Drainage Analysis
for the

Millbury Fire Station
130 Elm Street
Millbury, MA 01527
Map 53 / Lot 22

Owner/Applicant:

Town of Millbury c/o Town Manager
127 Elm Street
Millbury, MA 01527

COMMONWEALTH OF MASSACHUSETTS
CHRISTOPHER
M. GARCIA
CIVIL
No. 45034
REGISTERED
PROFESSIONAL ENGINEER

Architect:

Context Architecture
68 Harrison Avenue, 5th Floor
Boston, MA 02111
(617) 423-1400 fax(617) 423-2939

Representative/Engineer:

GARCIA•GALUSKA•DESOUSA
Consulting Engineers Inc.
375 Faunce Corner Road – Suite D, Dartmouth, MA 02747
(508) 998-5700 Fax: (508) 998-0883 Email: info@g-g-d.com

Date:

January 25, 2021

Revised:
March 1, 2021

TOWN OF MILLBURY
APPLICATON FOR STORMWATER PERMIT

APPLICANT:

NAME Town of Millbury c/o Sean Hendricks, Town Manager

STREET 127 Elm Street CITY/TOWN Millbury

STATE MA ZIP 01527 TELEPHONE (508) 865-4710

NAME OF PROPERTY OWNER (if different from Applicant) Town of Millbury

Deed recorded in the Worcester District Registry of Deeds Book Null Page Null

SITE INFORMATION:

STREET AND NUMBER 130 Elm Street

ZONING DISTRICT R1 ASSESSOR'S MAP/LOT #(S) Map 53/Lot 22

LOT SIZE 1.84 Acres FRONTAGE 236.5 Feet

CURRENT USE Educational Center

PROJECT PLAN INFORMATION:

PLAN TITLE Millbury Fire Station

PREPARED BY (name/address of PE/Architect) Garcia, Galuska, DeSousa, Inc.
370 Faunce Corner Rd- Suite D, Dartmouth, MA 02747

DATES January 25, 2021

USES FOR WHICH STORMWATER PERMIT IS SOUGHT

Municipal Use Not Elsewhere More Specifically Cited - Fire Station

CITE ALL APPROPRIATE SECTIONS OF THE GENERAL BYLAW WHICH PERTAIN TO THIS APPLICATION; USE AND SITE: Zoning Bylaw Section 22.12,

Section 22.3, Section 33.

TO THE MILLBURY PLANNING BOARD:

The undersigned, being the Applicant named above, hereby applies for a Stormwater Permit to be granted by the Planning Board and certifies that, to the best of applicant's knowledge and belief, the information contained herein is correct and complete.

Applicant's Signature ______________________

Property Owner's Signature (if not Applicant) ______________________

CHECKLIST

Millbury Planning Board

Submission of Stormwater Plan Review

Plan Name: Millbury Fire Station

Property Address: 130 Elm Street Assessor's Map 53, Lot 22

Applicant's Name: Town of Millbury Address: 127 Elm Street Tel. No. (508) 865-4710

(If the applicant is not the owner, a notarized statement authorizing the applicant to act on the owner's behalf and disclosing his interest shall be submitted)

Owner's Name: Town of Millbury Address: 127 Elm Street Tel. No. (508) 865-4710

Engineering Firm: Garcia, Galuska, DeSousa, Inc. Address: 375 Faunce Corner Rd-Suite D North Dartmouth, MA 02747 Tel. No. (508) 998-5700

Submission Checklist:

______ **1)** Submission Fee of $ Waiver and Technical Review Fee of $_________ made payable to the Town of Millbury

______ **2)** One original Stormwater Management Plan and ten (10) copies thereof showing:

______ a)Names, addresses and telephone numbers of the owner, applicant and person(s) or firm(s) preparing the plan

______ b)Name of project, property address, assessor's map and lot number, the date, north arrow, names of abutters and scale

______ c)A locus map

______ d)The existing zoning, and land use at the site

______ e)The proposed land use

______ f)The location(s) of existing and proposed easements

______ g)The location of existing and proposed utilities

______ h)The site's existing & proposed topography with contours at one (1) foot intervals

______ I)The existing site hydrology

______ j)A description and delineation of existing stormwater conveyances, impoundments, and wetlands on or adjacent to the site or into which stormwater flows

N/A k)A delineation of 100 year flood plains, if applicable

______ l)Estimated seasonal high groundwater elevation (November to April) in areas to be used for stormwater retention, detention or infiltration

______ m)The existing and proposed vegetation and ground surfaces with runoff coefficient for each

______ n)A drainage area map showing pre and post construction watershed boundaries, drainage area and stormwater flow paths

______ o)A description and drawings of all components of the proposed drainage system, including:

  ____ Locations, cross sections and profiles of all brooks, streams, drainage swales and their method of stabilization
  ____ All measures for the detention, retention or infiltration of water
  ____ All measures for the protection of water quality
  ____ The structural details for all components of the proposed drainage systems and stormwater management facilities
  ____ Notes on drawings specifying materials to be used, construction specifications and typicals
  ____ Expected hydrology with supporting calculations

______ p) Proposed improvements including locations of buildings or other structures, impervious surfaces, and drainage facilities if applicable

______ q)Timing schedules and sequence of development including clearing, stripping, rough grading, construction, final grading and vegetative stabilization

______ r)A maintenance schedule for the period of construction

______ **3)** One original Operation and Maintenance Plan and ten (10) copies thereof showing:

______ a)The names(s) of the owners(s) for all components of the system

______ b)Maintenance agreements that specify:

  ____ The names and addresses of the person(s)responsible for operation and maintenance
  ____ The person(s) responsible for financing maintenance and emergency repairs
  ____ A maintenance schedule for all drainage structures, including swales and ponds
  ____ A list of easements with the purpose and location of each
  ____ The signature(s) of the owner(s)

Note: The Planning Board may waive any of the above listed requirements if it believes that said requirement is not necessary based on the size and scope of the project. The applicant may petition the Planning Board prior to making a formal application to request notification as to which sections (s) of the stormwater plan review by-law requirements are necessary. The Planning Board will then notify the applicant within thirty (30) days as to which sections relate to the proposed project based on the size and scope of the project.

The Millbury Planning Board has accepted the submission of the above Stormwater Plan. This document certifies that, as currently submitted, the Stormwater Plan meets the minimum submission guidelines as set forth by the Town of Millbury. This document certifies that the Stormwater Plan is officially accepted for Planning Board review and consideration. It does not constitute approval of the Stormwater Plan.

Town Planner/Planning Board Clerk Signature ____ Date ___________________

TOWN OF MILLBURY, MASSACHUSETTS
FORM E

CERTIFIED LIST OF ABUTTERS

To the Town of Millbury Planning Board:

The undersigned being an applicant for approval of a Special Permit and/or Definitive Plan of a Subdivision entitled: Millbury Fire Station

requests the names and addresses of each abutter within a 300 foot radius of said property.

Applicant's Signature:
Mailing Address: 127 Elm Street
Owner of Property: Town of Millbury c/o Town Manager
Property Address: 130 Elm Street
Assessor's Map #: 53
Parcel #: 22
Date of Public Hearing: February 22, 2021

To the Town of Millbury Planning Board:

This is to certify that at the time of the last assessment for taxation made by the Town of Millbury, the names and addresses of the parties assessed as adjoining owners to the parcel of land shown above, where as above written, except as follows:

Assessor's Signature:
Date:

APPLICATION REVIEW

I, Sean Hendricks, Millbury Town Manager hereby request that my application for Millbury Fire Station be reviewed by the Millbury Planning Department whenever possible. I understand that I will be billed for review of said application at an hourly rate determined by the Town Treasurer for Planning and Secretarial support. Payments to the Town of Millbury, will be in accordance with Article 1, Section 14.6, 14.7 and 14.8 of the Town's Zoning Bylaws, and in accordance with the Town's Rules & Regulations Governing the Subdivision of Land.

Date: ________________________ Signature: ________________________________

I, Sean Hendricks, Millbury Town Manager hereby request that my application for Millbury Fire Station be reviewed by consultant(s) at my expense on behalf of the Town of Millbury Planning Board. I understand that the Planning Board shall hire the consultant of their choice in accordance with Section 53G, G.L. Chapter 44. Payments to the Town of Millbury will be in accordance with Article 1, Section 14.6, 14.7 and 14.8 of the Town's Zoning Bylaws, and in accordance with the Town's Rules & Regulations Governing the Subdivision of Land.

Date: ________________________ Signature: ________________________________

Drainage Analysis Narrative
For The Millbury Fire Station

Description of Project

The project site proposed for the new Millbury Fire Station, is located on the north side of Elm Street in Millbury, MA, and sits on approximately 1.84 acres of land. The site is located at 130 Elm Street and is further identified on Millbury Assessor's Map 53 as Lot 22. The project site is located in the Residential 1 (R-1) Zoning District.

The Millbury Fire Station construction project involves the removal of an existing three story, 7,400 square foot (footprint) building, removal of existing bituminous concrete driveways, walkways, play areas and parking facilities and selective tree, brush and branch removal on the parcel. In its place, a fire station structure with a footprint totaling approximately 17,535 gross square feet will be constructed on the site consisting of one and two story segments, along with new parking facilities located north, east and south of the proposed building. New water, sewer, drainage, natural gas, site lighting, electrical and communications utilities will be installed as well. The project is expected to be publically bid in the spring of 2021. Funding for the project will be considered for approval at a future Town Meeting.

The building will be accessed by the public from the main entrance located on the east side of the building. An illuminated sidewalk will be provided from the parking lot to the entrance. Multiple employee entrance will be provided around the building with paved walkways from the parking areas.

The existing impervious coverage on the site is approximately 32,247 square feet consisting of the existing building, driveways, walkways, parking facilities and play areas. The proposed construction will result in a total impervious cover of approximately 50,175 square feet.

Drainage improvements include the installation of hooded deep sump catch basins, trench drains stormwater quality separators, and subsurface detention bed systems with sand filters.

Study Area

The existing site is located at the peak of a hill. The majority of the site slopes to Elm Street with components that also discharge to Waters Street as well as abutting parcels to the west and north. Stormwater runoff discharges as surface flow with no means of attenuation or water quality treatment.

The area encompassed by this analysis and design includes all onsite catchment areas that will be disturbed by the proposed fire station construction as well as offsite areas that contribute to the subject site. Areas outside of the catchment limits will not be disturbed under this project and are not included in this analysis.

For purpose of design the site was divided into a number of sub-catchment areas. Runoff rates and storm volumes for both the existing and developed conditions were calculated utilizing the SCS TR-20 method and analyzed for the 2, 10, 25 and 100 year storm frequencies utilizing HydroCAD 10.00. Rainfall distribution is based on 24-Hour Storm event rainfall intensity utilizing a Type-III distribution. The rainfall intensity is based on values published by Cornell University for the region. The HydroCAD stormwater modeling associated with the subject site is based on the Dynamic Storage Indicator method, which is capable of simultaneously analyzing upstream and downstream effect of the modeled system.

The site soils are classified as Chatfield-Hollis-Rock outcrop complex, 0 to 15 percent slopes based on the United States Department of Agriculture Natural Resources Conservation Service soil maps. The USDA indicates the soil components consisting of both Hydrologic Soil Group 'B' and 'D', depending on the soil component encountered. Borings (building area) and test pits (around site) performed as part of the project geotechnical investigations indicate that the site generally consists of fill to depth of up to five feet, compact sands, silt and gravel (glacial outwash) and very hard gneiss bedrock. The depth to bedrock ranges from one foot below existing grade to greater than fifteen feet below existing grade. A subsurface infiltration bed has been provided with a minimum of two feet of separation to the existing bedrock. Stormwater recharge will be provided to the maximum extent practicable.

A geotechnical data report was prepared by McPhail Associates, LLC for the project which included boring and test pit logs for the site. The geotechnical data report is included as part of this Analysis.

Existing Conditions

The site is divided into four (4) sub-catchment areas. A description of each sub-catchment is as follows:

Sub-catchment E1:

This area is approximately 0.75 acres in size and consists of the majority of the existing building, walkways and lawn areas. Runoff from the roof discharges directly to grade and sheet flows towards the Waters and Elm Street. Upon intercepting the roadway gutter line, the runoff flows as shallow concentrated flow westerly on Elm Street where the majority of the runoff is intercepted by a municipal catch basin at the corner of Elm and River Streets. Some of the lawn area discharges to the street west of the catch basin. That runoff is collected at a subsequent catch basin on River Street.

Sub-catchment E2:

This area is approximately 0.3 acres in size and consists of a portion of the existing building, driveway, parking surfaces, walkways and lawn areas. Runoff from the roof discharges directly to grade and sheet flows on the parking surface towards the lawn area northeast of the existing building. The runoff is intercepted by the driveway where it is discharged to Waters Street.

Sub-catchment E3:

This area is approximately 0.4 acres in size and consists of a portion of the existing building, the majority of the existing parking surface, some of the existing driveway and lawn areas. Runoff from the roof discharges directly to grade and sheet flows on the parking surface towards the lawn area north of the building. The runoff crosses the northerly property line onto an abutting parcel. Based on available topographic information, the runoff likely continues to flow westerly and is intercepted by River Street.

Sub-catchment E4:

This area is approximately 0.3 acres in size and consists of a portion of the existing building, a portion of the existing parking surface and lawn areas. Runoff from the roof discharges directly to grade and sheet flows on the parking surface towards the lawn area west of the building. The runoff crosses the westerly property line onto abutting parcels. Based on available topographic information, the runoff likely continues to flow westerly and is intercepted by River Street.

Summary of peak runoff rates for the existing catchment areas are as follows:

Catchment		**2-Year**	**10-Year**	**25-Year**	**100-Year**
DP1 (E1)	Peak Flow (cfs)	1.54	2.80	3.72	5.58
	Volume (a-f)	0.115	0.209	0.278	0.421
DP2 (E2)	Peak Flow (cfs)	0.69	1.21	1.59	2.35
	Volume (a-f)	0.054	0.094	0.124	0.185
DP3 (E3)	Peak Flow (cfs)	1.12	1.84	2.36	3.40
	Volume (a-f)	0.087	0.144	0.186	0.27
DP4 (E4)	Peak Flow (cfs)	0.72	1.28	1.69	2.50
	Volume (a-f)	0.055	0.097	0.128	0.191

Proposed Conditions

The post construction site was divided into nine (9) sub-catchment areas. For the purpose of analysis, a cumulative design point was established for comparison to the existing conditions. A description of each sub-catchment is as follows:

Sub-catchment N1A:

This area is approximately 0.3 acres in size. The area consists of a large portion of lawn area the southwest corner of the site and existing sidewalks. This runoff will continue to sheet flows towards the Waters and Elm Street. Upon intercepting the roadway gutter line, the runoff flows as shallow concentrated flow westerly on Elm Street where the majority of the runoff is intercepted by a municipal catch basin at the corner of Elm and River Streets. Some of the lawn area discharges to the street west of the catch basin. That runoff is collected at a subsequent catch basin on River Street.

Sub-catchment N1B:

This area is approximately 0.11 acres in size and consists of a portion of the proposed parking spaces, driveway and a small area of landscaping. Parking surface runoff is collected by a deep sump catch basin which discharges the runoff to a hydrodynamic water quality structure for total suspended solids removal prior to discharging to Subsurface Detention Bed #1 which provides peak flow attenuation and Total Phosphorus removal. Overflow is provided by means of an Outlet Control Structure which discharges to an overflow drain pipe on the site which connects to the municipal drainage system in Elm Street.

Sub-catchment N1C:

This area is approximately 0.56 acres in size and consists of a portion of the proposed building roof, parking spaces, driveway, walkways and a small area of landscaping. Runoff from the pitched portion of the roof is collected by gutters and discharged directly to downspouts connected to the underground drainage system. Parking and driveway surface runoff is collected by deep sump catch basins which discharges the runoff to a hydrodynamic water quality structure for total suspended solids removal prior to discharging to Subsurface Detention Bed #2 which provides peak flow attenuation and Total Phosphorus removal. Overflow is provided by means of an Outlet Control Structure which discharges to an overflow drain pipe on the site which connects to the municipal drainage system in Elm Street.

Sub-catchment N1D:

This area is approximately 0.5 acres in size and consists of a portion of the proposed building roof, the south apparatus apron, parking spaces, lawn and landscape areas. Runoff from the pitched portion of the roof is collected by gutters and discharged directly to downspouts connected to the underground drainage system. Lawn, parking and driveway surface runoff is collected by a trench drain where the apparatus apron approaches Elm Street which discharges the runoff to a hydrodynamic water quality structure for total suspended solids removal prior to discharging to Subsurface Detention Bed #3 which provides peak flow attenuation and Total Phosphorus removal. Overflow is provided by means of an Outlet Control Structure which discharges to an overflow drain pipe on the site which connects to the municipal drainage system in Elm Street.

Sub-catchment N2:

This area is approximately 0.05 acres in size and consists of a portion of the driveway and lawn areas. Runoff discharges directly to grade and sheet flows on the driveway or sidewalk and discharges to Waters Street.

Sub-catchment N3:

This area is approximately 0.04 acres in size and consists of a portion of the landscape, lawn, gravel surround at the generator and concrete pad. Runoff sheet flows across the property line onto the abutting parcel. Based on available topographic information, the runoff likely continues to flow westerly and is intercepted by River Street.

Sub-catchment N4:

This area is approximately 0.03 acres in size and consists of a portion of the landscape and egress sidewalk from the building. Runoff sheet flows across the property line onto abutting parcels. Based on available topographic information, the runoff likely continues to flow westerly and is intercepted by River Street.

Sub-catchment R1:

This area is approximately 0.23 acres in size and consists of a portion of the proposed building roof. Runoff from the pitched portion of the roof is collected by gutters and discharged directly to downspouts connected to the underground drainage system. Runoff from the flat roof portion of the building are collected by interior roof drains and discharged to the underground drainage system. Runoff is collected in underground piping and discharges to Subsurface Infiltration Bed #1 which provides groundwater recharge, peak flow attenuation and Total Phosphorus removal. Overflow is provided by means of an Outlet Control Structure which discharges to an overflow drain pipe on the site which connects to the municipal drainage system in Elm Street.

Summary of peak runoff rates for the proposed catchment areas are as follows:

Catchment		**2-Year**	**10-Year**	**25-Year**	**100-Year**
DP1 (N1A, N1B, N1C, N1D & N1E)	Peak Flow (cfs)	1.32	2.66	3.66	5.54
	Volume (a-f)	0.316	0.543	0.716	1.050
DP2 (N2)	Peak Flow (cfs)	0.11	0.19	0.25	0.36
	Volume (a-f)	0.008	0.014	0.019	0.028
DP3 (N3)	Peak Flow (cfs)	0.08	0.15	0.20	0.31
	Volume (a-f)	0.006	0.011	0.015	0.023
DP4 (N4)	Peak Flow (cfs)	0.05	0.10	0.13	0.20
	Volume (a-f)	0.004	0.007	0.009	0.015

The analysis indicates that the runoff rates to the design point will either be matched or reduced.

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.

✓ tab

return ✗

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.

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

CHRISTOPHER M. GARCIA
CIVIL
No. 45034

Christopher Garcia

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): ______________________

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.

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[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 for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

  ☒ The ½" or 1" Water Quality Volume or

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

Checklist (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.

GARCIA • GALUSKA • DESOUSA
Consulting Engineers Inc.

ILLICIT DISCHARGE COMPLIANCE STATEMENT

DATE: March 1, 2021

OWNER: Town of Millbury
127 Elm Street
Millbury, MA 01527

PROJECT: Millbury Fire Station
130 Elm Street
Millbury, MA 01527
Map 53 / Lot 22

This statement is provided in accordance with the provisions of the Massachusetts Stormwater Management Standard 10 of the Massachusetts Stormwater Management Handbook.

To the best of my knowledge, no existing illicit discharges are present on the currently developed site. The proposed design does not include any connections to the stormwater drainage system other than from parking and driveway surfaces, downspouts, roof drains and surface runoff interceptor trenches.

Upon completion of construction, it is the listed Owner's responsibility to prevent new connections to the stormwater drainage system except for those previously noted to be allowed.

Christopher M. Garcia, PE

Project: Millbury Fire Station
Location: Millbury, MA

Drainage Calculations
Existing Conditions

1 SW1.1 EXISTING DRAINAGE CATCHMENT PLAN
SCALE: 1"=20'

context
ARCHITECTURE
68 HARRISON AVENUE BOSTON, MA 02111 TEL 617.423.1400 WEB CONTEXTARC.COM

GARCIA•GALUSKA•DESOUSA INC.
CONSULTING ENGINEERS
375 Faunce Corner Road - Suite D, Dartmouth, MA 02747-1271
508-998-5700 • FAX 508-998-0883 • E-MAIL info@g-g-d.com

SITE PLAN REVIEW UPDATES:
MARCH 1, 2021
NOT FOR CONSTRUCTION

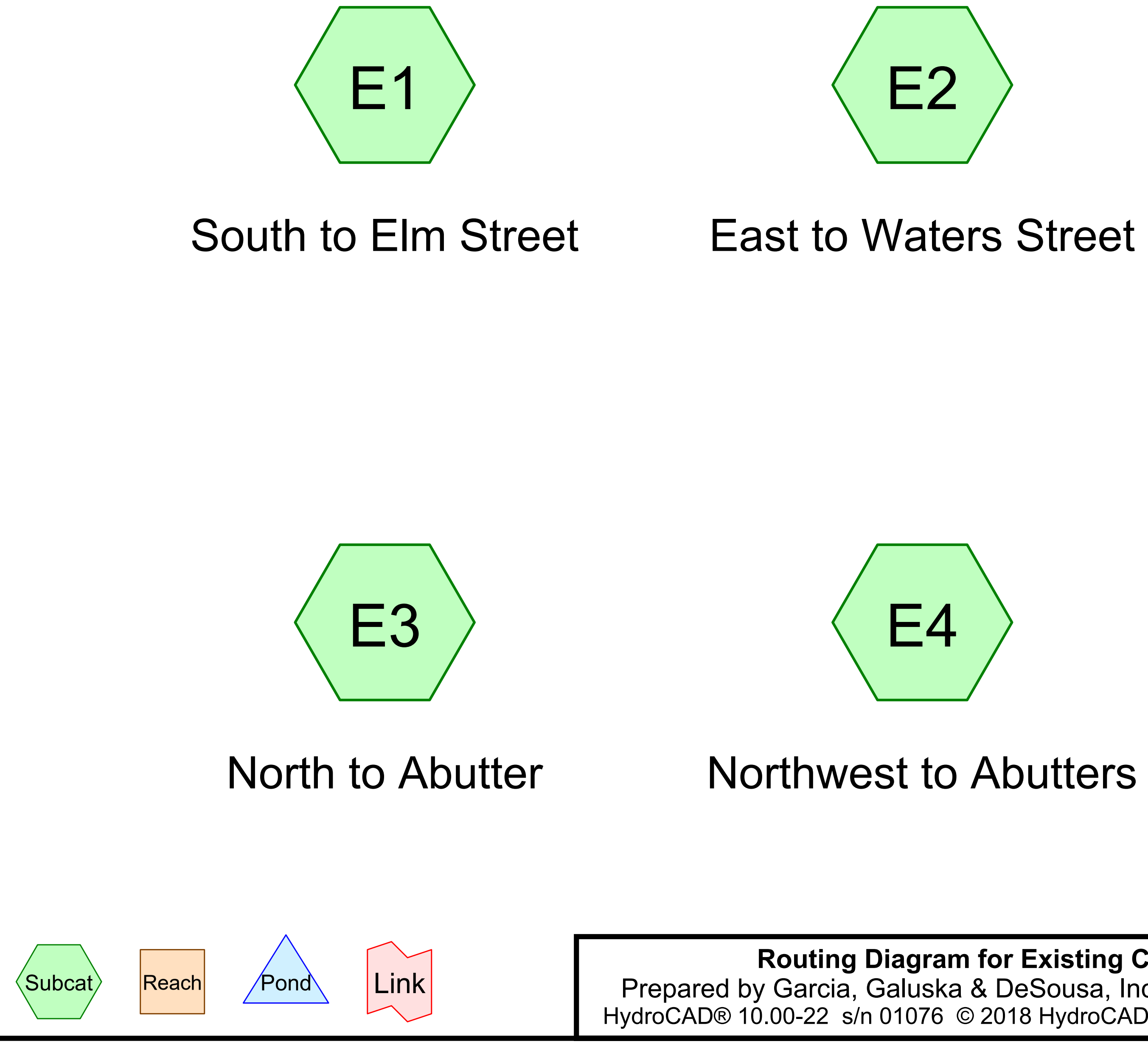
Millbury Fire Station
130 Elm Street, Millbury, MA
project number: 1902

Existing Drainage Catchment Plan

Scale: 1" = 20
Drawn by: NCK

No.	Issue	Date
1	PLANNING BOARD	1/25/21
2	PB REVISIONS	3/1/21

SW1.1



Routing Diagram for Existing Condition
Prepared by Garcia, Galuska & DeSousa, Inc., Printed 3/1/2021

Summary for Subcatchment E1: South to Elm Street

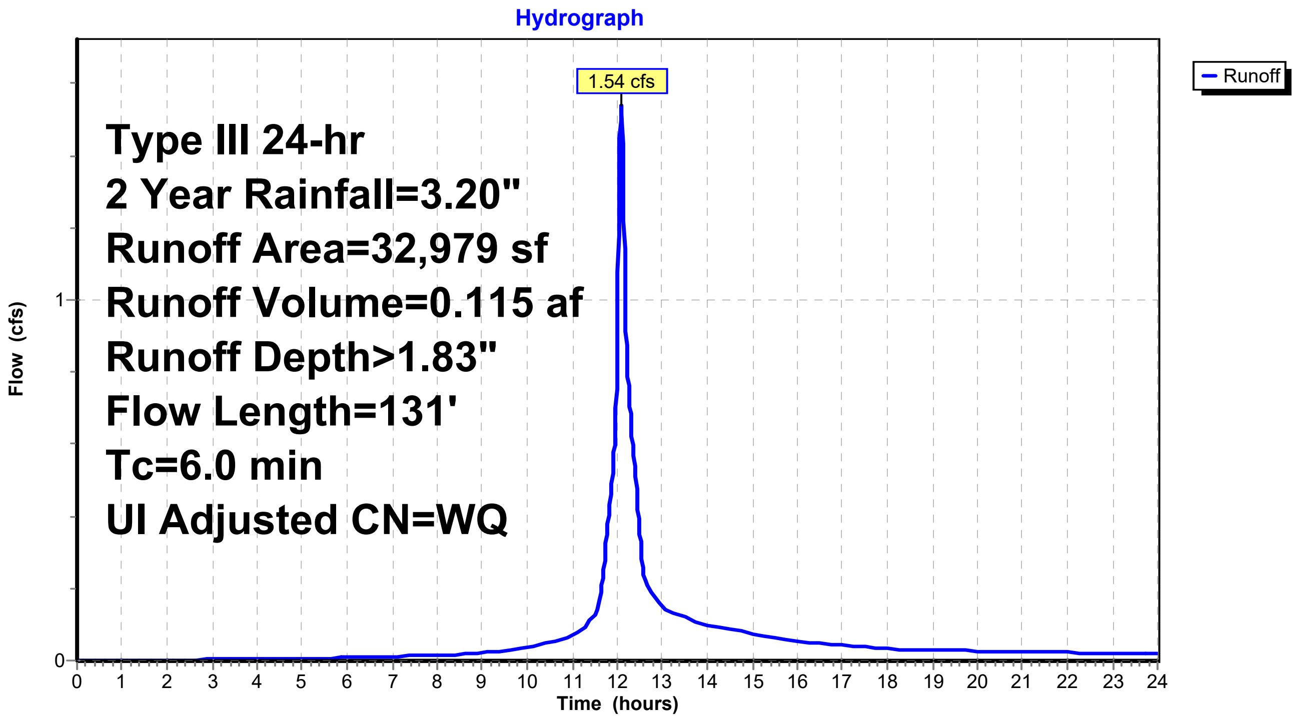
Runoff = 1.54 cfs @ 12.09 hrs, Volume= 0.115 af, Depth> 1.83"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Year Rainfall=3.20"

Area (sf)	CN	Adj	Description
23,996	80	80	>75% Grass cover, Good, HSG D
5,776	98	98	Unconnected pavement, HSG D
3,207	98	98	Unconnected roofs, HSG D
32,979			Weighted Average
23,996			72.76% Pervious Area
8,983			27.24% Impervious Area
8,983			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.5	50	0.0880	0.18		**Sheet Flow, A to B** Grass: Dense n= 0.240 P2= 3.20"
0.2	81	0.1230	5.65		**Shallow Concentrated Flow, B to C** Unpaved Kv= 16.1 fps
4.7	131	Total, Increased to minimum Tc = 6.0 min			

Subcatchment E1: South to Elm Street



Summary for Subcatchment E2: East to Waters Street

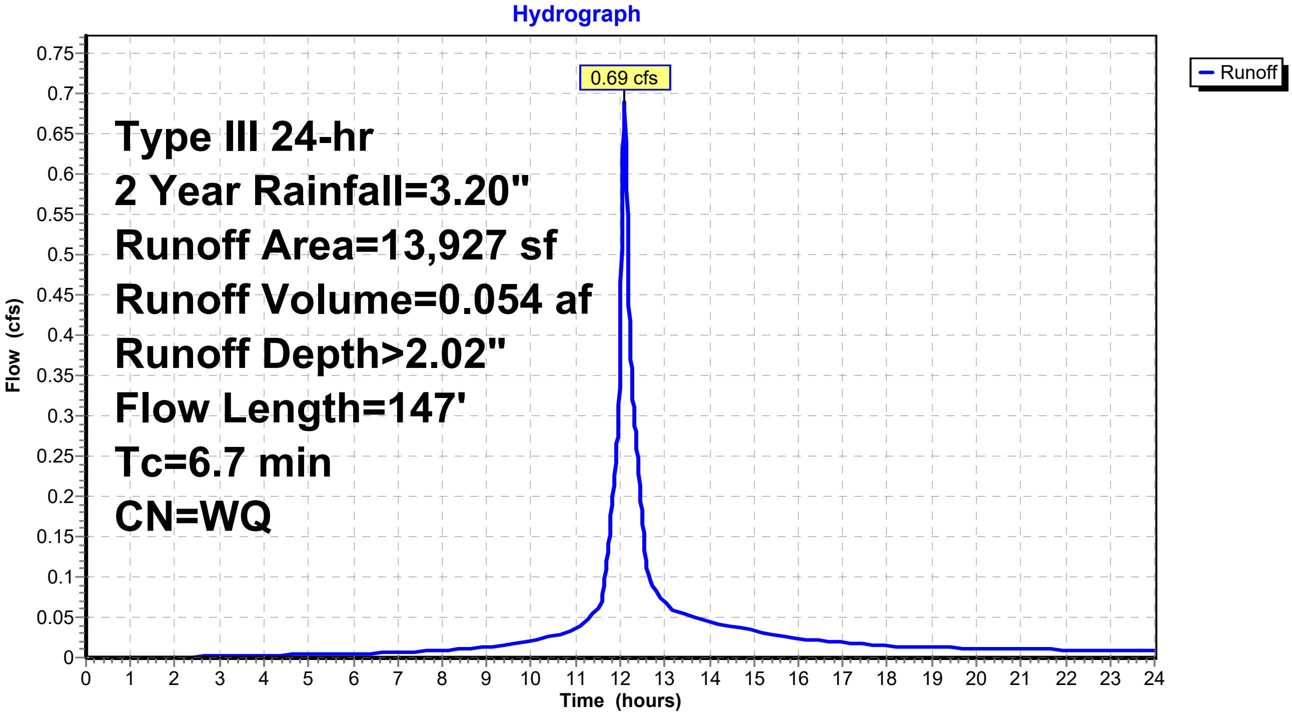
Runoff = 0.69 cfs @ 12.10 hrs, Volume= 0.054 af, Depth> 2.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Year Rainfall=3.20"

Area (sf)	CN	Description
8,352	80	>75% Grass cover, Good, HSG D
41	61	>75% Grass cover, Good, HSG B
5,021	98	Unconnected pavement, HSG D
20	98	Unconnected pavement, HSG B
493	98	Unconnected roofs, HSG D
13,927		Weighted Average
8,393		60.26% Pervious Area
5,534		39.74% Impervious Area
5,534		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	50	0.0380	0.13		**Sheet Flow, A to B** Grass: Dense n= 0.240 P2= 3.20"
0.0	21	0.1950	7.11		**Shallow Concentrated Flow, B to C** Unpaved Kv= 16.1 fps
0.4	76	0.0260	3.27		**Shallow Concentrated Flow, C to D** Paved Kv= 20.3 fps
6.7	147	Total			

Subcatchment E2: East to Waters Street



Summary for Subcatchment E3: North to Abutter

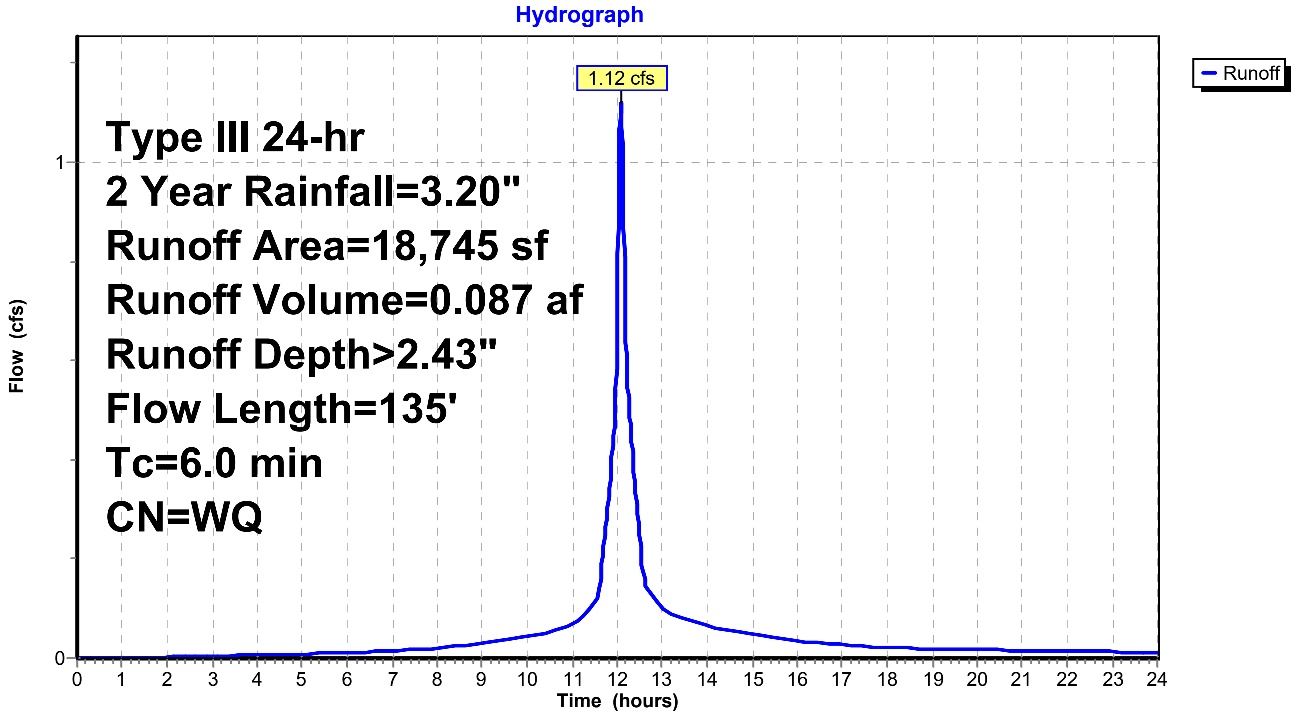
Runoff = 1.12 cfs @ 12.09 hrs, Volume= 0.087 af, Depth> 2.43"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Year Rainfall=3.20"

Area (sf)	CN	Description
6,366	80	>75% Grass cover, Good, HSG D
10,131	98	Unconnected pavement, HSG D
2,248	98	Unconnected roofs, HSG D
18,745		Weighted Average
6,366		33.96% Pervious Area
12,379		66.04% Impervious Area
12,379		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.1	50	0.1100	0.20		**Sheet Flow, A to B** Grass: Dense n= 0.240 P2= 3.20"
0.2	48	0.0290	3.46		**Shallow Concentrated Flow, B to C** Paved Kv= 20.3 fps
0.1	37	0.0700	4.26		**Shallow Concentrated Flow, C to D** Unpaved Kv= 16.1 fps
4.4	135	Total, Increased to minimum Tc = 6.0 min			

Subcatchment E3: North to Abutter



Summary for Subcatchment E4: Northwest to Abutters

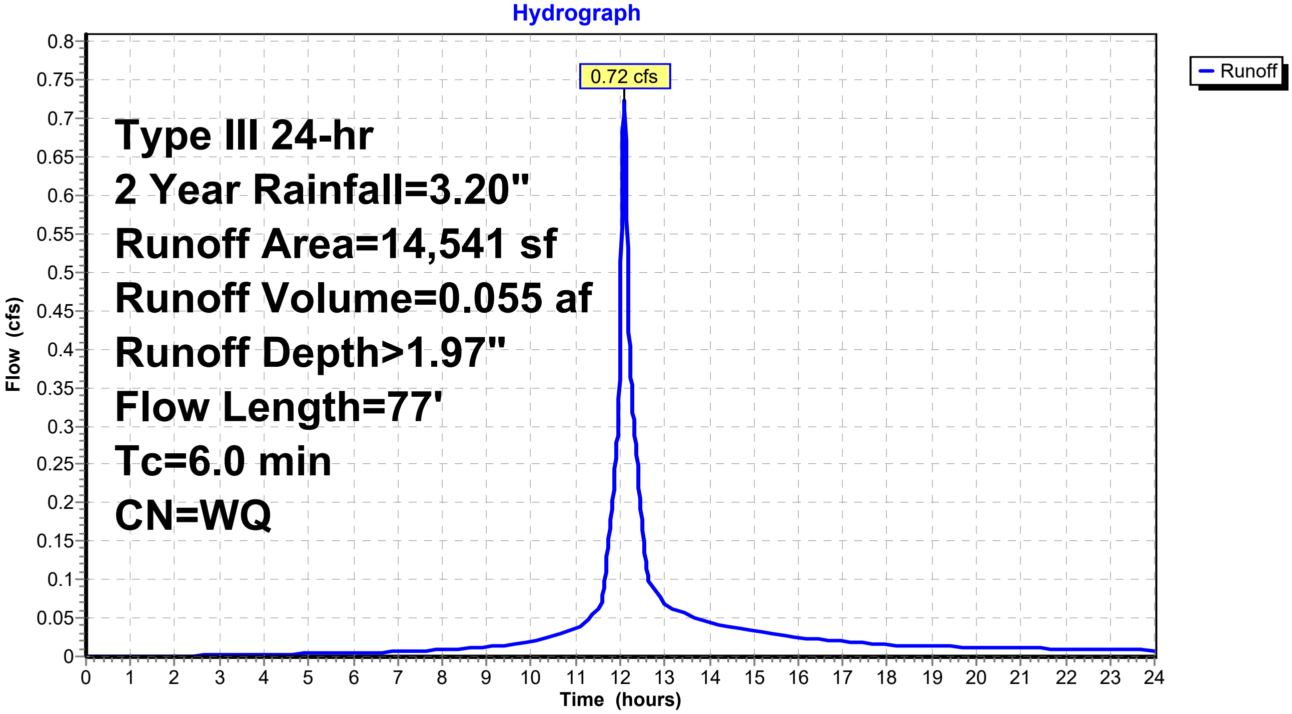
Runoff = 0.72 cfs @ 12.09 hrs, Volume= 0.055 af, Depth> 1.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Year Rainfall=3.20"

Area (sf)	CN	Description
9,214	80	>75% Grass cover, Good, HSG D
4,016	98	Paved parking, HSG D
1,311	98	Unconnected roofs, HSG D
14,541		Weighted Average
9,214		63.37% Pervious Area
5,327		36.63% Impervious Area
1,311		24.61% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.1	50	0.1100	0.20		**Sheet Flow, A to B** Grass: Dense n= 0.240 P2= 3.20"
0.1	27	0.0550	3.78		**Shallow Concentrated Flow, B to C** Unpaved Kv= 16.1 fps
4.2	77	Total, Increased to minimum Tc = 6.0 min			

Subcatchment E4: Northwest to Abutters



Summary for Subcatchment E1: South to Elm Street

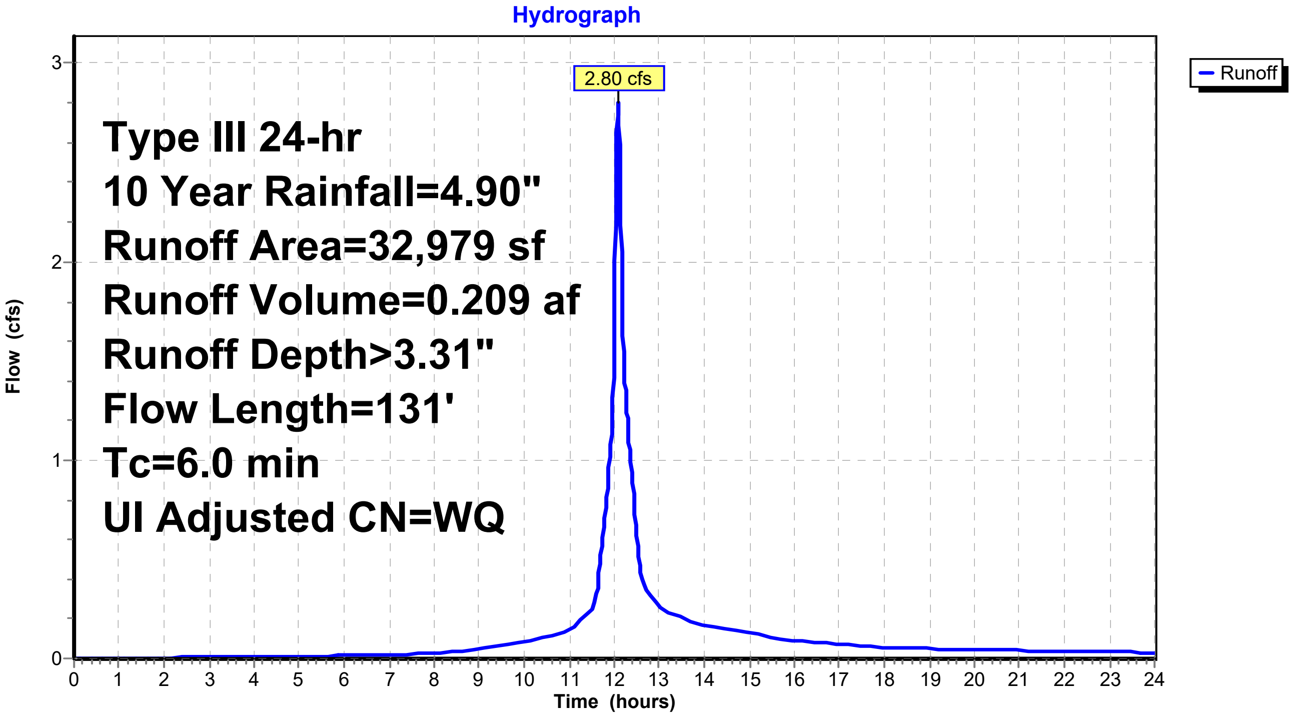
Runoff = 2.80 cfs @ 12.09 hrs, Volume= 0.209 af, Depth> 3.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Year Rainfall=4.90"

Area (sf)	CN	Adj	Description
23,996	80	80	>75% Grass cover, Good, HSG D
5,776	98	98	Unconnected pavement, HSG D
3,207	98	98	Unconnected roofs, HSG D
32,979			Weighted Average
23,996			72.76% Pervious Area
8,983			27.24% Impervious Area
8,983			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.5	50	0.0880	0.18		**Sheet Flow, A to B** Grass: Dense n= 0.240 P2= 3.20"
0.2	81	0.1230	5.65		**Shallow Concentrated Flow, B to C** Unpaved Kv= 16.1 fps
4.7	131	Total, Increased to minimum Tc = 6.0 min			

Subcatchment E1: South to Elm Street



Summary for Subcatchment E2: East to Waters Street

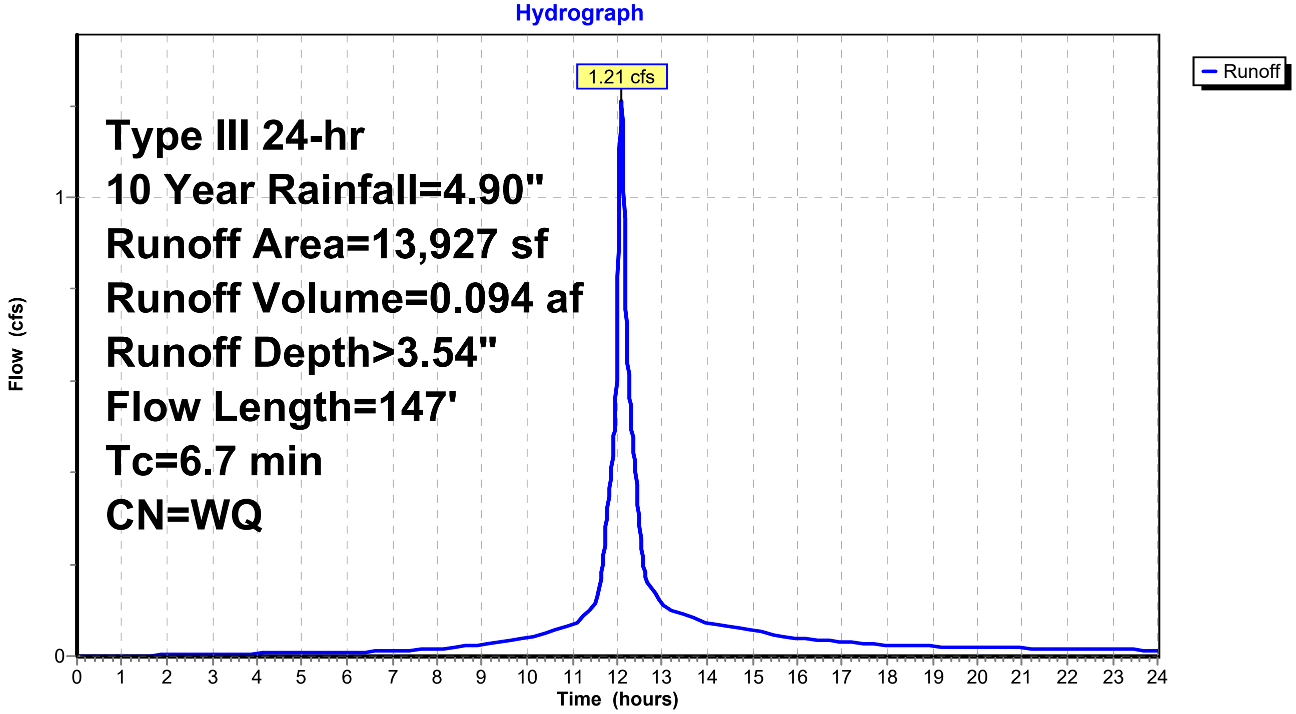
Runoff = 1.21 cfs @ 12.10 hrs, Volume= 0.094 af, Depth> 3.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Year Rainfall=4.90"

Area (sf)	CN	Description
8,352	80	>75% Grass cover, Good, HSG D
41	61	>75% Grass cover, Good, HSG B
5,021	98	Unconnected pavement, HSG D
20	98	Unconnected pavement, HSG B
493	98	Unconnected roofs, HSG D
13,927		Weighted Average
8,393		60.26% Pervious Area
5,534		39.74% Impervious Area
5,534		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	50	0.0380	0.13		**Sheet Flow, A to B** Grass: Dense n= 0.240 P2= 3.20"
0.0	21	0.1950	7.11		**Shallow Concentrated Flow, B to C** Unpaved Kv= 16.1 fps
0.4	76	0.0260	3.27		**Shallow Concentrated Flow, C to D** Paved Kv= 20.3 fps
6.7	147	Total			

Subcatchment E2: East to Waters Street



Summary for Subcatchment E3: North to Abutter

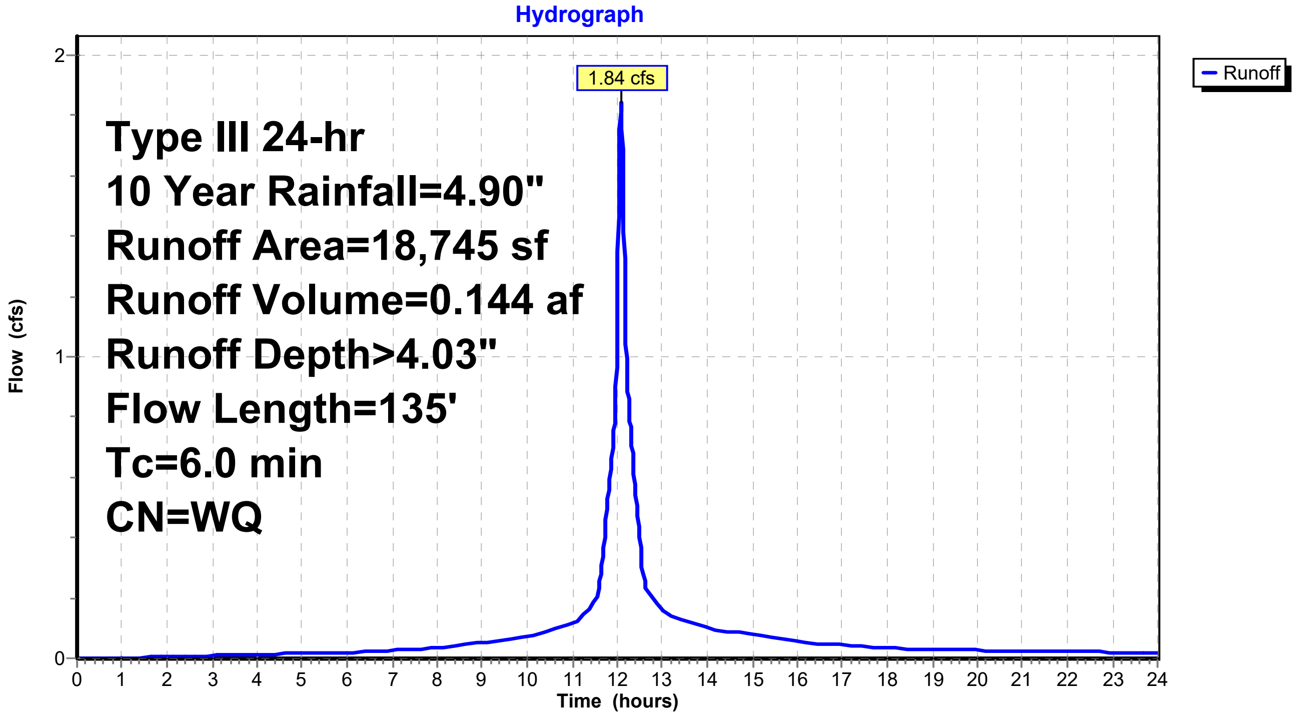
Runoff = 1.84 cfs @ 12.08 hrs, Volume= 0.144 af, Depth> 4.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Year Rainfall=4.90"

Area (sf)	CN	Description
6,366	80	>75% Grass cover, Good, HSG D
10,131	98	Unconnected pavement, HSG D
2,248	98	Unconnected roofs, HSG D
18,745		Weighted Average
6,366		33.96% Pervious Area
12,379		66.04% Impervious Area
12,379		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.1	50	0.1100	0.20		**Sheet Flow, A to B** Grass: Dense n= 0.240 P2= 3.20"
0.2	48	0.0290	3.46		**Shallow Concentrated Flow, B to C** Paved Kv= 20.3 fps
0.1	37	0.0700	4.26		**Shallow Concentrated Flow, C to D** Unpaved Kv= 16.1 fps
4.4	135	Total, Increased to minimum Tc = 6.0 min			

Subcatchment E3: North to Abutter



Summary for Subcatchment E4: Northwest to Abutters

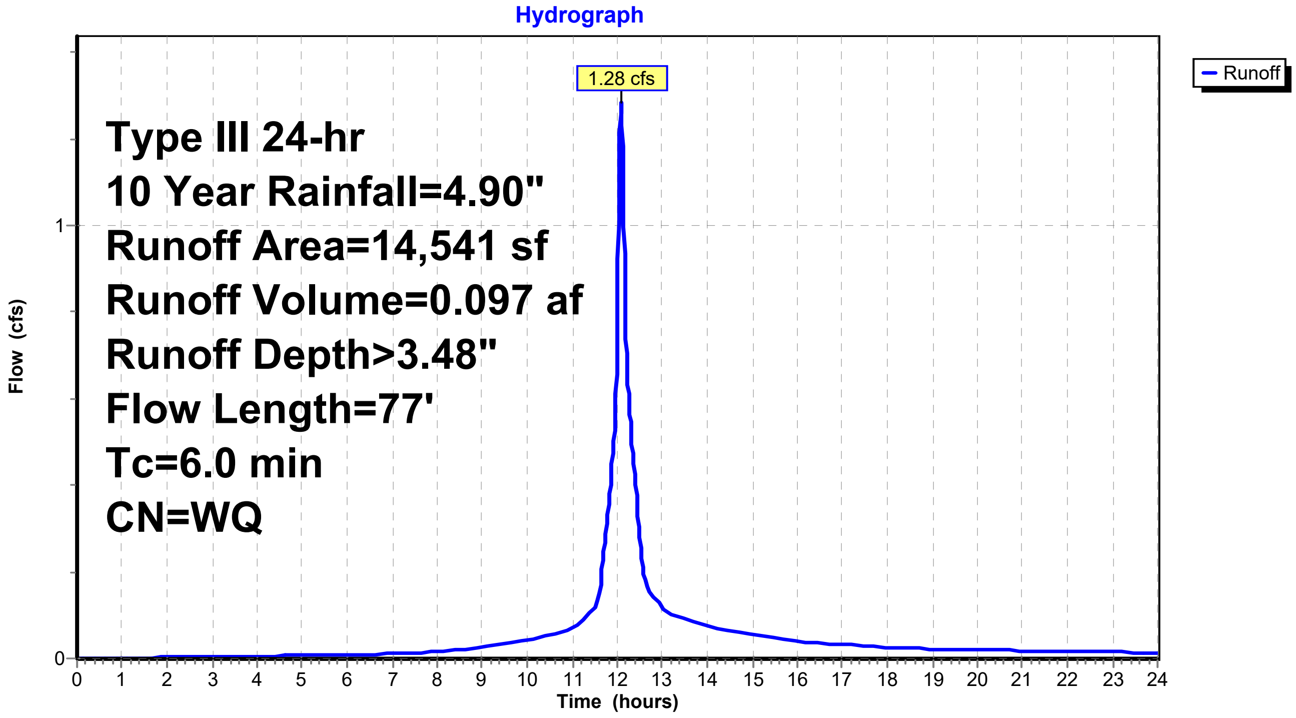
Runoff = 1.28 cfs @ 12.09 hrs, Volume= 0.097 af, Depth> 3.48"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Year Rainfall=4.90"

Area (sf)	CN	Description
9,214	80	>75% Grass cover, Good, HSG D
4,016	98	Paved parking, HSG D
1,311	98	Unconnected roofs, HSG D
14,541		Weighted Average
9,214		63.37% Pervious Area
5,327		36.63% Impervious Area
1,311		24.61% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.1	50	0.1100	0.20		**Sheet Flow, A to B** Grass: Dense n= 0.240 P2= 3.20"
0.1	27	0.0550	3.78		**Shallow Concentrated Flow, B to C** Unpaved Kv= 16.1 fps
4.2	77	Total, Increased to minimum Tc = 6.0 min			

Subcatchment E4: Northwest to Abutters



Summary for Subcatchment E1: South to Elm Street

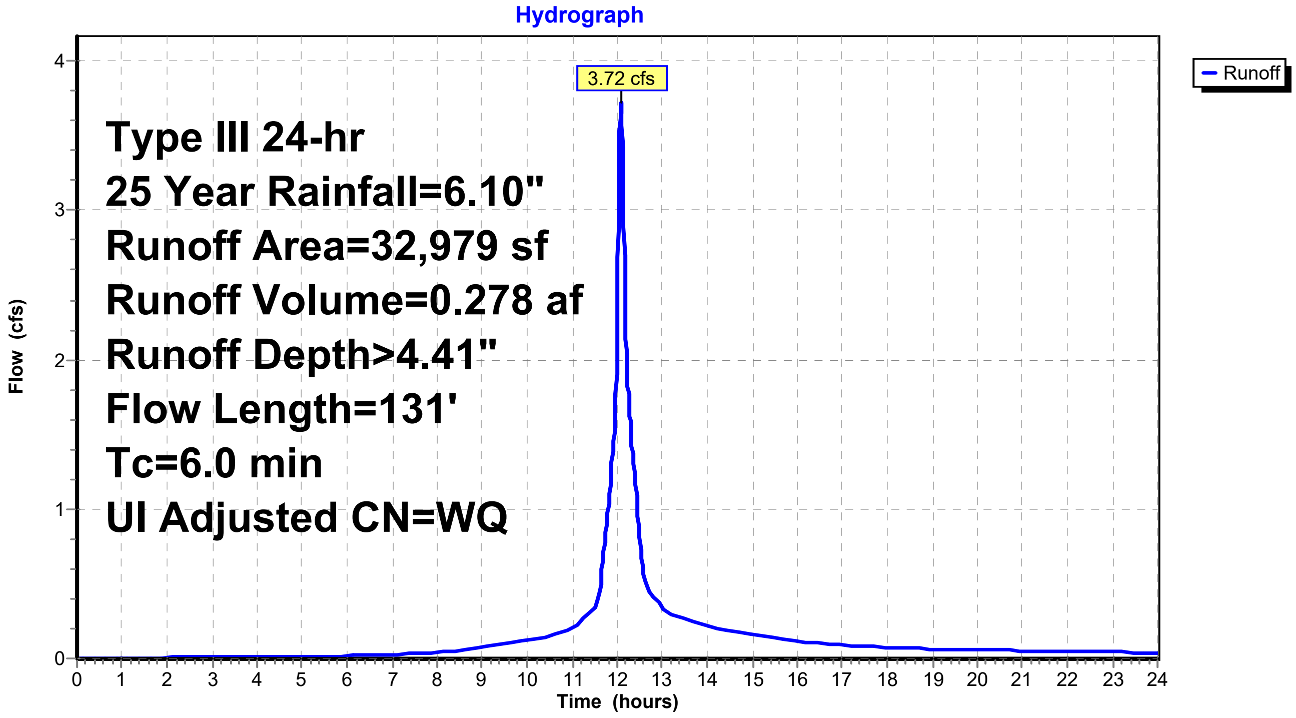
Runoff = 3.72 cfs @ 12.09 hrs, Volume= 0.278 af, Depth> 4.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Year Rainfall=6.10"

Area (sf)	CN	Adj	Description
23,996	80	80	>75% Grass cover, Good, HSG D
5,776	98	98	Unconnected pavement, HSG D
3,207	98	98	Unconnected roofs, HSG D
32,979			Weighted Average
23,996			72.76% Pervious Area
8,983			27.24% Impervious Area
8,983			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.5	50	0.0880	0.18		**Sheet Flow, A to B** Grass: Dense n= 0.240 P2= 3.20"
0.2	81	0.1230	5.65		**Shallow Concentrated Flow, B to C** Unpaved Kv= 16.1 fps
4.7	131	Total, Increased to minimum Tc = 6.0 min			

Subcatchment E1: South to Elm Street



Summary for Subcatchment E2: East to Waters Street

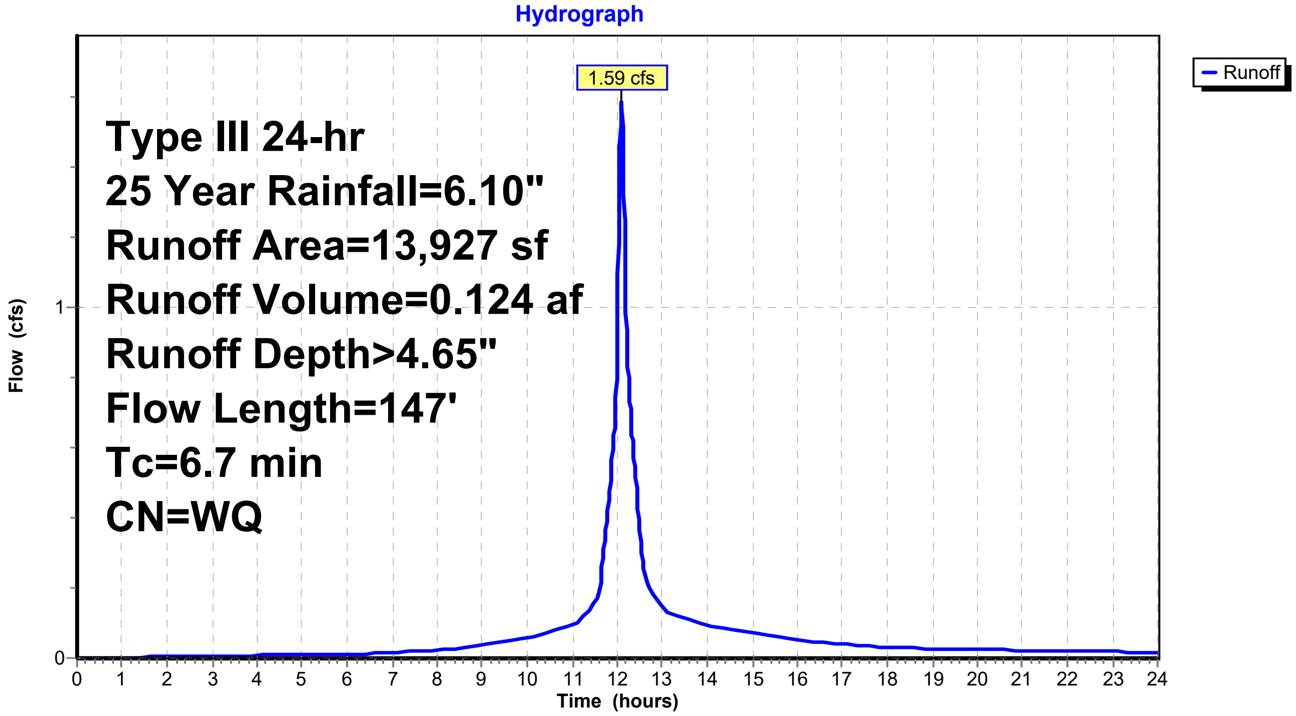
Runoff = 1.59 cfs @ 12.09 hrs, Volume= 0.124 af, Depth> 4.65"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Year Rainfall=6.10"

Area (sf)	CN	Description
8,352	80	>75% Grass cover, Good, HSG D
41	61	>75% Grass cover, Good, HSG B
5,021	98	Unconnected pavement, HSG D
20	98	Unconnected pavement, HSG B
493	98	Unconnected roofs, HSG D
13,927		Weighted Average
8,393		60.26% Pervious Area
5,534		39.74% Impervious Area
5,534		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	50	0.0380	0.13		**Sheet Flow, A to B** Grass: Dense n= 0.240 P2= 3.20"
0.0	21	0.1950	7.11		**Shallow Concentrated Flow, B to C** Unpaved Kv= 16.1 fps
0.4	76	0.0260	3.27		**Shallow Concentrated Flow, C to D** Paved Kv= 20.3 fps
6.7	147	Total			

Subcatchment E2: East to Waters Street



Summary for Subcatchment E3: North to Abutter

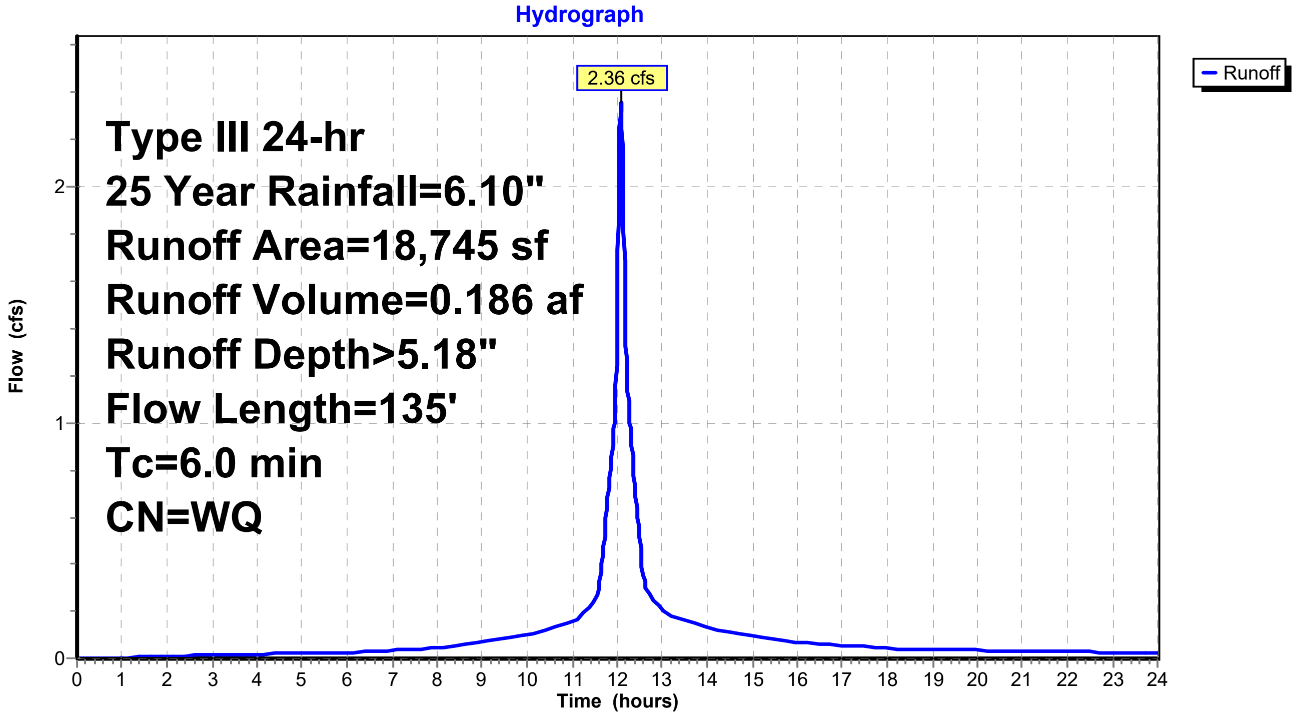
Runoff = 2.36 cfs @ 12.08 hrs, Volume= 0.186 af, Depth> 5.18"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Year Rainfall=6.10"

Area (sf)	CN	Description
6,366	80	>75% Grass cover, Good, HSG D
10,131	98	Unconnected pavement, HSG D
2,248	98	Unconnected roofs, HSG D
18,745		Weighted Average
6,366		33.96% Pervious Area
12,379		66.04% Impervious Area
12,379		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.1	50	0.1100	0.20		**Sheet Flow, A to B** Grass: Dense n= 0.240 P2= 3.20"
0.2	48	0.0290	3.46		**Shallow Concentrated Flow, B to C** Paved Kv= 20.3 fps
0.1	37	0.0700	4.26		**Shallow Concentrated Flow, C to D** Unpaved Kv= 16.1 fps
4.4	135	Total, Increased to minimum Tc = 6.0 min			

