LEVEL DESIGN GROUP
Civil Engineers & Land Surveyors

STORMWATER REPORT

FOR

15 LIBERTY WAY
FRANKLIN, MA

DATED: JANUARY 13, 2023
REVISED: OCTOBER 16, 2023
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LDG Project No.: 2081.00

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HYDROLOGIC SUMMARY

METHODOLOGY

The HydroCAD computer program (Hydro CAD) was used to model the existing and proposed hydrology of the site and design a stormwater management system. HydroCAD generates flood hydrographs dependent upon the type of land use, vegetation, soil types, land slope, watershed areas and rainfall data. HydroCAD also takes into account the antecedent moisture condition of the soil. The peak rate of runoff and volume of runoff are projected for the input storm frequency events (design storms).

Rainfall data was obtained from the Northeast Regional Climate Center and are based on Extreme Precipitation Events for the 2-, 10-, 25- and 100-year return periods for Franklin, Massachusetts. A 24-hour type III rainfall distribution was used in the HydroCAD analysis as prescribed for New England by the Northeast Regional Climate Center. A copy of the precipitation table is included herein.

PRE-DEVELOPMENT CONDITIONS

The existing site property is located at 15 Liberty Way between Constitution Boulevard and Rachael Circle. The existing property is developed and contains an approximately 95,000 square foot warehouse, paved driveway, and paved parking areas for cars and for trailer trucks. For the purposes of hydrological calculations, the proposed development consists of approximately 138,274 square feet located at the rear of the existing warehouse as shown on the site plans.

The existing topography of the site generally slopes from east to west and directs runoff to an existing stormwater basin located onsite. The southeastern corner of the site slopes south directing runoff to the existing paved driveway and parking area to the site east of the existing warehouse. The land cover is mostly wooded area and also includes pavement from the rear portion of the existing driveway and some grass areas.

Test pits were dug on-site in the areas of the proposed infiltration basin to verify the groundwater elevation. Groundwater depth in the area of the infiltration basin varies between approximately 2.5-feet to 3-feet below the surface. The soil logs of the test pits are attached.

Portions of the abutting properties to the east are included in the site area for the purposes of hydrological calculations. This area is approximately 5.5 acres and consists mostly of wooded area along with driveway pavement areas, building roof, and grass area. Runoff from the rear portion of this area is collected in existing swale at the rear of the site and conveyed to the existing rip rap basin. The remaining portion is diverted south towards the front of the site and drains towards the existing parking lot on the site property.

The on-site soils as classified by the Soil Survey for Norfolk County Massachusetts are:

312B – Woodbridge fine sandy loam; 0 to 8 percent slopes; Hydrologic Soil Group (HSG) C/D

See the attached SCS soils documentation herein for additional soil details

POST-DEVELOPMENT CONDITIONS

The Applicant is proposing construct a new paved area to provide additional driveway and trailer parking area at the rear of the site. The project will also include the installation of a new stormwater management system and associated grading for this development.

A new fully compliant stormwater management system has been designed to mitigate the impacts of the proposed site redevelopment. Runoff from the impervious areas will be directed to new catch basins and trench drains which will convey runoff to both a new subsurface infiltration basin and a modified detention basin. Both basins will provide water quality treatment, groundwater recharge, and attenuate peak rates of runoff.

Invasive Species Management is proposed as mitigation for the impacts to the 25-foot Buffer Zone which total 16,533 SF and impacts to the Isolated Vegetated Wetlands (IVW) which total 2,680 SF. The area proposed for invasive species management is mostly located within the easement area to the west of the project site and totals 37,621 SF. The primary invasive species on site consist of oriental bittersweet *(Celastrus orbiculatus)*, Multiflora rose *(Rosa multiflora)*, Loosestrife *(Lythrum salicaria)*, Common Reed *(Phragmites australis)*, and Honeysuckle *(Lonicara spp.)*. These species are known to outcompete native plant species that are important to native wildlife for food and habitat. Management of these species will allow native vegetation present in the area to thrive.

Because a majority of the invasive species management area is located within an existing easement area that is regularly mowed, planting of trees and shrubs is not proposed. Instead, the entire area will be seeded with the New England Conservation/Wildlife Mix from New England Wetland Plants at the recommended rate of 1lb/1750sf. This mix provides a lasting cover of grasses, wildflowers, and legumes. The seed will be spread after the initial invasive removal effort and raked into the soil. This will establish high-quality herbaceous vegetation that will aid in preventing the spread of invasive species. Existing native vegetation in the invasive species management area is expected to fill in any remaining gaps

A fully compliant stormwater management system for the entire site addressing compliance with the 10 MADEP Stormwater Standards will be part of the site redevelopment. Site improvements have been made to the maximum extent practicable in accordance with MADEP Stormwater Regulations.

STANDARD 1: Untreated Discharges

Stormwater Management Standard 1 requires that, "No new stormwater conveyances (e.g. outfalls) may discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth".

This standard is met by the proposed redevelopment not creating any new non-treated stormwater discharges and improving an existing residential site with no existing stormwater management system. All surface runoff from proposed impervious areas, with the exception of a redeveloped portion of the existing driveway, is collected in deep sump catch basins and trench drains and directed to a CDS Unit treatment unit prior to discharging to a subsurface infiltration basin. Overflow from the subsurface infiltration basin discharges from an outlet control structure to the existing detention basin through a 15" HPDE pipe. All discharges are designed to be placed in areas which mimic existing drainage flow patterns.

Redevelopment: The project has been designed to fully comply with Massachusetts Stormwater Regulations for Standard 1.

Full compliance with Standard 1 is required for new outfalls.

- What BMPs are proposed to ensure that all new discharges associated with the discharge are adequately treated? Proprietary Treatment Units, Subsurface infiltration basin
- What BMPs are proposed to ensure that no new discharges cause erosion in wetlands or waters of the Commonwealth? rip rap outlets are proposed in the existing stormwater basin designed to prevent erosion.
- Will the proposed discharge comply with all applicable requirements of the Massachusetts Clean Waters Act and the regulations promulgated thereunder at 314 CMR 3.00, 314 CMR 4.00 and 314 CMR 5.00? yes

Existing outfalls shall be brought into compliance with Standard 1 to the maximum extent practicable.

- Are there any existing discharges associated with the redevelopment project for which new treatment could be provided? No existing outfalls
- If so, the proponent shall specify the stormwater BMP retrofit measures that have been considered to ensure that the discharges are adequately treated and indicate the reasons for adopting or rejecting those measures. (See Section entitled "Retrofit of Existing BMPs".) N/A
- What BMPs have been considered to prevent erosion from existing stormwater discharges? N/A

STANDARD 2: Peak Rate Control and Flood Prevention

Stormwater Management Standard 2 requires that, "Stormwater management systems must be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates. This Standard may be waived for land subject to coastal storm flowage."
This standard is met by the proposed development mitigating the post-development peak discharge rates at the designated control points for all design storm events. This is accomplished by directing stormwater flow to a subsurface infiltration basin. Below is a description of the design points used in the hydrologic analysis and a summary of pre- and post- development discharge rates. The proposed development will reduce the peak rate of runoff at all the design points and provide ample groundwater recharge.

Redevelopment: The project has been designed to fully comply with Massachusetts Stormwater Regulations for Standard 2.

Compliance to the Maximum Extent Practicable:

- Does the redevelopment design meet Standard 2, comparing post-development to pre-development conditions? Yes
- If not, the applicant shall document an analysis of alternative approaches for meeting the Standard. (See Menu of Strategies to Reduce Runoff and Peak Flows and/or Increase Recharge Menu included at the end of this chapter.) N/A

Improvement of existing conditions:

- Does the project reduce the volume and/or rate of runoff to less than current estimated conditions? Has the applicant considered all the alternatives for reducing the volume and/or rate of runoff from the site? (See Menu.) Yes
- Is the project located within a watershed subject to damage by flooding during the 2-year or 10-year 24-hour storm event? If so, does the project design provide for attenuation of the 2-year and 10-year 24-hour storm event to less than current estimated conditions? Have measures been implemented to reduce the volume of runoff from the site resulting from the 2 year or 10 year 24 hour storm event? (See Menu.) N/A
- Is the project located adjacent to a water body or watercourse subject to adverse impacts from flooding during the 100-year 24-hour storm event? If so, are portions of the site available to increase flood storage adjacent to existing Bordering Land Subject to Flooding (BLSF)? N/A
- Have measures been implemented to attenuate peak rates of discharge during the 100-year 24-hour storm event to less than the peak rates under current estimated conditions? Have measures been implemented to reduce the volume of runoff from the site resulting from the 100-year 24-hour storm event? (See Menu.) Yes

SUMMARY OF PEAK STORMWATER RUNOFF (CFS)

Two design points were utilized to analyze the runoff characteristics of the site. Design Point 1 (DP-1) is the existing drainage manhole to the south of the rip rap detention basin which is included in the model. The existing drain manhole is the ultimate design point and no further analysis is included in the stormwater model. The existing basin currently collects runoff from surrounding areas on the site and discharges through an outlet without any issues. The proposed flow from the developed portion of the site is less than existing flow from the same area and therefore no adverse impacts are expected. As part of this project the existing basin is being redesigned to provide additional storage. Design Point 2 (DP-2) is the existing paved driveway and parking area to the east of the existing warehouse. The pre- and post- development peak discharge rates for all analyzed design storms is summarized in the following table:

Design Point – DP-1				
Year Storm	**Pre-Development**		**Post-Development**	
	Flow (cfs)	Volume (Acre-Ft.)	Flow (cfs)	Volume (Acre-Ft.)
2-yr	6.66	0.530	6.23	0.733
10-yr	16.30	1.381	15.12	1.686
25-yr	22.17	1.913	22.09	2.266
100-yr	31.14	2.742	31.43	3.166
Design Point – DP-2				
Year Storm	**Pre-Development**		**Post-Development**	
	Flow (cfs)	Volume (Acre-Ft.)	Flow (cfs)	Volume (Acre-Ft.)
2-yr	2.75	0.244	2.41	0.214
10-yr	7.07	0.604	6.23	0.533
25-yr	9.73	0.832	8.66	0.734
100-yr	13.84	1.190	12.34	1.052

The net peak discharge for both design points is decreased under proposed conditions. The peak rate for DP-1 is controlled by the subsurface infiltration basin and modified infiltration basin and does not increase flows off site for any of the evaluated design storms. There is a slight increase in volumes for the evaluated storms however based on the size of the total contributing area on abutting properties, the increase is negligible and there will be no adverse impacts to the existing drainage system. The net peak discharge for DP-2 is un-controlled and flows off-site overland to the existing parking lot as occurs in existing conditions. There is an increase in peak runoff rates and volumes for the evaluated storms for DP-1 however based on the size of the total contributing area on abutting properties, the increase is negligible and there will be no adverse impacts to the property.

STANDARD 3: Recharge to Groundwater

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

GROUND WATER RECHARGE

The proposed project will result in an increase of 63,919±SF of impervious area. The on-site soils of the areas contributing to the proposed subsurface infiltration system as classified by the Soil Survey for Norfolk County Massachusetts are 312B – Woodbridge fine sandy loam 0 to 8 percent slopes with a hydrologic soil group classification of HSG C/D. On-site soil textures are sandy loam based on test pits performed by Level Design Group, LLC. Groundwater recharge will be provided by a proposed subsurface infiltration system. A curtain drain is proposed around the system to lower the groundwater in order to provide the minimum 2-feet of separation.

The on-site soils as classified by the Soil Survey for Plymouth County Massachusetts as Hydrologic Soil Group (HSG) C. The required infiltration for HSG C soil is 0.25 inches of runoff times the total impervious area.

The total post-development impervious area created is 63,919±SF entirely located within soils with an HSA rating of C.

Water used to satisfy the recharge to groundwater standard is from proposed pavement area. The Simple Dynamic Method of Recharge Volume was utilized to calculate recharged groundwater.

Simple Dynamic Method Calculations for all proposed infiltration practices:

Required Recharge Volume:

Massachusetts Stormwater Handbook:
Rv = (F) x (New Impervious Area)

F = 0.25 (HSG C)
Impervious Area = 63,919 SF
Rv = (0.25) x (63,919 SF) x (1 ft./12 in.)
= 1,332 CF

Recharge Volume Provided:

SSI-1
Lowest Outlet Invert = 325.00 (2) 6" orifices
Volume at El. 325.00 = 2,253 CF → HydroCAD Report

IB-1
Lowest Outlet Invert = 323.50 (32"Wx6"H orifice)
Volume at El. 323.50 = 806 CF → HydroCAD Report for Infiltration volume (Excludes forebay and 50' buffer area)

2,253 CF + 806 CF = 3,059 SF
3,059 SF > 1,332 CF

The recharge volume requirement 1,332 CF is exceeded with a total volume of 3,059 SF of storage provided below the lowest outlet of the infiltration systems.

Drawdown Calculations
$Time_{drawdown}$ = Rv / (K) x (Bottom Area)
Rv = Required recharge volume
K = Saturated Conductivity Rate
Bottom Area = Bottom area of recharge structure

SSI-1
Bottom Area = 4,220 SF
K = 0.17 in./hr.
$Time_{drawdown}$ = 2,253 CF / (0.17 in./hr.) x (4,220 SF) x (1 ft./12 in.)
= 37.69 hours

IB-1
Bottom Area = 3,831 SF
K = 0.17 in./hr.
$Time_{drawdown}$ = 806 CF / (0.17 in./hr.) x (3,831 SF) x (1 ft./12 in.)
= 14.85 hours

Redevelopment: The project has been designed comply with Massachusetts Stormwater Regulations for Standard 3 to the Maximum Extent Practicable.

Compliance to the Maximum Extent Practicable:

- Does the redevelopment design meet Standard 3, comparing post-development to pre-development conditions? No

- If not, the applicant shall document an analysis of alternative approaches for meeting the Standard? See Alternatives Analysis above.
- What soil types are present on the site? Is the site is comprised solely of C and D soils and bedrock at the land surface? Solely of C and D soils
- Does the project include sites where recharge is proposed at or adjacent to an area classified as contaminated, sites where contamination has been capped in place, sites that have an Activity and Use Limitation (AUL) that precludes inducing runoff to the groundwater, pursuant to MGL Chapter 21E and the Massachusetts Contingency Plan 310 CMR 40.0000; sites that are the location of a solid waste landfill as defined in 310 CMR 19.000; or sites where groundwater from the recharge location flows directly toward a solid waste landfill or 21E site?[1] N/A
- Is the stormwater runoff from a land use with a higher potential pollutant load? N/A
- Is the discharge to the ground located within the Zone II or Interim Wellhead Protection Area of a public water supply? No
- Does the site have an infiltration rate greater than 2.4 inches per hour? No

Improvements to Existing Conditions:

- Does the project increase the required recharge volume over existing (developed) conditions? If so, can the project be redesigned to reduce the required recharge volume by decreasing impervious surfaces (make building higher, put parking under the building, narrower roads, sidewalks on only one side of street, etc.) or using low impact development techniques such as porous pavement?
  The site increases the recharge volume requirement. Porous pavement was considered as an alternative to provide infiltration but is not practical based on it being primarily utilized by trailer trucks.
- Is the project located within a basin or sub-basin that has been categorized as under high or medium stress by the Massachusetts Water Resources Commission, or where there is other evidence that there are rivers and streams experiencing low flow problems? If so, have measures been considered to replace the natural recharge lost as a result of the prior development? (See Menu.) N/A
- Has the applicant evaluated measures for reducing site runoff? (See Menu.)
  Yes, See Alternatives Analysis above.

STANDARD 4: 80% TSS Removal

Stormwater Management Standard 4 requires that, "Stormwater management systems must be designed to remove 80% of the average annual post-construction of Total Suspended Solids (TSS). This standard is met when:

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

Franklin Stormwater Bylaws require a minimum of 90% TSS removal for new developments. The project will result in an increase of 63,919±SF of impervious area which consists entirely of pavement. Of this area, 125±SF will bypass collection for treatment however, additional runoff from existing pavement will

[1] A mounding analysis is needed if a site falls within this category. See Volume 3.

be captured that was not previously, providing a total impervious area of 66,243±SF to be directed to treatment devices. To achieve the required 90% TSS removal, new stormwater BMP's will be installed. A subsurface infiltration basin is proposed which will collect runoff from all impervious areas within Drainage Area P-1a and provide the maximum level or stormwater treatment practicable. A proprietary stormwater treatment unit is proposed which provides treatment prior to discharge to the subsurface infiltration basin. A Modified Infiltration Basin is proposed which will collect flows from MADEP TSS Removal Sheets are included herein which show an average TSS removal for the site of greater than 90% by the proprietary stormwater treatment units and the subsurface infiltration basin meeting the requirements for total treatment.

Water Quality Calculations:

The volume of stormwater runoff to be pretreated for water quality is calculated as the total of 0.1-inch times the total post-development impervious area being directed to the new sediment forebay. The water quality volume calculation is detailed below.

Water Quality Pre-Treatment Volume Required:
V_{wq} = (D_{wq}) x (Impervious Area)
D_{wq} = Water Quality Depth
D_{wq} = 0.1 in. (Sediment Forebay)
Contributing Impervious area = 41,770 SF

V_{wq} = (0.1 in.) x (41,770) x (1 ft./12 in.)
= 349 CF

Water Quality Pre-Treatment Volume Provided:

Sediment Forebay
Lowest Outlet Invert = 324.00 (Stone Gabion)
Volume at El. 324.00 = 595 CF → HydroCAD Report
595 CF > 349 CF

CDS Stormwater Treatment Unit Sizing
Water quality treatment is provided by using CDS treatment units. The CDS Units are sized using the *Massachusetts Department of Environmental Protection Wetlands Program – Standard Method to Convert Required Water Quality Volume to a Discharge Rate for Sizing Flow Based Manufactured Proprietary Stormwater Treatment Practices*.

TSS Removal sheets are attached under the Stormwater Treatment Unit Information section of this report which show 98% TSS removal for 37.0% of the site and 86% TSS removal for 63.0% of the impervious area to be treated for the site for a total of 90.5% TSS removal.

Redevelopment: The project has been designed to fully comply with Massachusetts Stormwater Regulations for Standard 4.

Full compliance for any component that is not a redevelopment

Full compliance with the long-term pollution plan requirement for new developments and redevelopments.

- Has the proponent developed a long-term pollution plan that fully meets the requirements of Standard 4? A Long Term Pollution Prevention Plan is provided
- Does the pollution prevention plan include the following source control measures?
    - Street sweeping - yes
    - Proper management of snow, salt, sand and other deicing chemicals – yes
    - Proper management of fertilizers, herbicides and pesticides - yes
    - Stabilization of existing eroding surfaces - yes

Compliance to the Maximum Extent Practicable for the other requirements:

- Does the redevelopment design provide for treatment of all runoff from existing (as well as new) impervious areas to achieve 80% TSS removal? If 80% TSS removal is not achieved, has the stormwater management system been designed to remove TSS to the maximum extent practicable? 80% TSS removal achieved
- Have the proposed stormwater BMPs been properly sized to capture the prescribed runoff volume? Yes
    - One inch rule applies for discharge
        - within a Zone II or Interim Wellhead Protection Area, - N/A
        - near or to another critical area, - N/A
        - from a land use with a higher potential pollutant load - N/A
        - to the ground where the infiltration rate is greater than 2.4 inches per hour - N/A
- Has adequate pretreatment been proposed?
    - 44% TSS Removal Pretreatment Requirement applies if:
        - Stormwater runoff is from a land use with a higher potential pollutant load
        - Stormwater is discharged - Yes, 44% TSS removal achieved (Zone II and rapid infiltration)
            - To the ground within the Zone II or Interim Wellhead Protection Area of a Public Water Supply - N/A
            - To the ground with an infiltration rate greater than 2.4 inches per hour - N/A
            - Near or to an Outstanding Resource Water, Special Resource Water, Cold-Water Fishery, Shellfish Growing Area, or Bathing Beach. - N/A

- If the stormwater BMPs do not meet all the requirements set forth above, the applicant shall document an analysis of alternative approaches for meeting the these requirements. (See Section on Retrofitting Existing BMPs (the "Retrofit Section"). N/A

Improvements to Existing Conditions:

- Have measures been provided to achieve at least partial compliance with the TSS removal standard? Fully complies
- Have any of the best management practices in the Retrofit Section been considered? N/A
- Have any of the following pollution prevention measures been considered?

Operation & Maintenance and Long Term Pollution Prevention Plans have been prepared for the site in accordance with Massachusetts Stormwater regulations and are included in the Stormwater Report.

- Reduction or elimination of winter sanding, where safe and prudent to do so
- Tighter controls over the application of fertilizers, herbicides, and pesticides
- Landscaping that reduces the need for fertilizer, herbicides and pesticides
- High frequency sweeping of paved surfaces using vacuum sweepers
- Improved catch basin cleaning
- Waterfowl control programs

Are there any discharges (new or existing) to impaired waters? If so, see TMDL section. N/A

STANDARD 5: Higher Potential Pollutant Loads

Stormwater Management Standard 5 requires that, "For land uses with higher potential pollutant loads, source control and pollution prevention shall be implemented in accordance with the Massachusetts Stormwater Handbook to eliminate or reduce the discharge of stormwater runoff from such land uses to the maximum extent practicable. If through source control and/or pollution prevention, all land uses with higher potential pollutant loads cannot be completely protected from exposure to rain, snow, snow melt and stormwater runoff, the proponent shall use the specific stormwater BMPs determined by the Department to be suitable for such use as provided in the Massachusetts Stormwater Handbook. Stormwater discharges from land uses with higher potential pollutant loads shall also comply with the requirements of the Massachusetts Clean Waters Act, M.G.L. c. 2,§26-53, and the regulations promulgated thereunder at 314 CMF 3.00, 314 CMR 4.00 and 314 CMR 5.00."

The proposed use in not considered a use that would generate Higher Potential Pollutant Loads.

Redevelopment: The project use is not considered a use that would generate Higher Potential Pollutant Loads.

STANDARD 6: Critical Areas

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

The development site is not located within a Critical Area as defined by the Massachusetts Stormwater Handbook.

Redevelopment: The project is not located in a critical area as defined by the Massachusetts Stormwater Regulations for Standard 6.

STANDARD 7: Redevelopment and Other Projects Subject to the Standards only to the Maximum Extent Practicable

The definition of a Redevelopment Project under the definition provided in the MADEP Stormwater Handbook for Standard 7 is listed below:

> "Development rehabilitation, expansion and phased projected on previously developed sites, provided that redevelopment results in no next increase in impervious area."

The proposed development is not considered a Redevelopment Project and fully complies with the requirements of the MADEP Stormwater Management Standards.

STANDARD 8: Erosion and Sediment Control

Stormwater Management Standard 8 requires that, "A plan to control construction-related impacts, including erosion sedimentation and other pollutant sources during construction and land disturbance activities (construction period erosion, sedimentation, and pollution prevention plan), must be developed and implemented."

This standard is met through the type and style of construction. The site is self-contained with abutting properties draining overland to the rear of the subject property. Thereby there will be no additional erosion from this property to abutting properties. With careful construction the project will limit erosion potential through the development itself and no additional structural measures, passive or active, are proposed. A Construction Period Pollution and Erosion & Sedimentation Control Plan has also been prepared and is included as part of the Stormwater Report.

Redevelopment: The project has been designed to fully comply with Massachusetts Stormwater Regulations for Standard 8.

All redevelopment projects shall fully comply with Standard 8.

- Has the proponent submitted a construction period erosion, sedimentation and pollution prevention plan that meets the requirements of Standard 8?
  A draft Stormwater Pollution Prevention Plan will be finalized prior to the start of construction.

STANDARD 9: Operation and Maintenance

Stormwater Management Standard 9 requires that, "A long-term operation and maintenance plan must be developed and implemented to ensure that stormwater management systems function as designed".

This standard is fully met with development and implementation of an Operation and Maintenance Plan is included in Stormwater Management Report.

Redevelopment: The project has been designed to fully comply with Massachusetts Stormwater Regulations for Standard 9.

All redevelopment projects shall fully comply with Standard 9.

- Has the proponent submitted a long-term Operation and Maintenance plan that meets the requirements of Standard 9?
  O&M included in Stormwater Report

STANDARD 10: Illicit Discharges

Stormwater Management Standard 10 requires that, "All illicit discharges to the stormwater management system are prohibited".

This standard is fully met with development and implementation of a Long-Term Pollution Prevention which is included in the Stormwater Management Report. An Illicit Discharge statement has been prepared and is included herein.
Redevelopment: The project has been designed to fully comply with Massachusetts Stormwater Regulations for Standard 10.

All redevelopment projects shall fully comply with Standard 10.

- Are there any known or suspected illicit discharges to the stormwater management system at the redevelopment project site? No
- Has an illicit connection detection program been implemented using visual screening, dye or smoke testing? No
- Have an Illicit Discharge Compliance Statement and associated site map been submitted verifying that there are no illicit discharges to the stormwater management system at the site? Yes

Improvements to Existing Conditions:

- Once all illicit discharges are removed, has the proponent implemented any measures to prevent additional illicit discharges? N/A

CONCLUSION

The proposed redevelopment of this parcel will be a significant improvement to the area and to the resource area on and adjacent to the site. The proposed redevelopment meets or exceeds the current MADEP Stormwater Management Standards and Guidelines and provides a stormwater management system that will maintain water quality while attenuating peak rates of runoff at the control points. This was achieved by using pretreatment BMPs and directing the stormwater runoff to the subsurface infiltration basin and modified infiltration basin which attenuate peak flows, provide groundwater recharge, and provide a high level of TSS removal. An Operation and Maintenance Plan for post-construction maintenance of the Stormwater Management System has been developed and is included with this report.

MADEP Stormwater Report Checklist

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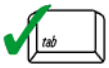
Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

Checklist for Stormwater Report

A. Introduction

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



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

The Stormwater Report must include:

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

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

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

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

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

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

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

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

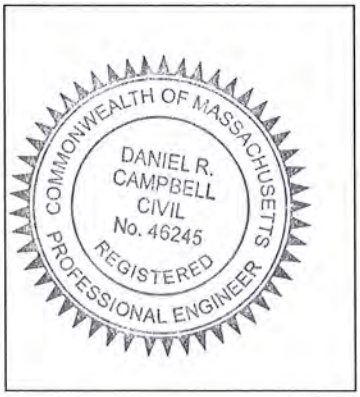
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature



10/16/23
Signature and Date

Checklist

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

☐ New development

☐ Redevelopment

☒ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

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

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

Standard 1: No New Untreated Discharges

- ☒ No new untreated discharges
- ☐ Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth
- ☐ Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☒ Soil Analysis provided.

☐ Required Recharge Volume calculation provided.

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

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

☐ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

Standard 9: Operation and Maintenance Plan

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

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

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

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

Standard 10: Prohibition of Illicit Discharges

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

☒ An Illicit Discharge Compliance Statement is attached;

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

LEVEL DESIGN GROUP
Civil Engineers & Land Surveyors

Aerial Photograph (MAGIS)

15 Liberty Way

Franklin, MA

1 inch = 300 Feet

0 300 600 900

January 17, 2023

www.cai-tech.com

This information is believed to be correct but is subject to change and is not warrantied.

USGS Topographic Map (MAGIS)

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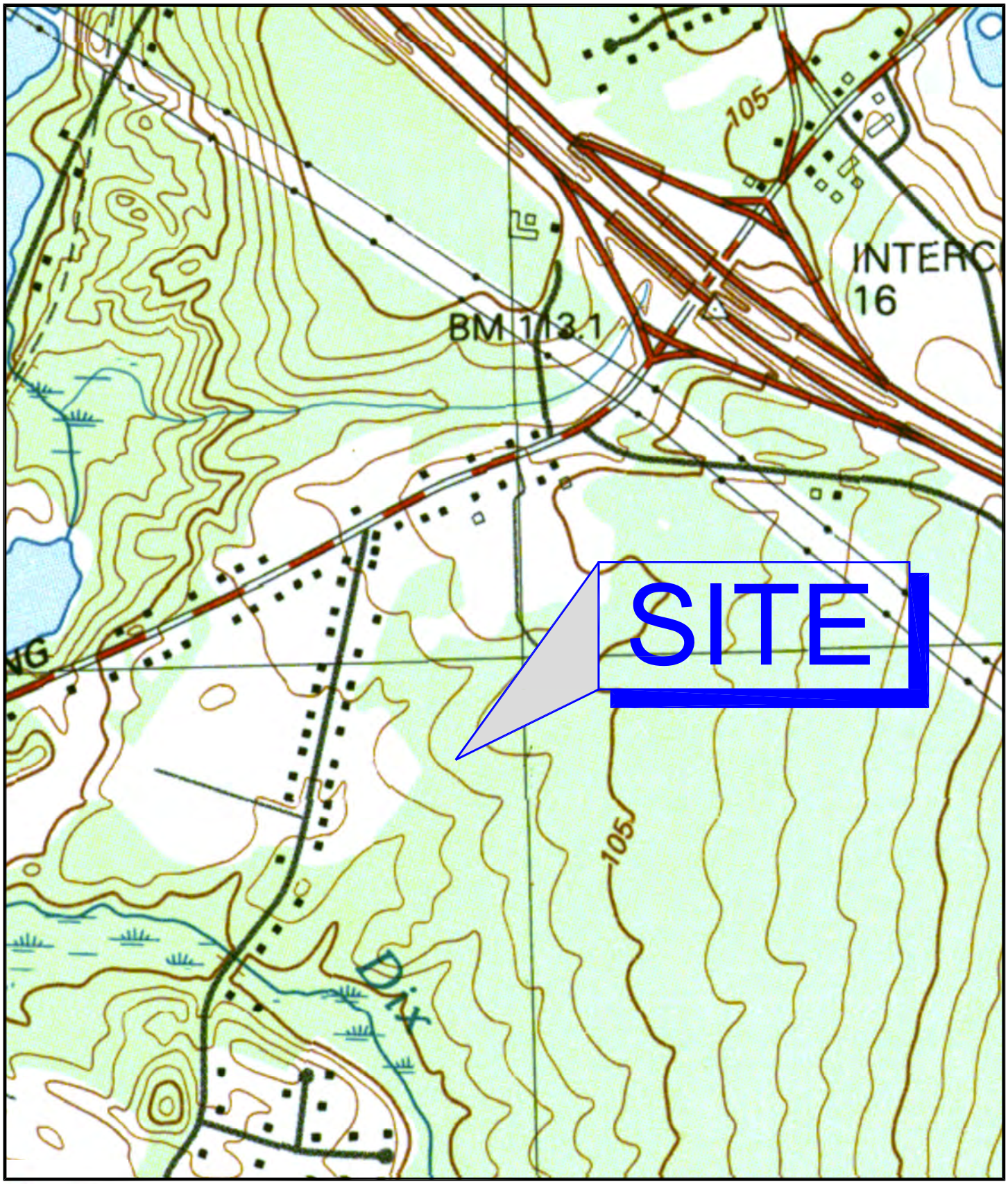


USGS LOCUS MAP

LEVEL DESIGN GROUP
Civil Engineers & Land Surveyors

CIVIL ENGINEERS AND LAND SURVEYORS
249 SOUTH STREET, UNIT 1
PLAINVILLE, MA 02762
508.695.2221 (F) 508.695.2219
WWW.LEVELDG.COM

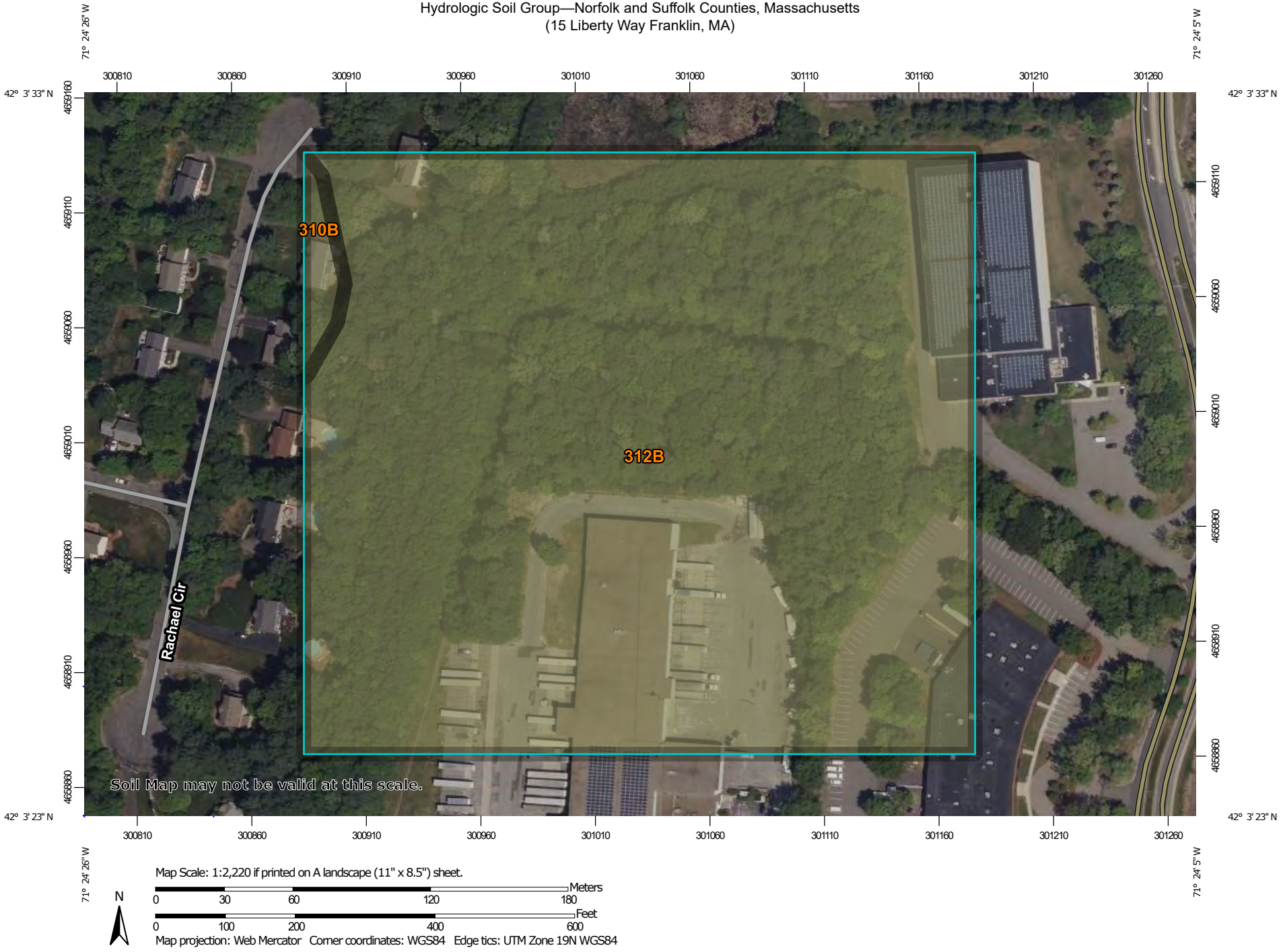
15 LIBERTY WAY
FRANKLIN, MA

PROJ NO.: 2081.00
SCALE: 1" = 1,000'

LEVEL DESIGN GROUP
Civil Engineers & Land Surveyors

On-Site Soils Documentation

Hydrologic Soil Group—Norfolk and Suffolk Counties, Massachusetts
(15 Liberty Way Franklin, MA)



Map Scale: 1:2,220 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 30 60 120 180

Feet
0 100 200 400 600

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

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

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

Soil Rating Lines

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

Soil Rating Points

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

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:25,000.

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

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

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
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: Norfolk and Suffolk Counties, Massachusetts
Survey Area Data: Version 18, Sep 9, 2022

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

Date(s) aerial images were photographed: May 22, 2022—Jun 5, 2022

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
310B	Woodbridge fine sandy loam, 3 to 8 percent slopes	C/D	0.3	1.5%
312B	Woodbridge fine sandy loam, 0 to 8 percent slopes, extremely stony	C/D	18.8	98.5%
Totals for Area of Interest			**19.0**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

LEVEL DESIGN GROUP
Civil Engineers & Land Surveyors

Stormwater Treatment Unit Information

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Hydrodynamic Separation Product Calculator

15 Liberty Way

Flow to DMH-2

CDS 2015-4

Project Information					
Project Name	15 Liberty Way			**Option #**	A
Country	UNITED_STATES	**State**	Massachusetts	**City**	Franklin

Contact Information			
First Name	Adam	**Last Name**	Hunt
Company	Level Design Group, LLC	**Phone #**	508-333-3625
Email	ahunt@leveldg.com		

Design Criteria					
Site Designation	Flow to DMH-2			**Sizing Method**	Net Annual
Screening Required?	Yes	**Drainage Area (ac)**	0.56	**Peak Flow (cfs)**	3.70
Groundwater Depth (ft)	0 - 5	**Pipe Invert Depth (ft)**	0 - 5	**Bedrock Depth (ft)**	>15
Multiple Inlets?	No	**Grate Inlet Required?**	No	**Pipe Size (in)**	12.00
Required Particle Size Distribution?	No	**90° between two inlets?**	N/A	**180° between inlet and outlet?**	No
Runoff Coefficient	0.98	**Rainfall Station**	69 - Boston Airport, MA	**TC (Min)**	6

Treatment Selection					
Treatment Unit	CDS	**System Model**	2015-4		
Target Removal	80%	**Particle Size Distribution (PSD)**	125	**Predicted Net Annual Removal**	91.40%

CONTECH ENGINEERED SOLUTIONS

Hydrodynamic Separation Product Calculator

15 Liberty Way

Flow to DMH-2

CDS 2015-4

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION BASED ON THE RATIONAL RAINFALL METHOD								
Rainfall Intensity[1] (in/hr)	% Rainfall Volume[1]	Cumulative Rainfall Volume	Rainfall Volume Treated	Total Flowrate (cfs)	Treated Flowrate (cfs)	Operating Rate (%)	Removal Efficiency (%)	Incremental Removal (%)
0.0200	10.17%	10.17%	10.17%	0.0110	0.0110	1.57%	100.00%	10.17%
0.0400	9.65%	19.82%	9.65%	0.0220	0.0220	3.14%	100.00%	9.65%
0.0600	9.45%	29.27%	9.45%	0.0329	0.0329	4.70%	100.00%	9.45%
0.0800	7.74%	37.01%	7.74%	0.0439	0.0439	6.27%	100.00%	7.74%
0.1000	8.57%	45.58%	8.57%	0.0549	0.0549	7.84%	99.84%	8.56%
0.1200	6.30%	51.88%	6.30%	0.0659	0.0659	9.41%	99.53%	6.27%
0.1400	4.66%	56.54%	4.66%	0.0768	0.0768	10.97%	99.21%	4.62%
0.1600	4.64%	61.18%	4.64%	0.0878	0.0878	12.54%	98.90%	4.59%
0.1800	3.54%	64.72%	3.54%	0.0988	0.0988	14.11%	98.59%	3.49%
0.2000	4.34%	69.06%	4.34%	0.1098	0.1098	15.69%	98.27%	4.26%
0.2500	8.00%	77.06%	8.00%	0.1372	0.1372	19.60%	97.49%	7.80%
0.3000	5.59%	82.65%	5.59%	0.1646	0.1646	23.51%	96.71%	5.41%
0.3500	4.37%	87.02%	4.37%	0.1921	0.1921	27.44%	95.92%	4.19%
0.4000	2.53%	89.55%	2.53%	0.2195	0.2195	31.36%	95.13%	2.41%
0.4500	2.53%	92.08%	2.53%	0.2470	0.2470	35.29%	94.35%	2.39%
0.5000	1.38%	93.46%	1.38%	0.2744	0.2744	39.20%	93.57%	1.29%
0.7500	5.04%	98.50%	5.04%	0.4116	0.4116	58.80%	89.64%	4.52%
1.0000	1.01%	99.51%	1.01%	0.5488	0.5488	78.40%	85.72%	0.87%
1.5000	0.00%	99.51%	0.00%	0.8232	0.7000	100.00%	69.22%	0.00%
2.0000	0.00%	99.51%	0.00%	1.0976	0.7000	100.00%	51.91%	0.00%
3.0000	0.48%	99.99%	0.20%	1.6464	0.7000	100.00%	34.61%	0.17%
								97.85%
							Removal Efficiency Adjustment[2] =	6.45%
							Predicted % Annual Rainfall Treated =	93.26%
							Predicted Net Annual Load Removal Efficiency =	91.40%

1 - Based on 10 years of hourly precipitation data from NCDC Station 770, Boston WSFO AP, Suffolk County, MA

2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

SECTION (_____)
STORM WATER TREATMENT DEVICE

1.0 GENERAL

1.1 This item shall govern the furnishing and installation of the CDS® by Contech Engineered Solutions LLC, complete and operable as shown and as specified herein, in accordance with the requirements of the plans and contract documents.

1.2 The Contractor shall furnish all labor, equipment and materials necessary to install the storm water treatment device(s) (SWTD) and appurtenances specified in the Drawings and these specifications.

1.3 The manufacturer of the SWTD shall be one that is regularly engaged in the engineering design and production of systems deployed for the treatment of storm water runoff for at least five (5) years and which have a history of successful production, acceptable to the Engineer. In accordance with the Drawings, the SWTD(s) shall be a CDS® device manufactured by:

Contech Engineered Solutions LLC
9025 Centre Pointe Drive
West Chester, OH, 45069
Tel: 1 800 338 1122

1.4 Related Sections

1.4.1 Section 02240: Dewatering
1.4.2 Section 02260: Excavation Support and Protection
1.4.3 Section 02315: Excavation and Fill
1.4.4 Section 02340: Soil Stabilization

1.5 All components shall be subject to inspection by the engineer at the place of manufacture and/or installation. All components are subject to being rejected or identified for repair if the quality of materials and manufacturing do not comply with the requirements of this specification. Components which have been identified as defective may be subject for repair where final acceptance of the component is contingent on the discretion of the Engineer.

1.6 The manufacturer shall guarantee the SWTD components against all manufacturer originated defects in materials or workmanship for a period of twelve (12) months from the date the components are delivered to the owner for installation. The manufacturer shall upon its determination repair, correct or replace any manufacturer originated defects advised in writing to the manufacturer within the referenced warranty period. The use of SWTD components shall be limited to the application for which it was specifically designed.

1.7 The SWTD manufacturer shall submit to the Engineer of Record a “Manufacturer’s Performance Certification” certifying that each SWTD is capable of achieving the specified removal efficiencies listed in these specifications. The certification shall be supported by independent third-party research

1.8 No product substitutions shall be accepted unless submitted 10 days prior to project bid date, or as directed by the Engineer of Record. Submissions for substitutions require review and approval by the Engineer of Record, for hydraulic performance, impact to project designs, equivalent treatment performance, and any required project plan and report (hydrology/hydraulic, water quality, stormwater pollution) modifications that would be required by the approving jurisdictions/agencies. Contractor to coordinate with the Engineer of Record any applicable modifications to the project estimates of cost, bonding amount determinations, plan check fees for changes to approved documents, and/or any other regulatory requirements resulting from the product substitution.

2.0 MATERIALS

2.1 Housing unit of stormwater treatment device shall be constructed of pre-cast or cast-in-place concrete, no exceptions. Precast concrete components shall conform to applicable sections of ASTM C 478, ASTM C 857 and ASTM C 858 and the following:

- 2.1.1 Concrete shall achieve a minimum 28-day compressive strength of 4,000 pounds per square-inch (psi);
- 2.1.2 Unless otherwise noted, the precast concrete sections shall be designed to withstand lateral earth and AASHTO H-20 traffic loads;
- 2.1.3 Cement shall be Type III Portland Cement conforming to ASTM C 150;
- 2.1.4 Aggregates shall conform to ASTM C 33;
- 2.1.5 Reinforcing steel shall be deformed billet-steel bars, welded steel wire or deformed welded steel wire conforming to ASTM A 615, A 185, or A 497.
- 2.1.6 Joints shall be sealed with preformed joint sealing compound conforming to ASTM C 990.
- 2.1.7 Shipping of components shall not be initiated until a minimum compressive strength of 4,000 psi is attained or five (5) calendar days after fabrication has expired, whichever occurs first.

2.2 Internal Components and appurtenances shall conform to the following:

- 2.2.1 Screen and support structure shall be manufactured of Type 316 and 316L stainless steel conforming to ASTM F 1267-01;
- 2.2.2 Hardware shall be manufactured of Type 316 stainless steel conforming to ASTM A 320;
- 2.2.3 Fiberglass components shall conform to applicable sections of ASTM D-4097
- 2.2.4 Access system(s) conform to the following:
- 2.2.5 Manhole castings shall be designed to withstand AASHTO H-20 loadings and manufactured of cast-iron conforming to ASTM A 48 Class 30.

3.0 PERFORMANCE

3.1 The SWTD shall be sized to either achieve an 80 percent average annual reduction in the total suspended solid load with a particle size distribution having a mean particle size (d_{50}) of 125 microns unless otherwise stated.

3.2 The SWTD shall be capable of capturing and retaining 100 percent of pollutants greater than or equal to 2.4 millimeters (mm) regardless of the pollutant's specific gravity (i.e.: floatable and neutrally buoyant materials) for flows up to the device's rated-treatment capacity. The SWTD shall be designed to retain all previously captured pollutants addressed by this

subsection under all flow conditions. The SWTD shall be capable of capturing and retaining total petroleum hydrocarbons. The SWTD shall be capable of achieving a removal efficiency of 92 and 78 percent when the device is operating at 25 and 50 percent of its rated-treatment capacity. These removal efficiencies shall be based on independent third-party research for influent oil concentrations representative of storm water runoff (20 ± 5 mg/L). The SWTD shall be greater than 99 percent effective in controlling dry-weather accidental oil spills.

3.3 The SWTD shall be designed with a sump chamber for the storage of captured sediments and other negatively buoyant pollutants in between maintenance cycles. The minimum storage capacity provided by the sump chamber shall be in accordance with the volume listed in Table 1. The boundaries of the sump chamber shall be limited to that which do not degrade the SWTD's treatment efficiency as captured pollutants accumulate. The sump chamber shall be separate from the treatment processing portion(s) of the SWTD to minimize the probability of fine particle re-suspension. In order to not restrict the Owner's ability to maintain the SWTD, the minimum dimension providing access from the ground surface to the sump chamber shall be 16 inches in diameter.

3.4 The SWTD shall be designed to capture and retain Total Petroleum Hydrocarbons generated by wet-weather flow and dry-weather gross spills and have a capacity listed in Table 1 of the required unit.

3.5 The SWTD shall convey the flow from the peak storm event of the drainage network, in accordance with required hydraulic upstream conditions as defined by the Engineer. If a substitute SWTD is proposed, supporting documentation shall be submitted that demonstrates equal or better upstream hydraulic conditions compared to that specified herein. This documentation shall be signed and sealed by a Professional Engineer registered in the State of the work. All costs associated with preparing and certifying this documentation shall be born solely by the Contractor.

3.6 The SWTD shall have completed field tested following TARP Tier II protocol requirements

4.0 EXECUTION

4.1 The contractor shall exercise care in the storage and handling of the SWTD components prior to and during installation. Any repair or replacement costs associated with events occurring after delivery is accepted and unloading has commenced shall be borne by the contractor.

4.2 The SWTD shall be installed in accordance with the manufacturer's recommendations and related sections of the contract documents. The manufacturer shall provide the contractor installation instructions and offer on-site guidance during the important stages of the installation as identified by the manufacturer at no additional expense. A minimum of 72 hours notice shall be provided to the manufacturer prior to their performance of the services included under this subsection.

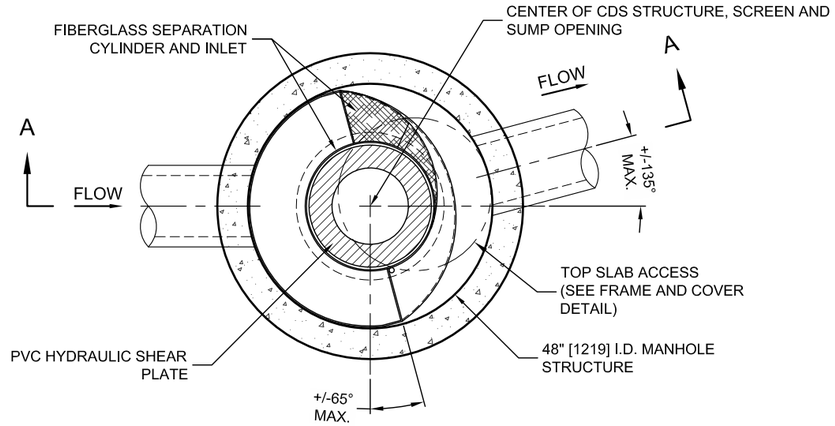
4.3 The contractor shall fill all voids associated with lifting provisions provided by the manufacturer. These voids shall be filled with non-shrinking grout providing a finished surface consistent with adjacent surfaces. The contractor shall trim all protruding lifting provisions flush with the adjacent concrete surface in a manner, which leaves no sharp points or edges.

4.4 The contractor shall removal all loose material and pooling water from the SWTD prior to the transfer of operational responsibility to the Owner.

