= 11.0' RCP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 150.00' / 149.30' S= 0.0636 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf

#2	Device 1	154.00'	**24.0" Horiz. Orifice/Grate X 2.00** C= 0.600 Limited to weir flow at low heads
#3	Discarded	152.00'	**8.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.3 cfs @ 12.14 hrs HW=152.02' (Free Discharge)
└─**3=Exfiltration** (Exfiltration Controls 0.3 cfs)

Primary OutFlow Max=0.0 cfs @ 0.00 hrs HW=152.00' (Free Discharge)
└─**1=Culvert** (Passes 0.0 cfs of 9.5 cfs potential flow)
  └─**2=Orifice/Grate** (Controls 0.0 cfs)

Summary for Pond B-3: Bridges Bio Reten 1

Inflow Area = 0.6 ac, 42.67% Impervious, Inflow Depth = 0.05" for 1-Inch event
Inflow = 0.0 cfs @ 12.42 hrs, Volume= 0.0 af
Outflow = 0.0 cfs @ 12.49 hrs, Volume= 0.0 af, Atten= 9%, Lag= 4.4 min
Discarded = 0.0 cfs @ 12.49 hrs, Volume= 0.0 af
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0.0 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 149.00' @ 12.49 hrs Surf.Area= 1,162 sf Storage= 2 cf

Plug-Flow detention time= 4.5 min calculated for 0.0 af (100% of inflow)
Center-of-Mass det. time= 4.5 min (998.6 - 994.2)

Volume	Invert	Avail.Storage	Storage Description
#1	149.00'	2,850 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
149.00	1,161	254.0	0	0	1,161
150.00	1,951	272.0	1,539	1,539	1,959
150.50	3,354	354.0	1,311	2,850	6,047

Device	Routing	Invert	Outlet Devices
#1	Discarded	149.00'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	148.35'	**12.0" Round Culvert** L= 473.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 148.35' / 145.40' S= 0.0062 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#3	Device 2	150.00'	**24.0" Horiz. Orifice/Grate X 2.00** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.1 cfs @ 12.49 hrs HW=149.00' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.1 cfs)

Primary OutFlow Max=0.0 cfs @ 0.00 hrs HW=149.00' (Free Discharge)
└─**2=Culvert** (Passes 0.0 cfs of 1.5 cfs potential flow)
  └─**3=Orifice/Grate** (Controls 0.0 cfs)

Summary for Pond B-4: Bridges Bio Reten 2

Inflow Area = 0.6 ac, 37.48% Impervious, Inflow Depth = 0.03" for 1-Inch event
Inflow = 0.0 cfs @ 13.75 hrs, Volume= 0.0 af
Outflow = 0.0 cfs @ 13.85 hrs, Volume= 0.0 af, Atten= 0%, Lag= 6.2 min
Discarded = 0.0 cfs @ 13.85 hrs, Volume= 0.0 af
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0.0 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 148.00' @ 13.85 hrs Surf.Area= 819 sf Storage= 1 cf

Plug-Flow detention time= 5.9 min calculated for 0.0 af (100% of inflow)
Center-of-Mass det. time= 5.9 min (1,039.9 - 1,033.9)

Volume	Invert	Avail.Storage	Storage Description
#1	148.00'	2,767 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
148.00	819	152.0	0	0	819
149.00	1,305	171.0	1,053	1,053	1,333
150.00	2,159	200.0	1,714	2,767	2,209

Device	Routing	Invert	Outlet Devices
#1	Discarded	148.00'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	146.65'	**12.0" Round Culvert** L= 56.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 146.65' / 146.36' S= 0.0052 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#3	Device 2	149.00'	**24.0" Horiz. Orifice/Grate X 2.00** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.0 cfs @ 13.85 hrs HW=148.00' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.0 cfs @ 0.00 hrs HW=148.00' (Free Discharge)
└─**2=Culvert** (Passes 0.0 cfs of 3.0 cfs potential flow)
  └─**3=Orifice/Grate** (Controls 0.0 cfs)

Summary for Pond P-1A: Existing Pond at Center of Property

Inflow Area = 73.4 ac, 38.60% Impervious, Inflow Depth = 0.01" for 1-Inch event
Inflow = 0.3 cfs @ 12.13 hrs, Volume= 0.0 af
Outflow = 0.0 cfs @ 24.07 hrs, Volume= 0.0 af, Atten= 96%, Lag= 716.3 min
Primary = 0.0 cfs @ 24.07 hrs, Volume= 0.0 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Starting Elev= 144.70' Surf.Area= 48,178 sf Storage= 33,047 cf
Peak Elev= 144.74' @ 24.07 hrs Surf.Area= 48,280 sf Storage= 34,809 cf (1,762 cf above start)
Flood Elev= 152.00' Surf.Area= 132,117 sf Storage= 566,694 cf (533,647 cf above start)

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= 588.1 min (1,523.0 - 934.9)

Volume	Invert	Avail.Storage	Storage Description
#1	144.00'	566,694 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
144.00	46,247	909.0	0	0	46,247
145.00	49,018	939.0	47,626	47,626	50,754
146.00	53,432	1,337.0	51,209	98,835	122,849
147.00	56,882	1,331.0	55,148	153,983	124,693
148.00	64,042	21,449.0	60,427	214,410	36,594,098
149.00	70,994	2,381.0	67,488	281,898	72,753,343
150.00	84,015	2,596.0	77,413	359,311	72,838,531
151.00	99,807	2,841.0	91,798	451,109	72,944,568
152.00	132,117	5,056.0	115,585	566,694	74,336,532

Device	Routing	Invert	Outlet Devices
#1	Device 4	144.70'	**12.0" Round Culvert** L= 97.0' Ke= 0.500 Inlet / Outlet Invert= 144.70' / 143.80' S= 0.0093 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Device 3	147.00'	**24.0" W x 18.0" H Vert. Orifice/Grate** C= 0.600
#3	Device 4	144.00'	**24.0" Round Culvert** L= 57.0' Ke= 0.500 Inlet / Outlet Invert= 144.00' / 143.80' S= 0.0035 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf
#4	Primary	143.80'	**36.0" Round Culvert** L= 1,434.0' Ke= 0.500 Inlet / Outlet Invert= 143.80' / 140.93' S= 0.0020 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 7.07 sf

Primary OutFlow Max=0.0 cfs @ 24.07 hrs HW=144.74' (Free Discharge)
└─**4=Culvert** (Passes 0.0 cfs of 4.2 cfs potential flow)
  ├─**1=Culvert** (Barrel Controls 0.0 cfs @ 0.89 fps)
  └─**3=Culvert** (Passes 0.0 cfs of 2.3 cfs potential flow)
    └─**2=Orifice/Grate** (Controls 0.0 cfs)

Summary for Pond P-1B: SW Wetland/Swale at Western Prop Line

Inflow Area = 37.4 ac, 29.31% Impervious, Inflow Depth = 0.00" for 1-Inch event
Inflow = 0.0 cfs @ 0.00 hrs, Volume= 0.0 af
Outflow = 0.0 cfs @ 0.00 hrs, Volume= 0.0 af, Atten= 0%, Lag= 0.0 min
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0.0 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 151.00' @ 0.00 hrs Surf.Area= 498 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	151.00'	126,119 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
151.00	498	198.0	0	0	498
152.00	1,368	715.0	897	897	38,063
153.00	8,822	6,900.0	4,555	5,452	3,786,066
154.00	25,925	1,559.0	16,623	22,075	7,381,341
155.00	50,627	1,626.0	37,594	59,669	7,398,397
156.00	83,648	1,717.0	66,450	126,119	7,422,663

Device	Routing	Invert	Outlet Devices
#1	Primary	149.70'	**24.0" Round Culvert** L= 300.0' Ke= 0.500 Inlet / Outlet Invert= 149.70' / 146.90' S= 0.0093 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf

Primary OutFlow Max=0.0 cfs @ 0.00 hrs HW=151.00' (Free Discharge)
↑**1=Culvert** (Passes 0.0 cfs of 8.4 cfs potential flow)

Summary for Pond P-C: Subsurface Infiltration System

Inflow Area = 4.3 ac, 59.27% Impervious, Inflow Depth = 0.13" for 1-Inch event
Inflow = 0.4 cfs @ 12.11 hrs, Volume= 0.0 af
Outflow = 0.1 cfs @ 12.09 hrs, Volume= 0.0 af, Atten= 83%, Lag= 0.0 min
Discarded = 0.1 cfs @ 12.09 hrs, Volume= 0.0 af
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0.0 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 152.94' @ 13.86 hrs Surf.Area= 2,934 sf Storage= 522 cf
Flood Elev= 155.50' Surf.Area= 2,934 sf Storage= 5,785 cf

Plug-Flow detention time= 74.2 min calculated for 0.0 af (100% of inflow)
Center-of-Mass det. time= 74.2 min (991.3 - 917.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	152.50'	2,593 cf	**39.50'W x 73.64'L x 3.50'H Field A** 10,180 cf Overall - 3,698 cf Embedded = 6,483 cf x 40.0% Voids
#2A	153.00'	3,698 cf	**ADS_StormTech SC-740** x 80 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap Row Length Adjustment= +0.44' x 6.45 sf x 8 rows
#3	152.50'	126 cf	**4.00'D x 5.00'H Vertical Cone/Cylinder** x 2
		6,417 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	152.50'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	148.70'	**30.0" Round Culvert out of OCS302** L= 244.0' Ke= 0.500 Inlet / Outlet Invert= 148.70' / 146.60' S= 0.0086 '/' Cc= 0.900

			n= 0.011 Concrete pipe, straight & clean, Flow Area= 4.91 sf
#3	Device 2	155.50'	**4.0' long x 2.50' rise Sharp-Crested Rectangular Weir**
			0 End Contraction(s) 3.5' Crest Height

Discarded OutFlow Max=0.1 cfs @ 12.09 hrs HW=152.56' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.1 cfs)

Primary OutFlow Max=0.0 cfs @ 0.00 hrs HW=152.50' (Free Discharge)
└─**2=Culvert out of OCS302** (Passes 0.0 cfs of 37.7 cfs potential flow)
  └─**3=Sharp-Crested Rectangular Weir** (Controls 0.0 cfs)

Summary for Pond P-ROOF: Perforated Pipe System

Inflow Area = 4.0 ac,100.00% Impervious, Inflow Depth = 0.79" for 1-Inch event
Inflow = 3.7 cfs @ 12.07 hrs, Volume= 0.3 af
Outflow = 0.8 cfs @ 11.82 hrs, Volume= 0.3 af, Atten= 79%, Lag= 0.0 min
Discarded = 0.8 cfs @ 11.82 hrs, Volume= 0.3 af
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0.0 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 150.50' @ 12.48 hrs Surf.Area= 14,250 sf Storage= 2,869 cf

Plug-Flow detention time= 22.8 min calculated for 0.3 af (100% of inflow)
Center-of-Mass det. time= 22.8 min (809.8 - 786.9)

Volume	Invert	Avail.Storage	Storage Description
#1	150.50'	1,865 cf	**6.0" Round Pipe Storage** Inside #2
			L= 9,500.0'
#2	150.00'	7,804 cf	**1.50'W x 9,500.00'L x 1.50'H Prismatoid**
			21,375 cf Overall - 1,865 cf Embedded = 19,510 cf x 40.0% Voids
#3	150.50'	138 cf	**4.00'D x 5.50'H Vertical Cone/Cylinder** x 2 -Impervious
		9,807 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	150.00'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	151.00'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=0.8 cfs @ 11.82 hrs HW=150.06' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.8 cfs)

Primary OutFlow Max=0.0 cfs @ 0.00 hrs HW=150.00' (Free Discharge)
└─**2=Sharp-Crested Rectangular Weir** (Controls 0.0 cfs)

Summary for Pond P-Roof 2: Bridges Perf Pipe System

Inflow Area = 1.0 ac,100.00% Impervious, Inflow Depth = 0.79" for 1-Inch event
Inflow = 0.9 cfs @ 12.07 hrs, Volume= 0.1 af
Outflow = 0.2 cfs @ 11.85 hrs, Volume= 0.1 af, Atten= 76%, Lag= 0.0 min
Discarded = 0.2 cfs @ 11.85 hrs, Volume= 0.1 af
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0.0 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 150.42' @ 12.45 hrs Surf.Area= 4,013 sf Storage= 670 cf

Plug-Flow detention time= 19.2 min calculated for 0.1 af (100% of inflow)
Center-of-Mass det. time= 19.2 min (806.1 - 786.9)

Volume	Invert	Avail.Storage	Storage Description
#1	150.00'	3,043 cf	**2.00'W x 2,000.00'L x 2.00'H Prismatoid** 8,000 cf Overall - 393 cf Embedded = 7,607 cf x 40.0% Voids
#2	150.50'	393 cf	**6.0" Round Pipe Storage** Inside #1 L= 2,000.0'
#3	150.00'	75 cf	**4.00'D x 6.00'H Vertical Cone/Cylinder**
		3,511 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	150.00'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	151.50'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=0.2 cfs @ 11.85 hrs HW=150.06' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.2 cfs)

Primary OutFlow Max=0.0 cfs @ 0.00 hrs HW=150.00' (Free Discharge)
└─**2=Sharp-Crested Rectangular Weir** (Controls 0.0 cfs)

Summary for Pond ROOF: Perforated Pipe System

Inflow Area =	0.6 ac,100.00% Impervious,	Inflow Depth = 0.79"	for 1-Inch event	
Inflow =	0.5 cfs @	12.07 hrs, Volume=	0.0 af	
Outflow =	0.2 cfs @	11.93 hrs, Volume=	0.0 af,	Atten= 69%, Lag= 0.0 min
Discarded =	0.2 cfs @	11.93 hrs, Volume=	0.0 af	
Primary =	0.0 cfs @	0.00 hrs, Volume=	0.0 af	

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 153.76' @ 12.37 hrs Surf.Area= 3,000 sf Storage= 308 cf

Plug-Flow detention time= 12.6 min calculated for 0.0 af (100% of inflow)
Center-of-Mass det. time= 12.6 min (799.5 - 786.9)

Volume	Invert	Avail.Storage	Storage Description
#1	154.00'	393 cf	**6.0" Round Pipe Storage** Inside #2 L= 2,000.0'
#2	153.50'	1,643 cf	**1.50'W x 2,000.00'L x 1.50'H Prismatoid** 4,500 cf Overall - 393 cf Embedded = 4,107 cf x 40.0% Voids
#3	154.00'	63 cf	**4.00'D x 5.00'H Vertical Cone/Cylinder**
		2,098 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	153.50'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	154.50'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=0.2 cfs @ 11.93 hrs HW=153.56' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.2 cfs)

Primary OutFlow Max=0.0 cfs @ 0.00 hrs HW=153.50' (Free Discharge)
└─**2=Sharp-Crested Rectangular Weir** (Controls 0.0 cfs)

Summary for Link DP-1: 48" RCP Across Boston Post Road

Inflow Area = 85.8 ac, 43.93% Impervious, Inflow Depth > 0.02" for 1-Inch event
Inflow = 1.5 cfs @ 12.10 hrs, Volume= 0.2 af
Primary = 1.5 cfs @ 12.10 hrs, Volume= 0.2 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Link DP-2: Overland Flow to Boston Post Road

Inflow Area = 0.0 ac, 35.19% Impervious, Inflow Depth = 0.02" for 1-Inch event
Inflow = 0.0 cfs @ 14.75 hrs, Volume= 0.0 af
Primary = 0.0 cfs @ 14.75 hrs, Volume= 0.0 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Link DP-3: Wetland at Northeast Corner

Inflow Area = 0.7 ac, 0.00% Impervious, Inflow Depth = 0.00" for 1-Inch event
Inflow = 0.0 cfs @ 0.00 hrs, Volume= 0.0 af
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0.0 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

2-Year Storm Event – Proposed

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

SubcatchmentS-1A-1: WFM Parking Lot Runoff Area=97,026 sf 90.11% Impervious Runoff Depth=2.54"
Tc=5.0 min CN=94 Runoff=6.6 cfs 0.5 af

SubcatchmentS-1A-2: SW Retail - Runoff Area=53,667 sf 73.74% Impervious Runoff Depth=2.00"
Flow Length=891' Tc=10.1 min CN=88 Runoff=2.5 cfs 0.2 af

SubcatchmentS-1A-2A: SW Retail - Runoff Area=13,612 sf 100.00% Impervious Runoff Depth=2.97"
Tc=5.0 min CN=98 Runoff=1.0 cfs 0.1 af

SubcatchmentS-1A-4: Retail Roadways Runoff Area=167,617 sf 62.93% Impervious Runoff Depth=1.68"
Tc=5.0 min CN=84 Runoff=7.9 cfs 0.5 af

SubcatchmentS-1A-5: Road in front of Runoff Area=16,532 sf 79.91% Impervious Runoff Depth=2.26"
Tc=5.0 min CN=91 Runoff=1.0 cfs 0.1 af

SubcatchmentS-1A-6: Central Park Runoff Area=35,240 sf 27.59% Impervious Runoff Depth=0.88"
Flow Length=819' Tc=17.8 min CN=71 Runoff=0.5 cfs 0.1 af

SubcatchmentS-1B-1A: Assisted Living Runoff Area=44,351 sf 100.00% Impervious Runoff Depth=2.97"
Tc=5.0 min CN=98 Runoff=3.3 cfs 0.3 af

SubcatchmentS-1B-1B: Assisted Living Runoff Area=24,236 sf 37.48% Impervious Runoff Depth=1.09"
Tc=5.0 min CN=75 Runoff=0.7 cfs 0.1 af

SubcatchmentS-1B-1C: Assisted Living Runoff Area=46,929 sf 61.74% Impervious Runoff Depth=1.68"
Flow Length=1,032' Tc=14.7 min CN=84 Runoff=1.6 cfs 0.2 af

SubcatchmentS-1B-1D: Assisted Living Runoff Area=27,332 sf 42.67% Impervious Runoff Depth=1.21"
Tc=5.0 min CN=77 Runoff=0.9 cfs 0.1 af

SubcatchmentS-1B-1E: Assisted Living Runoff Area=53,724 sf 31.75% Impervious Runoff Depth=0.98"
Tc=5.0 min CN=73 Runoff=1.4 cfs 0.1 af

SubcatchmentS-1B-2: Age Restricted Runoff Area=206,575 sf 50.94% Impervious Runoff Depth=1.40"
Flow Length=375' Tc=5.0 min CN=80 Runoff=8.0 cfs 0.6 af

SubcatchmentS-1C-1: Avalon Parking Runoff Area=28,905 sf 43.77% Impervious Runoff Depth=1.21"
Tc=5.0 min CN=77 Runoff=1.0 cfs 0.1 af

SubcatchmentS-1C-2: Avalon Parking Runoff Area=82,736 sf 61.44% Impervious Runoff Depth=1.68"
Tc=5.0 min CN=84 Runoff=3.9 cfs 0.3 af

SubcatchmentS-1C-3: Avalon Sudbury Runoff Area=187,450 sf 59.27% Impervious Runoff Depth=1.61"
Tc=5.0 min CN=83 Runoff=8.4 cfs 0.6 af

SubcatchmentS-1C-4: Avalon Sudbury Runoff Area=176,027 sf 100.00% Impervious Runoff Depth=2.97"
Tc=5.0 min CN=98 Runoff=13.0 cfs 1.0 af

SubcatchmentS-1C-5: Multi-Family Runoff Area=313,748 sf 37.45% Impervious Runoff Depth=0.69"
Flow Length=1,845' Tc=12.2 min CN=67 Runoff=3.9 cfs 0.4 af

SubcatchmentS-1D: Central Pervious Runoff Area=368,478 sf 16.57% Impervious Runoff Depth=0.69"
Tc=5.0 min CN=67 Runoff=5.9 cfs 0.5 af

SubcatchmentS-1E-1: Avalon Sudbury Runoff Area=25,470 sf 100.00% Impervious Runoff Depth=2.97"
Tc=5.0 min CN=98 Runoff=1.9 cfs 0.1 af

SubcatchmentS-1E-2: Grocery Store, Runoff Area=157,982 sf 30.11% Impervious Runoff Depth=0.60"
Flow Length=533' Tc=7.7 min CN=65 Runoff=1.9 cfs 0.2 af

SubcatchmentS-1F: Offsite Farm Area Runoff Area=1,470,921 sf 29.23% Impervious Runoff Depth=0.15"
Flow Length=1,734' Tc=17.0 min UI Adjusted CN=51 Runoff=1.0 cfs 0.4 af

SubcatchmentS-1G-1: SE Retail Bldg 3 Runoff Area=26,763 sf 74.84% Impervious Runoff Depth=2.08"
Tc=5.0 min CN=89 Runoff=1.5 cfs 0.1 af

SubcatchmentS-1G-1A: SE Retail Bldg 3 Runoff Area=6,137 sf 100.00% Impervious Runoff Depth=2.97"
Tc=5.0 min CN=98 Runoff=0.5 cfs 0.0 af

SubcatchmentS-1G-2: NE Retail - Runoff Area=59,109 sf 91.46% Impervious Runoff Depth=2.64"
Tc=5.0 min CN=95 Runoff=4.1 cfs 0.3 af

SubcatchmentS-2: Southern Prop Line - Runoff Area=520 sf 35.19% Impervious Runoff Depth=1.04"
Tc=5.0 min CN=74 Runoff=0.0 cfs 0.0 af

SubcatchmentS-3: Eastern Prop Line Runoff Area=29,000 sf 0.00% Impervious Runoff Depth=0.44"
Flow Length=20' Slope=0.0810 '/' Tc=5.0 min CN=61 Runoff=0.2 cfs 0.0 af

SubcatchmentS-4: Roadway runoff from Runoff Area=45,746 sf 95.22% Impervious Runoff Depth=2.75"
Tc=5.0 min CN=96 Runoff=3.3 cfs 0.2 af

Reach R-1: Swale in WFM Parking Lot Avg. Flow Depth=0.50' Max Vel=2.33 fps Inflow=6.6 cfs 0.5 af
n=0.040 L=200.0' S=0.0140 '/' Capacity=99.3 cfs Outflow=6.4 cfs 0.5 af

Pond 1P: Bldg 4&5 Subsurface Infiltration Peak Elev=146.87' Storage=5,086 cf Inflow=4.1 cfs 0.3 af
Discarded=0.2 cfs 0.3 af Primary=0.4 cfs 0.0 af Outflow=0.6 cfs 0.3 af

Pond 2P: Bldg 2 Subsurface Infiltation System Peak Elev=150.39' Storage=664 cf Inflow=1.0 cfs 0.1 af
Discarded=0.0 cfs 0.0 af Primary=0.9 cfs 0.0 af Outflow=1.0 cfs 0.1 af

Pond 3P: Subsurface Infiltration System Peak Elev=150.87' Storage=5,882 cf Inflow=6.4 cfs 0.5 af
Discarded=1.0 cfs 0.5 af Primary=0.3 cfs 0.0 af Outflow=1.2 cfs 0.5 af

Pond 4P: Bldg 3 Subsurface Infiltration System Peak Elev=148.03' Storage=1,632 cf Inflow=2.0 cfs 0.1 af
Discarded=0.0 cfs 0.0 af Primary=2.0 cfs 0.1 af Outflow=2.0 cfs 0.1 af

Pond B-1: Bio-retention Basin 1 Peak Elev=154.08' Storage=219 cf Inflow=1.0 cfs 0.1 af
Discarded=0.5 cfs 0.1 af Primary=0.0 cfs 0.0 af Outflow=0.5 cfs 0.1 af

Pond B-2: Bio-retention Basin 2 Peak Elev=153.75' Storage=3,889 cf Inflow=3.9 cfs 0.3 af
Discarded=0.6 cfs 0.3 af Primary=0.0 cfs 0.0 af Outflow=0.6 cfs 0.3 af

Pond B-3: Bridges Bio Reten 1 Peak Elev=149.72' Storage=1,022 cf Inflow=0.9 cfs 0.1 af
Discarded=0.1 cfs 0.1 af Primary=0.0 cfs 0.0 af Outflow=0.1 cfs 0.1 af

Pond B-4: Bridges Bio Reten 2 Peak Elev=148.84' Storage=849 cf Inflow=0.7 cfs 0.1 af
Discarded=0.1 cfs 0.1 af Primary=0.0 cfs 0.0 af Outflow=0.1 cfs 0.1 af

Pond P-1A: Existing Pond at Center of Peak Elev=145.88' Storage=92,593 cf Inflow=39.7 cfs 3.0 af
Outflow=3.1 cfs 2.7 af

Pond P-1B: SW Wetland/Swale at Western Prop Peak Elev=151.01' Storage=5 cf Inflow=1.9 cfs 0.6 af
24.0" Round Culvert n=0.011 L=300.0' S=0.0093 '/' Outflow=1.9 cfs 0.6 af

Pond P-C: Subsurface Infiltration System Peak Elev=156.25' Storage=6,385 cf Inflow=8.4 cfs 0.6 af
Discarded=0.1 cfs 0.2 af Primary=8.7 cfs 0.4 af Outflow=8.8 cfs 0.5 af

Pond P-ROOF: Perforated Pipe System Peak Elev=151.99' Storage=9,707 cf Inflow=13.0 cfs 1.0 af
Discarded=0.8 cfs 0.7 af Primary=12.1 cfs 0.3 af Outflow=12.9 cfs 1.0 af

Pond P-Roof 2: Bridges Perf Pipe System Peak Elev=151.70' Storage=2,984 cf Inflow=3.3 cfs 0.3 af
Discarded=0.2 cfs 0.2 af Primary=1.2 cfs 0.0 af Outflow=1.4 cfs 0.3 af

Pond ROOF: Perforated Pipe System Peak Elev=154.63' Storage=1,603 cf Inflow=1.9 cfs 0.1 af
Discarded=0.2 cfs 0.1 af Primary=0.6 cfs 0.0 af Outflow=0.8 cfs 0.1 af

Link DP-1: 48" RCP Across Boston Post Road Inflow=17.4 cfs 4.0 af
Primary=17.4 cfs 4.0 af

Link DP-2: Overland Flow to Boston Post Road Inflow=0.0 cfs 0.0 af
Primary=0.0 cfs 0.0 af

Link DP-3: Wetland at Northeast Corner Inflow=0.2 cfs 0.0 af
Primary=0.2 cfs 0.0 af

Total Runoff Area = 86.5 ac Runoff Volume = 6.9 af Average Runoff Depth = 0.95"
56.41% Pervious = 48.8 ac 43.59% Impervious = 37.7 ac

Summary for Subcatchment S-1A-1: WFM Parking Lot

Runoff = 6.6 cfs @ 12.07 hrs, Volume= 0.5 af, Depth= 2.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.20"

Area (sf)	CN	Description
87,427	98	Unconnected pavement, HSG B
9,599	61	>75% Grass cover, Good, HSG B
97,026	94	Weighted Average
9,599		9.89% Pervious Area
87,427		90.11% Impervious Area
87,427		100.00% Unconnected

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

Summary for Subcatchment S-1A-2: SW Retail - Building 2

Runoff = 2.5 cfs @ 12.14 hrs, Volume= 0.2 af, Depth= 2.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.20"

	Area (sf)	CN	Description
*	39,573	98	Parking
	14,094	61	>75% Grass cover, Good, HSG B
	53,667	88	Weighted Average
	14,094		26.26% Pervious Area
	39,573		73.74% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.6	50	0.0240	0.11		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.5	103	0.0330	3.69		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.7	266	0.0150	6.57	5.16	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
0.2	76	0.0050	6.02	18.90	**Pipe Channel,** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.011 Concrete pipe, straight & clean
0.5	215	0.0050	7.89	55.74	**Pipe Channel,** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.011 Concrete pipe, straight & clean
0.6	181	0.0020	4.99	35.25	**Pipe Channel,** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.011 Concrete pipe, straight & clean

10.1	891	Total

Summary for Subcatchment S-1A-2A: SW Retail - Building 2 Roof

Runoff = 1.0 cfs @ 12.07 hrs, Volume= 0.1 af, Depth= 2.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.20"

	Area (sf)	CN	Description
*	13,612	98	Rooftop
	13,612		100.00% Impervious Area

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

Summary for Subcatchment S-1A-4: Retail Roadways

Runoff = 7.9 cfs @ 12.08 hrs, Volume= 0.5 af, Depth= 1.68"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.20"

Area (sf)	CN	Description
105,483	98	Roofs, HSG B
62,134	61	>75% Grass cover, Good, HSG B
167,617	84	Weighted Average
62,134		37.07% Pervious Area
105,483		62.93% Impervious Area

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

Summary for Subcatchment S-1A-5: Road in front of Bridges

Runoff = 1.0 cfs @ 12.07 hrs, Volume= 0.1 af, Depth= 2.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.20"

