ENVIRONMENTAL SERVICES

CMG EST. 2002

ENGINEERING SERVICES

STORMWATER REPORT

PROPOSED "INTERSTATE TOWING" FACILITY
#698 MAIN STREET (ROUTE 20)
STURBRIDGE, MA

REVISED: NOVEMBER 30, 2022

PREPARED FOR:

WRECKER, LLC.
1660 WESTOVER ROAD
CHICOPEE, MA 01020

PREPARED BY:

CMG ENVIRONMENTAL, INC.
CMG ID 2022-035

67 HALL ROAD
STURBRIDGE, MA 01566
PHONE (774) 241-0901
FAX (774) 241-0906

TABLE OF CONTENTS

TABLES

ATTACHMENTS

Stormwater Report
Proposed "Interstate Towing" Facility
#698 Main Street, Sturbridge, MA
Revised November 30, 2022

Project Description:

The project Applicant, *Wrecker, LLC.,* retained *CMG Engineering* to prepare this engineering analysis of pre- and post-development drainage runoff conditions for a proposed **7,000 s.f. "Interstate Towing" Facility.** The proposed site improvements are located on assessor's parcel 415-02343-698 with a total area of 8.94 Acres, identified as #698 Main Street (Site).

The site is currently undeveloped woodlands with bordering vegetated wetlands located in the central portion of the site within the General Industrial zoning district. The property is within close proximity to municipal water and sewer located within the Main Street (Route 20) right-of-way.

The current site topography pitches towards the Route 20 right-of-way along the front of the site. There are currently no existing stormwater BMP's implemented on the site. A majority of the front portion of the site is within the local 200-foot jurisdictional wetland buffer and will require a Notice of Intent filing with the Sturbridge Conservation Commission.

The applicant is proposing to construct a 7,000 s.f. metal building with associated parking and utilities. The new building will be operated as the new "Interstate Towing" facility. The easterly portion of the site will be a paved storage yard to store equipment, impounded vehicles, and fleet vehicles. Per the Massachusetts Stormwater Handbook, the storage yard is considered a land use with higher potential pollutant loads (LUHPPL) and will utilize specific stormwater BMP's. Customer parking will be located in front of the proposed building. As previously stated, the existing parcel is currently undeveloped woodlands, therefore, the project is considered new development.

A copy of the "MA-DEP Checklist for Stormwater Report" is included as **Appendix A**.

Hydrologic Calculation Methodology:

Hydrology

Computer Model: HydroCAD 10.0 © 2015 Applied Microcomputer Systems, drainage modeling software;

Hydrologic Methodology: TR-55 Methodology is used for analysis of peak flow and drywell sizing.

Surface Runoff Conditions

Rainfall Intensity: TR-55 (Type III) – Rainfall Data
2-Year Storm = 3.20 in.
10-Year Storm = 4.60 in
25-Year Storm = 5.40 in.
100-Year Storm = 6.70 in.

Watershed Areas: Watershed areas are calculated using AutoCAD software based on the subcatchment areas delineated on topographic mapping included as "Pre-Development Drainage" and "Post-Development Drainage". The areas shown, times of concentration and runoff coefficients are all consistent with the TR-55 drainage calculation method.

Flood Plain:

FEMA Flood Mapping: Site is not in the 100-year flood plain based on Flood Insurance Rate Map (FIRM) Town of Sturbridge, Worcester County Massachusetts (All Jurisdictions) Map Number 25027C0907E, Effective Date July 04, 2011 (see **Appendix B).**

Soils & Topography:

The Site soils are mapped as and appear to be consistent with Paxton Fine Sandy Loam (305B) with 3 ~ 8% slopes & (307B) with 0 ~ 8% slopes classified as Hydrologic Soil Group "C".

A copy of the *National Resources Conservation Service* (NRCS) Soils Map, listed area soil types are included as **Appendix C.**

On-Site Soil Testing:

May 13, 2022 Soil Testing – O'Driscoll Land Surveying, Inc. (Daniel O'Driscoll, PLS, LSE)

On May 13, 2022 O'Driscoll Land Surveying, Inc. completed six (6) on-site soil test pits within the proposed project area. The purpose of these test pits was to verify the ESHGW and soil conditions within the proposed stormwater management areas.

Depth to Groundwater:

Estimated seasonal high groundwater (ESHGW) elevations based on soil mottling are as follows:

TH - 1	**TH - 2**	**TH - 3**	**TH – 4**	**TH - 6**
ESHGW = 42"	**ESHGW=48"**	**ESHGW = 48"**	**ESHGW = 78"**	**ESHGW =54"**

TH – 5 did not contain mottling as the excavator encountered shallow refusal.

Soil Conditions:

Test pit TH – 1 was excavated in the northern portion of the proposed paved storage yard to approximately 5 ft. below ground surface (b.g.s.). Soil testing results are consistent with the NRCS mapping for sandy loam with an ESHGW located approximately 3.5 ft. b.g.s. Refusal was encountered at 5 ft. b.g.s.

Test pit TH - 2 was excavated in the central portion of the proposed paved storage yard to approximately 7 ft. b.g.s. Soil testing results were also consistent with the NRCS mapping for sandy loam with an ESHGW located approximately 4' b.g.s. Refusal was encountered at 7.25 ft. b.g.s.

Test pit TH – 3 was excavated at the entrance of the proposed paved storage yard to approximately 8.5' below grade. Soils were consistent with NRCS mapping for sandy loam with ESHGW at 4'b.g.s.

Test pit TH – 4 was excavated in the location of the proposed customer parking area to approximately 6.5' b.g.s. Soils were consistent with NRCS mapping for sandy loam. Mottling was observed at the bottom of the excavation, therefore indicating ESHGW at 6.5' b.g.s.

Test pit TH – 5 was excavated in the westerly portion of the site to approximately 30" b.g.s. Soils were consistent with the rest of the site with sandy loam. Shallow refusal was encountered in this test pit at 30" b.g.s.

Test pit TH – 6 was excavated in the location of the proposed stormwater basin to approximately 6.5' b.g.s. Soils encountered in the test pit were loamy sands with ESHGW at 4.5' b.g.s.

Copies of Site Soil Investigation Data are also included in **Appendix C**.

Soil Permeability (k):
Based upon on-site classification by a State of Massachusetts Licensed Soil Evaluator Daniel O'Driscoll, PLS, Site subsurface soils within the development area are classified as a "sandy loam". Sandy loams correlate to a "B" type soil classification within the Rawls Rate soil permeability table, therefore the drainage design permeability has been identified as follows:

Design permeability (k) values of Type "B" Soils:
***k* = 1.02 in / hr** (Rawls Rate: Type "B" Soils) Sandy Loam

Existing Conditions:

The existing site currently consists of one industrial zoned property located at #698 Main Street with an area of 8.94 Acres. The parcel consists of undeveloped woodland with bordering vegetated wetlands located in the central portion of the site. The site topography pitches towards the Route 20 right-of-way which abuts the southern portion of the site. There is one (1) stormwater outfall location for the site:

Outfall 1S – Main Street Approximately 86,000 s.f. of the undeveloped woodland site discharges stormwater runoff, via overland flow, to the Main Street (Route 20) right-of-way. No existing stormwater BMP's are present on-site to treat and convey existing stormwater flows. Stormwater runoff entering the Main Street right-of-way is captured and conveyed the Mass DOT owned drainage system. Based on limited information obtained from Mass DOT as-built plans and ortho imagery, the drainage system appears to eventually discharge into East Brimfield Reservoir or one of its associated tributaries.

Outfall 2S – Bordering Vegetated Wetlands The remaining 18,700 +/- s.f. of the undeveloped woodland site discharge to a bordering vegetated wetland located in the southeastern portion of the site. As previously stated, the site does not currently employ stormwater management structures to treat and convey existing stormwater flows. The wetlands eventually discharge to East Brimfield Reservoir.

Proposed Conditions:

The project Applicant is proposing to construct a 7,000 s.f. metal building to be used as a towing operation. A paved parking area will be located along the front of the proposed building and a paved storage yard will be located on the eastern side of the proposed building. The proposed storage yard will be used to store fleet vehicles, impounded vehicles, and equipment and will be categorized as a Land Use with Higher Potential Pollutant Load (LUHPPL). Specific LUHPPL stormwater treatment technologies will be used for stormwater runoff associated with the storage yard. CMG is proposing the following Stormwater Management System for the Site in order to meet the MA-DEP Stormwater Management Standards for a new development project.

Outfall 1S – Main Street Subcatchment 1A consists of the proposed paved storage area, which is considered a LUHPPL. Per the Massachusetts Stormwater Handbook, the area categorized as a LUHPPL will need to utilize specific BMP's to capture potential hazardous material and also provide extensive TSS removal prior to infiltration. The paved storage area will utilize a combination of a deep-sump hooded catch basin and a Hydroworks water quality unit to capture and treat stormwater runoff from the LUHPPL. Stormwater flows will then be discharged to an off-line oil/ water separator to capture any potential release of oil from the storage yard. Once treated, flows from the oil/ water separator are then discharged to a stormwater basin located along the front of the site. During larger storm events, a majority of the stormwater flows will by-pass the oil/water separator to an underground infiltration system located underneath the front parking area. An overflow pipe will then convey stormwater to the infiltration basin located along the front portion of the site. An overflow broad crested weir will then discharge stormwater flows into the Route 20 right-of-way, which will be collected via the existing drainage system.

Subcatchment 1B consists of the proposed paved customer parking area located in the front of the proposed building. Stormwater flows will be captured and treated via a trench drain and Hydroworks water quality unit and then conveyed to the proposed infiltration basin located along the front portion of the site.

Subcatchment 1C consists of the front stormwater basin along the Route 20 right-of-way. During larger storm events, the basin will discharge stormwater flows into the Route 20 drainage system.

Subcatchment 1D consists of the remaining portion of the paved access driveway not conveyed or treated by the on-site stormwater management system. Stormwater runoff from this subcatchment will flow via overland flow to the Route 20 drainage system.

Stormwater runoff associated with the proposed building roof area will be collected and conveyed to the proposed stormwater basin via underground piping.

Outfall 2S – Bordering Vegetated Wetlands Subcatchment 2A consists of the remaining undeveloped portion of woodland located in the southwest portion of the site. A majority of this subcatchment falls within the jurisdictional wetland buffers, including a 25' "no disturb" buffer. As a result, a majority of this subcatchment will remain undeveloped woodland with a smaller area used to accommodate site grading. Stormwater runoff from this subcatchment will discharge via overland flow to the wetlands located in the southeast corner of the site.

Proposed Stormwater Management System:

Proposed "Interstate Towing" Facility:

- Deep sump hooded catch basins collect runoff for site's impervious and landscaped areas.
- An off-line 4,500-gallon oil grit separator treats stormwater runoff for paved storage area.
- Two (2) Hydrostorm water quality units treats stormwater runoff for the proposed paved parking and storage areas.
- A proposed underground infiltration system is proposed under the proposed customer parking area to enhance groundwater recharge on-site.
- A proposed stormwater infiltration basin will be utilized prior to stormwater discharges into the Route 20 right-of-way.
- Site Long-term Operation and Maintenance plan is provided for the Site.

MA-DEP Stormwater Management Standards:

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

Proposed Full Compliance:

- **Combination of on-site stormwater BMPs including deep sump catch basins with hoods, oil-grit separators, and water quality units provide treatment for on-site stormwater prior to discharge to Outfall 1S.**

STANDARD 2: (Peak rate control and flood prevention):
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.

Proposed Full Compliance:

- **No proposed increase to post-development Site peak runoff and Site is not in the 100-year flood plain.**

STANDARD 3: (Recharge to Groundwater):

Loss of annual recharge to ground water 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 conditions based on soil type. This Standard is met when the storm water management system is design to infiltrate the required recharge volume as determined in accordance with the Massachusetts Storm water Handbook.

Proposed Full Compliance:

- **The site will be utilizing a combination of underground infiltration chambers and a stormwater infiltration basin to meet the required recharge.**
- **Site specific BMPs are utilized to treat stormwater runoff associated with LUHPPL's prior to discharging to infiltration practices.**

STANDARD 4: (TSS Removal):

Stormwater management systems must be designed to remove 80% of the average annual post construction load of Total Suspended Solids (TSS).

Proposed Full Compliance:

- **Outfall 1S –will achieve minimum 96% TSS removal through a combination of; water quality units, an oil/ grit separator, and a stormwater infiltration basin.**
- **A "Long Term Operation and Maintenance Plan" is being provided as Appendix H.**

STANDARD 5: (Higher Potential Pollutant Loads (LUHPPL)):

For land uses with higher potential pollutant loads, source control and pollution prevention shall be implemented in accordance with the Massachusetts Storm water Handbook to eliminate or reduce the discharge of storm water 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, or storm water runoff, the proponent shall use the specific storm water BMP's determined by the Department to be suitable for such use as provided in the Massachusetts Storm water Handbook.

Proposed Full Compliance:

- **The stormwater management design incorporates increased stormwater volumes (1") as required in LUHPPL areas by incorporating the following.**
- **The site will utilize water quality units and a 2,000-gallon oil grit separator to achieve TSS removal and provide oil storage in the case of a spill.**
- **Long Term Pollution Prevention Plan is included in Stormwater Management Report, Appendix H.**

STANDARD 6: (Critical Areas)

Storm water discharges to a Zone II or Interim Wellhead Protection Area of a public water supply and storm water discharges near or any other critical area require the use of the specific storm water best management practices determined by the Department to be suitable for managing discharges to such area as provided in the Massachusetts Storm water Handbook.

Proposed Full Compliance:

- **The site does not appear to lie within a Zone II, Interim Wellhead Protection Area, or any other critical area.**

STANDARD 7: (Redevelopment)

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

Proposed Full Compliance:

- **Site is considered new development and will meet all applicable Stormwater Management Standards.**

STANDARD 8: (Erosion, Sediment Control):
A plan to control construction related impacts including erosion sedimentation and other pollution prevention sources during construction and land disturbance activities (construction period erosion, sedimentation, and pollution prevention plan) must be implemented.

Proposed Full Compliance:

- **The "Erosion and Sedimentation Control Plan" Sheet C-4.0 and "Erosion and Sediment Control Details" Sheet C-4.1 are incorporated into the Plan Set.**
- **Project will disturb > 1 Acre, therefore an EPA–NPDES Stormwater General Permit is required prior to construction and will be accompanied with a comprehensive SWPP Plan.**

STANDARD 9: (Operation and Maintenance):
A long-term operation and maintenance plan must be developed and implemented to ensure that storm water management systems function as designed.

Proposed Full Compliance:

- **Long Term Operation and Maintenance Plan is included in Stormwater Management Report, Appendix H.**

STANDARD 10: (Illicit Discharges):
All illicit discharges to the stormwater management system are prohibited.

Proposed Full Compliance:

- A signed "illicit discharge compliance statement" will be provided as part of the final "Storm water Management System Long-Term Operation & Maintenance Plan".

A copy of the "MA-DEP Checklist for Stormwater Report" is included as **Appendix A**.

Table No. 1 provides a summary of off-site Pre- and Post-Development peak runoff flow rates and volumes**.**

Table No. 2 provides a summary of the subcatchment drainage area calculations.

Appendix D & E includes the complete Pre-Development and Post-Development *HydroCAD* drainage calculation reports and **Figures D-1 and D-2 "Pre- "and "Post-Development Drainage Areas" plans**.

Appendix F provides additional stormwater calculations.

Appendix G provides the Manufacturer's Design Report for the two Hydrostorm Water Quality Units.

Appendix H provides a DRAFT "Long Term Stormwater Operation & Maintenance Plan"

The complete Site Plans for the **"Proposed "Interstate Towing" Facility - #698 Main Street, Sturbridge, MA" prepared by CMG Engineering, dated 10/11/2022** (or latest version) provide details of the complete storm water management system design**.** Please note these plans are subject to review and approval by two (2) separate Town Boards including: the Sturbridge Conservation Commission & Planning Board.

TABLE 1

PRE- VS. POST-DEVELOPMENT STORMWATER RUNOFF SUMMARY

TABLE NO. 1

10/12/2022

STORMWATER RUNOFF PEAK FLOW SUMMARY
PROPOSED INTERSTATE TOWING FACILITY
#698 MAIN ST
STURBRIDGE, MA

Pre-Existing Site Development (Fig D1) Conditions					
		2-Year	10-Year	25-Year	100-Year
1S - EX. CATCH BASIN (RT. 20)	*Peak Flow (cfs)*	*1.43*	*3.44*	*4.49*	*6.55*
2S - WETLANDS	*Peak Flow (cfs)*	*0.40*	*0.95*	*1.23*	*1.79*

Proposed - Site Development (Fig D2) Conditions					
1S - EX. CATCH BASIN (RT. 20)	*Peak Flow (cfs)*	*0.48*	*2.56*	*4.44*	*6.43*
2S - WETLANDS	*Peak Flow (cfs)*	*0.33*	*0.79*	*1.04*	*1.51*

TABLE 2

SUBCATCHMENT DRAINAGE AREA CALCULATIONS

TABLE NO. 2
DRAINAGE AREA CALCULATIONS
PROPOSED INTERSTATE TOWING FACILITY
#698 MAIN STREET
STURBRIDGE, MA

PRE-DEVELOPMENT DRAINAGE AREAS (s.f.)

On-Site	Soil Type C						Watershed
Area	Impervious	Gravel	Grass/Ldscp	Woods			Total
1				19,266			19,266
2				85,480			85,480
							Total
	0	0	0	104,746			**104,746 s.f.**
				Total Site Area=	104,746	s.f.	**2.40** Ac
Total Impervious=		**0 s.f.**			2.40	Ac	
Total Open Space =		**104,746 s.f.**					

POST-DEVELOPMENT DRAINAGE AREAS (s.f.)

On-Site	Soil Type C						Watershed
Area	Impervious	Gravel	Grass/Ldscp	Woods			Total
1a	32,770		15,547				48,317
1b	6,282		3,924				10,206
1c			4,828				4,828
1d	3,546		6,082	6,083			15,711
BLD	7,000						7,000
2a				18,684			18,684
							0
							Total
	49,598	0	30,381	24,767			***104,746 s.f.***
				Total Site Area=	104,746	s.f.	**2.40** Ac
Total Impervious=		**49,598 s.f.**			2.40	Ac	
Total Open Space =		**55,148 s.f.**					

Note:

[1] All Drainage Areas are calculated using CAD Software based on Pre- & Post Development Drainage Plans prepared by CMG date 10/10/22

Appendix A

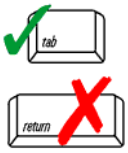
MA-DEP Stormwater Checklist

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

Checklist for Stormwater Report

A. Introduction

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



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

The Stormwater Report must include:

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

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

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

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

[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

11-30-22
10-11-22

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.

Appendix B

USGS FIGURE
FEMA Flood Plain Mapping

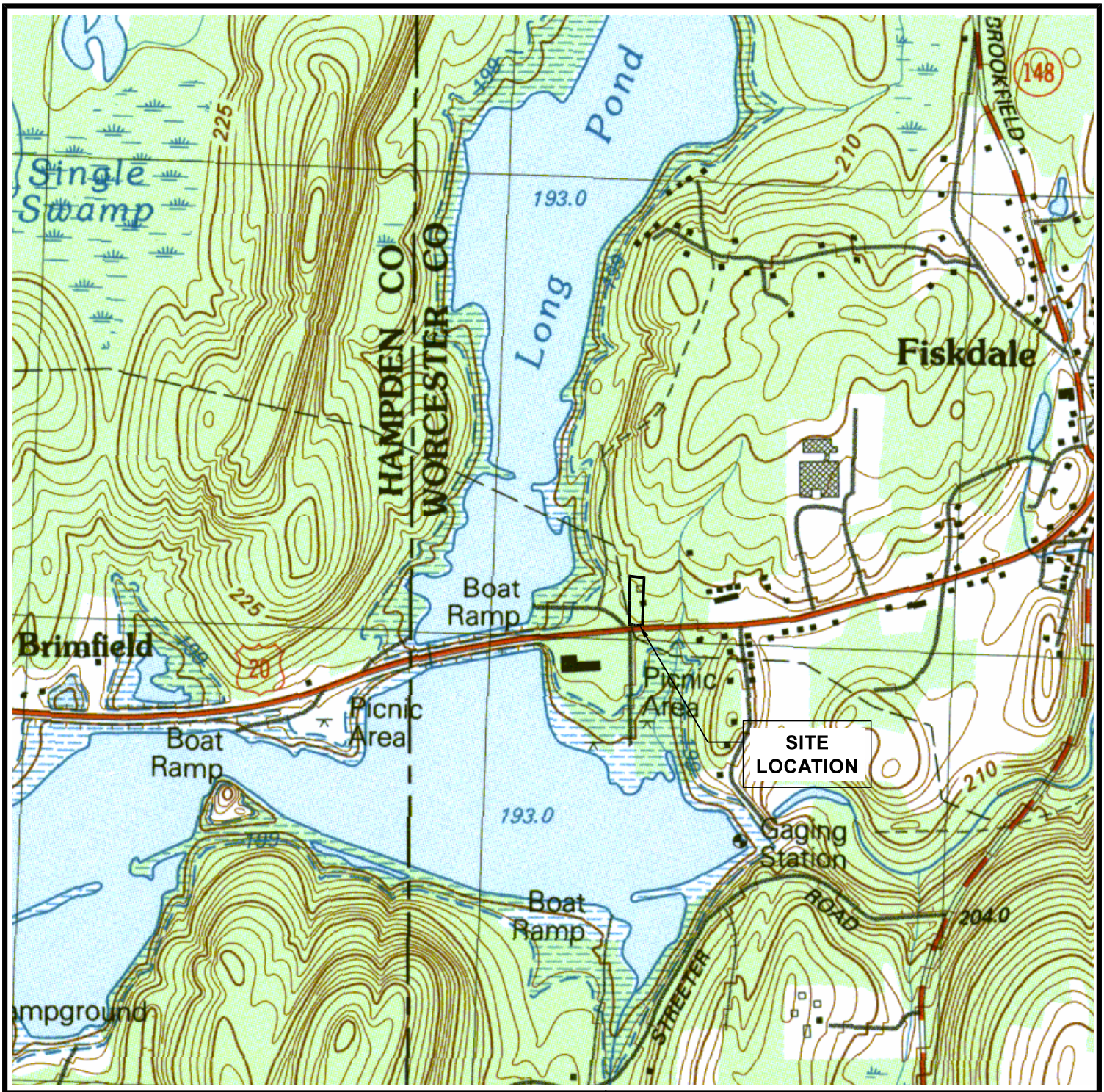


FIGURE 1: SITE LOCATION

698 MAIN STREET
STURBRIDGE, MA 01566
CMG ID 2022-035

SCALE 1" = 1,000'

1000 FT 0 1000 FT

ENVIRONMENTAL SERVICES

CMG EST. 2002

ENGINEERING SERVICES

67 HALL ROAD. STURBRIDGE MA 01566

National Flood Hazard Layer FIRMette

FEMA

72°8'3"W 42°7'4"N

72°7'25"W 42°6'38"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 2/16/2022 at 3:00 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

Appendix C

NCRS Soil Mapping
&
On-Site Soil Testing Logs

Map Scale: 1:3,010 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 40 80 160 240

Feet: 0 100 200 400 600

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Worcester County, Massachusetts, Southern Part
Survey Area Data: Version 14, Sep 3, 2021

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

Date(s) aerial images were photographed: May 18, 2019—Jul 9, 2019

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
102C	Chatfield-Hollis-Rock outcrop complex, 0 to 15 percent slopes	1.6	6.3%
305B	Paxton fine sandy loam, 3 to 8 percent slopes	8.4	33.3%
307B	Paxton fine sandy loam, 0 to 8 percent slopes, extremely stony	12.4	49.0%
307E	Paxton fine sandy loam, 15 to 35 percent slopes, extremely stony	2.9	11.4%
Totals for Area of Interest		**25.3**	**100.0%**

Worcester County, Massachusetts, Southern Part

305B—Paxton fine sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2t2qp
Elevation: 0 to 1,570 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Paxton and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Paxton

Setting

Landform: Ground moraines, drumlins, hills
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Nose slope, side slope, crest
Down-slope shape: Convex, linear
Across-slope shape: Convex
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Ap - 0 to 8 inches: fine sandy loam
Bw1 - 8 to 15 inches: fine sandy loam
Bw2 - 15 to 26 inches: fine sandy loam
Cd - 26 to 65 inches: gravelly fine sandy loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 18 to 39 inches to densic material
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 18 to 37 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 3.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s

Hydrologic Soil Group: C
Ecological site: F144AY007CT - Well Drained Dense Till Uplands
Hydric soil rating: No

Minor Components

Woodbridge
Percent of map unit: 9 percent
Landform: Ground moraines, drumlins, hills
Landform position (two-dimensional): Summit, backslope, footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Ridgebury
Percent of map unit: 6 percent
Landform: Hills, drainageways, depressions, ground moraines
Landform position (two-dimensional): Toeslope, backslope, footslope
Landform position (three-dimensional): Base slope, head slope, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Charlton
Percent of map unit: 5 percent
Landform: Hills
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Data Source Information

Soil Survey Area: Worcester County, Massachusetts, Southern Part
Survey Area Data: Version 14, Sep 3, 2021

Worcester County, Massachusetts, Southern Part

307B—Paxton fine sandy loam, 0 to 8 percent slopes, extremely stony

Map Unit Setting

National map unit symbol: 2w675
Elevation: 0 to 1,580 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Paxton, extremely stony, and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Paxton, Extremely Stony

Setting

Landform: Ground moraines, hills, drumlins
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex, linear
Across-slope shape: Linear, convex
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Oe - 0 to 2 inches: moderately decomposed plant material
A - 2 to 10 inches: fine sandy loam
Bw1 - 10 to 17 inches: fine sandy loam
Bw2 - 17 to 28 inches: fine sandy loam
Cd - 28 to 67 inches: gravelly fine sandy loam

Properties and qualities

Slope: 0 to 8 percent
Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: 20 to 43 inches to densic material
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 18 to 37 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: C
Ecological site: F144AY007CT - Well Drained Dense Till Uplands
Hydric soil rating: No

Minor Components

Woodbridge, extremely stony

Percent of map unit: 10 percent
Landform: Hills, drumlins, ground moraines
Landform position (two-dimensional): Summit, backslope, footslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Charlton, extremely stony

Percent of map unit: 5 percent
Landform: Hills
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Ridgebury, extremely stony

Percent of map unit: 4 percent
Landform: Drumlins, drainageways, depressions, ground moraines, hills
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Head slope, base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Whitman, extremely stony

Percent of map unit: 1 percent
Landform: Depressions
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: Worcester County, Massachusetts, Southern Part
Survey Area Data: Version 14, Sep 3, 2021

Commonwealth of Massachusetts
City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review *(minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: 5/22-1 (Hole #) | May 13, 2022 (Date) | 9:10 (Time) | Cldy 60's (Weather) | _____ (Latitude) | _____ (Longitude)

1. Land Use: Vacant lot (e.g., woodland, agricultural field, vacant lot, etc.) | wooded (Vegetation) | visible boulders (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 5 (Slope (%))

Description of Location: _____

2. Soil Parent Material: Ice Contact Outwash | Moraine (Landform) | Side slope (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body N/A feet | Drainage Way N/A feet | Wetlands N/A feet
Property Line TBD feet | Drinking Water Well _____ feet | Other _____ feet

4. Unsuitable Materials Present: ☒ Yes ☐ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☒ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: _____ Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-12	A	Loam	10 YR 3/3								
12-18	Bw	Sandy Loam	10 YR 6/6								
18-60	C1	Sandy Loam	10 YR 4/6	42"	5 YR 5/8		10%	10%	loose		
60+	Cr										

Additional Notes:
Refusal at 60"

Commonwealth of Massachusetts
City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review *(minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: 5/22-2 (Hole #) | May 13, 2022 (Date) | 9:30 (Time) | Cldy 60's (Weather) | _____ (Latitude) | _____ (Longitude)

1. Land Use: Vacant lot (e.g., woodland, agricultural field, vacant lot, etc.) | wooded (Vegetation) | visible boulders (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 5 (Slope (%))

Description of Location: _____

2. Soil Parent Material: Ice Contact Outwash | Moraine (Landform) | Side slope (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body N/A feet | Drainage Way N/A feet | Wetlands N/A feet | Property Line TBD feet | Drinking Water Well _____ feet | Other _____ feet

4. Unsuitable Materials Present: ☒ Yes ☐ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☒ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: _____ Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-10	A	Loam	10 YR 3/3								
10-16	Bw	Sandy Loam	10 YR 6/6								
16-87	C1	Sandy Loam	10 YR 4/6	48"	10 YR 6/6		10%	20%	loose		
87+	Cr										

Additional Notes:
Refusal at 87"

Commonwealth of Massachusetts
City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review *(minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: 5/22-3 (Hole #) | May 13, 2022 (Date) | 8:40 (Time) | Cldy 60's (Weather) | _____ (Latitude) | _____ (Longitude)

1. Land Use: Vacant lot (e.g., woodland, agricultural field, vacant lot, etc.) | wooded (Vegetation) | visible boulders (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 5 (Slope (%))

Description of Location: _____

2. Soil Parent Material: Ice Contact Outwash | Moraine (Landform) | Side slope (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body N/A feet | Drainage Way N/A feet | Wetlands N/A feet | Property Line TBD feet | Drinking Water Well _____ feet | Other _____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 84" Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-12	A	Loam	10 YR 3/3								
12-26	Bw	Sandy Loam	10 YR 6/6								
26-102	C1	Sandy Loam	10 YR 4/4	48"	10 YR 5/6	20%	20%	20%	loose		

Additional Notes:

Commonwealth of Massachusetts
City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review *(minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: 5/22-4 (Hole #) | May 13, 2022 (Date) | 8:25 (Time) | Cldy 60's (Weather) | _____ (Latitude) | _____ (Longitude:)

1. Land Use: Vacant lot (e.g., woodland, agricultural field, vacant lot, etc.) | wooded (Vegetation) | visible boulders (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 5 (Slope (%))

Description of Location: _____

2. Soil Parent Material: Ice Contact Outwash | Moraine (Landform) | Side slope (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body N/A feet | Drainage Way N/A feet | Wetlands N/A feet | Property Line TBD feet | Drinking Water Well _____ feet | Other _____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: _____ Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-60	HTM	Fill									
60-114	C1	Sandy Loam	10 YR 5/4	78"	5 YR 5/8	>20%	20%	30%	loose		

Additional Notes:

Commonwealth of Massachusetts
City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review *(minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: 5/22-5 (Hole #) | May 13, 2022 (Date) | 10:20 (Time) | Cldy 60's (Weather) | _____ (Latitude) | _____ (Longitude)

1. Land Use: Vacant lot (e.g., woodland, agricultural field, vacant lot, etc.) | wooded (Vegetation) | visible boulders (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 5 (Slope (%))

Description of Location: _____

2. Soil Parent Material: Ice Contact Outwash | Moraine (Landform) | Side slope (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body N/A feet | Drainage Way N/A feet | Wetlands N/A feet | Property Line TBD feet | Drinking Water Well _____ feet | Other _____ feet

4. Unsuitable Materials Present: ☒ Yes ☐ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-9	A	Loam	10 YR 3/3								
9-12	Bw	Sandy Loam	10 YR 6/6								
12-30	Cr	Bedrock									

Additional Notes:
Refusal 12-30"

Commonwealth of Massachusetts
City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review *(minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: 5/22-6 (Hole #) | May 13, 2022 (Date) | 10:55 (Time) | Cldy 60's (Weather) | _____ (Latitude) | _____ (Longitude:)

1. Land Use: Vacant lot (e.g., woodland, agricultural field, vacant lot, etc.) | wooded (Vegetation) | visible boulders (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 5 (Slope (%))

Description of Location: _____

2. Soil Parent Material: Ice Contact Outwash | Moraine (Landform) | Side slope (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body N/A feet | Drainage Way N/A feet | Wetlands N/A feet
Property Line TBD feet | Drinking Water Well _____ feet | Other _____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: _____ Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-10	A	Loam	10 YR 3/3								
10-24	Bw	Sandy Loam	10 YR 6/6								
24-78	C1	Loamy Sand	5 YR 5/6	54"	10 YR 5/8	>20%		30%	loose		

Additional Notes:

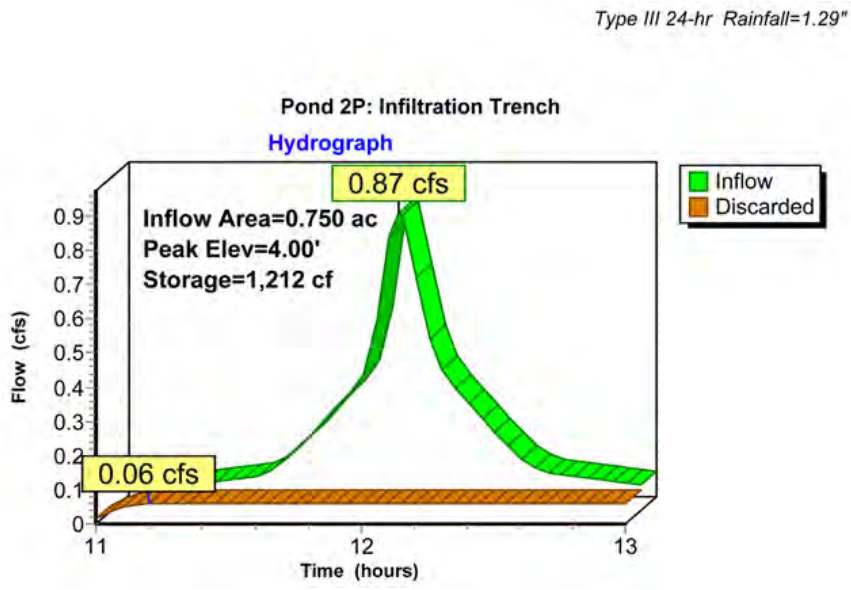


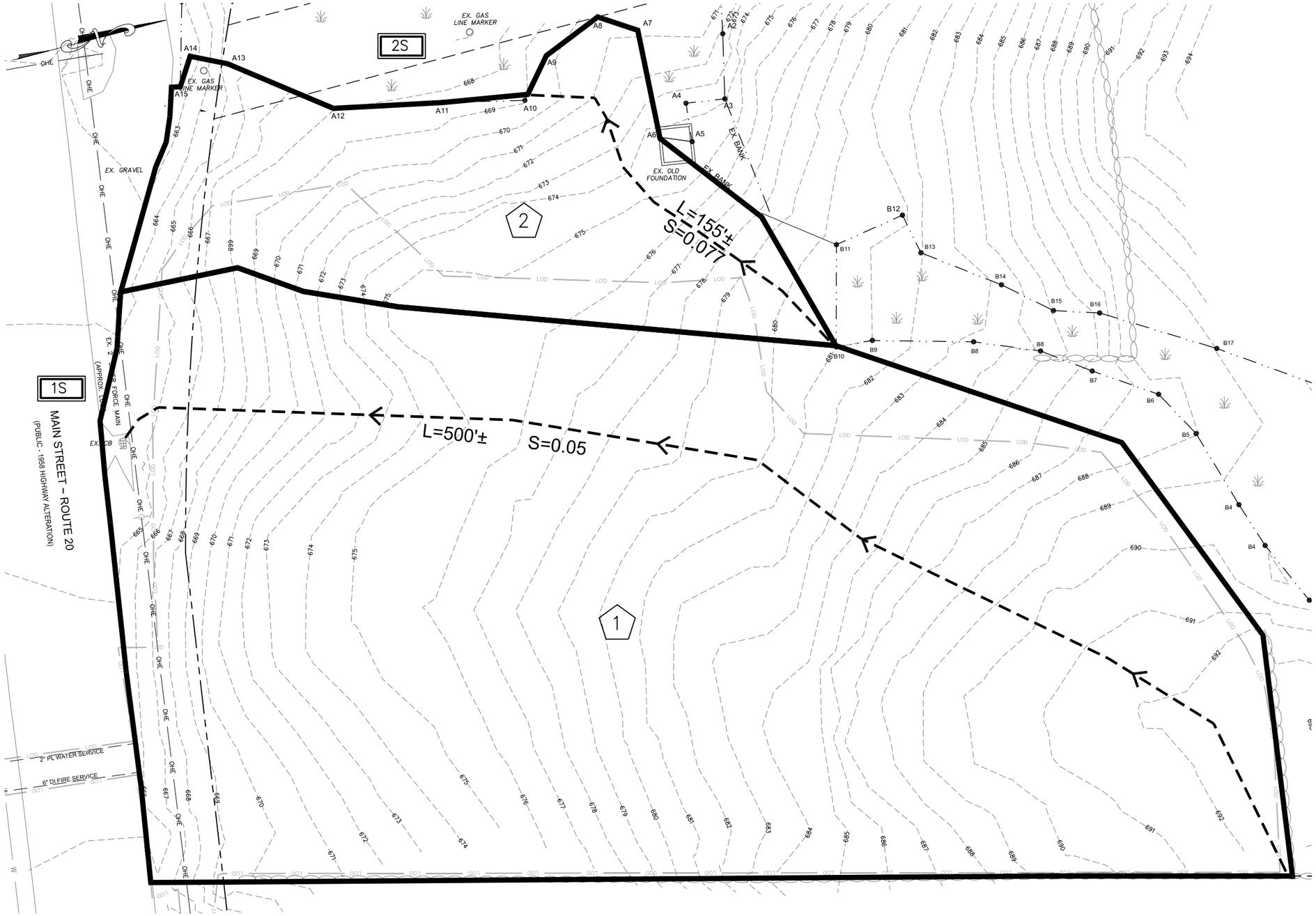
Table 2.3.3. 1982 Rawls Rates[18]

Texture Class	NRCS Hydrologic Soil Group (HSG)	Infiltration Rate Inches/Hour
Sand	A	8.27
Loamy Sand	A	2.41
Sandy Loam	B	1.02
Loam	B	0.52
Silt Loam	C	0.27
Sandy Clay Loam	C	0.17
Clay Loam	D	0.09
Silty Clay Loam	D	0.06
Sandy Clay	D	0.05
Silty Clay	D	0.04
Clay	D	0.02

[18] Rawls, Brakensiek and Saxton, 1982

Appendix D

Pre-Development Drainage Calculations



LEGEND

- 100 — EXISTING CONTOURS
- (A) WATERSHED SUBCATCHMENT
- 1S OFF-SITE STORMWATER OUTFALL LOCATION
- WATERSHED BOUNDARY
- TIME OF CONCENTRATION FLOW PATH
- TP#1 TEST PIT LOCATION

GRAPHIC SCALE

40 0 20 40 80

(IN FEET)

1 inch = 40 ft.

NO.	DATE	REVISIONS DESCRIPTION	BY	CKD

PROFESSIONAL SEAL

PROJECT:
PROPOSED "INTERSTATE TOWING" FACILITY
#698 MAIN STREET
STURBRIDGE, MA 01518

PREPARED FOR:
WRECKER, LLC.
1660 WESTOVER ROAD
CHICOPEE, MA 01020

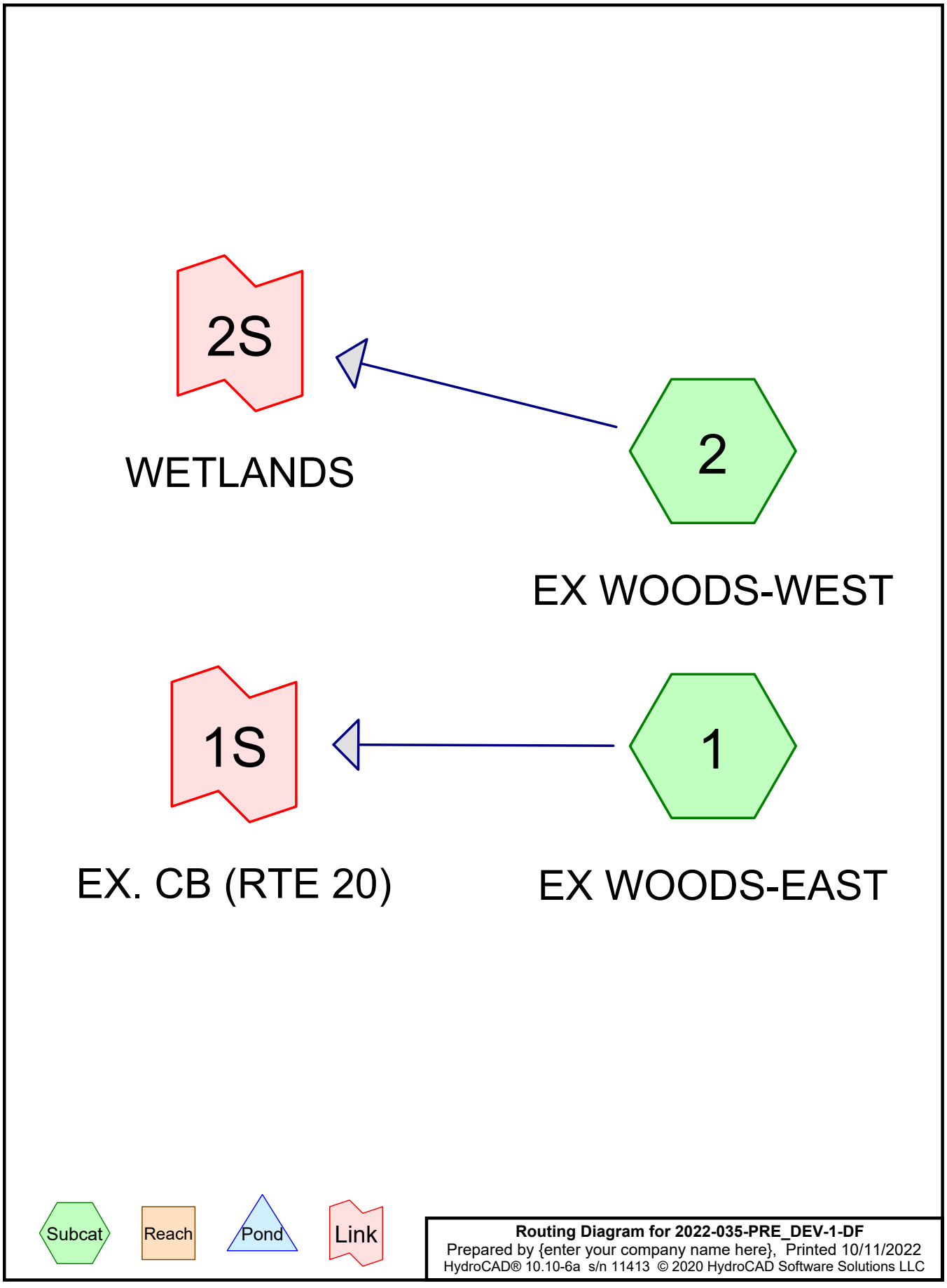
ENGINEERING SERVICES
ENVIRONMENTAL SERVICES
67 Hall Road
Sturbridge, MA 01560
Phone: 774-241-0901
fax: 774-241-0906

CMG EST. 2002

ISSUE DATE:	10/11/2022
DRAWN BY: RL	CHECKED BY: DF
SCALE:	1" = 40'
PROJECT NO.:	2022-035

SHEET NAME:
PRE-DEVELOPMENT DRAINAGE MAP

SHEET NO.:
D - 1.0



Routing Diagram for 2022-035-PRE_DEV-1-DF
Prepared by {enter your company name here}, Printed 10/11/2022
HydroCAD® 10.10-6a s/n 11413 © 2020 HydroCAD Software Solutions LLC

Time span=3.00-30.00 hrs, dt=0.03 hrs, 901 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 1: EX WOODS-EAST Runoff Area=85,480 sf 0.00% Impervious Runoff Depth=0.00"
Flow Length=500' Slope=0.0500 '/' Tc=10.9 min CN=70 Runoff=0.00 cfs 0.001 af

Subcatchment 2: EX WOODS-WEST Runoff Area=19,266 sf 0.00% Impervious Runoff Depth=0.00"
Tc=5.0 min CN=70 Runoff=0.00 cfs 0.000 af

Link 1S: EX. CB (RTE 20) Inflow=0.00 cfs 0.001 af
Primary=0.00 cfs 0.001 af

Link 2S: WETLANDS Inflow=0.00 cfs 0.000 af
Primary=0.00 cfs 0.000 af

Total Runoff Area = 2.405 ac Runoff Volume = 0.001 af Average Runoff Depth = 0.00"
100.00% Pervious = 2.405 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1: EX WOODS-EAST

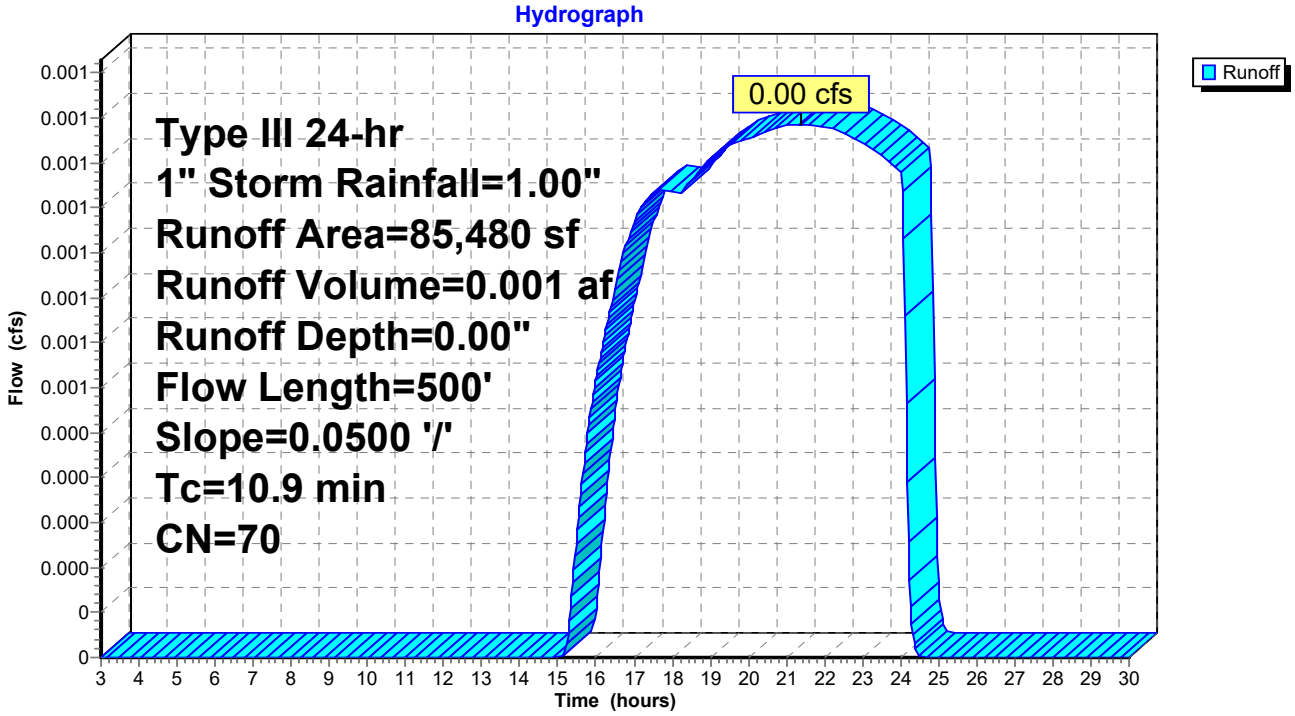
Runoff = 0.00 cfs @ 21.39 hrs, Volume= 0.001 af, Depth= 0.00"
Routed to Link 1S : EX. CB (RTE 20)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 3.00-30.00 hrs, dt= 0.03 hrs
Type III 24-hr 1" Storm Rainfall=1.00"

Area (sf)	CN	Description
85,480	70	Woods, Good, HSG C
85,480		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.9	500	0.0500	0.77		**Lag/CN Method, CN/LAG METHOD**

Subcatchment 1: EX WOODS-EAST



Summary for Subcatchment 2: EX WOODS-WEST

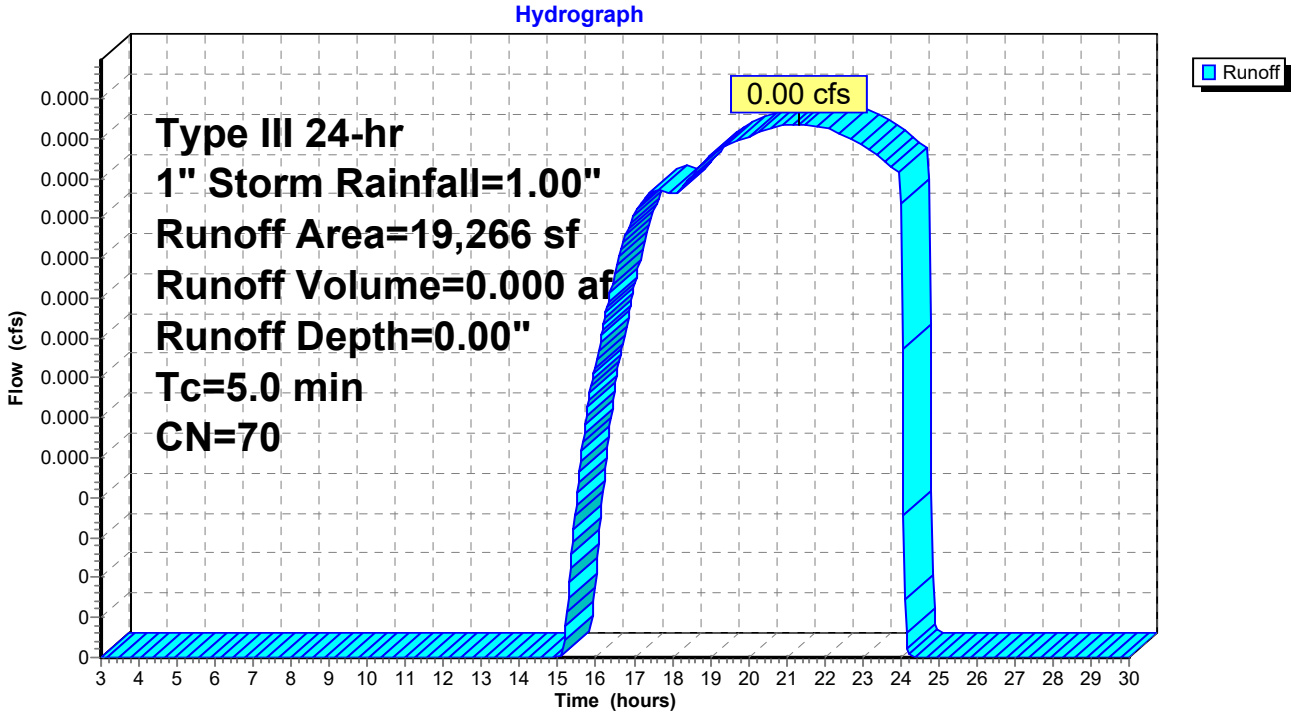
Runoff = 0.00 cfs @ 21.35 hrs, Volume= 0.000 af, Depth= 0.00"
Routed to Link 2S : WETLANDS

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 3.00-30.00 hrs, dt= 0.03 hrs
Type III 24-hr 1" Storm Rainfall=1.00"

Area (sf)	CN	Description
19,266	70	Woods, Good, HSG C
19,266		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Minimum Tc= 5 min.**

Subcatchment 2: EX WOODS-WEST

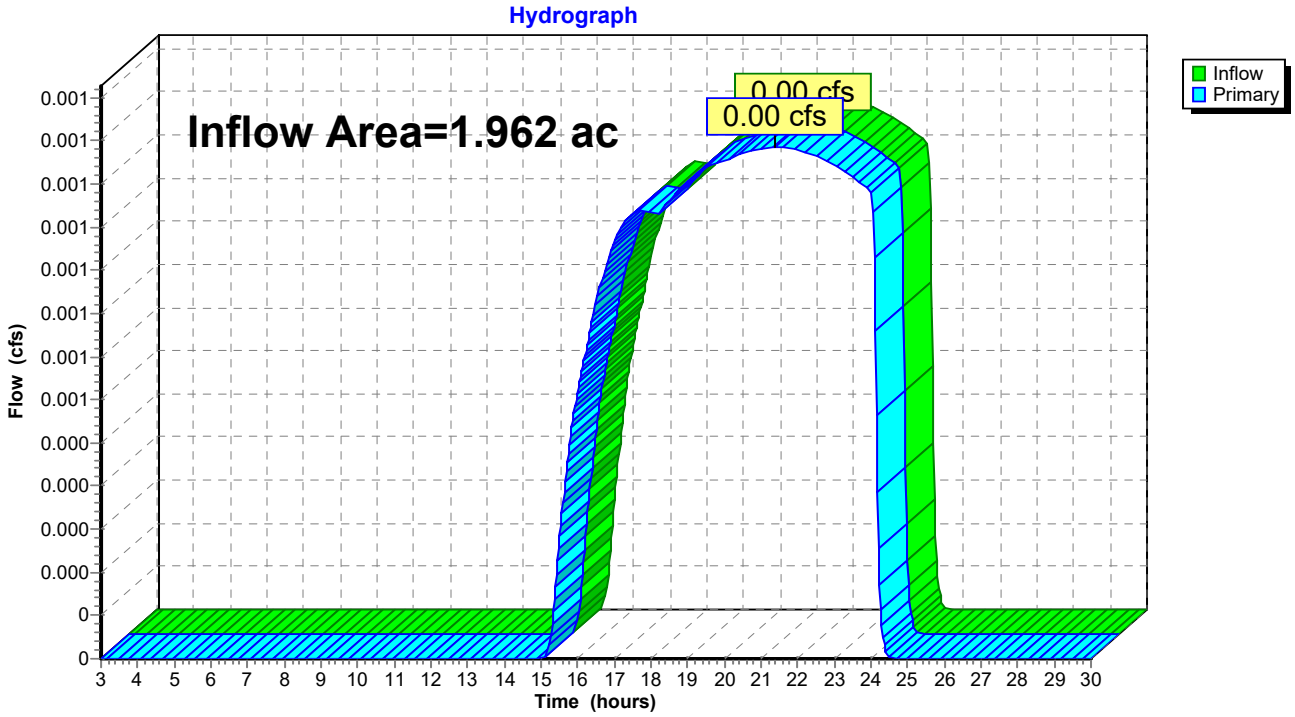


Summary for Link 1S: EX. CB (RTE 20)

Inflow Area = 1.962 ac, 0.00% Impervious, Inflow Depth = 0.00" for 1" Storm event
Inflow = 0.00 cfs @ 21.39 hrs, Volume= 0.001 af
Primary = 0.00 cfs @ 21.39 hrs, Volume= 0.001 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 3.00-30.00 hrs, dt= 0.03 hrs

Link 1S: EX. CB (RTE 20)

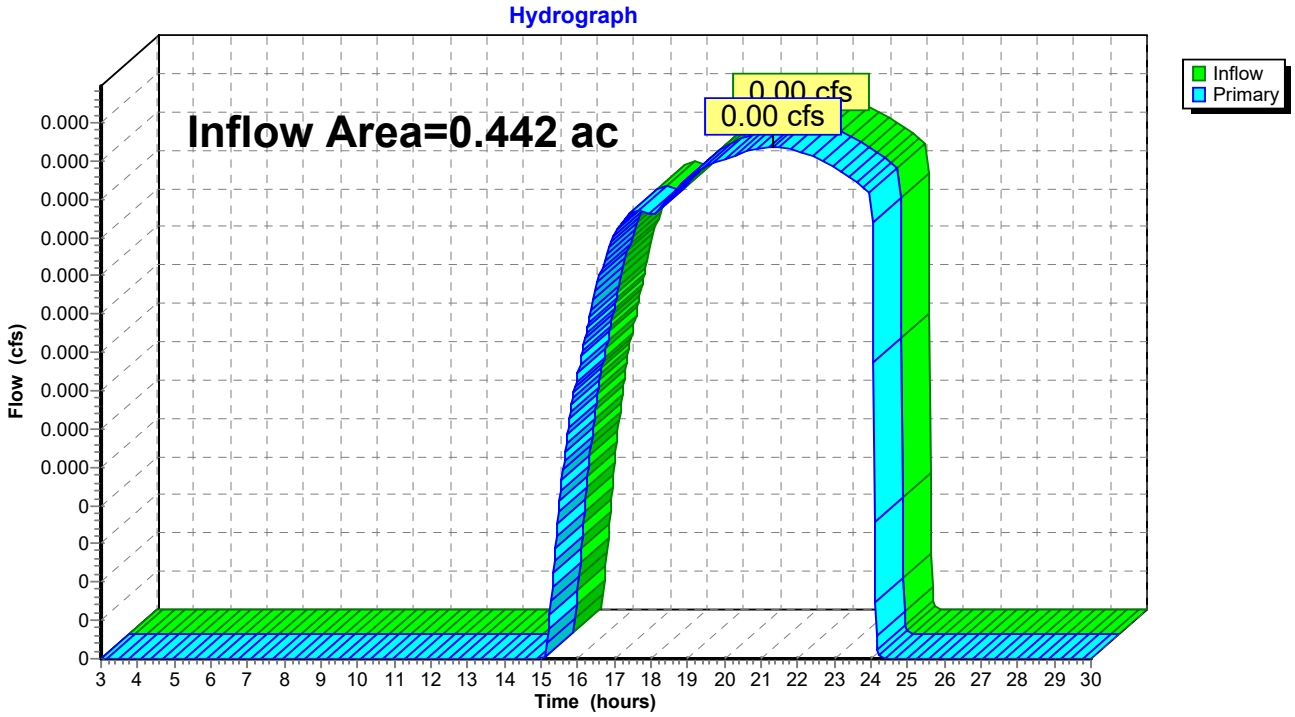


Summary for Link 2S: WETLANDS

Inflow Area = 0.442 ac, 0.00% Impervious, Inflow Depth = 0.00" for 1" Storm event
Inflow = 0.00 cfs @ 21.35 hrs, Volume= 0.000 af
Primary = 0.00 cfs @ 21.35 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 3.00-30.00 hrs, dt= 0.03 hrs

Link 2S: WETLANDS



Time span=3.00-30.00 hrs, dt=0.03 hrs, 901 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 1: EX WOODS-EAST Runoff Area=85,480 sf 0.00% Impervious Runoff Depth=0.83"
Flow Length=500' Slope=0.0500 '/' Tc=10.9 min CN=70 Runoff=1.43 cfs 0.135 af

Subcatchment 2: EX WOODS-WEST Runoff Area=19,266 sf 0.00% Impervious Runoff Depth=0.83"
Tc=5.0 min CN=70 Runoff=0.40 cfs 0.031 af

Link 1S: EX. CB (RTE 20) Inflow=1.43 cfs 0.135 af
Primary=1.43 cfs 0.135 af

Link 2S: WETLANDS Inflow=0.40 cfs 0.031 af
Primary=0.40 cfs 0.031 af

Total Runoff Area = 2.405 ac Runoff Volume = 0.166 af Average Runoff Depth = 0.83"
100.00% Pervious = 2.405 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1: EX WOODS-EAST

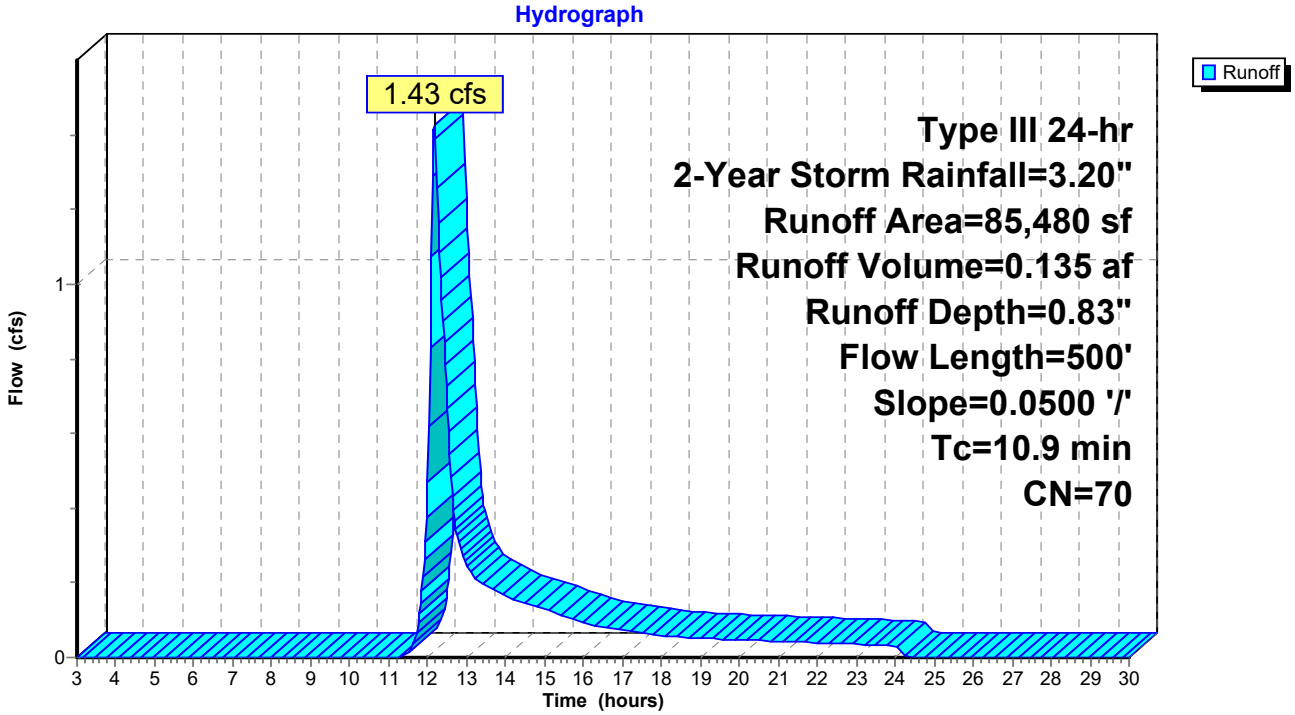
Runoff = 1.43 cfs @ 12.17 hrs, Volume= 0.135 af, Depth= 0.83"
Routed to Link 1S : EX. CB (RTE 20)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 3.00-30.00 hrs, dt= 0.03 hrs
Type III 24-hr 2-Year Storm Rainfall=3.20"

Area (sf)	CN	Description
85,480	70	Woods, Good, HSG C
85,480		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.9	500	0.0500	0.77		**Lag/CN Method, CN/LAG METHOD**

Subcatchment 1: EX WOODS-EAST



Summary for Subcatchment 2: EX WOODS-WEST

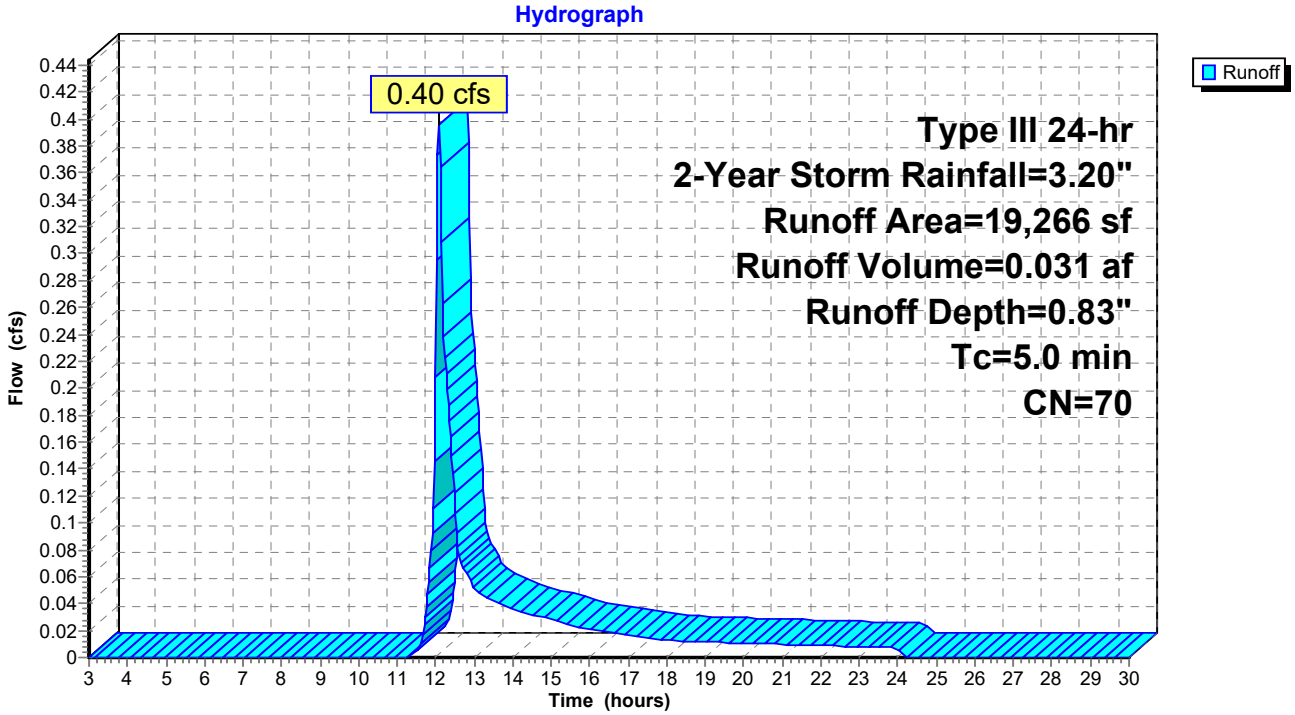
Runoff = 0.40 cfs @ 12.09 hrs, Volume= 0.031 af, Depth= 0.83"
Routed to Link 2S : WETLANDS

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 3.00-30.00 hrs, dt= 0.03 hrs
Type III 24-hr 2-Year Storm Rainfall=3.20"

Area (sf)	CN	Description
19,266	70	Woods, Good, HSG C
19,266		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Minimum Tc= 5 min.**

Subcatchment 2: EX WOODS-WEST

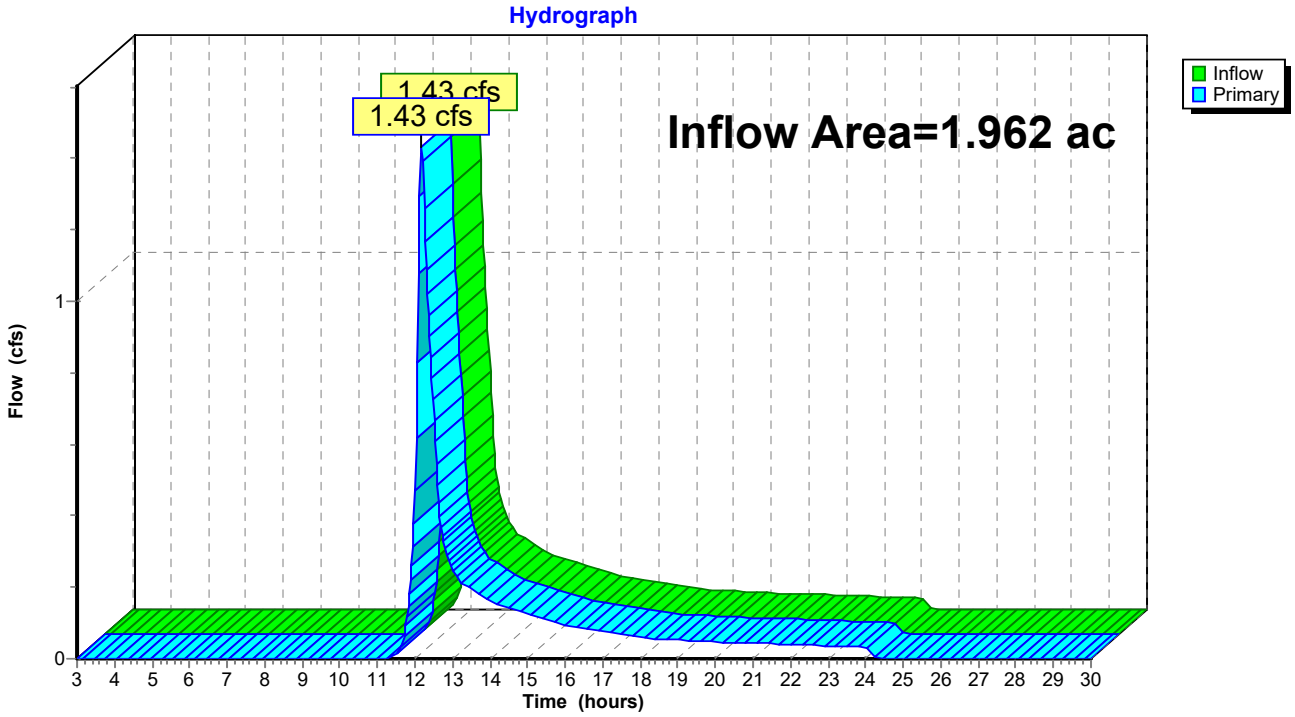


Summary for Link 1S: EX. CB (RTE 20)

Inflow Area = 1.962 ac, 0.00% Impervious, Inflow Depth = 0.83" for 2-Year Storm event
Inflow = 1.43 cfs @ 12.17 hrs, Volume= 0.135 af
Primary = 1.43 cfs @ 12.17 hrs, Volume= 0.135 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 3.00-30.00 hrs, dt= 0.03 hrs

Link 1S: EX. CB (RTE 20)

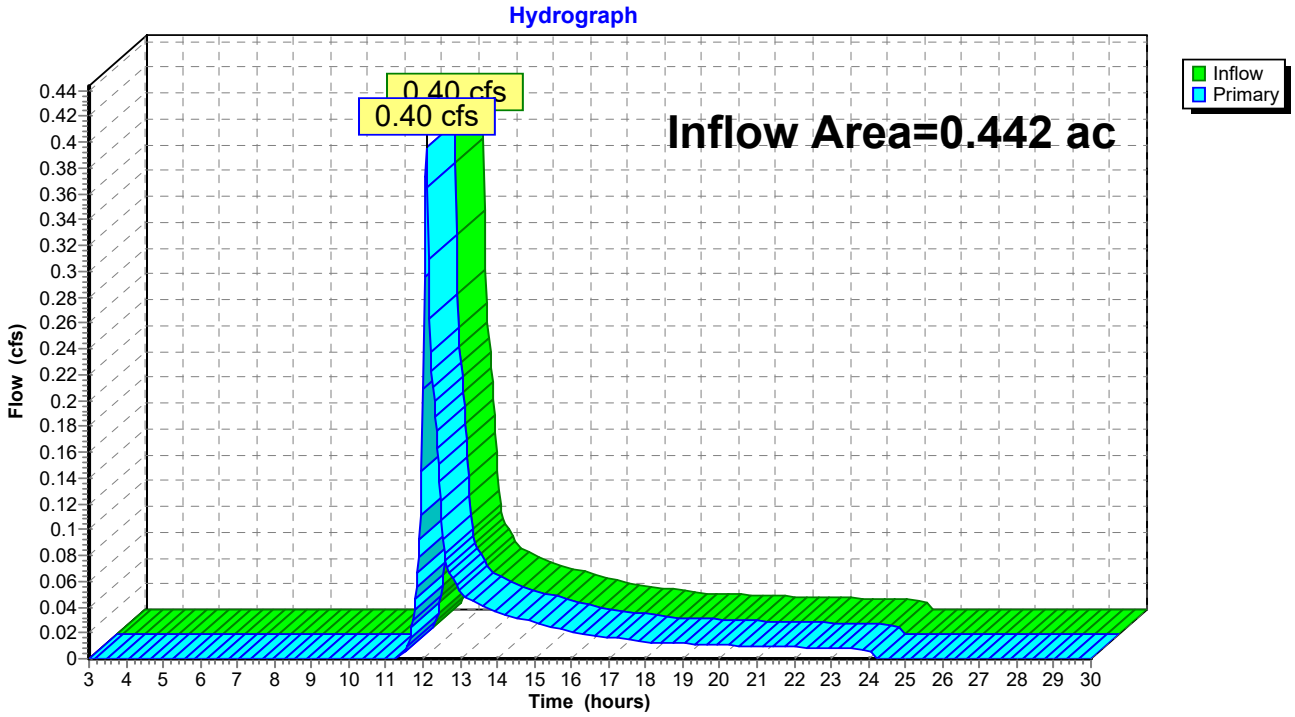


Summary for Link 2S: WETLANDS

Inflow Area = 0.442 ac, 0.00% Impervious, Inflow Depth = 0.83" for 2-Year Storm event
Inflow = 0.40 cfs @ 12.09 hrs, Volume= 0.031 af
Primary = 0.40 cfs @ 12.09 hrs, Volume= 0.031 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 3.00-30.00 hrs, dt= 0.03 hrs

