ALLEN & MAJOR
ASSOCIATES, INC.

SITE LOCUS
NOT TO SCALE

ALTA at RIVER'S EDGE
490 BOSTON POST ROAD
WAYLAND, MASSACHUSETTS
DRAINAGE REPORT

PREPARED: JUNE 20, 2019

REVISED:

CLIENT:
WP EAST ACQUISITIONS, LLC.
91 HARTWELL AVENUE
LEXINGTON, MA 02421

PREPARED BY:
ALLEN & MAJOR ASSOCIATES, INC.
100 COMMERCE WAY, SUITE #5
WOBURN, MASSACHUSETTS, 01801

COMMONWEALTH OF MASSACHUSETTS
CARLTON M.
QUINN
CIVIL
No.49923
REGISTERED
PROFESSIONAL ENGINEER
6.20.19

A&M PROJECT NO. : 1670-09A

DRAINAGE REPORT

ALTA AT RIVER'S EDGE
#490 BOSTON POST ROAD
WAYLAND, MA

PROPONENT:

WP EAST ACQUISITIONS, LLC
91 HARTWELL AVENUE, 3RD FLOOR
BOSTON POST, MA 02421

PREPARED BY:

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100 COMMERCE WAY, SUITE 5
WOBURN, MA 01801I

ISSUED: JUNE 20, 2019
REVISED: TBD

A&M PROJECT #1670-09A

Section 1.0

Section 2.0

Section 3.0

Section 4.0

Section 5.0

Section 6.0

INTRODUCTION

The purpose of this drainage report is to provide an overview of the proposed stormwater management system (SMS) for the multi-family residential development located at #490 Boston Post Road (MA Route 20) in Wayland, MA. The report will show by means of narrative, calculations and exhibits that the proposed stormwater management system will meet or exceed the 10 Massachusetts Department of Environment Protection (DEP) stormwater standards.

The proposed site development includes three (3) three- and four-story multi-family residential apartment buildings with parking garages beneath, off-street surface parking, utilities, drainage and associated site-work. A proposed driveway will provide access to the site from an existing access drive immediately adjacent to Boston Post Road (MA Route 20). The project will be serviced by municipal water and an on-site wastewater treatment plant and associated leach field.

The SMS incorporates structural and non-structural Best Management Practices (BMPs) to provide stormwater peak flow mitigation, quality treatment, and conveyance. The SMS includes deep-sump, hooded catch basins, drain manholes, hydrodynamic separators, underground infiltration ponds, outlet protection, concrete headwalls with rip-rap lined aprons and a long-term Operation and Maintenance Plan.

SITE CATEGORIZATION FOR STORMWATER REGULATIONS

The proposed project at #490 Boston Post Road is considered a new development under the DEP Stormwater Management Standards due to the net decrease in impervious area. A new development project is required to meet the Standards within the MA DEP Stormwater Handbook. Standards 1, 8, 9 and 10 must always be fully met.

SITE LOCATION AND ACCESS

The subject parcel is located at #490 Boston Post Road along the western edge of the Town of Wayland and directly abuts the Town of Sudbury. The parcel is 8.25+/- acres and is comprised of Lots A, C and E from Plan of Land 260 of 2017. See the ALTA/NSPS Land Title survey for more information.

Wayland is located in Middlesex County and is approximately 20 miles west of the City of Boston. The site is located approximately 2.0 miles southeast on Middlesex Turnpike from the intersection at Concord Road. Exhibit 1 shows the location of the property on Boston Post Road.

The parcel is abutted by Boston Post Road (MA Route 20) to the south of the property; an undeveloped lot owned by the Town of Wayland to the north and east (0 Boston Post Road); and the Town of Sudbury to the west. The northern portion of the property contains bordering vegetated wetlands.

EXISTING SITE CONDITIONS

The site currently includes a 7,000± square-foot (SF) one-story brick and concrete building, a loading dock, a paved parking lot, several circular storage tanks, and multiple outbuildings including sheds. A portion of the site was previously used as a refuse facility. The parcel has two (2) access points, from an unnamed access road which connects to Boston Post Road, as well as an unnmaed access road which connects to an adjacnet property to the west located in the Town of Sudbury.

The site topography slopes varies significanitly over the site, due to its use as a refuse facility as well as a gun range. Some existing slopes are relatively steep, with multiple localized high points throughout the site. Elevations range from El. 160± at the southwest corner of the site along Boston Post Road to a low point of approximately El. 117± abutting the wetlands near the northerly property line. The main building on the subject parcel is at elevation 149.5±, with a four-foot high loading dock to the rear at approximately El. 153.3±. There is a landscaped buffer area along the southern, eastern, and northern property lines consisting of trees and grass, and a bordering vegetated wetland area to the north.

The majority of the site (notated as Watershed E-1 in the HydroCAD model and existing watershed plan) flows to the northern wetland area (notated as Study Point #1 in the HydroCAD model and existing watershed plan) with the exception of Watershed E-2 which flows to the southeastern corner of the site, notated as Study Point #2.

WATERSHED

The subject property is located within the SuAsCo Watershed. The SuAsCo Watershed is one of the 27 major watersheds in Massachusetts. SuAsCo stands for the Sudbury, Assabet, and Concord Rivers. The SuAsCo Watershed is the land area surrounding these three rivers. Any rain falling within the SuAsCo watershed eventually drains into the Sudbury, Assabet or Concord rivers. The SuAsCo Watershed is a 377-square mile area encompassing, partially or wholly, 36 Massachusetts towns and cities. The SuAsCo Watershed is not protected under the Watershed Protection Act and has no associated land use restrictions.

EXISTING SOIL CONDITIONS

The on-site soils were identified using the USDA Natural Resources Conservation Services (NRCS) Soil Survey for Middlesex County. The sites soil types and corresponding Hydrologic Soil Groups (HSG) include:

- 51A (HSG-B/D) - Swansea Muck
- 253D (HSG-A) - Hinckley Loamy Sand

- 652 (Assumed HSG-C) - Udorthents, Refuse Substratum
- 656 (Assumed HSG-C) - Udorthents-Urban Land Complex

Urban land consists of areas where the soil has been altered or obscured by buildings, or paved areas; neither Urban land nor Udorthents are assigned a hydrologic soil group (HSG). Based on a textural analysis of the in-situ soils, the site was assumed to have a conservative HSG of "C."

There is adequate separation between the infiltration systems and the seasonal high groundwater table of four (4) feet. A copy of the soil mapping is included in the Appendix of this report.

FEMA FLOODPLAIN/ENVIRONMENTAL DUE DILIGENCE

The Flood Insurance Rate Map (FIRM) (Map Number 25017C0507F) for the Town of Wayland dated July 7, 2014 indicates that the parcel lies within the FEMA Zone X as well as FEMA Zone AE. The FEMA Zone X in this area is defined as "areas determined to be outside the 0.2% annual chance floodplain." The FEMA Zone X in this area is defined as a "special flood hazard area" with a Base Flood Elevation (BFE). The entire subject property is outside of the 500-year Floodplain. See the appendix of this report for a copy of the FEMA FIRM.

ENVIRONMENTALLY SENSITIVE ZONES

The Commonwealth of Massachusetts asserts control over numerous protected and regulated areas including: Areas of Critical Environmental Concern (ACEC); Outstanding Resource Waters (ORWs); areas protected under the Wetlands Protection Act and the Rivers Protection Act, as well as Priority and Protected Habitat for rare and endangered species. The subject property is not located within any of these regulated areas.

DRAINAGE ANALYSIS METHODOLOGY

A peak rate of runoff will be determined using techniques and data found in the following:

1. Urban Hydrology for Small Watersheds – Technical Release 55 by the United States Department of Agriculture Soils Conservation Service, June 1986. Runoff curve numbers and 24-hour precipitation values were obtained from this reference.

2. HydroCAD© Stormwater Modeling System by HydroCAD Software Solutions LLC, version 10.00, 2013. The HydroCAD program was used to generate the runoff hydrographs for the watershed areas, to determine discharge/stage/storage characteristics for the stormwater BMPs, to perform drainage routing and to combine the results of the runoff hydrographs. HydroCAD uses the TR-20 methodology of the SCS Unit Hydrograph procedure (SCS-UH).

3. Soil Survey of Middlesex County Massachusetts by United States Department of Agriculture, NRCS. Soil types and boundaries were obtained from this reference.

PROPOSED CONDITIONS - PEAK RATE OF RUNOFF

The storm water runoff analysis of the existing and proposed conditions includes an estimate of the peak rate of runoff from various rainfall events. Peak runoff rates were developed using TR-55 Urban Hydrology for Small Watersheds, developed by the U.S. Department of Commerce, Engineering Division and the HydroCAD computer program. Further, the analysis has been prepared in accordance with the MA DEP and the Town of Wayland requirements and standard engineering practices. The peak rate of runoff has been estimated for each watershed during the 2, 10, 25 and 100-year storm events.

Proposed underground infiltration ponds receive storm water directly from the proposed roof and pretreated site areas. Infiltration Ponds #1 and #3 provide recharge for building roofs as well as paved surface parking areas, and therefore requires pretreatment which is provided by the catch basins with deep sumps and hoods as well as ConTech CDS-2015-4-C hydrodynamic separators. Overflow from the Infiltration Pond #1 and #3 to the wetlands for peak storm events is provided by outlet control structures #1 and #3, and eventually to headwall #2.

Runoff directed towards Infiltration Pond #2 is pretreated with deep-sump, hooded catch basins and a ConTech CDS-2015-4-C hydrodynamic separator. Outlet control structures at this pond is provided by an outlet to OCS-2 for peak storm events, and eventually to headwall #1.

Each of the four (3) systems provide a sufficient four (4) feet of separation from groundwater and drain down within the recommended 72 hours. The proposed infiltration system provides the minimum required four (4) feet of separation between the Estimated Seasonal High-Water Table (ESHWT) and the systems are not used to attenuate peak flows. Therefore, a mounding analysis is not required.

See HydroCAD, DEP Calculations, and mounding analysis in the appendix of this report.

The stormwater runoff model shows that the proposed site development reduces the rate of runoff during all storm events at the identified points of analysis. The following tables provide a summary of the estimated peak rate at each Study Point during each of the design storm events. The HydroCAD worksheets are included in Section 4 of this report.

PEAK FLOW RATES TABLE

STUDY POINT #1 (Flow to northern wetlands)

	2-Year	10-Year	25-Year	100-Year
Existing Runoff (CFS)	2.47	5.16	6.83	9.42
Proposed Runoff (CFS)	1.94	5.06	6.59	9.00
REDUCTION	0.53	0.10	0.24	0.42

STUDY POINT #2 (Off-site flow to southeast corner)

	2-Year	10-Year	25-Year	100-Year
Existing Runoff (CFS)	4.92	8.79	11.07	14.51
Proposed Runoff (CFS)	3.84	8.56	10.53	13.50
REDUCTION	1.08	0.23	0.54	1.01

MA DEP STORMWATER PERFORMANCE STANDARDS

The MA DEP Stormwater Management Policy was developed to improve water quality by implementing performance standards for storm water management. The intent is to implement the stormwater management standards through the review of Notice of Intent filings by the issuing authority (Conservation Commission or DEP). The following section outlines how the proposed Stormwater Management System meets the standards set forth by the Policy.

BMP's implemented in the design include:

- Deep-sump, hooded catch basins
- Hydro-dynamic (Proprietary) separators
- Underground infiltration systems
- Isolator row
- Specific maintenance schedule

Stormwater Best Management Practices have been incorporated into the design of the project to mitigate the anticipated pollutant loading. An Operations and Maintenance Plan has been developed for the project, which addresses the long-term maintenance requirements of the proposed system.

Temporary erosion and sedimentation controls will be incorporated into the construction phase of the project. These temporary controls may include straw bale and/or silt fence barriers, inlet sediment traps, diversion channels, slope stabilization, and stabilized construction entrances.

The Massachusetts Department of Environmental Protection has established ten (10) Stormwater

Management Standards. A project that meets or exceeds the standards is presumed to satisfy the regulatory requirements regarding stormwater management. The Standards are enumerated below as well as descriptions and supporting calculations as to how the Project will comply with the Standards:

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

The proposed development will not introduce any new stormwater conveyances (e.g. outfalls) that discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth.

For computations demonstrating discharges are adequately treated please see computations for Standard 4 through Standard 6. Additionally, all outfalls have been designed to provide standard Rip Rap outfalls as calculated in Section 6.11.

2. *Stormwater management systems shall be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates. This Standard may be waived for discharges to land subject to coastal storm flowage as defined in 310 CMR 10.04.*

The proposed development will be designed so that the post-development peak discharge rates do not exceed the pre-development peak discharge rates. See the peak flow rate table, above.

3. *Loss of annual recharge to groundwater shall be eliminated or minimized through the use of infiltration measures including environmentally sensitive site design, low impact development techniques, stormwater best management practices, and good operation and maintenance. At a minimum, the annual recharge from the post-development site shall approximate the annual recharge from pre-development conditions based on soil type. This Standard is met when the stormwater management system is designed to infiltrate the required recharge volume as determined in accordance with the Massachusetts Stormwater Handbook.*

The existing annual recharge for the site will be approximated in the developed condition. Subsurface infiltration chambers will be designed to meet this requirement. All Infiltration Systems were designed using the Static Method per the MA DEP Stormwater Management Standards, Volume 3, Chapter 1.

See Section 6.9 for water quality/recharge calculations for Underground Infiltration Pond# 1-3.

4. *Stormwater management systems shall be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS). This Standard is met when:*

    a. *Suitable practices for source control and pollution prevention are identified in a long-term pollution prevention plan, and thereafter are implemented and maintained;*
    b. *Structural stormwater best management practices are sized to capture the required water quality volume determined in accordance with the Massachusetts Stormwater Handbook; and*
    c. *Pretreatment is provided in accordance with the Massachusetts Stormwater Handbook.*

The proposed stormwater management system will be designed so that the 80% TSS removal standard will be met for each drainage area. Standard #4 is met when structural stormwater best management practices are sized to capture and treat the required water quality volume and pretreatment is provided in accordance with the Massachusetts Stormwater Handbook. Standard #4 also requires that suitable source control measures are identified in the Long-Term Pollution Prevention Plan.

Additionally, because discharge is from land uses with higher potential pollutant loads, the proposed stormwater management system will be designed so that prior to each discharge to an infiltration structure, the 44% TSS removal standard will be met using some combination of the following: deep-sump, hooded catch basins and proprietary separators.

The water quality volume for the site development will be captured and treated using proprietary separators and infiltration systems equipped with isolator rows. All systems will be sized to meet the water quality flow rate for the 1" storm event. See DEP Calculations in the appendix of this report for water quality flow rate and volume calculations.

5. *For land uses with higher potential pollutant loads, source control and pollution prevention shall be implemented in accordance with the Massachusetts Stormwater Handbook to eliminate or reduce the discharge of stormwater runoff from such land uses to the maximum extent practicable. If through source control and/or pollution prevention all land uses with higher potential pollutant loads cannot be completely protected from exposure to rain, snow, snow melt, and stormwater runoff, the proponent shall use the specific structural stormwater BMPs determined by the Department to be suitable for*

such uses as provided in the Massachusetts Stormwater Handbook. Stormwater discharges from land uses with higher potential pollutant loads shall also comply with the requirements of the Massachusetts Clean Waters Act, M.G.L. c. 21, §§ 26-53 and the regulations promulgated thereunder at 314 CMR 3.00, 314 CMR 4.00 and 314 CMR 5.00.

The proposed development may be considered a source of higher potential pollutant loads because the proposed parking area is considered a high-intensity parking area (over 1,000 vehicle trips per day. Pre-treatment and source reduction are provided to the maximum extent practicable. The drainage system will be designed to treat 1" water quality volume and provide 44% TSS removal prior to discharge to an infiltration device. The SMS will be designed with Stormceptor hydrodynamic separators, deep-sump, hooded catch basins, and infiltration chambers equipped with isolator rows to provide 44% TSS removal prior to recharge.

6. *Stormwater discharges within the Zone II or Interim Wellhead Protection Area of a public water supply, and stormwater discharges near or to any other critical area, require the use of the specific source control and pollution prevention measures and the specific structural stormwater best management practices determined by the Department to be suitable for managing discharges to such areas, as provided in the Massachusetts Stormwater Handbook. A discharge is near a critical area if there is a strong likelihood of a significant impact occurring to said area, taking into account site-specific factors. Stormwater discharges to Outstanding Resource Waters and Special Resource Waters shall be removed and set back from the receiving water or wetland and receive the highest and best practical method of treatment. A "storm water discharge" as defined in 314 CMR 3.04(2)(a)1 or (b) to an Outstanding Resource Water or Special Resource Water shall comply with 314 CMR 3.00 and 314 CMR 4.00. Stormwater discharges to a Zone I or Zone A are prohibited unless essential to the operation of a public water supply.*

The proposed project is not located within a critical area.

7. *A redevelopment project is required to meet the following Stormwater Management Standards only to the maximum extent practicable: Standard 2, Standard 3, and the pretreatment and structural best management practice requirements of Standards 4, 5, and 6. Existing stormwater discharges shall comply with Standard 1 only to the maximum extent practicable. A redevelopment project shall also comply with all other requirements of the Stormwater Management Standards and improve existing conditions.*

The proposed project is considered a new development project under the Stormwater Management Handbook guidelines as there is an increase in the amount of impervious area.

8. *A plan to control construction-related impacts including erosion, sedimentation and other pollutant sources during construction and land disturbance activities (construction period erosion, sedimentation, and pollution prevention plan) shall be developed and implemented.*

A plan to control construction-related impacts, including erosion, sedimentation and other pollutant sources during construction and land disturbance activities will be developed. The proponent will prepare and submit a Stormwater Pollution Prevention Plan (SWPPP) prior to commencement of construction activities that will result in the disturbance of one acre of land or more.

9. *A long-term operation and maintenance plan shall be developed and implemented to ensure that stormwater management systems function as designed.*

A Long-Term Operation and Maintenance (O&M) Plan has been developed for the proposed stormwater management system and is included within this document. See Section 2.0 of this report.

10. All illicit discharges to the stormwater management system are prohibited.

There are no expected illicit discharges to the stormwater management system. The Applicant has submitted an Illicit Discharge Compliance Statement with this report. See Section 6.12 of the Appendix.

See the next page for the Mass DEP Stormwater Checklist.

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

Checklist for Stormwater Report

A. Introduction

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

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

The Stormwater Report must include:

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

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

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

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

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[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
CARLTON M.
QUINN
CIVIL
No 49923
REGISTERED
PROFESSIONAL ENGINEER
6.20.19

[signature] 6.20.19
Signature and Date

Checklist

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

☒ New development

☐ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist (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): Underground Infiltration Systems (Chambers); Isolator row; Water quality unit

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.

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

Checklist (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.
- ☒ 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.

OPERATION AND MAINTENANCE PLAN

In accordance with the standards set forth by the Stormwater Management Policy issued by the Department of Environmental Protection (DEP), Allen & Major Associates, Inc. (A&M) has prepared the following Operation and Maintenance plan for the ALTA at Rivers Edge project located at #490 Boston Post Road.

This plan is broken into two major sections. The first section describes construction-related erosion and sedimentation controls. The second section is devoted to a post-development operation and maintenance plan. An operation and maintenance schedule has been included with this report.

Stormwater Management System Owner: WP East Acquisitions, LLC
91 Hartwell Avenue, 3rd Floor
Lexington, MA 02421

Emergency Contact Information:

- WP East Acquisitions, LLC
  c/o David Moore Phone (978) 369-8111
- Allen & Major Associates, Inc. (Site Civil Engineer) Phone (781) 935-6889
- Wayland Public Works Phone (508) 358-3672
- Wayland Fire Department (business line) Phone (508) 358-4747

INTRODUCTION

The stormwater management system (SMS) for this project is owned by WP East Acquisitions, LLC; and shall be legally responsible for long-term operation and maintenance for this SMS as outlined in this Operation and Maintenance (O&M) Plan. Should ownership of the SMS change the succeeding owner will be presented with this O&M Plan and supporting attachments at or before legal conveyance of ownership and will assume the obligations of the O&M Plan.

In the event that the SMS will be operated and maintained by an entity other than that listed in this document, the applicant shall provide a plan and easement deed that provides a right of access for the legal entity to be able to perform said operation and maintenance functions. In the event the SMS will serve multiple lots/owners, the applicant shall also provide 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 entire SMS.

DEMOLITION & CONSRUCTION MAINTENANCE PLAN

1. Call Digsafe: 1-888-344-7233

2. Contact the Town of Wayland at least three (3) days prior to start of demolition and/or construction activities.

3. Install Erosion Control measures as shown on the Plans prepared by A&M. The Town of Wayland shall review the installation of straw bales and silt fencing prior to the start of any site demotion work. Install Construction fencing if determined to be necessary at the commencement of construction.

4. Install construction entrances & straw bales and silt fence at the locations shown on the Erosion Control Plan prepared by A&M.

5. Site access shall be achieved only from the designated construction entrances.

6. Cut and clear trees in construction areas only (within the limit of work; see plans).

7. Stockpiles of materials subject to erosion shall be stabilized with erosion control matting or temporary seeding whenever practicable, but in no case more than 14 days after the construction activity in that portion of the site has temporarily or permanently ceased.

8. Install silt sacks and straw bales around each drain inlet prior to any demolition and or construction activities.

9. All erosion control measures shall be inspected weekly and after every rainfall event. Records of these inspections shall be kept on site for review.

10. All erosion control measures shall be maintained, repaired or replaced as required or at the direction of the owner's engineer or the Town of Wayland.

11. Sediment accumulation up-gradient of the straw bales, silt fence, and stone check dams greater than 6" in depth shall be removed and disposed of in accordance with all applicable regulations.

12. If it appears that sediment is exiting the site, silt sacks shall be installed in all catch basins adjacent to the site. Sediment accumulation on all adjacent catch basin inlets shall be removed and the silt sack replaced if torn or damaged.

13. Install stone check dams on site during construction as needed. Refer to the erosion

control details. Temporary sediment basins combined with stone check dams shall be installed on site during construction to control and collect runoff from upland areas of this site during demolition and construction activities.

14. The contractor shall comply with the Sedimentation and Erosion Control Notes as shown on the Site Development Plans and Specifications.

15. The stabilized construction entrances shall be inspected weekly and records of inspections kept. The entrances shall be maintained by adding additional clean, angular, durable stone to remove the soil from the construction vehicle's tires when exiting the site. If soil is still leaving the site via the construction vehicle tires, adjacent roadways shall be kept clean by street sweeping.

16. Dust pollution shall be controlled using on-site water trucks and or an approved soil stabilization product.

17. During demolition and construction activities Status Reports on compliance with this O&M Document shall be submitted weekly. The report shall document any deficiencies and corrective actions taken by the applicant.

<u>POST CONSRUCTION MAINTENANCE PLAN</u>

The SMS shall be inspected immediately after construction. A maintenance log will be kept (i.e. report) summarizing inspections, maintenance, and any corrective actions taken. The log will include the date on which each inspection or maintenance task was performed, a description of the inspection findings or maintenance completed, and the name of the inspector or maintenance personnel performing the task. If a maintenance task requires the clean-out of any sediments or debris, the location where the sediment and debris was disposed after removal will be indicated. The log will be made accessible to department staff and a copy provided to the department upon request.

Inspection and Maintenance Frequency and Corrective Measures:

The following areas, facilities, and measures will be inspected and the identified deficiencies will be corrected. Clean-out must include the removal and legal disposal of any accumulated sediments, trash, and debris. In any and all cases, operations, inspections, and maintenance activities shall utilize best practical measures to avoid and minimize impacts to wetland resource areas outside the foot print of the SMS.

Attached is an Grading and Drainage Plan (C-103) illustrating the location of the following SMS components that will require continuing inspections as outlined in this document:

- Deep Sump Catch Basins (3)
- Sediment Forebay (1)
- Proprietary Separators (2)
- Subsurface Infiltration Systems (3)
- Outlet Control Structures (2)
- Snow Storage (as outlined on plan)

Monthly Post Construction Inspection (First three months only)

- **Sub-surface Infiltration Systems:**

Inspect the Infiltration system after all rainfalls greater than 1" to ensure that the system is draining within 72 hours. Repair as required.

Quarterly Inspections (specifically after foliage and snow season)

Deep Sump Catch Basins:
Inspect catch basins to ensure that the catch basins are working in their intended fashion and that they are free of debris. Structures will be skimmed of floatable debris at each inspection and sediment will be removed at a minimum once per year (typically after snow season) or when sediment has accumulated to within 2 feet of the outlet invert. If the basin outlet is designed with a hood to trap floatable materials (i.e. Snout), check to ensure watertight seal is working.

Proprietary Separators:
Separators shall be operated in strict accordance with manufacturer's recommend practices. Available manufacturer specific O&M plans attached as Appendix. Separators shall be inspected to ensure that they are working in their intended fashion and that they are free of debris. Structures shall be cleaned with a vacuum truck at least once annually (typically after snow season) or when sediment has accumulated to a depth of six inches (6"), whichever is more frequent.

Sediment Forebay:
Inspect the Sediment Forebay for accumulations of sediment. The forebay shall be cleaned at least once annually (typically after snow season) or when sediment has accumulated to a depth of one and a half inches (1.5"), whichever is more frequent.

Sub-surface Infiltration Systems:
The sub-surface structures will be inspected 24 hours or several days after large rain events (greater than 1.5"), to look for ponded water. Inspection can be accomplished by using the observation well, inspection port, and/or access structure for underground chamber systems.

Semi-Annual Inspection (specifically after foliage & snow season)

Isolator rows:
Inspect Isolator row by using inspection port and/or access structure. Remove any accumulated sediment as needed when average depths reach 1" with a vacuum truck or per the manufactures recommendation.

Culverts:
Inspect culverts to ensure that the culverts are working in their intended fashion and that they are free of debris. Remove any obstructions to flow; remove accumulated sediments and debris at the inlet, at the outlet, and within the conduit and to repair any erosion damage at the culvert's inlet and outlet.

Vegetated Areas:
Inspect slopes and embankments early in the growing season to identify active or potential erosion problems. Replant bare areas or areas with sparse growth. Where rill erosion is evident, armor the area with an appropriate lining or divert the erosive flows to on-site areas able to withstand the concentrated flows.

Roadways and Parking Surfaces:
Sweep paved areas as soon as possible after snow melt and no less than four times annually. Clear accumulations of winter sand in parking lots and along roadways at least once a year, preferably in the spring. Accumulations on pavement may be removed by pavement sweeping.

Accumulations of sand along road shoulders may be removed by grading excess sand to the pavement edge and removing it manually or by a front-end loader.

Level Spreaders, Check Dams, Rip-Rap:
These accessories will be inspected for erosion, debris accumulation, and unwanted vegetation. Erosion will be stabilized and sediment, debris, and woody vegetation will be removed.

LANDSCAPE MANAGEMENT PLAN

It should be recognized that this is a general guideline towards achieving high quality and well-groomed landscaped areas. The grounds staff / landscape contractor must recognize the shortcomings of a general maintenance program such as this, and modify and/or augment it based on weekly, monthly, and yearly observations. In order to assure the highest quality conditions, the staff must also recognize and appreciate the need to be aware of the constantly changing conditions of the landscaping and be able to respond to them on a proactive basis.

Additional care must be taken in landscape areas that are functioning as BMP drainage structures. These areas have been specifically designed to treat and convey stormwater and shall be maintained as such. These areas include the Bioretention Areas, Gravel Infiltration Swale, Grassed Filter Strips, Sediment Forebay and Detention Basin and are illustrated on the attached Operation and Maintenance Plan (OM-1)

Fertilizer

Maintenance practices should be aimed at reducing environmental, mechanical and pest stresses to promote healthy and vigorous growth. When necessary, pest outbreaks should be treated with the most sensitive control measure available. Synthetic chemical controls should be used only as a last resort to organic and biological control methods. Fertilizer, synthetic chemical controls and pest management applications (when necessary) should be performed only by licensed applicators in accordance with the manufacturer's label instructions when environmental conditions are conducive to controlled product application.

Only slow-release organic fertilizers should be used in the landscaped areas to limit the amount of nutrients that could enter downstream resource areas. Fertilization of developed areas on site will be performed within manufacturers labeling instructions. Additionally, the fertilizer will include a slow release element and be Phosphorous free.

Suggested Aeration Program

In-season aeration of lawn areas is good cultural practice, and is recommended whenever feasible. It should be accomplished with a solid thin tine aeration method to reduce disruption to the use of the area. The depth of solid tine aeration is similar to core type, but should be performed when the soil is somewhat drier for a greater overall effect.

Depending on the intensity of use, it can be expected that all landscaped lawn areas will need aeration to reduce compaction at least once per year. The first operation should occur in late May following the spring season. Methods of reducing compaction will vary based on the nature of the compaction. Compaction on newly established landscaped areas is generally limited to the top 2-3" and can be alleviated using hollow core or thin tine aeration methods.

The spring aeration should consist of two passes at opposite directions with 1/4" hollow core tines penetrating 3-5" into the soil profile. Aeration should occur when the soil is moist but not saturated. The cores should be shattered in place and dragged or swept back into the turf to control thatch. If desired the cores may also be removed and the area top-dressed with sand or sandy loam. If the area drains on average too slowly, the topdressing should contain a higher percentage of sand. If it is draining on average too quickly, the top dressing should contain a higher percentage of soil and organic matter.

Landscape Maintenance Program Practices:

Lawn

- Mow a minimum of once a week in spring, to a height of 2" to 2 1/2" high. Mowing should be frequent enough so that no more than 1/3 of grass blade is removed at each mowing. The top growth supports the roots; the shorter the grass is cut, the less the roots will grow. Short cutting also dries out the soil and encourages weeds to germinate.
- Mow approximately once every two weeks from July 1st to August 15th depending on lawn growth.
- Mow on a ten-day cycle in fall, when growth is stimulated by cooler nights and increased moisture.
- Do not remove grass clippings after mowing. (Except in Drainage BMP's)
- Keep mower blades sharp to prevent ragged cuts on grass leaves, which cause a brownish appearance and increase the chance for disease to enter a leaf.
- Supplemental irrigation of lawn areas should provide 1" of water per week in two watering's per week—when no natural rainfall has occurred.

Shrubs

- Mulch not more than 3" depth with shredded pine or fir bark.
- Hand pruning shall be performed annually based on the natural growth characteristics of each species to keep plants from overgrowing walks and windows. NO SHEARING OF SHRUBS IS PERMITTED. Typically, pruning of each variety shall be immediately after blooming.
- Fertilize with ½ lb. slow-release fertilizer (see above section on Fertilizer) every second year.
- Hand prune evergreen shrubs only as needed to remove dead and damaged wood and to maintain the naturalistic form of the shrub. Never mechanically shear evergreen shrubs.

Trees

- Provide aftercare for new tree plantings for the first three years.
- Do not fertilize trees, it artificially stimulates them (unless tree health warrants).
- Water once a week for the first year; twice a month the second, once a month the third year.
- Prune trees on a four-year cycle.

Grassland Management Protocol

During the first three growing seasons, the native grasslands should mowed one or two times with a sickle bar mower to suppress weed species. The blade shall be set between 5"-10" as directed. If weed growth is not rampant, the first mowing should be done in mid-July. More than one mowing may be necessary over the course of the first and second growing season if extensive weed growth is evident. During the third year of growth, one mowing shall be performed in late July. No rotary mowers shall be used. All cuttings should be removed and disposed of away from the planted area until the grassland habitat is fully established.

No fertilizers shall be used after planting. The low nitrogen available from the soil is an important factor in suppressing many potential invasive species from establishing in the grassland restoration areas.

Herbicides shall only be used where non-grass herbaceous species comprise more than 30 percent of vegetative cover based as determined from monitoring. Appropriate broad-leaf herbicides should be used only according to their directions.
Supplemental Seeding shall be done in areas where the primary seeding has not been successful as directed by the monitor.

Maintenance Phase

By the fourth growing season, the planted grasslands should be reaching maturity. At this time, half of the grassland habitat area should be mown annually in mid- August to maintain the grassland habitat, limiting the opportunity for shrubs and late-blooming forbs to spread, and allowing the grasses time to recover before dormancy.

Management of Deicing Chemicals and Snow

Snow shall not be plowed towards any area protected by the Massachusetts Wetlands Protection Act. Additionally, it is prohibited to dump snow into the bioretention swales, or gravel swales. Snow shall only be stockpiled on site within the snow storage areas depicted on the Snow Storage plan, Sheet C-106. If the stockpiles of snow do not fit within the designated areas, then snow will be disposed off-site. It will be the responsibility of the snow removal contractor to properly dispose of transported snow according to the Massachusetts DEP, Bureau of Resource Protection – Snow Disposal Guideline #BRPG01-0, governing the proper disposal of snow. It will be the responsibility of the snow removal contractor to follow these guidelines and all applicable laws and regulations. A copy of the MA DEP Snow Disposal Guideline #BRPG01-01 has been included at the end of Section 2 for reference.
The sites maintenance staff (or its designee) will be responsible for the clearing of the sidewalk and building entrances. The site may be required to use a de-icing agent such as potassium chloride (or approved equal) to maintain a safe walking surface; however, these

are to be used at the minimum amount practicable. The de-icing agent for the walkways and building entrances will be kept within the storage rooms located within the buildings. De-icing agents will not be stored outside.

Spill Prevention and Response

Sources of potential spill hazards include vehicle fluids, liquid fuels, pesticides, paints, solvents, and liquid cleaning products. The majority of the spill hazards would likely occur within the building and would not enter the stormwater drainage system. However, there are spill hazards from vehicle fluids or liquid fuels located outside of the buildings. These exterior spill hazards have the potential to enter the stormwater drainage system and are to be addressed as follows:

1. Spill Hazards of pesticides, paints, and solvents shall be remediated using the Manufacturers' recommended spill cleanup protocol.
2. Vehicle fluids and liquid fuel spill shall be remediated according to the local and state regulations governing fuel spills.
3. The owner shall have the following equipment and materials on hand to address a spill clean-up: brooms, dust pans, mops, rags, gloves, absorptive material, sand, sawdust, plastic and metal trash containers.
4. All spills shall be cleaned up immediately after discovery
5. Spills of toxic or hazardous material shall be reported, regardless of size, to the Massachusetts Department of Environmental Protection at 888-304-1133.
6. Should a spill occur, the pollution prevention plan will be adjusted to include measures to prevent another spill of a similar nature. A description of the spill, along with the causes and cleanup measures will be included in the updated pollution prevention plan.

Pet Waste Management

Pet waste stations will be provided on site. Ultimately, it will be the responsibility of the pet owner to clean any waste and discard it in the provided stations.

OPERATION & MAINTENANCE PLAN SCHEDULE

Project: ALTA at River's Edge
Address: 490 Boston Post Road
Wayland, MA

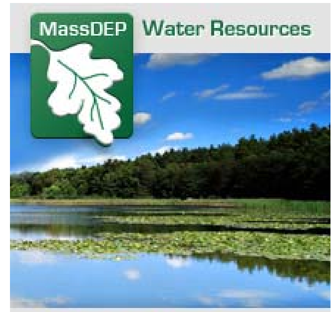
ty Responsible for O & M Plan: WP East Acquisitions, LLC.
Address: 91 Hartwell Avenue
3rd Floor
Lexington, MA 02421
Phone: (978)-369-8111

Date: 5/31/2017
Revised: ------

Structure or Task	Maintenance Activity	Schedule/Notes	Annual Maintenance Cost	Inspection Performed Date:	Inspection Performed By:
Street Sweeping	Sweep, power broom or vacuum paved areas.	Sweep paved areas as needed, but not less than four times annually.	$2,000		
		Submit information that confirms that all street sweepings have been disposed in accordance with state and local requirements			
Deep Sump Catch Basins(s)	Clam shell or vacuum sumps	Inspect at least twice annually. Clean when sediment is within 2.5 feet of the outlet invert.	$500		
		Submit information that confirms that all catch basin sediments have been disposed in accordance with state and local requirements			
Storm Water Management System					
Proprietary Separators	See the ConTECH Maintenance package for the inspection and cleaning procedure.	Inspect at least four times annually as well as following storms exceeding 1" of rainfall. Devices shall be cleaned at leaast once annually or when sediment reaches 6 inches of depth whichever is more frequent. See also note #1 below.	$250		
		Submit information that confirms that all water quality inlets sediments have been disposed in accordance with state and local requirements			
Subsurface Infiltration Systems	Inspect to ensure it is draining properly.	Perform every other month as well as after every storm event over 1/2". See also note #1 below.	$500		
	Inspect isolator row using inspection ports and remove any accumulated sediment when average depth reaches 1" per the manufacturers recommendation.	On a semi-annual basis.			
Outlet Control Structure(s)	Vacuum.	Periodic cleaning of Outlet Control Structures as needed.	$50		
Mosquito Control	CB management targeted larviciding treatment to CB's and all storm drains to control mosquitoes in their aquatic stages.	Surveillance is a non chemical inspection method that involves classification of mosquito breeding sites, larval presents, and survey.	$100		
Snow Storage	Debris shall be cleared from the site and properly disposed of at the end of the snow season, but shall be cleared no later than May 15.	Avoid dumping snow removal over catch basins, in detention ponds, sediment forebays, rivers, wetlands, and flood plain. It is also prohibited to dump snow in the bioretention basins or gravel swales. (See Site Plan for appropriate locations)	$500		

Note #1 - During the first year of operation, all of the BMP's shall be inspected during and after large storm events to ensure they are functioning properly. The subsurface infiltration systems should be fully drained within 72 hours after a rain event. If they are not drained within this time period, the systems shall be evaluated and corrective actions should be implemented.

Snow Disposal Guidance



A to Z Quick Links

Water Resources Index

Effective Date: March 8, 2001

Guideline No. BRPG01-01

Applicability: Applies to all federal, state, regional and local agencies, as well as to private businesses.

Supersedes: BRP Snow Disposal Guideline BRPG97-1 issued 12/19/97, and all previous snow disposal guidance

Approved by: Glenn Haas, Assistant Commissioner for Resource Protection

PURPOSE: To provide guidelines to all government agencies and private businesses regarding snow disposal site selection, site preparation and maintenance, and emergency snow disposal options that are acceptable to the Department of Environmental Protection, Bureau of Resource Protection.

APPLICABILITY: These Guidelines are issued by the Bureau of Resource Protection on behalf of all Bureau Programs (including Drinking Water Supply, Wetlands and Waterways, Wastewater Management, and Watershed Planning and Permitting). They apply to public agencies and private businesses disposing of snow in the Commonwealth of Massachusetts.

INTRODUCTION

Finding a place to dispose of collected snow poses a challenge to municipalities and businesses as they clear roads, parking lots, bridges, and sidewalks. While we are all aware of the threats to public safety caused by snow, collected snow that is contaminated with road salt, sand, litter, and automotive pollutants such as oil also threatens public health and the environment.

As snow melts, road salt, sand, litter, and other pollutants are transported into surface water or through the soil where they may eventually reach the groundwater. Road salt and other pollutants can contaminate water supplies and are toxic to aquatic life at certain levels. Sand washed into waterbodies can create sand bars or fill in wetlands and ponds, impacting aquatic life, causing flooding, and affecting our use of these resources.

There are several steps that communities can take to minimize the impacts of snow disposal on public health and the environment. These steps will help communities avoid the costs of a contaminated water supply, degraded waterbodies, and flooding. Everything we do on the land has the potential to impact our water resources. Given the authority of local government over the use of the land, municipal officials and staff have a critically important role to play in protecting our water resources.

The purpose of these guidelines is to help municipalities and businesses select, prepare, and maintain appropriate snow disposal sites before the snow begins to accumulate through the winter.

RECOMMENDED GUIDELINES

These snow disposal guidelines address: (1) site selection; (2) site preparation and maintenance; and (3) emergency snow disposal.

1. SITE SELECTION

The key to selecting effective snow disposal sites is to locate them adjacent to or on pervious surfaces in upland areas away from water resources and wells. At these locations, the snow meltwater can filter in to the soil, leaving behind sand and debris which can be removed in the springtime. The following areas should be avoided:

- Avoid dumping of snow into any waterbody, including rivers, the ocean, reservoirs, ponds, or wetlands. In addition to water quality impacts and flooding, snow disposed of in open water can cause navigational hazards when it freezes into ice blocks.
- Do not dump snow within a Zone II or Interim Wellhead Protection Area (IWPA) of a public water supply well or within 75 feet of a private well, where road salt may contaminate water supplies.
- Avoid dumping snow on MassDEP-designated high and medium-yield aquifers where it may contaminate groundwater (see the next page for information on ordering maps from MassGIS showing the locations of aquifers, Zone II's, and IWPAs in your community).
- Avoid dumping snow in sanitary landfills and gravel pits. Snow meltwater will create more contaminated leachate in landfills posing a greater risk to groundwater, and in gravel pits, there is little opportunity for pollutants to be filtered out of the meltwater because groundwater is close to the land surface.

- Avoid disposing of snow on top of storm drain catch basins or in stormwater drainage swales or ditches. Snow combined with sand and debris may block a storm drainage system, causing localized flooding. A high volume of sand, sediment, and litter released from melting snow also may be quickly transported through the system into surface water.

Site Selection Procedures

1. It is important that the municipal Department of Public Works or Highway Department, Conservation Commission, and Board of Health work together to select appropriate snow disposal sites. The following steps should be taken:
2. Estimate how much snow disposal capacity is needed for the season so that an adequate number of disposal sites can be selected and prepared.
3. Identify sites that could potentially be used for snow disposal such as municipal open space (e.g., parking lots or parks).
4. Sites located in upland locations that are not likely to impact sensitive environmental resources should be selected first.
5. If more storage space is still needed, prioritize the sites with the least environmental impact (using the site selection criteria, and local or MassGIS maps as a guide).

MassGIS Maps of Open Space and Water Resources

If local maps do not show the information you need to select appropriate snow disposal sites, you may order maps from MassGIS (Massachusetts Geographic Information System) which show publicly owned open spaces and approximate locations of sensitive environmental resources (locations should be field-verified where possible). Different coverages or map themes depicting sensitive environmental resources are available from MassGIS on the map you order. At a minimum, you should order the Priority Resources Map. The Priority Resources Map includes aquifers, public water supplies, MassDEP-approved Zone II's, Interim Wellhead Protection Areas, Wetlands, Open Space, Areas of Critical Environmental Concern, NHESP Wetlands Habitats, MassDEP Permitted Solid Waste facilities, Surface Water Protection areas (Zone A's) and base map features. The cost of this map is $25.00. Other coverages or map themes you may consider, depending on the location of your city or town, include Outstanding Resource Waters and MassDEP Eelgrass Resources. These are available at $25.00 each, with each map theme being depicted on a separate map. Maps should be ordered from MassGIS . Maps may also be ordered by fax at 617-626-1249 (order form available from the MassGIS web site) or mail. For further information, contact MassGIS at 617-626-1189.

2. SITE PREPARATION AND MAINTENANCE

In addition to carefully selecting disposal sites before the winter begins, it is important to prepare and maintain these sites to maximize their effectiveness. The following maintenance measures should be undertaken for all snow disposal sites:

- A silt fence or equivalent barrier should be placed securely on the downgradient side of the snow disposal site.
- To filter pollutants out of the meltwater, a 50-foot vegetative buffer strip should be maintained during the growth season between the disposal site and adjacent waterbodies.
- Debris should be cleared from the site prior to using the site for snow disposal.
- Debris should be cleared from the site and properly disposed of at the end of the snow season and no later than May 15.

3. EMERGENCY SNOW DISPOSAL

As mentioned earlier, it is important to estimate the amount of snow disposal capacity you will need so that an adequate number of upland disposal sites can be selected and prepared.

If despite your planning, upland disposal sites have been exhausted, snow may be disposed of near waterbodies. A vegetated buffer of at least 50 feet should still be maintained between the site and the waterbody in these situations. Furthermore, it is essential that the other guidelines for preparing and maintaining snow disposal sites be followed to minimize the threat to adjacent waterbodies.

Under extraordinary conditions, when all land-based snow disposal options are exhausted, disposal of snow that is not obviously contaminated with road salt, sand, and other pollutants may be allowed in certain waterbodies under certain conditions. In these dire situations, notify your Conservation Commission and the appropriate MassDEP Regional Service Center before disposing of snow in a waterbody.

Use the following guidelines in these emergency situations:

- Dispose of snow in open water with adequate flow and mixing to prevent ice dams from forming.
- Do not dispose of snow in saltmarshes, vegetated wetlands, certified vernal pools, shellfish beds, mudflats, drinking water reservoirs and their tributaries, Zone IIs or IWPAs of public water supply wells, Outstanding Resource Waters, or Areas of Critical Environmental Concern.
- Do not dispose of snow where trucks may cause shoreline damage or erosion.
- Consult with the municipal Conservation Commission to ensure that snow disposal in open water complies with local

ordinances and bylaws.

FOR MORE INFORMATION

If you need more information, contact one of MassDEP's Regional Service Centers:

Northeast Regional Office, Wilmington, 978-694-3200
Southeast Regional Office, Lakeville, 508-946-2714
Central Regional Office, Worcester, 508-792-7683
Western Regional Office, Springfield, 413-755-2214

or

Call Thomas Maguire of DEP's Bureau of Resource Protection in Boston at 617-292-5602.

Chapter 5
Miscellaneous Stormwater Topics

Mosquito Control in Stormwater Management Practices

Both aboveground and underground stormwater BMPs have the potential to serve as mosquito breeding areas. Good design, proper operation and maintenance and treatment with larvicides can minimize this potential.

EPA recommends that stormwater treatment practices dewater within 3 days (72 hours) to reduce the number of mosquitoes that mature to adults, since the aquatic stage of many mosquito species is 7 to 10 days. Massachusetts has had a 72-hour dewatering rule in its Stormwater Management Standards since 1996. The 2008 technical specifications for BMPs set forth in Volume 2, Chapter 2 of the Massachusetts Stormwater Handbook also concur with this practice by requiring that all stormwater practices designed to drain do so within 72 hours.

Some stormwater practices are designed to include permanent wet pools. These practices – if maintained properly – can limit mosquito breeding by providing habitat for mosquito predators. Additional measures that can be taken to reduce mosquito populations include increasing water circulation, attracting mosquito predators by adding suitable habitat, and applying larvicides.

The Massachusetts State Reclamation and Mosquito Control Board (SRMCB), through the Massachusetts Mosquito Control Districts, can undertake further mosquito control actions specifically for the purpose of mosquito control pursuant to Massachusetts General Law Chapter 252. The Mosquito Control Board, http://www.mass.gov/agr/mosquito/, describes mosquito control methods and is in the process of developing guidance documents that describe Best Management Practices for mosquito control projects.

The SRMCB and Mosquito Control Districts are not responsible for operating and maintaining stormwater BMPs to reduce mosquito populations. The owners of property that construct the stormwater BMPs or municipalities that "accept" them through local subdivision approval are responsible for their maintenance.[1] The SRMCB is composed of officials from MassDEP, Department of Agricultural Resources, and Department of Conservation and Recreation. The nine (9) Mosquito Control Districts overseen by the SRMCB are located throughout Massachusetts, covering 176 municipalities.

Construction Period Best Management Practices for Mosquito Control

To minimize mosquito breeding during construction, it is essential that the following actions be taken to minimize the creation of standing pools by taking the following actions:

- ***Minimize Land Disturbance:*** Minimizing land disturbance reduces the likelihood of mosquito breeding by reducing silt in runoff that will cause construction period controls to clog and retain standing pools of water for more than 72 hours.
- ***Catch Basin inlets:*** Inspect and refresh filter fabric, hay bales, filter socks or stone dams on a regular basis to ensure that any stormwater ponded at the inlet drains within 8 hours after precipitation stops. Shorter periods may be necessary to avoid hydroplaning in roads

[1] MassDEP and MassHighway understand that the numerous stormwater BMPs along state highways pose a unique challenge. To address this challenge, the 2004 MassHighway Stormwater Handbook will provide additional information on appropriate operation and maintenance practices for mosquito control when the Handbook is revised to reflect the 2008 changes to the Stormwater Management Standards..

caused by water ponded at the catch basin inlet. Treat catch basin sumps with larvicides such as *Bacillus sphaericus* (*Bs*) using a licensed pesticide applicator.