Subcatchment E3: North to Abutter



Summary for Subcatchment E4: Northwest to Abutters

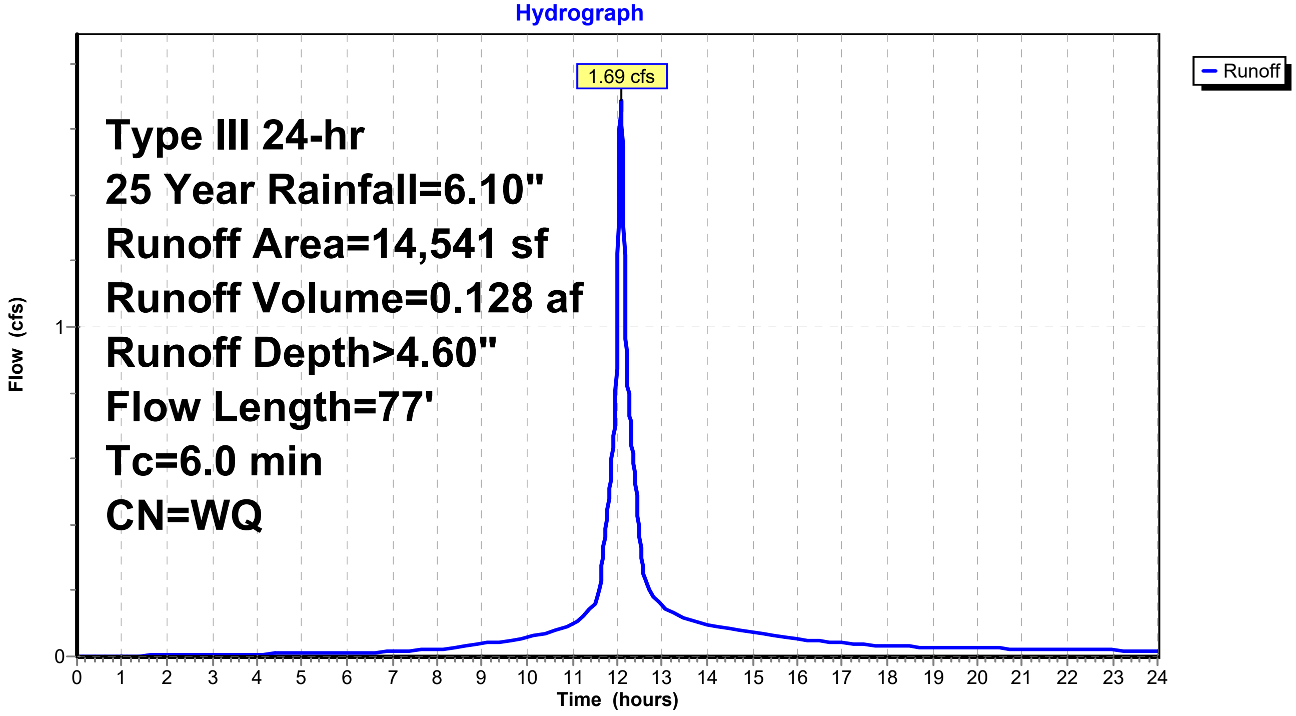
Runoff = 1.69 cfs @ 12.09 hrs, Volume= 0.128 af, Depth> 4.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Year Rainfall=6.10"

Area (sf)	CN	Description
9,214	80	>75% Grass cover, Good, HSG D
4,016	98	Paved parking, HSG D
1,311	98	Unconnected roofs, HSG D
14,541		Weighted Average
9,214		63.37% Pervious Area
5,327		36.63% Impervious Area
1,311		24.61% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.1	50	0.1100	0.20		**Sheet Flow, A to B** Grass: Dense n= 0.240 P2= 3.20"
0.1	27	0.0550	3.78		**Shallow Concentrated Flow, B to C** Unpaved Kv= 16.1 fps
4.2	77	Total, Increased to minimum Tc = 6.0 min			

Subcatchment E4: Northwest to Abutters



Summary for Subcatchment E1: South to Elm Street

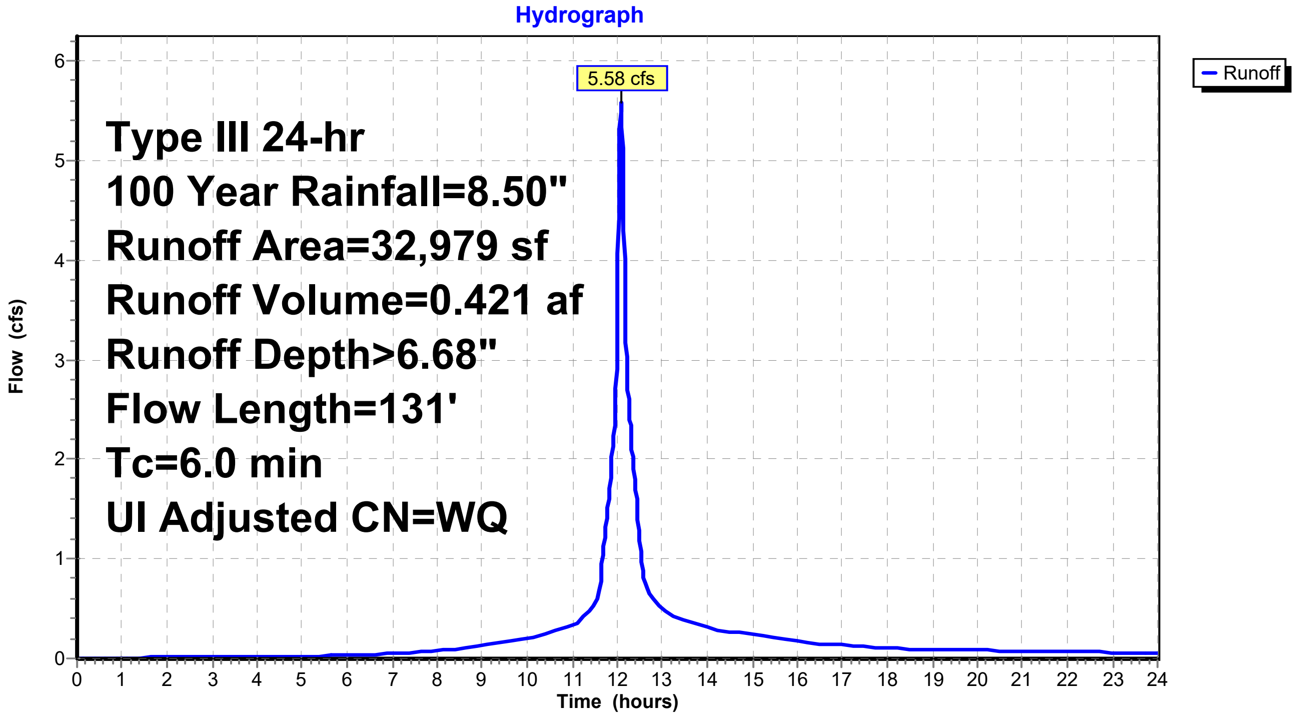
Runoff = 5.58 cfs @ 12.09 hrs, Volume= 0.421 af, Depth> 6.68"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Year Rainfall=8.50"

Area (sf)	CN	Adj	Description
23,996	80	80	>75% Grass cover, Good, HSG D
5,776	98	98	Unconnected pavement, HSG D
3,207	98	98	Unconnected roofs, HSG D
32,979			Weighted Average
23,996			72.76% Pervious Area
8,983			27.24% Impervious Area
8,983			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.5	50	0.0880	0.18		**Sheet Flow, A to B** Grass: Dense n= 0.240 P2= 3.20"
0.2	81	0.1230	5.65		**Shallow Concentrated Flow, B to C** Unpaved Kv= 16.1 fps
4.7	131	Total, Increased to minimum Tc = 6.0 min			

Subcatchment E1: South to Elm Street



Summary for Subcatchment E2: East to Waters Street

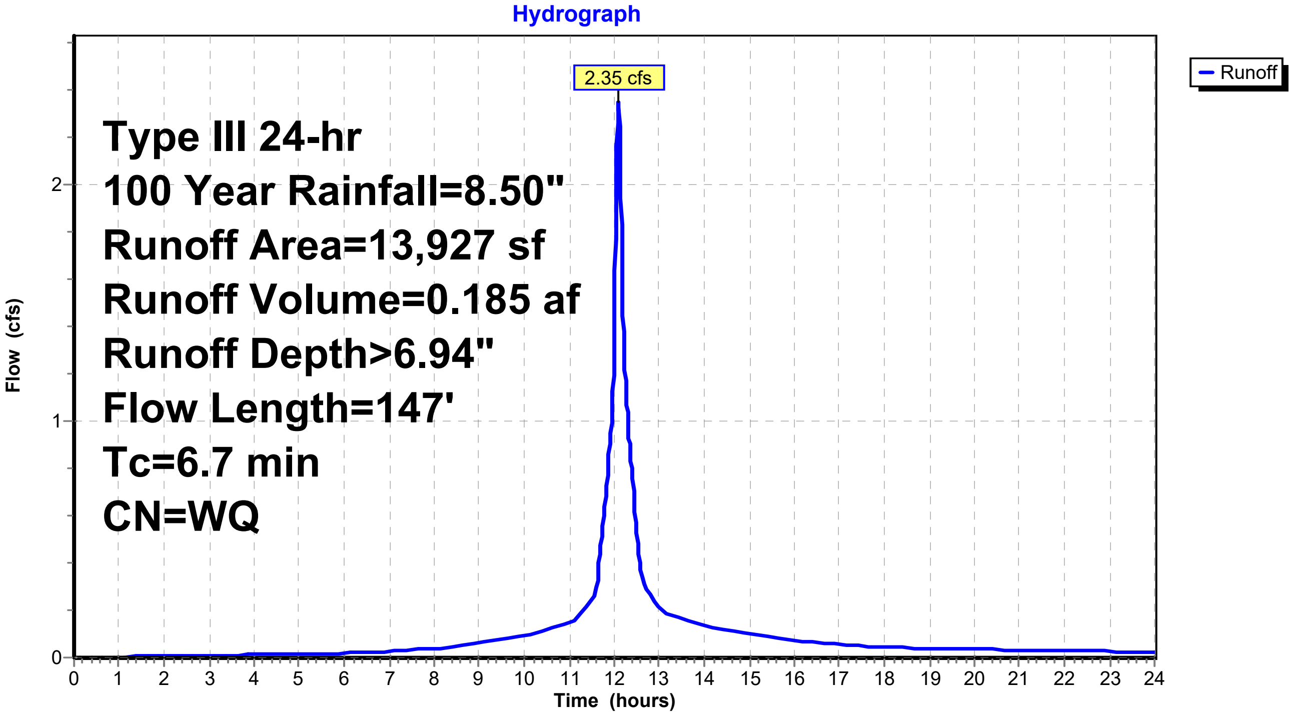
Runoff = 2.35 cfs @ 12.09 hrs, Volume= 0.185 af, Depth> 6.94"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Year Rainfall=8.50"

Area (sf)	CN	Description
8,352	80	>75% Grass cover, Good, HSG D
41	61	>75% Grass cover, Good, HSG B
5,021	98	Unconnected pavement, HSG D
20	98	Unconnected pavement, HSG B
493	98	Unconnected roofs, HSG D
13,927		Weighted Average
8,393		60.26% Pervious Area
5,534		39.74% Impervious Area
5,534		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	50	0.0380	0.13		**Sheet Flow, A to B** Grass: Dense n= 0.240 P2= 3.20"
0.0	21	0.1950	7.11		**Shallow Concentrated Flow, B to C** Unpaved Kv= 16.1 fps
0.4	76	0.0260	3.27		**Shallow Concentrated Flow, C to D** Paved Kv= 20.3 fps
6.7	147	Total			

Subcatchment E2: East to Waters Street



Summary for Subcatchment E3: North to Abutter

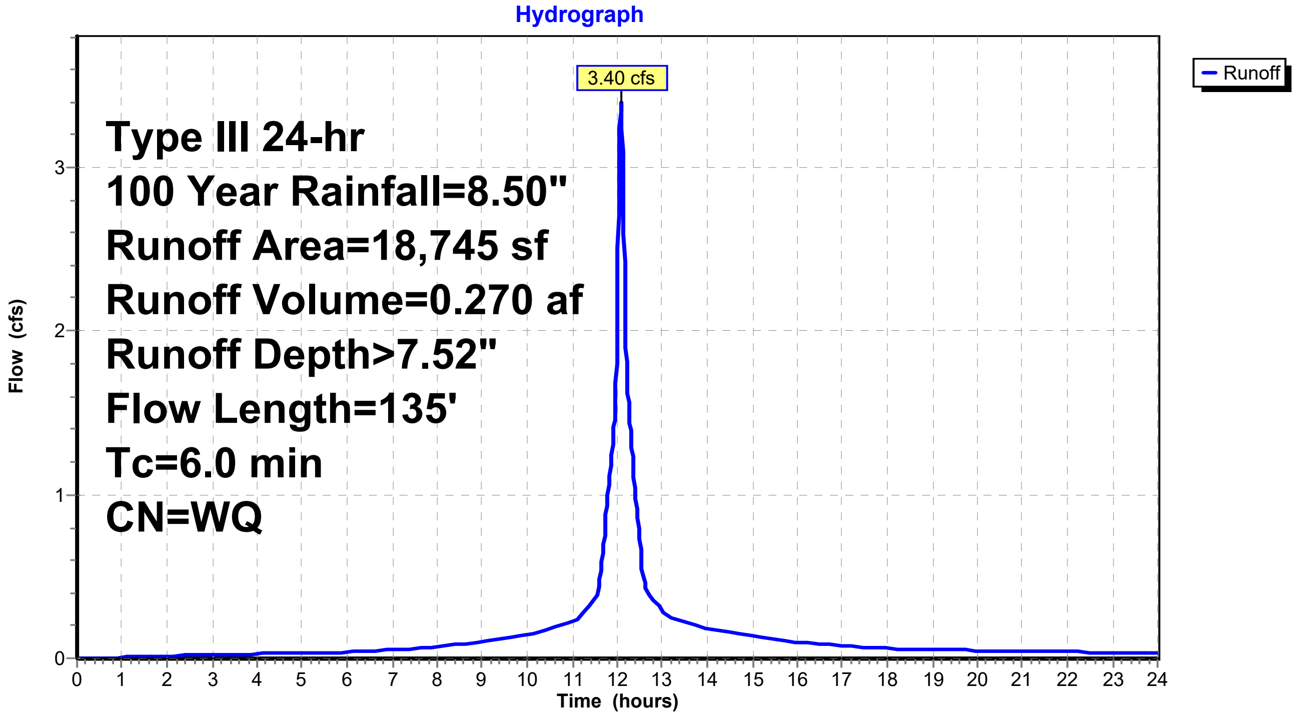
Runoff = 3.40 cfs @ 12.08 hrs, Volume= 0.270 af, Depth> 7.52"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Year Rainfall=8.50"

Area (sf)	CN	Description
6,366	80	>75% Grass cover, Good, HSG D
10,131	98	Unconnected pavement, HSG D
2,248	98	Unconnected roofs, HSG D
18,745		Weighted Average
6,366		33.96% Pervious Area
12,379		66.04% Impervious Area
12,379		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.1	50	0.1100	0.20		**Sheet Flow, A to B** Grass: Dense n= 0.240 P2= 3.20"
0.2	48	0.0290	3.46		**Shallow Concentrated Flow, B to C** Paved Kv= 20.3 fps
0.1	37	0.0700	4.26		**Shallow Concentrated Flow, C to D** Unpaved Kv= 16.1 fps
4.4	135	Total, Increased to minimum Tc = 6.0 min			

Subcatchment E3: North to Abutter



Summary for Subcatchment E4: Northwest to Abutters

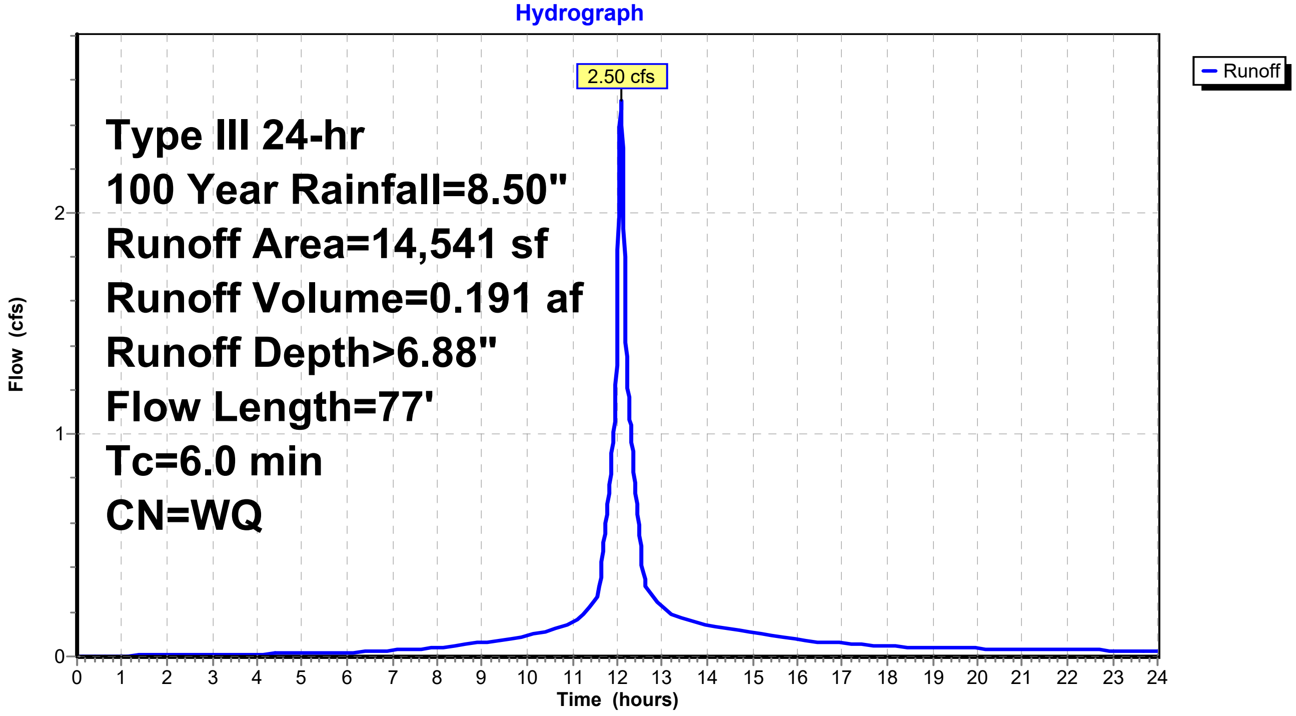
Runoff = 2.50 cfs @ 12.08 hrs, Volume= 0.191 af, Depth> 6.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Year Rainfall=8.50"

Area (sf)	CN	Description
9,214	80	>75% Grass cover, Good, HSG D
4,016	98	Paved parking, HSG D
1,311	98	Unconnected roofs, HSG D
14,541		Weighted Average
9,214		63.37% Pervious Area
5,327		36.63% Impervious Area
1,311		24.61% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.1	50	0.1100	0.20		**Sheet Flow, A to B** Grass: Dense n= 0.240 P2= 3.20"
0.1	27	0.0550	3.78		**Shallow Concentrated Flow, B to C** Unpaved Kv= 16.1 fps
4.2	77	Total, Increased to minimum Tc = 6.0 min			

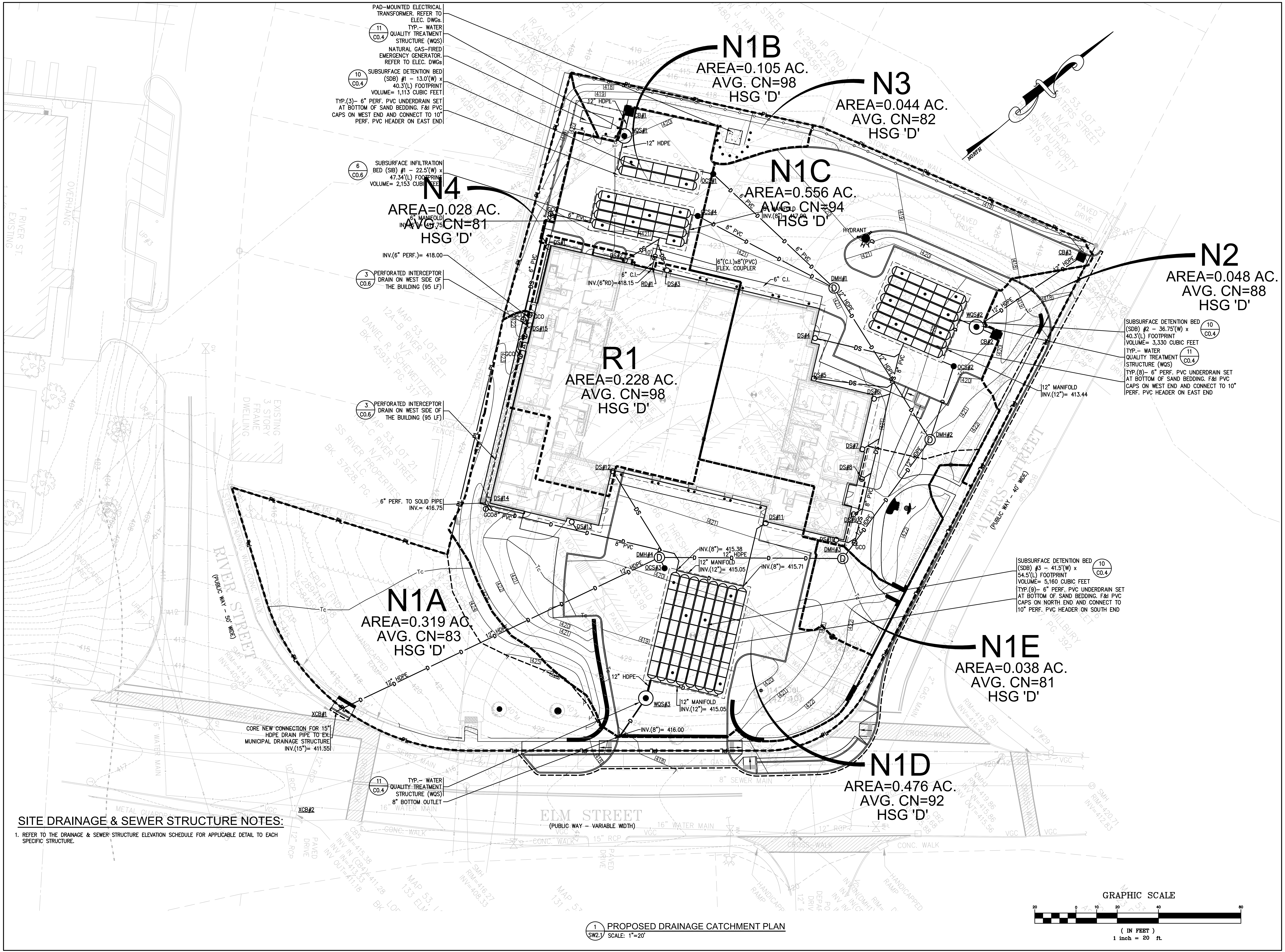
Subcatchment E4: Northwest to Abutters



GARCIA • GALUSKA • DESOUSA
Consulting Engineers Inc.

Project: Millbury Fire Station
Location: Millbury, MA

Drainage Calculations
Developed Conditions



PAD–MOUNTED ELECTRICAL TRANSFORMER. REFER TO ELEC. DWGs.

11/C0.4 TYP.– WATER QUALITY TREATMENT STRUCTURE (WQS)

NATURAL GAS–FIRED EMERGENCY GENERATOR. REFER TO ELEC. DWGs

10/C0.4 SUBSURFACE DETENTION BED (SDB) #1 – 13.0'(W) x 40.3'(L) FOOTPRINT VOLUME= 1,113 CUBIC FEET

TYP.(3)– 6" PERF. PVC UNDERDRAIN SET AT BOTTOM OF SAND BEDDING. F&I PVC CAPS ON WEST END AND CONNECT TO 10" PERF. PVC HEADER ON EAST END

6/C0.6 SUBSURFACE INFILTRATION BED (SIB) #1 – 22.5'(W) x 47.34'(L) FOOTPRINT VOLUME= 2,153 CUBIC FEET

6" MANIFOLD INV.(6")= 417.75

INV.(6" PERF.)= 418.00

3/C0.6 PERFORATED INTERCEPTOR DRAIN ON WEST SIDE OF THE BUILDING (95 LF)

3/C0.6 PERFORATED INTERCEPTOR DRAIN ON WEST SIDE OF THE BUILDING (95 LF)

10/C0.4 SUBSURFACE DETENTION BED (SDB) #2 – 36.75'(W) x 40.3'(L) FOOTPRINT VOLUME= 3,330 CUBIC FEET

11/C0.4 TYP.– WATER QUALITY TREATMENT STRUCTURE (WQS)

TYP.(8)– 6" PERF. PVC UNDERDRAIN SET AT BOTTOM OF SAND BEDDING. F&I PVC CAPS ON WEST END AND CONNECT TO 10" PERF. PVC HEADER ON EAST END

10/C0.4 SUBSURFACE DETENTION BED (SDB) #3 – 41.5'(W) x 54.5'(L) FOOTPRINT VOLUME= 5,160 CUBIC FEET

TYP.(9)– 6" PERF. PVC UNDERDRAIN SET AT BOTTOM OF SAND BEDDING. F&I PVC CAPS ON NORTH END AND CONNECT TO 10" PERF. PVC HEADER ON SOUTH END

CORE NEW CONNECTION FOR 15" HDPE DRAIN PIPE TO EX. MUNICIPAL DRAINAGE STRUCTURE INV.(15")= 411.55

11/C0.4 TYP.– WATER QUALITY TREATMENT STRUCTURE (WQS)

8" BOTTOM OUTLET

SITE DRAINAGE & SEWER STRUCTURE NOTES:

1. REFER TO THE DRAINAGE & SEWER STRUCTURE ELEVATION SCHEDULE FOR APPLICABLE DETAIL TO EACH SPECIFIC STRUCTURE.

1/SW2.1 PROPOSED DRAINAGE CATCHMENT PLAN
SCALE: 1"=20'

context
ARCHITECTURE
68 HARRISON AVENUE BOSTON, MA 02111 TEL 617.423.1400 WEB CONTEXTARC.COM

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CONSULTING ENGINEERS INC.
375 Faunce Corner Road - Suite D, Dartmouth, MA 02747-1271
508-998-5700 • FAX 508-998-0883 • E-MAIL info@g-g-d.com

SITE PLAN REVIEW UPDATES:
MARCH 1, 2021
NOT FOR CONSTRUCTION

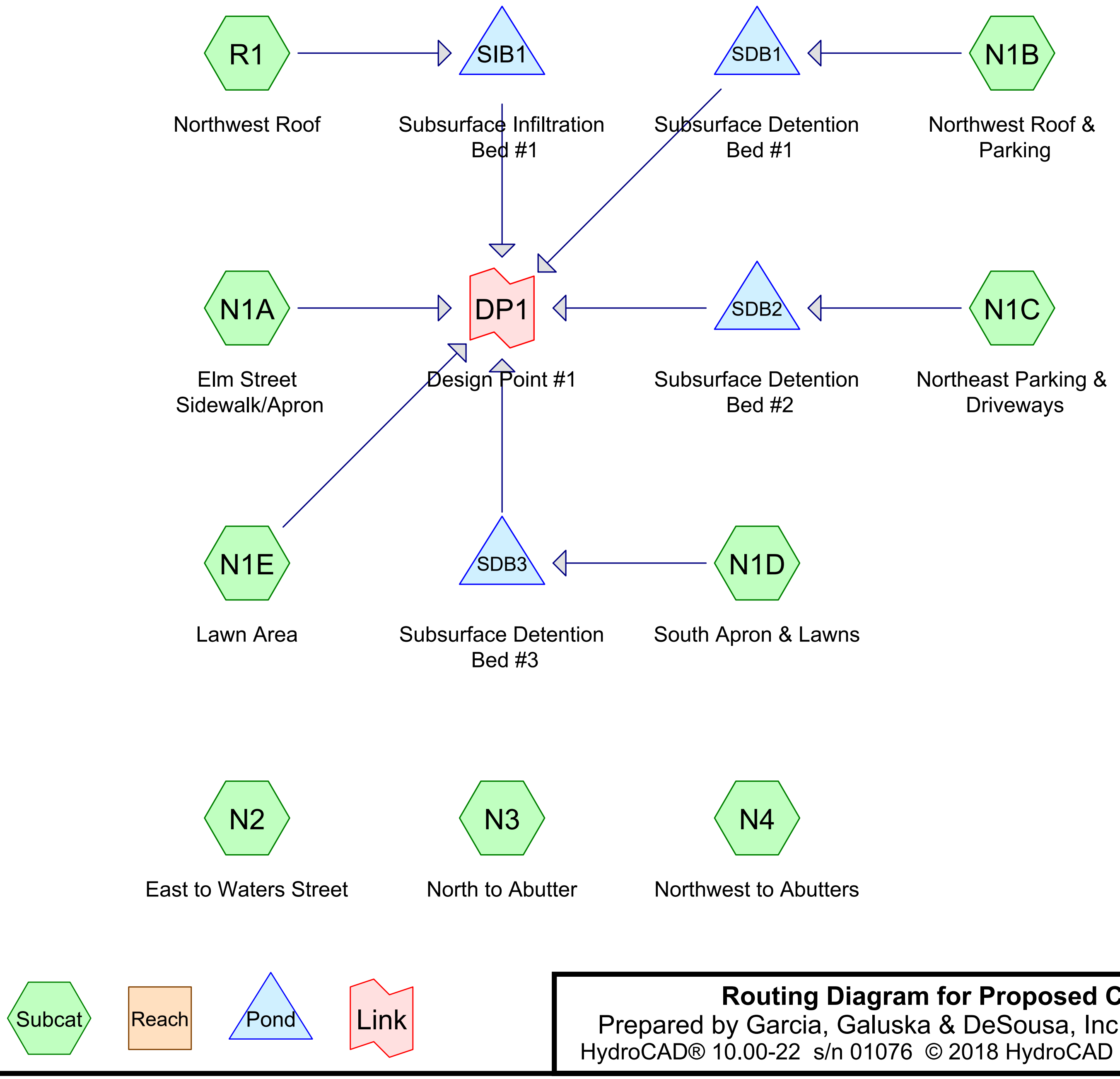
Millbury Fire Station
130 Elm Street, Millbury, MA
project number: 1902

Proposed Drainage Catchment Plan

Scale: 1" = 20
Drawn by: NCK

No.	Issue	Date
1	PLANNING BOARD	1/25/21
2	PB REVISIONS	3/1/21

SW2.1



Routing Diagram for Proposed Condition

Prepared by Garcia, Galuska & DeSousa, Inc., Printed 3/1/2021

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Summary for Subcatchment R1: Northwest Roof

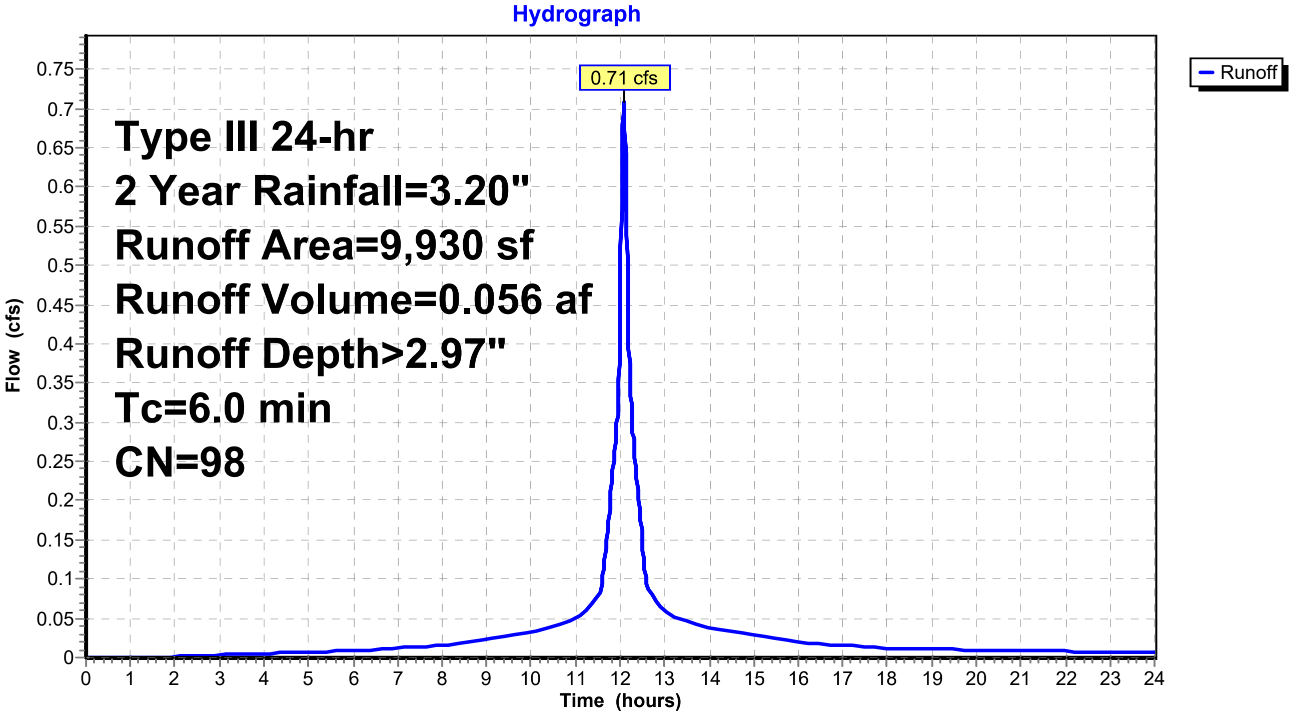
Runoff = 0.71 cfs @ 12.08 hrs, Volume= 0.056 af, Depth> 2.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Year Rainfall=3.20"

Area (sf)	CN	Description
9,930	98	Unconnected roofs, HSG D
9,930		100.00% Impervious Area
9,930		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct Entry (Tc<6 mins.)**

Subcatchment R1: Northwest Roof



Summary for Pond SIB1: Subsurface Infiltration Bed #1

Inflow Area = 0.228 ac,100.00% Impervious, Inflow Depth > 2.97" for 2 Year event
Inflow = 0.71 cfs @ 12.08 hrs, Volume= 0.056 af
Outflow = 0.23 cfs @ 12.37 hrs, Volume= 0.033 af, Atten= 67%, Lag= 17.1 min
Discarded = 0.00 cfs @ 5.72 hrs, Volume= 0.007 af
Primary = 0.23 cfs @ 12.37 hrs, Volume= 0.025 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 417.33' @ 12.37 hrs Surf.Area= 0.024 ac Storage= 0.028 af
Flood Elev= 419.00' Surf.Area= 0.024 ac Storage= 0.049 af

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 91.4 min (847.2 - 755.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	415.50'	0.024 af	**22.50'W x 47.34'L x 3.50'H Field A** 0.086 af Overall - 0.025 af Embedded = 0.060 af x 40.0% Voids
#2A	416.00'	0.025 af	**ADS_StormTech SC-740 +Cap** x 24 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 4 Rows of 6 Chambers
		0.049 af	Total Available Storage

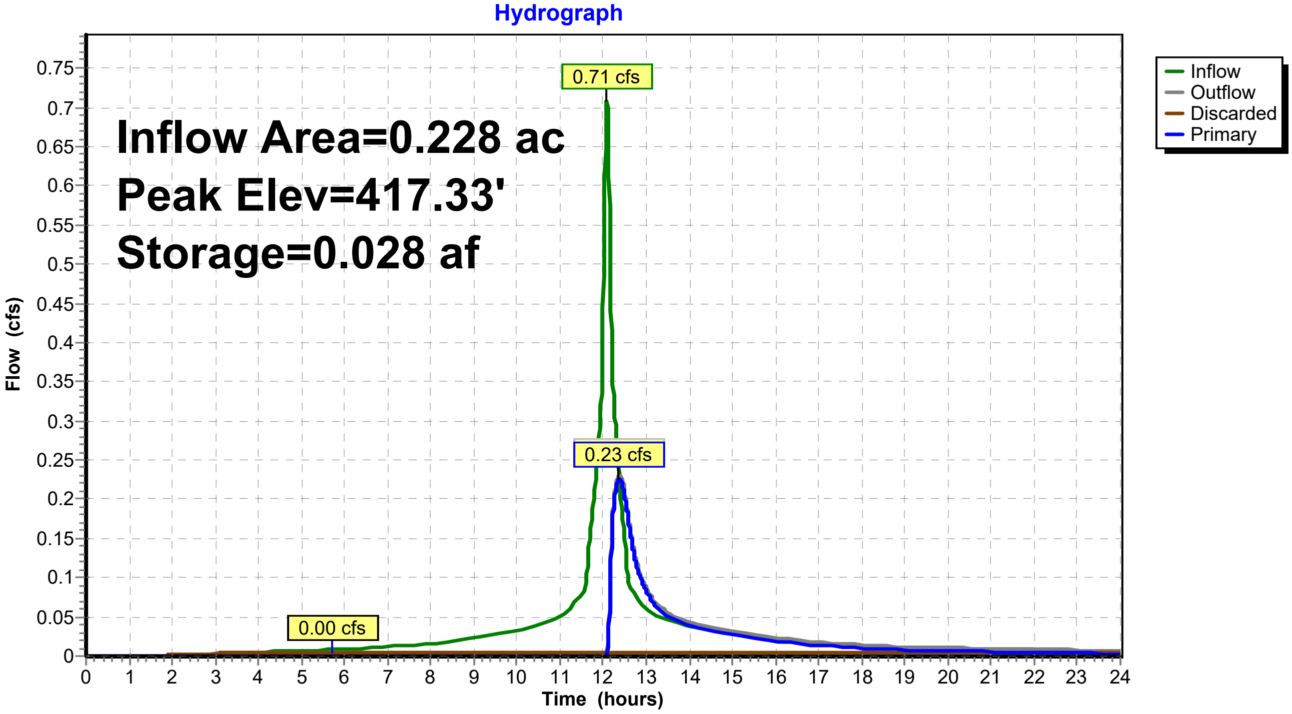
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	415.50'	**0.170 in/hr Exfiltration over Surface area**
#2	Primary	417.00'	**8.0" Round Culvert** L= 72.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 417.00' / 416.28' S= 0.0100 '/' Cc= 0.900 n= 0.011, Flow Area= 0.35 sf
#3	Device 2	417.00'	**5.0" Vert. Orifice/Grate** C= 0.600
#4	Device 2	418.00'	**2.0" Vert. Orifice/Grate** C= 0.600

Discarded OutFlow Max=0.00 cfs @ 5.72 hrs HW=415.54' (Free Discharge)
↑└**1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.23 cfs @ 12.37 hrs HW=417.33' TW=0.00' (Dynamic Tailwater)
↑└**2=Culvert** (Passes 0.23 cfs of 0.27 cfs potential flow)
  ↑├**3=Orifice/Grate** (Orifice Controls 0.23 cfs @ 1.96 fps)
  └**4=Orifice/Grate** (Controls 0.00 cfs)

Pond SIB1: Subsurface Infiltration Bed #1



Summary for Subcatchment N1B: Northwest Roof & Parking

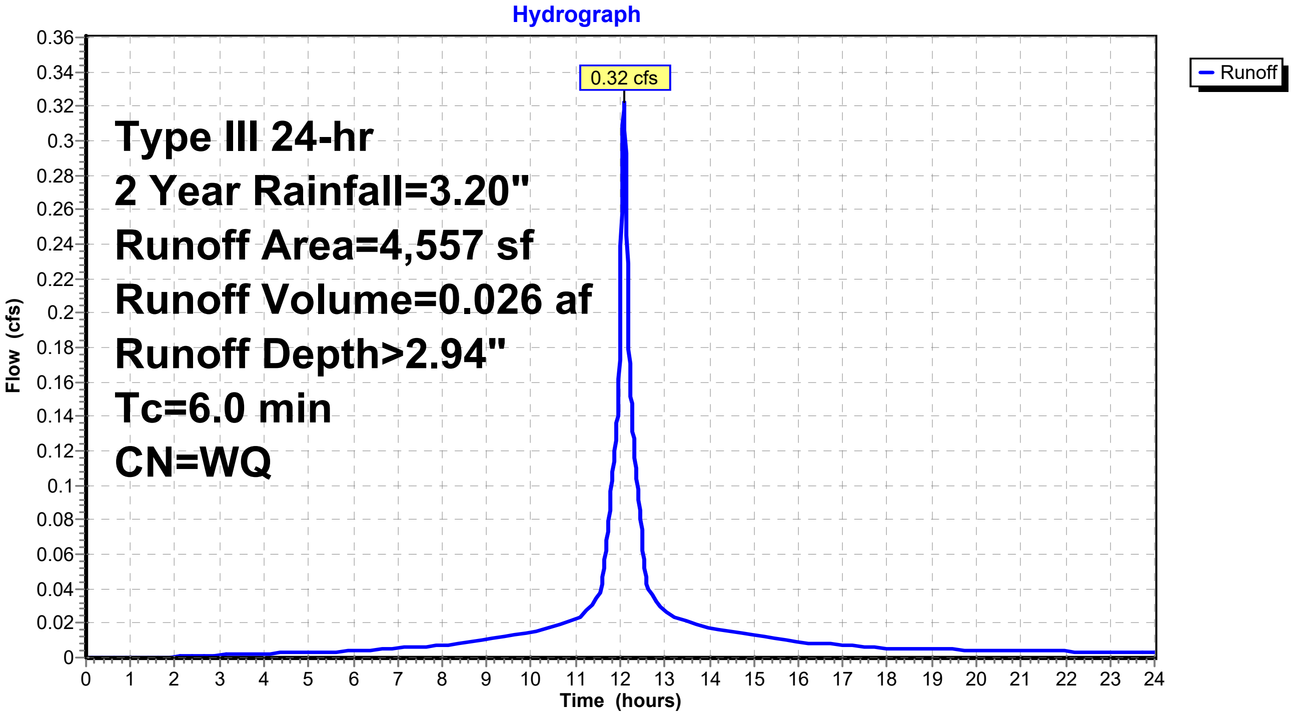
Runoff = 0.32 cfs @ 12.08 hrs, Volume= 0.026 af, Depth> 2.94"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Year Rainfall=3.20"

Area (sf)	CN	Description
72	80	>75% Grass cover, Good, HSG D
4,485	98	Unconnected pavement, HSG D
4,557		Weighted Average
72		1.58% Pervious Area
4,485		98.42% Impervious Area
4,485		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct Entry (Tc<6 mins.)**

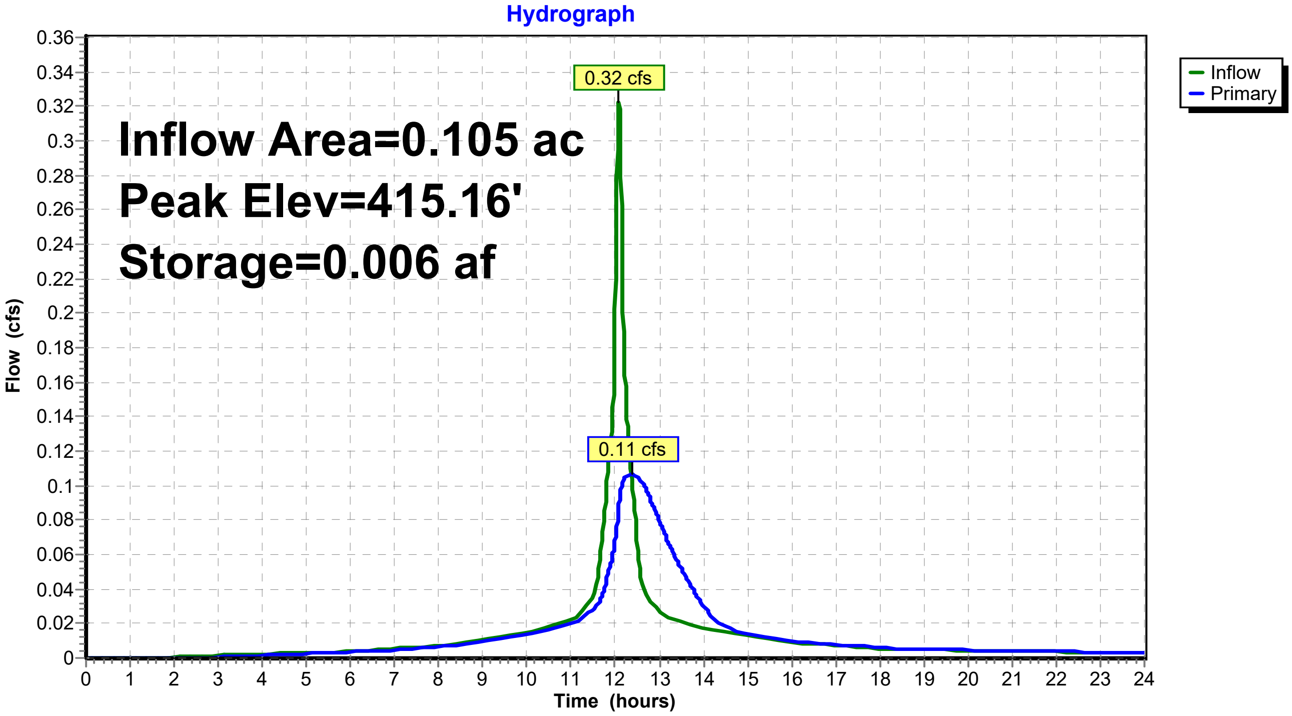
Subcatchment N1B: Northwest Roof & Parking



Summary for Pond SDB1: Subsurface Detention Bed #1

```
Inflow Area =      0.105 ac,  98.42% Impervious,  Inflow Depth >   2.94"    for  2 Year event
Inflow      =      0.32 cfs @   12.08 hrs,  Volume=           0.026 af
Outflow     =      0.11 cfs @   12.37 hrs,  Volume=           0.025 af,  Atten= 67%,  Lag= 16.9 min
Primary     =      0.11 cfs @   12.37 hrs,  Volume=           0.025 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 415.16' @ 12.37 hrs   Surf.Area= 0.012 ac   Storage= 0.006 af
Flood Elev= 418.05'   Surf.Area= 0.012 ac   Storage= 0.026 af

Plug-Flow detention time= 32.0 min calculated for 0.025 af (99% of inflow)
Center-of-Mass det. time= 26.6 min ( 783.1 - 756.5 )

Volume        Invert    Avail.Storage   Storage Description
   #1A       414.05'         0.015 af   13.00'W x 40.22'L x 4.00'H Field A
                                        0.048 af Overall - 0.011 af Embedded = 0.037 af  x 40.0% Voids
   #2A       415.05'         0.011 af   ADS_StormTech SC-740 +Cap x 10  Inside #1
                                        Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
                                        Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap
                                        2 Rows of 5 Chambers
   #3        414.06'         0.001 af   6.0"  Round Underdrain Storage x 3  Inside #1
                                        L= 40.0'
                                        0.001 af Overall - 0.1" Wall Thickness = 0.001 af
                             0.026 af   Total Available Storage

   Storage Group A created with Chamber Wizard

Device   Routing          Invert   Outlet Devices
   #1    Primary         414.05'   6.0"  Round 6" PVC
                                   L= 78.0'   CPP, end-section conforming to fill,  Ke= 0.500
                                   Inlet / Outlet Invert= 414.05' / 413.58'   S= 0.0060 '/'   Cc= 0.900
                                   n= 0.011,  Flow Area= 0.20 sf
   #2    Device 1        414.05'   2.0" Vert. Orifice/Grate   C= 0.600

Primary OutFlow  Max=0.11 cfs @ 12.37 hrs  HW=415.16'  TW=0.00'   (Dynamic Tailwater)
└─1=6" PVC  (Passes 0.11 cfs of 0.67 cfs potential flow)
   └─2=Orifice/Grate  (Orifice Controls 0.11 cfs @ 4.87 fps)
```

Pond SDB1: Subsurface Detention Bed #1



Summary for Subcatchment N1C: Northeast Parking & Driveways

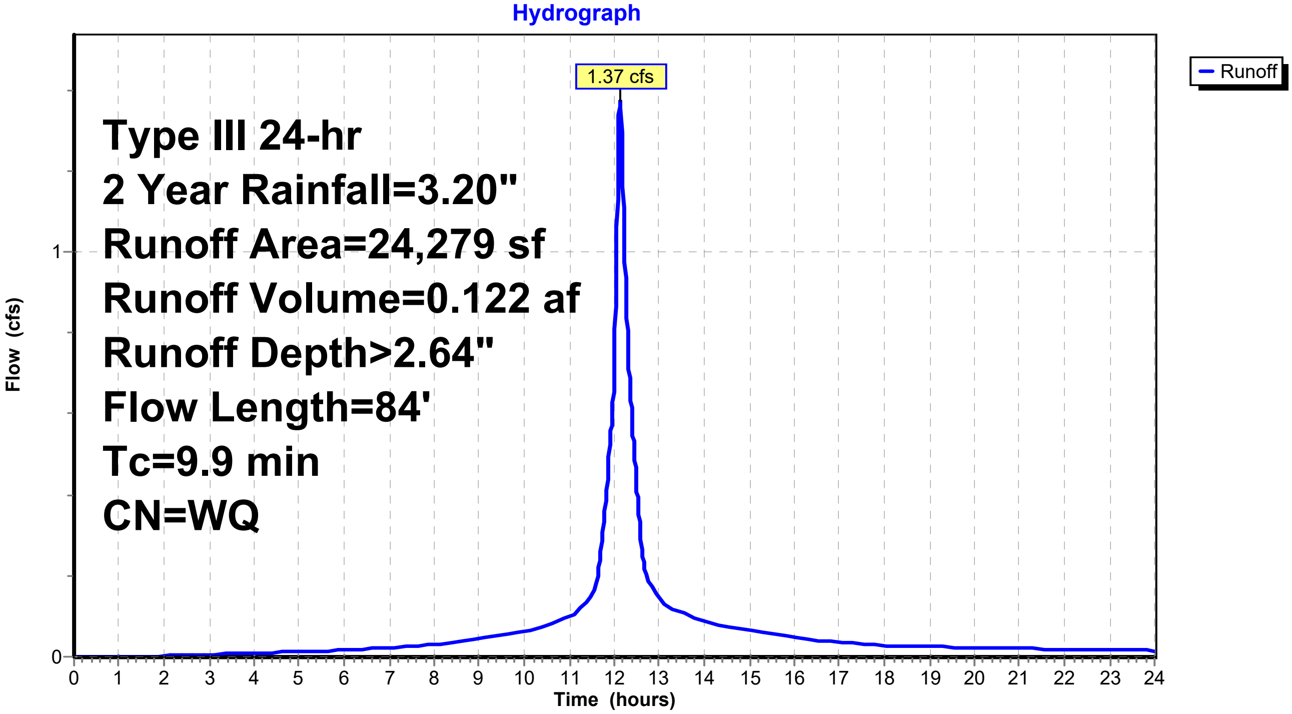
Runoff = 1.37 cfs @ 12.13 hrs, Volume= 0.122 af, Depth> 2.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Year Rainfall=3.20"

Area (sf)	CN	Description
5,025	80	>75% Grass cover, Good, HSG D
42	61	>75% Grass cover, Good, HSG B
12,912	98	Unconnected pavement, HSG D
13	98	Unconnected pavement, HSG B
6,287	98	Unconnected roofs, HSG D
24,279		Weighted Average
5,067		20.87% Pervious Area
19,212		79.13% Impervious Area
19,212		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.6	43	0.0100	0.07		**Sheet Flow, A to B** Grass: Dense n= 0.240 P2= 3.20"
0.3	41	0.0146	2.45		**Shallow Concentrated Flow, B to C** Paved Kv= 20.3 fps
9.9	84	Total			

Subcatchment N1C: Northeast Parking & Driveways



Summary for Pond SDB2: Subsurface Detention Bed #2

Inflow Area = 0.557 ac, 79.13% Impervious, Inflow Depth > 2.64" for 2 Year event
Inflow = 1.37 cfs @ 12.13 hrs, Volume= 0.122 af
Outflow = 0.52 cfs @ 12.44 hrs, Volume= 0.121 af, Atten= 62%, Lag= 18.3 min
Primary = 0.52 cfs @ 12.44 hrs, Volume= 0.121 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 412.62' @ 12.44 hrs Surf.Area= 0.034 ac Storage= 0.034 af
Flood Elev= 414.85' Surf.Area= 0.034 ac Storage= 0.077 af

Plug-Flow detention time= 47.5 min calculated for 0.121 af (99% of inflow)
Center-of-Mass det. time= 40.8 min (809.3 - 768.6)

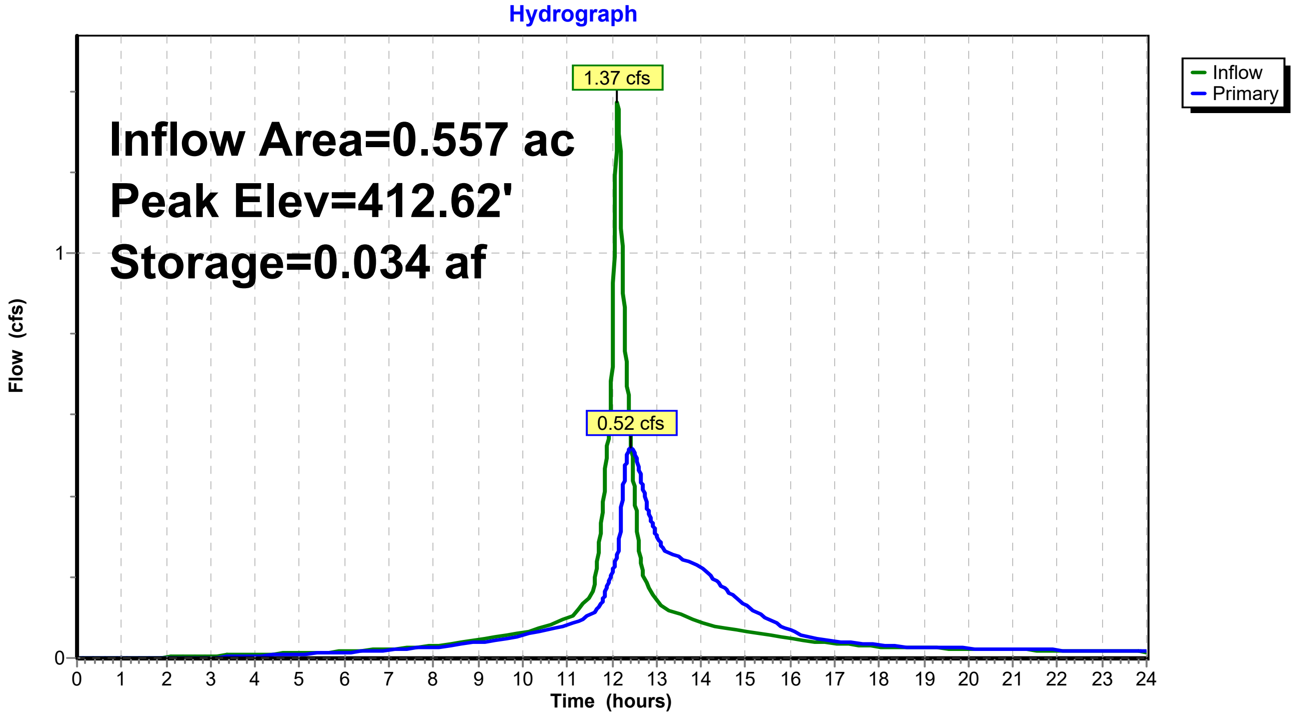
Volume	Invert	Avail.Storage	Storage Description
#1A	410.85'	0.039 af	**36.75'W x 40.22'L x 4.00'H Field A** 0.136 af Overall - 0.038 af Embedded = 0.097 af x 40.0% Voids
#2A	411.85'	0.037 af	**ADS_StormTech SC-740 +Cap** x 35 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 7 Rows of 5 Chambers
#3	410.86'	0.001 af	**6.0" Round Underdrain Storage** x 7 Inside #1 L= 40.0' 0.001 af Overall - 0.1" Wall Thickness = 0.001 af
		0.077 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	410.85'	**12.0" Round Culvert** L= 35.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 410.85' / 410.71' S= 0.0040 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Device 1	410.85'	**3.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	412.20'	**3.0" W x 14.0" H Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.52 cfs @ 12.44 hrs HW=412.62' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 0.52 cfs of 3.84 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.30 cfs @ 6.17 fps)
  └─**3=Orifice/Grate** (Orifice Controls 0.22 cfs @ 2.07 fps)

Pond SDB2: Subsurface Detention Bed #2



Summary for Subcatchment N1D: South Apron & Lawns

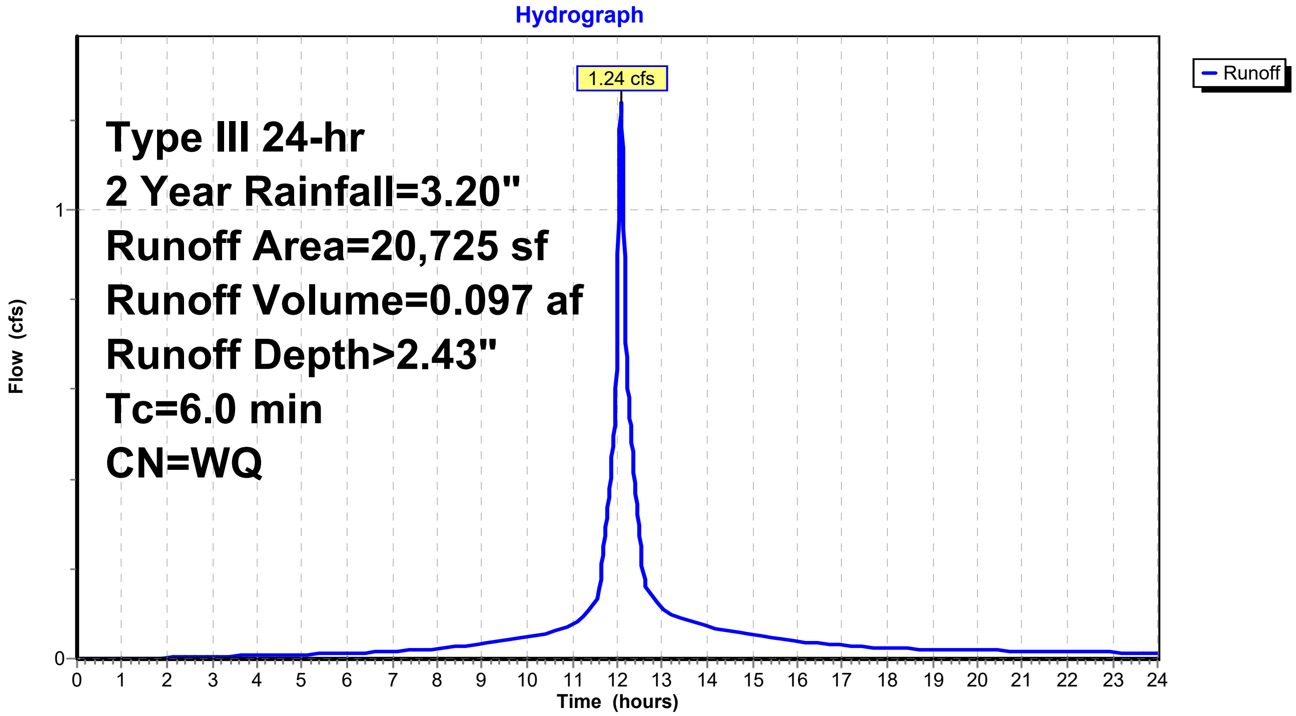
Runoff = 1.24 cfs @ 12.09 hrs, Volume= 0.097 af, Depth> 2.43"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Year Rainfall=3.20"

Area (sf)	CN	Description
7,022	80	>75% Grass cover, Good, HSG D
10,546	98	Unconnected pavement, HSG D
3,157	98	Unconnected roofs, HSG D
20,725		Weighted Average
7,022		33.88% Pervious Area
13,703		66.12% Impervious Area
13,703		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct Entry (Tc<6 mins.)**

Subcatchment N1D: South Apron & Lawns



Summary for Pond SDB3: Subsurface Detention Bed #3

Inflow Area = 0.476 ac, 66.12% Impervious, Inflow Depth > 2.43" for 2 Year event
Inflow = 1.24 cfs @ 12.09 hrs, Volume= 0.097 af
Outflow = 0.23 cfs @ 12.53 hrs, Volume= 0.095 af, Atten= 81%, Lag= 27.0 min
Primary = 0.23 cfs @ 12.53 hrs, Volume= 0.095 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 414.07' @ 12.53 hrs Surf.Area= 0.052 ac Storage= 0.033 af
Flood Elev= 416.80' Surf.Area= 0.052 ac Storage= 0.120 af

Plug-Flow detention time= 71.9 min calculated for 0.095 af (99% of inflow)
Center-of-Mass det. time= 62.7 min (835.3 - 772.6)

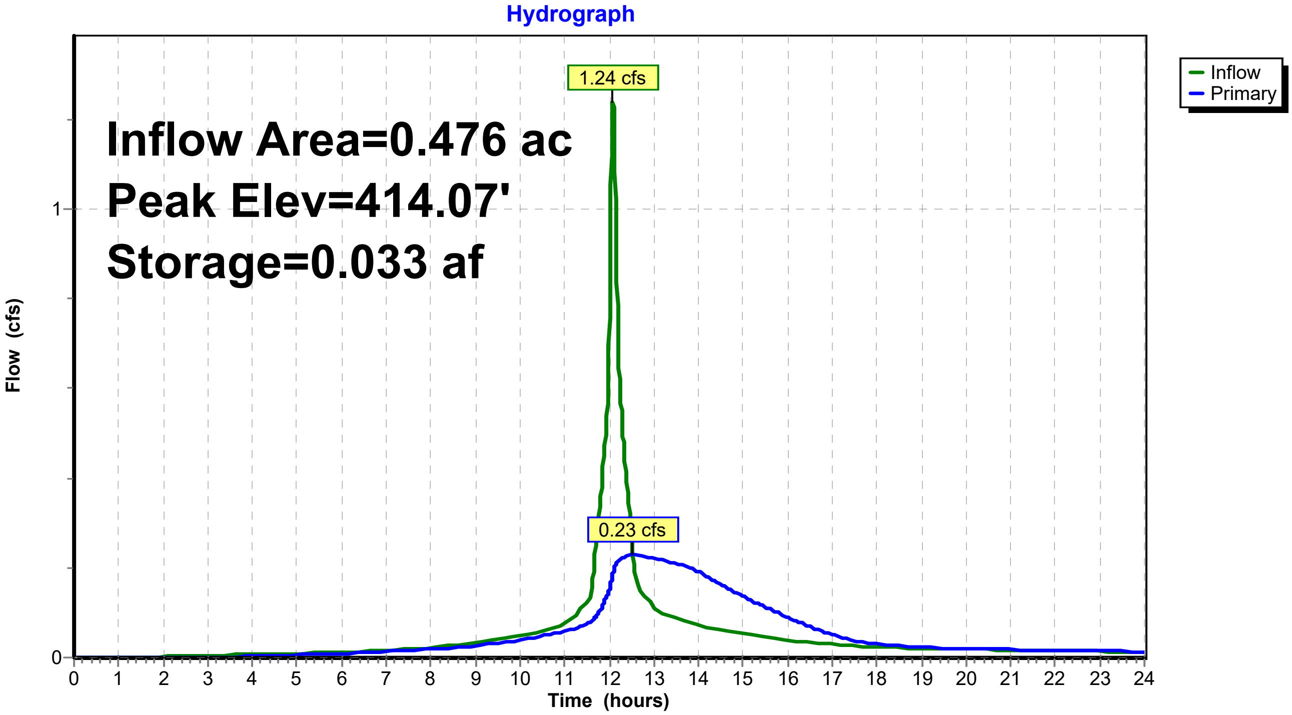
Volume	Invert	Avail.Storage	Storage Description
#1A	412.80'	0.058 af	**41.50'W x 54.46'L x 4.00'H Field A** 0.208 af Overall - 0.061 af Embedded = 0.146 af x 40.0% Voids
#2A	413.80'	0.059 af	**ADS_StormTech SC-740 +Cap** x 56 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 8 Rows of 7 Chambers
#3	412.81'	0.002 af	**6.0" Round Underdrain Storage** x 9 Inside #1 L= 55.0' 0.002 af Overall - 0.1" Wall Thickness = 0.002 af
		0.120 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	412.35'	**12.0" Round Culvert** L= 3.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 412.35' / 412.25' S= 0.0333 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Device 1	412.80'	**2.0" Vert. Orifice/Grate X 2.00** C= 0.600
#3	Device 1	415.75'	**2.0" W x 3.0" H Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.23 cfs @ 12.53 hrs HW=414.07' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 0.23 cfs of 4.18 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.23 cfs @ 5.26 fps)
  └─**3=Orifice/Grate** (Controls 0.00 cfs)

Pond SDB3: Subsurface Detention Bed #3



Summary for Subcatchment N1A: Elm Street Sidewalk/Apron

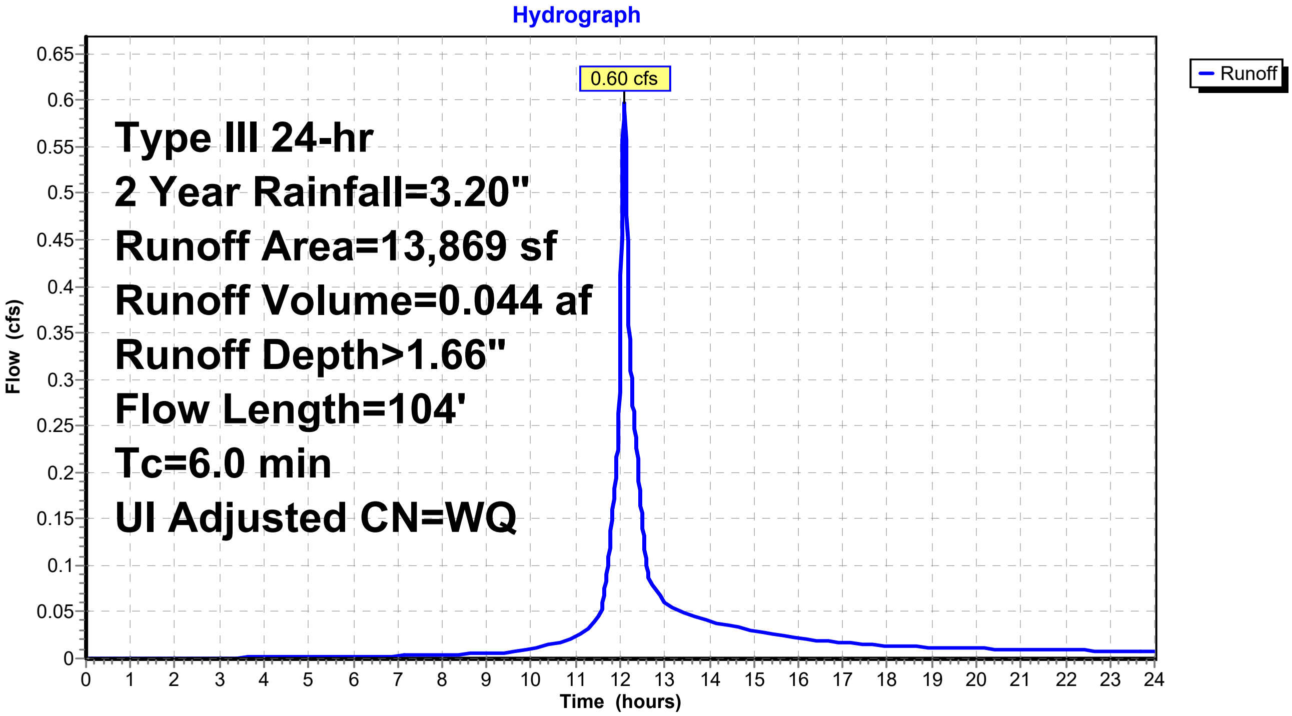
Runoff = 0.60 cfs @ 12.09 hrs, Volume= 0.044 af, Depth> 1.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Year Rainfall=3.20"