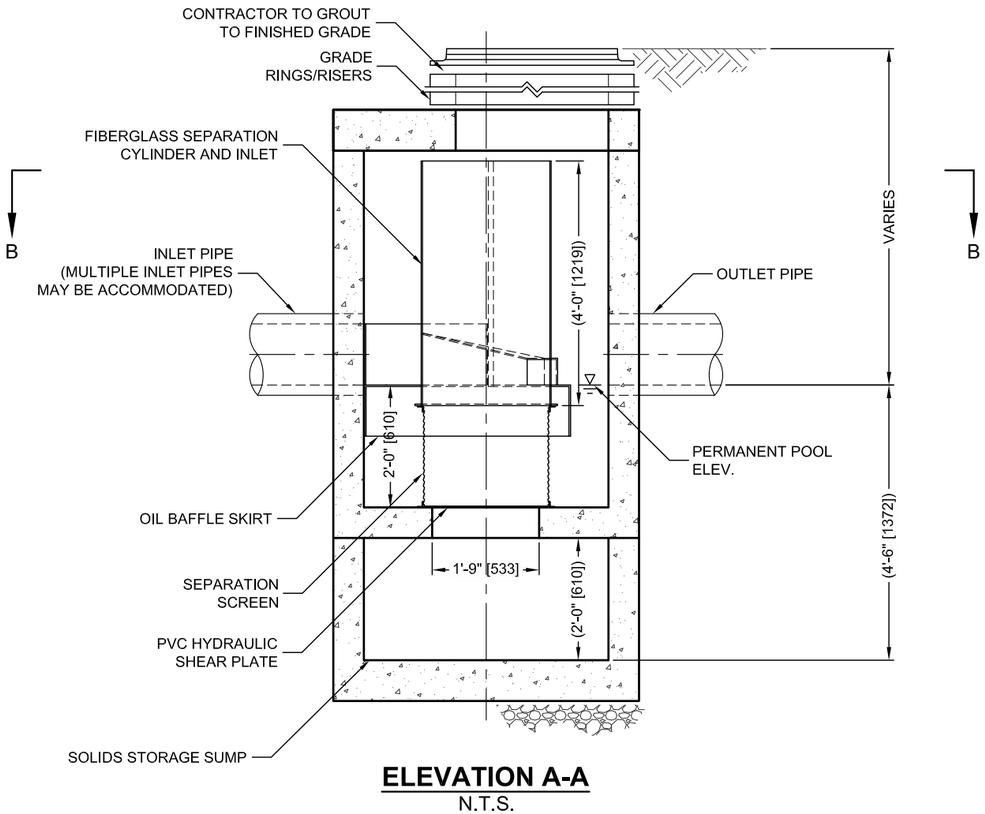
TABLE 1
Storm Water Treatment Device
Storage Capacities

CDS Model	Minimum Sump Storage Capacity $(yd^3)/(m^3)$	Minimum Oil Storage Capacity (gal)/(L)
CDS2015-4	0.9(0.7)	61(232)
CDS2015-5	1.5(1.1)	83(313)
CDS2020-5	1.5(1.1)	99(376)
CDS2025-5	1.5(1.1)	116(439)
CDS3020-6	2.1 (1.6)	184(696)
CDS3025-6	2.1(1.6)	210(795)
CDS3030-6	2.1 (1.6)	236(895)
CDS3035-6	2.1 (1.6)	263(994)
CDS3535-7	2.9(2.2)	377(1426)
CDS4030-8	5.6(4.3)	426(1612)
CDS4040-8	5.6 (4.3)	520(1970)
CDS4045-8	5.6 (4.3)	568(2149)
CDS5640-10	8.7(6.7)	758(2869)
CDS5653-10	8.7(6.7)	965(3652)
CDS5668-10	8.7(6.7)	1172(4435)
CDS5678-10	8.7(6.7)	1309(4956)
CDS7070-DV	3.6(2.8)	914 (3459)
CDS10060-DV	5.0 (3.8)	792 (2997)
CDS10080-DV	5.0 (3.8)	1057 (4000)
CDS100100-DV	5.0 (3.8)	1320 (4996)

END OF SECTION



PLAN VIEW B-B
N.T.S.



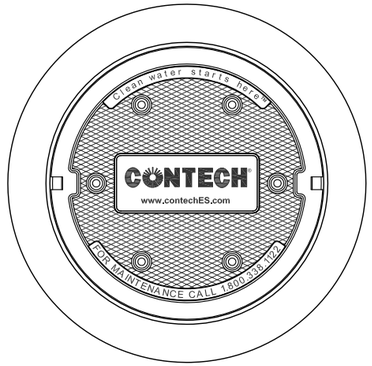
ELEVATION A-A
N.T.S.

THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING U.S. PATENTS: 5,788,848; 6,641,720; 6,511,595; 6,581,782; RELATED FOREIGN PATENTS, OR OTHER PATENTS PENDING.

CDS2015-4-C DESIGN NOTES

THE STANDARD CDS2015-4-C CONFIGURATION IS SHOWN. ALTERNATE CONFIGURATIONS ARE AVAILABLE AND ARE LISTED BELOW. SOME CONFIGURATIONS MAY BE COMBINED TO SUIT SITE REQUIREMENTS.

CONFIGURATION DESCRIPTION
GRATED INLET ONLY (NO INLET PIPE)
GRATED INLET WITH INLET PIPE OR PIPES
CURB INLET ONLY (NO INLET PIPE)
CURB INLET WITH INLET PIPE OR PIPES
SEPARATE OIL BAFFLE (SINGLE INLET PIPE REQUIRED FOR THIS CONFIGURATION)
SEDIMENT WEIR FOR NJDEP / NJCAT CONFORMING UNITS



FRAME AND COVER
(DIAMETER VARIES)
N.T.S.

SITE SPECIFIC DATA REQUIREMENTS

STRUCTURE ID	
WATER QUALITY FLOW RATE (CFS OR L/s)	*
PEAK FLOW RATE (CFS OR L/s)	*
RETURN PERIOD OF PEAK FLOW (YRS)	*
SCREEN APERTURE (2400 OR 4700)	*

PIPE DATA:	I.E.	MATERIAL	DIAMETER
INLET PIPE 1	*	*	*
INLET PIPE 2	*	*	*
OUTLET PIPE	*	*	*

RIM ELEVATION	*

ANTI-FLOTATION BALLAST	WIDTH	HEIGHT
	*	*

NOTES/SPECIAL REQUIREMENTS:

* PER ENGINEER OF RECORD

GENERAL NOTES
1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. DIMENSIONS MARKED WITH ( ) ARE REFERENCE DIMENSIONS. ACTUAL DIMENSIONS MAY VARY.
3. FOR FABRICATION DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR CONTECH ENGINEERED SOLUTIONS LLC REPRESENTATIVE. www.contechES.com
4. CDS WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING.
5. STRUCTURE SHALL MEET AASHTO HS20 AND CASTINGS SHALL MEET HS20 (AASHTO M 306) LOAD RATING, ASSUMING GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION.
6. PVC HYDRAULIC SHEAR PLATE IS PLACED ON SHELF AT BOTTOM OF SCREEN CYLINDER. REMOVE AND REPLACE AS NECESSARY DURING MAINTENANCE CLEANING.

INSTALLATION NOTES
A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE CDS MANHOLE STRUCTURE (LIFTING CLUTCHES PROVIDED).
C. CONTRACTOR TO ADD JOINT SEALANT BETWEEN ALL STRUCTURE SECTIONS, AND ASSEMBLE STRUCTURE.
D. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT PIPES. MATCH PIPE INVERTS WITH ELEVATIONS SHOWN.
E. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO ASSURE UNIT IS WATER TIGHT, HOLDING WATER TO FLOWLINE INVERT MINIMUM. IT IS SUGGESTED THAT ALL JOINTS BELOW PIPE INVERTS ARE GROUTED.

CONTECH® ENGINEERED SOLUTIONS LLC
www.contechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

CDS2015-4-C INLINE CDS STANDARD DETAIL

CONTECH®
ENGINEERED SOLUTIONS

Hydrodynamic Separation
Southern New England

The experts you need to solve your stormwater challenges

Contech is the leader in stormwater solutions, helping engineers, contractors and owners with infrastructure and land development projects throughout North America.

With our responsive team of stormwater experts, local regulatory expertise and flexible solutions, Contech is the trusted partner you can count on for stormwater management solutions.

Your Contech Team

STORMWATER CONSULTANT

It's my job to recommend the best solution to meet permitting requirements.

STORMWATER DESIGN ENGINEER

I work with consultants to design the best approved solution to meet your project's needs.

REGULATORY MANAGER

I understand the local stormwater regulations and what solutions will be approved.

SALES ENGINEER

I make sure our solutions meet the needs of the contractor during construction.

Contech is your partner in stormwater management solutions

Removing Pollutants using Hydrodynamic Separation

Utilize high-performance hydrodynamic separation to effectively remove finer sediment, oil and grease, and floating and sinking debris.

CASCADE separator®

CDS®

Vortechs®

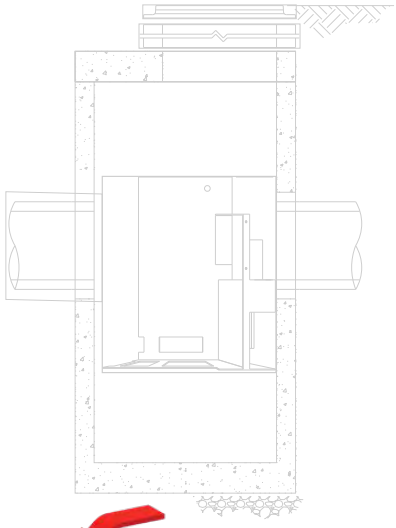
Stormceptor® STC

HDS systems play a vital role in protecting our waterways by removing high levels of sediment, trash, debris, and hydrocarbons from stormwater runoff.

Frequently used as end-of-pipe solutions, they are also used to provide stormwater quality treatment in places where space is limited.

HDS systems capture and retain a variety of stormwater pollutants and are very easy to maintain. These two key benefits have resulted in new uses for HDS technologies, such as pretreating detention, Low Impact Development, and green infrastructure practices, as well as other land-based stormwater treatment systems.

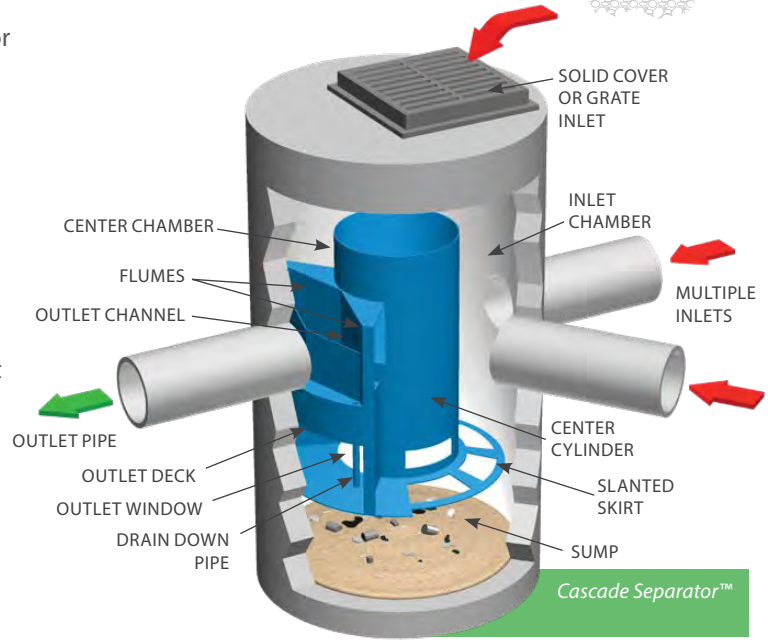
The Cascade Separator® System



Advanced Sediment Capture Technology ...

The Cascade Separator® is the newest innovation in stormwater treatment from Contech. The Cascade Separator was developed by Contech's stormwater experts using advanced modeling tools and Contech's industry leading stormwater laboratory.

This innovative hydrodynamic separator excels at sediment capture and retention while also removing hydrocarbons, trash, and debris from stormwater runoff. What makes the Cascade Separator unique is the use of opposing vortices that enhance particle settling and a unique skirt design that allows for sediment transport into the sump while reducing turbulence and resuspension of previously captured material. These two factors allow the Cascade Separator to treat high flow rates in a small footprint, resulting in an efficient and economical solution for any site.



FEATURE	BENEFIT
Unique skirt design & opposing vortices	Superior TSS removal; reduced system size and costs
Inlet area accepts wide range of inlet pipe angles	Design and installation flexibility
Accepts multiple inlet pipes*	Eliminates the need for separate junction structure
Grate inlet option*	Eliminates the need for a separate grate inlet structure
Internal bypass	Eliminates the need for a separate bypass structure
Clear access to sump and stored pollutants	Fast, easy maintenance

** NJDEP testing based on Cascade Separator with one inlet pipe and no grate inlet*

Learn More:
www.ContechES.com/cascade

SELECT CASCADE APPROVALS

- New Jersey Department of Environmental Protection Certification (NJDEP)

CASCADE MAINTENANCE

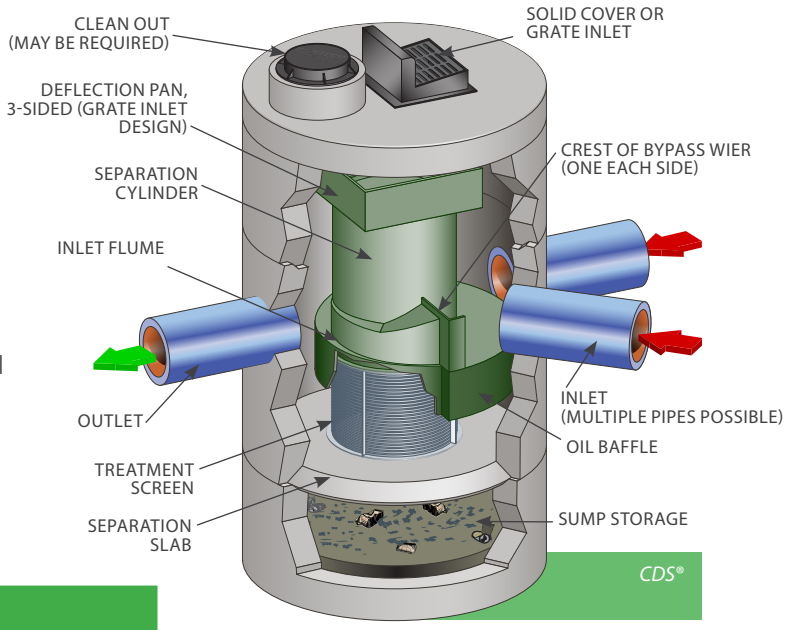
Cascade provides unobstructed access to stored pollutants, making it easy to maintain using a vacuum truck, with no requirement to enter the unit.

The CDS® System

Superior TSS and Trash Removal ...

The CDS is a hybrid technology that uses a combination of swirl concentration and indirect screening to separate and trap sediment, trash, debris, and hydrocarbons from stormwater runoff.

At the heart of the CDS system is a unique screening technology used to capture and retain sediment. The screen face is louvered so that it is smooth in the downstream direction. The effect created is called "Continuous Deflective Separation." The power of the incoming flow is harnessed to continually shear debris off the screen and to direct trash and sediment toward the center of the separation cylinder. This results in a screen that is self-cleaning and provides 100% removal of floatables and neutrally buoyant material debris 2.4 mm or larger, without blinding.



FEATURE	BENEFIT
Unique flow path and isolated storage sump	Excellent TSS capture and retention
Captures and retains 100% of floatables and neutrally buoyant debris 2.4 MM or larger	Superior trash removal
Self-cleaning screen	Ease of maintenance
Inline, offline, multiple inlet pipes, grate inlet, and drop inlet configurations available	Design flexibility
Internal bypass	Eliminates the need for additional structures
Clear access to sump and stored pollutants	Fast, easy maintenance

Learn More:
www.ContechES.com/cds

SELECT CDS APPROVALS

- Washington Department of Ecology (GULD) – Pretreatment
- New Jersey Department of Environmental Protection Certification (NJDEP)
- Canadian Environmental Technology Verification (ETV)
- MASTEP
- Connecticut DOT

The CDS system has been accepted and used extensively in all New England states for over 20 years with thousands of installations.

The Vortechs® System

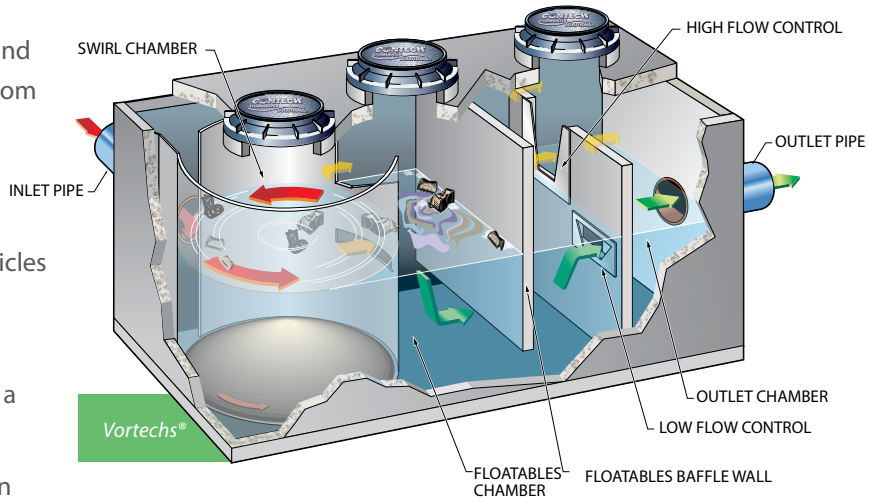
Stormwater Treatment in a Shallow Footprint ....

Vortechs combines swirl concentration and flow controls into a single treatment unit that captures and retains trash, debris, sediment, and hydrocarbons from stormwater runoff.

The Vortechs system's large swirl chamber and flow controls work together to create a low energy environment, ideal for capturing and retaining particles down to 50 microns.

Vortechs is the ideal solution for sites with high groundwater, bedrock, utility conflicts, or sites with a large volume runoff.

The Vortechs System is approved by the Washington Department of Ecology (GULD) - Pretreatment.



Learn More:
www.ContechES.com/vortechs

SELECT VORTECHS APPROVALS

- Washington Department of Ecology (GULD) – Pretreatment
- MASTEP
- Connecticut DOT

FEATURE	BENEFIT
Large swirl chamber	Fine particle removal down to 50 microns
Shallow profile – Typical depth below pipe invert is only 3 feet.	Can be used on sites with high groundwater, bedrock, or utility conflicts
Unobstructed access to stored pollutants	Fast, easy maintenance

The Vortechs System was developed in New England and has been used extensively in the region for over 20 years.

The ideal solution for sites with high groundwater

Stormceptor® STC

Stormceptor STC is the recognized leader in stormwater treatment, offering a range of versatile treatment systems that effectively remove pollutants from stormwater and snowmelt runoff. Stormceptor is flexibly designed to protect waterways from hazardous material spills and stormwater pollution, including suspended sediment, free oils, and other pollutants that attach to particles, no matter how fierce the storm.

Stormceptor's scour prevention technology ensures pollutants are captured and contained during all rainfall events.

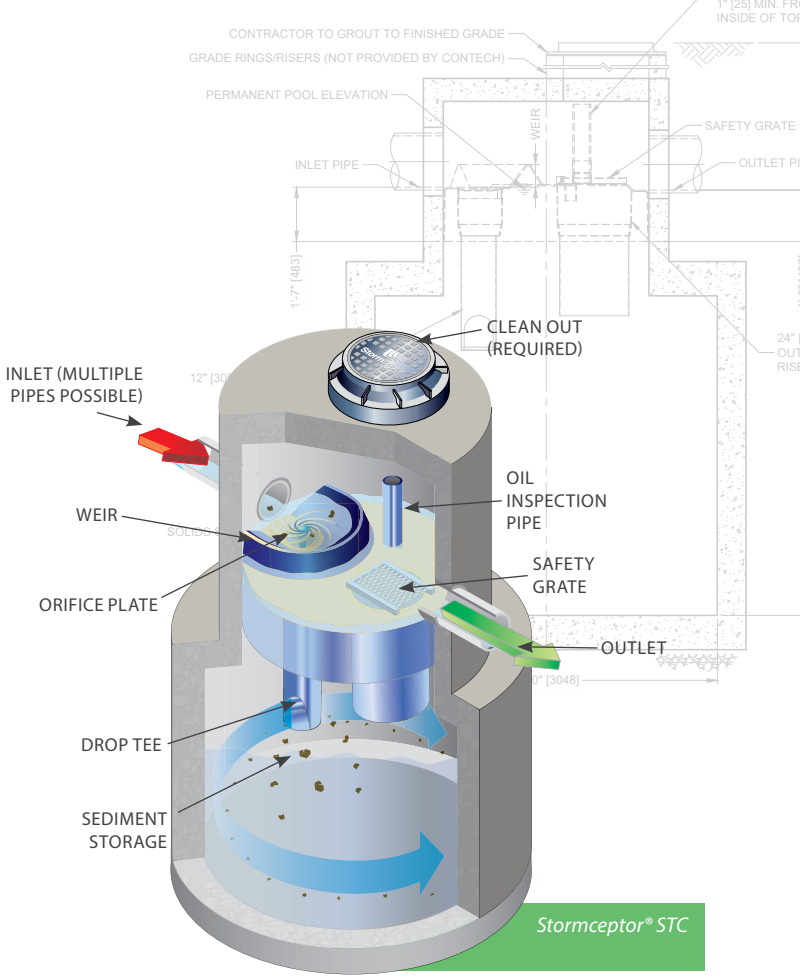
Ideal uses

- Sediment (TSS) removal
- Spill control
- Debris and small floatables capture
- Pretreatment for filtration, detention/retention systems, ponds, wetlands, Low Impact Development (LID), green infrastructure, and water-sensitive urban design

Proven performance

With more than 20 years of industry experience, Stormceptor has been performance tested and verified by some of the most stringent technology evaluation programs in North America.

- NJCAT
- Washington Ecology to Washington Department of Ecology (GULD) – Pretreatment
- EN858 Class 2



Learn More:
www.ContechES.com/stormceptor

FEATURE	BENEFIT
Patented scour prevention technology	Superior pollutant removal and retention
Can take the place of a conventional junction or inlet structure	Eliminates the need for additional structures
Minimal drop between inlet and outlet	Site flexibility
Multiple inlets can connect to a single unit	Design flexibility
3rd party tested and verified performance (Sediment & Oil)	Eliminates the need for a separate bypass structure

With over 40,000 units operating worldwide, Stormceptor performs and protects every day, in every storm.

Product Flow Rates

CASCADE

Model	Treatment Rate (cfs)	Sediment Capacity[1] (CF)
CS-3	1.02	11
CS-4	2.00	19
CS-5	3.50	29
CS-6	5.60	42
CS-8	12.00	75
CS-10	18.00	118

CDS

Model	Treatment Rate[2] (cfs)	Sediment Capacity[1] (CF)
1515-3	1.00	14
2015-4	1.40	25
2015-5	1.40	39
2015-6	1.40	57
2020-5	2.20	39
2020-6	2.20	57
2025-5	3.20	39
2025-6	3.20	57
3020-6	3.90	57
3025-6	5.00	57
3030-6	5.70	57
3035-6	6.50	57
4030-8	7.50	151
4040-8	9.50	151

VORTECHS

Model	Treatment Rate (cfs)	Sediment Capacity[3] (CF)
1000	1.60	16
2000	2.80	32
3000	4.50	49
4000	6.00	65
5000	8.50	86
7000	11.00	108
9000	14.00	130
11000	17.5	151
16000	25	192

STORMCEPTOR STC

Model	Treatment Rate (cfs)	Sediment Capacity[1] (CF)
STC 450i	0.40	46
STC 900	0.89	89
STC 2400	1.58	205
STC 4800	2.47	543
STC 7200	3.56	839
STC 11000	4.94	1086
STC 16000	7.12	1677

1 Additional sediment storage capacity available – Check with your local representative for information.

2 Treatment Capacity is based on laboratory testing using OK-110 (average D50 particle size of approximately 100 microns) and a 2400 micron screen.

3 Maintenance recommended when sediment depth has accumulated to within 12-18 inches of the dry weather water surface elevation.

STORMWATER SOLUTIONS

PIPE SOLUTIONS

STRUCTURES SOLUTIONS

CONTECH® ENGINEERED SOLUTIONS

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800-338-1122 | www.ContechES.com

LEVEL DESIGN GROUP
Civil Engineers & Land Surveyors

MADEP TSS Removal Calculation Sheets

INSTRUCTIONS:

Non-automated: Mar. 4, 2008

1. Sheet is nonautomated. Print sheet and complete using hand calculations. Column A and B: See MassDEP Structural BMP Table
2. The calculations must be completed using the Column Headings specified in Chart and Not the Excel Column Headings
3. To complete Chart Column D, multiple Column B value within Row x Column C value within Row
4. To complete Chart Column E value, subtract Column D value within Row from Column C within Row
5. Total TSS Removal = Sum All Values in Column D

Location: Flow to SSD-1 (full treatment)

TSS Removal Calculation Worksheet

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Deep Sump CBs & DMH's	0.10	1.00	0.10	0.90
CDS Unit	0.91	0.90	0.82	0.08
SSI-1	0.80	0.08	0.06	0.02

Total TSS Removal = 98%

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

Project: 15 Liberty Way

Prepared By: APH

Date: 02/01/24

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

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed

1. From MassDEP Stormwater Handbook Vol. 1

INSTRUCTIONS:

Non-automated: Mar. 4, 2008

1. Sheet is nonautomated. Print sheet and complete using hand calculations. Column A and B: See MassDEP Structural BMP Table
2. The calculations must be completed using the Column Headings specified in Chart and Not the Excel Column Headings
3. To complete Chart Column D, multiple Column B value within Row x Column C value within Row
4. To complete Chart Column E value, subtract Column D value within Row from Column C within Row
5. Total TSS Removal = Sum All Values in Column D

Location: Modified Detention Basin (full treatment)

TSS Removal Calculation Worksheet

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Deep Sump CBs & DMH's	0.10	1.00	0.10	0.90
Sediment Forebay	0.25	0.90	0.23	0.67
Detention Basin	0.80	0.67	0.54	0.14

Total TSS Removal = 86%

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

Project: 15 Liberty Way

Prepared By: APH

Date: 2/01/24

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

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed

1. From MassDEP Stormwater Handbook Vol. 1

INSTRUCTIONS:

Non-automated: Mar. 4, 2008

1. Sheet is nonautomated. Print sheet and complete using hand calculations. Column A and B: See MassDEP Structural BMP Table
2. The calculations must be completed using the Column Headings specified in Chart and Not the Excel Column Headings
3. To complete Chart Column D, multiple Column B value within Row x Column C value within Row
4. To complete Chart Column E value, subtract Column D value within Row from Column C within Row
5. Total TSS Removal = Sum All Values in Column D

Location: CB-1 & TD-1 to CDS (pretreatment)

TSS Removal Calculation Worksheet

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Deep Sump CB's & DMH's	0.10	1.00	0.10	0.90
CDS Unit	0.91	0.90	0.82	0.08

Total TSS Removal = 88%

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

Project: 15 Liberty Way

Prepared By: APH

Date: 02/01/24

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

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed

1. From MassDEP Stormwater Handbook Vol. 1

INSTRUCTIONS:

Non-automated: Mar. 4, 2008

1. Sheet is nonautomated. Print sheet and complete using hand calculations. Column A and B: See MassDEP Structural BMP Table
2. The calculations must be completed using the Column Headings specified in Chart and Not the Excel Column Headings
3. To complete Chart Column D, multiple Column B value within Row x Column C value within Row
4. To complete Chart Column E value, subtract Column D value within Row from Column C within Row
5. Total TSS Removal = Sum All Values in Column D

Location: Modified Detention Basin (pretreatment)

TSS Removal Calculation Worksheet

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Deep Sump CBs & DMH's	0.10	1.00	0.10	0.90
Sediment Forebay	0.25	0.90	0.23	0.67

Total TSS Removal = 33%

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

Project: 15 Liberty Way

Prepared By: APH

Date: 2/01/24

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

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed

1. From MassDEP Stormwater Handbook Vol. 1

LEVEL DESIGN GROUP
Civil Engineers & Land Surveyors

Phosphorous Removal Calculations

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PHOSPHORUS LOAD REDUCTION CALCUATION – SSI-1

Note - Phosphorus Load Reductions Calculations are based on MA MS4 General Permit (Effective July 1, 2018 with Modification Effective January 6, 2021) - ATTACHMENT 3 TO APPENDIX F - Methods to Calculate Phosphorus and Nitrogen Load Reductions for Structural Stormwater Best Management Practices

1) Phosphorous Load reduction target (P_{target}) = 60%

2) Infiltration Basin. Information for the contributing impervious (IA) and pervious (PA) areas are summarized below:

Impervious Area Draining to SSI-Basin-1: 0.572 Ac. HSG C
Pervious Area Draining to SSI-Basin-1: 0.000 Ac. HSG C

3) Infiltration Rate = 0.17 in./hr.

4) BMP Volume (IA-in) = 0.28 in. (From Table 3-12 & Figure 3.7)

5) BMP Volume (IA-ft^3) = (0.572 Ac. x 0.28 in) x (3,630 ft^3/acre-in) = 572 ft^3

The available storage volume (ft^3) of the infiltration basin (BMP-Volume ft^3) below the lowest proposed outlet is 2,253 ft^3 (taken from HydroCAD summary of node SSD-1)

2,253 ft^3 > 572 ft^3

PHOSPHORUS LOAD REDUCTION CALCUATION – MODIFIED INFILTRATION BASIN

Note - Phosphorus Load Reductions Calculations are based on MA MS4 General Permit (Effective July 1, 2018 with Modification Effective January 6, 2021) - ATTACHMENT 3 TO APPENDIX F - Methods to Calculate Phosphorus and Nitrogen Load Reductions for Structural Stormwater Best Management Practices

1) Phosphorous Load reduction target (P_{target}) = 60%

2) Infiltration Basin. Information for the contributing impervious (IA) and pervious (PA) areas are summarized below:

Impervious Area Draining to Infiltration-Basin-1: 0.959 Ac. HSG C
Pervious Area Draining to Infiltration-Basin-1: 0.007 Ac. HSG C

Note: These areas are from Drain Area P-1b only as this area flows directly to the infiltration basin. Flow from Drain Area P-1a is treated by Subsurface Infiltration Basin-1 (SSI-1)

3) Infiltration Rate = 0.17 in./hr.

4) BMP Volume (IA-in) = 0.28 in. (From Table 3-12 & Figure 3.7)

5) Pervious Area runoff depth = 0.02 (From Table 3-4)
BMP Volume (PA- ft^3)= (0.007 acre) x (0.02 in) x (3,630 ft^3/acre-in) = 0.49 ft^3

BMP Volume (IA&PA-ft^3)= (0.49 ft^3 + ((0.959 acre x 0.28 in) x (3,630 ft^3/acre-in)) = 976 ft^3

The available storage volume (ft^3) of the infiltration basin (BMP-Volume ft^3) below the lowest proposed outlet is 1,289 ft^3 (taken from HydroCAD summary of node IB-1)

1,289 ft^3 > 976 ft^3

Groundwater Mounding Calculations

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Gilbert Street Warehouse
Mansfield, MA

Bioretention Basin
Mounding Analysis

Level Design Group, LLC
249 South Street
Plainville, MA 02762

This spreadsheet will calculate the height of a groundwater mound beneath a stormwater infiltration basin. More information can be found in the U.S. Geological Survey Scientific Investigations Report 2010-5102 "Simulation of groundwater mounding beneath hypothetical stormwater infiltration basins".

The user must specify infiltration rate (R), specific yield (Sy), horizontal hydraulic conductivity (Kh), basin dimensions (x, y), duration of infiltration period (t), and the initial thickness of the saturated zone (hi(0), height of the water table if the bottom of the aquifer is the datum). For a square basin the half width equals the half length (x = y). For a rectangular basin, if the user wants the water-table changes perpendicular to the long side, specify x as the short dimension and y as the long dimension. Conversely, if the user wants the values perpendicular to the short side, specify y as the short dimension, x as the long dimension. All distances are from the center of the basin. Users can change the distances from the center of the basin at which water-table aquifer thickness are calculated.
Cells highlighted in yellow are values that can be changed by the user. Cells highlighted in red are output values based on user-specified inputs. The user MUST click the blue "Re-Calculate Now" button each time ANY of the user-specified inputs are changed otherwise necessary iterations to converge on the correct solution will not be done and values shown will be incorrect. Use consistent units for all input values (for example, feet and days)

use consistent units (e.g. feet & days **or** inches & hours)

Input Values		
0.0810	***R***	**Recharge (infiltration) rate (feet/day)**
0.200	**Sy**	**Specific yield, Sy (dimensionless, between 0 and 1)**
3.40	**K**	**Horizontal hydraulic conductivity, Kh (feet/day)***
75.000	**x**	**1/2 length of basin (x direction, in feet)**
20.000	**y**	**1/2 width of basin (y direction, in feet)**
3.000	**t**	**duration of infiltration period (days)**
10.000	**hi(0)**	**initial thickness of saturated zone (feet)**

Conversion Table

inch/hour	feet/day
0.67	1.33
2.00	4.00

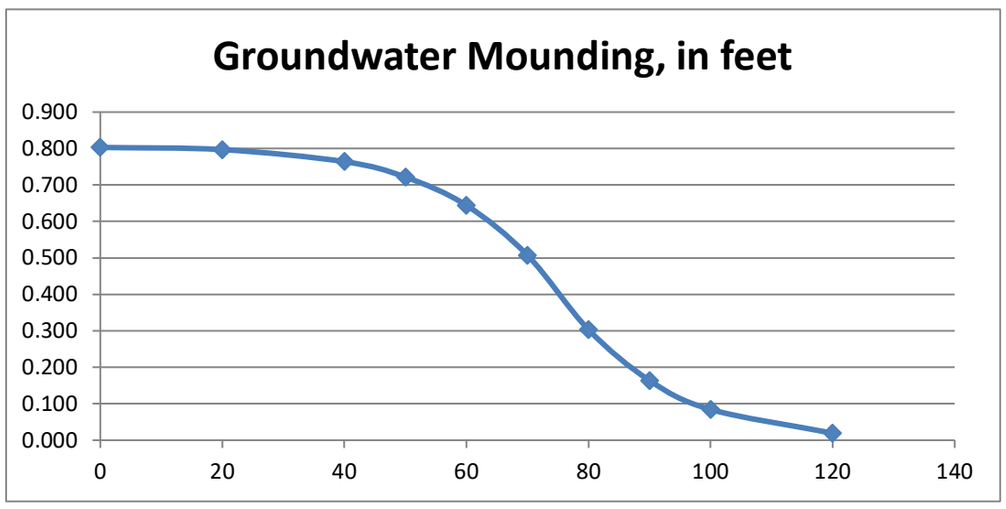
hours	days
36	1.50

In the report accompanying this spreadsheet (USGS SIR 2010-5102), vertical soil permeability (ft/d) is assumed to be one-tenth horizontal hydraulic conductivity (ft/d).

10.803	**h(max)**	**maximum thickness of saturated zone (beneath center of basin at end of infiltration period)**
0.803	**Δh(max)**	**maximum groundwater mounding (beneath center of basin at end of infiltration period)**

Ground-water Mounding, in feet	Distance from center of basin in x direction, in feet
0.803	0
0.797	20
0.764	40
0.722	50
0.644	60
0.507	70
0.303	80
0.164	90
0.084	100
0.019	120

Re-Calculate Now



Disclaimer

This spreadsheet solving the Hantush (1967) equation for ground-water mounding beneath an infiltration basin is made available to the general public as a convenience for those wishing to replicate values documented in the USGS Scientific Investigations Report 2010-5102 "Groundwater mounding beneath hypothetical stormwater infiltration basins" or to calculate values based on user-specified site conditions. Any changes made to the spreadsheet (other than values identified as user-specified) after transmission from the USGS could have unintended, undesirable consequences. These consequences could include, but may not be limited to: erroneous output, numerical instabilities, and violations of underlying assumptions that are inherent in results presented in the accompanying USGS published report. The USGS assumes no responsibility for the consequences of any changes made to the spreadsheet. If changes are made to the spreadsheet, the user is responsible for documenting the changes and justifying the results and conclusions.

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R	Design Storm Depth / Infiltration Period	**0.081**	(1,289 cu ft vol. below outlet / 5291 sq.ft syst. footprint) / 3 days
Sy	Specific yield (dimensionless constant) =	**0.2**	
K	Hydraulic conductivity (feet/day) 2.41 in/hr =	**3.4**	ft/day =0.17 in/hr (24 hr/day * 1 ft/12 in) = 0.34 ft/day * 10
x	1/2 legth basin (feet) =	**75**	ft. = 150/2 (conv. Vert Perm to Horz Perm)
y	1/2 width basin (feet) =	**20**	ft. = 40/2
t	t Duration of infiltration period (days) =	**3**	day = (MADEP req. time for basin to empy)
hi	hi(o) Initial saturated thickness	**10**	ft

Gilbert Street Warehouse
Mansfield, MA

Bioretention Basin
Mounding Analysis

Level Design Group, LLC
249 South Street
Plainville, MA 02762

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The user must specify infiltration rate (R), specific yield (Sy), horizontal hydraulic conductivity (Kh), basin dimensions (x, y), duration of infiltration period (t), and the initial thickness of the saturated zone (hi(0), height of the water table if the bottom of the aquifer is the datum). For a square basin the half width equals the half length (x = y). For a rectangular basin, if the user wants the water-table changes perpendicular to the long side, specify x as the short dimension and y as the long dimension. Conversely, if the user wants the values perpendicular to the short side, specify y as the short dimension, x as the long dimension. All distances are from the center of the basin. Users can change the distances from the center of the basin at which water-table aquifer thickness are calculated.
Cells highlighted in yellow are values that can be changed by the user. Cells highlighted in red are output values based on user-specified inputs. The user MUST click the blue "Re-Calculate Now" button each time ANY of the user-specified inputs are changed otherwise necessary iterations to converge on the correct solution will not be done and values shown will be incorrect. Use consistent units for all input values (for example, feet and days)

use consistent units (e.g. feet & days **or** inches & hours)

Input Values		
0.1969	***R***	**Recharge (infiltration) rate (feet/day)**
0.200	**Sy**	**Specific yield, Sy (dimensionless, between 0 and 1)**
3.40	**K**	**Horizontal hydraulic conductivity, Kh (feet/day)***
55.000	**x**	**1/2 length of basin (x direction, in feet)**
25.750	**y**	**1/2 width of basin (y direction, in feet)**
3.000	**t**	**duration of infiltration period (days)**
10.000	**hi(0)**	**initial thickness of saturated zone (feet)**

12.162	**h(max)**	**maximum thickness of saturated zone (beneath center of basin at end of infiltration period)**
2.162	**Δh(max)**	**maximum groundwater mounding (beneath center of basin at end of infiltration period)**

Conversion Table

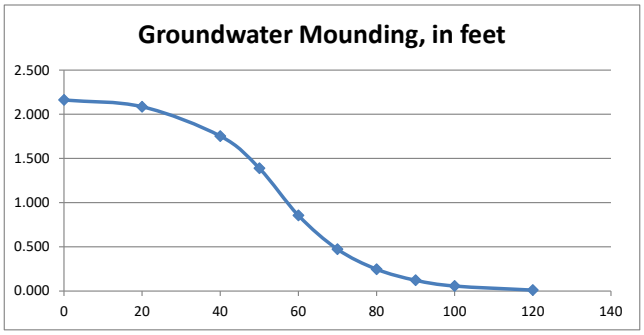
inch/hour	**feet/day**
0.67	1.33
2.00	4.00

hours	**days**
36	1.50

In the report accompanying this spreadsheet (USGS SIR 2010-5102), vertical soil permeability (ft/d) is assumed to be one-tenth horizontal hydraulic conductivity (ft/d).

Ground-water Mounding, in feet	**Distance from center of basin in x direction, in feet**
2.162	**0**
2.086	**20**
1.754	**40**
1.389	**50**
0.856	**60**
0.473	**70**
0.247	**80**
0.122	**90**
0.057	**100**
0.011	**120**

Re-Calculate Now



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R	Design Storm Depth / Infiltration Period	**0.1969**	(3,346 cu ft vol. below outlet / 5665 sq.ft syst. footprint) / 3 days
Sy	Specific yield (dimensionless constant) =	**0.2**	
K	Hydraulic conductivity (feet/day) 2.41 in/hr =	**3.4**	ft/day =0.17 in/hr (24 hr/day * 1 ft/12 in) = 0.34 ft/day * 10
x	1/2 legth basin (feet) =	**55**	ft. = 110/2 (conv. Vert Perm to Horz Perm)
y	1/2 width basin (feet) =	**25.75**	ft. = 51.5/2
t	t Duration of infiltration period (days) =	**3**	day = (MADEP req. time for basin to empy)
hi	hi(o) Initial saturated thickness	**10**	ft

LEVEL DESIGN GROUP
Civil Engineers & Land Surveyors

Rational Method Pipe-to-Pipe Calculations

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STORM SEWER SYSTEM
15 Liberty Way
Franklin, MA
LDG Proj# 2081.00

FLOW PATH		EGMEN	TIME TO	TIME IN	ACCUMUL	RUNOFF	AREA	SUM OF	ACCUMUL	RAINFALL	SYSTEM	PIPE	PIPE (ft)	SLOPE	Vfull	Qfull	ROUGH.	CAPACITY
FROM	TO	TYPE	INLET	PIPE	TIME	COEFF "C"	(acres)	AxC	AxC	I	Q (cfs)	SIZE (in)	LENGTH	(ft/ft)	(fps)	(cfs)	COEFF. "n"	CHECK
TD-1/DMH-1	DMH 2	I	5.00	0.19	5.19	0.90	0.576											
	`					0.30	0.000											
						0.20	0.000											
								0.518	0.518	6.00	3.11	12	58	0.0110	5.15	4.05	0.0120	WITHIN CAPACITY
CB-1	OUTLET-1	I	5.00	0.27	5.27	0.90	0.681											
						0.30	0.007											
						0.20	0.000											
								0.615	0.615	6.00	3.69	12	82	0.0110	5.15	4.05	0.0120	WITHIN CAPACITY
CB-2	OUTLET-2	I	5.00	0.14	5.14	0.90	0.394											
						0.30	0.000											
						0.20	0.000											
								0.355	0.355	6.00	2.13	12	38	0.0080	4.40	3.45	0.0120	WITHIN CAPACITY
SSI-1	OUTLET-3	C	5.00	0.07	5.22	0.90	0.000											
						0.30	0.000											
						0.20	0.000											
								0.000	0.000	6.00	2.53	12	23	0.0110	5.15	4.05	0.0120	WITHIN CAPACITY
											*100-Year Storm Flow From System Out							

LEVEL DESIGN GROUP, LLC
249 South Street, Unit 1
Plainville, MA 02762
Phone # (508) 695-2221

Outlet Protection Sizing Calculations

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OUTLET PROTECTION CALCULATIONS
15 Liberty Way
Franklin, MA

LDG Proj # 2081.00

	Outlet-1		Outlet-2		Outlet-3	
Apron Dimensions						
Do=inside culvet diameter (ft)	Do=	1.25	Do=	0.67	Do=	0.67
Approx Width(W) = Do+3	W=	4.25	W=	3.67	W=	3.67
Approx Length(La) = 2W	La=	8.50	La=	7.34	La=	7.34
Riprap Types	d50 (ft)	d50(in)	d50 (ft)	d50(in)	d50 (ft)	d50(in)
Modified	0.42	5	0.42	5	0.42	5
Intermediate	0.67	8	0.67	8	0.67	8
Standard	1.25	15	1.25	15	1.25	15
MADOT Guidelines	Vel. (ft/s)		Vel. (ft/s)		Vel. (ft/s)	
Modified	0-8		0-8		0-8	
Intermediate	8-10		8-10		8-10	
Standard	10-14		10-14		10-14	
Calculated Apron Dimensions						
Length(La)						
Q=flow (cfs) 25 year storm	Q=	3.69	Q=	2.13	Q=	2.53
Do=max. inside culvet diameter (ft)	Do=	1.00	Do=	1.00	Do=	1.00
La=(1.7Q/Do^2/3)+8Do	La=	14.27	La=	11.62	La=	12.30
Width(W)						
W=3Do+0.4La	W=	8.71	W=	7.65	W=	7.92

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LEVEL DESIGN GROUP
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Earthwork Calculations

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EARTHWORK CALCULATIONS
15 Liberty Way
Franklin, MA

Project No: 2081.00
Project: 15 Liberty Way Franklin
Date 3/19/24

EARTHWORK CALCULATIONS

Net Site Grading Cut = -1648 CY (From Civil3D)

Subsurface Infiltration Basin

Area = 3,832 SF
Height = 2.33 LF
Volume = 3,832 SF x 2.33 LF = 331 CY

Total Site Cut = -1648 CY - 331 CY = -1979 CY

Earthwork includes Net Cut & Fill volume from AutoCAD and Subsurface Infiltration Basin Volume

LEVEL DESIGN GROUP
Civil Engineers & Land Surveyors

Illicit Discharge Statement

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Illicit Discharge Statement

Under the Massachusetts Wetlands Protection Act – Stormwater Management Standards
For
15 LIBERTY WAY
FRANKLIN, MA

All illicit discharges to the Stormwater Management System are prohibited. The Stormwater Management System is the system for conveying, treating, and infiltrating stormwater. Illicit discharges to Stormwater Management Systems are discharges that are not entirely comprised of stormwater, but do not include discharges from the following activities or facilities:

- Firefighting
- Water Line Flushing
- Potable Water Sources
- Landscape Irrigation
- Potable Water Sources
- Uncontaminated Groundwater
- Air-conditioning Condensation
- Dechlorinated Water from Swimming Pools
- Water used for street washing
- Water used for clean residential buildings without detergents
- Foundation Drains

The site will be operated and maintained in accordance with the Operation and Maintenance Plan dated January 17, 2023 prepared by Level Design Group, LLC.

I, Atlantic Oliver 15 Liberty Way, LLC ***(Applicant)*** do hereby agree to comply with requirements set forth within the Illicit Discharge Statement and will not knowingly discharge illicit materials to the stormwater management system once it is brought online **upon** completion of construction.

Signature: _____ Date: 2/7/23

LEVEL DESIGN GROUP
Civil Engineers & Land Surveyors

Existing Drainage Plan & HydroCAD Diagram

WATERSHED LEGEND

XXXX — SOIL TYPE

X — HYDROLOGIC SOIL GROUP

SOILS

312B — WOODBRIDGE FINE SANDY LOAM

N/F
COOKE
PARCEL 320–021
DB 11508 PG 376
4 RACHAEL CIRCLE

N/F
HARDING & MURPHY
PARCEL 320–022
DB 10636 PG 581
6 RACHAEL CIRCLE

N/F
SMITH
CEL 320–023
0681 PG 633
CHAEL CIRCLE

024
178
RCLE

LOT B–211
N/F
IRON MOUNTAIN INFORMATION MANAGEMENT, LLC
PARCEL ID 320–006
DB 32508 PG 480
PLAN NO. 659 OF 1998
77 CONSTITUTION BLVD.

LOT B-21A
653,400± S.F.
=15.000± ACRES
PARCEL ID 320–004
DB 39279 PG 298
PLAN NO. 879 OF 1994
15 LIBERTY WAY

EXISTING ONE STORY WAREHOUSE BUILDING HEIGHT=24'±
#15

E1
AREA=114,809 S.F.
CN=73
TC=12.0 MIN.

E1a
AREA=149,743 S.F.
CN=83
TC=12.0 MIN.

E2
AREA=45,523 S.F.
CN=74
TC=11.3 MIN.

E2a
AREA=69,184 S.F.
CN=79
TC=11.3 MIN.