Link 2S: WETLANDS



Time span=3.00-30.00 hrs, dt=0.03 hrs, 901 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 1: EX WOODS-EAST Runoff Area=85,480 sf 0.00% Impervious Runoff Depth=1.82"
Flow Length=500' Slope=0.0500 '/' Tc=10.9 min CN=70 Runoff=3.44 cfs 0.297 af

Subcatchment 2: EX WOODS-WEST Runoff Area=19,266 sf 0.00% Impervious Runoff Depth=1.82"
Tc=5.0 min CN=70 Runoff=0.95 cfs 0.067 af

Link 1S: EX. CB (RTE 20) Inflow=3.44 cfs 0.297 af
Primary=3.44 cfs 0.297 af

Link 2S: WETLANDS Inflow=0.95 cfs 0.067 af
Primary=0.95 cfs 0.067 af

Total Runoff Area = 2.405 ac Runoff Volume = 0.364 af Average Runoff Depth = 1.82"
100.00% Pervious = 2.405 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1: EX WOODS-EAST

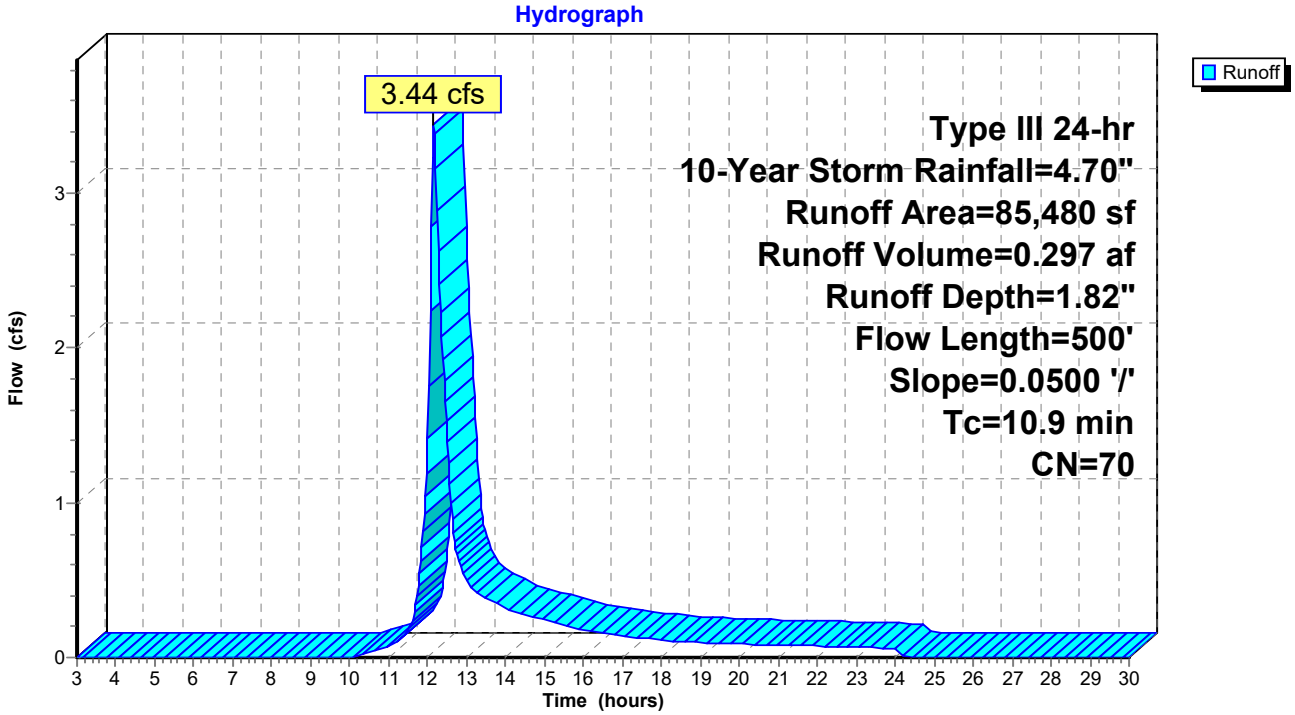
Runoff = 3.44 cfs @ 12.16 hrs, Volume= 0.297 af, Depth= 1.82"
Routed to Link 1S : EX. CB (RTE 20)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 3.00-30.00 hrs, dt= 0.03 hrs
Type III 24-hr 10-Year Storm Rainfall=4.70"

Area (sf)	CN	Description
85,480	70	Woods, Good, HSG C
85,480		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.9	500	0.0500	0.77		**Lag/CN Method, CN/LAG METHOD**

Subcatchment 1: EX WOODS-EAST



Summary for Subcatchment 2: EX WOODS-WEST

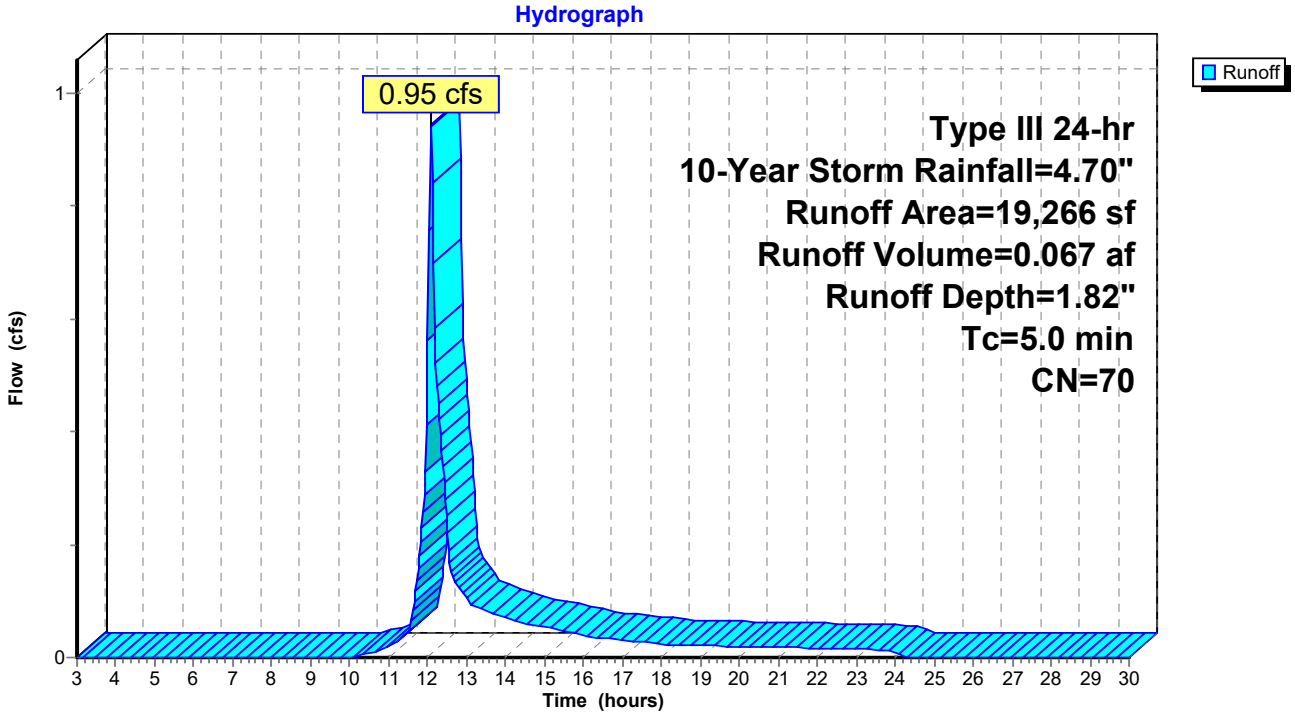
Runoff = 0.95 cfs @ 12.08 hrs, Volume= 0.067 af, Depth= 1.82"
Routed to Link 2S : WETLANDS

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 3.00-30.00 hrs, dt= 0.03 hrs
Type III 24-hr 10-Year Storm Rainfall=4.70"

Area (sf)	CN	Description
19,266	70	Woods, Good, HSG C
19,266		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Minimum Tc= 5 min.**

Subcatchment 2: EX WOODS-WEST

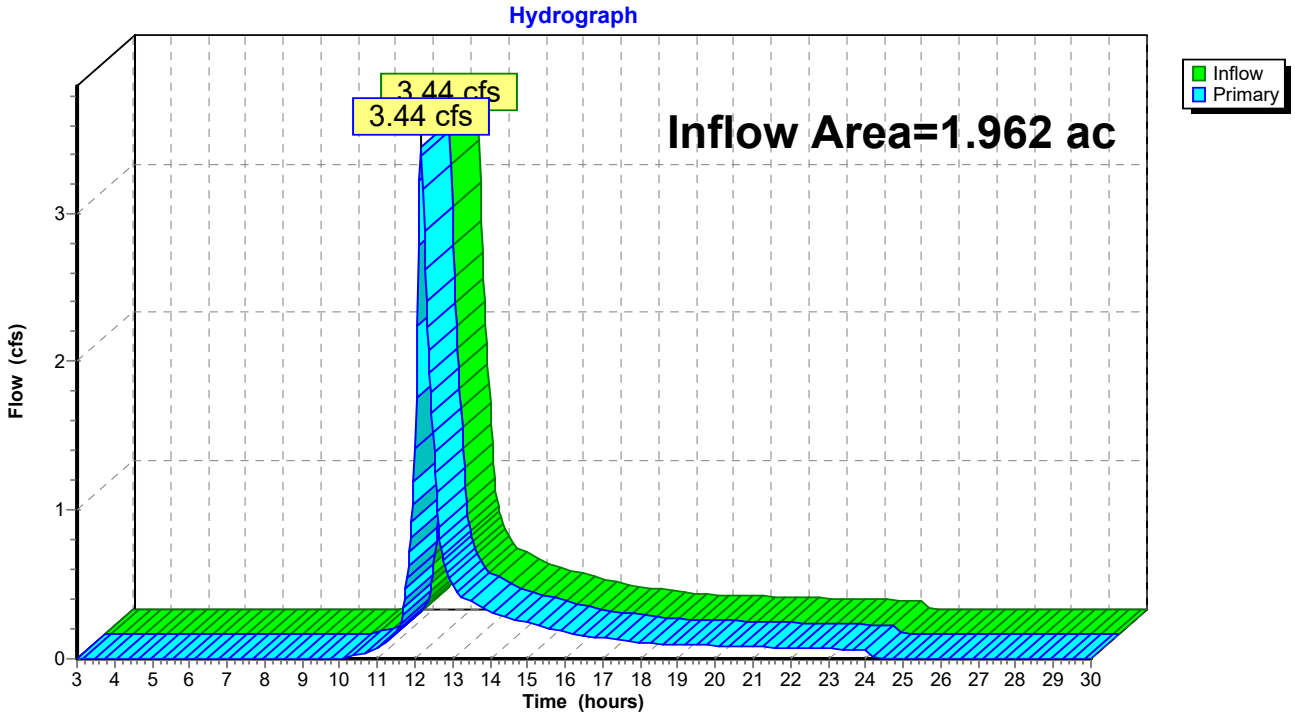


Summary for Link 1S: EX. CB (RTE 20)

Inflow Area = 1.962 ac, 0.00% Impervious, Inflow Depth = 1.82" for 10-Year Storm event
Inflow = 3.44 cfs @ 12.16 hrs, Volume= 0.297 af
Primary = 3.44 cfs @ 12.16 hrs, Volume= 0.297 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 3.00-30.00 hrs, dt= 0.03 hrs

Link 1S: EX. CB (RTE 20)

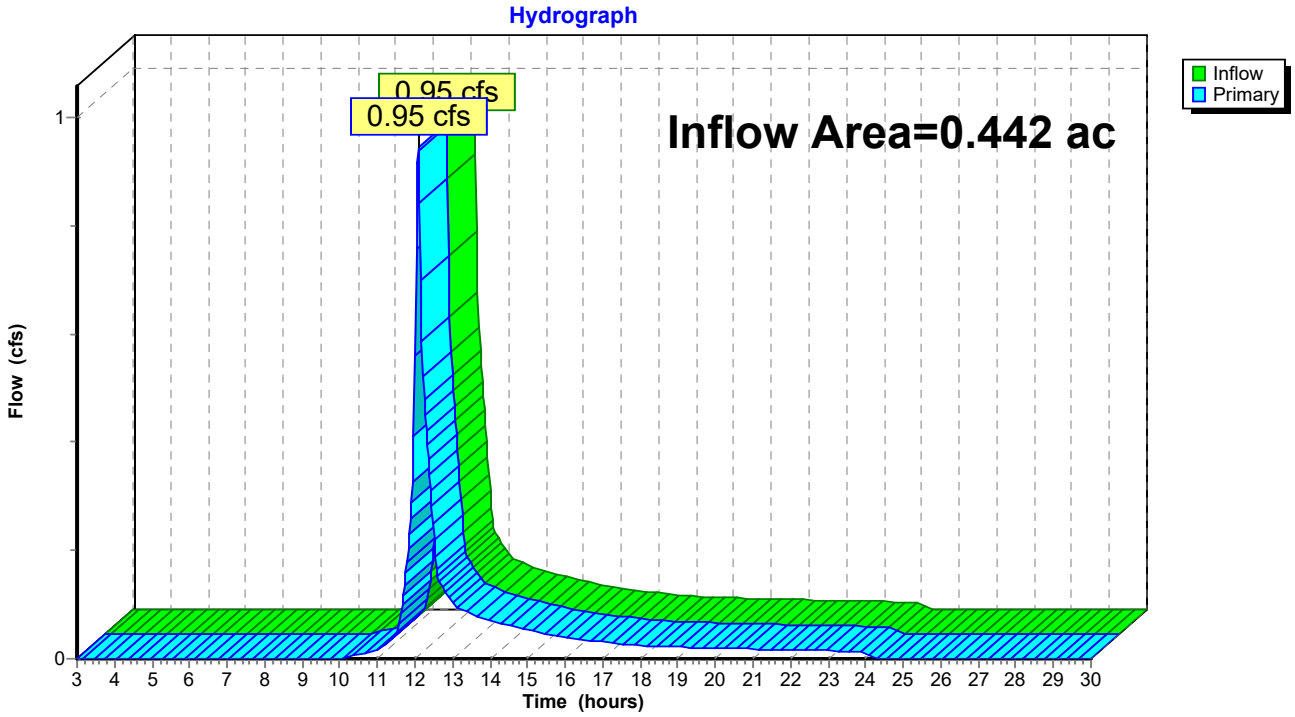


Summary for Link 2S: WETLANDS

Inflow Area = 0.442 ac, 0.00% Impervious, Inflow Depth = 1.82" for 10-Year Storm event
Inflow = 0.95 cfs @ 12.08 hrs, Volume= 0.067 af
Primary = 0.95 cfs @ 12.08 hrs, Volume= 0.067 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 3.00-30.00 hrs, dt= 0.03 hrs

Link 2S: WETLANDS



Time span=3.00-30.00 hrs, dt=0.03 hrs, 901 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 1: EX WOODS-EAST Runoff Area=85,480 sf 0.00% Impervious Runoff Depth=2.34"
Flow Length=500' Slope=0.0500 '/' Tc=10.9 min CN=70 Runoff=4.49 cfs 0.382 af

Subcatchment 2: EX WOODS-WEST Runoff Area=19,266 sf 0.00% Impervious Runoff Depth=2.34"
Tc=5.0 min CN=70 Runoff=1.23 cfs 0.086 af

Link 1S: EX. CB (RTE 20) Inflow=4.49 cfs 0.382 af
Primary=4.49 cfs 0.382 af

Link 2S: WETLANDS Inflow=1.23 cfs 0.086 af
Primary=1.23 cfs 0.086 af

Total Runoff Area = 2.405 ac Runoff Volume = 0.468 af Average Runoff Depth = 2.34"
100.00% Pervious = 2.405 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1: EX WOODS-EAST

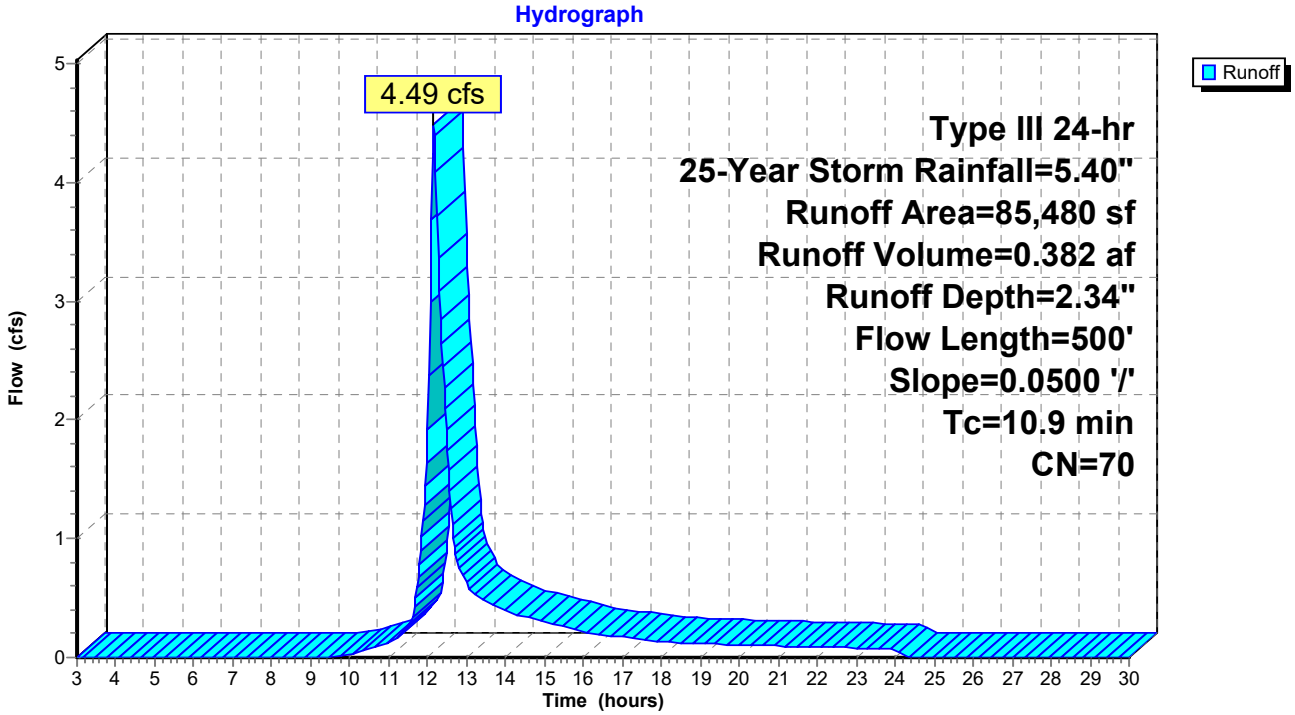
Runoff = 4.49 cfs @ 12.16 hrs, Volume= 0.382 af, Depth= 2.34"
Routed to Link 1S : EX. CB (RTE 20)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 3.00-30.00 hrs, dt= 0.03 hrs
Type III 24-hr 25-Year Storm Rainfall=5.40"

Area (sf)	CN	Description
85,480	70	Woods, Good, HSG C
85,480		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.9	500	0.0500	0.77		**Lag/CN Method, CN/LAG METHOD**

Subcatchment 1: EX WOODS-EAST



Summary for Subcatchment 2: EX WOODS-WEST

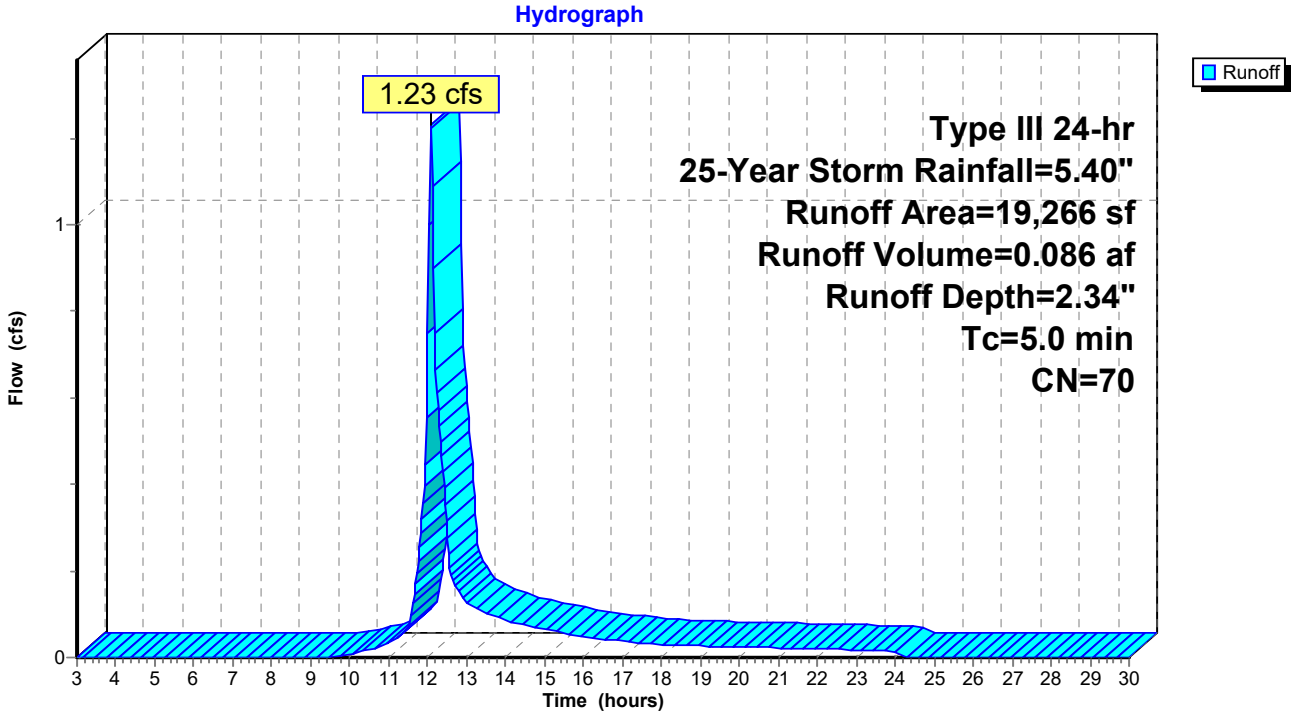
Runoff = 1.23 cfs @ 12.08 hrs, Volume= 0.086 af, Depth= 2.34"
Routed to Link 2S : WETLANDS

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 3.00-30.00 hrs, dt= 0.03 hrs
Type III 24-hr 25-Year Storm Rainfall=5.40"

Area (sf)	CN	Description
19,266	70	Woods, Good, HSG C
19,266		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Minimum Tc= 5 min.**

Subcatchment 2: EX WOODS-WEST

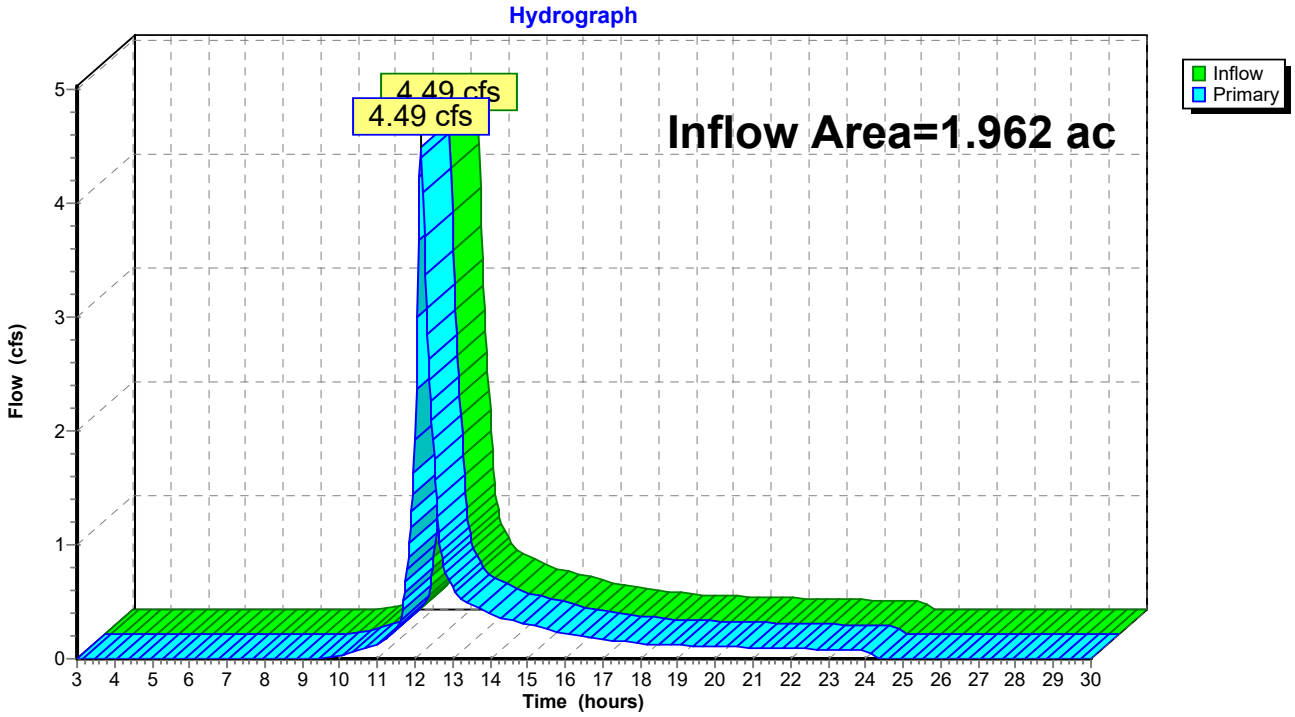


Summary for Link 1S: EX. CB (RTE 20)

Inflow Area = 1.962 ac, 0.00% Impervious, Inflow Depth = 2.34" for 25-Year Storm event
Inflow = 4.49 cfs @ 12.16 hrs, Volume= 0.382 af
Primary = 4.49 cfs @ 12.16 hrs, Volume= 0.382 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 3.00-30.00 hrs, dt= 0.03 hrs

Link 1S: EX. CB (RTE 20)

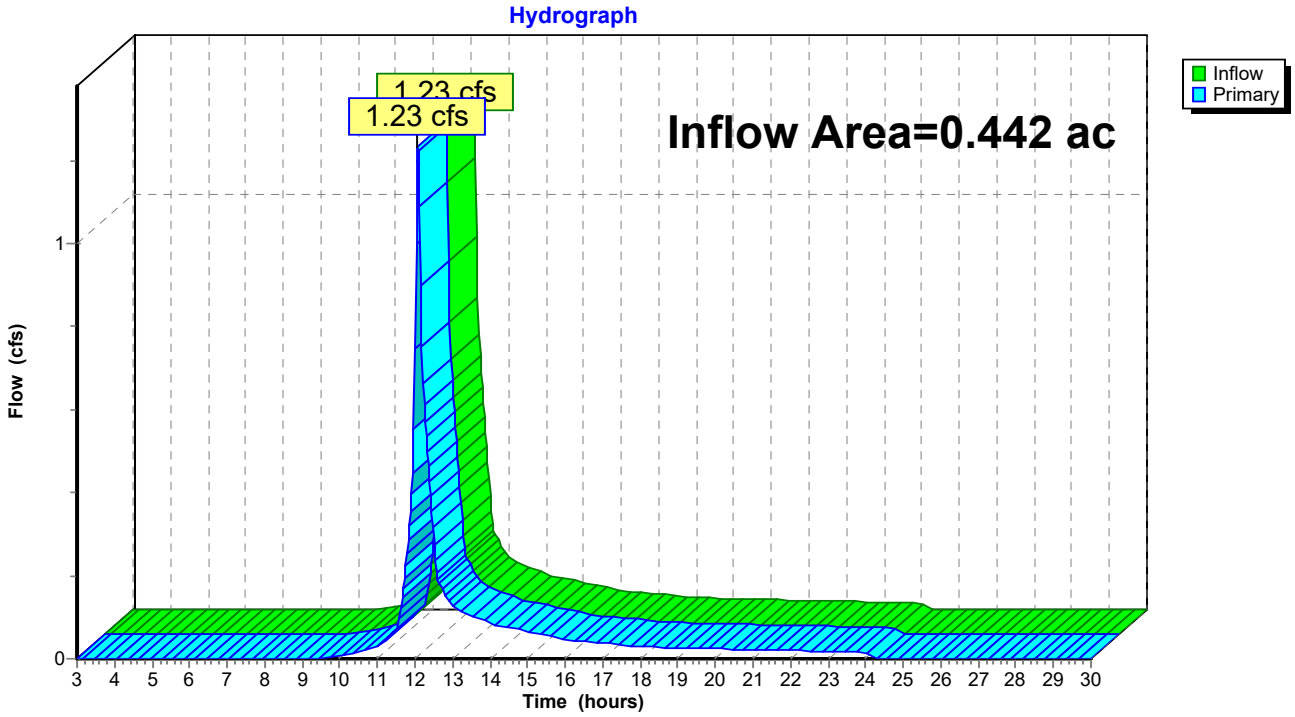


Summary for Link 2S: WETLANDS

Inflow Area = 0.442 ac, 0.00% Impervious, Inflow Depth = 2.34" for 25-Year Storm event
Inflow = 1.23 cfs @ 12.08 hrs, Volume= 0.086 af
Primary = 1.23 cfs @ 12.08 hrs, Volume= 0.086 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 3.00-30.00 hrs, dt= 0.03 hrs

Link 2S: WETLANDS



Time span=3.00-30.00 hrs, dt=0.03 hrs, 901 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 1: EX WOODS-EAST Runoff Area=85,480 sf 0.00% Impervious Runoff Depth=3.37"
Flow Length=500' Slope=0.0500 '/' Tc=10.9 min CN=70 Runoff=6.55 cfs 0.551 af

Subcatchment 2: EX WOODS-WEST Runoff Area=19,266 sf 0.00% Impervious Runoff Depth=3.37"
Tc=5.0 min CN=70 Runoff=1.79 cfs 0.124 af

Link 1S: EX. CB (RTE 20) Inflow=6.55 cfs 0.551 af
Primary=6.55 cfs 0.551 af

Link 2S: WETLANDS Inflow=1.79 cfs 0.124 af
Primary=1.79 cfs 0.124 af

Total Runoff Area = 2.405 ac Runoff Volume = 0.675 af Average Runoff Depth = 3.37"
100.00% Pervious = 2.405 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1: EX WOODS-EAST

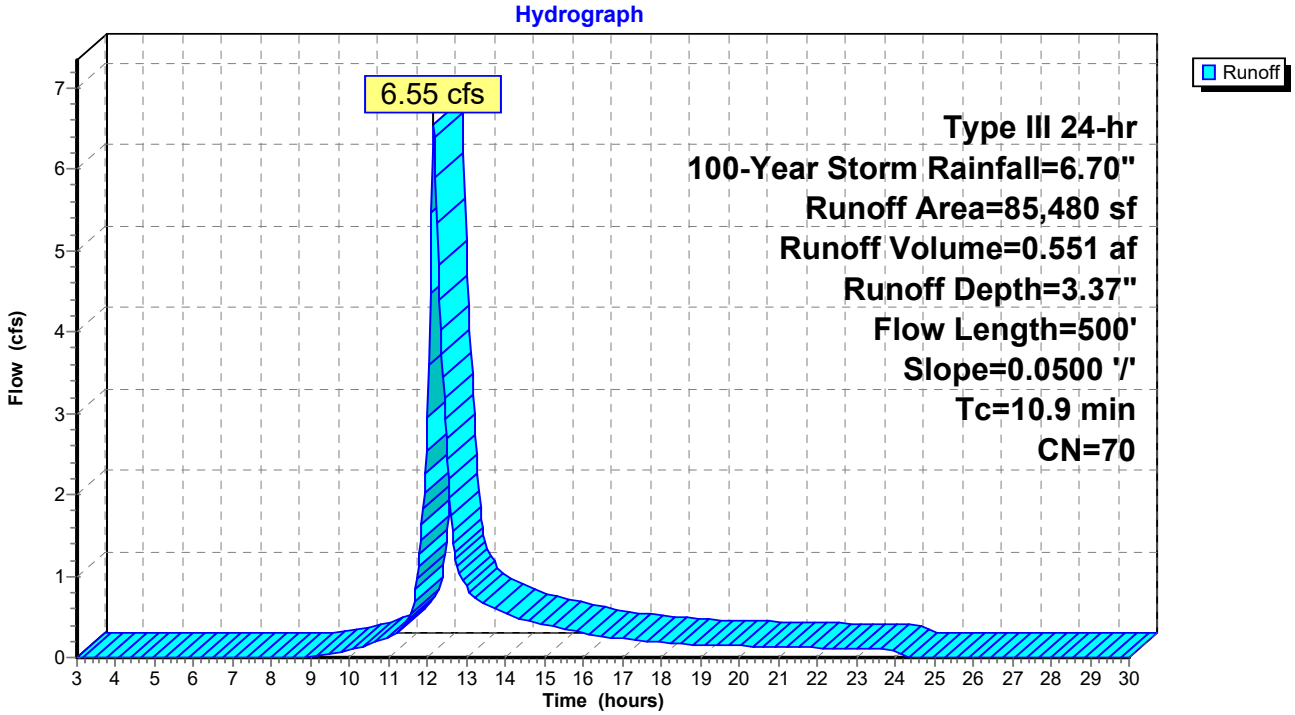
Runoff = 6.55 cfs @ 12.15 hrs, Volume= 0.551 af, Depth= 3.37"
Routed to Link 1S : EX. CB (RTE 20)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 3.00-30.00 hrs, dt= 0.03 hrs
Type III 24-hr 100-Year Storm Rainfall=6.70"

Area (sf)	CN	Description
85,480	70	Woods, Good, HSG C
85,480		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.9	500	0.0500	0.77		**Lag/CN Method, CN/LAG METHOD**

Subcatchment 1: EX WOODS-EAST



Summary for Subcatchment 2: EX WOODS-WEST

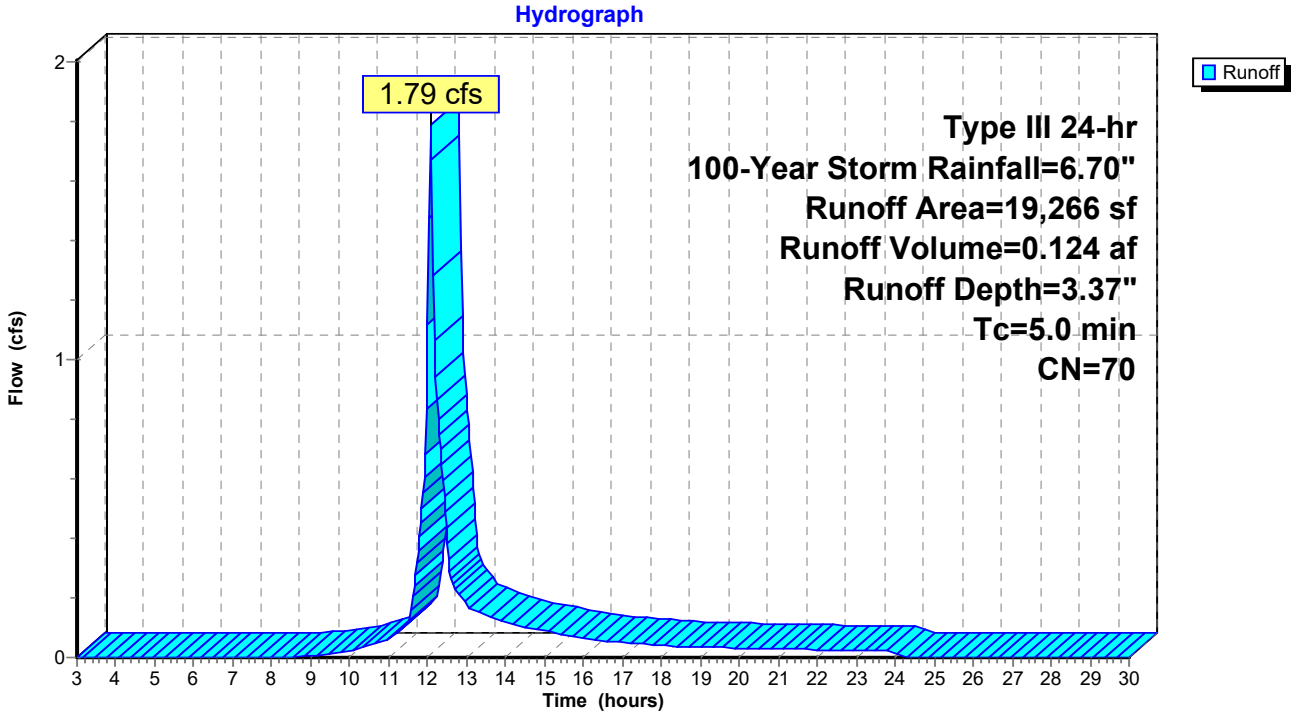
Runoff = 1.79 cfs @ 12.08 hrs, Volume= 0.124 af, Depth= 3.37"
Routed to Link 2S : WETLANDS

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 3.00-30.00 hrs, dt= 0.03 hrs
Type III 24-hr 100-Year Storm Rainfall=6.70"

Area (sf)	CN	Description
19,266	70	Woods, Good, HSG C
19,266		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Minimum Tc= 5 min.**

Subcatchment 2: EX WOODS-WEST

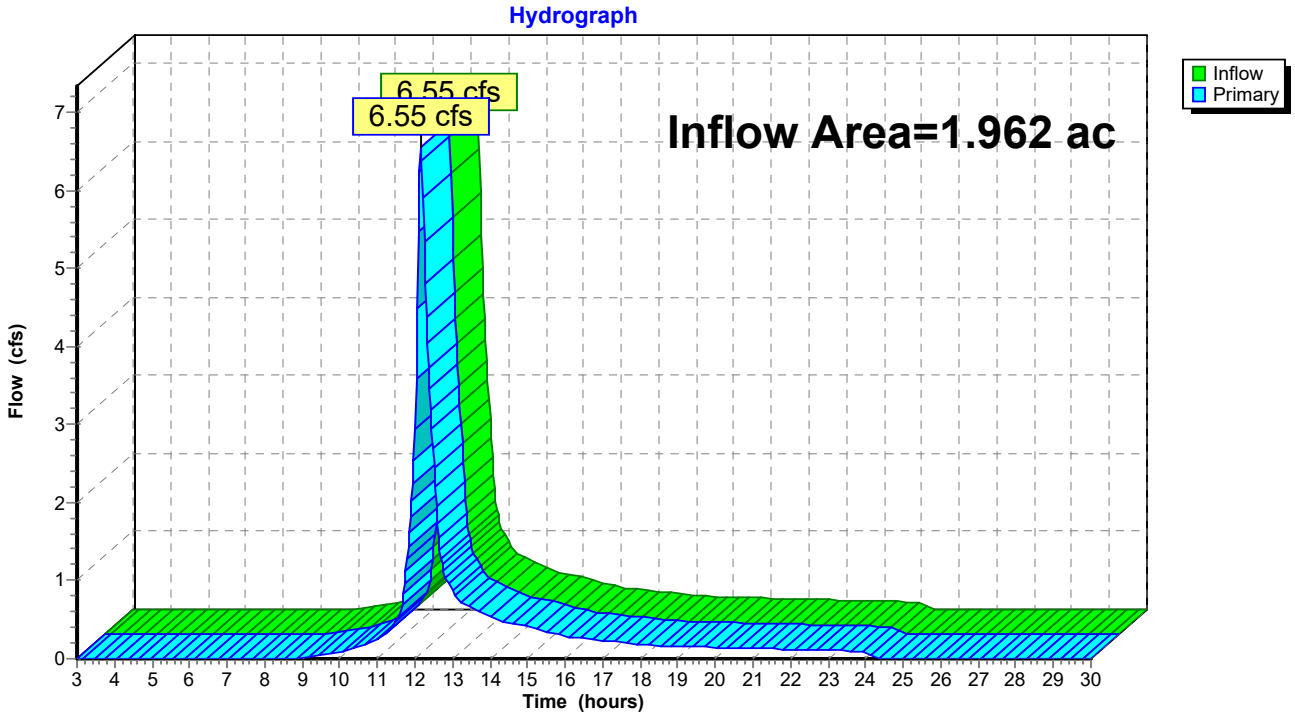


Summary for Link 1S: EX. CB (RTE 20)

Inflow Area = 1.962 ac, 0.00% Impervious, Inflow Depth = 3.37" for 100-Year Storm event
Inflow = 6.55 cfs @ 12.15 hrs, Volume= 0.551 af
Primary = 6.55 cfs @ 12.15 hrs, Volume= 0.551 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 3.00-30.00 hrs, dt= 0.03 hrs

Link 1S: EX. CB (RTE 20)

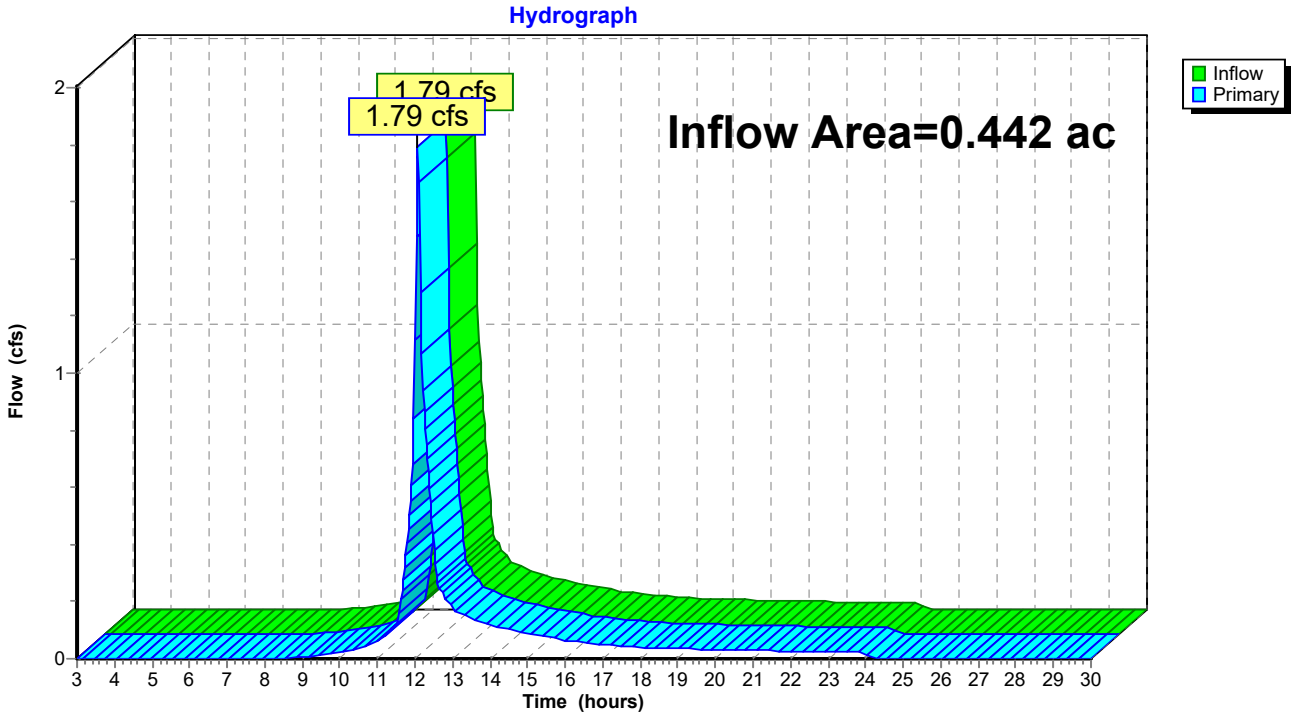


Summary for Link 2S: WETLANDS

Inflow Area = 0.442 ac, 0.00% Impervious, Inflow Depth = 3.37" for 100-Year Storm event
Inflow = 1.79 cfs @ 12.08 hrs, Volume= 0.124 af
Primary = 1.79 cfs @ 12.08 hrs, Volume= 0.124 af, Atten= 0%, Lag= 0.0 min

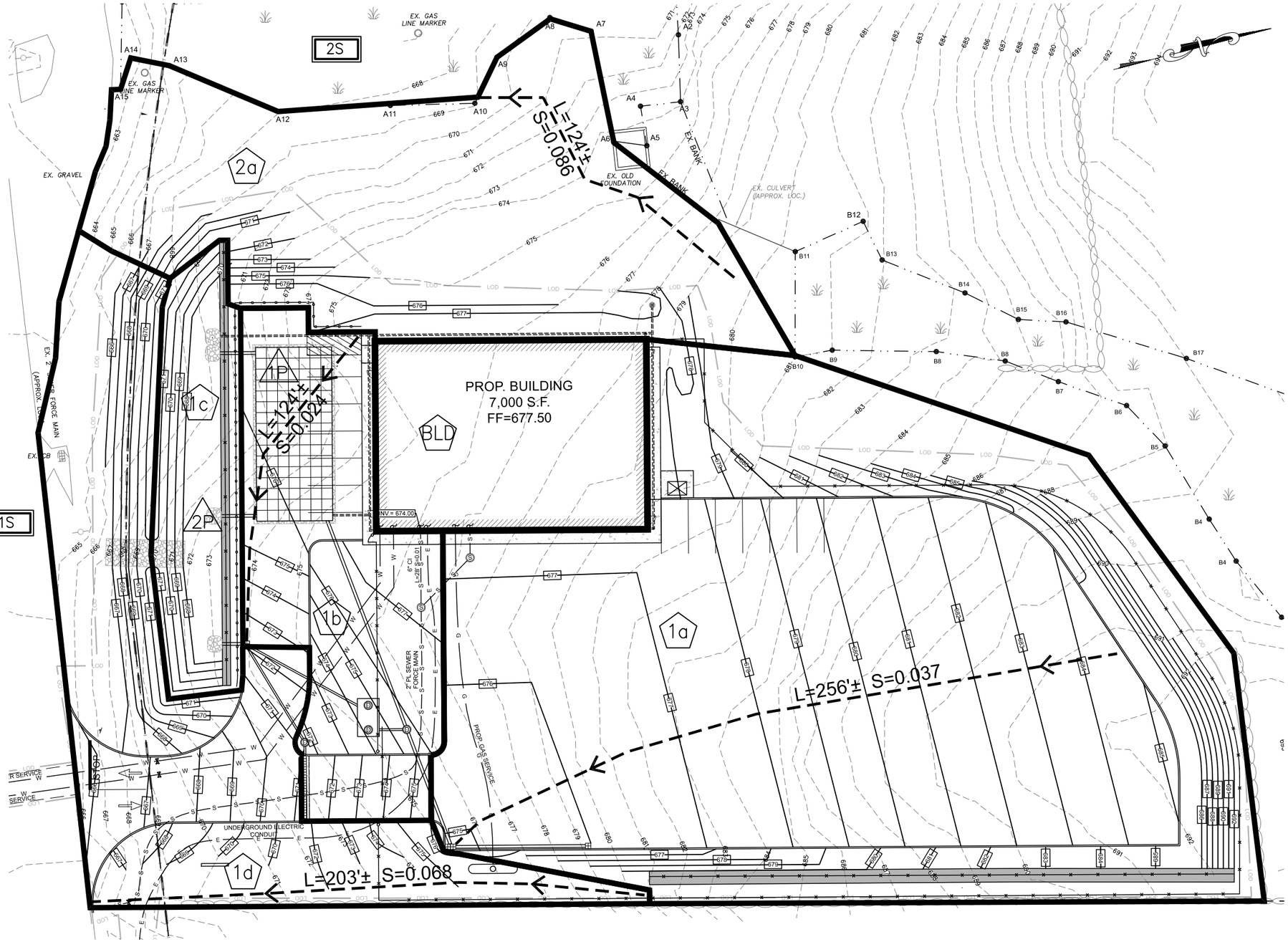
Primary outflow = Inflow, Time Span= 3.00-30.00 hrs, dt= 0.03 hrs

Link 2S: WETLANDS



Appendix E

Post-Development Drainage Calculations



LEGEND

- 100 — EXISTING CONTOURS
- A — WATERSHED SUBCATCHMENT
- 1P — POND
- 1S — OFF-SITE STORMWATER OUTFALL LOCATION
- WATERSHED BOUNDARY
- TIME OF CONCENTRATION FLOW PATH
- TP # 1 — TEST PIT LOCATION

GRAPHIC SCALE

40 0 20 40 80

(IN FEET)

1 inch = 40 ft.

NO.	DATE	DESCRIPTION	BY	CKD

REVISIONS

PROFESSIONAL SEAL

PROJECT:

PROPOSED "INTERSTATE TOWING" FACILITY
#698 MAIN STREET
STURBRIDGE, MA 01518

PREPARED FOR:

WRECKER, LLC.
1660 WESTOVER ROAD
CHICOPEE, MA 01020

ENGINEERING SERVICES
ENVIRONMENTAL SERVICES

67 Hall Road
Sturbridge, MA 01560
Phone: 774-241-0901
fax: 774-241-0906

CMG EST. 2002

ISSUE DATE: 10/11/2022

DRAWN BY: RL | CHECKED BY: DF

SCALE: 1" = 40'

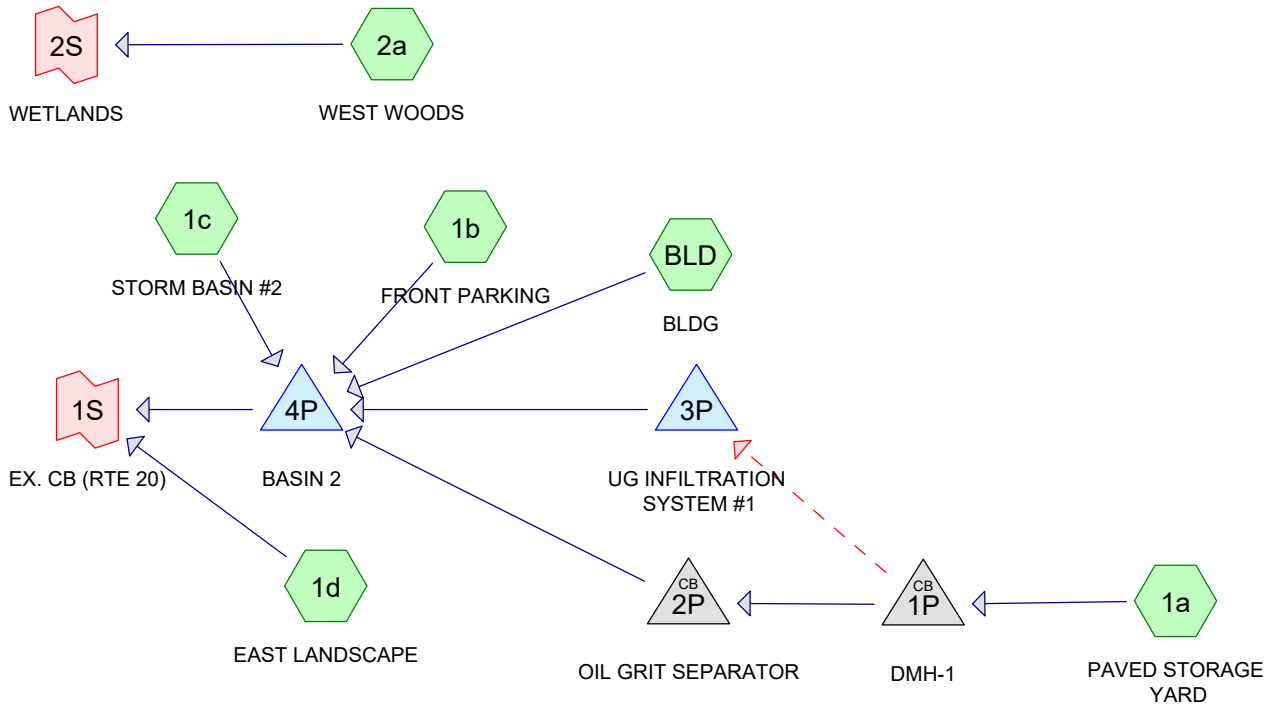
PROJECT NO.: 2022-035

SHEET NAME:

POST-DEVELOPMENT DRAINAGE MAP

SHEET NO.:

D - 2.0



Subcat Reach Pond Link

Routing Diagram for 2022-035-POST_DEV-1-DF
Prepared by {enter your company name here}, Printed 10/11/2022
HydroCAD® 10.10-6a s/n 11413 © 2020 HydroCAD Software Solutions LLC

Time span=0.00-48.00 hrs, dt=0.03 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 1a: PAVED STORAGE YARD Runoff Area=48,317 sf 67.82% Impervious Runoff Depth=0.32"
Tc=5.0 min CN=90 Runoff=0.41 cfs 0.030 af

Subcatchment 1b: FRONT PARKING Runoff Area=10,206 sf 61.55% Impervious Runoff Depth=0.28"
Tc=5.0 min CN=89 Runoff=0.07 cfs 0.006 af

Subcatchment 1c: STORM BASIN #2 Runoff Area=4,828 sf 0.00% Impervious Runoff Depth=0.02"
Tc=5.0 min CN=74 Runoff=0.00 cfs 0.000 af

Subcatchment 1d: EAST LANDSCAPE Runoff Area=15,711 sf 22.57% Impervious Runoff Depth=0.04"
Tc=5.0 min CN=76 Runoff=0.00 cfs 0.001 af

Subcatchment 2a: WEST WOODS Runoff Area=18,684 sf 0.00% Impervious Runoff Depth=0.00"
Flow Length=320' Slope=0.0340 '/' Tc=9.2 min CN=70 Runoff=0.00 cfs 0.000 af

Subcatchment BLD: BLDG Runoff Area=7,000 sf 100.00% Impervious Runoff Depth=0.79"
Tc=5.0 min CN=98 Runoff=0.15 cfs 0.011 af

Pond 1P: DMH-1 Peak Elev=672.38' Inflow=0.41 cfs 0.030 af
Primary=0.41 cfs 0.030 af Secondary=0.00 cfs 0.000 af Outflow=0.41 cfs 0.030 af

Pond 2P: OIL GRIT SEPARATOR Peak Elev=672.12' Inflow=0.41 cfs 0.030 af
8.0" Round Culvert n=0.013 L=30.0' S=0.0100 '/' Outflow=0.41 cfs 0.030 af

Pond 3P: UG INFILTRATION SYSTEM #1 Peak Elev=670.50' Storage=0 cf Inflow=0.00 cfs 0.000 af
Discarded=0.00 cfs 0.000 af Primary=0.00 cfs 0.000 af Outflow=0.00 cfs 0.000 af

Pond 4P: BASIN 2 Peak Elev=668.43' Storage=778 cf Inflow=0.62 cfs 0.046 af
Discarded=0.06 cfs 0.046 af Primary=0.00 cfs 0.000 af Outflow=0.06 cfs 0.046 af

Link 1S: EX. CB (RTE 20) Inflow=0.00 cfs 0.001 af
Primary=0.00 cfs 0.001 af

Link 2S: WETLANDS Inflow=0.00 cfs 0.000 af
Primary=0.00 cfs 0.000 af

Total Runoff Area = 2.405 ac Runoff Volume = 0.047 af Average Runoff Depth = 0.24"
52.65% Pervious = 1.266 ac 47.35% Impervious = 1.139 ac

Summary for Subcatchment 1a: PAVED STORAGE YARD

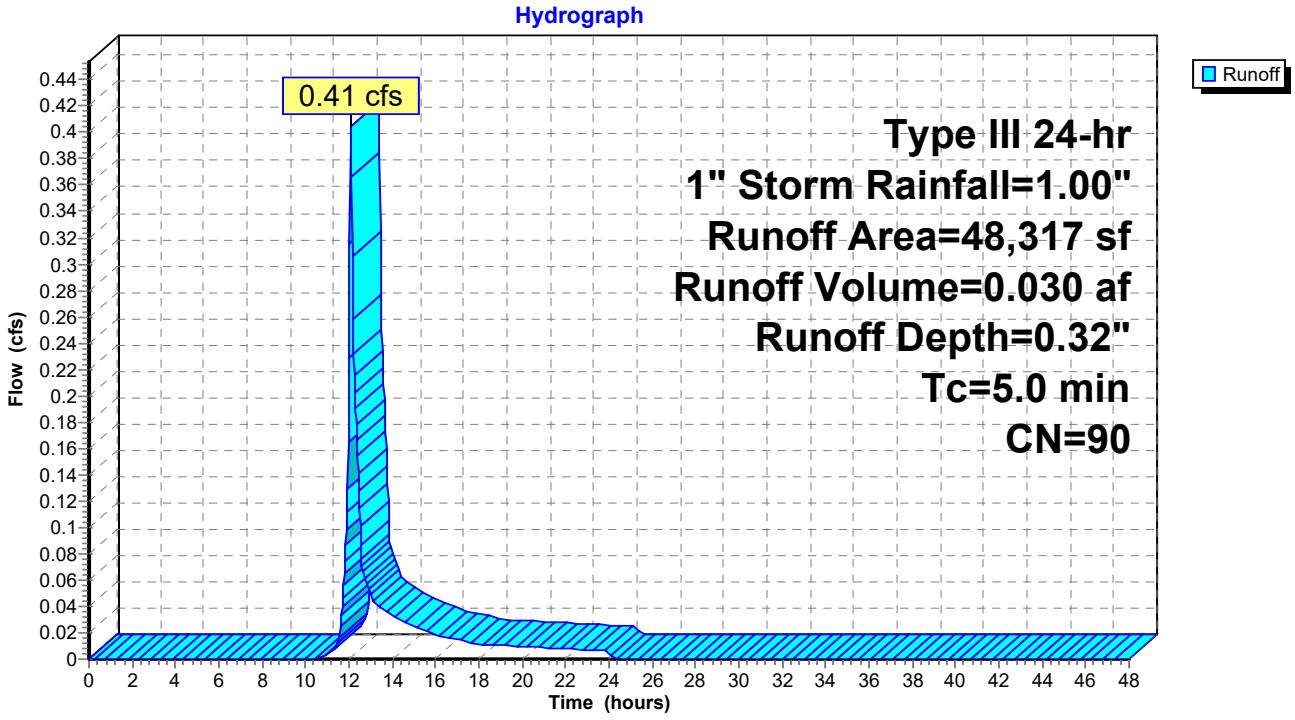
Runoff = 0.41 cfs @ 12.08 hrs, Volume= 0.030 af, Depth= 0.32"
Routed to Pond 1P : DMH-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type III 24-hr 1" Storm Rainfall=1.00"

Area (sf)	CN	Description
32,770	98	Paved parking, HSG C
15,547	74	>75% Grass cover, Good, HSG C
48,317	90	Weighted Average
15,547		32.18% Pervious Area
32,770		67.82% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, TCmin=5 Minutes**

Subcatchment 1a: PAVED STORAGE YARD



Summary for Subcatchment 1b: FRONT PARKING

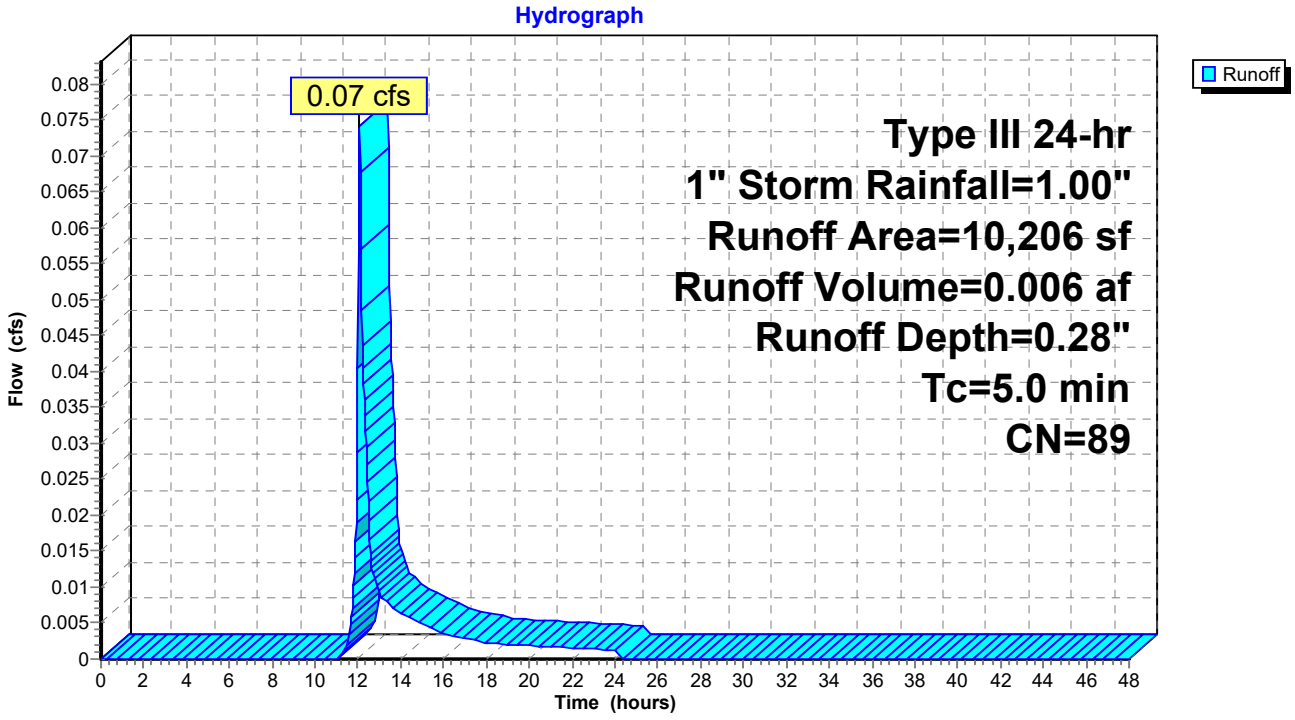
Runoff = 0.07 cfs @ 12.09 hrs, Volume= 0.006 af, Depth= 0.28"
Routed to Pond 4P : BASIN 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type III 24-hr 1" Storm Rainfall=1.00"

Area (sf)	CN	Description
6,282	98	Paved parking, HSG C
3,924	74	>75% Grass cover, Good, HSG C
10,206	89	Weighted Average
3,924		38.45% Pervious Area
6,282		61.55% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, TCmin=5 Minutes**

Subcatchment 1b: FRONT PARKING



Summary for Subcatchment 1c: STORM BASIN #2

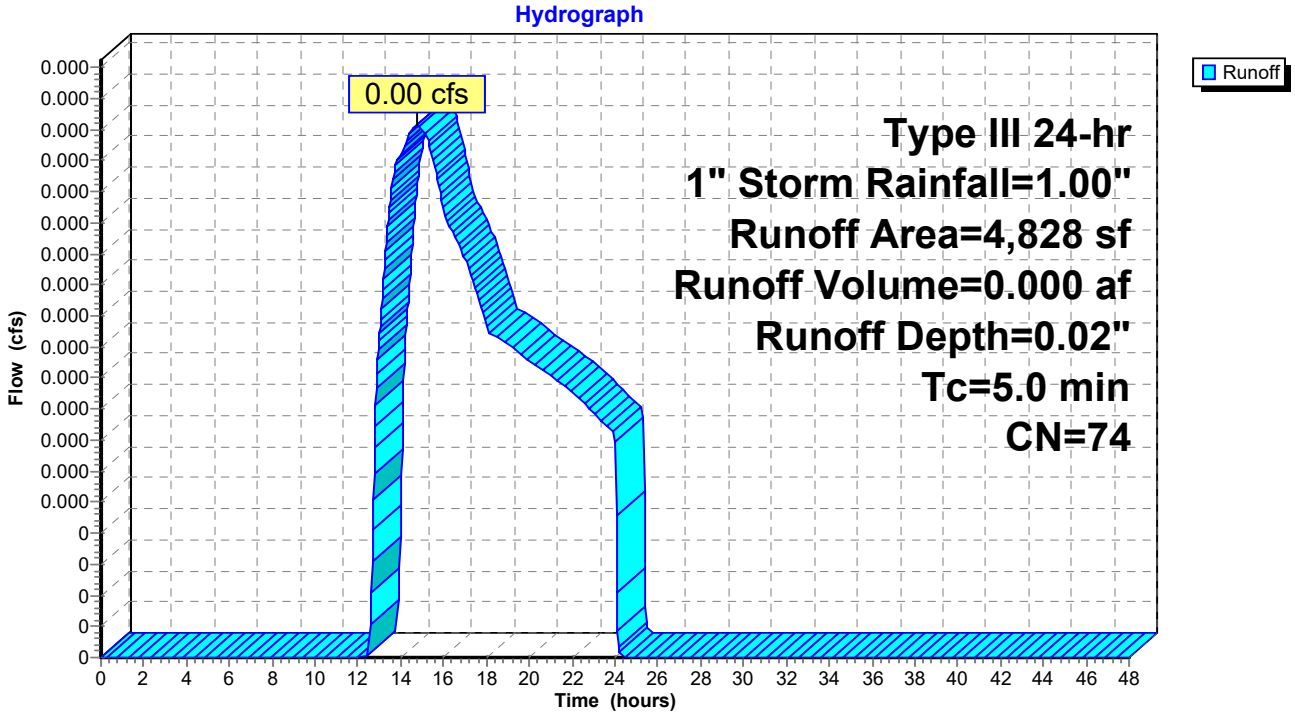
Runoff = 0.00 cfs @ 14.76 hrs, Volume= 0.000 af, Depth= 0.02"
Routed to Pond 4P : BASIN 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type III 24-hr 1" Storm Rainfall=1.00"

Area (sf)	CN	Description
4,828	74	>75% Grass cover, Good, HSG C
4,828		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Minimum Tc = 5 min.**

Subcatchment 1c: STORM BASIN #2



Summary for Subcatchment 1d: EAST LANDSCAPE

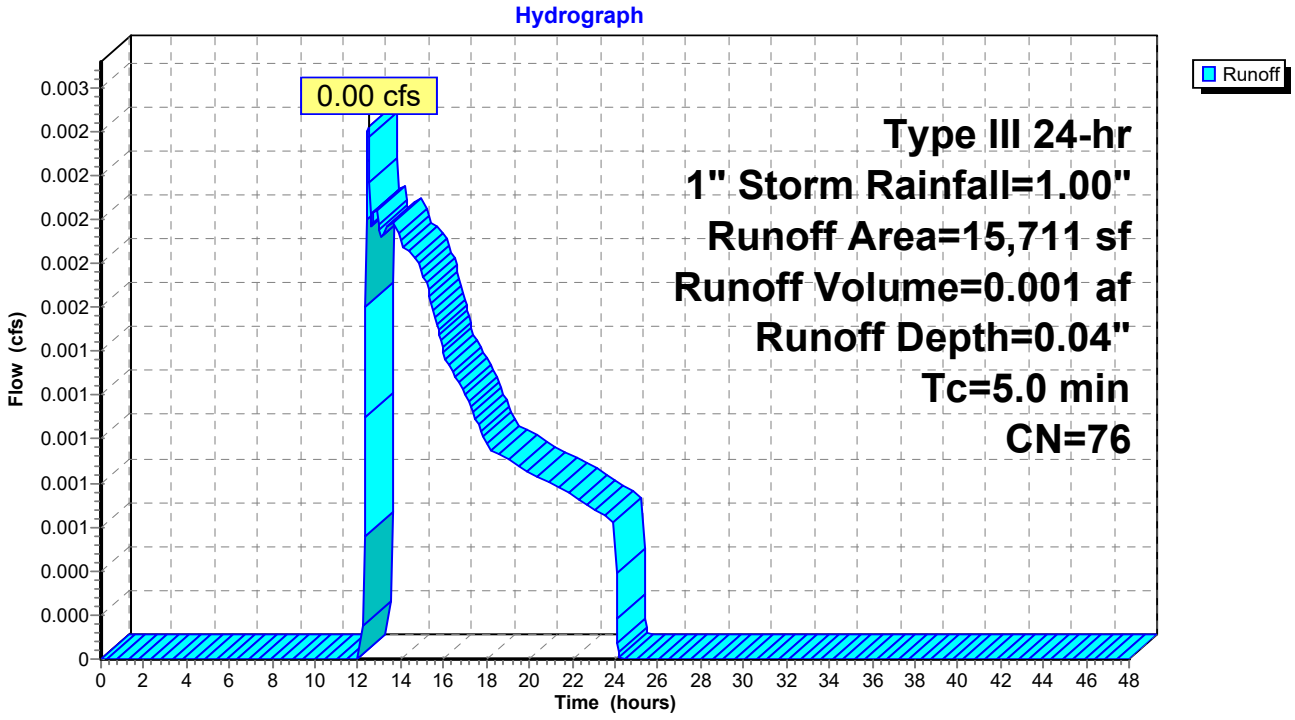
Runoff = 0.00 cfs @ 12.47 hrs, Volume= 0.001 af, Depth= 0.04"
Routed to Link 1S : EX. CB (RTE 20)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type III 24-hr 1" Storm Rainfall=1.00"

Area (sf)	CN	Description
12,165	70	Woods, Good, HSG C
3,546	98	Paved parking, HSG C
15,711	76	Weighted Average
12,165		77.43% Pervious Area
3,546		22.57% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, TCmin=5 Minutes**

Subcatchment 1d: EAST LANDSCAPE



Summary for Subcatchment 2a: WEST WOODS

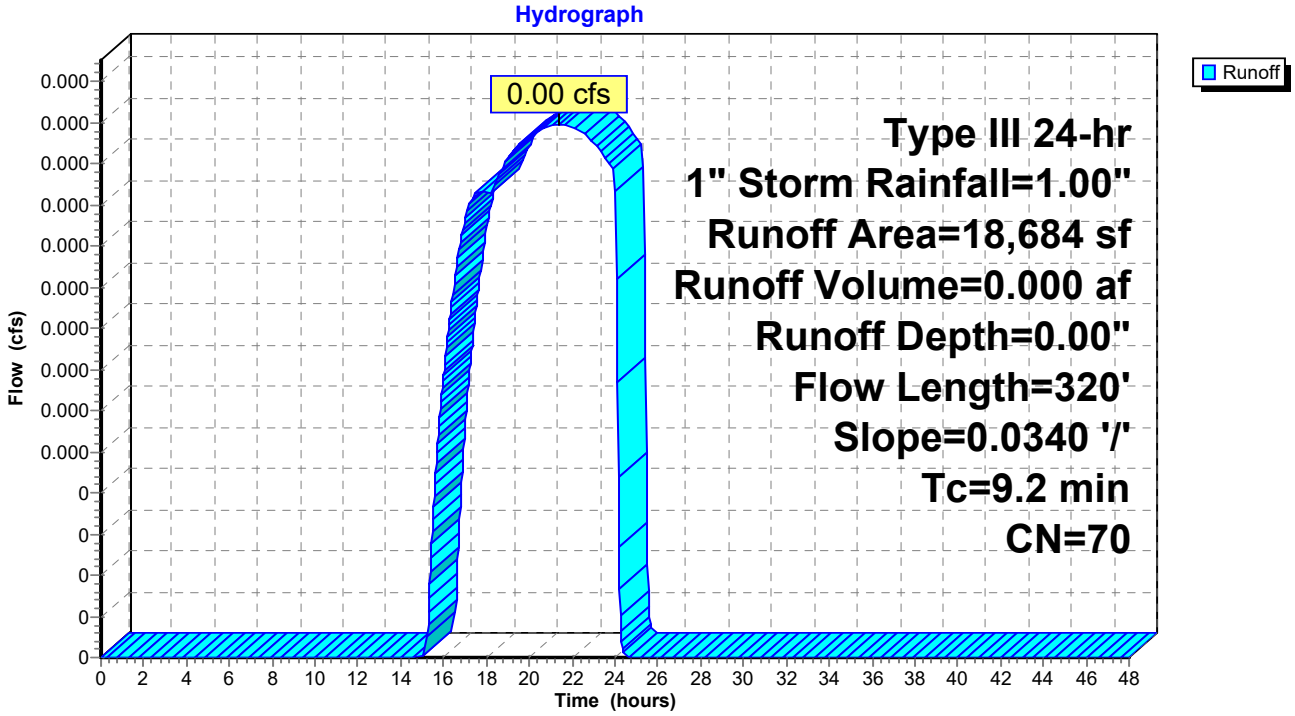
Runoff = 0.00 cfs @ 21.37 hrs, Volume= 0.000 af, Depth= 0.00"
Routed to Link 2S : WETLANDS