Area (sf)	CN	Adj	Description
11,538	80	80	>75% Grass cover, Good, HSG D
2,331	98	98	Unconnected pavement, HSG D
13,869			Weighted Average
11,538			83.19% Pervious Area
2,331			16.81% Impervious Area
2,331			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.5	50	0.0920	0.19		**Sheet Flow, A to B** Grass: Dense n= 0.240 P2= 3.20"
0.2	54	0.1230	5.65		**Shallow Concentrated Flow, B to C** Unpaved Kv= 16.1 fps
4.7	104	Total, Increased to minimum Tc = 6.0 min			

Subcatchment N1A: Elm Street Sidewalk/Apron



Summary for Subcatchment N1E: Lawn Area

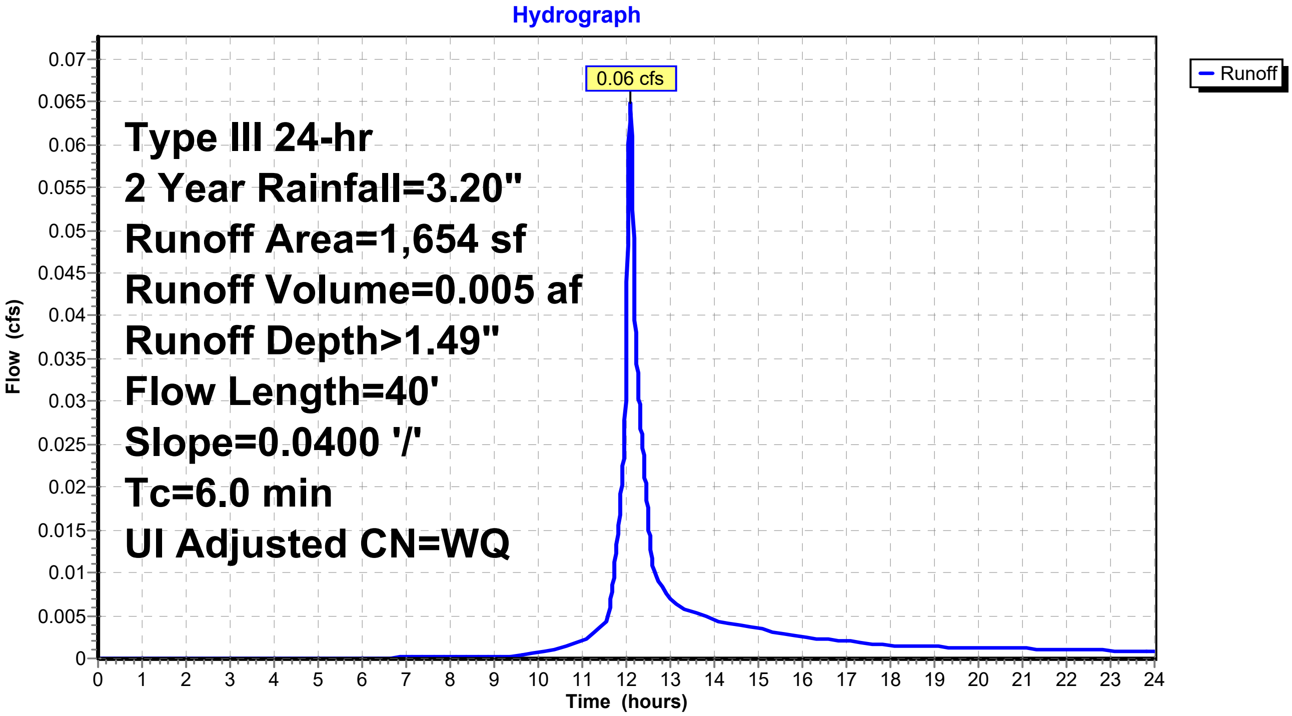
Runoff = 0.06 cfs @ 12.09 hrs, Volume= 0.005 af, Depth> 1.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Year Rainfall=3.20"

Area (sf)	CN	Adj	Description
1,563	80	80	>75% Grass cover, Good, HSG D
91	98	98	Unconnected pavement, HSG D
1,654			Weighted Average
1,563			94.50% Pervious Area
91			5.50% Impervious Area
91			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.2	40	0.0400	0.13		**Sheet Flow, A to B** Grass: Dense n= 0.240 P2= 3.20"
5.2	40	Total, Increased to minimum Tc = 6.0 min			

Subcatchment N1E: Lawn Area

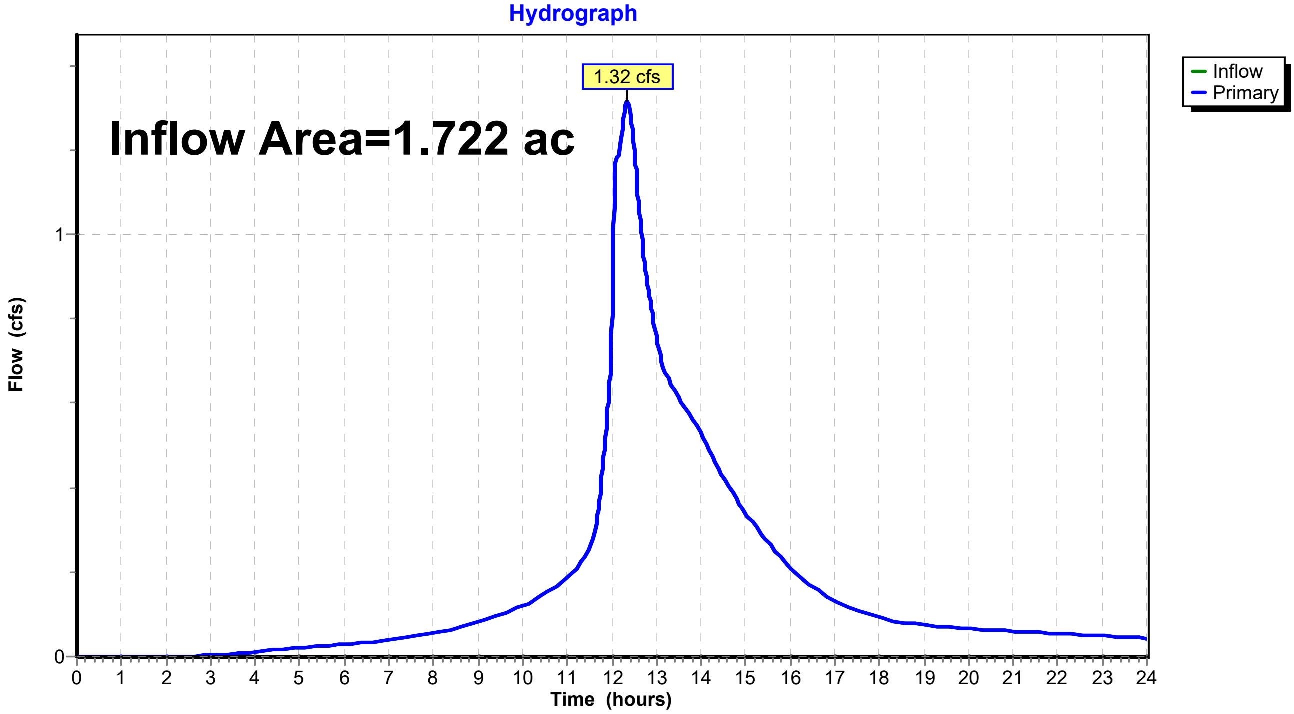


Summary for Link DP1: Design Point #1

Inflow Area = 1.722 ac, 66.32% Impervious, Inflow Depth > 2.20" for 2 Year event
Inflow = 1.32 cfs @ 12.34 hrs, Volume= 0.316 af
Primary = 1.32 cfs @ 12.34 hrs, Volume= 0.316 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Link DP1: Design Point #1



Summary for Subcatchment N2: East to Waters Street

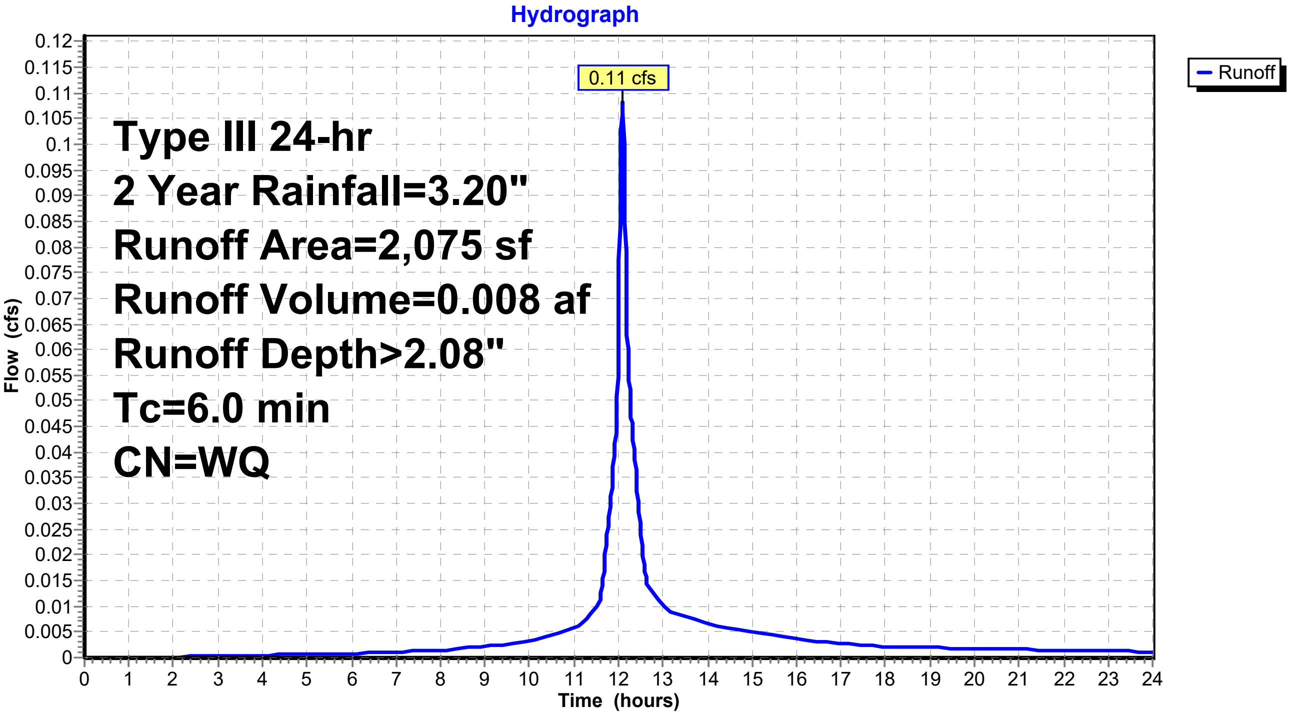
Runoff = 0.11 cfs @ 12.09 hrs, Volume= 0.008 af, Depth> 2.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Year Rainfall=3.20"

Area (sf)	CN	Description
1,168	80	>75% Grass cover, Good, HSG D
907	98	Unconnected pavement, HSG D
2,075		Weighted Average
1,168		56.29% Pervious Area
907		43.71% Impervious Area
907		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct Entry (Tc<6 mins.)**

Subcatchment N2: East to Waters Street



Summary for Subcatchment N3: North to Abutter

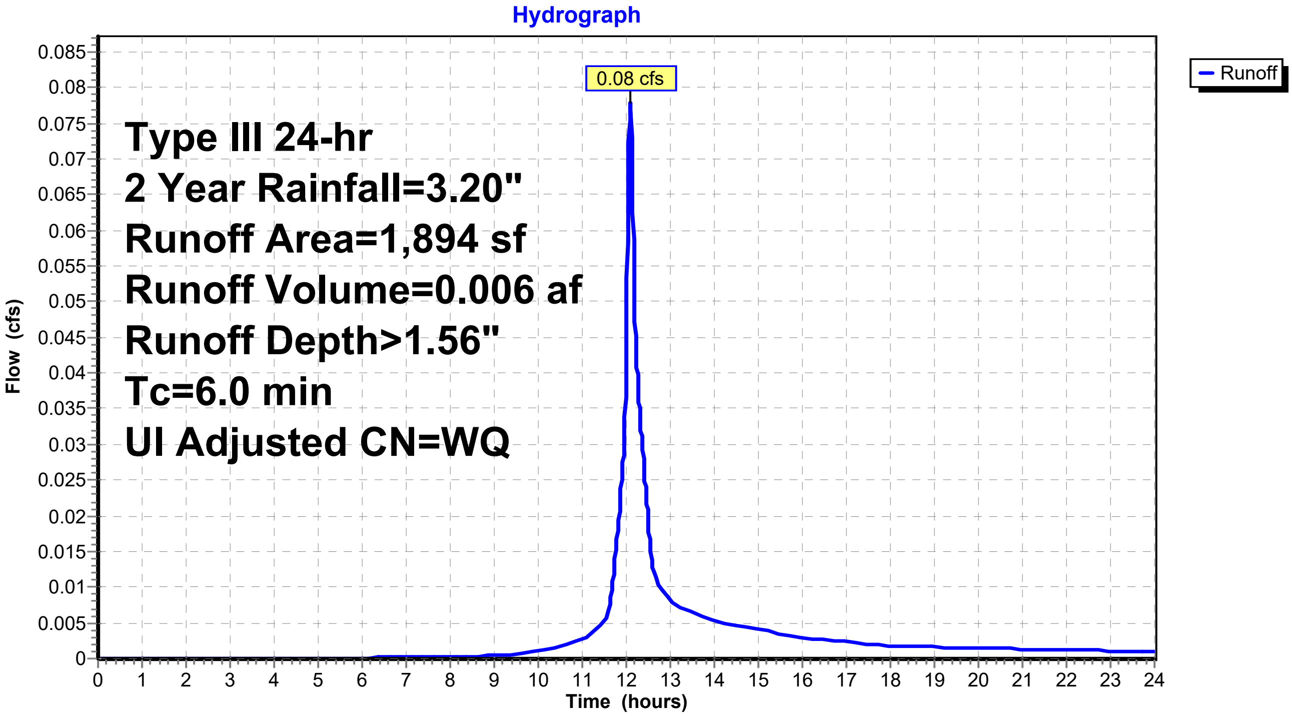
Runoff = 0.08 cfs @ 12.09 hrs, Volume= 0.006 af, Depth> 1.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Year Rainfall=3.20"

Area (sf)	CN	Adj	Description
1,634	80	80	>75% Grass cover, Good, HSG D
113	98	98	Unconnected pavement, HSG D
147	91	91	Gravel roads, HSG D
1,894			Weighted Average
1,781			94.03% Pervious Area
113			5.97% Impervious Area
113			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct Entry (Tc<6 mins.)**

Subcatchment N3: North to Abutter



Summary for Subcatchment N4: Northwest to Abutters

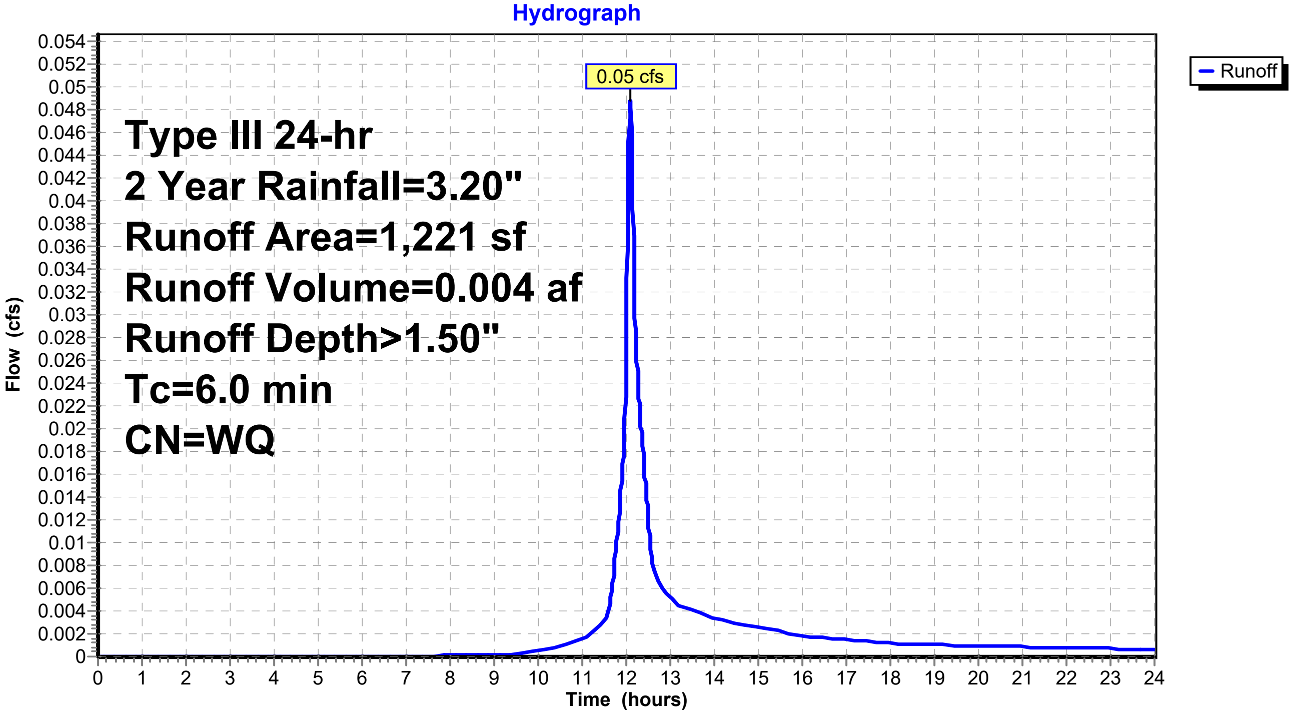
Runoff = 0.05 cfs @ 12.09 hrs, Volume= 0.004 af, Depth> 1.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Year Rainfall=3.20"

Area (sf)	CN	Description
1,092	80	>75% Grass cover, Good, HSG D
22	98	Unconnected pavement, HSG D
107	91	Gravel roads, HSG D
1,221		Weighted Average
1,199		98.20% Pervious Area
22		1.80% Impervious Area
22		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct Entry (Tc<6 mins.)**

Subcatchment N4: Northwest to Abutters



Summary for Subcatchment R1: Northwest Roof

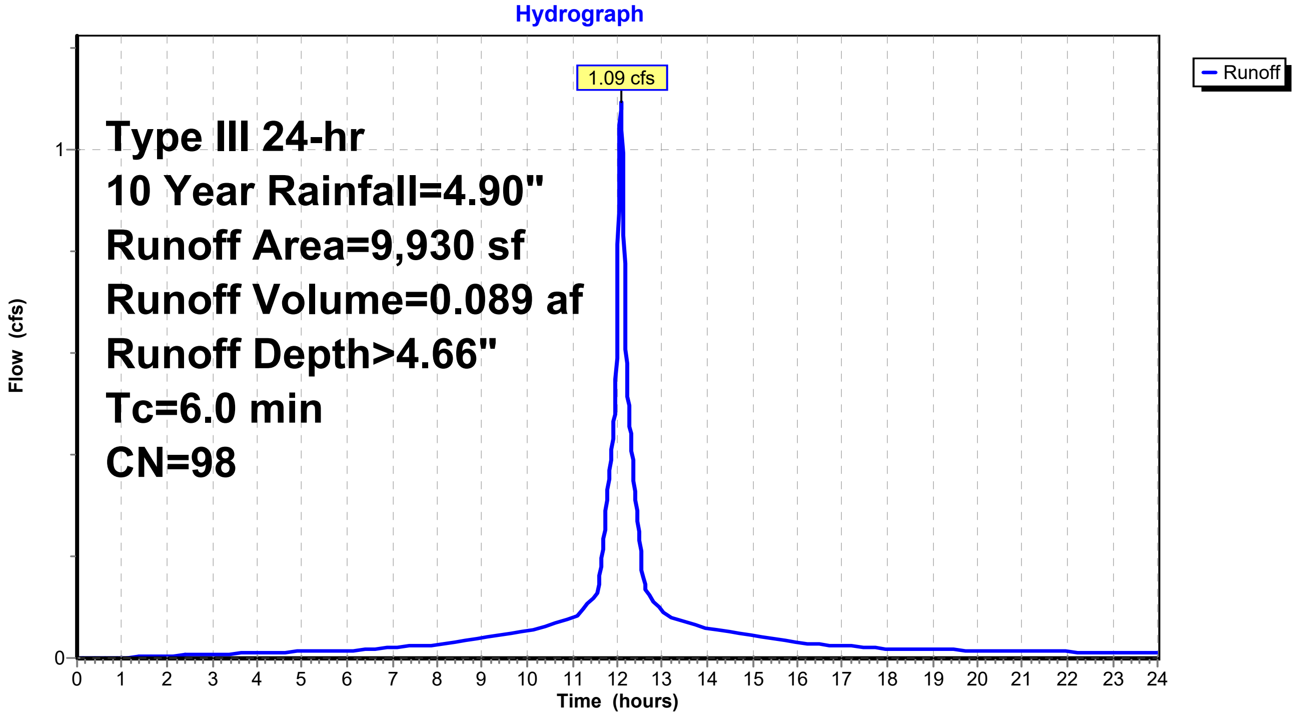
Runoff = 1.09 cfs @ 12.08 hrs, Volume= 0.089 af, Depth> 4.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Year Rainfall=4.90"

Area (sf)	CN	Description
9,930	98	Unconnected roofs, HSG D
9,930		100.00% Impervious Area
9,930		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct Entry (Tc<6 mins.)**

Subcatchment R1: Northwest Roof



Summary for Pond SIB1: Subsurface Infiltration Bed #1

Inflow Area = 0.228 ac,100.00% Impervious, Inflow Depth > 4.66" for 10 Year event
Inflow = 1.09 cfs @ 12.08 hrs, Volume= 0.089 af
Outflow = 0.54 cfs @ 12.23 hrs, Volume= 0.065 af, Atten= 51%, Lag= 8.6 min
Discarded = 0.00 cfs @ 3.67 hrs, Volume= 0.008 af
Primary = 0.54 cfs @ 12.23 hrs, Volume= 0.057 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 417.87' @ 12.23 hrs Surf.Area= 0.024 ac Storage= 0.037 af
Flood Elev= 419.00' Surf.Area= 0.024 ac Storage= 0.049 af

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 77.0 min (824.8 - 747.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	415.50'	0.024 af	**22.50'W x 47.34'L x 3.50'H Field A** 0.086 af Overall - 0.025 af Embedded = 0.060 af x 40.0% Voids
#2A	416.00'	0.025 af	**ADS_StormTech SC-740 +Cap** x 24 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 4 Rows of 6 Chambers
		0.049 af	Total Available Storage

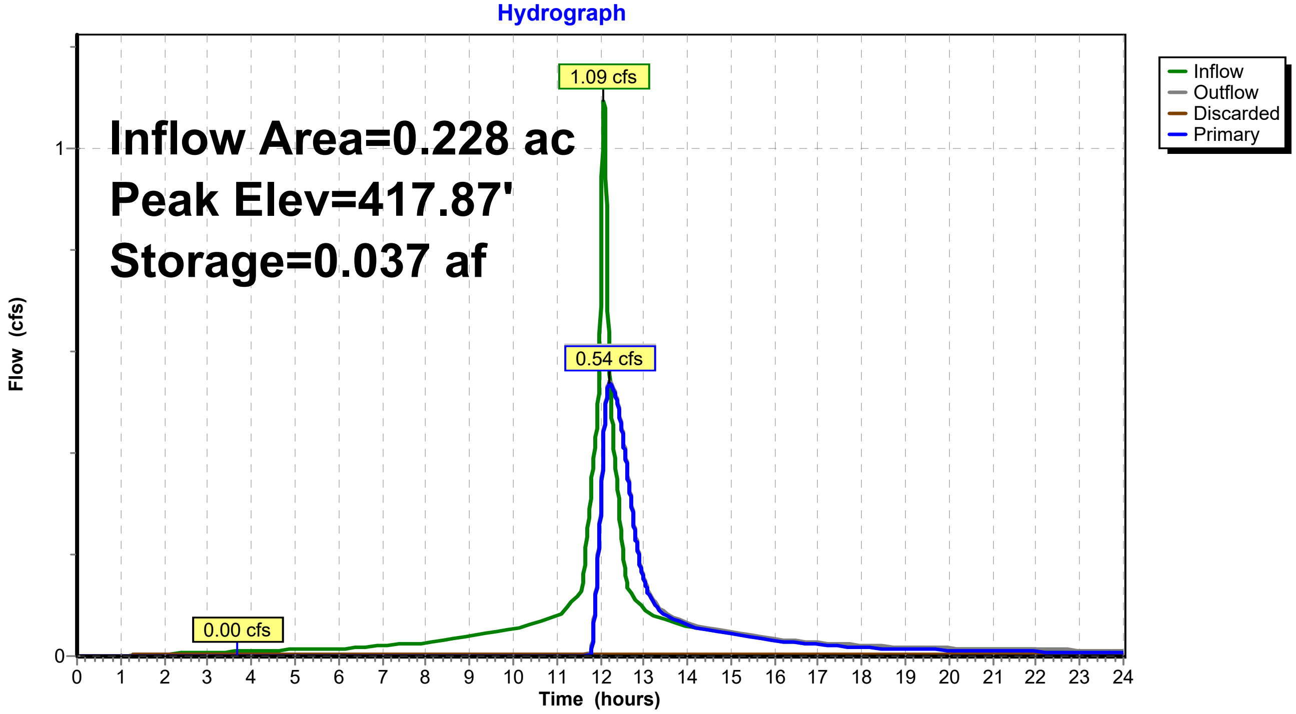
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	415.50'	**0.170 in/hr Exfiltration over Surface area**
#2	Primary	417.00'	**8.0" Round Culvert** L= 72.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 417.00' / 416.28' S= 0.0100 '/' Cc= 0.900 n= 0.011, Flow Area= 0.35 sf
#3	Device 2	417.00'	**5.0" Vert. Orifice/Grate** C= 0.600
#4	Device 2	418.00'	**2.0" Vert. Orifice/Grate** C= 0.600

Discarded OutFlow Max=0.00 cfs @ 3.67 hrs HW=415.54' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.54 cfs @ 12.23 hrs HW=417.87' TW=0.00' (Dynamic Tailwater)
└─**2=Culvert** (Passes 0.54 cfs of 0.98 cfs potential flow)
  ├─**3=Orifice/Grate** (Orifice Controls 0.54 cfs @ 3.93 fps)
  └─**4=Orifice/Grate** (Controls 0.00 cfs)

Pond SIB1: Subsurface Infiltration Bed #1



Summary for Subcatchment N1B: Northwest Roof & Parking

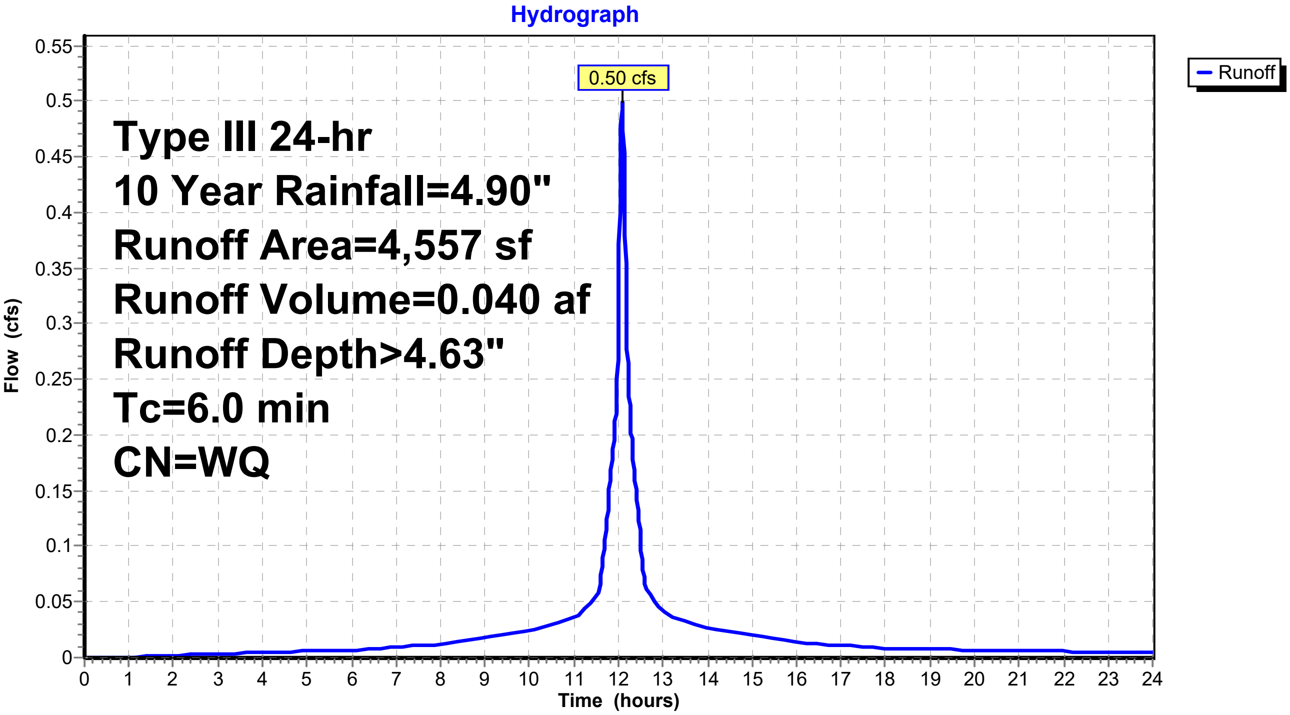
Runoff = 0.50 cfs @ 12.08 hrs, Volume= 0.040 af, Depth> 4.63"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Year Rainfall=4.90"

Area (sf)	CN	Description
72	80	>75% Grass cover, Good, HSG D
4,485	98	Unconnected pavement, HSG D
4,557		Weighted Average
72		1.58% Pervious Area
4,485		98.42% Impervious Area
4,485		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct Entry (Tc<6 mins.)**

Subcatchment N1B: Northwest Roof & Parking



Summary for Pond SDB1: Subsurface Detention Bed #1

Inflow Area = 0.105 ac, 98.42% Impervious, Inflow Depth > 4.63" for 10 Year event
Inflow = 0.50 cfs @ 12.08 hrs, Volume= 0.040 af
Outflow = 0.13 cfs @ 12.44 hrs, Volume= 0.040 af, Atten= 74%, Lag= 21.2 min
Primary = 0.13 cfs @ 12.44 hrs, Volume= 0.040 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 415.71' @ 12.44 hrs Surf.Area= 0.012 ac Storage= 0.011 af
Flood Elev= 418.05' Surf.Area= 0.012 ac Storage= 0.026 af

Plug-Flow detention time= 36.2 min calculated for 0.040 af (99% of inflow)
Center-of-Mass det. time= 31.8 min (780.3 - 748.5)

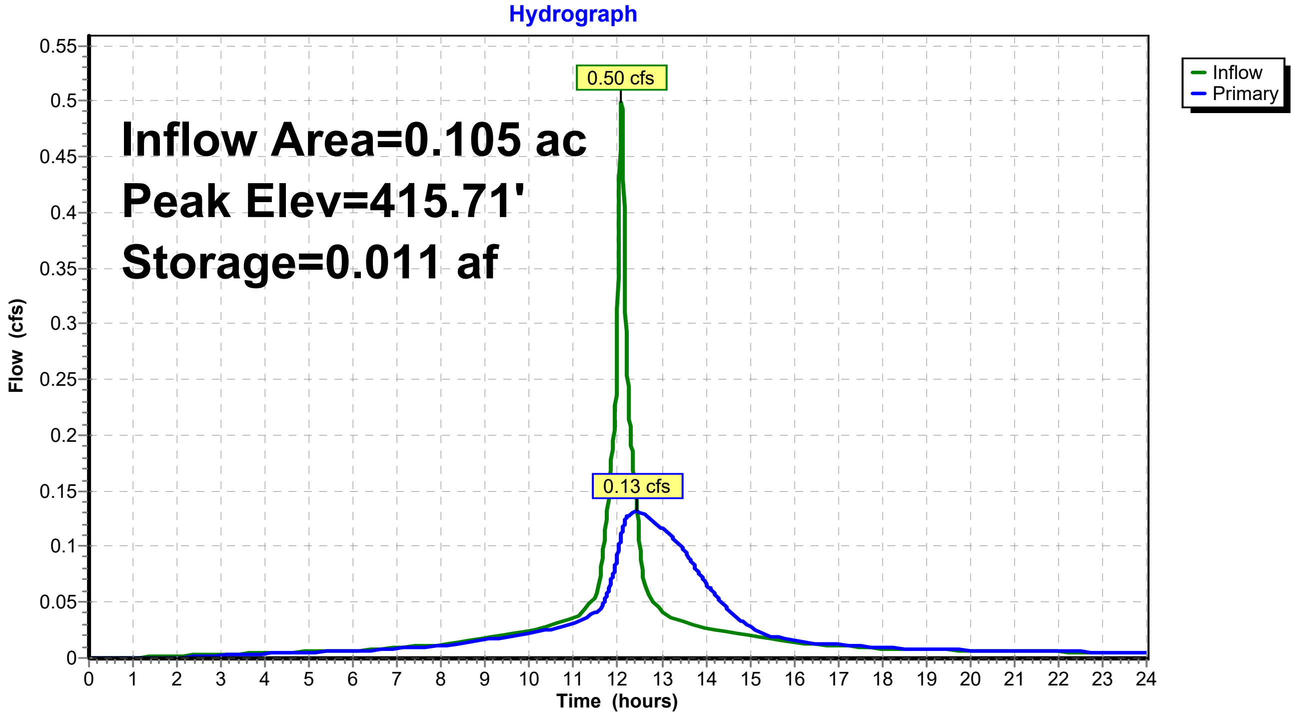
Volume	Invert	Avail.Storage	Storage Description
#1A	414.05'	0.015 af	**13.00'W x 40.22'L x 4.00'H Field A** 0.048 af Overall - 0.011 af Embedded = 0.037 af x 40.0% Voids
#2A	415.05'	0.011 af	**ADS_StormTech SC-740 +Cap** x 10 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 2 Rows of 5 Chambers
#3	414.06'	0.001 af	**6.0" Round Underdrain Storage** x 3 Inside #1 L= 40.0' 0.001 af Overall - 0.1" Wall Thickness = 0.001 af
		0.026 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	414.05'	**6.0" Round 6" PVC** L= 78.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 414.05' / 413.58' S= 0.0060 '/' Cc= 0.900 n= 0.011, Flow Area= 0.20 sf
#2	Device 1	414.05'	**2.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.13 cfs @ 12.44 hrs HW=415.71' TW=0.00' (Dynamic Tailwater)
↑—**1=6" PVC** (Passes 0.13 cfs of 0.83 cfs potential flow)
  ↑—**2=Orifice/Grate** (Orifice Controls 0.13 cfs @ 6.04 fps)

Pond SDB1: Subsurface Detention Bed #1



Summary for Subcatchment N1C: Northeast Parking & Driveways

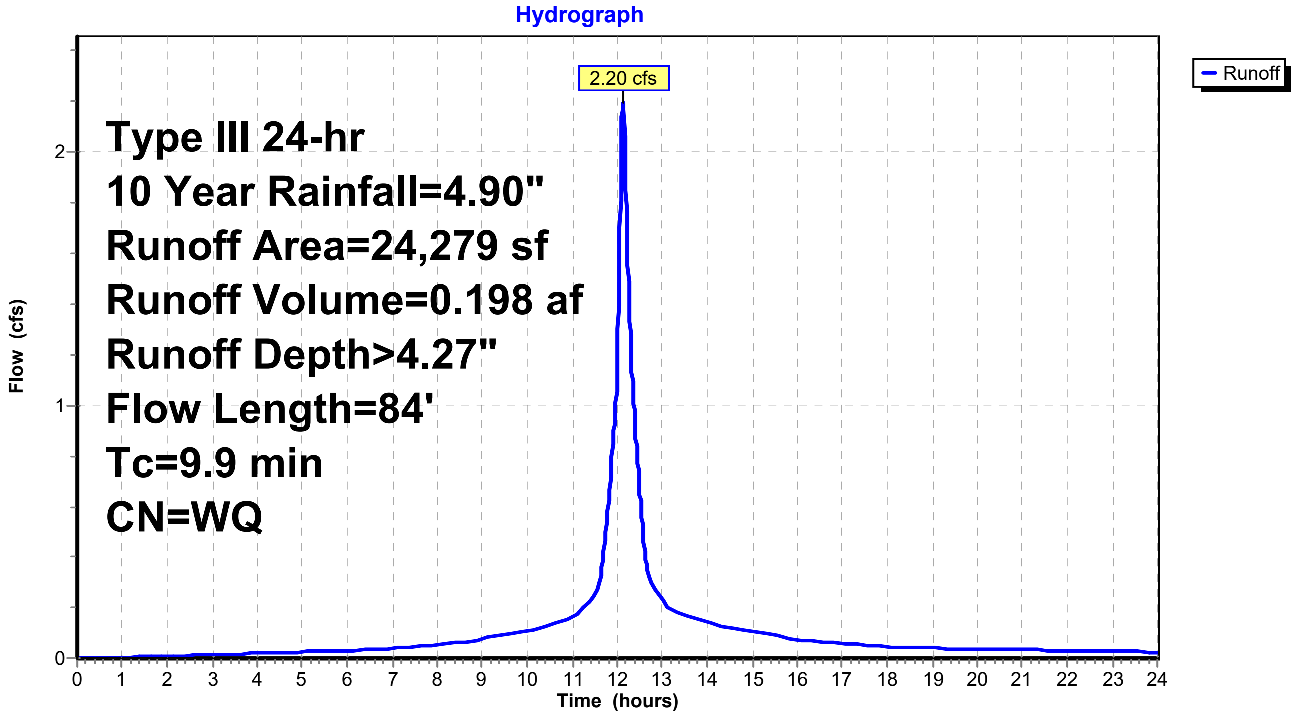
Runoff = 2.20 cfs @ 12.13 hrs, Volume= 0.198 af, Depth> 4.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Year Rainfall=4.90"

Area (sf)	CN	Description
5,025	80	>75% Grass cover, Good, HSG D
42	61	>75% Grass cover, Good, HSG B
12,912	98	Unconnected pavement, HSG D
13	98	Unconnected pavement, HSG B
6,287	98	Unconnected roofs, HSG D
24,279		Weighted Average
5,067		20.87% Pervious Area
19,212		79.13% Impervious Area
19,212		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.6	43	0.0100	0.07		**Sheet Flow, A to B** Grass: Dense n= 0.240 P2= 3.20"
0.3	41	0.0146	2.45		**Shallow Concentrated Flow, B to C** Paved Kv= 20.3 fps
9.9	84	Total			

Subcatchment N1C: Northeast Parking & Driveways



Summary for Pond SDB2: Subsurface Detention Bed #2

Inflow Area = 0.557 ac, 79.13% Impervious, Inflow Depth > 4.27" for 10 Year event
Inflow = 2.20 cfs @ 12.13 hrs, Volume= 0.198 af
Outflow = 1.16 cfs @ 12.32 hrs, Volume= 0.197 af, Atten= 47%, Lag= 11.3 min
Primary = 1.16 cfs @ 12.32 hrs, Volume= 0.197 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 413.21' @ 12.32 hrs Surf.Area= 0.034 ac Storage= 0.048 af
Flood Elev= 414.85' Surf.Area= 0.034 ac Storage= 0.077 af

Plug-Flow detention time= 42.5 min calculated for 0.197 af (99% of inflow)
Center-of-Mass det. time= 37.1 min (798.3 - 761.2)

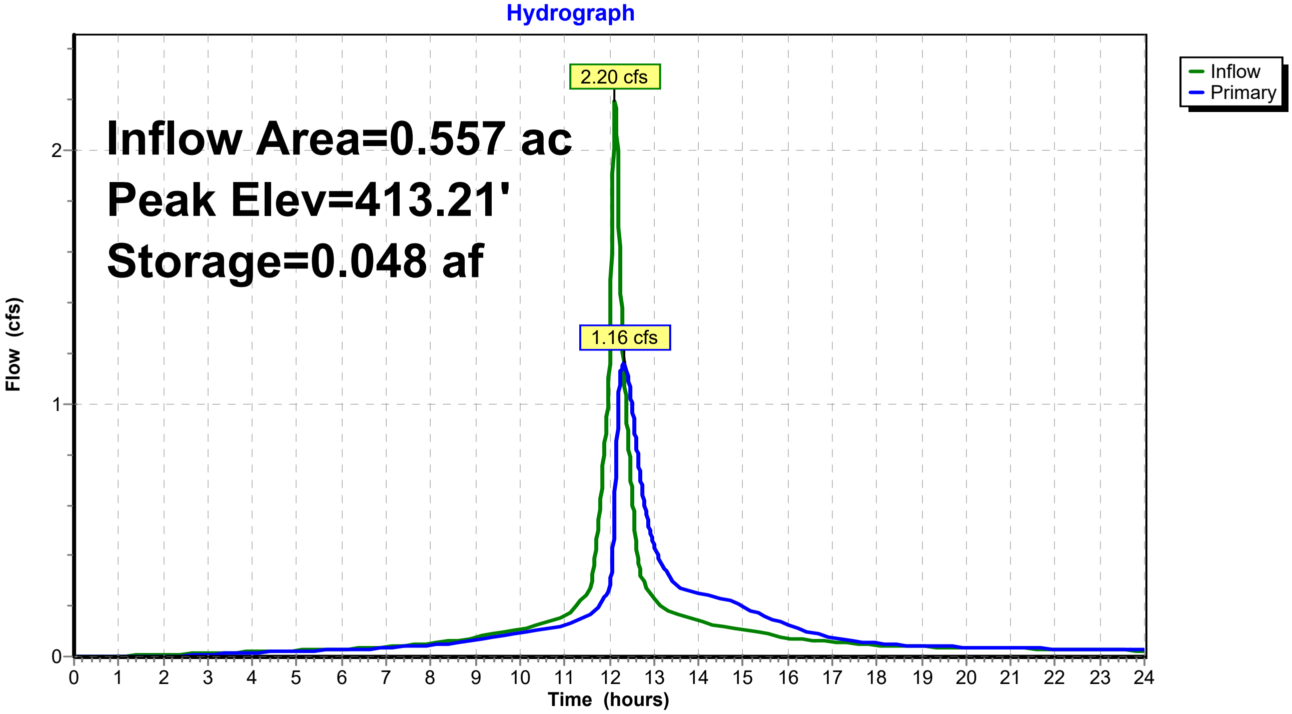
Volume	Invert	Avail.Storage	Storage Description
#1A	410.85'	0.039 af	**36.75'W x 40.22'L x 4.00'H Field A** 0.136 af Overall - 0.038 af Embedded = 0.097 af x 40.0% Voids
#2A	411.85'	0.037 af	**ADS_StormTech SC-740 +Cap** x 35 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 7 Rows of 5 Chambers
#3	410.86'	0.001 af	**6.0" Round Underdrain Storage** x 7 Inside #1 L= 40.0' 0.001 af Overall - 0.1" Wall Thickness = 0.001 af
		0.077 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	410.85'	**12.0" Round Culvert** L= 35.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 410.85' / 410.71' S= 0.0040 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Device 1	410.85'	**3.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	412.20'	**3.0" W x 14.0" H Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=1.16 cfs @ 12.32 hrs HW=413.21' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 1.16 cfs of 4.94 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.35 cfs @ 7.19 fps)
  └─**3=Orifice/Grate** (Orifice Controls 0.81 cfs @ 3.22 fps)

Pond SDB2: Subsurface Detention Bed #2



Summary for Subcatchment N1D: South Apron & Lawns

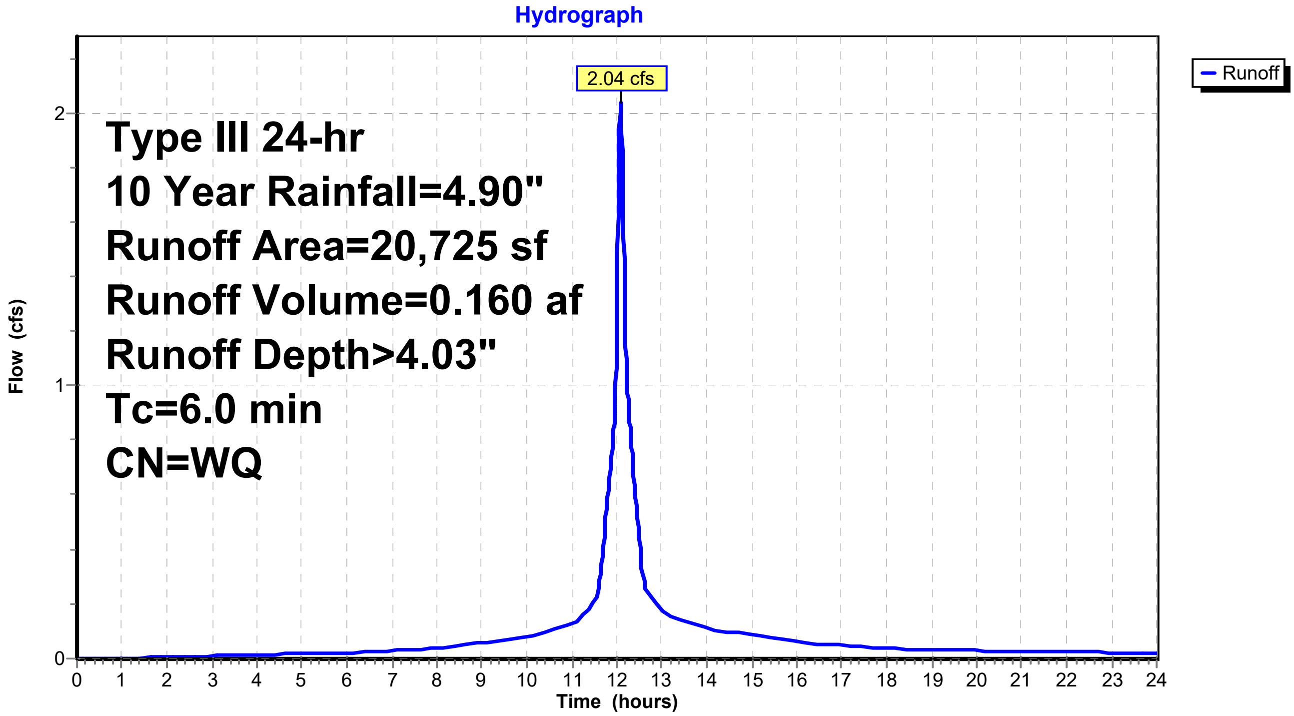
Runoff = 2.04 cfs @ 12.08 hrs, Volume= 0.160 af, Depth> 4.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Year Rainfall=4.90"

Area (sf)	CN	Description
7,022	80	>75% Grass cover, Good, HSG D
10,546	98	Unconnected pavement, HSG D
3,157	98	Unconnected roofs, HSG D
20,725		Weighted Average
7,022		33.88% Pervious Area
13,703		66.12% Impervious Area
13,703		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct Entry (Tc<6 mins.)**

Subcatchment N1D: South Apron & Lawns



Summary for Pond SDB3: Subsurface Detention Bed #3

Inflow Area = 0.476 ac, 66.12% Impervious, Inflow Depth > 4.03" for 10 Year event
Inflow = 2.04 cfs @ 12.08 hrs, Volume= 0.160 af
Outflow = 0.29 cfs @ 12.59 hrs, Volume= 0.158 af, Atten= 86%, Lag= 30.5 min
Primary = 0.29 cfs @ 12.59 hrs, Volume= 0.158 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 414.76' @ 12.59 hrs Surf.Area= 0.052 ac Storage= 0.060 af
Flood Elev= 416.80' Surf.Area= 0.052 ac Storage= 0.120 af

Plug-Flow detention time= 94.8 min calculated for 0.158 af (99% of inflow)
Center-of-Mass det. time= 87.4 min (852.7 - 765.3)

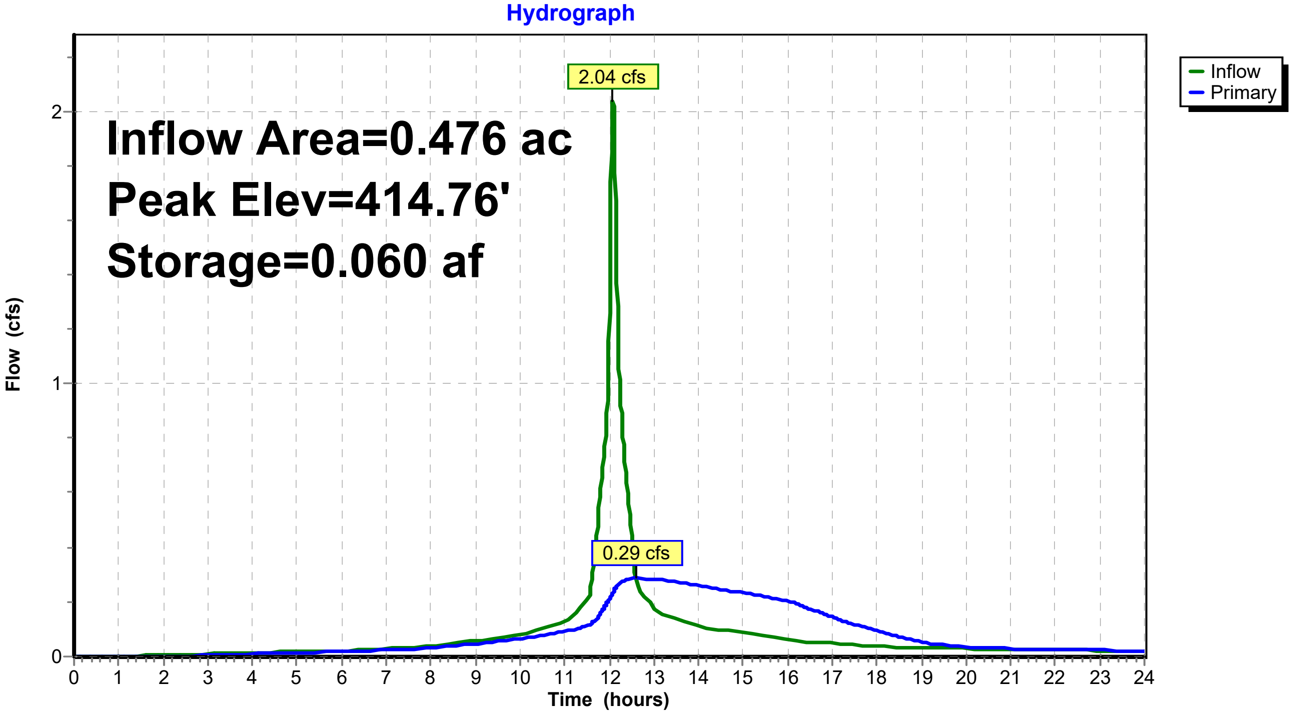
Volume	Invert	Avail.Storage	Storage Description
#1A	412.80'	0.058 af	**41.50'W x 54.46'L x 4.00'H Field A** 0.208 af Overall - 0.061 af Embedded = 0.146 af x 40.0% Voids
#2A	413.80'	0.059 af	**ADS_StormTech SC-740 +Cap** x 56 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 8 Rows of 7 Chambers
#3	412.81'	0.002 af	**6.0" Round Underdrain Storage** x 9 Inside #1 L= 55.0' 0.002 af Overall - 0.1" Wall Thickness = 0.002 af
		0.120 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	412.35'	**12.0" Round Culvert** L= 3.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 412.35' / 412.25' S= 0.0333 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Device 1	412.80'	**2.0" Vert. Orifice/Grate X 2.00** C= 0.600
#3	Device 1	415.75'	**2.0" W x 3.0" H Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.29 cfs @ 12.59 hrs HW=414.76' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 0.29 cfs of 5.23 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.29 cfs @ 6.60 fps)
  └─**3=Orifice/Grate** (Controls 0.00 cfs)

Pond SDB3: Subsurface Detention Bed #3



Summary for Subcatchment N1A: Elm Street Sidewalk/Apron

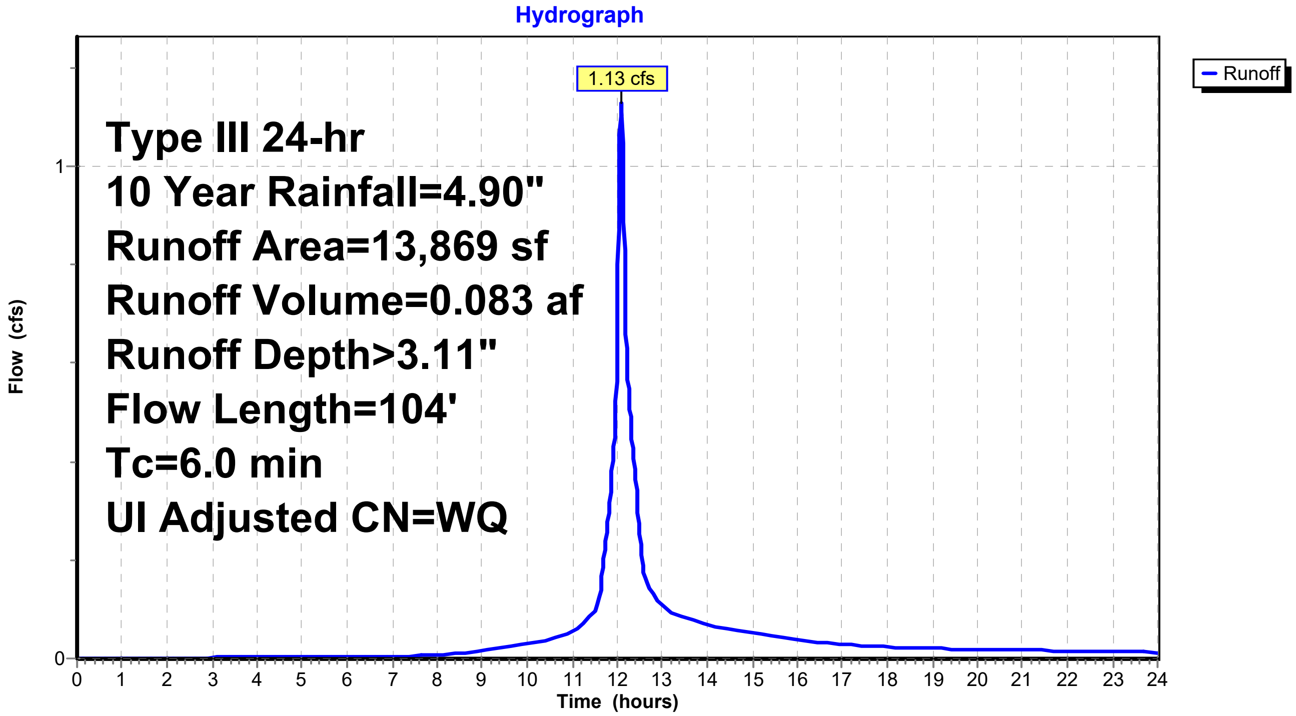
Runoff = 1.13 cfs @ 12.09 hrs, Volume= 0.083 af, Depth> 3.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Year Rainfall=4.90"

Area (sf)	CN	Adj	Description
11,538	80	80	>75% Grass cover, Good, HSG D
2,331	98	98	Unconnected pavement, HSG D
13,869			Weighted Average
11,538			83.19% Pervious Area
2,331			16.81% Impervious Area
2,331			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.5	50	0.0920	0.19		**Sheet Flow, A to B** Grass: Dense n= 0.240 P2= 3.20"
0.2	54	0.1230	5.65		**Shallow Concentrated Flow, B to C** Unpaved Kv= 16.1 fps
4.7	104	Total, Increased to minimum Tc = 6.0 min			

Subcatchment N1A: Elm Street Sidewalk/Apron



Summary for Subcatchment N1E: Lawn Area

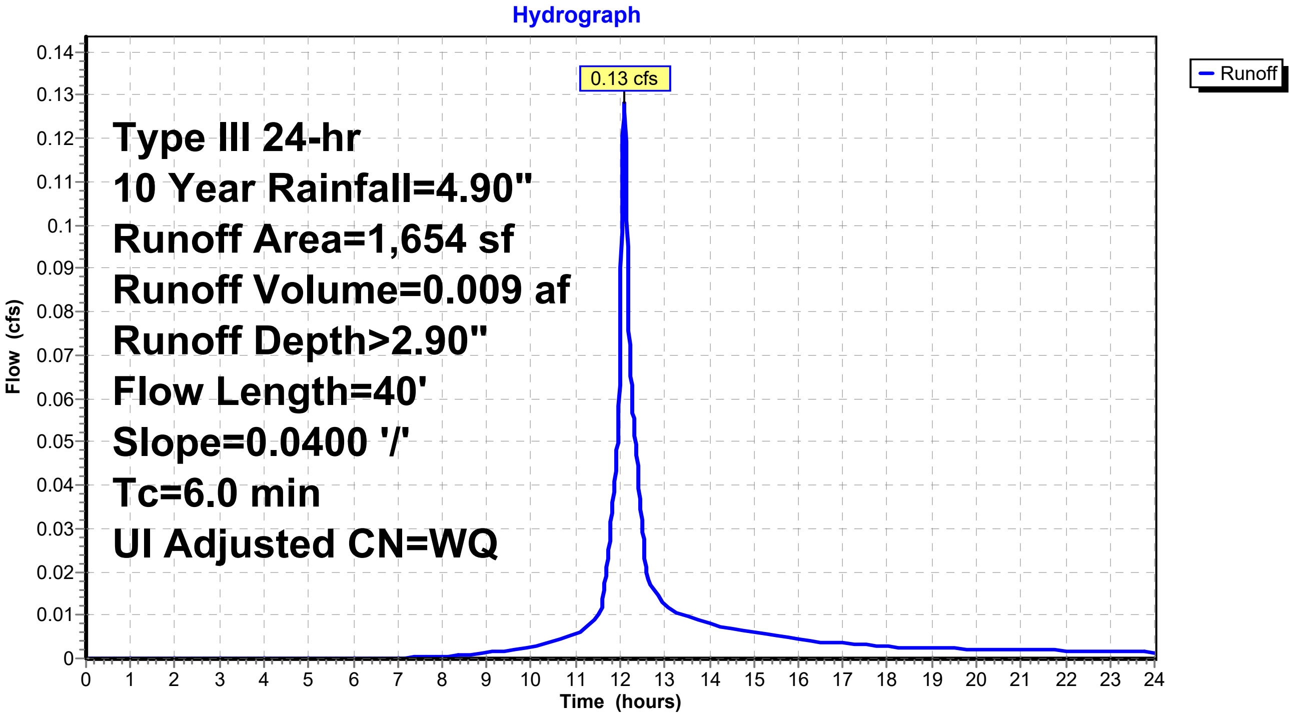
Runoff = 0.13 cfs @ 12.09 hrs, Volume= 0.009 af, Depth> 2.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Year Rainfall=4.90"

Area (sf)	CN	Adj	Description
1,563	80	80	>75% Grass cover, Good, HSG D
91	98	98	Unconnected pavement, HSG D
1,654			Weighted Average
1,563			94.50% Pervious Area
91			5.50% Impervious Area
91			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.2	40	0.0400	0.13		**Sheet Flow, A to B** Grass: Dense n= 0.240 P2= 3.20"
5.2	40	Total, Increased to minimum Tc = 6.0 min			

Subcatchment N1E: Lawn Area

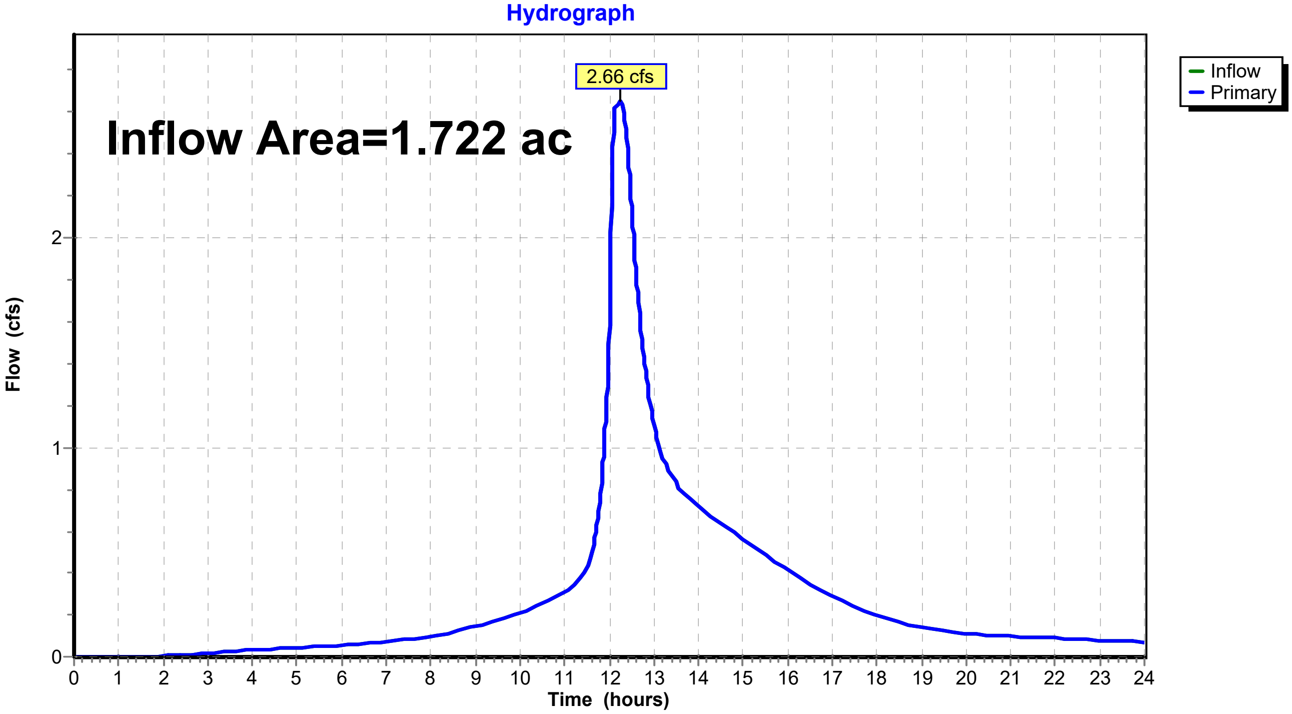


Summary for Link DP1: Design Point #1

```
Inflow Area =        1.722 ac,  66.32% Impervious,  Inflow Depth >   3.79"    for  10 Year event
Inflow      =       2.66 cfs @   12.25 hrs,  Volume=            0.543 af
Primary     =       2.66 cfs @   12.25 hrs,  Volume=            0.543 af,  Atten= 0%,  Lag= 0.0 min
```

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Link DP1: Design Point #1



Summary for Subcatchment N2: East to Waters Street

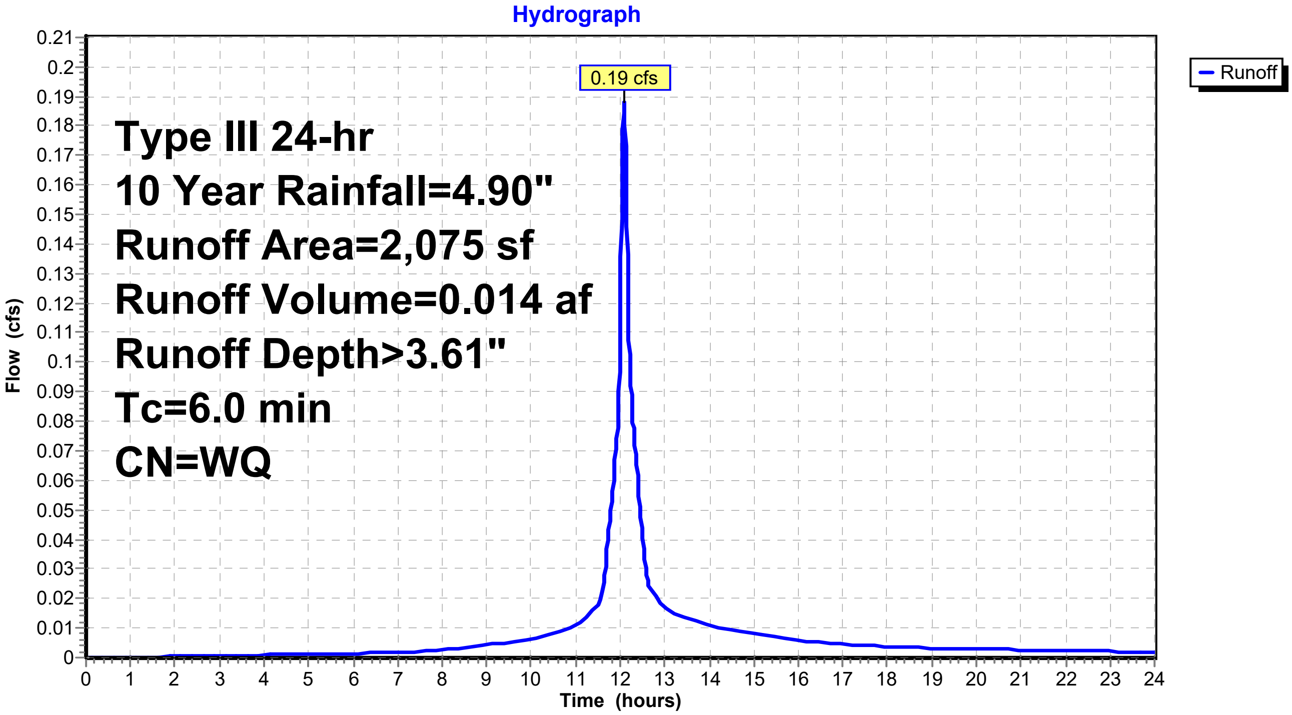
Runoff = 0.19 cfs @ 12.09 hrs, Volume= 0.014 af, Depth> 3.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Year Rainfall=4.90"

Area (sf)	CN	Description
1,168	80	>75% Grass cover, Good, HSG D
907	98	Unconnected pavement, HSG D
2,075		Weighted Average
1,168		56.29% Pervious Area
907		43.71% Impervious Area
907		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct Entry (Tc<6 mins.)**