- ***Check Dams:*** If temporary check dams are used during the construction period to lag peak rate of runoff or pond runoff for exfiltration, inspect and repair the check dams on a regular basis to ensure that any stormwater ponded behind the check dam drains within 72 hours.
- ***Design construction period sediment traps*** to dewater within 72 hours after precipitation. Because these traps are subject to high silt loads and tend to clog, treat them with the larvicide *Bs* after it rains from June through October, until the first frost occurs.
- ***Construction period open conveyances:*** When temporary manmade ditches are used for channelizing construction period runoff, inspect them on a regular basis to remove any accumulated sediment to restore flow capacity to the temporary ditch.
- ***Revegetating Disturbed Surfaces:*** Revegetating disturbed surfaces reduces sediment in runoff that will cause construction period controls to clog and retain standing pools of water for greater than 72 hours.
- ***Sediment fences/hay bale barriers:*** When inspections find standing pools of water beyond the 24-hour period after a storm, take action to restore barrier to its normal function.

<u>Post-Construction Stormwater Treatment Practices</u>

- Mosquito control begins with the environmentally sensitive site design. Environmentally sensitive site design that minimizes impervious surfaces reduces the amount of stormwater runoff. Disconnecting runoff using the LID Site Design credits outlined in the Massachusetts Stormwater Handbook reduces the amount of stormwater that must be conveyed to a treatment practice. Utilizing green roofs minimizes runoff from smaller storms. Storage media must be designed to dewater within 72 hours after precipitation.
- Mosquito control continues with the selection of structural stormwater BMPs that are unlikely to become breeding grounds for mosquitoes, such as:
  - ***Bioretention Areas/Rain Gardens/Sand Filter:*** These practices tend not to result in mosquito breeding. If any level spreaders, weirs or sediment forebays are used as part of the design, inspect them and correct them as necessary to prevent standing pools of water for more than 72 hours.
  - ***Infiltration Trenches:*** This practice tends not to result in mosquito breeding. If any level spreaders, weirs, or sediment forebays are used as part of the design, inspect them and correct them as necessary to prevent standing pools of water for more than 72 hours.
- Another mosquito control strategy is to select BMPs that can become habitats for mosquito predators, such as:
  - ***Constructed Stormwater Wetlands:*** Habitat features can be incorporated in constructed stormwater wetlands to attract dragonflies, amphibians, turtles, birds, bats, and other natural predators of mosquitoes.
  - ***Wet Basins:*** Wet basins can be designed to incorporate fish habitat features, such as deep pools. Introduce fish in consultation with Massachusetts Division of Fisheries and Wildlife. Vegetation within wet basins designed as fish habitat must be properly managed to ensure that vegetation does not overtake the habitat. Proper design to ensure that no low circulation or “dead” zones are created may reduce the potential for mosquito breeding. Introducing bubblers may increase water circulation in the wet basin.

Effective mosquito controls require proponents to design structural BMPs to prevent ponding and facilitate maintenance and, if necessary, the application of larvicides. Examples of such design practices include the following:

- ***Basins:*** Provide perimeter access around wet basins, extended dry detention basins and dry detention basins for both larviciding and routine maintenance. Control vegetation to ensure that access pathways stay open.
- ***BMPs without a permanent pool of water:*** All structural BMPs that do not rely on a permanent pool of water must drain and completely dewater within 72 hours after precipitation. This includes dry detention basins, extended dry detention basins, infiltration basins, and dry water quality swales. Use underdrains at extended dry detention basins to drain the small pools that form due to accumulation of silts. Wallace indicates that extended dry extended detention basins may breed more mosquitoes than wet basins. It is, therefore, imperative to design outlets from extended dry detention basins to completely dewater within the 72-hour period.
- ***Energy Dissipators and Flow Spreaders:*** Currier and Moeller, 2000 indicate that shallow recesses in energy dissipators and flow spreaders trap water where mosquitoes breed. Set the riprap in grout to reduce the shallow recesses and minimize mosquito breeding.
- ***Outlet control structures:*** Debris trapped in small orifices or on trash racks of outlet control structures such as multiple stage outlet risers may clog the orifices or the trash rack, causing a standing pool of water. Optimize the orifice size or trash rack mesh size to provide required peak rate attenuation/water quality detention/retention time while minimizing clogging.
- ***Rain Barrels and Cisterns:*** Seal lids to reduce the likelihood of mosquitoes laying eggs in standing water. Install mosquito netting over inlets. The cistern system should be designed to ensure that all collected water is drained into it within 72 hours.
- ***Subsurface Structures, Deep Sump Catch Basins, Oil Grit Separators, and Leaching Catch Basins:*** Seal all manhole covers to reduce likelihood of mosquitoes laying eggs in standing water. Install mosquito netting over the outlet (CALTRANS 2004).

The Operation and Maintenance Plan should provide for mosquito prevention and control.

- ***Check dams:*** Inspect permanent check dams on the schedule set forth in the O&M Plan. Inspect check dams 72 hours after storms for standing water ponding behind the dam. Take corrective action if standing water is found.
- ***Cisterns:*** Apply *Bs* larvicide in the cistern if any evidence of mosquitoes is found. The Operation and Maintenance Plan shall specify how often larvicides should be applied to waters in the cistern.
- ***Water quality swales:*** Remove and properly dispose of any accumulated sediment as scheduled in the Operation and Maintenance Plan.
- ***Larvicide Treatment:*** The Operation and Maintenance Plan must include measures to minimize mosquito breeding, including larviciding.
- The party identified in the Operation and Maintenance Plan as responsible for maintenance shall see that larvicides are applied as necessary to the following stormwater treatment practices: catch basins, oil/grit separators, wet basins, wet water quality swales, dry extended detention basins, infiltration basins, and constructed stormwater wetlands. The Operation and Maintenance Plan must ensure that all larvicides are applied by a licensed pesticide applicator and in compliance with all pesticide label requirements.
- The Operation and Maintenance Plan should identify the appropriate larvicide and the time and method of application. For example, *Bacillus sphaericus (Bs)*, the preferred

larvicide for stormwater BMPs, should be hand-broadcast.[2] Alternatively, Altosid, a Methopren product, may be used. Because some practices are designed to dewater between storms, such as dry extended detention and infiltration basins, the Operation and Maintenance Plan should provide that larviciding must be conducted during or immediately after wet weather, when the detention or infiltration basin has a standing pool of water, unless a product is used that can withstand extended dry periods.

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[2] *Bacillus thuringienis israelensis* or *Bti* is usually applied by helicopter to wetlands and floodplains

CONTECH®
ENGINEERED SOLUTIONS

CDS Guide
Operation, Design, Performance and Maintenance

CDS®

Using patented continuous deflective separation technology, the CDS system screens, separates and traps debris, sediment, and oil and grease from stormwater runoff. The indirect screening capability of the system allows for 100% removal of floatables and neutrally buoyant material without blinding. Flow and screening controls physically separate captured solids, and minimize the re-suspension and release of previously trapped pollutants. Inline units can treat up to 6 cfs, and internally bypass flows in excess of 50 cfs (1416 L/s). Available precast or cast-in-place, offline units can treat flows from 1 to 300 cfs (28.3 to 8495 L/s). The pollutant removal capacity of the CDS system has been proven in lab and field testing.

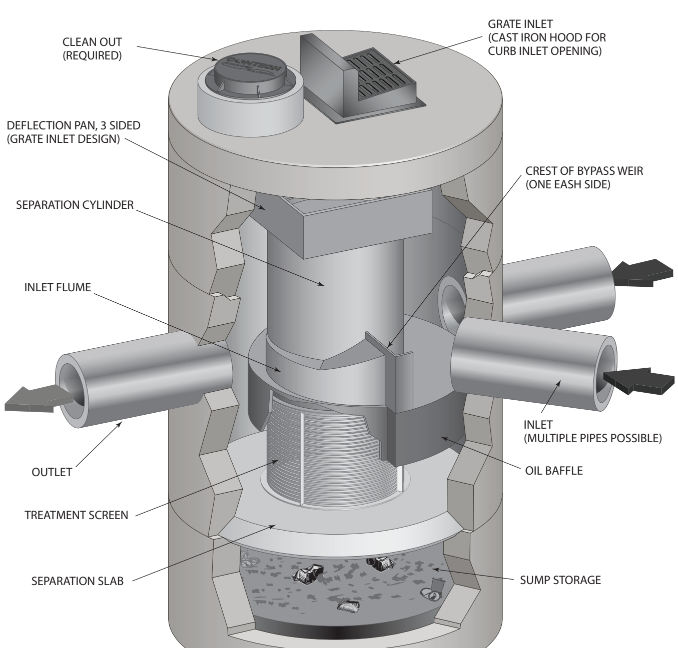
Operation Overview

Stormwater enters the diversion chamber where the diversion weir guides the flow into the unit's separation chamber and pollutants are removed from the flow. All flows up to the system's treatment design capacity enter the separation chamber and are treated.

Swirl concentration and screen deflection force floatables and solids to the center of the separation chamber where 100% of floatables and neutrally buoyant debris larger than the screen apertures are trapped.

Stormwater then moves through the separation screen, under the oil baffle and exits the system. The separation screen remains clog free due to continuous deflection.

During the flow events exceeding the treatment design capacity, the diversion weir bypasses excessive flows around the separation chamber, so captured pollutants are retained in the separation cylinder.



Design Basics

There are three primary methods of sizing a CDS system. The Water Quality Flow Rate Method determines which model size provides the desired removal efficiency at a given flow rate for a defined particle size. The Rational Rainfall Method™ or the and Probabilistic Method is used when a specific removal efficiency of the net annual sediment load is required.

Typically in the Unites States, CDS systems are designed to achieve an 80% annual solids load reduction based on lab generated performance curves for a gradation with an average particle size (d50) of 125 microns (μm). For some regulatory environments, CDS systems can also be designed to achieve an 80% annual solids load reduction based on an average particle size (d50) of 75 microns (μm) or 50 microns (μm).

Water Quality Flow Rate Method

In some cases, regulations require that a specific treatment rate, often referred to as the water quality design flow (WQQ), be treated. This WQQ represents the peak flow rate from either an event with a specific recurrence interval, e.g. the six-month storm, or a water quality depth, e.g. 1/2-inch (13 mm) of rainfall.

The CDS is designed to treat all flows up to the WQQ. At influent rates higher than the WQQ, the diversion weir will direct most flow exceeding the WQQ around the separation chamber. This allows removal efficiency to remain relatively constant in the separation chamber and eliminates the risk of washout during bypass flows regardless of influent flow rates.

Treatment flow rates are defined as the rate at which the CDS will remove a specific gradation of sediment at a specific removal efficiency. Therefore the treatment flow rate is variable, based on the gradation and removal efficiency specified by the design engineer.

Rational Rainfall Method™

Differences in local climate, topography and scale make every site hydraulically unique. It is important to take these factors into consideration when estimating the long-term performance of any stormwater treatment system. The Rational Rainfall Method combines site-specific information with laboratory generated performance data, and local historical precipitation records to estimate removal efficiencies as accurately as possible.

Short duration rain gauge records from across the United States and Canada were analyzed to determine the percent of the total annual rainfall that fell at a range of intensities. US stations' depths were totaled every 15 minutes, or hourly, and recorded in 0.01-inch increments. Depths were recorded hourly with 1-mm resolution at Canadian stations. One trend was consistent at all sites; the vast majority of precipitation fell at low intensities and high intensity storms contributed relatively little to the total annual depth.

These intensities, along with the total drainage area and runoff coefficient for each specific site, are translated into flow rates using the Rational Rainfall Method. Since most sites are relatively small and highly impervious, the Rational Rainfall Method is appropriate. Based on the runoff flow rates calculated for each intensity, operating rates within a proposed CDS system are determined. Performance efficiency curve determined from full scale laboratory tests on defined sediment PSDs is applied to calculate solids removal efficiency. The relative removal efficiency at each operating rate is added to produce a net annual pollutant removal efficiency estimate.

Probabilistic Rational Method

The Probabilistic Rational Method is a sizing program Contech developed to estimate a net annual sediment load reduction for a particular CDS model based on site size, site runoff coefficient, regional rainfall intensity distribution, and anticipated pollutant characteristics.

The Probabilistic Method is an extension of the Rational Method used to estimate peak discharge rates generated by storm events of varying statistical return frequencies (e.g. 2-year storm event). Under the Rational Method, an adjustment factor is used to adjust the runoff coefficient estimated for the 10-year event, correlating a known hydrologic parameter with the target storm event. The rainfall intensities vary depending on the return frequency of the storm event under consideration. In general, these two frequency dependent parameters (rainfall intensity and runoff coefficient) increase as the return frequency increases while the drainage area remains constant.

These intensities, along with the total drainage area and runoff coefficient for each specific site, are translated into flow rates using the Rational Method. Since most sites are relatively small and highly impervious, the Rational Method is appropriate. Based on the runoff flow rates calculated for each intensity, operating rates within a proposed CDS are determined. Performance efficiency curve on defined sediment PSDs is applied to calculate solids removal efficiency. The relative removal efficiency at each operating rate is added to produce a net annual pollutant removal efficiency estimate.

Treatment Flow Rate

The inlet throat area is sized to ensure that the WQQ passes through the separation chamber at a water surface elevation equal to the crest of the diversion weir. The diversion weir bypasses excessive flows around the separation chamber, thus preventing re-suspension or re-entrainment of previously captured particles.

Hydraulic Capacity

The hydraulic capacity of a CDS system is determined by the length and height of the diversion weir and by the maximum allowable head in the system. Typical configurations allow hydraulic capacities of up to ten times the treatment flow rate. The crest of the diversion weir may be lowered and the inlet throat may be widened to increase the capacity of the system at a given water surface elevation. The unit is designed to meet project specific hydraulic requirements.

Performance

Full-Scale Laboratory Test Results

A full-scale CDS system (Model CDS2020-5B) was tested at the facility of University of Florida, Gainesville, FL. This CDS unit was evaluated under controlled laboratory conditions of influent flow rate and addition of sediment.

Two different gradations of silica sand material (UF Sediment & OK-110) were used in the CDS performance evaluation. The particle size distributions (PSDs) of the test materials were analyzed using standard method "Gradation ASTM D-422 "Standard Test Method for Particle-Size Analysis of Soils" by a certified laboratory.

UF Sediment is a mixture of three different products produced by the U.S. Silica Company: "Sil-Co-Sil 106", "#1 DRY" and "20/40 Oil Frac". Particle size distribution analysis shows that the UF Sediment has a very fine gradation (d50 = 20 to 30 μm) covering a wide size range (Coefficient of Uniformity, C averaged at 10.6). In comparison with the hypothetical TSS gradation specified in the NJDEP (New Jersey Department of Environmental Protection) and NJCAT (New Jersey Corporation for Advanced Technology) protocol for lab testing, the UF Sediment covers a similar range of particle size but with a finer d50 (d50 for NJDEP is approximately 50 μm) (NJDEP, 2003).

The OK-110 silica sand is a commercial product of U.S. Silica Sand. The particle size distribution analysis of this material, also included in Figure 1, shows that 99.9% of the OK-110 sand is finer than 250 microns, with a mean particle size (d50) of 106 microns. The PSDs for the test material are shown in Figure 1.

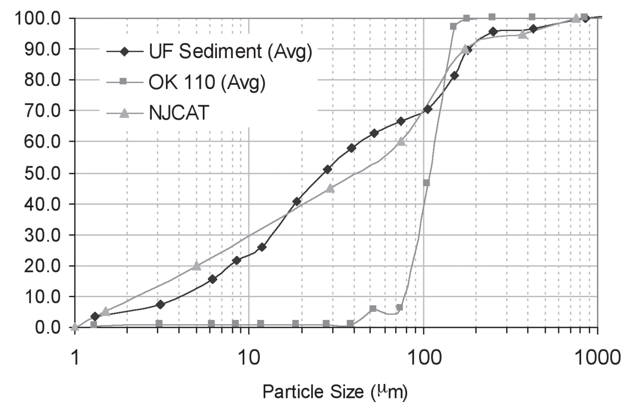


Figure 1. Particle size distributions

Tests were conducted to quantify the performance of a specific CDS unit (1.1 cfs (31.3-L/s) design capacity) at various flow rates, ranging from 1% up to 125% of the treatment design capacity of the unit, using the 2400 micron screen. All tests were conducted with controlled influent concentrations of approximately 200 mg/L. Effluent samples were taken at equal time intervals across the entire duration of each test run. These samples were then processed with a Dekaport Cone sample splitter to obtain representative sub-samples for Suspended Sediment Concentration (SSC) testing using ASTM D3977-97 "Standard Test Methods for Determining Sediment Concentration in Water Samples", and particle size distribution analysis.

Results and Modeling

Based on the data from the University of Florida, a performance model was developed for the CDS system. A regression analysis was used to develop a fitting curve representative of the scattered data points at various design flow rates. This model, which demonstrated good agreement with the laboratory data, can then be used to predict CDS system performance with respect to SSC removal for any particle size gradation, assuming the particles are inorganic sandy-silt. Figure 2 shows CDS predictive performance for two typical particle size gradations (NJCAT gradation and OK-110 sand) as a function of operating rate.

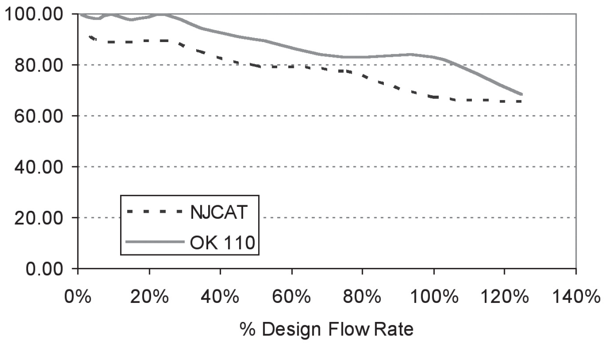


Figure 2. CDS stormwater treatment predictive performance for various particle gradations as a function of operating rate.

Many regulatory jurisdictions set a performance standard for hydrodynamic devices by stating that the devices shall be capable of achieving an 80% removal efficiency for particles having a mean particle size (d50) of 125 microns (e.g. Washington State Department of Ecology — WASDOE - 2008). The model can be used to calculate the expected performance of such a PSD (shown in Figure 3). The model indicates (Figure 4) that the CDS system with 2400 micron screen achieves approximately 80% removal at the design (100%) flow rate, for this particle size distribution (d50 = 125 μm).

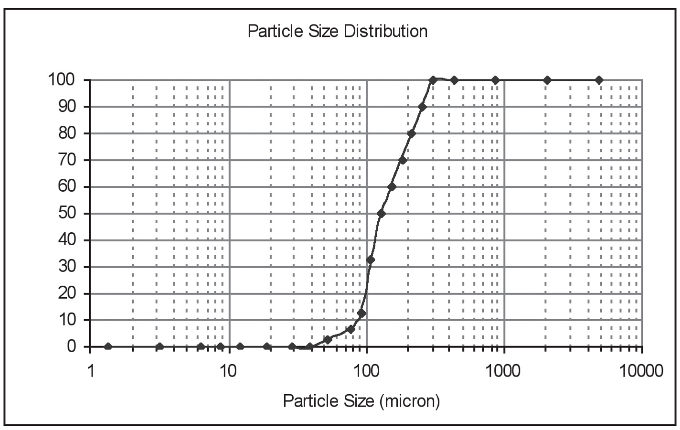


Figure 3. WASDOE PSD

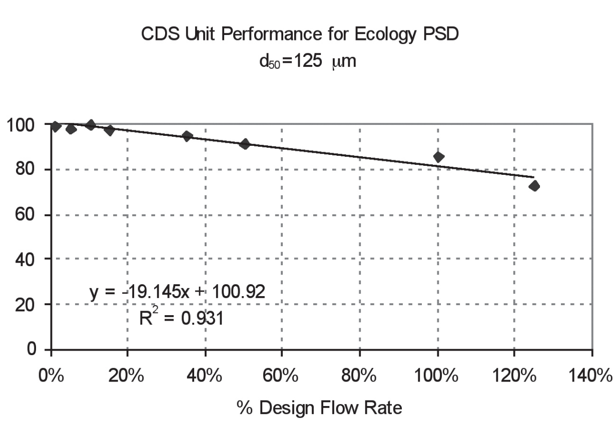


Figure 4. Modeled performance for WASDOE PSD.

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.

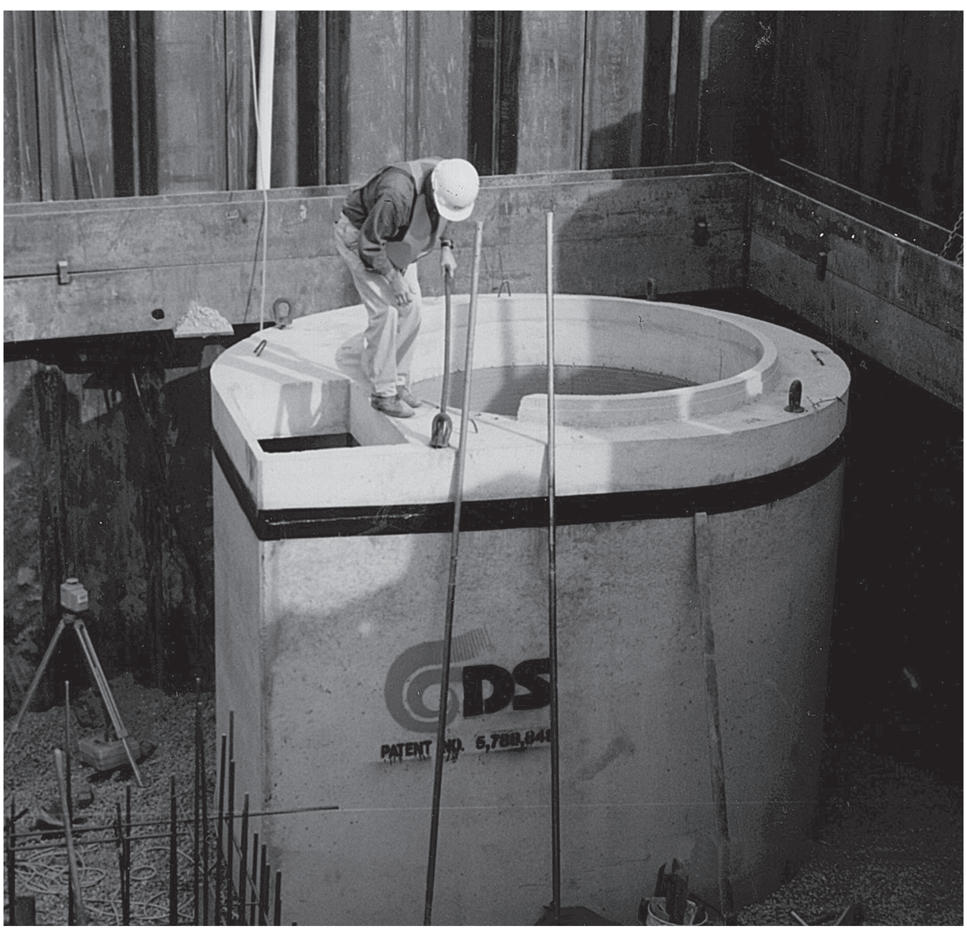
In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, the system should be cleaned out immediately in the event of an oil or gasoline spill. Motor oil and other hydrocarbons that accumulate on a more routine basis should 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 cleaned 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. Check your local regulations for specific requirements on disposal.

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	0.5	0.4
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

Table 1: CDS Maintenance Indicators and Sediment Storage Capacities

Note: To avoid underestimating the volume of sediment in the chamber, carefully lower the measuring device to the top of the sediment pile. Finer silty particles at the top of the pile may be more difficult to feel with a measuring stick. These finer particles typically offer less resistance to the end of the rod than larger particles toward the bottom of the pile.



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.

Support

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

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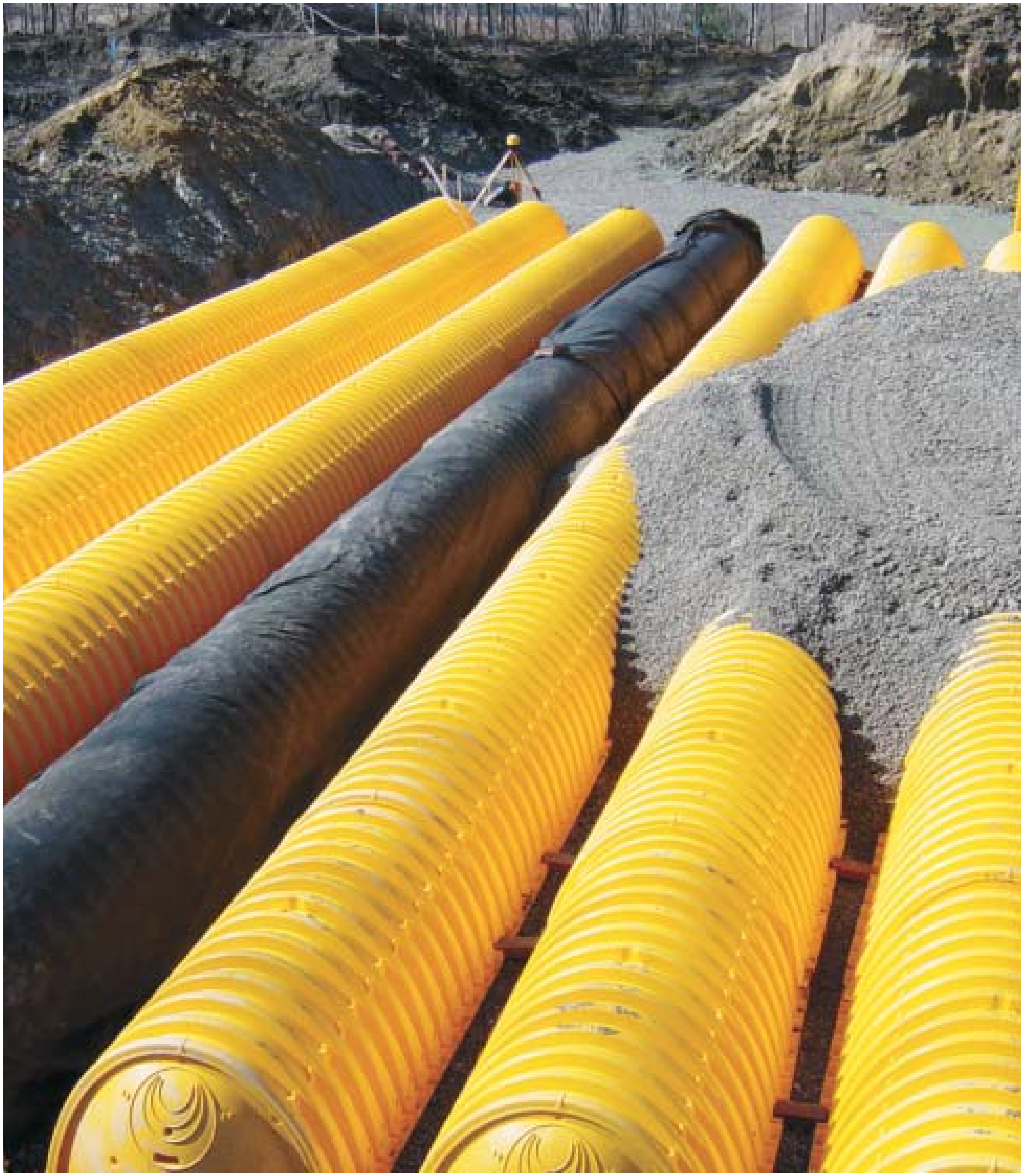
Detention • Retention • Recharge

Subsurface Stormwater Management℠



Isolator™ Row O&M Manual

StormTech® Chamber System for Stormwater Management

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 patent pending 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-740 or SC-310 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 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.

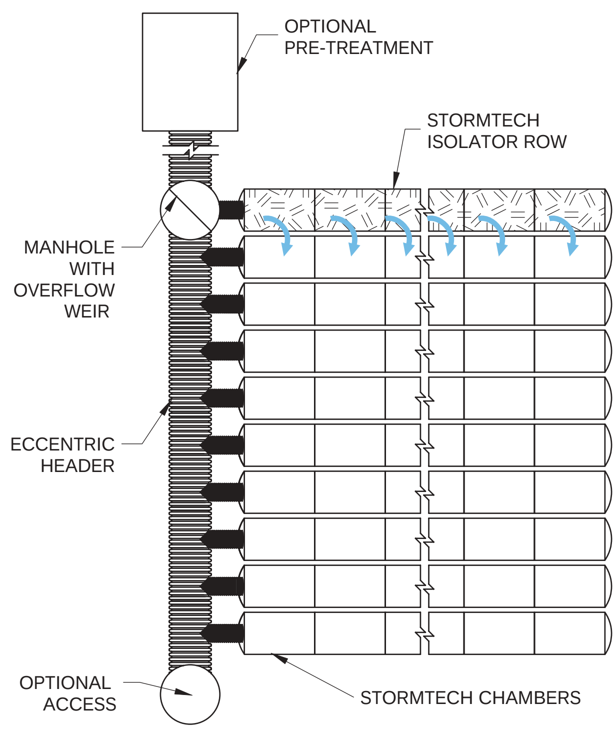
Two different fabrics are used for the Isolator Row. A woven geotextile fabric is placed between the stone and the Isolator Row chambers. The tough geotextile provides a media for storm water filtration and provides a durable surface for maintenance operations. It is also designed to prevent scour of 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 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)



2.1 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.

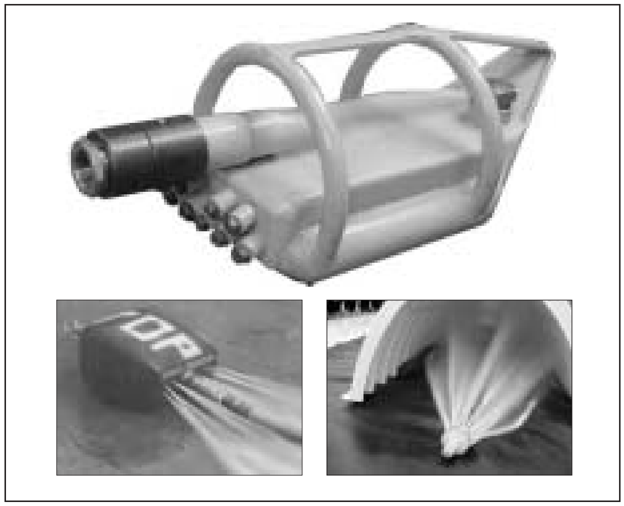
At a minimum, StormTech recommends annual inspections. Initially, the Isolator Row should be inspected every 6 months for the first year of operation. For subsequent years, the inspection should be adjusted based upon previous observation of sediment deposition.

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

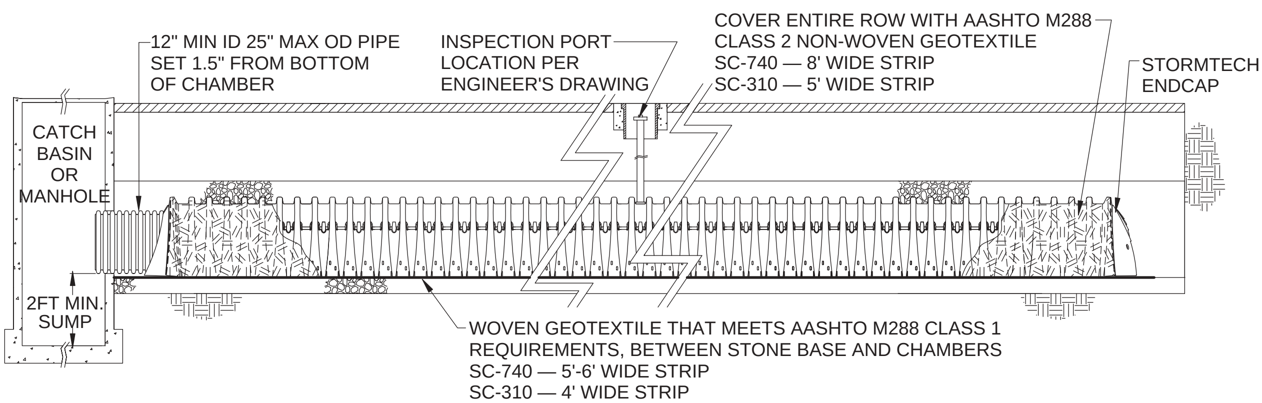
The Isolator Row was designed to reduce the cost of periodic maintenance. By "isolating" sediments to just one row, costs are dramatically reduced by eliminating the need to clean out each row of the entire storage bed. If inspection indicates the potential need for maintenance, access is provided via 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)



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

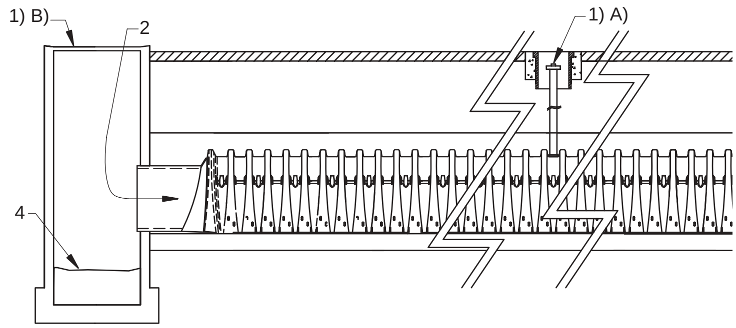
i. Remove cover from manhole at upstream end of Isolator Row

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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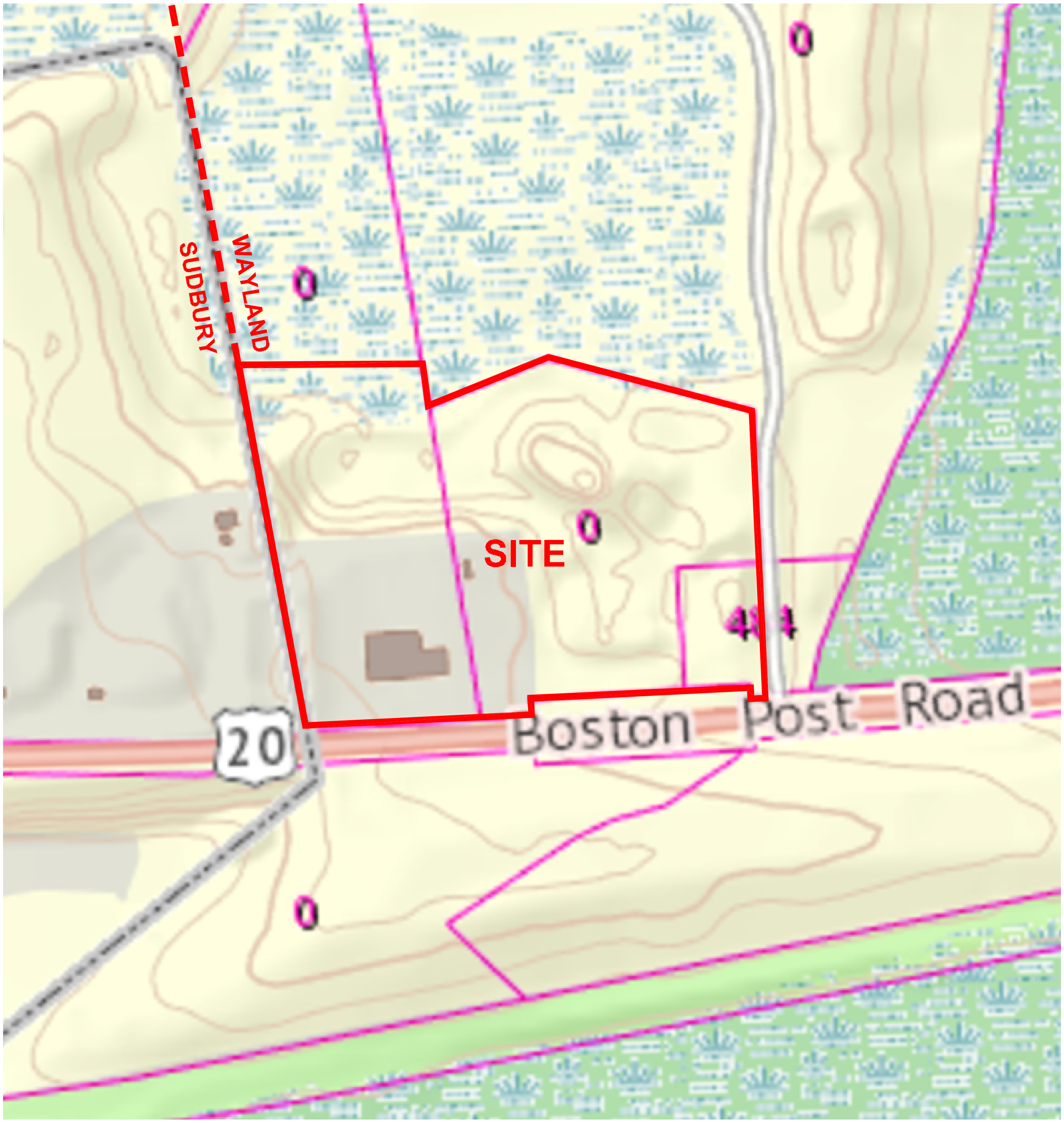

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WOBURN, MA ◆ LAKEVILLE, MA ◆ MANCHESTER, NH

PROJECT:
ALTA AT RIVER'S EDGE
490 BOSTON POST ROAD
WAYLAND, MA

USGS SITE LOCUS MAP

PROJECT NO.	1670-09A	DATE:	JUNE 20, 2019
SCALE:	1"=250'	DWG. NAME:	C-1670-09A
DESIGNED BY:	DMR	CHECKED BY:	CMQ

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SHEET No.

EXH-1

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AERIAL PHOTO

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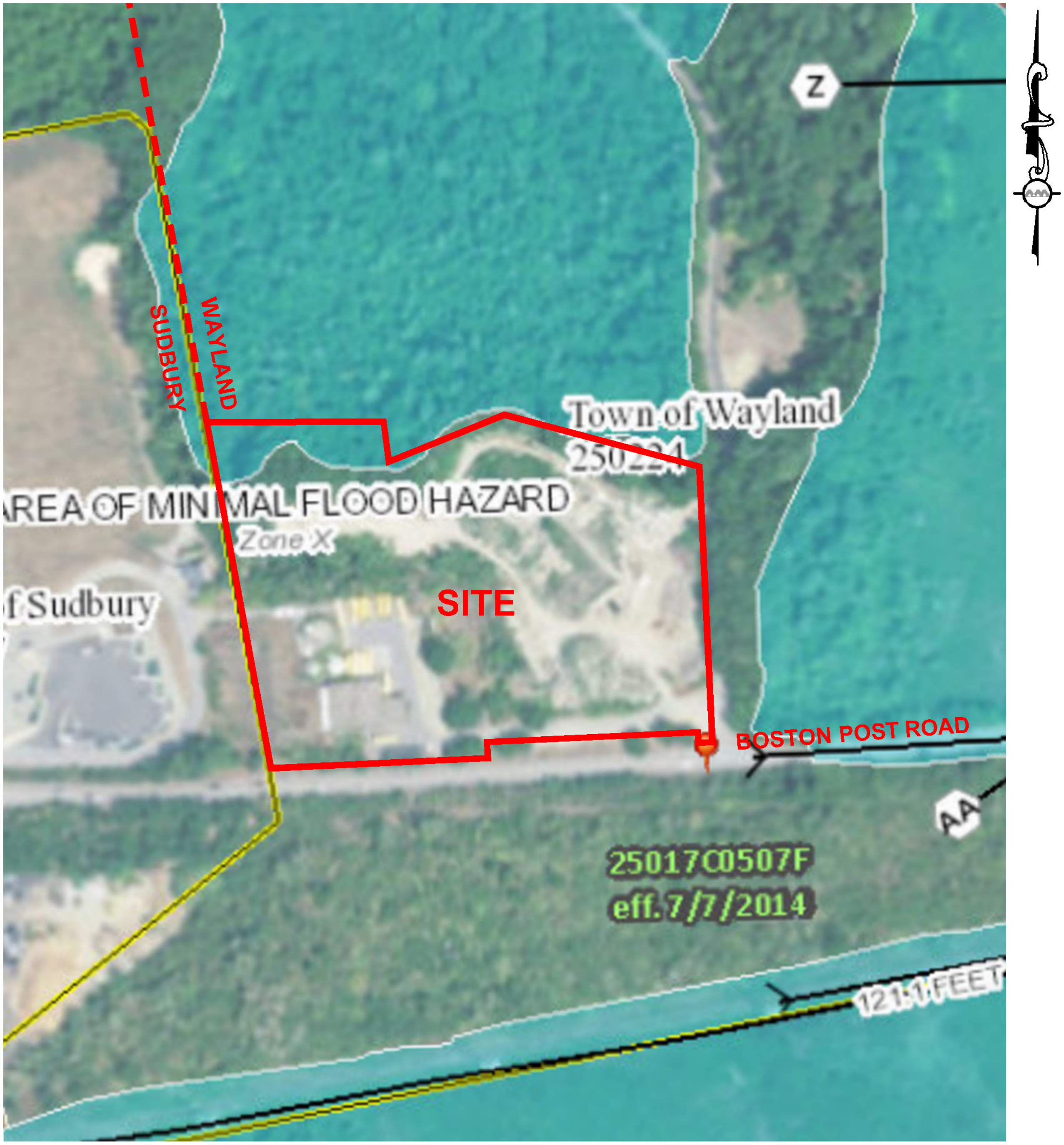
SHEET No.
EXH-2



FEMA FLOOD INSURANCE RATE MAP
MIDDLESEX COUNTY, MASSACHUSETTS
MAP NUMBERS: 25017C0507F
JULY 7, 2014

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FEMA FIRM MAP

PROJECT NO.	1670-09A	DATE:	JUNE 20, 2019
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SHEET No.
EXH-3

LEGEND

- Shrub Swamp
- Tidal Flat
- Wooded Swamp Coniferous
- Wooded Swamp Deciduous
- Wooded Swamp Mixed Trees

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MASS DEP WETLANDS

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SCALE:	1"=250'	DWG. NAME:	C-1670-09A
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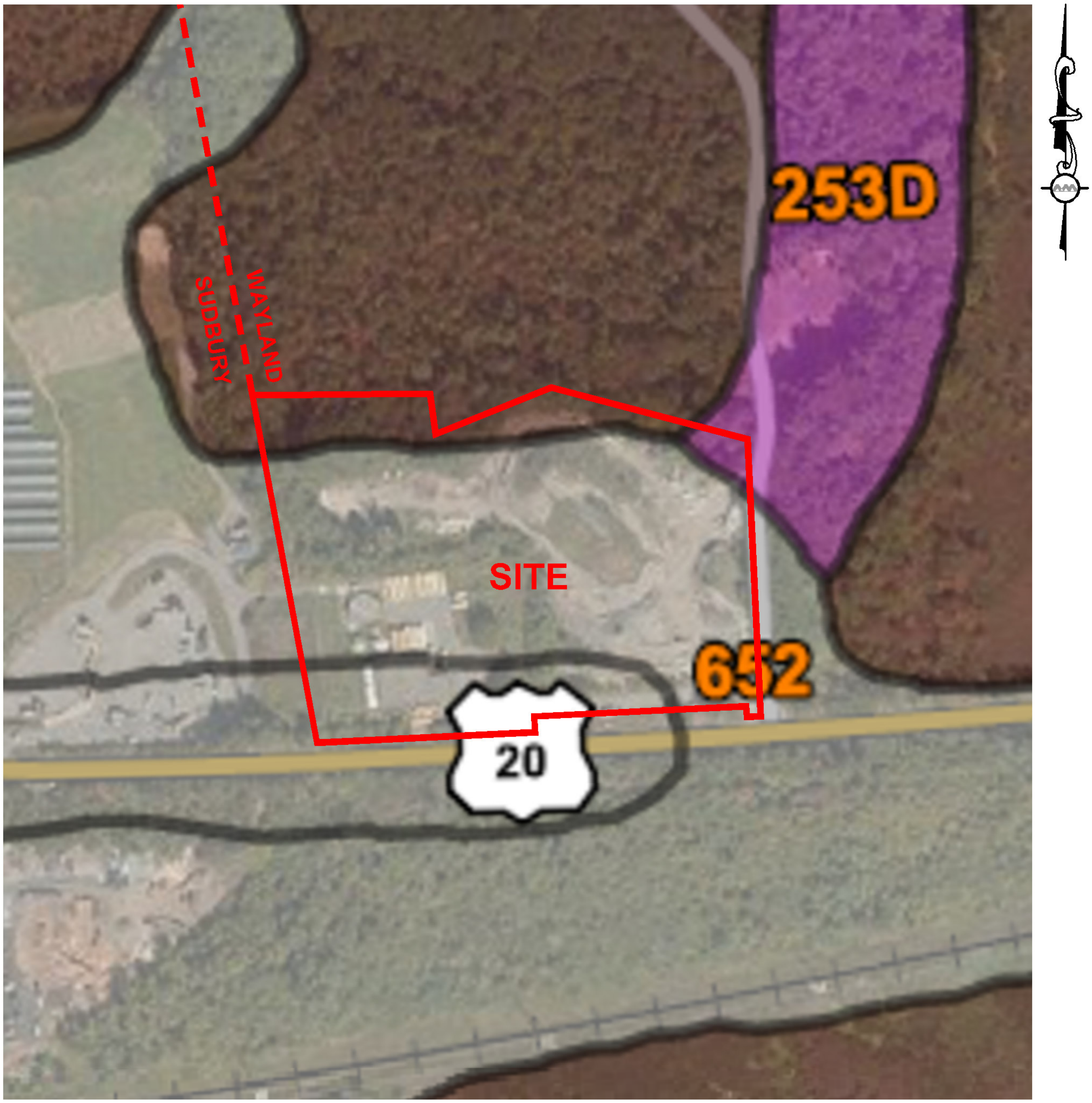
SHEET No.
EXH-4



LEGEND:

51A: SWANSEA MUCK (HSG B/D)
253D: HINCKLEY LOAMY SAND; (HSG A)
652: UDORTHENTS; REFUSE SUBSTRATUM (ASSUMED HSG C)
656: UDORTHENTS-URBAN LAND COMPLEX (ASSUMED HSG C)

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SOILS MAP

PROJECT NO.	1670-09A	DATE:	JUNE 20, 2019
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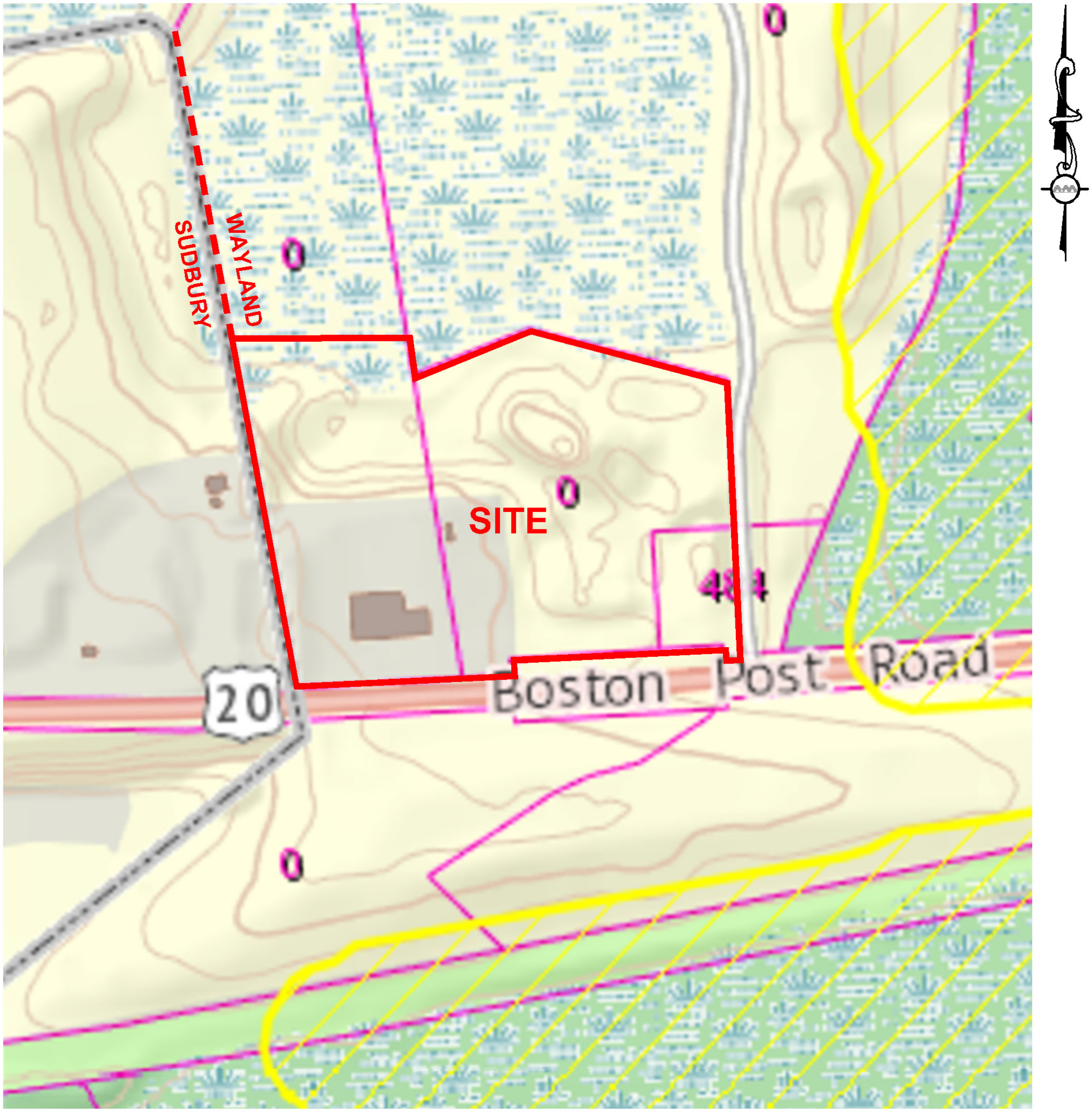
SHEET No.
EXH-5



NO NHESP PRIORITY HABITATS ON-SITE.
NHESP HABITAT PH-1463 LOCATED ON ADJACENT PROPERTIES.