TP–1 GR.=334.70 GW.=331.78
TP–2 GR.=331.05 GW.=328.38
TP–3 GR.=328.50 GW.=326.00
TP–4 GR.=325.65 GW.=323.14
TP–5 GR.=326.45 GW.=323.03
TP–6 GR.=325.70 GW.=323.45
TP–7 GR.=324.90 GW.=322.65

DMH RIM=326.41

FES INV=330.63
FES INV=335.15

SWALE
DRAINAGE SWALE
SEDIMENT FOREBAY
RIP-RAP DETENTION POND
EXISTING CHAINLINK FENCE (TYP.)
EXISTING TREELINE (TYP.)
BUILDING SETBACK LINE
GENERAL RESIDENTIAL "A" ZONING DISTRICT
INDUSTRIAL ZONING DISTRICT
10' WIDE DRAIN EASEMENT
20' WIDE UTILITY EASEMENT
35' WIDE DRAINAGE EASEMENT
25' WIDE WATER MAIN EASEMENT
100' WETLAND BUFFER
50' WETLAND BUFFER
25' WETLAND BUFFER

NO	DATE	REVISIONS
1	10/17/2023	RESOURCE AREA FLAGS
2	02/01/2024	REVIEW COMMENTS
3	03/19/2024	REVISE LAYOUT

SEAL

DATE : JANUARY 13, 2023
DRAWN : AH / DRC
SCALE : 1" = 20'

LIBERTY PARKING EXPANSION

MAP SHEET 320, PARCEL 004
15 LIBERTY WAY
FRANKLIN, MASSACHUSETTS

LEVEL DESIGN GROUP
Civil Engineers & Land Surveyors
249 SOUTH STREET, UNIT 1
PLAINVILLE, MA 02762
TEL. (508) 695-2221 FAX. (508) 695-2219

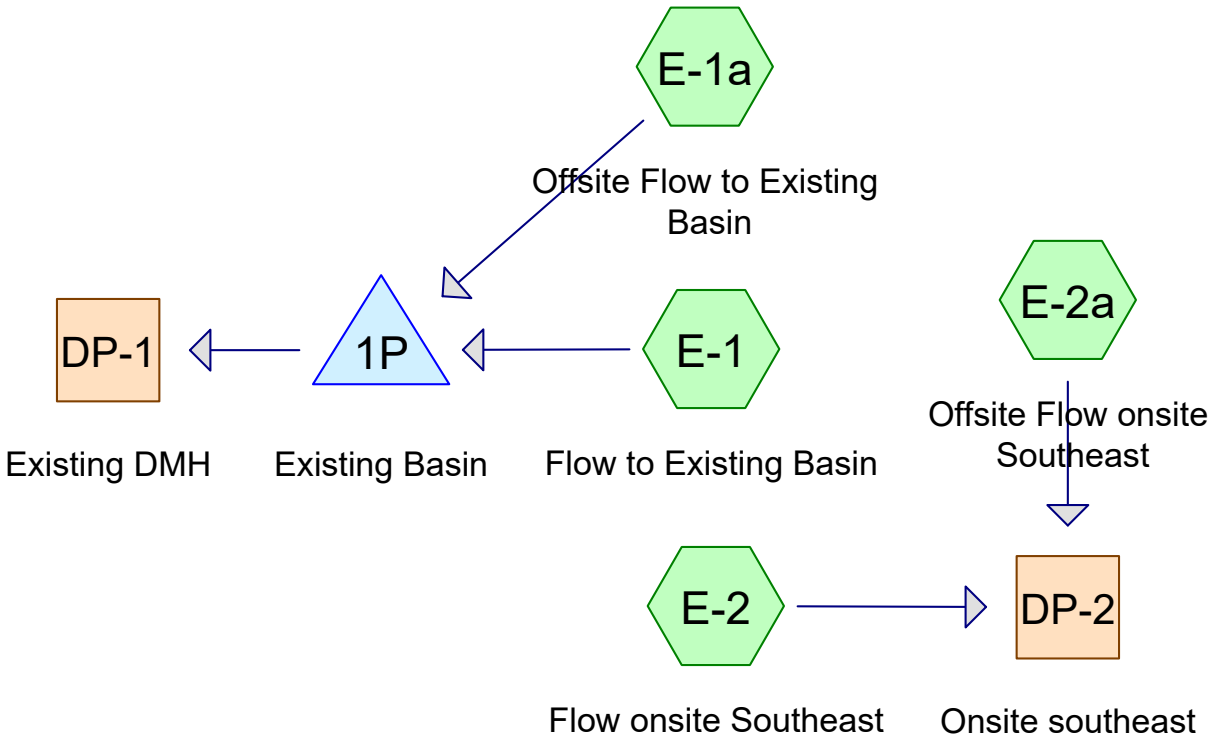
EXISTING DRAINAGE

D-1.0

SHEET 1 OF 2

0' 10' 20' 40'

2081.00



Subcat Reach Pond Link

Routing Diagram for Existing-7

Prepared by {enter your company name here}, Printed 3/18/2024

HydroCAD Analysis

Existing Conditions – 2 Year Storm

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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
1.325	79	50-75% Grass cover, Fair, HSG C (E-1, E-1a, E-2, E-2a)
1.285	98	Paved parking, HSG C (E-1, E-1a, E-2, E-2a)
0.757	98	Roofs (E-1a)
5.339	70	Woods, Good, HSG C (E-1, E-1a, E-2, E-2a)
8.707	**78**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
7.949	HSG C	E-1, E-1a, E-2, E-2a
0.000	HSG D	
0.757	Other	E-1a
8.707		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	1.325	0.000	0.000	1.325	50-75% Grass cover, Fair	E-1, E-1a, E-2, E-2a
0.000	0.000	1.285	0.000	0.000	1.285	Paved parking	E-1, E-1a, E-2, E-2a
0.000	0.000	0.000	0.000	0.757	0.757	Roofs	E-1a
0.000	0.000	5.339	0.000	0.000	5.339	Woods, Good	E-1, E-1a, E-2, E-2a
0.000	**0.000**	**7.949**	**0.000**	**0.757**	**8.707**	**TOTAL AREA**	

Time span=0.00-80.00 hrs, dt=0.05 hrs, 1601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E-1: Flow to Existing Basin Runoff Area=114,809 sf 4.75% Impervious Runoff Depth=0.89"
Flow Length=317' Tc=12.7 min CN=73 Runoff=2.01 cfs 0.195 af

Subcatchment E-1a: Offsite Flow to Existing Basin Runoff Area=149,743 sf 40.33% Impervious Runoff Depth=1.49"
Flow Length=553' Tc=12.0 min CN=83 Runoff=4.87 cfs 0.426 af

Subcatchment E-2: Flow onsite Southeast Runoff Area=45,523 sf 12.60% Impervious Runoff Depth=0.94"
Flow Length=140' Tc=11.3 min CN=74 Runoff=0.89 cfs 0.082 af

Subcatchment E-2a: Offsite Flow onsite Southeast Runoff Area=69,184 sf 25.14% Impervious Runoff Depth=1.23"
Flow Length=140' Tc=11.3 min CN=79 Runoff=1.86 cfs 0.162 af

Reach DP-1: Existing DMH Inflow=6.66 cfs 0.530 af
Outflow=6.66 cfs 0.530 af

Reach DP-2: Onsite southeast Inflow=2.75 cfs 0.244 af
Outflow=2.75 cfs 0.244 af

Pond 1P: Existing Basin Peak Elev=323.70' Storage=3,993 cf Inflow=6.81 cfs 0.621 af
Discarded=0.02 cfs 0.069 af Primary=6.66 cfs 0.530 af Outflow=6.68 cfs 0.599 af

Total Runoff Area = 8.707 ac Runoff Volume = 0.865 af Average Runoff Depth = 1.19"
76.54% Pervious = 6.664 ac 23.46% Impervious = 2.043 ac

Summary for Subcatchment E-1: Flow to Existing Basin

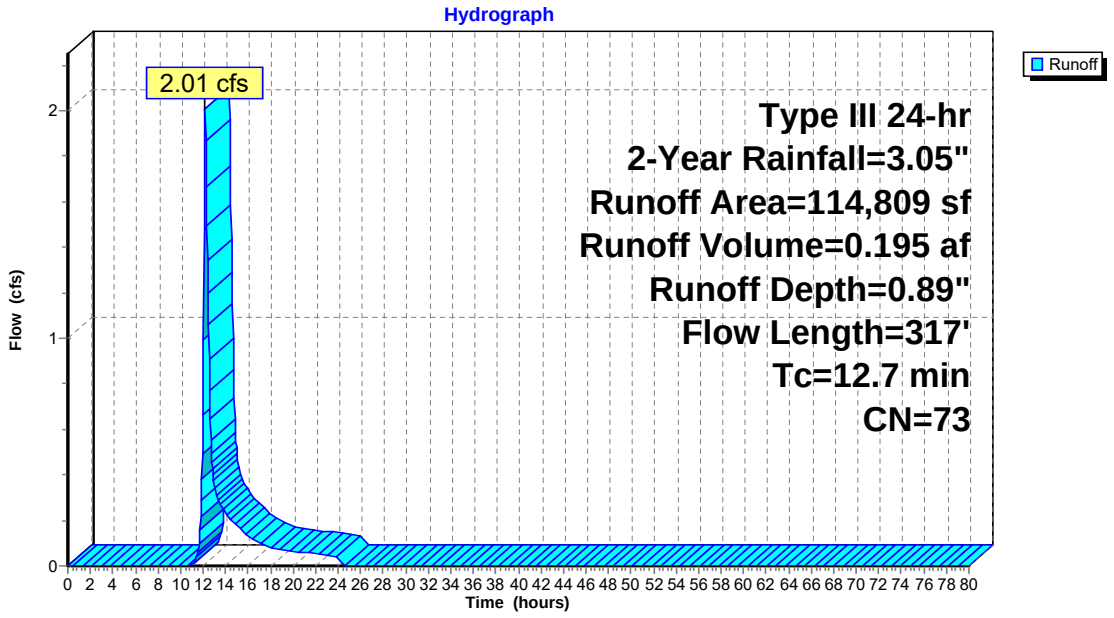
Runoff = 2.01 cfs @ 12.20 hrs, Volume= 0.195 af, Depth= 0.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.05"

Area (sf)	CN	Description
5,457	98	Paved parking, HSG C
93,734	70	Woods, Good, HSG C
15,618	79	50-75% Grass cover, Fair, HSG C
114,809	73	Weighted Average
109,352		95.25% Pervious Area
5,457		4.75% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.7	50	0.0300	0.08		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.05"
2.0	267	0.0190	2.22		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
12.7	317	Total			

Subcatchment E-1: Flow to Existing Basin



Summary for Subcatchment E-1a: Offsite Flow to Existing Basin

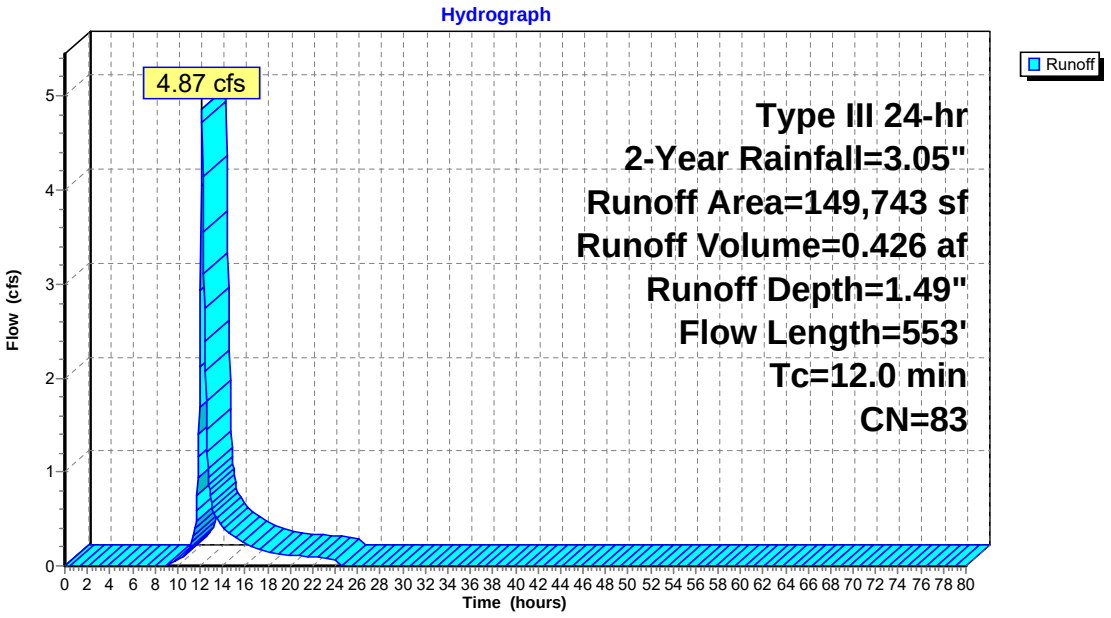
Runoff = 4.87 cfs @ 12.17 hrs, Volume= 0.426 af, Depth= 1.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.05"

	Area (sf)	CN	Description
*	32,987	98	Roofs
	27,404	98	Paved parking, HSG C
	65,641	70	Woods, Good, HSG C
	23,711	79	50-75% Grass cover, Fair, HSG C
	149,743	83	Weighted Average
	89,352		59.67% Pervious Area
	60,391		40.33% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.6	50	0.0530	0.10		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.05"
3.4	503	0.0240	2.49		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
12.0	553	Total			

Subcatchment E-1a: Offsite Flow to Existing Basin



Summary for Subcatchment E-2: Flow onsite Southeast

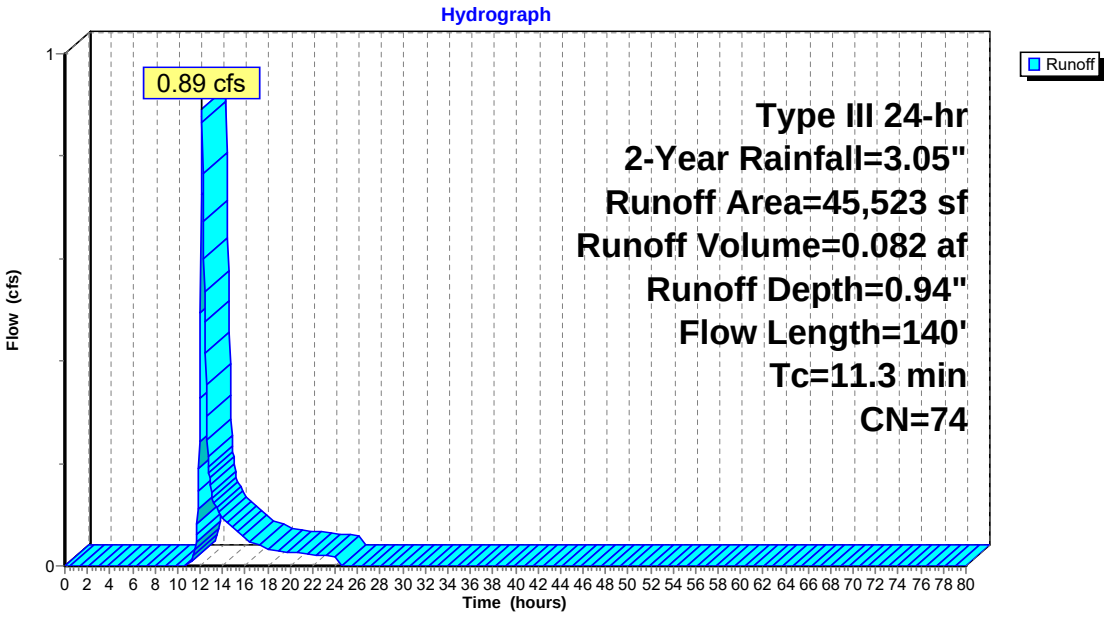
Runoff = 0.89 cfs @ 12.17 hrs, Volume= 0.082 af, Depth= 0.94"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.05"

Area (sf)	CN	Description
5,736	98	Paved parking, HSG C
38,141	70	Woods, Good, HSG C
1,646	79	50-75% Grass cover, Fair, HSG C
45,523	74	Weighted Average
39,787		87.40% Pervious Area
5,736		12.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.0	50	0.0280	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.05"
0.1	45	0.1750	6.74		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.0	11	0.1640	6.52		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.2	34	0.0240	3.14		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
11.3	140	Total			

Subcatchment E-2: Flow onsite Southeast



Summary for Subcatchment E-2a: Offsite Flow onsite Southeast

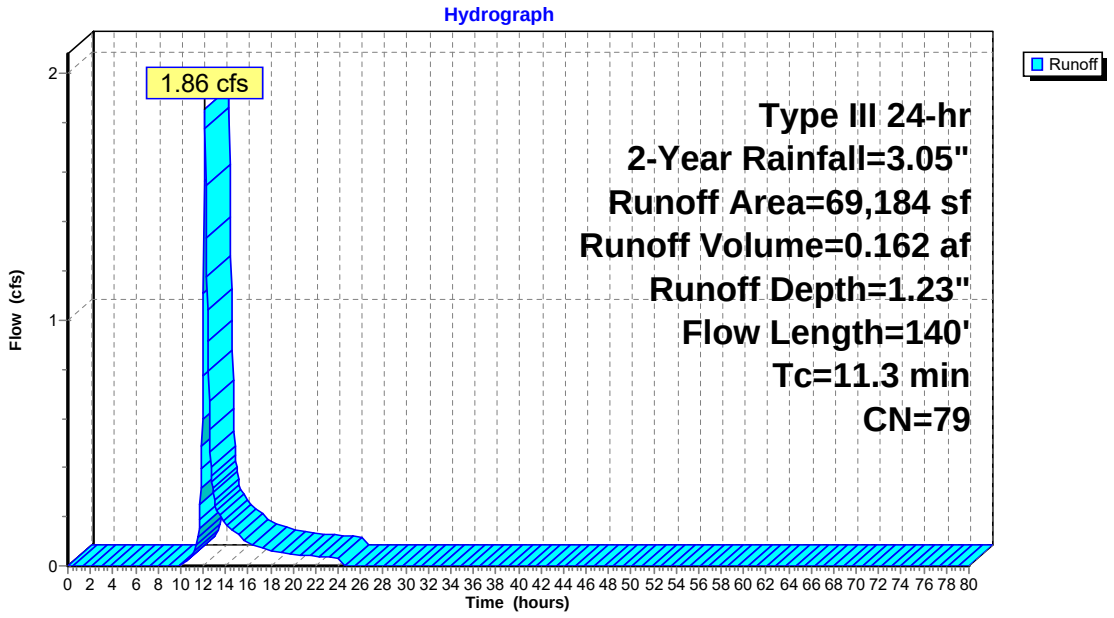
Runoff = 1.86 cfs @ 12.17 hrs, Volume= 0.162 af, Depth= 1.23"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.05"

Area (sf)	CN	Description
17,392	98	Paved parking, HSG C
35,059	70	Woods, Good, HSG C
16,733	79	50-75% Grass cover, Fair, HSG C
69,184	79	Weighted Average
51,792		74.86% Pervious Area
17,392		25.14% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.0	50	0.0280	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.05"
0.1	45	0.1750	6.74		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.0	11	0.1640	6.52		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.2	34	0.0240	3.14		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
11.3	140	Total			

Subcatchment E-2a: Offsite Flow onsite Southeast



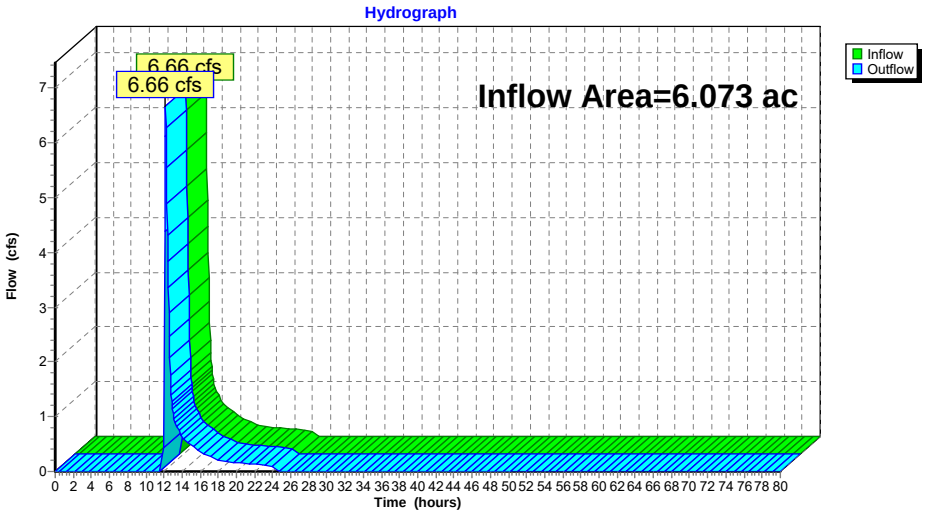
Summary for Reach DP-1: Existing DMH

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 6.073 ac, 24.89% Impervious, Inflow Depth = 1.05" for 2-Year event
Inflow = 6.66 cfs @ 12.20 hrs, Volume= 0.530 af
Outflow = 6.66 cfs @ 12.20 hrs, Volume= 0.530 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs

Reach DP-1: Existing DMH



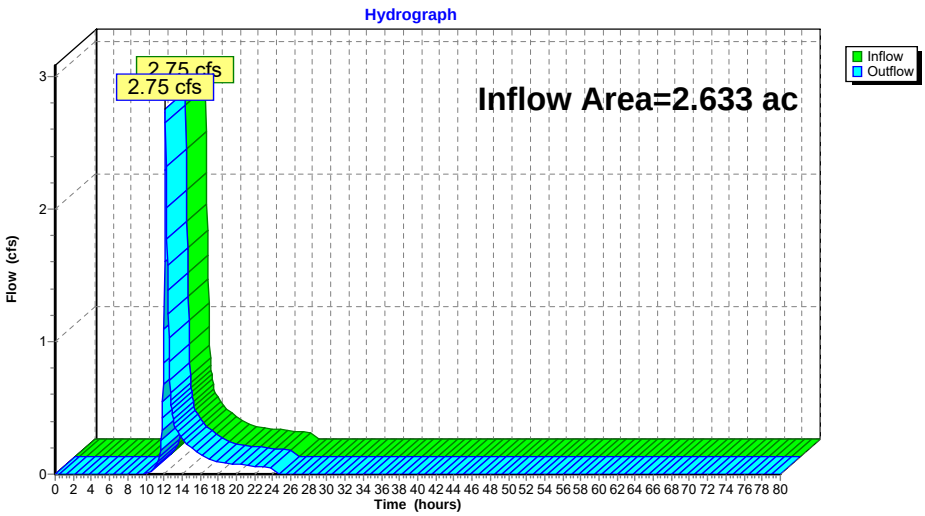
Summary for Reach DP-2: Onsite southeast

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.633 ac, 20.16% Impervious, Inflow Depth = 1.11" for 2-Year event
Inflow = 2.75 cfs @ 12.17 hrs, Volume= 0.244 af
Outflow = 2.75 cfs @ 12.17 hrs, Volume= 0.244 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs

Reach DP-2: Onsite southeast



Summary for Pond 1P: Existing Basin

Inflow Area = 6.073 ac, 24.89% Impervious, Inflow Depth = 1.23" for 2-Year event
Inflow = 6.81 cfs @ 12.18 hrs, Volume= 0.621 af
Outflow = 6.68 cfs @ 12.20 hrs, Volume= 0.599 af, Atten= 2%, Lag= 1.6 min
Discarded = 0.02 cfs @ 12.20 hrs, Volume= 0.069 af
Primary = 6.66 cfs @ 12.20 hrs, Volume= 0.530 af

Routing by Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs / 4
Peak Elev= 323.70' @ 12.20 hrs Surf.Area= 3,151 sf Storage= 3,993 cf

Plug-Flow detention time= 231.0 min calculated for 0.599 af (96% of inflow)
Center-of-Mass det. time= 211.2 min (1,062.7 - 851.5)

Volume	Invert	Avail.Storage	Storage Description
#1	322.00'	5,009 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

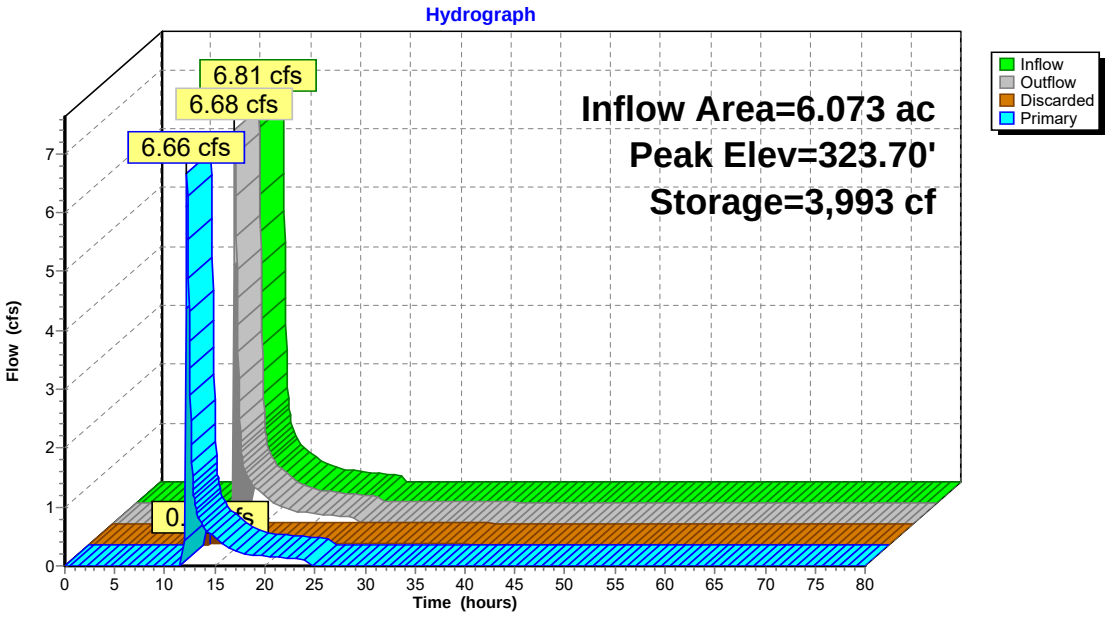
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
322.00	1,801	206.0	0	0	1,801
323.00	2,370	235.0	2,079	2,079	2,842
324.00	3,528	239.0	2,930	5,009	3,123

Device	Routing	Invert	Outlet Devices
#1	Discarded	322.00'	**0.170 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 318.00'
#2	Primary	323.45'	**23.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

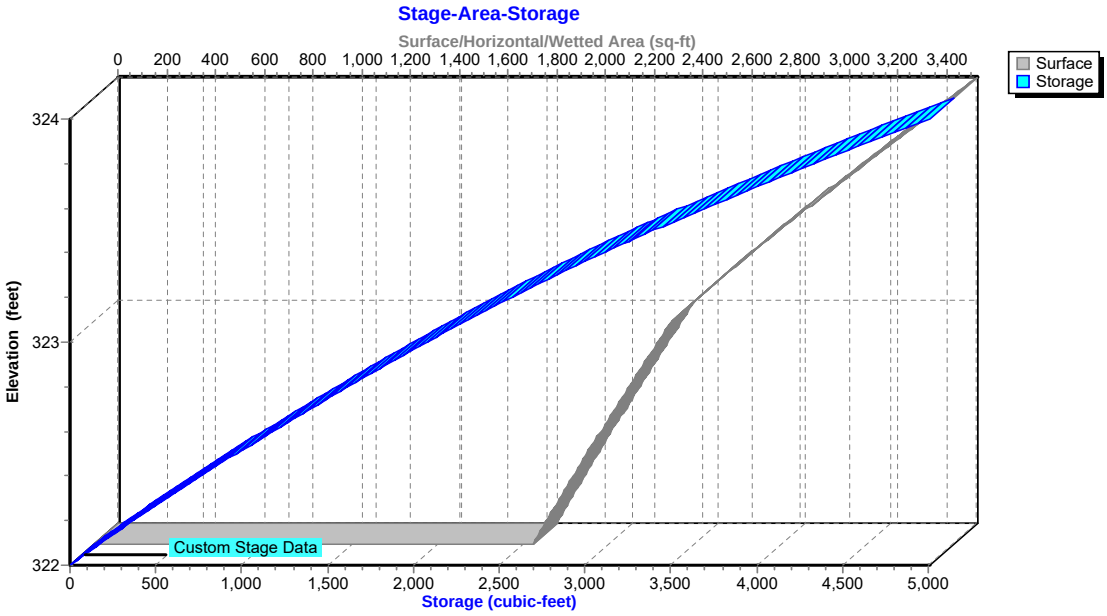
Discarded OutFlow Max=0.02 cfs @ 12.20 hrs HW=323.69' (Free Discharge)
└**1=Exfiltration** (Controls 0.02 cfs)

Primary OutFlow Max=6.62 cfs @ 12.20 hrs HW=323.69' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 6.62 cfs @ 1.18 fps)

Pond 1P: Existing Basin



Pond 1P: Existing Basin



Stage-Area-Storage for Pond 1P: Existing Basin

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
322.00	1,801	0	322.74	2,215	1,483	323.48	2,897	3,341
322.02	1,812	36	322.76	2,226	1,528	323.50	2,920	3,399
322.04	1,822	72	322.78	2,238	1,572	323.52	2,944	3,458
322.06	1,833	109	322.80	2,250	1,617	323.54	2,967	3,517
322.08	1,844	146	322.82	2,262	1,662	323.56	2,990	3,576
322.10	1,854	183	322.84	2,274	1,708	323.58	3,014	3,637
322.12	1,865	220	322.86	2,286	1,753	323.60	3,037	3,697
322.14	1,876	257	322.88	2,298	1,799	323.62	3,061	3,758
322.16	1,887	295	322.90	2,310	1,845	323.64	3,085	3,819
322.18	1,898	333	322.92	2,322	1,891	323.66	3,109	3,881
322.20	1,909	371	322.94	2,334	1,938	323.68	3,132	3,944
322.22	1,919	409	322.96	2,346	1,985	323.70	3,156	4,007
322.24	1,930	448	322.98	2,358	2,032	323.72	3,181	4,070
322.26	1,941	486	323.00	2,370	2,079	323.74	3,205	4,134
322.28	1,952	525	323.02	2,391	2,127	323.76	3,229	4,198
322.30	1,964	565	323.04	2,412	2,175	323.78	3,254	4,263
322.32	1,975	604	323.06	2,433	2,223	323.80	3,278	4,328
322.34	1,986	643	323.08	2,454	2,272	323.82	3,303	4,394
322.36	1,997	683	323.10	2,475	2,321	323.84	3,327	4,461
322.38	2,008	723	323.12	2,497	2,371	323.86	3,352	4,527
322.40	2,019	764	323.14	2,518	2,421	323.88	3,377	4,595
322.42	2,030	804	323.16	2,540	2,472	323.90	3,402	4,662
322.44	2,042	845	323.18	2,561	2,523	323.92	3,427	4,731
322.46	2,053	886	323.20	2,583	2,574	323.94	3,452	4,799
322.48	2,064	927	323.22	2,605	2,626	323.96	3,477	4,869
322.50	2,076	968	323.24	2,627	2,678	323.98	3,503	4,939
322.52	2,087	1,010	323.26	2,649	2,731	324.00	**3,528**	**5,009**
322.54	2,099	1,052	323.28	2,671	2,784			
322.56	2,110	1,094	323.30	2,693	2,838			
322.58	2,122	1,136	323.32	2,716	2,892			
322.60	2,133	1,179	323.34	2,738	2,947			
322.62	2,145	1,222	323.36	2,760	3,002			
322.64	2,156	1,265	323.38	2,783	3,057			
322.66	2,168	1,308	323.40	2,806	3,113			
322.68	2,179	1,351	323.42	2,828	3,169			
322.70	2,191	1,395	323.44	2,851	3,226			
322.72	2,203	1,439	323.46	2,874	3,283			

HydroCAD Analysis

Existing Conditions – 10 Year Storm

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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
1.325	79	50-75% Grass cover, Fair, HSG C (E-1, E-1a, E-2, E-2a)
1.285	98	Paved parking, HSG C (E-1, E-1a, E-2, E-2a)
0.757	98	Roofs (E-1a)
5.339	70	Woods, Good, HSG C (E-1, E-1a, E-2, E-2a)
8.707	**78**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
7.949	HSG C	E-1, E-1a, E-2, E-2a
0.000	HSG D	
0.757	Other	E-1a
8.707		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	1.325	0.000	0.000	1.325	50-75% Grass cover, Fair	E-1, E-1a, E-2, E-2a
0.000	0.000	1.285	0.000	0.000	1.285	Paved parking	E-1, E-1a, E-2, E-2a
0.000	0.000	0.000	0.000	0.757	0.757	Roofs	E-1a
0.000	0.000	5.339	0.000	0.000	5.339	Woods, Good	E-1, E-1a, E-2, E-2a
0.000	**0.000**	**7.949**	**0.000**	**0.757**	**8.707**	**TOTAL AREA**	

Time span=0.00-80.00 hrs, dt=0.05 hrs, 1601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E-1: Flow to Existing Basin Runoff Area=114,809 sf 4.75% Impervious Runoff Depth=2.40"
Flow Length=317' Tc=12.7 min CN=73 Runoff=5.85 cfs 0.527 af

Subcatchment E-1a: Offsite Flow to Existing Basin Runoff Area=149,743 sf 40.33% Impervious Runoff Depth=3.31"
Flow Length=553' Tc=12.0 min CN=83 Runoff=10.85 cfs 0.948 af

Subcatchment E-2: Flow onsite Southeast Runoff Area=45,523 sf 12.60% Impervious Runoff Depth=2.48"
Flow Length=140' Tc=11.3 min CN=74 Runoff=2.52 cfs 0.216 af

Subcatchment E-2a: Offsite Flow onsite Southeast Runoff Area=69,184 sf 25.14% Impervious Runoff Depth=2.93"
Flow Length=140' Tc=11.3 min CN=79 Runoff=4.55 cfs 0.388 af

Reach DP-1: Existing DMH Inflow=16.30 cfs 1.381 af
Outflow=16.30 cfs 1.381 af

Reach DP-2: Onsite southeast Inflow=7.07 cfs 0.604 af
Outflow=7.07 cfs 0.604 af

Pond 1P: Existing Basin Peak Elev=323.88' Storage=4,589 cf Inflow=16.70 cfs 1.475 af
Discarded=0.02 cfs 0.072 af Primary=16.30 cfs 1.381 af Outflow=16.32 cfs 1.453 af

Total Runoff Area = 8.707 ac Runoff Volume = 2.079 af Average Runoff Depth = 2.87"
76.54% Pervious = 6.664 ac 23.46% Impervious = 2.043 ac

Summary for Subcatchment E-1: Flow to Existing Basin

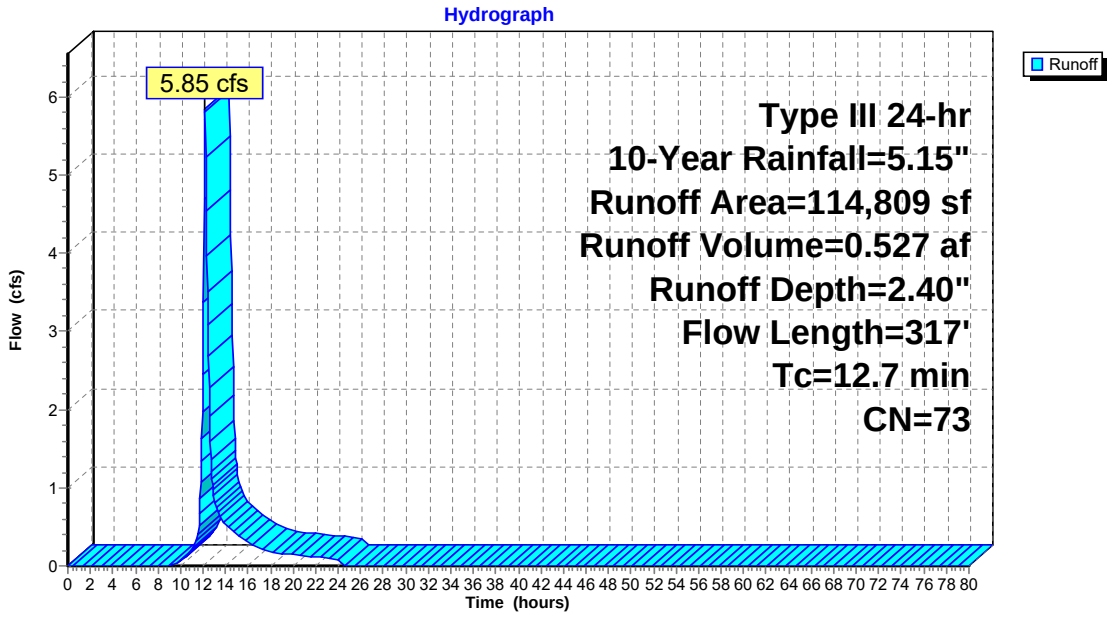
Runoff = 5.85 cfs @ 12.18 hrs, Volume= 0.527 af, Depth= 2.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=5.15"

Area (sf)	CN	Description
5,457	98	Paved parking, HSG C
93,734	70	Woods, Good, HSG C
15,618	79	50-75% Grass cover, Fair, HSG C
114,809	73	Weighted Average
109,352		95.25% Pervious Area
5,457		4.75% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.7	50	0.0300	0.08		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.05"
2.0	267	0.0190	2.22		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
12.7	317	Total			

Subcatchment E-1: Flow to Existing Basin



Summary for Subcatchment E-1a: Offsite Flow to Existing Basin

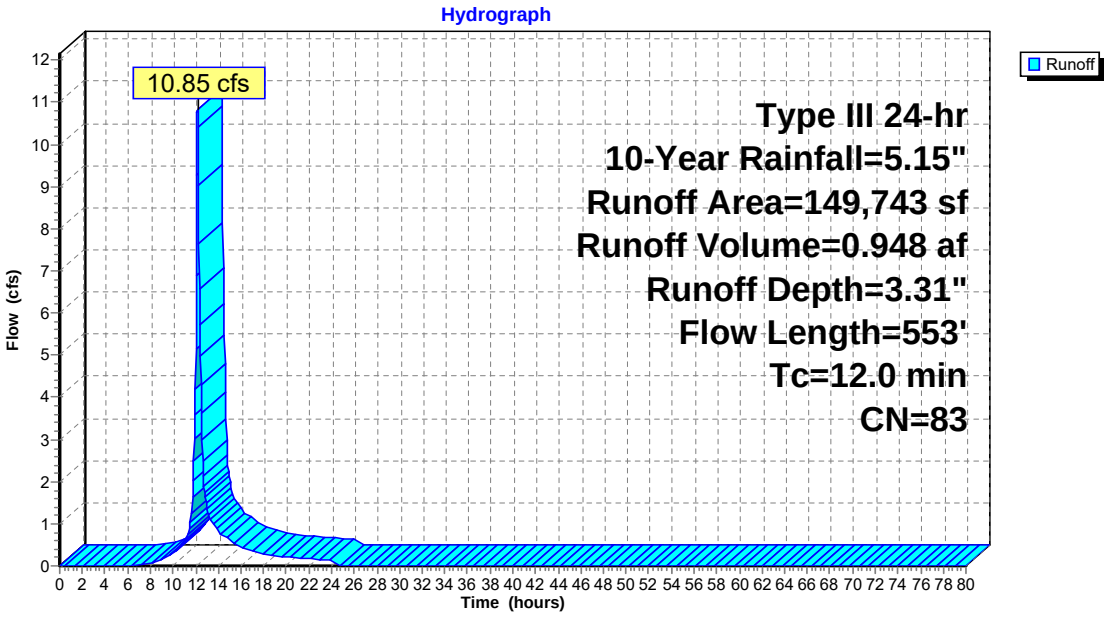
Runoff = 10.85 cfs @ 12.17 hrs, Volume= 0.948 af, Depth= 3.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=5.15"

	Area (sf)	CN	Description
*	32,987	98	Roofs
	27,404	98	Paved parking, HSG C
	65,641	70	Woods, Good, HSG C
	23,711	79	50-75% Grass cover, Fair, HSG C
	149,743	83	Weighted Average
	89,352		59.67% Pervious Area
	60,391		40.33% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.6	50	0.0530	0.10		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.05"
3.4	503	0.0240	2.49		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
12.0	553	Total			

Subcatchment E-1a: Offsite Flow to Existing Basin



Summary for Subcatchment E-2: Flow onsite Southeast

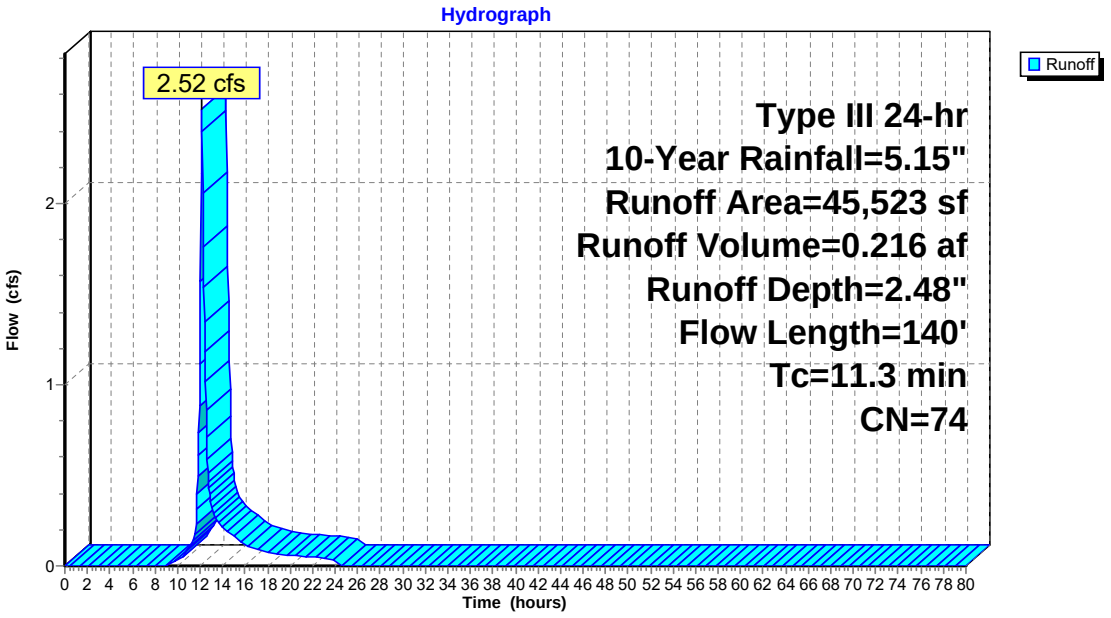
Runoff = 2.52 cfs @ 12.16 hrs, Volume= 0.216 af, Depth= 2.48"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=5.15"

Area (sf)	CN	Description
5,736	98	Paved parking, HSG C
38,141	70	Woods, Good, HSG C
1,646	79	50-75% Grass cover, Fair, HSG C
45,523	74	Weighted Average
39,787		87.40% Pervious Area
5,736		12.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.0	50	0.0280	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.05"
0.1	45	0.1750	6.74		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.0	11	0.1640	6.52		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.2	34	0.0240	3.14		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
11.3	140	Total			

Subcatchment E-2: Flow onsite Southeast



Summary for Subcatchment E-2a: Offsite Flow onsite Southeast

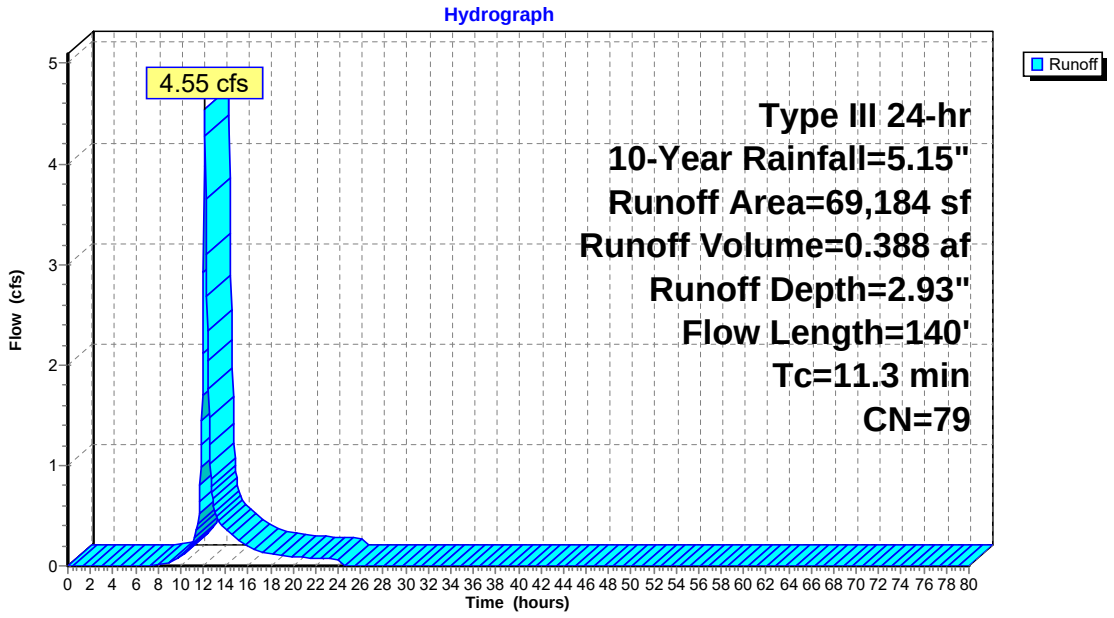
Runoff = 4.55 cfs @ 12.16 hrs, Volume= 0.388 af, Depth= 2.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=5.15"

Area (sf)	CN	Description
17,392	98	Paved parking, HSG C
35,059	70	Woods, Good, HSG C
16,733	79	50-75% Grass cover, Fair, HSG C
69,184	79	Weighted Average
51,792		74.86% Pervious Area
17,392		25.14% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.0	50	0.0280	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.05"
0.1	45	0.1750	6.74		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.0	11	0.1640	6.52		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.2	34	0.0240	3.14		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
11.3	140	Total			

Subcatchment E-2a: Offsite Flow onsite Southeast



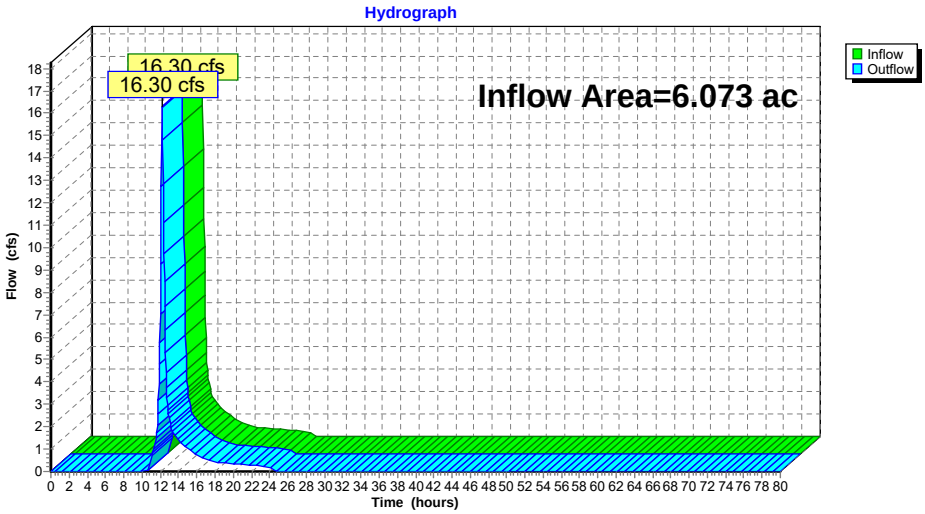
Summary for Reach DP-1: Existing DMH

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 6.073 ac, 24.89% Impervious, Inflow Depth = 2.73" for 10-Year event
Inflow = 16.30 cfs @ 12.19 hrs, Volume= 1.381 af
Outflow = 16.30 cfs @ 12.19 hrs, Volume= 1.381 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs

Reach DP-1: Existing DMH



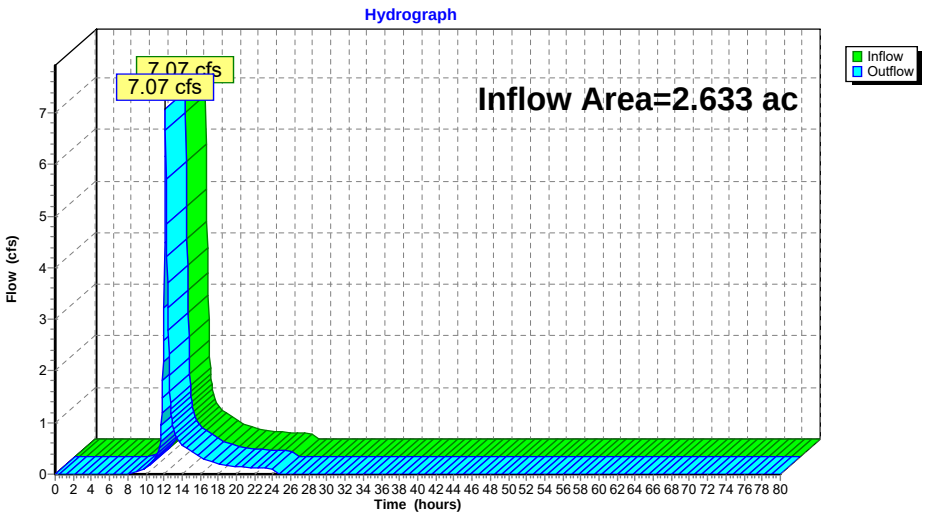
Summary for Reach DP-2: Onsite southeast

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.633 ac, 20.16% Impervious, Inflow Depth = 2.75" for 10-Year event
Inflow = 7.07 cfs @ 12.16 hrs, Volume= 0.604 af
Outflow = 7.07 cfs @ 12.16 hrs, Volume= 0.604 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs

Reach DP-2: Onsite southeast



Summary for Pond 1P: Existing Basin

Inflow Area = 6.073 ac, 24.89% Impervious, Inflow Depth = 2.91" for 10-Year event
Inflow = 16.70 cfs @ 12.17 hrs, Volume= 1.475 af
Outflow = 16.32 cfs @ 12.19 hrs, Volume= 1.453 af, Atten= 2%, Lag= 1.1 min
Discarded = 0.02 cfs @ 12.19 hrs, Volume= 0.072 af
Primary = 16.30 cfs @ 12.19 hrs, Volume= 1.381 af

Routing by Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs / 4
Peak Elev= 323.88' @ 12.19 hrs Surf.Area= 3,375 sf Storage= 4,589 cf

Plug-Flow detention time= 102.0 min calculated for 1.453 af (98% of inflow)
Center-of-Mass det. time= 92.9 min (920.3 - 827.4)

Volume	Invert	Avail.Storage	Storage Description
#1	322.00'	5,009 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