Subcatchment N2: East to Waters Street



Summary for Subcatchment N3: North to Abutter

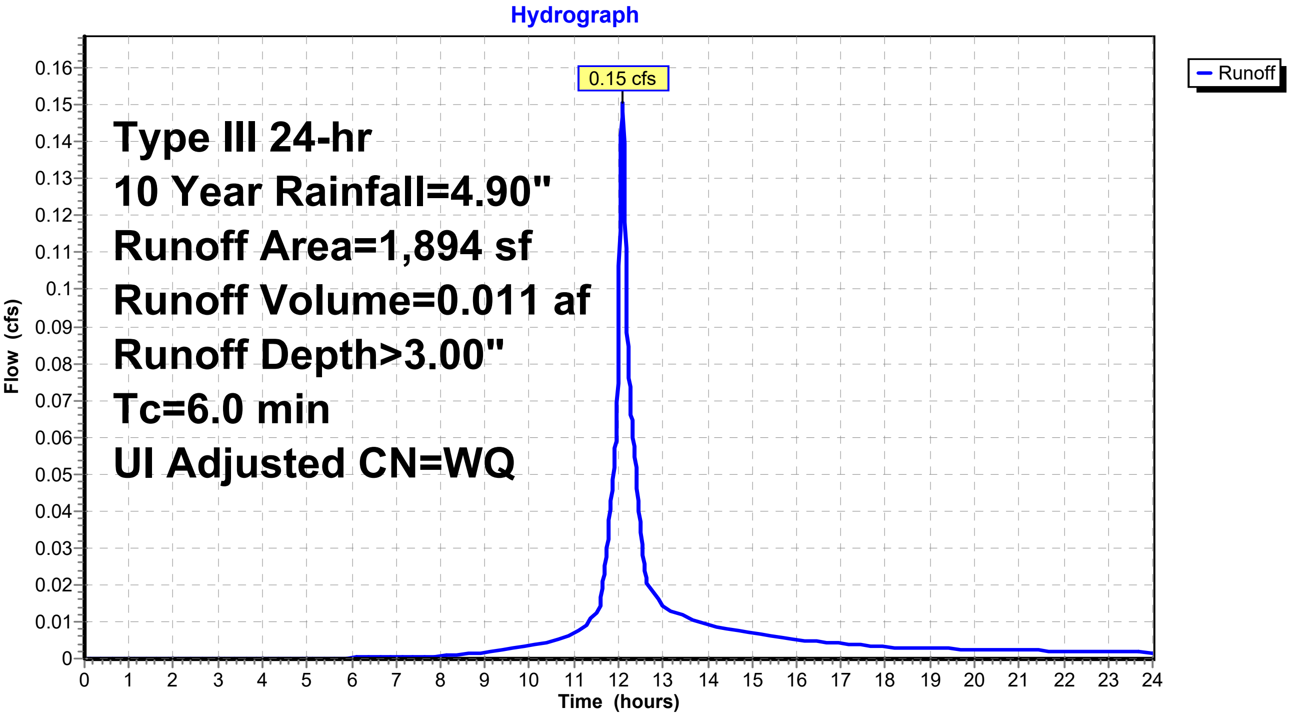
Runoff = 0.15 cfs @ 12.09 hrs, Volume= 0.011 af, Depth> 3.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Year Rainfall=4.90"

Area (sf)	CN	Adj	Description
1,634	80	80	>75% Grass cover, Good, HSG D
113	98	98	Unconnected pavement, HSG D
147	91	91	Gravel roads, HSG D
1,894			Weighted Average
1,781			94.03% Pervious Area
113			5.97% Impervious Area
113			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct Entry (Tc<6 mins.)**

Subcatchment N3: North to Abutter



Summary for Subcatchment N4: Northwest to Abutters

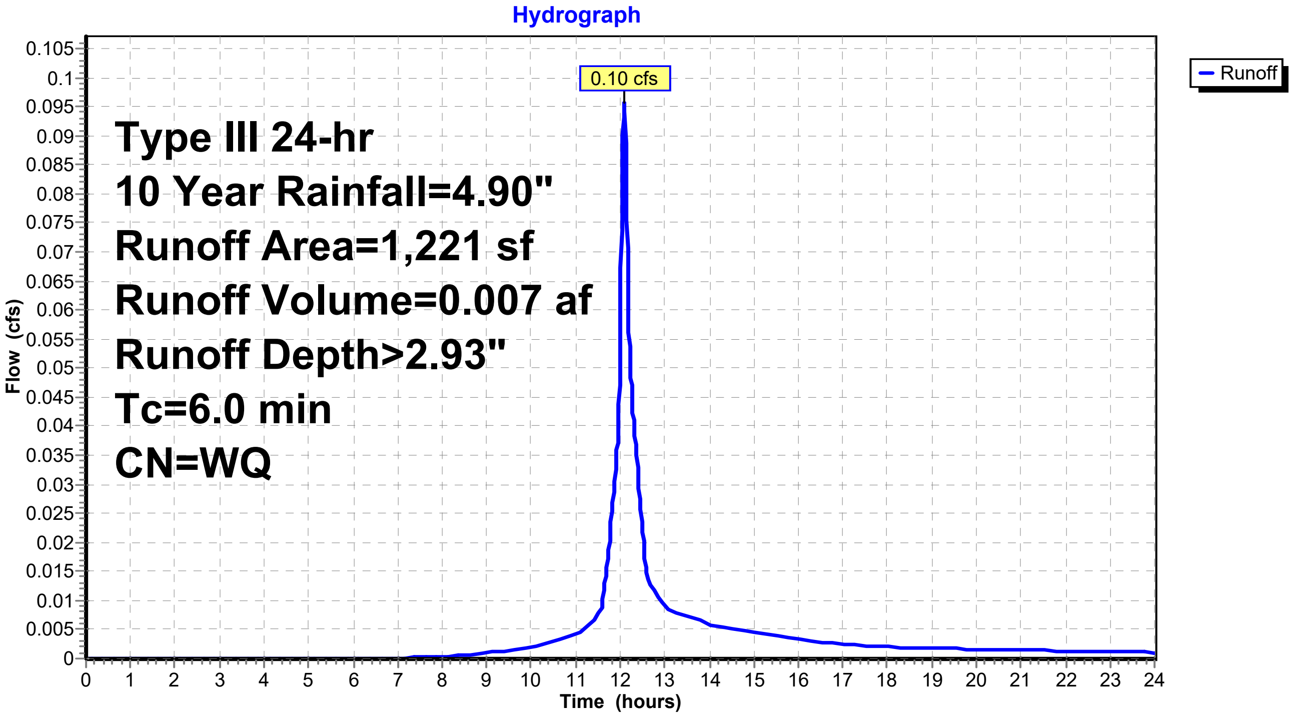
Runoff = 0.10 cfs @ 12.09 hrs, Volume= 0.007 af, Depth> 2.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Year Rainfall=4.90"

Area (sf)	CN	Description
1,092	80	>75% Grass cover, Good, HSG D
22	98	Unconnected pavement, HSG D
107	91	Gravel roads, HSG D
1,221		Weighted Average
1,199		98.20% Pervious Area
22		1.80% Impervious Area
22		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct Entry (Tc<6 mins.)**

Subcatchment N4: Northwest to Abutters



Summary for Subcatchment R1: Northwest Roof

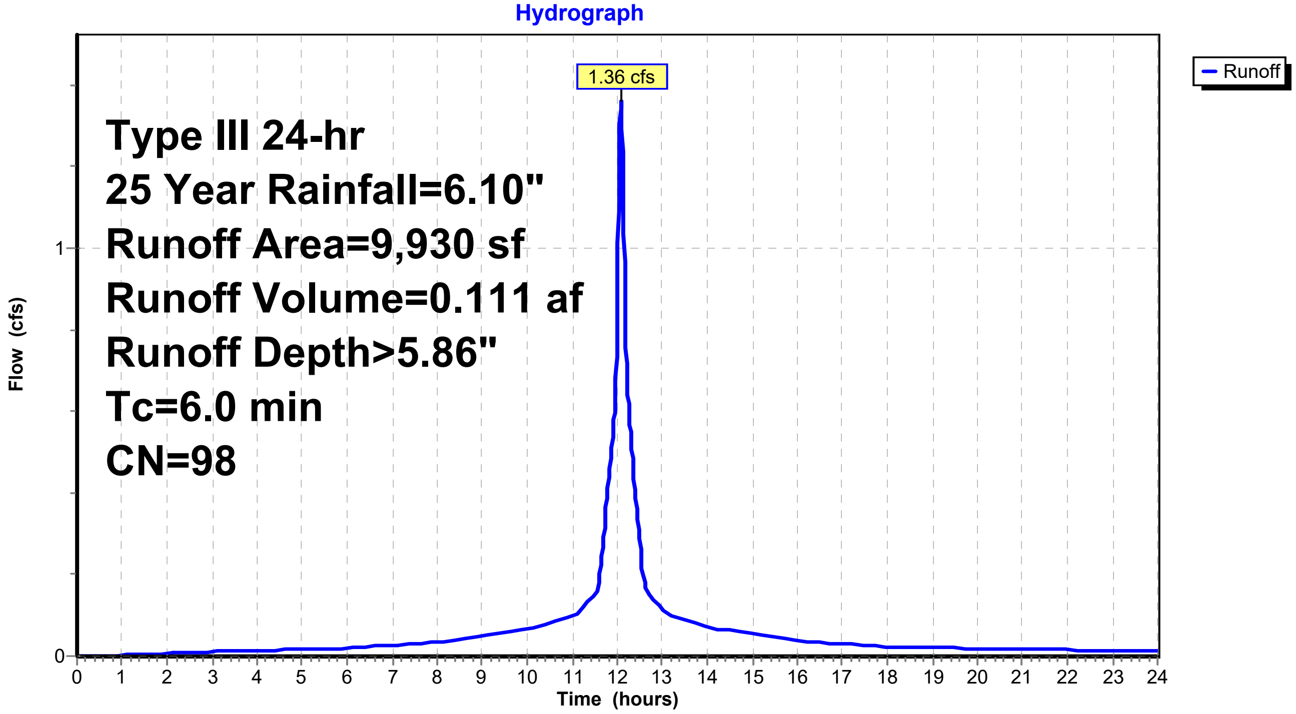
Runoff = 1.36 cfs @ 12.08 hrs, Volume= 0.111 af, Depth> 5.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Year Rainfall=6.10"

Area (sf)	CN	Description
9,930	98	Unconnected roofs, HSG D
9,930		100.00% Impervious Area
9,930		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct Entry (Tc<6 mins.)**

Subcatchment R1: Northwest Roof



Summary for Pond SIB1: Subsurface Infiltration Bed #1

```
Inflow Area =          0.228 ac,100.00% Impervious,  Inflow Depth >   5.86"    for  25 Year event
Inflow      =        1.36 cfs @   12.08 hrs,  Volume=           0.111 af
Outflow     =        0.71 cfs @   12.21 hrs,  Volume=           0.087 af,  Atten= 48%,  Lag= 7.9 min
Discarded   =        0.00 cfs @    0.00 hrs,  Volume=           0.000 af
Primary     =        0.71 cfs @   12.21 hrs,  Volume=           0.087 af
```

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 418.24' @ 12.21 hrs Surf.Area= 0.024 ac Storage= 0.042 af
Flood Elev= 419.00' Surf.Area= 0.024 ac Storage= 0.049 af

Plug-Flow detention time= 166.7 min calculated for 0.087 af (78% of inflow)
Center-of-Mass det. time= 86.5 min (830.8 - 744.4)

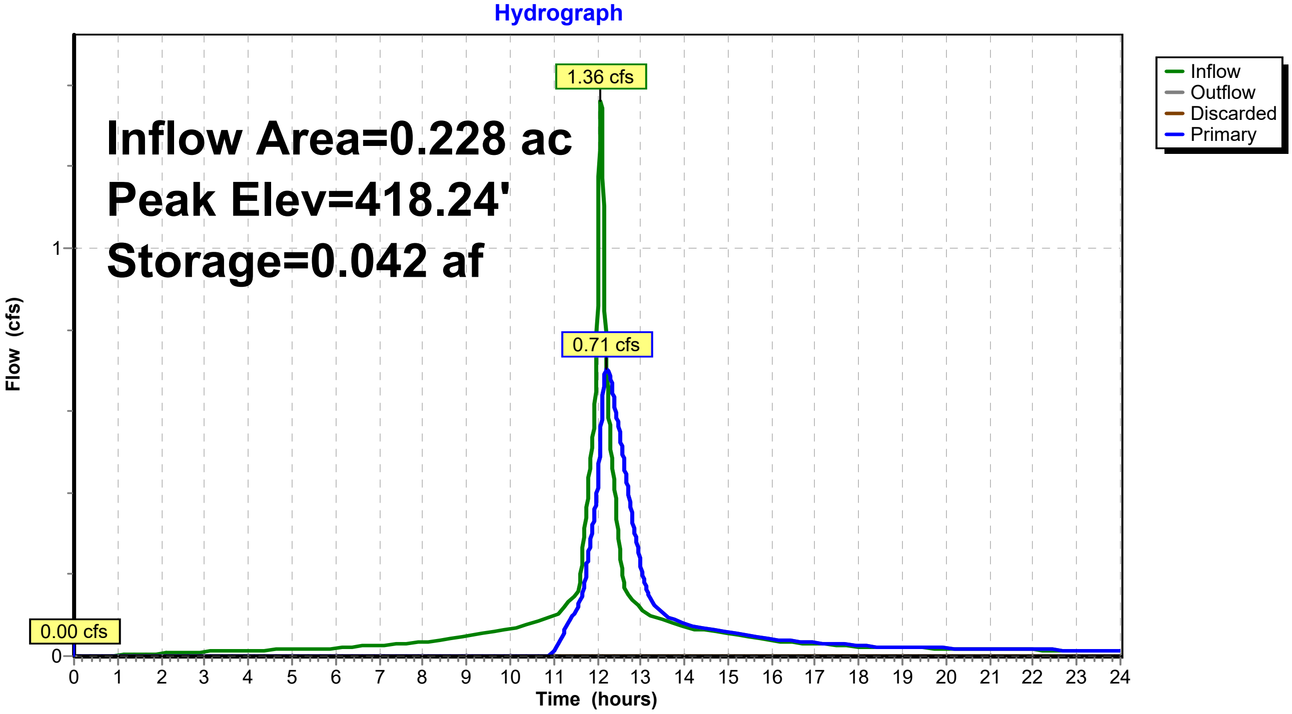
Volume	Invert	Avail.Storage	Storage Description
#1A	415.50'	0.024 af	**22.50'W x 47.34'L x 3.50'H Field A** 0.086 af Overall - 0.025 af Embedded = 0.060 af x 40.0% Voids
#2A	416.00'	0.025 af	**ADS_StormTech SC-740 +Cap** x 24 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 4 Rows of 6 Chambers
		0.049 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	415.50'	**0.170 in/hr Exfiltration X 0.00 over Surface area**
#2	Primary	417.00'	**8.0" Round Culvert** L= 72.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 417.00' / 416.28' S= 0.0100 '/' Cc= 0.900 n= 0.011, Flow Area= 0.35 sf
#3	Device 2	417.00'	**5.0" Vert. Orifice/Grate** C= 0.600
#4	Device 2	418.00'	**2.0" Vert. Orifice/Grate** C= 0.600

```
Discarded OutFlow  Max=0.00 cfs @ 0.00 hrs  HW=415.50'   (Free Discharge)
↑
└─1=Exfiltration  ( Controls 0.00 cfs)

Primary OutFlow  Max=0.71 cfs @ 12.21 hrs  HW=418.24'  TW=0.00'   (Dynamic Tailwater)
↑
└─2=Culvert  (Passes 0.71 cfs of 1.26 cfs potential flow)
   ↑
   ├─3=Orifice/Grate  (Orifice Controls 0.67 cfs @ 4.88 fps)
   └─4=Orifice/Grate  (Orifice Controls 0.04 cfs @ 1.88 fps)
```

Pond SIB1: Subsurface Infiltration Bed #1



Summary for Subcatchment N1B: Northwest Roof & Parking

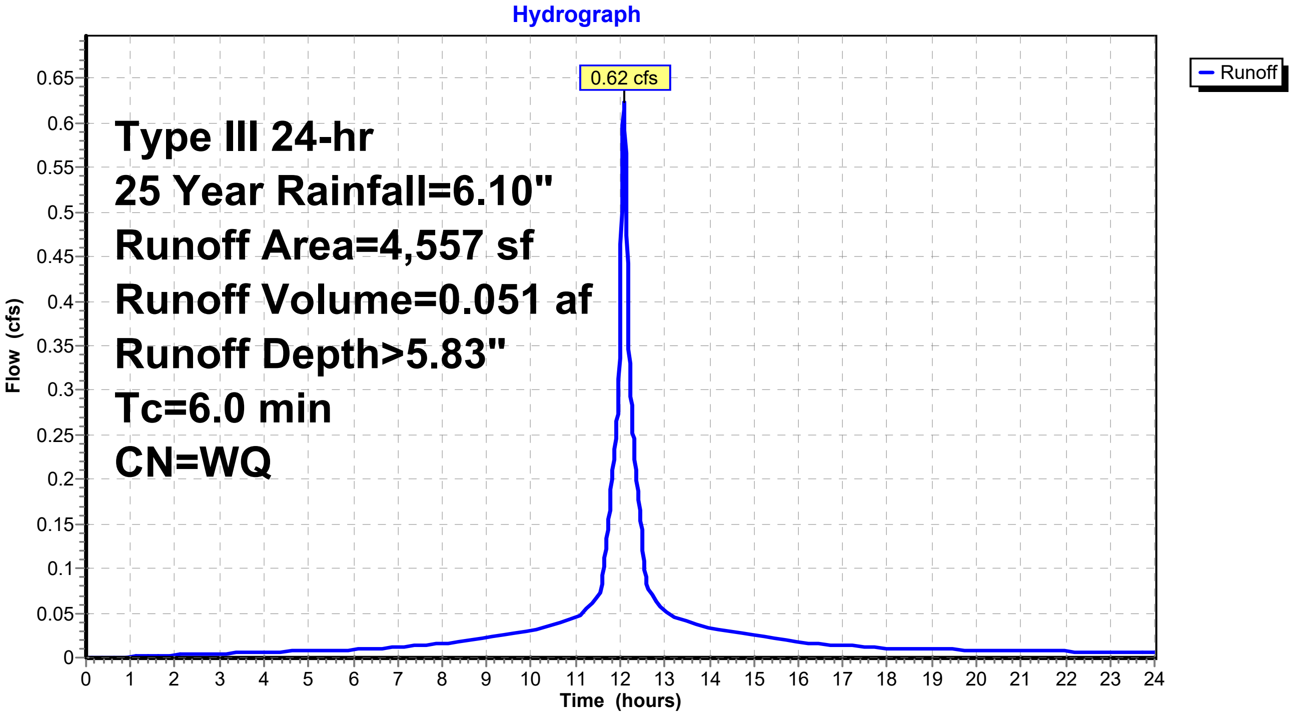
Runoff = 0.62 cfs @ 12.08 hrs, Volume= 0.051 af, Depth> 5.83"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Year Rainfall=6.10"

Area (sf)	CN	Description
72	80	>75% Grass cover, Good, HSG D
4,485	98	Unconnected pavement, HSG D
4,557		Weighted Average
72		1.58% Pervious Area
4,485		98.42% Impervious Area
4,485		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct Entry (Tc<6 mins.)**

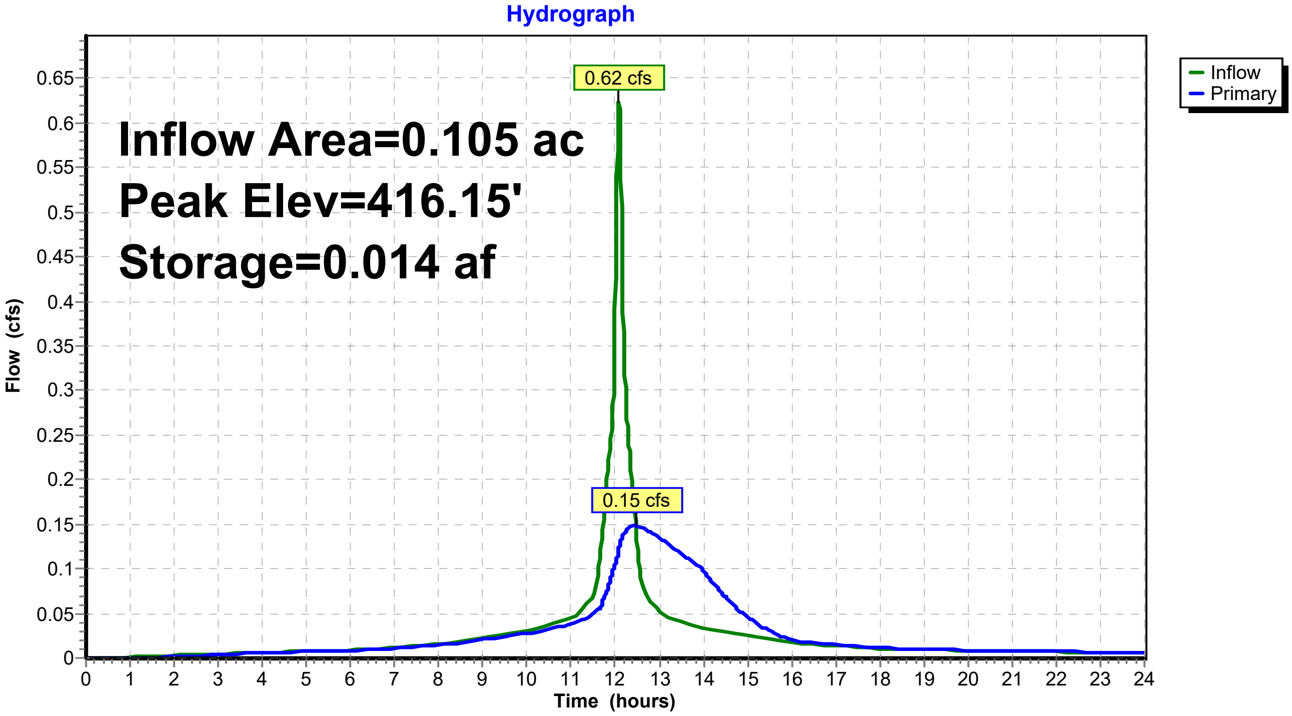
Subcatchment N1B: Northwest Roof & Parking



Summary for Pond SDB1: Subsurface Detention Bed #1

```
Inflow Area =       0.105 ac,  98.42% Impervious,  Inflow Depth >   5.83"    for  25 Year event
Inflow      =      0.62 cfs @   12.08 hrs,  Volume=          0.051 af
Outflow     =      0.15 cfs @   12.46 hrs,  Volume=          0.050 af,  Atten= 76%,  Lag= 22.8 min
Primary     =      0.15 cfs @   12.46 hrs,  Volume=          0.050 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 416.15' @ 12.46 hrs   Surf.Area= 0.012 ac   Storage= 0.014 af
Flood Elev= 418.05'   Surf.Area= 0.012 ac   Storage= 0.026 af

Plug-Flow detention time= 39.9 min calculated for 0.050 af (99% of inflow)
Center-of-Mass det. time= 35.9 min ( 781.0 - 745.1 )

Volume      Invert   Avail.Storage   Storage Description
  #1A      414.05'        0.015 af   13.00'W x 40.22'L x 4.00'H Field A
                                     0.048 af Overall - 0.011 af Embedded = 0.037 af  x 40.0% Voids
  #2A      415.05'        0.011 af   ADS_StormTech SC-740 +Cap x 10  Inside #1
                                     Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
                                     Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap
                                     2 Rows of 5 Chambers
   #3      414.06'        0.001 af   6.0"  Round Underdrain Storage x 3  Inside #1
                                     L= 40.0'
                                     0.001 af Overall - 0.1" Wall Thickness = 0.001 af
                          0.026 af   Total Available Storage

   Storage Group A created with Chamber Wizard

Device   Routing        Invert   Outlet Devices
   #1    Primary       414.05'   6.0"  Round 6" PVC
                                 L= 78.0'   CPP, end-section conforming to fill,  Ke= 0.500
                                 Inlet / Outlet Invert= 414.05' / 413.58'   S= 0.0060 '/'   Cc= 0.900
                                 n= 0.011,  Flow Area= 0.20 sf
   #2    Device 1      414.05'   2.0" Vert. Orifice/Grate   C= 0.600

Primary OutFlow  Max=0.15 cfs @ 12.46 hrs  HW=416.15'  TW=0.00'   (Dynamic Tailwater)
↑─1=6" PVC  (Passes 0.15 cfs of 0.93 cfs potential flow)
   ↑─2=Orifice/Grate  (Orifice Controls 0.15 cfs @ 6.83 fps)
```

Pond SDB1: Subsurface Detention Bed #1



Summary for Subcatchment N1C: Northeast Parking & Driveways

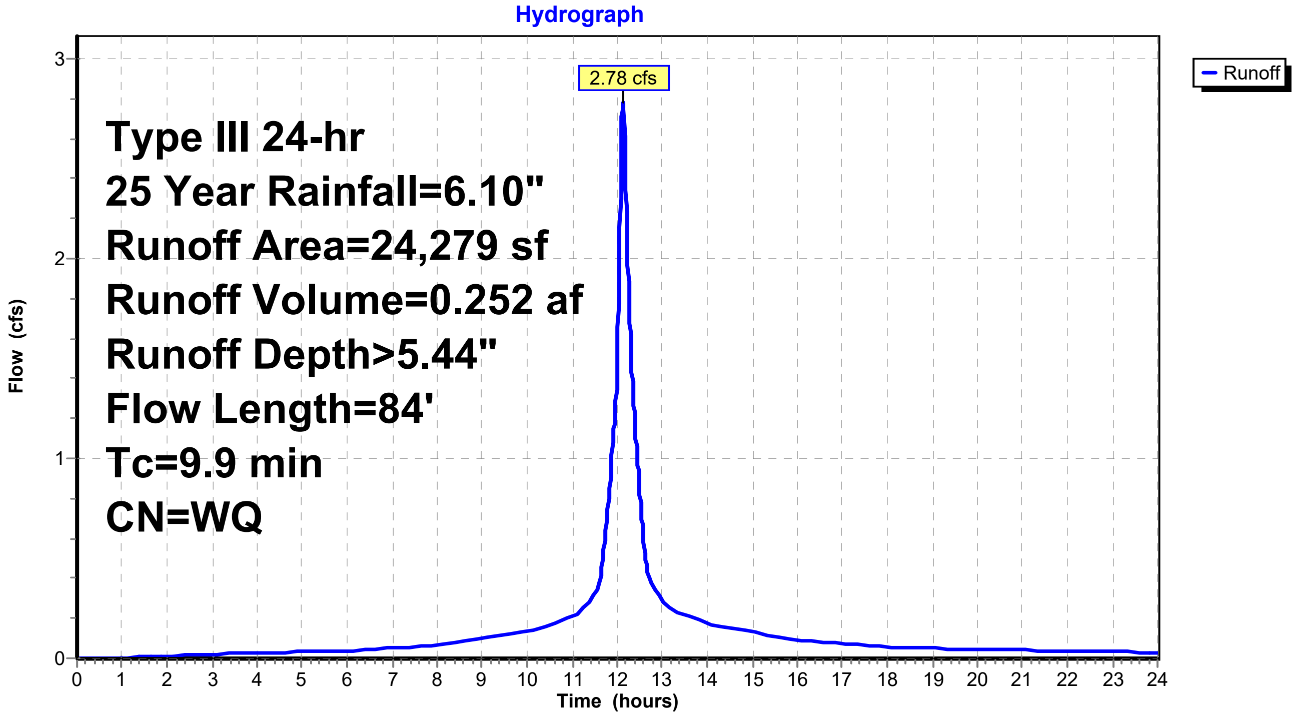
Runoff = 2.78 cfs @ 12.13 hrs, Volume= 0.252 af, Depth> 5.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Year Rainfall=6.10"

Area (sf)	CN	Description
5,025	80	>75% Grass cover, Good, HSG D
42	61	>75% Grass cover, Good, HSG B
12,912	98	Unconnected pavement, HSG D
13	98	Unconnected pavement, HSG B
6,287	98	Unconnected roofs, HSG D
24,279		Weighted Average
5,067		20.87% Pervious Area
19,212		79.13% Impervious Area
19,212		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.6	43	0.0100	0.07		**Sheet Flow, A to B** Grass: Dense n= 0.240 P2= 3.20"
0.3	41	0.0146	2.45		**Shallow Concentrated Flow, B to C** Paved Kv= 20.3 fps
9.9	84	Total			

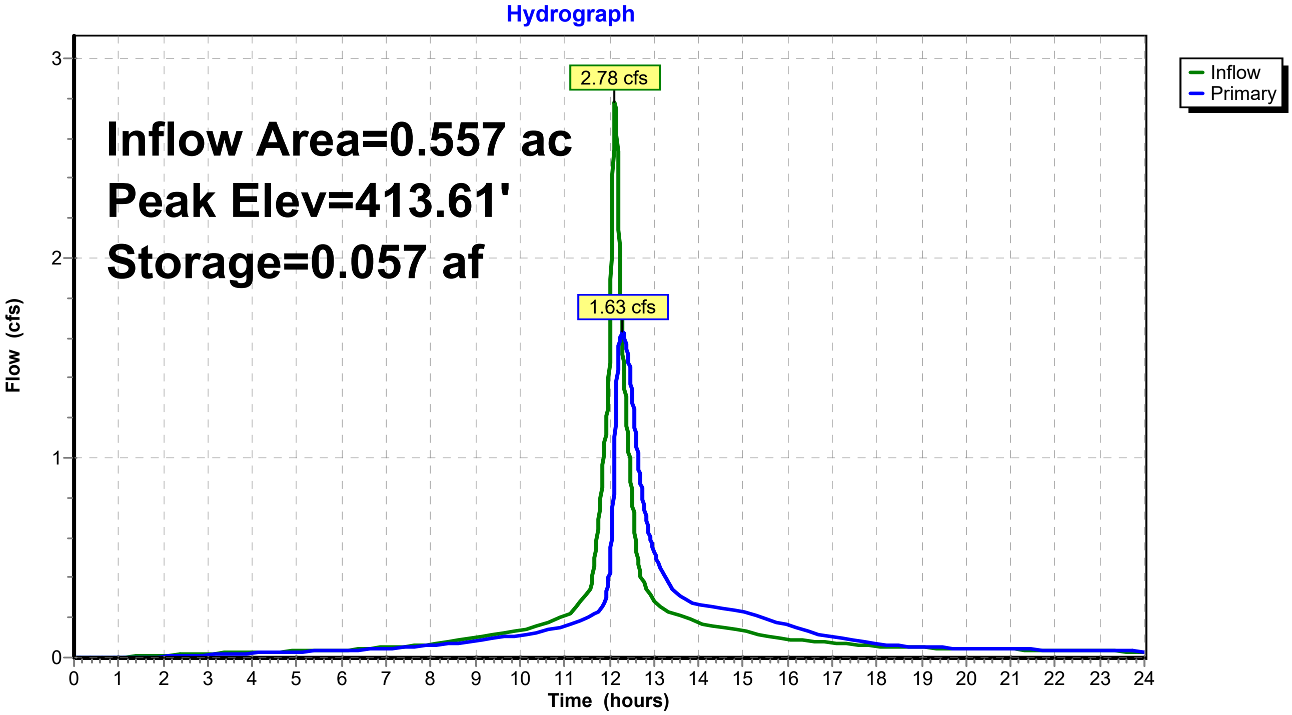
Subcatchment N1C: Northeast Parking & Driveways



Summary for Pond SDB2: Subsurface Detention Bed #2

```
Inflow Area =        0.557 ac, 79.13% Impervious, Inflow Depth >  5.44"   for 25 Year event
Inflow      =      2.78 cfs @  12.13 hrs, Volume=         0.252 af
Outflow     =      1.63 cfs @  12.29 hrs, Volume=         0.251 af, Atten= 41%, Lag= 9.4 min
Primary     =      1.63 cfs @  12.29 hrs, Volume=         0.251 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 413.61' @ 12.29 hrs  Surf.Area= 0.034 ac  Storage= 0.057 af
Flood Elev= 414.85'  Surf.Area= 0.034 ac  Storage= 0.077 af

Plug-Flow detention time= 40.3 min calculated for 0.251 af (99% of inflow)
Center-of-Mass det. time= 35.5 min ( 793.2 - 757.7 )

Volume     Invert   Avail.Storage  Storage Description
  #1A     410.85'        0.039 af  36.75'W x 40.22'L x 4.00'H Field A
                                   0.136 af Overall - 0.038 af Embedded = 0.097 af  x 40.0% Voids
  #2A     411.85'        0.037 af  ADS_StormTech SC-740 +Cap x 35  Inside #1
                                   Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
                                   Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap
                                   7 Rows of 5 Chambers
  #3      410.86'        0.001 af  6.0"  Round Underdrain Storage x 7  Inside #1
                                   L= 40.0'
                                   0.001 af Overall - 0.1" Wall Thickness = 0.001 af
                         0.077 af  Total Available Storage

  Storage Group A created with Chamber Wizard

Device  Routing       Invert  Outlet Devices
  #1    Primary      410.85'  12.0"  Round Culvert
                              L= 35.0'  CPP, end-section conforming to fill,  Ke= 0.500
                              Inlet / Outlet Invert= 410.85' / 410.71'  S= 0.0040 '/'  Cc= 0.900
                              n= 0.012,  Flow Area= 0.79 sf
  #2    Device 1     410.85'  3.0" Vert. Orifice/Grate  C= 0.600
  #3    Device 1     412.20'  3.0" W x 14.0" H Vert. Orifice/Grate  C= 0.600

Primary OutFlow  Max=1.63 cfs @ 12.29 hrs  HW=413.61'  TW=0.00'  (Dynamic Tailwater)
└─1=Culvert  (Passes 1.63 cfs of 5.56 cfs potential flow)
   ├─2=Orifice/Grate  (Orifice Controls 0.38 cfs @ 7.81 fps)
   └─3=Orifice/Grate  (Orifice Controls 1.25 cfs @ 4.27 fps)
```

Pond SDB2: Subsurface Detention Bed #2



Summary for Subcatchment N1D: South Apron & Lawns

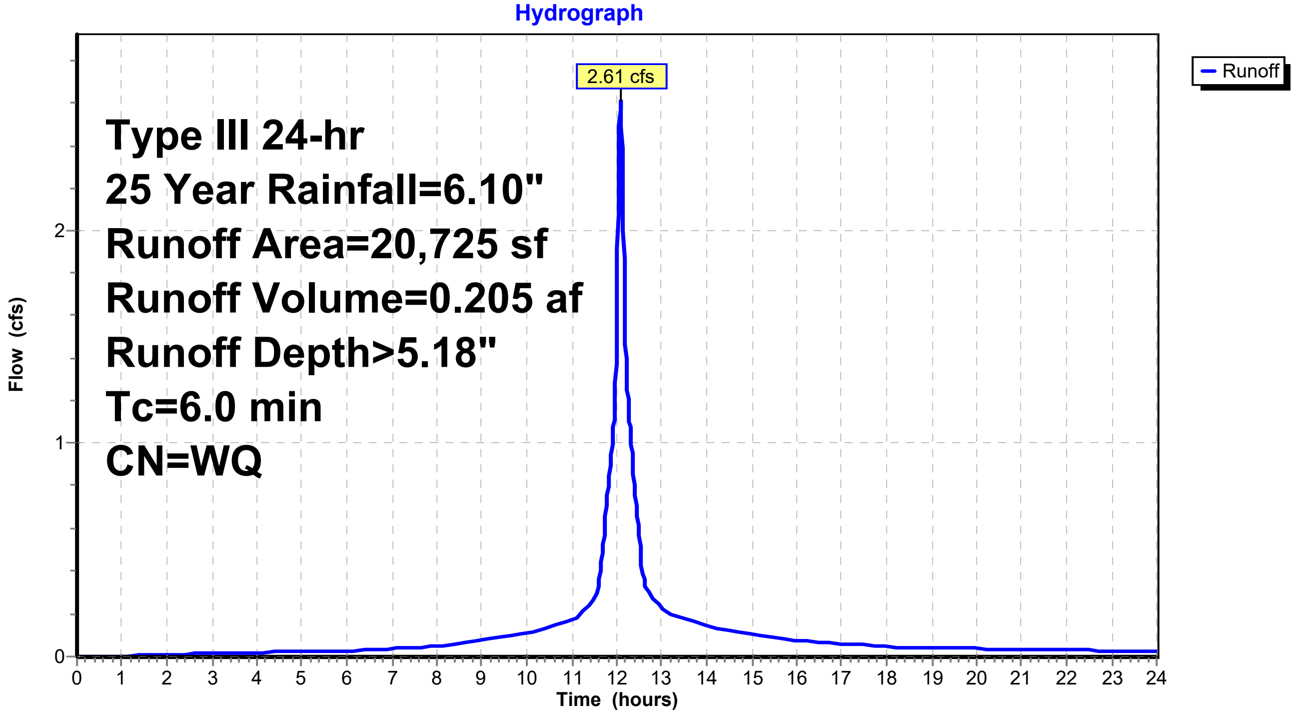
Runoff = 2.61 cfs @ 12.08 hrs, Volume= 0.205 af, Depth> 5.18"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Year Rainfall=6.10"

Area (sf)	CN	Description
7,022	80	>75% Grass cover, Good, HSG D
10,546	98	Unconnected pavement, HSG D
3,157	98	Unconnected roofs, HSG D
20,725		Weighted Average
7,022		33.88% Pervious Area
13,703		66.12% Impervious Area
13,703		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct Entry (Tc<6 mins.)**

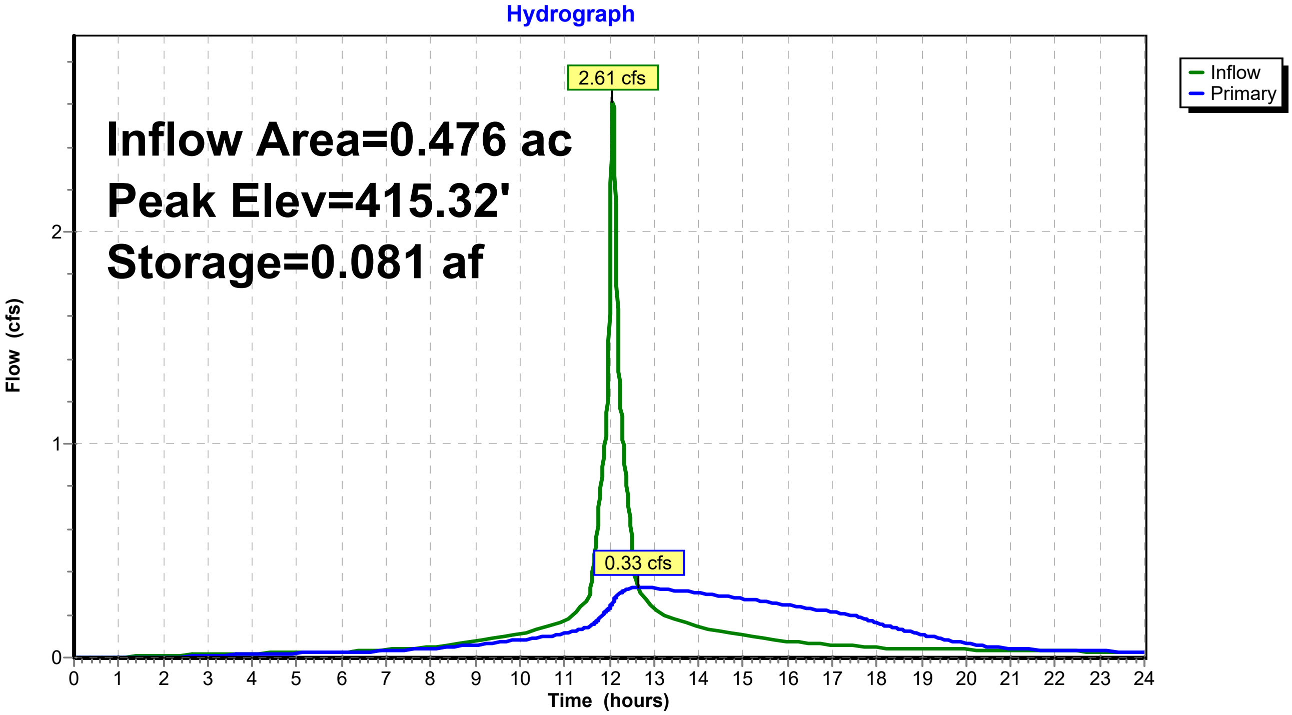
Subcatchment N1D: South Apron & Lawns



Summary for Pond SDB3: Subsurface Detention Bed #3

```
Inflow Area =      0.476 ac, 66.12% Impervious, Inflow Depth >  5.18"   for 25 Year event
Inflow      =     2.61 cfs @  12.08 hrs, Volume=        0.205 af
Outflow     =     0.33 cfs @  12.64 hrs, Volume=        0.203 af, Atten= 87%, Lag= 33.4 min
Primary     =     0.33 cfs @  12.64 hrs, Volume=        0.203 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 415.32' @ 12.64 hrs  Surf.Area= 0.052 ac  Storage= 0.081 af
Flood Elev= 416.80'  Surf.Area= 0.052 ac  Storage= 0.120 af

Plug-Flow detention time= 111.3 min calculated for 0.203 af (99% of inflow)
Center-of-Mass det. time= 104.7 min ( 866.3 - 761.7 )

Volume      Invert   Avail.Storage  Storage Description
  #1A      412.80'        0.058 af  41.50'W x 54.46'L x 4.00'H Field A
                                    0.208 af Overall - 0.061 af Embedded = 0.146 af  x 40.0% Voids
  #2A      413.80'        0.059 af  ADS_StormTech SC-740 +Cap x 56  Inside #1
                                    Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
                                    Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap
                                    8 Rows of 7 Chambers
  #3       412.81'        0.002 af  6.0"  Round Underdrain Storage x 9  Inside #1
                                    L= 55.0'
                                    0.002 af Overall - 0.1" Wall Thickness = 0.002 af
                          0.120 af  Total Available Storage

   Storage Group A created with Chamber Wizard

Device  Routing       Invert  Outlet Devices
  #1    Primary      412.35'  12.0"  Round Culvert
                              L= 3.0'  CPP, end-section conforming to fill,  Ke= 0.500
                              Inlet / Outlet Invert= 412.35' / 412.25'  S= 0.0333 '/'  Cc= 0.900
                              n= 0.012,  Flow Area= 0.79 sf
  #2    Device 1     412.80'  2.0" Vert. Orifice/Grate X 2.00   C= 0.600
  #3    Device 1     415.75'  2.0" W x 3.0" H Vert. Orifice/Grate   C= 0.600

Primary OutFlow  Max=0.33 cfs @ 12.64 hrs  HW=415.32'  TW=0.00'  (Dynamic Tailwater)
└─1=Culvert  (Passes 0.33 cfs of 5.95 cfs potential flow)
   ├─2=Orifice/Grate  (Orifice Controls 0.33 cfs @ 7.52 fps)
   └─3=Orifice/Grate  ( Controls 0.00 cfs)
```

Pond SDB3: Subsurface Detention Bed #3



Summary for Subcatchment N1A: Elm Street Sidewalk/Apron

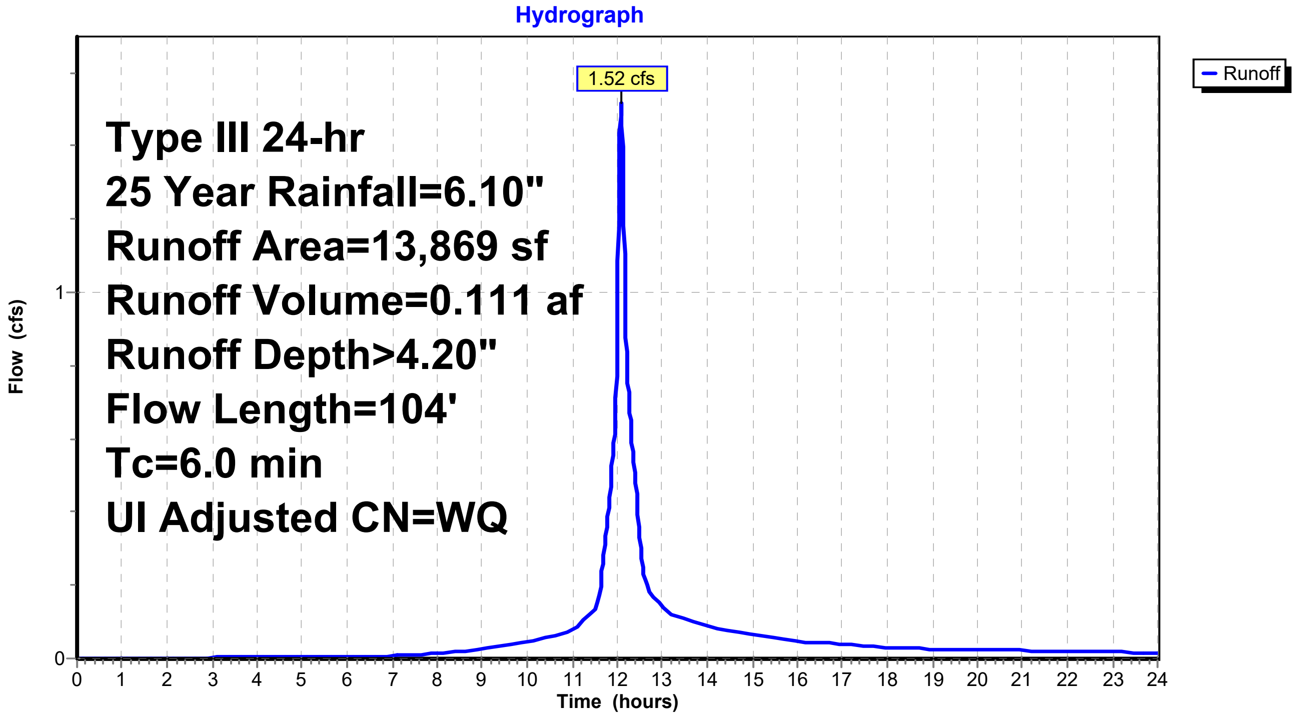
Runoff = 1.52 cfs @ 12.09 hrs, Volume= 0.111 af, Depth> 4.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Year Rainfall=6.10"

Area (sf)	CN	Adj	Description
11,538	80	80	>75% Grass cover, Good, HSG D
2,331	98	98	Unconnected pavement, HSG D
13,869			Weighted Average
11,538			83.19% Pervious Area
2,331			16.81% Impervious Area
2,331			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.5	50	0.0920	0.19		**Sheet Flow, A to B** Grass: Dense n= 0.240 P2= 3.20"
0.2	54	0.1230	5.65		**Shallow Concentrated Flow, B to C** Unpaved Kv= 16.1 fps
4.7	104	Total, Increased to minimum Tc = 6.0 min			

Subcatchment N1A: Elm Street Sidewalk/Apron



Summary for Subcatchment N1E: Lawn Area

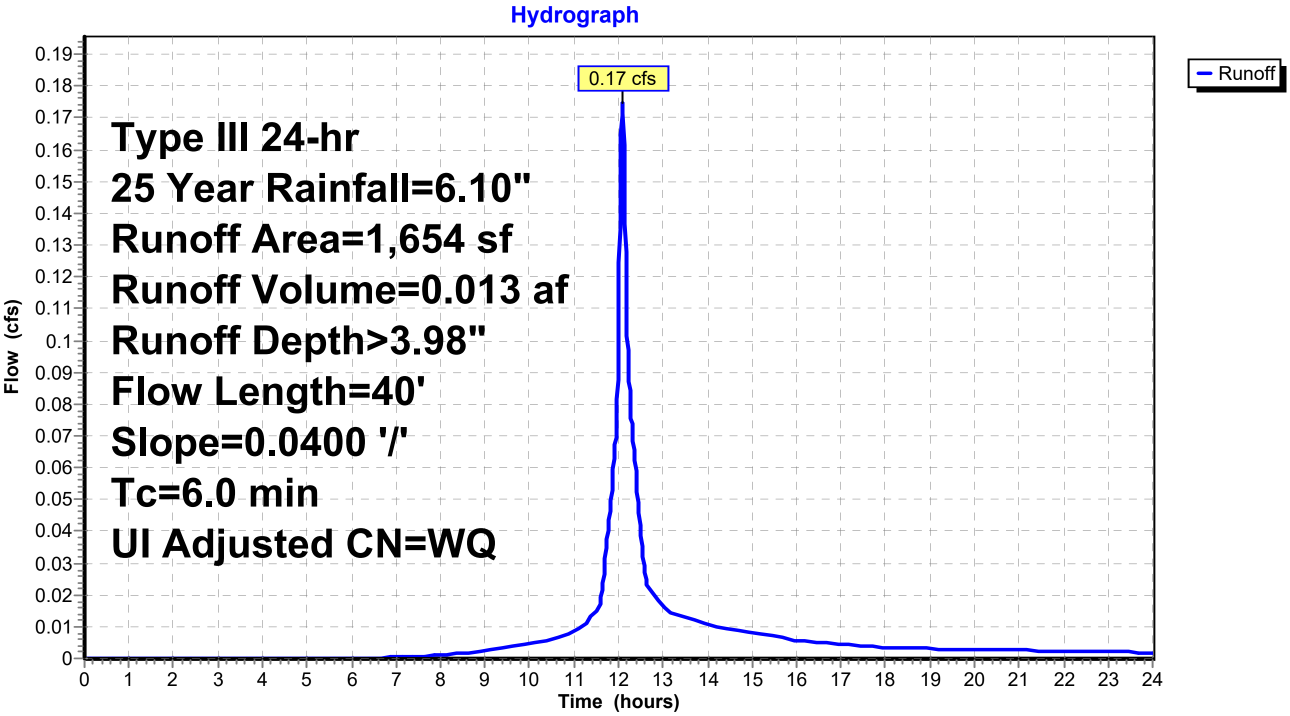
Runoff = 0.17 cfs @ 12.09 hrs, Volume= 0.013 af, Depth> 3.98"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Year Rainfall=6.10"

Area (sf)	CN	Adj	Description
1,563	80	80	>75% Grass cover, Good, HSG D
91	98	98	Unconnected pavement, HSG D
1,654			Weighted Average
1,563			94.50% Pervious Area
91			5.50% Impervious Area
91			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.2	40	0.0400	0.13		**Sheet Flow, A to B** Grass: Dense n= 0.240 P2= 3.20"
5.2	40	Total, Increased to minimum Tc = 6.0 min			

Subcatchment N1E: Lawn Area

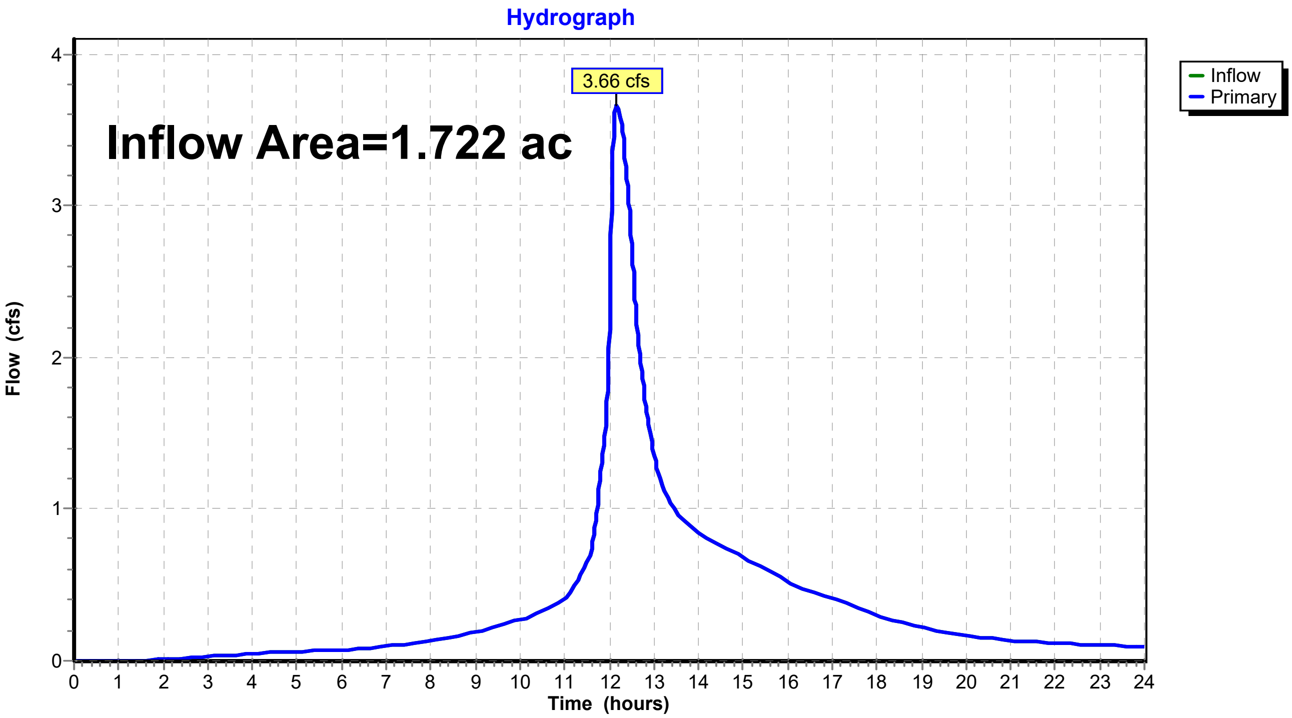


Summary for Link DP1: Design Point #1

Inflow Area = 1.722 ac, 66.32% Impervious, Inflow Depth > 4.99" for 25 Year event
Inflow = 3.66 cfs @ 12.16 hrs, Volume= 0.716 af
Primary = 3.66 cfs @ 12.16 hrs, Volume= 0.716 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Link DP1: Design Point #1



Summary for Subcatchment N2: East to Waters Street

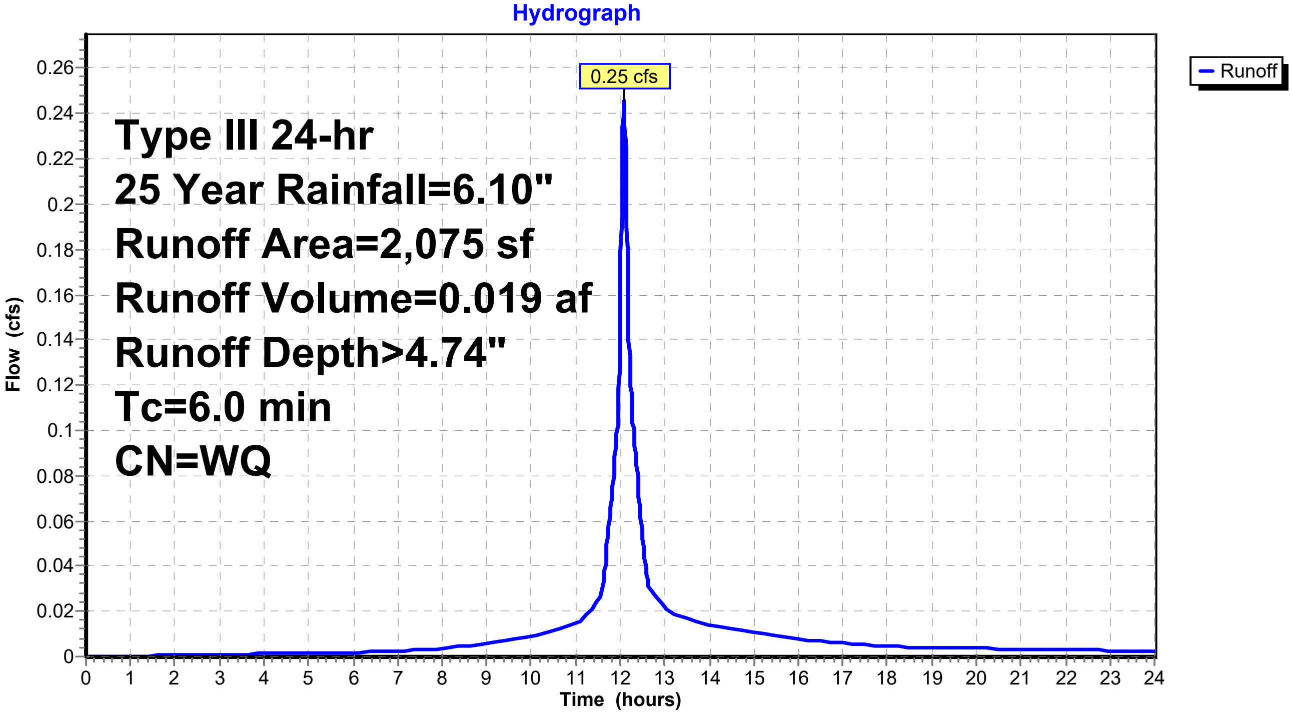
Runoff = 0.25 cfs @ 12.09 hrs, Volume= 0.019 af, Depth> 4.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Year Rainfall=6.10"

Area (sf)	CN	Description
1,168	80	>75% Grass cover, Good, HSG D
907	98	Unconnected pavement, HSG D
2,075		Weighted Average
1,168		56.29% Pervious Area
907		43.71% Impervious Area
907		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct Entry (Tc<6 mins.)**

Subcatchment N2: East to Waters Street



Summary for Subcatchment N3: North to Abutter

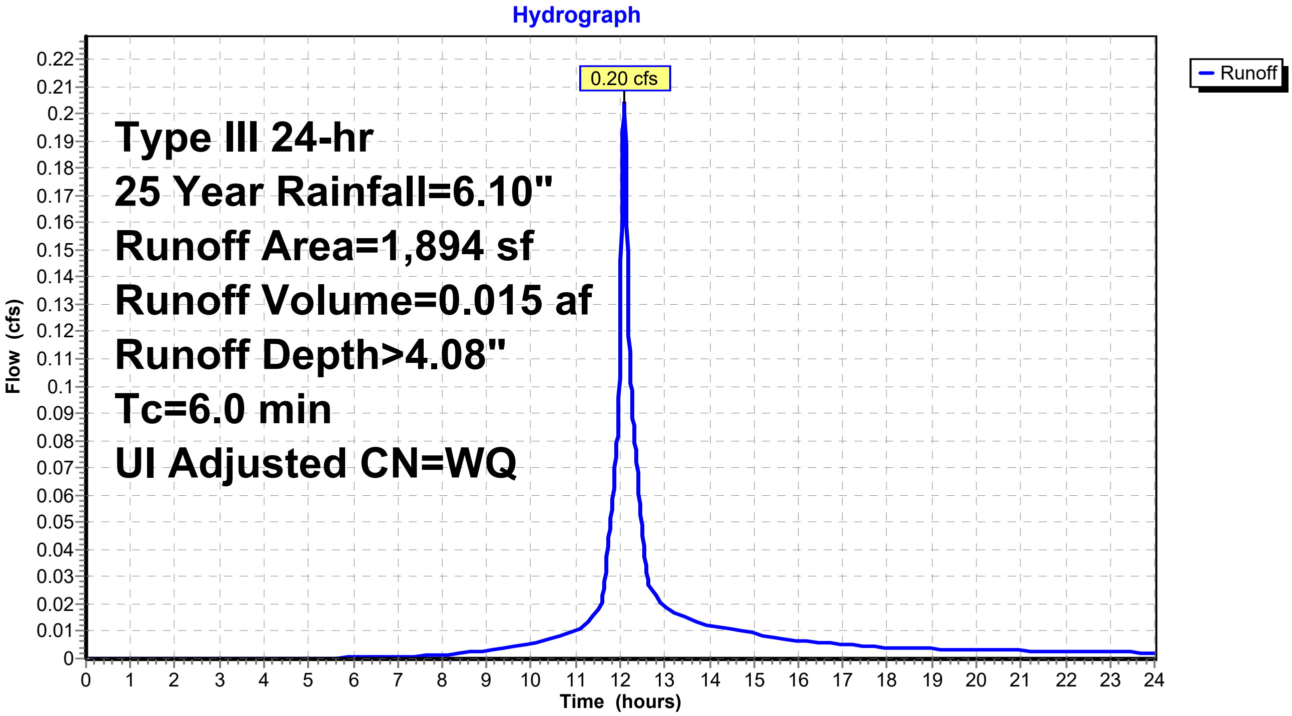
Runoff = 0.20 cfs @ 12.09 hrs, Volume= 0.015 af, Depth> 4.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Year Rainfall=6.10"

Area (sf)	CN	Adj	Description
1,634	80	80	>75% Grass cover, Good, HSG D
113	98	98	Unconnected pavement, HSG D
147	91	91	Gravel roads, HSG D
1,894			Weighted Average
1,781			94.03% Pervious Area
113			5.97% Impervious Area
113			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct Entry (Tc<6 mins.)**

Subcatchment N3: North to Abutter



Summary for Subcatchment N4: Northwest to Abutters

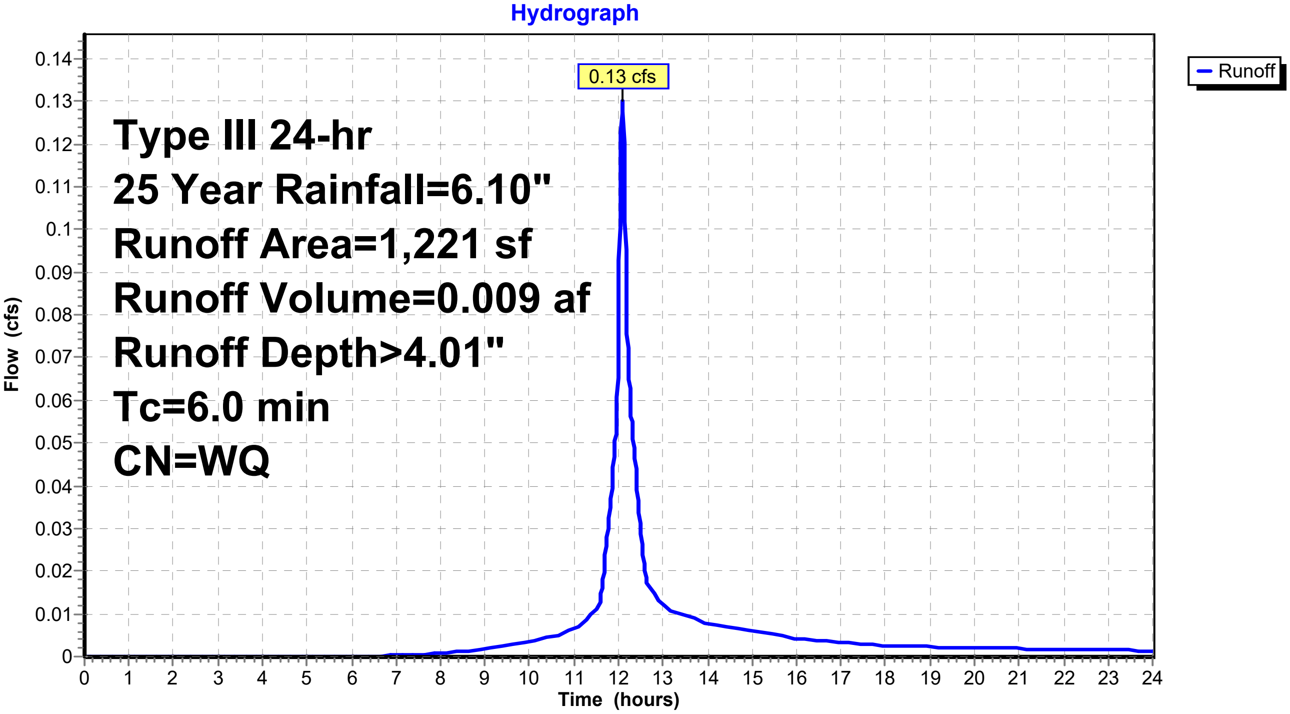
Runoff = 0.13 cfs @ 12.09 hrs, Volume= 0.009 af, Depth> 4.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Year Rainfall=6.10"

Area (sf)	CN	Description
1,092	80	>75% Grass cover, Good, HSG D
22	98	Unconnected pavement, HSG D
107	91	Gravel roads, HSG D
1,221		Weighted Average
1,199		98.20% Pervious Area
22		1.80% Impervious Area
22		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct Entry (Tc<6 mins.)**

Subcatchment N4: Northwest to Abutters



Summary for Subcatchment R1: Northwest Roof

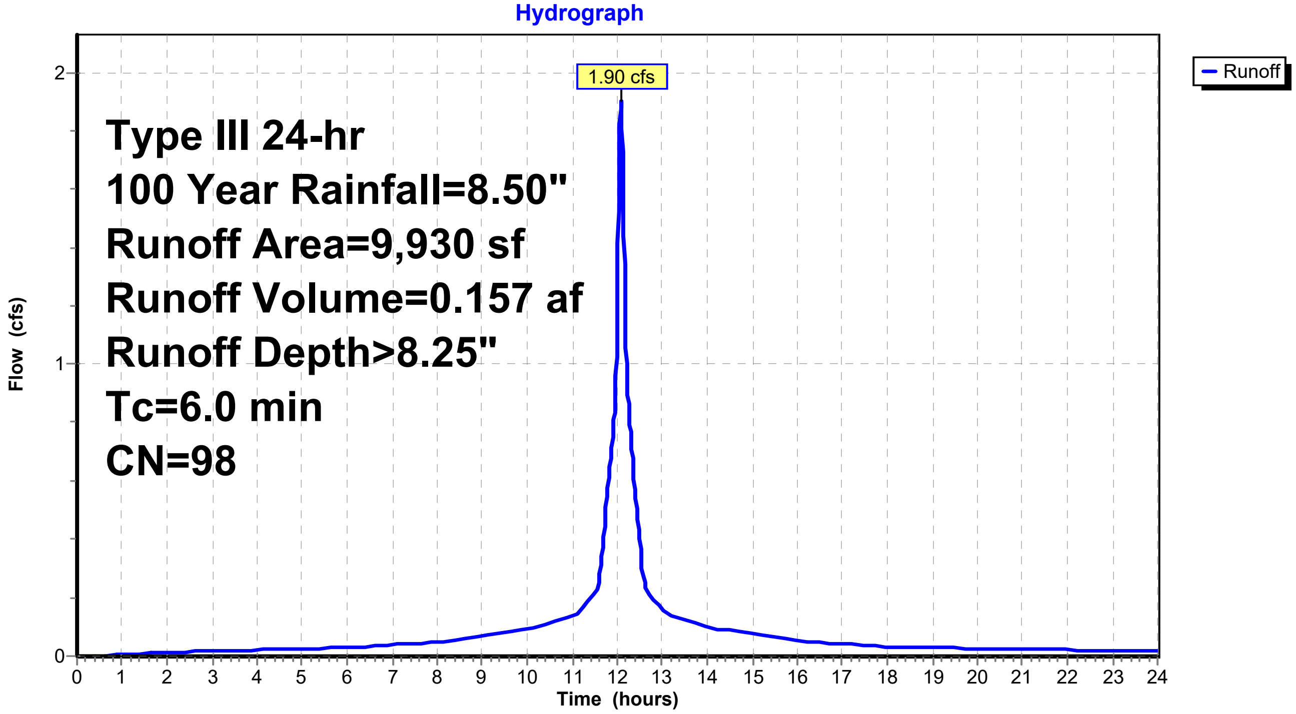
Runoff = 1.90 cfs @ 12.08 hrs, Volume= 0.157 af, Depth> 8.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Year Rainfall=8.50"

Area (sf)	CN	Description
9,930	98	Unconnected roofs, HSG D
9,930		100.00% Impervious Area
9,930		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct Entry (Tc<6 mins.)**