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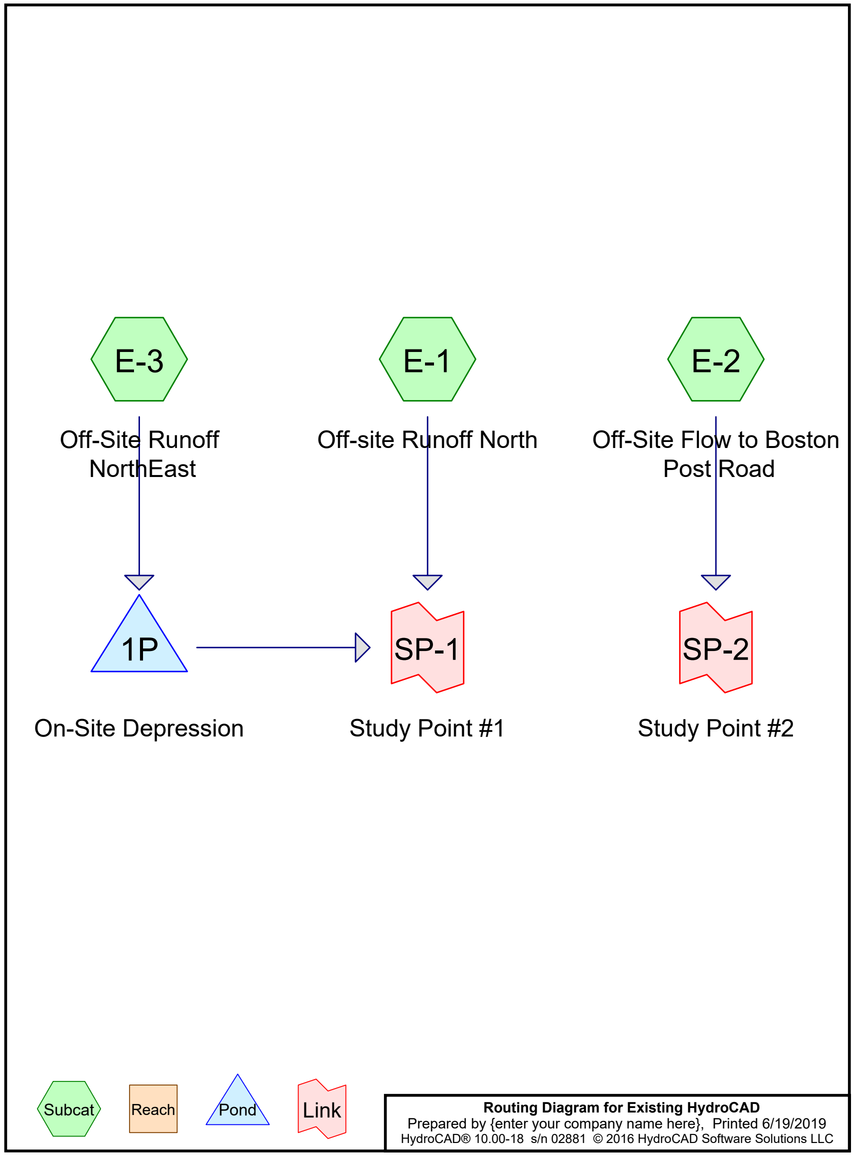
PROJECT:
ALTA AT RIVER'S EDGE
490 BOSTON POST ROAD
WAYLAND, MA

NHESP PRIORITY HABITATS

PROJECT NO. 1670-09A	DATE: JUNE 20, 2019
SCALE: NOT TO SCALE	DWG. NAME: C-1670-09A
DESIGNED BY: DMR	CHECKED BY: CMQ

SHEET No.
EXH-6



Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
73,706	74	>75% Grass cover, Good, HSG C (E-1, E-2, E-3)
10,747	85	Gravel roads, HSG B (E-1)
152,395	89	Gravel roads, HSG C (E-1, E-2, E-3)
10,637	98	Paved parking, HSG C (E-3)
34,321	98	Unconnected pavement, HSG C (E-2)
35,309	30	Woods, Good, HSG A (E-1, E-3)
27,262	55	Woods, Good, HSG B (E-1)
14,911	70	Woods, Good, HSG C (E-1, E-2)
359,288	**78**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
35,309	HSG A	E-1, E-3
38,009	HSG B	E-1
285,970	HSG C	E-1, E-2, E-3
0	HSG D	
0	Other	
359,288		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Sub Num
0	0	73,706	0	0	73,706	>75% Grass cover, Good	
0	10,747	152,395	0	0	163,142	Gravel roads	
0	0	10,637	0	0	10,637	Paved parking	
0	0	34,321	0	0	34,321	Unconnected pavement	
35,309	27,262	14,911	0	0	77,482	Woods, Good	
35,309	**38,009**	**285,970**	**0**	**0**	**359,288**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	E-1	0.00	0.00	204.0	0.0180	0.011	24.0	0.0	0.0

Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E-1: Off-site Runoff North Runoff Area=99,811 sf 0.00% Impervious Runoff Depth=1.03"
Flow Length=371' Tc=7.3 min CN=75 Runoff=2.47 cfs 8,540 cf

Subcatchment E-2: Off-Site Flow to Runoff Area=137,008 sf 25.05% Impervious Runoff Depth=1.53"
Flow Length=699' Tc=9.4 min UI Adjusted CN=83 Runoff=4.92 cfs 17,440 cf

Subcatchment E-3: Off-Site Runoff Runoff Area=122,469 sf 8.69% Impervious Runoff Depth=0.87"
Tc=6.0 min CN=72 Runoff=2.58 cfs 8,861 cf

Pond 1P: On-Site Depression Peak Elev=125.89' Storage=8,858 cf Inflow=2.58 cfs 8,861 cf
Outflow=0.00 cfs 0 cf

Link SP-1: Study Point #1 Inflow=2.47 cfs 8,540 cf
Primary=2.47 cfs 8,540 cf

Link SP-2: Study Point #2 Inflow=4.92 cfs 17,440 cf
Primary=4.92 cfs 17,440 cf

Total Runoff Area = 359,288 sf Runoff Volume = 34,841 cf Average Runoff Depth = 1.16"
87.49% Pervious = 314,330 sf 12.51% Impervious = 44,958 sf

Summary for Subcatchment E-1: Off-site Runoff North

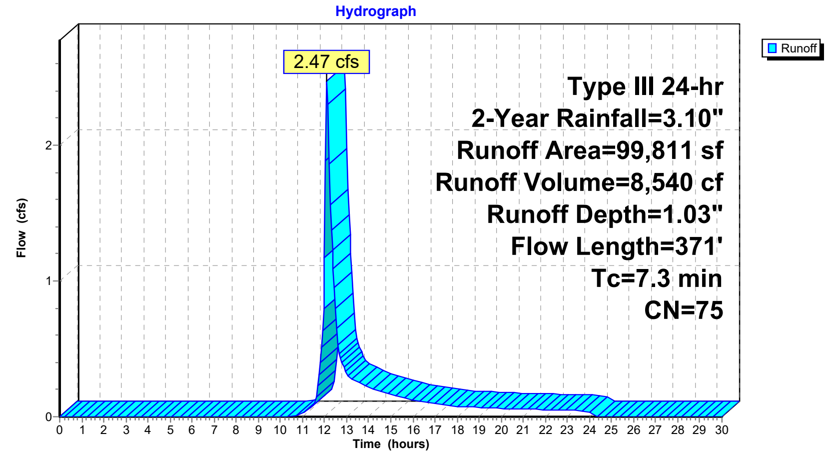
Runoff = 2.47 cfs @ 12.11 hrs, Volume= 8,540 cf, Depth= 1.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
10,747	85	Gravel roads, HSG B
47,905	89	Gravel roads, HSG C
1,799	74	>75% Grass cover, Good, HSG C
4,965	30	Woods, Good, HSG A
27,262	55	Woods, Good, HSG B
7,133	70	Woods, Good, HSG C
99,811	75	Weighted Average
99,811		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.7	50	0.0200	0.15		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.16"
0.4	42	0.0700	1.85		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
0.0	6	0.0200	2.87		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
0.8	47	0.0200	0.99		**Shallow Concentrated Flow, D-E** Short Grass Pasture Kv= 7.0 fps
0.3	204	0.0180	11.42	35.87	**Pipe Channel, E-F** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.011 Concrete pipe, straight & clean
0.1	22	0.4500	3.35		**Shallow Concentrated Flow, F-G** Woodland Kv= 5.0 fps
7.3	371	Total			

Subcatchment E-1: Off-site Runoff North



Summary for Subcatchment E-2: Off-Site Flow to Boston Post Road

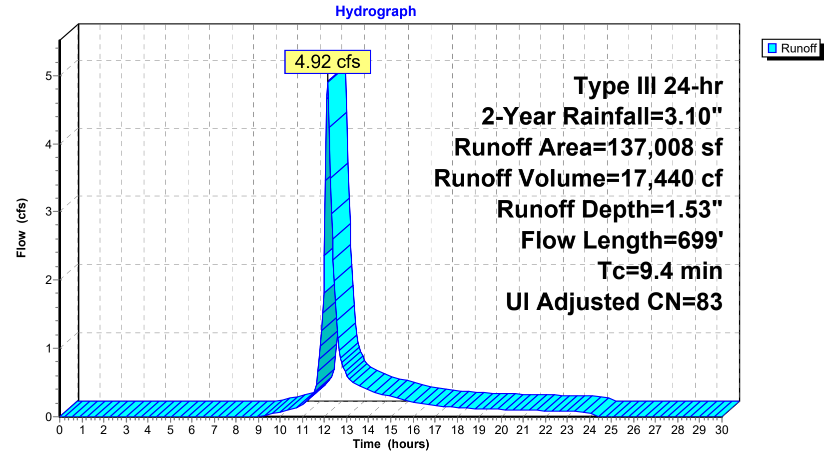
Runoff = 4.92 cfs @ 12.14 hrs, Volume= 17,440 cf, Depth= 1.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Adj	Description
34,321	98		Unconnected pavement, HSG C
46,464	89		Gravel roads, HSG C
48,445	74		>75% Grass cover, Good, HSG C
7,778	70		Woods, Good, HSG C
137,008	85	83	Weighted Average, UI Adjusted
102,687			74.95% Pervious Area
34,321			25.05% Impervious Area
34,321			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	50	0.0450	0.14		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.16"
1.2	98	0.0690	1.31		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
2.2	551	0.0420	4.16		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
9.4	699	Total			

Subcatchment E-2: Off-Site Flow to Boston Post Road



Summary for Subcatchment E-3: Off-Site Runoff NorthEast

Tc of 4.6 rounds to minimum of 5.0. Use Tc = 5.0 mimutes for E-2.

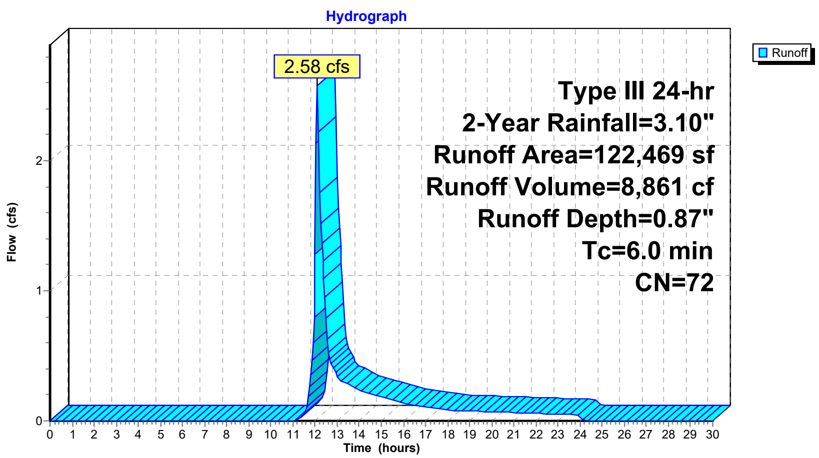
Runoff = 2.58 cfs @ 12.10 hrs, Volume= 8,861 cf, Depth= 0.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
10,637	98	Paved parking, HSG C
58,026	89	Gravel roads, HSG C
23,462	74	>75% Grass cover, Good, HSG C
30,344	30	Woods, Good, HSG A
122,469	72	Weighted Average
111,832		91.31% Pervious Area
10,637		8.69% Impervious Area

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

Subcatchment E-3: Off-Site Runoff NorthEast



Summary for Pond 1P: On-Site Depression

Inflow Area = 122,469 sf, 8.69% Impervious, Inflow Depth = 0.87" for 2-Year event
Inflow = 2.58 cfs @ 12.10 hrs, Volume= 8,861 cf
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 125.89' @ 24.40 hrs Surf.Area= 15,123 sf Storage= 8,858 cf

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

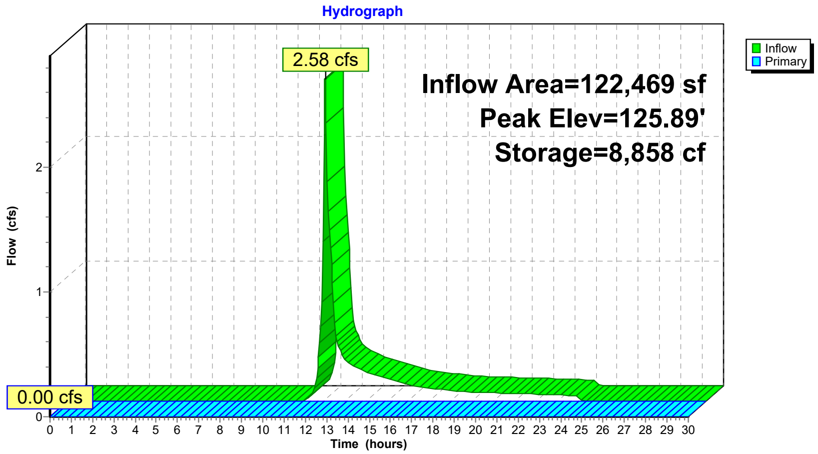
Volume	Invert	Avail.Storage	Storage Description
#1	125.00'	74,276 cf	**Custom Stage Data (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
125.00	5,573	547.9	0	0	5,573
126.00	16,635	762.0	10,612	10,612	27,900
127.00	19,483	823.9	18,040	28,652	35,752
128.00	22,540	960.8	20,993	49,645	55,215
129.00	26,782	825.3	24,631	74,276	74,495

Device	Routing	Invert	Outlet Devices
#1	Primary	129.00'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 1.00 Width (feet) 73.00 113.50

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=125.00' (Free Discharge)
└─**1=Custom Weir/Orifice** (Controls 0.00 cfs)

Pond 1P: On-Site Depression

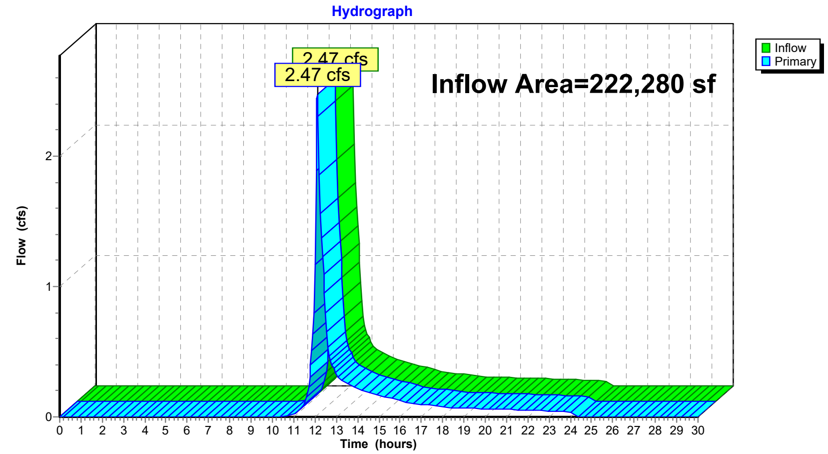


Summary for Link SP-1: Study Point #1

Inflow Area = 222,280 sf, 4.79% Impervious, Inflow Depth = 0.46" for 2-Year event
Inflow = 2.47 cfs @ 12.11 hrs, Volume= 8,540 cf
Primary = 2.47 cfs @ 12.11 hrs, Volume= 8,540 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link SP-1: Study Point #1

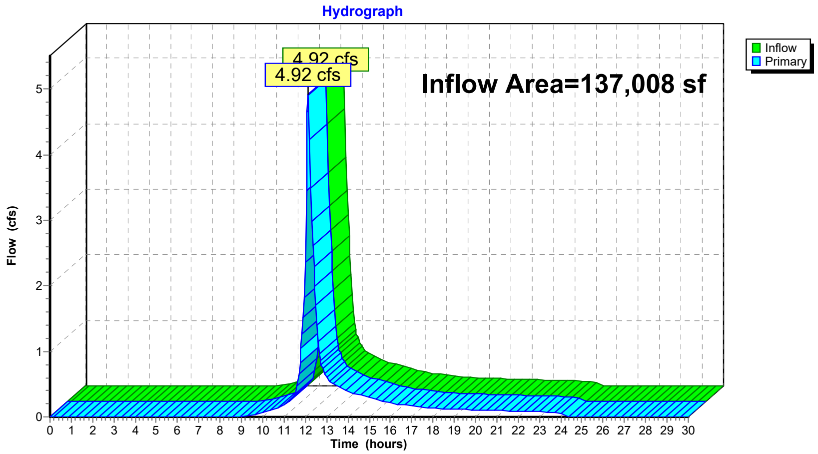


Summary for Link SP-2: Study Point #2

Inflow Area =	137,008 sf, 25.05% Impervious, Inflow Depth = 1.53"	for 2-Year event
Inflow =	4.92 cfs @ 12.14 hrs, Volume=	17,440 cf
Primary =	4.92 cfs @ 12.14 hrs, Volume=	17,440 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link SP-2: Study Point #2



Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E-1: Off-site Runoff North Runoff Area=99,811 sf 0.00% Impervious Runoff Depth=2.05"
Flow Length=371' Tc=7.3 min CN=75 Runoff=5.16 cfs 17,054 cf

Subcatchment E-2: Off-Site Flow to Runoff Area=137,008 sf 25.05% Impervious Runoff Depth=2.73"
Flow Length=699' Tc=9.4 min UI Adjusted CN=83 Runoff=8.79 cfs 31,119 cf

Subcatchment E-3: Off-Site Runoff Runoff Area=122,469 sf 8.69% Impervious Runoff Depth=1.82"
Tc=6.0 min CN=72 Runoff=5.79 cfs 18,578 cf

Pond 1P: On-Site Depression Peak Elev=126.46' Storage=18,577 cf Inflow=5.79 cfs 18,578 cf
Outflow=0.00 cfs 0 cf

Link SP-1: Study Point #1 Inflow=5.16 cfs 17,054 cf
Primary=5.16 cfs 17,054 cf

Link SP-2: Study Point #2 Inflow=8.79 cfs 31,119 cf
Primary=8.79 cfs 31,119 cf

Total Runoff Area = 359,288 sf Runoff Volume = 66,751 cf Average Runoff Depth = 2.23"
87.49% Pervious = 314,330 sf 12.51% Impervious = 44,958 sf

Summary for Subcatchment E-1: Off-site Runoff North

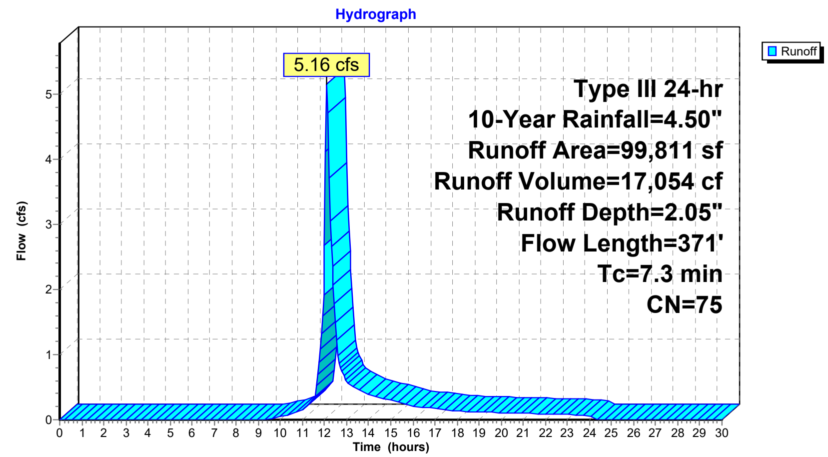
Runoff = 5.16 cfs @ 12.11 hrs, Volume= 17,054 cf, Depth= 2.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
10,747	85	Gravel roads, HSG B
47,905	89	Gravel roads, HSG C
1,799	74	>75% Grass cover, Good, HSG C
4,965	30	Woods, Good, HSG A
27,262	55	Woods, Good, HSG B
7,133	70	Woods, Good, HSG C
99,811	75	Weighted Average
99,811		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.7	50	0.0200	0.15		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.16"
0.4	42	0.0700	1.85		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
0.0	6	0.0200	2.87		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
0.8	47	0.0200	0.99		**Shallow Concentrated Flow, D-E** Short Grass Pasture Kv= 7.0 fps
0.3	204	0.0180	11.42	35.87	**Pipe Channel, E-F** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.011 Concrete pipe, straight & clean
0.1	22	0.4500	3.35		**Shallow Concentrated Flow, F-G** Woodland Kv= 5.0 fps
7.3	371	Total			

Subcatchment E-1: Off-site Runoff North



Summary for Subcatchment E-2: Off-Site Flow to Boston Post Road

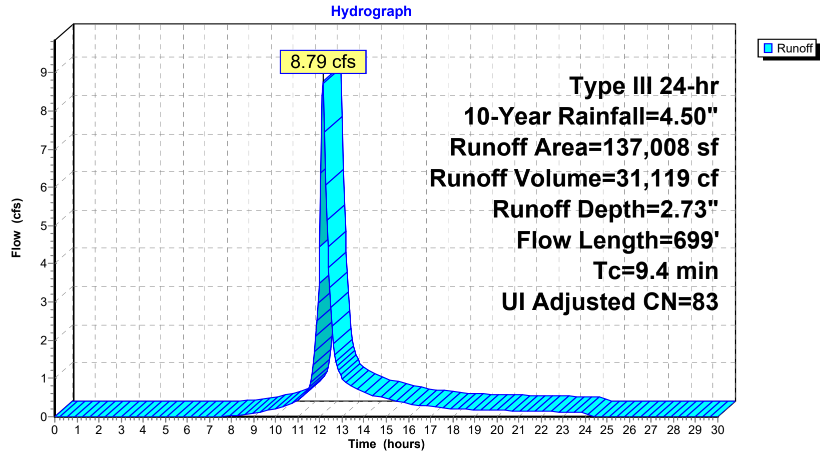
Runoff = 8.79 cfs @ 12.13 hrs, Volume= 31,119 cf, Depth= 2.73"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Adj	Description
34,321	98		Unconnected pavement, HSG C
46,464	89		Gravel roads, HSG C
48,445	74		>75% Grass cover, Good, HSG C
7,778	70		Woods, Good, HSG C
137,008	85	83	Weighted Average, UI Adjusted
102,687			74.95% Pervious Area
34,321			25.05% Impervious Area
34,321			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	50	0.0450	0.14		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.16"
1.2	98	0.0690	1.31		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
2.2	551	0.0420	4.16		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
9.4	699	Total			

Subcatchment E-2: Off-Site Flow to Boston Post Road



Summary for Subcatchment E-3: Off-Site Runoff NorthEast

Tc of 4.6 rounds to minimum of 5.0. Use Tc = 5.0 mimutes for E-2.

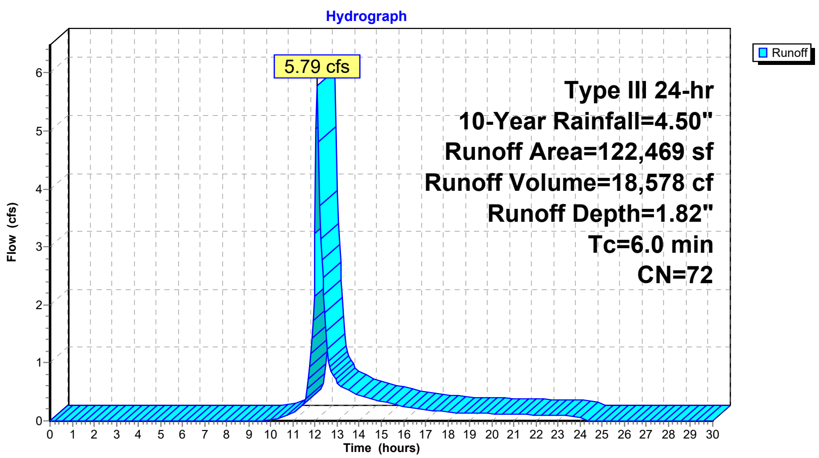
Runoff = 5.79 cfs @ 12.10 hrs, Volume= 18,578 cf, Depth= 1.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
10,637	98	Paved parking, HSG C
58,026	89	Gravel roads, HSG C
23,462	74	>75% Grass cover, Good, HSG C
30,344	30	Woods, Good, HSG A
122,469	72	Weighted Average
111,832		91.31% Pervious Area
10,637		8.69% Impervious Area

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

Subcatchment E-3: Off-Site Runoff NorthEast



Summary for Pond 1P: On-Site Depression

Inflow Area = 122,469 sf, 8.69% Impervious, Inflow Depth = 1.82" for 10-Year event
Inflow = 5.79 cfs @ 12.10 hrs, Volume= 18,578 cf
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 126.46' @ 24.40 hrs Surf.Area= 17,920 sf Storage= 18,577 cf

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

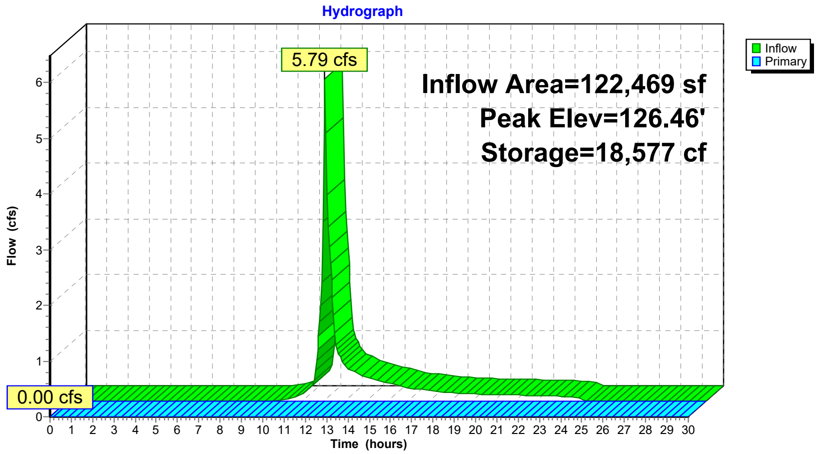
Volume	Invert	Avail.Storage	Storage Description
#1	125.00'	74,276 cf	**Custom Stage Data (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
125.00	5,573	547.9	0	0	5,573
126.00	16,635	762.0	10,612	10,612	27,900
127.00	19,483	823.9	18,040	28,652	35,752
128.00	22,540	960.8	20,993	49,645	55,215
129.00	26,782	825.3	24,631	74,276	74,495

Device	Routing	Invert	Outlet Devices
#1	Primary	129.00'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 1.00 Width (feet) 73.00 113.50

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=125.00' (Free Discharge)
└─**1=Custom Weir/Orifice** (Controls 0.00 cfs)

Pond 1P: On-Site Depression

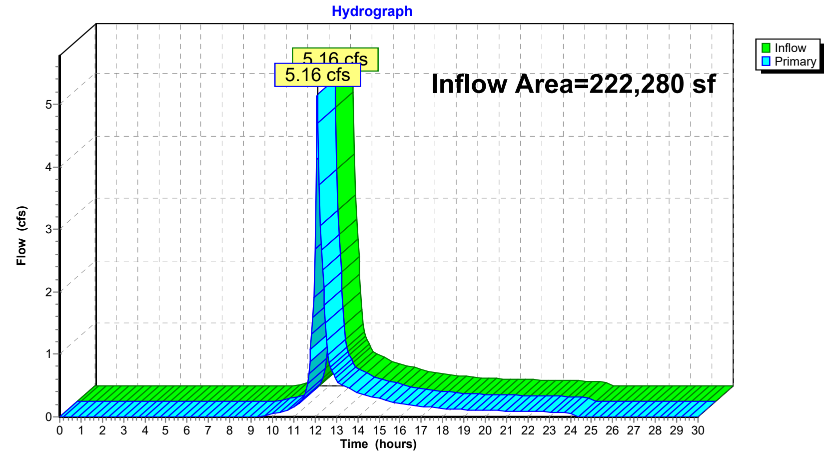


Summary for Link SP-1: Study Point #1

Inflow Area =	222,280 sf, 4.79% Impervious,	Inflow Depth = 0.92"	for 10-Year event
Inflow =	5.16 cfs @ 12.11 hrs, Volume=	17,054 cf	
Primary =	5.16 cfs @ 12.11 hrs, Volume=	17,054 cf, Atten= 0%, Lag= 0.0 min	

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link SP-1: Study Point #1

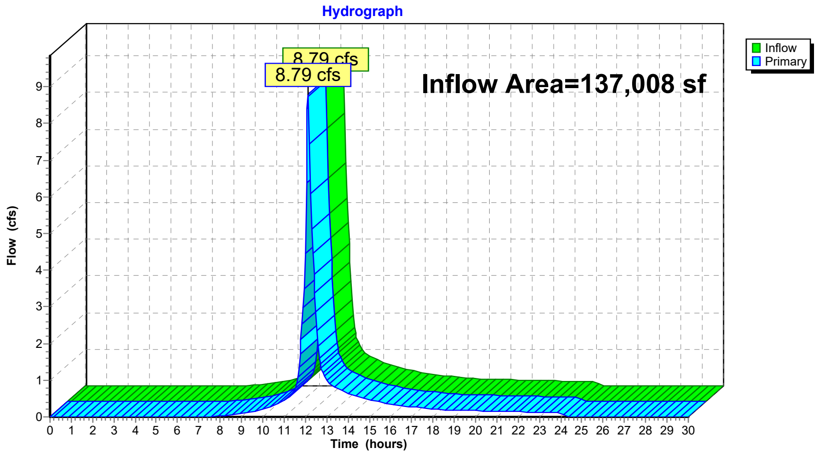


Summary for Link SP-2: Study Point #2

Inflow Area =	137,008 sf, 25.05% Impervious,	Inflow Depth = 2.73" for 10-Year event
Inflow =	8.79 cfs @ 12.13 hrs, Volume=	31,119 cf
Primary =	8.79 cfs @ 12.13 hrs, Volume=	31,119 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link SP-2: Study Point #2



Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E-1: Off-site Runoff North Runoff Area=99,811 sf 0.00% Impervious Runoff Depth=2.69"
Flow Length=371' Tc=7.3 min CN=75 Runoff=6.83 cfs 22,413 cf

Subcatchment E-2: Off-Site Flow to Runoff Area=137,008 sf 25.05% Impervious Runoff Depth=3.45"
Flow Length=699' Tc=9.4 min UI Adjusted CN=83 Runoff=11.07 cfs 39,353 cf

Subcatchment E-3: Off-Site Runoff Runoff Area=122,469 sf 8.69% Impervious Runoff Depth=2.43"
Tc=6.0 min CN=72 Runoff=7.81 cfs 24,814 cf

Pond 1P: On-Site Depression Peak Elev=126.80' Storage=24,814 cf Inflow=7.81 cfs 24,814 cf
Outflow=0.00 cfs 0 cf

Link SP-1: Study Point #1 Inflow=6.83 cfs 22,413 cf
Primary=6.83 cfs 22,413 cf

Link SP-2: Study Point #2 Inflow=11.07 cfs 39,353 cf
Primary=11.07 cfs 39,353 cf

Total Runoff Area = 359,288 sf Runoff Volume = 86,580 cf Average Runoff Depth = 2.89"
87.49% Pervious = 314,330 sf 12.51% Impervious = 44,958 sf

Summary for Subcatchment E-1: Off-site Runoff North

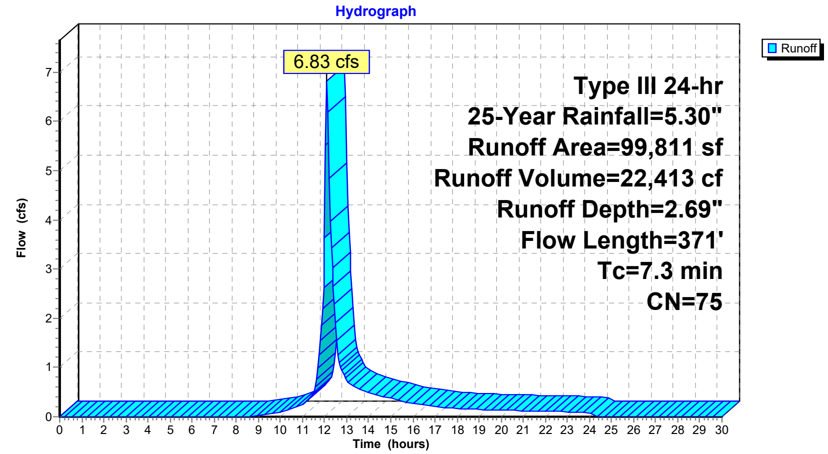
Runoff = 6.83 cfs @ 12.11 hrs, Volume= 22,413 cf, Depth= 2.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=5.30"

Area (sf)	CN	Description
10,747	85	Gravel roads, HSG B
47,905	89	Gravel roads, HSG C
1,799	74	>75% Grass cover, Good, HSG C
4,965	30	Woods, Good, HSG A
27,262	55	Woods, Good, HSG B
7,133	70	Woods, Good, HSG C
99,811	75	Weighted Average
99,811		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.7	50	0.0200	0.15		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.16"
0.4	42	0.0700	1.85		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
0.0	6	0.0200	2.87		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
0.8	47	0.0200	0.99		**Shallow Concentrated Flow, D-E** Short Grass Pasture Kv= 7.0 fps
0.3	204	0.0180	11.42	35.87	**Pipe Channel, E-F** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.011 Concrete pipe, straight & clean
0.1	22	0.4500	3.35		**Shallow Concentrated Flow, F-G** Woodland Kv= 5.0 fps
7.3	371	Total			

Subcatchment E-1: Off-site Runoff North



Summary for Subcatchment E-2: Off-Site Flow to Boston Post Road

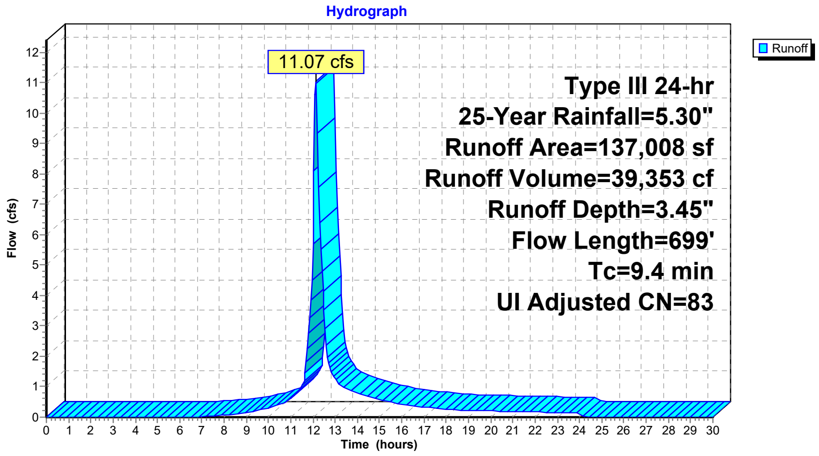
Runoff = 11.07 cfs @ 12.13 hrs, Volume= 39,353 cf, Depth= 3.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=5.30"

Area (sf)	CN	Adj	Description
34,321	98		Unconnected pavement, HSG C
46,464	89		Gravel roads, HSG C
48,445	74		>75% Grass cover, Good, HSG C
7,778	70		Woods, Good, HSG C
137,008	85	83	Weighted Average, UI Adjusted
102,687			74.95% Pervious Area
34,321			25.05% Impervious Area
34,321			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	50	0.0450	0.14		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.16"
1.2	98	0.0690	1.31		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
2.2	551	0.0420	4.16		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
9.4	699	Total			

Subcatchment E-2: Off-Site Flow to Boston Post Road



Summary for Subcatchment E-3: Off-Site Runoff NorthEast

Tc of 4.6 rounds to minimum of 5.0. Use Tc = 5.0 mimutes for E-2.

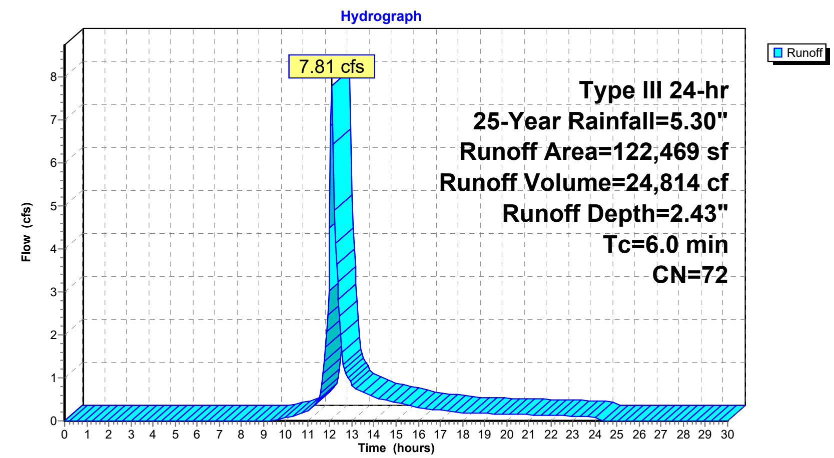
Runoff = 7.81 cfs @ 12.10 hrs, Volume= 24,814 cf, Depth= 2.43"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=5.30"

Area (sf)	CN	Description
10,637	98	Paved parking, HSG C
58,026	89	Gravel roads, HSG C
23,462	74	>75% Grass cover, Good, HSG C
30,344	30	Woods, Good, HSG A
122,469	72	Weighted Average
111,832		91.31% Pervious Area
10,637		8.69% Impervious Area

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

Subcatchment E-3: Off-Site Runoff NorthEast



Summary for Pond 1P: On-Site Depression

Inflow Area = 122,469 sf, 8.69% Impervious, Inflow Depth = 2.43" for 25-Year event
Inflow = 7.81 cfs @ 12.10 hrs, Volume= 24,814 cf
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 126.80' @ 24.40 hrs Surf.Area= 18,895 sf Storage= 24,814 cf

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

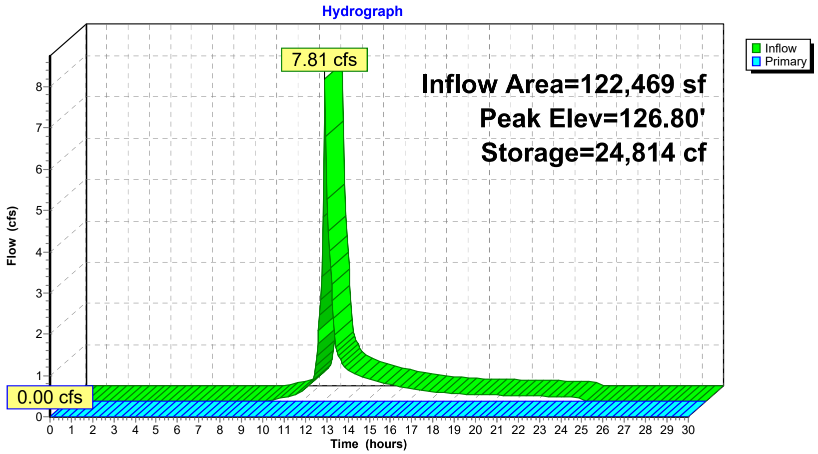
Volume	Invert	Avail.Storage	Storage Description
#1	125.00'	74,276 cf	**Custom Stage Data (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
125.00	5,573	547.9	0	0	5,573
126.00	16,635	762.0	10,612	10,612	27,900
127.00	19,483	823.9	18,040	28,652	35,752
128.00	22,540	960.8	20,993	49,645	55,215
129.00	26,782	825.3	24,631	74,276	74,495

Device	Routing	Invert	Outlet Devices
#1	Primary	129.00'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 1.00 Width (feet) 73.00 113.50

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=125.00' (Free Discharge)
└─**1=Custom Weir/Orifice** (Controls 0.00 cfs)

Pond 1P: On-Site Depression

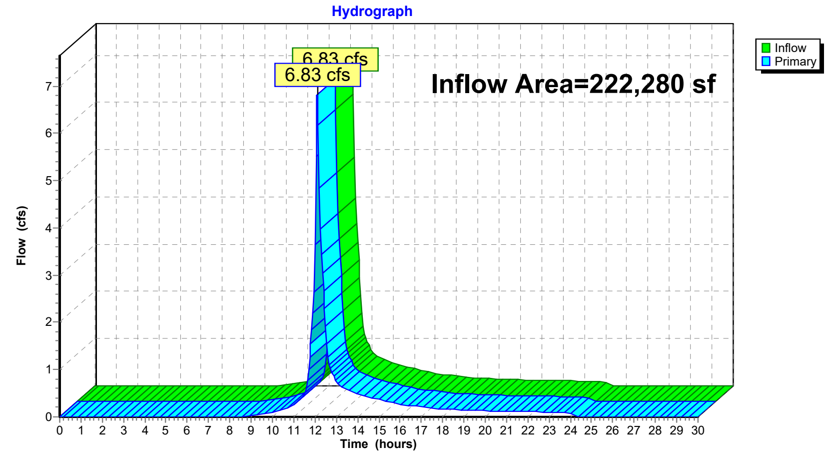


Summary for Link SP-1: Study Point #1

Inflow Area = 222,280 sf, 4.79% Impervious, Inflow Depth = 1.21" for 25-Year event
Inflow = 6.83 cfs @ 12.11 hrs, Volume= 22,413 cf
Primary = 6.83 cfs @ 12.11 hrs, Volume= 22,413 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link SP-1: Study Point #1

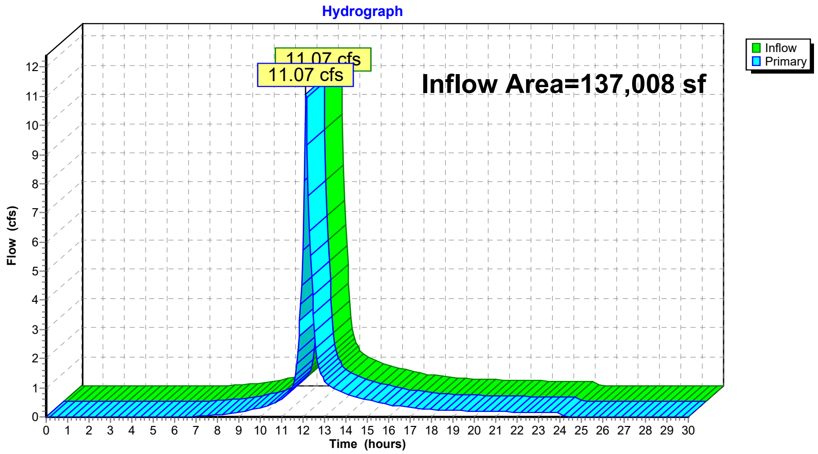


Summary for Link SP-2: Study Point #2

Inflow Area = 137,008 sf, 25.05% Impervious, Inflow Depth = 3.45" for 25-Year event
Inflow = 11.07 cfs @ 12.13 hrs, Volume= 39,353 cf
Primary = 11.07 cfs @ 12.13 hrs, Volume= 39,353 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link SP-2: Study Point #2



Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E-1: Off-site Runoff North Runoff Area=99,811 sf 0.00% Impervious Runoff Depth=3.71"
Flow Length=371' Tc=7.3 min CN=75 Runoff=9.42 cfs 30,876 cf

Subcatchment E-2: Off-Site Flow to Runoff Area=137,008 sf 25.05% Impervious Runoff Depth=4.56"
Flow Length=699' Tc=9.4 min UI Adjusted CN=83 Runoff=14.51 cfs 52,036 cf

Subcatchment E-3: Off-Site Runoff Runoff Area=122,469 sf 8.69% Impervious Runoff Depth=3.41"
Tc=6.0 min CN=72 Runoff=11.01 cfs 34,770 cf

Pond 1P: On-Site Depression Peak Elev=127.31' Storage=34,769 cf Inflow=11.01 cfs 34,770 cf
Outflow=0.00 cfs 0 cf

Link SP-1: Study Point #1 Inflow=9.42 cfs 30,876 cf
Primary=9.42 cfs 30,876 cf

Link SP-2: Study Point #2 Inflow=14.51 cfs 52,036 cf
Primary=14.51 cfs 52,036 cf

Total Runoff Area = 359,288 sf Runoff Volume = 117,682 cf Average Runoff Depth = 3.93"
87.49% Pervious = 314,330 sf 12.51% Impervious = 44,958 sf

Summary for Subcatchment E-1: Off-site Runoff North

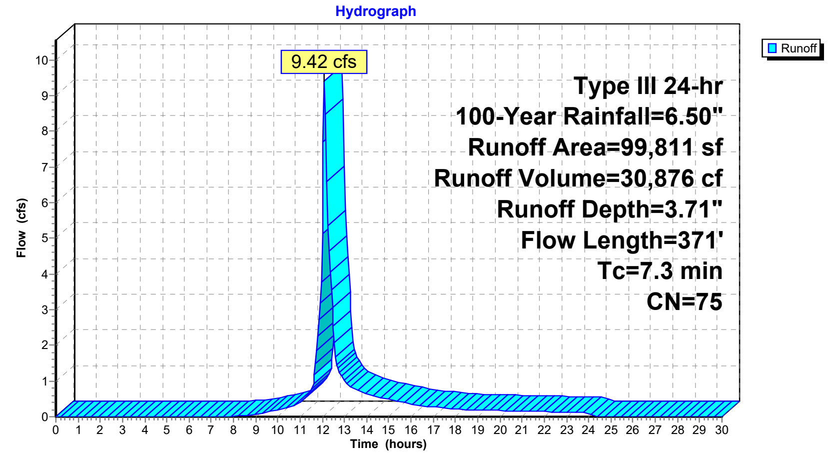
Runoff = 9.42 cfs @ 12.11 hrs, Volume= 30,876 cf, Depth= 3.71"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
10,747	85	Gravel roads, HSG B
47,905	89	Gravel roads, HSG C
1,799	74	>75% Grass cover, Good, HSG C
4,965	30	Woods, Good, HSG A
27,262	55	Woods, Good, HSG B
7,133	70	Woods, Good, HSG C
99,811	75	Weighted Average
99,811		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.7	50	0.0200	0.15		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.16"
0.4	42	0.0700	1.85		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
0.0	6	0.0200	2.87		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
0.8	47	0.0200	0.99		**Shallow Concentrated Flow, D-E** Short Grass Pasture Kv= 7.0 fps
0.3	204	0.0180	11.42	35.87	**Pipe Channel, E-F** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.011 Concrete pipe, straight & clean
0.1	22	0.4500	3.35		**Shallow Concentrated Flow, F-G** Woodland Kv= 5.0 fps
7.3	371	Total			

Subcatchment E-1: Off-site Runoff North



Summary for Subcatchment E-2: Off-Site Flow to Boston Post Road

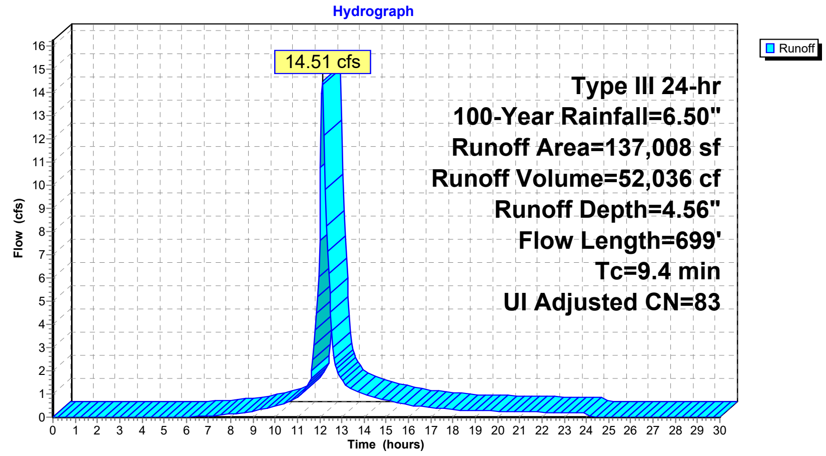
Runoff = 14.51 cfs @ 12.13 hrs, Volume= 52,036 cf, Depth= 4.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Adj	Description
34,321	98		Unconnected pavement, HSG C
46,464	89		Gravel roads, HSG C
48,445	74		>75% Grass cover, Good, HSG C
7,778	70		Woods, Good, HSG C
137,008	85	83	Weighted Average, UI Adjusted
102,687			74.95% Pervious Area
34,321			25.05% Impervious Area
34,321			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	50	0.0450	0.14		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.16"
1.2	98	0.0690	1.31		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
2.2	551	0.0420	4.16		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
9.4	699	Total			

Subcatchment E-2: Off-Site Flow to Boston Post Road



Summary for Subcatchment E-3: Off-Site Runoff NorthEast

Tc of 4.6 rounds to minimum of 5.0. Use Tc = 5.0 mimutes for E-2.