Area (sf)	CN	Description
13,211	98	Roofs, HSG B
3,321	61	>75% Grass cover, Good, HSG B
16,532	91	Weighted Average
3,321		20.09% Pervious Area
13,211		79.91% Impervious Area

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

Summary for Subcatchment S-1A-6: Central Park

Runoff = 0.5 cfs @ 12.28 hrs, Volume= 0.1 af, Depth= 0.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.20"

Area (sf)	CN	Description
9,723	98	Roofs, HSG B
25,517	61	>75% Grass cover, Good, HSG B
35,240	71	Weighted Average
25,517		72.41% Pervious Area
9,723		27.59% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.8	50	0.0100	0.08		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
3.8	159	0.0100	0.70		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.3	162	0.0050	2.02	0.40	**Pipe Channel,** 6.0" Round Area= 0.2 sf Perim= 1.6' r= 0.13' n= 0.013 Corrugated PE, smooth interior
0.3	94	0.0100	4.54	3.56	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
1.6	354	0.0050	3.79	2.98	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
17.8	819	Total			

Summary for Subcatchment S-1B-1A: Assisted Living Facility Roof

Runoff = 3.3 cfs @ 12.07 hrs, Volume= 0.3 af, Depth= 2.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.20"

	Area (sf)	CN	Description
*	44,351	98	Roofs & Parking
	44,351		100.00% Impervious Area

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

Summary for Subcatchment S-1B-1B: Assisted Living Rear Parking

Runoff = 0.7 cfs @ 12.08 hrs, Volume= 0.1 af, Depth= 1.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.20"

	Area (sf)	CN	Description
*	9,084	98	Roofs & Parking
	15,152	61	>75% Grass cover, Good, HSG B
	24,236	75	Weighted Average
	15,152		62.52% Pervious Area
	9,084		37.48% Impervious Area

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

Summary for Subcatchment S-1B-1C: Assisted Living Road East Side

Runoff = 1.6 cfs @ 12.20 hrs, Volume= 0.2 af, Depth= 1.68"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.20"

	Area (sf)	CN	Description
*	28,975	98	Roofs & Parking
	17,954	61	>75% Grass cover, Good, HSG B
	46,929	84	Weighted Average
	17,954		38.26% Pervious Area
	28,975		61.74% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.8	50	0.0100	0.08		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.6	27	0.0100	0.70		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.4	95	0.0200	4.04	0.79	**Pipe Channel,** 6.0" Round Area= 0.2 sf Perim= 1.6' r= 0.13' n= 0.013 Corrugated PE, smooth interior
2.9	860	0.0020	4.99	35.25	**Pipe Channel,** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.011 Concrete pipe, straight & clean
14.7	1,032	Total			

Summary for Subcatchment S-1B-1D: Assisted Living Front Parking

Runoff = 0.9 cfs @ 12.08 hrs, Volume= 0.1 af, Depth= 1.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.20"

	Area (sf)	CN	Description
*	11,662	98	Roofs & Parking
	15,670	61	>75% Grass cover, Good, HSG B
	27,332	77	Weighted Average
	15,670		57.33% Pervious Area
	11,662		42.67% Impervious Area

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

Summary for Subcatchment S-1B-1E: Assisted Living Facility

Runoff = 1.4 cfs @ 12.08 hrs, Volume= 0.1 af, Depth= 0.98"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.20"

	Area (sf)	CN	Description
*	17,055	98	Roofs & Parking
*	36,669	61	>75% Grass cover, Good, HSG B
	53,724	73	Weighted Average
	36,669		68.25% Pervious Area
	17,055		31.75% Impervious Area

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

Summary for Subcatchment S-1B-2: Age Restricted Housing

Runoff = 8.0 cfs @ 12.08 hrs, Volume= 0.6 af, Depth= 1.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.20"

	Area (sf)	CN	Description
*	105,219	98	Roofs & Parking
*	101,356	61	>75% Grass cover, Good, HSG B
	206,575	80	Weighted Average
	101,356		49.06% Pervious Area
	105,219		50.94% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.20		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"
1.2	175	0.0150	2.49		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.4	150	0.0150	6.57	5.16	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
2.3	375	Total, Increased to minimum Tc = 5.0 min			

Summary for Subcatchment S-1C-1: Avalon Parking near Buildings G,F,&T1

Runoff = 1.0 cfs @ 12.08 hrs, Volume= 0.1 af, Depth= 1.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.20"

Area (sf)	CN	Description
12,651	98	Unconnected pavement, HSG B
16,254	61	>75% Grass cover, Good, HSG B
28,905	77	Weighted Average
16,254		56.23% Pervious Area
12,651		43.77% Impervious Area
12,651		100.00% Unconnected

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

Summary for Subcatchment S-1C-2: Avalon Parking near Buildings T,U,V

Runoff = 3.9 cfs @ 12.08 hrs, Volume= 0.3 af, Depth= 1.68"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.20"

Area (sf)	CN	Description
50,831	98	Unconnected pavement, HSG B
31,905	61	>75% Grass cover, Good, HSG B
82,736	84	Weighted Average
31,905		38.56% Pervious Area
50,831		61.44% Impervious Area
50,831		100.00% Unconnected

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

Summary for Subcatchment S-1C-3: Avalon Sudbury Road & Sidewalk to Subsurface Infiltration

Runoff = 8.4 cfs @ 12.08 hrs, Volume= 0.6 af, Depth= 1.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.20"

Area (sf)	CN	Description
111,097	98	Unconnected pavement, HSG B
76,353	61	>75% Grass cover, Good, HSG B
187,450	83	Weighted Average
76,353		40.73% Pervious Area
111,097		59.27% Impervious Area
111,097		100.00% Unconnected

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

Summary for Subcatchment S-1C-4: Avalon Sudbury Rooftop Runoff to Subsurface Infiltration

Runoff = 13.0 cfs @ 12.07 hrs, Volume= 1.0 af, Depth= 2.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.20"

Area (sf)	CN	Description
176,027	98	Unconnected pavement, HSG B
176,027		100.00% Impervious Area
176,027		100.00% Unconnected

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

Summary for Subcatchment S-1C-5: Multi-Family Housing - Direct to Pond

Runoff = 3.9 cfs @ 12.19 hrs, Volume= 0.4 af, Depth= 0.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.20"

	Area (sf)	CN	Description
*	117,511	98	Road & Sidewalk
*	89,299	61	>75% Grass cover, Good, HSG B
	106,938	39	>75% Grass cover, Good, HSG A
	313,748	67	Weighted Average
	196,237		62.55% Pervious Area
	117,511		37.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.0200	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
3.9	500	0.0180	2.16		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.2	471	0.0150	6.57	5.16	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
0.3	141	0.0150	8.60	15.20	**Pipe Channel,** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.011 Concrete pipe, straight & clean
0.3	188	0.0150	10.42	32.74	**Pipe Channel,** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.011 Concrete pipe, straight & clean
0.9	495	0.0070	9.33	65.95	**Pipe Channel,** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.011 Concrete pipe, straight & clean
12.2	1,845	Total			

Summary for Subcatchment S-1D: Central Pervious Area

Runoff = 5.9 cfs @ 12.09 hrs, Volume= 0.5 af, Depth= 0.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.20"

	Area (sf)	CN	Description
*	10,045	98	Road & Sidewalk
	1,564	39	>75% Grass cover, Good, HSG A
*	305,875	61	>75% Grass cover, Good, HSG B
	50,994	98	Water Surface, HSG B
	368,478	67	Weighted Average
	307,439		83.43% Pervious Area
	61,039		16.57% Impervious Area

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

Summary for Subcatchment S-1E-1: Avalon Sudbury Rooftop Runoff to Subsurface Infiltration

Runoff = 1.9 cfs @ 12.07 hrs, Volume= 0.1 af, Depth= 2.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.20"

Area (sf)	CN	Description
25,470	98	Unconnected pavement, HSG B
25,470		100.00% Impervious Area
25,470		100.00% Unconnected

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

Summary for Subcatchment S-1E-2: Grocery Store, Beltran Area & Western Prop Line

Runoff = 1.9 cfs @ 12.13 hrs, Volume= 0.2 af, Depth= 0.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.20"

	Area (sf)	CN	Description
*	47,568	98	Roofs
*	57,122	61	>75% Grass cover, Good, HSG B
*	53,292	39	>75% Grass cover, Good, HSG A
	157,982	65	Weighted Average
	110,414		69.89% Pervious Area
	47,568		30.11% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.0200	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
1.2	178	0.0220	2.39		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.9	305	0.0100	5.36	4.21	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
7.7	533	Total			

Summary for Subcatchment S-1F: Offsite Farm Area

Runoff = 1.0 cfs @ 12.60 hrs, Volume= 0.4 af, Depth= 0.15"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.20"

Area (sf)	CN	Adj	Description
10,003	98		Water Surface, HSG B
181,224	61		>75% Grass cover, Good, HSG B
859,788	30		Meadow, non-grazed, HSG A
301,859	98		Roofs, HSG B
118,047	98		Unconnected pavement, HSG B
1,470,921	54	51	Weighted Average, UI Adjusted
1,041,012			70.77% Pervious Area
429,909			29.23% Impervious Area
118,047			27.46% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.0210	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
0.6	264	0.1900	7.02		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.8	100	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
4.9	610	0.0050	2.08	1.64	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.020 Corrugated PE, corrugated interior
0.6	307	0.0100	8.51	26.74	**Pipe Channel,** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.011 Concrete pipe, straight & clean
0.3	140	0.0200	8.87	70.94	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=2.00' Z= 2.0 '/' Top.W=8.00' n= 0.022 Earth, clean & straight
4.1	172	0.0100	0.70		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	91	0.0100	6.27	50.16	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=2.00' Z= 2.0 '/' Top.W=8.00' n= 0.022 Earth, clean & straight
17.0	1,734	Total			

Summary for Subcatchment S-1G-1: SE Retail Bldg 3

Runoff = 1.5 cfs @ 12.07 hrs, Volume= 0.1 af, Depth= 2.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.20"

	Area (sf)	CN	Description
*	20,029	98	Roof, Parking, Sidewalk
	6,734	61	>75% Grass cover, Good, HSG B
	26,763	89	Weighted Average
	6,734		25.16% Pervious Area
	20,029		74.84% Impervious Area

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

Summary for Subcatchment S-1G-1A: SE Retail Bldg 3 Roof

Runoff = 0.5 cfs @ 12.07 hrs, Volume= 0.0 af, Depth= 2.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.20"

	Area (sf)	CN	Description
*	6,137	98	Rooftop
	6,137		100.00% Impervious Area

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

Summary for Subcatchment S-1G-2: NE Retail - Buildings 4&5

Runoff = 4.1 cfs @ 12.07 hrs, Volume= 0.3 af, Depth= 2.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.20"

	Area (sf)	CN	Description
*	54,061	98	Parking and Rooftop
	5,048	61	>75% Grass cover, Good, HSG B
	59,109	95	Weighted Average
	5,048		8.54% Pervious Area
	54,061		91.46% Impervious Area

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

Summary for Subcatchment S-2: Southern Prop Line - Pervious Area

Runoff = 0.0 cfs @ 12.08 hrs, Volume= 0.0 af, Depth= 1.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.20"

	Area (sf)	CN	Description
*	337	61	>75% Grass cover, Good, HSG B
*	183	98	Road
	520	74	Weighted Average
	337		64.81% Pervious Area
	183		35.19% Impervious Area

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

Summary for Subcatchment S-3: Eastern Prop Line

Runoff = 0.2 cfs @ 12.11 hrs, Volume= 0.0 af, Depth= 0.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.20"

	Area (sf)	CN	Description
*	29,000	61	>75% Grass cover, Good, HSG B
	29,000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.5	20	0.0810	0.22		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
1.5	20	Total, Increased to minimum Tc = 5.0 min			

Summary for Subcatchment S-4: Roadway runoff from Rte 20

Runoff = 3.3 cfs @ 12.07 hrs, Volume= 0.2 af, Depth= 2.75"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.20"

	Area (sf)	CN	Description
	2,186	61	>75% Grass cover, Good, HSG B
*	43,560	98	Road
	45,746	96	Weighted Average
	2,186		4.78% Pervious Area
	43,560		95.22% Impervious Area

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

Summary for Reach R-1: Swale in WFM Parking Lot

Inflow Area = 2.2 ac, 90.11% Impervious, Inflow Depth = 2.54" for 2-Year event
Inflow = 6.6 cfs @ 12.07 hrs, Volume= 0.5 af
Outflow = 6.4 cfs @ 12.09 hrs, Volume= 0.5 af, Atten= 2%, Lag= 1.0 min

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Max. Velocity= 2.33 fps, Min. Travel Time= 1.4 min
Avg. Velocity = 0.64 fps, Avg. Travel Time= 5.2 min

Peak Storage= 553 cf @ 12.09 hrs
Average Depth at Peak Storage= 0.50'
Bank-Full Depth= 2.00' Flow Area= 20.0 sf, Capacity= 99.3 cfs

4.00' x 2.00' deep channel, n= 0.040 Earth, cobble bottom, clean sides
Side Slope Z-value= 3.0 '/' Top Width= 16.00'
Length= 200.0' Slope= 0.0140 '/'
Inlet Invert= 155.80', Outlet Invert= 153.00'

‡

Summary for Pond 1P: Bldg 4&5 Subsurface Infiltration System

Inflow Area =	1.4 ac,	91.46% Impervious,	Inflow Depth = 2.64"	for 2-Year event		
Inflow =	4.1 cfs @	12.07 hrs,	Volume=	0.3 af		
Outflow =	0.6 cfs @	12.54 hrs,	Volume=	0.3 af,	Atten= 85%,	Lag= 28.2 min
Discarded =	0.2 cfs @	10.80 hrs,	Volume=	0.3 af		
Primary =	0.4 cfs @	12.54 hrs,	Volume=	0.0 af		

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 146.87' @ 12.54 hrs Surf.Area= 3,918 sf Storage= 5,086 cf

Plug-Flow detention time= 150.8 min calculated for 0.3 af (100% of inflow)
Center-of-Mass det. time= 150.8 min (930.8 - 780.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	145.00'	3,494 cf	**30.00'W x 130.60'L x 3.50'H Field A** 13,713 cf Overall - 4,978 cf Embedded = 8,734 cf x 40.0% Voids
#2A	145.50'	4,978 cf	**ADS_StormTech SC-740** x 108 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap Row Length Adjustment= +0.44' x 6.45 sf x 6 rows
#3	145.50'	63 cf	**4.00'D x 5.00'H Vertical Cone/Cylinder**-Impervious
		8,535 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	145.00'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	144.50'	**15.0" Round Culvert** L= 20.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 144.50' / 144.00' S= 0.0250 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.23 sf
#3	Device 2	148.30'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#4	Device 2	146.50'	**8.0" Vert. Orifice/Grate** C= 0.600

Discarded OutFlow Max=0.2 cfs @ 10.80 hrs HW=145.06' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.2 cfs)

Primary OutFlow Max=0.4 cfs @ 12.54 hrs HW=146.87' (Free Discharge)
└─**2=Culvert** (Passes 0.4 cfs of 7.8 cfs potential flow)
  ├─**3=Sharp-Crested Rectangular Weir**(Controls 0.0 cfs)
  └─**4=Orifice/Grate** (Orifice Controls 0.4 cfs @ 2.08 fps)

Summary for Pond 2P: Bldg 2 Subsurface Infiltation System

Inflow Area = 0.3 ac,100.00% Impervious, Inflow Depth = 2.97" for 2-Year event
Inflow = 1.0 cfs @ 12.07 hrs, Volume= 0.1 af
Outflow = 1.0 cfs @ 12.09 hrs, Volume= 0.1 af, Atten= 4%, Lag= 1.4 min
Discarded = 0.0 cfs @ 11.38 hrs, Volume= 0.0 af
Primary = 0.9 cfs @ 12.09 hrs, Volume= 0.0 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 150.39' @ 12.09 hrs Surf.Area= 622 sf Storage= 664 cf

Plug-Flow detention time= 82.1 min calculated for 0.1 af (100% of inflow)
Center-of-Mass det. time= 82.1 min (837.6 - 755.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	148.50'	445 cf	**24.83'W x 24.56'L x 2.33'H Field A** 1,423 cf Overall - 310 cf Embedded = 1,114 cf x 40.0% Voids
#2A	149.00'	310 cf	**ADS_StormTech RC-310 +Cap** x 21 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap 7 Rows of 3 Chambers
#3	149.10'	24 cf	**4.00'D x 1.90'H Vertical Cone/Cylinder**
		779 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	148.50'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	149.90'	**12.0" Round Culvert** L= 501.0' Ke= 0.500 Inlet / Outlet Invert= 149.90' / 140.93' S= 0.0179 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Discarded OutFlow Max=0.0 cfs @ 11.38 hrs HW=149.10' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.9 cfs @ 12.09 hrs HW=150.39' (Free Discharge)
└─**2=Culvert** (Inlet Controls 0.9 cfs @ 2.39 fps)

Summary for Pond 3P: Subsurface Infiltration System

Inflow Area = 2.2 ac, 90.11% Impervious, Inflow Depth = 2.54" for 2-Year event
Inflow = 6.4 cfs @ 12.09 hrs, Volume= 0.5 af
Outflow = 1.2 cfs @ 12.53 hrs, Volume= 0.5 af, Atten= 81%, Lag= 26.6 min
Discarded = 1.0 cfs @ 11.69 hrs, Volume= 0.5 af
Primary = 0.3 cfs @ 12.53 hrs, Volume= 0.0 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 150.87' @ 12.53 hrs Surf.Area= 5,124 sf Storage= 5,882 cf

Plug-Flow detention time= 36.2 min calculated for 0.5 af (100% of inflow)
Center-of-Mass det. time= 36.2 min (825.8 - 789.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	149.00'	3,575 cf	**41.50'W x 123.48'L x 2.33'H Field A**
			11,957 cf Overall - 3,018 cf Embedded = 8,939 cf x 40.0% Voids
#2A	149.50'	3,018 cf	**ADS_StormTech SC-310** x 204 Inside #1
			Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf
			Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap
			Row Length Adjustment= +0.44' x 2.07 sf x 12 rows
#3	149.00'	628 cf	**4.00'D x 5.00'H Vertical Cone/Cylinder** x 10 -Impervious
		7,222 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	149.00'	**8.270 in/hr Exfiltration over Surface area**
#2	Primary	149.00'	**18.0" Round Culvert** L= 27.0' Ke= 0.500
			Inlet / Outlet Invert= 149.00' / 148.50' S= 0.0185 '/' Cc= 0.900
			n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#3	Device 2	150.80'	**4.0' long Sharp-Crested Rectangular Weir** 0 End Contraction(s)
			3.5' Crest Height

Discarded OutFlow Max=1.0 cfs @ 11.69 hrs HW=149.05' (Free Discharge)
└—**1=Exfiltration** (Exfiltration Controls 1.0 cfs)

Primary OutFlow Max=0.2 cfs @ 12.53 hrs HW=150.87' (Free Discharge)
└—**2=Culvert** (Passes 0.2 cfs of 9.0 cfs potential flow)
  └—**3=Sharp-Crested Rectangular Weir** (Weir Controls 0.2 cfs @ 0.87 fps)

Summary for Pond 4P: Bldg 3 Subsurface Infiltration System

Inflow Area = 0.8 ac, 79.53% Impervious, Inflow Depth = 2.25" for 2-Year event
Inflow = 2.0 cfs @ 12.07 hrs, Volume= 0.1 af
Outflow = 2.0 cfs @ 12.08 hrs, Volume= 0.1 af, Atten= 1%, Lag= 0.7 min
Discarded = 0.0 cfs @ 8.36 hrs, Volume= 0.0 af
Primary = 2.0 cfs @ 12.08 hrs, Volume= 0.1 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Peak Elev= 148.03' @ 12.08 hrs Surf.Area= 868 sf Storage= 1,632 cf

Plug-Flow detention time= 243.7 min calculated for 0.1 af (89% of inflow)
Center-of-Mass det. time= 193.3 min (990.0 - 796.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	145.00'	829 cf	**34.75'W x 24.98'L x 3.50'H Field A** 3,038 cf Overall - 965 cf Embedded = 2,073 cf x 40.0% Voids
#2A	145.50'	965 cf	**ADS_StormTech SC-740 +Cap** x 21 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 7 Rows of 3 Chambers
		1,794 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	145.00'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	145.00'	**12.0" Round Culvert** L= 16.0' Ke= 0.500 Inlet / Outlet Invert= 145.00' / 144.60' S= 0.0250 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#3	Device 2	147.75'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=0.0 cfs @ 8.36 hrs HW=145.04' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=1.9 cfs @ 12.08 hrs HW=148.03' (Free Discharge)
└─**2=Culvert** (Passes 1.9 cfs of 6.0 cfs potential flow)
  └─**3=Sharp-Crested Rectangular Weir** (Weir Controls 1.9 cfs @ 1.74 fps)

Summary for Pond B-1: Bio-retention Basin 1

Inflow Area =	0.7 ac, 43.77% Impervious, Inflow Depth = 1.21"	for 2-Year event
Inflow =	1.0 cfs @ 12.08 hrs, Volume=	0.1 af
Outflow =	0.5 cfs @ 12.22 hrs, Volume=	0.1 af, Atten= 47%, Lag= 8.3 min
Discarded =	0.5 cfs @ 12.22 hrs, Volume=	0.1 af
Primary =	0.0 cfs @ 0.00 hrs, Volume=	0.0 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 154.08' @ 12.22 hrs Surf.Area= 2,657 sf Storage= 219 cf
Flood Elev= 155.00' Surf.Area= 3,882 sf Storage= 3,214 cf

Plug-Flow detention time= 2.3 min calculated for 0.1 af (100% of inflow)
Center-of-Mass det. time= 2.3 min (853.7 - 851.4)

Volume	Invert	Avail.Storage	Storage Description
#1	154.00'	3,214 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
154.00	2,545	0	0
155.00	3,882	3,214	3,214

Device	Routing	Invert	Outlet Devices
#1	Primary	151.00'	**12.0" Round Culvert** L= 275.0' RCP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 151.00' / 146.90' S= 0.0149 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	154.50'	**24.0" Horiz. Orifice/Grate X 2.00** C= 0.600 Limited to weir flow at low heads
#3	Discarded	154.00'	**8.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.5 cfs @ 12.22 hrs HW=154.08' (Free Discharge)
└─**3=Exfiltration** (Exfiltration Controls 0.5 cfs)

Primary OutFlow Max=0.0 cfs @ 0.00 hrs HW=154.00' (Free Discharge)
└─**1=Culvert** (Passes 0.0 cfs of 4.9 cfs potential flow)
  └─**2=Orifice/Grate** (Controls 0.0 cfs)

Summary for Pond B-2: Bio-retention Basin 2

Inflow Area =	1.9 ac, 61.44% Impervious, Inflow Depth = 1.68"	for 2-Year event	
Inflow =	3.9 cfs @ 12.08 hrs, Volume=	0.3 af	
Outflow =	0.6 cfs @ 12.57 hrs, Volume=	0.3 af,	Atten= 84%, Lag= 29.5 min
Discarded =	0.6 cfs @ 12.57 hrs, Volume=	0.3 af	
Primary =	0.0 cfs @ 0.00 hrs, Volume=	0.0 af	

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 153.75' @ 12.57 hrs Surf.Area= 3,208 sf Storage= 3,889 cf
Flood Elev= 155.00' Surf.Area= 5,206 sf Storage= 6,908 cf

Plug-Flow detention time= 56.9 min calculated for 0.3 af (100% of inflow)
Center-of-Mass det. time= 56.9 min (885.5 - 828.6)

Volume	Invert	Avail.Storage	Storage Description
#1	152.00'	6,908 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
152.00	1,364	0	0
153.00	2,290	1,827	1,827
154.00	3,513	2,902	4,729
154.50	5,206	2,180	6,908

Device	Routing	Invert	Outlet Devices
#1	Primary	150.00'	**18.0" Round Culvert** L= 11.0' RCP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 150.00' / 149.30' S= 0.0636 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf

#2	Device 1	154.00'	**24.0" Horiz. Orifice/Grate X 2.00** C= 0.600 Limited to weir flow at low heads
#3	Discarded	152.00'	**8.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.6 cfs @ 12.57 hrs HW=153.75' (Free Discharge)
└─**3=Exfiltration** (Exfiltration Controls 0.6 cfs)

Primary OutFlow Max=0.0 cfs @ 0.00 hrs HW=152.00' (Free Discharge)
└─**1=Culvert** (Passes 0.0 cfs of 9.5 cfs potential flow)
  └─**2=Orifice/Grate** (Controls 0.0 cfs)

Summary for Pond B-3: Bridges Bio Reten 1

Inflow Area = 0.6 ac, 42.67% Impervious, Inflow Depth = 1.21" for 2-Year event
Inflow = 0.9 cfs @ 12.08 hrs, Volume= 0.1 af
Outflow = 0.1 cfs @ 13.03 hrs, Volume= 0.1 af, Atten= 89%, Lag= 57.2 min
Discarded = 0.1 cfs @ 13.03 hrs, Volume= 0.1 af
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0.0 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 149.72' @ 13.03 hrs Surf.Area= 1,707 sf Storage= 1,022 cf

Plug-Flow detention time= 105.7 min calculated for 0.1 af (100% of inflow)
Center-of-Mass det. time= 105.7 min (957.1 - 851.4)

Volume	Invert	Avail.Storage	Storage Description
#1	149.00'	2,850 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
149.00	1,161	254.0	0	0	1,161
150.00	1,951	272.0	1,539	1,539	1,959
150.50	3,354	354.0	1,311	2,850	6,047

Device	Routing	Invert	Outlet Devices
#1	Discarded	149.00'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	148.35'	**12.0" Round Culvert** L= 473.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 148.35' / 145.40' S= 0.0062 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#3	Device 2	150.00'	**24.0" Horiz. Orifice/Grate X 2.00** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.1 cfs @ 13.03 hrs HW=149.72' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.1 cfs)

Primary OutFlow Max=0.0 cfs @ 0.00 hrs HW=149.00' (Free Discharge)
└─**2=Culvert** (Passes 0.0 cfs of 1.5 cfs potential flow)
  └─**3=Orifice/Grate** (Controls 0.0 cfs)

Summary for Pond B-4: Bridges Bio Reten 2

Inflow Area = 0.6 ac, 37.48% Impervious, Inflow Depth = 1.09" for 2-Year event
Inflow = 0.7 cfs @ 12.08 hrs, Volume= 0.1 af
Outflow = 0.1 cfs @ 13.39 hrs, Volume= 0.1 af, Atten= 90%, Lag= 78.7 min
Discarded = 0.1 cfs @ 13.39 hrs, Volume= 0.1 af
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0.0 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 148.84' @ 13.39 hrs Surf.Area= 1,219 sf Storage= 849 cf

Plug-Flow detention time= 130.6 min calculated for 0.1 af (100% of inflow)
Center-of-Mass det. time= 130.5 min (988.4 - 857.9)

Volume	Invert	Avail.Storage	Storage Description
#1	148.00'	2,767 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
148.00	819	152.0	0	0	819
149.00	1,305	171.0	1,053	1,053	1,333
150.00	2,159	200.0	1,714	2,767	2,209

Device	Routing	Invert	Outlet Devices
#1	Discarded	148.00'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	146.65'	**12.0" Round Culvert** L= 56.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 146.65' / 146.36' S= 0.0052 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#3	Device 2	149.00'	**24.0" Horiz. Orifice/Grate X 2.00** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.1 cfs @ 13.39 hrs HW=148.84' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.1 cfs)

Primary OutFlow Max=0.0 cfs @ 0.00 hrs HW=148.00' (Free Discharge)
└─**2=Culvert** (Passes 0.0 cfs of 3.0 cfs potential flow)
  └─**3=Orifice/Grate** (Controls 0.0 cfs)

Summary for Pond P-1A: Existing Pond at Center of Property

Inflow Area = 73.4 ac, 38.60% Impervious, Inflow Depth = 0.48" for 2-Year event
Inflow = 39.7 cfs @ 12.11 hrs, Volume= 3.0 af
Outflow = 3.1 cfs @ 14.25 hrs, Volume= 2.7 af, Atten= 92%, Lag= 128.5 min
Primary = 3.1 cfs @ 14.25 hrs, Volume= 2.7 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Starting Elev= 144.70' Surf.Area= 48,178 sf Storage= 33,047 cf
Peak Elev= 145.88' @ 14.25 hrs Surf.Area= 52,904 sf Storage= 92,593 cf (59,547 cf above start)
Flood Elev= 152.00' Surf.Area= 132,117 sf Storage= 566,694 cf (533,647 cf above start)

Plug-Flow detention time= 499.7 min calculated for 2.0 af (67% of inflow)
Center-of-Mass det. time= 268.1 min (1,142.0 - 873.9)