Subcatchment R1: Northwest Roof



Summary for Pond SIB1: Subsurface Infiltration Bed #1

Inflow Area = 0.228 ac,100.00% Impervious, Inflow Depth > 8.25" for 100 Year event
Inflow = 1.90 cfs @ 12.08 hrs, Volume= 0.157 af
Outflow = 0.98 cfs @ 12.22 hrs, Volume= 0.133 af, Atten= 49%, Lag= 8.0 min
Discarded = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Primary = 0.98 cfs @ 12.22 hrs, Volume= 0.133 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 419.00' @ 12.22 hrs Surf.Area= 0.024 ac Storage= 0.049 af
Flood Elev= 419.00' Surf.Area= 0.024 ac Storage= 0.049 af

Plug-Flow detention time= 141.5 min calculated for 0.132 af (84% of inflow)
Center-of-Mass det. time= 75.0 min (814.9 - 739.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	415.50'	0.024 af	**22.50'W x 47.34'L x 3.50'H Field A** 0.086 af Overall - 0.025 af Embedded = 0.060 af x 40.0% Voids
#2A	416.00'	0.025 af	**ADS_StormTech SC-740 +Cap** x 24 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 4 Rows of 6 Chambers
		0.049 af	Total Available Storage

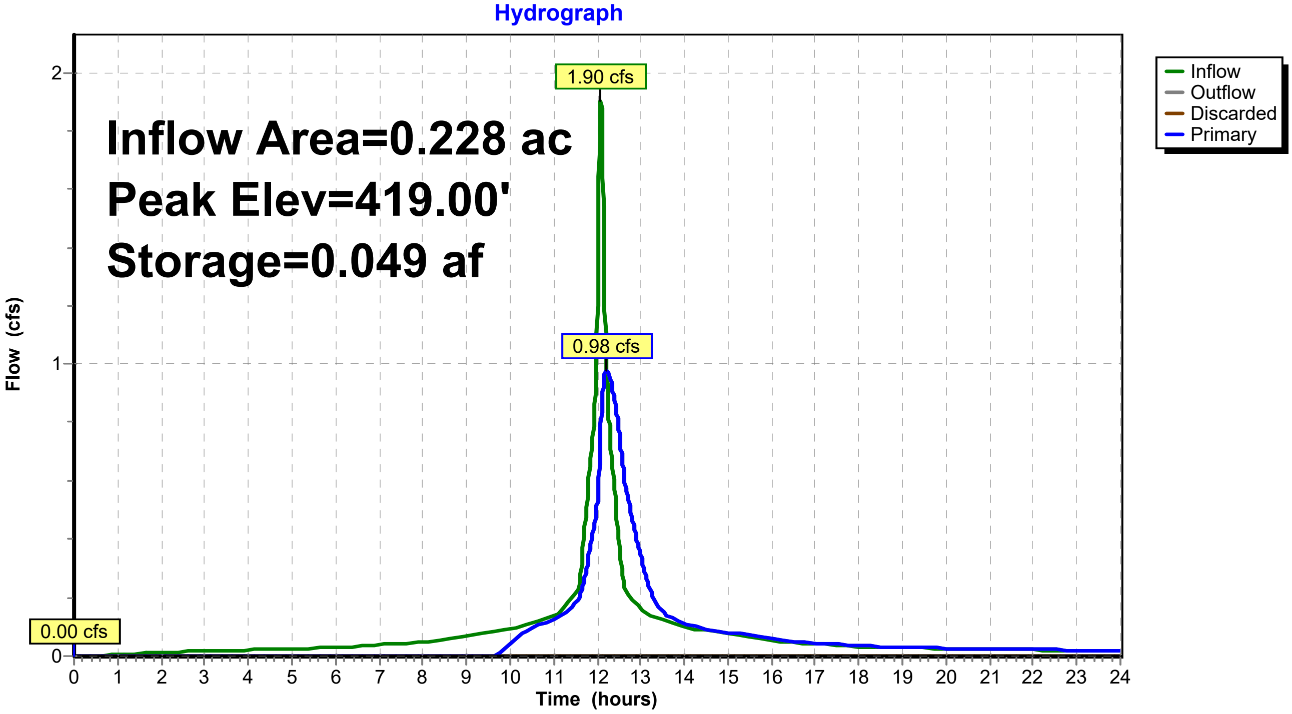
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	415.50'	**0.170 in/hr Exfiltration X 0.00 over Surface area**
#2	Primary	417.00'	**8.0" Round Culvert** L= 72.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 417.00' / 416.28' S= 0.0100 '/' Cc= 0.900 n= 0.011, Flow Area= 0.35 sf
#3	Device 2	417.00'	**5.0" Vert. Orifice/Grate** C= 0.600
#4	Device 2	418.00'	**2.0" Vert. Orifice/Grate** C= 0.600

Discarded OutFlow Max=0.00 cfs @ 0.00 hrs HW=415.50' (Free Discharge)
└─**1=Exfiltration** (Controls 0.00 cfs)

Primary OutFlow Max=0.98 cfs @ 12.22 hrs HW=419.00' TW=0.00' (Dynamic Tailwater)
└─**2=Culvert** (Passes 0.98 cfs of 1.71 cfs potential flow)
  ├─**3=Orifice/Grate** (Orifice Controls 0.88 cfs @ 6.44 fps)
  └─**4=Orifice/Grate** (Orifice Controls 0.10 cfs @ 4.60 fps)

Pond SIB1: Subsurface Infiltration Bed #1



Summary for Subcatchment N1B: Northwest Roof & Parking

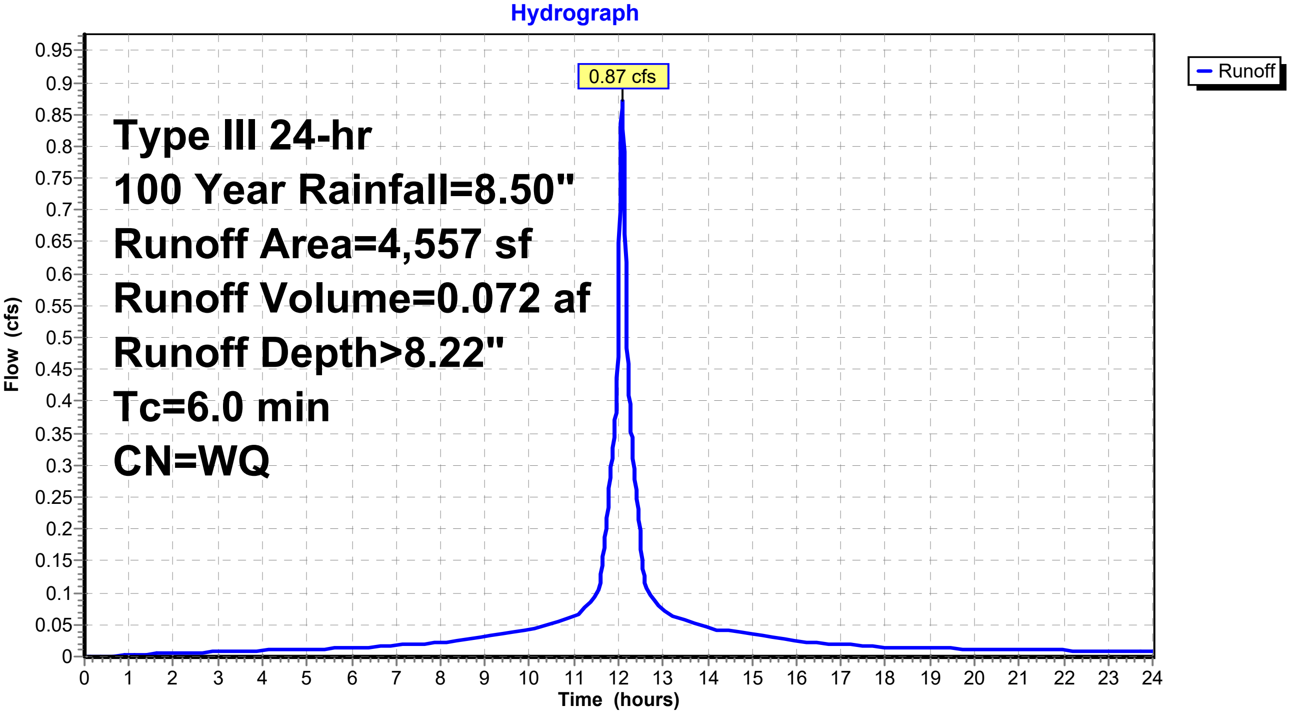
Runoff = 0.87 cfs @ 12.08 hrs, Volume= 0.072 af, Depth> 8.22"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Year Rainfall=8.50"

Area (sf)	CN	Description
72	80	>75% Grass cover, Good, HSG D
4,485	98	Unconnected pavement, HSG D
4,557		Weighted Average
72		1.58% Pervious Area
4,485		98.42% Impervious Area
4,485		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct Entry (Tc<6 mins.)**

Subcatchment N1B: Northwest Roof & Parking



Summary for Pond SDB1: Subsurface Detention Bed #1

Inflow Area = 0.105 ac, 98.42% Impervious, Inflow Depth > 8.22" for 100 Year event
Inflow = 0.87 cfs @ 12.08 hrs, Volume= 0.072 af
Outflow = 0.18 cfs @ 12.50 hrs, Volume= 0.071 af, Atten= 79%, Lag= 24.7 min
Primary = 0.18 cfs @ 12.50 hrs, Volume= 0.071 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 417.17' @ 12.50 hrs Surf.Area= 0.012 ac Storage= 0.021 af
Flood Elev= 418.05' Surf.Area= 0.012 ac Storage= 0.026 af

Plug-Flow detention time= 47.6 min calculated for 0.071 af (99% of inflow)
Center-of-Mass det. time= 44.2 min (784.8 - 740.6)

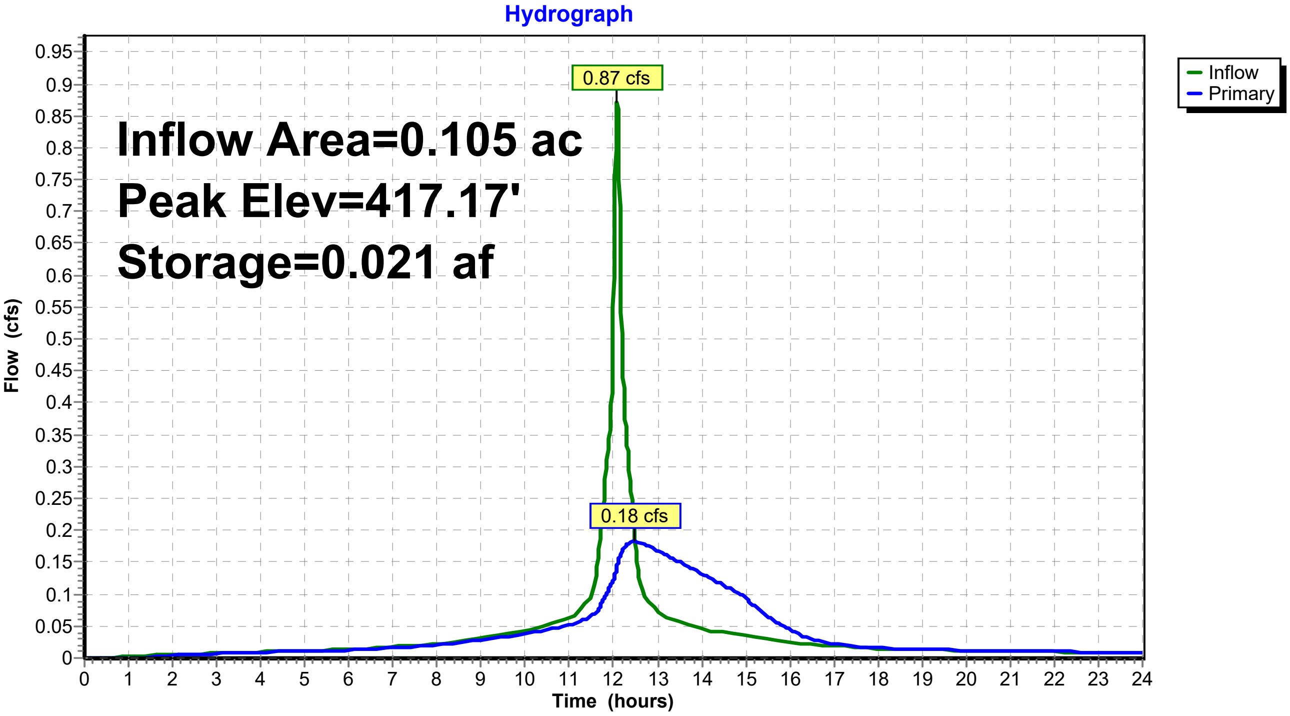
Volume	Invert	Avail.Storage	Storage Description
#1A	414.05'	0.015 af	**13.00'W x 40.22'L x 4.00'H Field A** 0.048 af Overall - 0.011 af Embedded = 0.037 af x 40.0% Voids
#2A	415.05'	0.011 af	**ADS_StormTech SC-740 +Cap** x 10 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 2 Rows of 5 Chambers
#3	414.06'	0.001 af	**6.0" Round Underdrain Storage** x 3 Inside #1 L= 40.0' 0.001 af Overall - 0.1" Wall Thickness = 0.001 af
		0.026 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	414.05'	**6.0" Round 6" PVC** L= 78.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 414.05' / 413.58' S= 0.0060 '/' Cc= 0.900 n= 0.011, Flow Area= 0.20 sf
#2	Device 1	414.05'	**2.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.18 cfs @ 12.50 hrs HW=417.17' TW=0.00' (Dynamic Tailwater)
└─**1=6" PVC** (Passes 0.18 cfs of 1.14 cfs potential flow)
  └─**2=Orifice/Grate** (Orifice Controls 0.18 cfs @ 8.39 fps)

Pond SDB1: Subsurface Detention Bed #1



Summary for Subcatchment N1C: Northeast Parking & Driveways

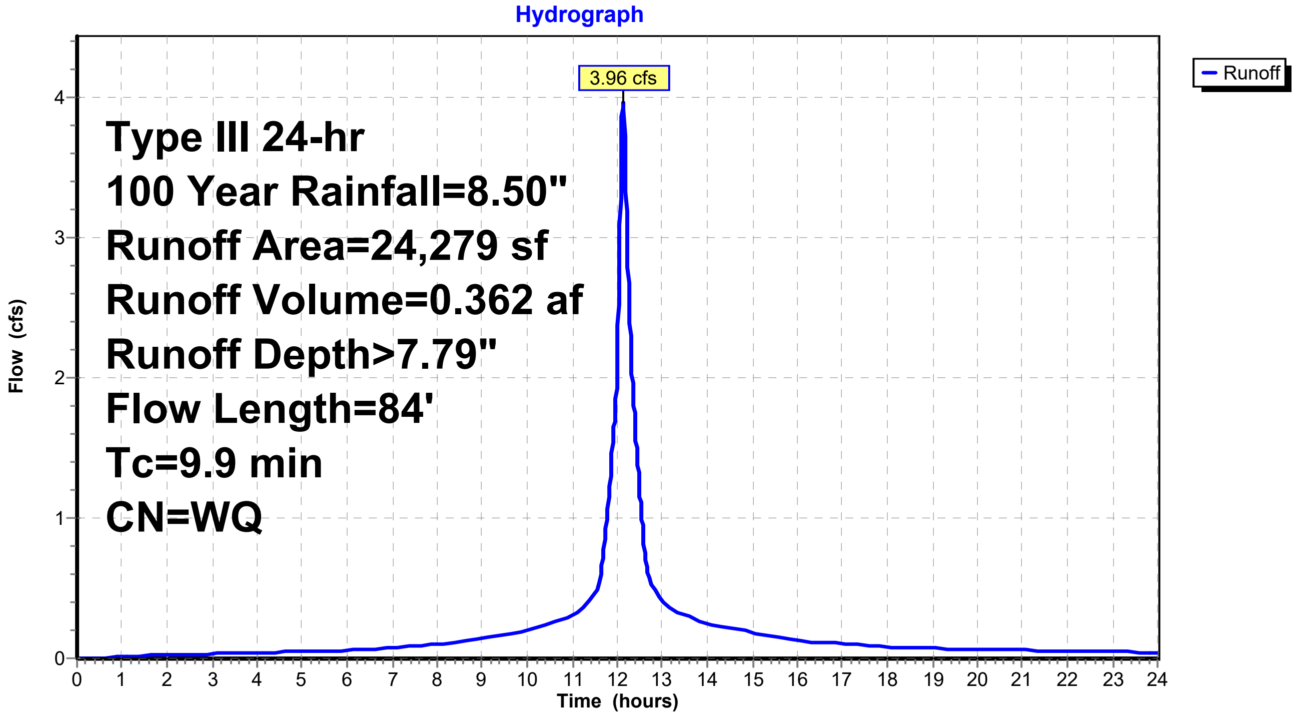
Runoff = 3.96 cfs @ 12.13 hrs, Volume= 0.362 af, Depth> 7.79"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Year Rainfall=8.50"

Area (sf)	CN	Description
5,025	80	>75% Grass cover, Good, HSG D
42	61	>75% Grass cover, Good, HSG B
12,912	98	Unconnected pavement, HSG D
13	98	Unconnected pavement, HSG B
6,287	98	Unconnected roofs, HSG D
24,279		Weighted Average
5,067		20.87% Pervious Area
19,212		79.13% Impervious Area
19,212		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.6	43	0.0100	0.07		**Sheet Flow, A to B** Grass: Dense n= 0.240 P2= 3.20"
0.3	41	0.0146	2.45		**Shallow Concentrated Flow, B to C** Paved Kv= 20.3 fps
9.9	84	Total			

Subcatchment N1C: Northeast Parking & Driveways



Summary for Pond SDB2: Subsurface Detention Bed #2

Inflow Area = 0.557 ac, 79.13% Impervious, Inflow Depth > 7.79" for 100 Year event
Inflow = 3.96 cfs @ 12.13 hrs, Volume= 0.362 af
Outflow = 2.41 cfs @ 12.28 hrs, Volume= 0.360 af, Atten= 39%, Lag= 8.7 min
Primary = 2.41 cfs @ 12.28 hrs, Volume= 0.360 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 414.73' @ 12.28 hrs Surf.Area= 0.034 ac Storage= 0.076 af
Flood Elev= 414.85' Surf.Area= 0.034 ac Storage= 0.077 af

Plug-Flow detention time= 38.1 min calculated for 0.360 af (99% of inflow)
Center-of-Mass det. time= 33.9 min (786.9 - 753.0)

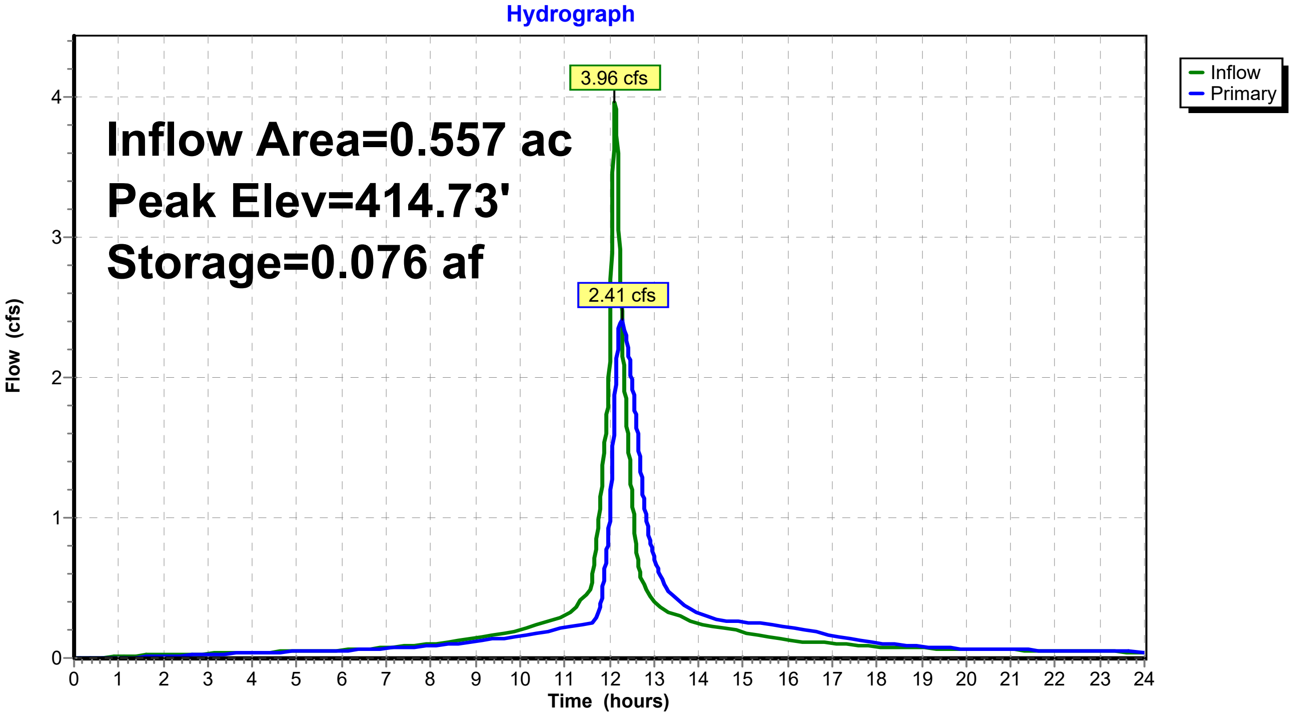
Volume	Invert	Avail.Storage	Storage Description
#1A	410.85'	0.039 af	**36.75'W x 40.22'L x 4.00'H Field A** 0.136 af Overall - 0.038 af Embedded = 0.097 af x 40.0% Voids
#2A	411.85'	0.037 af	**ADS_StormTech SC-740 +Cap** x 35 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 7 Rows of 5 Chambers
#3	410.86'	0.001 af	**6.0" Round Underdrain Storage** x 7 Inside #1 L= 40.0' 0.001 af Overall - 0.1" Wall Thickness = 0.001 af
		0.077 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	410.85'	**12.0" Round Culvert** L= 35.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 410.85' / 410.71' S= 0.0040 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Device 1	410.85'	**3.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	412.20'	**3.0" W x 14.0" H Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=2.41 cfs @ 12.28 hrs HW=414.73' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 2.41 cfs of 6.96 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.46 cfs @ 9.33 fps)
  └─**3=Orifice/Grate** (Orifice Controls 1.95 cfs @ 6.70 fps)

Pond SDB2: Subsurface Detention Bed #2



Summary for Subcatchment N1D: South Apron & Lawns

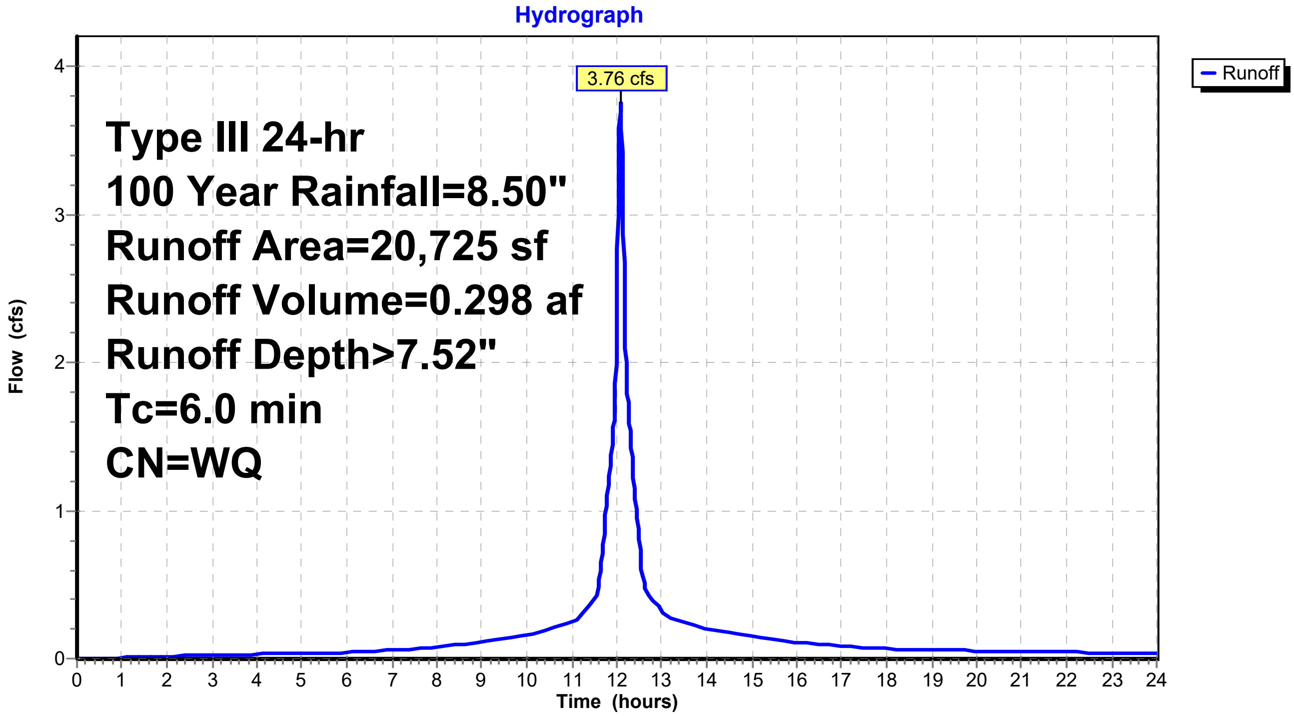
Runoff = 3.76 cfs @ 12.08 hrs, Volume= 0.298 af, Depth> 7.52"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Year Rainfall=8.50"

Area (sf)	CN	Description
7,022	80	>75% Grass cover, Good, HSG D
10,546	98	Unconnected pavement, HSG D
3,157	98	Unconnected roofs, HSG D
20,725		Weighted Average
7,022		33.88% Pervious Area
13,703		66.12% Impervious Area
13,703		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct Entry (Tc<6 mins.)**

Subcatchment N1D: South Apron & Lawns



Summary for Pond SDB3: Subsurface Detention Bed #3

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Inflow Area =        0.476 ac,  66.12% Impervious,  Inflow Depth >   7.52"    for  100 Year event
Inflow      =       3.76 cfs @   12.08 hrs,  Volume=          0.298 af
Outflow     =       0.60 cfs @   12.56 hrs,  Volume=          0.296 af,  Atten= 84%,  Lag= 28.3 min
Primary     =       0.60 cfs @   12.56 hrs,  Volume=          0.296 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 416.77' @ 12.56 hrs   Surf.Area= 0.052 ac   Storage= 0.119 af
Flood Elev= 416.80'   Surf.Area= 0.052 ac   Storage= 0.120 af

Plug-Flow detention time= 123.9 min calculated for 0.296 af (99% of inflow)
Center-of-Mass det. time= 118.1 min ( 874.5 - 756.4 )

Volume        Invert    Avail.Storage   Storage Description
   #1A       412.80'         0.058 af   41.50'W x 54.46'L x 4.00'H Field A
                                        0.208 af Overall - 0.061 af Embedded = 0.146 af  x 40.0% Voids
   #2A       413.80'         0.059 af   ADS_StormTech SC-740 +Cap x 56  Inside #1
                                        Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
                                        Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap
                                        8 Rows of 7 Chambers
   #3        412.81'         0.002 af   6.0"  Round Underdrain Storage x 9  Inside #1
                                        L= 55.0'
                                        0.002 af Overall - 0.1" Wall Thickness = 0.002 af
                             0.120 af   Total Available Storage

   Storage Group A created with Chamber Wizard

Device   Routing          Invert   Outlet Devices
   #1    Primary         412.35'   12.0"  Round Culvert
                                   L= 3.0'   CPP, end-section conforming to fill,  Ke= 0.500
                                   Inlet / Outlet Invert= 412.35' / 412.25'   S= 0.0333 '/'   Cc= 0.900
                                   n= 0.012,  Flow Area= 0.79 sf
   #2    Device 1        412.80'   2.0" Vert. Orifice/Grate X 2.00   C= 0.600
   #3    Device 1        415.75'   2.0" W x 3.0" H Vert. Orifice/Grate   C= 0.600

Primary OutFlow  Max=0.60 cfs @ 12.56 hrs  HW=416.77'  TW=0.00'   (Dynamic Tailwater)
└─1=Culvert  (Passes 0.60 cfs of 7.49 cfs potential flow)
   ├─2=Orifice/Grate  (Orifice Controls 0.41 cfs @ 9.50 fps)
   └─3=Orifice/Grate  (Orifice Controls 0.19 cfs @ 4.56 fps)
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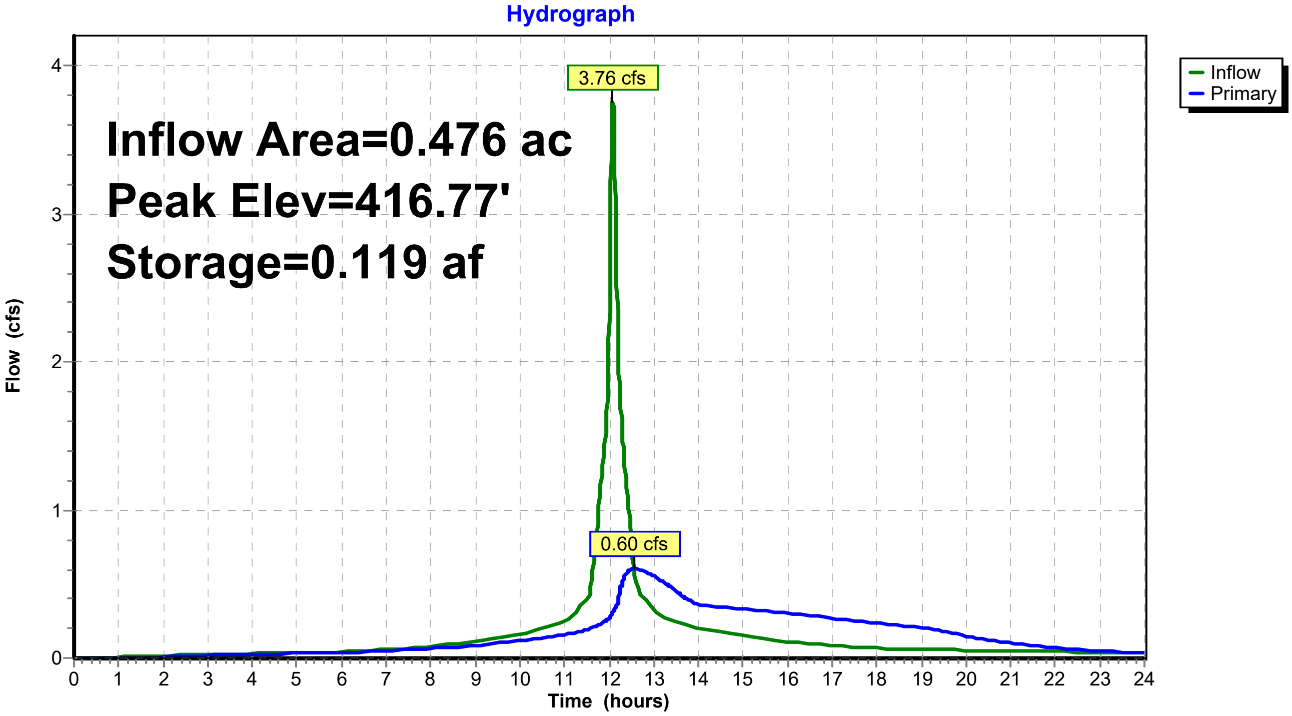
Pond SDB3: Subsurface Detention Bed #3



Summary for Subcatchment N1A: Elm Street Sidewalk/Apron

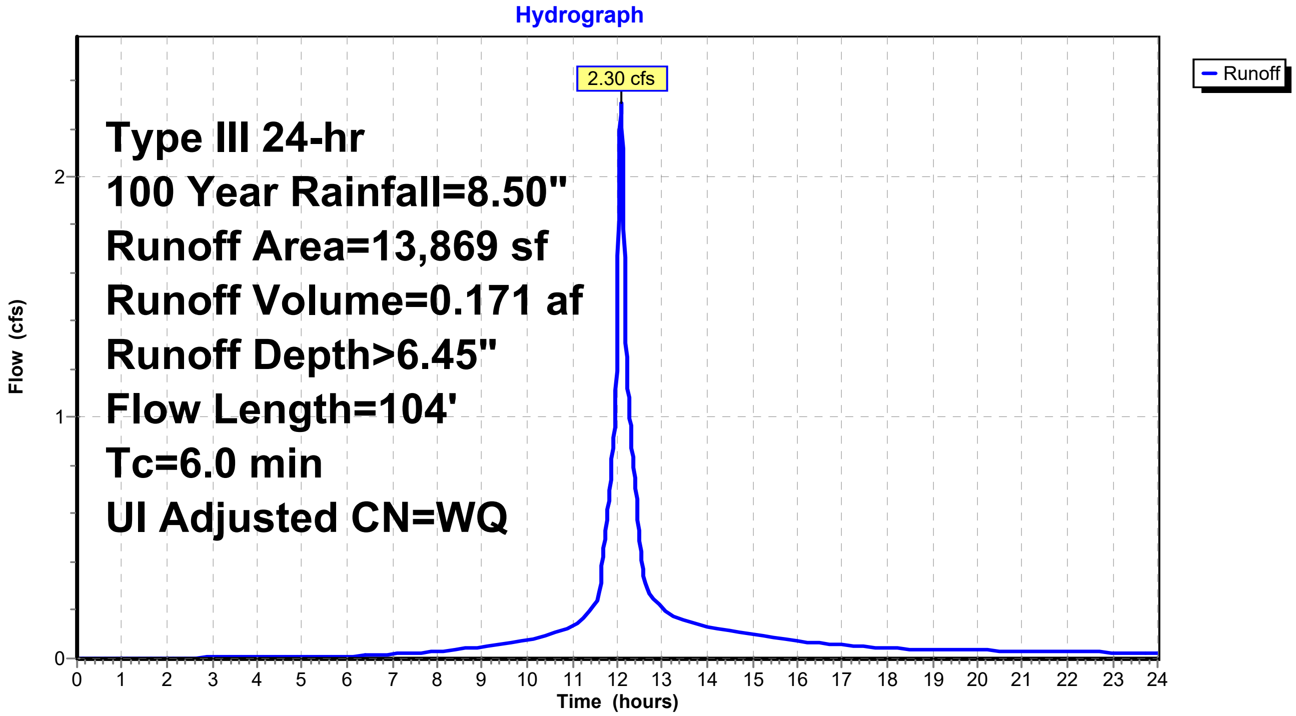
Runoff = 2.30 cfs @ 12.09 hrs, Volume= 0.171 af, Depth> 6.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Year Rainfall=8.50"

Area (sf)	CN	Adj	Description
11,538	80	80	>75% Grass cover, Good, HSG D
2,331	98	98	Unconnected pavement, HSG D
13,869			Weighted Average
11,538			83.19% Pervious Area
2,331			16.81% Impervious Area
2,331			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.5	50	0.0920	0.19		**Sheet Flow, A to B** Grass: Dense n= 0.240 P2= 3.20"
0.2	54	0.1230	5.65		**Shallow Concentrated Flow, B to C** Unpaved Kv= 16.1 fps
4.7	104	Total, Increased to minimum Tc = 6.0 min			

Subcatchment N1A: Elm Street Sidewalk/Apron



Summary for Subcatchment N1E: Lawn Area

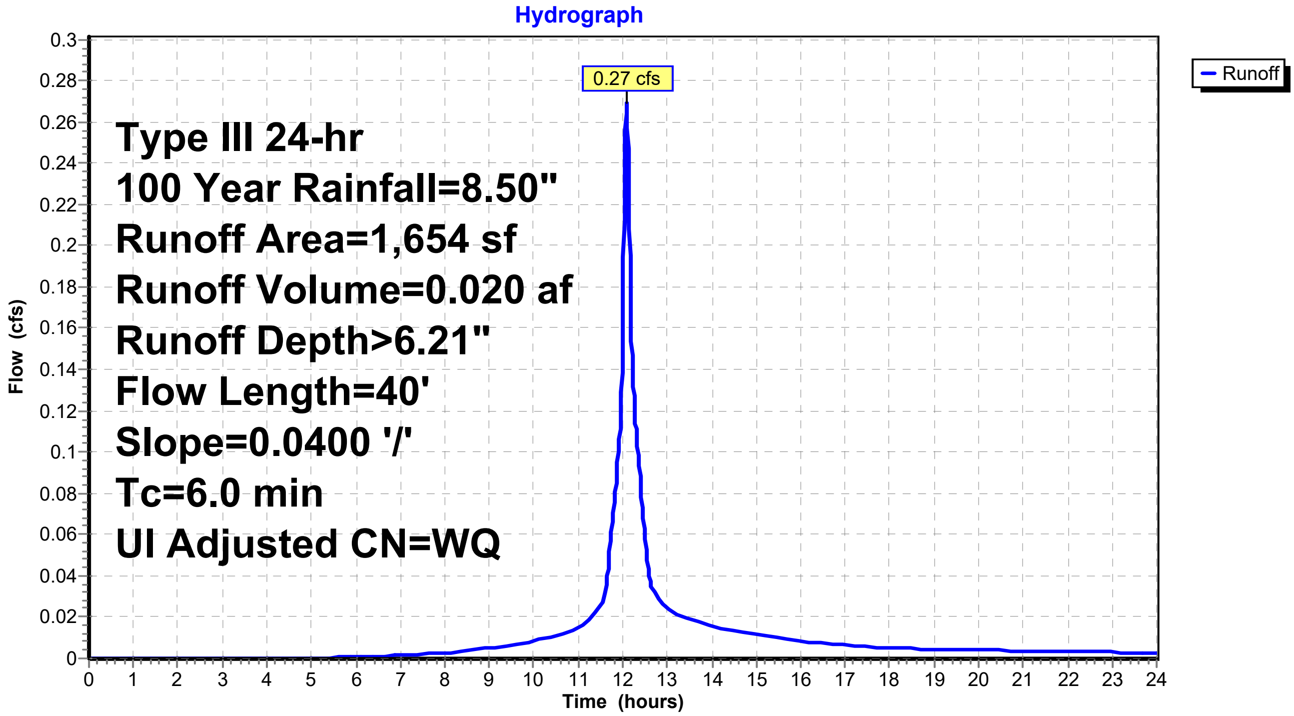
Runoff = 0.27 cfs @ 12.09 hrs, Volume= 0.020 af, Depth> 6.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Year Rainfall=8.50"

Area (sf)	CN	Adj	Description
1,563	80	80	>75% Grass cover, Good, HSG D
91	98	98	Unconnected pavement, HSG D
1,654			Weighted Average
1,563			94.50% Pervious Area
91			5.50% Impervious Area
91			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.2	40	0.0400	0.13		**Sheet Flow, A to B** Grass: Dense n= 0.240 P2= 3.20"
5.2	40	Total, Increased to minimum Tc = 6.0 min			

Subcatchment N1E: Lawn Area

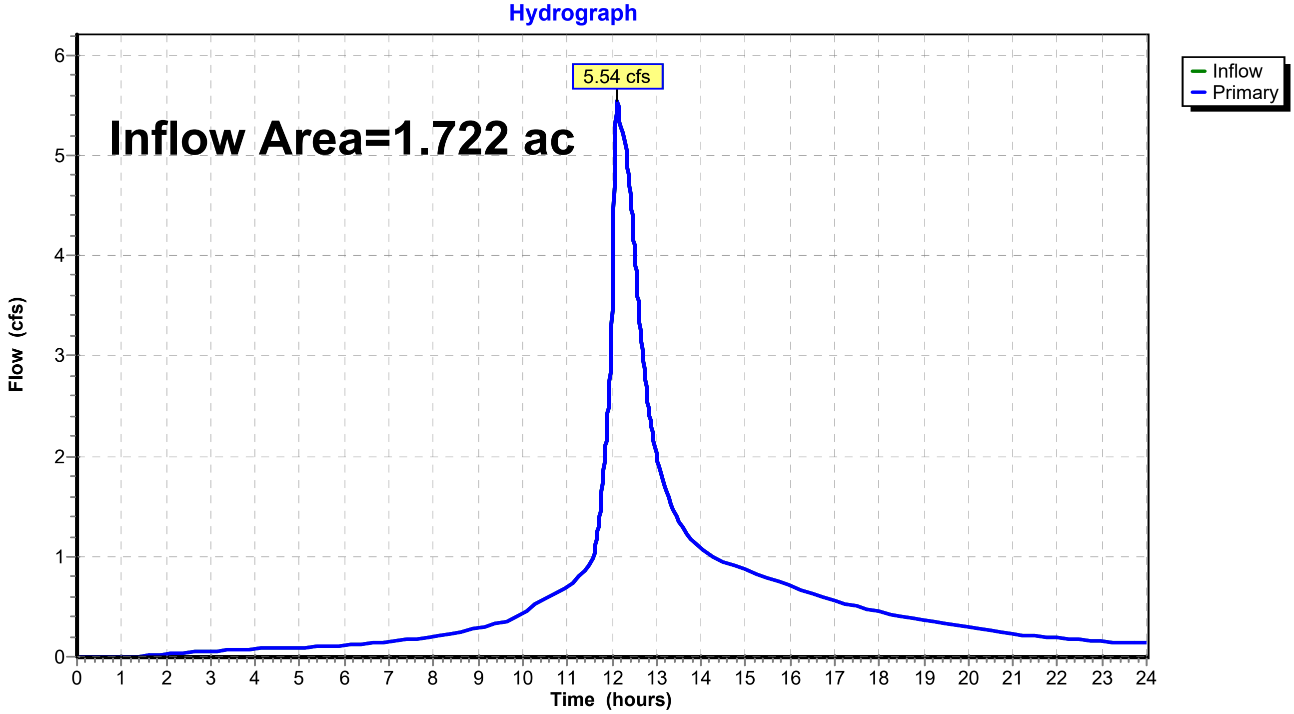


Summary for Link DP1: Design Point #1

Inflow Area =	1.722 ac,	66.32% Impervious,	Inflow Depth > 7.32"	for 100 Year event	
Inflow =	5.54 cfs @	12.12 hrs,	Volume=	1.050 af	
Primary =	5.54 cfs @	12.12 hrs,	Volume=	1.050 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Link DP1: Design Point #1



Summary for Subcatchment N2: East to Waters Street

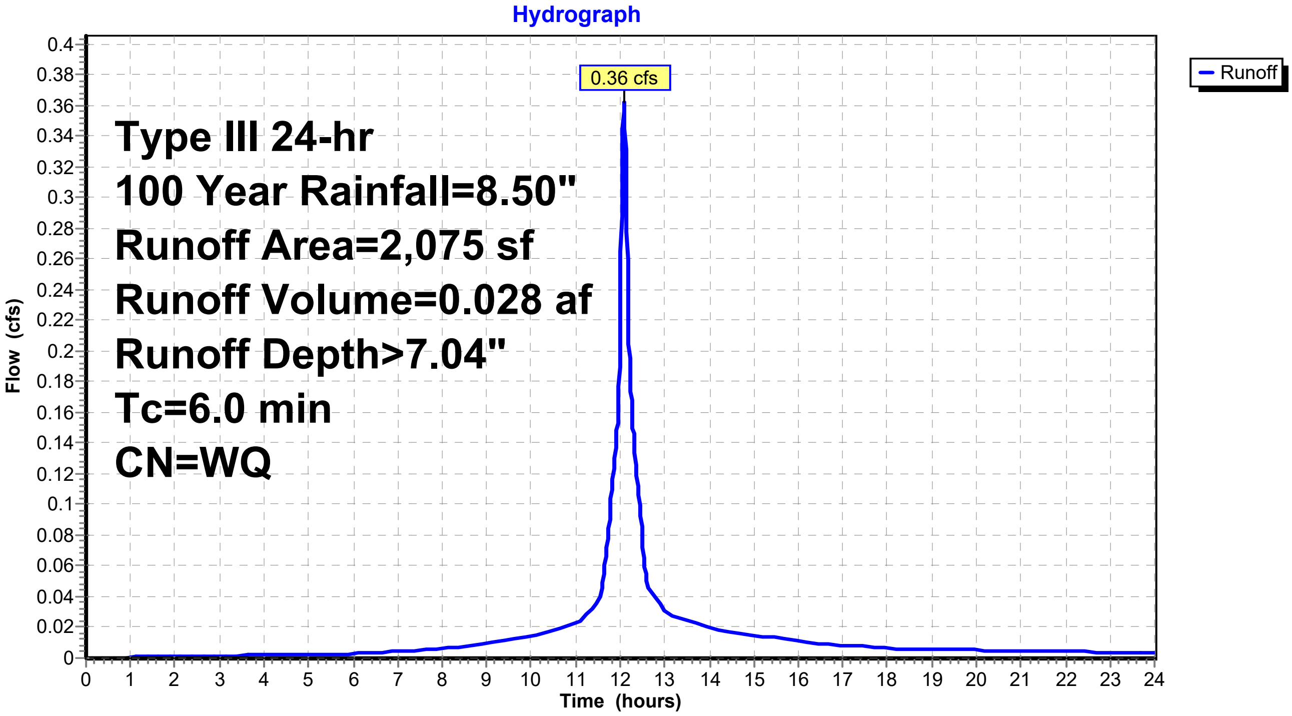
Runoff = 0.36 cfs @ 12.08 hrs, Volume= 0.028 af, Depth> 7.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Year Rainfall=8.50"

Area (sf)	CN	Description
1,168	80	>75% Grass cover, Good, HSG D
907	98	Unconnected pavement, HSG D
2,075		Weighted Average
1,168		56.29% Pervious Area
907		43.71% Impervious Area
907		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct Entry (Tc<6 mins.)**

Subcatchment N2: East to Waters Street



Summary for Subcatchment N3: North to Abutter

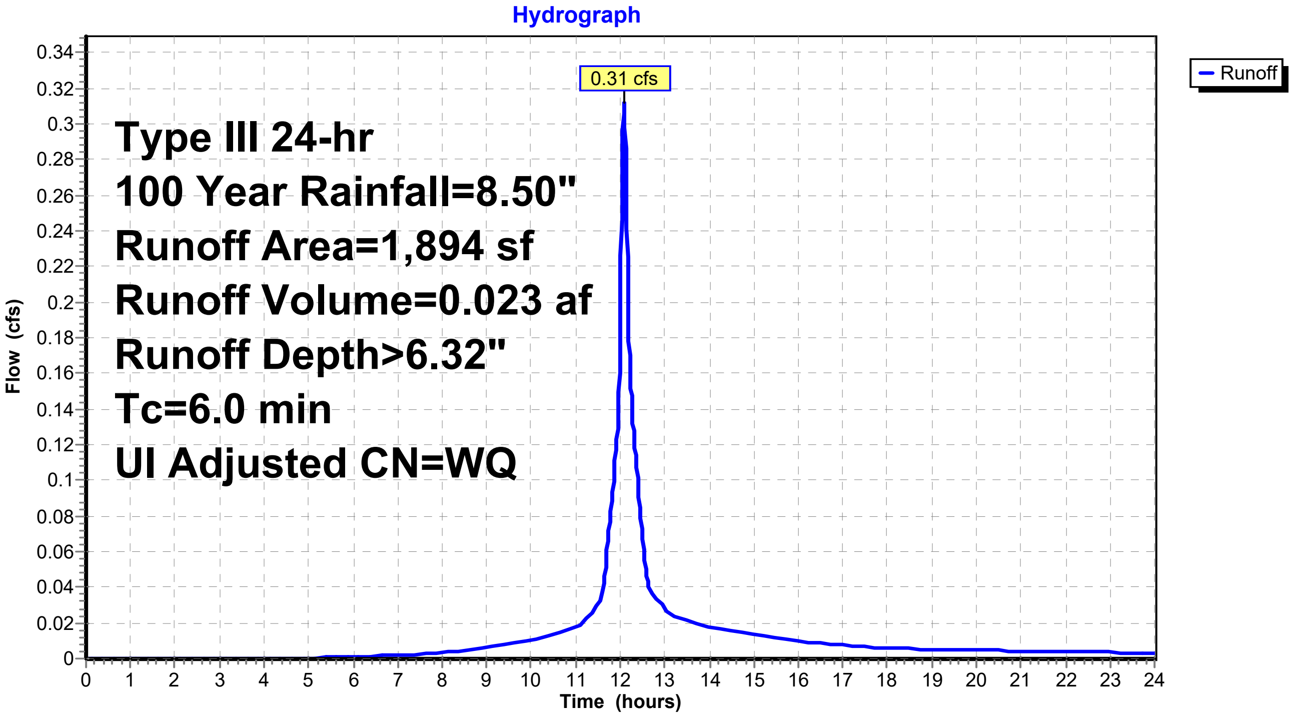
Runoff = 0.31 cfs @ 12.09 hrs, Volume= 0.023 af, Depth> 6.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Year Rainfall=8.50"

Area (sf)	CN	Adj	Description
1,634	80	80	>75% Grass cover, Good, HSG D
113	98	98	Unconnected pavement, HSG D
147	91	91	Gravel roads, HSG D
1,894			Weighted Average
1,781			94.03% Pervious Area
113			5.97% Impervious Area
113			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct Entry (Tc<6 mins.)**

Subcatchment N3: North to Abutter



Summary for Subcatchment N4: Northwest to Abutters

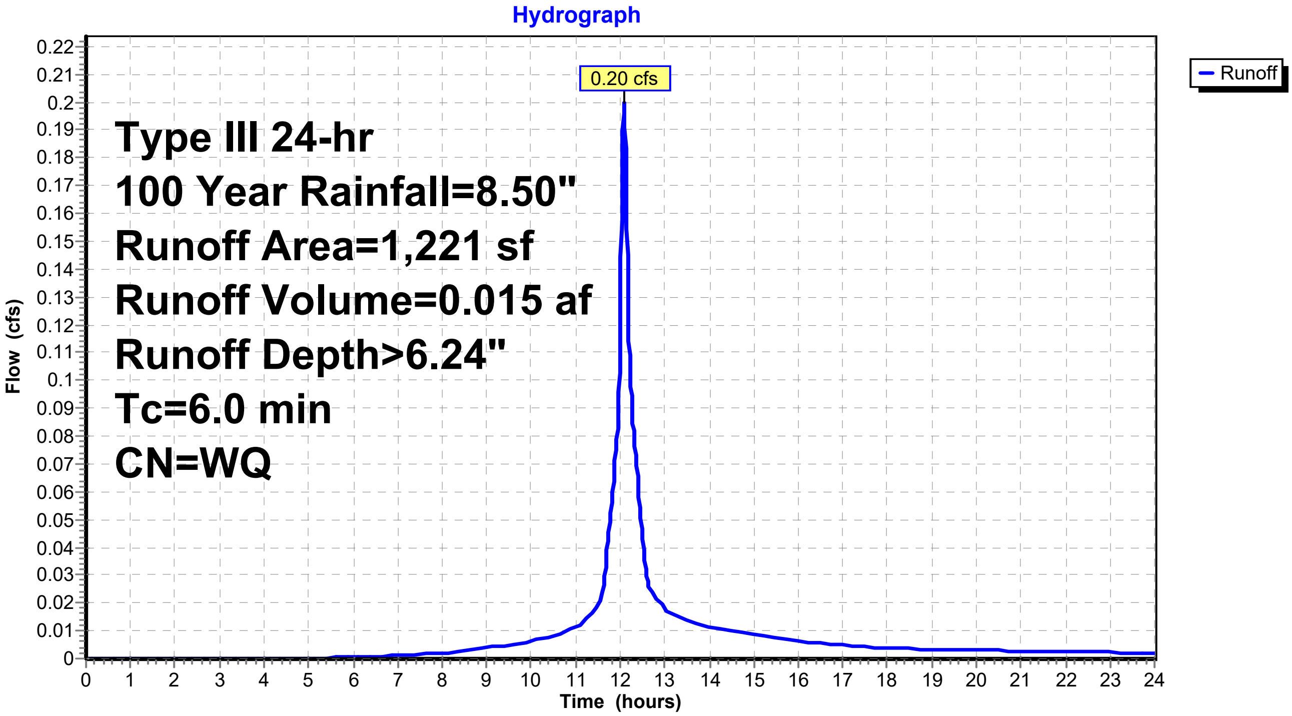
Runoff = 0.20 cfs @ 12.09 hrs, Volume= 0.015 af, Depth> 6.24"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Year Rainfall=8.50"

Area (sf)	CN	Description
1,092	80	>75% Grass cover, Good, HSG D
22	98	Unconnected pavement, HSG D
107	91	Gravel roads, HSG D
1,221		Weighted Average
1,199		98.20% Pervious Area
22		1.80% Impervious Area
22		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct Entry (Tc<6 mins.)**

Subcatchment N4: Northwest to Abutters



GARCIA • GALUSKA • DESOUSA
Consulting Engineers Inc.

Project: Millbury Fire Station
Location: Millbury, MA

Drainage Calculations
Closed Pipe Drainage System

Closed pipe system calculations are provided for the 25-yr storm event.

Calculation of Equivalent Area
Project: Millbury Fire Station
Location: Millbury, MA
Calc. By: NCK Date: 03/01/2021
Chk. By: CMG Date: 03/01/2021

Garcia-Galuska-DeSousa
370 Faunce Corner Road
Dartmouth, MA 02747
Tel.: (508)998-5700

Sub Area Number	**Structure Number**	**Area (Ac.)**				**Equiv. Area (C x A)**				**Tot.Area**
		Impervious	Woods	Grass	Gravel	Impervious	Wood	Grass	Gravel	Σ(CxA)
1	CB#1	5,042	0	107	39	0.104	0.000	0.001	0.001	0.106
2	CB#2	4,756	0	1,646	0	0.098	0.000	0.015	0.000	0.113
4	CB#3	7,937	0	1,593	0	0.164	0.000	0.015	0.000	0.179
5	TD#1	10,439	0	6,916	0	0.216	0.000	0.064	0.000	0.279
6	IT#1	0	0	782	196	0.000	0.000	0.007	0.003	0.010
7	XCB#1	16,453	0	4,297	0	0.340	0.000	0.039	0.000	0.379
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23										
24										
25										
26										

Calculation of Equivalent Area

Project: Millbury Fire Station

Location: Millbury, MA

Calc. By: NCK Date: 03/01/2021

Chk. By: CMG Date: 03/01/2021

Garcia-Galuska-DeSousa

370 Faunce Corner Road

Dartmouth, MA 02747

Tel.: (508)998-5700

Sub Area	**Structure**	**Area (SF)**				**Equiv. Area (C x A)**				**Tot.Area**
Number	**Number**	Impervious	Woods	Grass	Gravel	Impervious	Wood	Grass	Gravel	Σ(CxA)
1	DS#1	459	0	0	0	0.009	0.000	0.000	0.000	0.009
2	DS#2	140	0	0	0	0.003	0.000	0.000	0.000	0.003
4	DS#3	256	0	0	0	0.005	0.000	0.000	0.000	0.005
5	DS#4	782	0	0	0	0.016	0.000	0.000	0.000	0.016
6	DS#5	788	0	0	0	0.016	0.000	0.000	0.000	0.016
7	DS#6	1,148	0	0	0	0.024	0.000	0.000	0.000	0.024
8	DS#7	3,305	0	0	0	0.068	0.000	0.000	0.000	0.068
9	DS#8	45	0	0	0	0.001	0.000	0.000	0.000	0.001
10	DS#9	45	0	0	0	0.001	0.000	0.000	0.000	0.001
11	DS#10	520	0	0	0	0.011	0.000	0.000	0.000	0.011
12	DS#11	1,180	0	0	0	0.024	0.000	0.000	0.000	0.024
13	DS#12	193	0	0	0	0.004	0.000	0.000	0.000	0.004
14	DS#13	698	0	0	0	0.014	0.000	0.000	0.000	0.014
15	DS#14	1,088	0	0	0	0.022	0.000	0.000	0.000	0.022
16	DS#15	1,376	0	0	0	0.028	0.000	0.000	0.000	0.028
17	RD#1	7,699	0	0	0	0.159	0.000	0.000	0.000	0.159
18										
19										
20										
21										
22										
23										
24										
25										
26										

Hydraulic Design
Project: Millbury Fire Station
Location: Millbury, MA
Calc. By: NCK Date: 03/01/2021
Chk. By: CMG Date: 03/01/2021

Garcia-Galuska-DeSousa
375 Faunce Corner Road - Suite D
Dartmouth, MA 02747
Tel.: (508)998-5700
1 of 2

Storm Freq.= 25 Year **Curve: USDA** **Method = Rational**

Location	**Struct. No.**		**Equiv. Ac.**		**T.O.C.**	**I**	**Q**	**Length**	**Slope**	**Dia.**	**Q_{full}**	**V_{full}**	**T_c**
	From	To	Add	Total	(min.)	(in/hr)	(cfs)	(ft.)	(ft./ft.)	(in.)	(cfs)	(ft./sec)	(min.)
	DS#15	DS#1		0.028	6.0	6.8	**0.19**	45	0.023	6	**1.00**	5.12	0.1
	DS#1	SIB#1	0.009	0.038	6.1	6.8	**0.26**	37	0.023	6	**1.00**	5.12	0.1
Pipe Run End													
	RD#1	DS#3		0.159	6.0	6.8	**1.08**	13	0.015	8	**1.75**	5.01	0.0
	DS#3	RD#1		0.005	6.0	6.8	**0.04**	14	0.01	6	**0.66**	3.37	0.1
	RD#1	DS#2		0.164	6.0	6.8	**1.12**	2	0.015	8	**1.75**	5.01	0.0
	DS#2	RD#1		0.003	6.0	6.8	**0.02**	20	0.01	6	**0.66**	3.37	0.1
	RD#1	SIB#1		0.167	6.1	6.8	**1.14**	1	0.015	8	**1.75**	5.01	0.0
Pipe Run End													
	CB#1	WQS#1		0.106	6.0	6.8	**0.72**	7	0.01	12	**3.86**	4.91	0.0
	WQS#1	SDB#1		0.106	6.1	6.8	**0.72**	6	0.01	12	**3.86**	4.91	0.0
Pipe Run End													
	CB#2	WQS#2		0.113	6.0	6.8	**0.77**	8	0.010	12	**3.86**	4.91	0.0
	CB#3	WQS#2		0.179	6.0	6.8	**1.21**	55	0.010	12	**3.86**	4.91	0.2
	WQS#2	SDB#2	0.113	0.292	6.2	6.7	**1.96**	6	0.010	12	**3.86**	4.91	0.0
	DS#4-#10	SDB#2		0.137	6.0	6.8	**0.93**	8	0.042	8	**2.92**	8.38	0.0
Pipe Run End													
	TD#1	WQS#3		0.279	6.0	6.8	**1.90**	15	0.03	8	**2.47**	7.08	0.0
	WQS#3	SDB#3		0.279	6.0	6.8	**1.90**	10	0.01	12	**3.86**	4.91	0.0
Pipe Run End													
	IT#1	DS#14		0.010	6.0	6.8	**0.07**	95	0.015	6	**0.81**	4.13	0.4
	DS#12-14	SDB#3		0.051	6.4	6.8	**0.35**	101	0.015	8	**1.75**	5.01	0.3
Pipe Run End													
	DS#11	SDB#3		0.024	6.0	6.8	**0.17**	34	0.055	6	**1.55**	7.91	0.1
Pipe Run End													

n-values: PVC= 0.011 HDPE= 0.012 RCP= 0.013

Hydraulic Design
Project: Millbury Fire Station
Location: Millbury, MA
Calc. By: NCK Date: 03/01/2021
Chk. By: CMG Date: 03/01/2021

Garcia-Galuska-DeSousa
375 Faunce Corner Road - Suite D
Dartmouth, MA 02747
Tel.: (508)998-5700

2 of 2

Storm Freq.= 25 Year **Curve: USDA** **Method = Rational**

Location	**Struct. No.**		**Equiv. Ac.**		**T.O.C.**	**I**	**Q**	**Length**	**Slope**	**Dia.**	**Q_{full}**	**V_{full}**	**T_c**
	From	To	Add	Total	(min.)	(in/hr)	(cfs)	(ft.)	(ft./ft.)	(in.)	(cfs)	(ft./sec)	(min.)
	SDB#1	DMH#1		0.106	38.9	2.9	**0.31**	78	0.006	6	**0.51**	2.61	0.5
	SIB#1	DMH#1		0.205	15.5	4.6	**0.94**	72	0.01	8	**1.43**	4.09	0.3
	DMH#1	DMH#2		0.311	39.4	2.9	**0.90**	82	0.004	12	**2.44**	3.11	0.4
	SDB#2	DMH#2		0.429	35.5	3.0	**1.29**	34	0.004	12	**2.44**	3.11	0.2
	DMH#2	DMH#3		0.740	39.8	2.9	**2.15**	66	0.004	12	**2.44**	3.11	0.4
	DMH#3	DMH#4		0.740	40.2	2.9	**2.15**	84	0.004	12	**2.44**	3.11	0.5
	SDB#3	DMH#4		0.354	104.7	1.5	**0.53**	3	0.033	12	**7.00**	8.92	0.0
	DMH#4	XCB#1		1.094	104.7	1.5	**1.64**	171	0.004	12	**2.44**	3.11	0.9
	XCB#1	XCB#2	0.379	1.474	105.5	1.5	**2.21**	50	0.005	12	**2.52**	3.21	0.3
Pipe Run End													

n-values: PVC= 0.011 HDPE= 0.012 RCP= 0.013

Project: Millbury Fire Station
Location: Millbury, MA

Groundwater Recharge

GARCIA GALUSKA DESOUSA
Consulting Engineers
375 Faunce Corner Road - Suite D, Dartmouth, MA 02747
508-998-5700 FAX 508-998-0883 e-mail: info@g-g-d.com

Recharge Requirement Worksheet

Project:	Millbury Fire Station	Project Loc.:	Millbury, MA
Architect:	Context Architecture	Project No.:	640 053 00.00
Date:	3/1/2021		Sht. No. 1 of 1
By: NCK	Chk. By: CMG		

Proposed Developed Site (For New Construction)

A	B	C	D
Soil Type	Impervious Area (ft^2)	Recharge Factor (Inches)	Recharge Volume Required (ft^3)
HSG 'D'	50,709	0.10"	423
		Recharge Volume Required=	423

Existing Developed Site (For Redevelopment Projects)

A	B	C	D
Soil Type	Impervious Area (ft^2)	Recharge Factor (Inches)	Recharge Volume Required (ft^3)
HSG 'D'	32,247	0.10"	269
		Recharge Volume Required=	269

Redevelopment Area Volume (For Redevelopment)

A	B	C	D
		Required for New Development	423
		Existing Deloped Site	269
		Recharge Volume Required=	154

Recharge Provided (Based on Annual Storm - 2.66")

A	B	C
Infiltration Structure	Volume Storage (ft^3)	Annual Vol. Contributed (ft^3)
SIB#1	1,001	1,001
	Recharge Volume Provided=	1,001

Project: Millbury Fire Station
Location: Millbury, MA

Drawdown Calculations

GARCIA GALUSKA DESOUSA
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375 Faunce Corner Road - Suite D, Dartmouth, MA 02747
508-998-5700 FAX 508-998-0883 e-mail: info@g-g-d.com

Recharge Facilities Drawdown Calculation

Project: Millbury Fire Station
Project Loc.: Millbury, MA
Architect: Context Architecture
Project No.: 640 053 00.00
Date: 3/1/2021
Sht. No. 1 of 1
By: NCK
Chk. By: CMG

Subsurface Infiltration Bed - SIB #1				
A	B	C	D	
Storage Volume (ft^3)	Bottom Area (ft^2) (LxW)	Infiltration Rate (Inches/Hour)	Drawdown Time (Hrs) (A / (B x (C / 12)))	
1,001	1,044	0.17	67.68	< 72 hrs. **OK**

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Consulting Engineers Inc.

Project: Millbury Fire Station
Location: Millbury, MA

TSS Removal Worksheet

GARCIA GALUSKA DESOUSA
Consulting Engineers
370 Faunce Corner Road, Dartmouth, MA 02747-1217
508-998-5700 FAX 508-998-0883 e-mail: info@g-g-d.com

TSS Removal Worksheet

Project:	Millbury Fire Station	Project Loc.:	Millbury, MA
Architect:	Context Architecture	Project No.:	640 053 00.00
Date:	1/25/2021		Sht. No. 1 of 1
By: NCK	Chk. By: CMG		

All Parking Areas

A	B	C	D	E
BMP	TSS Removal Rate	Starting TSS	Amount Removed (BxC)	Remaing Load (C-D)
DSCB	0.25	1.00	0.25	0.75
STC	0.75	0.75	0.56	0.19
		0.19	0.00	0.19
		0.19	0.00	0.19
		0.19	0.00	0.19
			Total TSS Removal=	0.81

Legend:

SW=sweeping; DSCB=deep sump catch basin; DW=drywell; IT=infiltration trench; IB=infiltration basin; WQS=water quality swale; WQI=water quality inlet; EDP=extended detention pond; RB=retention basin; CW=constructed wetland; SF=sediment forebay; DC=drainage channel; DP=Detention Pond; BIO=bioretention cell; STC = Stormceptor; POR = Porous Pavement

GARCIA • GALUSKA • DESOUSA
Consulting Engineers Inc.

Project: Millbury Fire Station
Location: Millbury, MA

Stormwater Quality
Structure Sizing Worksheet

GARCIA GALUSKA DESOUSA
Consulting Engineers
370 Faunce Corner Road, Dartmouth, MA 02747-1217
508-998-5700 FAX 508-998-0883 e-mail: info@g-g-d.com

Water Quality Structure Worksheet

Project:	Millbury Fire Station	Project Loc.:	Millbury, MA
Architect:	Context Architecture	Project No.:	640 053 00.00
Date:	1/25/2021		Sht. No. 1 of 1
By: NCK	Chk. By: CMG		

A	B	C	D	E
Structure	Contrb. Impervious Area (acres)	Water Quality Volume (ft^3)	Water Quality Volume (gal.)	$Q_{First\ Flush}$ (ft^3/s)
WQS#1	0.12	435.6	3258.3	0.11
WQS#2	0.29	1052.7	7874.2	0.28
WQS#3	0.24	867.6	6489.4	0.23

V=(43,560 ft^2/acre)(Contributing Impervious Area)(1 in.)(1 ft./12 in.)
Q=(c)(i)(A) = (0.95)(1")(Contributing Impervious Area)

Brief Stormceptor Sizing Report - WQS#1

Project Information & Location			
Project Name	Millbury Fire Station	**Project Number**	640 053
City	Millbury	**State/ Province**	Massachusetts
Country	United States of America	**Date**	1/25/2021
Designer Information		**EOR Information (optional)**	
Name	Nathan Ketchel	**Name**	
Company	Garcia, Galuska, DeSousa, Inc.	**Company**	
Phone #	508-998-5700	**Phone #**	
Email	nathan_ketchel@g-g-d.com	**Email**	

Stormwater Treatment Recommendation

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

Site Name	WQS#1
Target TSS Removal (%)	75
TSS Removal (%) Provided	93
Recommended Stormceptor Model	STC 450i

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

Stormceptor Sizing Summary	
Stormceptor Model	**% TSS Removal Provided**
STC 450i	93
STC 900	96
STC 1200	96
STC 1800	96
STC 2400	97
STC 3600	98
STC 4800	98
STC 6000	98
STC 7200	99
STC 11000	99
STC 13000	99
STC 16000	99

Sizing Details

Drainage Area

Total Area (acres)	0.12
Imperviousness %	97.0

Rainfall

Station Name	WORCESTER WSO AP
State/Province	Massachusetts
Station ID #	9923
Years of Records	58
Latitude	42°16'2"N
Longitude	71°52'34"W

Water Quality Objective

TSS Removal (%)	75.0
Runoff Volume Capture (%)	
Oil Spill Capture Volume (Gal)	
Peak Conveyed Flow Rate (CFS)	1.00
Water Quality Flow Rate (CFS)	0.11

Up Stream Storage

Storage (ac-ft)	Discharge (cfs)
0.000	0.000

Up Stream Flow Diversion

Max. Flow to Stormceptor (cfs)	

Particle Size Distribution (PSD)
The selected PSD defines TSS removal

Fine Distribution

Particle Diameter (microns)	Distribution %	Specific Gravity
20.0	20.0	1.30
60.0	20.0	1.80
150.0	20.0	2.20
400.0	20.0	2.65
2000.0	20.0	2.65

Notes

- Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor, which uses the EPA Rainfall and Runoff modules.
- Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed.
- For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance.