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type III 24-hr 1" Storm Rainfall=1.00"

Area (sf)	CN	Description
18,684	70	Woods, Good, HSG C
18,684		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.2	320	0.0340	0.58		**Lag/CN Method,**

Subcatchment 2a: WEST WOODS



Summary for Subcatchment BLD: BLDG

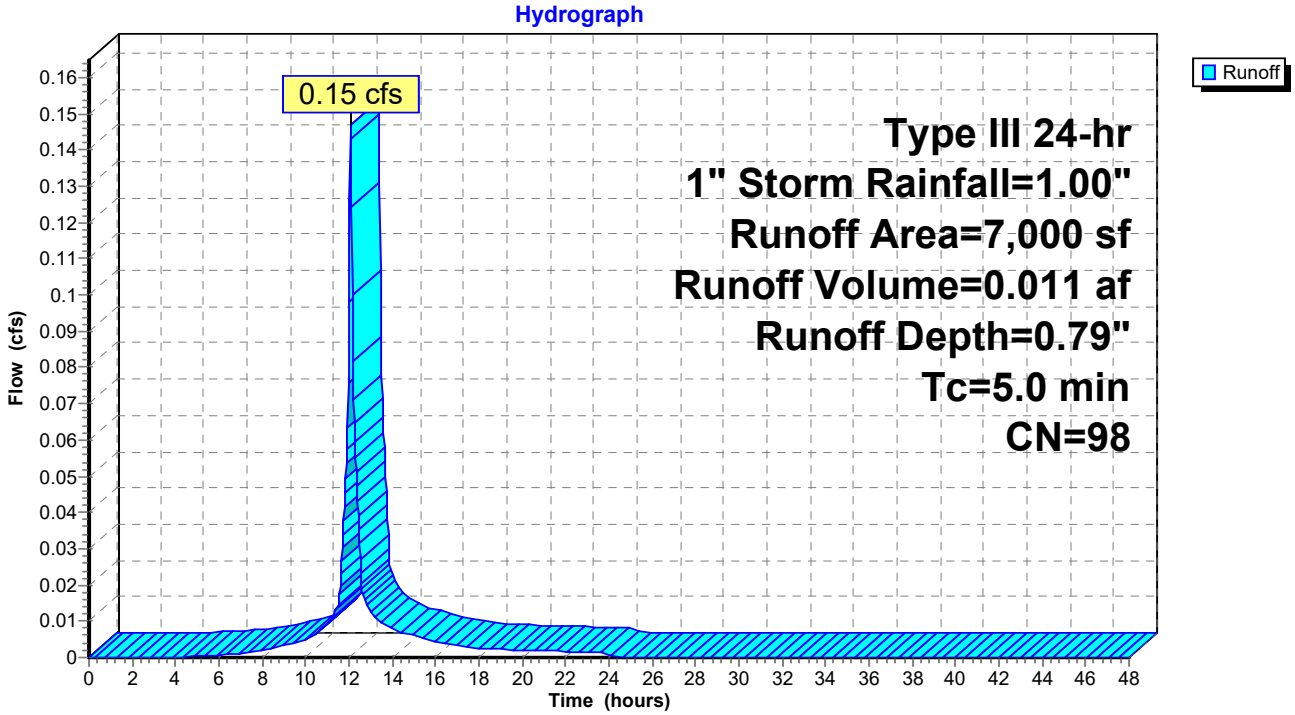
Runoff = 0.15 cfs @ 12.07 hrs, Volume= 0.011 af, Depth= 0.79"
Routed to Pond 4P : BASIN 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type III 24-hr 1" Storm Rainfall=1.00"

Area (sf)	CN	Description
7,000	98	Roofs, HSG C
7,000		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, TCmin=5 Minutes**

Subcatchment BLD: BLDG



Summary for Pond 1P: DMH-1

Inflow Area = 1.109 ac, 67.82% Impervious, Inflow Depth = 0.32" for 1" Storm event
Inflow = 0.41 cfs @ 12.08 hrs, Volume= 0.030 af
Outflow = 0.41 cfs @ 12.08 hrs, Volume= 0.030 af, Atten= 0%, Lag= 0.0 min
Primary = 0.41 cfs @ 12.08 hrs, Volume= 0.030 af
Routed to Pond 2P : OIL GRIT SEPARATOR
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond 3P : UG INFILTRATION SYSTEM #1

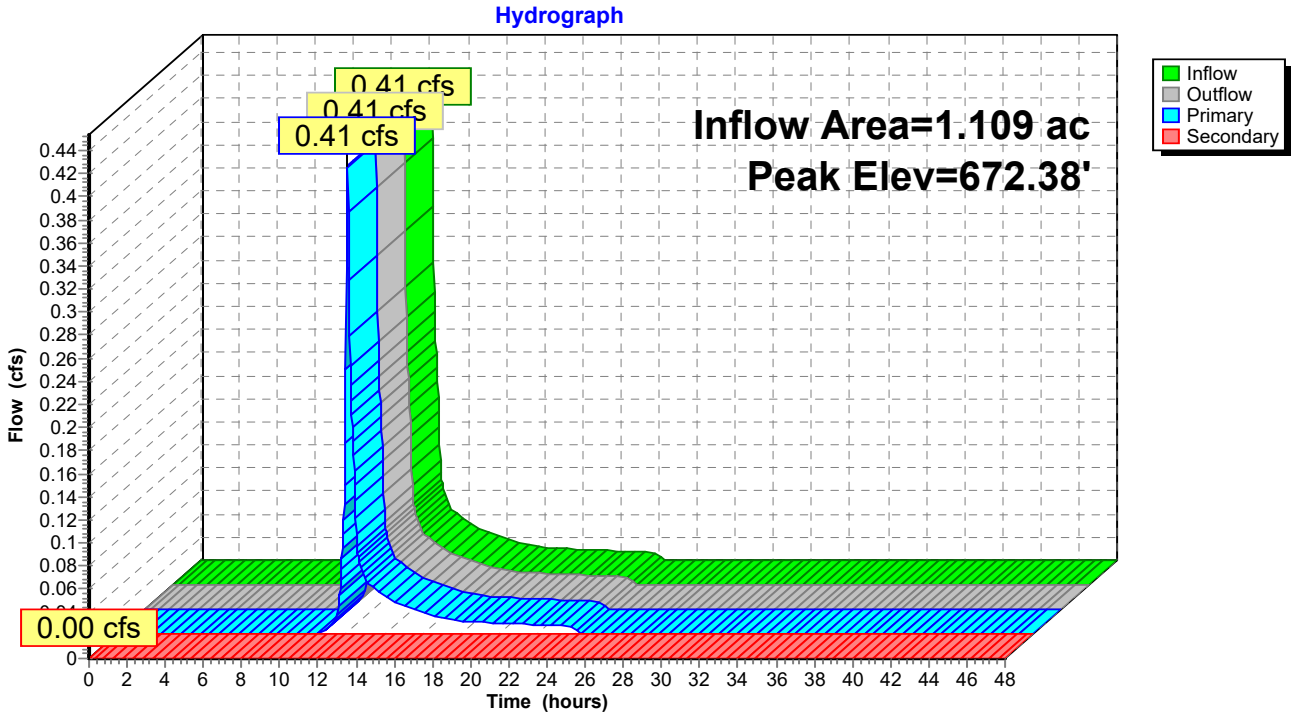
Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Peak Elev= 672.38' @ 12.08 hrs
Flood Elev= 675.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	671.95'	**8.0" Round Culvert** L= 6.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 671.95' / 671.85' S= 0.0167 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf
#2	Secondary	672.45'	**12.0" Round Culvert** L= 40.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 672.45' / 672.00' S= 0.0113 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.40 cfs @ 12.08 hrs HW=672.37' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 0.40 cfs @ 2.44 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=671.95' (Free Discharge)
↑—**2=Culvert** (Controls 0.00 cfs)

Pond 1P: DMH-1


Hydrograph
Inflow Area=1.109 ac
Peak Elev=672.38'
0.41 cfs
0.41 cfs
0.41 cfs
0.00 cfs
Inflow
Outflow
Primary
Secondary
Flow (cfs)
Time (hours)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48
0 0.06 0.08 0.1 0.12 0.14 0.16 0.18 0.2 0.22 0.24 0.26 0.28 0.3 0.32 0.34 0.36 0.38 0.4 0.42 0.44

Summary for Pond 2P: OIL GRIT SEPARATOR

[79] Warning: Submerged Pond 1P Primary device # 1 INLET by 0.17'

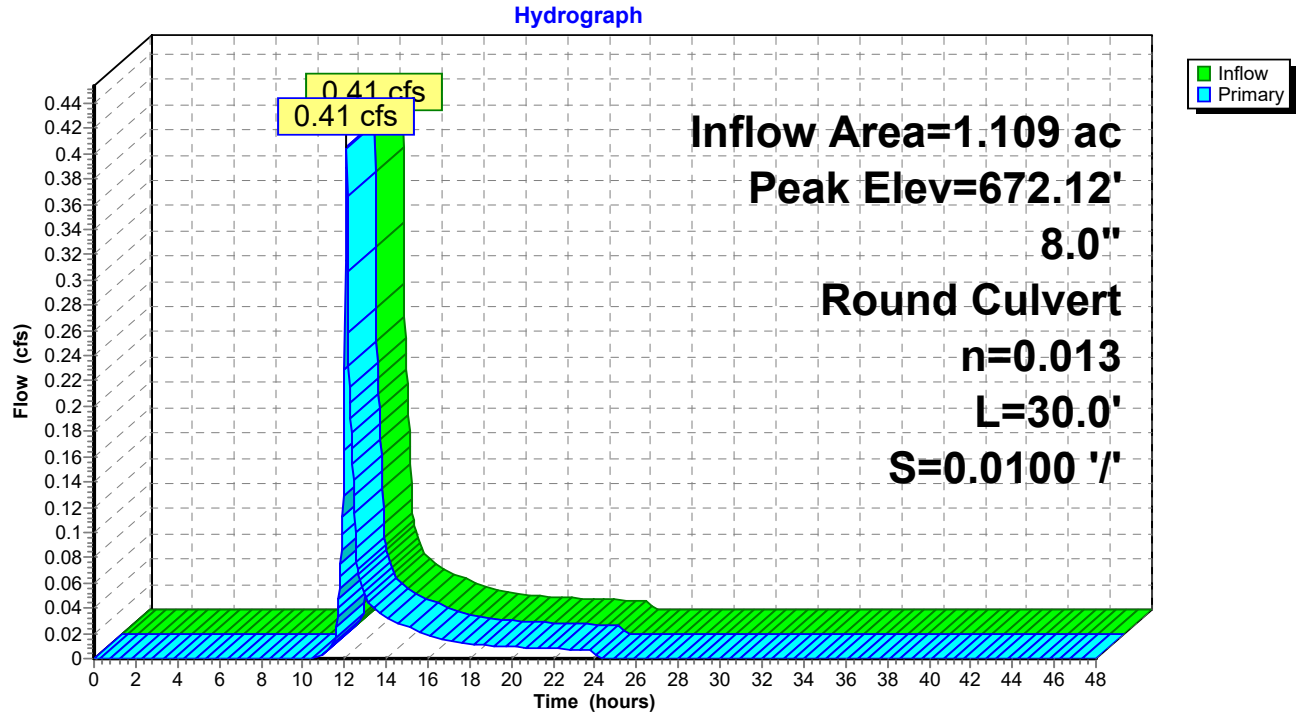
Inflow Area = 1.109 ac, 67.82% Impervious, Inflow Depth = 0.32" for 1" Storm event
Inflow = 0.41 cfs @ 12.08 hrs, Volume= 0.030 af
Outflow = 0.41 cfs @ 12.08 hrs, Volume= 0.030 af, Atten= 0%, Lag= 0.0 min
Primary = 0.41 cfs @ 12.08 hrs, Volume= 0.030 af
Routed to Pond 4P : BASIN 2

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Peak Elev= 672.12' @ 12.08 hrs
Flood Elev= 675.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	671.70'	**8.0" Round Culvert** L= 30.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 671.70' / 671.40' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=0.40 cfs @ 12.08 hrs HW=672.12' (Free Discharge)
1=Culvert (Inlet Controls 0.40 cfs @ 1.74 fps)

Pond 2P: OIL GRIT SEPARATOR



Summary for Pond 3P: UG INFILTRATION SYSTEM #1

Inflow	=	0.00 cfs @	0.00 hrs,	Volume=	0.000 af
Outflow	=	0.00 cfs @	0.00 hrs,	Volume=	0.000 af, Atten= 0%, Lag= 0.0 min
Discarded	=	0.00 cfs @	0.00 hrs,	Volume=	0.000 af
Primary	=	0.00 cfs @	0.00 hrs,	Volume=	0.000 af

Routed to Pond 4P : BASIN 2

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Peak Elev= 670.50' @ 0.00 hrs Surf.Area= 1,980 sf Storage= 0 cf

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

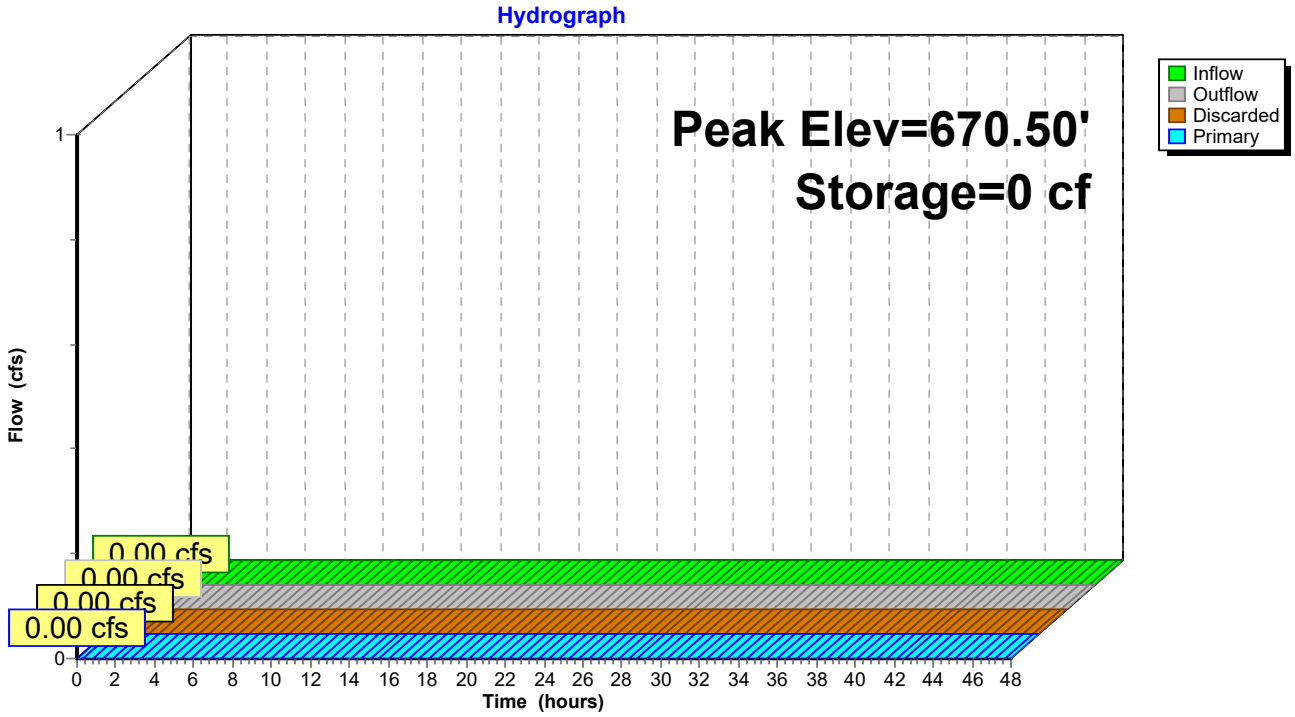
Volume	Invert	Avail.Storage	Storage Description
#1	670.50'	1,265 cf	**30.00'W x 66.00'L x 4.00'H Prismatoid** 7,920 cf Overall - 4,757 cf Embedded = 3,163 cf x 40.0% Voids
#2	671.00'	3,416 cf	**Shea Leaching Chamber 4x4x3** x 112 Inside #1 Inside= 41.0"W x 30.0"H => 8.72 sf x 3.50'L = 30.5 cf Outside= 47.0"W x 36.0"H => 10.62 sf x 4.00'L = 42.5 cf 112 Chambers in 7 Rows
		4,681 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	670.50'	**1.020 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 666.00'
#2	Primary	672.50'	**8.0" Round Culvert X 2.00** L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 672.50' / 671.00' S= 0.0750 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf

Discarded OutFlow Max=0.00 cfs @ 0.00 hrs HW=670.50' (Free Discharge)
↑**1=Exfiltration** (Passes 0.00 cfs of 0.05 cfs potential flow)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=670.50' (Free Discharge)
↑**2=Culvert** (Controls 0.00 cfs)

Pond 3P: UG INFILTRATION SYSTEM #1



Summary for Pond 4P: BASIN 2

Inflow Area = 1.615 ac, 65.46% Impervious, Inflow Depth = 0.34" for 1" Storm event
Inflow = 0.62 cfs @ 12.08 hrs, Volume= 0.046 af
Outflow = 0.06 cfs @ 13.33 hrs, Volume= 0.046 af, Atten= 90%, Lag= 75.2 min
Discarded = 0.06 cfs @ 13.33 hrs, Volume= 0.046 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Link 1S : EX. CB (RTE 20)

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Peak Elev= 668.43' @ 13.33 hrs Surf.Area= 1,914 sf Storage= 778 cf
Flood Elev= 671.00' Surf.Area= 3,280 sf Storage= 7,102 cf

Plug-Flow detention time= 136.4 min calculated for 0.046 af (100% of inflow)
Center-of-Mass det. time= 136.3 min (982.7 - 846.4)

Volume	Invert	Avail.Storage	Storage Description
#1	668.00'	7,102 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

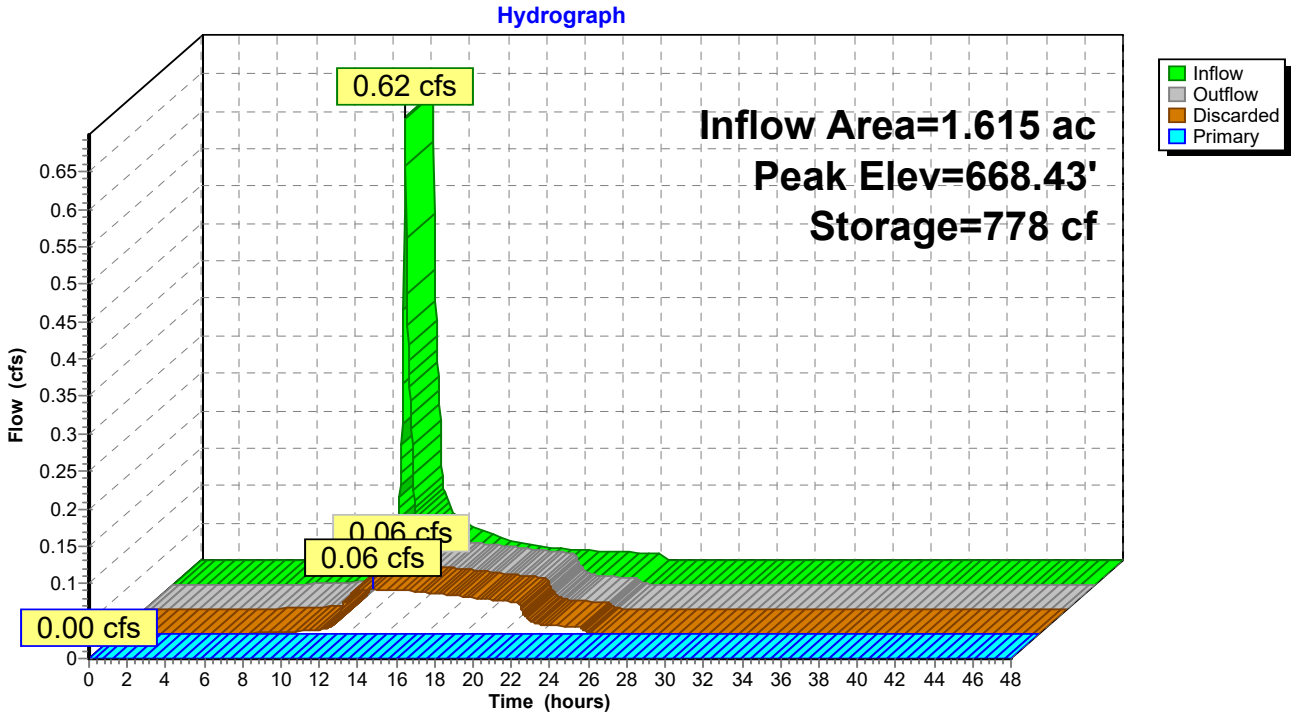
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
668.00	1,711	299.2	0	0	1,711
669.00	2,200	318.0	1,950	1,950	2,685
670.00	2,423	337.0	2,311	4,261	3,728
671.00	3,280	356.0	2,841	7,102	4,831

Device	Routing	Invert	Outlet Devices
#1	Discarded	668.00'	**1.020 in/hr Exfiltration - Sandy Loam over Wetted area** Conductivity to Groundwater Elevation = 666.00'
#2	Primary	670.50'	**10.0' 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=0.06 cfs @ 13.33 hrs HW=668.43' (Free Discharge)
↑—**1=Exfiltration - Sandy Loam** (Controls 0.06 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=668.00' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 4P: BASIN 2

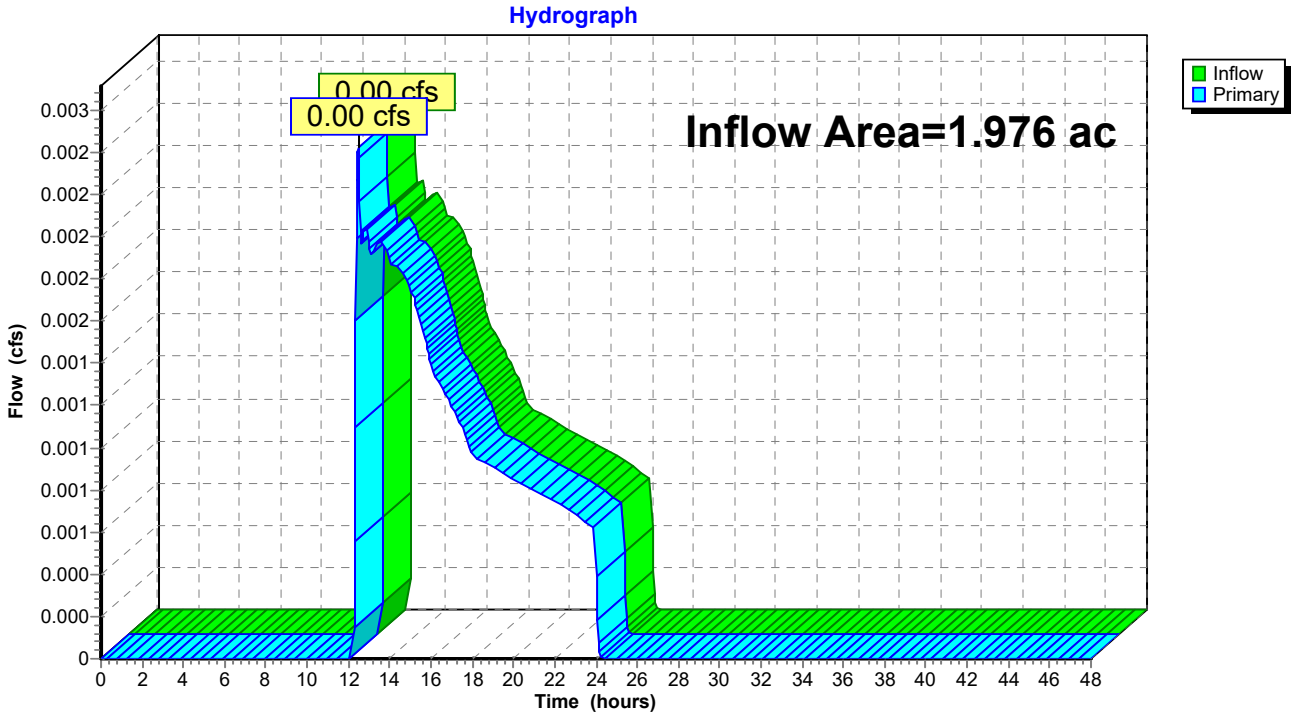


Summary for Link 1S: EX. CB (RTE 20)

Inflow Area = 1.976 ac, 57.63% Impervious, Inflow Depth = 0.01" for 1" Storm event
Inflow = 0.00 cfs @ 12.47 hrs, Volume= 0.001 af
Primary = 0.00 cfs @ 12.47 hrs, Volume= 0.001 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs

Link 1S: EX. CB (RTE 20)

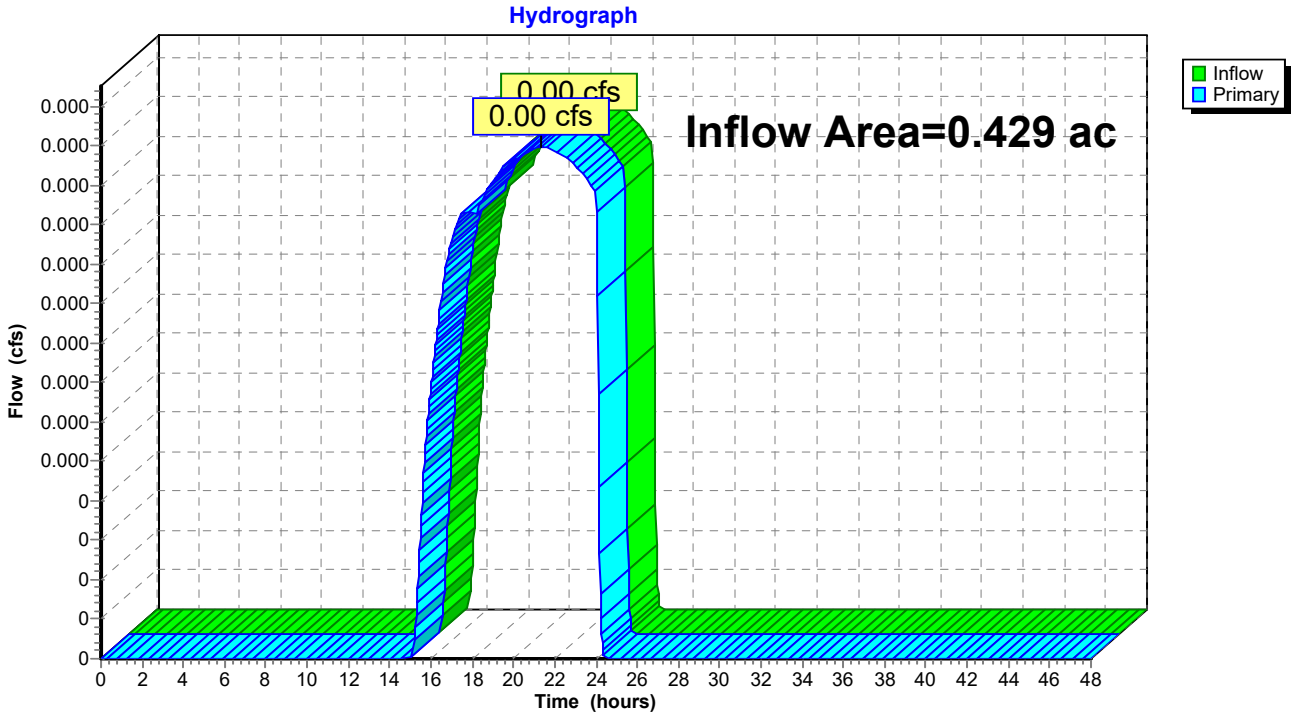


Summary for Link 2S: WETLANDS

Inflow Area = 0.429 ac, 0.00% Impervious, Inflow Depth = 0.00" for 1" Storm event
Inflow = 0.00 cfs @ 21.37 hrs, Volume= 0.000 af
Primary = 0.00 cfs @ 21.37 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs

Link 2S: WETLANDS



Time span=0.00-48.00 hrs, dt=0.03 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 1a: PAVED STORAGE YARD Runoff Area=48,317 sf 67.82% Impervious Runoff Depth=2.17"
Tc=5.0 min CN=90 Runoff=2.87 cfs 0.200 af

Subcatchment 1b: FRONT PARKING Runoff Area=10,206 sf 61.55% Impervious Runoff Depth=2.08"
Tc=5.0 min CN=89 Runoff=0.58 cfs 0.041 af

Subcatchment 1c: STORM BASIN #2 Runoff Area=4,828 sf 0.00% Impervious Runoff Depth=1.04"
Tc=5.0 min CN=74 Runoff=0.13 cfs 0.010 af

Subcatchment 1d: EAST LANDSCAPE Runoff Area=15,711 sf 22.57% Impervious Runoff Depth=1.15"
Tc=5.0 min CN=76 Runoff=0.48 cfs 0.035 af

Subcatchment 2a: WEST WOODS Runoff Area=18,684 sf 0.00% Impervious Runoff Depth=0.83"
Flow Length=320' Slope=0.0340 '/' Tc=9.2 min CN=70 Runoff=0.33 cfs 0.030 af

Subcatchment BLD: BLDG Runoff Area=7,000 sf 100.00% Impervious Runoff Depth=2.97"
Tc=5.0 min CN=98 Runoff=0.51 cfs 0.040 af

Pond 1P: DMH-1 Peak Elev=673.24' Inflow=2.87 cfs 0.200 af
Primary=1.30 cfs 0.173 af Secondary=1.58 cfs 0.027 af Outflow=2.87 cfs 0.200 af

Pond 2P: OIL GRIT SEPARATOR Peak Elev=672.99' Inflow=1.30 cfs 0.173 af
8.0" Round Culvert n=0.013 L=30.0' S=0.0100 '/' Outflow=1.30 cfs 0.173 af

Pond 3P: UG INFILTRATION SYSTEM #1 Peak Elev=671.43' Storage=1,067 cf Inflow=1.58 cfs 0.027 af
Discarded=0.06 cfs 0.027 af Primary=0.00 cfs 0.000 af Outflow=0.06 cfs 0.027 af

Pond 4P: BASIN 2 Peak Elev=670.53' Storage=5,671 cf Inflow=2.52 cfs 0.263 af
Discarded=0.18 cfs 0.249 af Primary=0.16 cfs 0.014 af Outflow=0.34 cfs 0.263 af

Link 1S: EX. CB (RTE 20) Inflow=0.48 cfs 0.049 af
Primary=0.48 cfs 0.049 af

Link 2S: WETLANDS Inflow=0.33 cfs 0.030 af
Primary=0.33 cfs 0.030 af

Total Runoff Area = 2.405 ac Runoff Volume = 0.355 af Average Runoff Depth = 1.77"
52.65% Pervious = 1.266 ac 47.35% Impervious = 1.139 ac

Summary for Subcatchment 1a: PAVED STORAGE YARD

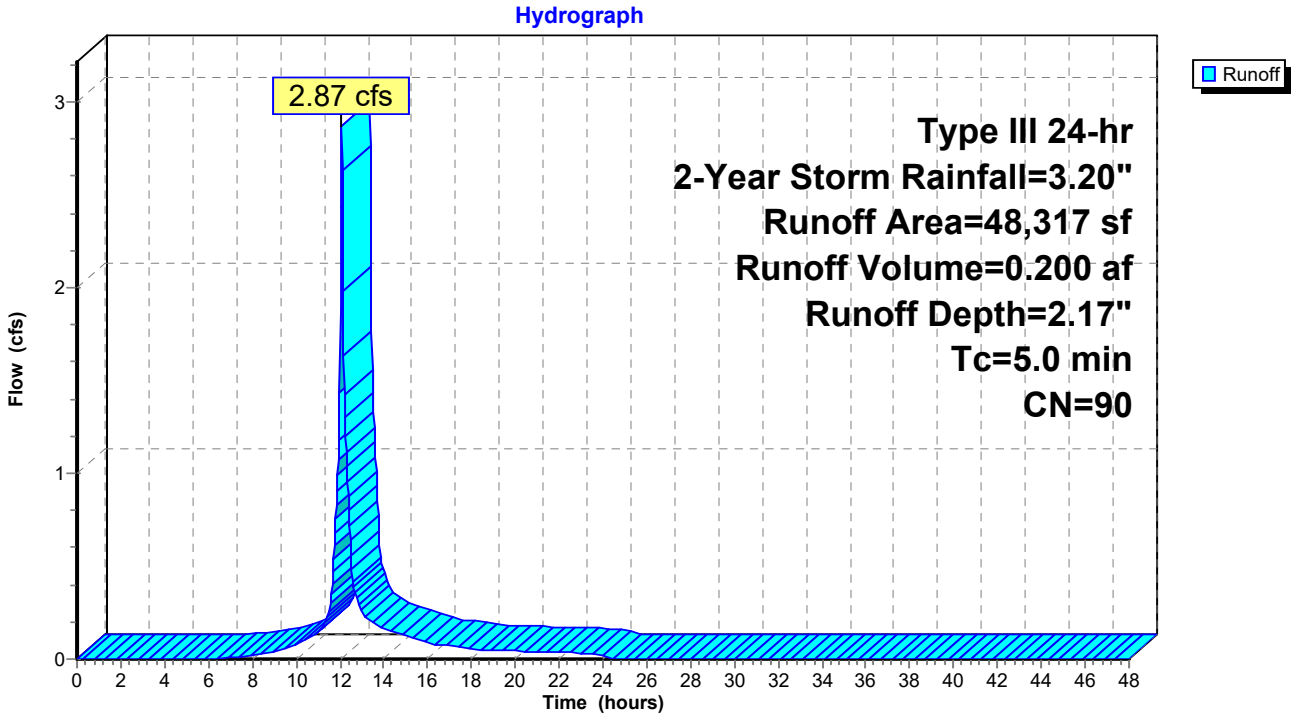
Runoff = 2.87 cfs @ 12.07 hrs, Volume= 0.200 af, Depth= 2.17"
Routed to Pond 1P : DMH-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type III 24-hr 2-Year Storm Rainfall=3.20"

Area (sf)	CN	Description
32,770	98	Paved parking, HSG C
15,547	74	>75% Grass cover, Good, HSG C
48,317	90	Weighted Average
15,547		32.18% Pervious Area
32,770		67.82% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, TCmin=5 Minutes**

Subcatchment 1a: PAVED STORAGE YARD



Summary for Subcatchment 1b: FRONT PARKING

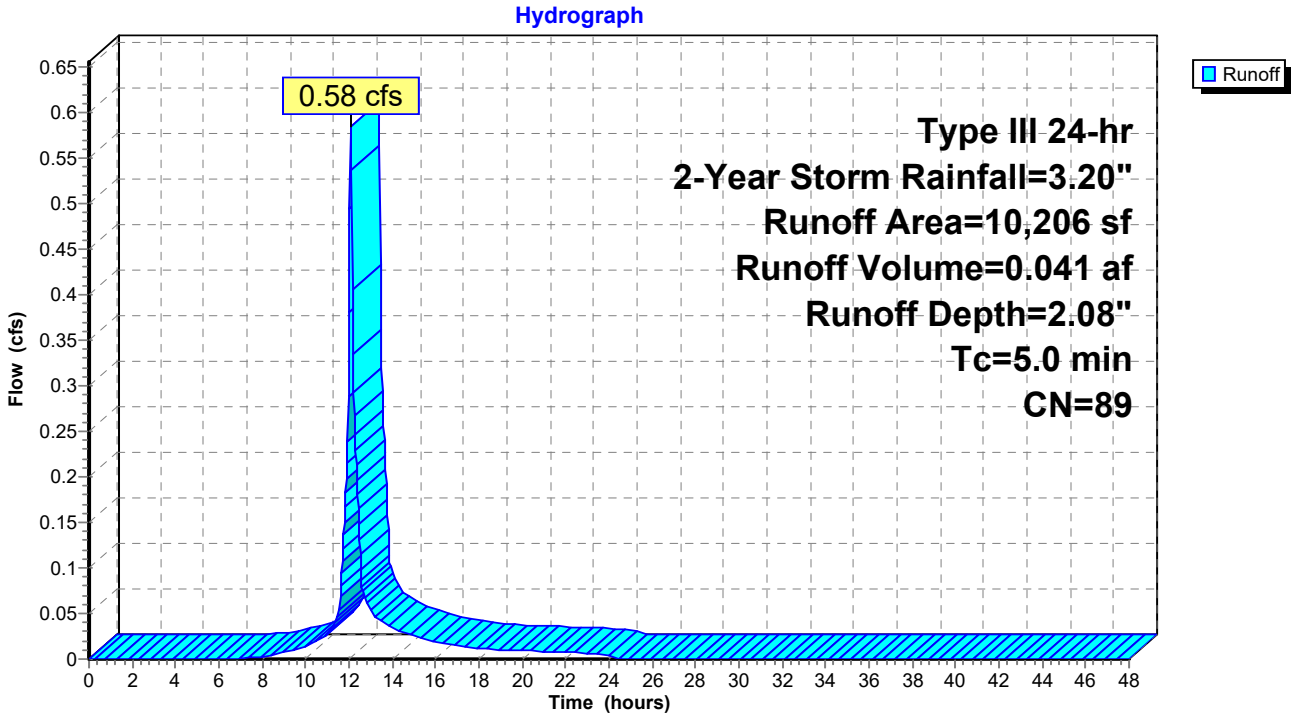
Runoff = 0.58 cfs @ 12.07 hrs, Volume= 0.041 af, Depth= 2.08"
Routed to Pond 4P : BASIN 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type III 24-hr 2-Year Storm Rainfall=3.20"

Area (sf)	CN	Description
6,282	98	Paved parking, HSG C
3,924	74	>75% Grass cover, Good, HSG C
10,206	89	Weighted Average
3,924		38.45% Pervious Area
6,282		61.55% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, TCmin=5 Minutes**

Subcatchment 1b: FRONT PARKING



Summary for Subcatchment 1c: STORM BASIN #2

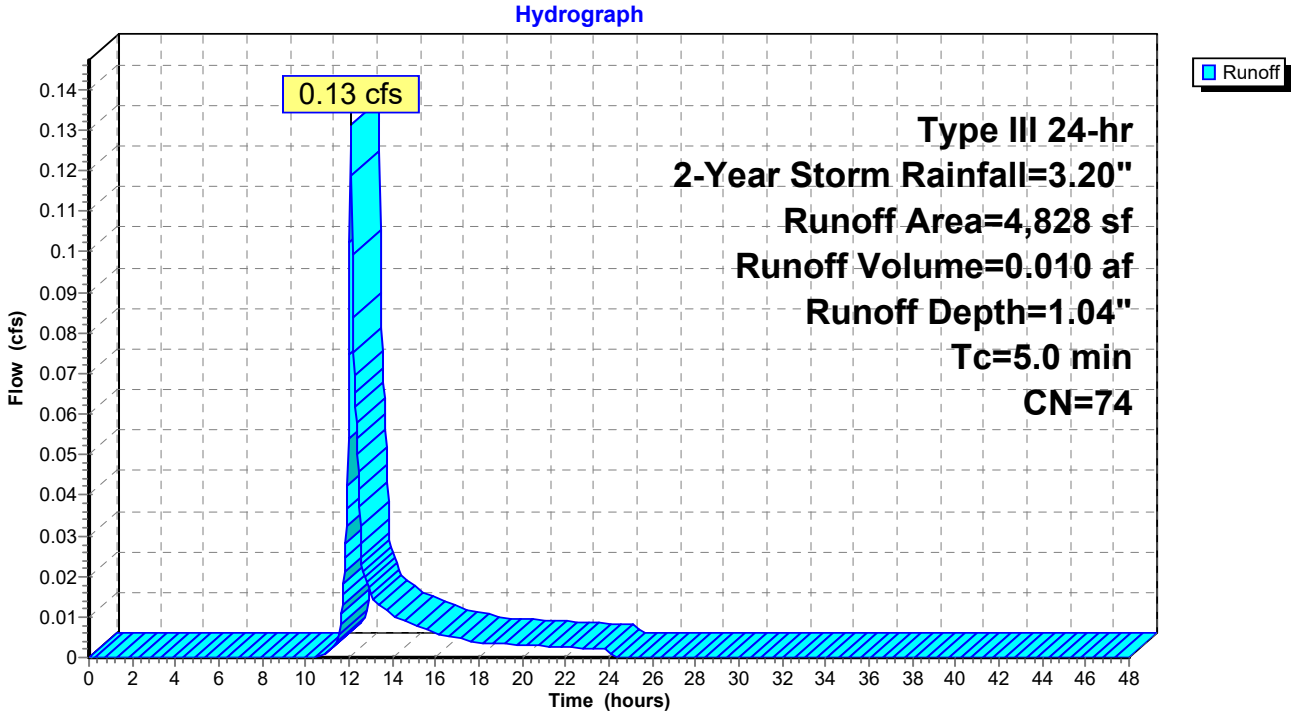
Runoff = 0.13 cfs @ 12.08 hrs, Volume= 0.010 af, Depth= 1.04"
Routed to Pond 4P : BASIN 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type III 24-hr 2-Year Storm Rainfall=3.20"

Area (sf)	CN	Description
4,828	74	>75% Grass cover, Good, HSG C
4,828		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Minimum Tc = 5 min.**

Subcatchment 1c: STORM BASIN #2



Summary for Subcatchment 1d: EAST LANDSCAPE

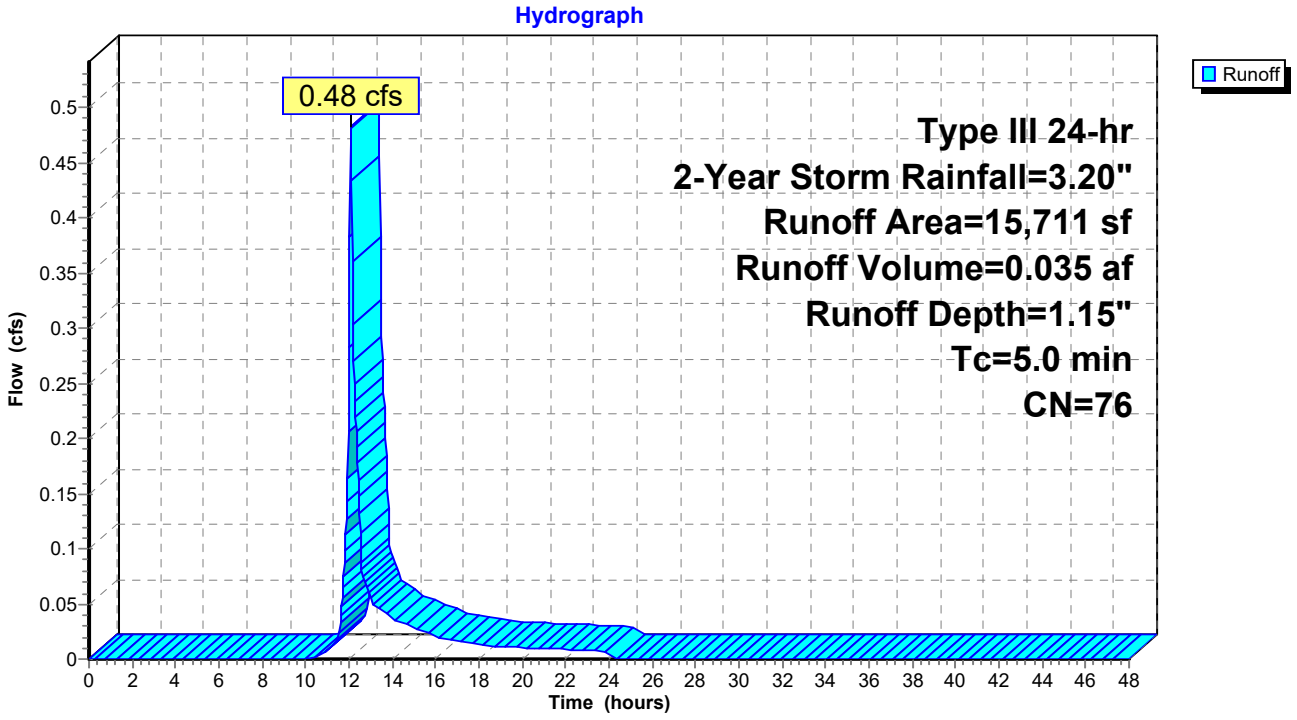
Runoff = 0.48 cfs @ 12.08 hrs, Volume= 0.035 af, Depth= 1.15"
Routed to Link 1S : EX. CB (RTE 20)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type III 24-hr 2-Year Storm Rainfall=3.20"

Area (sf)	CN	Description
12,165	70	Woods, Good, HSG C
3,546	98	Paved parking, HSG C
15,711	76	Weighted Average
12,165		77.43% Pervious Area
3,546		22.57% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, TCmin=5 Minutes**

Subcatchment 1d: EAST LANDSCAPE



Summary for Subcatchment 2a: WEST WOODS

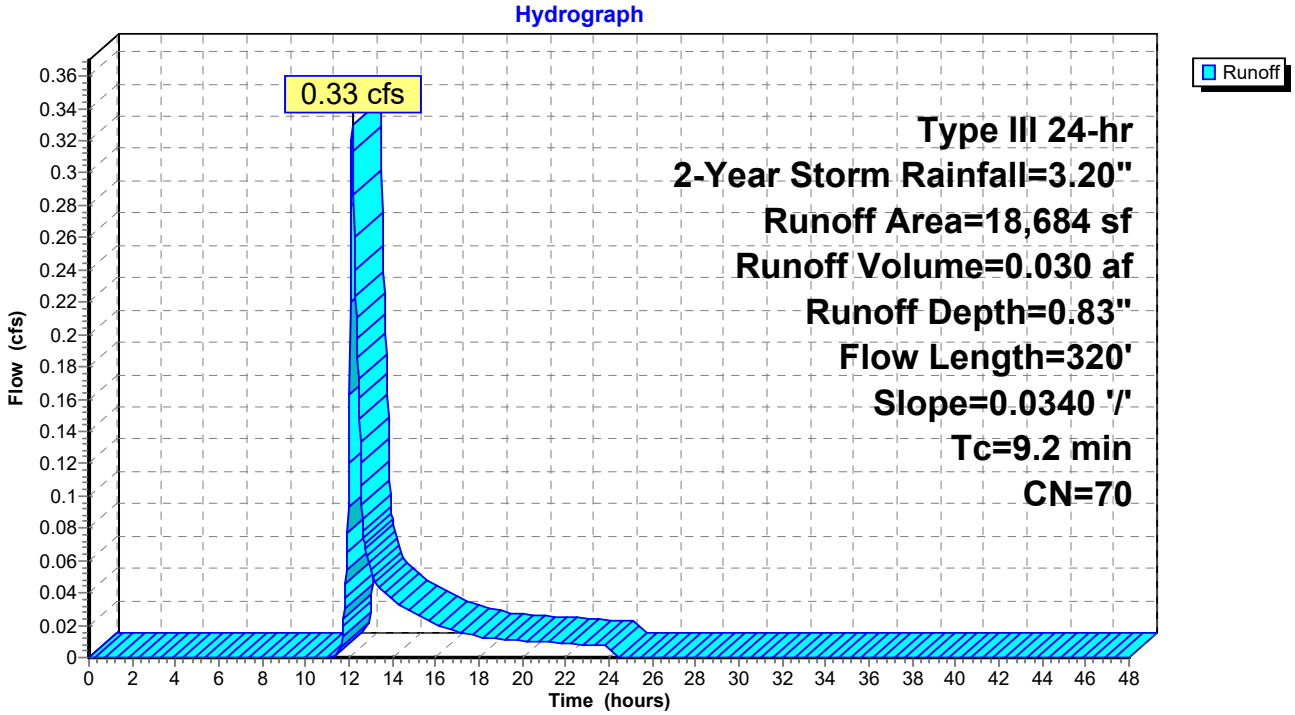
Runoff = 0.33 cfs @ 12.15 hrs, Volume= 0.030 af, Depth= 0.83"
Routed to Link 2S : WETLANDS

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type III 24-hr 2-Year Storm Rainfall=3.20"

Area (sf)	CN	Description
18,684	70	Woods, Good, HSG C
18,684		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.2	320	0.0340	0.58		**Lag/CN Method,**

Subcatchment 2a: WEST WOODS



Summary for Subcatchment BLD: BLDG

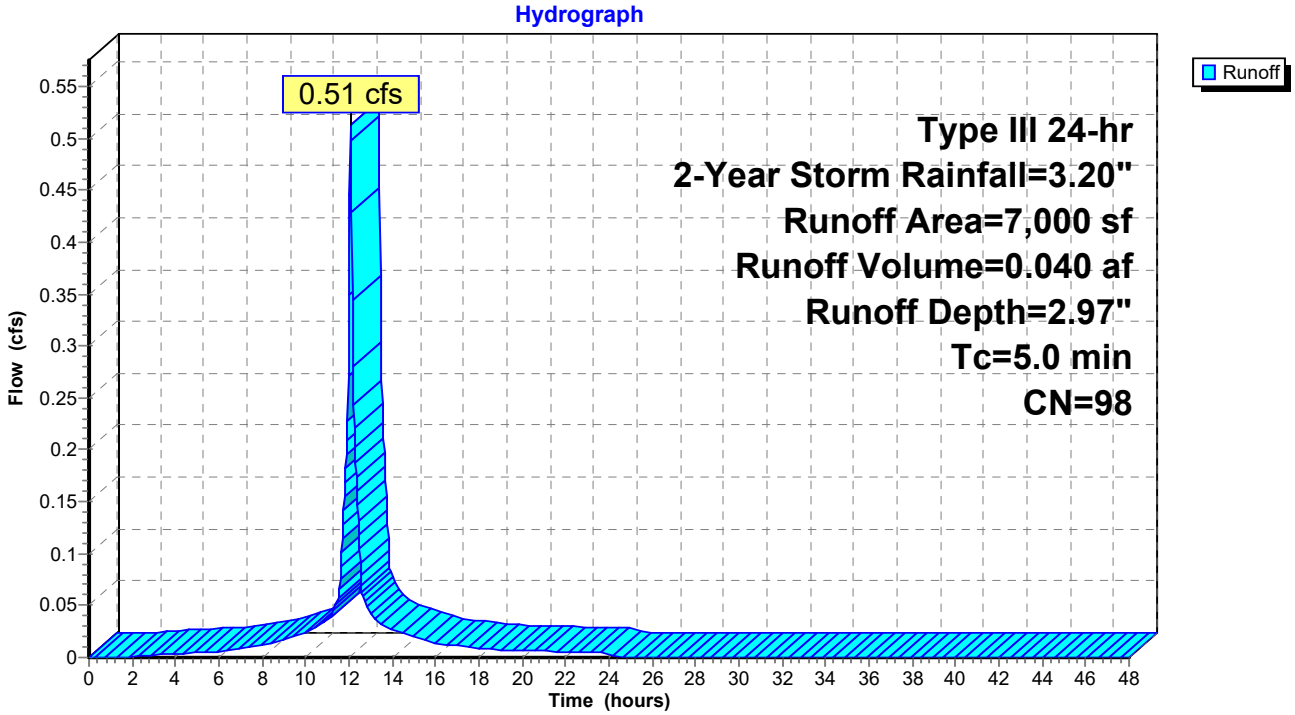
Runoff = 0.51 cfs @ 12.07 hrs, Volume= 0.040 af, Depth= 2.97"
Routed to Pond 4P : BASIN 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type III 24-hr 2-Year Storm Rainfall=3.20"

Area (sf)	CN	Description
7,000	98	Roofs, HSG C
7,000		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, TCmin=5 Minutes**

Subcatchment BLD: BLDG



Summary for Pond 1P: DMH-1

Inflow Area = 1.109 ac, 67.82% Impervious, Inflow Depth = 2.17" for 2-Year Storm event
Inflow = 2.87 cfs @ 12.07 hrs, Volume= 0.200 af
Outflow = 2.87 cfs @ 12.07 hrs, Volume= 0.200 af, Atten= 0%, Lag= 0.0 min
Primary = 1.30 cfs @ 12.07 hrs, Volume= 0.173 af
Routed to Pond 2P : OIL GRIT SEPARATOR
Secondary = 1.58 cfs @ 12.07 hrs, Volume= 0.027 af
Routed to Pond 3P : UG INFILTRATION SYSTEM #1

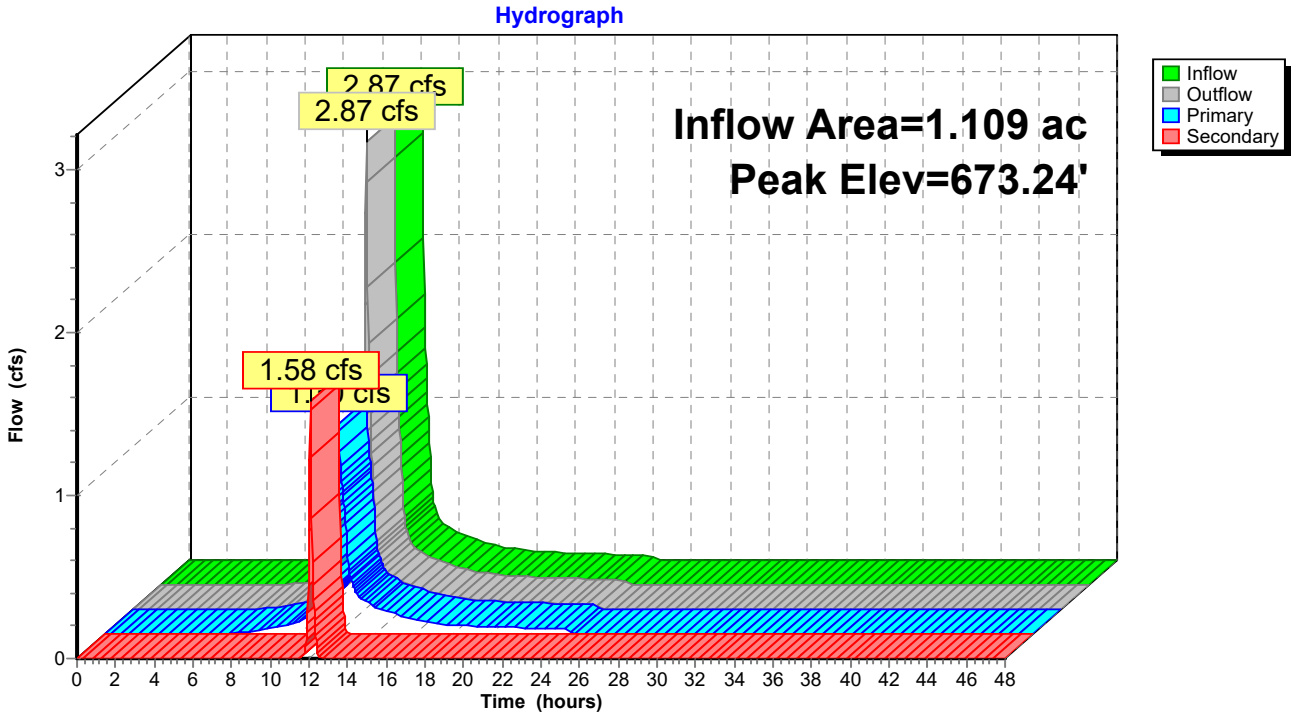
Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Peak Elev= 673.24' @ 12.07 hrs
Flood Elev= 675.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	671.95'	**8.0" Round Culvert** L= 6.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 671.95' / 671.85' S= 0.0167 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf
#2	Secondary	672.45'	**12.0" Round Culvert** L= 40.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 672.45' / 672.00' S= 0.0113 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.29 cfs @ 12.07 hrs HW=673.22' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 1.29 cfs @ 3.68 fps)

Secondary OutFlow Max=1.53 cfs @ 12.07 hrs HW=673.22' (Free Discharge)
↑—**2=Culvert** (Inlet Controls 1.53 cfs @ 2.36 fps)

Pond 1P: DMH-1


Hydrograph
Inflow Area=1.109 ac
Peak Elev=673.24'
2.87 cfs
2.87 cfs
1.58 cfs
Inflow
Outflow
Primary
Secondary
Flow (cfs)
Time (hours)
0
1
2
3
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48

Summary for Pond 2P: OIL GRIT SEPARATOR

[79] Warning: Submerged Pond 1P Primary device # 1 INLET by 1.02'

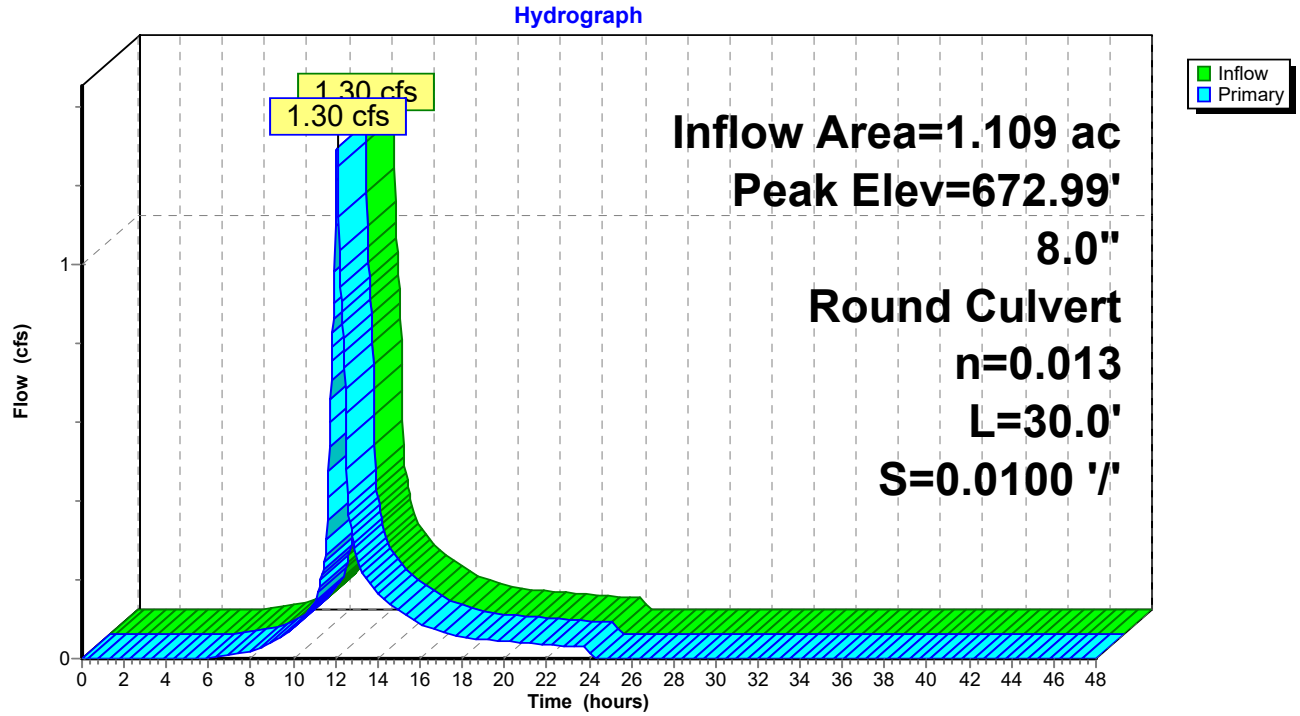
Inflow Area = 1.109 ac, 67.82% Impervious, Inflow Depth = 1.87" for 2-Year Storm event
Inflow = 1.30 cfs @ 12.07 hrs, Volume= 0.173 af
Outflow = 1.30 cfs @ 12.07 hrs, Volume= 0.173 af, Atten= 0%, Lag= 0.0 min
Primary = 1.30 cfs @ 12.07 hrs, Volume= 0.173 af
Routed to Pond 4P : BASIN 2

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Peak Elev= 672.99' @ 12.07 hrs
Flood Elev= 675.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	671.70'	**8.0" Round Culvert** L= 30.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 671.70' / 671.40' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=1.29 cfs @ 12.07 hrs HW=672.97' (Free Discharge)
1=Culvert (Inlet Controls 1.29 cfs @ 3.68 fps)

Pond 2P: OIL GRIT SEPARATOR



Summary for Pond 3P: UG INFILTRATION SYSTEM #1

Inflow = 1.58 cfs @ 12.07 hrs, Volume= 0.027 af
Outflow = 0.06 cfs @ 12.42 hrs, Volume= 0.027 af, Atten= 96%, Lag= 21.1 min
Discarded = 0.06 cfs @ 12.42 hrs, Volume= 0.027 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond 4P : BASIN 2

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Peak Elev= 671.43' @ 12.42 hrs Surf.Area= 1,980 sf Storage= 1,067 cf

Plug-Flow detention time= 159.1 min calculated for 0.027 af (100% of inflow)
Center-of-Mass det. time= 159.1 min (884.9 - 725.8)

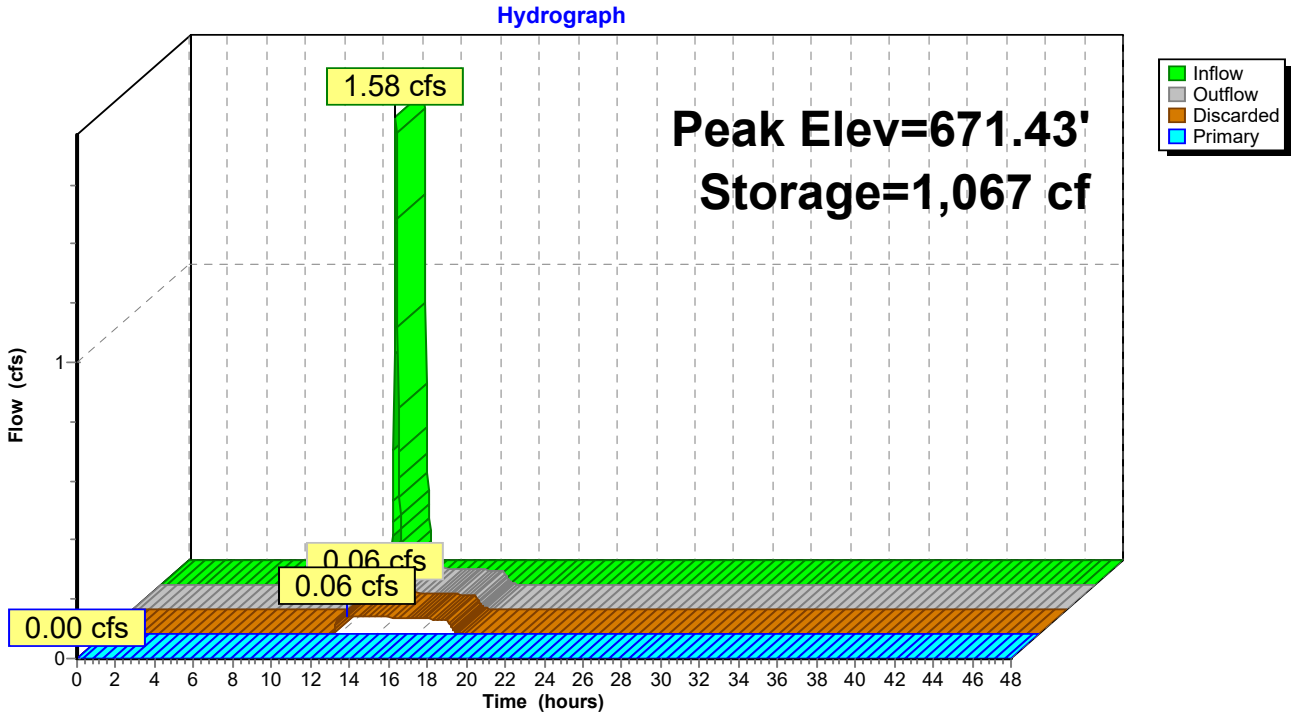
Volume	Invert	Avail.Storage	Storage Description
#1	670.50'	1,265 cf	**30.00'W x 66.00'L x 4.00'H Prismatoid** 7,920 cf Overall - 4,757 cf Embedded = 3,163 cf x 40.0% Voids
#2	671.00'	3,416 cf	**Shea Leaching Chamber 4x4x3** x 112 Inside #1 Inside= 41.0"W x 30.0"H => 8.72 sf x 3.50'L = 30.5 cf Outside= 47.0"W x 36.0"H => 10.62 sf x 4.00'L = 42.5 cf 112 Chambers in 7 Rows
		4,681 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	670.50'	**1.020 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 666.00'
#2	Primary	672.50'	**8.0" Round Culvert X 2.00** L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 672.50' / 671.00' S= 0.0750 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf

Discarded OutFlow Max=0.06 cfs @ 12.42 hrs HW=671.43' (Free Discharge)
↑—**1=Exfiltration** (Controls 0.06 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=670.50' (Free Discharge)
↑—**2=Culvert** (Controls 0.00 cfs)

Pond 3P: UG INFILTRATION SYSTEM #1



Summary for Pond 4P: BASIN 2

Inflow Area = 1.615 ac, 65.46% Impervious, Inflow Depth = 1.95" for 2-Year Storm event
Inflow = 2.52 cfs @ 12.07 hrs, Volume= 0.263 af
Outflow = 0.34 cfs @ 13.07 hrs, Volume= 0.263 af, Atten= 87%, Lag= 59.8 min
Discarded = 0.18 cfs @ 13.07 hrs, Volume= 0.249 af
Primary = 0.16 cfs @ 13.07 hrs, Volume= 0.014 af
Routed to Link 1S : EX. CB (RTE 20)

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Peak Elev= 670.53' @ 13.07 hrs Surf.Area= 2,865 sf Storage= 5,671 cf
Flood Elev= 671.00' Surf.Area= 3,280 sf Storage= 7,102 cf

Plug-Flow detention time= 389.0 min calculated for 0.263 af (100% of inflow)
Center-of-Mass det. time= 389.2 min (1,198.6 - 809.3)

Volume	Invert	Avail.Storage	Storage Description
#1	668.00'	7,102 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

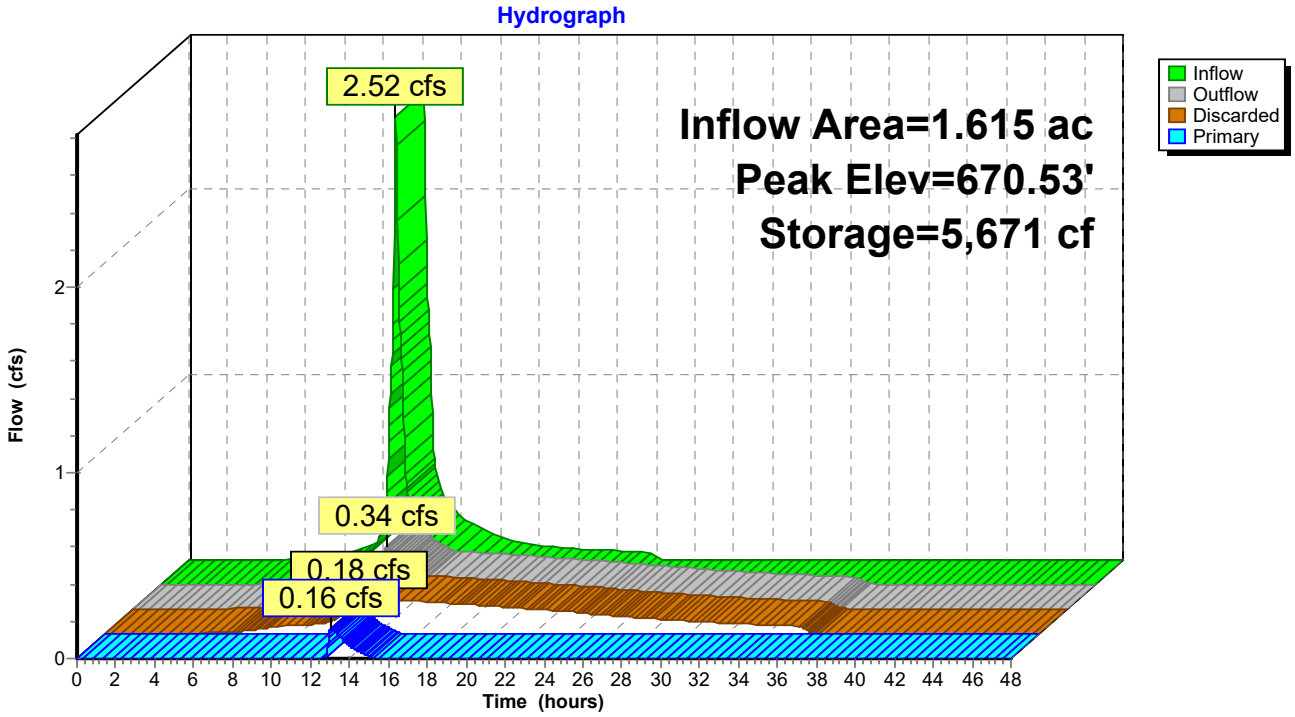
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
668.00	1,711	299.2	0	0	1,711
669.00	2,200	318.0	1,950	1,950	2,685
670.00	2,423	337.0	2,311	4,261	3,728
671.00	3,280	356.0	2,841	7,102	4,831

Device	Routing	Invert	Outlet Devices
#1	Discarded	668.00'	**1.020 in/hr Exfiltration - Sandy Loam over Wetted area** Conductivity to Groundwater Elevation = 666.00'
#2	Primary	670.50'	**10.0' 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=0.18 cfs @ 13.07 hrs HW=670.53' (Free Discharge)
↑—**1=Exfiltration - Sandy Loam** (Controls 0.18 cfs)

Primary OutFlow Max=0.15 cfs @ 13.07 hrs HW=670.53' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Weir Controls 0.15 cfs @ 0.43 fps)

Pond 4P: BASIN 2

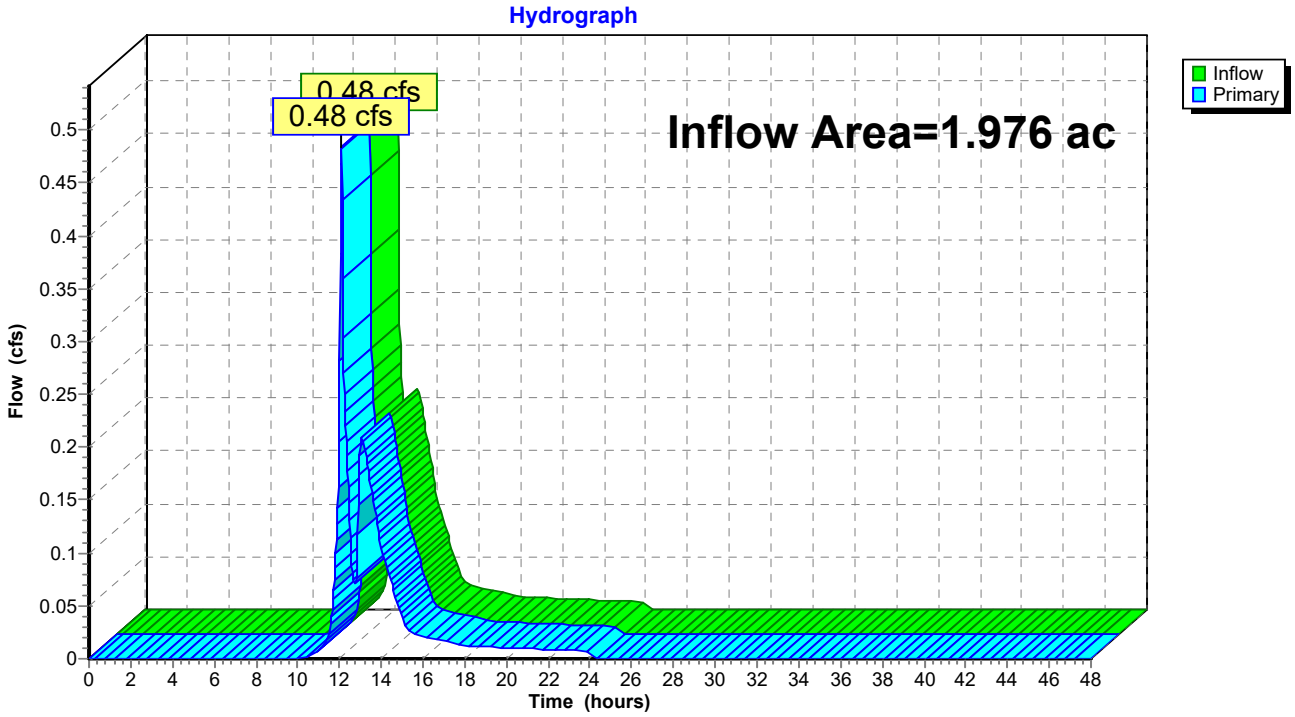


Summary for Link 1S: EX. CB (RTE 20)