Volume	Invert	Avail.Storage	Storage Description
#1	144.00'	566,694 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
144.00	46,247	909.0	0	0	46,247
145.00	49,018	939.0	47,626	47,626	50,754
146.00	53,432	1,337.0	51,209	98,835	122,849
147.00	56,882	1,331.0	55,148	153,983	124,693
148.00	64,042	21,449.0	60,427	214,410	36,594,098
149.00	70,994	2,381.0	67,488	281,898	72,753,343
150.00	84,015	2,596.0	77,413	359,311	72,838,531
151.00	99,807	2,841.0	91,798	451,109	72,944,568
152.00	132,117	5,056.0	115,585	566,694	74,336,532

Device	Routing	Invert	Outlet Devices
#1	Device 4	144.70'	**12.0" Round Culvert** L= 97.0' Ke= 0.500 Inlet / Outlet Invert= 144.70' / 143.80' S= 0.0093 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Device 3	147.00'	**24.0" W x 18.0" H Vert. Orifice/Grate** C= 0.600
#3	Device 4	144.00'	**24.0" Round Culvert** L= 57.0' Ke= 0.500 Inlet / Outlet Invert= 144.00' / 143.80' S= 0.0035 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf
#4	Primary	143.80'	**36.0" Round Culvert** L= 1,434.0' Ke= 0.500 Inlet / Outlet Invert= 143.80' / 140.93' S= 0.0020 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 7.07 sf

Primary OutFlow Max=3.1 cfs @ 14.25 hrs HW=145.88' (Free Discharge)
└─**4=Culvert** (Passes 3.1 cfs of 18.6 cfs potential flow)
  ├─**1=Culvert** (Inlet Controls 3.1 cfs @ 3.98 fps)
  └─**3=Culvert** (Passes 0.0 cfs of 11.3 cfs potential flow)
    └─**2=Orifice/Grate** (Controls 0.0 cfs)

Summary for Pond P-1B: SW Wetland/Swale at Western Prop Line

Inflow Area = 37.4 ac, 29.31% Impervious, Inflow Depth = 0.19" for 2-Year event
Inflow = 1.9 cfs @ 12.13 hrs, Volume= 0.6 af
Outflow = 1.9 cfs @ 12.13 hrs, Volume= 0.6 af, Atten= 0%, Lag= 0.0 min
Primary = 1.9 cfs @ 12.13 hrs, Volume= 0.6 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 151.01' @ 12.13 hrs Surf.Area= 505 sf Storage= 5 cf

Plug-Flow detention time= 0.0 min calculated for 0.6 af (100% of inflow)
Center-of-Mass det. time= 0.0 min (973.9 - 973.9)

Volume	Invert	Avail.Storage	Storage Description
#1	151.00'	126,119 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
151.00	498	198.0	0	0	498
152.00	1,368	715.0	897	897	38,063
153.00	8,822	6,900.0	4,555	5,452	3,786,066
154.00	25,925	1,559.0	16,623	22,075	7,381,341
155.00	50,627	1,626.0	37,594	59,669	7,398,397
156.00	83,648	1,717.0	66,450	126,119	7,422,663

Device	Routing	Invert	Outlet Devices
#1	Primary	149.70'	**24.0" Round Culvert** L= 300.0' Ke= 0.500 Inlet / Outlet Invert= 149.70' / 146.90' S= 0.0093 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf

Primary OutFlow Max=8.5 cfs @ 12.13 hrs HW=151.01' (Free Discharge)
└─**1=Culvert** (Inlet Controls 8.5 cfs @ 3.90 fps)

Summary for Pond P-C: Subsurface Infiltration System

Inflow Area =	4.3 ac, 59.27% Impervious,	Inflow Depth = 1.61"	for 2-Year event
Inflow =	8.4 cfs @ 12.08 hrs,	Volume=	0.6 af
Outflow =	8.8 cfs @ 12.10 hrs,	Volume=	0.5 af, Atten= 0%, Lag= 1.6 min
Discarded =	0.1 cfs @ 9.87 hrs,	Volume=	0.2 af
Primary =	8.7 cfs @ 12.10 hrs,	Volume=	0.4 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 156.25' @ 12.10 hrs Surf.Area= 2,934 sf Storage= 6,385 cf
Flood Elev= 155.50' Surf.Area= 2,934 sf Storage= 5,785 cf

Plug-Flow detention time= 218.6 min calculated for 0.5 af (89% of inflow)
Center-of-Mass det. time= 165.4 min (997.4 - 832.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	152.50'	2,593 cf	**39.50'W x 73.64'L x 3.50'H Field A** 10,180 cf Overall - 3,698 cf Embedded = 6,483 cf x 40.0% Voids
#2A	153.00'	3,698 cf	**ADS_StormTech SC-740** x 80 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap Row Length Adjustment= +0.44' x 6.45 sf x 8 rows
#3	152.50'	126 cf	**4.00'D x 5.00'H Vertical Cone/Cylinder** x 2
		6,417 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	152.50'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	148.70'	**30.0" Round Culvert out of OCS302** L= 244.0' Ke= 0.500 Inlet / Outlet Invert= 148.70' / 146.60' S= 0.0086 '/' Cc= 0.900

			n= 0.011 Concrete pipe, straight & clean, Flow Area= 4.91 sf
#3	Device 2	155.50'	**4.0' long x 2.50' rise Sharp-Crested Rectangular Weir** 0 End Contraction(s) 3.5' Crest Height

Discarded OutFlow Max=0.1 cfs @ 9.87 hrs HW=152.56' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.1 cfs)

Primary OutFlow Max=8.3 cfs @ 12.10 hrs HW=156.23' (Free Discharge)
└─**2=Culvert out of OCS302** (Passes 8.3 cfs of 59.2 cfs potential flow)
  └─**3=Sharp-Crested Rectangular Weir** (Weir Controls 8.3 cfs @ 2.86 fps)

Summary for Pond P-ROOF: Perforated Pipe System

Inflow Area = 4.0 ac,100.00% Impervious, Inflow Depth = 2.97" for 2-Year event
Inflow = 13.0 cfs @ 12.07 hrs, Volume= 1.0 af
Outflow = 12.9 cfs @ 12.11 hrs, Volume= 1.0 af, Atten= 1%, Lag= 2.6 min
Discarded = 0.8 cfs @ 10.84 hrs, Volume= 0.7 af
Primary = 12.1 cfs @ 12.11 hrs, Volume= 0.3 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 151.99' @ 12.11 hrs Surf.Area= 14,250 sf Storage= 9,707 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 50.7 min (806.2 - 755.5)

Volume	Invert	Avail.Storage	Storage Description
#1	150.50'	1,865 cf	**6.0" Round Pipe Storage** Inside #2 L= 9,500.0'
#2	150.00'	7,804 cf	**1.50'W x 9,500.00'L x 1.50'H Prismatoid** 21,375 cf Overall - 1,865 cf Embedded = 19,510 cf x 40.0% Voids
#3	150.50'	138 cf	**4.00'D x 5.50'H Vertical Cone/Cylinder** x 2 -Impervious
		9,807 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	150.00'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	151.00'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=0.8 cfs @ 10.84 hrs HW=150.06' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.8 cfs)

Primary OutFlow Max=11.1 cfs @ 12.11 hrs HW=151.93' (Free Discharge)
└─**2=Sharp-Crested Rectangular Weir** (Weir Controls 11.1 cfs @ 3.15 fps)

Summary for Pond P-Roof 2: Bridges Perf Pipe System

Inflow Area = 1.0 ac,100.00% Impervious, Inflow Depth = 2.97" for 2-Year event
Inflow = 3.3 cfs @ 12.07 hrs, Volume= 0.3 af
Outflow = 1.4 cfs @ 12.23 hrs, Volume= 0.3 af, Atten= 56%, Lag= 9.8 min
Discarded = 0.2 cfs @ 11.12 hrs, Volume= 0.2 af
Primary = 1.2 cfs @ 12.23 hrs, Volume= 0.0 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 151.70' @ 12.23 hrs Surf.Area= 4,013 sf Storage= 2,984 cf

Plug-Flow detention time= 75.3 min calculated for 0.3 af (100% of inflow)
Center-of-Mass det. time= 75.3 min (830.8 - 755.5)

Volume	Invert	Avail.Storage	Storage Description
#1	150.00'	3,043 cf	**2.00'W x 2,000.00'L x 2.00'H Prismatoid** 8,000 cf Overall - 393 cf Embedded = 7,607 cf x 40.0% Voids
#2	150.50'	393 cf	**6.0" Round Pipe Storage** Inside #1 L= 2,000.0'
#3	150.00'	75 cf	**4.00'D x 6.00'H Vertical Cone/Cylinder**
		3,511 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	150.00'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	151.50'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=0.2 cfs @ 11.12 hrs HW=150.06' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.2 cfs)

Primary OutFlow Max=1.2 cfs @ 12.23 hrs HW=151.70' (Free Discharge)
└─**2=Sharp-Crested Rectangular Weir** (Weir Controls 1.2 cfs @ 1.48 fps)

Summary for Pond ROOF: Perforated Pipe System

Inflow Area =	0.6 ac,100.00% Impervious,	Inflow Depth = 2.97"	for 2-Year event
Inflow =	1.9 cfs @ 12.07 hrs,	Volume=	0.1 af
Outflow =	0.8 cfs @ 12.24 hrs,	Volume=	0.1 af, Atten= 57%, Lag= 10.0 min
Discarded =	0.2 cfs @ 11.97 hrs,	Volume=	0.1 af
Primary =	0.6 cfs @ 12.24 hrs,	Volume=	0.0 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 154.63' @ 12.24 hrs Surf.Area= 3,013 sf Storage= 1,603 cf

Plug-Flow detention time= 52.0 min calculated for 0.1 af (100% of inflow)
Center-of-Mass det. time= 52.0 min (807.4 - 755.5)

Volume	Invert	Avail.Storage	Storage Description
#1	154.00'	393 cf	**6.0" Round Pipe Storage** Inside #2 L= 2,000.0'
#2	153.50'	1,643 cf	**1.50'W x 2,000.00'L x 1.50'H Prismatoid** 4,500 cf Overall - 393 cf Embedded = 4,107 cf x 40.0% Voids
#3	154.00'	63 cf	**4.00'D x 5.00'H Vertical Cone/Cylinder**
		2,098 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	153.50'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	154.50'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=0.2 cfs @ 11.97 hrs HW=154.01' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.2 cfs)

Primary OutFlow Max=0.6 cfs @ 12.24 hrs HW=154.63' (Free Discharge)
└─**2=Sharp-Crested Rectangular Weir** (Weir Controls 0.6 cfs @ 1.19 fps)

Summary for Link DP-1: 48" RCP Across Boston Post Road

Inflow Area = 85.8 ac, 43.93% Impervious, Inflow Depth > 0.56" for 2-Year event
Inflow = 17.4 cfs @ 12.09 hrs, Volume= 4.0 af
Primary = 17.4 cfs @ 12.09 hrs, Volume= 4.0 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Link DP-2: Overland Flow to Boston Post Road

Inflow Area = 0.0 ac, 35.19% Impervious, Inflow Depth = 1.04" for 2-Year event
Inflow = 0.0 cfs @ 12.08 hrs, Volume= 0.0 af
Primary = 0.0 cfs @ 12.08 hrs, Volume= 0.0 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Link DP-3: Wetland at Northeast Corner

Inflow Area = 0.7 ac, 0.00% Impervious, Inflow Depth = 0.44" for 2-Year event
Inflow = 0.2 cfs @ 12.11 hrs, Volume= 0.0 af
Primary = 0.2 cfs @ 12.11 hrs, Volume= 0.0 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

10-Year Storm Event – Proposed

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

SubcatchmentS-1A-1: WFM Parking Lot Runoff Area=97,026 sf 90.11% Impervious Runoff Depth=4.11"
Tc=5.0 min CN=94 Runoff=10.4 cfs 0.8 af

SubcatchmentS-1A-2: SW Retail - Runoff Area=53,667 sf 73.74% Impervious Runoff Depth=3.48"
Flow Length=891' Tc=10.1 min CN=88 Runoff=4.3 cfs 0.4 af

SubcatchmentS-1A-2A: SW Retail - Runoff Area=13,612 sf 100.00% Impervious Runoff Depth=4.56"
Tc=5.0 min CN=98 Runoff=1.5 cfs 0.1 af

SubcatchmentS-1A-4: Retail Roadways Runoff Area=167,617 sf 62.93% Impervious Runoff Depth=3.09"
Tc=5.0 min CN=84 Runoff=14.4 cfs 1.0 af

SubcatchmentS-1A-5: Road in front of Runoff Area=16,532 sf 79.91% Impervious Runoff Depth=3.79"
Tc=5.0 min CN=91 Runoff=1.7 cfs 0.1 af

SubcatchmentS-1A-6: Central Park Runoff Area=35,240 sf 27.59% Impervious Runoff Depth=1.97"
Flow Length=819' Tc=17.8 min CN=71 Runoff=1.3 cfs 0.1 af

SubcatchmentS-1B-1A: Assisted Living Runoff Area=44,351 sf 100.00% Impervious Runoff Depth=4.56"
Tc=5.0 min CN=98 Runoff=5.0 cfs 0.4 af

SubcatchmentS-1B-1B: Assisted Living Runoff Area=24,236 sf 37.48% Impervious Runoff Depth=2.29"
Tc=5.0 min CN=75 Runoff=1.5 cfs 0.1 af

SubcatchmentS-1B-1C: Assisted Living Runoff Area=46,929 sf 61.74% Impervious Runoff Depth=3.09"
Flow Length=1,032' Tc=14.7 min CN=84 Runoff=3.0 cfs 0.3 af

SubcatchmentS-1B-1D: Assisted Living Runoff Area=27,332 sf 42.67% Impervious Runoff Depth=2.46"
Tc=5.0 min CN=77 Runoff=1.9 cfs 0.1 af

SubcatchmentS-1B-1E: Assisted Living Runoff Area=53,724 sf 31.75% Impervious Runoff Depth=2.12"
Tc=5.0 min CN=73 Runoff=3.2 cfs 0.2 af

SubcatchmentS-1B-2: Age Restricted Runoff Area=206,575 sf 50.94% Impervious Runoff Depth=2.72"
Flow Length=375' Tc=5.0 min CN=80 Runoff=15.7 cfs 1.1 af

SubcatchmentS-1C-1: Avalon Parking Runoff Area=28,905 sf 43.77% Impervious Runoff Depth=2.46"
Tc=5.0 min CN=77 Runoff=2.0 cfs 0.1 af

SubcatchmentS-1C-2: Avalon Parking Runoff Area=82,736 sf 61.44% Impervious Runoff Depth=3.09"
Tc=5.0 min CN=84 Runoff=7.1 cfs 0.5 af

SubcatchmentS-1C-3: Avalon Sudbury Runoff Area=187,450 sf 59.27% Impervious Runoff Depth=2.99"
Tc=5.0 min CN=83 Runoff=15.6 cfs 1.1 af

SubcatchmentS-1C-4: Avalon Sudbury Runoff Area=176,027 sf 100.00% Impervious Runoff Depth=4.56"
Tc=5.0 min CN=98 Runoff=19.6 cfs 1.5 af

SubcatchmentS-1C-5: Multi-Family Runoff Area=313,748 sf 37.45% Impervious Runoff Depth=1.67"
Flow Length=1,845' Tc=12.2 min CN=67 Runoff=11.0 cfs 1.0 af

SubcatchmentS-1D: Central Pervious Runoff Area=368,478 sf 16.57% Impervious Runoff Depth=1.67"
Tc=5.0 min CN=67 Runoff=16.4 cfs 1.2 af

SubcatchmentS-1E-1: Avalon Sudbury Runoff Area=25,470 sf 100.00% Impervious Runoff Depth=4.56"
Tc=5.0 min CN=98 Runoff=2.8 cfs 0.2 af

SubcatchmentS-1E-2: Grocery Store, Runoff Area=157,982 sf 30.11% Impervious Runoff Depth=1.52"
Flow Length=533' Tc=7.7 min CN=65 Runoff=5.7 cfs 0.5 af

SubcatchmentS-1F: Offsite Farm Area Runoff Area=1,470,921 sf 29.23% Impervious Runoff Depth=0.66"
Flow Length=1,734' Tc=17.0 min UI Adjusted CN=51 Runoff=12.1 cfs 1.9 af

SubcatchmentS-1G-1: SE Retail Bldg 3 Runoff Area=26,763 sf 74.84% Impervious Runoff Depth=3.58"
Tc=5.0 min CN=89 Runoff=2.6 cfs 0.2 af

SubcatchmentS-1G-1A: SE Retail Bldg 3 Runoff Area=6,137 sf 100.00% Impervious Runoff Depth=4.56"
Tc=5.0 min CN=98 Runoff=0.7 cfs 0.1 af

SubcatchmentS-1G-2: NE Retail - Runoff Area=59,109 sf 91.46% Impervious Runoff Depth=4.22"
Tc=5.0 min CN=95 Runoff=6.4 cfs 0.5 af

SubcatchmentS-2: Southern Prop Line - Runoff Area=520 sf 35.19% Impervious Runoff Depth=2.21"
Tc=5.0 min CN=74 Runoff=0.0 cfs 0.0 af

SubcatchmentS-3: Eastern Prop Line Runoff Area=29,000 sf 0.00% Impervious Runoff Depth=1.25"
Flow Length=20' Slope=0.0810 '/' Tc=5.0 min CN=61 Runoff=0.9 cfs 0.1 af

SubcatchmentS-4: Roadway runoff from Runoff Area=45,746 sf 95.22% Impervious Runoff Depth=4.33"
Tc=5.0 min CN=96 Runoff=5.0 cfs 0.4 af

Reach R-1: Swale in WFM Parking Lot Avg. Flow Depth=0.64' Max Vel=2.67 fps Inflow=10.4 cfs 0.8 af
n=0.040 L=200.0' S=0.0140 '/' Capacity=99.3 cfs Outflow=10.2 cfs 0.8 af

Pond 1P: Bldg 4&5 Subsurface Infiltration Peak Elev=147.75' Storage=7,284 cf Inflow=6.4 cfs 0.5 af
Discarded=0.2 cfs 0.3 af Primary=1.6 cfs 0.2 af Outflow=1.8 cfs 0.5 af

Pond 2P: Bldg 2 Subsurface Infiltation System Peak Elev=150.54' Storage=701 cf Inflow=1.5 cfs 0.1 af
Discarded=0.0 cfs 0.1 af Primary=1.4 cfs 0.1 af Outflow=1.5 cfs 0.1 af

Pond 3P: Subsurface Infiltration System Peak Elev=151.38' Storage=6,893 cf Inflow=10.2 cfs 0.8 af
Discarded=1.0 cfs 0.6 af Primary=5.9 cfs 0.1 af Outflow=6.9 cfs 0.8 af

Pond 4P: Bldg 3 Subsurface Infiltration System Peak Elev=148.15' Storage=1,673 cf Inflow=3.3 cfs 0.2 af
Discarded=0.0 cfs 0.1 af Primary=3.2 cfs 0.2 af Outflow=3.3 cfs 0.2 af

Pond B-1: Bio-retention Basin 1 Peak Elev=154.39' Storage=1,101 cf Inflow=2.0 cfs 0.1 af
Discarded=0.6 cfs 0.1 af Primary=0.0 cfs 0.0 af Outflow=0.6 cfs 0.1 af

Pond B-2: Bio-retention Basin 2 Peak Elev=154.19' Storage=5,447 cf Inflow=7.1 cfs 0.5 af
Discarded=0.8 cfs 0.4 af Primary=3.3 cfs 0.1 af Outflow=4.1 cfs 0.5 af

Pond B-3: Bridges Bio Reten 1 Peak Elev=150.07' Storage=1,676 cf Inflow=1.9 cfs 0.1 af
Discarded=0.1 cfs 0.1 af Primary=0.7 cfs 0.0 af Outflow=0.8 cfs 0.1 af

Pond B-4: Bridges Bio Reten 2 Peak Elev=149.08' Storage=1,159 cf Inflow=1.5 cfs 0.1 af
Discarded=0.1 cfs 0.1 af Primary=0.9 cfs 0.0 af Outflow=1.0 cfs 0.1 af

Pond P-1A: Existing Pond at Center of Peak Elev=147.76' Storage=198,961 cf Inflow=92.5 cfs 7.8 af
Outflow=9.9 cfs 7.5 af

Pond P-1B: SW Wetland/Swale at Western Prop Peak Elev=151.68' Storage=517 cf Inflow=15.2 cfs 2.3 af
24.0" Round Culvert n=0.011 L=300.0' S=0.0093 '/' Outflow=15.0 cfs 2.3 af

Pond P-C: Subsurface Infiltration System Peak Elev=156.59' Storage=6,394 cf Inflow=15.6 cfs 1.1 af
Discarded=0.1 cfs 0.2 af Primary=15.5 cfs 0.8 af Outflow=15.6 cfs 1.0 af

Pond P-ROOF: Perforated Pipe System Peak Elev=152.34' Storage=9,715 cf Inflow=19.6 cfs 1.5 af
Discarded=0.8 cfs 0.9 af Primary=18.8 cfs 0.6 af Outflow=19.6 cfs 1.5 af

Pond P-Roof 2: Bridges Perf Pipe System Peak Elev=151.97' Storage=3,416 cf Inflow=5.0 cfs 0.4 af
Discarded=0.2 cfs 0.3 af Primary=4.1 cfs 0.1 af Outflow=4.4 cfs 0.4 af

Pond ROOF: Perforated Pipe System Peak Elev=154.82' Storage=1,828 cf Inflow=2.8 cfs 0.2 af
Discarded=0.2 cfs 0.2 af Primary=2.3 cfs 0.1 af Outflow=2.5 cfs 0.2 af

Link DP-1: 48" RCP Across Boston Post Road Inflow=34.8 cfs 10.0 af
Primary=34.8 cfs 10.0 af

Link DP-2: Overland Flow to Boston Post Road Inflow=0.0 cfs 0.0 af
Primary=0.0 cfs 0.0 af

Link DP-3: Wetland at Northeast Corner Inflow=0.9 cfs 0.1 af
Primary=0.9 cfs 0.1 af

Total Runoff Area = 86.5 ac Runoff Volume = 13.8 af Average Runoff Depth = 1.92"
56.41% Pervious = 48.8 ac 43.59% Impervious = 37.7 ac

Summary for Subcatchment S-1A-1: WFM Parking Lot

Runoff = 10.4 cfs @ 12.07 hrs, Volume= 0.8 af, Depth= 4.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (sf)	CN	Description
	87,427	98	Unconnected pavement, HSG B
	9,599	61	>75% Grass cover, Good, HSG B
	97,026	94	Weighted Average
	9,599		9.89% Pervious Area
	87,427		90.11% Impervious Area
	87,427		100.00% Unconnected

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

Summary for Subcatchment S-1A-2: SW Retail - Building 2

Runoff = 4.3 cfs @ 12.14 hrs, Volume= 0.4 af, Depth= 3.48"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (sf)	CN	Description
*	39,573	98	Parking
	14,094	61	>75% Grass cover, Good, HSG B
	53,667	88	Weighted Average
	14,094		26.26% Pervious Area
	39,573		73.74% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.6	50	0.0240	0.11		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.5	103	0.0330	3.69		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.7	266	0.0150	6.57	5.16	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
0.2	76	0.0050	6.02	18.90	**Pipe Channel,** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.011 Concrete pipe, straight & clean
0.5	215	0.0050	7.89	55.74	**Pipe Channel,** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.011 Concrete pipe, straight & clean
0.6	181	0.0020	4.99	35.25	**Pipe Channel,** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.011 Concrete pipe, straight & clean

10.1	891	Total

Summary for Subcatchment S-1A-2A: SW Retail - Building 2 Roof

Runoff = 1.5 cfs @ 12.07 hrs, Volume= 0.1 af, Depth= 4.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (sf)	CN	Description
*	13,612	98	Rooftop
	13,612		100.00% Impervious Area

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

Summary for Subcatchment S-1A-4: Retail Roadways

Runoff = 14.4 cfs @ 12.07 hrs, Volume= 1.0 af, Depth= 3.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (sf)	CN	Description
105,483	98	Roofs, HSG B
62,134	61	>75% Grass cover, Good, HSG B
167,617	84	Weighted Average
62,134		37.07% Pervious Area
105,483		62.93% Impervious Area

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

Summary for Subcatchment S-1A-5: Road in front of Bridges

Runoff = 1.7 cfs @ 12.07 hrs, Volume= 0.1 af, Depth= 3.79"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (sf)	CN	Description
13,211	98	Roofs, HSG B
3,321	61	>75% Grass cover, Good, HSG B
16,532	91	Weighted Average
3,321		20.09% Pervious Area
13,211		79.91% Impervious Area

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

Summary for Subcatchment S-1A-6: Central Park

Runoff = 1.3 cfs @ 12.25 hrs, Volume= 0.1 af, Depth= 1.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (sf)	CN	Description
9,723	98	Roofs, HSG B
25,517	61	>75% Grass cover, Good, HSG B
35,240	71	Weighted Average
25,517		72.41% Pervious Area
9,723		27.59% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.8	50	0.0100	0.08		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
3.8	159	0.0100	0.70		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.3	162	0.0050	2.02	0.40	**Pipe Channel,** 6.0" Round Area= 0.2 sf Perim= 1.6' r= 0.13' n= 0.013 Corrugated PE, smooth interior
0.3	94	0.0100	4.54	3.56	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
1.6	354	0.0050	3.79	2.98	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
17.8	819	Total			

Summary for Subcatchment S-1B-1A: Assisted Living Facility Roof

Runoff = 5.0 cfs @ 12.07 hrs, Volume= 0.4 af, Depth= 4.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (sf)	CN	Description
*	44,351	98	Roofs & Parking
	44,351		100.00% Impervious Area

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

Summary for Subcatchment S-1B-1B: Assisted Living Rear Parking

Runoff = 1.5 cfs @ 12.08 hrs, Volume= 0.1 af, Depth= 2.29"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (sf)	CN	Description
*	9,084	98	Roofs & Parking
	15,152	61	>75% Grass cover, Good, HSG B
	24,236	75	Weighted Average
	15,152		62.52% Pervious Area
	9,084		37.48% Impervious Area

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

Summary for Subcatchment S-1B-1C: Assisted Living Road East Side

Runoff = 3.0 cfs @ 12.20 hrs, Volume= 0.3 af, Depth= 3.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (sf)	CN	Description
*	28,975	98	Roofs & Parking
	17,954	61	>75% Grass cover, Good, HSG B
	46,929	84	Weighted Average
	17,954		38.26% Pervious Area
	28,975		61.74% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.8	50	0.0100	0.08		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.6	27	0.0100	0.70		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.4	95	0.0200	4.04	0.79	**Pipe Channel,** 6.0" Round Area= 0.2 sf Perim= 1.6' r= 0.13' n= 0.013 Corrugated PE, smooth interior
2.9	860	0.0020	4.99	35.25	**Pipe Channel,** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.011 Concrete pipe, straight & clean
14.7	1,032	Total			

Summary for Subcatchment S-1B-1D: Assisted Living Front Parking

Runoff = 1.9 cfs @ 12.08 hrs, Volume= 0.1 af, Depth= 2.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (sf)	CN	Description
*	11,662	98	Roofs & Parking
	15,670	61	>75% Grass cover, Good, HSG B
	27,332	77	Weighted Average
	15,670		57.33% Pervious Area
	11,662		42.67% Impervious Area

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

Summary for Subcatchment S-1B-1E: Assisted Living Facility

Runoff = 3.2 cfs @ 12.08 hrs, Volume= 0.2 af, Depth= 2.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (sf)	CN	Description
*	17,055	98	Roofs & Parking
*	36,669	61	>75% Grass cover, Good, HSG B
	53,724	73	Weighted Average
	36,669		68.25% Pervious Area
	17,055		31.75% Impervious Area

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

Summary for Subcatchment S-1B-2: Age Restricted Housing

Runoff = 15.7 cfs @ 12.07 hrs, Volume= 1.1 af, Depth= 2.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (sf)	CN	Description
*	105,219	98	Roofs & Parking
*	101,356	61	>75% Grass cover, Good, HSG B
	206,575	80	Weighted Average
	101,356		49.06% Pervious Area
	105,219		50.94% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.20		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"
1.2	175	0.0150	2.49		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.4	150	0.0150	6.57	5.16	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
2.3	375	Total, Increased to minimum Tc = 5.0 min			

Summary for Subcatchment S-1C-1: Avalon Parking near Buildings G,F,&T1

Runoff = 2.0 cfs @ 12.08 hrs, Volume= 0.1 af, Depth= 2.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (sf)	CN	Description
12,651	98	Unconnected pavement, HSG B
16,254	61	>75% Grass cover, Good, HSG B
28,905	77	Weighted Average
16,254		56.23% Pervious Area
12,651		43.77% Impervious Area
12,651		100.00% Unconnected