For Stormceptor Specifications and Drawings Please Visit:
https://www.conteches.com/technical-guides/search?filter=1WBC0O5EYX

Brief Stormceptor Sizing Report - WQS#2

Project Information & Location			
Project Name	Millbury Fire Station	**Project Number**	640 053
City	Millbury	**State/ Province**	Massachusetts
Country	United States of America	**Date**	1/25/2021
Designer Information		**EOR Information (optional)**	
Name	Nathan Ketchel	**Name**	
Company	Garcia, Galuska, DeSousa, Inc.	**Company**	
Phone #	508-998-5700	**Phone #**	
Email	nathan_ketchel@g-g-d.com	**Email**	

Stormwater Treatment Recommendation

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

Site Name	WQS#2
Target TSS Removal (%)	80
TSS Removal (%) Provided	93
Recommended Stormceptor Model	STC 450i

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

Stormceptor Sizing Summary	
Stormceptor Model	**% TSS Removal Provided**
STC 450i	93
STC 900	96
STC 1200	96
STC 1800	97
STC 2400	97
STC 3600	98
STC 4800	98
STC 6000	98
STC 7200	99
STC 11000	99
STC 13000	99
STC 16000	99

Sizing Details

Drainage Area

Total Area (acres)	0.15
Imperviousness %	75.0

Rainfall

Station Name	WORCESTER WSO AP
State/Province	Massachusetts
Station ID #	9923
Years of Records	58
Latitude	42°16'2"N
Longitude	71°52'34"W

Water Quality Objective

TSS Removal (%)	80.0
Runoff Volume Capture (%)	
Oil Spill Capture Volume (Gal)	
Peak Conveyed Flow Rate (CFS)	2.63
Water Quality Flow Rate (CFS)	0.28

Up Stream Storage

Storage (ac-ft)	Discharge (cfs)
0.000	0.000

Up Stream Flow Diversion

Max. Flow to Stormceptor (cfs)	

Particle Size Distribution (PSD)
The selected PSD defines TSS removal

Fine Distribution

Particle Diameter (microns)	Distribution %	Specific Gravity
20.0	20.0	1.30
60.0	20.0	1.80
150.0	20.0	2.20
400.0	20.0	2.65
2000.0	20.0	2.65

Notes

- Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor, which uses the EPA Rainfall and Runoff modules.
- Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed.
- For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance.

For Stormceptor Specifications and Drawings Please Visit:
https://www.conteches.com/technical-guides/search?filter=1WBC0O5EYX

Brief Stormceptor Sizing Report - WQS#3

Project Information & Location			
Project Name	Millbury Fire Station	**Project Number**	640 053
City	Millbury	**State/ Province**	Massachusetts
Country	United States of America	**Date**	1/25/2021
Designer Information		**EOR Information (optional)**	
Name	Nathan Ketchel	**Name**	
Company	Garcia, Galuska, DeSousa, Inc.	**Company**	
Phone #	508-998-5700	**Phone #**	
Email	nathan_ketchel@g-g-d.com	**Email**	

Stormwater Treatment Recommendation

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

Site Name	WQS#3
Target TSS Removal (%)	80
TSS Removal (%) Provided	84
Recommended Stormceptor Model	STC 450i

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

Stormceptor Sizing Summary	
Stormceptor Model	**% TSS Removal Provided**
STC 450i	84
STC 900	89
STC 1200	89
STC 1800	90
STC 2400	92
STC 3600	92
STC 4800	94
STC 6000	94
STC 7200	95
STC 11000	97
STC 13000	97
STC 16000	97

Sizing Details

Drainage Area

Total Area (acres)	0.4
Imperviousness %	60.0

Rainfall

Station Name	WORCESTER WSO AP
State/Province	Massachusetts
Station ID #	9923
Years of Records	58
Latitude	42°16'2"N
Longitude	71°52'34"W

Water Quality Objective

TSS Removal (%)	80.0
Runoff Volume Capture (%)	
Oil Spill Capture Volume (Gal)	
Peak Conveyed Flow Rate (CFS)	2.51
Water Quality Flow Rate (CFS)	0.23

Up Stream Storage

Storage (ac-ft)	**Discharge (cfs)**
0.000	0.000

Up Stream Flow Diversion

Max. Flow to Stormceptor (cfs)	

Particle Size Distribution (PSD)
The selected PSD defines TSS removal

Fine Distribution

Particle Diameter (microns)	**Distribution %**	**Specific Gravity**
20.0	20.0	1.30
60.0	20.0	1.80
150.0	20.0	2.20
400.0	20.0	2.65
2000.0	20.0	2.65

Notes

- Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor, which uses the EPA Rainfall and Runoff modules.
- Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed.
- For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance.

For Stormceptor Specifications and Drawings Please Visit:
https://www.conteches.com/technical-guides/search?filter=1WBC0O5EYX

Project: Millbury Fire Station
Location: Millbury, MA

Attached Figures

- Figure 1: Quadrangle Map
- Figure 2: FEMA Flood Insurance Rate Map
- Figure 3: Water Supply Protection Areas Map
- Figure 4: Natural Resources Conservation Service Soil Map

Figure 1

USGS Topographic Map

Worcester South Quad 1983

Millbury, Massachusetts

Source: MassGIS Oliver

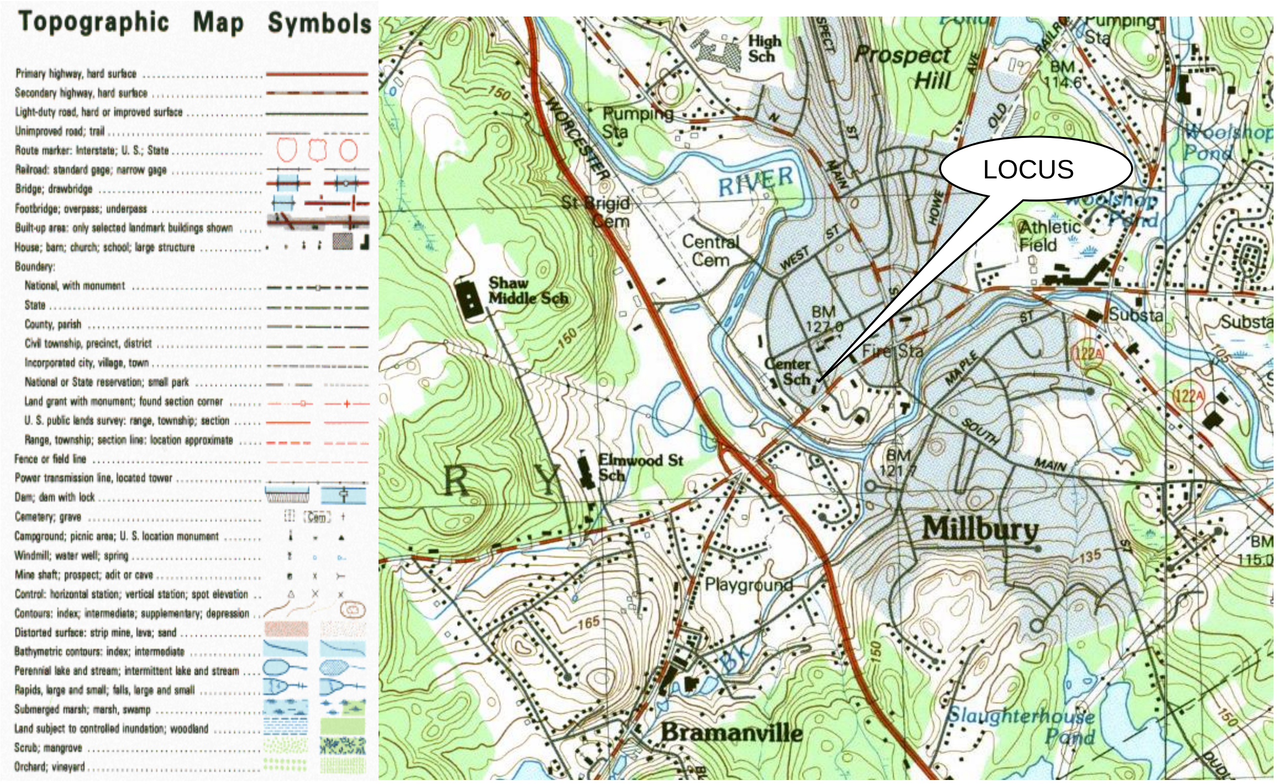


Figure 2

Flood Insurance Rate Map
Town of Millbury, MA
Worcester County
Community Panel Number: 25027C 0809E **Effective Date: July 4, 2011**

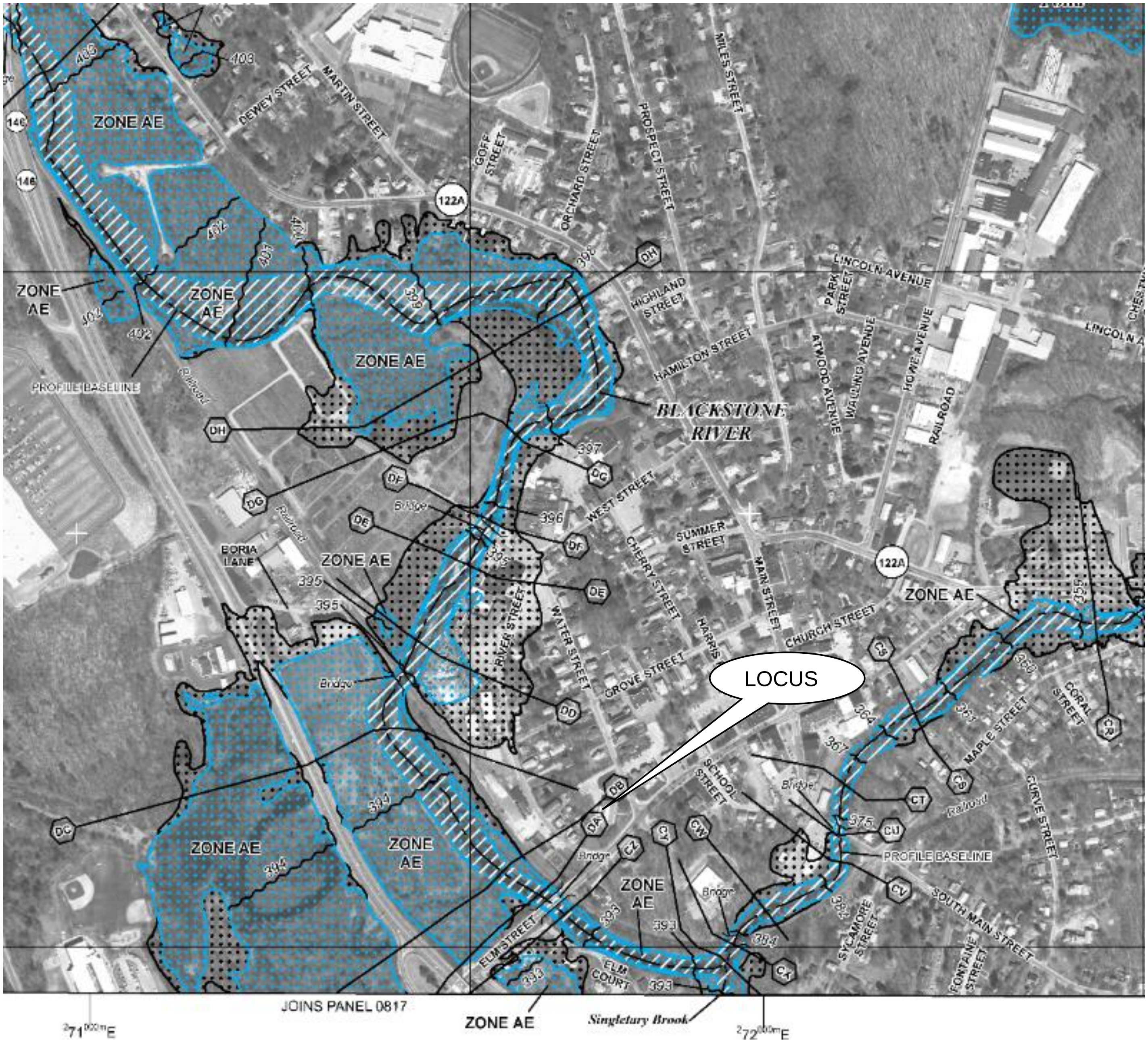


Figure 3

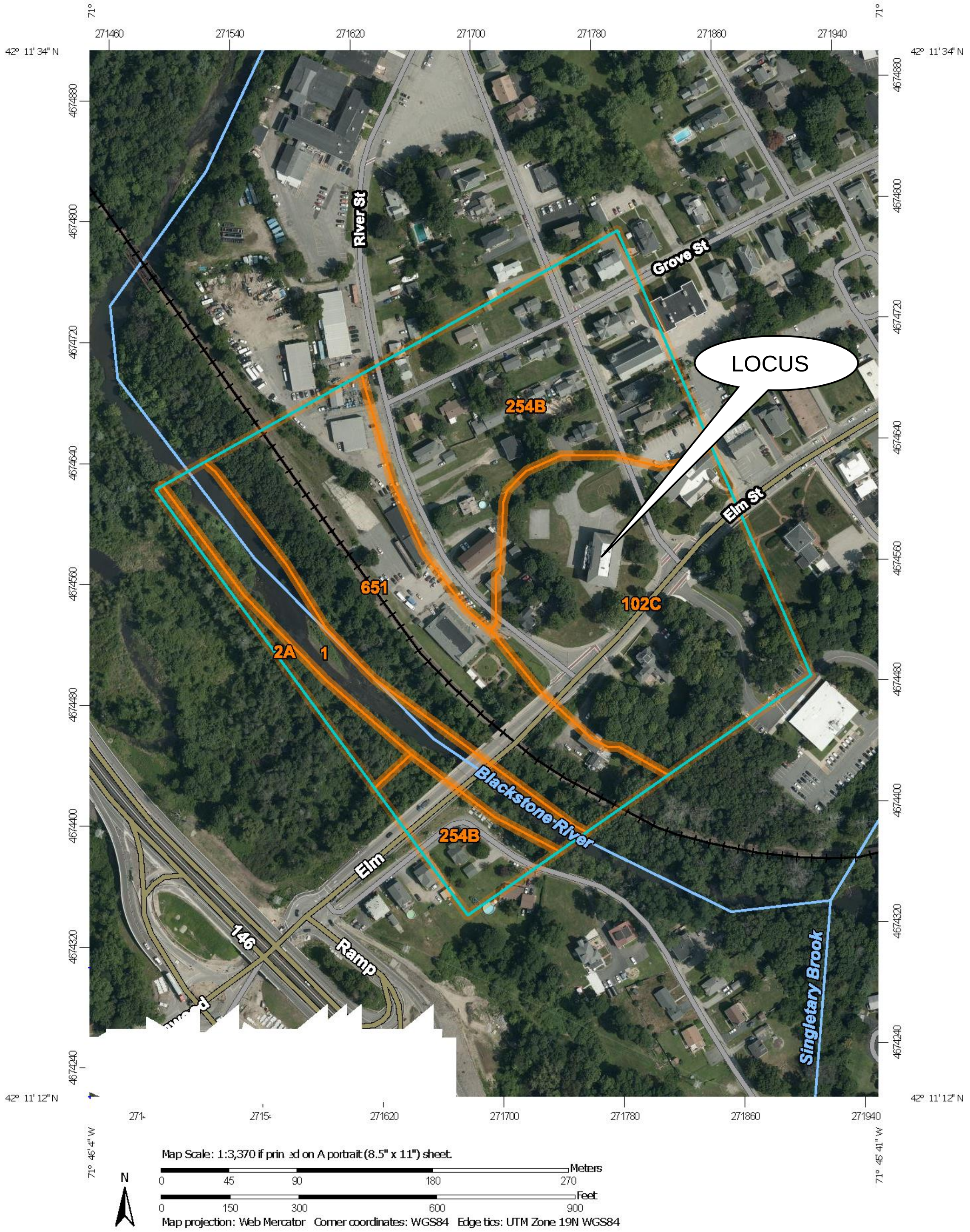
Water Supply Protection Areas Map
Millbury, MA

Source: Mass GIS

Figure 4

Natural Resources Conservation Service Soil Map **Effective Date: June 11, 2020**

Soil Map—Worcester County, Massachusetts, Southern Part
(Millbury Fire Station)



Natural Resources Conservation Service

Web Soil Survey
National Cooperative Soil Survey

2/22/2021
Page 1 of 3

Soil Map—Worcester County, Massachusetts, Southern Part
(Millbury Fire Station)

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
- ø 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: Worcester County, Massachusetts, Southern Part
Survey Area Data: Version 13, Jun 11, 2020

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

Date(s) aerial images were photographed: Jul 26, 2019—Oct 5, 2019

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
1 N/A	Water	2.4	9.4%
2A HSG 'B'	Pootatuck fine sandy loam, 0 to 3 percent slopes	0.8	3.1%
102C HSG 'B'* & 'D' *'B' is present only in Chatfield component consisting of fine sandy loam.	Chatfield-Hollis-Rock outcrop complex, 0 to 15 percent slopes	7.8	30.0%
254B HSG 'A'	Merrimac fine sandy loam, 3 to 8 percent slopes	8.3	31.9%
651 HSG 'A'	Udorthents, smoothed	6.7	25.6%
Totals for Area of Interest		**26.0**	**100.0%**

GARCIA • GALUSKA • DESOUSA
Consulting Engineers Inc.

Project: Millbury Fire Station
Location: Millbury, MA

Stormwater Operations & Maintenance Plan

Stormwater Operation & Maintenance Plan

Millbury Fire Station
130 Elm Street
Millbury, MA 01527
Map 53 / Lot 22

Prepared By:

GARCIA•GALUSKA•DESOUSA
Consulting Engineers Inc.
375 Faunce Corner Road – Suite D, Dartmouth, MA 02747-1217
(508) 998-5700 Fax: (508) 998-0883 Email: info@g-g-d.com

Date:
January 25, 2021

SITE DESCRIPTION

Location:

Millbury Fire Station Located at
130 Elm Street
Millbury, MA 01527

Owner (Responsible Party for Maintenance):

Town of Millbury
127 Elm Street
Millbury, MA 01527
Tel.: (508) 865-4710

The owner shall designate a qualified professional entity or individual to perform all monitoring. The name, address and telephone number of the entity or individual shall be provided to the Millbury Planning Board and Conservation Commission. The owner's representative shall be required to keep a log of all required inspections and maintenance required. The log shall be made available to the Millbury Planning Board upon request.

Land Use & Site Area:

The Property is located at 130 Elm Street, Millbury, MA. The disturbed area from this project encompasses Lot 22 of Assessor’s Map 53 and consists of approximately 1.8 acres of disturbed land.

Stormwater Management Systems:

The Stormwater management system consist of deep sump catch basins, trench drains, hydrodynamic water quality units and subsurface detention chamber beds with sand filter bedding. The three systems overflow to the municipal drainage system in Elm Street.

Inspections

Stormwater facilities and permanent BMP’s must be inspected in accordance with this document. All documentation on scheduled inspections, times of inspections, maintenance completed, remedial actions taken to make repairs, and any modifications or reconstruction of the storm system shall be submitted to the Millbury Planning Board within (30) days of the inspection.

Disposal of the accumulated sediment must be in accordance with all applicable local, state, and federal guidelines and regulations. If any drainage structure or outfall indicates the presence of petroleum it shall be removed and disposed of immediately in accordance with applicable regulations.

Pavement Sweeping & Vacuuming:
All paved areas shall be swept every three months using a mechanical sweeper, or every six months using a high efficiency vacuum sweeper or regenerative air sweeper scheduled in spring and fall.

Catch Basins & Drain Inlets:
All catch basins and drain inlets shall be inspected to ensure they have adequate sump capacity, oil/grease hoods are in place, frames and grates are not damaged, and access manhole brick and mortar is intact.

- Inspect catch basins and drain inlets four times per year and at the end of the foliage and snow removal seasons.
- Clean sump annually or whenever basin sump becomes filled with sediment to half the depth of the lowest pipe invert (2').

If inspection indicates the presence of petroleum, it shall be removed and disposed of immediately in accordance with applicable regulations.

Drain Manholes:
All drain manholes shall be inspected to ensure manhole frames and covers are not damaged, inlet and outlet pipes are draining freely, and access manhole brick and mortar is intact.

- Inspect structures monthly.
- Clean structures twice annual; at the end of foliage and snow removal seasons.

If inspection indicates the presence of petroleum, it shall be removed and disposed of immediately in accordance with applicable regulations.

Water Quality Structures:

All water quality structures shall be inspected to ensure manhole frames and covers are not damaged, and unit is draining freely.

- Inspect structures monthly.
- Inspect units immediately after any fuel, oil or chemical spill.
- Clean structures twice annual; at the end of foliage and snow removal seasons.
- Clean units once sediment depth reaches 15%, approximately 8”, of storage capacity.

If inspection indicates the presence of petroleum, it shall be removed and disposed of immediately in accordance with applicable regulations.

Subsurface Detention Bed Systems:

Access to subsurface infiltration/detention ponds is provided by access risers. All subsurface infiltration trenches shall be inspected to ensure system is draining. Systems shall be inspected every 6 months and after every major storm event (1" or greater rainfall over a 24-hour period). Any accumulated sediment in subsurface piping shall be removed via a vacuum truck.

If inspection indicates the presence of petroleum, it shall be removed and disposed of immediately in accordance with applicable regulations.

Housekeeping Operations:

1. Good house keeping and material management reduce the risk of spills or other accidental exposure of materials and substances to stormwater runoff.

   A. All materials stored on-site must be stored in a neat, orderly manner in their appropriate containers and, if possible, under a roof or other enclosure.

   B. Products shall be kept in their original containers with the original manufacturer's label.

   C. Substances should not be mixed with one another unless recommended by the manufacturer.

   D. Whenever possible, all of a product will be used up before disposing of a container.

   E. Original materials labels and material safety data sheets (MSDS) shall be kept by the Owner.

   F. Petroleum products:

      - All on-site vehicles and parking areas shall be monitored weekly for leaks and spills. Spills shall be cleaned immediately.

      - Petroleum products shall be stored under cover and shall be in tightly sealed containers that are clearly labeled.

   H. Fertilizers:

      - Fertilizers shall only be used in the minimum amounts as recommended by the manufacturer.

- The contents of any un-used fertilizer shall be transferred to a clearly labeled, sealable plastic bin, to avoid spillage.

I. Paints solvents.

- All paints and solvents shall be stored in original manufacturer's containers in a covered location.

- The use of paints and solvents shall, whenever possible, be limited to service or storage bays. Where not possible, the work area shall be protected with impermeable drop clothes or tarps. At no point shall material be used in parking or access ways that are tributaries to the drainage system.

2. Spill Control Practices:

A. Manufacturer's recommended methods shall be clearly posted for spill clean-up and School personnel shall be made aware of the procedures and the locations of clean-up information and supplies.

B. Material and equipment necessary for spill clean-up will be kept on-site in a designated material storage area. Equipment will include, but not be limited to, brooms, dust pans, mops, rags, gloves, goggles, absorbent materials, sand, sawdust and plastic & metal trash containers specifically kept and labeled for this purpose.

C. All spills must be cleaned-up immediately after discovery.

D. Spills of toxic or hazardous material must be reported to the appropriate state, local or federal agency, as required by-law.

3. Snow plowing operations shall stockpile snow, ice and accumulated materials in areas where snow melt will flow into the on-site drainage systems, including drainage basins.

4. During winter conditions sand use site-wide shall be applied to the minimum extent possible to maintain safe conditions.

<u>Emergency Contacts</u>:

Millbury Fire Department: 508-865-5328

Millbury Police Department: 508-865-3521

Millbury Highway Department: 508-865-4966

MassDEP Central Regional Office: 508-792-7650

STORMWATER MANAGEMENT SYSTEM INSPECTION FORM

Millbury Fire Station
Millbury, MA

Inspected by: ____________
Date: ____________

Component	Status/Inspection	Action Taken
Deep Sump Catch Basins		
Water Quality Structures		
Drain Manholes		
Subsurface Detention Beds		
Stormwater System Discharges		
General Site Conditions – Evidence of Erosion, Etc.		

SUBMIT COPIES OF STORMWATER MANAGEMENT SYSTEM INSPECTION FORMS TO THE MILLBURY PLANNING BOARD.

Appendix A

Stormwater BMP’s
MA Stormwater Handbook

Deep Sump Catch Basin

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

Ability to meet specific standards

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

Advantages/Benefits:

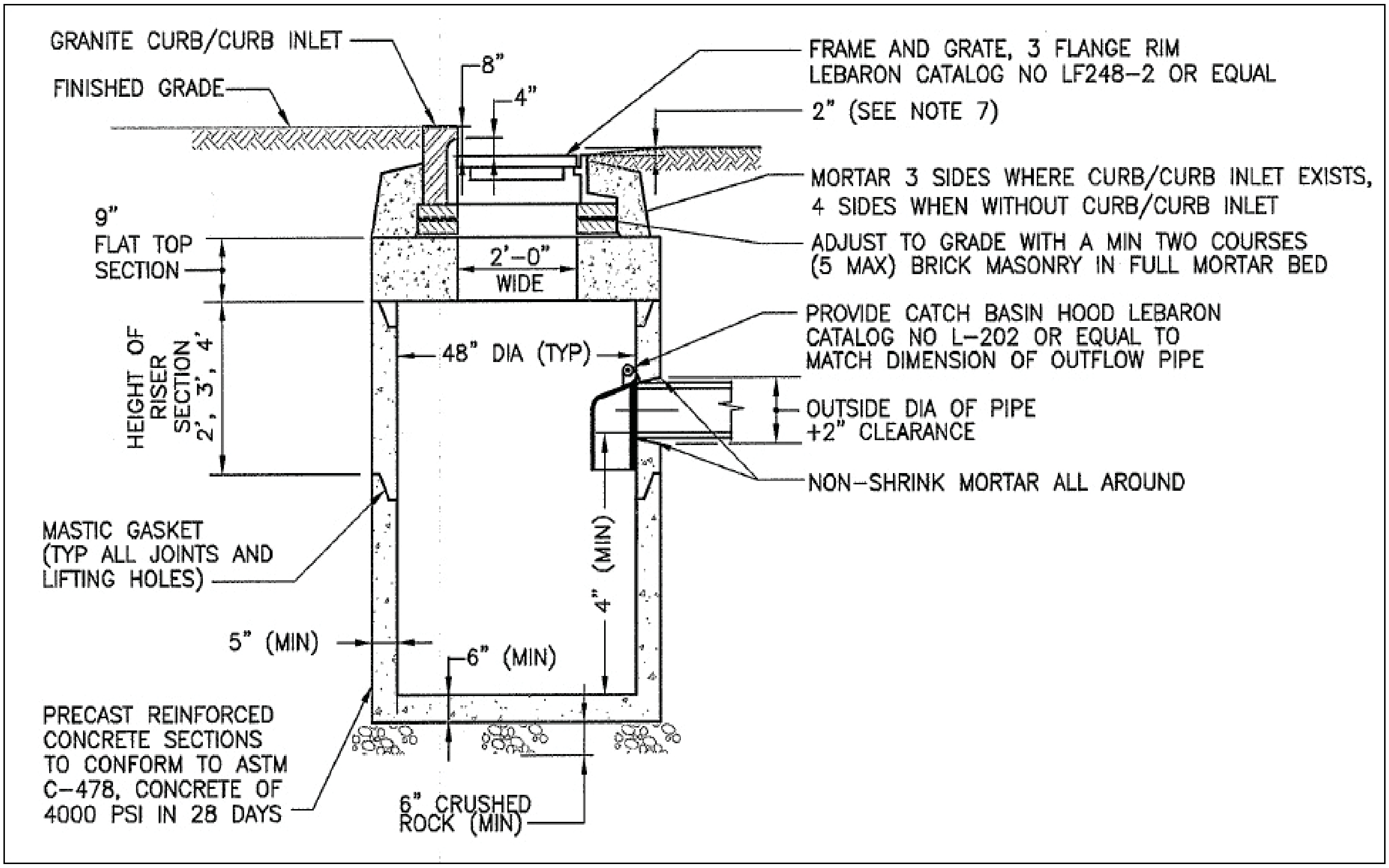
- Located underground, so limited lot size is not a deterrent.
- Compatible with subsurface storm drain systems.
- Can be used for retrofitting small urban lots where larger BMPs are not feasible.
- Provide pretreatment of runoff before it is delivered to other BMPs.
- Easily accessed for maintenance.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

Disadvantages/Limitations:

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

Pollutant Removal Efficiencies

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



adapted from the University of New Hampshire

Maintenance

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

Special Features

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

LID Alternative

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

Deep Sump Catch Basin

Suitable Applications

- Pretreatment
- Residential subdivisions
- Office
- Retail

Design Considerations

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

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

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

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

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

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

Site Constraints

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

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

Maintenance

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

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

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

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

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

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

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

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

Proprietary Separators

Description: A proprietary separator is a flow-through structure with a settling or separation unit to remove sediments and other pollutants. They typically use the power of swirling or flowing water to separate floatables and coarser sediments, are typically designed and manufactured by private businesses, and come in different sizes to accommodate different design storms and flow conditions. Some rely solely on gravity separation and contain no swirl chamber. Since proprietary separators can be placed in almost any location on a site, they are particularly useful when either site constraints prevent the use of other stormwater techniques or as part of a larger treatment train. The effectiveness of proprietary separators varies greatly by size and design, so make sure that the units are sized correctly for the site's soil conditions and flow profiles, otherwise the unit will not work as designed.

Ability to meet specific standards

Standard	Description
2 - Peak Flow	Provides no peak flow attenuation
3 - Recharge	Provides no groundwater recharge
4 - TSS Removal	Varies by unit. Must be used for pretreatment and be placed first in the treatment train to receive TSS removal credit. Follow procedures described in Chapter 4 to determine TSS credit.
5 - Higher Pollutant Loading	Suitable as pretreatment device.
6 - Discharges near or to Critical Areas	Suitable as pretreatment device or potentially a spill control device
7 - Redevelopment	Suitable as pretreatment device or treatment device if it is not possible to provide other BMPs.

Advantages/Benefits:

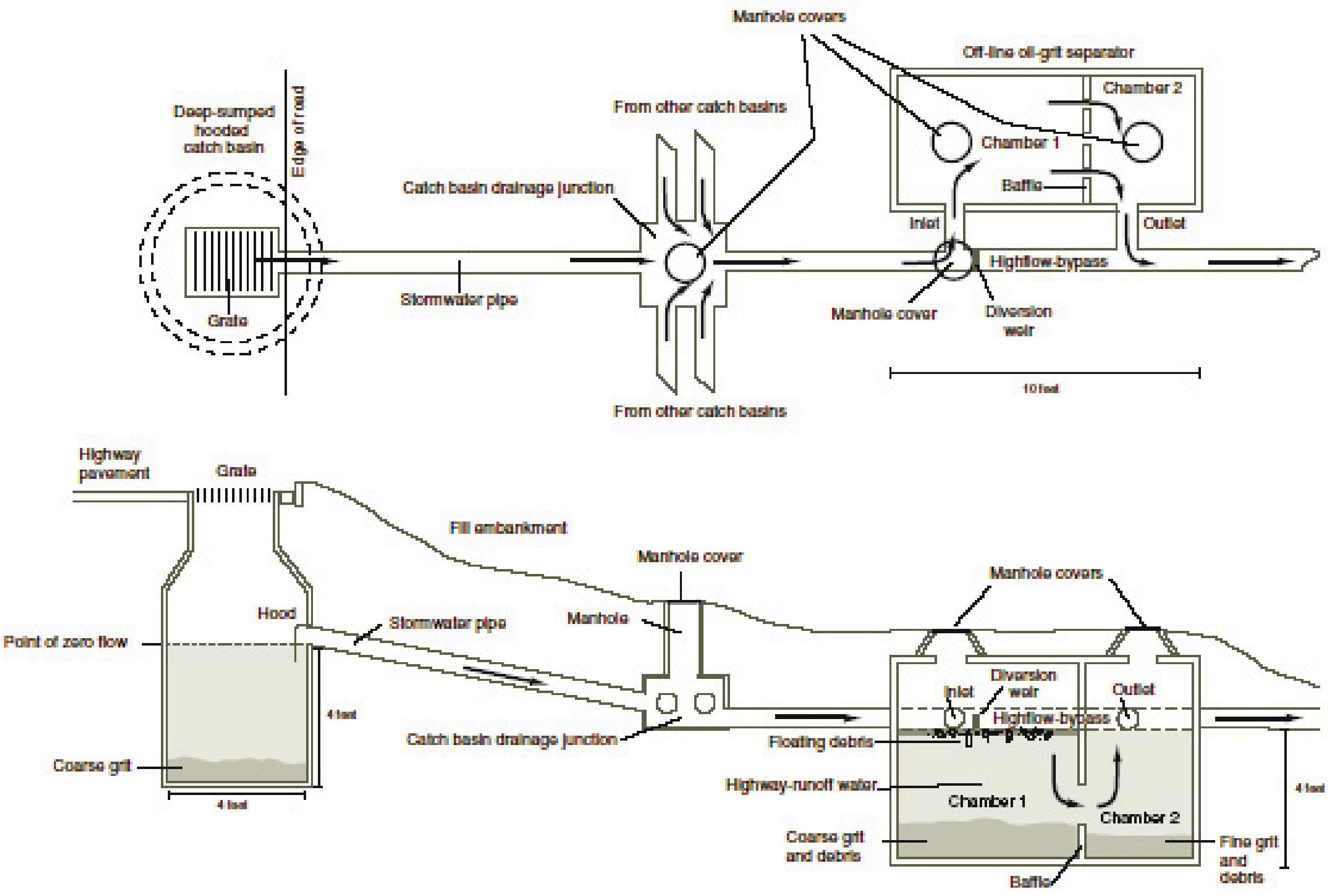
- Removes coarser sediment.
- Useful on constrained sites.
- Can be custom-designed to fit specific needs of a specific site.

Disadvantages/Limitations:

- Removes only coarse sediment fractions
- Provides no recharge to groundwater
- No control of the volume of runoff
- Frequent maintenance is essential

Pollutant Removal Efficiencies

- Total Suspended Solids (TSS) - Varies.
- Nutrients (Nitrogen, phosphorus) - Insufficient data
- Metals (copper, lead, zinc, cadmium) - Insufficient data
- Pathogens (coliform, e coli) - Insufficient data



Schematic section of a deep-sump hooded catch basin and a 1,500-gallon off-line water quality inlet.

adapted from the MassHighway Storm Water Handbook for Highways

Maintenance

Activity	Frequency
Inspect in accordance with manufacturer requirements, but no less than twice a year following installation, and no less than once a year thereafter.	See activity
Remove sediment and other trapped pollutants at frequency or level specified by manufacturer.	See manufacturer information

Special Features

Can be custom-designed to fit specific needs at a specific site.

LID Alternative

Reduce impervious surfaces
Disconnect runoff from non-metal roofs, roadways, and driveways

Proprietary Separators

Applicability

Because they have limited pollutant removal and storage capacity, proprietary separators must be used for pretreatment only. Because they are placed underground, proprietary separators may be the only structural pretreatment BMPs feasible on certain constrained redevelopment sites where space or storage is not available for more effective BMPs. They may be especially useful in ultra-urban settings such as Boston or Worcester. Some proprietary separators may be used for spill control.

Effectiveness

Proprietary separators have a wide range of TSS efficiencies. To assess the ability of proprietary separators to remove TSS and other pollutants, a proponent should follow the procedures set forth in Chapter 4. The specific units proposed for a particular project cannot be effective unless they are sized correctly. Proprietary separators are usually sized based on flow rate. A proprietary separator must be sized to treat the required water quality volume. To be effective at removing TSS and other pollutants the system must be designed, constructed, and maintained in accordance with the manufacturer's specifications and the specifications in this Handbook.

Planning Considerations

To receive TSS removal credit, proprietary separators must be used for pretreatment and placed at the beginning of a stormwater treatment train. They can be configured either in-line or if subject to higher flows, off-line to reduce scouring. They must be sized in accordance with the manufacturer's specifications and the specifications in this Handbook. Proprietary separators used as spill control devices may have to be sized differently than those used for TSS removal.

Design

The design of proprietary separators varies by manufacturer. Units are typically precast concrete, but larger systems may be cast in place. Units may have baffles or other devices to direct incoming water into and through a series of chambers, slowing the water down to allow sediment to drop out into internal storage areas, then directing this pre-treated water to exit to other treatment or infiltration devices. In some cases, flow will be introduced tangentially, to induce swirl or vortex. Units may include skirts or weirs, to keep trapped sediments from becoming re-entrained. Some units combine a catch basin with the treatment function, providing off-line rather than in-line treatment.

Generally they are placed below ground on a gravel or stone base. Make sure all units contain inspection and access ports so that they may be inspected and cleaned. During design, take care to place the inspection and access ports where they will be accessible. Do not place the ports in locations such as travel lanes of roadways/highways and parking stalls.

Construction

Install construction barriers around the excavation area to prevent access by pedestrians. Use diversions and other soil erosion practices up-slope of the proprietary separator to prevent runoff from entering the site before construction of the units is complete. Implement practices to prevent construction period runoff from being discharged to the units until construction is complete and the soil is stabilized. Stabilize all surrounding area and any established outlets. Remove temporary structures after vegetation is established.

Maintenance

Inspect and clean these units in strict accordance with manufacturers' recommendations and requirements. Clean the units using the method specified by the manufacturer. Vactor trucks are typically used to clean these units. Clamshell buckets typically used for cleaning catch basins are almost never allowed by manufacturers. Sometimes it will be necessary to remove sediment manually.

Adapted from:
MassHighway. Storm Water Handbook for Highways and Bridges. May 2004.

Subsurface Structures

Description: Subsurface structures are underground systems that capture runoff, and gradually infiltrate it into the groundwater through rock and gravel. There are a number of underground infiltration systems that can be installed to enhance groundwater recharge. The most common types include pre-cast concrete or plastic pits, chambers (manufactured pipes), perforated pipes, and galleys.

Ability to meet specific standards

Standard	Description
2 - Peak Flow	N/A
3 - Recharge	Provides groundwater recharge
4 - TSS Removal	80%
5 - Higher Pollutant Loading	May be used if 44% of TSS is removed with a pretreatment BMP prior to infiltration. Land uses with the potential to generate runoff with high concentrations of oil and grease require an oil grit separator or equivalent prior to discharge to the infiltration structure. Infiltration must be done in accordance with 314 CMR 5.00.
6 - Discharges near or to Critical Areas	Highly recommended
7 - Redevelopment	Suitable with pretreatment

Advantages/Benefits:

- Provides groundwater recharge
- Reduces downstream flooding
- Preserves the natural water balance of the site
- Can remove other pollutants besides TSS
- Can be installed on properties with limited space
- Useful in stormwater retrofit applications

Disadvantages/Limitations:

- Limited data on field performance
- Susceptible to clogging by sediment
- Potential for mosquito breeding due to standing water if system fails

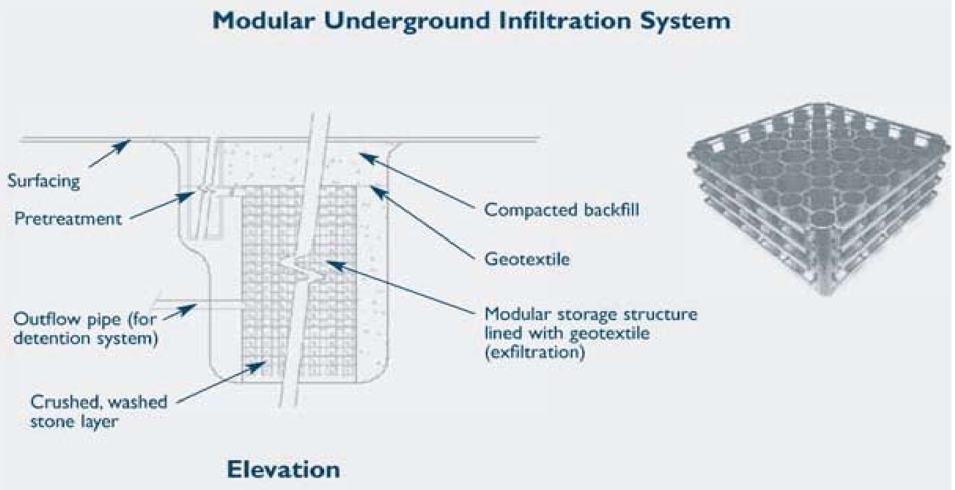
Pollutant Removal Efficiencies

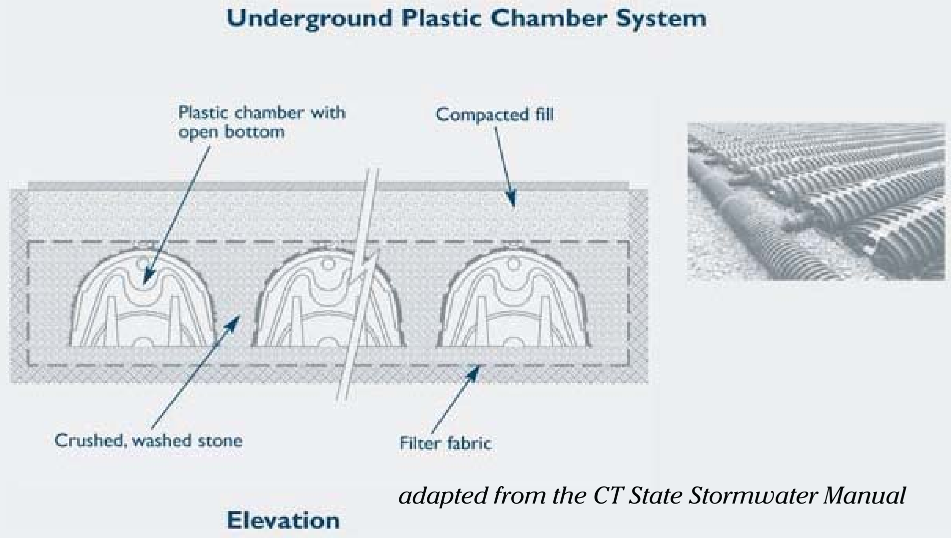
• Total Suspended Solids (TSS)	80%
• Nutrients (Nitrogen, phosphorus)	Insufficient data
• Metals (copper, lead, zinc, cadmium)	Insufficient data
• Pathogens (coliform, e coli)	Insufficient data

Subsurface Structures

There are different types of subsurface structures:

Infiltration Pit: A pre-cast concrete or plastic barrel with uniform perforations. The bottom of the pit should be closed with the lowest row of perforations at least 6 inches above the bottom, to serve as a sump. Infiltration pits typically include an observation well. The pits may be placed linearly, so that as the infiltrative surfaces in the first pit clog, the overflow moves to the second pit for exfiltration. Place an outlet near the top of the infiltration pit to accommodate emergency overflows. MassDEP provides recharge credit for storage below the emergency outflow invert. To make an infiltration pit, excavate the pit, wrap fabric around the barrel, place stone in the bottom of the pit, place the barrel in the pit, and then backfill stone around the barrel. Take a boring or dig an observation trench at the site of each proposed pit.





adapted from the CT State Stormwater Manual

Chambers: These are typically manufactured pipes containing open bottoms and sometimes perforations. The chambers are placed atop a stone bed. Take the same number of borings or observation pits as for infiltration trenches. Do not confuse these systems with underground detention systems (UDS) that use similar chambers. UDS are designed to attenuate peak rates of runoff--not to recharge groundwater.

Perforated Pipes: In this system, pipes containing perforations are placed in a leaching bed, similar to a Title 5 soil absorption system (SAS). The pipes dose the leaching bed. Take the same number of borings or observation pits as for infiltration trenches. Perforated pipes by themselves do not constitute a stormwater recharge system and receive no credit pursuant to Stormwater Standard No. 3. Do not confuse recharge systems that use perforated pipes with perforated pipes installed to lower the water table or divert groundwater flows.

Galleys: Similar to infiltration pits. Some designs consist of concrete perforated rectangular vaults. Others are modular systems usually placed under parking lots. When the galley design consists of a single rectangular perforated vault, conduct one boring or observation trench per galley. When the galleys consist of interlocking modular units, take the same number of borings or observation pits as for infiltration trenches. Do not confuse these galleys with vaults storing water for purposes of underground detention, which do not contain perforations.

Applicability

Subsurface structures are constructed to store stormwater temporarily and let it percolate into the underlying soil. These structures are used for small drainage areas (typically less than 2 acres). They are feasible only where the soil is adequately permeable and the maximum water table and/or bedrock elevation is sufficiently low. They can be used to control the quantity as well as quality of stormwater runoff, if properly designed and constructed. The structures serve as storage chambers for captured stormwater, while the soil matrix provides treatment.

Without adequate pretreatment, subsurface structures are not suitable for stormwater runoff from land uses or activities with the potential for high sediment or pollutant loads. Structural pretreatment BMPs for these systems include, but are not limited to, deep sump catch basins, proprietary separators, and oil/grit separators. They are suitable alternatives to traditional infiltration trenches and basins for space-limited sites. These systems can be installed beneath parking lots and other developed areas provided the systems can be accessed for routine maintenance.

Subsurface systems are highly prone to clogging. Pretreatment is always required unless the runoff is strictly from residential rooftops.

Effectiveness

Performance of subsurface systems varies by manufacturer and system design. Although there are limited field performance data, pollutant removal efficiency is expected to be similar to those of infiltration trenches and basins (i.e., up to 80% of TSS removal). MassDEP awards a TSS removal credit of 80% for systems designed in accordance with the specifications in this handbook.

Planning Considerations

Subsurface structures are excellent groundwater recharge alternatives where space is limited. Because infiltration systems discharge runoff to groundwater, they are inappropriate for use in areas with potentially higher pollutant loads (such as gas stations), unless adequate pretreatment is provided. In that event, oil grit separators, sand filters or equivalent BMPs must be used to remove sediment, floatables and grease prior to discharge to the subsurface structure.

Design

Unlike infiltration basins, widely accepted design standards and procedures for designing subsurface structures are not available. Generally, a subsurface structure is designed to store a “capture volume” of runoff for a specified period of “storage time.” The definition of capture volume differs depending on the purpose of the subsurface structure and the stormwater management program being used. Subsurface structures should infiltrate good quality runoff only. Pretreatment prior to infiltration is essential.
The composition, configuration and layout of subsurface structures varies considerably depending on the manufacturer. Follow the design criteria specified by vendors or system manufacturers. Install subsurface structures in areas that are easily accessible for routine and non-routine maintenance.

As with infiltration trenches and basins, install subsurface structures only in soils having suitable infiltration capacities as determined through field testing. Determine the infiltrative capacity of the underlying native soil through the soil evaluation set forth in Volume 3. Never use a standard septic system percolation test to determine soil permeability because this test tends to greatly overestimate the infiltration capacity of soils.

Subsurface structures are typically designed to function off-line. Place a flow bypass structure upgradient of the infiltration structure to convey high flows around the structure during large storms.

Design the subsurface structure so that it drains within 72 hours after the storm event and completely dewaters between storms. Use a minimum draining time of 6 hours to ensure adequate pollutant removal. Design all ports to be mosquito-proof, i.e., to inhibit or reduce the number of mosquitoes able to breed within the BMP.

The minimum acceptable field infiltration rate is 0.17 inches per hour. Subsurface structures must be sized in accordance with the procedures set forth in Volume 3. Manufactured structures must also be sized in accordance with the manufacturers’ specifications. Design the system to totally exfiltrate within 72 hours.

Design the subsurface structure for live and dead loads appropriate for their location. Provide measures to dissipate inlet flow velocities and prevent channeling of the stone media. Generally, design the system so that inflow velocities are less than 2 feet per second (fps).
All of these devices must have an appropriate number of observation wells, to monitor the water surface elevation within the well, and to serve as a sampling port.

Each of these different types of structures, with the exception of perforated pipes in leaching fields similar to Title 5 systems, must have entry ports to allow worker access for maintenance, in accordance with OSHA requirements.

Construction

Stabilize the site prior to installing the subsurface structure. Do not allow runoff from any disturbed areas on the site to flow to the structure. Rope off the area where the subsurface structures are to be placed. Accomplish any required excavation with equipment placed just outside of this area. If the size of the area intended for exfiltration is too large to accommodate this approach, use trucks with low-pressure tires to minimize compaction. Do not allow any other vehicles within the area to be excavated. Keep the area above and immediately surrounding the subsurface structure roped off to all construction vehicles until the final top surface is installed (either paving or landscaping). This prevents additional compaction. When installing the final top surface, work from the edges to minimize compaction of the underlying soils.

Before installing the top surface, implement erosion and sediment controls to prevent sheet flow or wind blown sediment from entering the leach field. This includes, but is not limited to, minimizing land disturbances at any one time, placing stockpiles away from the area intended for infiltration, stabilizing any stockpiles through use of vegetation or tarps, and placing sediment fences around the perimeter of the infiltration field.

Provide an access port, man-way, and observation well to enable inspection of water levels within the system. Make the observation well pipe visible at grade (i.e., not buried).

Maintenance

Because subsurface structures are installed underground, they are extremely difficult to maintain. Inspect inlets at least twice a year. Remove any debris that might clog the system. Include mosquito controls in the Operation and Maintenance Plan.

Adapted from:
Connecticut Department of Environmental Conservation. Connecticut Stormwater Quality Manual. 2004.
MassHighway. Storm Water Handbook for Highways and Bridges. May 2004.

Sand & Organic Filters

Description: Also known as filtration basins, sand and organic filters consist of self-contained beds of sand or peat (or combinations of these and other materials) either underlaid with perforated underdrains or designed with cells and baffles with inlets/outlets. Stormwater runoff is filtered through the sand, and in some designs may be subject to biological uptake. Runoff is discharged or conveyed to another BMP for further treatment. Another type of filter is the tree box filter. Information on this practice appears at the end of this section.

Advantages/Benefits:

- Applicable to small drainage areas of 1 to 10 acres, although some designs may accept runoff of up to 50 acres.
- Good retrofit capability.
- Long design life if properly maintained
- Good for densely populated urban areas and parking lots with high intensity use

Disadvantages/Limitations:

- Pretreatment required to prevent the filter media from clogging.
- Frequent maintenance required.
- Relatively costly to build and install.
- Without grass cover, the surface of sand filters can be extremely unattractive.
- May have odor problems, which can be overcome with design and maintenance.
- May not be able to be used on certain sites because of inadequate depth to bedrock or high groundwater
- May not be effective in winter

Ability to meet specific standards

Standard	Description
2 - Peak Flow	Not applicable
3 - Recharge	Not applicable
4 - TSS Removal	80% TSS removal credit provided it's combined with one or more pretreatment BMPs prior to infiltration.
5 - Higher Pollutant Loading	Can be used in lieu of an oil grit separator for certain land uses with higher potential pollutant loads of oil and grease such as high intensity parking lots and gas stations
6 - Discharges near or to Critical Areas	Recommended treatment BMP.
7 - Redevelopment	Suitable when combined with pretreatment BMP. Good option for ultra urban areas, since they consume no surface space.

Pollutant Removal Efficiencies

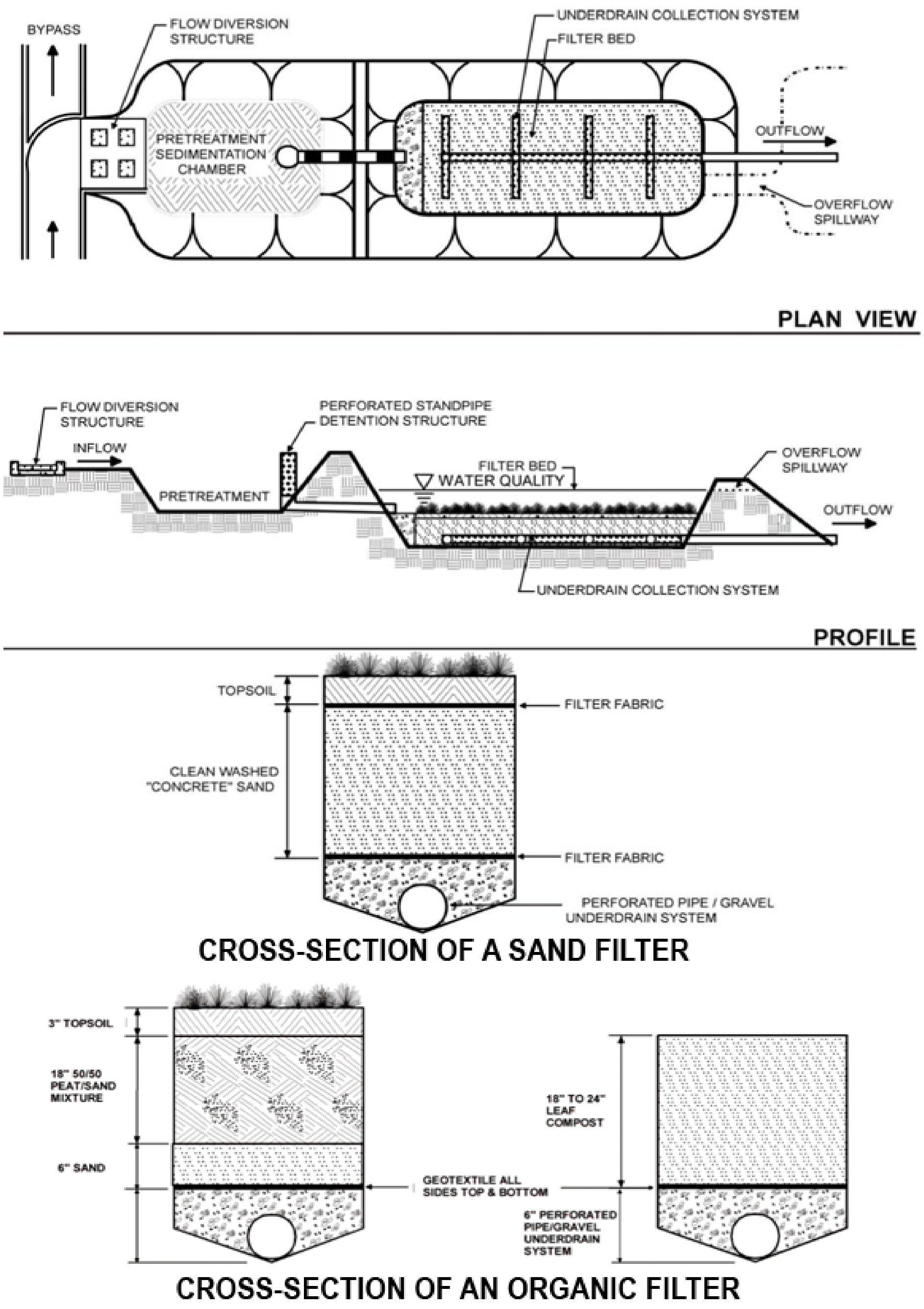
• Total Suspended Solids (TSS)	80% with pretreatment
• Total Nitrogen	20% to 40%
• Total Phosphorus	10% to 50%
• Metals (copper, lead, zinc, cadmium)	50% to 90%
• Pathogens (coliform, e coli)	Insufficient data

Special Features:

Design as off-line device. Include a Sediment Forebay or equivalent pretreatment device.

LID Alternative:

Bioretention areas



adapted from the Vermont Stormwater Manual

Maintenance

Activity	Frequency
Inspect filters and remove debris	After every major storm for the first few months after construction is complete to ensure proper function and every 6 months thereafter.

Sand Filters

Applicability

Sand filters are adaptable to most developments. They can be installed in areas with thin soils, high evaporation rates, low soil infiltration rates and limited space. Sand filters can be used in ultra-urban sites with small drainage areas that are completely impervious, such as small parking lots and fast food restaurants. They are suitable for many areas that are difficult to retrofit due to space limitations.

Sand filters can be used in areas with poor soil infiltration rates, where groundwater concerns restrict the use of infiltration, or for high pollutant loading areas. Design sand filters as off-line BMPs; they are intended primarily for quality control, not quantity control. A diversion structure, such as a flow splitter or weir, typically routes a portion of the runoff into the sand filter, while the remainder continues on to a stormwater quantity control BMP. Large sand filters can be designed to play a role in the control of peak discharge rates.

Because of the potential for clogging, install sand filters only at sites that have been stabilized. Never use sand filters as sedimentation traps during construction.

Effectiveness

Sand filters improve water quality by straining pollutants through a filtering media and by settling pollutants on top of the sand bed and/or in a pretreatment basin.

Planning Considerations

The surface of sand filters can be unattractive and create odors, and may not be appropriate for residential areas without a grass cover.

Sand filters require a sediment forebay or equivalent pretreatment device. Locate sand filters off-line from the primary conveyance/ detention systems. Design sand filters large enough to handle runoff from the storm associated with the required water quality volume, i.e., one inch or one half inch rain event. Fit stormwater conveyances with flow splitters or weirs to route the required volume of runoff to the sand filter. Allow excess runoff to bypass the sand filter and continue on to another BMP designed to accommodate the necessary stormwater quantity.

Design

See the following for complete design references:

- *Developments in Sand Filter Technology to Treat Stormwater Runoff, Article 105, and Further Developments in Sand Filter Technology, Article 106, in the Practice of Stormwater Protection*
- *Georgia Stormwater Manual 2004*
- *Connecticut Stormwater Manual*
- *North Carolina Department of Environment and Natural Resources Stormwater BMP Manual 2007*

Two key design principles for sand filters are visibility and simplicity. A visible sand filter is more apt to be adequately operated and maintained. Complex designs are more expensive and difficult to operate and maintain. Typically, sand filter systems are designed with two components, a pretreatment component and a filtering component. The pretreatment component is a sediment forebay or vegetated filter strip designed to reduce the sediment load to the filtering component. Pre-settling also slows the runoff velocity and spreads it evenly across the top of the filter component.

Generally, the volume of the sediment forebay should be equal to or greater than the filtering capacity. Design the filter to capture finer silt and clay particles and other pollutants in the runoff. Sand filters are designed to function as a stormwater quality control practice, and not to provide detention for downstream areas. Therefore, locate them as off-line systems, away from the primary conveyance/ detention system.Design the pretreatment component to settle out coarse sediments that may clog the sand filter and reduce its effectiveness.

Use a design filtration rate of 2 inches/hour. Although this rate is low compared to published values for sand, it reflects actual rates achieved by sand filters in urban areas. Using Darcy's Law, design the sand filter to completely drain within 24 hours or less, because there is little storm storage available in the sand filter if a second storm occurs.

Use eighteen inches of 0.02-inch to 0.04-inch diameter sand (smaller sand is acceptable) for the sand bed. Consider that sand may consolidate during construction. Stabilize the depth of the bed by wetting the sand periodically, allowing it to consolidate, and then adding extra sand. There are several possible sand bed configurations; most use a gravel bed at the bottom overlaid with a layer of sand and/or peat, leaf compost, or topsoil/grass. In all configurations, make sure the top surface layer of the bed is level to provide equal distribution of the runoff in the bed. The gravel bed layer is generally composed of 4 to 6 inches of 0.5-inch to 2-inch diameter gravel. Separate the gravel and top media layers with a layer of geotextile fabric to prevent sand from infiltrating into the gravel layer and the underdrain piping.

Recent research (Erickson, et al., 2007) shows that enhancing sand filters with steel wool can reduce phosphorus concentrations by as much as 80%.

Organic Media Filters

Organic media filters are essentially the same as sand filters with the sand media replaced or supplemented with another medium. Two examples are the peat sand filter and the compost sand filter. According to the Center for Watershed Protection, many practioners believe that organic sand filter systems have enhanced pollutant removal for many compounds due to the increased cation exhange capacity achieved by increasing the organic matter. See Performance of Delaware Sand Filter Assessed, Article 107 of the Practice of Watershed Protection.

Maintenance Features Incorporated in Filter Design

Ease of access is essential for sand filter maintenance. Some designs use a geotextile layer, surface screen, or grating at the top to filter out coarse sediment and debris and for ease of maintenance. Typical maintenance for sand filters includes removing the top several inches of discolored sand and replacing it with clean media. Designs should include ramps, manhole steps, or ringbolts that allow a maintenance worker to manually remove this material. In addition, avoid heavy grates or manhole covers that cannot be lifted manually.

Trench Design

Trench designs have lateral underdrain pipes that are covered with 0.5-inch to 2-inch diameter gravel and geotextile fabric. The underdrains are underlaid with drainage matting, which is necessary to provide adequate hydraulic conductivity to the lateral pipes. Reinforce the underdrain piping so it withstands the weight of the overburden. The minimum grade of the piping should be 1/8 inch per foot (at 1% slope). An impermeable liner (clay, geomembrane, concrete) may be required under the filter to protect groundwater. If the impermeable liner is not required, install a geotextile liner, unless the bed has been excavated to bedrock. Make sure that the side slopes of the earthen embankments do not exceed 3:1 (horizontal: vertical). Fencing around sand filters may be needed to reduce safety hazards. Carefully selecting topsoil and sod for natural cover will help reduce the potential for failure. Sod with fine silts and clays will clog the top of the sand filter. Maximize the life of the sand filter by limiting its use to treating runoff from impervious areas only.

Construction

- Take care during construction to minimize the risk of premature failure of the sand filter.
- Diversion berms should be placed around the perimeter of the sand filters during all phases of construction.
- Sand filters should not be used as temporary sediment traps for construction activities.
- Consolidation of material in the sand filters during construction must be taken into consideration. The depth of the bed can be stabilized by wetting the sand periodically, allowing it to consolidate, and then adding extra sand.
- During and after excavation, all excavated materials should be placed downstream, away from the sand filters, to prevent redeposition during runoff events. All excavated materials should be handled properly and disposed of properly during and after construction.

Cold Weather Modifications

Surface sand filters will not provide treatment during the winter. Underground filers are not effective in winter unless the filter bed is placed below the frost line. Peat and compost media are ineffective during the winter in cold climates. These filters retain water and can freeze solid, and thus become impervious.

To prevent freezing, the diameter of the underdrain pipe should be at least 8 inches, and the slope of the underdrain pipe should be at least 1%. Place eighteen inches of gravel at the base of the filter. Make the slope of the inflow pipes at least 2%. In addition, place the filter below the frost line. If freezing cannot be prevented, remove snow from the contributing area and place it elsewhere.

Maintenance

Inspect sand filters after every major storm in the first few months after construction to ensure proper function. Thereafter, inspect the sand filter at least once every 6 months. Sand filters require frequent manual maintenance. Important maintenance tasks include raking the sand and removing surface sediment, trash and debris. Eventually a layer of sediment will accumulate on the top of the sand, which can be easily scraped off using rakes or other devices. Finer sediments will penetrate deeper into the sand over time, necessitating replacement of some (several inches) or all of the sand. Discolored sand indicates the presence of fine sediments. Dewater and properly dispose of sand removed from the filter.

References

Erickson, Andrew J., et al., Enhanced Sand Filtration for Storm Water Phosphorus Removal, Journal of Environmental Engineering. Volume 133, Issue 5, pp. 485-497, May 2007.

Tree Box Filter

Description: The Tree Box Filter consists of an open bottom concrete barrel filled with a porous soil media, an underdrain in crushed gravel, and a tree. Stormwater is directed from surrounding impervious surfaces through the top of the soil media. Stormwater percolates through the media to the underlying ground. Treated stormwater beyond the design capacity is directed to the underdrain where it may be directed to a storm drain, other device, or surface water discharge.

Advantages/Benefits:

- May be used as a pretreatment device
- Provides decentralized stormwater treatment
- Ideal for redevelopment or in the ultra-urban setting

Disadvantages/Limitations:

- Treats small volumes

Special Features

Reduces volume and rate of runoff.

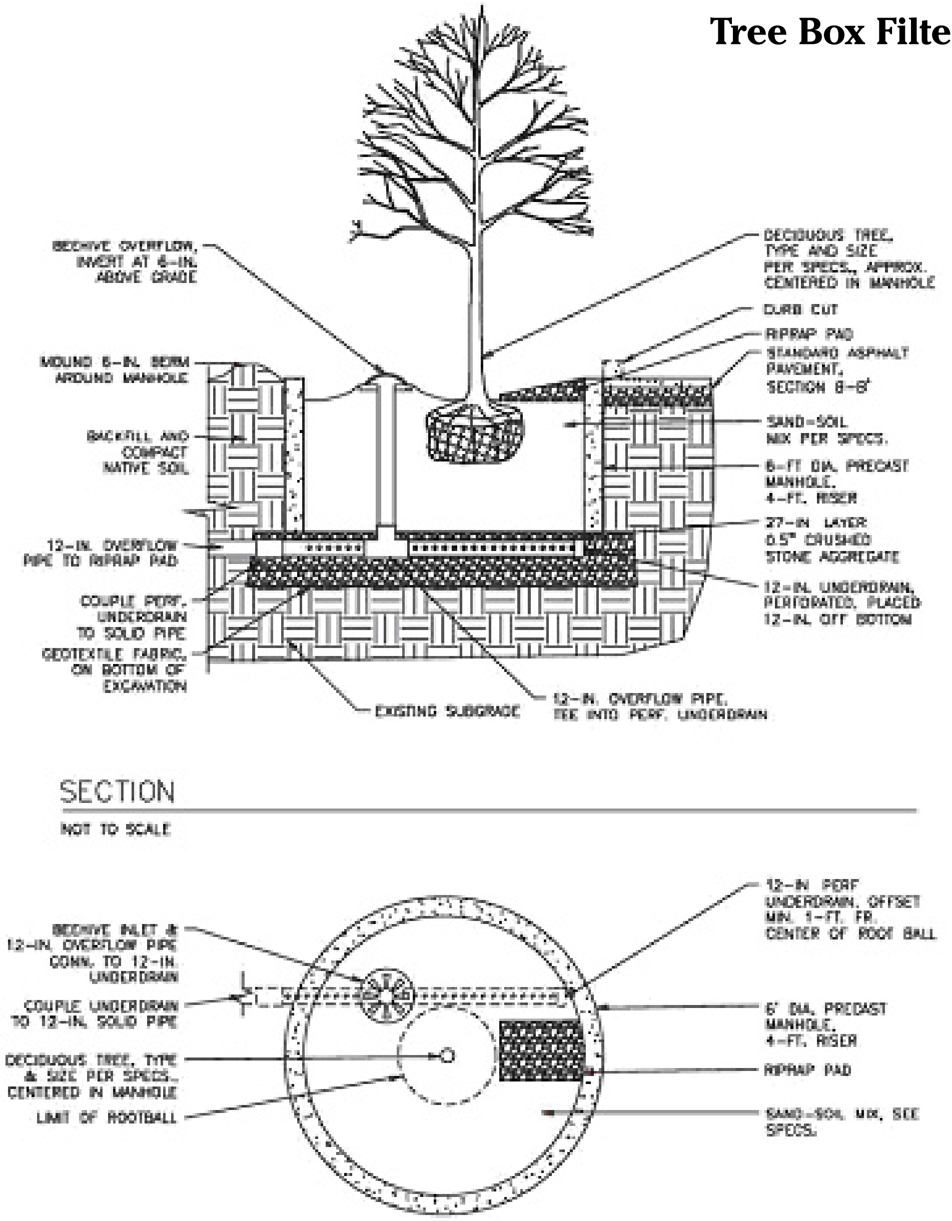
Ability to meet specific standards

Standard	Description
2 - Peak Flow	N/A
3 - Recharge	No infiltration credit
4 - TSS Removal	Presumed to remove 80% TSS
5 - Higher Pollutant Loading	May be used as pretreatment device if lined
6 - Discharges to near or to Critical Areas	Not suitable for vernal pools or swimming areas. At other critical areas, may be used as a pretreatment device.
7 - Redevelopment	May be used for retrofit.

Pollutant Removal Efficiencies

- Total Suspended Solids (TSS)- 80% presumed for regulatory purposes
- Total phosphorus (TP)- Not Reported
- Dissolved Inorganic Nitrogen- Not Reported
- Zinc- Not Reported
- Pathogens (coliform, e. coli)- Not Reported

Tree Box Filter



adapted from the Vermont Stormwater Manual

Maintenance

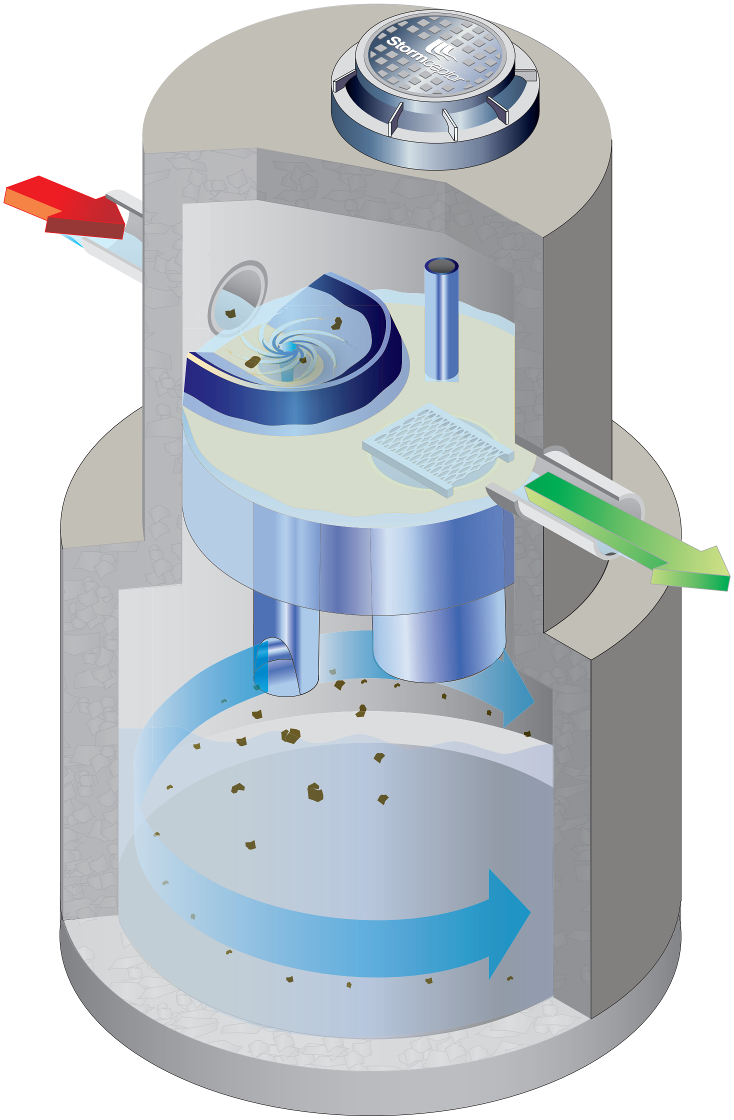
Activity	Frequency
Check tree	Annually. Expected tree life is 5-10 years.
Rake media surface to maintain permeability	Twice a year
Replace media	When tree is replaced

Appendix B

Stormceptor Owner's Manual

Stormceptor®

Owner's Manual



Stormceptor is protected by one or more of the following patents:

Canadian Patent No. 2,137,942
Canadian Patent No. 2,175,277
Canadian Patent No. 2,180,305
Canadian Patent No. 2,180,338
Canadian Patent No. 2,206,338
Canadian Patent No. 2,327,768
U.S. Patent No. 5,753,115
U.S. Patent No. 5,849,181
U.S. Patent No. 6,068,765
U.S. Patent No. 6,371,690
U.S. Patent No. 7,582,216
U.S. Patent No. 7,666,303
Australia Patent No. 693.164
Australia Patent No. 707,133
Australia Patent No. 729,096
Australia Patent No. 779,401
Australia Patent No. 2008,279,378
Australia Patent No. 2008,288,900
Indonesia Patent No. 0007058
Japan Patent No. 3581233
Japan Patent No. 9-11476
Korean Patent No. 0519212
Malaysia Patent No. 118987
New Zealand Patent No. 314,646
New Zealand Patent No. 583,008
New Zealand Patent No. 583,583
South African Patent No. 2010/00682
South African Patent No. 2010/01796
Other Patents Pending

Table of Contents

Congratulations!

Your selection of a Stormceptor® means that you have chosen the most recognized and efficient stormwater oil/sediment separator available for protecting the environment. Stormceptor is a pollution control device often referred to as a “Hydrodynamic Separator (HDS)” or an “Oil Grit Separator (OGS)”, engineered to remove and retain pollutants from stormwater runoff to protect our lakes, rivers and streams from the harmful effects of non-point source pollution.

1 – Stormceptor Overview

Stormceptor is a patented stormwater quality structure most often utilized as a treatment component of the underground storm drain network for stormwater pollution prevention. Stormceptor is designed to remove sediment, total suspended solids (TSS), other pollutants attached to sediment, hydrocarbons and free oil from stormwater runoff. Collectively the Stormceptor provides spill protection and prevents non-point source pollution from entering downstream waterways.

Key benefits of Stormceptor include:

- Removes sediment, suspended solids, debris, nutrients, heavy metals, and hydrocarbons (oil and grease) from runoff and snowmelt.
- Will not scour or re-suspend trapped pollutants.
- Provides sediment and oil storage.
- Provides spill control for accidents, commercial and industrial developments.
- Easy to inspect and maintain (vacuum truck).
- “STORMCEPTOR” is *clearly* marked on the access cover (excluding inlet designs).
- Relatively small footprint.
- 3rd Party tested and independently verified.
- Dedicated team of experts available to provide support.

Model Types:

- STC (Standard)
- STF (Fiberglass)
- EOS (Extended Oil Storage)
- OSR (Oil and Sand Removal)
- MAX (Custom designed unit, specific to site)

Configuration Types:

- Inlet unit (accommodates inlet flow entry, and multi-pipe entry)
- In-Line (accommodates multi-pipe entry)
- Submerged Unit (accommodates the site’s tailwater conditions)
- Series Unit (combines treatment in two systems)

Please Maintain Your Stormceptor

To ensure long-term environmental protection through continued performance as originally designed for your site, **Stormceptor must be maintained**, as any stormwater treatment practice does. The need for maintenance is determined through inspection of the Stormceptor. Procedures for inspection are provided within this document. Maintenance of the Stormceptor is performed from the surface via vacuum truck.

If you require information about Stormceptor, or assistance in finding resources to facilitate inspections or maintenance of your Stormceptor please call your local Stormceptor Licensee or Imbrium® Systems.

2 – Stormceptor Operation & Components

Stormceptor is a flexibly designed underground stormwater quality treatment device that is unparalleled in its effectiveness for pollutant capture and retention using patented flow separation technology.

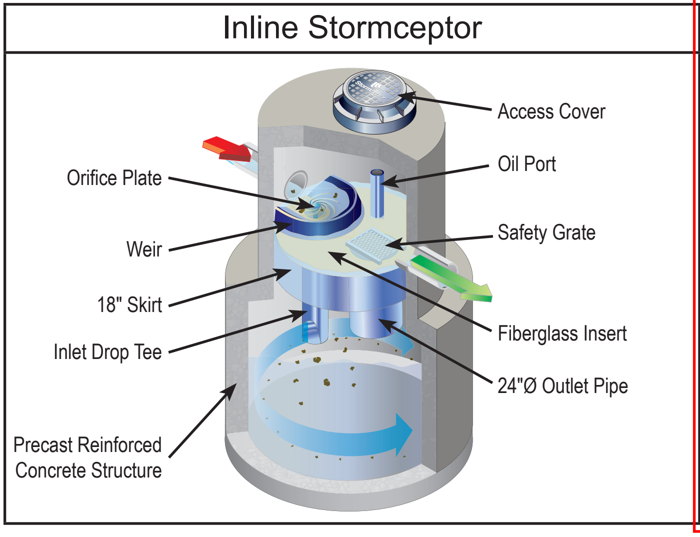
Stormceptor creates a non-turbulent treatment environment below the insert platform within the system. The insert diverts water into the lower chamber, allowing free oils and debris to rise, and sediment to settle under relatively low velocity conditions. These pollutants are trapped and stored below the insert and protected from large runoff events for later removal during the maintenance procedure.

With thousands of units operating worldwide, Stormceptor delivers reliable protection every day, in every storm. The patented Stormceptor design prohibits the scour and release of captured pollutants, ensuring superior water quality treatment and protection during even the most extreme storm events. Stormceptor's proven performance is backed by the longest record of lab and field verification in the industry.

Stormceptor Schematic and Component Functions

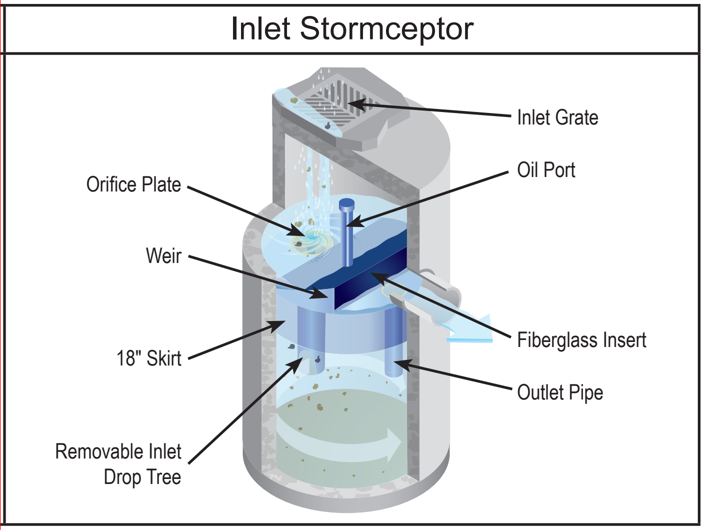
Below are schematics of two common Stormceptor configurations with key components identified and their functions briefly described.

Figure 1.



Inline Stormceptor

Figure 2.



Inlet Stormceptor

- **Manhole access cover** – provides access to the subsurface components
- **Precast reinforced concrete structure** – provides the vessel's watertight structural support
- **Fiberglass insert** – separates vessel into upper and lower chambers
- **Weir** – directs incoming stormwater and oil spills into the lower chamber
- **Orifice plate** – prevents scour of accumulated pollutants
- **Inlet drop tee** – conveys stormwater into the lower chamber
- **Fiberglass skirt** – provides double-wall containment of hydrocarbons
- **Outlet riser pipe** – conveys treated water to the upper chamber; primary vacuum line access port for sediment removal
- **Oil inspection port** – primary access for measuring oil depth and oil removal
- **Safety grate** – safety measure to cover riser pipe in the event of manned entry into vessel

3 – Stormceptor Identification

Stormceptor is available in both precast concrete and fiberglass vessels, with precast concrete often being the dominant material of construction.

In the Stormceptor, a patented, engineered fiberglass insert separates the structure into an upper chamber and lower chamber. The lower chamber will remain full of water, as this is where the pollutants are sequestered for later removal. Multiple Stormceptor model (STC, OSR, EOS, MAX and STF) configurations exist, each to be inspected and maintained in a similar fashion.

Each unit is easily identifiable as a Stormceptor by the trade name "Stormceptor" embossed on each access cover at the surface. To determine the location of "inlet" Stormceptor units with horizontal catch basin inlet, look down into the grate as the Stormceptor insert will be visible. The name "Stormceptor" is not embossed on inlet models due to the variability of inlet grates used/ approved across North America.

Once the location of the Stormceptor is determined, the model number may be identified by comparing the measured depth from the fiberglass insert level at the outlet pipe's invert (water level) to the bottom of the tank using **Table 1**.

In addition, starting in 1996 a metal serial number tag containing the model number has been affixed to the inside of the unit, on the fiberglass insert. If the unit does not have a serial number, or if there is any uncertainty regarding the size of the unit using depth measurements, please contact your local Stormceptor Representative for assistance.

Sizes/Models

Typical general dimensions and capacities of the standard precast STC, EOS & OSR Stormceptor models in both USA and Canada/International (excluding South East Asia and Australia) are provided in **Tables 1 and 2**. Typical rim to invert measurements are provided later in this document. The total depth for cleaning will be the sum of the depth from outlet pipe invert (generally the water level) to rim (grade) and the depth from outlet pipe invert to the precast bottom of the unit. Note that depths and capacities may vary slightly between regions.

Table 1A. (US) Stormceptor Dimensions – Insert to Base of Structure

STC Model	Insert to Base (in.)
450	60
900	55
1200	71
1800	105
2400	94
3600	134
4800	128
6000	150
7200	134
11000*	128
13000*	150
16000*	134

EOS Model	Insert to Base (in.)
4-175	60
9-365	55
12-590	71
18-1000	105
24-1400	94
36-1700	134
48-2000	128
60-2500	150
72-3400	134
110-5000*	128
130-6000*	150
160-7800*	134

OSR Model	Insert to Base (in.)
65	60
140	55
250	94
390	128
560	134
780*	128
1125*	134

Typical STF m (in.)
1.5 (60)
1.5 (61)
1.8 (73)
2.9 (115)
2.3 (89)
3.2 (127)
2.9 (113)
3.5 (138)
3.3 (128)

Notes:

1. *Depth Below Pipe Inlet Invert to the Bottom of Base Slab can vary slightly by manufacturing facility, and can be modified to accommodate specific site designs, pollutant loads or site conditions. Contact your local representative for assistance.*

   **Consist of two chamber structures in series.*

Table 1B. (CA & Int'l) Stormceptor Dimensions – Insert to Base of Structure

STC Model	Insert to Base (m)	EOS Model	Insert to Base (m)	OSR Model	Insert to Base (m)	Typical STF m (in.)
300	1.5	300	1.5	300	1.7	1.5 (60)
750	1.5	750	1.5	750	1.6	1.5 (61)
1000	1.8	1000	1.8			1.8 (73)
1500	2.8					2.9 (115)
2000	2.8	2000	2.8	2000	2.6	2.3 (89)
3000	3.7	3000	3.7			3.2 (127)
4000	3.4	4000	3.4	4000	3.6	2.9 (113)
5000	4.0	5000	4.0			3.5 (138)
6000	3.7	6000	3.7	6000	3.7	3.3 (128)
9000*	3.4	9000*	3.4	9000*	3.6	
11000*	4.0	10000*	4.0			
14000*	3.7	14000*	3.7	14000*	3.7	

Notes:

1. *Depth Below Pipe Inlet Invert to the Bottom of Base Slab can vary slightly by manufacturing facility, and can be modified to accommodate specific site designs, pollutant loads or site conditions. Contact your local representative for assistance.*

   **Consist of two chamber structures in series.*

Table 2A. (US) Storage Capacities

STC Model	Hydrocarbon Storage Capacity gal	Sediment Capacity ft^3	**EOS Model**	Hydrocarbon Storage Capacity gal	**OSR Model**	Hydrocarbon Storage Capacity gal	Sediment Capacity ft^3
450	86	46	**4-175**	175	**065**	115	46
900	251	89	**9-365**	365	**140**	233	58
1200	251	127	**12-590**	591			
1800	251	207	**18-1000**	1198			
2400	840	205	**24-1400**	1457	**250**	792	156
3600	840	373	**36-1700**	1773			
4800	909	543	**48-2000**	2005	**390**	1233	465
6000	909	687	**60-2500**	2514			
7200	1059	839	**72-3400**	3418	**560**	1384	690
11000*	2797	1089	**110-5000***	5023	**780***	2430	930
13000*	2797	1374	**130-6000***	6041			
16000*	3055	1677	**160-7800***	7850	**1125***	2689	1378

Notes:

1. *Hydrocarbon & Sediment capacities can be modified to accommodate specific site design requirements, contact your local representative for assistance.*

   **Consist of two chamber structures in series.*

Table 2B. (CA & Int'l) Storage Capacities

STC Model	Hydrocarbon Storage Capacity L	Sediment Capacity L	**EOS Model**	Hydrocarbon Storage Capacity L	**OSR Model**	Hydrocarbon Storage Capacity L	Sediment Capacity L
300	300	1450	**300**	662	**300**	300	1500
750	915	3000	**750**	1380	**750**	900	3000
1000	915	3800	**1000**	2235			
1500	915	6205					
2000	2890	7700	**2000**	5515	**2000**	2790	7700
3000	2890	11965	**3000**	6710			
4000	3360	16490	**4000**	7585	**4000**	4700	22200
5000	3360	20940	**5000**	9515			
6000	3930	26945	**6000**	12940	**6000**	5200	26900
9000*	10555	32980	**9000***	19010	**9000***	9300	33000
11000*	10555	37415	**10000***	22865			
14000*	11700	53890	**14000***	29715	**14000***	10500	53900

Notes:

1. *Hydrocarbon & Sediment capacities can be modified to accommodate specific site design requirements, contact your local representative for assistance.*

   **Consist of two chamber structures in series.*

4 – Stormceptor Inspection & Maintenance

Regular inspection and maintenance is a proven, cost-effective way to maximize water resource protection for all stormwater pollution control practices, and is required to insure proper functioning of the Stormceptor. Both inspection and maintenance of the Stormceptor is easily performed from the surface. Stormceptor's patented technology has no moving parts, simplifying the inspection and maintenance process.

Please refer to the following information and guidelines before conducting inspection and maintenance activities.

When is inspection needed?

- Post-construction inspection is required prior to putting the Stormceptor into service.
- Routine inspections are recommended during the first year of operation to accurately assess the sediment accumulation.
- Inspection frequency in subsequent years is based on the maintenance plan developed in the first year.
- Inspections should also be performed immediately after oil, fuel, or other chemical spills.

When is maintenance cleaning needed?

- For optimum performance, the unit should be cleaned out once the sediment depth reaches the recommended maintenance sediment depth, which is approximately 15% of the unit's total storage capacity (see **Table 2**). The frequency should be adjusted based on historical inspection results due to variable site pollutant loading.

- Sediment removal is easier when removed on a regular basis at or prior to the recommended maintenance sediment depths, as sediment build-up can compact making removal more difficult.
- The unit should be cleaned out immediately after an oil, fuel or chemical spill.

What conditions can compromise Stormceptor performance?

- If construction sediment and debris is not removed prior to activating the Stormceptor unit, maintenance frequency may be reduced.
- If the system is not maintained regularly and fills with sediment and debris beyond the capacity as indicated in **Table 2**, pollutant removal efficiency may be reduced.
- If an oil spill(s) exceeds the oil capacity of the system, subsequent spills may not be captured.
- If debris clogs the inlet of the system, removal efficiency of sediment and hydrocarbons may be reduced.
- If a downstream blockage occurs, a backwater condition may occur for the Stormceptor and removal efficiency of sediment and hydrocarbons may be reduced.

What training is required?

The Stormceptor is to be inspected and maintained by professional vacuum cleaning service providers with experience in the maintenance of underground tanks, sewers and catch basins. For typical inspection and maintenance activities, no specific supplemental training is required for the Stormceptor. Information provided within this Manual (provided to the site owner) contains sufficient guidance to maintain the system properly.

In unusual circumstances, such as if a damaged component needs replacement or some other condition requires manned entry into the vessel, confined space entry procedures must be followed. Only professional maintenance service providers trained in these procedures should enter the vessel. Service provider companies typically have personnel who are trained and certified in confined space entry procedures according to local, state, and federal standards.

What equipment is typically required for inspection?

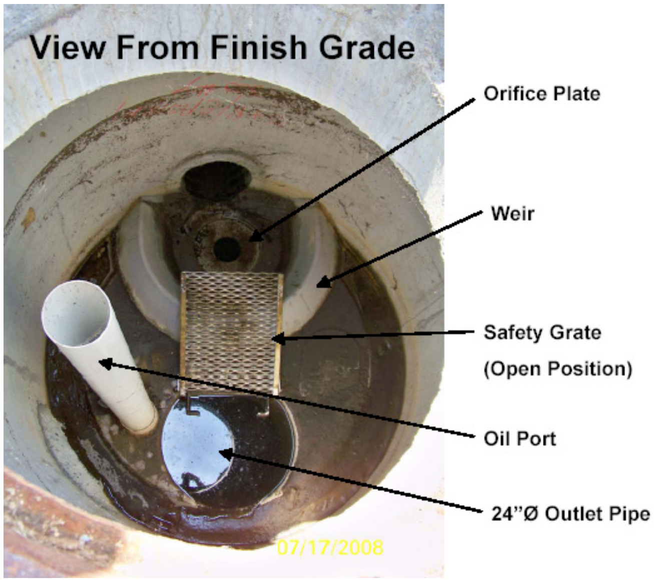
- Manhole access cover lifting tool
- Oil dipstick / Sediment probe with ball valve (typically ¾-inch to 1-inch diameter)
- Flashlight
- Camera
- Data log / Inspection Report
- Safety cones and caution tape
- Hard hat, safety shoes, safety glasses, and chemical-resistant gloves

Recommended Stormceptor Inspection Procedure:

- Stormceptor is to be inspected from grade through a standard surface manhole access cover.
- Sediment and oil depth inspections are performed with a sediment probe and oil dipstick.
- Oil depth is measured through the oil inspection port, either a 4-inch (100 mm) or 6-inch (150 mm) diameter port.
- Sediment depth can be measured through the oil inspection port or the 24-inch (610 mm) diameter outlet riser pipe.
- Inspections also involve a visual inspection of the internal components of the system.

Figure 3.

Figure 4.



What equipment is typically required for maintenance?

- Vacuum truck equipped with water hose and jet nozzle
- Small pump and tubing for oil removal
- Manhole access cover lifting tool
- Oil dipstick / Sediment probe with ball valve (typically ¾-inch to 1-inch diameter)
- Flashlight
- Camera
- Data log / Inspection Report
- Safety cones
- Hard hats, safety shoes, safety glasses, chemical-resistant gloves, and hearing protection for service providers
- Gas analyzer, respiratory gear, and safety harness for specially trained personnel if confined space entry is required

Recommended Stormceptor Maintenance Procedure

Maintenance of Stormceptor is performed using a vacuum truck.

No entry into the unit is required for maintenance. ***DO NOT ENTER THE STORMCEPTOR CHAMBER*** unless you have the proper personal safety equipment, have been trained and are qualified to enter a confined space, as identified by local Occupational Safety and Health Regulations (e.g. 29 CFR 1910.146 or Canada Occupational Safety and Health Regulations – SOR/86-304). Without the proper equipment, training and permit, entry into confined spaces can result in serious bodily harm and potentially death. Consult local, provincial, and/or state regulations to determine the requirements for confined space entry. Be aware, and take precaution that the Stormceptor fiberglass insert may be slippery. In addition, be aware that some units do not have a safety grate to cover the outlet riser pipe that leads to the submerged, lower chamber.

- Ideally maintenance should be conducted during dry weather conditions when no flow is entering the unit.
- Stormceptor is to be maintained through a standard surface manhole access cover.
- Insert the oil dipstick into the oil inspection port. If oil is present, pump off the oil layer into separate containment using a small pump and tubing.
- Maintenance cleaning of accumulated sediment is performed with a vacuum truck.
    - For 6-ft (1800 mm) diameter models and larger, the vacuum hose is inserted into the lower chamber via the 24-inch (610 mm) outlet riser pipe.
    - For 4-ft (1200 mm) diameter model, the removable drop tee is lifted out, and the vacuum hose is inserted into the lower chamber via the 12-inch (305 mm) drop tee hole.

Figure 5.

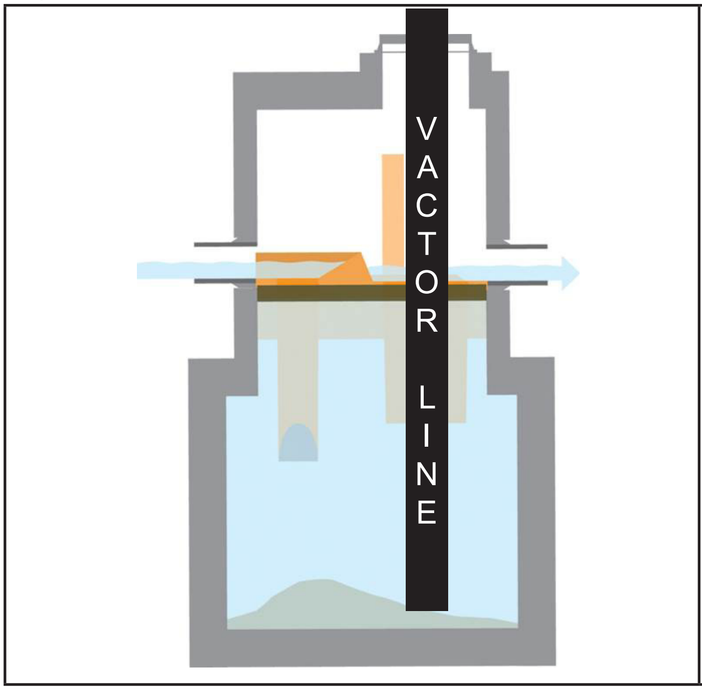
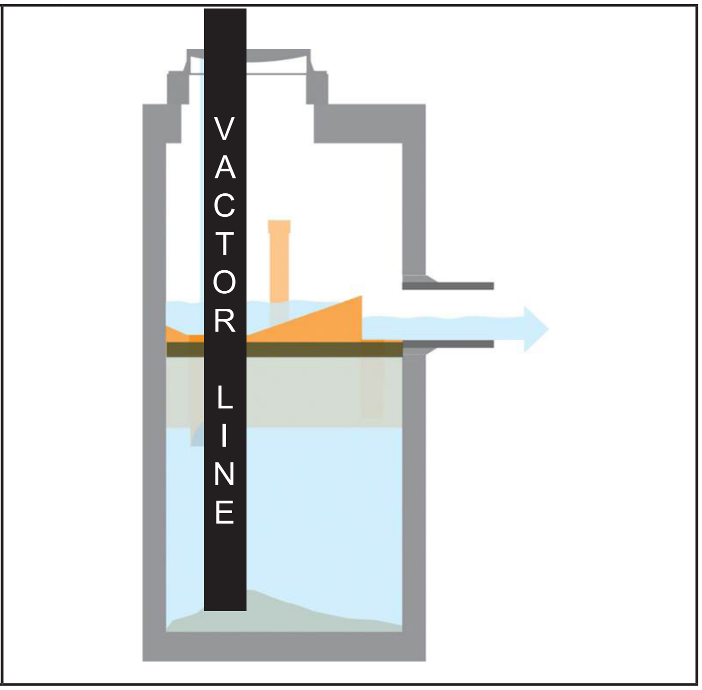


Figure 6.



- Using the vacuum hose, decant the water from the lower chamber into a separate containment tank or to the sanitary sewer, if permitted by the local regulating authority.
- Remove the sediment sludge from the bottom of the unit using the vacuum hose. For large Stormceptor units, a flexible hose is often connected to the primary vacuum line for ease of movement in the lower chamber.
- Units that have not been maintained regularly, have surpassed the maximum recommended sediment capacity, or contain damaged components may require manned entry by trained personnel using safe and proper confined space entry procedures.

Figure 7.

Figure 8.

A maintenance worker stationed at the above ground surface uses a vacuum hose to evacuate water, sediment, and debris from the system.

What is required for proper disposal?

The requirements for the disposal of material removed from Stormceptor units are similar to that of any other stormwater treatment Best Management Practices (BMP). Local guidelines should be consulted prior to disposal of the separator contents. In most areas the sediment, once dewatered, can be disposed of in a sanitary landfill. It is not anticipated that the sediment would be classified as hazardous waste. This could be site and pollutant dependent. In some cases, approval from the disposal facility operator/agency may be required.

What about oil spills?

Stormceptor is often implemented in areas where there is high potential for oil, fuel or other hydrocarbon or chemical spills. Stormceptor units should be cleaned immediately after a spill occurs by a licensed liquid waste hauler. You should also notify the appropriate regulatory agencies as required in the event of a spill.

What if I see an oil rainbow or sheen at the Stormceptor outlet?

With a steady influx of water with high concentrations of oil, a sheen may be noticeable at the Stormceptor outlet. This may occur because a hydrocarbon rainbow or sheen can be seen at very small oil concentrations (< 10 ppm). Stormceptor is effective at removing 95% of free oil, and the appearance of a sheen at the outlet with high influent oil concentrations does not mean that the unit is not working to this level of removal. In addition, if the influent oil is emulsified, the Stormceptor will not be able to remove it. The Stormceptor is designed for free oil removal and not emulsified or dissolved oil conditions.

What factors affect the costs involved with inspection/maintenance?

The Vacuum Service Industry for stormwater drainage and sewer systems is a well-established sector of the service industry that cleans underground tanks, sewers and catch basins. Costs to clean Stormceptor units will vary. Inspection and maintenance costs are most often based on unit size, the number of units on a site, sediment/oil/hazardous material loads, transportation distances, tipping fees, disposal requirements and other local regulations.

What factors predict maintenance frequency?

Maintenance frequency will vary with the amount of pollution on your site (number of hydrocarbon spills, amount of sediment, site activity and use, etc.). It is recommended that the frequency of maintenance be increased or reduced based on local conditions. If the sediment load is high from an unstable site or sediment loads transported from upstream catchments, maintenance may be required semi-annually. Conversely once a site has stabilized, maintenance may be required less frequently (for example: two to seven year, site and situation dependent). Maintenance should be performed immediately after an oil spill or once the sediment depth in Stormceptor reaches the value specified in **Table 3** based on the unit size.

Table 3A. (US) Recommended Sediment Depths Indicating Maintenance

STC Model	Maintenance Sediment depth (in)	EOS Model	Maintenance Sediment depth (in)	Oil Storage Depth (in)	OSR Model	Maintenance Sediment depth (in)
450	8	**4-175**	9	24	**065**	8
900	8	**9-365**	9	24	**140**	8
1200	10	**12-590**	11	39		
1800	15					
2400	12	**24-1400**	14	68	**250**	12
3600	17	**36-1700**	19	79		
4800	15	**48-2000**	16	68	**390**	17
6000	18	**60-2500**	20	79		
7200	15	**72-3400**	17	79	**560**	17
11000*	17	**110-5000***	16	68	**780***	17
13000*	20	**130-6000***	20	79		
16000*	17	**160-7800***	17	79	**1125***	17

Note:

1. *The values above are for typical standard units.*

   **Per structure.*

Table 3B. (CA & Int'l) Recommended Sediment Depths Indicating Maintenance

STC Model	Maintenance Sediment depth (mm)	EOS Model	Maintenance Sediment depth (mm)	Oil Storage Depth (mm)	OSR Model	Maintenance Sediment depth (mm)
300	225	**300**	225	610	**300**	200
750	230	**750**	230	610	**750**	200
1000	275	**1000**	275	990		
1500	400					
2000	350	**2000**	350	1727	**2000**	300
3000	475	**3000**	475	2006		
4000	400	**4000**	400	1727	**4000**	375
5000	500	**5000**	500	2006		
6000	425	**6000**	425	2006	**6000**	375
9000*	400	**9000***	400	1727	**9000***	425
11000*	500	**10000***	500	2006		
14000*	425	**14000***	425	2006	**14000***	425

Note:

1. *The values above are for typical standard units.*

   **Per structure.*

Replacement parts

Since there are no moving parts during operation in a Stormceptor, broken, damaged, or worn parts are not typically encountered. Therefore, inspection and maintenance activities are generally focused on pollutant removal. However, if replacements parts are necessary, they may be purchased by contacting your local Stormceptor Representative, or Imbrium Systems.

The benefits of regular inspection and maintenance are many – from ensuring maximum operation efficiency, to keeping maintenance costs low, to the continued protection of natural waterways – and provide the key to Stormceptor's long and effective service life.

Stormceptor Inspection and Maintenance Log

Stormceptor Model No: ______________________________

Allowable Sediment Depth: ______________________________

Serial Number: ______________________________

Installation Date: ______________________________

Location Description of Unit: ______________________________

Other Comments: ______________________________

Contact Information

Questions regarding the Stormceptor can be addressed by contacting your area Stormceptor Licensee, Imbrium Systems, or visit our website at www.stormceptor.com.

Stormceptor Licensees:

CANADA

Lafarge Canada Inc.
www.lafargepipe.com

403-292-9502 / 1-888-422-4022	Calgary, AB
780-468-5910	Edmonton, AB
204-958-6348	Winnipeg, MB, NW. ON, SK

Langley Concrete Group
www.langleyconcretegroup.com

604-502-5236	BC

Hanson Pipe & Precast Inc.
www.hansonpipeandprecast.com

519-622-7574 / 1-888-888-3222	ON

Lécuyer et Fils Ltée.
www.lecuyerbeton.com

450-454-3928 / 1-800-561-0970	QC

Strescon Limited
www.strescon.com

902-494-7400	NS, NF
506-633-8877	NB, PE

UNITED STATES

Rinker Materials
www.rinkerstormceptor.com
1-800-909-7763

AUSTRALIA & SOUTHEAST ASIA, including New Zealand & Japan

Humes Water Solutions
www.humes.com.au
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Imbrium Systems Inc. & Imbrium Systems LLC

Canada	1-416-960-9900 / 1-800-565-4801
United States	1-301-279-8827 / 1-888-279-8826
International	+1-416-960-9900 / +1-301-279-8827
Email	info@imbriumsystems.com

www.imbriumsystems.com
www.stormceptor.com

GARCIA • GALUSKA • DESOUSA
Consulting Engineers Inc.

Project: Millbury Fire Station
Location: Millbury, MA

Geotechnical Data Report

Prepared by McPhail Associates, LLC dated November 3, 2020.

GEOTECHNICAL DATA REPORT

MILLBURY FIRE STATION

MILLBURY, MASSACHUSETTS

NOVEMBER 3, 2020

Prepared For:

Context Architecture
68 Harrison Avenue
Boston, MA 02111

2269 Massachusetts Avenue
Cambridge, MA 02140
www.mcphailgeo.com
(617) 868-1420

PROJECT NO. 6775.2.01

November 3, 2020

Context Architecture
68 Harrison Avenue
Boston, MA 02111

Attention: Mr. Zeljko Toncic, AIA, LEED AP

Reference: Proposed Millbury Fire Station; Millbury, Massachusetts
Geotechnical Data Report

Ladies and Gentlemen:

This report documents our supplementary subsurface exploration program for the proposed Millbury Fire Station to be located at 130 Elm Street in Millbury, Massachusetts.

This letter was prepared in accordance with our proposal dated August 27, 2020, and the subsequent authorization of Context Architecture. These services are subject to the limitations contained in **Appendix A**.

Purpose and Scope

The purpose of our supplementary subsurface exploration program was to provide additional subsurface information across the site. Specifically, the top of bedrock and its condition were assessed to improve the understanding of how it will impact our preliminary foundation design recommendations and construction considerations for the proposed fire station.

Available Information

Information provided to McPhail Associates, LLC (McPhail) by Context Architecture included the following:

- A boundary and topographic survey drawing entitled “Existing Conditions Plan of 130 Elm Street in Millbury, MA, Owned by Town of Millbury,” prepared by Andrews Survey and Engineering, Inc. of Uxbridge, Massachusetts, and dated September 25, 2019; and

- A draft proposed site grading plan entitled “Millbury Fire Station,” prepared by Garcia Galuska DeSousa Consulting Engineers Inc. of Dartmouth, Massachusetts and dated October 13, 2020.

Elevations referenced herein are in feet and are understood to be referenced to the National Geodetic Vertical Datum of 1929 (NGVD 29).

Previous Reports

A Preliminary Geotechnical Engineering Report (PGER) dated May 23, 2019 for the subject project was previously prepared by McPhail.

Existing Conditions and Proposed Construction

Fronting onto Elm Street to the southeast, the project site, which is irregularly-shaped and occupies an approximate 85,000-square-foot plan area, is also bounded by Waters Street to the northeast, residences that front onto River Street to the southwest, and residential properties to the northwest. The subject site is located about 500 feet to the west of the Millbury Fire Department Headquarters located at 127 Elm Street. The center of the site is currently occupied by a three-story brick building with an approximate footprint of 7,250 square-feet, which is surrounded by asphalt-paved parking areas and landscaped areas at the limits of the property. The existing ground surface generally slopes gradually downward from approximate Elevation +431 at the exterior walls of the existing building towards the perimeter of the site. Existing slope gradients are generally 12 horizontal to 1 vertical (12H:1V) to the northwest of the existing building and 7H:1V to the northeast, southeast, and southwest. There are mortared stone retaining walls along the site frontages on Water Street, Elm Street, and River Street, supporting up to an approximate 4-foot difference in grade between the site and the lower concrete sidewalks along these streets.

The proposed redevelopment is understood to consist of the demolition of the existing three-story brick building and the construction of a new fire station in the middle of the site. No below-grade space is anticipated to be included as part of the proposed fire station. The lowest level slab of the proposed structure is understood to be at approximate Elevation +423.6, up to 8 feet lower than the existing grades. It is understood that the remainder of the site outside of the proposed building will also be regraded to establish surrounding grades level with the lowest level slab. Asphalt-paved driveways, including parking areas, connecting the proposed lowest level equipment bays with Elm Street to the southeast and Waters Street to the northeast are also included in the proposed construction, along with stormwater infiltration systems to the southeast and north of the proposed building.

Previous Subsurface Explorations

A subsurface exploration program consisting of four (4) borings was conducted at the site on April 19, 2019 by Carr-Dee Corp. of Medford, Massachusetts under contract to McPhail. A detailed description of the subsurface conditions encountered within the borings is documented on the boring logs contained in **Appendix C**. Approximate locations of the borings are indicated on the enclosed Subsurface Exploration Plans, **Figure 2**. The previous subsurface exploration program is discussed in greater detail in our Preliminary Geotechnical Engineering Report dated May 23, 2019.

Recent Subsurface Explorations

A subsurface exploration program consisting of fourteen (14) test pits was completed at the site on October 23, 2020 by G. Lopes Construction Company of Taunton, Massachusetts under contract to McPhail. Locations of the test pits are as indicated on the attached Subsurface Exploration Plan, **Figure 2**. Logs of the test pits prepared by McPhail are presented in **Appendix B**.

The test pits were performed utilizing a Caterpillar BH-65 rubber-tired backhoe and backfilled with the excavated soil following completion of the test pit. Eleven (11) of the test pits were terminated upon encountering bedrock or, if bedrock was not encountered within the reach of the excavator, within the natural glacial outwash deposit.

The test pits were monitored by a McPhail representative who performed field layout, prepared field logs, obtained and visually classified soil samples, monitored groundwater conditions in the completed explorations, and determined the required exploration depths based upon the actual subsurface conditions encountered.

Field locations of the explorations were determined by taping from existing site features indicated on the topographic plan. The existing ground surface elevation at each of the recent test pits was determined by a level survey performed by our field staff utilizing vertical control information indicated on the topographic plan provided to us.

Subsurface Conditions

A detailed description of the subsurface conditions encountered within the explorations is documented on the test pit and boring logs contained in **Appendix B** and **Appendix C**, respectively. Approximate locations of the explorations are indicated on the enclosed Subsurface Exploration Plan, **Figure 2**.

The following are generalized descriptions of the subsurface strata that were encountered in the test pits and borings from ground surface downward:

- **Asphalt** – Observed to be approximately 0.2 to 0.5 feet in thickness. Asphalt was encountered within borings B-1 and B-2 and in test pit TP-8, all performed within paved walkways or parking areas adjacent to the existing building.

- **Topsoil** – Very loose, dark brown silty sand with trace gravel. The topsoil was also observed to contain roots and other plant matter. Topsoil was encountered in borings B-3 and B-4 and test pits TP-1, TP-2, TP-3, TP-4, TP-5, TP-6, TP-7, TP-9, TP-10, TP-11, TP-12, TP-13, and TP-14. The topsoil was observed to be approximately 0.5 to 2 feet in thickness.

- **Subsoil** – Very loose to loose, orange to brown silt and sand, varying to a silty sand with trace gravel. The subsoil was encountered underlying the topsoil in test pits

TP-3, TP-4, TP-5, and TP-7, and was observed to be approximately 0.5 feet to 1 foot in thickness.

- **Fill** – Loose to compact, brown silty sand with trace to some gravel. The fill was also observed to contain brick, concrete, asphalt, plastic, metal, wood, and ash and cinders. Within test pit TP-1, several pieces of unreinforced concrete slabs were encountered, which had a maximum dimension of 6 feet and were approximately 6 to 8 inches thick. A section of steel beam, approximately 4 feet long and 4 inches wide, was also encountered within test pit TP-1. Occasional boulders and cobbles were also observed within the fill. The fill material was encountered underlying surficial materials within borings B-1, B-2, B-3, and B-4 and test pits TP-1, TP-2, TP-3, TP-8, TP-9, TP-11, TP-13, and TP-14. Where encountered, the fill was observed to be approximately 1.5 to 7 feet in thickness and extended to depths ranging between 2 to 8 feet below the existing ground surface. Generally, the fill was encountered within the explorations closest to the existing building, and was observed to be underlain by a natural, inorganic glacial outwash deposit or by bedrock.

- **Glacial Outwash** – Compact to very dense, gray to brown to tan silt and sand with some gravel, varying to silty sand and gravel. The glacial outwash was also observed to contain cobbles and boulders, with maximum dimensions of up to 7 feet. The glacial outwash was observed to range in thickness between approximately 2 to at least 9 feet thick and to extend to depths ranging from 1.5 feet to at least 15 feet below the existing ground surface. The glacial outwash was encountered within test pits TP-1, TP-2, TP-3, TP-4, TP-6, TP-7, TP-9, TP-10, TP-11, and TP-13. Test pits TP-1, TP-2, and TP-4 were terminated within the glacial outwash deposit.

- **Bedrock** – Moderately hard to very hard, black to gray, fresh to slightly weathered, sound to moderately closely fractured gneiss. Bedrock was observed to underlie the topsoil within test pit TP-12, the subsoil within test pit TP-5, the fill within test pits TP-8 and TP-14, and the glacial outwash within test pits TP-3, TP-6, TP-7, TP-9, TP-10, TP-11, and TP-14 and borings B-1, B-2, B-3, and B-4. Bedrock was not encountered within test pits TP-1, TP-2, and TP-4, which extended to depths of about 15, 12, and 10 feet, respectively, corresponding to approximate Elevation +412.6, +415.6, and +413.3. The surface of bedrock was encountered at depths ranging between 1 to 10.7 feet below the existing ground surface, or between Elevation +411.8 and Elevation +428.8.

  Within the borings, the surface of bedrock was interpreted from roller bit and sampler refusal, except within boring B-3, which confirmed the surface of bedrock by obtaining one (1) 5-foot long NX size rock core, RC-1. Rock core RC-1 obtained 80% recovery, and was observed to consist of hard to very hard, very slightly to fleshly weathered, slightly to moderately fractured, blended white and gray, fine-grained gneiss, with very close, tight, shallow dipping, smooth to relatively jagged joints, and with thin shallow bedding. The surface of bedrock was observed to generally slope downward in all directions from a high point located to the east of the existing building, defined by test pits TP-6 and TP-10. While the recent program of test pits did not include a test pit to the east of test pits TP-6 and TP-10, the surface of bedrock encountered within test pit TP-10 was observed to slope downwards towards the east. While small pieces of bedrock were able to be broken off utilizing the excavator, the bedrock was generally not "rippable" by the force of the excavator utilized for the test pits. **Figure 3** presents a bedrock surface contour map, generally created by linear interpolation between the elevation of the top of bedrock observed in the test pits and borings.

- **Groundwater** - Groundwater was not encountered within the test pits or borings. It is anticipated that future groundwater levels across the project site may vary from those reported herein based on such factors such as normal seasonal changes, runoff during or following periods of heavy precipitation, and alterations to existing drainage patterns.

Final Comments

The subsurface conditions encountered within the recent explorations, as described herein, are considered to be generally consistent with our initial foundation design recommendations and geotechnical construction considerations presented in our Preliminary Geotechnical Engineering Report dated May 23, 2019. However, it should be noted that based on the proposed building floor slab at Elevation +423.6 and the subsurface conditions encountered in TP-5, TP-7 and TP-8, up to approximately 4 feet of bedrock is anticipated to be required to be removed within the southeast corner of the building. Furthermore, based on the proposed site grading plan, 1 to 10 feet of bedrock removal is anticipated to be required to the south of the proposed building footprint.

McPhail has been retained to provide design assistance during the design phase of this project. The purpose of this involvement is to review the structural foundation drawings and foundation notes for conformance with the recommendations presented in our Preliminary Geotechnical Engineering Report dated May 23, 2019 and to prepare or review the earthwork specification section for inclusion into the Contract Documents for construction.

It is recommended that McPhail also be retained during the construction period to review geotechnical-related submittals, observe final preparation of the foundation bearing surfaces, and observe the placement and compaction of all fill materials in accordance with the provisions of the Massachusetts State Building Code and the provisions of the Contract Documents. Our involvement during the construction phase of the work should minimize costly delays due to unanticipated field problems since our field engineer would be under the direct supervision of our project staff who was responsible for the subsurface exploration programs and foundation design recommendations documented herein and in our Preliminary Geotechnical Engineering Report dated May 23, 2019.

We trust that the above is sufficient for your present requirements. Should you have any questions concerning the recommendations presented herein, please do not hesitate to call us.

Very truly yours,

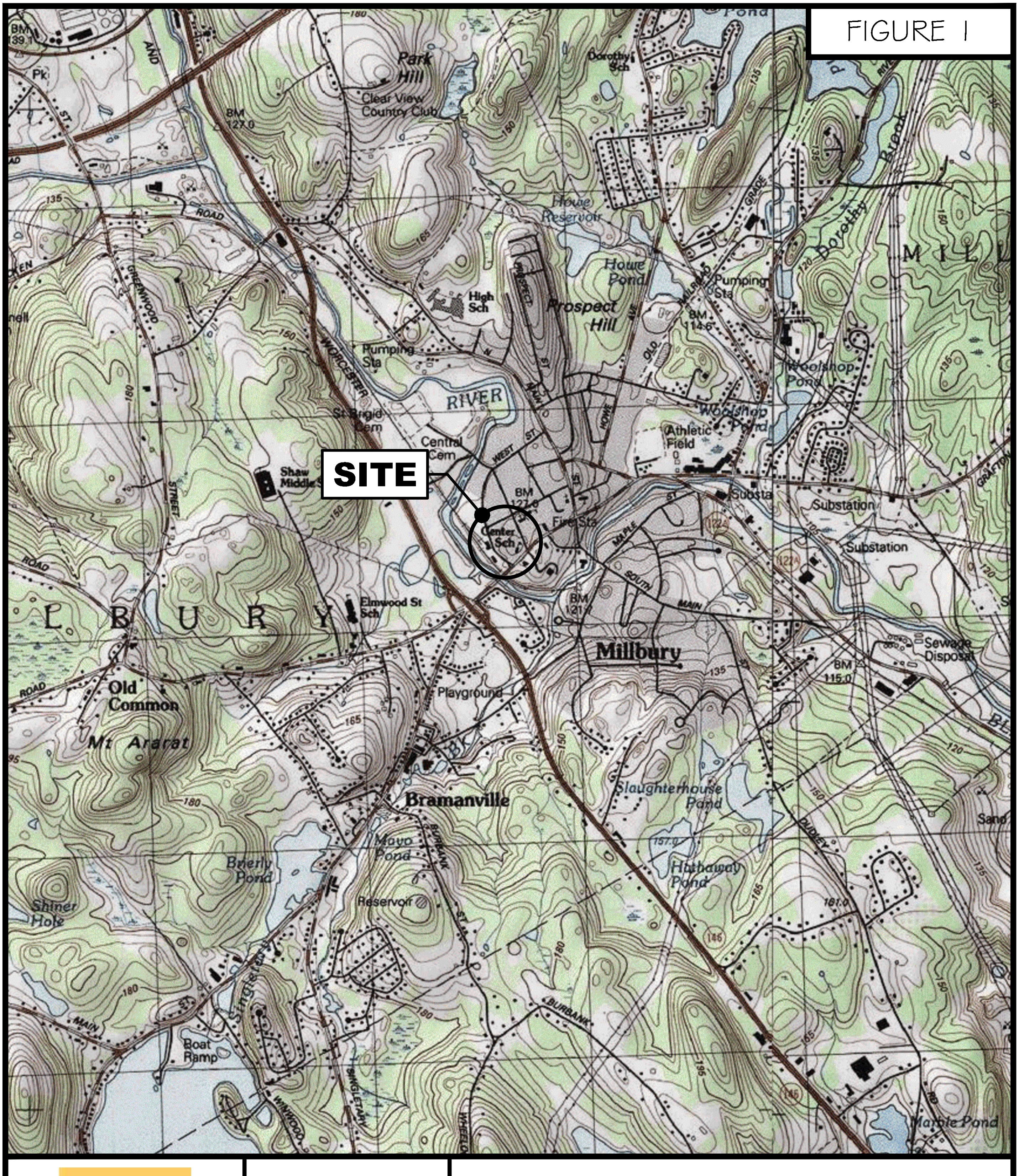
McPHAIL ASSOCIATES, LLC

Eric S. Hinds

Chris M. Erikson, P.E.

N:\Working Documents\Reports\6775_MillburyFireStation_GDR_110320.docx
ESH/cme

FIGURE 1



McPHAIL ASSOCIATES, LLC
Geotechnical and
Geoenvironmental Engineers
2269 Massachusetts Avenue
Cambridge, MA 02140
617/868-1420
617/868-1423 (Fax)
www.mcphailgeo.com

N

SCALE 1:25,000

PROJECT LOCATION PLAN

MILLBURY FIRE STATION

MILLBURY MASSACHUSETTS

LEGEND

▣ — APPROXIMATE LOCATION OF TEST PIT PERFORMED BY G. LOPES CONSTRUCTION, INC. ON OCTOBER 23, 2020 FOR McPHAIL ASSOCIATES, LLC

⊕ — APPROXIMATE LOCATION OF BORING PERFORMED BY CARR-DEE CORP. ON APRIL 19, 2019 FOR McPHAIL ASSOCIATES, LLC

REFERENCE: THIS PLAN WAS PREPARED FROM A 20-SCALE DRAWING ENTITLED, "SITE GRADING PLAN" DATED OCTOBER 15, 2020 PREPARED BY CONTEXT ARCHITECTURE

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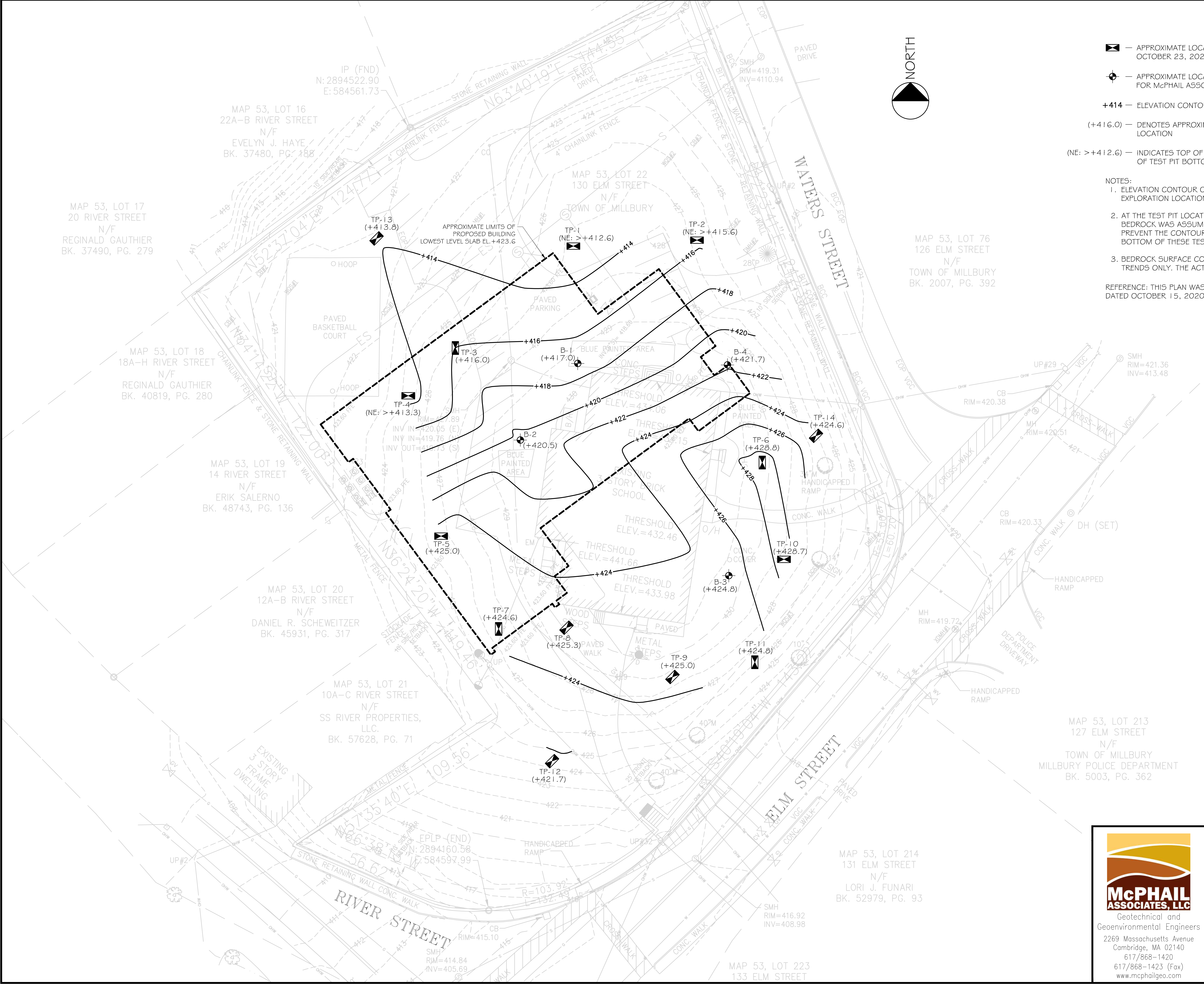
www.mcphailgeo.com

MILLBURY FIRE STATION
MILLBURY MASSACHUSETTS
SUBSURFACE EXPLORATION PLAN
FOR
CONTEXT ARCHITECTURE
BY
McPHAIL ASSOCIATES, LLC

Date: OCTOBER 2020	Dwn: M.B.S.	Chkd: E.S.H.	Scale: 1" = 20'
Project No: 6775			FIGURE 2

FILE NAME: N:\Acad\JOBS\6775\FER\6775-F02.dwg



LEGEND

■ — APPROXIMATE LOCATION OF TEST PIT PERFORMED BY G. LOPES CONSTRUCTION, INC. ON OCTOBER 23, 2020 FOR McPHAIL ASSOCIATES, LLC

⊕ — APPROXIMATE LOCATION OF BORING PERFORMED BY CARR-DEE CORP. ON APRIL 19, 2019 FOR McPHAIL ASSOCIATES, LLC

+414 — ELEVATION CONTOUR OF THE TOP OF BEDROCK

(+416.0) — DENOTES APPROXIMATE ELEVATION OF TOP OF BEDROCK ENCOUNTERED AT EXPLORATION LOCATION

(NE: >+412.6) — INDICATES TOP OF BEDROCK NOT ENCOUNTERED AT EXPLORATION AND DENOTES ELEVATION OF TEST PIT BOTTOM

NOTES:

1. ELEVATION CONTOUR OF THE TOP OF BEDROCK ARE BASED ON LINEAR INTERPOLATION BETWEEN EXPLORATION LOCATIONS.
2. AT THE TEST PIT LOCATIONS WHERE BEDROCK WAS NOT ENCOUNTERED, THE SURFACE OF BEDROCK WAS ASSUMED TO BE LOCATED AT THE BOTTOM ELEVATION OF THE TEST PITS TO PREVENT THE CONTOUR LINES FROM INDICATING BEDROCK AT HIGHER ELEVATIONS THAN THE BOTTOM OF THESE TEST PITS.
3. BEDROCK SURFACE CONTOUR LINES ARE PRESENTED FOR THE PURPOSE OF INDICATING GENERAL TRENDS ONLY. THE ACTUAL FIELD CONDITIONS MAY VARY FROM THE INDICATED CONTOURS.

REFERENCE: THIS PLAN WAS PREPARED FROM A 20-SCALE DRAWING ENTITLED, "SITE GRADING PLAN" DATED OCTOBER 15, 2020 PREPARED BY CONTEXT ARCHITECTURE

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MILLBURY FIRE STATION

MILLBURY MASSACHUSETTS

TOP OF BEDROCK CONTOUR PLAN

FOR
CONTEXT ARCHITECTURE
BY
McPHAIL ASSOCIATES, LLC

Date: NOVEMBER 2020
Dwn: M.B.S.
Chkd: E.S.H.
Scale: 1" = 20'
Project No: 6775
FIGURE 3

FILE NAME: N:\Acad\JOBS\6775\FER\6775-F03_Contour.dwg

APPENDIX A:

LIMITATIONS

LIMITATIONS

This data report has been prepared on behalf of and for the exclusive use of Context Architecture for specific application to the proposed Millbury Fire Station in Millbury, Massachusetts in accordance with generally accepted soil and geotechnical engineering practices. No other warranty, expressed or implied, is made.

The information contained in this report was to supplement our preliminary foundation engineering report.

In the event that any changes in nature or design of the proposed construction are planned, the conclusions and recommendations contained in our preliminary report should not be considered valid unless the changes are reviewed and conclusions of this report modified or verified in writing by McPhail Associates, LLC.

The analyses and recommendations presented in our preliminary report are based upon the data obtained from the subsurface explorations performed at the approximate locations indicated on the enclosed plan. If variations in the nature and extent of subsurface conditions between the widely spaced explorations become evident during the course of construction, it will be necessary for a re-evaluation of the recommendations of this report to be made after performing on-site observations during the construction period and noting the characteristics of any variations.

APPENDIX B:

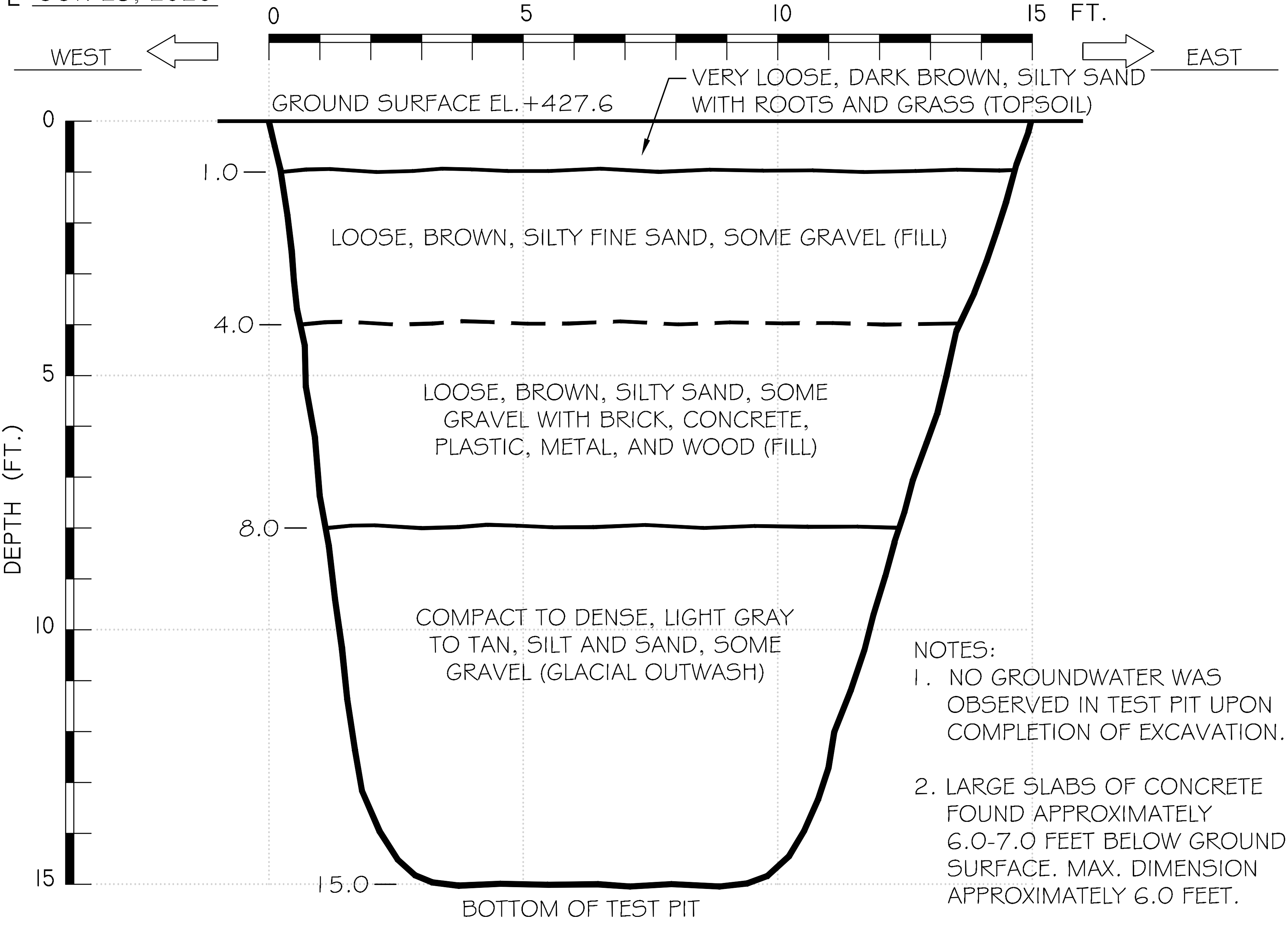
TEST PIT LOGS PREPARED BY MCPHAIL

JOB NO. 6775

DATE OCT. 23, 2020

TEST PIT LOG

TEST PIT NO. 1



NOTES:

1. NO GROUNDWATER WAS OBSERVED IN TEST PIT UPON COMPLETION OF EXCAVATION.

2. LARGE SLABS OF CONCRETE FOUND APPROXIMATELY 6.0-7.0 FEET BELOW GROUND SURFACE. MAX. DIMENSION APPROXIMATELY 6.0 FEET.

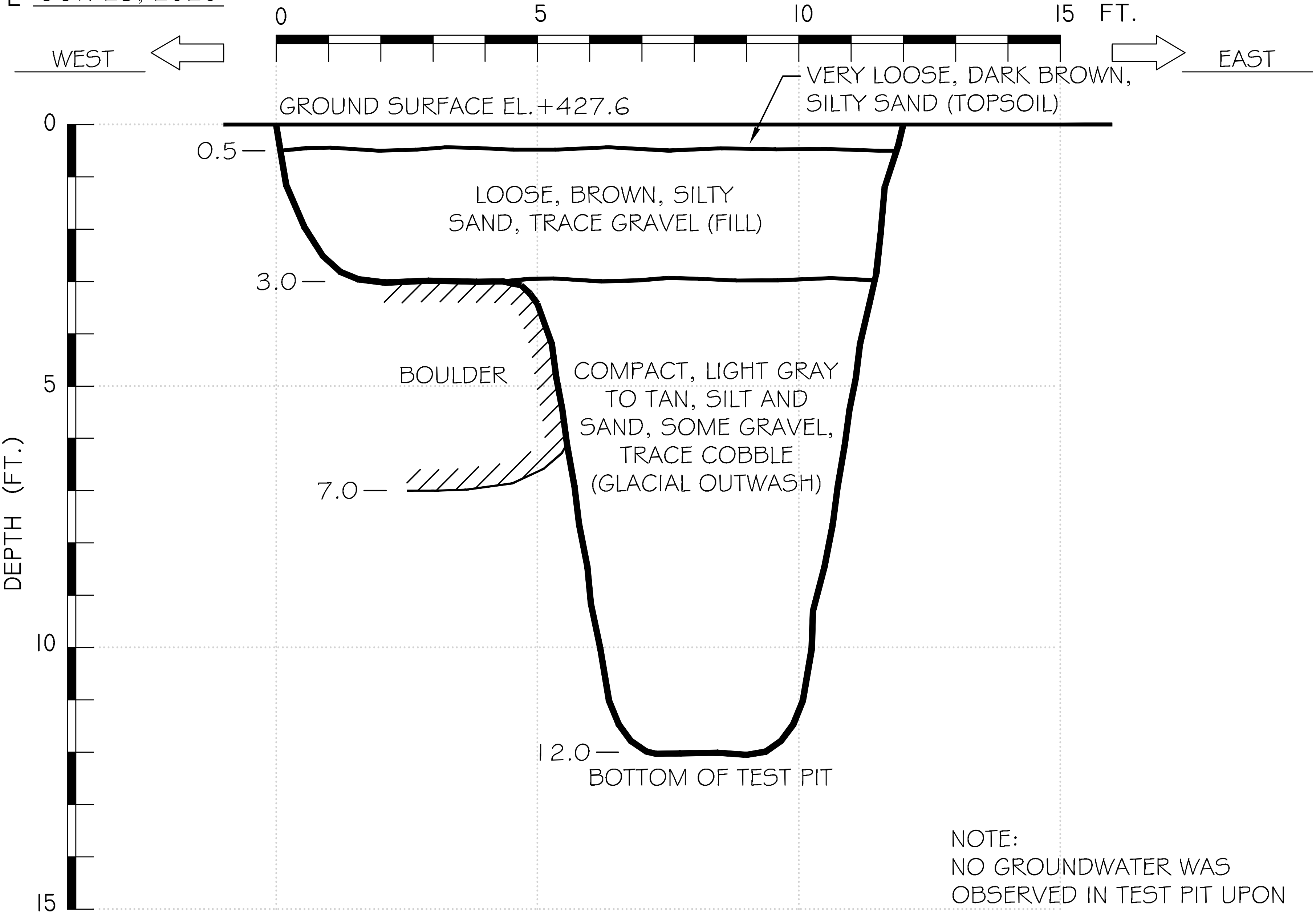
McPHAIL ASSOCIATES, LLC

JOB NO. 6775

DATE OCT. 23, 2020

TEST PIT LOG

TEST PIT NO. 2



NOTE:
NO GROUNDWATER WAS OBSERVED IN TEST PIT UPON COMPLETION OF EXCAVATION

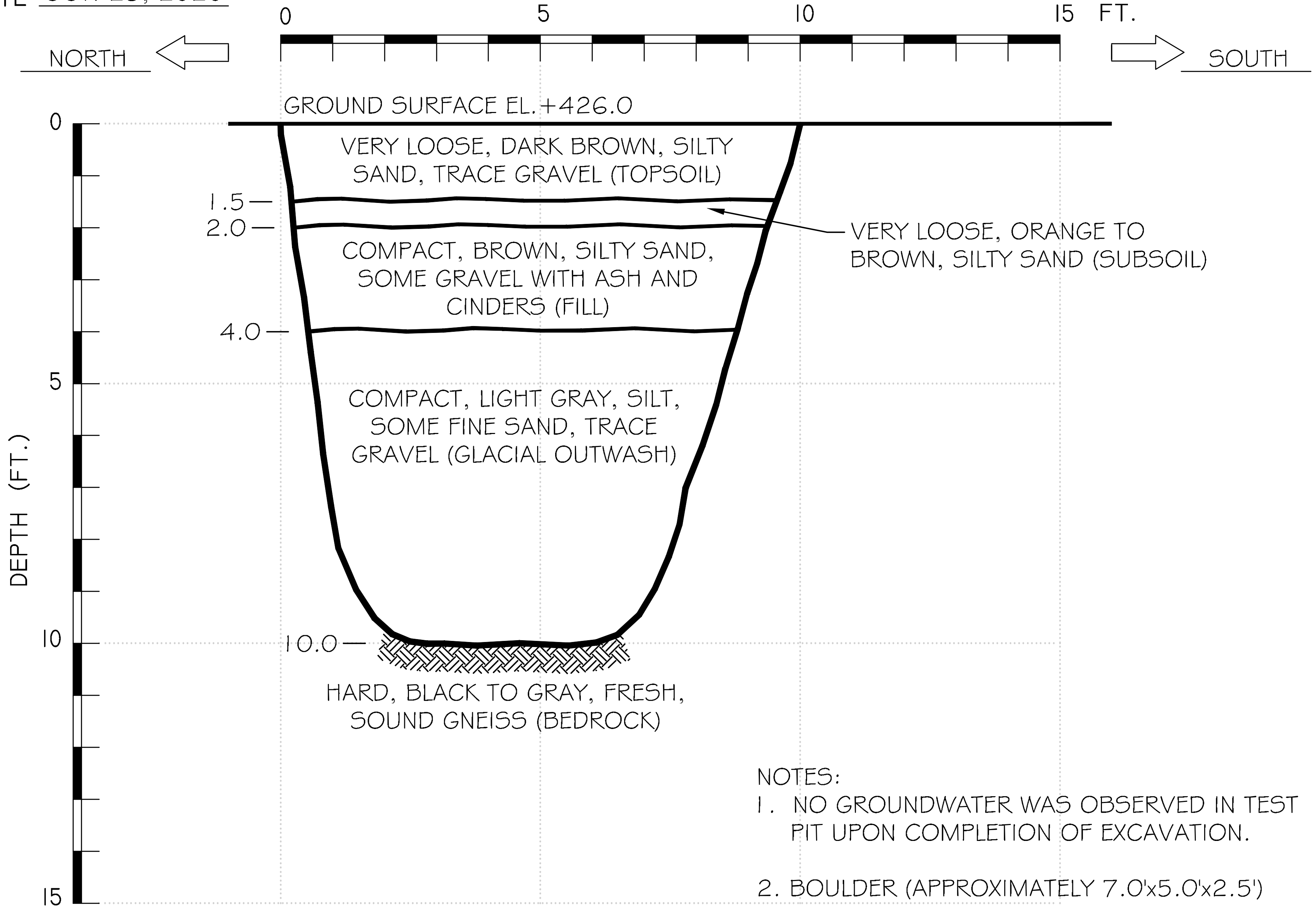
McPHAIL ASSOCIATES, LLC

JOB NO. 6775

DATE OCT. 23, 2020

TEST PIT LOG

TEST PIT NO. 3



NOTES:

1. NO GROUNDWATER WAS OBSERVED IN TEST PIT UPON COMPLETION OF EXCAVATION.

2. BOULDER (APPROXIMATELY 7.0'x5.0'x2.5') ENCOUNTERED IN FILL.

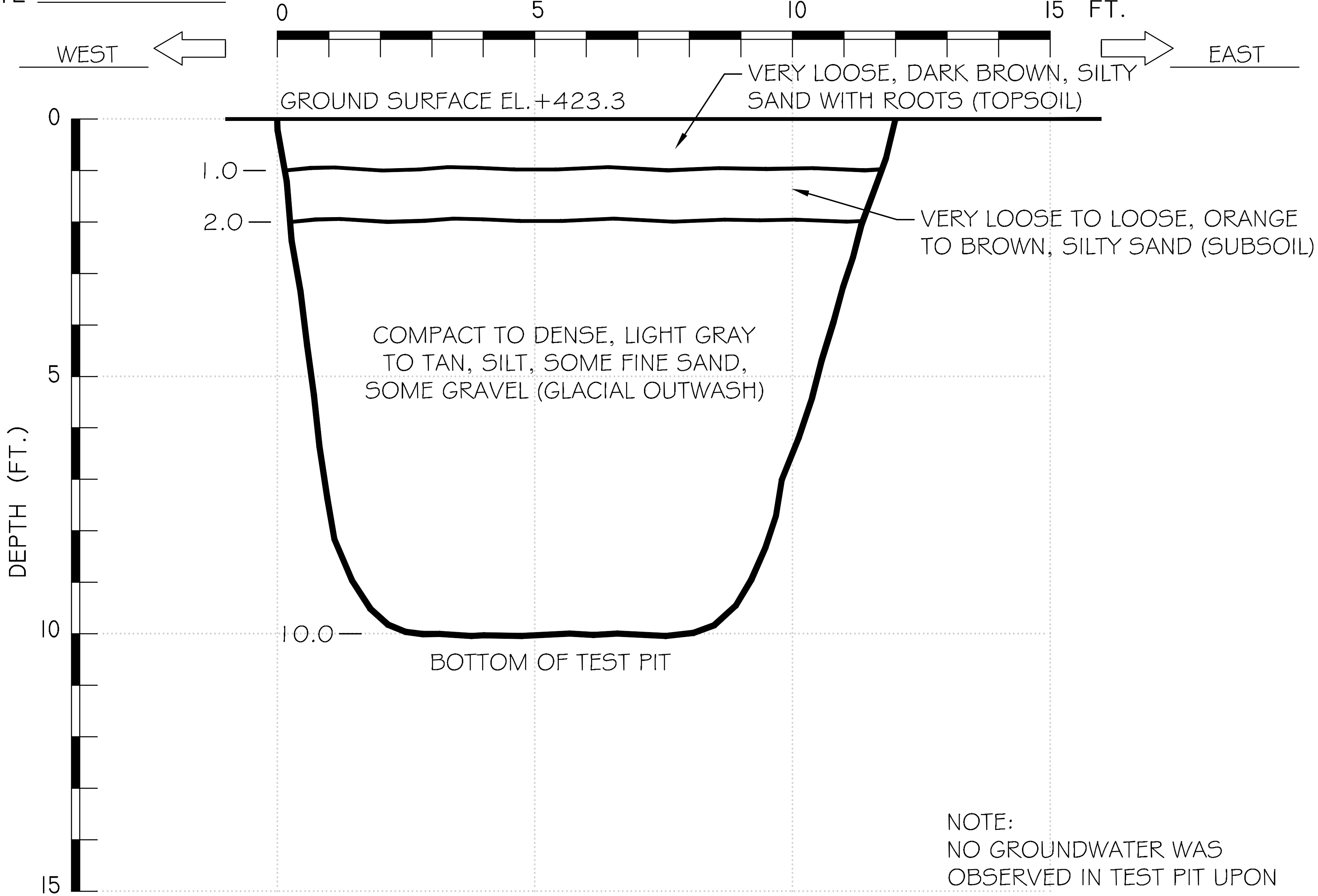
McPHAIL ASSOCIATES, LLC

JOB NO. 6775

DATE OCT. 23, 2020

TEST PIT LOG

TEST PIT NO. 4



GROUND SURFACE EL.+423.3

VERY LOOSE, DARK BROWN, SILTY SAND WITH ROOTS (TOPSOIL)

VERY LOOSE TO LOOSE, ORANGE TO BROWN, SILTY SAND (SUBSOIL)

COMPACT TO DENSE, LIGHT GRAY TO TAN, SILT, SOME FINE SAND, SOME GRAVEL (GLACIAL OUTWASH)

BOTTOM OF TEST PIT

NOTE:
NO GROUNDWATER WAS OBSERVED IN TEST PIT UPON COMPLETION OF EXCAVATION

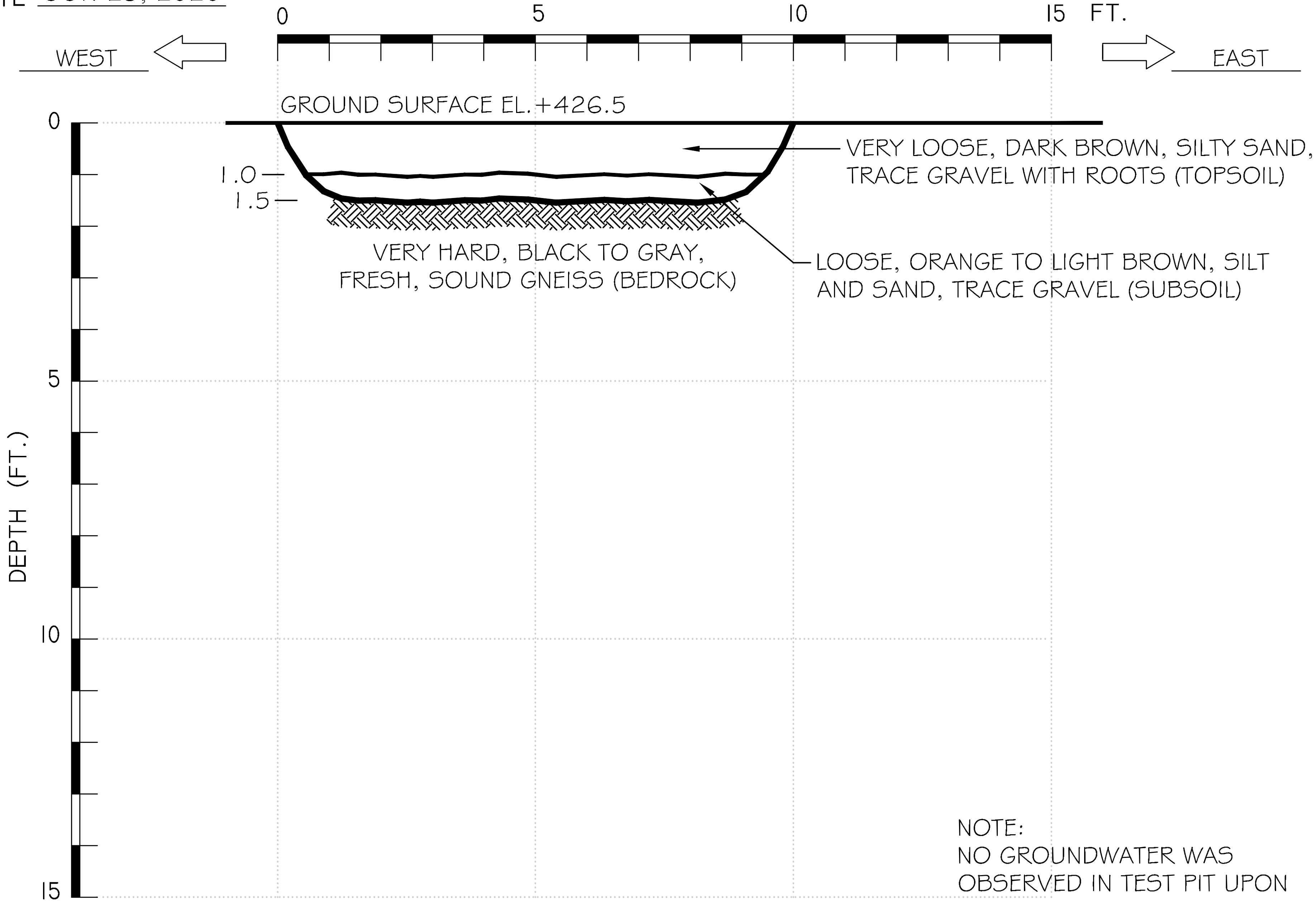
McPHAIL ASSOCIATES, LLC

JOB NO. 6775

DATE OCT. 23, 2020

TEST PIT LOG

TEST PIT NO. 5



NOTE:
NO GROUNDWATER WAS OBSERVED IN TEST PIT UPON COMPLETION OF EXCAVATION

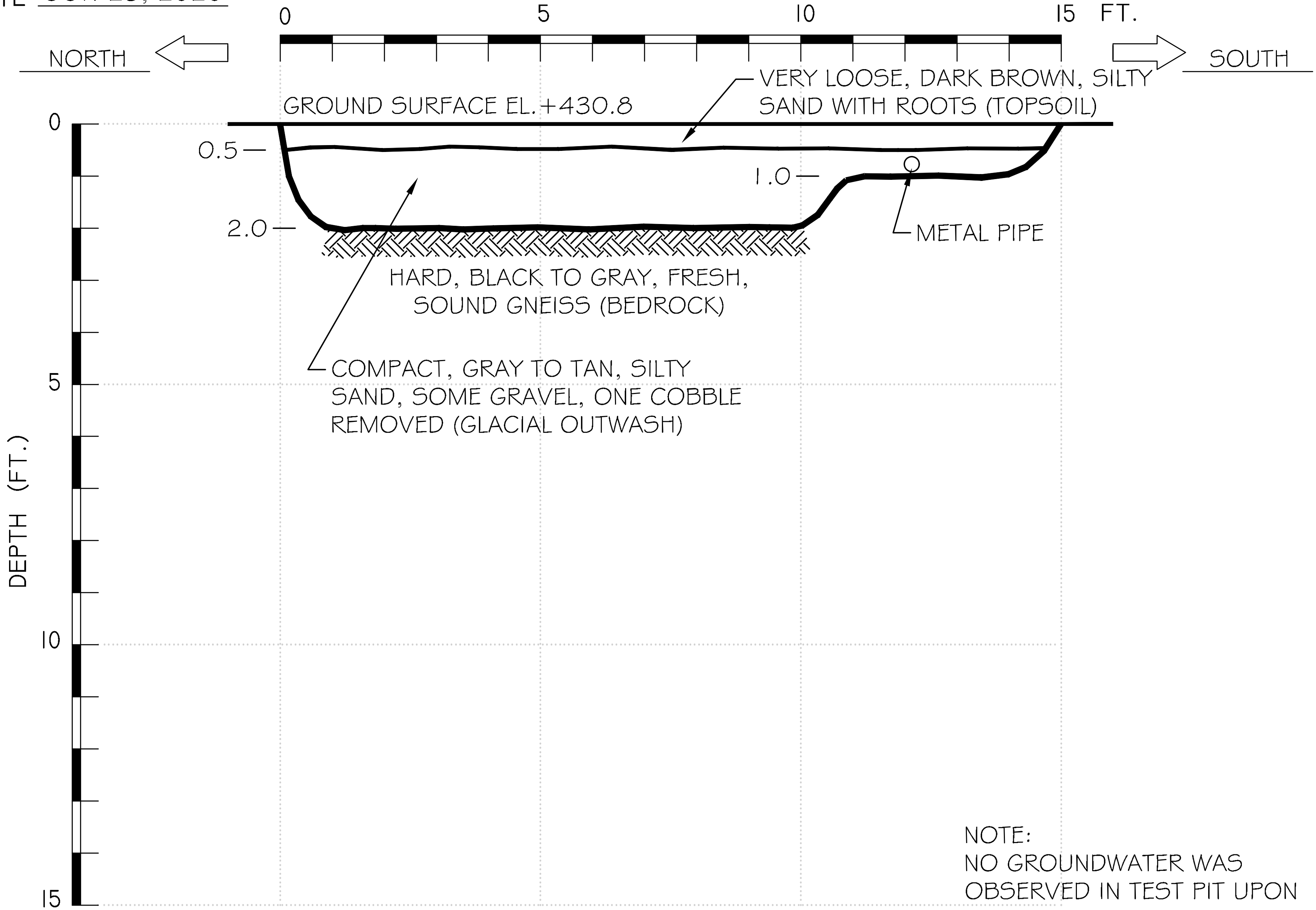
McPHAIL ASSOCIATES, LLC

JOB NO. 6775

DATE OCT. 23, 2020

TEST PIT LOG

TEST PIT NO. 6



NOTE:
NO GROUNDWATER WAS OBSERVED IN TEST PIT UPON COMPLETION OF EXCAVATION

McPHAIL ASSOCIATES, LLC

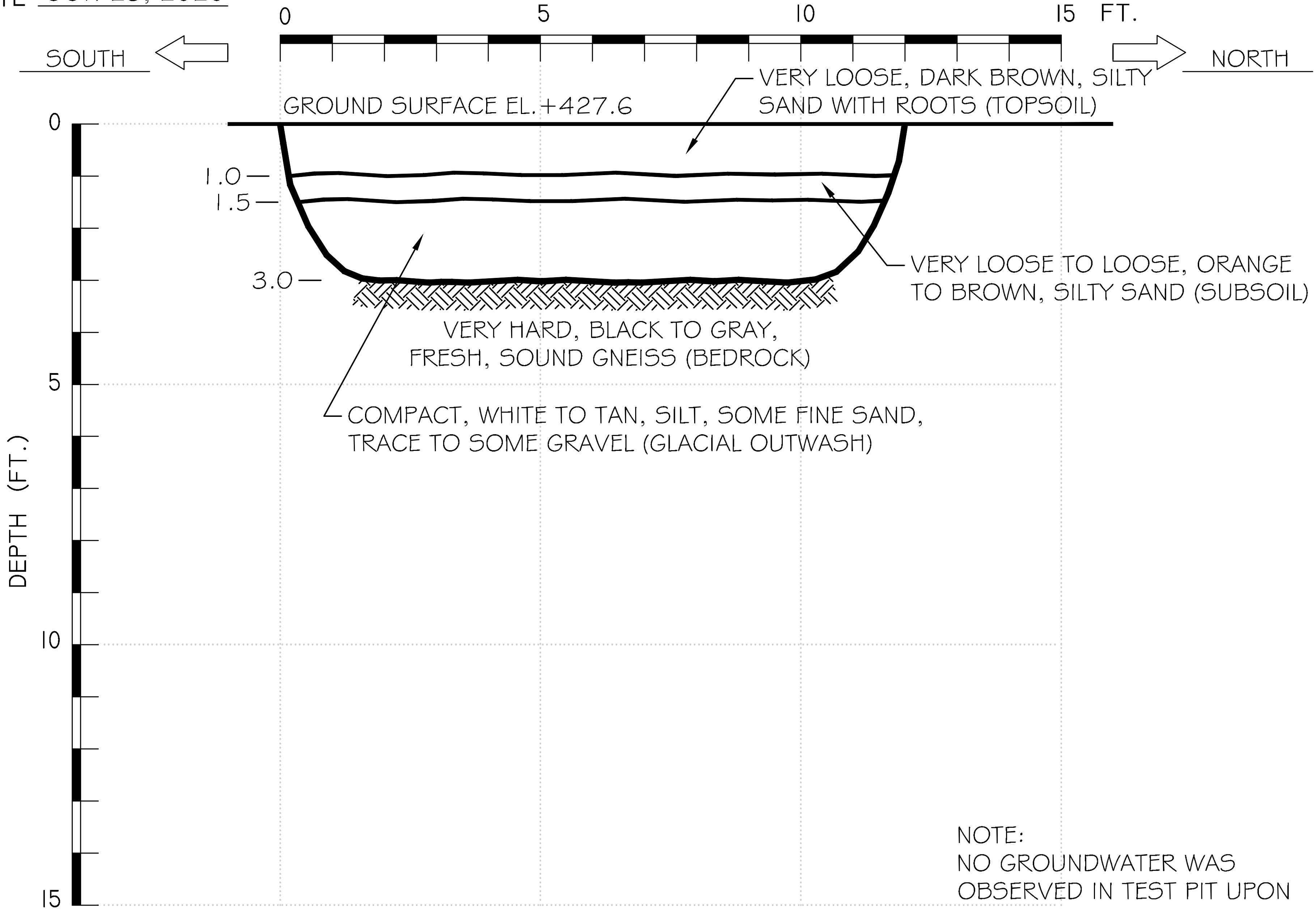
JOB NO. 6775

DATE OCT. 23, 2020

TEST PIT LOG

TEST PIT NO. 7

McPHAIL ASSOCIATES, LLC



VERY LOOSE, DARK BROWN, SILTY SAND WITH ROOTS (TOPSOIL)

VERY LOOSE TO LOOSE, ORANGE TO BROWN, SILTY SAND (SUBSOIL)

VERY HARD, BLACK TO GRAY, FRESH, SOUND GNEISS (BEDROCK)

COMPACT, WHITE TO TAN, SILT, SOME FINE SAND, TRACE TO SOME GRAVEL (GLACIAL OUTWASH)

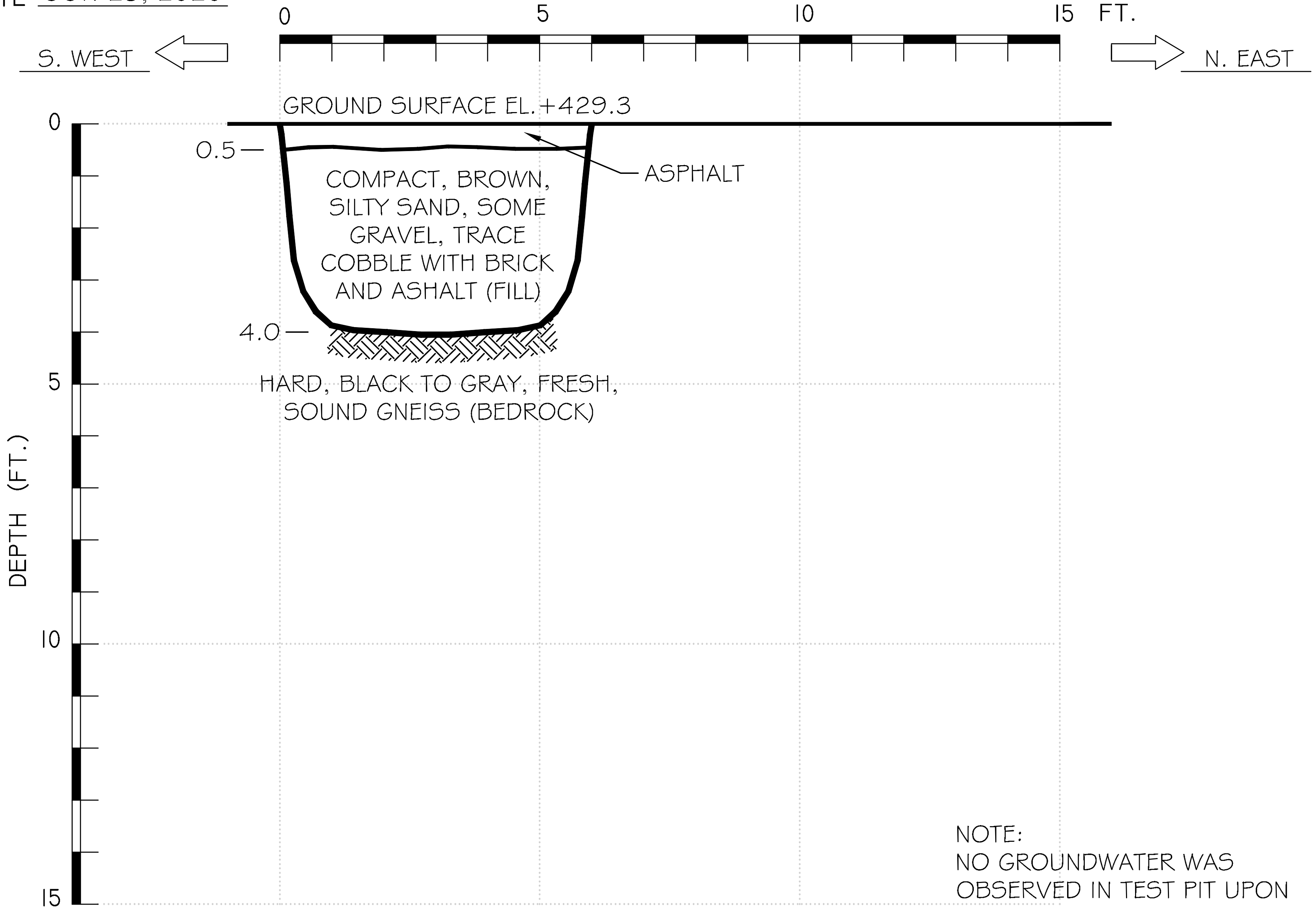
NOTE:
NO GROUNDWATER WAS OBSERVED IN TEST PIT UPON COMPLETION OF EXCAVATION

JOB NO. 6775

DATE OCT. 23, 2020

TEST PIT LOG

TEST PIT NO. 8



NOTE:
NO GROUNDWATER WAS
OBSERVED IN TEST PIT UPON
COMPLETION OF EXCAVATION

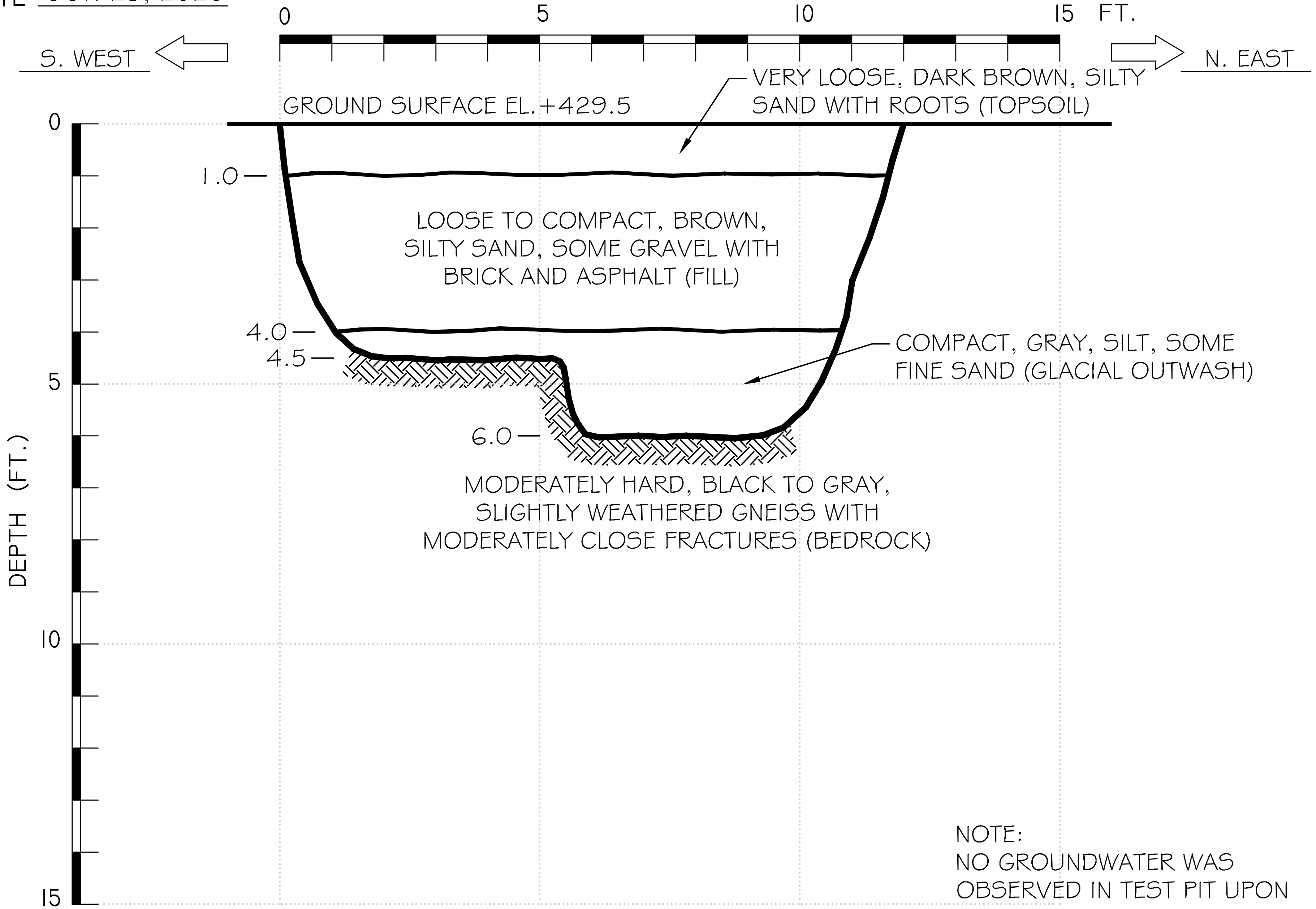
McPHAIL ASSOCIATES, LLC

JOB NO. 6775

DATE OCT. 23, 2020

TEST PIT LOG

TEST PIT NO. 9



GROUND SURFACE EL.+429.5

VERY LOOSE, DARK BROWN, SILTY SAND WITH ROOTS (TOPSOIL)

LOOSE TO COMPACT, BROWN, SILTY SAND, SOME GRAVEL WITH BRICK AND ASPHALT (FILL)

COMPACT, GRAY, SILT, SOME FINE SAND (GLACIAL OUTWASH)

MODERATELY HARD, BLACK TO GRAY, SLIGHTLY WEATHERED GNEISS WITH MODERATELY CLOSE FRACTURES (BEDROCK)

NOTE:
NO GROUNDWATER WAS OBSERVED IN TEST PIT UPON COMPLETION OF EXCAVATION

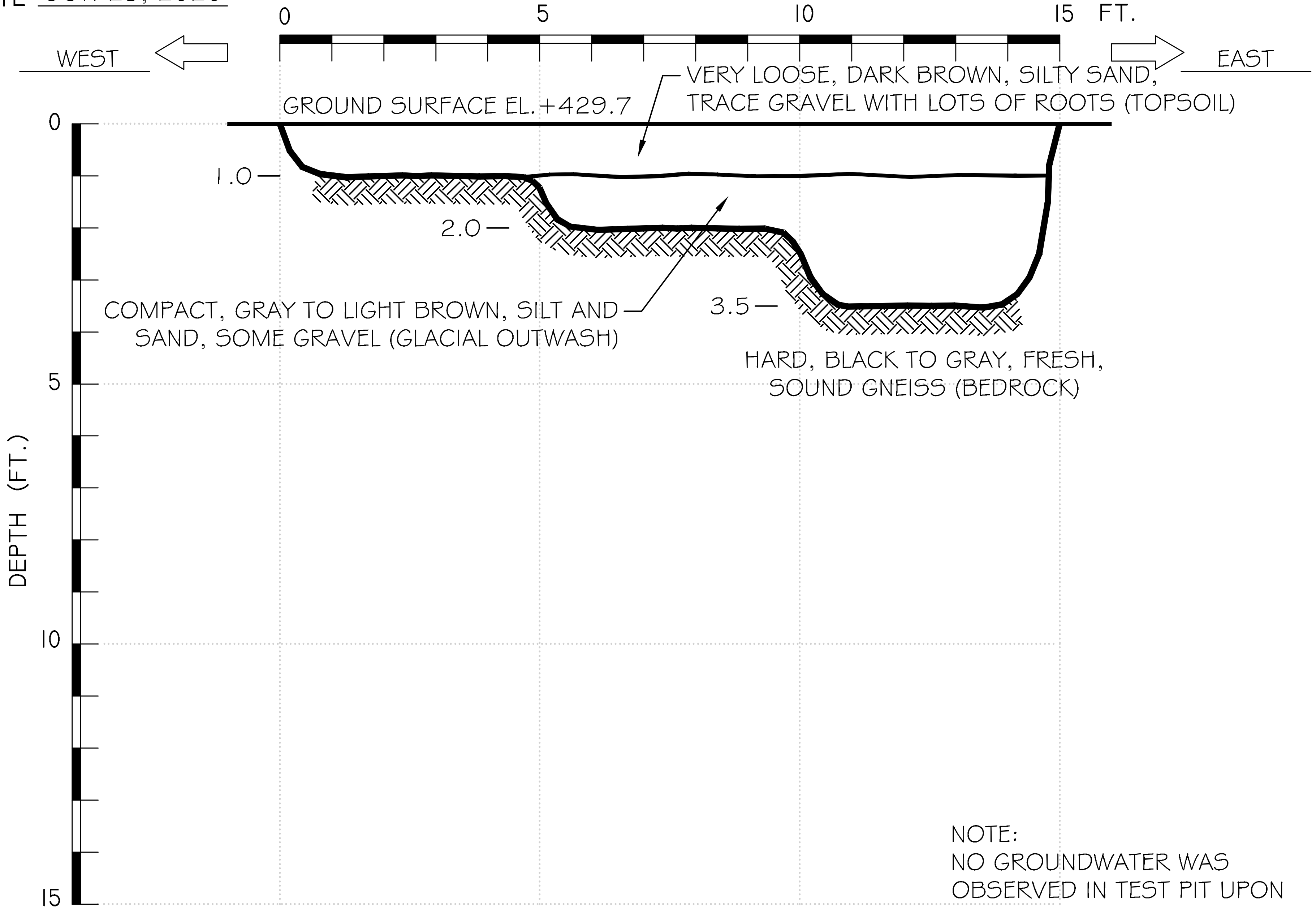
McPHAIL ASSOCIATES, LLC

JOB NO. 6775

DATE OCT. 23, 2020

TEST PIT LOG

TEST PIT NO. 10



NOTE:
NO GROUNDWATER WAS OBSERVED IN TEST PIT UPON COMPLETION OF EXCAVATION

McPHAIL ASSOCIATES, LLC

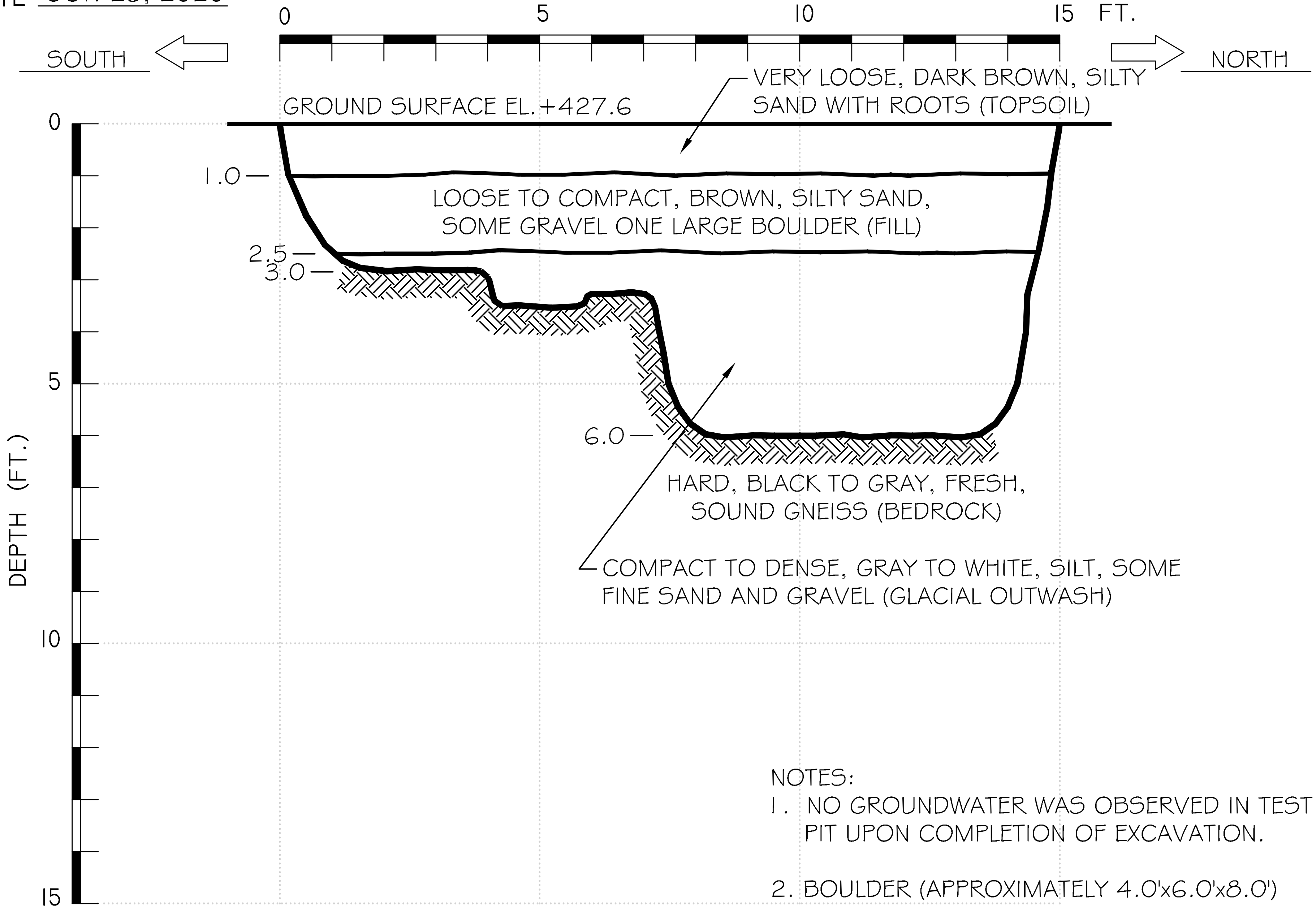
JOB NO. 6775

DATE OCT. 23, 2020

TEST PIT LOG

TEST PIT NO. 11

McPHAIL ASSOCIATES, LLC



GROUND SURFACE EL.+427.6

VERY LOOSE, DARK BROWN, SILTY SAND WITH ROOTS (TOPSOIL)

LOOSE TO COMPACT, BROWN, SILTY SAND, SOME GRAVEL ONE LARGE BOULDER (FILL)

HARD, BLACK TO GRAY, FRESH, SOUND GNEISS (BEDROCK)

COMPACT TO DENSE, GRAY TO WHITE, SILT, SOME FINE SAND AND GRAVEL (GLACIAL OUTWASH)

NOTES:

1. NO GROUNDWATER WAS OBSERVED IN TEST PIT UPON COMPLETION OF EXCAVATION.

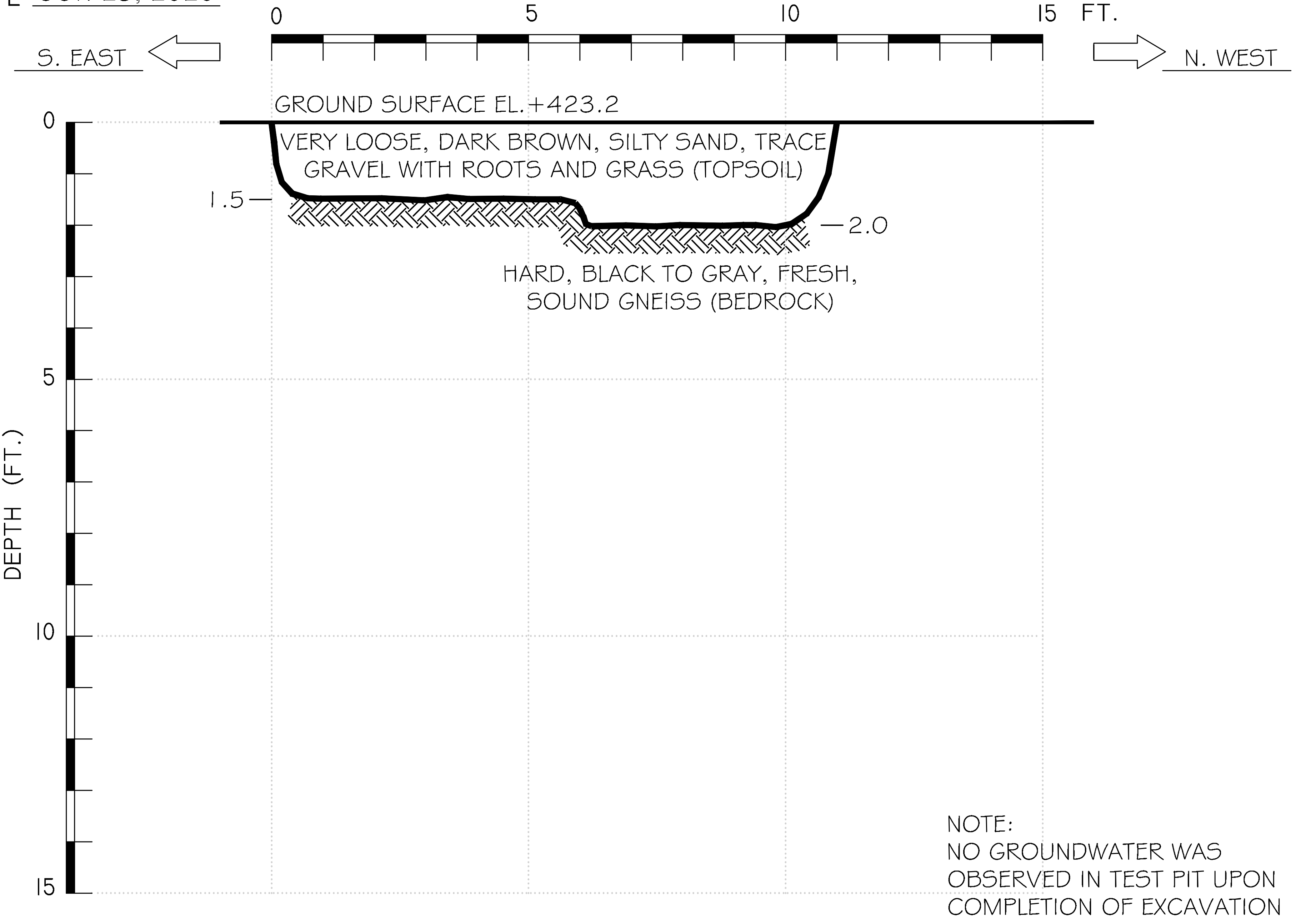
2. BOULDER (APPROXIMATELY 4.0'x6.0'x8.0') ENCOUNTERED IN FILL.

JOB NO. 6775

DATE OCT. 23, 2020

TEST PIT LOG

TEST PIT NO. 12



NOTE:
NO GROUNDWATER WAS
OBSERVED IN TEST PIT UPON
COMPLETION OF EXCAVATION

McPHAIL ASSOCIATES, LLC

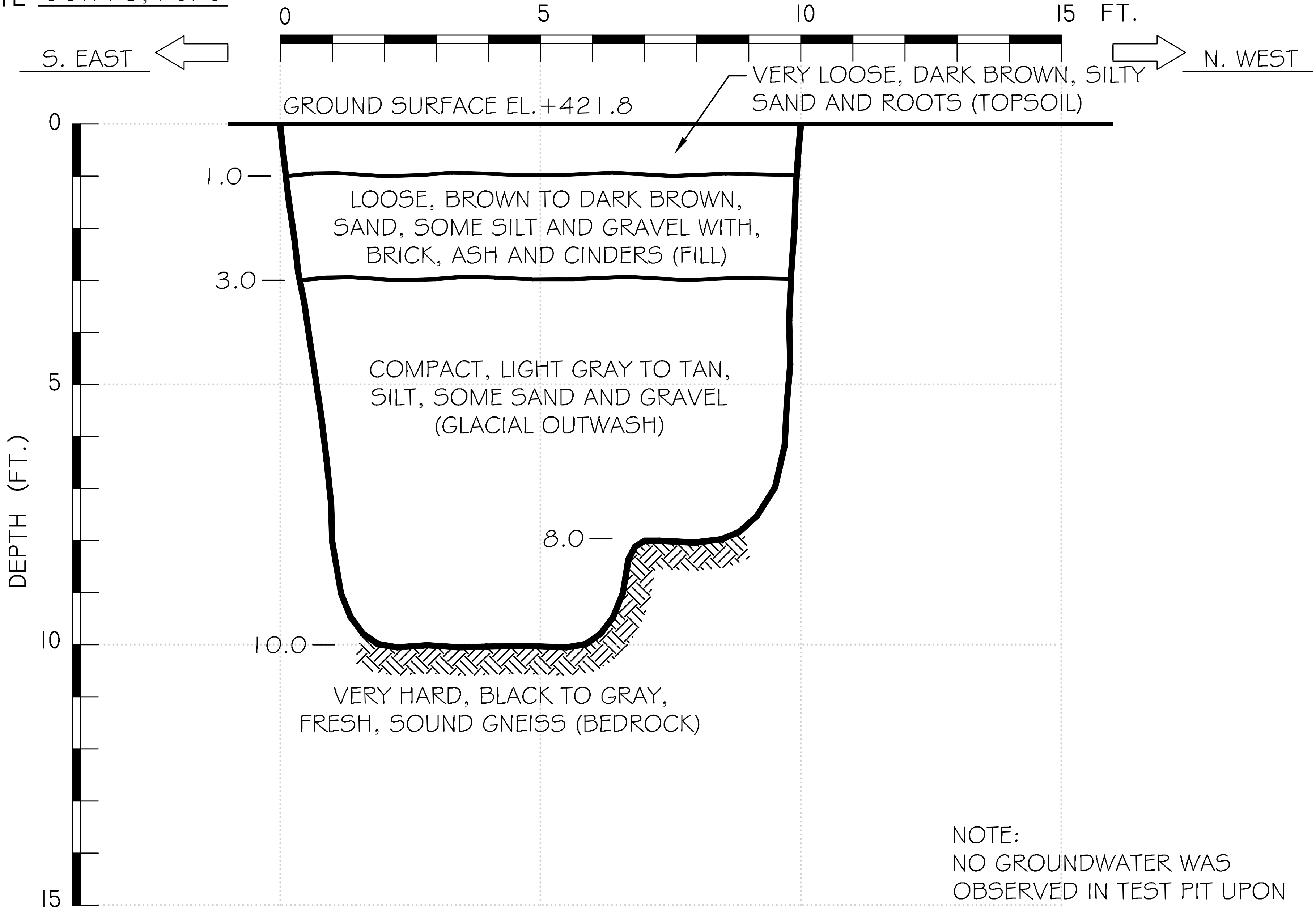
JOB NO. 6775

DATE OCT. 23, 2020

TEST PIT LOG

TEST PIT NO. 13

McPHAIL ASSOCIATES, LLC



VERY LOOSE, DARK BROWN, SILTY SAND AND ROOTS (TOPSOIL)

LOOSE, BROWN TO DARK BROWN, SAND, SOME SILT AND GRAVEL WITH, BRICK, ASH AND CINDERS (FILL)

COMPACT, LIGHT GRAY TO TAN, SILT, SOME SAND AND GRAVEL (GLACIAL OUTWASH)

VERY HARD, BLACK TO GRAY, FRESH, SOUND GNEISS (BEDROCK)

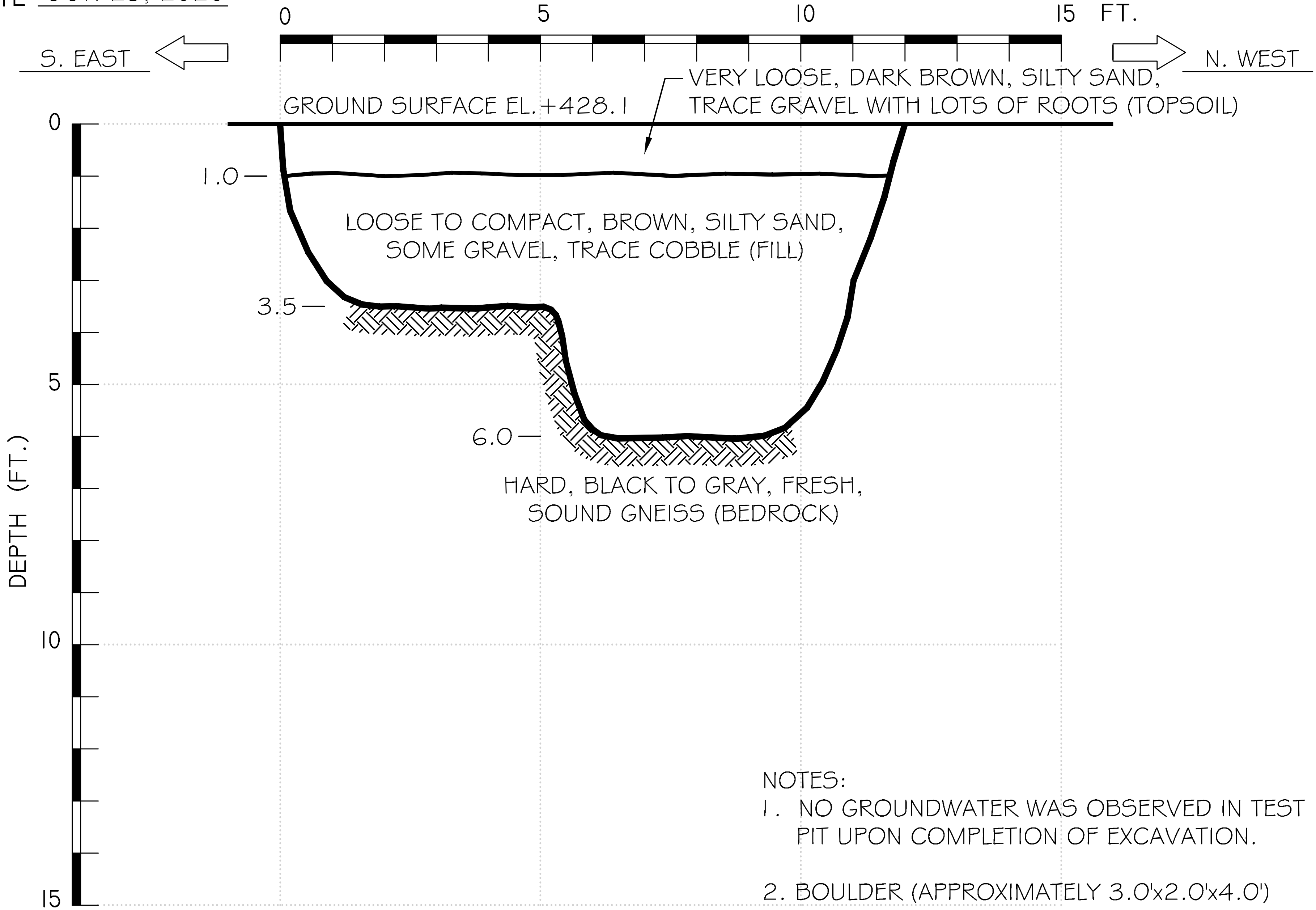
NOTE:
NO GROUNDWATER WAS OBSERVED IN TEST PIT UPON COMPLETION OF EXCAVATION

JOB NO. 6775

DATE OCT. 23, 2020

TEST PIT LOG

TEST PIT NO. 14



McPHAIL ASSOCIATES, LLC

NOTES:

1. NO GROUNDWATER WAS OBSERVED IN TEST PIT UPON COMPLETION OF EXCAVATION.

2. BOULDER (APPROXIMATELY 3.0'x2.0'x4.0') ENCOUNTERED IN FILL.

APPENDIX C:

BORING LOGS PREPARED BY CARR-DEE

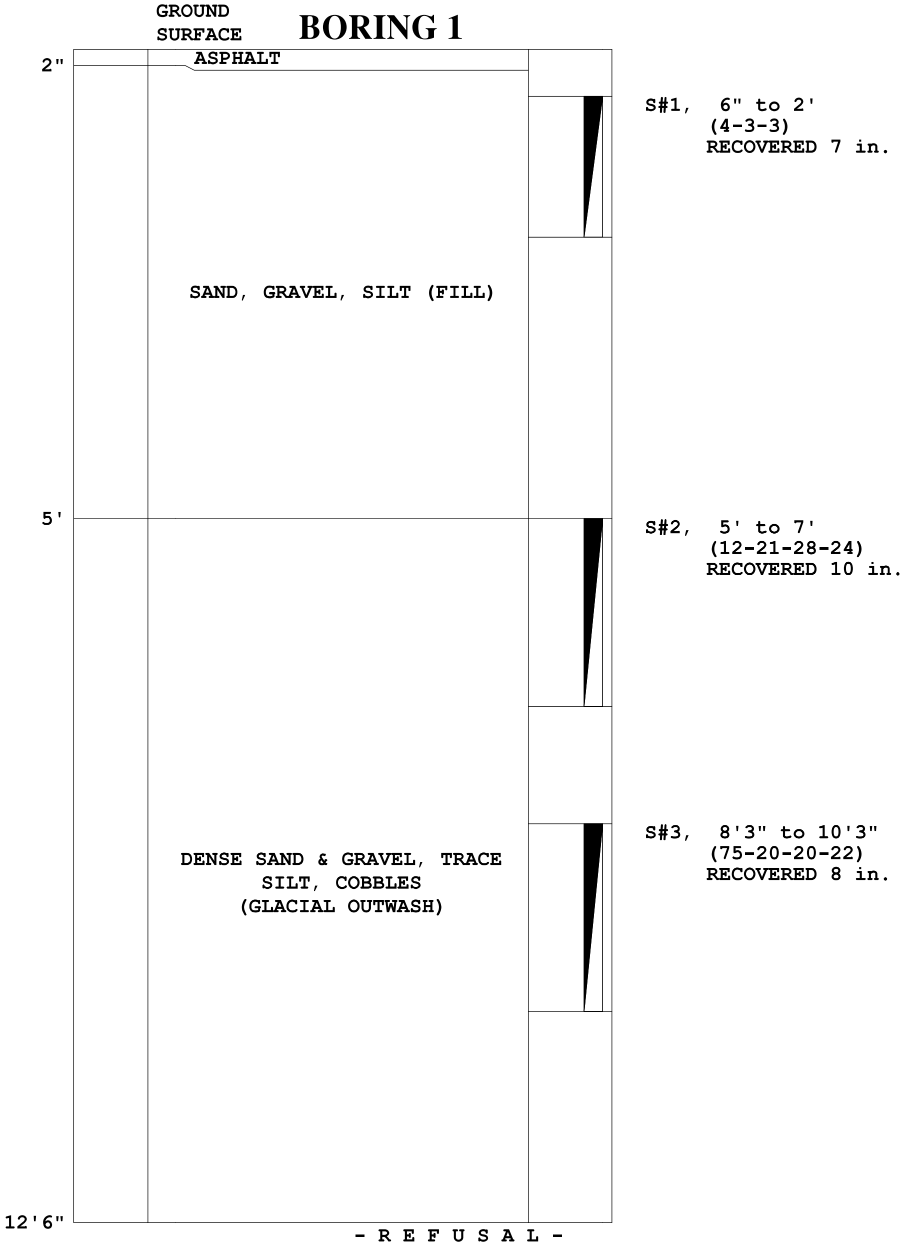
CARR-DEE CORP.

37 LINDEN STREET MEDFORD, MA 02155-0001 Telephone (781) 391-4500

To: MCPHAIL ASSOC., LLC, 2269 MASS. AVE., CAMBRIDGE, MA Date: 4-22-2019 Job No.: 2019-82

Location: 130 ELM STREET, MILLBURY, MA Scale: 1 in.= 2 ft.

BORING 1



- REFUSAL -
(NO PENETRATION WITH AUGERS & 2" S.S.)
NO WATER ENCOUNTERED
SIZE OF AUGERS: 2-1/4" I.D.LENGTH: 12'6"
DRILLER: S. DESIMONE, JR., INSPECTOR: D. TRUSSELL
DATE STARTED & COMPLETED: 4-19-2019

All samples have been visually classified by . Unless otherwise specified, water levels noted were observed at completion of borings, and do not necessarily represent permanent ground water levels. Figures in parenthesis indicate the number of blows required to drive Two-inch Split Sampler 6 inches using 140 lb. weight falling 30 inches(±). Figures in column to left (if noted) indicate number of blows to drive casing one foot, using 300 lb. weight falling 24 inches (±).

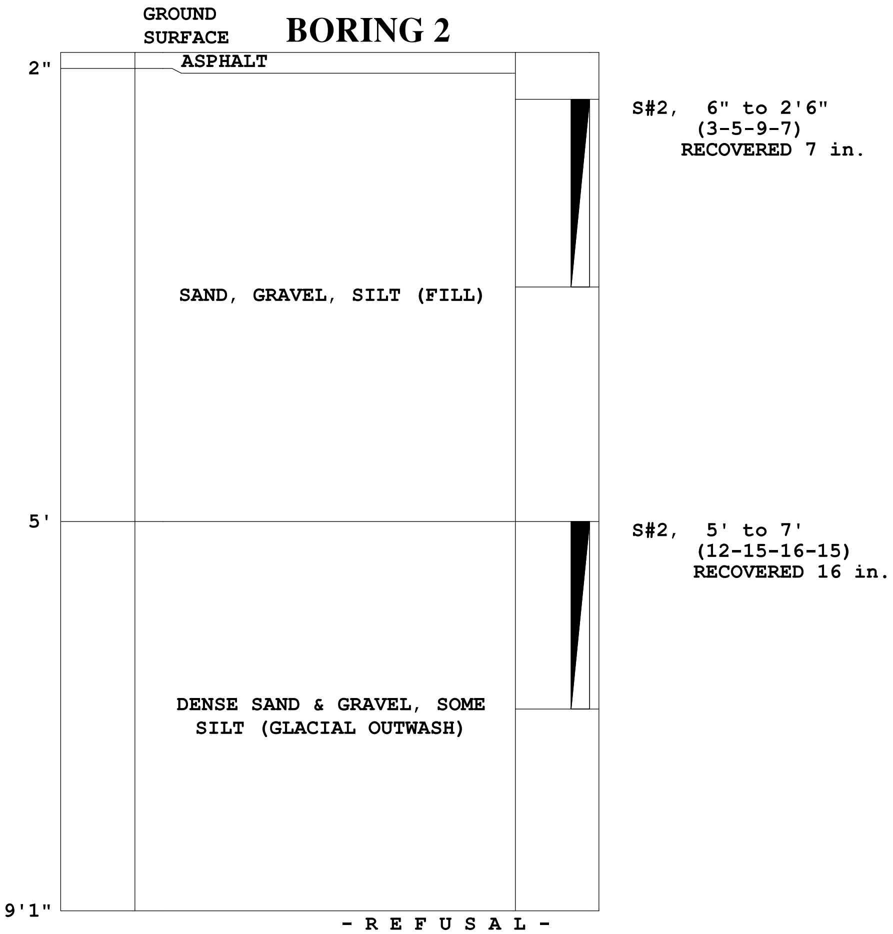
CARR-DEE CORP.

37 LINDEN STREET MEDFORD, MA 02155-0001 Telephone (781) 391-4500

To: MCPHAIL ASSOC., LLC, 2269 MASS. AVE., CAMBRIDGE, MA Date: 4-22-2019 Job No.: 2019-82

Location: 130 ELM STREET, MILLBURY, MA Scale: 1 in.= 2 ft.

BORING 2



- REFUSAL -

(NO PENETRATION WITH AUGERS & 2" S.S.)
NO WATER ENCOUNTERED
SIZE OF AUGERS: 2-1/4" I.D.LENGTH: 9'1"
DRILLER: S. DESIMONE, JR., INSPECTOR: D. TRUSSELL
DATE STARTED & COMPLETED: 4-19-2019

All samples have been visually classified by . Unless otherwise specified, water levels noted were observed at completion of borings, and do not necessarily represent permanent ground water levels. Figures in parenthesis indicate the number of blows required to drive Two-inch Split Sampler 6 inches using 140 lb. weight falling 30 inches(±). Figures in column to left (if noted) indicate number of blows to drive casing one foot, using 300 lb. weight falling 24 inches (±).

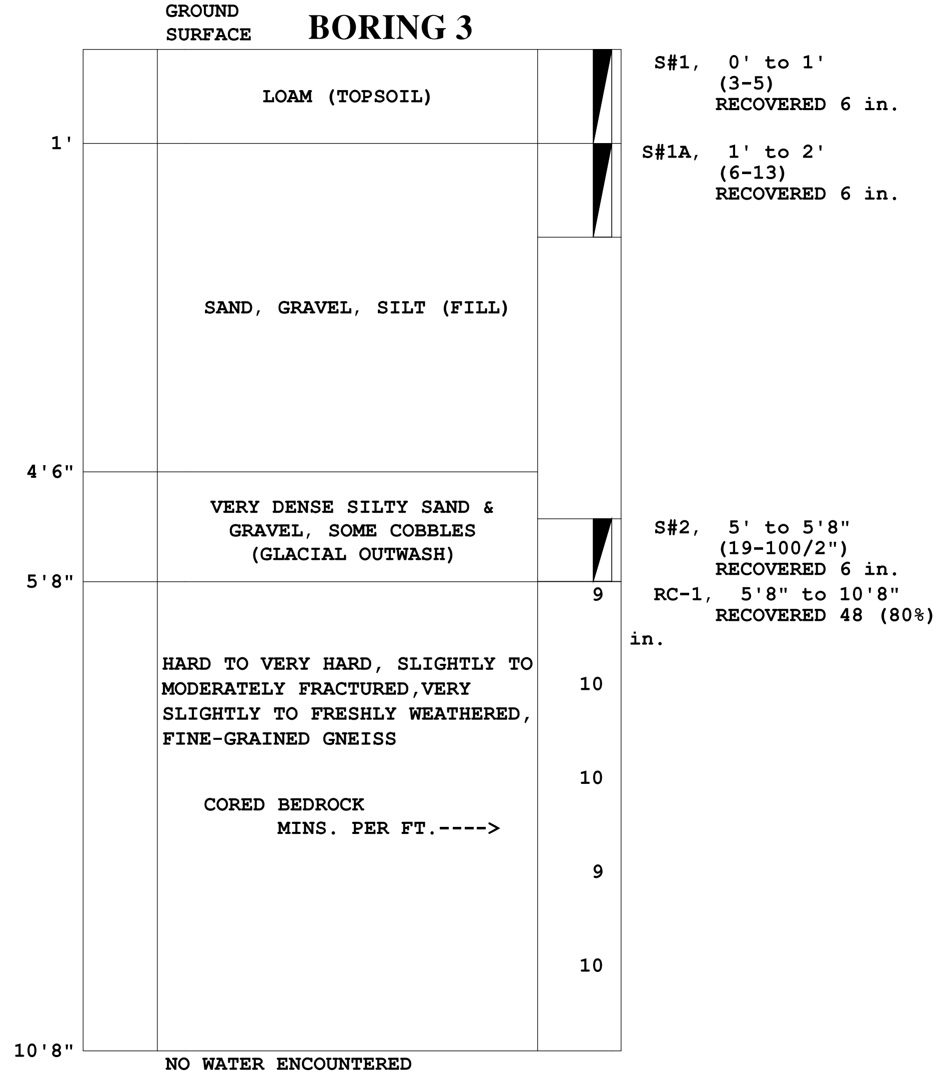
CARR-DEE CORP.

37 LINDEN STREET MEDFORD, MA 02155-0001 Telephone (781) 391-4500

To: MCPHAIL ASSOC., LLC, 2269 MASS. AVE., CAMBRIDGE, MA Date: 4-22-2019 Job No.: 2019-82

Location: 130 ELM STREET, MILLBURY, MA Scale: 1 in.= 2 ft.

BORING 3



S#1, 0' to 1'
(3-5)
RECOVERED 6 in.

S#1A, 1' to 2'
(6-13)
RECOVERED 6 in.

S#2, 5' to 5'8"
(19-100/2")
RECOVERED 6 in.

RC-1, 5'8" to 10'8"
RECOVERED 48 (80%) in.

NO WATER ENCOUNTERED
SIZE OF CASING: HW, LENGTH: 5'0"
SIZE OF ROCK CORE: NX, LENGTH: 60"
DRILLER: S. DESIMONE, JR., INSPECTOR: D. TRUSSELL
DATE STARTED & COMPLETED: 4-19-2019

All samples have been visually classified by . Unless otherwise specified, water levels noted were observed at completion of borings, and do not necessarily represent permanent ground water levels. Figures in parenthesis indicate the number of blows required to drive Two-inch Split Sampler 6 inches using 140 lb. weight falling 30 inches(±). Figures in column to left (if noted) indicate number of blows to drive casing one foot, using 300 lb. weight falling 24 inches (±).

CARR-DEE CORP.

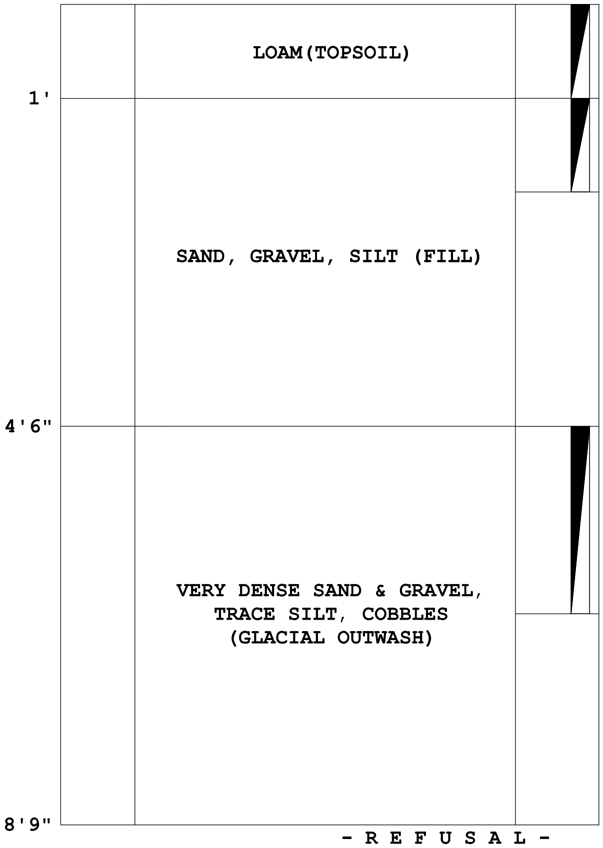
37 LINDEN STREET MEDFORD, MA 02155-0001 Telephone (781) 391-4500

To: MCPHAIL ASSOC., LLC, 2269 MASS. AVE., CAMBRIDGE, MA Date: 4-22-2019 Job No.: 2019-82

Location: 130 ELM STREET, MILLBURY, MA Scale: 1 in.= 2 ft.

GROUND SURFACE

BORING 4



S#1, 0' to 1'
(4-4)
RECOVERED 6 in.

S#1A, 1' to 2'
(3-5)
RECOVERED 6 in.

S#2, 4'6" to 6'6"
(29-53-69-50)
RECOVERED 13 in.

- R E F U S A L -
(NO PENETRATION WITH AUGERS & 2" S.S.)
NO WATER ENCOUNTERED
SIZE OF AUGERS: 2-1/4" I.D.LENGTH: 8'9"
DRILLER: S. DESIMONE, JR., INSPECTOR: D. TRUSSELL
DATE STARTED & COMPLETED: 4-19-2019

All samples have been visually classified by . Unless otherwise specified, water levels noted were observed at completion of borings, and do not necessarily represent permanent ground water levels. Figures in parenthesis indicate the number of blows required to drive Two-inch Split Sampler 6 inches using 140 lb. weight falling 30 inches(±). Figures in column to left (if noted) indicate number of blows to drive casing one foot, using 300 lb. weight falling 24 inches (±).