Inflow Area = 1.976 ac, 57.63% Impervious, Inflow Depth = 0.30" for 2-Year Storm event
Inflow = 0.48 cfs @ 12.08 hrs, Volume= 0.049 af
Primary = 0.48 cfs @ 12.08 hrs, Volume= 0.049 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs

Link 1S: EX. CB (RTE 20)

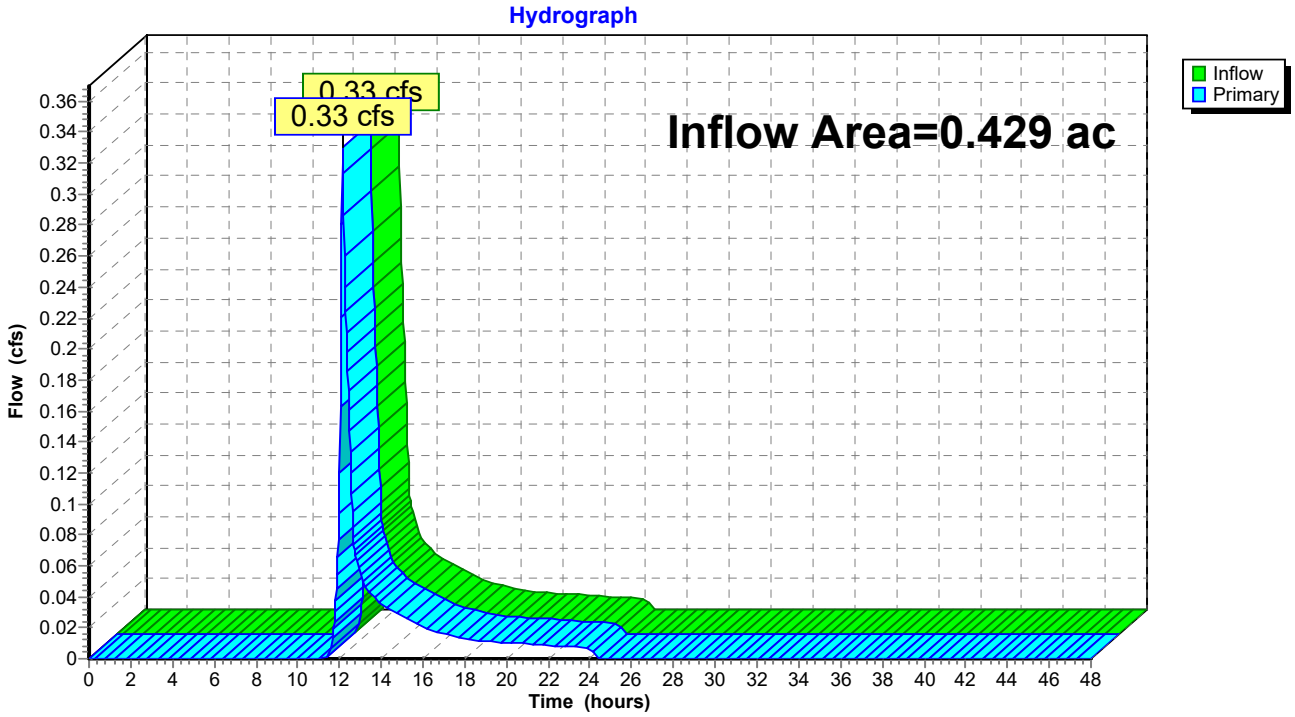


Summary for Link 2S: WETLANDS

Inflow Area = 0.429 ac, 0.00% Impervious, Inflow Depth = 0.83" for 2-Year Storm event
Inflow = 0.33 cfs @ 12.15 hrs, Volume= 0.030 af
Primary = 0.33 cfs @ 12.15 hrs, Volume= 0.030 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs

Link 2S: WETLANDS



Time span=0.00-48.00 hrs, dt=0.03 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 1a: PAVED STORAGE YARD Runoff Area=48,317 sf 67.82% Impervious Runoff Depth=3.59"
Tc=5.0 min CN=90 Runoff=4.65 cfs 0.332 af

Subcatchment 1b: FRONT PARKING Runoff Area=10,206 sf 61.55% Impervious Runoff Depth=3.49"
Tc=5.0 min CN=89 Runoff=0.96 cfs 0.068 af

Subcatchment 1c: STORM BASIN #2 Runoff Area=4,828 sf 0.00% Impervious Runoff Depth=2.13"
Tc=5.0 min CN=74 Runoff=0.28 cfs 0.020 af

Subcatchment 1d: EAST LANDSCAPE Runoff Area=15,711 sf 22.57% Impervious Runoff Depth=2.29"
Tc=5.0 min CN=76 Runoff=0.99 cfs 0.069 af

Subcatchment 2a: WEST WOODS Runoff Area=18,684 sf 0.00% Impervious Runoff Depth=1.82"
Flow Length=320' Slope=0.0340 '/' Tc=9.2 min CN=70 Runoff=0.79 cfs 0.065 af

Subcatchment BLD: BLDG Runoff Area=7,000 sf 100.00% Impervious Runoff Depth=4.46"
Tc=5.0 min CN=98 Runoff=0.76 cfs 0.060 af

Pond 1P: DMH-1 Peak Elev=673.92' Inflow=4.65 cfs 0.332 af
Primary=1.70 cfs 0.265 af Secondary=2.95 cfs 0.067 af Outflow=4.65 cfs 0.332 af

Pond 2P: OIL GRIT SEPARATOR Peak Elev=673.67' Inflow=1.70 cfs 0.265 af
8.0" Round Culvert n=0.013 L=30.0' S=0.0100 '/' Outflow=1.70 cfs 0.265 af

Pond 3P: UG INFILTRATION SYSTEM #1 Peak Elev=672.51' Storage=2,705 cf Inflow=2.95 cfs 0.067 af
Discarded=0.08 cfs 0.067 af Primary=0.00 cfs 0.000 af Outflow=0.08 cfs 0.067 af

Pond 4P: BASIN 2 Peak Elev=670.69' Storage=6,141 cf Inflow=3.70 cfs 0.412 af
Discarded=0.19 cfs 0.288 af Primary=2.00 cfs 0.124 af Outflow=2.19 cfs 0.412 af

Link 1S: EX. CB (RTE 20) Inflow=2.56 cfs 0.193 af
Primary=2.56 cfs 0.193 af

Link 2S: WETLANDS Inflow=0.79 cfs 0.065 af
Primary=0.79 cfs 0.065 af

Total Runoff Area = 2.405 ac Runoff Volume = 0.613 af Average Runoff Depth = 3.06"
52.65% Pervious = 1.266 ac 47.35% Impervious = 1.139 ac

Summary for Subcatchment 1a: PAVED STORAGE YARD

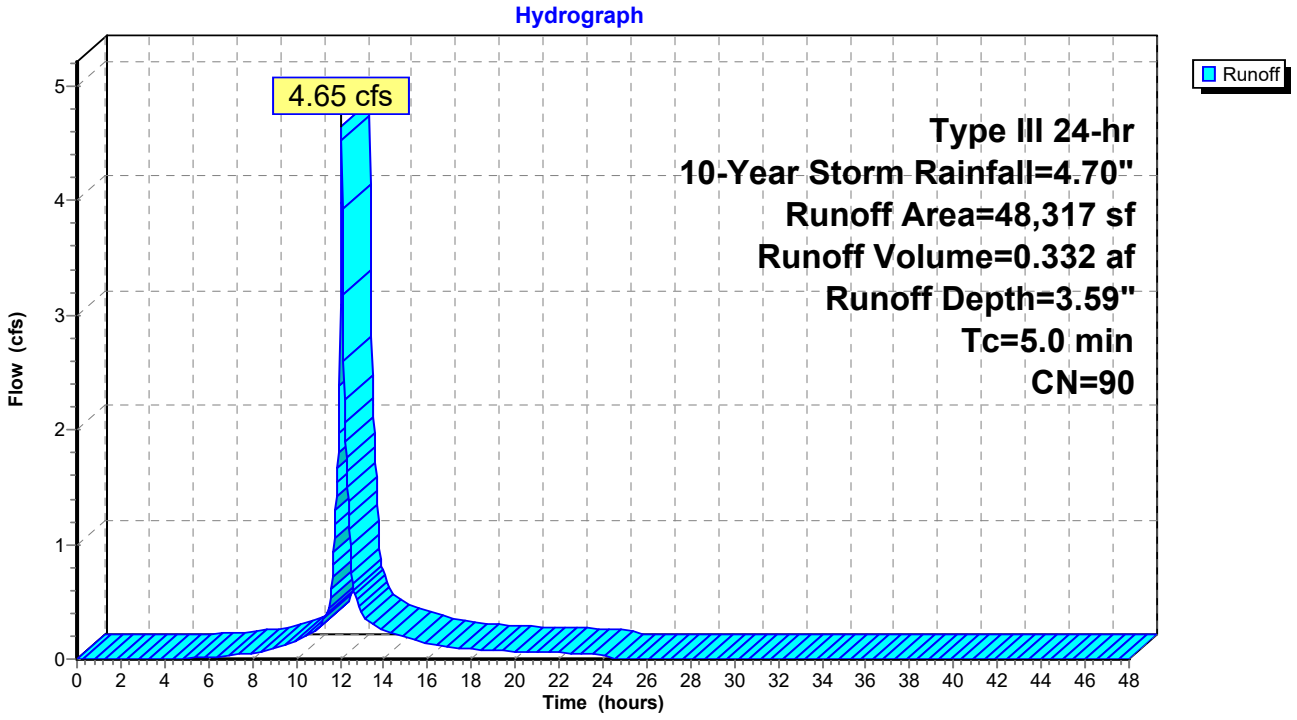
Runoff = 4.65 cfs @ 12.07 hrs, Volume= 0.332 af, Depth= 3.59"
Routed to Pond 1P : DMH-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type III 24-hr 10-Year Storm Rainfall=4.70"

Area (sf)	CN	Description
32,770	98	Paved parking, HSG C
15,547	74	>75% Grass cover, Good, HSG C
48,317	90	Weighted Average
15,547		32.18% Pervious Area
32,770		67.82% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, TCmin=5 Minutes**

Subcatchment 1a: PAVED STORAGE YARD



Summary for Subcatchment 1b: FRONT PARKING

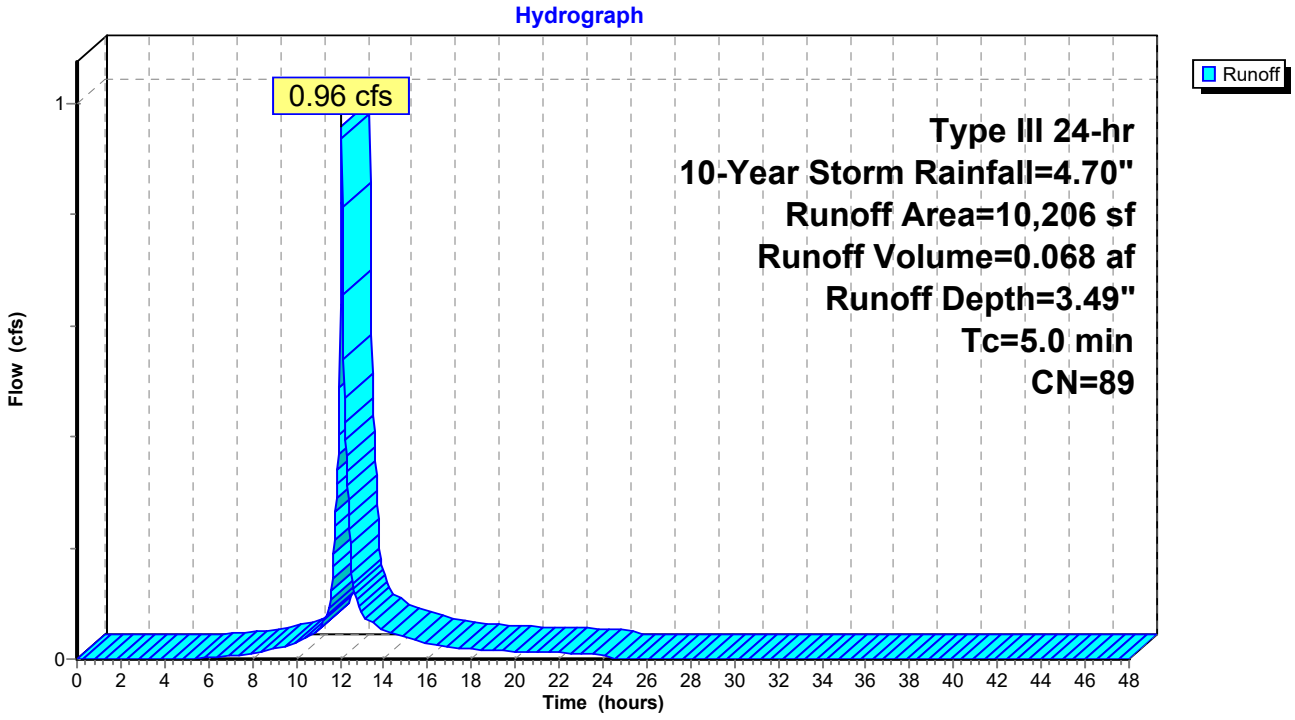
Runoff = 0.96 cfs @ 12.07 hrs, Volume= 0.068 af, Depth= 3.49"
Routed to Pond 4P : BASIN 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type III 24-hr 10-Year Storm Rainfall=4.70"

Area (sf)	CN	Description
6,282	98	Paved parking, HSG C
3,924	74	>75% Grass cover, Good, HSG C
10,206	89	Weighted Average
3,924		38.45% Pervious Area
6,282		61.55% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, TCmin=5 Minutes**

Subcatchment 1b: FRONT PARKING



Summary for Subcatchment 1c: STORM BASIN #2

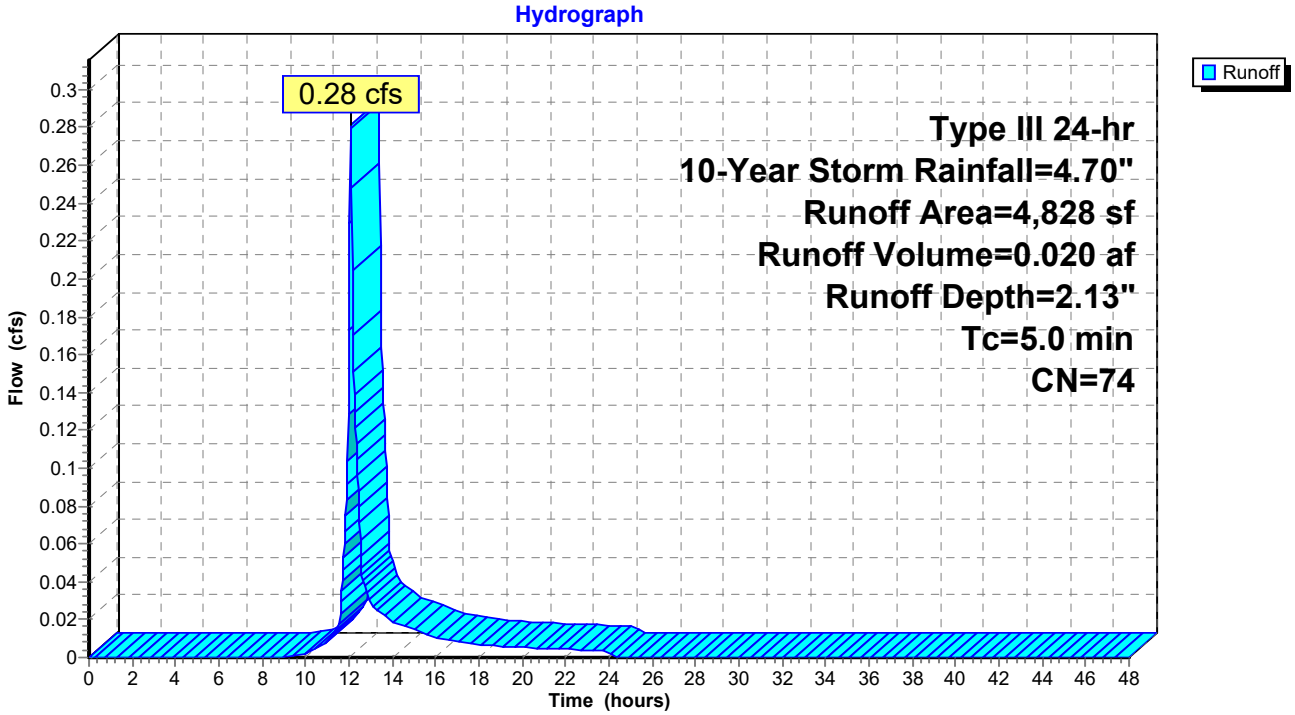
Runoff = 0.28 cfs @ 12.08 hrs, Volume= 0.020 af, Depth= 2.13"
Routed to Pond 4P : BASIN 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type III 24-hr 10-Year Storm Rainfall=4.70"

Area (sf)	CN	Description
4,828	74	>75% Grass cover, Good, HSG C
4,828		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Minimum Tc = 5 min.**

Subcatchment 1c: STORM BASIN #2



Summary for Subcatchment 1d: EAST LANDSCAPE

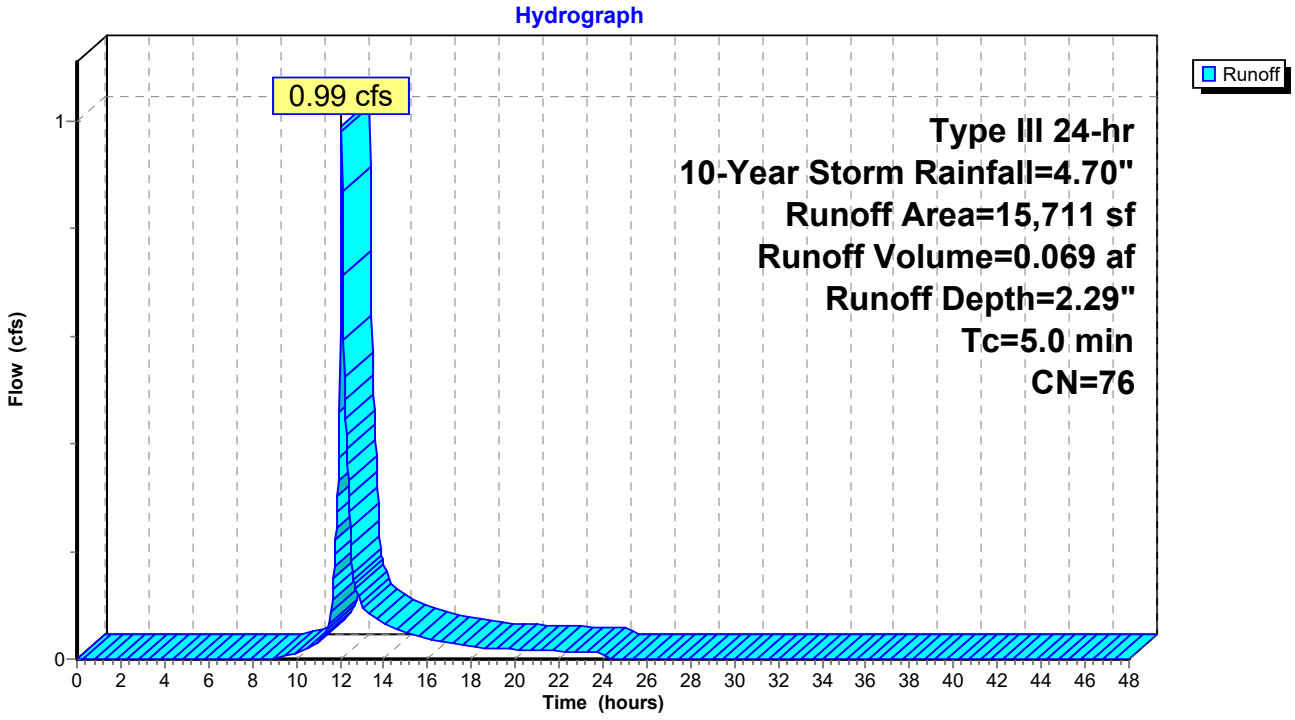
Runoff = 0.99 cfs @ 12.08 hrs, Volume= 0.069 af, Depth= 2.29"
Routed to Link 1S : EX. CB (RTE 20)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type III 24-hr 10-Year Storm Rainfall=4.70"

Area (sf)	CN	Description
12,165	70	Woods, Good, HSG C
3,546	98	Paved parking, HSG C
15,711	76	Weighted Average
12,165		77.43% Pervious Area
3,546		22.57% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, TCmin=5 Minutes**

Subcatchment 1d: EAST LANDSCAPE



Summary for Subcatchment 2a: WEST WOODS

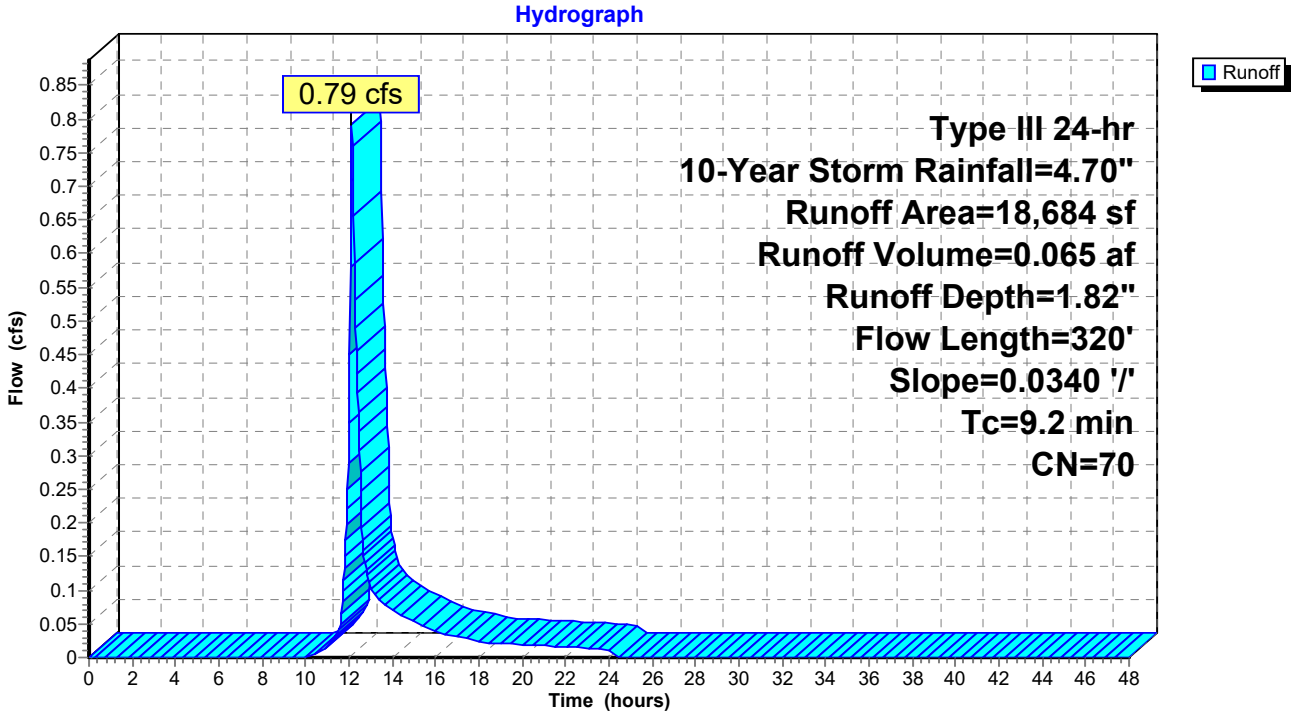
Runoff = 0.79 cfs @ 12.14 hrs, Volume= 0.065 af, Depth= 1.82"
Routed to Link 2S : WETLANDS

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type III 24-hr 10-Year Storm Rainfall=4.70"

Area (sf)	CN	Description
18,684	70	Woods, Good, HSG C
18,684		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.2	320	0.0340	0.58		**Lag/CN Method,**

Subcatchment 2a: WEST WOODS



Summary for Subcatchment BLD: BLDG

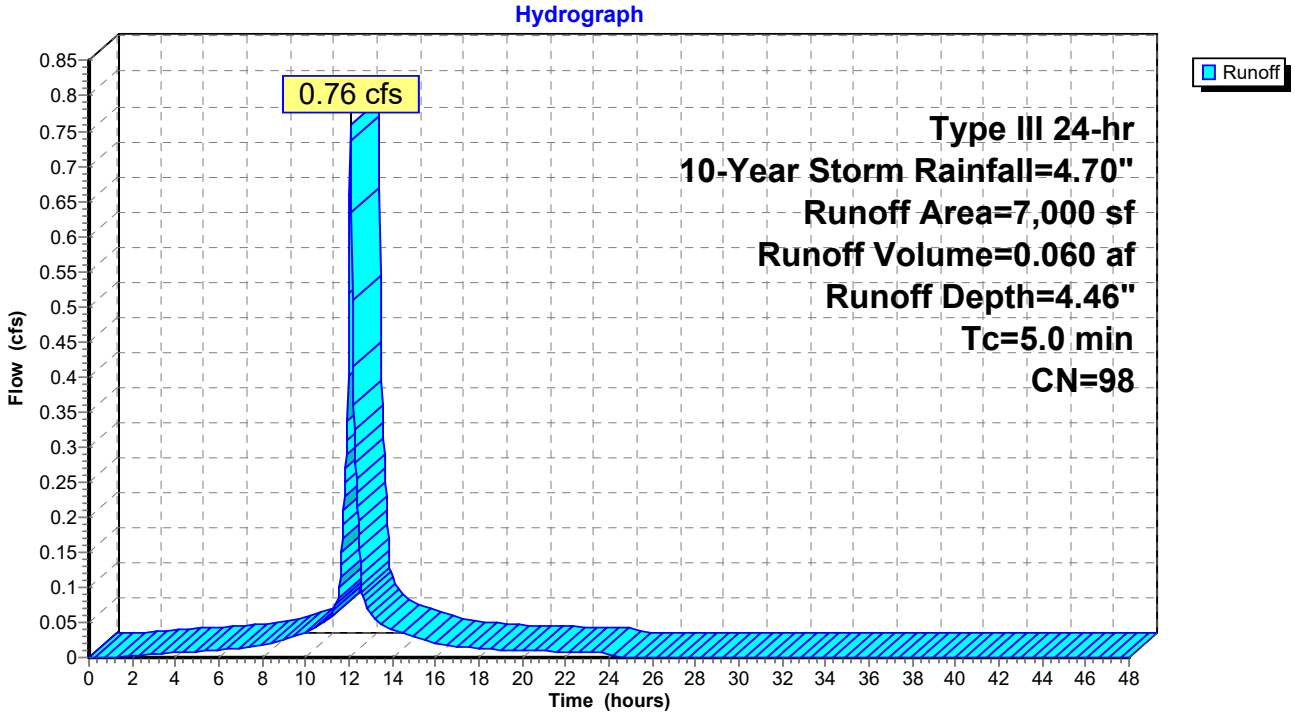
Runoff = 0.76 cfs @ 12.07 hrs, Volume= 0.060 af, Depth= 4.46"
Routed to Pond 4P : BASIN 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type III 24-hr 10-Year Storm Rainfall=4.70"

Area (sf)	CN	Description
7,000	98	Roofs, HSG C
7,000		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, TCmin=5 Minutes**

Subcatchment BLD: BLDG



Summary for Pond 1P: DMH-1

Inflow Area = 1.109 ac, 67.82% Impervious, Inflow Depth = 3.59" for 10-Year Storm event
Inflow = 4.65 cfs @ 12.07 hrs, Volume= 0.332 af
Outflow = 4.65 cfs @ 12.07 hrs, Volume= 0.332 af, Atten= 0%, Lag= 0.0 min
Primary = 1.70 cfs @ 12.07 hrs, Volume= 0.265 af
Routed to Pond 2P : OIL GRIT SEPARATOR
Secondary = 2.95 cfs @ 12.07 hrs, Volume= 0.067 af
Routed to Pond 3P : UG INFILTRATION SYSTEM #1

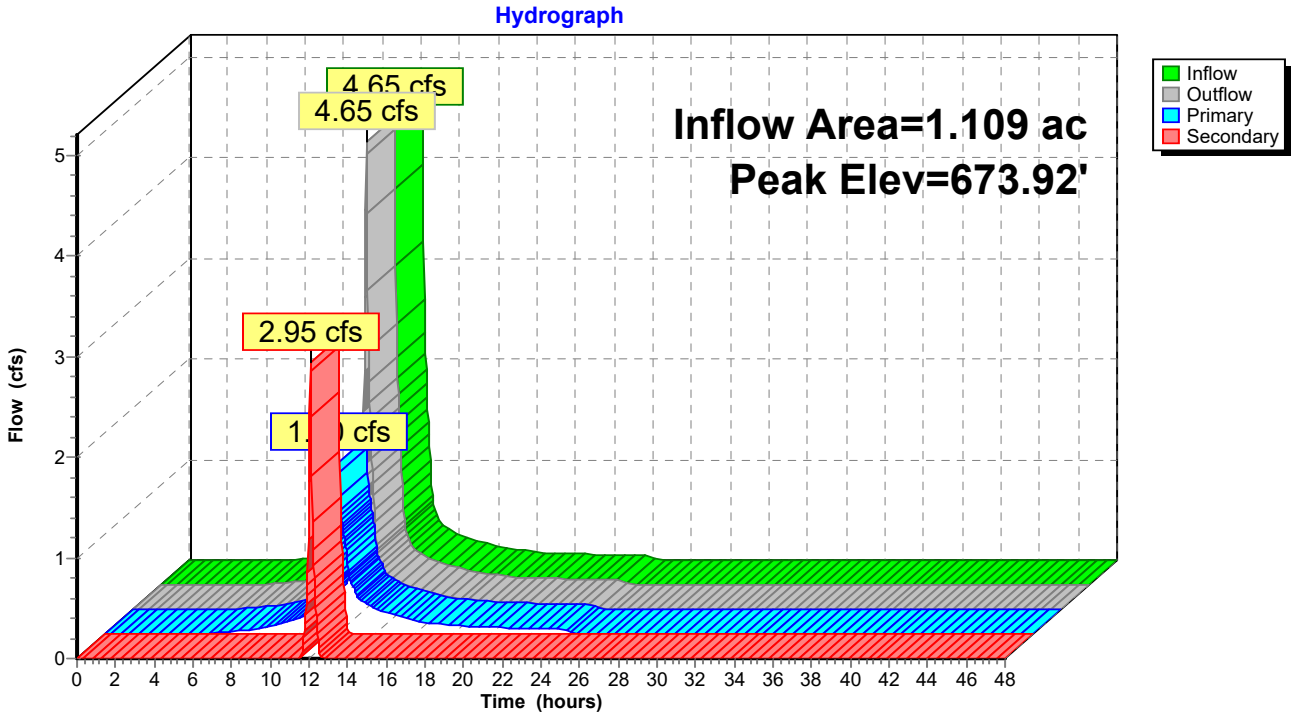
Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Peak Elev= 673.92' @ 12.07 hrs
Flood Elev= 675.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	671.95'	**8.0" Round Culvert** L= 6.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 671.95' / 671.85' S= 0.0167 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf
#2	Secondary	672.45'	**12.0" Round Culvert** L= 40.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 672.45' / 672.00' S= 0.0113 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.68 cfs @ 12.07 hrs HW=673.89' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 1.68 cfs @ 4.81 fps)

Secondary OutFlow Max=2.89 cfs @ 12.07 hrs HW=673.89' (Free Discharge)
↑—**2=Culvert** (Inlet Controls 2.89 cfs @ 3.68 fps)

Pond 1P: DMH-1


Hydrograph
Inflow Area=1.109 ac
Peak Elev=673.92'
4.65 cfs
4.65 cfs
2.95 cfs
Inflow
Outflow
Primary
Secondary
Flow (cfs)
Time (hours)
0
1
2
3
4
5
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48

Summary for Pond 2P: OIL GRIT SEPARATOR

[79] Warning: Submerged Pond 1P Primary device # 1 INLET by 1.70'

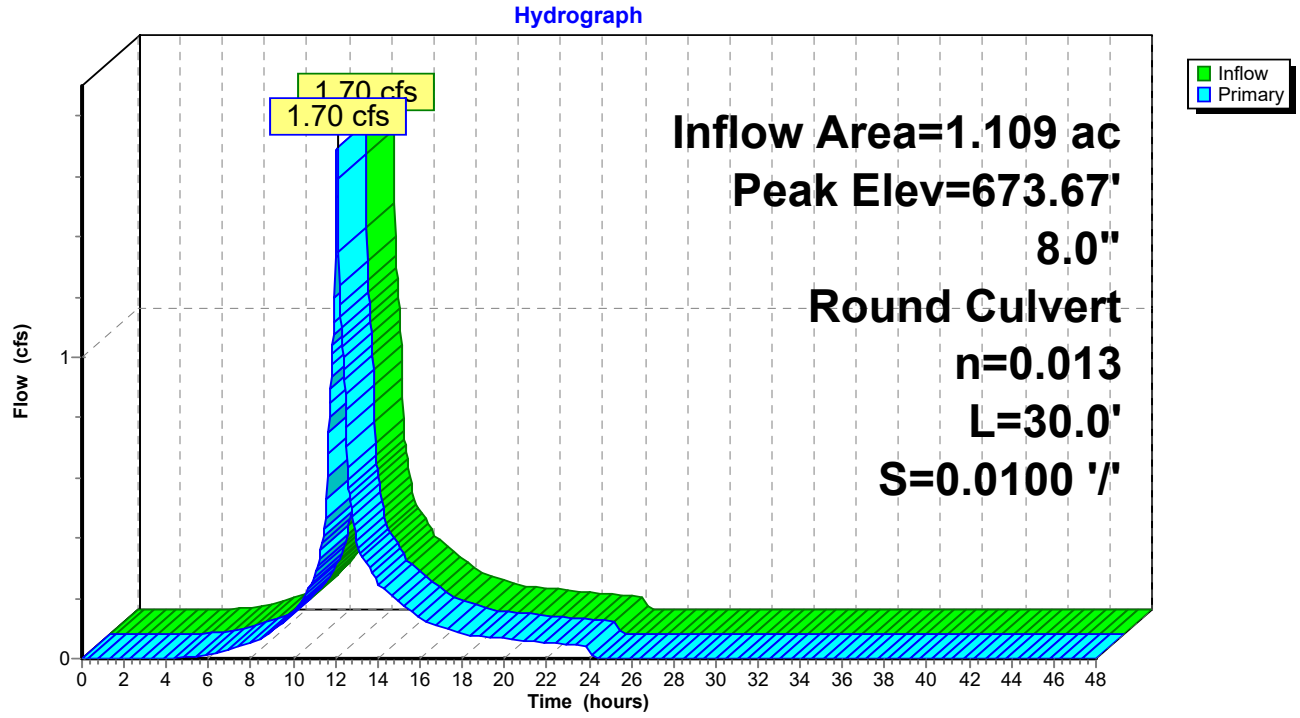
Inflow Area = 1.109 ac, 67.82% Impervious, Inflow Depth = 2.87" for 10-Year Storm event
Inflow = 1.70 cfs @ 12.07 hrs, Volume= 0.265 af
Outflow = 1.70 cfs @ 12.07 hrs, Volume= 0.265 af, Atten= 0%, Lag= 0.0 min
Primary = 1.70 cfs @ 12.07 hrs, Volume= 0.265 af
Routed to Pond 4P : BASIN 2

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Peak Elev= 673.67' @ 12.07 hrs
Flood Elev= 675.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	671.70'	**8.0" Round Culvert** L= 30.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 671.70' / 671.40' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=1.68 cfs @ 12.07 hrs HW=673.64' (Free Discharge)
1=Culvert (Inlet Controls 1.68 cfs @ 4.81 fps)

Pond 2P: OIL GRIT SEPARATOR



Summary for Pond 3P: UG INFILTRATION SYSTEM #1

[81] Warning: Exceeded Pond 1P by 0.04' @ 12.84 hrs

Inflow	=	2.95 cfs @	12.07 hrs, Volume=	0.067 af
Outflow	=	0.08 cfs @	12.52 hrs, Volume=	0.067 af, Atten= 97%, Lag= 26.9 min
Discarded	=	0.08 cfs @	12.52 hrs, Volume=	0.067 af
Primary	=	0.00 cfs @	12.52 hrs, Volume=	0.000 af

Routed to Pond 4P : BASIN 2

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Peak Elev= 672.51' @ 12.52 hrs Surf.Area= 1,980 sf Storage= 2,705 cf

Plug-Flow detention time= 333.9 min calculated for 0.067 af (100% of inflow)
Center-of-Mass det. time= 334.1 min (1,059.6 - 725.5)

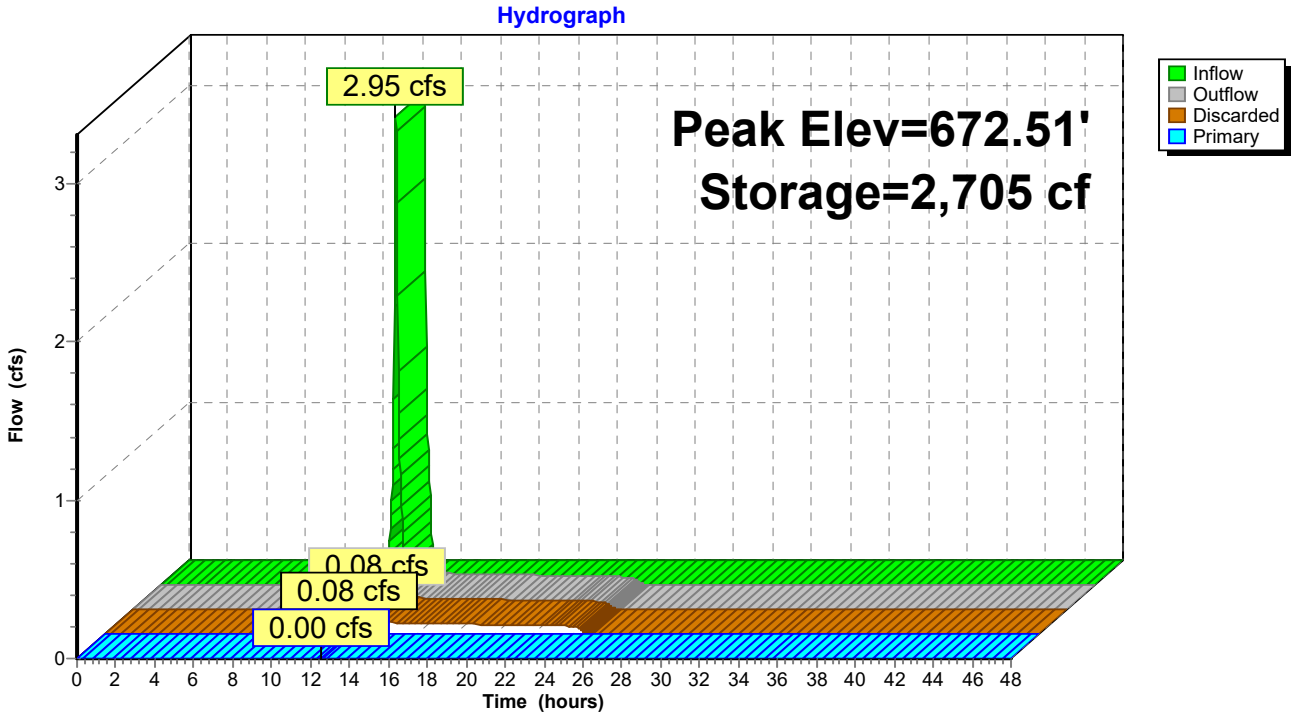
Volume	Invert	Avail.Storage	Storage Description
#1	670.50'	1,265 cf	**30.00'W x 66.00'L x 4.00'H Prismatoid** 7,920 cf Overall - 4,757 cf Embedded = 3,163 cf x 40.0% Voids
#2	671.00'	3,416 cf	**Shea Leaching Chamber 4x4x3** x 112 Inside #1 Inside= 41.0"W x 30.0"H => 8.72 sf x 3.50'L = 30.5 cf Outside= 47.0"W x 36.0"H => 10.62 sf x 4.00'L = 42.5 cf 112 Chambers in 7 Rows
		4,681 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	670.50'	**1.020 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 666.00'
#2	Primary	672.50'	**8.0" Round Culvert X 2.00** L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 672.50' / 671.00' S= 0.0750 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf

Discarded OutFlow Max=0.08 cfs @ 12.52 hrs HW=672.51' (Free Discharge)
↑—**1=Exfiltration** (Controls 0.08 cfs)

Primary OutFlow Max=0.00 cfs @ 12.52 hrs HW=672.51' (Free Discharge)
↑—**2=Culvert** (Inlet Controls 0.00 cfs @ 0.22 fps)

Pond 3P: UG INFILTRATION SYSTEM #1



Summary for Pond 4P: BASIN 2

Inflow Area = 1.615 ac, 65.46% Impervious, Inflow Depth = 3.06" for 10-Year Storm event
Inflow = 3.70 cfs @ 12.07 hrs, Volume= 0.412 af
Outflow = 2.19 cfs @ 12.21 hrs, Volume= 0.412 af, Atten= 41%, Lag= 8.3 min
Discarded = 0.19 cfs @ 12.21 hrs, Volume= 0.288 af
Primary = 2.00 cfs @ 12.21 hrs, Volume= 0.124 af
Routed to Link 1S : EX. CB (RTE 20)

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Peak Elev= 670.69' @ 12.21 hrs Surf.Area= 3,004 sf Storage= 6,141 cf
Flood Elev= 671.00' Surf.Area= 3,280 sf Storage= 7,102 cf

Plug-Flow detention time= 295.4 min calculated for 0.412 af (100% of inflow)
Center-of-Mass det. time= 295.8 min (1,095.0 - 799.2)

Volume	Invert	Avail.Storage	Storage Description
#1	668.00'	7,102 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

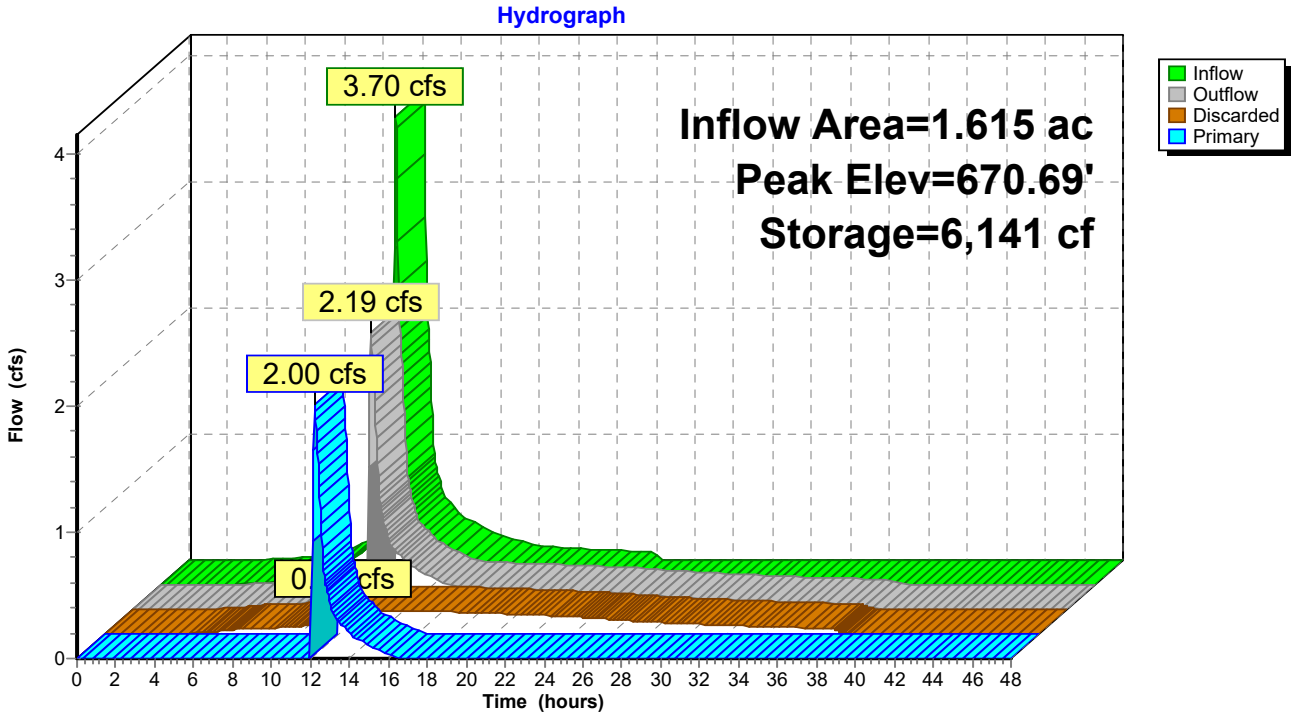
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
668.00	1,711	299.2	0	0	1,711
669.00	2,200	318.0	1,950	1,950	2,685
670.00	2,423	337.0	2,311	4,261	3,728
671.00	3,280	356.0	2,841	7,102	4,831

Device	Routing	Invert	Outlet Devices
#1	Discarded	668.00'	**1.020 in/hr Exfiltration - Sandy Loam over Wetted area** Conductivity to Groundwater Elevation = 666.00'
#2	Primary	670.50'	**10.0' 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=0.19 cfs @ 12.21 hrs HW=670.69' (Free Discharge)
↑—**1=Exfiltration - Sandy Loam** (Controls 0.19 cfs)

Primary OutFlow Max=2.00 cfs @ 12.21 hrs HW=670.69' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Weir Controls 2.00 cfs @ 1.03 fps)

Pond 4P: BASIN 2

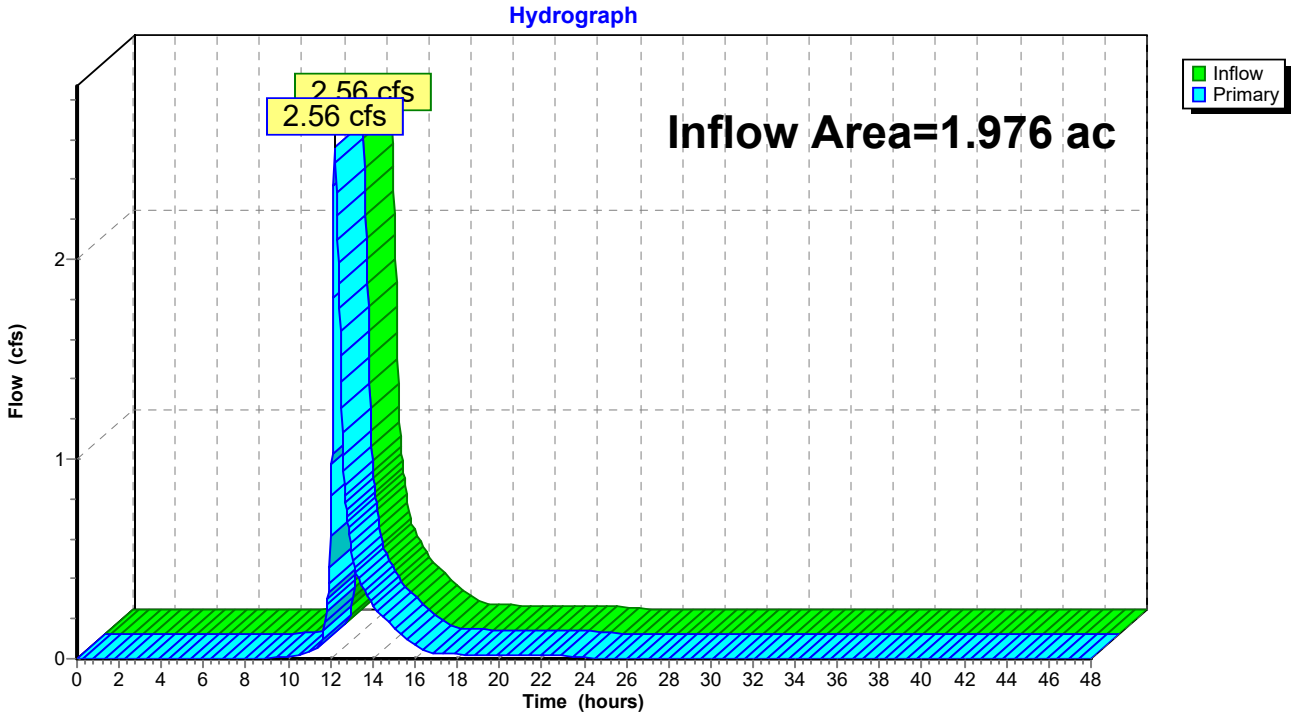


Summary for Link 1S: EX. CB (RTE 20)

Inflow Area = 1.976 ac, 57.63% Impervious, Inflow Depth = 1.17" for 10-Year Storm event
Inflow = 2.56 cfs @ 12.19 hrs, Volume= 0.193 af
Primary = 2.56 cfs @ 12.19 hrs, Volume= 0.193 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs

Link 1S: EX. CB (RTE 20)

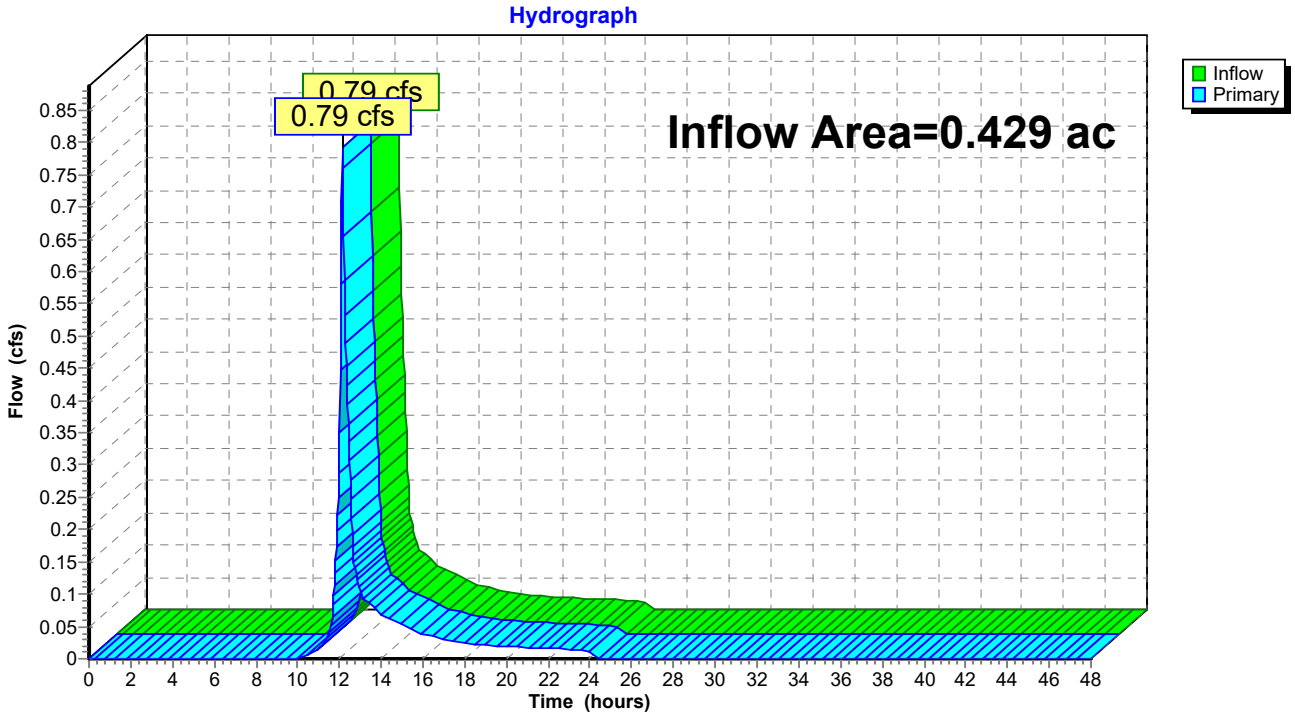


Summary for Link 2S: WETLANDS

Inflow Area = 0.429 ac, 0.00% Impervious, Inflow Depth = 1.82" for 10-Year Storm event
Inflow = 0.79 cfs @ 12.14 hrs, Volume= 0.065 af
Primary = 0.79 cfs @ 12.14 hrs, Volume= 0.065 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs

Link 2S: WETLANDS



Time span=0.00-48.00 hrs, dt=0.03 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 1a: PAVED STORAGE YARD Runoff Area=48,317 sf 67.82% Impervious Runoff Depth=4.26"
Tc=5.0 min CN=90 Runoff=5.48 cfs 0.394 af

Subcatchment 1b: FRONT PARKING Runoff Area=10,206 sf 61.55% Impervious Runoff Depth=4.16"
Tc=5.0 min CN=89 Runoff=1.14 cfs 0.081 af

Subcatchment 1c: STORM BASIN #2 Runoff Area=4,828 sf 0.00% Impervious Runoff Depth=2.69"
Tc=5.0 min CN=74 Runoff=0.36 cfs 0.025 af

Subcatchment 1d: EAST LANDSCAPE Runoff Area=15,711 sf 22.57% Impervious Runoff Depth=2.87"
Tc=5.0 min CN=76 Runoff=1.25 cfs 0.086 af

Subcatchment 2a: WEST WOODS Runoff Area=18,684 sf 0.00% Impervious Runoff Depth=2.34"
Flow Length=320' Slope=0.0340 '/' Tc=9.2 min CN=70 Runoff=1.04 cfs 0.084 af

Subcatchment BLD: BLDG Runoff Area=7,000 sf 100.00% Impervious Runoff Depth=5.16"
Tc=5.0 min CN=98 Runoff=0.87 cfs 0.069 af

Pond 1P: DMH-1 Peak Elev=674.37' Inflow=5.48 cfs 0.394 af
Primary=1.92 cfs 0.307 af Secondary=3.56 cfs 0.087 af Outflow=5.48 cfs 0.394 af

Pond 2P: OIL GRIT SEPARATOR Peak Elev=674.12' Inflow=1.92 cfs 0.307 af
8.0" Round Culvert n=0.013 L=30.0' S=0.0100 '/' Outflow=1.92 cfs 0.307 af

Pond 3P: UG INFILTRATION SYSTEM #1 Peak Elev=672.82' Storage=3,180 cf Inflow=3.56 cfs 0.087 af
Discarded=0.08 cfs 0.072 af Primary=0.51 cfs 0.015 af Outflow=0.59 cfs 0.087 af

Pond 4P: BASIN 2 Peak Elev=670.77' Storage=6,375 cf Inflow=4.29 cfs 0.498 af
Discarded=0.20 cfs 0.304 af Primary=3.38 cfs 0.194 af Outflow=3.58 cfs 0.498 af

Link 1S: EX. CB (RTE 20) Inflow=4.44 cfs 0.280 af
Primary=4.44 cfs 0.280 af

Link 2S: WETLANDS Inflow=1.04 cfs 0.084 af
Primary=1.04 cfs 0.084 af

Total Runoff Area = 2.405 ac Runoff Volume = 0.739 af Average Runoff Depth = 3.69"
52.65% Pervious = 1.266 ac 47.35% Impervious = 1.139 ac

Summary for Subcatchment 1a: PAVED STORAGE YARD

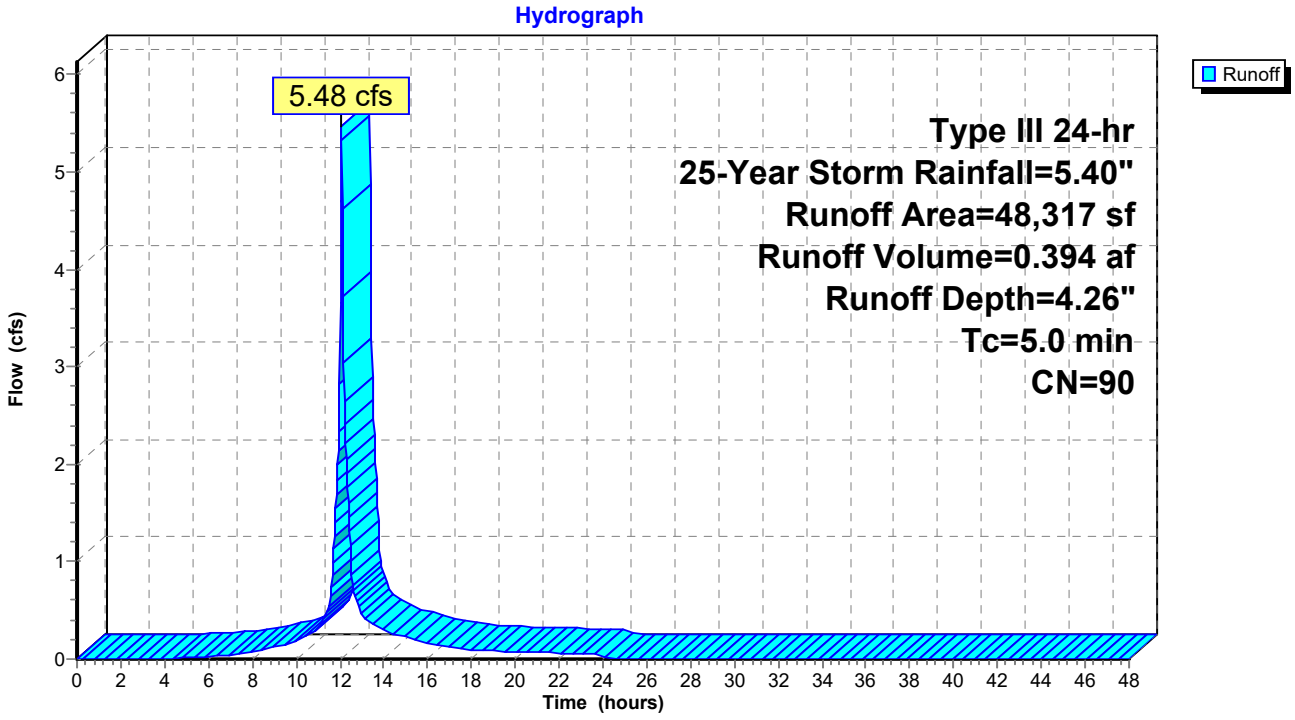
Runoff = 5.48 cfs @ 12.07 hrs, Volume= 0.394 af, Depth= 4.26"
Routed to Pond 1P : DMH-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type III 24-hr 25-Year Storm Rainfall=5.40"

Area (sf)	CN	Description
32,770	98	Paved parking, HSG C
15,547	74	>75% Grass cover, Good, HSG C
48,317	90	Weighted Average
15,547		32.18% Pervious Area
32,770		67.82% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, TCmin=5 Minutes**

Subcatchment 1a: PAVED STORAGE YARD



Summary for Subcatchment 1b: FRONT PARKING

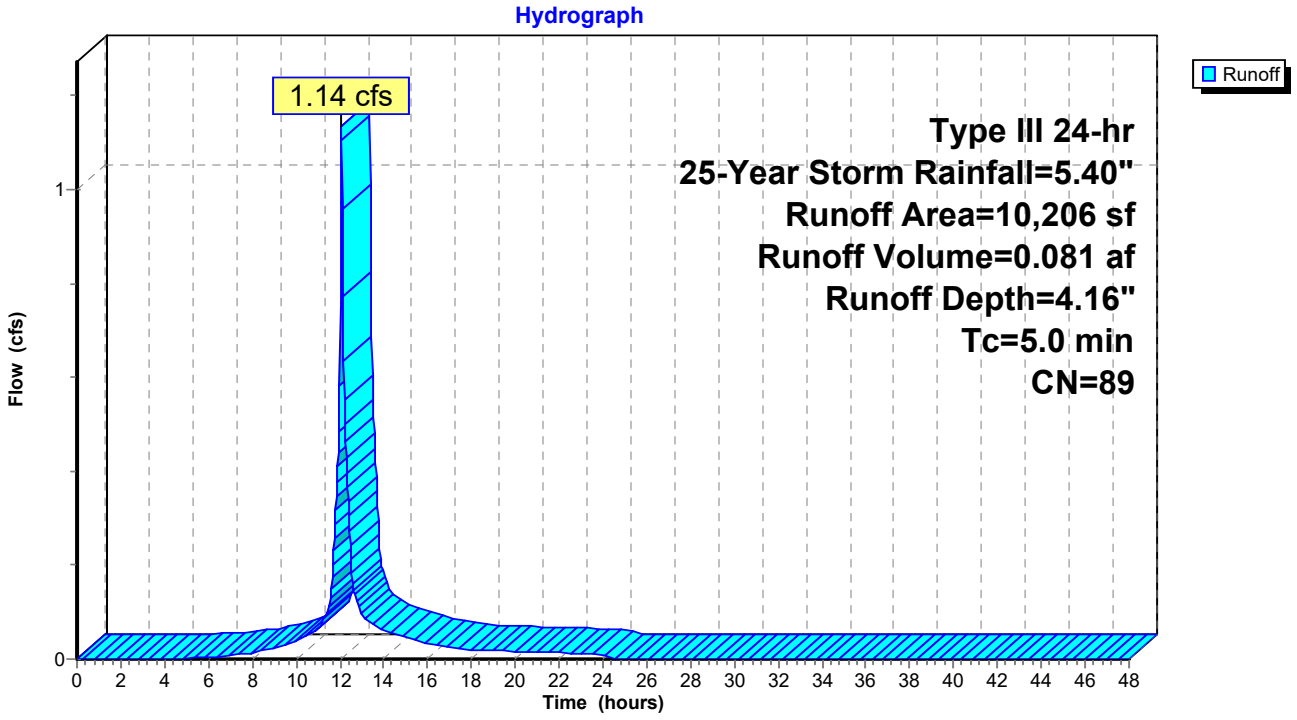
Runoff = 1.14 cfs @ 12.07 hrs, Volume= 0.081 af, Depth= 4.16"
Routed to Pond 4P : BASIN 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type III 24-hr 25-Year Storm Rainfall=5.40"

Area (sf)	CN	Description
6,282	98	Paved parking, HSG C
3,924	74	>75% Grass cover, Good, HSG C
10,206	89	Weighted Average
3,924		38.45% Pervious Area
6,282		61.55% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, TCmin=5 Minutes**

Subcatchment 1b: FRONT PARKING



Summary for Subcatchment 1c: STORM BASIN #2

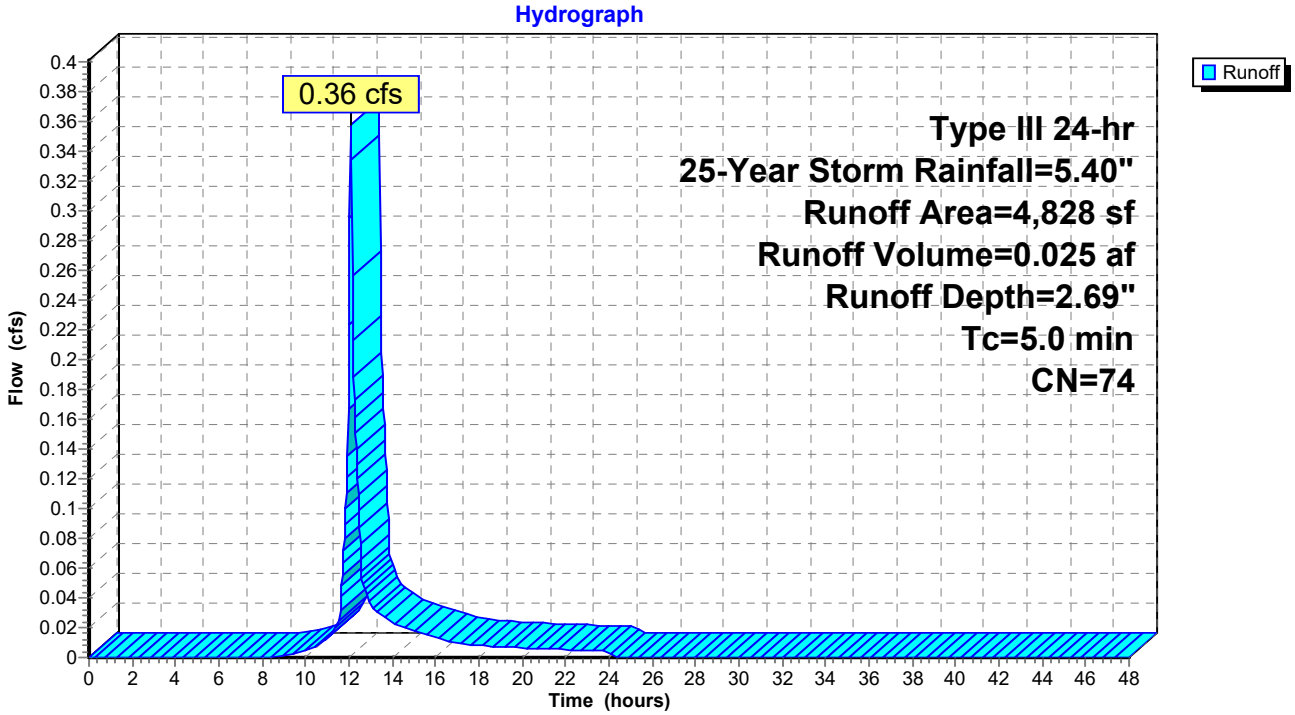
Runoff = 0.36 cfs @ 12.08 hrs, Volume= 0.025 af, Depth= 2.69"
Routed to Pond 4P : BASIN 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type III 24-hr 25-Year Storm Rainfall=5.40"

Area (sf)	CN	Description
4,828	74	>75% Grass cover, Good, HSG C
4,828		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Minimum Tc = 5 min.**

Subcatchment 1c: STORM BASIN #2



Summary for Subcatchment 1d: EAST LANDSCAPE

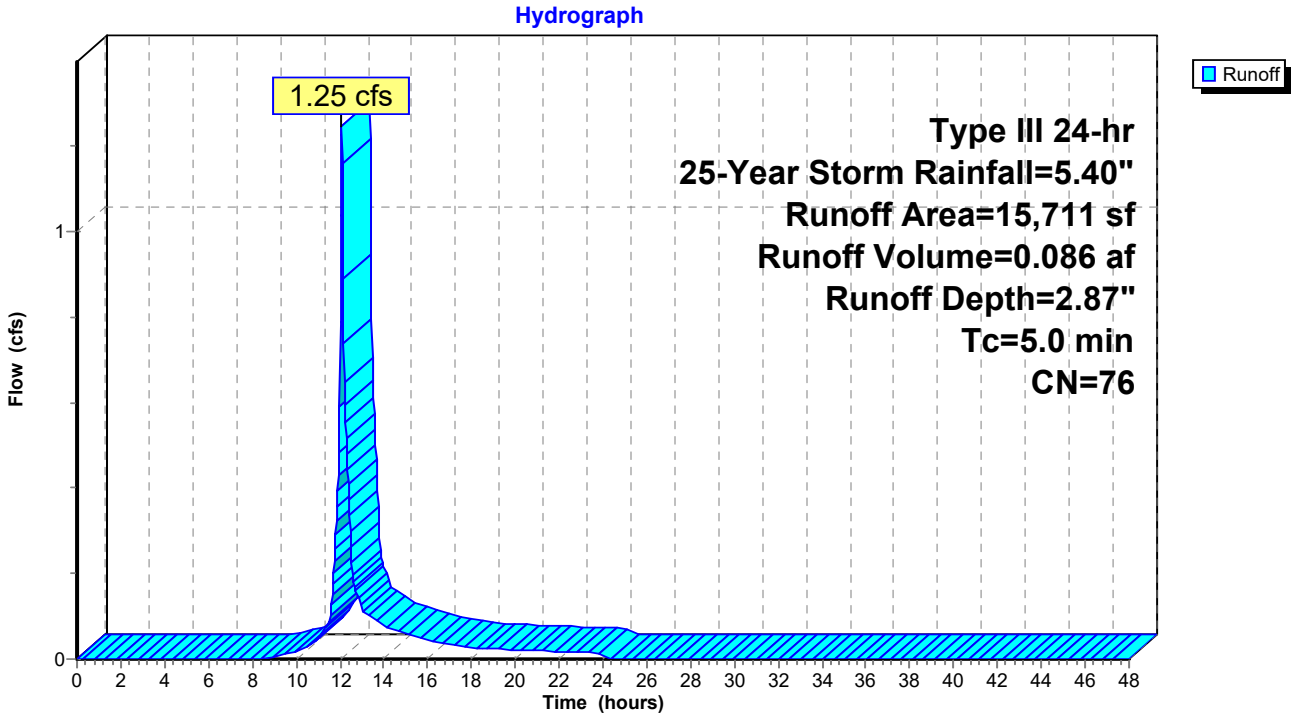
Runoff = 1.25 cfs @ 12.08 hrs, Volume= 0.086 af, Depth= 2.87"
Routed to Link 1S : EX. CB (RTE 20)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type III 24-hr 25-Year Storm Rainfall=5.40"

Area (sf)	CN	Description
12,165	70	Woods, Good, HSG C
3,546	98	Paved parking, HSG C
15,711	76	Weighted Average
12,165		77.43% Pervious Area
3,546		22.57% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, TCmin=5 Minutes**

Subcatchment 1d: EAST LANDSCAPE



Summary for Subcatchment 2a: WEST WOODS

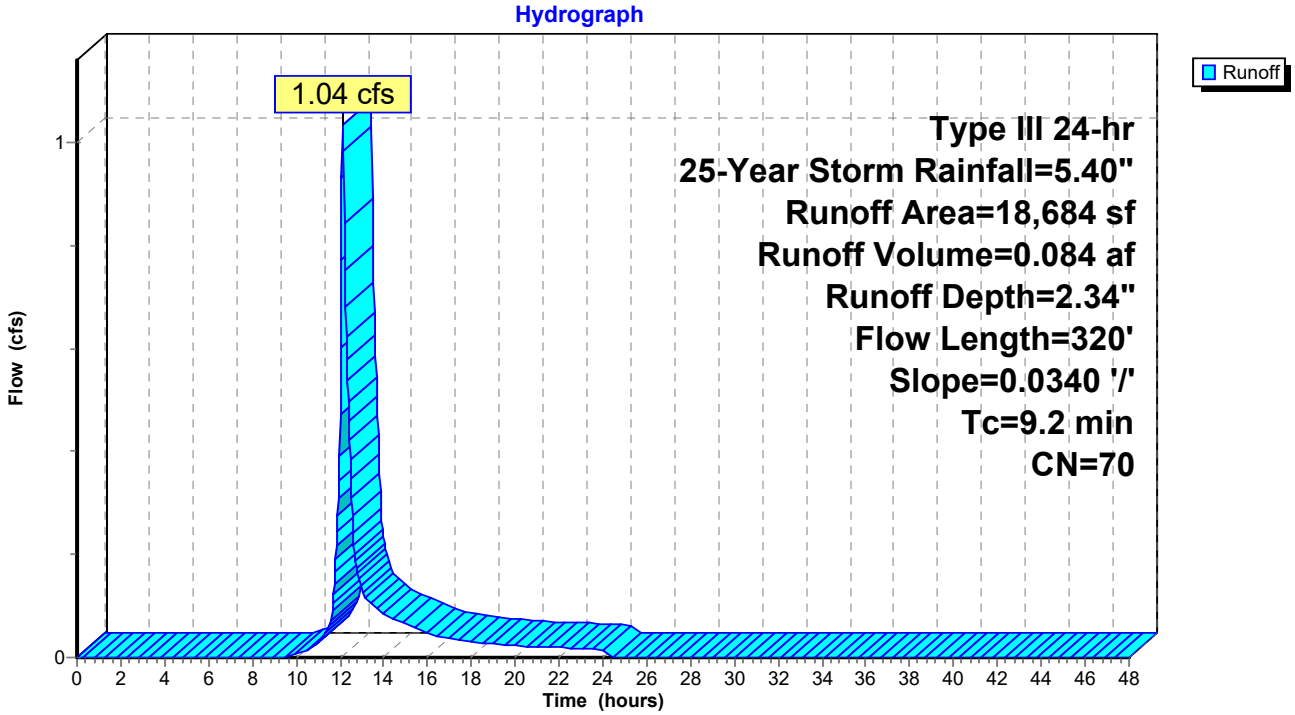
Runoff = 1.04 cfs @ 12.13 hrs, Volume= 0.084 af, Depth= 2.34"
Routed to Link 2S : WETLANDS