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

Summary for Subcatchment S-1C-2: Avalon Parking near Buildings T,U,V

Runoff = 7.1 cfs @ 12.07 hrs, Volume= 0.5 af, Depth= 3.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (sf)	CN	Description
50,831	98	Unconnected pavement, HSG B
31,905	61	>75% Grass cover, Good, HSG B
82,736	84	Weighted Average
31,905		38.56% Pervious Area
50,831		61.44% Impervious Area
50,831		100.00% Unconnected

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

Summary for Subcatchment S-1C-3: Avalon Sudbury Road & Sidewalk to Subsurface Infiltration

Runoff = 15.6 cfs @ 12.07 hrs, Volume= 1.1 af, Depth= 2.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (sf)	CN	Description
111,097	98	Unconnected pavement, HSG B
76,353	61	>75% Grass cover, Good, HSG B
187,450	83	Weighted Average
76,353		40.73% Pervious Area
111,097		59.27% Impervious Area
111,097		100.00% Unconnected

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

Summary for Subcatchment S-1C-4: Avalon Sudbury Rooftop Runoff to Subsurface Infiltration

Runoff = 19.6 cfs @ 12.07 hrs, Volume= 1.5 af, Depth= 4.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (sf)	CN	Description
176,027	98	Unconnected pavement, HSG B
176,027		100.00% Impervious Area
176,027		100.00% Unconnected

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

Summary for Subcatchment S-1C-5: Multi-Family Housing - Direct to Pond

Runoff = 11.0 cfs @ 12.18 hrs, Volume= 1.0 af, Depth= 1.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (sf)	CN	Description
*	117,511	98	Road & Sidewalk
*	89,299	61	>75% Grass cover, Good, HSG B
	106,938	39	>75% Grass cover, Good, HSG A
	313,748	67	Weighted Average
	196,237		62.55% Pervious Area
	117,511		37.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.0200	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
3.9	500	0.0180	2.16		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.2	471	0.0150	6.57	5.16	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
0.3	141	0.0150	8.60	15.20	**Pipe Channel,** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.011 Concrete pipe, straight & clean
0.3	188	0.0150	10.42	32.74	**Pipe Channel,** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.011 Concrete pipe, straight & clean
0.9	495	0.0070	9.33	65.95	**Pipe Channel,** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.011 Concrete pipe, straight & clean
12.2	1,845	Total			

Summary for Subcatchment S-1D: Central Pervious Area

Runoff = 16.4 cfs @ 12.08 hrs, Volume= 1.2 af, Depth= 1.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (sf)	CN	Description
*	10,045	98	Road & Sidewalk
	1,564	39	>75% Grass cover, Good, HSG A
*	305,875	61	>75% Grass cover, Good, HSG B
	50,994	98	Water Surface, HSG B
	368,478	67	Weighted Average
	307,439		83.43% Pervious Area
	61,039		16.57% Impervious Area

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

Summary for Subcatchment S-1E-1: Avalon Sudbury Rooftop Runoff to Subsurface Infiltration

Runoff = 2.8 cfs @ 12.07 hrs, Volume= 0.2 af, Depth= 4.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (sf)	CN	Description
25,470	98	Unconnected pavement, HSG B
25,470		100.00% Impervious Area
25,470		100.00% Unconnected

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

Summary for Subcatchment S-1E-2: Grocery Store, Beltran Area & Western Prop Line

Runoff = 5.7 cfs @ 12.12 hrs, Volume= 0.5 af, Depth= 1.52"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (sf)	CN	Description
*	47,568	98	Roofs
*	57,122	61	>75% Grass cover, Good, HSG B
*	53,292	39	>75% Grass cover, Good, HSG A
	157,982	65	Weighted Average
	110,414		69.89% Pervious Area
	47,568		30.11% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.0200	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
1.2	178	0.0220	2.39		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.9	305	0.0100	5.36	4.21	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
7.7	533	Total			

Summary for Subcatchment S-1F: Offsite Farm Area

Runoff = 12.1 cfs @ 12.34 hrs, Volume= 1.9 af, Depth= 0.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (sf)	CN	Adj	Description
10,003	98		Water Surface, HSG B
181,224	61		>75% Grass cover, Good, HSG B
859,788	30		Meadow, non-grazed, HSG A
301,859	98		Roofs, HSG B
118,047	98		Unconnected pavement, HSG B
1,470,921	54	51	Weighted Average, UI Adjusted
1,041,012			70.77% Pervious Area
429,909			29.23% Impervious Area
118,047			27.46% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.0210	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
0.6	264	0.1900	7.02		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.8	100	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
4.9	610	0.0050	2.08	1.64	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.020 Corrugated PE, corrugated interior
0.6	307	0.0100	8.51	26.74	**Pipe Channel,** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.011 Concrete pipe, straight & clean
0.3	140	0.0200	8.87	70.94	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=2.00' Z= 2.0 '/' Top.W=8.00' n= 0.022 Earth, clean & straight
4.1	172	0.0100	0.70		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	91	0.0100	6.27	50.16	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=2.00' Z= 2.0 '/' Top.W=8.00' n= 0.022 Earth, clean & straight
17.0	1,734	Total			

Summary for Subcatchment S-1G-1: SE Retail Bldg 3

Runoff = 2.6 cfs @ 12.07 hrs, Volume= 0.2 af, Depth= 3.58"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (sf)	CN	Description
*	20,029	98	Roof, Parking, Sidewalk
	6,734	61	>75% Grass cover, Good, HSG B
	26,763	89	Weighted Average
	6,734		25.16% Pervious Area
	20,029		74.84% Impervious Area

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

Summary for Subcatchment S-1G-1A: SE Retail Bldg 3 Roof

Runoff = 0.7 cfs @ 12.07 hrs, Volume= 0.1 af, Depth= 4.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (sf)	CN	Description
*	6,137	98	Rooftop
	6,137		100.00% Impervious Area

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

Summary for Subcatchment S-1G-2: NE Retail - Buildings 4&5

Runoff = 6.4 cfs @ 12.07 hrs, Volume= 0.5 af, Depth= 4.22"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (sf)	CN	Description
*	54,061	98	Parking and Rooftop
	5,048	61	>75% Grass cover, Good, HSG B
	59,109	95	Weighted Average
	5,048		8.54% Pervious Area
	54,061		91.46% Impervious Area

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

Summary for Subcatchment S-2: Southern Prop Line - Pervious Area

Runoff = 0.0 cfs @ 12.08 hrs, Volume= 0.0 af, Depth= 2.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (sf)	CN	Description
*	337	61	>75% Grass cover, Good, HSG B
*	183	98	Road
	520	74	Weighted Average
	337		64.81% Pervious Area
	183		35.19% Impervious Area

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

Summary for Subcatchment S-3: Eastern Prop Line

Runoff = 0.9 cfs @ 12.09 hrs, Volume= 0.1 af, Depth= 1.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (sf)	CN	Description
*	29,000	61	>75% Grass cover, Good, HSG B
	29,000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.5	20	0.0810	0.22		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
1.5	20	Total, Increased to minimum Tc = 5.0 min			

Summary for Subcatchment S-4: Roadway runoff from Rte 20

Runoff = 5.0 cfs @ 12.07 hrs, Volume= 0.4 af, Depth= 4.33"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (sf)	CN	Description
	2,186	61	>75% Grass cover, Good, HSG B
*	43,560	98	Road
	45,746	96	Weighted Average
	2,186		4.78% Pervious Area
	43,560		95.22% Impervious Area

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

Summary for Reach R-1: Swale in WFM Parking Lot

Inflow Area = 2.2 ac, 90.11% Impervious, Inflow Depth = 4.11" for 10-Year event
Inflow = 10.4 cfs @ 12.07 hrs, Volume= 0.8 af
Outflow = 10.2 cfs @ 12.09 hrs, Volume= 0.8 af, Atten= 2%, Lag= 0.9 min

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Max. Velocity= 2.67 fps, Min. Travel Time= 1.3 min
Avg. Velocity = 0.74 fps, Avg. Travel Time= 4.5 min

Peak Storage= 762 cf @ 12.09 hrs
Average Depth at Peak Storage= 0.64'
Bank-Full Depth= 2.00' Flow Area= 20.0 sf, Capacity= 99.3 cfs

4.00' x 2.00' deep channel, n= 0.040 Earth, cobble bottom, clean sides
Side Slope Z-value= 3.0 '/' Top Width= 16.00'
Length= 200.0' Slope= 0.0140 '/'
Inlet Invert= 155.80', Outlet Invert= 153.00'

‡

Summary for Pond 1P: Bldg 4&5 Subsurface Infiltration System

Inflow Area =	1.4 ac, 91.46% Impervious,	Inflow Depth = 4.22"	for 10-Year event
Inflow =	6.4 cfs @ 12.07 hrs,	Volume=	0.5 af
Outflow =	1.8 cfs @ 12.39 hrs,	Volume=	0.5 af, Atten= 72%, Lag= 19.2 min
Discarded =	0.2 cfs @ 9.53 hrs,	Volume=	0.3 af
Primary =	1.6 cfs @ 12.39 hrs,	Volume=	0.2 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 147.75' @ 12.39 hrs Surf.Area= 3,918 sf Storage= 7,284 cf

Plug-Flow detention time= 127.2 min calculated for 0.5 af (100% of inflow)
Center-of-Mass det. time= 127.1 min (895.5 - 768.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	145.00'	3,494 cf	**30.00'W x 130.60'L x 3.50'H Field A**
			13,713 cf Overall - 4,978 cf Embedded = 8,734 cf x 40.0% Voids
#2A	145.50'	4,978 cf	**ADS_StormTech SC-740** x 108 Inside #1
			Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
			Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap
			Row Length Adjustment= +0.44' x 6.45 sf x 6 rows
#3	145.50'	63 cf	**4.00'D x 5.00'H Vertical Cone/Cylinder**-Impervious
		8,535 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	145.00'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	144.50'	**15.0" Round Culvert**
			L= 20.0' RCP, sq.cut end projecting, Ke= 0.500
			Inlet / Outlet Invert= 144.50' / 144.00' S= 0.0250 '/' Cc= 0.900
			n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.23 sf
#3	Device 2	148.30'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#4	Device 2	146.50'	**8.0" Vert. Orifice/Grate** C= 0.600

Discarded OutFlow Max=0.2 cfs @ 9.53 hrs HW=145.06' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.2 cfs)

Primary OutFlow Max=1.6 cfs @ 12.39 hrs HW=147.75' (Free Discharge)
└─**2=Culvert** (Passes 1.6 cfs of 9.6 cfs potential flow)
  ├─**3=Sharp-Crested Rectangular Weir** (Controls 0.0 cfs)
  └─**4=Orifice/Grate** (Orifice Controls 1.6 cfs @ 4.60 fps)

Summary for Pond 2P: Bldg 2 Subsurface Infiltation System

Inflow Area = 0.3 ac,100.00% Impervious, Inflow Depth = 4.56" for 10-Year event
Inflow = 1.5 cfs @ 12.07 hrs, Volume= 0.1 af
Outflow = 1.5 cfs @ 12.09 hrs, Volume= 0.1 af, Atten= 3%, Lag= 1.1 min
Discarded = 0.0 cfs @ 10.22 hrs, Volume= 0.1 af
Primary = 1.4 cfs @ 12.09 hrs, Volume= 0.1 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 150.54' @ 12.09 hrs Surf.Area= 622 sf Storage= 701 cf

Plug-Flow detention time= 72.3 min calculated for 0.1 af (100% of inflow)
Center-of-Mass det. time= 72.4 min (820.1 - 747.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	148.50'	445 cf	**24.83'W x 24.56'L x 2.33'H Field A**
			1,423 cf Overall - 310 cf Embedded = 1,114 cf x 40.0% Voids
#2A	149.00'	310 cf	**ADS_StormTech RC-310 +Cap** x 21 Inside #1
			Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf
			Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap
			7 Rows of 3 Chambers
#3	149.10'	24 cf	**4.00'D x 1.90'H Vertical Cone/Cylinder**
		779 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	148.50'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	149.90'	**12.0" Round Culvert** L= 501.0' Ke= 0.500
			Inlet / Outlet Invert= 149.90' / 140.93' S= 0.0179 '/' Cc= 0.900
			n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Discarded OutFlow Max=0.0 cfs @ 10.22 hrs HW=149.10' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=1.4 cfs @ 12.09 hrs HW=150.54' (Free Discharge)
└─**2=Culvert** (Inlet Controls 1.4 cfs @ 2.72 fps)

Summary for Pond 3P: Subsurface Infiltration System

Inflow Area = 2.2 ac, 90.11% Impervious, Inflow Depth = 4.11" for 10-Year event
Inflow = 10.2 cfs @ 12.09 hrs, Volume= 0.8 af
Outflow = 6.9 cfs @ 12.17 hrs, Volume= 0.8 af, Atten= 32%, Lag= 5.2 min
Discarded = 1.0 cfs @ 11.47 hrs, Volume= 0.6 af
Primary = 5.9 cfs @ 12.17 hrs, Volume= 0.1 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 151.38' @ 12.17 hrs Surf.Area= 5,124 sf Storage= 6,893 cf

Plug-Flow detention time= 32.1 min calculated for 0.8 af (100% of inflow)
Center-of-Mass det. time= 32.0 min (808.6 - 776.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	149.00'	3,575 cf	**41.50'W x 123.48'L x 2.33'H Field A** 11,957 cf Overall - 3,018 cf Embedded = 8,939 cf x 40.0% Voids
#2A	149.50'	3,018 cf	**ADS_StormTech SC-310** x 204 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap Row Length Adjustment= +0.44' x 2.07 sf x 12 rows
#3	149.00'	628 cf	**4.00'D x 5.00'H Vertical Cone/Cylinder** x 10 -Impervious
		7,222 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	149.00'	**8.270 in/hr Exfiltration over Surface area**
#2	Primary	149.00'	**18.0" Round Culvert** L= 27.0' Ke= 0.500 Inlet / Outlet Invert= 149.00' / 148.50' S= 0.0185 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#3	Device 2	150.80'	**4.0' long Sharp-Crested Rectangular Weir** 0 End Contraction(s) 3.5' Crest Height

Discarded OutFlow Max=1.0 cfs @ 11.47 hrs HW=149.05' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 1.0 cfs)

Primary OutFlow Max=5.8 cfs @ 12.17 hrs HW=151.37' (Free Discharge)
└─**2=Culvert** (Passes 5.8 cfs of 10.8 cfs potential flow)
  └─**3=Sharp-Crested Rectangular Weir** (Weir Controls 5.8 cfs @ 2.53 fps)

Summary for Pond 4P: Bldg 3 Subsurface Infiltration System

Inflow Area = 0.8 ac, 79.53% Impervious, Inflow Depth = 3.76" for 10-Year event
Inflow = 3.3 cfs @ 12.07 hrs, Volume= 0.2 af
Outflow = 3.3 cfs @ 12.08 hrs, Volume= 0.2 af, Atten= 1%, Lag= 0.5 min
Discarded = 0.0 cfs @ 6.66 hrs, Volume= 0.1 af
Primary = 3.2 cfs @ 12.08 hrs, Volume= 0.2 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Peak Elev= 148.15' @ 12.08 hrs Surf.Area= 868 sf Storage= 1,673 cf

Plug-Flow detention time= 153.2 min calculated for 0.2 af (94% of inflow)
Center-of-Mass det. time= 119.1 min (903.4 - 784.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	145.00'	829 cf	**34.75'W x 24.98'L x 3.50'H Field A** 3,038 cf Overall - 965 cf Embedded = 2,073 cf x 40.0% Voids
#2A	145.50'	965 cf	**ADS_StormTech SC-740 +Cap** x 21 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 7 Rows of 3 Chambers
		1,794 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	145.00'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	145.00'	**12.0" Round Culvert** L= 16.0' Ke= 0.500 Inlet / Outlet Invert= 145.00' / 144.60' S= 0.0250 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#3	Device 2	147.75'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=0.0 cfs @ 6.66 hrs HW=145.04' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=3.2 cfs @ 12.08 hrs HW=148.15' (Free Discharge)
└─**2=Culvert** (Passes 3.2 cfs of 6.2 cfs potential flow)
  └─**3=Sharp-Crested Rectangular Weir** (Weir Controls 3.2 cfs @ 2.07 fps)

Summary for Pond B-1: Bio-retention Basin 1

Inflow Area = 0.7 ac, 43.77% Impervious, Inflow Depth = 2.46" for 10-Year event
Inflow = 2.0 cfs @ 12.08 hrs, Volume= 0.1 af
Outflow = 0.6 cfs @ 12.42 hrs, Volume= 0.1 af, Atten= 70%, Lag= 20.8 min
Discarded = 0.6 cfs @ 12.42 hrs, Volume= 0.1 af
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0.0 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 154.39' @ 12.42 hrs Surf.Area= 3,070 sf Storage= 1,101 cf
Flood Elev= 155.00' Surf.Area= 3,882 sf Storage= 3,214 cf

Plug-Flow detention time= 10.2 min calculated for 0.1 af (100% of inflow)
Center-of-Mass det. time= 10.2 min (840.9 - 830.7)

Volume	Invert	Avail.Storage	Storage Description
#1	154.00'	3,214 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
154.00	2,545	0	0
155.00	3,882	3,214	3,214

Device	Routing	Invert	Outlet Devices
#1	Primary	151.00'	**12.0" Round Culvert** L= 275.0' RCP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 151.00' / 146.90' S= 0.0149 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	154.50'	**24.0" Horiz. Orifice/Grate X 2.00** C= 0.600 Limited to weir flow at low heads
#3	Discarded	154.00'	**8.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.6 cfs @ 12.42 hrs HW=154.39' (Free Discharge)
└─**3=Exfiltration** (Exfiltration Controls 0.6 cfs)

Primary OutFlow Max=0.0 cfs @ 0.00 hrs HW=154.00' (Free Discharge)
└─**1=Culvert** (Passes 0.0 cfs of 4.9 cfs potential flow)
  └─**2=Orifice/Grate** (Controls 0.0 cfs)

Summary for Pond B-2: Bio-retention Basin 2

Inflow Area =	1.9 ac, 61.44% Impervious,	Inflow Depth = 3.09"	for 10-Year event
Inflow =	7.1 cfs @ 12.07 hrs,	Volume= 0.5 af	
Outflow =	4.1 cfs @ 12.18 hrs,	Volume= 0.5 af,	Atten= 42%, Lag= 6.1 min
Discarded =	0.8 cfs @ 12.18 hrs,	Volume= 0.4 af	
Primary =	3.3 cfs @ 12.18 hrs,	Volume= 0.1 af	

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 154.19' @ 12.18 hrs Surf.Area= 4,148 sf Storage= 5,447 cf
Flood Elev= 155.00' Surf.Area= 5,206 sf Storage= 6,908 cf

Plug-Flow detention time= 56.6 min calculated for 0.5 af (100% of inflow)
Center-of-Mass det. time= 56.6 min (867.9 - 811.2)

Volume	Invert	Avail.Storage	Storage Description
#1	152.00'	6,908 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
152.00	1,364	0	0
153.00	2,290	1,827	1,827
154.00	3,513	2,902	4,729
154.50	5,206	2,180	6,908

Device	Routing	Invert	Outlet Devices
#1	Primary	150.00'	**18.0" Round Culvert** L= 11.0' RCP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 150.00' / 149.30' S= 0.0636 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf

#2	Device 1	154.00'	**24.0" Horiz. Orifice/Grate X 2.00** C= 0.600 Limited to weir flow at low heads
#3	Discarded	152.00'	**8.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.8 cfs @ 12.18 hrs HW=154.19' (Free Discharge)
└─**3=Exfiltration** (Exfiltration Controls 0.8 cfs)

Primary OutFlow Max=3.3 cfs @ 12.18 hrs HW=154.19' (Free Discharge)
└─**1=Culvert** (Passes 3.3 cfs of 15.8 cfs potential flow)
  └─**2=Orifice/Grate** (Weir Controls 3.3 cfs @ 1.42 fps)

Summary for Pond B-3: Bridges Bio Reten 1

Inflow Area = 0.6 ac, 42.67% Impervious, Inflow Depth = 2.46" for 10-Year event
Inflow = 1.9 cfs @ 12.08 hrs, Volume= 0.1 af
Outflow = 0.8 cfs @ 12.26 hrs, Volume= 0.1 af, Atten= 55%, Lag= 11.3 min
Discarded = 0.1 cfs @ 12.26 hrs, Volume= 0.1 af
Primary = 0.7 cfs @ 12.26 hrs, Volume= 0.0 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 150.07' @ 12.26 hrs Surf.Area= 2,118 sf Storage= 1,676 cf

Plug-Flow detention time= 126.0 min calculated for 0.1 af (100% of inflow)
Center-of-Mass det. time= 126.0 min (956.6 - 830.7)

Volume	Invert	Avail.Storage	Storage Description
#1	149.00'	2,850 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
149.00	1,161	254.0	0	0	1,161
150.00	1,951	272.0	1,539	1,539	1,959
150.50	3,354	354.0	1,311	2,850	6,047

Device	Routing	Invert	Outlet Devices
#1	Discarded	149.00'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	148.35'	**12.0" Round Culvert** L= 473.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 148.35' / 145.40' S= 0.0062 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#3	Device 2	150.00'	**24.0" Horiz. Orifice/Grate X 2.00** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.1 cfs @ 12.26 hrs HW=150.07' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.1 cfs)

Primary OutFlow Max=0.7 cfs @ 12.26 hrs HW=150.07' (Free Discharge)
└─**2=Culvert** (Passes 0.7 cfs of 3.5 cfs potential flow)
  └─**3=Orifice/Grate** (Weir Controls 0.7 cfs @ 0.85 fps)

Summary for Pond B-4: Bridges Bio Reten 2

Inflow Area = 0.6 ac, 37.48% Impervious, Inflow Depth = 2.29" for 10-Year event
Inflow = 1.5 cfs @ 12.08 hrs, Volume= 0.1 af
Outflow = 1.0 cfs @ 12.16 hrs, Volume= 0.1 af, Atten= 35%, Lag= 5.3 min
Discarded = 0.1 cfs @ 12.16 hrs, Volume= 0.1 af
Primary = 0.9 cfs @ 12.16 hrs, Volume= 0.0 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 149.08' @ 12.16 hrs Surf.Area= 1,365 sf Storage= 1,159 cf

Plug-Flow detention time= 119.6 min calculated for 0.1 af (100% of inflow)
Center-of-Mass det. time= 119.6 min (955.5 - 835.9)

Volume	Invert	Avail.Storage	Storage Description
#1	148.00'	2,767 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
148.00	819	152.0	0	0	819
149.00	1,305	171.0	1,053	1,053	1,333
150.00	2,159	200.0	1,714	2,767	2,209

Device	Routing	Invert	Outlet Devices
#1	Discarded	148.00'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	146.65'	**12.0" Round Culvert** L= 56.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 146.65' / 146.36' S= 0.0052 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#3	Device 2	149.00'	**24.0" Horiz. Orifice/Grate X 2.00** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.1 cfs @ 12.16 hrs HW=149.08' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.1 cfs)

Primary OutFlow Max=0.9 cfs @ 12.16 hrs HW=149.08' (Free Discharge)
└─**2=Culvert** (Passes 0.9 cfs of 5.0 cfs potential flow)
  └─**3=Orifice/Grate** (Weir Controls 0.9 cfs @ 0.92 fps)

Summary for Pond P-1A: Existing Pond at Center of Property

Inflow Area = 73.4 ac, 38.60% Impervious, Inflow Depth = 1.27" for 10-Year event
Inflow = 92.5 cfs @ 12.09 hrs, Volume= 7.8 af
Outflow = 9.9 cfs @ 13.57 hrs, Volume= 7.5 af, Atten= 89%, Lag= 89.0 min
Primary = 9.9 cfs @ 13.57 hrs, Volume= 7.5 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Starting Elev= 144.70' Surf.Area= 48,178 sf Storage= 33,047 cf
Peak Elev= 147.76' @ 13.57 hrs Surf.Area= 62,251 sf Storage= 198,961 cf (165,914 cf above start)
Flood Elev= 152.00' Surf.Area= 132,117 sf Storage= 566,694 cf (533,647 cf above start)

Plug-Flow detention time= 400.6 min calculated for 6.7 af (86% of inflow)
Center-of-Mass det. time= 295.3 min (1,147.5 - 852.2)

Volume	Invert	Avail.Storage	Storage Description
#1	144.00'	566,694 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
144.00	46,247	909.0	0	0	46,247
145.00	49,018	939.0	47,626	47,626	50,754
146.00	53,432	1,337.0	51,209	98,835	122,849
147.00	56,882	1,331.0	55,148	153,983	124,693
148.00	64,042	21,449.0	60,427	214,410	36,594,098
149.00	70,994	2,381.0	67,488	281,898	72,753,343
150.00	84,015	2,596.0	77,413	359,311	72,838,531
151.00	99,807	2,841.0	91,798	451,109	72,944,568
152.00	132,117	5,056.0	115,585	566,694	74,336,532

Device	Routing	Invert	Outlet Devices
#1	Device 4	144.70'	**12.0" Round Culvert** L= 97.0' Ke= 0.500 Inlet / Outlet Invert= 144.70' / 143.80' S= 0.0093 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Device 3	147.00'	**24.0" W x 18.0" H Vert. Orifice/Grate** C= 0.600
#3	Device 4	144.00'	**24.0" Round Culvert** L= 57.0' Ke= 0.500 Inlet / Outlet Invert= 144.00' / 143.80' S= 0.0035 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf
#4	Primary	143.80'	**36.0" Round Culvert** L= 1,434.0' Ke= 0.500 Inlet / Outlet Invert= 143.80' / 140.93' S= 0.0020 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 7.07 sf

Primary OutFlow Max=9.9 cfs @ 13.57 hrs HW=147.76' (Free Discharge)
└─**4=Culvert** (Passes 9.9 cfs of 38.6 cfs potential flow)
  ├─**1=Culvert** (Barrel Controls 5.6 cfs @ 7.19 fps)
  └─**3=Culvert** (Passes 4.2 cfs of 24.9 cfs potential flow)
    └─**2=Orifice/Grate** (Orifice Controls 4.2 cfs @ 2.79 fps)

Summary for Pond P-1B: SW Wetland/Swale at Western Prop Line

Inflow Area = 37.4 ac, 29.31% Impervious, Inflow Depth = 0.75" for 10-Year event
Inflow = 15.2 cfs @ 12.30 hrs, Volume= 2.3 af
Outflow = 15.0 cfs @ 12.35 hrs, Volume= 2.3 af, Atten= 1%, Lag= 2.8 min
Primary = 15.0 cfs @ 12.35 hrs, Volume= 2.3 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 151.68' @ 12.35 hrs Surf.Area= 1,047 sf Storage= 517 cf

Plug-Flow detention time= 0.2 min calculated for 2.3 af (100% of inflow)
Center-of-Mass det. time= 0.1 min (913.4 - 913.3)

Volume	Invert	Avail.Storage	Storage Description
#1	151.00'	126,119 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
151.00	498	198.0	0	0	498
152.00	1,368	715.0	897	897	38,063
153.00	8,822	6,900.0	4,555	5,452	3,786,066
154.00	25,925	1,559.0	16,623	22,075	7,381,341
155.00	50,627	1,626.0	37,594	59,669	7,398,397
156.00	83,648	1,717.0	66,450	126,119	7,422,663

Device	Routing	Invert	Outlet Devices
#1	Primary	149.70'	**24.0" Round Culvert** L= 300.0' Ke= 0.500 Inlet / Outlet Invert= 149.70' / 146.90' S= 0.0093 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf

Primary OutFlow Max=15.0 cfs @ 12.35 hrs HW=151.68' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 15.0 cfs @ 4.80 fps)

Summary for Pond P-C: Subsurface Infiltration System

Inflow Area =	4.3 ac, 59.27% Impervious, Inflow Depth = 2.99"	for 10-Year event	
Inflow =	15.6 cfs @ 12.07 hrs, Volume=	1.1 af	
Outflow =	15.6 cfs @ 12.07 hrs, Volume=	1.0 af,	Atten= 0%, Lag= 0.0 min
Discarded =	0.1 cfs @ 8.35 hrs, Volume=	0.2 af	
Primary =	15.5 cfs @ 12.07 hrs, Volume=	0.8 af	

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 156.59' @ 12.07 hrs Surf.Area= 2,934 sf Storage= 6,394 cf
Flood Elev= 155.50' Surf.Area= 2,934 sf Storage= 5,785 cf