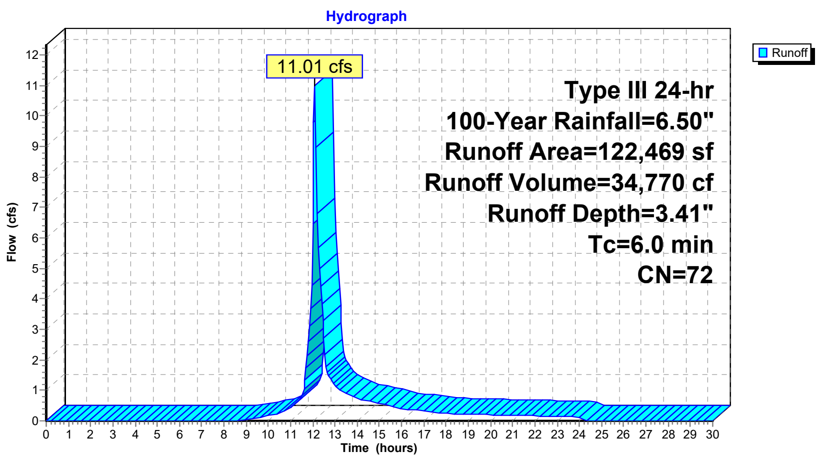
Runoff = 11.01 cfs @ 12.09 hrs, Volume= 34,770 cf, Depth= 3.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
10,637	98	Paved parking, HSG C
58,026	89	Gravel roads, HSG C
23,462	74	>75% Grass cover, Good, HSG C
30,344	30	Woods, Good, HSG A
122,469	72	Weighted Average
111,832		91.31% Pervious Area
10,637		8.69% Impervious Area

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

Subcatchment E-3: Off-Site Runoff NorthEast



Summary for Pond 1P: On-Site Depression

Inflow Area = 122,469 sf, 8.69% Impervious, Inflow Depth = 3.41" for 100-Year event
Inflow = 11.01 cfs @ 12.09 hrs, Volume= 34,770 cf
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 127.31' @ 24.40 hrs Surf.Area= 20,397 sf Storage= 34,769 cf

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

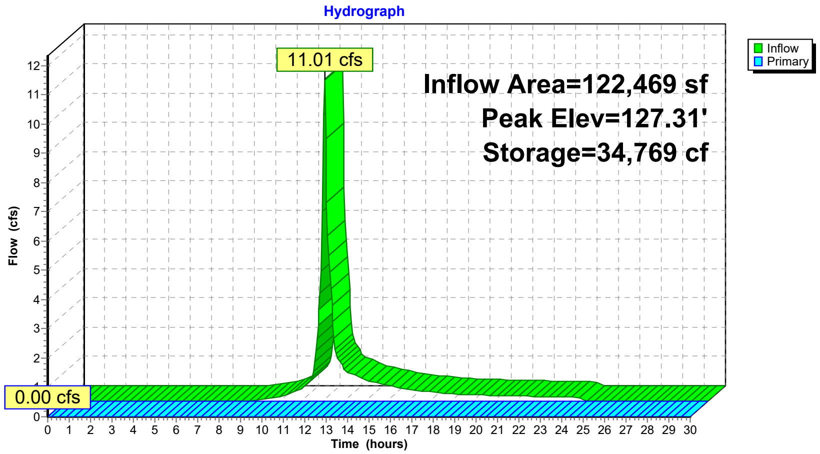
Volume	Invert	Avail.Storage	Storage Description
#1	125.00'	74,276 cf	**Custom Stage Data (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
125.00	5,573	547.9	0	0	5,573
126.00	16,635	762.0	10,612	10,612	27,900
127.00	19,483	823.9	18,040	28,652	35,752
128.00	22,540	960.8	20,993	49,645	55,215
129.00	26,782	825.3	24,631	74,276	74,495

Device	Routing	Invert	Outlet Devices
#1	Primary	129.00'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 1.00 Width (feet) 73.00 113.50

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=125.00' (Free Discharge)
└1=**Custom Weir/Orifice** (Controls 0.00 cfs)

Pond 1P: On-Site Depression

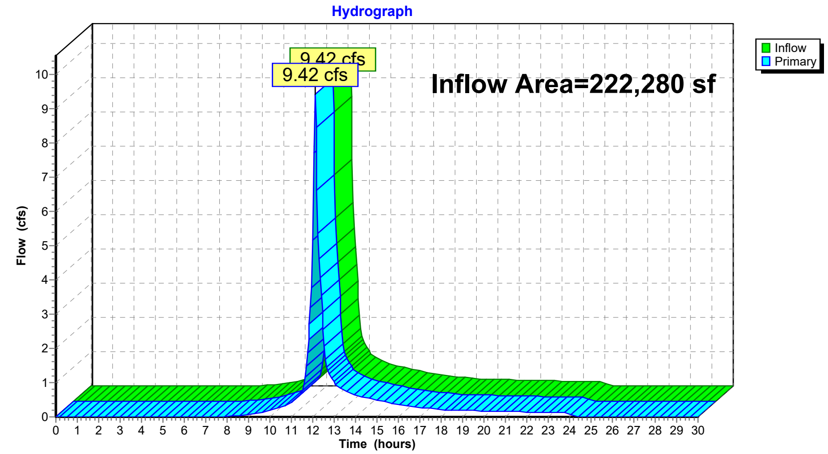


Summary for Link SP-1: Study Point #1

Inflow Area =	222,280 sf,	4.79% Impervious,	Inflow Depth = 1.67"	for 100-Year event	
Inflow =	9.42 cfs @	12.11 hrs,	Volume=	30,876 cf	
Primary =	9.42 cfs @	12.11 hrs,	Volume=	30,876 cf,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link SP-1: Study Point #1

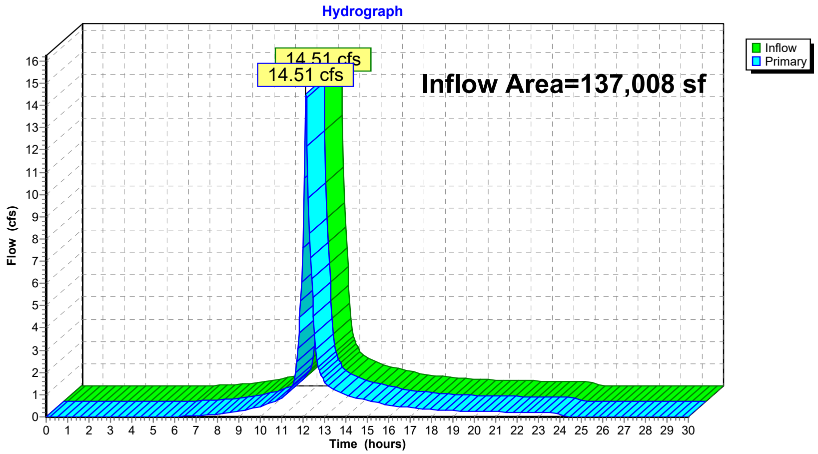


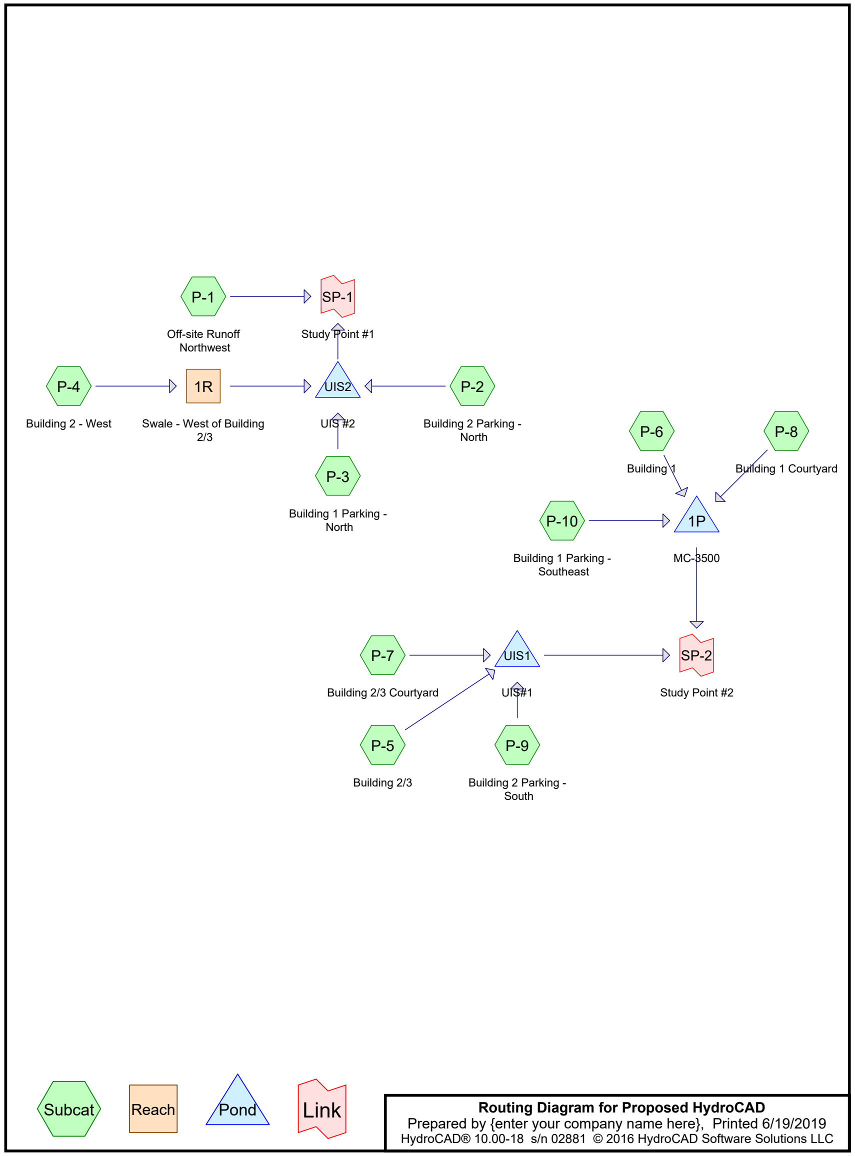
Summary for Link SP-2: Study Point #2

Inflow Area = 137,008 sf, 25.05% Impervious, Inflow Depth = 4.56" for 100-Year event
Inflow = 14.51 cfs @ 12.13 hrs, Volume= 52,036 cf
Primary = 14.51 cfs @ 12.13 hrs, Volume= 52,036 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link SP-2: Study Point #2





Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
3,360	39	>75% Grass cover, Good, HSG A (P-1)
10,231	61	>75% Grass cover, Good, HSG B (P-1)
135,792	74	>75% Grass cover, Good, HSG C (P-1, P-10, P-2, P-3, P-4, P-7, P-8, P-9)
44,652	98	Paved parking, HSG C (P-10, P-2)
131,306	98	Unconnected pavement, HSG C (P-3, P-5, P-6, P-7, P-8, P-9)
27,255	55	Woods, Good, HSG B (P-1)
6,692	70	Woods, Good, HSG C (P-1)
359,288	**84**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
3,360	HSG A	P-1
37,486	HSG B	P-1
318,442	HSG C	P-1, P-10, P-2, P-3, P-4, P-5, P-6, P-7, P-8, P-9
0	HSG D	
0	Other	
359,288		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Sub Num
3,360	10,231	135,792	0	0	149,383	>75% Grass cover, Good	
0	0	44,652	0	0	44,652	Paved parking	
0	0	131,306	0	0	131,306	Unconnected pavement	
0	27,255	6,692	0	0	33,947	Woods, Good	
3,360	**37,486**	**318,442**	**0**	**0**	**359,288**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	1P	124.75	123.75	100.0	0.0100	0.013	15.0	0.0	0.0
2	UIS1	135.25	132.25	100.0	0.0300	0.013	15.0	0.0	0.0
3	UIS2	125.75	125.25	50.0	0.0100	0.013	18.0	0.0	0.0

Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P-1: Off-site Runoff Runoff Area=60,923 sf 0.00% Impervious Runoff Depth=0.40"
Tc=6.0 min CN=61 Runoff=0.38 cfs 2,050 cf

Subcatchment P-10: Building 1 Parking - Runoff Area=38,312 sf 54.69% Impervious Runoff Depth=1.83"
Tc=6.0 min CN=87 Runoff=1.84 cfs 5,832 cf

Subcatchment P-2: Building 2 Parking - Runoff Area=35,850 sf 66.11% Impervious Runoff Depth=2.08"
Tc=6.0 min CN=90 Runoff=1.94 cfs 6,203 cf

Subcatchment P-3: Building 1 Parking - Runoff Area=31,194 sf 69.40% Impervious Runoff Depth=2.16"
Tc=6.0 min CN=91 Runoff=1.75 cfs 5,627 cf

Subcatchment P-4: Building 2 - West Runoff Area=19,145 sf 0.00% Impervious Runoff Depth=0.97"
Tc=6.0 min CN=74 Runoff=0.46 cfs 1,551 cf

Subcatchment P-5: Building 2/3 Runoff Area=57,136 sf 100.00% Impervious Runoff Depth=2.87"
Tc=6.0 min CN=98 Runoff=3.85 cfs 13,655 cf

Subcatchment P-6: Building 1 Runoff Area=21,727 sf 100.00% Impervious Runoff Depth=2.87"
Tc=6.0 min CN=98 Runoff=1.46 cfs 5,193 cf

Subcatchment P-7: Building 2/3 Courtyard Runoff Area=21,205 sf 39.73% Impervious Runoff Depth=1.60"
Tc=6.0 min CN=84 Runoff=0.89 cfs 2,825 cf

Subcatchment P-8: Building 1 Courtyard Runoff Area=43,160 sf 15.16% Impervious Runoff Depth=1.08"
Tc=6.0 min UI Adjusted CN=76 Runoff=1.19 cfs 3,895 cf

Subcatchment P-9: Building 2 Parking - Runoff Area=30,636 sf 51.66% Impervious Runoff Depth=1.75"
Tc=6.0 min CN=86 Runoff=1.41 cfs 4,464 cf

Reach 1R: Swale - West of Building 2/3 Avg. Flow Depth=0.07' Max Vel=0.98 fps Inflow=0.46 cfs 1,551 cf
n=0.050 L=255.0' S=0.0392 '/' Capacity=141.63 cfs Outflow=0.40 cfs 1,551 cf

Pond 1P: MC-3500 Peak Elev=126.70' Storage=6,419 cf Inflow=4.49 cfs 14,920 cf
Outflow=1.79 cfs 10,308 cf

Pond UIS1: UIS#1 Peak Elev=137.20' Storage=10,511 cf Inflow=6.16 cfs 20,944 cf
Outflow=2.05 cfs 13,796 cf

Pond UIS2: UIS #2 Peak Elev=127.80' Storage=5,692 cf Inflow=3.89 cfs 13,381 cf
Outflow=1.66 cfs 9,237 cf

Link SP-1: Study Point #1 Inflow=1.94 cfs 11,288 cf
Primary=1.94 cfs 11,288 cf

Link SP-2: Study Point #2 Inflow=3.84 cfs 24,104 cf
Primary=3.84 cfs 24,104 cf

Total Runoff Area = 359,288 sf Runoff Volume = 51,294 cf Average Runoff Depth = 1.71"
51.03% Pervious = 183,330 sf 48.97% Impervious = 175,958 sf

Summary for Subcatchment P-1: Off-site Runoff Northwest

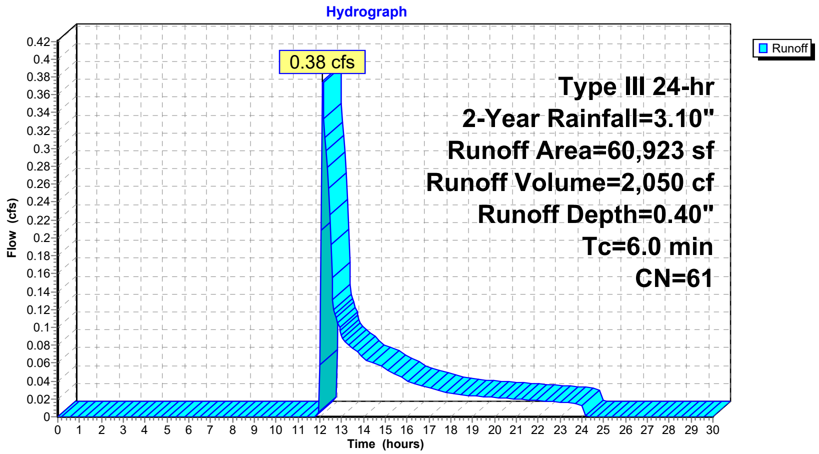
Runoff = 0.38 cfs @ 12.14 hrs, Volume= 2,050 cf, Depth= 0.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
3,360	39	>75% Grass cover, Good, HSG A
10,231	61	>75% Grass cover, Good, HSG B
13,385	74	>75% Grass cover, Good, HSG C
27,255	55	Woods, Good, HSG B
6,692	70	Woods, Good, HSG C
60,923	61	Weighted Average
60,923		100.00% Pervious Area

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

Subcatchment P-1: Off-site Runoff Northwest



Summary for Subcatchment P-10: Building 1 Parking - Southeast

Tc of 4.6 rounds to minimum of 5.0. Use Tc = 5.0 mimutes for E-2.

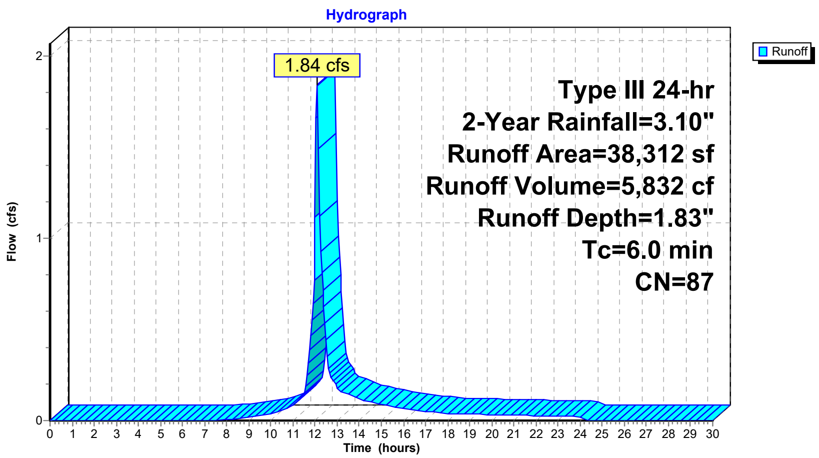
Runoff = 1.84 cfs @ 12.09 hrs, Volume= 5,832 cf, Depth= 1.83"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
20,952	98	Paved parking, HSG C
17,360	74	>75% Grass cover, Good, HSG C
38,312	87	Weighted Average
17,360		45.31% Pervious Area
20,952		54.69% Impervious Area

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

Subcatchment P-10: Building 1 Parking - Southeast



Summary for Subcatchment P-2: Building 2 Parking - North

Tc of 4.6 rounds to minimum of 5.0. Use Tc = 5.0 mimutes for E-2.

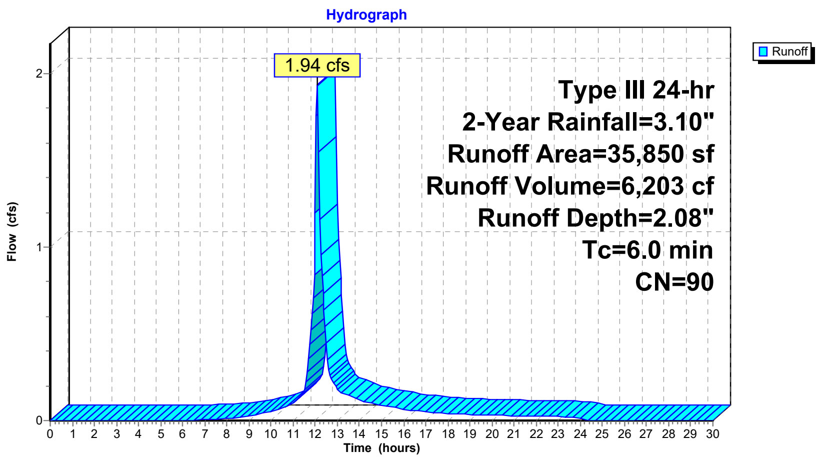
Runoff = 1.94 cfs @ 12.09 hrs, Volume= 6,203 cf, Depth= 2.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
23,700	98	Paved parking, HSG C
12,150	74	>75% Grass cover, Good, HSG C
35,850	90	Weighted Average
12,150		33.89% Pervious Area
23,700		66.11% Impervious Area

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

Subcatchment P-2: Building 2 Parking - North



Summary for Subcatchment P-3: Building 1 Parking - North

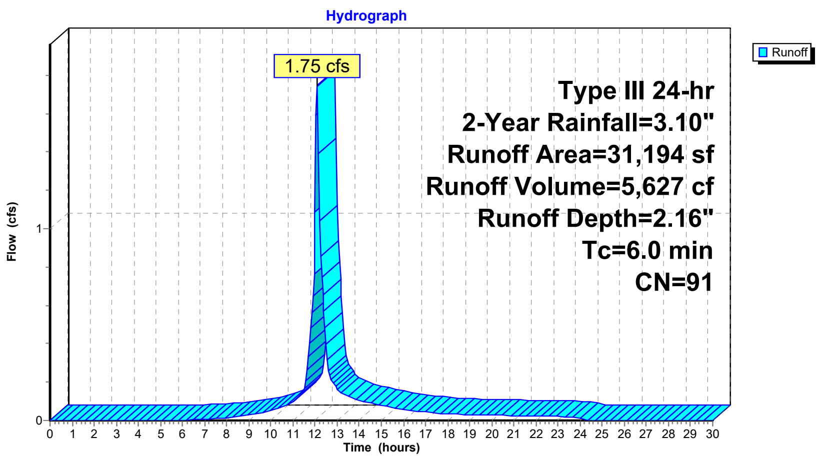
Runoff = 1.75 cfs @ 12.09 hrs, Volume= 5,627 cf, Depth= 2.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
21,650	98	Unconnected pavement, HSG C
9,544	74	>75% Grass cover, Good, HSG C
31,194	91	Weighted Average
9,544		30.60% Pervious Area
21,650		69.40% Impervious Area
21,650		100.00% Unconnected

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

Subcatchment P-3: Building 1 Parking - North



Summary for Subcatchment P-4: Building 2 - West

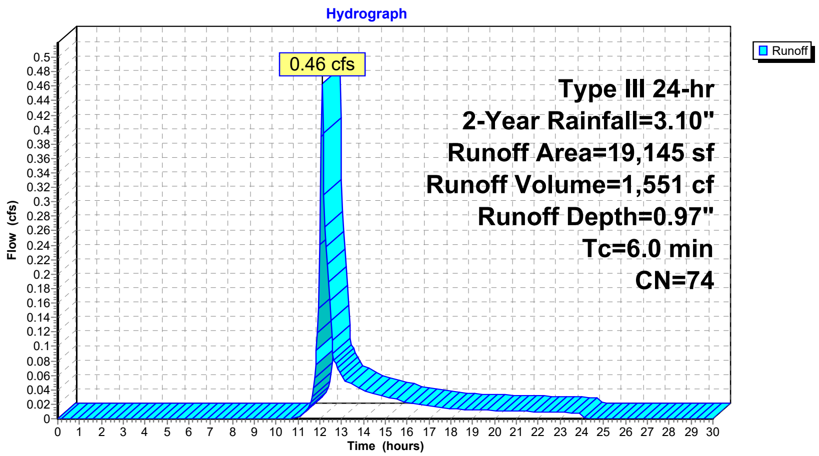
Runoff = 0.46 cfs @ 12.10 hrs, Volume= 1,551 cf, Depth= 0.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
0	98	Unconnected pavement, HSG C
19,145	74	>75% Grass cover, Good, HSG C
19,145	74	Weighted Average
19,145		100.00% Pervious Area

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

Subcatchment P-4: Building 2 - West



Summary for Subcatchment P-5: Building 2/3

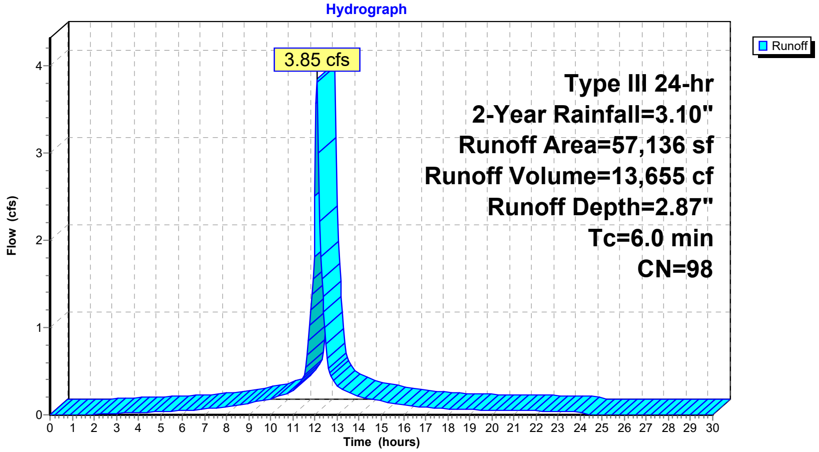
Runoff = 3.85 cfs @ 12.09 hrs, Volume= 13,655 cf, Depth= 2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
57,136	98	Unconnected pavement, HSG C
57,136		100.00% Impervious Area
57,136		100.00% Unconnected

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

Subcatchment P-5: Building 2/3



Summary for Subcatchment P-6: Building 1

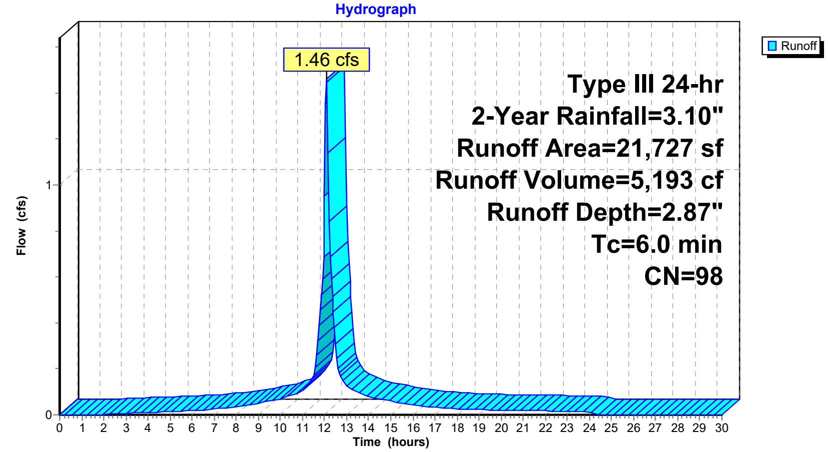
Runoff = 1.46 cfs @ 12.09 hrs, Volume= 5,193 cf, Depth= 2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
21,727	98	Unconnected pavement, HSG C
21,727		100.00% Impervious Area
21,727		100.00% Unconnected

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

Subcatchment P-6: Building 1



Summary for Subcatchment P-7: Building 2/3 Courtyard

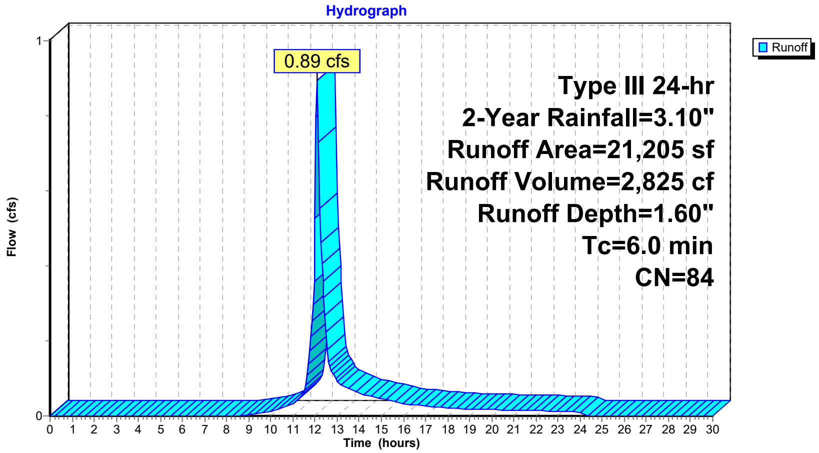
Runoff = 0.89 cfs @ 12.09 hrs, Volume= 2,825 cf, Depth= 1.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
8,424	98	Unconnected pavement, HSG C
12,781	74	>75% Grass cover, Good, HSG C
21,205	84	Weighted Average
12,781		60.27% Pervious Area
8,424		39.73% Impervious Area
8,424		100.00% Unconnected

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

Subcatchment P-7: Building 2/3 Courtyard



Summary for Subcatchment P-8: Building 1 Courtyard

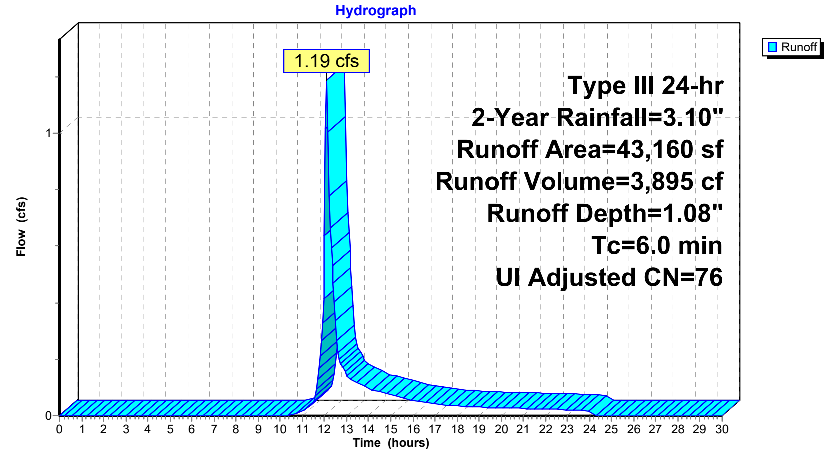
Runoff = 1.19 cfs @ 12.10 hrs, Volume= 3,895 cf, Depth= 1.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Adj	Description
6,542	98		Unconnected pavement, HSG C
36,618	74		>75% Grass cover, Good, HSG C
43,160	78	76	Weighted Average, UI Adjusted
36,618			84.84% Pervious Area
6,542			15.16% Impervious Area
6,542			100.00% Unconnected

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

Subcatchment P-8: Building 1 Courtyard



Summary for Subcatchment P-9: Building 2 Parking - South

Tc of 4.6 rounds to minimum of 5.0. Use Tc = 5.0 mimutes for E-2.

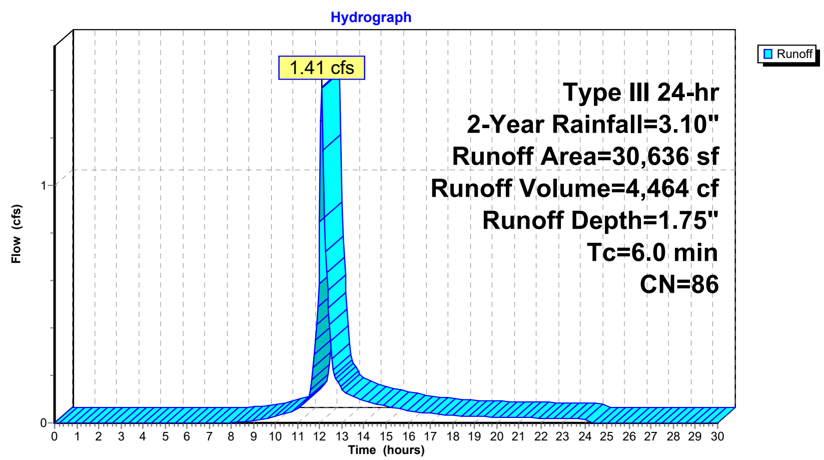
Runoff = 1.41 cfs @ 12.09 hrs, Volume= 4,464 cf, Depth= 1.75"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
15,827	98	Unconnected pavement, HSG C
14,809	74	>75% Grass cover, Good, HSG C
30,636	86	Weighted Average
14,809		48.34% Pervious Area
15,827		51.66% Impervious Area
15,827		100.00% Unconnected

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

Subcatchment P-9: Building 2 Parking - South



Summary for Reach 1R: Swale - West of Building 2/3

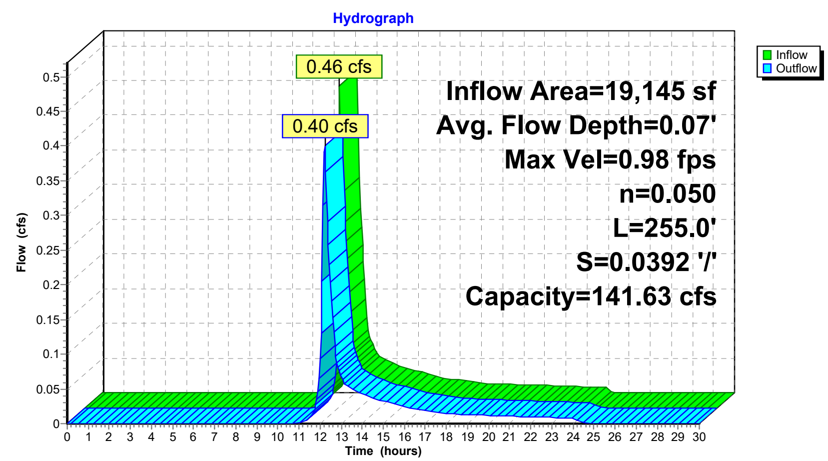
Inflow Area = 19,145 sf, 0.00% Impervious, Inflow Depth = 0.97" for 2-Year event
Inflow = 0.46 cfs @ 12.10 hrs, Volume= 1,551 cf
Outflow = 0.40 cfs @ 12.22 hrs, Volume= 1,551 cf, Atten= 14%, Lag= 7.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.98 fps, Min. Travel Time= 4.3 min
Avg. Velocity = 0.45 fps, Avg. Travel Time= 9.4 min

Peak Storage= 107 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.07'
Bank-Full Depth= 2.00' Flow Area= 20.0 sf, Capacity= 141.63 cfs

6.00' x 2.00' deep channel, n= 0.050 Earth, cobble bottom, clean sides
Side Slope Z-value= 1.0 3.0 '/' Top Width= 14.00'
Length= 255.0' Slope= 0.0392 '/'
Inlet Invert= 144.00', Outlet Invert= 134.00'

Reach 1R: Swale - West of Building 2/3



Summary for Pond 1P: MC-3500

Inflow Area = 103,199 sf, 47.70% Impervious, Inflow Depth = 1.73" for 2-Year event
Inflow = 4.49 cfs @ 12.09 hrs, Volume= 14,920 cf
Outflow = 1.79 cfs @ 12.35 hrs, Volume= 10,308 cf, Atten= 60%, Lag= 15.4 min
Primary = 1.79 cfs @ 12.35 hrs, Volume= 10,308 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 126.70' @ 12.35 hrs Surf.Area= 3,402 sf Storage= 6,419 cf

Plug-Flow detention time= 203.5 min calculated for 10,291 cf (69% of inflow)
Center-of-Mass det. time= 104.8 min (912.7 - 808.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	124.00'	4,786 cf	**37.08'W x 91.74'L x 5.50'H Field A** 18,711 cf Overall - 6,746 cf Embedded = 11,965 cf x 40.0% Voids
#2A	124.75'	6,746 cf	**ADS_StormTech MC-3500 d +Cap** x 60 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 5 Rows of 12 Chambers Cap Storage= +14.9 cf x 2 x 5 rows = 149.0 cf
		11,532 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	124.75'	**15.0" Round 15" HDPE** L= 100.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 124.75' / 123.75' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf
#2	Device 1	126.00'	**13.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=1.79 cfs @ 12.35 hrs HW=126.70' (Free Discharge)
└─**1=15" HDPE** (Passes 1.79 cfs of 5.37 cfs potential flow)
  └─**2=Orifice/Grate** (Orifice Controls 1.79 cfs @ 2.85 fps)

Pond 1P: MC-3500 - Chamber Wizard Field A

Chamber Model = ADS_StormTech MC-3500 d +Cap (ADS StormTech® MC-3500 d rev 03/14 with Cap volume)
Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf
Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap
Cap Storage= +14.9 cf x 2 x 5 rows = 149.0 cf

77.0" Wide + 9.0" Spacing = 86.0" C-C Row Spacing

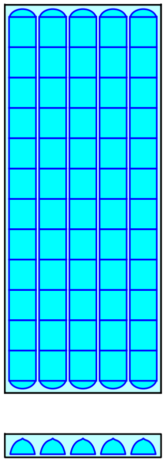
12 Chambers/Row x 7.17' Long +1.85' Cap Length x 2 = 89.74' Row Length +12.0" End Stone x 2 = 91.74' Base Length
5 Rows x 77.0" Wide + 9.0" Spacing x 4 + 12.0" Side Stone x 2 = 37.08' Base Width
9.0" Base + 45.0" Chamber Height + 12.0" Cover = 5.50' Field Height

60 Chambers x 110.0 cf + 14.9 cf Cap Volume x 2 x 5 Rows = 6,746.1 cf Chamber Storage

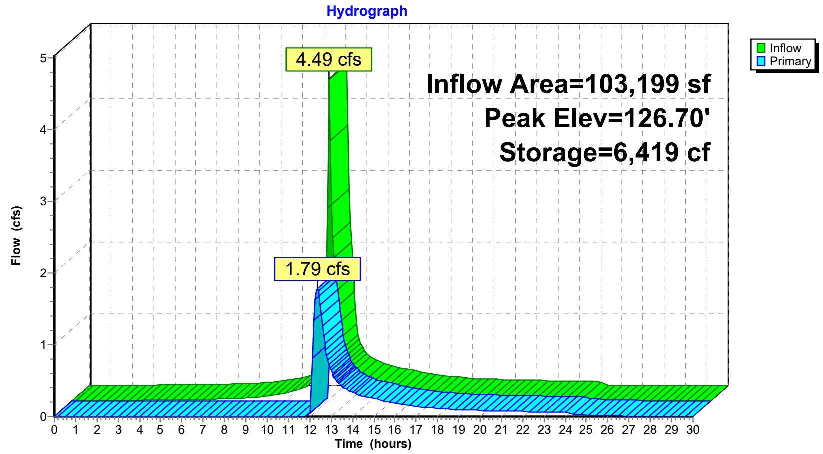
18,711.1 cf Field - 6,746.1 cf Chambers = 11,965.0 cf Stone x 40.0% Voids = 4,786.0 cf Stone Storage

Chamber Storage + Stone Storage = 11,532.1 cf = 0.265 af
Overall Storage Efficiency = 61.6%
Overall System Size = 91.74' x 37.08' x 5.50'

60 Chambers
693.0 cy Field
443.1 cy Stone



Pond 1P: MC-3500



Summary for Pond UIS1: UIS#1

Inflow Area = 108,977 sf, 74.68% Impervious, Inflow Depth = 2.31" for 2-Year event
Inflow = 6.16 cfs @ 12.09 hrs, Volume= 20,944 cf
Outflow = 2.05 cfs @ 12.39 hrs, Volume= 13,796 cf, Atten= 67%, Lag= 18.0 min
Primary = 2.05 cfs @ 12.39 hrs, Volume= 13,796 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 137.20' @ 12.39 hrs Surf.Area= 5,529 sf Storage= 10,511 cf

Plug-Flow detention time= 232.4 min calculated for 13,773 cf (66% of inflow)
Center-of-Mass det. time= 132.5 min (913.8 - 781.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	134.50'	7,706 cf	**37.08'W x 149.10'L x 5.50'H Field A** 30,410 cf Overall - 11,144 cf Embedded = 19,266 cf x 40.0% Voids
#2A	135.25'	11,144 cf	**ADS_StormTech MC-3500 d +Cap** x 100 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 5 Rows of 20 Chambers Cap Storage= +14.9 cf x 2 x 5 rows = 149.0 cf
		18,851 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	135.25'	**15.0" Round 15" HDPE** L= 100.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 135.25' / 132.25' S= 0.0300 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf
#2	Device 1	136.40'	**12.0" Vert. 12" Orifice** C= 0.600

Primary OutFlow Max=2.05 cfs @ 12.39 hrs HW=137.20' (Free Discharge)
└─**1=15" HDPE** (Passes 2.05 cfs of 5.37 cfs potential flow)
  └─**2=12" Orifice** (Orifice Controls 2.05 cfs @ 3.04 fps)

Pond UIS1: UIS#1 - Chamber Wizard Field A

Chamber Model = ADS_StormTechMC-3500 d +Cap (ADS StormTech®MC-3500 d rev 03/14 with Cap volume)
Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf
Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap
Cap Storage= +14.9 cf x 2 x 5 rows = 149.0 cf

77.0" Wide + 9.0" Spacing = 86.0" C-C Row Spacing

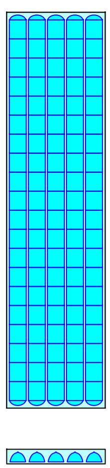
20 Chambers/Row x 7.17' Long +1.85' Cap Length x 2 = 147.10' Row Length +12.0" End Stone x 2 = 149.10' Base Length
5 Rows x 77.0" Wide + 9.0" Spacing x 4 + 12.0" Side Stone x 2 = 37.08' Base Width
9.0" Base + 45.0" Chamber Height + 12.0" Cover = 5.50' Field Height

100 Chambers x 110.0 cf + 14.9 cf Cap Volume x 2 x 5 Rows = 11,144.2 cf Chamber Storage

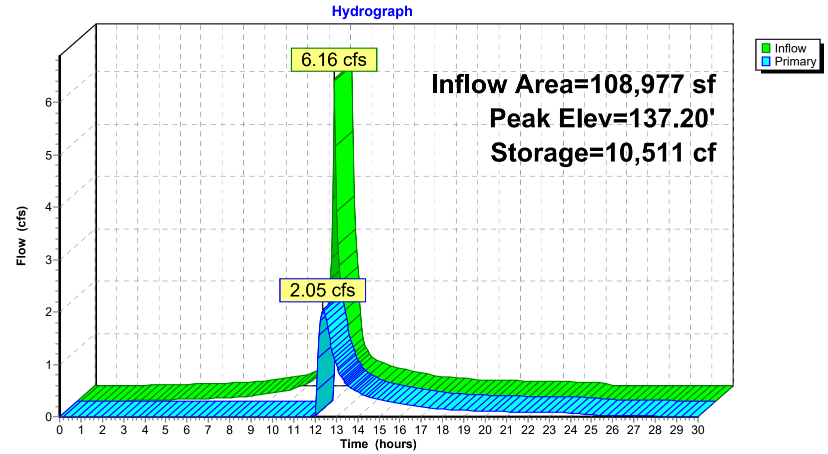
30,410.2 cf Field - 11,144.2 cf Chambers = 19,266.0 cf Stone x 40.0% Voids = 7,706.4 cf Stone Storage

Chamber Storage + Stone Storage = 18,850.6 cf = 0.433 af
Overall Storage Efficiency = 62.0%
Overall System Size = 149.10' x 37.08' x 5.50'

100 Chambers
1,126.3 cy Field
713.6 cy Stone



Pond UIS1: UIS#1



Summary for Pond UIS2: UIS #2

Inflow Area = 86,189 sf, 52.62% Impervious, Inflow Depth = 1.86" for 2-Year event
Inflow = 3.89 cfs @ 12.09 hrs, Volume= 13,381 cf
Outflow = 1.66 cfs @ 12.36 hrs, Volume= 9,237 cf, Atten= 57%, Lag= 15.7 min
Primary = 1.66 cfs @ 12.36 hrs, Volume= 9,237 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 127.80' @ 12.36 hrs Surf.Area= 2,915 sf Storage= 5,692 cf

Plug-Flow detention time= 194.0 min calculated for 9,237 cf (69% of inflow)
Center-of-Mass det. time= 97.0 min (911.1 - 814.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	125.00'	4,107 cf	**22.75'W x 127.59'L x 5.50'H Field A** 15,965 cf Overall - 5,697 cf Embedded = 10,268 cf x 40.0% Voids
#2A	125.75'	5,697 cf	**ADS_StormTech MC-3500 d +Cap** x 51 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 3 Rows of 17 Chambers Cap Storage= +14.9 cf x 2 x 3 rows = 89.4 cf
#3	125.75'	82 cf	**4.00'D x 6.50'H Vertical Cone/Cylinder**
		9,886 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	125.75'	**18.0" Round 18" HDPE** L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 125.75' / 125.25' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#2	Device 1	127.10'	**12.0" Vert. 12" Orifice** C= 0.600

Primary OutFlow Max=1.66 cfs @ 12.36 hrs HW=127.80' (Free Discharge)
└─**1=18" HDPE** (Passes 1.66 cfs of 7.65 cfs potential flow)
  └─**2=12" Orifice** (Orifice Controls 1.66 cfs @ 2.84 fps)

Pond UIS2: UIS #2 - Chamber Wizard Field A

Chamber Model = ADS_StormTech MC-3500 d +Cap (ADS StormTech® MC-3500 d rev 03/14 with Cap volume)
Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf
Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap
Cap Storage= +14.9 cf x 2 x 3 rows = 89.4 cf