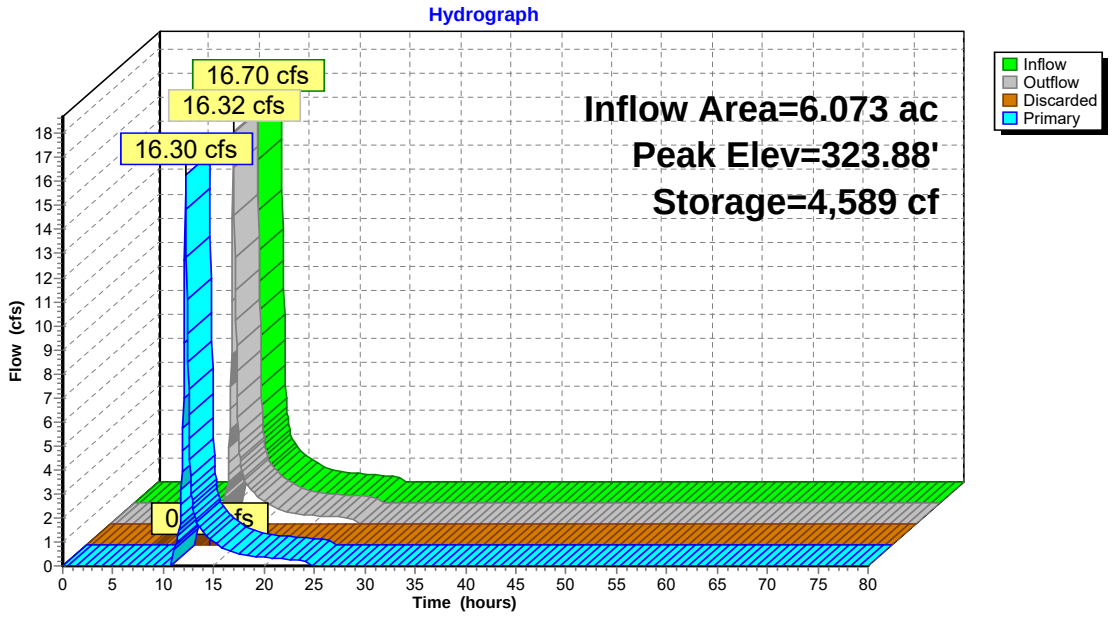
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
322.00	1,801	206.0	0	0	1,801
323.00	2,370	235.0	2,079	2,079	2,842
324.00	3,528	239.0	2,930	5,009	3,123

Device	Routing	Invert	Outlet Devices
#1	Discarded	322.00'	**0.170 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 318.00'
#2	Primary	323.45'	**23.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

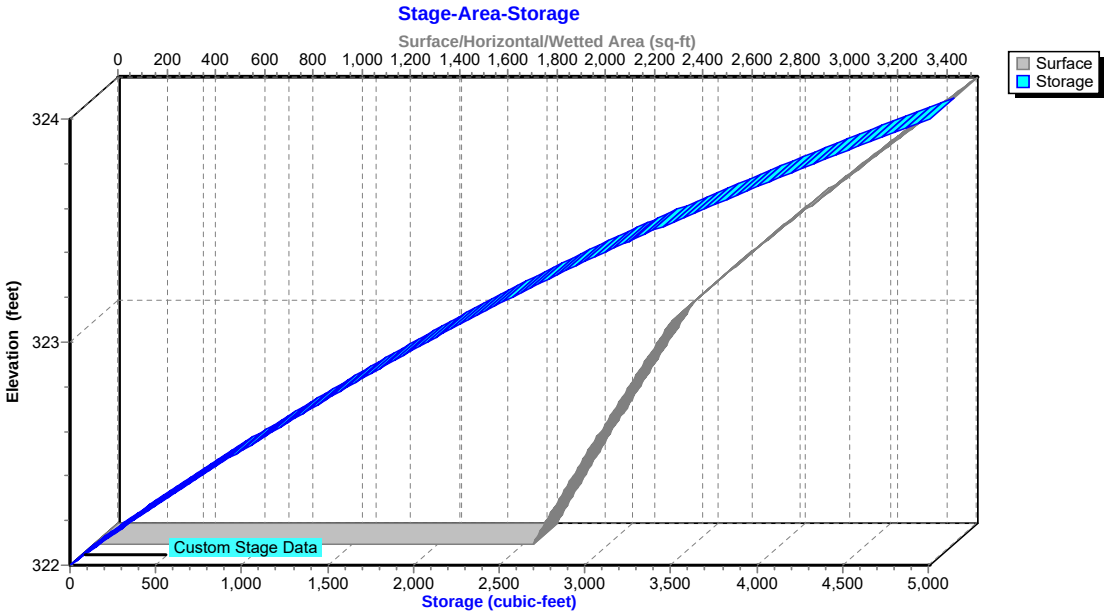
Discarded OutFlow Max=0.02 cfs @ 12.19 hrs HW=323.88' (Free Discharge)
└**1=Exfiltration** (Controls 0.02 cfs)

Primary OutFlow Max=16.13 cfs @ 12.19 hrs HW=323.88' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 16.13 cfs @ 1.65 fps)

Pond 1P: Existing Basin



Pond 1P: Existing Basin



Stage-Area-Storage for Pond 1P: Existing Basin

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
322.00	1,801	0	322.74	2,215	1,483	323.48	2,897	3,341
322.02	1,812	36	322.76	2,226	1,528	323.50	2,920	3,399
322.04	1,822	72	322.78	2,238	1,572	323.52	2,944	3,458
322.06	1,833	109	322.80	2,250	1,617	323.54	2,967	3,517
322.08	1,844	146	322.82	2,262	1,662	323.56	2,990	3,576
322.10	1,854	183	322.84	2,274	1,708	323.58	3,014	3,637
322.12	1,865	220	322.86	2,286	1,753	323.60	3,037	3,697
322.14	1,876	257	322.88	2,298	1,799	323.62	3,061	3,758
322.16	1,887	295	322.90	2,310	1,845	323.64	3,085	3,819
322.18	1,898	333	322.92	2,322	1,891	323.66	3,109	3,881
322.20	1,909	371	322.94	2,334	1,938	323.68	3,132	3,944
322.22	1,919	409	322.96	2,346	1,985	323.70	3,156	4,007
322.24	1,930	448	322.98	2,358	2,032	323.72	3,181	4,070
322.26	1,941	486	323.00	2,370	2,079	323.74	3,205	4,134
322.28	1,952	525	323.02	2,391	2,127	323.76	3,229	4,198
322.30	1,964	565	323.04	2,412	2,175	323.78	3,254	4,263
322.32	1,975	604	323.06	2,433	2,223	323.80	3,278	4,328
322.34	1,986	643	323.08	2,454	2,272	323.82	3,303	4,394
322.36	1,997	683	323.10	2,475	2,321	323.84	3,327	4,461
322.38	2,008	723	323.12	2,497	2,371	323.86	3,352	4,527
322.40	2,019	764	323.14	2,518	2,421	323.88	3,377	4,595
322.42	2,030	804	323.16	2,540	2,472	323.90	3,402	4,662
322.44	2,042	845	323.18	2,561	2,523	323.92	3,427	4,731
322.46	2,053	886	323.20	2,583	2,574	323.94	3,452	4,799
322.48	2,064	927	323.22	2,605	2,626	323.96	3,477	4,869
322.50	2,076	968	323.24	2,627	2,678	323.98	3,503	4,939
322.52	2,087	1,010	323.26	2,649	2,731	324.00	**3,528**	**5,009**
322.54	2,099	1,052	323.28	2,671	2,784			
322.56	2,110	1,094	323.30	2,693	2,838			
322.58	2,122	1,136	323.32	2,716	2,892			
322.60	2,133	1,179	323.34	2,738	2,947			
322.62	2,145	1,222	323.36	2,760	3,002			
322.64	2,156	1,265	323.38	2,783	3,057			
322.66	2,168	1,308	323.40	2,806	3,113			
322.68	2,179	1,351	323.42	2,828	3,169			
322.70	2,191	1,395	323.44	2,851	3,226			
322.72	2,203	1,439	323.46	2,874	3,283			

HydroCAD Analysis

Existing Conditions - 25 Year Storm

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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
1.325	79	50-75% Grass cover, Fair, HSG C (E-1, E-1a, E-2, E-2a)
1.285	98	Paved parking, HSG C (E-1, E-1a, E-2, E-2a)
0.757	98	Roofs (E-1a)
5.339	70	Woods, Good, HSG C (E-1, E-1a, E-2, E-2a)
8.707	**78**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
7.949	HSG C	E-1, E-1a, E-2, E-2a
0.000	HSG D	
0.757	Other	E-1a
8.707		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	1.325	0.000	0.000	1.325	50-75% Grass cover, Fair	E-1, E-1a, E-2, E-2a
0.000	0.000	1.285	0.000	0.000	1.285	Paved parking	E-1, E-1a, E-2, E-2a
0.000	0.000	0.000	0.000	0.757	0.757	Roofs	E-1a
0.000	0.000	5.339	0.000	0.000	5.339	Woods, Good	E-1, E-1a, E-2, E-2a
0.000	**0.000**	**7.949**	**0.000**	**0.757**	**8.707**	**TOTAL AREA**	

Time span=0.00-80.00 hrs, dt=0.05 hrs, 1601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E-1: Flow to Existing Basin Runoff Area=114,809 sf 4.75% Impervious Runoff Depth=3.38"
Flow Length=317' Tc=12.7 min CN=73 Runoff=8.31 cfs 0.743 af

Subcatchment E-1a: Offsite Flow to Existing Basin Runoff Area=149,743 sf 40.33% Impervious Runoff Depth=4.42"
Flow Length=553' Tc=12.0 min CN=83 Runoff=14.37 cfs 1.265 af

Subcatchment E-2: Flow onsite Southeast Runoff Area=45,523 sf 12.60% Impervious Runoff Depth=3.48"
Flow Length=140' Tc=11.3 min CN=74 Runoff=3.55 cfs 0.303 af

Subcatchment E-2a: Offsite Flow onsite Southeast Runoff Area=69,184 sf 25.14% Impervious Runoff Depth=3.99"
Flow Length=140' Tc=11.3 min CN=79 Runoff=6.18 cfs 0.529 af

Reach DP-1: Existing DMH Inflow=22.17 cfs 1.913 af
Outflow=22.17 cfs 1.913 af

Reach DP-2: Onsite southeast Inflow=9.73 cfs 0.832 af
Outflow=9.73 cfs 0.832 af

Pond 1P: Existing Basin Peak Elev=323.96' Storage=4,883 cf Inflow=22.68 cfs 2.008 af
Discarded=0.02 cfs 0.073 af Primary=22.17 cfs 1.913 af Outflow=22.18 cfs 1.986 af

Total Runoff Area = 8.707 ac Runoff Volume = 2.840 af Average Runoff Depth = 3.91"
76.54% Pervious = 6.664 ac 23.46% Impervious = 2.043 ac

Summary for Subcatchment E-1: Flow to Existing Basin

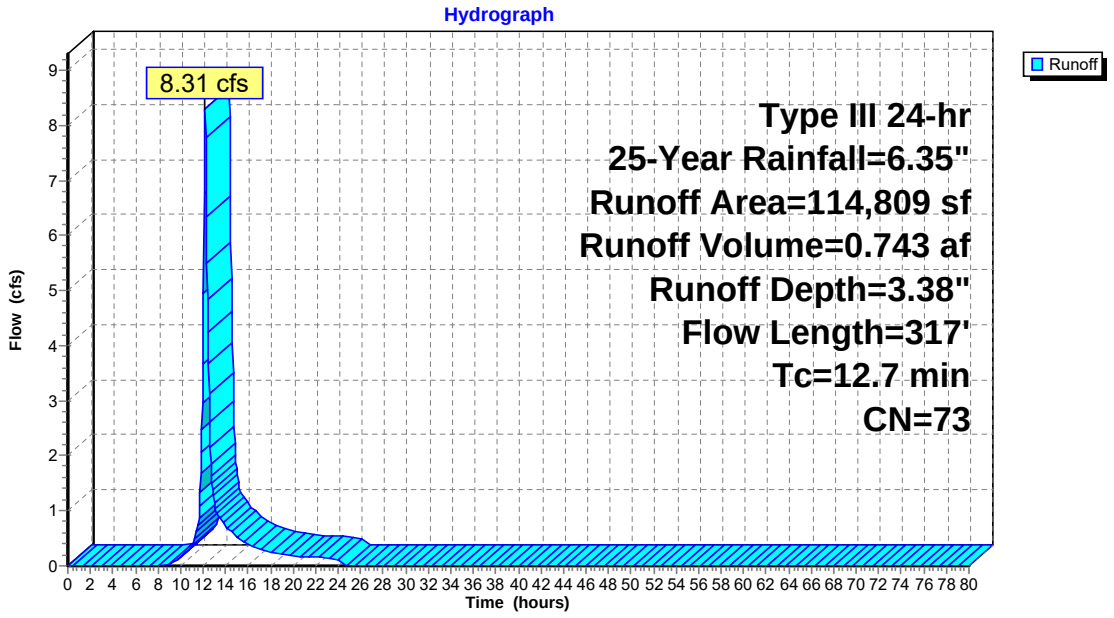
Runoff = 8.31 cfs @ 12.18 hrs, Volume= 0.743 af, Depth= 3.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.35"

Area (sf)	CN	Description
5,457	98	Paved parking, HSG C
93,734	70	Woods, Good, HSG C
15,618	79	50-75% Grass cover, Fair, HSG C
114,809	73	Weighted Average
109,352		95.25% Pervious Area
5,457		4.75% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.7	50	0.0300	0.08		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.05"
2.0	267	0.0190	2.22		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
12.7	317	Total			

Subcatchment E-1: Flow to Existing Basin



Summary for Subcatchment E-1a: Offsite Flow to Existing Basin

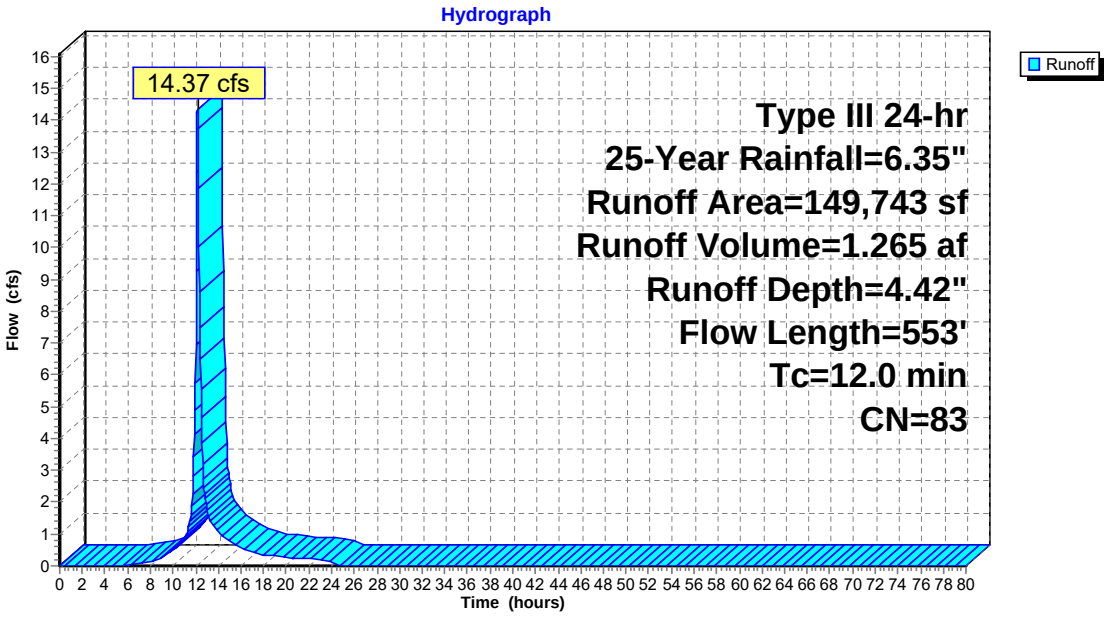
Runoff = 14.37 cfs @ 12.16 hrs, Volume= 1.265 af, Depth= 4.42"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.35"

	Area (sf)	CN	Description
*	32,987	98	Roofs
	27,404	98	Paved parking, HSG C
	65,641	70	Woods, Good, HSG C
	23,711	79	50-75% Grass cover, Fair, HSG C
	149,743	83	Weighted Average
	89,352		59.67% Pervious Area
	60,391		40.33% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.6	50	0.0530	0.10		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.05"
3.4	503	0.0240	2.49		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
12.0	553	Total			

Subcatchment E-1a: Offsite Flow to Existing Basin



Summary for Subcatchment E-2: Flow onsite Southeast

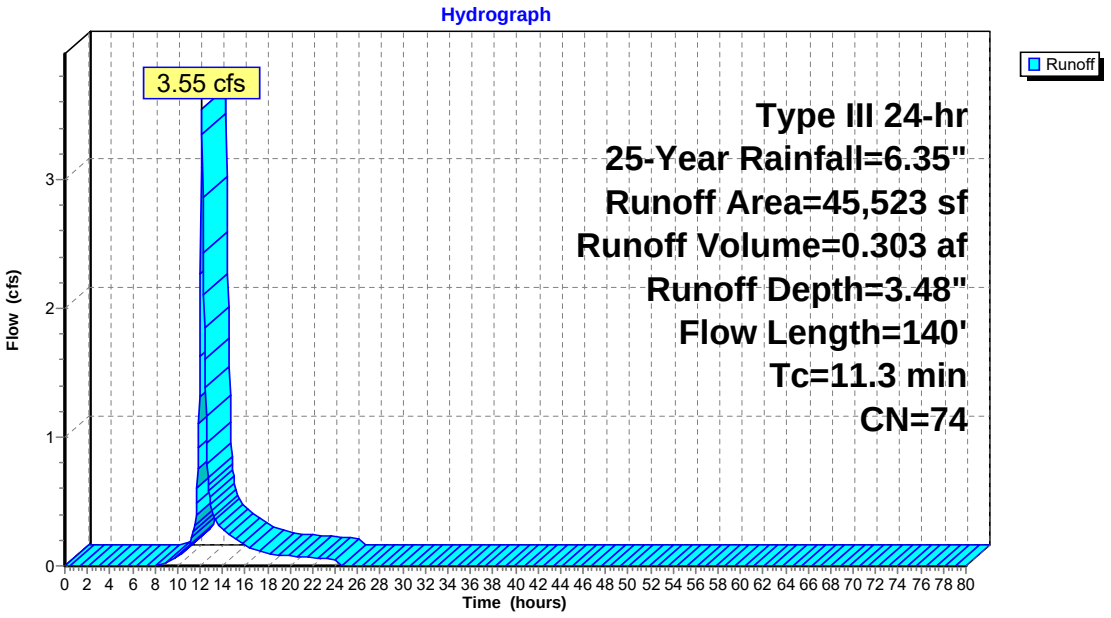
Runoff = 3.55 cfs @ 12.16 hrs, Volume= 0.303 af, Depth= 3.48"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.35"

Area (sf)	CN	Description
5,736	98	Paved parking, HSG C
38,141	70	Woods, Good, HSG C
1,646	79	50-75% Grass cover, Fair, HSG C
45,523	74	Weighted Average
39,787		87.40% Pervious Area
5,736		12.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.0	50	0.0280	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.05"
0.1	45	0.1750	6.74		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.0	11	0.1640	6.52		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.2	34	0.0240	3.14		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
11.3	140	Total			

Subcatchment E-2: Flow onsite Southeast



Summary for Subcatchment E-2a: Offsite Flow onsite Southeast

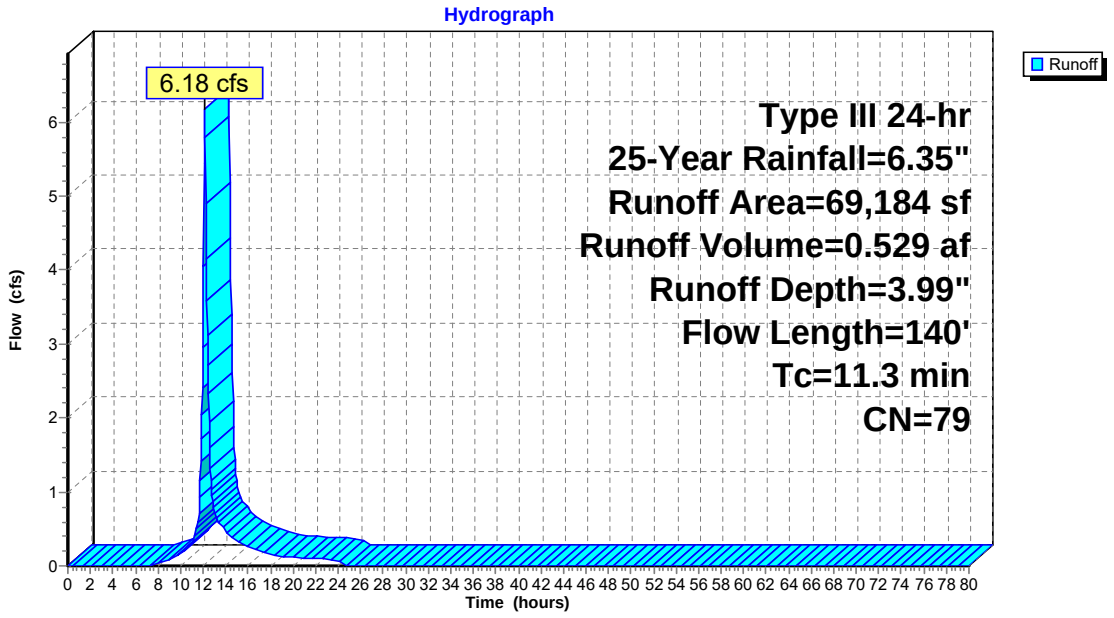
Runoff = 6.18 cfs @ 12.16 hrs, Volume= 0.529 af, Depth= 3.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.35"

Area (sf)	CN	Description
17,392	98	Paved parking, HSG C
35,059	70	Woods, Good, HSG C
16,733	79	50-75% Grass cover, Fair, HSG C
69,184	79	Weighted Average
51,792		74.86% Pervious Area
17,392		25.14% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.0	50	0.0280	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.05"
0.1	45	0.1750	6.74		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.0	11	0.1640	6.52		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.2	34	0.0240	3.14		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
11.3	140	Total			

Subcatchment E-2a: Offsite Flow onsite Southeast



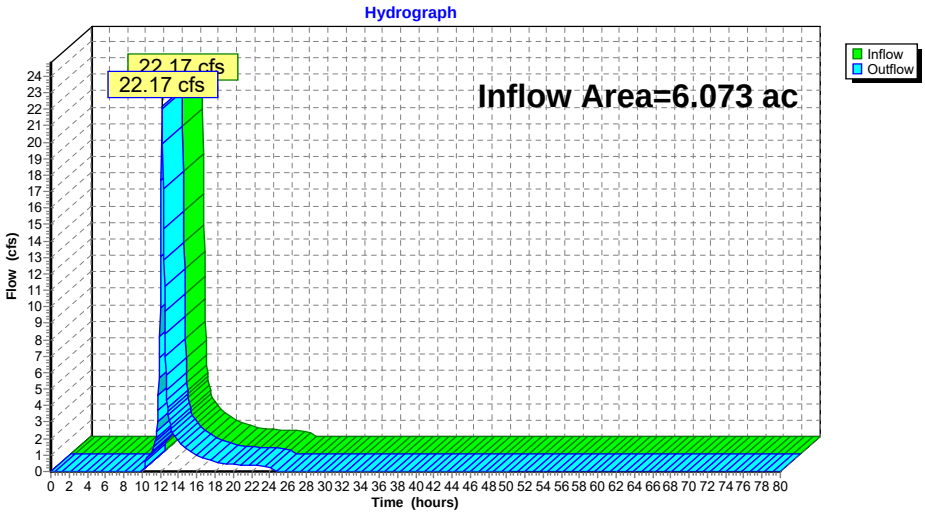
Summary for Reach DP-1: Existing DMH

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 6.073 ac, 24.89% Impervious, Inflow Depth = 3.78" for 25-Year event
Inflow = 22.17 cfs @ 12.19 hrs, Volume= 1.913 af
Outflow = 22.17 cfs @ 12.19 hrs, Volume= 1.913 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs

Reach DP-1: Existing DMH



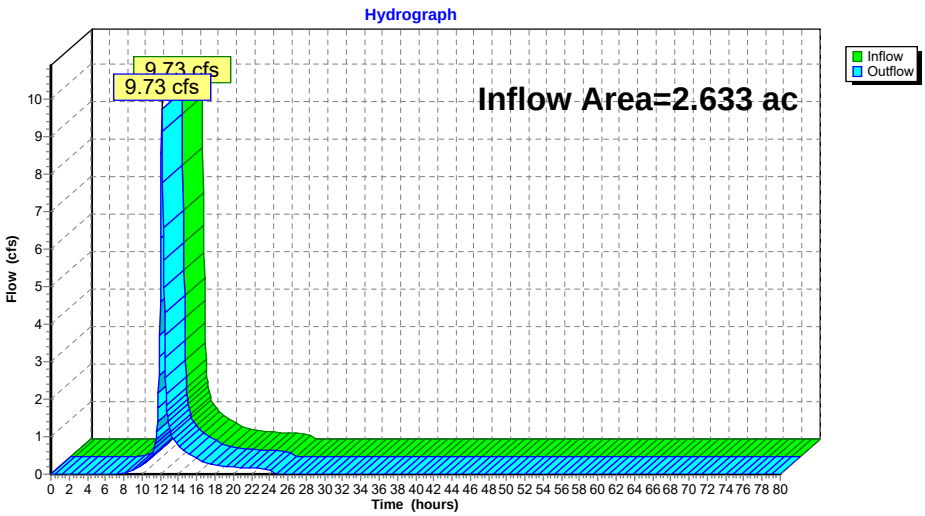
Summary for Reach DP-2: Onsite southeast

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.633 ac, 20.16% Impervious, Inflow Depth = 3.79" for 25-Year event
Inflow = 9.73 cfs @ 12.16 hrs, Volume= 0.832 af
Outflow = 9.73 cfs @ 12.16 hrs, Volume= 0.832 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs

Reach DP-2: Onsite southeast



Summary for Pond 1P: Existing Basin

Inflow Area = 6.073 ac, 24.89% Impervious, Inflow Depth = 3.97" for 25-Year event
Inflow = 22.68 cfs @ 12.17 hrs, Volume= 2.008 af
Outflow = 22.18 cfs @ 12.19 hrs, Volume= 1.986 af, Atten= 2%, Lag= 1.0 min
Discarded = 0.02 cfs @ 12.19 hrs, Volume= 0.073 af
Primary = 22.17 cfs @ 12.19 hrs, Volume= 1.913 af

Routing by Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs / 4
Peak Elev= 323.96' @ 12.19 hrs Surf.Area= 3,483 sf Storage= 4,883 cf

Plug-Flow detention time= 77.0 min calculated for 1.986 af (99% of inflow)
Center-of-Mass det. time= 70.2 min (889.1 - 818.9)

Volume	Invert	Avail.Storage	Storage Description
#1	322.00'	5,009 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

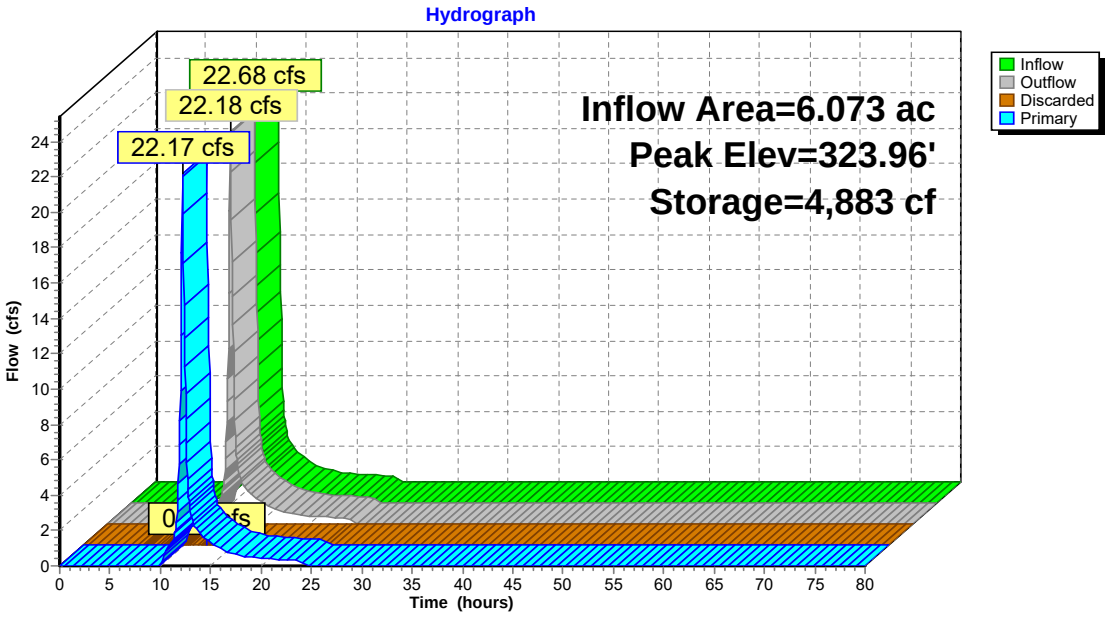
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
322.00	1,801	206.0	0	0	1,801
323.00	2,370	235.0	2,079	2,079	2,842
324.00	3,528	239.0	2,930	5,009	3,123

Device	Routing	Invert	Outlet Devices
#1	Discarded	322.00'	**0.170 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 318.00'
#2	Primary	323.45'	**23.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

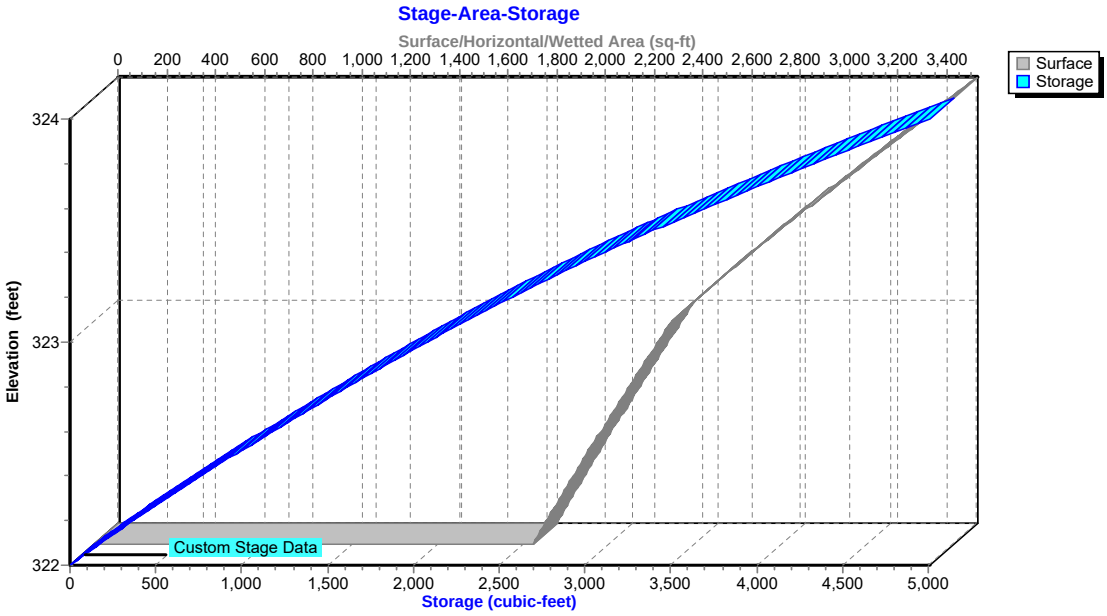
Discarded OutFlow Max=0.02 cfs @ 12.19 hrs HW=323.96' (Free Discharge)
└**1=Exfiltration** (Controls 0.02 cfs)

Primary OutFlow Max=21.88 cfs @ 12.19 hrs HW=323.96' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 21.88 cfs @ 1.86 fps)

Pond 1P: Existing Basin



Pond 1P: Existing Basin



Stage-Area-Storage for Pond 1P: Existing Basin

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
322.00	1,801	0	322.74	2,215	1,483	323.48	2,897	3,341
322.02	1,812	36	322.76	2,226	1,528	323.50	2,920	3,399
322.04	1,822	72	322.78	2,238	1,572	323.52	2,944	3,458
322.06	1,833	109	322.80	2,250	1,617	323.54	2,967	3,517
322.08	1,844	146	322.82	2,262	1,662	323.56	2,990	3,576
322.10	1,854	183	322.84	2,274	1,708	323.58	3,014	3,637
322.12	1,865	220	322.86	2,286	1,753	323.60	3,037	3,697
322.14	1,876	257	322.88	2,298	1,799	323.62	3,061	3,758
322.16	1,887	295	322.90	2,310	1,845	323.64	3,085	3,819
322.18	1,898	333	322.92	2,322	1,891	323.66	3,109	3,881
322.20	1,909	371	322.94	2,334	1,938	323.68	3,132	3,944
322.22	1,919	409	322.96	2,346	1,985	323.70	3,156	4,007
322.24	1,930	448	322.98	2,358	2,032	323.72	3,181	4,070
322.26	1,941	486	323.00	2,370	2,079	323.74	3,205	4,134
322.28	1,952	525	323.02	2,391	2,127	323.76	3,229	4,198
322.30	1,964	565	323.04	2,412	2,175	323.78	3,254	4,263
322.32	1,975	604	323.06	2,433	2,223	323.80	3,278	4,328
322.34	1,986	643	323.08	2,454	2,272	323.82	3,303	4,394
322.36	1,997	683	323.10	2,475	2,321	323.84	3,327	4,461
322.38	2,008	723	323.12	2,497	2,371	323.86	3,352	4,527
322.40	2,019	764	323.14	2,518	2,421	323.88	3,377	4,595
322.42	2,030	804	323.16	2,540	2,472	323.90	3,402	4,662
322.44	2,042	845	323.18	2,561	2,523	323.92	3,427	4,731
322.46	2,053	886	323.20	2,583	2,574	323.94	3,452	4,799
322.48	2,064	927	323.22	2,605	2,626	323.96	3,477	4,869
322.50	2,076	968	323.24	2,627	2,678	323.98	3,503	4,939
322.52	2,087	1,010	323.26	2,649	2,731	324.00	**3,528**	**5,009**
322.54	2,099	1,052	323.28	2,671	2,784			
322.56	2,110	1,094	323.30	2,693	2,838			
322.58	2,122	1,136	323.32	2,716	2,892			
322.60	2,133	1,179	323.34	2,738	2,947			
322.62	2,145	1,222	323.36	2,760	3,002			
322.64	2,156	1,265	323.38	2,783	3,057			
322.66	2,168	1,308	323.40	2,806	3,113			
322.68	2,179	1,351	323.42	2,828	3,169			
322.70	2,191	1,395	323.44	2,851	3,226			
322.72	2,203	1,439	323.46	2,874	3,283			

HydroCAD Analysis

Existing Conditions - 100 Year Storm

249 SOUTH STREET • UNIT 1 • PLAINVILLE, MA • 02762 | P 508.695.2221 | F 508.695.2219 | LEVELDG.COM

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
1.325	79	50-75% Grass cover, Fair, HSG C (E-1, E-1a, E-2, E-2a)
1.285	98	Paved parking, HSG C (E-1, E-1a, E-2, E-2a)
0.757	98	Roofs (E-1a)
5.339	70	Woods, Good, HSG C (E-1, E-1a, E-2, E-2a)
8.707	**78**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
7.949	HSG C	E-1, E-1a, E-2, E-2a
0.000	HSG D	
0.757	Other	E-1a
8.707		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	1.325	0.000	0.000	1.325	50-75% Grass cover, Fair	E-1, E-1a, E-2, E-2a
0.000	0.000	1.285	0.000	0.000	1.285	Paved parking	E-1, E-1a, E-2, E-2a
0.000	0.000	0.000	0.000	0.757	0.757	Roofs	E-1a
0.000	0.000	5.339	0.000	0.000	5.339	Woods, Good	E-1, E-1a, E-2, E-2a
0.000	**0.000**	**7.949**	**0.000**	**0.757**	**8.707**	**TOTAL AREA**	

Time span=0.00-80.00 hrs, dt=0.05 hrs, 1601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E-1: Flow to Existing Basin Runoff Area=114,809 sf 4.75% Impervious Runoff Depth=4.95"
Flow Length=317' Tc=12.7 min CN=73 Runoff=12.16 cfs 1.088 af

Subcatchment E-1a: Offsite Flow to Existing Basin Runoff Area=149,743 sf 40.33% Impervious Runoff Depth=6.13"
Flow Length=553' Tc=12.0 min CN=83 Runoff=19.68 cfs 1.756 af

Subcatchment E-2: Flow onsite Southeast Runoff Area=45,523 sf 12.60% Impervious Runoff Depth=5.07"
Flow Length=140' Tc=11.3 min CN=74 Runoff=5.16 cfs 0.441 af

Subcatchment E-2a: Offsite Flow onsite Southeast Runoff Area=69,184 sf 25.14% Impervious Runoff Depth=5.66"
Flow Length=140' Tc=11.3 min CN=79 Runoff=8.67 cfs 0.749 af

Reach DP-1: Existing DMH Inflow=31.14 cfs 2.742 af
Outflow=31.14 cfs 2.742 af

Reach DP-2: Onsite southeast Inflow=13.84 cfs 1.190 af
Outflow=13.84 cfs 1.190 af

Pond 1P: Existing Basin Peak Elev=324.08' Storage=5,009 cf Inflow=31.87 cfs 2.844 af
Discarded=0.02 cfs 0.074 af Primary=31.14 cfs 2.742 af Outflow=31.16 cfs 2.816 af

Total Runoff Area = 8.707 ac Runoff Volume = 4.034 af Average Runoff Depth = 5.56"
76.54% Pervious = 6.664 ac 23.46% Impervious = 2.043 ac

Summary for Subcatchment E-1: Flow to Existing Basin

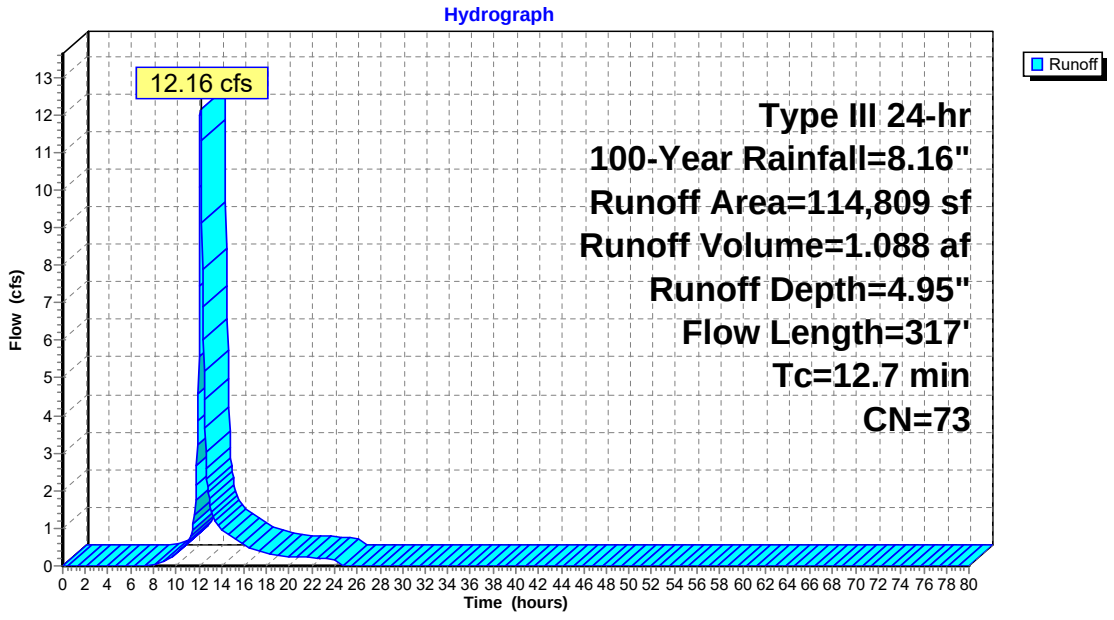
Runoff = 12.16 cfs @ 12.18 hrs, Volume= 1.088 af, Depth= 4.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.16"

Area (sf)	CN	Description
5,457	98	Paved parking, HSG C
93,734	70	Woods, Good, HSG C
15,618	79	50-75% Grass cover, Fair, HSG C
114,809	73	Weighted Average
109,352		95.25% Pervious Area
5,457		4.75% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.7	50	0.0300	0.08		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.05"
2.0	267	0.0190	2.22		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
12.7	317	Total			

Subcatchment E-1: Flow to Existing Basin



Summary for Subcatchment E-1a: Offsite Flow to Existing Basin

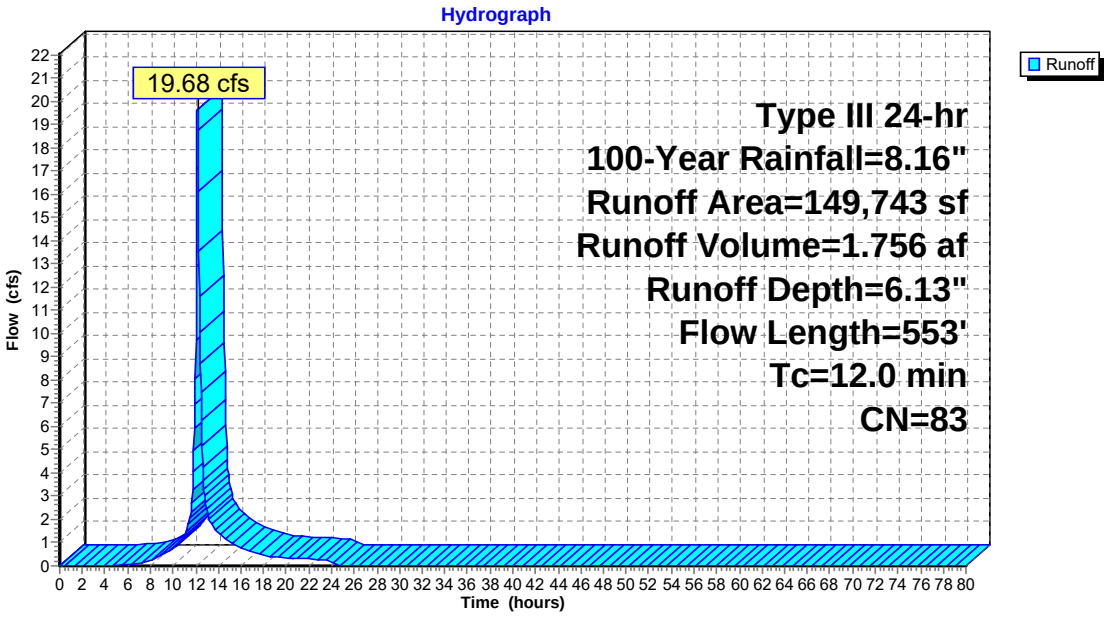
Runoff = 19.68 cfs @ 12.16 hrs, Volume= 1.756 af, Depth= 6.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.16"

	Area (sf)	CN	Description
*	32,987	98	Roofs
	27,404	98	Paved parking, HSG C
	65,641	70	Woods, Good, HSG C
	23,711	79	50-75% Grass cover, Fair, HSG C
	149,743	83	Weighted Average
	89,352		59.67% Pervious Area
	60,391		40.33% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.6	50	0.0530	0.10		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.05"
3.4	503	0.0240	2.49		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
12.0	553	Total			

Subcatchment E-1a: Offsite Flow to Existing Basin



Summary for Subcatchment E-2: Flow onsite Southeast

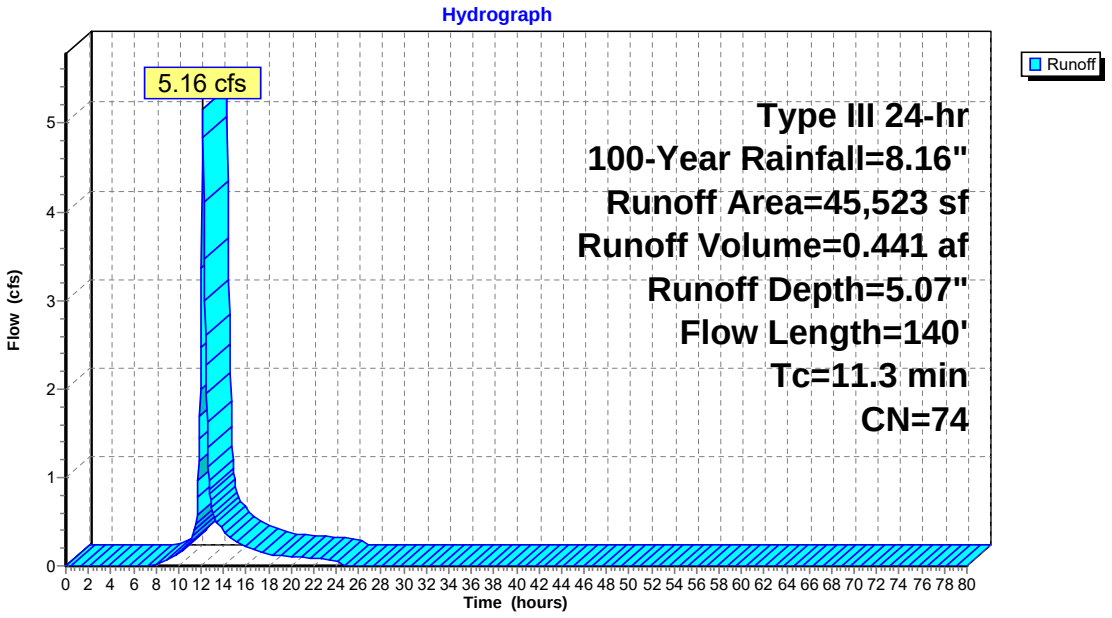
Runoff = 5.16 cfs @ 12.16 hrs, Volume= 0.441 af, Depth= 5.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.16"

Area (sf)	CN	Description
5,736	98	Paved parking, HSG C
38,141	70	Woods, Good, HSG C
1,646	79	50-75% Grass cover, Fair, HSG C
45,523	74	Weighted Average
39,787		87.40% Pervious Area
5,736		12.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.0	50	0.0280	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.05"
0.1	45	0.1750	6.74		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.0	11	0.1640	6.52		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.2	34	0.0240	3.14		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
11.3	140	Total			

Subcatchment E-2: Flow onsite Southeast



Summary for Subcatchment E-2a: Offsite Flow onsite Southeast

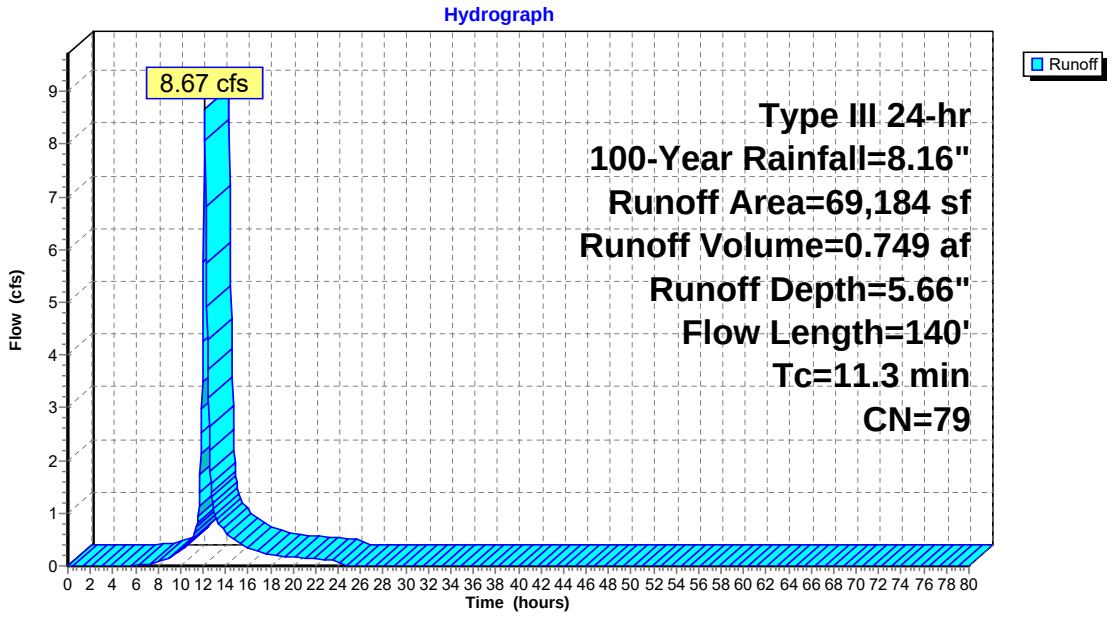
Runoff = 8.67 cfs @ 12.16 hrs, Volume= 0.749 af, Depth= 5.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.16"

Area (sf)	CN	Description
17,392	98	Paved parking, HSG C
35,059	70	Woods, Good, HSG C
16,733	79	50-75% Grass cover, Fair, HSG C
69,184	79	Weighted Average
51,792		74.86% Pervious Area
17,392		25.14% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.0	50	0.0280	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.05"
0.1	45	0.1750	6.74		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.0	11	0.1640	6.52		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.2	34	0.0240	3.14		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
11.3	140	Total			

Subcatchment E-2a: Offsite Flow onsite Southeast



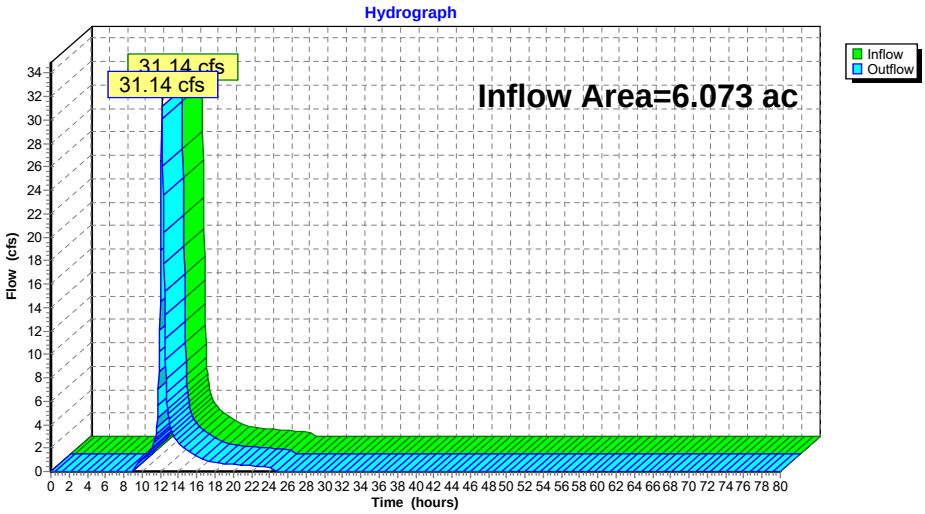
Summary for Reach DP-1: Existing DMH

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 6.073 ac, 24.89% Impervious, Inflow Depth = 5.42" for 100-Year event
Inflow = 31.14 cfs @ 12.17 hrs, Volume= 2.742 af
Outflow = 31.14 cfs @ 12.17 hrs, Volume= 2.742 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs

Reach DP-1: Existing DMH



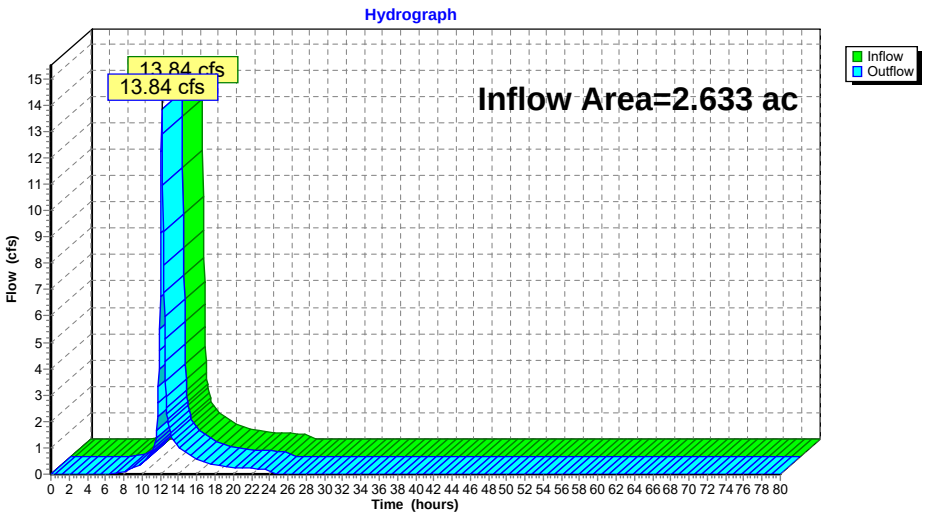
Summary for Reach DP-2: Onsite southeast

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.633 ac, 20.16% Impervious, Inflow Depth = 5.42" for 100-Year event
Inflow = 13.84 cfs @ 12.16 hrs, Volume= 1.190 af
Outflow = 13.84 cfs @ 12.16 hrs, Volume= 1.190 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs

Reach DP-2: Onsite southeast



Summary for Pond 1P: Existing Basin

[93] Warning: Storage range exceeded by 0.08'

Inflow Area = 6.073 ac, 24.89% Impervious, Inflow Depth = 5.62" for 100-Year event
Inflow = 31.87 cfs @ 12.17 hrs, Volume= 2.844 af
Outflow = 31.16 cfs @ 12.17 hrs, Volume= 2.816 af, Atten= 2%, Lag= 0.0 min
Discarded = 0.02 cfs @ 12.17 hrs, Volume= 0.074 af
Primary = 31.14 cfs @ 12.17 hrs, Volume= 2.742 af

Routing by Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs / 4
Peak Elev= 324.08' @ 12.17 hrs Surf.Area= 3,528 sf Storage= 5,009 cf

Plug-Flow detention time= 55.6 min calculated for 2.815 af (99% of inflow)
Center-of-Mass det. time= 51.6 min (861.0 - 809.4)

Volume	Invert	Avail.Storage	Storage Description
#1	322.00'	5,009 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

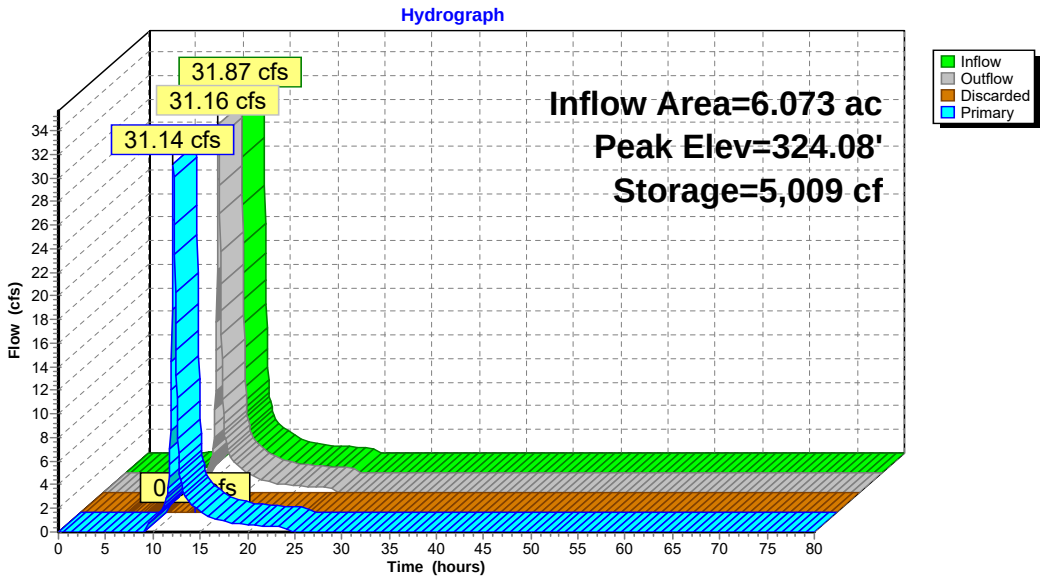
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
322.00	1,801	206.0	0	0	1,801
323.00	2,370	235.0	2,079	2,079	2,842
324.00	3,528	239.0	2,930	5,009	3,123

Device	Routing	Invert	Outlet Devices
#1	Discarded	322.00'	**0.170 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 318.00'
#2	Primary	323.45'	**23.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

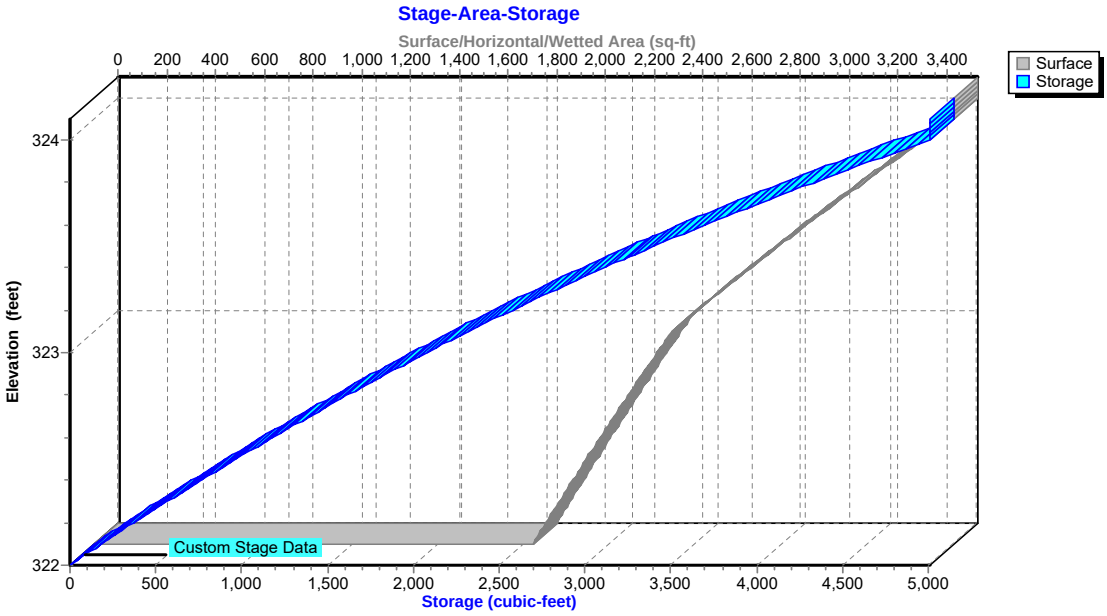
Discarded OutFlow Max=0.02 cfs @ 12.17 hrs HW=324.07' (Free Discharge)
└**1=Exfiltration** (Controls 0.02 cfs)

Primary OutFlow Max=30.55 cfs @ 12.17 hrs HW=324.07' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 30.55 cfs @ 2.13 fps)

Pond 1P: Existing Basin



Pond 1P: Existing Basin



Stage-Area-Storage for Pond 1P: Existing Basin

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
322.00	1,801	0	322.74	2,215	1,483	323.48	2,897	3,341
322.02	1,812	36	322.76	2,226	1,528	323.50	2,920	3,399
322.04	1,822	72	322.78	2,238	1,572	323.52	2,944	3,458
322.06	1,833	109	322.80	2,250	1,617	323.54	2,967	3,517
322.08	1,844	146	322.82	2,262	1,662	323.56	2,990	3,576
322.10	1,854	183	322.84	2,274	1,708	323.58	3,014	3,637
322.12	1,865	220	322.86	2,286	1,753	323.60	3,037	3,697
322.14	1,876	257	322.88	2,298	1,799	323.62	3,061	3,758
322.16	1,887	295	322.90	2,310	1,845	323.64	3,085	3,819
322.18	1,898	333	322.92	2,322	1,891	323.66	3,109	3,881
322.20	1,909	371	322.94	2,334	1,938	323.68	3,132	3,944
322.22	1,919	409	322.96	2,346	1,985	323.70	3,156	4,007
322.24	1,930	448	322.98	2,358	2,032	323.72	3,181	4,070
322.26	1,941	486	323.00	2,370	2,079	323.74	3,205	4,134
322.28	1,952	525	323.02	2,391	2,127	323.76	3,229	4,198
322.30	1,964	565	323.04	2,412	2,175	323.78	3,254	4,263
322.32	1,975	604	323.06	2,433	2,223	323.80	3,278	4,328
322.34	1,986	643	323.08	2,454	2,272	323.82	3,303	4,394
322.36	1,997	683	323.10	2,475	2,321	323.84	3,327	4,461
322.38	2,008	723	323.12	2,497	2,371	323.86	3,352	4,527
322.40	2,019	764	323.14	2,518	2,421	323.88	3,377	4,595
322.42	2,030	804	323.16	2,540	2,472	323.90	3,402	4,662
322.44	2,042	845	323.18	2,561	2,523	323.92	3,427	4,731
322.46	2,053	886	323.20	2,583	2,574	323.94	3,452	4,799
322.48	2,064	927	323.22	2,605	2,626	323.96	3,477	4,869
322.50	2,076	968	323.24	2,627	2,678	323.98	3,503	4,939
322.52	2,087	1,010	323.26	2,649	2,731	324.00	**3,528**	**5,009**
322.54	2,099	1,052	323.28	2,671	2,784	324.02	3,528	5,009
322.56	2,110	1,094	323.30	2,693	2,838	324.04	3,528	5,009
322.58	2,122	1,136	323.32	2,716	2,892	324.06	3,528	5,009
322.60	2,133	1,179	323.34	2,738	2,947	324.08	3,528	5,009
322.62	2,145	1,222	323.36	2,760	3,002	324.10	3,528	5,009
322.64	2,156	1,265	323.38	2,783	3,057			
322.66	2,168	1,308	323.40	2,806	3,113			
322.68	2,179	1,351	323.42	2,828	3,169			
322.70	2,191	1,395	323.44	2,851	3,226			
322.72	2,203	1,439	323.46	2,874	3,283			

LEVEL DESIGN GROUP
Civil Engineers & Land Surveyors

Proposed Drainage Plan & HydroCAD Diagram

WATERSHED LEGEND

XXXX — SOIL TYPE

X — HYDROLOGIC SOIL GROUP

SOILS

312B — WOODBRIDGE FINE SANDY LOAM

N/F
COOKE
PARCEL 320–021
DB 11508 PG 376
4 RACHAEL CIRCLE

N/F
HARDING & MURPHY
PARCEL 320–022
DB 10636 PG 581
6 RACHAEL CIRCLE

N/F
SMITH
PARCEL 320–023
DB 10681 PG 633
6 RACHAEL CIRCLE

LOT B–211
N/F
IRON MOUNTAIN INFORMATION MANAGEMENT, LLC
PARCEL ID 320–006
DB 32508 PG 480
PLAN NO. 659 OF 1998
77 CONSTITUTION BLVD.

LOT B-21A
653,400± S.F.
=15.000± ACRES
PARCEL ID 320–004
DB 39279 PG 298
PLAN NO. 879 OF 1994
15 LIBERTY WAY

EXISTING
ONE STORY
WAREHOUSE
BUILDING HEIGHT=24'±
#15

P1
AREA=38,355 S.F.
CN=73
TC=10.0 MIN.

P1b
AREA=40,066 S.F.
CN=98
TC=6.0 MIN.

P1a
AREA=24,473 S.F.
CN=98
TC=6.0 MIN.

P1c
AREA=172,610 S.F.
CN=81
TC=6.0 MIN.

P2
AREA=38,577 S.F.
CN=75
TC=6.0 MIN.

P2a
AREA=63,177 S.F.
CN=76
TC=6.0 MIN.

DMH–3 (OCS)
RIM=328.80
INV.(IN)=325.00
WEIR EL.=325.83
(2) 6"ø ORIFICE=325.00
INV.(OUT)=323.25

EXISTING
INFILTRATION BASIN
TOP EL=326.0±
BOTTOM EL=323.0±

12" RCP
L=23'
S=0.011

OUTLET–3
FES W/RIP–RAP APRON.
INV(END)=323.00
(MIN RIP–RAP PAD
SIZE=14'Lx10'W)

BOTTOM OF BASIN TO
BE CLEAN OF DEBRIS
AND REGRADED AS
NECESSARY TO
EL.=323.0±

OUTLET–1
RIP–RAP APRON.
INV(END)=323.00
(MIN RIP–RAP
PAD SIZE=16'Lx10'W)

CURTAIN DRAIN
CONNECTION
INV.=321.00

CURTAIN DRAIN
L=333'
S=LEVEL
INV.=321.00
(SEE DETAIL
SHEET C–6.2)

60"X60" OUTLET CONTROL
STRUCTURE
RIM EL.=325.00
10"Hx20"W ORIFICE EL.=324.00
6"HX32"W ORIFICE EL.=323.50
REMOVE 24" FES
AND EXTEND 24" RCP TO OCS
INV.=321.0±
(FIELD VERIFY)

STONE GABION
48'LX3'W
TOP EL.=324.00

OUTLET–2
RIP–RAP APRON.
INV(END)=323.00
(MIN RIP–RAP PAD
SIZE=12'Lx8'W)

8" HDPE
L=37'
S=0.010

12" RCP
L=82'
S=0.011

CB–1
RIM=326.90
INV.=323.90

CB 2
RIM=325.95
INV=323.30

INSPECTION
PORT
(TYP. OF 10)

INSPECTION PORT
(TYP. OF 4)

SSI–1
STC–310
(150 UNITS)
TOS=326.33
TOC=325.83
BOC=324.50
BOS=324.00

TP–6
GR.=326.70
GW.=323.45

TP–5
GR.=326.45
GW.=323.03

TP–1
GR.=334.70
GW.=331.78

312B
C/D

12" RCP
L=4'
S=LEVEL

12" RCP
L=4'
S=LEVEL

DMH–2
(CDS 2015–4)
RIM=328.90
INV.(IN)=324.60
INV.(OUT)=324.50

CLEANOUT
RIM=328.40

12" RCP
L=58'
S=0.010

TD–1 (LOW END)
RIM=327.95
INV.=327.10

TRENCH
DRAIN–1
L=159'
S=0.010

DMH
RIM=326.41

DMH–1 (DEEP SUMP)
RIM=327.95
INV.(IN)=327.63 (TD–1)
INV.(OUT)=325.20
SUMP=321.20

DMH
RIM=327.67

RECORD DATA

STONE GABION
CHECK DAM
TOP EL.=334.05

STONE GABION
CHECK DAM
TOP EL.=332.50

STONE GABION CHECK DAM
TOP EL.=331.00

STONE GABION
CHECK DAM
TOP
EL.=329.50

DISCHARGE
FROM
SWALE

TD–1 (HIGH
END)
RIM=329.20
INV.=328.70

FES
INV=330.63

FES
INV=335.15

SWALE

DRAINAGE SWALE

SEDIMENT
FOREBAY

BUILDING SETBACK LINE

CHAINLINK
FENCE

EXISTING
TREELINE
(TYP.)

100' WETLAND
BUFFER

50' WETLAND
BUFFER

25' WETLAND
BUFFER

GENERAL RESIDENTIAL "R" ZONING DISTRICT

INDUSTRIAL ZONING DISTRICT

40' WIDE

20' WIDE UTILITY

35' WIDE DRAINAGE

25' WIDE WATER MAIN EASEMENT

16

NO	DATE	REVISIONS
1	10/17/2023	RESOURCE AREA FLAGS
2	11/22/2023	REVIEW COMMENTS
3	02/01/2024	REVIEW COMMENTS
4	03/19/2024	REVISE LAYOUT

SEAL

DATE : JANUARY 13, 2023
DRAWN : AH / DRC
SCALE : 1" = 20'

LIBERTY PARKING EXPANSION

MAP SHEET 320, PARCEL 004
15 LIBERTY WAY
FRANKLIN, MASSACHUSETTS

LEVEL
DESIGN GROUP
Civil Engineers & Land Surveyors
249 SOUTH STREET, UNIT 1
PLAINVILLE, MA 02762
TEL. (508) 695-2221 FAX. (508) 695-2219

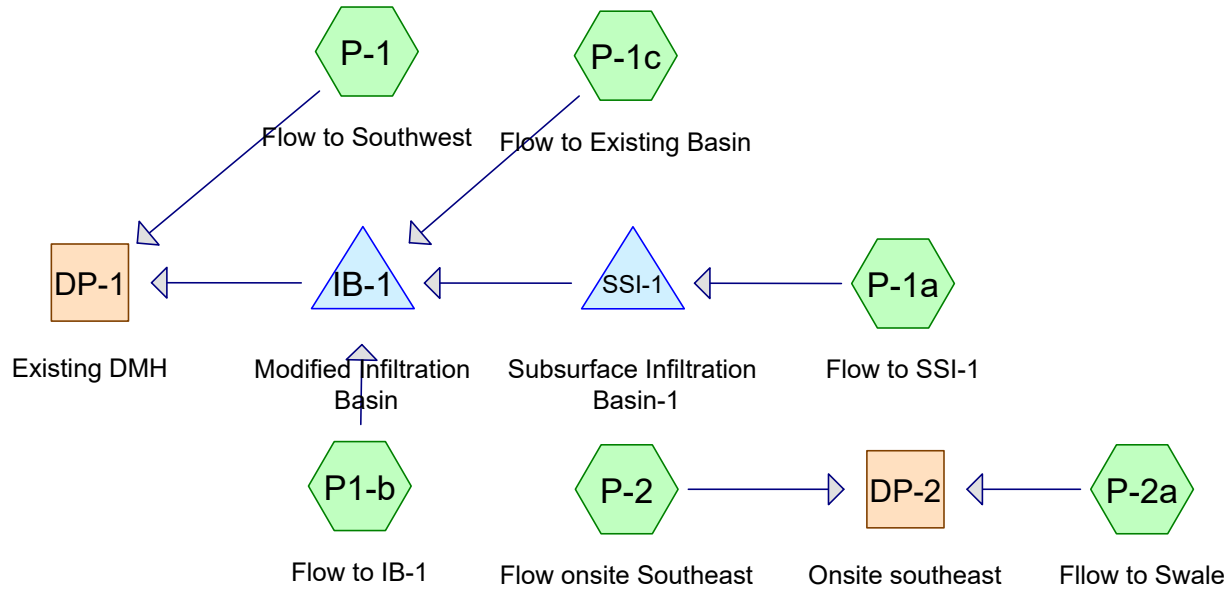
PROPOSED
DRAINAGE

D-2.0

SHEET 2 OF 2

0' 10' 20' 40'

2081.00



Subcat Reach Pond Link

Routing Diagram for Proposed-14

Prepared by {enter your company name here}, Printed 3/18/2024

HydroCAD Analysis

Proposed Conditions - 2 Year Storm

249 SOUTH STREET • UNIT 1 • PLAINVILLE, MA • 02762 | P 508.695.2221 | F 508.695.2219 | LEVELDG.COM

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
60,813	74	>75% Grass cover, Good, HSG C (P-1, P-1c, P-2, P-2a, P1-b)
119,908	98	Paved parking, HSG C (P-1, P-1a, P-1c, P-2, P-2a, P1-b)
1,327	66	Rip Rap Swale, HSG C (P-2a)
32,987	98	Roofs (P-1c)
164,224	70	Woods, Good, HSG C (P-1, P-1c, P-2, P-2a)
379,259	**82**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
0	HSG B	
346,272	HSG C	P-1, P-1a, P-1c, P-2, P-2a, P1-b
0	HSG D	
32,987	Other	P-1c
379,259		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Subcatchment Numbers
0	0	60,813	0	0	60,813	>75% Grass cover, Good	P-1, P-1c, P-2, P-2a, P1-b
0	0	119,908	0	0	119,908	Paved parking	P-1, P-1a, P-1c, P-2, P-2a, P1-b
0	0	1,327	0	0	1,327	Rip Rap Swale	P-2a
0	0	0	0	32,987	32,987	Roofs	P-1c
0	0	164,224	0	0	164,224	Woods, Good	P-1, P-1c, P-2, P-2a
0	**0**	**346,272**	**0**	**32,987**	**379,259**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	IB-1	321.00	320.56	44.0	0.0100	0.013	24.0	0.0	0.0
2	SSI-1	323.25	323.00	23.0	0.0109	0.013	12.0	0.0	0.0

Time span=0.00-80.00 hrs, dt=0.05 hrs, 1601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P-1: Flow to Southwest Runoff Area=38,355 sf 6.04% Impervious Runoff Depth=0.89"
Flow Length=461' Tc=13.4 min CN=73 Runoff=0.66 cfs 2,839 cf

Subcatchment P-1a: Flow to SSI-1 Runoff Area=24,473 sf 100.00% Impervious Runoff Depth=2.82"
Flow Length=553' Tc=12.0 min CN=98 Runoff=1.37 cfs 5,747 cf

Subcatchment P-1c: Flow to Existing Basin Runoff Area=172,610 sf 34.99% Impervious Runoff Depth=1.35"
Tc=15.0 min CN=81 Runoff=4.68 cfs 19,448 cf

Subcatchment P-2: Flow onsite Southeast Runoff Area=38,577 sf 16.99% Impervious Runoff Depth=0.99"
Tc=6.0 min CN=75 Runoff=0.96 cfs 3,194 cf

Subcatchment P-2a: FIlow to Swale Runoff Area=63,177 sf 27.53% Impervious Runoff Depth=1.16"
Flow Length=140' Tc=11.3 min CN=78 Runoff=1.60 cfs 6,131 cf

Subcatchment P1-b: Flow to IB-1 Runoff Area=42,067 sf 99.29% Impervious Runoff Depth=2.82"
Tc=6.0 min CN=98 Runoff=2.79 cfs 9,879 cf

Reach DP-1: Existing DMH Inflow=6.23 cfs 31,937 cf
Outflow=6.23 cfs 31,937 cf

Reach DP-2: Onsite southeast Inflow=2.41 cfs 9,325 cf
Outflow=2.41 cfs 9,325 cf

Pond IB-1: Modified Infiltration Basin Peak Elev=324.30' Storage=3,847 cf Inflow=6.39 cfs 31,340 cf
Discarded=0.02 cfs 2,243 cf Primary=5.62 cfs 29,098 cf Outflow=5.64 cfs 31,340 cf

Pond SSI-1: Subsurface Infiltration Basin-1 Peak Elev=325.26' Storage=2,951 cf Inflow=1.37 cfs 5,747 cf
Discarded=0.02 cfs 3,734 cf Primary=0.35 cfs 2,013 cf Outflow=0.38 cfs 5,747 cf

Total Runoff Area = 379,259 sf Runoff Volume = 47,239 cf Average Runoff Depth = 1.49"
59.69% Pervious = 226,364 sf 40.31% Impervious = 152,895 sf

Summary for Subcatchment P-1: Flow to Southwest

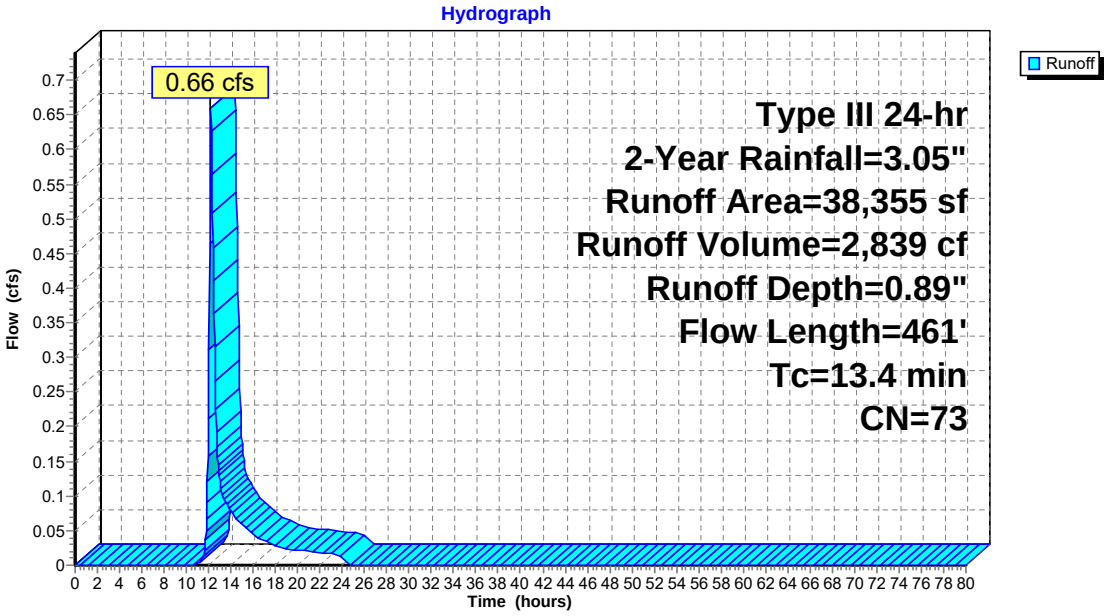
Runoff = 0.66 cfs @ 12.21 hrs, Volume= 2,839 cf, Depth= 0.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.05"

Area (sf)	CN	Description
2,315	98	Paved parking, HSG C
26,195	70	Woods, Good, HSG C
9,845	74	>75% Grass cover, Good, HSG C
38,355	73	Weighted Average
36,040		93.96% Pervious Area
2,315		6.04% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.7	50	0.0300	0.08		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.05"
2.7	411	0.0240	2.49		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
13.4	461	Total			

Subcatchment P-1: Flow to Southwest



Summary for Subcatchment P-1a: Flow to SSI-1

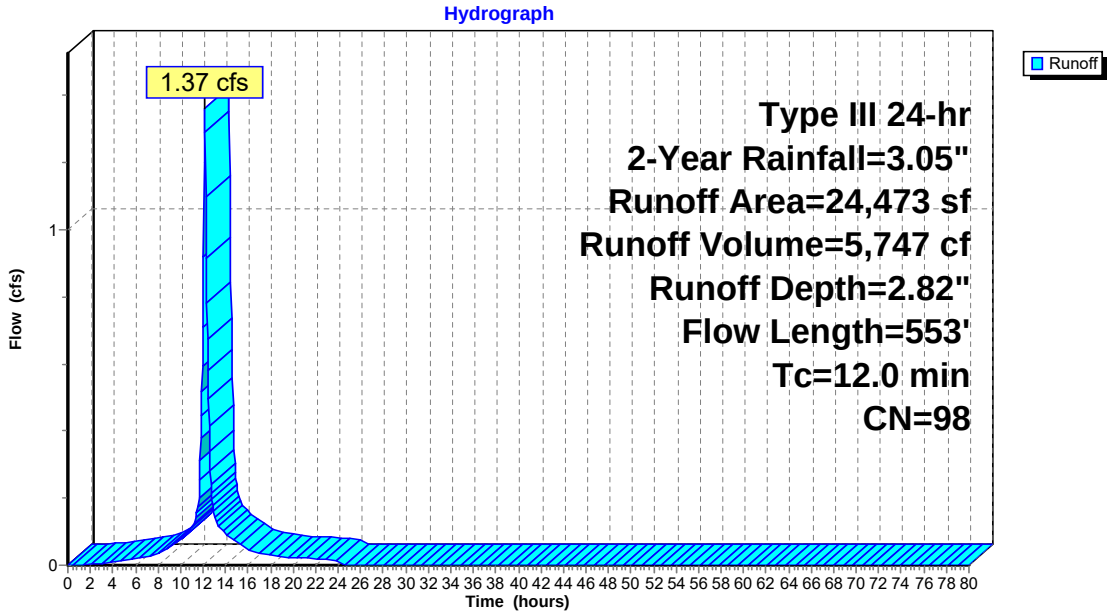
Runoff = 1.37 cfs @ 12.16 hrs, Volume= 5,747 cf, Depth= 2.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.05"

Area (sf)	CN	Description
24,473	98	Paved parking, HSG C
24,473		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.6	50	0.0530	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.05"
3.4	503	0.0240	2.49		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
12.0	553	Total			

Subcatchment P-1a: Flow to SSI-1



Summary for Subcatchment P-1c: Flow to Existing Basin

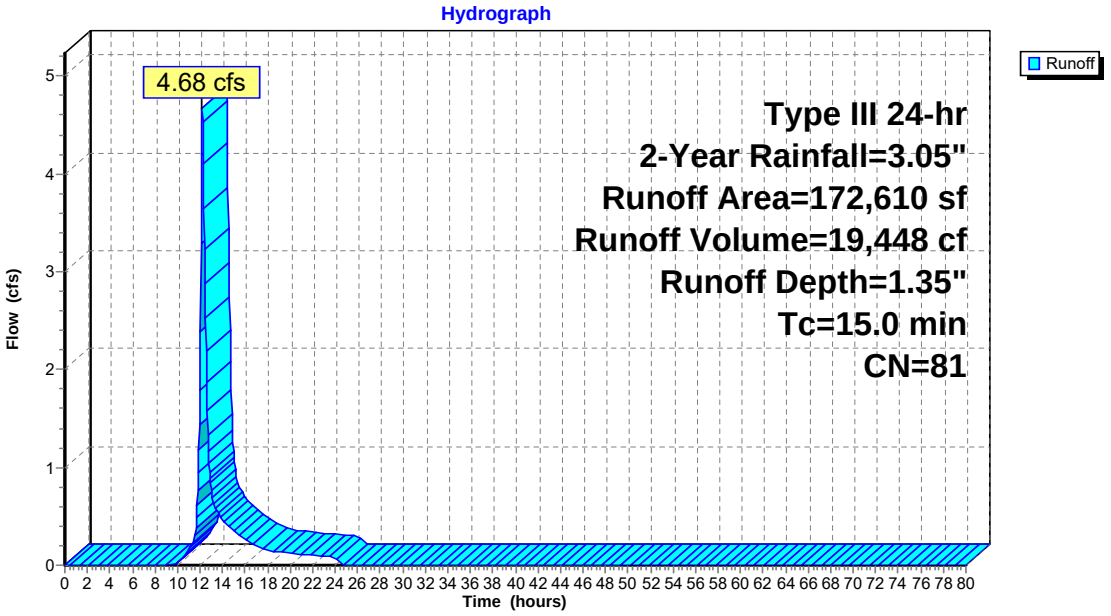
Runoff = 4.68 cfs @ 12.21 hrs, Volume= 19,448 cf, Depth= 1.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.05"

	Area (sf)	CN	Description
*	32,987	98	Roofs
	27,404	98	Paved parking, HSG C
	71,146	70	Woods, Good, HSG C
	41,073	74	>75% Grass cover, Good, HSG C
	172,610	81	Weighted Average
	112,219		65.01% Pervious Area
	60,391		34.99% Impervious Area

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

Subcatchment P-1c: Flow to Existing Basin



Summary for Subcatchment P-2: Flow onsite Southeast

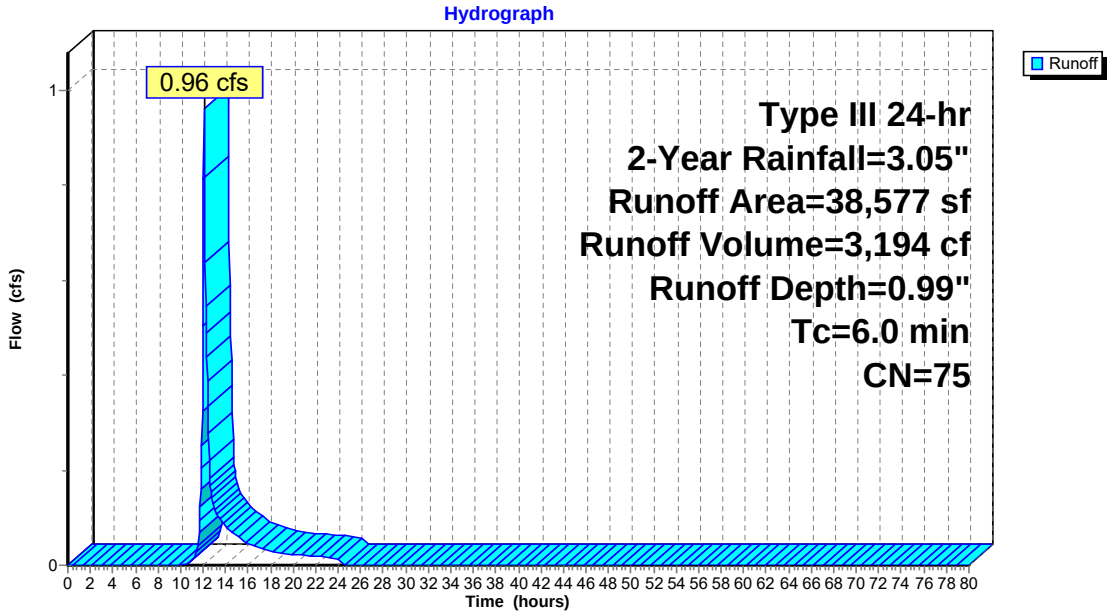
Runoff = 0.96 cfs @ 12.10 hrs, Volume= 3,194 cf, Depth= 0.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.05"

Area (sf)	CN	Description
6,554	98	Paved parking, HSG C
31,258	70	Woods, Good, HSG C
765	74	>75% Grass cover, Good, HSG C
38,577	75	Weighted Average
32,023		83.01% Pervious Area
6,554		16.99% Impervious Area

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

Subcatchment P-2: Flow onsite Southeast



Summary for Subcatchment P-2a: Fllow to Swale

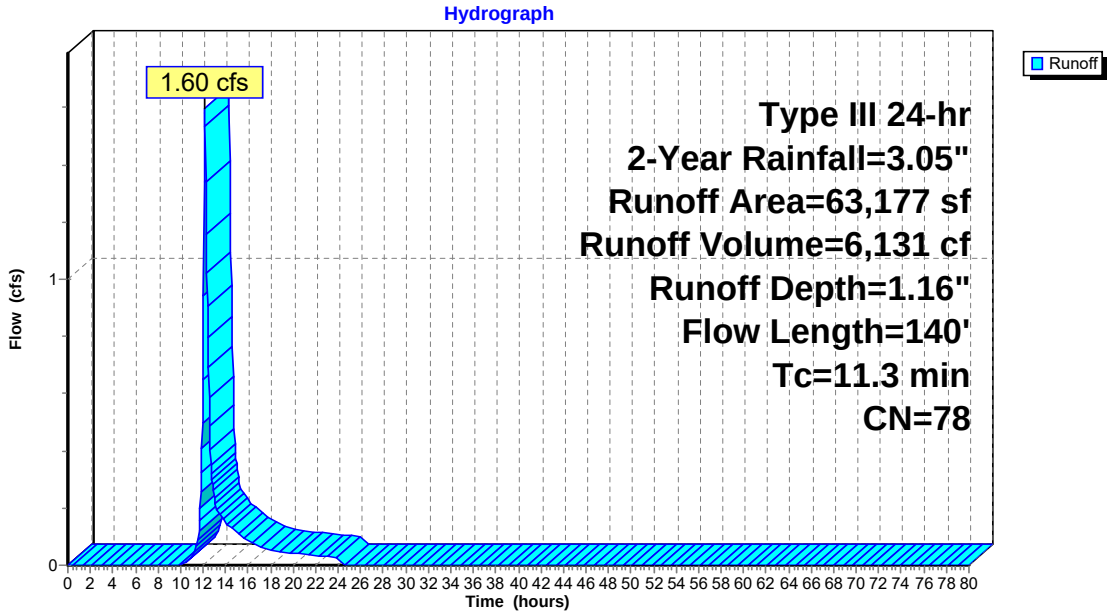
Runoff = 1.60 cfs @ 12.17 hrs, Volume= 6,131 cf, Depth= 1.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.05"

	Area (sf)	CN	Description
	17,392	98	Paved parking, HSG C
*	1,327	66	Rip Rap Swale, HSG C
	35,625	70	Woods, Good, HSG C
	8,833	74	>75% Grass cover, Good, HSG C
	63,177	78	Weighted Average
	45,785		72.47% Pervious Area
	17,392		27.53% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.0	50	0.0280	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.05"
0.1	45	0.1750	6.74		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.0	11	0.1640	6.52		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.2	34	0.0240	3.14		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
11.3	140	Total			

Subcatchment P-2a: Fllow to Swale



Summary for Subcatchment P1-b: Flow to IB-1

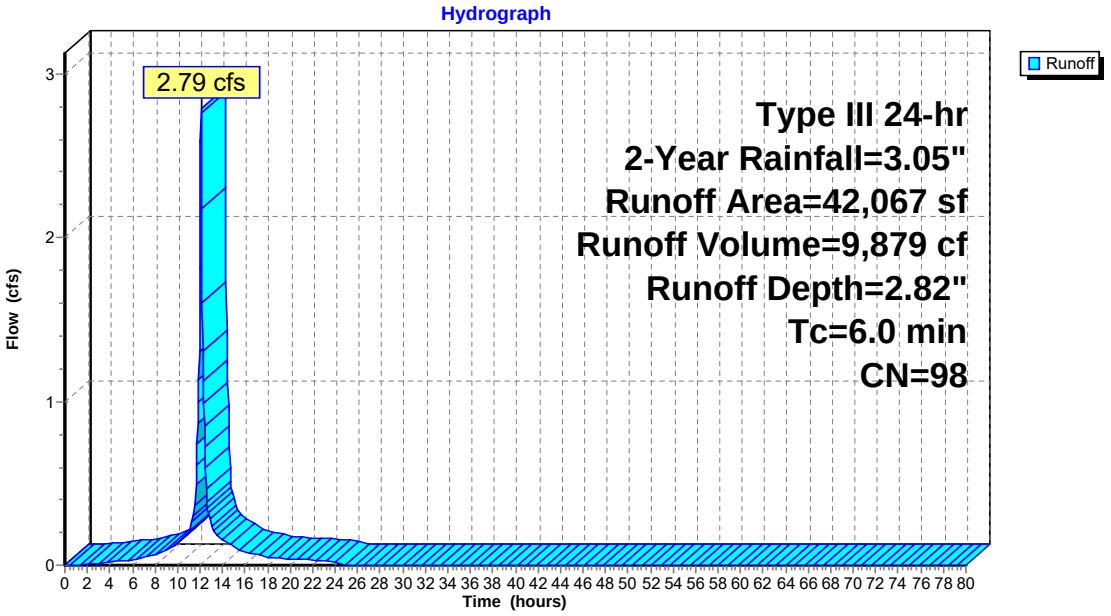
Runoff = 2.79 cfs @ 12.09 hrs, Volume= 9,879 cf, Depth= 2.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.05"

Area (sf)	CN	Description
41,770	98	Paved parking, HSG C
297	74	>75% Grass cover, Good, HSG C
42,067	98	Weighted Average
297		0.71% Pervious Area
41,770		99.29% Impervious Area

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

Subcatchment P1-b: Flow to IB-1



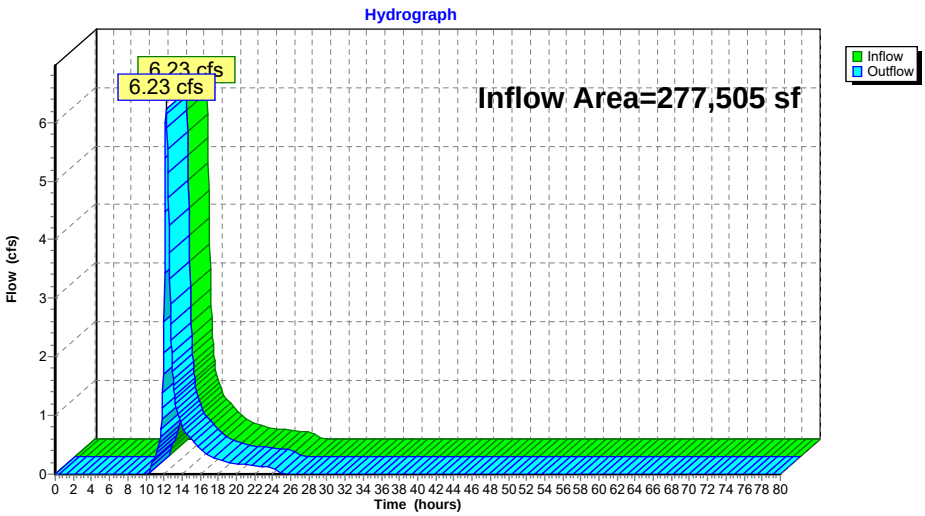
Summary for Reach DP-1: Existing DMH

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 277,505 sf, 46.47% Impervious, Inflow Depth = 1.38" for 2-Year event
Inflow = 6.23 cfs @ 12.26 hrs, Volume= 31,937 cf
Outflow = 6.23 cfs @ 12.26 hrs, Volume= 31,937 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs

Reach DP-1: Existing DMH



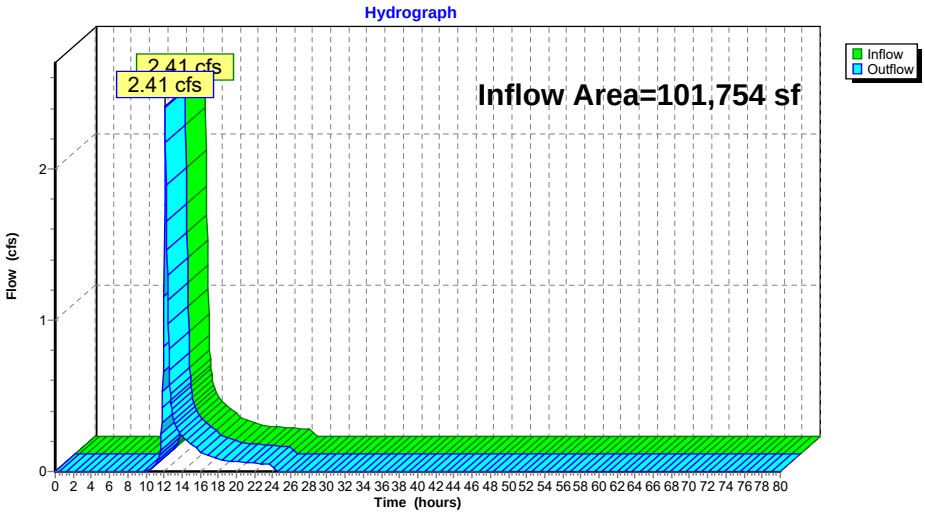
Summary for Reach DP-2: Onsite southeast

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 101,754 sf, 23.53% Impervious, Inflow Depth = 1.10" for 2-Year event
Inflow = 2.41 cfs @ 12.14 hrs, Volume= 9,325 cf
Outflow = 2.41 cfs @ 12.14 hrs, Volume= 9,325 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs

Reach DP-2: Onsite southeast



Summary for Pond IB-1: Modified Infiltration Basin

[79] Warning: Submerged Pond SSI-1 Primary device # 1 INLET by 1.05'

Inflow Area = 239,150 sf, 52.95% Impervious, Inflow Depth = 1.57" for 2-Year event
Inflow = 6.39 cfs @ 12.16 hrs, Volume= 31,340 cf
Outflow = 5.64 cfs @ 12.27 hrs, Volume= 31,340 cf, Atten= 12%, Lag= 6.8 min
Discarded = 0.02 cfs @ 12.27 hrs, Volume= 2,243 cf
Primary = 5.62 cfs @ 12.27 hrs, Volume= 29,098 cf

Routing by Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 324.30' @ 12.27 hrs Surf.Area= 3,567 sf Storage= 3,847 cf

Plug-Flow detention time= 92.1 min calculated for 31,321 cf (100% of inflow)
Center-of-Mass det. time= 93.4 min (914.2 - 820.8)

Volume	Invert	Avail.Storage	Storage Description
#1	323.00'	11,339 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

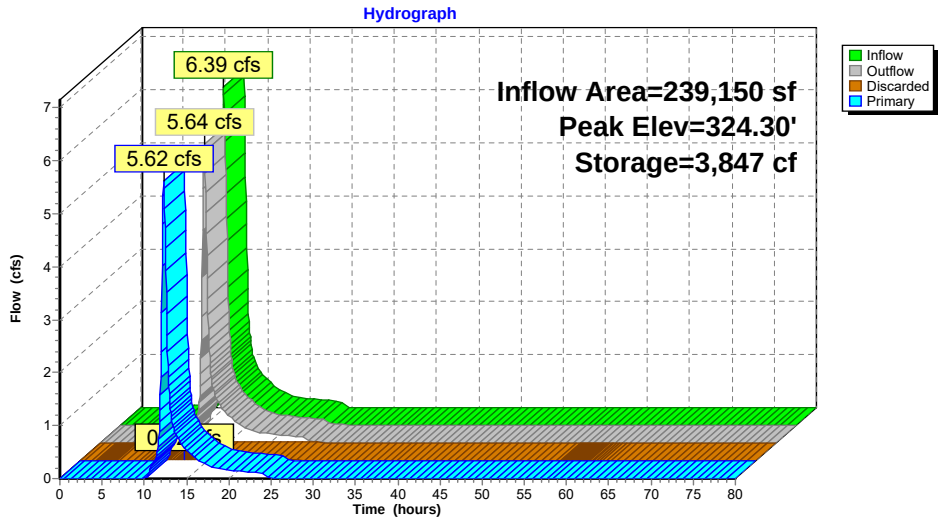
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
323.00	2,360	290.0	0	0	2,360
324.00	3,286	315.0	2,810	2,810	3,601
325.00	4,260	334.0	3,762	6,573	4,635
326.00	5,291	353.0	4,766	11,339	5,729

Device	Routing	Invert	Outlet Devices
#1	Discarded	323.00'	**0.170 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 318.00'
#2	Primary	321.00'	**24.0" Round Culvert** L= 44.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 321.00' / 320.56' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf
#3	Device 2	325.00'	**60.0" x 60.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 2	324.00'	**20.0" W x 10.0" H Vert. Orifice** C= 0.600
#5	Device 2	323.50'	**32.0" W x 6.0" H Vert. Orifice** C= 0.600

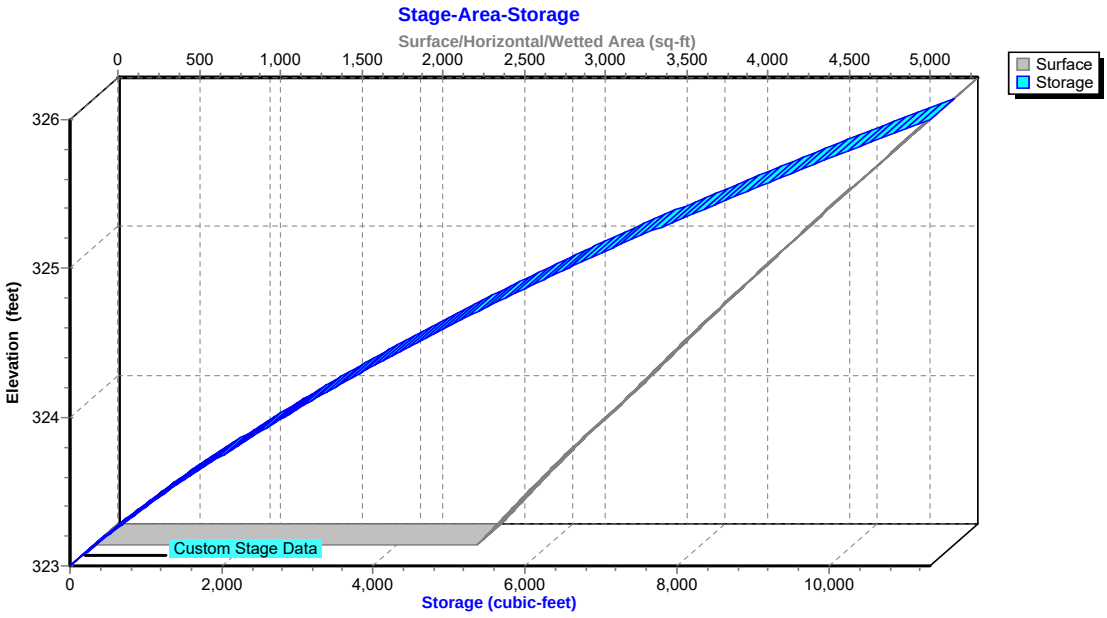
Discarded OutFlow Max=0.02 cfs @ 12.27 hrs HW=324.30' (Free Discharge)
└**1=Exfiltration** (Controls 0.02 cfs)

Primary OutFlow Max=5.59 cfs @ 12.27 hrs HW=324.30' (Free Discharge)
└**2=Culvert** (Passes 5.59 cfs of 22.94 cfs potential flow)
  ├**3=Grate** (Controls 0.00 cfs)
  ├**4=Orifice** (Orifice Controls 0.87 cfs @ 1.75 fps)
  └**5=Orifice** (Orifice Controls 4.71 cfs @ 3.54 fps)

Pond IB-1: Modified Infiltration Basin



Pond IB-1: Modified Infiltration Basin



Stage-Area-Storage for Pond IB-1: Modified Infiltration Basin

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
323.00	2,360	0	324.85	4,106	5,945
323.05	2,403	119	324.90	4,157	6,152
323.10	2,446	240	324.95	4,208	6,361
323.15	2,489	364	325.00	4,260	6,573
323.20	2,533	489	325.05	4,309	6,787
323.25	2,577	617	325.10	4,358	7,004
323.30	2,622	747	325.15	4,408	7,223
323.35	2,667	879	325.20	4,457	7,444
323.40	2,712	1,014	325.25	4,507	7,669
323.45	2,758	1,150	325.30	4,558	7,895
323.50	2,804	1,289	325.35	4,608	8,124
323.55	2,850	1,431	325.40	4,659	8,356
323.60	2,897	1,574	325.45	4,710	8,590
323.65	2,945	1,720	325.50	4,762	8,827
323.70	2,992	1,869	325.55	4,813	9,066
323.75	3,040	2,020	325.60	4,865	9,308
323.80	3,089	2,173	325.65	4,917	9,553
323.85	3,137	2,329	325.70	4,970	9,800
323.90	3,187	2,487	325.75	5,023	10,050
323.95	3,236	2,647	325.80	5,076	10,302
324.00	3,286	2,810	325.85	5,129	10,557
324.05	3,332	2,976	325.90	5,183	10,815
324.10	3,378	3,143	325.95	5,237	11,076
324.15	3,424	3,313	326.00	**5,291**	**11,339**
324.20	3,471	3,486			
324.25	3,518	3,661			
324.30	3,565	3,838			
324.35	3,613	4,017			
324.40	3,660	4,199			
324.45	3,709	4,383			
324.50	3,757	4,570			
324.55	3,806	4,759			
324.60	3,855	4,950			
324.65	3,905	5,144			
324.70	3,955	5,341			
324.75	4,005	5,540			
324.80	4,055	5,741			

Summary for Pond SSI-1: Subsurface Infiltration Basin-1

Inflow Area = 24,473 sf,100.00% Impervious, Inflow Depth = 2.82" for 2-Year event
Inflow = 1.37 cfs @ 12.16 hrs, Volume= 5,747 cf
Outflow = 0.38 cfs @ 12.58 hrs, Volume= 5,747 cf, Atten= 72%, Lag= 24.9 min
Discarded = 0.02 cfs @ 12.58 hrs, Volume= 3,734 cf
Primary = 0.35 cfs @ 12.58 hrs, Volume= 2,013 cf

Routing by Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs / 6
Peak Elev= 325.26' @ 12.58 hrs Surf.Area= 3,832 sf Storage= 2,951 cf

Plug-Flow detention time= 687.1 min calculated for 5,747 cf (100% of inflow)
Center-of-Mass det. time= 686.8 min (1,449.8 - 763.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	324.00'	2,692 cf	**34.83'W x 110.00'L x 2.33'H Field A** 8,941 cf Overall - 2,211 cf Embedded = 6,729 cf x 40.0% Voids
#2A	324.50'	2,211 cf	**ADS_StormTech SC-310 +Cap** x 150 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap 150 Chambers in 10 Rows
		4,903 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	323.25'	**12.0" Round Culvert** L= 23.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 323.25' / 323.00' S= 0.0109 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	325.83'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#3	Device 1	325.00'	**6.0" Vert. Orifice/Grate X 2.00** C= 0.600
#4	Discarded	324.00'	**0.170 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 322.00'

Discarded OutFlow Max=0.02 cfs @ 12.58 hrs HW=325.26' (Free Discharge)
└**4=Exfiltration** (Controls 0.02 cfs)

Primary OutFlow Max=0.35 cfs @ 12.58 hrs HW=325.26' (Free Discharge)
└**1=Culvert** (Passes 0.35 cfs of 4.64 cfs potential flow)
  └**2=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)
  └**3=Orifice/Grate** (Orifice Controls 0.35 cfs @ 1.73 fps)

Pond SSI-1: Subsurface Infiltration Basin-1 - Chamber Wizard Field A

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

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

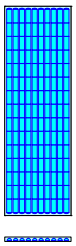
15 Chambers/Row x 7.12' Long +0.60' Cap Length x 2 = 108.00' Row Length +12.0" End Stone x 2 = 110.00' Base Length
10 Rows x 34.0" Wide + 6.0" Spacing x 9 + 12.0" Side Stone x 2 = 34.83' Base Width
6.0" Base + 16.0" Chamber Height + 6.0" Cover = 2.33' Field Height

150 Chambers x 14.7 cf = 2,211.3 cf Chamber Storage

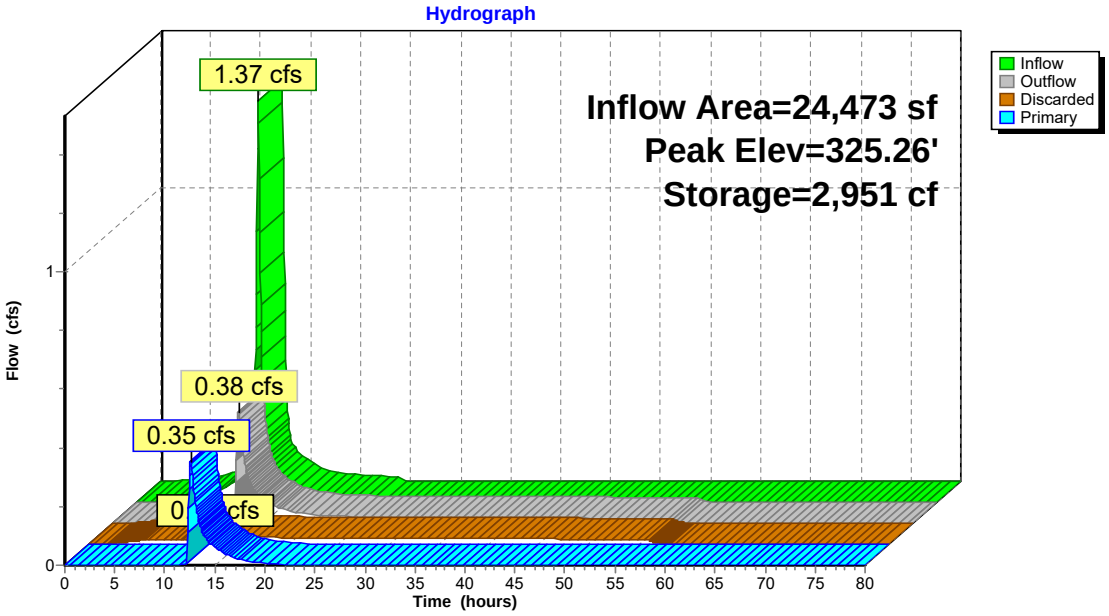
8,940.6 cf Field - 2,211.3 cf Chambers = 6,729.3 cf Stone x 40.0% Voids = 2,691.7 cf Stone Storage

Chamber Storage + Stone Storage = 4,903.0 cf = 0.113 af
Overall Storage Efficiency = 54.8%
Overall System Size = 110.00' x 34.83' x 2.33'

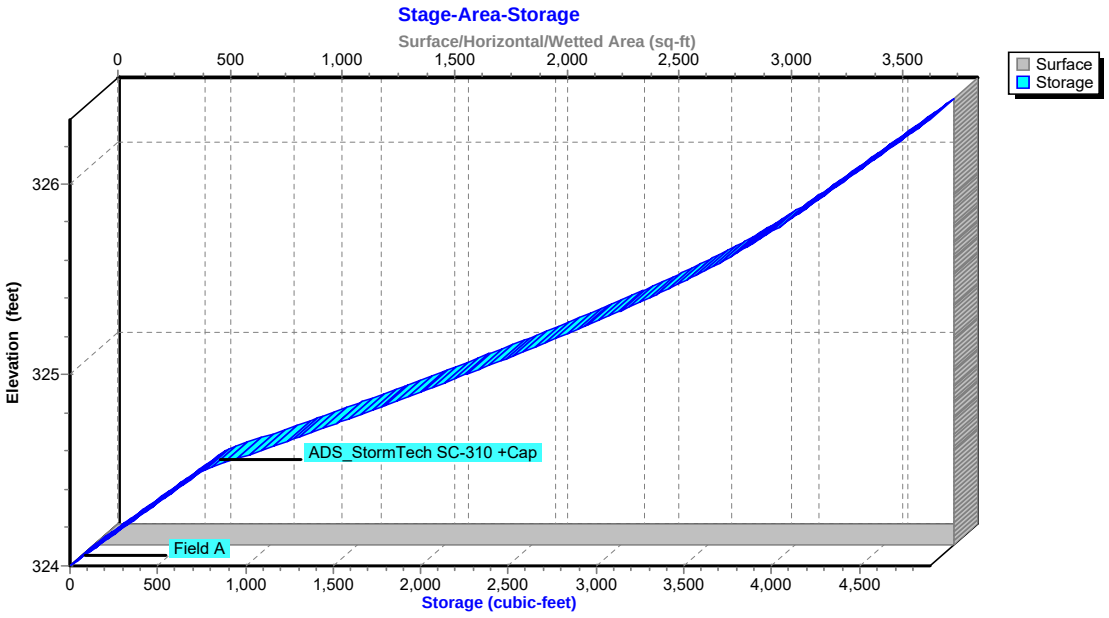
150 Chambers
331.1 cy Field
249.2 cy Stone



Pond SSI-1: Subsurface Infiltration Basin-1



Pond SSI-1: Subsurface Infiltration Basin-1



Stage-Area-Storage for Pond SSI-1: Subsurface Infiltration Basin-1

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
324.00	**3,832**	0	325.85	3,832	4,162
324.05	3,832	77	325.90	3,832	4,239
324.10	3,832	153	325.95	3,832	4,315
324.15	3,832	230	326.00	3,832	4,392
324.20	3,832	307	326.05	3,832	4,469
324.25	3,832	383	326.10	3,832	4,545
324.30	3,832	460	326.15	3,832	4,622
324.35	3,832	536	326.20	3,832	4,699
324.40	3,832	613	326.25	3,832	4,775
324.45	3,832	690	326.30	3,832	**4,852**
324.50	3,832	766			
324.55	3,832	920			
324.60	3,832	1,073			
324.65	3,832	1,225			
324.70	3,832	1,377			
324.75	3,832	1,527			
324.80	3,832	1,675			
324.85	3,832	1,822			
324.90	3,832	1,968			
324.95	3,832	2,111			
325.00	3,832	2,253			
325.05	3,832	2,392			
325.10	3,832	2,530			
325.15	3,832	2,666			
325.20	3,832	2,799			
325.25	3,832	2,929			
325.30	3,832	3,057			
325.35	3,832	3,181			
325.40	3,832	3,302			
325.45	3,832	3,420			
325.50	3,832	3,532			
325.55	3,832	3,639			
325.60	3,832	3,739			
325.65	3,832	3,832			
325.70	3,832	3,920			
325.75	3,832	4,004			
325.80	3,832	4,085			

HydroCAD Analysis

Proposed Conditions - 10 Year Storm

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Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
60,813	74	>75% Grass cover, Good, HSG C (P-1, P-1c, P-2, P-2a, P1-b)
119,908	98	Paved parking, HSG C (P-1, P-1a, P-1c, P-2, P-2a, P1-b)
1,327	66	Rip Rap Swale, HSG C (P-2a)
32,987	98	Roofs (P-1c)
164,224	70	Woods, Good, HSG C (P-1, P-1c, P-2, P-2a)
379,259	**82**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
0	HSG B	
346,272	HSG C	P-1, P-1a, P-1c, P-2, P-2a, P1-b
0	HSG D	
32,987	Other	P-1c
379,259		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Subcatchment Numbers
0	0	60,813	0	0	60,813	>75% Grass cover, Good	P-1, P-1c, P-2, P-2a, P1-b
0	0	119,908	0	0	119,908	Paved parking	P-1, P-1a, P-1c, P-2, P-2a, P1-b
0	0	1,327	0	0	1,327	Rip Rap Swale	P-2a
0	0	0	0	32,987	32,987	Roofs	P-1c
0	0	164,224	0	0	164,224	Woods, Good	P-1, P-1c, P-2, P-2a
0	**0**	**346,272**	**0**	**32,987**	**379,259**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	IB-1	321.00	320.56	44.0	0.0100	0.013	24.0	0.0	0.0
2	SSI-1	323.25	323.00	23.0	0.0109	0.013	12.0	0.0	0.0

Time span=0.00-80.00 hrs, dt=0.05 hrs, 1601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P-1: Flow to Southwest Runoff Area=38,355 sf 6.04% Impervious Runoff Depth=2.40"
Flow Length=461' Tc=13.4 min CN=73 Runoff=1.92 cfs 7,667 cf

Subcatchment P-1a: Flow to SSI-1 Runoff Area=24,473 sf 100.00% Impervious Runoff Depth=4.91"
Flow Length=553' Tc=12.0 min CN=98 Runoff=2.33 cfs 10,020 cf

Subcatchment P-1c: Flow to Existing Basin Runoff Area=172,610 sf 34.99% Impervious Runoff Depth=3.12"
Tc=15.0 min CN=81 Runoff=10.91 cfs 44,853 cf

Subcatchment P-2: Flow onsite Southeast Runoff Area=38,577 sf 16.99% Impervious Runoff Depth=2.57"
Tc=6.0 min CN=75 Runoff=2.61 cfs 8,267 cf

Subcatchment P-2a: FIlow to Swale Runoff Area=63,177 sf 27.53% Impervious Runoff Depth=2.84"
Flow Length=140' Tc=11.3 min CN=78 Runoff=4.02 cfs 14,949 cf

Subcatchment P1-b: Flow to IB-1 Runoff Area=42,067 sf 99.29% Impervious Runoff Depth=4.91"
Tc=6.0 min CN=98 Runoff=4.75 cfs 17,223 cf

Reach DP-1: Existing DMH Inflow=15.12 cfs 73,427 cf
Outflow=15.12 cfs 73,427 cf

Reach DP-2: Onsite southeast Inflow=6.23 cfs 23,216 cf
Outflow=6.23 cfs 23,216 cf

Pond IB-1: Modified Infiltration Basin Peak Elev=325.06' Storage=6,819 cf Inflow=14.82 cfs 68,116 cf
Discarded=0.02 cfs 2,352 cf Primary=13.41 cfs 65,761 cf Outflow=13.43 cfs 68,113 cf

Pond SSI-1: Subsurface Infiltration Basin-1 Peak Elev=325.73' Storage=3,979 cf Inflow=2.33 cfs 10,020 cf
Discarded=0.03 cfs 3,979 cf Primary=1.32 cfs 6,040 cf Outflow=1.34 cfs 10,020 cf

Total Runoff Area = 379,259 sf Runoff Volume = 102,978 cf Average Runoff Depth = 3.26"
59.69% Pervious = 226,364 sf 40.31% Impervious = 152,895 sf

Summary for Subcatchment P-1: Flow to Southwest

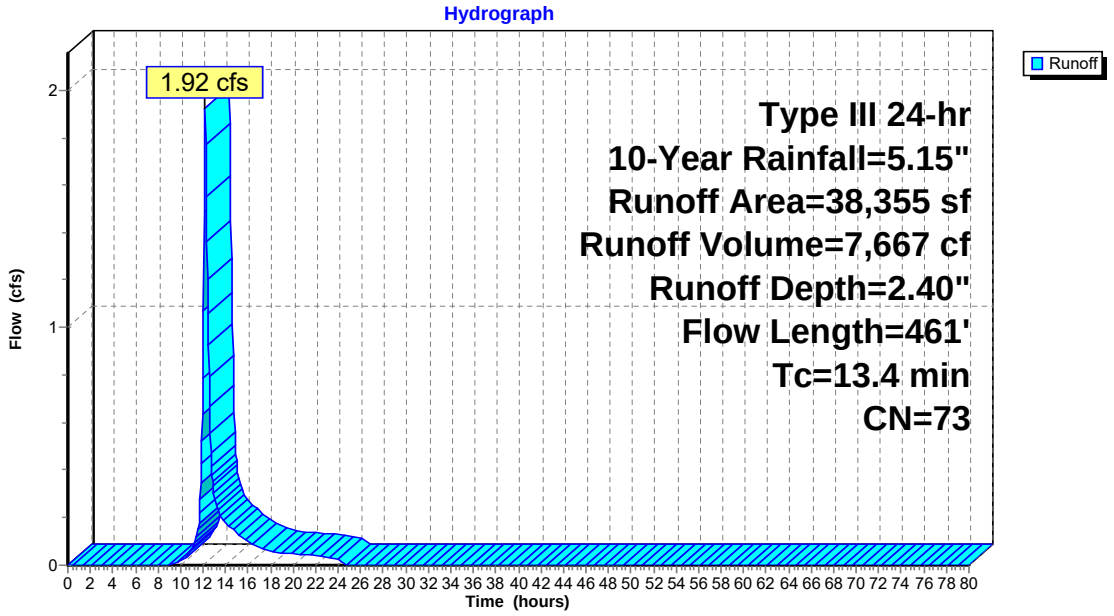
Runoff = 1.92 cfs @ 12.19 hrs, Volume= 7,667 cf, Depth= 2.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=5.15"

Area (sf)	CN	Description
2,315	98	Paved parking, HSG C
26,195	70	Woods, Good, HSG C
9,845	74	>75% Grass cover, Good, HSG C
38,355	73	Weighted Average
36,040		93.96% Pervious Area
2,315		6.04% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.7	50	0.0300	0.08		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.05"
2.7	411	0.0240	2.49		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
13.4	461	Total			

Subcatchment P-1: Flow to Southwest



Summary for Subcatchment P-1a: Flow to SSI-1

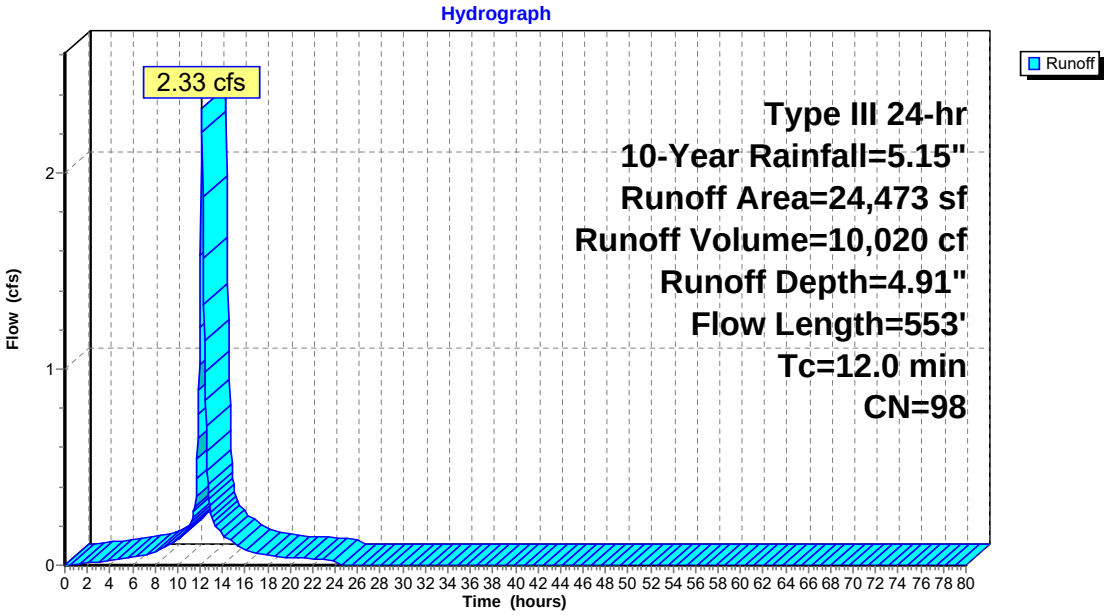
Runoff = 2.33 cfs @ 12.16 hrs, Volume= 10,020 cf, Depth= 4.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=5.15"

Area (sf)	CN	Description
24,473	98	Paved parking, HSG C
24,473		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.6	50	0.0530	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.05"
3.4	503	0.0240	2.49		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
12.0	553	Total			

Subcatchment P-1a: Flow to SSI-1



Summary for Subcatchment P-1c: Flow to Existing Basin

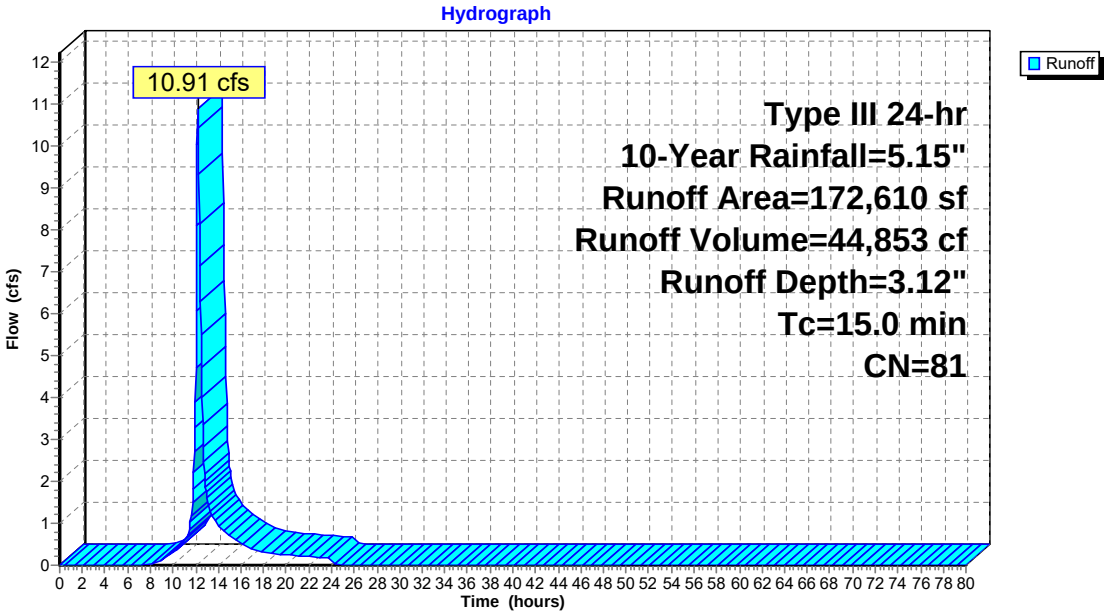
Runoff = 10.91 cfs @ 12.21 hrs, Volume= 44,853 cf, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=5.15"

	Area (sf)	CN	Description
*	32,987	98	Roofs
	27,404	98	Paved parking, HSG C
	71,146	70	Woods, Good, HSG C
	41,073	74	>75% Grass cover, Good, HSG C
	172,610	81	Weighted Average
	112,219		65.01% Pervious Area
	60,391		34.99% Impervious Area

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

Subcatchment P-1c: Flow to Existing Basin



Summary for Subcatchment P-2: Flow onsite Southeast

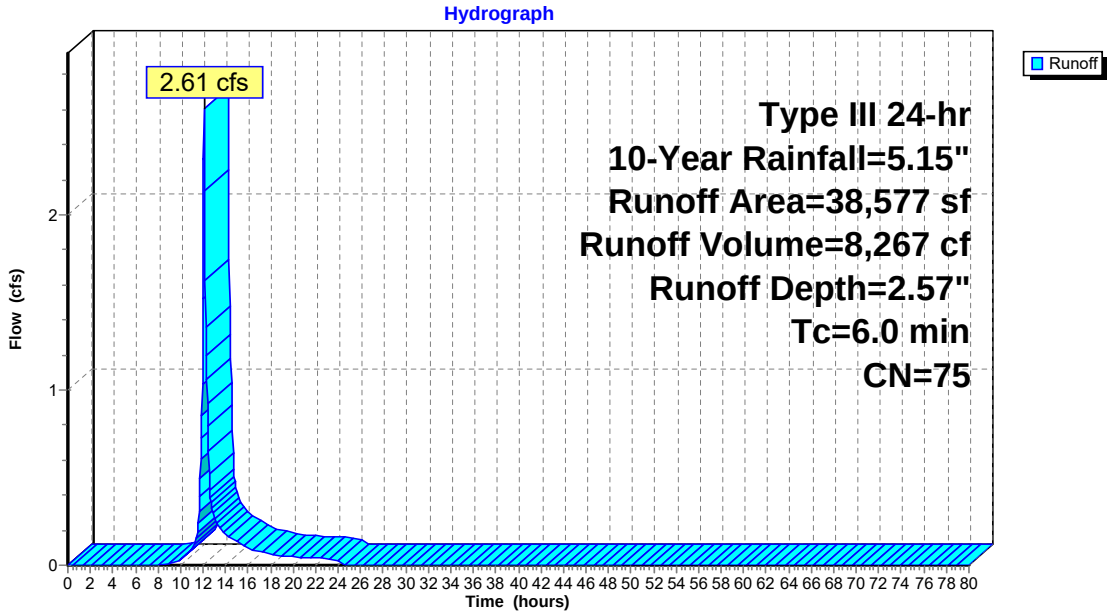
Runoff = 2.61 cfs @ 12.09 hrs, Volume= 8,267 cf, Depth= 2.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=5.15"

Area (sf)	CN	Description
6,554	98	Paved parking, HSG C
31,258	70	Woods, Good, HSG C
765	74	>75% Grass cover, Good, HSG C
38,577	75	Weighted Average
32,023		83.01% Pervious Area
6,554		16.99% Impervious Area

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

Subcatchment P-2: Flow onsite Southeast



Summary for Subcatchment P-2a: Fllow to Swale

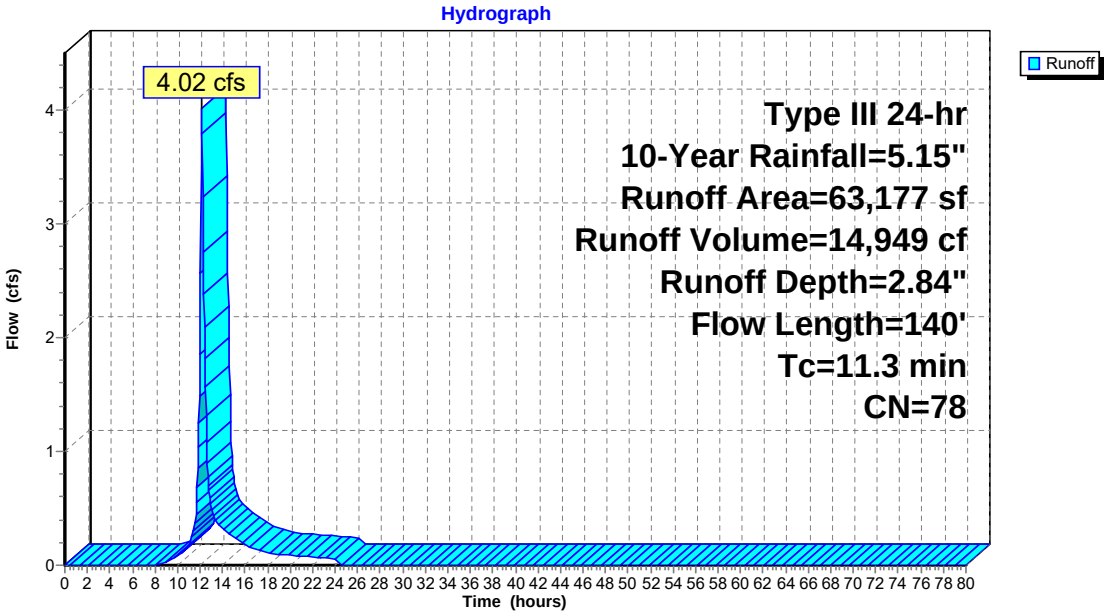
Runoff = 4.02 cfs @ 12.16 hrs, Volume= 14,949 cf, Depth= 2.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=5.15"

	Area (sf)	CN	Description
	17,392	98	Paved parking, HSG C
*	1,327	66	Rip Rap Swale, HSG C
	35,625	70	Woods, Good, HSG C
	8,833	74	>75% Grass cover, Good, HSG C
	63,177	78	Weighted Average
	45,785		72.47% Pervious Area
	17,392		27.53% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.0	50	0.0280	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.05"
0.1	45	0.1750	6.74		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.0	11	0.1640	6.52		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.2	34	0.0240	3.14		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
11.3	140	Total			

Subcatchment P-2a: Fllow to Swale



Summary for Subcatchment P1-b: Flow to IB-1

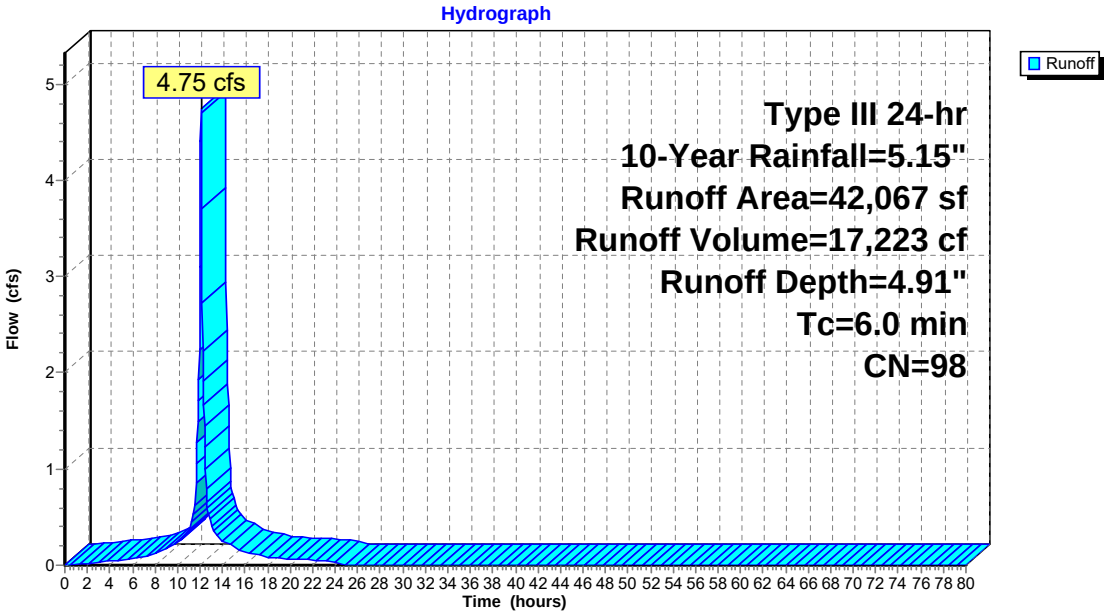
Runoff = 4.75 cfs @ 12.09 hrs, Volume= 17,223 cf, Depth= 4.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=5.15"

Area (sf)	CN	Description
41,770	98	Paved parking, HSG C
297	74	>75% Grass cover, Good, HSG C
42,067	98	Weighted Average
297		0.71% Pervious Area
41,770		99.29% Impervious Area

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

Subcatchment P1-b: Flow to IB-1



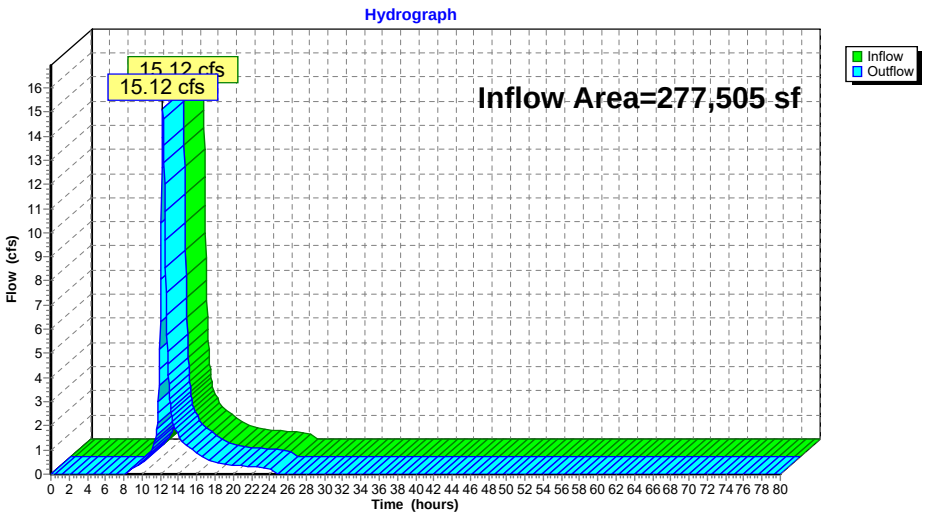
Summary for Reach DP-1: Existing DMH

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 277,505 sf, 46.47% Impervious, Inflow Depth = 3.18" for 10-Year event
Inflow = 15.12 cfs @ 12.26 hrs, Volume= 73,427 cf
Outflow = 15.12 cfs @ 12.26 hrs, Volume= 73,427 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs

Reach DP-1: Existing DMH



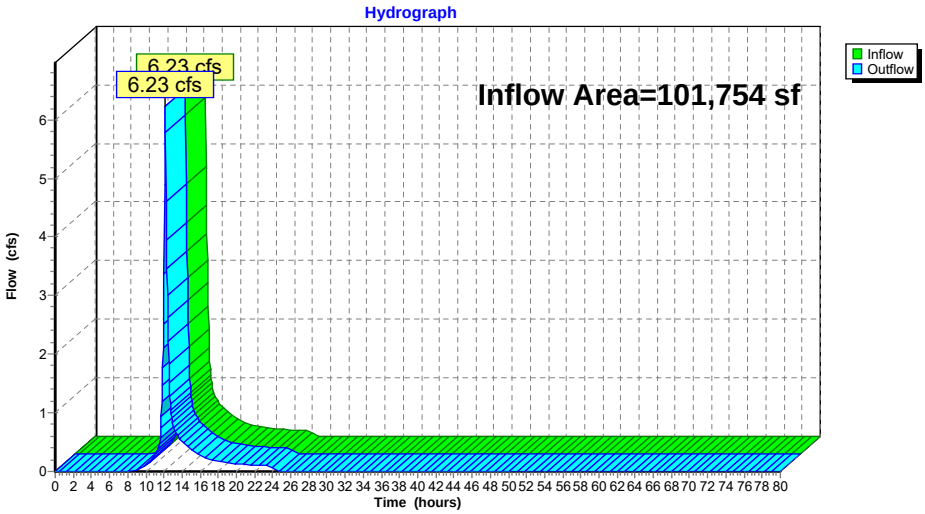
Summary for Reach DP-2: Onsite southeast

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 101,754 sf, 23.53% Impervious, Inflow Depth = 2.74" for 10-Year event
Inflow = 6.23 cfs @ 12.13 hrs, Volume= 23,216 cf
Outflow = 6.23 cfs @ 12.13 hrs, Volume= 23,216 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs

Reach DP-2: Onsite southeast



Summary for Pond IB-1: Modified Infiltration Basin

[79] Warning: Submerged Pond SSI-1 Primary device # 1 INLET by 1.80'

Inflow Area = 239,150 sf, 52.95% Impervious, Inflow Depth = 3.42" for 10-Year event
Inflow = 14.82 cfs @ 12.18 hrs, Volume= 68,116 cf
Outflow = 13.43 cfs @ 12.27 hrs, Volume= 68,113 cf, Atten= 9%, Lag= 5.5 min
Discarded = 0.02 cfs @ 12.27 hrs, Volume= 2,352 cf
Primary = 13.41 cfs @ 12.27 hrs, Volume= 65,761 cf

Routing by Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 325.06' @ 12.27 hrs Surf.Area= 4,316 sf Storage= 6,819 cf

Plug-Flow detention time= 50.7 min calculated for 68,113 cf (100% of inflow)
Center-of-Mass det. time= 50.3 min (856.6 - 806.3)

Volume	Invert	Avail.Storage	Storage Description
#1	323.00'	11,339 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

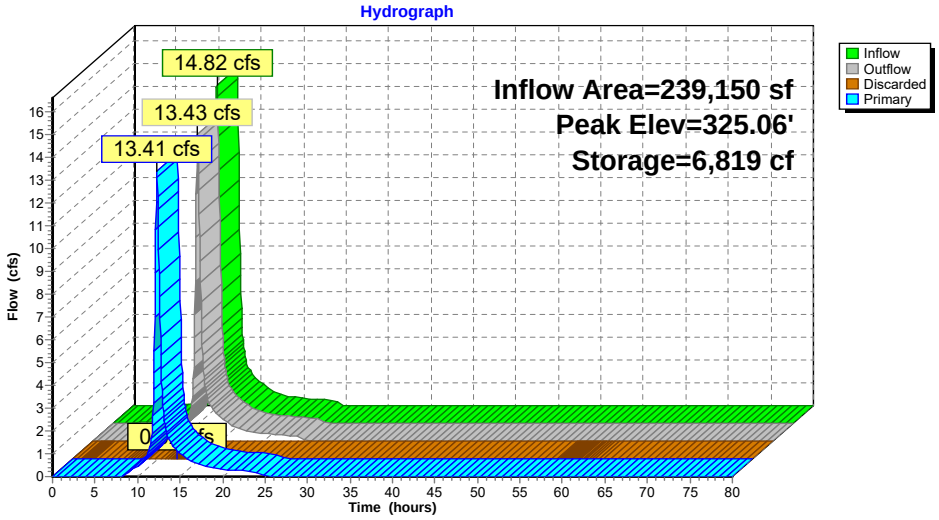
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
323.00	2,360	290.0	0	0	2,360
324.00	3,286	315.0	2,810	2,810	3,601
325.00	4,260	334.0	3,762	6,573	4,635
326.00	5,291	353.0	4,766	11,339	5,729

Device	Routing	Invert	Outlet Devices
#1	Discarded	323.00'	**0.170 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 318.00'
#2	Primary	321.00'	**24.0" Round Culvert** L= 44.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 321.00' / 320.56' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf
#3	Device 2	325.00'	**60.0" x 60.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 2	324.00'	**20.0" W x 10.0" H Vert. Orifice** C= 0.600
#5	Device 2	323.50'	**32.0" W x 6.0" H Vert. Orifice** C= 0.600

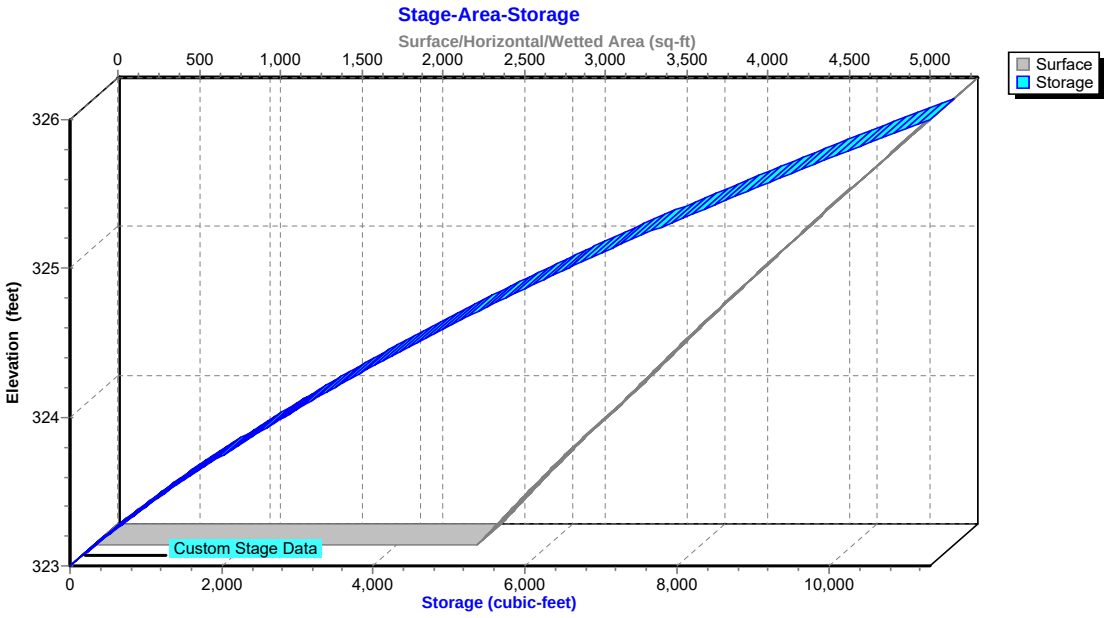
Discarded OutFlow Max=0.02 cfs @ 12.27 hrs HW=325.05' (Free Discharge)
└**1=Exfiltration** (Controls 0.02 cfs)

Primary OutFlow Max=13.21 cfs @ 12.27 hrs HW=325.05' (Free Discharge)
└**2=Culvert** (Passes 13.21 cfs of 26.41 cfs potential flow)
  ├**3=Grate** (Weir Controls 0.70 cfs @ 0.72 fps)
  ├**4=Orifice** (Orifice Controls 5.21 cfs @ 3.75 fps)
  └**5=Orifice** (Orifice Controls 7.30 cfs @ 5.48 fps)

Pond IB-1: Modified Infiltration Basin



Pond IB-1: Modified Infiltration Basin



Stage-Area-Storage for Pond IB-1: Modified Infiltration Basin

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
323.00	2,360	0	324.85	4,106	5,945
323.05	2,403	119	324.90	4,157	6,152
323.10	2,446	240	324.95	4,208	6,361
323.15	2,489	364	325.00	4,260	6,573
323.20	2,533	489	325.05	4,309	6,787
323.25	2,577	617	325.10	4,358	7,004
323.30	2,622	747	325.15	4,408	7,223
323.35	2,667	879	325.20	4,457	7,444
323.40	2,712	1,014	325.25	4,507	7,669
323.45	2,758	1,150	325.30	4,558	7,895
323.50	2,804	1,289	325.35	4,608	8,124
323.55	2,850	1,431	325.40	4,659	8,356
323.60	2,897	1,574	325.45	4,710	8,590
323.65	2,945	1,720	325.50	4,762	8,827
323.70	2,992	1,869	325.55	4,813	9,066
323.75	3,040	2,020	325.60	4,865	9,308
323.80	3,089	2,173	325.65	4,917	9,553
323.85	3,137	2,329	325.70	4,970	9,800
323.90	3,187	2,487	325.75	5,023	10,050
323.95	3,236	2,647	325.80	5,076	10,302
324.00	3,286	2,810	325.85	5,129	10,557
324.05	3,332	2,976	325.90	5,183	10,815
324.10	3,378	3,143	325.95	5,237	11,076
324.15	3,424	3,313	326.00	**5,291**	**11,339**
324.20	3,471	3,486			
324.25	3,518	3,661			
324.30	3,565	3,838			
324.35	3,613	4,017			
324.40	3,660	4,199			
324.45	3,709	4,383			
324.50	3,757	4,570			
324.55	3,806	4,759			
324.60	3,855	4,950			
324.65	3,905	5,144			
324.70	3,955	5,341			
324.75	4,005	5,540			
324.80	4,055	5,741			

Summary for Pond SSI-1: Subsurface Infiltration Basin-1

Inflow Area = 24,473 sf,100.00% Impervious, Inflow Depth = 4.91" for 10-Year event
Inflow = 2.33 cfs @ 12.16 hrs, Volume= 10,020 cf
Outflow = 1.34 cfs @ 12.35 hrs, Volume= 10,020 cf, Atten= 42%, Lag= 11.5 min
Discarded = 0.03 cfs @ 12.35 hrs, Volume= 3,979 cf
Primary = 1.32 cfs @ 12.35 hrs, Volume= 6,040 cf

Routing by Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs / 6
Peak Elev= 325.73' @ 12.35 hrs Surf.Area= 3,832 sf Storage= 3,979 cf

Plug-Flow detention time= 440.1 min calculated for 10,013 cf (100% of inflow)
Center-of-Mass det. time= 441.1 min (1,194.2 - 753.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	324.00'	2,692 cf	**34.83'W x 110.00'L x 2.33'H Field A** 8,941 cf Overall - 2,211 cf Embedded = 6,729 cf x 40.0% Voids
#2A	324.50'	2,211 cf	**ADS_StormTech SC-310 +Cap** x 150 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap 150 Chambers in 10 Rows
		4,903 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	323.25'	**12.0" Round Culvert** L= 23.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 323.25' / 323.00' S= 0.0109 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	325.83'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#3	Device 1	325.00'	**6.0" Vert. Orifice/Grate X 2.00** C= 0.600
#4	Discarded	324.00'	**0.170 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 322.00'

Discarded OutFlow Max=0.03 cfs @ 12.35 hrs HW=325.73' (Free Discharge)
└**4=Exfiltration** (Controls 0.03 cfs)

Primary OutFlow Max=1.32 cfs @ 12.35 hrs HW=325.73' (Free Discharge)
└**1=Culvert** (Passes 1.32 cfs of 5.33 cfs potential flow)
  └**2=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)
  └**3=Orifice/Grate** (Orifice Controls 1.32 cfs @ 3.35 fps)

Pond SSI-1: Subsurface Infiltration Basin-1 - Chamber Wizard Field A

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

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

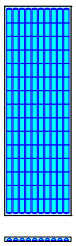
15 Chambers/Row x 7.12' Long +0.60' Cap Length x 2 = 108.00' Row Length +12.0" End Stone x 2 = 110.00' Base Length
10 Rows x 34.0" Wide + 6.0" Spacing x 9 + 12.0" Side Stone x 2 = 34.83' Base Width
6.0" Base + 16.0" Chamber Height + 6.0" Cover = 2.33' Field Height

150 Chambers x 14.7 cf = 2,211.3 cf Chamber Storage

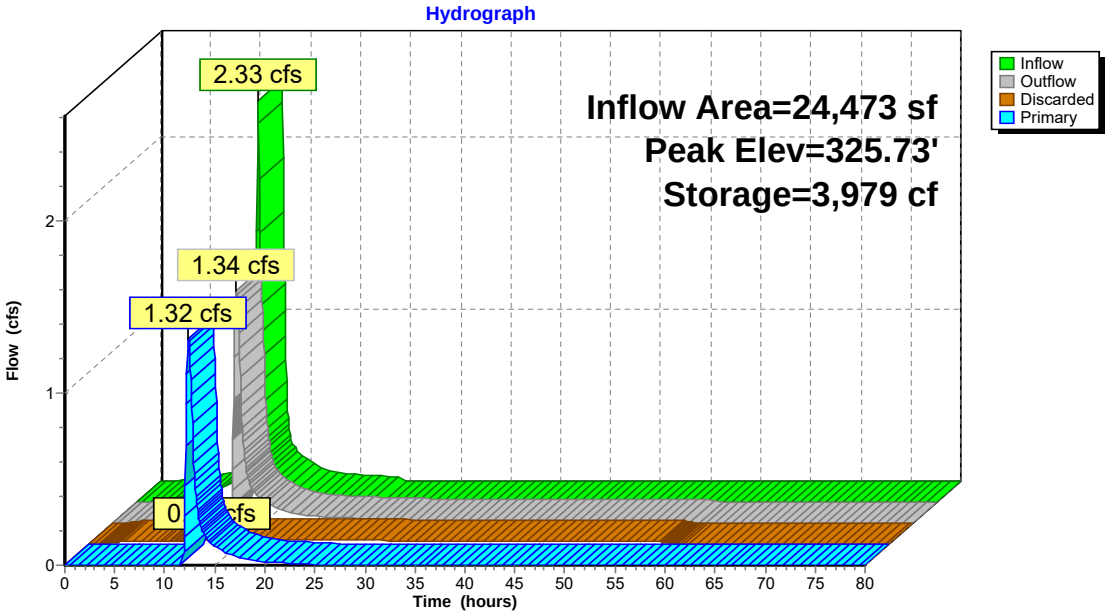
8,940.6 cf Field - 2,211.3 cf Chambers = 6,729.3 cf Stone x 40.0% Voids = 2,691.7 cf Stone Storage

Chamber Storage + Stone Storage = 4,903.0 cf = 0.113 af
Overall Storage Efficiency = 54.8%
Overall System Size = 110.00' x 34.83' x 2.33'

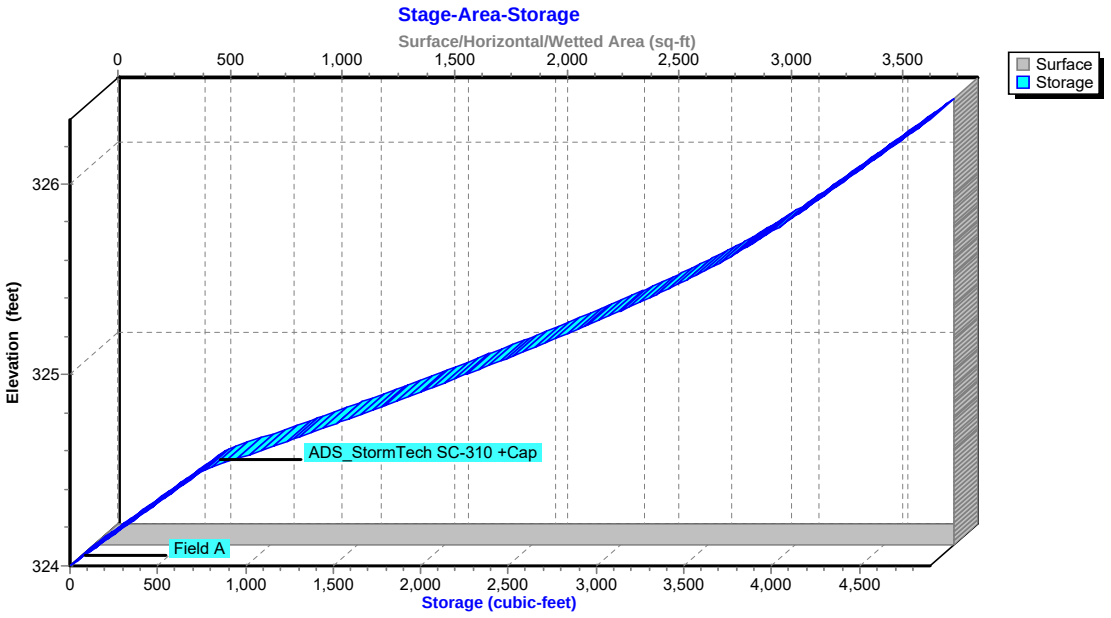
150 Chambers
331.1 cy Field
249.2 cy Stone



Pond SSI-1: Subsurface Infiltration Basin-1



Pond SSI-1: Subsurface Infiltration Basin-1



Stage-Area-Storage for Pond SSI-1: Subsurface Infiltration Basin-1

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
324.00	**3,832**	0	325.85	3,832	4,162
324.05	3,832	77	325.90	3,832	4,239
324.10	3,832	153	325.95	3,832	4,315
324.15	3,832	230	326.00	3,832	4,392
324.20	3,832	307	326.05	3,832	4,469
324.25	3,832	383	326.10	3,832	4,545
324.30	3,832	460	326.15	3,832	4,622
324.35	3,832	536	326.20	3,832	4,699
324.40	3,832	613	326.25	3,832	4,775
324.45	3,832	690	326.30	3,832	**4,852**
324.50	3,832	766			
324.55	3,832	920			
324.60	3,832	1,073			
324.65	3,832	1,225			
324.70	3,832	1,377			
324.75	3,832	1,527			
324.80	3,832	1,675			
324.85	3,832	1,822			
324.90	3,832	1,968			
324.95	3,832	2,111			
325.00	3,832	2,253			
325.05	3,832	2,392			
325.10	3,832	2,530			
325.15	3,832	2,666			
325.20	3,832	2,799			
325.25	3,832	2,929			
325.30	3,832	3,057			
325.35	3,832	3,181			
325.40	3,832	3,302			
325.45	3,832	3,420			
325.50	3,832	3,532			
325.55	3,832	3,639			
325.60	3,832	3,739			
325.65	3,832	3,832			
325.70	3,832	3,920			
325.75	3,832	4,004			
325.80	3,832	4,085			

HydroCAD Analysis

Proposed Conditions - 25 Year Storm

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Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
60,813	74	>75% Grass cover, Good, HSG C (P-1, P-1c, P-2, P-2a, P1-b)
119,908	98	Paved parking, HSG C (P-1, P-1a, P-1c, P-2, P-2a, P1-b)
1,327	66	Rip Rap Swale, HSG C (P-2a)
32,987	98	Roofs (P-1c)
164,224	70	Woods, Good, HSG C (P-1, P-1c, P-2, P-2a)
379,259	**82**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
0	HSG B	
346,272	HSG C	P-1, P-1a, P-1c, P-2, P-2a, P1-b
0	HSG D	
32,987	Other	P-1c
379,259		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Subcatchment Numbers
0	0	60,813	0	0	60,813	>75% Grass cover, Good	P-1, P-1c, P-2, P-2a, P1-b
0	0	119,908	0	0	119,908	Paved parking	P-1, P-1a, P-1c, P-2, P-2a, P1-b
0	0	1,327	0	0	1,327	Rip Rap Swale	P-2a
0	0	0	0	32,987	32,987	Roofs	P-1c
0	0	164,224	0	0	164,224	Woods, Good	P-1, P-1c, P-2, P-2a
0	**0**	**346,272**	**0**	**32,987**	**379,259**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	IB-1	321.00	320.56	44.0	0.0100	0.013	24.0	0.0	0.0
2	SSI-1	323.25	323.00	23.0	0.0109	0.013	12.0	0.0	0.0

Time span=0.00-80.00 hrs, dt=0.05 hrs, 1601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P-1: Flow to Southwest Runoff Area=38,355 sf 6.04% Impervious Runoff Depth=3.38"
Flow Length=461' Tc=13.4 min CN=73 Runoff=2.73 cfs 10,807 cf

Subcatchment P-1a: Flow to SSI-1 Runoff Area=24,473 sf 100.00% Impervious Runoff Depth=6.11"
Flow Length=553' Tc=12.0 min CN=98 Runoff=2.88 cfs 12,464 cf

Subcatchment P-1c: Flow to Existing Basin Runoff Area=172,610 sf 34.99% Impervious Runoff Depth=4.20"
Tc=15.0 min CN=81 Runoff=14.63 cfs 60,471 cf

Subcatchment P-2: Flow onsite Southeast Runoff Area=38,577 sf 16.99% Impervious Runoff Depth=3.58"
Tc=6.0 min CN=75 Runoff=3.65 cfs 11,516 cf

Subcatchment P-2a: FIlow to Swale Runoff Area=63,177 sf 27.53% Impervious Runoff Depth=3.89"
Flow Length=140' Tc=11.3 min CN=78 Runoff=5.50 cfs 20,478 cf

Subcatchment P1-b: Flow to IB-1 Runoff Area=42,067 sf 99.29% Impervious Runoff Depth=6.11"
Tc=6.0 min CN=98 Runoff=5.87 cfs 21,424 cf

Reach DP-1: Existing DMH Inflow=22.09 cfs 98,712 cf
Outflow=22.09 cfs 98,712 cf

Reach DP-2: Onsite southeast Inflow=8.66 cfs 31,995 cf
Outflow=8.66 cfs 31,995 cf

Pond IB-1: Modified Infiltration Basin Peak Elev=325.20' Storage=7,446 cf Inflow=19.67 cfs 90,299 cf
Discarded=0.02 cfs 2,395 cf Primary=19.42 cfs 87,905 cf Outflow=19.45 cfs 90,300 cf

Pond SSI-1: Subsurface Infiltration Basin-1 Peak Elev=325.95' Storage=4,320 cf Inflow=2.88 cfs 12,464 cf
Discarded=0.03 cfs 4,062 cf Primary=2.14 cfs 8,403 cf Outflow=2.17 cfs 12,465 cf

Total Runoff Area = 379,259 sf Runoff Volume = 137,161 cf Average Runoff Depth = 4.34"
59.69% Pervious = 226,364 sf 40.31% Impervious = 152,895 sf

Summary for Subcatchment P-1: Flow to Southwest

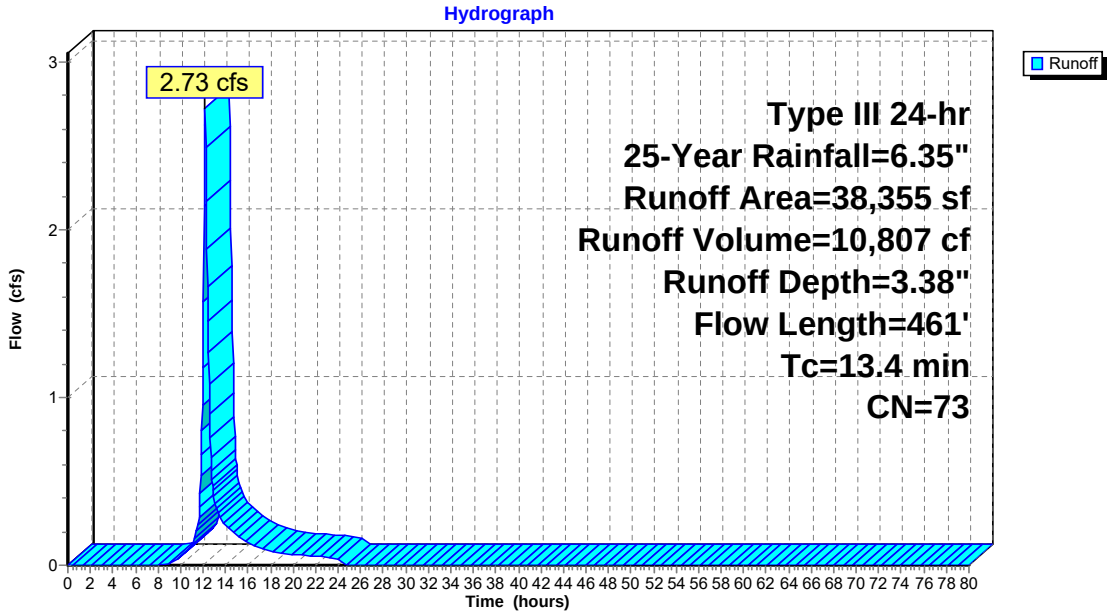
Runoff = 2.73 cfs @ 12.19 hrs, Volume= 10,807 cf, Depth= 3.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.35"

Area (sf)	CN	Description
2,315	98	Paved parking, HSG C
26,195	70	Woods, Good, HSG C
9,845	74	>75% Grass cover, Good, HSG C
38,355	73	Weighted Average
36,040		93.96% Pervious Area
2,315		6.04% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.7	50	0.0300	0.08		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.05"
2.7	411	0.0240	2.49		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
13.4	461	Total			

Subcatchment P-1: Flow to Southwest



Summary for Subcatchment P-1a: Flow to SSI-1

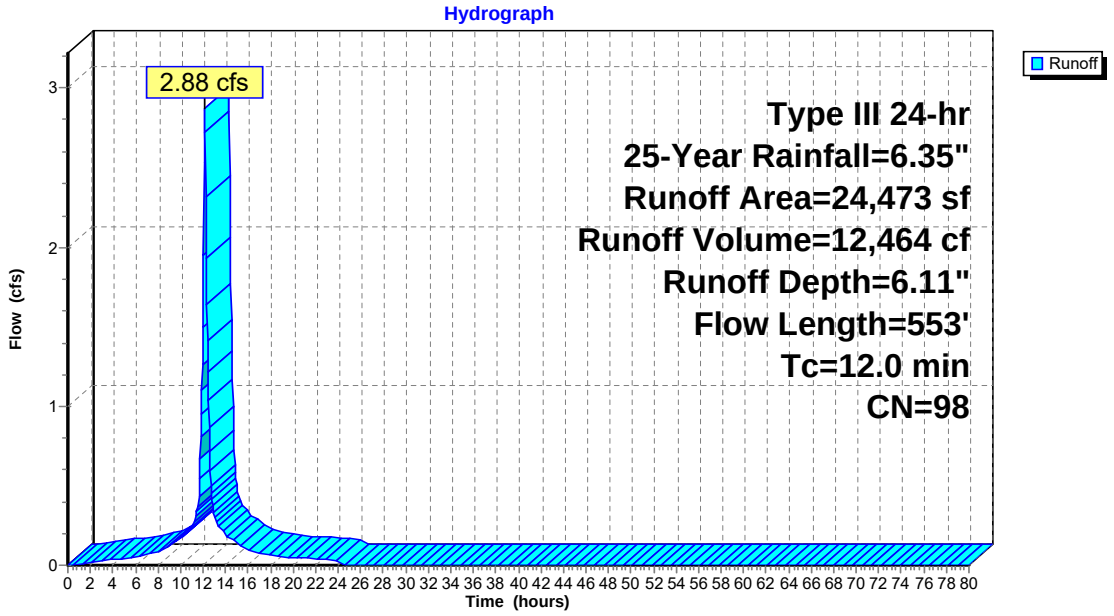
Runoff = 2.88 cfs @ 12.16 hrs, Volume= 12,464 cf, Depth= 6.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.35"

Area (sf)	CN	Description
24,473	98	Paved parking, HSG C
24,473		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.6	50	0.0530	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.05"
3.4	503	0.0240	2.49		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
12.0	553	Total			

Subcatchment P-1a: Flow to SSI-1



Summary for Subcatchment P-1c: Flow to Existing Basin

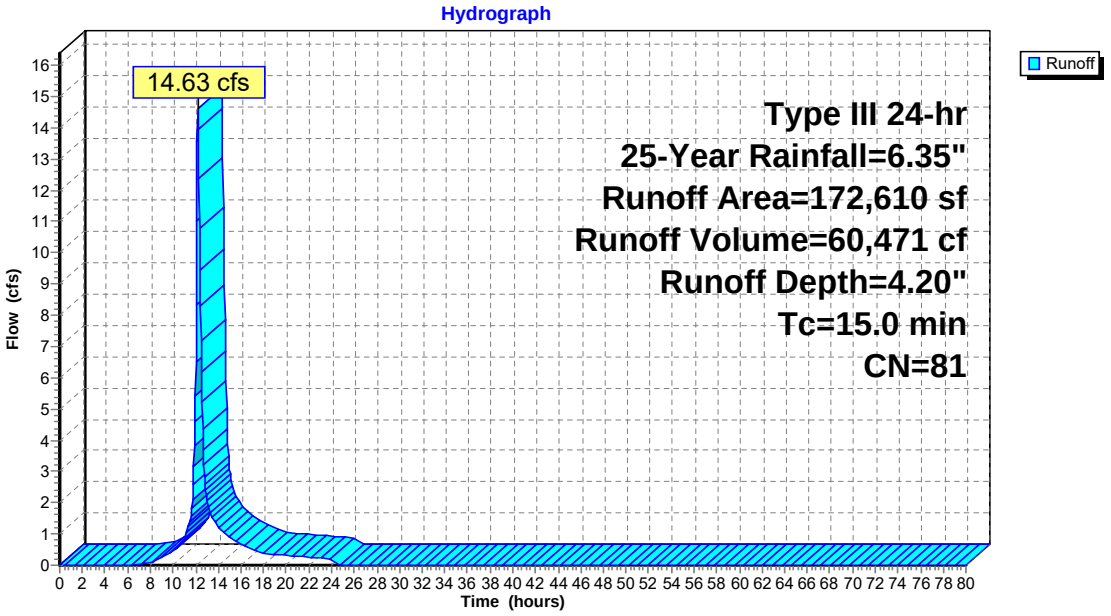
Runoff = 14.63 cfs @ 12.21 hrs, Volume= 60,471 cf, Depth= 4.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.35"

	Area (sf)	CN	Description
*	32,987	98	Roofs
	27,404	98	Paved parking, HSG C
	71,146	70	Woods, Good, HSG C
	41,073	74	>75% Grass cover, Good, HSG C
	172,610	81	Weighted Average
	112,219		65.01% Pervious Area
	60,391		34.99% Impervious Area

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

Subcatchment P-1c: Flow to Existing Basin



Summary for Subcatchment P-2: Flow onsite Southeast

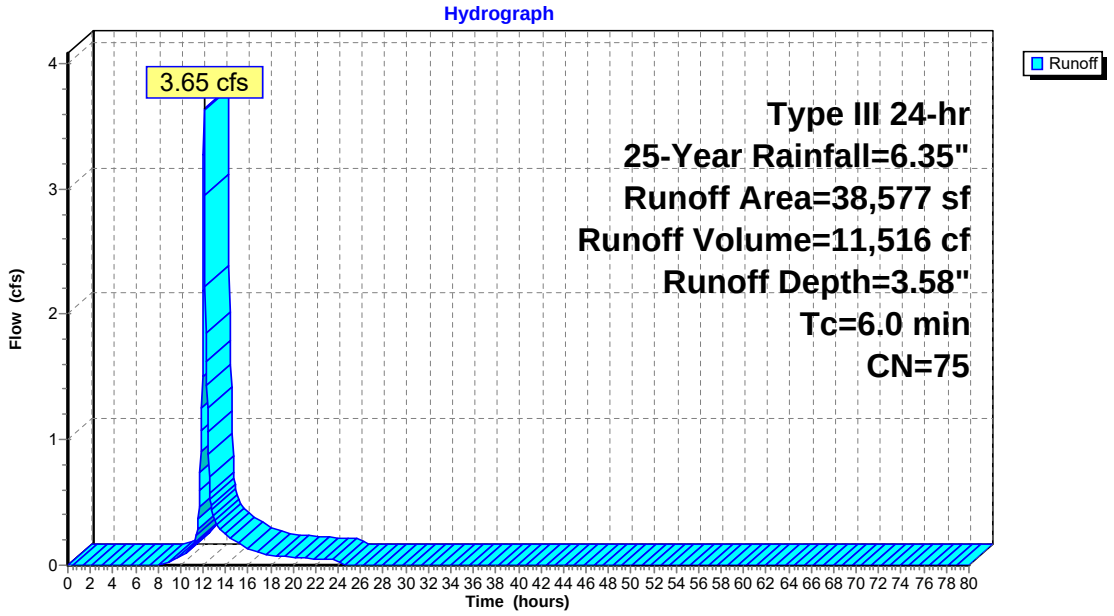
Runoff = 3.65 cfs @ 12.09 hrs, Volume= 11,516 cf, Depth= 3.58"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.35"

Area (sf)	CN	Description
6,554	98	Paved parking, HSG C
31,258	70	Woods, Good, HSG C
765	74	>75% Grass cover, Good, HSG C
38,577	75	Weighted Average
32,023		83.01% Pervious Area
6,554		16.99% Impervious Area

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

Subcatchment P-2: Flow onsite Southeast



Summary for Subcatchment P-2a: Fllow to Swale

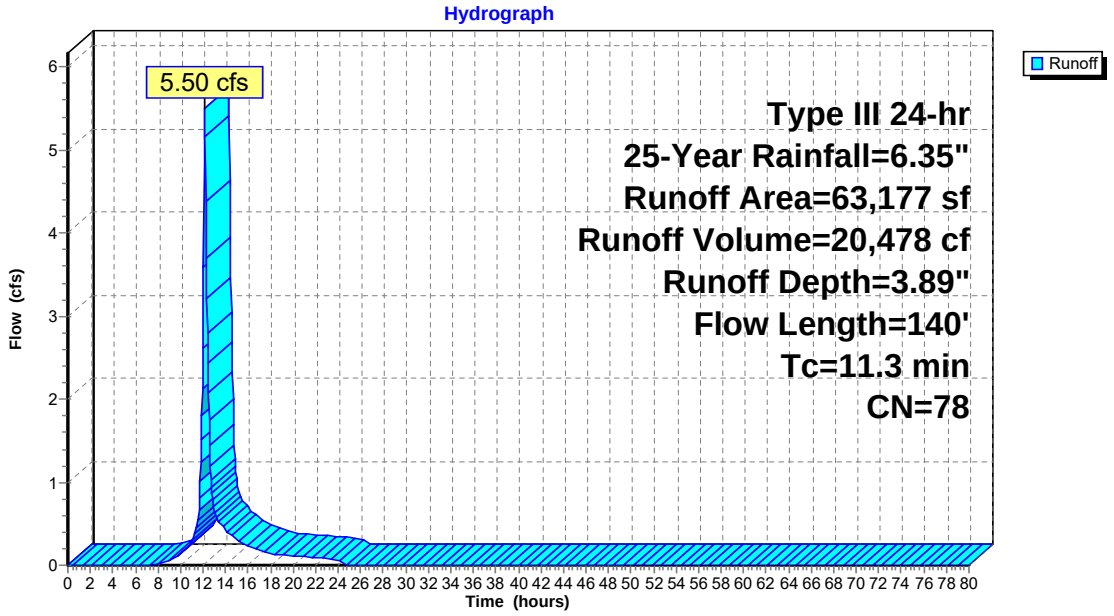
Runoff = 5.50 cfs @ 12.16 hrs, Volume= 20,478 cf, Depth= 3.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.35"

	Area (sf)	CN	Description
	17,392	98	Paved parking, HSG C
*	1,327	66	Rip Rap Swale, HSG C
	35,625	70	Woods, Good, HSG C
	8,833	74	>75% Grass cover, Good, HSG C
	63,177	78	Weighted Average
	45,785		72.47% Pervious Area
	17,392		27.53% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.0	50	0.0280	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.05"
0.1	45	0.1750	6.74		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.0	11	0.1640	6.52		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.2	34	0.0240	3.14		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
11.3	140	Total			

Subcatchment P-2a: Fllow to Swale



Summary for Subcatchment P1-b: Flow to IB-1

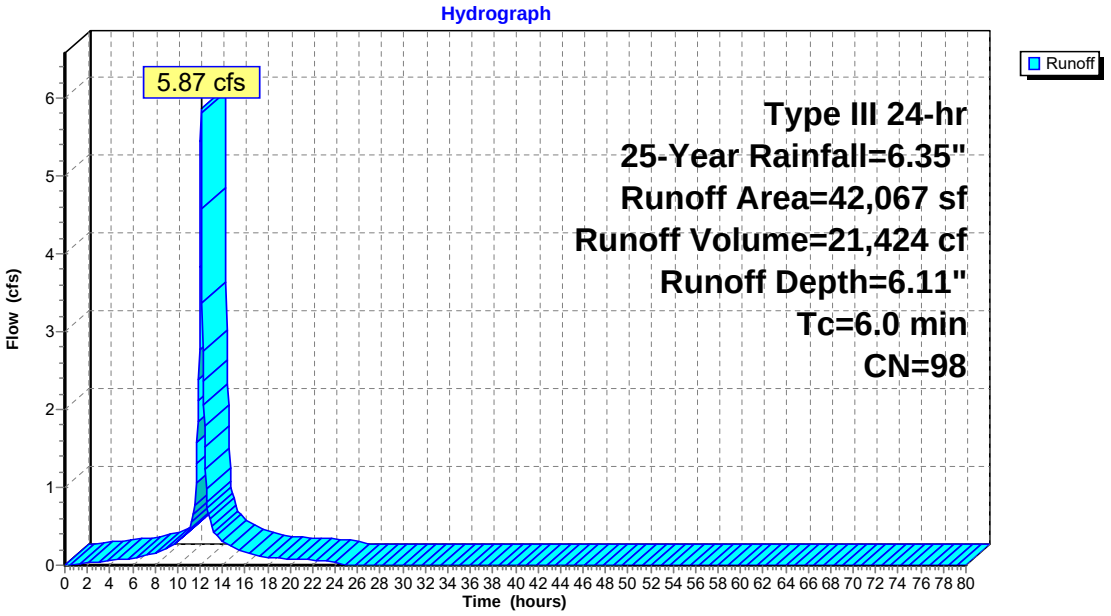
Runoff = 5.87 cfs @ 12.09 hrs, Volume= 21,424 cf, Depth= 6.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.35"

Area (sf)	CN	Description
41,770	98	Paved parking, HSG C
297	74	>75% Grass cover, Good, HSG C
42,067	98	Weighted Average
297		0.71% Pervious Area
41,770		99.29% Impervious Area

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

Subcatchment P1-b: Flow to IB-1



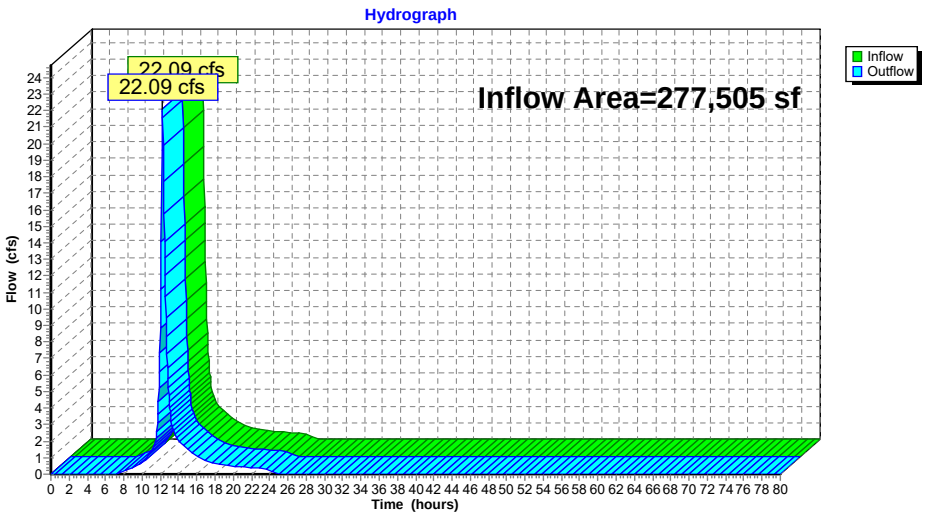
Summary for Reach DP-1: Existing DMH

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 277,505 sf, 46.47% Impervious, Inflow Depth = 4.27" for 25-Year event
Inflow = 22.09 cfs @ 12.22 hrs, Volume= 98,712 cf
Outflow = 22.09 cfs @ 12.22 hrs, Volume= 98,712 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs

Reach DP-1: Existing DMH



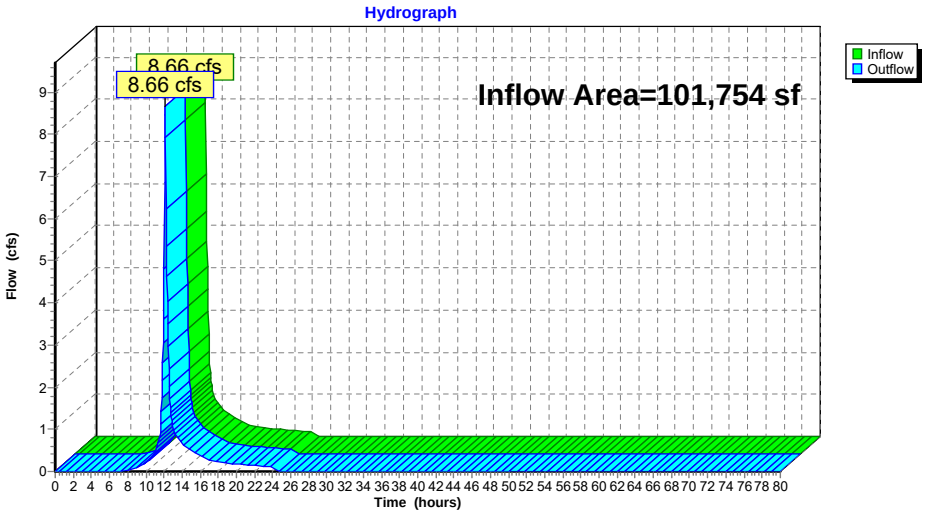
Summary for Reach DP-2: Onsite southeast

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 101,754 sf, 23.53% Impervious, Inflow Depth = 3.77" for 25-Year event
Inflow = 8.66 cfs @ 12.12 hrs, Volume= 31,995 cf
Outflow = 8.66 cfs @ 12.12 hrs, Volume= 31,995 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs

Reach DP-2: Onsite southeast



Summary for Pond IB-1: Modified Infiltration Basin

[79] Warning: Submerged Pond SSI-1 Primary device # 1 INLET by 1.95'

Inflow Area = 239,150 sf, 52.95% Impervious, Inflow Depth = 4.53" for 25-Year event
Inflow = 19.67 cfs @ 12.18 hrs, Volume= 90,299 cf
Outflow = 19.45 cfs @ 12.22 hrs, Volume= 90,300 cf, Atten= 1%, Lag= 2.3 min
Discarded = 0.02 cfs @ 12.22 hrs, Volume= 2,395 cf
Primary = 19.42 cfs @ 12.22 hrs, Volume= 87,905 cf

Routing by Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 325.20' @ 12.22 hrs Surf.Area= 4,458 sf Storage= 7,446 cf

Plug-Flow detention time= 39.2 min calculated for 90,243 cf (100% of inflow)
Center-of-Mass det. time= 40.5 min (841.1 - 800.6)

Volume	Invert	Avail.Storage	Storage Description
#1	323.00'	11,339 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

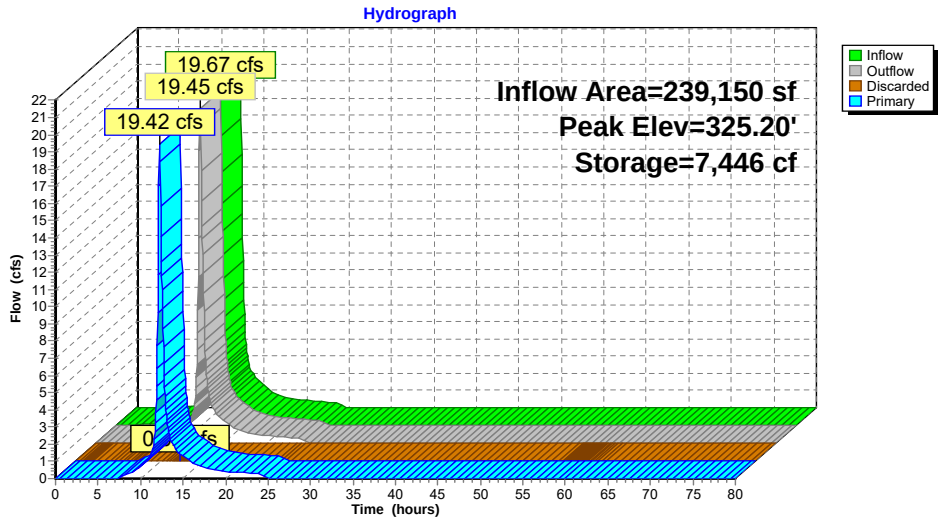
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
323.00	2,360	290.0	0	0	2,360
324.00	3,286	315.0	2,810	2,810	3,601
325.00	4,260	334.0	3,762	6,573	4,635
326.00	5,291	353.0	4,766	11,339	5,729

Device	Routing	Invert	Outlet Devices
#1	Discarded	323.00'	**0.170 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 318.00'
#2	Primary	321.00'	**24.0" Round Culvert** L= 44.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 321.00' / 320.56' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf
#3	Device 2	325.00'	**60.0" x 60.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 2	324.00'	**20.0" W x 10.0" H Vert. Orifice** C= 0.600
#5	Device 2	323.50'	**32.0" W x 6.0" H Vert. Orifice** C= 0.600

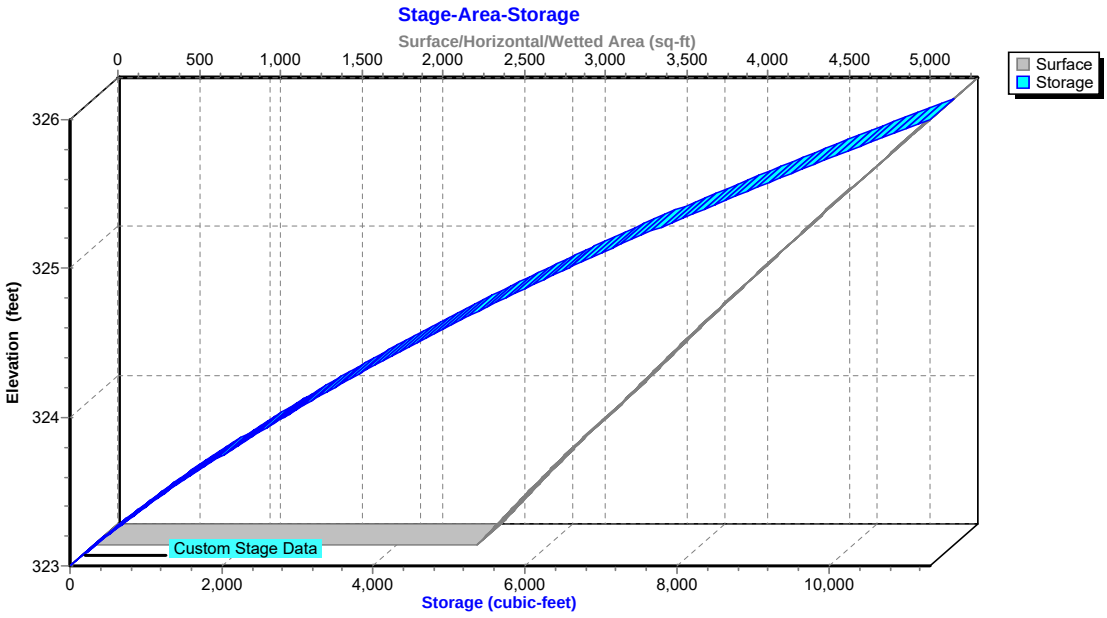
Discarded OutFlow Max=0.02 cfs @ 12.22 hrs HW=325.19' (Free Discharge)
└**1=Exfiltration** (Controls 0.02 cfs)

Primary OutFlow Max=19.13 cfs @ 12.22 hrs HW=325.19' (Free Discharge)
└**2=Culvert** (Passes 19.13 cfs of 27.04 cfs potential flow)
  ├**3=Grate** (Weir Controls 5.60 cfs @ 1.44 fps)
  ├**4=Orifice** (Orifice Controls 5.82 cfs @ 4.19 fps)
  └**5=Orifice** (Orifice Controls 7.71 cfs @ 5.78 fps)

Pond IB-1: Modified Infiltration Basin



Pond IB-1: Modified Infiltration Basin



Stage-Area-Storage for Pond IB-1: Modified Infiltration Basin

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
323.00	2,360	0	324.85	4,106	5,945
323.05	2,403	119	324.90	4,157	6,152
323.10	2,446	240	324.95	4,208	6,361
323.15	2,489	364	325.00	4,260	6,573
323.20	2,533	489	325.05	4,309	6,787
323.25	2,577	617	325.10	4,358	7,004
323.30	2,622	747	325.15	4,408	7,223
323.35	2,667	879	325.20	4,457	7,444
323.40	2,712	1,014	325.25	4,507	7,669
323.45	2,758	1,150	325.30	4,558	7,895
323.50	2,804	1,289	325.35	4,608	8,124
323.55	2,850	1,431	325.40	4,659	8,356
323.60	2,897	1,574	325.45	4,710	8,590
323.65	2,945	1,720	325.50	4,762	8,827
323.70	2,992	1,869	325.55	4,813	9,066
323.75	3,040	2,020	325.60	4,865	9,308
323.80	3,089	2,173	325.65	4,917	9,553
323.85	3,137	2,329	325.70	4,970	9,800
323.90	3,187	2,487	325.75	5,023	10,050
323.95	3,236	2,647	325.80	5,076	10,302
324.00	3,286	2,810	325.85	5,129	10,557
324.05	3,332	2,976	325.90	5,183	10,815
324.10	3,378	3,143	325.95	5,237	11,076
324.15	3,424	3,313	326.00	**5,291**	**11,339**
324.20	3,471	3,486			
324.25	3,518	3,661			
324.30	3,565	3,838			
324.35	3,613	4,017			
324.40	3,660	4,199			
324.45	3,709	4,383			
324.50	3,757	4,570			
324.55	3,806	4,759			
324.60	3,855	4,950			
324.65	3,905	5,144			
324.70	3,955	5,341			
324.75	4,005	5,540			
324.80	4,055	5,741			

Summary for Pond SSI-1: Subsurface Infiltration Basin-1

Inflow Area = 24,473 sf,100.00% Impervious, Inflow Depth = 6.11" for 25-Year event
Inflow = 2.88 cfs @ 12.16 hrs, Volume= 12,464 cf
Outflow = 2.17 cfs @ 12.27 hrs, Volume= 12,465 cf, Atten= 25%, Lag= 6.8 min
Discarded = 0.03 cfs @ 12.27 hrs, Volume= 4,062 cf
Primary = 2.14 cfs @ 12.27 hrs, Volume= 8,403 cf

Routing by Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs / 6
Peak Elev= 325.95' @ 12.27 hrs Surf.Area= 3,832 sf Storage= 4,320 cf

Plug-Flow detention time= 370.4 min calculated for 12,458 cf (100% of inflow)
Center-of-Mass det. time= 371.6 min (1,121.5 - 749.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	324.00'	2,692 cf	**34.83'W x 110.00'L x 2.33'H Field A** 8,941 cf Overall - 2,211 cf Embedded = 6,729 cf x 40.0% Voids
#2A	324.50'	2,211 cf	**ADS_StormTech SC-310 +Cap** x 150 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap 150 Chambers in 10 Rows
		4,903 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	323.25'	**12.0" Round Culvert** L= 23.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 323.25' / 323.00' S= 0.0109 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	325.83'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#3	Device 1	325.00'	**6.0" Vert. Orifice/Grate X 2.00** C= 0.600
#4	Discarded	324.00'	**0.170 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 322.00'

Discarded OutFlow Max=0.03 cfs @ 12.27 hrs HW=325.94' (Free Discharge)
└**4=Exfiltration** (Controls 0.03 cfs)

Primary OutFlow Max=2.08 cfs @ 12.27 hrs HW=325.94' (Free Discharge)
└**1=Culvert** (Passes 2.08 cfs of 5.60 cfs potential flow)
  └**2=Sharp-Crested Rectangular Weir** (Weir Controls 0.50 cfs @ 1.11 fps)
  └**3=Orifice/Grate** (Orifice Controls 1.58 cfs @ 4.01 fps)

Pond SSI-1: Subsurface Infiltration Basin-1 - Chamber Wizard Field A

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

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

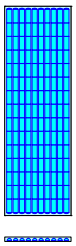
15 Chambers/Row x 7.12' Long +0.60' Cap Length x 2 = 108.00' Row Length +12.0" End Stone x 2 = 110.00' Base Length
10 Rows x 34.0" Wide + 6.0" Spacing x 9 + 12.0" Side Stone x 2 = 34.83' Base Width
6.0" Base + 16.0" Chamber Height + 6.0" Cover = 2.33' Field Height

150 Chambers x 14.7 cf = 2,211.3 cf Chamber Storage

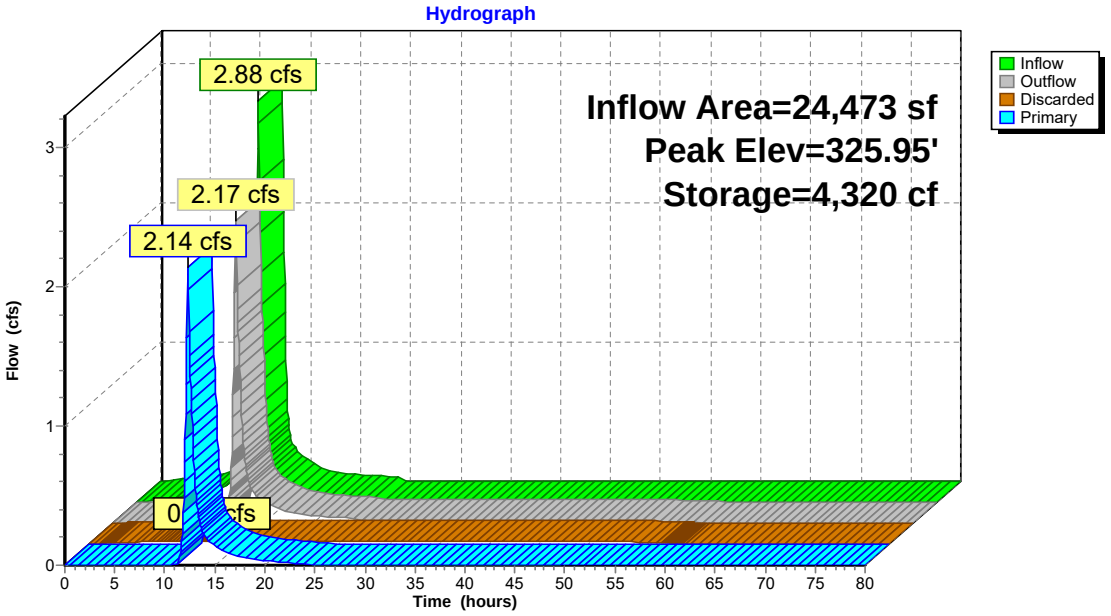
8,940.6 cf Field - 2,211.3 cf Chambers = 6,729.3 cf Stone x 40.0% Voids = 2,691.7 cf Stone Storage

Chamber Storage + Stone Storage = 4,903.0 cf = 0.113 af
Overall Storage Efficiency = 54.8%
Overall System Size = 110.00' x 34.83' x 2.33'

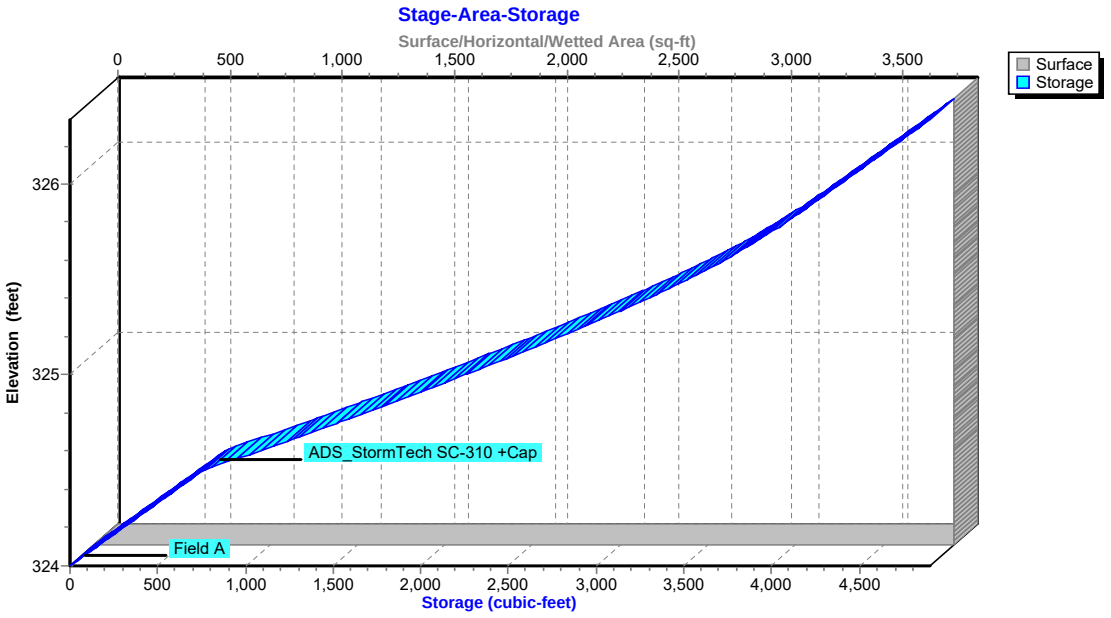
150 Chambers
331.1 cy Field
249.2 cy Stone



Pond SSI-1: Subsurface Infiltration Basin-1



Pond SSI-1: Subsurface Infiltration Basin-1



Stage-Area-Storage for Pond SSI-1: Subsurface Infiltration Basin-1

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
324.00	**3,832**	0	325.85	3,832	4,162
324.05	3,832	77	325.90	3,832	4,239
324.10	3,832	153	325.95	3,832	4,315
324.15	3,832	230	326.00	3,832	4,392
324.20	3,832	307	326.05	3,832	4,469
324.25	3,832	383	326.10	3,832	4,545
324.30	3,832	460	326.15	3,832	4,622
324.35	3,832	536	326.20	3,832	4,699
324.40	3,832	613	326.25	3,832	4,775
324.45	3,832	690	326.30	3,832	**4,852**
324.50	3,832	766			
324.55	3,832	920			
324.60	3,832	1,073			
324.65	3,832	1,225			
324.70	3,832	1,377			
324.75	3,832	1,527			
324.80	3,832	1,675			
324.85	3,832	1,822			
324.90	3,832	1,968			
324.95	3,832	2,111			
325.00	3,832	2,253			
325.05	3,832	2,392			
325.10	3,832	2,530			
325.15	3,832	2,666			
325.20	3,832	2,799			
325.25	3,832	2,929			
325.30	3,832	3,057			
325.35	3,832	3,181			
325.40	3,832	3,302			
325.45	3,832	3,420			
325.50	3,832	3,532			
325.55	3,832	3,639			
325.60	3,832	3,739			
325.65	3,832	3,832			
325.70	3,832	3,920			
325.75	3,832	4,004			
325.80	3,832	4,085			

HydroCAD Analysis

Proposed Conditions - 100 Year Storm

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Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
60,813	74	>75% Grass cover, Good, HSG C (P-1, P-1c, P-2, P-2a, P1-b)
119,908	98	Paved parking, HSG C (P-1, P-1a, P-1c, P-2, P-2a, P1-b)
1,327	66	Rip Rap Swale, HSG C (P-2a)
32,987	98	Roofs (P-1c)
164,224	70	Woods, Good, HSG C (P-1, P-1c, P-2, P-2a)
379,259	**82**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
0	HSG B	
346,272	HSG C	P-1, P-1a, P-1c, P-2, P-2a, P1-b
0	HSG D	
32,987	Other	P-1c
379,259		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Subcatchment Numbers
0	0	60,813	0	0	60,813	>75% Grass cover, Good	P-1, P-1c, P-2, P-2a, P1-b
0	0	119,908	0	0	119,908	Paved parking	P-1, P-1a, P-1c, P-2, P-2a, P1-b
0	0	1,327	0	0	1,327	Rip Rap Swale	P-2a
0	0	0	0	32,987	32,987	Roofs	P-1c
0	0	164,224	0	0	164,224	Woods, Good	P-1, P-1c, P-2, P-2a
0	**0**	**346,272**	**0**	**32,987**	**379,259**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	IB-1	321.00	320.56	44.0	0.0100	0.013	24.0	0.0	0.0
2	SSI-1	323.25	323.00	23.0	0.0109	0.013	12.0	0.0	0.0

Time span=0.00-80.00 hrs, dt=0.05 hrs, 1601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P-1: Flow to Southwest Runoff Area=38,355 sf 6.04% Impervious Runoff Depth=4.95"
Flow Length=461' Tc=13.4 min CN=73 Runoff=4.00 cfs 15,828 cf

Subcatchment P-1a: Flow to SSI-1 Runoff Area=24,473 sf 100.00% Impervious Runoff Depth=7.92"
Flow Length=553' Tc=12.0 min CN=98 Runoff=3.70 cfs 16,152 cf

Subcatchment P-1c: Flow to Existing Basin Runoff Area=172,610 sf 34.99% Impervious Runoff Depth=5.89"
Tc=15.0 min CN=81 Runoff=20.30 cfs 84,772 cf

Subcatchment P-2: Flow onsite Southeast Runoff Area=38,577 sf 16.99% Impervious Runoff Depth=5.19"
Tc=6.0 min CN=75 Runoff=5.25 cfs 16,673 cf

Subcatchment P-2a: Fllow to Swale Runoff Area=63,177 sf 27.53% Impervious Runoff Depth=5.54"
Flow Length=140' Tc=11.3 min CN=78 Runoff=7.78 cfs 29,162 cf

Subcatchment P1-b: Flow to IB-1 Runoff Area=42,067 sf 99.29% Impervious Runoff Depth=7.92"
Tc=6.0 min CN=98 Runoff=7.56 cfs 27,765 cf

Reach DP-1: Existing DMH Inflow=31.43 cfs 137,921 cf
Outflow=31.43 cfs 137,921 cf

Reach DP-2: Onsite southeast Inflow=12.34 cfs 45,835 cf
Outflow=12.34 cfs 45,835 cf

Pond IB-1: Modified Infiltration Basin Peak Elev=325.34' Storage=8,087 cf Inflow=27.91 cfs 124,538 cf
Discarded=0.02 cfs 2,445 cf Primary=27.47 cfs 122,093 cf Outflow=27.49 cfs 124,538 cf

Pond SSI-1: Subsurface Infiltration Basin-1 Peak Elev=326.08' Storage=4,509 cf Inflow=3.70 cfs 16,152 cf
Discarded=0.03 cfs 4,151 cf Primary=3.29 cfs 12,001 cf Outflow=3.32 cfs 16,152 cf

Total Runoff Area = 379,259 sf Runoff Volume = 190,351 cf Average Runoff Depth = 6.02"
59.69% Pervious = 226,364 sf 40.31% Impervious = 152,895 sf

Summary for Subcatchment P-1: Flow to Southwest

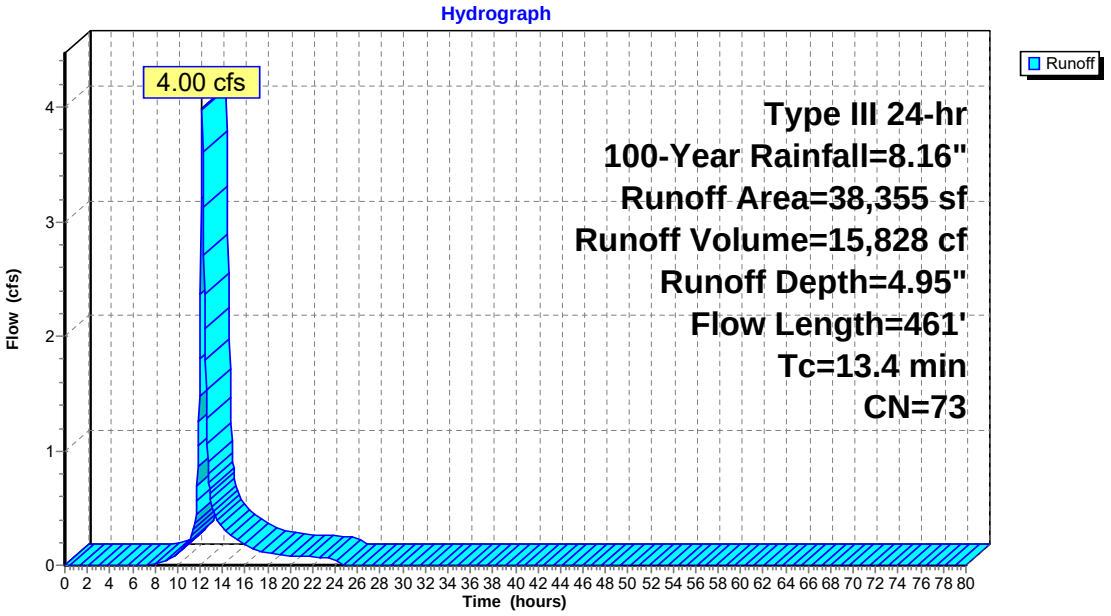
Runoff = 4.00 cfs @ 12.19 hrs, Volume= 15,828 cf, Depth= 4.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.16"

Area (sf)	CN	Description
2,315	98	Paved parking, HSG C
26,195	70	Woods, Good, HSG C
9,845	74	>75% Grass cover, Good, HSG C
38,355	73	Weighted Average
36,040		93.96% Pervious Area
2,315		6.04% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.7	50	0.0300	0.08		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.05"
2.7	411	0.0240	2.49		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
13.4	461	Total			

Subcatchment P-1: Flow to Southwest



Summary for Subcatchment P-1a: Flow to SSI-1

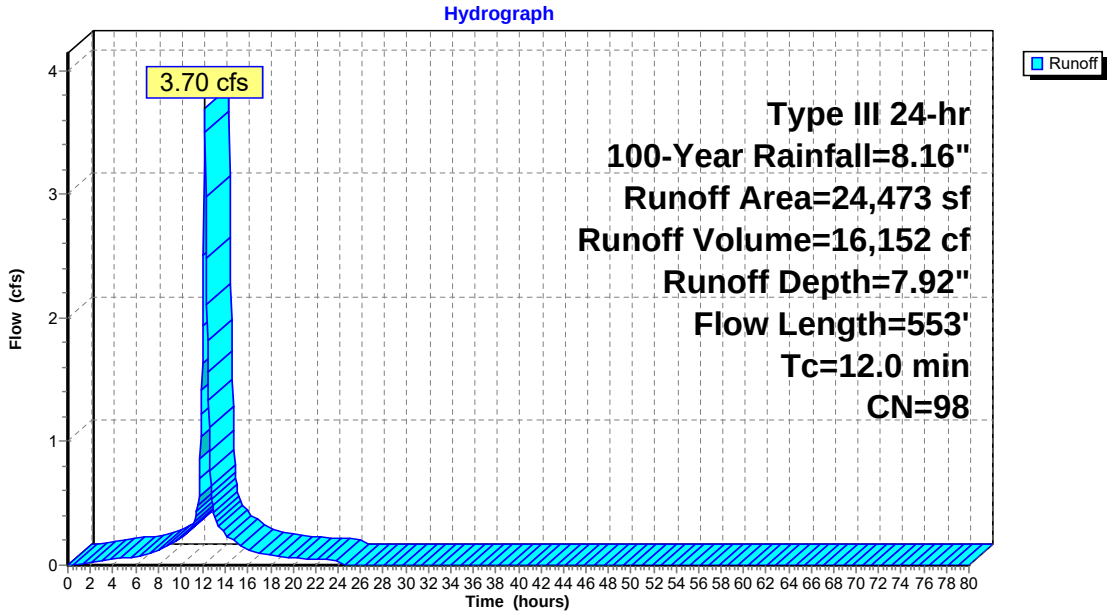
Runoff = 3.70 cfs @ 12.16 hrs, Volume= 16,152 cf, Depth= 7.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.16"

Area (sf)	CN	Description
24,473	98	Paved parking, HSG C
24,473		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.6	50	0.0530	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.05"
3.4	503	0.0240	2.49		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
12.0	553	Total			

Subcatchment P-1a: Flow to SSI-1



Summary for Subcatchment P-1c: Flow to Existing Basin

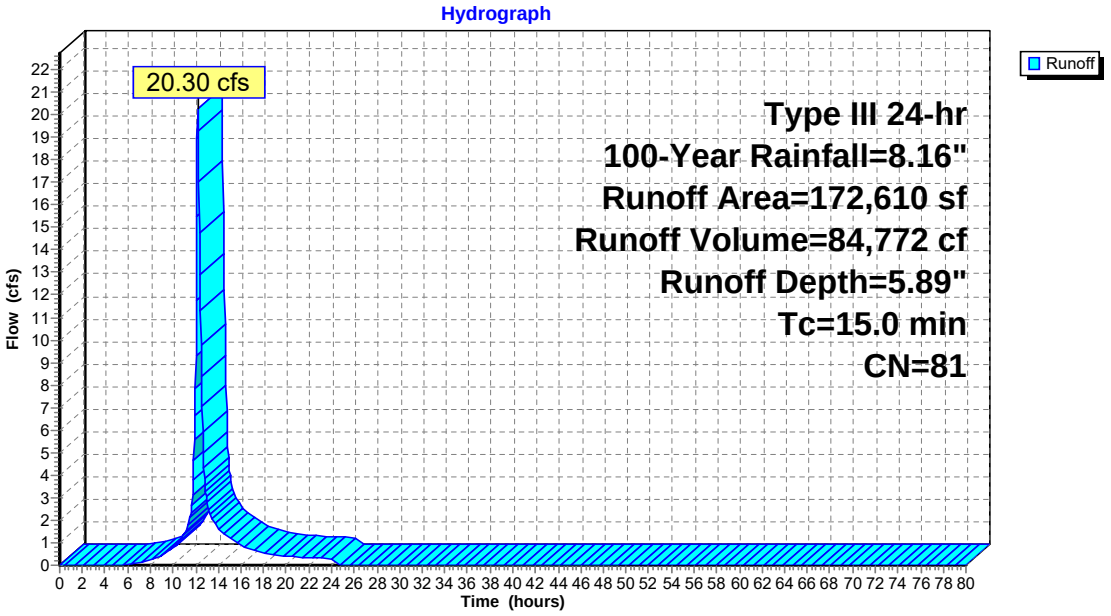
Runoff = 20.30 cfs @ 12.20 hrs, Volume= 84,772 cf, Depth= 5.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.16"

	Area (sf)	CN	Description
*	32,987	98	Roofs
	27,404	98	Paved parking, HSG C
	71,146	70	Woods, Good, HSG C
	41,073	74	>75% Grass cover, Good, HSG C
	172,610	81	Weighted Average
	112,219		65.01% Pervious Area
	60,391		34.99% Impervious Area

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

Subcatchment P-1c: Flow to Existing Basin



Summary for Subcatchment P-2: Flow onsite Southeast

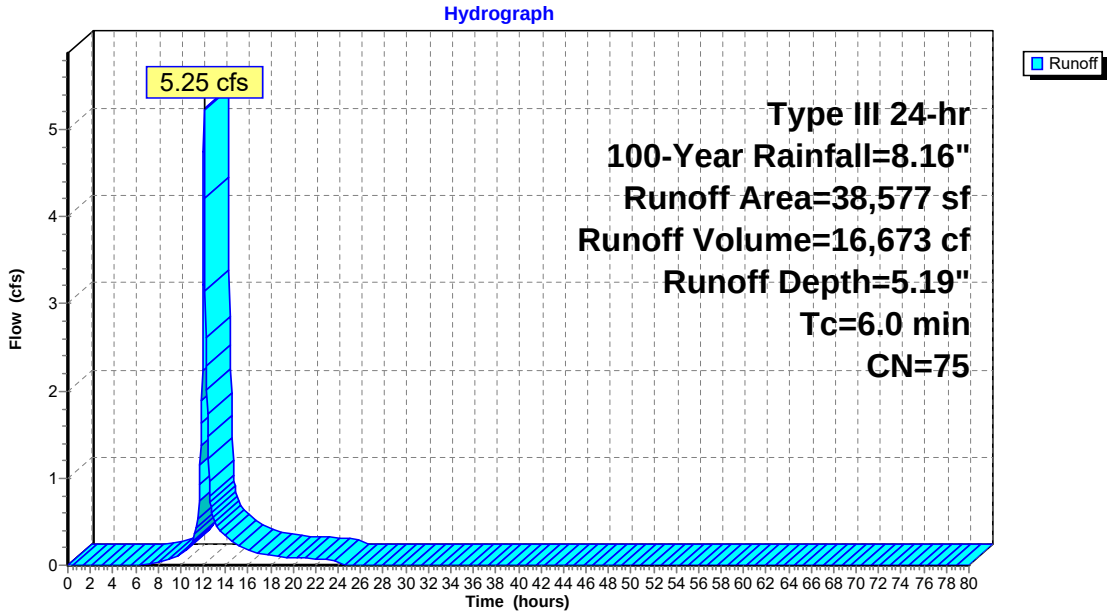
Runoff = 5.25 cfs @ 12.09 hrs, Volume= 16,673 cf, Depth= 5.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.16"

Area (sf)	CN	Description
6,554	98	Paved parking, HSG C
31,258	70	Woods, Good, HSG C
765	74	>75% Grass cover, Good, HSG C
38,577	75	Weighted Average
32,023		83.01% Pervious Area
6,554		16.99% Impervious Area

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

Subcatchment P-2: Flow onsite Southeast



Summary for Subcatchment P-2a: Fllow to Swale

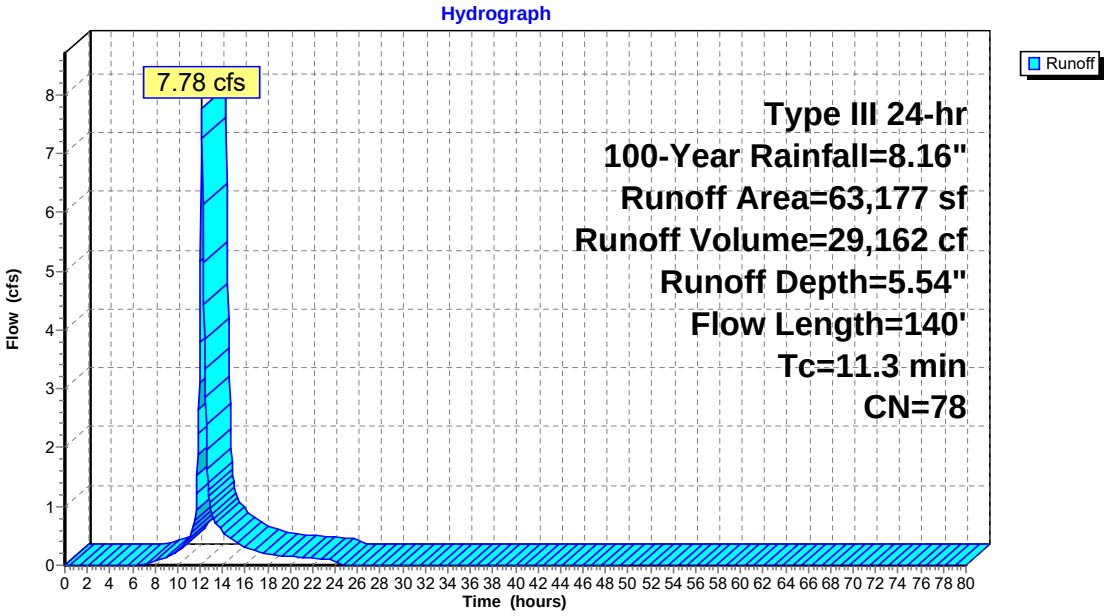
Runoff = 7.78 cfs @ 12.16 hrs, Volume= 29,162 cf, Depth= 5.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.16"

	Area (sf)	CN	Description
	17,392	98	Paved parking, HSG C
*	1,327	66	Rip Rap Swale, HSG C
	35,625	70	Woods, Good, HSG C
	8,833	74	>75% Grass cover, Good, HSG C
	63,177	78	Weighted Average
	45,785		72.47% Pervious Area
	17,392		27.53% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.0	50	0.0280	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.05"
0.1	45	0.1750	6.74		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.0	11	0.1640	6.52		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.2	34	0.0240	3.14		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
11.3	140	Total			

Subcatchment P-2a: Fllow to Swale



Summary for Subcatchment P1-b: Flow to IB-1

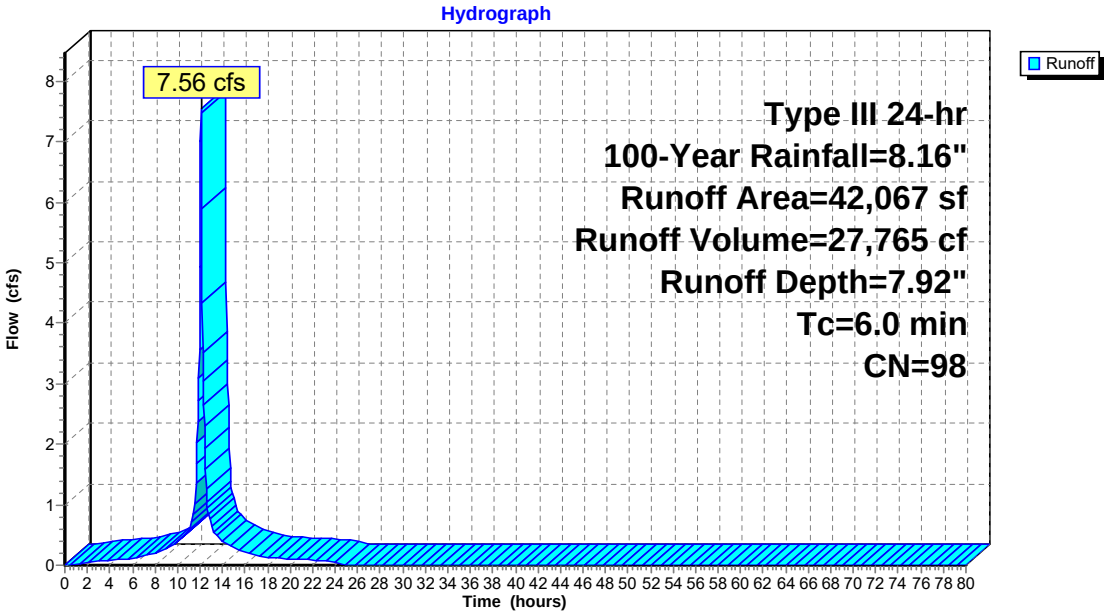
Runoff = 7.56 cfs @ 12.09 hrs, Volume= 27,765 cf, Depth= 7.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.16"

Area (sf)	CN	Description
41,770	98	Paved parking, HSG C
297	74	>75% Grass cover, Good, HSG C
42,067	98	Weighted Average
297		0.71% Pervious Area
41,770		99.29% Impervious Area

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

Subcatchment P1-b: Flow to IB-1



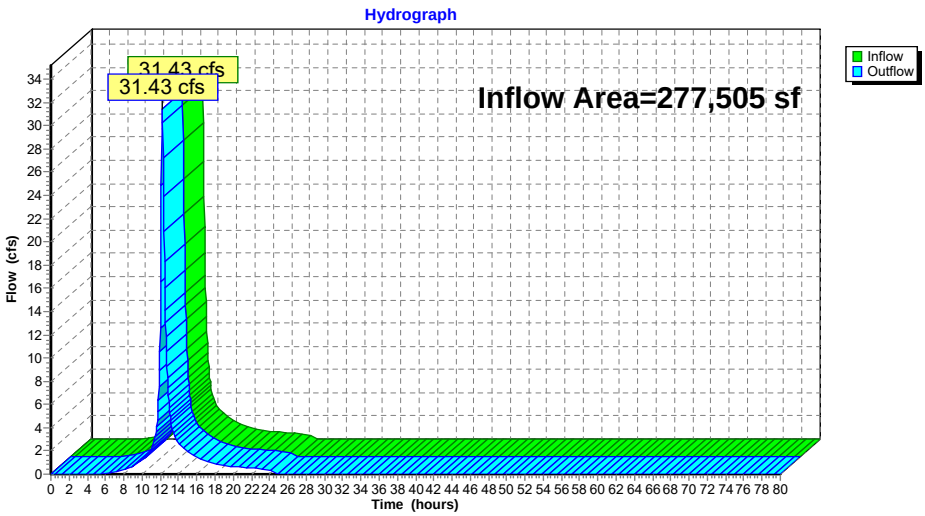
Summary for Reach DP-1: Existing DMH

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 277,505 sf, 46.47% Impervious, Inflow Depth = 5.96" for 100-Year event
Inflow = 31.43 cfs @ 12.20 hrs, Volume= 137,921 cf
Outflow = 31.43 cfs @ 12.20 hrs, Volume= 137,921 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs

Reach DP-1: Existing DMH



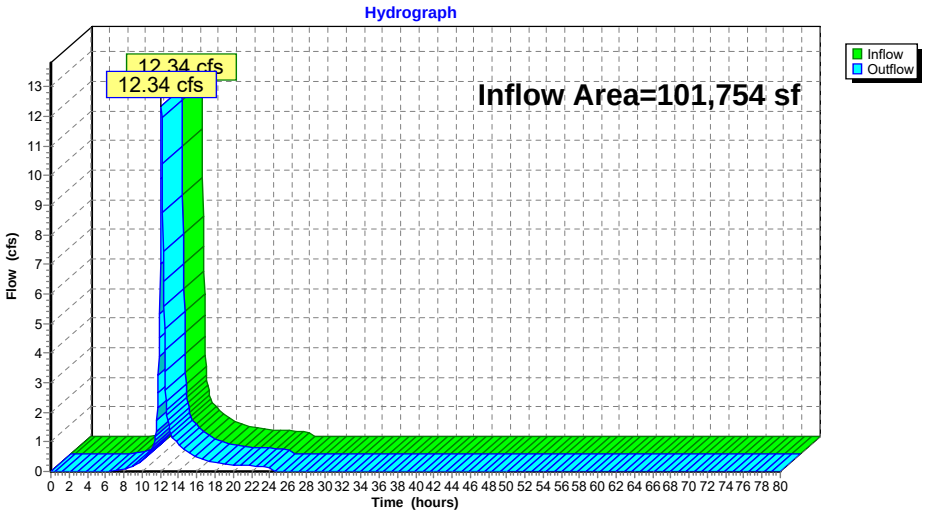
Summary for Reach DP-2: Onsite southeast

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 101,754 sf, 23.53% Impervious, Inflow Depth = 5.41" for 100-Year event
Inflow = 12.34 cfs @ 12.12 hrs, Volume= 45,835 cf
Outflow = 12.34 cfs @ 12.12 hrs, Volume= 45,835 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs

Reach DP-2: Onsite southeast



Summary for Pond IB-1: Modified Infiltration Basin

[79] Warning: Submerged Pond SSI-1 Primary device # 1 INLET by 2.09'

Inflow Area = 239,150 sf, 52.95% Impervious, Inflow Depth = 6.25" for 100-Year event
Inflow = 27.91 cfs @ 12.19 hrs, Volume= 124,538 cf
Outflow = 27.49 cfs @ 12.21 hrs, Volume= 124,538 cf, Atten= 2%, Lag= 1.3 min
Discarded = 0.02 cfs @ 12.21 hrs, Volume= 2,445 cf
Primary = 27.47 cfs @ 12.21 hrs, Volume= 122,093 cf

Routing by Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 325.34' @ 12.21 hrs Surf.Area= 4,600 sf Storage= 8,087 cf

Plug-Flow detention time= 30.4 min calculated for 124,460 cf (100% of inflow)
Center-of-Mass det. time= 31.7 min (825.5 - 793.8)

Volume	Invert	Avail.Storage	Storage Description
#1	323.00'	11,339 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

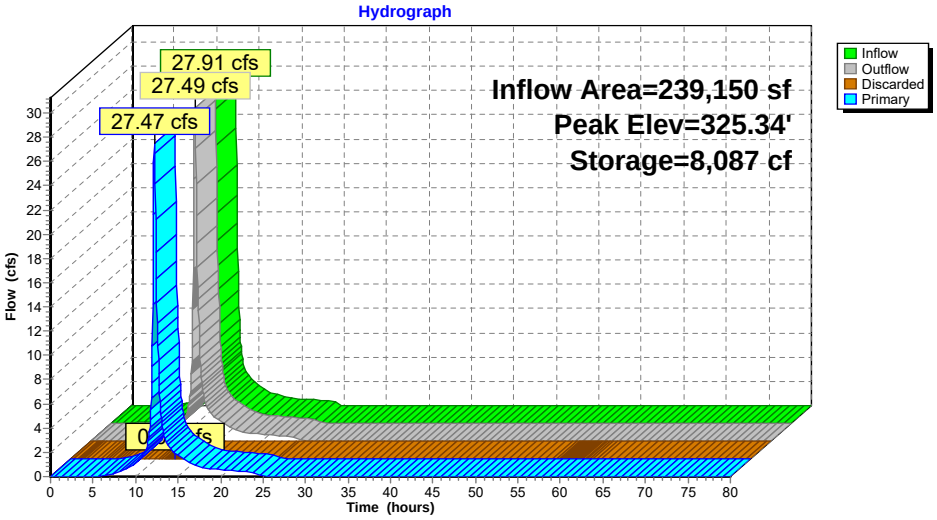
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
323.00	2,360	290.0	0	0	2,360
324.00	3,286	315.0	2,810	2,810	3,601
325.00	4,260	334.0	3,762	6,573	4,635
326.00	5,291	353.0	4,766	11,339	5,729

Device	Routing	Invert	Outlet Devices
#1	Discarded	323.00'	**0.170 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 318.00'
#2	Primary	321.00'	**24.0" Round Culvert** L= 44.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 321.00' / 320.56' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf
#3	Device 2	325.00'	**60.0" x 60.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 2	324.00'	**20.0" W x 10.0" H Vert. Orifice** C= 0.600
#5	Device 2	323.50'	**32.0" W x 6.0" H Vert. Orifice** C= 0.600

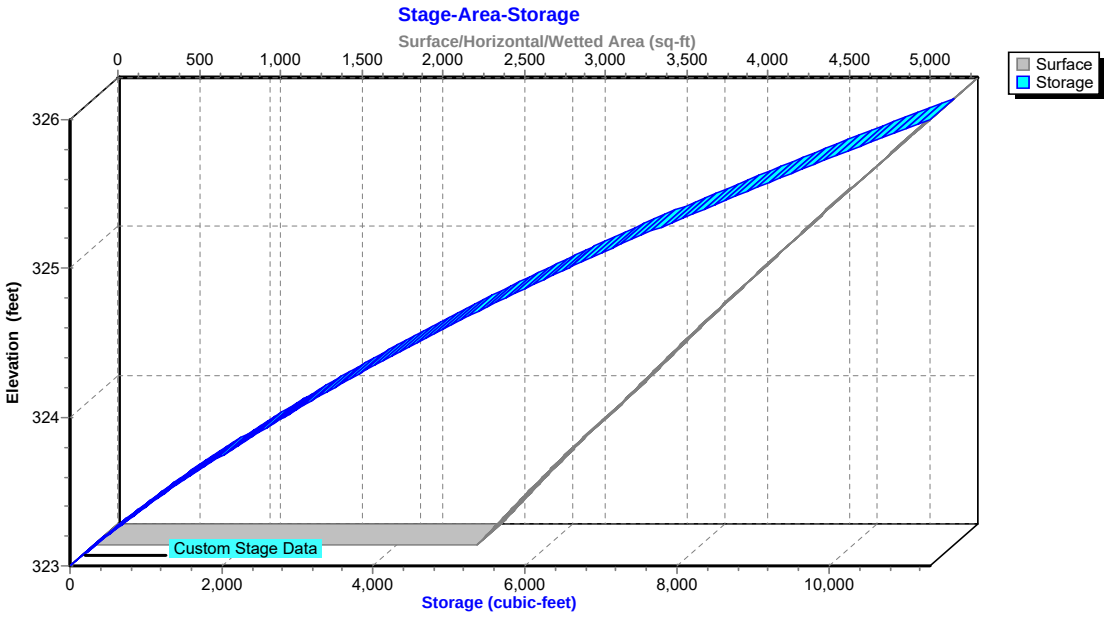
Discarded OutFlow Max=0.02 cfs @ 12.21 hrs HW=325.34' (Free Discharge)
└**1=Exfiltration** (Controls 0.02 cfs)

Primary OutFlow Max=27.37 cfs @ 12.21 hrs HW=325.34' (Free Discharge)
└**2=Culvert** (Passes 27.37 cfs of 27.64 cfs potential flow)
  ├**3=Grate** (Weir Controls 12.92 cfs @ 1.90 fps)
  ├**4=Orifice** (Orifice Controls 6.37 cfs @ 4.58 fps)
  └**5=Orifice** (Orifice Controls 8.08 cfs @ 6.06 fps)

Pond IB-1: Modified Infiltration Basin



Pond IB-1: Modified Infiltration Basin



Stage-Area-Storage for Pond IB-1: Modified Infiltration Basin

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
323.00	2,360	0	324.85	4,106	5,945
323.05	2,403	119	324.90	4,157	6,152
323.10	2,446	240	324.95	4,208	6,361
323.15	2,489	364	325.00	4,260	6,573
323.20	2,533	489	325.05	4,309	6,787
323.25	2,577	617	325.10	4,358	7,004
323.30	2,622	747	325.15	4,408	7,223
323.35	2,667	879	325.20	4,457	7,444
323.40	2,712	1,014	325.25	4,507	7,669
323.45	2,758	1,150	325.30	4,558	7,895
323.50	2,804	1,289	325.35	4,608	8,124
323.55	2,850	1,431	325.40	4,659	8,356
323.60	2,897	1,574	325.45	4,710	8,590
323.65	2,945	1,720	325.50	4,762	8,827
323.70	2,992	1,869	325.55	4,813	9,066
323.75	3,040	2,020	325.60	4,865	9,308
323.80	3,089	2,173	325.65	4,917	9,553
323.85	3,137	2,329	325.70	4,970	9,800
323.90	3,187	2,487	325.75	5,023	10,050
323.95	3,236	2,647	325.80	5,076	10,302
324.00	3,286	2,810	325.85	5,129	10,557
324.05	3,332	2,976	325.90	5,183	10,815
324.10	3,378	3,143	325.95	5,237	11,076
324.15	3,424	3,313	326.00	**5,291**	**11,339**
324.20	3,471	3,486			
324.25	3,518	3,661			
324.30	3,565	3,838			
324.35	3,613	4,017			
324.40	3,660	4,199			
324.45	3,709	4,383			
324.50	3,757	4,570			
324.55	3,806	4,759			
324.60	3,855	4,950			
324.65	3,905	5,144			
324.70	3,955	5,341			
324.75	4,005	5,540			
324.80	4,055	5,741			

Summary for Pond SSI-1: Subsurface Infiltration Basin-1

Inflow Area = 24,473 sf,100.00% Impervious, Inflow Depth = 7.92" for 100-Year event
Inflow = 3.70 cfs @ 12.16 hrs, Volume= 16,152 cf
Outflow = 3.32 cfs @ 12.22 hrs, Volume= 16,152 cf, Atten= 10%, Lag= 3.8 min
Discarded = 0.03 cfs @ 12.22 hrs, Volume= 4,151 cf
Primary = 3.29 cfs @ 12.22 hrs, Volume= 12,001 cf

Routing by Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs / 6
Peak Elev= 326.08' @ 12.22 hrs Surf.Area= 3,832 sf Storage= 4,509 cf

Plug-Flow detention time= 303.3 min calculated for 16,152 cf (100% of inflow)
Center-of-Mass det. time= 303.0 min (1,049.6 - 746.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	324.00'	2,692 cf	**34.83'W x 110.00'L x 2.33'H Field A** 8,941 cf Overall - 2,211 cf Embedded = 6,729 cf x 40.0% Voids
#2A	324.50'	2,211 cf	**ADS_StormTech SC-310 +Cap** x 150 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap 150 Chambers in 10 Rows
		4,903 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	323.25'	**12.0" Round Culvert** L= 23.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 323.25' / 323.00' S= 0.0109 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	325.83'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#3	Device 1	325.00'	**6.0" Vert. Orifice/Grate X 2.00** C= 0.600
#4	Discarded	324.00'	**0.170 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 322.00'

Discarded OutFlow Max=0.03 cfs @ 12.22 hrs HW=326.07' (Free Discharge)
└**4=Exfiltration** (Controls 0.03 cfs)

Primary OutFlow Max=3.19 cfs @ 12.22 hrs HW=326.07' (Free Discharge)
└**1=Culvert** (Passes 3.19 cfs of 5.76 cfs potential flow)
  └**2=Sharp-Crested Rectangular Weir** (Weir Controls 1.48 cfs @ 1.59 fps)
  └**3=Orifice/Grate** (Orifice Controls 1.71 cfs @ 4.35 fps)

Pond SSI-1: Subsurface Infiltration Basin-1 - Chamber Wizard Field A

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

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

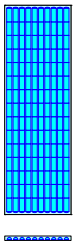
15 Chambers/Row x 7.12' Long +0.60' Cap Length x 2 = 108.00' Row Length +12.0" End Stone x 2 = 110.00' Base Length
10 Rows x 34.0" Wide + 6.0" Spacing x 9 + 12.0" Side Stone x 2 = 34.83' Base Width
6.0" Base + 16.0" Chamber Height + 6.0" Cover = 2.33' Field Height

150 Chambers x 14.7 cf = 2,211.3 cf Chamber Storage

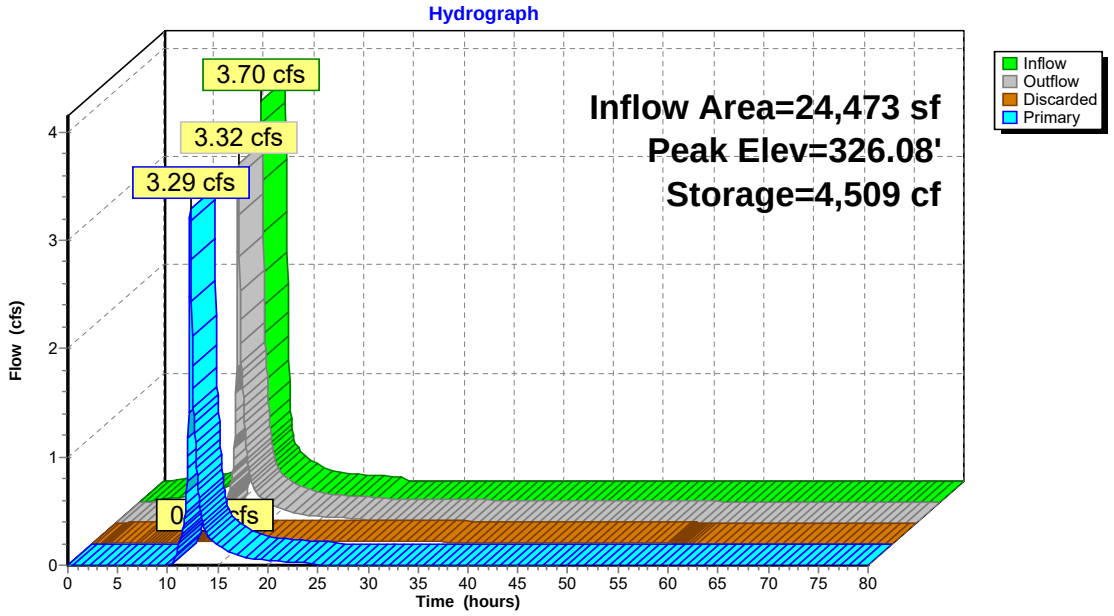
8,940.6 cf Field - 2,211.3 cf Chambers = 6,729.3 cf Stone x 40.0% Voids = 2,691.7 cf Stone Storage

Chamber Storage + Stone Storage = 4,903.0 cf = 0.113 af
Overall Storage Efficiency = 54.8%
Overall System Size = 110.00' x 34.83' x 2.33'

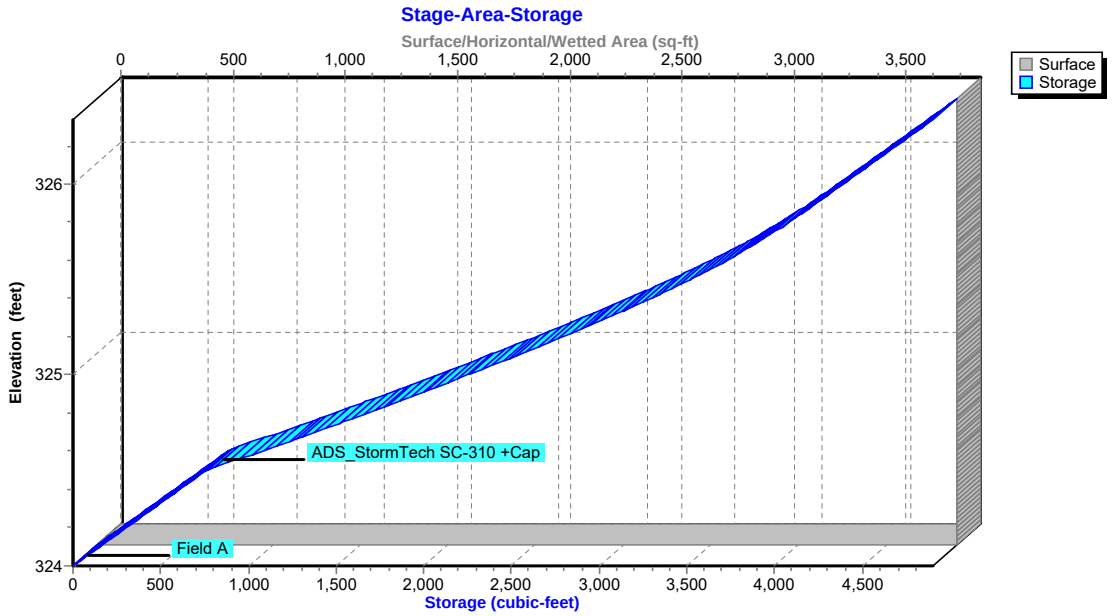
150 Chambers
331.1 cy Field
249.2 cy Stone



Pond SSI-1: Subsurface Infiltration Basin-1



Pond SSI-1: Subsurface Infiltration Basin-1



Stage-Area-Storage for Pond SSI-1: Subsurface Infiltration Basin-1

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
324.00	**3,832**	0	325.85	3,832	4,162
324.05	3,832	77	325.90	3,832	4,239
324.10	3,832	153	325.95	3,832	4,315
324.15	3,832	230	326.00	3,832	4,392
324.20	3,832	307	326.05	3,832	4,469
324.25	3,832	383	326.10	3,832	4,545
324.30	3,832	460	326.15	3,832	4,622
324.35	3,832	536	326.20	3,832	4,699
324.40	3,832	613	326.25	3,832	4,775
324.45	3,832	690	326.30	3,832	**4,852**
324.50	3,832	766			
324.55	3,832	920			
324.60	3,832	1,073			
324.65	3,832	1,225			
324.70	3,832	1,377			
324.75	3,832	1,527			
324.80	3,832	1,675			
324.85	3,832	1,822			
324.90	3,832	1,968			
324.95	3,832	2,111			
325.00	3,832	2,253			
325.05	3,832	2,392			
325.10	3,832	2,530			
325.15	3,832	2,666			
325.20	3,832	2,799			
325.25	3,832	2,929			
325.30	3,832	3,057			
325.35	3,832	3,181			
325.40	3,832	3,302			
325.45	3,832	3,420			
325.50	3,832	3,532			
325.55	3,832	3,639			
325.60	3,832	3,739			
325.65	3,832	3,832			
325.70	3,832	3,920			
325.75	3,832	4,004			
325.80	3,832	4,085			

LEVEL DESIGN GROUP
Civil Engineers & Land Surveyors

Operation and Maintenance Plan

249 SOUTH STREET • UNIT 1 • PLAINVILLE, MA • 02762 | P 508.695.2221 | F 508.695.2219 | LEVELDG.COM

OPERATION AND MAINTENANCE PLAN

FOR

15 LIBERTY WAY

FRANKLIN, MA

DATED: JANUARY 17, 2023

REVISED: OCTOBER 17, 2023

REVISED: FEBRUARY 1, 2024

Prepared By:

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249 South Street, Unit 1
Plainville, MA 02762

Prepared For:

Oliver Street Capital
125 High Street, Suite 220
Boston, MA 02110

LDG Project No.:
2081.00

The proposed Stormwater Management System is designed to function properly provided that routine maintenance is performed. It is the responsibility during construction and until purchase of the units and turnover of the project to a Home Owners Association to be formed, that the Owner and Developer, Oliver Street Capital, shall be responsible for the long-term maintenance and to provide the required maintenance outlined in this plan for the site infiltration systems as well as the remainder of the on-site storm drainage system.

Upon completion of construction and the formation of the Home Owners Association, maintenance of driveways and the stormwater appurtenances required to ensure that sedimentation and pollution is controlled and that storm water detention and infiltration capacity is sustained are the on-going responsibility of the Oliver Street Capital. To ensure the proper functioning of these facilities the following maintenance practices will be used:

DRIVEWAYS AND PARKING AREAS

Spring Maintenance
Driveways and Parking Areas are to be swept monthly to remove sand which has accumulated. Sand shall be removed from the site and legally disposed of.

Summer & Fall Maintenance
Leaves and debris which accumulates within the Driveways and Parking Areas during the summer and fall shall be collected and legally disposed of.

Winter Maintenance & Snow Removal
Snow removal within Driveways and Parking Area shall be stockpiled in the designated Snow Stockpile Areas outside of the traveled driveways. These areas should be located within or adjacent to the parking surface and should drain to the stormwater management system. Under no circumstances shall snow be directed onto abutting parcels or into the on-site resource areas (wetlands, wetland buffer zone, and riverfront areas).

Estimated Yearly Cost $1,000.00 (not including cost for snow plowing)

DRAIN MANHOLES

- All drain manholes must be inspected and maintained on a bi-annual basis in March and October of each year. Drain manholes must be inspected to ensure frames and covers are not damaged, inlet and outlet pipes are flowing freely and there are no blockages within the manhole, and brick course is intact.
- Drain manholes shall be cleaned whenever any sediment has accumulated within the drain manhole.
- If inspection indicates the presence of petroleum, it shall be removed immediately and disposed of off-site in accordance with all applicable local, state and federal regulations including M.G.L.c. 21C and 310 CMR 30.00.

Estimated Yearly Cost $1,000

DEEP SUMP CATCH BASINS

- All catch basins must be inspected and maintained on a bi-annual basis in March and October of each year. Catch basins must be inspected to ensure frames and grates are not damaged, inlet and outlet pipes are flowing freely and there are no blockages within the catch basin.
- Catch basins are to be cleaned once per year at minimum, and shall be cleaned whenever the depth of sediment is equal to or greater than half the sump depth. Care shall be taken during inspection and cleaning operations to avoid damage to basin hoods.
- All debris, sediment, and/or grease shall be removed from any catch basins and disposed of off-site in accordance with state and federal guidelines including M.G.L.c. 21C and 310 CMR 30.00.

Estimated Yearly Cost $4,000

TRENCH DRAINS

Trench Drains shall be inspected and cleaned four times per year or when outlet pipes are obstructed.

Spring Maintenance
Trench drains require the removal of sediment each spring. This procedure is comprised of removing the trench drain grate followed by removal of sediment trapped in the structure with a clamshell shovel. The outlet pipe from the trench drain shall be inspected and any obstructions are to be removed. The sediment and debris removed from the catch basin shall be legally disposed of.

Fall Maintenance
Trench drain grates shall be cleared of leaves and debris so they may function properly.

Estimated Yearly Cost $2,000.00

SUBSURFACE INFILTRATION BASIN

Once the system has gone online, inspections should occur after every storm event accumulating greater than 1 inch of rainfall for the first year to ensure proper stabilization and function. Attention should be paid to how long water remains standing in the chambers after a storm. Thereafter, the system should be inspected at least twice per year. Observations and measurements shall be made from the observation ports provided. Important items to check for include: differential settlement, cracking, erosion or leakage. If the system appears to be clogged or not functioning properly at any time, the system is to be flushed in accordance with the 10-year maintenance procedure listed below. Sediment should be removed from the system as necessary. Removal procedures should not take place until the pipes in the system are thoroughly dry. A vacuum truck is usually the most effective and convenient method. If the sediment has traveled past the reach of the vacuum truck the system shall be thoroughly flushed with water, a fire hose or the like is typically the most effective method of flushing. The manhole downstream of this process shall be plugged and sediment collected at this point.

If inspection of the inflow point indicates sediments are accumulating, removal of sediment within the basin may be required. Remove sediments from the catch basin discharge pipes which outlet into the

basin. Sediment shall be flushed from the basin at least once every 10-years. Sediments should be flushed and captured on the outlet side of the basin prior to discharge. If the sediment has traveled past the reach of a vacuum truck the system shall be thoroughly flushed with water, a fire hose or the like is typically the most effective method of flushing. The manhole downstream of this process shall be plugged and sediment collected at this point. Sediment which is removed shall be legally disposed of.

The system shall be monitored at several intervals during and after a small and large rainfall event to ensure runoff is detained. Inlet and outlet pipes shall be kept free of obstructions. Any material obstructing the pipes shall be removed and legally disposed of.

Estimated Yearly Cost $2,000.00

INFILTRATION BASIN

Spring Maintenance
The infiltration basins require biannual inspections for accumulations of settled of solids. If these materials have accumulated to a point where removal is necessary this shall be completed immediately. Accumulated trash and debris shall also be removed and legally disposed of during the biannual inspections.

During the initial growing season, the wet basin shall be inspected to ensure that vegetation has become adequately established and will be reseeded and mulched, as necessary.

Infiltration basins shall be inspected at least twice per year at a minimum to ensure they are operating as designed. Sediment shall be removed from the bottom of the basin as necessary, and at least once per 10 years.

At least twice during the growing season the upper-stage, side slopes, and all other grass areas shall be mowed with mower blades set to no lower than 3-inches. If riling or gullying is observed these areas shall be raked out and reseeded.

Estimated Yearly Cost $500.00

RIP RAP SWALE

The rip-rap swales shall be inspected as part of the routine site maintenance for necessary maintenance. This consists of visually inspecting the swale for the accumulation of sediment; obstructions to the inlet pipes; erosion; and cracking or tree growth on the embankment and damage the stability of the swale.
No sediment should pass through the swales to the infiltration basins and/or wetlands. If inspection of the discharge point of the outflow pipe indicates sediments are accumulating, removal of sediment within the basin is required. Sediment shall be removed from the rip-rap swale at least once every 5 years where the swale is the re-graded / re-constructed as needed. Accumulated sediment should be excavated to one inch below the of the swale base grade, removed, and legally disposed of.

During the first year of operation, the swales shall be monitored during and after a small and large rainfall event to ensure runoff from the site is draining towards the swales and that they are property flowing as designed.
Estimated Yearly Cost $2,000.00

STONE CHECK DAMS & STONE FILTER STRIPS

The stone check dams and stone filter strips shall be inspected as part of the routine site maintenance for necessary maintenance. This consists of visually inspecting the stone check dams and stone filter strips for the accumulation of sediment; obstructions; erosion; and vegetation growth on the through the stone check dams or stone filter that may damage the it's stability. Sediment shall be removed from the stone check dams and stone filter strips at least once every 2 years and re-constructed as needed.
Estimated Yearly Cost $2,000.00

PUBLIC SAFETY FEATURES

Many of the Public Safety Features of the Stormwater Management System are incorporated into its design. The Infiltration basin was designed to minimize its depth to 2-feet deep. This combined with sediment forebay being approximately 1-foot deep provide for a safe and effective system.

Despite all the well-designed safety features within the Stormwater Management System all components of the system must be properly maintained to be effective. All maintenance procedures detailed above must be done on schedule and documented. Standing or stagnant water provides mosquito-breeding habitat and increases the potential for disease transmission. The basin is designed to fully infiltrate within 72 hours after a storm even which will prevent standing water from becoming a safety hazard. Routine monitoring for and management of mosquito-breeding conditions by qualified maintenance staff is required during the peak breading season between April and September ensure that unforeseen conditions do not develop.

While risks can be mitigated through proper design and maintenance, it is impossible to entirely eliminate risk. Therefore, education regarding stormwater management facilities and their inherent risks is valuable and should be a part of every community's activity. Employees and tenants of the Facility shall be given an overview of the Stormwater System and which areas to avoid. Public participation also increases the level of maintenance as community members can notify staff if a component of the stormwater system is not functioning properly.

The O&M shall be recorded with the Home Owners Agreement or other approving maintenance agreement to properly notify future owners of maintenance requirements.

STORMWATER TREATMENT UNITS (CDS UNITS BY CONTECH)

The Stormwater Treatment Units should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects pollutants will depend

more heavily on-site activities than the size of the unit, i.e., unstable soils or heavy winter sanding will cause the treatment chamber to fill more quickly, but regular sweeping will slow accumulation.

Inspection

Inspection is the key to effective maintenance and is easily performed. Pollutant deposition and transport may vary from year to year and regular inspections will help ensure that the system is cleaned out at the appropriate time. At a minimum, inspections should be performed twice per year (i.e. spring and fall) however more frequent inspections may be necessary in equipment washdown areas and in climates where winter sanding operations may lead to rapid accumulations of a large volume of sediment. It is useful and often required as part of a permit to keep a record of each inspection. A simple inspection and maintenance log form for doing so is available for download at www.ContechES.com/stormwater

The Stormwater Treatment Units should be cleaned when the sediment has accumulated to a depth of two feet in the treatment chamber. This determination can be made by taking two measurements with a stadia rod or similar measuring device; one measurement from the manhole opening to the top of the sediment pile and the other from the manhole opening to the water surface. If the difference between these measurements is less than the distance given in Table 2, the Stormwater Treatment Units should be maintained to ensure effective treatment.

Cleaning

Cleaning of the Stormwater Treatment Units should be done during dry weather conditions when no flow is entering the system. Cleanout of the Stormwater Treatment Units with a vacuum truck is generally the most effective and convenient method of excavating pollutants from the system. Simply remove the manhole cover and insert the vacuum hose into the sump. All pollutants can be removed from this one access point from the surface with no requirements for Confined Space Entry. In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, an oil or gasoline spill should be cleaned out immediately. Motor oil and other hydrocarbons that accumulate on a more routine basis should be removed when an appreciable layer has been captured. To remove these pollutants, it may be preferable to use adsorbent pads, which solidify the oils. These are usually much easier to remove from the unit individually, and less expensive to dispose than the oil/water emulsion that may be created by vacuuming the oily layer. Floating trash can be netted out if you wish to separate it from the other pollutants. Manhole covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and also to ensure proper safety precautions. If anyone physically enters the unit, Confined Space Entry procedures need to be followed. Disposal of all material removed from the Stormwater Treatment Units should be done is accordance with local regulations. In many locations, disposal of evacuated sediments may be handled in the same manner as disposal of sediments removed from catch basins or deep sump manholes. Check your local regulations for specific requirements on disposal.

Estimated Yearly Cost $2,000

STORMWATER MANAGEMENT OPREATOIN AND MAINTENANCE LOG

It is the responsibility of the owner and developer, Oliver Street Capital, to provide the maintenance of the Stormwater Management System Maintenance in accordance with the Town of Franklin Stormwater Management Standards until such time as an entity is created for overall site management at which time the agreement will spell out responsibility with appropriate contact information for all parties. The log form below is a template and shall be reproduced as needed. Copies of all log forms shall be kept on file for a minimum of three years from the date of inspection.

Name of Inspector:
Date and Time of Inspection:
Weather Conditions:

Stormwater BMP	Observations	Action Required

LEVEL DESIGN GROUP
Civil Engineers & Land Surveyors

Long Term Pollution Prevention Plan

249 SOUTH STREET • UNIT 1 • PLAINVILLE, MA • 02762 | P 508.695.2221 | F 508.695.2219 | LEVELDG.COM

LONG TERM POLLUTION PREVENTION PLAN

FOR

15 LIBERTY WAY

FRANKLIN, MA

DATED: JANUARY 13, 2023

Prepared By:

Level Design Group, L.L.C.
249 South Street, Unit 1
Plainville, MA 02762

Prepared For:

Oliver Street Capital
125 High Street, Suite 220
Boston, MA 02110

LDG Project No.:
2081.00

GOOD HOUSEKEEPING PRACTICES

It is the responsibility of the developer, Oliver Street Capital, to provide for maintenance of the parking areas and the storm drainage system until the site is turned over to the condominium association which will be created prior to the sale of any units. The Owner shall utilize good housekeeping practices as outlined in the Operation and Maintenance Plan required for the maintenance of the Stormwater Management System.

PROVISIONS FOR STORAGE OF MATERIALS AND WASTE PRODUCTS INSIDE OR UNDER COVER

The storage of hazardous materials and waste is prohibited from being stored outdoor at the site. Any hazardous materials shall be stored under cover.

VEHICLE WASHING CONTROLS

Outdoor vehicle washing is allowed only for occupants of the condominium development for non-commercial vehicles owned by the residents of the units. No commercial vehicle washing operations is allowed in this area.

REQUIREMENTS FOR ROUTINE INSPECTION AND MAINTENANCE OF STORMWATER BMPS

The Owner / Operator shall keep a Maintenance Log Sheets of scheduled tasks outlined Operation and Maintenance Plan.

SPILL PREVENTION AND RESPONSE PLANS

The risk of significant spills requiring action at this site is limited and will most likely be associated with motor vehicle use or maintenance. In the event of a significant spill contact:

> Massachusetts Department of Environmental Protection 24-hour emergency response notification line – (888) 304-1133

PROVISIONS FOR MAINTENANCE OF LAWNS, GARDENS, AND OTHER LANDSCAPED AREAS

The use of chemical fertilizers shall not be used on-site. If chemical fertilizers are required to be used, the fertilizers must be worked into the soil to prevent washouts and stormwater contamination of fertilizers.

REQUIREMENTS FOR STORAGE AND USE OF FERTILIZERS, HERBICIDES, AND PESTICIDES

If fertilizers, herbicides, and pesticides are to be used and stored on site they are to be stored in their original containers and keep in a dry, safe area where children do not have access to.

PROVISIONS SOLID WASTE MANAGEMENT

Solid waste and recycling is to be disposed in designated areas in enclosed dumpsters and receptacles with covers and hauled by private certified waste management service operators. Solid waste management systems shall be inspected and maintained in accordance with state, local, and federal solid waste management regulations.

EMERGENCY AND REGULATORY CONTACTS

Franklin Fire Department:	911 / (508) 528-2323
Franklin Police Department:	911 / (508) 528-1212
Massachusetts Department of Environmental Protection – Central Regional Office:	(508) 792-7650
United State Environmental Protection Agency:	(617) 918-1111