Plug-Flow detention time= 122.4 min calculated for 1.0 af (94% of inflow)
Center-of-Mass det. time= 89.8 min (904.0 - 814.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	152.50'	2,593 cf	**39.50'W x 73.64'L x 3.50'H Field A** 10,180 cf Overall - 3,698 cf Embedded = 6,483 cf x 40.0% Voids
#2A	153.00'	3,698 cf	**ADS_StormTech SC-740** x 80 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap Row Length Adjustment= +0.44' x 6.45 sf x 8 rows
#3	152.50'	126 cf	**4.00'D x 5.00'H Vertical Cone/Cylinder** x 2
		6,417 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	152.50'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	148.70'	**30.0" Round Culvert out of OCS302** L= 244.0' Ke= 0.500 Inlet / Outlet Invert= 148.70' / 146.60' S= 0.0086 '/' Cc= 0.900

			n= 0.011 Concrete pipe, straight & clean, Flow Area= 4.91 sf
#3	Device 2	155.50'	**4.0' long x 2.50' rise Sharp-Crested Rectangular Weir** 0 End Contraction(s) 3.5' Crest Height

Discarded OutFlow Max=0.1 cfs @ 8.35 hrs HW=152.56' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.1 cfs)

Primary OutFlow Max=15.5 cfs @ 12.07 hrs HW=156.59' (Free Discharge)
└─**2=Culvert out of OCS302** (Passes 15.5 cfs of 60.9 cfs potential flow)
  └─**3=Sharp-Crested Rectangular Weir** (Weir Controls 15.5 cfs @ 3.55 fps)

Summary for Pond P-ROOF: Perforated Pipe System

Inflow Area = 4.0 ac,100.00% Impervious, Inflow Depth = 4.56" for 10-Year event
Inflow = 19.6 cfs @ 12.07 hrs, Volume= 1.5 af
Outflow = 19.6 cfs @ 12.07 hrs, Volume= 1.5 af, Atten= 0%, Lag= 0.0 min
Discarded = 0.8 cfs @ 9.65 hrs, Volume= 0.9 af
Primary = 18.8 cfs @ 12.07 hrs, Volume= 0.6 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 152.34' @ 12.07 hrs Surf.Area= 14,250 sf Storage= 9,715 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 45.6 min (793.4 - 747.8)

Volume	Invert	Avail.Storage	Storage Description
#1	150.50'	1,865 cf	**6.0" Round Pipe Storage** Inside #2 L= 9,500.0'
#2	150.00'	7,804 cf	**1.50'W x 9,500.00'L x 1.50'H Prismatoid** 21,375 cf Overall - 1,865 cf Embedded = 19,510 cf x 40.0% Voids
#3	150.50'	138 cf	**4.00'D x 5.50'H Vertical Cone/Cylinder** x 2 -Impervious
		9,807 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	150.00'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	151.00'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=0.8 cfs @ 9.65 hrs HW=150.06' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.8 cfs)

Primary OutFlow Max=18.8 cfs @ 12.07 hrs HW=152.34' (Free Discharge)
└─**2=Sharp-Crested Rectangular Weir** (Weir Controls 18.8 cfs @ 3.78 fps)

Summary for Pond P-Roof 2: Bridges Perf Pipe System

Inflow Area = 1.0 ac,100.00% Impervious, Inflow Depth = 4.56" for 10-Year event
Inflow = 5.0 cfs @ 12.07 hrs, Volume= 0.4 af
Outflow = 4.4 cfs @ 12.11 hrs, Volume= 0.4 af, Atten= 12%, Lag= 2.4 min
Discarded = 0.2 cfs @ 10.05 hrs, Volume= 0.3 af
Primary = 4.1 cfs @ 12.11 hrs, Volume= 0.1 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 151.97' @ 12.11 hrs Surf.Area= 4,013 sf Storage= 3,416 cf

Plug-Flow detention time= 65.7 min calculated for 0.4 af (100% of inflow)
Center-of-Mass det. time= 65.7 min (813.5 - 747.8)

Volume	Invert	Avail.Storage	Storage Description
#1	150.00'	3,043 cf	**2.00'W x 2,000.00'L x 2.00'H Prismatoid** 8,000 cf Overall - 393 cf Embedded = 7,607 cf x 40.0% Voids
#2	150.50'	393 cf	**6.0" Round Pipe Storage** Inside #1 L= 2,000.0'
#3	150.00'	75 cf	**4.00'D x 6.00'H Vertical Cone/Cylinder**
		3,511 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	150.00'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	151.50'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=0.2 cfs @ 10.05 hrs HW=150.06' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.2 cfs)

Primary OutFlow Max=4.1 cfs @ 12.11 hrs HW=151.97' (Free Discharge)
└─**2=Sharp-Crested Rectangular Weir** (Weir Controls 4.1 cfs @ 2.25 fps)

Summary for Pond ROOF: Perforated Pipe System

Inflow Area =	0.6 ac,100.00% Impervious,	Inflow Depth = 4.56"	for 10-Year event
Inflow =	2.8 cfs @ 12.07 hrs,	Volume=	0.2 af
Outflow =	2.5 cfs @ 12.11 hrs,	Volume=	0.2 af, Atten= 13%, Lag= 2.5 min
Discarded =	0.2 cfs @ 11.79 hrs,	Volume=	0.2 af
Primary =	2.3 cfs @ 12.11 hrs,	Volume=	0.1 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 154.82' @ 12.11 hrs Surf.Area= 3,013 sf Storage= 1,828 cf

Plug-Flow detention time= 46.7 min calculated for 0.2 af (100% of inflow)
Center-of-Mass det. time= 46.7 min (794.4 - 747.8)

Volume	Invert	Avail.Storage	Storage Description
#1	154.00'	393 cf	**6.0" Round Pipe Storage** Inside #2 L= 2,000.0'
#2	153.50'	1,643 cf	**1.50'W x 2,000.00'L x 1.50'H Prismatoid** 4,500 cf Overall - 393 cf Embedded = 4,107 cf x 40.0% Voids
#3	154.00'	63 cf	**4.00'D x 5.00'H Vertical Cone/Cylinder**
		2,098 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	153.50'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	154.50'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=0.2 cfs @ 11.79 hrs HW=154.00' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.2 cfs)

Primary OutFlow Max=2.3 cfs @ 12.11 hrs HW=154.82' (Free Discharge)
↑—**2=Sharp-Crested Rectangular Weir** (Weir Controls 2.3 cfs @ 1.84 fps)

Summary for Link DP-1: 48" RCP Across Boston Post Road

Inflow Area = 85.8 ac, 43.93% Impervious, Inflow Depth > 1.40" for 10-Year event
Inflow = 34.8 cfs @ 12.13 hrs, Volume= 10.0 af
Primary = 34.8 cfs @ 12.13 hrs, Volume= 10.0 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Link DP-2: Overland Flow to Boston Post Road

Inflow Area = 0.0 ac, 35.19% Impervious, Inflow Depth = 2.21" for 10-Year event
Inflow = 0.0 cfs @ 12.08 hrs, Volume= 0.0 af
Primary = 0.0 cfs @ 12.08 hrs, Volume= 0.0 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Link DP-3: Wetland at Northeast Corner

Inflow Area = 0.7 ac, 0.00% Impervious, Inflow Depth = 1.25" for 10-Year event
Inflow = 0.9 cfs @ 12.09 hrs, Volume= 0.1 af
Primary = 0.9 cfs @ 12.09 hrs, Volume= 0.1 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

25-Year Storm Event – Proposed

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

SubcatchmentS-1A-1: WFM Parking Lot Runoff Area=97,026 sf 90.11% Impervious Runoff Depth=5.30"
Tc=5.0 min CN=94 Runoff=13.2 cfs 1.0 af

SubcatchmentS-1A-2: SW Retail - Runoff Area=53,667 sf 73.74% Impervious Runoff Depth=4.63"
Flow Length=891' Tc=10.1 min CN=88 Runoff=5.6 cfs 0.5 af

SubcatchmentS-1A-2A: SW Retail - Runoff Area=13,612 sf 100.00% Impervious Runoff Depth=5.76"
Tc=5.0 min CN=98 Runoff=1.9 cfs 0.2 af

SubcatchmentS-1A-4: Retail Roadways Runoff Area=167,617 sf 62.93% Impervious Runoff Depth=4.20"
Tc=5.0 min CN=84 Runoff=19.3 cfs 1.3 af

SubcatchmentS-1A-5: Road in front of Runoff Area=16,532 sf 79.91% Impervious Runoff Depth=4.96"
Tc=5.0 min CN=91 Runoff=2.2 cfs 0.2 af

SubcatchmentS-1A-6: Central Park Runoff Area=35,240 sf 27.59% Impervious Runoff Depth=2.90"
Flow Length=819' Tc=17.8 min CN=71 Runoff=1.9 cfs 0.2 af

SubcatchmentS-1B-1A: Assisted Living Runoff Area=44,351 sf 100.00% Impervious Runoff Depth=5.76"
Tc=5.0 min CN=98 Runoff=6.2 cfs 0.5 af

SubcatchmentS-1B-1B: Assisted Living Runoff Area=24,236 sf 37.48% Impervious Runoff Depth=3.28"
Tc=5.0 min CN=75 Runoff=2.2 cfs 0.2 af

SubcatchmentS-1B-1C: Assisted Living Runoff Area=46,929 sf 61.74% Impervious Runoff Depth=4.20"
Flow Length=1,032' Tc=14.7 min CN=84 Runoff=4.0 cfs 0.4 af

SubcatchmentS-1B-1D: Assisted Living Runoff Area=27,332 sf 42.67% Impervious Runoff Depth=3.48"
Tc=5.0 min CN=77 Runoff=2.7 cfs 0.2 af

SubcatchmentS-1B-1E: Assisted Living Runoff Area=53,724 sf 31.75% Impervious Runoff Depth=3.09"
Tc=5.0 min CN=73 Runoff=4.6 cfs 0.3 af

SubcatchmentS-1B-2: Age Restricted Runoff Area=206,575 sf 50.94% Impervious Runoff Depth=3.78"
Flow Length=375' Tc=5.0 min CN=80 Runoff=21.7 cfs 1.5 af

SubcatchmentS-1C-1: Avalon Parking Runoff Area=28,905 sf 43.77% Impervious Runoff Depth=3.48"
Tc=5.0 min CN=77 Runoff=2.8 cfs 0.2 af

SubcatchmentS-1C-2: Avalon Parking Runoff Area=82,736 sf 61.44% Impervious Runoff Depth=4.20"
Tc=5.0 min CN=84 Runoff=9.5 cfs 0.7 af

SubcatchmentS-1C-3: Avalon Sudbury Runoff Area=187,450 sf 59.27% Impervious Runoff Depth=4.09"
Tc=5.0 min CN=83 Runoff=21.1 cfs 1.5 af

SubcatchmentS-1C-4: Avalon Sudbury Runoff Area=176,027 sf 100.00% Impervious Runoff Depth=5.76"
Tc=5.0 min CN=98 Runoff=24.6 cfs 1.9 af

SubcatchmentS-1C-5: Multi-Family Runoff Area=313,748 sf 37.45% Impervious Runoff Depth=2.53"
Flow Length=1,845' Tc=12.2 min CN=67 Runoff=17.1 cfs 1.5 af

SubcatchmentS-1D: Central Pervious Runoff Area=368,478 sf 16.57% Impervious Runoff Depth=2.53"
Tc=5.0 min CN=67 Runoff=25.7 cfs 1.8 af

SubcatchmentS-1E-1: Avalon Sudbury Runoff Area=25,470 sf 100.00% Impervious Runoff Depth=5.76"
Tc=5.0 min CN=98 Runoff=3.6 cfs 0.3 af

SubcatchmentS-1E-2: Grocery Store, Runoff Area=157,982 sf 30.11% Impervious Runoff Depth=2.35"
Flow Length=533' Tc=7.7 min CN=65 Runoff=9.2 cfs 0.7 af

SubcatchmentS-1F: Offsite Farm Area Runoff Area=1,470,921 sf 29.23% Impervious Runoff Depth=1.22"
Flow Length=1,734' Tc=17.0 min UI Adjusted CN=51 Runoff=27.8 cfs 3.4 af

SubcatchmentS-1G-1: SE Retail Bldg 3 Runoff Area=26,763 sf 74.84% Impervious Runoff Depth=4.74"
Tc=5.0 min CN=89 Runoff=3.4 cfs 0.2 af

SubcatchmentS-1G-1A: SE Retail Bldg 3 Runoff Area=6,137 sf 100.00% Impervious Runoff Depth=5.76"
Tc=5.0 min CN=98 Runoff=0.9 cfs 0.1 af

SubcatchmentS-1G-2: NE Retail - Runoff Area=59,109 sf 91.46% Impervious Runoff Depth=5.41"
Tc=5.0 min CN=95 Runoff=8.1 cfs 0.6 af

SubcatchmentS-2: Southern Prop Line - Runoff Area=520 sf 35.19% Impervious Runoff Depth=3.18"
Tc=5.0 min CN=74 Runoff=0.0 cfs 0.0 af

SubcatchmentS-3: Eastern Prop Line Runoff Area=29,000 sf 0.00% Impervious Runoff Depth=2.01"
Flow Length=20' Slope=0.0810 '/' Tc=5.0 min CN=61 Runoff=1.5 cfs 0.1 af

SubcatchmentS-4: Roadway runoff from Runoff Area=45,746 sf 95.22% Impervious Runoff Depth=5.53"
Tc=5.0 min CN=96 Runoff=6.3 cfs 0.5 af

Reach R-1: Swale in WFM Parking Lot Avg. Flow Depth=0.73' Max Vel=2.86 fps Inflow=13.2 cfs 1.0 af
n=0.040 L=200.0' S=0.0140 '/' Capacity=99.3 cfs Outflow=12.9 cfs 1.0 af

Pond 1P: Bldg 4&5 Subsurface Infiltration Peak Elev=148.67' Storage=8,512 cf Inflow=8.1 cfs 0.6 af
Discarded=0.2 cfs 0.3 af Primary=5.1 cfs 0.3 af Outflow=5.4 cfs 0.6 af

Pond 2P: Bldg 2 Subsurface Infiltation System Peak Elev=150.64' Storage=726 cf Inflow=1.9 cfs 0.2 af
Discarded=0.0 cfs 0.1 af Primary=1.8 cfs 0.1 af Outflow=1.8 cfs 0.2 af

Pond 3P: Subsurface Infiltration System Peak Elev=151.74' Storage=6,938 cf Inflow=12.9 cfs 1.0 af
Discarded=1.0 cfs 0.7 af Primary=11.9 cfs 0.2 af Outflow=12.9 cfs 1.0 af

Pond 4P: Bldg 3 Subsurface Infiltration System Peak Elev=148.23' Storage=1,699 cf Inflow=4.3 cfs 0.3 af
Discarded=0.0 cfs 0.1 af Primary=4.2 cfs 0.2 af Outflow=4.2 cfs 0.3 af

Pond B-1: Bio-retention Basin 1 Peak Elev=154.56' Storage=1,631 cf Inflow=2.8 cfs 0.2 af
Discarded=0.6 cfs 0.2 af Primary=0.6 cfs 0.0 af Outflow=1.2 cfs 0.2 af

Pond B-2: Bio-retention Basin 2 Peak Elev=154.32' Storage=6,012 cf Inflow=9.5 cfs 0.7 af
Discarded=0.9 cfs 0.5 af Primary=7.3 cfs 0.2 af Outflow=8.2 cfs 0.7 af

Pond B-3: Bridges Bio Reten 1 Peak Elev=150.14' Storage=1,827 cf Inflow=2.7 cfs 0.2 af
Discarded=0.1 cfs 0.1 af Primary=2.1 cfs 0.1 af Outflow=2.2 cfs 0.2 af

Pond B-4: Bridges Bio Reten 2 Peak Elev=149.14' Storage=1,236 cf Inflow=2.2 cfs 0.2 af
Discarded=0.1 cfs 0.1 af Primary=2.1 cfs 0.1 af Outflow=2.1 cfs 0.2 af

Pond P-1A: Existing Pond at Center of Peak Elev=148.99' Storage=281,233 cf Inflow=144.0 cfs 12.3 af
Outflow=22.5 cfs 11.9 af

Pond P-1B: SW Wetland/Swale at Western Peak Elev=153.40' Storage=10,116 cf Inflow=33.3 cfs 4.1 af
24.0" Round Culvert n=0.011 L=300.0' S=0.0093 '/' Outflow=24.9 cfs 4.1 af

Pond P-C: Subsurface Infiltration System Peak Elev=156.83' Storage=6,400 cf Inflow=21.1 cfs 1.5 af
Discarded=0.1 cfs 0.2 af Primary=21.1 cfs 1.2 af Outflow=21.1 cfs 1.4 af

Pond P-ROOF: Perforated Pipe System Peak Elev=152.57' Storage=9,721 cf Inflow=24.6 cfs 1.9 af
Discarded=0.8 cfs 1.1 af Primary=23.8 cfs 0.9 af Outflow=24.6 cfs 1.9 af

Pond P-Roof 2: Bridges Perf Pipe System Peak Elev=152.10' Storage=3,462 cf Inflow=6.2 cfs 0.5 af
Discarded=0.2 cfs 0.3 af Primary=5.9 cfs 0.2 af Outflow=6.1 cfs 0.5 af

Pond ROOF: Perforated Pipe System Peak Elev=154.89' Storage=1,920 cf Inflow=3.6 cfs 0.3 af
Discarded=0.2 cfs 0.2 af Primary=3.2 cfs 0.1 af Outflow=3.3 cfs 0.3 af

Link DP-1: 48" RCP Across Boston Post Road Inflow=59.0 cfs 15.5 af
Primary=59.0 cfs 15.5 af

Link DP-2: Overland Flow to Boston Post Road Inflow=0.0 cfs 0.0 af
Primary=0.0 cfs 0.0 af

Link DP-3: Wetland at Northeast Corner Inflow=1.5 cfs 0.1 af
Primary=1.5 cfs 0.1 af

Total Runoff Area = 86.5 ac Runoff Volume = 19.8 af Average Runoff Depth = 2.75"
56.41% Pervious = 48.8 ac 43.59% Impervious = 37.7 ac

Summary for Subcatchment S-1A-1: WFM Parking Lot

Runoff = 13.2 cfs @ 12.07 hrs, Volume= 1.0 af, Depth= 5.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.00"

	Area (sf)	CN	Description
	87,427	98	Unconnected pavement, HSG B
	9,599	61	>75% Grass cover, Good, HSG B
	97,026	94	Weighted Average
	9,599		9.89% Pervious Area
	87,427		90.11% Impervious Area
	87,427		100.00% Unconnected

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

Summary for Subcatchment S-1A-2: SW Retail - Building 2

Runoff = 5.6 cfs @ 12.14 hrs, Volume= 0.5 af, Depth= 4.63"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.00"

	Area (sf)	CN	Description
*	39,573	98	Parking
	14,094	61	>75% Grass cover, Good, HSG B
	53,667	88	Weighted Average
	14,094		26.26% Pervious Area
	39,573		73.74% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.6	50	0.0240	0.11		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.5	103	0.0330	3.69		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.7	266	0.0150	6.57	5.16	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
0.2	76	0.0050	6.02	18.90	**Pipe Channel,** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.011 Concrete pipe, straight & clean
0.5	215	0.0050	7.89	55.74	**Pipe Channel,** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.011 Concrete pipe, straight & clean
0.6	181	0.0020	4.99	35.25	**Pipe Channel,** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.011 Concrete pipe, straight & clean

10.1 891 Total

Summary for Subcatchment S-1A-2A: SW Retail - Building 2 Roof

Runoff = 1.9 cfs @ 12.07 hrs, Volume= 0.2 af, Depth= 5.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.00"

	Area (sf)	CN	Description
*	13,612	98	Rooftop
	13,612		100.00% Impervious Area

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

Summary for Subcatchment S-1A-4: Retail Roadways

Runoff = 19.3 cfs @ 12.07 hrs, Volume= 1.3 af, Depth= 4.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.00"

Area (sf)	CN	Description
105,483	98	Roofs, HSG B
62,134	61	>75% Grass cover, Good, HSG B
167,617	84	Weighted Average
62,134		37.07% Pervious Area
105,483		62.93% Impervious Area

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

Summary for Subcatchment S-1A-5: Road in front of Bridges

Runoff = 2.2 cfs @ 12.07 hrs, Volume= 0.2 af, Depth= 4.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.00"

Area (sf)	CN	Description
13,211	98	Roofs, HSG B
3,321	61	>75% Grass cover, Good, HSG B
16,532	91	Weighted Average
3,321		20.09% Pervious Area
13,211		79.91% Impervious Area

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

Summary for Subcatchment S-1A-6: Central Park

Runoff = 1.9 cfs @ 12.25 hrs, Volume= 0.2 af, Depth= 2.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.00"

Area (sf)	CN	Description
9,723	98	Roofs, HSG B
25,517	61	>75% Grass cover, Good, HSG B
35,240	71	Weighted Average
25,517		72.41% Pervious Area
9,723		27.59% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.8	50	0.0100	0.08		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
3.8	159	0.0100	0.70		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.3	162	0.0050	2.02	0.40	**Pipe Channel,** 6.0" Round Area= 0.2 sf Perim= 1.6' r= 0.13' n= 0.013 Corrugated PE, smooth interior
0.3	94	0.0100	4.54	3.56	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
1.6	354	0.0050	3.79	2.98	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
17.8	819	Total			

Summary for Subcatchment S-1B-1A: Assisted Living Facility Roof

Runoff = 6.2 cfs @ 12.07 hrs, Volume= 0.5 af, Depth= 5.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.00"

	Area (sf)	CN	Description
*	44,351	98	Roofs & Parking
	44,351		100.00% Impervious Area

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

Summary for Subcatchment S-1B-1B: Assisted Living Rear Parking

Runoff = 2.2 cfs @ 12.08 hrs, Volume= 0.2 af, Depth= 3.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.00"

	Area (sf)	CN	Description
*	9,084	98	Roofs & Parking
	15,152	61	>75% Grass cover, Good, HSG B
	24,236	75	Weighted Average
	15,152		62.52% Pervious Area
	9,084		37.48% Impervious Area

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

Summary for Subcatchment S-1B-1C: Assisted Living Road East Side

Runoff = 4.0 cfs @ 12.20 hrs, Volume= 0.4 af, Depth= 4.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.00"

	Area (sf)	CN	Description
*	28,975	98	Roofs & Parking
	17,954	61	>75% Grass cover, Good, HSG B
	46,929	84	Weighted Average
	17,954		38.26% Pervious Area
	28,975		61.74% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.8	50	0.0100	0.08		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.6	27	0.0100	0.70		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.4	95	0.0200	4.04	0.79	**Pipe Channel,** 6.0" Round Area= 0.2 sf Perim= 1.6' r= 0.13' n= 0.013 Corrugated PE, smooth interior
2.9	860	0.0020	4.99	35.25	**Pipe Channel,** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.011 Concrete pipe, straight & clean
14.7	1,032	Total			

Summary for Subcatchment S-1B-1D: Assisted Living Front Parking

Runoff = 2.7 cfs @ 12.07 hrs, Volume= 0.2 af, Depth= 3.48"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.00"

	Area (sf)	CN	Description
*	11,662	98	Roofs & Parking
	15,670	61	>75% Grass cover, Good, HSG B
	27,332	77	Weighted Average
	15,670		57.33% Pervious Area
	11,662		42.67% Impervious Area

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

Summary for Subcatchment S-1B-1E: Assisted Living Facility

Runoff = 4.6 cfs @ 12.08 hrs, Volume= 0.3 af, Depth= 3.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.00"

	Area (sf)	CN	Description
*	17,055	98	Roofs & Parking
*	36,669	61	>75% Grass cover, Good, HSG B
	53,724	73	Weighted Average
	36,669		68.25% Pervious Area
	17,055		31.75% Impervious Area

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

Summary for Subcatchment S-1B-2: Age Restricted Housing

Runoff = 21.7 cfs @ 12.07 hrs, Volume= 1.5 af, Depth= 3.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.00"

	Area (sf)	CN	Description
*	105,219	98	Roofs & Parking
*	101,356	61	>75% Grass cover, Good, HSG B
	206,575	80	Weighted Average
	101,356		49.06% Pervious Area
	105,219		50.94% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.20		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"
1.2	175	0.0150	2.49		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.4	150	0.0150	6.57	5.16	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
2.3	375	Total, Increased to minimum Tc = 5.0 min			

Summary for Subcatchment S-1C-1: Avalon Parking near Buildings G,F,&T1

Runoff = 2.8 cfs @ 12.07 hrs, Volume= 0.2 af, Depth= 3.48"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.00"

Area (sf)	CN	Description
12,651	98	Unconnected pavement, HSG B
16,254	61	>75% Grass cover, Good, HSG B
28,905	77	Weighted Average
16,254		56.23% Pervious Area
12,651		43.77% Impervious Area
12,651		100.00% Unconnected

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

Summary for Subcatchment S-1C-2: Avalon Parking near Buildings T,U,V

Runoff = 9.5 cfs @ 12.07 hrs, Volume= 0.7 af, Depth= 4.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.00"

Area (sf)	CN	Description
50,831	98	Unconnected pavement, HSG B
31,905	61	>75% Grass cover, Good, HSG B
82,736	84	Weighted Average
31,905		38.56% Pervious Area
50,831		61.44% Impervious Area
50,831		100.00% Unconnected

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

Summary for Subcatchment S-1C-3: Avalon Sudbury Road & Sidewalk to Subsurface Infiltration

Runoff = 21.1 cfs @ 12.07 hrs, Volume= 1.5 af, Depth= 4.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.00"

Area (sf)	CN	Description
111,097	98	Unconnected pavement, HSG B
76,353	61	>75% Grass cover, Good, HSG B
187,450	83	Weighted Average
76,353		40.73% Pervious Area
111,097		59.27% Impervious Area
111,097		100.00% Unconnected

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

Summary for Subcatchment S-1C-4: Avalon Sudbury Rooftop Runoff to Subsurface Infiltration

Runoff = 24.6 cfs @ 12.07 hrs, Volume= 1.9 af, Depth= 5.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.00"

Area (sf)	CN	Description
176,027	98	Unconnected pavement, HSG B
176,027		100.00% Impervious Area
176,027		100.00% Unconnected

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

Summary for Subcatchment S-1C-5: Multi-Family Housing - Direct to Pond

Runoff = 17.1 cfs @ 12.17 hrs, Volume= 1.5 af, Depth= 2.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.00"

	Area (sf)	CN	Description
*	117,511	98	Road & Sidewalk
*	89,299	61	>75% Grass cover, Good, HSG B
	106,938	39	>75% Grass cover, Good, HSG A
	313,748	67	Weighted Average
	196,237		62.55% Pervious Area
	117,511		37.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.0200	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
3.9	500	0.0180	2.16		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.2	471	0.0150	6.57	5.16	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
0.3	141	0.0150	8.60	15.20	**Pipe Channel,** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.011 Concrete pipe, straight & clean
0.3	188	0.0150	10.42	32.74	**Pipe Channel,** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.011 Concrete pipe, straight & clean
0.9	495	0.0070	9.33	65.95	**Pipe Channel,** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.011 Concrete pipe, straight & clean
12.2	1,845	Total			

Summary for Subcatchment S-1D: Central Pervious Area

Runoff = 25.7 cfs @ 12.08 hrs, Volume= 1.8 af, Depth= 2.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.00"

	Area (sf)	CN	Description
*	10,045	98	Road & Sidewalk
	1,564	39	>75% Grass cover, Good, HSG A
*	305,875	61	>75% Grass cover, Good, HSG B
	50,994	98	Water Surface, HSG B
	368,478	67	Weighted Average
	307,439		83.43% Pervious Area
	61,039		16.57% Impervious Area

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

Summary for Subcatchment S-1E-1: Avalon Sudbury Rooftop Runoff to Subsurface Infiltration

Runoff = 3.6 cfs @ 12.07 hrs, Volume= 0.3 af, Depth= 5.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.00"

Area (sf)	CN	Description
25,470	98	Unconnected pavement, HSG B
25,470		100.00% Impervious Area
25,470		100.00% Unconnected

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

Summary for Subcatchment S-1E-2: Grocery Store, Beltran Area & Western Prop Line

Runoff = 9.2 cfs @ 12.12 hrs, Volume= 0.7 af, Depth= 2.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.00"

	Area (sf)	CN	Description
*	47,568	98	Roofs
*	57,122	61	>75% Grass cover, Good, HSG B
*	53,292	39	>75% Grass cover, Good, HSG A
	157,982	65	Weighted Average
	110,414		69.89% Pervious Area
	47,568		30.11% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.0200	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
1.2	178	0.0220	2.39		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.9	305	0.0100	5.36	4.21	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
7.7	533	Total			