77.0" Wide + 9.0" Spacing = 86.0" C-C Row Spacing

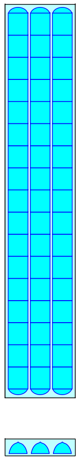
17 Chambers/Row x 7.17' Long +1.85' Cap Length x 2 = 125.59' Row Length +12.0" End Stone x 2 = 127.59' Base Length
3 Rows x 77.0" Wide + 9.0" Spacing x 2 + 12.0" Side Stone x 2 = 22.75' Base Width
9.0" Base + 45.0" Chamber Height + 12.0" Cover = 5.50' Field Height

51 Chambers x 110.0 cf + 14.9 cf Cap Volume x 2 x 3 Rows = 5,696.9 cf Chamber Storage

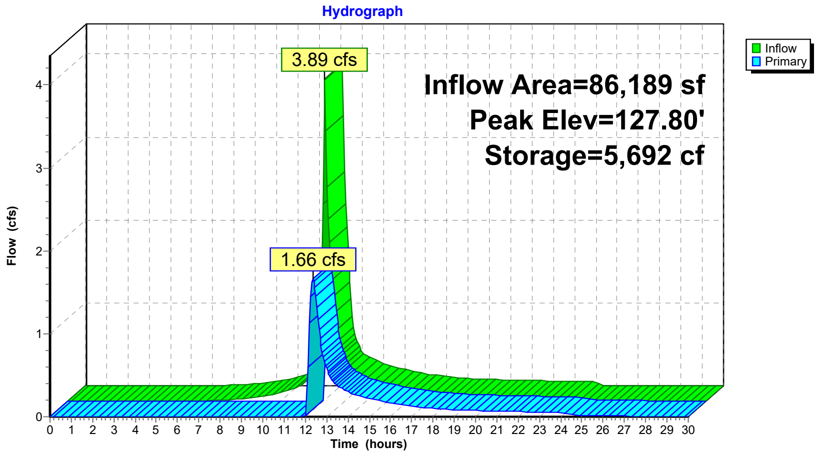
15,964.7 cf Field - 5,696.9 cf Chambers = 10,267.7 cf Stone x 40.0% Voids = 4,107.1 cf Stone Storage

Chamber Storage + Stone Storage = 9,804.0 cf = 0.225 af
Overall Storage Efficiency = 61.4%
Overall System Size = 127.59' x 22.75' x 5.50'

51 Chambers
591.3 cy Field
380.3 cy Stone



Pond UIS2: UIS #2

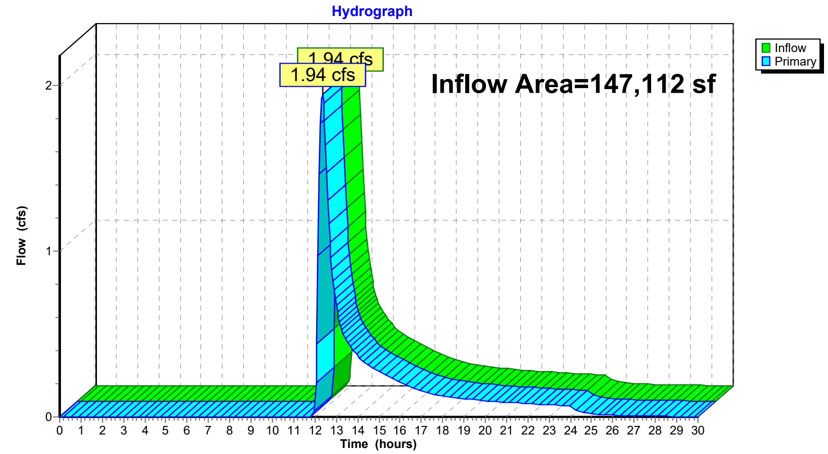


Summary for Link SP-1: Study Point #1

Inflow Area =	147,112 sf, 30.83% Impervious,	Inflow Depth > 0.92"	for 2-Year event
Inflow =	1.94 cfs @ 12.34 hrs, Volume=	11,288 cf	
Primary =	1.94 cfs @ 12.34 hrs, Volume=	11,288 cf, Atten= 0%, Lag= 0.0 min	

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link SP-1: Study Point #1

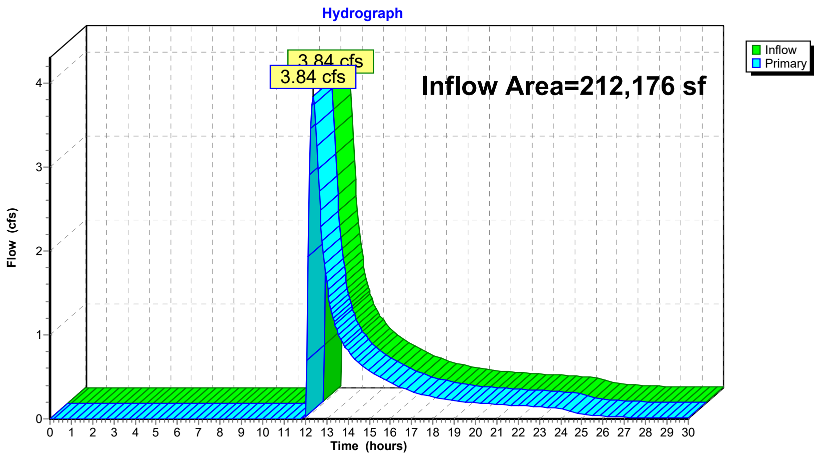


Summary for Link SP-2: Study Point #2

Inflow Area = 212,176 sf, 61.56% Impervious, Inflow Depth > 1.36" for 2-Year event
Inflow = 3.84 cfs @ 12.37 hrs, Volume= 24,104 cf
Primary = 3.84 cfs @ 12.37 hrs, Volume= 24,104 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link SP-2: Study Point #2



Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P-1: Off-site Runoff Runoff Area=60,923 sf 0.00% Impervious Runoff Depth=1.08"
Tc=6.0 min CN=61 Runoff=1.52 cfs 5,479 cf

Subcatchment P-10: Building 1 Parking - Runoff Area=38,312 sf 54.69% Impervious Runoff Depth=3.10"
Tc=6.0 min CN=87 Runoff=3.09 cfs 9,894 cf

Subcatchment P-2: Building 2 Parking - Runoff Area=35,850 sf 66.11% Impervious Runoff Depth=3.40"
Tc=6.0 min CN=90 Runoff=3.11 cfs 10,145 cf

Subcatchment P-3: Building 1 Parking - Runoff Area=31,194 sf 69.40% Impervious Runoff Depth=3.50"
Tc=6.0 min CN=91 Runoff=2.77 cfs 9,093 cf

Subcatchment P-4: Building 2 - West Runoff Area=19,145 sf 0.00% Impervious Runoff Depth=1.97"
Tc=6.0 min CN=74 Runoff=0.99 cfs 3,147 cf

Subcatchment P-5: Building 2/3 Runoff Area=57,136 sf 100.00% Impervious Runoff Depth=4.26"
Tc=6.0 min CN=98 Runoff=5.63 cfs 20,302 cf

Subcatchment P-6: Building 1 Runoff Area=21,727 sf 100.00% Impervious Runoff Depth=4.26"
Tc=6.0 min CN=98 Runoff=2.14 cfs 7,720 cf

Subcatchment P-7: Building 2/3 Courtyard Runoff Area=21,205 sf 39.73% Impervious Runoff Depth=2.82"
Tc=6.0 min CN=84 Runoff=1.57 cfs 4,977 cf

Subcatchment P-8: Building 1 Courtyard Runoff Area=43,160 sf 15.16% Impervious Runoff Depth=2.13"
Tc=6.0 min UI Adjusted CN=76 Runoff=2.42 cfs 7,660 cf

Subcatchment P-9: Building 2 Parking - Runoff Area=30,636 sf 51.66% Impervious Runoff Depth=3.00"
Tc=6.0 min CN=86 Runoff=2.40 cfs 7,667 cf

Reach 1R: Swale - West of Building 2/3 Avg. Flow Depth=0.11' Max Vel=1.32 fps Inflow=0.99 cfs 3,147 cf
n=0.050 L=255.0' S=0.0392 '/' Capacity=141.63 cfs Outflow=0.90 cfs 3,147 cf

Pond 1P: MC-3500 Peak Elev=127.56' Storage=8,493 cf Inflow=7.64 cfs 25,274 cf
Outflow=4.48 cfs 20,660 cf

Pond UIS1: UIS#1 Peak Elev=138.10' Storage=14,041 cf Inflow=9.60 cfs 32,947 cf
Outflow=4.14 cfs 25,791 cf

Pond UIS2: UIS #2 Peak Elev=128.68' Storage=7,461 cf Inflow=6.47 cfs 22,385 cf
Outflow=3.92 cfs 18,242 cf

Link SP-1: Study Point #1 Inflow=5.06 cfs 23,721 cf
Primary=5.06 cfs 23,721 cf

Link SP-2: Study Point #2 Inflow=8.56 cfs 46,450 cf
Primary=8.56 cfs 46,450 cf

Total Runoff Area = 359,288 sf Runoff Volume = 86,085 cf Average Runoff Depth = 2.88"
51.03% Pervious = 183,330 sf 48.97% Impervious = 175,958 sf

Summary for Subcatchment P-1: Off-site Runoff Northwest

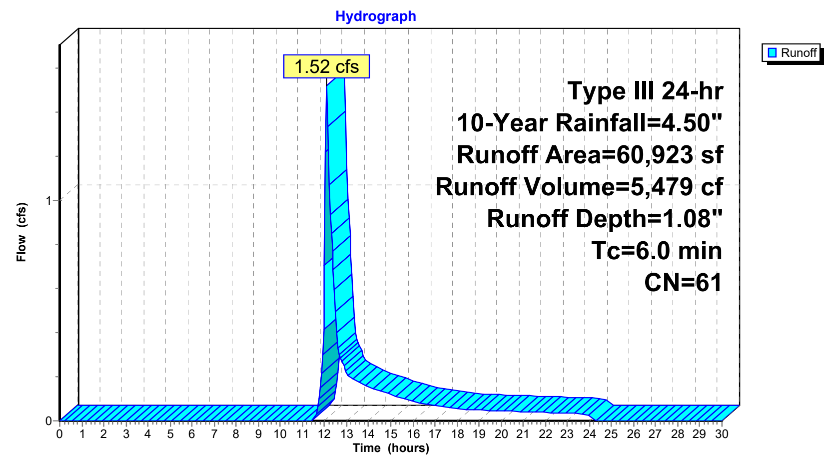
Runoff = 1.52 cfs @ 12.11 hrs, Volume= 5,479 cf, Depth= 1.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
3,360	39	>75% Grass cover, Good, HSG A
10,231	61	>75% Grass cover, Good, HSG B
13,385	74	>75% Grass cover, Good, HSG C
27,255	55	Woods, Good, HSG B
6,692	70	Woods, Good, HSG C
60,923	61	Weighted Average
60,923		100.00% Pervious Area

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

Subcatchment P-1: Off-site Runoff Northwest



Summary for Subcatchment P-10: Building 1 Parking - Southeast

Tc of 4.6 rounds to minimum of 5.0. Use Tc = 5.0 mimutes for E-2.

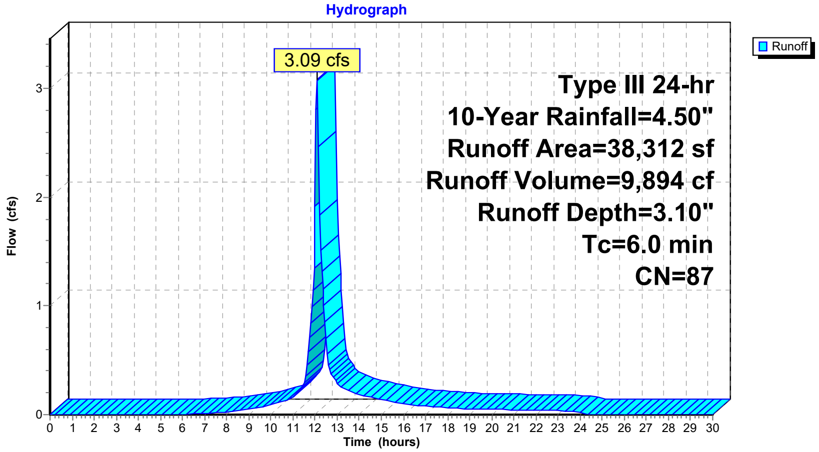
Runoff = 3.09 cfs @ 12.09 hrs, Volume= 9,894 cf, Depth= 3.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
20,952	98	Paved parking, HSG C
17,360	74	>75% Grass cover, Good, HSG C
38,312	87	Weighted Average
17,360		45.31% Pervious Area
20,952		54.69% Impervious Area

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

Subcatchment P-10: Building 1 Parking - Southeast



Summary for Subcatchment P-2: Building 2 Parking - North

Tc of 4.6 rounds to minimum of 5.0. Use Tc = 5.0 mimutes for E-2.

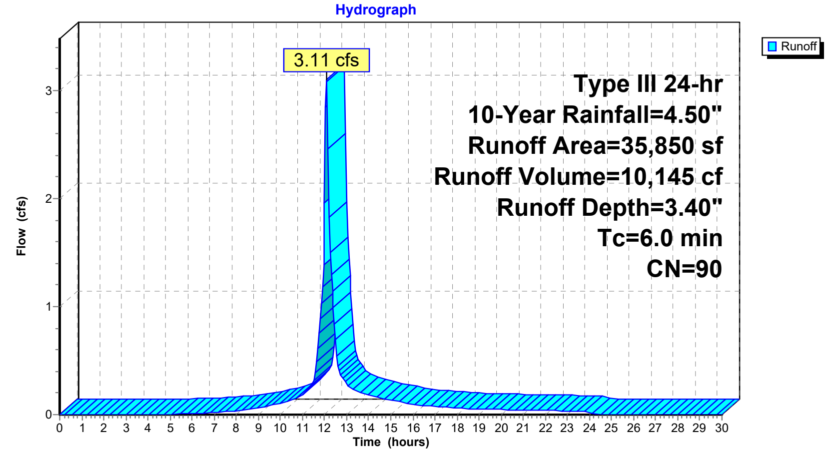
Runoff = 3.11 cfs @ 12.09 hrs, Volume= 10,145 cf, Depth= 3.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
23,700	98	Paved parking, HSG C
12,150	74	>75% Grass cover, Good, HSG C
35,850	90	Weighted Average
12,150		33.89% Pervious Area
23,700		66.11% Impervious Area

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

Subcatchment P-2: Building 2 Parking - North



Summary for Subcatchment P-3: Building 1 Parking - North

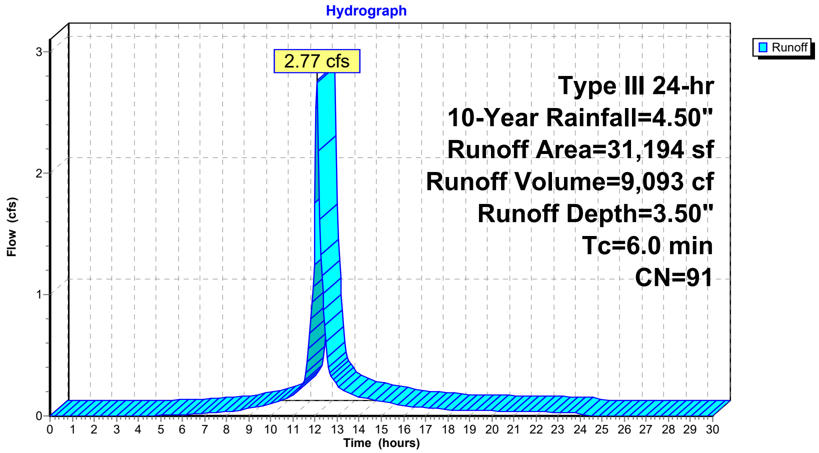
Runoff = 2.77 cfs @ 12.09 hrs, Volume= 9,093 cf, Depth= 3.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
21,650	98	Unconnected pavement, HSG C
9,544	74	>75% Grass cover, Good, HSG C
31,194	91	Weighted Average
9,544		30.60% Pervious Area
21,650		69.40% Impervious Area
21,650		100.00% Unconnected

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

Subcatchment P-3: Building 1 Parking - North



Summary for Subcatchment P-4: Building 2 - West

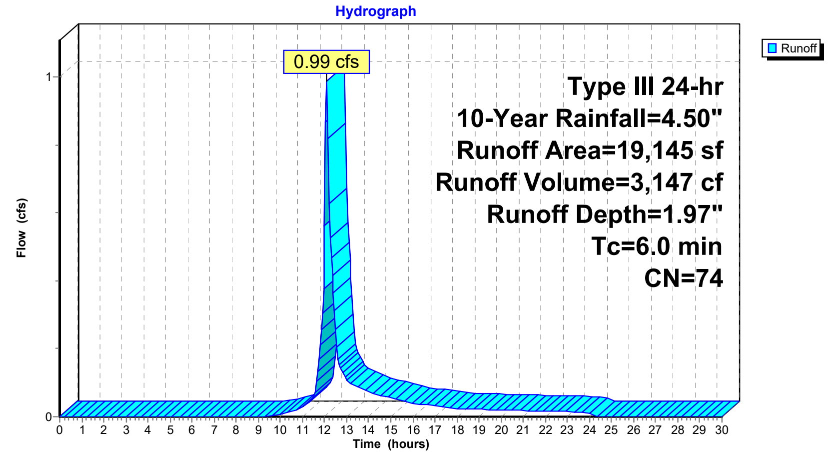
Runoff = 0.99 cfs @ 12.10 hrs, Volume= 3,147 cf, Depth= 1.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
0	98	Unconnected pavement, HSG C
19,145	74	>75% Grass cover, Good, HSG C
19,145	74	Weighted Average
19,145		100.00% Pervious Area

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

Subcatchment P-4: Building 2 - West



Summary for Subcatchment P-5: Building 2/3

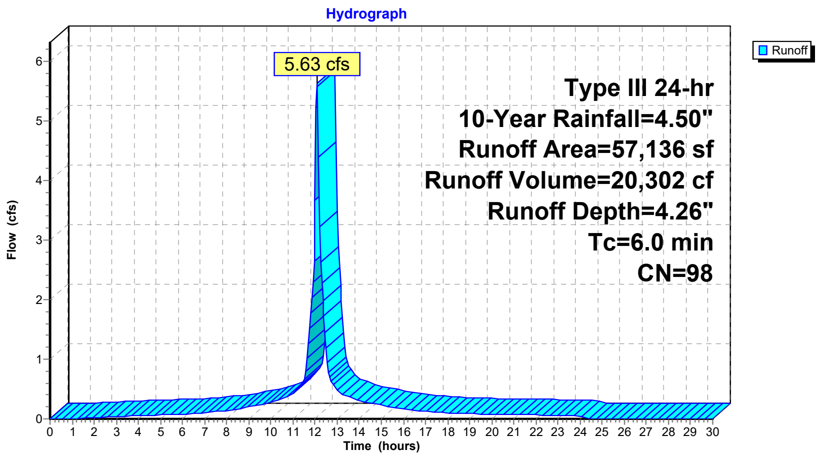
Runoff = 5.63 cfs @ 12.09 hrs, Volume= 20,302 cf, Depth= 4.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
57,136	98	Unconnected pavement, HSG C
57,136		100.00% Impervious Area
57,136		100.00% Unconnected

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

Subcatchment P-5: Building 2/3



Summary for Subcatchment P-6: Building 1

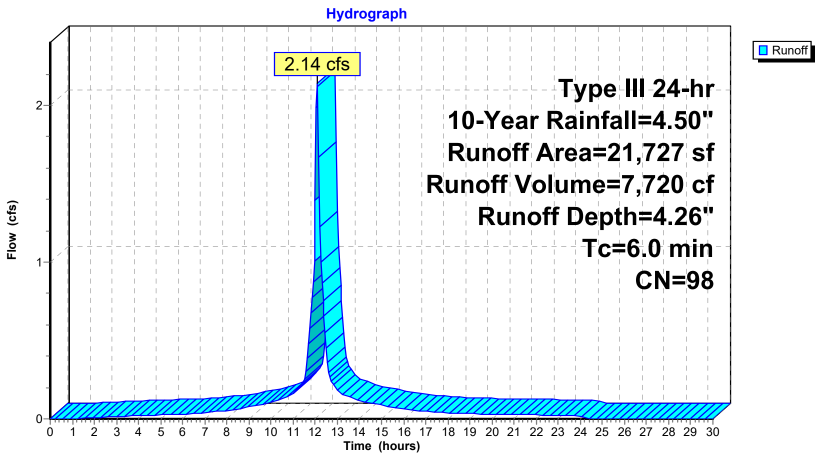
Runoff = 2.14 cfs @ 12.09 hrs, Volume= 7,720 cf, Depth= 4.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
21,727	98	Unconnected pavement, HSG C
21,727		100.00% Impervious Area
21,727		100.00% Unconnected

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

Subcatchment P-6: Building 1



Summary for Subcatchment P-7: Building 2/3 Courtyard

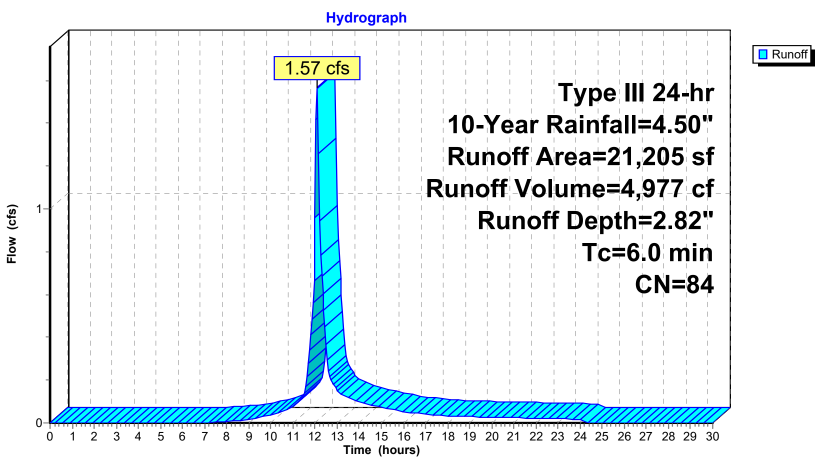
Runoff = 1.57 cfs @ 12.09 hrs, Volume= 4,977 cf, Depth= 2.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
8,424	98	Unconnected pavement, HSG C
12,781	74	>75% Grass cover, Good, HSG C
21,205	84	Weighted Average
12,781		60.27% Pervious Area
8,424		39.73% Impervious Area
8,424		100.00% Unconnected

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

Subcatchment P-7: Building 2/3 Courtyard



Summary for Subcatchment P-8: Building 1 Courtyard

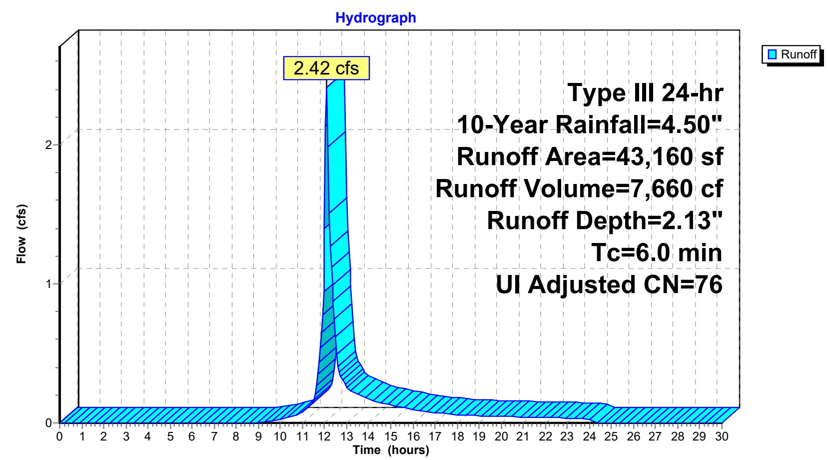
Runoff = 2.42 cfs @ 12.09 hrs, Volume= 7,660 cf, Depth= 2.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Adj	Description
6,542	98		Unconnected pavement, HSG C
36,618	74		>75% Grass cover, Good, HSG C
43,160	78	76	Weighted Average, UI Adjusted
36,618			84.84% Pervious Area
6,542			15.16% Impervious Area
6,542			100.00% Unconnected

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

Subcatchment P-8: Building 1 Courtyard



Summary for Subcatchment P-9: Building 2 Parking - South

Tc of 4.6 rounds to minimum of 5.0. Use Tc = 5.0 mimutes for E-2.

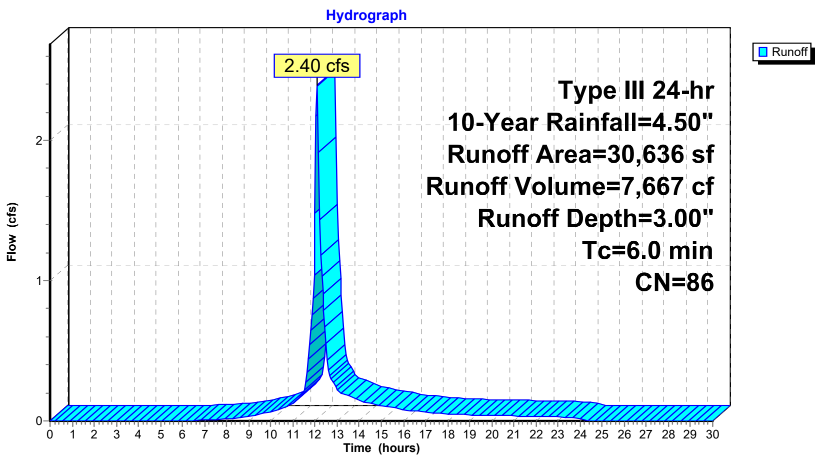
Runoff = 2.40 cfs @ 12.09 hrs, Volume= 7,667 cf, Depth= 3.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
15,827	98	Unconnected pavement, HSG C
14,809	74	>75% Grass cover, Good, HSG C
30,636	86	Weighted Average
14,809		48.34% Pervious Area
15,827		51.66% Impervious Area
15,827		100.00% Unconnected

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

Subcatchment P-9: Building 2 Parking - South



Summary for Reach 1R: Swale - West of Building 2/3

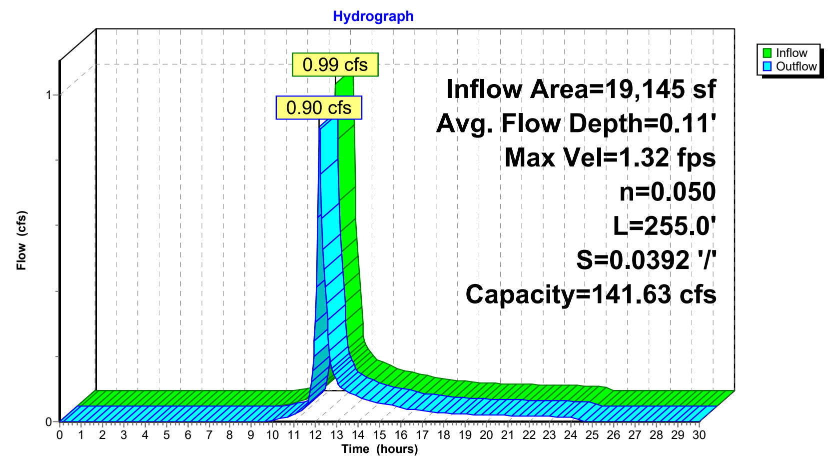
Inflow Area = 19,145 sf, 0.00% Impervious, Inflow Depth = 1.97" for 10-Year event
Inflow = 0.99 cfs @ 12.10 hrs, Volume= 3,147 cf
Outflow = 0.90 cfs @ 12.19 hrs, Volume= 3,147 cf, Atten= 9%, Lag= 5.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.32 fps, Min. Travel Time= 3.2 min
Avg. Velocity = 0.48 fps, Avg. Travel Time= 8.9 min

Peak Storage= 176 cf @ 12.13 hrs
Average Depth at Peak Storage= 0.11'
Bank-Full Depth= 2.00' Flow Area= 20.0 sf, Capacity= 141.63 cfs

6.00' x 2.00' deep channel, n= 0.050 Earth, cobble bottom, clean sides
Side Slope Z-value= 1.0 3.0 '/' Top Width= 14.00'
Length= 255.0' Slope= 0.0392 '/'
Inlet Invert= 144.00', Outlet Invert= 134.00'

Reach 1R: Swale - West of Building 2/3



Summary for Pond 1P: MC-3500

Inflow Area = 103,199 sf, 47.70% Impervious, Inflow Depth = 2.94" for 10-Year event
Inflow = 7.64 cfs @ 12.09 hrs, Volume= 25,274 cf
Outflow = 4.48 cfs @ 12.21 hrs, Volume= 20,660 cf, Atten= 41%, Lag= 7.4 min
Primary = 4.48 cfs @ 12.21 hrs, Volume= 20,660 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 127.56' @ 12.21 hrs Surf.Area= 3,402 sf Storage= 8,493 cf

Plug-Flow detention time= 145.1 min calculated for 20,660 cf (82% of inflow)
Center-of-Mass det. time= 71.5 min (869.5 - 798.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	124.00'	4,786 cf	**37.08'W x 91.74'L x 5.50'H Field A** 18,711 cf Overall - 6,746 cf Embedded = 11,965 cf x 40.0% Voids
#2A	124.75'	6,746 cf	**ADS_StormTech MC-3500 d +Cap** x 60 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 5 Rows of 12 Chambers Cap Storage= +14.9 cf x 2 x 5 rows = 149.0 cf
		11,532 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	124.75'	**15.0" Round 15" HDPE** L= 100.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 124.75' / 123.75' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf
#2	Device 1	126.00'	**13.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=4.46 cfs @ 12.21 hrs HW=127.55' (Free Discharge)
└**1=15" HDPE** (Passes 4.46 cfs of 6.88 cfs potential flow)
 └**2=Orifice/Grate** (Orifice Controls 4.46 cfs @ 4.84 fps)

Pond 1P: MC-3500 - Chamber Wizard Field A

Chamber Model = ADS_StormTech MC-3500 d +Cap (ADS StormTech® MC-3500 d rev 03/14 with Cap volume)
Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf
Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap
Cap Storage= +14.9 cf x 2 x 5 rows = 149.0 cf

77.0" Wide + 9.0" Spacing = 86.0" C-C Row Spacing

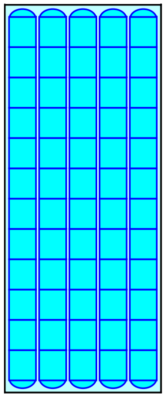
12 Chambers/Row x 7.17' Long +1.85' Cap Length x 2 = 89.74' Row Length +12.0" End Stone x 2 = 91.74' Base Length
5 Rows x 77.0" Wide + 9.0" Spacing x 4 + 12.0" Side Stone x 2 = 37.08' Base Width
9.0" Base + 45.0" Chamber Height + 12.0" Cover = 5.50' Field Height

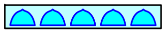
60 Chambers x 110.0 cf + 14.9 cf Cap Volume x 2 x 5 Rows = 6,746.1 cf Chamber Storage

18,711.1 cf Field - 6,746.1 cf Chambers = 11,965.0 cf Stone x 40.0% Voids = 4,786.0 cf Stone Storage

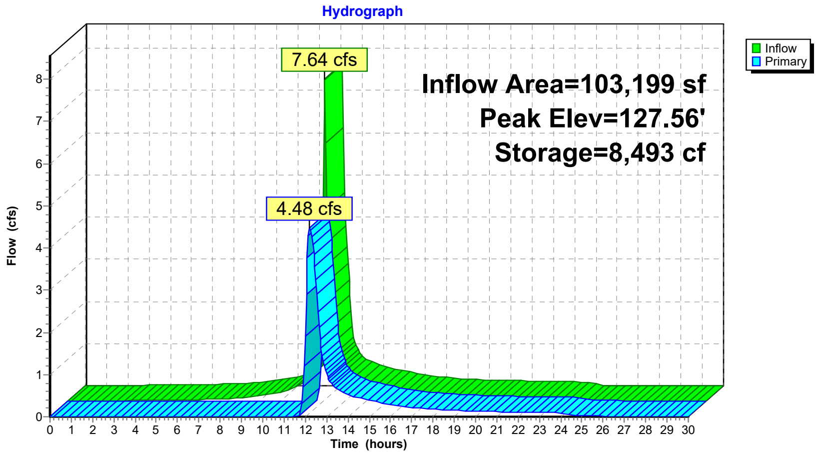
Chamber Storage + Stone Storage = 11,532.1 cf = 0.265 af
Overall Storage Efficiency = 61.6%
Overall System Size = 91.74' x 37.08' x 5.50'

60 Chambers
693.0 cy Field
443.1 cy Stone





Pond 1P: MC-3500



Summary for Pond UIS1: UIS#1

Inflow Area = 108,977 sf, 74.68% Impervious, Inflow Depth = 3.63" for 10-Year event
Inflow = 9.60 cfs @ 12.09 hrs, Volume= 32,947 cf
Outflow = 4.14 cfs @ 12.29 hrs, Volume= 25,791 cf, Atten= 57%, Lag= 12.1 min
Primary = 4.14 cfs @ 12.29 hrs, Volume= 25,791 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 138.10' @ 12.29 hrs Surf.Area= 5,529 sf Storage= 14,041 cf

Plug-Flow detention time= 180.0 min calculated for 25,748 cf (78% of inflow)
Center-of-Mass det. time= 100.7 min (874.0 - 773.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	134.50'	7,706 cf	**37.08'W x 149.10'L x 5.50'H Field A** 30,410 cf Overall - 11,144 cf Embedded = 19,266 cf x 40.0% Voids
#2A	135.25'	11,144 cf	**ADS_StormTech MC-3500 d +Cap** x 100 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 5 Rows of 20 Chambers Cap Storage= +14.9 cf x 2 x 5 rows = 149.0 cf
		18,851 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	135.25'	**15.0" Round 15" HDPE** L= 100.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 135.25' / 132.25' S= 0.0300 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf
#2	Device 1	136.40'	**12.0" Vert. 12" Orifice** C= 0.600

Primary OutFlow Max=4.14 cfs @ 12.29 hrs HW=138.10' (Free Discharge)
└─**1=15" HDPE** (Passes 4.14 cfs of 6.96 cfs potential flow)
  └─**2=12" Orifice** (Orifice Controls 4.14 cfs @ 5.27 fps)

Pond UIS1: UIS#1 - Chamber Wizard Field A

Chamber Model = ADS_StormTech MC-3500 d +Cap (ADS StormTech® MC-3500 d rev 03/14 with Cap volume)
Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf
Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap
Cap Storage= +14.9 cf x 2 x 5 rows = 149.0 cf

77.0" Wide + 9.0" Spacing = 86.0" C-C Row Spacing

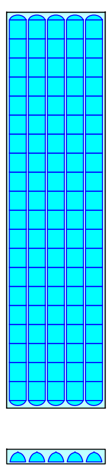
20 Chambers/Row x 7.17' Long +1.85' Cap Length x 2 = 147.10' Row Length +12.0" End Stone x 2 = 149.10' Base Length
5 Rows x 77.0" Wide + 9.0" Spacing x 4 + 12.0" Side Stone x 2 = 37.08' Base Width
9.0" Base + 45.0" Chamber Height + 12.0" Cover = 5.50' Field Height

100 Chambers x 110.0 cf + 14.9 cf Cap Volume x 2 x 5 Rows = 11,144.2 cf Chamber Storage

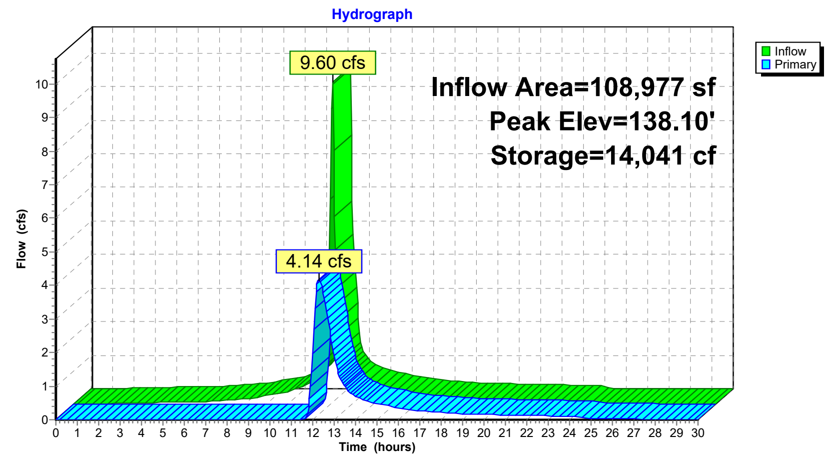
30,410.2 cf Field - 11,144.2 cf Chambers = 19,266.0 cf Stone x 40.0% Voids = 7,706.4 cf Stone Storage

Chamber Storage + Stone Storage = 18,850.6 cf = 0.433 af
Overall Storage Efficiency = 62.0%
Overall System Size = 149.10' x 37.08' x 5.50'

100 Chambers
1,126.3 cy Field
713.6 cy Stone



Pond UIS1: UIS#1



Summary for Pond UIS2: UIS #2

Inflow Area = 86,189 sf, 52.62% Impervious, Inflow Depth = 3.12" for 10-Year event
Inflow = 6.47 cfs @ 12.10 hrs, Volume= 22,385 cf
Outflow = 3.92 cfs @ 12.23 hrs, Volume= 18,242 cf, Atten= 39%, Lag= 8.0 min
Primary = 3.92 cfs @ 12.23 hrs, Volume= 18,242 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 128.68' @ 12.23 hrs Surf.Area= 2,915 sf Storage= 7,461 cf

Plug-Flow detention time= 140.0 min calculated for 18,242 cf (81% of inflow)
Center-of-Mass det. time= 66.9 min (867.9 - 800.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	125.00'	4,107 cf	**22.75'W x 127.59'L x 5.50'H Field A** 15,965 cf Overall - 5,697 cf Embedded = 10,268 cf x 40.0% Voids
#2A	125.75'	5,697 cf	**ADS_StormTech MC-3500 d +Cap** x 51 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 3 Rows of 17 Chambers Cap Storage= +14.9 cf x 2 x 3 rows = 89.4 cf
#3	125.75'	82 cf	**4.00'D x 6.50'H Vertical Cone/Cylinder**
		9,886 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	125.75'	**18.0" Round 18" HDPE** L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 125.75' / 125.25' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#2	Device 1	127.10'	**12.0" Vert. 12" Orifice** C= 0.600

Primary OutFlow Max=3.91 cfs @ 12.23 hrs HW=128.67' (Free Discharge)
└─**1=18" HDPE** (Passes 3.91 cfs of 9.89 cfs potential flow)
  └─**2=12" Orifice** (Orifice Controls 3.91 cfs @ 4.98 fps)

Pond UIS2: UIS #2 - Chamber Wizard Field A

Chamber Model = ADS_StormTech MC-3500 d +Cap (ADS StormTech® MC-3500 d rev 03/14 with Cap volume)
Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf
Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap
Cap Storage= +14.9 cf x 2 x 3 rows = 89.4 cf

77.0" Wide + 9.0" Spacing = 86.0" C-C Row Spacing

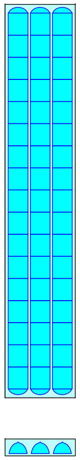
17 Chambers/Row x 7.17' Long +1.85' Cap Length x 2 = 125.59' Row Length +12.0" End Stone x 2 = 127.59' Base Length
3 Rows x 77.0" Wide + 9.0" Spacing x 2 + 12.0" Side Stone x 2 = 22.75' Base Width
9.0" Base + 45.0" Chamber Height + 12.0" Cover = 5.50' Field Height

51 Chambers x 110.0 cf + 14.9 cf Cap Volume x 2 x 3 Rows = 5,696.9 cf Chamber Storage

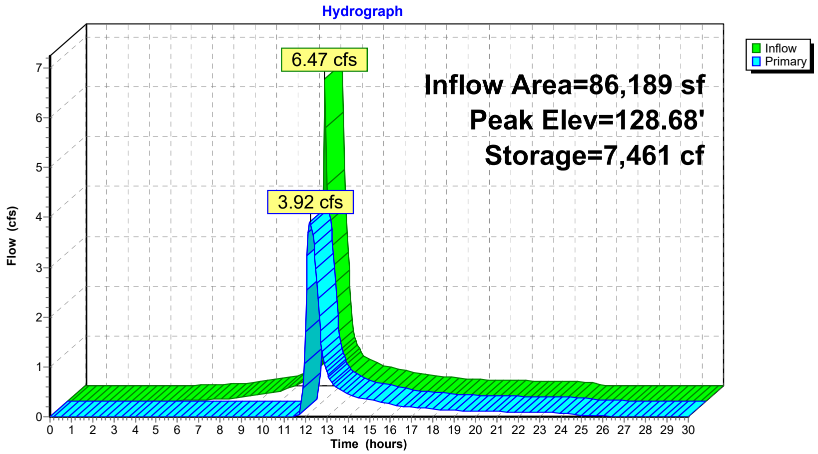
15,964.7 cf Field - 5,696.9 cf Chambers = 10,267.7 cf Stone x 40.0% Voids = 4,107.1 cf Stone Storage

Chamber Storage + Stone Storage = 9,804.0 cf = 0.225 af
Overall Storage Efficiency = 61.4%
Overall System Size = 127.59' x 22.75' x 5.50'

51 Chambers
591.3 cy Field
380.3 cy Stone



Pond UIS2: UIS #2

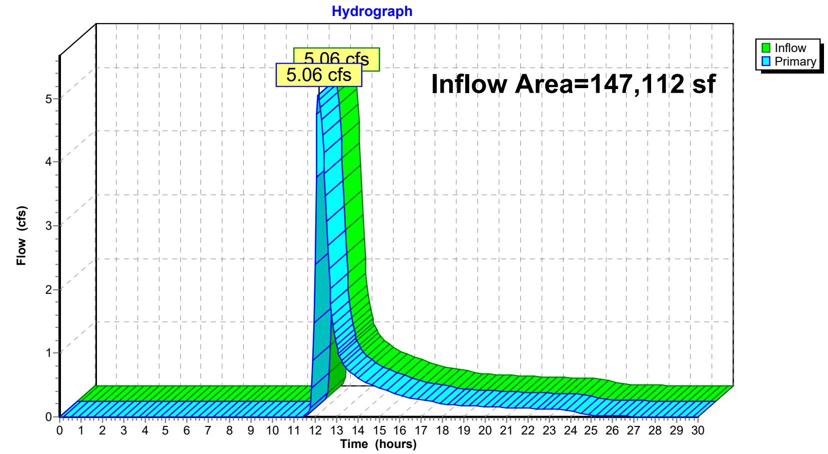


Summary for Link SP-1: Study Point #1

Inflow Area =	147,112 sf,	30.83% Impervious,	Inflow Depth > 1.93"	for 10-Year event
Inflow =	5.06 cfs @	12.17 hrs, Volume=	23,721 cf	
Primary =	5.06 cfs @	12.17 hrs, Volume=	23,721 cf, Atten= 0%, Lag= 0.0 min	

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link SP-1: Study Point #1

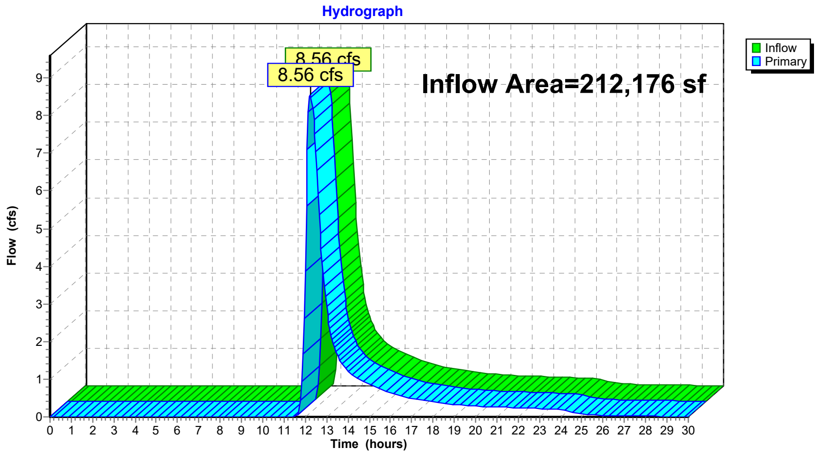


Summary for Link SP-2: Study Point #2

Inflow Area = 212,176 sf, 61.56% Impervious, Inflow Depth > 2.63" for 10-Year event
Inflow = 8.56 cfs @ 12.24 hrs, Volume= 46,450 cf
Primary = 8.56 cfs @ 12.24 hrs, Volume= 46,450 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link SP-2: Study Point #2



Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P-1: Off-site Runoff Runoff Area=60,923 sf 0.00% Impervious Runoff Depth=1.55"
Tc=6.0 min CN=61 Runoff=2.32 cfs 7,883 cf

Subcatchment P-10: Building 1 Parking - Runoff Area=38,312 sf 54.69% Impervious Runoff Depth=3.85"
Tc=6.0 min CN=87 Runoff=3.80 cfs 12,294 cf

Subcatchment P-2: Building 2 Parking - Runoff Area=35,850 sf 66.11% Impervious Runoff Depth=4.17"
Tc=6.0 min CN=90 Runoff=3.78 cfs 12,446 cf

Subcatchment P-3: Building 1 Parking - Runoff Area=31,194 sf 69.40% Impervious Runoff Depth=4.27"
Tc=6.0 min CN=91 Runoff=3.34 cfs 11,110 cf

Subcatchment P-4: Building 2 - West Runoff Area=19,145 sf 0.00% Impervious Runoff Depth=2.61"
Tc=6.0 min CN=74 Runoff=1.31 cfs 4,157 cf

Subcatchment P-5: Building 2/3 Runoff Area=57,136 sf 100.00% Impervious Runoff Depth=5.06"
Tc=6.0 min CN=98 Runoff=6.65 cfs 24,105 cf

Subcatchment P-6: Building 1 Runoff Area=21,727 sf 100.00% Impervious Runoff Depth=5.06"
Tc=6.0 min CN=98 Runoff=2.53 cfs 9,166 cf

Subcatchment P-7: Building 2/3 Courtyard Runoff Area=21,205 sf 39.73% Impervious Runoff Depth=3.55"
Tc=6.0 min CN=84 Runoff=1.96 cfs 6,266 cf

Subcatchment P-8: Building 1 Courtyard Runoff Area=43,160 sf 15.16% Impervious Runoff Depth=2.78"
Tc=6.0 min UI Adjusted CN=76 Runoff=3.17 cfs 10,016 cf

Subcatchment P-9: Building 2 Parking - Runoff Area=30,636 sf 51.66% Impervious Runoff Depth=3.75"
Tc=6.0 min CN=86 Runoff=2.97 cfs 9,568 cf

Reach 1R: Swale - West of Building 2/3 Avg. Flow Depth=0.13' Max Vel=1.47 fps Inflow=1.31 cfs 4,157 cf
n=0.050 L=255.0' S=0.0392 '/' Capacity=141.63 cfs Outflow=1.23 cfs 4,157 cf

Pond 1P: MC-3500 Peak Elev=128.12' Storage=9,601 cf Inflow=9.49 cfs 31,476 cf
Outflow=5.57 cfs 26,860 cf

Pond UIS1: UIS#1 Peak Elev=138.68' Storage=15,872 cf Inflow=11.58 cfs 39,940 cf
Outflow=5.04 cfs 32,780 cf

Pond UIS2: UIS #2 Peak Elev=129.27' Storage=8,403 cf Inflow=7.98 cfs 27,713 cf
Outflow=4.88 cfs 23,567 cf

Link SP-1: Study Point #1 Inflow=6.59 cfs 31,450 cf
Primary=6.59 cfs 31,450 cf

Link SP-2: Study Point #2 Inflow=10.53 cfs 59,640 cf
Primary=10.53 cfs 59,640 cf

Total Runoff Area = 359,288 sf Runoff Volume = 107,012 cf Average Runoff Depth = 3.57"
51.03% Pervious = 183,330 sf 48.97% Impervious = 175,958 sf

Summary for Subcatchment P-1: Off-site Runoff Northwest

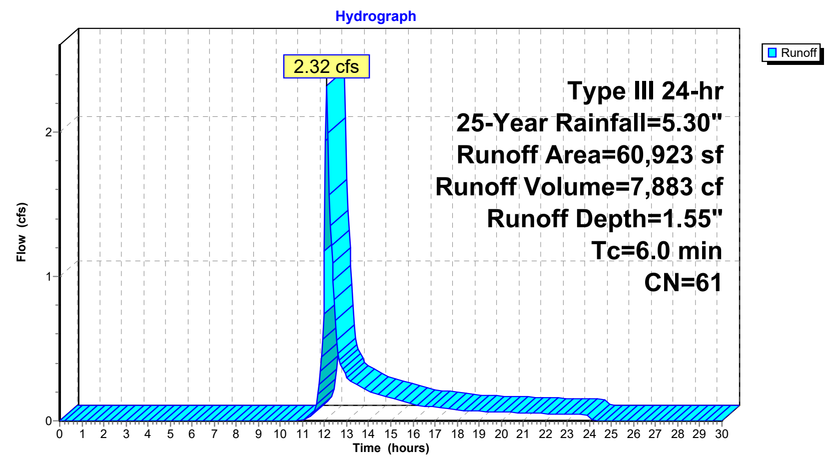
Runoff = 2.32 cfs @ 12.10 hrs, Volume= 7,883 cf, Depth= 1.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=5.30"

Area (sf)	CN	Description
3,360	39	>75% Grass cover, Good, HSG A
10,231	61	>75% Grass cover, Good, HSG B
13,385	74	>75% Grass cover, Good, HSG C
27,255	55	Woods, Good, HSG B
6,692	70	Woods, Good, HSG C
60,923	61	Weighted Average
60,923		100.00% Pervious Area

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

Subcatchment P-1: Off-site Runoff Northwest



Summary for Subcatchment P-10: Building 1 Parking - Southeast

Tc of 4.6 rounds to minimum of 5.0. Use Tc = 5.0 mimutes for E-2.

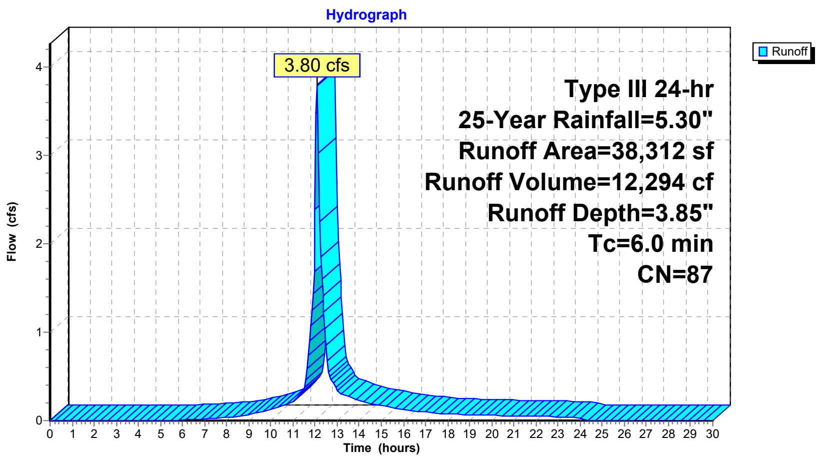
Runoff = 3.80 cfs @ 12.09 hrs, Volume= 12,294 cf, Depth= 3.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=5.30"

Area (sf)	CN	Description
20,952	98	Paved parking, HSG C
17,360	74	>75% Grass cover, Good, HSG C
38,312	87	Weighted Average
17,360		45.31% Pervious Area
20,952		54.69% Impervious Area

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

Subcatchment P-10: Building 1 Parking - Southeast



Summary for Subcatchment P-2: Building 2 Parking - North

Tc of 4.6 rounds to minimum of 5.0. Use Tc = 5.0 mimutes for E-2.

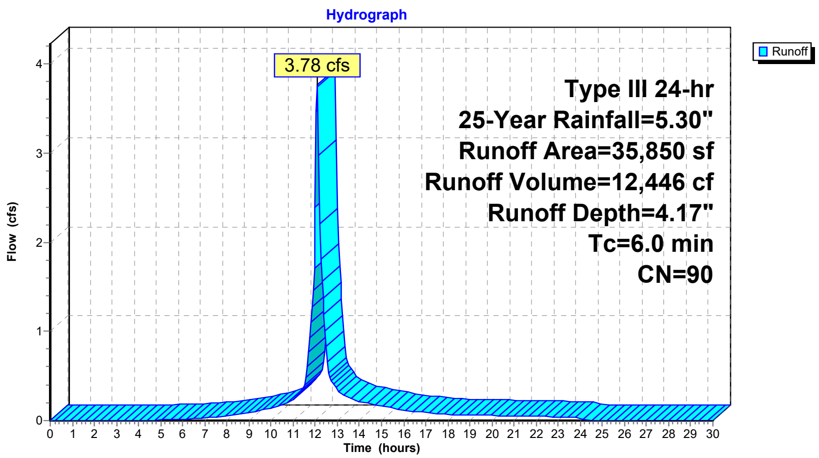
Runoff = 3.78 cfs @ 12.09 hrs, Volume= 12,446 cf, Depth= 4.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=5.30"

Area (sf)	CN	Description
23,700	98	Paved parking, HSG C
12,150	74	>75% Grass cover, Good, HSG C
35,850	90	Weighted Average
12,150		33.89% Pervious Area
23,700		66.11% Impervious Area

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

Subcatchment P-2: Building 2 Parking - North



Summary for Subcatchment P-3: Building 1 Parking - North

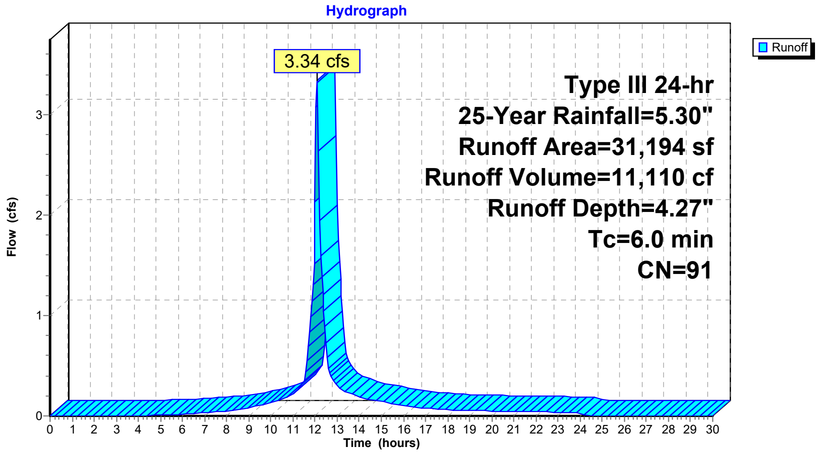
Runoff = 3.34 cfs @ 12.09 hrs, Volume= 11,110 cf, Depth= 4.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=5.30"

Area (sf)	CN	Description
21,650	98	Unconnected pavement, HSG C
9,544	74	>75% Grass cover, Good, HSG C
31,194	91	Weighted Average
9,544		30.60% Pervious Area
21,650		69.40% Impervious Area
21,650		100.00% Unconnected

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

Subcatchment P-3: Building 1 Parking - North



Summary for Subcatchment P-4: Building 2 - West

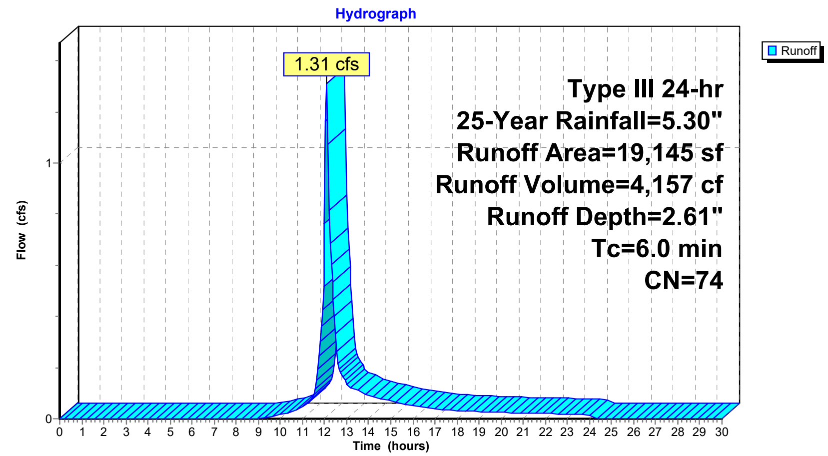
Runoff = 1.31 cfs @ 12.09 hrs, Volume= 4,157 cf, Depth= 2.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=5.30"

Area (sf)	CN	Description
0	98	Unconnected pavement, HSG C
19,145	74	>75% Grass cover, Good, HSG C
19,145	74	Weighted Average
19,145		100.00% Pervious Area

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

Subcatchment P-4: Building 2 - West



Summary for Subcatchment P-5: Building 2/3

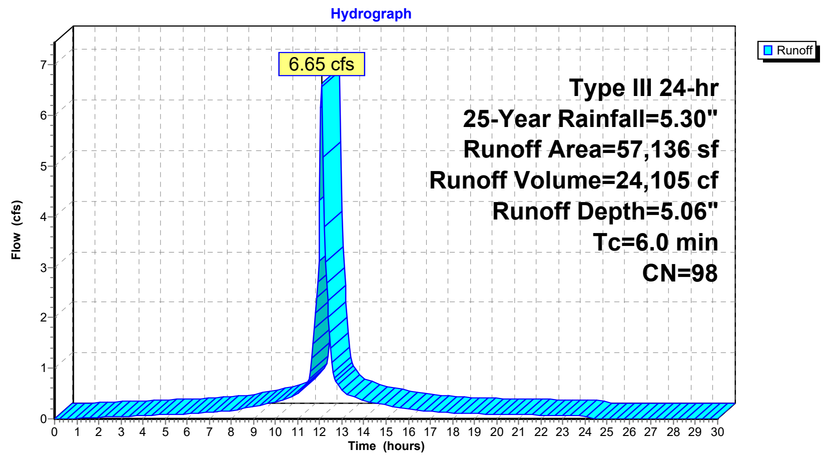
Runoff = 6.65 cfs @ 12.09 hrs, Volume= 24,105 cf, Depth= 5.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=5.30"

Area (sf)	CN	Description
57,136	98	Unconnected pavement, HSG C
57,136		100.00% Impervious Area
57,136		100.00% Unconnected

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

Subcatchment P-5: Building 2/3



Summary for Subcatchment P-6: Building 1

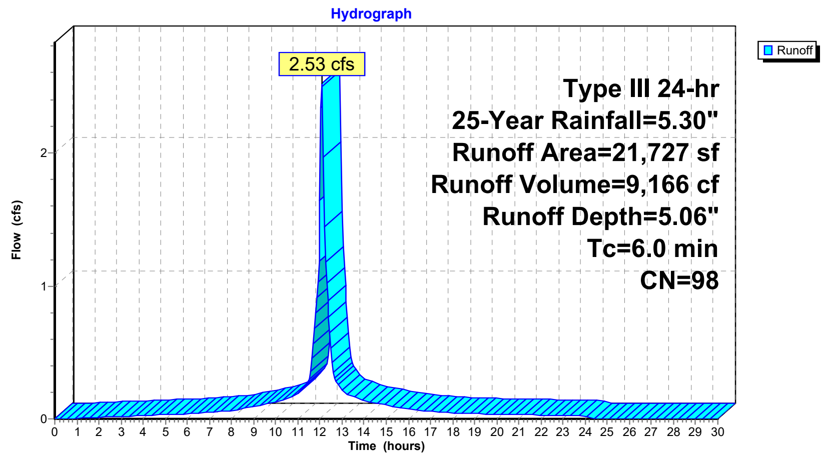
Runoff = 2.53 cfs @ 12.09 hrs, Volume= 9,166 cf, Depth= 5.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=5.30"

Area (sf)	CN	Description
21,727	98	Unconnected pavement, HSG C
21,727		100.00% Impervious Area
21,727		100.00% Unconnected

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

Subcatchment P-6: Building 1



Summary for Subcatchment P-7: Building 2/3 Courtyard

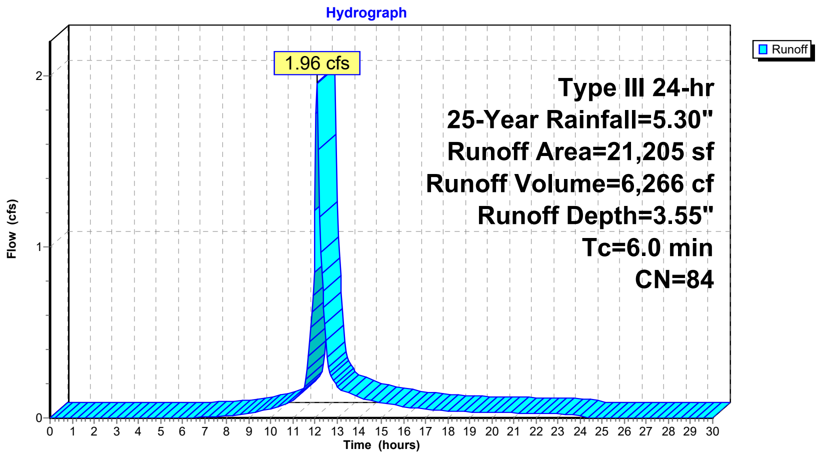
Runoff = 1.96 cfs @ 12.09 hrs, Volume= 6,266 cf, Depth= 3.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=5.30"

Area (sf)	CN	Description
8,424	98	Unconnected pavement, HSG C
12,781	74	>75% Grass cover, Good, HSG C
21,205	84	Weighted Average
12,781		60.27% Pervious Area
8,424		39.73% Impervious Area
8,424		100.00% Unconnected

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

Subcatchment P-7: Building 2/3 Courtyard



Summary for Subcatchment P-8: Building 1 Courtyard

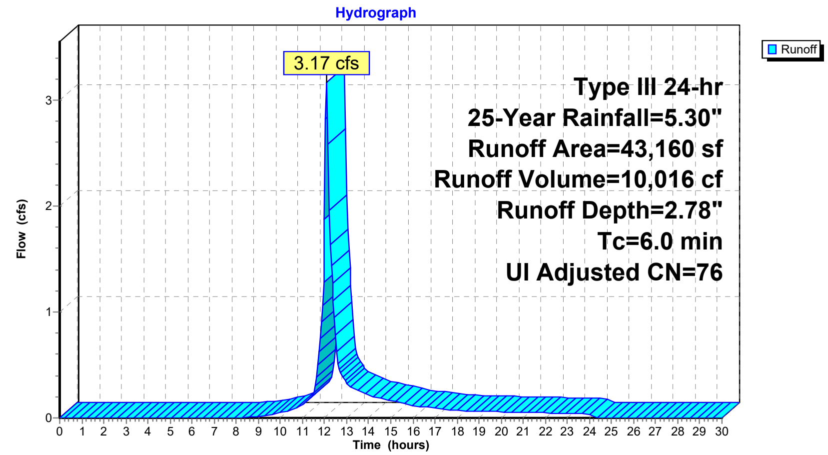
Runoff = 3.17 cfs @ 12.09 hrs, Volume= 10,016 cf, Depth= 2.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=5.30"

Area (sf)	CN	Adj	Description
6,542	98		Unconnected pavement, HSG C
36,618	74		>75% Grass cover, Good, HSG C
43,160	78	76	Weighted Average, UI Adjusted
36,618			84.84% Pervious Area
6,542			15.16% Impervious Area
6,542			100.00% Unconnected

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

Subcatchment P-8: Building 1 Courtyard



Summary for Subcatchment P-9: Building 2 Parking - South

Tc of 4.6 rounds to minimum of 5.0. Use Tc = 5.0 mimutes for E-2.

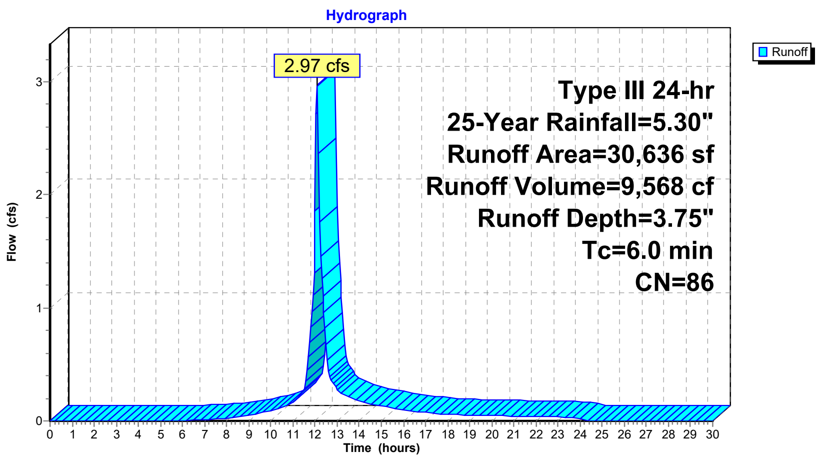
Runoff = 2.97 cfs @ 12.09 hrs, Volume= 9,568 cf, Depth= 3.75"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=5.30"

Area (sf)	CN	Description
15,827	98	Unconnected pavement, HSG C
14,809	74	>75% Grass cover, Good, HSG C
30,636	86	Weighted Average
14,809		48.34% Pervious Area
15,827		51.66% Impervious Area
15,827		100.00% Unconnected

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

Subcatchment P-9: Building 2 Parking - South



Summary for Reach 1R: Swale - West of Building 2/3

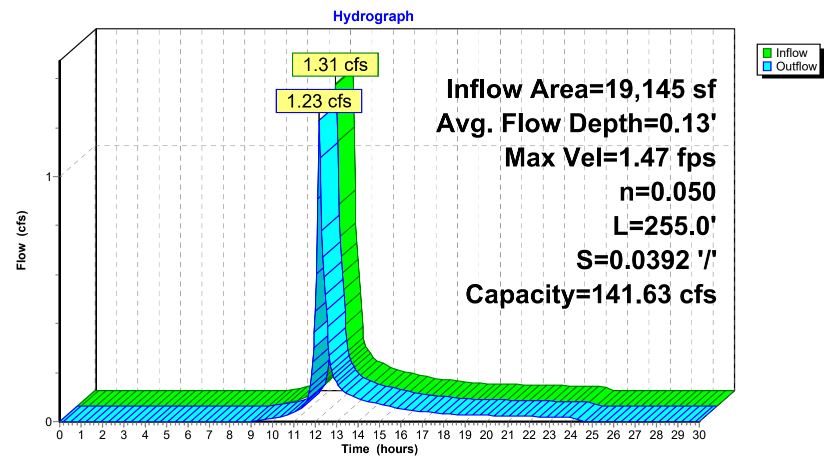
Inflow Area = 19,145 sf, 0.00% Impervious, Inflow Depth = 2.61" for 25-Year event
Inflow = 1.31 cfs @ 12.09 hrs, Volume= 4,157 cf
Outflow = 1.23 cfs @ 12.17 hrs, Volume= 4,157 cf, Atten= 6%, Lag= 4.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.47 fps, Min. Travel Time= 2.9 min
Avg. Velocity = 0.50 fps, Avg. Travel Time= 8.6 min

Peak Storage= 212 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.13'
Bank-Full Depth= 2.00' Flow Area= 20.0 sf, Capacity= 141.63 cfs

6.00' x 2.00' deep channel, n= 0.050 Earth, cobble bottom, clean sides
Side Slope Z-value= 1.0 3.0 '/' Top Width= 14.00'
Length= 255.0' Slope= 0.0392 '/'
Inlet Invert= 144.00', Outlet Invert= 134.00'

Reach 1R: Swale - West of Building 2/3



Summary for Pond 1P: MC-3500

Inflow Area = 103,199 sf, 47.70% Impervious, Inflow Depth = 3.66" for 25-Year event
Inflow = 9.49 cfs @ 12.09 hrs, Volume= 31,476 cf
Outflow = 5.57 cfs @ 12.21 hrs, Volume= 26,860 cf, Atten= 41%, Lag= 7.3 min
Primary = 5.57 cfs @ 12.21 hrs, Volume= 26,860 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 128.12' @ 12.21 hrs Surf.Area= 3,402 sf Storage= 9,601 cf

Plug-Flow detention time= 127.9 min calculated for 26,860 cf (85% of inflow)
Center-of-Mass det. time= 64.0 min (857.6 - 793.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	124.00'	4,786 cf	**37.08'W x 91.74'L x 5.50'H Field A** 18,711 cf Overall - 6,746 cf Embedded = 11,965 cf x 40.0% Voids
#2A	124.75'	6,746 cf	**ADS_StormTech MC-3500 d +Cap** x 60 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 5 Rows of 12 Chambers Cap Storage= +14.9 cf x 2 x 5 rows = 149.0 cf
		11,532 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	124.75'	**15.0" Round 15" HDPE** L= 100.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 124.75' / 123.75' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf
#2	Device 1	126.00'	**13.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=5.55 cfs @ 12.21 hrs HW=128.10' (Free Discharge)
└**1=15" HDPE** (Passes 5.55 cfs of 7.71 cfs potential flow)
 └**2=Orifice/Grate** (Orifice Controls 5.55 cfs @ 6.02 fps)

Pond 1P: MC-3500 - Chamber Wizard Field A

Chamber Model = ADS_StormTech MC-3500 d +Cap (ADS StormTech® MC-3500 d rev 03/14 with Cap volume)
Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf
Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap
Cap Storage= +14.9 cf x 2 x 5 rows = 149.0 cf

77.0" Wide + 9.0" Spacing = 86.0" C-C Row Spacing

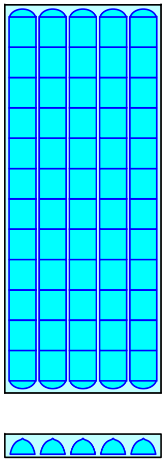
12 Chambers/Row x 7.17' Long +1.85' Cap Length x 2 = 89.74' Row Length +12.0" End Stone x 2 = 91.74' Base Length
5 Rows x 77.0" Wide + 9.0" Spacing x 4 + 12.0" Side Stone x 2 = 37.08' Base Width
9.0" Base + 45.0" Chamber Height + 12.0" Cover = 5.50' Field Height

60 Chambers x 110.0 cf + 14.9 cf Cap Volume x 2 x 5 Rows = 6,746.1 cf Chamber Storage

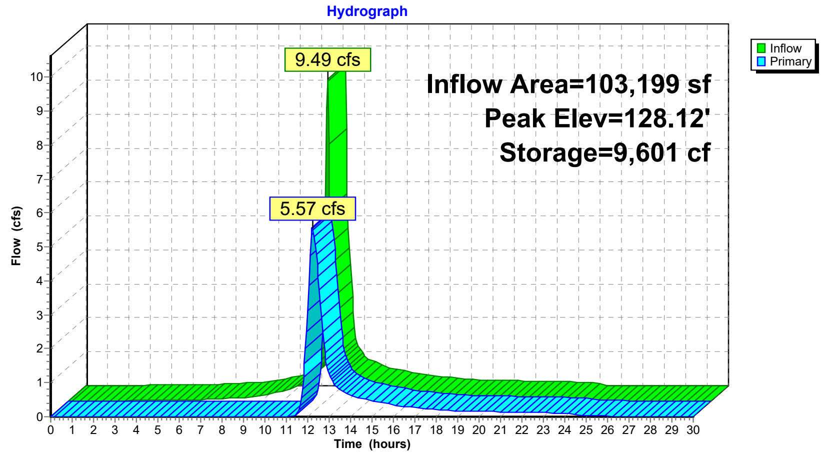
18,711.1 cf Field - 6,746.1 cf Chambers = 11,965.0 cf Stone x 40.0% Voids = 4,786.0 cf Stone Storage

Chamber Storage + Stone Storage = 11,532.1 cf = 0.265 af
Overall Storage Efficiency = 61.6%
Overall System Size = 91.74' x 37.08' x 5.50'

60 Chambers
693.0 cy Field
443.1 cy Stone



Pond 1P: MC-3500



Summary for Pond UIS1: UIS#1

Inflow Area = 108,977 sf, 74.68% Impervious, Inflow Depth = 4.40" for 25-Year event
Inflow = 11.58 cfs @ 12.09 hrs, Volume= 39,940 cf
Outflow = 5.04 cfs @ 12.28 hrs, Volume= 32,780 cf, Atten= 56%, Lag= 11.8 min
Primary = 5.04 cfs @ 12.28 hrs, Volume= 32,780 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 138.68' @ 12.28 hrs Surf.Area= 5,529 sf Storage= 15,872 cf

Plug-Flow detention time= 164.9 min calculated for 32,780 cf (82% of inflow)
Center-of-Mass det. time= 92.9 min (862.8 - 769.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	134.50'	7,706 cf	**37.08'W x 149.10'L x 5.50'H Field A** 30,410 cf Overall - 11,144 cf Embedded = 19,266 cf x 40.0% Voids
#2A	135.25'	11,144 cf	**ADS_StormTech MC-3500 d +Cap** x 100 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 5 Rows of 20 Chambers Cap Storage= +14.9 cf x 2 x 5 rows = 149.0 cf
		18,851 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	135.25'	**15.0" Round 15" HDPE** L= 100.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 135.25' / 132.25' S= 0.0300 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf
#2	Device 1	136.40'	**12.0" Vert. 12" Orifice** C= 0.600

Primary OutFlow Max=5.04 cfs @ 12.28 hrs HW=138.67' (Free Discharge)
└─**1=15" HDPE** (Passes 5.04 cfs of 7.80 cfs potential flow)
  └─**2=12" Orifice** (Orifice Controls 5.04 cfs @ 6.41 fps)

Pond UIS1: UIS#1 - Chamber Wizard Field A

Chamber Model = ADS_StormTech MC-3500 d +Cap (ADS StormTech® MC-3500 d rev 03/14 with Cap volume)
Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf
Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap
Cap Storage= +14.9 cf x 2 x 5 rows = 149.0 cf

77.0" Wide + 9.0" Spacing = 86.0" C-C Row Spacing

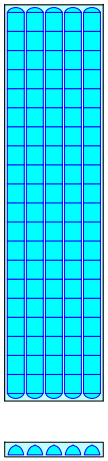
20 Chambers/Row x 7.17' Long +1.85' Cap Length x 2 = 147.10' Row Length +12.0" End Stone x 2 = 149.10' Base Length
5 Rows x 77.0" Wide + 9.0" Spacing x 4 + 12.0" Side Stone x 2 = 37.08' Base Width
9.0" Base + 45.0" Chamber Height + 12.0" Cover = 5.50' Field Height

100 Chambers x 110.0 cf + 14.9 cf Cap Volume x 2 x 5 Rows = 11,144.2 cf Chamber Storage

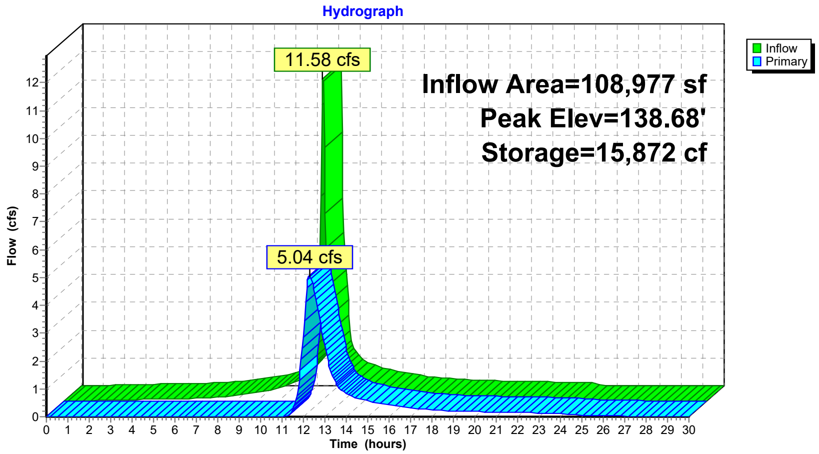
30,410.2 cf Field - 11,144.2 cf Chambers = 19,266.0 cf Stone x 40.0% Voids = 7,706.4 cf Stone Storage

Chamber Storage + Stone Storage = 18,850.6 cf = 0.433 af
Overall Storage Efficiency = 62.0%
Overall System Size = 149.10' x 37.08' x 5.50'

100 Chambers
1,126.3 cy Field
713.6 cy Stone



Pond UIS1: UIS#1



Summary for Pond UIS2: UIS #2

Inflow Area = 86,189 sf, 52.62% Impervious, Inflow Depth = 3.86" for 25-Year event
Inflow = 7.98 cfs @ 12.10 hrs, Volume= 27,713 cf
Outflow = 4.88 cfs @ 12.22 hrs, Volume= 23,567 cf, Atten= 39%, Lag= 7.7 min
Primary = 4.88 cfs @ 12.22 hrs, Volume= 23,567 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 129.27' @ 12.22 hrs Surf.Area= 2,915 sf Storage= 8,403 cf

Plug-Flow detention time= 124.6 min calculated for 23,567 cf (85% of inflow)
Center-of-Mass det. time= 60.5 min (856.0 - 795.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	125.00'	4,107 cf	**22.75'W x 127.59'L x 5.50'H Field A** 15,965 cf Overall - 5,697 cf Embedded = 10,268 cf x 40.0% Voids
#2A	125.75'	5,697 cf	**ADS_StormTech MC-3500 d +Cap** x 51 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 3 Rows of 17 Chambers Cap Storage= +14.9 cf x 2 x 3 rows = 89.4 cf
#3	125.75'	82 cf	**4.00'D x 6.50'H Vertical Cone/Cylinder**
		9,886 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	125.75'	**18.0" Round 18" HDPE** L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 125.75' / 125.25' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#2	Device 1	127.10'	**12.0" Vert. 12" Orifice** C= 0.600

Primary OutFlow Max=4.85 cfs @ 12.22 hrs HW=129.25' (Free Discharge)
└─**1=18" HDPE** (Passes 4.85 cfs of 11.13 cfs potential flow)
  └─**2=12" Orifice** (Orifice Controls 4.85 cfs @ 6.18 fps)

Pond UIS2: UIS #2 - Chamber Wizard Field A

Chamber Model = ADS_StormTech MC-3500 d +Cap (ADS StormTech® MC-3500 d rev 03/14 with Cap volume)
Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf
Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap
Cap Storage= +14.9 cf x 2 x 3 rows = 89.4 cf

77.0" Wide + 9.0" Spacing = 86.0" C-C Row Spacing

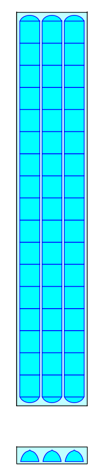
17 Chambers/Row x 7.17' Long +1.85' Cap Length x 2 = 125.59' Row Length +12.0" End Stone x 2 = 127.59' Base Length
3 Rows x 77.0" Wide + 9.0" Spacing x 2 + 12.0" Side Stone x 2 = 22.75' Base Width
9.0" Base + 45.0" Chamber Height + 12.0" Cover = 5.50' Field Height

51 Chambers x 110.0 cf + 14.9 cf Cap Volume x 2 x 3 Rows = 5,696.9 cf Chamber Storage

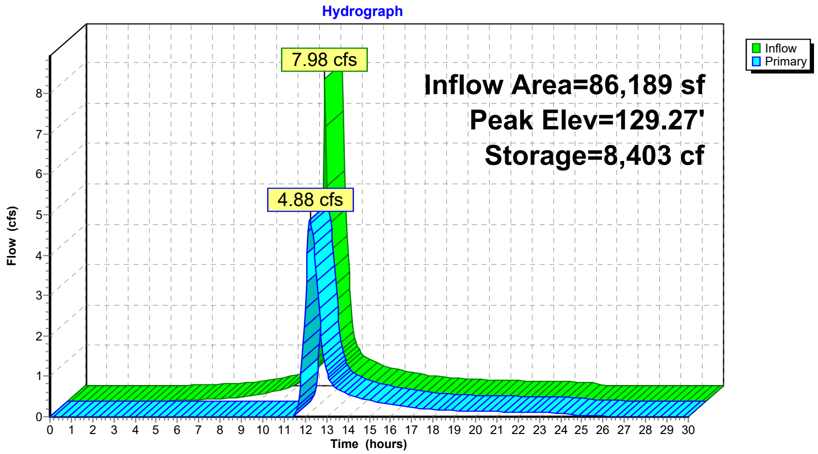
15,964.7 cf Field - 5,696.9 cf Chambers = 10,267.7 cf Stone x 40.0% Voids = 4,107.1 cf Stone Storage

Chamber Storage + Stone Storage = 9,804.0 cf = 0.225 af
Overall Storage Efficiency = 61.4%
Overall System Size = 127.59' x 22.75' x 5.50'

51 Chambers
591.3 cy Field
380.3 cy Stone



Pond UIS2: UIS #2

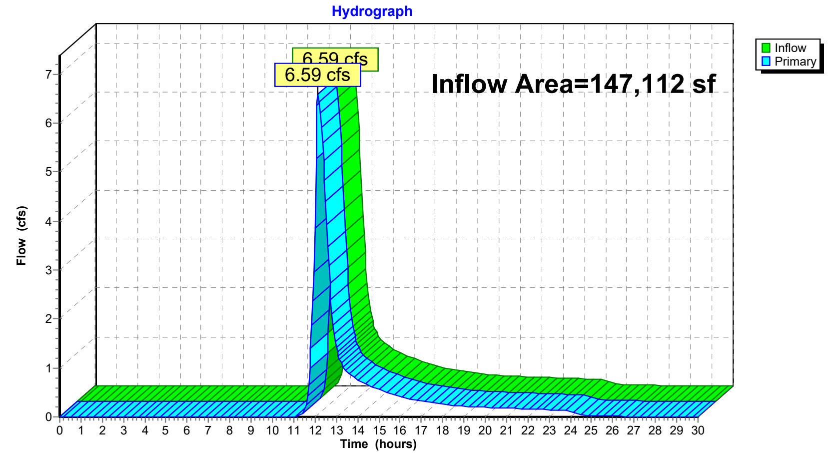


Summary for Link SP-1: Study Point #1

Inflow Area = 147,112 sf, 30.83% Impervious, Inflow Depth > 2.57" for 25-Year event
Inflow = 6.59 cfs @ 12.15 hrs, Volume= 31,450 cf
Primary = 6.59 cfs @ 12.15 hrs, Volume= 31,450 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link SP-1: Study Point #1

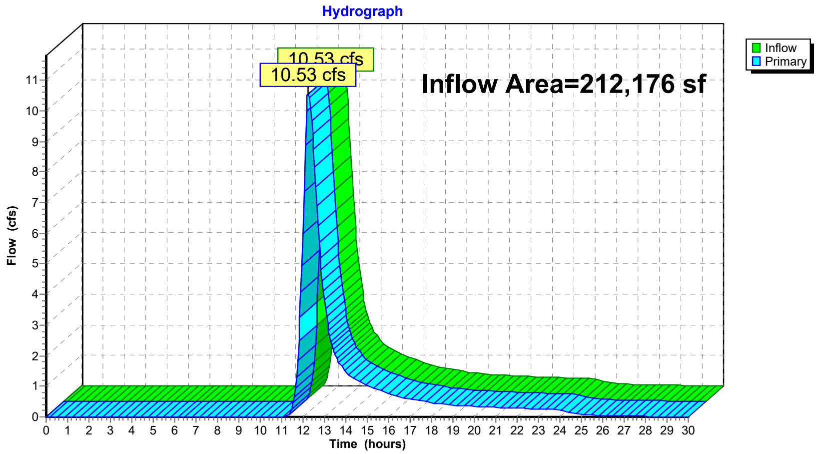


Summary for Link SP-2: Study Point #2

Inflow Area = 212,176 sf, 61.56% Impervious, Inflow Depth > 3.37" for 25-Year event
Inflow = 10.53 cfs @ 12.23 hrs, Volume= 59,640 cf
Primary = 10.53 cfs @ 12.23 hrs, Volume= 59,640 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link SP-2: Study Point #2



Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P-1: Off-site Runoff Runoff Area=60,923 sf 0.00% Impervious Runoff Depth=2.35"
Tc=6.0 min CN=61 Runoff=3.66 cfs 11,917 cf

Subcatchment P-10: Building 1 Parking - Runoff Area=38,312 sf 54.69% Impervious Runoff Depth=5.00"
Tc=6.0 min CN=87 Runoff=4.87 cfs 15,954 cf

Subcatchment P-2: Building 2 Parking - Runoff Area=35,850 sf 66.11% Impervious Runoff Depth=5.33"
Tc=6.0 min CN=90 Runoff=4.77 cfs 15,935 cf

Subcatchment P-3: Building 1 Parking - Runoff Area=31,194 sf 69.40% Impervious Runoff Depth=5.45"
Tc=6.0 min CN=91 Runoff=4.20 cfs 14,160 cf

Subcatchment P-4: Building 2 - West Runoff Area=19,145 sf 0.00% Impervious Runoff Depth=3.61"
Tc=6.0 min CN=74 Runoff=1.82 cfs 5,759 cf

Subcatchment P-5: Building 2/3 Runoff Area=57,136 sf 100.00% Impervious Runoff Depth=6.26"
Tc=6.0 min CN=98 Runoff=8.16 cfs 29,812 cf

Subcatchment P-6: Building 1 Runoff Area=21,727 sf 100.00% Impervious Runoff Depth=6.26"
Tc=6.0 min CN=98 Runoff=3.10 cfs 11,337 cf

Subcatchment P-7: Building 2/3 Courtyard Runoff Area=21,205 sf 39.73% Impervious Runoff Depth=4.67"
Tc=6.0 min CN=84 Runoff=2.55 cfs 8,246 cf

Subcatchment P-8: Building 1 Courtyard Runoff Area=43,160 sf 15.16% Impervious Runoff Depth=3.82"
Tc=6.0 min UI Adjusted CN=76 Runoff=4.34 cfs 13,722 cf

Subcatchment P-9: Building 2 Parking - Runoff Area=30,636 sf 51.66% Impervious Runoff Depth=4.89"
Tc=6.0 min CN=86 Runoff=3.83 cfs 12,474 cf

Reach 1R: Swale - West of Building 2/3 Avg. Flow Depth=0.16' Max Vel=1.67 fps Inflow=1.82 cfs 5,759 cf
n=0.050 L=255.0' S=0.0392 '/' Capacity=141.63 cfs Outflow=1.71 cfs 5,759 cf

Pond 1P: MC-3500 Peak Elev=129.20' Storage=11,117 cf Inflow=12.31 cfs 41,013 cf
Outflow=7.23 cfs 36,396 cf

Pond UIS1: UIS#1 Peak Elev=139.74' Storage=18,277 cf Inflow=14.55 cfs 50,533 cf
Outflow=6.37 cfs 43,369 cf

Pond UIS2: UIS #2 Peak Elev=130.33' Storage=9,666 cf Inflow=10.27 cfs 35,854 cf
Outflow=6.25 cfs 31,707 cf

Link SP-1: Study Point #1 Inflow=9.00 cfs 43,624 cf
Primary=9.00 cfs 43,624 cf

Link SP-2: Study Point #2 Inflow=13.50 cfs 79,765 cf
Primary=13.50 cfs 79,765 cf

Total Runoff Area = 359,288 sf Runoff Volume = 139,316 cf Average Runoff Depth = 4.65"
51.03% Pervious = 183,330 sf 48.97% Impervious = 175,958 sf

Summary for Subcatchment P-1: Off-site Runoff Northwest

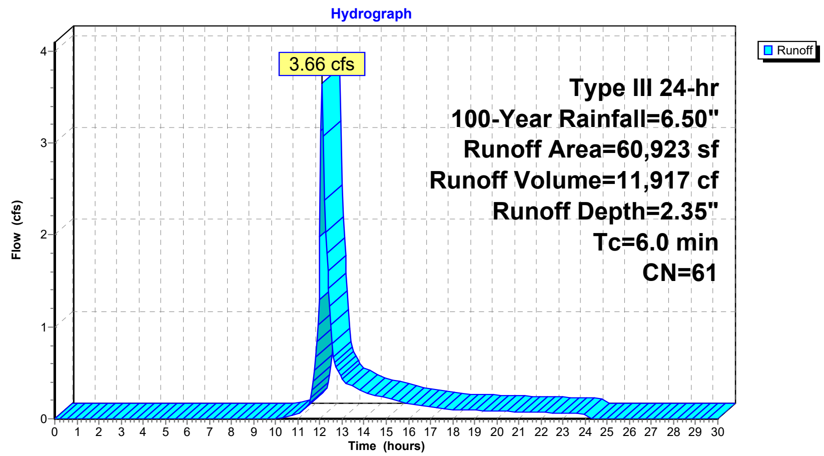
Runoff = 3.66 cfs @ 12.10 hrs, Volume= 11,917 cf, Depth= 2.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
3,360	39	>75% Grass cover, Good, HSG A
10,231	61	>75% Grass cover, Good, HSG B
13,385	74	>75% Grass cover, Good, HSG C
27,255	55	Woods, Good, HSG B
6,692	70	Woods, Good, HSG C
60,923	61	Weighted Average
60,923		100.00% Pervious Area

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

Subcatchment P-1: Off-site Runoff Northwest



Summary for Subcatchment P-10: Building 1 Parking - Southeast

Tc of 4.6 rounds to minimum of 5.0. Use Tc = 5.0 mimutes for E-2.

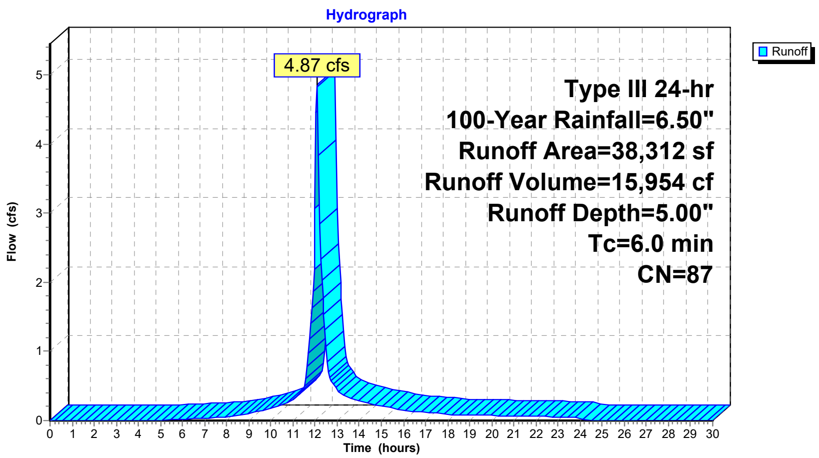
Runoff = 4.87 cfs @ 12.09 hrs, Volume= 15,954 cf, Depth= 5.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
20,952	98	Paved parking, HSG C
17,360	74	>75% Grass cover, Good, HSG C
38,312	87	Weighted Average
17,360		45.31% Pervious Area
20,952		54.69% Impervious Area

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

Subcatchment P-10: Building 1 Parking - Southeast



Summary for Subcatchment P-2: Building 2 Parking - North

Tc of 4.6 rounds to minimum of 5.0. Use Tc = 5.0 mimutes for E-2.

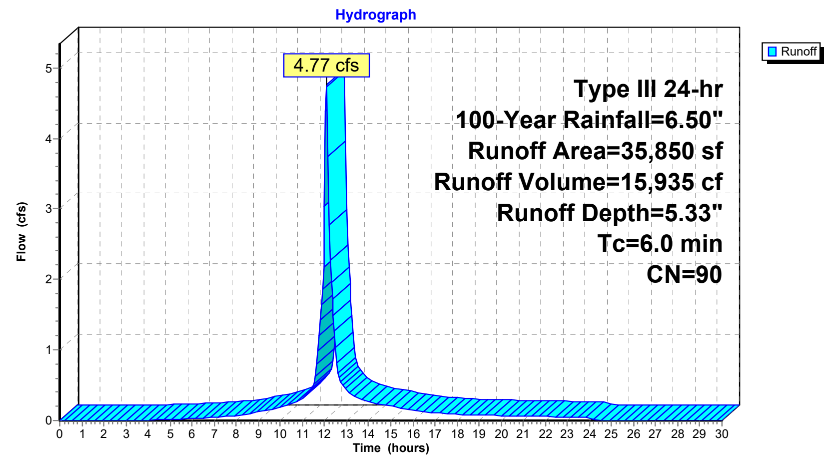
Runoff = 4.77 cfs @ 12.09 hrs, Volume= 15,935 cf, Depth= 5.33"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
23,700	98	Paved parking, HSG C
12,150	74	>75% Grass cover, Good, HSG C
35,850	90	Weighted Average
12,150		33.89% Pervious Area
23,700		66.11% Impervious Area

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

Subcatchment P-2: Building 2 Parking - North



Summary for Subcatchment P-3: Building 1 Parking - North

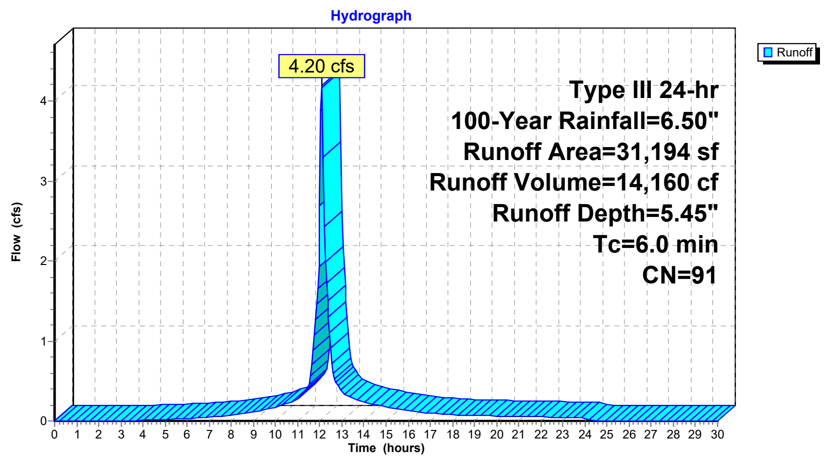
Runoff = 4.20 cfs @ 12.09 hrs, Volume= 14,160 cf, Depth= 5.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
21,650	98	Unconnected pavement, HSG C
9,544	74	>75% Grass cover, Good, HSG C
31,194	91	Weighted Average
9,544		30.60% Pervious Area
21,650		69.40% Impervious Area
21,650		100.00% Unconnected

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

Subcatchment P-3: Building 1 Parking - North



Summary for Subcatchment P-4: Building 2 - West

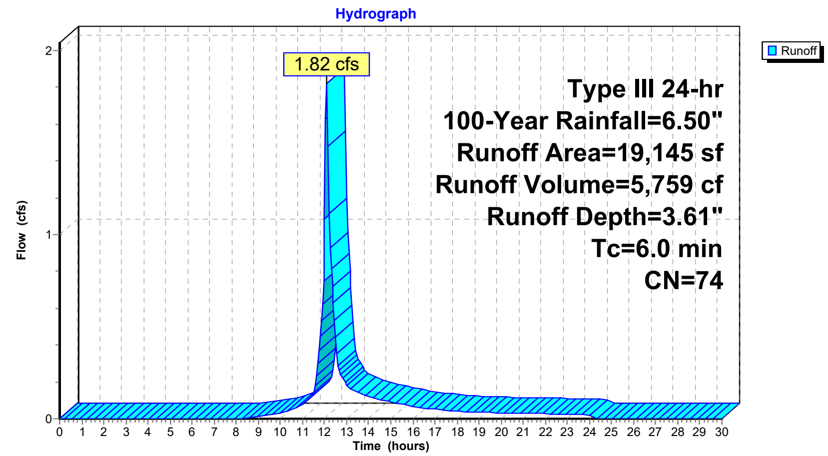
Runoff = 1.82 cfs @ 12.09 hrs, Volume= 5,759 cf, Depth= 3.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
0	98	Unconnected pavement, HSG C
19,145	74	>75% Grass cover, Good, HSG C
19,145	74	Weighted Average
19,145		100.00% Pervious Area

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

Subcatchment P-4: Building 2 - West



Summary for Subcatchment P-5: Building 2/3

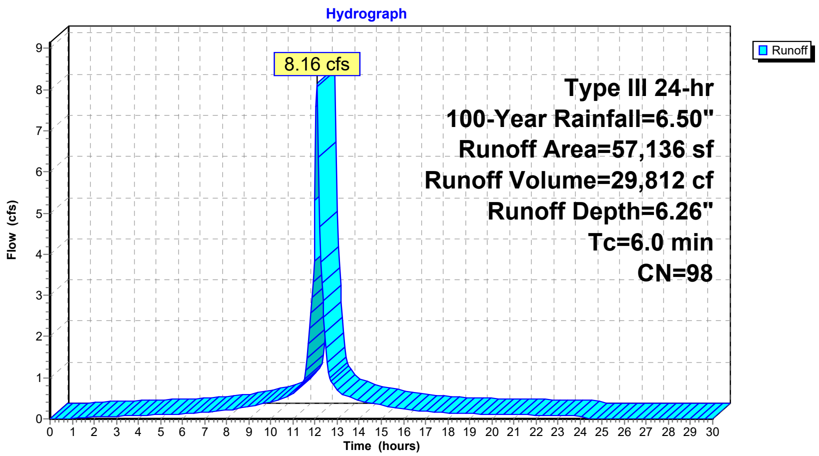
Runoff = 8.16 cfs @ 12.09 hrs, Volume= 29,812 cf, Depth= 6.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
57,136	98	Unconnected pavement, HSG C
57,136		100.00% Impervious Area
57,136		100.00% Unconnected

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

Subcatchment P-5: Building 2/3



Summary for Subcatchment P-6: Building 1

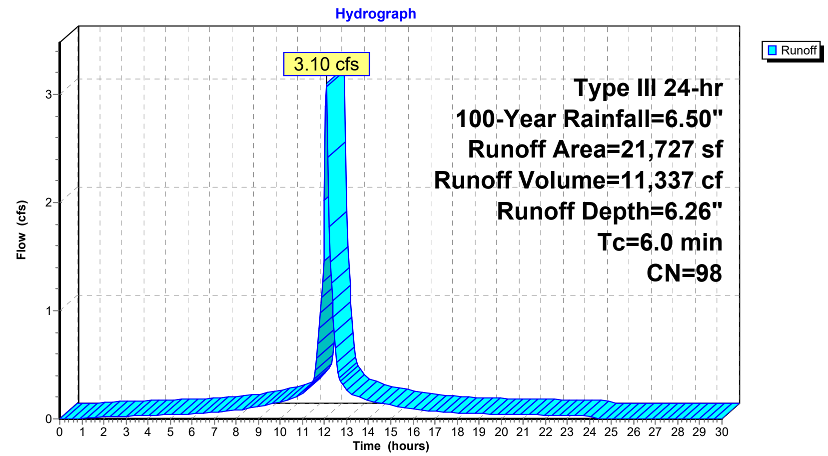
Runoff = 3.10 cfs @ 12.09 hrs, Volume= 11,337 cf, Depth= 6.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
21,727	98	Unconnected pavement, HSG C
21,727		100.00% Impervious Area
21,727		100.00% Unconnected

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

Subcatchment P-6: Building 1



Summary for Subcatchment P-7: Building 2/3 Courtyard

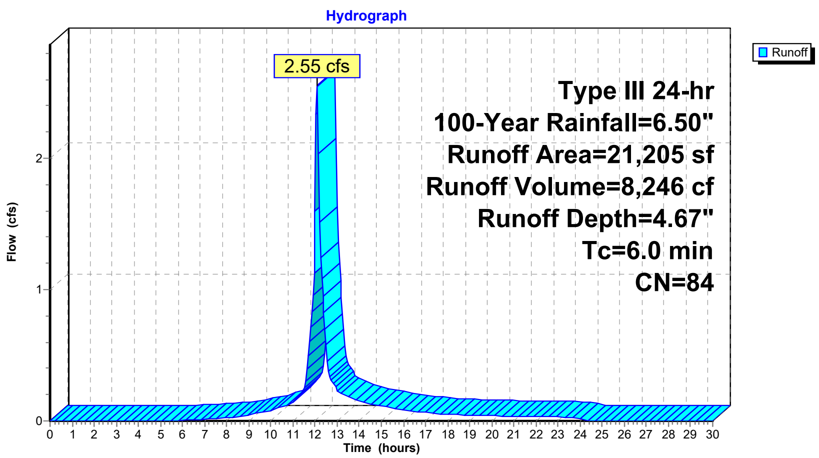
Runoff = 2.55 cfs @ 12.09 hrs, Volume= 8,246 cf, Depth= 4.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
8,424	98	Unconnected pavement, HSG C
12,781	74	>75% Grass cover, Good, HSG C
21,205	84	Weighted Average
12,781		60.27% Pervious Area
8,424		39.73% Impervious Area
8,424		100.00% Unconnected

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

Subcatchment P-7: Building 2/3 Courtyard



Summary for Subcatchment P-8: Building 1 Courtyard

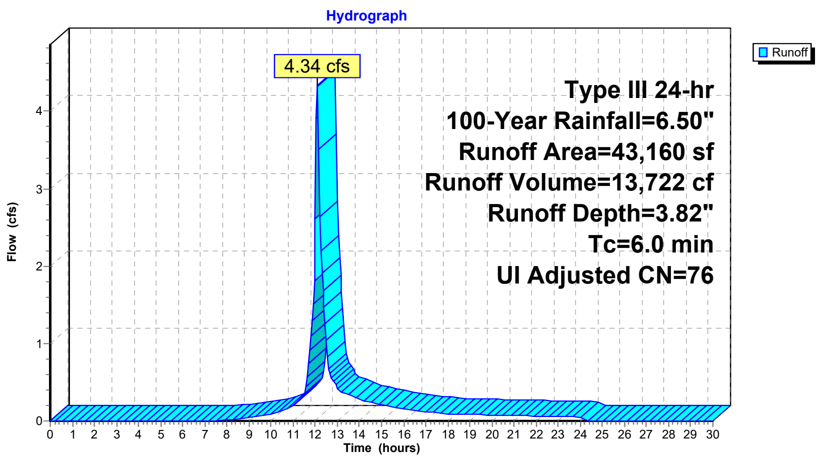
Runoff = 4.34 cfs @ 12.09 hrs, Volume= 13,722 cf, Depth= 3.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Adj	Description
6,542	98		Unconnected pavement, HSG C
36,618	74		>75% Grass cover, Good, HSG C
43,160	78	76	Weighted Average, UI Adjusted
36,618			84.84% Pervious Area
6,542			15.16% Impervious Area
6,542			100.00% Unconnected

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

Subcatchment P-8: Building 1 Courtyard



Summary for Subcatchment P-9: Building 2 Parking - South

Tc of 4.6 rounds to minimum of 5.0. Use Tc = 5.0 mimutes for E-2.

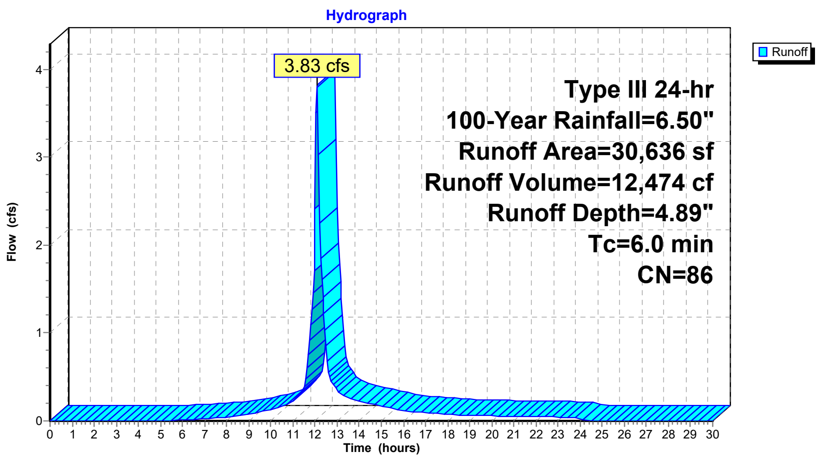
Runoff = 3.83 cfs @ 12.09 hrs, Volume= 12,474 cf, Depth= 4.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
15,827	98	Unconnected pavement, HSG C
14,809	74	>75% Grass cover, Good, HSG C
30,636	86	Weighted Average
14,809		48.34% Pervious Area
15,827		51.66% Impervious Area
15,827		100.00% Unconnected

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

Subcatchment P-9: Building 2 Parking - South



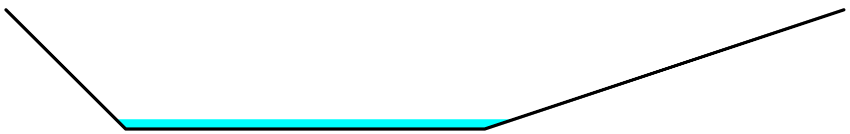
Summary for Reach 1R: Swale - West of Building 2/3

Inflow Area = 19,145 sf, 0.00% Impervious, Inflow Depth = 3.61" for 100-Year event
Inflow = 1.82 cfs @ 12.09 hrs, Volume= 5,759 cf
Outflow = 1.71 cfs @ 12.16 hrs, Volume= 5,759 cf, Atten= 6%, Lag= 4.3 min

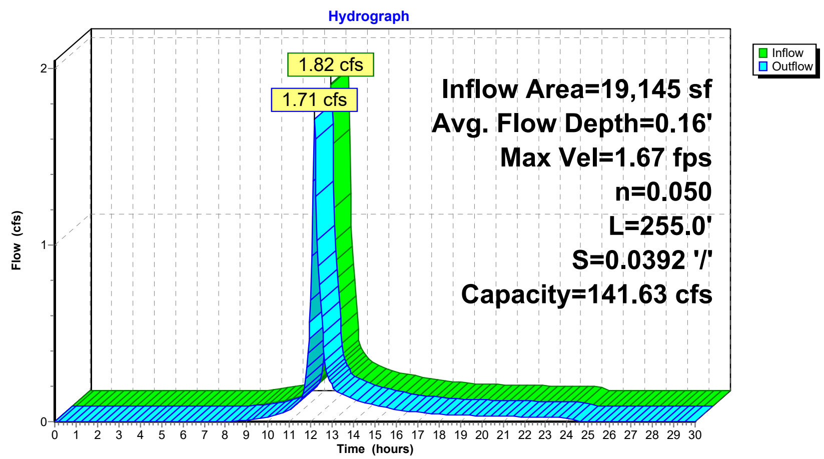
Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.67 fps, Min. Travel Time= 2.5 min
Avg. Velocity = 0.52 fps, Avg. Travel Time= 8.2 min

Peak Storage= 263 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.16'
Bank-Full Depth= 2.00' Flow Area= 20.0 sf, Capacity= 141.63 cfs

6.00' x 2.00' deep channel, n= 0.050 Earth, cobble bottom, clean sides
Side Slope Z-value= 1.0 3.0 '/' Top Width= 14.00'
Length= 255.0' Slope= 0.0392 '/'
Inlet Invert= 144.00', Outlet Invert= 134.00'



Reach 1R: Swale - West of Building 2/3



Summary for Pond 1P: MC-3500

Inflow Area = 103,199 sf, 47.70% Impervious, Inflow Depth = 4.77" for 100-Year event
Inflow = 12.31 cfs @ 12.09 hrs, Volume= 41,013 cf
Outflow = 7.23 cfs @ 12.21 hrs, Volume= 36,396 cf, Atten= 41%, Lag= 7.3 min
Primary = 7.23 cfs @ 12.21 hrs, Volume= 36,396 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 129.20' @ 12.21 hrs Surf.Area= 3,402 sf Storage= 11,117 cf

Plug-Flow detention time= 110.1 min calculated for 36,396 cf (89% of inflow)
Center-of-Mass det. time= 56.9 min (845.1 - 788.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	124.00'	4,786 cf	**37.08'W x 91.74'L x 5.50'H Field A** 18,711 cf Overall - 6,746 cf Embedded = 11,965 cf x 40.0% Voids
#2A	124.75'	6,746 cf	**ADS_StormTech MC-3500 d +Cap** x 60 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 5 Rows of 12 Chambers Cap Storage= +14.9 cf x 2 x 5 rows = 149.0 cf
		11,532 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	124.75'	**15.0" Round 15" HDPE** L= 100.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 124.75' / 123.75' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf
#2	Device 1	126.00'	**13.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=7.20 cfs @ 12.21 hrs HW=129.17' (Free Discharge)
└─**1=15" HDPE** (Passes 7.20 cfs of 9.09 cfs potential flow)
  └─**2=Orifice/Grate** (Orifice Controls 7.20 cfs @ 7.81 fps)

Pond 1P: MC-3500 - Chamber Wizard Field A

Chamber Model = ADS_StormTech MC-3500 d +Cap (ADS StormTech® MC-3500 d rev 03/14 with Cap volume)
Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf
Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap
Cap Storage= +14.9 cf x 2 x 5 rows = 149.0 cf

77.0" Wide + 9.0" Spacing = 86.0" C-C Row Spacing

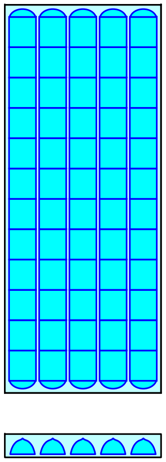
12 Chambers/Row x 7.17' Long +1.85' Cap Length x 2 = 89.74' Row Length +12.0" End Stone x 2 = 91.74' Base Length
5 Rows x 77.0" Wide + 9.0" Spacing x 4 + 12.0" Side Stone x 2 = 37.08' Base Width
9.0" Base + 45.0" Chamber Height + 12.0" Cover = 5.50' Field Height

60 Chambers x 110.0 cf + 14.9 cf Cap Volume x 2 x 5 Rows = 6,746.1 cf Chamber Storage

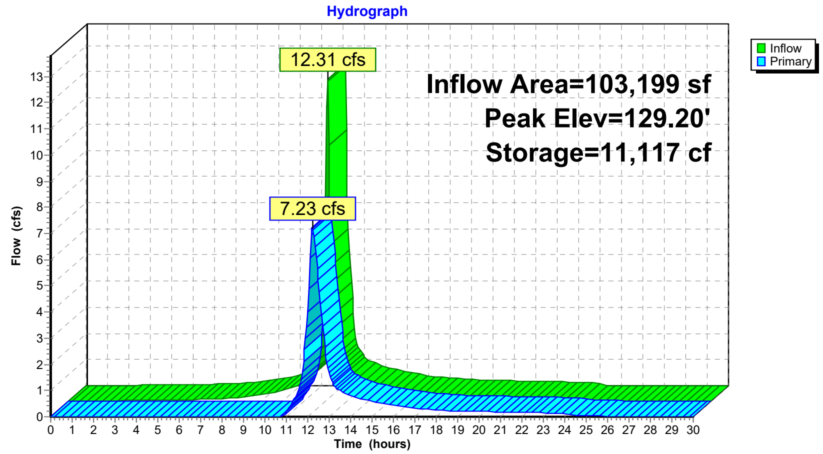
18,711.1 cf Field - 6,746.1 cf Chambers = 11,965.0 cf Stone x 40.0% Voids = 4,786.0 cf Stone Storage

Chamber Storage + Stone Storage = 11,532.1 cf = 0.265 af
Overall Storage Efficiency = 61.6%
Overall System Size = 91.74' x 37.08' x 5.50'

60 Chambers
693.0 cy Field
443.1 cy Stone



Pond 1P: MC-3500



Summary for Pond UIS1: UIS#1

Inflow Area = 108,977 sf, 74.68% Impervious, Inflow Depth = 5.56" for 100-Year event
Inflow = 14.55 cfs @ 12.09 hrs, Volume= 50,533 cf
Outflow = 6.37 cfs @ 12.28 hrs, Volume= 43,369 cf, Atten= 56%, Lag= 11.5 min
Primary = 6.37 cfs @ 12.28 hrs, Volume= 43,369 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 139.74' @ 12.28 hrs Surf.Area= 5,529 sf Storage= 18,277 cf

Plug-Flow detention time= 146.0 min calculated for 43,297 cf (86% of inflow)
Center-of-Mass det. time= 84.7 min (850.5 - 765.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	134.50'	7,706 cf	**37.08'W x 149.10'L x 5.50'H Field A** 30,410 cf Overall - 11,144 cf Embedded = 19,266 cf x 40.0% Voids
#2A	135.25'	11,144 cf	**ADS_StormTech MC-3500 d +Cap** x 100 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 5 Rows of 20 Chambers Cap Storage= +14.9 cf x 2 x 5 rows = 149.0 cf
		18,851 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	135.25'	**15.0" Round 15" HDPE** L= 100.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 135.25' / 132.25' S= 0.0300 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf
#2	Device 1	136.40'	**12.0" Vert. 12" Orifice** C= 0.600

Primary OutFlow Max=6.36 cfs @ 12.28 hrs HW=139.73' (Free Discharge)
└─**1=15" HDPE** (Passes 6.36 cfs of 9.16 cfs potential flow)
  └─**2=12" Orifice** (Orifice Controls 6.36 cfs @ 8.10 fps)

Pond UIS1: UIS#1 - Chamber Wizard Field A

Chamber Model = ADS_StormTechMC-3500 d +Cap (ADS StormTech®MC-3500 d rev 03/14 with Cap volume)
Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf
Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap
Cap Storage= +14.9 cf x 2 x 5 rows = 149.0 cf

77.0" Wide + 9.0" Spacing = 86.0" C-C Row Spacing

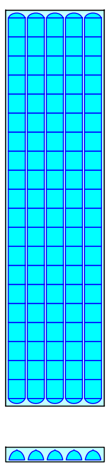
20 Chambers/Row x 7.17' Long +1.85' Cap Length x 2 = 147.10' Row Length +12.0" End Stone x 2 = 149.10' Base Length
5 Rows x 77.0" Wide + 9.0" Spacing x 4 + 12.0" Side Stone x 2 = 37.08' Base Width
9.0" Base + 45.0" Chamber Height + 12.0" Cover = 5.50' Field Height

100 Chambers x 110.0 cf + 14.9 cf Cap Volume x 2 x 5 Rows = 11,144.2 cf Chamber Storage

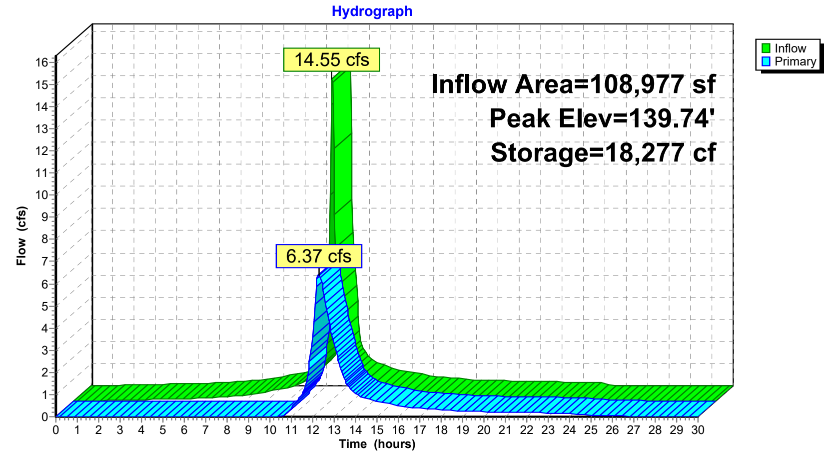
30,410.2 cf Field - 11,144.2 cf of Chambers = 19,266.0 cf Stone x 40.0% Voids = 7,706.4 cf Stone Storage

Chamber Storage + Stone Storage = 18,850.6 cf = 0.433 af
Overall Storage Efficiency = 62.0%
Overall System Size = 149.10' x 37.08' x 5.50'

100 Chambers
1,126.3 cy Field
713.6 cy Stone



Pond UIS1: UIS#1



Summary for Pond UIS2: UIS #2

Inflow Area =	86,189 sf,	52.62% Impervious,	Inflow Depth = 4.99"	for 100-Year event	
Inflow =	10.27 cfs @	12.10 hrs,	Volume=	35,854 cf	
Outflow =	6.25 cfs @	12.22 hrs,	Volume=	31,707 cf,	Atten= 39%, Lag= 7.7 min
Primary =	6.25 cfs @	12.22 hrs,	Volume=	31,707 cf	

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 130.33' @ 12.22 hrs Surf.Area= 2,915 sf Storage= 9,666 cf

Plug-Flow detention time= 108.5 min calculated for 31,707 cf (88% of inflow)
Center-of-Mass det. time= 54.5 min (843.5 - 789.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	125.00'	4,107 cf	**22.75'W x 127.59'L x 5.50'H Field A** 15,965 cf Overall - 5,697 cf Embedded = 10,268 cf x 40.0% Voids
#2A	125.75'	5,697 cf	**ADS_StormTech MC-3500 d +Cap** x 51 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 3 Rows of 17 Chambers Cap Storage= +14.9 cf x 2 x 3 rows = 89.4 cf
#3	125.75'	82 cf	**4.00'D x 6.50'H Vertical Cone/Cylinder**
		9,886 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	125.75'	**18.0" Round 18" HDPE** L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 125.75' / 125.25' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#2	Device 1	127.10'	**12.0" Vert. 12" Orifice** C= 0.600

Primary OutFlow Max=6.21 cfs @ 12.22 hrs HW=130.30' (Free Discharge)
└**1=18" HDPE** (Passes 6.21 cfs of 13.09 cfs potential flow)
 └**2=12" Orifice** (Orifice Controls 6.21 cfs @ 7.91 fps)

Pond UIS2: UIS #2 - Chamber Wizard Field A

Chamber Model = ADS_StormTech MC-3500 d +Cap (ADS StormTech® MC-3500 d rev 03/14 with Cap volume)
Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf
Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap
Cap Storage= +14.9 cf x 2 x 3 rows = 89.4 cf

77.0" Wide + 9.0" Spacing = 86.0" C-C Row Spacing

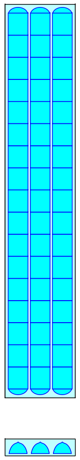
17 Chambers/Row x 7.17' Long +1.85' Cap Length x 2 = 125.59' Row Length +12.0" End Stone x 2 = 127.59' Base Length
3 Rows x 77.0" Wide + 9.0" Spacing x 2 + 12.0" Side Stone x 2 = 22.75' Base Width
9.0" Base + 45.0" Chamber Height + 12.0" Cover = 5.50' Field Height

51 Chambers x 110.0 cf + 14.9 cf Cap Volume x 2 x 3 Rows = 5,696.9 cf Chamber Storage

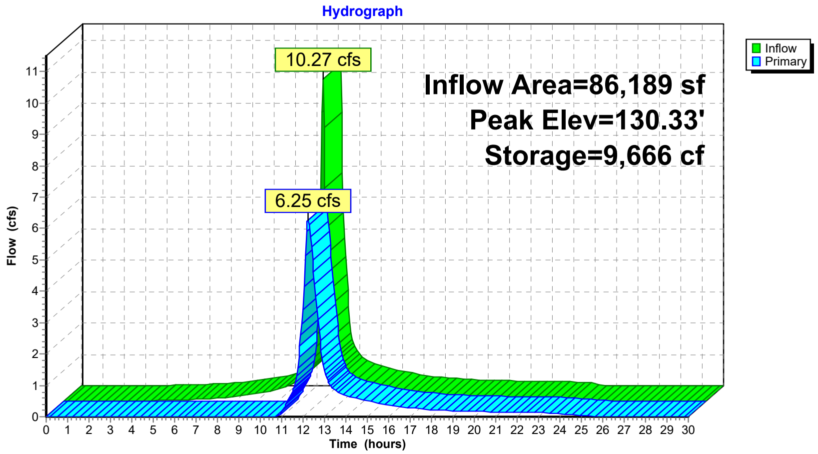
15,964.7 cf Field - 5,696.9 cf Chambers = 10,267.7 cf Stone x 40.0% Voids = 4,107.1 cf Stone Storage

Chamber Storage + Stone Storage = 9,804.0 cf = 0.225 af
Overall Storage Efficiency = 61.4%
Overall System Size = 127.59' x 22.75' x 5.50'

51 Chambers
591.3 cy Field
380.3 cy Stone



Pond UIS2: UIS #2

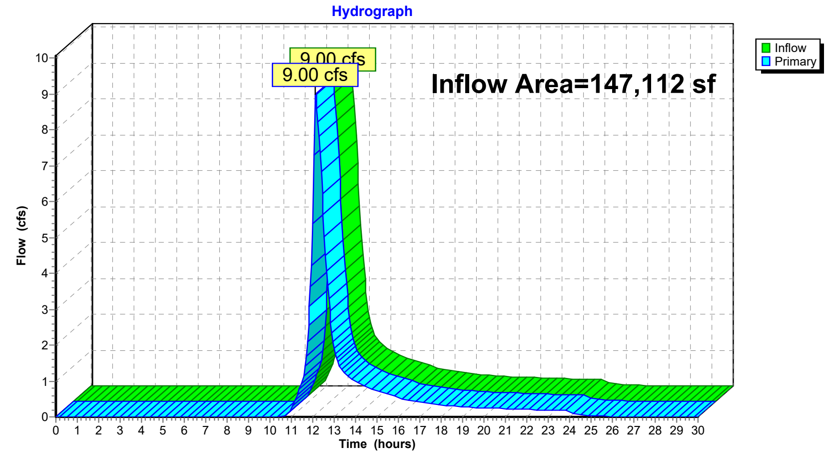


Summary for Link SP-1: Study Point #1

Inflow Area = 147,112 sf, 30.83% Impervious, Inflow Depth > 3.56" for 100-Year event
Inflow = 9.00 cfs @ 12.14 hrs, Volume= 43,624 cf
Primary = 9.00 cfs @ 12.14 hrs, Volume= 43,624 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link SP-1: Study Point #1

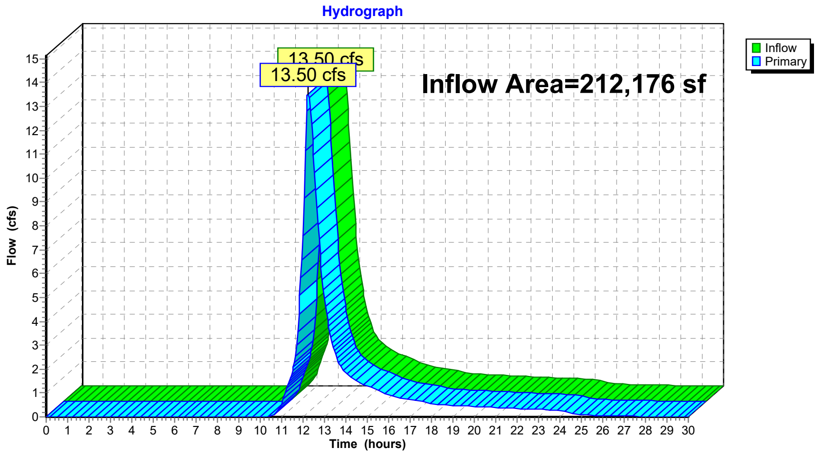


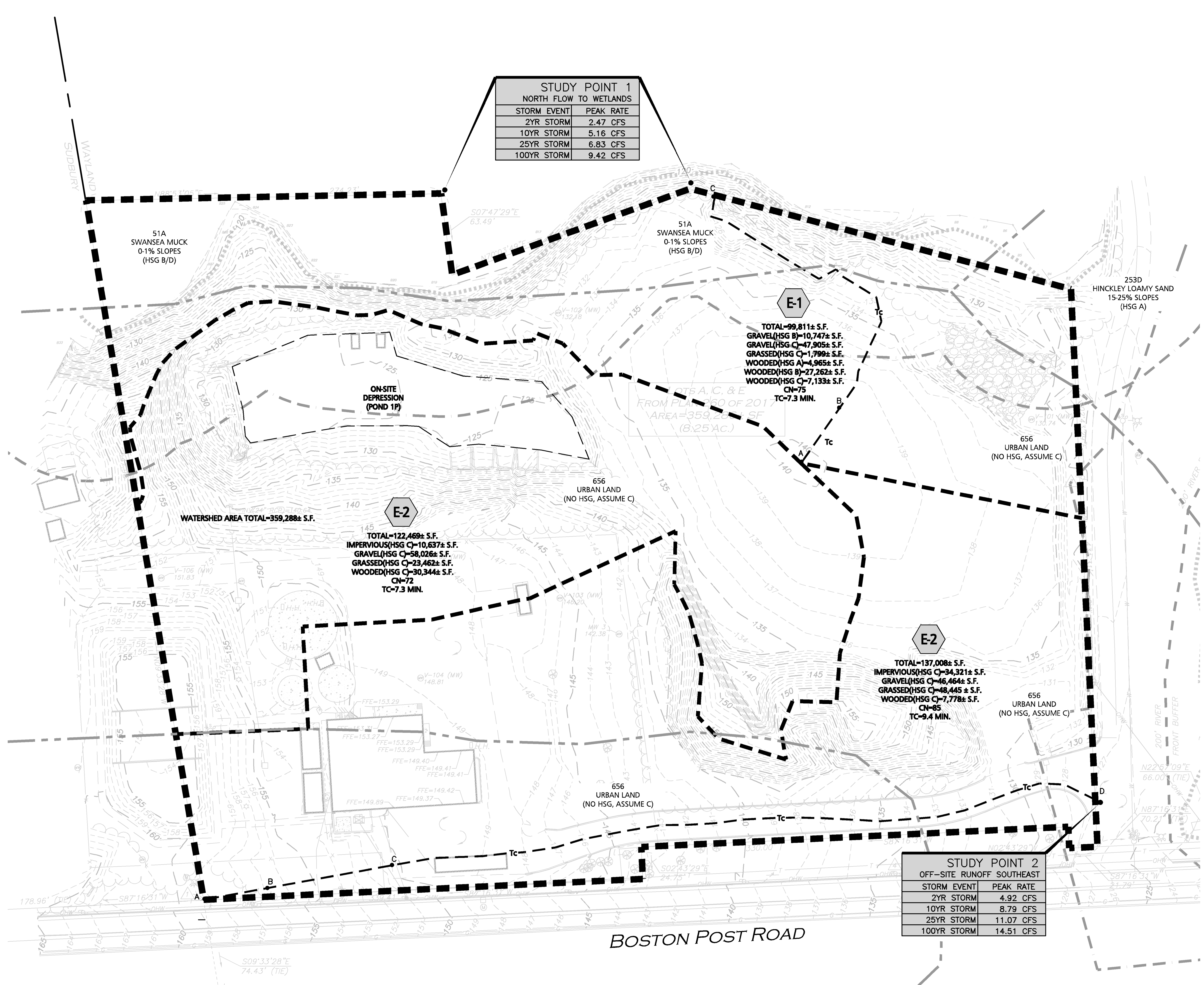
Summary for Link SP-2: Study Point #2

Inflow Area =	212,176 sf, 61.56% Impervious,	Inflow Depth > 4.51"	for 100-Year event
Inflow =	13.50 cfs @ 12.23 hrs, Volume=	79,765 cf	
Primary =	13.50 cfs @ 12.23 hrs, Volume=	79,765 cf, Atten= 0%, Lag= 0.0 min	

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link SP-2: Study Point #2





STUDY POINT 1 NORTH FLOW TO WETLANDS	
STORM EVENT	PEAK RATE
2YR STORM	2.47 CFS
10YR STORM	5.16 CFS
25YR STORM	6.83 CFS
100YR STORM	9.42 CFS

STUDY POINT 2 OFF-SITE RUNOFF SOUTHEAST	
STORM EVENT	PEAK RATE
2YR STORM	4.92 CFS
10YR STORM	8.79 CFS
25YR STORM	11.07 CFS
100YR STORM	14.51 CFS

LEGEND

- EXISTING WATERSHED
- SCS SOILS BOUNDARY
- Tc FLOW PATH (A — B)
- SUBCATCHMENT LABEL (E-1)
- SUBCATCHMENT BOUNDARY
- FLOW DIRECTION

NOTES:

1. THE LOCATIONS OF EXISTING UNDERGROUND UTILITIES ARE SHOWN IN AN APPROXIMATE WAY ONLY AND HAVE NOT BEEN INDEPENDENTLY VERIFIED BY THE OWNER OR IT'S REPRESENTATIVE. THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION OF ALL EXISTING UTILITIES BEFORE COMMENCING WORK, AND AGREES TO BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT BE OCCASIONED BY THE CONTRACTOR'S FAILURE TO EXACTLY LOCATE AND PRESERVE ANY AND ALL UNDERGROUND UTILITIES.
2. THE INFORMATION SHOWN ON THIS PLAN IS THE SOLE PROPERTY OF ALLEN & MAJOR ASSOCIATES, INC. ITS INTENDED USE IS TO PROVIDE INFORMATION. ANY ALTERATION, MISUSE, OR RECALCULATION OF INFORMATION OR DATA WITHOUT THE EXPRESSED, WRITTEN CONSENT OF ALLEN & MAJOR ASSOCIATES, INC. IS STRICTLY PROHIBITED.
3. BASE PLAN TAKEN FROM PLAN ENTITLED "EXISTING CONDITIONS" PREPARED BY ALLEN & MAJOR ASSOCIATES.
4. ADDITIONAL SURVEY INFORMATION TAKEN FROM BASE PLAN ENTITLED "EXISTING CONDITIONS SURVEY – 484-490 BOSTON POST ROAD, WAYLAND MASSACHUSETTS" PREPARED BY WSP SELLS, PREPARED FOR TATA & HOWARD, DATED JULY 16, 2015, ORIGINAL SCALE 1"=60'.
5. ALL EXISTING AND PROPOSED COVER TYPES SHALL BE CONSIDERED "GOOD" FOR MODELING PURPOSES UNLESS OTHERWISE NOTED.
6. TOTAL SITE WATERSHED AREA IS 359,288± S.F.

DIG SAFE

BEFORE YOU DIG
CALL 811 OR
1-888-DIG-SAFE
1-888-344-7233

GRAPHIC SCALE
40 0 20 40 80 160
(IN FEET)
1 inch = 40 ft.

N:\PROJECTS\1670-09A\CIVIL\DRAWINGS\CURRENT\C-1670-09A_WATERSHED-EXISTING.DWG

ISSUED FOR DRAINAGE REPORT
JUNE 20, 2019

PROFESSIONAL ENGINEER FOR
ALLEN & MAJOR ASSOCIATES, INC.

REV	DATE	DESCRIPTION

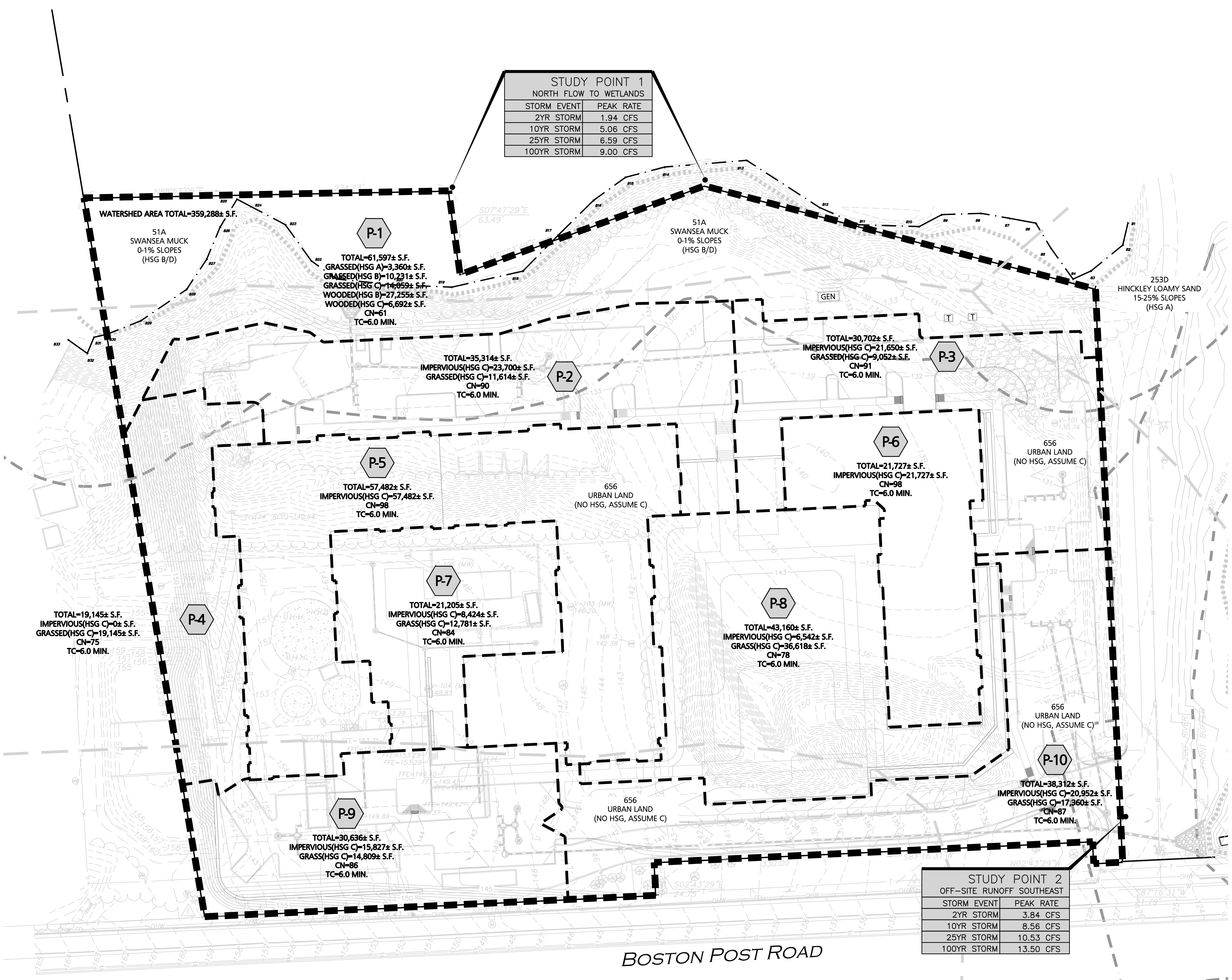
APPLICANT\OWNER:
WP EAST ACQUISITIONS, LLC.
91 HARTWELL AVENUE
LEXINGTON, MA 02421

PROJECT:
ALTA AT RIVER'S EDGE
490 BOSTON POST ROAD
WAYLAND, MA

PROJECT NO.	1670-09A	DATE:	06-20-2019
SCALE:	1" = 40'	DWG. NAME:	1670-09A
DESIGNED BY:	SJL	CHECKED BY:	CMQ

PREPARED BY:
ALLEN & MAJOR
ASSOCIATES, INC.
civil & structural engineering ◆ land surveying
environmental consulting ◆ landscape architecture
www.allenmajor.com
100 COMMERCE WAY, SUITE 5
WOBURN MA 01801
TEL: (781) 935-6889
FAX: (781) 935-2896
WOBURN, MA ◆ LAKEVILLE, MA ◆ MANCHESTER, NH

DRAWING TITLE:	SHEET No.
EXISTING WATERSHED PLAN	EWP



STUDY POINT 1
NORTH FLOW TO WETLANDS

STORM EVENT	PEAK RATE
2YR STORM	1.94 CFS
10YR STORM	5.06 CFS
25YR STORM	6.59 CFS
100YR STORM	9.00 CFS

STUDY POINT 2
OFF-SITE RUNOFF SOUTHEAST

STORM EVENT	PEAK RATE
2YR STORM	3.84 CFS
10YR STORM	8.56 CFS
25YR STORM	10.53 CFS
100YR STORM	13.50 CFS

LEGEND

- EXISTING WATERSHED
- PROPOSED WATERSHED
- SCS SOILS BOUNDARY
- Tc FLOW PATH (A — B)
- SUBCATCHMENT LABEL (P-1)
- SUBCATCHMENT BOUNDARY
- FLOW DIRECTION

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6. TOTAL SITE WATERSHED AREA IS 359,288± S.F.

DIG SAFE
BEFORE YOU DIG
CALL 811 OR
1-888-DIG-SAFE
1-888-344-7233

GRAPHIC SCALE
40 0 20 40 80 160
(IN FEET)
1 inch = 40 ft.

ISSUED FOR DRAINAGE REPORT
JUNE 20, 2019

PROFESSIONAL ENGINEER FOR
ALLEN & MAJOR ASSOCIATES, INC.

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PROJECT NO.	1670-09A	DATE:	06-20-2019
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DESIGNED BY:	SJL	CHECKED BY:	CMQ

PREPARED BY:
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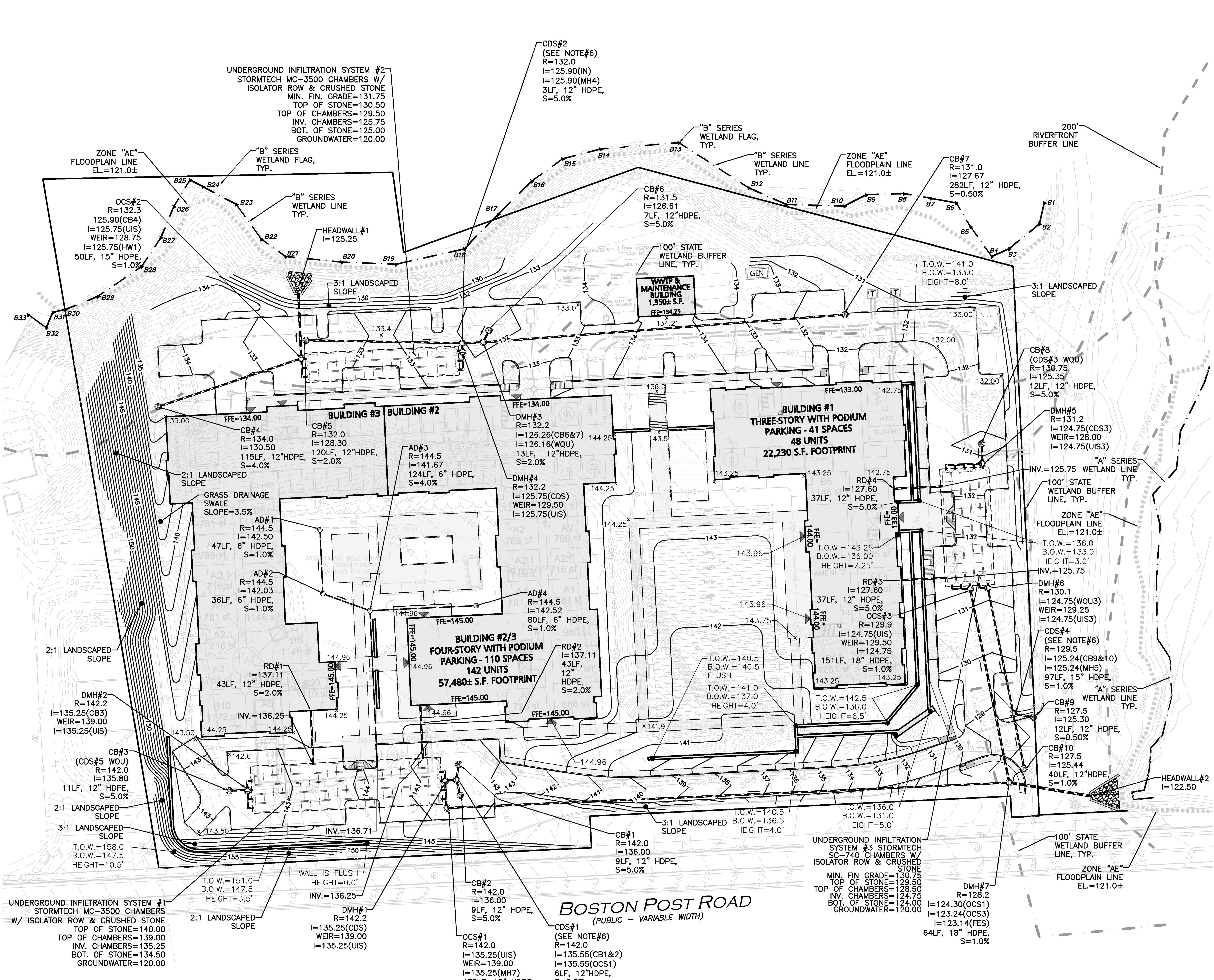
TEL: (781) 935-6889
FAX: (781) 935-2896
WOBURN, MA ◆ LAKEVILLE, MA ◆ MANCHESTER, NH

DRAWING TITLE: PROPOSED WATERSHED PLAN
SHEET No. PWS-1

N:\PROJECTS\1670-09A\CIVIL\DRAWINGS\CURRENT\C-1670-09A_WATERSHED-PROPOSED.DWG



DIG SAFE

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1-888-344-7233

LEGEND

DRAIN MANHOLE	⊙
CATCH BASIN	⊙
CATCH BASIN – DOUBLE GRATE	⊙
DRAIN MANHOLE W/ WEIR	◑
AREA DRAIN	◦
CLEANOUT	•
SPOT GRADE	×148.00
DRAIN LINE	
5' CONTOUR	—200—
1' CONTOUR	—198—
INFILTRATION SYSTEM	
INFILTRATION CHAMBERS	
ISOLATOR ROW	

NOTES:

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3. PIPE DIMENSIONS ARE MEASURED FROM THE INSIDE FACE OF THE STRUCTURE.
4. THE CONTRACTOR SHALL CONTACT "DIGSAFE" AND THE AT LEAST 72 HOURS PRIOR TO ANY EXCAVATION WORK TO REQUEST THE LOCATION OF THE EXISTING UTILITIES. DIGSAFE: 1-888-344-7233
5. ANY ROOF DRAINAGE PIPE LOCATED WITHIN 10' OF THE BUILDING FOUNDATION SHALL BE CAST IRON PIPE PER MA PLUMBING CODE.
6. ALL "CDS" STRUCTURES HAVE BEEN SIZED USING THE WATER QUALITY FLOW RATE PER MASS STORMWATER HANDBOOK AND SHALL BE CONTECH CDS2015-4-C OR APPROVED EQUIVALENT.

GRAPHIC SCALE

40 0 20 40 80 160

(IN FEET)
1 inch = 40 ft.

ISSUED FOR DRAINAGE REPORT
JUNE 20, 2019

PROFESSIONAL ENGINEER FOR ALLEN & MAJOR ASSOCIATES, INC.

REV	DATE	DESCRIPTION

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FAX: (781) 935-2896

WOBURN, MA ◆ LAKEVILLE, MA ◆ MANCHESTER, NH

DRAWING TITLE:	SHEET No.
GRADING & DRAINAGE PLAN	C-103

N:\PROJECTS\1670-09A\CIVIL\DRAWINGS\CURRENT\C-1670-09A_GRADING & DRAINAGE.DWG

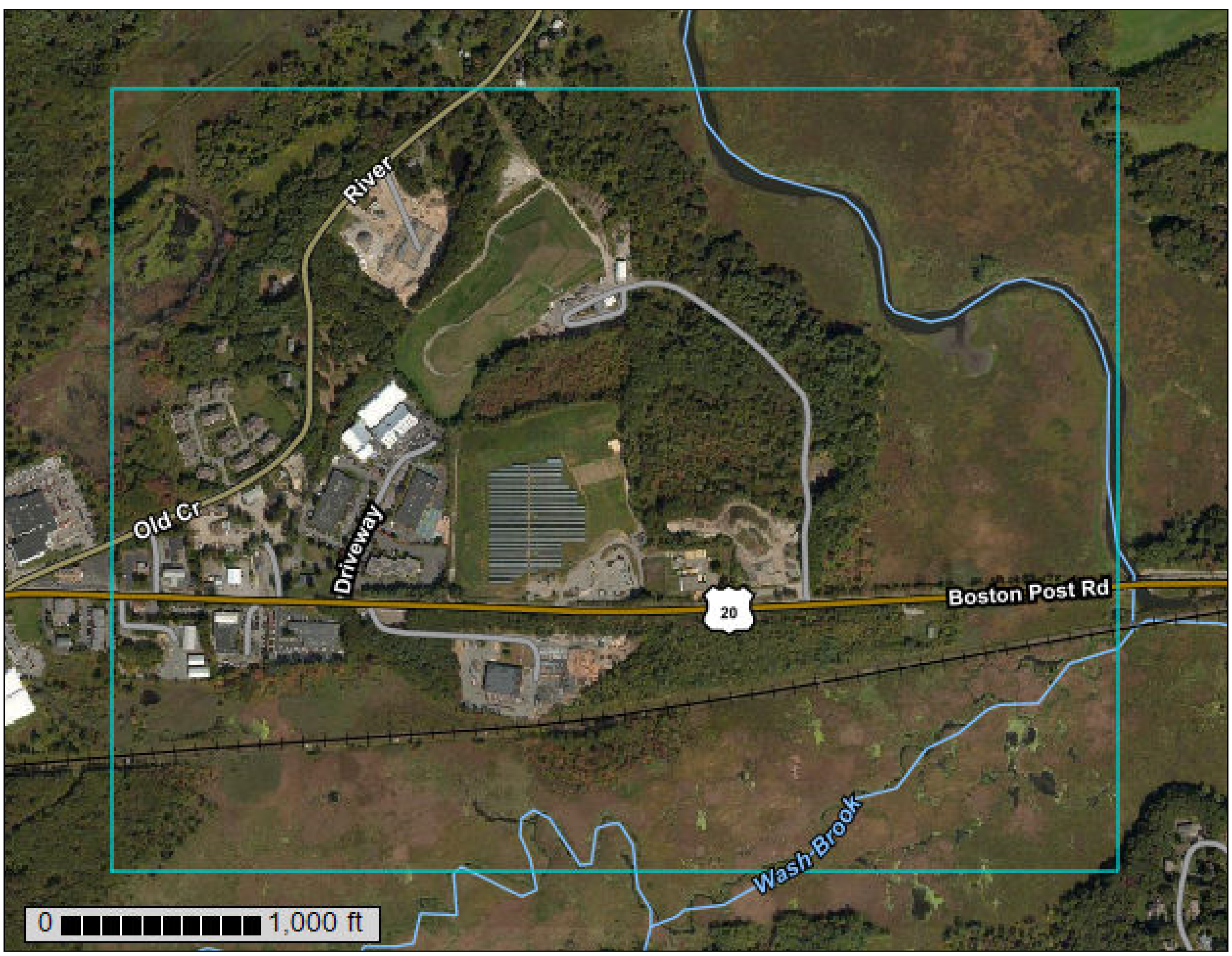
United States Department of Agriculture

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for

Middlesex County, Massachusetts



April 30, 2019

Soil Map

Map Scale: 1:10,100 if printed on A landscape (11" x 8.5") sheet.

Meters: 0 100 200 400 600

Feet: 0 450 900 1800 2700

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:25,000.

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:
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 18, Sep 7, 2018

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.

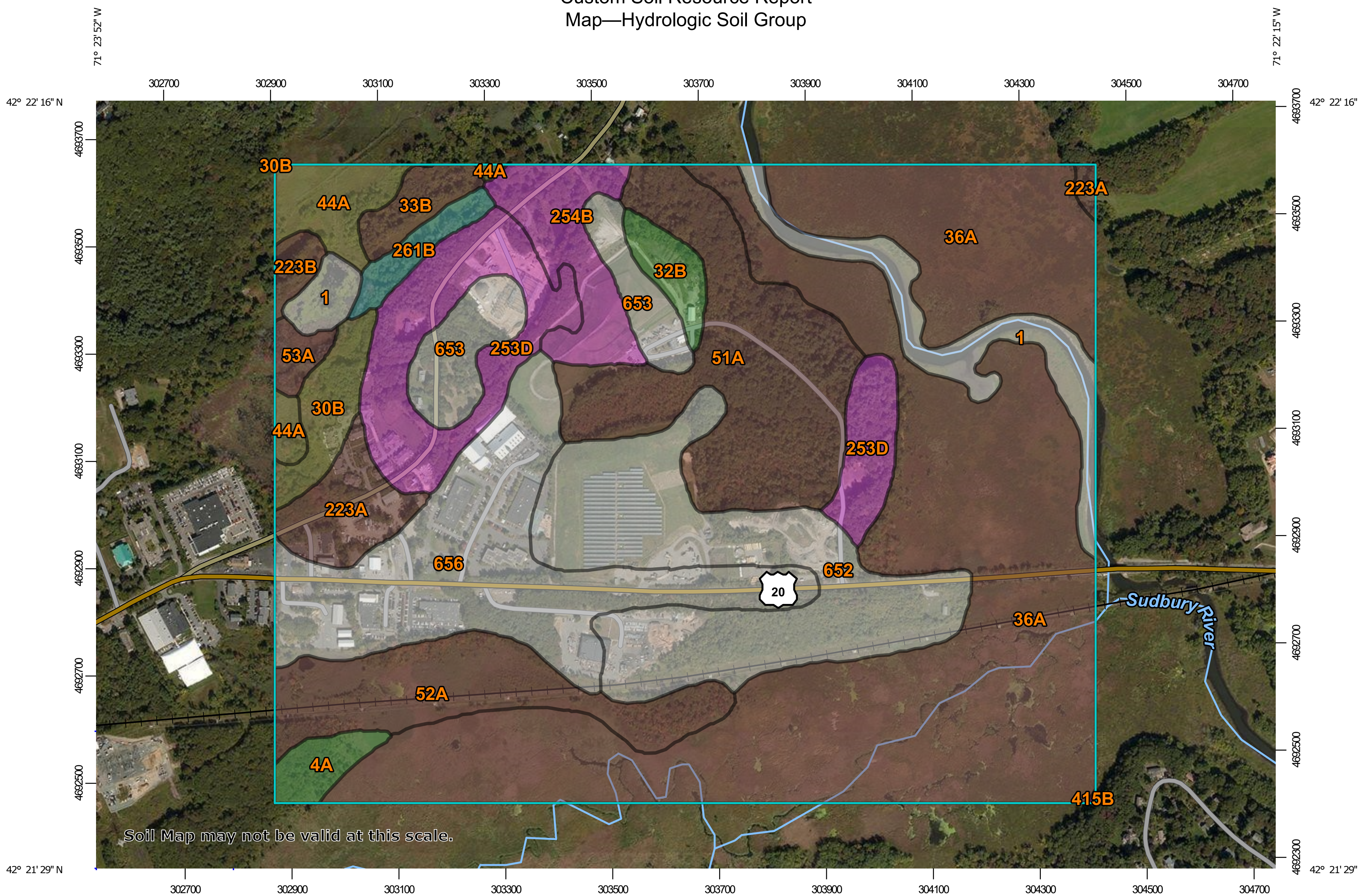
Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
1	Water	18.0	4.0%
4A	Rippowam fine sandy loam, 0 to 3 percent slopes	4.3	0.9%
30B	Raynham silt loam, 0 to 5 percent slopes	7.4	1.6%
32B	Wareham loamy fine sand, 0 to 5 percent slopes	4.7	1.0%
33B	Raypol silt loam, 0 to 5 percent slopes	4.9	1.1%
36A	Saco mucky silt loam, 0 to 1 percent slopes	158.7	35.0%
44A	Birdsall mucky silt loam, 0 to 1 percent slopes	9.6	2.1%
51A	Swansea muck, 0 to 1 percent slopes	42.6	9.4%
52A	Freetown muck, 0 to 1 percent slopes	24.7	5.4%
53A	Freetown muck, ponded, 0 to 1 percent slopes	2.6	0.6%
223A	Scio very fine sandy loam, 0 to 3 percent slopes	10.4	2.3%
223B	Scio very fine sandy loam, 3 to 8 percent slopes	2.4	0.5%
253D	Hinckley loamy sand, 15 to 25 percent slopes	30.1	6.6%
254B	Merrimac fine sandy loam, 3 to 8 percent slopes	13.3	2.9%
261B	Tisbury silt loam, 3 to 8 percent slopes	4.2	0.9%
415B	Narragansett silt loam, 3 to 8 percent slopes	0.0	0.0%
652	Udorthents, refuse substratum	50.9	11.2%
653	Udorthents, sandy	15.1	3.3%
656	Udorthents-Urban land complex	49.9	11.0%
Totals for Area of Interest		**453.7**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

Map—Hydrologic Soil Group



Map Scale: 1:10,100 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0, 100, 200, 400, 600

Feet: 0, 450, 900, 1800, 2700

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.

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

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Table—Hydrologic Soil Group

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32B	Wareham loamy fine sand, 0 to 5 percent slopes	A/D	4.7	1.0%
33B	Raypol silt loam, 0 to 5 percent slopes	B/D	4.9	1.1%
36A	Saco mucky silt loam, 0 to 1 percent slopes	B/D	158.7	35.0%
44A	Birdsall mucky silt loam, 0 to 1 percent slopes	C/D	9.6	2.1%
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223B	Scio very fine sandy loam, 3 to 8 percent slopes	B/D	2.4	0.5%
253D	Hinckley loamy sand, 15 to 25 percent slopes	A	30.1	6.6%
254B	Merrimac fine sandy loam, 3 to 8 percent slopes	A	13.3	2.9%
261B	Tisbury silt loam, 3 to 8 percent slopes	C	4.2	0.9%
415B	Narragansett silt loam, 3 to 8 percent slopes	A	0.0	0.0%
652	Udorthents, refuse substratum		50.9	11.2%
653	Udorthents, sandy		15.1	3.3%
656	Udorthents-Urban land complex		49.9	11.0%
Totals for Area of Interest			**453.7**	**100.0%**

3. Site Subsurface Conditions

3.1 SOIL AND BEDROCK

The test borings typically indicated the following sequence of subsurface units:

Stratum/Subsurface Unit	Top of Stratum	Range in Thickness (ft)
Fill Soils	El. 125.0 to El. 154.5	1.6 to 17
Glaciofluvial Deposits	El. 120.2 to El. 149.5	>41

- Fill: Fill was encountered at each exploration location consisting of existing in-situ fill soils or stockpiled fill brought to the site by the Wayland DPW for storage. General descriptions of the materials are included below:
  - Existing Fill: Existing Fill soils are present above the natural, Glaciofluvial deposits at thicknesses ranging from 1.6 to 7 ft. The following explorations were performed outside the stockpile limits: TP-1 to 6; TP-101 to 103; and HA19-1, 6, 8 to 11, and 14. The Existing Fill was observed to consist of a loose to dense SAND or silty SAND with gravel and a few cobbles. Some debris was noted in the fill, including brick, wood, and asphalt pieces. Thin layers of topsoil were present at select locations above or intermixed within the Fill.
  - Stockpiled Fill: The Stockpiled Fill was located within a portion of the proposed Building 1 footprint and leaching field footprint ranging in thickness of 8 to 17 ft. Note that the stockpile was flattened in February 2019 as part of the environmental characterization program conducted by Vertex, which modified the limits of the stockpile and the site grading. The following explorations were performed within the stockpile limits: TP-105; and HA19-2 to 4, 12 to 13, and 15. The Fill was observed to consist of a loose to dense SAND or silty/clayey SAND with gravel and cobbles. Debris included brick, wood, roots, asphalt pieces, oversized concrete and construction debris.

    Results of geotechnical laboratory testing conducted on the Stockpiled Fill soils, which are included in Appendix D, indicated a maximum dry density in the range of about 133.3 to 135.2 pounds per cubic foot with an optimum moisture content in the range of about 6.4% to 6.6%. The in-situ moisture content of the Stockpiled Fill soils generally ranged from 8.9% to 14.3%, with one result at 7.7%. The laboratory data indicate that the Stockpiled Fill soils are wet of optimum and therefore will be difficult to reuse in its current state.

- Glaciofluvial Deposits: Naturally-deposited, inorganic Glaciofluvial Deposits were encountered at each exploration with the top of the deposit observed from El. 120.2 to 149.5. The Glaciofluvial Deposits were highly variable granular deposits and ranged from medium dense to very dense poorly graded to well graded SAND or SAND with gravel or medium dense to very dense, poorly graded to well graded GRAVEL with sand.

- Bedrock: Bedrock was not encountered in explorations.

3.2 GROUNDWATER

Depth to water ranged from approximately 13.8 to 34 ft below existing grades, corresponding to about El. 110 to El. 125.2, as noted in the table below. Groundwater was not encountered in the test pit excavations, except at TP-102 where water slowly entered the excavation at a depth of 12.5 ft below ground surface, corresponding to approximately El. 117.5.

A portion of the site is within the Zone AE flood plain. The existing conditions drawings indicated that base flood elevation is El. 121.

Well ID	Ground Surface Elevation (ft, NAVD 88)[1]	Date	Groundwater	
			Depth from Ground Surface (ft)[2,3]	Elevation (ft, NAVD 88)
V-101	130	1-Apr-19	14.5	115.5
		2-Apr-19	13.8	116.2
		18-Apr-19	13.8	116.2
V-102	125	1-Apr-19	15.0	110.0
		2-Apr-19	14.7	110.3
		18-Apr-19	14.7	110.3
V-103	147	1-Apr-19	30.0	117.0
		2-Apr-19	29.1	117.9
		18-Apr-19	29.1	117.9
V-104	150	1-Apr-19	32.5	117.5
		2-Apr-19	31.2	118.8
		18-Apr-19	31.2	118.8
V-105	148	1-Apr-19	31.0	117.0
		2-Apr-19	29.9	118.1
		18-Apr-19	30.3	117.7
V-106	153	1-Apr-19	34.0	119.0
		2-Apr-19	27.8	125.2
		18-Apr-19	33.8	119.2
HA19-B1(OW)	132	18-Apr-19	14.9	116.6
HA19-13 (OW)	134	9-Apr-19	17.5	116.6
		18-Apr-19	18.5	115.6
HA19-14(OW)	139	18-Apr-19	21.9	117.0

Notes:

1. Ground surface elevations at Vertex's observation wells were estimated based on drawing CP-1, prepared by Allen & Major Associates, Inc., dated 13 June 2016.
2. Readings from 1 and 2 April 2019 were provided by Vertex.
3. Readings from 18 April 2019 were collected by a Haley & Aldrich Representative.

Groundwater levels can fluctuate, as they are influenced by precipitation, snow melt, leakage into or out of utility pipes, nearby construction activities and other factors. Accordingly, groundwater levels during and following construction can differ from those reported herein.

4. Geotechnical Design Recommendations

4.1 GENERAL

Recommendations presented herein are based on the proposed building layout and site development plan as understood at the time this report was prepared. As further information is developed by design team concerning these items, the design criteria should be reviewed by Haley & Aldrich for continued applicability.

4.2 BUILDING CODE AND APPLICABILITY

Building foundations should be designed and constructed in accordance with the Massachusetts State Building Code (Building Code). Recommendations provided herein are intended to be consistent with the requirements of the 9th Edition of the Building Code.

4.3 FOUNDATION DESIGN RECOMMENDATION

4.3.1 Building Foundations

The Existing Fill and Stockpiled Fill soils (in their current state) are not considered suitable bearing materials for building foundations. The naturally deposited, inorganic Glaciofluvial Deposits represent the uppermost subsurface strata suitable for building foundation support (the bearing stratum). The recommendations below assume that the Stockpiled Fill soils have been removed from the site or relocated prior to foundation preparation activities.

Therefore, based on our evaluations, the most economical foundation is a "hybrid" foundation system approach, consisting of conventional shallow foundations bearing on a combination of natural soils, Compacted Granular Fill placed above natural soils, and existing Fill soils stiffened using ground improvement.

Based on proposed finished floor elevation at El. 132 for Building 1 and El. 134 for Building 2, the bottom of foundation elevation is planned to be at approximately El. 128 and 130, respectively.

- In Building 1, the top of suitable bearing soils is encountered up to 5 feet below planned bottom of footing elevations. Building loads can be supported on conventional, reinforced concrete spread footings bearing at normal bearing depths following the excavation and replacement of the existing Fill with Compacted Granular Fill within the zone of influence of the proposed foundations. Alternately, the Existing Fill soils could be stiffened with short ground improvement elements to allow for the construction of conventional reinforced spread footing foundations without the need for over-excavation and replacement (unless obstructions are encountered). The attached Figure 2 illustrates this building as Zone A, where over-excavation and replacement Compacted Granular Fill or ground improvement are options for bearing at normal bearing depth.

- The slab elevation at the new Wastewater Treatment Building was not provided. Based on surrounding proposed grades, the slab is estimated to be finished at El. 130 and the top of

Glaciofluvial deposits to El. 120.2. The recommendations stated above for Building 1 and Zone A are also applicable to the Wastewater Treatment Building.

- Within a large portion of Building 2, illustrated as Zone B on Figure 2, suitable bearing soils are located at or above the planned bottom of footing elevation. In these areas, building loads can be supported on conventional, reinforced concrete spread footings bearing at normal bearing depths in the natural in-organic soils. Additionally, foundations for the at-grade Clubhouse at El. 145 with a planned foundation elevation at El. 141 will be within suitable natural bearing soils. Foundations for the clubhouse will need to be stepped to avoid loading the adjacent foundation walls. The proposed pool will also be constructed within suitable natural bearing soils and can be earth supported.

- Within the north portion of Building 2, illustrated as Zone A on Figure 2, site filling is required to raise grades to proposed footing elevations. The total thickness of existing and new fill up to 9 ft below planned bottom of footing elevations. We recommend that the general grading be conducted in this area with on-site Fill soils and then the placed Fill soils be stiffened with ground improvement to allow for the construction of conventional reinforced spread footing foundations at normal bearing depths. Alternately, the existing Fill can be over-excavated (approximately 2 to 4 feet of Fill will require excavation) and replaced with compacted Granular Fill and the remainder of the site filling in this area can be conducted with Compacted Granular Fill.

The proposed site development involves significant re-grading and soil management. The most economical foundation solution is interdependent on the physical and environmental quality of the Fill and the net-balance for export/import at the site. The following recommendations outline a "hybrid" foundation system approach, consisting of conventional shallow foundations bearing on a combination of natural soils, Structural Fill placed above natural soils, and existing Fill soils stiffened using ground improvement.

4.3.2 Conventional Spread Footings

Specific recommended criteria for design of spread footings are as follows:

- Design footings using the following maximum allowable bearing pressures:

Bearing Condition	**Maximum allowable bearing pressure (Kips per square foot, ksf)**
Inorganic, naturally deposited Glaciofluvial (Zone B)	6 ksf
Compacted Granular Fill (Zone A)	5 ksf
Ground Improvement Stiffened Fill (Zone A)	5 ksf

- Design footings to have a least lateral dimension of 18 in. or greater. The maximum allowable bearing pressure noted above should be reduced proportionally for footings with widths less than 3 ft.
- Locate bottoms of footings at least 48 in. below lowest adjacent ground surface exposed to freezing, and a minimum 18 in. below the top of the adjacent ground floor slab at heated interior locations.
- The Fill Soils are unsuitable foundation bearing strata. Should these soils be encountered within the zone of influence (ZOI) beneath foundations, they should be removed in their entirety and backfilled with Compacted Granular Fill. The ZOI is defined as the zone beneath the footings and beneath imaginary lines extending from points 1 ft laterally beyond the footing outer bottom edge, and out and down on a 1H:1V slope to the top of suitable bearing materials.
- Design footings to bear below a reference line drawn upward and outward on a 1.5 horizontal to 1 vertical (1.5H:1V) slope from the bottom of adjacent utilities or other underground structures, or future planned excavations. Where possible, footing elevations and construction sequencing should be coordinated with utility elevations to allow utilities to pass through the foundation wall (rather than through or beneath the footing). Footing bearing surfaces may locally need to be lowered or stepped to achieve this criterion. Footings should be installed at depth prior to installation of shallower utilities. If pressurized pipes are to pass beneath or within 5 ft of soil-bearing foundations, the configuration should be reviewed on a case by case basis to determine if special measures are needed to protect the foundations from undermining in the event of pipeline failure.
- Tops of individual column or wall footings should be positioned a minimum of 4 in. beneath the underside of an overlying floor slab. This space should be filled with granular soil having maximum particle size of 2 in.

Gradation and placement procedures for Compacted Granular Fill are described below in the Construction Considerations section of the report.

4.3.3 Ground Improvement

Where used to stiffen existing Fill Soils, Ground improvement should consist of semi-rigid vertical elements (e.g., Aggregate Piers or equivalent) installed through unsuitable soils to create a stiffened mass suitable for footing bearing. The detailed final design and installation of ground improvement is performed by specialty subcontractors, in accordance with performance criteria established by the Owner's Geotechnical Engineer. Proposals by perspective specialty Contractors bidding the work are typically reviewed by the Geotechnical Engineer for suitability of the proposed system and compliance with the project requirements.

For preliminary design and pricing, we recommend that the same footing design criteria as described above for conventional spread footings be used to design the spread footings bearing on ground improvement.

Other ground improvement considerations are as follows:

- Ground improvement design should consider the effects of site raises-in-grade, bottom of footing elevations, post-ground improvement utility installations, temporary construction loads, and other site and building conditions.

- Testing (modulus and/or load testing) should be performed on ground improvement elements to confirm the design assumptions.

- Other details of the ground improvement including footing pad requirements (if required) should be outlined in the project specifications and specialty contractors' proposals. Detailed design submittals should be provided for the ground improvement system, for review by Haley & Aldrich.

4.3.4 Settlements

At the recommended allowable bearing pressures, we estimate that settlement of individual footings under static loading conditions, constructed as recommended herein, will not exceed about 1 in., with differential settlements between individual footings, or within a 30-ft distance along a continuous strip footing, not exceeding about 1/2-in.

4.4 LOWEST FLOORS

The lowest level floor for each of the four proposed buildings can be designed and constructed as a conventional, soil-supported, concrete slab-on-grade in accordance with the following options. For each option, concrete slabs-on-grade should bear on an 8-in. minimum thickness of Compacted Granular Fill over a properly-prepared subgrade. The selected approach will need to be coordinated with the approach opted for footing support. The assumptions presented below assume that the existing Stockpiled Fill will be removed from the site.

- <u>Existing</u>– Within Zone A of Buildings 1 and 2, undocumented Existing Fill soils will be present beneath the proposed floor subgrades. In these zones, we recommend partial over-excavation and replacement of Existing Fill soils provided the risk of some slab settlement and/or cracking is tolerable or ground improvement through these fill soils (with no over-excavation and replacement) should the risk of slab settlement and/or cracking not be tolerable. The partial over-excavation and replacement option would entail removing the Existing Fill soils to a depth of 2 ft below the proposed bottom of slab elevation and recompacting the subgrade with a minimum of 6 passes of a large vibratory roller large vibratory roller imparting at least 25,000 lbs. of dynamic force. Excavated Fill soils can be used to backfill the over-excavation provided these materials are placed and compacted in accordance with the requirements for Compacted Granular Fill discussed in this report. If the quality and/or moisture content of the excavated Fill renders the material unsuitable, Compacted Granular Fill may be used as backfill. Ground improvement, if used, would consist of aggregate piers.

- <u>Natural Glaciofluvial Deposits</u> - In Zone B, natural Glaciofluvial soils will be present at the slab elevation and are suitable for placement of the slab on grade on the 8-in. minimum thickness of Compacted Granular Fill following re-compaction of the subgrade with a minimum of 6 passes of a large vibratory roller imparting at least 25,000 lbs. of dynamic force. If localized Fill soils are encountered at the slab subgrade elevation, we recommend they be removed and replaced with Compacted Granular Fill following compaction of the subgrade.

4.5 DESIGN GROUNDWATER LEVEL

We recommend a design groundwater level at El. 121, which is coincident with the base flood elevation, be used for calculation of hydrostatic pressures on below-grade structures.

4.6 FOUNDATION DRAINAGE AND WATERPROOFING

The lowest level floors of the proposed building are planned to be finished above proposed design groundwater level, but at or below proposed adjacent finished site grades. The following are general guidelines for foundation drainage and waterproofing. The scheme for waterproofing and drainage should be revisited after completion of the leaching field design and mounding analyses.

- Permanent underslab drainage is not required since the buildings finished floors are above the design groundwater level and above the mound level based on communications from the leaching field designer.

- Given that the mound level from the leaching field is not anticipated to reach the foundation bearing level, waterproofing is not required on foundation walls adjacent to the leaching field.

- Where finished grades are less than 2 ft above adjacent floor slabs, perimeter drainage is not required.

- We recommend that perimeter drainage consist of the following:

  - Waterstops, caulking, or other seals provided at all foundation wall and wall/footing construction joints where the exterior grading immediately adjacent to the building is higher than the interior floor slab of the building;
  - A perimeter foundation drainage system consisting of a continuous loop of 6-in. diameter perforated PVC placed adjacent to the perimeter footings, laid flat or with a slight pitch (if possible) downward toward the ejection/discharge point(s). The pipe should be surrounded by a minimum thickness of 6 in. of ¾-in. crushed stone, which in turn is surrounded by 6-oz. per sq. yd. non-woven geotextile;
  - Where perimeter foundation drainage is provided, below-grade walls should be waterproofed and geocomposite drainage board should be placed against the wall, up to 12 in. below ground surface, and hydraulically connected to the perimeter drainage pipe;
  - Inverts of perimeter drainage pipes should be positioned above the bearing elevation of adjacent footings and at least 12 inches below the adjacent finished floor elevations;
  - All points in the perimeter drainage should have redundant flow paths to the ejection/discharge point(s) to on-site recharge systems;
  - Discharge from the drainage systems should be directed to at least one reliable gravity outlet. If gravity discharge is not possible, effluent should be directed to a sump system having redundant pumps and emergency backup power.
  - The drainage system piping should be provided with cleanouts.

- Surface runoff should be directed away from the buildings. In general, the ground surface within 10 ft immediately around the buildings should be sloped downward away from the structures to divert surface runoff.

F-1. Rainfall Data for Massachusetts from *Rainfall Frequency Atlas of the United States* (TP-40)

- Users of this Handbook should note that current MA DEP written guidance (see DEP Waterlines newsletter -- Fall 2000) requires the use of TP-40 Rainfall Data for calculations under the Wetlands Protection Regulations and the Stormwater Management Policy. More stringent design storms may be used under a local bylaw or ordinance. However, DEP will continue to require the use of TP-40 in any case it reviews under the Wetlands Protection Act and Stormwater Management Policy.

Adjusted Technical Paper 40 Design Storms for 24-hour Event by County

County Name	1-yr 24-hr	2-yr 24-hr	5-yr 24-hr	10-yr 24-hr	25-yr 24-hr	50-yr 24-hr	100-yr 24-hr
Barnstable	2.5	3.6	4.5	4.8	5.7	6.4	7.1
Berkshire	2.5	2.9	3.8	4.4	5.1	5.9	6.4
Bristol	2.5	3.4	4.3	4.8	5.6	6.3	7.0
Dukes	2.5	3.6	4.6	4.9	5.8	6.5	7.2
Essex	2.5	3.1	3.9	4.5	5.4	5.9	6.5
Franklin	2.5	2.9	3.8	4.3	5.1	5.8	6.2
Hampden	2.5	3.0	4.0	4.6	5.3	6.0	6.5
Hampshire	2.5	3.0	3.9	4.5	5.2	5.9	6.4
Middlesex	2.5	3.1	4.0	4.5	5.3	5.9	6.5
Nantucket	2.5	3.6	4.6	4.9	5.8	6.5	7.2
Norfolk	2.5	3.2	4.1	4.7	5.5	6.1	6.7
Plymouth	2.5	3.4	4.3	4.7	5.6	6.2	7.0
Suffolk	2.5	3.2	4.0	4.6	5.5	6.0	6.6
Worcester	2.5	3.0	4.0	4.5	5.3	5.9	6.5

Manning's Roughness Coefficients ("n")

Conduit	Manning's Coefficients
Closed Conduits	
Asbestos-Cement Pipe	0.011 to 0.015
Brick	0.013 to 0.017
Cast Iron Pipe	
Cement-lined and seal-coated	0.011 to 0.015
Concrete (Monolithic)	
Smooth forms	0.012 to 0.014
Rough forms	0.015 to 0.017
Concrete Pipe	0.011 to 0.015
Corrugated-Metal Pipe (1/2 - STUL 34470 2 1/2-inch corrgtn.)	
Plain	0.022 to 0.026
Paved invert	0.018 to 0.022
Spun asphalt-lined	0.011 to 0.015
Plastic Pipe (Smooth)	0.011 to 0.015
Vitrified Clay	
Pipes	0.011 to 0.015
Liner channels	0.013 to 0.017
Open Channels	
Lined Channels	
Asphalt	0.013 to 0.017
Brick	0.012 to 0.018
Concrete	0.011 to 0.020
Rubble or riprap	0.020 to 0.035
Vegetal	0.030 to 0.040
Excavated or Dredged	
Earth, straight and uniform	0.020 to 0.030
Earth, winding, fairly uniform	0.025 to 0.040
Rock	0.030 to 0.045
Unmaintained	0.050 to 0.140
Natural Channels (minor streams, top width at flood state < 100 feet)	
Fairly regular section	0.030 to 0.070
Irregular section with pools	0.040 to 0.100

Source: Design and Construction of Sanitary and Storm Sewers, American Society of Civil Engineers and the Water Pollution Control Federation, 1969.

State of New Jersey

DEPARTMENT OF ENVIRONMENTAL PROTECTION
Bureau of Nonpoint Pollution Control
Division of Water Quality
Post Office Box 029
Trenton, New Jersey 08625-029
609-633-7021 Fax: 609-984-2147
http://www.state.nj.us/dep/dwq/bnpc_home.htm

Derek Berg
Regulatory Manager – Stormwater
CONTECH Engineered Solutions
200 Enterprise Drive
Scarborough, ME 04074

Re: Final Certification
Continuous Deflective Separator (CDS) by CONTECH Engineered Solutions LLC

Expiration Date: December 1, 2016
TSS Removal Rate: 50%

Dear Mr. Berg:

The Stormwater Management rules under N.J.A.C. 7:8-5.5(b) and 5.7(c) allow the use of manufactured treatment devices (MTDs) for compliance with the design and performance standards at N.J.A.C. 7:8-5 if the pollutant removal rates have been verified by the New Jersey Corporation for Advanced Technology (NJCAT) and have been certified by the New Jersey Department of Environmental Protection (NJDEP). CONTECH Engineered Solutions LLC has requested a Final Certification for the Continuous Deflective Separator (CDS) Stormwater Treatment System.

This project falls under the July 15, 2011 "Transition for Manufactured Treatment Devices," under *C. Manufactured Treatment Devices Seeking Final Certification – In Process* which are MTDs that have commenced field testing on or before August 1, 2011.

NJDEP received the required information and signed statements by the NJCAT Technical Director and the manufacturer indicating that the requirements of the Field Testing Protocols in place at the initiation of testing have been met or exceeded. The NJCAT letter also includes a recommended certified TSS removal rate and the required maintenance plan.

The NJDEP certifies the use of the CONTECH Engineered Solutions LLC CDS Stormwater Treatment System at a TSS removal rate of 50%, subject to the following conditions:

1. The various models and associated water quality flow capacities shall be sized for the peak flow of the New Jersey Water Quality Design Storm per N.J.A.C. 7:8-5, as shown in Table 1 below.

New Jersey Treatment Rates for CDS Models Based on a Surface Area Secific Loading Rate of 25.16gpm/ft^2		
CDS Model	Manhole Diameter (ft)	Treatment Flow Rate (cfs)
CDS-4	4	0.7
CDS-5	5	1.1
CDS-6	6	1.6
CDS-8	8	2.8
CDS-10	10	4.4
CDS-12	12	6.3

2. The CDS Stormwater Treatment System can be used on-line or off-line.

3. A hydrodynamic separator, such as the CDS Stormwater Treatment System, cannot be used in series with another hydrodynamic separator to achieve an enhanced removal rate for total suspended solids (TSS) removal under N.J.A.C. 7:8-5.5.

4. The maintenance plan for the sites using this device shall incorporate at a minimum, the maintenance requirements for the CDS Stormwater Treatment System shown attached.

In addition to the attached, the detailed maintenance plan must include all of the items identified in Chapter 8: Maintenance of the New Jersey Stormwater Best Management Manual. Such items include, but are not limited to, the list of inspection and maintenance equipment and tools, specific corrective and preventative maintenance tasks, indication of problems in the system, and training of maintenance personnel.

Additional information regarding the implementation of the Stormwater Management rules N.J.A.C. 7:8 are available at www.njstormwater.org. Please contact Sandra Blick of my office at (609) 633-7021 if you have any questions.

Sincerely,

James J. Murphy, Chief
Bureau of Nonpoint Pollution Control

c: Chron File
Richard Magee, NJCAT
Mark Pedersen, DLUR
Elizabeth Dragon, BNPC

CDS Maintenance

The CDS system must 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, e.g., unstable soils or heavy winter sanding will cause the grit chamber to fill more quickly but regular sweeping will slow accumulation.

Inspection

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

The visual inspection must ascertain that the system components are in working order and that there are no blockages or obstructions to the inlet and/or separation screen. The inspection must also identify accumulations of hydrocarbons, trash, and sediment in the system. Measuring pollutant accumulation can be done with a calibrated dipstick such as a stadia rod, tape measure or other measuring instrument. If sorbent material is used for enhanced removal of hydrocarbons then the level of discoloration of the sorbent material should also be identified during inspection. Sorbent material must be replaced when it is predominantly dark in color (similar to oil). It is useful and often required as part of a permit to keep a record of each inspection.

Access to the CDS unit is typically achieved through two manhole access covers. One opening allows for inspection and cleanout of the separation chamber (screen/cylinder) and isolated sump. The other allows for inspection and cleanout of sediment captured and retained behind the screen. For units possessing a sizable depth below grade (depth to pipe), a single access point allows for both sump cleanout and access behind the screen.

The CDS system must be cleaned when the level of sediment in the sump has reached a depth of 12 inches or more to avoid exceeding the maximum 24 inch sediment depth and/or when an appreciable level of hydrocarbons and trash has accumulated. If sorbent material is used, it must be replaced when significant discoloration has occurred. Performance 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. Finer, silty particles at the top of the pile typically offer less resistance to the end of the rod than larger particles toward the bottom of the pile. Once this measurement is recorded, it should be compared to the as-built drawing for the unit to determine if the height of the sediment pile off the bottom of the sump floor exceeds 75% (18 inches) of the total height of isolated sump.

Cleaning

Cleaning of the CDS systems should be done during dry weather conditions when no flow is entering the system. Cleanout of the CDS with a vacuum truck is generally the most effective and convenient method of excavating 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 pumped 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, an oil or gasoline spill should be cleaned out immediately. Motor oil and other hydrocarbons that accumulate on a more routine basis must be removed when an appreciable layer has been captured. To remove these pollutants, it may be preferable to use adsorbent pads since they are usually less expensive to dispose of than the oil/water emulsion that may be created by vacuuming the oily layer. Trash can be netted out if you wish 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 proper safety precautions. Confined Space Entry procedures need to be followed.

Disposal of all material removed from the CDS system must be done is accordance with local regulations. In many locations, disposal of evacuated sediments may be handled in the same manner as disposal of sediments removed from catch basins or deep sump manholes. Check your local regulations for specific requirements on disposal.

#490 BOSTON POST ROAD, WAYLAND, MA

Allen & Major Associates, Inc.

Computation Sheet

By	DMR/SJL
Chk'd	CMQ
Apprv'd	CMQ

Title: ***RipRap Sizing Spreadsheet***
Project: #490 Boston Post Road, Wayland, MA
Date: June 20, 2019
Revised: ----------------
A&M Project Number: 1670-09A

OUTLET	Do (ft.)	Q25 (cfs)***	Tw (ft.)	La (ft.)	Wup (ft.)	Wdn (ft.)**	d50 (ft.)*
Headwall-1	1.25	5.63	0.5	16.0	3.8	19.8	0.30
Headwall-2	1.50	10.77	0.5	21.1	4.5	25.6	0.59

Notes:

Assume 6" Tw at Outfall
Use MHD M2.02.2 Stone
Depth of Stone to be 6" or 1.5 times d50 - which ever is larger

***6" Minimum Stone Diameter**
****Apron width shall meet defined downstream channel**
****See pipe sizing spreadsheet for Q25 flows**

<u>When Tw < 0.5Do at pipe outlet:</u>

La = 1.8Q/Do^1.5 + 7Do
Wup = 3Do
Wdn = 3Do + La
d50 = (0.02Q^1.3)/(TwDo)

<u>When Tw > or = 0.5Do at pipe outlet:</u>

La = 3Q/Do^1.5 + 7Do
Wup = 3Do
Wdn = 3Do + 0.4La
d50 = (0.02Q^1.3)/(TwDo)

Where:

Tw = the tailwater depth at the outlet of the pipe or channel
Do = the diameter of the pipe or the width of channel
Q = the discharge from the pipe of channel (25 year Storm)
La = the length of apron
Wup = the upstream width of apron
Wdn = the downstream width of apron
d50 = the median stone diameter

Computation Sheet

Title	***MA DEP Standard Calculations***	By	SJL
Project	*484 Boston Post Road*	Chk'd	CMQ
Date	June 20, 2019	Apprv'd	CMQ
Revised			

Stormwater Recharge/Water Quality Volume Table

Rv = F * Impervious Area

Rv *= Required Recharge Volume, expressed in* ft^3*, cubic yards or acre-feet*

F *= Target Depth Factor associated with each Hydraulic Soil Group*

Impervious Area *= pavement & rooftop area on site*

V_{WQ} *= Required Water Quality Treatment Volume (*ft^3*)*

D_{WQ} *= Water Quality Depth (in)*

A_{IMP} *= Impervious Area (excluding non-metal roofs)*

			Impervious Area by Soil HSG		***Recharge Required***			***Water Quality Volume Required***	
W'SHED	Area (Sq. Ft)	Landscaped	HSG B (F=.35)	HSG C (F=.25)	***F Avg. (Inches)***	***Impervious Area (Sq. Ft)***	***Rv*** *(*ft^3*)*	D_{WQ} *(Inch)*	V_{WQ}
P-1	61,597	61,597	0	0	0.000	0	0	1.0	0
P-2	35,314	11,614	0	23,700	0.250	23,700	494	1.0	1,975
P-3	30,702	9,052	0	21,650	0.250	21,650	451	1.0	1,804
P-4	19,145	19,145	0	0	0.000	0	0	1.0	0
P-5 (ROOF)	57,482	0	0	57,482	0.250	57,482	1,198	1.0	4,790
P-6 (ROOF)	21,727	0	0	21,727	0.250	21,727	453	1.0	1,811
P-7	21,205	12,781	0	8,424	0.250	8,424	176	1.0	702
P-8	43,160	36,618	0	6,542	0.250	6,542	136	1.0	545
P-9	30,636	14,809	0	15,827	0.250	15,827	330	1.0	1,319
P-10	38,312	17,360	0	20,952	0.250	20,952	437	1.0	1,746
Total	359,280	182,976	0	176,304		176,304	**3,673**		**14,692**

Title	***MA DEP Standard Calculations***	By	SJL
Project	*484 Boston Post Road*	Chk'd	CMQ
Date	June 20, 2019	Apprv'd	CMQ
Revised			

Stormwater Recharge Summary

Rv = F * Impervious Area

Rv = *Required Recharge Volume, expressed in ft^3, cubic yards or acre-feet*

F = *Target Depth Factor associated with each Hydraulic Soil Group*

	Required (cf)	Provided (cf)	
Rv =	***1,703***	***7,014***	***Underground Infiltration System #1 (P-5, P-7, & P-9)***
Rv =	***945***	***3,887***	***Underground Infiltration System #2 (P-2, P-3, & P-4)***
Rv =	***1,025***	***4,562***	***Underground Infiltration System #3 (P-6, P-8, & P-10)***
Rv =	***3,673***	***15,463***	

Water Quality Volume

V_{WQ} = *Required Water Quality Treatment Volume, expressed in ft^3*

D_{WQ} = *Water Quality Depth*

A_{IMP} = *Impervious Area (pavement & rooftop area excluding non-metal roofs)*

	Required (cf)	Provided (cf)	
V_{WQ} =	***6,811***	***7,014***	***Underground Infiltration System #1 (P-5, P-7, & P-9)***
V_{WQ} =	***3,779***	***3,887***	***Underground Infiltration System #2 (P-2 & P-4)***
V_{WQ} =	***4,102***	***4,562***	***Underground Infiltration System #3 (P-3, P-6, P-8, & P-10)***
V_{WQ} =	***14,692***	***15,463***	

Draindown Within 72 Hours

$\text{Time}_{drawdown}$=(Rv) (1/Design Infiltration Rate in inches per hour) (Conversion for inches to feet) (1/bottom area in feet)

Underground Infiltration System #1 (Sand)	
Infiltration Rate (in/Hr)=	1.02
Bottom Area (ft^2) =	5,529
Infiltration Volume (ft^3) =	7,014
$\text{Time}_{drawdown}$ (Hours)=	14.92

Underground Infiltration System #2 (Sand)	
Infiltration Rate (in/Hr)=	1.02
Bottom Area (ft^2) =	2,576
Infiltration Volume (ft^3) =	3,887
$\text{Time}_{drawdown}$ (Hours)=	17.75

Underground Infiltration System #3 (Sand)	
Infiltration Rate (in/Hr)=	1.02
Bottom Area (ft^2) =	5,823
Infiltration Volume (ft^3) =	4,562
$\text{Time}_{drawdown}$ (Hours)=	9.22

Title	***MA DEP Standard Calculations***	By	SJL
Project	*484 Boston Post Road*	Chk'd	CMQ
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TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Deep Sump Catch Basins	0.25	1.00	0.25	0.75
Contech Proprietary Device	0.50	0.75	0.38	0.38
Subsurface Infiltration System #2	0.80	0.38	0.30	0.08
		Total TSS Removal =	93%	

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Deep Sump Catch Basins	0.25	1.00	0.25	0.75
Contech Proprietary Device	0.50	0.75	0.38	0.38
Subsurface Infiltration System #2	0.80	0.38	0.30	0.08
		Total TSS Removal =	93%	

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Deep Sump Catch Basins	0.25	1.00	0.25	0.75
Contech Proprietary Device	0.50	0.75	0.38	0.38
Subsurface Infiltration System #2	0.80	0.38	0.30	0.08
		Total TSS Removal =	93%	

Title	***MA DEP Standard Calculations***	By	SJL
Project	*484 Boston Post Road*	Chk'd	CMQ
Date	June 20, 2019	Apprv'd	CMQ
Revised			

Mounding Analysis

Infiltration System	*Water Table*	*System Bottom*	*Vertical Separation*	*Attenuated System*	**Mounding Analysis Required**
1	121.00	134.50	13.5	Yes	No
2	121.00	125.00	4.0	Yes	No
3	121.00	124.75	3.75	Yes	Yes

Water Quality Flow Rate Calculations for Proprietary Stormwater Separators

Reference: **Massachusetts Department of Environmental Protection Wetlands Program:** Standard Method to Convert Water Quality Volume to a Discharge Rate for Sizing Flow Based Manufactured Proprietary Stormwater Treatment

Structure Name	**Total Area (Acres)**	**Imp. Area (Acres)**	**A^{IMP} (Sq. Miles)**	**Tc (min.)**	**Tc (hrs.)**	**WQV (inches)**	**qu (csm/in)**
CDS #1	0.71	0.35	0.00055	6.0	0.10	1	774
CDS #2	0.87	0.55	0.00086	6.0	0.10	1	774
CDS #3	0.68	0.48	0.00075	6.0	0.10	1	774
CDS #4	0.86	0.43	0.00067	6.0	0.10	1	774

Water Quality Flow Rate = Q1 = (qu) (A) (WQV)

Structure Name	**Q1 (cfs)**
CDS #1	0.42
CDS #2	0.67
CDS #3	0.58
CDS #4	0.52

Computation Sheet

Title	***Pipe Sizing Table***	Minimum Slope:	0.50%	By	SJL
Project	#490 Boston Post Road, Wayland, MA	Minimum Pipe Size:	6	Chk'd	CMQ
Date	June 20, 2019	Rainfall Intensity (in/hr):	6.00 (25 year storm)	Apprv'd	CMQ
Revised		Manning's n:	0.012 HDPE/PVC		
A&M Project Number: 1670-09A		Minimum Pipe Cover:	1.5		

#164 Lexington Road

Line						Req'd. Capac.	Pipe Size	Slope	Design Capacity		Drop	Invert Elevation		Rim Elev.	
From Upper	To Lower	Length (feet)	Area (acres)	wgt. *C*	*C* A	*Qd* (cfs)	*D* (in)	*s* (%)	Q_{full} (cfs)	V_{full} (fps)	(feet)	Upper (ft)	Lower (ft)	Upper (ft)	Cover (ft)
CB1	CDS1	9	0.346	0.70	0.244	1.46	12	5.00%	8.6	10.99	0.45	136.00	135.55	142.00	4.88
CB2	CDS1	9	0.360	0.60	0.215	1.29	12	5.00%	8.6	10.99	0.45	136.00	135.55	142.00	4.88
CDS1	DMH1/UIS1	6				2.75	12	5.00%	8.6	10.99	0.30	135.55	135.25	142.00	5.32
RD1	UIS1	43	0.615	0.95	0.584	3.50	12	2.00%	5.5	6.95	0.86	137.11	136.25	144.20	5.96
RD2	UIS1	43	0.699	0.95	0.664	3.99	12	2.00%	5.5	6.95	0.86	137.11	136.25	144.20	5.96
OCS1	DMH7	438	***(From HydroCAD 25-Year Storm)***			5.14	15	2.50%	11.1	9.02	10.95	135.25	124.30	142.00	5.38
CB3	DMH2/UIS2	11	0.387	0.66	0.254	1.52	12	5.00%	8.6	10.99	0.55	135.80	135.25	142.00	5.07
CB4	OCS2	115	0.488	0.79	0.385	2.31	12	4.13%	7.9	9.99	4.75	130.50	125.75	134.00	2.38
CDS2	DMH3/UIS3	3				3.83	12	5.00%	8.6	10.99	0.15	125.25	125.10	131.20	4.82
OCS2	HW1	50	(From HydroCAD 25-Year Storm)			5.63	15	1.00%	7.0	5.70	0.50	125.00	124.50	132.50	6.13
CB5	CDS2	120	0.396	0.84	0.334	2.01	12	2.00%	5.5	6.95	2.40	128.30	125.90	132.00	2.57
CB6	DMH3	7	0.286	0.68	0.194	1.16	12	5.00%	8.6	10.99	0.35	126.61	126.26	131.50	3.77
CB7	DMH3	282	0.573	0.68	0.388	2.33	12	0.50%	2.7	3.47	1.41	127.67	126.26	131.00	2.21
DMH3	CDS2	13				3.49	12	2.00%	5.5	6.95	0.26	126.16	125.90	132.20	4.91
CDS2	DMH4/UIS4	3				5.50	12	5.00%	8.6	10.99	0.15	125.90	125.75	131.20	4.17
CB8	DMH4/UIS4	12	0.290	0.59	0.172	1.03	12	5.00%	8.6	10.99	0.60	125.35	124.75	130.75	4.28
RD3	UIS3	27	0.188	0.95	0.178	1.07	12	6.85%	10.1	12.86	1.85	127.60	125.75	144.20	15.48
RD4	UIS3	30	0.309	0.95	0.294	1.76	12	9.50%	11.9	15.15	2.85	128.60	125.75	144.20	14.48
CB9	CDS4	12	0.286	0.68	0.194	1.16	12	0.50%	2.7	3.47	0.06	125.30	125.24	131.50	5.08
CB10	CDS4	40	0.573	0.68	0.388	2.33	12	0.50%	2.7	3.47	0.20	125.44	125.24	131.00	4.44
CDS4	DMH6	97				3.49	15	0.51%	5.0	4.05	0.49	125.24	124.75	132.20	5.58
OCS3	DMH7	77	***(From HydroCAD 25-Year Storm)***			5.63	18	0.58%	8.7	4.92	0.45	124.75	124.30	129.90	3.53
DMH7	HW2	69				10.77	18	0.93%	11.0	6.20	0.64	123.14	122.50	128.20	3.43

Illicit Discharge Compliance Statement

Responsibility:

The Owner is responsible for ultimate compliance with all provisions of the Massachusetts Stormwater Management Policy, the USEPA NPDES Construction General Permit and responsible for identifying and eliminating illicit discharges (as defined by the USEPA).

OWNER NAME: Broadstone Billerica Alliance, LLC.

ADDRESS: 184 High Street, Suite 401
Boston, MA 02110

TEL. NUMBER: (617) 356-1000

Engineer's Compliance Statement:

To the best of my knowledge, the attached plans, computations and specifications meet the requirements of Standard 10 of the Massachusetts Stormwater Handbook regarding illicit discharges to the stormwater management system and that no detectable illicit discharges exist on the site. All documents and attachments were prepared under my direction and qualified personnel properly gathered and evaluated the information submitted, to the best of my knowledge.

Included with this statement are site plans, drawn to scale, that identify the location of systems for conveying stormwater on the site and show that these systems do not allow the entry of any illicit discharges into the stormwater management system. The plans also show any systems for conveying wastewater and/or groundwater on the site and show that there are no connections between the stormwater and wastewater systems.

For a redevelopment project (if applicable), all actions taken to identify and remove illicit discharges, including without limitation, visual screening, dye or smoke testing, and the removal of any sources of illicit discharges to the stormwater management system are documented and included with this statement.