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type III 24-hr 25-Year Storm Rainfall=5.40"

Area (sf)	CN	Description
18,684	70	Woods, Good, HSG C
18,684		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.2	320	0.0340	0.58		**Lag/CN Method,**

Subcatchment 2a: WEST WOODS



Summary for Subcatchment BLD: BLDG

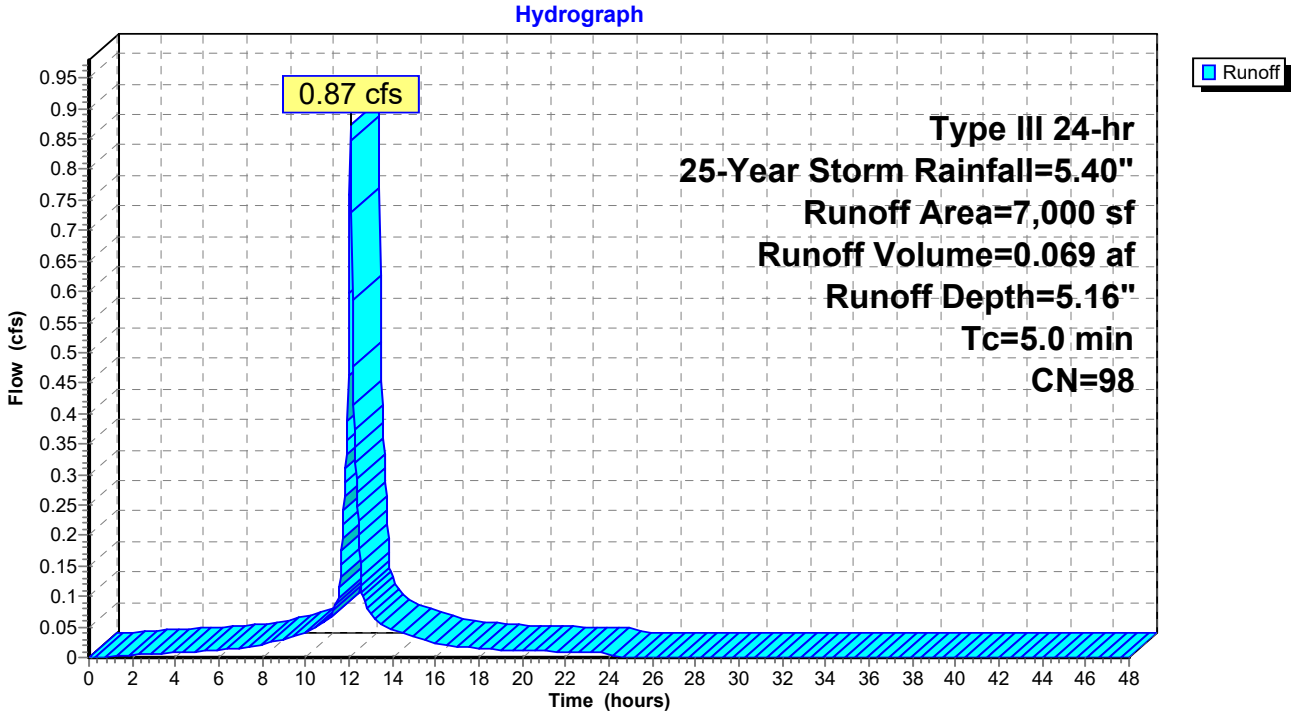
Runoff = 0.87 cfs @ 12.07 hrs, Volume= 0.069 af, Depth= 5.16"
Routed to Pond 4P : BASIN 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type III 24-hr 25-Year Storm Rainfall=5.40"

Area (sf)	CN	Description
7,000	98	Roofs, HSG C
7,000		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, TCmin=5 Minutes**

Subcatchment BLD: BLDG



Summary for Pond 1P: DMH-1

Inflow Area = 1.109 ac, 67.82% Impervious, Inflow Depth = 4.26" for 25-Year Storm event
Inflow = 5.48 cfs @ 12.07 hrs, Volume= 0.394 af
Outflow = 5.48 cfs @ 12.07 hrs, Volume= 0.394 af, Atten= 0%, Lag= 0.0 min
Primary = 1.92 cfs @ 12.07 hrs, Volume= 0.307 af
Routed to Pond 2P : OIL GRIT SEPARATOR
Secondary = 3.56 cfs @ 12.07 hrs, Volume= 0.087 af
Routed to Pond 3P : UG INFILTRATION SYSTEM #1

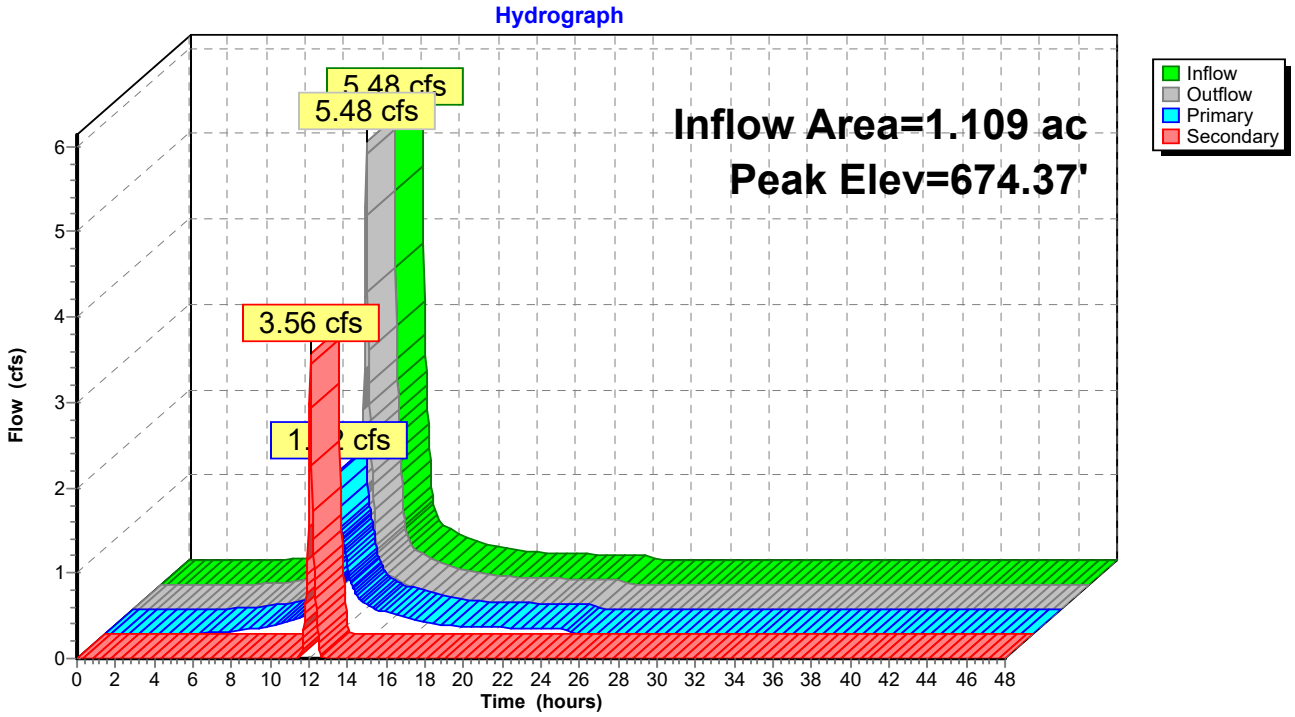
Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Peak Elev= 674.37' @ 12.07 hrs
Flood Elev= 675.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	671.95'	**8.0" Round Culvert** L= 6.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 671.95' / 671.85' S= 0.0167 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf
#2	Secondary	672.45'	**12.0" Round Culvert** L= 40.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 672.45' / 672.00' S= 0.0113 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.89 cfs @ 12.07 hrs HW=674.32' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 1.89 cfs @ 5.42 fps)

Secondary OutFlow Max=3.49 cfs @ 12.07 hrs HW=674.32' (Free Discharge)
↑—**2=Culvert** (Inlet Controls 3.49 cfs @ 4.44 fps)

Pond 1P: DMH-1


Hydrograph
Inflow Area=1.109 ac
Peak Elev=674.37'
5.48 cfs
5.48 cfs
3.56 cfs
Inflow
Outflow
Primary
Secondary
Flow (cfs)
Time (hours)
0
1
2
3
4
5
6
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48

Summary for Pond 2P: OIL GRIT SEPARATOR

[79] Warning: Submerged Pond 1P Primary device # 1 INLET by 2.14'

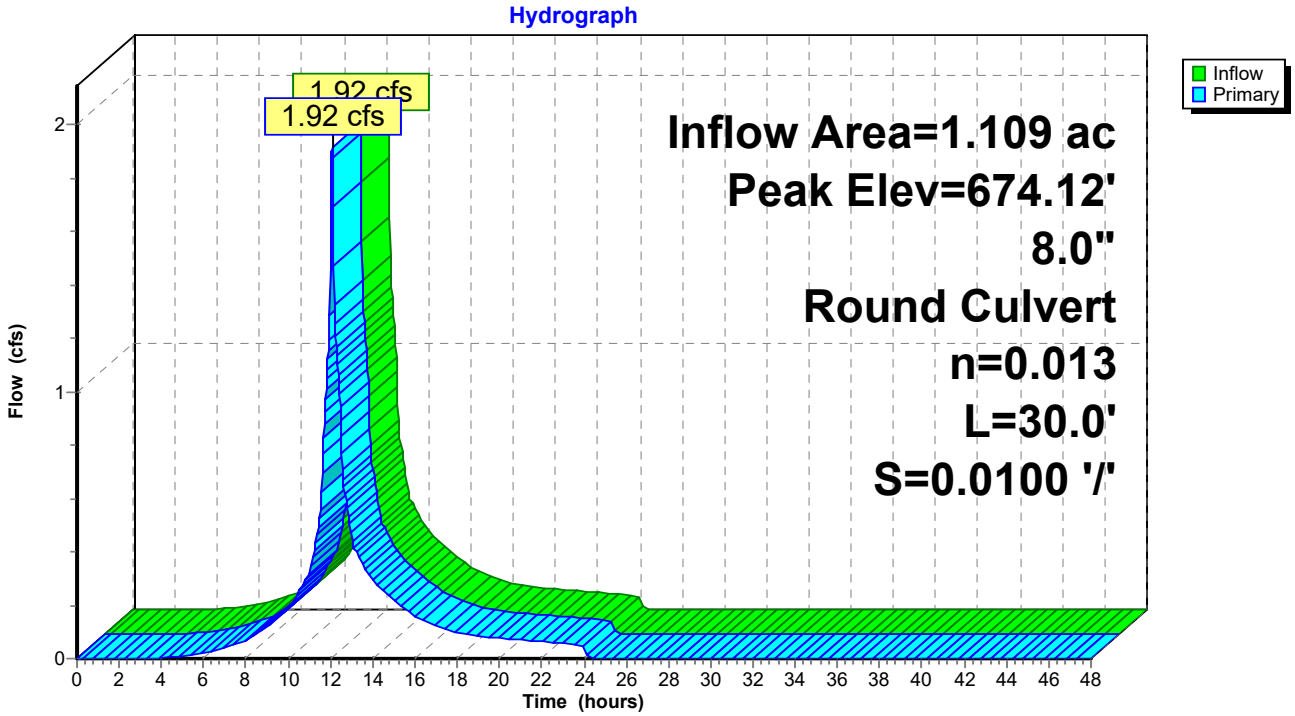
Inflow Area = 1.109 ac, 67.82% Impervious, Inflow Depth = 3.32" for 25-Year Storm event
Inflow = 1.92 cfs @ 12.07 hrs, Volume= 0.307 af
Outflow = 1.92 cfs @ 12.07 hrs, Volume= 0.307 af, Atten= 0%, Lag= 0.0 min
Primary = 1.92 cfs @ 12.07 hrs, Volume= 0.307 af
Routed to Pond 4P : BASIN 2

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Peak Elev= 674.12' @ 12.07 hrs
Flood Elev= 675.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	671.70'	**8.0" Round Culvert** L= 30.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 671.70' / 671.40' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=1.89 cfs @ 12.07 hrs HW=674.07' (Free Discharge)
1=Culvert (Inlet Controls 1.89 cfs @ 5.42 fps)

Pond 2P: OIL GRIT SEPARATOR



Summary for Pond 3P: UG INFILTRATION SYSTEM #1

[81] Warning: Exceeded Pond 1P by 0.17' @ 12.60 hrs

Inflow	=	3.56 cfs @	12.07 hrs, Volume=	0.087 af
Outflow	=	0.59 cfs @	12.39 hrs, Volume=	0.087 af, Atten= 83%, Lag= 19.0 min
Discarded	=	0.08 cfs @	12.39 hrs, Volume=	0.072 af
Primary	=	0.51 cfs @	12.39 hrs, Volume=	0.015 af

Routed to Pond 4P : BASIN 2

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Peak Elev= 672.82' @ 12.39 hrs Surf.Area= 1,980 sf Storage= 3,180 cf

Plug-Flow detention time= 292.0 min calculated for 0.087 af (100% of inflow)
Center-of-Mass det. time= 292.3 min (1,017.7 - 725.5)

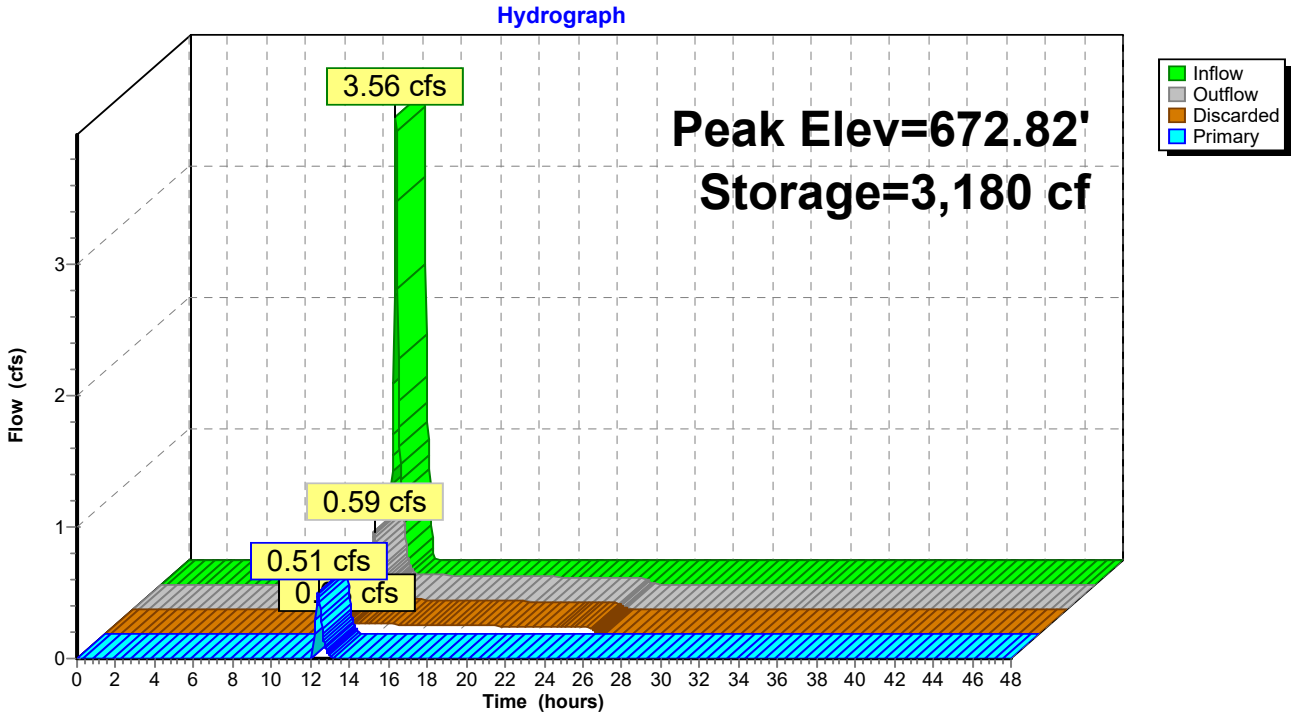
Volume	Invert	Avail.Storage	Storage Description
#1	670.50'	1,265 cf	**30.00'W x 66.00'L x 4.00'H Prismatoid** 7,920 cf Overall - 4,757 cf Embedded = 3,163 cf x 40.0% Voids
#2	671.00'	3,416 cf	**Shea Leaching Chamber 4x4x3** x 112 Inside #1 Inside= 41.0"W x 30.0"H => 8.72 sf x 3.50'L = 30.5 cf Outside= 47.0"W x 36.0"H => 10.62 sf x 4.00'L = 42.5 cf 112 Chambers in 7 Rows
		4,681 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	670.50'	**1.020 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 666.00'
#2	Primary	672.50'	**8.0" Round Culvert X 2.00** L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 672.50' / 671.00' S= 0.0750 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf

Discarded OutFlow Max=0.08 cfs @ 12.39 hrs HW=672.82' (Free Discharge)
1=Exfiltration (Controls 0.08 cfs)

Primary OutFlow Max=0.51 cfs @ 12.39 hrs HW=672.82' (Free Discharge)
2=Culvert (Inlet Controls 0.51 cfs @ 1.52 fps)

Pond 3P: UG INFILTRATION SYSTEM #1



Summary for Pond 4P: BASIN 2

Inflow Area = 1.615 ac, 65.46% Impervious, Inflow Depth = 3.70" for 25-Year Storm event
Inflow = 4.29 cfs @ 12.07 hrs, Volume= 0.498 af
Outflow = 3.58 cfs @ 12.13 hrs, Volume= 0.498 af, Atten= 16%, Lag= 3.5 min
Discarded = 0.20 cfs @ 12.13 hrs, Volume= 0.304 af
Primary = 3.38 cfs @ 12.13 hrs, Volume= 0.194 af
Routed to Link 1S : EX. CB (RTE 20)

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Peak Elev= 670.77' @ 12.13 hrs Surf.Area= 3,072 sf Storage= 6,375 cf
Flood Elev= 671.00' Surf.Area= 3,280 sf Storage= 7,102 cf

Plug-Flow detention time= 261.1 min calculated for 0.498 af (100% of inflow)
Center-of-Mass det. time= 260.9 min (1,054.8 - 793.9)

Volume	Invert	Avail.Storage	Storage Description
#1	668.00'	7,102 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

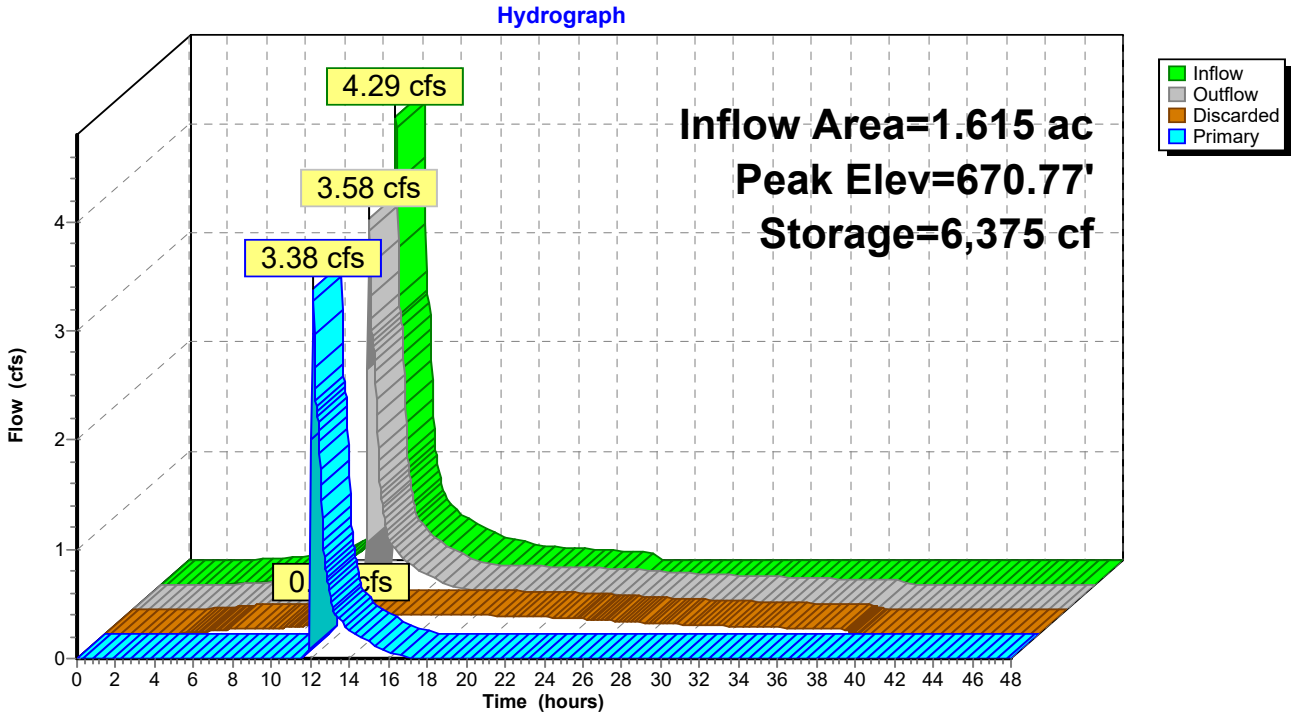
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
668.00	1,711	299.2	0	0	1,711
669.00	2,200	318.0	1,950	1,950	2,685
670.00	2,423	337.0	2,311	4,261	3,728
671.00	3,280	356.0	2,841	7,102	4,831

Device	Routing	Invert	Outlet Devices
#1	Discarded	668.00'	**1.020 in/hr Exfiltration - Sandy Loam over Wetted area** Conductivity to Groundwater Elevation = 666.00'
#2	Primary	670.50'	**10.0' 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=0.20 cfs @ 12.13 hrs HW=670.77' (Free Discharge)
↑—**1=Exfiltration - Sandy Loam** (Controls 0.20 cfs)

Primary OutFlow Max=3.33 cfs @ 12.13 hrs HW=670.77' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Weir Controls 3.33 cfs @ 1.24 fps)

Pond 4P: BASIN 2

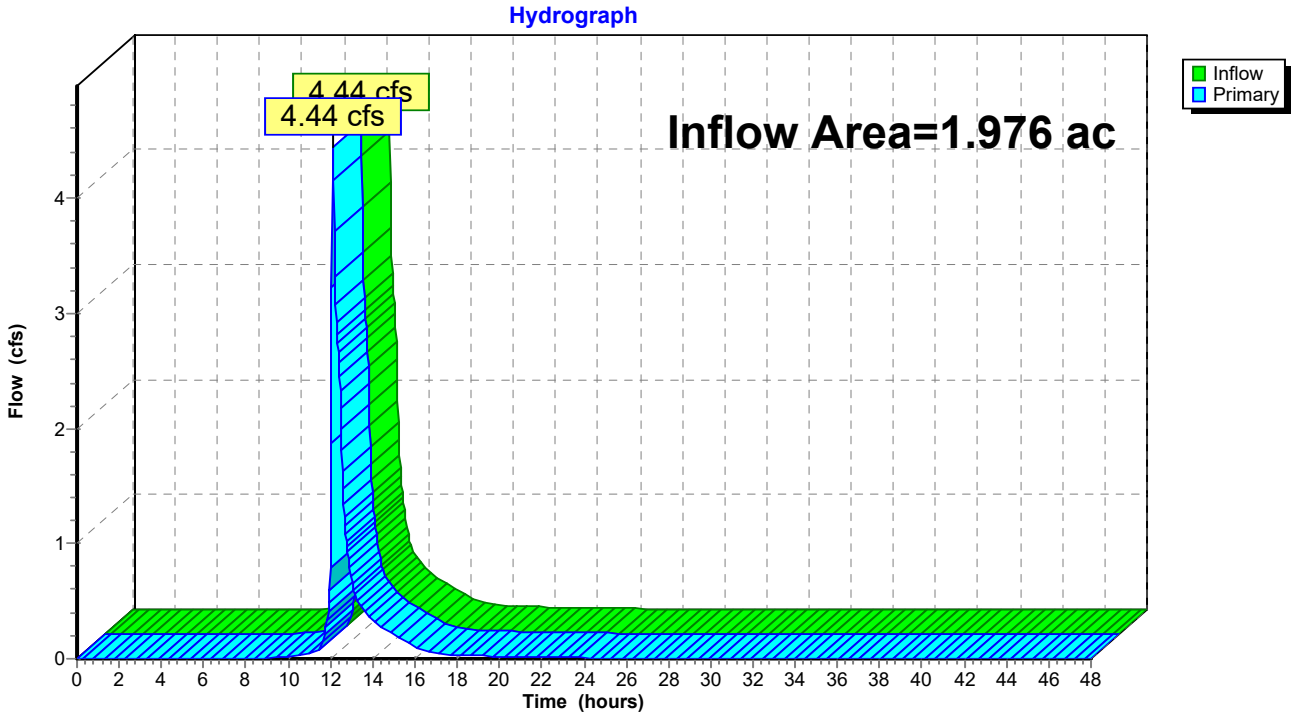


Summary for Link 1S: EX. CB (RTE 20)

Inflow Area = 1.976 ac, 57.63% Impervious, Inflow Depth = 1.70" for 25-Year Storm event
Inflow = 4.44 cfs @ 12.12 hrs, Volume= 0.280 af
Primary = 4.44 cfs @ 12.12 hrs, Volume= 0.280 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs

Link 1S: EX. CB (RTE 20)

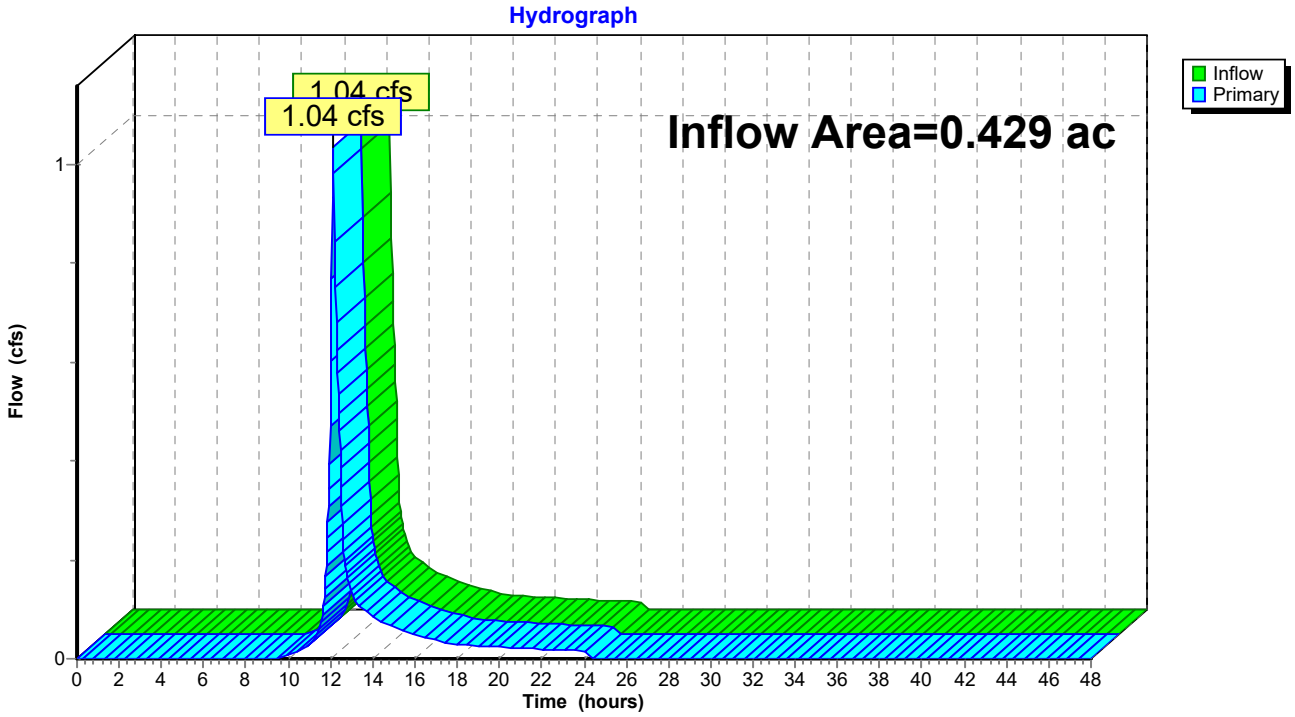


Summary for Link 2S: WETLANDS

Inflow Area = 0.429 ac, 0.00% Impervious, Inflow Depth = 2.34" for 25-Year Storm event
Inflow = 1.04 cfs @ 12.13 hrs, Volume= 0.084 af
Primary = 1.04 cfs @ 12.13 hrs, Volume= 0.084 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs

Link 2S: WETLANDS



Time span=0.00-48.00 hrs, dt=0.03 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 1a: PAVED STORAGE YARD Runoff Area=48,317 sf 67.82% Impervious Runoff Depth=5.53"
Tc=5.0 min CN=90 Runoff=7.00 cfs 0.511 af

Subcatchment 1b: FRONT PARKING Runoff Area=10,206 sf 61.55% Impervious Runoff Depth=5.42"
Tc=5.0 min CN=89 Runoff=1.46 cfs 0.106 af

Subcatchment 1c: STORM BASIN #2 Runoff Area=4,828 sf 0.00% Impervious Runoff Depth=3.78"
Tc=5.0 min CN=74 Runoff=0.50 cfs 0.035 af

Subcatchment 1d: EAST LANDSCAPE Runoff Area=15,711 sf 22.57% Impervious Runoff Depth=3.99"
Tc=5.0 min CN=76 Runoff=1.74 cfs 0.120 af

Subcatchment 2a: WEST WOODS Runoff Area=18,684 sf 0.00% Impervious Runoff Depth=3.37"
Flow Length=320' Slope=0.0340 '/' Tc=9.2 min CN=70 Runoff=1.51 cfs 0.120 af

Subcatchment BLD: BLDG Runoff Area=7,000 sf 100.00% Impervious Runoff Depth=6.46"
Tc=5.0 min CN=98 Runoff=1.09 cfs 0.087 af

Pond 1P: DMH-1 Peak Elev=675.38' Inflow=7.00 cfs 0.511 af
Primary=2.34 cfs 0.385 af Secondary=4.66 cfs 0.126 af Outflow=7.00 cfs 0.511 af

Pond 2P: OIL GRIT SEPARATOR Peak Elev=675.13' Inflow=2.34 cfs 0.385 af
8.0" Round Culvert n=0.013 L=30.0' S=0.0100 '/' Outflow=2.34 cfs 0.385 af

Pond 3P: UG INFILTRATION SYSTEM #1 Peak Elev=673.17' Storage=3,698 cf Inflow=4.66 cfs 0.126 af
Discarded=0.09 cfs 0.073 af Primary=1.53 cfs 0.053 af Outflow=1.62 cfs 0.126 af

Pond 4P: BASIN 2 Peak Elev=670.84' Storage=6,587 cf Inflow=5.39 cfs 0.665 af
Discarded=0.20 cfs 0.329 af Primary=4.85 cfs 0.335 af Outflow=5.06 cfs 0.665 af

Link 1S: EX. CB (RTE 20) Inflow=6.43 cfs 0.455 af
Primary=6.43 cfs 0.455 af

Link 2S: WETLANDS Inflow=1.51 cfs 0.120 af
Primary=1.51 cfs 0.120 af

Total Runoff Area = 2.405 ac Runoff Volume = 0.979 af Average Runoff Depth = 4.88"
52.65% Pervious = 1.266 ac 47.35% Impervious = 1.139 ac

Summary for Subcatchment 1a: PAVED STORAGE YARD

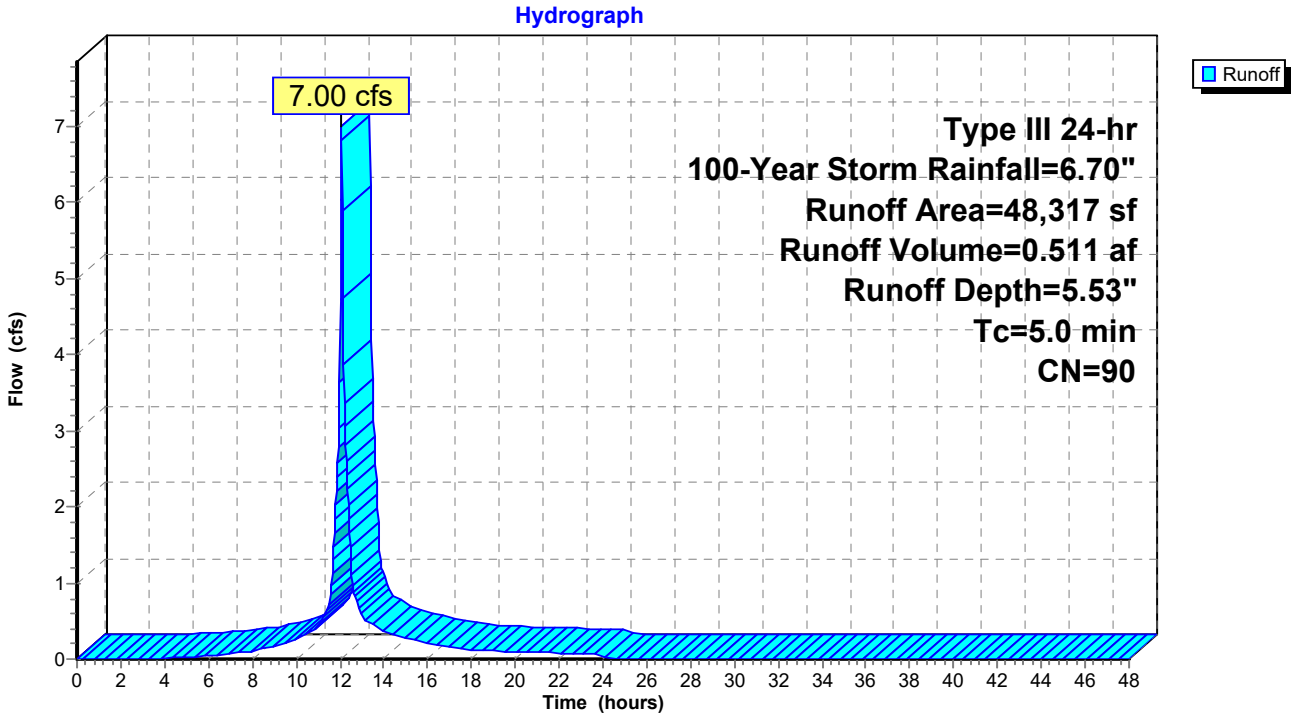
Runoff = 7.00 cfs @ 12.07 hrs, Volume= 0.511 af, Depth= 5.53"
Routed to Pond 1P : DMH-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type III 24-hr 100-Year Storm Rainfall=6.70"

Area (sf)	CN	Description
32,770	98	Paved parking, HSG C
15,547	74	>75% Grass cover, Good, HSG C
48,317	90	Weighted Average
15,547		32.18% Pervious Area
32,770		67.82% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, TCmin=5 Minutes**

Subcatchment 1a: PAVED STORAGE YARD



Summary for Subcatchment 1b: FRONT PARKING

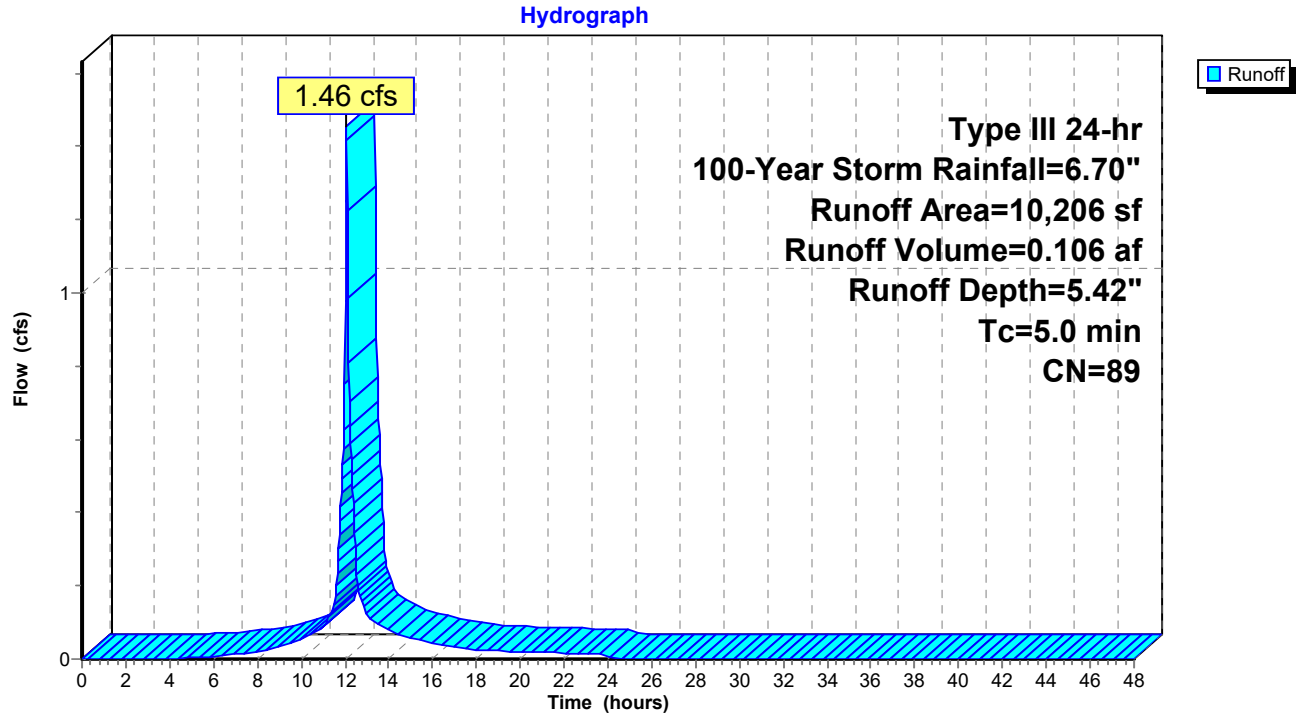
Runoff = 1.46 cfs @ 12.07 hrs, Volume= 0.106 af, Depth= 5.42"
Routed to Pond 4P : BASIN 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type III 24-hr 100-Year Storm Rainfall=6.70"

Area (sf)	CN	Description
6,282	98	Paved parking, HSG C
3,924	74	>75% Grass cover, Good, HSG C
10,206	89	Weighted Average
3,924		38.45% Pervious Area
6,282		61.55% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, TCmin=5 Minutes**

Subcatchment 1b: FRONT PARKING



Summary for Subcatchment 1c: STORM BASIN #2

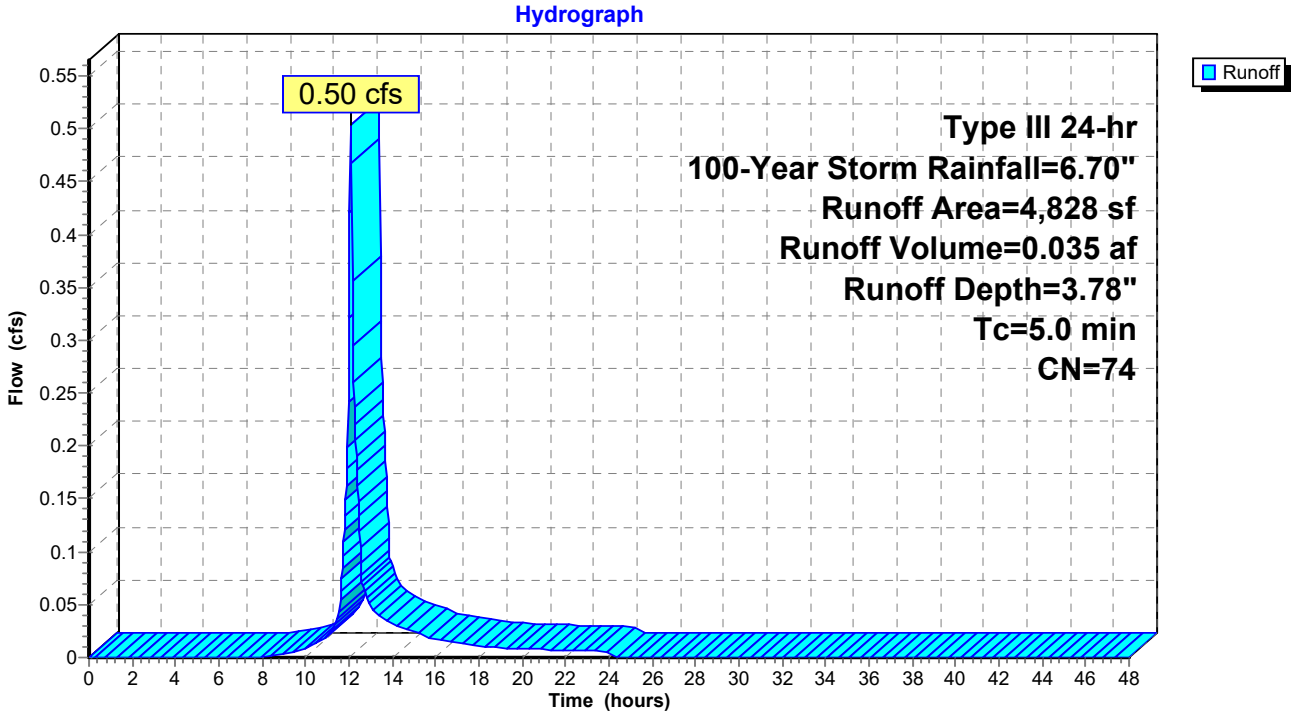
Runoff = 0.50 cfs @ 12.08 hrs, Volume= 0.035 af, Depth= 3.78"
Routed to Pond 4P : BASIN 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type III 24-hr 100-Year Storm Rainfall=6.70"

Area (sf)	CN	Description
4,828	74	>75% Grass cover, Good, HSG C
4,828		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Minimum Tc = 5 min.**

Subcatchment 1c: STORM BASIN #2



Summary for Subcatchment 1d: EAST LANDSCAPE

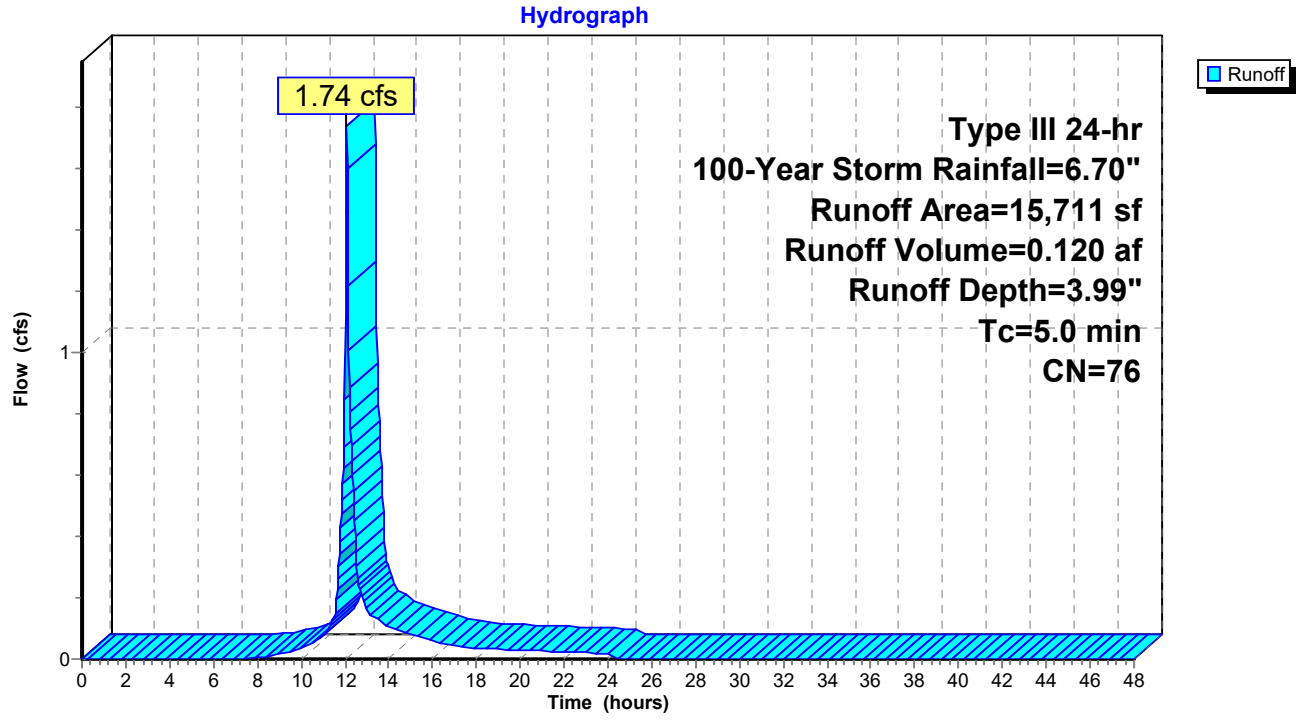
Runoff = 1.74 cfs @ 12.07 hrs, Volume= 0.120 af, Depth= 3.99"
Routed to Link 1S : EX. CB (RTE 20)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type III 24-hr 100-Year Storm Rainfall=6.70"

Area (sf)	CN	Description
12,165	70	Woods, Good, HSG C
3,546	98	Paved parking, HSG C
15,711	76	Weighted Average
12,165		77.43% Pervious Area
3,546		22.57% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, TCmin=5 Minutes**

Subcatchment 1d: EAST LANDSCAPE



Summary for Subcatchment 2a: WEST WOODS

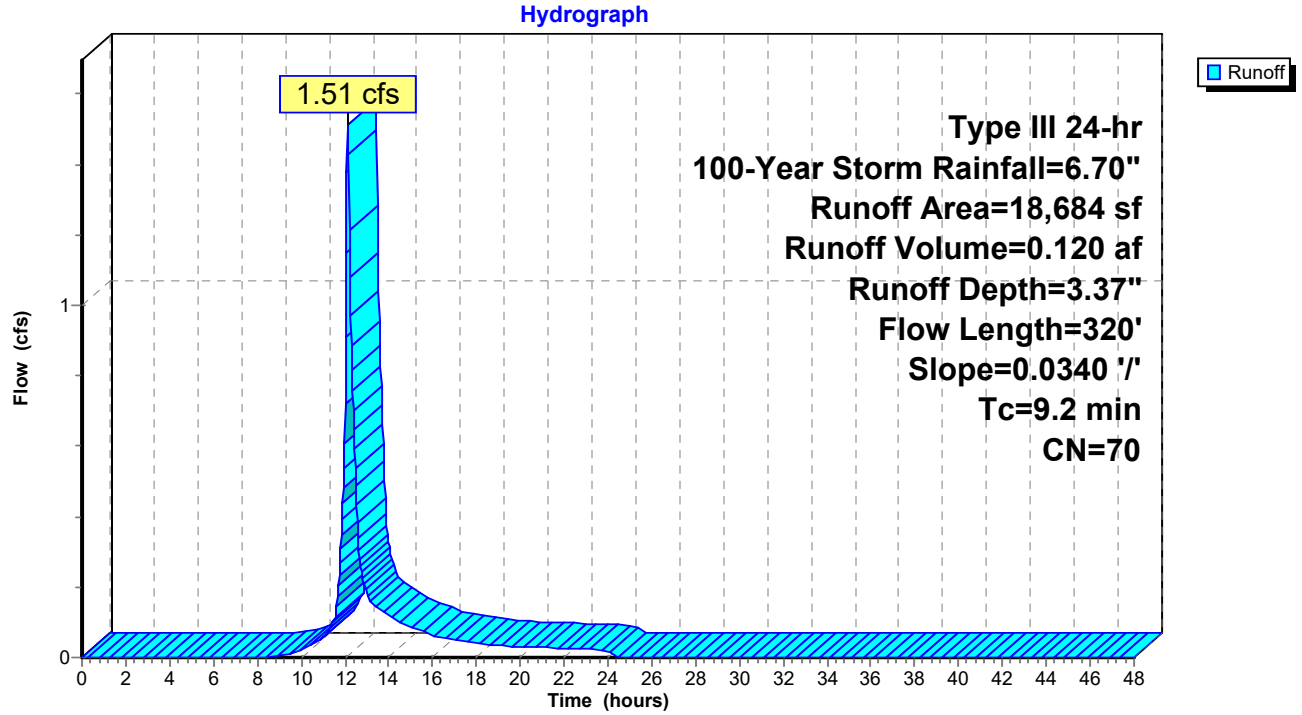
Runoff = 1.51 cfs @ 12.13 hrs, Volume= 0.120 af, Depth= 3.37"
Routed to Link 2S : WETLANDS

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type III 24-hr 100-Year Storm Rainfall=6.70"

Area (sf)	CN	Description
18,684	70	Woods, Good, HSG C
18,684		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.2	320	0.0340	0.58		**Lag/CN Method,**

Subcatchment 2a: WEST WOODS



Summary for Subcatchment BLD: BLDG

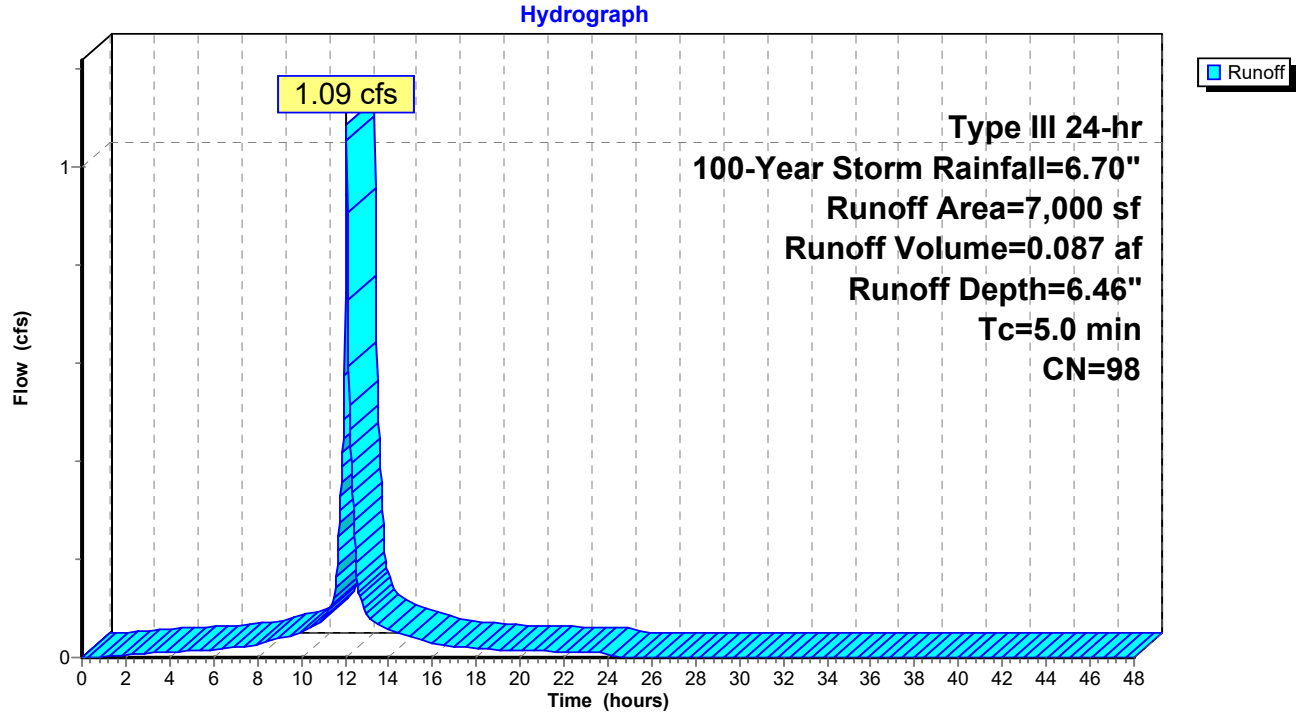
Runoff = 1.09 cfs @ 12.07 hrs, Volume= 0.087 af, Depth= 6.46"
Routed to Pond 4P : BASIN 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type III 24-hr 100-Year Storm Rainfall=6.70"

Area (sf)	CN	Description
7,000	98	Roofs, HSG C
7,000		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, TCmin=5 Minutes**

Subcatchment BLD: BLDG



Summary for Pond 1P: DMH-1

Inflow Area = 1.109 ac, 67.82% Impervious, Inflow Depth = 5.53" for 100-Year Storm event
Inflow = 7.00 cfs @ 12.07 hrs, Volume= 0.511 af
Outflow = 7.00 cfs @ 12.07 hrs, Volume= 0.511 af, Atten= 0%, Lag= 0.0 min
Primary = 2.34 cfs @ 12.07 hrs, Volume= 0.385 af
Routed to Pond 2P : OIL GRIT SEPARATOR
Secondary = 4.66 cfs @ 12.07 hrs, Volume= 0.126 af
Routed to Pond 3P : UG INFILTRATION SYSTEM #1

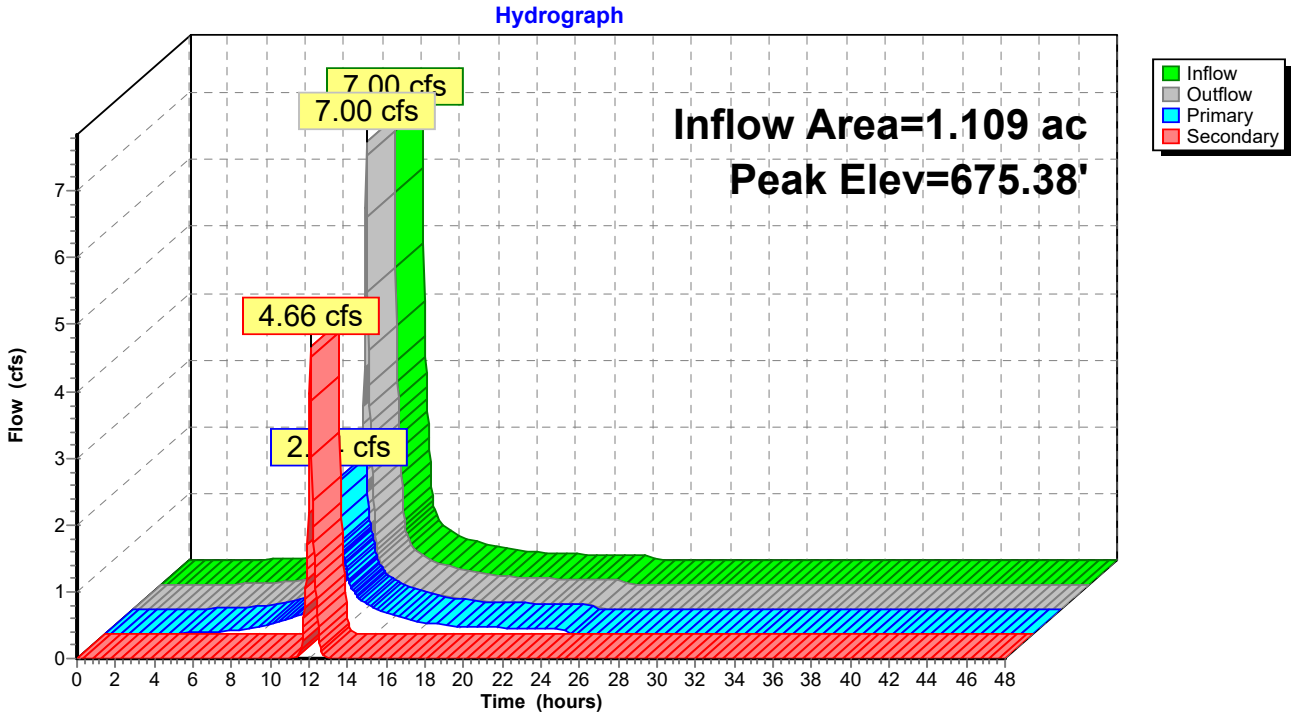
Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Peak Elev= 675.38' @ 12.07 hrs
Flood Elev= 675.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	671.95'	**8.0" Round Culvert** L= 6.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 671.95' / 671.85' S= 0.0167 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf
#2	Secondary	672.45'	**12.0" Round Culvert** L= 40.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 672.45' / 672.00' S= 0.0113 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=2.30 cfs @ 12.07 hrs HW=675.30' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 2.30 cfs @ 6.60 fps)

Secondary OutFlow Max=4.58 cfs @ 12.07 hrs HW=675.30' (Free Discharge)
↑—**2=Culvert** (Inlet Controls 4.58 cfs @ 5.83 fps)

Pond 1P: DMH-1


Hydrograph
7.00 cfs
7.00 cfs
Inflow Area=1.109 ac
Peak Elev=675.38'
4.66 cfs
Inflow
Outflow
Primary
Secondary
Flow (cfs)
Time (hours)
0 1 2 3 4 5 6 7
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48

Summary for Pond 2P: OIL GRIT SEPARATOR

[79] Warning: Submerged Pond 1P Primary device # 1 INLET by 3.13'

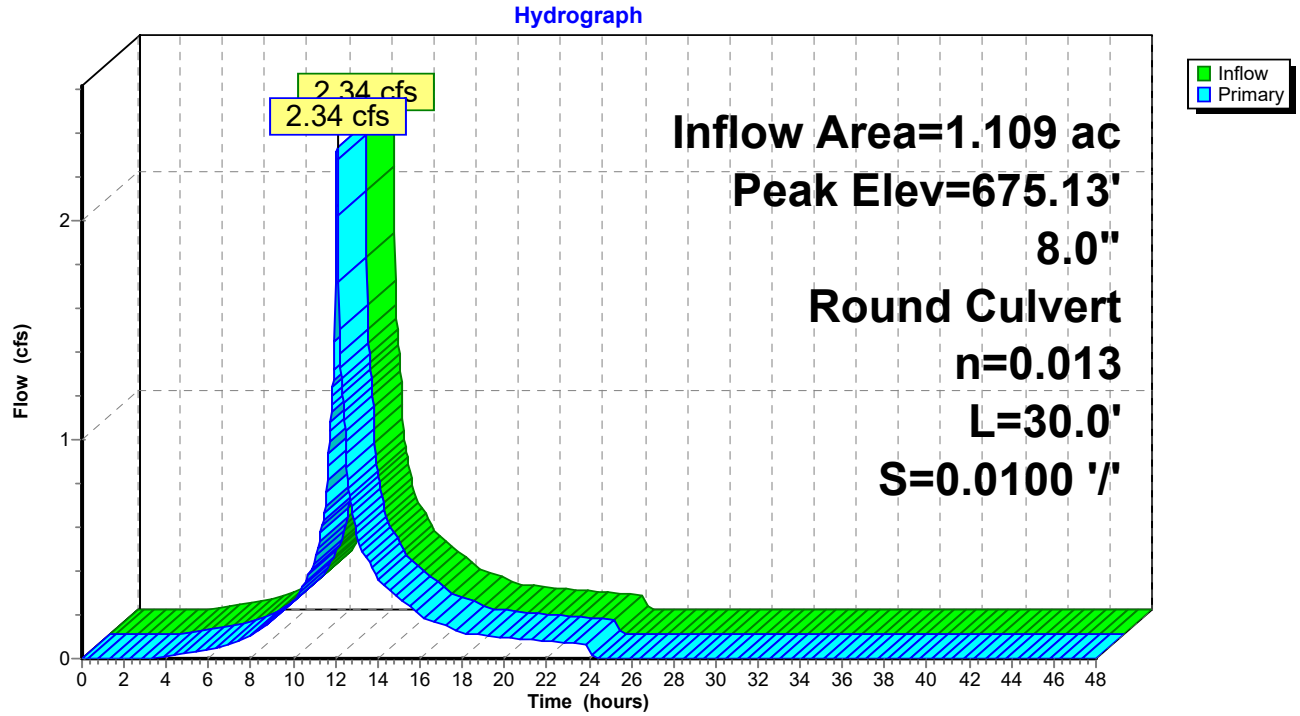
Inflow Area = 1.109 ac, 67.82% Impervious, Inflow Depth = 4.16" for 100-Year Storm event
Inflow = 2.34 cfs @ 12.07 hrs, Volume= 0.385 af
Outflow = 2.34 cfs @ 12.07 hrs, Volume= 0.385 af, Atten= 0%, Lag= 0.0 min
Primary = 2.34 cfs @ 12.07 hrs, Volume= 0.385 af
Routed to Pond 4P : BASIN 2

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Peak Elev= 675.13' @ 12.07 hrs
Flood Elev= 675.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	671.70'	**8.0" Round Culvert** L= 30.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 671.70' / 671.40' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=2.30 cfs @ 12.07 hrs HW=675.05' (Free Discharge)
1=Culvert (Inlet Controls 2.30 cfs @ 6.60 fps)

Pond 2P: OIL GRIT SEPARATOR



Summary for Pond 3P: UG INFILTRATION SYSTEM #1

[81] Warning: Exceeded Pond 1P by 0.18' @ 12.57 hrs

Inflow	=	4.66 cfs @	12.07 hrs,	Volume=	0.126 af
Outflow	=	1.62 cfs @	12.26 hrs,	Volume=	0.126 af, Atten= 65%, Lag= 11.1 min
Discarded	=	0.09 cfs @	12.26 hrs,	Volume=	0.073 af
Primary	=	1.53 cfs @	12.26 hrs,	Volume=	0.053 af

Routed to Pond 4P : BASIN 2

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Peak Elev= 673.17' @ 12.26 hrs Surf.Area= 1,980 sf Storage= 3,698 cf

Plug-Flow detention time= 210.3 min calculated for 0.126 af (100% of inflow)
Center-of-Mass det. time= 210.2 min (935.7 - 725.4)

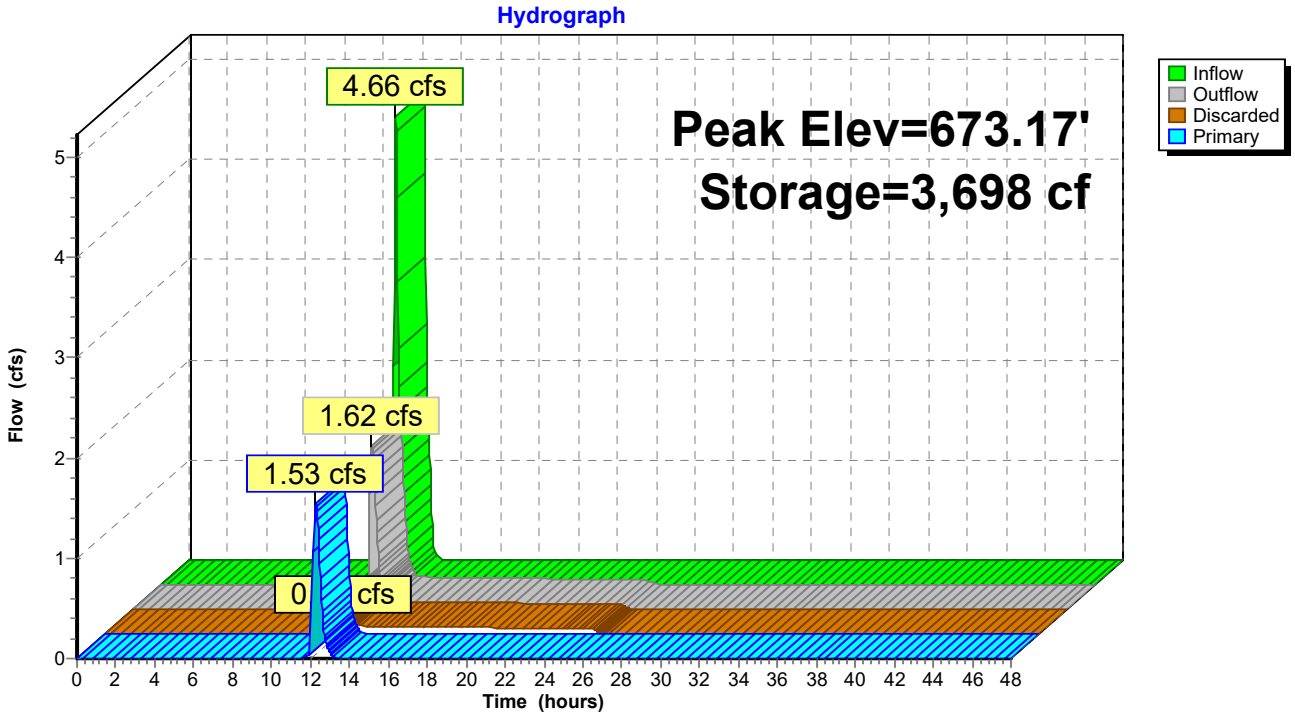
Volume	Invert	Avail.Storage	Storage Description
#1	670.50'	1,265 cf	**30.00'W x 66.00'L x 4.00'H Prismatoid** 7,920 cf Overall - 4,757 cf Embedded = 3,163 cf x 40.0% Voids
#2	671.00'	3,416 cf	**Shea Leaching Chamber 4x4x3** x 112 Inside #1 Inside= 41.0"W x 30.0"H => 8.72 sf x 3.50'L = 30.5 cf Outside= 47.0"W x 36.0"H => 10.62 sf x 4.00'L = 42.5 cf 112 Chambers in 7 Rows
		4,681 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	670.50'	**1.020 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 666.00'
#2	Primary	672.50'	**8.0" Round Culvert X 2.00** L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 672.50' / 671.00' S= 0.0750 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf

Discarded OutFlow Max=0.09 cfs @ 12.26 hrs HW=673.16' (Free Discharge)
1=Exfiltration (Controls 0.09 cfs)

Primary OutFlow Max=1.53 cfs @ 12.26 hrs HW=673.16' (Free Discharge)
2=Culvert (Inlet Controls 1.53 cfs @ 2.19 fps)

Pond 3P: UG INFILTRATION SYSTEM #1



Summary for Pond 4P: BASIN 2

Inflow Area = 1.615 ac, 65.46% Impervious, Inflow Depth = 4.94" for 100-Year Storm event
Inflow = 5.39 cfs @ 12.07 hrs, Volume= 0.665 af
Outflow = 5.06 cfs @ 12.13 hrs, Volume= 0.665 af, Atten= 6%, Lag= 3.5 min
Discarded = 0.20 cfs @ 12.13 hrs, Volume= 0.329 af
Primary = 4.85 cfs @ 12.13 hrs, Volume= 0.335 af
Routed to Link 1S : EX. CB (RTE 20)

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Peak Elev= 670.84' @ 12.13 hrs Surf.Area= 3,134 sf Storage= 6,587 cf
Flood Elev= 671.00' Surf.Area= 3,280 sf Storage= 7,102 cf

Plug-Flow detention time= 215.3 min calculated for 0.665 af (100% of inflow)
Center-of-Mass det. time= 215.2 min (1,000.8 - 785.6)

Volume	Invert	Avail.Storage	Storage Description
#1	668.00'	7,102 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

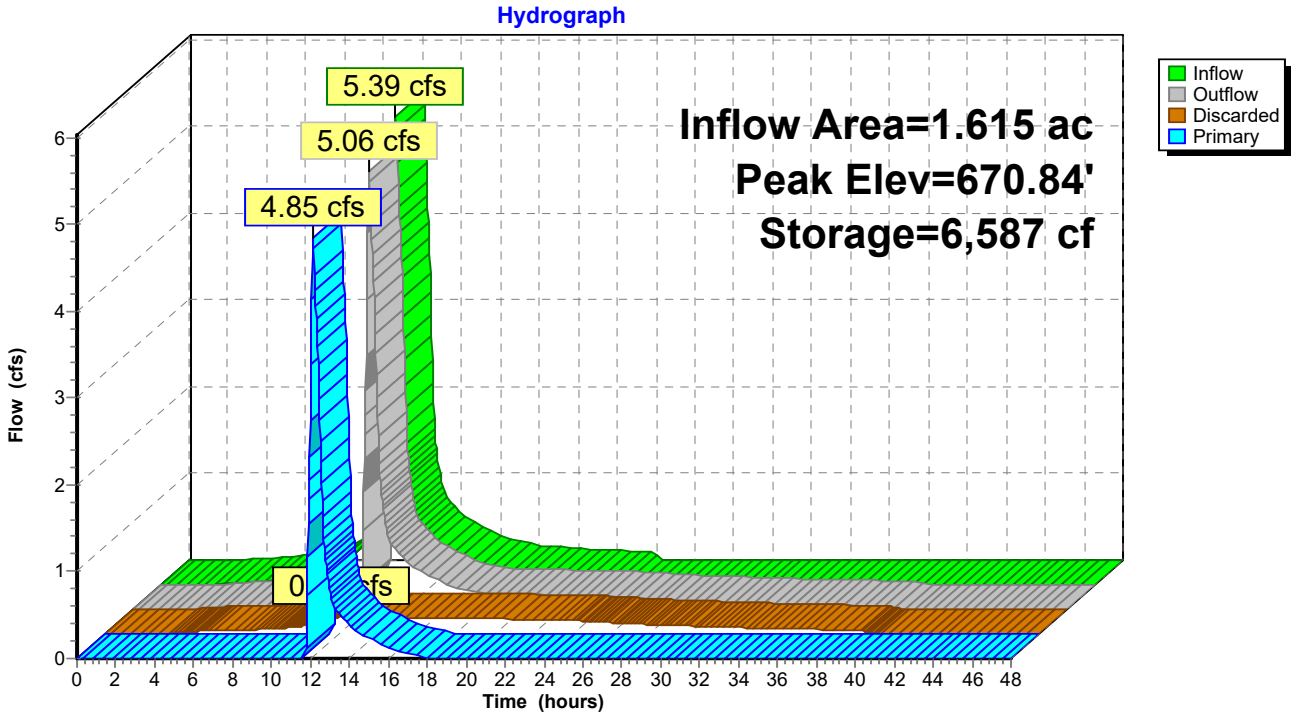
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
668.00	1,711	299.2	0	0	1,711
669.00	2,200	318.0	1,950	1,950	2,685
670.00	2,423	337.0	2,311	4,261	3,728
671.00	3,280	356.0	2,841	7,102	4,831

Device	Routing	Invert	Outlet Devices
#1	Discarded	668.00'	**1.020 in/hr Exfiltration - Sandy Loam over Wetted area** Conductivity to Groundwater Elevation = 666.00'
#2	Primary	670.50'	**10.0' 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=0.20 cfs @ 12.13 hrs HW=670.84' (Free Discharge)
↑—**1=Exfiltration - Sandy Loam** (Controls 0.20 cfs)

Primary OutFlow Max=4.83 cfs @ 12.13 hrs HW=670.84' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Weir Controls 4.83 cfs @ 1.43 fps)

Pond 4P: BASIN 2

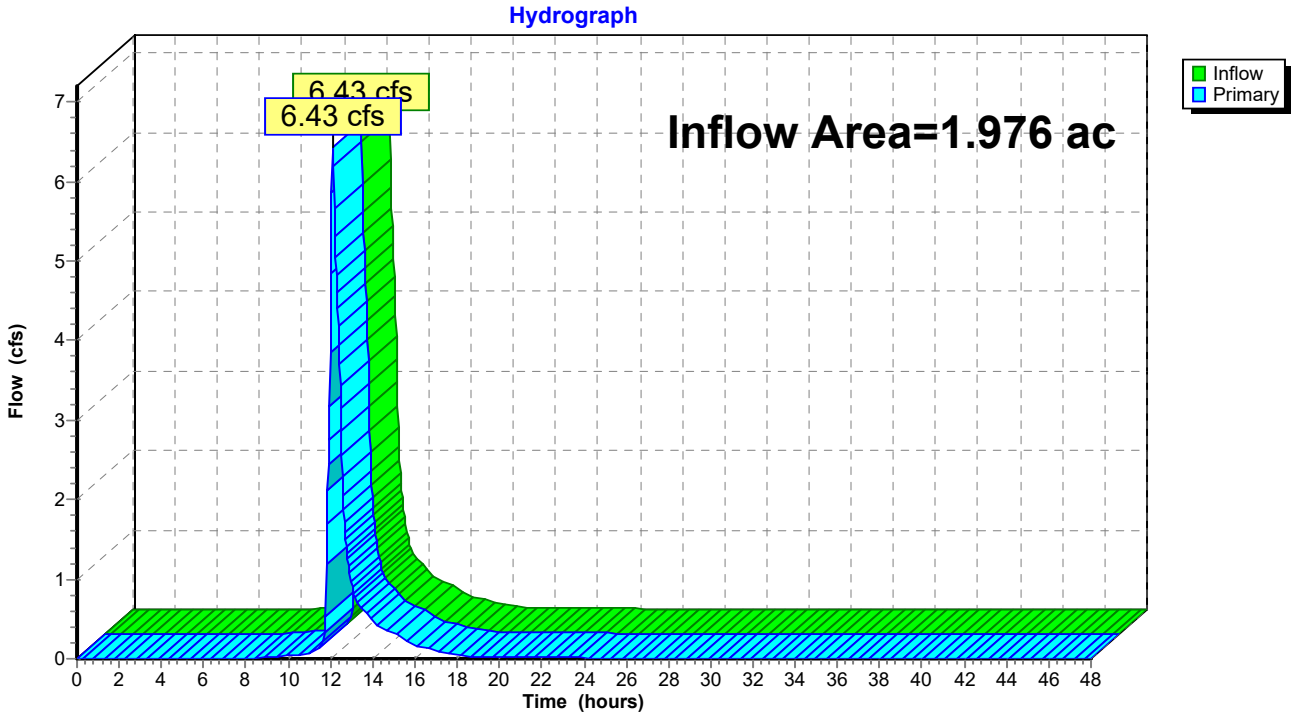


Summary for Link 1S: EX. CB (RTE 20)

Inflow Area = 1.976 ac, 57.63% Impervious, Inflow Depth = 2.77" for 100-Year Storm event
Inflow = 6.43 cfs @ 12.10 hrs, Volume= 0.455 af
Primary = 6.43 cfs @ 12.10 hrs, Volume= 0.455 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs

Link 1S: EX. CB (RTE 20)

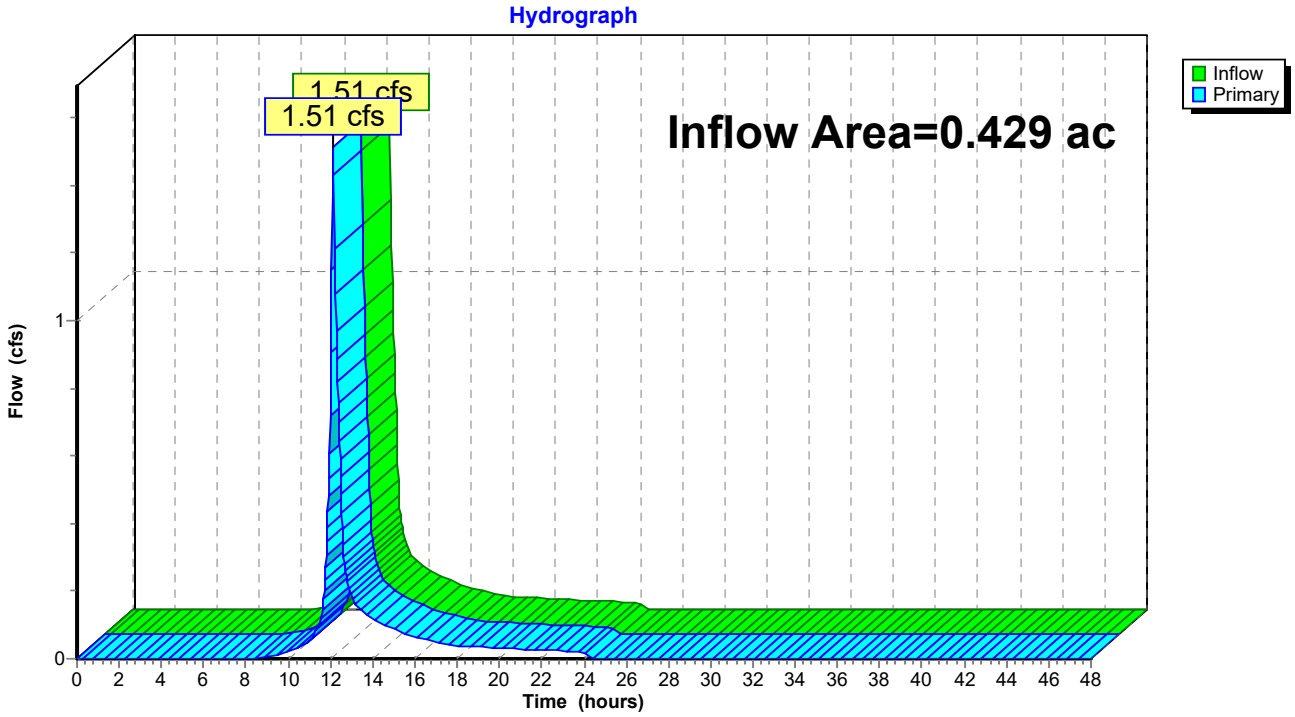


Summary for Link 2S: WETLANDS

Inflow Area = 0.429 ac, 0.00% Impervious, Inflow Depth = 3.37" for 100-Year Storm event
Inflow = 1.51 cfs @ 12.13 hrs, Volume= 0.120 af
Primary = 1.51 cfs @ 12.13 hrs, Volume= 0.120 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs

Link 2S: WETLANDS



Appendix F

Additional Stormwater Design
Drainage Calculations

TABLE NO. 3
STORMWATER MANAGEMENT CALCULATIONS
PROPOSED INTERSTATE TOWING FACILITY
#698 MAIN STREET
STURBRIDGE, MA

STANDARD 3 - RECHARGE
REQUIRED RECHARGE VOLUME
RECHARGE VOLUME (Rv)

Existing Impervious Area =	0	s.f.
Proposed Impervious Area =	**49,598**	**s.f.**

Impervious Area (s.f.)	**Rv (cf)**	**Soil Type - Type C = 0.25 inches**
Impervious Area s.f. x (0.25") x (1'/12")	**1,033**	c.f.

Proposed Underground Infiltration Chambers (Pond 3P)

Storage Volume =	2,694	c.f.	(Elev. 672.50 = 2-8" Diam. Outlet Pipes)

Proposed Stormwater Infiltration Basin (Pond 4P)

Storage Volume =	5,574	c.f.	(Elev. 670.50 = Broad-Crested Weir Outlet)

STANDARD 4 - WATER QUALITY

Impervious Area (s.f.)	**WQv (cf)**	**LUHPPL = 1" Runoff**
Impervious Area s.f. x (1") x (1'/12")	**4,133**	**c.f.**
Proposed Storage in Drywell & Basin =	**8,268**	**c.f.**

SUBCATCHMENT 1A - Paved Storage Area (LUHPPL)

TSS Removal Calculation		**TSS Removal**	**TSS Remaining**
1. Water Quality Unit 1 & 2	90%	0.90	**0.10**
2. Oil Water Separator	25%	0.25	**0.08**
3. Stormwater Infiltration Basin & Drywell	80%	0.80	**0.02**
		TSS Removal Efficiency =	**0.99 < 80%***

*TSS removal calculations account for 81% of site impervious area

SUBCATCHMENT 1B - Front Parking Area

TSS Removal Calculation		**TSS Removal**	**TSS Remaining**
1. Water Quality Unit	80%	0.99	**0.01**
2. Stormwater Infiltration Basin	80%	0.80	**0.002**
		TSS Removal Efficiency =	**0.998 < 80%****

**TSS removal calculations account for 11% of site impervious area

Total Site TSS Removal Calculation	Impervious Area (s.f.)	TSS Removal
Subcatchment 1a	32,770	99%
Subcatchment 1b	6,282	99%
Subcatchment 1d	3,546	0%
Total Site	**42,598**	**91%**

Proposed Underground Infiltration Chambers (Pond 3P)

Drawdown (Td) = Rv / k A	**5.48**	**hours**	< 72 Hours OK
Recharge Volume (Rv) =	1,033	c.f.	
Permeability (k) =	1.02	in/hr	
Bottom Area (A) =	2,220	s.f.	

Proposed Stormwater Basin (Pond 4P)

Drawdown (Td) = Rv / k A	**7.87**	**hours**	< 72 Hours OK
Recharge Volume (Rv) =	1,033	c.f.	
Permeability (k) =	1.02	in/hr	
Bottom Area (A) =	1,544	s.f.	

Stage-Area-Storage for Pond 3P: UG INFILTRATION SYSTEM #1

Elevation (feet)	Wetted (sq-ft)	Storage (cubic-feet)
670.50	1,980	0
670.55	1,990	40
670.60	1,999	79
670.65	2,009	119
670.70	2,018	158
670.75	2,028	198
670.80	2,038	238
670.85	2,047	277
670.90	2,057	317
670.95	2,066	356
671.00	2,076	396
671.05	2,086	473
671.10	2,095	551
671.15	2,105	628
671.20	2,114	705
671.25	2,124	782
671.30	2,134	859
671.35	2,143	936
671.40	2,153	1,013
671.45	2,162	1,090
671.50	2,172	1,167
671.55	2,182	1,244
671.60	2,191	1,320
671.65	2,201	1,397
671.70	2,210	1,474
671.75	2,220	1,550
671.80	2,230	1,627
671.85	2,239	1,703
671.90	2,249	1,780
671.95	2,258	1,856
672.00	2,268	1,933
672.05	2,278	2,009
672.10	2,287	2,085
672.15	2,297	2,161
672.20	2,306	2,238
672.25	2,316	2,314
672.30	2,326	2,390
672.35	2,335	2,466
672.40	2,345	2,542
672.45	2,354	2,618
672.50	2,364	2,694
672.55	2,374	2,769
672.60	2,383	2,845
672.65	2,393	2,921
672.70	2,402	2,997
672.75	2,412	3,072
672.80	2,422	3,148
672.85	2,431	3,223
672.90	2,441	3,299
672.95	2,450	3,374
673.00	2,460	3,450
673.05	2,470	3,525
673.10	2,479	3,600

2 - 8" Pipes

Elevation (feet)	Wetted (sq-ft)	Storage (cubic-feet)
673.15	2,489	3,675
673.20	2,498	3,751
673.25	2,508	3,826
673.30	2,518	3,901
673.35	2,527	3,976
673.40	2,537	4,051
673.45	2,546	4,126
673.50	2,556	4,201
673.55	2,566	4,209
673.60	2,575	4,218
673.65	2,585	4,226
673.70	2,594	4,235
673.75	2,604	4,243
673.80	2,614	4,252
673.85	2,623	4,260
673.90	2,633	4,269
673.95	2,642	4,277
674.00	2,652	4,285
674.05	2,662	4,325
674.10	2,671	4,365
674.15	2,681	4,404
674.20	2,690	4,444
674.25	2,700	4,483
674.30	2,710	4,523
674.35	2,719	4,563
674.40	2,729	4,602
674.45	2,738	4,642
674.50	**2,748**	**4,681**

Stage-Area-Storage for Pond 4P: BASIN 2

Elevation (feet)	Surface (sq-ft)	Wetted (sq-ft)	Storage (cubic-feet)	
668.00	1,711	1,711	0	
668.10	1,757	1,806	173	
668.20	1,804	1,901	351	
668.30	1,851	1,997	534	
668.40	1,899	2,093	722	
668.50	1,948	2,190	914	
668.60	1,997	2,288	1,111	
668.70	2,047	2,386	1,313	
668.80	2,097	2,485	1,521	
668.90	2,148	2,585	1,733	
669.00	2,200	2,685	1,950	
669.10	2,222	2,786	2,171	
669.20	2,244	2,888	2,395	
669.30	2,266	2,991	2,620	
669.40	2,288	3,095	2,848	
669.50	2,310	3,199	3,078	
669.60	2,333	3,303	3,310	
669.70	2,355	3,408	3,544	
669.80	2,378	3,514	3,781	
669.90	2,400	3,621	4,020	
670.00	2,423	3,728	4,261	
670.10	2,503	3,835	4,507	
670.20	2,584	3,944	4,762	
670.30	2,667	4,052	5,024	
670.40	2,750	4,162	5,295	
670.50	2,835	4,272	5,574	Overflow Weir
670.60	2,922	4,383	5,862	
670.70	3,009	4,494	6,159	
670.80	3,098	4,606	6,464	
670.90	3,188	4,718	6,778	
671.00	**3,280**	**4,831**	**7,102**	

10/12/2022

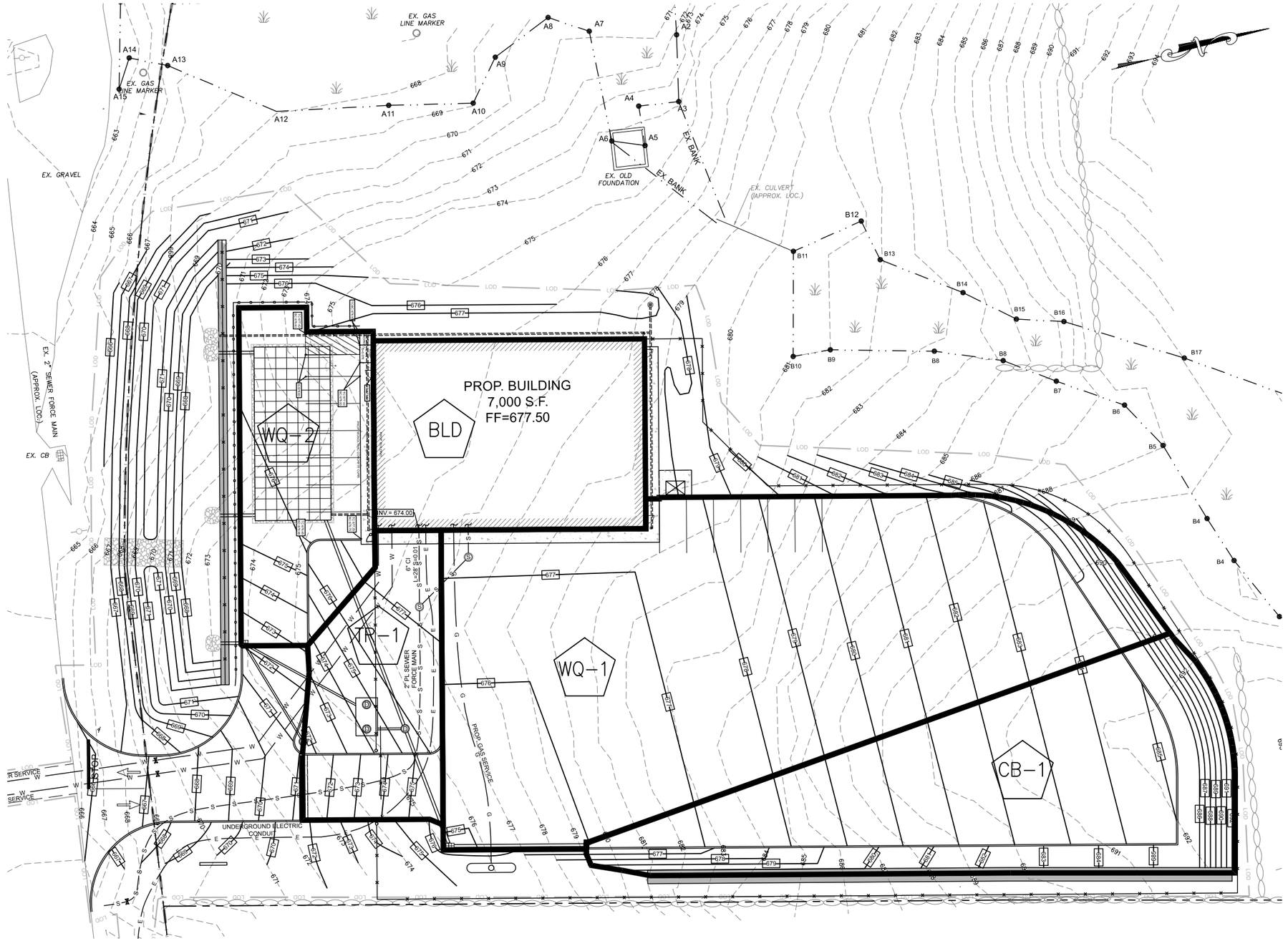
RATIONAL METHOD PIPE DESIGN WORKSHEET
PROPOSED INTERSTATE TOWING FACILITY
STURBRIDGE, MA

LOCATION	PIPE SEGMENT		INCREMENTAL AREA						FLOW TIME (min.)			25-Yr	25-Yr	DESIGN CONDITIONS					Design (25-Yr)		Inverts		Remarks
	From	To	DESIGNATION	A (Acres)	Total A	C	C*A	Sum (C*A)	To Inlet	In Chan.	Tot.	I (in/hr)	Q (cfs)	Pipe Diam (in.)	Length (ft)	Slope (%)	Q-full (cfs)	V-Full (fps)	Depth Peak (in.)	V-Peak (fps)	Up	Down	
CB-1 to Basin																							
	CB-1	WQ-1		0.29		0.68	**0.19**		5		5	6.3	**1.22**	12	49	0.012	**4.28**	5.45	3.4	1.55	673.10	672.50	CB-1 Rim =676.10
	WQ-1	DMH-1		0.55		0.87	**0.48**	**0.67**	5		5	6.3	**4.25**	12	41	0.011	**4.05**	5.16	12.6	5.41	672.50	672.05	WQ-1 Rim =675.00
	DMH-1	O/G			0.84			**0.67**	5		5	6.3	**1.91**	8	10	0.045	**2.78**	7.98	5.5	5.47	671.95	671.50	DMH-1 Rim =675.50
	DMH-1	CHAMBERS			0.84			**0.67**	5		5	6.3	**3.53**	12	81	0.011	**4.08**	5.19	10.4	4.50	672.40	671.50	DMH-1 Rim =675.50
	O/G	WQ-2			0.84			**0.67**	5		5	6.3	**1.91**	8	48	0.045	**2.78**	7.96	5.5	5.47	671.25	669.10	O/G Rim =673.00
	CHAMBERS	BASIN			0.84			**0.67**	5		5	6.3	**0.56**	8	13	0.410	**8.40**	24.08	0.5	1.61	673.33	668.00	
TR-4 TO BASIN																							
	TR-1	DMH-2		0.107		0.41	**0.04**		5		5	6.3	**0.28**	8	5	0.010	**1.31**	3.76	1.7	0.79	670.50	670.45	TR-1 Rim=671.50
	DMH-2	WQ-2						**0.04**	5		5	6.3	**0.28**	8	41	0.010	**1.30**	3.71	1.7	0.79	669.50	669.10	DMH-2 Rim=672.50
	WQ-2	BASIN		0.129		0.83	**0.11**	**0.82**	5		5	6.3	**5.19**	12	10	0.100	**12.23**	15.58	5.1	6.62	669.00	668.00	WQ-2 Rim=672.00

Notes:

1) Runoff Coefficient C-Values used; Impervious(Pavement) C=0.90 Grass/OpenSpace C=0.20, Residential Suburban C=.25~.40, Mannings "n" HDPE n=0.012, RCP n=0.013
2) Rainfall Intensity I (in/hr) values taken from Figure 10-4 Intensity-Duration-Frequency Curve for Boston, Massachusetts, Mass Highway Design Manual.
3) Five (5) minute minimum flow time used for minimum time of concentration (Tc) to CB inlet to system
4) Massachusetts Cascade Grate Inlet Capacity = 1.26 cfs @ 100% efficiency, Standard Grate = 0.95 cfs est.
5) Blue Highlight denotes calculated peak flow (cfs) to CB Inlet

Drainage Structure	Contributing Area Impervious	Grass/Lawn	Total s.f.	Ac.	Runoff Coefficient C
CB-1	8,454	4,003	12,457	0.286	0.68
WQ-1	23,061	1,026	24,087	0.553	0.87
TR-1	1,394	3,265	4,659	0.107	0.41
WQ-2	5,016	589	5,605	0.129	0.83



LEGEND

- 100 — EXISTING CONTOURS
- A — WATERSHED SUBCATCHMENT
- 1P — POND
- 1S — OFF-SITE STORMWATER OUTFALL LOCATION
- WATERSHED BOUNDARY
- TIME OF CONCENTRATION FLOW PATH
- TP#1 — TEST PIT LOCATION

GRAPHIC SCALE

40 0 20 40 80

(IN FEET)

1 inch = 40 ft.

NO.	DATE	REVISIONS DESCRIPTION	BY	CKD

PROFESSIONAL SEAL

PROJECT:
PROPOSED "INTERSTATE TOWING" FACILITY
#698 MAIN STREET
STURBRIDGE, MA 01518

PREPARED FOR:
WRECKER, LLC.
1660 WESTOVER ROAD
CHICOPEE, MA 01020

ENGINEERING SERVICES
ENVIRONMENTAL SERVICES
67 Hall Road
Sturbridge, MA 01560
Phone: 774-241-0901
fax: 774-241-0906

CMG EST. 2002

ISSUE DATE: 10/11/2022
DRAWN BY: RL | CHECKED BY: DF
SCALE: 1" = 40'
PROJECT NO.: 2022-035
SHEET NAME:
RATIONAL METHOD DRAINAGE MAP
SHEET NO.:
D - 3.0

Groundwater Mounding Analysis - Hantush Method

Project:	Interstate Towing Facility	**Project #:**	2022-035
Performed By:	RL	**Description:**	Infiltration Chambers
Checked By:	DF	**Calculated Mound Height:**	1.9 **feet**

Input Parameters (input only shaded areas)**:**

Recharge Period	t =	1.05	days	Time to equilibrium (Dewater in 25.28 hrs)
Width of Field	W =	30	feet	
Length of Field	L =	66	feet	
Hydraulic Conductivity	K =	2.04	ft/day	**1.02 in / hr - Rawls Rate Sandy Loam**
Specific Yield	V =	0.22	ft^3/ft^3	Sandy Loam = 0.22 See Specific Yield Tab
Saturated Thickness	D =	18.5	feet	**ESHGW @ 78", Assumed bed rock depth 25'**
Daily Flow	Q =	8,228	gpd	**1,100 c.f. = Required Recharge Volume**

Calculated Parameters:

1/2 width	a =	15	feet
1/2 length	b =	33	feet
Recharge Rate	j =	0.56	ft/day

$$\gamma = \frac{KD}{V} = 171.5 \text{ ft}^2/\text{day}$$

Dimensionless width $$\alpha = \frac{a}{\sqrt{4\gamma t}} = 0.5588$$

Dimensionless length $$\beta = \frac{b}{\sqrt{4\gamma t}} = 1.2294$$

Solution:

From Table 1of Hantush (1967), attached:

Function S*(a , b) = 0.7478

Water Table + Mound $$h_m = \sqrt{h_i^2 + \left[\frac{2j}{K}\lambda t \cdot S^*(\alpha,\beta)\right]}$$

h_m = 20.4 feet

Mound Height =	**h_m - D =**	**1.9**	**feet**

Reference: Hantush, M.S. 1967. "Growth and Decay of Groundwater Mounds in Response to Uniform Percolation."
Water Resources Research, 3, pp. 227-234.

Groundwater Mounding Analysis - Hantush Method

Project:	Interstate Towing Facility	**Project #:**	2022-035
Performed By:	RL	**Description:**	Stormwater Basin
Checked By:	DF	**Calculated Mound Height:**	1.8 **feet**

Input Parameters (input only shaded areas)**:**

Recharge Period	t =	1.67	days	Time to equilibrium (Dewater in 40.29 hrs)
Width of Field	W =	11	feet	
Length of Field	L =	120	feet	
Hydraulic Conductivity	K =	2.04	ft/day	**1.02 in / hr - Rawls Rate Sandy Loam**
Specific Yield	V =	0.22	ft^3/ft^3	Sandy Loam = 0.22 See Specific Yield Tab
Saturated Thickness	D =	20.5	feet	**ESHGW @ 54", Assumed bed rock depth 25'**
Daily Flow	Q =	8,228	gpd	**1,100 c.f. = Required Recharge Volume**

Calculated Parameters:

1/2 width	a =	5.5	feet
1/2 length	b =	60	feet
Recharge Rate	j =	0.83	ft/day

$$\gamma = \frac{KD}{V} = \quad 190.1 \quad ft^2/day$$

Dimensionless width $$\alpha = \frac{a}{\sqrt{4\gamma t}} = \quad 0.1543$$

Dimensionless length $$\beta = \frac{b}{\sqrt{4\gamma t}} = \quad 1.6838$$

Solution:

From Table 1of Hantush (1967), attached:

Function S*(a , b) = 0.3019

Water Table + Mound $$h_m = \sqrt{h_i^2 + \left[\frac{2j}{K}\lambda t \cdot S^*(\alpha,\beta)\right]}$$

h_m = 22.3 feet

Mound Height =	**h_m - D =**	**1.8**	**feet**

Reference: Hantush, M.S. 1967. "Growth and Decay of Groundwater Mounds in Response to Uniform Percolation."
Water Resources Research, 3, pp. 227-234.

RIP RAP SIZING CALCULATIONS
INTERSTATE TOWING FACILITY
#698 MAIN STREET
STURBRIDGE, MA

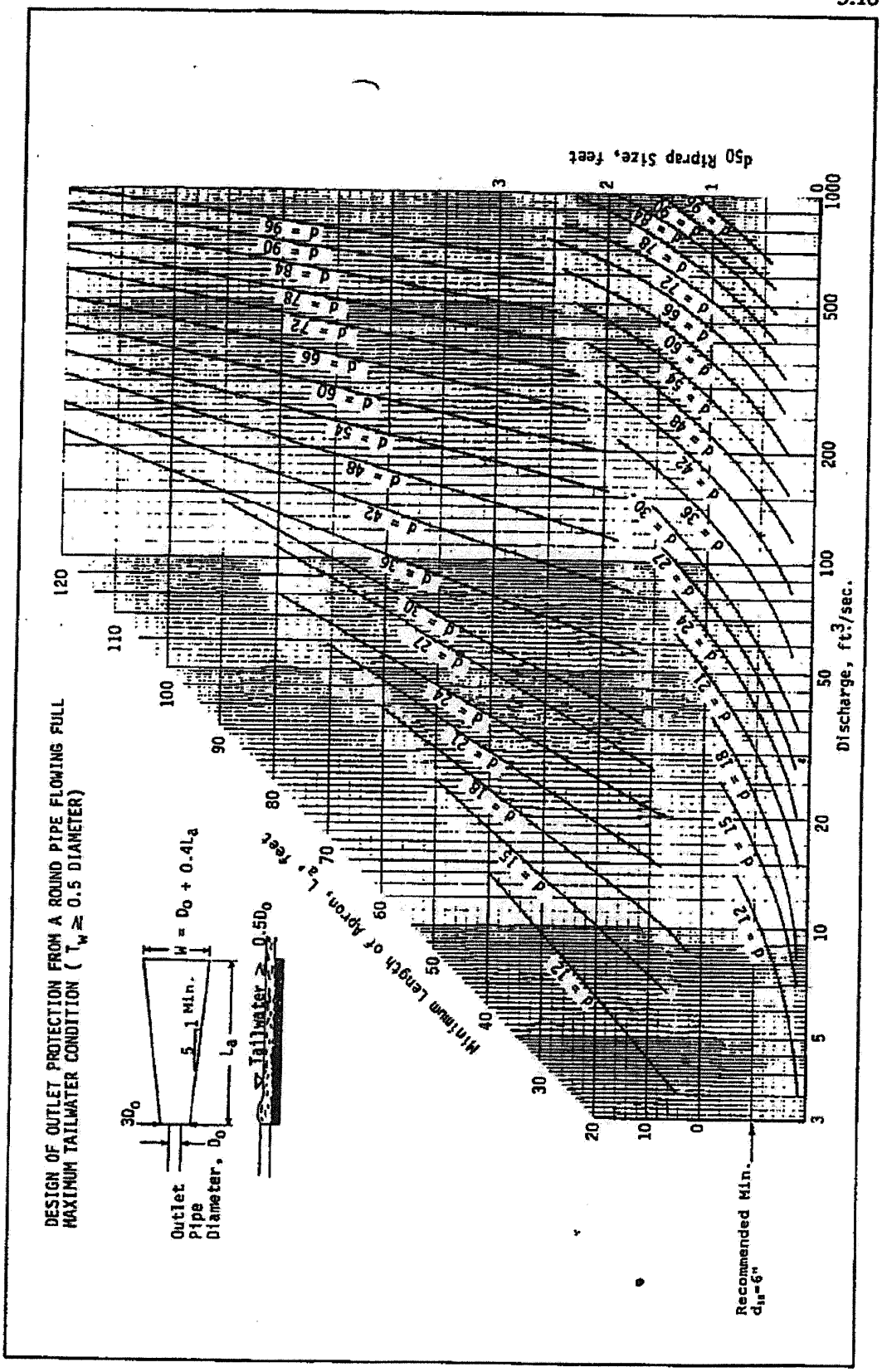
STANDARD 1 - DRAINAGE OUTFALL RIPRAP APRON SIZING

INFILTRATION BASIN #1	Flow Rate (cfs)	Min. Stone Diam. (in)*	Apron Length (ft)*	Apron Width (Upstream)*	Apron Width (Downstream)*
INFILTRATION CHAMBERS (8" HDPE)	0.56	6	5	2	3
WATER QUALITY UNIT 6 (12" HDPE)**	5.19	6	10	3	5

*Minimum Stone Diameter, Riprap Apron Length, and Riprap Apron Width were determined by USDA-NRCS Outlet Protection Spec 3.18, dated 1992. See attached nomographs from applicable sections.

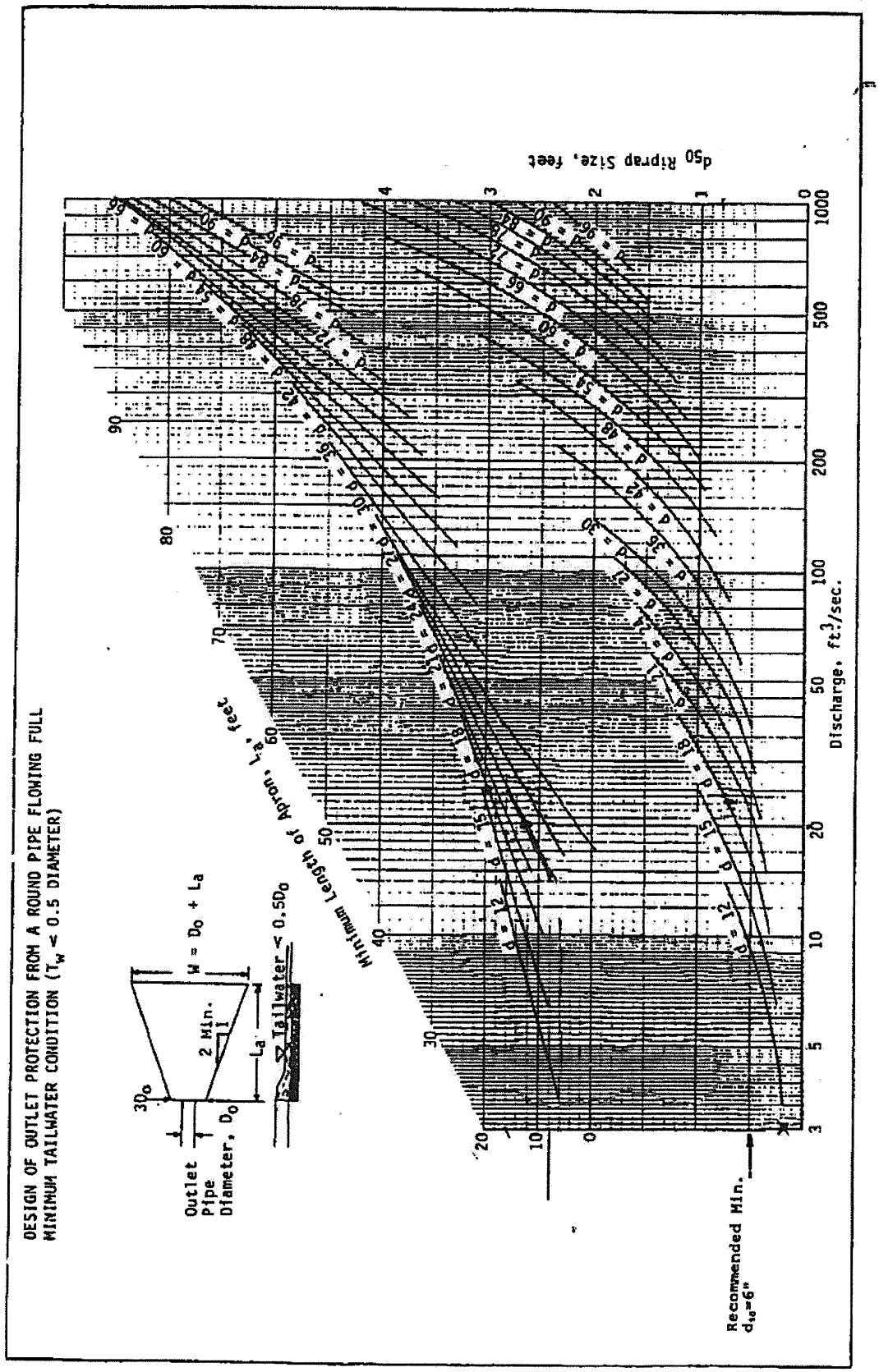
**All outlets designed for 100-year storm flow conditions. Outlets assumed to be under water during design storm flows, therefore, maximum tailwater design calculations were used.

***Outlets assumed to be discharging to grassy slope with no tailwater during design storm flows, therefore, minimum tailwater design calculations were used.



Source: USDA-SCS

Plate 3.18-4



Source: USDA-SCS

Plate 3.18-3

Appendix G

Hydrostorm Manufacturer's Design Report

Technical Design Submission

Interstate Towing
Sturbridge, MA

Revised
9/6/2022

Hydroworks, LLC

Hydroworks Technical Submission for Interstate Towing

Hydroworks is pleased to make a submission regarding the stormwater treatment structure for Interstate Towing in Sturbridge, MA. We propose the use of three HD 3 hydrodynamic separators for this project. Sizing calculations were based on an annual TSS removal objective of 80% for the fine particle size distribution and treatment of the MADEP water quality flow rate.

Hydroworks HydroDome Operation

HydroDome is unique since it provides benefits for both water quality and water quantity or flow control. HydroDome comes complete and simply slides into the outlet pipe from a drainage structure and is secured to the wall with two anchor bolts. (Figure 1).

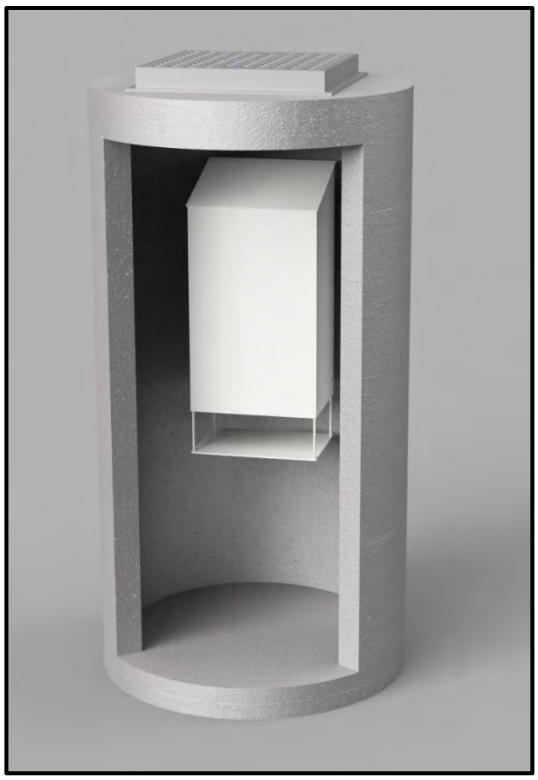


Figure 1. Hydroworks HydroDome

HydroDome consists of two main components:

1. A siphon with flow control
2. An overflow weir

At the heart of HydroDome is a siphon that regulates the water level in the structure and the flow rate leaving the structure. (Figure 2)

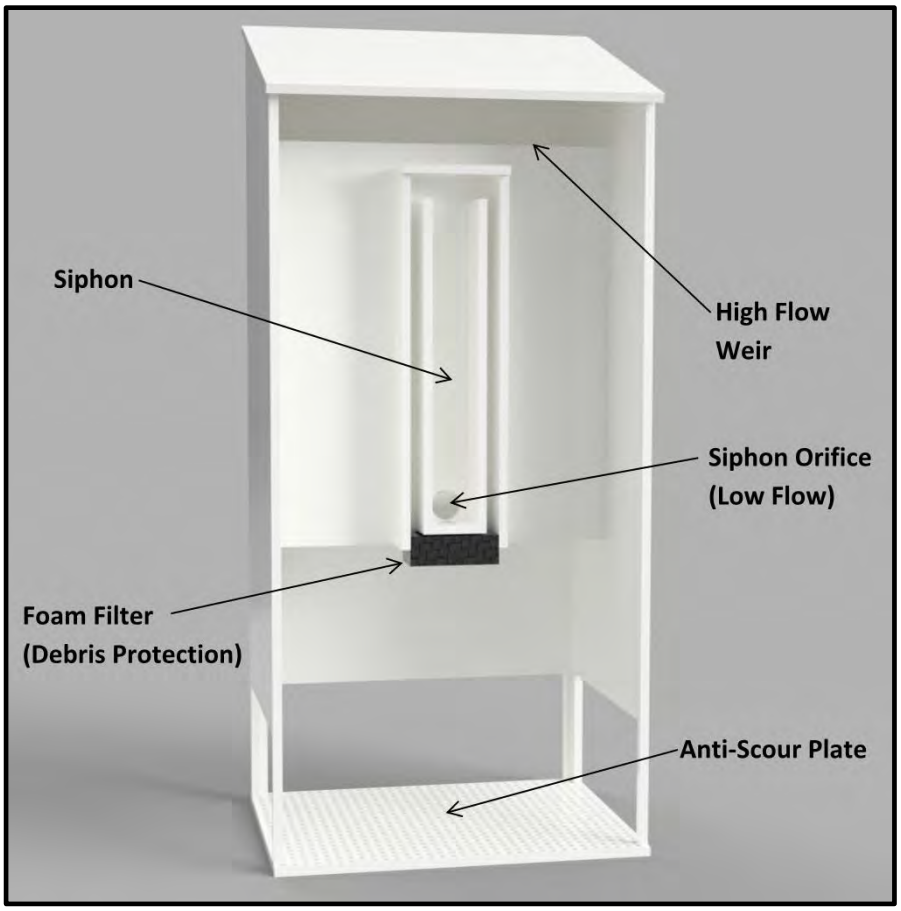


Figure 2 HydroDome Components

The siphon raises the water level to a pre-determined level without allowing water to exit the structure. The raised water level provides greater time for initial TSS removal, additional dilution to reduce effluent concentrations of any pollutants and provides a greater volume or buffer of water to prevent scour of previously settled solids.

Water flows into the device through horizontal openings at the bottom of the HydroDome. Water then must travel upwards through a siphon. A foam screen is located at the entrance to the siphon to provide secondary protection for the siphon (primary protection provided by the body of the HydroDome itself). Once the water level reaches a pre-determined height the siphon begins to engage and water flows out of the structure downstream. The siphon flow is controlled by an orifice whose size can be changed to provide the desired flow control. The water level continues to rise or begins to lower depending on the rate of flow from the orifice compared to the inflow of water to the structure.

A high flow weir above the siphon provides a high flow path to prevent the system from surcharging. A scour protection plate minimizes scour by preventing upward velocities/flow from the structure floor during periods of peak flow.

HydroDome combines the function of separator, hood, and flow control with active storage to provide a multi-purpose stormwater management solution in one structure.

HydroDome can be used as an inlet structure or as a regular drainage structure without any modification.

Construction Materials

The inner chamber and outlet baffle are made out of a copolymer plastic. The shell of the structure is pre-cast concrete. Pre-cast concrete is readily accepted by all municipalities since it has the following advantages:

- long service life
- ease of installation (less dependent on backfill (contractor proficiency) for structural integrity)
- concrete structures are designed for both anti-buoyancy and traffic loading without any field requirements (such as structural loading slabs in traffic areas and anti-buoyancy slabs to prevent groundwater uplift).
- low maintenance requirements

Hydroworks HD Separator Dimensions and Capacities

The HD separator is manufactured in a variety of sizes from 4 ft inside diameter to 12 ft inside diameter as shown in Table 1.

Table 1. Hydroworks HD Separator Dimensions*

Model	Structure Inside Diam. (ft)	Structure Depth (ft)*	Sediment/ Sinking Trash Volume (ft^3)	Oil/Floating Trash Volume (gal)	Permanent Pool (Wet) Volume (gal)
HD 3	3	4	11	31	210
HD 4	4	4	25	70	420
HD 5	5	5.5	47	134	805
HD 6	6	6.5	80	230	1375
HD 7	7	7.5	125	360	2155
HD 8	8	8.5	188	560	3195
HD 10	10	10.5	367	1125	6165
HD 12	12	12.5	631	1975	10575

*Dimensions vary with project requirements

The volumes provided in Table 1 for oil and sediment are to full capacity and not indicative of recommended depths/volumes for maintenance.

Headloss

Any water quality system implemented in a storm drain network will create headloss in the system. In general, depending on the configuration of the by-pass, systems designed to treat high flows or all of the flow will have a higher headloss impact on the storm drain network than systems that by-pass high flows.

The headloss created by the HD separator was measured in an independent laboratory (Alden Research Laboratory) for a full-scale HD 3 (Figures 3).

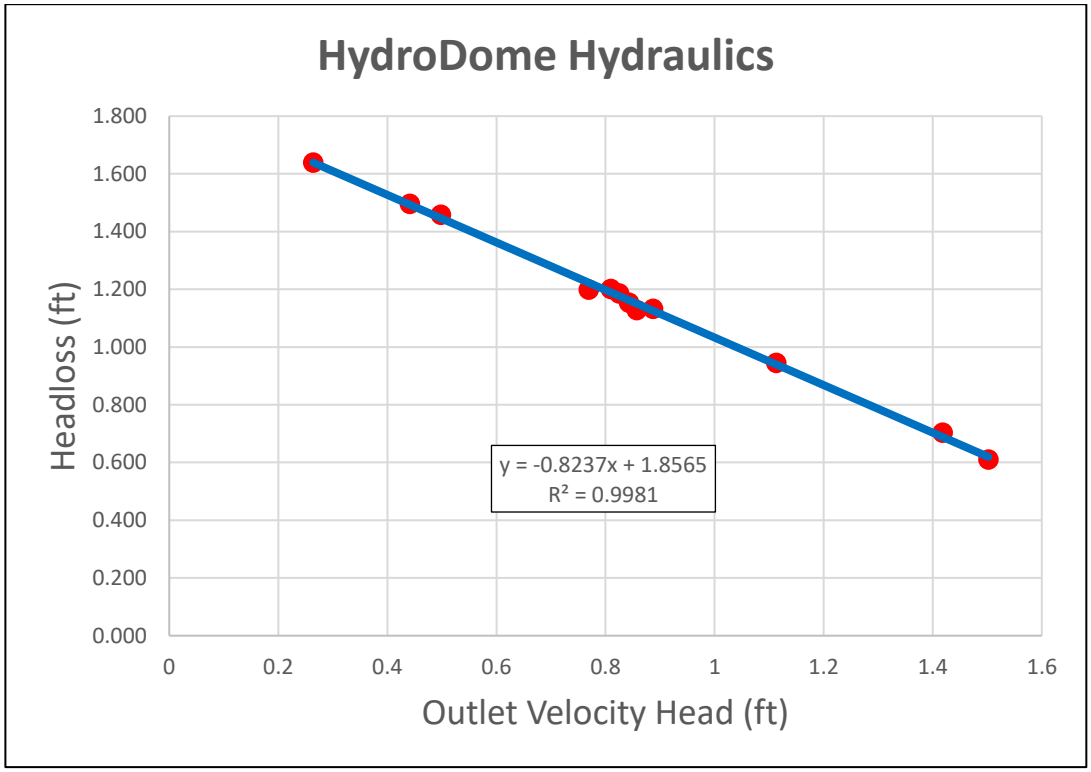


Figure 3. HydroDome Headloss

Headloss in the HydroDome decreases with velocity head due to the siphon. The water level inside the HydroDome must exceed the level of the siphon for water to flow out of the structure. This creates an initially high headloss and a discontinuity between the upstream and downstream flow depths.

The sizing program calculates upstream flow head based on either the provided downstream flow rate or full pipe flow assuming the flow is not surcharged in the outlet pipe. Please contact Hydroworks to determine headloss in designs where tailwater creates a surcharge condition to ensure the headloss created by the HydroDome is acceptable for these site-specific applications.

Site Drainage

Drainage area and imperviousness was provided by CMG. Table 2 provides the design information for the specified separators. These areas are shown on Figure 4.

Table 2. Interstate Towing Water Quality Separator Parameters				
Location	Area (ac)	Impervious (%)	WQF (cfs)*	Recommended Unit
WQ1	0.32	80	0.31	HD 3
WQ2	0.74	80	0.72	HD 3
WQ4	0.14	82	0.14	HD 3

*Based on 1" of runoff and 6 min time of concentration

Figure 4. Interstate Towing HydroDynamic Separator Drainage Areas

The HydroDome HD 3 water quality treatment rate based on NJDEP ratings is 0.85 cfs. Therefore, the HD 3 is the appropriate size of separator for all units on this project.

TSS Removal Calculations for the Specified System

Hydroworks sizes separators based on continuous analysis of rainfall, runoff, and TSS settling in the HydroDome based on laboratory testing.

These calculations require a user input particle size distribution. We have used a fine TSS based on the fine particle size distribution for this project.

Table 3. Interstate Towing TSS Particle Size Distribution	
Particle Size (um)	% by Mass
20	35
35	10
63	5
88	10
125	15
200	15
325	5
750	5

TSS removal calculations in the sizing program are based on the HydroDome being a completely mixed reactor vessel. The removal calculations solve a first order differential equation for the concentration of solids in the tank at any time. The first order differential equation is for continuity of mass.

$C'V = QC_i - QC_t - r_cV$

C' = the change in concentration of solids in the tank with time
Q = flow rate through the tank
C_i = solids concentration in the influent to the tank
C_t = solids concentration in the tank
V = tank volume
r_c = reduction in solids in the tank (TSS Removal)

Continuous simulation requires historical rainfall data. Forty-five years of rainfall data (1957-2001) from Worcester, MA were used to analyze Interstate Towing project.

Laboratory testing (Alden, 2020) results for TSS removal for the HydroDome using the NJDEP TSS distribution is provided in Figure 5. Figure 6 shows the NJDEP TSS particle size distribution tested with the HD 3.

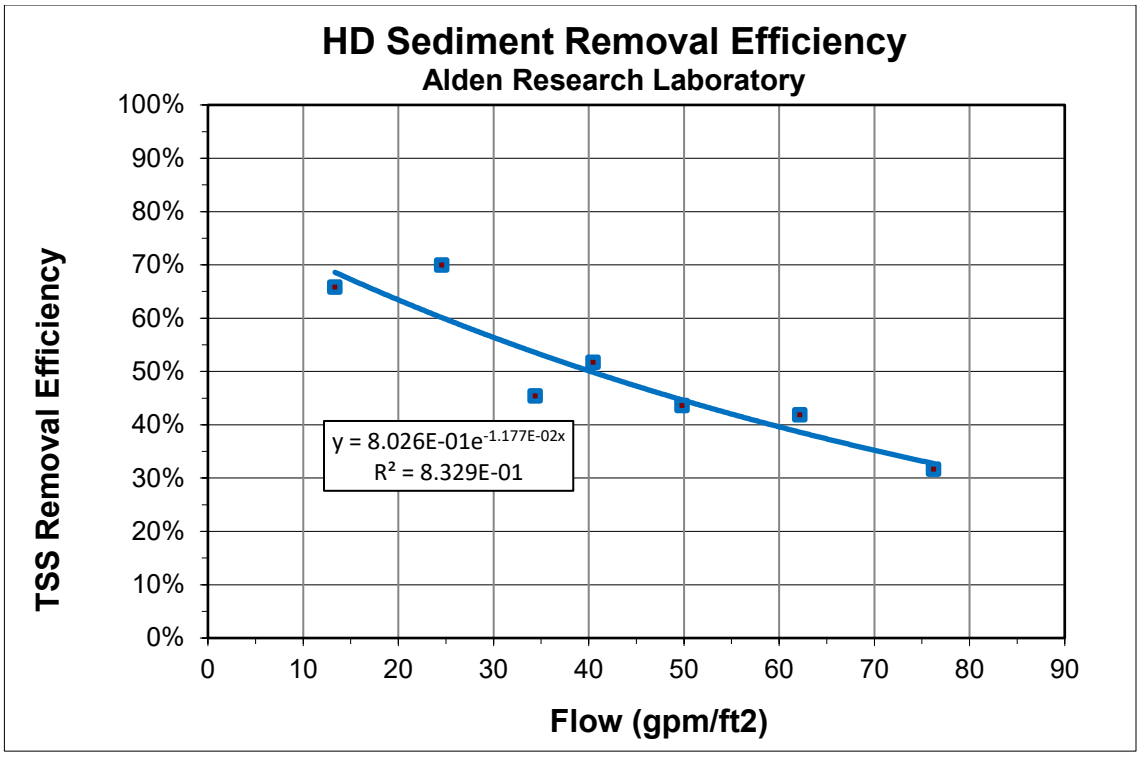


Figure 5. HydroDome TSS Removal Results (Alden, 2020)

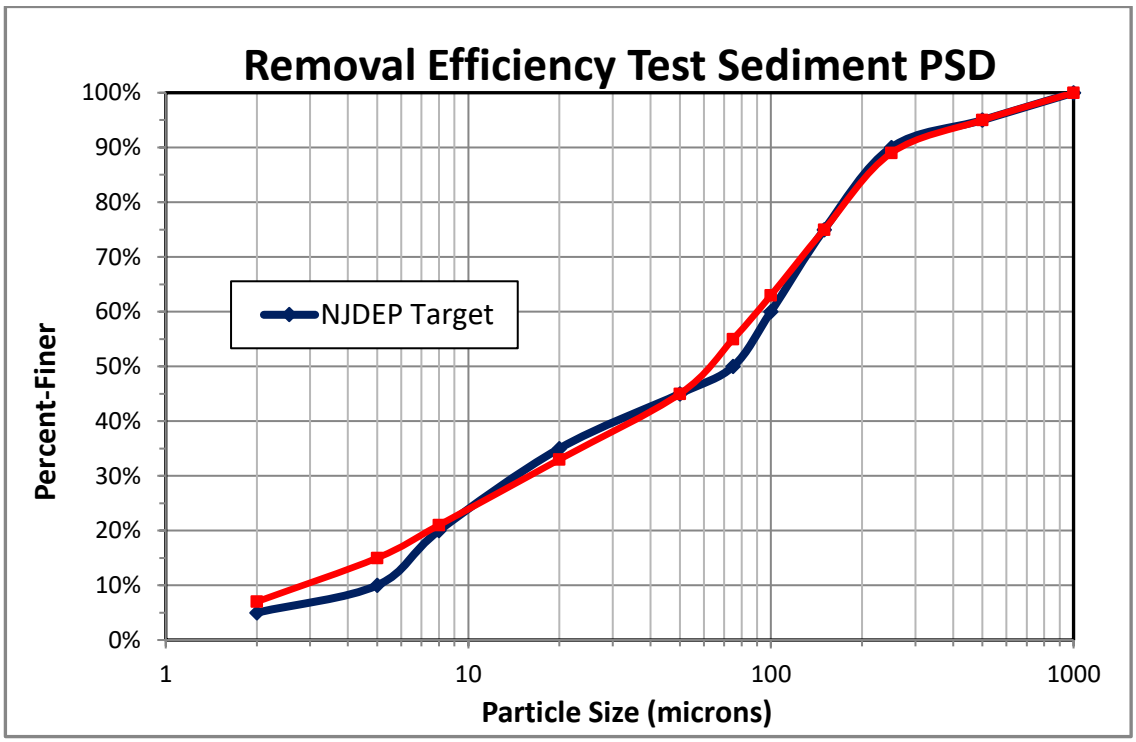


Figure 6. NJDEP TSS Particle Size Distribution (Alden, 2020)

Hydroworks uses the Peclet Number to calculate TSS removal based on the independent laboratory testing. The Peclet number has been used as a dimensionless scaling number for sediment deposition in lakes (Dhamotharan, et. Al. 1981). Others have suggested its use for scaling of TSS removal results for hydrodynamic separators (Dhanak, 2008, Gulliver, Guo and Wu, 2008).

The Peclet number is the ratio of convection (convective settling) to diffusion (turbulence keeping particles in suspension). The Peclet number (Equation 1) varies with the size of separator, particle size of TSS, and flow rate.

$$Pe = Vs\ h\ d\ /Q \qquad \text{Equation 1}$$

Where Pe = Peclet number
Vs = settling velocity
h = depth of separator sump
d = separator diameter
Q = flow rate

A particle will be removed in the separator if the Peclet number is equal to, or greater than, the Peclet number calculated for removal of that particle based on the independent laboratory results. Based on the NJDEP PSD in Figure 6, the TSS removal in Figure 5, and the dimensions of the tested HD 3, critical Peclet Numbers can be calculated for each particle size in Figure 6 (critical Peclet number is the Peclet Number above which the particle is removed). A critical Peclet Number curve was then developed and input to the model (Figure 7).

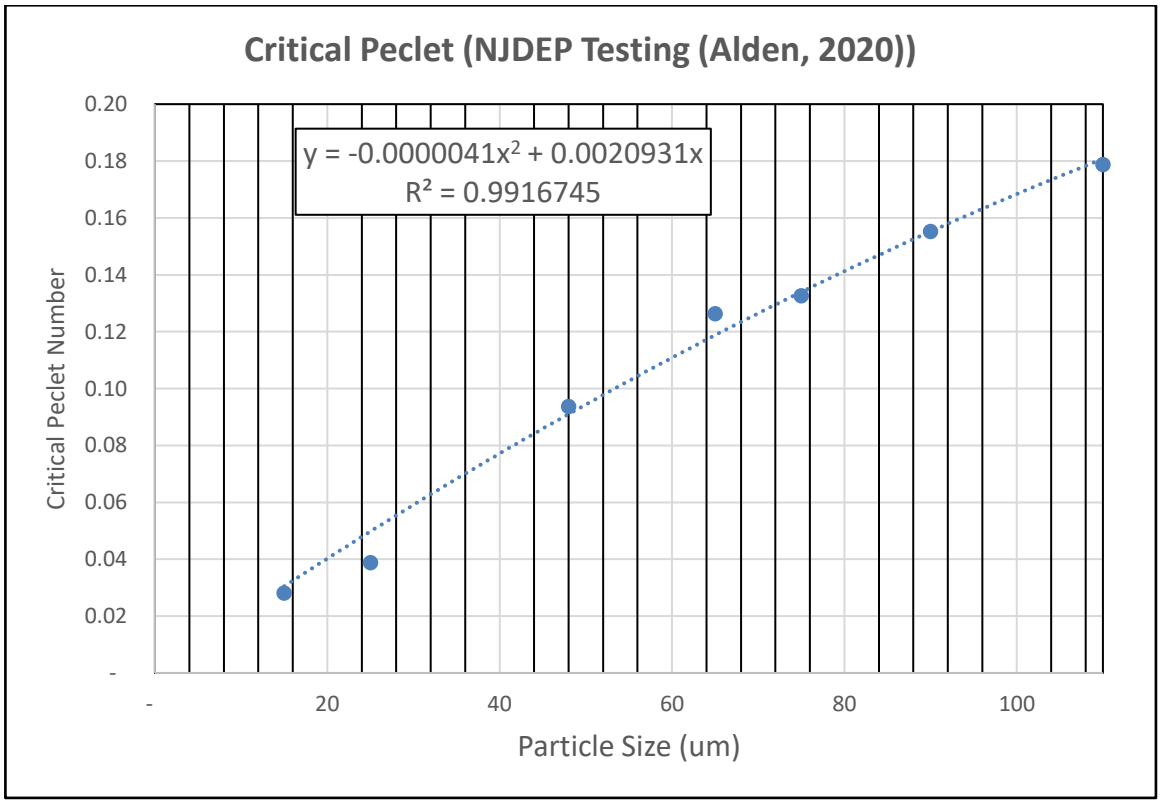


Figure 7. Critical Peclet Number Curve

At each timestep the Peclet Number is calculated for every flow and every HydroDome separator for each particle size in the design particle size distribution. The calculated Peclet Number is then compared to the Critical Peclet Number to determine if the particle is removed at that timestep or not (removed if the calculated Peclet Number is greater than the Critical Peclet Number and not removed if less than the Critical Peclet Number). These calculations are done for the entire rainfall record to determine an overall TSS removal percentage.

Hydroworks added a Peclet routine to the USEPA SWMM model to determine TSS removal based on the Peclet number calibrated to the independent laboratory testing completed by Alden Research Laboratory (Figure 7). Figure 8 shows the calibrated model results compared to the independent laboratory testing results from Alden Labs for a HydroDome HD3 based on the NJDEP particle size distribution used by Alden for testing purposes.

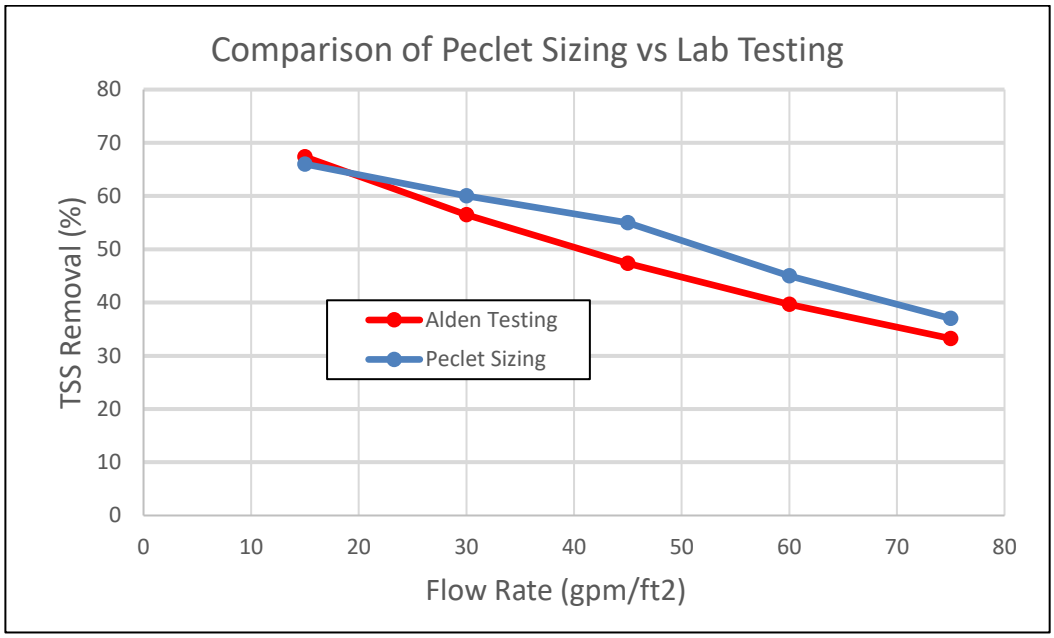


Figure 8. Independent Laboratory TSS Removal Performance versus Peclet Sizing Model

The use of the Peclet Number allows Hydroworks to size the HydroDome based on any particle size and design storm or local hydrology

Sizing Recommendations

TSS Removal

The annual TSS removal results are given in Figures 9-11. The sizing indicates the HD 3 is appropriately sized to provide 80% TSS removal for all three separators.

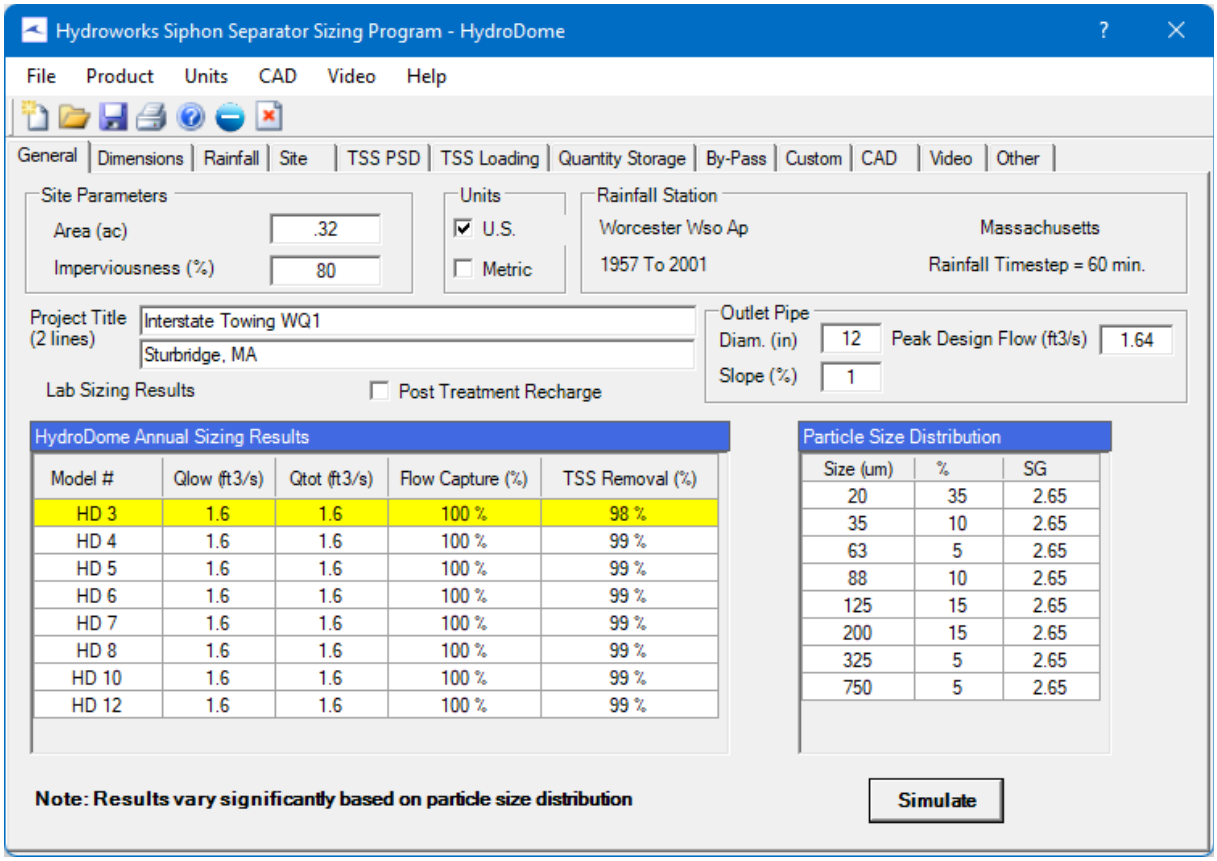


Figure 9. Interstate Towing Separator Sizing Results WQ1

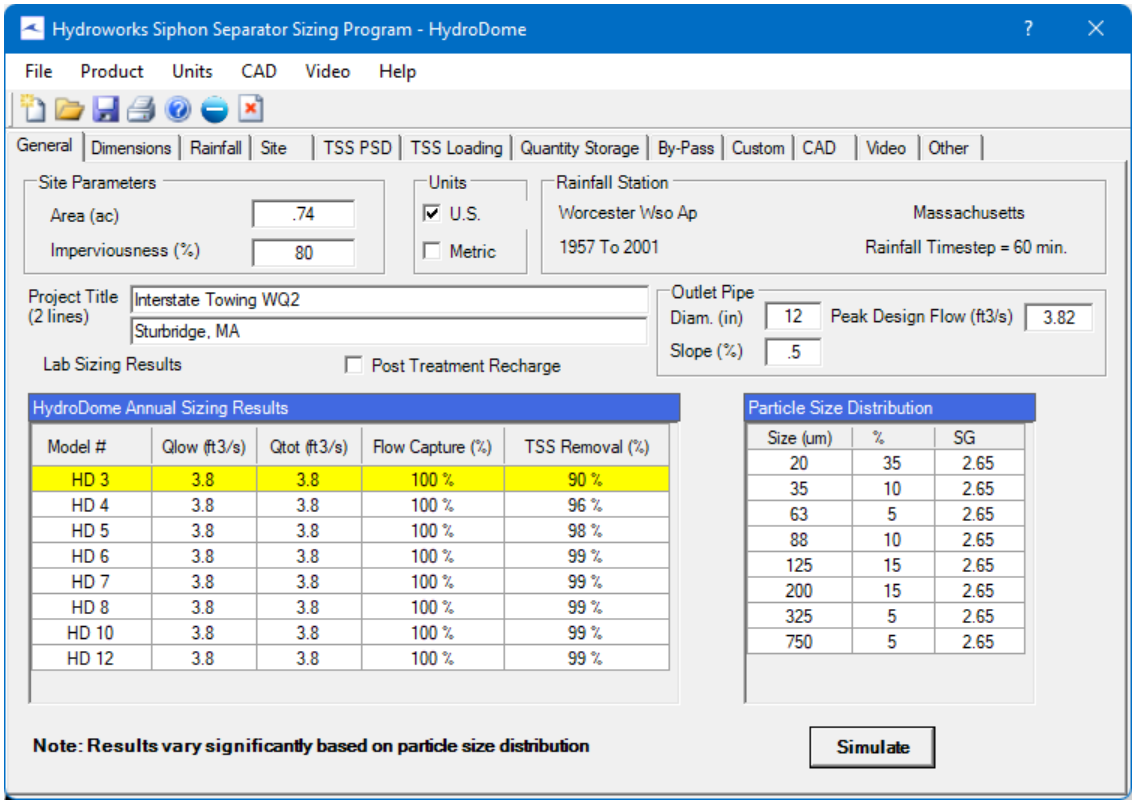


Figure 10. Interstate Towing Separator Sizing Results WQ2

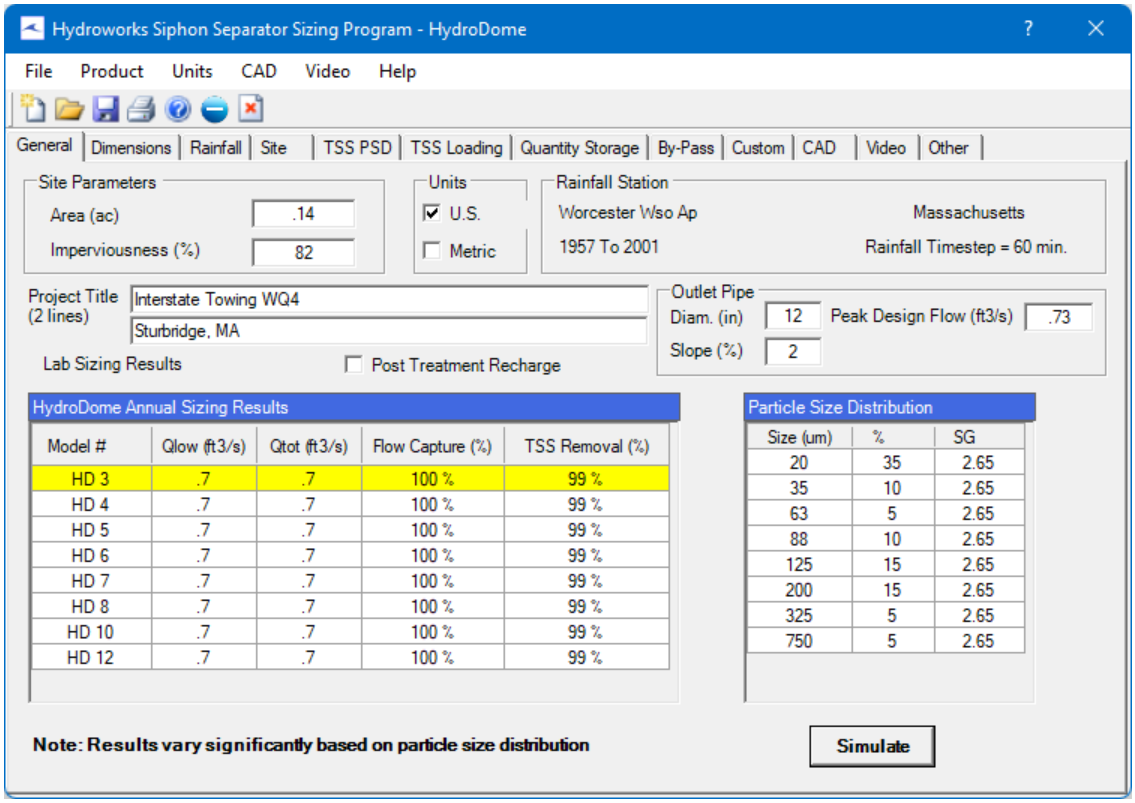


Figure 11. Interstate Towing Separator Sizing Results WQ4

Local Production

Hydroworks units are made locally in by United Concrete in CT, CSI in Hudson, NH, and STI in Leominster, MA. Therefore, the use of HydroDome supports the local MA and New England economy.

Summary

We propose the use of three HydroDome HD 3 separators for Interstate Towing project in Sturbridge, MA. The proposed HydroDome separator will provide 80% annual TSS removal for the fine TSS particle size distribution and treat the site water quality flow rate.

APPENDIX 1

HydroDome Approvals

State of New Jersey
DEPARTMENT OF ENVIRONMENTAL PROTECTION
PHILIP D. MURPHY
Governor
SHEILA Y. OLIVER
Lt. Governor
DIVISION OF WATERSHED PROTECTION AND RESTORATION
BUREAU OF NJPDES STORMWATER PERMITTING & WATER QUALITY MANAGEMENT
P.O. Box 420 Mail Code 401-02B
Trenton, New Jersey 08625-0420
609-633-7021 / Fax: 609-777-0432
www.njstormwater.org
SHAWN M. LATOURETTE
Commissioner

June 30, 2021

Graham Bryant
President
Hydroworks, LLC
257 Cox Street
Roselle, NJ 07203

Re: MTD Lab Certification
HydroDome (HD) Stormwater Separator by Hydroworks, LLC
On-line Installation

TSS Removal Rate 50%

Dear Mr. Bryant:

The Stormwater Management rules under N.J.A.C. 7:8-5.2(f) and 5.2(j) allow the use of manufactured treatment devices (MTDs) for compliance with the design and performance standards at N.J.A.C. 7:8-5 if the pollutant removal rates have been verified by the New Jersey Corporation for Advanced Technology (NJCAT) and have been certified by the New Jersey Department of Environmental Protection (NJDEP). Hydroworks, LLC has requested an MTD Laboratory Certification for the HydroDome Stormwater Separator (HydroDome).

The project falls under the "Procedure for Obtaining Verification of a Stormwater Manufactured Treatment Device from New Jersey Corporation for Advance Technology" dated January 25, 2013. The applicable protocol is the "New Jersey Laboratory Testing Protocol to Assess Total Suspended Solids Removal by a Hydrodynamic Sedimentation Manufactured Treatment Device" dated January 25, 2013.

NJCAT verification documents submitted to the NJDEP indicate that the requirements of the protocol have been met or exceeded. The NJCAT letter also included a recommended certification TSS removal rate and the required maintenance plan. The NJCAT Verification Report dated May 2021 with the Verification Appendix for this device is published online at http://www.njcat.org/verification-process/technology-verification-database.html.

The NJDEP certifies the use of the HydroDome by Hydroworks, LLC at a TSS removal rate of 50% when designed, operated and maintained in accordance with the information provided in the Verification Appendix and the following conditions:

1. The maximum treatment flow rate (MTFR) for the manufactured treatment device (MTD) is calculated using the New Jersey Water Quality Design Storm (1.25 inches in 2 hrs) in N.J.A.C. 7:8-5.5.

2. The HydroDome shall be installed using the same configuration reviewed by NJCAT and shall be sized in accordance with the criteria specified in in item 6 below.

3. This HydroDome cannot be used in series with another MTD or a media filter (such as a sand filter), to achieve an enhanced removal rate for total suspended solids (TSS) removal under N.J.A.C. 7:8-5.5.

4. Additional design criteria for MTDs can be found in Chapter 11.3 of the New Jersey Stormwater Best Management Practices (NJ Stormwater BMP) Manual which can be found on-line at www.njstormwater.org.

5. The maintenance plan for a site using this device shall incorporate, at a minimum, the maintenance requirements for the HydroDome, which is attached to this document. However, it is recommended to review the maintenance manual at www.hydroworks.com\hdmaintenance.pdf for any changes to the maintenance requirements.

6. Sizing Requirements:

   The example below demonstrates the sizing procedure for the HydroDome:

   Example: A 0.25-acre impervious site is to be treated to 50% TSS removal using a HydroDome. The impervious site runoff (Q) based on the New Jersey Water Quality Design Storm was determined to be 0.79 cfs.

   Maximum Treatment Flow Rate (MTFR) Evaluation:

   The site runoff (Q) was based on the following:
   time of concentration = 10 minutes
   i=3.2 in/hr (page 21, Fig. 5-10 of Chapter 5 of the NJ Stormwater BMP Manual)
   c=0.99 (curve number for impervious)
   Q=ciA=0.99x3.2x0.25=0.79 cfs

   Given the site runoff is 0.79 cfs and based on Table 1 below, the HydroDome Model HD 3 with a MTFR of 0.85 cfs would be the smallest model approved that could be used for this site that could remove 50% of the TSS from the impervious area without exceeding the MTFR.

   The sizing table corresponding to the available system models is noted below. Additional specifications regarding each model can be found in the Verification Appendix under Table A-1 and Table A-2.

Table 1 HydroDome Models

HydroDome Model	Manhole Diameter (ft)	Maximum Treatment Flowrate, MTFR (cfs)
HD 3	3	0.85
HD 4	4	1.51
HD 5	5	2.36
HD 6	6	3.40
HD 7	7	4.63
HD 8	8	6.03
HD 10	10	9.44
HD 12	12	13.60

Be advised a detailed maintenance plan is mandatory for any project with a Stormwater BMP subject to the Stormwater Management Rules, N.J.A.C. 7:8. The plan must include all the items identified in the Stormwater Management Rules, N.J.A.C. 7:8-5.8. Such items include, but are not limited to, the list of inspection and maintenance equipment and tools, specific corrective and preventative maintenance tasks, indication of problems in the system, and training of maintenance personnel. Additional information can be found in Chapter 8: Maintenance and Retrofit of Stormwater Management Measures.

If you have any questions regarding the above information, please contact Lisa Schaefer of my office at lisa.schaefer@dep.nj.gov.

Sincerely,

Gabriel Mahon

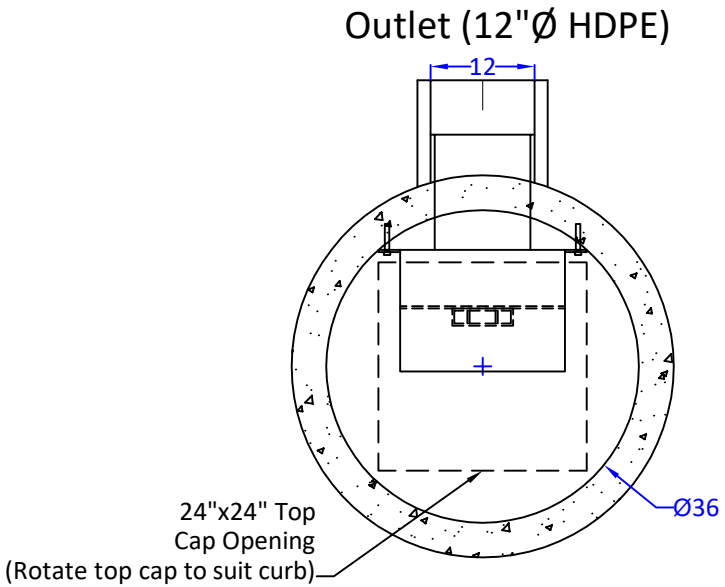
Gabriel Mahon, Chief
Bureau of NJPDES Stormwater Permitting & Water Quality Management
Division of Watershed Protection and Restoration
New Jersey Department of Environmental Protection

Attachment: Maintenance Plan

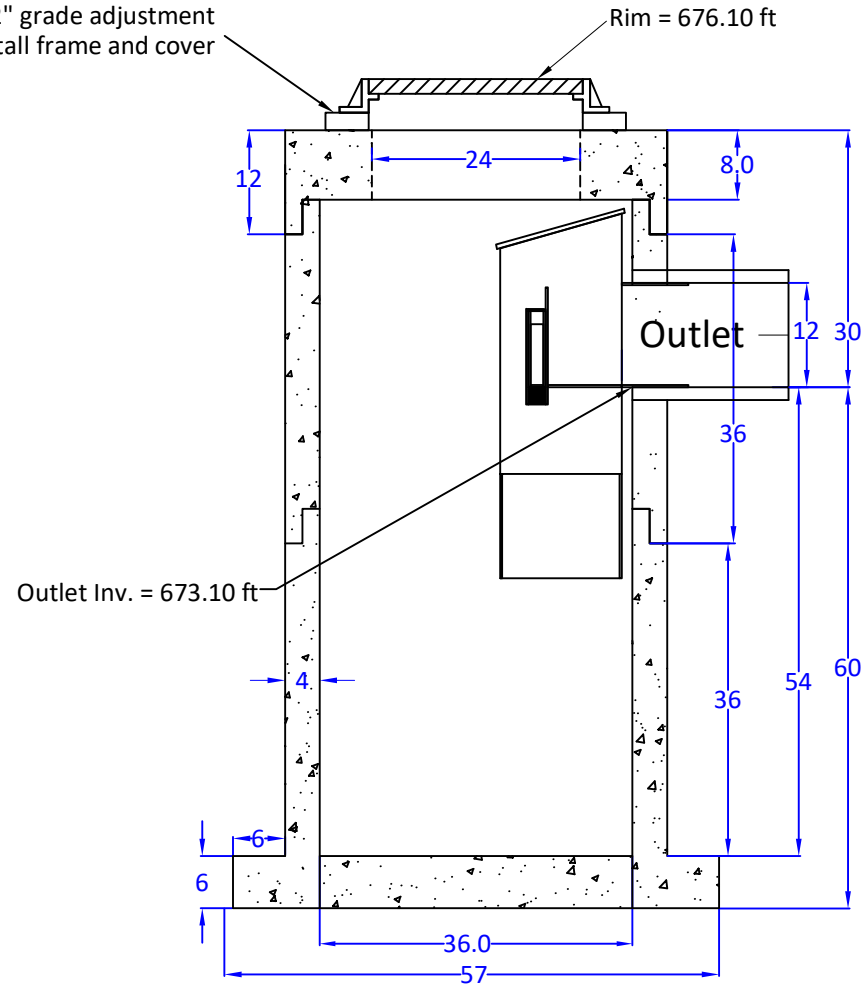
cc: Richard Magee, NJCAT

APPENDIX 2

CAD Drawings



Plan



Profile

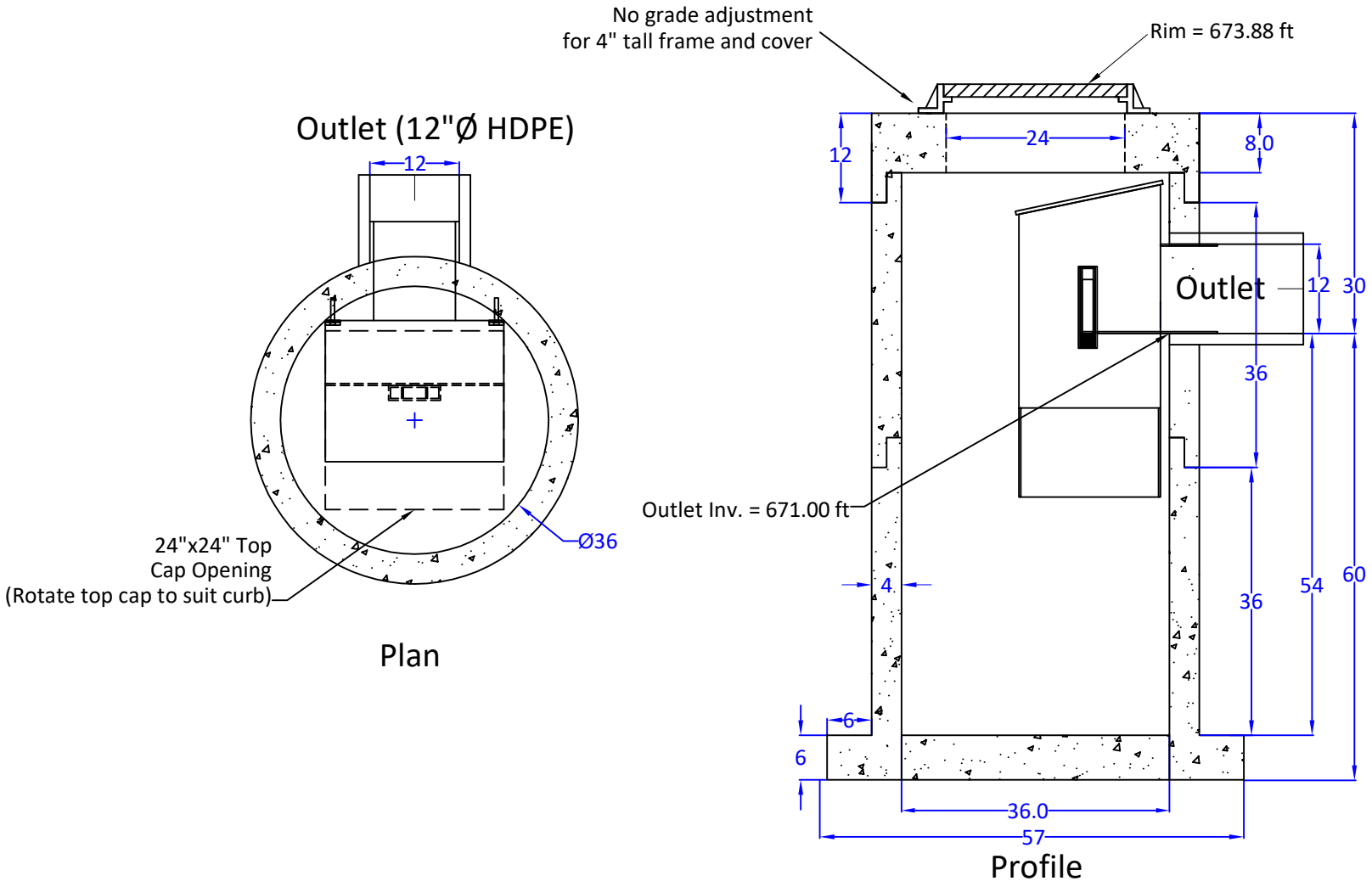
SELLING AGENT RESPONSIBLE FOR PROVIDING CONTRACTOR WITH PAGE 1

Any alternate equal must have independent testing to both the 2013 NJDEP separator protocol and the 2013 ETV Canada separator protocol

HydroDome by
Hydroworks, LLC
U.S. Patent #10,801,196
www.hydroworks.com
888-290-7900

Hydroworks HD3 (36"Ø)	
PROJECT: Interstate Towing WQ1	
LOCATION: Sturbridge, MA	
REVISION DATE: 9/6/22	

Hydroworks



SELLING AGENT RESPONSIBLE FOR PROVIDING CONTRACTOR WITH PAGE 1

Any alternate equal must have independent testing to both the 2013 NJDEP separator protocol and the 2013 ETV Canada separator protocol

HydroDome by
Hydroworks, LLC
U.S. Patent #10,801,196
www.hydroworks.com
888-290-7900

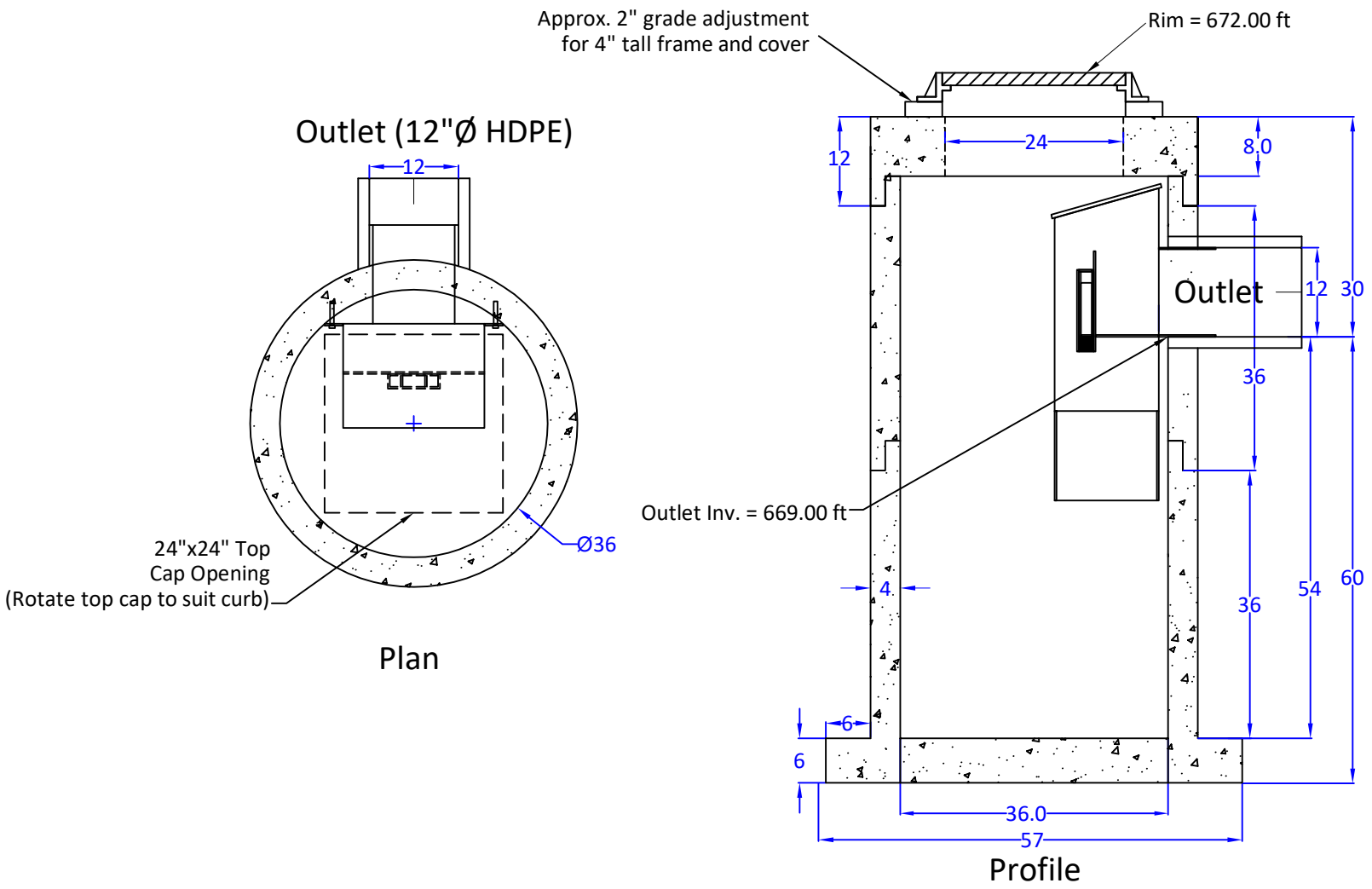
Hydroworks HD3 (36"Ø)

PROJECT: Interstate Towing WQ2

LOCATION: Sturbridge, MA

REVISION DATE: 9/6/22

Hydroworks



SELLING AGENT RESPONSIBLE FOR PROVIDING CONTRACTOR WITH PAGE 1

Any alternate equal must have independent testing to both the 2013 NJDEP separator protocol and the 2013 ETV Canada separator protocol

HydroDome by
Hydroworks, LLC
U.S. Patent #10,801,196
www.hydroworks.com
888-290-7900

Hydroworks HD3 (36"Ø)

PROJECT: Interstate Towing WQ4

LOCATION: Sturbridge, MA

REVISION DATE: 9/6/22

Hydroworks

APPENDIX 3

HydroDome Sizing Output

Hydroworks Sizing Summary

Interstate Towing WQ1
Sturbridge, MA

09-06-2022

Recommended Size: HydroDome HD 3i

A HydroDome HD 3i is recommended to provide 80 % annual TSS removal based on a drainage area of .32 (ac) with an imperviousness of 80 % and Worcester Wso Ap, Massachusetts rainfall for the Hydroworks standard particle size distribution.

The recommended HydroDome HD 3i treats 100 % of the annual runoff and provides 98 % annual TSS removal for the Worcester Wso Ap rainfall records and Hydroworks standard particle size distribution.

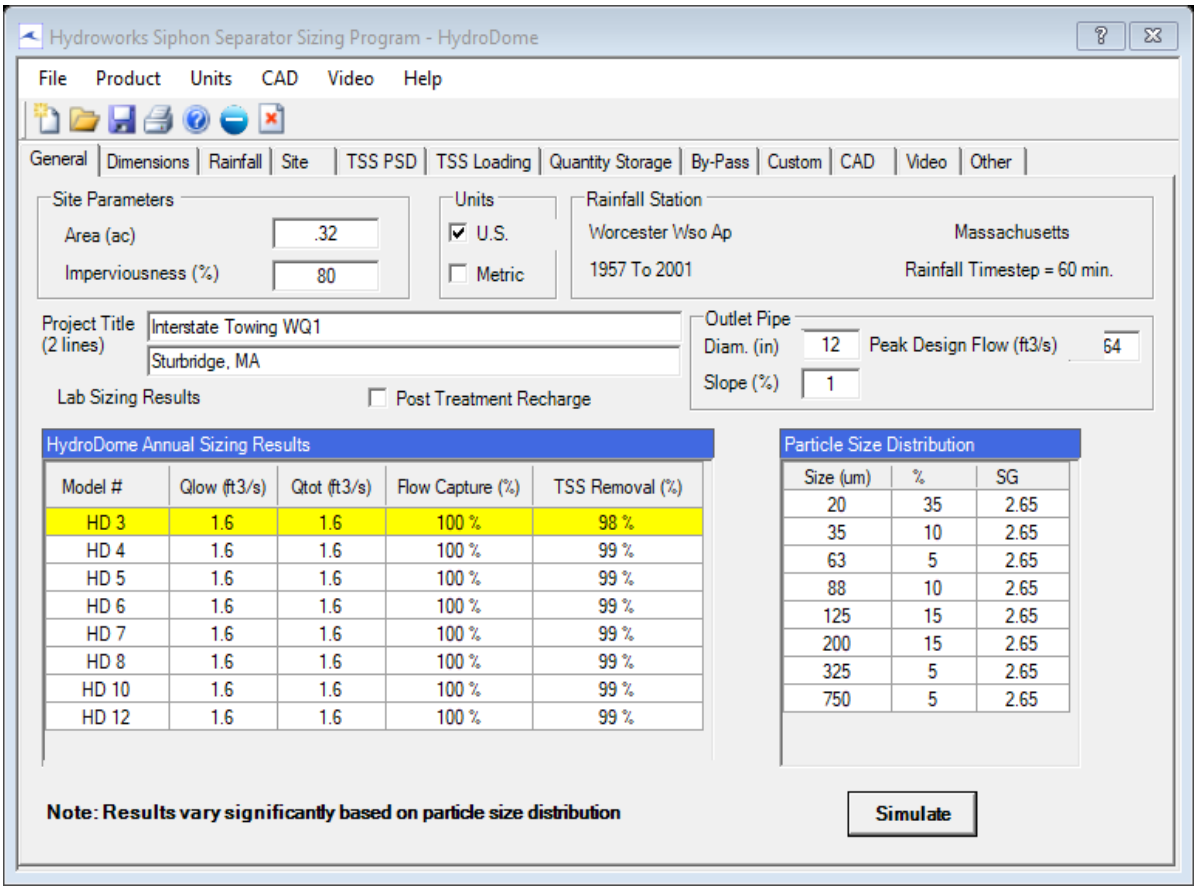
The HydroDome has a siphon which creates a discontinuity in headloss. The given peak flow of 1.64 (ft3/s) Is less than the full pipe flow of 3.56 (ft3/s) indicating free flow in the pipe during the peak flow assuming no tailwater condition. Partial pipe flow was assumed for the headloss calculations. The headloss was calculated to be 11 (in) above the crown of the 12 (in) outlet pipe.

This summary report provides the main parameters that were used for sizing. These parameters are shown on the summary tables and graphs provided in this report.

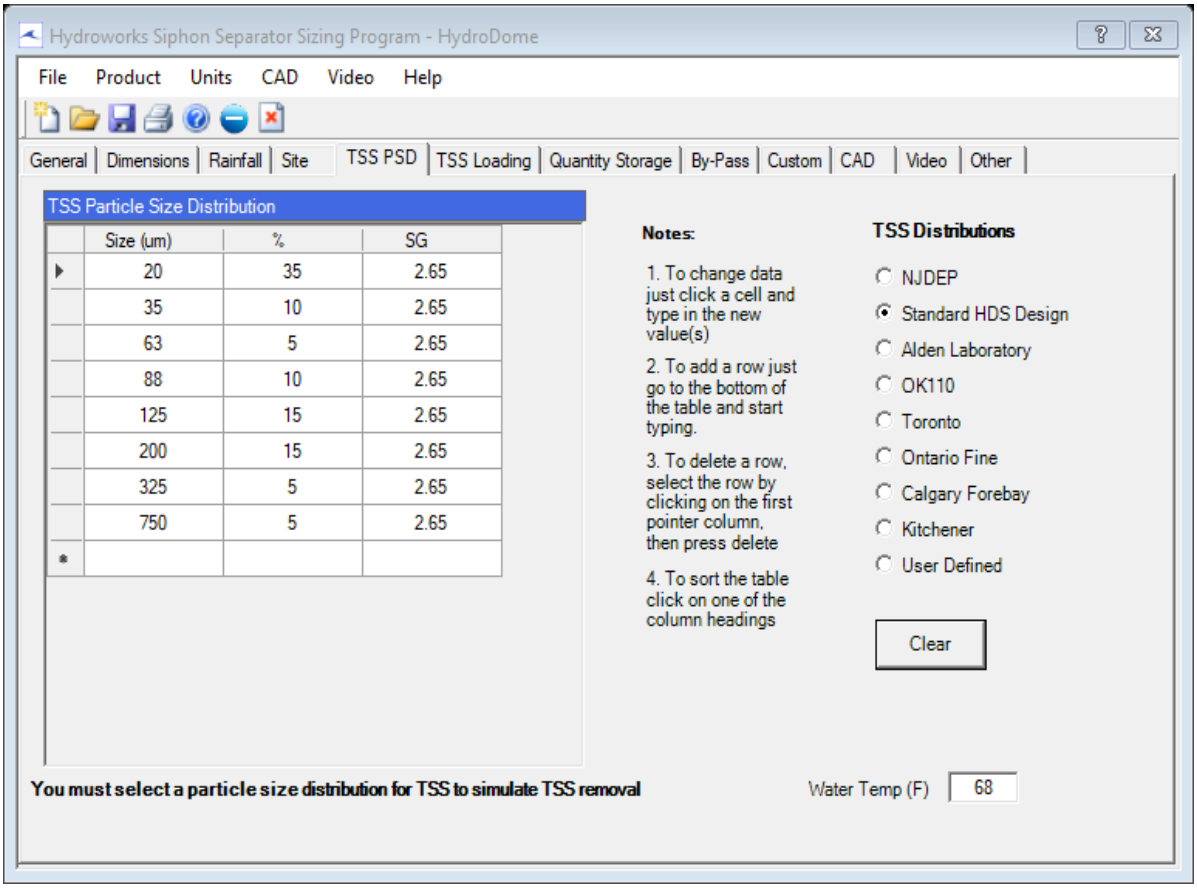
If you have any questions regarding this sizing summary please do not hesitate to contact Hydroworks at 888-290-7900 or email us at support@hydroworks.com.

The sizing program is for sizing purposes only and does not address any site specific parameters such as hydraulic gradeline, tailwater submergence, groundwater, soils bearing capacity, etc. Headloss calculations are not a hydraulic gradeline calculation since this requires a starting water level and an analysis of the entire system downstream of the HydroDome .

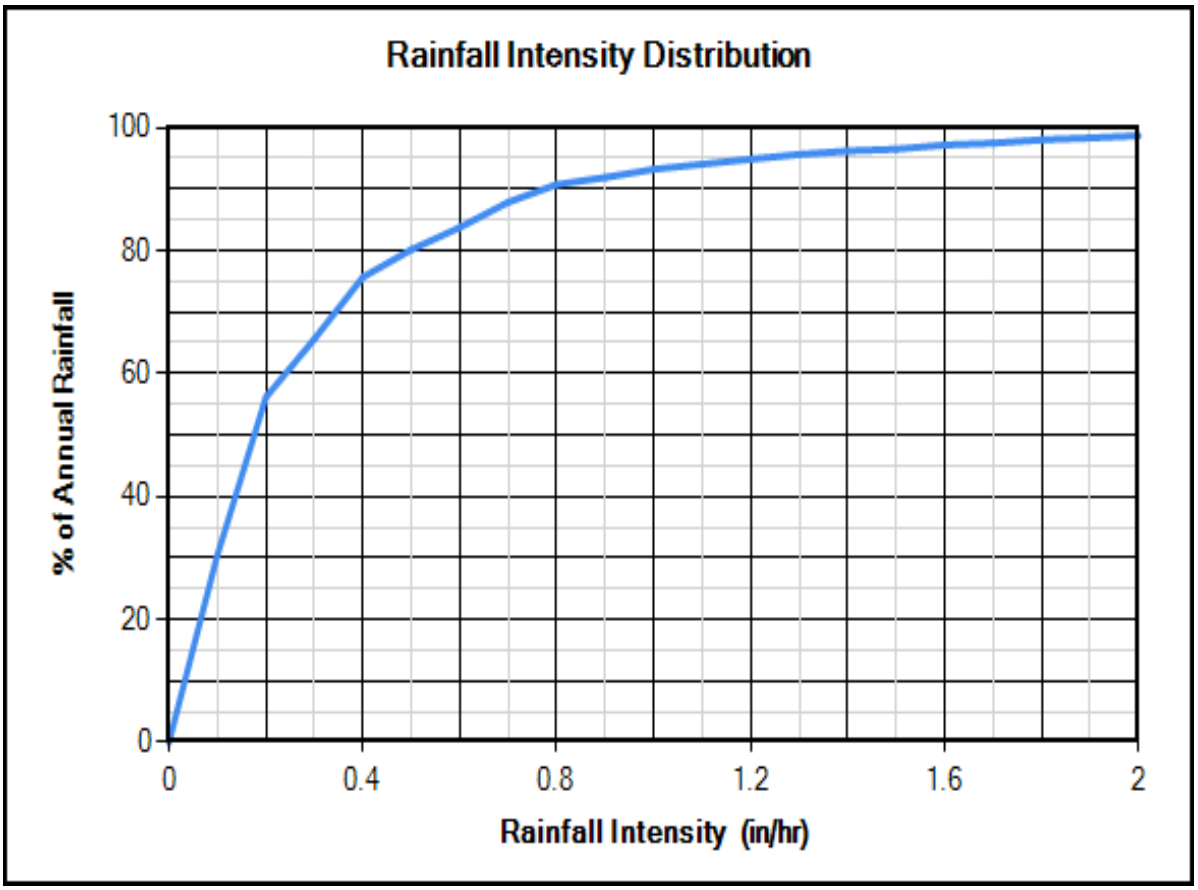
TSS Removal Sizing Summary



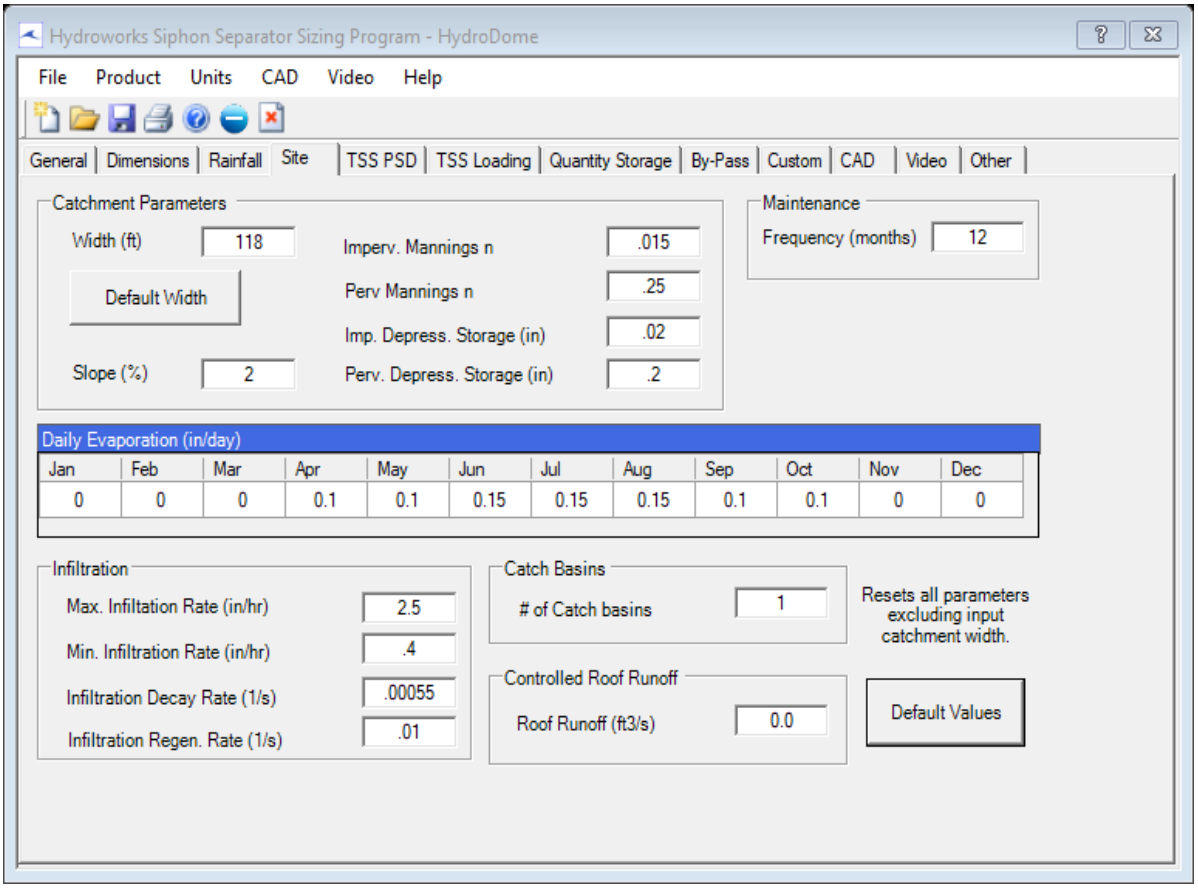
TSS Particle Size Distribution



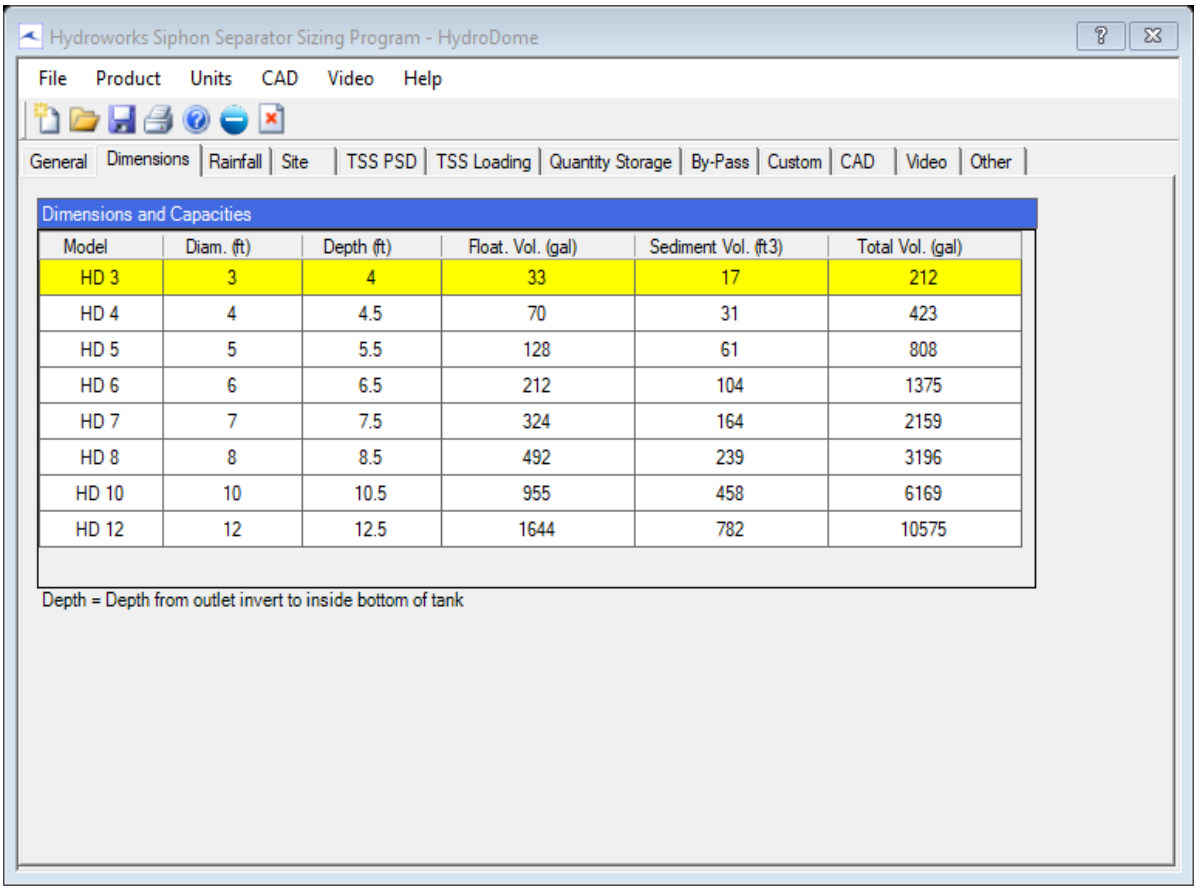
Rainfall Station - Worcester Wso Ap, Massachusetts(1957 To 2001)



Site Physical Characteristics



Dimensions And Capacities

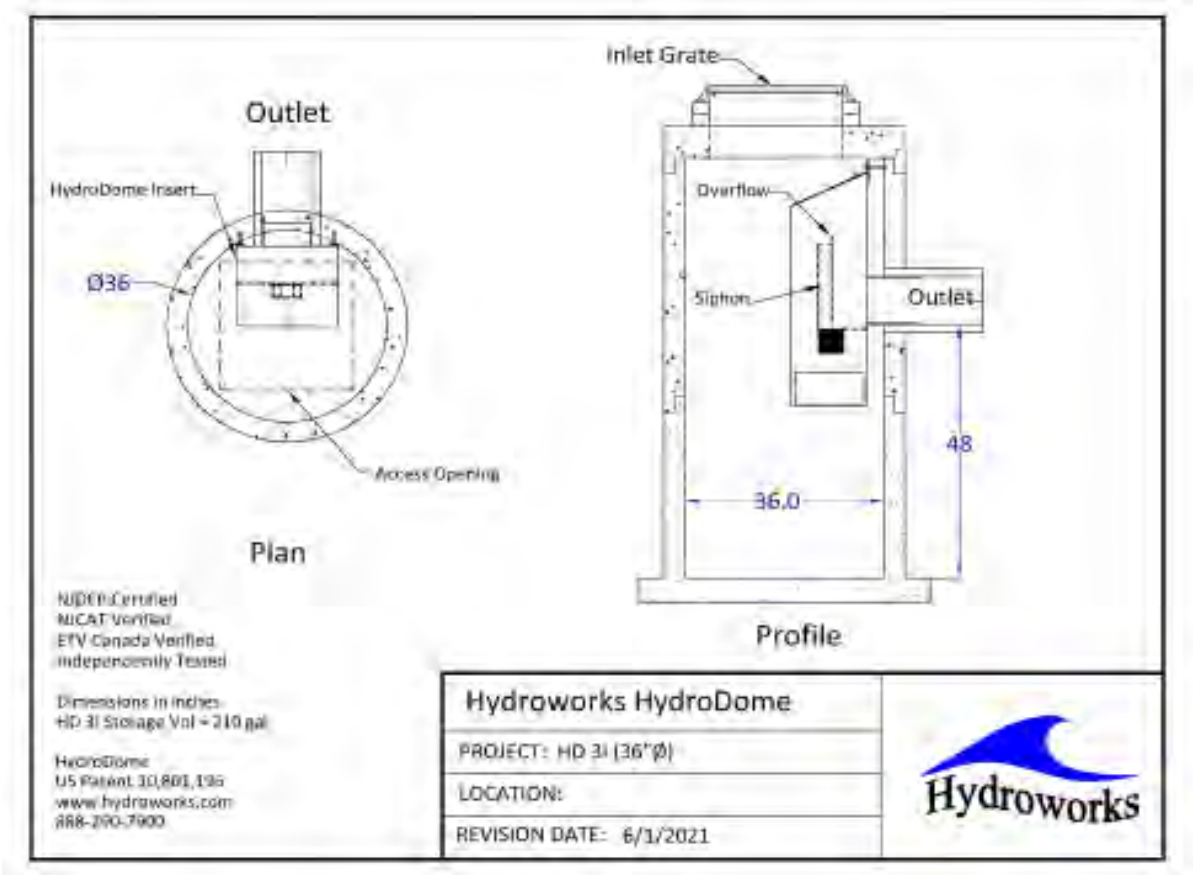


Dimensions and Capacities

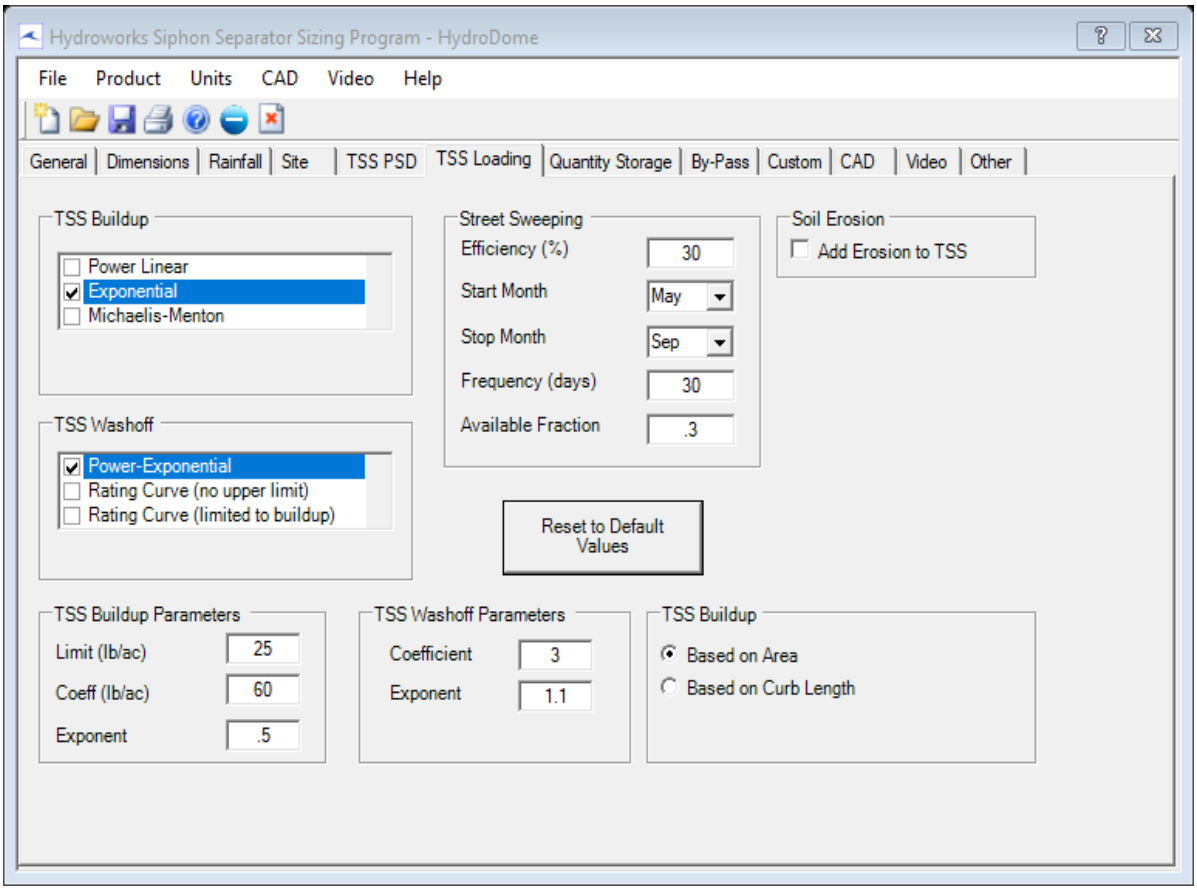
Model	Diam. (ft)	Depth (ft)	Float. Vol. (gal)	Sediment Vol. (ft3)	Total Vol. (gal)
HD 3	3	4	33	17	212
HD 4	4	4.5	70	31	423
HD 5	5	5.5	128	61	808
HD 6	6	6.5	212	104	1375
HD 7	7	7.5	324	164	2159
HD 8	8	8.5	492	239	3196
HD 10	10	10.5	955	458	6169
HD 12	12	12.5	1644	782	10575

Depth = Depth from outlet invert to inside bottom of tank

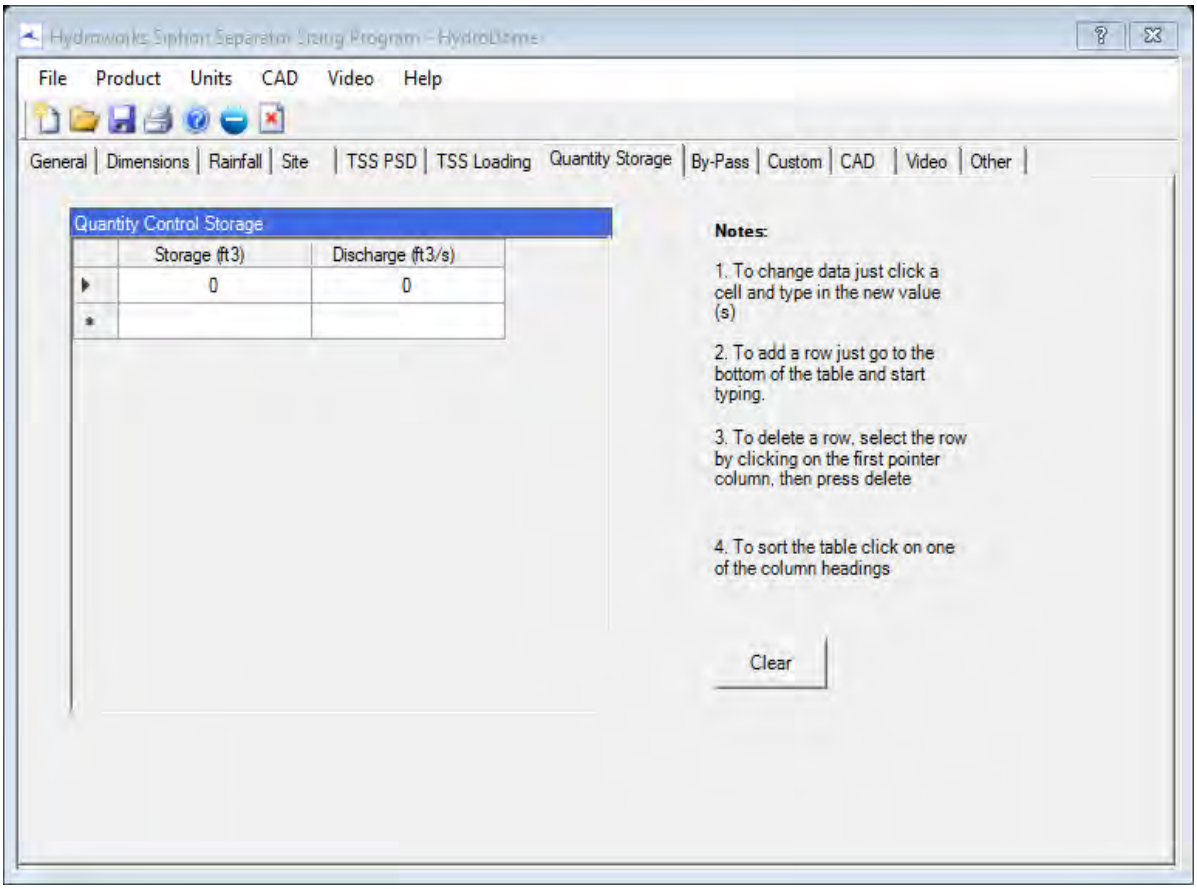
Generic HD 3i CAD Drawing



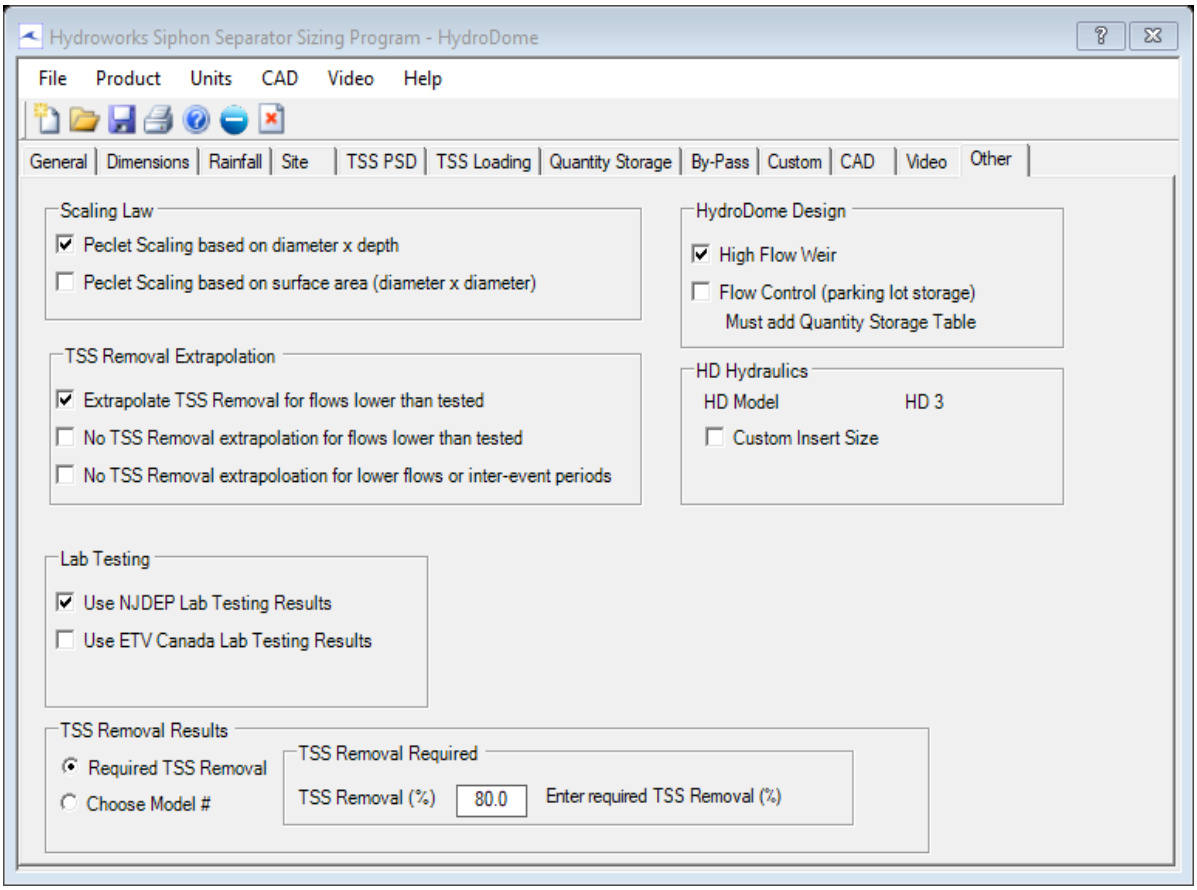
TSS Buildup And Washoff



Upstream Quantity Storage



Other Parameters



Flagged Issues

If there is underground detention storage upstream of the HydroDome please contact Hydroworks to ensure it has been modeled correctly.

Hydroworks Sizing Program - Version 5.7
Copyright Hydroworks, LLC, 2022
1-800-290-7900
www.hydroworks.com

Hydroworks Sizing Summary

Interstate Towing WQ2
Sturbridge, MA

09-06-2022

Recommended Size: HydroDome HD 3i

A HydroDome HD 3i is recommended to provide 80 % annual TSS removal based on a drainage area of .74 (ac) with an imperviousness of 80 % and Worcester Wso Ap, Massachusetts rainfall for the Hydroworks standard particle size distribution.

The recommended HydroDome HD 3i treats 100 % of the annual runoff and provides 90 % annual TSS removal for the Worcester Wso Ap rainfall records and Hydroworks standard particle size distribution.

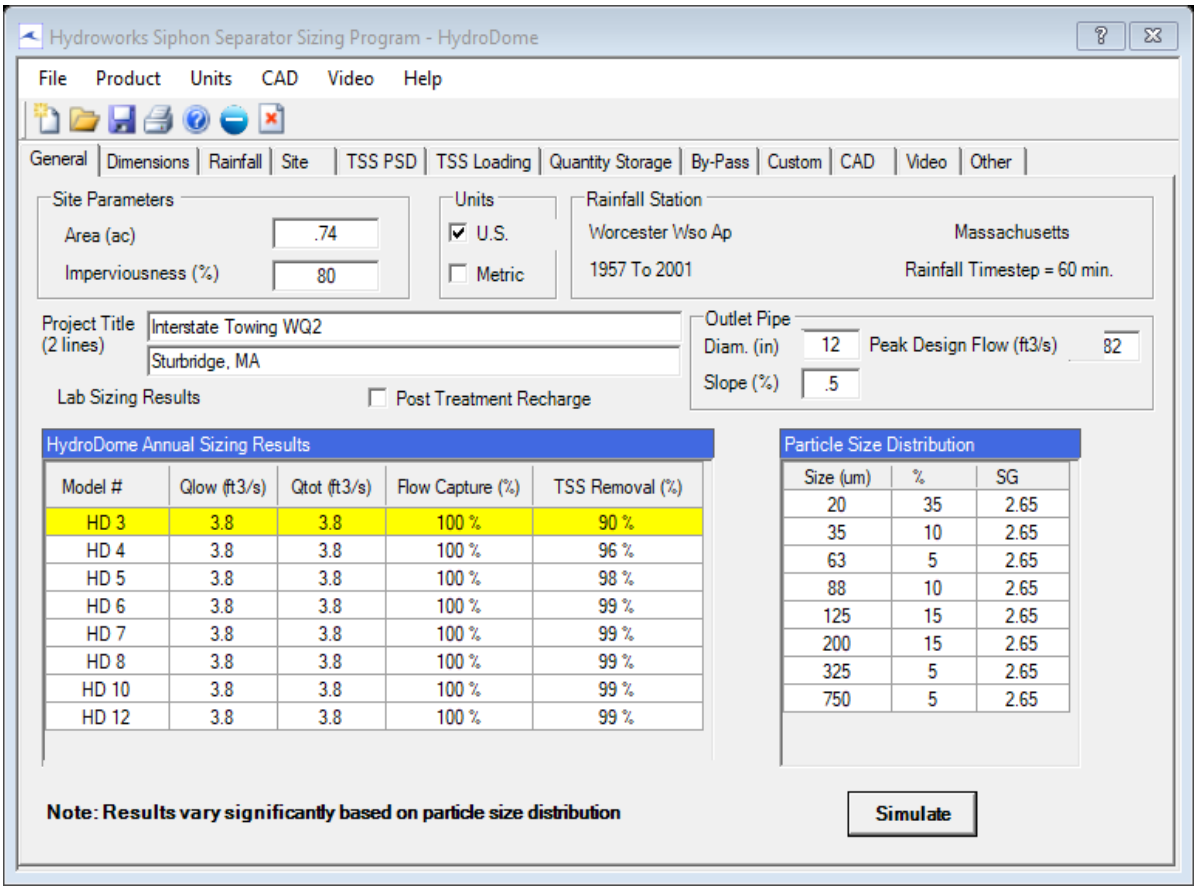
The HydroDome has a siphon which creates a discontinuity in headloss. The given peak flow of 3.82 (ft3/s) is greater than the full pipe flow of 2.52 (ft3/s) indicating the pipe will be surcharged during the peak flow. Full pipe flow was assumed for the headloss calculations. The pressure head in the pipe was not evaluated since this would require a hydraulic gradeline analysis. The headloss was calculated to be 13 (in) above the crown of the 12 (in) outlet pipe.

This summary report provides the main parameters that were used for sizing. These parameters are shown on the summary tables and graphs provided in this report.

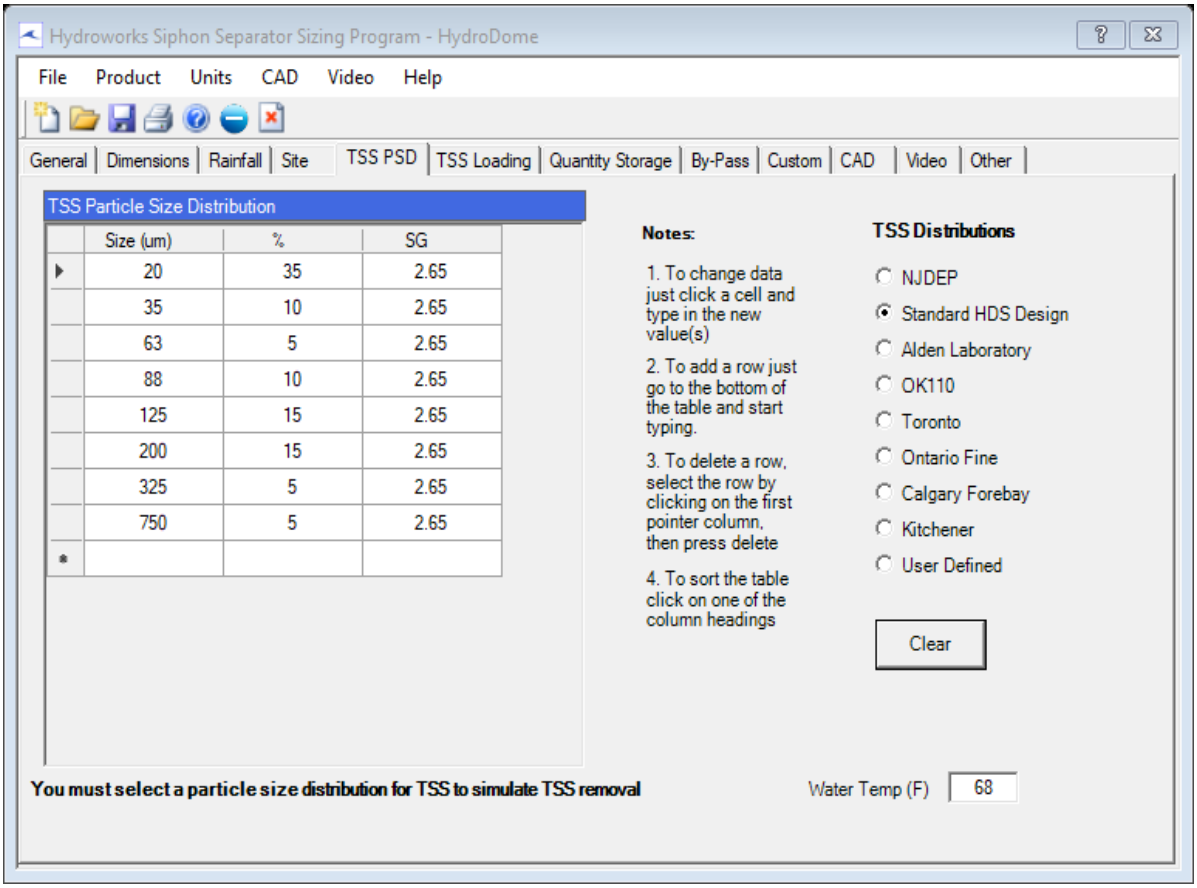
If you have any questions regarding this sizing summary please do not hesitate to contact Hydroworks at 888-290-7900 or email us at support@hydroworks.com.

The sizing program is for sizing purposes only and does not address any site specific parameters such as hydraulic gradeline, tailwater submergence, groundwater, soils bearing capacity, etc. Headloss calculations are not a hydraulic gradeline calculation since this requires a starting water level and an analysis of the entire system downstream of the HydroDome .

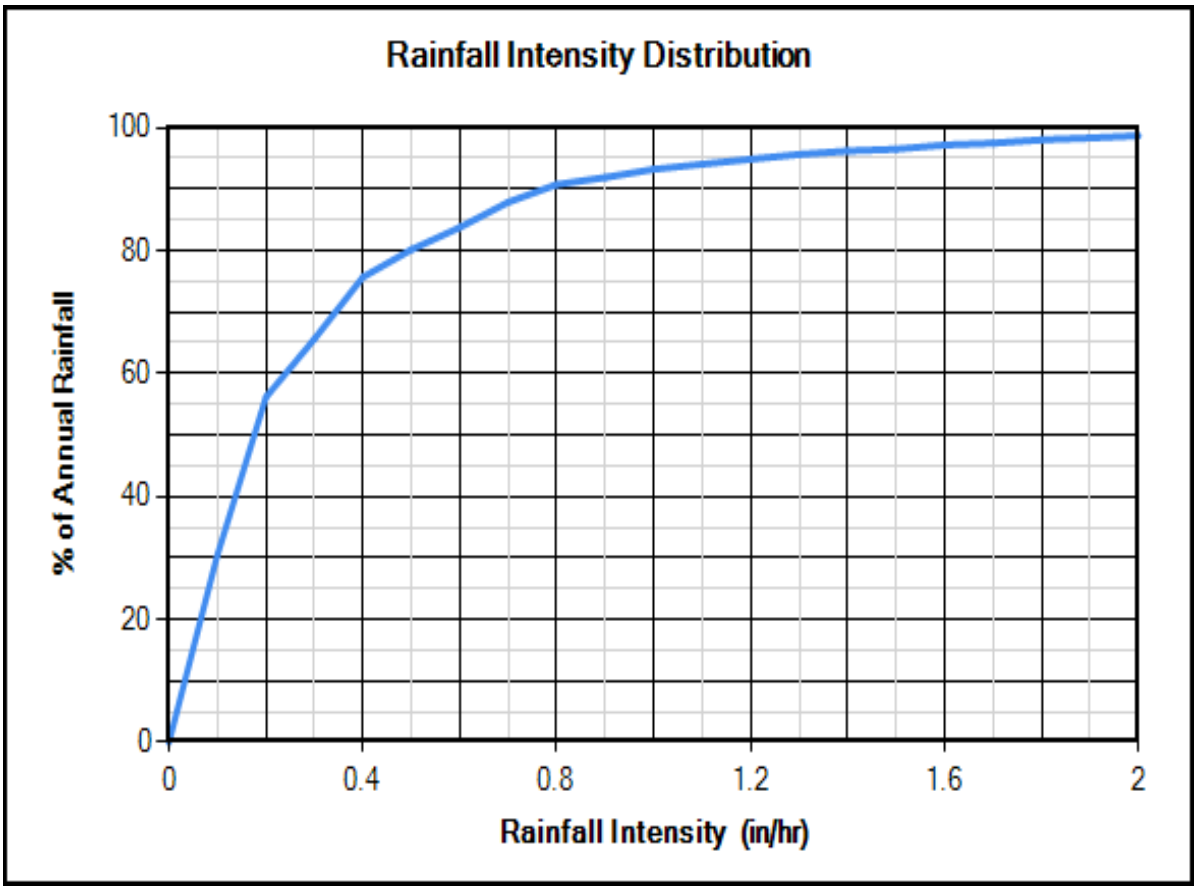
TSS Removal Sizing Summary



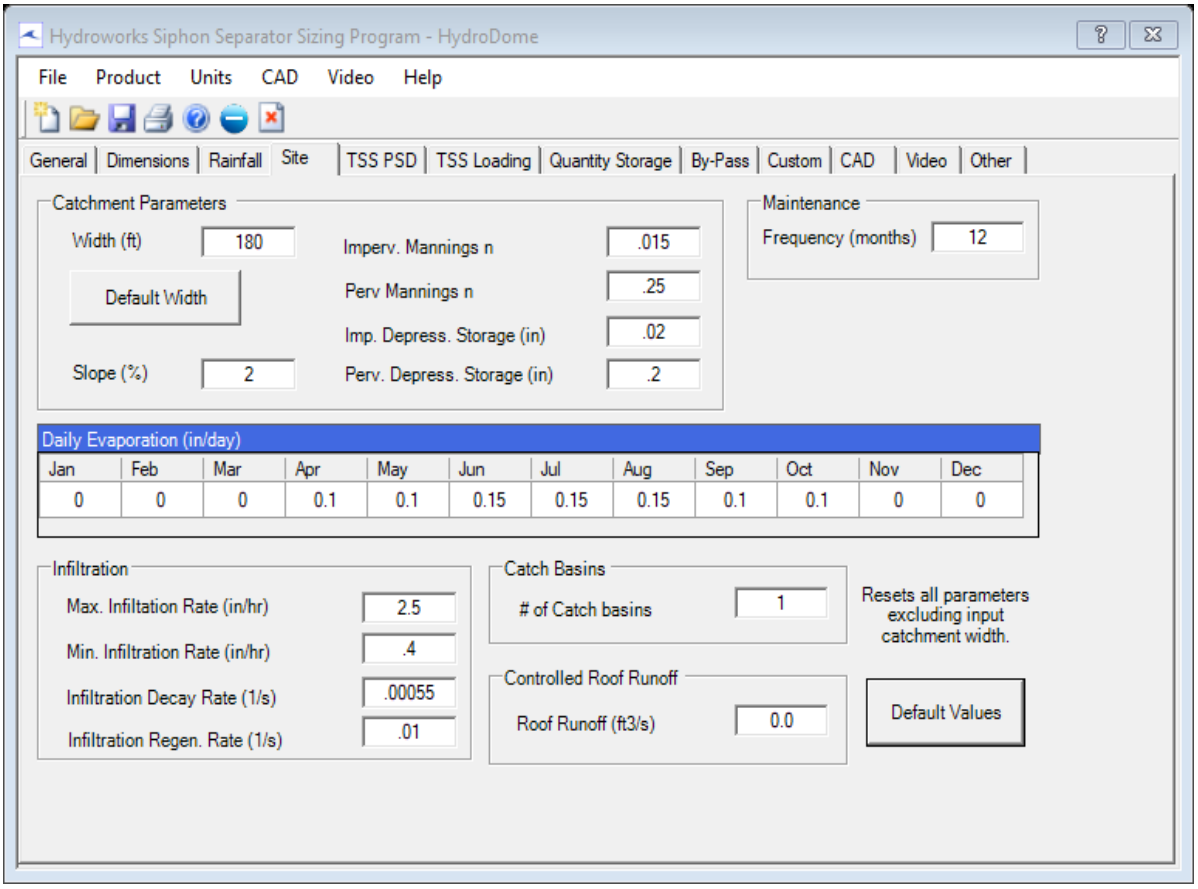
TSS Particle Size Distribution



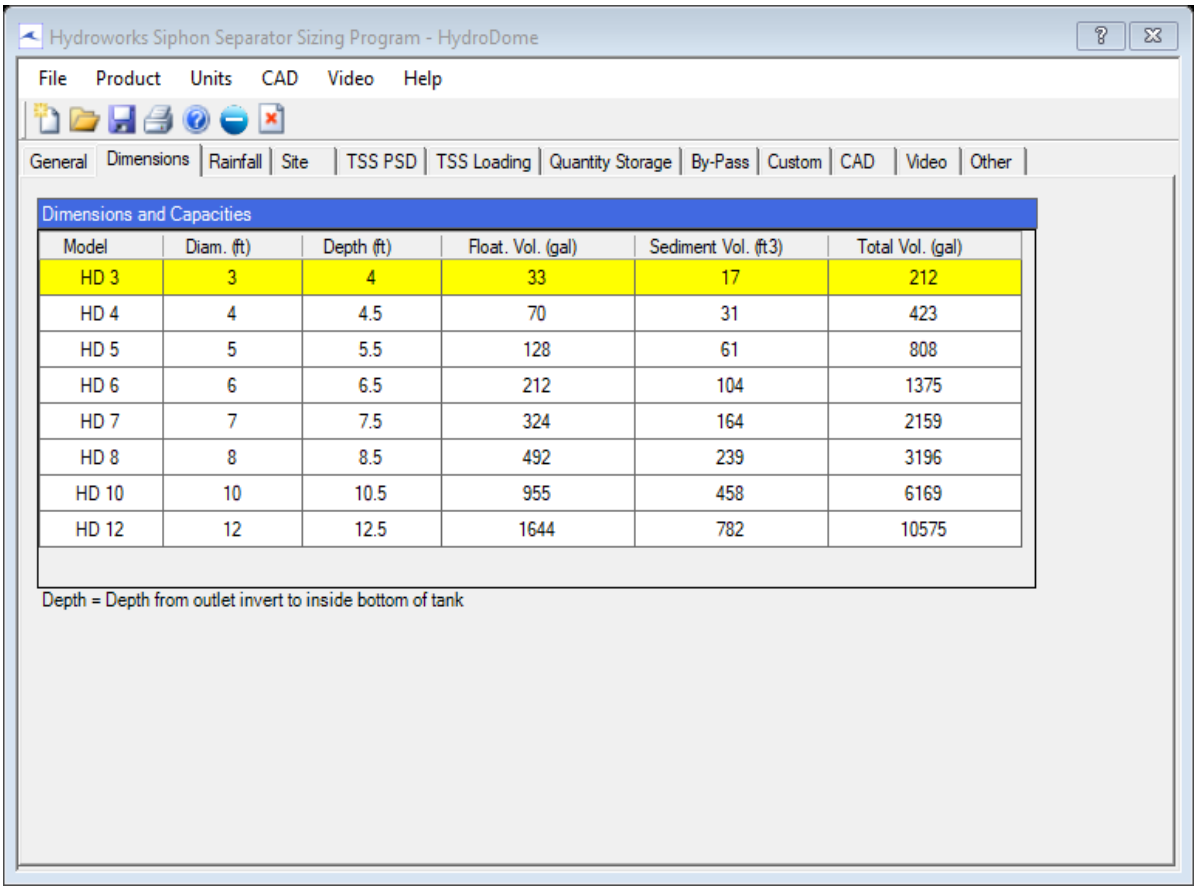
Rainfall Station - Worcester Wso Ap, Massachusetts(1957 To 2001)



Site Physical Characteristics



Dimensions And Capacities

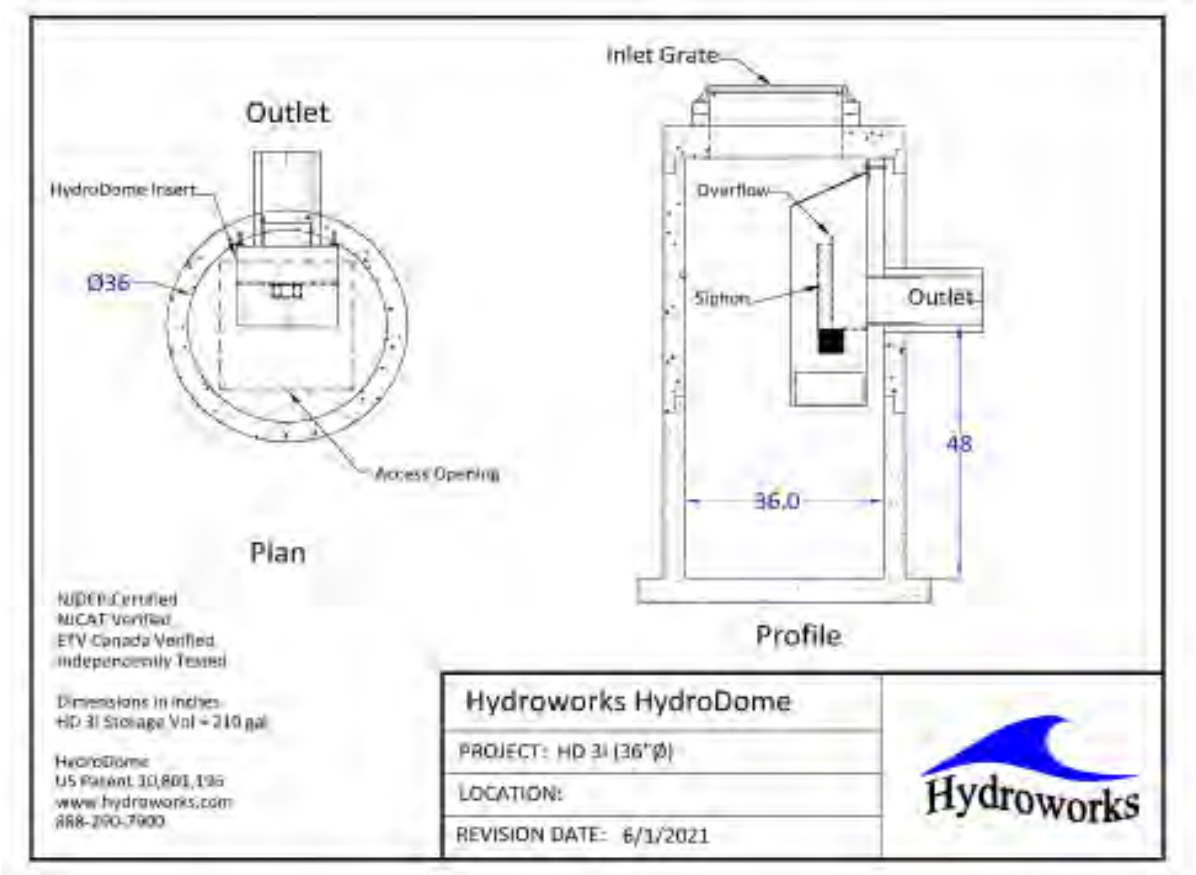


Dimensions and Capacities

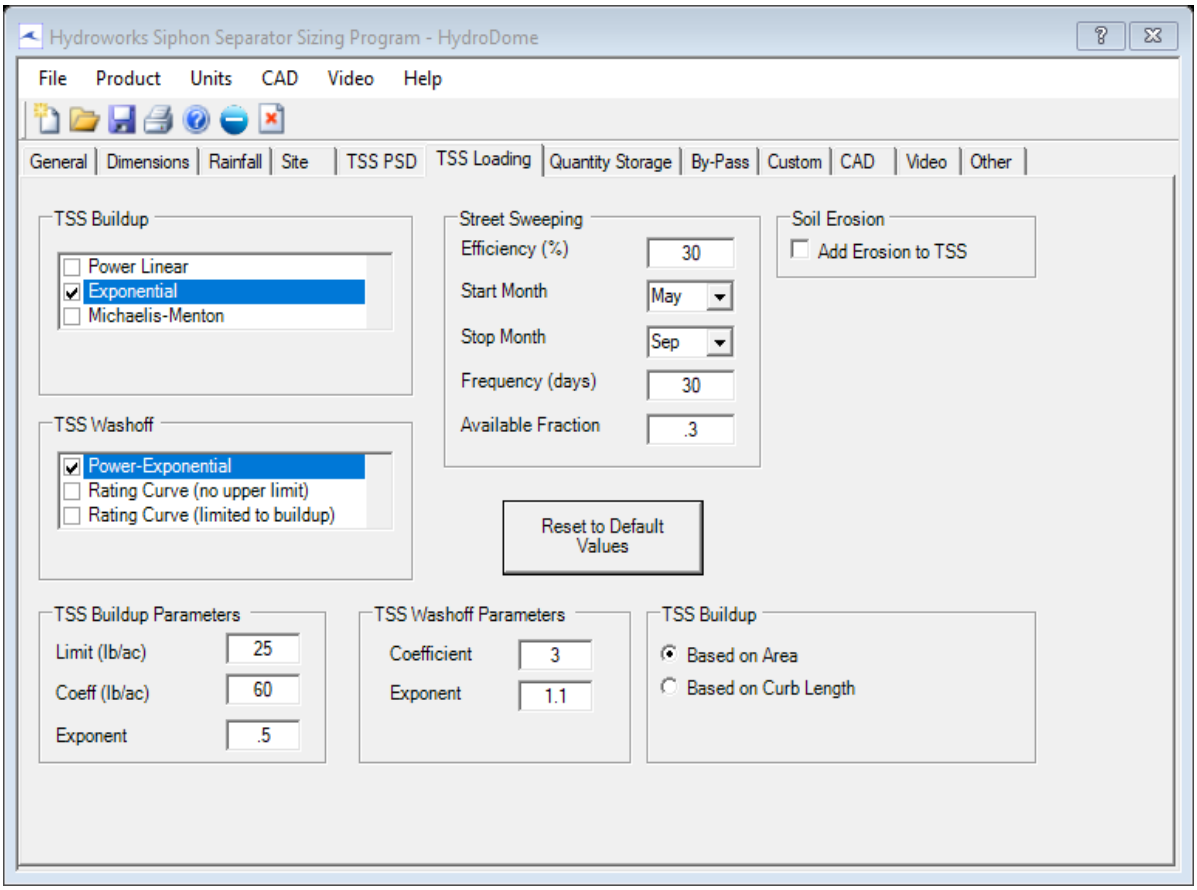
Model	Diam. (ft)	Depth (ft)	Float. Vol. (gal)	Sediment Vol. (ft3)	Total Vol. (gal)
HD 3	3	4	33	17	212
HD 4	4	4.5	70	31	423
HD 5	5	5.5	128	61	808
HD 6	6	6.5	212	104	1375
HD 7	7	7.5	324	164	2159
HD 8	8	8.5	492	239	3196
HD 10	10	10.5	955	458	6169
HD 12	12	12.5	1644	782	10575

Depth = Depth from outlet invert to inside bottom of tank

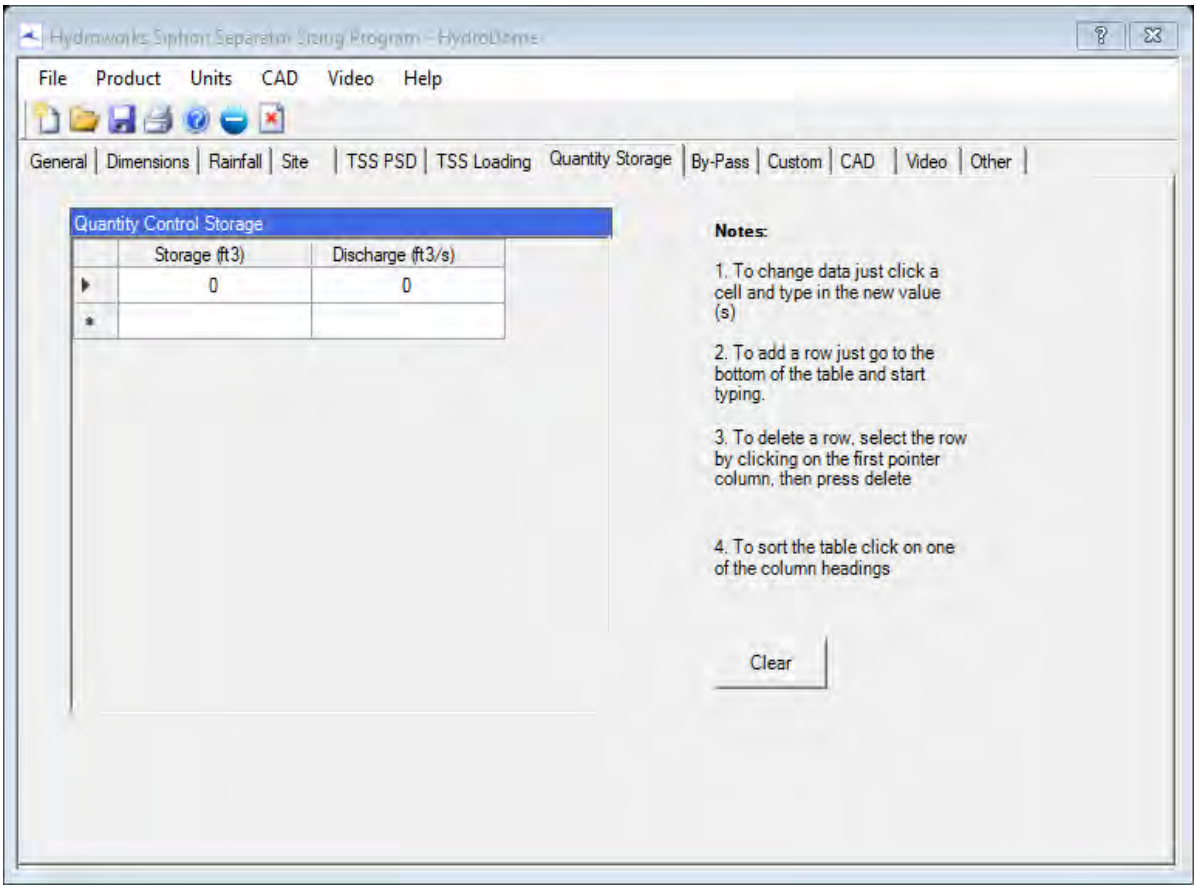
Generic HD 3i CAD Drawing



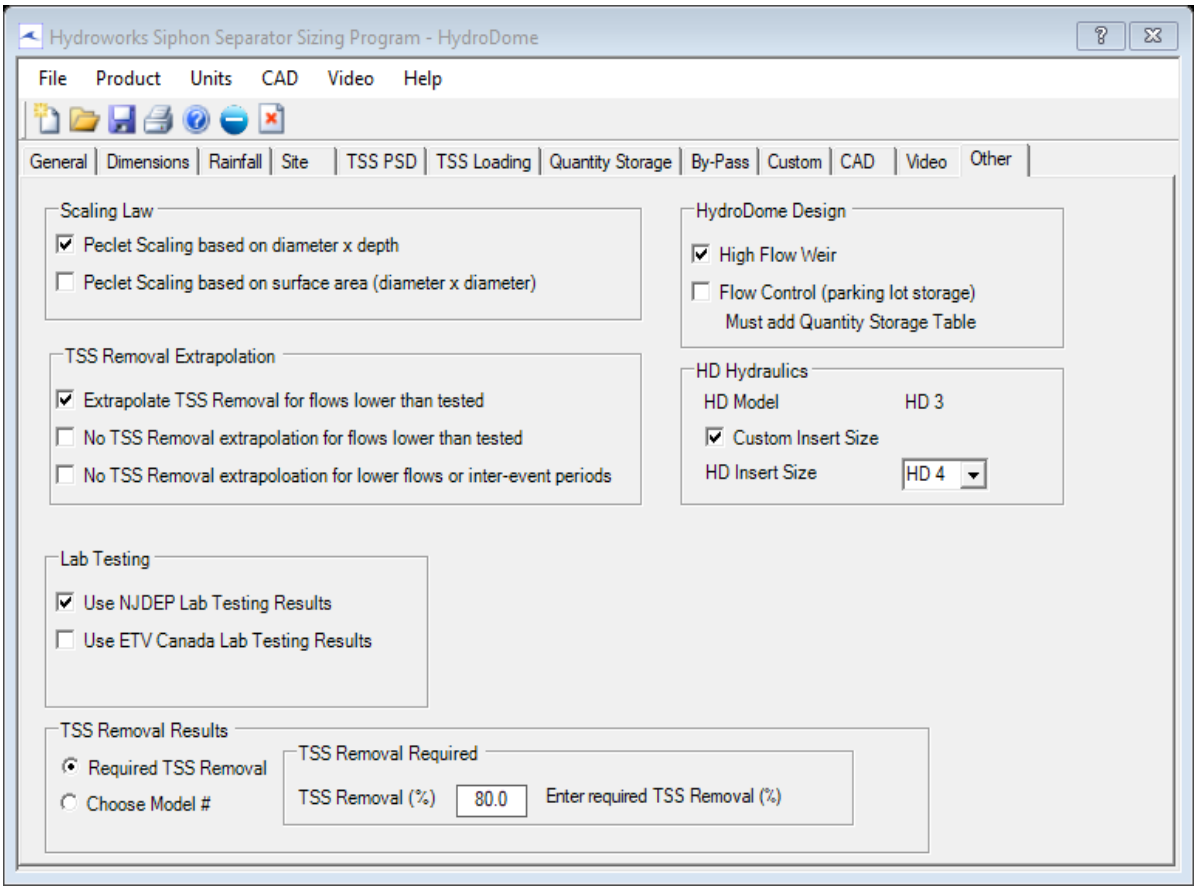
TSS Buildup And Washoff



Upstream Quantity Storage



Other Parameters



Flagged Issues

If there is underground detention storage upstream of the HydroDome please contact Hydroworks to ensure it has been modeled correctly.

Hydroworks Sizing Program - Version 5.7

1-800-290-7900
www.hydroworks.com

Hydroworks Sizing Summary

Interstate Towing WQ4
Sturbridge, MA

09-06-2022

Recommended Size: HydroDome HD 3i

A HydroDome HD 3i is recommended to provide 80 % annual TSS removal based on a drainage area of .14 (ac) with an imperviousness of 82 % and Worcester Wso Ap, Massachusetts rainfall for the Hydroworks standard particle size distribution.

The recommended HydroDome HD 3i treats 100 % of the annual runoff and provides 99 % annual TSS removal for the Worcester Wso Ap rainfall records and Hydroworks standard particle size distribution.

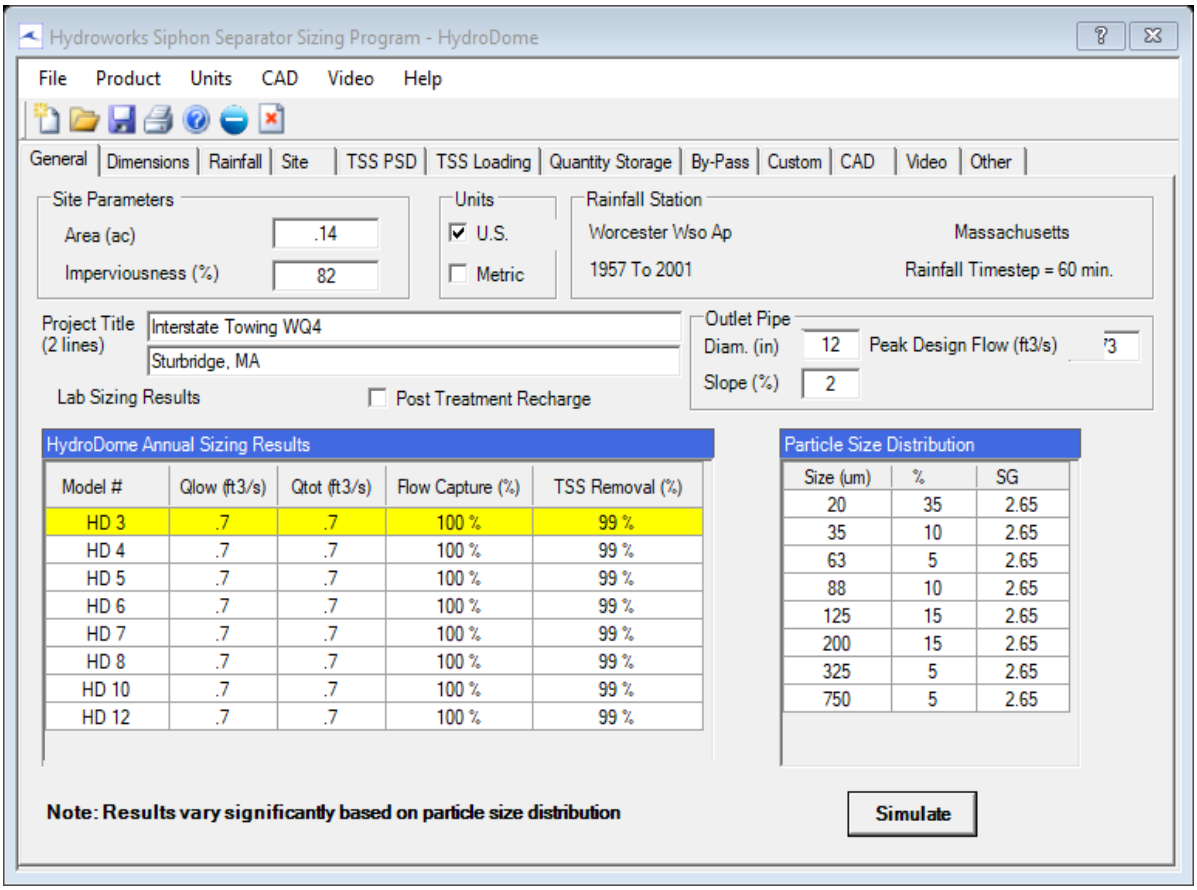
The HydroDome has a siphon which creates a discontinuity in headloss. The given peak flow of .73 (ft3/s) Is less than the full pipe flow of 5.04 (ft3/s) indicating free flow in the pipe during the peak flow assuming no tailwater condition. Partial pipe flow was assumed for the headloss calculations. The headloss was calculated to be 9 (in) above the crown of the 12 (in) outlet pipe.

This summary report provides the main parameters that were used for sizing. These parameters are shown on the summary tables and graphs provided in this report.

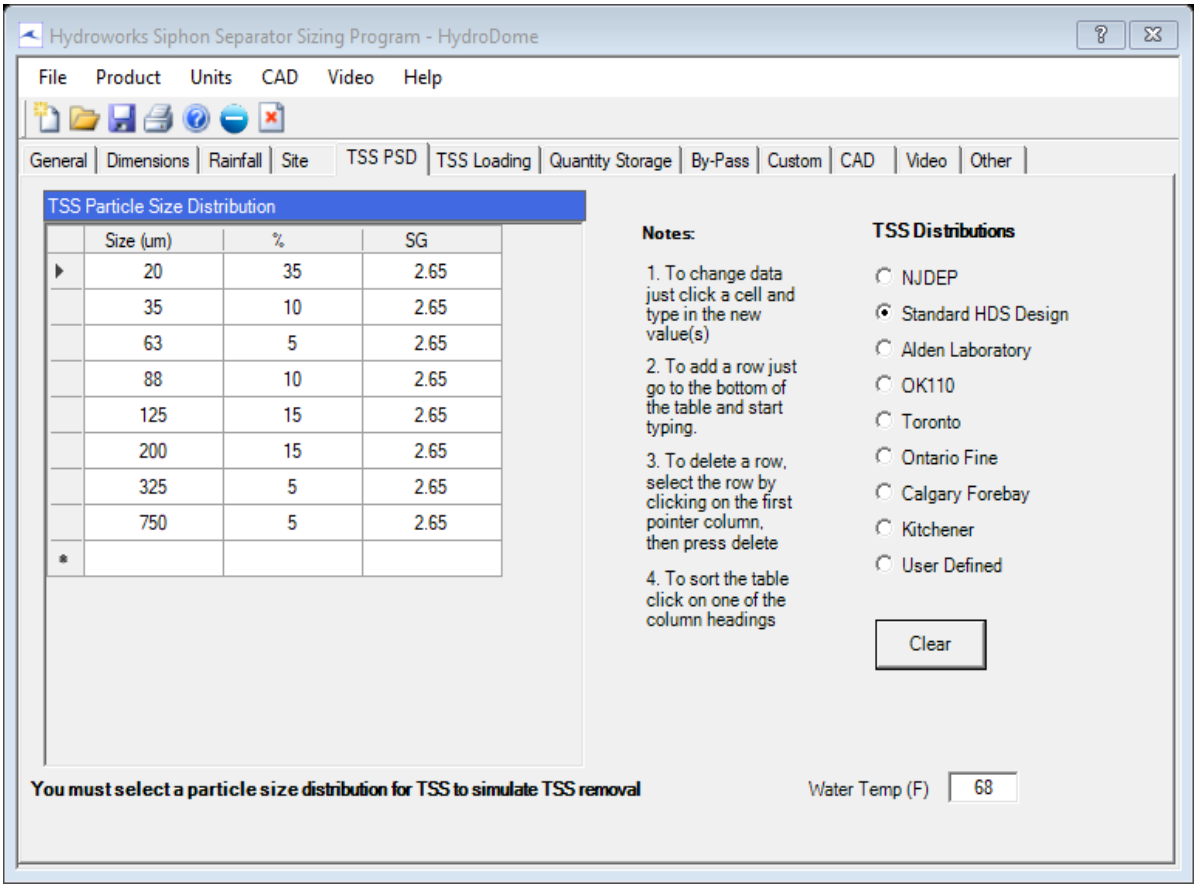
If you have any questions regarding this sizing summary please do not hesitate to contact Hydroworks at 888-290-7900 or email us at support@hydroworks.com.

The sizing program is for sizing purposes only and does not address any site specific parameters such as hydraulic gradeline, tailwater submergence, groundwater, soils bearing capacity, etc. Headloss calculations are not a hydraulic gradeline calculation since this requires a starting water level and an analysis of the entire system downstream of the HydroDome .

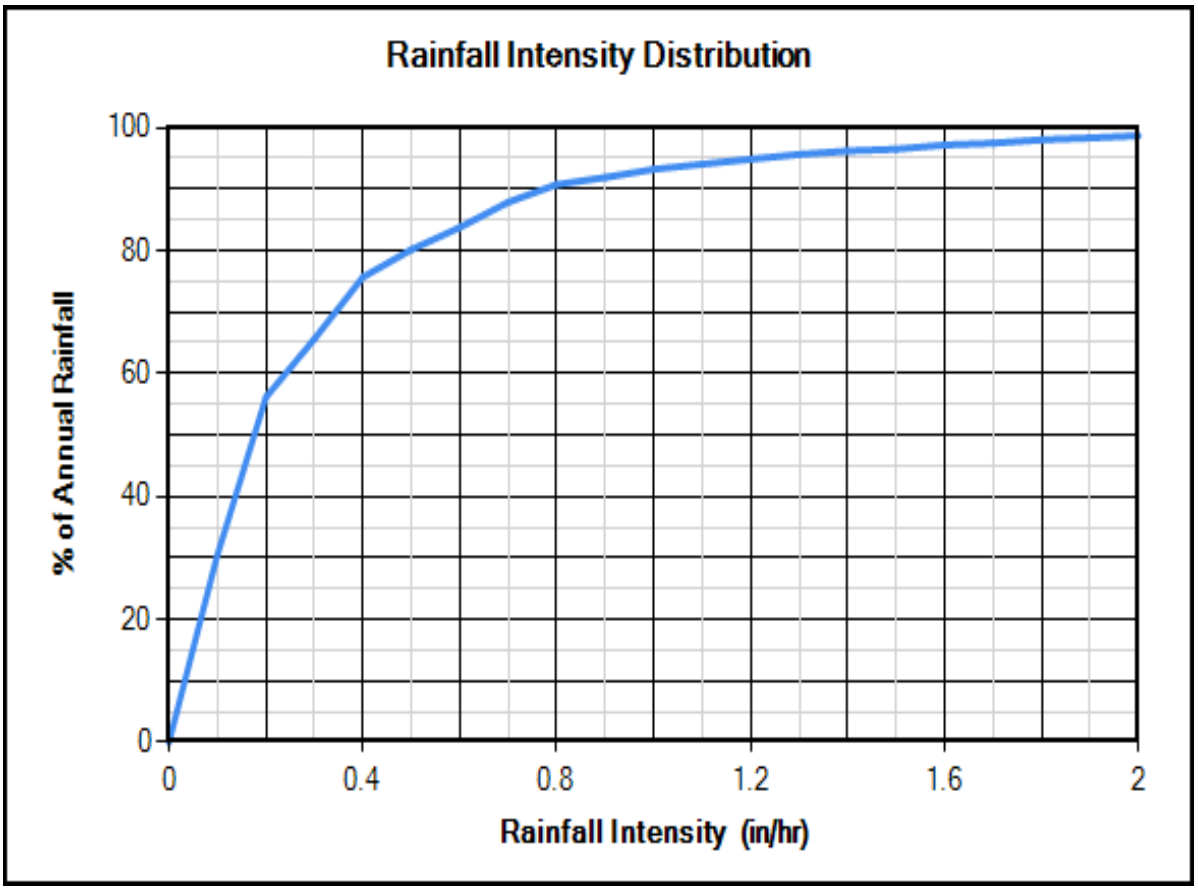
TSS Removal Sizing Summary



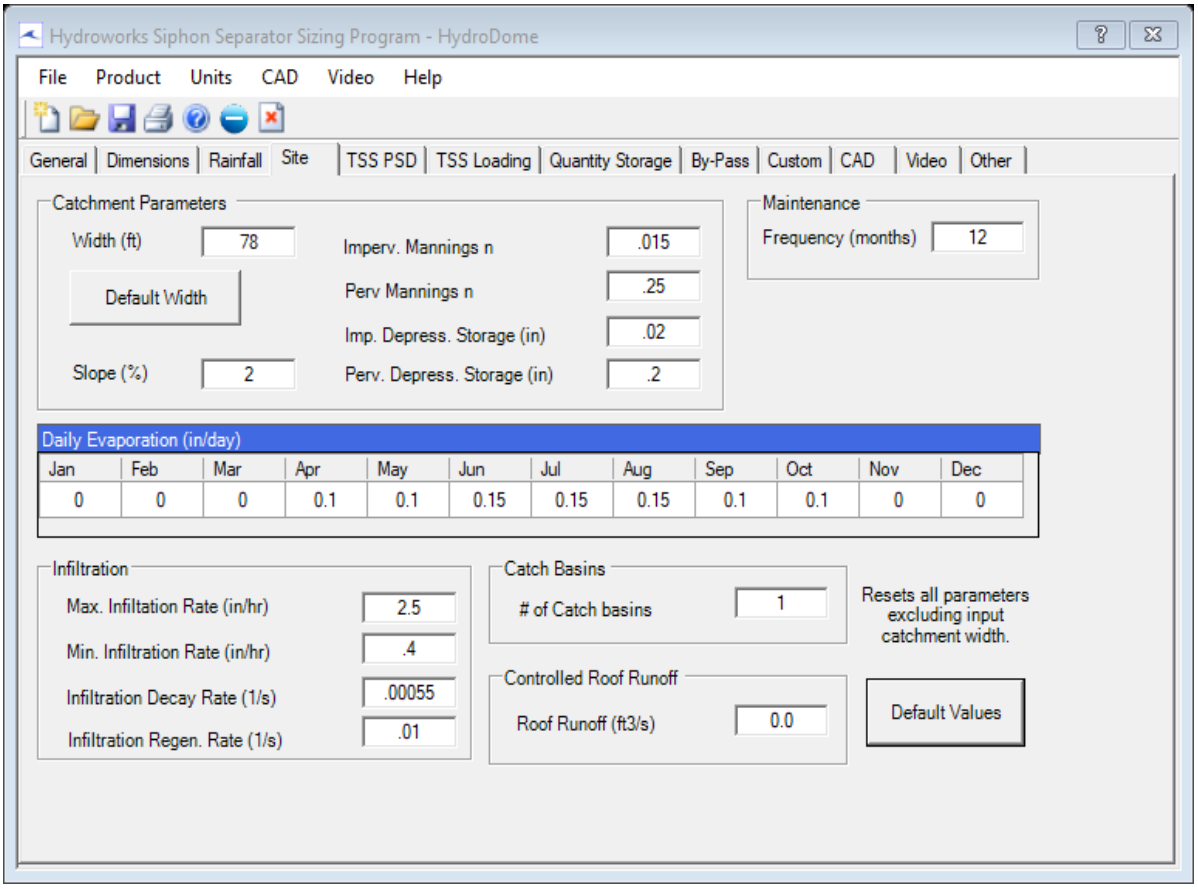
TSS Particle Size Distribution



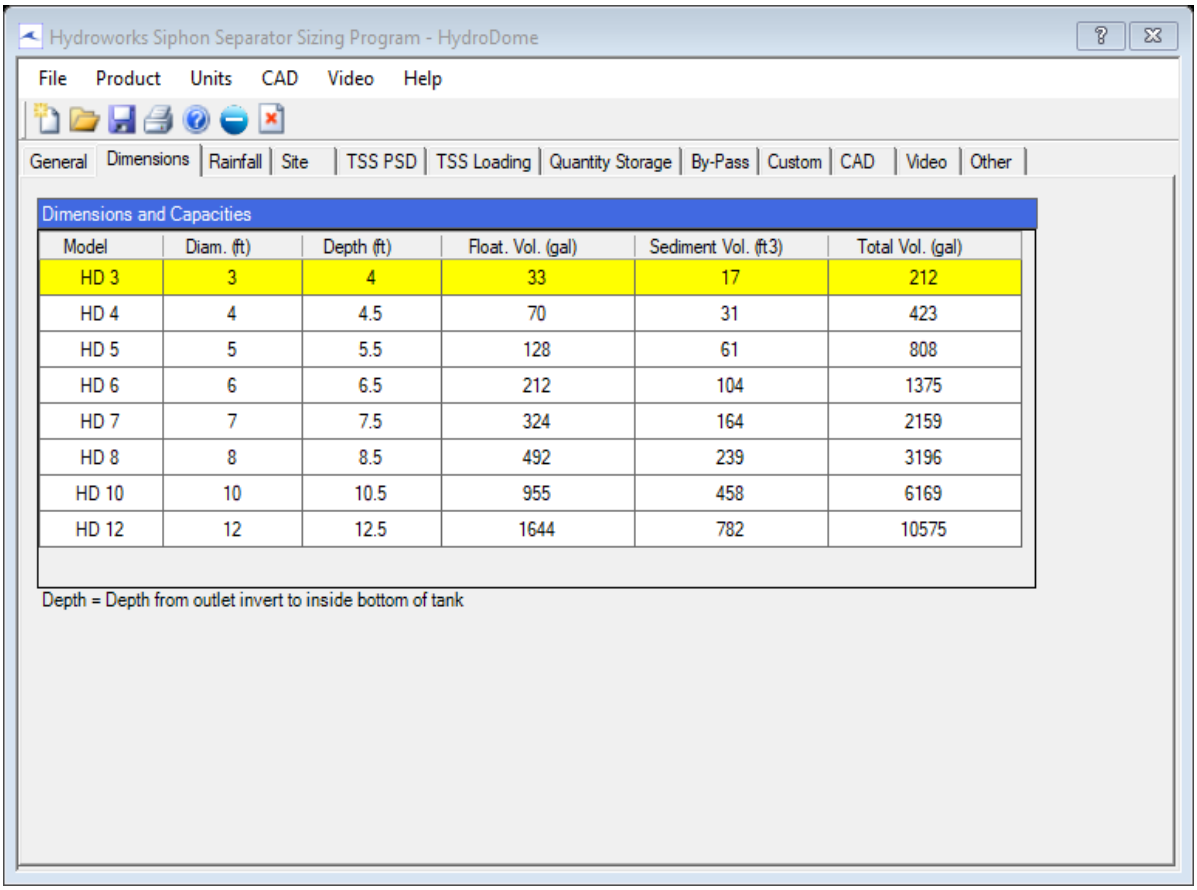
Rainfall Station - Worcester Wso Ap, Massachusetts(1957 To 2001)



Site Physical Characteristics



Dimensions And Capacities

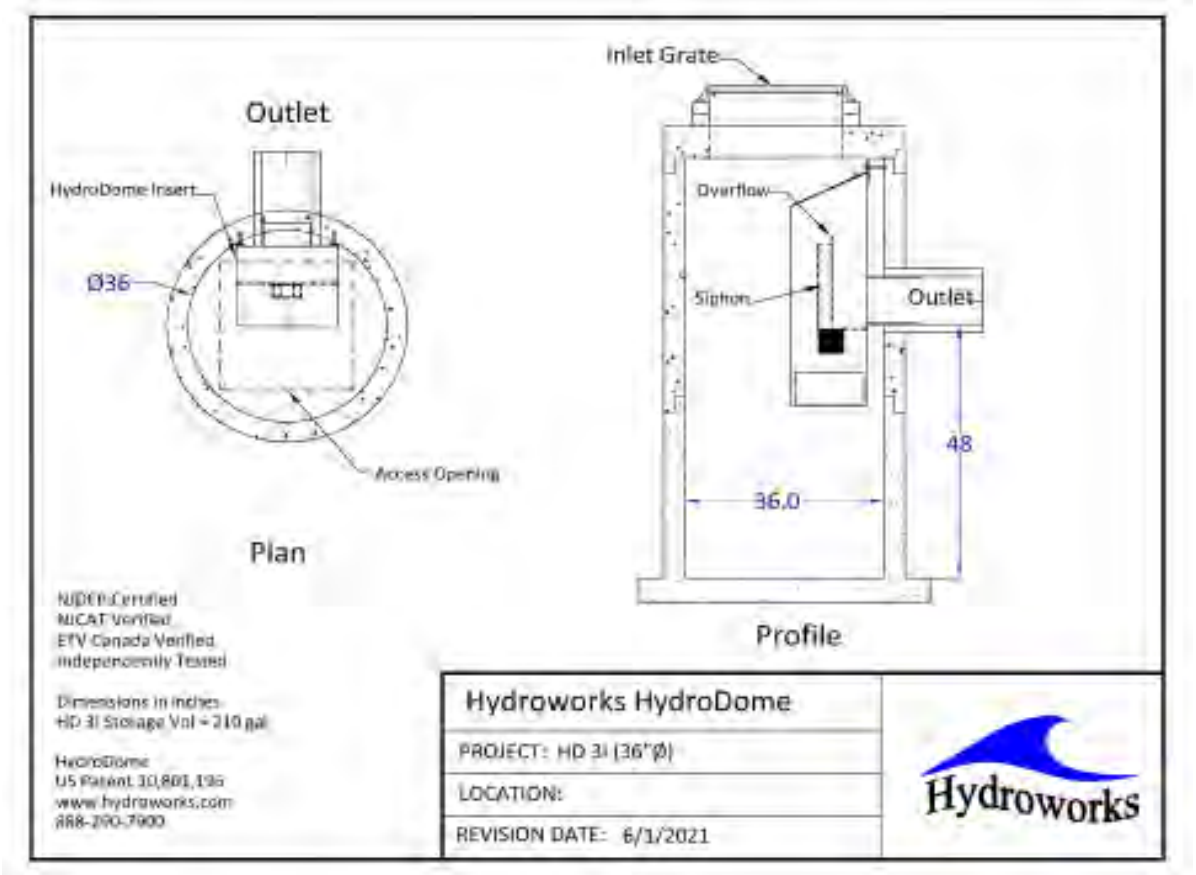


Dimensions and Capacities

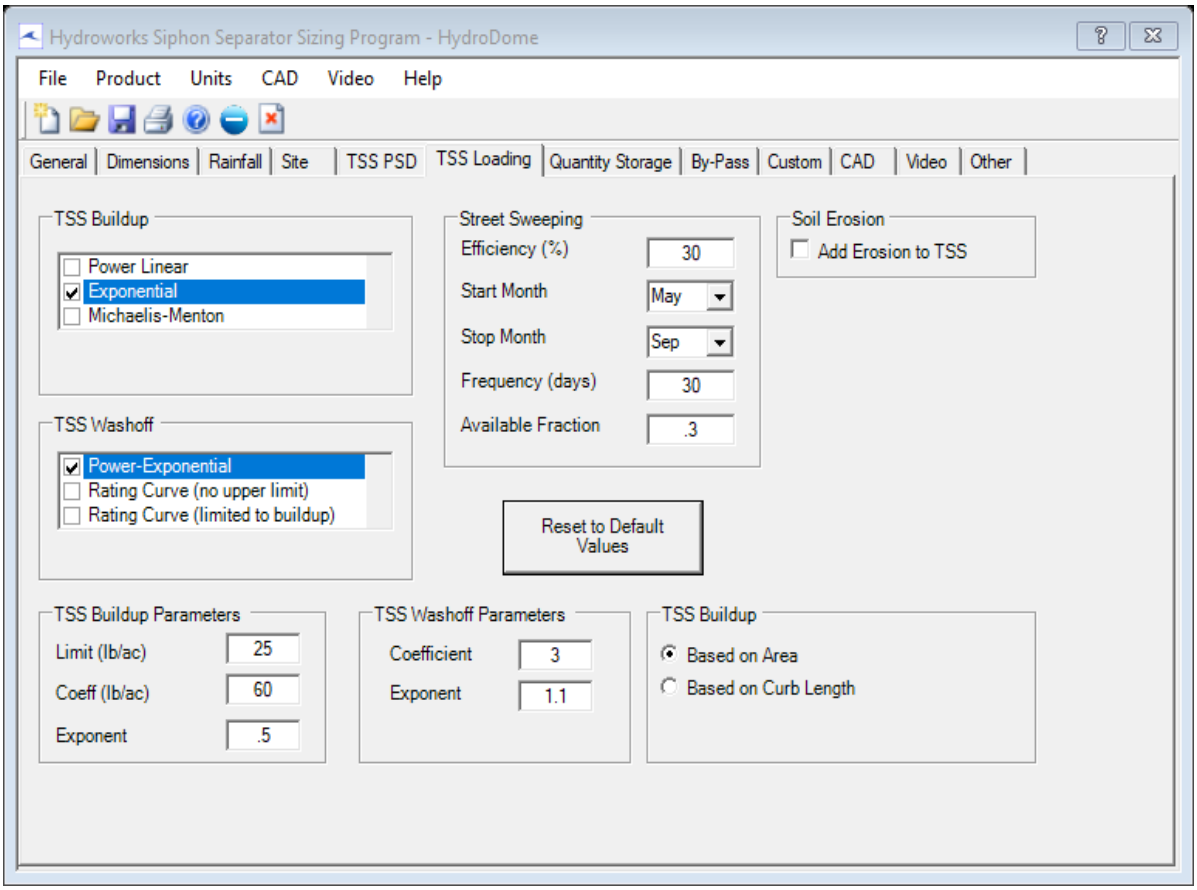
Model	Diam. (ft)	Depth (ft)	Float. Vol. (gal)	Sediment Vol. (ft3)	Total Vol. (gal)
HD 3	3	4	33	17	212
HD 4	4	4.5	70	31	423
HD 5	5	5.5	128	61	808
HD 6	6	6.5	212	104	1375
HD 7	7	7.5	324	164	2159
HD 8	8	8.5	492	239	3196
HD 10	10	10.5	955	458	6169
HD 12	12	12.5	1644	782	10575

Depth = Depth from outlet invert to inside bottom of tank

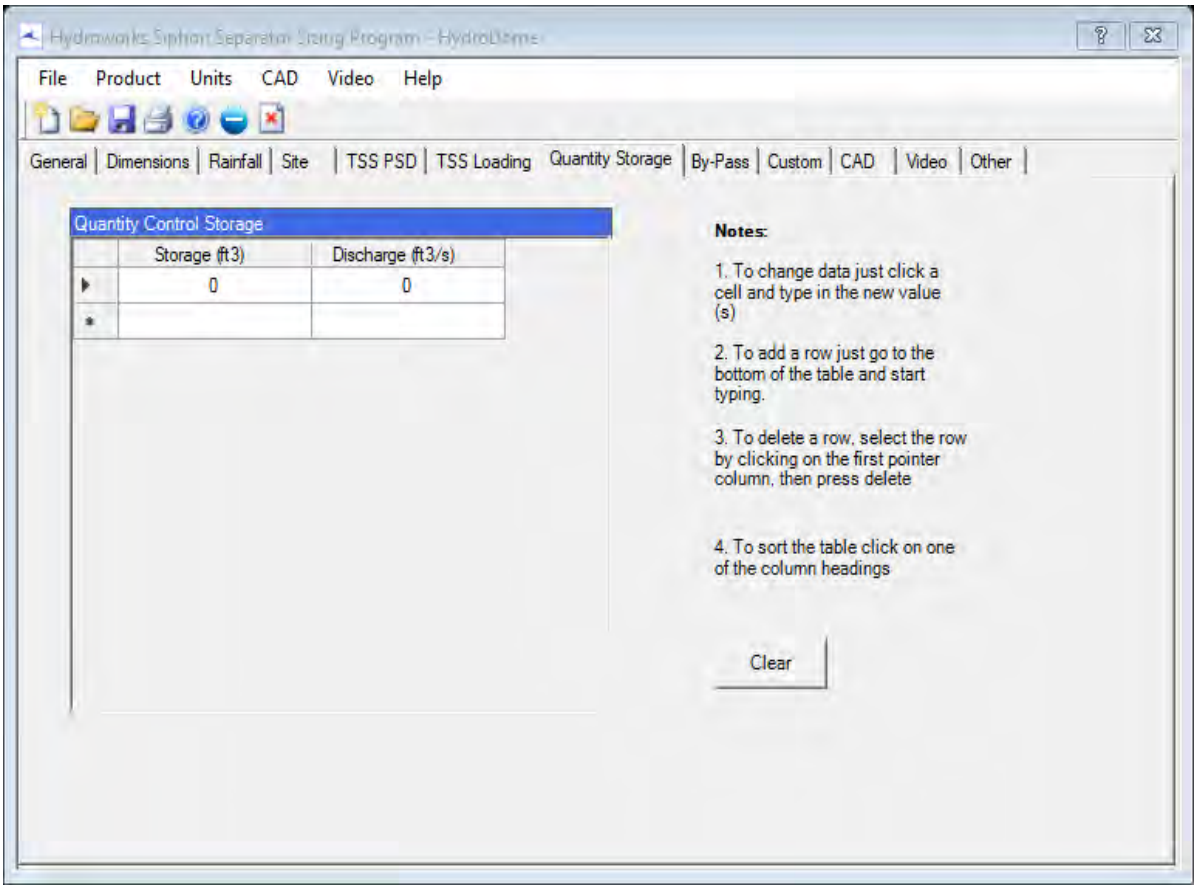
Generic HD 3i CAD Drawing



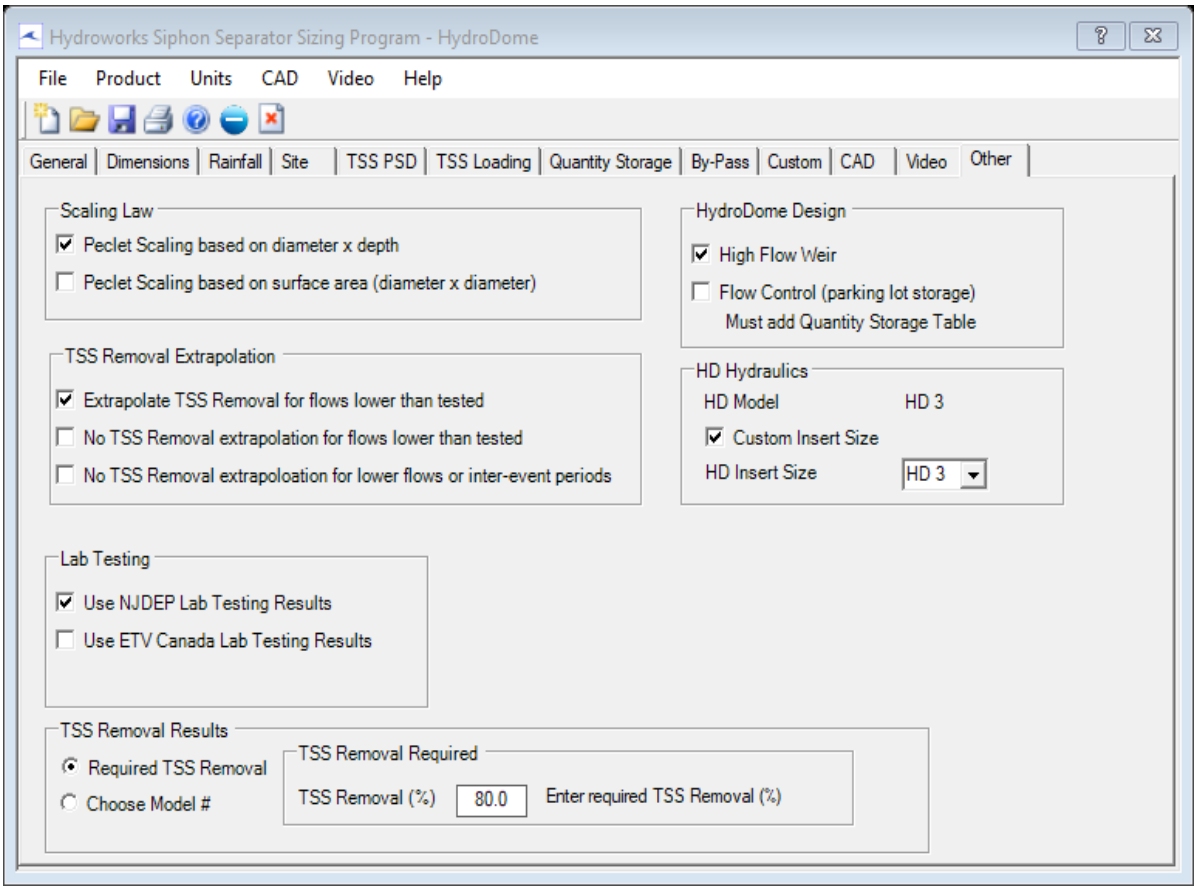
TSS Buildup And Washoff



Upstream Quantity Storage



Other Parameters



Flagged Issues

If there is underground detention storage upstream of the HydroDome please contact Hydroworks to ensure it has been modeled correctly.

Hydroworks Sizing Program - Version 5.7

1-800-290-7900
www.hydroworks.com

Appendix H

Stormwater Management System
Long-Term Operation & Maintenance (O&M) Plan

STORM WATER MANAGEMENT SYSTEM
LONG-TERM OPERATION & MAINTENANCE PLAN

Revised November 30, 2022

Proposed "Interstate Towing" Facility
#698 Main Street (Route 20)
Sturbridge, MA

Prepared For:
Wrecker, LLC.
1660 Westover Road
Chicopee, MA 02451

Prepared By:
CMG Environmental, Inc.
67 Hall Road
Sturbridge, MA 01566
Phone: (774) 241-0901

CMG ID 2022-035

TABLE OF CONTENTS

TABLES

ATTACHMENTS

Long Term Operation & Maintenance Plan
Site Stormwater Management System
#698 Main Street
Proposed "Interstate Towing" Facility
STURBRIDGE, MA

Operation and Maintenance (O&M) Plan

The purpose of this Storm Water Management System Operation and Maintenance Plan is to prevent erosion, sedimentation, pollution or other deterioration of the storm water management system and resource areas located on and adjacent to the site property located at **#698 Main Street in Sturbridge, MA** (the "Site"). The storm water management system shall be maintained properly to assure its continued performance.

Responsible Party:
Wrecker, LLC.
1660 Westover Road
Chicopee, MA 01020
p. (413) 593-1900

Storm water Management System Owner: **(same as above)**

Site subject to Wetlands Protection Act: **YES**

The "Responsible Party" Shall:

- Prepare and submit an **"Operation and Maintenance (O & M) Compliance Statement" (see Attachment #1)** upon completion of site construction activities.
- Implement the routine and non-routine operation, maintenance, and inspection tasks in accordance with the procedures specified in this document to ensure that all storm water management systems function as designed;
- Maintain a log of all operation and maintenance (O & M) activities for the last five (5) years, including inspections, repairs, replacement and disposal (for disposal, the log shall indicate the type of material and disposal location);
- Make this log available to **Town of Sturbridge** official representatives upon request;
- Agree to notify in writing all "future property owners" of the presence of the storm water management system and the requirement for proper operation and maintenance.

"Interstate Towing." maintains a contract with the following companies:

Landscaping & Pavement Maintenance: _____

Snow Removal & Plowing: _____

Storm Water System Maintenance: _____

Table No. 1
#698 Main Street, Sturbridge, MA
Proposed Interstate Towing Facility

STORMWATER SYSTEM INSPECTION AND MAINTENANCE SCHEDULE		
Best Management Practice (BMP)	**Inspection Frequency**	**Maintenance Frequency**
STRUCTURAL BMPs		
DEEP-SUMP HOODED CATCH BASIN	Four (4) Times/ Year At end of foliage & snow removal seasons	Remove Sediment if Sediment Depth Reaches 50% of Sump as Min 2 Times per Year (End of Foliage & Snow Removal Season)
HYDROSTORM WATER QUALITY UNITS	Four (4) Times / Year	Per Manufacturer's Recommendations (See Attached Hydrostorm Operation and Maintenance Manual)
OIL/ GRIT SEPARATORS 4,500 Gal. Capacity	Monthly	Bi-annual Twice per Year Or Following a Spill Event
UNDERGROUND INFILTRATION CHAMBERS	Bi-Annual (Early Spring & Late Fall)	As needed
INFILTRATION BASIN	Monthly	Bi-Annual (Spring and Fall) Remove/ Replace Dead Vegetation Mulch and Prune
8" & 12" OUTLET PIPES Rip-Rap Apron	Four (4) Times / Year	Remove Sediment Four (4) Times / Year (Including End of Foliage & Snow Removal Seasons)
NON-STRUCTURAL STORMWATER CONTROLS		
SPILL KIT	Four (4) Times / Year	Replenish Spill Kit as Needed
Landscaping	Four (4) Times / Year	Seasonally As Needed
Roadway / Driveway Sweeping	Two (2) Times /Year	Seasonally As Needed
Snow Removal	Seasonally As Needed	In Accordance with M.G.L. Title XIV. Public Ways and Works; Chapter 85

STRUCTURAL STORMWATER BMP MAINTENANCE:

Deep Sump Catch Basin(s):

- Inspect or clean catch basin(s) at least four (4) times per year, including the end of the foliage and snow removal seasons.
- Inspection shall occur by probing the structure with a rod to determine the depth of accumulated sediment.
- Sediments must be removed whenever the depth of sediment is greater than or equal to one half of the depth from the bottom of the invert of the lowest pipe in the basin. At a minimum, cleaning shall occur twice a year during the spring and fall.
- The structure will be cleaned of water and sand/debris with the use of a vacuum truck. Material removed from the structure will be disposed of legally off-site by the vendor.
- Unless there is evidence that they have been contaminated by a spill or other means, catch basin cleanings may be taken to a landfill or other facility permitted by MassDEP to accept solid waste.

Hydrostorm Water Quality Units (HS-4 & HS-6)

- Per manufacturer's recommendations, see Attachment #2: Hydroworks Hydrostorm Operation and Maintenance Manual

4,500-Gallon Oil / Grit Separators Maintenance

- Separator shall be inspected on a monthly basis for proper operation.
- Typical maintenance (removal of accumulated oil/grease, floatables, and sediment) shall be conducted twice / year or following a spill event with the use of a vacuum truck.
- Material removed from the structures will be disposed of legally off-site by the vendor.

Underground Infiltration Chambers

- Inspect inlet at least twice a year and remove any debris that may clog the system.

Stormwater Infiltration Basin

- Inspect basin inlets twice per year for signs of accumulation of sediment or debris. Any debris or sediment that could potentially clog the system shall be removed as necessary.
- Inspection shall also involve visual observations of failure apparent in the area surrounding the gardens perimeter and outlet structure.
- Inspect soil and repair eroded areas monthly. Re-mulch void areas as needed. Remove trash and debris from garden monthly.
- Remove and replace dead vegetation twice per year (spring and fall).

Rip-rap Apron Outlets

- Inspect regularly, especially after large rainfall events;
- Note and repair any erosion & sediment buildup at the Rip-Rap outlet protection.

NON- STRUCTURAL STORM WATER MANAGEMENT CONTROLS:

Non-Structural Control Measures & Stormwater Treatment

Vehicle Maintenance Areas:

- No outdoor vehicle maintenance is proposed for this application. Any light fleet maintenance or vehicle washing will be done indoors. Please note, floor drains connected to an oil-grit separator is proposed to handle vehicle wash water prior to being discharged into the municipal sanitary sewer system.

- **SPILL KIT** - a minimum of one (1) 55-gallon overpack drum, spill response equipment, and oil absorbents need to be located on-site in an accessible location within the building.

Landscape & Pavement Maintenance:

- **No debris, refuse or other materials,** including but not limited to landscaping debris, leaves, shrubs and tree trimmings, logs, bricks, stone or trash shall be deposited within the vegetated wetland.

- The use of pesticides, herbicides, and fertilizers on the site shall be minimized to the extent practicable and shall be applied in accordance with manufacture recommendations by experienced and if applicable, licensed personnel.

- Pavement areas will be swept seasonally as necessary to remove accumulated winter sand and salt and fall leaves, and shall be swept as required to remove litter. Collected material will be properly disposed of off-site.

Trash Removal

- Inspect on-site area for litter and trash as needed. Any accumulated trash, litter, and discarded materials in this area will be removed and will be disposed of at a suitable location on a weekly basis. Solid waste will be collected in the proposed dumpster and discarded from the site via the trash removal contractor.

Materials & Waste Storage

- Non-hazardous materials are to be stored within the limits of the secured/ fenced-in "storage yard" as shown on the enclosed Site Plans. Non-hazardous waste will be discarded in the proposed dumpster (location shown on site plans). Any combustibles are to be stored inside the proposed building in fire rated cabinets. No other hazardous materials or waste is to be stored on premise.

HAZARDOUS WASTE / OIL SPILL RESPONSE PROCEDURE

Initial Notification. In the event of a spill of hazardous waste or oil the facility manager or supervisor will be notified immediately by telephone.

Assessment – Initial Containment. The supervisor or manager will assess the incident and initiate control measures. The supervisor will first contact the **Town of Sturbridge Fire Department** and then notify the **Town of Sturbridge Police Department**. The Fire Department is ultimately responsible for matters of public health and safety and should be notified immediately.

Fire Department Telephone: 911 (Emergency); (508) 347-2525 (Non-Emergency)

Police Department Telephone: 911 (Emergency); 508-347-2525 (Non-Emergency)

Further Notification. Based on the assessment by the Fire Chief, additional notification to a clean up contractor may be made. The Massachusetts Department of Environmental Protection and the EPA may be notified depending upon the nature and severity of the spill. The Fire Chief will be responsible for determining the level of clean up and notification required.

SNOW MANAGEMENT PLAN:

- No snow storage shall be located within or "deposited" within wetland resource areas on or off-site.
- No salt shall be used to treat unpaved areas during snow and ice conditions. The storage of all "de-icing" chemicals and treatment products is to be inside the building.
- Per the Town of Sturbridge Wetland Regulations § 365-3.7, no salt shall be used within the 100-foot wetland buffer.
- If Site snow storage interferes with driveway maneuvers or sight distances (i.e., blocking of travel aisles, sight distance, or parking) the snow pile will be either removed or reduced legally in a legal manner by the snow plow vendor within 24-hours.
- Pavement areas will be swept seasonally as necessary to remove accumulated winter sand and salt and fall leaves, and shall be swept as required to remove litter. Collected material will be properly disposed of off-site.

INSPECTIONS / RECORDKEEPING:

Routine Inspections:
Routine inspections and maintenance to be conducted with the frequency described in this Operation and Maintenance Plan. All repairs and maintenance activities regarding the stormwater management system should be recorded and provided to the Sturbridge Planning Board upon request. An example inspection form is provided in **Attachment #2**.

Recordkeeping
Records of all drainage system inspections and maintenance shall be kept on file for a period of at least **five (5) years.**

PUBLIC SAFETY FEATURES:

- All cast iron storm water structure grates and covers shall be kept in good condition and kept closed at all times. Any damaged or broken structures will be replaced immediately upon discovery;

STAFF TRAINING:

- Staff training shall be conducted on an annual basis regarding the long-term operation and maintenance of the proposed stormwater management system. A training log is recommended for each annual training and kept for recording purposes for a minimum of three (3) years.

Attachment #1

Illicit Discharge Compliance Statement

Illicit Discharge Compliance Statement
Site Storm Water Management System
#698 Main Street
Proposed Interstate Towing Facility
STURBRIDGE, MA

Responsible Party:
Wrecker, LLC.
1660 Westover Road
Chicopee, MA 01020
p. (413) 593-1900

Storm Water Management System Owner: (same as above)

Site subject to Wetlands Protection Act: YES

The above listed "responsible party" is responsible for implementation of this "Long-Term Operation and Maintenance Plan" and certifies that:

- The site has been inspected for erosion and appropriate steps have been taken to permanently stabilize any eroded areas;
- All aspects of storm water BMPs have been inspected for damage, wear and malfunction, and appropriate steps have been taken to repair or replace the system or portions of the system so that the storm water at the site may be managed in accordance with:
    - MA-DEP Stormwater Management Standards, revise date January 2, 2008;
- There is no record or knowledge of illicit discharges to the on-site stormwater management system;
- All "future property owners" must be notified of their continuing legal responsibility to operate and maintain the Site Stormwater Management System.
- The "Long-Term Operation and Maintenance Plan" for the storm water BMPs is being implemented.

Signature of Responsible Party:

_____ _____
Wrecker, LLC. Date

Attachment #2

Hydroworks Hydrostorm
Operations & Maintenance Manual

Hydroworks® HydroDome

Operations & Maintenance Manual

Version 1.0

Please call Hydroworks at 888-290-7900 or email us at support@hydroworks.com if you have any questions regarding the Inspection Checklist. Please email a copy of the completed checklist to Hydroworks at support@hydroworks.com for our records.

Introduction

The HydroDome (Figure 1) is a state-of-the-art hydrodynamic separator. HydroDome can be used for water quality and quantity flow control if desired.

Hydrodynamic separators remove solids, debris and lighter than water (oil, trash, floating debris) pollutants from stormwater. Hydrodynamic separators and other water quality measures are mandated by regulatory agencies (Town/City, State, Federal Government) to protect storm water quality from pollution generated by urban development (traffic, people) as part of new development permitting requirements.

As storm water treatment structures fill up with pollutants they become less and less effective in removing new pollution. Therefore, it is important that storm water treatment structures be maintained on a regular basis to ensure that they are operating at optimum performance. The HydroDome is no different in this regard and this manual has been assembled to provide the owner/operator with the necessary information to inspect and coordinate maintenance of their HydroDome.

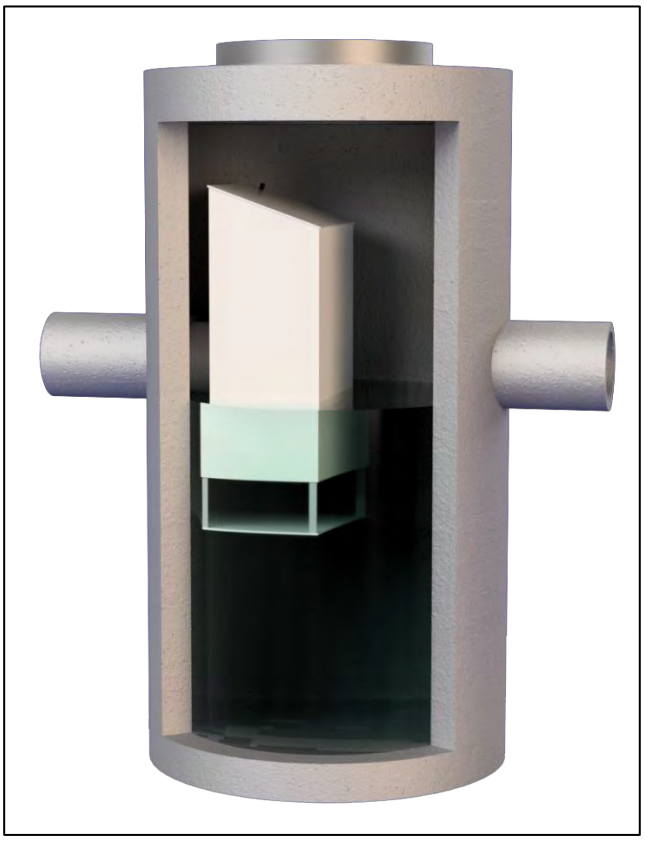


Figure 1. Hydroworks HydroDome

Hydroworks

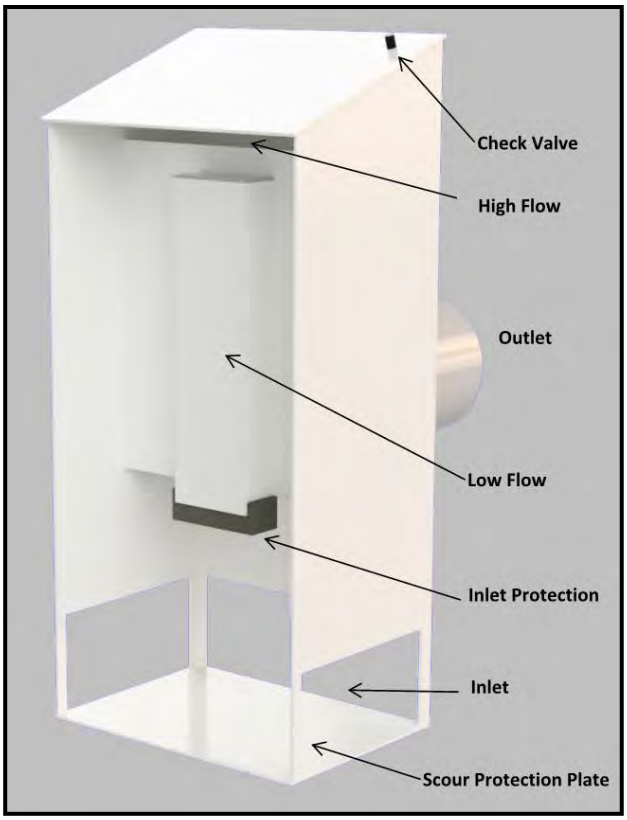


Figure 2 HydroDome Internal Components

Inspection

Procedure

Floatables

A visual inspection can be conducted for floatables by removing the cover/grate and looking down into the separator.

TSS/Sediment

Inspection for TSS build-up can be conducted using a Sludge Judge®, Core Pro®, AccuSludge® or equivalent sampling device that allows the measurement of the depth of TSS/sediment in the unit. These devices typically have a ball valve at the bottom of the tube that allows water and TSS to flow into the tube when lowering the tube into the unit. Once the unit touches the bottom of the device, it is quickly pulled upward such that the water and TSS in the tube forces the ball valve closed allowing the user to see a full core of water/TSS in the unit. Several readings (2 or 3) should be made at different locations of the structure to ensure that an accurate TSS depth measurement is recorded.

Operation

The water level during periods without rain should be near the outlet invert of the structure. If the water level remains near the top of the HydroDome this may suggest that there is an obstruction downstream of the HydroDome or that the inlet protection at the HydroDome may need to be cleaned.

Frequency

Construction Period

The HydroDome separator should be inspected every four weeks and after every large storm (over 0.5" (12.5 mm) of rain) during the construction period.

Post-Construction Period

The Hydroworks HydroDome separator should be inspected during the first year of operation for normal stabilized sites (grassed or paved areas). If the unit is subject to oil spills or runoff from unstabilized areas (storage piles, exposed soils), the HydroDome separator should be inspected more frequently (4 times per year). The initial annual inspection will indicate the required frequency of inspection and maintenance if the unit was maintained after the construction period.

Reporting

Reports should be prepared as part of each inspection and include the following information:

1. Date of inspection
2. GPS coordinates of Hydroworks unit
3. Time since last rainfall
4. Date of last inspection
5. Installation deficiencies (missing parts, incorrect installation of parts)
6. Structural deficiencies (concrete cracks, broken parts)
7. Operational deficiencies (leaks, elevated water level)
8. Presence of oil sheen or depth of oil layer
9. Estimate of depth/volume of floatables (trash, leaves) captured
10. Sediment depth measured
11. Recommendations for any repairs and/or maintenance for the unit
12. Estimation of time before maintenance is required if not required at time of inspection

A sample inspection checklist is provided at the end of this manual.

Maintenance

Procedure

The Hydroworks HydroDome unit is typically maintained using a vacuum truck. There are numerous companies that can maintain the HydroDome separator. Maintenance with a vacuum truck involves removing all of the water and sediment together. The water is then separated from the sediment on the truck or at the disposal facility.

The area around the HydroDome provides clear access to the bottom of the structure (Figure 3). This is the area where a vacuum hose would be lowered to clean the unit.

In instances where a vacuum truck is not available other maintenance methods (i.e. clamshell bucket) can be used, but they will be less effective. If a clamshell bucket is used the water must be decanted prior to cleaning since the sediment is under water and typically fine in nature.

The local municipality should be consulted for the allowable disposal options for both water and sediments prior to any maintenance operation. Once the water is decanted the sediment can be removed with the clamshell bucket.

Maintenance of a Hydroworks HydroDome unit will typically take 1 to 2 hours depending on size of unit and using a vacuum truck. Cleaning may take longer for other cleaning methods (i.e. clamshell bucket).

Inlet protection (Figure 2) is located at the inlet to the low flow opening in the HydroDome to ensure the opening does not become clogged. Although it is not anticipated that the inlet protection will have to be replaced on a regular (i.e. annual) basis since the inlet protection is protected by the submerged entrance to the HydroDome , the inlet protection should be checked each time the HydroDome is inspected or maintained. The inlet protection is removable and should be rinsed with water to ensure any debris caught on the protection is discarded. Unless damaged, the inlet protection can be reinstalled. A replacement piece can be bought through Hydroworks and/or retail stores. Hydroworks can provide information on the inlet protection and where it can be bought. A sign that the inlet protection needs cleaning/replacement would be a water level near the crown of the outlet pipe in the structure during periods with no flow (i.e. unit does not drain down to the pipe invert).

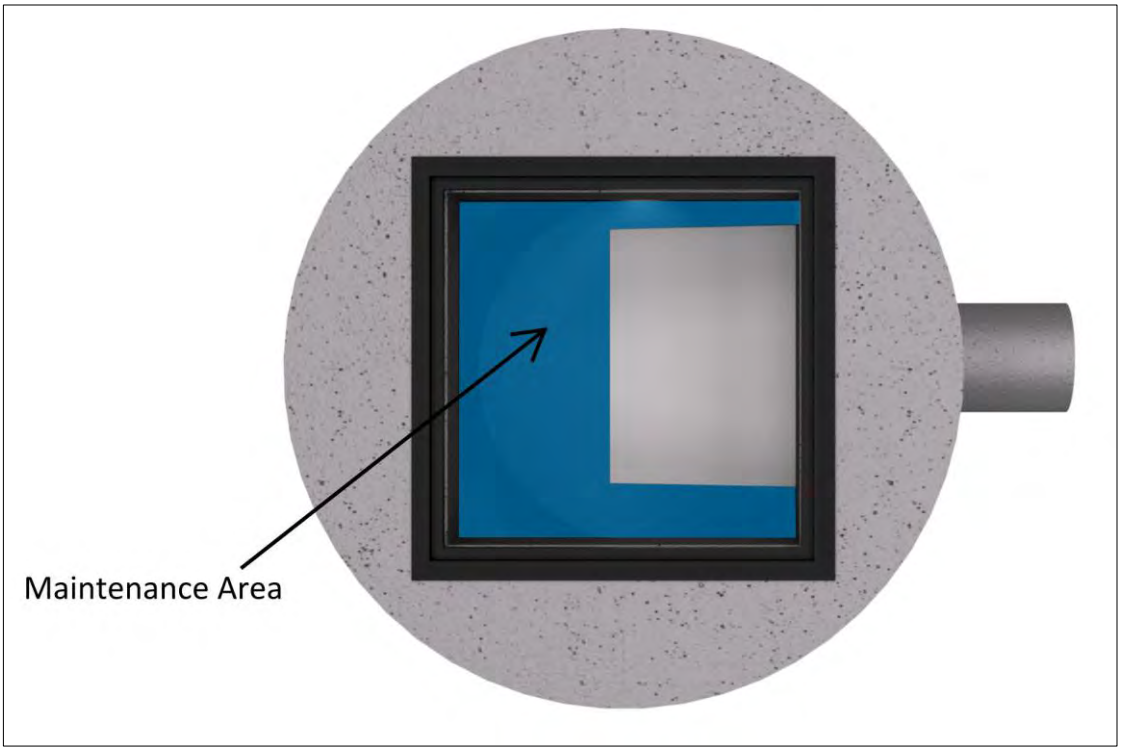


Figure 3. HydroDome Maintenance Access

Frequency

Construction Period

A HydroDome separator can fill with construction sediment quickly during the construction period. The HydroDome must be maintained during the construction period when the depth of TSS/sediment reaches 24” (600 mm). It must also be maintained during the construction period if there is an appreciable depth of oil in the unit (more than a sheen) or if floatables other than oil cover over 50% of the area of the separator

The HydroDome separator should be maintained at the end of the construction period, prior to operation for the post-construction period.

Post-Construction Period

The maintenance for sediment accumulation is required if the depth of sediment is 1 ft or greater in separators with standard water (sump) depths (Table 1).

There will be designs with increased sediment storage based on specifications or site-specific criteria. Please contact Hydroworks at 888-290-7900 to inquire whether your HydroDome was designed with extra sump depth to extend the frequency of maintenance.

The HydroDome separator must also be maintained if there is an appreciable depth of oil in the unit (more than a sheen) or if floatables other than oil cover over 75% of the water surface of the separator.

Table 1 Standard Dimensions for Hydroworks HydroDome Models

Model	Diameter ft (mm)	Maintenance Sediment Depth in (mm)
HD 3	3 (900)	12 (300)
HD 4	4 (1200)	12 (300)
HD 5	5 (1500)	12 (300)
HD 6	6 (1800)	12 (300)
HD 7	7 (2100)	12 (300)
HD 8	8 (2400)	12 (300)
HD 10	10 (3000)	12 (300)
HD 12	12 (3600)	12 (300)

HYDRODOME INSPECTION SHEET

Date _____
Date of Last Inspection _____

Site _____
City _____
State _____
Owner _____

GPS Coordinates _____

Date of last rainfall _____

Site Characteristics	**Yes**	**No**
Soil erosion evident	☐	☐
Exposed material storage on site	☐	☐
Large exposure to leaf litter (lots of trees)	☐	☐
High traffic (vehicle) area	☐	☐

HydroDome	**Yes**	**No**
Obstructions in the inlet	☐ *	☐
Damage to HydroDome (cracked, broken, loose pieces)	☐ **	☐
Improperly installed outlet pipe	☐ ***	☐
Internal component damage (cracked, broken, loose pieces)	☐ **	☐
Floating debris in the separator (oil, leaves, trash)	☐	☐
Large debris visible in the separator	☐ *	☐
Concrete cracks/deficiencies	☐ ***	☐
Exposed rebar	☐ **	☐
Raised water level (water level close to top of HydroDome)	☐ ***	☐
Water seepage (water level not at outlet pipe invert)	☐ ***	☐

Water level depth below outlet pipe invert _____"

Routine Measurements

Floating debris depth	**< 0.5" (13mm)**	☐	**>0.5" 13mm)**	☐ *
Floating debris coverage	**< 75% of surface area**	☐	**> 75% surface area**	☐ *
Sludge depth	**< 12" (300mm)**	☐	**> 12" (300mm)**	☐ *

* Maintenance required
** Repairs required
*** Further investigation is required

Note: Inspections should not be made within 24 hours of a storm to allow the water to drain from the structure to assess a raised water level or water level seepage

Hydroworks

Other Comments:

Hydroworks

Hydroworks® HydroDome

One Year Limited Warranty

Hydroworks, LLC warrants, to the purchaser and subsequent owner(s) during the warranty period subject to the terms and conditions hereof, the Hydroworks HydroDome to be free from defects in material and workmanship under normal use and service, when properly installed, used, inspected and maintained in accordance with Hydroworks written instructions, for the period of the warranty. The standard warranty period is 1 year.

The warranty period begins once the separator has been manufactured and is available for delivery. Any components determined to be defective, either by failure or by inspection, in material and workmanship will be repaired, replaced or remanufactured at Hydroworks' option provided, however, that by doing so Hydroworks, LLC will not be obligated to replace an entire insert or concrete section, or the complete unit. This warranty does not cover shipping charges, damages, labor, any costs incurred to obtain access to the unit, any costs to repair/replace any surface treatment/cover after repair/replacement, or other charges that may occur due to product failure, repair or replacement.

This warranty does not apply to any material that has been disassembled or modified without prior approval of Hydroworks, LLC, that has been subjected to misuse, misapplication, neglect, alteration, accident or act of God, or that has not been installed, inspected, operated or maintained in accordance with Hydroworks, LLC instructions and is in lieu of all other warranties expressed or implied. Hydroworks, LLC does not authorize any representative or other person to expand or otherwise modify this limited warranty.

The owner shall provide Hydroworks, LLC with written notice of any alleged defect in material or workmanship including a detailed description of the alleged defect upon discovery of the defect. Hydroworks, LLC should be contacted at 136 Central Ave., Clark, NJ 07066 or any other address as supplied by Hydroworks, LLC. (888-290-7900).

This limited warranty is exclusive. There are no other warranties, express or implied, or merchantability or fitness for a particular purpose and none shall be created whether under the uniform commercial code, custom or usage in the industry or the course of dealings between the parties. Hydroworks, LLC will replace any goods that are defective under this warranty as the sole and exclusive remedy for breach of this warranty.

Subject to the foregoing, all conditions, warranties, terms, undertakings or liabilities (including liability as to negligence), expressed or implied, and howsoever arising, as to the condition, suitability, fitness, safety, or title to the Hydroworks HydroDome are hereby negated and excluded and Hydroworks, LLC gives and makes no such representation, warranty or undertaking except as expressly set forth herein. Under no circumstances shall Hydroworks, LLC be liable to the Purchaser or to any third party for product liability claims; claims arising from the design, shipment, or installation of the HydroDome, or the cost of other goods or services related to the purchase and installation of the HydroDome. For this Limited Warranty to apply, the HydroDome must be installed in accordance with all site conditions required by state and local codes; all other applicable laws; and Hydroworks' written installation instructions.

Hydroworks, LLC expressly disclaims liability for special, consequential or incidental damages (even if it has been advised of the possibility of the same) or breach of expressed or implied warranty. Hydroworks, LLC shall not be liable for penalties or liquidated damages, including loss of production and profits; labor and materials; overhead costs; or other loss or expense incurred by the purchaser or any third party. Specifically excluded from limited warranty coverage are damages to the HydroDome arising from ordinary wear and tear; alteration, accident, misuse, abuse or neglect; improper maintenance, failure of the product due to improper installation of the concrete sections or improper sizing; or any other event not caused by Hydroworks, LLC. This limited warranty represents Hydroworks' sole liability to the purchaser for claims related to the HydroDome, whether the claim is based upon contract, tort, or other legal basis.

Attachment #3

Stormwater Management System
Quarterly Inspection Form

Inspection Form - Storm Water Management System
Interstate Towing
#698 Main Street, Sturbridge, Massachusetts

QUARTERLY INSPECTION AND MAINTENANCE REPORT

Jan.-Mar. Apr.-Jun. July-Sep. Oct. – Dec.

Note: This Log should be copied prior to use. Note Additional Comments on back of Form.

Inspector's Name: _____ Date: _____ Time: _____ am/pm

Inspector's Qualifications: _____

Days Since Last Rainfall: _____ Amount of Last Rainfall: _____ inches

Item/Condition to be Checked	Maintenance Required		Corrective Action & Date
	No	Yes	
HYDROSTORM WATER QUALITY UNIT #1			*Clean when sediment Depth > 24 in. or sheen present
HYDROSTORM WATER QUALITY UNIT #2			Clean Unit Twice /Year or After Spill Event
Catch Basins			Clean Unit Twice /Year or After Spill Event
OIL / GRIT SEPARATOR 4,500 GAL. CAPACITY			
Underground Infiltration Chambers			
Infiltration Basin			
Rip-Rap Aprons			
SPILL KIT			
Parking Lot / Driveway Sweeping			*Sweep Seasonally – As Needed
Landscaping / Trash Removal			
Snow Removal (seasonal)			*All De-icing chemical storage to be inside building

Additional Comments: _____