Summary for Subcatchment S-1F: Offsite Farm Area

Runoff = 27.8 cfs @ 12.28 hrs, Volume= 3.4 af, Depth= 1.22"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.00"

Area (sf)	CN	Adj	Description
10,003	98		Water Surface, HSG B
181,224	61		>75% Grass cover, Good, HSG B
859,788	30		Meadow, non-grazed, HSG A
301,859	98		Roofs, HSG B
118,047	98		Unconnected pavement, HSG B
1,470,921	54	51	Weighted Average, UI Adjusted
1,041,012			70.77% Pervious Area
429,909			29.23% Impervious Area
118,047			27.46% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.0210	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
0.6	264	0.1900	7.02		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.8	100	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
4.9	610	0.0050	2.08	1.64	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.020 Corrugated PE, corrugated interior
0.6	307	0.0100	8.51	26.74	**Pipe Channel,** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.011 Concrete pipe, straight & clean
0.3	140	0.0200	8.87	70.94	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=2.00' Z= 2.0 '/' Top.W=8.00' n= 0.022 Earth, clean & straight
4.1	172	0.0100	0.70		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	91	0.0100	6.27	50.16	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=2.00' Z= 2.0 '/' Top.W=8.00' n= 0.022 Earth, clean & straight
17.0	1,734	Total			

Summary for Subcatchment S-1G-1: SE Retail Bldg 3

Runoff = 3.4 cfs @ 12.07 hrs, Volume= 0.2 af, Depth= 4.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.00"

	Area (sf)	CN	Description
*	20,029	98	Roof, Parking, Sidewalk
	6,734	61	>75% Grass cover, Good, HSG B
	26,763	89	Weighted Average
	6,734		25.16% Pervious Area
	20,029		74.84% Impervious Area

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

Summary for Subcatchment S-1G-1A: SE Retail Bldg 3 Roof

Runoff = 0.9 cfs @ 12.07 hrs, Volume= 0.1 af, Depth= 5.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.00"

	Area (sf)	CN	Description
*	6,137	98	Rooftop
	6,137		100.00% Impervious Area

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

Summary for Subcatchment S-1G-2: NE Retail - Buildings 4&5

Runoff = 8.1 cfs @ 12.07 hrs, Volume= 0.6 af, Depth= 5.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.00"

	Area (sf)	CN	Description
*	54,061	98	Parking and Rooftop
	5,048	61	>75% Grass cover, Good, HSG B
	59,109	95	Weighted Average
	5,048		8.54% Pervious Area
	54,061		91.46% Impervious Area

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

Summary for Subcatchment S-2: Southern Prop Line - Pervious Area

Runoff = 0.0 cfs @ 12.08 hrs, Volume= 0.0 af, Depth= 3.18"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.00"

	Area (sf)	CN	Description
*	337	61	>75% Grass cover, Good, HSG B
*	183	98	Road
	520	74	Weighted Average
	337		64.81% Pervious Area
	183		35.19% Impervious Area

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

Summary for Subcatchment S-3: Eastern Prop Line

Runoff = 1.5 cfs @ 12.08 hrs, Volume= 0.1 af, Depth= 2.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.00"

	Area (sf)	CN	Description
*	29,000	61	>75% Grass cover, Good, HSG B
	29,000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.5	20	0.0810	0.22		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
1.5	20	Total, Increased to minimum Tc = 5.0 min			

Summary for Subcatchment S-4: Roadway runoff from Rte 20

Runoff = 6.3 cfs @ 12.07 hrs, Volume= 0.5 af, Depth= 5.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.00"

	Area (sf)	CN	Description
	2,186	61	>75% Grass cover, Good, HSG B
*	43,560	98	Road
	45,746	96	Weighted Average
	2,186		4.78% Pervious Area
	43,560		95.22% Impervious Area

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

Summary for Reach R-1: Swale in WFM Parking Lot

Inflow Area = 2.2 ac, 90.11% Impervious, Inflow Depth = 5.30" for 25-Year event
Inflow = 13.2 cfs @ 12.07 hrs, Volume= 1.0 af
Outflow = 12.9 cfs @ 12.08 hrs, Volume= 1.0 af, Atten= 2%, Lag= 0.8 min

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Max. Velocity= 2.86 fps, Min. Travel Time= 1.2 min
Avg. Velocity = 0.80 fps, Avg. Travel Time= 4.2 min

Peak Storage= 904 cf @ 12.08 hrs
Average Depth at Peak Storage= 0.73'
Bank-Full Depth= 2.00' Flow Area= 20.0 sf, Capacity= 99.3 cfs

4.00' x 2.00' deep channel, n= 0.040 Earth, cobble bottom, clean sides
Side Slope Z-value= 3.0 '/' Top Width= 16.00'
Length= 200.0' Slope= 0.0140 '/'
Inlet Invert= 155.80', Outlet Invert= 153.00'

‡

Summary for Pond 1P: Bldg 4&5 Subsurface Infiltration System

Inflow Area =	1.4 ac, 91.46% Impervious,	Inflow Depth = 5.41"	for 25-Year event	
Inflow =	8.1 cfs @	12.07 hrs, Volume=	0.6 af	
Outflow =	5.4 cfs @	12.17 hrs, Volume=	0.6 af,	Atten= 34%, Lag= 6.1 min
Discarded =	0.2 cfs @	8.79 hrs, Volume=	0.3 af	
Primary =	5.1 cfs @	12.17 hrs, Volume=	0.3 af	

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 148.67' @ 12.17 hrs Surf.Area= 3,918 sf Storage= 8,512 cf

Plug-Flow detention time= 116.3 min calculated for 0.6 af (100% of inflow)
Center-of-Mass det. time= 116.9 min (879.6 - 762.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	145.00'	3,494 cf	**30.00'W x 130.60'L x 3.50'H Field A**
			13,713 cf Overall - 4,978 cf Embedded = 8,734 cf x 40.0% Voids
#2A	145.50'	4,978 cf	**ADS_StormTech SC-740** x 108 Inside #1
			Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
			Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap
			Row Length Adjustment= +0.44' x 6.45 sf x 6 rows
#3	145.50'	63 cf	**4.00'D x 5.00'H Vertical Cone/Cylinder**-Impervious
		8,535 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	145.00'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	144.50'	**15.0" Round Culvert**
			L= 20.0' RCP, sq.cut end projecting, Ke= 0.500
			Inlet / Outlet Invert= 144.50' / 144.00' S= 0.0250 '/' Cc= 0.900
			n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.23 sf
#3	Device 2	148.30'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#4	Device 2	146.50'	**8.0" Vert. Orifice/Grate** C= 0.600

Discarded OutFlow Max=0.2 cfs @ 8.79 hrs HW=145.06' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.2 cfs)

Primary OutFlow Max=5.0 cfs @ 12.17 hrs HW=148.65' (Free Discharge)
└─**2=Culvert** (Passes 5.0 cfs of 11.1 cfs potential flow)
  ├─**3=Sharp-Crested Rectangular Weir** (Weir Controls 2.7 cfs @ 1.94 fps)
  └─**4=Orifice/Grate** (Orifice Controls 2.3 cfs @ 6.49 fps)

Summary for Pond 2P: Bldg 2 Subsurface Infiltation System

Inflow Area = 0.3 ac,100.00% Impervious, Inflow Depth = 5.76" for 25-Year event
Inflow = 1.9 cfs @ 12.07 hrs, Volume= 0.2 af
Outflow = 1.8 cfs @ 12.09 hrs, Volume= 0.2 af, Atten= 3%, Lag= 1.1 min
Discarded = 0.0 cfs @ 9.45 hrs, Volume= 0.1 af
Primary = 1.8 cfs @ 12.09 hrs, Volume= 0.1 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 150.64' @ 12.09 hrs Surf.Area= 622 sf Storage= 726 cf

Plug-Flow detention time= 67.6 min calculated for 0.2 af (100% of inflow)
Center-of-Mass det. time= 67.6 min (811.8 - 744.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	148.50'	445 cf	**24.83'W x 24.56'L x 2.33'H Field A**
			1,423 cf Overall - 310 cf Embedded = 1,114 cf x 40.0% Voids
#2A	149.00'	310 cf	**ADS_StormTech RC-310 +Cap** x 21 Inside #1
			Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf
			Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap
			7 Rows of 3 Chambers
#3	149.10'	24 cf	**4.00'D x 1.90'H Vertical Cone/Cylinder**
		779 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	148.50'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	149.90'	**12.0" Round Culvert** L= 501.0' Ke= 0.500
			Inlet / Outlet Invert= 149.90' / 140.93' S= 0.0179 '/' Cc= 0.900
			n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Discarded OutFlow Max=0.0 cfs @ 9.45 hrs HW=149.10' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=1.8 cfs @ 12.09 hrs HW=150.64' (Free Discharge)
└─**2=Culvert** (Inlet Controls 1.8 cfs @ 2.92 fps)

Summary for Pond 3P: Subsurface Infiltration System

Inflow Area = 2.2 ac, 90.11% Impervious, Inflow Depth = 5.30" for 25-Year event
Inflow = 12.9 cfs @ 12.08 hrs, Volume= 1.0 af
Outflow = 12.9 cfs @ 12.09 hrs, Volume= 1.0 af, Atten= 0%, Lag= 0.4 min
Discarded = 1.0 cfs @ 11.22 hrs, Volume= 0.7 af
Primary = 11.9 cfs @ 12.09 hrs, Volume= 0.2 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 151.74' @ 12.09 hrs Surf.Area= 5,124 sf Storage= 6,938 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 30.3 min (800.5 - 770.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	149.00'	3,575 cf	**41.50'W x 123.48'L x 2.33'H Field A**
			11,957 cf Overall - 3,018 cf Embedded = 8,939 cf x 40.0% Voids
#2A	149.50'	3,018 cf	**ADS_StormTech SC-310** x 204 Inside #1
			Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf
			Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap
			Row Length Adjustment= +0.44' x 2.07 sf x 12 rows
#3	149.00'	628 cf	**4.00'D x 5.00'H Vertical Cone/Cylinder** x 10 -Impervious
		7,222 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	149.00'	**8.270 in/hr Exfiltration over Surface area**
#2	Primary	149.00'	**18.0" Round Culvert** L= 27.0' Ke= 0.500
			Inlet / Outlet Invert= 149.00' / 148.50' S= 0.0185 '/' Cc= 0.900
			n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#3	Device 2	150.80'	**4.0' long Sharp-Crested Rectangular Weir** 0 End Contraction(s)
			3.5' Crest Height

Discarded OutFlow Max=1.0 cfs @ 11.22 hrs HW=149.05' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 1.0 cfs)

Primary OutFlow Max=12.0 cfs @ 12.09 hrs HW=151.74' (Free Discharge)
└─**2=Culvert** (Inlet Controls 12.0 cfs @ 6.79 fps)
  └─**3=Sharp-Crested Rectangular Weir** (Passes 12.0 cfs of 12.3 cfs potential flow)

Summary for Pond 4P: Bldg 3 Subsurface Infiltration System

Inflow Area = 0.8 ac, 79.53% Impervious, Inflow Depth = 4.93" for 25-Year event
Inflow = 4.3 cfs @ 12.07 hrs, Volume= 0.3 af
Outflow = 4.2 cfs @ 12.08 hrs, Volume= 0.3 af, Atten= 1%, Lag= 0.5 min
Discarded = 0.0 cfs @ 5.57 hrs, Volume= 0.1 af
Primary = 4.2 cfs @ 12.08 hrs, Volume= 0.2 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Peak Elev= 148.23' @ 12.08 hrs Surf.Area= 868 sf Storage= 1,699 cf

Plug-Flow detention time= 122.4 min calculated for 0.3 af (95% of inflow)
Center-of-Mass det. time= 95.1 min (873.0 - 777.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	145.00'	829 cf	**34.75'W x 24.98'L x 3.50'H Field A** 3,038 cf Overall - 965 cf Embedded = 2,073 cf x 40.0% Voids
#2A	145.50'	965 cf	**ADS_StormTech SC-740 +Cap** x 21 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 7 Rows of 3 Chambers
		1,794 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	145.00'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	145.00'	**12.0" Round Culvert** L= 16.0' Ke= 0.500 Inlet / Outlet Invert= 145.00' / 144.60' S= 0.0250 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#3	Device 2	147.75'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=0.0 cfs @ 5.57 hrs HW=145.04' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=4.2 cfs @ 12.08 hrs HW=148.23' (Free Discharge)
└─**2=Culvert** (Passes 4.2 cfs of 6.2 cfs potential flow)
  └─**3=Sharp-Crested Rectangular Weir** (Weir Controls 4.2 cfs @ 2.26 fps)

Summary for Pond B-1: Bio-retention Basin 1

Inflow Area = 0.7 ac, 43.77% Impervious, Inflow Depth = 3.48" for 25-Year event
Inflow = 2.8 cfs @ 12.07 hrs, Volume= 0.2 af
Outflow = 1.2 cfs @ 12.27 hrs, Volume= 0.2 af, Atten= 57%, Lag= 11.5 min
Discarded = 0.6 cfs @ 12.27 hrs, Volume= 0.2 af
Primary = 0.6 cfs @ 12.27 hrs, Volume= 0.0 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 154.56' @ 12.27 hrs Surf.Area= 3,292 sf Storage= 1,631 cf
Flood Elev= 155.00' Surf.Area= 3,882 sf Storage= 3,214 cf

Plug-Flow detention time= 13.5 min calculated for 0.2 af (100% of inflow)
Center-of-Mass det. time= 13.6 min (834.2 - 820.7)

Volume	Invert	Avail.Storage	Storage Description
#1	154.00'	3,214 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
154.00	2,545	0	0
155.00	3,882	3,214	3,214

Device	Routing	Invert	Outlet Devices
#1	Primary	151.00'	**12.0" Round Culvert** L= 275.0' RCP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 151.00' / 146.90' S= 0.0149 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	154.50'	**24.0" Horiz. Orifice/Grate X 2.00** C= 0.600 Limited to weir flow at low heads
#3	Discarded	154.00'	**8.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.6 cfs @ 12.27 hrs HW=154.56' (Free Discharge)
└─**3=Exfiltration** (Exfiltration Controls 0.6 cfs)

Primary OutFlow Max=0.6 cfs @ 12.27 hrs HW=154.56' (Free Discharge)
└─**1=Culvert** (Passes 0.6 cfs of 5.1 cfs potential flow)
  └─**2=Orifice/Grate** (Weir Controls 0.6 cfs @ 0.79 fps)

Summary for Pond B-2: Bio-retention Basin 2

Inflow Area = 1.9 ac, 61.44% Impervious, Inflow Depth = 4.20" for 25-Year event
Inflow = 9.5 cfs @ 12.07 hrs, Volume= 0.7 af
Outflow = 8.2 cfs @ 12.12 hrs, Volume= 0.7 af, Atten= 14%, Lag= 2.7 min
Discarded = 0.9 cfs @ 12.12 hrs, Volume= 0.5 af
Primary = 7.3 cfs @ 12.12 hrs, Volume= 0.2 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 154.32' @ 12.12 hrs Surf.Area= 4,586 sf Storage= 6,012 cf
Flood Elev= 155.00' Surf.Area= 5,206 sf Storage= 6,908 cf

Plug-Flow detention time= 51.9 min calculated for 0.7 af (100% of inflow)
Center-of-Mass det. time= 51.9 min (854.4 - 802.6)

Volume	Invert	Avail.Storage	Storage Description
#1	152.00'	6,908 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
152.00	1,364	0	0
153.00	2,290	1,827	1,827
154.00	3,513	2,902	4,729
154.50	5,206	2,180	6,908

Device	Routing	Invert	Outlet Devices
#1	Primary	150.00'	**18.0" Round Culvert** L= 11.0' RCP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 150.00' / 149.30' S= 0.0636 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf

#2	Device 1	154.00'	**24.0" Horiz. Orifice/Grate X 2.00** C= 0.600 Limited to weir flow at low heads
#3	Discarded	152.00'	**8.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.9 cfs @ 12.12 hrs HW=154.32' (Free Discharge)
└─**3=Exfiltration** (Exfiltration Controls 0.9 cfs)

Primary OutFlow Max=7.3 cfs @ 12.12 hrs HW=154.32' (Free Discharge)
└─**1=Culvert** (Passes 7.3 cfs of 16.1 cfs potential flow)
  └─**2=Orifice/Grate** (Weir Controls 7.3 cfs @ 1.84 fps)

Summary for Pond B-3: Bridges Bio Reten 1

Inflow Area = 0.6 ac, 42.67% Impervious, Inflow Depth = 3.48" for 25-Year event
Inflow = 2.7 cfs @ 12.07 hrs, Volume= 0.2 af
Outflow = 2.2 cfs @ 12.13 hrs, Volume= 0.2 af, Atten= 17%, Lag= 3.1 min
Discarded = 0.1 cfs @ 12.13 hrs, Volume= 0.1 af
Primary = 2.1 cfs @ 12.13 hrs, Volume= 0.1 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 150.14' @ 12.13 hrs Surf.Area= 2,295 sf Storage= 1,827 cf

Plug-Flow detention time= 106.2 min calculated for 0.2 af (100% of inflow)
Center-of-Mass det. time= 106.1 min (926.8 - 820.7)

Volume	Invert	Avail.Storage	Storage Description
#1	149.00'	2,850 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
149.00	1,161	254.0	0	0	1,161
150.00	1,951	272.0	1,539	1,539	1,959
150.50	3,354	354.0	1,311	2,850	6,047

Device	Routing	Invert	Outlet Devices
#1	Discarded	149.00'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	148.35'	**12.0" Round Culvert** L= 473.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 148.35' / 145.40' S= 0.0062 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#3	Device 2	150.00'	**24.0" Horiz. Orifice/Grate X 2.00** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.1 cfs @ 12.13 hrs HW=150.14' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.1 cfs)

Primary OutFlow Max=2.1 cfs @ 12.13 hrs HW=150.14' (Free Discharge)
└─**2=Culvert** (Passes 2.1 cfs of 3.5 cfs potential flow)
  └─**3=Orifice/Grate** (Weir Controls 2.1 cfs @ 1.20 fps)

Summary for Pond B-4: Bridges Bio Reten 2

Inflow Area = 0.6 ac, 37.48% Impervious, Inflow Depth = 3.28" for 25-Year event
Inflow = 2.2 cfs @ 12.08 hrs, Volume= 0.2 af
Outflow = 2.1 cfs @ 12.10 hrs, Volume= 0.2 af, Atten= 4%, Lag= 1.3 min
Discarded = 0.1 cfs @ 12.10 hrs, Volume= 0.1 af
Primary = 2.1 cfs @ 12.10 hrs, Volume= 0.1 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 149.14' @ 12.10 hrs Surf.Area= 1,408 sf Storage= 1,236 cf

Plug-Flow detention time= 99.2 min calculated for 0.2 af (100% of inflow)
Center-of-Mass det. time= 99.2 min (924.7 - 825.5)

Volume	Invert	Avail.Storage	Storage Description
#1	148.00'	2,767 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
148.00	819	152.0	0	0	819
149.00	1,305	171.0	1,053	1,053	1,333
150.00	2,159	200.0	1,714	2,767	2,209

Device	Routing	Invert	Outlet Devices
#1	Discarded	148.00'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	146.65'	**12.0" Round Culvert** L= 56.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 146.65' / 146.36' S= 0.0052 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#3	Device 2	149.00'	**24.0" Horiz. Orifice/Grate X 2.00** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.1 cfs @ 12.10 hrs HW=149.14' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.1 cfs)

Primary OutFlow Max=2.0 cfs @ 12.10 hrs HW=149.14' (Free Discharge)
└─**2=Culvert** (Passes 2.0 cfs of 5.1 cfs potential flow)
  └─**3=Orifice/Grate** (Weir Controls 2.0 cfs @ 1.20 fps)

Summary for Pond P-1A: Existing Pond at Center of Property

Inflow Area = 73.4 ac, 38.60% Impervious, Inflow Depth = 2.00" for 25-Year event
Inflow = 144.0 cfs @ 12.09 hrs, Volume= 12.3 af
Outflow = 22.5 cfs @ 12.95 hrs, Volume= 11.9 af, Atten= 84%, Lag= 51.8 min
Primary = 22.5 cfs @ 12.95 hrs, Volume= 11.9 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Starting Elev= 144.70' Surf.Area= 48,178 sf Storage= 33,047 cf
Peak Elev= 148.99' @ 12.95 hrs Surf.Area= 70,927 sf Storage= 281,233 cf (248,187 cf above start)
Flood Elev= 152.00' Surf.Area= 132,117 sf Storage= 566,694 cf (533,647 cf above start)

Plug-Flow detention time= 310.8 min calculated for 11.1 af (91% of inflow)
Center-of-Mass det. time= 242.4 min (1,085.1 - 842.7)

Volume	Invert	Avail.Storage	Storage Description
#1	144.00'	566,694 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
144.00	46,247	909.0	0	0	46,247
145.00	49,018	939.0	47,626	47,626	50,754
146.00	53,432	1,337.0	51,209	98,835	122,849
147.00	56,882	1,331.0	55,148	153,983	124,693
148.00	64,042	21,449.0	60,427	214,410	36,594,098
149.00	70,994	2,381.0	67,488	281,898	72,753,343
150.00	84,015	2,596.0	77,413	359,311	72,838,531
151.00	99,807	2,841.0	91,798	451,109	72,944,568
152.00	132,117	5,056.0	115,585	566,694	74,336,532

Device	Routing	Invert	Outlet Devices
#1	Device 4	144.70'	**12.0" Round Culvert** L= 97.0' Ke= 0.500 Inlet / Outlet Invert= 144.70' / 143.80' S= 0.0093 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Device 3	147.00'	**24.0" W x 18.0" H Vert. Orifice/Grate** C= 0.600
#3	Device 4	144.00'	**24.0" Round Culvert** L= 57.0' Ke= 0.500 Inlet / Outlet Invert= 144.00' / 143.80' S= 0.0035 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf
#4	Primary	143.80'	**36.0" Round Culvert** L= 1,434.0' Ke= 0.500 Inlet / Outlet Invert= 143.80' / 140.93' S= 0.0020 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 7.07 sf

Primary OutFlow Max=22.5 cfs @ 12.95 hrs HW=148.99' (Free Discharge)
└—**4=Culvert** (Passes 22.5 cfs of 42.6 cfs potential flow)
  ├—**1=Culvert** (Barrel Controls 6.7 cfs @ 8.56 fps)
  └—**3=Culvert** (Passes 15.8 cfs of 30.2 cfs potential flow)
    └—**2=Orifice/Grate** (Orifice Controls 15.8 cfs @ 5.27 fps)

Summary for Pond P-1B: SW Wetland/Swale at Western Prop Line

Inflow Area = 37.4 ac, 29.31% Impervious, Inflow Depth = 1.33" for 25-Year event
Inflow = 33.3 cfs @ 12.26 hrs, Volume= 4.1 af
Outflow = 24.9 cfs @ 12.49 hrs, Volume= 4.1 af, Atten= 25%, Lag= 13.5 min
Primary = 24.9 cfs @ 12.49 hrs, Volume= 4.1 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 153.40' @ 12.49 hrs Surf.Area= 14,618 sf Storage= 10,116 cf

Plug-Flow detention time= 1.7 min calculated for 4.1 af (100% of inflow)
Center-of-Mass det. time= 1.7 min (894.0 - 892.4)

Volume	Invert	Avail.Storage	Storage Description
#1	151.00'	126,119 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
151.00	498	198.0	0	0	498
152.00	1,368	715.0	897	897	38,063
153.00	8,822	6,900.0	4,555	5,452	3,786,066
154.00	25,925	1,559.0	16,623	22,075	7,381,341
155.00	50,627	1,626.0	37,594	59,669	7,398,397
156.00	83,648	1,717.0	66,450	126,119	7,422,663

Device	Routing	Invert	Outlet Devices
#1	Primary	149.70'	**24.0" Round Culvert** L= 300.0' Ke= 0.500 Inlet / Outlet Invert= 149.70' / 146.90' S= 0.0093 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf

Primary OutFlow Max=24.9 cfs @ 12.49 hrs HW=153.40' (Free Discharge)
└─**1=Culvert** (Inlet Controls 24.9 cfs @ 7.91 fps)

Summary for Pond P-C: Subsurface Infiltration System

Inflow Area =	4.3 ac, 59.27% Impervious, Inflow Depth = 4.09"	for 25-Year event	
Inflow =	21.1 cfs @ 12.07 hrs, Volume=	1.5 af	
Outflow =	21.1 cfs @ 12.07 hrs, Volume=	1.4 af,	Atten= 0%, Lag= 0.0 min
Discarded =	0.1 cfs @ 7.39 hrs, Volume=	0.2 af	
Primary =	21.1 cfs @ 12.07 hrs, Volume=	1.2 af	

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 156.83' @ 12.07 hrs Surf.Area= 2,934 sf Storage= 6,400 cf
Flood Elev= 155.50' Surf.Area= 2,934 sf Storage= 5,785 cf

Plug-Flow detention time= 93.6 min calculated for 1.4 af (96% of inflow)
Center-of-Mass det. time= 68.7 min (874.0 - 805.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	152.50'	2,593 cf	**39.50'W x 73.64'L x 3.50'H Field A** 10,180 cf Overall - 3,698 cf Embedded = 6,483 cf x 40.0% Voids
#2A	153.00'	3,698 cf	**ADS_StormTech SC-740** x 80 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap Row Length Adjustment= +0.44' x 6.45 sf x 8 rows
#3	152.50'	126 cf	**4.00'D x 5.00'H Vertical Cone/Cylinder** x 2
		6,417 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	152.50'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	148.70'	**30.0" Round Culvert out of OCS302** L= 244.0' Ke= 0.500 Inlet / Outlet Invert= 148.70' / 146.60' S= 0.0086 '/' Cc= 0.900

			n= 0.011 Concrete pipe, straight & clean, Flow Area= 4.91 sf
#3	Device 2	155.50'	**4.0' long x 2.50' rise Sharp-Crested Rectangular Weir** 0 End Contraction(s) 3.5' Crest Height

Discarded OutFlow Max=0.1 cfs @ 7.39 hrs HW=152.56' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.1 cfs)

Primary OutFlow Max=21.0 cfs @ 12.07 hrs HW=156.83' (Free Discharge)
└─**2=Culvert out of OCS302** (Passes 21.0 cfs of 62.0 cfs potential flow)
  └─**3=Sharp-Crested Rectangular Weir** (Weir Controls 21.0 cfs @ 3.95 fps)

Summary for Pond P-ROOF: Perforated Pipe System

Inflow Area = 4.0 ac,100.00% Impervious, Inflow Depth = 5.76" for 25-Year event
Inflow = 24.6 cfs @ 12.07 hrs, Volume= 1.9 af
Outflow = 24.6 cfs @ 12.07 hrs, Volume= 1.9 af, Atten= 0%, Lag= 0.0 min
Discarded = 0.8 cfs @ 8.90 hrs, Volume= 1.1 af
Primary = 23.8 cfs @ 12.07 hrs, Volume= 0.9 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 152.57' @ 12.07 hrs Surf.Area= 14,250 sf Storage= 9,721 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 43.5 min (787.7 - 744.2)

Volume	Invert	Avail.Storage	Storage Description
#1	150.50'	1,865 cf	**6.0" Round Pipe Storage** Inside #2 L= 9,500.0'
#2	150.00'	7,804 cf	**1.50'W x 9,500.00'L x 1.50'H Prismatoid** 21,375 cf Overall - 1,865 cf Embedded = 19,510 cf x 40.0% Voids
#3	150.50'	138 cf	**4.00'D x 5.50'H Vertical Cone/Cylinder** x 2 -Impervious
		9,807 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	150.00'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	151.00'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=0.8 cfs @ 8.90 hrs HW=150.06' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.8 cfs)

Primary OutFlow Max=23.8 cfs @ 12.07 hrs HW=152.57' (Free Discharge)
└─**2=Sharp-Crested Rectangular Weir** (Weir Controls 23.8 cfs @ 4.10 fps)

Summary for Pond P-Roof 2: Bridges Perf Pipe System

Inflow Area = 1.0 ac,100.00% Impervious, Inflow Depth = 5.76" for 25-Year event
Inflow = 6.2 cfs @ 12.07 hrs, Volume= 0.5 af
Outflow = 6.1 cfs @ 12.07 hrs, Volume= 0.5 af, Atten= 2%, Lag= 0.2 min
Discarded = 0.2 cfs @ 9.23 hrs, Volume= 0.3 af
Primary = 5.9 cfs @ 12.07 hrs, Volume= 0.2 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 152.10' @ 12.07 hrs Surf.Area= 4,013 sf Storage= 3,462 cf

Plug-Flow detention time= 61.9 min calculated for 0.5 af (100% of inflow)
Center-of-Mass det. time= 61.4 min (805.6 - 744.2)

Volume	Invert	Avail.Storage	Storage Description
#1	150.00'	3,043 cf	**2.00'W x 2,000.00'L x 2.00'H Prismatoid** 8,000 cf Overall - 393 cf Embedded = 7,607 cf x 40.0% Voids
#2	150.50'	393 cf	**6.0" Round Pipe Storage** Inside #1 L= 2,000.0'
#3	150.00'	75 cf	**4.00'D x 6.00'H Vertical Cone/Cylinder**
		3,511 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	150.00'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	151.50'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=0.2 cfs @ 9.23 hrs HW=150.06' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.2 cfs)

Primary OutFlow Max=5.8 cfs @ 12.07 hrs HW=152.10' (Free Discharge)
└─**2=Sharp-Crested Rectangular Weir** (Weir Controls 5.8 cfs @ 2.53 fps)

Summary for Pond ROOF: Perforated Pipe System

Inflow Area =	0.6 ac,100.00% Impervious,	Inflow Depth = 5.76"	for 25-Year event
Inflow =	3.6 cfs @ 12.07 hrs,	Volume=	0.3 af
Outflow =	3.3 cfs @ 12.10 hrs,	Volume=	0.3 af, Atten= 6%, Lag= 1.6 min
Discarded =	0.2 cfs @ 11.64 hrs,	Volume=	0.2 af
Primary =	3.2 cfs @ 12.10 hrs,	Volume=	0.1 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 154.89' @ 12.10 hrs Surf.Area= 3,013 sf Storage= 1,920 cf

Plug-Flow detention time= 44.3 min calculated for 0.3 af (100% of inflow)
Center-of-Mass det. time= 44.3 min (788.5 - 744.2)

Volume	Invert	Avail.Storage	Storage Description
#1	154.00'	393 cf	**6.0" Round Pipe Storage** Inside #2 L= 2,000.0'
#2	153.50'	1,643 cf	**1.50'W x 2,000.00'L x 1.50'H Prismatoid** 4,500 cf Overall - 393 cf Embedded = 4,107 cf x 40.0% Voids
#3	154.00'	63 cf	**4.00'D x 5.00'H Vertical Cone/Cylinder**
		2,098 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	153.50'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	154.50'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=0.2 cfs @ 11.64 hrs HW=154.01' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.2 cfs)

Primary OutFlow Max=3.2 cfs @ 12.10 hrs HW=154.89' (Free Discharge)
└─**2=Sharp-Crested Rectangular Weir** (Weir Controls 3.2 cfs @ 2.05 fps)

Summary for Link DP-1: 48" RCP Across Boston Post Road

Inflow Area = 85.8 ac, 43.93% Impervious, Inflow Depth > 2.17" for 25-Year event
Inflow = 59.0 cfs @ 12.09 hrs, Volume= 15.5 af
Primary = 59.0 cfs @ 12.09 hrs, Volume= 15.5 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Link DP-2: Overland Flow to Boston Post Road

Inflow Area = 0.0 ac, 35.19% Impervious, Inflow Depth = 3.18" for 25-Year event
Inflow = 0.0 cfs @ 12.08 hrs, Volume= 0.0 af
Primary = 0.0 cfs @ 12.08 hrs, Volume= 0.0 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Link DP-3: Wetland at Northeast Corner

Inflow Area = 0.7 ac, 0.00% Impervious, Inflow Depth = 2.01" for 25-Year event
Inflow = 1.5 cfs @ 12.08 hrs, Volume= 0.1 af
Primary = 1.5 cfs @ 12.08 hrs, Volume= 0.1 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

100-Year Storm Event – Proposed

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

SubcatchmentS-1A-1: WFM Parking Lot Runoff Area=97,026 sf 90.11% Impervious Runoff Depth=7.88"
Tc=5.0 min CN=94 Runoff=19.2 cfs 1.5 af

SubcatchmentS-1A-2: SW Retail - Runoff Area=53,667 sf 73.74% Impervious Runoff Depth=7.16"
Flow Length=891' Tc=10.1 min CN=88 Runoff=8.5 cfs 0.7 af

SubcatchmentS-1A-2A: SW Retail - Runoff Area=13,612 sf 100.00% Impervious Runoff Depth=8.36"
Tc=5.0 min CN=98 Runoff=2.7 cfs 0.2 af

SubcatchmentS-1A-4: Retail Roadways Runoff Area=167,617 sf 62.93% Impervious Runoff Depth=6.67"
Tc=5.0 min CN=84 Runoff=30.1 cfs 2.1 af

SubcatchmentS-1A-5: Road in front of Runoff Area=16,532 sf 79.91% Impervious Runoff Depth=7.52"
Tc=5.0 min CN=91 Runoff=3.2 cfs 0.2 af

SubcatchmentS-1A-6: Central Park Runoff Area=35,240 sf 27.59% Impervious Runoff Depth=5.10"
Flow Length=819' Tc=17.8 min CN=71 Runoff=3.4 cfs 0.3 af

SubcatchmentS-1B-1A: Assisted Living Runoff Area=44,351 sf 100.00% Impervious Runoff Depth=8.36"
Tc=5.0 min CN=98 Runoff=8.9 cfs 0.7 af

SubcatchmentS-1B-1B: Assisted Living Runoff Area=24,236 sf 37.48% Impervious Runoff Depth=5.59"
Tc=5.0 min CN=75 Runoff=3.8 cfs 0.3 af

SubcatchmentS-1B-1C: Assisted Living Runoff Area=46,929 sf 61.74% Impervious Runoff Depth=6.67"
Flow Length=1,032' Tc=14.7 min CN=84 Runoff=6.2 cfs 0.6 af

SubcatchmentS-1B-1D: Assisted Living Runoff Area=27,332 sf 42.67% Impervious Runoff Depth=5.83"
Tc=5.0 min CN=77 Runoff=4.4 cfs 0.3 af

SubcatchmentS-1B-1E: Assisted Living Runoff Area=53,724 sf 31.75% Impervious Runoff Depth=5.35"
Tc=5.0 min CN=73 Runoff=8.0 cfs 0.5 af

SubcatchmentS-1B-2: Age Restricted Runoff Area=206,575 sf 50.94% Impervious Runoff Depth=6.19"
Flow Length=375' Tc=5.0 min CN=80 Runoff=35.0 cfs 2.4 af

SubcatchmentS-1C-1: Avalon Parking Runoff Area=28,905 sf 43.77% Impervious Runoff Depth=5.83"
Tc=5.0 min CN=77 Runoff=4.6 cfs 0.3 af

SubcatchmentS-1C-2: Avalon Parking Runoff Area=82,736 sf 61.44% Impervious Runoff Depth=6.67"
Tc=5.0 min CN=84 Runoff=14.9 cfs 1.1 af

SubcatchmentS-1C-3: Avalon Sudbury Runoff Area=187,450 sf 59.27% Impervious Runoff Depth=6.55"
Tc=5.0 min CN=83 Runoff=33.2 cfs 2.3 af

SubcatchmentS-1C-4: Avalon Sudbury Runoff Area=176,027 sf 100.00% Impervious Runoff Depth=8.36"
Tc=5.0 min CN=98 Runoff=35.4 cfs 2.8 af

SubcatchmentS-1C-5: Multi-Family Runoff Area=313,748 sf 37.45% Impervious Runoff Depth=4.62"
Flow Length=1,845' Tc=12.2 min CN=67 Runoff=31.9 cfs 2.8 af

SubcatchmentS-1D: Central Pervious Runoff Area=368,478 sf 16.57% Impervious Runoff Depth=4.62"
Tc=5.0 min CN=67 Runoff=47.6 cfs 3.3 af

SubcatchmentS-1E-1: Avalon Sudbury Runoff Area=25,470 sf 100.00% Impervious Runoff Depth=8.36"
Tc=5.0 min CN=98 Runoff=5.1 cfs 0.4 af

SubcatchmentS-1E-2: Grocery Store, Runoff Area=157,982 sf 30.11% Impervious Runoff Depth=4.38"
Flow Length=533' Tc=7.7 min CN=65 Runoff=17.6 cfs 1.3 af

SubcatchmentS-1F: Offsite Farm Area Runoff Area=1,470,921 sf 29.23% Impervious Runoff Depth=2.74"
Flow Length=1,734' Tc=17.0 min UI Adjusted CN=51 Runoff=73.1 cfs 7.7 af

SubcatchmentS-1G-1: SE Retail Bldg 3 Runoff Area=26,763 sf 74.84% Impervious Runoff Depth=7.28"
Tc=5.0 min CN=89 Runoff=5.1 cfs 0.4 af

SubcatchmentS-1G-1A: SE Retail Bldg 3 Runoff Area=6,137 sf 100.00% Impervious Runoff Depth=8.36"
Tc=5.0 min CN=98 Runoff=1.2 cfs 0.1 af

SubcatchmentS-1G-2: NE Retail - Runoff Area=59,109 sf 91.46% Impervious Runoff Depth=8.00"
Tc=5.0 min CN=95 Runoff=11.7 cfs 0.9 af

SubcatchmentS-2: Southern Prop Line - Runoff Area=520 sf 35.19% Impervious Runoff Depth=5.47"
Tc=5.0 min CN=74 Runoff=0.1 cfs 0.0 af

SubcatchmentS-3: Eastern Prop Line Runoff Area=29,000 sf 0.00% Impervious Runoff Depth=3.91"
Flow Length=20' Slope=0.0810 '/' Tc=5.0 min CN=61 Runoff=3.1 cfs 0.2 af

SubcatchmentS-4: Roadway runoff from Runoff Area=45,746 sf 95.22% Impervious Runoff Depth=8.12"
Tc=5.0 min CN=96 Runoff=9.1 cfs 0.7 af

Reach R-1: Swale in WFM Parking Lot Avg. Flow Depth=0.89' Max Vel=3.18 fps Inflow=19.2 cfs 1.5 af
n=0.040 L=200.0' S=0.0140 '/' Capacity=99.3 cfs Outflow=18.9 cfs 1.5 af

Pond 1P: Bldg 4&5 Subsurface Infiltration Peak Elev=149.10' Storage=8,518 cf Inflow=11.7 cfs 0.9 af
Discarded=0.2 cfs 0.4 af Primary=11.5 cfs 0.5 af Outflow=11.7 cfs 0.9 af

Pond 2P: Bldg 2 Subsurface Infiltation System Peak Elev=150.90' Storage=778 cf Inflow=2.7 cfs 0.2 af
Discarded=0.0 cfs 0.1 af Primary=2.7 cfs 0.1 af Outflow=2.7 cfs 0.2 af

Pond 3P: Subsurface Infiltration System Peak Elev=153.99' Storage=7,221 cf Inflow=18.9 cfs 1.5 af
Discarded=1.0 cfs 0.9 af Primary=17.5 cfs 0.5 af Outflow=18.5 cfs 1.5 af

Pond 4P: Bldg 3 Subsurface Infiltration System Peak Elev=148.38' Storage=1,752 cf Inflow=6.3 cfs 0.5 af
Discarded=0.0 cfs 0.1 af Primary=6.3 cfs 0.4 af Outflow=6.3 cfs 0.5 af

Pond B-1: Bio-retention Basin 1 Peak Elev=154.68' Storage=2,051 cf Inflow=4.6 cfs 0.3 af
Discarded=0.7 cfs 0.3 af Primary=3.2 cfs 0.1 af Outflow=3.9 cfs 0.3 af

Pond B-2: Bio-retention Basin 2 Peak Elev=154.46' Storage=6,705 cf Inflow=14.9 cfs 1.1 af
Discarded=1.0 cfs 0.6 af Primary=12.8 cfs 0.4 af Outflow=13.8 cfs 1.1 af

Pond B-3: Bridges Bio Reten 1 Peak Elev=150.24' Storage=2,091 cf Inflow=4.4 cfs 0.3 af
Discarded=0.1 cfs 0.1 af Primary=3.5 cfs 0.2 af Outflow=3.7 cfs 0.3 af

Pond B-4: Bridges Bio Reten 2 Peak Elev=149.20' Storage=1,324 cf Inflow=3.8 cfs 0.3 af
Discarded=0.1 cfs 0.1 af Primary=3.6 cfs 0.2 af Outflow=3.7 cfs 0.3 af

Pond P-1A: Existing Pond at Center of Peak Elev=151.46' Storage=499,794 cf Inflow=242.1 cfs 23.5 af
Outflow=36.2 cfs 23.1 af

Pond P-1B: SW Wetland/Swale at Western Peak Elev=155.35' Storage=78,931 cf Inflow=83.7 cfs 9.0 af
24.0" Round Culvert n=0.011 L=300.0' S=0.0093 '/' Outflow=31.3 cfs 9.0 af

Pond P-C: Subsurface Infiltration System Peak Elev=157.28' Storage=6,411 cf Inflow=33.2 cfs 2.3 af
Discarded=0.1 cfs 0.2 af Primary=33.1 cfs 2.1 af Outflow=33.2 cfs 2.3 af

Pond P-ROOF: Perforated Pipe System Peak Elev=153.05' Storage=9,733 cf Inflow=35.4 cfs 2.8 af
Discarded=0.8 cfs 1.3 af Primary=34.5 cfs 1.6 af Outflow=35.3 cfs 2.8 af

Pond P-Roof 2: Bridges Perf Pipe System Peak Elev=152.28' Storage=3,464 cf Inflow=8.9 cfs 0.7 af
Discarded=0.2 cfs 0.4 af Primary=8.7 cfs 0.4 af Outflow=8.9 cfs 0.7 af

Pond ROOF: Perforated Pipe System Peak Elev=155.03' Storage=2,049 cf Inflow=5.1 cfs 0.4 af
Discarded=0.2 cfs 0.2 af Primary=4.9 cfs 0.2 af Outflow=5.1 cfs 0.4 af

Link DP-1: 48" RCP Across Boston Post Road Inflow=110.2 cfs 29.0 af
Primary=110.2 cfs 29.0 af

Link DP-2: Overland Flow to Boston Post Road Inflow=0.1 cfs 0.0 af
Primary=0.1 cfs 0.0 af

Link DP-3: Wetland at Northeast Corner Inflow=3.1 cfs 0.2 af
Primary=3.1 cfs 0.2 af

Total Runoff Area = 86.5 ac Runoff Volume = 34.3 af Average Runoff Depth = 4.77"
56.41% Pervious = 48.8 ac 43.59% Impervious = 37.7 ac

Summary for Subcatchment S-1A-1: WFM Parking Lot

Runoff = 19.2 cfs @ 12.07 hrs, Volume= 1.5 af, Depth= 7.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.60"

	Area (sf)	CN	Description
	87,427	98	Unconnected pavement, HSG B
	9,599	61	>75% Grass cover, Good, HSG B
	97,026	94	Weighted Average
	9,599		9.89% Pervious Area
	87,427		90.11% Impervious Area
	87,427		100.00% Unconnected

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

Summary for Subcatchment S-1A-2: SW Retail - Building 2

Runoff = 8.5 cfs @ 12.13 hrs, Volume= 0.7 af, Depth= 7.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.60"

	Area (sf)	CN	Description
*	39,573	98	Parking
	14,094	61	>75% Grass cover, Good, HSG B
	53,667	88	Weighted Average
	14,094		26.26% Pervious Area
	39,573		73.74% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.6	50	0.0240	0.11		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.5	103	0.0330	3.69		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.7	266	0.0150	6.57	5.16	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
0.2	76	0.0050	6.02	18.90	**Pipe Channel,** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.011 Concrete pipe, straight & clean
0.5	215	0.0050	7.89	55.74	**Pipe Channel,** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.011 Concrete pipe, straight & clean
0.6	181	0.0020	4.99	35.25	**Pipe Channel,** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.011 Concrete pipe, straight & clean

10.1	891	Total

Summary for Subcatchment S-1A-2A: SW Retail - Building 2 Roof

Runoff = 2.7 cfs @ 12.07 hrs, Volume= 0.2 af, Depth= 8.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.60"

	Area (sf)	CN	Description
*	13,612	98	Rooftop
	13,612		100.00% Impervious Area

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

Summary for Subcatchment S-1A-4: Retail Roadways

Runoff = 30.1 cfs @ 12.07 hrs, Volume= 2.1 af, Depth= 6.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.60"

Area (sf)	CN	Description
105,483	98	Roofs, HSG B
62,134	61	>75% Grass cover, Good, HSG B
167,617	84	Weighted Average
62,134		37.07% Pervious Area
105,483		62.93% Impervious Area

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

Summary for Subcatchment S-1A-5: Road in front of Bridges

Runoff = 3.2 cfs @ 12.07 hrs, Volume= 0.2 af, Depth= 7.52"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.60"

Area (sf)	CN	Description
13,211	98	Roofs, HSG B
3,321	61	>75% Grass cover, Good, HSG B
16,532	91	Weighted Average
3,321		20.09% Pervious Area
13,211		79.91% Impervious Area

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

Summary for Subcatchment S-1A-6: Central Park

Runoff = 3.4 cfs @ 12.24 hrs, Volume= 0.3 af, Depth= 5.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.60"

Area (sf)	CN	Description
9,723	98	Roofs, HSG B
25,517	61	>75% Grass cover, Good, HSG B
35,240	71	Weighted Average
25,517		72.41% Pervious Area
9,723		27.59% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.8	50	0.0100	0.08		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
3.8	159	0.0100	0.70		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.3	162	0.0050	2.02	0.40	**Pipe Channel,** 6.0" Round Area= 0.2 sf Perim= 1.6' r= 0.13' n= 0.013 Corrugated PE, smooth interior
0.3	94	0.0100	4.54	3.56	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
1.6	354	0.0050	3.79	2.98	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
17.8	819	Total			

Summary for Subcatchment S-1B-1A: Assisted Living Facility Roof

Runoff = 8.9 cfs @ 12.07 hrs, Volume= 0.7 af, Depth= 8.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.60"

	Area (sf)	CN	Description
*	44,351	98	Roofs & Parking
	44,351		100.00% Impervious Area

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

Summary for Subcatchment S-1B-1B: Assisted Living Rear Parking

Runoff = 3.8 cfs @ 12.07 hrs, Volume= 0.3 af, Depth= 5.59"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.60"

	Area (sf)	CN	Description
*	9,084	98	Roofs & Parking
	15,152	61	>75% Grass cover, Good, HSG B
	24,236	75	Weighted Average
	15,152		62.52% Pervious Area
	9,084		37.48% Impervious Area

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

Summary for Subcatchment S-1B-1C: Assisted Living Road East Side

Runoff = 6.2 cfs @ 12.20 hrs, Volume= 0.6 af, Depth= 6.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.60"

	Area (sf)	CN	Description
*	28,975	98	Roofs & Parking
	17,954	61	>75% Grass cover, Good, HSG B
	46,929	84	Weighted Average
	17,954		38.26% Pervious Area
	28,975		61.74% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.8	50	0.0100	0.08		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.6	27	0.0100	0.70		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.4	95	0.0200	4.04	0.79	**Pipe Channel,** 6.0" Round Area= 0.2 sf Perim= 1.6' r= 0.13' n= 0.013 Corrugated PE, smooth interior
2.9	860	0.0020	4.99	35.25	**Pipe Channel,** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.011 Concrete pipe, straight & clean
14.7	1,032	Total			

Summary for Subcatchment S-1B-1D: Assisted Living Front Parking

Runoff = 4.4 cfs @ 12.07 hrs, Volume= 0.3 af, Depth= 5.83"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.60"

	Area (sf)	CN	Description
*	11,662	98	Roofs & Parking
	15,670	61	>75% Grass cover, Good, HSG B
	27,332	77	Weighted Average
	15,670		57.33% Pervious Area
	11,662		42.67% Impervious Area

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

Summary for Subcatchment S-1B-1E: Assisted Living Facility

Runoff = 8.0 cfs @ 12.07 hrs, Volume= 0.5 af, Depth= 5.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.60"

	Area (sf)	CN	Description
*	17,055	98	Roofs & Parking
*	36,669	61	>75% Grass cover, Good, HSG B
	53,724	73	Weighted Average
	36,669		68.25% Pervious Area
	17,055		31.75% Impervious Area

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

Summary for Subcatchment S-1B-2: Age Restricted Housing

Runoff = 35.0 cfs @ 12.07 hrs, Volume= 2.4 af, Depth= 6.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.60"

	Area (sf)	CN	Description
*	105,219	98	Roofs & Parking
*	101,356	61	>75% Grass cover, Good, HSG B
	206,575	80	Weighted Average
	101,356		49.06% Pervious Area
	105,219		50.94% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.20		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"
1.2	175	0.0150	2.49		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.4	150	0.0150	6.57	5.16	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
2.3	375	Total, Increased to minimum Tc = 5.0 min			

Summary for Subcatchment S-1C-1: Avalon Parking near Buildings G,F,&T1

Runoff = 4.6 cfs @ 12.07 hrs, Volume= 0.3 af, Depth= 5.83"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.60"

Area (sf)	CN	Description
12,651	98	Unconnected pavement, HSG B
16,254	61	>75% Grass cover, Good, HSG B
28,905	77	Weighted Average
16,254		56.23% Pervious Area
12,651		43.77% Impervious Area
12,651		100.00% Unconnected

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

Summary for Subcatchment S-1C-2: Avalon Parking near Buildings T,U,V

Runoff = 14.9 cfs @ 12.07 hrs, Volume= 1.1 af, Depth= 6.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.60"

Area (sf)	CN	Description
50,831	98	Unconnected pavement, HSG B
31,905	61	>75% Grass cover, Good, HSG B
82,736	84	Weighted Average
31,905		38.56% Pervious Area
50,831		61.44% Impervious Area
50,831		100.00% Unconnected

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

Summary for Subcatchment S-1C-3: Avalon Sudbury Road & Sidewalk to Subsurface Infiltration

Runoff = 33.2 cfs @ 12.07 hrs, Volume= 2.3 af, Depth= 6.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.60"

Area (sf)	CN	Description
111,097	98	Unconnected pavement, HSG B
76,353	61	>75% Grass cover, Good, HSG B
187,450	83	Weighted Average
76,353		40.73% Pervious Area
111,097		59.27% Impervious Area
111,097		100.00% Unconnected

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

Summary for Subcatchment S-1C-4: Avalon Sudbury Rooftop Runoff to Subsurface Infiltration

Runoff = 35.4 cfs @ 12.07 hrs, Volume= 2.8 af, Depth= 8.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.60"

Area (sf)	CN	Description
176,027	98	Unconnected pavement, HSG B
176,027		100.00% Impervious Area
176,027		100.00% Unconnected

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

Summary for Subcatchment S-1C-5: Multi-Family Housing - Direct to Pond

Runoff = 31.9 cfs @ 12.17 hrs, Volume= 2.8 af, Depth= 4.62"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.60"

	Area (sf)	CN	Description
*	117,511	98	Road & Sidewalk
*	89,299	61	>75% Grass cover, Good, HSG B
	106,938	39	>75% Grass cover, Good, HSG A
	313,748	67	Weighted Average
	196,237		62.55% Pervious Area
	117,511		37.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.0200	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
3.9	500	0.0180	2.16		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.2	471	0.0150	6.57	5.16	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
0.3	141	0.0150	8.60	15.20	**Pipe Channel,** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.011 Concrete pipe, straight & clean
0.3	188	0.0150	10.42	32.74	**Pipe Channel,** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.011 Concrete pipe, straight & clean
0.9	495	0.0070	9.33	65.95	**Pipe Channel,** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.011 Concrete pipe, straight & clean
12.2	1,845	Total			

Summary for Subcatchment S-1D: Central Pervious Area

Runoff = 47.6 cfs @ 12.08 hrs, Volume= 3.3 af, Depth= 4.62"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.60"

	Area (sf)	CN	Description
*	10,045	98	Road & Sidewalk
	1,564	39	>75% Grass cover, Good, HSG A
*	305,875	61	>75% Grass cover, Good, HSG B
	50,994	98	Water Surface, HSG B
	368,478	67	Weighted Average
	307,439		83.43% Pervious Area
	61,039		16.57% Impervious Area

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

Summary for Subcatchment S-1E-1: Avalon Sudbury Rooftop Runoff to Subsurface Infiltration

Runoff = 5.1 cfs @ 12.07 hrs, Volume= 0.4 af, Depth= 8.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.60"

Area (sf)	CN	Description
25,470	98	Unconnected pavement, HSG B
25,470		100.00% Impervious Area
25,470		100.00% Unconnected

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

Summary for Subcatchment S-1E-2: Grocery Store, Beltran Area & Western Prop Line

Runoff = 17.6 cfs @ 12.11 hrs, Volume= 1.3 af, Depth= 4.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.60"

	Area (sf)	CN	Description
*	47,568	98	Roofs
*	57,122	61	>75% Grass cover, Good, HSG B
*	53,292	39	>75% Grass cover, Good, HSG A
	157,982	65	Weighted Average
	110,414		69.89% Pervious Area
	47,568		30.11% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.0200	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
1.2	178	0.0220	2.39		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.9	305	0.0100	5.36	4.21	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
7.7	533	Total			

Summary for Subcatchment S-1F: Offsite Farm Area

Runoff = 73.1 cfs @ 12.26 hrs, Volume= 7.7 af, Depth= 2.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.60"

Area (sf)	CN	Adj	Description
10,003	98		Water Surface, HSG B
181,224	61		>75% Grass cover, Good, HSG B
859,788	30		Meadow, non-grazed, HSG A
301,859	98		Roofs, HSG B
118,047	98		Unconnected pavement, HSG B
1,470,921	54	51	Weighted Average, UI Adjusted
1,041,012			70.77% Pervious Area
429,909			29.23% Impervious Area
118,047			27.46% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.0210	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
0.6	264	0.1900	7.02		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.8	100	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
4.9	610	0.0050	2.08	1.64	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.020 Corrugated PE, corrugated interior
0.6	307	0.0100	8.51	26.74	**Pipe Channel,** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.011 Concrete pipe, straight & clean
0.3	140	0.0200	8.87	70.94	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=2.00' Z= 2.0 '/' Top.W=8.00' n= 0.022 Earth, clean & straight
4.1	172	0.0100	0.70		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	91	0.0100	6.27	50.16	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=2.00' Z= 2.0 '/' Top.W=8.00' n= 0.022 Earth, clean & straight
17.0	1,734	Total			

Summary for Subcatchment S-1G-1: SE Retail Bldg 3

Runoff = 5.1 cfs @ 12.07 hrs, Volume= 0.4 af, Depth= 7.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.60"

	Area (sf)	CN	Description
*	20,029	98	Roof, Parking, Sidewalk
	6,734	61	>75% Grass cover, Good, HSG B
	26,763	89	Weighted Average
	6,734		25.16% Pervious Area
	20,029		74.84% Impervious Area

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

Summary for Subcatchment S-1G-1A: SE Retail Bldg 3 Roof

Runoff = 1.2 cfs @ 12.07 hrs, Volume= 0.1 af, Depth= 8.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.60"

	Area (sf)	CN	Description
*	6,137	98	Rooftop
	6,137		100.00% Impervious Area

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

Summary for Subcatchment S-1G-2: NE Retail - Buildings 4&5

Runoff = 11.7 cfs @ 12.07 hrs, Volume= 0.9 af, Depth= 8.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.60"

	Area (sf)	CN	Description
*	54,061	98	Parking and Rooftop
	5,048	61	>75% Grass cover, Good, HSG B
	59,109	95	Weighted Average
	5,048		8.54% Pervious Area
	54,061		91.46% Impervious Area

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

Summary for Subcatchment S-2: Southern Prop Line - Pervious Area

Runoff = 0.1 cfs @ 12.07 hrs, Volume= 0.0 af, Depth= 5.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.60"

	Area (sf)	CN	Description
*	337	61	>75% Grass cover, Good, HSG B
*	183	98	Road
	520	74	Weighted Average
	337		64.81% Pervious Area
	183		35.19% Impervious Area

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

Summary for Subcatchment S-3: Eastern Prop Line

Runoff = 3.1 cfs @ 12.08 hrs, Volume= 0.2 af, Depth= 3.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.60"

	Area (sf)	CN	Description
*	29,000	61	>75% Grass cover, Good, HSG B
	29,000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.5	20	0.0810	0.22		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
1.5	20	Total, Increased to minimum Tc = 5.0 min			

Summary for Subcatchment S-4: Roadway runoff from Rte 20

Runoff = 9.1 cfs @ 12.07 hrs, Volume= 0.7 af, Depth= 8.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.60"

	Area (sf)	CN	Description
	2,186	61	>75% Grass cover, Good, HSG B
*	43,560	98	Road
	45,746	96	Weighted Average
	2,186		4.78% Pervious Area
	43,560		95.22% Impervious Area

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

Summary for Reach R-1: Swale in WFM Parking Lot

Inflow Area = 2.2 ac, 90.11% Impervious, Inflow Depth = 7.88" for 100-Year event
Inflow = 19.2 cfs @ 12.07 hrs, Volume= 1.5 af
Outflow = 18.9 cfs @ 12.08 hrs, Volume= 1.5 af, Atten= 2%, Lag= 0.8 min

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Max. Velocity= 3.18 fps, Min. Travel Time= 1.0 min
Avg. Velocity = 0.91 fps, Avg. Travel Time= 3.7 min

Peak Storage= 1,187 cf @ 12.08 hrs
Average Depth at Peak Storage= 0.89'
Bank-Full Depth= 2.00' Flow Area= 20.0 sf, Capacity= 99.3 cfs

4.00' x 2.00' deep channel, n= 0.040 Earth, cobble bottom, clean sides
Side Slope Z-value= 3.0 '/' Top Width= 16.00'
Length= 200.0' Slope= 0.0140 '/'
Inlet Invert= 155.80', Outlet Invert= 153.00'

‡

Summary for Pond 1P: Bldg 4&5 Subsurface Infiltration System

Inflow Area =	1.4 ac, 91.46% Impervious,	Inflow Depth = 8.00"	for 100-Year event	
Inflow =	11.7 cfs @	12.07 hrs, Volume=	0.9 af	
Outflow =	11.7 cfs @	12.07 hrs, Volume=	0.9 af,	Atten= 0%, Lag= 0.0 min
Discarded =	0.2 cfs @	7.50 hrs, Volume=	0.4 af	
Primary =	11.5 cfs @	12.07 hrs, Volume=	0.5 af	

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 149.10' @ 12.07 hrs Surf.Area= 3,918 sf Storage= 8,518 cf

Plug-Flow detention time= 101.2 min calculated for 0.9 af (100% of inflow)
Center-of-Mass det. time= 101.1 min (855.7 - 754.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	145.00'	3,494 cf	**30.00'W x 130.60'L x 3.50'H Field A**
			13,713 cf Overall - 4,978 cf Embedded = 8,734 cf x 40.0% Voids
#2A	145.50'	4,978 cf	**ADS_StormTech SC-740** x 108 Inside #1
			Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
			Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap
			Row Length Adjustment= +0.44' x 6.45 sf x 6 rows
#3	145.50'	63 cf	**4.00'D x 5.00'H Vertical Cone/Cylinder** -Impervious
		8,535 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	145.00'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	144.50'	**15.0" Round Culvert**
			L= 20.0' RCP, sq.cut end projecting, Ke= 0.500
			Inlet / Outlet Invert= 144.50' / 144.00' S= 0.0250 '/' Cc= 0.900
			n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.23 sf
#3	Device 2	148.30'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#4	Device 2	146.50'	**8.0" Vert. Orifice/Grate** C= 0.600

Discarded OutFlow Max=0.2 cfs @ 7.50 hrs HW=145.06' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.2 cfs)

Primary OutFlow Max=11.6 cfs @ 12.07 hrs HW=149.10' (Free Discharge)
└─**2=Culvert** (Passes 11.6 cfs of 11.8 cfs potential flow)
 ├─**3=Sharp-Crested Rectangular Weir** (Weir Controls 9.0 cfs @ 2.93 fps)
 └─**4=Orifice/Grate** (Orifice Controls 2.5 cfs @ 7.25 fps)

Summary for Pond 2P: Bldg 2 Subsurface Infiltation System

Inflow Area = 0.3 ac,100.00% Impervious, Inflow Depth = 8.36" for 100-Year event
Inflow = 2.7 cfs @ 12.07 hrs, Volume= 0.2 af
Outflow = 2.7 cfs @ 12.08 hrs, Volume= 0.2 af, Atten= 1%, Lag= 0.5 min
Discarded = 0.0 cfs @ 8.09 hrs, Volume= 0.1 af
Primary = 2.7 cfs @ 12.08 hrs, Volume= 0.1 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 150.90' @ 12.08 hrs Surf.Area= 622 sf Storage= 778 cf

Plug-Flow detention time= 58.7 min calculated for 0.2 af (100% of inflow)
Center-of-Mass det. time= 58.8 min (798.2 - 739.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	148.50'	445 cf	**24.83'W x 24.56'L x 2.33'H Field A**
			1,423 cf Overall - 310 cf Embedded = 1,114 cf x 40.0% Voids
#2A	149.00'	310 cf	**ADS_StormTech RC-310 +Cap** x 21 Inside #1
			Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf
			Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap
			7 Rows of 3 Chambers
#3	149.10'	24 cf	**4.00'D x 1.90'H Vertical Cone/Cylinder**
		779 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	148.50'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	149.90'	**12.0" Round Culvert** L= 501.0' Ke= 0.500
			Inlet / Outlet Invert= 149.90' / 140.93' S= 0.0179 '/' Cc= 0.900
			n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Discarded OutFlow Max=0.0 cfs @ 8.09 hrs HW=149.10' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=2.7 cfs @ 12.08 hrs HW=150.90' (Free Discharge)
└─**2=Culvert** (Inlet Controls 2.7 cfs @ 3.40 fps)

Summary for Pond 3P: Subsurface Infiltration System

```
Inflow Area =      2.2 ac,  90.11% Impervious,  Inflow Depth =  7.88"   for  100-Year event
Inflow      =     18.9 cfs @  12.08 hrs,  Volume=        1.5 af
Outflow     =     18.5 cfs @  12.10 hrs,  Volume=        1.5 af,  Atten= 2%,  Lag= 0.9 min
Discarded  =       1.0 cfs @  10.40 hrs,  Volume=        0.9 af
Primary     =     17.5 cfs @  12.10 hrs,  Volume=        0.5 af
```

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 153.99' @ 12.10 hrs Surf.Area= 5,124 sf Storage= 7,221 cf

Plug-Flow detention time= 28.7 min calculated for 1.5 af (100% of inflow)
Center-of-Mass det. time= 28.3 min (789.5 - 761.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	149.00'	3,575 cf	**41.50'W x 123.48'L x 2.33'H Field A** 11,957 cf Overall - 3,018 cf Embedded = 8,939 cf x 40.0% Voids
#2A	149.50'	3,018 cf	**ADS_StormTech SC-310** x 204 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap Row Length Adjustment= +0.44' x 2.07 sf x 12 rows
#3	149.00'	628 cf	**4.00'D x 5.00'H Vertical Cone/Cylinder** x 10 -Impervious
		7,222 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	149.00'	**8.270 in/hr Exfiltration over Surface area**
#2	Primary	149.00'	**18.0" Round Culvert** L= 27.0' Ke= 0.500 Inlet / Outlet Invert= 149.00' / 148.50' S= 0.0185 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#3	Device 2	150.80'	**4.0' long Sharp-Crested Rectangular Weir** 0 End Contraction(s) 3.5' Crest Height

Discarded OutFlow Max=1.0 cfs @ 10.40 hrs HW=149.05' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 1.0 cfs)

Primary OutFlow Max=17.5 cfs @ 12.10 hrs HW=153.98' (Free Discharge)
└─**2=Culvert** (Inlet Controls 17.5 cfs @ 9.91 fps)
  └─**3=Sharp-Crested Rectangular Weir** (Passes 17.5 cfs of 82.6 cfs potential flow)

Summary for Pond 4P: Bldg 3 Subsurface Infiltration System

```
Inflow Area =      0.8 ac,  79.53% Impervious,  Inflow Depth =  7.48"   for  100-Year event
Inflow      =      6.3 cfs @  12.07 hrs,  Volume=        0.5 af
Outflow     =      6.3 cfs @  12.08 hrs,  Volume=        0.5 af,  Atten= 1%,  Lag= 0.5 min
Discarded  =       0.0 cfs @   3.87 hrs,  Volume=        0.1 af
Primary     =      6.3 cfs @  12.08 hrs,  Volume=        0.4 af
```

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Peak Elev= 148.38' @ 12.08 hrs Surf.Area= 868 sf Storage= 1,752 cf

Plug-Flow detention time= 87.5 min calculated for 0.5 af (97% of inflow)
Center-of-Mass det. time= 68.4 min (836.8 - 768.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	145.00'	829 cf	**34.75'W x 24.98'L x 3.50'H Field A** 3,038 cf Overall - 965 cf Embedded = 2,073 cf x 40.0% Voids
#2A	145.50'	965 cf	**ADS_StormTech SC-740 +Cap** x 21 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 7 Rows of 3 Chambers
		1,794 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	145.00'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	145.00'	**12.0" Round Culvert** L= 16.0' Ke= 0.500 Inlet / Outlet Invert= 145.00' / 144.60' S= 0.0250 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#3	Device 2	147.75'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=0.0 cfs @ 3.87 hrs HW=145.04' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=6.3 cfs @ 12.08 hrs HW=148.38' (Free Discharge)
└─**2=Culvert** (Passes 6.3 cfs of 6.4 cfs potential flow)
  └─**3=Sharp-Crested Rectangular Weir** (Weir Controls 6.3 cfs @ 2.59 fps)

Summary for Pond B-1: Bio-retention Basin 1

Inflow Area =	0.7 ac, 43.77% Impervious,	Inflow Depth =	5.83"	for 100-Year event
Inflow =	4.6 cfs @	12.07 hrs, Volume=	0.3 af	
Outflow =	3.9 cfs @	12.12 hrs, Volume=	0.3 af,	Atten= 16%, Lag= 3.0 min
Discarded =	0.7 cfs @	12.12 hrs, Volume=	0.3 af	
Primary =	3.2 cfs @	12.12 hrs, Volume=	0.1 af	

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 154.68' @ 12.12 hrs Surf.Area= 3,459 sf Storage= 2,051 cf
Flood Elev= 155.00' Surf.Area= 3,882 sf Storage= 3,214 cf

Plug-Flow detention time= 12.2 min calculated for 0.3 af (100% of inflow)
Center-of-Mass det. time= 12.2 min (818.2 - 806.0)

Volume	Invert	Avail.Storage	Storage Description
#1	154.00'	3,214 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
154.00	2,545	0	0
155.00	3,882	3,214	3,214

Device	Routing	Invert	Outlet Devices
#1	Primary	151.00'	**12.0" Round Culvert** L= 275.0' RCP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 151.00' / 146.90' S= 0.0149 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	154.50'	**24.0" Horiz. Orifice/Grate X 2.00** C= 0.600 Limited to weir flow at low heads
#3	Discarded	154.00'	**8.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.7 cfs @ 12.12 hrs HW=154.68' (Free Discharge)
└─**3=Exfiltration** (Exfiltration Controls 0.7 cfs)

Primary OutFlow Max=3.2 cfs @ 12.12 hrs HW=154.68' (Free Discharge)
└─**1=Culvert** (Passes 3.2 cfs of 5.2 cfs potential flow)
  └─**2=Orifice/Grate** (Weir Controls 3.2 cfs @ 1.40 fps)

Summary for Pond B-2: Bio-retention Basin 2

Inflow Area = 1.9 ac, 61.44% Impervious, Inflow Depth = 6.67" for 100-Year event
Inflow = 14.9 cfs @ 12.07 hrs, Volume= 1.1 af
Outflow = 13.8 cfs @ 12.10 hrs, Volume= 1.1 af, Atten= 7%, Lag= 1.8 min
Discarded = 1.0 cfs @ 12.10 hrs, Volume= 0.6 af
Primary = 12.8 cfs @ 12.10 hrs, Volume= 0.4 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 154.46' @ 12.10 hrs Surf.Area= 5,072 sf Storage= 6,705 cf
Flood Elev= 155.00' Surf.Area= 5,206 sf Storage= 6,908 cf

Plug-Flow detention time= 46.0 min calculated for 1.1 af (100% of inflow)
Center-of-Mass det. time= 46.0 min (835.7 - 789.7)

Volume	Invert	Avail.Storage	Storage Description
#1	152.00'	6,908 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
152.00	1,364	0	0
153.00	2,290	1,827	1,827
154.00	3,513	2,902	4,729
154.50	5,206	2,180	6,908

Device	Routing	Invert	Outlet Devices
#1	Primary	150.00'	**18.0" Round Culvert** L= 11.0' RCP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 150.00' / 149.30' S= 0.0636 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf

#2	Device 1	154.00'	**24.0" Horiz. Orifice/Grate X 2.00** C= 0.600 Limited to weir flow at low heads
#3	Discarded	152.00'	**8.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=1.0 cfs @ 12.10 hrs HW=154.46' (Free Discharge)
└─**3=Exfiltration** (Exfiltration Controls 1.0 cfs)

Primary OutFlow Max=12.8 cfs @ 12.10 hrs HW=154.46' (Free Discharge)
└─**1=Culvert** (Passes 12.8 cfs of 16.4 cfs potential flow)
  └─**2=Orifice/Grate** (Weir Controls 12.8 cfs @ 2.22 fps)

Summary for Pond B-3: Bridges Bio Reten 1

Inflow Area = 0.6 ac, 42.67% Impervious, Inflow Depth = 5.83" for 100-Year event
Inflow = 4.4 cfs @ 12.07 hrs, Volume= 0.3 af
Outflow = 3.7 cfs @ 12.12 hrs, Volume= 0.3 af, Atten= 16%, Lag= 2.9 min
Discarded = 0.1 cfs @ 12.12 hrs, Volume= 0.1 af
Primary = 3.5 cfs @ 12.12 hrs, Volume= 0.2 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 150.24' @ 12.12 hrs Surf.Area= 2,589 sf Storage= 2,091 cf

Plug-Flow detention time= 82.9 min calculated for 0.3 af (100% of inflow)
Center-of-Mass det. time= 82.9 min (888.9 - 806.0)

Volume	Invert	Avail.Storage	Storage Description
#1	149.00'	2,850 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
149.00	1,161	254.0	0	0	1,161
150.00	1,951	272.0	1,539	1,539	1,959
150.50	3,354	354.0	1,311	2,850	6,047

Device	Routing	Invert	Outlet Devices
#1	Discarded	149.00'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	148.35'	**12.0" Round Culvert** L= 473.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 148.35' / 145.40' S= 0.0062 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#3	Device 2	150.00'	**24.0" Horiz. Orifice/Grate X 2.00** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.1 cfs @ 12.12 hrs HW=150.24' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.1 cfs)

Primary OutFlow Max=3.5 cfs @ 12.12 hrs HW=150.24' (Free Discharge)
└─**2=Culvert** (Barrel Controls 3.5 cfs @ 4.52 fps)
  └─**3=Orifice/Grate** (Passes 3.5 cfs of 4.9 cfs potential flow)

Summary for Pond B-4: Bridges Bio Reten 2

Inflow Area = 0.6 ac, 37.48% Impervious, Inflow Depth = 5.59" for 100-Year event
Inflow = 3.8 cfs @ 12.07 hrs, Volume= 0.3 af
Outflow = 3.7 cfs @ 12.09 hrs, Volume= 0.3 af, Atten= 2%, Lag= 0.9 min
Discarded = 0.1 cfs @ 12.09 hrs, Volume= 0.1 af
Primary = 3.6 cfs @ 12.09 hrs, Volume= 0.2 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 149.20' @ 12.09 hrs Surf.Area= 1,456 sf Storage= 1,324 cf

Plug-Flow detention time= 75.6 min calculated for 0.3 af (100% of inflow)
Center-of-Mass det. time= 75.6 min (885.9 - 810.3)

Volume	Invert	Avail.Storage	Storage Description
#1	148.00'	2,767 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
148.00	819	152.0	0	0	819
149.00	1,305	171.0	1,053	1,053	1,333
150.00	2,159	200.0	1,714	2,767	2,209

Device	Routing	Invert	Outlet Devices
#1	Discarded	148.00'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	146.65'	**12.0" Round Culvert** L= 56.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 146.65' / 146.36' S= 0.0052 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#3	Device 2	149.00'	**24.0" Horiz. Orifice/Grate X 2.00** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.1 cfs @ 12.09 hrs HW=149.20' (Free Discharge)
└—**1=Exfiltration** (Exfiltration Controls 0.1 cfs)

Primary OutFlow Max=3.6 cfs @ 12.09 hrs HW=149.20' (Free Discharge)
└—**2=Culvert** (Passes 3.6 cfs of 5.1 cfs potential flow)
  └—**3=Orifice/Grate** (Weir Controls 3.6 cfs @ 1.45 fps)

Summary for Pond P-1A: Existing Pond at Center of Property

Inflow Area = 73.4 ac, 38.60% Impervious, Inflow Depth = 3.84" for 100-Year event
Inflow = 242.1 cfs @ 12.08 hrs, Volume= 23.5 af
Outflow = 36.2 cfs @ 14.04 hrs, Volume= 23.1 af, Atten= 85%, Lag= 117.4 min
Primary = 36.2 cfs @ 14.04 hrs, Volume= 23.1 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Starting Elev= 144.70' Surf.Area= 48,178 sf Storage= 33,047 cf
Peak Elev= 151.46' @ 14.04 hrs Surf.Area= 113,973 sf Storage= 499,794 cf (466,747 cf above start)
Flood Elev= 152.00' Surf.Area= 132,117 sf Storage= 566,694 cf (533,647 cf above start)

Plug-Flow detention time= 251.5 min calculated for 22.3 af (95% of inflow)
Center-of-Mass det. time= 212.7 min (1,046.5 - 833.8)

Volume	Invert	Avail.Storage	Storage Description
#1	144.00'	566,694 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
144.00	46,247	909.0	0	0	46,247
145.00	49,018	939.0	47,626	47,626	50,754
146.00	53,432	1,337.0	51,209	98,835	122,849
147.00	56,882	1,331.0	55,148	153,983	124,693
148.00	64,042	21,449.0	60,427	214,410	36,594,098
149.00	70,994	2,381.0	67,488	281,898	72,753,343
150.00	84,015	2,596.0	77,413	359,311	72,838,531
151.00	99,807	2,841.0	91,798	451,109	72,944,568
152.00	132,117	5,056.0	115,585	566,694	74,336,532

Device	Routing	Invert	Outlet Devices
#1	Device 4	144.70'	**12.0" Round Culvert** L= 97.0' Ke= 0.500 Inlet / Outlet Invert= 144.70' / 143.80' S= 0.0093 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Device 3	147.00'	**24.0" W x 18.0" H Vert. Orifice/Grate** C= 0.600
#3	Device 4	144.00'	**24.0" Round Culvert** L= 57.0' Ke= 0.500 Inlet / Outlet Invert= 144.00' / 143.80' S= 0.0035 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf
#4	Primary	143.80'	**36.0" Round Culvert** L= 1,434.0' Ke= 0.500 Inlet / Outlet Invert= 143.80' / 140.93' S= 0.0020 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 7.07 sf

Primary OutFlow Max=36.2 cfs @ 14.04 hrs HW=151.46' (Free Discharge)
└─**4=Culvert** (Passes 36.2 cfs of 52.0 cfs potential flow)
  ├─**1=Culvert** (Barrel Controls 8.5 cfs @ 10.79 fps)
  └─**3=Culvert** (Passes 27.8 cfs of 38.4 cfs potential flow)
    └─**2=Orifice/Grate** (Orifice Controls 27.8 cfs @ 9.25 fps)

Summary for Pond P-1B: SW Wetland/Swale at Western Prop Line

Inflow Area = 37.4 ac, 29.31% Impervious, Inflow Depth = 2.90" for 100-Year event
Inflow = 83.7 cfs @ 12.24 hrs, Volume= 9.0 af
Outflow = 31.3 cfs @ 12.69 hrs, Volume= 9.0 af, Atten= 63%, Lag= 26.9 min
Primary = 31.3 cfs @ 12.69 hrs, Volume= 9.0 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 155.35' @ 12.69 hrs Surf.Area= 61,098 sf Storage= 78,931 cf

Plug-Flow detention time= 14.9 min calculated for 9.0 af (100% of inflow)
Center-of-Mass det. time= 14.9 min (882.5 - 867.5)

Volume	Invert	Avail.Storage	Storage Description
#1	151.00'	126,119 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
151.00	498	198.0	0	0	498
152.00	1,368	715.0	897	897	38,063
153.00	8,822	6,900.0	4,555	5,452	3,786,066
154.00	25,925	1,559.0	16,623	22,075	7,381,341
155.00	50,627	1,626.0	37,594	59,669	7,398,397
156.00	83,648	1,717.0	66,450	126,119	7,422,663

Device	Routing	Invert	Outlet Devices
#1	Primary	149.70'	**24.0" Round Culvert** L= 300.0' Ke= 0.500 Inlet / Outlet Invert= 149.70' / 146.90' S= 0.0093 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf

Primary OutFlow Max=31.3 cfs @ 12.69 hrs HW=155.35' (Free Discharge)
└─**1=Culvert** (Barrel Controls 31.3 cfs @ 9.97 fps)

Summary for Pond P-C: Subsurface Infiltration System

Inflow Area =	4.3 ac, 59.27% Impervious, Inflow Depth = 6.55" for 100-Year event			
Inflow =	33.2 cfs @	12.07 hrs, Volume=	2.3 af	
Outflow =	33.2 cfs @	12.07 hrs, Volume=	2.3 af,	Atten= 0%, Lag= 0.0 min
Discarded =	0.1 cfs @	5.80 hrs, Volume=	0.2 af	
Primary =	33.1 cfs @	12.07 hrs, Volume=	2.1 af	

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 157.28' @ 12.07 hrs Surf.Area= 2,934 sf Storage= 6,411 cf
Flood Elev= 155.50' Surf.Area= 2,934 sf Storage= 5,785 cf

Plug-Flow detention time= 63.6 min calculated for 2.3 af (97% of inflow)
Center-of-Mass det. time= 47.1 min (839.3 - 792.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	152.50'	2,593 cf	**39.50'W x 73.64'L x 3.50'H Field A** 10,180 cf Overall - 3,698 cf Embedded = 6,483 cf x 40.0% Voids
#2A	153.00'	3,698 cf	**ADS_StormTech SC-740** x 80 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap Row Length Adjustment= +0.44' x 6.45 sf x 8 rows
#3	152.50'	126 cf	**4.00'D x 5.00'H Vertical Cone/Cylinder** x 2
		6,417 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	152.50'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	148.70'	**30.0" Round Culvert out of OCS302** L= 244.0' Ke= 0.500 Inlet / Outlet Invert= 148.70' / 146.60' S= 0.0086 '/' Cc= 0.900

			n= 0.011 Concrete pipe, straight & clean, Flow Area= 4.91 sf
#3	Device 2	155.50'	**4.0' long x 2.50' rise Sharp-Crested Rectangular Weir** 0 End Contraction(s) 3.5' Crest Height

Discarded OutFlow Max=0.1 cfs @ 5.80 hrs HW=152.56' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.1 cfs)

Primary OutFlow Max=33.1 cfs @ 12.07 hrs HW=157.28' (Free Discharge)
└─**2=Culvert out of OCS302** (Passes 33.1 cfs of 63.8 cfs potential flow)
  └─**3=Sharp-Crested Rectangular Weir** (Weir Controls 33.1 cfs @ 4.64 fps)

Summary for Pond P-ROOF: Perforated Pipe System

Inflow Area = 4.0 ac,100.00% Impervious, Inflow Depth = 8.36" for 100-Year event
Inflow = 35.4 cfs @ 12.07 hrs, Volume= 2.8 af
Outflow = 35.3 cfs @ 12.07 hrs, Volume= 2.8 af, Atten= 0%, Lag= 0.0 min
Discarded = 0.8 cfs @ 7.72 hrs, Volume= 1.3 af
Primary = 34.5 cfs @ 12.07 hrs, Volume= 1.6 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 153.05' @ 12.07 hrs Surf.Area= 14,250 sf Storage= 9,733 cf

Plug-Flow detention time= 40.6 min calculated for 2.8 af (100% of inflow)
Center-of-Mass det. time= 41.0 min (780.4 - 739.4)

Volume	Invert	Avail.Storage	Storage Description
#1	150.50'	1,865 cf	**6.0" Round Pipe Storage** Inside #2 L= 9,500.0'
#2	150.00'	7,804 cf	**1.50'W x 9,500.00'L x 1.50'H Prismatoid** 21,375 cf Overall - 1,865 cf Embedded = 19,510 cf x 40.0% Voids
#3	150.50'	138 cf	**4.00'D x 5.50'H Vertical Cone/Cylinder** x 2 -Impervious
		9,807 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	150.00'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	151.00'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=0.8 cfs @ 7.72 hrs HW=150.06' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.8 cfs)

Primary OutFlow Max=34.5 cfs @ 12.07 hrs HW=153.05' (Free Discharge)
└─**2=Sharp-Crested Rectangular Weir** (Weir Controls 34.5 cfs @ 4.69 fps)

Summary for Pond P-Roof 2: Bridges Perf Pipe System

Inflow Area = 1.0 ac,100.00% Impervious, Inflow Depth = 8.36" for 100-Year event
Inflow = 8.9 cfs @ 12.07 hrs, Volume= 0.7 af
Outflow = 8.9 cfs @ 12.07 hrs, Volume= 0.7 af, Atten= 0%, Lag= 0.0 min
Discarded = 0.2 cfs @ 8.19 hrs, Volume= 0.4 af
Primary = 8.7 cfs @ 12.07 hrs, Volume= 0.4 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 152.28' @ 12.07 hrs Surf.Area= 4,013 sf Storage= 3,464 cf

Plug-Flow detention time= 56.7 min calculated for 0.7 af (100% of inflow)
Center-of-Mass det. time= 56.2 min (795.6 - 739.4)

Volume	Invert	Avail.Storage	Storage Description
#1	150.00'	3,043 cf	**2.00'W x 2,000.00'L x 2.00'H Prismatoid** 8,000 cf Overall - 393 cf Embedded = 7,607 cf x 40.0% Voids
#2	150.50'	393 cf	**6.0" Round Pipe Storage** Inside #1 L= 2,000.0'
#3	150.00'	75 cf	**4.00'D x 6.00'H Vertical Cone/Cylinder**
		3,511 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	150.00'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	151.50'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=0.2 cfs @ 8.19 hrs HW=150.06' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.2 cfs)

Primary OutFlow Max=8.6 cfs @ 12.07 hrs HW=152.28' (Free Discharge)
└─**2=Sharp-Crested Rectangular Weir** (Weir Controls 8.6 cfs @ 2.89 fps)

Summary for Pond ROOF: Perforated Pipe System

Inflow Area =	0.6 ac,100.00% Impervious,	Inflow Depth = 8.36"	for 100-Year event
Inflow =	5.1 cfs @ 12.07 hrs,	Volume=	0.4 af
Outflow =	5.1 cfs @ 12.08 hrs,	Volume=	0.4 af, Atten= 0%, Lag= 0.7 min
Discarded =	0.2 cfs @ 10.86 hrs,	Volume=	0.2 af
Primary =	4.9 cfs @ 12.08 hrs,	Volume=	0.2 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 155.03' @ 12.08 hrs Surf.Area= 3,013 sf Storage= 2,049 cf

Plug-Flow detention time= 41.2 min calculated for 0.4 af (100% of inflow)
Center-of-Mass det. time= 41.0 min (780.4 - 739.4)

Volume	Invert	Avail.Storage	Storage Description
#1	154.00'	393 cf	**6.0" Round Pipe Storage** Inside #2 L= 2,000.0'
#2	153.50'	1,643 cf	**1.50'W x 2,000.00'L x 1.50'H Prismatoid** 4,500 cf Overall - 393 cf Embedded = 4,107 cf x 40.0% Voids
#3	154.00'	63 cf	**4.00'D x 5.00'H Vertical Cone/Cylinder**
		2,098 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	153.50'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	154.50'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=0.2 cfs @ 10.86 hrs HW=154.00' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.2 cfs)

Primary OutFlow Max=4.9 cfs @ 12.08 hrs HW=155.03' (Free Discharge)
└─**2=Sharp-Crested Rectangular Weir** (Weir Controls 4.9 cfs @ 2.38 fps)

Summary for Link DP-1: 48" RCP Across Boston Post Road

Inflow Area = 85.8 ac, 43.93% Impervious, Inflow Depth > 4.05" for 100-Year event
Inflow = 110.2 cfs @ 12.09 hrs, Volume= 29.0 af
Primary = 110.2 cfs @ 12.09 hrs, Volume= 29.0 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Link DP-2: Overland Flow to Boston Post Road

Inflow Area = 0.0 ac, 35.19% Impervious, Inflow Depth = 5.47" for 100-Year event
Inflow = 0.1 cfs @ 12.07 hrs, Volume= 0.0 af
Primary = 0.1 cfs @ 12.07 hrs, Volume= 0.0 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Link DP-3: Wetland at Northeast Corner

Inflow Area = 0.7 ac, 0.00% Impervious, Inflow Depth = 3.91" for 100-Year event
Inflow = 3.1 cfs @ 12.08 hrs, Volume= 0.2 af
Primary = 3.1 cfs @ 12.08 hrs, Volume= 0.2 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs