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Stormwater Management Report
For

Hanover Weymouth Residential Development
1325 Washington Street
Weymouth, MA

April 8, 2021
REVISED July 14, 2021

Prepared for:
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1.1 EXECUTIVE SUMMARY

In accordance with the provisions of the Town of Weymouth Zoning Bylaws, the Applicant, Hanover R.S. Limited Partnership (Hanover), proposes to construct a mixed use of leasing with 270 residential units, including (148) 1-bedroom units, (106) 2-bedroom units and (14) 3-bedroom units in 270,000±SF of floor area, 4,200SF of commercial/retail space and 8,910SF development amenity and support space with associated parking and site infrastructure on 9.8± acres of land on the subject property with frontage at 1325 Washington Street in Weymouth, Massachusetts.

The project site is comprised of several parcels identified as Assessors Map 35, Block 448, Lot 7, 8, 9 and 25 by the Norfolk County Registry of deeds. The project site is a portion of a 19.9-acre parcel bound by Washington Street to the north, White Oaks Lane to the east, Brady Enterprises/ Moore Rd the south and an active quarry the west. The project site development area is approximately 9.8+/- acre portion of the overall property. See Figure 1 – USGS Map and Figure 2 –Aerial Map. The project site is located on a newly consolidated parcel, Lot A (19.9 acres) per ANR plan endorsed on September 3, 2020 and enclosed in Section 10. A follow up ANR to divide the land into Hanover's parcel and a remainder parcel, to be retained by seller, will follow. The Hanover Parcel is to be approximately a 9.8± acres portion of Lot A.

This Stormwater Report and the accompanying permit applications, include all of the parcels and work proposed in the above narrative.

The property is within three (3) Zoning Districts including HT (fronting on Washington Street); R-2 (abutting both sides of White Oaks Lane); and I-1 (majority of property behind HT and R-2). The entirety of the property is included within the Commercial Corridor Overlay District.

1.2 APPROVALS BEING SOUGHT

A Notice of Intent (NOI) is being filed with the Town of Weymouth Conservation Commission and the Massachusetts Department of Environmental Protection (MA DEP) for the proposed work. The project is proposed to be permitted through a Special Permit process with Site Plan Review with the Board of Zoning Appeals (application has been filed) under the Commercial Corridor Overlay District (CCOD) as a Mixed-Use Development project.

The applicant requests that the permit approvals encompass the entirety of the scope listed below, and as shown in the accompanying plan set:

- The construction of two (2) new mixed-use buildings that include residential and commercial space
- Amenity and support space
- Surface parking for vehicles
- Associated drainage and utilities
- Ancillary buildings including mail buildings, bicycle storage, carports and maintenance functions.

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1.3 FEMA – FLOODPLAIN SUMMARY

This site is not located within the "current" mapped 100-year floodplain per FEMA Firm Panel 25021C0233E (please refer to Figure 3) with effective date of 7/17/2012. While, FEMA has prepared a "Preliminary Plan" (please refer to Figure 4) that is available on their website with a date of 6/19/2020, this plan has not been "adopted" by the Town of Weymouth and it is not referenced in the current Zoning Bylaw.

1.4 ON-SITE SOIL INFORMATION

The Natural Resource Conservation Service (NRCS) maps the majority of on-site soil as Hollis- Rock outcrop- Charlton Complex, 0to 15 percent slopes, Soil Map Unit 104C, classified as Hydrologic Soil Group (HSG) "D." This soil is primarily representative in the location of the proposed development. According to the NRCS mapping, there are also three (5) other soils present in the southern areas of the parcel; Swansea Muck, Soil Map Unit 51, Freetown Muck, Soil Map Unit 52, Whitman Fine Sandy Loam, Soil Map Unit 73A, Urban Land, Soil Map Unit 602 and Unorthents loamy, Soil Map 654. The soils within the area of the proposed development have "D" HSG Ratings, and this rating was used for the drainage calculations and design enclosed with this permit submission.

A test pit plan and associated logs, observed by Sanborn Head on November 12, 2020, are enclosed in Section 6. Please refer to Section 6 for complete soil information.

1.5 WETLANDS AND ENVIRONMENTAL RESOURCE AREAS ANALYSIS

The project contains several jurisdictional wetland resources and therefore the project must be permitted through MA DEP and the Weymouth Conservation Commission. An Order of Resource Area Delineation (ORAD) (MA DEP# 81-1253) was issued on July 28, 2020 for the entirety of the 19.9 acre parcel and is enclosed with this report in Section 8. Work is proposed within the buffer zones of the Bordering Vegetated Wetlands (BVW) within the site. The project also includes the filling of two (2), local jurisdiction only, Isolated Vegetated Wetlands (IVW) totaling approximately 4,400 SF which will require approval by the Commission and will trigger 2 to 1 wetland replication on the site under the Bylaw. Work within the 100 FT Resource Area of the local jurisdictional only vernal pool (and its outer 100' buffer zone) is proposed. The plan includes buffer zone enhancement/restoration work proximate to the locally jurisdictional quarry hole/vernal pool, accordingly.

The site does not contain any areas designated as Estimated or Priority Endangered Species Habitat, certified vernal pools or Areas of Critical Environmental Concern. The site does not contain areas classified as Estimated Habitats of Rare Wildlife by the Natural Heritage and Endangered Species Program of the Division of Fisheries and Wildlife. The project site is not within any "Critical Areas" (Per MassGIS Oliver Viewer) which would require enhanced water quality treatment per the Massachusetts Stormwater Standards.

The wetland resource areas throughout and bordering the property were delineated by South River Environmental on January 7, 2020, March 27, 2020 and May 14, 2020. An Order of Resource Area

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Delineation (ORAD) (MA DEP# 034-1350) was issued on July 28, 2020 and is enclosed with this submission in Section 8.

The following is a summary of the buffer and protection zones that portions of the project are proposed within:

1) 100’ Bordering Vegetated Wetland (BVW) Buffer (310 CMR 10.55).

   Portions of the proposed improvements, including, but not limited to a parking lot, a retaining wall, portions of the residential buildings, garages, a swimming pool/outdoor amenity space and related drainage and utilities are proposed within the 100’ BVW buffer zone. The proposed construction will improve the quality and the peak flows of the runoff into the BVW from within the 100’ BVW buffer. Please see the accompanying plan set and supporting information for more details on the work proposed within the 100’ BVW.

2) 25’ BVW No- Touch-Buffer (Weymouth Wetland Regulations, Part IX (2))

   The Town of Weymouth does have Town by-laws for wetland protection, including a 25’ “No-touch” Buffer to the BVW for residential projects. The project complies, and provides a 25’ buffer to the surrounding BVW’s.

3) Isolated Vegetated Wetlands (IVW), Vernal Pools (Weymouth Wetland Regulations)

   Local jurisdictional wetland impacts are being proposed including the filling of two (2) locally jurisdictional IVW including the wetland series “H” and “G.” The total square footage impact of the filling is approximately 4,437SF. The Town Bylaws require at 2:1 wetland replication. A. The required mitigation is proposed to be buffer zone enhancement throughout the project site. Details of the proposed mitigation are included on Sheets W-1 and W-2 of the Site Plans, enclosed with this Report. The enhancement area is approximately 9,509± greater than the 2:1 required.

   Two “quarry holes” exist within the acre including series “E” and “F”. These are considered local jurisdiction only IVW and local jurisdiction only vernal pools. The Weymouth Wetland’s Bylaw defines a “Vernal Pool” as “Includes a confined basin depression which, at least in most years, holds water for a minimum of two months during the spring and/or summer, and which is free of adult fish populations, as well as the area within 100 feet of the mean annual boundary of such a depression, regardless of whether the site has been certified by the Massachusetts Division of Wildlife and Fisheries. The bylaw defines the “resource area” to include an area of 100 feet of the mean annual boundary of such a depression. Thus, the “resource area” would extend out 100 feet from the quarry hole in all directions. Mitigation for work proposed within the 100ft buffer is provided through the buffer enhancements along the two (2) sections of Quarry Road closest to the quarry hole.

1.6 BUFFER ZONE RESTORATION AND ENHANCEMENT

The Project will result in approximately 4,437SF of permanent impacts to two Isolated Vegetated Wetlands ("IVWs") that are regulated under the Weymouth Wetlands Protection Bylaw (the "Bylaw"). The Project does not propose any alterations to Bordering Vegetated Wetlands ("BVW") regulated under the Bylaw and Massachusetts Wetlands Protection Act regulations (310 CMR 10.55). The Project proposes to enhance and restore portions of the adjoining buffer zone, including upland area habitat associated with a vernal pool, with native plantings like those found in the surrounding area. Buffer zone enhancement IS approximately 9,509 SF±.

Work within the buffer enhancement area also includes the removal of the existing culvert. The existing culvert is to be removed and replaced with a 18" culvert pipe partially buried that will provide hydraulic connectivity between the wetlands and also a natural passage way for aquatic organisms. Also a 3ft wide x 2ft in height open bottom concrete culvert is proposed along the frontage of the property that will provide hydraulic connectivity and also a natural passage way for aquatic organisms between wetlands adjacent to our project and across Washington Street to connect to the downstream wetland system.

Buffer Zone Restoration and Enhancement

To enhance wildlife habitat value within the 100-foot buffer zone adjacent to the Project, the southern portion of the existing access road adjacent to the constructed wetland replication area will be restored and planted. Construction of the "Buffer Zone Restoration and Enhancement Area" will consist of: (1) removal of fill material and replacement with a suitable planting medium within the gravel road; (2) installation of woody plantings and a conservation seed mix; and placement of coarse woody debris. Supplemental native plantings will also be installed in appropriate locations near the former access road in the adjacent upland areas, as determined by the qualified wetland scientist.

The location of the buffer zone restoration area is depicted on Sheet W-1 in the enclosed Site Plans. The goal of the restoration area is to enhance the value of this area to wildlife, particularly those species using this upland forest edge. Further, a locally jurisdictional vernal pool is located just west of the access road in this location. Thus, the goal is to enhance the value of this buffer zone strip, which is currently a relatively sparse access road. Planted shrubs and coarse woody debris will provide food, cover and perching habitat for a variety of wildlife species.

The fill material will be removed, supplemented with about 6 inches of loam, rototilled, and planted with native plant species. The native plants will be installed in clusters. The WS will help provide direction on where to install the plantings based on field conditions and to ensure they replicate a natural environment. A planting table for the restoration area is provided below.

1.7 OBJECTIVE OF CALCULATIONS

The purpose of this stormwater analysis is to examine the stormwater runoff from the proposed site based upon the Massachusetts Department of Environmental Protection Stormwater Management Policy and the applicable provisions of the Town of Weymouth Bylaws and regulations.

The goal of the stormwater management system design on this project is to comply with the MA Stormwater Management Requirements and provide improved water quality, reduce post-development peak runoff rates below pre-development peak flow rates, maximize the opportunities for recharge and infiltration, and protect the surrounding area from any potential flooding and/or environmental impacts associated with the unmitigated condition. The following stormwater hydrology calculations were performed using the 2-year, 10-year, 25-year, and 100-year frequency, Type III, 24-hour storm events utilizing the NOAA Atlas 14 rainfall data entered at recommendation of the Conservation Commission and were compared for both pre-development and post-development conditions. The 2, 10 and 100 were evaluated to demonstrate the proposed peak rates of discharge do not exceed pre-development peak rates. The Atlas 14 rainfall amounts are as follow: 2-year=3.35 inch, 10-year=5.10 inch, 25-year=6.19 inch, 100-year=7.87 inch.

1.8 METHODOLOGY

We utilized the latest version of Hydro CAD for the overall stormwater hydrology/routing analysis to assess and compare peak rates of runoff at the various discharge points from the subject property. We then utilized the Hydraflow Storm Sewers Extension Pack through AutoCAD Civil 3d to analyze the pipe design and to select appropriate pipe sizing.

Refer to Section 3 – Hydrocad Model, which includes the detailed print-out of the HydroCAD Model Reports for the 2, 10, 25 and 100-year storms as well as Section 7 – Hydraulic Pipe Analysis / Sizing, which includes the Hydraflow reports for the 10 and 100-year storms for pipe capacity analysis and sizing.

1.9 SITE HYDROLOGY

Exhibits that include descriptions of existing and proposed stormwater BMP's is included in Section 1.14 as Figure 8 and Figure 9. The watersheds described below are within the limit of work.

Existing Conditions

Please refer to the attached Existing Conditions Watershed Analysis Plan in Section 3.3, The property has been divided into numerous subcatchment areas based on the existing site topography and flow paths.

Each subcatchment area has been analyzed and assigned an appropriate Curve Number to represent the existing vegetative cover and underlying soils conditions. Times of concentration have been calculated and the extent of pervious vs. impervious cover computed. This data was then input into HydroCAD to determine peak rates of runoff at the various design points which provide the locations for which to compare existing versus proposed conditions to document compliance that the peak rates have been reduced in the regulatory storm events as required. A Summary table is provided in the Hydrology Model Results and Conclusions Section below.

For the purposes of this analysis, the pre- and post- development drainage conditions were analyzed at six (6) “design points” where stormwater runoff currently drains to under existing conditions, and one u The design points are described below:

- Design Point #1 (PD1) is toward the Washington Street ROW (Rt. 53) and ultimately ends up flowing into the Washington Street drainage system.
- Design Point #2 (PD2) is Wetland Series “A”
- Design Point #3 (PD3) is the Intermittent Stream to the southwest corner of the proposed development.
- Design Point #4 (PD4) is Wetland Series “B”.
- Design Point #5 (PD5) is Wetland Series “E”.
- Design Point #6 (PD6) is Wetland Series “F” that ultimately flows into the Washington Street drainage system.
- Washington Street ROW Drainage System- drainage infrastructure within the Washington St ROW that outlets directly across from the proposed development.

The analyzed watershed consists of approximately 9.778 acres of mostly undeveloped land made up of wooded area, wetlands, and exposed outcrops of ledge. The site conveys a significant amount of stormwater to the Washington Street ROW drainage system, while the rest of the site appears to convey stormwater to the various BVW’s located throughout the perimeter of the parcel. A more comprehensive description of the existing subcatchment areas is provided below:

- Subcatchment E1 is approximately 140,284SF (3.22AC) consisting of an isolated wetland series “H”, roofs of the existing residential homes, the gravel/dirt road and driveways, ledge outcrops and wooded areas. The subcatchment drains to the Washington Street ROW (PD1) and eventually discharges to the Washington Street drainage system without treatment or attenuation. This area is a mix of pervious and impervious surfaces (CN: 80) and the time of concentration was calculated to be 13.2 minutes.
- Subcatchment E-2 is approximately 40,558SF (0.931AC) of wooded area, exposed ledge, a portion of the dirt road and a small portion of BVW Wetland Series “A”. Runoff from this subcatchment area overland flows to Wetland Series “A”, or PD2. This area is a mix of pervious and impervious surfaces (CN: 82) and the time of concentration was calculated to be 9.7 minutes.
- Subcatchment E-3, approximately 44,084SF (1.012AC), is wooded area, exposed ledge outcrops and a portion of the intermittent stream. Runoff from the subcatchment area overland flows to the intermittent stream, or PD3. This area is a mix of pervious and impervious surfaces (CN: 80) and the time of concentration was calculated to be 9.7 minutes.

- Subcatchment E-4, approximately 82,954SF (1.904AC), of ledge outcrops, wooded area, wetlands, dirt roads and a small area of grass. Stormwater overland flows to the Northwest, and then to the south, eventually discharging into Wetland Series "B", PD4 without treatment or attenuation. from the northwest to the southeast of the subcatchment area to CB-2, and eventually discharges into PD1 without treatment or attenuation. This area is a mix of pervious and impervious surfaces (CN: 85) and the time of concentration was calculated to be 12.8 minutes.
- Subcatchment E-5, approximately 84,333SF (1.936AC) of ledge outcrops, wooded area, wetlands, and dirt road. Stormwater in this location overland flows from west to east eventually discharging to Wetland Series "E", PD5, without treatment or attenuation. This area is a mix of pervious and impervious surfaces (CN: 86) and the time of concentration was calculated to be 10.0 minutes.
- Subcatchment E-6 is approximately 33,666SF (0.772AC) ledge outcrops, wooded area, wetlands, dirt roads and a small area of grass. This subcatchment overland flows ro the north, and then to the east, and eventually discharging to Wetland Series "F", PD6, without treatment or attenuation. This area is a mix of pervious and impervious surfaces (CN: 79) and the time of concentration was calculated to be 6.9 minutes.

Proposed Conditions

The proposed project consists of the construction of two (2) four-story mixed-use buildings consisting of 270 residential apartments and first floor commercial space. The project also includes site amenities, parking lots, drainage improvements and utility infrastructure. The parking lot has been designed to drain to deep sump hooded catch basins, which will capture and convey stormwater runoff, via an underground pipe system, trough oil/grit separators (to achieve 44%pretreatment per LUHPPL criteria) to an underground detention or infiltration system. Rooftop runoff has been designed to flow directly to the infiltration systems since the roof runoff is considered clean.

Please refer to the attached Proposed Conditions Watershed Analysis Plan. The proposed project has been divided into numerous subcatchment areas and the various stormwater detention and infiltration BMPs have been modeled. Appropriate Times of Concentration and Curve Numbers have been assigned for each catchment area. A more comprehensive description of the proposed subcatchment areas is provided below:

- Subcatchments P1-1a and P1-1b are 49,888SF (1.145AC) which consists of a portion of the proposed Building 1, a portion of the parking lot, the courtyard area of Building 1, and a small landscaped/grass area. Building 1 is proposed to have an internal collection system which will discharge directly to UG-1a (detention basin) and UG-1b (recharge and infiltration basin). These basins eventually discharges to the Washington Street ROW (PD1) and then eventually to the Washington Street Drainage System. This area is mostly impervious (CN: 94) and the minimum time of concentration of 6.0 minutes is used.
- Subcatchment P1-2 is 16,720SF (0.384AC) which consist of a portion of the bituminous paved driveway and parking area and a small grass area. The stormwater runoff in this area overland

flows to deep sump catch basins, then to detention system UG-2, and then eventually discharging to the Washington Street ROW (PD1) and then eventually to the Washington Street Drainage System. This area is mostly impervious (CN: 92) and the minimum time of concentration of 6.0 minutes is used.

- Subcatchment P1-U1 is 1,003SF (0.023AC) of grass cover. The stormwater in this subcatchment overland flows towards the Washington St ROW, eventually ending up in the Washington Street drainage system. The area is pervious (CN: 80) and the minimum time of concentration of 6.0 minutes is used.
- Subcatchment P1-U2 is 238SF (0.005AC) of pavement. The stormwater in this subcatchment overland flows towards the Washington St ROW, eventually ending up in the Washington Street drainage system. The area is completely impervious (CN: 98) and the minimum time of concentration of 6.0 minutes is used.
- Subcatchment P1-U3 is 3,334SF (0.077AC) of grass cover. The stormwater in this subcatchment overland flows towards the Washington St ROW, eventually ending up in the Washington Street drainage system. The area is pervious (CN: 80) and the minimum time of concentration of 6.0 minutes is used.
- Subcatchment P1-3 is 46,987SF (1.079AC) which consists of a portion of the proposed Building 1, and a portion of the parking lot, and a small landscaped/grass area. Building 1 is proposed to have an internal collection system which will discharge directly to UG-3. The rest of the runoff throughout P1-3 will be captured by deep sump catch basins, and a series of pipes and manholes, before discharging to detention system UG-3. UG-3 eventually discharges to the Washington Street ROW (PD1) and then eventually to the Washington Street Drainage System. This area is mostly impervious (CN: 96) and the minimum time of concentration of 6.0 minutes is used.
- Subcatchment P1-4 is 50,810SF (1.167AC) which consists almost entirely of the bituminous pavement driveway and parking lot, and the grass islands and landscaped areas within and surrounding the parking lot. The stormwater runoff in this area overland flows to deep sump catch basins, then to detention system UG-7, and then eventually discharging to the Washington Street ROW (PD1) and then eventually to the Washington Street Drainage System. This area is mostly impervious (CN: 95) and the minimum time of concentration of 6.0 minutes is used.
- Subcatchment P2 and P2-R are 38,652 sf (0.88AC) which consists of a portion of the proposed Building 2, a portion of the parking lot, and a small landscaped/grass area. Building 2 is proposed to have an internal collection system which will discharge directly to UG-4a (detention basin) and UG-4b (recharge and infiltration basin). These basins eventually discharges to Wetland Series "A", or PD2. This area is mostly impervious (CN: 97) and the minimum time of concentration of 6.0 minutes is used.
- Subcatchment P2-U is 10,585SF (0.243AC) consists of ledge outcrops, wooded areas, wetlands and grassed landscaped areas. The surface in this location will remain mostly in its existing

condition. Stormwater overland flows unattenuated in this watershed and discharges directly to Wetland Series “A”, or PD2. This area is a mix of impervious and pervious surfaces (CN: 83) and the minimum time of concentration of 6.0 minutes is used.

- Subcatchment P3 is 64,812SF (1.489AC) which consists of most of proposed Building 2, a portion of the parking lot, and a small landscaped/grass area. Building 2 is proposed to have an internal collection system which will discharge directly to an infiltration system (UG-5). The rest of the runoff throughout P2 will be captured by deep sump catch basins, and a series of pipes and manholes, before discharging to UG-5. Any overflow from UG-5 eventually discharges to the intermittent stream, or PD3. This area is mostly impervious (CN: 94) and the minimum time of concentration of 6.0 minutes is used.
- Subcatchment P3-U is 12,466SF (0.286AC) consists of ledge outcrops, wooded areas, and wetlands. The surface in this location will remain mostly in its existing condition. Stormwater overland flows unattenuated in this watershed and discharges directly to the intermittent stream, or PD3. This area is a mix of impervious and pervious surfaces (CN: 85) and the minimum time of concentration of 6.0 minutes is used.
- Subcatchment P4 is 19,643SF (0.451AC) which consists of a small portion of the parking lot and a small area of grass. Stormwater flows overland in this location and discharges to Wetland Series “B” or PD4. This area is mostly impervious (CN: 97) and the minimum time of concentration of 6.0 minutes is used.
- Subcatchment P4-U is 11,607SF (0.266AC) consists of ledge outcrops, wooded areas, and wetlands. The surface in this location will remain mostly in its existing condition. Stormwater overland flows unattenuated in this watershed and discharges directly to Wetland Series “B”, or PD4. This area is a mix of impervious and pervious surfaces (CN: 84) and the minimum time of concentration of 6.0 minutes is used.
- Subcatchment P5 is 43,674 (1.003AC) which consists of the southeastern portion of the parking lot, the grass islands throughout the parking lot, ledge outcrops and wooded areas. The stormwater runoff throughout P5 will be captured by deep sump catch basins, and a series of pipes and manholes, before discharging to UG-6. This area is mostly impervious (CN: 94) and the minimum time of concentration of 6.0 minutes is used.
- Subcatchment P5-U is 50,990SF (1.172AC) consists of ledge outcrops, wooded areas, grass areas and wetlands. This location will be used for wetland replication, and wetland buffer zone enhancements. Please see section 1.6 above for more information on wetland replication and mitigation. Stormwater overland flows in this watershed and discharges directly to Wetland Series “E”, or PD5. This area is a mix of impervious and pervious surfaces (CN: 88) and the time of concentration was calculated to be 10.0 minutes.

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Hydrology Model Results and Conclusions

The goal of the stormwater design for the project is to fully comply with the Massachusetts Stormwater Standards and the Town of Weymouth Regulations. This analysis confirms that the stormwater system is receiving proper treatment and peak rates of runoff have been significantly reduced to below pre-development rates using stormwater Best Management Practices including deep sump hooded catch basins, and underground Detention/Infiltration Systems. The discharge points from the site have been engineered to employ properly designed rip-rap splash pads to further reduce discharge velocities and to spread out the discharge to prevent scour and point discharge erosion. The underground infiltration system has been sized and designed to meet the required TSS removal rate, to provide the required recharge to the maximum extent practicable. The underground detention systems have been sized and designed to meet the required TSS removal requirement, and provide peak flow attenuation.

The results of the pre- and post-development hydrology calculations provided in Section 3 are summarized in the following tables:

Table 1.7.1 shows the peak rate of runoff and runoff volume for the existing site as well as for the developed site at 2, 10, and 100-year design storms.

Table 1.7.1

Peak Rates

Point of Analysis	2-Year Storm (cfs)			10-Year Storm (cfs)			100-Year Storm (cfs)			
	Pre	Post	Δ	Pre	Post	Δ	Pre	Post	Δ	% Reductio
PD1	4.51	2.69	**-1.82**	8.93	3.86	**-5.07**	16.3	5.71	**-10.59**	-65%
PD2	1.59	1.58	**-0.01**	3.04	2.58	**-0.46**	5.41	4.3	**-1.11**	-21%
PD3	1.57	0.63	**-0.94**	3.12	1.15	**-1.97**	5.68	1.97	**-3.71**	-65%
PD4	3.38	2.01	**-1.37**	6.15	3.28	**-2.87**	10.58	5.28	**-5.30**	-50%
PD5	3.9	3.66	**-0.24**	6.97	6.94	**-0.03**	11.84	11.69	**-0.15**	-1%
PD6	1.26	0.69	**-0.57**	2.54	1.39	**-1.15**	4.67	2.55	**-2.12**	-45%
WD	5.47	3.31	**-2.16**	10.9	5.09	**-5.81**	19.93	7.93	**-12.00**	-60%

Volume

Point of Analysis	2-Year Storm (cf)			10-Year Storm (cf)			100-Year Storm (cf)		
	Pre	Post	Δ	Pre	Post	Δ	Pre	Post	Δ
PD1	17794	32387	**14593**	34840	53267	**18427**	64335	87376	**23041**
PD2	5690	5646	**-44**	10710	9762	**-948**	19388	19528	**140**
PD3	5577	1960	**-3617**	10949	3595	**-7354**	20217	9819	**-10398**
PD4	13040	6669	**-6371**	23923	11022	**-12901**	42084	18069	**-24015**
PD5	13811	18844	**5033**	25009	32026	**7017**	43589	53396	**9807**
PD6	4069	2154	**-1915**	8102	4289	**-3813**	15113	8001	**-7112**
WD=PD6+PD1	21818	34541	**12723**	42943	57556	**14613**	79448	95377	**15929**
Total (PD1+PD2+PD3+PD4 +PD5+PD6)	59981	67660	**7679**	113533	113961	**428**	204726	196189	**-8537**

As shown in Table 1.7.1 above, the project results in a reduction of peak rates in all storm events at all points of discharge. The peak rates of discharge ultimately heading to the downstream wetland system across Washington Street, which connects into the Plymouth River, have been reduced significantly, including a 40% reduction in 2-year storm and a 65% reduction in the 100-year storm event. Also, as you can see from the above table, the project as a whole, results in an overall reduction in total volume by approximately 8,537 cf. In addition, this revised analysis, utilizing the larger Atlas 14 storm events for the 100-year, only resulted in a total of 15,929+/- cubic feet of additional volume discharges directly to the downstream wetland system. The downstream system includes approximately 10 Acres of wetlands which ultimately discharges trough two large culvert crossings. The first culvert crossing is at Colonel's Lane which consists of two (2) 4.5'x4.5' box culverts. The second downstream culvert crossing is at Colonel's Drive and consists of two (2) 6' diameter half-pipes with open bottoms. These culverts have flown-full

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capacity of +/- 280 cfs and +/-300 cfs respectively. The reduction of peak rates from the site will only help improve the available downstream capacity of both these culverts and therefore will not adversely impact downstream flooding. In addition, even in the extremely unlikely event that both downstream culverts were completely blocked off, the small amount of added runoff volume from this site will only amount of 0.4 inches of rise across the wetland system, which is diminish.

1.10 STORMWATER MANAGEMENT

The following section describes each of the ten (10) Massachusetts Stormwater Management Standards and describes how the project complies with each.

Standard 1: No New 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.

All new stormwater system conveyances are treated prior to discharge and result in no erosion occurring on site. The drainage system has been designed to direct stormwater runoff from impervious areas through various stormwater systems designed to capture, convey, treat, detain, recharge and infiltrate (where appropriate) the runoff prior to discharge. In addition, the treatment systems have been designed to comply with the Land Use of Higher Potential Pollutant Land (LUHPPL) requirements.

Standard 2: Peak Rate Attenuation – Stormwater management systems have been designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates. Please refer to Table 1.7.1 above.

The stormwater system reduces peak rates of runoff to below pre-development levels.

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

The new stormwater system has been designed to comply with the recharge requirements for MA Stormwater Management Standards. Refer to Section 4 for a summary of the stormwater recharge calculations.

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<u>Standard 4: Water Quality</u> – Stormwater management systems shall be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS).

The project has been designed to comply with providing at least 80% TSS removal rate throughout the site. This is achieved trough the use of deep sump hooded catch basins, oil/grit separators (to meet the 44% pretreatment prior to discharge to the underground systems) ADS Isolator Rows and in some cases, separate proprietary treatment devices. In addition, the rear overflow parking lot has been designed with porous pavement. This lot is expected to receive minimal daily use and thus would not be considered a LUHPPL. This porous pavement section complies with the UNH Design Specifications and meets the 80% TSS removal criteria.

<u>Standard 5: Land Uses with Higher Potential Pollutant Loads (LUHPPL)</u> – For land uses with higher potential pollutant loads, source control and pollution prevention shall be implemented in accordance with the Massachusetts Stormwater Handbook to eliminate or reduce the discharge of stormwater runoff from such land uses to the maximum extent practicable.

The project has been designed to comply with the LUHPPL criteria with the exception of the rear overflow lot, which is not considered to be a LUHPPL.

<u>Standard 6: Critical Areas</u> – Stormwater discharges within the Zone II or Interim Wellhead Protection Area of a public water supply, and stormwater discharges near or to any other critical area, require the use of the specific source control and pollution prevention measures and the specific structural stormwater best management practices determined by the Department to be suitable for managing discharges to such areas, as provided in the Massachusetts Stormwater Handbook.

The project is located near a critical area, which would be considered the locally jurisdictional vernal pool. However, no existing or proposed runoff discharges to the vernal pool and thus the design will not adversely effect the critical area.

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

The project does not qualify as a redevelopment and therefore this standard does not apply.

Standard 8: Construction Period Pollution Prevention Plan and Erosion and Sedimentation Control – A plan to control construction-related impacts including erosion, sedimentation and other pollutant sources during construction and land disturbance activities (construction period erosion, sedimentation, and pollution prevention plan) shall be developed and implemented.

An Erosion and Sedimentation Controls Plan has been incorporated into the Site Plans.

Standard 9: Operation and Maintenance Plan – A long-term operation and maintenance plan shall be developed and implemented to ensure that stormwater management systems function as designed.

A long-term Operation and Maintenance Plan has been incorporated herein. See Section 5.

Standard 10: Prohibition of Illicit Discharges – All illicit discharges to the stormwater management system are prohibited.

An Illicit Discharge Compliance Statement is included as required, and will be signed and submitted as a requirement of the final Order of Conditions, prior to the discharge of stormwater runoff to post-construction stormwater BMP's.

1.11 BEST MANAGEMENT PRACTICES (BMP'S)

A system of deep sump hooded catch basins, subsurface infiltration systems, subsurface detention/treatment will be used to treat stormwater runoff on the site. See Section 4 for stormwater management calculations.

1.12 PIPE SIZING

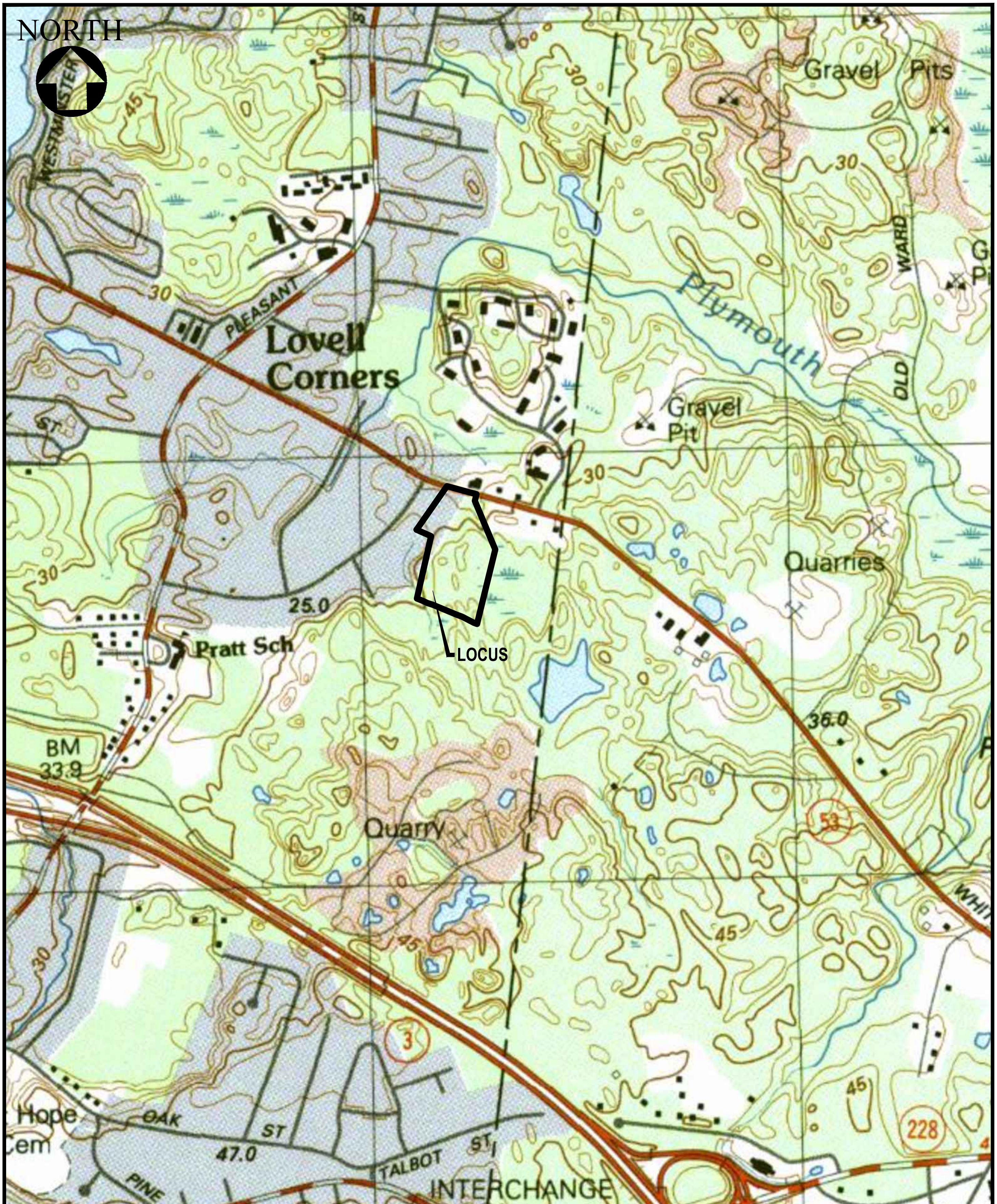
Refer to Section 7 for the output results from the Hydraflow Sewer Storm Sewers Extension for AutoCAD Civil 3D. Hydraflow utilized the Rational Method. The tributary area for each inlet/subcatchment area has been computed along with pipe length, slope and friction coefficient. The Rational Method is then utilized to determine the hydraulic grade line. For design purposes, this approach was used to size the pipes such that the 10-year storm event is contained within the pipe. The 100-year storm was then checked to confirm the hydraulic grade line for the pipe network does not exceed the rim elevations of the drainage structures. In addition, pipe velocities were checked to be within the range of 2fps to 10 fps flowing 1/3 full. Those calculations are included in Section 4.7 herein.

1.13 CONCLUSION

In conclusion, the project has been designed in accordance with the requirements of the MA DEP's Stormwater Management Standards and in compliance with the Town of Weymouth's Conservation Commission Wetland Regulations.

1.14 Figures

FIG 1 USGS MAP
FIG 2 ORTHOGRAPHIC/AERIAL MAP
FIG 3 FEMA FLOODPLAIN MAP (EFFECTIVE PANEL)
FIG 4 FEMA FLOODPLAIN MAP (PRELIMINARY PANEL)
FIG 5 NHESP HABITAT MAP
FIG 6 MASSDEP WETLANDS MAP



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2 SHARP STREET, UNIT B
HINGHAM, MA 02043

Project

HANOVER WEYMOUTH RESIDENTIAL DEVELOPMENT

#1325 WASHINGTON STREET
WEYMOUTH, MA

Prepared for

HANOVER R.S. LIMITED PARTNERSHIP

ONE MARINE PARK DRIVE, STE 701, BOSTON, MA 02210

Drawing Title

USGS MAP

DATE: 4.8.2021	DRAWN: DJN
JOB NO.:100-124	CHECK: ML

SCALE:
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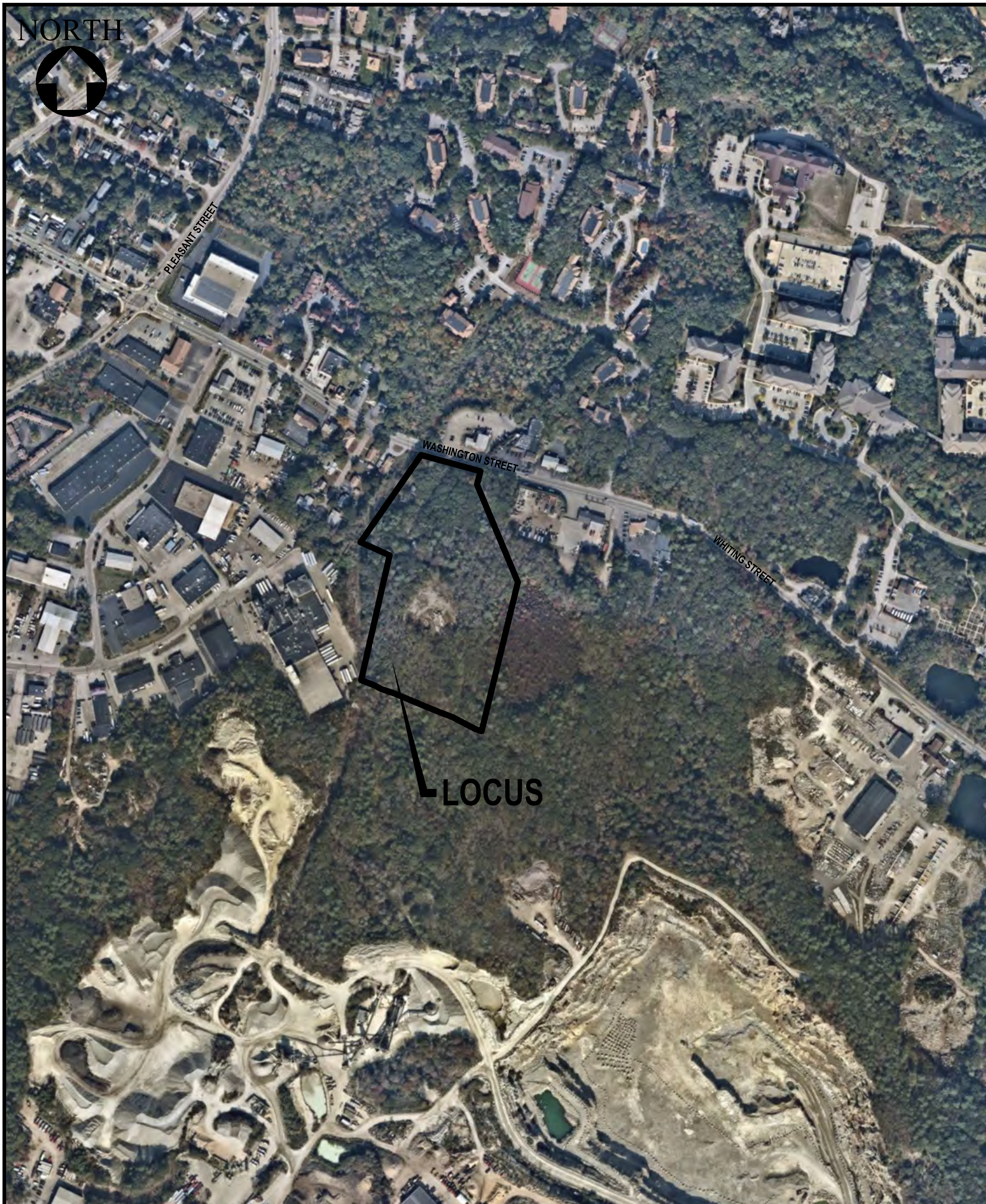

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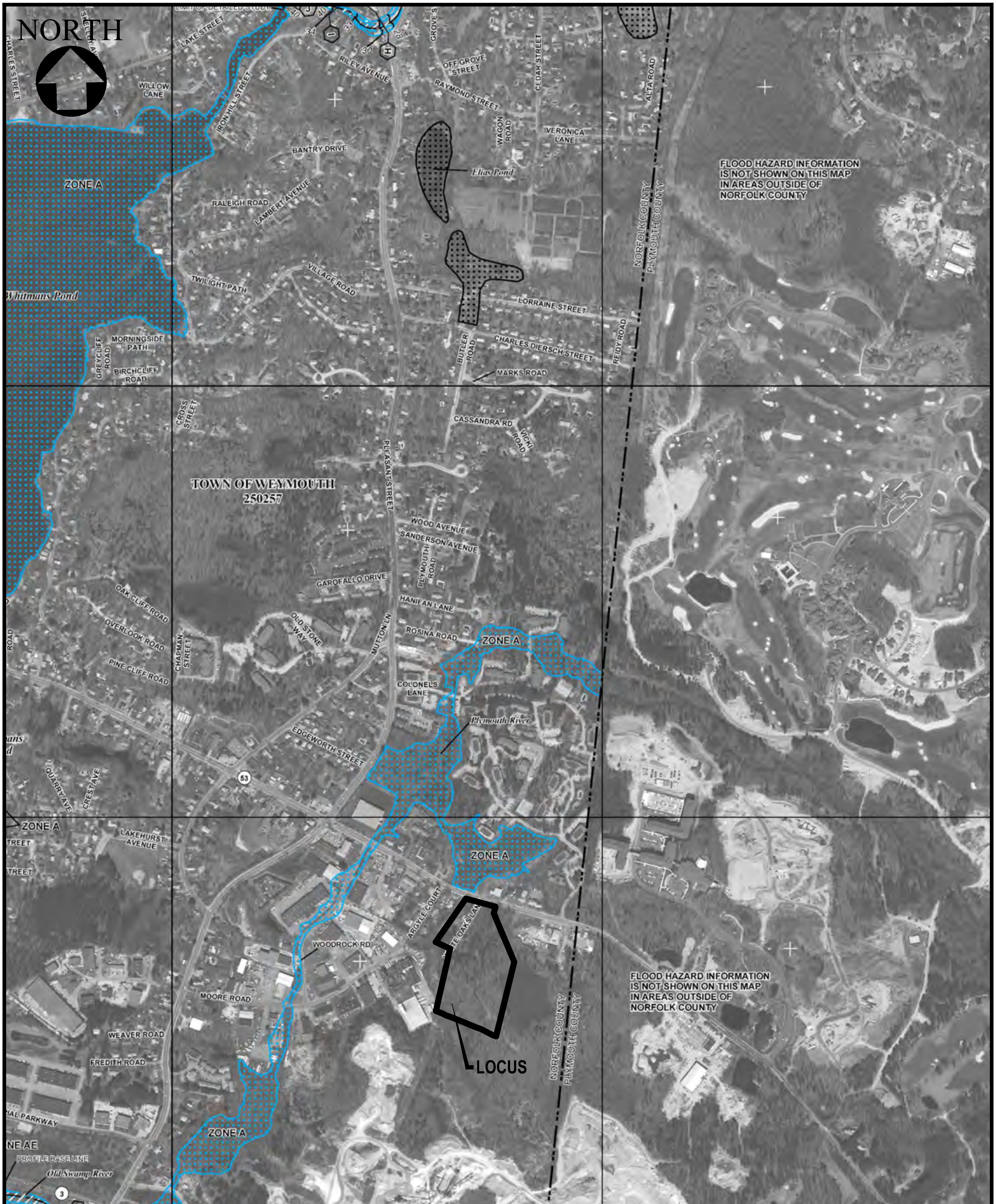

Crocker Design Group
2 SHARP STREET, UNIT B
HINGHAM, MA 02043

Project
HANOVER WEYMOUTH RESIDENTIAL DEVELOPMENT
#1325 WASHINGTON STREET
WEYMOUTH, MA

Prepared for
HANOVER R.S. LIMITED PARTNERSHIP
ONE MARINE PARK DRIVE, STE 701, BOSTON, MA 02210

Drawing Title
FEMA FLOOD MAP
EFFECTIVE PANEL 25021C0233E (7.17.2012)

DATE: 4.8.2021 | DRAWN: DJN
JOB NO.:100-124 | CHECK: ML
SCALE: 1000 500 0 1000

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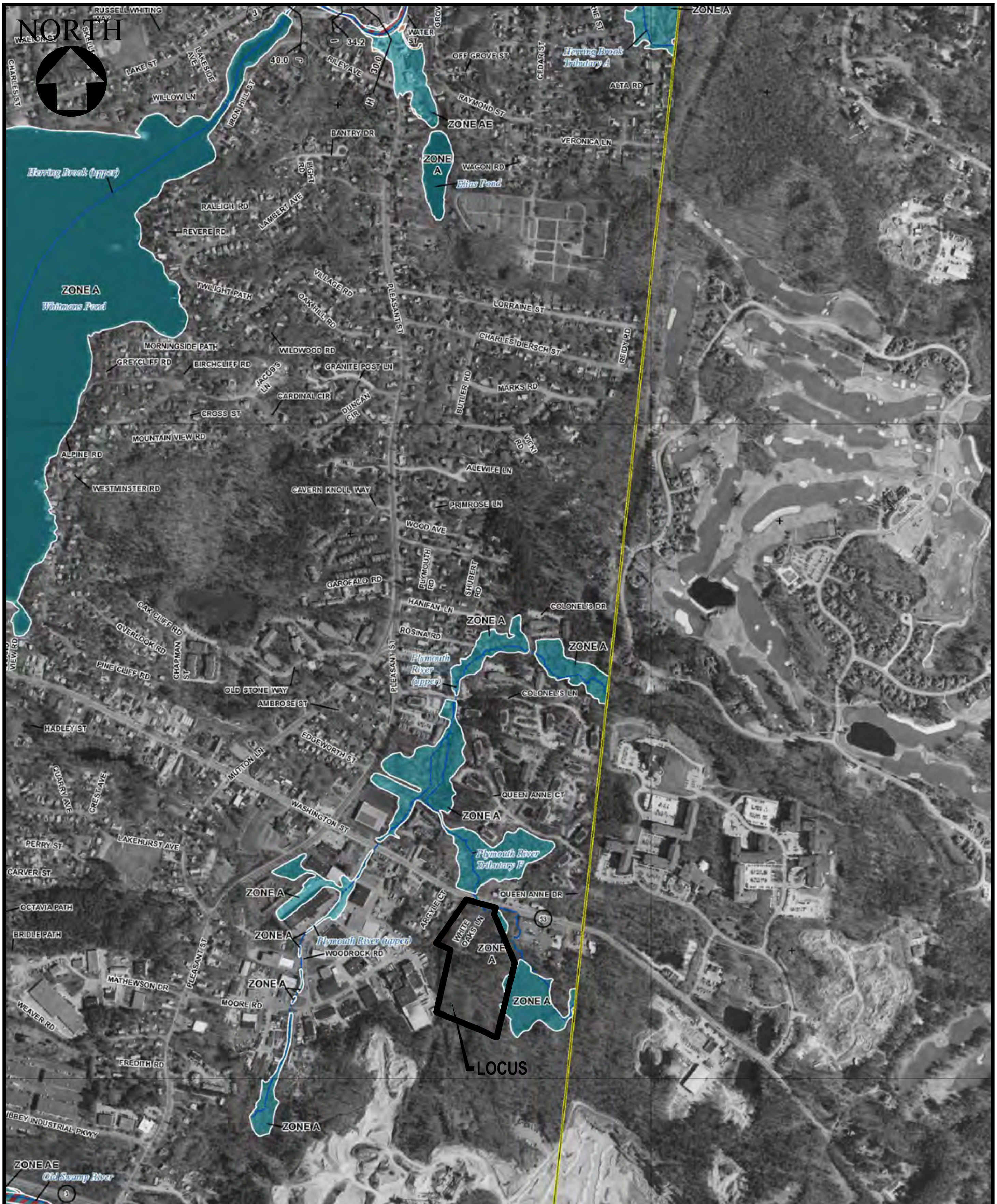

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HINGHAM, MA 02043

Project
HANOVER WEYMOUTH RESIDENTIAL DEVELOPMENT
#1325 WASHINGTON STREET WEYMOUTH, MA

Prepared for
HANOVER R.S. LIMITED PARTNERSHIP
ONE MARINE PARK DRIVE, STE 701, BOSTON, MA 02210

Drawing Title **PRELIMINARY FEMA FLOOD MAP**
PANEL 25021C0233F

DATE: 4.8.2021
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CHECK: ML
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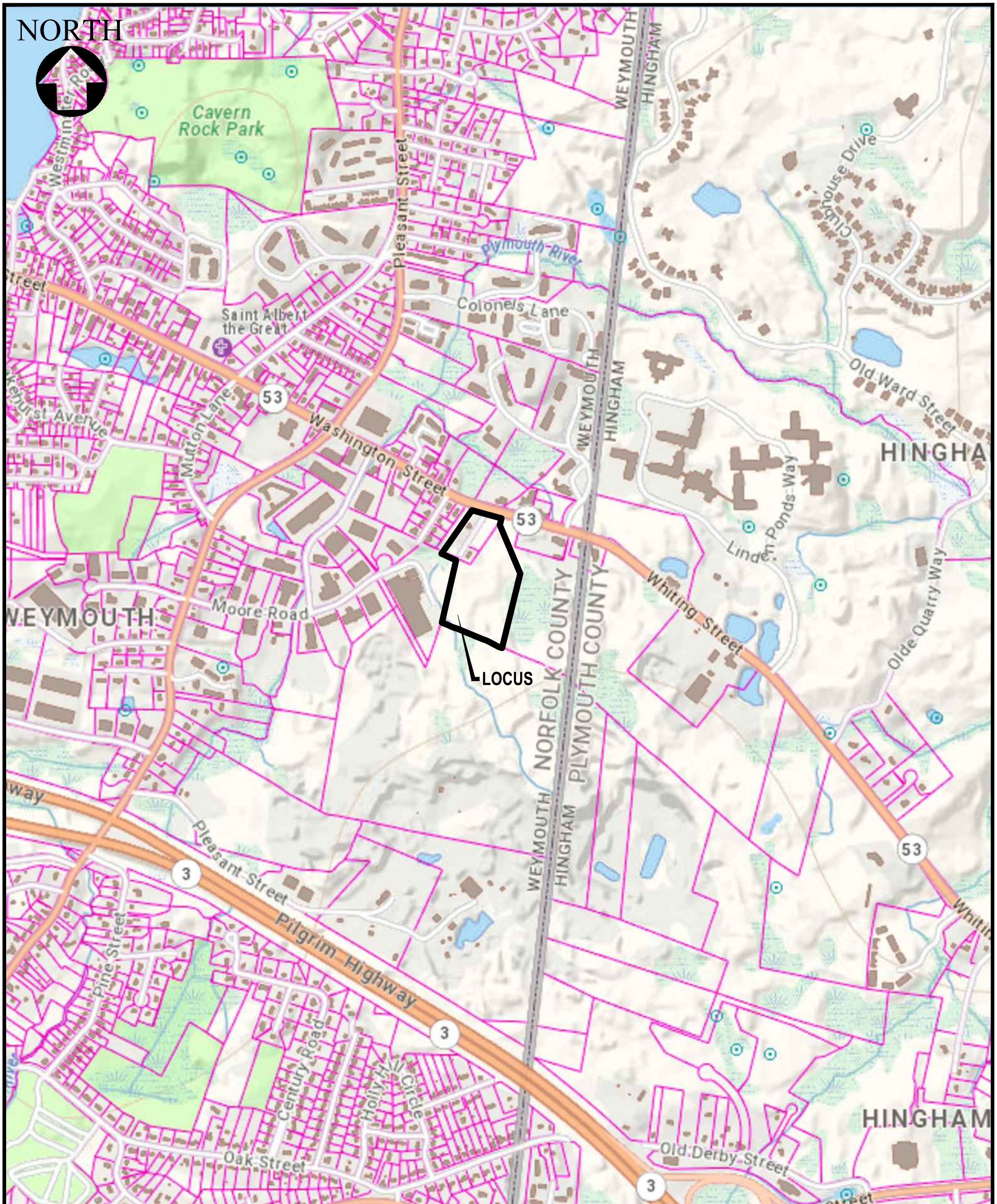

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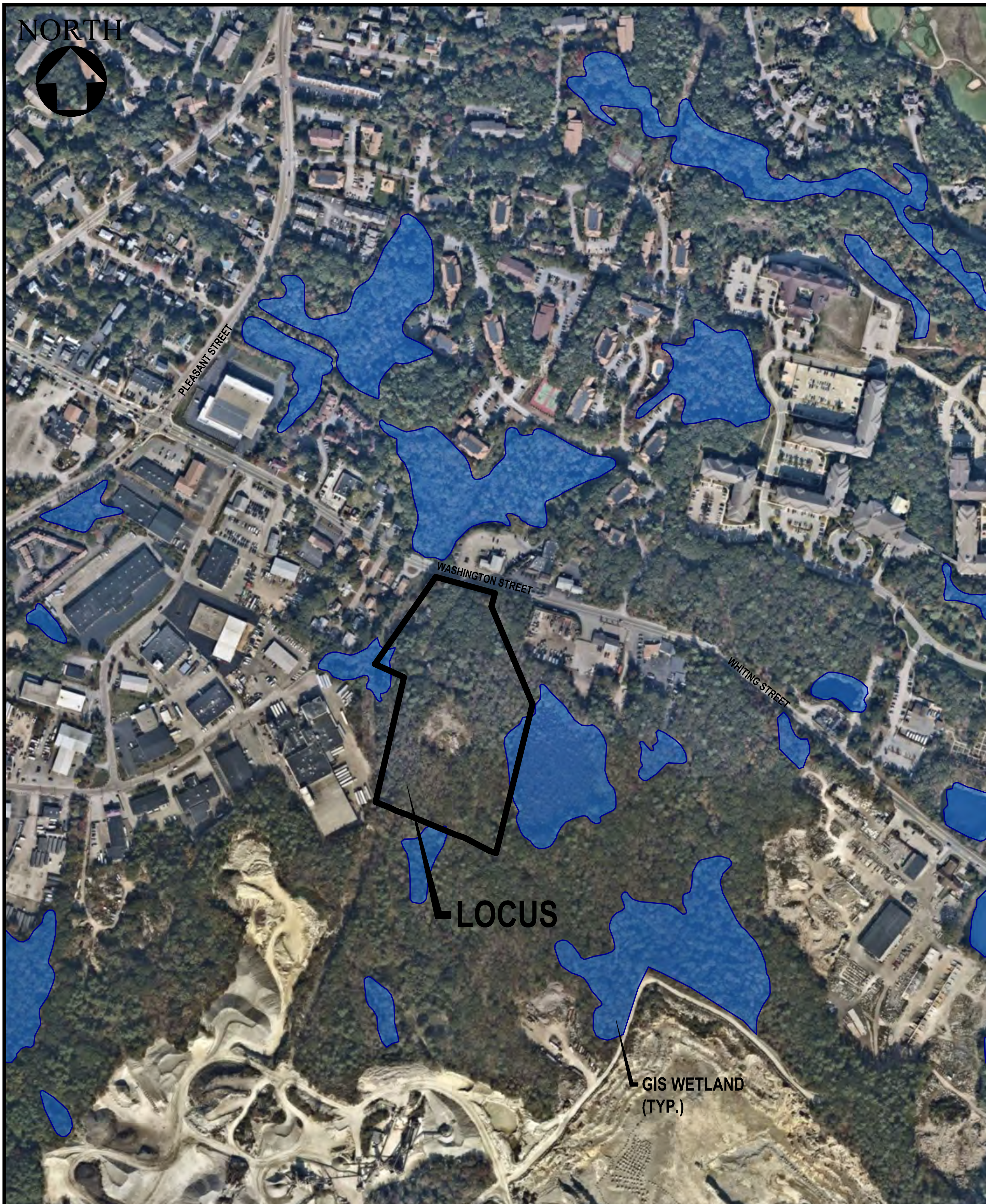

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2 SHARP STREET, UNIT B
HINGHAM, MA 02043

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HANOVER WEYMOUTH RESIDENTIAL DEVELOPMENT
#1325 WASHINGTON STREET WEYMOUTH, MA

Prepared for
HANOVER R.S. LIMITED PARTNERSHIP
ONE MARINE PARK DRIVE, STE 701, BOSTON, MA 02210

Drawing Title **WETLANDS MAP**

DATE: 4.8.2021	DRAWN: DJN
JOB NO.:100-124	CHECK: ML

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SECTION 2 – 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.

B. Stormwater Checklist and Certification

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

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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature

COMMONWEALTH OF MASSACHUSETTS
GABRIEL R.
CROCKER
CIVIL
No. 47917
REGISTERED
PROFESSIONAL ENGINEER

7-14-2021

Signature and Date

Checklist

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

☒ New development

☐ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist (continued)

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

☒ No disturbance to any Wetland Resource Areas

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

☐ Reduced Impervious Area (Redevelopment Only)

☐ Minimizing disturbance to existing trees and shrubs

☐ LID Site Design Credit Requested:

 ☐ Credit 1

 ☐ Credit 2

 ☐ Credit 3

☐ Use of "country drainage" versus curb and gutter conveyance and pipe

☐ Bioretention Cells (includes Rain Gardens)

☐ Constructed Stormwater Wetlands (includes Gravel Wetlands designs)

☐ Treebox Filter

☐ Water Quality Swale

☐ Grass Channel

☐ Green Roof

☐ Other (describe): ____________________

Standard 1: No New Untreated Discharges

☒ No new untreated discharges

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

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

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

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

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

☐ Static ☒ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

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

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

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

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

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

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

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

  ☐ is within the Zone II or Interim Wellhead Protection Area

  ☐ is near or to other critical areas

  ☐ is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)

  ☒ involves runoff from land uses with higher potential pollutant loads.

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

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

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

Checklist (continued)

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

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

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

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

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

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

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

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

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

Checklist (continued)

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

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

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

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

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

Standard 9: Operation and Maintenance Plan

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

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

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

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

Standard 10: Prohibition of Illicit Discharges

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

☒ An Illicit Discharge Compliance Statement is attached;

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

ILLICIT DISCHARGE COMPLIANCE STATEMENT

Standard 10: Massachusetts Stormwater Standards Handbook

Illicit discharges are defined as discharges into waters of the State or municipal separate stormwater system (MS4) that are not entirely comprised of stormwater. Exclusions for non-stormwater discharges into drainage systems include activities or facilities for firefighting, water line flushing, landscape irrigation, uncontaminated groundwater discharge, potable water sources, foundation drains, air conditioning condensation, footing drains, individual resident car washing, water used to clean residential buildings without detergents, water used for street washing, and flows from riparian habitats/wetlands. These exclusions are subject to change and are under the discretion of the local governing authority.

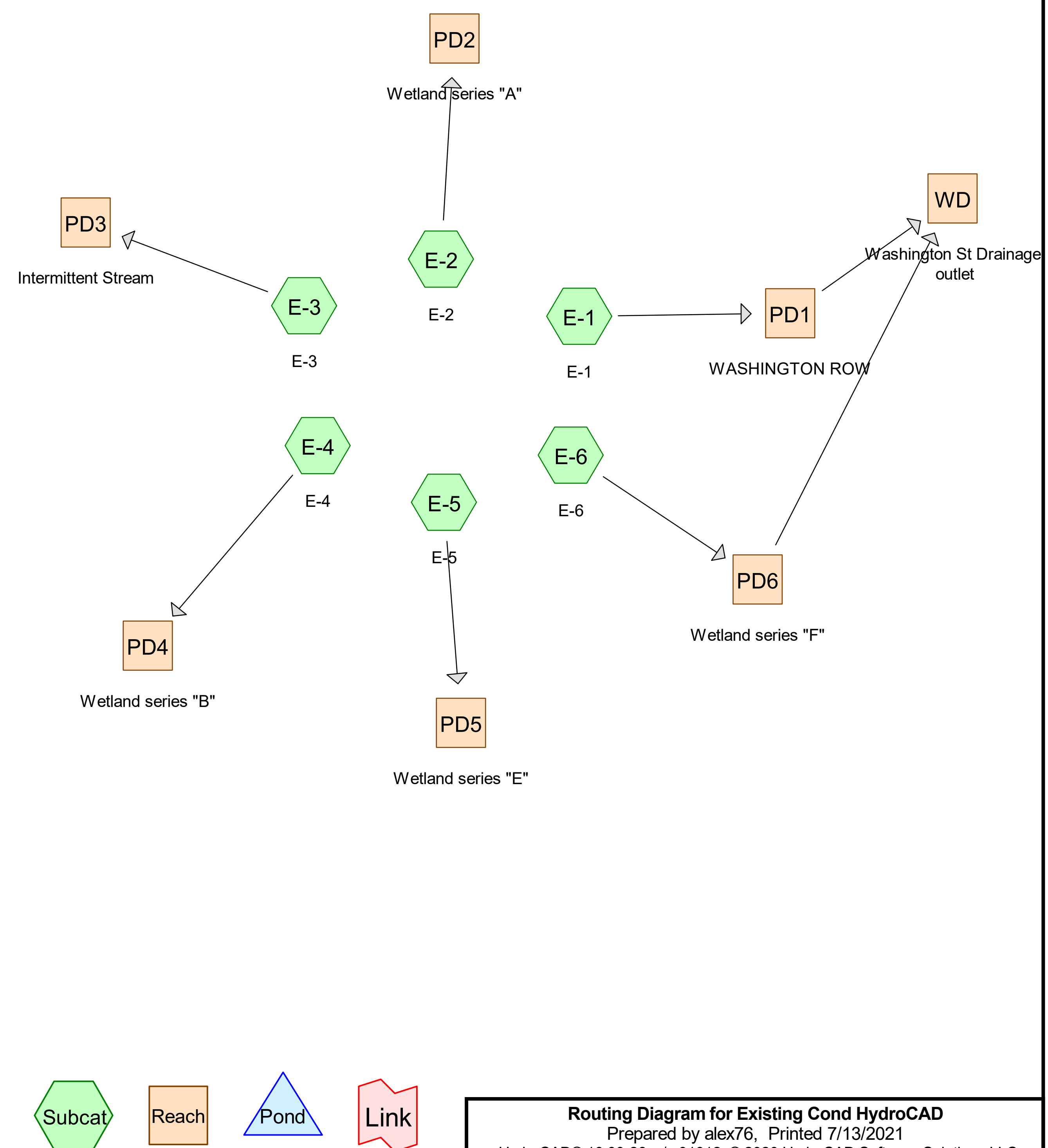
To the best of our knowledge and professional belief no illicit discharges to the stormwater system, surface waters, or wetland resource areas will remain on the site after construction. We will agree to implement a pollution prevention plan to prevent illicit discharges into the stormwater management system. The design of the site based on the plans entitled "SITE DEVELOPMENT PLANS: HANOVER WEYMOUTH RESIDENTIAL DEVELOPMENT." prepared by Crocker Design Group, 2 Sharp Street, Unit B, Hingham, Massachusetts show a separation and no direct connection between the stormwater management systems and the wastewater and/ or groundwater on the site. To the maximum extent practicable, the design prevents entry of illicit discharges into the stormwater management system.

Engineer's Name: ___GABE CROCKER___________________________
(please print)

Engineer's Signature: Date: 7-14-2021

Company: Crocker Design Group, LLC.

SECTION 3 – STORMATER HYDROLOGY MODEL



Routing Diagram for Existing Cond HydroCAD
Prepared by alex76, Printed 7/13/2021
HydroCAD® 10.00-26 s/n 01012 © 2020 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
11,062	89	Dirt roads, HSG D (E-2, E-4, E-5)
6,775	89	Dirt/Gravell roads, HSG D (E-1)
55,917	98	Ledge, HSG D (E-1, E-2, E-3, E-4, E-5, E-6)
1,931	78	Meadow, non-grazed, HSG D (E-2)
29,504	80	Pasture/grassland/range, Good, HSG D (E-1, E-4, E-6)
3,535	98	Pavement and Roofs, HSG D (E-1)
31,092	98	Wetland Surface, HSG D (E-2, E-3, E-4, E-5, E-6)
283,136	77	Woods, Good, HSG D (E-1, E-2, E-3, E-4, E-5, E-6)
2,885	98	isol wetland HSG D (E-1)
425,837	**82**	**TOTAL AREA**

Summary for Subcatchment E-1: E-1

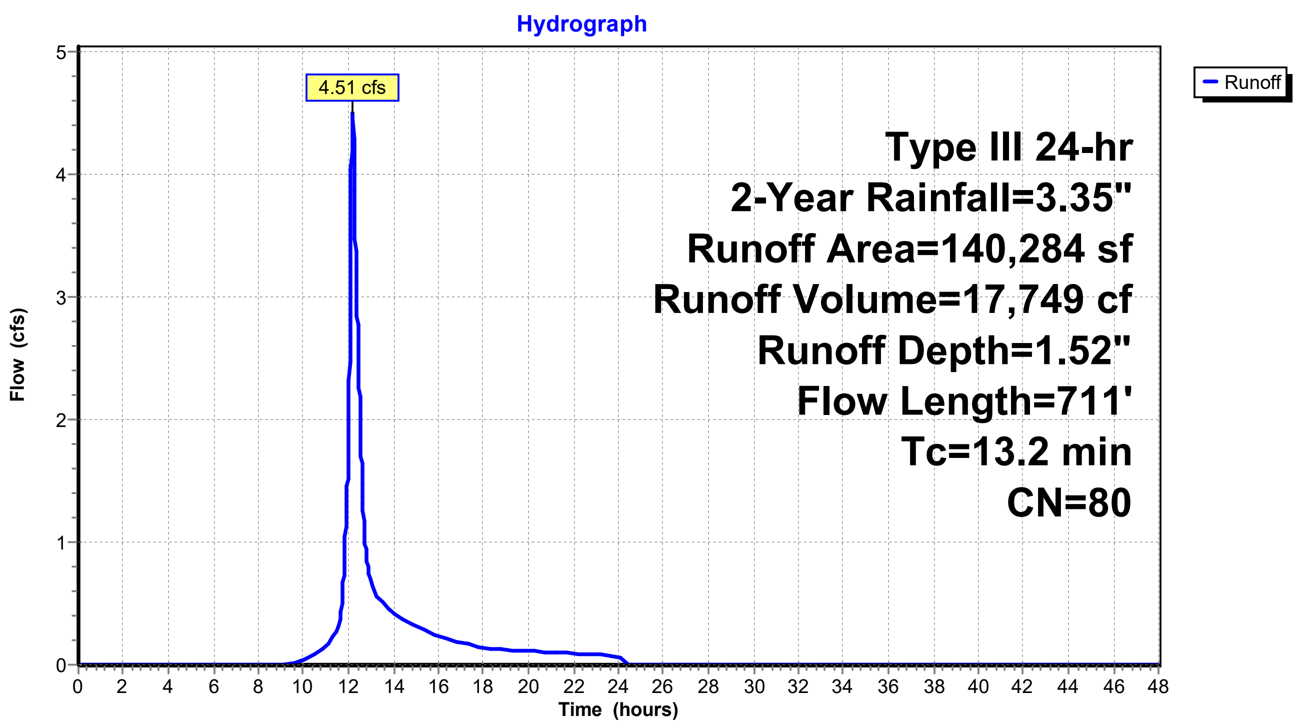
Runoff = 4.51 cfs @ 12.19 hrs, Volume= 17,749 cf, Depth= 1.52"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.35"

	Area (sf)	CN	Description
*	2,885	98	isol wetland HSG D
*	3,535	98	Pavement and Roofs, HSG D
*	6,775	89	Dirt/Gravell roads, HSG D
*	7,944	98	Ledge, HSG D
	93,250	77	Woods, Good, HSG D
	25,895	80	Pasture/grassland/range, Good, HSG D
	140,284	80	Weighted Average
	125,920	78	89.76% Pervious Area
	14,364	98	10.24% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.4	50	0.1200	0.35		**Sheet Flow,** Range n= 0.130 P2= 3.40"
10.8	661	0.0420	1.02		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
13.2	711	Total			

Subcatchment E-1: E-1



Summary for Subcatchment E-2: E-2

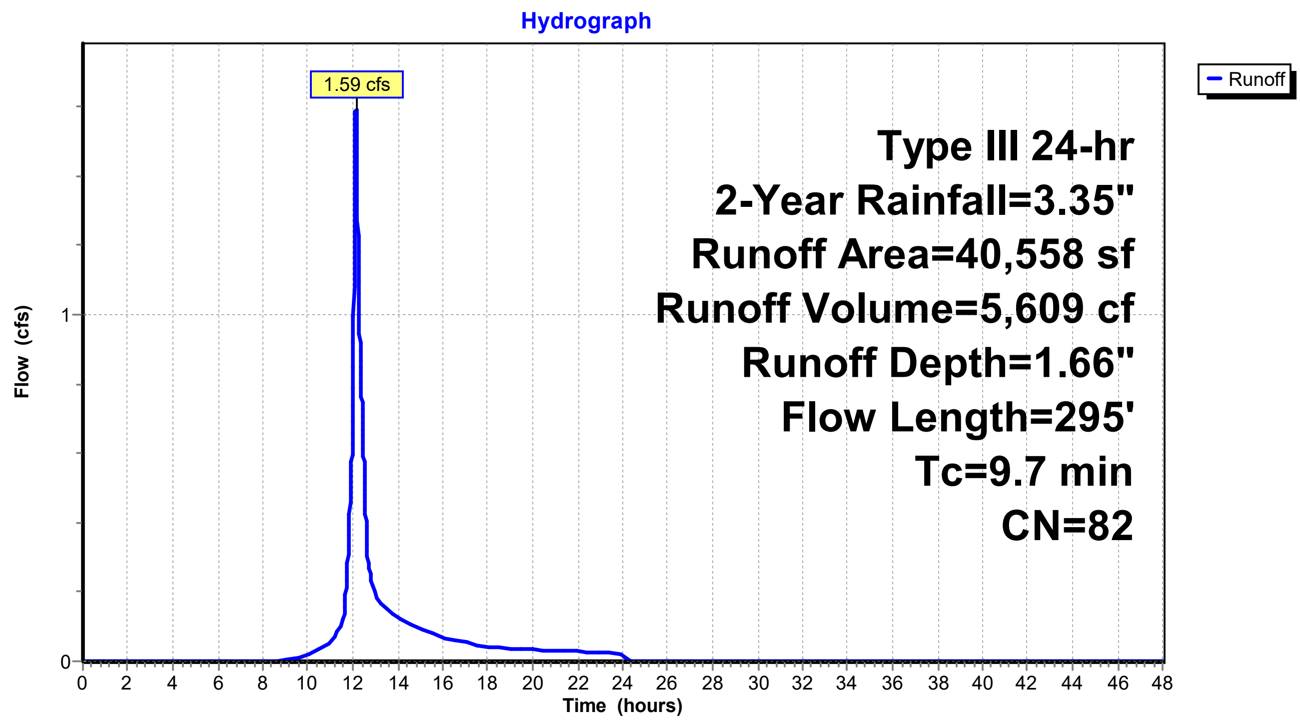
Runoff = 1.59 cfs @ 12.14 hrs, Volume= 5,609 cf, Depth= 1.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.35"

	Area (sf)	CN	Description
*	5,020	98	Ledge, HSG D
	28,312	77	Woods, Good, HSG D
*	2,902	98	Wetland Surface, HSG D
	2,393	89	Dirt roads, HSG D
	1,931	78	Meadow, non-grazed, HSG D
	40,558	82	Weighted Average
	32,636	78	80.47% Pervious Area
	7,922	98	19.53% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	50	0.0700	0.11		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.40"
2.5	245	0.1100	1.66		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
9.7	295	Total			

Subcatchment E-2: E-2



Summary for Subcatchment E-3: E-3

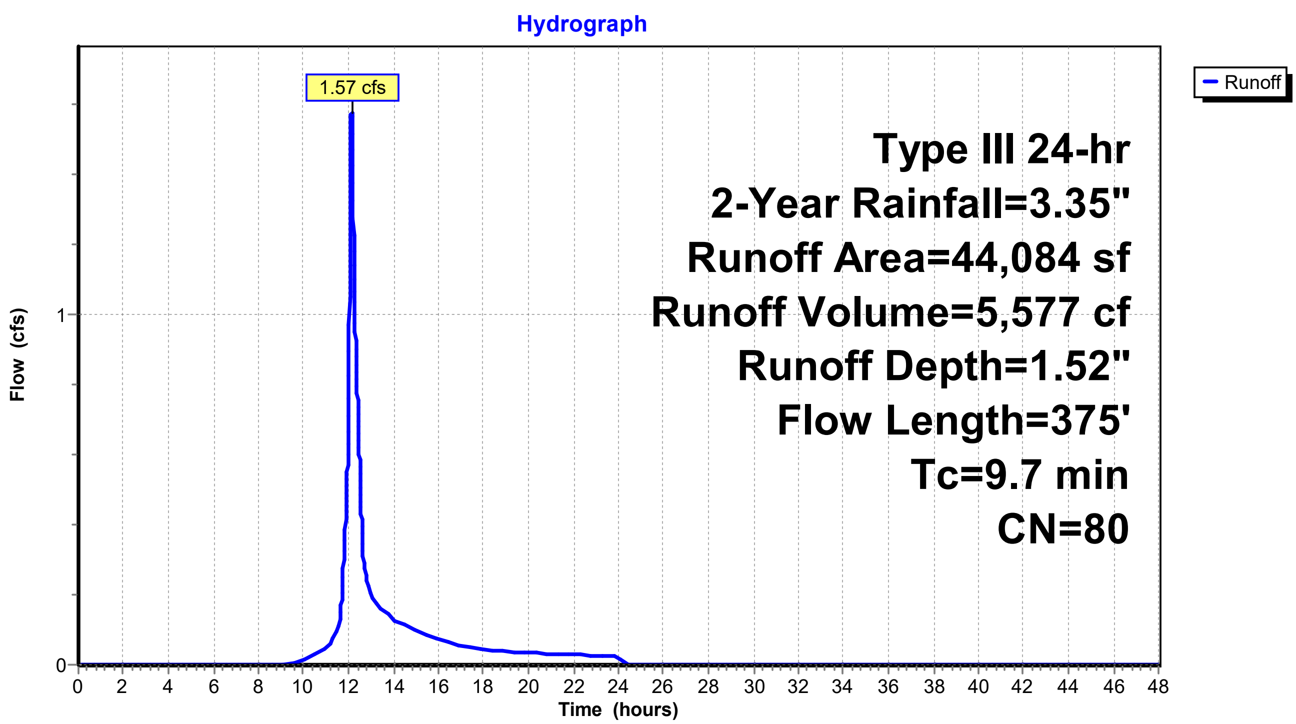
Runoff = 1.57 cfs @ 12.14 hrs, Volume= 5,577 cf, Depth= 1.52"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.35"

	Area (sf)	CN	Description
*	1,868	98	Ledge, HSG D
	38,259	77	Woods, Good, HSG D
*	3,957	98	Wetland Surface, HSG D
	44,084	80	Weighted Average
	38,259	77	86.79% Pervious Area
	5,825	98	13.21% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	50	0.1000	0.13		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.40"
3.3	241	0.0600	1.22		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.1	84	0.0700	14.18	127.58	**Channel Flow,** Area= 9.0 sf Perim= 8.0' r= 1.13' n= 0.030 Stream, clean & straight
9.7	375	Total			

Subcatchment E-3: E-3



Summary for Subcatchment E-4: E-4

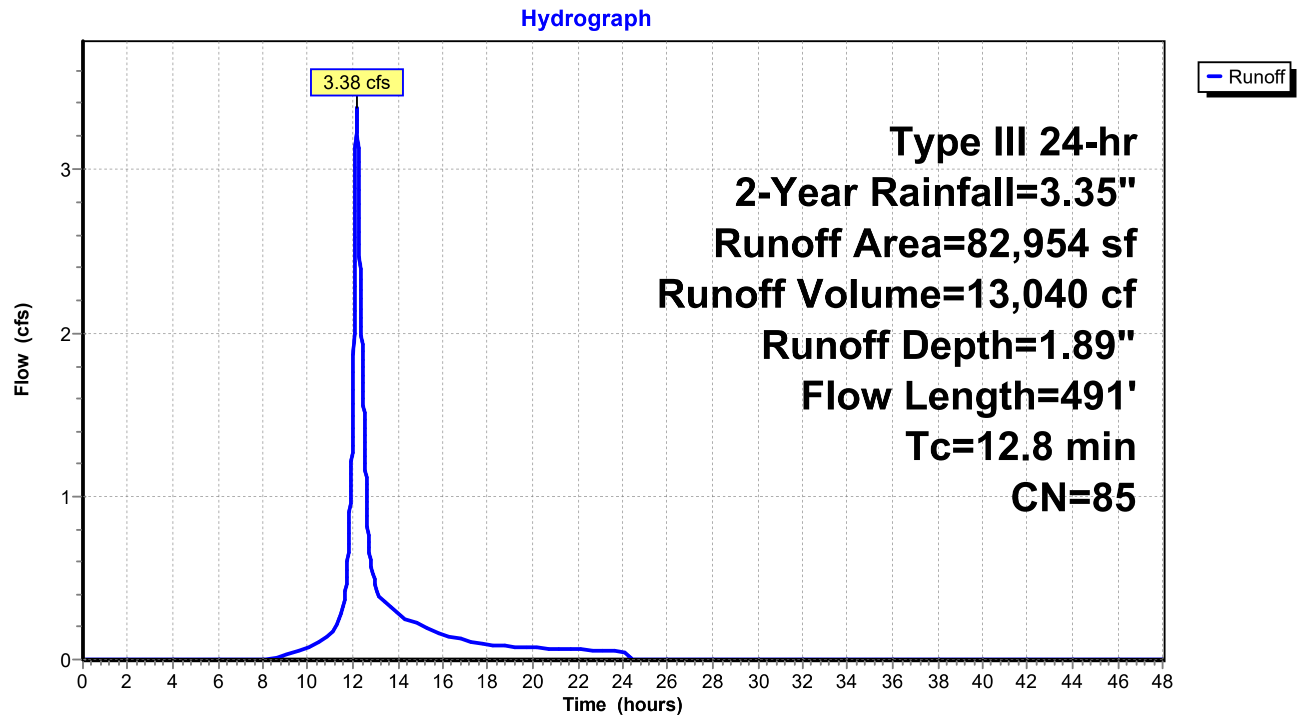
Runoff = 3.38 cfs @ 12.18 hrs, Volume= 13,040 cf, Depth= 1.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.35"

	Area (sf)	CN	Description
*	25,716	98	Ledge, HSG D
	47,000	77	Woods, Good, HSG D
	2,512	80	Pasture/grassland/range, Good, HSG D
*	2,410	98	Wetland Surface, HSG D
	5,316	89	Dirt roads, HSG D
	82,954	85	Weighted Average
	54,828	78	66.09% Pervious Area
	28,126	98	33.91% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	50	0.0700	0.11		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.40"
1.0	232	0.0560	3.81		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
4.6	209	0.0230	0.76		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
12.8	491	Total			

Subcatchment E-4: E-4



Summary for Subcatchment E-5: E-5

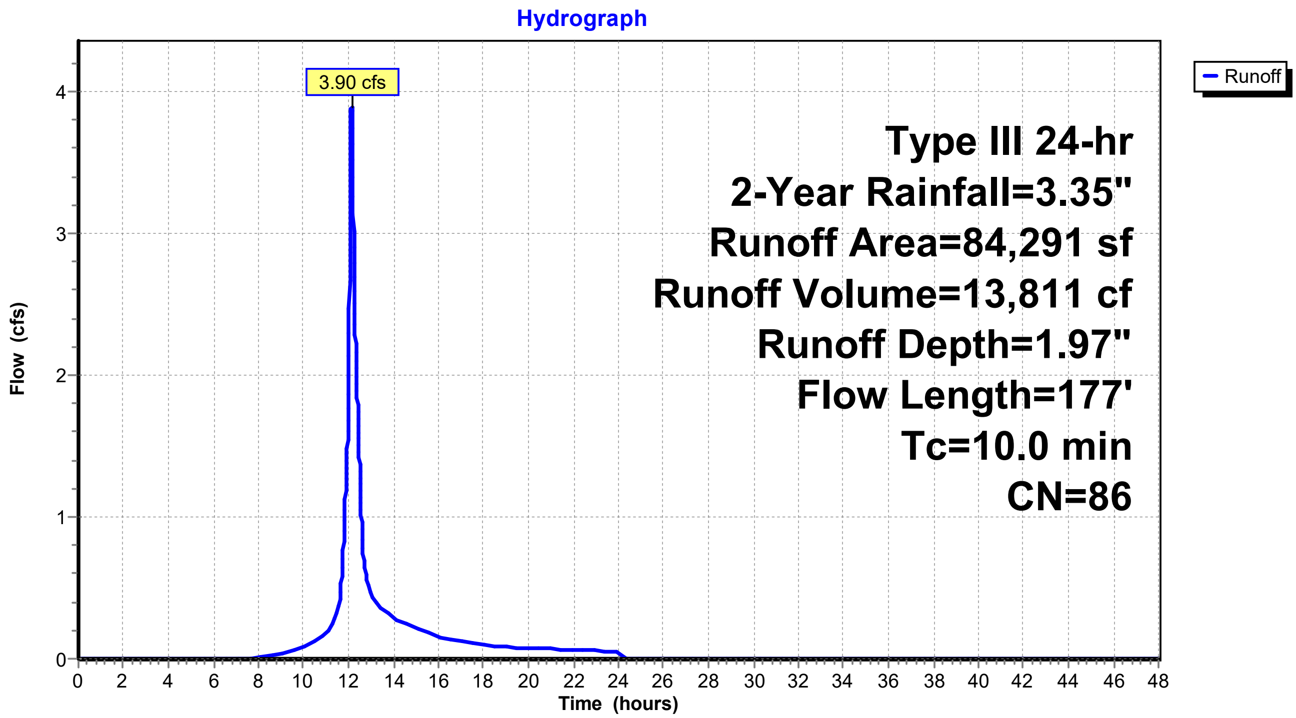
Runoff = 3.90 cfs @ 12.14 hrs, Volume= 13,811 cf, Depth= 1.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.35"

	Area (sf)	CN	Description
*	13,500	98	Ledge, HSG D
	47,115	77	Woods, Good, HSG D
	3,353	89	Dirt roads, HSG D
*	20,323	98	Wetland Surface, HSG D
	84,291	86	Weighted Average
	50,468	78	59.87% Pervious Area
	33,823	98	40.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	50	0.0500	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.40"
1.7	127	0.0620	1.24		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
10.0	177	Total			

Subcatchment E-5: E-5



Summary for Subcatchment E-6: E-6

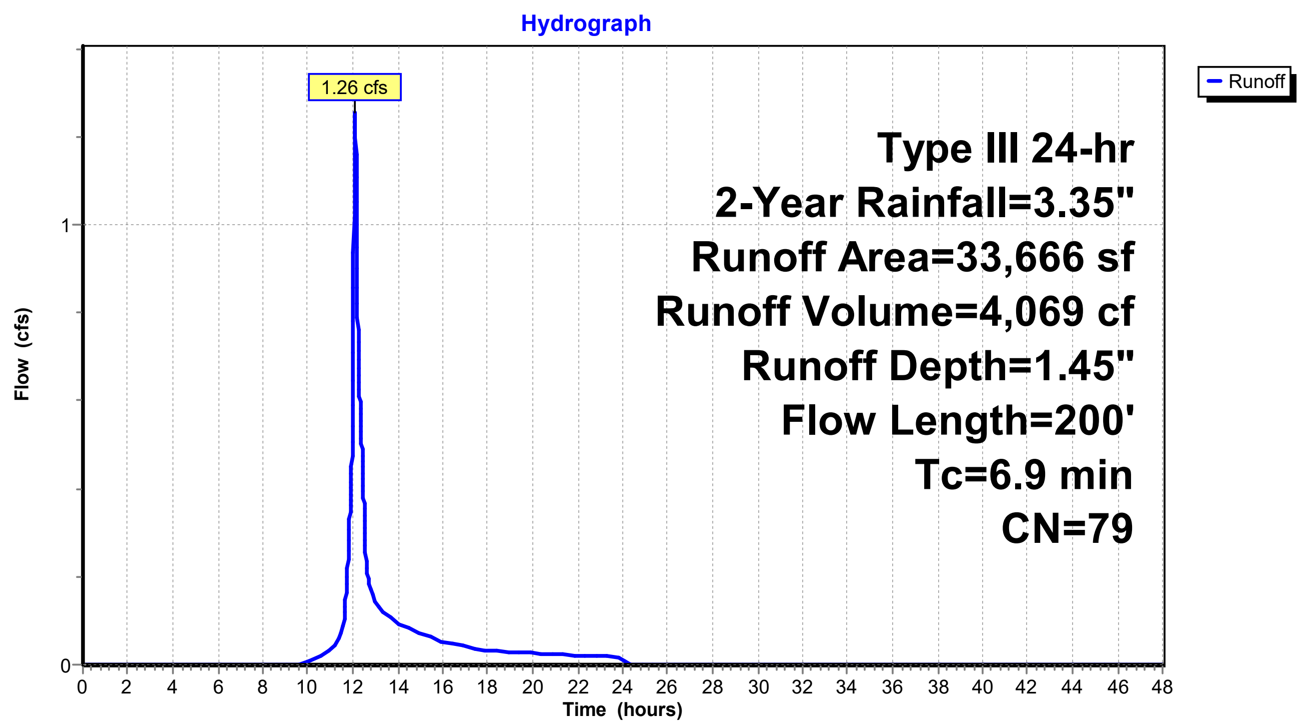
Runoff = 1.26 cfs @ 12.10 hrs, Volume= 4,069 cf, Depth= 1.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.35"

	Area (sf)	CN	Description
*	1,869	98	Ledge, HSG D
	29,200	77	Woods, Good, HSG D
	1,097	80	Pasture/grassland/range, Good, HSG D
*	1,500	98	Wetland Surface, HSG D
	33,666	79	Weighted Average
	30,297	77	89.99% Pervious Area
	3,369	98	10.01% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.1400	0.15		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.40"
1.4	150	0.1200	1.73		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
6.9	200	Total			

Subcatchment E-6: E-6

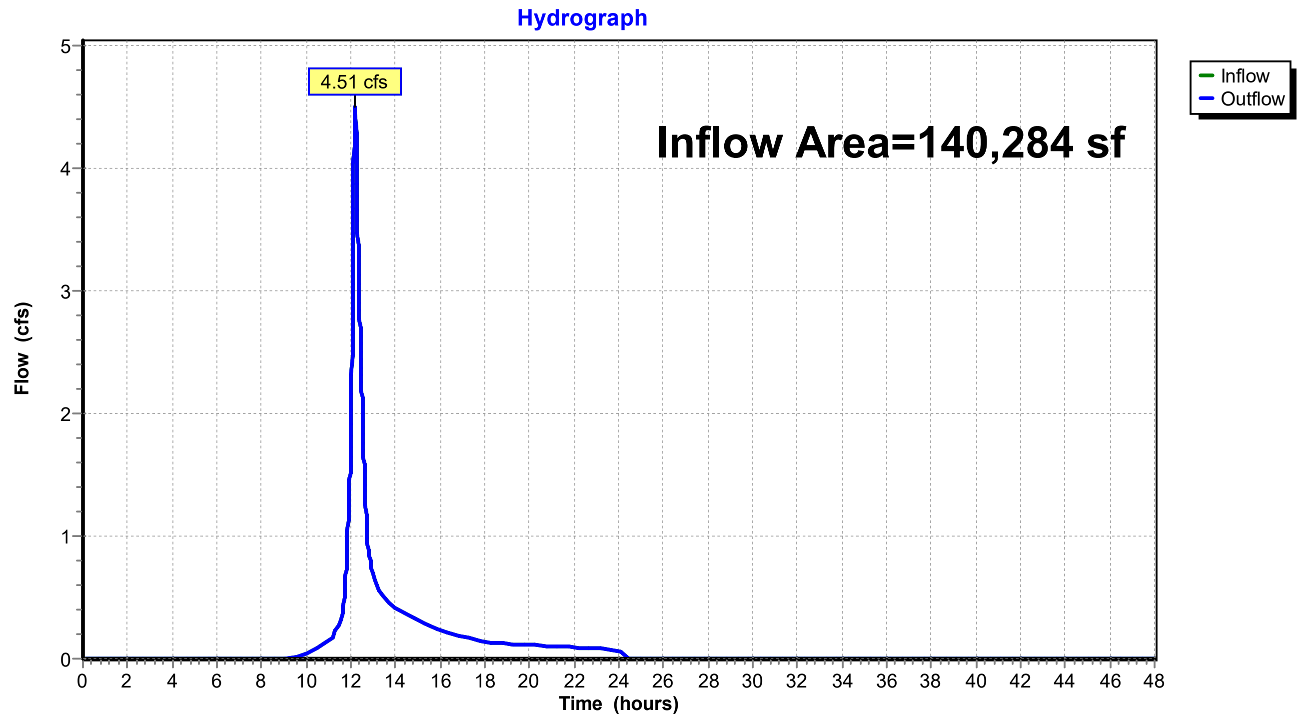


Summary for Reach PD1: WASHINGTON ROW

Inflow Area =	140,284 sf,	10.24% Impervious,	Inflow Depth =	1.52"	for 2-Year event
Inflow =	4.51 cfs @	12.19 hrs,	Volume=	17,749 cf	
Outflow =	4.51 cfs @	12.19 hrs,	Volume=	17,749 cf,	Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach PD1: WASHINGTON ROW

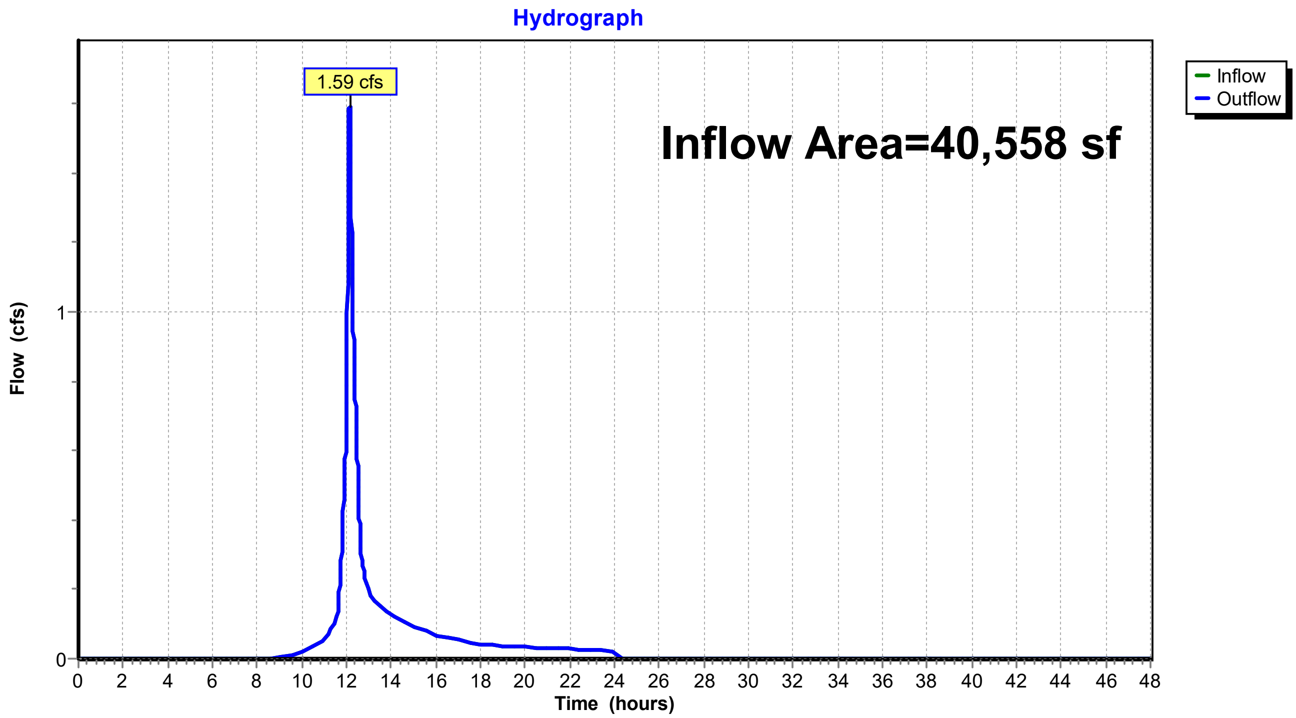


Summary for Reach PD2: Wetland series "A"

Inflow Area =	40,558 sf, 19.53% Impervious,	Inflow Depth = 1.66"	for 2-Year event
Inflow =	1.59 cfs @ 12.14 hrs, Volume=	5,609 cf	
Outflow =	1.59 cfs @ 12.14 hrs, Volume=	5,609 cf, Atten= 0%, Lag= 0.0 min	

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach PD2: Wetland series "A"

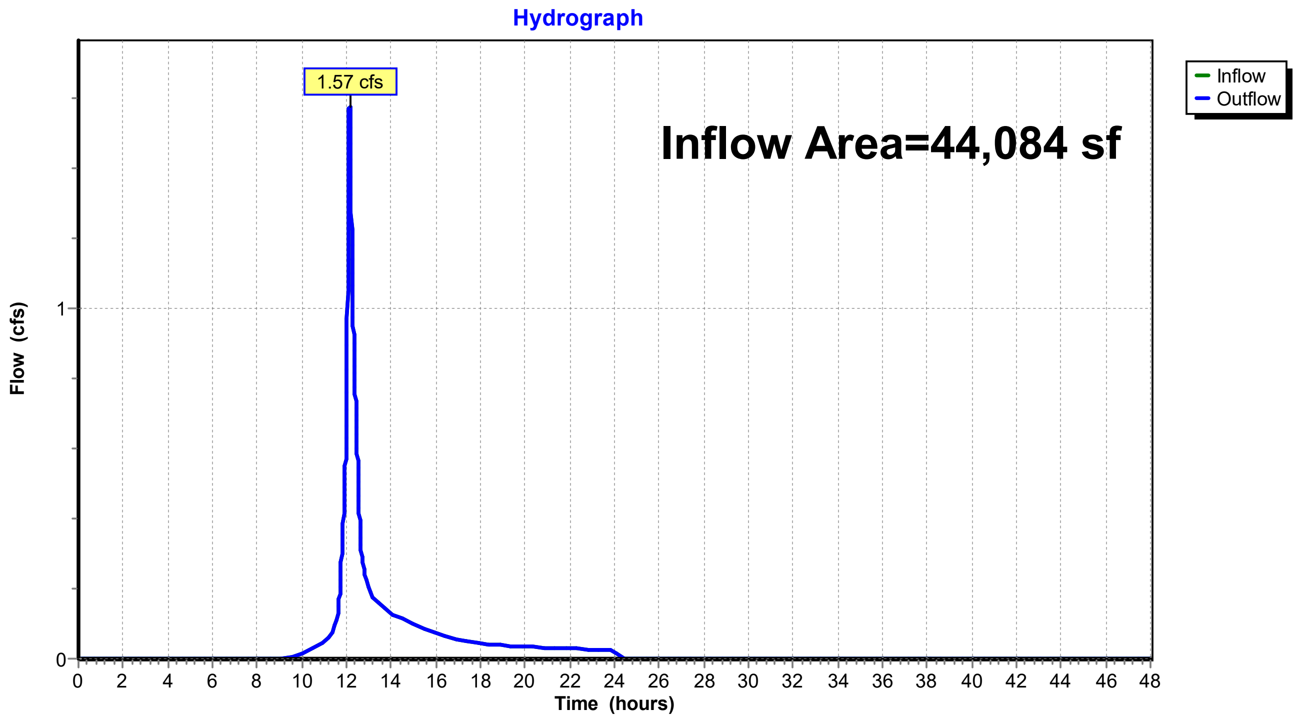


Summary for Reach PD3: Intermittent Stream

Inflow Area =	44,084 sf,	13.21% Impervious,	Inflow Depth = 1.52"	for 2-Year event
Inflow =	1.57 cfs @	12.14 hrs, Volume=	5,577 cf	
Outflow =	1.57 cfs @	12.14 hrs, Volume=	5,577 cf,	Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach PD3: Intermittent Stream

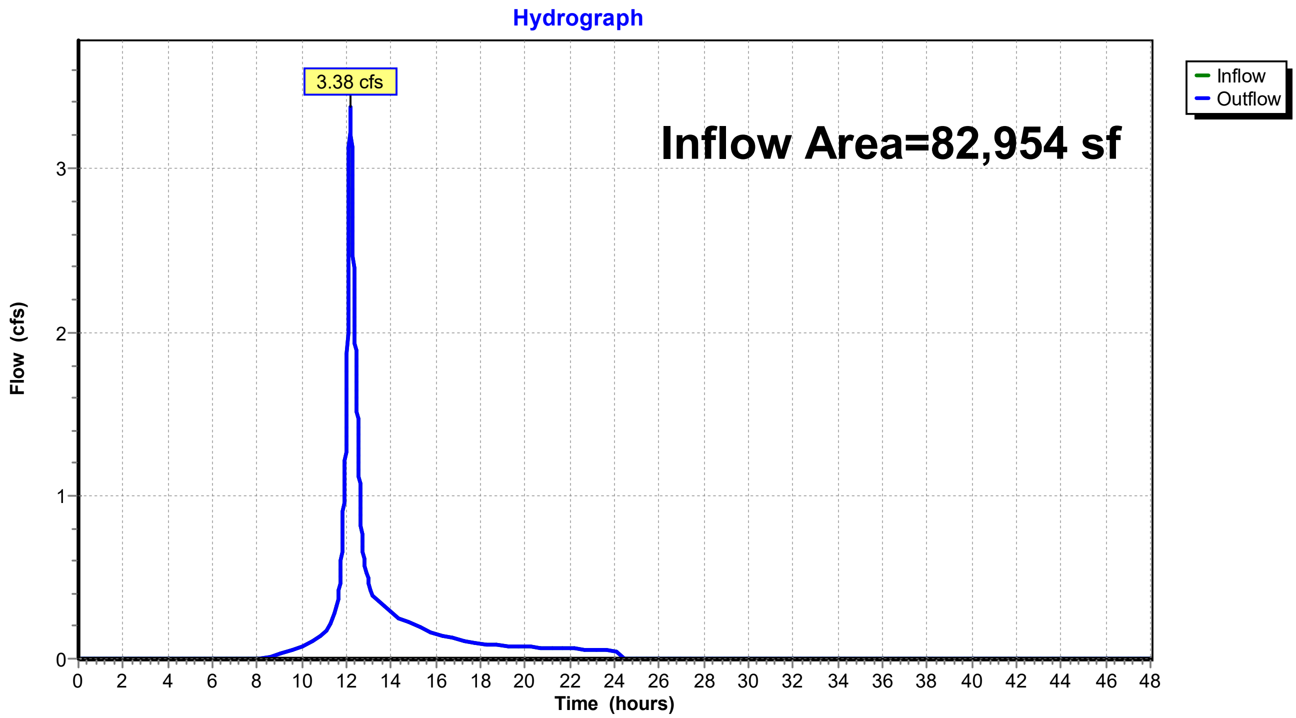


Summary for Reach PD4: Wetland series "B"

Inflow Area =	82,954 sf,	33.91% Impervious,	Inflow Depth = 1.89"	for 2-Year event
Inflow =	3.38 cfs @	12.18 hrs, Volume=	13,040 cf	
Outflow =	3.38 cfs @	12.18 hrs, Volume=	13,040 cf, Atten= 0%, Lag= 0.0 min	

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach PD4: Wetland series "B"

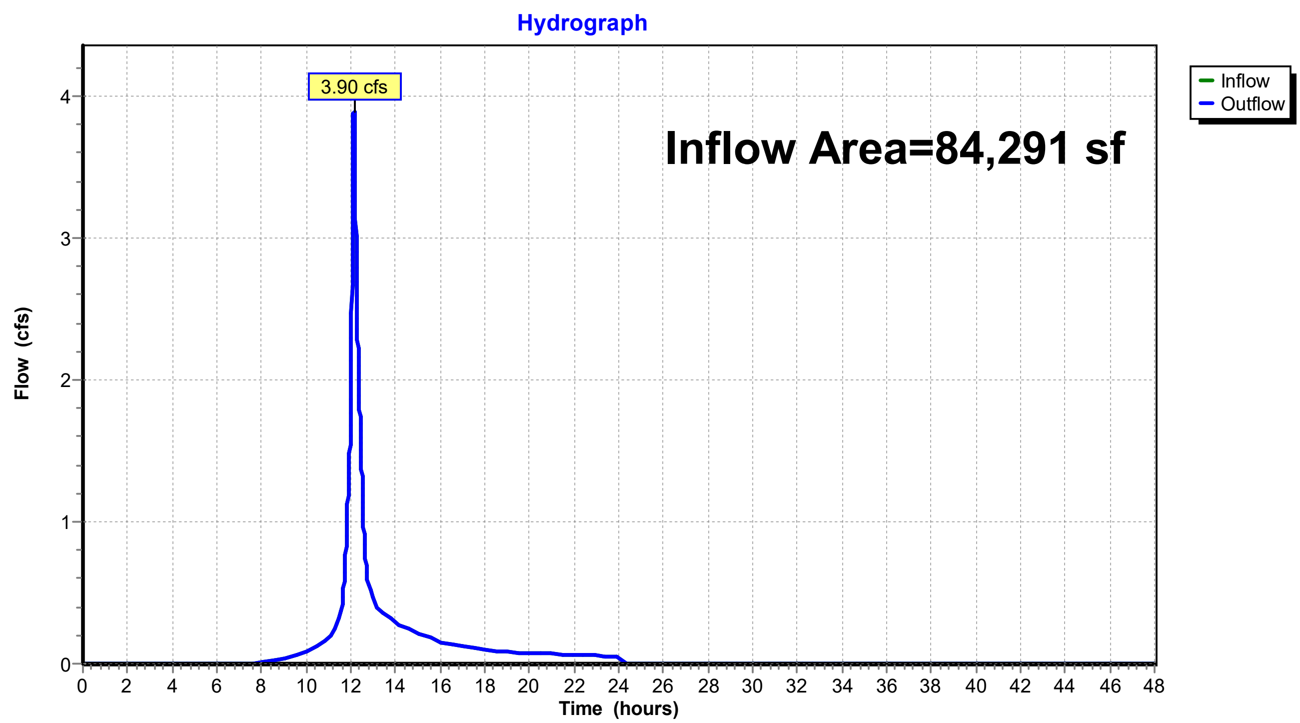


Summary for Reach PD5: Wetland series "E"

Inflow Area =	84,291 sf,	40.13% Impervious,	Inflow Depth = 1.97"	for 2-Year event
Inflow =	3.90 cfs @	12.14 hrs, Volume=	13,811 cf	
Outflow =	3.90 cfs @	12.14 hrs, Volume=	13,811 cf, Atten= 0%, Lag= 0.0 min	

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach PD5: Wetland series "E"

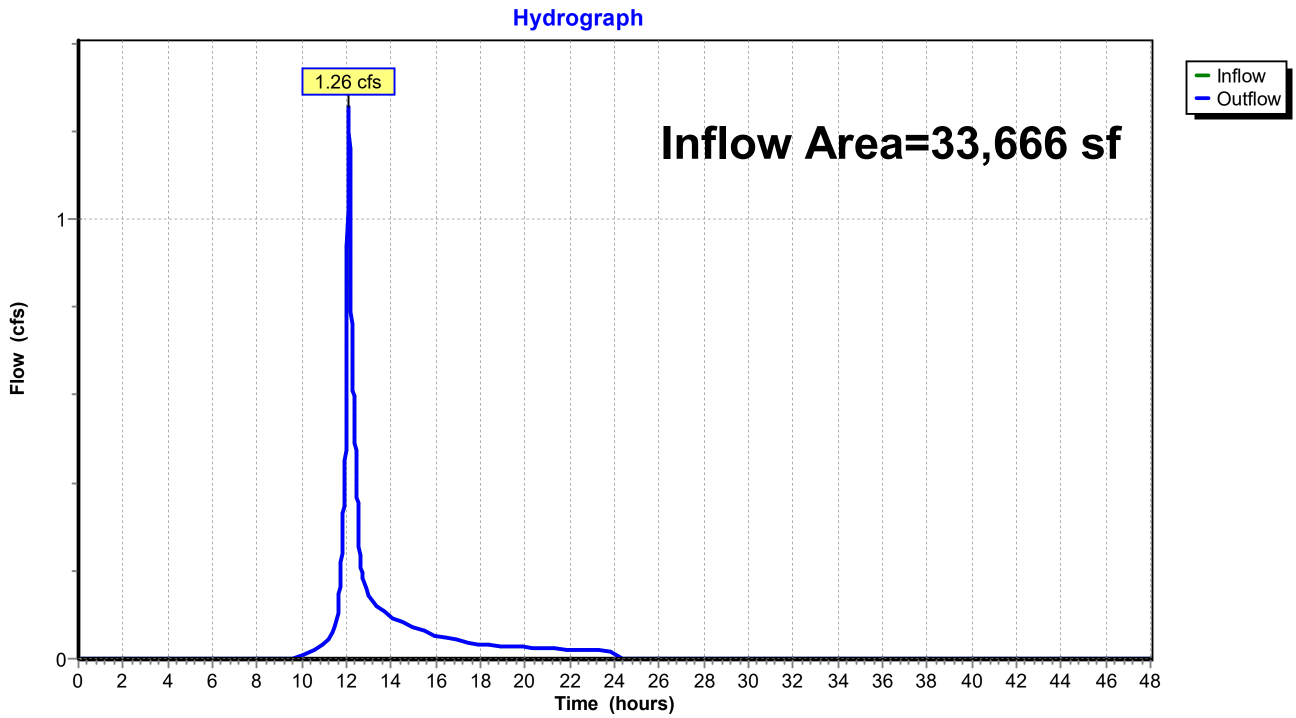


Summary for Reach PD6: Wetland series "F"

Inflow Area = 33,666 sf, 10.01% Impervious, Inflow Depth = 1.45" for 2-Year event
Inflow = 1.26 cfs @ 12.10 hrs, Volume= 4,069 cf
Outflow = 1.26 cfs @ 12.10 hrs, Volume= 4,069 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach PD6: Wetland series "F"

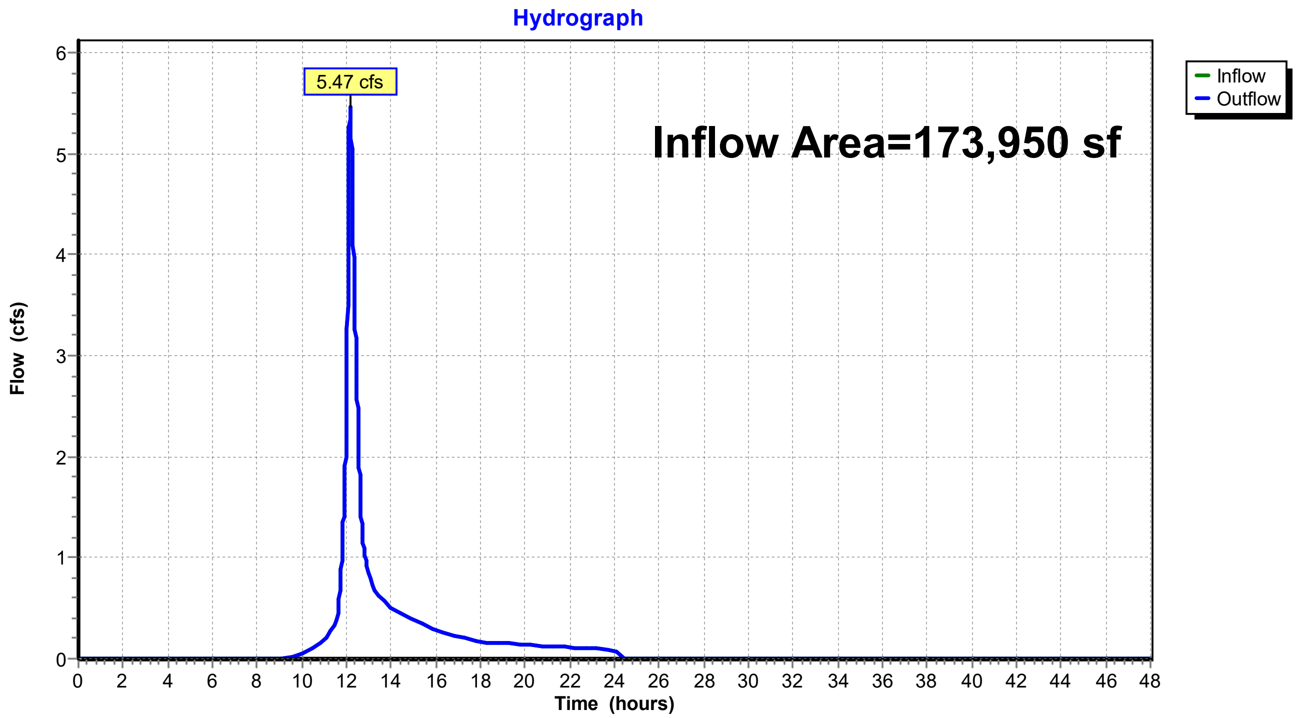


Summary for Reach WD: Washington St Drainage outlet

Inflow Area = 173,950 sf, 10.19% Impervious, Inflow Depth = 1.51" for 2-Year event
Inflow = 5.47 cfs @ 12.17 hrs, Volume= 21,818 cf
Outflow = 5.47 cfs @ 12.17 hrs, Volume= 21,818 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach WD: Washington St Drainage outlet



Summary for Subcatchment E-1: E-1

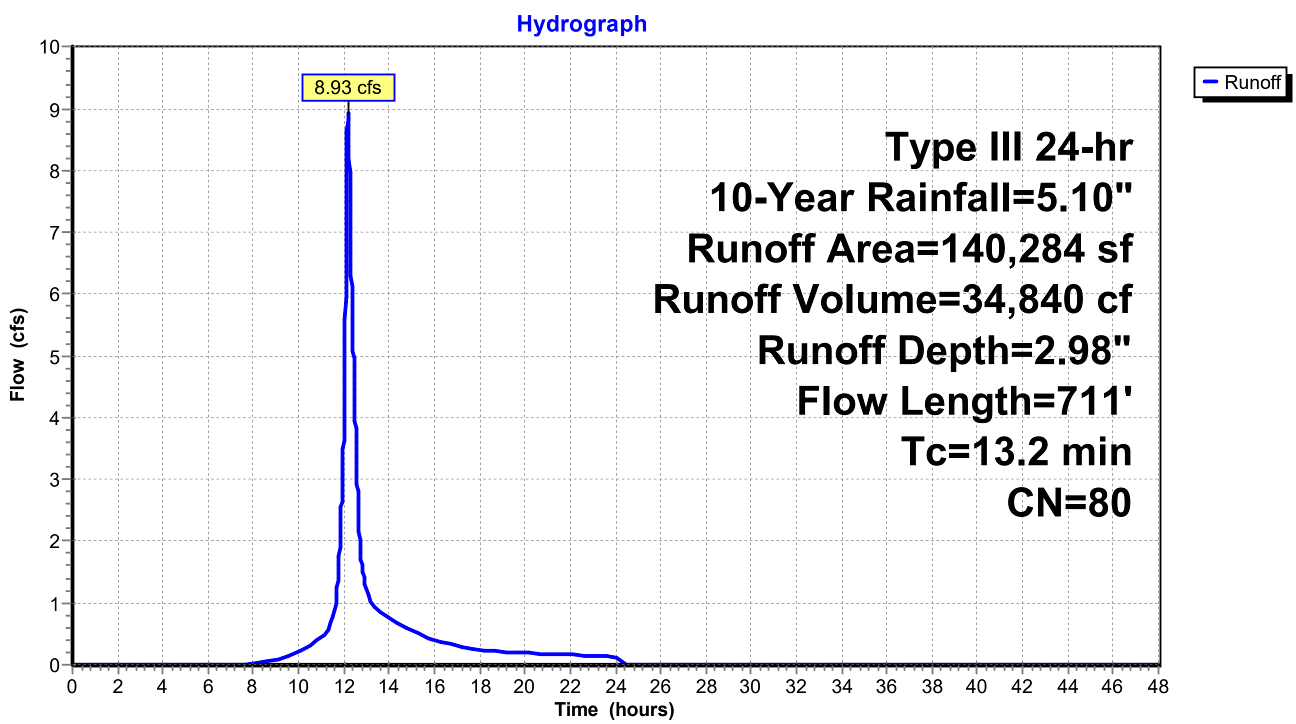
Runoff = 8.93 cfs @ 12.18 hrs, Volume= 34,840 cf, Depth= 2.98"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.10"

	Area (sf)	CN	Description
*	2,885	98	isol wetland HSG D
*	3,535	98	Pavement and Roofs, HSG D
*	6,775	89	Dirt/Gravell roads, HSG D
*	7,944	98	Ledge, HSG D
	93,250	77	Woods, Good, HSG D
	25,895	80	Pasture/grassland/range, Good, HSG D
	140,284	80	Weighted Average
	125,920	78	89.76% Pervious Area
	14,364	98	10.24% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.4	50	0.1200	0.35		**Sheet Flow,** Range n= 0.130 P2= 3.40"
10.8	661	0.0420	1.02		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
13.2	711	Total			

Subcatchment E-1: E-1



Summary for Subcatchment E-2: E-2

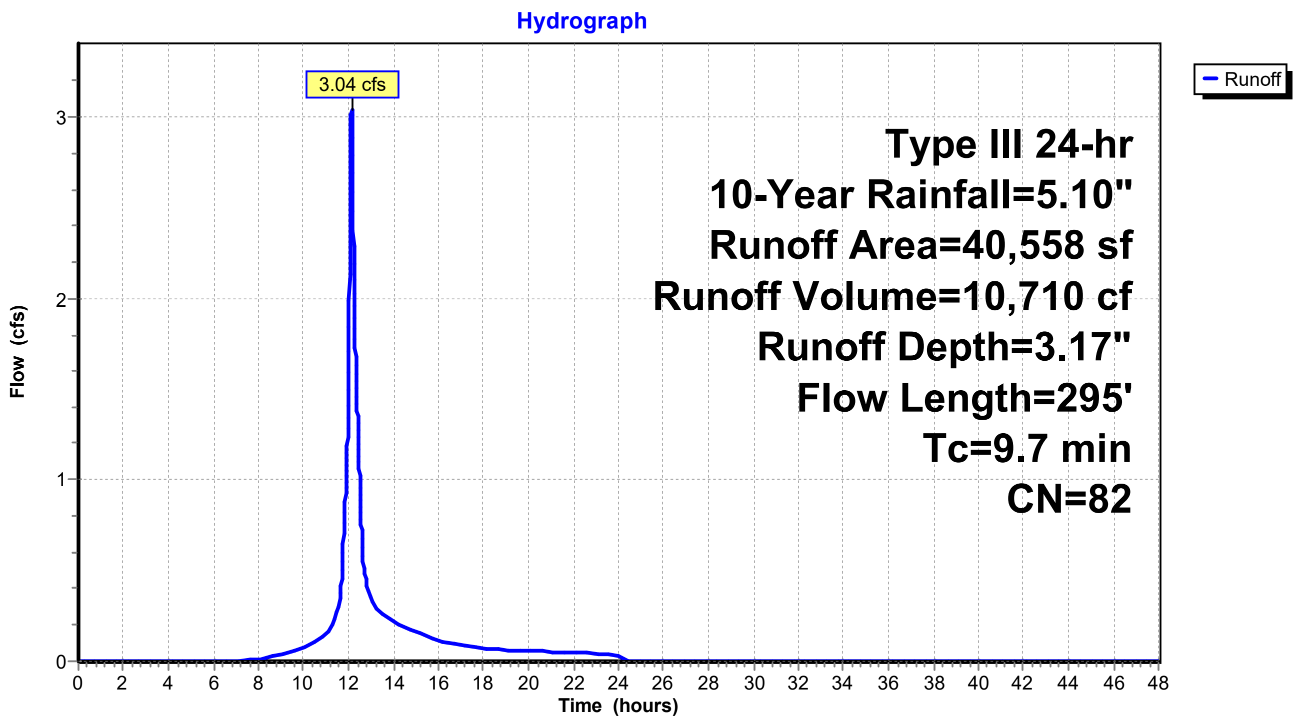
Runoff = 3.04 cfs @ 12.13 hrs, Volume= 10,710 cf, Depth= 3.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.10"

	Area (sf)	CN	Description
*	5,020	98	Ledge, HSG D
	28,312	77	Woods, Good, HSG D
*	2,902	98	Wetland Surface, HSG D
	2,393	89	Dirt roads, HSG D
	1,931	78	Meadow, non-grazed, HSG D
	40,558	82	Weighted Average
	32,636	78	80.47% Pervious Area
	7,922	98	19.53% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	50	0.0700	0.11		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.40"
2.5	245	0.1100	1.66		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
9.7	295	Total			

Subcatchment E-2: E-2



Summary for Subcatchment E-3: E-3

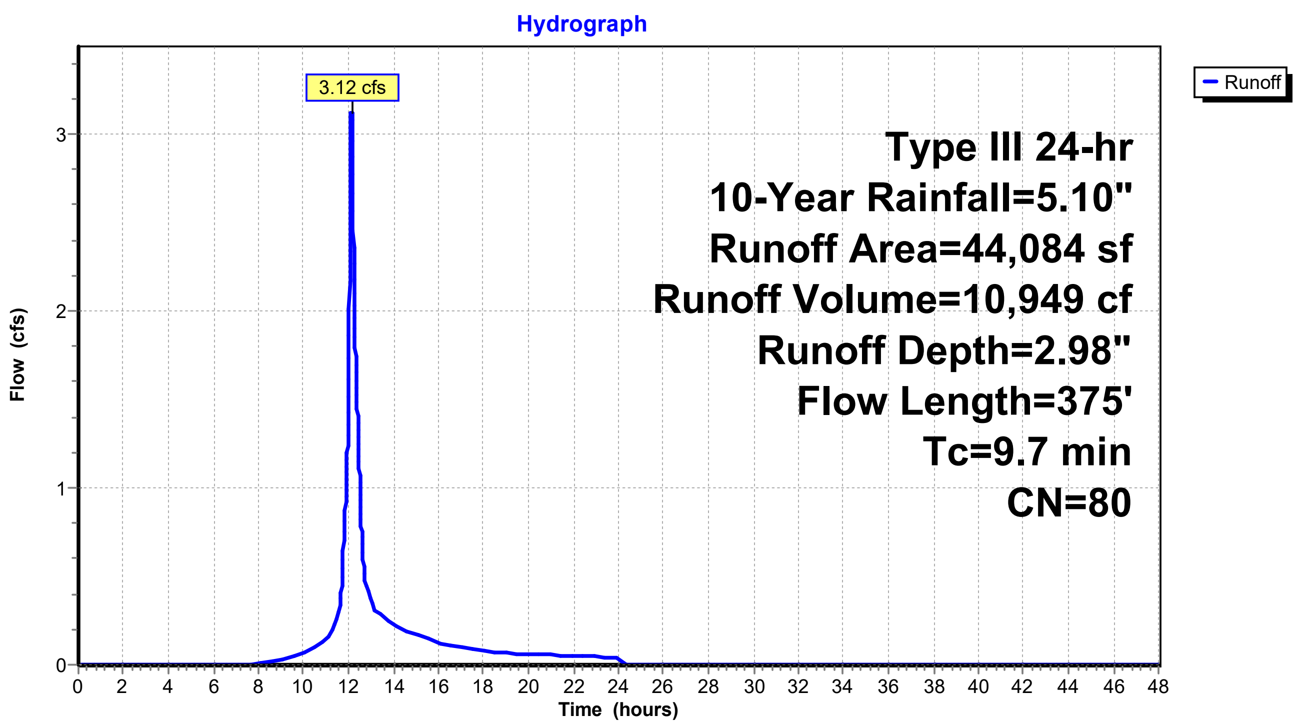
Runoff = 3.12 cfs @ 12.14 hrs, Volume= 10,949 cf, Depth= 2.98"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.10"

	Area (sf)	CN	Description
*	1,868	98	Ledge, HSG D
	38,259	77	Woods, Good, HSG D
*	3,957	98	Wetland Surface, HSG D
	44,084	80	Weighted Average
	38,259	77	86.79% Pervious Area
	5,825	98	13.21% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	50	0.1000	0.13		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.40"
3.3	241	0.0600	1.22		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.1	84	0.0700	14.18	127.58	**Channel Flow,** Area= 9.0 sf Perim= 8.0' r= 1.13' n= 0.030 Stream, clean & straight
9.7	375	Total			

Subcatchment E-3: E-3



Summary for Subcatchment E-4: E-4

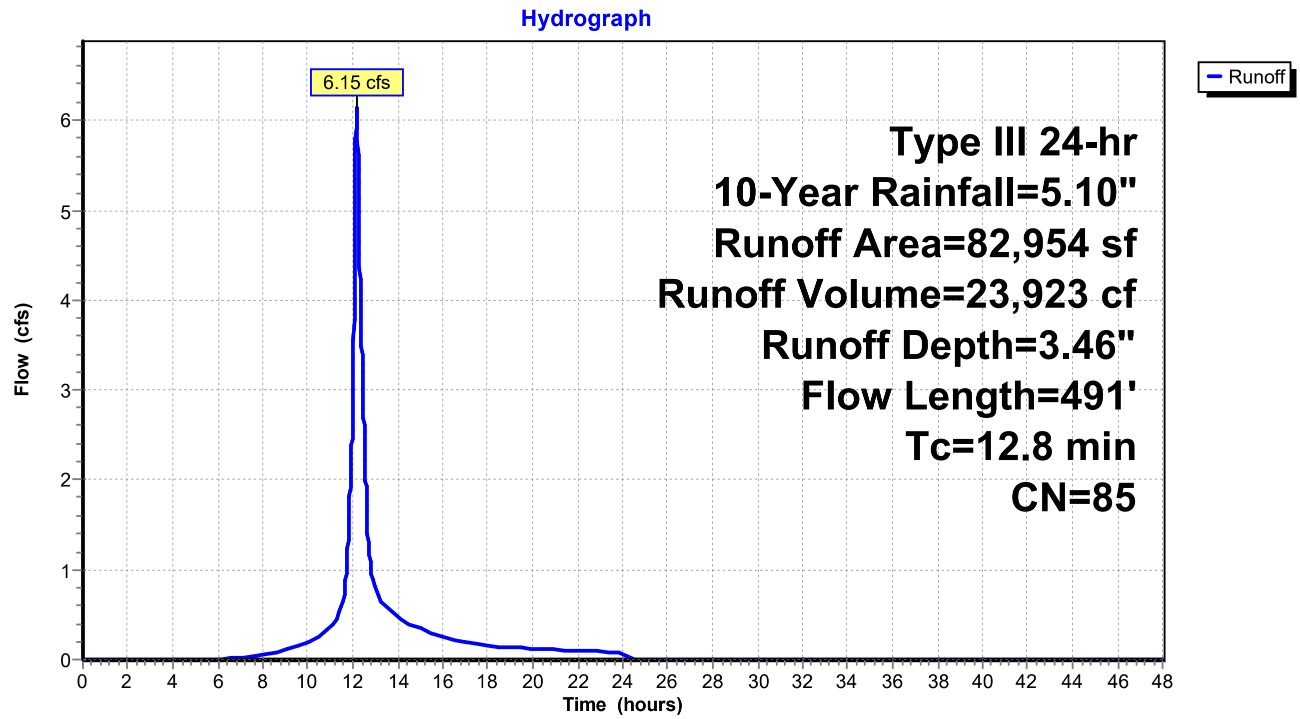
Runoff = 6.15 cfs @ 12.17 hrs, Volume= 23,923 cf, Depth= 3.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.10"

	Area (sf)	CN	Description
*	25,716	98	Ledge, HSG D
	47,000	77	Woods, Good, HSG D
	2,512	80	Pasture/grassland/range, Good, HSG D
*	2,410	98	Wetland Surface, HSG D
	5,316	89	Dirt roads, HSG D
	82,954	85	Weighted Average
	54,828	78	66.09% Pervious Area
	28,126	98	33.91% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	50	0.0700	0.11		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.40"
1.0	232	0.0560	3.81		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
4.6	209	0.0230	0.76		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
12.8	491	Total			

Subcatchment E-4: E-4



Summary for Subcatchment E-5: E-5

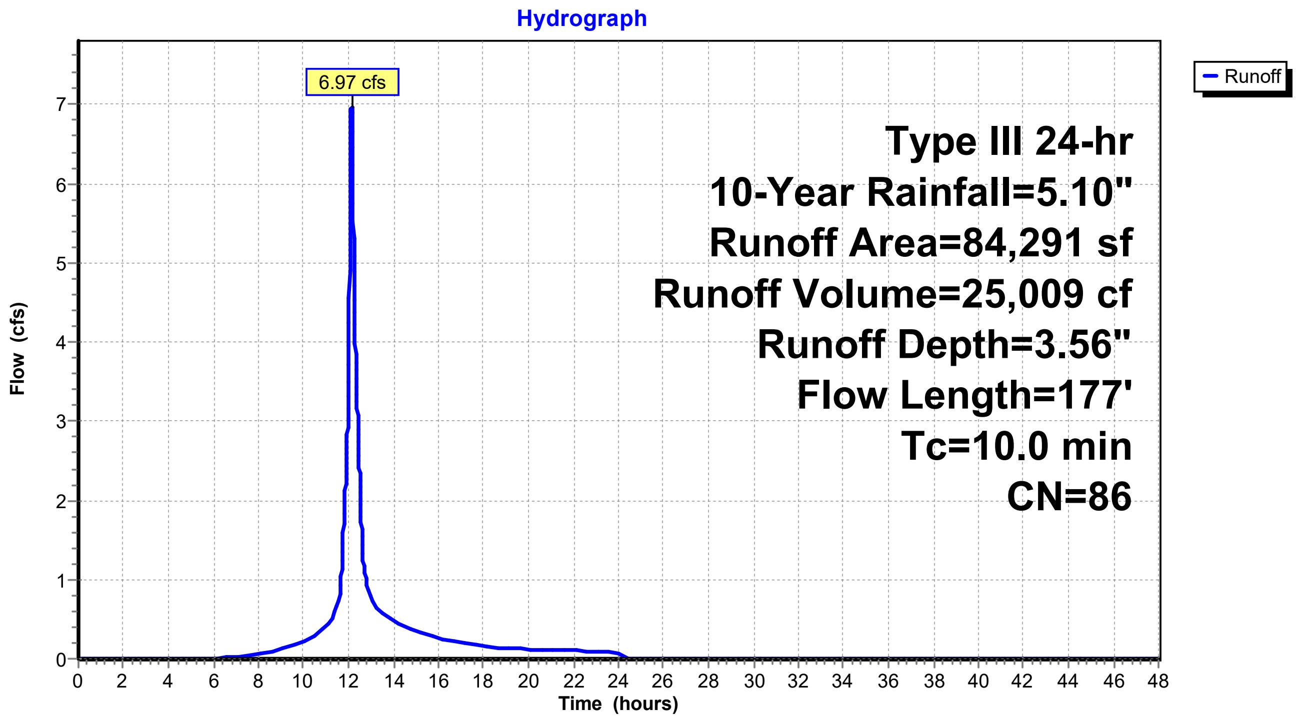
Runoff = 6.97 cfs @ 12.14 hrs, Volume= 25,009 cf, Depth= 3.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.10"

	Area (sf)	CN	Description
*	13,500	98	Ledge, HSG D
	47,115	77	Woods, Good, HSG D
	3,353	89	Dirt roads, HSG D
*	20,323	98	Wetland Surface, HSG D
	84,291	86	Weighted Average
	50,468	78	59.87% Pervious Area
	33,823	98	40.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	50	0.0500	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.40"
1.7	127	0.0620	1.24		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
10.0	177	Total			

Subcatchment E-5: E-5



Summary for Subcatchment E-6: E-6

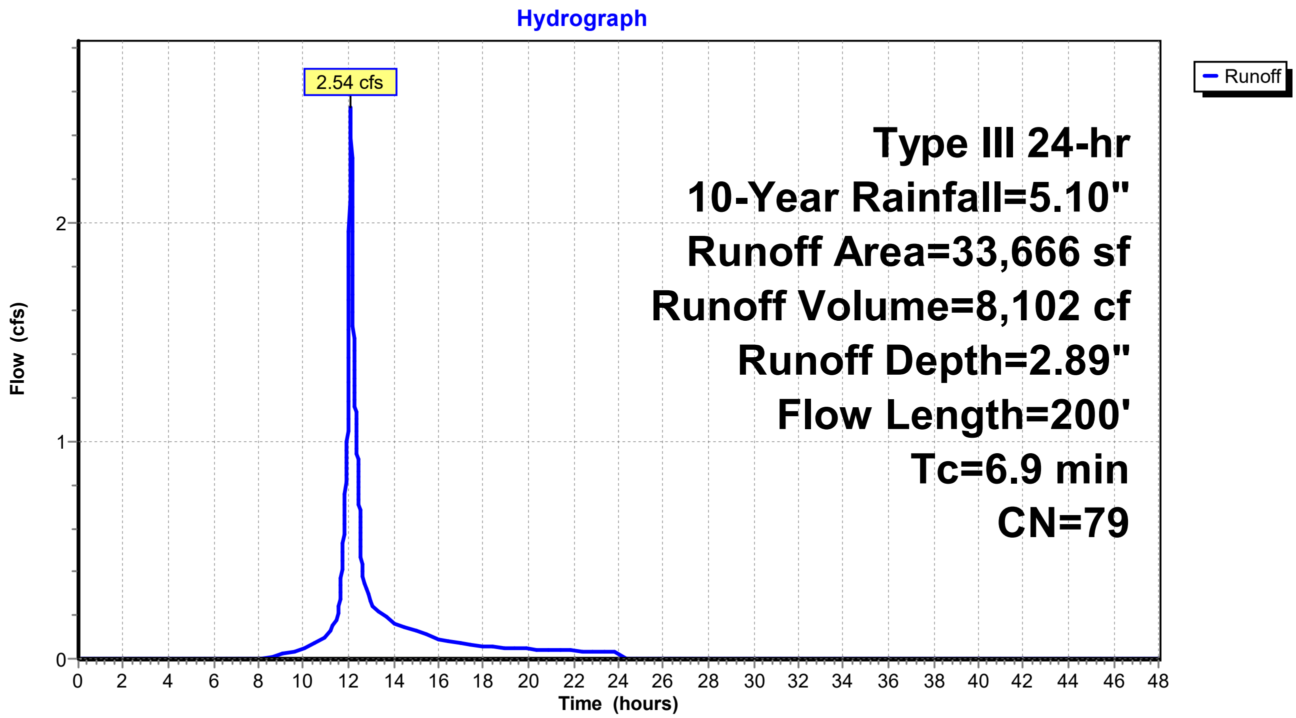
Runoff = 2.54 cfs @ 12.10 hrs, Volume= 8,102 cf, Depth= 2.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.10"

	Area (sf)	CN	Description
*	1,869	98	Ledge, HSG D
	29,200	77	Woods, Good, HSG D
	1,097	80	Pasture/grassland/range, Good, HSG D
*	1,500	98	Wetland Surface, HSG D
	33,666	79	Weighted Average
	30,297	77	89.99% Pervious Area
	3,369	98	10.01% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.1400	0.15		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.40"
1.4	150	0.1200	1.73		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
6.9	200	Total			

Subcatchment E-6: E-6

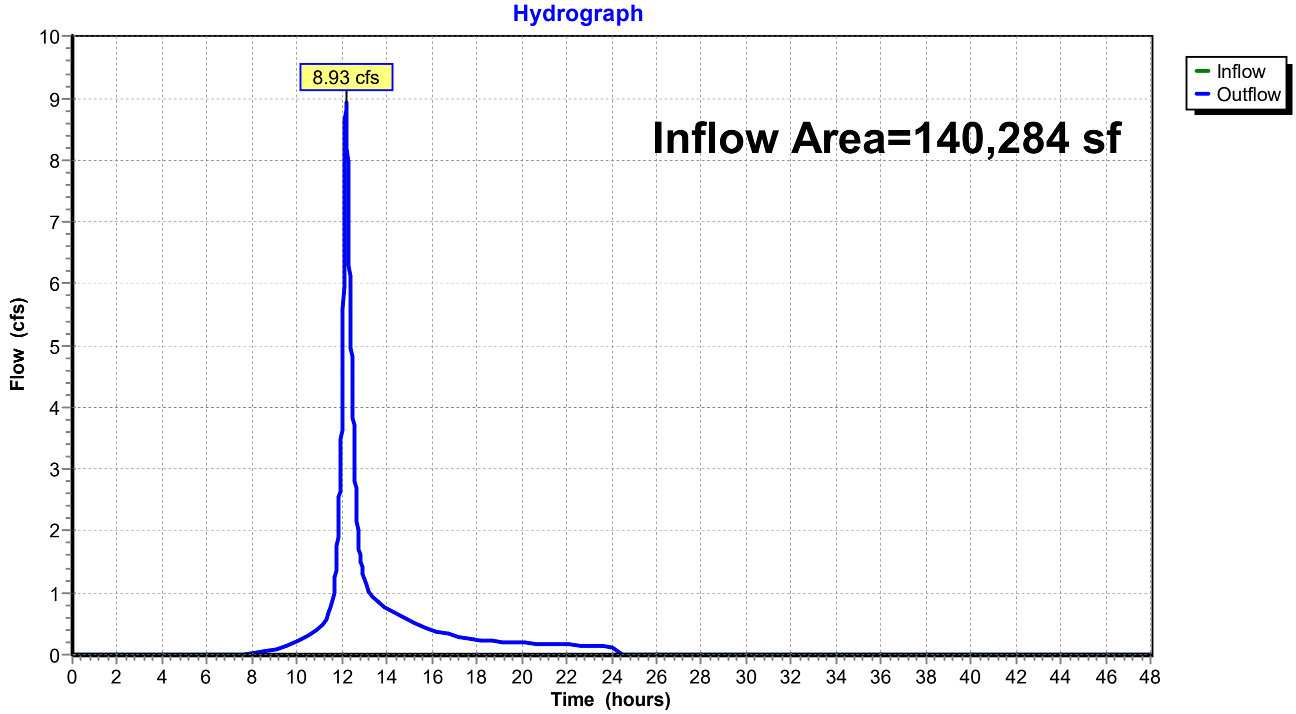


Summary for Reach PD1: WASHINGTON ROW

Inflow Area =	140,284 sf,	10.24% Impervious,	Inflow Depth = 2.98"	for 10-Year event
Inflow =	8.93 cfs @	12.18 hrs, Volume=	34,840 cf	
Outflow =	8.93 cfs @	12.18 hrs, Volume=	34,840 cf, Atten= 0%, Lag= 0.0 min	

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach PD1: WASHINGTON ROW

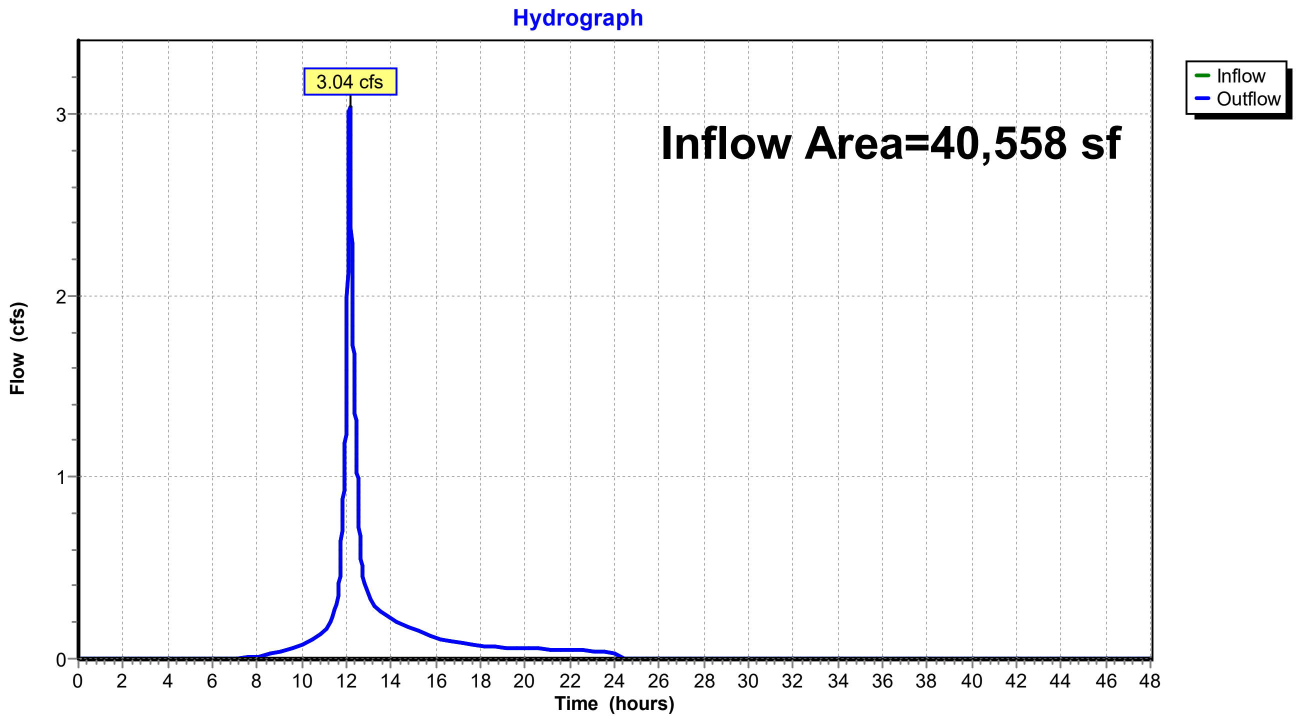


Summary for Reach PD2: Wetland series "A"

Inflow Area = 40,558 sf, 19.53% Impervious, Inflow Depth = 3.17" for 10-Year event
Inflow = 3.04 cfs @ 12.13 hrs, Volume= 10,710 cf
Outflow = 3.04 cfs @ 12.13 hrs, Volume= 10,710 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach PD2: Wetland series "A"

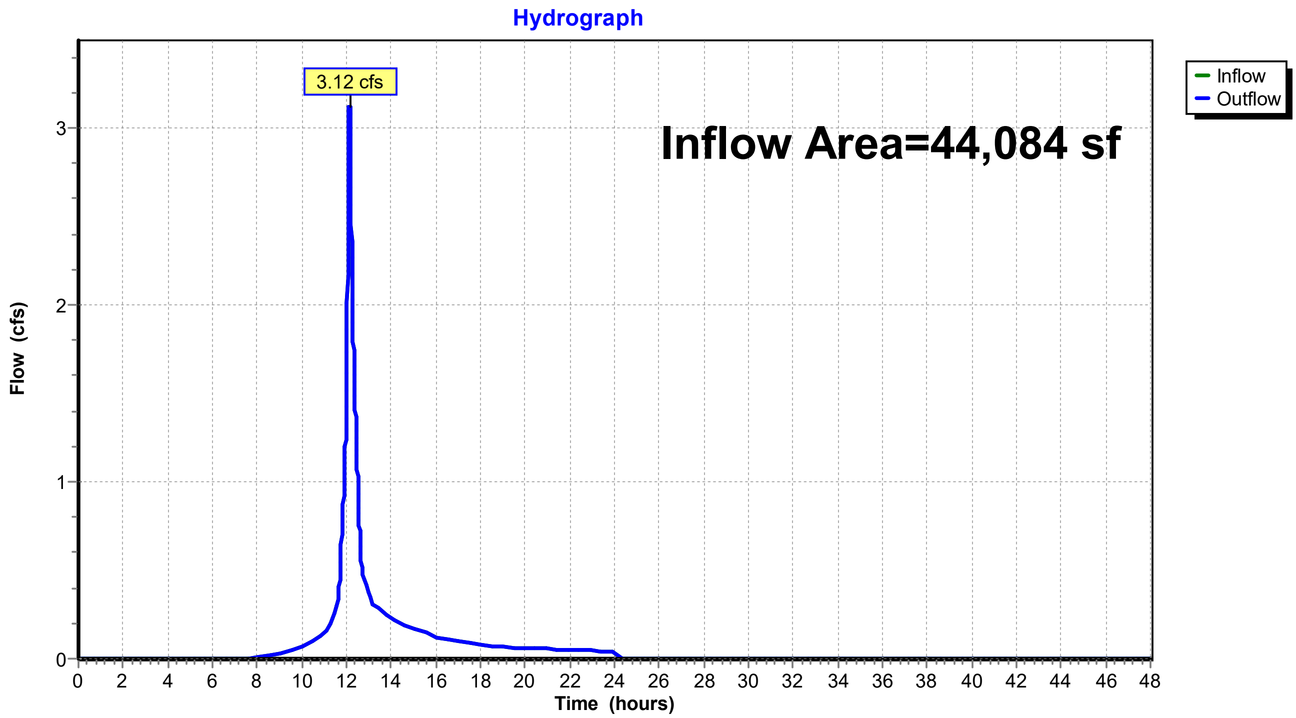


Summary for Reach PD3: Intermittent Stream

Inflow Area =	44,084 sf,	13.21% Impervious,	Inflow Depth = 2.98"	for 10-Year event	
Inflow =	3.12 cfs @	12.14 hrs,	Volume=	10,949 cf	
Outflow =	3.12 cfs @	12.14 hrs,	Volume=	10,949 cf,	Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach PD3: Intermittent Stream

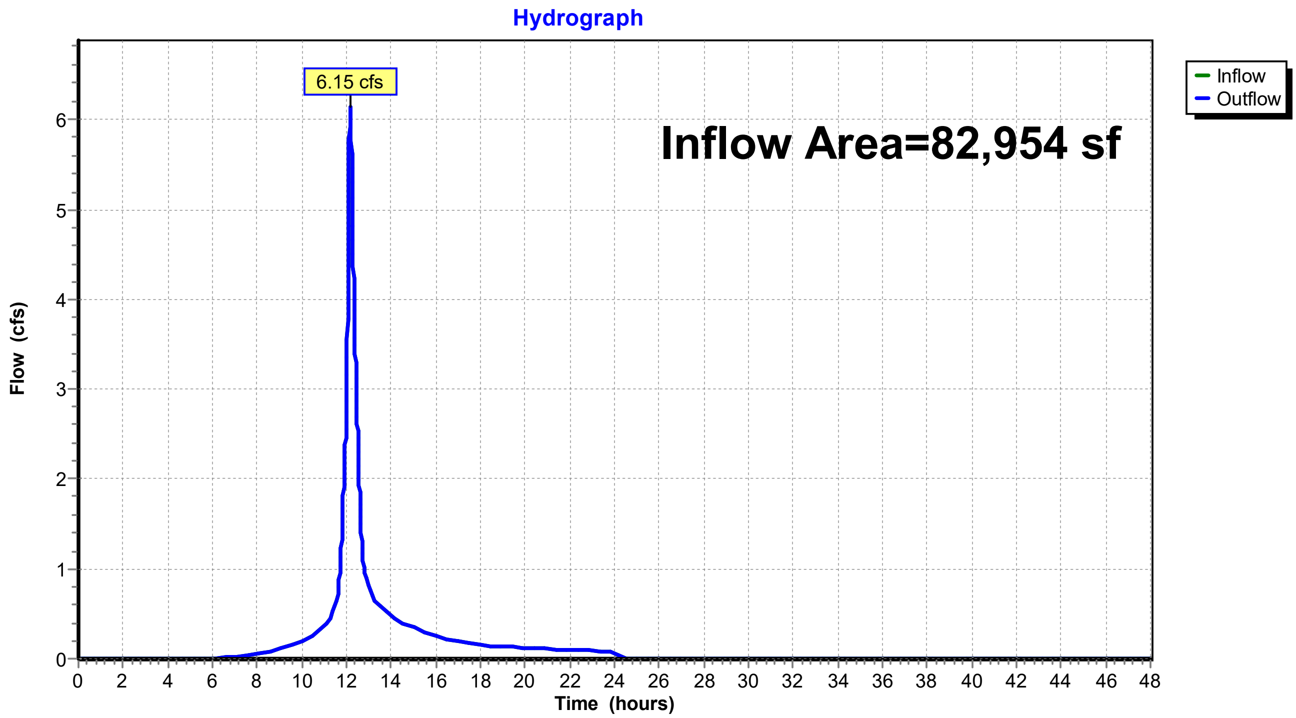


Summary for Reach PD4: Wetland series "B"

Inflow Area = 82,954 sf, 33.91% Impervious, Inflow Depth = 3.46" for 10-Year event
Inflow = 6.15 cfs @ 12.17 hrs, Volume= 23,923 cf
Outflow = 6.15 cfs @ 12.17 hrs, Volume= 23,923 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach PD4: Wetland series "B"

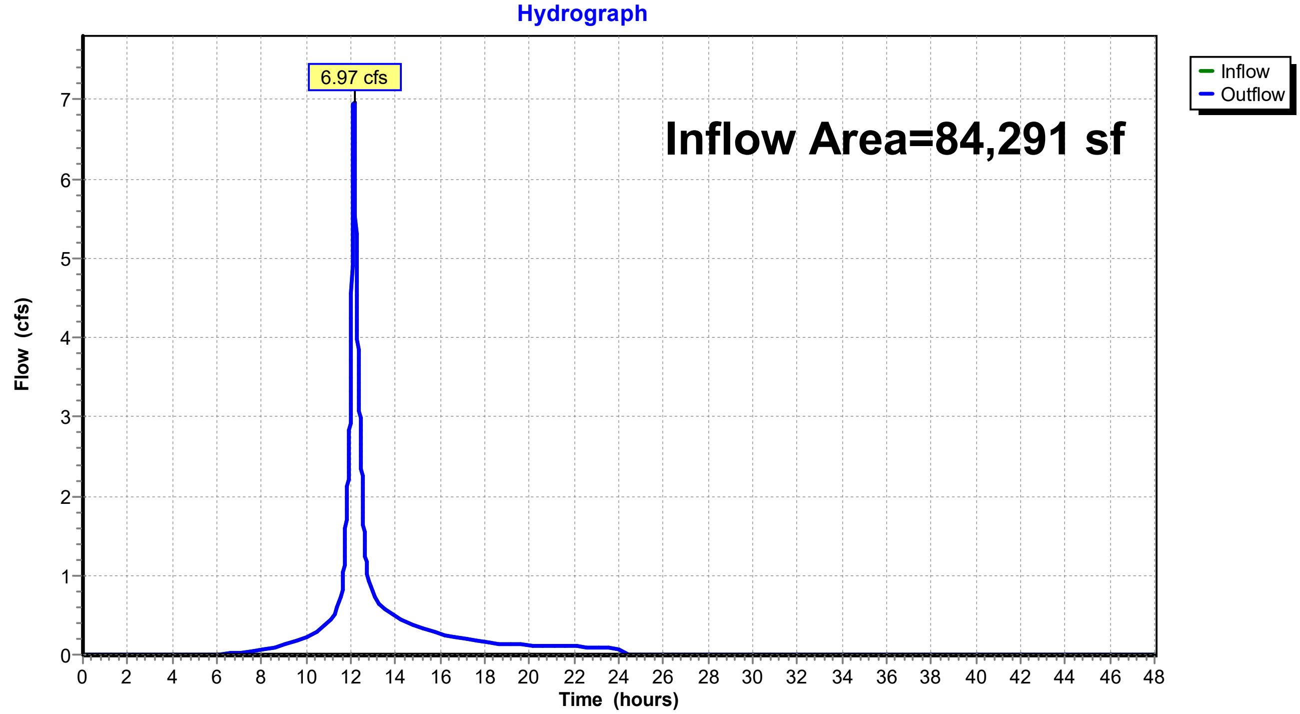


Summary for Reach PD5: Wetland series "E"

Inflow Area =	84,291 sf,	40.13% Impervious,	Inflow Depth = 3.56"	for 10-Year event
Inflow =	6.97 cfs @	12.14 hrs, Volume=	25,009 cf	
Outflow =	6.97 cfs @	12.14 hrs, Volume=	25,009 cf, Atten= 0%, Lag= 0.0 min	

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach PD5: Wetland series "E"

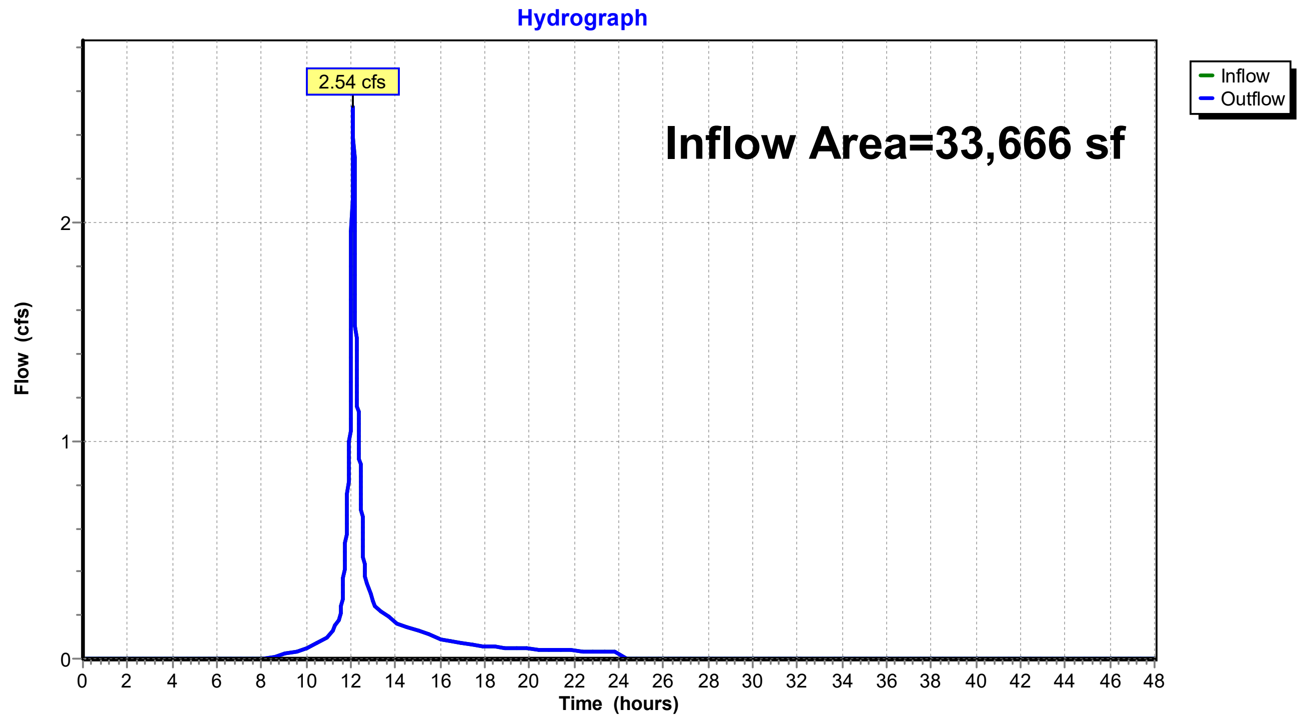


Summary for Reach PD6: Wetland series "F"

Inflow Area =	33,666 sf,	10.01% Impervious,	Inflow Depth = 2.89"	for 10-Year event	
Inflow =	2.54 cfs @	12.10 hrs,	Volume=	8,102 cf	
Outflow =	2.54 cfs @	12.10 hrs,	Volume=	8,102 cf,	Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach PD6: Wetland series "F"

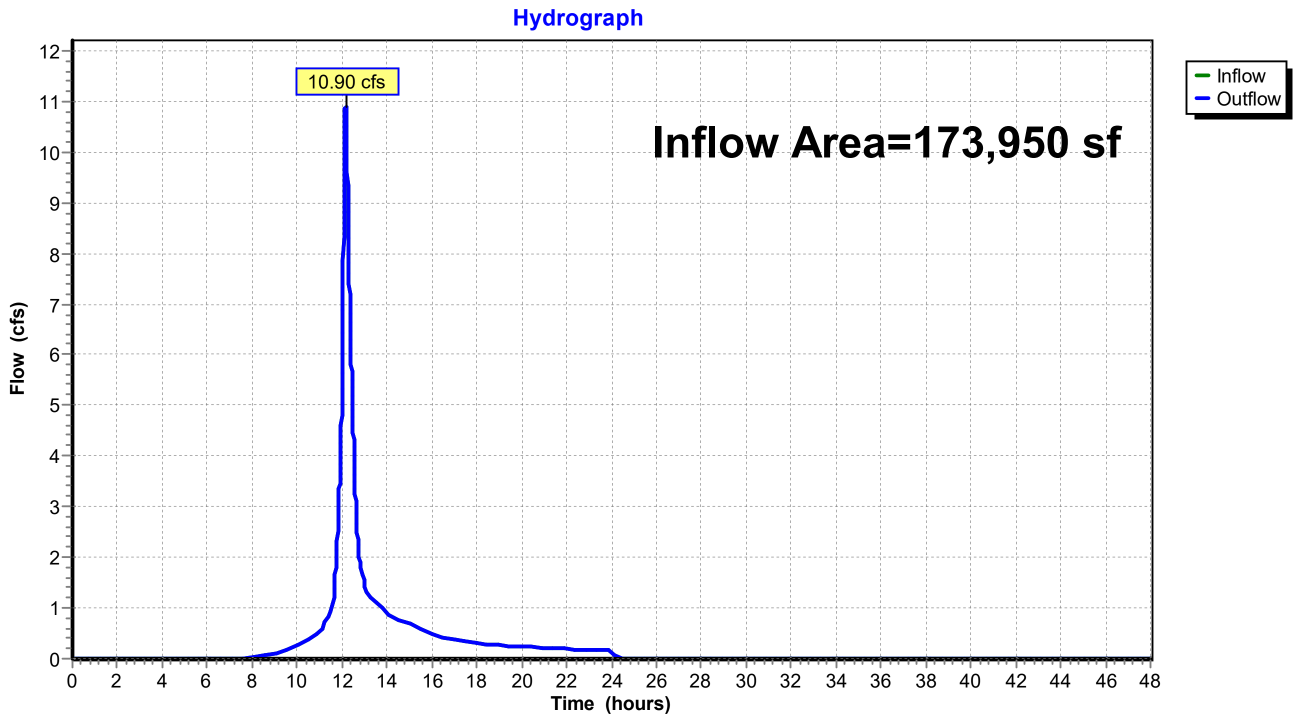


Summary for Reach WD: Washington St Drainage outlet

Inflow Area =	173,950 sf,	10.19% Impervious,	Inflow Depth = 2.96"	for 10-Year event
Inflow =	10.90 cfs @	12.16 hrs, Volume=	42,943 cf	
Outflow =	10.90 cfs @	12.16 hrs, Volume=	42,943 cf, Atten= 0%, Lag= 0.0 min	

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach WD: Washington St Drainage outlet



Summary for Subcatchment E-1: E-1

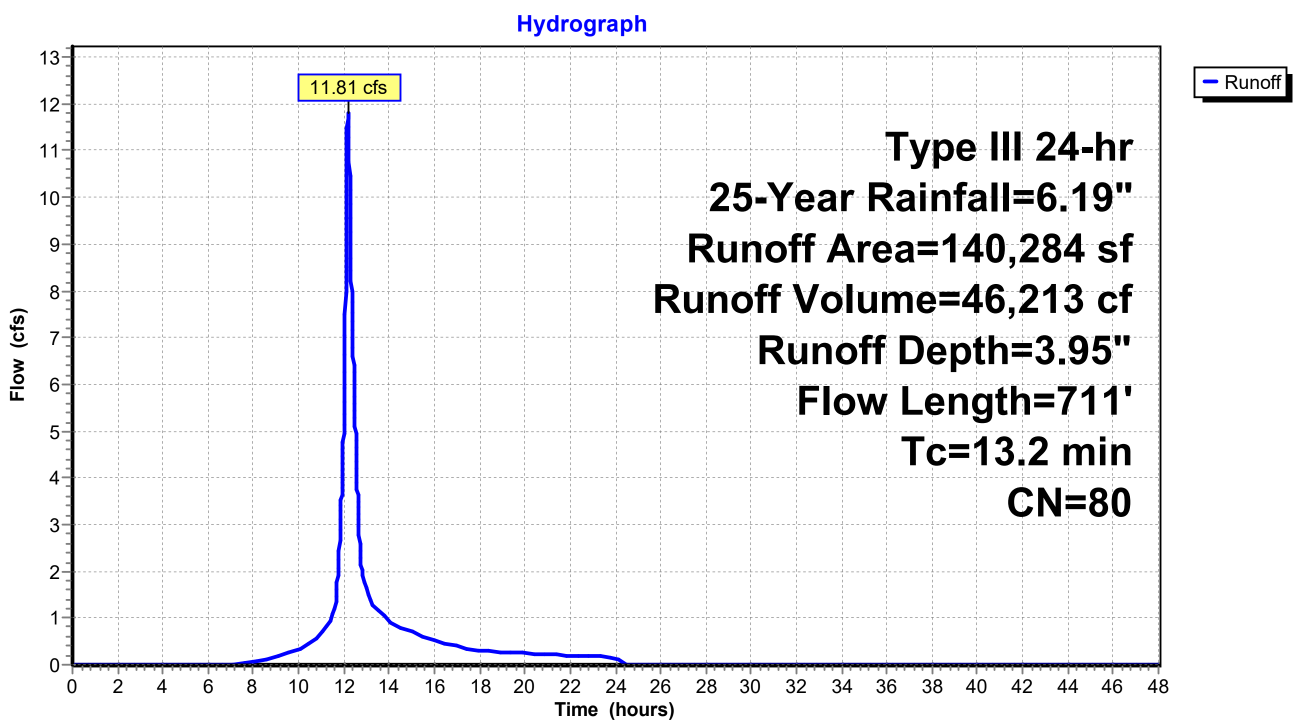
Runoff = 11.81 cfs @ 12.18 hrs, Volume= 46,213 cf, Depth= 3.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.19"

	Area (sf)	CN	Description
*	2,885	98	isol wetland HSG D
*	3,535	98	Pavement and Roofs, HSG D
*	6,775	89	Dirt/Gravell roads, HSG D
*	7,944	98	Ledge, HSG D
	93,250	77	Woods, Good, HSG D
	25,895	80	Pasture/grassland/range, Good, HSG D
	140,284	80	Weighted Average
	125,920	78	89.76% Pervious Area
	14,364	98	10.24% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.4	50	0.1200	0.35		**Sheet Flow,** Range n= 0.130 P2= 3.40"
10.8	661	0.0420	1.02		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
13.2	711	Total			

Subcatchment E-1: E-1



Summary for Subcatchment E-2: E-2

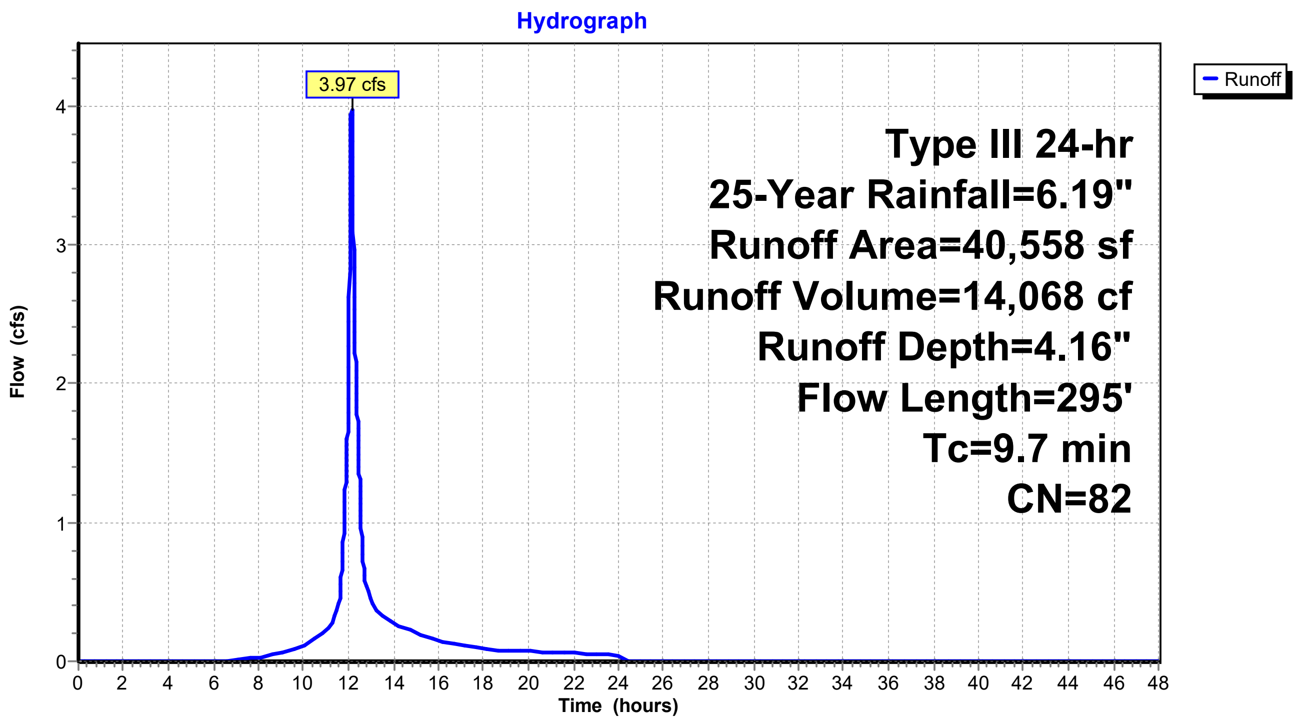
Runoff = 3.97 cfs @ 12.13 hrs, Volume= 14,068 cf, Depth= 4.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.19"

	Area (sf)	CN	Description
*	5,020	98	Ledge, HSG D
	28,312	77	Woods, Good, HSG D
*	2,902	98	Wetland Surface, HSG D
	2,393	89	Dirt roads, HSG D
	1,931	78	Meadow, non-grazed, HSG D
	40,558	82	Weighted Average
	32,636	78	80.47% Pervious Area
	7,922	98	19.53% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	50	0.0700	0.11		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.40"
2.5	245	0.1100	1.66		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
9.7	295	Total			

Subcatchment E-2: E-2



Summary for Subcatchment E-3: E-3

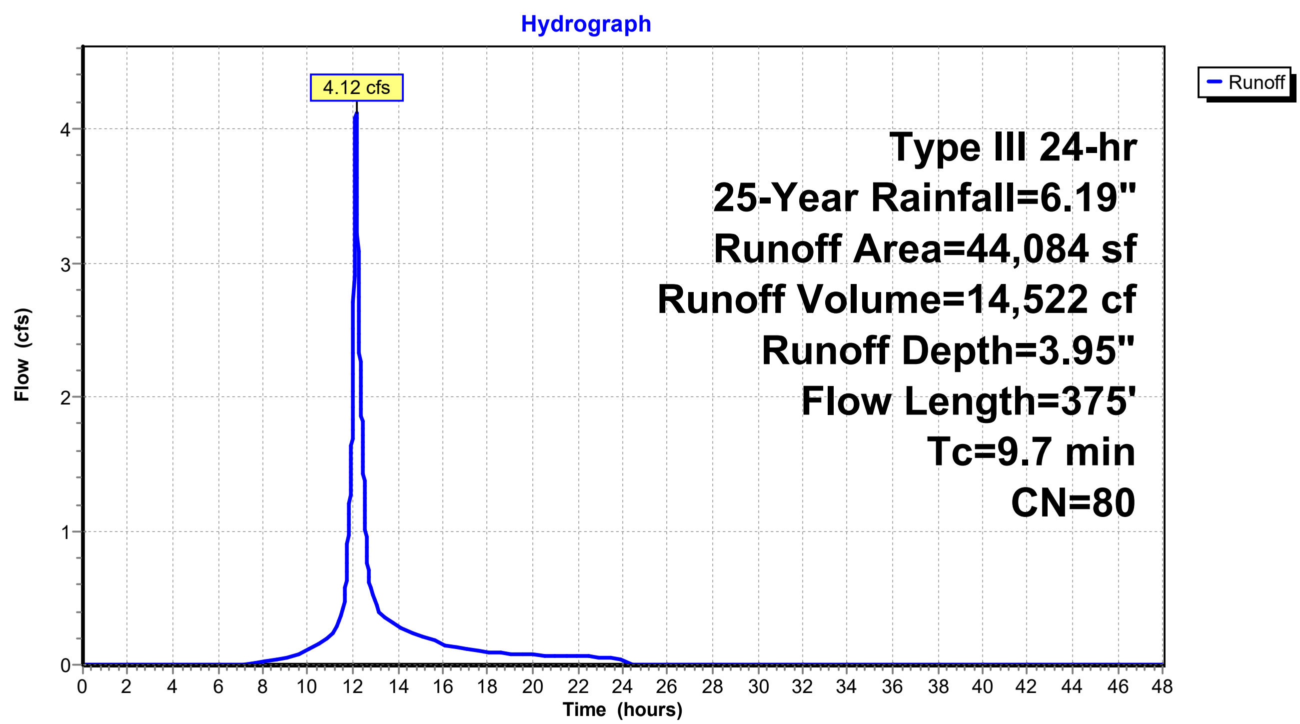
Runoff = 4.12 cfs @ 12.13 hrs, Volume= 14,522 cf, Depth= 3.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.19"

	Area (sf)	CN	Description
*	1,868	98	Ledge, HSG D
	38,259	77	Woods, Good, HSG D
*	3,957	98	Wetland Surface, HSG D
	44,084	80	Weighted Average
	38,259	77	86.79% Pervious Area
	5,825	98	13.21% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	50	0.1000	0.13		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.40"
3.3	241	0.0600	1.22		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.1	84	0.0700	14.18	127.58	**Channel Flow,** Area= 9.0 sf Perim= 8.0' r= 1.13' n= 0.030 Stream, clean & straight
9.7	375	Total			

Subcatchment E-3: E-3



Summary for Subcatchment E-4: E-4

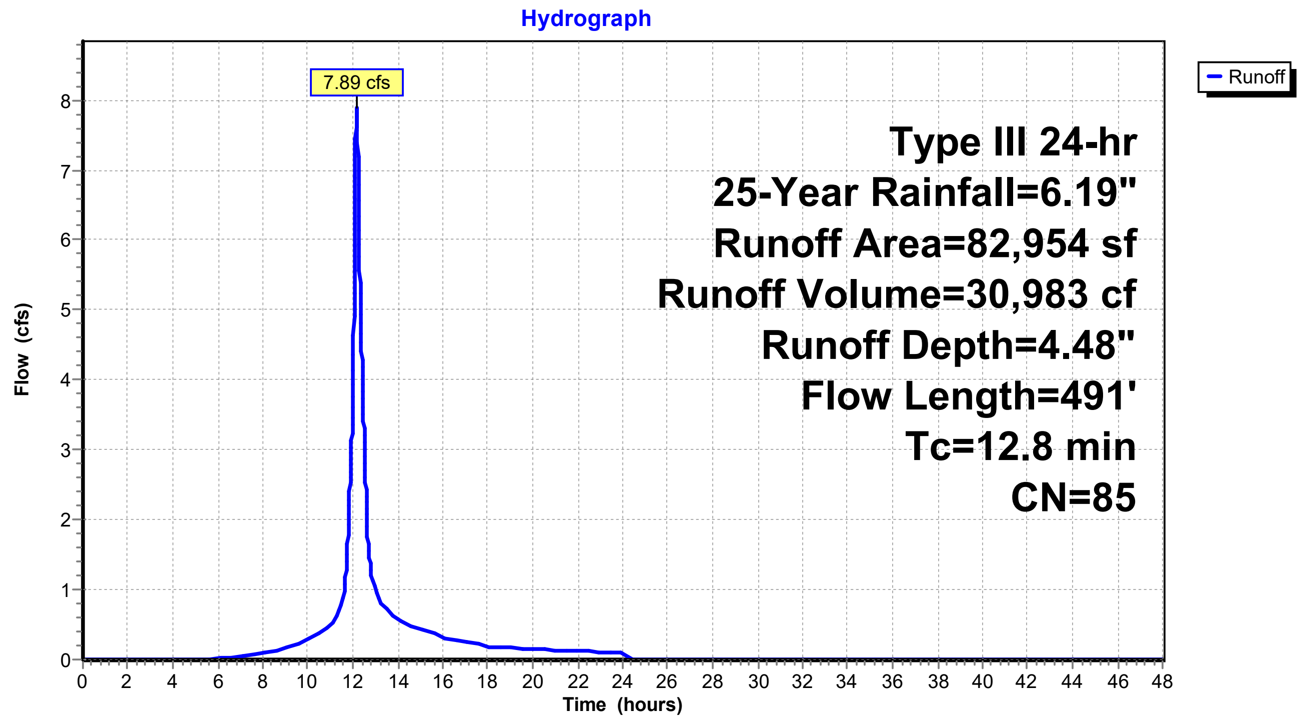
Runoff = 7.89 cfs @ 12.17 hrs, Volume= 30,983 cf, Depth= 4.48"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.19"

	Area (sf)	CN	Description
*	25,716	98	Ledge, HSG D
	47,000	77	Woods, Good, HSG D
	2,512	80	Pasture/grassland/range, Good, HSG D
*	2,410	98	Wetland Surface, HSG D
	5,316	89	Dirt roads, HSG D
	82,954	85	Weighted Average
	54,828	78	66.09% Pervious Area
	28,126	98	33.91% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	50	0.0700	0.11		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.40"
1.0	232	0.0560	3.81		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
4.6	209	0.0230	0.76		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
12.8	491	Total			

Subcatchment E-4: E-4



Summary for Subcatchment E-5: E-5

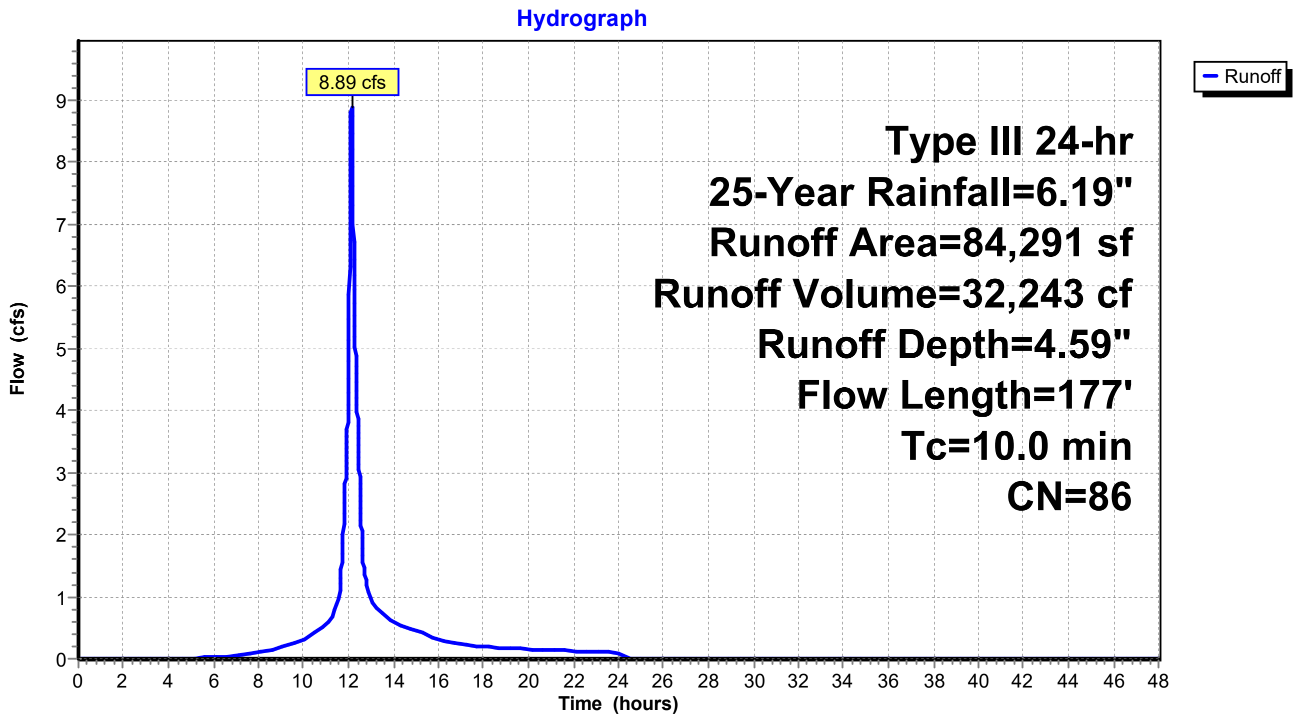
Runoff = 8.89 cfs @ 12.14 hrs, Volume= 32,243 cf, Depth= 4.59"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.19"

	Area (sf)	CN	Description
*	13,500	98	Ledge, HSG D
	47,115	77	Woods, Good, HSG D
	3,353	89	Dirt roads, HSG D
*	20,323	98	Wetland Surface, HSG D
	84,291	86	Weighted Average
	50,468	78	59.87% Pervious Area
	33,823	98	40.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	50	0.0500	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.40"
1.7	127	0.0620	1.24		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
10.0	177	Total			

Subcatchment E-5: E-5



Summary for Subcatchment E-6: E-6

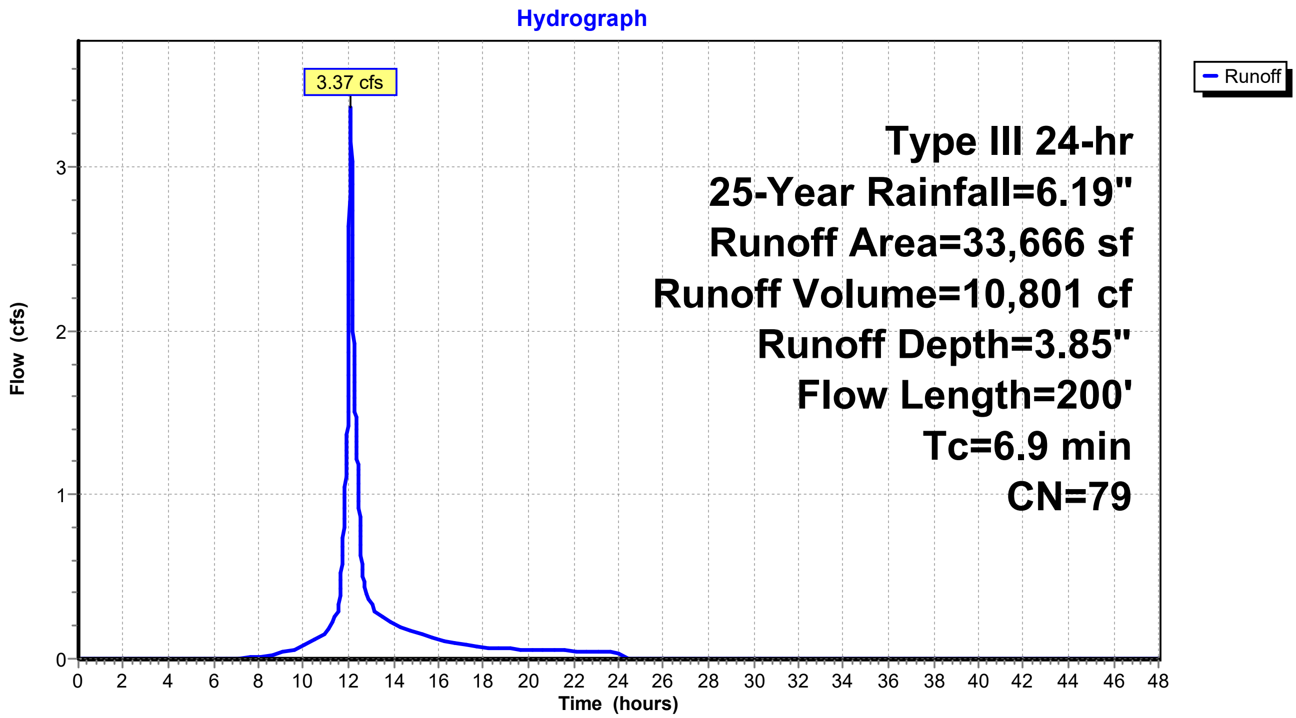
Runoff = 3.37 cfs @ 12.10 hrs, Volume= 10,801 cf, Depth= 3.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.19"

	Area (sf)	CN	Description
*	1,869	98	Ledge, HSG D
	29,200	77	Woods, Good, HSG D
	1,097	80	Pasture/grassland/range, Good, HSG D
*	1,500	98	Wetland Surface, HSG D
	33,666	79	Weighted Average
	30,297	77	89.99% Pervious Area
	3,369	98	10.01% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.1400	0.15		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.40"
1.4	150	0.1200	1.73		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
6.9	200	Total			

Subcatchment E-6: E-6

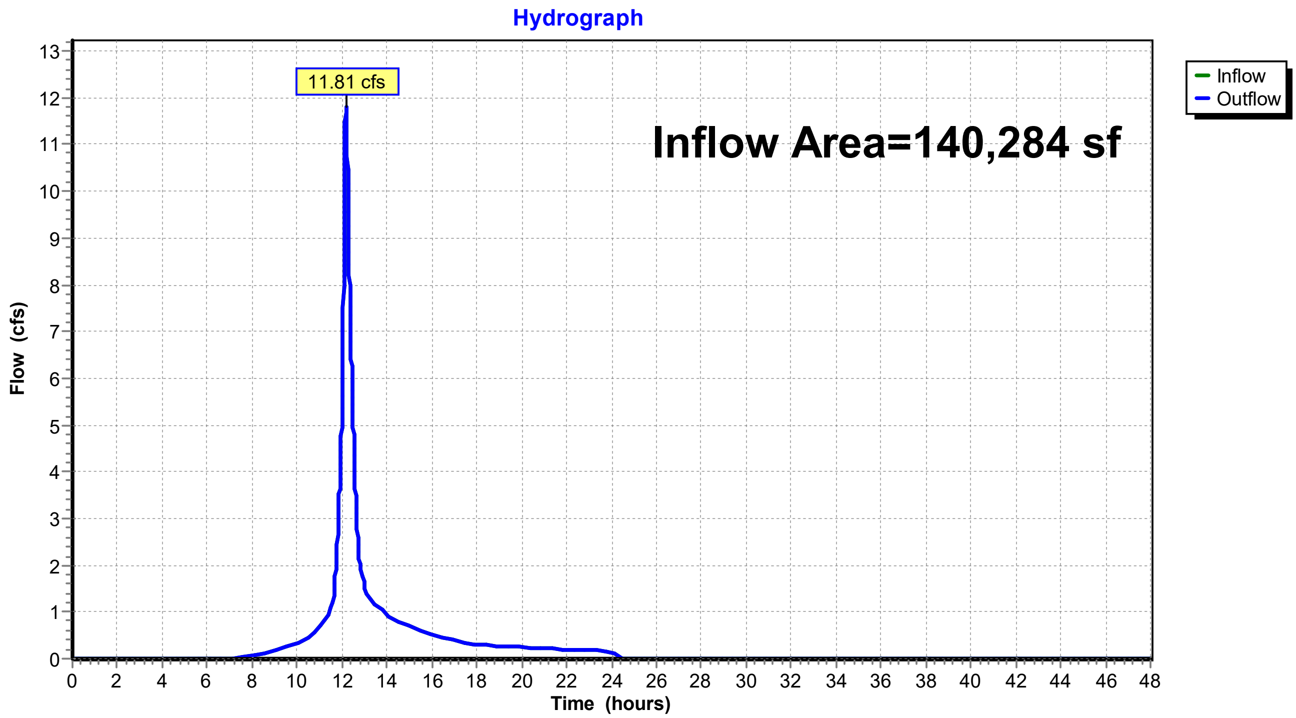


Summary for Reach PD1: WASHINGTON ROW

Inflow Area = 140,284 sf, 10.24% Impervious, Inflow Depth = 3.95" for 25-Year event
Inflow = 11.81 cfs @ 12.18 hrs, Volume= 46,213 cf
Outflow = 11.81 cfs @ 12.18 hrs, Volume= 46,213 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach PD1: WASHINGTON ROW

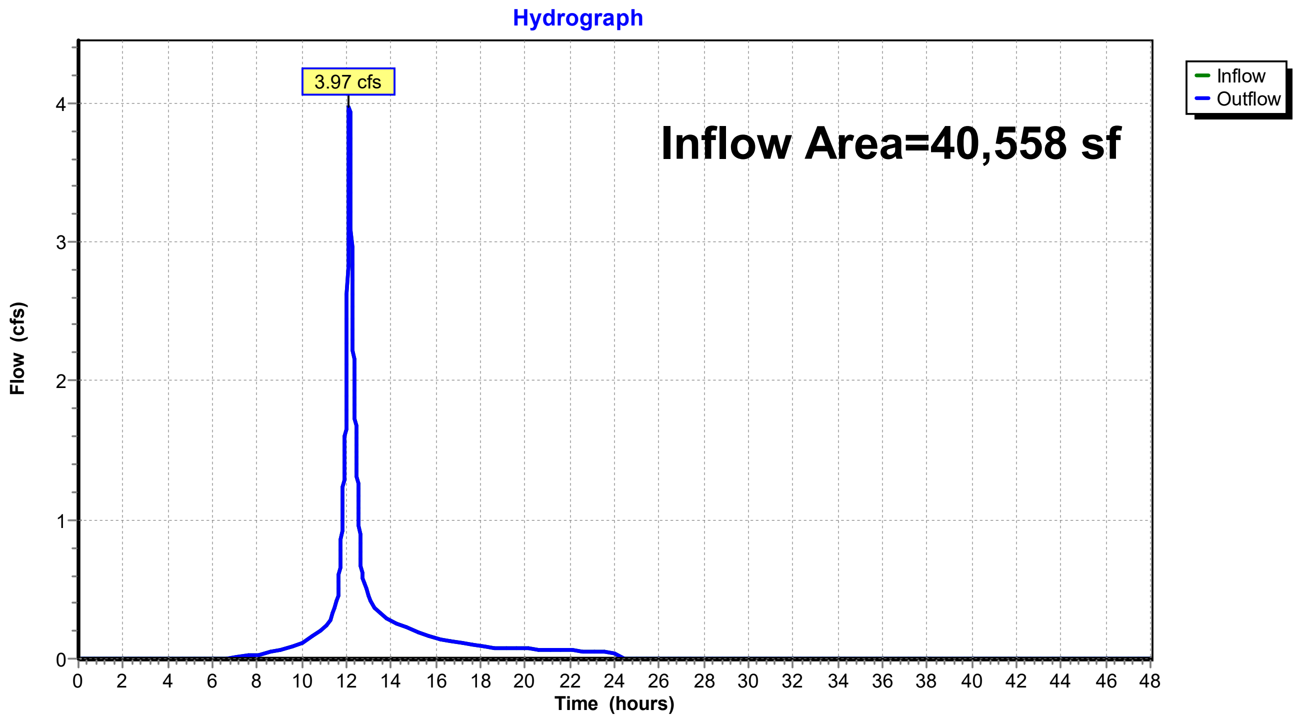


Summary for Reach PD2: Wetland series "A"

Inflow Area =	40,558 sf,	19.53% Impervious,	Inflow Depth = 4.16"	for 25-Year event
Inflow =	3.97 cfs @	12.13 hrs, Volume=	14,068 cf	
Outflow =	3.97 cfs @	12.13 hrs, Volume=	14,068 cf, Atten= 0%, Lag= 0.0 min	

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach PD2: Wetland series "A"

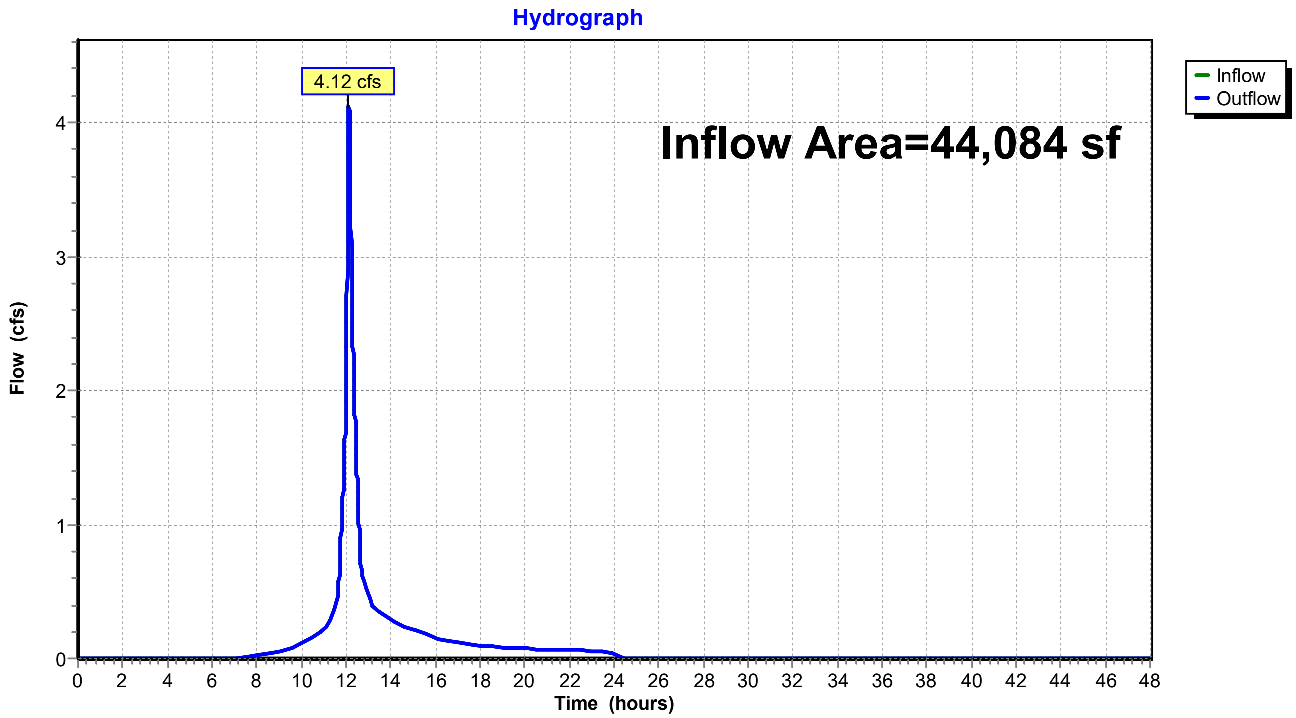


Summary for Reach PD3: Intermittent Stream

Inflow Area =	44,084 sf,	13.21% Impervious,	Inflow Depth = 3.95"	for 25-Year event
Inflow =	4.12 cfs @	12.13 hrs, Volume=	14,522 cf	
Outflow =	4.12 cfs @	12.13 hrs, Volume=	14,522 cf, Atten= 0%, Lag= 0.0 min	

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach PD3: Intermittent Stream

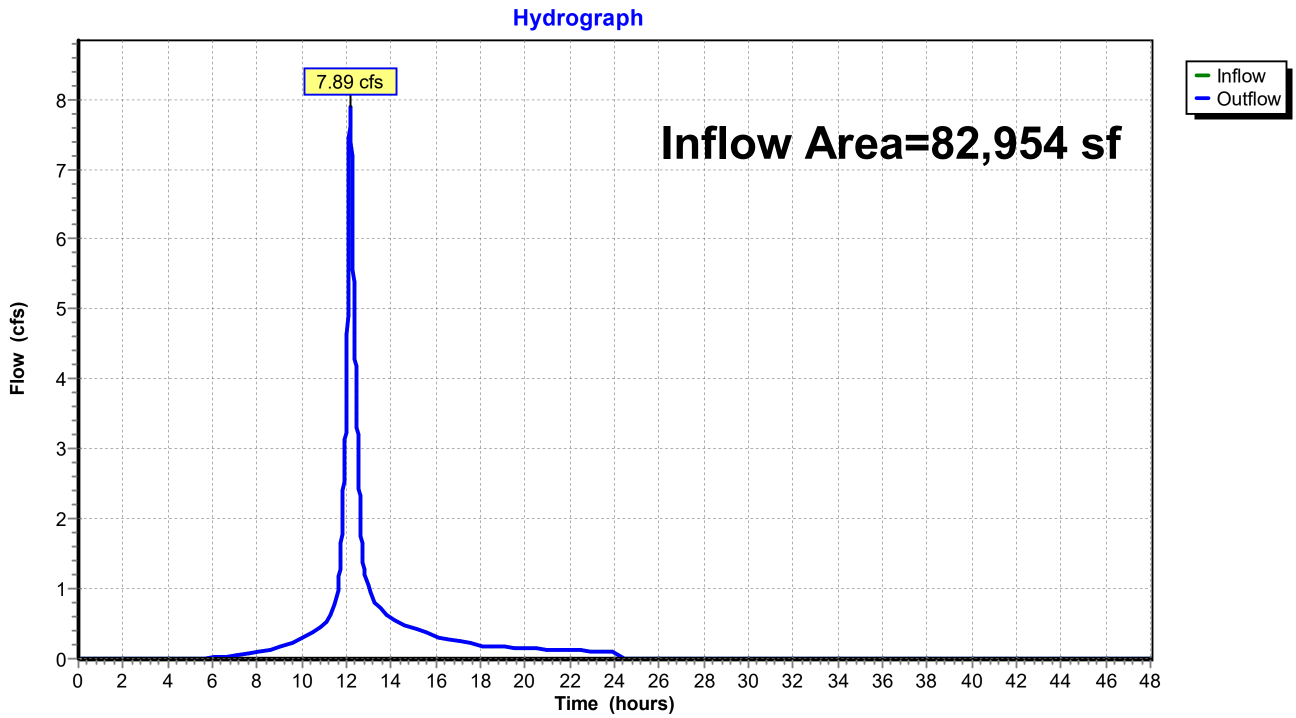


Summary for Reach PD4: Wetland series "B"

Inflow Area =	82,954 sf,	33.91% Impervious,	Inflow Depth = 4.48"	for 25-Year event
Inflow =	7.89 cfs @	12.17 hrs, Volume=	30,983 cf	
Outflow =	7.89 cfs @	12.17 hrs, Volume=	30,983 cf, Atten= 0%, Lag= 0.0 min	

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach PD4: Wetland series "B"

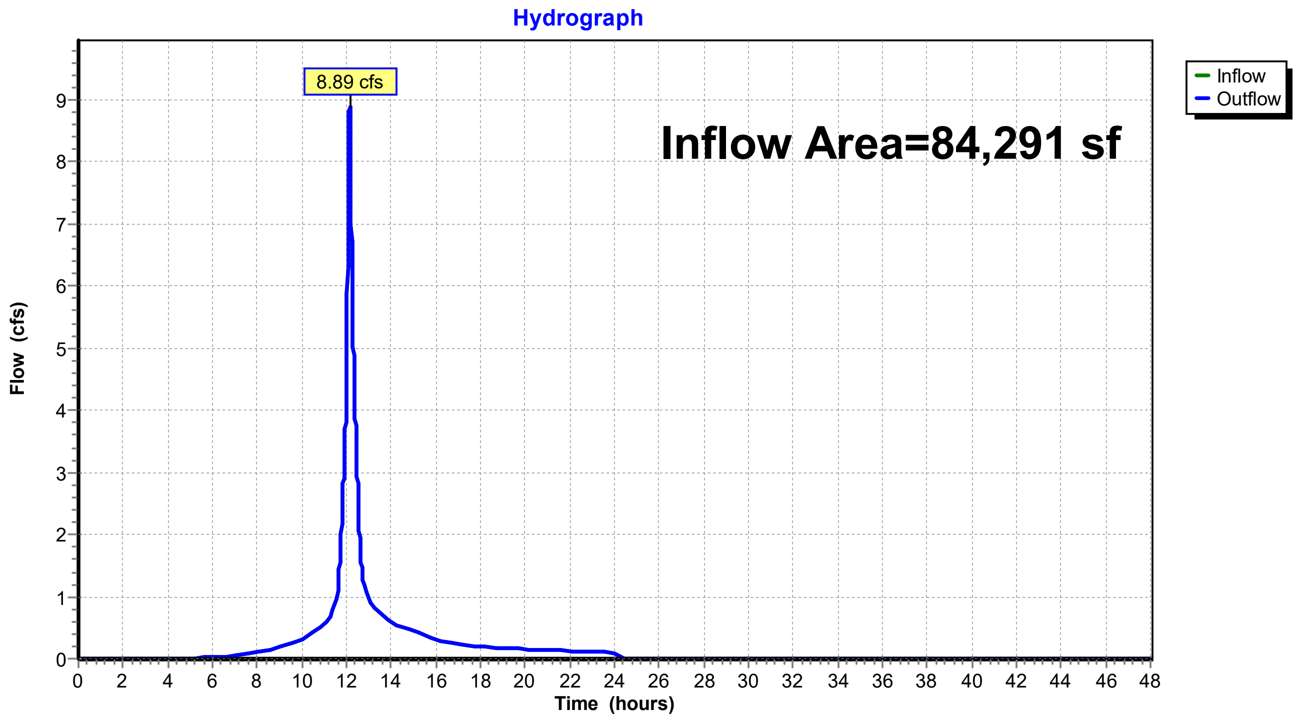


Summary for Reach PD5: Wetland series "E"

Inflow Area = 84,291 sf, 40.13% Impervious, Inflow Depth = 4.59" for 25-Year event
Inflow = 8.89 cfs @ 12.14 hrs, Volume= 32,243 cf
Outflow = 8.89 cfs @ 12.14 hrs, Volume= 32,243 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach PD5: Wetland series "E"

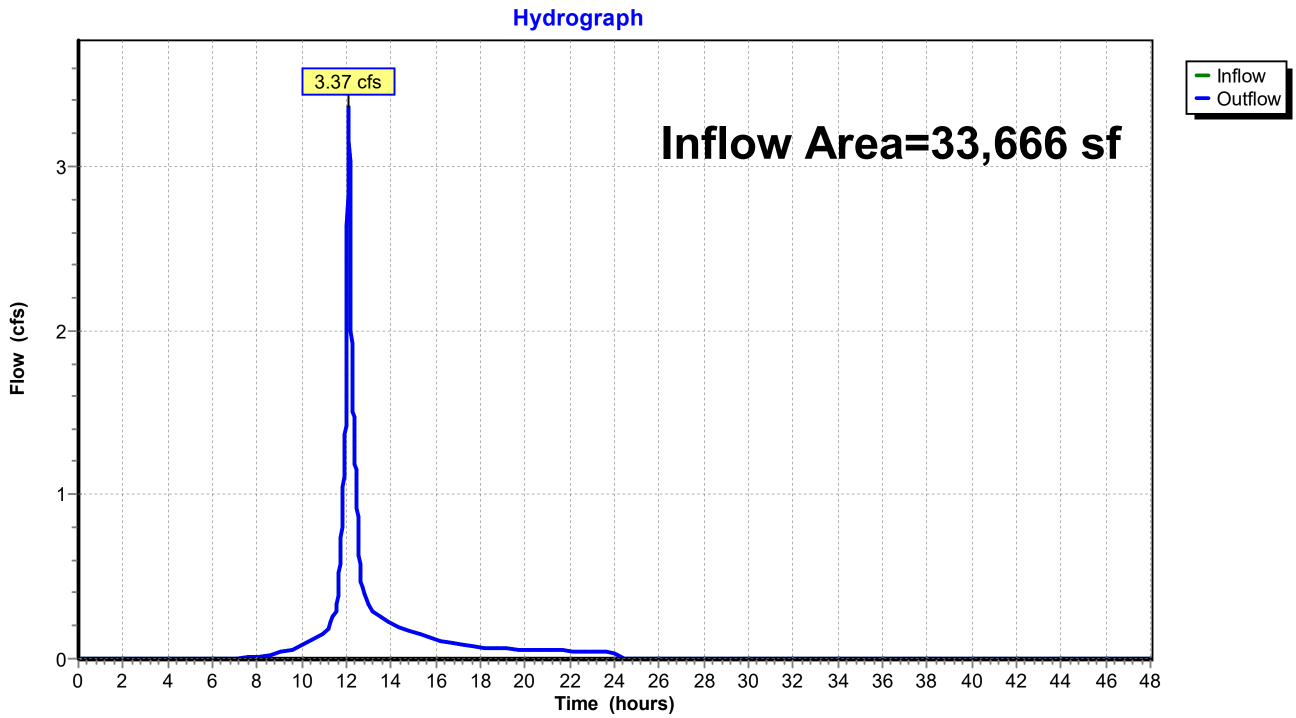


Summary for Reach PD6: Wetland series "F"

Inflow Area = 33,666 sf, 10.01% Impervious, Inflow Depth = 3.85" for 25-Year event
Inflow = 3.37 cfs @ 12.10 hrs, Volume= 10,801 cf
Outflow = 3.37 cfs @ 12.10 hrs, Volume= 10,801 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach PD6: Wetland series "F"

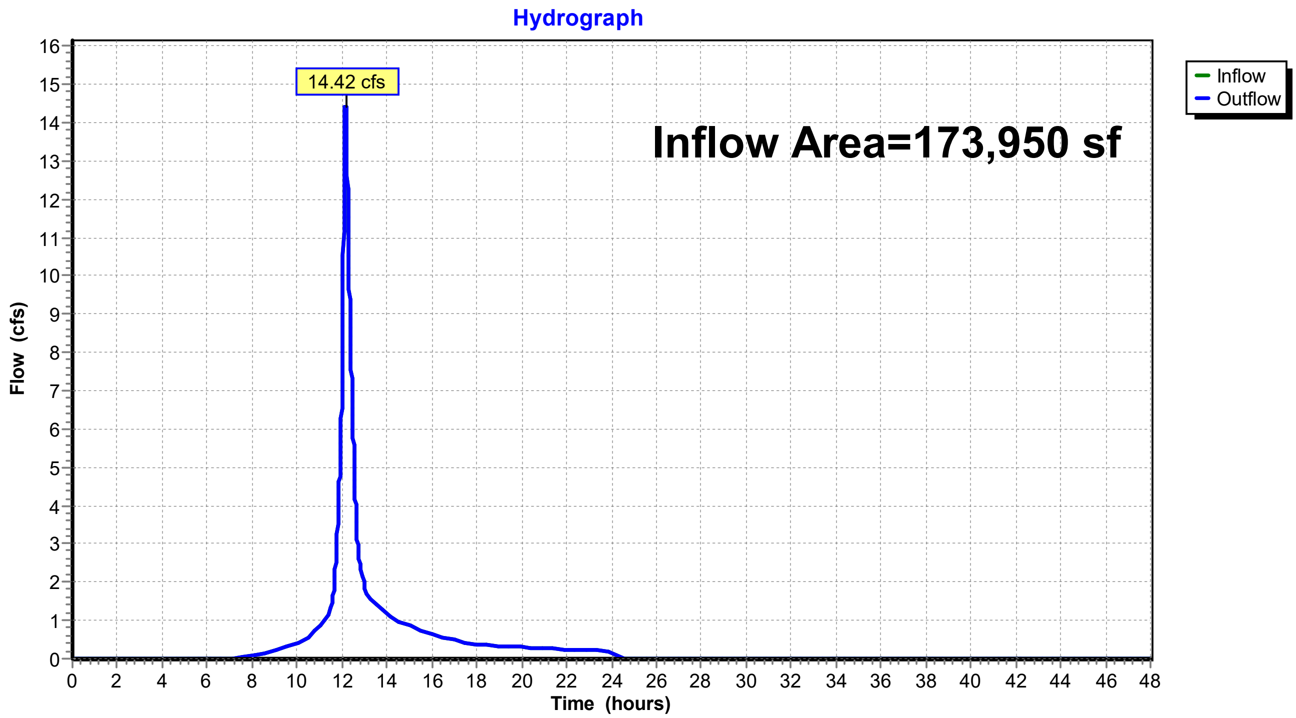


Summary for Reach WD: Washington St Drainage outlet

Inflow Area =	173,950 sf, 10.19% Impervious,	Inflow Depth = 3.93"	for 25-Year event
Inflow =	14.42 cfs @ 12.16 hrs, Volume=	57,014 cf	
Outflow =	14.42 cfs @ 12.16 hrs, Volume=	57,014 cf, Atten= 0%, Lag= 0.0 min	

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach WD: Washington St Drainage outlet



Summary for Subcatchment E-1: E-1

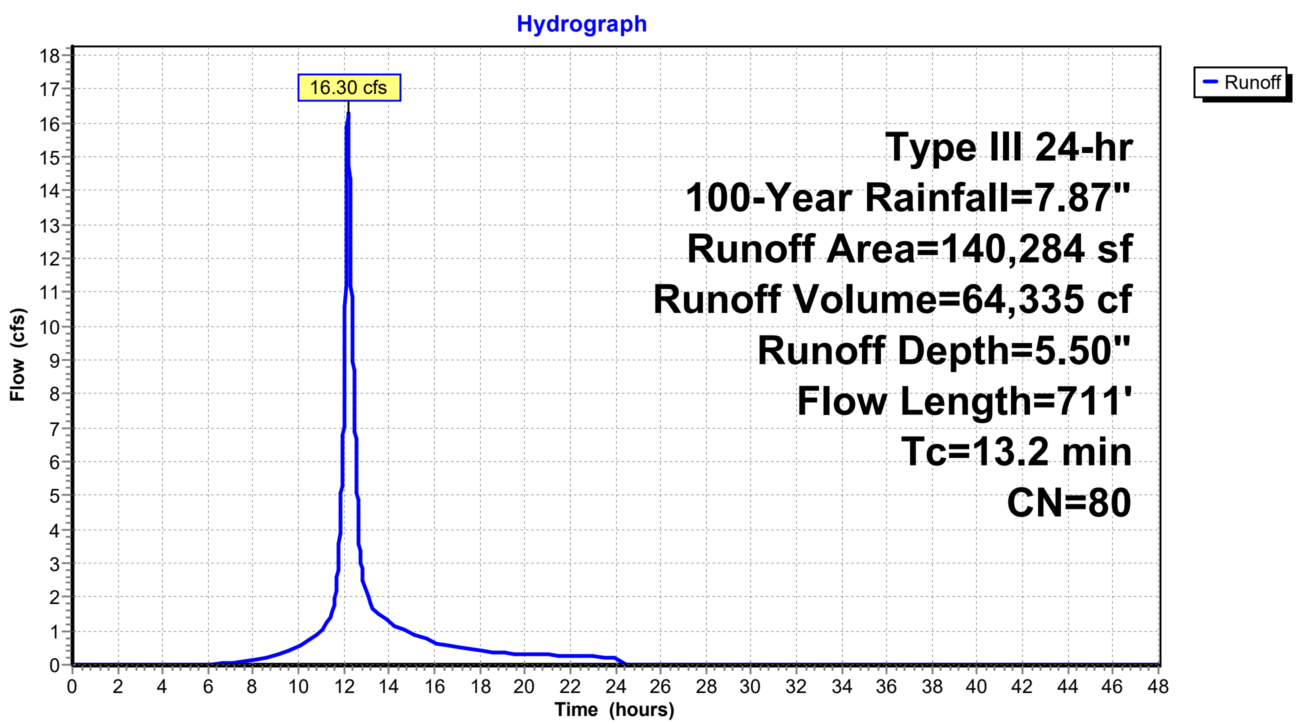
Runoff = 16.30 cfs @ 12.18 hrs, Volume= 64,335 cf, Depth= 5.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.87"

	Area (sf)	CN	Description
*	2,885	98	isol wetland HSG D
*	3,535	98	Pavement and Roofs, HSG D
*	6,775	89	Dirt/Gravell roads, HSG D
*	7,944	98	Ledge, HSG D
	93,250	77	Woods, Good, HSG D
	25,895	80	Pasture/grassland/range, Good, HSG D
	140,284	80	Weighted Average
	125,920	78	89.76% Pervious Area
	14,364	98	10.24% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.4	50	0.1200	0.35		**Sheet Flow,** Range n= 0.130 P2= 3.40"
10.8	661	0.0420	1.02		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
13.2	711	Total			

Subcatchment E-1: E-1



Summary for Subcatchment E-2: E-2

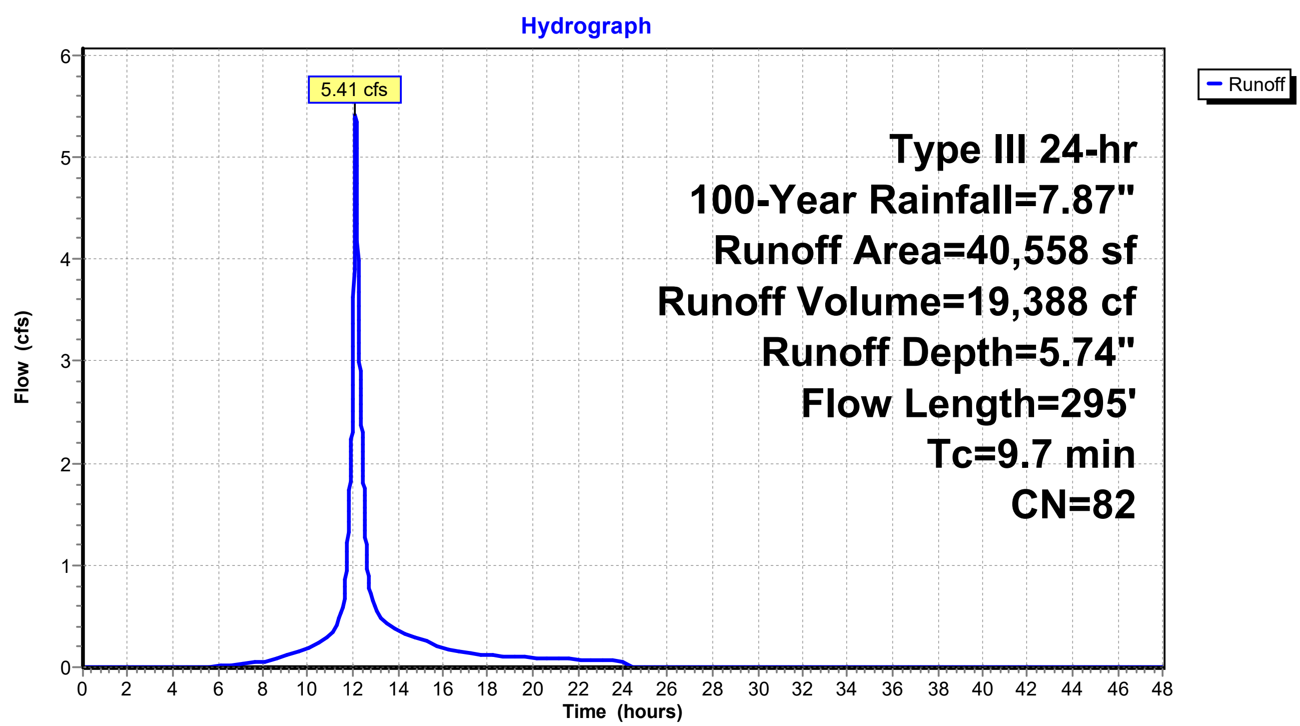
Runoff = 5.41 cfs @ 12.13 hrs, Volume= 19,388 cf, Depth= 5.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.87"

	Area (sf)	CN	Description
*	5,020	98	Ledge, HSG D
	28,312	77	Woods, Good, HSG D
*	2,902	98	Wetland Surface, HSG D
	2,393	89	Dirt roads, HSG D
	1,931	78	Meadow, non-grazed, HSG D
	40,558	82	Weighted Average
	32,636	78	80.47% Pervious Area
	7,922	98	19.53% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	50	0.0700	0.11		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.40"
2.5	245	0.1100	1.66		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
9.7	295	Total			

Subcatchment E-2: E-2



Summary for Subcatchment E-3: E-3

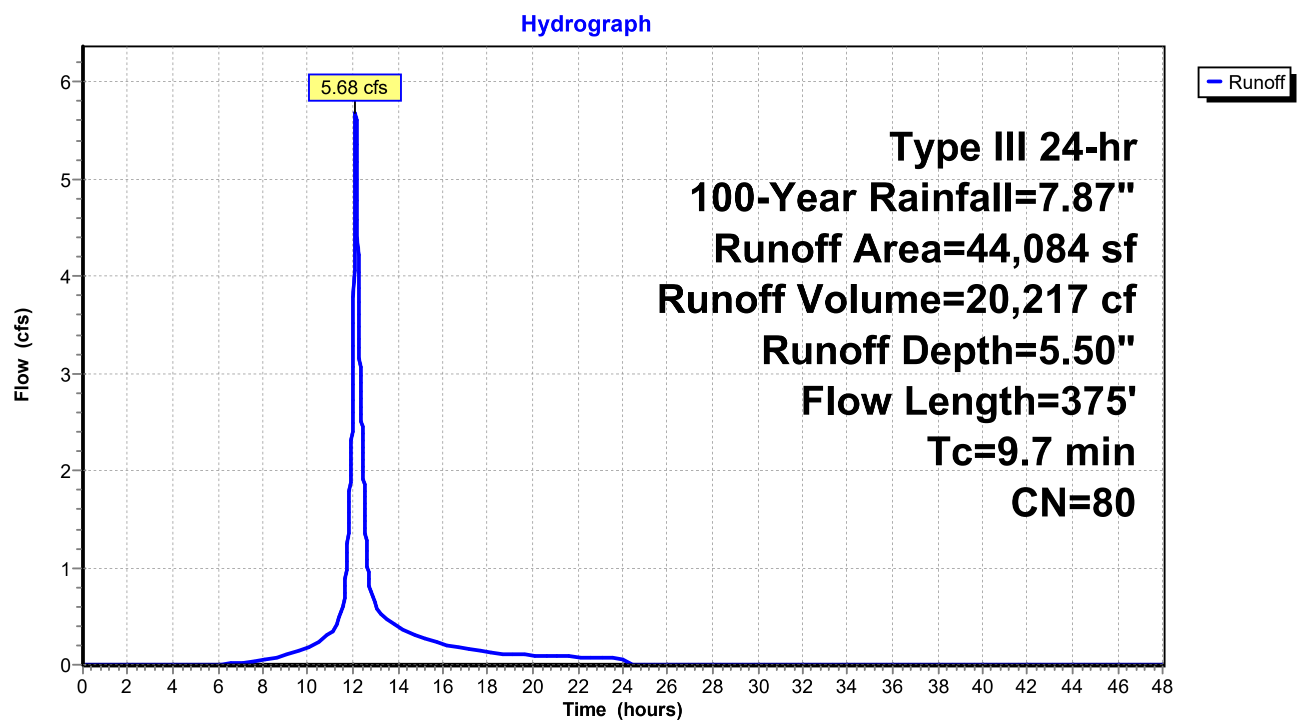
Runoff = 5.68 cfs @ 12.13 hrs, Volume= 20,217 cf, Depth= 5.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.87"

	Area (sf)	CN	Description
*	1,868	98	Ledge, HSG D
	38,259	77	Woods, Good, HSG D
*	3,957	98	Wetland Surface, HSG D
	44,084	80	Weighted Average
	38,259	77	86.79% Pervious Area
	5,825	98	13.21% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	50	0.1000	0.13		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.40"
3.3	241	0.0600	1.22		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.1	84	0.0700	14.18	127.58	**Channel Flow,** Area= 9.0 sf Perim= 8.0' r= 1.13' n= 0.030 Stream, clean & straight
9.7	375	Total			

Subcatchment E-3: E-3



Summary for Subcatchment E-4: E-4

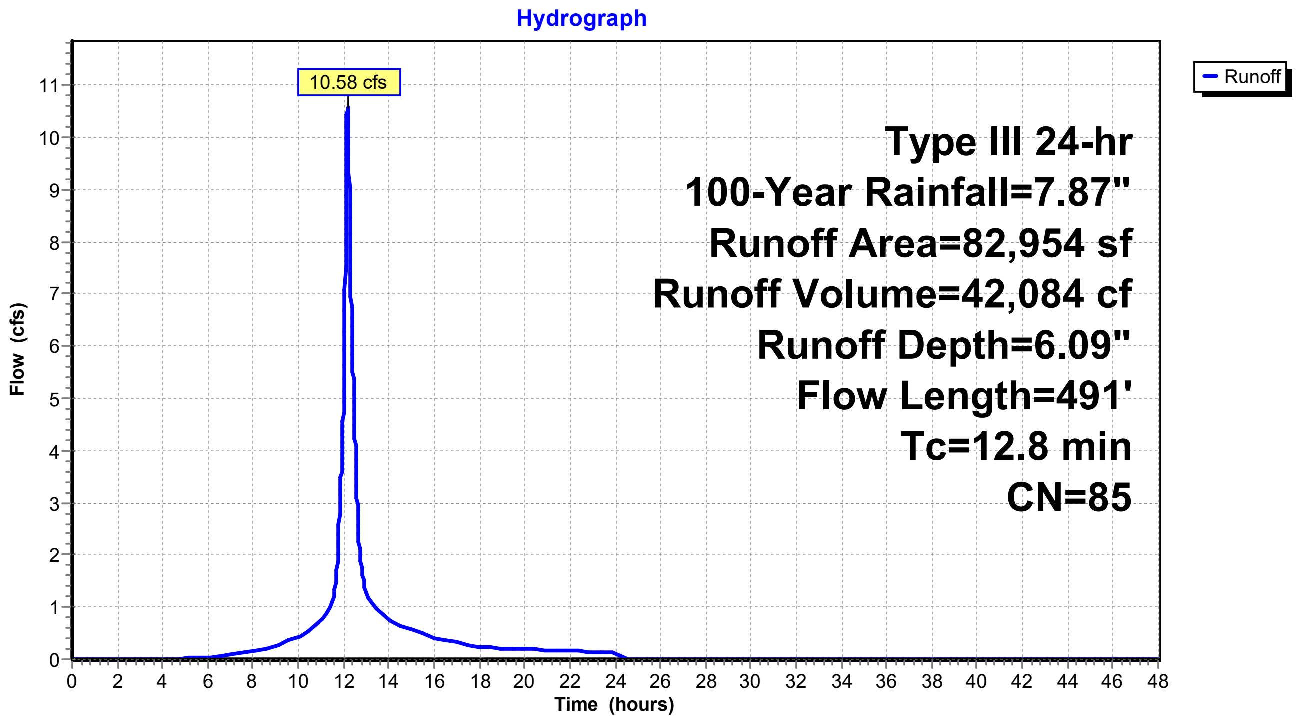
Runoff = 10.58 cfs @ 12.17 hrs, Volume= 42,084 cf, Depth= 6.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.87"

	Area (sf)	CN	Description
*	25,716	98	Ledge, HSG D
	47,000	77	Woods, Good, HSG D
	2,512	80	Pasture/grassland/range, Good, HSG D
*	2,410	98	Wetland Surface, HSG D
	5,316	89	Dirt roads, HSG D
	82,954	85	Weighted Average
	54,828	78	66.09% Pervious Area
	28,126	98	33.91% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	50	0.0700	0.11		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.40"
1.0	232	0.0560	3.81		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
4.6	209	0.0230	0.76		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
12.8	491	Total			

Subcatchment E-4: E-4



Summary for Subcatchment E-5: E-5

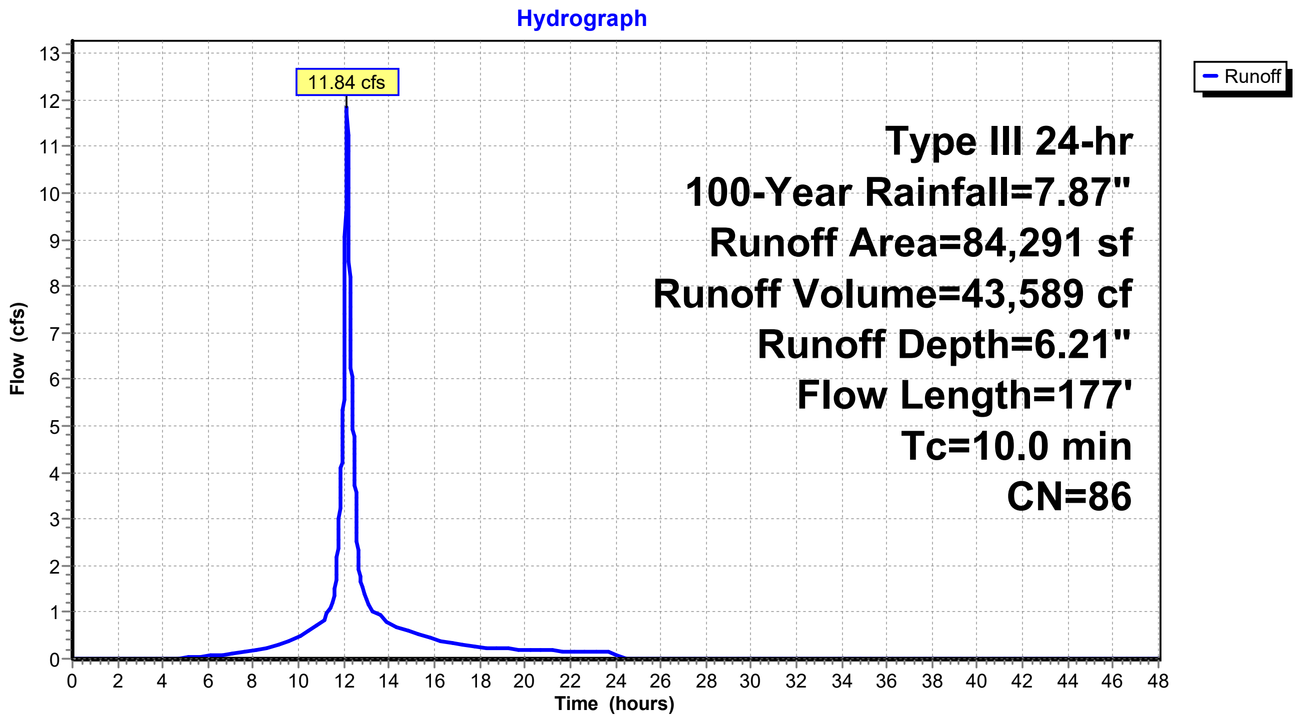
Runoff = 11.84 cfs @ 12.14 hrs, Volume= 43,589 cf, Depth= 6.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.87"

	Area (sf)	CN	Description
*	13,500	98	Ledge, HSG D
	47,115	77	Woods, Good, HSG D
	3,353	89	Dirt roads, HSG D
*	20,323	98	Wetland Surface, HSG D
	84,291	86	Weighted Average
	50,468	78	59.87% Pervious Area
	33,823	98	40.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	50	0.0500	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.40"
1.7	127	0.0620	1.24		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
10.0	177	Total			

Subcatchment E-5: E-5



Summary for Subcatchment E-6: E-6

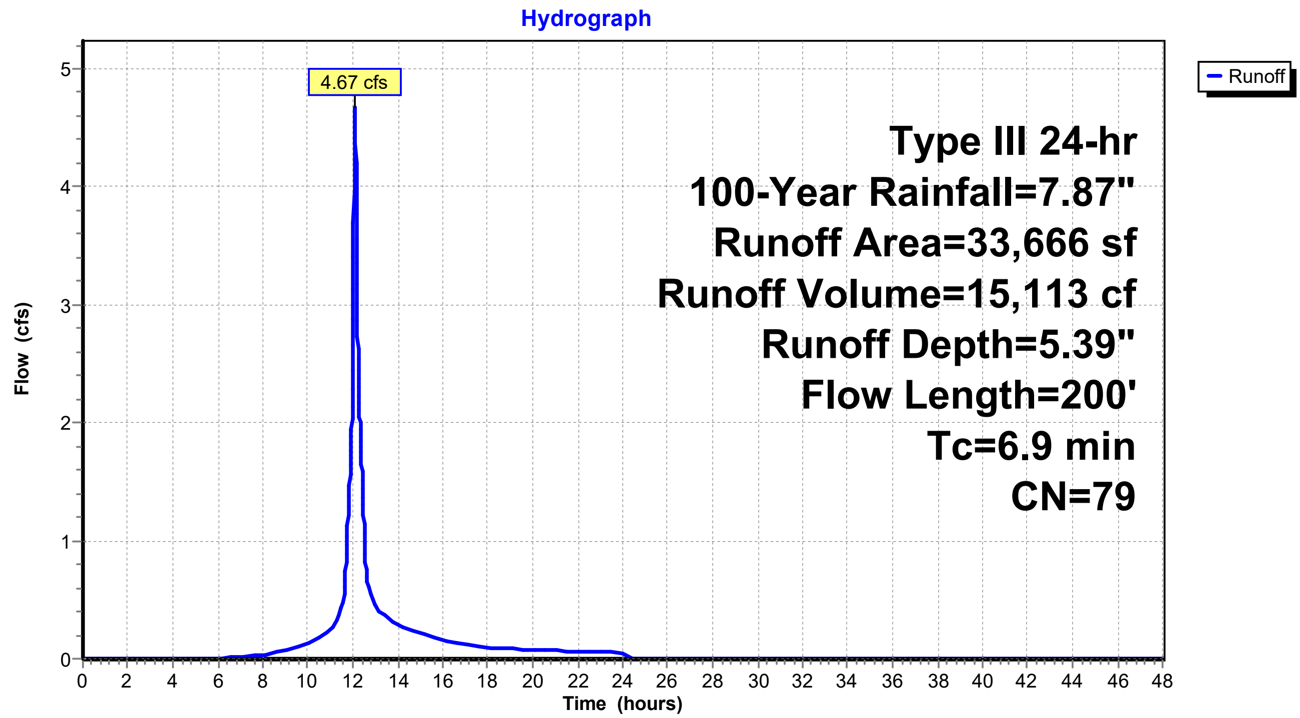
Runoff = 4.67 cfs @ 12.10 hrs, Volume= 15,113 cf, Depth= 5.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.87"

	Area (sf)	CN	Description
*	1,869	98	Ledge, HSG D
	29,200	77	Woods, Good, HSG D
	1,097	80	Pasture/grassland/range, Good, HSG D
*	1,500	98	Wetland Surface, HSG D
	33,666	79	Weighted Average
	30,297	77	89.99% Pervious Area
	3,369	98	10.01% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.1400	0.15		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.40"
1.4	150	0.1200	1.73		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
6.9	200	Total			

Subcatchment E-6: E-6

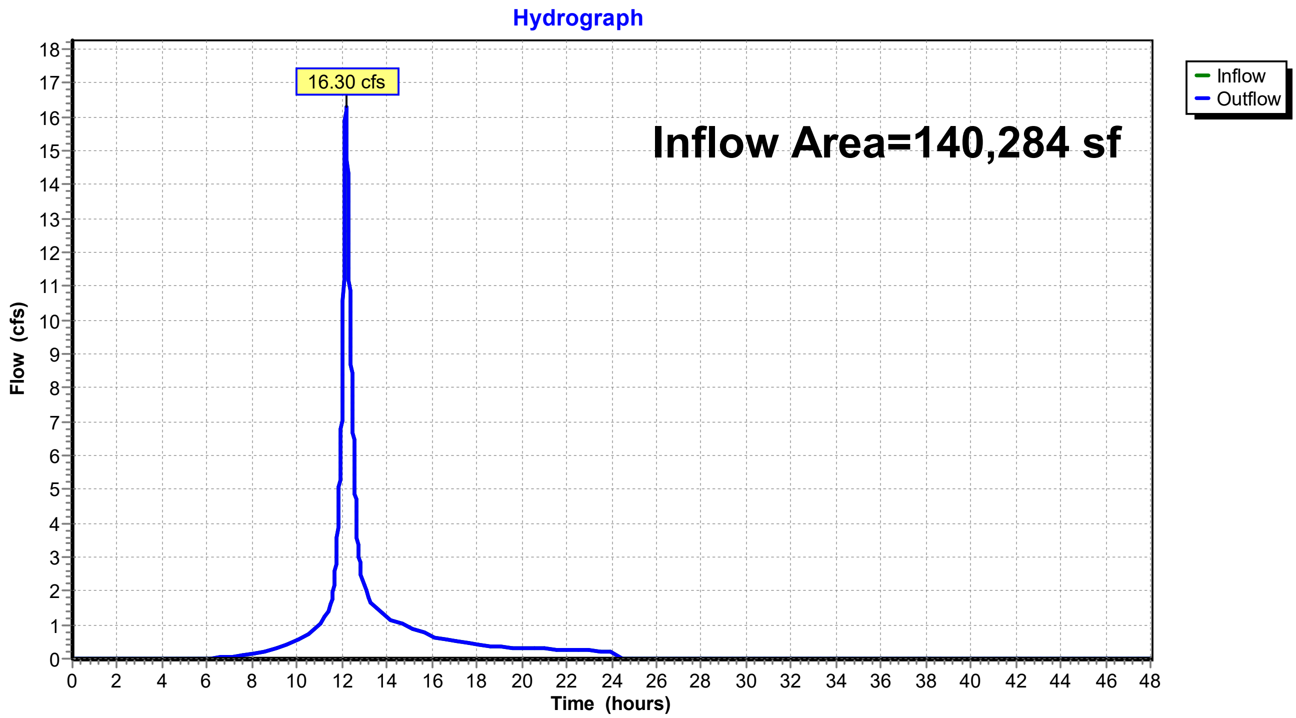


Summary for Reach PD1: WASHINGTON ROW

Inflow Area = 140,284 sf, 10.24% Impervious, Inflow Depth = 5.50" for 100-Year event
Inflow = 16.30 cfs @ 12.18 hrs, Volume= 64,335 cf
Outflow = 16.30 cfs @ 12.18 hrs, Volume= 64,335 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach PD1: WASHINGTON ROW

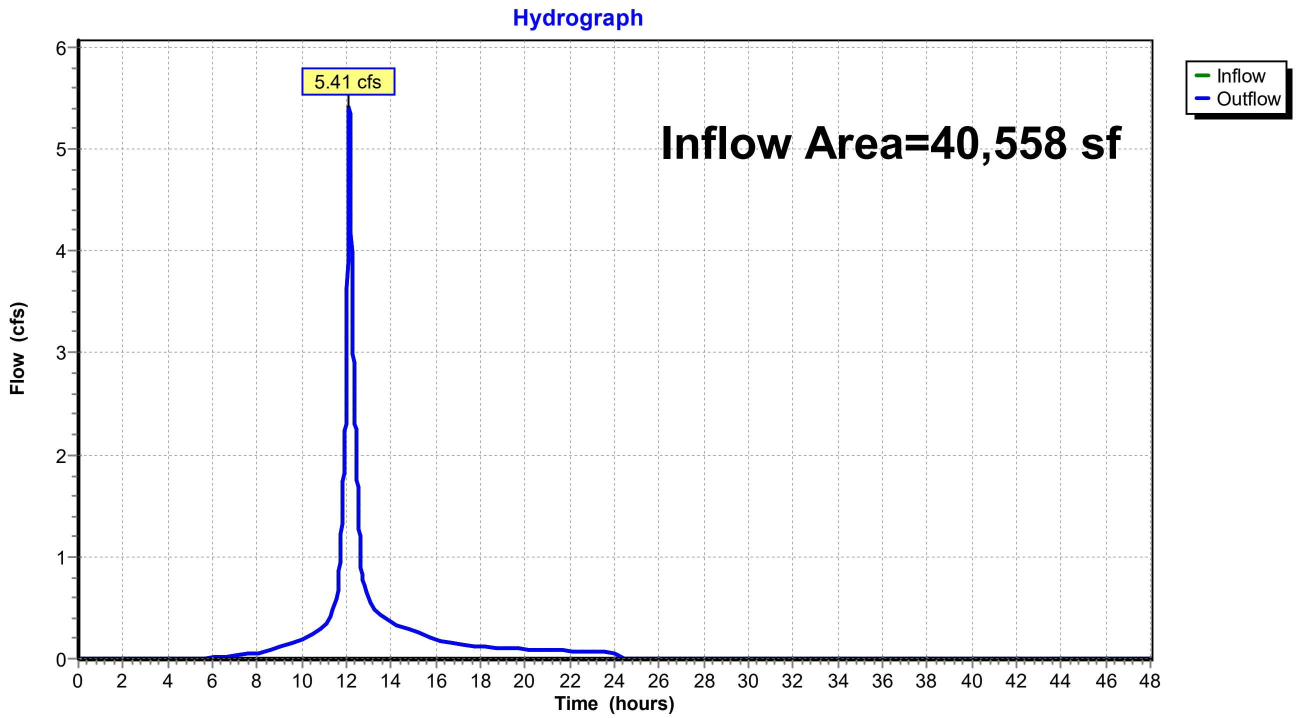


Summary for Reach PD2: Wetland series "A"

Inflow Area = 40,558 sf, 19.53% Impervious, Inflow Depth = 5.74" for 100-Year event
Inflow = 5.41 cfs @ 12.13 hrs, Volume= 19,388 cf
Outflow = 5.41 cfs @ 12.13 hrs, Volume= 19,388 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach PD2: Wetland series "A"

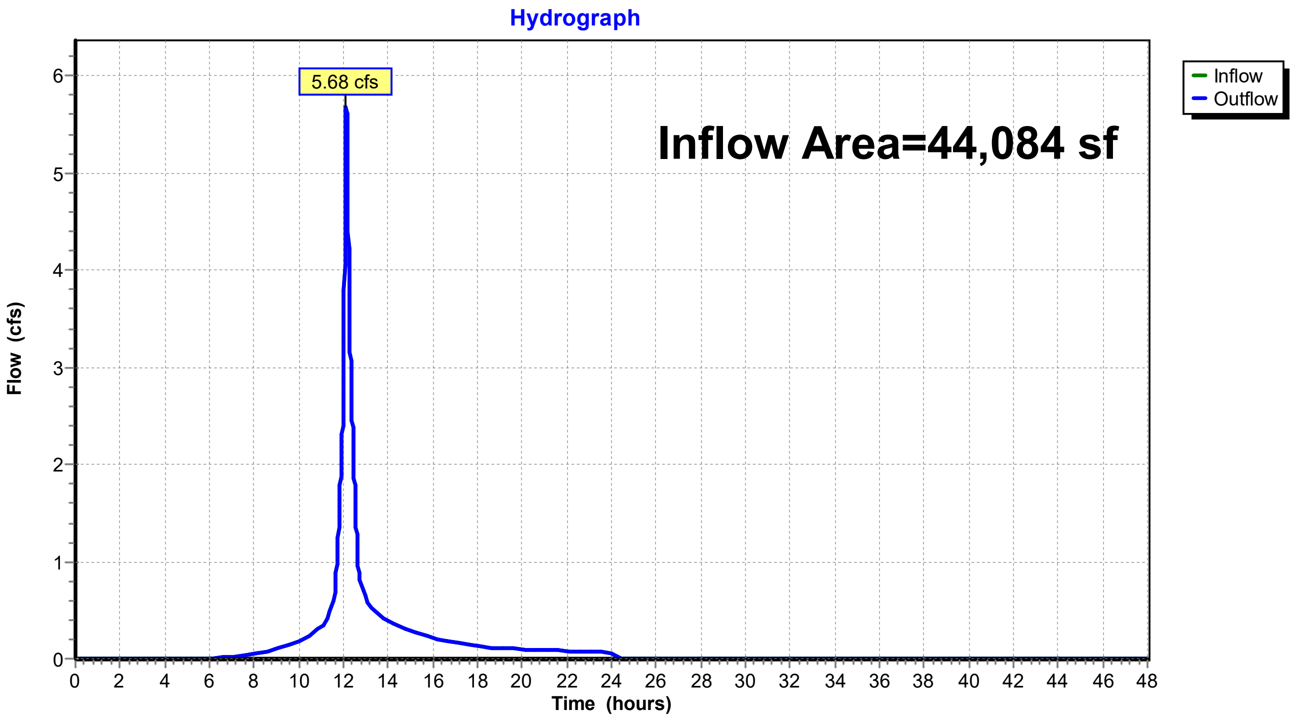


Summary for Reach PD3: Intermittent Stream

Inflow Area = 44,084 sf, 13.21% Impervious, Inflow Depth = 5.50" for 100-Year event
Inflow = 5.68 cfs @ 12.13 hrs, Volume= 20,217 cf
Outflow = 5.68 cfs @ 12.13 hrs, Volume= 20,217 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach PD3: Intermittent Stream

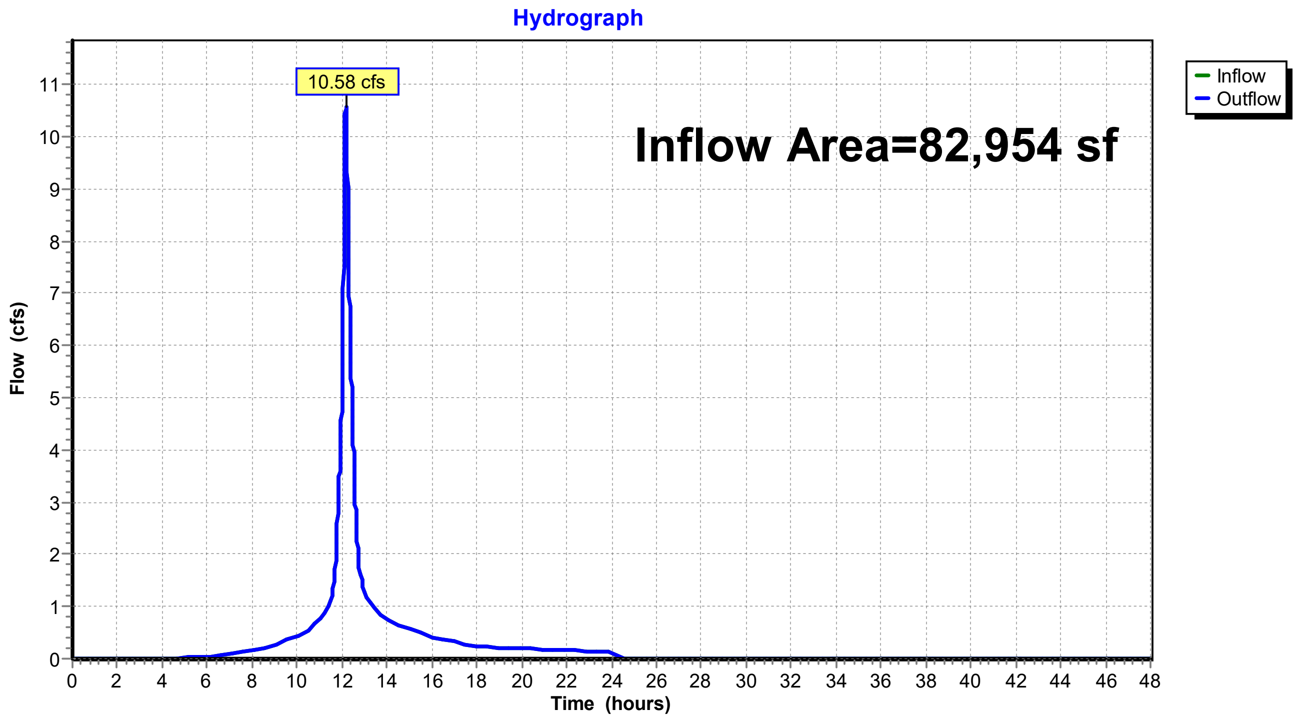


Summary for Reach PD4: Wetland series "B"

Inflow Area = 82,954 sf, 33.91% Impervious, Inflow Depth = 6.09" for 100-Year event
Inflow = 10.58 cfs @ 12.17 hrs, Volume= 42,084 cf
Outflow = 10.58 cfs @ 12.17 hrs, Volume= 42,084 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach PD4: Wetland series "B"

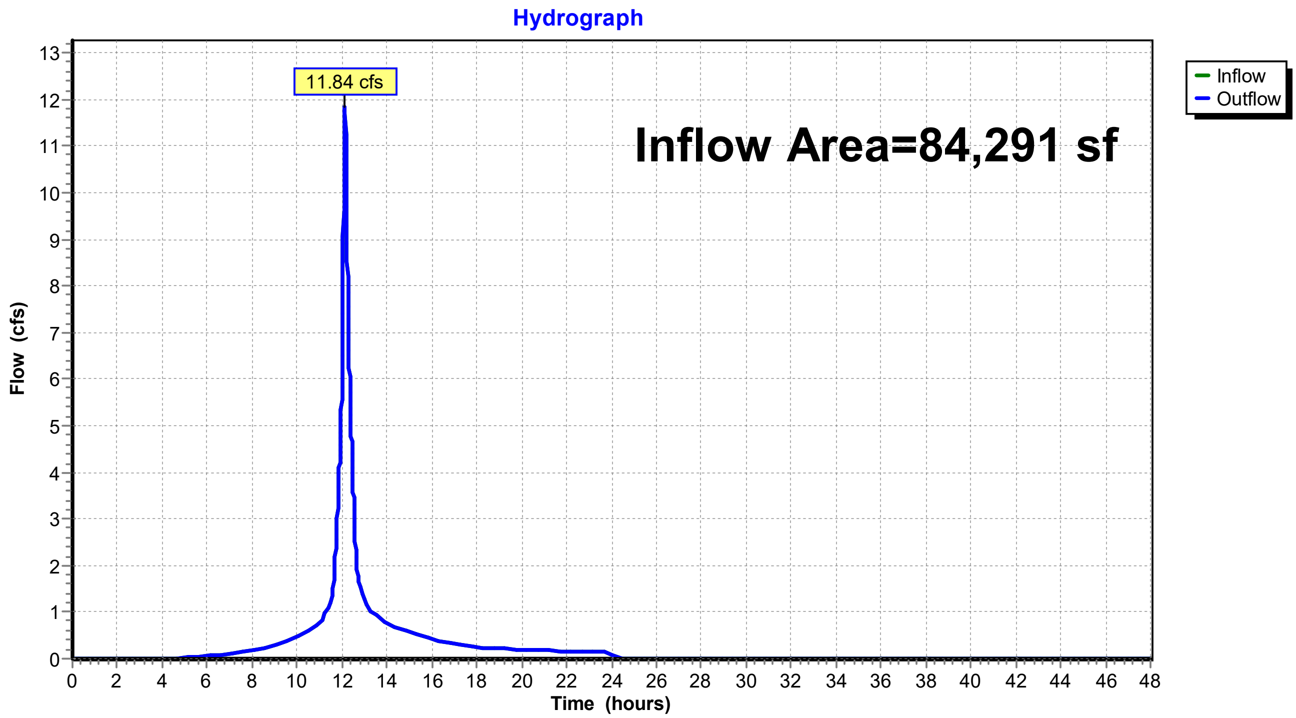


Summary for Reach PD5: Wetland series "E"

Inflow Area = 84,291 sf, 40.13% Impervious, Inflow Depth = 6.21" for 100-Year event
Inflow = 11.84 cfs @ 12.14 hrs, Volume= 43,589 cf
Outflow = 11.84 cfs @ 12.14 hrs, Volume= 43,589 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach PD5: Wetland series "E"

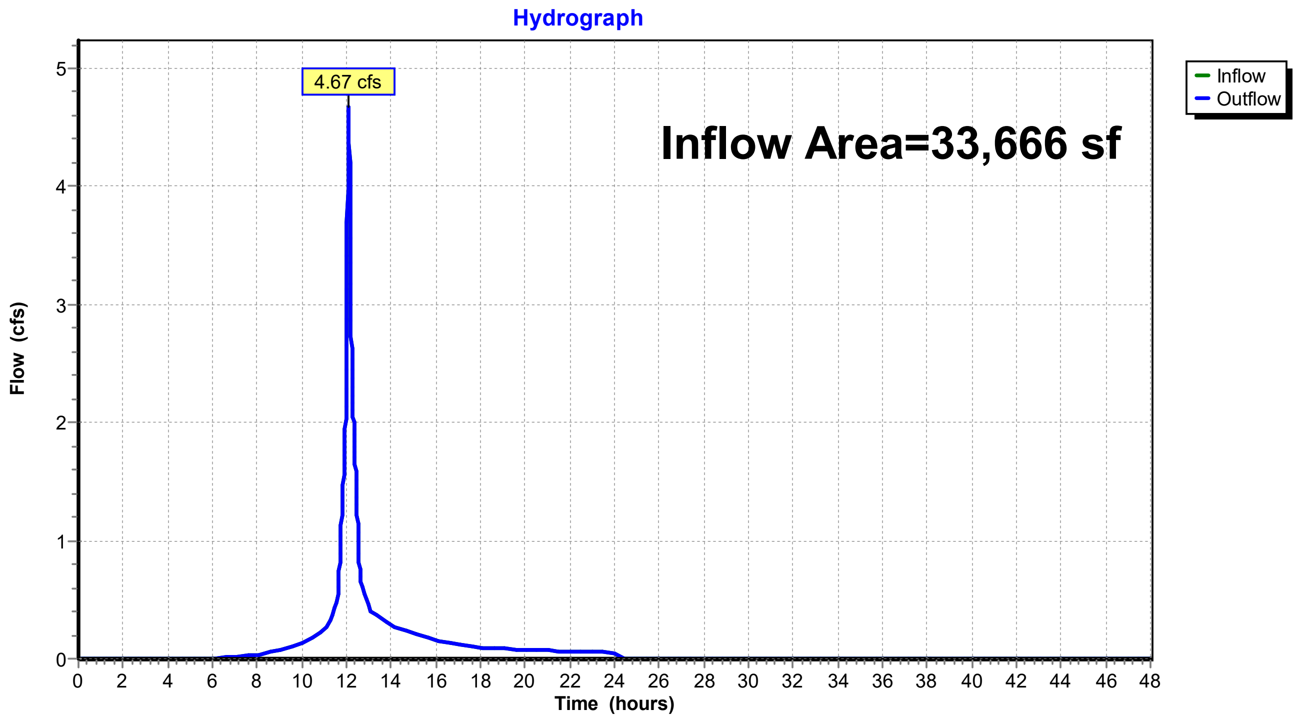


Summary for Reach PD6: Wetland series "F"

Inflow Area = 33,666 sf, 10.01% Impervious, Inflow Depth = 5.39" for 100-Year event
Inflow = 4.67 cfs @ 12.10 hrs, Volume= 15,113 cf
Outflow = 4.67 cfs @ 12.10 hrs, Volume= 15,113 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach PD6: Wetland series "F"

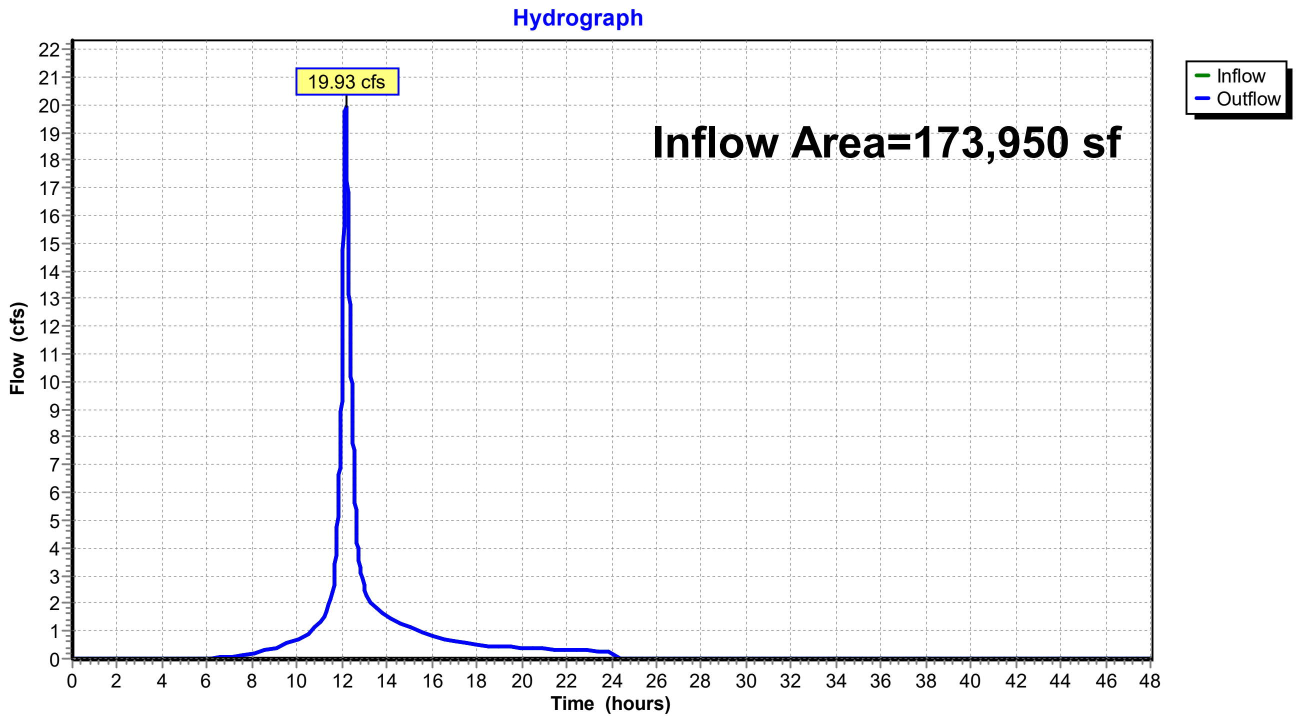


Summary for Reach WD: Washington St Drainage outlet

Inflow Area = 173,950 sf, 10.19% Impervious, Inflow Depth = 5.48" for 100-Year event
Inflow = 19.93 cfs @ 12.16 hrs, Volume= 79,448 cf
Outflow = 19.93 cfs @ 12.16 hrs, Volume= 79,448 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach WD: Washington St Drainage outlet



Date	Description	No.
7.14.2021	REVISED PER CONSERVATION COMMISSION	1.

Revisions

7-14-2021
GABRIEL R. CROCKER
PROFESSIONAL ENGINEER, MA REGISTRATION #47917

COMMONWEALTH OF MASSACHUSETTS
GABRIEL R. CROCKER
CIVIL
No. 47917
REGISTERED
PROFESSIONAL ENGINEER

Crocker Design Group
2 SHARP STREET, UNIT B
HINGHAM, MA 02043
P: 781-919-0808

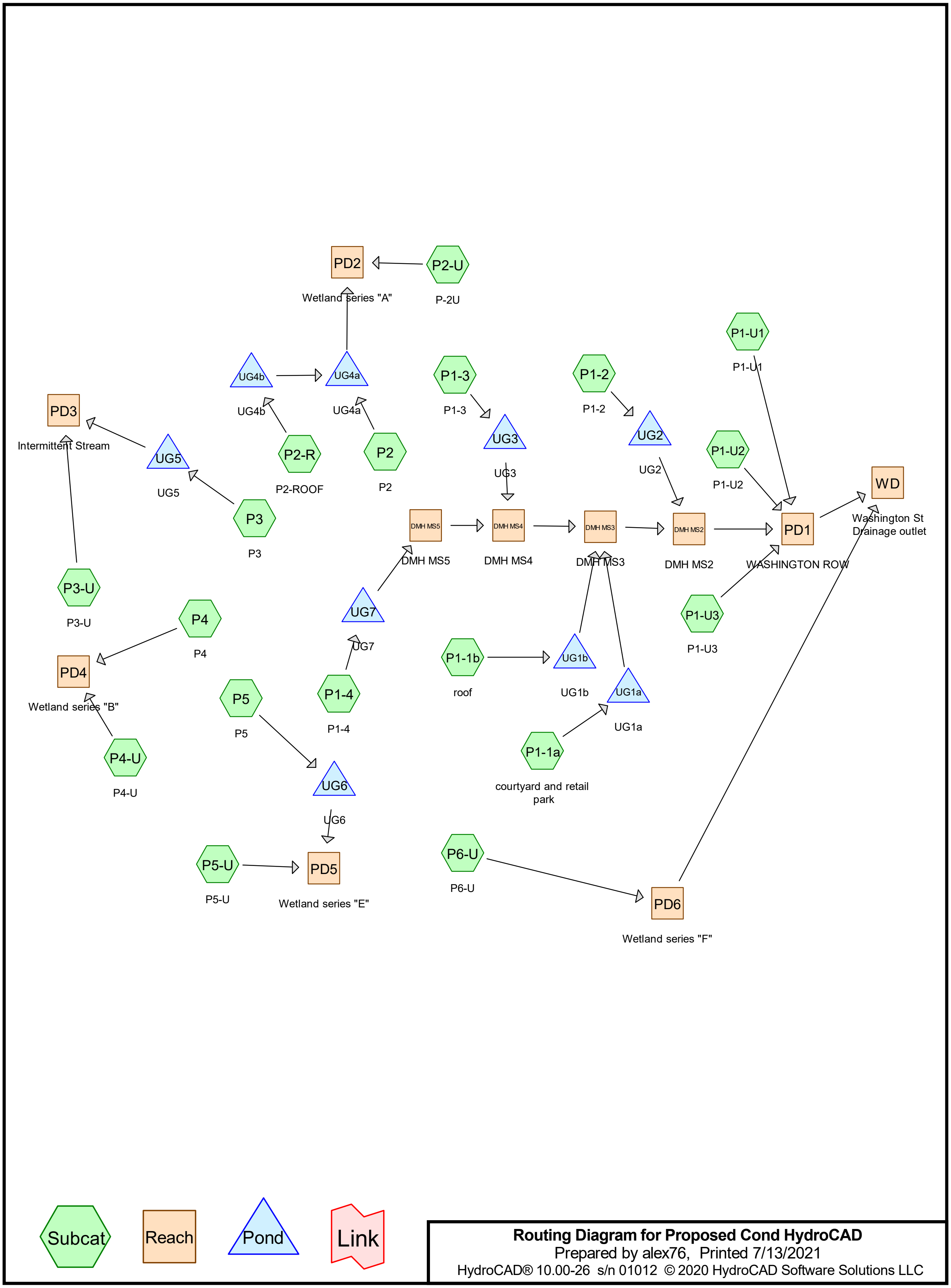
Project
HANOVER WEYMOUTH RESIDENTIAL DEVELOPMENT
#1325 WASHINGTON STREET, WEYMOUTH, MA

Prepared for
HANOVER R.S. LIMITED PARTNERSHIP
ONE MARINE PARK DRIVE, SUITE 701, BOSTON, MA 02210
HANOVER COMPANY

Drawing Title
EXISTING CONDITIONS WATERSHED MAP

Project No.	100-124
Date	4.8.2021
Scale	1"=40'
Drawn By	AS
Approved By	GC

Drawing No.
EH-1



Routing Diagram for Proposed Cond HydroCAD
Prepared by alex76, Printed 7/13/2021
HydroCAD® 10.00-26 s/n 01012 © 2020 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
53,241	80	>75% Grass cover, Good, HSG D (P1-1a, P1-2, P1-3, P1-4, P1-U1, P1-U3, P2, P3, P4, P5)
19,600	89	Courtyard, HSG D (P1-1a)
13,422	98	Ledge, HSG D (P2-U, P3-U, P4-U, P5, P5-U)
13,588	78	Meadow, non-grazed, HSG D (P2-U, P5-U)
1,097	80	Pasture/grassland/range, Good, HSG D (P6-U)
36,278	98	Paved parking, HSG D (P1-1a, P5)
15,248	98	Pavement, HSG D (P1-U2, P2)
11,507	98	Roof & Paved parking, HSG D (P1-2)
22,129	98	Roof, HSG D (P1-1b)
18,066	98	Roofs & Paved parking, HSG D (P4)
139,536	98	Roofs & Pavement, HSG D (P1-3, P1-4, P2-R, P3)
31,092	98	Wetland Surface, HSG D (P2-U, P3-U, P4-U, P5-U, P6-U)
51,425	77	Woods, Good, HSG D (P2-U, P3-U, P4-U, P5, P5-U, P6-U)
426,229	**92**	**TOTAL AREA**

Summary for Subcatchment P1-1a: courtyard and retail park

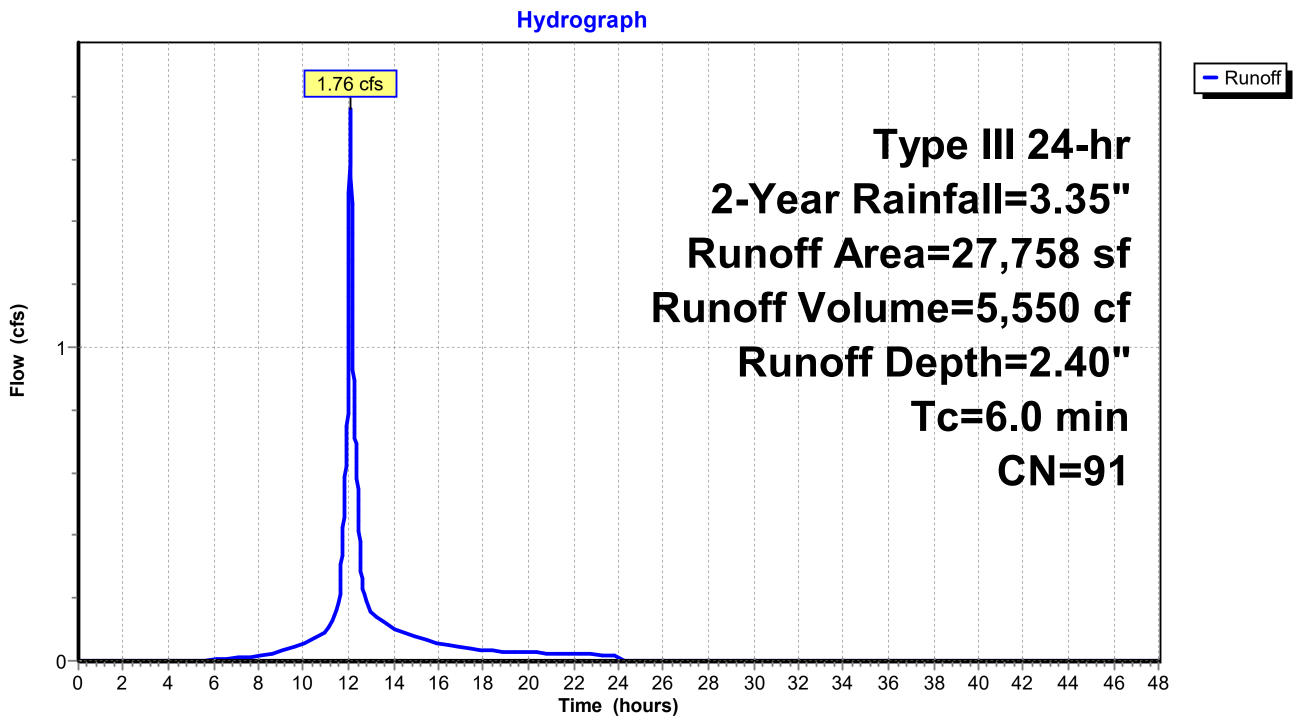
Runoff = 1.76 cfs @ 12.09 hrs, Volume= 5,550 cf, Depth= 2.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.35"

	Area (sf)	CN	Description
*	19,600	89	Courtyard, HSG D
	1,350	80	>75% Grass cover, Good, HSG D
*	6,808	98	Paved parking, HSG D
	27,758	91	Weighted Average
	20,950	88	75.47% Pervious Area
	6,808	98	24.53% Impervious Area

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

Subcatchment P1-1a: courtyard and retail park



Summary for Subcatchment P1-1b: roof

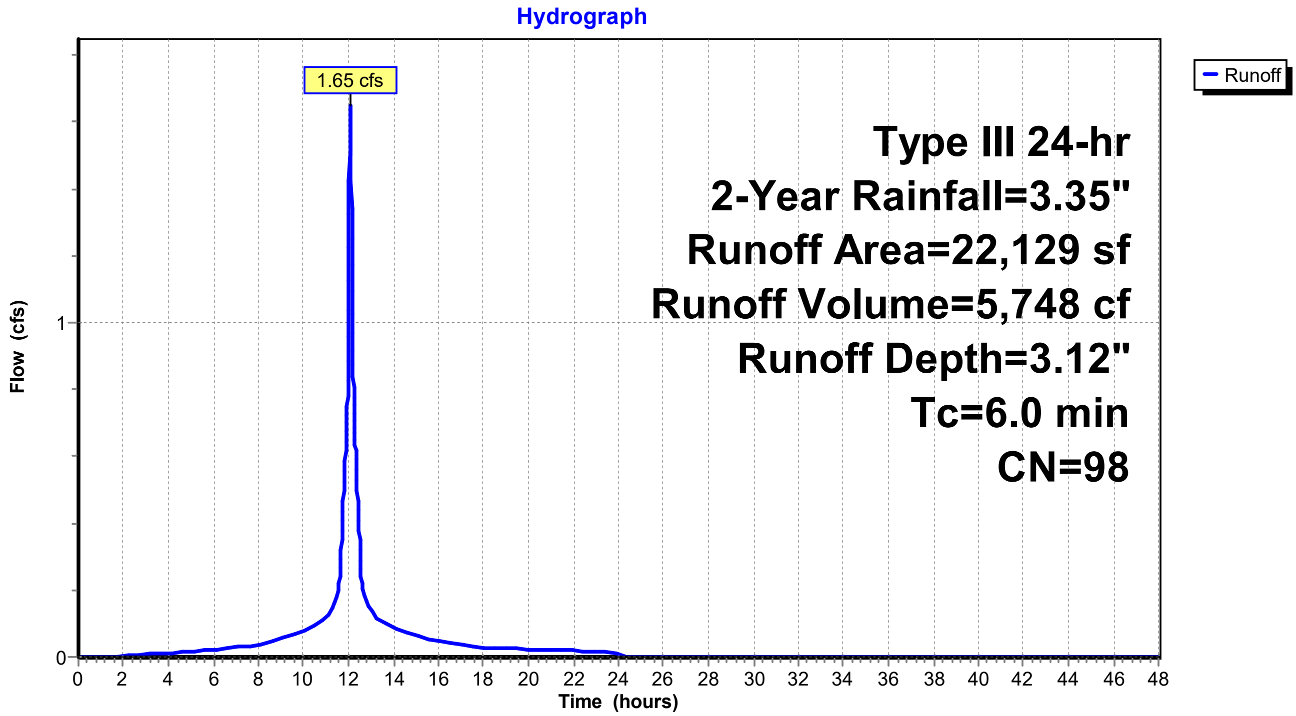
Runoff = 1.65 cfs @ 12.08 hrs, Volume= 5,748 cf, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.35"

	Area (sf)	CN	Description
*	22,129	98	Roof, HSG D
	22,129	98	100.00% Impervious Area

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

Subcatchment P1-1b: roof



Summary for Subcatchment P1-2: P1-2

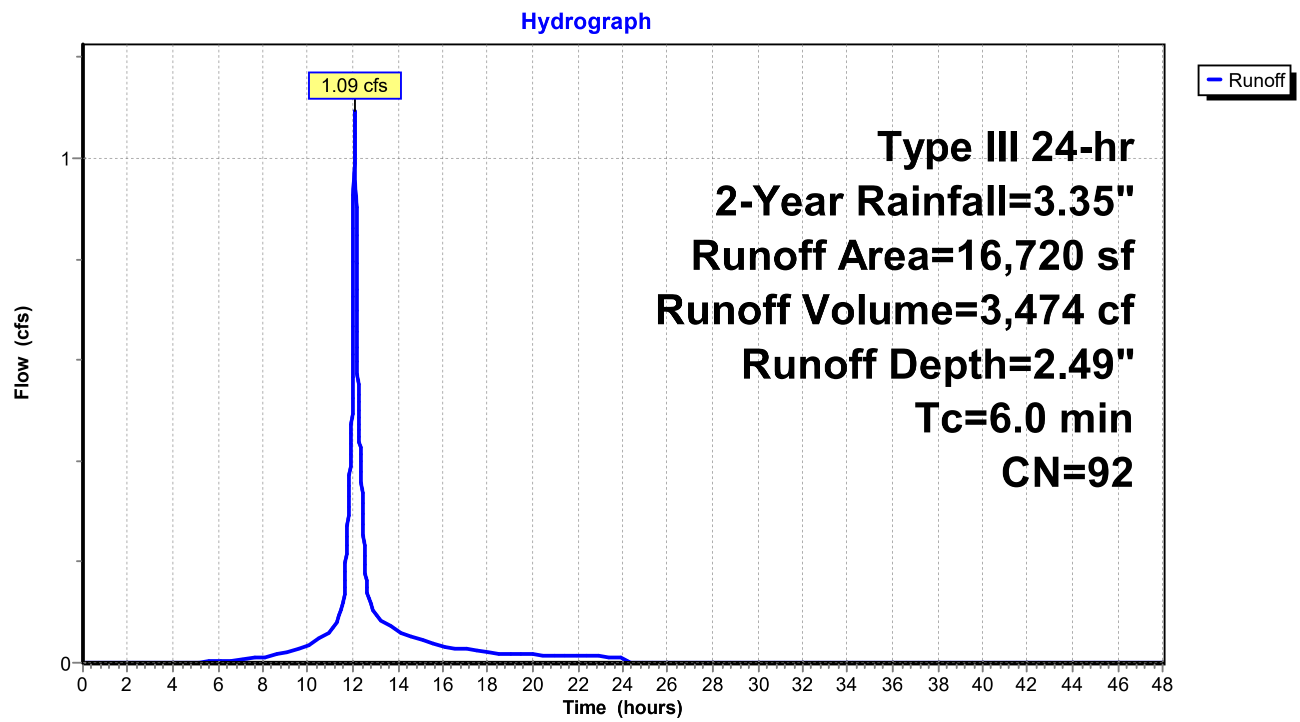
Runoff = 1.09 cfs @ 12.09 hrs, Volume= 3,474 cf, Depth= 2.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.35"

	Area (sf)	CN	Description
	5,213	80	>75% Grass cover, Good, HSG D
*	11,507	98	Roof & Paved parking, HSG D
	16,720	92	Weighted Average
	5,213	80	31.18% Pervious Area
	11,507	98	68.82% Impervious Area

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

Subcatchment P1-2: P1-2



Summary for Subcatchment P1-3: P1-3

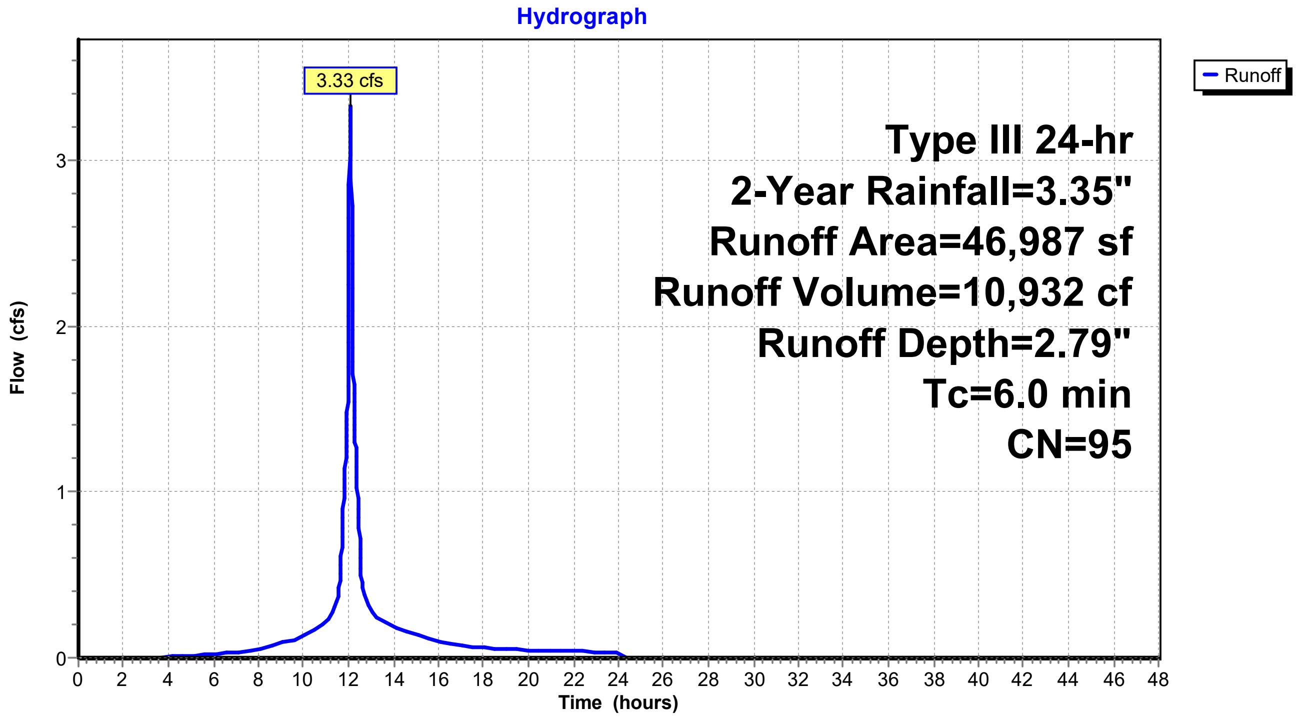
Runoff = 3.33 cfs @ 12.08 hrs, Volume= 10,932 cf, Depth= 2.79"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.35"

	Area (sf)	CN	Description
*	39,413	98	Roofs & Pavement, HSG D
	7,574	80	>75% Grass cover, Good, HSG D
	46,987	95	Weighted Average
	7,574	80	16.12% Pervious Area
	39,413	98	83.88% Impervious Area

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

Subcatchment P1-3: P1-3



Summary for Subcatchment P1-4: P1-4

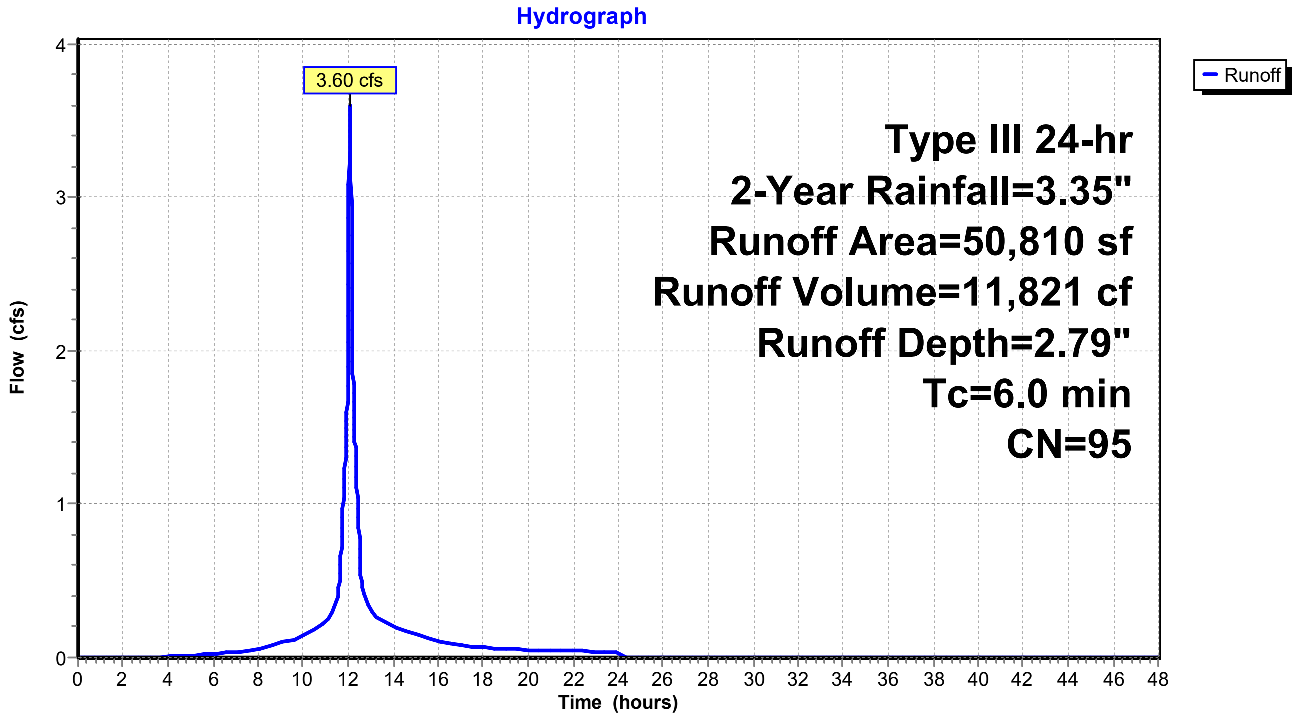
Runoff = 3.60 cfs @ 12.08 hrs, Volume= 11,821 cf, Depth= 2.79"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.35"

	Area (sf)	CN	Description
*	41,376	98	Roofs & Pavement, HSG D
	9,434	80	>75% Grass cover, Good, HSG D
	50,810	95	Weighted Average
	9,434	80	18.57% Pervious Area
	41,376	98	81.43% Impervious Area

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

Subcatchment P1-4: P1-4



Summary for Subcatchment P1-U1: P1-U1

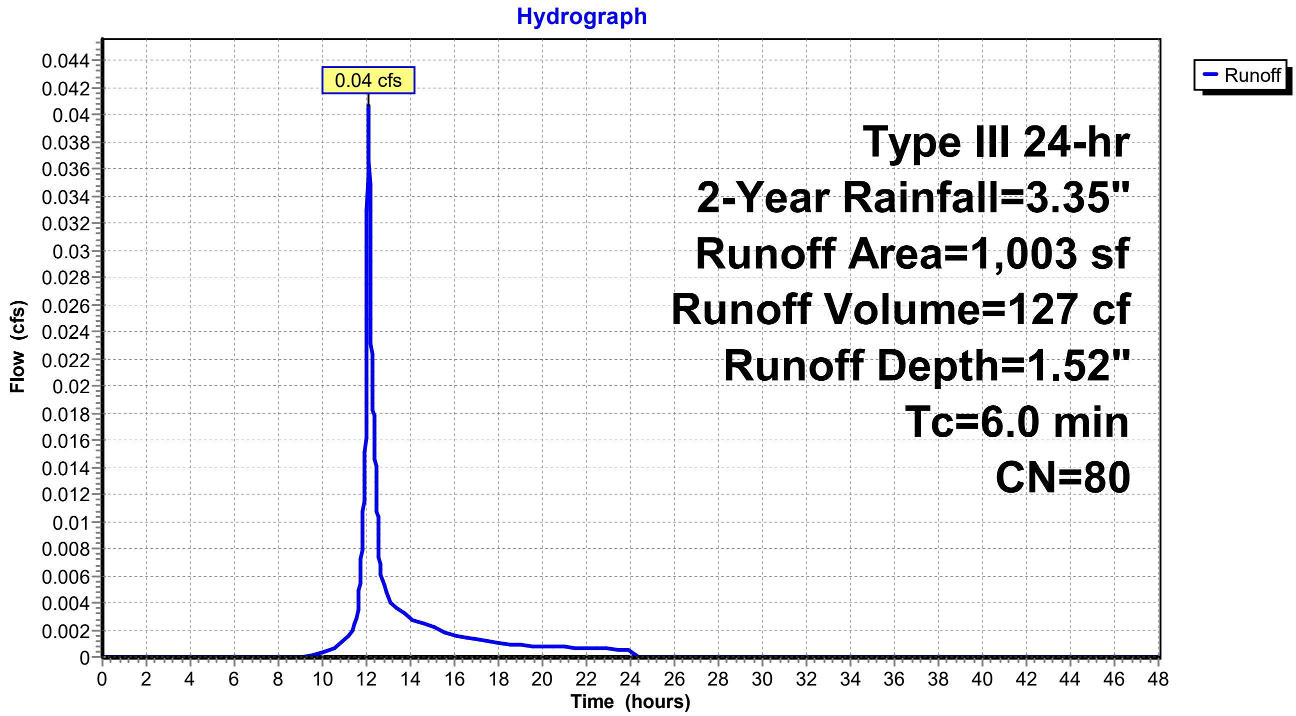
Runoff = 0.04 cfs @ 12.09 hrs, Volume= 127 cf, Depth= 1.52"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.35"

Area (sf)	CN	Description
1,003	80	>75% Grass cover, Good, HSG D
1,003	80	100.00% Pervious Area

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

Subcatchment P1-U1: P1-U1



Summary for Subcatchment P1-U2: P1-U2

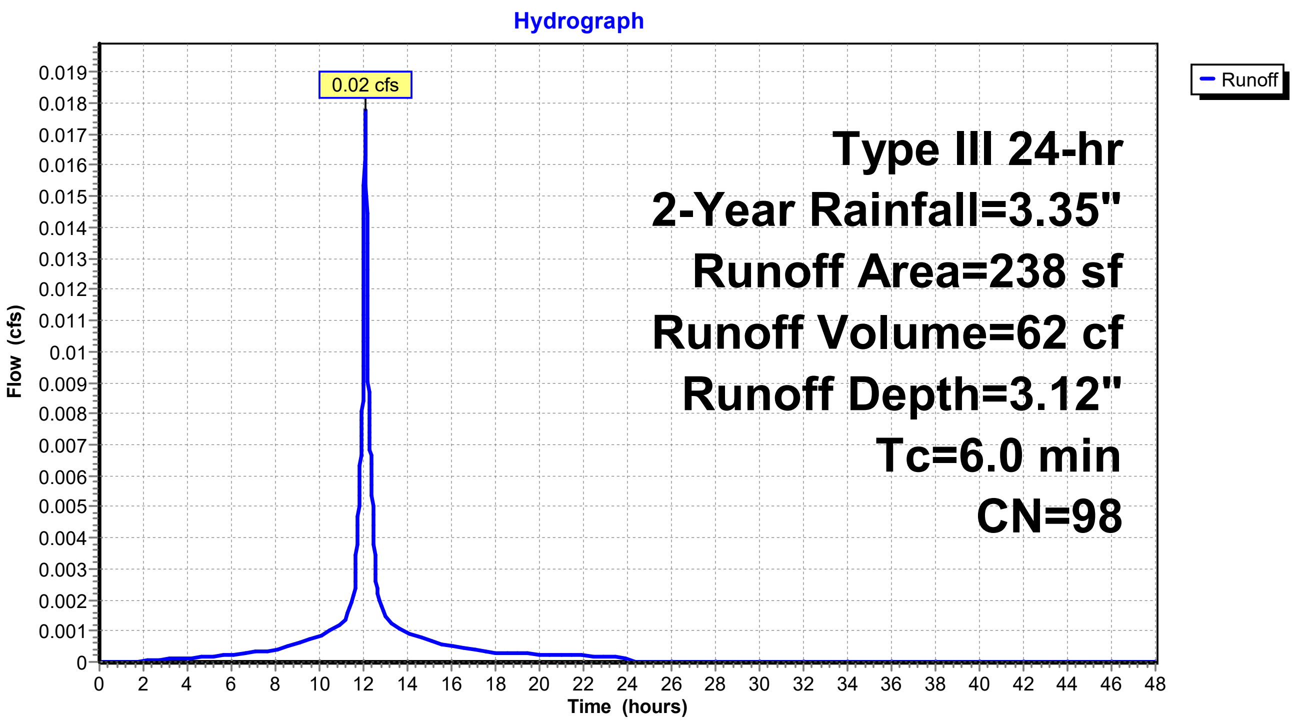
Runoff = 0.02 cfs @ 12.08 hrs, Volume= 62 cf, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.35"

	Area (sf)	CN	Description
*	238	98	Pavement, HSG D
	238	98	100.00% Impervious Area

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

Subcatchment P1-U2: P1-U2



Summary for Subcatchment P1-U3: P1-U3

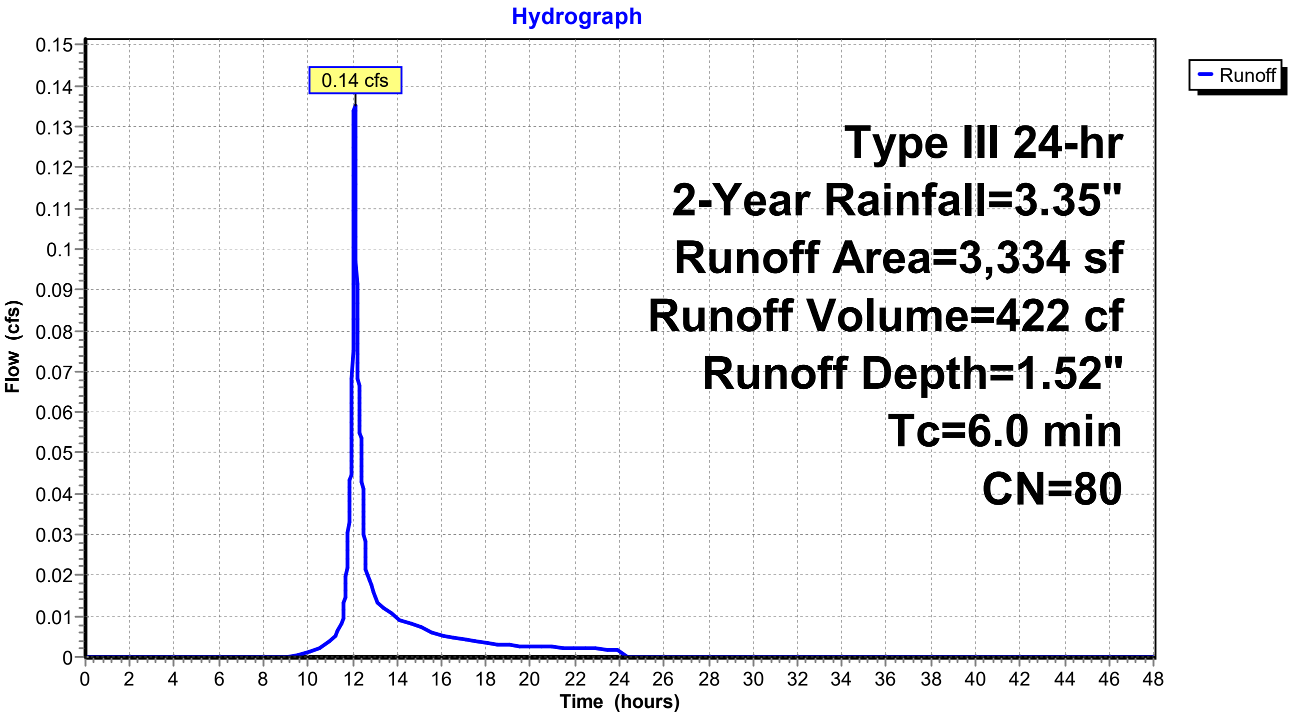
Runoff = 0.14 cfs @ 12.09 hrs, Volume= 422 cf, Depth= 1.52"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.35"

Area (sf)	CN	Description
3,334	80	>75% Grass cover, Good, HSG D
3,334	80	100.00% Pervious Area

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

Subcatchment P1-U3: P1-U3



Summary for Subcatchment P2: P2

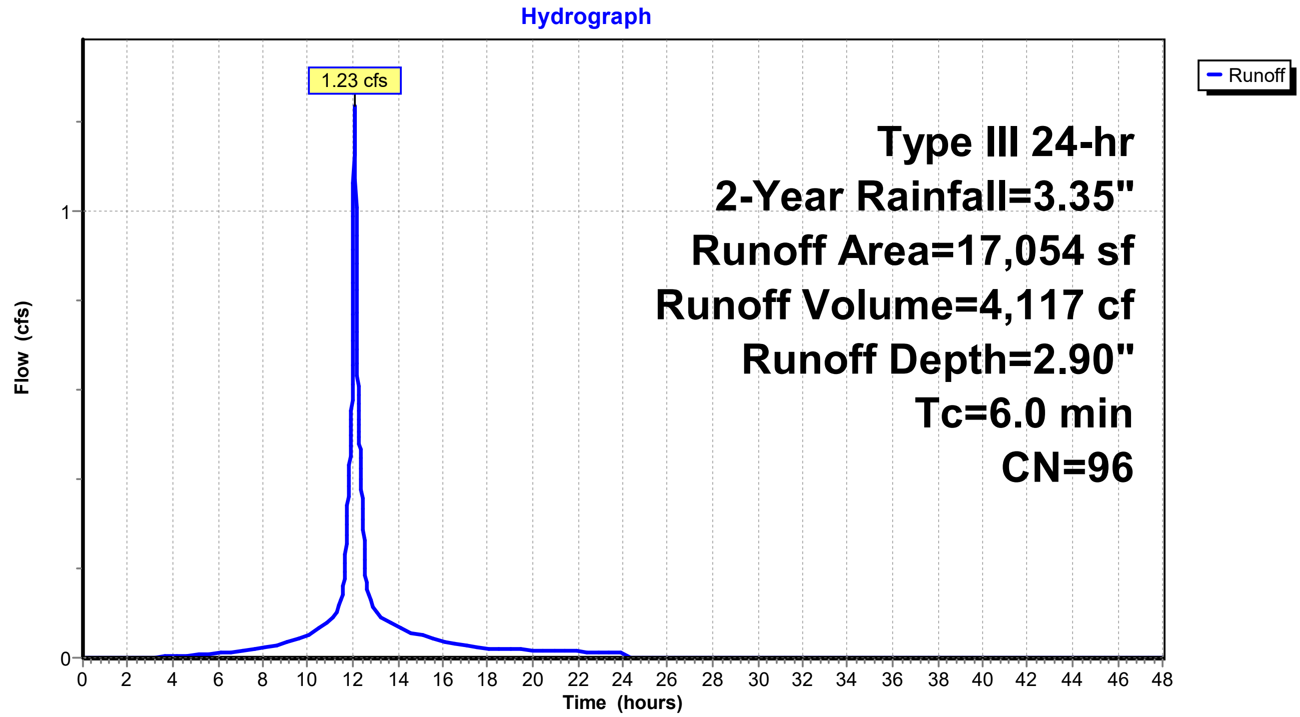
Runoff = 1.23 cfs @ 12.08 hrs, Volume= 4,117 cf, Depth= 2.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.35"

	Area (sf)	CN	Description
*	15,010	98	Pavement, HSG D
	2,044	80	>75% Grass cover, Good, HSG D
	17,054	96	Weighted Average
	2,044	80	11.99% Pervious Area
	15,010	98	88.01% Impervious Area

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

Subcatchment P2: P2



Summary for Subcatchment P2-R: P2-ROOF

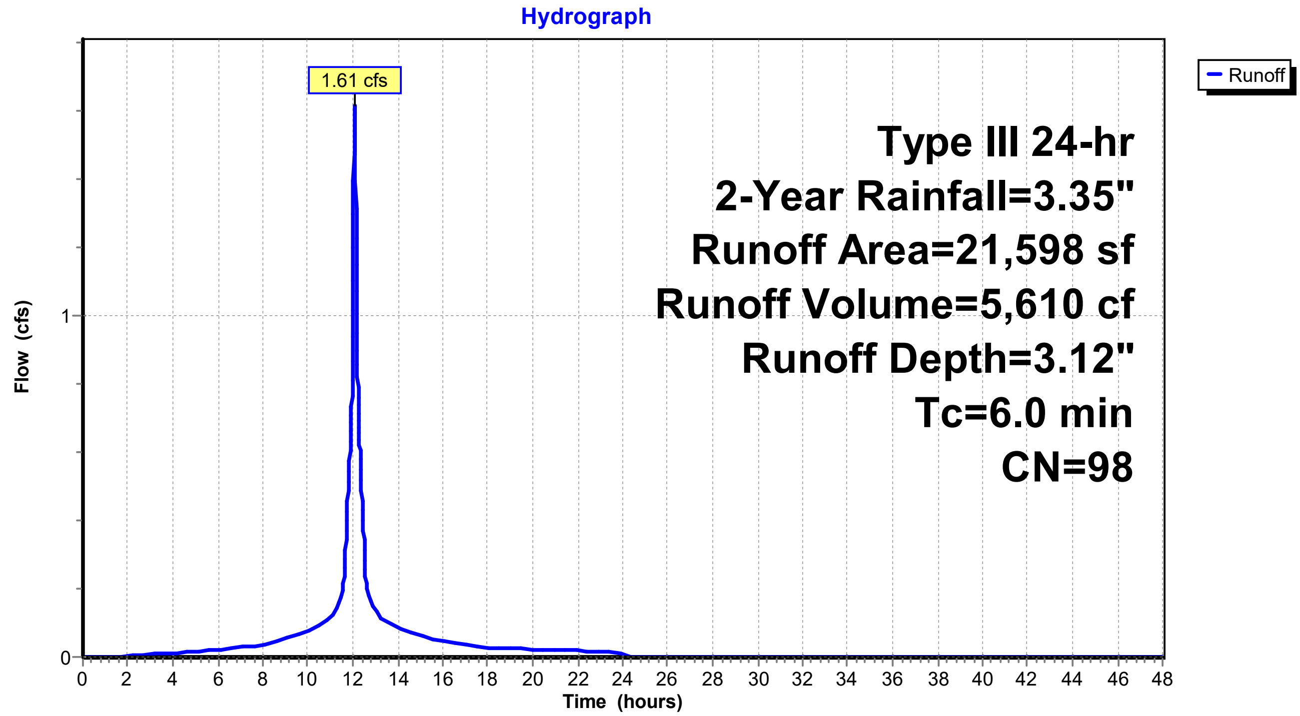
Runoff = 1.61 cfs @ 12.08 hrs, Volume= 5,610 cf, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.35"

	Area (sf)	CN	Description
*	21,598	98	Roofs & Pavement, HSG D
	21,598	98	100.00% Impervious Area

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

Subcatchment P2-R: P2-ROOF



Summary for Subcatchment P2-U: P-2U

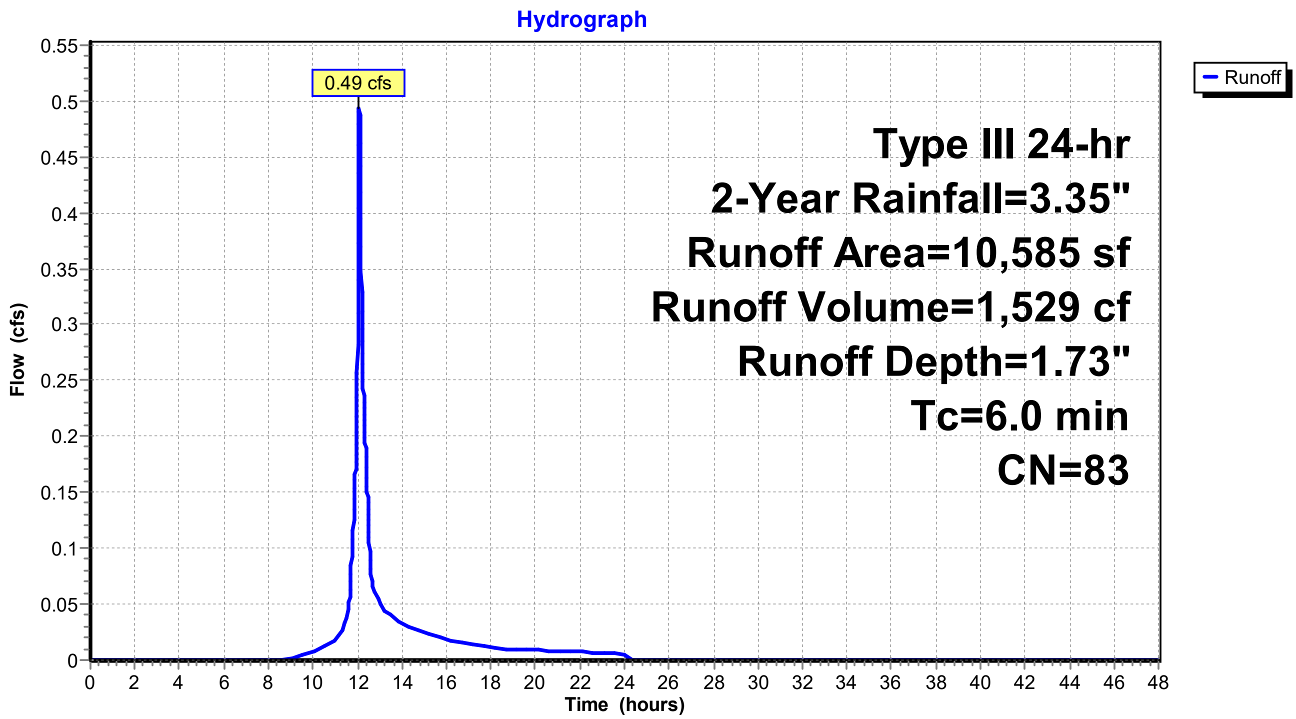
Runoff = 0.49 cfs @ 12.09 hrs, Volume= 1,529 cf, Depth= 1.73"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.35"

	Area (sf)	CN	Description
*	183	98	Ledge, HSG D
	6,620	77	Woods, Good, HSG D
*	2,902	98	Wetland Surface, HSG D
	880	78	Meadow, non-grazed, HSG D
	10,585	83	Weighted Average
	7,500	77	70.85% Pervious Area
	3,085	98	29.15% Impervious Area

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

Subcatchment P2-U: P-2U



Summary for Subcatchment P3: P3

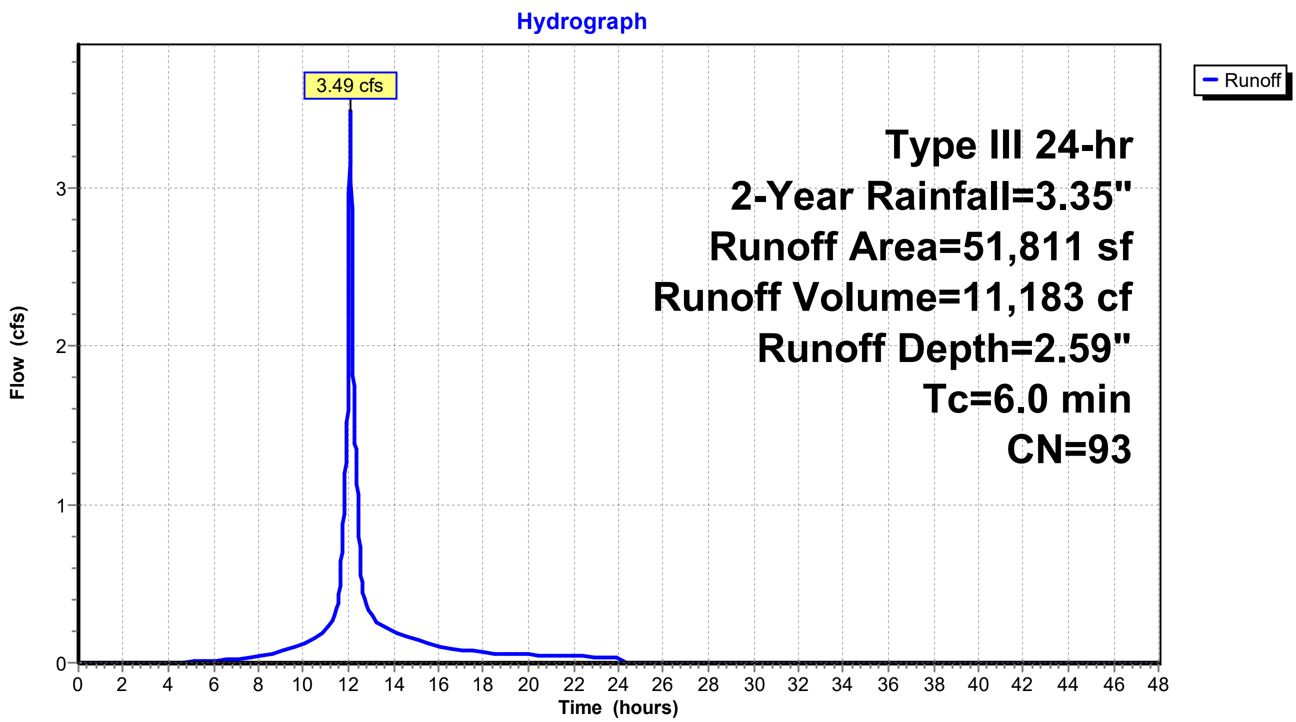
Runoff = 3.49 cfs @ 12.09 hrs, Volume= 11,183 cf, Depth= 2.59"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.35"

	Area (sf)	CN	Description
*	37,149	98	Roofs & Pavement, HSG D
	14,662	80	>75% Grass cover, Good, HSG D
	51,811	93	Weighted Average
	14,662	80	28.30% Pervious Area
	37,149	98	71.70% Impervious Area

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

Subcatchment P3: P3



Summary for Subcatchment P3-U: P3-U

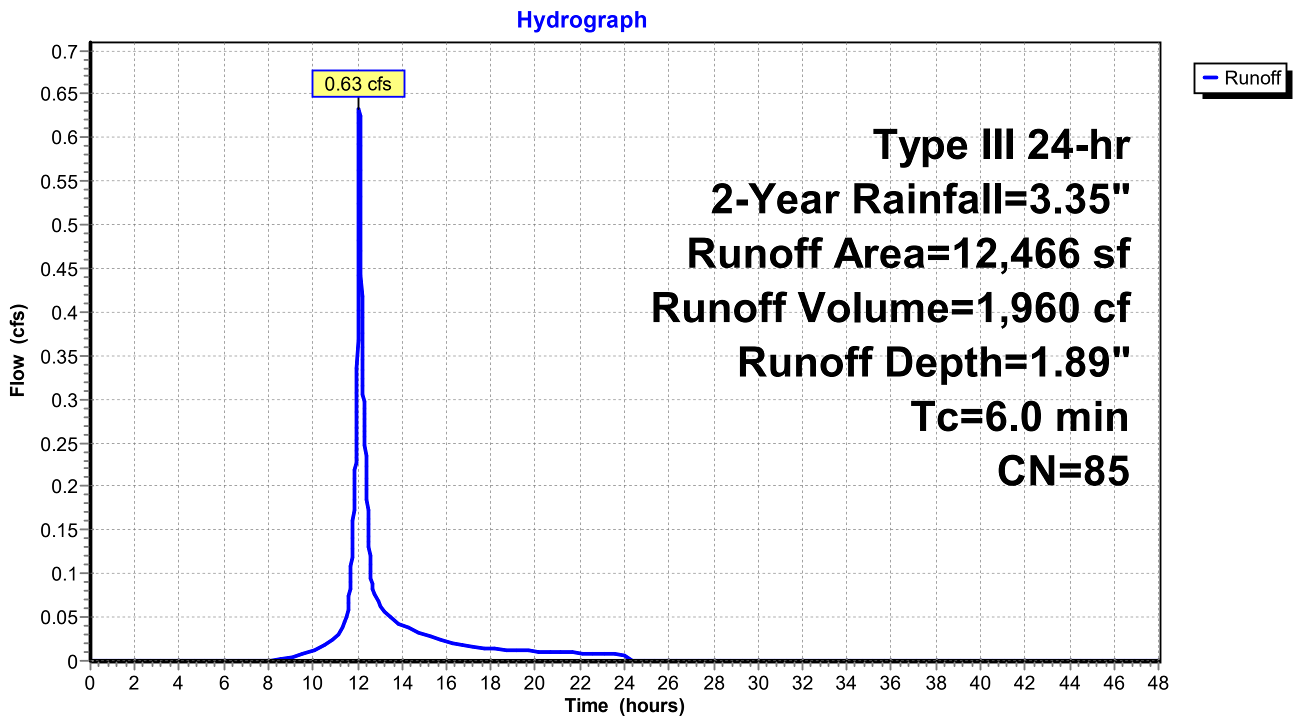
Runoff = 0.63 cfs @ 12.09 hrs, Volume= 1,960 cf, Depth= 1.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.35"

	Area (sf)	CN	Description
*	700	98	Ledge, HSG D
	7,809	77	Woods, Good, HSG D
*	3,957	98	Wetland Surface, HSG D
	12,466	85	Weighted Average
	7,809	77	62.64% Pervious Area
	4,657	98	37.36% Impervious Area

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

Subcatchment P3-U: P3-U



Summary for Subcatchment P4: P4

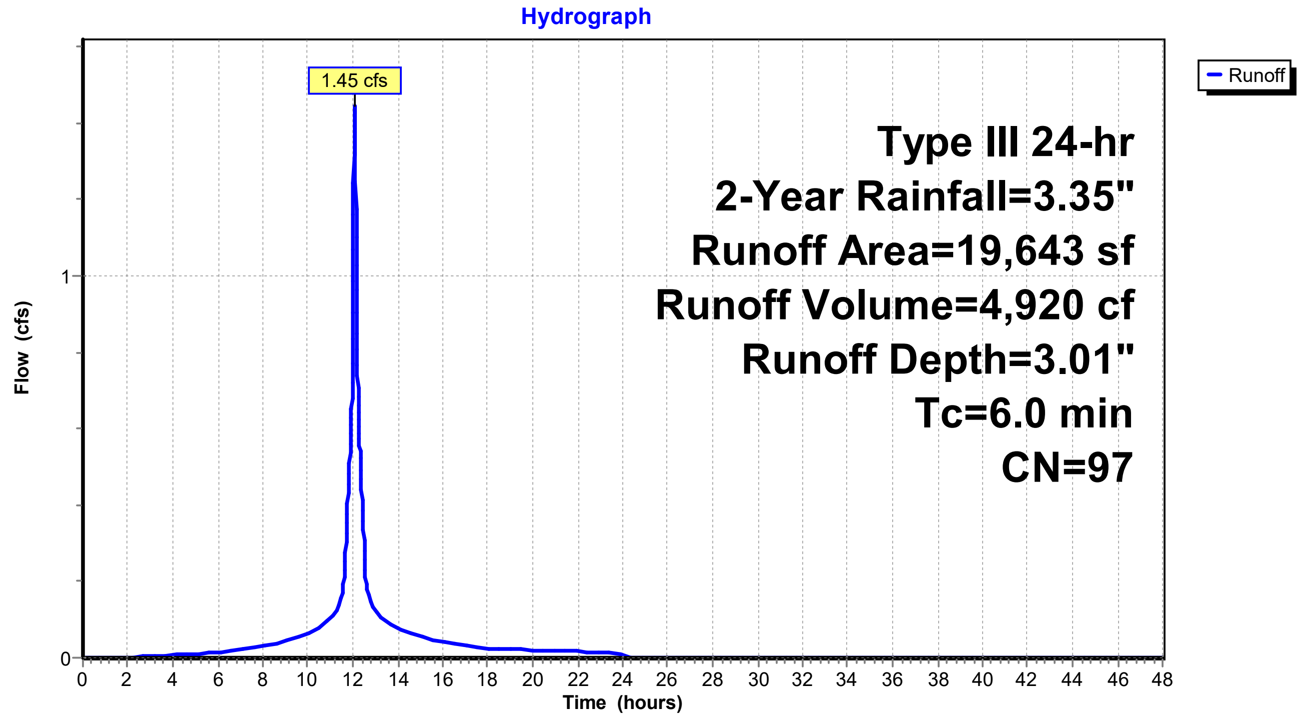
Runoff = 1.45 cfs @ 12.08 hrs, Volume= 4,920 cf, Depth= 3.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.35"

	Area (sf)	CN	Description
	1,577	80	>75% Grass cover, Good, HSG D
*	18,066	98	Roofs & Paved parking, HSG D
	19,643	97	Weighted Average
	1,577	80	8.03% Pervious Area
	18,066	98	91.97% Impervious Area

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

Subcatchment P4: P4



Summary for Subcatchment P4-U: P4-U

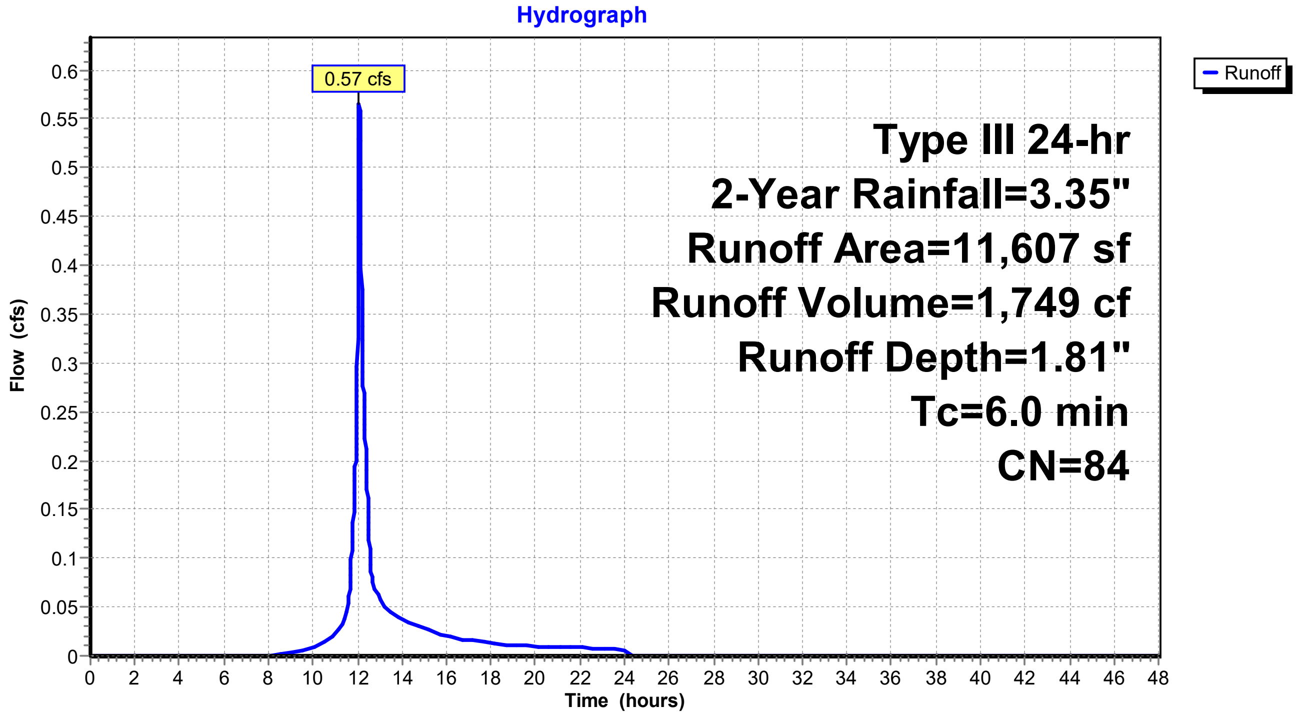
Runoff = 0.57 cfs @ 12.09 hrs, Volume= 1,749 cf, Depth= 1.81"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.35"

	Area (sf)	CN	Description
*	1,650	98	Ledge, HSG D
	7,547	77	Woods, Good, HSG D
*	2,410	98	Wetland Surface, HSG D
	11,607	84	Weighted Average
	7,547	77	65.02% Pervious Area
	4,060	98	34.98% Impervious Area

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

Subcatchment P4-U: P4-U



Summary for Subcatchment P5: P5

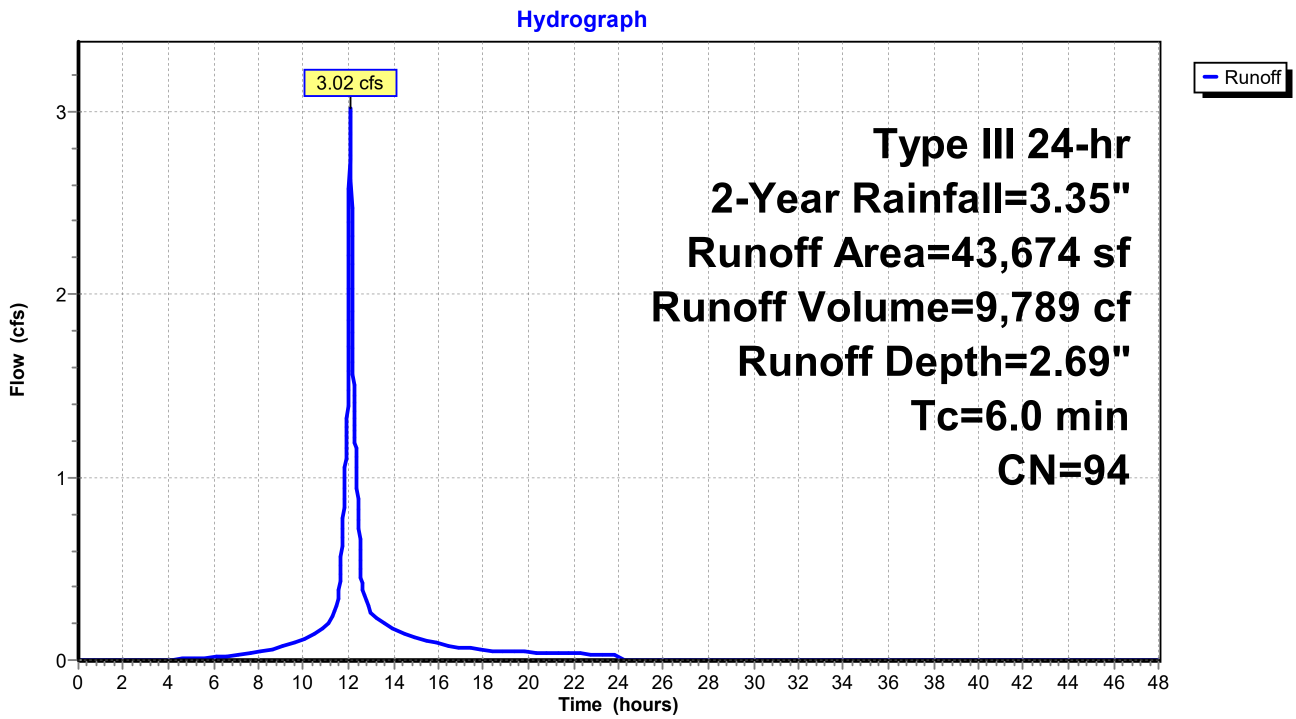
Runoff = 3.02 cfs @ 12.08 hrs, Volume= 9,789 cf, Depth= 2.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.35"

	Area (sf)	CN	Description
*	5,025	98	Ledge, HSG D
	7,050	80	>75% Grass cover, Good, HSG D
*	29,470	98	Paved parking, HSG D
	2,129	77	Woods, Good, HSG D
	43,674	94	Weighted Average
	9,179	79	21.02% Pervious Area
	34,495	98	78.98% Impervious Area

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

Subcatchment P5: P5



Summary for Subcatchment P5-U: P5-U

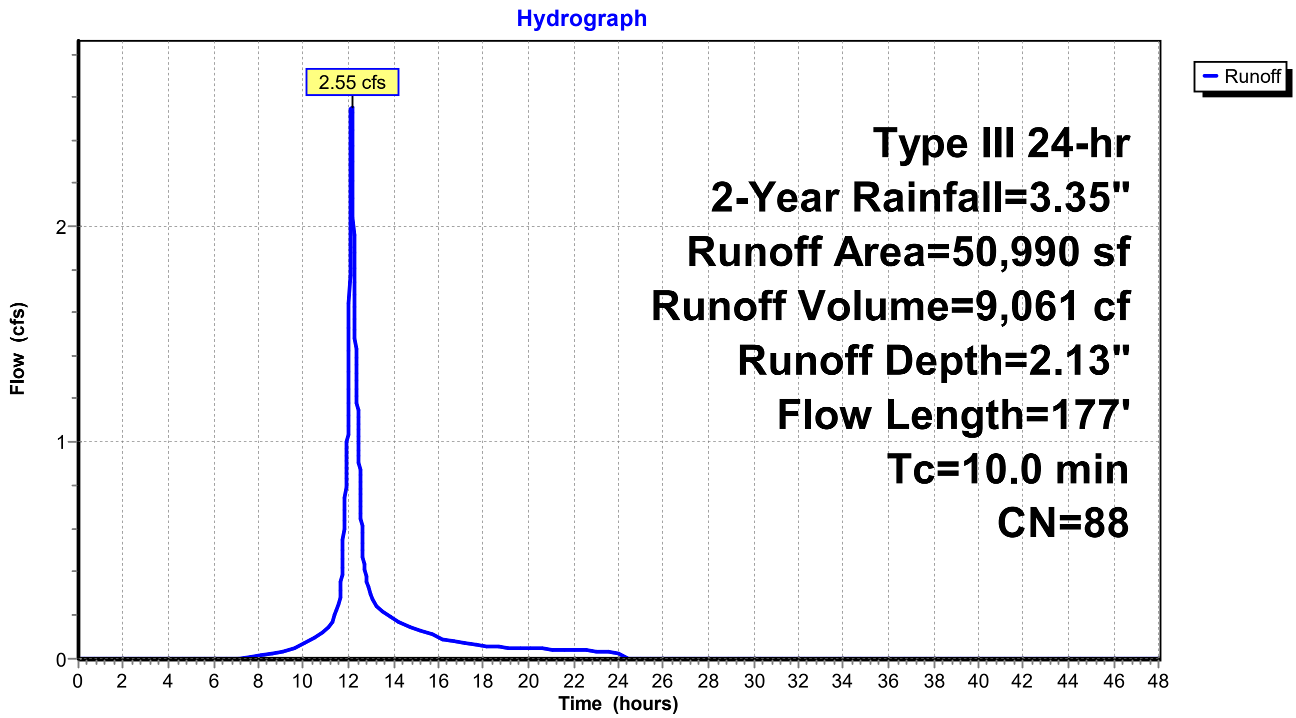
Runoff = 2.55 cfs @ 12.14 hrs, Volume= 9,061 cf, Depth= 2.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.35"

	Area (sf)	CN	Description
*	5,864	98	Ledge, HSG D
	12,095	77	Woods, Good, HSG D
*	20,323	98	Wetland Surface, HSG D
	12,708	78	Meadow, non-grazed, HSG D
	50,990	88	Weighted Average
	24,803	78	48.64% Pervious Area
	26,187	98	51.36% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	50	0.0500	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.40"
1.7	127	0.0620	1.24		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
10.0	177	Total			

Subcatchment P5-U: P5-U



Summary for Subcatchment P6-U: P6-U

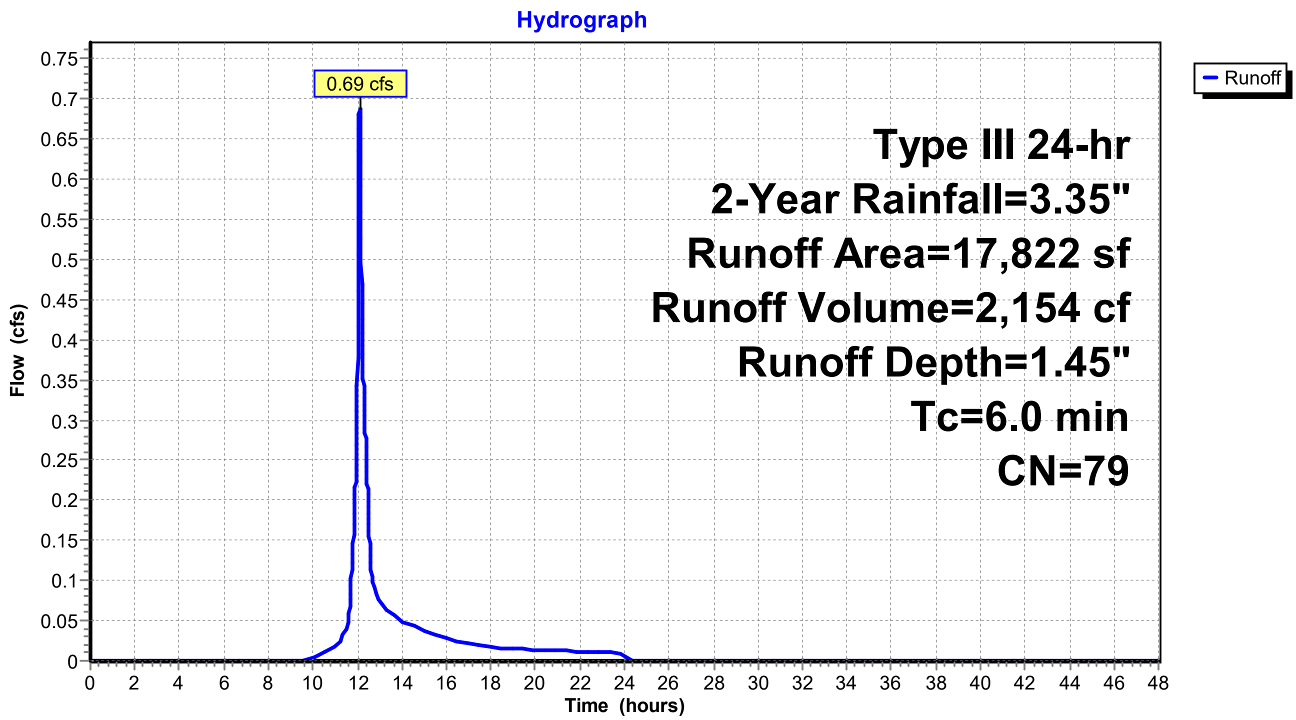
Runoff = 0.69 cfs @ 12.09 hrs, Volume= 2,154 cf, Depth= 1.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.35"

	Area (sf)	CN	Description
	15,225	77	Woods, Good, HSG D
	1,097	80	Pasture/grassland/range, Good, HSG D
*	1,500	98	Wetland Surface, HSG D
	17,822	79	Weighted Average
	16,322	77	91.58% Pervious Area
	1,500	98	8.42% Impervious Area

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

Subcatchment P6-U: P6-U

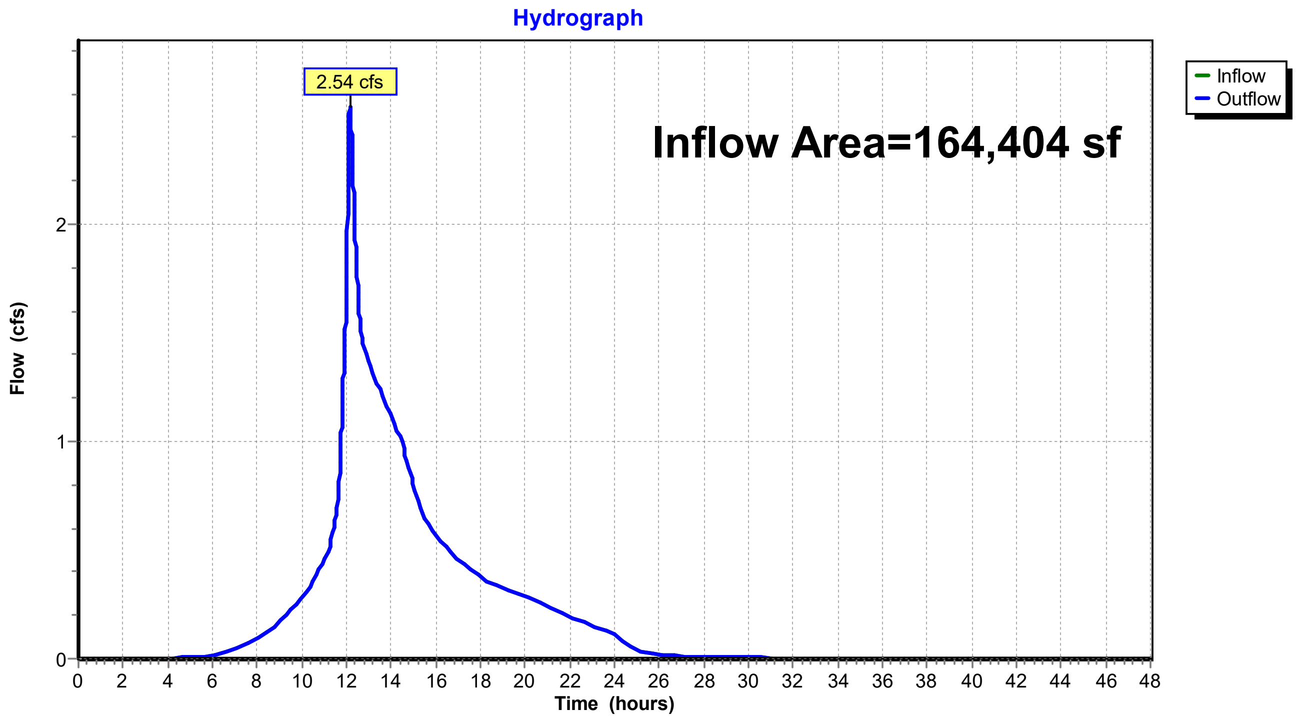


Summary for Reach DMH MS2: DMH MS2

Inflow Area =	164,404 sf,	73.74% Impervious,	Inflow Depth = 2.32"	for 2-Year event	
Inflow =	2.54 cfs @	12.16 hrs,	Volume=	31,777 cf	
Outflow =	2.54 cfs @	12.16 hrs,	Volume=	31,777 cf,	Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach DMH MS2: DMH MS2

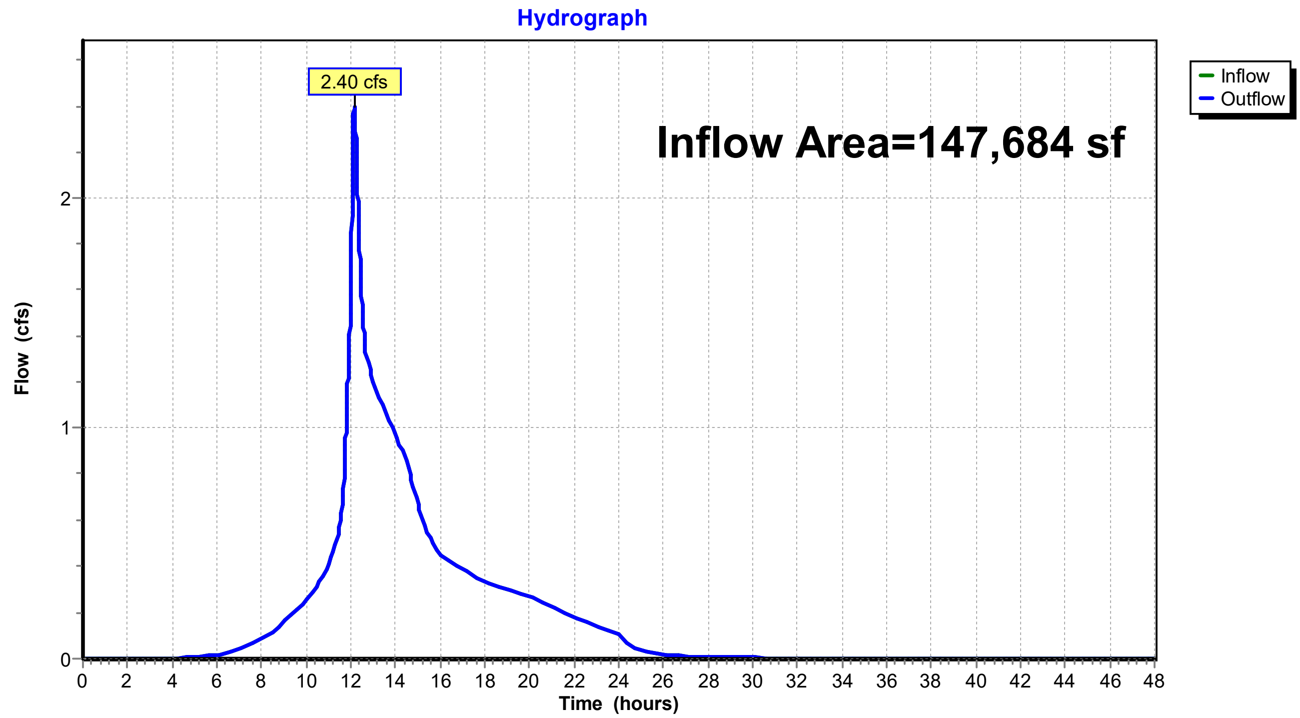


Summary for Reach DMH MS3: DMH MS3

Inflow Area = 147,684 sf, 74.30% Impervious, Inflow Depth = 2.30" for 2-Year event
Inflow = 2.40 cfs @ 12.16 hrs, Volume= 28,303 cf
Outflow = 2.40 cfs @ 12.16 hrs, Volume= 28,303 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach DMH MS3: DMH MS3

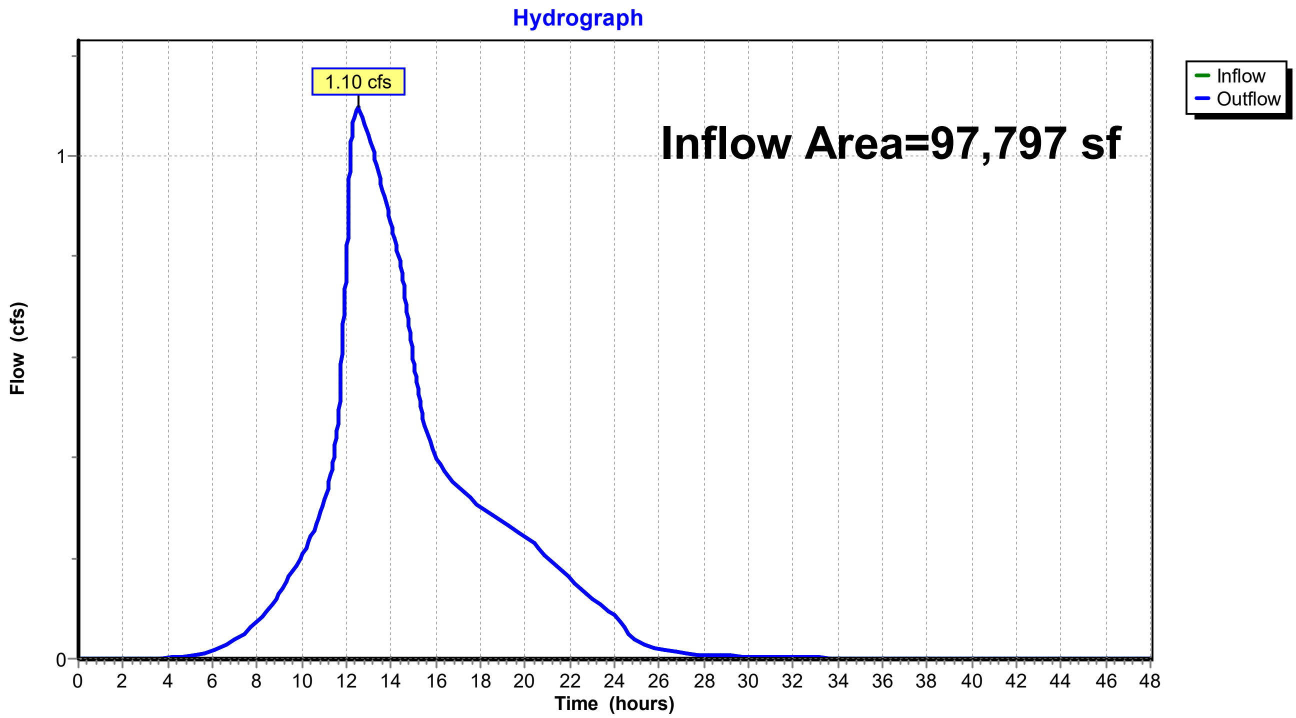


Summary for Reach DMH MS4: DMH MS4

Inflow Area = 97,797 sf, 82.61% Impervious, Inflow Depth = 2.79" for 2-Year event
Inflow = 1.10 cfs @ 12.52 hrs, Volume= 22,752 cf
Outflow = 1.10 cfs @ 12.52 hrs, Volume= 22,752 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach DMH MS4: DMH MS4

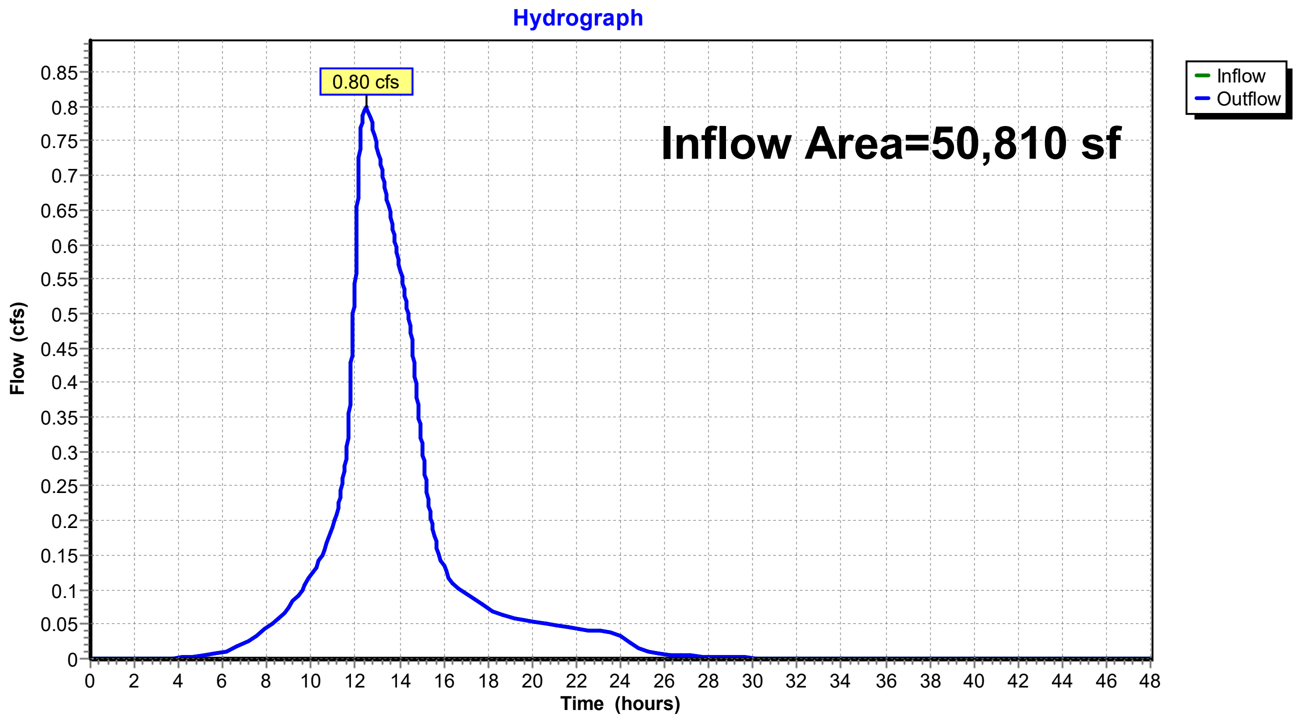


Summary for Reach DMH MS5: DMH MS5

Inflow Area =	50,810 sf,	81.43% Impervious,	Inflow Depth = 2.79"	for 2-Year event
Inflow =	0.80 cfs @	12.49 hrs, Volume=	11,821 cf	
Outflow =	0.80 cfs @	12.49 hrs, Volume=	11,821 cf, Atten= 0%, Lag= 0.0 min	

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach DMH MS5: DMH MS5

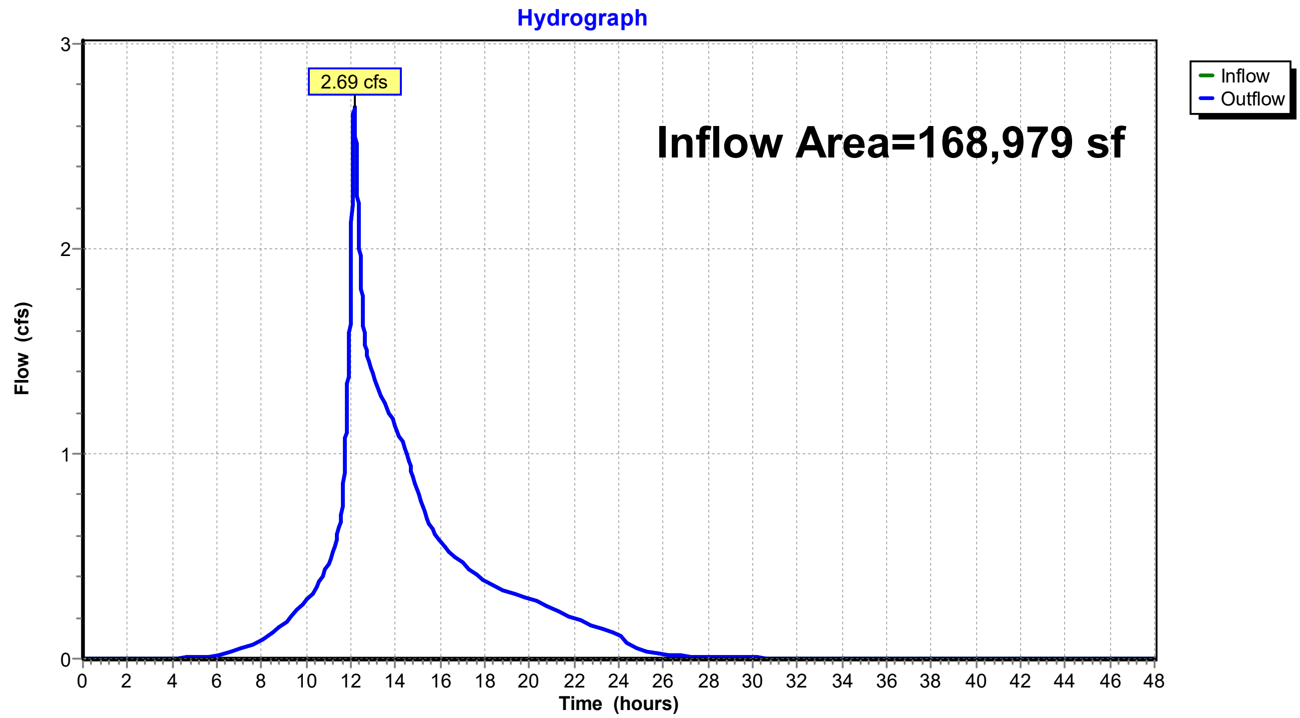


Summary for Reach PD1: WASHINGTON ROW

Inflow Area =	168,979 sf,	71.89% Impervious,	Inflow Depth = 2.30"	for 2-Year event
Inflow =	2.69 cfs @	12.15 hrs, Volume=	32,387 cf	
Outflow =	2.69 cfs @	12.15 hrs, Volume=	32,387 cf, Atten= 0%, Lag= 0.0 min	

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach PD1: WASHINGTON ROW

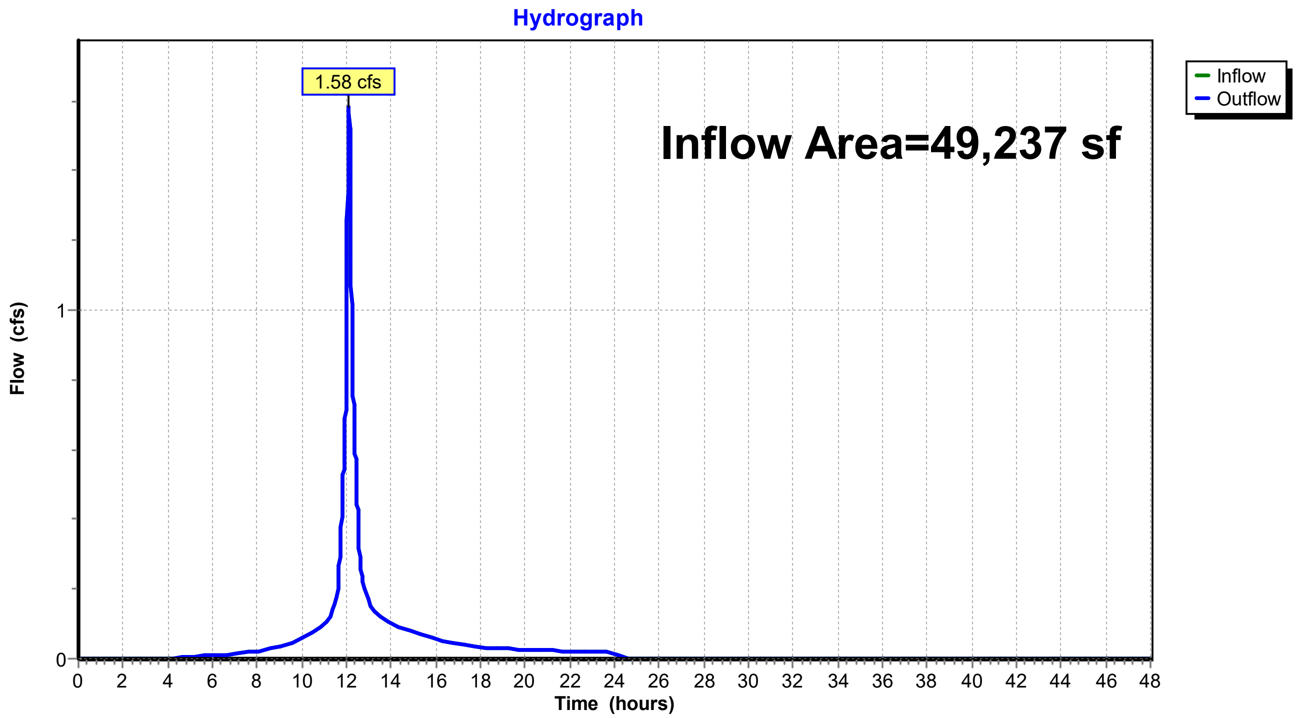


Summary for Reach PD2: Wetland series "A"

Inflow Area = 49,237 sf, 80.62% Impervious, Inflow Depth = 1.38" for 2-Year event
Inflow = 1.58 cfs @ 12.11 hrs, Volume= 5,646 cf
Outflow = 1.58 cfs @ 12.11 hrs, Volume= 5,646 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach PD2: Wetland series "A"

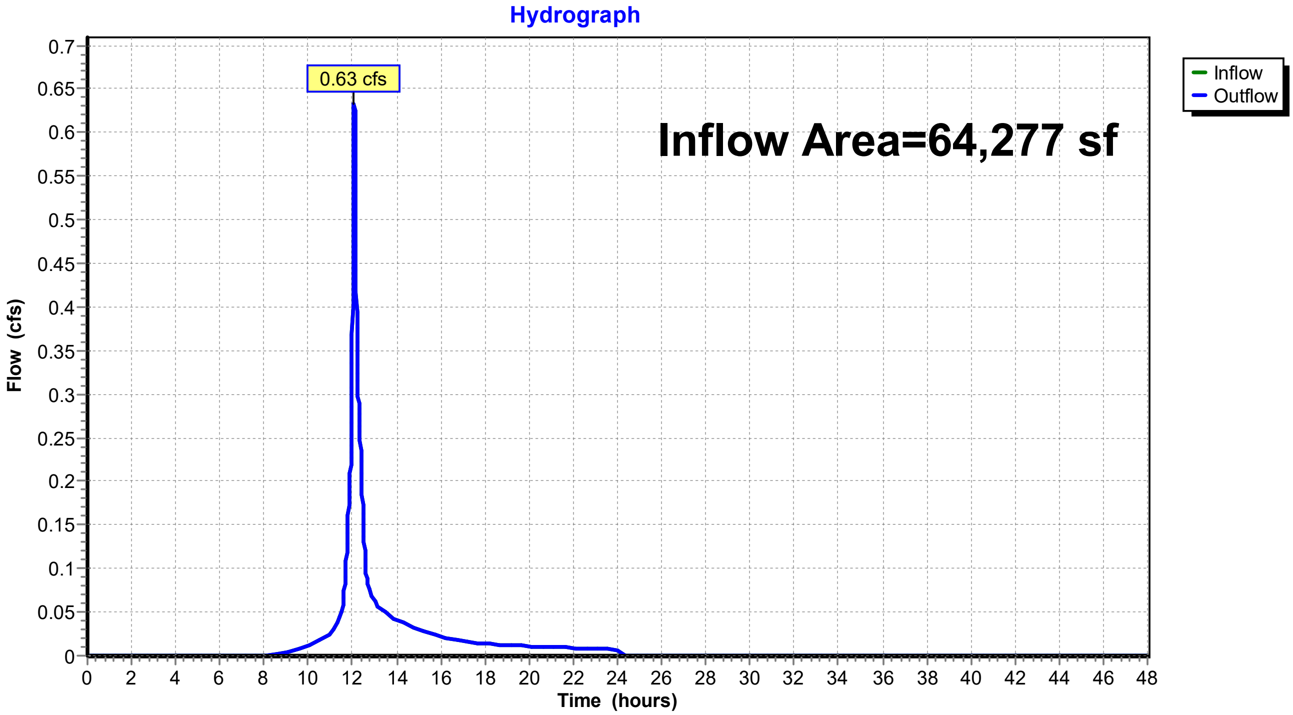


Summary for Reach PD3: Intermittent Stream

Inflow Area =	64,277 sf,	65.04% Impervious,	Inflow Depth = 0.37"	for 2-Year event	
Inflow =	0.63 cfs @	12.09 hrs,	Volume=	1,960 cf	
Outflow =	0.63 cfs @	12.09 hrs,	Volume=	1,960 cf,	Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach PD3: Intermittent Stream

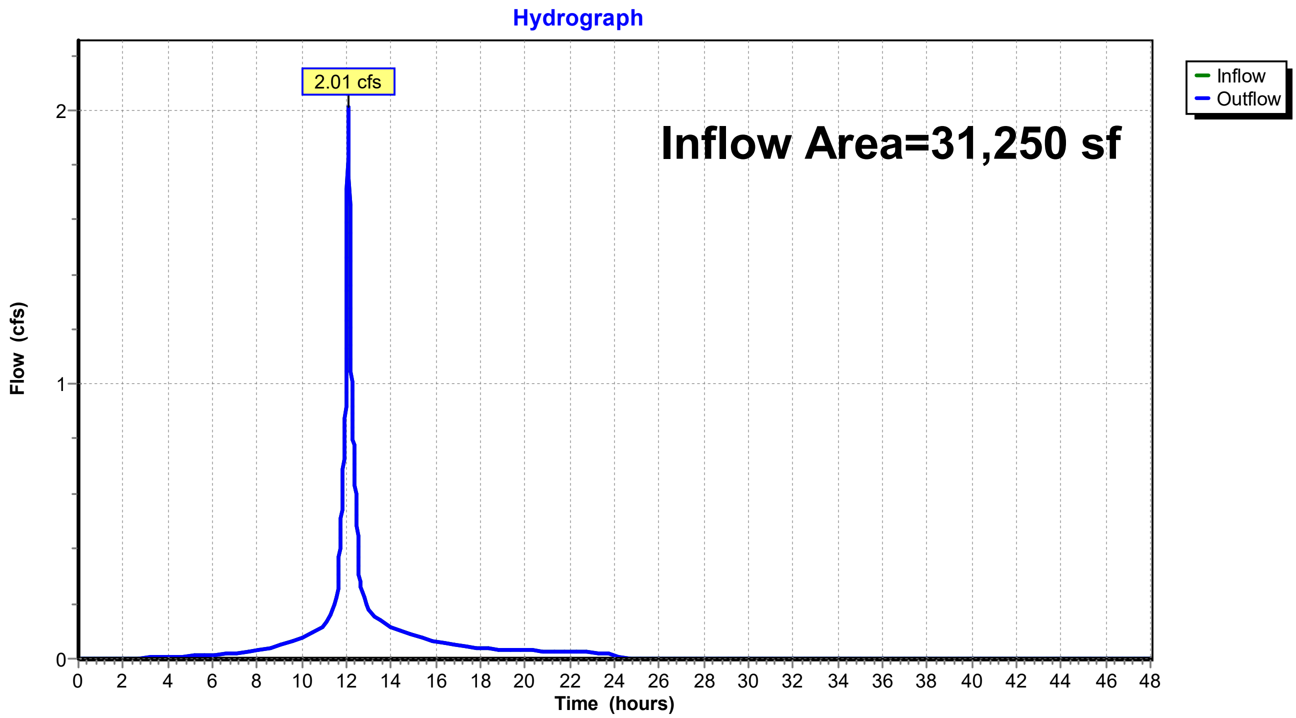


Summary for Reach PD4: Wetland series "B"

Inflow Area =	31,250 sf, 70.80% Impervious,	Inflow Depth = 2.56"	for 2-Year event
Inflow =	2.01 cfs @ 12.09 hrs, Volume=	6,669 cf	
Outflow =	2.01 cfs @ 12.09 hrs, Volume=	6,669 cf, Atten= 0%, Lag= 0.0 min	

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach PD4: Wetland series "B"

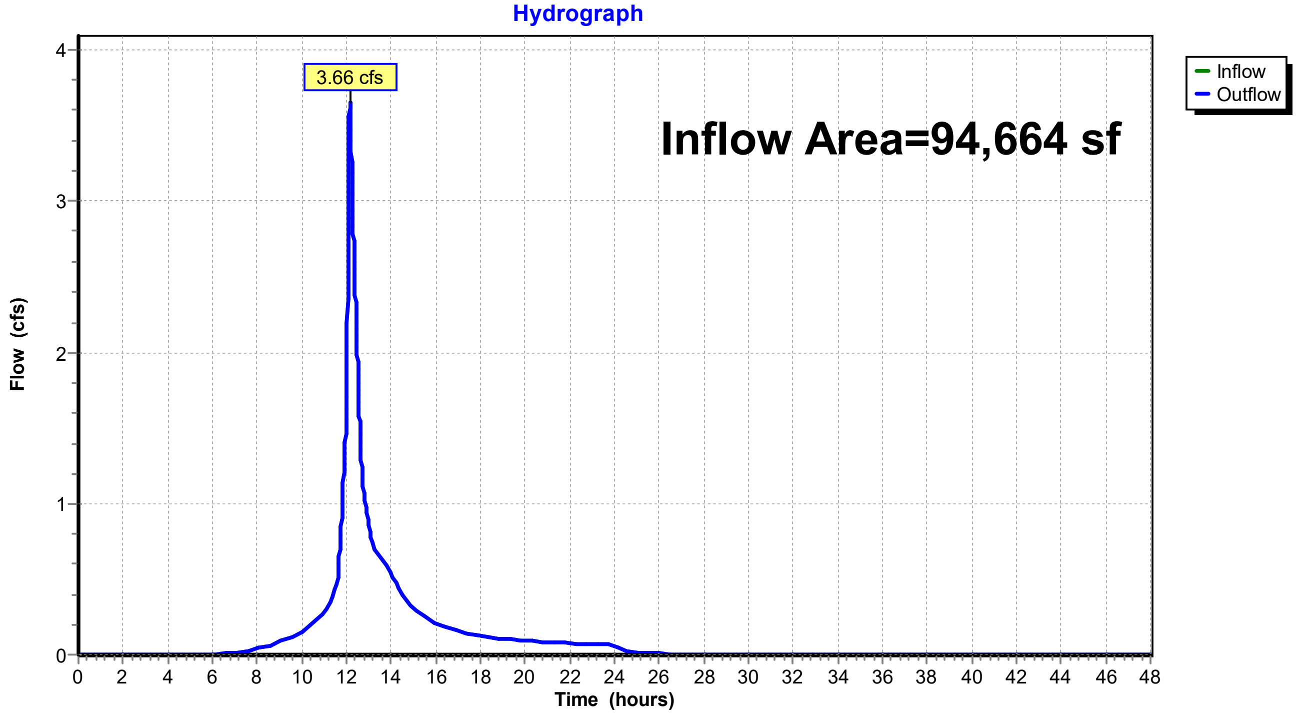


Summary for Reach PD5: Wetland series "E"

Inflow Area =	94,664 sf, 64.10% Impervious,	Inflow Depth = 2.39"	for 2-Year event
Inflow =	3.66 cfs @ 12.16 hrs, Volume=	18,844 cf	
Outflow =	3.66 cfs @ 12.16 hrs, Volume=	18,844 cf, Atten= 0%, Lag= 0.0 min	

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach PD5: Wetland series "E"

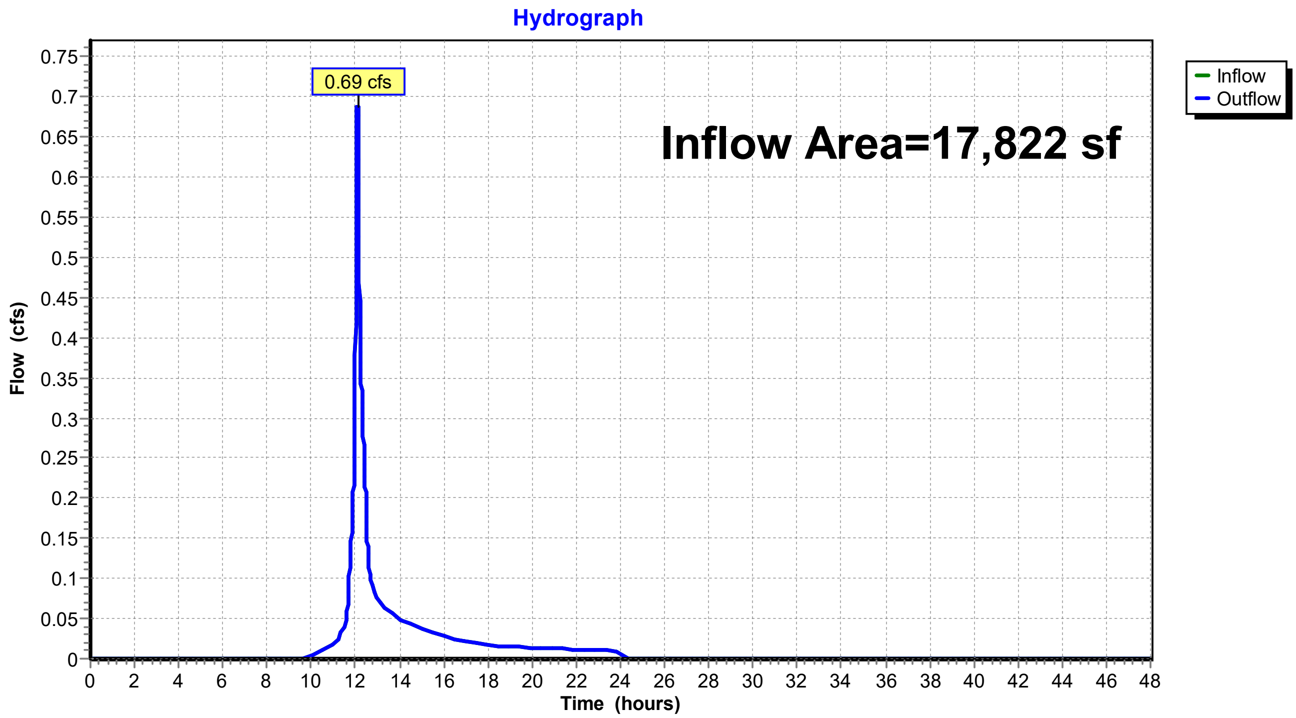


Summary for Reach PD6: Wetland series "F"

Inflow Area = 17,822 sf, 8.42% Impervious, Inflow Depth = 1.45" for 2-Year event
Inflow = 0.69 cfs @ 12.09 hrs, Volume= 2,154 cf
Outflow = 0.69 cfs @ 12.09 hrs, Volume= 2,154 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach PD6: Wetland series "F"

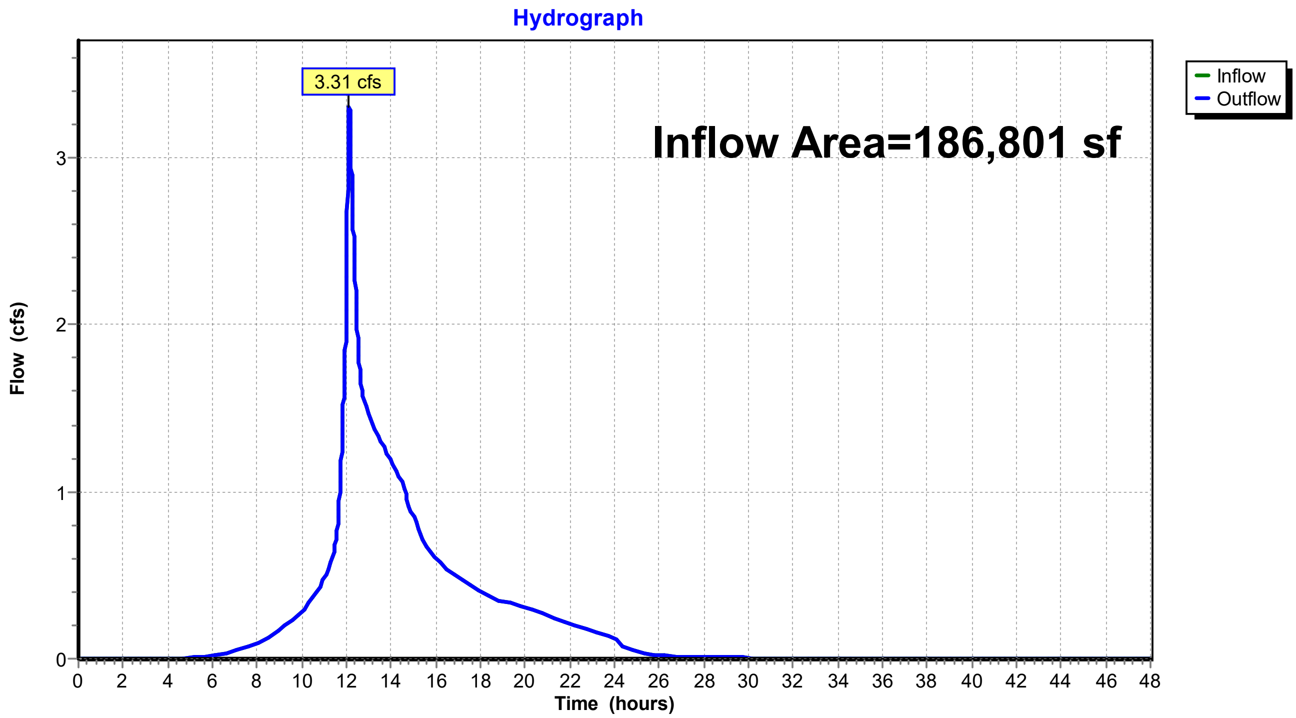


Summary for Reach WD: Washington St Drainage outlet

Inflow Area =	186,801 sf,	65.83% Impervious,	Inflow Depth = 2.22"	for 2-Year event	
Inflow =	3.31 cfs @	12.12 hrs,	Volume=	34,541 cf	
Outflow =	3.31 cfs @	12.12 hrs,	Volume=	34,541 cf,	Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach WD: Washington St Drainage outlet



Summary for Pond UG1a: UG1a

Inflow Area = 27,758 sf, 24.53% Impervious, Inflow Depth = 2.40" for 2-Year event
Inflow = 1.76 cfs @ 12.09 hrs, Volume= 5,550 cf
Outflow = 1.42 cfs @ 12.14 hrs, Volume= 5,550 cf, Atten= 19%, Lag= 3.5 min
Primary = 1.42 cfs @ 12.14 hrs, Volume= 5,550 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 83.91' @ 12.14 hrs Surf.Area= 666 sf Storage= 346 cf

Plug-Flow detention time= 7.2 min calculated for 5,550 cf (100% of inflow)
Center-of-Mass det. time= 7.1 min (807.9 - 800.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	83.00'	639 cf	**11.00'W x 60.58'L x 3.50'H Field A** 2,332 cf Overall - 735 cf Embedded = 1,597 cf x 40.0% Voids
#2A	83.50'	735 cf	**ADS_StormTech SC-740 +Cap** x 16 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 16 Chambers in 2 Rows
		1,374 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Device 2	83.00'	**8.5" Vert. Orifice/Grate** C= 0.600
#2	Primary	83.00'	**12.0" Round RCP_Round 12"** L= 51.4' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 83.00' / 82.74' S= 0.0051 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=1.42 cfs @ 12.14 hrs HW=83.91' (Free Discharge)
↑—**2=RCP_Round 12"** (Passes 1.42 cfs of 2.20 cfs potential flow)
↑—**1=Orifice/Grate** (Orifice Controls 1.42 cfs @ 3.60 fps)

Pond UG1a: UG1a - Chamber Wizard Field A

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

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

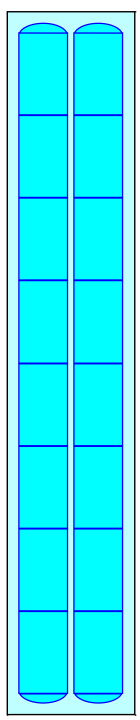
8 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 58.58' Row Length +12.0" End Stone x 2 = 60.58' Base Length
2 Rows x 51.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 11.00' Base Width
6.0" Base + 30.0" Chamber Height + 6.0" Cover = 3.50' Field Height

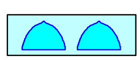
16 Chambers x 45.9 cf = 735.0 cf Chamber Storage

2,332.2 cf Field - 735.0 cf Chambers = 1,597.2 cf Stone x 40.0% Voids = 638.9 cf Stone Storage

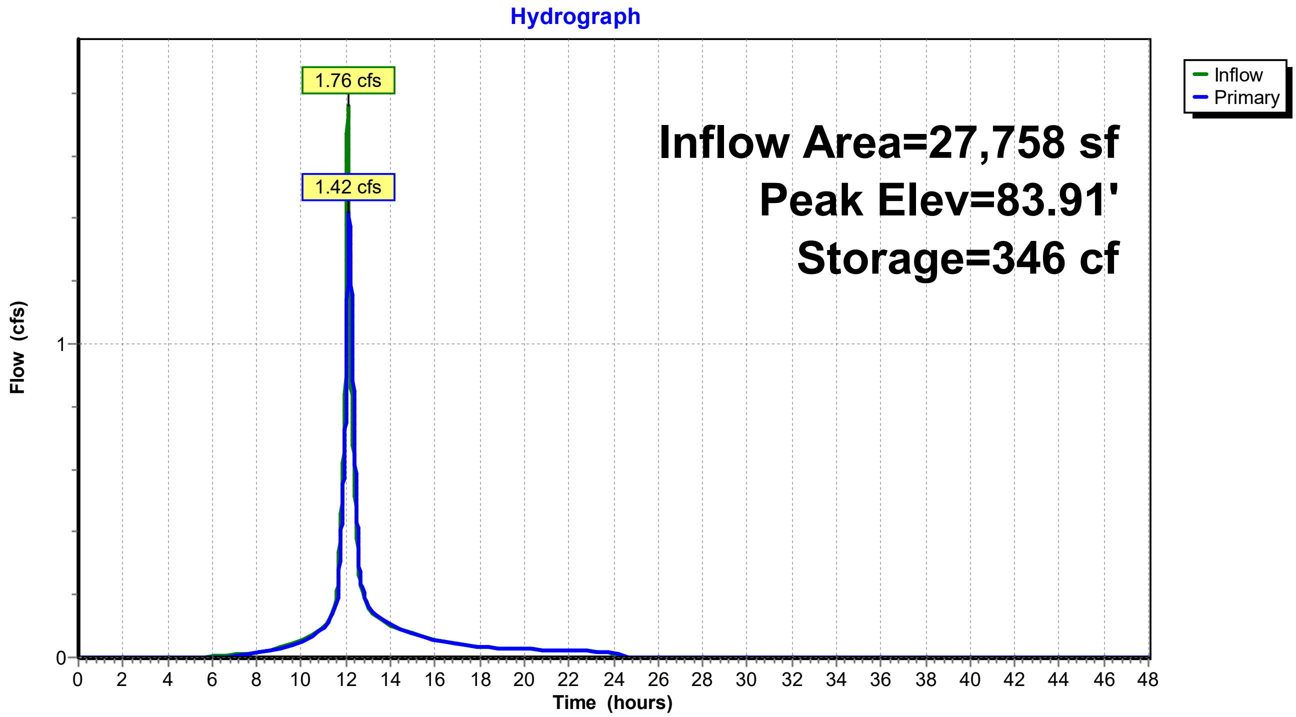
Chamber Storage + Stone Storage = 1,373.9 cf = 0.032 af
Overall Storage Efficiency = 58.9%
Overall System Size = 60.58' x 11.00' x 3.50'

16 Chambers
86.4 cy Field
59.2 cy Stone





Pond UG1a: UG1a



Summary for Pond UG1b: UG1b

Inflow Area = 22,129 sf,100.00% Impervious, Inflow Depth = 3.12" for 2-Year event
Inflow = 1.65 cfs @ 12.08 hrs, Volume= 5,748 cf
Outflow = 0.39 cfs @ 11.75 hrs, Volume= 5,748 cf, Atten= 76%, Lag= 0.0 min
Discarded = 0.39 cfs @ 11.75 hrs, Volume= 5,748 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 85.42' @ 12.47 hrs Surf.Area= 2,044 sf Storage= 1,155 cf

Plug-Flow detention time= 14.1 min calculated for 5,748 cf (100% of inflow)
Center-of-Mass det. time= 14.1 min (769.5 - 755.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	84.50'	1,589 cf	**28.00'W x 73.00'L x 3.21'H Field A**
			6,558 cf Overall - 2,587 cf Embedded = 3,971 cf x 40.0% Voids
#2A	85.00'	2,587 cf	**Cultec R-280HD** x 60 Inside #1
			Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf
			Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap
			Row Length Adjustment= +1.00' x 6.07 sf x 6 rows
		4,175 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Device 2	87.33'	**0.9' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#2	Primary	84.07'	**12.0" Round RCP_Round 12"**
			L= 12.0' RCP, groove end projecting, Ke= 0.200
			Inlet / Outlet Invert= 84.07' / 83.53' S= 0.0450 '/' Cc= 0.900
			n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#3	Discarded	84.50'	**8.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.39 cfs @ 11.75 hrs HW=84.53' (Free Discharge)
↑—**3=Exfiltration** (Exfiltration Controls 0.39 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=84.50' (Free Discharge)
↑—**2=RCP_Round 12"** (Passes 0.00 cfs of 0.90 cfs potential flow)
  ↑—**1=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond UG1b: UG1b - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)
Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf
Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap
Row Length Adjustment= +1.00' x 6.07 sf x 6 rows

47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

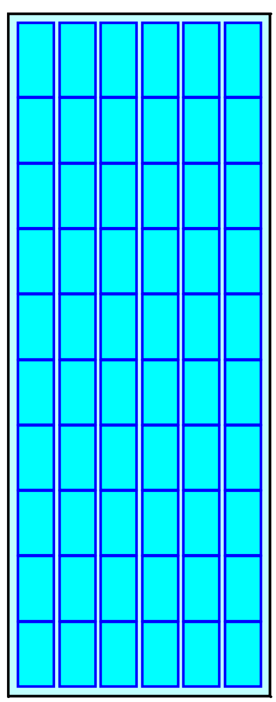
10 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 71.00' Row Length +12.0" End Stone x 2 = 73.00' Base Length
6 Rows x 47.0" Wide + 6.0" Spacing x 5 + 12.0" Side Stone x 2 = 28.00' Base Width
6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

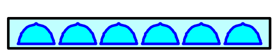
60 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 6 Rows = 2,586.6 cf Chamber Storage

6,557.8 cf Field - 2,586.6 cf Chambers = 3,971.3 cf Stone x 40.0% Voids = 1,588.5 cf Stone Storage

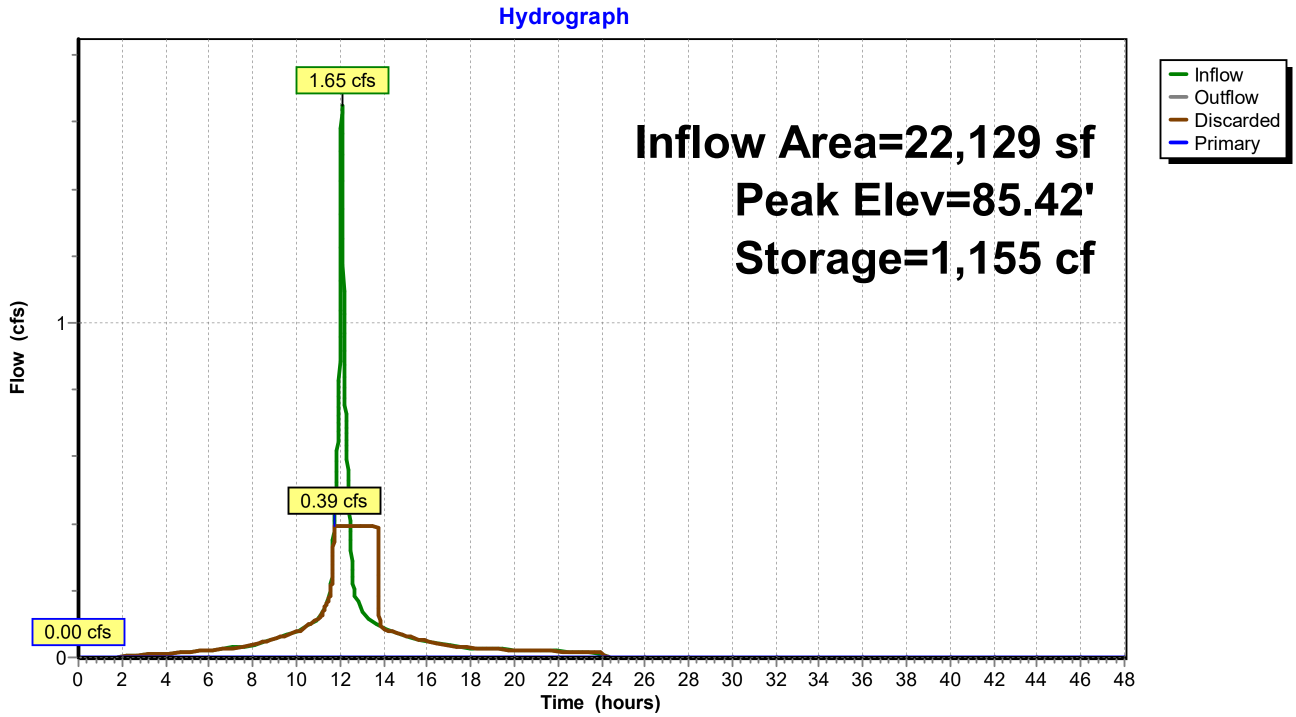
Chamber Storage + Stone Storage = 4,175.1 cf = 0.096 af
Overall Storage Efficiency = 63.7%
Overall System Size = 73.00' x 28.00' x 3.21'

60 Chambers
242.9 cy Field
147.1 cy Stone





Pond UG1b: UG1b



Summary for Pond UG2: UG2

Inflow Area = 16,720 sf, 68.82% Impervious, Inflow Depth = 2.49" for 2-Year event
Inflow = 1.09 cfs @ 12.09 hrs, Volume= 3,474 cf
Outflow = 0.16 cfs @ 12.58 hrs, Volume= 3,474 cf, Atten= 85%, Lag= 29.9 min
Primary = 0.16 cfs @ 12.58 hrs, Volume= 3,474 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 83.09' @ 12.58 hrs Surf.Area= 0.047 ac Storage= 0.031 af

Plug-Flow detention time= 97.0 min calculated for 3,474 cf (100% of inflow)
Center-of-Mass det. time= 96.9 min (893.0 - 796.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	82.00'	0.042 af	**30.00'W x 67.70'L x 3.50'H Field A** 0.163 af Overall - 0.057 af Embedded = 0.106 af x 40.0% Voids
#2A	82.50'	0.057 af	**ADS_StormTech SC-740 +Cap** x 54 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 54 Chambers in 6 Rows
		0.099 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Device 2	82.00'	**2.5" Vert. Orifice/Grate** C= 0.600
#2	Primary	82.00'	**12.0" Round RCP_Round 12"** L= 9.7' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 82.00' / 81.95' S= 0.0052 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=0.16 cfs @ 12.58 hrs HW=83.09' (Free Discharge)
↑—**2=RCP_Round 12"** (Passes 0.16 cfs of 2.66 cfs potential flow)
  ↑—**1=Orifice/Grate** (Orifice Controls 0.16 cfs @ 4.77 fps)

Pond UG2: UG2 - Chamber Wizard Field A

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

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

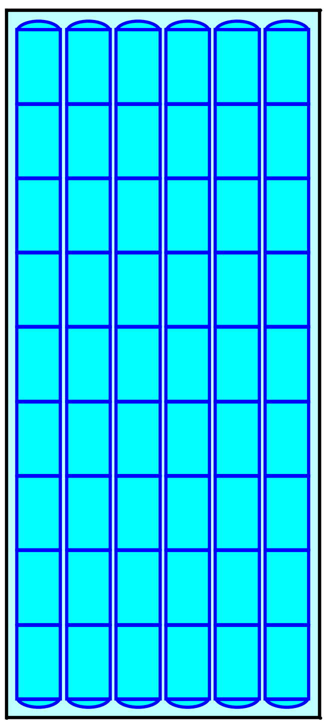
9 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 65.70' Row Length +12.0" End Stone x 2 = 67.70' Base Length
6 Rows x 51.0" Wide + 6.0" Spacing x 5 + 12.0" Side Stone x 2 = 30.00' Base Width
6.0" Base + 30.0" Chamber Height + 6.0" Cover = 3.50' Field Height

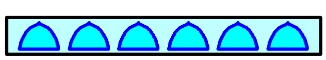
54 Chambers x 45.9 cf = 2,480.8 cf Chamber Storage

7,108.2 cf Field - 2,480.8 cf Chambers = 4,627.4 cf Stone x 40.0% Voids = 1,851.0 cf Stone Storage

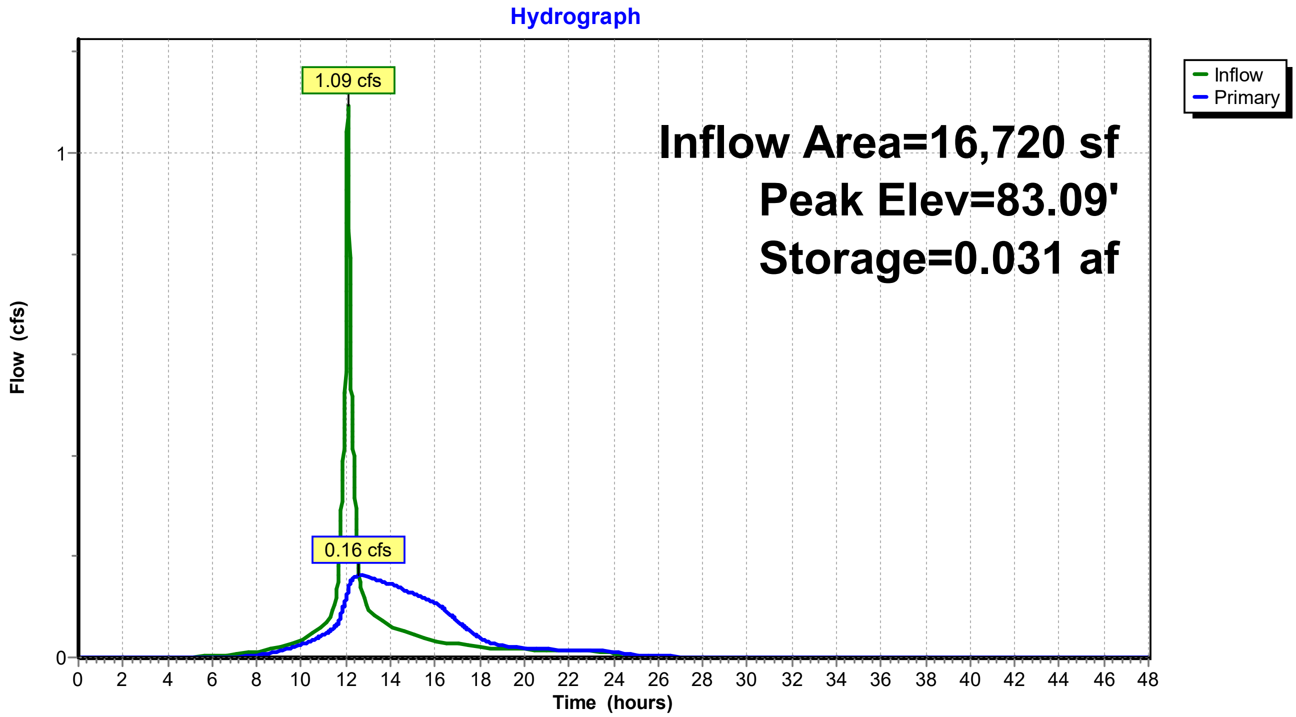
Chamber Storage + Stone Storage = 4,331.7 cf = 0.099 af
Overall Storage Efficiency = 60.9%
Overall System Size = 67.70' x 30.00' x 3.50'

54 Chambers
263.3 cy Field
171.4 cy Stone





Pond UG2: UG2


Hydrograph
1.09 cfs
0.16 cfs
Inflow Area=16,720 sf
Peak Elev=83.09'
Storage=0.031 af
Inflow
Primary
Flow (cfs)
Time (hours)
0
1
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 UG3: UG3

Inflow Area =	46,987 sf, 83.88% Impervious,	Inflow Depth = 2.79"	for 2-Year event
Inflow =	3.33 cfs @ 12.08 hrs, Volume=	10,932 cf	
Outflow =	0.30 cfs @ 12.95 hrs, Volume=	10,931 cf, Atten= 91%, Lag= 52.0 min	
Primary =	0.30 cfs @ 12.95 hrs, Volume=	10,931 cf	

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 90.77' @ 12.95 hrs Surf.Area= 0.103 ac Storage= 0.118 af

Plug-Flow detention time= 193.0 min calculated for 10,929 cf (100% of inflow)
Center-of-Mass det. time= 193.2 min (972.7 - 779.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	89.00'	0.145 af	**80.08'W x 55.89'L x 5.50'H Field A**
			0.565 af Overall - 0.202 af Embedded = 0.363 af x 40.0% Voids
#2A	89.75'	0.202 af	**ADS_StormTech MC-3500 d +Cap** x 77 Inside #1
			Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf
			Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap
			77 Chambers in 11 Rows
			Cap Storage= +14.9 cf x 2 x 11 rows = 327.8 cf
		0.347 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Device 2	89.00'	**3.0" Vert. Orifice/Grate** C= 0.600
#2	Primary	89.00'	**12.0" Round RCP_Round 12"**
			L= 20.9' RCP, groove end projecting, Ke= 0.200
			Inlet / Outlet Invert= 89.00' / 88.90' S= 0.0048 '/' Cc= 0.900
			n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=0.30 cfs @ 12.95 hrs HW=90.77' (Free Discharge)
└─**2=RCP_Round 12"** (Passes 0.30 cfs of 4.55 cfs potential flow)
  └─**1=Orifice/Grate** (Orifice Controls 0.30 cfs @ 6.17 fps)

Pond UG3: UG3 - Chamber Wizard Field A

Chamber Model = ADS_StormTech MC-3500 d +Cap (ADS StormTech® MC-3500 d rev 03/14 with Cap volume)
Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf
Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap
Cap Storage= +14.9 cf x 2 x 11 rows = 327.8 cf

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

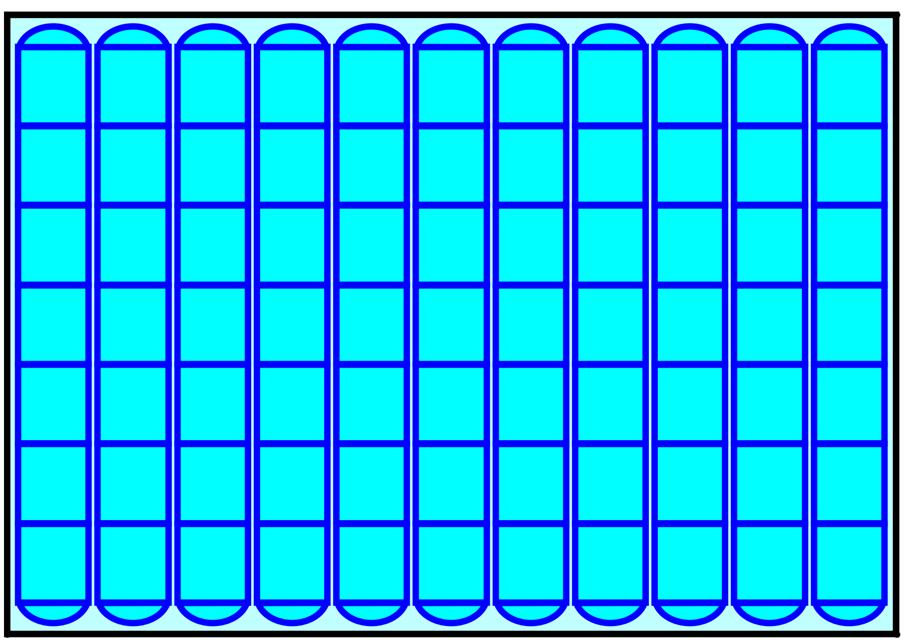
7 Chambers/Row x 7.17' Long +1.85' Cap Length x 2 = 53.89' Row Length +12.0" End Stone x 2 = 55.89' Base Length
11 Rows x 77.0" Wide + 9.0" Spacing x 10 + 12.0" Side Stone x 2 = 80.08' Base Width
9.0" Base + 45.0" Chamber Height + 12.0" Cover = 5.50' Field Height

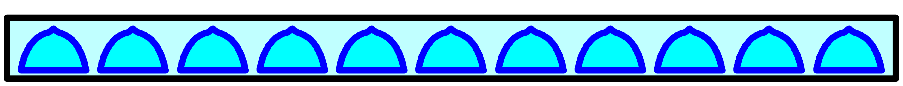
77 Chambers x 110.0 cf + 14.9 cf Cap Volume x 2 x 11 Rows = 8,794.1 cf Chamber Storage

24,617.2 cf Field - 8,794.1 cf Chambers = 15,823.1 cf Stone x 40.0% Voids = 6,329.2 cf Stone Storage

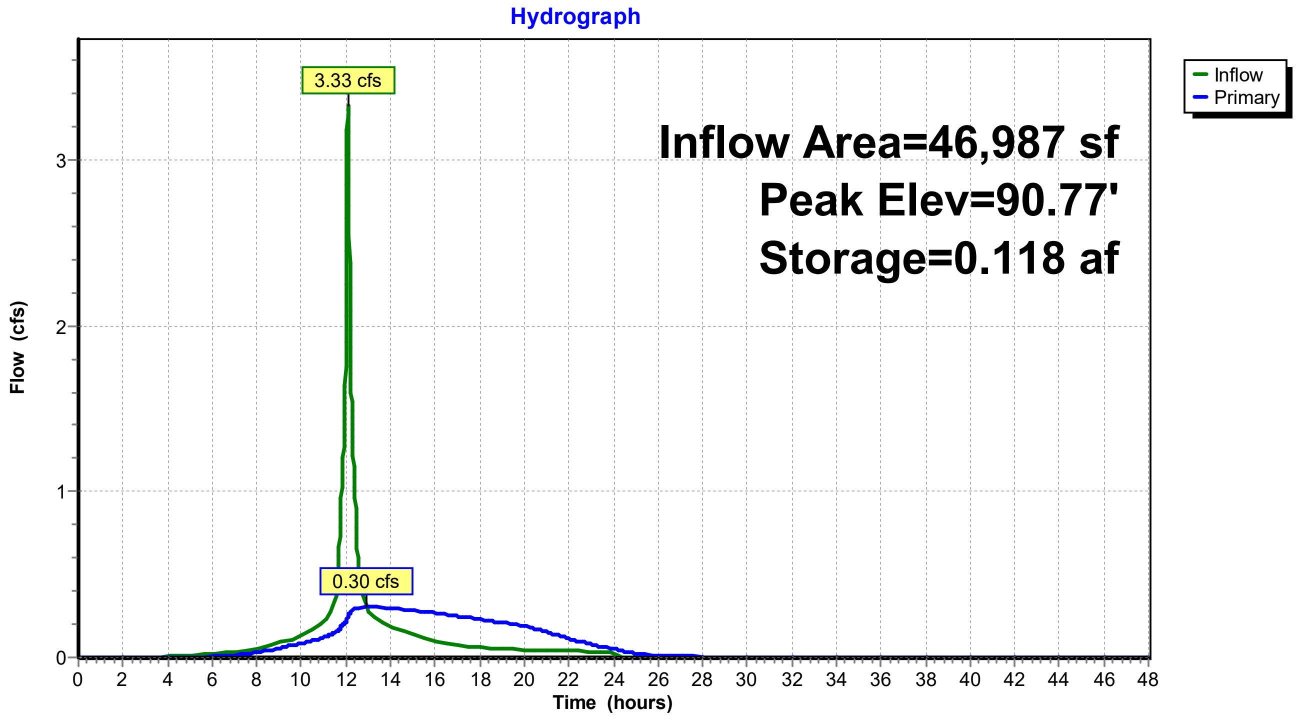
Chamber Storage + Stone Storage = 15,123.3 cf = 0.347 af
Overall Storage Efficiency = 61.4%
Overall System Size = 55.89' x 80.08' x 5.50'

77 Chambers
911.7 cy Field
586.0 cy Stone





Pond UG3: UG3


Hydrograph
3.33 cfs
0.30 cfs
Inflow Area=46,987 sf
Peak Elev=90.77'
Storage=0.118 af
Inflow
Primary
Flow (cfs)
0
1
2
3
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

Summary for Pond UG4a: UG4a

Inflow Area = 38,652 sf, 94.71% Impervious, Inflow Depth = 1.28" for 2-Year event
Inflow = 1.23 cfs @ 12.08 hrs, Volume= 4,117 cf
Outflow = 1.11 cfs @ 12.12 hrs, Volume= 4,117 cf, Atten= 10%, Lag= 2.3 min
Primary = 1.11 cfs @ 12.12 hrs, Volume= 4,117 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 100.07' @ 12.12 hrs Surf.Area= 0.019 ac Storage= 0.005 af

Plug-Flow detention time= 9.5 min calculated for 4,116 cf (100% of inflow)
Center-of-Mass det. time= 9.5 min (782.2 - 772.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	99.50'	0.014 af	**18.17'W x 45.92'L x 2.33'H Field A** 0.045 af Overall - 0.010 af Embedded = 0.035 af x 40.0% Voids
#2A	100.00'	0.010 af	**ADS_StormTech SC-310 +Cap** x 30 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap 30 Chambers in 5 Rows
		0.024 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Device 2	99.50'	**11.0" Vert. Orifice/Grate** C= 0.600
#2	Primary	99.50'	**12.0" Round RCP_Round 12"** L= 43.2' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 99.50' / 98.00' S= 0.0347 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=1.11 cfs @ 12.12 hrs HW=100.07' (Free Discharge)
↑—**2=RCP_Round 12"** (Passes 1.11 cfs of 1.49 cfs potential flow)
  ↑—**1=Orifice/Grate** (Orifice Controls 1.11 cfs @ 2.57 fps)

Pond UG4a: UG4a - Chamber Wizard Field A

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

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

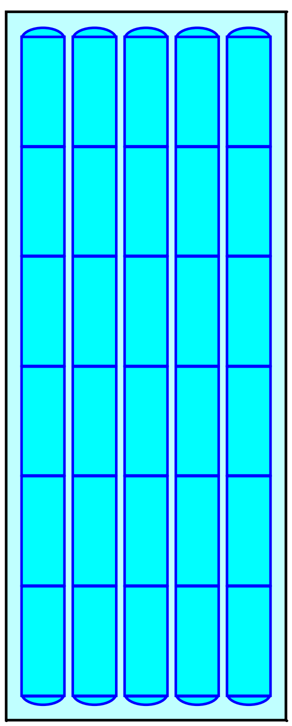
6 Chambers/Row x 7.12' Long +0.60' Cap Length x 2 = 43.92' Row Length +12.0" End Stone x 2 = 45.92' Base Length
5 Rows x 34.0" Wide + 6.0" Spacing x 4 + 12.0" Side Stone x 2 = 18.17' Base Width
6.0" Base + 16.0" Chamber Height + 6.0" Cover = 2.33' Field Height

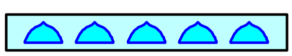
30 Chambers x 14.7 cf = 442.3 cf Chamber Storage

1,946.5 cf Field - 442.3 cf Chambers = 1,504.2 cf Stone x 40.0% Voids = 601.7 cf Stone Storage

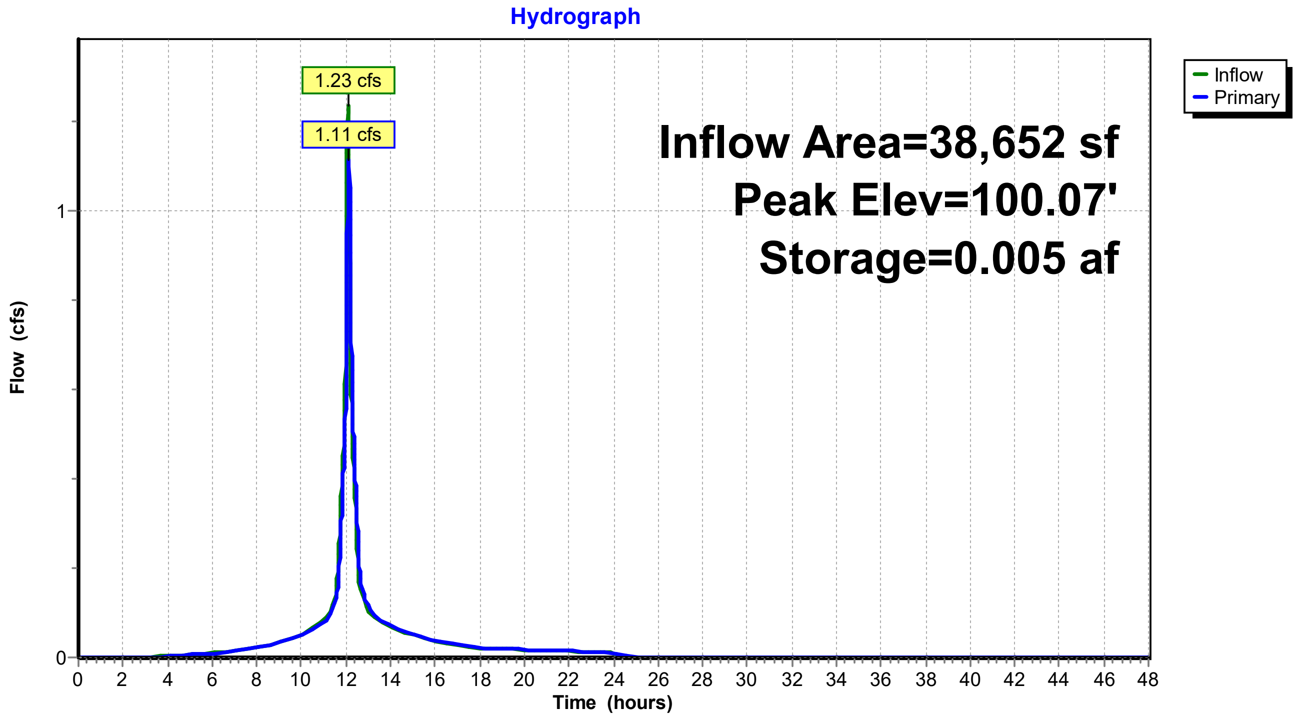
Chamber Storage + Stone Storage = 1,044.0 cf = 0.024 af
Overall Storage Efficiency = 53.6%
Overall System Size = 45.92' x 18.17' x 2.33'

30 Chambers
72.1 cy Field
55.7 cy Stone





Pond UG4a: UG4a



Summary for Pond UG4b: UG4b

Inflow Area =	21,598 sf,100.00% Impervious,	Inflow Depth = 3.12"	for 2-Year event	
Inflow =	1.61 cfs @	12.08 hrs, Volume=	5,610 cf	
Outflow =	0.12 cfs @	11.11 hrs, Volume=	5,610 cf,	Atten= 93%, Lag= 0.0 min
Discarded =	0.12 cfs @	11.11 hrs, Volume=	5,610 cf	
Primary =	0.00 cfs @	0.00 hrs, Volume=	0 cf	

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 108.57' @ 13.25 hrs Surf.Area= 2,069 sf Storage= 2,167 cf

Plug-Flow detention time= 141.8 min calculated for 5,609 cf (100% of inflow)
Center-of-Mass det. time= 141.8 min (897.3 - 755.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	107.00'	1,886 cf	**25.25'W x 81.94'L x 3.50'H Field A**
			7,241 cf Overall - 2,527 cf Embedded = 4,714 cf x 40.0% Voids
#2A	107.50'	2,527 cf	**ADS_StormTech SC-740 +Cap** x 55 Inside #1
			Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
			Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap
			55 Chambers in 5 Rows
		4,412 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Device 2	109.70'	**1.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#2	Primary	107.00'	**12.0" Round RCP_Round 12"**
			L= 100.0' RCP, groove end projecting, Ke= 0.200
			Inlet / Outlet Invert= 107.00' / 104.00' S= 0.0300 '/' Cc= 0.900
			n= 0.013 Concrete sewer w/manholes & inlets, Flow Area= 0.79 sf
#3	Discarded	107.00'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.12 cfs @ 11.11 hrs HW=107.04' (Free Discharge)
↑—**3=Exfiltration** (Exfiltration Controls 0.12 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=107.00' (Free Discharge)
↑—**2=RCP_Round 12"** (Controls 0.00 cfs)
  ↑—**1=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond UG4b: UG4b - Chamber Wizard Field A

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

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

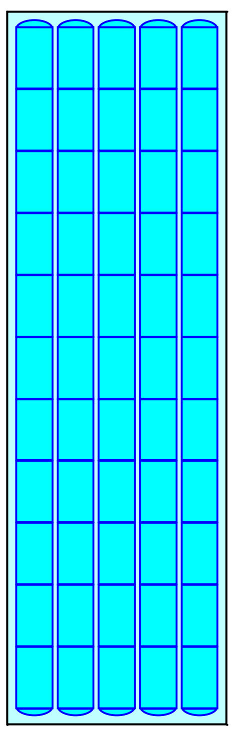
11 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 79.94' Row Length +12.0" End Stone x 2 = 81.94' Base Length
5 Rows x 51.0" Wide + 6.0" Spacing x 4 + 12.0" Side Stone x 2 = 25.25' Base Width
6.0" Base + 30.0" Chamber Height + 6.0" Cover = 3.50' Field Height

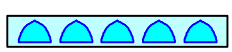
55 Chambers x 45.9 cf = 2,526.7 cf Chamber Storage

7,241.2 cf Field - 2,526.7 cf Chambers = 4,714.5 cf Stone x 40.0% Voids = 1,885.8 cf Stone Storage

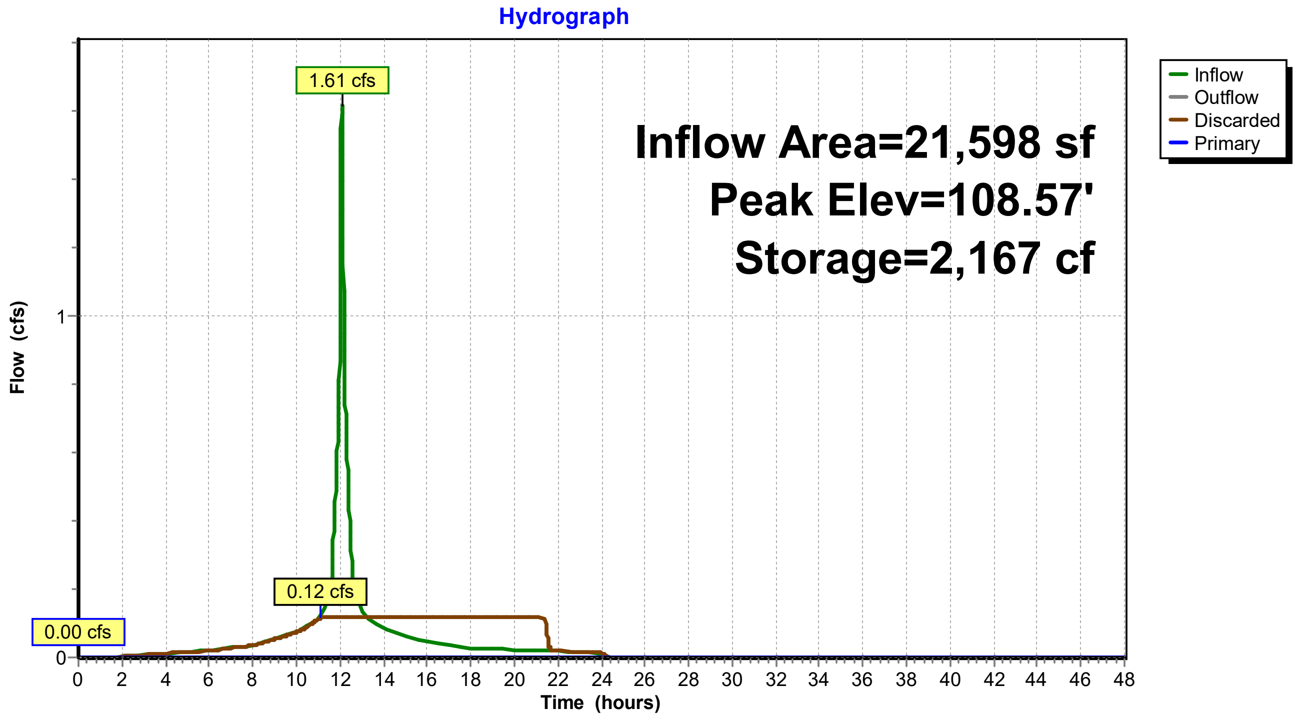
Chamber Storage + Stone Storage = 4,412.5 cf = 0.101 af
Overall Storage Efficiency = 60.9%
Overall System Size = 81.94' x 25.25' x 3.50'

55 Chambers
268.2 cy Field
174.6 cy Stone





Pond UG4b: UG4b



Summary for Pond UG5: UG5

Inflow Area = 51,811 sf, 71.70% Impervious, Inflow Depth = 2.59" for 2-Year event
Inflow = 3.49 cfs @ 12.09 hrs, Volume= 11,183 cf
Outflow = 0.25 cfs @ 11.31 hrs, Volume= 11,183 cf, Atten= 93%, Lag= 0.0 min
Discarded = 0.25 cfs @ 11.31 hrs, Volume= 11,183 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 109.63' @ 13.40 hrs Surf.Area= 4,461 sf Storage= 4,641 cf

Plug-Flow detention time= 156.3 min calculated for 11,181 cf (100% of inflow)
Center-of-Mass det. time= 156.3 min (947.4 - 791.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	108.00'	6,247 cf	**29.92'W x 149.10'L x 5.50'H Field A** 24,533 cf Overall - 8,915 cf Embedded = 15,618 cf x 40.0% Voids
#2A	108.75'	8,915 cf	**ADS_StormTech MC-3500 d +Cap** x 80 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 80 Chambers in 4 Rows Cap Storage= +14.9 cf x 2 x 4 rows = 119.2 cf
		15,162 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Device 2	113.05'	**0.7' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#2	Primary	101.47'	**12.0" Round RCP_Round 12"** L= 14.6' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 101.47' / 100.30' S= 0.0801 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#3	Discarded	108.00'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.25 cfs @ 11.31 hrs HW=108.06' (Free Discharge)
↑—**3=Exfiltration** (Exfiltration Controls 0.25 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=108.00' (Free Discharge)
↑—**2=RCP_Round 12"** (Passes 0.00 cfs of 11.61 cfs potential flow)
  ↑—**1=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond UG5: UG5 - Chamber Wizard Field A

Chamber Model = ADS_StormTech MC-3500 d +Cap (ADS StormTech® MC-3500 d rev 03/14 with Cap volume)
Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf
Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap
Cap Storage= +14.9 cf x 2 x 4 rows = 119.2 cf

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

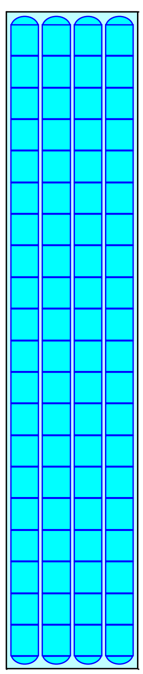
20 Chambers/Row x 7.17' Long +1.85' Cap Length x 2 = 147.10' Row Length +12.0" End Stone x 2 = 149.10' Base Length
4 Rows x 77.0" Wide + 9.0" Spacing x 3 + 12.0" Side Stone x 2 = 29.92' Base Width
9.0" Base + 45.0" Chamber Height + 12.0" Cover = 5.50' Field Height

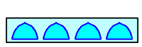
80 Chambers x 110.0 cf + 14.9 cf Cap Volume x 2 x 4 Rows = 8,915.4 cf Chamber Storage

24,533.2 cf Field - 8,915.4 cf Chambers = 15,617.8 cf Stone x 40.0% Voids = 6,247.1 cf Stone Storage

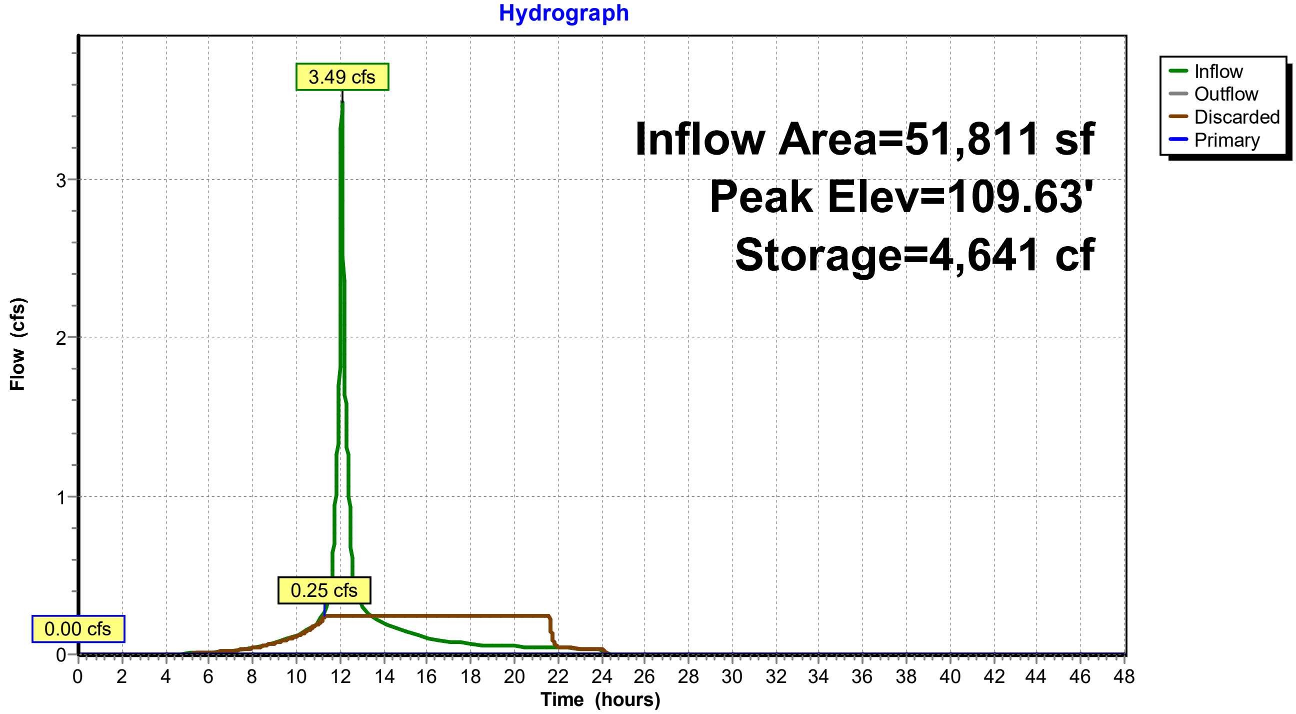
Chamber Storage + Stone Storage = 15,162.5 cf = 0.348 af
Overall Storage Efficiency = 61.8%
Overall System Size = 149.10' x 29.92' x 5.50'

80 Chambers
908.6 cy Field
578.4 cy Stone





Pond UG5: UG5


Hydrograph
3.49 cfs
0.25 cfs
0.00 cfs
Inflow Area=51,811 sf
Peak Elev=109.63'
Storage=4,641 cf
Inflow
Outflow
Discarded
Primary
Flow (cfs)
Time (hours)

Summary for Pond UG6: UG6

Inflow Area = 43,674 sf, 78.98% Impervious, Inflow Depth = 2.69" for 2-Year event
Inflow = 3.02 cfs @ 12.08 hrs, Volume= 9,789 cf
Outflow = 1.32 cfs @ 12.27 hrs, Volume= 9,783 cf, Atten= 56%, Lag= 11.2 min
Primary = 1.32 cfs @ 12.27 hrs, Volume= 9,783 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 113.66' @ 12.27 hrs Surf.Area= 4,101 sf Storage= 2,591 cf

Plug-Flow detention time= 52.3 min calculated for 9,783 cf (100% of inflow)
Center-of-Mass det. time= 52.0 min (837.6 - 785.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	112.60'	2,884 cf	**28.17'W x 145.60'L x 2.33'H Field A** 9,569 cf Overall - 2,359 cf Embedded = 7,210 cf x 40.0% Voids
#2A	113.10'	2,359 cf	**ADS_StormTech RC-310 +Cap** x 160 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap 160 Chambers in 8 Rows
		5,243 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Device 3	112.60'	**5.0" Vert. Orifice/Grate** C= 0.600
#2	Device 3	113.22'	**11.0" Vert. Orifice/Grate** C= 0.600
#3	Primary	112.60'	**12.0" Round RCP_Round 12"** L= 68.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 112.60' / 112.40' S= 0.0029 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=1.32 cfs @ 12.27 hrs HW=113.66' (Free Discharge)
└─**3=RCP_Round 12"** (Passes 1.32 cfs of 2.38 cfs potential flow)
  ├─**1=Orifice/Grate** (Orifice Controls 0.61 cfs @ 4.45 fps)
  └─**2=Orifice/Grate** (Orifice Controls 0.71 cfs @ 2.26 fps)

Pond UG6: UG6 - Chamber Wizard Field A

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

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

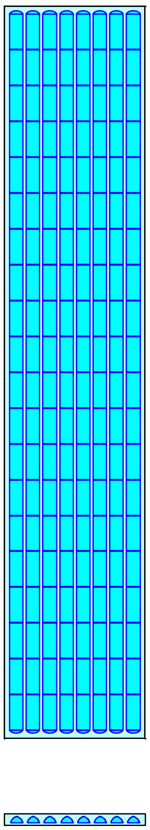
20 Chambers/Row x 7.12' Long +0.60' Cap Length x 2 = 143.60' Row Length +12.0" End Stone x 2 = 145.60' Base Length
8 Rows x 34.0" Wide + 6.0" Spacing x 7 + 12.0" Side Stone x 2 = 28.17' Base Width
6.0" Base + 16.0" Chamber Height + 6.0" Cover = 2.33' Field Height

160 Chambers x 14.7 cf = 2,358.7 cf Chamber Storage

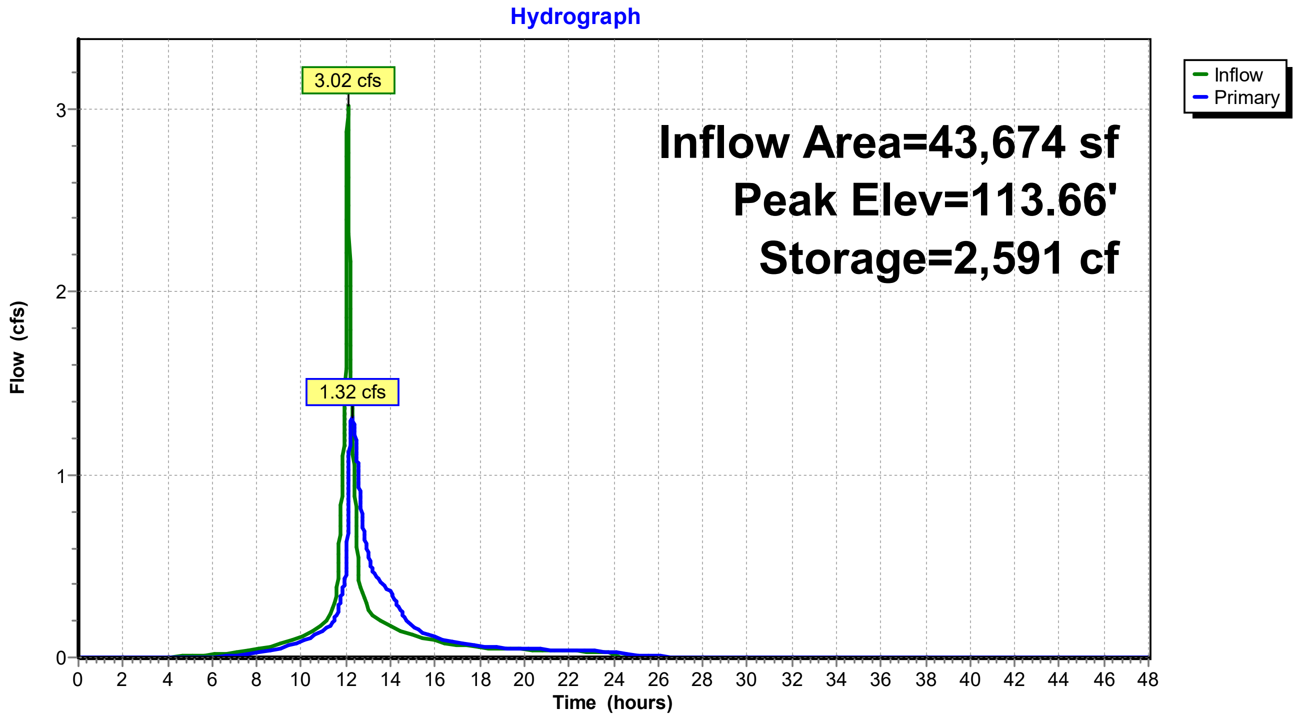
9,569.2 cf Field - 2,358.7 cf Chambers = 7,210.4 cf Stone x 40.0% Voids = 2,884.2 cf Stone Storage

Chamber Storage + Stone Storage = 5,242.9 cf = 0.120 af
Overall Storage Efficiency = 54.8%
Overall System Size = 145.60' x 28.17' x 2.33'

160 Chambers
354.4 cy Field
267.1 cy Stone



Pond UG6: UG6


Hydrograph
3.02 cfs
1.32 cfs
Inflow Area=43,674 sf
Peak Elev=113.66'
Storage=2,591 cf
Inflow
Primary
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 UG7: UG7

Inflow Area = 50,810 sf, 81.43% Impervious, Inflow Depth = 2.79" for 2-Year event
Inflow = 3.60 cfs @ 12.08 hrs, Volume= 11,821 cf
Outflow = 0.80 cfs @ 12.49 hrs, Volume= 11,821 cf, Atten= 78%, Lag= 24.2 min
Primary = 0.80 cfs @ 12.49 hrs, Volume= 11,821 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 100.19' @ 12.49 hrs Surf.Area= 0.079 ac Storage= 0.086 af

Plug-Flow detention time= 55.3 min calculated for 11,821 cf (100% of inflow)
Center-of-Mass det. time= 55.3 min (834.8 - 779.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	98.50'	0.111 af	**44.25'W x 77.40'L x 5.50'H Field A** 0.432 af Overall - 0.156 af Embedded = 0.277 af x 40.0% Voids
#2A	99.25'	0.156 af	**ADS_StormTech MC-3500 d +Cap** x 60 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 60 Chambers in 6 Rows Cap Storage= +14.9 cf x 2 x 6 rows = 178.8 cf
		0.266 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Device 2	98.50'	**5.0" Vert. Orifice/Grate** C= 0.600
#2	Primary	98.50'	**12.0" Round RCP_Round 12"** L= 34.7' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 98.50' / 98.33' S= 0.0049 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=0.80 cfs @ 12.49 hrs HW=100.19' (Free Discharge)
└**2=RCP_Round 12"** (Passes 0.80 cfs of 4.16 cfs potential flow)
└**1=Orifice/Grate** (Orifice Controls 0.80 cfs @ 5.87 fps)

Pond UG7: UG7 - Chamber Wizard Field A

Chamber Model = ADS_StormTech MC-3500 d +Cap (ADS StormTech® MC-3500 d rev 03/14 with Cap volume)
Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf
Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap
Cap Storage= +14.9 cf x 2 x 6 rows = 178.8 cf

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

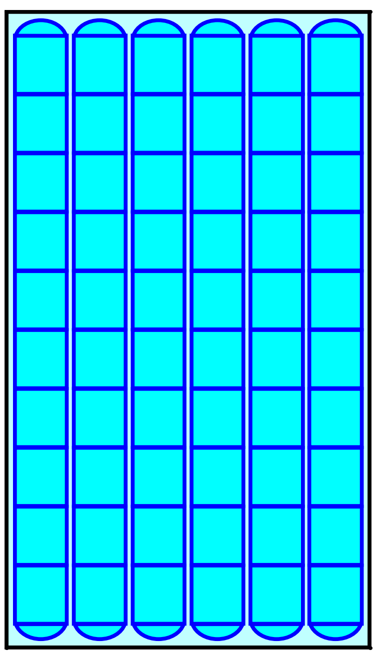
10 Chambers/Row x 7.17' Long +1.85' Cap Length x 2 = 75.40' Row Length +12.0" End Stone x 2 = 77.40' Base Length
6 Rows x 77.0" Wide + 9.0" Spacing x 5 + 12.0" Side Stone x 2 = 44.25' Base Width
9.0" Base + 45.0" Chamber Height + 12.0" Cover = 5.50' Field Height

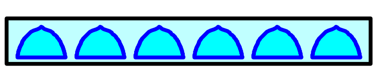
60 Chambers x 110.0 cf + 14.9 cf Cap Volume x 2 x 6 Rows = 6,775.9 cf Chamber Storage

18,837.2 cf Field - 6,775.9 cf Chambers = 12,061.3 cf Stone x 40.0% Voids = 4,824.5 cf Stone Storage

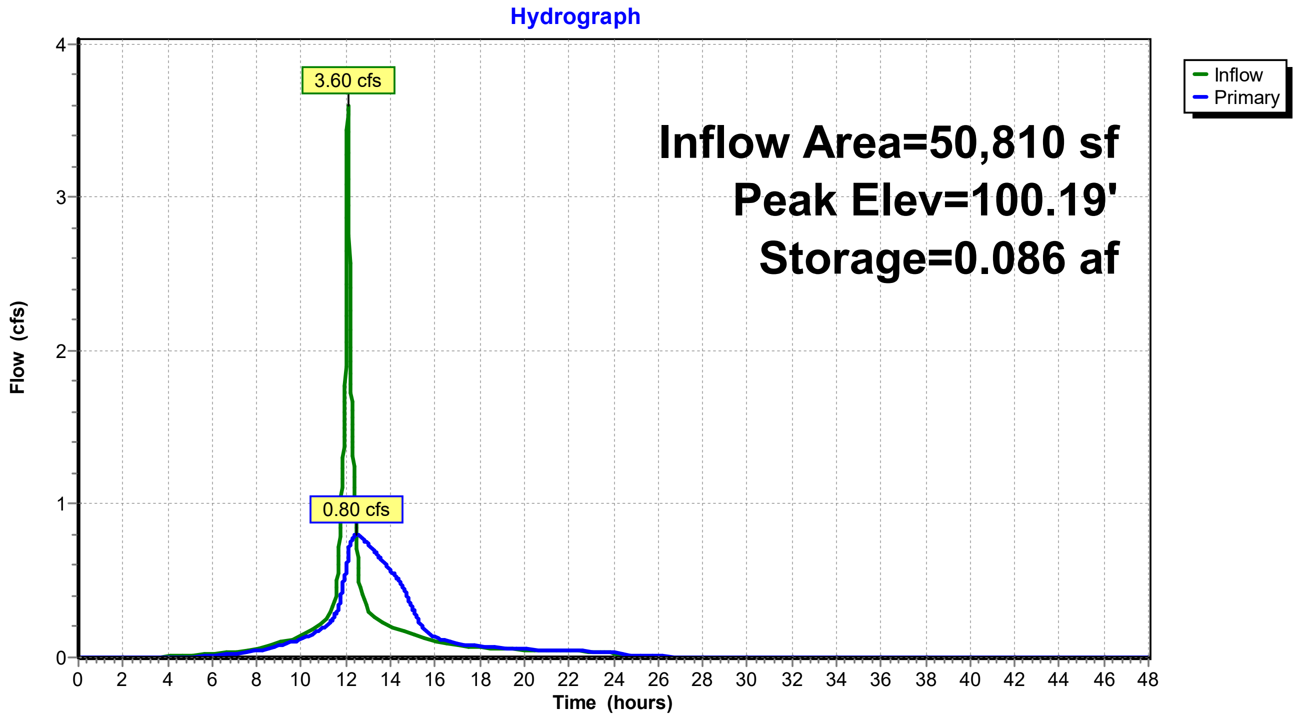
Chamber Storage + Stone Storage = 11,600.4 cf = 0.266 af
Overall Storage Efficiency = 61.6%
Overall System Size = 77.40' x 44.25' x 5.50'

60 Chambers
697.7 cy Field
446.7 cy Stone





Pond UG7: UG7


Hydrograph
3.60 cfs
0.80 cfs
Inflow Area=50,810 sf
Peak Elev=100.19'
Storage=0.086 af
Inflow
Primary
Flow (cfs)
Time (hours)
0
1
2
3
4
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 Subcatchment P1-1a: courtyard and retail park

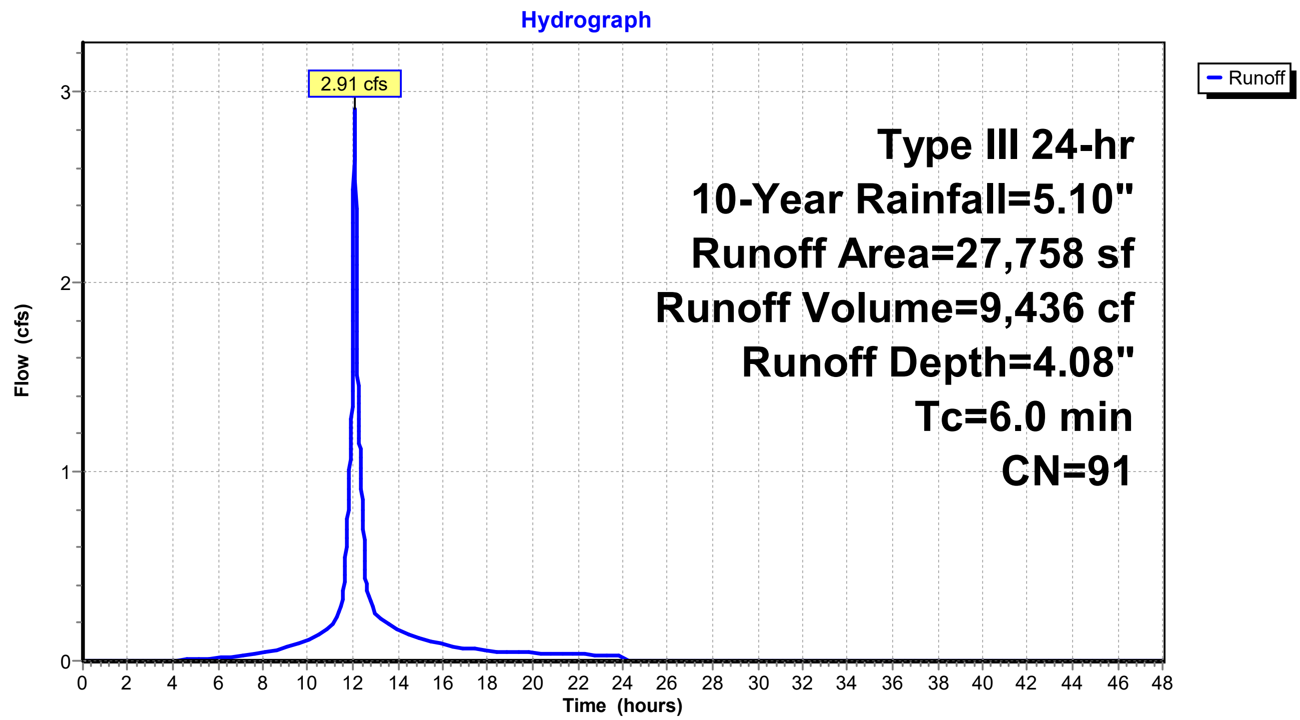
Runoff = 2.91 cfs @ 12.08 hrs, Volume= 9,436 cf, Depth= 4.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.10"

	Area (sf)	CN	Description
*	19,600	89	Courtyard, HSG D
	1,350	80	>75% Grass cover, Good, HSG D
*	6,808	98	Paved parking, HSG D
	27,758	91	Weighted Average
	20,950	88	75.47% Pervious Area
	6,808	98	24.53% Impervious Area

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

Subcatchment P1-1a: courtyard and retail park



Summary for Subcatchment P1-1b: roof

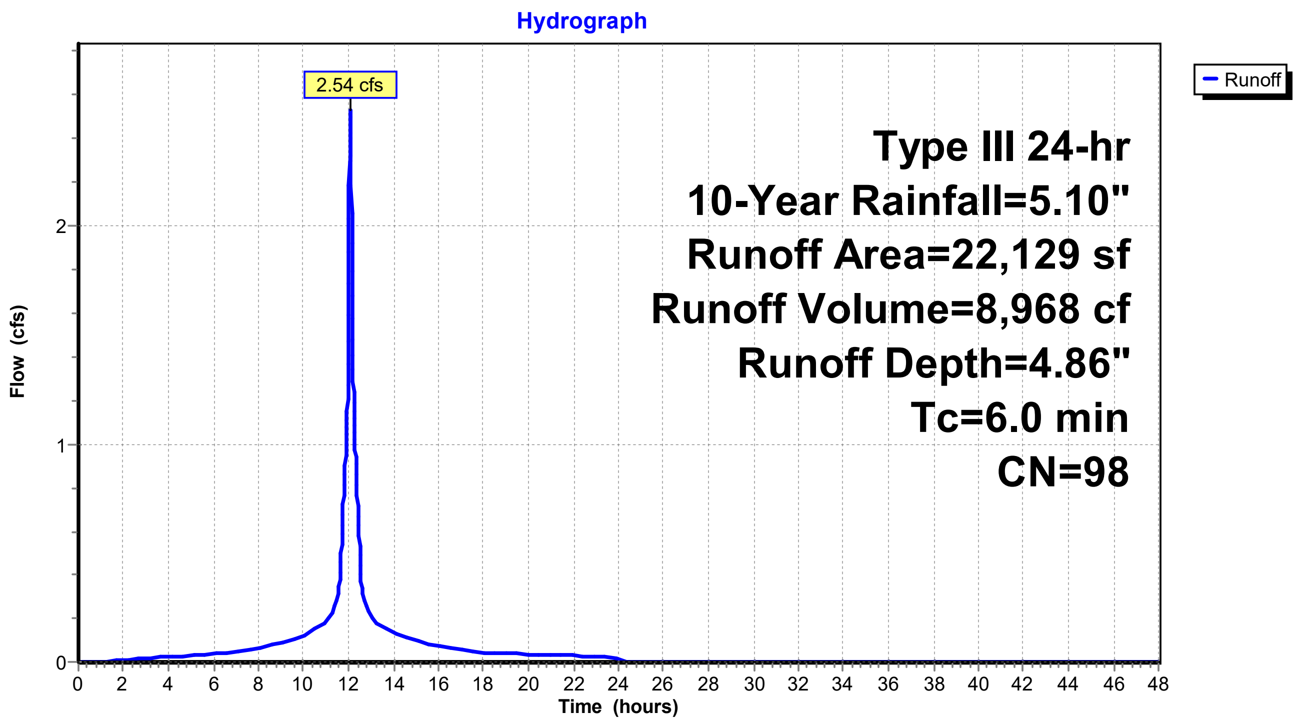
Runoff = 2.54 cfs @ 12.08 hrs, Volume= 8,968 cf, Depth= 4.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.10"

	Area (sf)	CN	Description
*	22,129	98	Roof, HSG D
	22,129	98	100.00% Impervious Area

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

Subcatchment P1-1b: roof



Summary for Subcatchment P1-2: P1-2

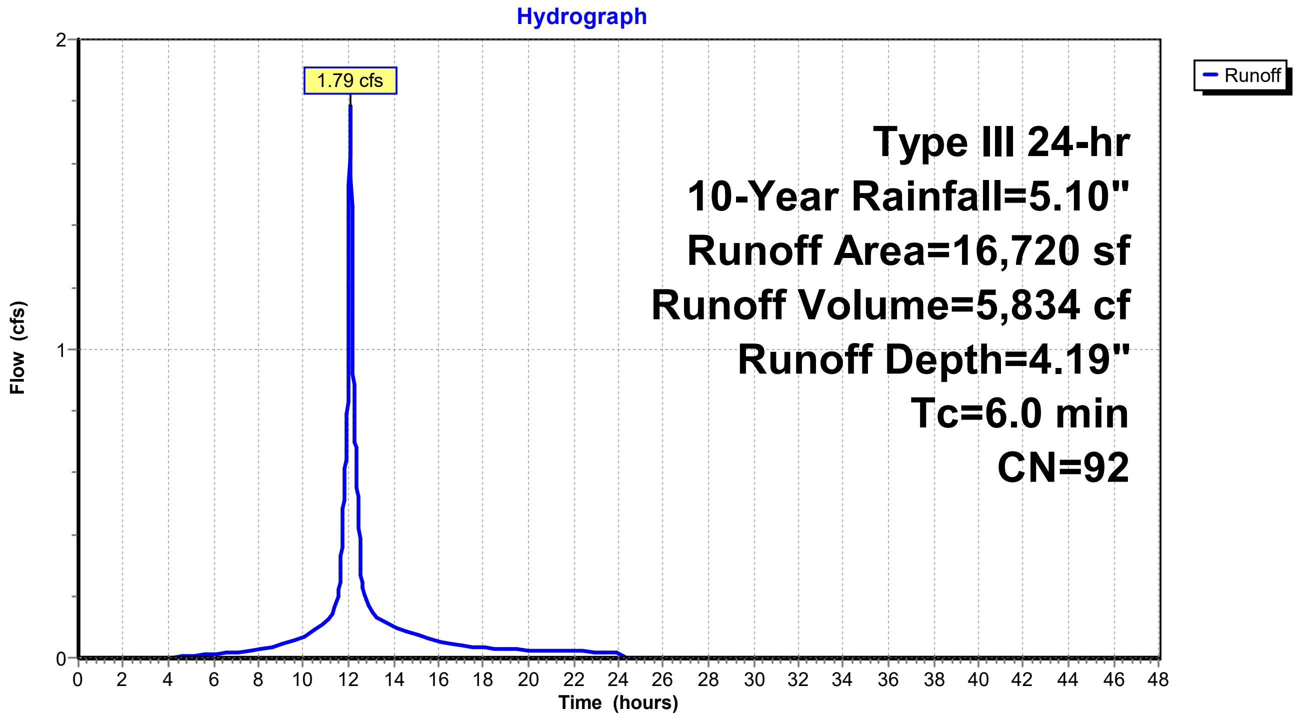
Runoff = 1.79 cfs @ 12.08 hrs, Volume= 5,834 cf, Depth= 4.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.10"

	Area (sf)	CN	Description
	5,213	80	>75% Grass cover, Good, HSG D
*	11,507	98	Roof & Paved parking, HSG D
	16,720	92	Weighted Average
	5,213	80	31.18% Pervious Area
	11,507	98	68.82% Impervious Area

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

Subcatchment P1-2: P1-2



Summary for Subcatchment P1-3: P1-3

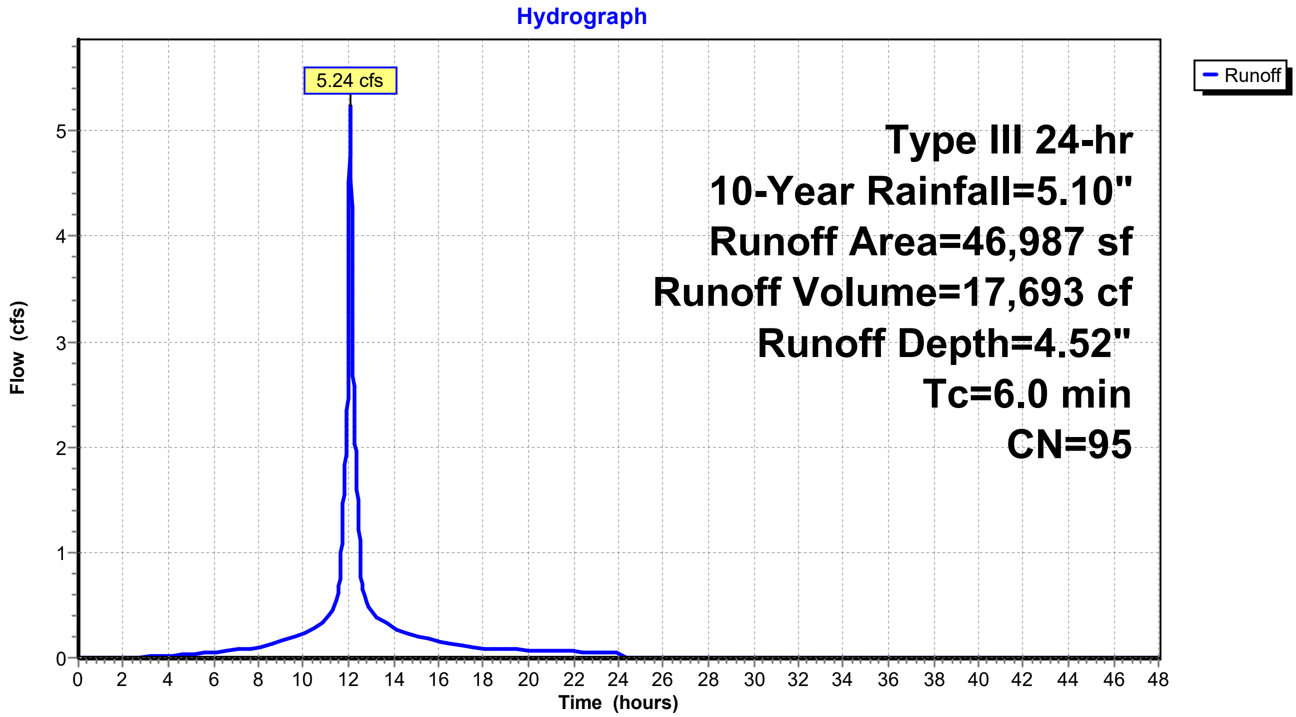
Runoff = 5.24 cfs @ 12.08 hrs, Volume= 17,693 cf, Depth= 4.52"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.10"

	Area (sf)	CN	Description
*	39,413	98	Roofs & Pavement, HSG D
	7,574	80	>75% Grass cover, Good, HSG D
	46,987	95	Weighted Average
	7,574	80	16.12% Pervious Area
	39,413	98	83.88% Impervious Area

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

Subcatchment P1-3: P1-3



Summary for Subcatchment P1-4: P1-4

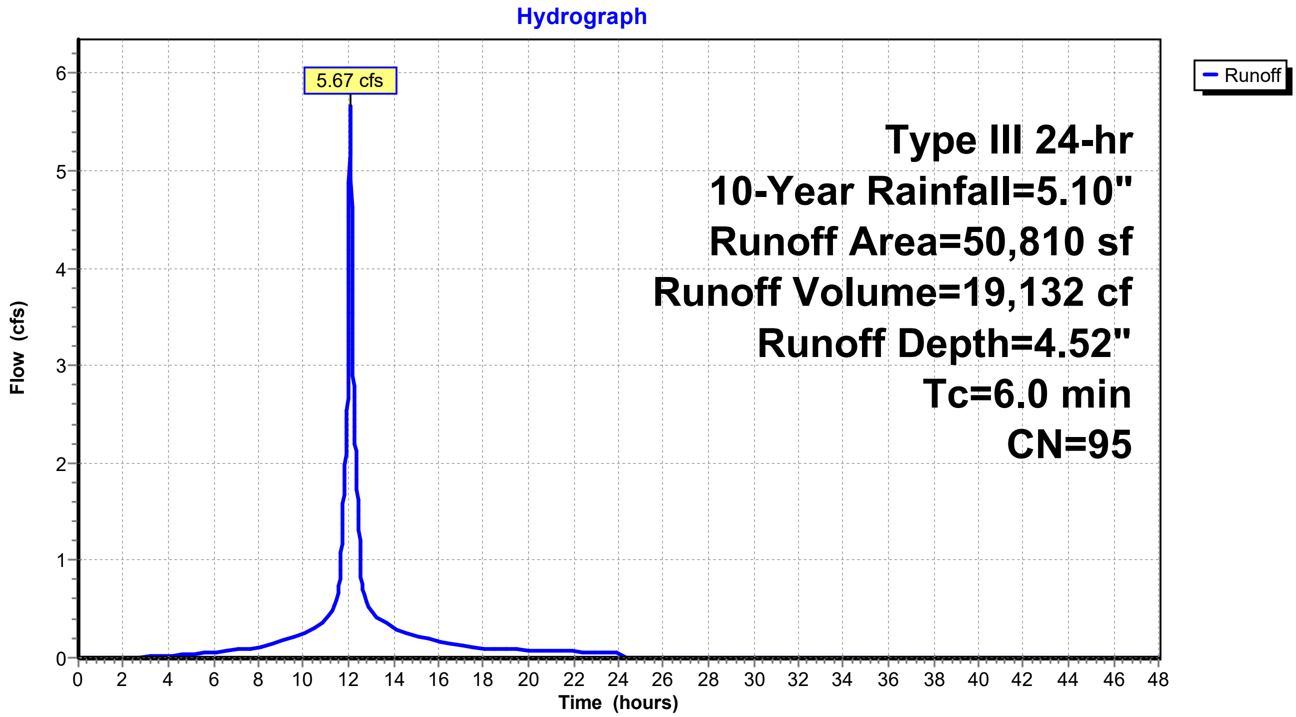
Runoff = 5.67 cfs @ 12.08 hrs, Volume= 19,132 cf, Depth= 4.52"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.10"

	Area (sf)	CN	Description
*	41,376	98	Roofs & Pavement, HSG D
	9,434	80	>75% Grass cover, Good, HSG D
	50,810	95	Weighted Average
	9,434	80	18.57% Pervious Area
	41,376	98	81.43% Impervious Area

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

Subcatchment P1-4: P1-4



Summary for Subcatchment P1-U1: P1-U1

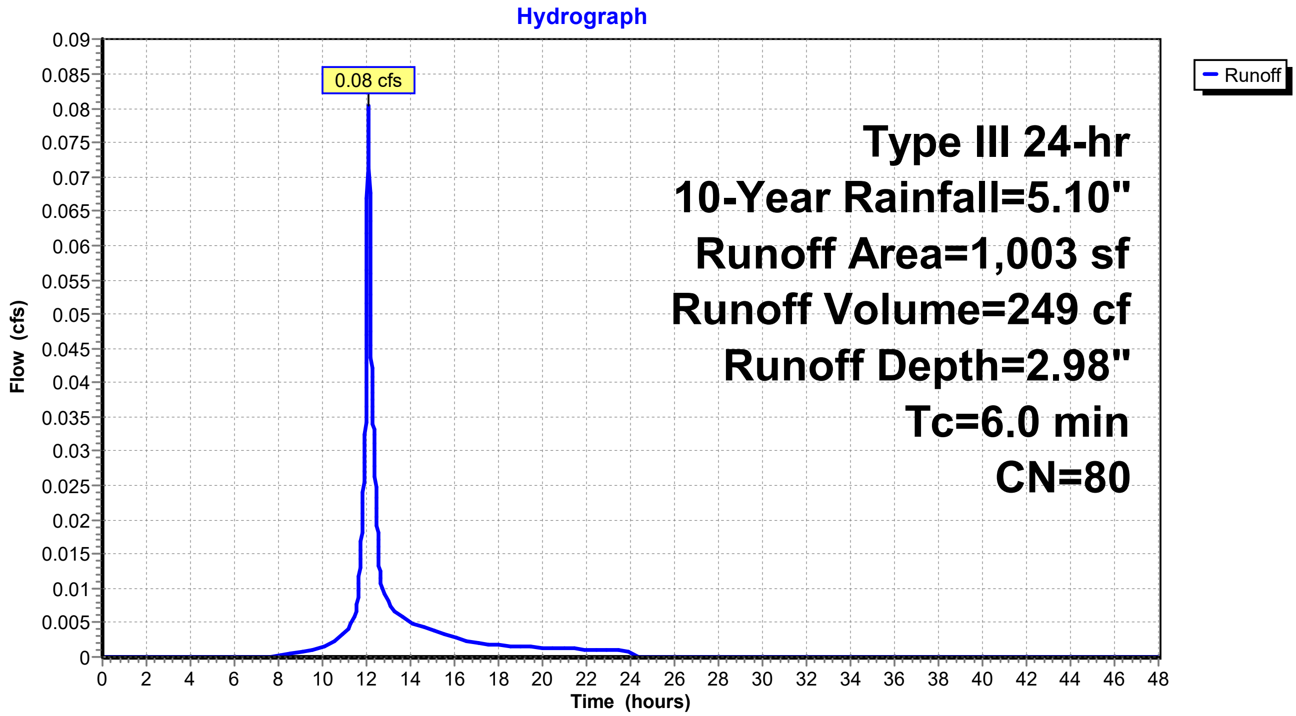
Runoff = 0.08 cfs @ 12.09 hrs, Volume= 249 cf, Depth= 2.98"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.10"

Area (sf)	CN	Description
1,003	80	>75% Grass cover, Good, HSG D
1,003	80	100.00% Pervious Area

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

Subcatchment P1-U1: P1-U1



Summary for Subcatchment P1-U2: P1-U2

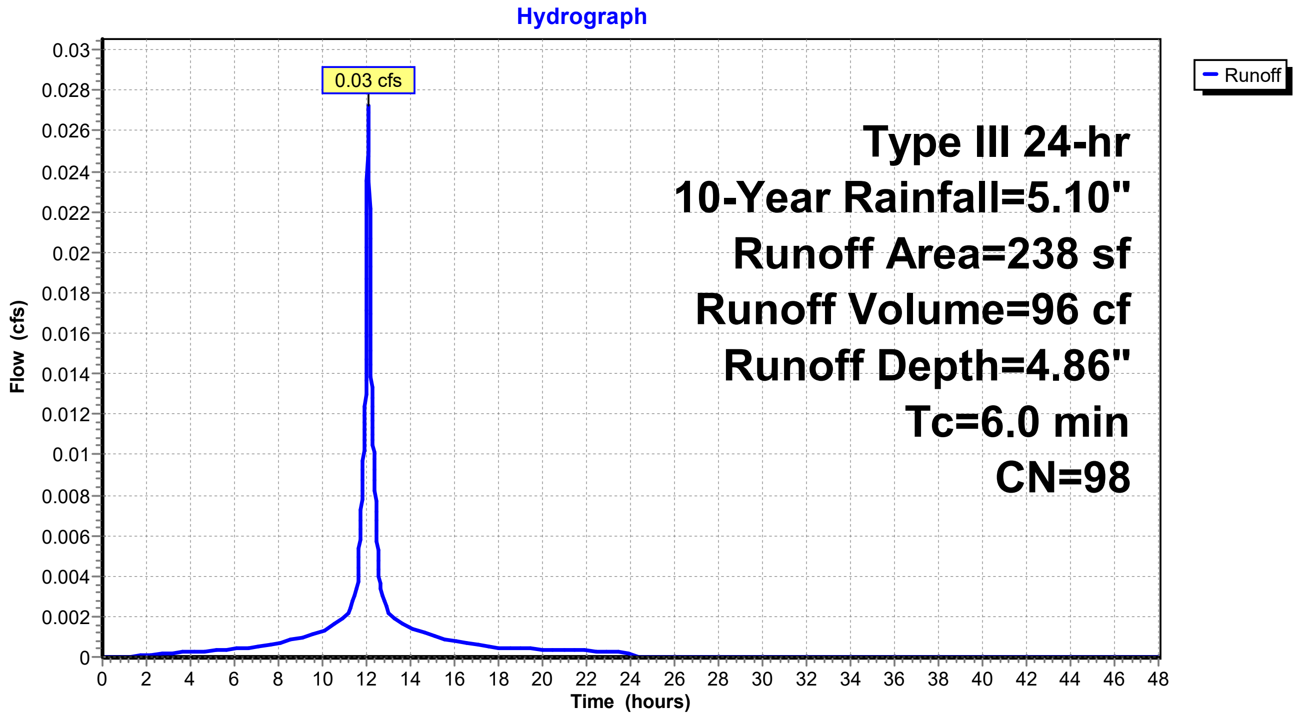
Runoff = 0.03 cfs @ 12.08 hrs, Volume= 96 cf, Depth= 4.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.10"

	Area (sf)	CN	Description
*	238	98	Pavement, HSG D
	238	98	100.00% Impervious Area

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

Subcatchment P1-U2: P1-U2



Summary for Subcatchment P1-U3: P1-U3

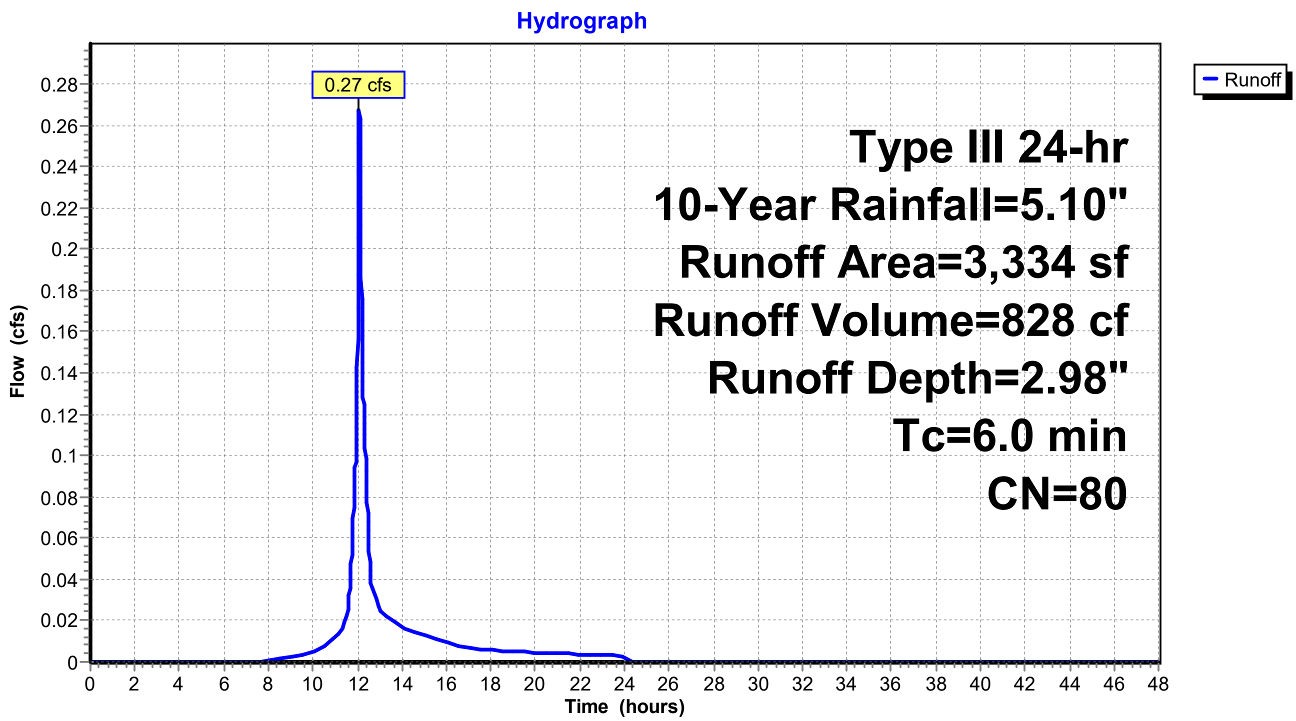
Runoff = 0.27 cfs @ 12.09 hrs, Volume= 828 cf, Depth= 2.98"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.10"

Area (sf)	CN	Description
3,334	80	>75% Grass cover, Good, HSG D
3,334	80	100.00% Pervious Area

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

Subcatchment P1-U3: P1-U3



Summary for Subcatchment P2: P2

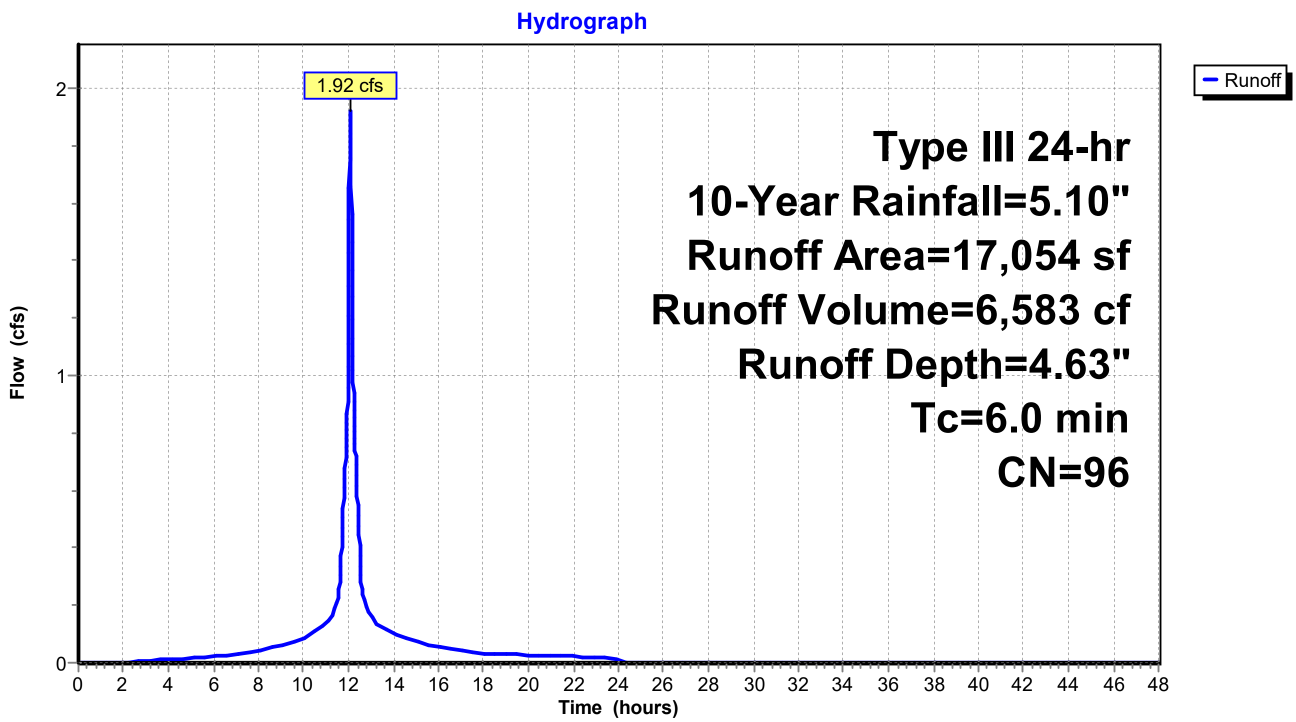
Runoff = 1.92 cfs @ 12.08 hrs, Volume= 6,583 cf, Depth= 4.63"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.10"

	Area (sf)	CN	Description
*	15,010	98	Pavement, HSG D
	2,044	80	>75% Grass cover, Good, HSG D
	17,054	96	Weighted Average
	2,044	80	11.99% Pervious Area
	15,010	98	88.01% Impervious Area

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

Subcatchment P2: P2



Summary for Subcatchment P2-R: P2-ROOF

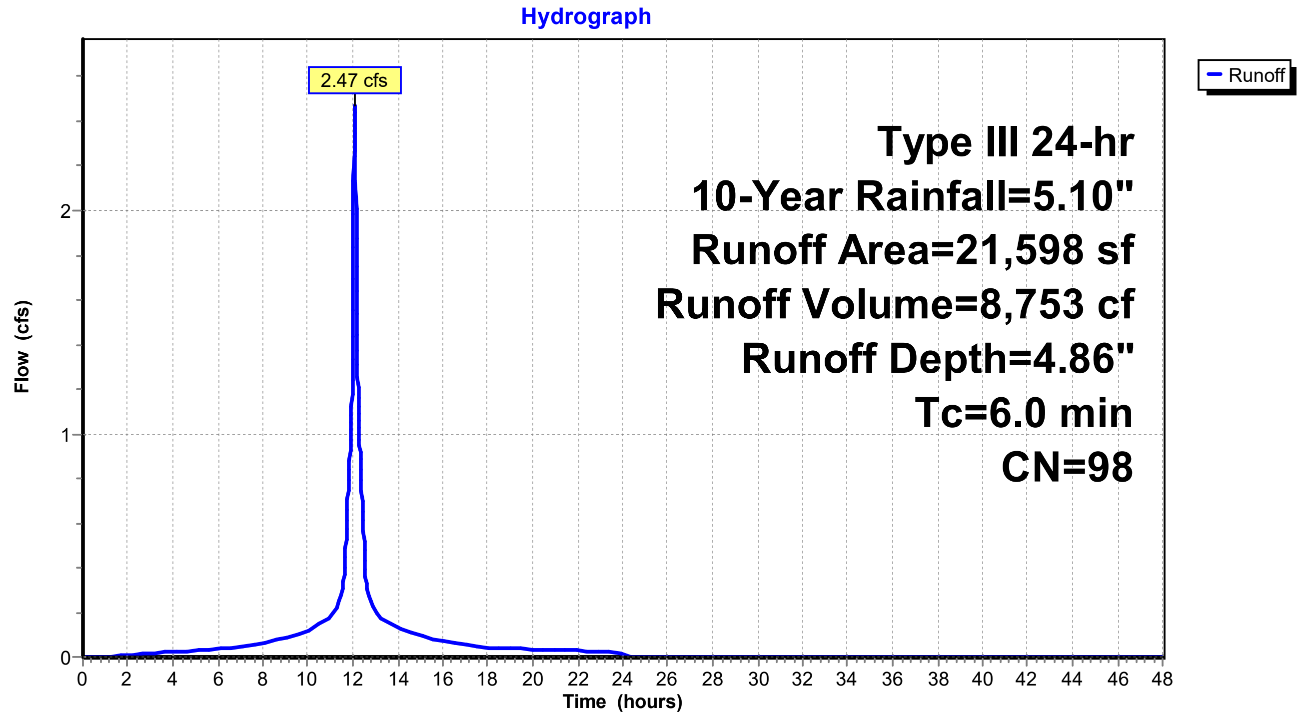
Runoff = 2.47 cfs @ 12.08 hrs, Volume= 8,753 cf, Depth= 4.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.10"

	Area (sf)	CN	Description
*	21,598	98	Roofs & Pavement, HSG D
	21,598	98	100.00% Impervious Area

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

Subcatchment P2-R: P2-ROOF



Summary for Subcatchment P2-U: P-2U

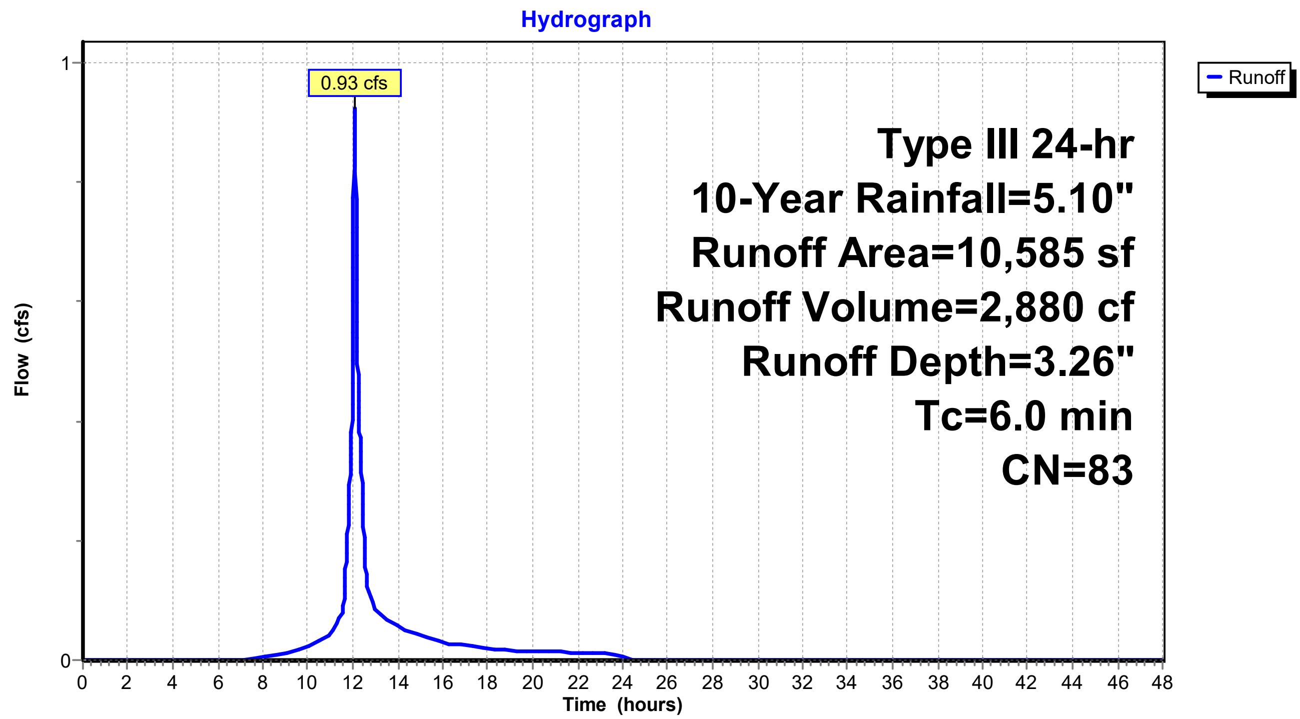
Runoff = 0.93 cfs @ 12.09 hrs, Volume= 2,880 cf, Depth= 3.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.10"

	Area (sf)	CN	Description
*	183	98	Ledge, HSG D
	6,620	77	Woods, Good, HSG D
*	2,902	98	Wetland Surface, HSG D
	880	78	Meadow, non-grazed, HSG D
	10,585	83	Weighted Average
	7,500	77	70.85% Pervious Area
	3,085	98	29.15% Impervious Area

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

Subcatchment P2-U: P-2U



Summary for Subcatchment P3: P3

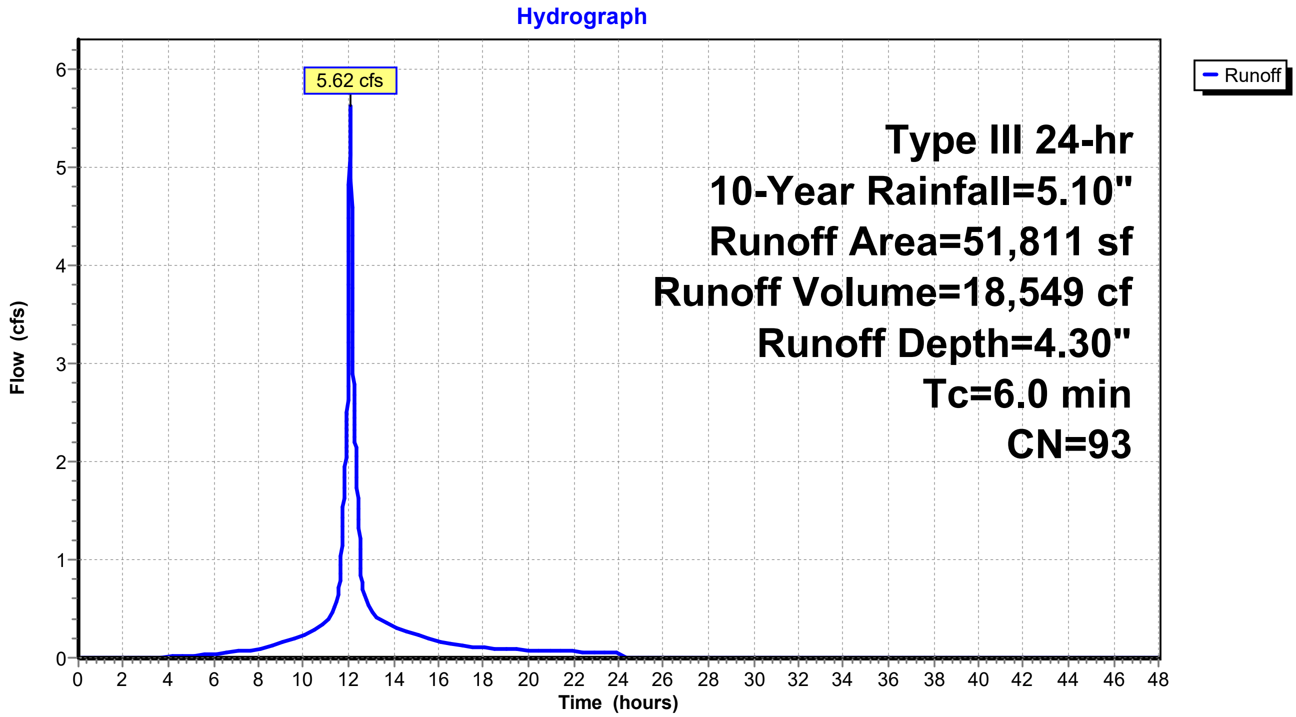
Runoff = 5.62 cfs @ 12.08 hrs, Volume= 18,549 cf, Depth= 4.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.10"

	Area (sf)	CN	Description
*	37,149	98	Roofs & Pavement, HSG D
	14,662	80	>75% Grass cover, Good, HSG D
	51,811	93	Weighted Average
	14,662	80	28.30% Pervious Area
	37,149	98	71.70% Impervious Area

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

Subcatchment P3: P3



Summary for Subcatchment P3-U: P3-U

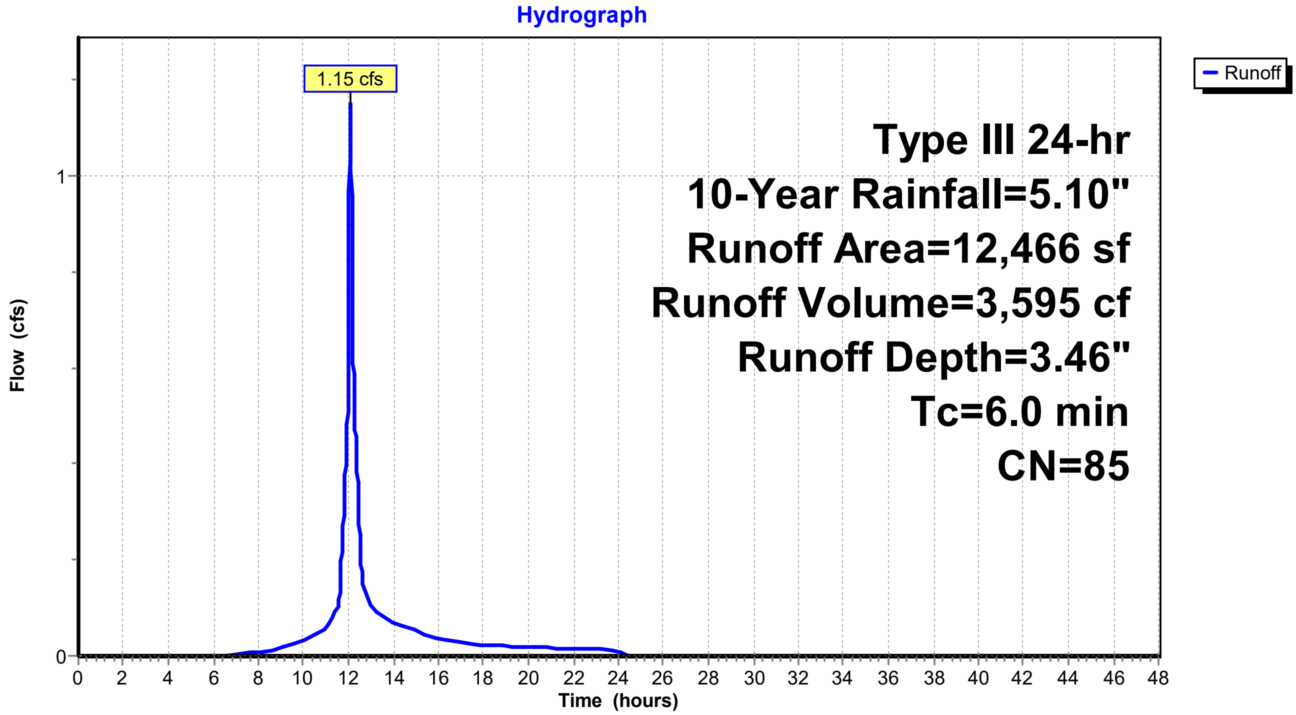
Runoff = 1.15 cfs @ 12.09 hrs, Volume= 3,595 cf, Depth= 3.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.10"

	Area (sf)	CN	Description
*	700	98	Ledge, HSG D
	7,809	77	Woods, Good, HSG D
*	3,957	98	Wetland Surface, HSG D
	12,466	85	Weighted Average
	7,809	77	62.64% Pervious Area
	4,657	98	37.36% Impervious Area

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

Subcatchment P3-U: P3-U



Summary for Subcatchment P4: P4

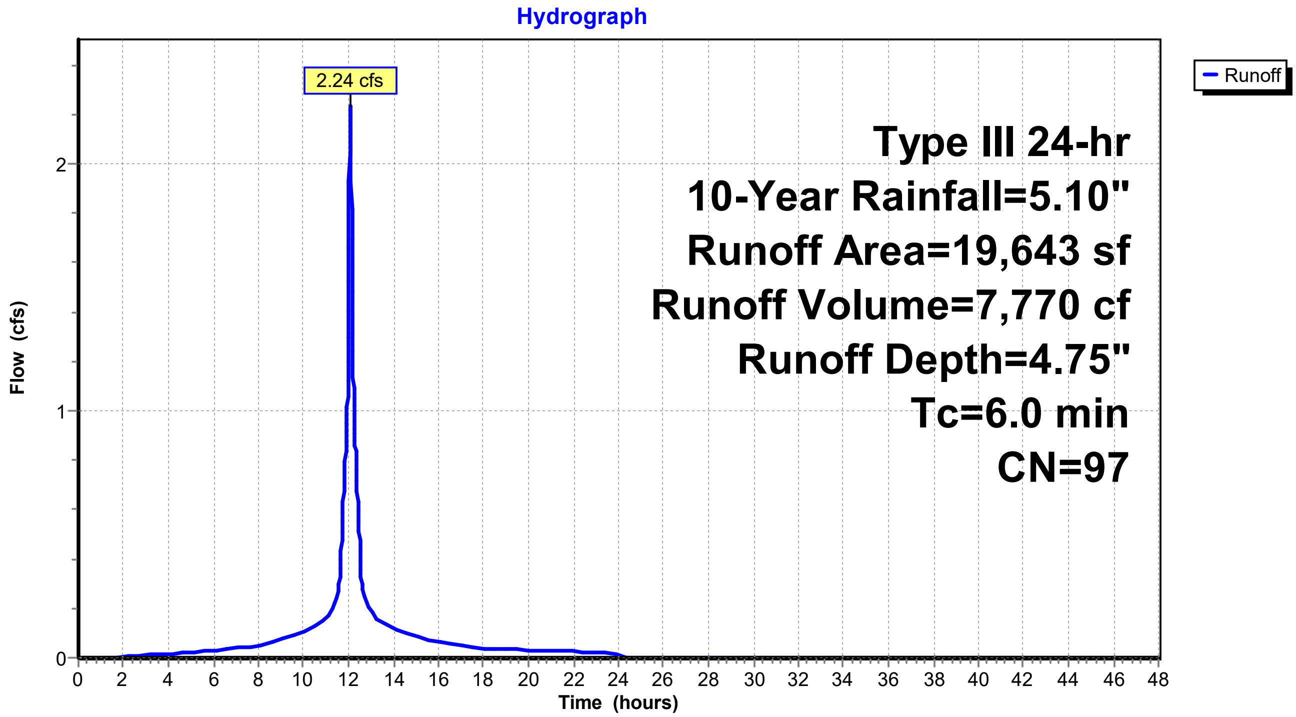
Runoff = 2.24 cfs @ 12.08 hrs, Volume= 7,770 cf, Depth= 4.75"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.10"

	Area (sf)	CN	Description
	1,577	80	>75% Grass cover, Good, HSG D
*	18,066	98	Roofs & Paved parking, HSG D
	19,643	97	Weighted Average
	1,577	80	8.03% Pervious Area
	18,066	98	91.97% Impervious Area

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

Subcatchment P4: P4



Summary for Subcatchment P4-U: P4-U

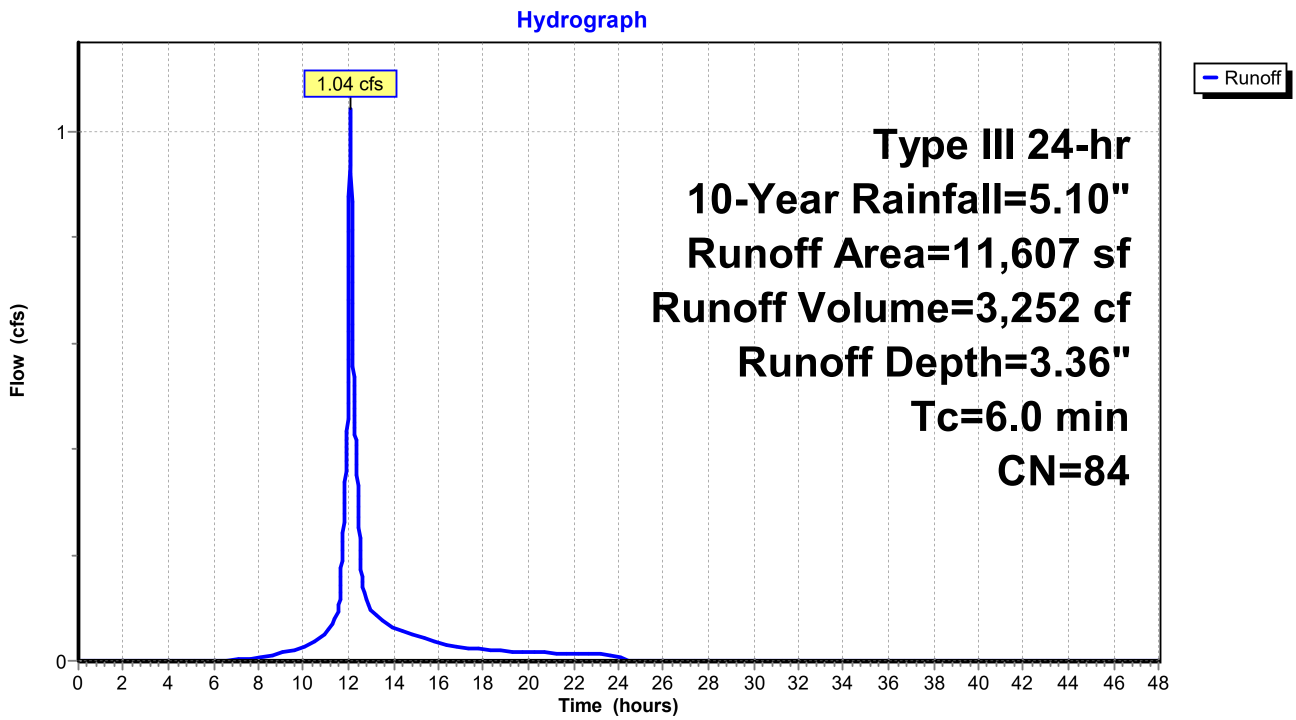
Runoff = 1.04 cfs @ 12.09 hrs, Volume= 3,252 cf, Depth= 3.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.10"

	Area (sf)	CN	Description
*	1,650	98	Ledge, HSG D
	7,547	77	Woods, Good, HSG D
*	2,410	98	Wetland Surface, HSG D
	11,607	84	Weighted Average
	7,547	77	65.02% Pervious Area
	4,060	98	34.98% Impervious Area

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

Subcatchment P4-U: P4-U



Summary for Subcatchment P5: P5

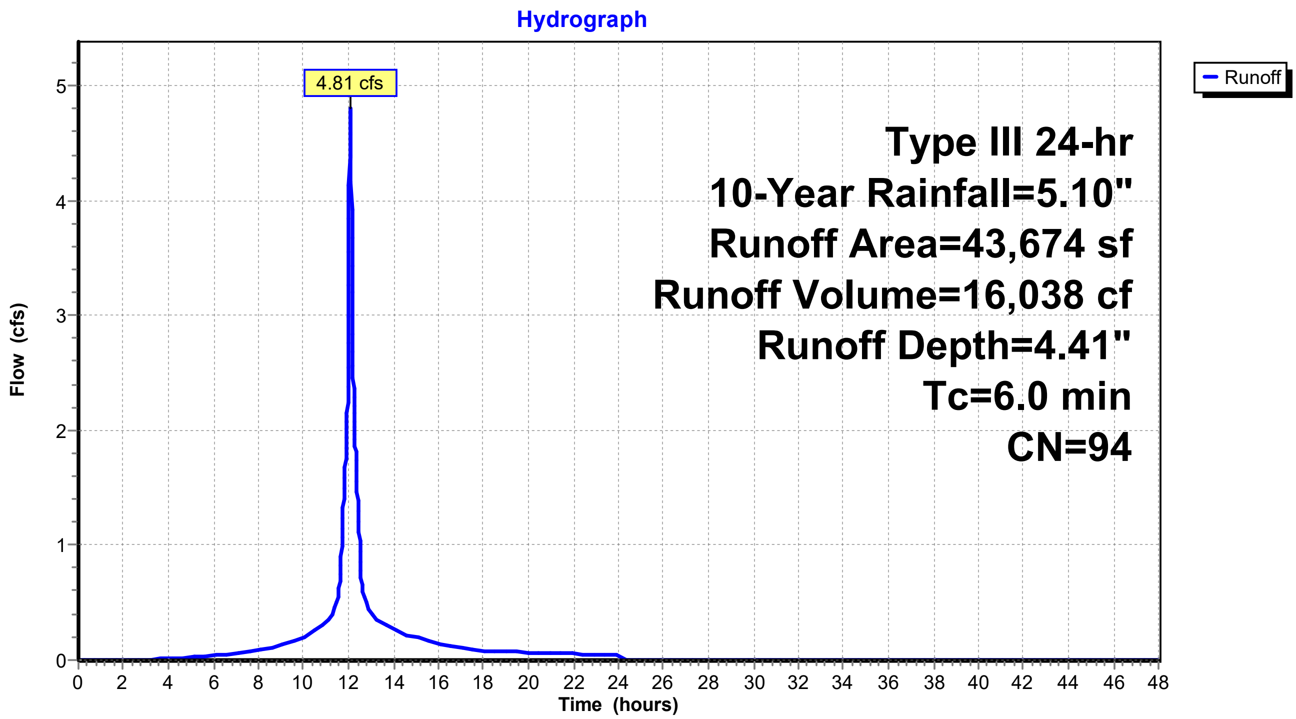
Runoff = 4.81 cfs @ 12.08 hrs, Volume= 16,038 cf, Depth= 4.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.10"

	Area (sf)	CN	Description
*	5,025	98	Ledge, HSG D
	7,050	80	>75% Grass cover, Good, HSG D
*	29,470	98	Paved parking, HSG D
	2,129	77	Woods, Good, HSG D
	43,674	94	Weighted Average
	9,179	79	21.02% Pervious Area
	34,495	98	78.98% Impervious Area

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

Subcatchment P5: P5



Summary for Subcatchment P5-U: P5-U

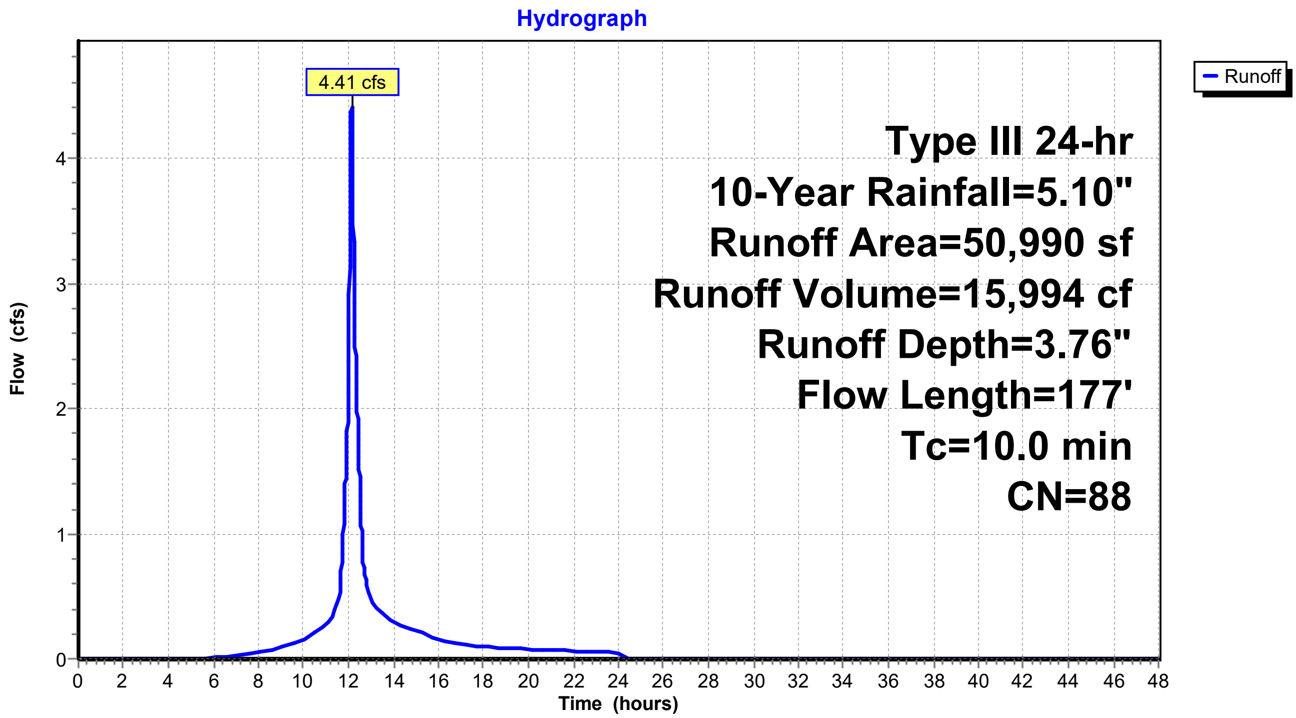
Runoff = 4.41 cfs @ 12.14 hrs, Volume= 15,994 cf, Depth= 3.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.10"

	Area (sf)	CN	Description
*	5,864	98	Ledge, HSG D
	12,095	77	Woods, Good, HSG D
*	20,323	98	Wetland Surface, HSG D
	12,708	78	Meadow, non-grazed, HSG D
	50,990	88	Weighted Average
	24,803	78	48.64% Pervious Area
	26,187	98	51.36% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	50	0.0500	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.40"
1.7	127	0.0620	1.24		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
10.0	177	Total			

Subcatchment P5-U: P5-U



Summary for Subcatchment P6-U: P6-U

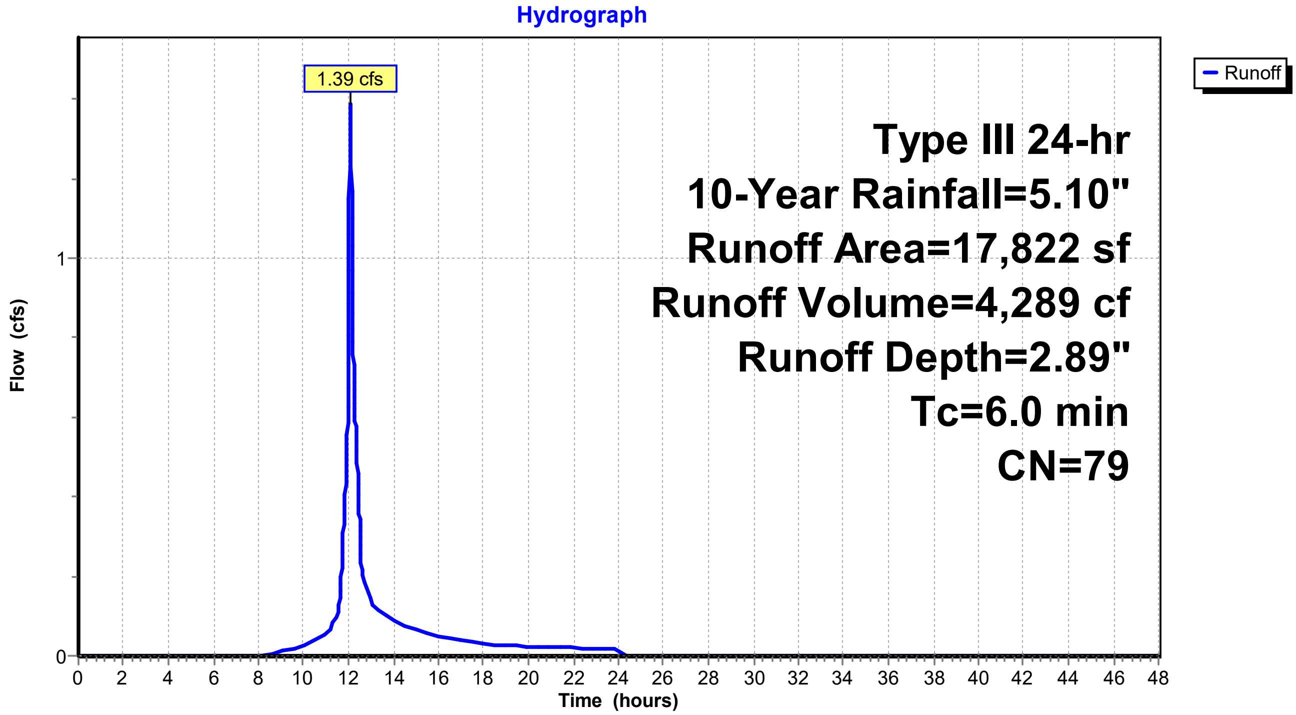
Runoff = 1.39 cfs @ 12.09 hrs, Volume= 4,289 cf, Depth= 2.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.10"

	Area (sf)	CN	Description
	15,225	77	Woods, Good, HSG D
	1,097	80	Pasture/grassland/range, Good, HSG D
*	1,500	98	Wetland Surface, HSG D
	17,822	79	Weighted Average
	16,322	77	91.58% Pervious Area
	1,500	98	8.42% Impervious Area

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

Subcatchment P6-U: P6-U

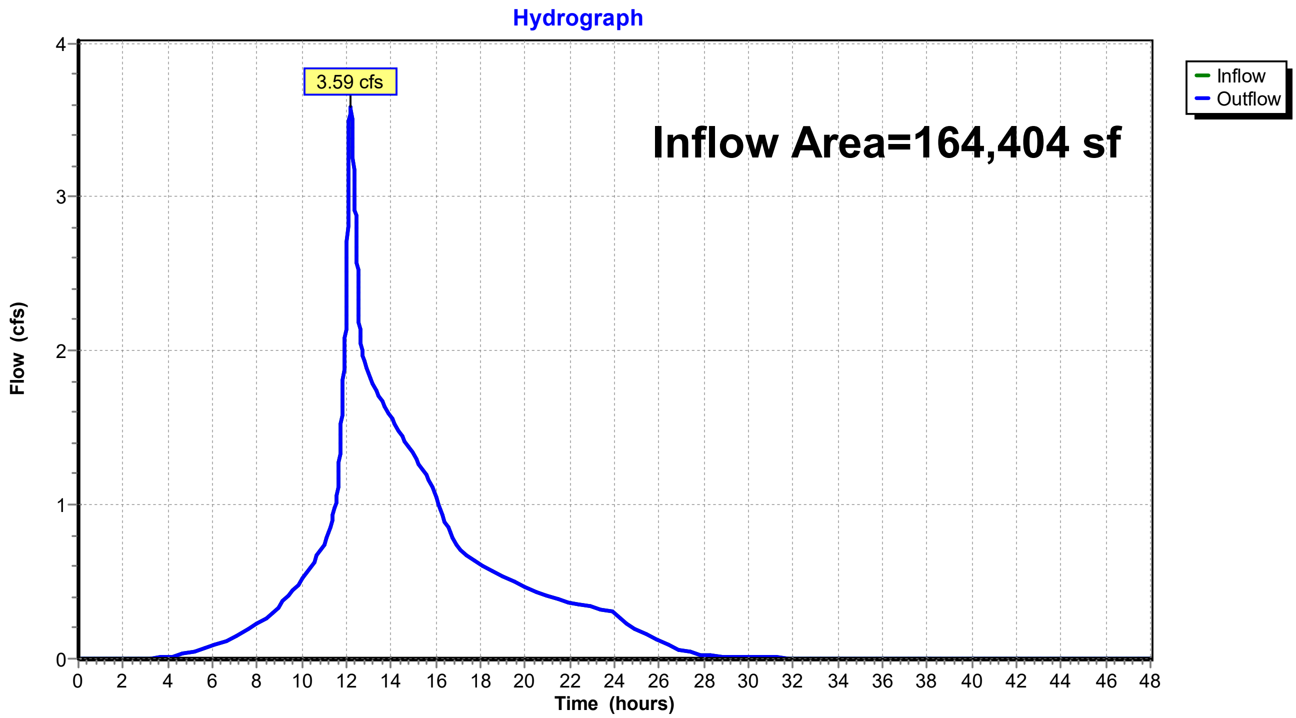


Summary for Reach DMH MS2: DMH MS2

Inflow Area = 164,404 sf, 73.74% Impervious, Inflow Depth = 3.80" for 10-Year event
Inflow = 3.59 cfs @ 12.17 hrs, Volume= 52,094 cf
Outflow = 3.59 cfs @ 12.17 hrs, Volume= 52,094 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach DMH MS2: DMH MS2

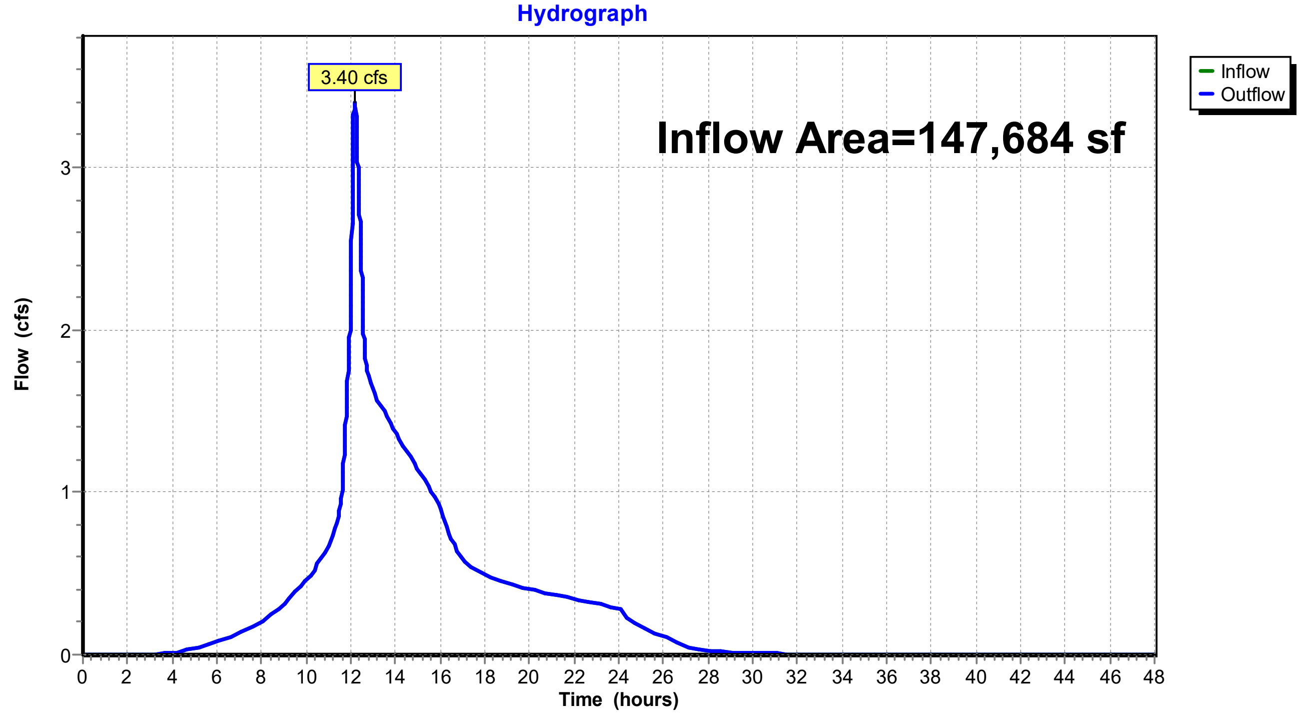


Summary for Reach DMH MS3: DMH MS3

Inflow Area = 147,684 sf, 74.30% Impervious, Inflow Depth = 3.76" for 10-Year event
Inflow = 3.40 cfs @ 12.17 hrs, Volume= 46,260 cf
Outflow = 3.40 cfs @ 12.17 hrs, Volume= 46,260 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach DMH MS3: DMH MS3

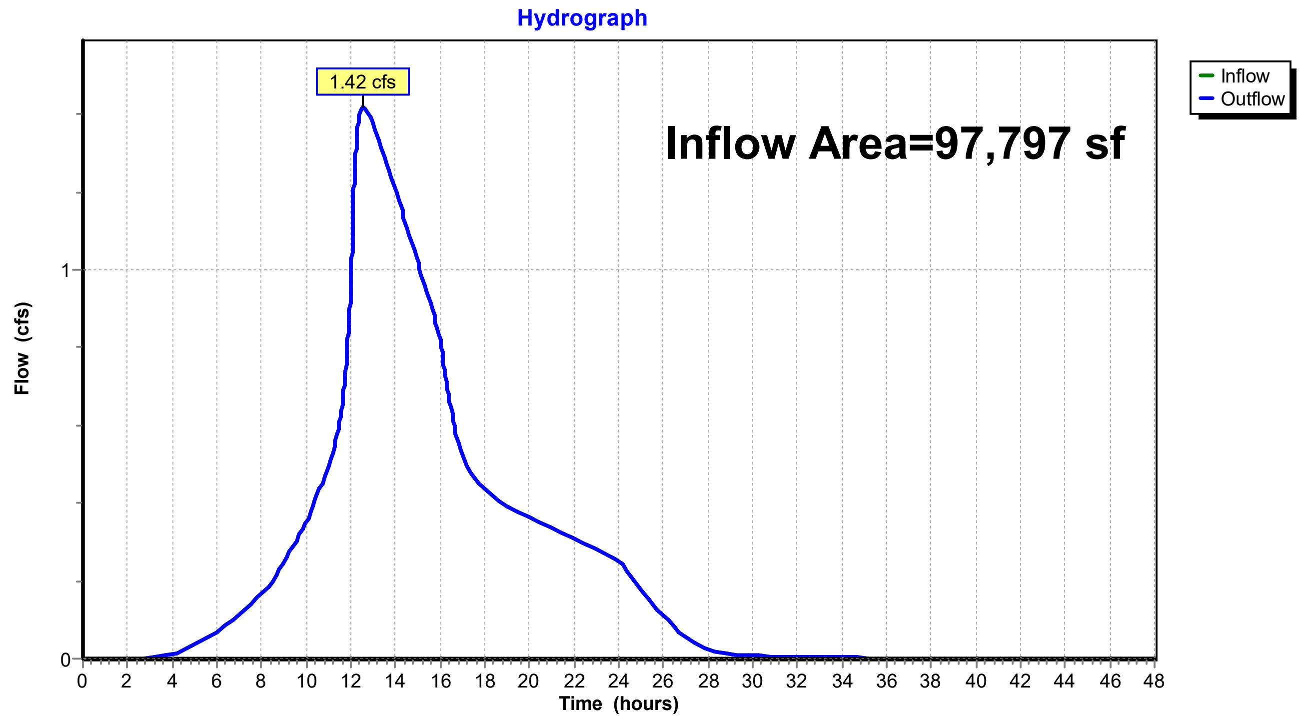


Summary for Reach DMH MS4: DMH MS4

Inflow Area = 97,797 sf, 82.61% Impervious, Inflow Depth = 4.52" for 10-Year event
Inflow = 1.42 cfs @ 12.55 hrs, Volume= 36,824 cf
Outflow = 1.42 cfs @ 12.55 hrs, Volume= 36,824 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach DMH MS4: DMH MS4

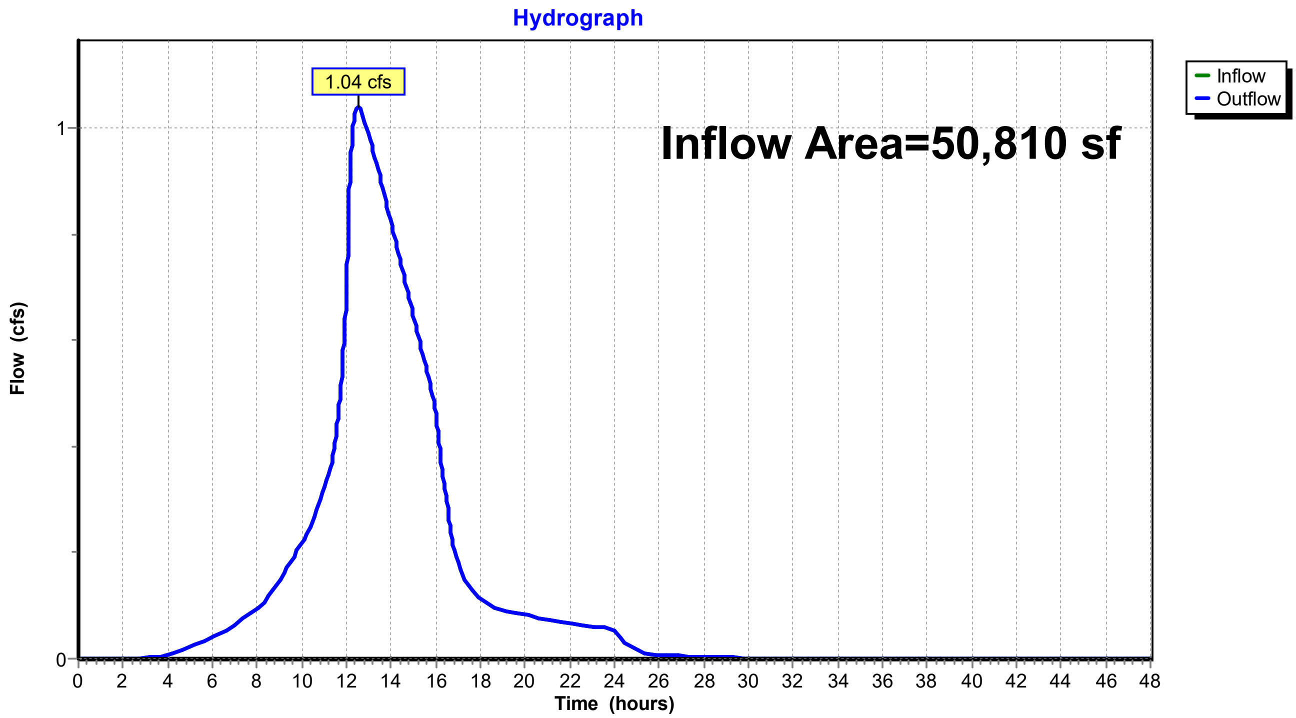


Summary for Reach DMH MS5: DMH MS5

Inflow Area = 50,810 sf, 81.43% Impervious, Inflow Depth = 4.52" for 10-Year event
Inflow = 1.04 cfs @ 12.53 hrs, Volume= 19,132 cf
Outflow = 1.04 cfs @ 12.53 hrs, Volume= 19,132 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach DMH MS5: DMH MS5

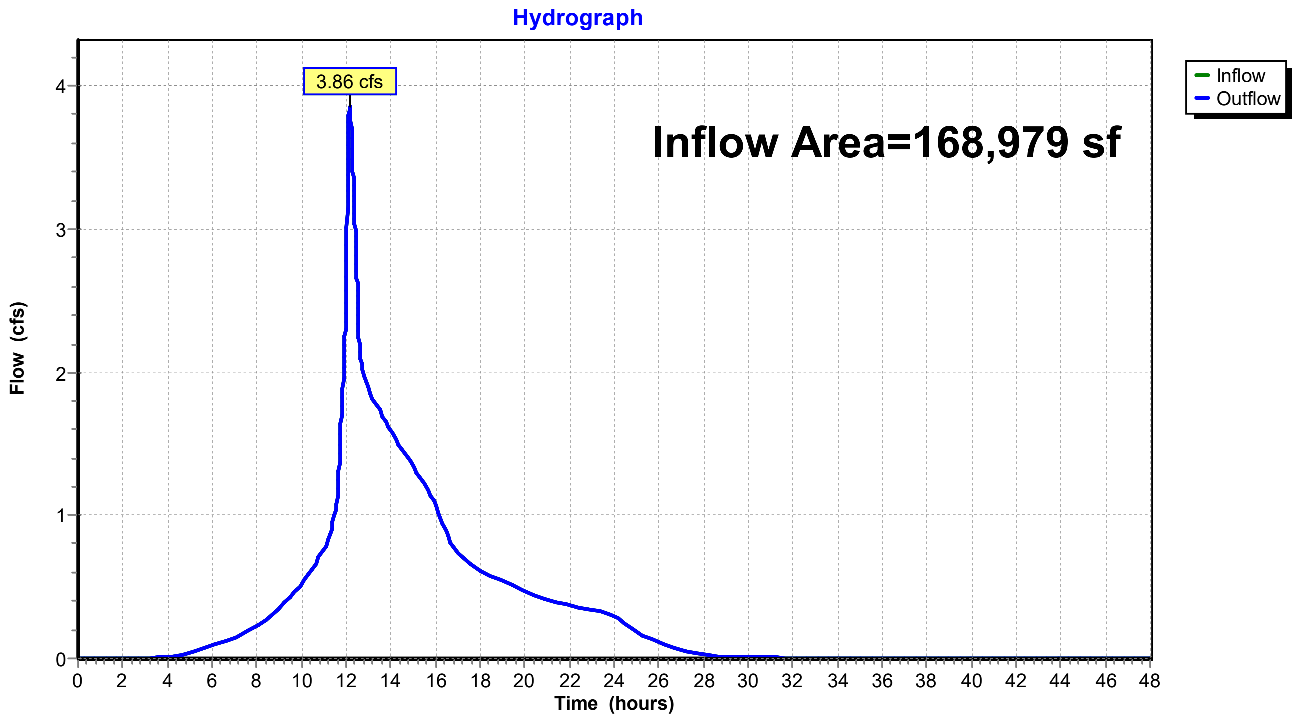


Summary for Reach PD1: WASHINGTON ROW

Inflow Area =	168,979 sf,	71.89% Impervious,	Inflow Depth = 3.78"	for 10-Year event
Inflow =	3.86 cfs @	12.15 hrs, Volume=	53,267 cf	
Outflow =	3.86 cfs @	12.15 hrs, Volume=	53,267 cf, Atten= 0%, Lag= 0.0 min	

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach PD1: WASHINGTON ROW

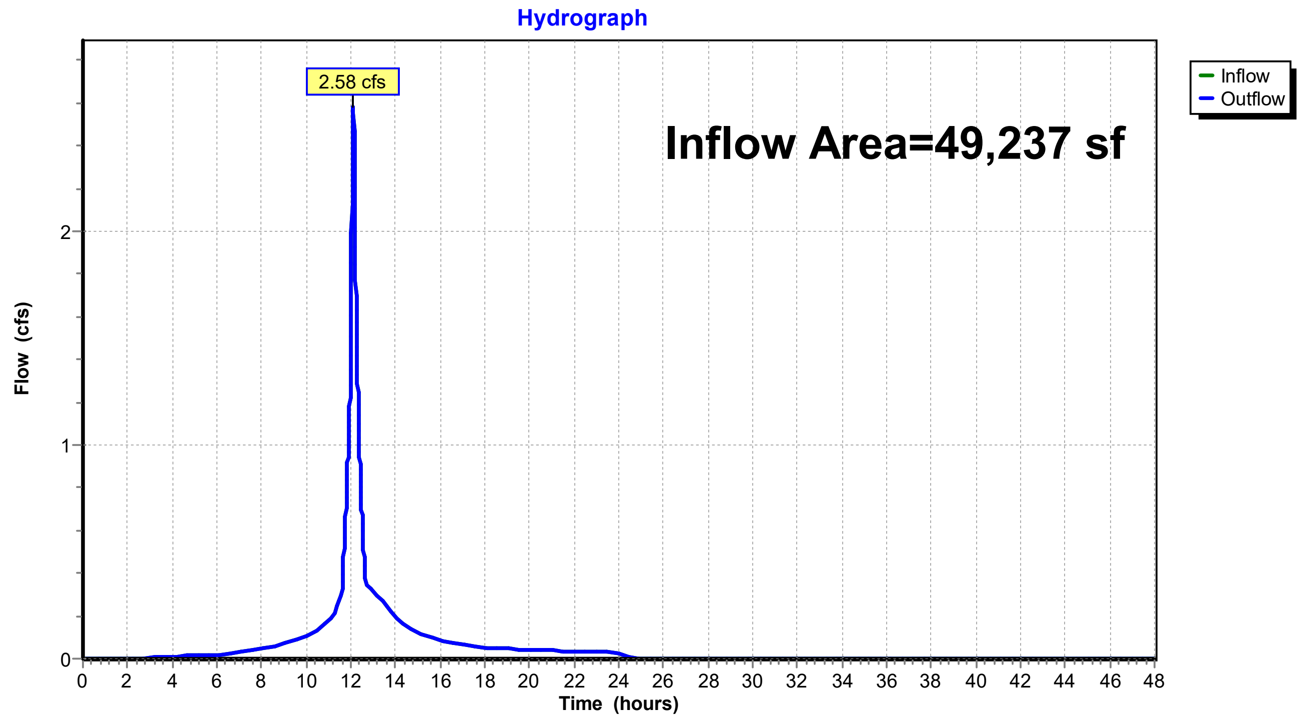


Summary for Reach PD2: Wetland series "A"

Inflow Area =	49,237 sf,	80.62% Impervious,	Inflow Depth = 2.38"	for 10-Year event
Inflow =	2.58 cfs @	12.11 hrs, Volume=	9,762 cf	
Outflow =	2.58 cfs @	12.11 hrs, Volume=	9,762 cf,	Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach PD2: Wetland series "A"

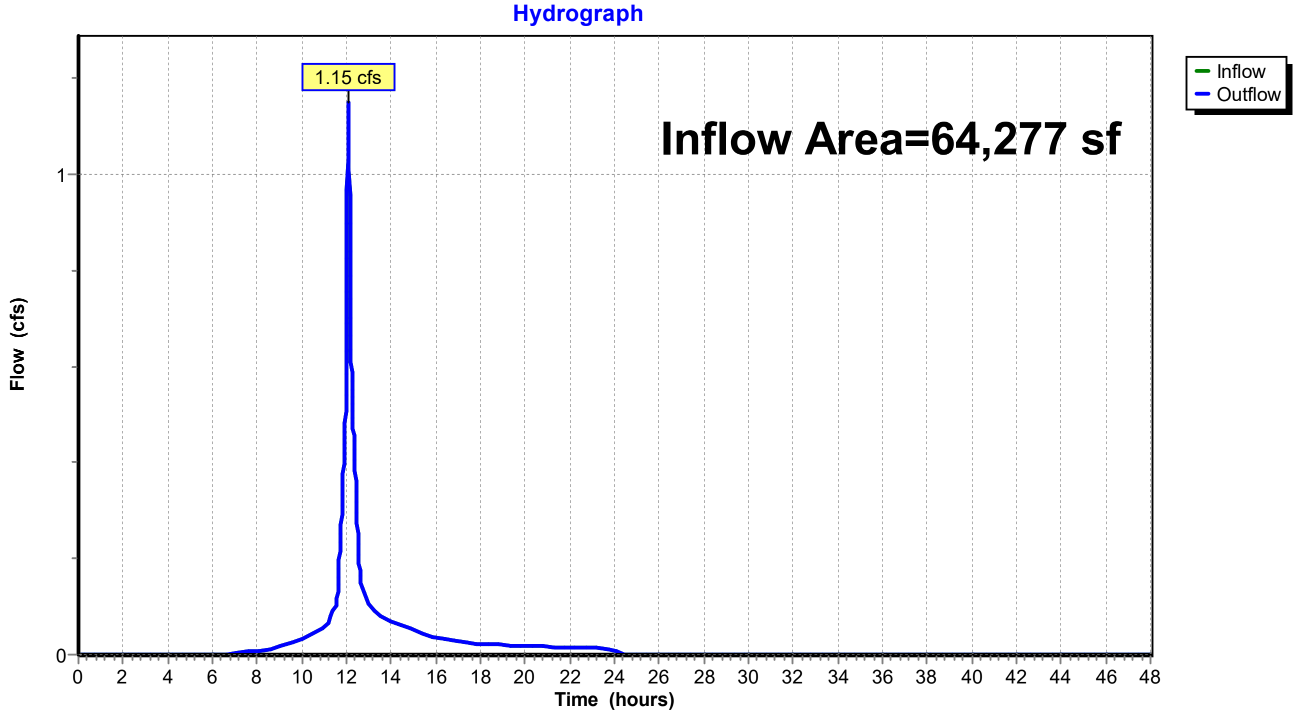


Summary for Reach PD3: Intermittent Stream

Inflow Area =	64,277 sf,	65.04% Impervious,	Inflow Depth = 0.67"	for 10-Year event
Inflow =	1.15 cfs @	12.09 hrs, Volume=	3,595 cf	
Outflow =	1.15 cfs @	12.09 hrs, Volume=	3,595 cf,	Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach PD3: Intermittent Stream

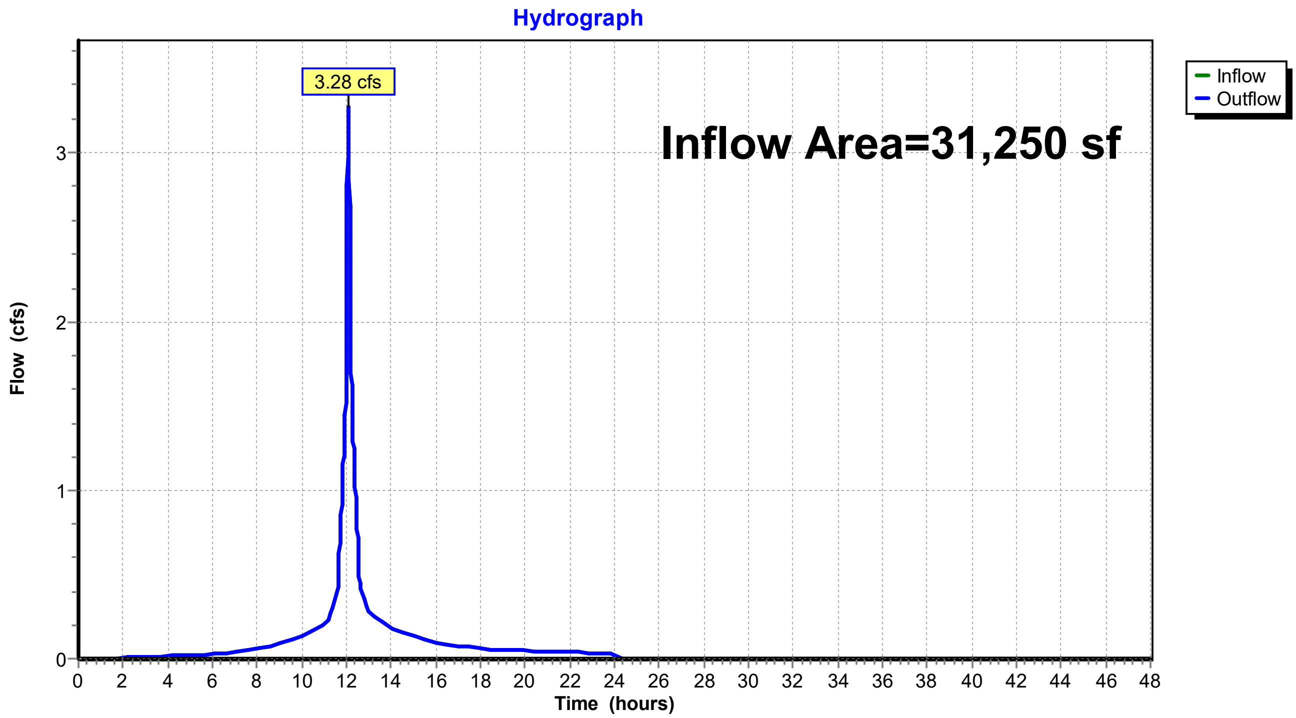


Summary for Reach PD4: Wetland series "B"

Inflow Area =	31,250 sf,	70.80% Impervious,	Inflow Depth = 4.23"	for 10-Year event
Inflow =	3.28 cfs @	12.08 hrs, Volume=	11,022 cf	
Outflow =	3.28 cfs @	12.08 hrs, Volume=	11,022 cf, Atten= 0%, Lag= 0.0 min	

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach PD4: Wetland series "B"

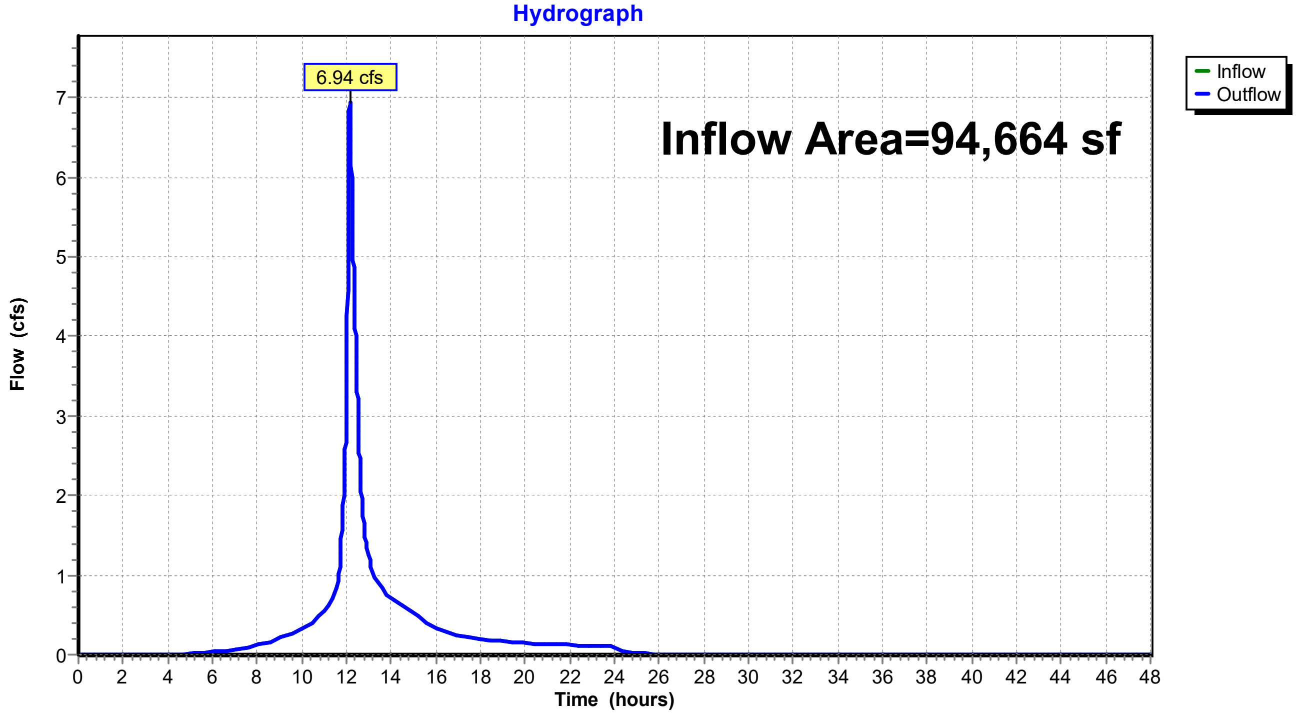


Summary for Reach PD5: Wetland series "E"

Inflow Area = 94,664 sf, 64.10% Impervious, Inflow Depth = 4.06" for 10-Year event
Inflow = 6.94 cfs @ 12.15 hrs, Volume= 32,026 cf
Outflow = 6.94 cfs @ 12.15 hrs, Volume= 32,026 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach PD5: Wetland series "E"

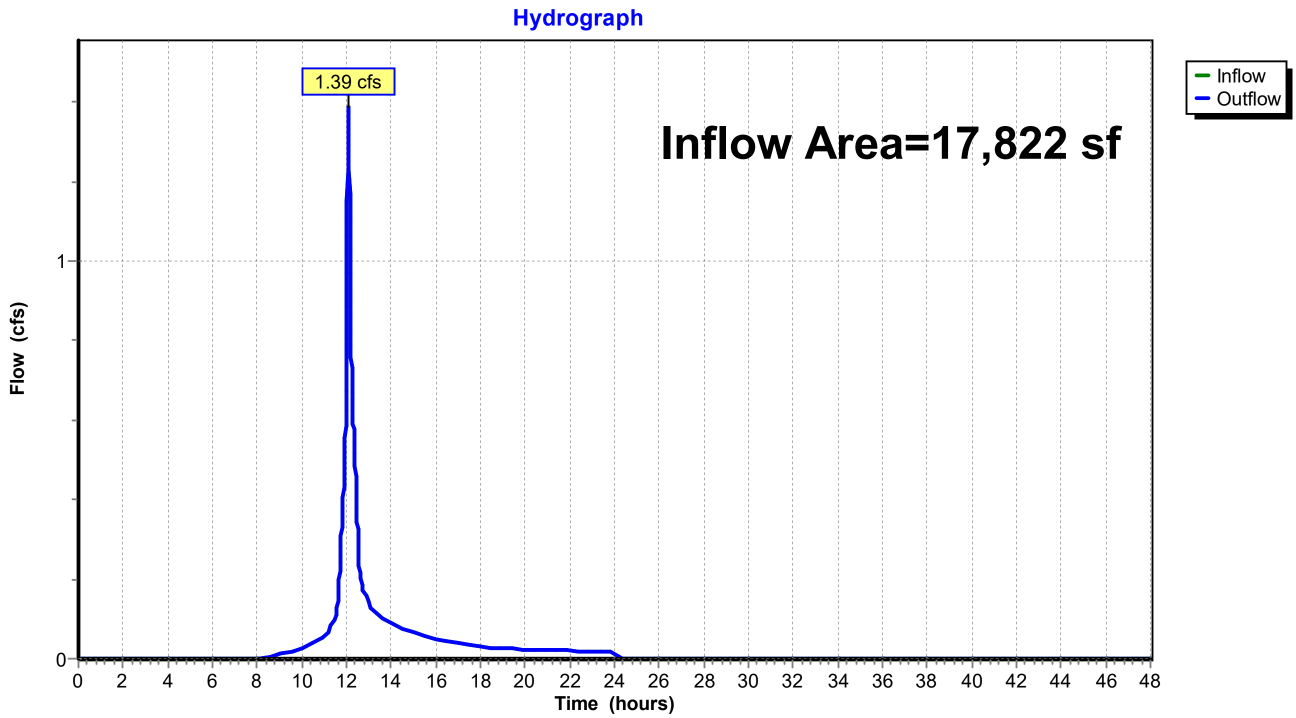


Summary for Reach PD6: Wetland series "F"

Inflow Area = 17,822 sf, 8.42% Impervious, Inflow Depth = 2.89" for 10-Year event
Inflow = 1.39 cfs @ 12.09 hrs, Volume= 4,289 cf
Outflow = 1.39 cfs @ 12.09 hrs, Volume= 4,289 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach PD6: Wetland series "F"

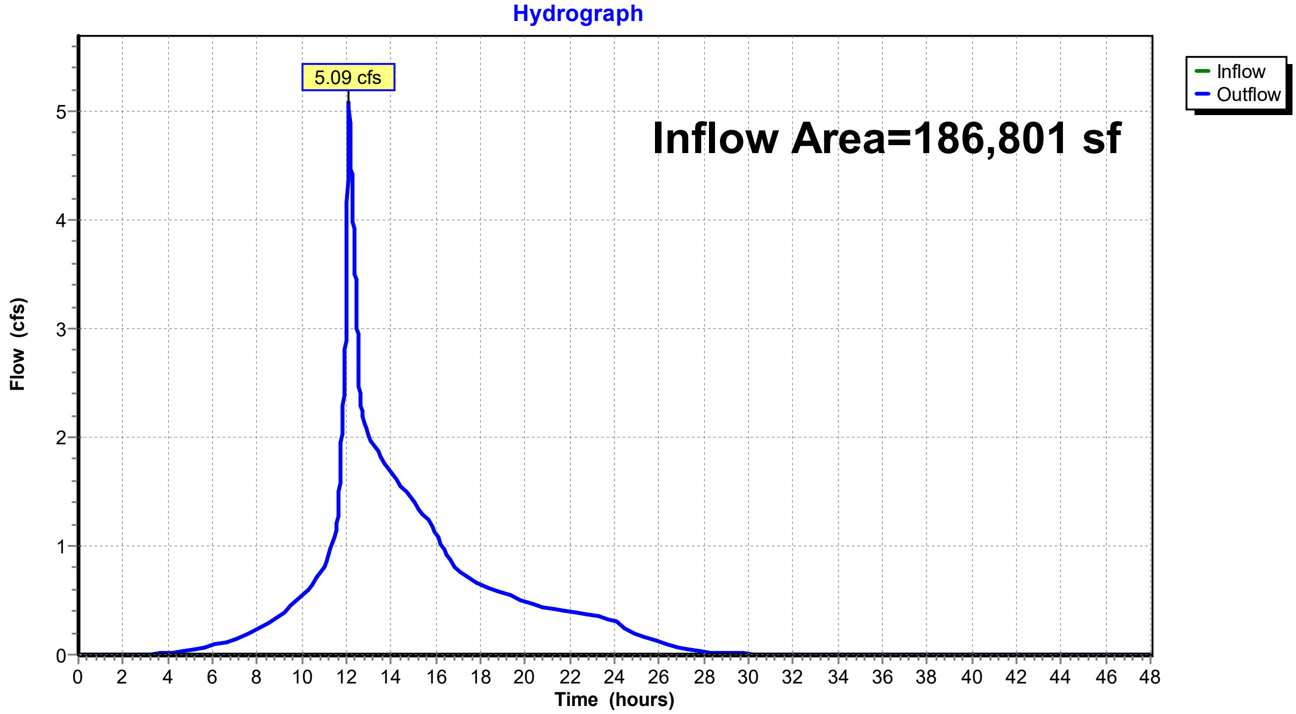


Summary for Reach WD: Washington St Drainage outlet

Inflow Area =	186,801 sf,	65.83% Impervious,	Inflow Depth = 3.70"	for 10-Year event
Inflow =	5.09 cfs @	12.12 hrs, Volume=	57,556 cf	
Outflow =	5.09 cfs @	12.12 hrs, Volume=	57,556 cf,	Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach WD: Washington St Drainage outlet



Summary for Pond UG1a: UG1a

Inflow Area =	27,758 sf, 24.53% Impervious,	Inflow Depth = 4.08"	for 10-Year event
Inflow =	2.91 cfs @ 12.08 hrs, Volume=	9,436 cf	
Outflow =	2.15 cfs @ 12.16 hrs, Volume=	9,436 cf, Atten= 26%, Lag= 4.3 min	
Primary =	2.15 cfs @ 12.16 hrs, Volume=	9,436 cf	

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 84.64' @ 12.16 hrs Surf.Area= 666 sf Storage= 704 cf

Plug-Flow detention time= 6.3 min calculated for 9,434 cf (100% of inflow)
Center-of-Mass det. time= 6.3 min (792.5 - 786.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	83.00'	639 cf	**11.00'W x 60.58'L x 3.50'H Field A** 2,332 cf Overall - 735 cf Embedded = 1,597 cf x 40.0% Voids
#2A	83.50'	735 cf	**ADS_StormTech SC-740 +Cap** x 16 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 16 Chambers in 2 Rows
		1,374 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Device 2	83.00'	**8.5" Vert. Orifice/Grate** C= 0.600
#2	Primary	83.00'	**12.0" Round RCP_Round 12"** L= 51.4' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 83.00' / 82.74' S= 0.0051 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=2.15 cfs @ 12.16 hrs HW=84.64' (Free Discharge)
└─**2=RCP_Round 12"** (Passes 2.15 cfs of 3.89 cfs potential flow)
  └─**1=Orifice/Grate** (Orifice Controls 2.15 cfs @ 5.45 fps)

Pond UG1a: UG1a - Chamber Wizard Field A

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

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

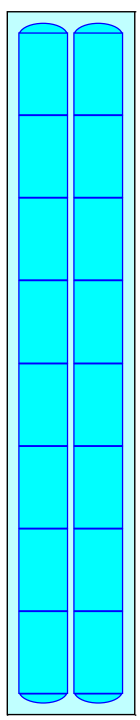
8 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 58.58' Row Length +12.0" End Stone x 2 = 60.58' Base Length
2 Rows x 51.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 11.00' Base Width
6.0" Base + 30.0" Chamber Height + 6.0" Cover = 3.50' Field Height

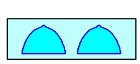
16 Chambers x 45.9 cf = 735.0 cf Chamber Storage

2,332.2 cf Field - 735.0 cf Chambers = 1,597.2 cf Stone x 40.0% Voids = 638.9 cf Stone Storage

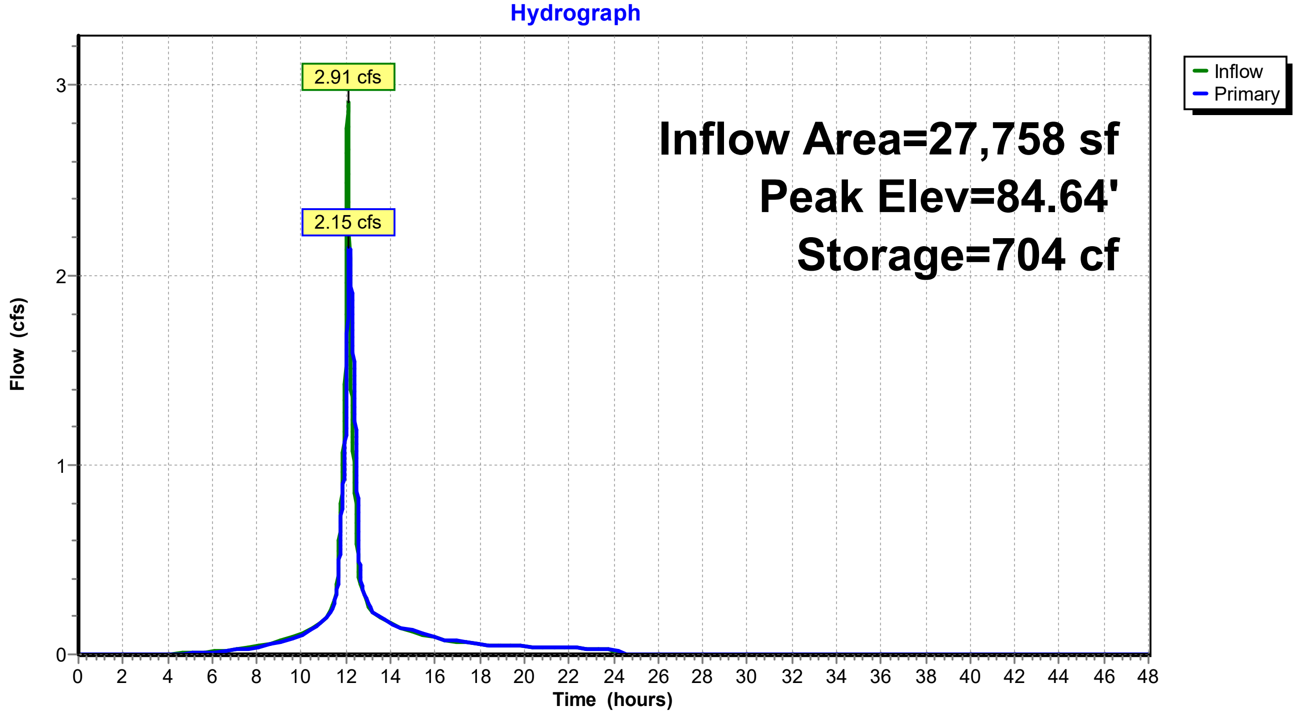
Chamber Storage + Stone Storage = 1,373.9 cf = 0.032 af
Overall Storage Efficiency = 58.9%
Overall System Size = 60.58' x 11.00' x 3.50'

16 Chambers
86.4 cy Field
59.2 cy Stone





Pond UG1a: UG1a



Summary for Pond UG1b: UG1b

Inflow Area = 22,129 sf,100.00% Impervious, Inflow Depth = 4.86" for 10-Year event
Inflow = 2.54 cfs @ 12.08 hrs, Volume= 8,968 cf
Outflow = 0.39 cfs @ 11.65 hrs, Volume= 8,968 cf, Atten= 85%, Lag= 0.0 min
Discarded = 0.39 cfs @ 11.65 hrs, Volume= 8,968 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 86.15' @ 12.56 hrs Surf.Area= 2,044 sf Storage= 2,388 cf

Plug-Flow detention time= 33.5 min calculated for 8,966 cf (100% of inflow)
Center-of-Mass det. time= 33.4 min (781.1 - 747.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	84.50'	1,589 cf	**28.00'W x 73.00'L x 3.21'H Field A** 6,558 cf Overall - 2,587 cf Embedded = 3,971 cf x 40.0% Voids
#2A	85.00'	2,587 cf	**Cultec R-280HD** x 60 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 6 rows
		4,175 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Device 2	87.33'	**0.9' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#2	Primary	84.07'	**12.0" Round RCP_Round 12"** L= 12.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 84.07' / 83.53' S= 0.0450 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#3	Discarded	84.50'	**8.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.39 cfs @ 11.65 hrs HW=84.53' (Free Discharge)
↑—**3=Exfiltration** (Exfiltration Controls 0.39 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=84.50' (Free Discharge)
↑—**2=RCP_Round 12"** (Passes 0.00 cfs of 0.90 cfs potential flow)
  ↑—**1=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond UG1b: UG1b - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)
Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf
Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap
Row Length Adjustment= +1.00' x 6.07 sf x 6 rows

47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

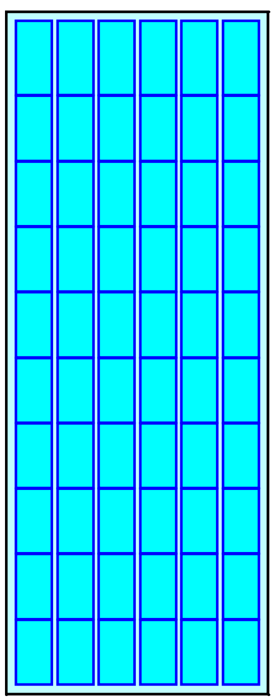
10 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 71.00' Row Length +12.0" End Stone x 2 = 73.00' Base Length
6 Rows x 47.0" Wide + 6.0" Spacing x 5 + 12.0" Side Stone x 2 = 28.00' Base Width
6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

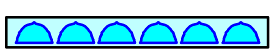
60 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 6 Rows = 2,586.6 cf Chamber Storage

6,557.8 cf Field - 2,586.6 cf Chambers = 3,971.3 cf Stone x 40.0% Voids = 1,588.5 cf Stone Storage

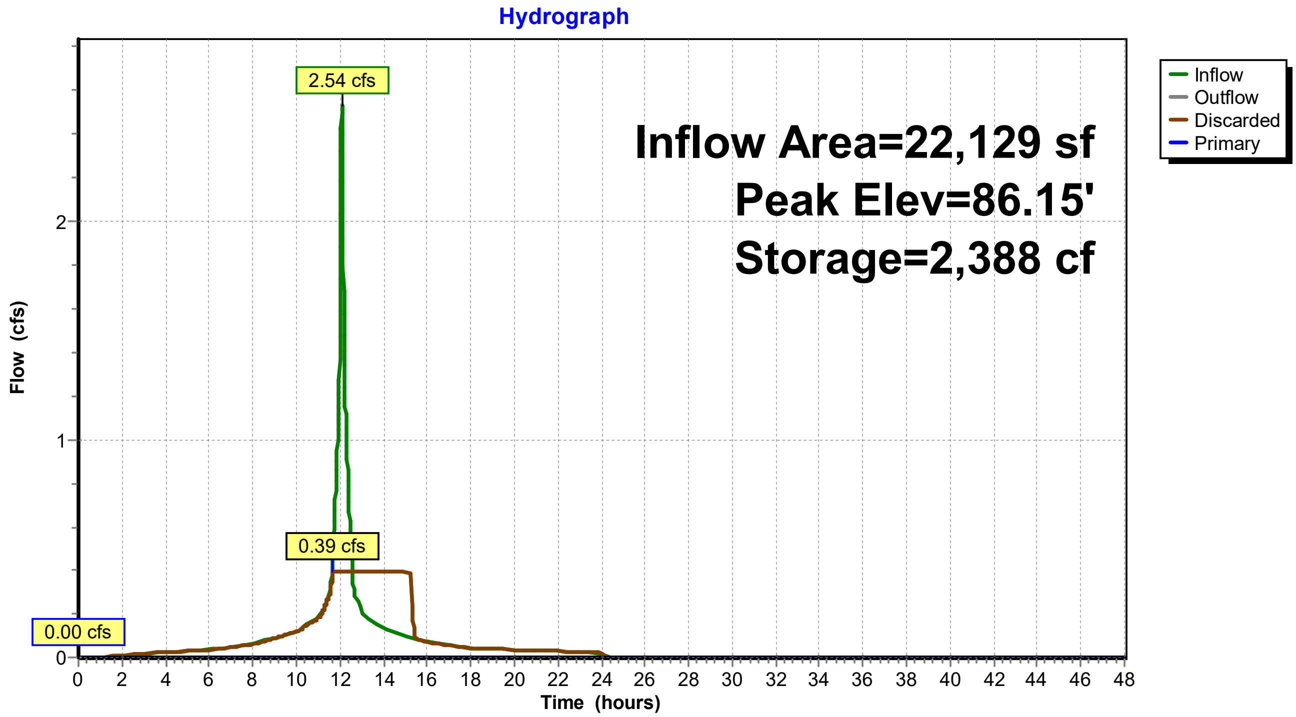
Chamber Storage + Stone Storage = 4,175.1 cf = 0.096 af
Overall Storage Efficiency = 63.7%
Overall System Size = 73.00' x 28.00' x 3.21'

60 Chambers
242.9 cy Field
147.1 cy Stone





Pond UG1b: UG1b



Summary for Pond UG2: UG2

Inflow Area = 16,720 sf, 68.82% Impervious, Inflow Depth = 4.19" for 10-Year event
Inflow = 1.79 cfs @ 12.08 hrs, Volume= 5,834 cf
Outflow = 0.21 cfs @ 12.68 hrs, Volume= 5,834 cf, Atten= 88%, Lag= 35.8 min
Primary = 0.21 cfs @ 12.68 hrs, Volume= 5,834 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 83.78' @ 12.68 hrs Surf.Area= 0.047 ac Storage= 0.056 af

Plug-Flow detention time= 126.4 min calculated for 5,834 cf (100% of inflow)
Center-of-Mass det. time= 126.4 min (908.5 - 782.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	82.00'	0.042 af	**30.00'W x 67.70'L x 3.50'H Field A** 0.163 af Overall - 0.057 af Embedded = 0.106 af x 40.0% Voids
#2A	82.50'	0.057 af	**ADS_StormTech SC-740 +Cap** x 54 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 54 Chambers in 6 Rows
		0.099 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Device 2	82.00'	**2.5" Vert. Orifice/Grate** C= 0.600
#2	Primary	82.00'	**12.0" Round RCP_Round 12"** L= 9.7' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 82.00' / 81.95' S= 0.0052 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=0.21 cfs @ 12.68 hrs HW=83.78' (Free Discharge)
↑—**2=RCP_Round 12"** (Passes 0.21 cfs of 4.83 cfs potential flow)
  ↑—**1=Orifice/Grate** (Orifice Controls 0.21 cfs @ 6.24 fps)

Pond UG2: UG2 - Chamber Wizard Field A

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

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

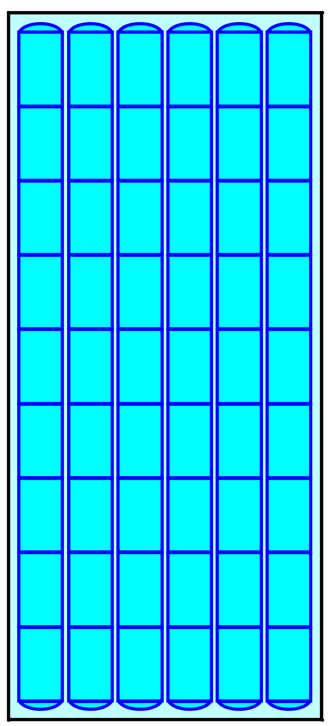
9 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 65.70' Row Length +12.0" End Stone x 2 = 67.70' Base Length
6 Rows x 51.0" Wide + 6.0" Spacing x 5 + 12.0" Side Stone x 2 = 30.00' Base Width
6.0" Base + 30.0" Chamber Height + 6.0" Cover = 3.50' Field Height

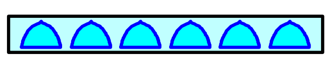
54 Chambers x 45.9 cf = 2,480.8 cf Chamber Storage

7,108.2 cf Field - 2,480.8 cf Chambers = 4,627.4 cf Stone x 40.0% Voids = 1,851.0 cf Stone Storage

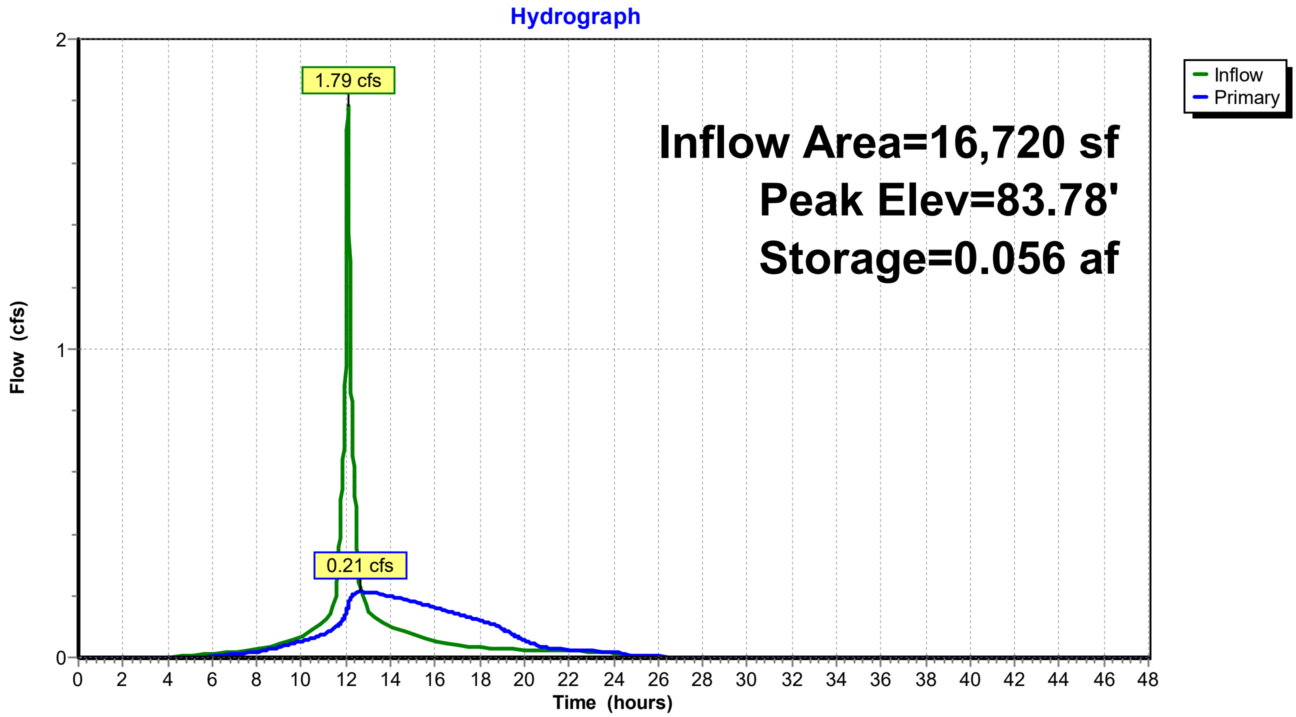
Chamber Storage + Stone Storage = 4,331.7 cf = 0.099 af
Overall Storage Efficiency = 60.9%
Overall System Size = 67.70' x 30.00' x 3.50'

54 Chambers
263.3 cy Field
171.4 cy Stone





Pond UG2: UG2


Hydrograph
1.79 cfs
0.21 cfs
Inflow Area=16,720 sf
Peak Elev=83.78'
Storage=0.056 af
Inflow
Primary
Flow (cfs)
Time (hours)
0
1
2
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 UG3: UG3

Inflow Area = 46,987 sf, 83.88% Impervious, Inflow Depth = 4.52" for 10-Year event
Inflow = 5.24 cfs @ 12.08 hrs, Volume= 17,693 cf
Outflow = 0.39 cfs @ 13.18 hrs, Volume= 17,692 cf, Atten= 93%, Lag= 65.8 min
Primary = 0.39 cfs @ 13.18 hrs, Volume= 17,692 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 91.82' @ 13.18 hrs Surf.Area= 0.103 ac Storage= 0.202 af

Plug-Flow detention time= 259.4 min calculated for 17,688 cf (100% of inflow)
Center-of-Mass det. time= 259.5 min (1,027.3 - 767.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	89.00'	0.145 af	**80.08'W x 55.89'L x 5.50'H Field A** 0.565 af Overall - 0.202 af Embedded = 0.363 af x 40.0% Voids
#2A	89.75'	0.202 af	**ADS_StormTech MC-3500 d +Cap** x 77 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 77 Chambers in 11 Rows Cap Storage= +14.9 cf x 2 x 11 rows = 327.8 cf
		0.347 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Device 2	89.00'	**3.0" Vert. Orifice/Grate** C= 0.600
#2	Primary	89.00'	**12.0" Round RCP_Round 12"** L= 20.9' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 89.00' / 88.90' S= 0.0048 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=0.39 cfs @ 13.18 hrs HW=91.82' (Free Discharge)
└─**2=RCP_Round 12"** (Passes 0.39 cfs of 6.76 cfs potential flow)
  └─**1=Orifice/Grate** (Orifice Controls 0.39 cfs @ 7.90 fps)

Pond UG3: UG3 - Chamber Wizard Field A

Chamber Model = ADS_StormTech MC-3500 d +Cap (ADS StormTech® MC-3500 d rev 03/14 with Cap volume)
Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf
Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap
Cap Storage= +14.9 cf x 2 x 11 rows = 327.8 cf

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

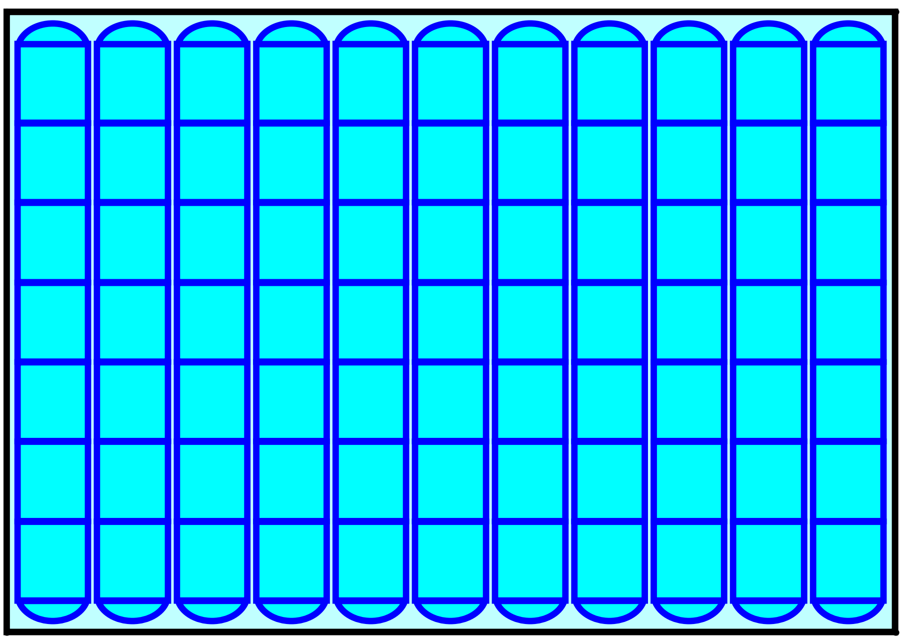
7 Chambers/Row x 7.17' Long +1.85' Cap Length x 2 = 53.89' Row Length +12.0" End Stone x 2 = 55.89' Base Length
11 Rows x 77.0" Wide + 9.0" Spacing x 10 + 12.0" Side Stone x 2 = 80.08' Base Width
9.0" Base + 45.0" Chamber Height + 12.0" Cover = 5.50' Field Height

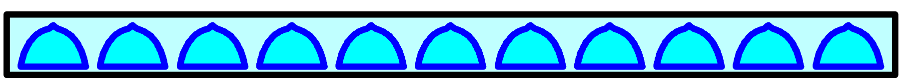
77 Chambers x 110.0 cf + 14.9 cf Cap Volume x 2 x 11 Rows = 8,794.1 cf Chamber Storage

24,617.2 cf Field - 8,794.1 cf Chambers = 15,823.1 cf Stone x 40.0% Voids = 6,329.2 cf Stone Storage

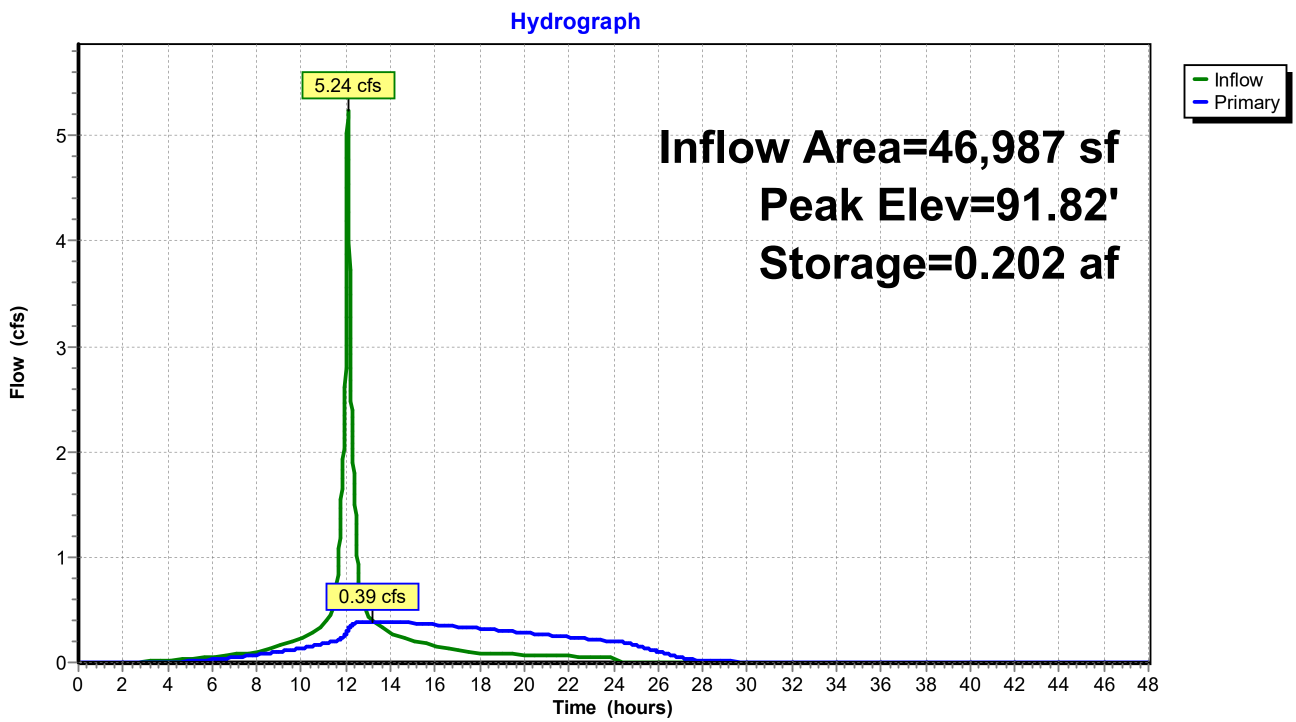
Chamber Storage + Stone Storage = 15,123.3 cf = 0.347 af
Overall Storage Efficiency = 61.4%
Overall System Size = 55.89' x 80.08' x 5.50'

77 Chambers
911.7 cy Field
586.0 cy Stone





Pond UG3: UG3


Hydrograph
5.24 cfs
0.39 cfs
Inflow Area=46,987 sf
Peak Elev=91.82'
Storage=0.202 af
Inflow
Primary
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 UG4a: UG4a

Inflow Area =	38,652 sf, 94.71% Impervious,	Inflow Depth = 2.14"	for 10-Year event
Inflow =	1.92 cfs @ 12.08 hrs, Volume=	6,882 cf	
Outflow =	1.71 cfs @ 12.12 hrs, Volume=	6,882 cf, Atten= 11%, Lag= 2.5 min	
Primary =	1.71 cfs @ 12.12 hrs, Volume=	6,882 cf	

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 100.25' @ 12.12 hrs Surf.Area= 0.019 ac Storage= 0.008 af

Plug-Flow detention time= 7.7 min calculated for 6,881 cf (100% of inflow)
Center-of-Mass det. time= 7.7 min (771.6 - 763.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	99.50'	0.014 af	**18.17'W x 45.92'L x 2.33'H Field A** 0.045 af Overall - 0.010 af Embedded = 0.035 af x 40.0% Voids
#2A	100.00'	0.010 af	**ADS_StormTech SC-310 +Cap** x 30 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap 30 Chambers in 5 Rows
		0.024 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Device 2	99.50'	**11.0" Vert. Orifice/Grate** C= 0.600
#2	Primary	99.50'	**12.0" Round RCP_Round 12"** L= 43.2' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 99.50' / 98.00' S= 0.0347 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=1.71 cfs @ 12.12 hrs HW=100.25' (Free Discharge)
↑—**2=RCP_Round 12"** (Passes 1.71 cfs of 2.34 cfs potential flow)
  ↑—**1=Orifice/Grate** (Orifice Controls 1.71 cfs @ 2.95 fps)

Pond UG4a: UG4a - Chamber Wizard Field A

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

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

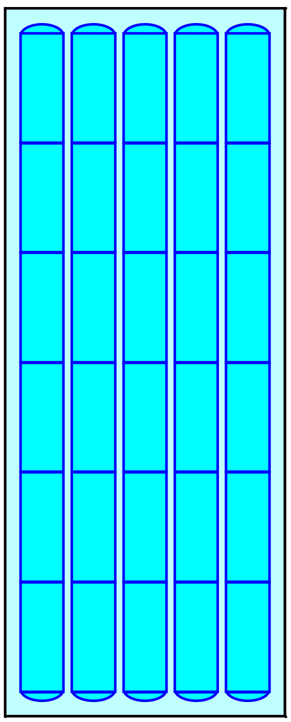
6 Chambers/Row x 7.12' Long +0.60' Cap Length x 2 = 43.92' Row Length +12.0" End Stone x 2 = 45.92' Base Length
5 Rows x 34.0" Wide + 6.0" Spacing x 4 + 12.0" Side Stone x 2 = 18.17' Base Width
6.0" Base + 16.0" Chamber Height + 6.0" Cover = 2.33' Field Height

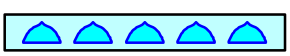
30 Chambers x 14.7 cf = 442.3 cf Chamber Storage

1,946.5 cf Field - 442.3 cf Chambers = 1,504.2 cf Stone x 40.0% Voids = 601.7 cf Stone Storage

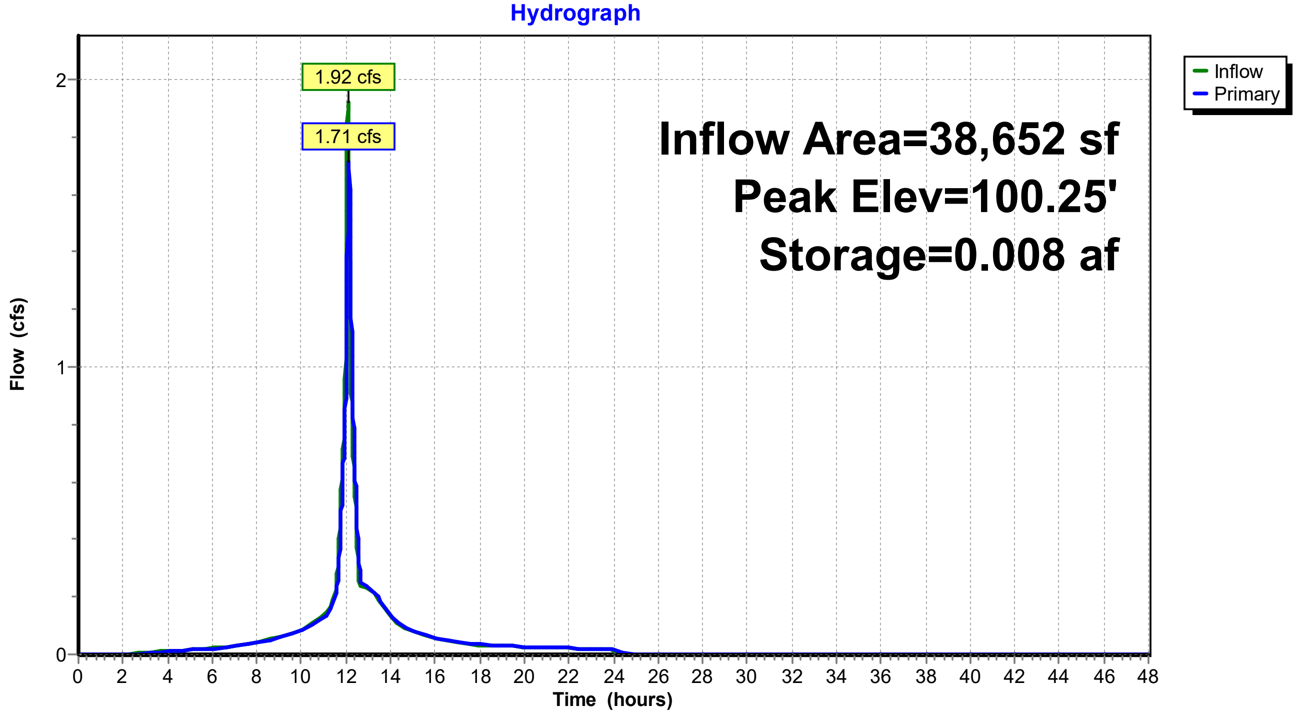
Chamber Storage + Stone Storage = 1,044.0 cf = 0.024 af
Overall Storage Efficiency = 53.6%
Overall System Size = 45.92' x 18.17' x 2.33'

30 Chambers
72.1 cy Field
55.7 cy Stone





Pond UG4a: UG4a



Summary for Pond UG4b: UG4b

Inflow Area = 21,598 sf,100.00% Impervious, Inflow Depth = 4.86" for 10-Year event
Inflow = 2.47 cfs @ 12.08 hrs, Volume= 8,753 cf
Outflow = 0.20 cfs @ 13.04 hrs, Volume= 8,753 cf, Atten= 92%, Lag= 57.7 min
Discarded = 0.12 cfs @ 9.99 hrs, Volume= 8,453 cf
Primary = 0.08 cfs @ 13.04 hrs, Volume= 299 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 109.79' @ 13.04 hrs Surf.Area= 2,069 sf Storage= 3,808 cf

Plug-Flow detention time= 258.6 min calculated for 8,751 cf (100% of inflow)
Center-of-Mass det. time= 258.6 min (1,006.3 - 747.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	107.00'	1,886 cf	**25.25'W x 81.94'L x 3.50'H Field A** 7,241 cf Overall - 2,527 cf Embedded = 4,714 cf x 40.0% Voids
#2A	107.50'	2,527 cf	**ADS_StormTech SC-740 +Cap** x 55 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 55 Chambers in 5 Rows
		4,412 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Device 2	109.70'	**1.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#2	Primary	107.00'	**12.0" Round RCP_Round 12"** L= 100.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 107.00' / 104.00' S= 0.0300 '/' Cc= 0.900 n= 0.013 Concrete sewer w/manholes & inlets, Flow Area= 0.79 sf
#3	Discarded	107.00'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.12 cfs @ 9.99 hrs HW=107.04' (Free Discharge)
└─**3=Exfiltration** (Exfiltration Controls 0.12 cfs)

Primary OutFlow Max=0.08 cfs @ 13.04 hrs HW=109.79' (Free Discharge)
└─**2=RCP_Round 12"** (Passes 0.08 cfs of 6.62 cfs potential flow)
  └─**1=Sharp-Crested Rectangular Weir** (Weir Controls 0.08 cfs @ 0.96 fps)

Pond UG4b: UG4b - Chamber Wizard Field A

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

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

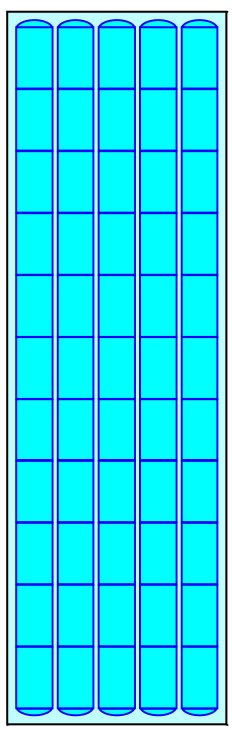
11 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 79.94' Row Length +12.0" End Stone x 2 = 81.94' Base Length
5 Rows x 51.0" Wide + 6.0" Spacing x 4 + 12.0" Side Stone x 2 = 25.25' Base Width
6.0" Base + 30.0" Chamber Height + 6.0" Cover = 3.50' Field Height

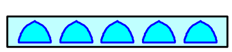
55 Chambers x 45.9 cf = 2,526.7 cf Chamber Storage

7,241.2 cf Field - 2,526.7 cf Chambers = 4,714.5 cf Stone x 40.0% Voids = 1,885.8 cf Stone Storage

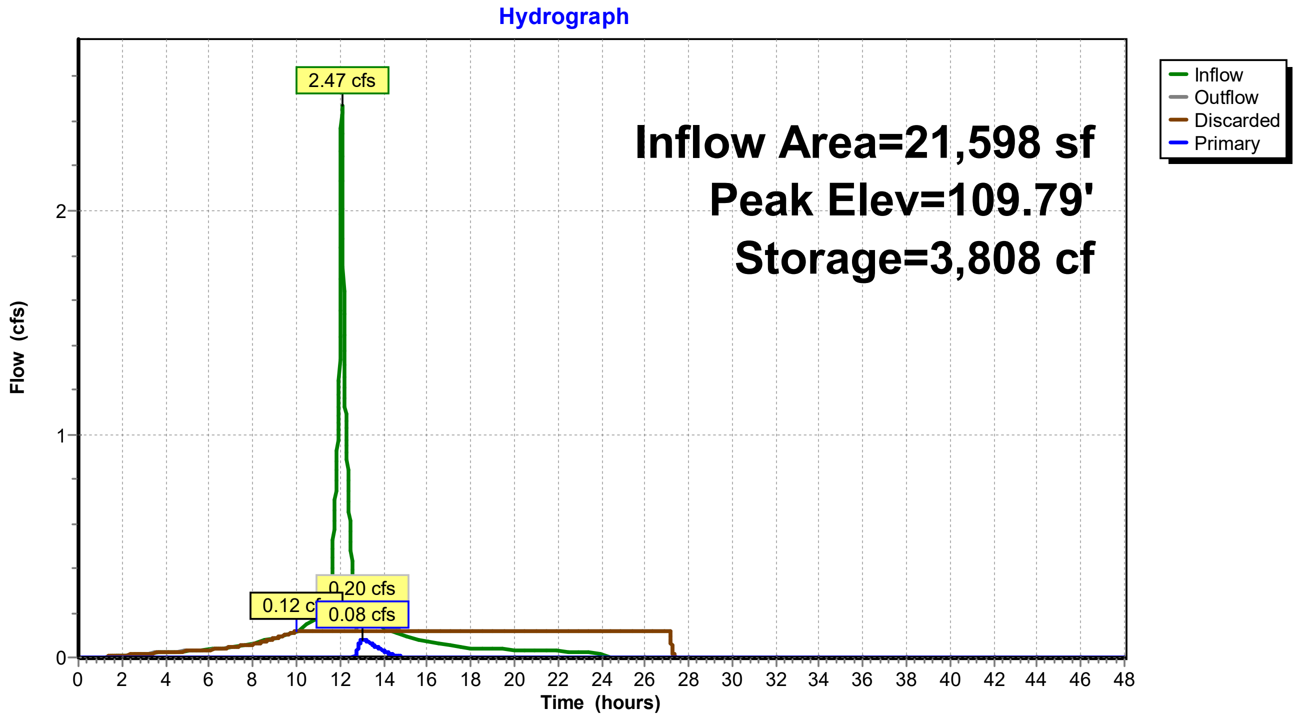
Chamber Storage + Stone Storage = 4,412.5 cf = 0.101 af
Overall Storage Efficiency = 60.9%
Overall System Size = 81.94' x 25.25' x 3.50'

55 Chambers
268.2 cy Field
174.6 cy Stone





Pond UG4b: UG4b



Summary for Pond UG5: UG5

Inflow Area =	51,811 sf,	71.70% Impervious,	Inflow Depth =	4.30"	for 10-Year event
Inflow =	5.62 cfs @	12.08 hrs, Volume=	18,549 cf		
Outflow =	0.25 cfs @	10.34 hrs, Volume=	18,549 cf,	Atten= 96%,	Lag= 0.0 min
Discarded =	0.25 cfs @	10.34 hrs, Volume=	18,549 cf		
Primary =	0.00 cfs @	0.00 hrs, Volume=	0 cf		

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 110.93' @ 14.73 hrs Surf.Area= 4,461 sf Storage= 9,216 cf

Plug-Flow detention time= 328.7 min calculated for 18,545 cf (100% of inflow)
Center-of-Mass det. time= 328.6 min (1,106.3 - 777.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	108.00'	6,247 cf	**29.92'W x 149.10'L x 5.50'H Field A** 24,533 cf Overall - 8,915 cf Embedded = 15,618 cf x 40.0% Voids
#2A	108.75'	8,915 cf	**ADS_StormTech MC-3500 d +Cap** x 80 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 80 Chambers in 4 Rows Cap Storage= +14.9 cf x 2 x 4 rows = 119.2 cf
		15,162 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Device 2	113.05'	**0.7' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#2	Primary	101.47'	**12.0" Round RCP_Round 12"** L= 14.6' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 101.47' / 100.30' S= 0.0801 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#3	Discarded	108.00'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.25 cfs @ 10.34 hrs HW=108.06' (Free Discharge)
└**3=Exfiltration** (Exfiltration Controls 0.25 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=108.00' (Free Discharge)
└**2=RCP_Round 12"** (Passes 0.00 cfs of 11.61 cfs potential flow)
  └**1=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond UG5: UG5 - Chamber Wizard Field A

Chamber Model = ADS_StormTech MC-3500 d +Cap (ADS StormTech® MC-3500 d rev 03/14 with Cap volume)
Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf
Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap
Cap Storage= +14.9 cf x 2 x 4 rows = 119.2 cf

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

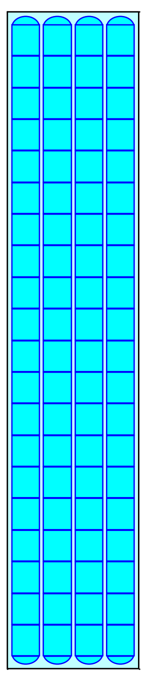
20 Chambers/Row x 7.17' Long +1.85' Cap Length x 2 = 147.10' Row Length +12.0" End Stone x 2 = 149.10' Base Length
4 Rows x 77.0" Wide + 9.0" Spacing x 3 + 12.0" Side Stone x 2 = 29.92' Base Width
9.0" Base + 45.0" Chamber Height + 12.0" Cover = 5.50' Field Height

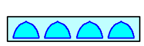
80 Chambers x 110.0 cf + 14.9 cf Cap Volume x 2 x 4 Rows = 8,915.4 cf Chamber Storage

24,533.2 cf Field - 8,915.4 cf Chambers = 15,617.8 cf Stone x 40.0% Voids = 6,247.1 cf Stone Storage

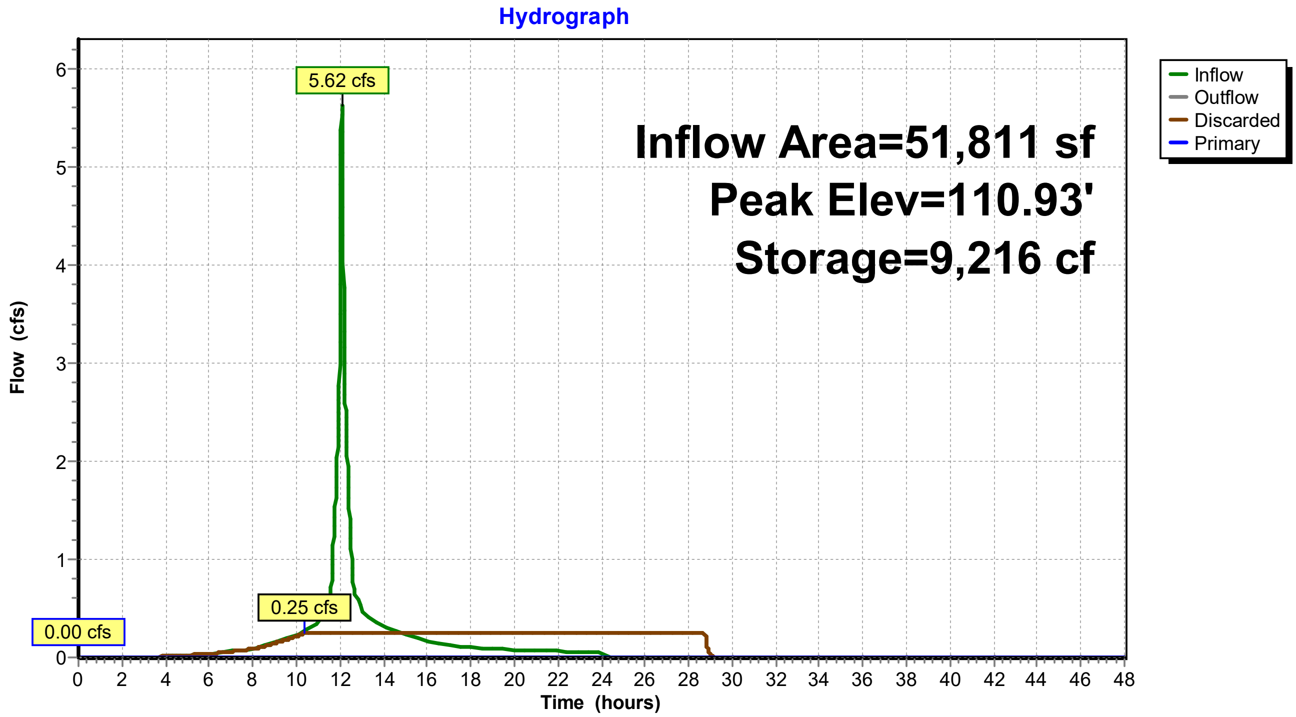
Chamber Storage + Stone Storage = 15,162.5 cf = 0.348 af
Overall Storage Efficiency = 61.8%
Overall System Size = 149.10' x 29.92' x 5.50'

80 Chambers
908.6 cy Field
578.4 cy Stone





Pond UG5: UG5


Hydrograph
Inflow Area=51,811 sf
Peak Elev=110.93'
Storage=9,216 cf
5.62 cfs
0.25 cfs
0.00 cfs
Inflow
Outflow
Discarded
Primary
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 UG6: UG6

Inflow Area = 43,674 sf, 78.98% Impervious, Inflow Depth = 4.41" for 10-Year event
Inflow = 4.81 cfs @ 12.08 hrs, Volume= 16,038 cf
Outflow = 2.68 cfs @ 12.20 hrs, Volume= 16,032 cf, Atten= 44%, Lag= 7.0 min
Primary = 2.68 cfs @ 12.20 hrs, Volume= 16,032 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 114.05' @ 12.20 hrs Surf.Area= 4,101 sf Storage= 3,658 cf

Plug-Flow detention time= 43.9 min calculated for 16,032 cf (100% of inflow)
Center-of-Mass det. time= 43.7 min (816.6 - 772.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	112.60'	2,884 cf	**28.17'W x 145.60'L x 2.33'H Field A** 9,569 cf Overall - 2,359 cf Embedded = 7,210 cf x 40.0% Voids
#2A	113.10'	2,359 cf	**ADS_StormTech RC-310 +Cap** x 160 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap 160 Chambers in 8 Rows
		5,243 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Device 3	112.60'	**5.0" Vert. Orifice/Grate** C= 0.600
#2	Device 3	113.22'	**11.0" Vert. Orifice/Grate** C= 0.600
#3	Primary	112.60'	**12.0" Round RCP_Round 12"** L= 68.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 112.60' / 112.40' S= 0.0029 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=2.68 cfs @ 12.20 hrs HW=114.05' (Free Discharge)
↑—**3=RCP_Round 12"** (Passes 2.68 cfs of 3.08 cfs potential flow)
  ↑—**1=Orifice/Grate** (Orifice Controls 0.73 cfs @ 5.37 fps)
  └—**2=Orifice/Grate** (Orifice Controls 1.95 cfs @ 3.10 fps)

Pond UG6: UG6 - Chamber Wizard Field A

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

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

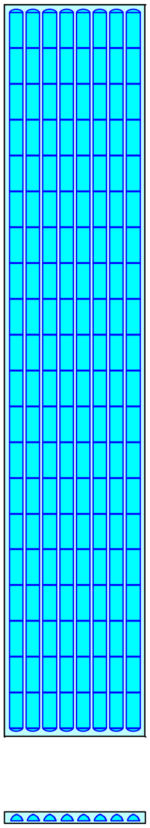
20 Chambers/Row x 7.12' Long +0.60' Cap Length x 2 = 143.60' Row Length +12.0" End Stone x 2 = 145.60' Base Length
8 Rows x 34.0" Wide + 6.0" Spacing x 7 + 12.0" Side Stone x 2 = 28.17' Base Width
6.0" Base + 16.0" Chamber Height + 6.0" Cover = 2.33' Field Height

160 Chambers x 14.7 cf = 2,358.7 cf Chamber Storage

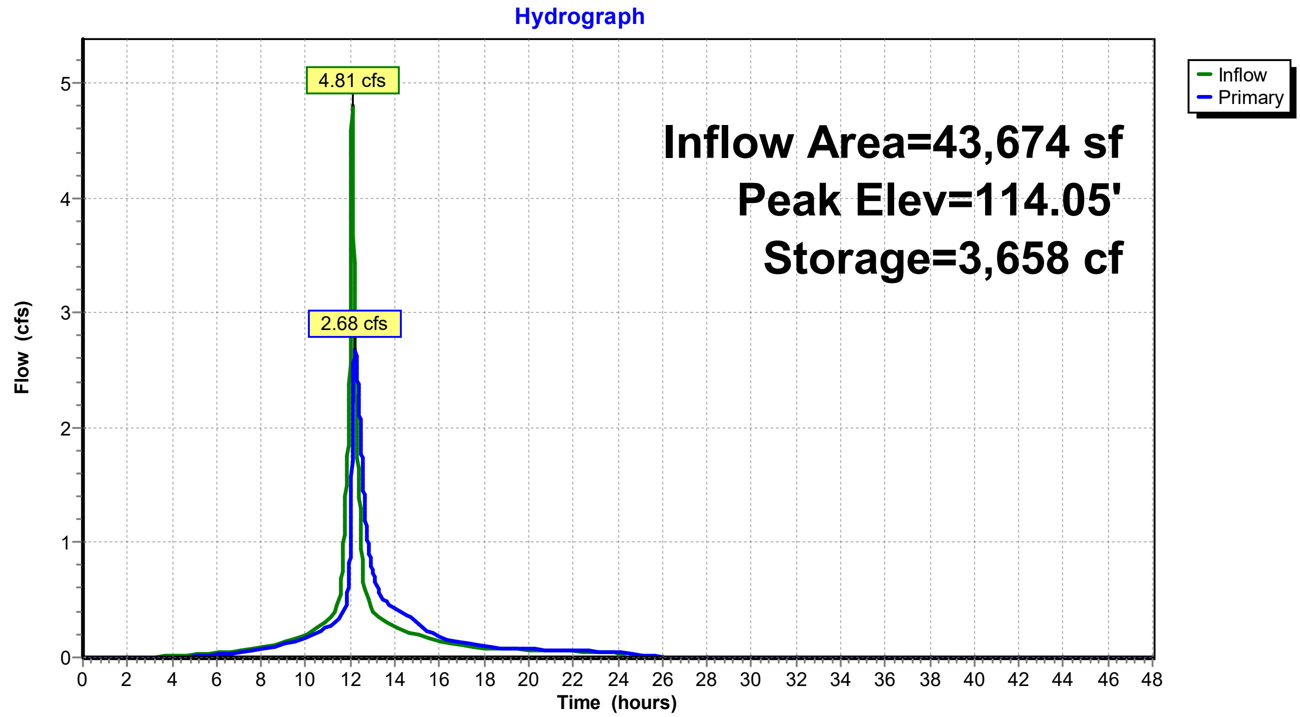
9,569.2 cf Field - 2,358.7 cf Chambers = 7,210.4 cf Stone x 40.0% Voids = 2,884.2 cf Stone Storage

Chamber Storage + Stone Storage = 5,242.9 cf = 0.120 af
Overall Storage Efficiency = 54.8%
Overall System Size = 145.60' x 28.17' x 2.33'

160 Chambers
354.4 cy Field
267.1 cy Stone



Pond UG6: UG6


Hydrograph
4.81 cfs
2.68 cfs
Inflow
Primary
Inflow Area=43,674 sf
Peak Elev=114.05'
Storage=3,658 cf
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 UG7: UG7

Inflow Area = 50,810 sf, 81.43% Impervious, Inflow Depth = 4.52" for 10-Year event
Inflow = 5.67 cfs @ 12.08 hrs, Volume= 19,132 cf
Outflow = 1.04 cfs @ 12.53 hrs, Volume= 19,132 cf, Atten= 82%, Lag= 26.6 min
Primary = 1.04 cfs @ 12.53 hrs, Volume= 19,132 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 101.21' @ 12.53 hrs Surf.Area= 0.079 ac Storage= 0.149 af

Plug-Flow detention time= 65.9 min calculated for 19,132 cf (100% of inflow)
Center-of-Mass det. time= 65.8 min (833.5 - 767.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	98.50'	0.111 af	**44.25'W x 77.40'L x 5.50'H Field A** 0.432 af Overall - 0.156 af Embedded = 0.277 af x 40.0% Voids
#2A	99.25'	0.156 af	**ADS_StormTech MC-3500 d +Cap** x 60 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 60 Chambers in 6 Rows Cap Storage= +14.9 cf x 2 x 6 rows = 178.8 cf
		0.266 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Device 2	98.50'	**5.0" Vert. Orifice/Grate** C= 0.600
#2	Primary	98.50'	**12.0" Round RCP_Round 12"** L= 34.7' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 98.50' / 98.33' S= 0.0049 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=1.04 cfs @ 12.53 hrs HW=101.21' (Free Discharge)
↑—**2=RCP_Round 12"** (Passes 1.04 cfs of 6.15 cfs potential flow)
↑—**1=Orifice/Grate** (Orifice Controls 1.04 cfs @ 7.62 fps)

Pond UG7: UG7 - Chamber Wizard Field A

Chamber Model = ADS_StormTech MC-3500 d +Cap (ADS StormTech® MC-3500 d rev 03/14 with Cap volume)
Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf
Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap
Cap Storage= +14.9 cf x 2 x 6 rows = 178.8 cf

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

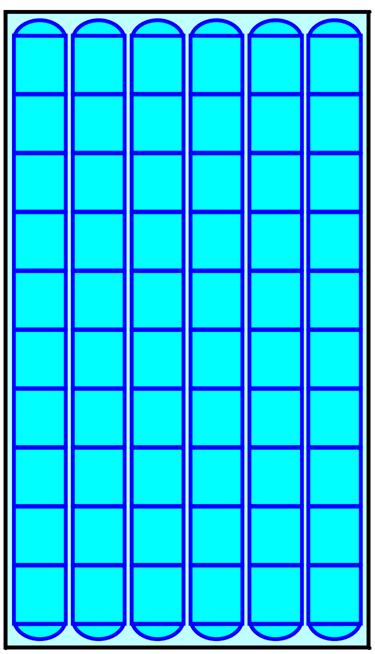
10 Chambers/Row x 7.17' Long +1.85' Cap Length x 2 = 75.40' Row Length +12.0" End Stone x 2 = 77.40' Base Length
6 Rows x 77.0" Wide + 9.0" Spacing x 5 + 12.0" Side Stone x 2 = 44.25' Base Width
9.0" Base + 45.0" Chamber Height + 12.0" Cover = 5.50' Field Height

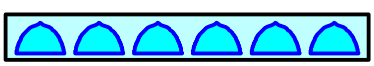
60 Chambers x 110.0 cf + 14.9 cf Cap Volume x 2 x 6 Rows = 6,775.9 cf Chamber Storage

18,837.2 cf Field - 6,775.9 cf Chambers = 12,061.3 cf Stone x 40.0% Voids = 4,824.5 cf Stone Storage

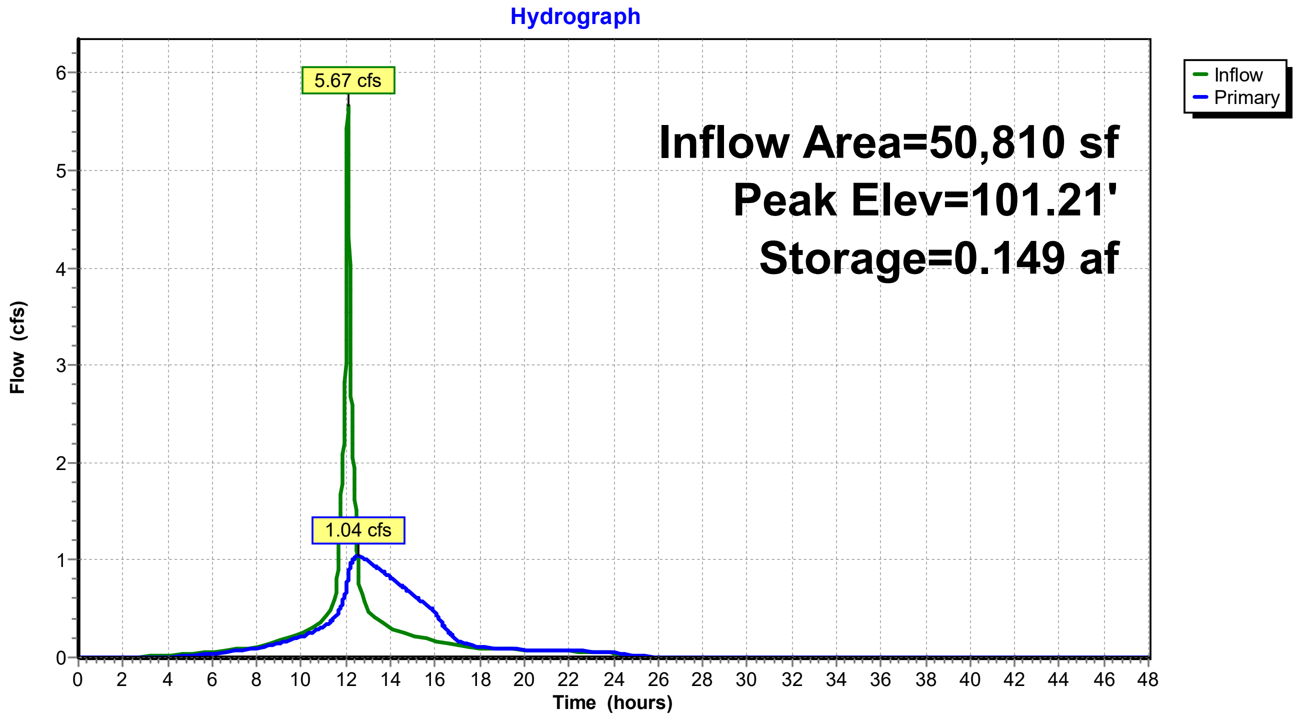
Chamber Storage + Stone Storage = 11,600.4 cf = 0.266 af
Overall Storage Efficiency = 61.6%
Overall System Size = 77.40' x 44.25' x 5.50'

60 Chambers
697.7 cy Field
446.7 cy Stone





Pond UG7: UG7


Hydrograph
5.67 cfs
1.04 cfs
Inflow Area=50,810 sf
Peak Elev=101.21'
Storage=0.149 af
Inflow
Primary
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 Subcatchment P1-1a: courtyard and retail park

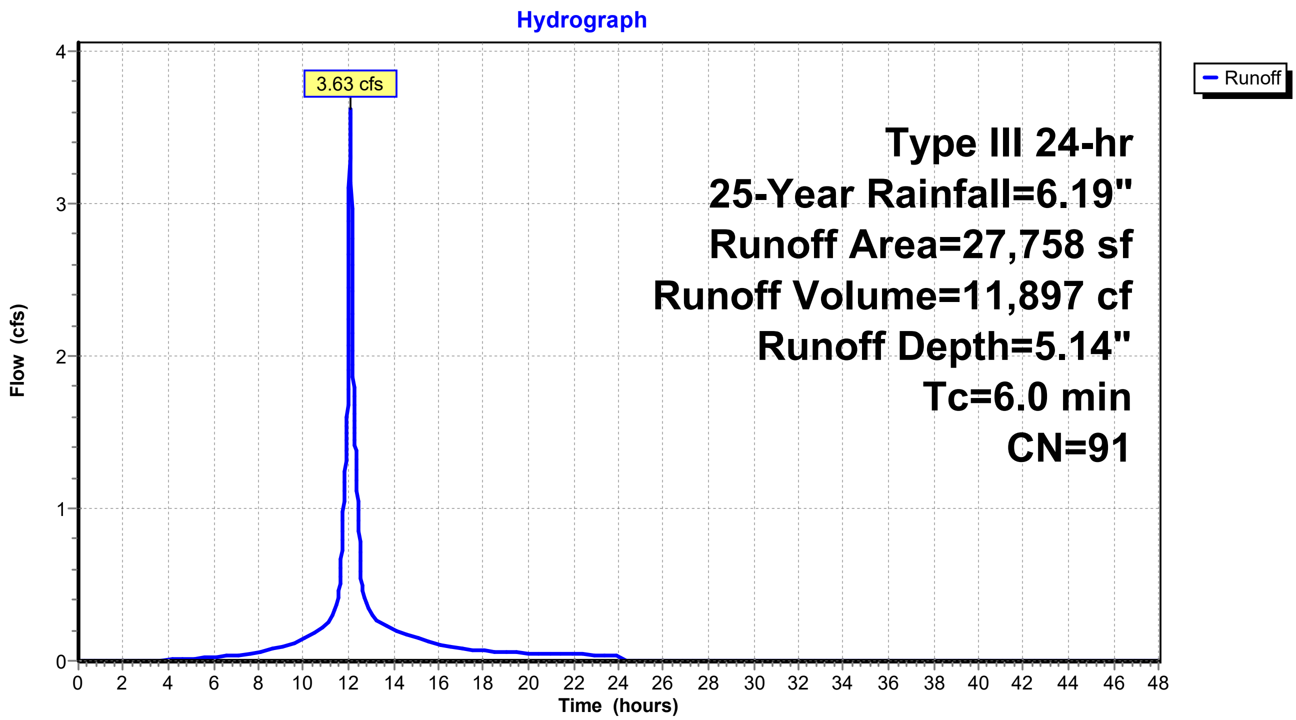
Runoff = 3.63 cfs @ 12.08 hrs, Volume= 11,897 cf, Depth= 5.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.19"

	Area (sf)	CN	Description
*	19,600	89	Courtyard, HSG D
	1,350	80	>75% Grass cover, Good, HSG D
*	6,808	98	Paved parking, HSG D
	27,758	91	Weighted Average
	20,950	88	75.47% Pervious Area
	6,808	98	24.53% Impervious Area

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

Subcatchment P1-1a: courtyard and retail park



Summary for Subcatchment P1-1b: roof

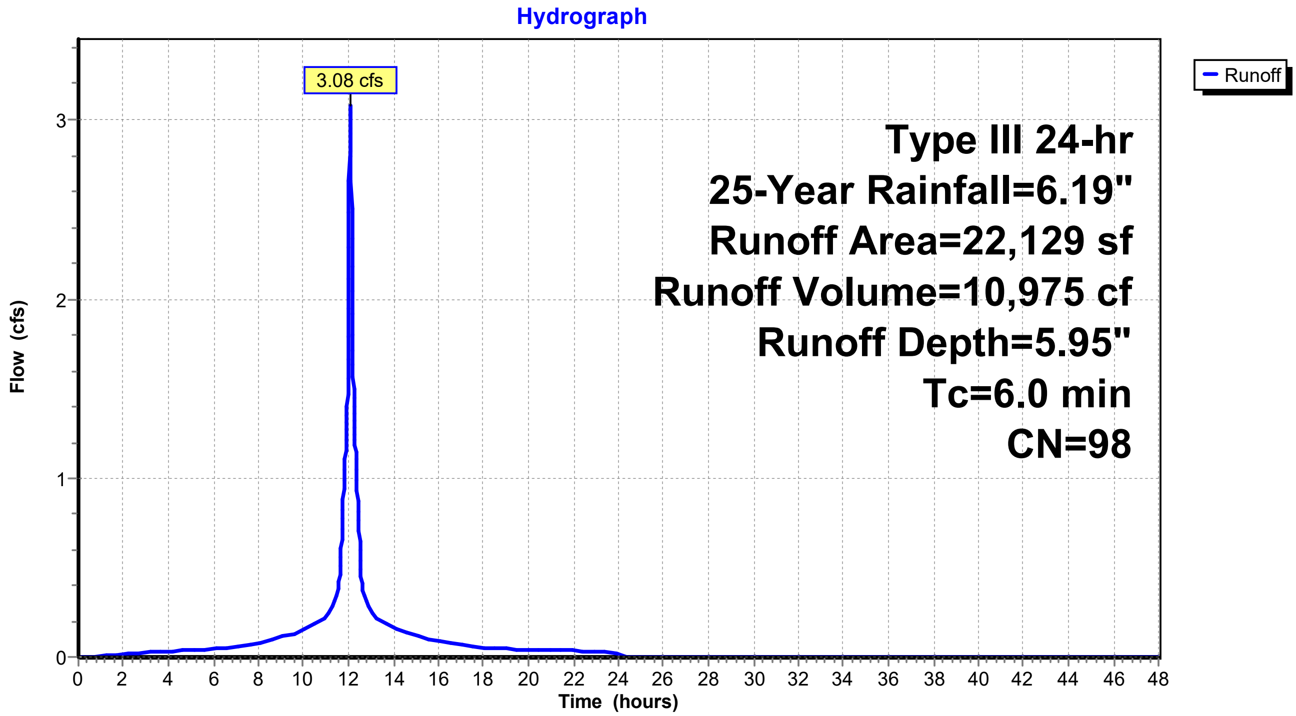
Runoff = 3.08 cfs @ 12.08 hrs, Volume= 10,975 cf, Depth= 5.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.19"

	Area (sf)	CN	Description
*	22,129	98	Roof, HSG D
	22,129	98	100.00% Impervious Area

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

Subcatchment P1-1b: roof



Summary for Subcatchment P1-2: P1-2

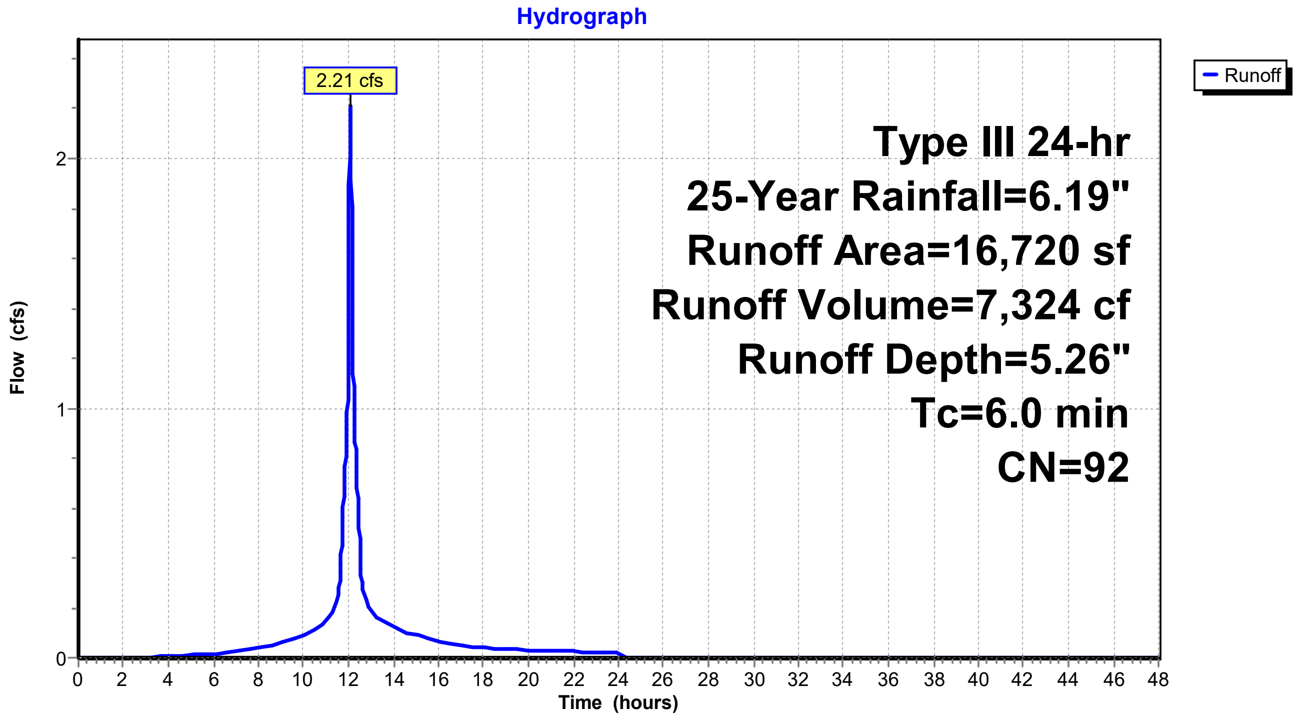
Runoff = 2.21 cfs @ 12.08 hrs, Volume= 7,324 cf, Depth= 5.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.19"

	Area (sf)	CN	Description
	5,213	80	>75% Grass cover, Good, HSG D
*	11,507	98	Roof & Paved parking, HSG D
	16,720	92	Weighted Average
	5,213	80	31.18% Pervious Area
	11,507	98	68.82% Impervious Area

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

Subcatchment P1-2: P1-2



Summary for Subcatchment P1-3: P1-3

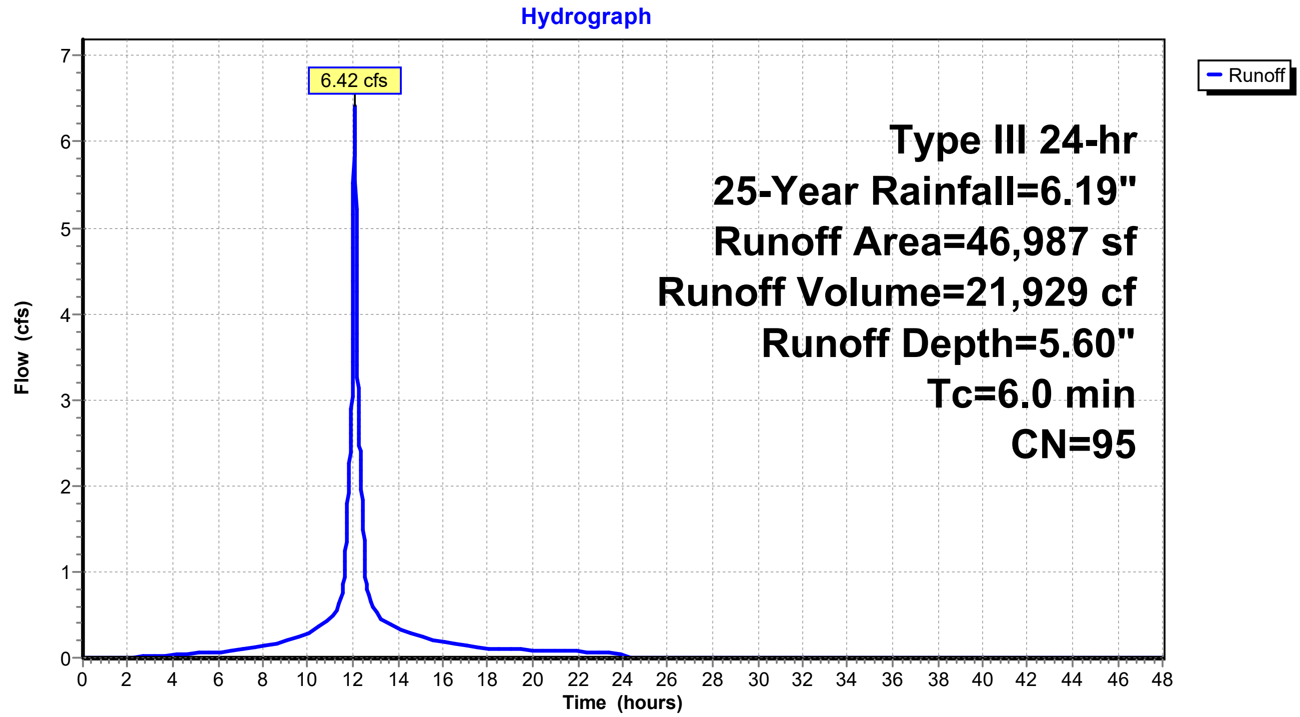
Runoff = 6.42 cfs @ 12.08 hrs, Volume= 21,929 cf, Depth= 5.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.19"

	Area (sf)	CN	Description
*	39,413	98	Roofs & Pavement, HSG D
	7,574	80	>75% Grass cover, Good, HSG D
	46,987	95	Weighted Average
	7,574	80	16.12% Pervious Area
	39,413	98	83.88% Impervious Area

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

Subcatchment P1-3: P1-3



Summary for Subcatchment P1-4: P1-4

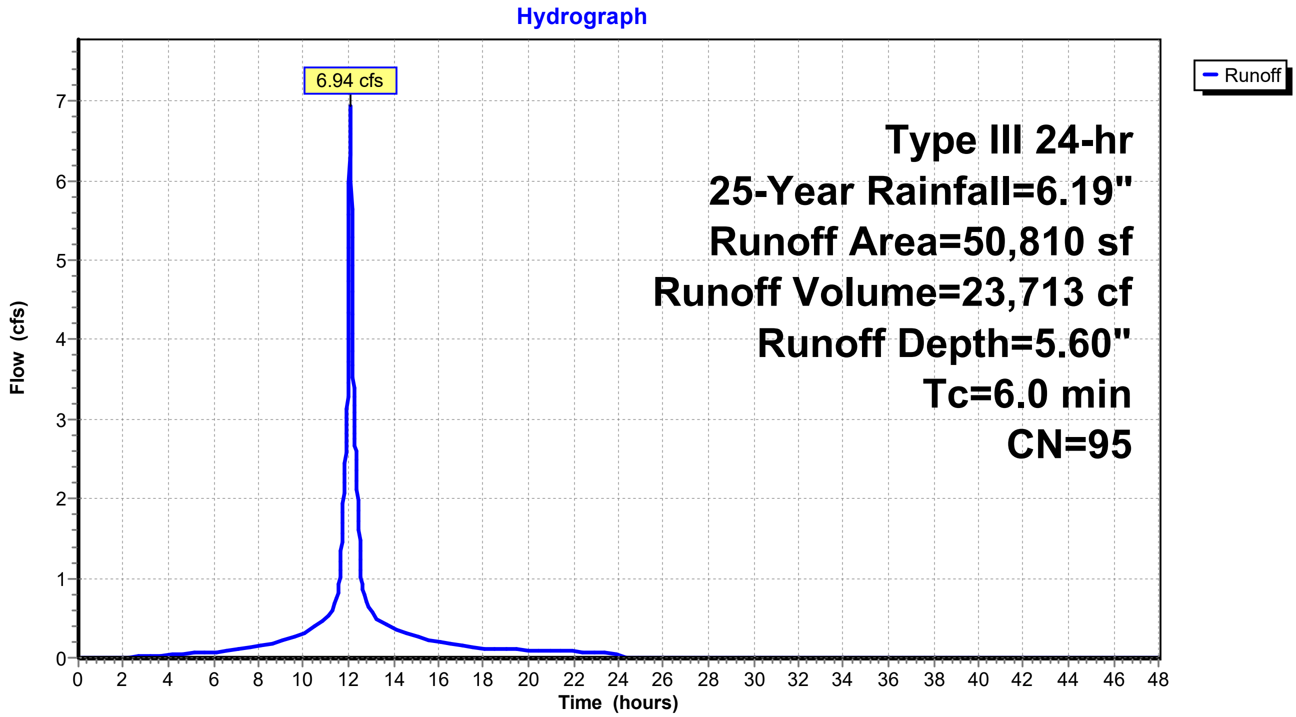
Runoff = 6.94 cfs @ 12.08 hrs, Volume= 23,713 cf, Depth= 5.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.19"

	Area (sf)	CN	Description
*	41,376	98	Roofs & Pavement, HSG D
	9,434	80	>75% Grass cover, Good, HSG D
	50,810	95	Weighted Average
	9,434	80	18.57% Pervious Area
	41,376	98	81.43% Impervious Area

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

Subcatchment P1-4: P1-4



Summary for Subcatchment P1-U1: P1-U1

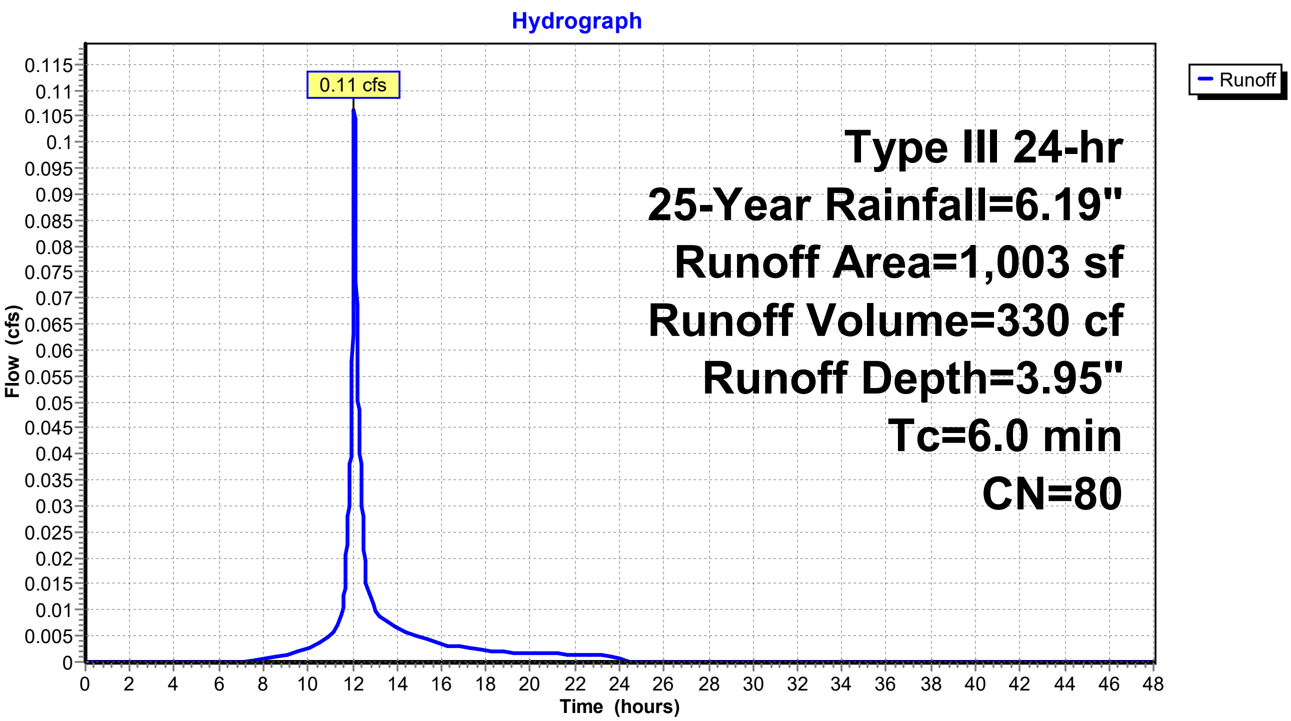
Runoff = 0.11 cfs @ 12.09 hrs, Volume= 330 cf, Depth= 3.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.19"

Area (sf)	CN	Description
1,003	80	>75% Grass cover, Good, HSG D
1,003	80	100.00% Pervious Area

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

Subcatchment P1-U1: P1-U1



Summary for Subcatchment P1-U2: P1-U2

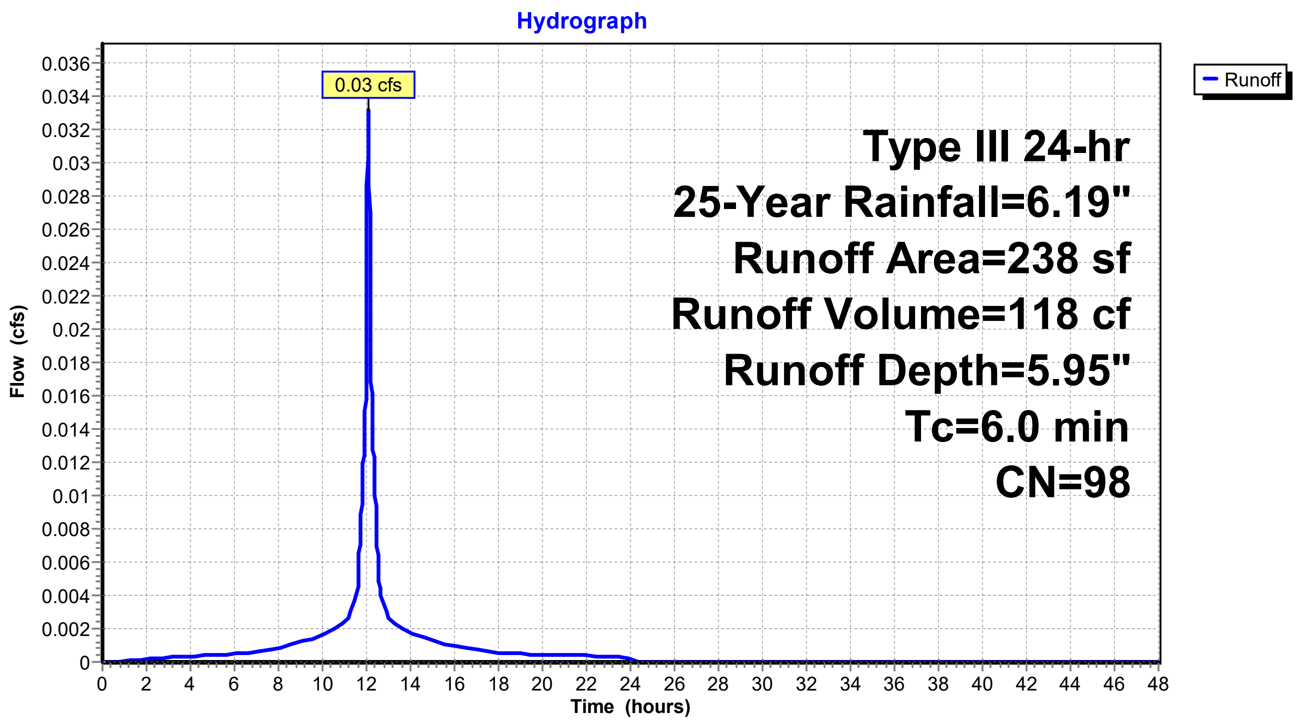
Runoff = 0.03 cfs @ 12.08 hrs, Volume= 118 cf, Depth= 5.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.19"

	Area (sf)	CN	Description
*	238	98	Pavement, HSG D
	238	98	100.00% Impervious Area

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

Subcatchment P1-U2: P1-U2



Summary for Subcatchment P1-U3: P1-U3

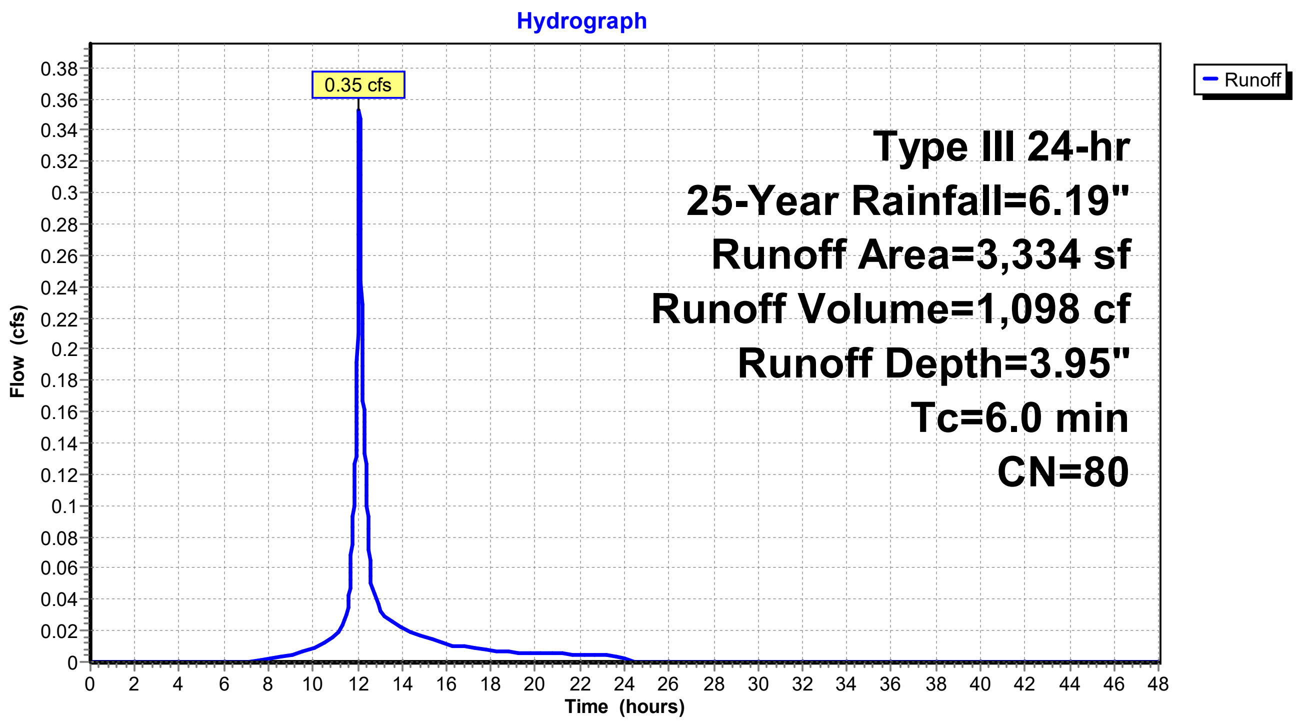
Runoff = 0.35 cfs @ 12.09 hrs, Volume= 1,098 cf, Depth= 3.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.19"

Area (sf)	CN	Description
3,334	80	>75% Grass cover, Good, HSG D
3,334	80	100.00% Pervious Area

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

Subcatchment P1-U3: P1-U3



Summary for Subcatchment P2: P2

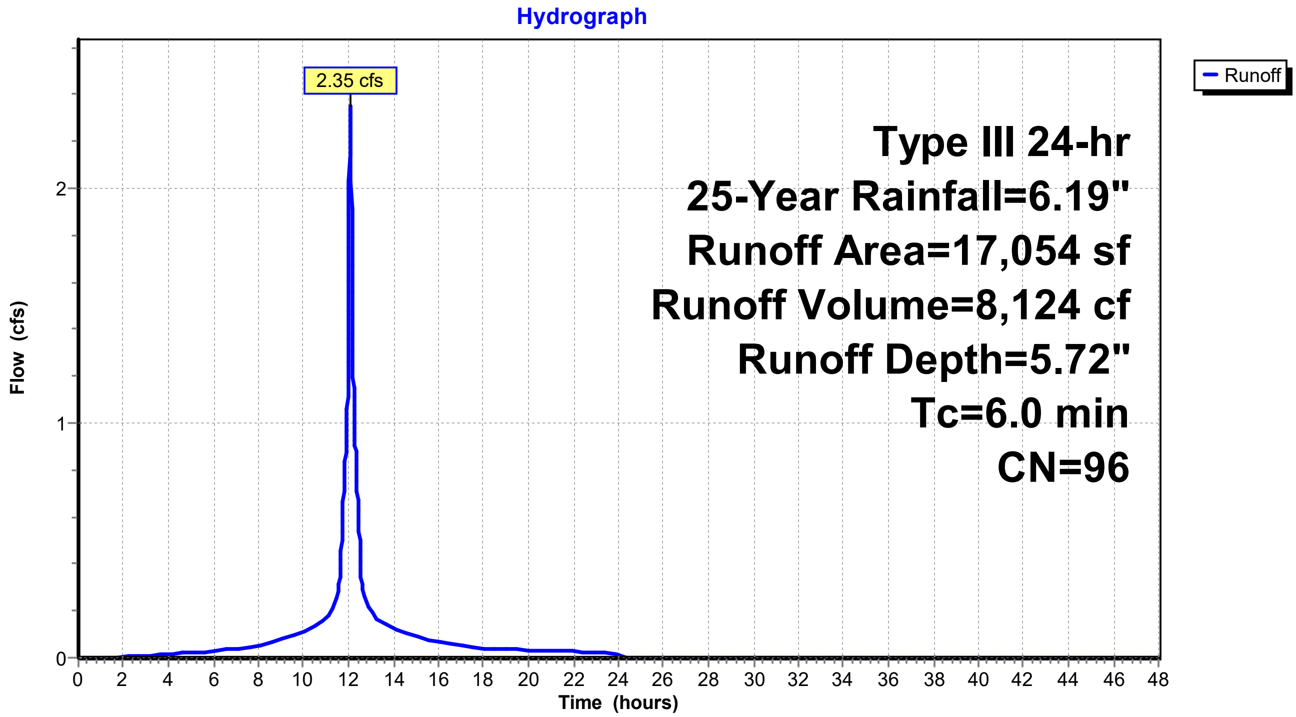
Runoff = 2.35 cfs @ 12.08 hrs, Volume= 8,124 cf, Depth= 5.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.19"

	Area (sf)	CN	Description
*	15,010	98	Pavement, HSG D
	2,044	80	>75% Grass cover, Good, HSG D
	17,054	96	Weighted Average
	2,044	80	11.99% Pervious Area
	15,010	98	88.01% Impervious Area

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

Subcatchment P2: P2



Summary for Subcatchment P2-R: P2-ROOF

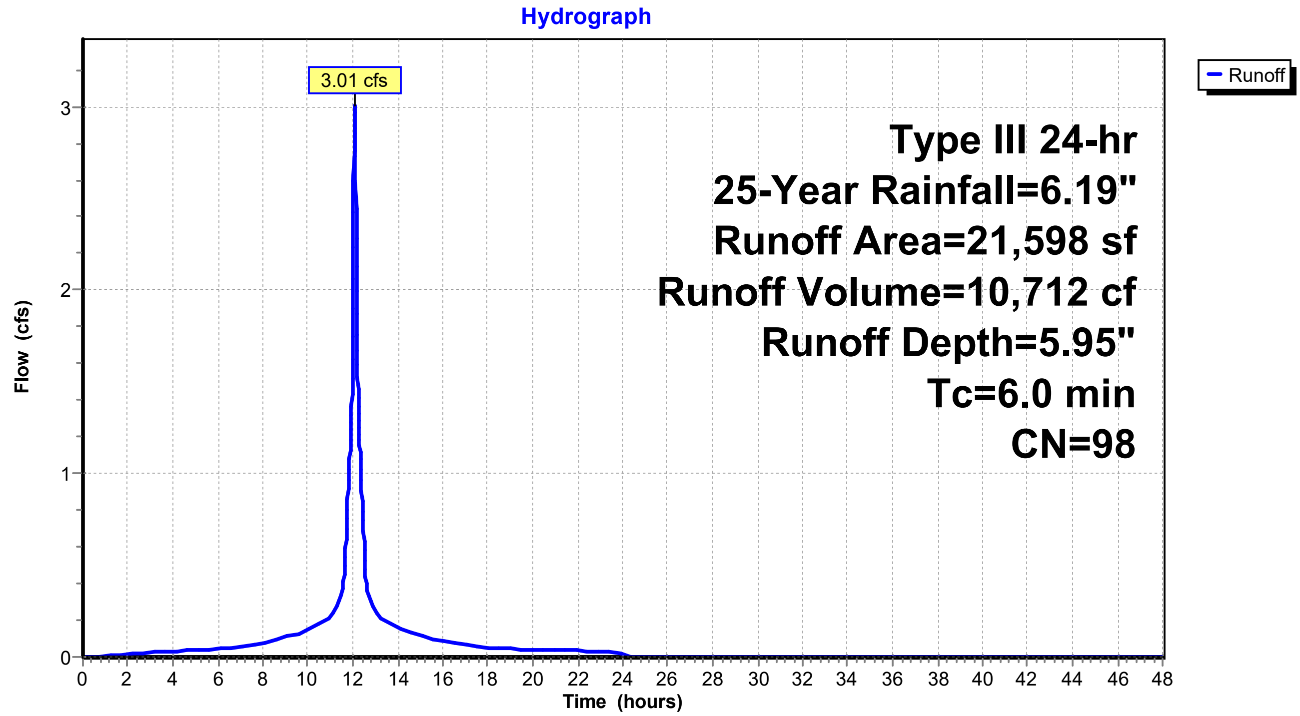
Runoff = 3.01 cfs @ 12.08 hrs, Volume= 10,712 cf, Depth= 5.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.19"

	Area (sf)	CN	Description
*	21,598	98	Roofs & Pavement, HSG D
	21,598	98	100.00% Impervious Area

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

Subcatchment P2-R: P2-ROOF



Summary for Subcatchment P2-U: P-2U

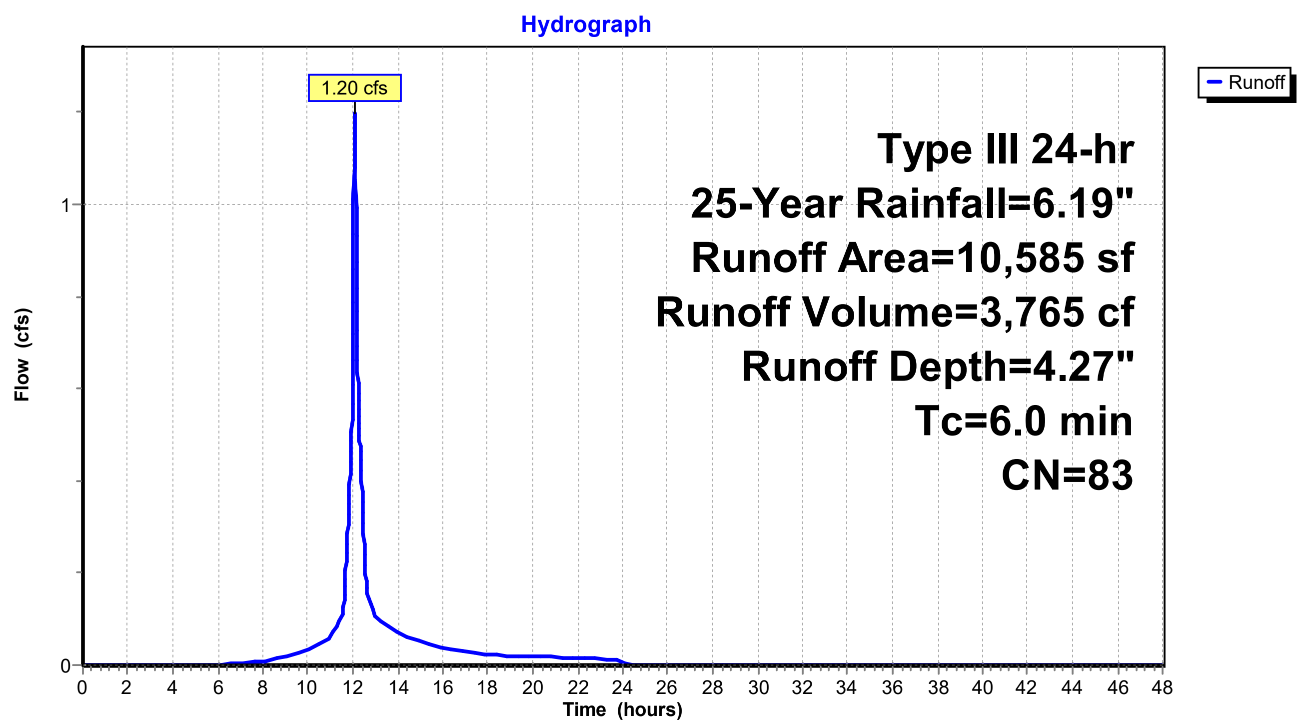
Runoff = 1.20 cfs @ 12.09 hrs, Volume= 3,765 cf, Depth= 4.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.19"

	Area (sf)	CN	Description
*	183	98	Ledge, HSG D
	6,620	77	Woods, Good, HSG D
*	2,902	98	Wetland Surface, HSG D
	880	78	Meadow, non-grazed, HSG D
	10,585	83	Weighted Average
	7,500	77	70.85% Pervious Area
	3,085	98	29.15% Impervious Area

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

Subcatchment P2-U: P-2U



Summary for Subcatchment P3: P3

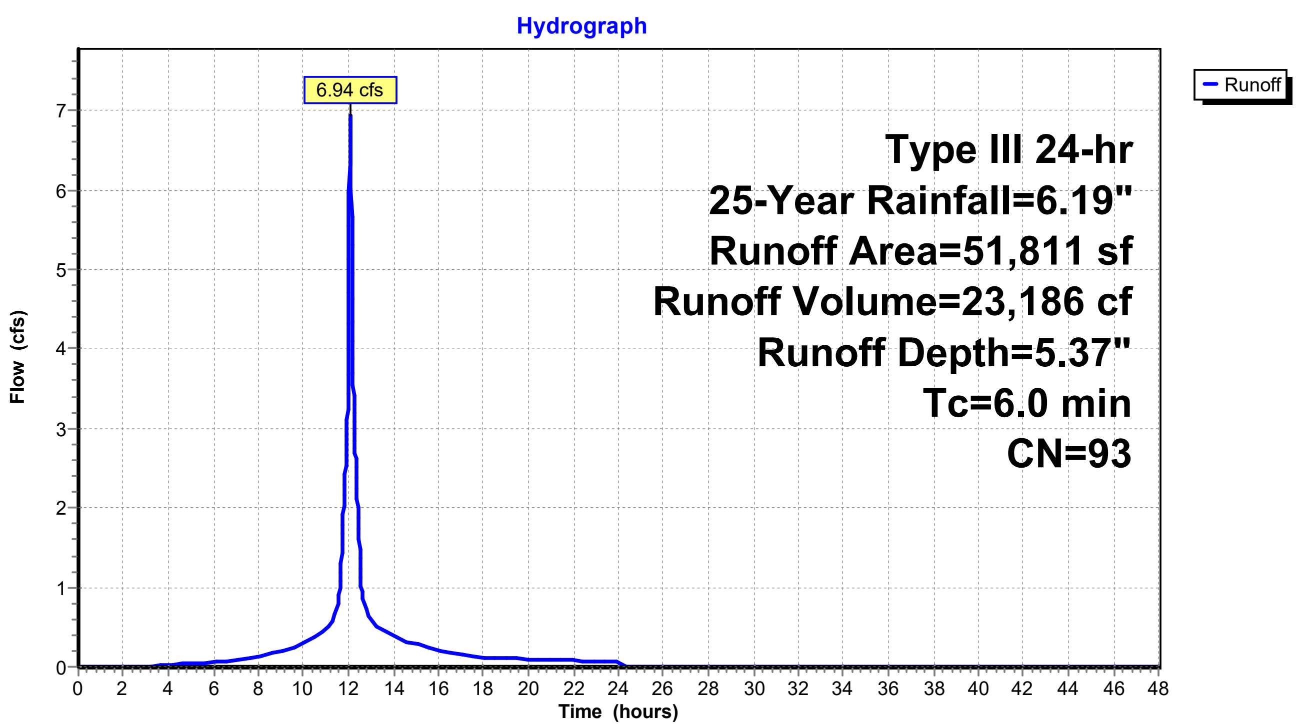
Runoff = 6.94 cfs @ 12.08 hrs, Volume= 23,186 cf, Depth= 5.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.19"

	Area (sf)	CN	Description
*	37,149	98	Roofs & Pavement, HSG D
	14,662	80	>75% Grass cover, Good, HSG D
	51,811	93	Weighted Average
	14,662	80	28.30% Pervious Area
	37,149	98	71.70% Impervious Area

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

Subcatchment P3: P3



Summary for Subcatchment P3-U: P3-U

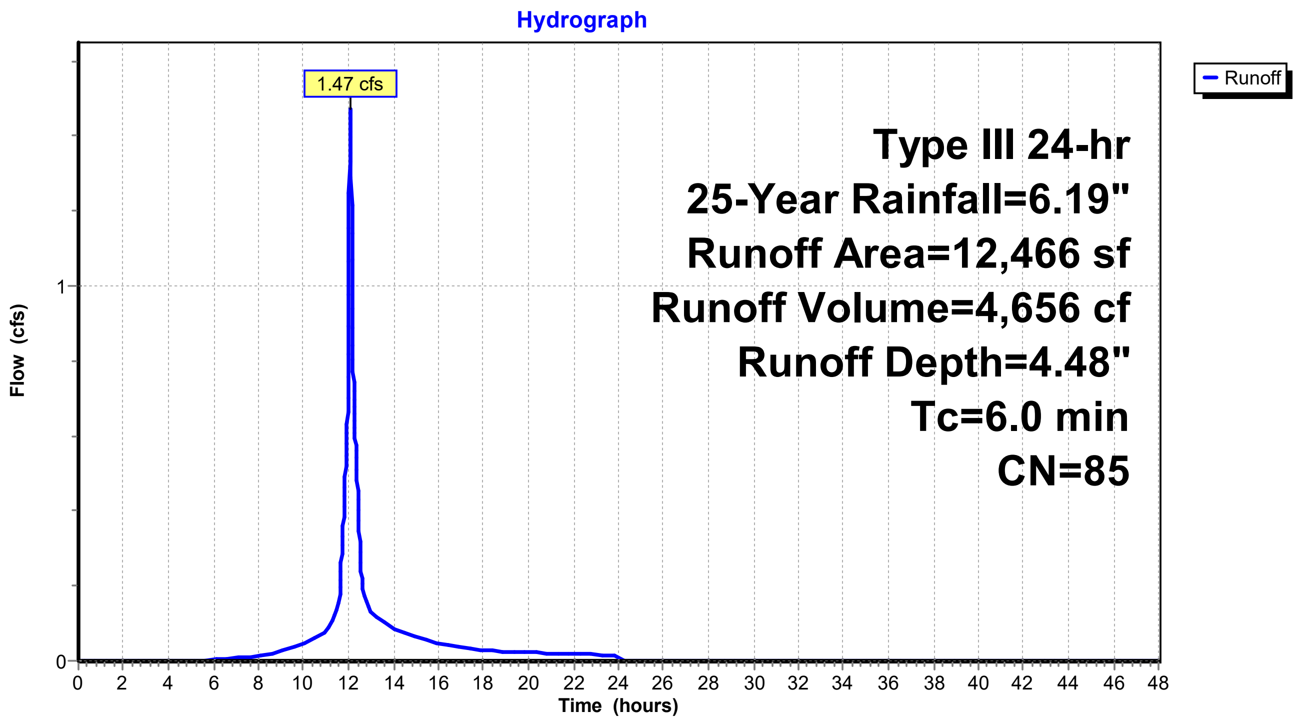
Runoff = 1.47 cfs @ 12.09 hrs, Volume= 4,656 cf, Depth= 4.48"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.19"

	Area (sf)	CN	Description
*	700	98	Ledge, HSG D
	7,809	77	Woods, Good, HSG D
*	3,957	98	Wetland Surface, HSG D
	12,466	85	Weighted Average
	7,809	77	62.64% Pervious Area
	4,657	98	37.36% Impervious Area

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

Subcatchment P3-U: P3-U



Summary for Subcatchment P4: P4

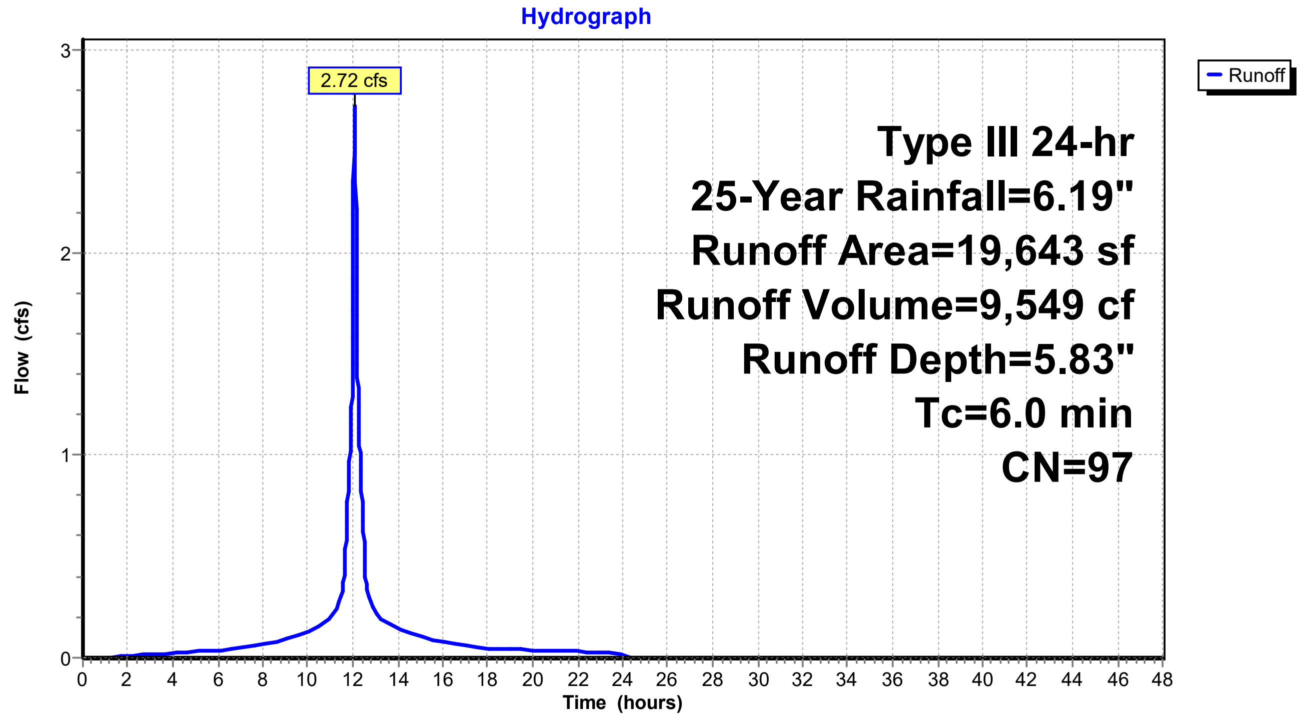
Runoff = 2.72 cfs @ 12.08 hrs, Volume= 9,549 cf, Depth= 5.83"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.19"

	Area (sf)	CN	Description
	1,577	80	>75% Grass cover, Good, HSG D
*	18,066	98	Roofs & Paved parking, HSG D
	19,643	97	Weighted Average
	1,577	80	8.03% Pervious Area
	18,066	98	91.97% Impervious Area

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

Subcatchment P4: P4



Summary for Subcatchment P4-U: P4-U

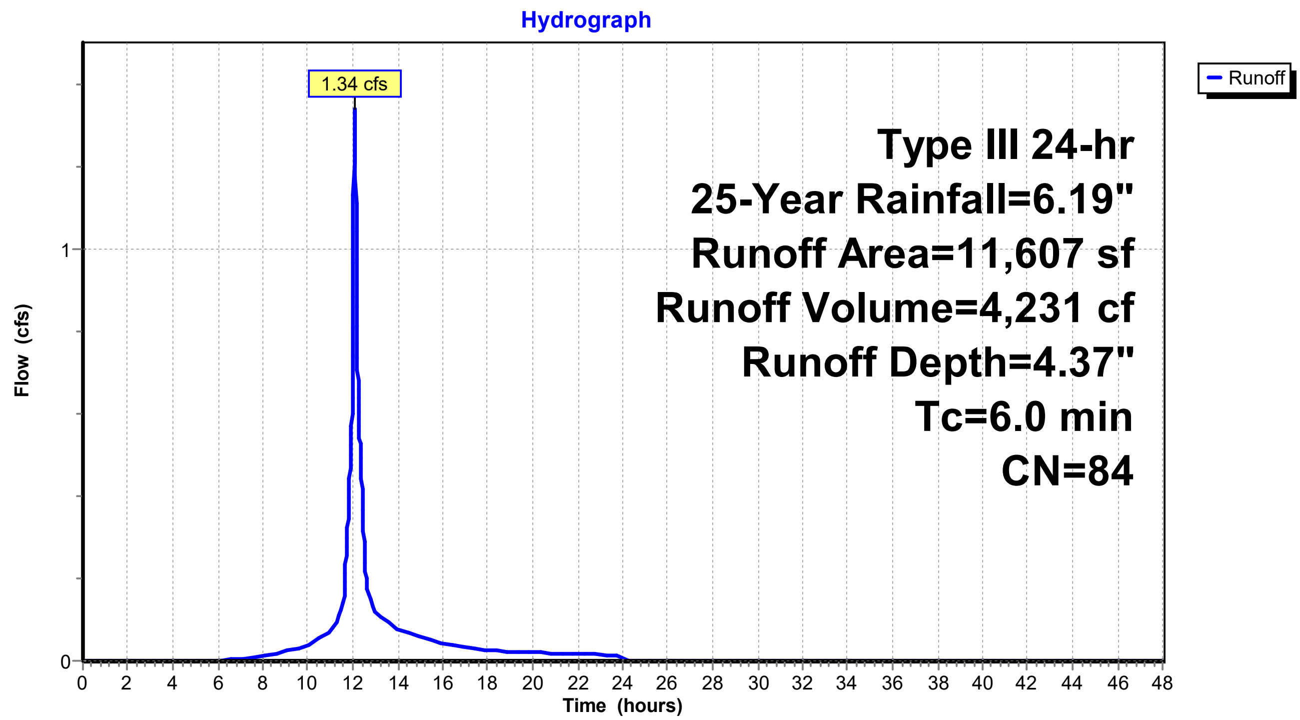
Runoff = 1.34 cfs @ 12.09 hrs, Volume= 4,231 cf, Depth= 4.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.19"

	Area (sf)	CN	Description
*	1,650	98	Ledge, HSG D
	7,547	77	Woods, Good, HSG D
*	2,410	98	Wetland Surface, HSG D
	11,607	84	Weighted Average
	7,547	77	65.02% Pervious Area
	4,060	98	34.98% Impervious Area

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

Subcatchment P4-U: P4-U



Summary for Subcatchment P5: P5

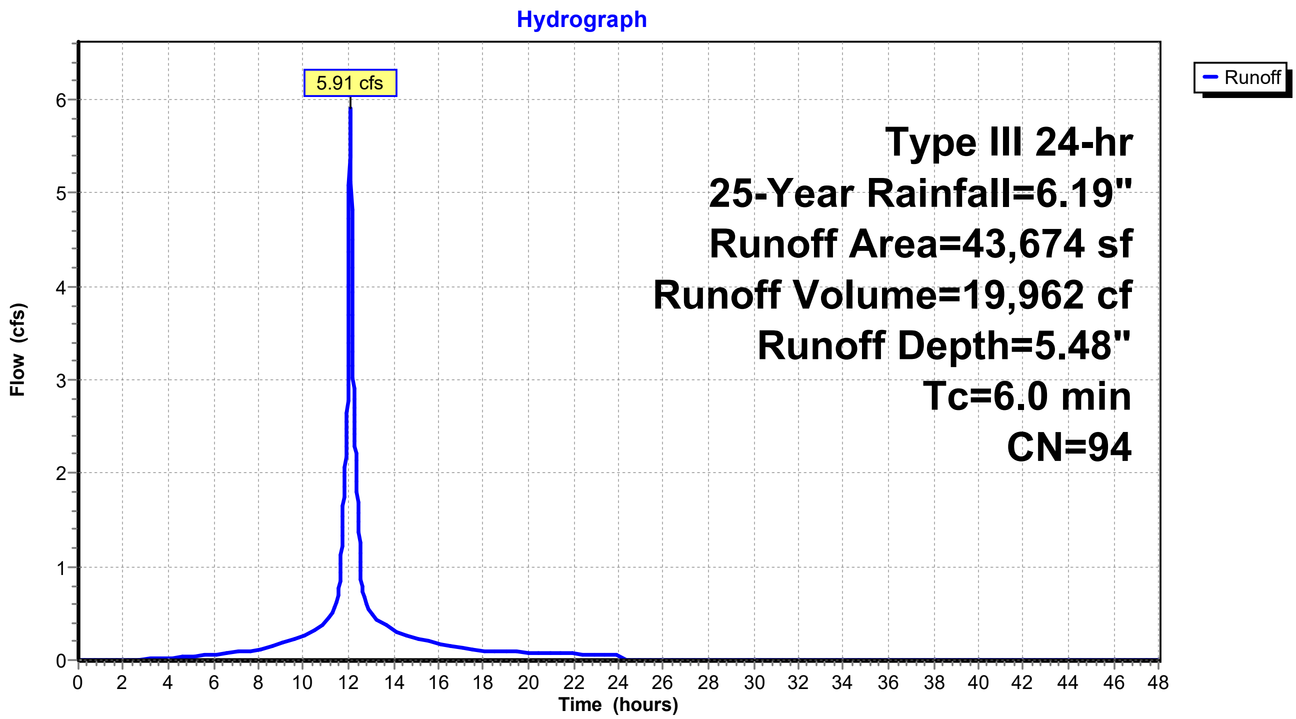
Runoff = 5.91 cfs @ 12.08 hrs, Volume= 19,962 cf, Depth= 5.48"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.19"

	Area (sf)	CN	Description
*	5,025	98	Ledge, HSG D
	7,050	80	>75% Grass cover, Good, HSG D
*	29,470	98	Paved parking, HSG D
	2,129	77	Woods, Good, HSG D
	43,674	94	Weighted Average
	9,179	79	21.02% Pervious Area
	34,495	98	78.98% Impervious Area

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

Subcatchment P5: P5



Summary for Subcatchment P5-U: P5-U

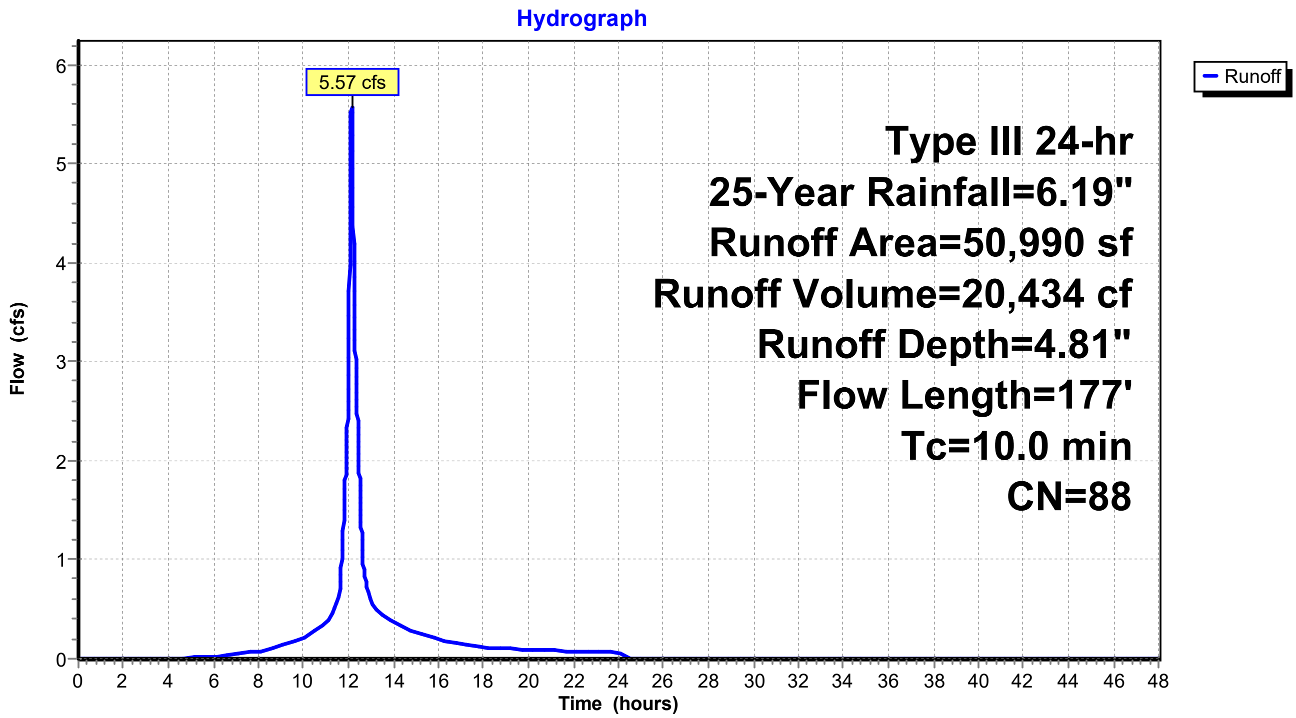
Runoff = 5.57 cfs @ 12.14 hrs, Volume= 20,434 cf, Depth= 4.81"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.19"

	Area (sf)	CN	Description
*	5,864	98	Ledge, HSG D
	12,095	77	Woods, Good, HSG D
*	20,323	98	Wetland Surface, HSG D
	12,708	78	Meadow, non-grazed, HSG D
	50,990	88	Weighted Average
	24,803	78	48.64% Pervious Area
	26,187	98	51.36% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	50	0.0500	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.40"
1.7	127	0.0620	1.24		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
10.0	177	Total			

Subcatchment P5-U: P5-U



Summary for Subcatchment P6-U: P6-U

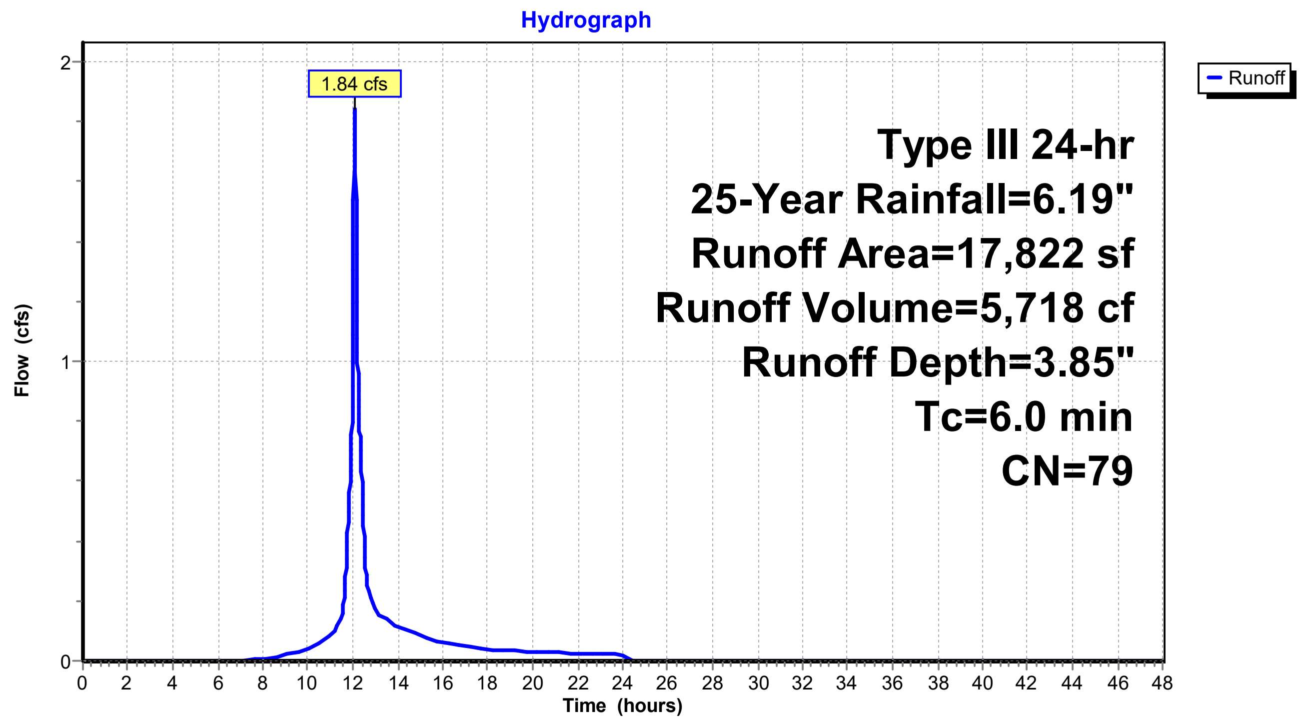
Runoff = 1.84 cfs @ 12.09 hrs, Volume= 5,718 cf, Depth= 3.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.19"

	Area (sf)	CN	Description
	15,225	77	Woods, Good, HSG D
	1,097	80	Pasture/grassland/range, Good, HSG D
*	1,500	98	Wetland Surface, HSG D
	17,822	79	Weighted Average
	16,322	77	91.58% Pervious Area
	1,500	98	8.42% Impervious Area

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

Subcatchment P6-U: P6-U

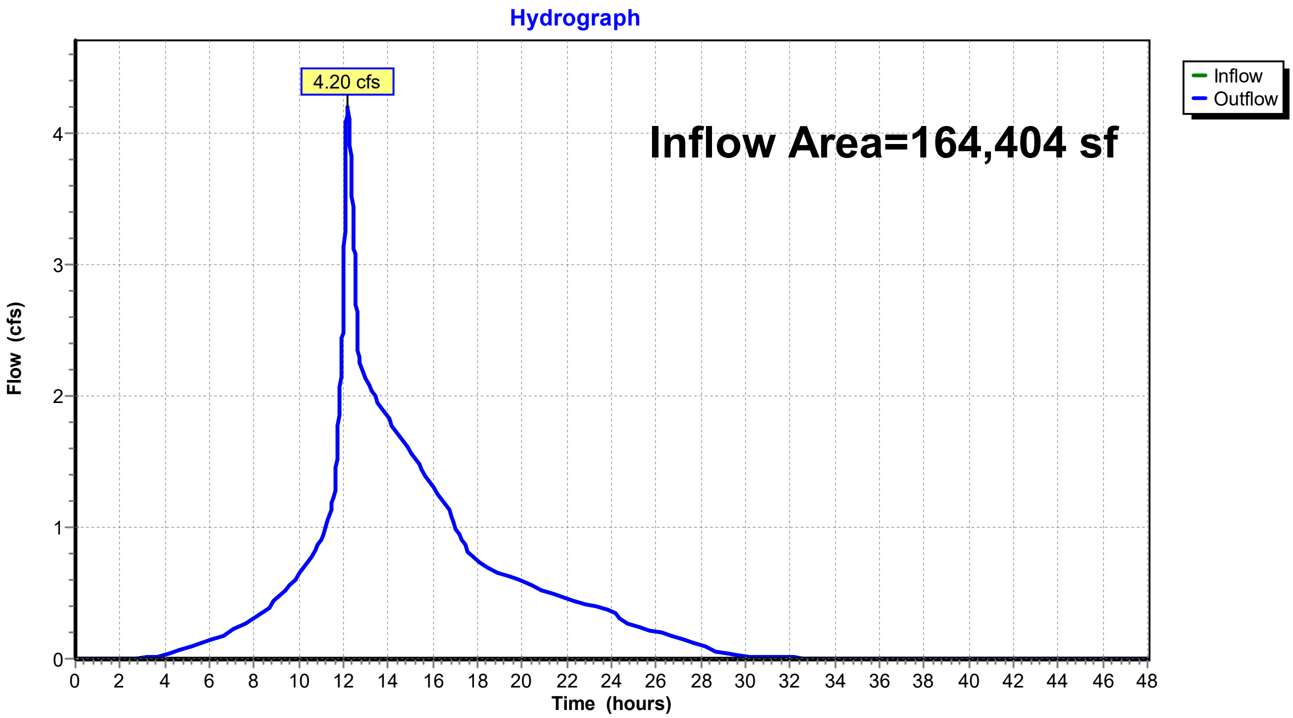


Summary for Reach DMH MS2: DMH MS2

Inflow Area =	164,404 sf,	73.74% Impervious,	Inflow Depth = 4.73"	for 25-Year event
Inflow =	4.20 cfs @	12.18 hrs, Volume=	64,860 cf	
Outflow =	4.20 cfs @	12.18 hrs, Volume=	64,860 cf,	Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach DMH MS2: DMH MS2

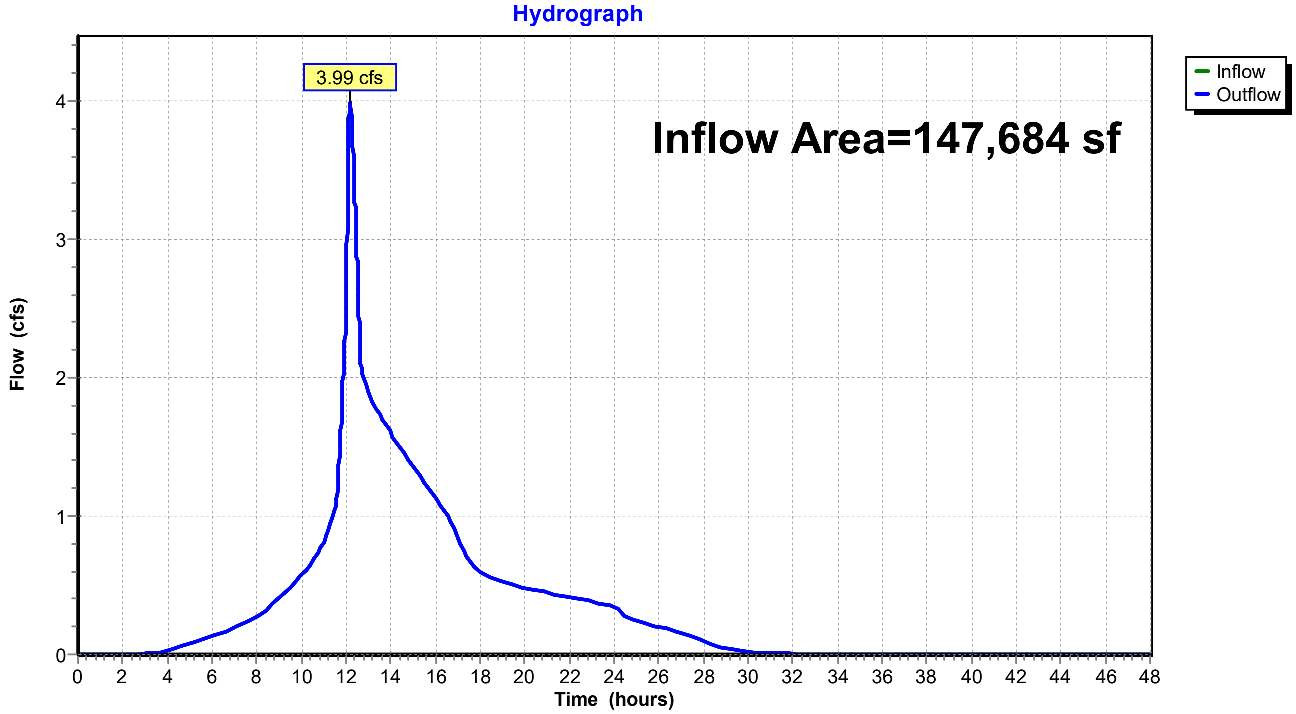


Summary for Reach DMH MS3: DMH MS3

Inflow Area = 147,684 sf, 74.30% Impervious, Inflow Depth = 4.68" for 25-Year event
Inflow = 3.99 cfs @ 12.17 hrs, Volume= 57,536 cf
Outflow = 3.99 cfs @ 12.17 hrs, Volume= 57,536 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach DMH MS3: DMH MS3

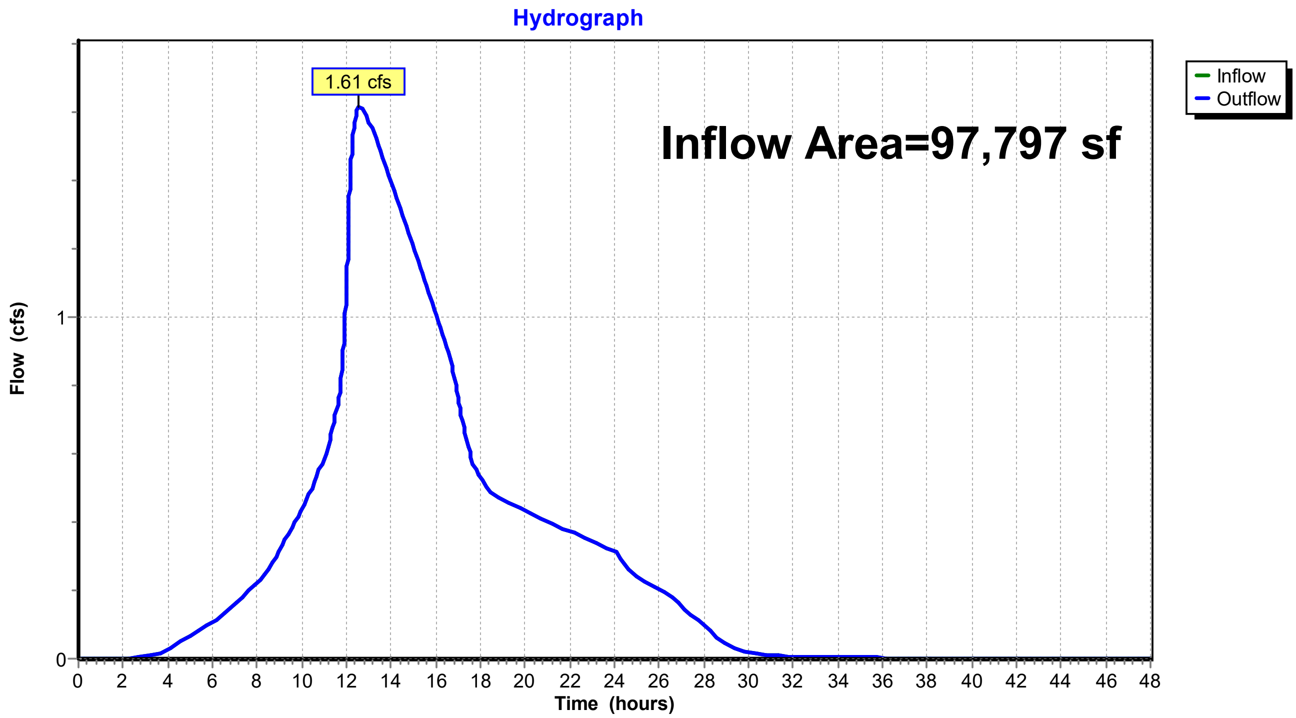


Summary for Reach DMH MS4: DMH MS4

Inflow Area =	97,797 sf,	82.61% Impervious,	Inflow Depth = 5.60"	for 25-Year event
Inflow =	1.61 cfs @	12.57 hrs, Volume=	45,639 cf	
Outflow =	1.61 cfs @	12.57 hrs, Volume=	45,639 cf, Atten= 0%, Lag= 0.0 min	

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

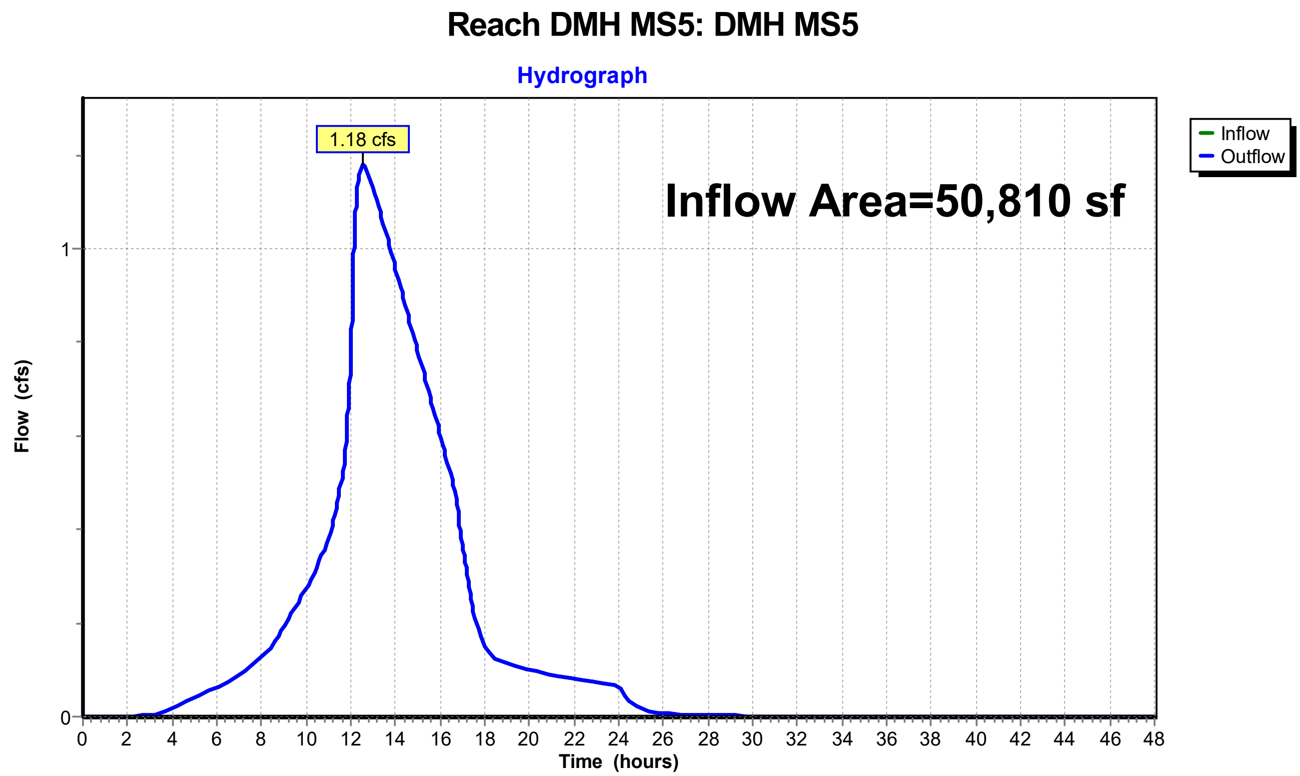
Reach DMH MS4: DMH MS4



Summary for Reach DMH MS5: DMH MS5

Inflow Area =	50,810 sf,	81.43% Impervious,	Inflow Depth = 5.60"	for 25-Year event
Inflow =	1.18 cfs @	12.54 hrs, Volume=	23,713 cf	
Outflow =	1.18 cfs @	12.54 hrs, Volume=	23,713 cf, Atten= 0%, Lag= 0.0 min	

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

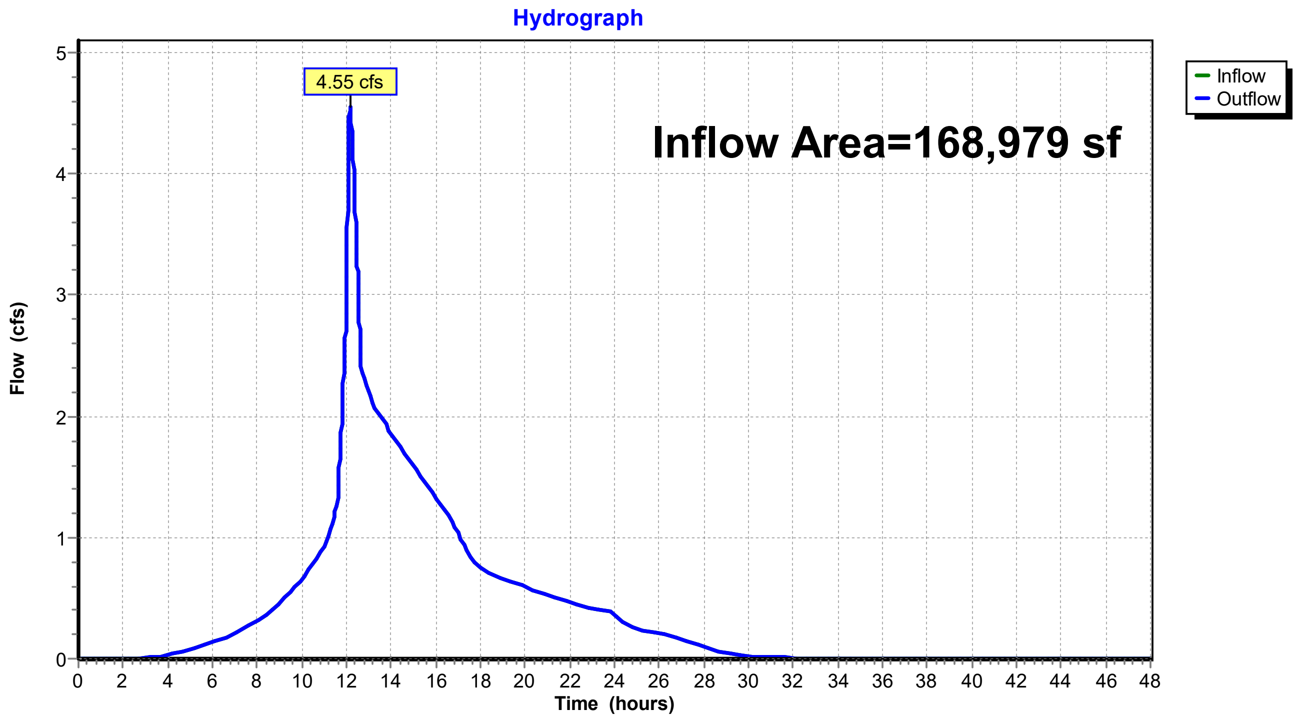


Summary for Reach PD1: WASHINGTON ROW

Inflow Area = 168,979 sf, 71.89% Impervious, Inflow Depth = 4.72" for 25-Year event
Inflow = 4.55 cfs @ 12.15 hrs, Volume= 66,407 cf
Outflow = 4.55 cfs @ 12.15 hrs, Volume= 66,407 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach PD1: WASHINGTON ROW

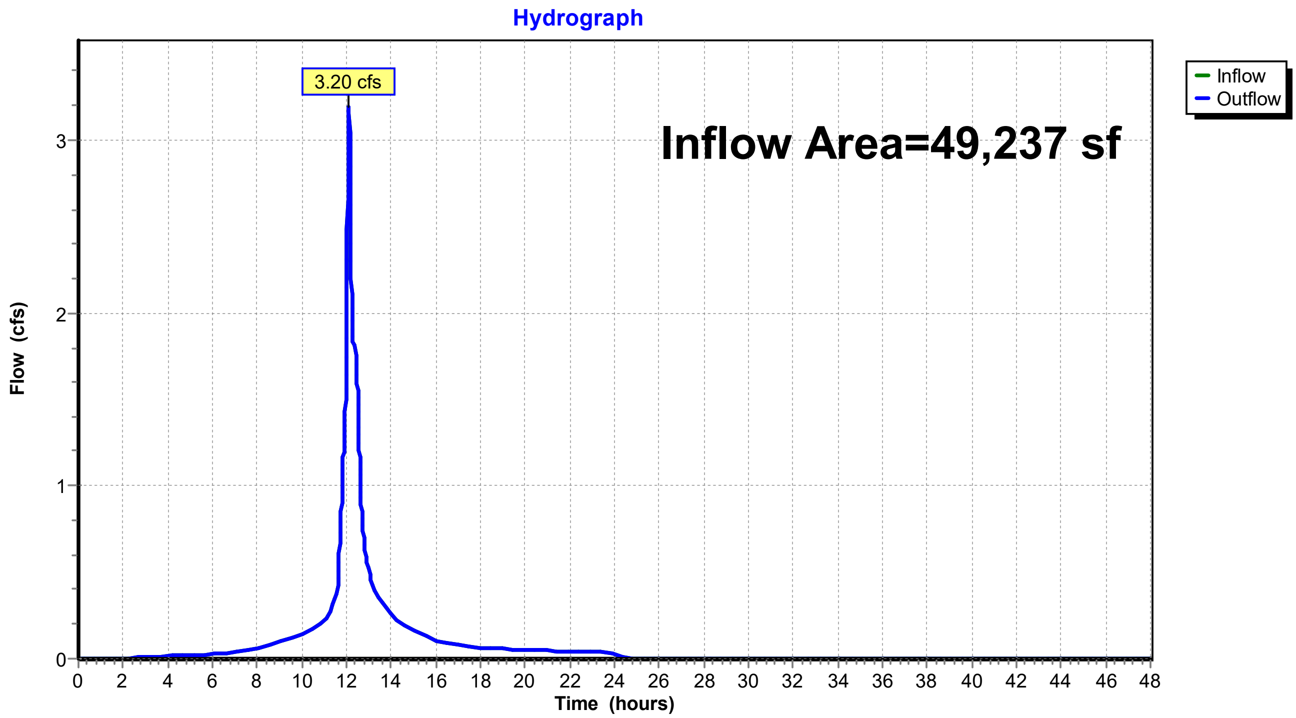


Summary for Reach PD2: Wetland series "A"

Inflow Area =	49,237 sf,	80.62% Impervious,	Inflow Depth = 3.30"	for 25-Year event	
Inflow =	3.20 cfs @	12.11 hrs,	Volume=	13,527 cf	
Outflow =	3.20 cfs @	12.11 hrs,	Volume=	13,527 cf,	Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach PD2: Wetland series "A"

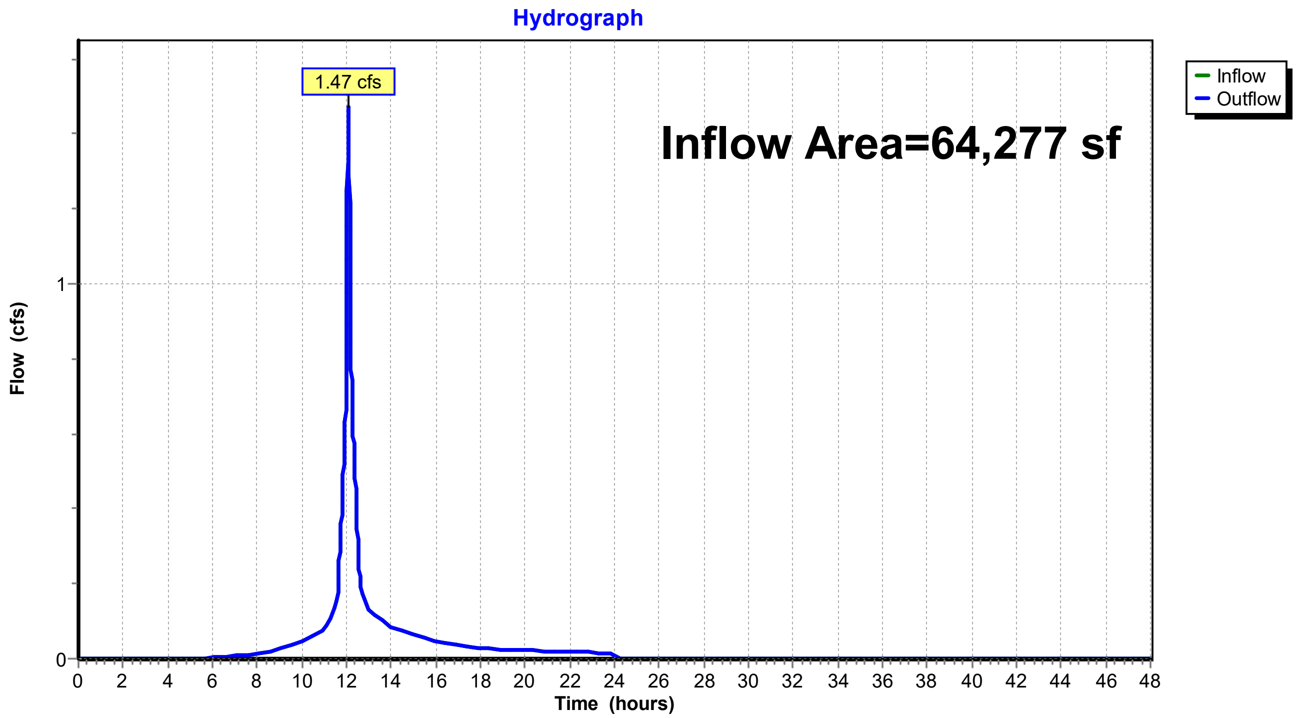


Summary for Reach PD3: Intermittent Stream

Inflow Area =	64,277 sf, 65.04% Impervious,	Inflow Depth = 0.87"	for 25-Year event
Inflow =	1.47 cfs @ 12.09 hrs, Volume=	4,656 cf	
Outflow =	1.47 cfs @ 12.09 hrs, Volume=	4,656 cf, Atten= 0%, Lag= 0.0 min	

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach PD3: Intermittent Stream

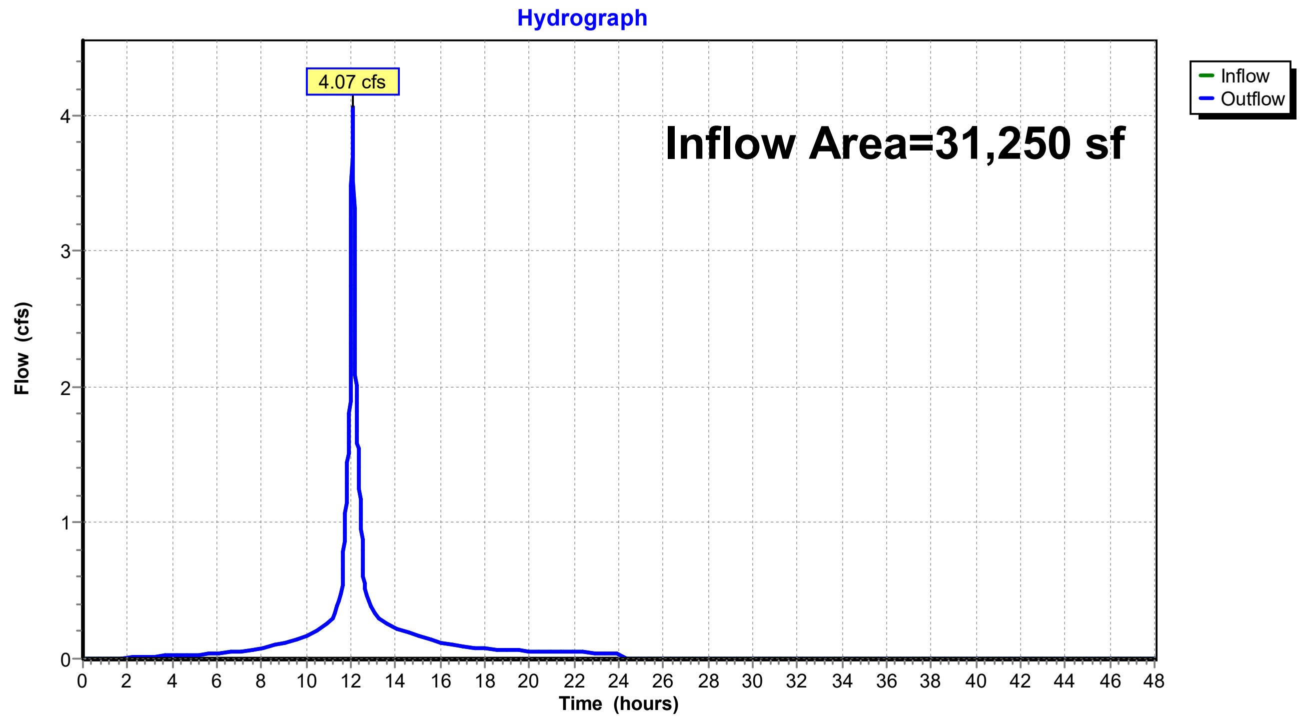


Summary for Reach PD4: Wetland series "B"

Inflow Area = 31,250 sf, 70.80% Impervious, Inflow Depth = 5.29" for 25-Year event
Inflow = 4.07 cfs @ 12.08 hrs, Volume= 13,781 cf
Outflow = 4.07 cfs @ 12.08 hrs, Volume= 13,781 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach PD4: Wetland series "B"

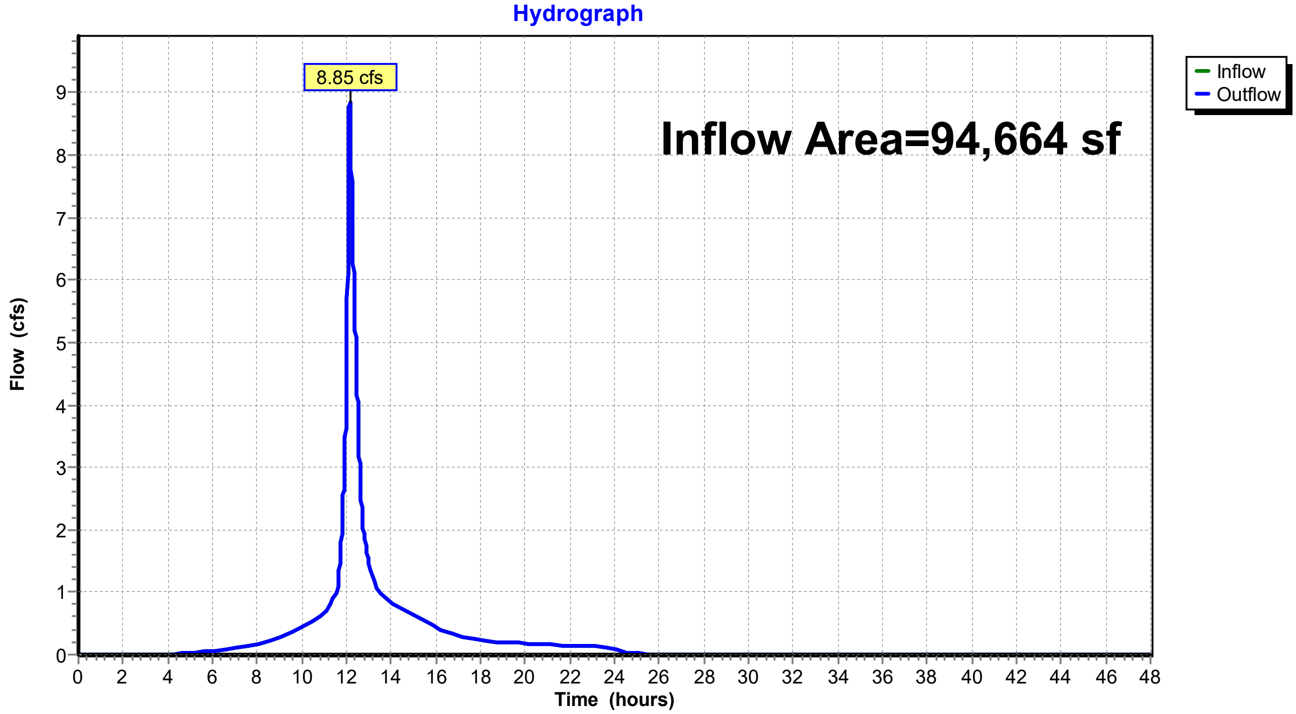


Summary for Reach PD5: Wetland series "E"

Inflow Area = 94,664 sf, 64.10% Impervious, Inflow Depth = 5.12" for 25-Year event
Inflow = 8.85 cfs @ 12.15 hrs, Volume= 40,391 cf
Outflow = 8.85 cfs @ 12.15 hrs, Volume= 40,391 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach PD5: Wetland series "E"

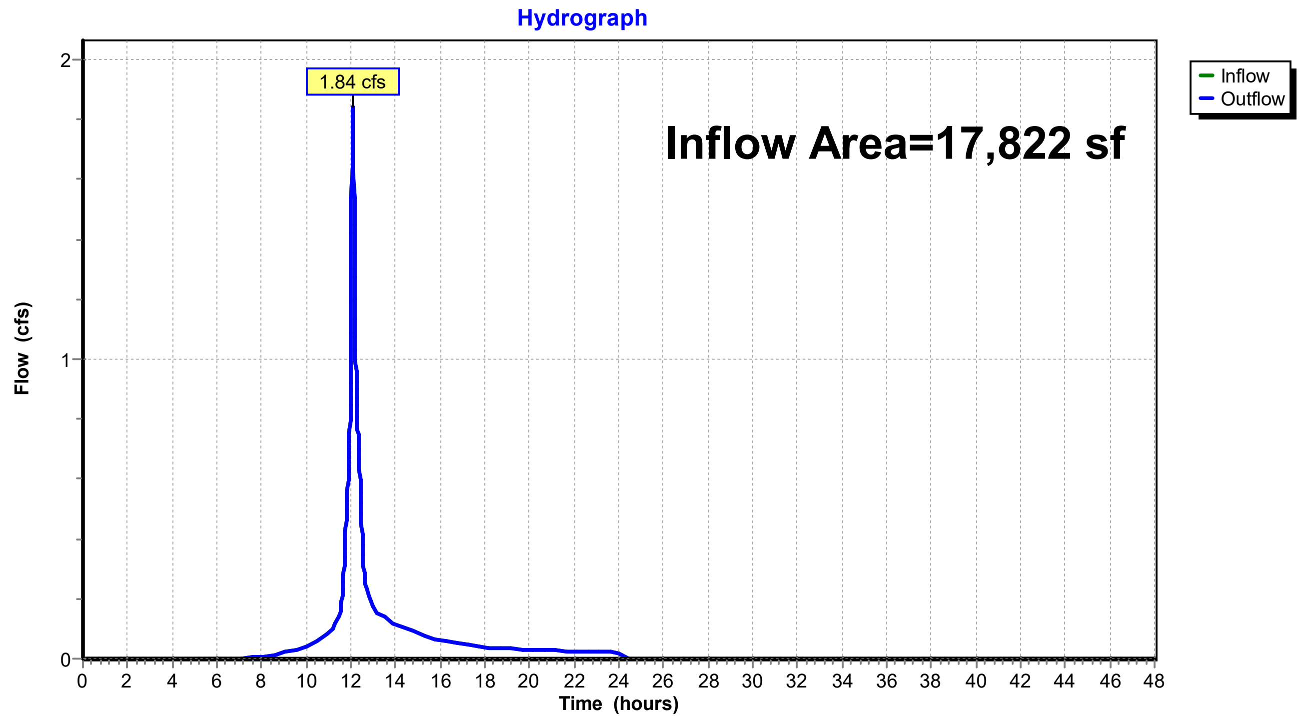


Summary for Reach PD6: Wetland series "F"

Inflow Area =	17,822 sf,	8.42% Impervious,	Inflow Depth = 3.85"	for 25-Year event
Inflow =	1.84 cfs @	12.09 hrs, Volume=	5,718 cf	
Outflow =	1.84 cfs @	12.09 hrs, Volume=	5,718 cf, Atten= 0%, Lag= 0.0 min	

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach PD6: Wetland series "F"

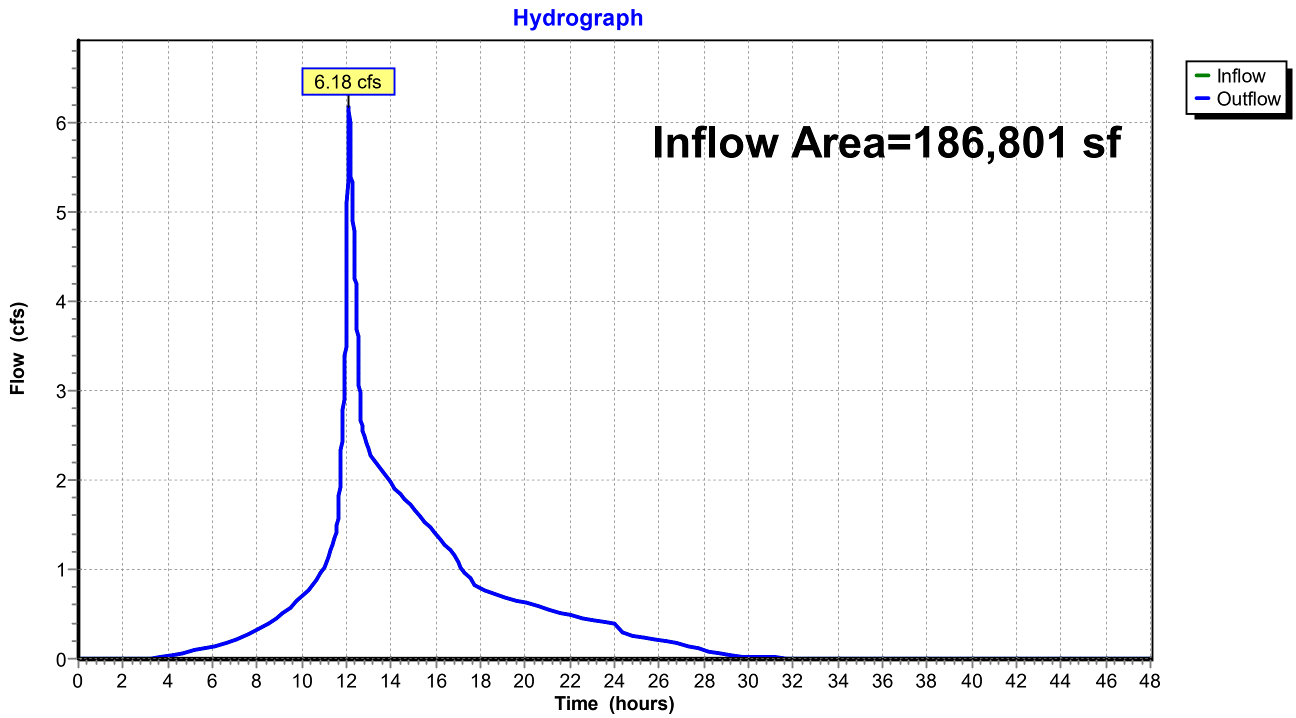


Summary for Reach WD: Washington St Drainage outlet

Inflow Area =	186,801 sf, 65.83% Impervious,	Inflow Depth = 4.63"	for 25-Year event
Inflow =	6.18 cfs @ 12.11 hrs,	Volume=	72,124 cf
Outflow =	6.18 cfs @ 12.11 hrs,	Volume=	72,124 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach WD: Washington St Drainage outlet



Summary for Pond UG1a: UG1a

Inflow Area = 27,758 sf, 24.53% Impervious, Inflow Depth = 5.14" for 25-Year event
Inflow = 3.63 cfs @ 12.08 hrs, Volume= 11,897 cf
Outflow = 2.58 cfs @ 12.16 hrs, Volume= 11,897 cf, Atten= 29%, Lag= 4.6 min
Primary = 2.58 cfs @ 12.16 hrs, Volume= 11,897 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 85.21' @ 12.16 hrs Surf.Area= 666 sf Storage= 961 cf

Plug-Flow detention time= 6.1 min calculated for 11,895 cf (100% of inflow)
Center-of-Mass det. time= 6.1 min (786.2 - 780.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	83.00'	639 cf	**11.00'W x 60.58'L x 3.50'H Field A**
			2,332 cf Overall - 735 cf Embedded = 1,597 cf x 40.0% Voids
#2A	83.50'	735 cf	**ADS_StormTech SC-740 +Cap** x 16 Inside #1
			Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
			Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap
			16 Chambers in 2 Rows
		1,374 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Device 2	83.00'	**8.5" Vert. Orifice/Grate** C= 0.600
#2	Primary	83.00'	**12.0" Round RCP_Round 12"**
			L= 51.4' RCP, groove end projecting, Ke= 0.200
			Inlet / Outlet Invert= 83.00' / 82.74' S= 0.0051 '/' Cc= 0.900
			n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=2.58 cfs @ 12.16 hrs HW=85.21' (Free Discharge)
↑—**2=RCP_Round 12"** (Passes 2.58 cfs of 4.97 cfs potential flow)
↑—**1=Orifice/Grate** (Orifice Controls 2.58 cfs @ 6.55 fps)

Pond UG1a: UG1a - Chamber Wizard Field A

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

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

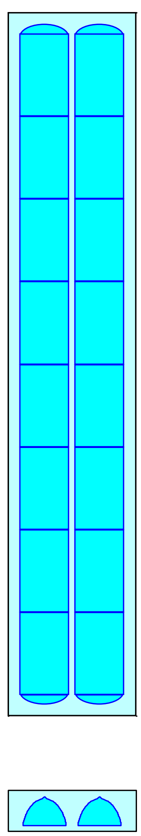
8 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 58.58' Row Length +12.0" End Stone x 2 = 60.58' Base Length
2 Rows x 51.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 11.00' Base Width
6.0" Base + 30.0" Chamber Height + 6.0" Cover = 3.50' Field Height

16 Chambers x 45.9 cf = 735.0 cf Chamber Storage

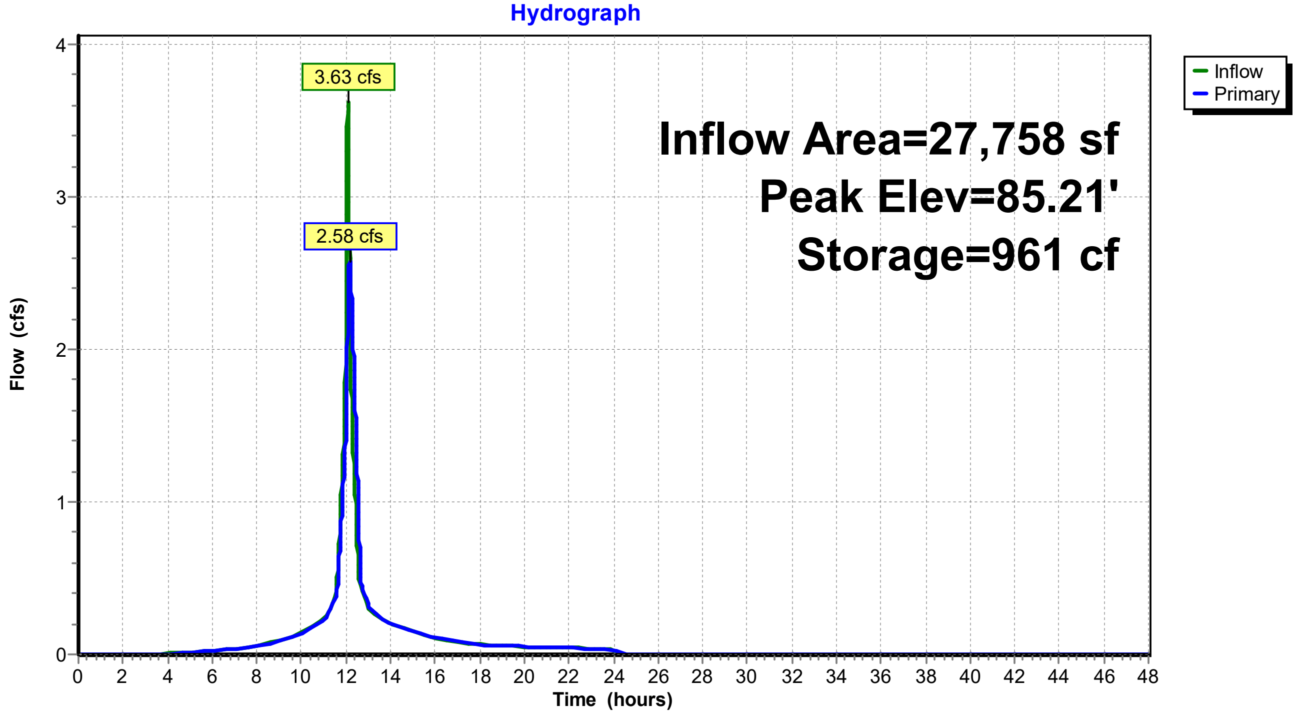
2,332.2 cf Field - 735.0 cf Chambers = 1,597.2 cf Stone x 40.0% Voids = 638.9 cf Stone Storage

Chamber Storage + Stone Storage = 1,373.9 cf = 0.032 af
Overall Storage Efficiency = 58.9%
Overall System Size = 60.58' x 11.00' x 3.50'

16 Chambers
86.4 cy Field
59.2 cy Stone



Pond UG1a: UG1a



Summary for Pond UG1b: UG1b

Inflow Area = 22,129 sf,100.00% Impervious, Inflow Depth = 5.95" for 25-Year event
Inflow = 3.08 cfs @ 12.08 hrs, Volume= 10,975 cf
Outflow = 0.39 cfs @ 11.60 hrs, Volume= 10,975 cf, Atten= 87%, Lag= 0.0 min
Discarded = 0.39 cfs @ 11.60 hrs, Volume= 10,975 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 86.69' @ 12.62 hrs Surf.Area= 2,044 sf Storage= 3,198 cf

Plug-Flow detention time= 48.3 min calculated for 10,973 cf (100% of inflow)
Center-of-Mass det. time= 48.2 min (792.9 - 744.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	84.50'	1,589 cf	**28.00'W x 73.00'L x 3.21'H Field A** 6,558 cf Overall - 2,587 cf Embedded = 3,971 cf x 40.0% Voids
#2A	85.00'	2,587 cf	**Cultec R-280HD** x 60 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 6 rows
		4,175 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Device 2	87.33'	**0.9' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#2	Primary	84.07'	**12.0" Round RCP_Round 12"** L= 12.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 84.07' / 83.53' S= 0.0450 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#3	Discarded	84.50'	**8.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.39 cfs @ 11.60 hrs HW=84.53' (Free Discharge)
└─**3=Exfiltration** (Exfiltration Controls 0.39 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=84.50' (Free Discharge)
└─**2=RCP_Round 12"** (Passes 0.00 cfs of 0.90 cfs potential flow)
  └─**1=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond UG1b: UG1b - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)
Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf
Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap
Row Length Adjustment= +1.00' x 6.07 sf x 6 rows

47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

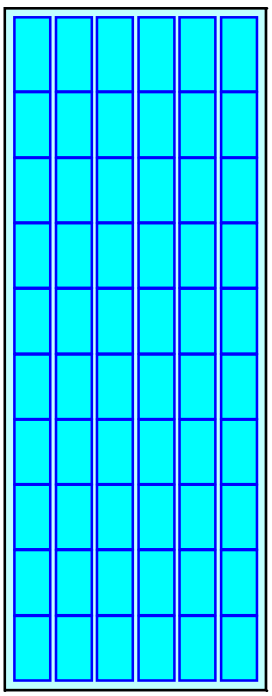
10 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 71.00' Row Length +12.0" End Stone x 2 = 73.00' Base Length
6 Rows x 47.0" Wide + 6.0" Spacing x 5 + 12.0" Side Stone x 2 = 28.00' Base Width
6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

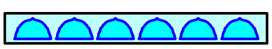
60 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 6 Rows = 2,586.6 cf Chamber Storage

6,557.8 cf Field - 2,586.6 cf Chambers = 3,971.3 cf Stone x 40.0% Voids = 1,588.5 cf Stone Storage

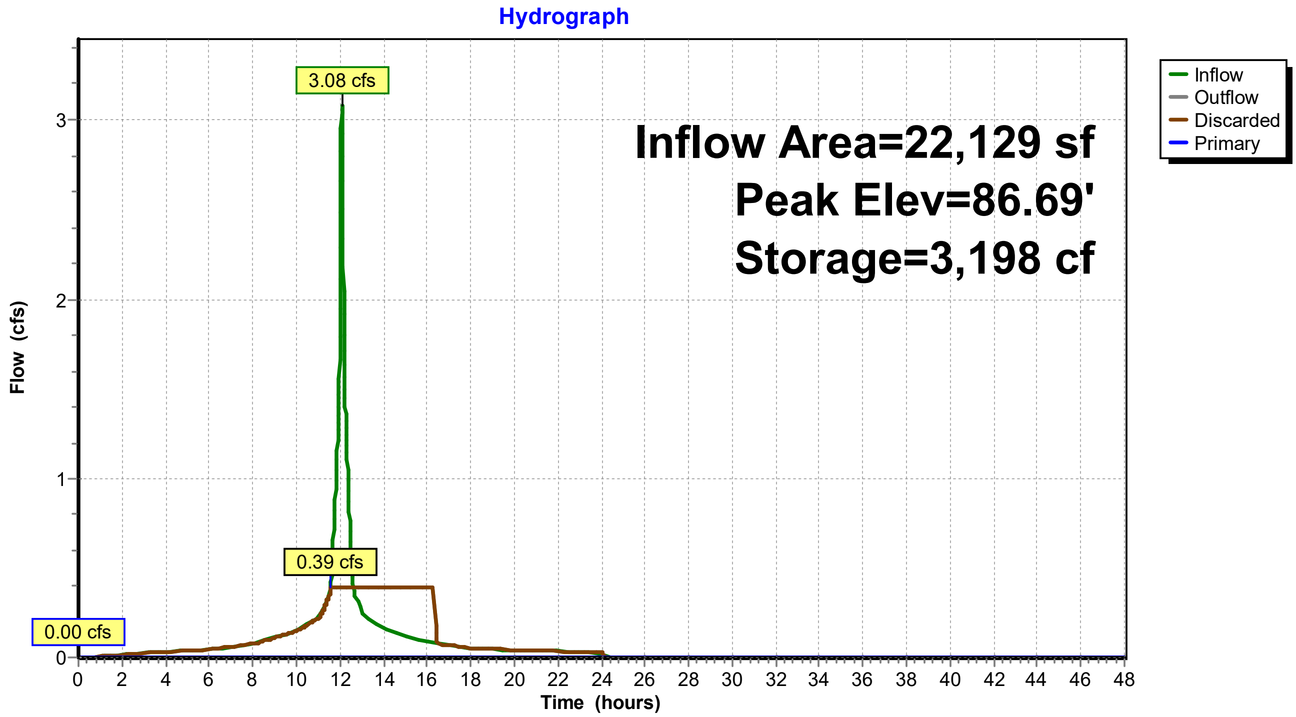
Chamber Storage + Stone Storage = 4,175.1 cf = 0.096 af
Overall Storage Efficiency = 63.7%
Overall System Size = 73.00' x 28.00' x 3.21'

60 Chambers
242.9 cy Field
147.1 cy Stone





Pond UG1b: UG1b



Summary for Pond UG2: UG2

Inflow Area = 16,720 sf, 68.82% Impervious, Inflow Depth = 5.26" for 25-Year event
Inflow = 2.21 cfs @ 12.08 hrs, Volume= 7,324 cf
Outflow = 0.24 cfs @ 12.75 hrs, Volume= 7,324 cf, Atten= 89%, Lag= 40.2 min
Primary = 0.24 cfs @ 12.75 hrs, Volume= 7,324 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 84.29' @ 12.75 hrs Surf.Area= 0.047 ac Storage= 0.073 af

Plug-Flow detention time= 143.3 min calculated for 7,324 cf (100% of inflow)
Center-of-Mass det. time= 143.3 min (919.5 - 776.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	82.00'	0.042 af	**30.00'W x 67.70'L x 3.50'H Field A** 0.163 af Overall - 0.057 af Embedded = 0.106 af x 40.0% Voids
#2A	82.50'	0.057 af	**ADS_StormTech SC-740 +Cap** x 54 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 54 Chambers in 6 Rows
		0.099 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Device 2	82.00'	**2.5" Vert. Orifice/Grate** C= 0.600
#2	Primary	82.00'	**12.0" Round RCP_Round 12"** L= 9.7' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 82.00' / 81.95' S= 0.0052 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=0.24 cfs @ 12.75 hrs HW=84.29' (Free Discharge)
↑—**2=RCP_Round 12"** (Passes 0.24 cfs of 6.13 cfs potential flow)
↑—**1=Orifice/Grate** (Orifice Controls 0.24 cfs @ 7.12 fps)

Pond UG2: UG2 - Chamber Wizard Field A

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

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

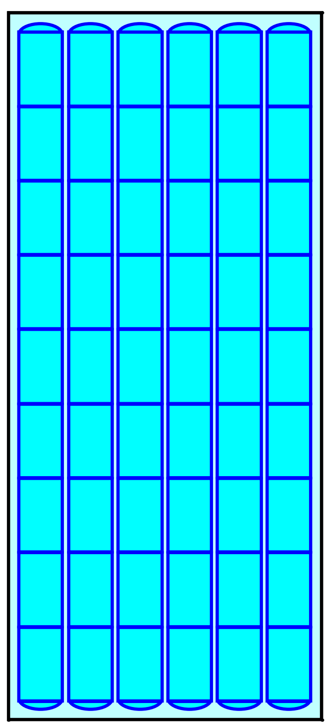
9 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 65.70' Row Length +12.0" End Stone x 2 = 67.70' Base Length
6 Rows x 51.0" Wide + 6.0" Spacing x 5 + 12.0" Side Stone x 2 = 30.00' Base Width
6.0" Base + 30.0" Chamber Height + 6.0" Cover = 3.50' Field Height

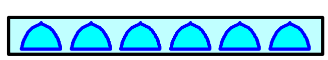
54 Chambers x 45.9 cf = 2,480.8 cf Chamber Storage

7,108.2 cf Field - 2,480.8 cf Chambers = 4,627.4 cf Stone x 40.0% Voids = 1,851.0 cf Stone Storage

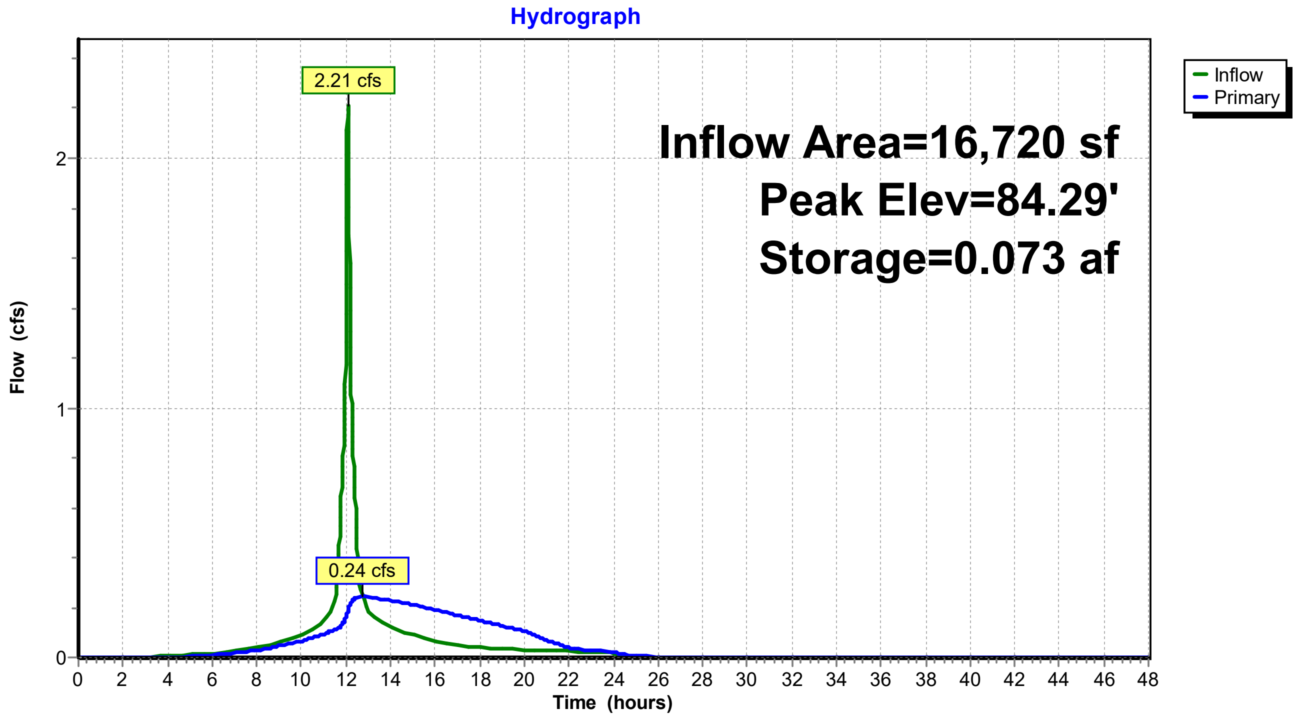
Chamber Storage + Stone Storage = 4,331.7 cf = 0.099 af
Overall Storage Efficiency = 60.9%
Overall System Size = 67.70' x 30.00' x 3.50'

54 Chambers
263.3 cy Field
171.4 cy Stone





Pond UG2: UG2


Hydrograph
2.21 cfs
0.24 cfs
Inflow Area=16,720 sf
Peak Elev=84.29'
Storage=0.073 af
Inflow
Primary
Flow (cfs)
Time (hours)
0
1
2
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 UG3: UG3

Inflow Area = 46,987 sf, 83.88% Impervious, Inflow Depth = 5.60" for 25-Year event
Inflow = 6.42 cfs @ 12.08 hrs, Volume= 21,929 cf
Outflow = 0.44 cfs @ 13.38 hrs, Volume= 21,926 cf, Atten= 93%, Lag= 77.9 min
Primary = 0.44 cfs @ 13.38 hrs, Volume= 21,926 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 92.59' @ 13.38 hrs Surf.Area= 0.103 ac Storage= 0.258 af

Plug-Flow detention time= 294.5 min calculated for 21,922 cf (100% of inflow)
Center-of-Mass det. time= 294.7 min (1,057.5 - 762.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	89.00'	0.145 af	**80.08'W x 55.89'L x 5.50'H Field A** 0.565 af Overall - 0.202 af Embedded = 0.363 af x 40.0% Voids
#2A	89.75'	0.202 af	**ADS_StormTech MC-3500 d +Cap** x 77 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 77 Chambers in 11 Rows Cap Storage= +14.9 cf x 2 x 11 rows = 327.8 cf
		0.347 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Device 2	89.00'	**3.0" Vert. Orifice/Grate** C= 0.600
#2	Primary	89.00'	**12.0" Round RCP_Round 12"** L= 20.9' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 89.00' / 88.90' S= 0.0048 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=0.44 cfs @ 13.38 hrs HW=92.59' (Free Discharge)
↑**2=RCP_Round 12"** (Passes 0.44 cfs of 8.01 cfs potential flow)
↑**1=Orifice/Grate** (Orifice Controls 0.44 cfs @ 8.97 fps)

Pond UG3: UG3 - Chamber Wizard Field A

Chamber Model = ADS_StormTech MC-3500 d +Cap (ADS StormTech® MC-3500 d rev 03/14 with Cap volume)
Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf
Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap
Cap Storage= +14.9 cf x 2 x 11 rows = 327.8 cf

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

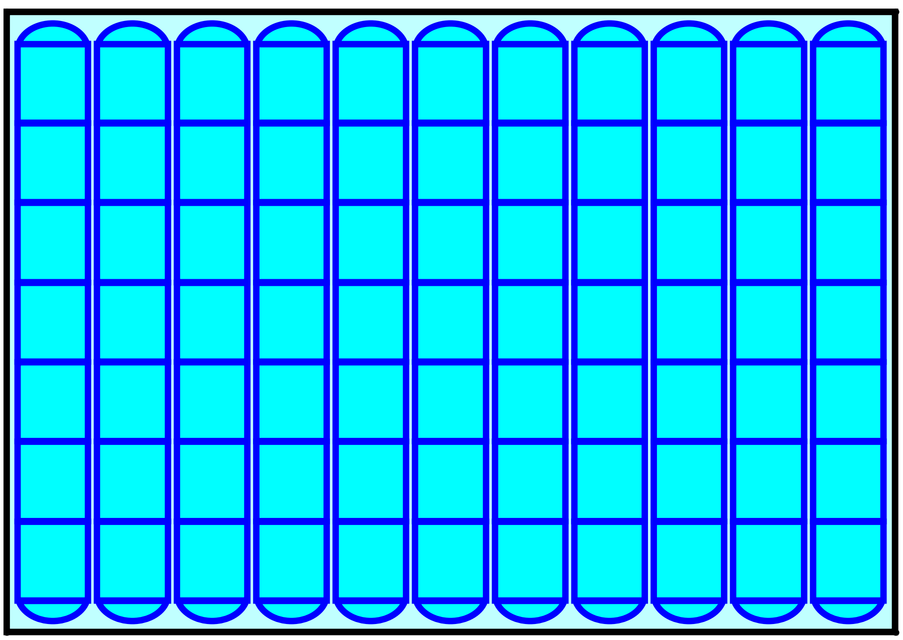
7 Chambers/Row x 7.17' Long +1.85' Cap Length x 2 = 53.89' Row Length +12.0" End Stone x 2 = 55.89' Base Length
11 Rows x 77.0" Wide + 9.0" Spacing x 10 + 12.0" Side Stone x 2 = 80.08' Base Width
9.0" Base + 45.0" Chamber Height + 12.0" Cover = 5.50' Field Height

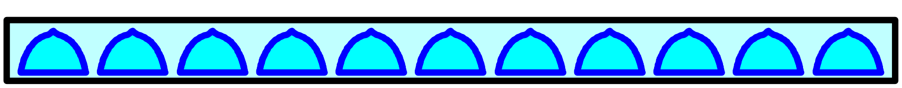
77 Chambers x 110.0 cf + 14.9 cf Cap Volume x 2 x 11 Rows = 8,794.1 cf Chamber Storage

24,617.2 cf Field - 8,794.1 cf Chambers = 15,823.1 cf Stone x 40.0% Voids = 6,329.2 cf Stone Storage

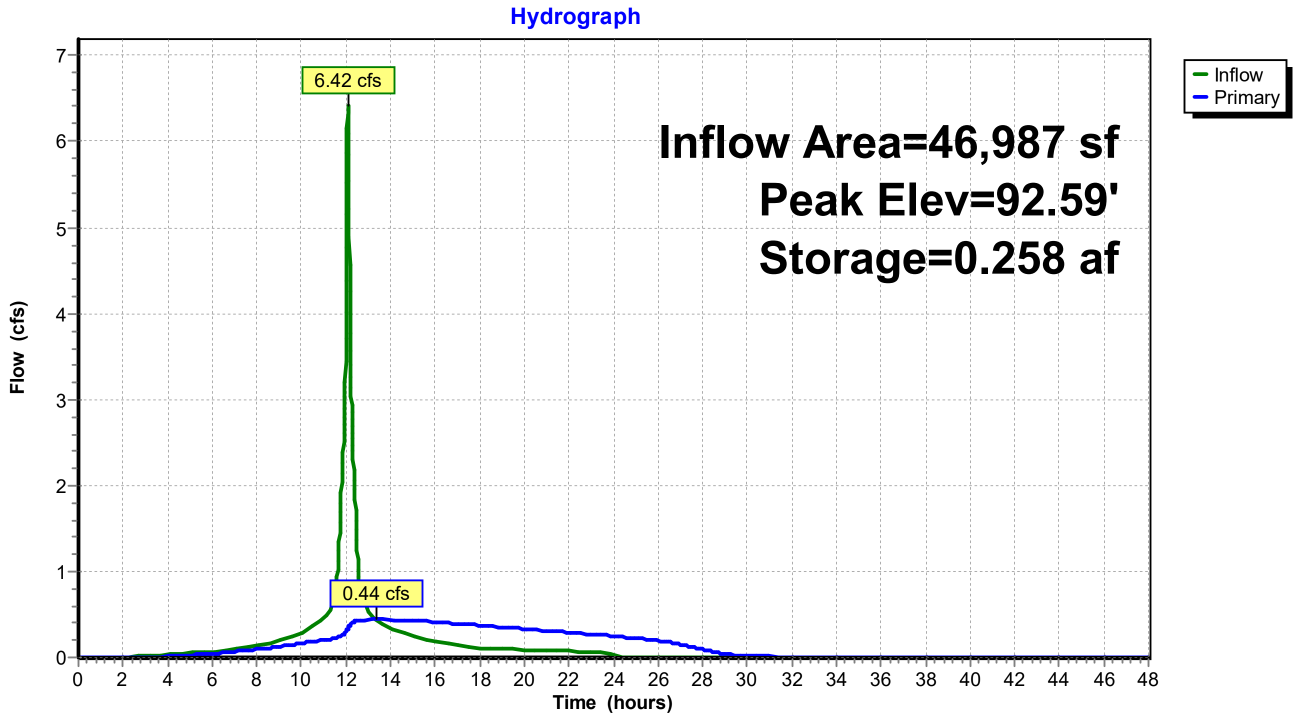
Chamber Storage + Stone Storage = 15,123.3 cf = 0.347 af
Overall Storage Efficiency = 61.4%
Overall System Size = 55.89' x 80.08' x 5.50'

77 Chambers
911.7 cy Field
586.0 cy Stone





Pond UG3: UG3


Hydrograph
6.42 cfs
0.44 cfs
Inflow Area=46,987 sf
Peak Elev=92.59'
Storage=0.258 af
Inflow
Primary
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 UG4a: UG4a

Inflow Area = 38,652 sf, 94.71% Impervious, Inflow Depth = 3.03" for 25-Year event
Inflow = 2.35 cfs @ 12.08 hrs, Volume= 9,762 cf
Outflow = 2.07 cfs @ 12.13 hrs, Volume= 9,762 cf, Atten= 12%, Lag= 2.6 min
Primary = 2.07 cfs @ 12.13 hrs, Volume= 9,762 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 100.37' @ 12.13 hrs Surf.Area= 0.019 ac Storage= 0.009 af

Plug-Flow detention time= 6.7 min calculated for 9,762 cf (100% of inflow)
Center-of-Mass det. time= 6.5 min (766.9 - 760.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	99.50'	0.014 af	**18.17'W x 45.92'L x 2.33'H Field A** 0.045 af Overall - 0.010 af Embedded = 0.035 af x 40.0% Voids
#2A	100.00'	0.010 af	**ADS_StormTech SC-310 +Cap** x 30 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap 30 Chambers in 5 Rows
		0.024 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Device 2	99.50'	**11.0" Vert. Orifice/Grate** C= 0.600
#2	Primary	99.50'	**12.0" Round RCP_Round 12"** L= 43.2' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 99.50' / 98.00' S= 0.0347 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=2.06 cfs @ 12.13 hrs HW=100.37' (Free Discharge)
↑—**2=RCP_Round 12"** (Passes 2.06 cfs of 2.90 cfs potential flow)
↑—**1=Orifice/Grate** (Orifice Controls 2.06 cfs @ 3.18 fps)

Pond UG4a: UG4a - Chamber Wizard Field A

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

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

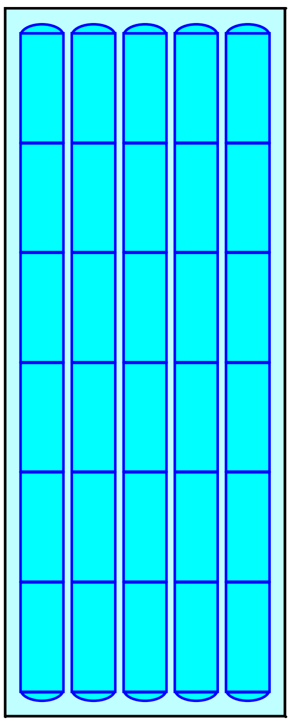
6 Chambers/Row x 7.12' Long +0.60' Cap Length x 2 = 43.92' Row Length +12.0" End Stone x 2 = 45.92' Base Length
5 Rows x 34.0" Wide + 6.0" Spacing x 4 + 12.0" Side Stone x 2 = 18.17' Base Width
6.0" Base + 16.0" Chamber Height + 6.0" Cover = 2.33' Field Height

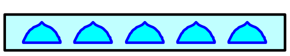
30 Chambers x 14.7 cf = 442.3 cf Chamber Storage

1,946.5 cf Field - 442.3 cf Chambers = 1,504.2 cf Stone x 40.0% Voids = 601.7 cf Stone Storage

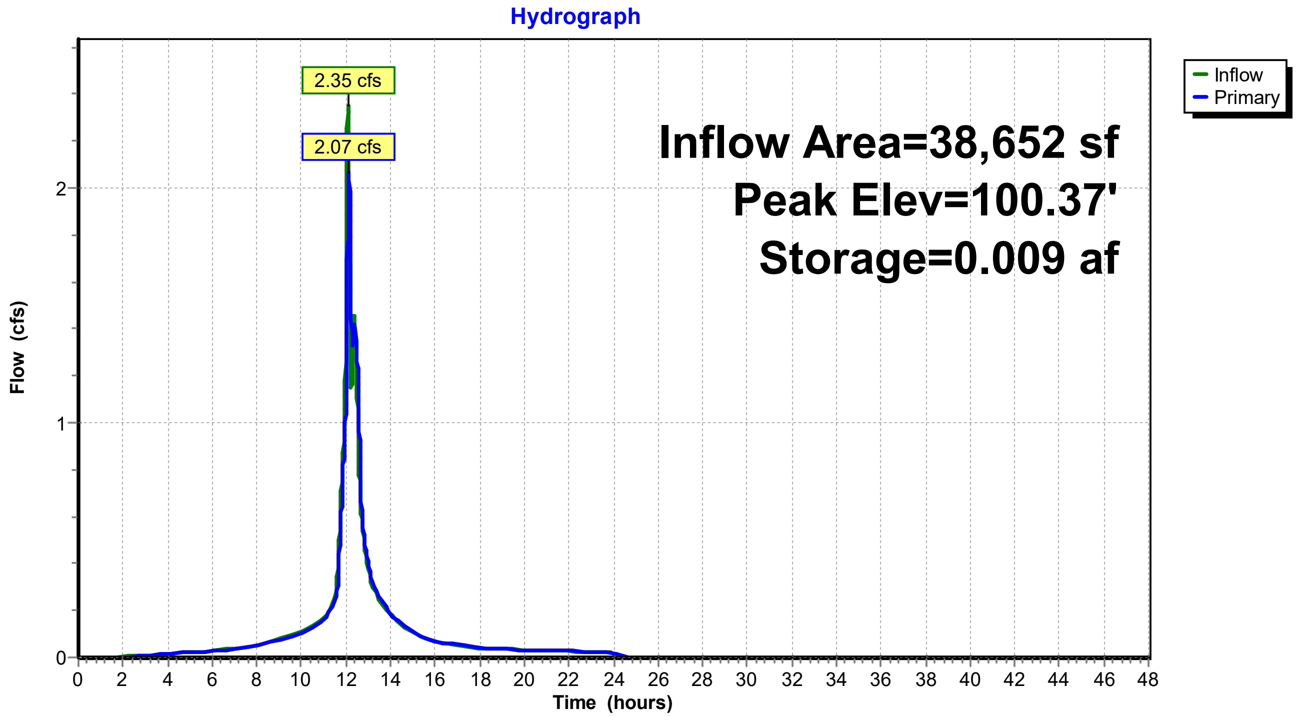
Chamber Storage + Stone Storage = 1,044.0 cf = 0.024 af
Overall Storage Efficiency = 53.6%
Overall System Size = 45.92' x 18.17' x 2.33'

30 Chambers
72.1 cy Field
55.7 cy Stone





Pond UG4a: UG4a



Summary for Pond UG4b: UG4b

Inflow Area = 21,598 sf,100.00% Impervious, Inflow Depth = 5.95" for 25-Year event
Inflow = 3.01 cfs @ 12.08 hrs, Volume= 10,712 cf
Outflow = 0.86 cfs @ 12.41 hrs, Volume= 10,712 cf, Atten= 72%, Lag= 19.8 min
Discarded = 0.12 cfs @ 9.27 hrs, Volume= 9,074 cf
Primary = 0.74 cfs @ 12.41 hrs, Volume= 1,638 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 110.09' @ 12.41 hrs Surf.Area= 2,069 sf Storage= 4,075 cf

Plug-Flow detention time= 232.8 min calculated for 10,710 cf (100% of inflow)
Center-of-Mass det. time= 232.8 min (977.4 - 744.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	107.00'	1,886 cf	**25.25'W x 81.94'L x 3.50'H Field A** 7,241 cf Overall - 2,527 cf Embedded = 4,714 cf x 40.0% Voids
#2A	107.50'	2,527 cf	**ADS_StormTech SC-740 +Cap** x 55 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 55 Chambers in 5 Rows
		4,412 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Device 2	109.70'	**1.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#2	Primary	107.00'	**12.0" Round RCP_Round 12"** L= 100.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 107.00' / 104.00' S= 0.0300 '/' Cc= 0.900 n= 0.013 Concrete sewer w/manholes & inlets, Flow Area= 0.79 sf
#3	Discarded	107.00'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.12 cfs @ 9.27 hrs HW=107.04' (Free Discharge)
↑—**3=Exfiltration** (Exfiltration Controls 0.12 cfs)

Primary OutFlow Max=0.74 cfs @ 12.41 hrs HW=110.09' (Free Discharge)
↑—**2=RCP_Round 12"** (Passes 0.74 cfs of 6.83 cfs potential flow)
  ↑—**1=Sharp-Crested Rectangular Weir** (Weir Controls 0.74 cfs @ 2.05 fps)

Pond UG4b: UG4b - Chamber Wizard Field A

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

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

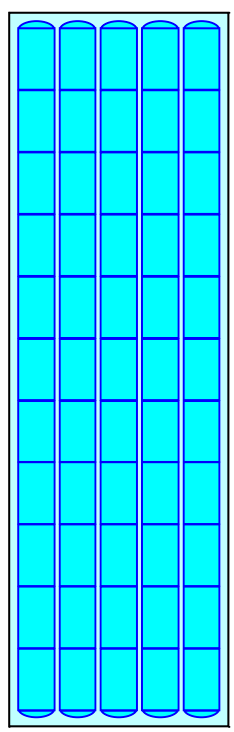
11 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 79.94' Row Length +12.0" End Stone x 2 = 81.94' Base Length
5 Rows x 51.0" Wide + 6.0" Spacing x 4 + 12.0" Side Stone x 2 = 25.25' Base Width
6.0" Base + 30.0" Chamber Height + 6.0" Cover = 3.50' Field Height

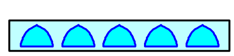
55 Chambers x 45.9 cf = 2,526.7 cf Chamber Storage

7,241.2 cf Field - 2,526.7 cf Chambers = 4,714.5 cf Stone x 40.0% Voids = 1,885.8 cf Stone Storage

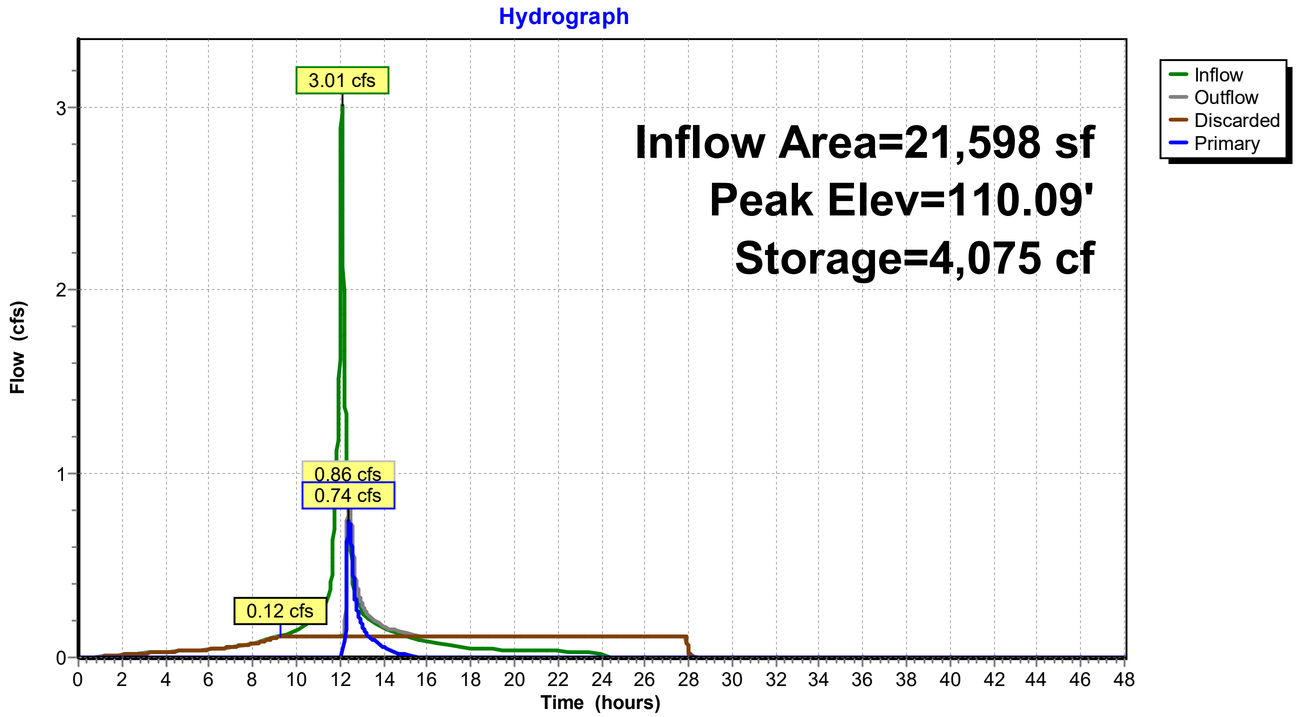
Chamber Storage + Stone Storage = 4,412.5 cf = 0.101 af
Overall Storage Efficiency = 60.9%
Overall System Size = 81.94' x 25.25' x 3.50'

55 Chambers
268.2 cy Field
174.6 cy Stone





Pond UG4b: UG4b



Summary for Pond UG5: UG5

Inflow Area = 51,811 sf, 71.70% Impervious, Inflow Depth = 5.37" for 25-Year event
Inflow = 6.94 cfs @ 12.08 hrs, Volume= 23,186 cf
Outflow = 0.25 cfs @ 9.67 hrs, Volume= 23,186 cf, Atten= 96%, Lag= 0.0 min
Discarded = 0.25 cfs @ 9.67 hrs, Volume= 23,186 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 112.06' @ 15.39 hrs Surf.Area= 4,461 sf Storage= 12,492 cf

Plug-Flow detention time= 445.8 min calculated for 23,181 cf (100% of inflow)
Center-of-Mass det. time= 445.8 min (1,217.9 - 772.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	108.00'	6,247 cf	**29.92'W x 149.10'L x 5.50'H Field A** 24,533 cf Overall - 8,915 cf Embedded = 15,618 cf x 40.0% Voids
#2A	108.75'	8,915 cf	**ADS_StormTech MC-3500 d +Cap** x 80 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 80 Chambers in 4 Rows Cap Storage= +14.9 cf x 2 x 4 rows = 119.2 cf
		15,162 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Device 2	113.05'	**0.7' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#2	Primary	101.47'	**12.0" Round RCP_Round 12"** L= 14.6' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 101.47' / 100.30' S= 0.0801 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#3	Discarded	108.00'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.25 cfs @ 9.67 hrs HW=108.06' (Free Discharge)
↑—**3=Exfiltration** (Exfiltration Controls 0.25 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=108.00' (Free Discharge)
↑—**2=RCP_Round 12"** (Passes 0.00 cfs of 11.61 cfs potential flow)
↑—**1=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond UG5: UG5 - Chamber Wizard Field A

Chamber Model = ADS_StormTech MC-3500 d +Cap (ADS StormTech® MC-3500 d rev 03/14 with Cap volume)
Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf
Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap
Cap Storage= +14.9 cf x 2 x 4 rows = 119.2 cf

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

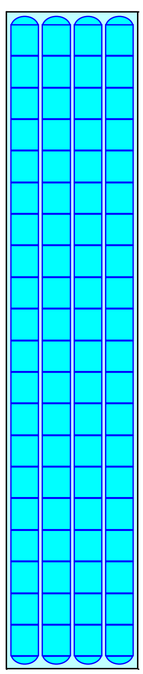
20 Chambers/Row x 7.17' Long +1.85' Cap Length x 2 = 147.10' Row Length +12.0" End Stone x 2 = 149.10' Base Length
4 Rows x 77.0" Wide + 9.0" Spacing x 3 + 12.0" Side Stone x 2 = 29.92' Base Width
9.0" Base + 45.0" Chamber Height + 12.0" Cover = 5.50' Field Height

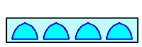
80 Chambers x 110.0 cf + 14.9 cf Cap Volume x 2 x 4 Rows = 8,915.4 cf Chamber Storage

24,533.2 cf Field - 8,915.4 cf Chambers = 15,617.8 cf Stone x 40.0% Voids = 6,247.1 cf Stone Storage

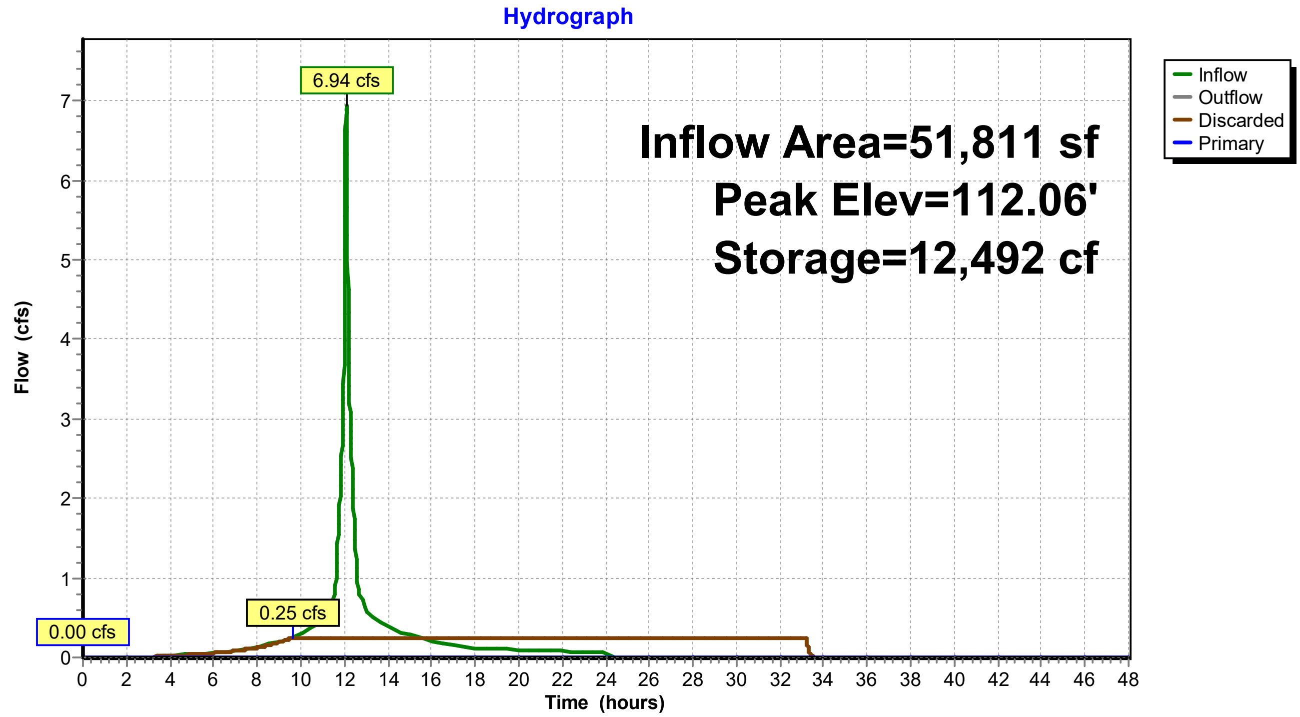
Chamber Storage + Stone Storage = 15,162.5 cf = 0.348 af
Overall Storage Efficiency = 61.8%
Overall System Size = 149.10' x 29.92' x 5.50'

80 Chambers
908.6 cy Field
578.4 cy Stone





Pond UG5: UG5


Hydrograph
6.94 cfs
0.25 cfs
0.00 cfs
Inflow Area=51,811 sf
Peak Elev=112.06'
Storage=12,492 cf
Inflow
Outflow
Discarded
Primary
Flow (cfs)
Time (hours)

Summary for Pond UG6: UG6

Inflow Area = 43,674 sf, 78.98% Impervious, Inflow Depth = 5.48" for 25-Year event
Inflow = 5.91 cfs @ 12.08 hrs, Volume= 19,962 cf
Outflow = 3.43 cfs @ 12.19 hrs, Volume= 19,956 cf, Atten= 42%, Lag= 6.6 min
Primary = 3.43 cfs @ 12.19 hrs, Volume= 19,956 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 114.35' @ 12.19 hrs Surf.Area= 4,101 sf Storage= 4,287 cf

Plug-Flow detention time= 40.7 min calculated for 19,952 cf (100% of inflow)
Center-of-Mass det. time= 40.8 min (808.5 - 767.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	112.60'	2,884 cf	**28.17'W x 145.60'L x 2.33'H Field A** 9,569 cf Overall - 2,359 cf Embedded = 7,210 cf x 40.0% Voids
#2A	113.10'	2,359 cf	**ADS_StormTech RC-310 +Cap** x 160 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap 160 Chambers in 8 Rows
		5,243 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Device 3	112.60'	**5.0" Vert. Orifice/Grate** C= 0.600
#2	Device 3	113.22'	**11.0" Vert. Orifice/Grate** C= 0.600
#3	Primary	112.60'	**12.0" Round RCP_Round 12"** L= 68.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 112.60' / 112.40' S= 0.0029 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=3.43 cfs @ 12.19 hrs HW=114.35' (Free Discharge)
└─**3=RCP_Round 12"** (Passes 3.43 cfs of 3.72 cfs potential flow)
  ├─**1=Orifice/Grate** (Orifice Controls 0.82 cfs @ 5.98 fps)
  └─**2=Orifice/Grate** (Orifice Controls 2.61 cfs @ 3.95 fps)

Pond UG6: UG6 - Chamber Wizard Field A

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

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

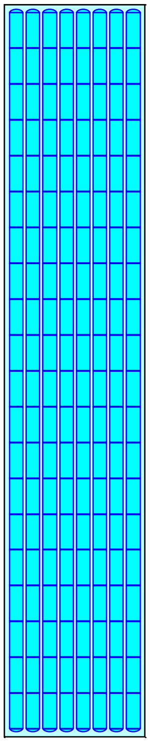
20 Chambers/Row x 7.12' Long +0.60' Cap Length x 2 = 143.60' Row Length +12.0" End Stone x 2 = 145.60' Base Length
8 Rows x 34.0" Wide + 6.0" Spacing x 7 + 12.0" Side Stone x 2 = 28.17' Base Width
6.0" Base + 16.0" Chamber Height + 6.0" Cover = 2.33' Field Height

160 Chambers x 14.7 cf = 2,358.7 cf Chamber Storage

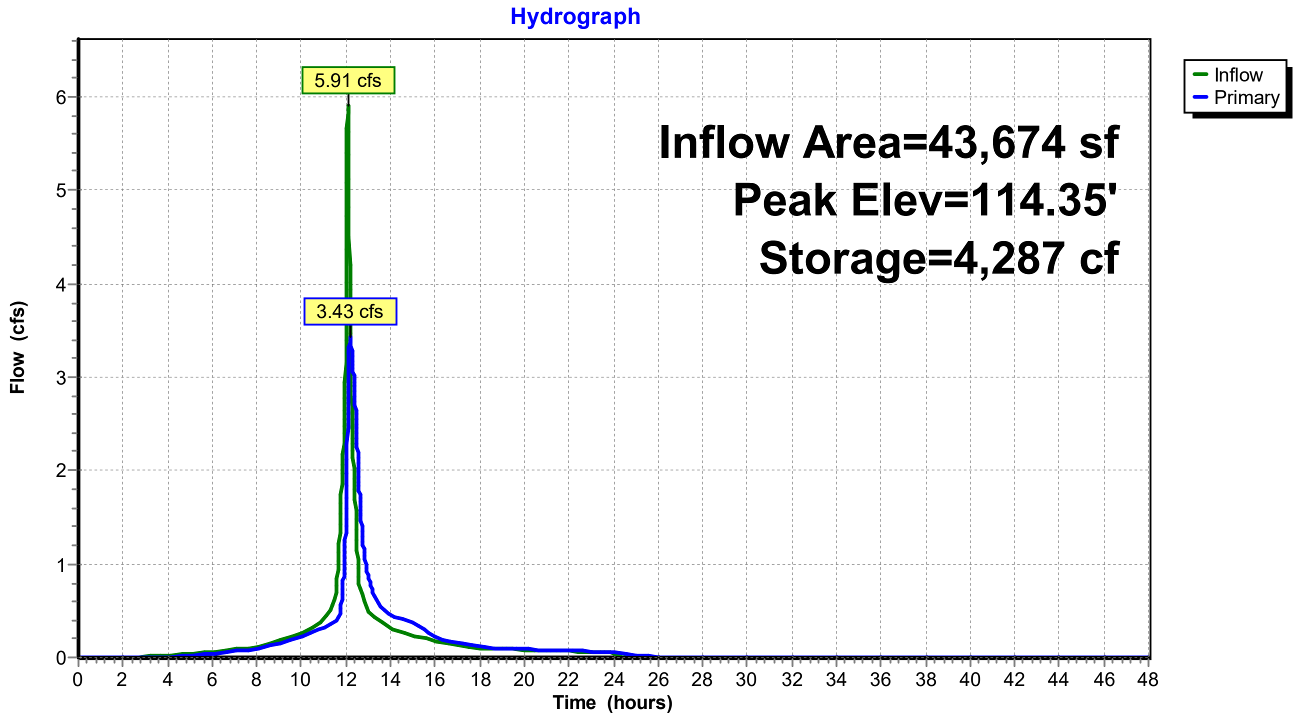
9,569.2 cf Field - 2,358.7 cf Chambers = 7,210.4 cf Stone x 40.0% Voids = 2,884.2 cf Stone Storage

Chamber Storage + Stone Storage = 5,242.9 cf = 0.120 af
Overall Storage Efficiency = 54.8%
Overall System Size = 145.60' x 28.17' x 2.33'

160 Chambers
354.4 cy Field
267.1 cy Stone



Pond UG6: UG6


Hydrograph
5.91 cfs
3.43 cfs
Inflow Area=43,674 sf
Peak Elev=114.35'
Storage=4,287 cf
Inflow
Primary
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 UG7: UG7

Inflow Area = 50,810 sf, 81.43% Impervious, Inflow Depth = 5.60" for 25-Year event
Inflow = 6.94 cfs @ 12.08 hrs, Volume= 23,713 cf
Outflow = 1.18 cfs @ 12.54 hrs, Volume= 23,713 cf, Atten= 83%, Lag= 27.5 min
Primary = 1.18 cfs @ 12.54 hrs, Volume= 23,713 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 101.95' @ 12.54 hrs Surf.Area= 0.079 ac Storage= 0.190 af

Plug-Flow detention time= 72.3 min calculated for 23,708 cf (100% of inflow)
Center-of-Mass det. time= 72.5 min (835.3 - 762.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	98.50'	0.111 af	**44.25'W x 77.40'L x 5.50'H Field A** 0.432 af Overall - 0.156 af Embedded = 0.277 af x 40.0% Voids
#2A	99.25'	0.156 af	**ADS_StormTech MC-3500 d +Cap** x 60 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 60 Chambers in 6 Rows Cap Storage= +14.9 cf x 2 x 6 rows = 178.8 cf
		0.266 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Device 2	98.50'	**5.0" Vert. Orifice/Grate** C= 0.600
#2	Primary	98.50'	**12.0" Round RCP_Round 12"** L= 34.7' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 98.50' / 98.33' S= 0.0049 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=1.18 cfs @ 12.54 hrs HW=101.95' (Free Discharge)
↑—**2=RCP_Round 12"** (Passes 1.18 cfs of 7.25 cfs potential flow)
  ↑—**1=Orifice/Grate** (Orifice Controls 1.18 cfs @ 8.67 fps)

Pond UG7: UG7 - Chamber Wizard Field A

Chamber Model = ADS_StormTech MC-3500 d +Cap (ADS StormTech® MC-3500 d rev 03/14 with Cap volume)
Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf
Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap
Cap Storage= +14.9 cf x 2 x 6 rows = 178.8 cf

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

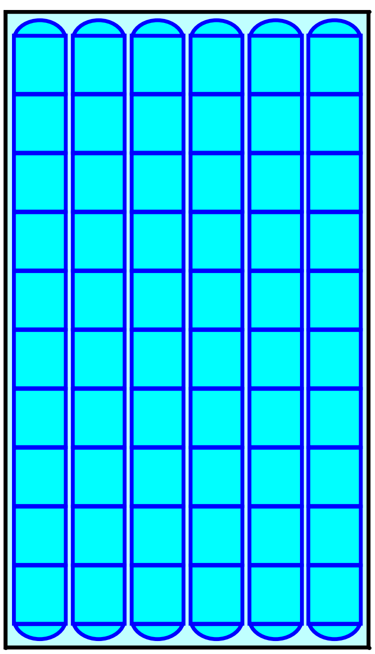
10 Chambers/Row x 7.17' Long +1.85' Cap Length x 2 = 75.40' Row Length +12.0" End Stone x 2 = 77.40' Base Length
6 Rows x 77.0" Wide + 9.0" Spacing x 5 + 12.0" Side Stone x 2 = 44.25' Base Width
9.0" Base + 45.0" Chamber Height + 12.0" Cover = 5.50' Field Height

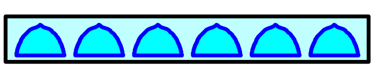
60 Chambers x 110.0 cf + 14.9 cf Cap Volume x 2 x 6 Rows = 6,775.9 cf Chamber Storage

18,837.2 cf Field - 6,775.9 cf Chambers = 12,061.3 cf Stone x 40.0% Voids = 4,824.5 cf Stone Storage

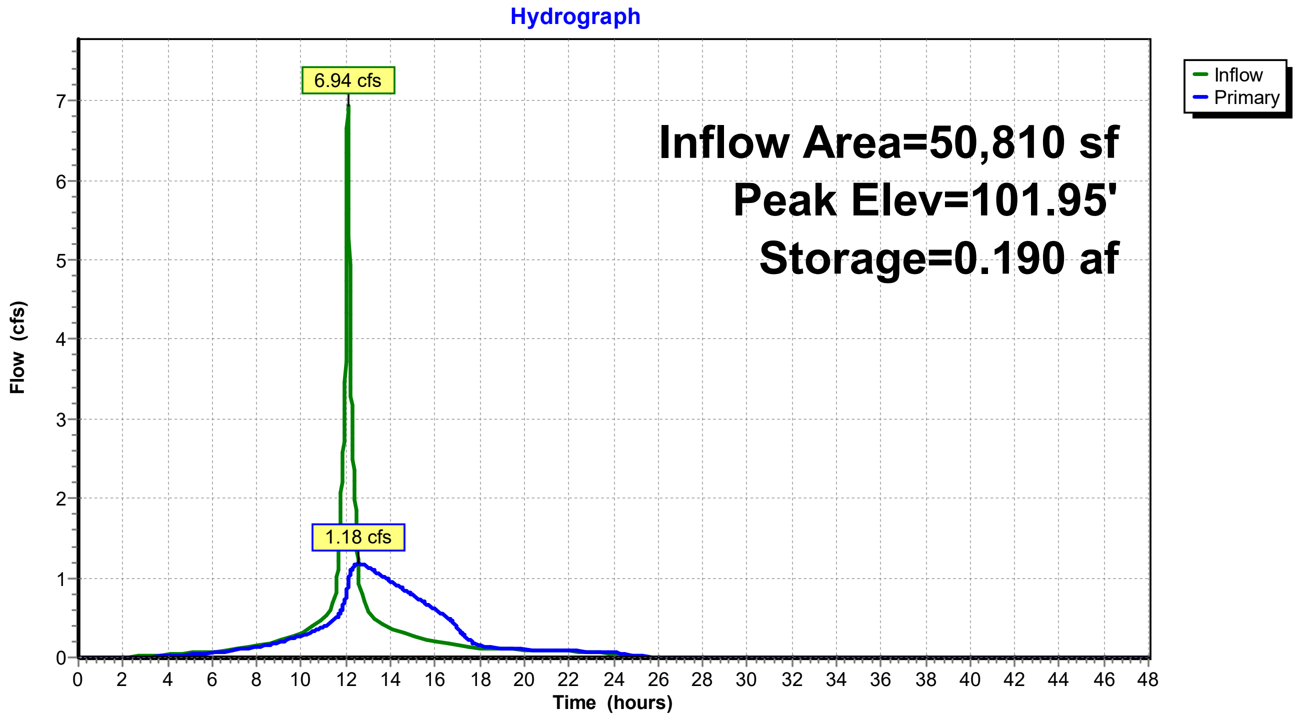
Chamber Storage + Stone Storage = 11,600.4 cf = 0.266 af
Overall Storage Efficiency = 61.6%
Overall System Size = 77.40' x 44.25' x 5.50'

60 Chambers
697.7 cy Field
446.7 cy Stone





Pond UG7: UG7


Hydrograph
6.94 cfs
1.18 cfs
Inflow Area=50,810 sf
Peak Elev=101.95'
Storage=0.190 af
Inflow
Primary
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 Subcatchment P1-1a: courtyard and retail park

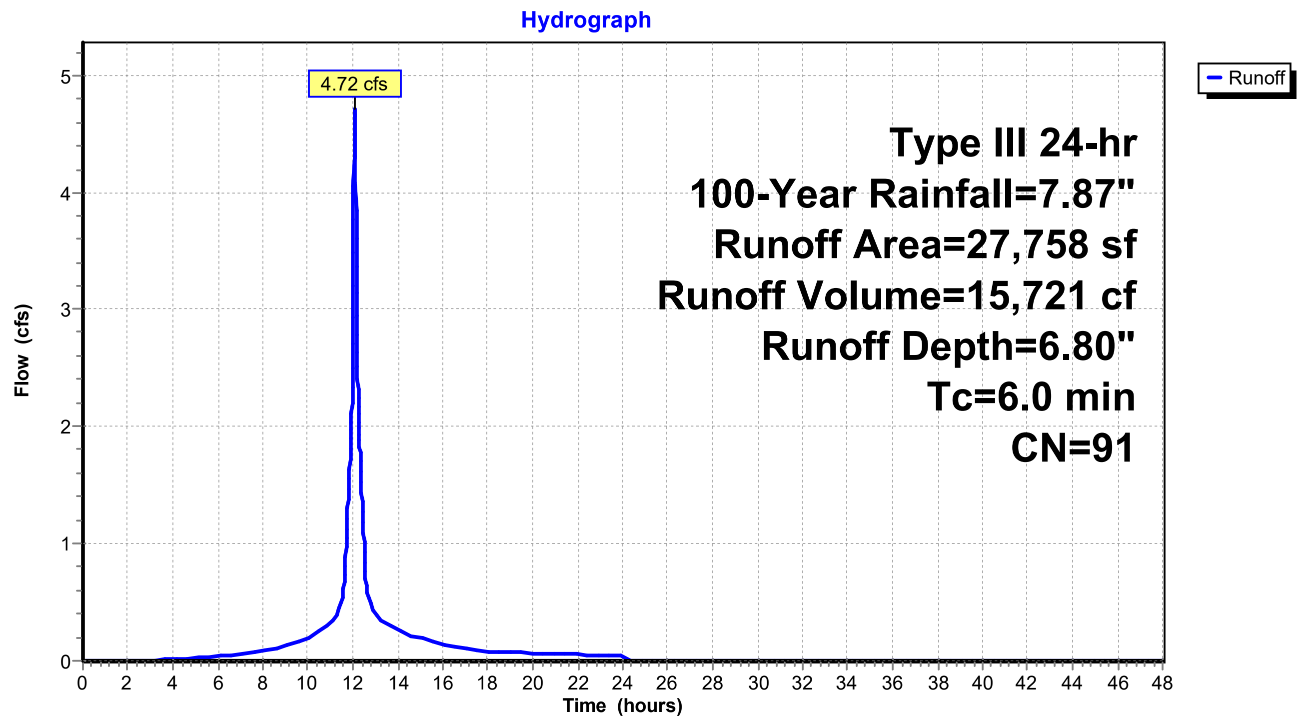
Runoff = 4.72 cfs @ 12.08 hrs, Volume= 15,721 cf, Depth= 6.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.87"

	Area (sf)	CN	Description
*	19,600	89	Courtyard, HSG D
	1,350	80	>75% Grass cover, Good, HSG D
*	6,808	98	Paved parking, HSG D
	27,758	91	Weighted Average
	20,950	88	75.47% Pervious Area
	6,808	98	24.53% Impervious Area

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

Subcatchment P1-1a: courtyard and retail park



Summary for Subcatchment P1-1b: roof

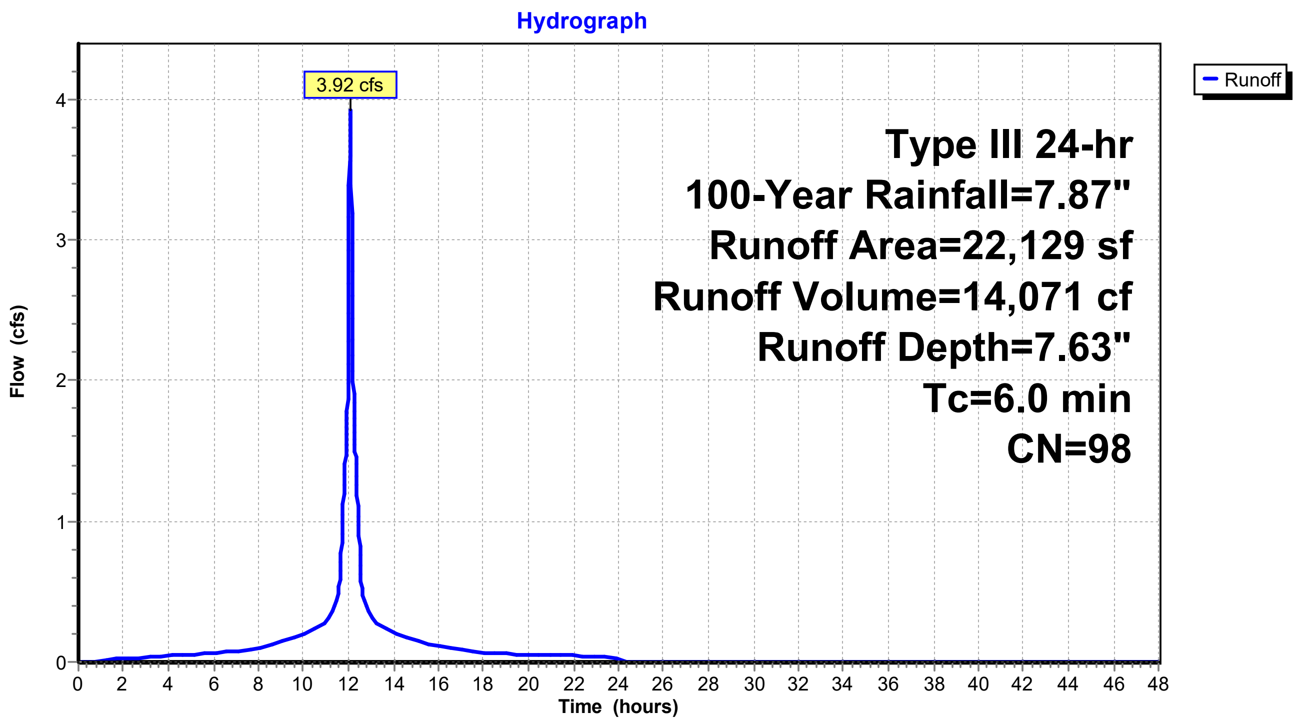
Runoff = 3.92 cfs @ 12.08 hrs, Volume= 14,071 cf, Depth= 7.63"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.87"

	Area (sf)	CN	Description
*	22,129	98	Roof, HSG D
	22,129	98	100.00% Impervious Area

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

Subcatchment P1-1b: roof



Summary for Subcatchment P1-2: P1-2

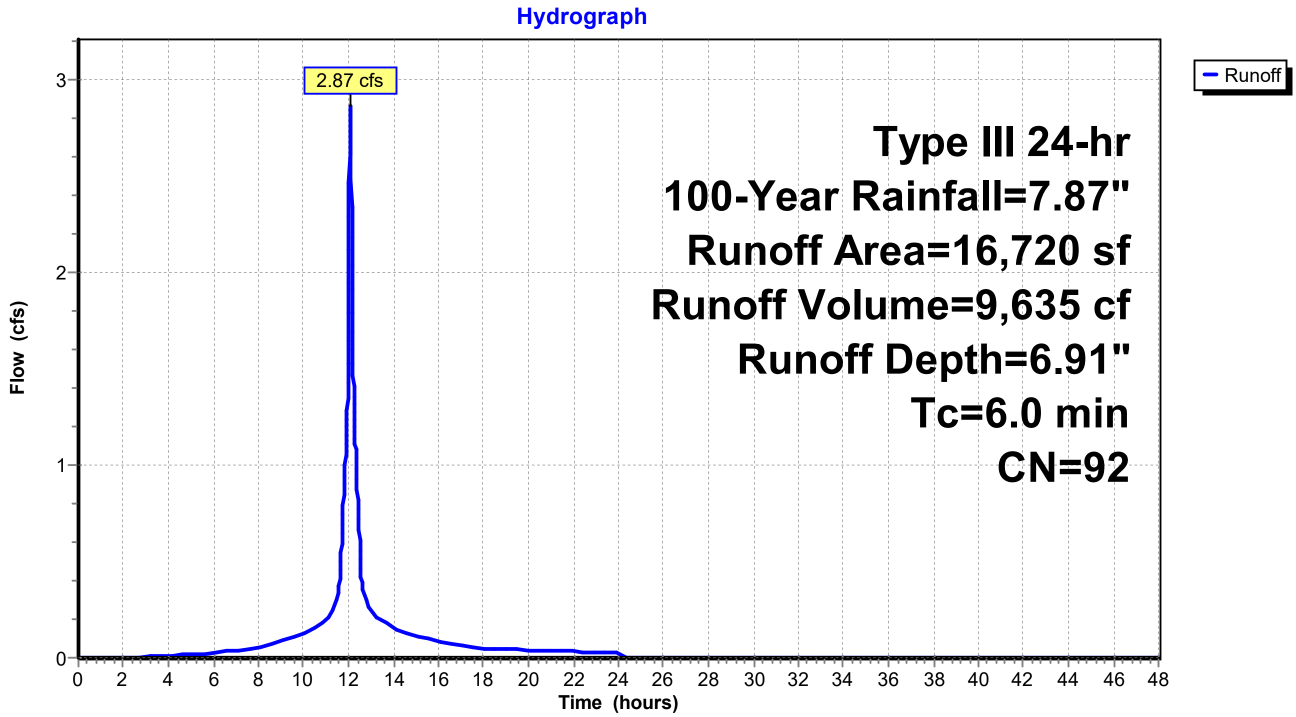
Runoff = 2.87 cfs @ 12.08 hrs, Volume= 9,635 cf, Depth= 6.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.87"

	Area (sf)	CN	Description
	5,213	80	>75% Grass cover, Good, HSG D
*	11,507	98	Roof & Paved parking, HSG D
	16,720	92	Weighted Average
	5,213	80	31.18% Pervious Area
	11,507	98	68.82% Impervious Area

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

Subcatchment P1-2: P1-2



Summary for Subcatchment P1-3: P1-3

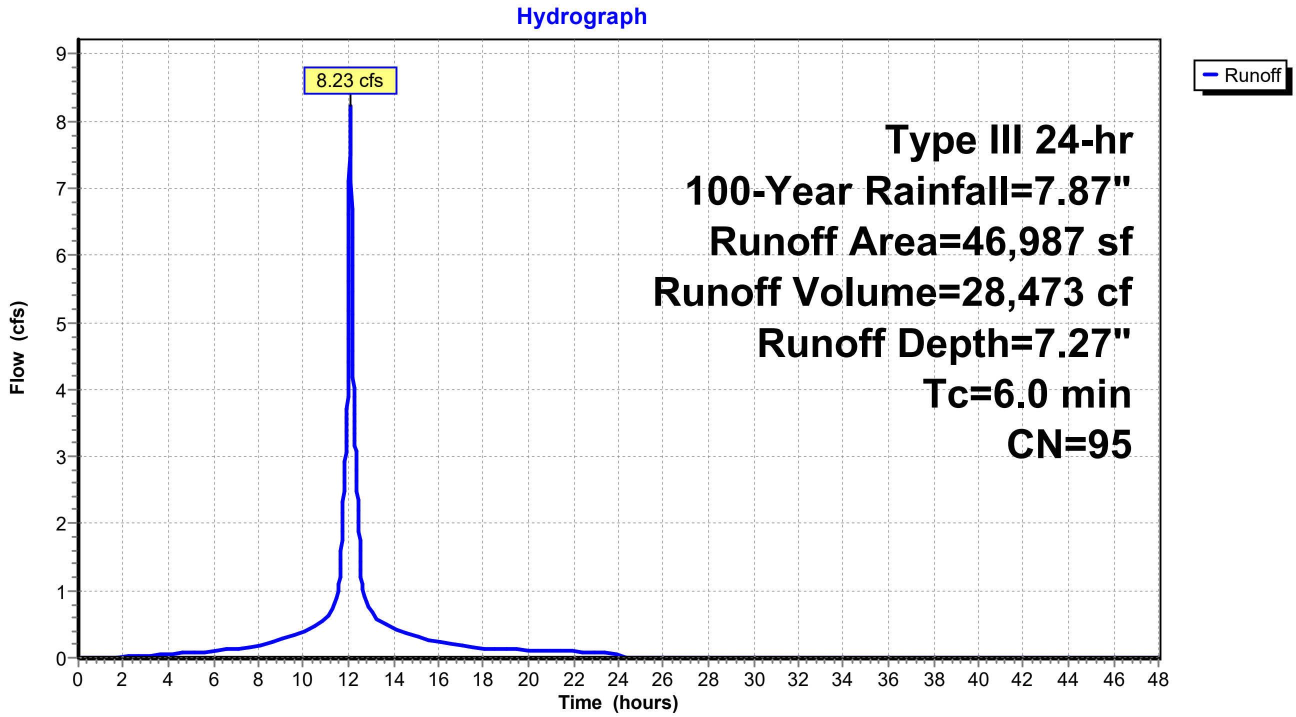
Runoff = 8.23 cfs @ 12.08 hrs, Volume= 28,473 cf, Depth= 7.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.87"

	Area (sf)	CN	Description
*	39,413	98	Roofs & Pavement, HSG D
	7,574	80	>75% Grass cover, Good, HSG D
	46,987	95	Weighted Average
	7,574	80	16.12% Pervious Area
	39,413	98	83.88% Impervious Area

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

Subcatchment P1-3: P1-3



Summary for Subcatchment P1-4: P1-4

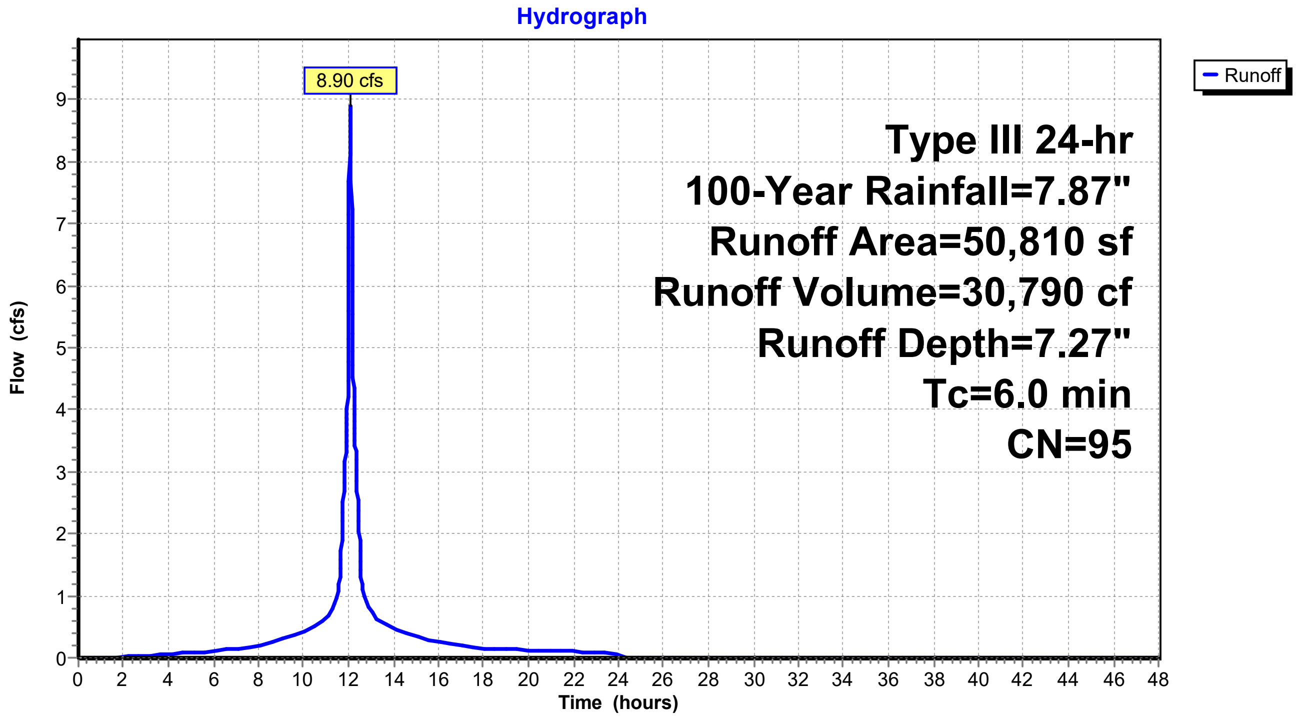
Runoff = 8.90 cfs @ 12.08 hrs, Volume= 30,790 cf, Depth= 7.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.87"

	Area (sf)	CN	Description
*	41,376	98	Roofs & Pavement, HSG D
	9,434	80	>75% Grass cover, Good, HSG D
	50,810	95	Weighted Average
	9,434	80	18.57% Pervious Area
	41,376	98	81.43% Impervious Area

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

Subcatchment P1-4: P1-4



Summary for Subcatchment P1-U1: P1-U1

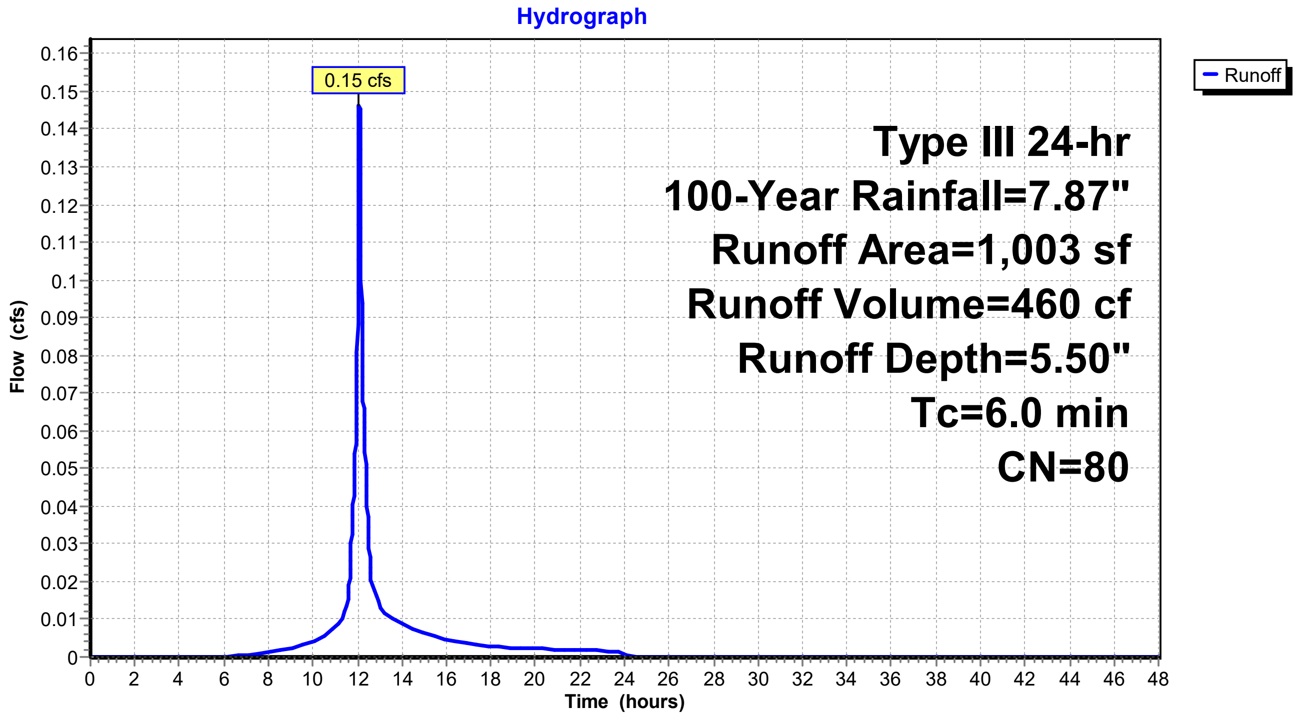
Runoff = 0.15 cfs @ 12.09 hrs, Volume= 460 cf, Depth= 5.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.87"

Area (sf)	CN	Description
1,003	80	>75% Grass cover, Good, HSG D
1,003	80	100.00% Pervious Area

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

Subcatchment P1-U1: P1-U1



Summary for Subcatchment P1-U2: P1-U2

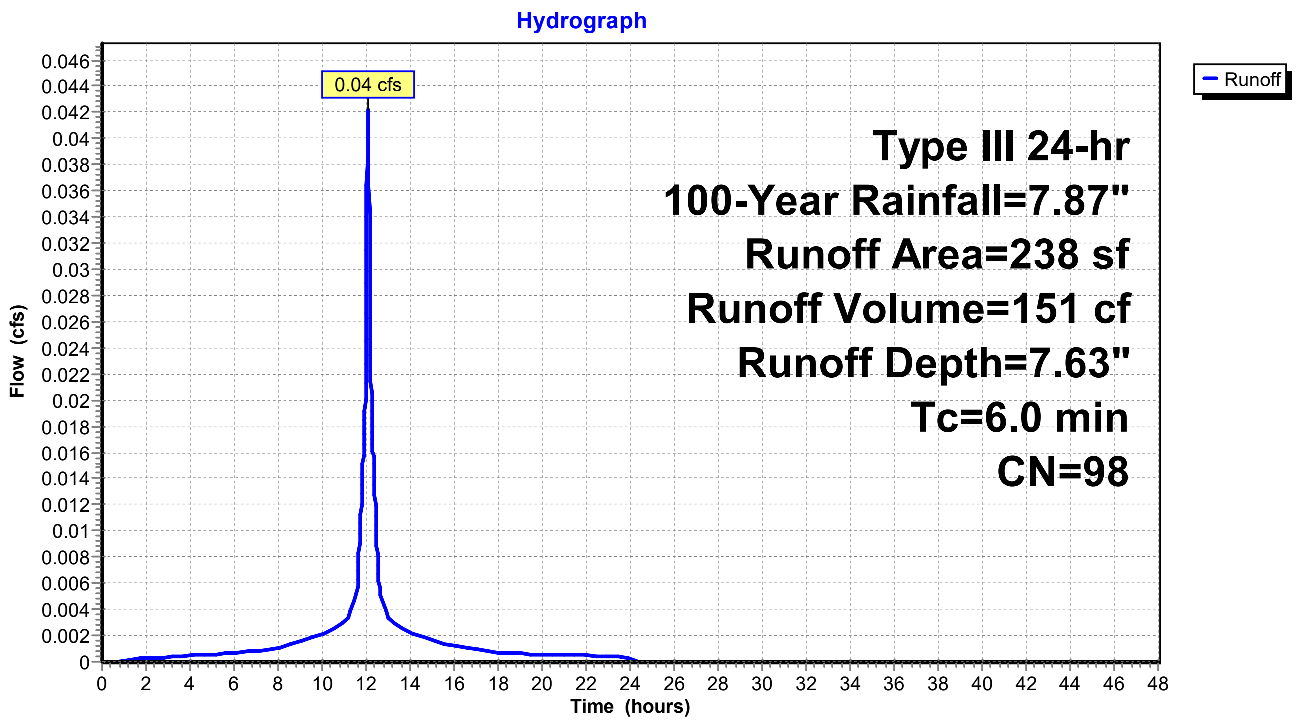
Runoff = 0.04 cfs @ 12.08 hrs, Volume= 151 cf, Depth= 7.63"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.87"

	Area (sf)	CN	Description
*	238	98	Pavement, HSG D
	238	98	100.00% Impervious Area

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

Subcatchment P1-U2: P1-U2



Summary for Subcatchment P1-U3: P1-U3

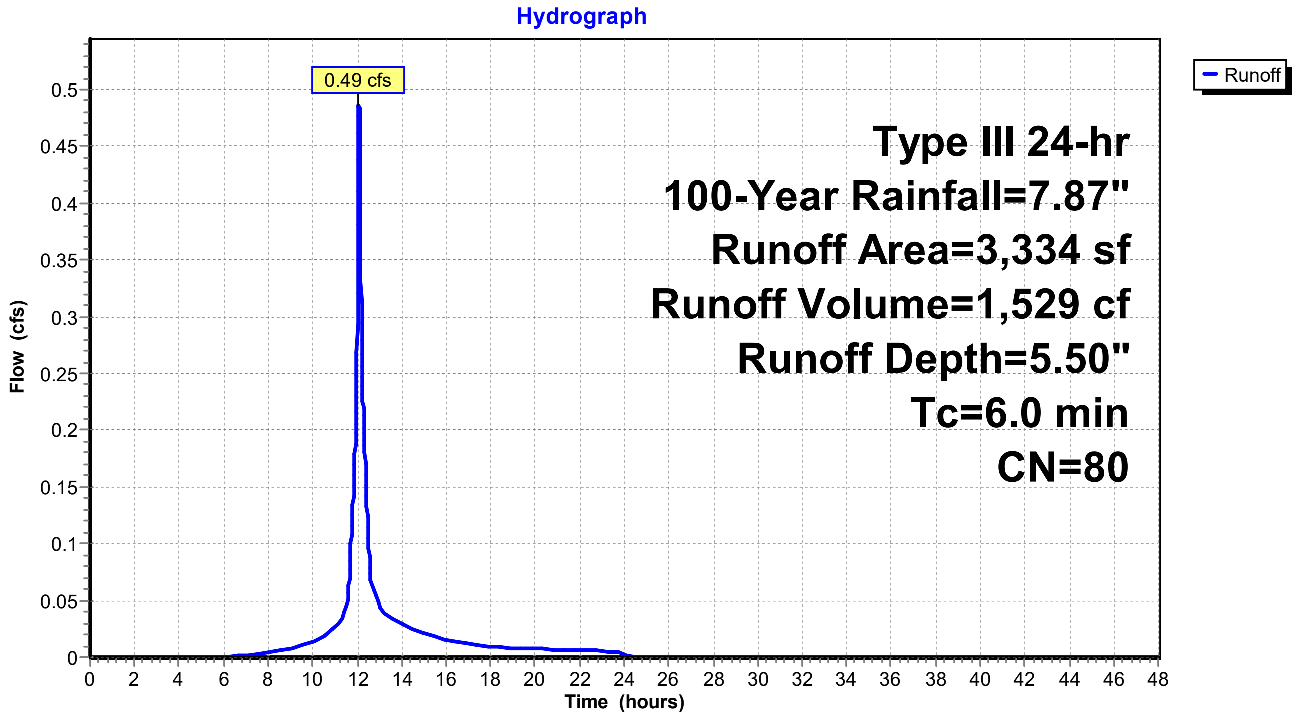
Runoff = 0.49 cfs @ 12.09 hrs, Volume= 1,529 cf, Depth= 5.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.87"

Area (sf)	CN	Description
3,334	80	>75% Grass cover, Good, HSG D
3,334	80	100.00% Pervious Area

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

Subcatchment P1-U3: P1-U3



Summary for Subcatchment P2: P2

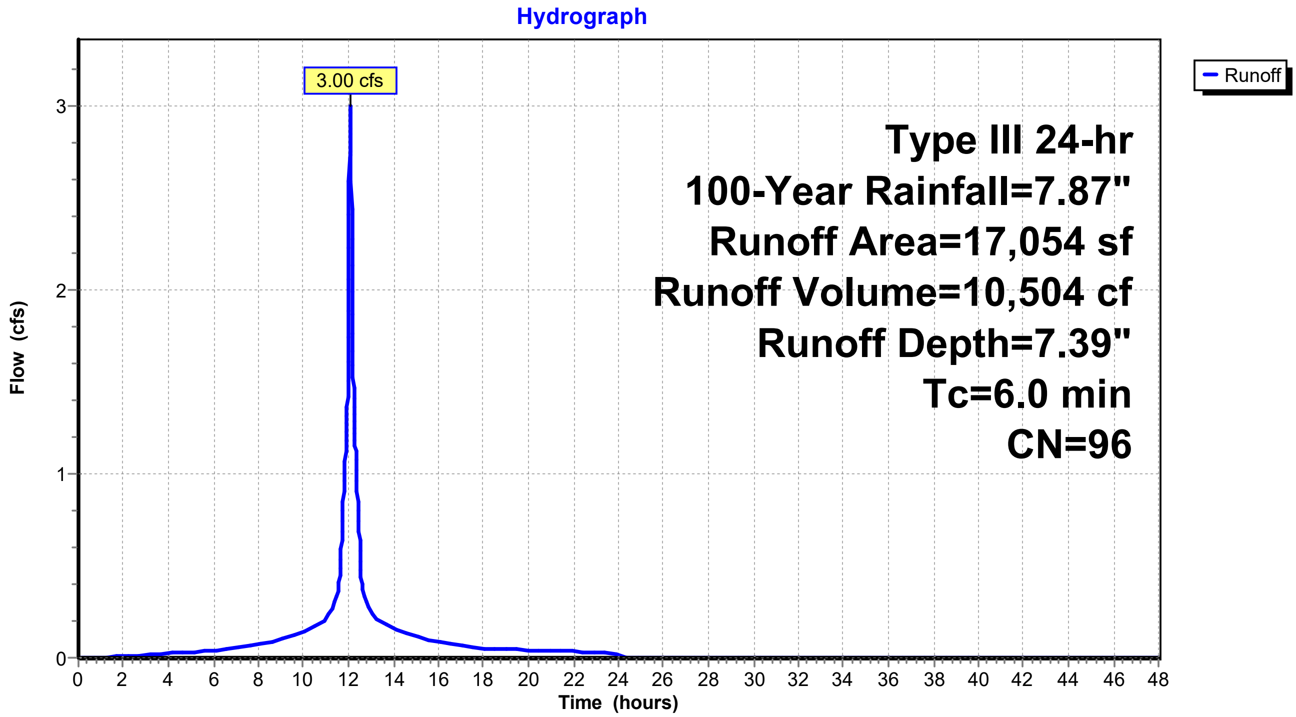
Runoff = 3.00 cfs @ 12.08 hrs, Volume= 10,504 cf, Depth= 7.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.87"

	Area (sf)	CN	Description
*	15,010	98	Pavement, HSG D
	2,044	80	>75% Grass cover, Good, HSG D
	17,054	96	Weighted Average
	2,044	80	11.99% Pervious Area
	15,010	98	88.01% Impervious Area

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

Subcatchment P2: P2



Summary for Subcatchment P2-R: P2-ROOF

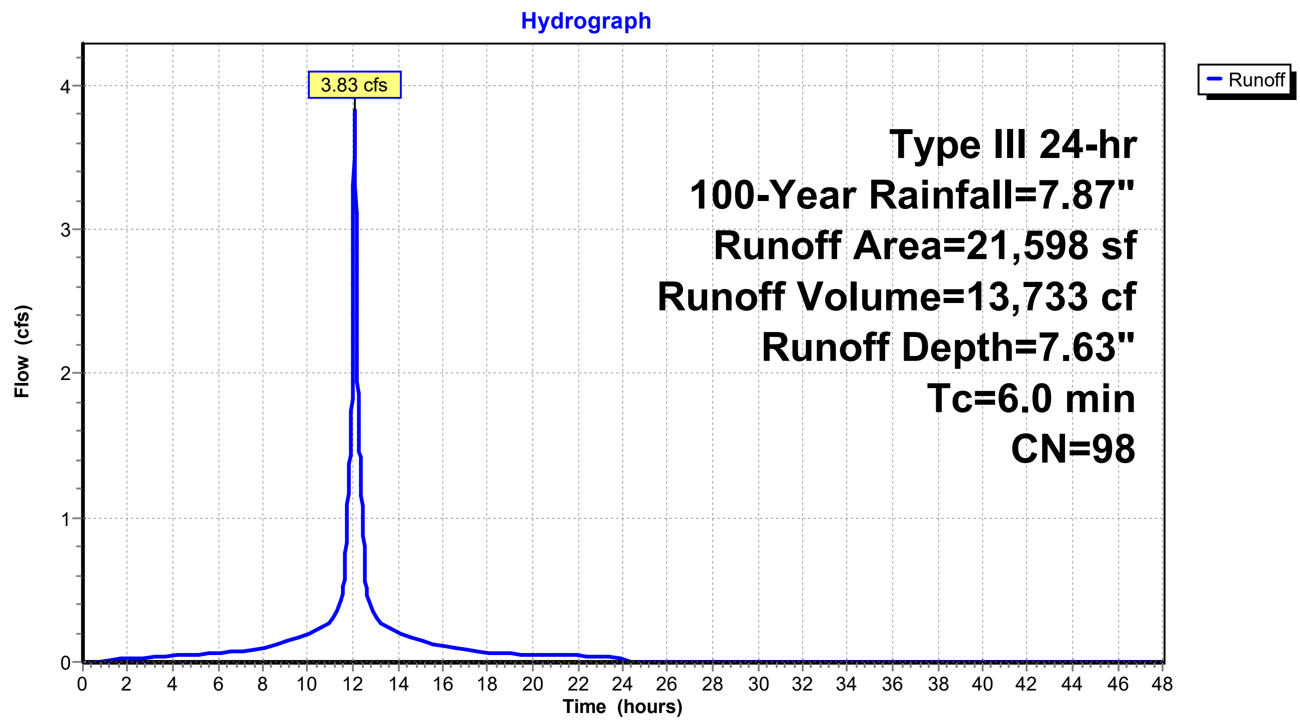
Runoff = 3.83 cfs @ 12.08 hrs, Volume= 13,733 cf, Depth= 7.63"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.87"

	Area (sf)	CN	Description
*	21,598	98	Roofs & Pavement, HSG D
	21,598	98	100.00% Impervious Area

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

Subcatchment P2-R: P2-ROOF



Summary for Subcatchment P2-U: P-2U

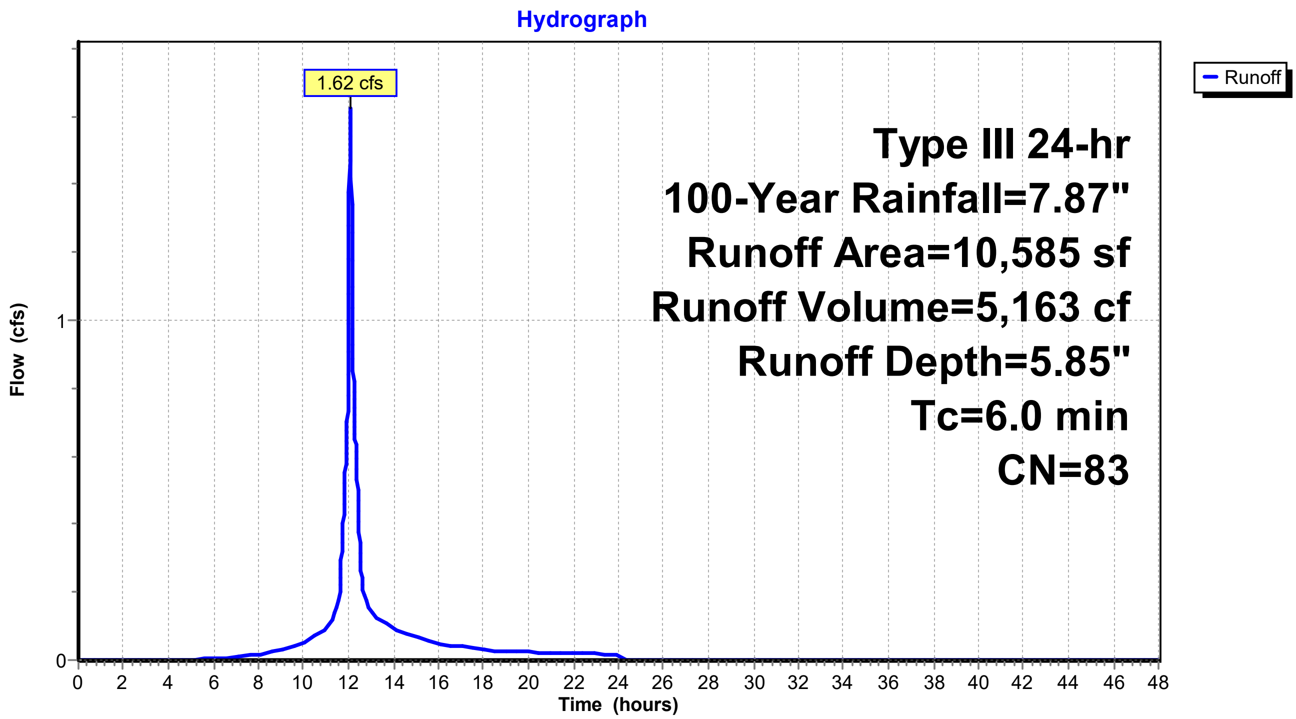
Runoff = 1.62 cfs @ 12.09 hrs, Volume= 5,163 cf, Depth= 5.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.87"

	Area (sf)	CN	Description
*	183	98	Ledge, HSG D
	6,620	77	Woods, Good, HSG D
*	2,902	98	Wetland Surface, HSG D
	880	78	Meadow, non-grazed, HSG D
	10,585	83	Weighted Average
	7,500	77	70.85% Pervious Area
	3,085	98	29.15% Impervious Area

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

Subcatchment P2-U: P-2U



Summary for Subcatchment P3: P3

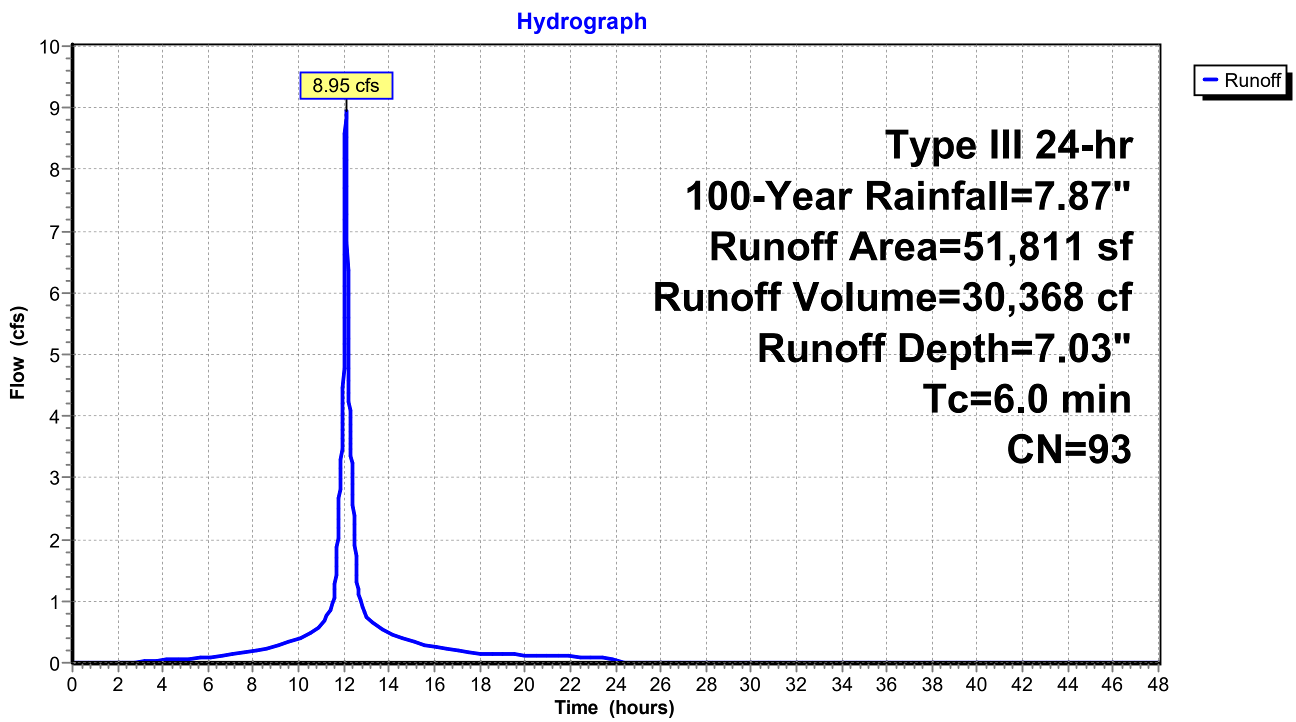
Runoff = 8.95 cfs @ 12.08 hrs, Volume= 30,368 cf, Depth= 7.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.87"

	Area (sf)	CN	Description
*	37,149	98	Roofs & Pavement, HSG D
	14,662	80	>75% Grass cover, Good, HSG D
	51,811	93	Weighted Average
	14,662	80	28.30% Pervious Area
	37,149	98	71.70% Impervious Area

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

Subcatchment P3: P3



Summary for Subcatchment P3-U: P3-U

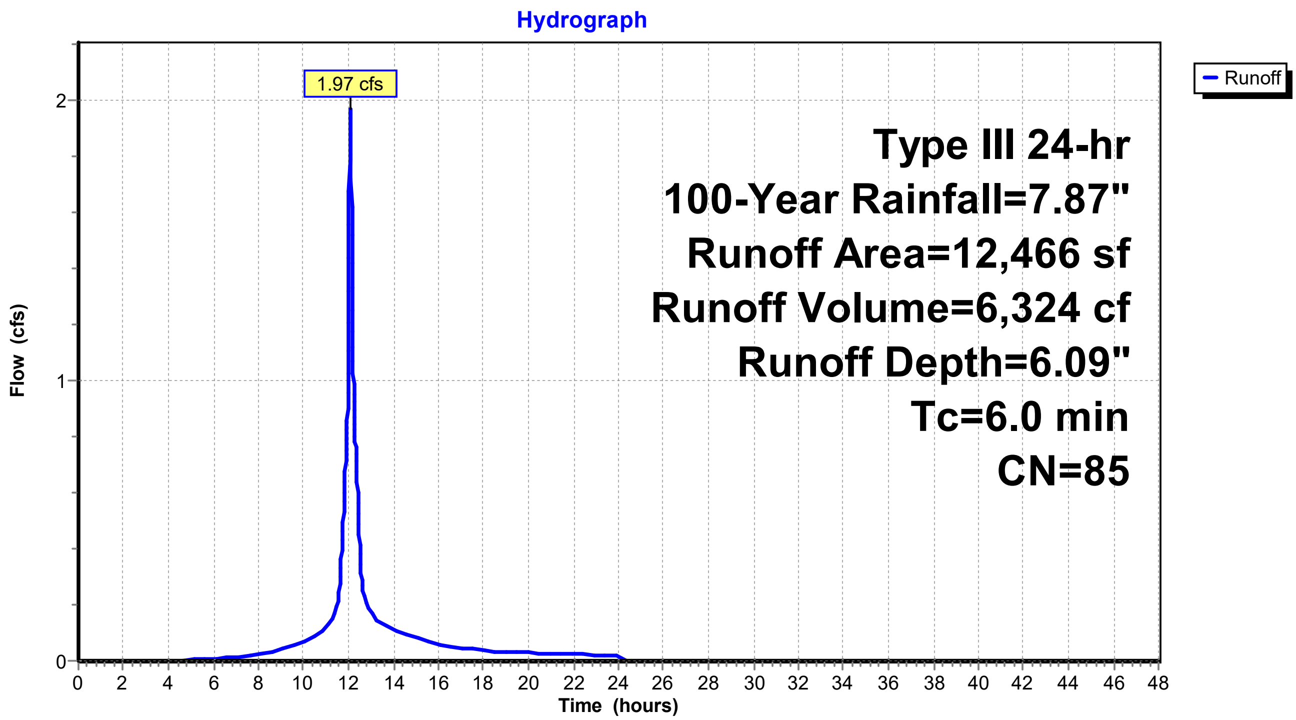
Runoff = 1.97 cfs @ 12.09 hrs, Volume= 6,324 cf, Depth= 6.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.87"

	Area (sf)	CN	Description
*	700	98	Ledge, HSG D
	7,809	77	Woods, Good, HSG D
*	3,957	98	Wetland Surface, HSG D
	12,466	85	Weighted Average
	7,809	77	62.64% Pervious Area
	4,657	98	37.36% Impervious Area

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

Subcatchment P3-U: P3-U



Summary for Subcatchment P4: P4

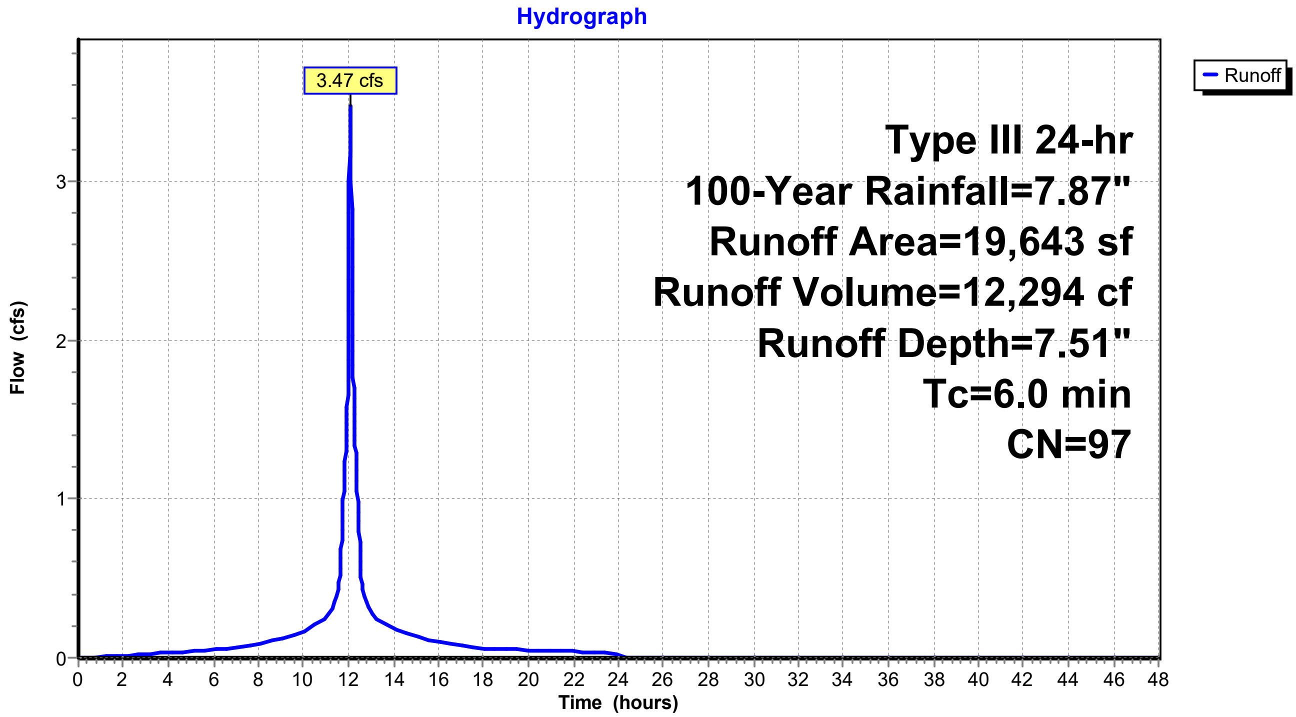
Runoff = 3.47 cfs @ 12.08 hrs, Volume= 12,294 cf, Depth= 7.51"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.87"

	Area (sf)	CN	Description
	1,577	80	>75% Grass cover, Good, HSG D
*	18,066	98	Roofs & Paved parking, HSG D
	19,643	97	Weighted Average
	1,577	80	8.03% Pervious Area
	18,066	98	91.97% Impervious Area

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

Subcatchment P4: P4



Summary for Subcatchment P4-U: P4-U

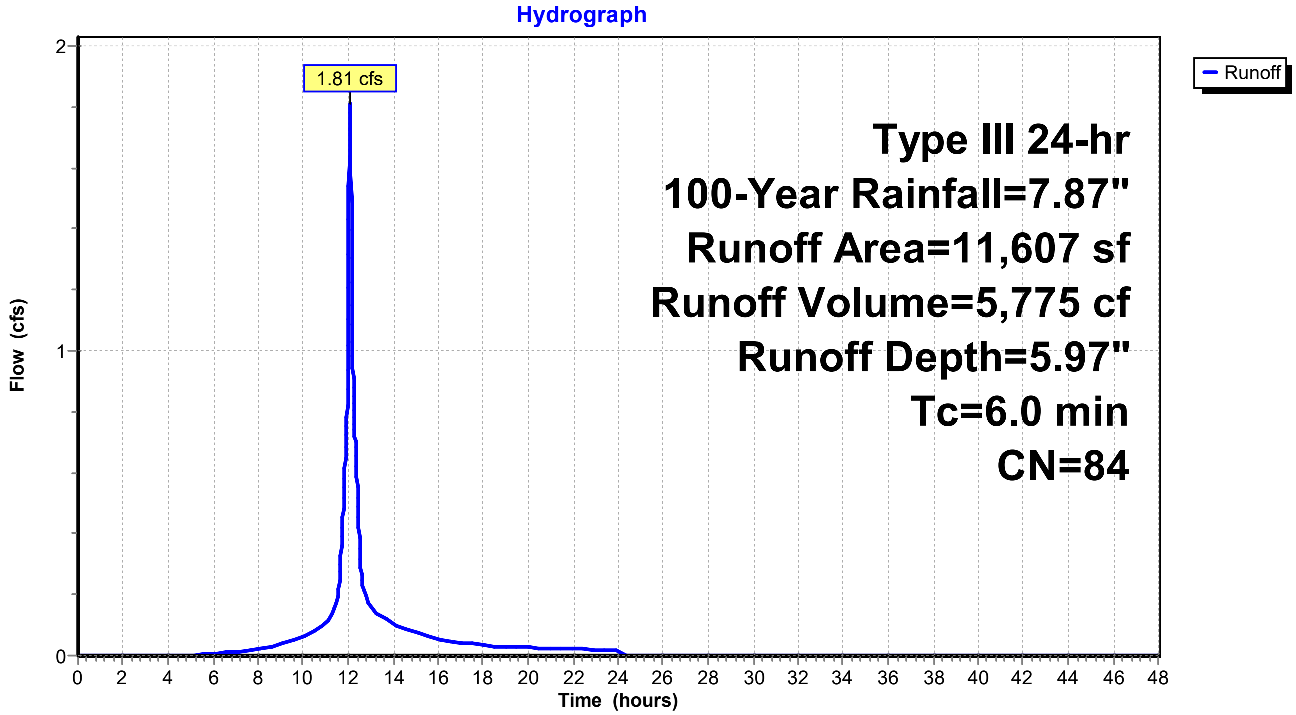
Runoff = 1.81 cfs @ 12.09 hrs, Volume= 5,775 cf, Depth= 5.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.87"

	Area (sf)	CN	Description
*	1,650	98	Ledge, HSG D
	7,547	77	Woods, Good, HSG D
*	2,410	98	Wetland Surface, HSG D
	11,607	84	Weighted Average
	7,547	77	65.02% Pervious Area
	4,060	98	34.98% Impervious Area

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

Subcatchment P4-U: P4-U



Summary for Subcatchment P5: P5

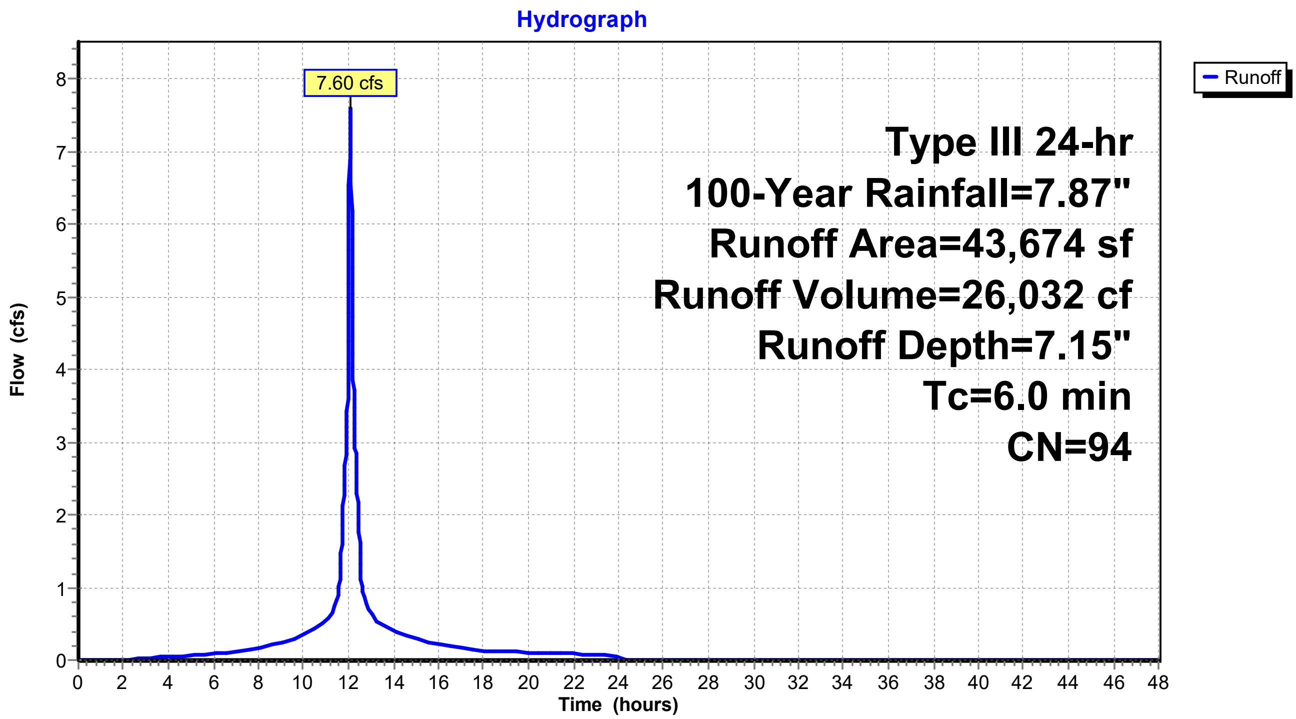
Runoff = 7.60 cfs @ 12.08 hrs, Volume= 26,032 cf, Depth= 7.15"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.87"

	Area (sf)	CN	Description
*	5,025	98	Ledge, HSG D
	7,050	80	>75% Grass cover, Good, HSG D
*	29,470	98	Paved parking, HSG D
	2,129	77	Woods, Good, HSG D
	43,674	94	Weighted Average
	9,179	79	21.02% Pervious Area
	34,495	98	78.98% Impervious Area

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

Subcatchment P5: P5



Summary for Subcatchment P5-U: P5-U

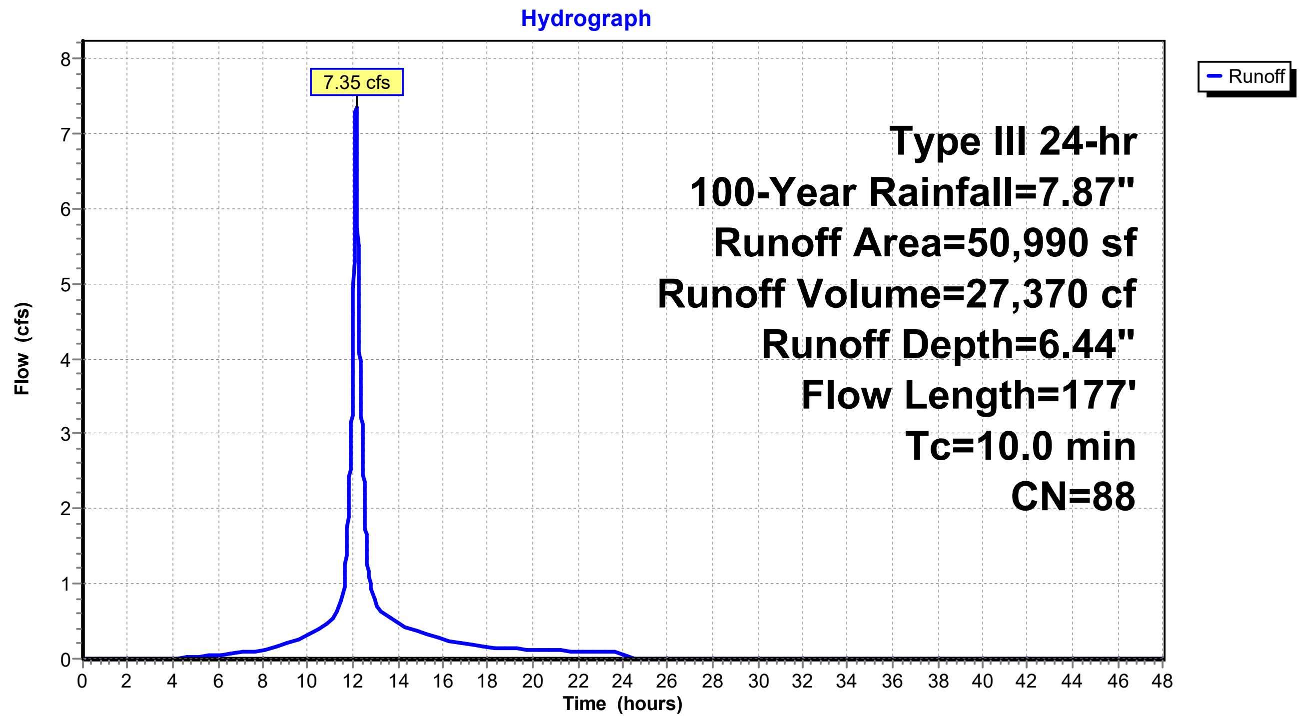
Runoff = 7.35 cfs @ 12.14 hrs, Volume= 27,370 cf, Depth= 6.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.87"

	Area (sf)	CN	Description
*	5,864	98	Ledge, HSG D
	12,095	77	Woods, Good, HSG D
*	20,323	98	Wetland Surface, HSG D
	12,708	78	Meadow, non-grazed, HSG D
	50,990	88	Weighted Average
	24,803	78	48.64% Pervious Area
	26,187	98	51.36% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	50	0.0500	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.40"
1.7	127	0.0620	1.24		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
10.0	177	Total			

Subcatchment P5-U: P5-U



Summary for Subcatchment P6-U: P6-U

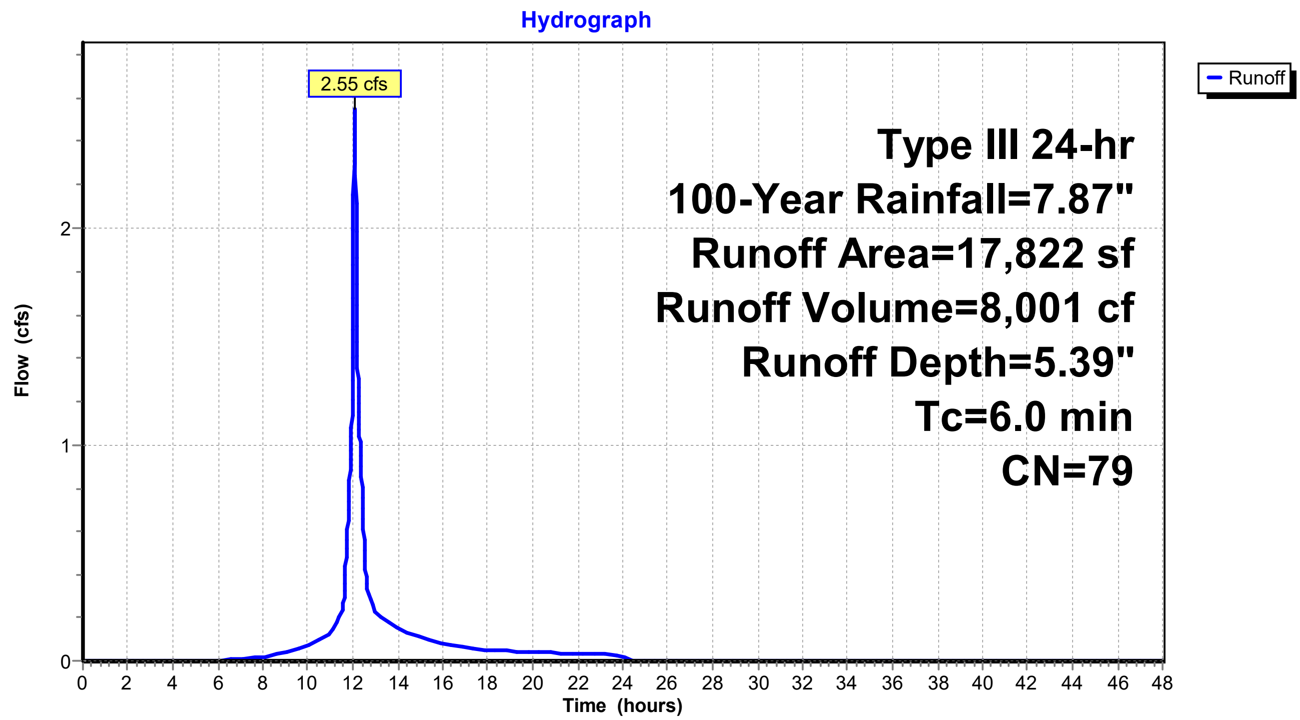
Runoff = 2.55 cfs @ 12.09 hrs, Volume= 8,001 cf, Depth= 5.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.87"

	Area (sf)	CN	Description
	15,225	77	Woods, Good, HSG D
	1,097	80	Pasture/grassland/range, Good, HSG D
*	1,500	98	Wetland Surface, HSG D
	17,822	79	Weighted Average
	16,322	77	91.58% Pervious Area
	1,500	98	8.42% Impervious Area

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

Subcatchment P6-U: P6-U

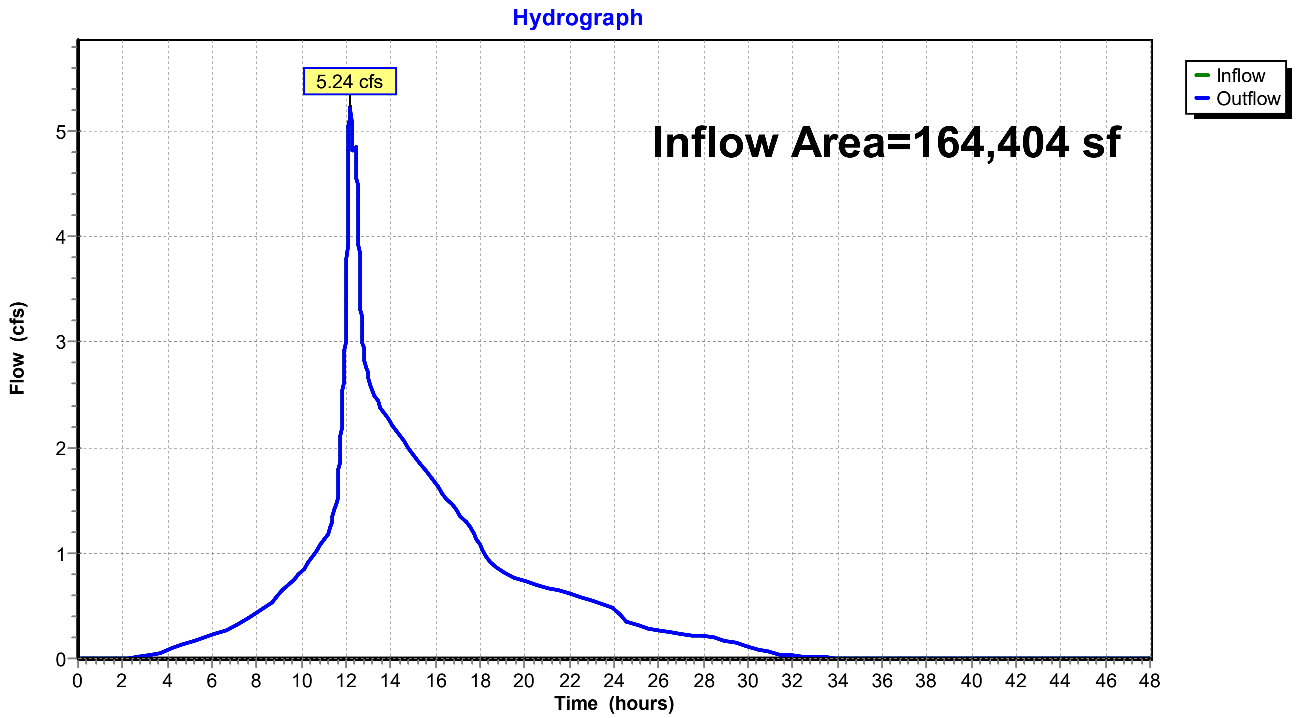


Summary for Reach DMH MS2: DMH MS2

Inflow Area = 164,404 sf, 73.74% Impervious, Inflow Depth = 6.22" for 100-Year event
Inflow = 5.24 cfs @ 12.17 hrs, Volume= 85,236 cf
Outflow = 5.24 cfs @ 12.17 hrs, Volume= 85,236 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach DMH MS2: DMH MS2

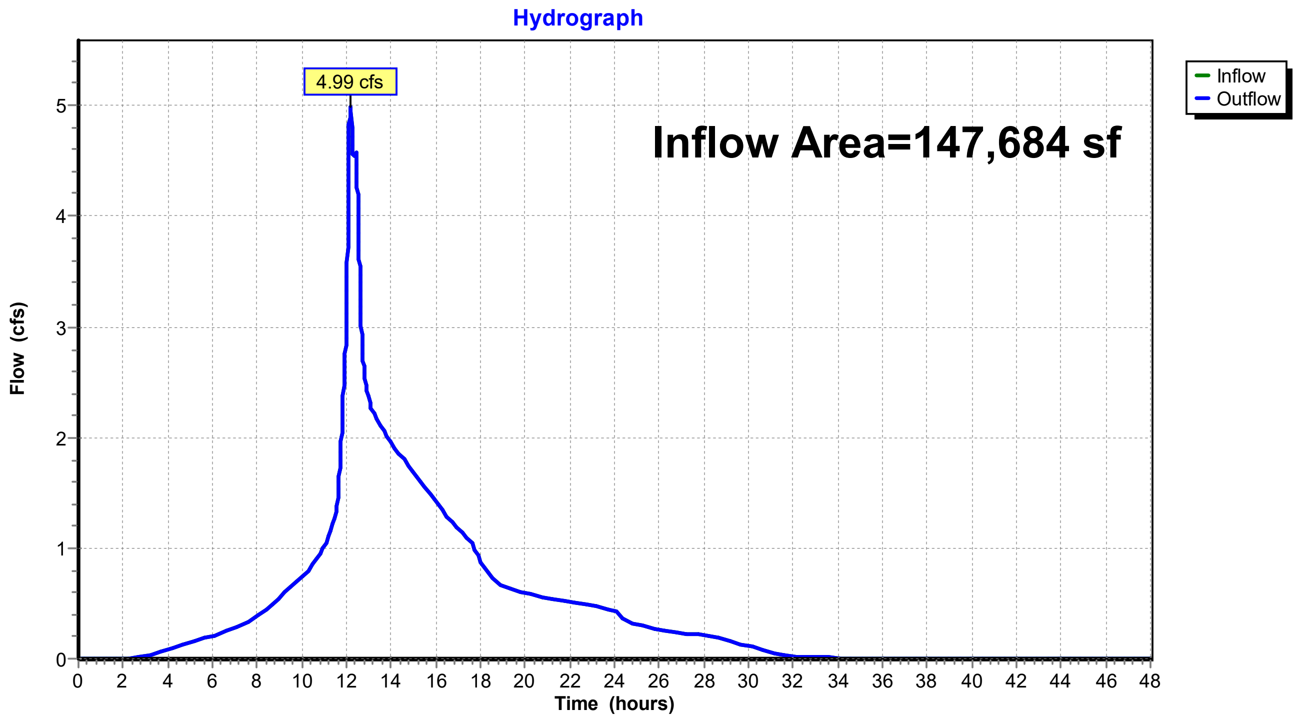


Summary for Reach DMH MS3: DMH MS3

Inflow Area = 147,684 sf, 74.30% Impervious, Inflow Depth = 6.14" for 100-Year event
Inflow = 4.99 cfs @ 12.17 hrs, Volume= 75,602 cf
Outflow = 4.99 cfs @ 12.17 hrs, Volume= 75,602 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach DMH MS3: DMH MS3

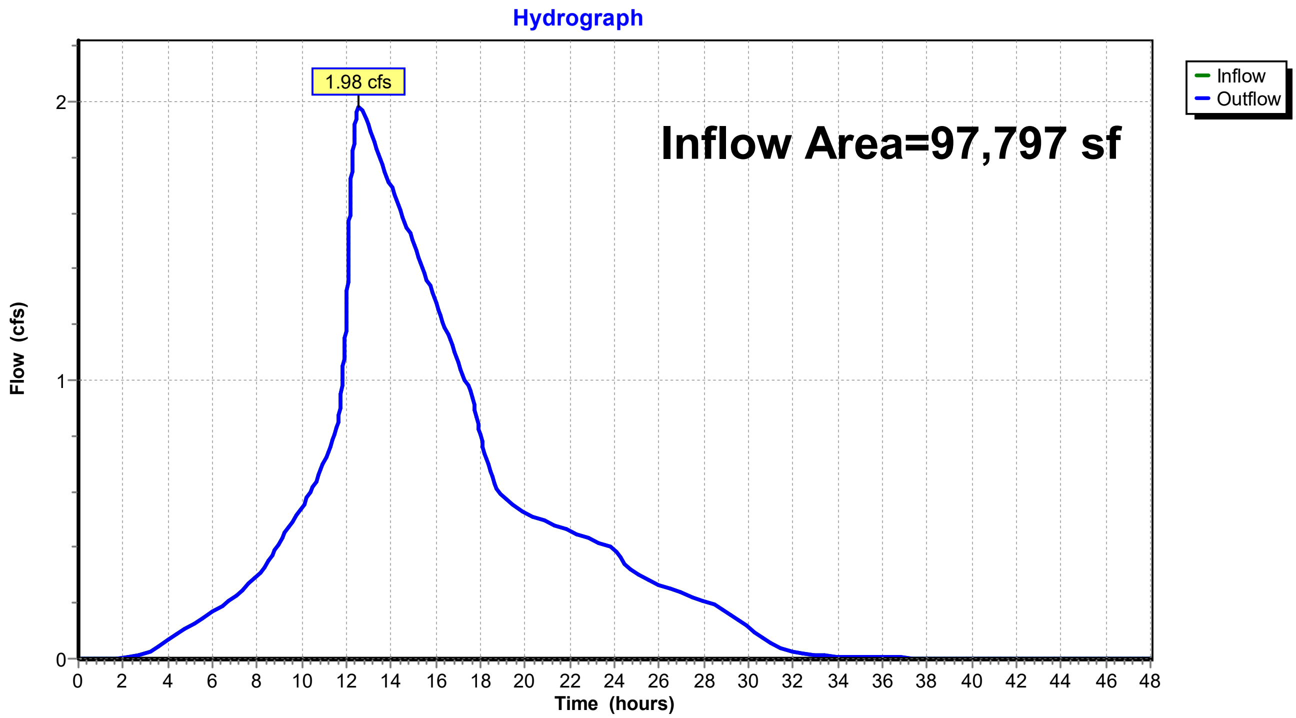


Summary for Reach DMH MS4: DMH MS4

Inflow Area =	97,797 sf,	82.61% Impervious,	Inflow Depth > 7.27"	for 100-Year event
Inflow =	1.98 cfs @	12.58 hrs, Volume=	59,260 cf	
Outflow =	1.98 cfs @	12.58 hrs, Volume=	59,260 cf, Atten= 0%, Lag= 0.0 min	

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach DMH MS4: DMH MS4

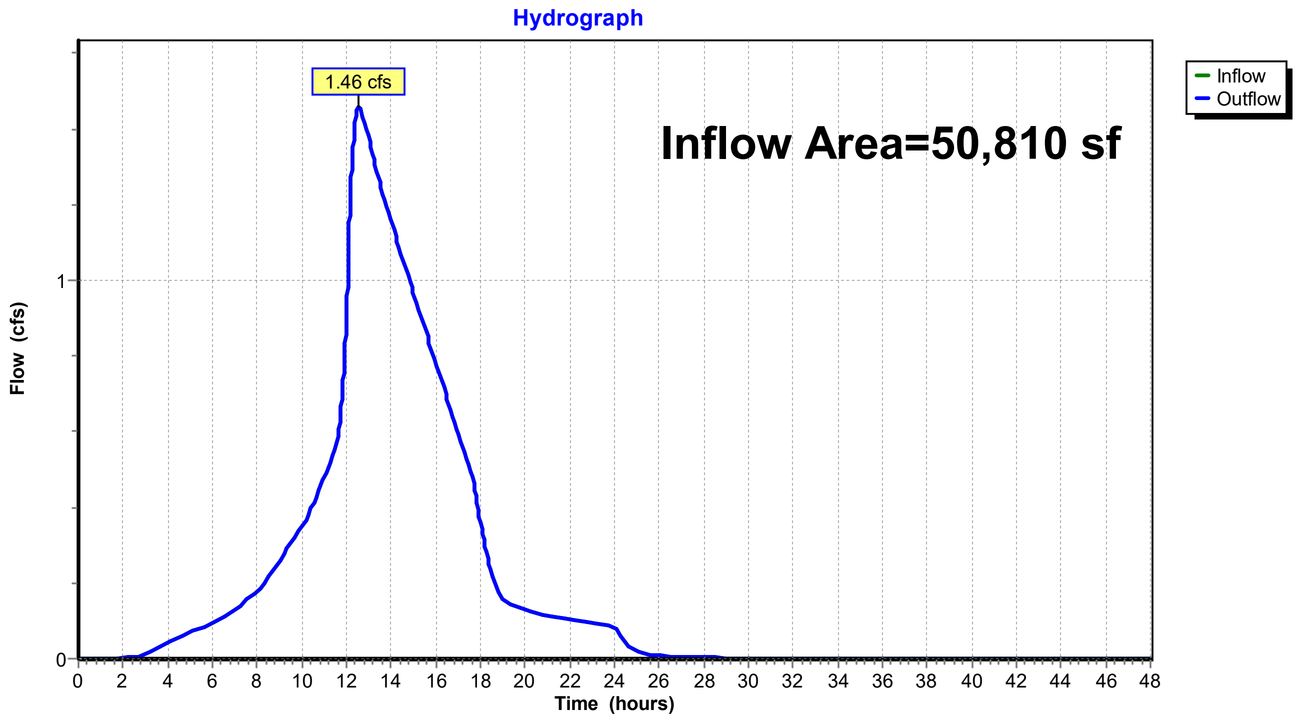


Summary for Reach DMH MS5: DMH MS5

Inflow Area =	50,810 sf,	81.43% Impervious,	Inflow Depth = 7.27"	for 100-Year event
Inflow =	1.46 cfs @	12.55 hrs, Volume=	30,790 cf	
Outflow =	1.46 cfs @	12.55 hrs, Volume=	30,790 cf, Atten= 0%,	Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach DMH MS5: DMH MS5

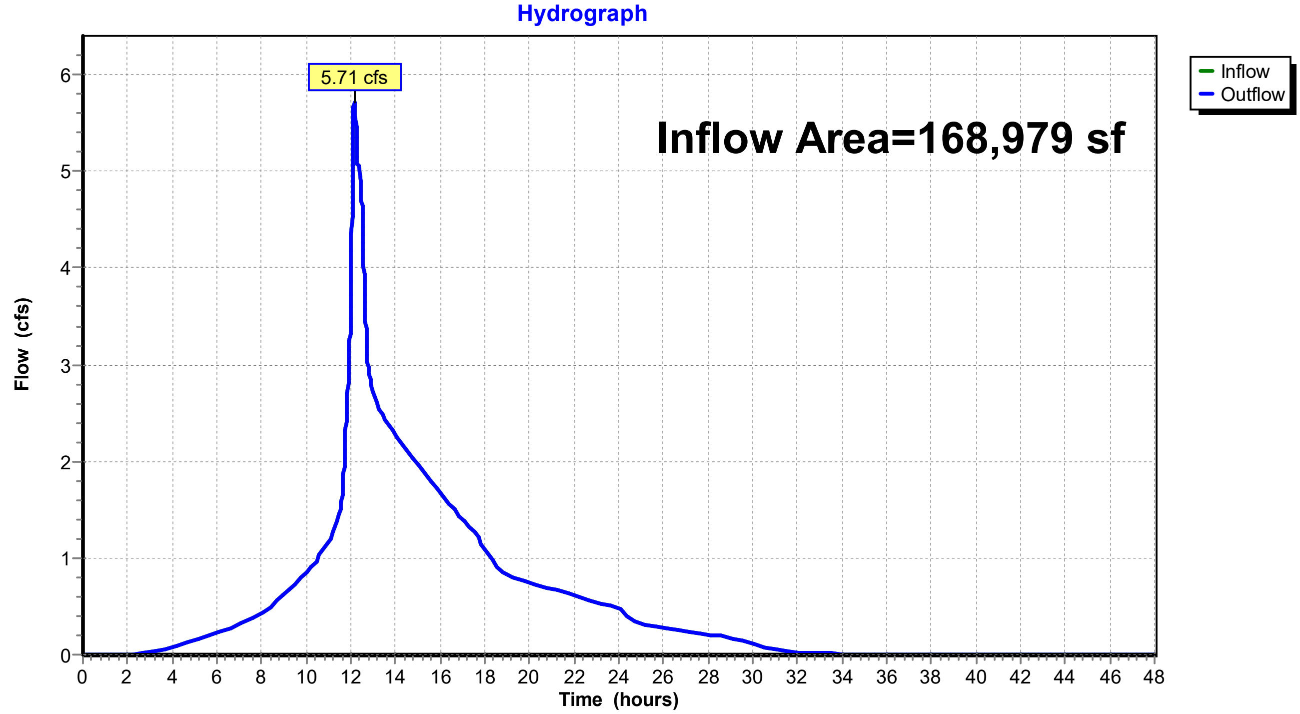


Summary for Reach PD1: WASHINGTON ROW

Inflow Area = 168,979 sf, 71.89% Impervious, Inflow Depth = 6.21" for 100-Year event
Inflow = 5.71 cfs @ 12.15 hrs, Volume= 87,376 cf
Outflow = 5.71 cfs @ 12.15 hrs, Volume= 87,376 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach PD1: WASHINGTON ROW

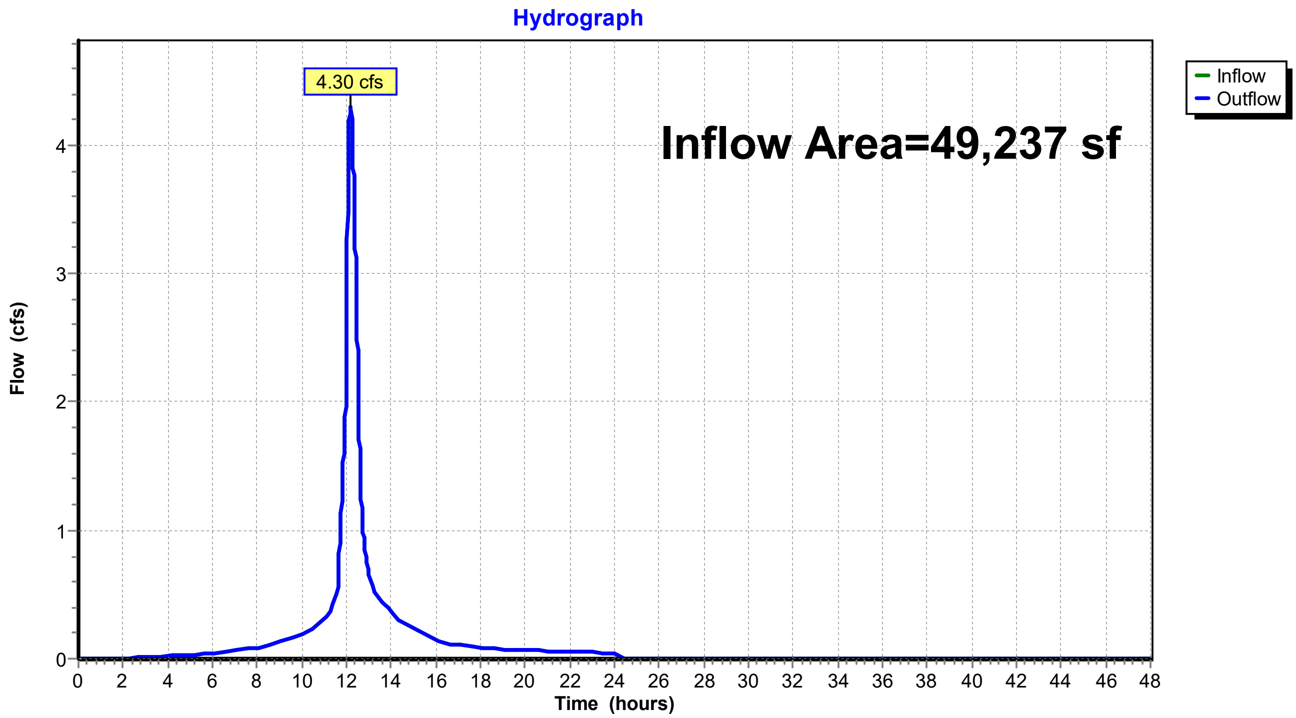


Summary for Reach PD2: Wetland series "A"

Inflow Area =	49,237 sf, 80.62% Impervious,	Inflow Depth = 4.76"	for 100-Year event
Inflow =	4.30 cfs @ 12.18 hrs, Volume=	19,528 cf	
Outflow =	4.30 cfs @ 12.18 hrs, Volume=	19,528 cf, Atten= 0%, Lag= 0.0 min	

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach PD2: Wetland series "A"

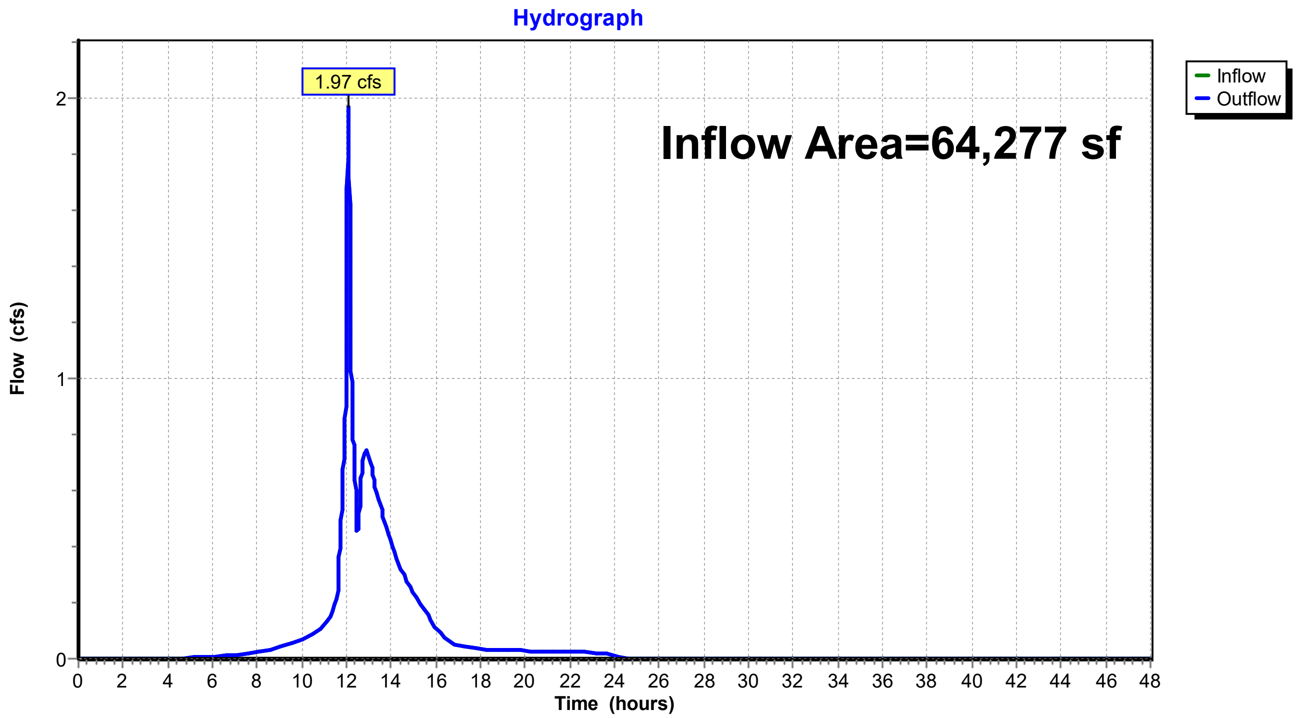


Summary for Reach PD3: Intermittent Stream

Inflow Area = 64,277 sf, 65.04% Impervious, Inflow Depth = 1.83" for 100-Year event
Inflow = 1.97 cfs @ 12.09 hrs, Volume= 9,819 cf
Outflow = 1.97 cfs @ 12.09 hrs, Volume= 9,819 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach PD3: Intermittent Stream

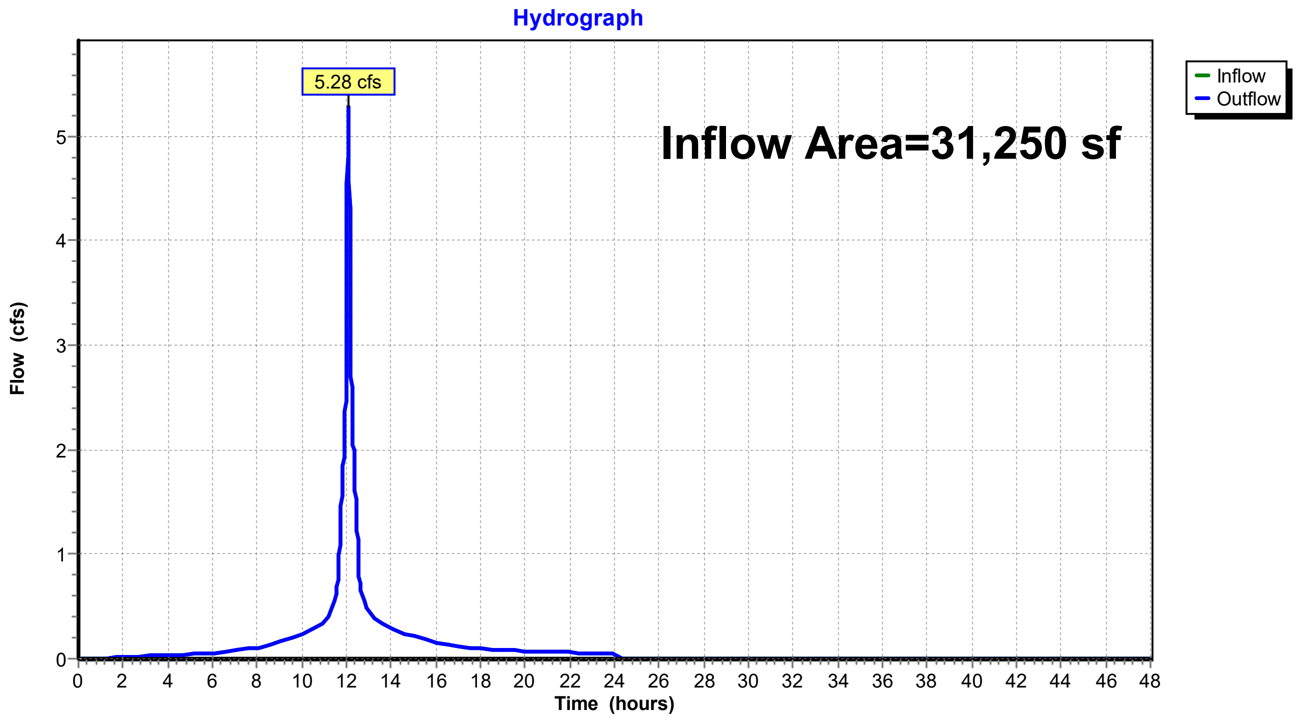


Summary for Reach PD4: Wetland series "B"

Inflow Area =	31,250 sf,	70.80% Impervious,	Inflow Depth = 6.94"	for 100-Year event
Inflow =	5.28 cfs @	12.08 hrs, Volume=	18,069 cf	
Outflow =	5.28 cfs @	12.08 hrs, Volume=	18,069 cf, Atten= 0%, Lag= 0.0 min	

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach PD4: Wetland series "B"

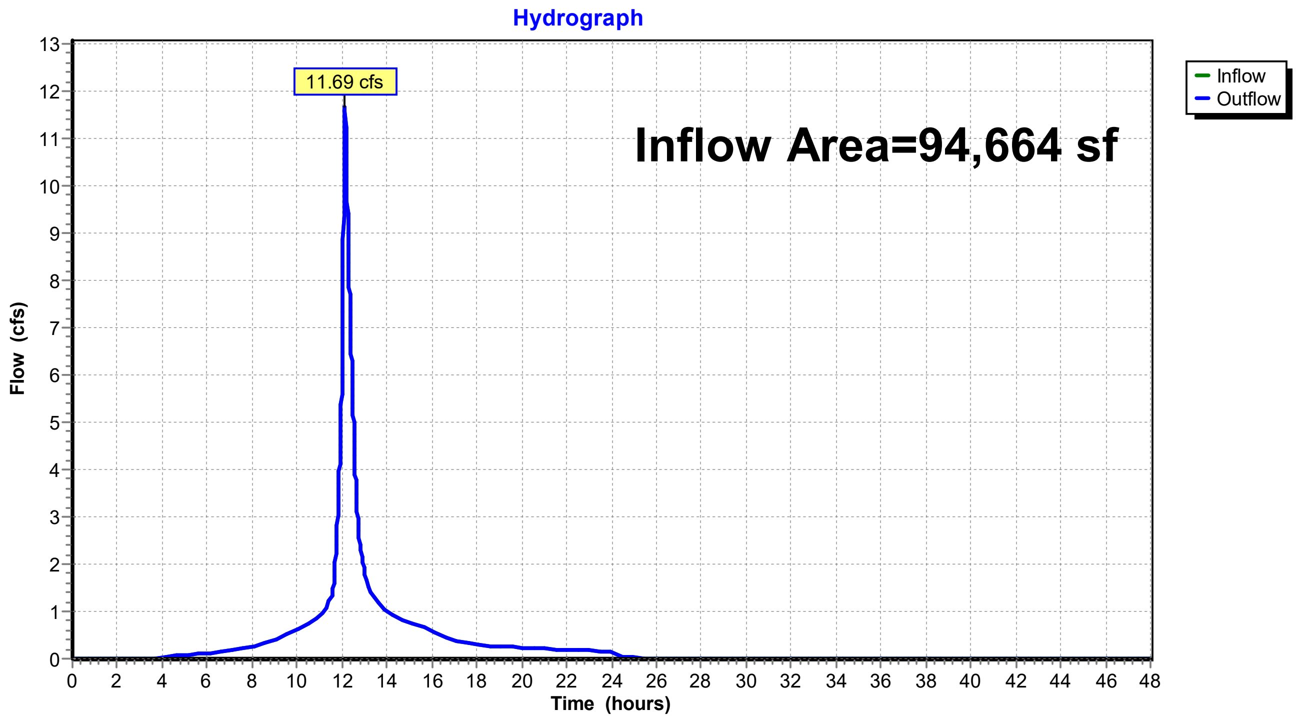


Summary for Reach PD5: Wetland series "E"

Inflow Area =	94,664 sf,	64.10% Impervious,	Inflow Depth = 6.77"	for 100-Year event
Inflow =	11.69 cfs @	12.14 hrs, Volume=	53,396 cf	
Outflow =	11.69 cfs @	12.14 hrs, Volume=	53,396 cf, Atten= 0%, Lag= 0.0 min	

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach PD5: Wetland series "E"

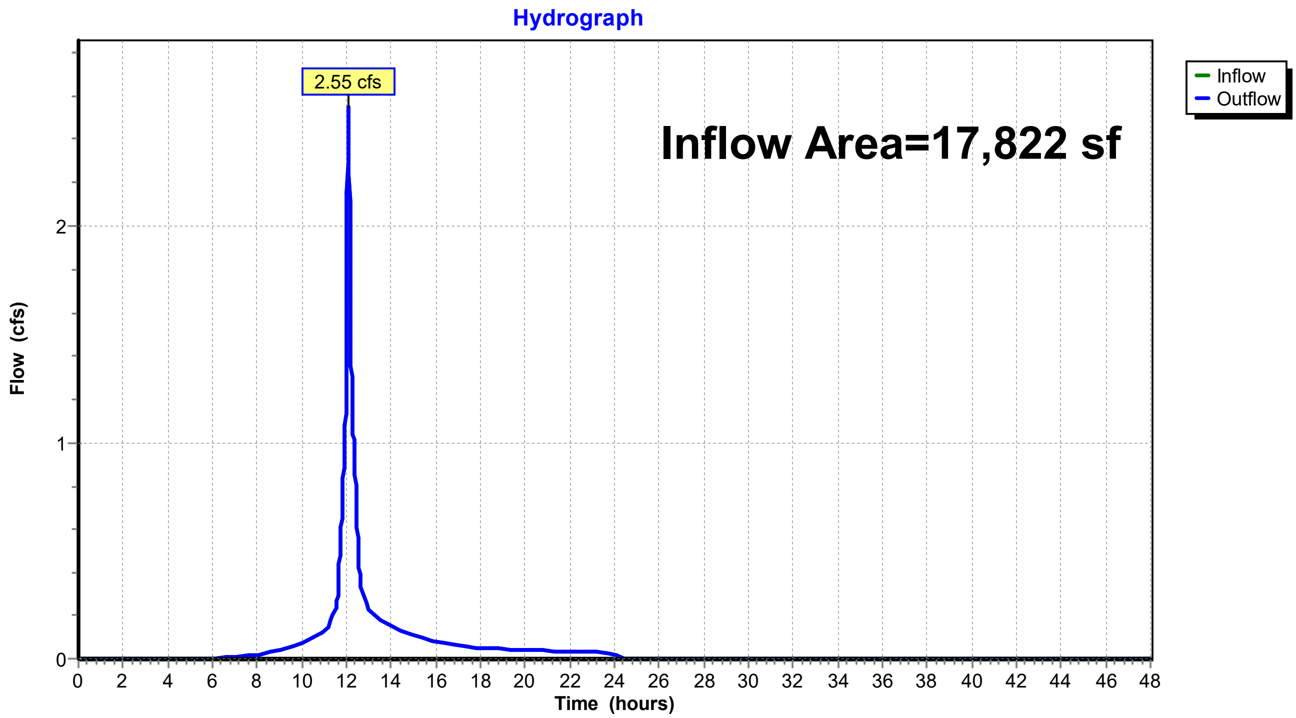


Summary for Reach PD6: Wetland series "F"

Inflow Area = 17,822 sf, 8.42% Impervious, Inflow Depth = 5.39" for 100-Year event
Inflow = 2.55 cfs @ 12.09 hrs, Volume= 8,001 cf
Outflow = 2.55 cfs @ 12.09 hrs, Volume= 8,001 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach PD6: Wetland series "F"

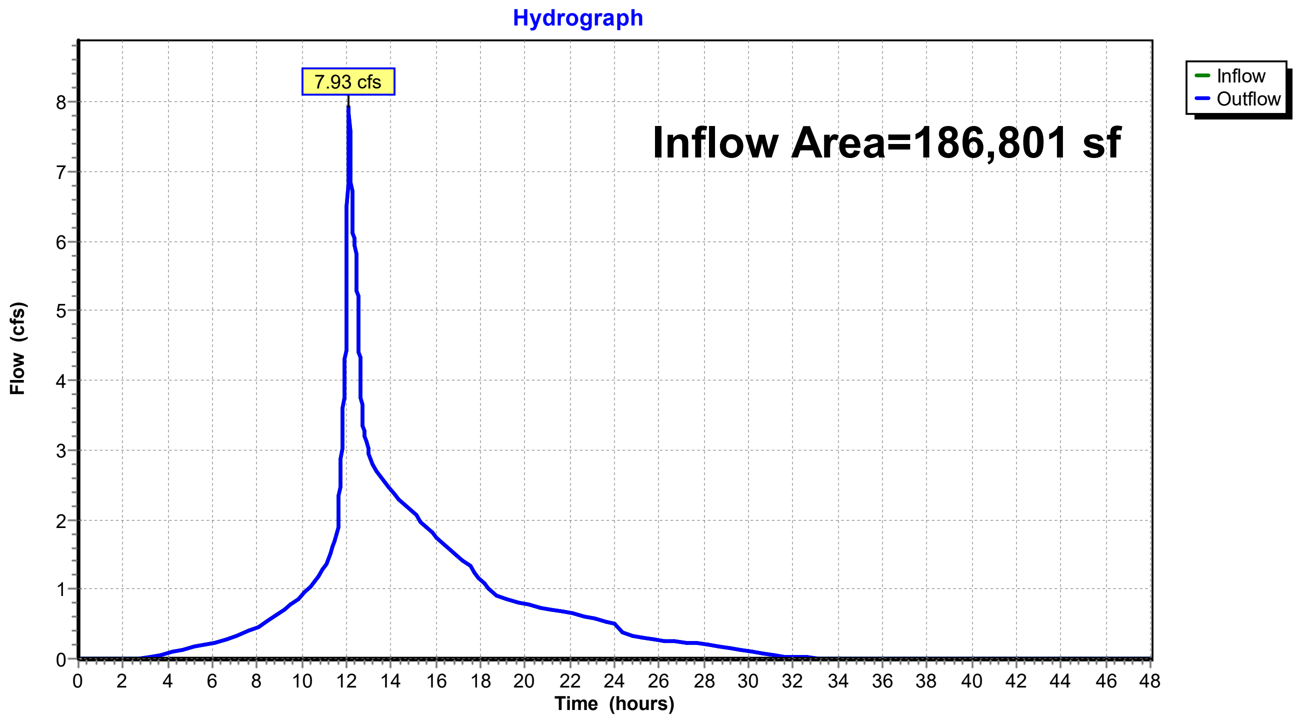


Summary for Reach WD: Washington St Drainage outlet

Inflow Area =	186,801 sf,	65.83% Impervious,	Inflow Depth = 6.13"	for 100-Year event
Inflow =	7.93 cfs @	12.12 hrs, Volume=	95,377 cf	
Outflow =	7.93 cfs @	12.12 hrs, Volume=	95,377 cf, Atten= 0%, Lag= 0.0 min	

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach WD: Washington St Drainage outlet



Summary for Pond UG1a: UG1a

Inflow Area =		27,758 sf,	24.53% Impervious,	Inflow Depth = 6.80"	for 100-Year event
Inflow	=	4.72 cfs @	12.08 hrs, Volume=	15,721 cf	
Outflow	=	3.34 cfs @	12.16 hrs, Volume=	15,721 cf,	Atten= 29%, Lag= 4.6 min
Primary	=	3.34 cfs @	12.16 hrs, Volume=	15,721 cf	

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 86.46' @ 12.16 hrs Surf.Area= 666 sf Storage= 1,363 cf

Plug-Flow detention time= 5.9 min calculated for 15,717 cf (100% of inflow)
Center-of-Mass det. time= 5.9 min (779.0 - 773.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	83.00'	639 cf	**11.00'W x 60.58'L x 3.50'H Field A** 2,332 cf Overall - 735 cf Embedded = 1,597 cf x 40.0% Voids
#2A	83.50'	735 cf	**ADS_StormTech SC-740 +Cap** x 16 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 16 Chambers in 2 Rows
		1,374 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Device 2	83.00'	**8.5" Vert. Orifice/Grate** C= 0.600
#2	Primary	83.00'	**12.0" Round RCP_Round 12"** L= 51.4' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 83.00' / 82.74' S= 0.0051 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=3.34 cfs @ 12.16 hrs HW=86.46' (Free Discharge)
↑—**2=RCP_Round 12"** (Passes 3.34 cfs of 6.77 cfs potential flow)
↑—**1=Orifice/Grate** (Orifice Controls 3.34 cfs @ 8.48 fps)

Pond UG1a: UG1a - Chamber Wizard Field A

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

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

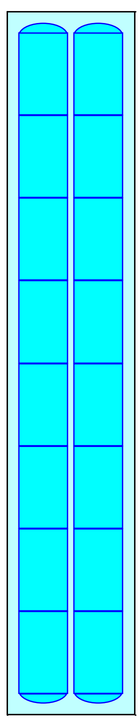
8 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 58.58' Row Length +12.0" End Stone x 2 = 60.58' Base Length
2 Rows x 51.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 11.00' Base Width
6.0" Base + 30.0" Chamber Height + 6.0" Cover = 3.50' Field Height

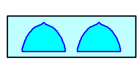
16 Chambers x 45.9 cf = 735.0 cf Chamber Storage

2,332.2 cf Field - 735.0 cf Chambers = 1,597.2 cf Stone x 40.0% Voids = 638.9 cf Stone Storage

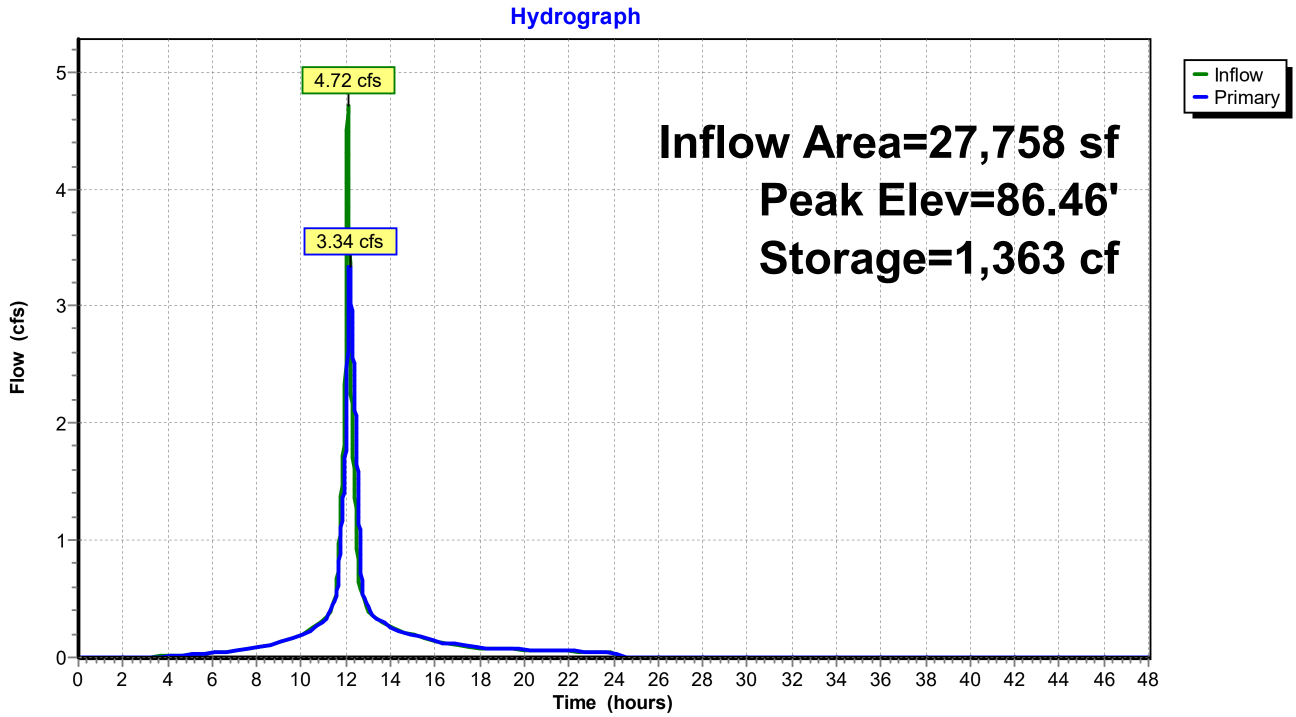
Chamber Storage + Stone Storage = 1,373.9 cf = 0.032 af
Overall Storage Efficiency = 58.9%
Overall System Size = 60.58' x 11.00' x 3.50'

16 Chambers
86.4 cy Field
59.2 cy Stone





Pond UG1a: UG1a



Summary for Pond UG1b: UG1b

Inflow Area = 22,129 sf,100.00% Impervious, Inflow Depth = 7.63" for 100-Year event
Inflow = 3.92 cfs @ 12.08 hrs, Volume= 14,071 cf
Outflow = 0.93 cfs @ 12.47 hrs, Volume= 14,071 cf, Atten= 76%, Lag= 23.0 min
Discarded = 0.39 cfs @ 11.39 hrs, Volume= 13,450 cf
Primary = 0.54 cfs @ 12.47 hrs, Volume= 621 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 87.67' @ 12.47 hrs Surf.Area= 2,044 sf Storage= 4,143 cf

Plug-Flow detention time= 60.7 min calculated for 14,068 cf (100% of inflow)
Center-of-Mass det. time= 60.6 min (802.1 - 741.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	84.50'	1,589 cf	**28.00'W x 73.00'L x 3.21'H Field A** 6,558 cf Overall - 2,587 cf Embedded = 3,971 cf x 40.0% Voids
#2A	85.00'	2,587 cf	**Cultec R-280HD** x 60 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 6 rows
		4,175 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Device 2	87.33'	**0.9' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#2	Primary	84.07'	**12.0" Round RCP_Round 12"** L= 12.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 84.07' / 83.53' S= 0.0450 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#3	Discarded	84.50'	**8.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.39 cfs @ 11.39 hrs HW=84.53' (Free Discharge)
↑3=**Exfiltration** (Exfiltration Controls 0.39 cfs)

Primary OutFlow Max=0.54 cfs @ 12.47 hrs HW=87.67' (Free Discharge)
↑2=**RCP_Round 12"** (Passes 0.54 cfs of 8.32 cfs potential flow)
  ↑1=**Sharp-Crested Rectangular Weir** (Weir Controls 0.54 cfs @ 1.90 fps)

Pond UG1b: UG1b - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)
Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf
Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap
Row Length Adjustment= +1.00' x 6.07 sf x 6 rows

47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

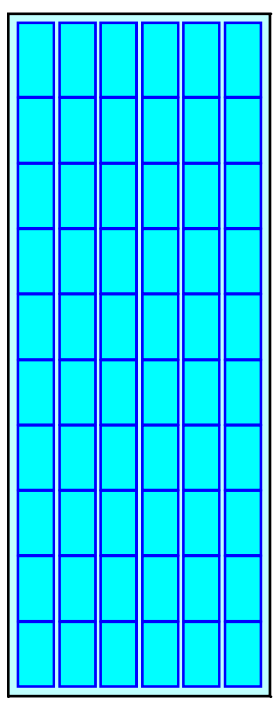
10 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 71.00' Row Length +12.0" End Stone x 2 = 73.00' Base Length
6 Rows x 47.0" Wide + 6.0" Spacing x 5 + 12.0" Side Stone x 2 = 28.00' Base Width
6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

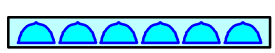
60 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 6 Rows = 2,586.6 cf Chamber Storage

6,557.8 cf Field - 2,586.6 cf Chambers = 3,971.3 cf Stone x 40.0% Voids = 1,588.5 cf Stone Storage

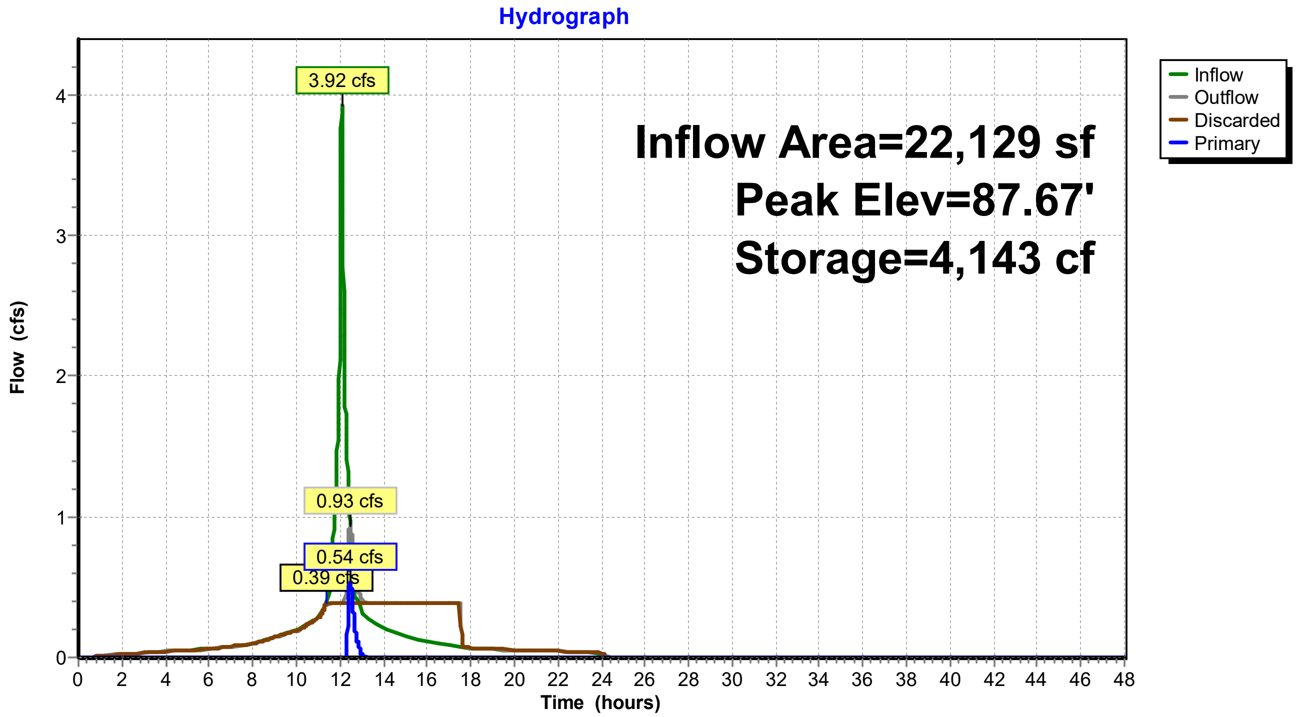
Chamber Storage + Stone Storage = 4,175.1 cf = 0.096 af
Overall Storage Efficiency = 63.7%
Overall System Size = 73.00' x 28.00' x 3.21'

60 Chambers
242.9 cy Field
147.1 cy Stone





Pond UG1b: UG1b



Summary for Pond UG2: UG2

Inflow Area =	16,720 sf, 68.82% Impervious,	Inflow Depth = 6.91"	for 100-Year event
Inflow =	2.87 cfs @ 12.08 hrs, Volume=	9,635 cf	
Outflow =	0.30 cfs @ 12.80 hrs, Volume=	9,635 cf, Atten= 90%, Lag= 42.7 min	
Primary =	0.30 cfs @ 12.80 hrs, Volume=	9,635 cf	

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 85.44' @ 12.80 hrs Surf.Area= 0.047 ac Storage= 0.098 af

Plug-Flow detention time= 164.6 min calculated for 9,633 cf (100% of inflow)
Center-of-Mass det. time= 164.7 min (934.2 - 769.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	82.00'	0.042 af	**30.00'W x 67.70'L x 3.50'H Field A** 0.163 af Overall - 0.057 af Embedded = 0.106 af x 40.0% Voids
#2A	82.50'	0.057 af	**ADS_StormTech SC-740 +Cap** x 54 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 54 Chambers in 6 Rows
		0.099 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Device 2	82.00'	**2.5" Vert. Orifice/Grate** C= 0.600
#2	Primary	82.00'	**12.0" Round RCP_Round 12"** L= 9.7' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 82.00' / 81.95' S= 0.0052 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=0.30 cfs @ 12.80 hrs HW=85.44' (Free Discharge)
↑—**2=RCP_Round 12"** (Passes 0.30 cfs of 8.11 cfs potential flow)
↑—**1=Orifice/Grate** (Orifice Controls 0.30 cfs @ 8.80 fps)

Pond UG2: UG2 - Chamber Wizard Field A

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

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

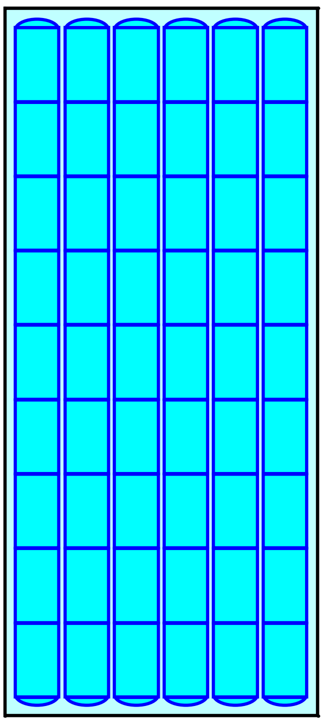
9 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 65.70' Row Length +12.0" End Stone x 2 = 67.70' Base Length
6 Rows x 51.0" Wide + 6.0" Spacing x 5 + 12.0" Side Stone x 2 = 30.00' Base Width
6.0" Base + 30.0" Chamber Height + 6.0" Cover = 3.50' Field Height

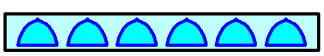
54 Chambers x 45.9 cf = 2,480.8 cf Chamber Storage

7,108.2 cf Field - 2,480.8 cf Chambers = 4,627.4 cf Stone x 40.0% Voids = 1,851.0 cf Stone Storage

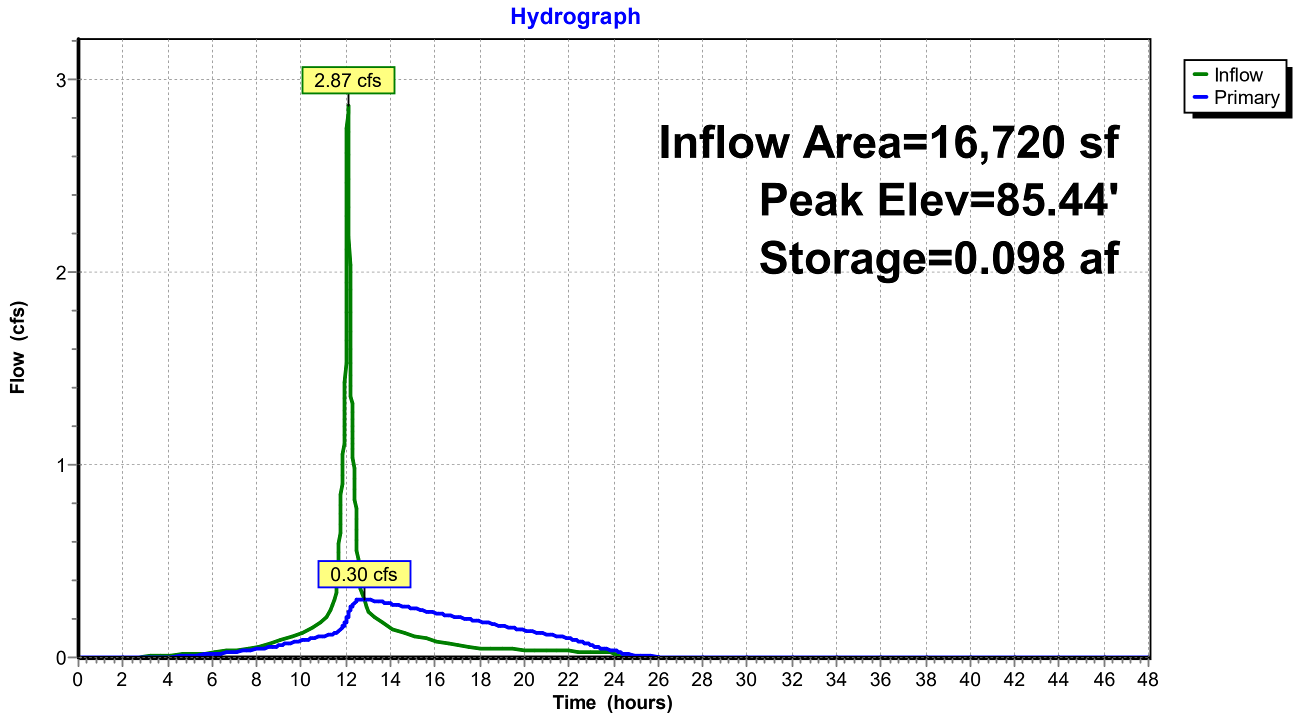
Chamber Storage + Stone Storage = 4,331.7 cf = 0.099 af
Overall Storage Efficiency = 60.9%
Overall System Size = 67.70' x 30.00' x 3.50'

54 Chambers
263.3 cy Field
171.4 cy Stone





Pond UG2: UG2


Hydrograph
Inflow
Primary
2.87 cfs
0.30 cfs
Inflow Area=16,720 sf
Peak Elev=85.44'
Storage=0.098 af
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 UG3: UG3

Inflow Area =	46,987 sf, 83.88% Impervious,	Inflow Depth = 7.27"	for 100-Year event
Inflow =	8.23 cfs @ 12.08 hrs, Volume=	28,473 cf	
Outflow =	0.54 cfs @ 13.47 hrs, Volume=	28,470 cf, Atten= 93%, Lag= 83.3 min	
Primary =	0.54 cfs @ 13.47 hrs, Volume=	28,470 cf	

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 94.41' @ 13.47 hrs Surf.Area= 0.103 ac Storage= 0.344 af

Plug-Flow detention time= 334.6 min calculated for 28,470 cf (100% of inflow)
Center-of-Mass det. time= 334.5 min (1,091.9 - 757.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	89.00'	0.145 af	**80.08'W x 55.89'L x 5.50'H Field A** 0.565 af Overall - 0.202 af Embedded = 0.363 af x 40.0% Voids
#2A	89.75'	0.202 af	**ADS_StormTech MC-3500 d +Cap** x 77 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 77 Chambers in 11 Rows Cap Storage= +14.9 cf x 2 x 11 rows = 327.8 cf
		0.347 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Device 2	89.00'	**3.0" Vert. Orifice/Grate** C= 0.600
#2	Primary	89.00'	**12.0" Round RCP_Round 12"** L= 20.9' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 89.00' / 88.90' S= 0.0048 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=0.54 cfs @ 13.47 hrs HW=94.41' (Free Discharge)
└─**2=RCP_Round 12"** (Passes 0.54 cfs of 10.36 cfs potential flow)
  └─**1=Orifice/Grate** (Orifice Controls 0.54 cfs @ 11.07 fps)

Pond UG3: UG3 - Chamber Wizard Field A

Chamber Model = ADS_StormTech MC-3500 d +Cap (ADS StormTech® MC-3500 d rev 03/14 with Cap volume)
Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf
Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap
Cap Storage= +14.9 cf x 2 x 11 rows = 327.8 cf

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

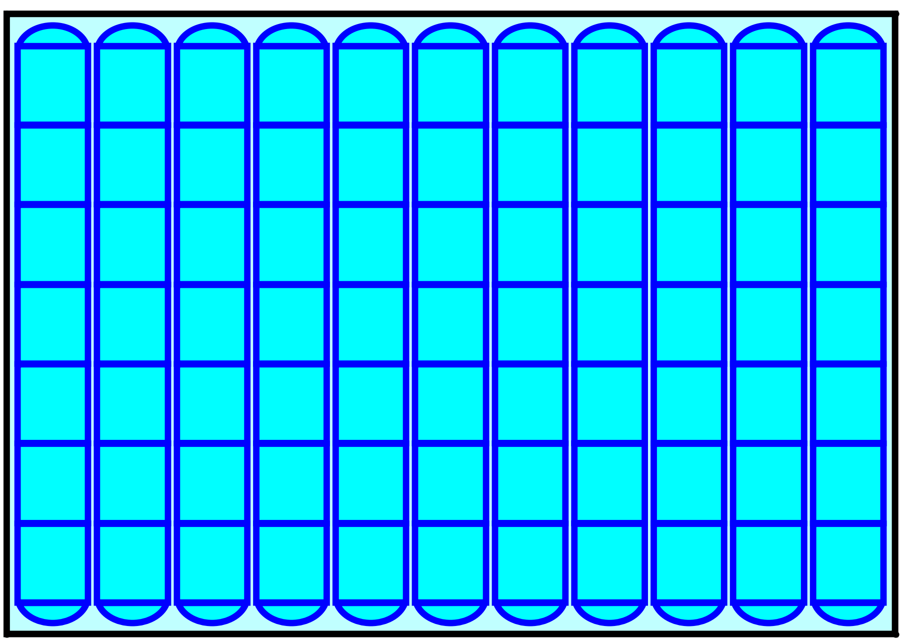
7 Chambers/Row x 7.17' Long +1.85' Cap Length x 2 = 53.89' Row Length +12.0" End Stone x 2 = 55.89' Base Length
11 Rows x 77.0" Wide + 9.0" Spacing x 10 + 12.0" Side Stone x 2 = 80.08' Base Width
9.0" Base + 45.0" Chamber Height + 12.0" Cover = 5.50' Field Height

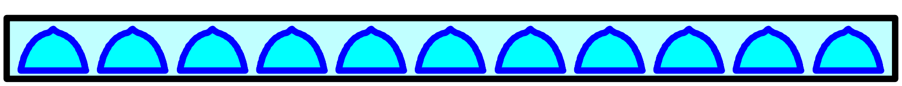
77 Chambers x 110.0 cf + 14.9 cf Cap Volume x 2 x 11 Rows = 8,794.1 cf Chamber Storage

24,617.2 cf Field - 8,794.1 cf Chambers = 15,823.1 cf Stone x 40.0% Voids = 6,329.2 cf Stone Storage

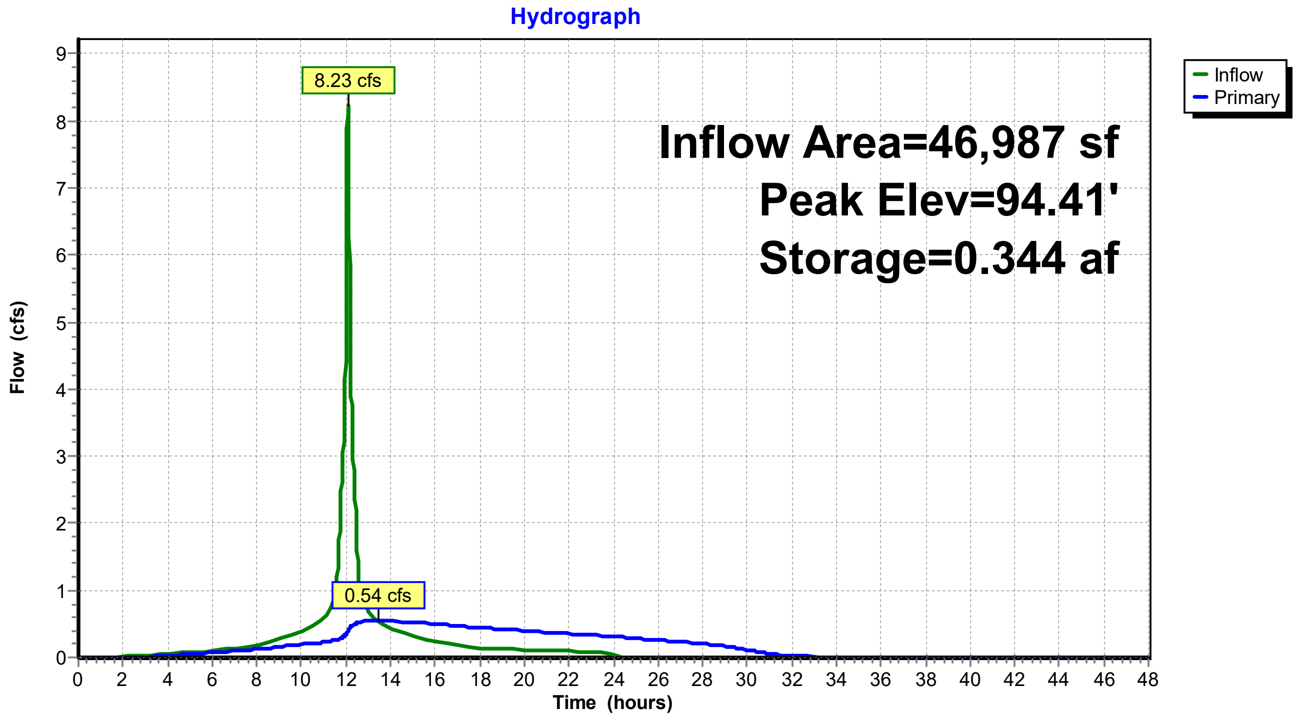
Chamber Storage + Stone Storage = 15,123.3 cf = 0.347 af
Overall Storage Efficiency = 61.4%
Overall System Size = 55.89' x 80.08' x 5.50'

77 Chambers
911.7 cy Field
586.0 cy Stone





Pond UG3: UG3


Hydrograph
8.23 cfs
0.54 cfs
Inflow
Primary
Inflow Area=46,987 sf
Peak Elev=94.41'
Storage=0.344 af
Flow (cfs)
Time (hours)
0
1
2
3
4
5
6
7
8
9
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 UG4a: UG4a

Inflow Area =	38,652 sf, 94.71% Impervious,	Inflow Depth = 4.46"	for 100-Year event
Inflow =	3.88 cfs @ 12.15 hrs, Volume=	14,365 cf	
Outflow =	3.40 cfs @ 12.23 hrs, Volume=	14,365 cf, Atten= 12%, Lag= 4.6 min	
Primary =	3.40 cfs @ 12.23 hrs, Volume=	14,365 cf	

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 101.11' @ 12.23 hrs Surf.Area= 0.019 ac Storage= 0.018 af

Plug-Flow detention time= 5.8 min calculated for 14,362 cf (100% of inflow)
Center-of-Mass det. time= 5.8 min (762.0 - 756.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	99.50'	0.014 af	**18.17'W x 45.92'L x 2.33'H Field A** 0.045 af Overall - 0.010 af Embedded = 0.035 af x 40.0% Voids
#2A	100.00'	0.010 af	**ADS_StormTech SC-310 +Cap** x 30 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap 30 Chambers in 5 Rows
		0.024 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Device 2	99.50'	**11.0" Vert. Orifice/Grate** C= 0.600
#2	Primary	99.50'	**12.0" Round RCP_Round 12"** L= 43.2' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 99.50' / 98.00' S= 0.0347 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=3.40 cfs @ 12.23 hrs HW=101.11' (Free Discharge)
↑**2=RCP_Round 12"** (Passes 3.40 cfs of 4.97 cfs potential flow)
↑**1=Orifice/Grate** (Orifice Controls 3.40 cfs @ 5.16 fps)

Pond UG4a: UG4a - Chamber Wizard Field A

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

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

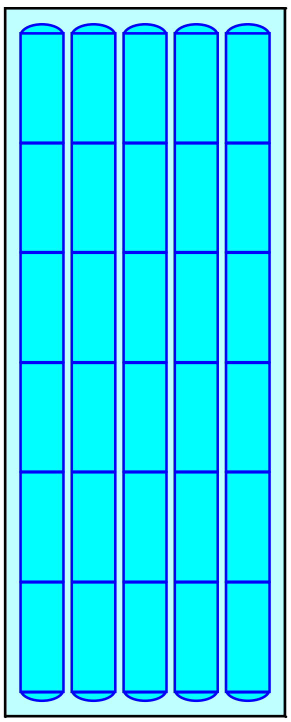
6 Chambers/Row x 7.12' Long +0.60' Cap Length x 2 = 43.92' Row Length +12.0" End Stone x 2 = 45.92' Base Length
5 Rows x 34.0" Wide + 6.0" Spacing x 4 + 12.0" Side Stone x 2 = 18.17' Base Width
6.0" Base + 16.0" Chamber Height + 6.0" Cover = 2.33' Field Height

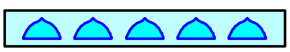
30 Chambers x 14.7 cf = 442.3 cf Chamber Storage

1,946.5 cf Field - 442.3 cf Chambers = 1,504.2 cf Stone x 40.0% Voids = 601.7 cf Stone Storage

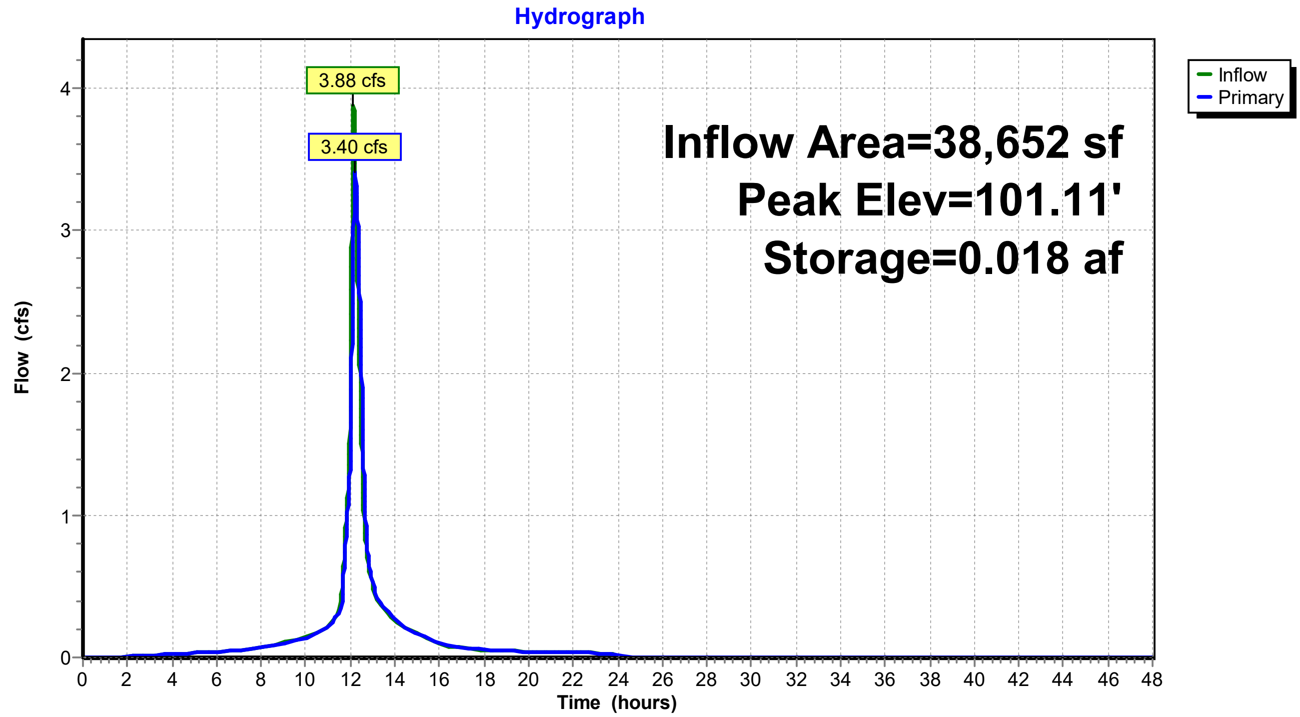
Chamber Storage + Stone Storage = 1,044.0 cf = 0.024 af
Overall Storage Efficiency = 53.6%
Overall System Size = 45.92' x 18.17' x 2.33'

30 Chambers
72.1 cy Field
55.7 cy Stone





Pond UG4a: UG4a



Summary for Pond UG4b: UG4b

Inflow Area = 21,598 sf,100.00% Impervious, Inflow Depth = 7.63" for 100-Year event
Inflow = 3.83 cfs @ 12.08 hrs, Volume= 13,733 cf
Outflow = 2.07 cfs @ 12.20 hrs, Volume= 13,733 cf, Atten= 46%, Lag= 7.3 min
Discarded = 0.12 cfs @ 8.54 hrs, Volume= 9,872 cf
Primary = 1.96 cfs @ 12.20 hrs, Volume= 3,861 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 110.50' @ 12.20 hrs Surf.Area= 2,069 sf Storage= 4,411 cf

Plug-Flow detention time= 203.9 min calculated for 13,730 cf (100% of inflow)
Center-of-Mass det. time= 203.9 min (945.4 - 741.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	107.00'	1,886 cf	**25.25'W x 81.94'L x 3.50'H Field A** 7,241 cf Overall - 2,527 cf Embedded = 4,714 cf x 40.0% Voids
#2A	107.50'	2,527 cf	**ADS_StormTech SC-740 +Cap** x 55 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 55 Chambers in 5 Rows
		4,412 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Device 2	109.70'	**1.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#2	Primary	107.00'	**12.0" Round RCP_Round 12"** L= 100.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 107.00' / 104.00' S= 0.0300 '/' Cc= 0.900 n= 0.013 Concrete sewer w/manholes & inlets, Flow Area= 0.79 sf
#3	Discarded	107.00'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.12 cfs @ 8.54 hrs HW=107.04' (Free Discharge)
↑—**3=Exfiltration** (Exfiltration Controls 0.12 cfs)

Primary OutFlow Max=1.96 cfs @ 12.20 hrs HW=110.50' (Free Discharge)
↑—**2=RCP_Round 12"** (Passes 1.96 cfs of 7.09 cfs potential flow)
  ↑—**1=Sharp-Crested Rectangular Weir** (Weir Controls 1.96 cfs @ 2.92 fps)

Pond UG4b: UG4b - Chamber Wizard Field A

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

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

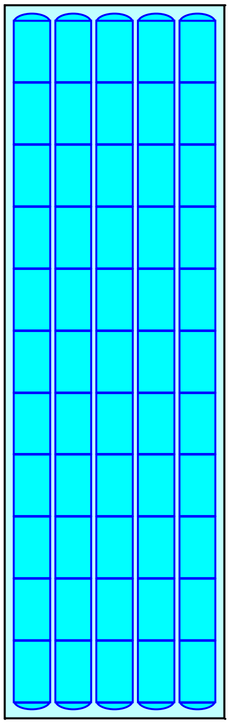
11 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 79.94' Row Length +12.0" End Stone x 2 = 81.94' Base Length
5 Rows x 51.0" Wide + 6.0" Spacing x 4 + 12.0" Side Stone x 2 = 25.25' Base Width
6.0" Base + 30.0" Chamber Height + 6.0" Cover = 3.50' Field Height

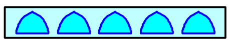
55 Chambers x 45.9 cf = 2,526.7 cf Chamber Storage

7,241.2 cf Field - 2,526.7 cf Chambers = 4,714.5 cf Stone x 40.0% Voids = 1,885.8 cf Stone Storage

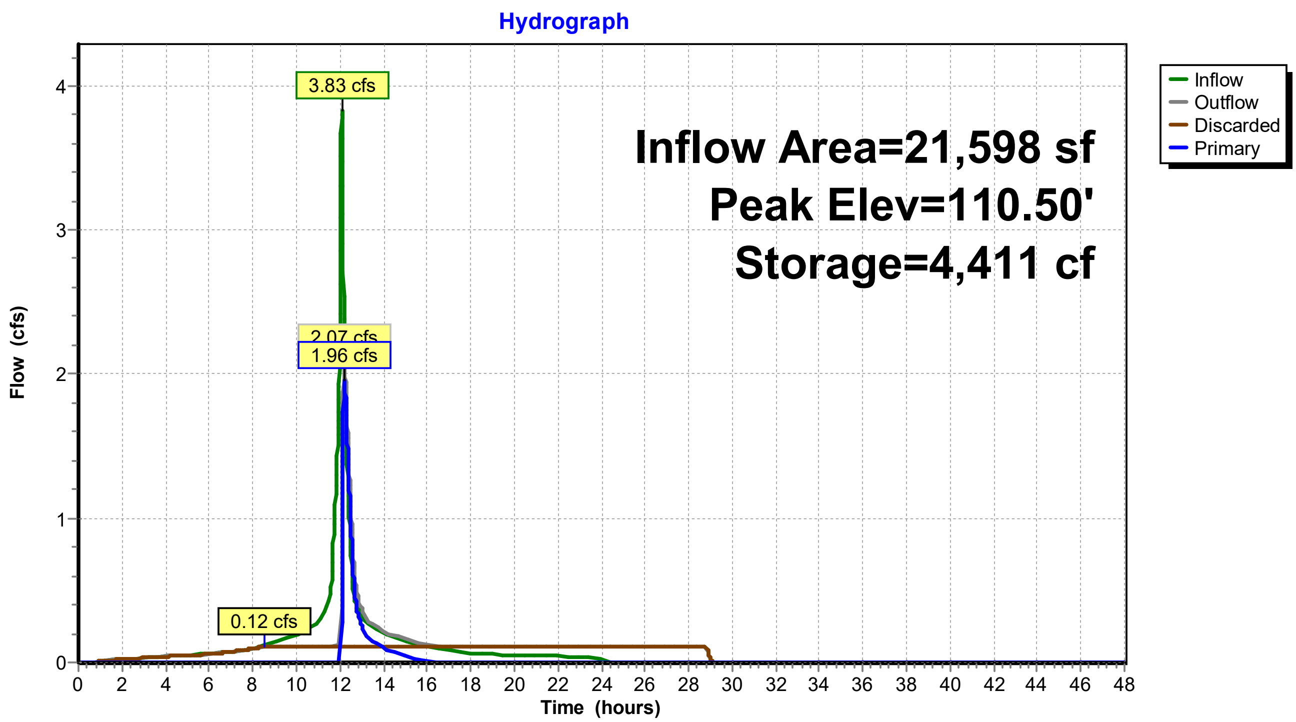
Chamber Storage + Stone Storage = 4,412.5 cf = 0.101 af
Overall Storage Efficiency = 60.9%
Overall System Size = 81.94' x 25.25' x 3.50'

55 Chambers
268.2 cy Field
174.6 cy Stone





Pond UG4b: UG4b



Summary for Pond UG5: UG5

Inflow Area =	51,811 sf,	71.70% Impervious,	Inflow Depth = 7.03"	for 100-Year event
Inflow =	8.95 cfs @	12.08 hrs, Volume=	30,368 cf	
Outflow =	0.81 cfs @	12.94 hrs, Volume=	30,368 cf,	Atten= 91%, Lag= 51.3 min
Discarded =	0.25 cfs @	8.84 hrs, Volume=	26,873 cf	
Primary =	0.56 cfs @	12.94 hrs, Volume=	3,495 cf	

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 113.48' @ 12.94 hrs Surf.Area= 4,461 sf Storage= 15,123 cf

Plug-Flow detention time= 467.1 min calculated for 30,362 cf (100% of inflow)
Center-of-Mass det. time= 467.2 min (1,232.9 - 765.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	108.00'	6,247 cf	**29.92'W x 149.10'L x 5.50'H Field A** 24,533 cf Overall - 8,915 cf Embedded = 15,618 cf x 40.0% Voids
#2A	108.75'	8,915 cf	**ADS_StormTech MC-3500 d +Cap** x 80 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 80 Chambers in 4 Rows Cap Storage= +14.9 cf x 2 x 4 rows = 119.2 cf
		15,162 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Device 2	113.05'	**0.7' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#2	Primary	101.47'	**12.0" Round RCP_Round 12"** L= 14.6' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 101.47' / 100.30' S= 0.0801 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#3	Discarded	108.00'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.25 cfs @ 8.84 hrs HW=108.06' (Free Discharge)
3=Exfiltration (Exfiltration Controls 0.25 cfs)

Primary OutFlow Max=0.56 cfs @ 12.94 hrs HW=113.48' (Free Discharge)
2=RCP_Round 12" (Passes 0.56 cfs of 16.04 cfs potential flow)
1=Sharp-Crested Rectangular Weir (Weir Controls 0.56 cfs @ 2.14 fps)

Pond UG5: UG5 - Chamber Wizard Field A

Chamber Model = ADS_StormTech MC-3500 d +Cap (ADS StormTech® MC-3500 d rev 03/14 with Cap volume)
Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf
Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap
Cap Storage= +14.9 cf x 2 x 4 rows = 119.2 cf

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

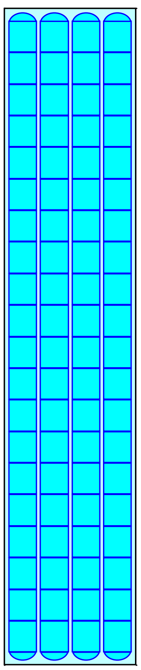
20 Chambers/Row x 7.17' Long +1.85' Cap Length x 2 = 147.10' Row Length +12.0" End Stone x 2 = 149.10' Base Length
4 Rows x 77.0" Wide + 9.0" Spacing x 3 + 12.0" Side Stone x 2 = 29.92' Base Width
9.0" Base + 45.0" Chamber Height + 12.0" Cover = 5.50' Field Height

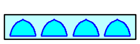
80 Chambers x 110.0 cf + 14.9 cf Cap Volume x 2 x 4 Rows = 8,915.4 cf Chamber Storage

24,533.2 cf Field - 8,915.4 cf Chambers = 15,617.8 cf Stone x 40.0% Voids = 6,247.1 cf Stone Storage

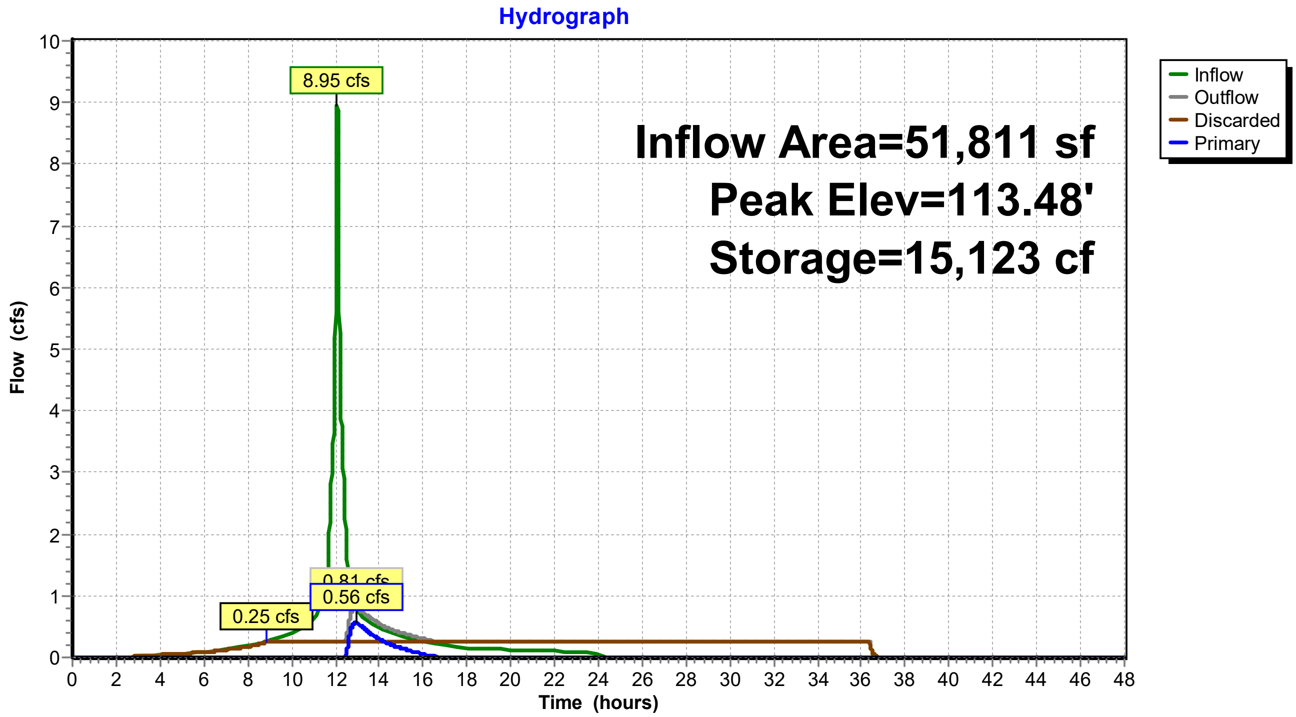
Chamber Storage + Stone Storage = 15,162.5 cf = 0.348 af
Overall Storage Efficiency = 61.8%
Overall System Size = 149.10' x 29.92' x 5.50'

80 Chambers
908.6 cy Field
578.4 cy Stone





Pond UG5: UG5


Hydrograph
8.95 cfs
0.81 cfs
0.56 cfs
0.25 cfs
Inflow Area=51,811 sf
Peak Elev=113.48'
Storage=15,123 cf
Inflow
Outflow
Discarded
Primary
Flow (cfs)
Time (hours)

Summary for Pond UG6: UG6

Inflow Area = 43,674 sf, 78.98% Impervious, Inflow Depth = 7.15" for 100-Year event
Inflow = 7.60 cfs @ 12.08 hrs, Volume= 26,032 cf
Outflow = 4.49 cfs @ 12.19 hrs, Volume= 26,026 cf, Atten= 41%, Lag= 6.4 min
Primary = 4.49 cfs @ 12.19 hrs, Volume= 26,026 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 114.91' @ 12.19 hrs Surf.Area= 4,101 sf Storage= 5,213 cf

Plug-Flow detention time= 37.8 min calculated for 26,021 cf (100% of inflow)
Center-of-Mass det. time= 37.9 min (799.7 - 761.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	112.60'	2,884 cf	**28.17'W x 145.60'L x 2.33'H Field A** 9,569 cf Overall - 2,359 cf Embedded = 7,210 cf x 40.0% Voids
#2A	113.10'	2,359 cf	**ADS_StormTech RC-310 +Cap** x 160 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap 160 Chambers in 8 Rows
		5,243 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Device 3	112.60'	**5.0" Vert. Orifice/Grate** C= 0.600
#2	Device 3	113.22'	**11.0" Vert. Orifice/Grate** C= 0.600
#3	Primary	112.60'	**12.0" Round RCP_Round 12"** L= 68.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 112.60' / 112.40' S= 0.0029 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=4.49 cfs @ 12.19 hrs HW=114.91' (Free Discharge)
└─**3=RCP_Round 12"** (Passes 4.49 cfs of 4.70 cfs potential flow)
  ├─**1=Orifice/Grate** (Orifice Controls 0.95 cfs @ 6.99 fps)
  └─**2=Orifice/Grate** (Orifice Controls 3.53 cfs @ 5.35 fps)

Pond UG6: UG6 - Chamber Wizard Field A

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

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

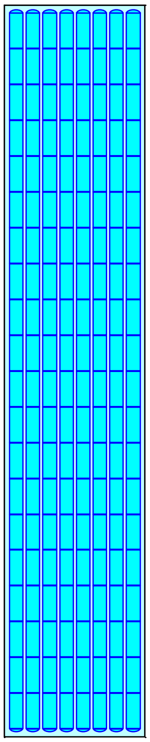
20 Chambers/Row x 7.12' Long +0.60' Cap Length x 2 = 143.60' Row Length +12.0" End Stone x 2 = 145.60' Base Length
8 Rows x 34.0" Wide + 6.0" Spacing x 7 + 12.0" Side Stone x 2 = 28.17' Base Width
6.0" Base + 16.0" Chamber Height + 6.0" Cover = 2.33' Field Height

160 Chambers x 14.7 cf = 2,358.7 cf Chamber Storage

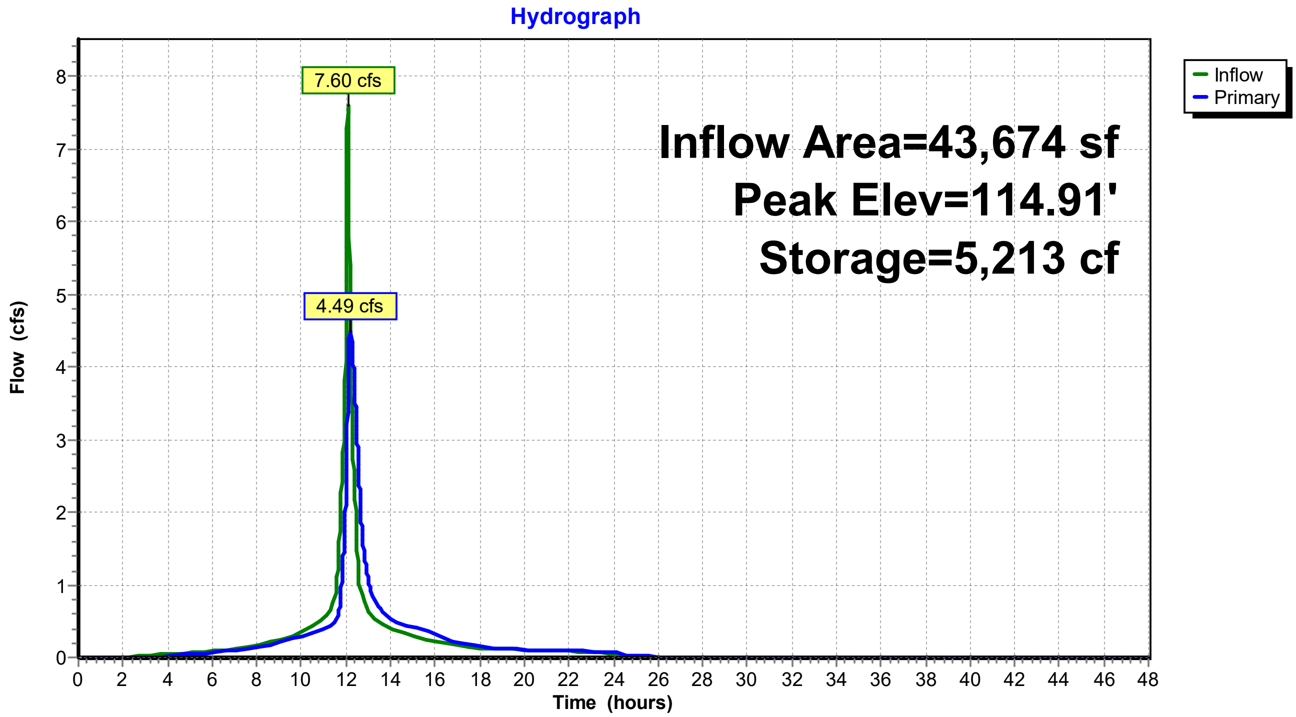
9,569.2 cf Field - 2,358.7 cf Chambers = 7,210.4 cf Stone x 40.0% Voids = 2,884.2 cf Stone Storage

Chamber Storage + Stone Storage = 5,242.9 cf = 0.120 af
Overall Storage Efficiency = 54.8%
Overall System Size = 145.60' x 28.17' x 2.33'

160 Chambers
354.4 cy Field
267.1 cy Stone



Pond UG6: UG6


Hydrograph
7.60 cfs
4.49 cfs
Inflow Area=43,674 sf
Peak Elev=114.91'
Storage=5,213 cf
Inflow
Primary
Flow (cfs)
Time (hours)
0
1
2
3
4
5
6
7
8
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 UG7: UG7

Inflow Area = 50,810 sf, 81.43% Impervious, Inflow Depth = 7.27" for 100-Year event
Inflow = 8.90 cfs @ 12.08 hrs, Volume= 30,790 cf
Outflow = 1.46 cfs @ 12.55 hrs, Volume= 30,790 cf, Atten= 84%, Lag= 27.9 min
Primary = 1.46 cfs @ 12.55 hrs, Volume= 30,790 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 103.65' @ 12.55 hrs Surf.Area= 0.079 ac Storage= 0.255 af

Plug-Flow detention time= 81.3 min calculated for 30,790 cf (100% of inflow)
Center-of-Mass det. time= 81.3 min (838.7 - 757.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	98.50'	0.111 af	**44.25'W x 77.40'L x 5.50'H Field A** 0.432 af Overall - 0.156 af Embedded = 0.277 af x 40.0% Voids
#2A	99.25'	0.156 af	**ADS_StormTech MC-3500 d +Cap** x 60 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 60 Chambers in 6 Rows Cap Storage= +14.9 cf x 2 x 6 rows = 178.8 cf
		0.266 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Device 2	98.50'	**5.0" Vert. Orifice/Grate** C= 0.600
#2	Primary	98.50'	**12.0" Round RCP_Round 12"** L= 34.7' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 98.50' / 98.33' S= 0.0049 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=1.46 cfs @ 12.55 hrs HW=103.65' (Free Discharge)
└─**2=RCP_Round 12"** (Passes 1.46 cfs of 9.31 cfs potential flow)
  └─**1=Orifice/Grate** (Orifice Controls 1.46 cfs @ 10.70 fps)

Pond UG7: UG7 - Chamber Wizard Field A

Chamber Model = ADS_StormTech MC-3500 d +Cap (ADS StormTech® MC-3500 d rev 03/14 with Cap volume)
Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf
Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap
Cap Storage= +14.9 cf x 2 x 6 rows = 178.8 cf

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

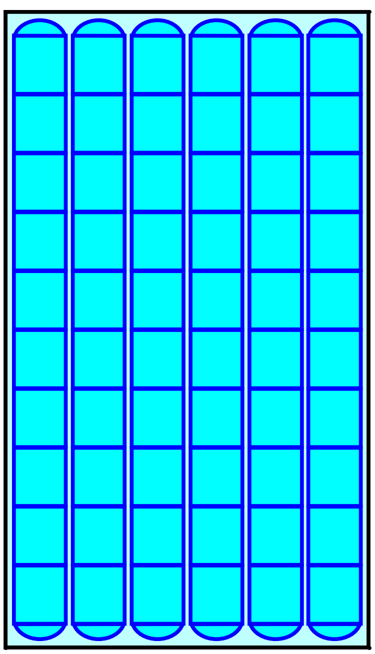
10 Chambers/Row x 7.17' Long +1.85' Cap Length x 2 = 75.40' Row Length +12.0" End Stone x 2 = 77.40' Base Length
6 Rows x 77.0" Wide + 9.0" Spacing x 5 + 12.0" Side Stone x 2 = 44.25' Base Width
9.0" Base + 45.0" Chamber Height + 12.0" Cover = 5.50' Field Height

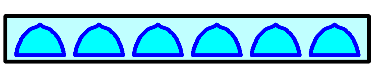
60 Chambers x 110.0 cf + 14.9 cf Cap Volume x 2 x 6 Rows = 6,775.9 cf Chamber Storage

18,837.2 cf Field - 6,775.9 cf Chambers = 12,061.3 cf Stone x 40.0% Voids = 4,824.5 cf Stone Storage

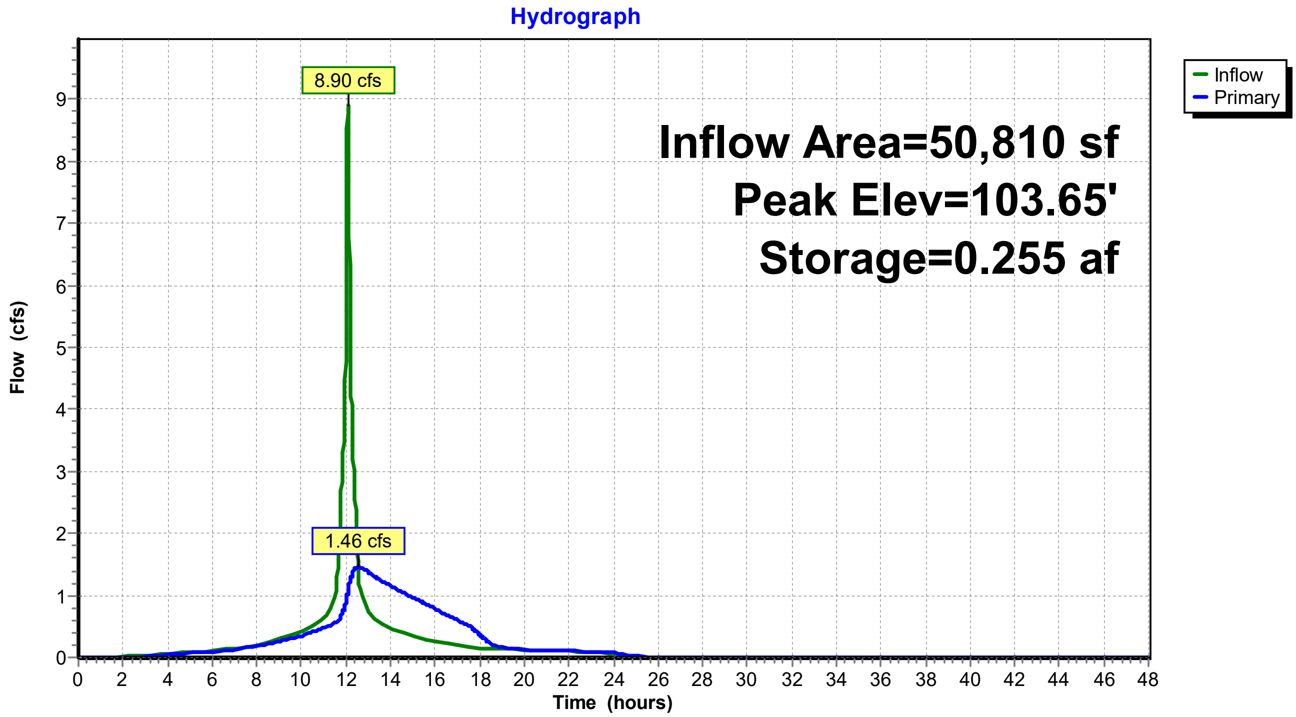
Chamber Storage + Stone Storage = 11,600.4 cf = 0.266 af
Overall Storage Efficiency = 61.6%
Overall System Size = 77.40' x 44.25' x 5.50'

60 Chambers
697.7 cy Field
446.7 cy Stone





Pond UG7: UG7


Hydrograph
8.90 cfs
1.46 cfs
Inflow
Primary
Inflow Area=50,810 sf
Peak Elev=103.65'
Storage=0.255 af
Flow (cfs)
Time (hours)
0
1
2
3
4
5
6
7
8
9
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
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44
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Date	Description	No.
7.14.2021	REVISED PER CONSERVATION COMMISSION	1.
	Revisions	

7-14-2021

GABRIEL R. CROCKER
PROFESSIONAL ENGINEER, MA REGISTRATION #47917

COMMONWEALTH OF MASSACHUSETTS
GABRIEL R. CROCKER
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No. 47917
REGISTERED
PROFESSIONAL ENGINEER

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Project
HANOVER WEYMOUTH RESIDENTIAL DEVELOPMENT
#1325 WASHINGTON STREET, WEYMOUTH, MA

Prepared for
HANOVER R.S. LIMITED PARTNERSHIP
ONE MARINE PARK DRIVE, SUITE 701, BOSTON, MA 02210
HANOVER COMPANY

Drawing Title
PROPOSED CONDITIONS WATERSHED MAP

Project No.	100-124
Date	4.8.2021
Scale	1"=40'
Drawn By	AS
Approved By	GC

Drawing No.
PH-1

SECTION 4 – STORMWATER MANAGEMENT CALCS

4.1 STANDARD 3: RECHARGE CALCULATIONS

The Required Recharge Volume is computed using the equation provided in the 2008 Massachusetts Stormwater Handbook. The volume is computed as an equivalent depth of rainfall over the proposed impervious areas in accordance with a Target Depth Factor based on the soil classifications. The Calculations is as follows:

Rv = (F) X (Impervious Area)
(Equation 1) Volume 3, Ch 1, page 15

- Rv = Required Recharge Volume, expressed in cubic feet, cubic yards, or acre-feet
- F = Target Depth Factor associated with each Hydrologic Soil Group (HSG)
- Impervious Area = new pavement, new rooftop area and courtyard areas
- The Target Depth Factor "F" per Table 2.3.2, Volume 3, Chapter 1 for each soil classification is as follows:
  - A soils = 0.60 inches
  - B soils = 0.35 inches
  - C soils = 0.25 inches
  - D soils = 0.10 inches

The proposed impervious area (pavement, roofs, and courtyards but not including ledge outcrops) within limit of work is 264,677 SF. Based on the above formula, the required recharge volume for the site is as follows:

Per Section 1.3, the onsite soils are considered "D" soils:

- F (D soils) = 0.10 inches
- Impervious Area (New Impervious) =264,677 SF

Rv = (F) X (Impervious Area)
Rv= (0.10 inches) x (1in/12 ft) x 264,677 SF = 2,206 CF

TOTAL RECHARGE VOLUME REQUIRED (Rv)= 2,206 CF

Capture Area Adjustment:

In the proposed conditions 58,895 SF of stormwater runoff from impervious surfaces is directed to the recharge BMP (UG-5), thus there is 205,782 SF of impervious is not directed to recharge BMP's. Dividing total impervious area of 264,677 SF by impervious area draining to recharge areas, 58,895 SF yields an adjusted required recharge volume of 4.49 times the calculated amount.

Adjusted RV = 4.49 x Rv

Adjusted RV = 4.49 x 2,206SF
Adjusted RV = 9,914 CF

ADJUSTED TOTAL RECHARGE VOLUME REQUIRED = 9,914 CF

Recharge Volume BMP Table

Infiltration BMP	*Infiltration Rate (in/hr) k*	*Storage (Recharge) Volume (c.f.) Rv*
UG-1b	*8.27*	*3,841*
UG-4b	*2.41*	*3,722*
UG-5	*2.41*	*14,270*
Totals		***21,833***
k = saturdated hydraulic conductivity (in/hr)		
Rv = storage volume (c.f.)		
Bottom Area (s.f.)		
Volume 3, Chapter 1 of the MA Stormwater Handbook		

TOTAL RECHARGE VOLUME PROVIDED = 21,833 CF

The Storage Recharge volume numbers provided in the table above have been derived utilizing the HydroCAD output for stage storage. The following pages provide a copy of those printouts and the cumulative stage-storage up to the controlling invert elevation has been highlighted.

Conclusion:

The recharge provided by the proposed underground systems exceeds the required recharge. The project satisfies Standard 3 of the Massachusetts DEP Stormwater.

4.2 DRAWDOWN TIME

Below are the drawdown time calculations for the infiltration systems proposed on the site. The calculation uses estimated hydraulic conductivity values "*K*" in accordance with the Rawls Rates table. The formula below utilized the recommended formula per the MA Stormwater Handbook as follows:

Drawdown Time = Rv / [(K*Bottom Area)*(1FT/12IN)]

- Rv = Storage Volume (CF)
- K = Saturated Hydraulic Conductivity per Rawls Rate Table (IN/HR)
- Bottom Area = Area of Bottom of Proposed Recharge Structure (SF)

Below is a summary table of the drawdown calculations:

BASIN DRAWDOWN CALCULATIONS				
Infiltration BMP	***Infiltration Rate (in/hr) k***	***Storage (Recharge) Volume (c.f.) Rv***	***Bottom Area (s.f.)***	***Draw Down Time(hours)***
UG-1b	*8.27*	*3,841*	*2,044*	2.7
UG-4b	*2.41*	*3,722*	*2,069*	9.0
UG-5	*2.41*	*14,270*	*4,461*	15.9
Totals		***21,833***		

k = saturdated hydraulic conductivity (in/hr)

Rv = storage volume (c.f.)

Bottom Area (s.f.)

Volume 3, Chapter 1 of the MA Stormwater Handbook

Conclusion:

The calculations above show that the infiltration BMP draws down in less than 72 hours, as required by Standard 3.

Stage-Area-Storage for Pond UG1b: UG1b

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
84.50	**2,044**	0
84.55	2,044	41
84.60	2,044	82
84.65	2,044	123
84.70	2,044	164
84.75	2,044	204
84.80	2,044	245
84.85	2,044	286
84.90	2,044	327
84.95	2,044	368
85.00	2,044	409
85.05	2,044	499
85.10	2,044	589
85.15	2,044	678
85.20	2,044	767
85.25	2,044	855
85.30	2,044	944
85.35	2,044	1,032
85.40	2,044	1,119
85.45	2,044	1,207
85.50	2,044	1,294
85.55	2,044	1,381
85.60	2,044	1,467
85.65	2,044	1,552
85.70	2,044	1,637
85.75	2,044	1,722
85.80	2,044	1,806
85.85	2,044	1,889
85.90	2,044	1,972
85.95	2,044	2,055
86.00	2,044	2,137
86.05	2,044	2,219
86.10	2,044	2,301
86.15	2,044	2,382
86.20	2,044	2,462
86.25	2,044	2,541
86.30	2,044	2,619
86.35	2,044	2,696
86.40	2,044	2,772
86.45	2,044	2,848
86.50	2,044	2,922
86.55	2,044	2,995
86.60	2,044	3,067
86.65	2,044	3,138
86.70	2,044	3,207
86.75	2,044	3,275
86.80	2,044	3,341
86.85	2,044	3,404
86.90	2,044	3,466
86.95	2,044	3,524
87.00	2,044	3,578
87.05	2,044	3,628
87.10	2,044	3,675
87.15	2,044	3,718

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
87.20	2,044	3,759
87.25	2,044	3,800
87.30	2,044	3,841
87.35	2,044	3,882
87.40	2,044	3,923
87.45	2,044	3,964
87.50	2,044	4,005
87.55	2,044	4,046
87.60	2,044	4,086
87.65	2,044	4,127
87.70	2,044	**4,168**

Stage-Area-Storage for Pond UG4b: UG4b

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
107.00	**2,069**	0	109.70	2,069	3,722
107.05	2,069	41	109.75	2,069	3,773
107.10	2,069	83	109.80	2,069	3,822
107.15	2,069	124	109.85	2,069	3,869
107.20	2,069	166	109.90	2,069	3,913
107.25	2,069	207	109.95	2,069	3,957
107.30	2,069	248	110.00	2,069	3,999
107.35	2,069	290	110.05	2,069	4,040
107.40	2,069	331	110.10	2,069	4,081
107.45	2,069	372	110.15	2,069	4,123
107.50	2,069	414	110.20	2,069	4,164
107.55	2,069	499	110.25	2,069	4,206
107.60	2,069	584	110.30	2,069	4,247
107.65	2,069	669	110.35	2,069	4,288
107.70	2,069	753	110.40	2,069	4,330
107.75	2,069	838	110.45	2,069	4,371
107.80	2,069	922	110.50	2,069	**4,412**
107.85	2,069	1,006			
107.90	2,069	1,089			
107.95	2,069	1,173			
108.00	2,069	1,256			
108.05	2,069	1,338			
108.10	2,069	1,420			
108.15	2,069	1,502			
108.20	2,069	1,584			
108.25	2,069	1,665			
108.30	2,069	1,745			
108.35	2,069	1,825			
108.40	2,069	1,905			
108.45	2,069	1,984			
108.50	2,069	2,063			
108.55	2,069	2,141			
108.60	2,069	2,219			
108.65	2,069	2,296			
108.70	2,069	2,372			
108.75	2,069	2,448			
108.80	2,069	2,524			
108.85	2,069	2,598			
108.90	2,069	2,672			
108.95	2,069	2,745			
109.00	2,069	2,818			
109.05	2,069	2,889			
109.10	2,069	2,960			
109.15	2,069	3,030			
109.20	2,069	3,099			
109.25	2,069	3,167			
109.30	2,069	3,234			
109.35	2,069	3,300			
109.40	2,069	3,364			
109.45	2,069	3,428			
109.50	2,069	3,490			
109.55	2,069	3,551			
109.60	2,069	3,610			
109.65	2,069	3,667			

Stage-Area-Storage for Pond UG5: UG5

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
108.00	**4,461**	0
108.10	4,461	178
108.20	4,461	357
108.30	4,461	535
108.40	4,461	714
108.50	4,461	892
108.60	4,461	1,071
108.70	4,461	1,249
108.80	4,461	1,530
108.90	4,461	1,912
109.00	4,461	2,292
109.10	4,461	2,671
109.20	4,461	3,048
109.30	4,461	3,424
109.40	4,461	3,798
109.50	4,461	4,171
109.60	4,461	4,541
109.70	4,461	4,909
109.80	4,461	5,276
109.90	4,461	5,640
110.00	4,461	6,001
110.10	4,461	6,360
110.20	4,461	6,716
110.30	4,461	7,069
110.40	4,461	7,419
110.50	4,461	7,765
110.60	4,461	8,108
110.70	4,461	8,448
110.80	4,461	8,783
110.90	4,461	9,114
111.00	4,461	9,441
111.10	4,461	9,762
111.20	4,461	10,079
111.30	4,461	10,389
111.40	4,461	10,694
111.50	4,461	10,992
111.60	4,461	11,283
111.70	4,461	11,566
111.80	4,461	11,840
111.90	4,461	12,104
112.00	4,461	12,355
112.10	4,461	12,590
112.20	4,461	12,805
112.30	4,461	13,004
112.40	4,461	13,195
112.50	4,461	13,378
112.60	4,461	13,557
112.70	4,461	13,735
112.80	4,461	13,914
112.90	4,461	14,092
113.00	4,461	14,270
113.10	4,461	14,449
113.20	4,461	14,627
113.30	4,461	14,806
113.40	4,461	14,984
113.50	4,461	**15,162**

4.3 STANDARD 4: WATER QUALITY

The BMP's have been designed to treat 1.0" of water quality volume (WQV), which exceeds the required 0.5" of WQV. A table has been provided below that provides the sizing of the Oil/Grit Separators (OGS). All the OGS have been sized to treat 400CF per acre-ft of impervious of the contributing tributary area. Also, a table has been provided below that provides the sizing of ADS Isolator Row treatment chamber systems, and one (1) Water Quality Unit (WQU).

Water Quality Unit Sizing Using Equivalent Flow from 1" Rainfall Depth											REQUIRED VOLUME FOR OGS IN FIRST CHAMBER	PROPOSED OIL/GRIT UNIT SIZE
UG Basin / Isolator row	Tributary Area	Tributary Area	Pervious	Impervious	CN Value	WQRD	WQ Volume	Tc	qu	WQF = qu A Q		
	(acres)	(sq miles)	(sf)	%	Estimated	(In)	(cf)	(min)	csm/in	(cfs)	400 cf / AC of imperv (GAL)*	(GAL)
UG-1a/OGS-1	0.14	0.0002	-	100%	98	1.00	508	5	795	0.17	418.9	1,000
UG-2/OGS-2	0.38	0.0006	4,790	71%	87	1.00	980	5	795	0.34	807.9	2,000
UG-3/OGS-3	0.79	0.0012	11,100	68%	86	1.00	1943	5	795	0.66	1,601.3	3,000
UG-4a/OGS-4	0.39	0.0006	1,755	90%	94	1.00	1269	5	795	0.43	1,046.3	3,000
UG-5/OGS-5	0.30	0.0005	2,350	82%	91	1.00	893	5	795	0.31	736.2	2,000
UG-6/OGS-6a	0.79	0.0012	15,795	54%	81	1.00	1551	5	795	0.53	1,278.8	3,000
UG-6/OGS-6b	0.20	0.0003	598	93%	95	1.00	676	5	795	0.23	557.3	1,500
UG-7/OGS-7	1.17	0.0018	7,305	86%	93	1.00	3638	5	795	1.25	2,998.9	6,000
OGS-8	0.45	0.0007	1,330	93%	95	1.00	1523	5	795	0.52	1,255.0	3,000

The WQU proposed is the SciClone Hydrodynamic Separator by BioClean Environmental Services, Inc. BioClean applied for and was granted a 50% TSS removal rate for the SciClone WQU which has been verified by the New Jersey Corporation for Advanced Technology (NJCAT) and certified by the New Jersey Department of Environmental Protection (NJDEP). In fact, the testing report, which is enclosed in this section, provides a removal efficiency of 65%. NJDEP only certifies for 50% and 80%; however, the testing completed by NJCAT resulted in a removal efficiency of 65%. Please refer to page 22 of the NJCAT Certification, enclosed in this section of the report. Based on the results of the NJCAT testing, 65% was used in the TSS Treatment Calculations enclosed in Section 4.5. The units were sized per NJDEP design criteria, which requires sizing based on Water Quality Flow (WQF), to the unit. There is 0.52CFS of WQF proposed to be routed through the SciClone model, therefore, the SC-4, is proposed.
The ADS Isolator Row systems were sized per the manufacturer recommendations, shown below. The manufacturer limits the amount of WQF per chamber for each of the systems proposed. The project proposes the SC-310, SC-740 and MC-3500 Stormtech Isolator Row Systems, each with their own treatment capabilities, shown below.

The table below shows the isolation chambers that have been provided in each underground system to treat the required WQV and to limit the flow in each chamber to the allowed WQF.

ISOLATOR ROW	UNIT TYPE	Treated flow per unit	Flow required to be treated	Number of units Provided	Treated Flow per Isolator Row
		cfs	cfs		cfs
UG-1 IR-1	SC-740	0.26	0.17	8	2.08
UG-2 IR-2	SC-740	0.26	0.34	10	2.60
UG-3 IR-3	MC-3500	0.40	0.66	7	2.80
UG-4a IR-4	SC-310	0.16	0.43	6	0.96
UG-5 IR-5	MC-3500	0.40	0.31	10	4.00
UG-6 IR-6a	SC-310	0.16	0.53	6	0.96
UG-6 IR-6b	SC-310	0.16	0.23	6	0.96
UG-7 IR-7	MC-3500	0.40	1.25	10	4.00

NJCAT TECHNOLOGY VERIFICATION

SciClone™ Hydrodynamic Separator

Performance Verification of Sediment Capture and Light Liquid Retention

Bio Clean Environmental Services Inc.

September 2017

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1. Introduction

The SciClone™ is a manufactured treatment device (MTD) designed by Bio Clean Environmental Services Inc., a Forterra Company. The SciClone is designed to remove pollutants from stormwater runoff using a series of flow splitters, weirs and baffles. The device traps suspended particulates by promoting gravity separation, as well as being able to capture and retain floatables and light liquids, such as oil.

The test program was conducted by Good Harbour Laboratories (GHL), an independent water technology testing lab based in Ontario, Canada. The study results were submitted to the New Jersey Corporation for Advanced Technology (NJCAT) for verification. NJCAT is a private/public partnership that provides independent technology verification, education and information on emerging environmental and energy technology fields.

This testing program was based primarily on the *New Jersey Department of Environmental Protection Laboratory Protocol to Assess Total Suspended Solids Removal by a Hydrodynamic Sedimentation Manufactured Treatment Device (January 25, 2013)*. However, the particle size distribution (PSD) of the test sediment used is larger than what is required for NJDEP approval. This larger PSD is common in many regions throughout the nation and thus is more applicable in these areas.

In addition to sediment capture, the testing program incorporated an assessment for the retention of light liquids. This portion of the study was based on the Canada Environmental Technologies Verification (ETV) procedure: *Procedure for Laboratory Testing of Oil-Grit Separators (Version 3.0)*. The performance test results have been submitted to NJCAT for verification only.

2. Description of Technology

The SciClone™ system captures the following pollutants: total suspended solids, particulate bound nutrients and metals, debris, floatables and free-floating oil from contaminated runoff.

The SciClone™ is designed to maximize the flow path of entering stormwater thus optimizing its ability to capture suspended solids efficiently with minimal surface area. The system has no moving parts and operates utilizing the principles of gravity separation and flow path maximization to increase settling of finer particulates. It is composed of three components as shown in **Figure 1**.

Runoff is directed into the system via the inflow pipe and enters the flow splitter deck, as illustrated in **Figure 2**. From the flow splitter, water is channeled along the chamber wall on both sides of the inlet pipe. This splitting of the flow reduces inlet velocity into the system and channels flow along the walls of the chamber. As the split flow encounters the oil/floatables skimmer wall, it is directed along the skimmer wall toward the center of the chamber. At the center of the chamber the flow paths from both sides meet one another. As this occurs the flow path from both directions circles back toward the inlet pipe. This configuration directs the flow back toward the inlet and underneath the flow splitter deck thus maximizing the flow path. Finer sediments are directed into the sump chamber below the flow splitter to the chamber wall under the inlet as shown in **Figure 3**.

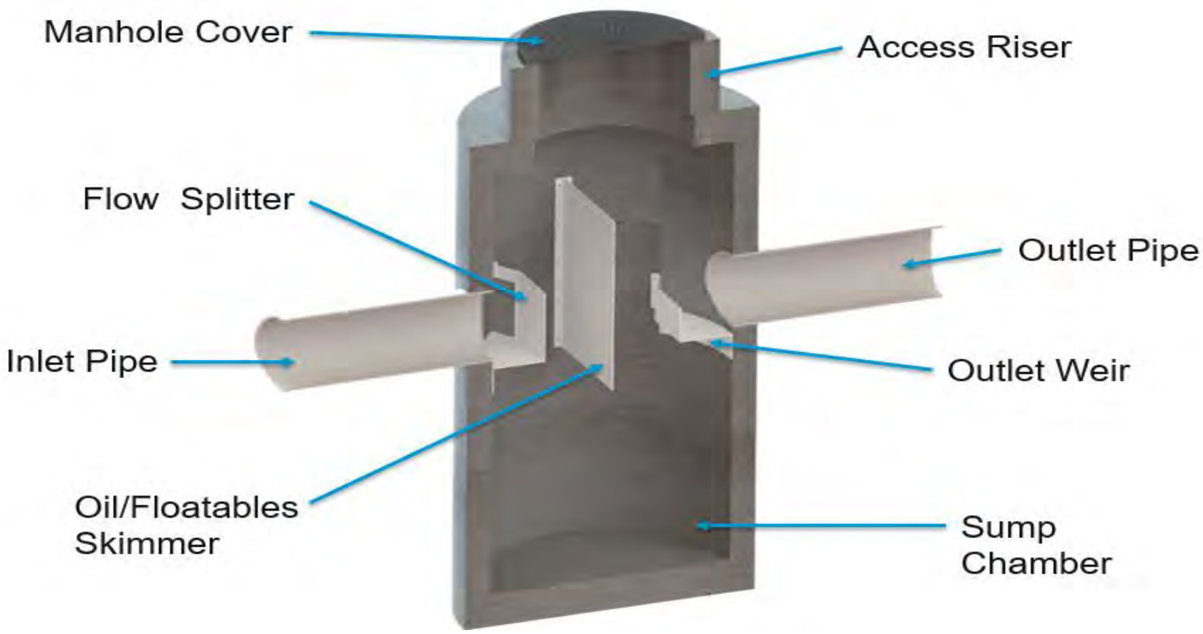

Figure 1 Cut-Away View

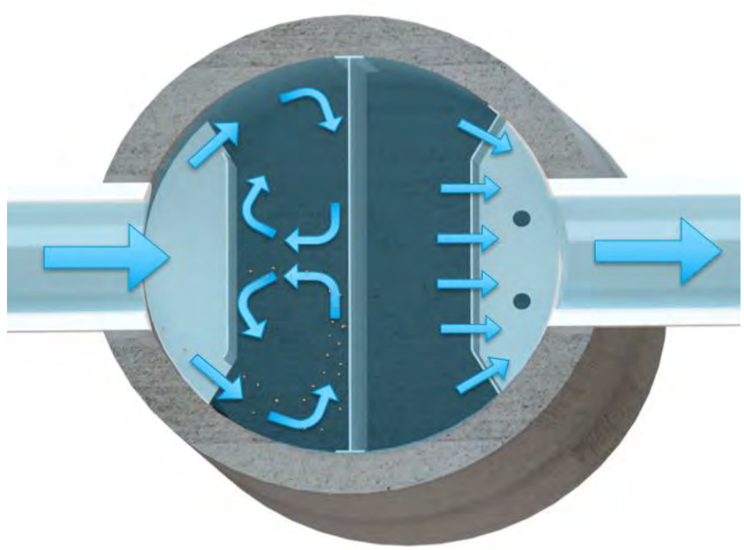

Figure 2 Operational Diagram

The oil/floatables skimmer is installed in the middle of the chamber and extends downward and upward to isolate free-floating oils and floatable trash and debris. Flows are forced to travel under the skimmer in the center of the system where the system is the widest thus creating a laminar flow under the weir and minimizing velocity. As water passes under the oil/floatables skimmer it rises back up and toward the outlet weir. The outlet weir extends across the width of the outlet pipe and protrudes up slightly above the outlet pipe invert. The outlet weir is much wider than the pipe and creates a laminar flow from the system into the outlet pipe to reduce entrance velocity back into the pipe in order to prevent channeling of flow as shown in **Figure 3**.

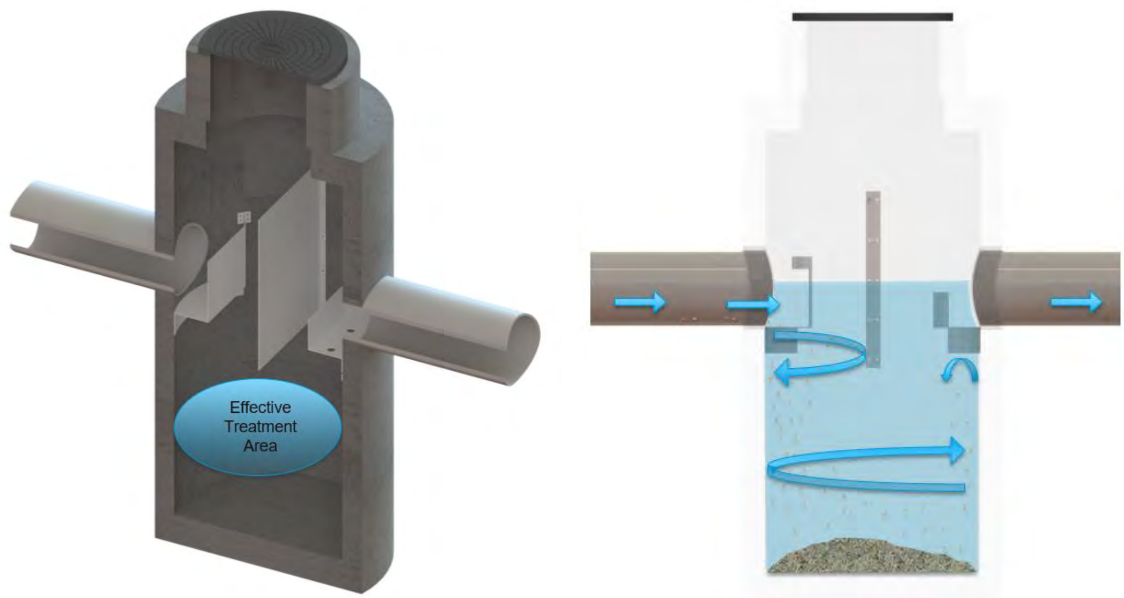

Figure 3 Effective Treatment Area and Flow Path Diagram

The unique design of the SciClone™, with a flow splitter, oil/floatables skimmer, and outlet weir maximizes the flow path and minimizes velocity for maximum performance. The system is designed to be installed online and process high flows internally. Higher flows are able to pass over the top of the flow splitter without impedance, under the oil/floatables skimmer and to the outlet. The outlet weir creates less turbulent conditions into the pipe and thus reduces head-loss during peak flow conditions as shown in **Figure 4**.

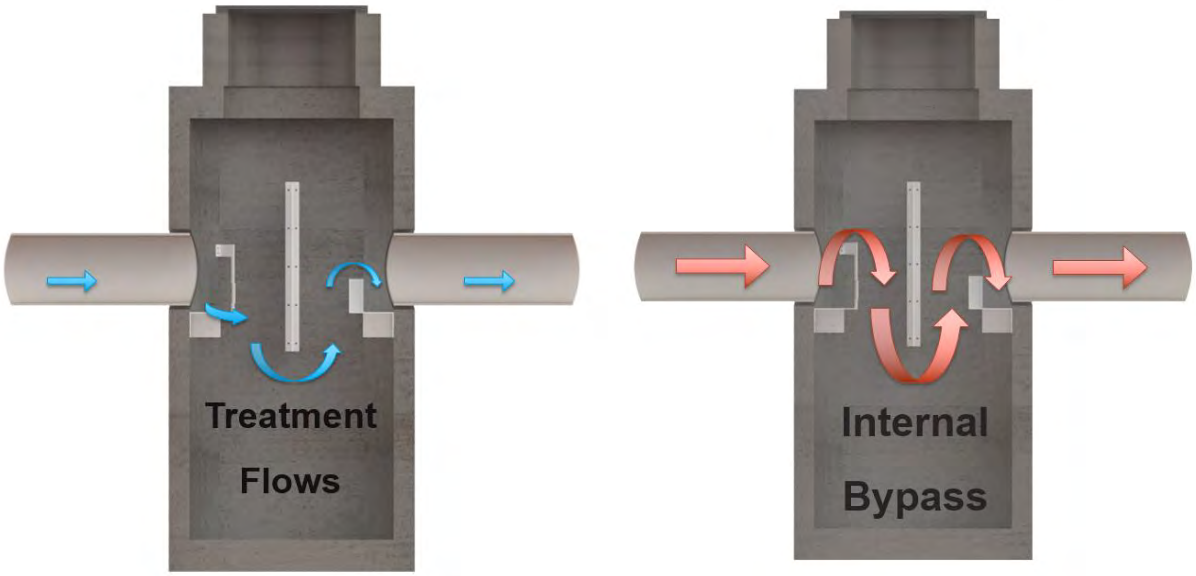

Figure 4 View During Treatment and Bypass Flows

3. Laboratory Testing

The device tested was a four-foot diameter SciClone™ unit (Model SC-4) consisting of internal components housed in a metal manhole. In commercial systems, the internal components are typically housed in a concrete manhole. The metal manhole of the test unit was equivalent to commercial concrete manholes in all key dimensions. The use of a metal manhole was proposed due to the difficulties associated with transporting and physically supporting the weight of a concrete vessel. Using a metal manhole in lieu of concrete did not impact system performance.

3.1 Test Setup

The specifications of the tested SciClone™ Hydrodynamic Separator (HDS) (Model SC-4) are provided in **Table 1**. The test unit had a total sedimentation area of 12.6 ft^2 and a maximum treatment flow rate (MTFR) of 0.70 cfs (315 gpm).

Table 1 SciClone™ Model SC-4 Dimensions

MTFR (cfs)	Diameter (ft)	50% of Sediment Storage Volume (ft^3)	Oil Capacity (Gal)	Effective Treatment Area (ft^2)
0.701	4	9.4	15.4	12.6

The laboratory test set-up was a water flow loop, capable of moving water at a rate of up to 2.2 cfs. The test loop, illustrated in **Figure 5**, was comprised of water storage tanks, pumps, sediment filter, receiving tank and flow meters.

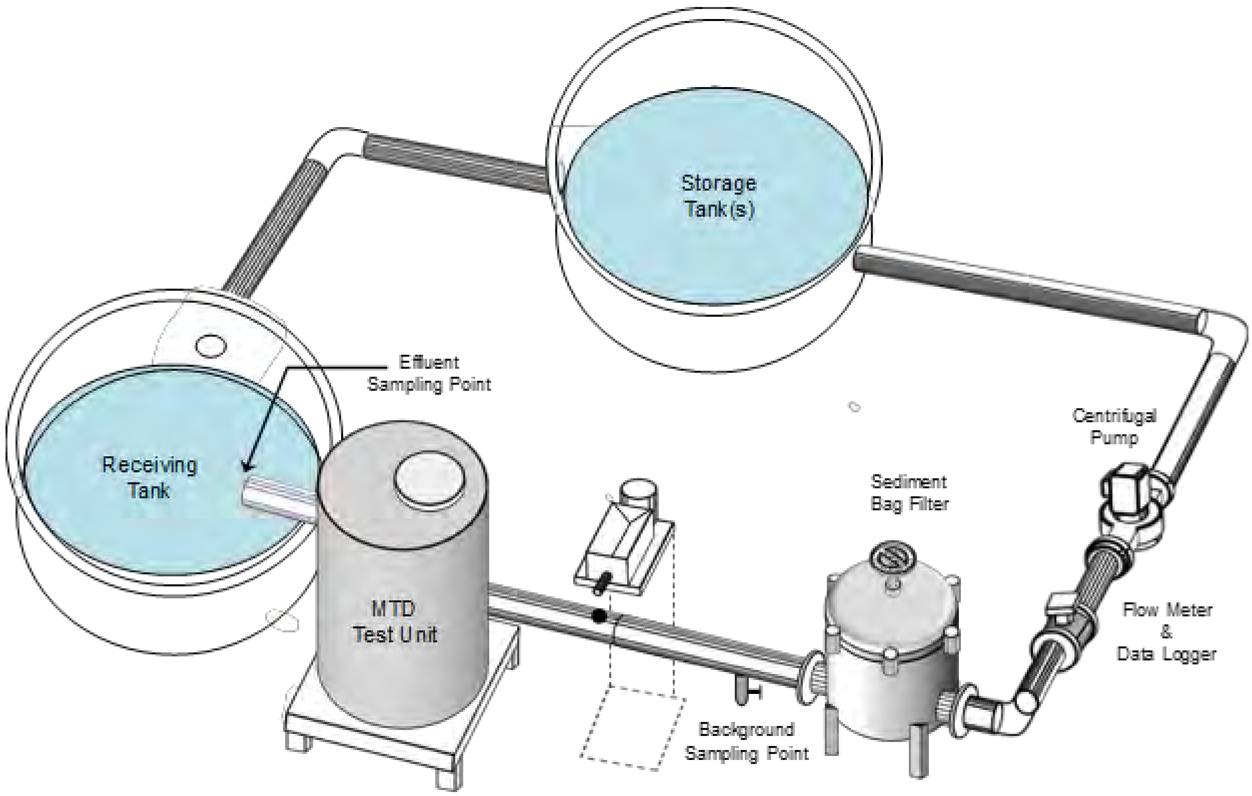

Figure 5 Test Flow Apparatus

Water Flow and Measurement

From the water supply tanks, water was pumped using either a WEG Model FC00312 (1 – 200 gpm) or an Armstrong Model 8X8X10 4380 (200 – 1000 gpm) centrifugal pump. Flow measurement was done using either a 3" Toshiba Model GF630 electromagnetic type flow meter with an accuracy of ± 0.5% of reading (1 – 200 gpm) or a MJK Magflux Type 7200 flow meter Model 297237 with an accuracy of ± 0.25% of reading (100 – 1000 gpm). The data logger used was a MadgeTech Process 101A data logger, configured to record a flow measurement once every minute.

The water in the flow loop was circulated through a filter housing containing high-efficiency pleated bag filters with a 0.5 µm absolute rating. The influent pipe was 24 inches in diameter and 132 inches long. Sediment addition was done through a port at the crown of the influent pipe, 118 inches upstream of the SciClone™. The sediment feeder was an Auger Feeders Model VF-1 volumetric screw feeder with vibratory hopper. The feeder had a 10-gallon hopper above the auger screw to provide a constant supply of sediment.

Water flow exited the SciClone™ and terminated with a free-fall into the receiving tank to complete the flow loop.

Sample Collection

Background water samples were collected in a 1 L jar from a sampling port located upstream of the auger feeder. The sampling port was controlled manually by a ball valve (**Figure 6**) that was opened approximately 5 seconds prior to sampling.

Effluent samples were also grabbed by hand. The effluent pipe drained freely into the receiving tank and the effluent sample was taken at that point (**Figure 7**). The sampling technique was to take the grab sample by sweeping a 1 L jar through the stream of effluent flow such that the jar was full after a single pass.

Figure 6 Background Sampling Point

Figure 7 Effluent Sampling Point

Duplicate samples were taken for both background and effluent. The primary set was analysed and reported while the second set was held under refrigerated conditions in case there was a need for an investigation following an aberrant result.

Other Instrumentation and Measurement

Effluent water temperature was taken as it exited the effluent pipe stub, using a Kangaroo digital, thermometer, Model 21800-068.

Run and sampling times were measured using a NIST traceable stopwatch, Control Company Model 62379-460.

The sediment feed samples that were taken during the run were collected in 500 mL jars and weighed on an analytical balance (Mettler Toledo, AB204-S).

3.2 Test Sediment

The test sediment was fed through an opening in the crown of the influent pipe, 118" upstream of the SciClone™. A funnel was used to direct the sediment into the pipe (**Figure 8**). The test sediment used for the removal efficiency study was commercially available silica sediment supplied by AGSCO Corporation, generally referred to as #110 but labeled #140-200. This particular batch was lot # 03311724648. Three samples of sediment were sent out for particle size analysis using the methodology of ASTM method D422-63 (reapproved 2007). The samples were composite samples created by taking a sediment sample from the hopper before the start of each of the five runs. The testing lab was Maxxam Analytics, an independent test lab also located in Ontario, Canada. The PSD results are summarized in **Table 2** and shown graphically in **Figure 9.**

Figure 8 Sediment Addition Point

Table 2 Particle Size Distribution of #110 Test Sediment

Particle Size (µm)	Test Sediment Particle size (%passing)			
	Sample 1	Sample 2	Sample 3	Average
1000	100.0	100.0	100.0	100.0
500	99.8	99.7	99.6	99.7
250	96.1	95.7	95.1	95.6
150	79.5	78.4	76.5	78.1
100	42.9	39.7	39.4	40.7
75	21.2	20.0	21.2	20.8
50	3.3	2.0	2.1	2.5
20	0	0	0	0
8	0	0	0	0
5	0	0	0	0
2	0	0	0	0
d_{50} (µm)	109	113	114	112

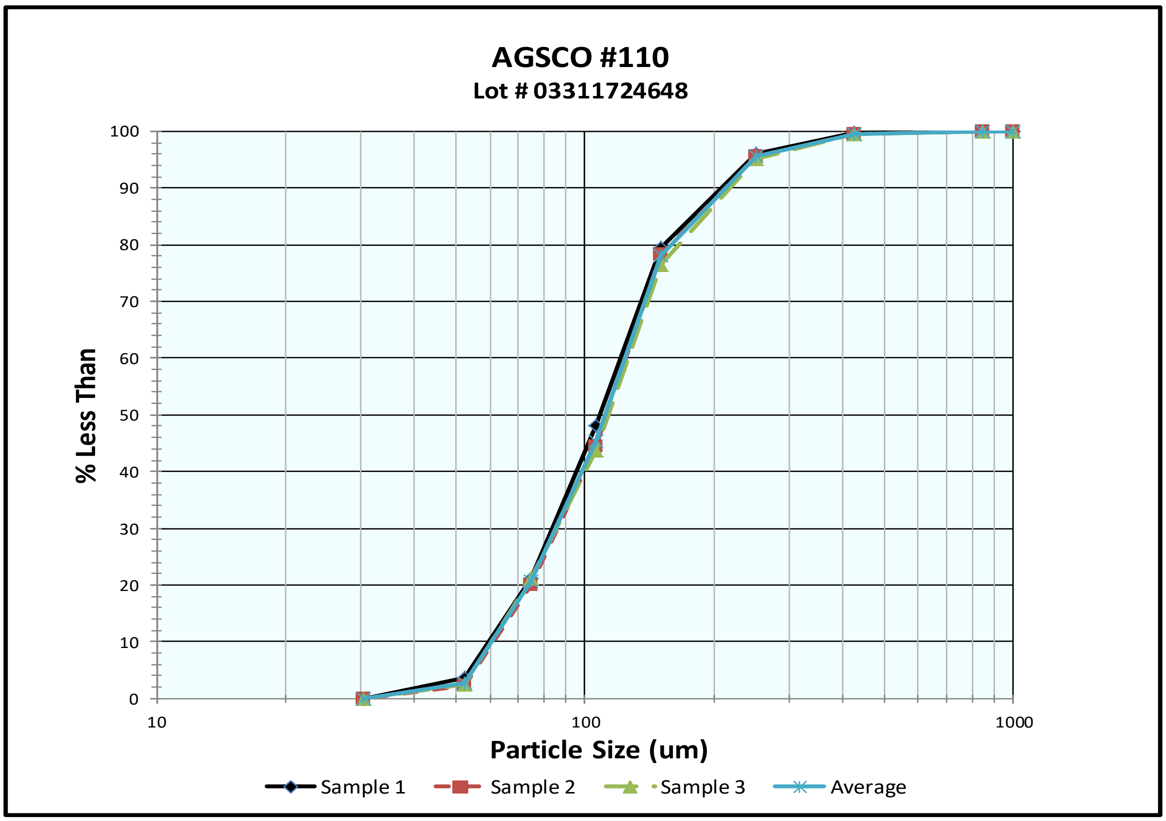

Figure 9 Particle Size Distribution of Test Sediment

For the scour test, the NJDEP specified scour test sediment was used. The sediment was blended by GHL using commercially available silica sands and the PSD of the sediment meet the specifications for the scour test sediment specified in the NJDEP laboratory test protocol. The scour test sediment PSD results are summarized in **Table 3** and shown graphically in **Figure 10**.

Table 3 Particle Size Distribution of Scour Test Sediment

Particle Size (µm)	Test Sediment Particle Size (% Less Than)				NJDEP Specification (Minimum % Less Than)
	Sample 1	Sample 2	Sample 3	Average	
1000	100	99	100	100	100
500	95	92	94	94	90
250	63	58	61	61	55
150	52	43	46	47	40
100	33	20	23	25	25
75	22	10	13	15	10
50	14	4	6	8	0

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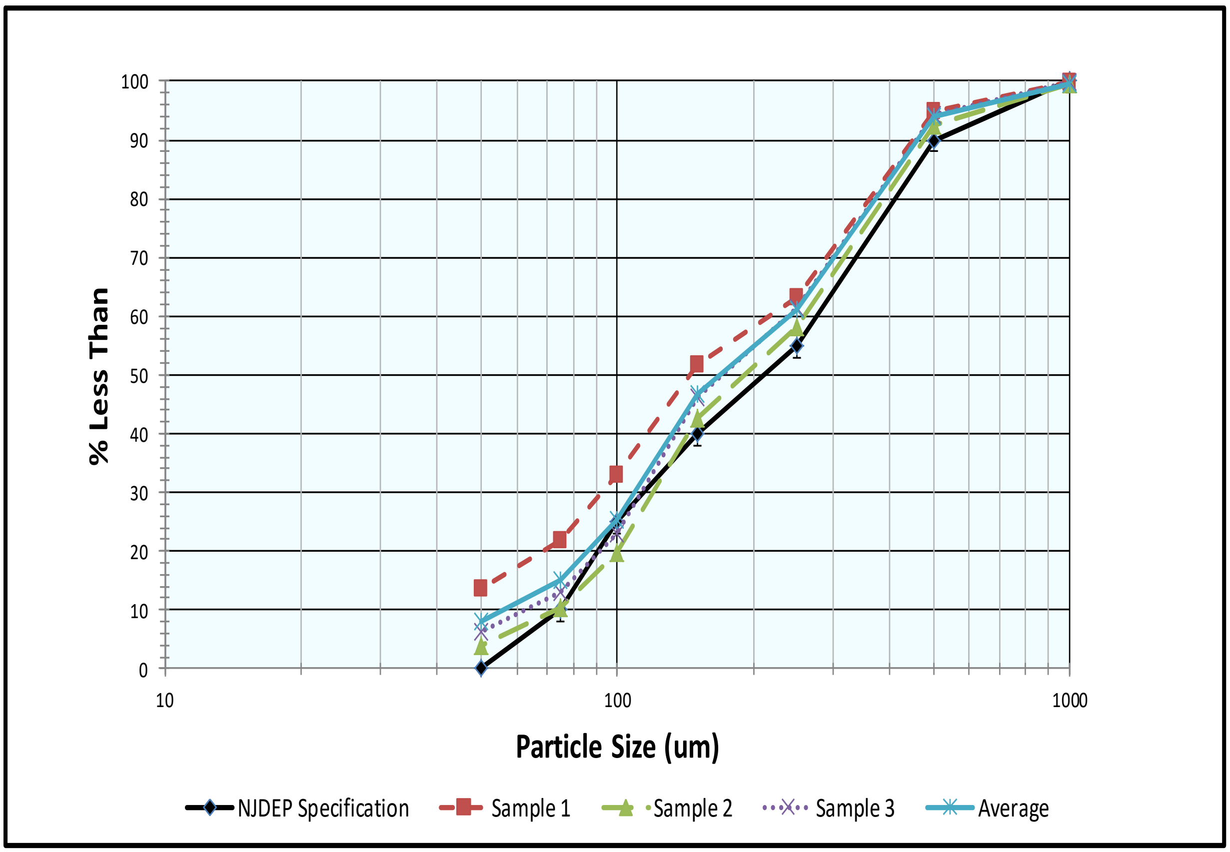


Figure 10 Particle Size Distribution of Scour Test Sediment

3.3 Removal Efficiency Testing

Removal efficiency testing was conducted on a clean unit with a false floor installed at 50% of the sump sediment storage depth, 9 inches above the device floor. Removal Efficiency Testing was based on Section 5 of the NJDEP Laboratory Protocol for Hydrodynamic Sedimentation MTDs.

The test sediment was sampled six times per run to confirm the sediment feed rate. Each sediment feed rate sample was collected in a 500-mL jar over an interval timed to the nearest second and was a minimum 0.1 liter or the collection interval did not exceed one minute, whichever came first.

Effluent grab sampling began following three MTD detention times after the initial sediment feed sample. The time interval between sequential samples was 1 minute, however, if the test sediment feed was interrupted for measurement, the next effluent sample was collected following three MTD detention times from the time the sediment feed was re-established. A total of 15 effluent samples were taken during each run.

Background water samples were taken with the odd-numbered effluent samples.

3.4 Scour Testing

Prior to the start of testing, sediment was loaded onto a 5-inch false floor of the sump of the SciClone™ and leveled at a depth of 4 inches. The final height of the sediment was at an elevation equivalent to 50% of the maximum sediment storage capacity of the MTD. After loading of the sediment, the unit was gradually filled with clear water, so as not to disturb the sediment, to the invert of the inlet pipe. The filled unit was allowed to sit for 89 hours.

The scour test was conducted at a flow rate of 630 gpm (1.4 cfs), two times the MTFR.

During the scour test, the water flow rate and temperature were recorded once every minute using a MadgeTech Process 101 data logger and a MicroTemp data logger. Testing commenced by gradually increasing the water flow into the system until the target flow rate was achieved (within five minutes of commencing the test). Background and effluent sampling began five minutes after adding water to the system. Sampling of background and effluent was completed as per the removal efficiency test. An effluent grab sample was taken once every two minutes, starting after achieving the target flow rate, until a total of 15 effluent samples were taken. A total of eight background water samples were collected at evenly spaced intervals throughout the scour test.

3.5 Light Liquid Re-Entrainment Simulation Test

The objective of this test was to assess whether light liquids captured in the SciClone™ are effectively retained at design flow rates. The test used low density polyethylene (LDPE) plastic beads as a surrogate for light liquids. The specifications of the LDPE beads are provided in **Table 4**. Since the density of the beads is similar to that of motor oil, the beads mimic the behaviour of light liquids trapped in a hydrodynamic separator.

Table 4 LDPE Bead Specifications

Manufacturer	Dow Chemical
Product Name	DOWLEX™ 2517 Polyethylene Resin
Batch Number	D204F5D01E
Density	0.9166 g/cm^3
Bulk Density	0.56074 g/cm^3

This test was run with clean water and with the false floor set at 50% of the maximum recommended sediment storage depth to ensure that the hydrodynamics of the SciClone™ were representative of an average condition. For the test, the SciClone™ was pre-loaded to its maximum recommended oil storage capacity, 15.4 gallons, with LDPE beads.

The potential for oil re-entrainment and washout was determined at five flow rates, ranging from 25% to 125% MTFR, increased in 5-minute intervals. Flow rates were recorded once every 30 seconds over the duration of the test and maintained within ±10% of the target flow rate with a COV of less than 0.03. The time to increase the flow initially, and from one rate to the next, did not exceed 1 minute.

All effluent during the test was screened for the entire duration of the test. The screen mesh size used ensured that all plastic beads washed out of the SciClone™ were retained on the screens while allowing water to pass through. The way the LDPE beads were collected and quantified ensured that they were associated with the flow rate interval in which they were washed out. Beads that washed out during a transition flow were associated with the higher target flow rate.

The volume, mass, and percentage of plastic beads washed out of the SciClone™ were determined for each flow rate.

4. Performance Claims

The following are the performance claims made by Bio Clean Environmental Services and/or established via the laboratory testing conducted for the SciClone™ Hydrodynamic Separator.

Total Suspended Solids (TSS) Removal Rate

The TSS removal rate of the SciClone™ using sediment with a median particle size (d_{50}) of 112 µm was determined using the weighted method specified by the NJDEP HDS MTD protocol. Based on a MTFR of 0.70 cfs, the SciClone™ achieved a weighted TSS removal rate, reported as Suspended Sediment Concentration (SSC) per the NJDEP protocol, of at least 80%.

Maximum Treatment Flow Rate (MTFR).

The SciClone™ unit had a total sedimentation area of 12.6 ft^2 and a maximum treatment flow rate (MTFR) of 0.70 cfs (315 gpm), which corresponds to a surface loading rate of 25 gpm/ft^2 of sedimentation area.

Maximum Sediment Storage Depth and Volume

The maximum sediment storage depth is 18" which equates to 18.8 ft^3 of sediment storage volume. A sediment storage depth of 9" corresponds to 50% full storage capacity (9.4 ft^3).

Effective Treatment/Sedimentation Area

The effective treatment area is 12.6 ft^2.

Detention Time and Wet Volume

The wet volume for the SciClone™ is 470 gallons. The detention time of the SciClone™ is dependent upon flow rate. The minimum design detention time, calculated by dividing the treatment volume by the MTFR of 315 gpm, is 89.5 seconds.

Light Liquid Retention

Based on the laboratory testing using polyethylene beads as a surrogate for light liquids, the SciClone™ can retain a minimum of 98.7% (on a mass basis) of trapped light liquids up to a flow rate of 100% MTFR and 89.1% at 125% MTFR.

5. Supporting Documentation

To support the performance claims, copies of the laboratory test reports, including all collected and measured data; all data from performance evaluation test runs; spreadsheets containing original data from all performance test runs; all pertinent calculations; etc. were made available to NJCAT for review. It was agreed that as long as such documentation could be made available upon request that it would not be prudent or necessary to include all this information in this verification report. All supporting documentation will be retained securely by GHL and has been provided to NJCAT.

5.1 Removal Efficiency

A total of 5 removal efficiency testing runs were completed in accordance with the NJDEP HDS protocol. The target flow rate ranged from 25 – 125% MTFR and the target influent sediment concentration was 200 mg/L. The results from all 5 runs were used to calculate an annualized weighted removal efficiency for the SciClone™.

The total water volume and average flow rate per run were calculated from the data collected by the flow data logger, one reading every minute. The average influent sediment concentration for each test flow was determined by mass balance. The amount of sediment fed into the auger feeder during dosing, and the amount remaining at the end of a run, was used to determine the amount of sediment fed during a run. The sediment mass was corrected for the mass of the six feed rate samples taken during the run. The mass of the sediment fed was divided by the volume of water that flowed through the SciClone™ during dosing to determine the average influent sediment concentration for each run.

Six feed rate samples were collected at evenly spaced intervals during the run to ensure the rate was stable. The COV of the samples had to be < 0.10 per the NJDEP protocol. The feed rate samples were also used to calculate an influent concentration in order to double check the concentration calculated by mass balance.

The average effluent sediment concentration was adjusted for the background sediment concentration. In cases where the reported background sediment concentration was less than 2.3 mg/L (the method quantitation limit), 2 mg/L was used in calculating the adjusted effluent concentration.

Removal efficiency for each test run was computed as follows:

$$Removal\ Efficiency\ (\%) = \left(\frac{\begin{matrix} Average\ Influent \\ Concentration \end{matrix} - \begin{matrix} Adjusted\ Average \\ Effluent\ Concentration \end{matrix}}{\begin{matrix} Average\ Influent \\ Concentration \end{matrix}} \right) \times 100\%$$

The data collected for each removal efficiency run is presented below.

25% MTFR

Table 5 Sampling Schedule - 25% MTFR

Runtime (min)	Sampling Schedule		
	Sediment Feed	Background	Effluent
0	1		
18.91		1	1
19.91			2
20.91	2	2	3
39.81			4
40.81		3	5
41.81	3		6
60.72		4	7
61.72			8
62.72	4	5	9
81.62			10
82.62		6	11
83.62	5		12
102.53		7	13
103.53			14
104.53	6	8	15
105.53	End of Testing		
MTD Detention Time = 5.968 minutes Target Sediment Sampling Time = 60 seconds			

Table 6 Water Flow and Temperature - 25% MTFR

Run Parameters	Water Flow Rate (GPM)				Maximum Water Temperature (°F)
	Target	Actual	Difference	COV	
	78.8	78.9	0.13%	0.006	64.2
QA/QC Limit	-	-	±10% PASS	0.03 PASS	80 PASS

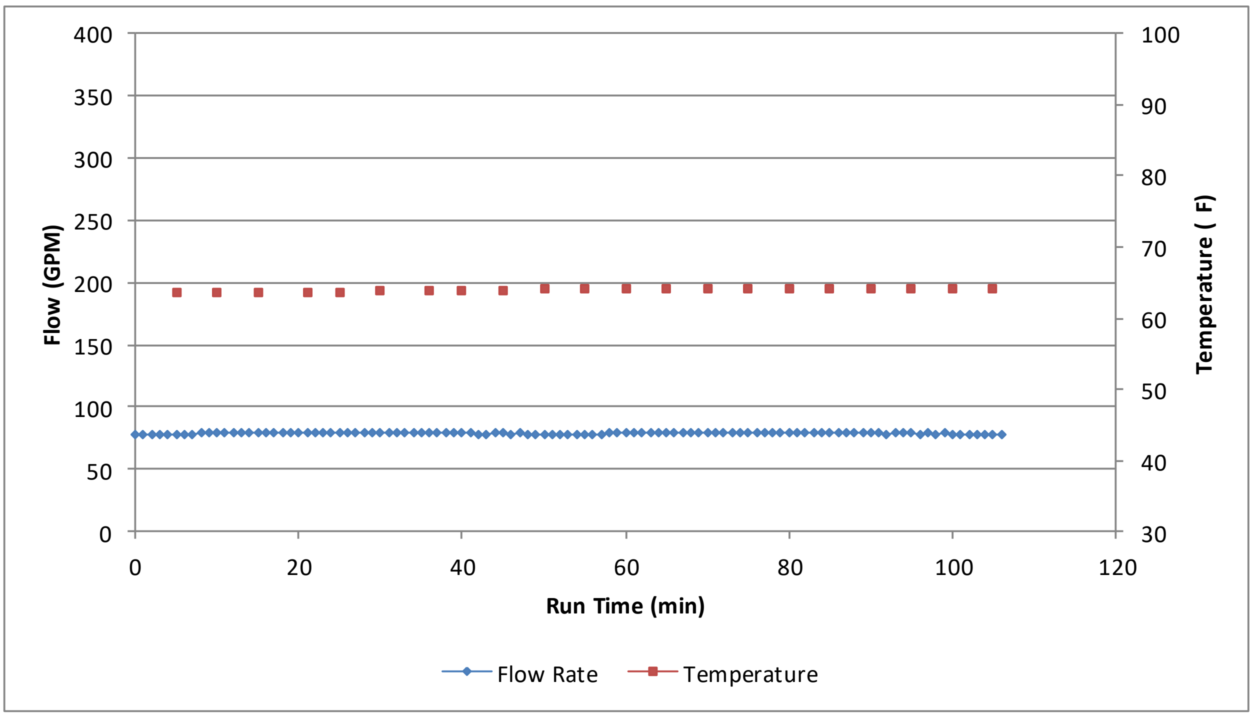


Figure 11 Water Flow and Temperature - 25% MTFR

Table 7 Sediment Feed Rate Summary – 25% MTFR

Sediment Feed Rate (g/min)		Sediment Mass Balance	
1	59.404	Starting Weight of Sediment (lbs.)	58.081
2	60.125		
3	61.024	Recovered Weight of Sediment (lbs.)	43.850
4	62.398		
5	60.995	Mass of Sediment Used (lbs.)	14.231
6	62.439	Volume of Water Through MTD During Dosing (gal)	7,860
Average	61.064		
COV	0.020	Average Influent Sediment Concentration (mg/L)	204.7*
QA/QC Limit	0.10 PASS	QA/QC Limit	180 – 220 mg/L PASS

*Corrected for sediment feed rate samples

Table 8 SSC and Removal Efficiency - 25% MTFR

	Suspended Sediment Concentration (mg/L)														
Sample #	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Effluent	6.9	7.4	6.5	6.9	7.4	6.6	6.9	7.5	6.7	7.3	7.5	7.9	6.7	6.8	7.3
Background	2		2		2		2		2		2		2		2
Adjusted Effluent	4.9	5.4	4.5	4.9	5.4	4.6	4.9	5.5	4.7	5.3	5.5	5.9	4.7	4.8	5.3

Average Adjusted Effluent Concentration	5.1 mg/L	Removal Efficiency	97.5%

50% MTFR

Table 9 Sampling Schedule - 50% MTFR

Runtime (min)	Sampling Schedule		
	Sediment Feed	Background	Effluent
0	1		
9.95		1	1
10.95			2
11.95	2	2	3
21.91			4
22.91		3	5
23.91	3		6
33.86		4	7
34.86			8
35.86	4	5	9
45.81			10
46.81		6	11
47.81	5		12
57.76		7	13
58.76			14
59.76	6	8	15
60.76	End of Testing		
MTD Detention Time = 2.984 minutes Target Sediment Sampling Time = 60 seconds			

Table 10 Water Flow and Temperature - 50% MTFR

Run Parameters	Water Flow Rate (GPM)				Maximum Water Temperature (°F)
	Target	Actual	Difference	COV	
	157.5	157.0	- 0.32%	0.010	64.4
QA/QC Limit	-	-	±10% PASS	0.03 PASS	80 PASS

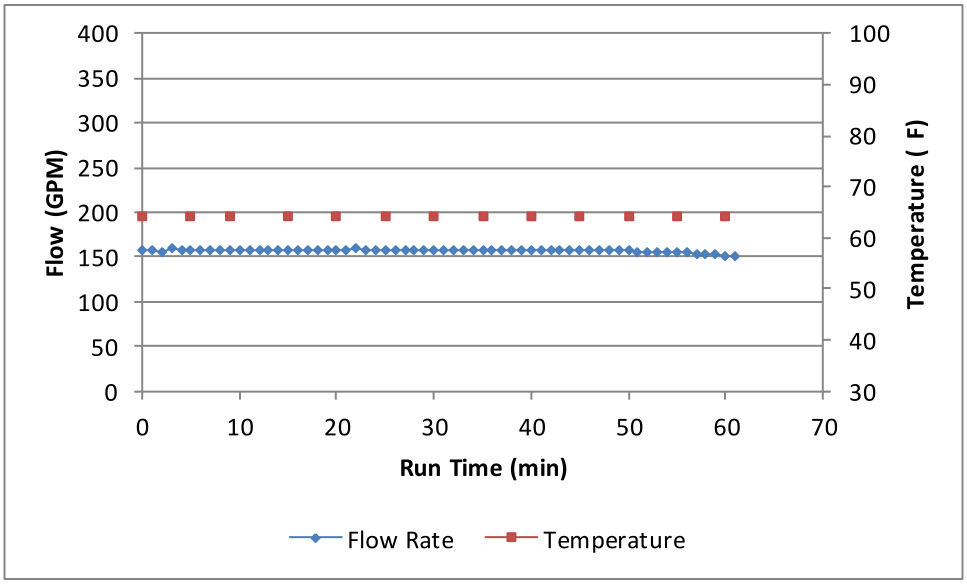


Figure 12 Water Flow and Temperature - 50% MTFR

Table 11 Sediment Feed Rate Summary – 50% MTFR

Sediment Feed Rate (g/min)		Sediment Mass Balance	
1	120.296	Starting Weight of Sediment (lbs.)	62.26
2	119.098		
3	122.968	Recovered Weight of Sediment (lbs.)	45.91
4	123.317		
5	122.352	Mass of Sediment Used (lbs.)	16.35
6	124.900	Volume of Water Through MTD During Dosing (gal)	8,607
Average	122.155		
COV	0.017	Average Influent Sediment Concentration (mg/L)	205.3*
QA/QC Limit	0.10 PASS	QA/QC Limit	180 – 220 mg/L PASS

*Corrected for sediment feed rate samples

Table 12 SSC and Removal Efficiency - 50% MTFR

	Suspended Sediment Concentration (mg/L)														
Sample #	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Effluent	28.8	28.1	28.4	29.0	29.4	31.4	28.8	28.9	26.4	28.5	27.9	30.2	33.2	30.9	31.8
Background	2		2		2		2		2		2		2		2
Adjusted Effluent	26.8	26.1	26.4	27.0	27.4	29.4	26.8	26.9	24.4	26.5	25.9	28.2	31.2	28.9	29.8
Average Adjusted Effluent Concentration					27.4				Removal Efficiency					86.6%	

75% MTFR

Table 13 Sampling Schedule - 75% MTFR

Runtime (min)	Sampling Schedule		
	Sediment Feed	Background	Effluent
0	1		
6.89		1	1
7.89			2
8.89	2	2	3
15.77			4
16.77		3	5
17.77	3		6
24.66		4	7
25.66			8
26.66	4	5	9
33.54			10
34.54		6	11
35.54	5		12
42.43		7	13
43.43			14
44.43	6	8	15
45.34	End of Testing		
MTD Detention Time = 1.989 minutes Target Sediment Sampling Time = 55 seconds			

Table 14 Water Flow and Temperature - 75% MTFR

Run Parameters	Water Flow Rate (GPM)				Maximum Water Temperature (°F)
	Target	Actual	Difference	COV	
	236.6	234.7	-0.80%	0.009	64.8
QA/QC Limit	-	-	±10% PASS	0.03 PASS	80 PASS

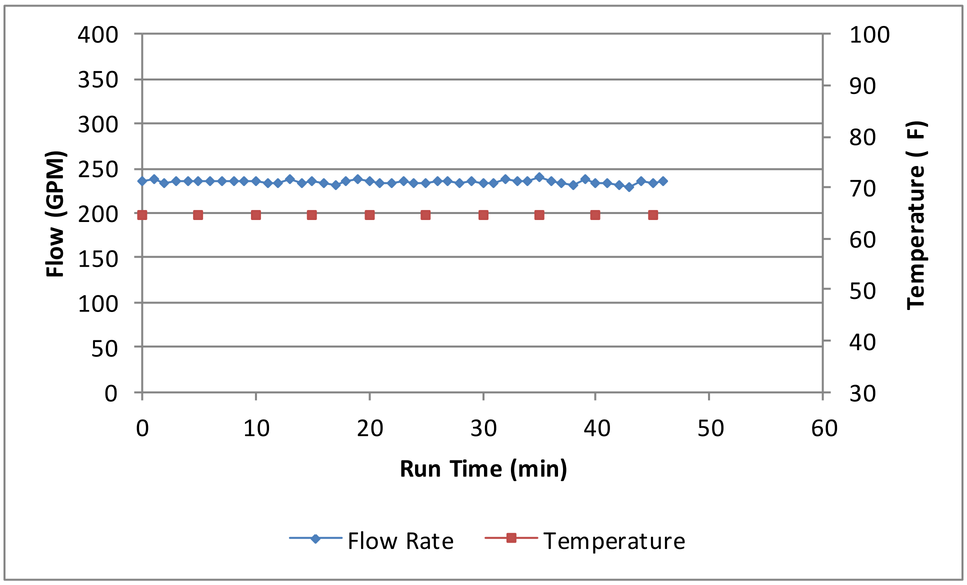


Figure 13 Water Flow and Temperature - 75% MTFR

Table 15 Sediment Feed Rate Summary – 75% MTFR

Sediment Feed Rate (g/min)		Sediment Mass Balance	
1	170.186	Starting Weight of Sediment (lbs.)	72.95
2	169.005		
3	170.214	Recovered Weight of Sediment (lbs.)	55.96
4	169.504		
5	171.289	Mass of Sediment Used (lbs.)	16.99
6	169.844	Volume of Water Through MTD During Dosing (gal)	9,355
Average	170.007		
COV	0.005	Average Influent Sediment Concentration (mg/L)	191.3*
QA/QC Limit	0.10 PASS	QA/QC Limit	180 – 220 mg/L PASS

*Corrected for sediment feed rate samples

Table 16 SSC and Removal Efficiency - 75% MTFR

	Suspended Sediment Concentration (mg/L)														
Sample #	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Effluent	46.0	47.4	46.2	44.8	52.0	51.7	55.2	48.4	51.5	57.1	54.2	53.2	51.7	49.6	51.0
Background	2		2		2		2		2		2		2		2
Adjusted Effluent	44.0	45.4	44.2	42.8	50.0	49.7	53.2	46.4	49.5	55.1	52.2	51.2	49.7	47.6	49.0

Average Adjusted Effluent Concentration	48.7 mg/L	Removal Efficiency	74.6%

100% MTFR

Table 17 Sampling Schedule - 100% MTFR

Runtime (min)	Sampling Schedule		
	Sediment Feed	**Background**	**Effluent**
0	1		
5.14		1	1
6.14			2
7.14	2	2	3
12.29			4
13.29		3	5
14.29	3		6
19.43		4	7
20.43			8
21.43	4	5	9
26.57			10
27.57		6	11
28.57	5		12
33.72		7	13
34.72			14
35.72	6	8	15
36.38	End of Testing		
MTD Detention Time = 1.492 minutes Target Sediment Sampling Time = 40 seconds			

Table 18 Water Flow and Temperature - 100% MTFR

Run Parameters	Water Flow Rate (GPM)				Maximum Water Temperature (°F)
	Target	Actual	Difference	COV	
	315.0	310.6	-1.40	0.008	64.9
QA/QC Limit	-	-	±10% PASS	0.03 PASS	80 PASS

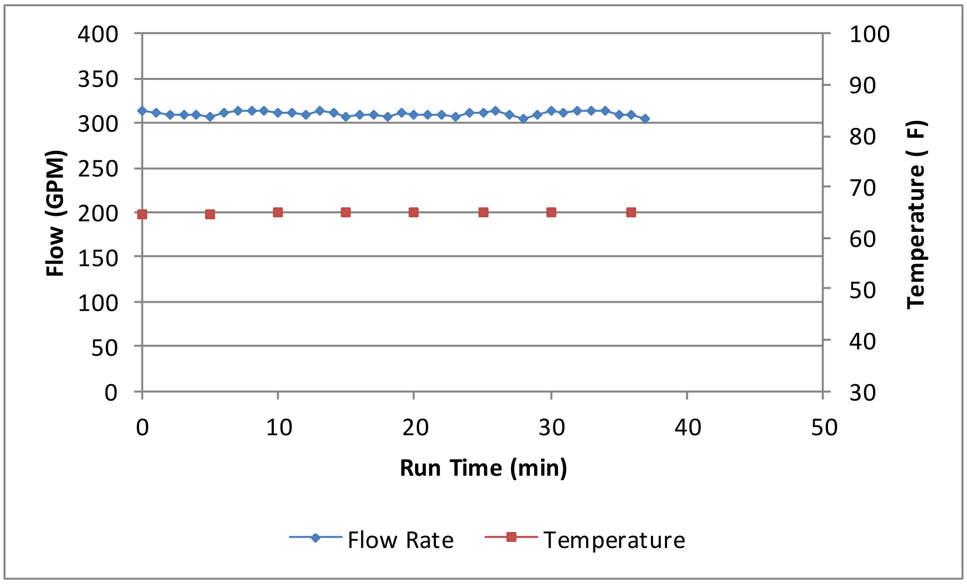


Figure 14 Water Flow and Temperature - 100% MTFR

Table 19 Sediment Feed Rate Summary – 100% MTFR

Sediment Feed Rate (g/min)		Sediment Mass Balance	
1	238.018	Starting Weight of Sediment (lbs.)	63.43
2	235.121		
3	240.393	Recovered Weight of Sediment (lbs.)	44.26
4	237.182		
5	236.349	Mass of Sediment Used (lbs.)	19.17
6	239.425	Volume of Water Through MTD During Dosing (gal)	10,056
Average	237.748		
COV	0.008	Average Influent Sediment Concentration (mg/L)	203.4*
QA/QC Limit	0.10 PASS	QA/QC Limit	180 – 220 mg/L PASS

*Corrected for sediment feed rate samples

Table 20 SSC and Removal Efficiency - 100% MTFR

	Suspended Sediment Concentration (mg/L)														
Sample #	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Effluent	68.9	66.7	59.6	75.0	69.2	70.0	73.3	74.1	71.6	72.9	71.3	75.1	73.4	78.8	72.6
Background	2		2		2		2		2		2		2		2
Adjusted Effluent	66.9	64.7	57.6	73.0	67.2	68.0	71.3	72.1	69.6	70.9	69.3	73.1	71.4	76.8	70.6
Average Adjusted Effluent Concentration				69.5 mg/L			Removal Efficiency						65.8%		

125% MTFR

Table 21 Sampling Schedule - 125% MTFR

Runtime (min)	Sampling Schedule		
	Sediment Feed	**Background**	**Effluent**
0	1		
4.08		1	1
5.08			2
6.08	2	2	3
10.16			4
11.16		3	5
12.16	3		6
16.24		4	7
17.24			8
18.24	4	5	9
22.32			10
23.32		6	11
24.32	5		12
28.41		7	13
29.41			14
30.41	6	8	15
30.91	End of Testing		
MTD Detention Time = 1.194 minutes Target Sediment Sampling Time = 30 seconds			

Table 22 Water Flow and Temperature - 125% MTFR

Run Parameters	Water Flow Rate (GPM)				Maximum Water Temperature (°F)
	Target	Actual	Difference	COV	
	393.8	388.6	-1.32%	0.009	65.1
QA/QC Limit	-	-	±10% PASS	0.03 PASS	80 PASS

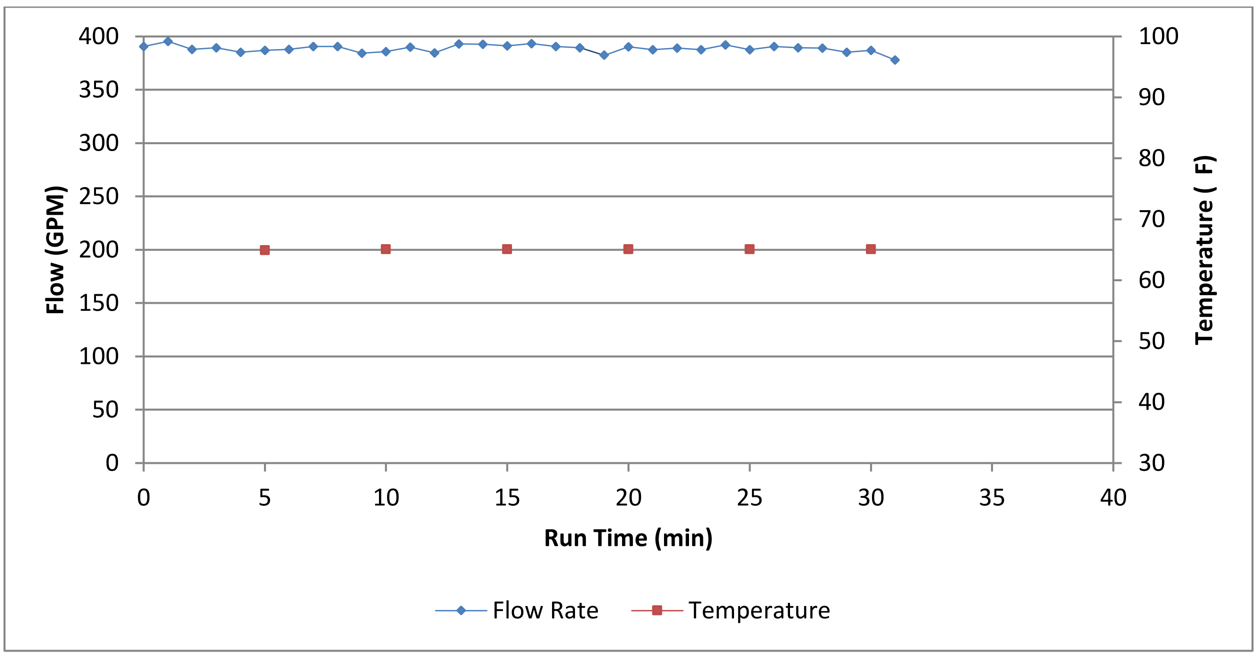


Figure 15 Water Flow and Temperature - 125% MTFR

Table 23 Sediment Feed Rate Summary – 125% MTFR

Sediment Feed Rate (g/min)		Sediment Mass Balance	
1	295.648	Starting Weight of Sediment (lbs.)	63.63
2	295.912		
3	293.050	Recovered Weight of Sediment (lbs.)	43.30
4	300.450		
5	297.978	Mass of Sediment Used (lbs.)	20.33
6	297.430	Volume of Water Through MTD During Dosing (gal)	10,841
Average	296.745		
COV	0.008	Average Influent Sediment Concentration (mg/L)	203.0*
QA/QC Limit	0.10 PASS	QA/QC Limit	180 – 220 mg/L PASS

*Corrected for sediment feed rate samples

Table 24 SSC and Removal Efficiency - 125% MTFR

	Suspended Sediment Concentration (mg/L)														
Sample #	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Effluent	84.2	83.2	94.6	96.6	89.4	89.2	99.7	92.5	95.2	99.0	98.8	95.2	100	94.0	98.4
Background	2		2		2		2		2		2		2		2
Adjusted Effluent	82.2	81.2	92.6	94.6	87.4	87.2	97.7	90.5	93.2	97.0	96.8	93.2	98.0	92.0	96.4

Average Adjusted Effluent Concentration	92.0	Removal Efficiency	54.7%

Annualized Weighted Removal Efficiency

The annualized weighted removal efficiency for sediment in stormwater has been calculated using the rainfall weighting factors provided in the NJDEP laboratory test protocol. The SciClone™ Hydrodynamic Separator annual weighted removal for a MTFR of 315 gpm is 80.6%, as shown in **Table 25.**

Table 25 Annualized Weighted Removal Efficiency for SciClone™ Model SC-4

%MTFR	Removal Efficiency (%)	Annual Weighting Fact	Weighted Removal Efficiency (%)
25	97.5	0.25	24.4
50	86.6	0.30	26.0
75	74.6	0.20	14.9
100	65.8	0.15	9.87
125	54.7	0.10	5.47
Annualized Weighted Removal Efficiency			**80.6%**

5.2 Scour

Scour testing was conducted in accordance with Section 4 of the NJDEP Laboratory Protocol to Assess Total Suspended Solids Removal by a Hydrodynamic Sedimentation MTD. Testing was conducted at a target flow rate of 630 gpm, 200% of the maximum treatment flow rate (MTFR).

In preparation for the scour test, the sump of the SciClone™ was cleaned out to remove all of the accumulated sediment from the previous removal efficiency testing. A false floor was installed 4 inches below the depth of the 50% maximum sediment storage height. The sump was then loaded with scour test sediment so that when levelled, the sediment formed a layer at least 4 inches thick, confirmed by measuring the sediment thickness with a yard stick. After sediment loading, the sump was filled with water and allowed to sit for 89 hours.

Scour testing began by gradually increasing the flow rate to the target flow within a 5-minute period. Effluent and background samples were taken from the same locations as for the removal efficiency testing, starting 5 minutes after flow was initiated. The sampling frequency is summarized in Table **26**.

Table 26 Scour Test Sampling Frequency

Sample/ Measurement Taken	Run Time (min.)															
	0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
Effluent		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Background	X		X		X		X		X		X		X		X	

Note: The Run Time of 0 minutes was the time that the 1st background sample was taken, just after achieving the target flow.

Water flow rate and water temperature measured during the scour testing are shown in **Table 27** and on **Figure 16**.

Table 27 Water Flow and Temperature - Scour Test

Run Parameters	Water Flow Rate (GPM)				Maximum Water Temperature (°F)
	Target	Actual	Difference	COV	
	630	630.2	0.0032 %	0.005	72
QA/QC Limit	-	-	±10% PASS	0.03 PASS	80 PASS

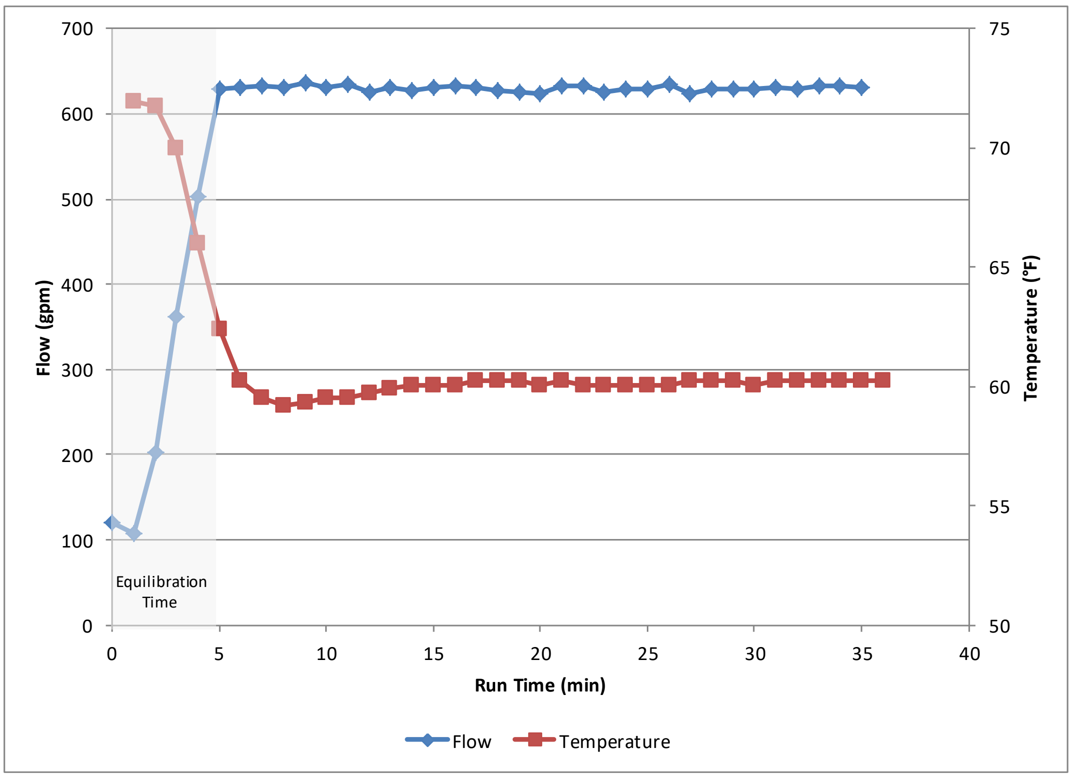


Figure 16 Water Flow and Temperature - Scour Test

The effluent and background SSC results are reported in **Table 28**. The adjusted effluent concentration was calculated as:

$$Adjusted\ Effluent\ Concentration\ \left(\frac{mg}{L}\right) = Initial\ Concentration - Background\ Concentration$$

The SSC method reporting limit was 2.3 mg/L. Any results below this value were reported as 2 mg/L for calculation purposes. For effluent samples that did not have a corresponding background sample, the background value was interpolated from the previous and subsequent samples. The average adjusted effluent concentration was 0.2 mg/L; therefore, when operated at 200% of the MTFR, the SciClone™ meets the criteria for online use.

Table 28 Suspended Sediment Concentrations for Scour Test

	Scour Suspended Sediment Concentration (mg/L)															
Sample #		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Effluent		2	2	2	2	2	2.3	2	2	2.4	2.6	2.3	2	2.6	2.9	2.5
Background	2		2		2		2		2		2		2.6		2	
Adjusted Effluent		0	0	0	0	0	0.3	0	0	0.4	0.6	0	0	0.3	0.9	0.5
Average Adjusted Effluent Concentration							0.2 mg/L									

5.3 Light Liquid Re-Entrainment

For the test, the SciClone™ had a false floor in place, set to represent 50% of the maximum recommended sediment storage depth, and the unit was pre-filled with clean water. The volume of beads added was 15.4 gallons, equivalent to 32.7 kg (72.1 lbs). The material was weighed into buckets and poured into the SciClone™ on the influent side of the Oil/Floatables Skimmer. To prevent the beads from traveling up the inlet pipe, a piece of acrylic sheet was placed over the mouth of the inlet and wedged in place. The acrylic sheet was pulled at the start of the test, immediately after the pump was started. The loaded SciClone™ is illustrated in **Figure 17**.

During the test, the effluent was screened through a mesh that captured any of the scoured beads (**Figure 18**). The captured beads were separated according to the scoured flow rate.

Following the test, the beads were dried in non-ferrous containers in an oven set at 103 °C until a constant weight was achieved. The mass, volume (calculated based on bulk density) and percentage of the pre-loaded beads scoured was determined for each flow rate.

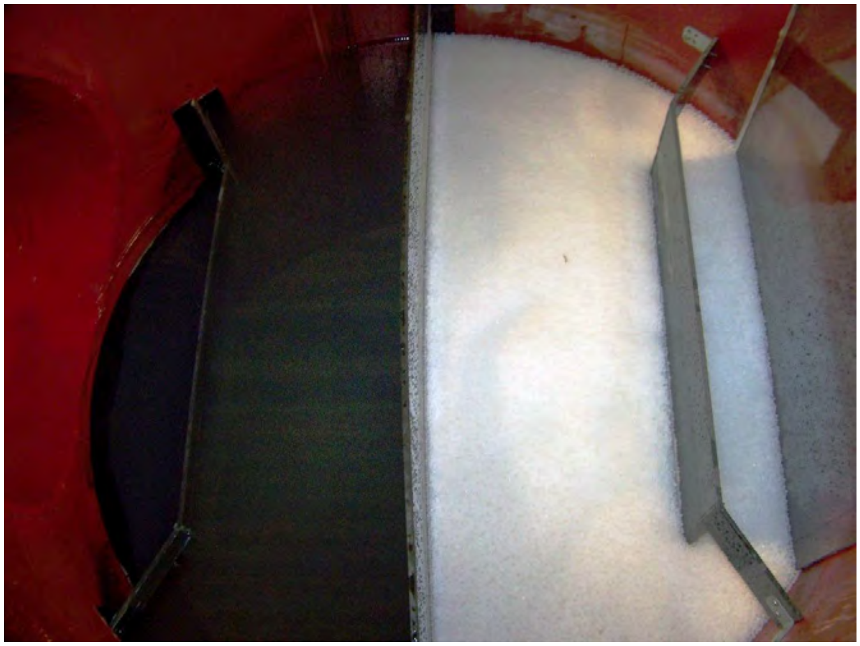


Figure 17 SciClone™ Inlet Loaded with LDPE Beads

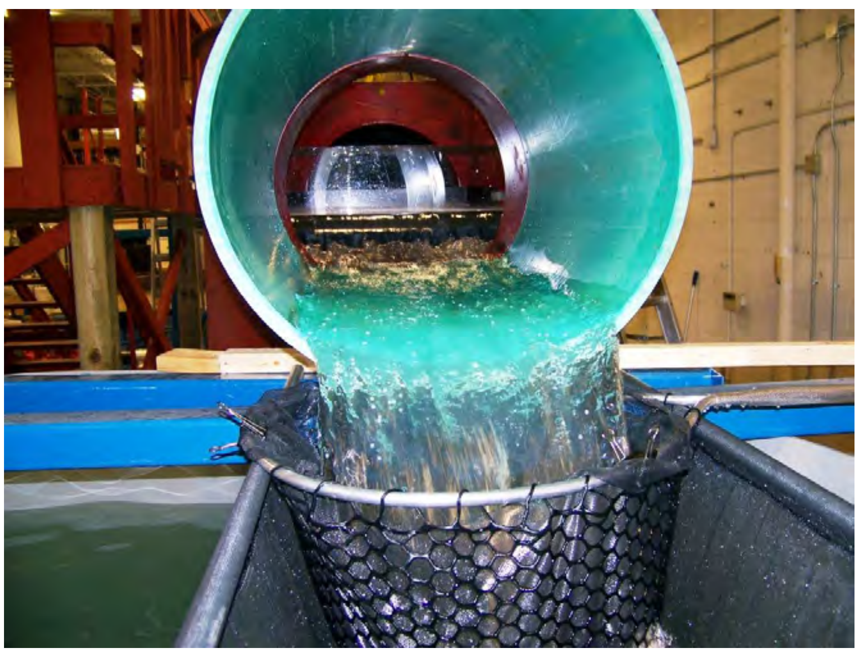


Figure 18 Screening of Scoured LDPE Beads

The flow rates for all five runs were recorded using a data logger, recording at 30 second intervals; the flow data is summarized in **Table 29**. The water temperature for the duration of the test was 74 °F.

Table 29 Light Liquid Re-Entrainment Testing Water Flow Rates

Target Flow Rate gpm	Actual Flow (gpm)			COV	QA/QC Compliance (COV < 0.03 and avg. ± 10% of target)
	Min	Max	Average		
78.8	77.3	83.8	80.1	0.022	Pass
157.5	153.8	158.3	155.9	0.010	Pass
236.7	236.5	239.6	237.9	0.004	Pass
315.0	313.9	318.7	316.0	0.004	Pass
393.8	390.2	396.1	392.5	0.005	Pass

The recovered scoured beads were dried to constant weight. **Table 30** summarizes the amount of beads scoured and captured at each flow rate. For flow rates up to the designed MTFR (315 gpm), the SciClone™ had retained 98.7% of the added LDPE beads. At 125% of the MTFR, the SciClone™ retained 89.1% of the LDPE beads.

Table 30 Amount of Scoured Beads Based on Flow Rate

Target Flow Rate (GPM)	Amount of Scoured Beads					
	Mass		Volume *		% of Total Beads Scoured	Cumulative %
	g	lbs	L	gal		
78.8	0.44	0.0010	0.0008	0.0002	0.001	0.001
157.5	0.23	0.0005	0.0004	0.0001	0.001	0.002
236.7	131.86	0.2907	0.2352	0.0621	0.403	0.405
315.0	300.38	0.6622	0.5357	0.1415	0.918	1.323
393.8	3144.62	6.9327	5.6080	1.4815	9.608	10.930
Total	3577.53	7.8871	6.3880	1.6854	10.930	

* Determined from bead bulk density

6. Maintenance Plans

As with all stormwater BMPs inspection and maintenance on the SciClone™ Hydrodynamic Separator is necessary. Stormwater regulations require that all BMPs be inspected and maintained to ensure they are operating as designed to allow for effective pollutant removal and provide protection to receiving water bodies. It is recommended that inspections be performed multiple times during the first year to assess site specific loading conditions. This is recommended because pollutant loading can vary greatly from site to site. Variables such as nearby soil erosion or construction sites, winter sanding of roads, amount of daily traffic and land use can increase pollutant loading on the system. The first year of inspections can be used to set inspection and maintenance intervals for subsequent years. Without appropriate maintenance, a BMP can exceed its storage capacity which can negatively affect its continued performance in removing and retaining captured pollutants. The SciClone™ Operation & Maintenance Manual is available at: http://www.biocleanenvironmental.com

Inspection Equipment

Following is a list of equipment to allow for simple and effective inspection of the SciClone™ Hydrodynamic Separator:

- Bio Clean Environmental Inspection Form (contained in O&M Manual).
- Flashlight.
- Manhole hook or appropriate tools to access hatches and covers.
- Appropriate traffic control signage and procedures.
- Measuring pole and/or tape measure.
- Protective clothing and eye protection.
- Note: entering a confined space requires appropriate safety and certification. It is generally not required for routine inspections of the system.

Inspection Steps

The core to any successful stormwater BMP maintenance program is routine inspections. The inspection steps required on the SciClone™ Hydrodynamic Separator are quick and easy. As mentioned above, the first year should be seen as the maintenance interval establishment phase. During the first year more frequent inspections should occur in order to gather loading data and maintenance requirements for that specific site. This information can be used to establish a base for long-term inspection and maintenance interval requirements.

The SciClone™ Separator can be inspected though visual observation without entry into the system. All necessary pre-inspection steps must be carried out before inspection occurs, especially traffic control and other safety measures to protect the inspector and near-by pedestrians from any dangers associated with an open access hatch or manhole. Once these access covers have been safely opened the inspection process can proceed:

- Prepare the inspection form by writing in the necessary information including project name, location, date & time, unit number and other info (see inspection form).

- Observe the inside of the system through the access hatches. If minimal light is available and vision into the unit is impaired utilize a flashlight to see inside the system.
- Look for any out of the ordinary obstructions in the inflow pipe, sump chamber, or outflow pipe. Write down any observations on the inspection form.
- Through observation and/or digital photographs estimate the amount of floatable debris accumulated on the influent side of the oil/floatables skimmer. Record this information on the inspection form. Next utilizing a tape measure or measuring stick estimate the amount of sediment accumulated in the sump. Record this depth on the inspection form.
- Finalize inspection report for analysis by the maintenance manager to determine if maintenance is required.

Maintenance Indicators

Based upon observations made during inspection, maintenance of the system may be required based on the following indicators:

- Missing or damaged internal components.
- Obstructions in the system or its inlet or outlet.
- Excessive accumulation of floatable in the sump chambers in which the length and width of the chambers behind oil/floatables skimmer is fully impacted extending down more than 9”.
- Excessive accumulation of sediment in the sump chamber of more than 18” in depth.

Maintenance Equipment

It is recommended that a vacuum truck be utilized to minimize the time required to maintain the SciClone™ Separator:

- Bio Clean Environmental Maintenance Form (contained in O&M Manual).
- Flashlight.
- Manhole hook or appropriate tools to access hatches and covers.
- Appropriate traffic control signage and procedures.
- Protective clothing and eye protection.
- Note: entering a confined space requires appropriate safety and certification. It is generally not required for routine maintenance of the system.
- Vacuum truck (with pressure washer attachment preferred).

Maintenance Procedures

It is recommended that maintenance occurs at least three days after the most recent rain event to allow for drain down of any associated upstream detention systems. Maintaining the system while flows are still entering it will increase the time and complexity required for maintenance. Cleaning of the sump chamber can be performed from the finish surface without entry into the vault utilizing a vacuum truck. Once all safety measures have been set up cleaning of the sump chamber can proceed as follows:

- Using an extension on a vacuum truck position the hose over the opened access hatch and lower into the center of the sump chamber on the inlet side of the oil/floatables skimmer. Remove all floating debris, standing water and sediment from the sump chamber. Access to the bottom of the sump chamber is unimpeded. The vac hose can be moved from side-to-side to fully remove sediments at the corners. A power washer can be used to assist if sediments have become hardened and stuck to the walls or the floor of the chamber. Repeat the same procedure on the effluent side of the oil/floatables skimmer to remove any remaining sediment. This completes the maintenance procedure required on the sump chamber and the SciClone™ Separator.

- The last step is to close and replace all access hatches and remove all traffic control.
- All removed debris and pollutants shall be disposed of following local and state requirements.
- Disposal requirements for recovered pollutants and spent cartridges may vary depending on local guidelines. In most areas the sediment, once dewatered, can be disposed of in a sanitary landfill. It is not anticipated that the sediment would be classified as hazardous waste.
- In the case of damaged components, replacement parts can be ordered by the manufacturer.

7. Scaling

Based on the test results of the SciClone™ Hydrodynamic Separator (model SC-4), the capacity of other model sizes has been determined based on a standard ratio of MTFR to effective treatment area.

Table 31 Scaling of SciClone™ Models

Model #	Diameter (ft)	Maximum Treatment Flow Rate[1] (cfs)	Surface Area (sq ft)	Storage Capacity (cu ft)
SC-3	3	0.39	7.1	11
SC-4	4	0.70	12.6	19
SC-5	5	1.09	19.6	29
SC-6	6	1.57	28.3	42
SC-7	7	2.14	38.5	58
SC-8	8	2.80	50.2	75
SC-9	9	3.54	63.6	95
SC-10	10	4.37	78.5	118
SC-11	11	5.29	95.0	142
SC-12	12	6.30	113.0	170
SC-13	13	7.39	132.7	199
SC-14	14	8.57	153.9	231

[1]*Based on a verified loading rate of 25 gpm/ft² for sediment with a mean particle size of 112 µm and an annualized weighted TSS removal of at least 80% using the method specified in the current NJDEP HDS protocol.*

8. Statements

The following attached pages are signed statements from the manufacturer (Bio Clean Environmental), the independent testing lab (Good Harbour Labs), and NJCAT. These statements are included to document that the requirements of the New Jersey Department of Environmental Protection Laboratory Protocol to Assess Total Suspended Solids Removal by a Hydrodynamic Sedimentation Manufactured Treatment Device (January 25, 2013) were followed with the exceptions as noted.

Bio Clean

A Forterra Company

Date: 7/7/2017

To Whom It May Concern,

We are providing this letter as our statement certifying that the protocol titled "New Jersey Department of Environmental Protection Laboratory Protocol to Assess Total Suspended Solids Removal by a Hydrodynamic Sedimentation Manufactured Treatment Device" (NJDEP HDS Protocol, January 2013) has been strictly followed with these exceptions. A larger particle size distribution (PSD) was used having a mean of 112 microns (d50) which replicates an OK110 PSD. A light liquid retention test was added to test the system's ability to retain hydrocarbons

With exception of the above deviations, we certify that all requirements and criteria were met and/or exceeded during testing of the SciClone™ Hydrodynamic Separator.

If you have any questions please contact us at your convenience.

Sincerely,

Zachariha J. Kent
Director of Research & Development
Bio Clean, a Forterra Company.

Signature: Zack Kent Date: 7/7/2017

Good Harbour

July 7, 2017

Dr. Greg Williams, Managing Director
Good Harbour Laboratories Ltd.
2596 Dunwin Dr., Mississauga, ON

Dr. Richard Magee
Executive Director,
New Jersey Corporation for Advancement of Technology

RE: Third party testing of the SciClone using Agsco 110

Dear Dr. Magee,

This purpose of this letter is to confirm that all of the testing described in the report **SciClone™ Hydrodynamic Separator - Performance Verification of Sediment Capture and Light Liquid Retention** (July 2017) was conducted at the Good Harbour Laboratories (GHL) facility in Mississauga, Ontario, in May and June of 2017.

The sediment and plastic beads used were delivered directly to GHL and were under our control at all times. Prior to testing we confirmed that the instrumentation being used was calibrated and in good working order. Testing was done and log books were maintained as required by our ISO 9001:2008 certification. GHL staff verified all sample bottle labels and confirmed the chains of custody for all samples sent to Maxxam.

After the testing was completed GHL wrote the test report, except for the sections not related to performance testing, and separately reviewed all of the data, calculations and conclusions contained in the report. I can confirm that the report accurately represents what we observed. Furthermore, we have retained copies of the background data, analytical reports and calibration certificates, as well as the calculations, in an independent and secure location on the GHL server. This supporting information is available to you upon request.

Sincerely,

Greg Williams

Greg Williams, Ph.D., P.Eng.

CC: Zach Kent, Bio Clean Environmental Services Inc.

Good Harbour Laboratories
t: 905.696.7276 | f: 905.696.7279
a: 2596 Dunwin Drive, Mississauga, ON L5L 1J5
w: www.goodharbourlabs.com

Good Harbour

July 7, 2017

Dr. Richard Magee, ScD., P.E., BCEE
Executive Director
New Jersey Corporation for Advanced Technology (NJCAT)

Re: Performance Verification of the Bio Clean Environmental Services SciCLone HDS using Agsco 110

Dear Dr. Magee,

Good Harbour Laboratories was contracted by Bio Clean Environmental Servicers to test the performance of their SciClone using a coarser material than that specified by the New Jersey Department of Environmental Protection (NJDEP) Laboratory Protocol to Assess Total Suspended Solids Removal by a Hydrodynamic Sedimentation Manufactured Treatment Device (January, 2013). While the testing was not intended for submission to NJDEP the intent was to follow best practices for independent verification of the results.

Good Harbour Laboratories (GHL), a wholly owned subsidiary of Monteco Ltd., is an independent hydraulic test facility located in Mississauga, Ontario, Canada. GHL provides testing and verification services for numerous water treatment technologies including stormwater treatment devices. GHL has had several different stormwater equipment manufacturers as clients and we have accumulated considerable experience in testing these devices. In order to be able to make this experience available to as many potential clients as possible, GHL is careful to maintain its position as an independent service provider.

With the above in mind I, the undersigned, on behalf of GHL and Monteco, confirm:

-that I do not have any conflict of interest in connection to the contracted testing. Potential conflict of interest may arise in particular as a result of economic interests, political or national affinities, family or emotional ties, or any other relevant connection or shared interest;

-that I will inform NJCAT, without delay, of any situation constituting a conflict of interest or potentially giving rise to a conflict of interest;

Good Harbour Laboratories
T: 905.696.7276 | F: 905.696.7279
A: 2596 Dunwin Drive, Mississauga, ON L5L 1J5
www.goodharbourlabs.com

Good Harbour Laboratories

-that I have not granted, sought, attempted to obtain or accepted and will not grant, seek, attempt to obtain, or accept any advantage, financial or in kind, to or from any party whatsoever, constituting an illegal or corrupt practice, either directly or indirectly, as an incentive or reward relating to the award of the contract.

Sincerely, Date

Greg Williams July 7/17

Dr. Greg Williams, P.Eng.
Managing Director
Good Harbour Laboratories

CC: Zach Kent, Bio Clean Environmental Services

Good Harbour Laboratories
T: 905.696.7276 | F: 905.696.7279
A: 2596 Dunwin Drive, Mississauga, ON L5L 1J5
www.goodharbourlabs.com

Center for Environmental Systems

Stevens Institute of Technology

One Castle Point

Hoboken, NJ 07030-0000

August 20, 2017

Mr. Zach J. Kent
VP of Product Development & Regulatory Compliance
Bio Clean Environmental Services Inc.
398 Via El Centro
Oceanside, CA 92058

Dear Mr. Kent,

Based on my review, evaluation and assessment of the testing on the SciClone™ Hydrodynamic Separator (Model SC-4) conducted by Good Harbour Laboratories, Ltd., Mississauga, Ontario, Canada, the test protocol requirements contained in the *"New Jersey Laboratory Testing Protocol to Assess Total Suspended Solids Removal by a Hydrodynamic Sedimentation Manufactured Treatment Device"* (NJDEP HDS Protocol) were met with two exceptions. The deviations from the protocol were: 1) the use of a coarser test sediment, and 2) the addition of a light liquid entrainment test.

Test Sediment Feed -The mean PSD of the test sediment utilized for removal efficiency testing was significantly coarser than the PSD criteria established by the NJDEP HDS protocol (112 µm vs 75 µm).

Removal Efficiency Testing – The New Jersey annualized weighted TSS removal efficiency was calculated to be 80.6% at an MTFR of 0.70 cfs for the coarser sediment.

Scour Testing – Scour testing was conducted with the NJDEP scour test sediment PSD requirement met, at a flow rate meeting the 200% MTFR requirement. The results qualified the SciClone™ Hydrodynamic Separator for online installation.

All other criteria and requirements of the NJDEP protocol were met. These include: flow rate measurements COV <0.03; test sediment influent concentration COV <0.10; test sediment influent concentration within 10% of the targeted value of 200 mg/L; influent background concentrations <20 mg/L; water temperature <80 °F; and adjusted scour effluent concentration <20 mg/L.

An additional test, based on the Canadian Environmental Technology Verification (CETV) *Procedure for Laboratory Testing of Oil-Grit Separators, June 6, 2014 – Version 3.0*, was conducted to demonstrate the light liquid retention capability of the SciClone™ Hydrodynamic Separator.

Sincerely,

Richard S. Magee, Sc.D., P.E., BCEE
Executive Director

9. References

1. NJDEP 2013. New Jersey Department of Environmental Protection Procedure for Obtaining Verification of a Stormwater Manufactured Treatment Device from New Jersey Corporation for Advanced Technology. January 25, 2013.

2. NJDEP 2013. New Jersey Department of Environmental Protection Laboratory Protocol to Assess Total Suspended Solids Removal by a Hydrodynamic Sedimentation Manufactured Treatment Device. January 25, 2013.

3. Canadian Environmental Technology Verification Program (CETV) Procedure for Laboratory Testing of Oil-Grit Separators, June 6, 2014 – Version 3.0.

4. GHL Laboratory Notebook: A016, pp. 59 – 125.

KIM GUADAGNO

CHRIS CHRISTIE
Governor

Lt. Governor

State of New Jersey

DEPARTMENT OF ENVIRONMENTAL PROTECTION
Bureau of Nonpoint Pollution Control
Division of Water Quality
401-02B
Post Office Box 420
Trenton, New Jersey 08625-0420
609-633-7021 Fax: 609-777-0432
http://www.state.nj.us/dep/dwq/bnpc_home.htm

BOB MARTIN
Commissioner

December 21, 2017

Zachariha J. Kent
Director of Research & Development
BioClean Environmental Services, Inc.
P O Box 869
Oceanside, CA 92049

Re: MTD Lab Certification
SciClone™ Hydrodynamic Separator by BioClean Environmental Services, Inc.
On-line Installation

TSS Removal Rate 50%

Dear Mr. Kent:

The Stormwater Management rules under N.J.A.C. 7:8-5.5(b) and 5.7 (c) allow the use of manufactured treatment devices (MTDs) for compliance with the design and performance standards at N.J.A.C. 7:8-5 if the pollutant removal rates have been verified by the New Jersey Corporation for Advanced Technology (NJCAT) and have been certified by the New Jersey Department of Environmental Protection (NJDEP). BioClean Environmental Services, Inc. has requested an MTD Laboratory Certification for the SciClone™ Hydrodynamic Separator (SciClone).

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 aforementioned 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 with the Verification Appendix (dated December 2017) for this device is published online at http://www.njcat.org/verification-process/technology-verification-database.html.

The NJDEP certifies the use of the SciClone by BioClean Environmental Services, Inc. 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 SciClone shall be installed using the same configuration reviewed by NJCAT and shall be sized in accordance with the criteria specified in item 6 below.

3. This SciClone 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 9.6 of the New Jersey Stormwater Best Management Practices (NJ Stormwater BMP) Manual, which can be found online at www.njstormwater.org.

5. The maintenance plan for a site using this device shall incorporate, at a minimum, the maintenance requirements for the SciClone. A copy of the maintenance plan is attached to this certification. However, it is recommended to review the maintenance website at http://www.biocleanenvironmental.com/wp-content/uploads/2017/07/Operations-Maintenance-SciClone-1.pdf for any changes to the maintenance requirements.

6. Sizing Requirement:

   The example below demonstrates the sizing procedure for the SciClone:

   Example: A 0.25-acre impervious site is to be treated to 50% TSS removal using a SciClone. 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 5-8, Fig. 5-3 of the NJ Stormwater BMP Manual)
   c = 0.99 (runoff coefficient for impervious)
   Q = ciA = 0.99 x 3.2 x 0.25 = 0.79 cfs

   Given the site runoff is 0.79 cfs and based on Table 1 below, the SciClone Model SC-5 with a MTFR of 1.09 cfs could be used for this site to 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 Tables A-1 and A-2.

Table 1 SciClone Sizing Information

SciClone Model	Maximum Treatment Flow Rate (cfs)	Treatment Area (ft^2)	Hydraulic Loading Rate (gpm/ft^2)	50% Maximum Sediment Storage (ft^3)
SC-3	0.39	7.1	25	5.3
SC-4	0.70	12.6	25	9.4
SC-5	1.09	19.6	25	14.7
SC-6	1.57	28.3	25	21.2
SC-7	2.14	38.5	25	28.9
SC-8	2.80	50.2	25	37.7
SC-9	3.54	63.6	25	47.7
SC-10	4.37	78.5	25	58.9
SC-11	5.29	95.0	25	71.2
SC-12	6.30	113.0	25	84.8
SC-13	7.39	132.7	25	99.5
SC-14	8.57	153.9	25	115.4

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 of 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 Mr. Shashi Nayak of my office at (609) 633-7021.

Sincerely,

James J. Murphy, Chief
Bureau of Nonpoint Pollution Control

Attachment: Maintenance Plan

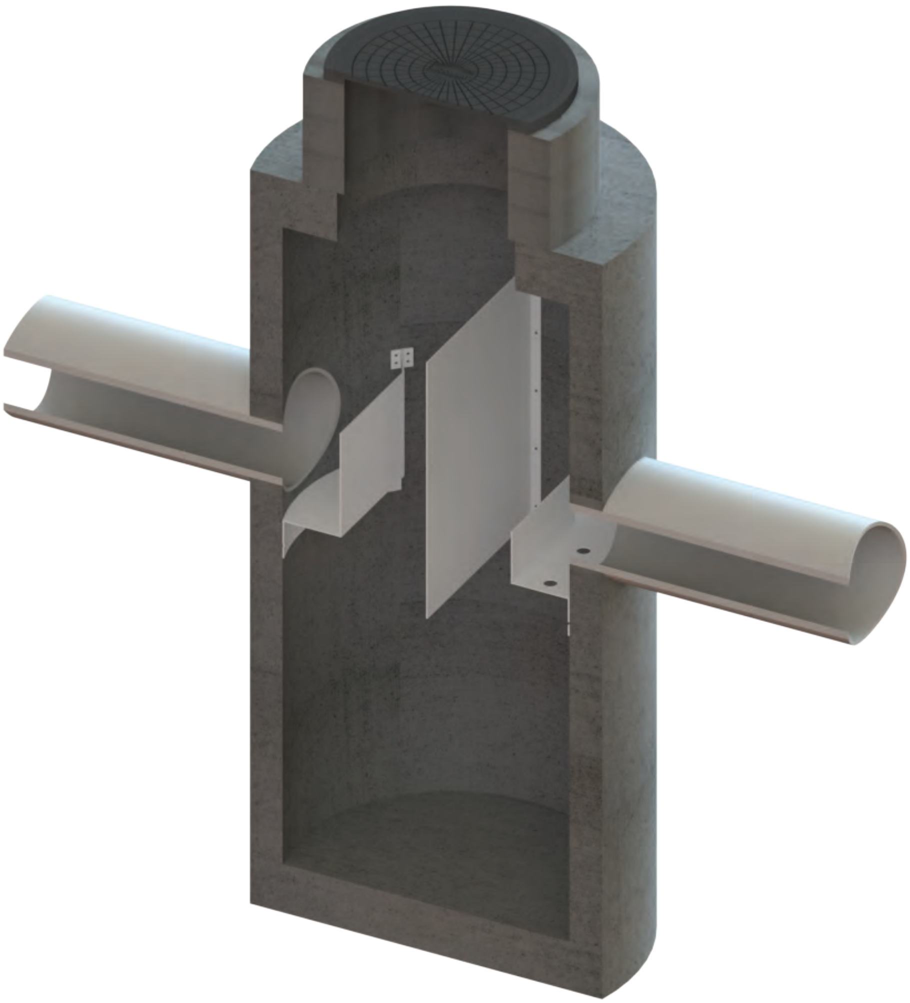
cc: Chron File
Richard Magee, NJCAT
Vince Mazzei, NJDEP - DLUR
Ravi Patraju, NJDEP - BES
Gabriel Mahon, NJDEP - BNPC
Shashi Nayak, NJDEP - BNPC

SciCLONE™

Hydrodynamic Separation

Bio Clean
A Forterra Company

OPERATION & MAINTENANCE



Bio Clean Environmental Services, Inc.
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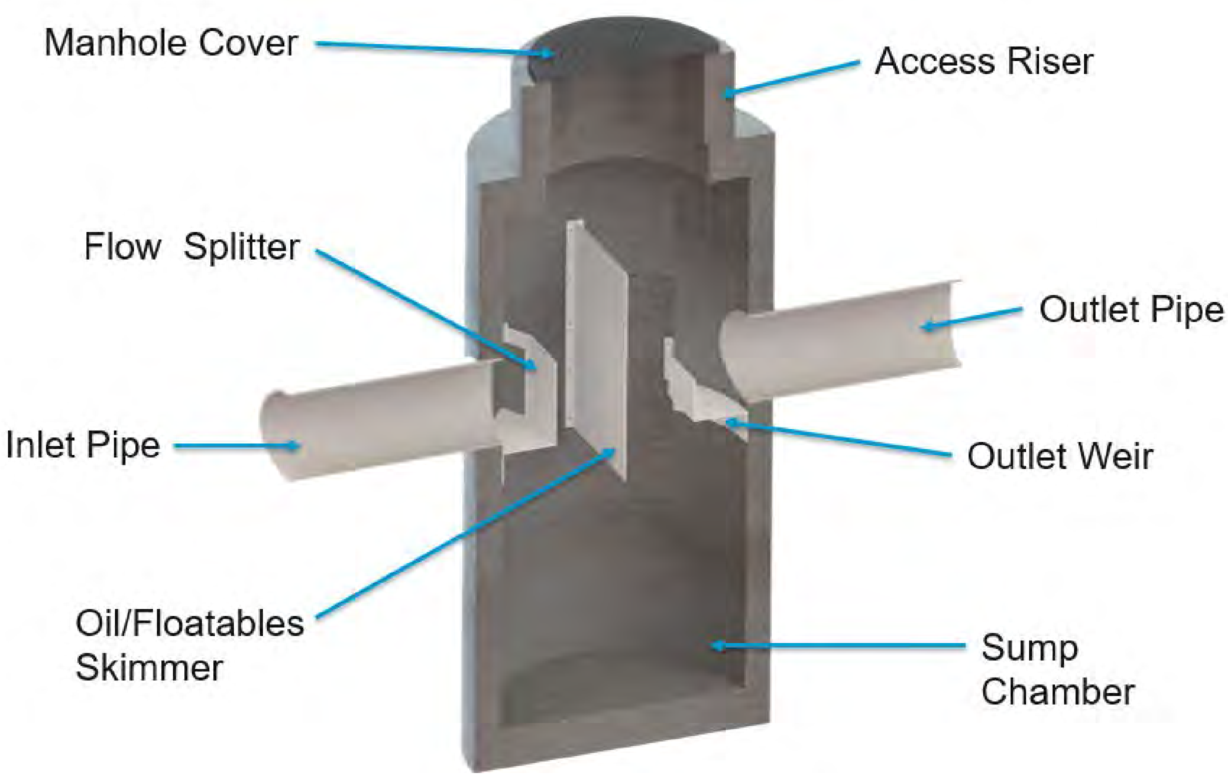
Oceanside, CA 92058

www.BioCleanEnvironmental.com
p: 760.433.7640
f: 760.433.3176

OPERATION & MAINTENANCE

The SciCLONE™ Hydrodynamic Separator is designed to remove high levels of trash, debris, sediments and hydrocarbons. Its efficient design and construction maximize longevity and minimize maintenance requirements. The simple design of the system allows for unimpeded access for quick and easy maintenance. The SciCLONE™ is able to effectively capture and store sediment with no maintenance or loss of treatment capacity for a several years based on annual average loading in most regions.

Yet, as with all stormwater BMPs inspection and maintenance on the SciCLONE™ Hydrodynamic Separator is necessary. Stormwater regulations require that all BMPs be inspected and maintained to ensure they are operating as designed to allow for effective pollutant removal and provide protection to receiving water bodies. It is recommended that inspections be performed multiple times during the first year to assess site-specific loading conditions. This is recommended because pollutant loading can vary greatly from site to site. Variables such as nearby soil erosion or construction sites, winter sanding of roads, amount of daily traffic and land use can increase pollutant loading on the system. The first year of inspections can be used to set inspection and maintenance intervals for subsequent years. Without appropriate maintenance a BMP can exceed its storage capacity which can negatively affect its continued performance in removing and retaining captured pollutants.

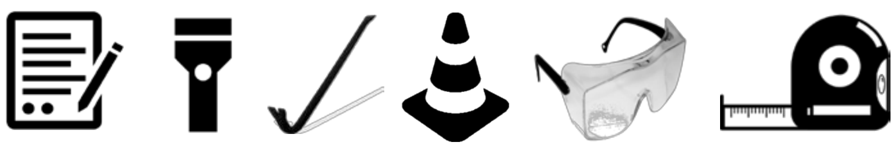


System Diagram:

Inspection Equipment

Following is a list of equipment to allow for simple and effective inspection of the SciCLONE™ Separator:

- Bio Clean Environmental Inspection Form (contained within this manual).
- Flashlight.
- Manhole hook or appropriate tools to remove access hatches and covers.
- Appropriate traffic control signage and procedures.
- Measuring pole and/or tape measure.
- Protective clothing and eye protection.
- Note: entering a confined space requires appropriate safety and certification. It is generally not required for routine inspections or maintenance of the system.



Inspection Steps

The core to any successful stormwater BMP maintenance program is routine inspections. The inspection steps required on the SciCLONE™ Separator are quick and easy. As mentioned above the first year should be seen as the maintenance interval establishment phase. During the first year more frequent inspections should occur in order to gather loading data and maintenance requirements for that specific site. This information can be used to establish a base for long-term inspection and maintenance interval requirements.

The SciCLONE™ Separator can be inspected though visual observation without entry into the system. All necessary pre-inspection steps must be carried out before inspection occurs, especially traffic control and other safety measures to protect the inspector and near-by pedestrians from any dangers associated with an open access hatch or manhole. Once these access covers have been safely opened the inspection process can proceed:

- Prepare the inspection form by writing in the necessary information including project name, location, date & time, unit number and other info (see inspection form).
- Observe the inside of the system through the access hatches. If minimal light is available and vision into the unit is impaired utilize a flashlight to see inside the system.
- Look for any out of the ordinary obstructions in the inflow pipe, sump chamber, or outflow pipe. Write down any observations on the inspection form.
- Through observation and/or digital photographs estimate the amount of floatable debris accumulated on the influent side of the oil/floatables skimmer. Record this information on the inspection form. Next utilizing a tape measure or measuring stick estimate the amount of sediment accumulated in the sump. Record this depth on the inspection form.

- Finalize inspection report for analysis by the maintenance manager to determine if maintenance is required.

Maintenance Indicators

Based upon observations made during inspection, maintenance of the system may be required based on the following indicators:

- Missing or damaged internal components.
- Obstructions in the system or its inlet or outlet.
- Excessive accumulation of floatable in the sump chambers in which the length and width of the chambers behind oil/floatables skimmer is fully impacted extending down more than 9".
- Excessive accumulation of sediment in the sump chamber of more than 18" in depth.

Maintenance Equipment

It is recommended that a vacuum truck be utilized to minimize the time required to maintain the SciCLONE™ Separator:

- Bio Clean Environmental Maintenance Form (contained in O&M Manual).
- Flashlight.
- Manhole hook or appropriate tools to access hatches and covers.
- Appropriate traffic control signage and procedures.
- Protective clothing and eye protection.
- Note: entering a confined space requires appropriate safety and certification. It is generally not required for routine maintenance of the system.
- Vacuum truck (with pressure washer attachment preferred).

Maintenance Procedures

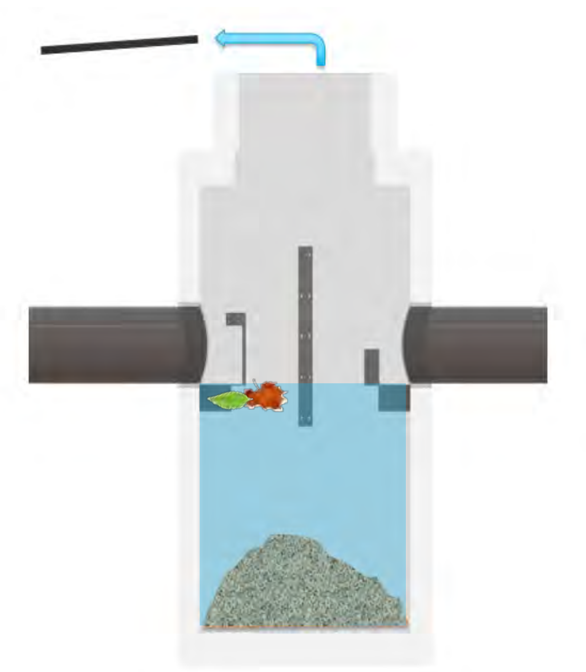
It is recommended that maintenance occurs at least three days after the most recent rain event to allow for drain down of any associated upstream detention systems. Maintaining the system while flows are still entering it will increase the time and complexity required for maintenance. Cleaning of the sump chamber can be performed from finish surface without entry into the vault utilizing a vacuum truck. Once all safety measures have been set up cleaning of the sump chamber can proceed as followed:

- Remove all access hatches (requires traffic control and safety measures to be completed prior).
- Using an extension on a vacuum truck position the hose over the opened access hatch and lower into the center of the sump chamber on the inlet side of the oil/floatables skimmer.

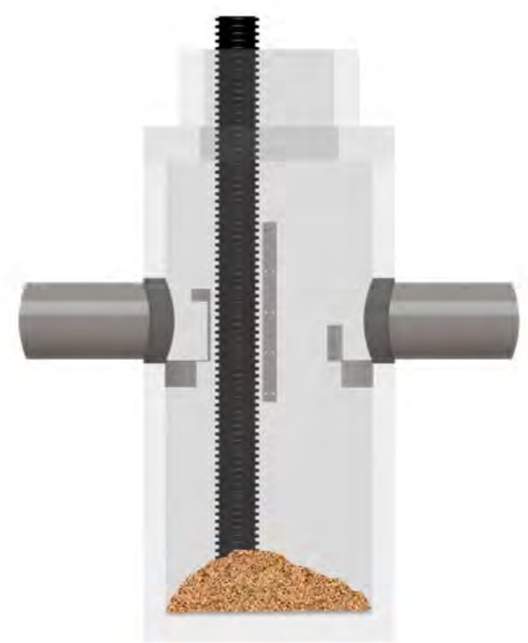
Remove all floating debris, standing water and sediment from the sump chamber. Access to the bottom of the sump chamber is unimpeded. The vac hose can be moved from side-to-side to fully remove sediments at the corners. A power washer can be used to assist if sediments have become hardened and stuck to the walls or the floor of the chamber. Repeat the same procedure on the effluent side of the oil/floatables skimmer to remove any remaining sediment. This completes the maintenance procedure required on the sump chamber and the SciCLONE™ Separator.

- The last step is to close up and replace all access hatches and remove all traffic control.
- All removed debris and pollutants shall be disposed of following local and state requirements.
- Disposal requirements for recovered pollutants may vary depending on local guidelines. In most areas the sediment, once dewatered, can be disposed of in a sanitary landfill. It is not anticipated that the sediment would be classified as hazardous waste.
- In the case of damaged components, replacement parts can be ordered by the manufacture.

Maintenance Sequence

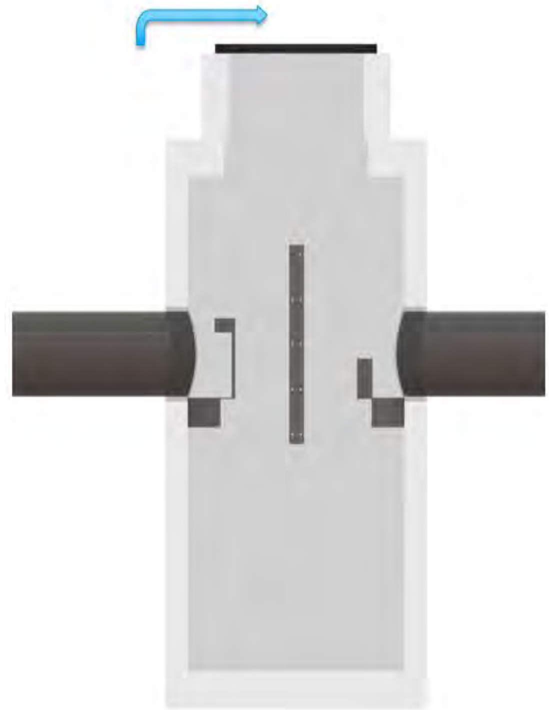


Remove Access Hatches Set Up Vacuum Truck to Clean the Sump Chamber.



Insert Vacuum Hose On the Inlet Side of the Oil/Floatables Skimmer and Vacuum Out All Trash, Sediment and Standing Water.

Insert Vacuum Hose On the Outlet Side of the Oil/Floatables Skimmer and Vacuum Out Any Remaining Sediment.



Replace Access Hatches and Remove Traffic Control and Safety Equipment.

For Maintenance Services or Information Please Contact Us At:
760-433-7640
Or Email: info@biocleanenvironmental.com

Bio Clean
A Forterra Company

SciCLONE™

Inspection and Maintenance Report
Bio Clean SciCLONE™ Separator

Project Name ______________________________

Project Address ______________________________
(city) (Zip Code)

Owner / Management Company ______________________________

Contact ______________________ Phone ( ) –

Inspector Name ______________________ Date ____/____/______ Time __________ AM / PM

Type of Inspection ☐ Routine ☐ Follow Up ☐ Complaint ☐ Stor

Storm Event in Last 72-hours? ☐ No ☐ Yes

Weather Condition ______________________ Additional Notes ______________________

For Office Use Only

(Reviewed By)

(Date)
Office personnel to complete section to the left.

Site Map #	GPS Coordinates of Vault	Model #	Oils and Floatables Accumilation on Inlet Side of Oil/Floatables Skimmers (lbs)	Sediment Accumulation In Sump Chamber (lbs) & Depth (inches)	Structural Notes	Operational Per Manufactures' Specifications (If not, why?)
	Lat:					
	Long:					
	Lat:					
	Long:					
	Lat:					
	Long:					

Comments:

NJCAT TECHNOLOGY VERIFICATION

Isolator® Row PLUS

StormTech, LLC

July 2020

Table of Contents

List of Figures

List of Tables

1. Description of Technology

The Isolator® Row PLUS (**shown in Figures 1 and 2**) is the first row of StormTech chambers that is surrounded with filter fabric and connected to a closely located manhole for easy access. The Isolator Row PLUS provides for settling and filtration of sediment as stormwater rises in the chamber and ultimately passes through the filter fabric. The open-bottom chambers allow stormwater to flow out of the chambers, while sediment is captured in the Isolator Row PLUS.

A single layer of proprietary Advanced Drainage Systems (ADS) PLUS fabric is placed between the angular base stone and the Isolator Row PLUS chamber. The geotextile provides the means for stormwater filtration and provides a durable surface for maintenance operations. A non-woven fabric is placed over the chambers. See link to O&M Manual (pg. 23) for installation pictures.

The Isolator Row PLUS is designed to capture the "first flush" runoff and offers the versatility to be sized on a volume basis or a flow basis. An upstream manhole not only provides access to the Isolator Row PLUS but includes a high/low concept such that stormwater flow rates or volumes that exceed the capacity of the Isolator Row PLUS bypass through a manifold to the other chambers. This is achieved with either an elevated bypass manifold or a high-flow weir. This creates a differential between the Isolator Row PLUS row of chambers and the manifold to the rest of the system, thus allowing for settlement time in the Isolator Row PLUS. After Stormwater flows through the Isolator Row PLUS and into the rest of the StormTech chamber system it is either infiltrated into the soils below or passed at a controlled rate through an outlet manifold and outlet control structure. **Since this technology fits under the infiltration basin BMP in the New Jersey Stormwater BMP Manual, it is not eligible for NJDEP MTD certification.**

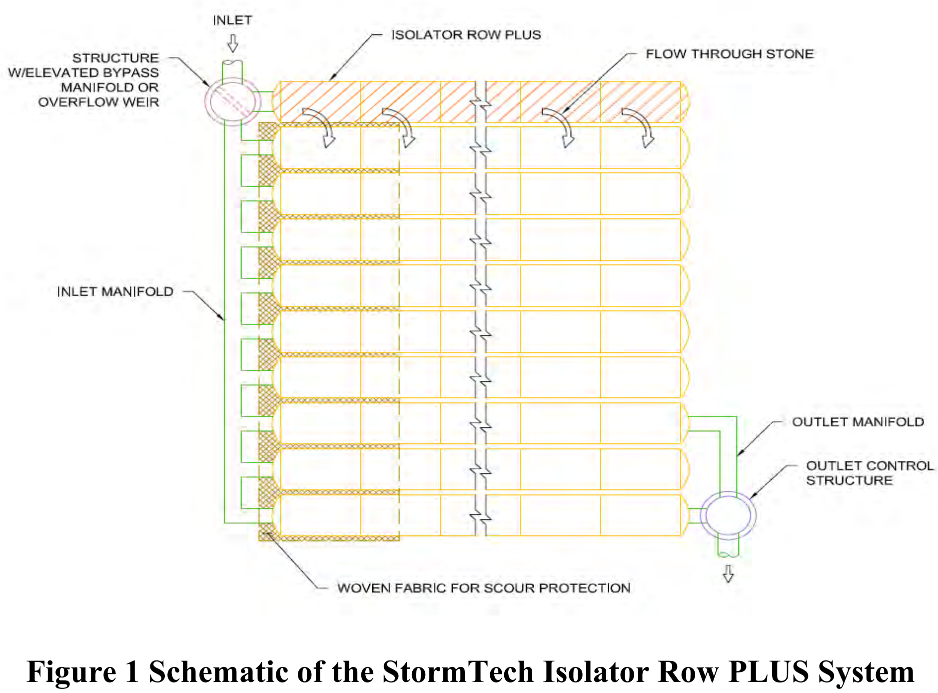


Figure 1 Schematic of the StormTech Isolator Row PLUS System

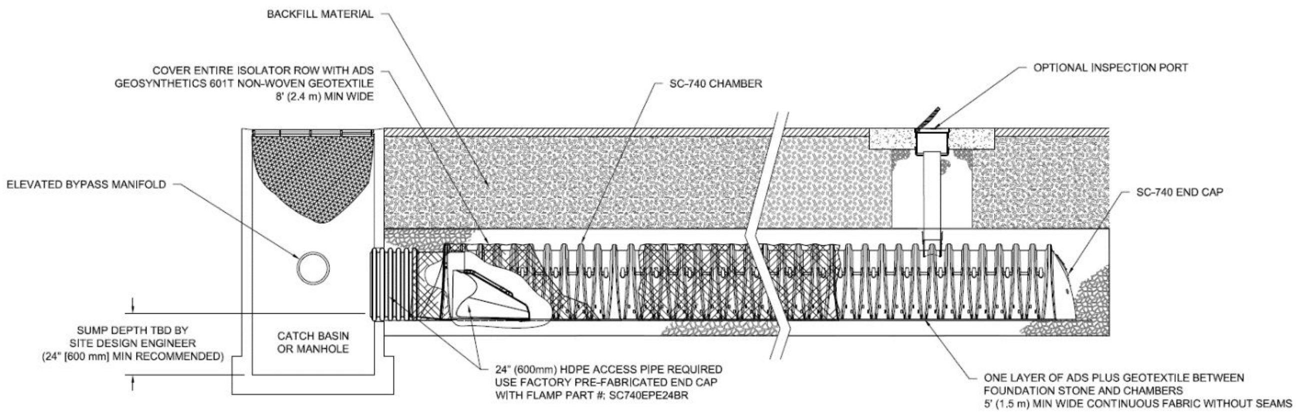


Figure 2 Isolator Row PLUS Detail

2. Laboratory Testing

Beginning in January 2020, two overlapping StormTech SC-740 Isolator Row PLUS commercial size chambers were installed at the BaySaver Laboratory in Mount Airy, Maryland, to evaluate the performance of Isolator Row PLUS on Total Suspended Solid (TSS) removal. Boggs Environmental Consultants (BEC) provided third-party review and oversight of all testing and data collection procedures, in accordance with the *New Jersey Department of Environmental Protection Laboratory Protocol to Assess Total Suspended Solids Removal by a Filtration Manufactured Treatment Device (January 2013)*. All sediment concentration samples were analyzed by Fredericktowne Labs (FTL) using ASTM D3977-97 (2019). All sediment PSD analysis was performed by Environmental Consulting Services (ECS), using the methodology of ASTM D422-63 (2007). Prior to the start of testing, a Quality Assurance Project Plan (QAPP), revision dated January 9, 2020, was submitted to, and approved by the New Jersey Corporation for Advanced Technology (NJCAT).

2.1 Test Setup

The testing system, shown in **Figure 3**, consisted of a source tank, feed pump, flow control valve, flow meter, background sample port, screw-auger sediment feeder (doser), and an Isolator Row PLUS test system. This verification report only addresses the performance of the Isolator Row PLUS and not the entire StormTech system, since this is the row designed to remove sediment until the system goes into bypass.

Testing Procedure

The water source was potable water from the Town of Mount Airy Water & Sewer Department, obtained from an onsite tap, which served as the raw water supply for the testing system. Municipal tap water was used to fill the source tank, and then pumped to the system. Flow rate was controlled to the target of 225 gpm by a flow control valve. An inline flow meter (FloCat MFE electromagnetic flow meter) was used to measure the flow, and a SeaMetrics DL76 data logger (pictured in **Figure 4**) recorded the flow at one-minute intervals. The test sediment was introduced to the inlet stream via a 12 -inch dosing port teed with a 12-inch influent line (pictured in **Figure 5**) located approximately 4 feet upstream of the system inlet. The dosing rate was controlled by a screw-auger Velodyne Barracuda 1000A volumetric feeder with a ½ HP variable speed motor. The dosing rate was set to deliver an amount of sediment that, when mixed with the water from the source tank, would produce influent water with a target test sediment concentration of 200 mg/L.

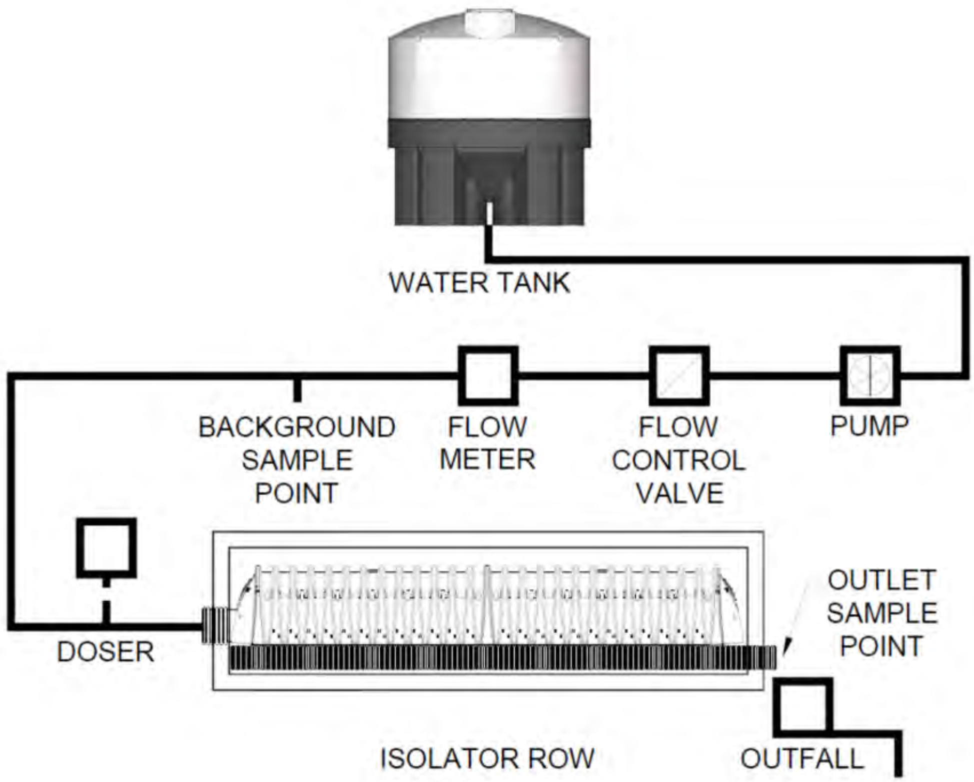


Figure 3 Schematic of the Isolator Row PLUS Test Configuration

The Isolator Row PLUS was installed inside a watertight 16'L x 6'W x 4'H test box (pictured in **Figures 6 and 7**). The Isolator Row PLUS is an arch-shaped stormwater detention/retention sediment collection and filtering device, sealed with end caps, with a 12"-inch inlet pipe welded into the upstream end cap. A ramp apparatus (patent pending) was attached to the inside of the chamber end cap to provide a smooth transition from pipe invert to fabric bottom. It is configured to improve chamber function performance over time by distributing sediment and debris that would otherwise collect at the inlet. It also serves to improve the fluid and solid flow back into the inlet pipe during maintenance and cleaning, and to guide cleaning and inspection equipment back into the inlet pipe when complete.

The chambers were installed on a 10-inch base of washed, angular, crushed stone, (#57, ¾ inch blue stone) containing an 8-inch perforated underdrain pipe running the length of the test box, penetrating the wall of the downstream end of the test box to the discharge collection point. An ADS non-woven geotextile fabric was placed over the top of the chamber row. The chambers were then backfilled with the washed crushed stone up to the top of the chamber elevation.

Additionally, an opening was cut into the top of one chamber to allow for visual monitoring and head measurement. No bypass or weir was installed upstream of the test box.

The test flow entered the chamber via the influent pipe and flowed across the filter fabric, filling the row. The water then flowed through the filter fabric, driven by hydrostatic head. The treated water exited the test box via the underdrain.

Figures 4 and 5 Photographs of Flow Meter and Sediment Delivery Port

Figure 6 Side View Photograph of Isolator Row PLUS Test Box

Figure 7 Top View Photograph of Isolator Row PLUS Test Box

Test Unit and Scaling Explanation

The Isolator Row PLUS used in this test was constructed from two (2) overlapping polypropylene open-bottom StormTech SC-740 chambers (one shortened by 5-in. to enable fitting into the test box), two (2) SC-740 end caps, a ramp apparatus and one layer of ADS PLUS geotextile fabric. The chamber floor filtration area (effective filtration treatment area, EFTA) was approximately 54.5 ft^2. (calculated using an average contact width inside the chamber of 45 in). The target test flow was 225 gpm. The calculated hydraulic loading rate, flow rate/EFTA is 4.13 gpm/ft^2 and the ratio of effective sedimentation treatment area to EFTA is 1.0. Given these data, one can effectively scale the test results for all commercial systems.

Sample Collection

The grab sampling method was used for all sample collection by sweeping a wide-mouth 1-L plastic bottle through the free-discharge effluent stream, to ensure the full cross section of the flow was sampled. The start time for each run was recorded.

The sampling schedule is provided in **Table 1**. The detention time for the Isolator Row PLUS unit operating at 20 inches hydrostatic head (maximum head tested) is 2.1 minutes. To comply with the NJDEP Filter Protocol, after initiating and stabilizing the flow rate at the MTFR and beginning sediment feed, effluent sampling did not begin until the filtration MTD has been in operation for a minimum of three detention times.

Background water samples were collected upstream of the doser (shown in **Figures 3 and 8**) in correspondence with the odd-numbered effluent samples (i.e., Samples E1, E3, E5 at t = 9, 20, 31 minutes).

Table 1 Sampling Schedule for the Isolator Row PLUS Tests

Time (min)	Sample(s)	Time (min)	Sample(s)
0	S1	22	S3
9	E1, BG1	31	E5, BG3
10	E2	32	E6
11	S2	33	Stop Flow
20	E3, BG2	N/A	DDA
21	E4	N/A	DDB

NOTE: S = sediment rate; E = effluent; BG = background; DD = drawdown

Figure 8 Photograph of Background Sampling Port

Two evenly-volume-spaced drawdown samples, DDA and DDB, were taken after the flow and sediment feed to the unit had been stopped.

Sediment injection rates were measured using a stopwatch and the mass collected measured on a calibrated scale once at the very beginning of the run and twice more during the run. A fourth sediment rate sample was taken after the run was finished as an internal check but was not included in the calculations for the report. The duration of each run was 33 minutes.

A Chain of Custody (COC) form was used for each test run to record sampling date and time for externally analyzed samples. Copies of these forms were maintained by BaySaver Laboratory and FTL. Sample bottles were labeled to identify the test run number and sample type (e.g., background, effluent), corresponding to the sample identification on the COC form. BEC was present during each test run and witnessed labeling, completion of COC forms, and packaging of samples for delivery to the external laboratory (FTL). Each person taking or relinquishing possession of the samples was required to sign a COC form before samples changed hands.

Other Instrumentation and Measurement

Water temperature was recorded every minute by a HOBO data logger placed in the source water tank of the test system. The water level in the Isolator Row PLUS was recorded every 5 minutes by visual observation of a yardstick mounted through the observation port on top of the first chamber. Run and sampling times were measured using a digital timer and a stopwatch, respectively.

2.2 Test Sediment

The test sediment had the particle size distribution (PSD) presented in **Figure 9**. The test sediment was custom-blended using various commercially available silica sands. The resulting blended sediment met the specification for the NJDEP Filter Protocol. The test sediment was batched, labeled, and stored in covered bins for the duration of this project. Under the supervision of BEC, twenty-one subsamples, taken from various locations within the test sediment containers, were composited. From the composite, three random samples were taken for PSD and moisture content analyses, which were performed by ECS, using the methodology of ASTM method D422-63 (2007).

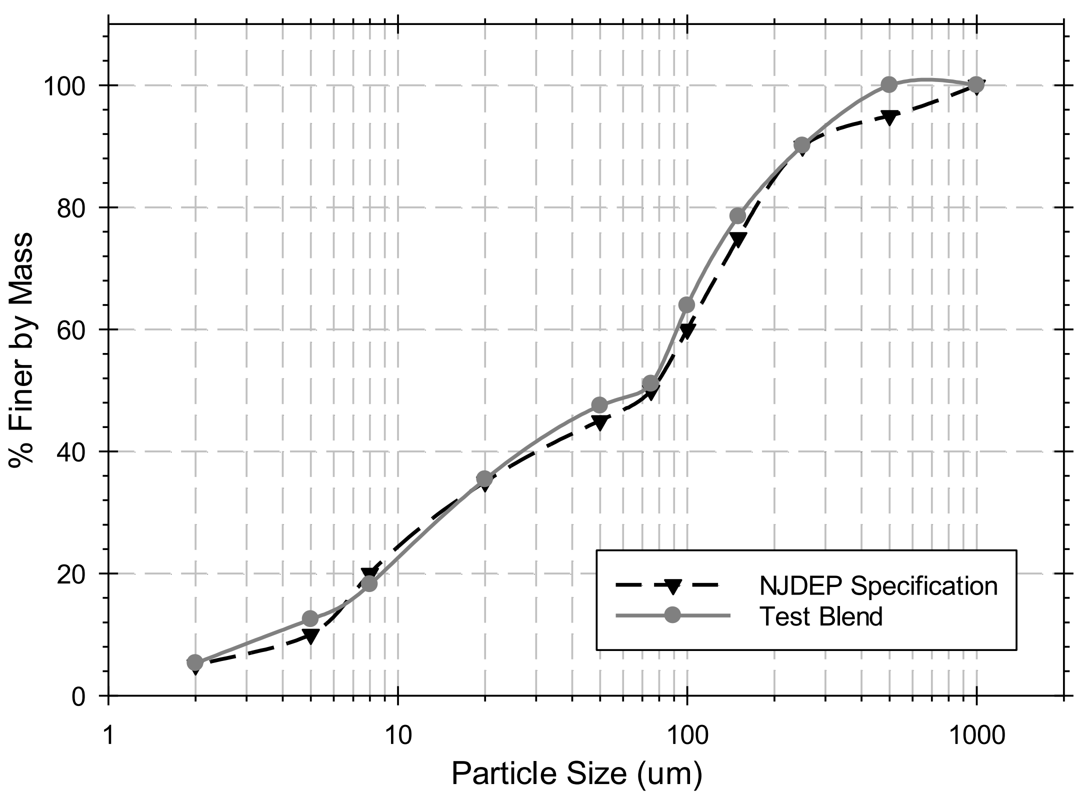


Figure 9 Average Particle Size Distribution of Test Sediment Verified by ECS

The PSD test analysis results are summarized in **Table 2**. ECS results showed that 17-19% of the particles were less than 8 µm and 89-90% of the particles were less than 250 µm. The d_{50} values (approximately 72 µm) also indicated that there was no significant difference between the NJDEP target gradation and the ECS-verified gradation of the test sediment. Thus, the blended test sediment was found to meet the NJDEP particle size specification and was acceptable for use. ECS also analyzed the sediment samples for moisture. The average moisture content was 0.1%.

Table 2 Particle Size Distribution of Test Sediment as Analyzed by ECS

Particle Size (µm)	Test Blend % Finer by Mass Analyzed by ECS				
	NJ Blend A	NJ Blend B	NJ Blend C	Average	NJDEP Specification (minimum % finer)
1000	100.0	100.0	100.0	100.0	98
500	100.0	100.0	100.0	100.0	93
250	90.3	89.8	90.2	90.1	88
150	79.3	78.1	78.1	78.5	73
100	66.0	63.2	62.7	63.9	58
75	52.0	50.9	50.3	51.1	50
50	47.5	47.7	47.4	47.5	43
20	35.9	36.0	34.3	35.4	33
8	18.6	18.7	17.4	18.2	18
5	13.0	13.0	11.6	12.5	8
2	5.5	5.4	5.1	5.3	3
d_{50}	69 µm	72 µm	74 µm	72 µm	75 µm

2.3 Sediment Removal Efficiency Testing

Sediment removal efficiency testing adhered to the guidelines set forth in Section 5 of the NJDEP Laboratory Protocol for Filtration MTDs. The target flow through the system was 225 gpm, with a target sediment concentration of 200 mg/L. All samples were collected in clean, 1-L wide-mouth bottles. Three background samples were taken at 9, 20 and 31 minutes after the test began to ensure the supply water met the sediment concentration requirement. According to the NJDEP Filter Protocol, these background concentrations cannot exceed a TSS concentration of 20 mg/L.

The test sediment screw-auger feeder introduced the test sediment into the influent stream to achieve the target influent TSS concentration of 200 mg/L. According to the NJDEP Filter Protocol, this influent concentration must stay within 10% of target, allowing for a 180 mg/L to 220 mg/L influent concentration. The feeder was calibrated prior to each run. In order to confirm sediment feed rates during the test, in accordance with the NJDEP Filter Protocol, three samples of the test sediment were collected from the injection point (**Figure 3**, "Doser") into a clean one-liter container for verification of sediment feed rate, over an interval timed to the nearest second, with a minimum volume of 0.1 liter or a collection interval not exceeding one minute (whichever came first). The time was measured with a stopwatch. The samples were weighed to the nearest milligram in the BaySaver Laboratory under the observation of BEC. The sediment feed rate coefficient of variance (COV) for the test sediment samples did not exceed 0.10. The mass from the sediment feed rate measurement samples was subtracted from the total mass introduced to the system when removal efficiency was calculated.

Effluent sampling was performed by the grab sampling method during each run, according to the schedule in **Table 1**. When the test sediment feed was interrupted for test sediment measurements, the next effluent samples were collected after at least three detention times had elapsed. During the drawdown period, two evenly volume-spaced samples were collected after flow and sediment feed had stopped. All sediment concentration samples were analyzed by Fredericktowne Labs (FTL) using ASTM D3977-97 (2019) "Standard Test Methods for Determining Sediment Concentrations in Water Samples."

2.4 Sediment Mass Loading Capacity

The sediment mass loading capacity testing occurred as a continuation of removal efficiency testing, with the target for influent concentration remaining at 200 mg/L, and all aspects of testing procedures kept the same to ensure consistency throughout. The sediment mass loading capacity of the Isolator Row PLUS is defined per the protocol as the point at which the cumulative mass removal drops below 80.0%. For this testing program, the sediment mass loading testing was stopped prior to that point (after Run 16), because it was incorrectly assumed this criterion was reached. Thus, the mass loading is defined as mass loaded into the unit through the end of Run 16.

3. Supporting Documentation

The Procedure for Obtaining Verification of a Stormwater Manufactured Treatment Device from NJCAT states that copies of the laboratory test reports, all data from performance evaluation test runs, original data, pertinent calculations, and documentation of any maintenance activities that occur during the testing process are to be included in this section. All of this information has been provided to NJCAT and is available upon request. It is not practical to include it in this report.

4. Testing Results

A total of 16 removal efficiency testing runs were completed in accordance with the NJDEP filter protocol. The target flow and influent sediment concentration were 225 gpm and 200 mg/L, respectively. The results from all 16 runs were used to calculate the overall cumulative removal efficiency of the Isolator Row PLUS.

4.1 Flow Rate

Flow was monitored by an inline flow meter (FloCat MFE electromagnetic flow meter) and recorded by a SeaMetrics DL76 data logger every minute during each run. For each run, the flow was maintained within 10% of the target (202.5 – 247.5 gpm). The average flow for all 16 runs was 226.1 gpm. The flow data with coefficient of variance (COV) values for all 16 runs are summarized in **Table 3**.

4.2 Water Temperature

Temperatures were recorded every minute by a HOBO water level logger (U20L-04). On average for all runs, the water temperature during testing was 45.7 degrees Fahrenheit, with a maximum of 52.2 degrees Fahrenheit, meeting the NJDEP Filter Protocol requirement to be below 80 degrees Fahrenheit. Data are summarized in **Table 3**.

Table 3 Flow Rate and Temperature Summary for All Runs

Run	Max Flow (gpm)	Min Flow (gpm)	Average Flow (gpm)	Flow COV	Flow Compliance (COV< 0.1)	Maximum Temperature (Fahrenheit)	NJDEP Temperature Compliance (< 80 F)
1	232.8	223.9	226.3	0.0078	Y	48.2	Y
2	228.9	218.6	220.8	0.0104	Y	51.5	Y
3	229.4	220.0	227.2	0.0094	Y	44.7	Y
4	230.2	218.7	223.2	0.0138	Y	40.5	Y
5	228.7	216.9	222.2	0.0103	Y	44.7	Y
6	227.6	217.0	224.2	0.0115	Y	46.7	Y
7	229.7	221.9	226.4	0.0092	Y	44.6	Y
8	230.3	222.2	226.8	0.0089	Y	43.5	Y
9	233.2	218.4	225.6	0.0136	Y	45.5	Y
10	232.2	219.7	228.4	0.0126	Y	44.7	Y
11	226.9	219.2	224.1	0.0088	Y	52.4	Y
12	232.2	222.1	226.9	0.0107	Y	48.5	Y
13	234.7	221.2	226.1	0.0109	Y	48.5	Y
14	231.9	223.4	228.7	0.0103	Y	45.6	Y
15	236.8	224.1	231.4	0.0131	Y	52.2	Y
16	232.5	221.3	229.0	0.0137	Y	47.8	Y
Average			226.1			45.7	
Max						52.2	

4.3 Head

The head level in the Isolator Row PLUS was recorded to the nearest 1/8 inch every five minutes, through visual observation of a yard stick mounted through the observation port of the first chamber. With each run, after the first several measurements, the head during the run remained the same or increased slightly over that of the previous run. The maximum head reached during all 16 runs was 18.75 inches. Maximum head for each run is summarized in **Table 4**.

Table 4 Maximum Head (inches) for All Runs

Run	Maximum Head (inches)	Run	Maximum Head (inches)
1	9.00	9	17.50
2	12.00	10	18.00
3	14.00	11	17.25
4	15.25	12	18.00
5	15.75	13	18.25
6	16.25	14	18.50
7	17.50	15	18.75
8	17.25	16	18.75

4.4 Sediment Concentration and Removal Efficiency

Background TSS

Municipal tap water was used as the water source during testing. The background TSS concentration for all runs was well below the 20 mg/L NJDEP Protocol limit. Background TSS concentrations for each run are provided in **Table 5**. The average background TSS concentration for each run was subtracted from the effluent and drawdown concentrations to provide adjusted figures, per the protocol.

Sediment Dosing Rate and Influent TSS

Influent TSS concentration was calculated by dividing the total mass of sediment added during a given run by the total volume of water flowing through the MTD during the addition of test sediment during that run. The volume of water flowing through the device during the run was calculated by multiplying the average measured flow by the time of sediment addition only. The average influent TSS was 204.2 mg/L, with individual run averages ranging from 195.9 to 216.7 mg/L. All values are within the target range of 200 ± 20 mg/L. **Tables 6 and 7** provide the measured sediment rates for each run, and the resulting calculated influent TSS concentration. In these tables, NJDEP Protocol compliance is defined as a TSS concentration in the range 180 – 220 mg/L and sediment feed rate COV < 0.1.

Table 5 Background TSS Concentrations

Run	BG TSS 9 min (mg/L)	BG TSS 20 min (mg/L)	BG TSS 31 min (mg/L)	Average (mg/L)	MDL (mg/L)
1	0.5	4	2	2.2	1.0
2	1	1	0.5	0.8	1.0
3	1	0.5	0.5	0.7	1.0
4	0.5	0.5	0.5	0.5	1.0
5	0.5	0.5	0.5	0.5	1.0
6	0.5	0.5	0.5	0.5	1.0
7	0.5	0.5	0.5	0.5	1.0
8	0.5	0.5	0.5	0.5	1.0
9	0.5	0.5	0.5	0.5	1.0
10	0.5	0.5	0.5	0.5	1.0
11	0.5	0.5	0.5	0.5	1.0
12	0.5	0.5	0.5	0.5	1.0
13	0.5	0.5	0.5	0.5	1.0
14	0.5	0.5	0.5	0.5	1.0
15	0.5	0.5	0.5	0.5	1.0
16	0.5	0.5	0.5	0.5	1.0

Note: In cases where the measured background TSS concentration was below the Minimum Detection Level (MDL) of 1.0 mg/L, half the MDL was reported for the background concentration.

Table 6 Sediment Rate Measurements for Runs 1-10

Run	Run Time (min)	Sediment Weight (g)	Duration (s)	Sediment Feed Rate (g/min)	Influent Water Flow Rate (gpm)	Influent TSS Conc. (mg/L)	NJDEP Compliance
1	0	117.767	39.78	177.6	226.3	202.9	Y
	11	110.674	40.16	165.4			
	22	118.819	40.00	178.2			
	COV			0.0418			
2	0	114.921	39.91	172.8	220.8	198.5	Y
	11	106.158	39.96	159.4			
	22	110.429	40.10	165.2			
	COV			0.0404			
3	0	117.364	39.85	176.7	227.2	206.8	Y
	11	116.700	39.90	175.5			
	22	120.156	39.72	181.5			
	COV			0.0179			
4	0	121.043	39.79	182.5	223.2	216.7	Y
	11	125.058	39.88	188.2			
	22	118.657	39.85	178.7			
	COV			0.0261			
5	0	111.624	40.03	167.3	222.2	215.0	Y
	11	117.883	40.00	176.8			
	22	132.393	39.88	199.2			
	COV			0.0904			
6	0	114.723	39.94	172.3	224.2	206.6	Y
	11	119.043	40.03	178.4			
	22	117.644	40.28	175.2			
	COV			0.0174			
7	0	115.351	40.00	173.0	226.4	198.1	Y
	11	110.196	40.25	164.3			
	22	114.603	40.00	171.9			
	COV			0.0281			
8	0	115.664	39.72	174.7	226.8	201.5	Y
	11	117.915	39.93	177.2			
	22	110.840	39.82	167.0			
	COV			0.0307			
9	0	116.845	39.87	175.8	225.6	205.2	Y
	11	114.135	39.81	172.0			
	22	117.894	39.75	178.0			
	COV			0.0172			
10	0	111.306	39.57	168.8	228.4	203.0	Y
	11	119.680	39.81	180.4			
	22	118.275	39.90	177.9			
	COV			0.0347			

Table 7 Sediment Rate Measurements for Runs 11-16

Run #	Run Time (min)	Sediment Weight (g)	Duration (s)	Sediment Feed Rate (g/min)	Influent Water Flow Rate (gpm)	Influent TSS Conc. (mg/L)	NJDEP Compliance
11	0	114.505	39.90	172.2	224.1	207.8	Y
	11	119.160	39.94	179.0			
	22	118.629	40.03	177.8			
	COV			0.0207			
12	0	115.516	39.78	174.2	226.9	208.8	Y
	11	118.805	39.87	178.8			
	22	124.236	40.22	185.3			
	COV			0.0311			
13	0	114.776	39.78	173.1	226.1	198.0	Y
	11	106.924	39.85	161.0			
	22	115.083	39.69	174.0			
	COV			0.0429			
14	0	112.871	39.72	170.5	228.7	199.9	Y
	11	116.869	39.84	176.0			
	22	114.529	39.81	172.6			
	COV			0.0161			
15	0	112.091	39.72	169.3	231.4	195.9	Y
	11	112.200	39.81	169.1			
	22	117.588	39.94	176.6			
	COV			0.0250			
16	0	118.503	39.59	179.6	229.0	202.3	Y
	11	116.834	39.78	176.2			
	22	112.971	39.84	170.1			
	COV			0.0273			

Effluent TSS

During each run, grab samples were taken of the effluent according to the schedule in **Table 1**, and all TSS analyses were conducted by Fredericktowne Labs. For each run, the average effluent concentration was adjusted by subtracting the average background TSS concentration. The average adjusted effluent TSS concentration during testing was 39 mg/L, with individual run averages ranging from 32.0 to 45.5 mg/L. Effluent and adjusted effluent TSS concentrations for each run are given in **Table 8**.

Table 8 Effluent Sample TSS Concentrations

Run	EFF TSS 9 min	EFF TSS 10 min	EFF TSS 20 min	EFF TSS 21 min	EFF TSS 31 min	EFF TSS 32 min	Mean	MDL	Adjusted Effluent TSS
	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
1	48	48	47	47	48	48	47.7	1.0	45.5
2	32	32	33	32	35	33	32.8	1.0	32.0
3	33	37	37	40	38	38	37.2	1.0	36.5
4	28	31	34	38	32	38	33.5	1.0	33.0
5	40	41	39	33	42	42	39.5	1.0	39.0
6	38	41	39	37	41	44	40.0	1.0	39.5
7	37	40	37	36	37	38	37.5	1.0	37.0
8	38	41	38	40	32	38	37.8	1.0	37.3
9	35	41	36	36	42	41	38.5	1.0	38.0
10	39	44	34	38	37	41	38.8	1.0	38.3
11	35	41	38	38	38	43	38.8	1.0	38.3
12	36	43	36	41	46	47	41.5	1.0	41.0
13	41	46	37	37	42	45	41.3	1.0	40.8
14	44	49	39	42	42	45	43.5	1.0	43.0
15	40	43	41	39	40	45	41.3	1.0	40.8
16	43	45	41	44	45	46	44.0	1.0	43.5

Note: Adjusted effluent TSS concentration is the average effluent TSS concentration minus the average background TSS concentration (Table 5).

Drawdown TSS

According to the NJDEP Filter Protocol, the amount of sediment that leaves the filter during the drawdown period must be accounted for and documented. During each run, two evenly volume-spaced grab samples were taken of the drawdown, and all TSS analyses were conducted by Fredericktowne Labs. For each run, the average drawdown concentration was adjusted by subtracting the average background TSS concentration (**Table 9**).

Table 9 Drawdown Sample TSS Concentrations

Run	DDA	DDB	Average	MDL	Adjusted Drawdown TSS
	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
1	62	11	36.5	1.0	34.3
2	39	16	27.5	1.0	26.7
3	42	14	28.0	1.0	27.3
4	41	18	29.5	1.0	29.0
5	42	16	29.0	1.0	28.5
6	45	17	31.0	1.0	30.5
7	44	16	30.0	1.0	29.5
8	48	17	32.5	1.0	32.0
9	42	18	30.0	1.0	29.5
10	45	17	31.0	1.0	30.5
11	43	17	30.0	1.0	29.5
12	44	16	30.0	1.0	29.5
13	46	18	32.0	1.0	31.5
14	50	18	34.0	1.0	33.5
15	47	17	32.0	1.0	31.5
16	48	15	31.5	1.0	31.0

Note: Adjusted drawdown TSS concentration is the average drawdown TSS concentration minus the average background TSS concentration (Table 5).

In order to estimate the volume of water during drawdown, under observation by BEC, the unit was filled prior to all testing with clean water and the drawdown volume as a function of time was calculated from the height of the flow stream in the effluent pipe as a function of time. Total drawdown volume was estimated at 268.6 gal at an operating head of 2.5 inches. This volume was used to determine the volume of the void space of the gravel bed, which was then used, along with the dimensions of the Isolator Row PLUS chambers, to calculate the drawdown volume for incremental head levels above 2.5 inches. Adjusted average drawdown TSS concentrations and drawdown losses are given in **Table 10**.

Table 10 Drawdown Losses

Run	Head Level at End of Run (in)	Drawdown Volume (gal)	Average Adjusted Drawdown TSS Conc. (mg/L)	Total Sediment Lost During Drawdown (g)
1	9.00	285.2	34.3	37.1
2	12.00	354.2	26.7	35.7
3	14.00	403.3	27.3	41.7
4	15.25	432.8	29.0	47.5
5	15.75	443.9	28.5	47.9
6	16.25	454.2	30.5	52.4
7	17.50	476.0	29.5	53.2
8	17.00	468.2	32.0	56.7
9	17.25	472.3	29.5	52.7
10	17.75	476.0	30.5	55.0
11	17.25	472.3	29.5	52.7
12	17.5	476.0	29.5	53.2
13	18.00	482.4	31.5	57.5
14	18.25	484.9	33.5	61.5
15	18.50	486.8	31.5	58.1
16	18.25	484.9	31.0	56.9

Removal Efficiency Calculation

Removal efficiency was calculated using the following equation from the NJDEP Filter Protocol:

$$\text{Removal Efficiency (\%)} = \frac{\begin{pmatrix}\text{Average Influent}\\ \text{TSS Concentration x}\\ \text{Total Volume}\\ \text{of Test Water}\end{pmatrix} - \begin{pmatrix}\text{Adjusted Effluent}\\ \text{TSS Concentration x}\\ \text{Total Volume}\\ \text{of Effluent Water}\end{pmatrix} - \begin{pmatrix}\text{Average}\\ \text{Drawdown Flow}\\ \text{TSS Concentration x}\\ \text{Total Volume}\\ \text{of Drawdown Water}\end{pmatrix}}{\text{Average Influent TSS Concentration x Total Volume of Test Water}} \text{ x } 100$$

For each run, sediment concentrations of background, influent, effluent, and drawdown, as well as the calculated removal efficiency, are summarized in **Table 11**. As shown in this summary table, the Isolator Row PLUS demonstrated a cumulative sediment removal efficiency of 81.2% over the course of 16 test runs.

Table 11 Removal Efficiency Results

Run	Average Influent TSS (mg/L)	Influent Water Volume (gal)	Adjusted Average Effluent TSS (mg/L)	Effluent Water Volume (gal)	Adjusted Average Drain Down TSS (mg/L)	Drain Down Water Volume (gal)	Single Run Removal Efficiency (%)	Mass of Captured Sediment (g)	Cumulative Removal Efficiency (%)
1	203	7166	46	6881	34	285	77.8	4282	77.8
2	199	6993	32	6639	27	354	84.0	4415	80.8
3	207	7197	37	6793	27	403	82.6	4654	81.4
4	217	7068	33	6635	29	433	84.9	4923	82.3
5	215	7037	39	6593	29	444	82.2	4705	82.3
6	207	7097	40	6643	31	454	81.2	4504	82.1
7	198	7169	37	6693	30	476	81.6	4386	82.0
8	201	7184	37	6716	32	468	81.6	4473	82.0
9	205	7147	38	6675	30	472	81.8	4539	82.0
10	203	7235	38	6759	31	476	81.4	4523	81.9
11	208	7096	38	6624	30	472	81.8	4567	81.9
12	209	7185	41	6709	30	476	80.7	4584	81.8
13	198	7162	41	6680	32	482	79.7	4277	81.6
14	200	7242	43	6757	34	485	78.8	4318	81.4
15	196	7329	41	6842	32	487	79.5	4320	81.3
16	202	7254	44	6769	31	485	78.9	4384	81.2
Ave.	204.2	7160	39	6713	31	447	81.2	4491	N/A
Cumulative Mass Removed (g)							71854		
Cumulative Mass Removed (lb)							158.4		
Total Mass Loaded (lb)							195.2		
Cumulative Removal Efficiency (%)							81.2		

4.5 Sediment Mass Loading

Sediment mass loading for each run was approximately 12.2 lbs on average. These data are summarized in **Table 12**.

Sediment mass loading was calculated from the summation of the total sediment mass added during dosing in each run.

Table 12 Sediment Mass Loading Summary

Run	Sediment Loading (lbs)	Cumulative Sediment Loading (lbs)	Run	Sediment Loading (lbs)	Cumulative Sediment Loading (lbs)
1	12.1	12.1	9	12.2	110.0
2	11.6	23.7	10	12.3	122.2
3	12.4	36.1	11	12.3	134.5
4	12.8	48.9	12	12.5	147.0
5	12.6	61.5	13	11.8	158.9
6	12.2	73.8	14	12.1	170.9
7	11.9	85.6	15	12.0	182.9
8	12.1	97.7	16	12.2	195.2

Overall, a total of 195.2 lbs of sediment was loaded into the Isolator Row PLUS over the course of the 16 runs. Total captured mass over the 16 runs was 158.4 lbs (**Table 11**).

The relationship between removal efficiency and sediment mass loading is shown in **Figure 10**. The relationship between driving head and sediment mass loading is shown in **Figure 11**.

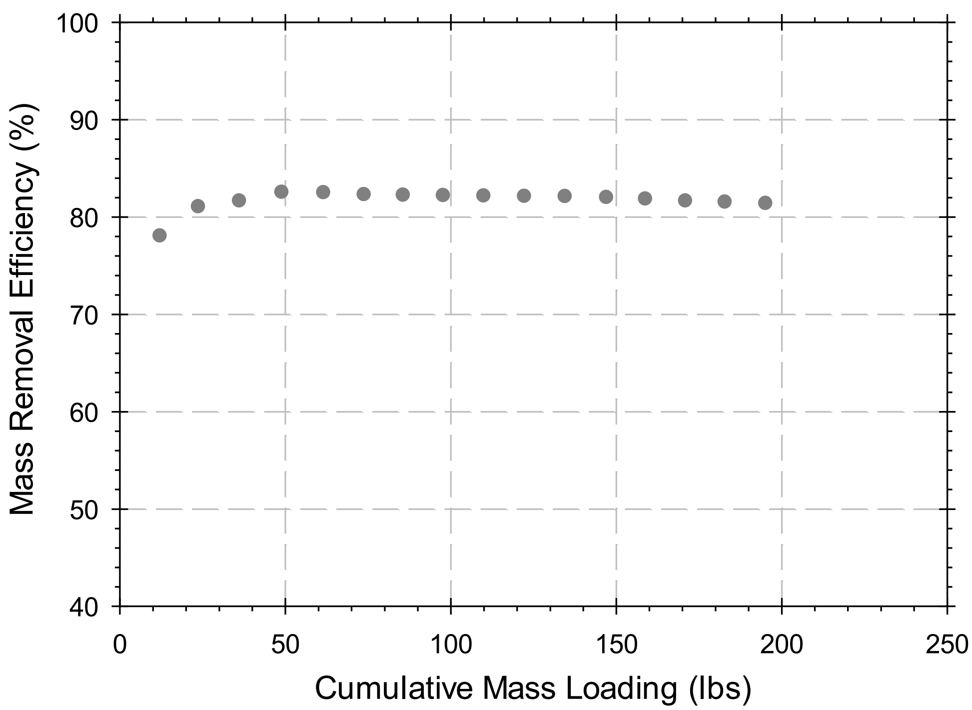


Figure 10 Removal Efficiency vs. Sediment Mass Loading

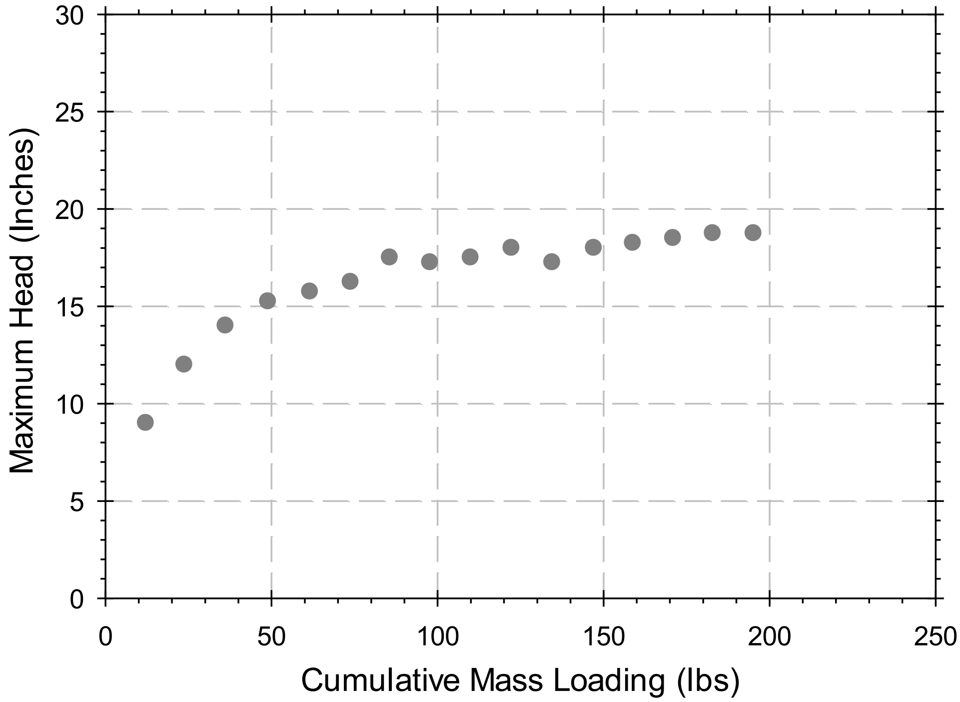


Figure 11 Driving Head vs. Sediment Mass Loading

5. Performance Verification

The Isolator Row PLUS used in this test, constructed from two (2) overlapping StormTech SC-740 chambers and one layer of ADS PLUS fabric, demonstrated a cumulative mass TSS removal efficiency of 81.2% and a sediment mass loading capacity of 3.58 lb./ft^2 (mass capture capacity of 2.91 lb./ft^2) of geotextile fabric filtration area when operated with a driving head < 20 inches at a hydraulic loading rate of 4.13 gpm/ft^2 of geotextile fabric filtration area. The MTFR's and maximum allowable drainage area for other StormTech Isolator Row PLUS models are shown in **Table 13**.

Table 13 Isolator Row PLUS System Model Sizes and New Jersey Treatment Capacities

Model	Surface Loading Rate (gpm/ft²) Single Chamber	Effective Filtration Treatment Area (ft²) Single Chamber	MTFR (cfs)[1] Single Chamber	Mass Loading Capacity (lbs) Single Chamber	Mass Capture Capacity (lbs) Single Chamber	Drainage Area (acres) Single Chamber
StormTech SC-160	4.13	11.45	0.105	41.0	33.4	0.06
StormTech SC-310	4.13	17.7	0.163	63.4	51.6	0.09
StormTech SC-740	4.13	27.8	0.256	99.6	81.0	0.14
StormTech DC-780	4.13	27.8	0.256	99.6	81.0	0.14
StormTech MC-3500	4.13	42.9	0.395	153.7	125.0	0.21
StormTech MC-4500	4.13	30.1	0.277	107.8	87.7	0.15

1. Based on 4.13 gpm/ft^2 of effective filtration treatment area.
2. Drainage Area is based on the equation in the NJDEP Filter Protocol wherein drainage area is calculated by dividing the pounds of mass captured by 600 lb/acre.

6. Design Limitations

Maximum Flow Rate

The StormTech Isolator Row PLUS unit has an MTFR of 0.501 cfs (225 gpm) and an effective filtration treatment area (EFTA) of 54.5 ft^2 (loading rate 4.13 gpm/ft^2).

Slope

The StormTech Isolator Row PLUS is recommended for installation with little to no slope to ensure proper, consistent operation. Steep slopes should be reviewed by ADS/StormTech Engineering support.

Allowable Head Loss

There is an operational head loss associated with the StormTech Isolator Row PLUS. The head loss will increase over time due to the sediment loading to the system. Site-specific treatment flow rates, peak flow rates, pipe diameter, and pipe slopes should be evaluated to ensure there is appropriate head for the system to function properly.

Sediment Load Capacity

Based on laboratory testing results, the StormTech Isolator Row PLUS unit has a mass loading capacity of 195.2 lbs. while operating at a sediment removal efficiency of 81.2%; the total sediment load captured by the tested Isolator Row PLUS is 158.4 lbs.

Pre-treatment Requirements

The StormTech Isolator Row PLUS unit does not require additional pre-treatment.

Configurations

The StormTech Isolator Row PLUS is available in multiple configurations. The length and size can be adjusted to meet project specific design volumes or flow rates.

Structure Load Limitations

The StormTech Isolator Row PLUS, as part of the overall chamber system, is designed to meet the full scope of design requirements of the American Society of Testing Materials (ASTM) International specification F2787 "Standard Practice for Structural Design of Thermoplastic Corrugated Wall Stormwater Collection Chambers" and produced to the requirements of the ASTM F2418 "Standard Specification for Polypropylene (PP) Corrugated Stormwater Collection Chambers". The StormTech chambers provide the full AASHTO safety factors for live loads and permanent earth loads. The ASTM F 2787 standard provides specific guidance on how to design thermoplastic chambers in accordance with AASHTO Section 12.12. of the AASHTO LRFD Bridge Design Specifications. ASTM F 2787 requires that the safety factors included in the AASHTO guidance are achieved as a prerequisite to meeting ASTM F 2418. The three standards provide both the assurance of product quality and safe structural design.

7. Maintenance Plan

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

The Isolator Row PLUS may also be part of a treatment train. By treating stormwater prior to entry into the chamber system, the service life can be extended and pollutants such as hydrocarbons can be captured.

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

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

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

The Isolator Row PLUS was designed to reduce the cost of periodic maintenance. By "isolating" sediment to just one row of the StormTech system, costs are dramatically reduced by eliminating the need to clean out each row of the entire storage bed. If inspection indicates the potential need for maintenance, access is provided via a manhole(s) located on the end(s) of the row for cleanout.

Maintenance is accomplished with the JetVac process. The JetVac process utilizes a high-pressure water nozzle to propel itself down the Isolator Row PLUS while scouring and suspending sediment. As the nozzle is retrieved, the captured pollutants are flushed back into the manhole for vacuuming. Most sewer and pipe maintenance companies have vacuum/JetVac combination vehicles. Selection of an appropriate JetVac nozzle will improve maintenance efficiency.

Fixed nozzles designed for culverts or large diameter pipe cleaning are preferable. Rear-facing jets with an effective spread of at least 45" are best. Most JetVac reels have 400 feet of hose, allowing maintenance of an Isolator Row PLUS up to 50 chambers long. The JetVac process should only be performed on StormTech Isolator Rows PLUS that have AASHTO class 1 woven geotextile (as specified by StormTech) over their angular base stone.

Complete details of the design, operation, and maintenance of the Isolator Row PLUS can be found in the StormTech O&M Manual, available online at:
https://www.stormtech.com/download_files/pdf/11081-stormtech-isolator-row-plus-manual-07-20.pdf

8. Statements

The attached pages include signed statements from the manufacturer (Advanced Drainage Systems, Inc.), the third-party environmental consulting firm (Boggs Environmental Consultants, Inc.), and NJCAT. These statements are included as a requirement for the verification process.

June 26th, 2020

Dr. Richard S. Magee, Sc.D., P.E., BCEE
NJCAT
Center for Environmental Systems
Steven Institute of Technology
Castle Point on Hudson
Hoboken, NJ 07030-0000

Dr. Magee,

Advanced Drainage Systems is pleased to provide this letter as our statement certifying that the protocol, "New Jersey Department of Environmental Protection Laboratory Protocol to Assess Total Suspended Solids Removal by a filtration Manufactured Treatment Device" (NJDEP Filter Protocol, January 25, 2013), was strictly followed while testing our StormTech Isolator® Row PLUS. The testing was performed at BaySaver Laboratories, located in Mount Airy, MD. All data pertaining to the StormTech Isolator Row PLUS NJDEP Protocol test is included in the Verification Report.

Respectfully,

Greg Spires, PE
General Manager - StormTech
Advanced Drainage Systems
614.325.0032
greg.spires@ads-pipe.com

BOGGS ENVIRONMENTAL CONSULTANTS

Middletown, MD & Morgantown, WV

Administrative Office:
200 W Main Street Middletown, Maryland 21769
Office (301) 694-5687
Fax (301) 694-9799

June 25, 2020

StormTech
Advanced Drainage Systems, Inc.
520 Cromwell Avenue
Rocky Hill, CT 06067
gregory.spires@ads-pipe.com

ATTENTION Greg Spires, PE
General Manager, StormTech
Advanced Drainage Systems, Inc.

REFERENCE: Third Party Review of Testing Procedures of the Isolator® Row PLUS at the
BaySaver Laboratory
1207 Park Ridge Drive
Mount Airy, MD 21771

BOGGS ENVIRONMENTAL CONSULTANTS, INC. (BEC) provided Third Party Review services for the testing of the Isolator® Row PLUS to evaluate if the required testing meets certification standards established by the New Jersey Department of Environmental Protection (NJDEP).

LABORATORY TESTING PROCEDURES & METHODOLOGIES

The following two procedures and testing requirements were followed during the testing process of the Isolator® Row PLUS:

- *New Jersey Department of Environmental Protection, Laboratory Protocol to Assess Total Suspended Solids Removal by a Filtration Manufactured Treatment Device, dated January 25, 2013.*
- *QAPP for Isolator® Row PLUS, New Jersey Department of Environmental Protection Testing,* prepared by StormTech (a subsidiary of Advanced Drainage Systems, Inc.), Revision dated January 9, 2020.

ONSITE THIRD-PARTY OBSERVATION OF TESTING PROCEDURES

BEC was present at the BaySaver Laboratory, at 1207 Park Ridge Drive, in Mount Airy, MD 21771, to observe the following testing of the Isolator® Row PLUS:

- The mixing and establishment of a sediment blend that included manufactured sands that when delivered to the feed water would result in influent Total Suspended Solids (TSS) concentrations within the established range of approximately 200 mg/L and a particle size distribution specified and approved by NJDEP;
- BEC assisted in the establishment of a Procedure Checklist to be used on each run to verify and document the following: Verify that pumps and measurement devices are turned on and functioning; Verification that the correct measurements of dry sediments are added to the doser and feed stream; Document that, background effluent, and duplicate samples are collected at established intervals during the run; and, Recording of periodic flow rates and head measurements during each run;
- Observation of Runs 1 through 16 from January 14, 2020 to February 12, 2020 and verified that that sediment, background, effluent samples were collected during each 33-minute run, and that drawdown samples were collected after the end of each run.
- After sampling was completed for each run, BEC was present for the downloading of flow data as well as sediment feed rates to verify that calculated sediment feed rates met NJDEP protocols for testing. BEC also verified that that sample containers were properly labeled and chain of custodies were filled and were boxed and sealed for delivery to Fredericktowne Labs for analysis of Total Suspended Solids (TSS).

THIRD-PARTY VERIFICATION & OPINIONS

Based on observations during the runs and the reported TSS analytical results, BEC verified the following:

- That the testing of the Isolator® Row PLUS at the BaySaver Laboratory was conducted in accordance with the *New Jersey Department of Environmental Protection, Laboratory Protocol to Assess Total Suspended Solids Removal by a Filtration Manufactured Treatment Device, dated January 25, 2013* and procedures established in Advanced Drainage Systems, Inc.'s *QAPP for Isolator® Row PLUS, New Jersey Department of Environmental Protection Testing,* prepared by StormTech (a subsidiary of Advanced Drainage Systems), Revision dated January 9, 2020.
- The report titled *NJCAT Technology Verification, of Isolator® Row PLUS,* prepared by StormTech, dated June 2020, used applicable NJCAT protocol and accurately reflects the testing observed by BEC.

BEC has no financial conflict of interest, as defined in the *Procedure for Obtaining Verification of a Stormwater Manufactured Treatment Device from New Jersey Corporation of Advanced Technology* (NJEP 2013).

Should you have any questions, contact our office at your earliest convenience.

Sincerely,
Boggs Environmental Consultants, Inc.

William R. Warfel
Principal Environmental Scientist

Center for Environmental Systems
Stevens Institute of Technology
One Castle Point
Hoboken, NJ 07030-0000

May 1, 2020

George F. Ives III, P.E.
StormTech, LLC
520 Cromwell Ave
Rocky Hill, CT 06067

Dear Mr. Ives,

Based on my review, evaluation and assessment of the testing conducted on the StormTech , LLC Isolator Row PLUS at the BaySaver Laboratory (Storm Tech, LLC and BaySaver Technologies, LLC are subsidiaries of Advanced Drainage Systems, Inc.), under the independent third-party oversight of Boggs Environmental Consultants (BEC), Inc., the test protocol requirements contained in the "New Jersey Department of Environmental Protection Laboratory Protocol to Assess Total Suspended Solids Removal by a Filtration Manufactured Treatment Device" (NJDEP Filter Protocol, January 2013) were met or exceeded. Specifically:

Test Sediment Feed

The test blend was custom-blended using various commercially available silica sands under the oversight of BEC. The particle size distribution was independently analyzed by Environmental Consulting Services (ECS), using the methodology of ASTM method D422-63. The blended silica met the specification within tolerance as described in Section 5B of the NJDEP filter protocol and was acceptable for use.

Removal Efficiency Testing

Sixteen (16) removal efficiency testing runs were completed in accordance with the NJDEP filter protocol. The target flow rate was 225 gpm and the influent sediment concentration was 200 mg/L. The average flow rate for all 16 runs was 226.1, with a coefficient of variation (COV) below the flow compliance (COV) < 0.1 for all the runs. Likewise, for all runs the sediment feed rate COV was below the < 0.03 protocol limit. The Isolator Row PLUS demonstrated a cumulative sediment removal efficiency of 81.2% over the course of the 16 test runs.

Sediment Mass Loading Capacity

Mass loading capacity testing was conducted concurrently with removal efficiency testing. The Isolator Row PLUS has a mass loading capture capacity of 158.4 lbs (2.91 lbs/ft^2 of filtration area).

No maintenance was performed on the test system during the entire testing program.

Scour Testing

No scour testing was performed. Hence the Isolator Row PLUS is verified for off-line installation only.

Sincerely,

Richard S Magee

Richard S. Magee, Sc.D., P.E., BCEE

Specifications

Introduction

- Manufacturer – StormTech, LLC, 520 Cromwell Ave, Rocky Hill, CT 06067
- Website: http://www.StormTech.com. Phone: 888-892-2694
- MTD – StormTech Isolator Row PLUS verified models are shown in **Table 13**
- TSS Removal Rate – 81.2%
- Off-line installation

Detailed Specification

• NJDEP sizing tables and physical dimensions of StormTech Isolator Row PLUS verified models are shown in **Table 13**. These sizing tables are valid for NJ following NJDEP Water Quality Design Storm Event of 1.25" in 2 hours (NJAC 7:8-5.5(a)).

• Maximum inflow drainage area

  - The maximum inflow drainage area is governed by the maximum treatment flow rate of each model as presented in **Table 13**.

• Driving head will vary for a given Isolator Row PLUS model based on the site-specific configuration. The maximum head without bypass is 36”, but the minimum head varies depending on the flow rate through the unit. Design support is given by StormTech for each project, and site-specific drawings (cut sheets) will be provided that show pipe inverts, finish surface elevation, and peak treatment and maximum flow rates through the unit.

• The drawdown flow exits via the underdrain. A clean filter draws down in approximately 20 minutes.

StormTech®

Detention • Retention • Water Quality

Division of ADS

STORMTECH ISOLATOR ROW SIZING CHART

	SC-310	SC-740	DC-780	MC-3500	MC-4500
Chamber Area (Sq.Ft.)	20	27.8	27.8	43.2	30.1
Treated Flow Rate per chamber (CFS)	0.11	0.15	0.15	0.24	0.17

NOTE: *Testing of the Isolator Row completed by Tennesse Tech has been verified by NJCAT and it has shown to have a TSS removal efficiency of 84% for SIL-CO-SIL 250*

NJCAT verified Treated Flow Rate (GPM / Sq.Ft.) 2.5

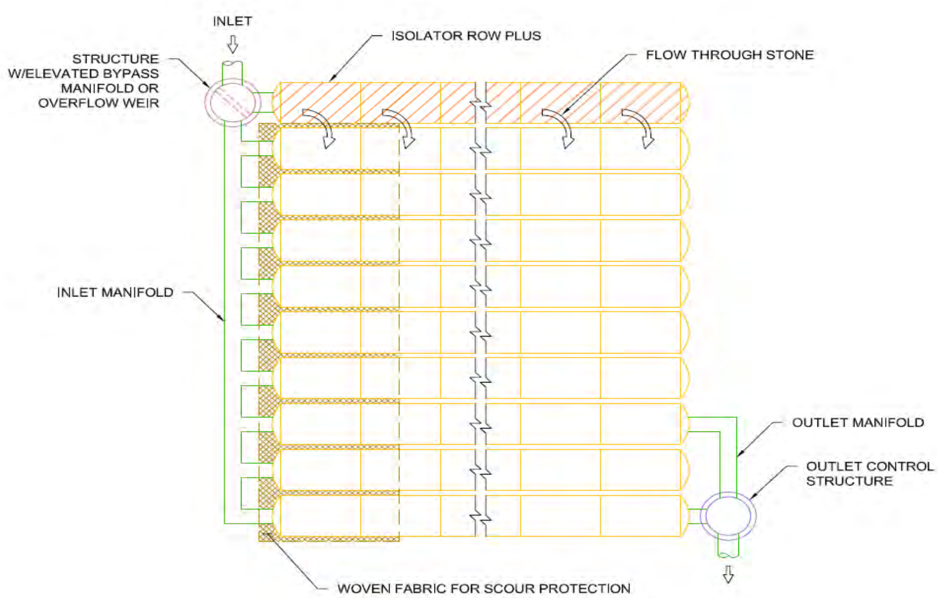
StormTech Isolator Row PLUS – Pollutant Removal

The following information is intended to provide a general overview of the pollutant removal capability of the StormTech Isolator™ Row PLUS, which is a patented filtration type BMP manufactured by StormTech, LLC. The StormTech Isolator Row PLUS is covered under several US and International patents.

I. Description:

The StormTech Isolator Row PLUS is a row or rows of thermoplastic chambers that sit on a layer of ADS PLUS fabric and are connected to a closely located structure for easy access. The chambers provide for settling and filtration of sediment and other contaminants as stormwater rises in the Isolator Row PLUS and ultimately passes through the fabric. The open-bottom chambers allow stormwater to flow out of the chambers. Sediment is captured in the Isolator Row PLUS, protecting the storage areas of the adjacent stone and chambers from sediment accumulation.

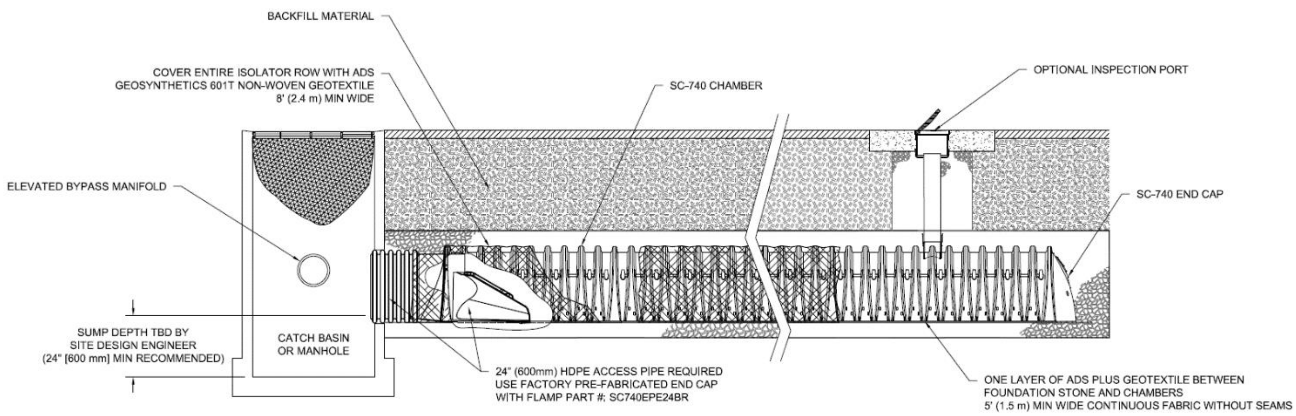
The StormTech Isolator Row PLUS is designed to capture the “first flush” and offers the versatility to be sized on a volume basis or a flow-rate basis. An upstream manhole not only provides access to the Isolator Row but includes a high low/concept such that stormwater flow rates or volumes that exceed the capacity of the Isolator Row bypass through a manifold to the other chambers. This is achieved with either a high-flow weir or an elevated manifold. This creates a differential between the Isolator Row PLUS and the manifold, thus allowing for settlement time in the Isolator Row PLUS.



Schematic of the StormTech Isolator Row PLUS System

Some of the unique features of the Isolator Row that contribute to its effectiveness and practicality include:

- Vast filtration surface area
- Large sediment storage volume
- Easily maintainable by most pipe and sewer maintenance companies
- Large network of ADS personnel that can help with designs and provide onsite guidance
- A state-of-the-art structural design that meets ASTM standards and incorporates AASHTO safety factors for both live loads and permanent dead loads



Isolator Row PLUS Cross Section Detail

II. Applicable Sites:

The Isolator Row PLUS can be effectively used for essentially all developed sites. The most common applications are highly impervious sites such as paved parking areas, roads as well as developed sites that include grassy or other landscaped areas. It is not intended to be used for construction sediments.

III. StormTech System & Isolator Row Testing:

October 2006 – Tennessee Tech University's Civil and Environmental Department prepared the "Performance Evaluation of Sediment Removal Efficiency – StormTech Isolator Row". Testing on a full-scale Isolator Row in a laboratory was done to determine the sediment removal efficiency with two different silica-water slurries in accordance with NJCAT protocols. In August of 2007, the technology was verified by NJCAT. Results are shown in Table 1.

September 2010 – The University of New Hampshire Stormwater Center released the "Final Report on Field Verification Testing of the StormTech Isolator Row Treatment Unit". Testing consisted of determining the water quality performance for multiple stormwater pollutants in accordance with TARP Tier II protocol. Testing was done for a system only consisting of the StormTech Isolator Row. Data was recorded for 23 storm events. Results are shown in Table 1.

January 2020 – BaySaver Technologies prepared the "NJCAT Technology Verification of Isolator Row PLUS". Testing on a full-scale Isolator Row PLUS in a laboratory was done to determine the sediment removal efficiency with a silica-water slurry in accordance with the updated NJCAT protocols. In July of 2020, the technology was verified by NJCAT. Results are shown in Table 1.

June 2020 – North Carolina State University Department of Biological and Agricultural Engineering prepared the technical report "An Evaluation of the StormTech Isolator Row and Subsurface Stormwater Management System at Capital Oaks Retirement Resort, Raleigh, North Carolina". 14 months of monitoring and over 73 precipitation events were completed to study the hydrologic and water quality performance of a StormTech MC-4500 system in Raleigh, NC. Results are shown in Table 1.

Table 1: StormTech Isolator Row 3rd Party Pollutant Removal Efficiency Data

Pollutant	University of New Hampshire (Isolator Row Only) Median	Raleigh, North Carolina (StormTech system with Isolator Row)	Tennessee Tech University (Isolator Row Only)	NJCAT Verification (Isolator Row PLUS only)
Total Suspended Solids	83%*	91%*	84%*	81%**
Total Phosphorus	33%	68%	Not Tested	Not Tested
Total Nitrogen	Not Tested	35%	Not Tested	Not Tested
Total Zinc	81%	Not Tested	Not Tested	Not Tested
Total Petroleum Hydrocarbons	91%	Not Tested	Not Tested	Not Tested

*Based on a flow rate of 2.5 gpm/sf (Isolator Row)
** Based on a flow rate of 4.1 gpm/sf (Isolator Row PLUS)

IV. Product Performance and Design

Minimum 80% TSS removal is achieved by sizing the Isolator Row PLUS to treat the water quality at a specific flow rate per chamber floor area using a single layer of ADS PLUS fabric. The design flow rates for each chamber size are listed below.

Model	Specific Flow Rate	Bottom Area	Flow Per Model
StormTech SC-160LP	4.1 gpm/sf	11.45 sf	0.11 cfs
StormTech SC-310	4.1 gpm/sf	17.7 sf	0.16 cfs
StormTech SC-740	4.1 gpm/sf	27.8 sf	0.26 cfs
StormTech DC-780	4.1 gpm/sf	27.8 sf	0.26 cfs
StormTech MC-3500	4.1 gpm/sf	42.9 sf	0.40 cfs
StormTech MC-4500	4.1 gpm/sf	30.1 sf	0.28 cfs

V. StormTech Isolator Row Approvals:

The StormTech Isolator Row and Isolator Row PLUS have been approved on a project by project basis for tens of thousands of projects around the world. Following are some examples:

- The Isolator Row PLUS is a verified filtration manufactured treatment device by the New Jersey Corporation for Advanced Testing (NJCAT) in accordance with NJDEP Filter Protocols.
- In Ohio, the Isolator Row is approved per the Ohio EPA as a pretreatment to underground storage and can be used for both storage volume and pretreatment as the water quality volume all passes through the Isolator Row.
- The Metropolitan St. Louis Sewer District (MSD) has approved the StormTech Isolator Row as a standalone post-construction stormwater Best Management Practice.
- In Massachusetts, approvals for the State DEP requirement of 80% TSS removal on an annual load basis are issued at the Conservation Commission level, and the Isolator Row is commonly used to meet these criteria.
- In Oregon, the Rogue Valley Storm Water Advisory Team (SWAT) has incorporated the StormTech Isolator Row into their Stormwater Design Manual as a pre-approved proprietary device for stormwater quality treatment.
- The Kansas City Metro Chapter of the American Public Works have included the StormTech Isolator Row wit a value rating of 3.0 in their Manual of Best Management Practices for Stormwater Quality.
- Maine DEP has approved the Isolator Row pollutant removal efficiency based on laboratory testing of 110 micron (US Silica OK-110) particle size
- In Texas, the City of Houston PWE as well as Harris county, has recognized the Isolator Row as an official water quality device.
- Under the New Environmental Technology Evaluation program, the Ontario (Canada) Ministry of the Environment has evaluated the Isolator row and issued a Certificate of Technology Assessment
- The Isolator Row PLUS is currently being evaluated for Canadian Environment Technology Verification (ETV) by VerifiGlobal.

V. Isolator Row Maintenance:

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

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

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

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

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

Maintenance is accomplished with the jetvac process. The jetvac process utilizes a high-pressure water nozzle to propel itself down the Isolator Row while scouring and suspending sediment. As the nozzle is retrieved, the captured pollutants are flushed back into the manhole for vacuuming. Most sewer and pipe maintenance companies have vacuum/jetvac combination vehicles. Selection of an appropriate jetvac nozzle will improve maintenance efficiency.

Fixed nozzles designed for culverts or large diameter pipe cleaning are preferable. Rear-facing jets with an effective spread of at least 45" are best. Most jetvac reels have 200 feet of hose, allowing maintenance of an Isolator Row up to 50 chambers long. The jetvac process shall only be performed on StormTech Isolator Rows that have fabric specified by StormTech over their angular base stone.

Complete details of the design, operation, and maintenance of the Isolator Row PLUS can be found in the StormTech Isolator Row and Isolator Row PLUS O&M Manuals.

ISOLATOR ROW	UNIT TYPE	Treated flow per unit	Flow required to be treated	Number of units Provided	Treated Flow per Isolator Row
		cfs	cfs		cfs
UG-1 IR-1	SC-740	0.26	0.17	8	2.08
UG-2 IR-2	SC-740	0.26	0.34	10	2.60
UG-3 IR-3	MC-3500	0.40	0.66	7	2.80
UG-4a IR-4	SC-310	0.16	0.43	6	0.96
UG-5 IR-5	MC-3500	0.40	0.31	10	4.00
UG-6 IR-6a	SC-310	0.16	0.53	6	0.96
UG-6 IR-6b	SC-310	0.16	0.23	6	0.96
UG-7 IR-7	MC-3500	0.40	1.25	10	4.00

Water Quality Unit Sizing Using Equivalent Flow from 1" Rainfall Depth

UG Basin / Isolator row	Tributary Area (acres)	Tributary Area (sq miles)	Pervious (sf)	Impervious %	CN Value (Estimated)	WQRD (In)	WQ Volume (cf)	Tc (min)	qu csm/in	WQF = qu A Q (cfs)	REQUIRED VOLUME FOR OGS IN FIRST CHAMBER 400 cf / AC of imperv (GAL)*	PROPOSED OIL/GRIT UNIT SIZE (GAL)
UG-1a/OGS-1	0.14	0.0002	-	100%	98	1.00	508	5	795	0.17	418.9	1,000
UG-2/OGS-2	0.38	0.0006	4,790	71%	87	1.00	980	5	795	0.34	807.9	2,000
UG-3/OGS-3	0.79	0.0012	11,100	68%	86	1.00	1943	5	795	0.66	1,601.3	3,000
UG-4a/OGS-4	0.39	0.0006	1,755	90%	94	1.00	1269	5	795	0.43	1,046.3	3,000
UG-5/OGS-5	0.30	0.0005	2,350	82%	91	1.00	893	5	795	0.31	736.2	2,000
UG-6/OGS-6a	0.79	0.0012	15,795	54%	81	1.00	1551	5	795	0.53	1,278.8	3,000
UG-6/OGS-6b	0.20	0.0003	598	93%	95	1.00	676	5	795	0.23	557.3	1,500
UG-7/OGS-7	1.17	0.0018	7,305	86%	93	1.00	3638	5	795	1.25	2,998.9	6,000
OGS-8	0.45	0.0007	1,330	93%	95	1.00	1523	5	795	0.52	1,255.0	3,000

*Based on MASS DEP: The pool storage in the first chamber of the Oil/Grit has to accommodate 400 cubic feet per acre of impervious surface.
First chamber is considered, at minimum, half of storage volume of the entire structure
formula used is : IMPERVIOUS (AC) X 400 (CF) X 7.48 to get the minimum storage volume in the FIRST CHAMBER of Oil/Grit structure

BIO-CLEAN SciCLONE Hydrodinamic separtaor Model SC-4 is proposed for area OGS-8

40 20 0 40 80

Date	Description	No.
7.14.2021	REVISED PER CONSERVATION COMMISSION	1.

Revisions

7-14-2021

COMMONWEALTH OF MASSACHUSETTS
GABRIEL R. CROCKER
CIVIL
No. 47917
REGISTERED PROFESSIONAL ENGINEER

GABRIEL R. CROCKER
PROFESSIONAL ENGINEER, MA REGISTRATION #47917

Crocker Design Group
2 SHARP STREET, UNIT B
HINGHAM, MA 02043
P: 781-919-0808

Project
HANOVER WEYMOUTH RESIDENTIAL DEVELOPMENT
#1325 WASHINGTON STREET, WEYMOUTH, MA

Prepared for
HANOVER R.S. LIMITED PARTNERSHIP
ONE MARINE PARK DRIVE, SUITE 701, BOSTON, MA 02210
HANOVER COMPANY

Drawing Title
PROPOSED WATER QUALITY CATCHMENT AREA MAP

Project No.	100-124
Date	4.8.2021
Scale	1"=40'
Drawn By	AS
Approved By	GC

Drawing No.
PH-3

4.4 RIP RAP SPLASH PAD

Rip rap splash pads are designed to dissipate energy, prevent scour at the stormwater outlet, and minimize the potential for downstream erosion. A LEVEL SPREADER / PLUNGE POOLE was sized for each of the outlets of the drainage system. The calculations below are in accordance with the methodology of the "2002 Connecticut Guidelines for Soil Erosion and Sediment Control" produced by The Connecticut Council on Soil and Water Conservation.

Preformed Scour Hole Calculations

	Q (25Y)	Do	TW	Depression	C	3Sp	B	2Sp	d50	
	(cfs)	(ft.)	(ft.)	(ft.)	(ft.)	(ft.)	(ft.)	(ft.)	(ft.)	(in.)
HEADWALL H4	2.1	1.0	0.30	0.50	6.00	3.00	5.00	2.00	0.11	1.32
HEADWALL H5	0.1	1.0	0.30	0.50	6.00	3.00	5.00	2.00	0.00	0.02
HEADWALL H6	2.7	1.0	0.30	0.50	6.00	3.00	5.00	2.00	0.16	1.89
HEADWALL F6	3.4	1.0	0.30	0.50	6.00	3.00	5.00	2.00	0.21	2.58

Conclusion:

As identified above, the discharge points have been designed to accommodate and exceed the required minimum Preformed scour hole sizing.

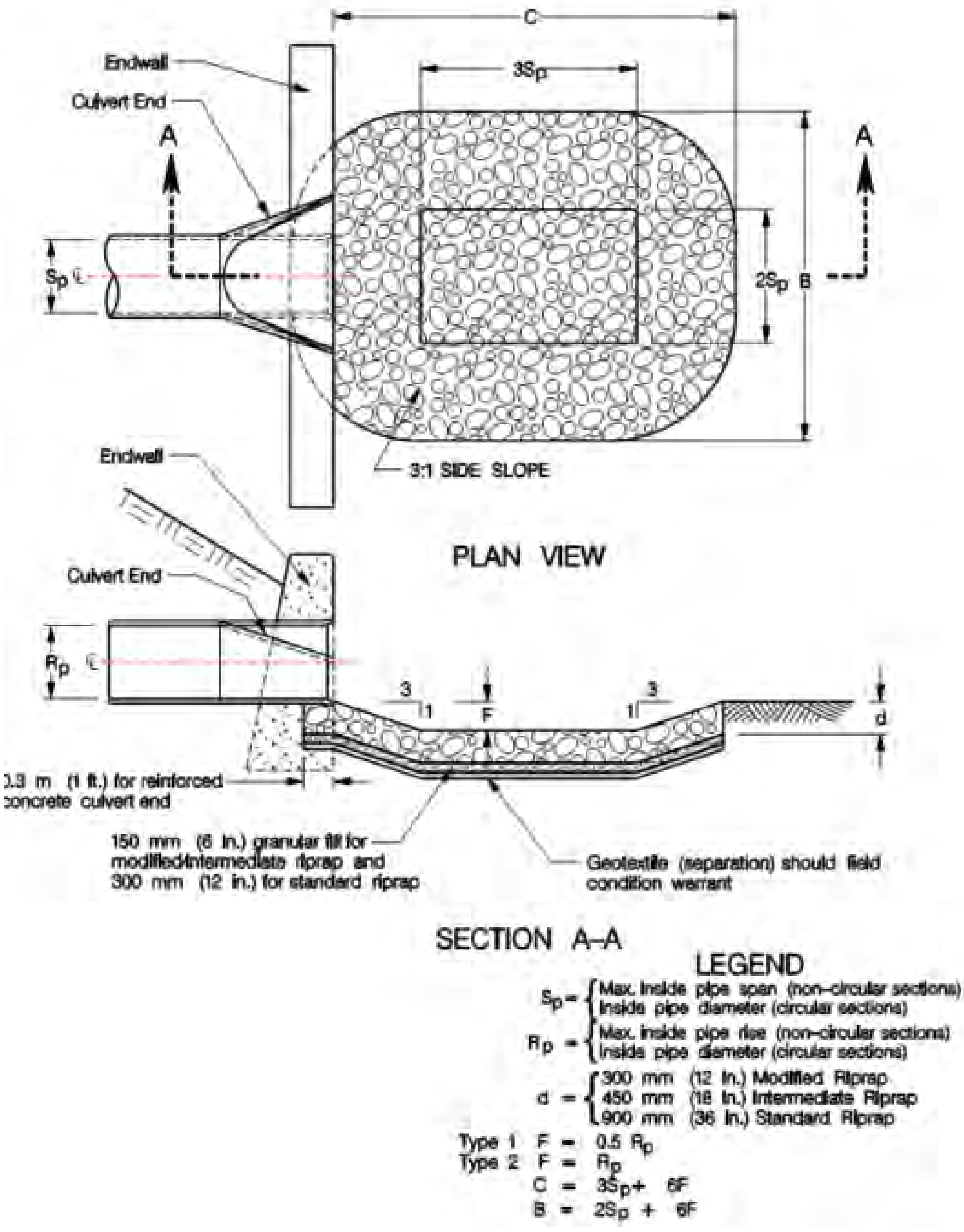


Figure 11-15 Preformed Scour Hole Type 1 and Type 2

4.5 TSS REMOVAL

The project has been designed to comply with the required 80% TSS (minimum) removal per the Massachusetts Stormwater Regulations. Various combinations of stormwater BMPs including deep sump hooded catch basins, oil grit separators, proprietary water quality units and subsurface infiltration or detention basins are utilized.

Please refer to the attached TSS calculation sheets that follow:

INSTRUCTIONS:

Non-automated: Mar. 4, 2008

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

Location: **NETWORK B TO UG-1a (via CB, OGS-1, ADS CHAMBER)**

TSS Removal Calculation Worksheet

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Deep Sump and Hooded Catch Basin	0.25	1.00	0.25	0.75
Oil-Grit Seperator OGS-1	0.25	0.75	0.19	0.56
DET. BASIN UG-1a (ADS ISOLATOR ROW)	0.80	0.56	0.45	0.11
	0.00	0.04	0.00	0.11
	0.00	0.40	0.00	0.11

Total TSS Removal = **89%**

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

Project: **HANOVER**

Prepared By: **AS**

Date: **7/13/2021**

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

INSTRUCTIONS:

Non-automated: Mar. 4, 2008

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

Location: **NETWORK D TO UG-2 (via CB, OGS-2, ADS CHAMBER)**

TSS Removal Calculation Worksheet

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Deep Sump and Hooded Catch Basin	**0.25**	**1.00**	**0.25**	**0.75**
Oil-Grit Seperator OGS-2	**0.25**	**0.75**	**0.19**	**0.56**
DET. BASIN UG-2 (ADS ISOLATOR ROW)	**0.80**	**0.56**	**0.45**	**0.11**
	0.00	**0.04**	**0.00**	**0.11**
	0.00	**0.40**	**0.00**	**0.11**

Total TSS Removal = 89%

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

Project: **HANOVER**

Prepared By: **AS**

Date: **7/13/2021**

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

INSTRUCTIONS:

Non-automated: Mar. 4, 2008

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

Location: **NETWORK E TO UG-3 (via CB, OGS-3, ADS CHAMBER)**

TSS Removal Calculation Worksheet

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Deep Sump and Hooded Catch Basin	**0.25**	**1.00**	**0.25**	**0.75**
Oil-Grit Seperator OGS-3	**0.25**	**0.75**	**0.19**	**0.56**
DET. BASIN UG-3 (ADS ISOLATOR ROW)	**0.80**	**0.56**	**0.45**	**0.11**
	0.00	**0.04**	**0.00**	**0.11**
	0.00	**0.40**	**0.00**	**0.11**

Total TSS Removal = 89%

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

Project: **HANOVER**

Prepared By: **AS**

Date: **7/13/2021**

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

INSTRUCTIONS:

Non-automated: Mar. 4, 2008

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

Location: **NETWORK G TO UG-7 (via CB, OGS-7, ADS CHAMBER)**

TSS Removal Calculation Worksheet

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Deep Sump and Hooded Catch Basin	0.25	1.00	0.25	0.75
Oil-Grit Seperator OGS-7	0.25	0.75	0.19	0.56
DET. BASIN UG-7 (ADS ISOLATOR ROW)	0.80	0.56	0.45	0.11
	0.00	0.04	0.00	0.11
	0.00	0.40	0.00	0.11

Total TSS Removal = **89%**

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

Project: **HANOVER**

Prepared By: **AS**

Date: **7/13/2021**

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

INSTRUCTIONS:

Non-automated: Mar. 4, 2008

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

Location: **NETWORK H TO UG-4a (via CB, OGS-4, ADS CHAMBER)**

TSS Removal Calculation Worksheet

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Deep Sump and Hooded Catch Basin	**0.25**	**1.00**	**0.25**	**0.75**
Oil-Grit Seperator OGS-4	**0.25**	**0.75**	**0.19**	**0.56**
DET. BASIN UG-4a (ADS ISOLATOR ROW)	**0.80**	**0.56**	**0.45**	**0.11**
	0.00	**0.04**	**0.00**	**0.11**
	0.00	**0.40**	**0.00**	**0.11**

Total TSS Removal = 89%

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

Project: **HANOVER**

Prepared By: **AS**

Date: **7/13/2021**

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

INSTRUCTIONS:

Non-automated: Mar. 4, 2008

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

Location: **NETWORK J TO UG-5 (via CB, OGS-4, ADS CHAMBER)**

TSS Removal Calculation Worksheet

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Deep Sump and Hooded Catch Basin	0.25	1.00	0.25	0.75
Oil-Grit Seperator OGS-5	0.25	0.75	0.19	0.56
INF. BASIN UG-5 (ADS ISOLATOR ROW)	0.80	0.56	0.45	0.11
	0.00	0.04	0.00	0.11
	0.00	0.40	0.00	0.11

Total TSS Removal = 89%

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

Project: **HANOVER**
Prepared By: **AS**
Date: **7/13/2021**

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

INSTRUCTIONS:

Non-automated: Mar. 4, 2008

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

Location: **NETWORK K TO WQ-SC-4 (via CB, OGS-8, WATER QUALITY STRUCTURE WQ-SC-4)**

TSS Removal Calculation Worksheet

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Deep Sump and Hooded Catch Basin	**0.25**	**1.00**	**0.25**	**0.75**
Oil-Grit Seperator OGS-8	**0.25**	**0.75**	**0.19**	**0.56**
WQ-SC-4 SCICLONE SC-4 WATER QUALITY	**0.80**	**0.56**	**0.45**	**0.11**
	0.00	**0.04**	**0.00**	**0.11**
	0.00	**0.40**	**0.00**	**0.11**

Total TSS Removal = 89%

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

Project: **HANOVER**

Prepared By: **AS**

Date: **7/13/2021**

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

INSTRUCTIONS:

Non-automated: Mar. 4, 2008

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

Location: **NETWORK L TO UG-6 (via CB, OGS-6a, ADS CHAMBER)**

TSS Removal Calculation Worksheet

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Deep Sump and Hooded Catch Basin	0.25	1.00	0.25	0.75
Oil-Grit Seperator OGS-6a	0.25	0.75	0.19	0.56
DET. BASIN UG-6 (ADS ISOLATOR ROW)	0.80	0.56	0.45	0.11
	0.00	0.04	0.00	0.11
	0.00	0.40	0.00	0.11

Total TSS Removal = **89%**

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

Project: **HANOVER**

Prepared By: **AS**

Date: **7/13/2021**

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

INSTRUCTIONS:

Non-automated: Mar. 4, 2008

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

Location: **NETWORK M TO UG-6 (via CB, OGS-6a, ADS CHAMBER)**

TSS Removal Calculation Worksheet

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Deep Sump and Hooded Catch Basin	0.25	1.00	0.25	0.75
Oil-Grit Seperator OGS-6b	0.25	0.75	0.19	0.56
DET. BASIN UG-6 (ADS ISOLATOR ROW)	0.80	0.56	0.45	0.11
	0.00	0.04	0.00	0.11
	0.00	0.40	0.00	0.11

Total TSS Removal = 89%

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

Project: **HANOVER**
Prepared By: **AS**
Date: **7/13/2021**

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

SECTION 5 – LONG TERM OPERATION & MAINTENANCE

LONG-TERM STORMWATER OPERATION & MAINTENANCE PLAN

HANOVER WEYMOUTH RESIDENTIAL DEVELOPMENT

1325 WASHINGTON STREET
WEYMOUTH, MA 02189
7/14/2021

PROJECT OVERVIEW:

The proposed project consists of two (2) mixed use buildings consisting of 270 residential units and 4,200 +/- SF of commercial/retail space and associated accessory garages, mail building and maintenance shed. The project also includes approximately 9,000 SF of amenity and support space with associated parking and site infrastructure on 9.8+/-acres of land on the subject property with frontage at 1325 Washington Street in Weymouth, Massachusetts. The project has been designed to comply with the Massachusetts Stormwater Management Regulations and has been designed to comply with the criteria of being considered a Land Use of Higher Potential Pollutant Loads (LUHPPL).

Appended to this document is a sample maintenance form and a chart describing the anticipated frequency of tasks.

OWNER AND RESPONSIBLE PARTY:

Current Landowners:
1317 Washington RE Holdings, LLC.
190 Old Derby Street, Suite 311
Hingham, MA 02043

Proposed Site Contractor:

To Be Determined

Future Owner:
Hanover R.S. Limited Partnership
One Marina Park Drive, Suite 701
Boston, MA 02210

CONSTRUCTION MANAGEMENT:

A construction manager with adequate knowledge and experience on projects of similar size and scope shall be employed to oversee all site work related construction. The contractor shall incorporate the appropriate techniques to control sediment and erosion pollution during construction in accordance with the *Massachusetts Erosion and Sediment Control Guidelines for Urban and Suburban Areas* and any conditions of approval from the local conservation commission.

Care should be taken when constructing stormwater control structures. Light earth-moving equipment shall be used to excavate in the vicinity of the infiltration areas. Use of heavy equipment causes excessive compaction of the soils beneath the basin resulting in reduced infiltration capacity. At no time shall temporary infiltration areas or settling basins be constructed in the vicinity of the proposed infiltration basins to prevent the soils from becoming clogged with sediment.

ON-GOING MAINTENANCE CONTRACT

The non-structural and structural approaches recommended below, as well as the required BMP maintenance, will be completed by the selected contractor. Adequate personnel with appropriate training and access to proper equipment will be available to complete the tasks. Future responsible parties must be notified of their responsibility to operate and maintain the system in perpetuity.

MAINTENANCE LOG

The Responsible Party shall develop and maintain a log of inspections, maintenance, repairs, and disposal (including location of disposal) during the life of the project. Records will be maintained for at least 3 years and be made available to the Massachusetts Department of Environmental Protection or the Town of Weymouth in accordance with the provisions of the Massachusetts Stormwater Handbook. A sample of such a maintenance log is provided.

STORMWATER BMP MAINTENANCE

The proposed stormwater management system has been designed with appropriate BMPs aimed at reducing the pollutants discharge based upon the intended use of the property. All BMPs require regular maintenance to function as intended. Some management measures have simple maintenance requirements; others are more involved. The Responsible Party must have all BMPs regularly inspected to ensure they are operating properly on an as needed basis, including during runoff events exceeding 0.5 inches of rainfall.

A description of the non-structural and structural approaches to be incorporated is indicated below. The following best management practices are proposed to be incorporated into the stormwater management design to reduce source runoff and improve stormwater runoff discharge quality. The Responsible Party will regularly inspect all BMPs to ensure they are operating properly. If any deficiencies are identified during these inspections, action to resolve it will be initiated and documented on the maintenance log.

STRUCTURAL BMPs

Deep Sump Hooded Catch Basins and Area/Yard Drains

On a regular basis the inlet pipe and outlet pipe shall be checked for debris and removed as necessary to ensure unobstructed flow of water. Inspections shall occur at least four times per year, and at the end of the foliage and snow removal seasons. Inspections shall verify the tees are secure and free flowing. Sediments must also be removed four times per year or whenever the depth of deposits is greater than or equal to one half the depth from the bottom of the invert of the lowest pipe in the basin. Basins shall be cleaned using a vacuum pump. All liquid shall be pumped from the sump of each basin at least once per year. All sediments and hydrocarbons should be properly handled and disposed of in accordance with local, state, and federal guidelines and regulations.

Subsurface Infiltration System

The subsurface system (Stormtech ADS Isolator Row Plus) has been designed with drain manholes at grade to aid in the removal of sediment and debris accumulating in the structure and inspection ports to monitor the accumulation of sediment. Preventative maintenance shall be performed in accordance with manufacturer's instructions, which is enclosed in this section. Inspection should occur monthly during the first year following installation, and then twice annually, once in the fall and then in the spring after the snow melts. Cleaning will take place at the completion of construction and as deemed necessary based on the inspections. Refer to the enclosed "StormTech Isolator Row O&M Manual."

Subsurface Detention System

The subsurface systems (Stormtech ADS Isolator Row Plus) have been designed with a combination of standard manholes and inspection ports to aid in the removal of sediment and debris. Preventative maintenance shall be performed in accordance with manufacturer's instructions, which is enclosed in this section. Stormtech suggests a minimum of annual inspections and initially the isolator row should be inspected every 6 months for the first year of operation. Cleaning will take place at the completion of construction and as deemed necessary based on the annual inspections. Stormtech recommends using a JetVac to clean and maintain the isolator row. Refer to the enclosed "Stormtech Isolator Row O&M Manual."

Proprietary Separator Water Quality Units

Water quality units shall be maintained in accordance with the manufacturer's recommendations. Refer to the enclosed "SciClone Operation and Maintenance" guide. Typically, a vacuum truck removes accumulated sediment and oil most efficiently. See maintenance documentation from the manufacturer. Inspection should occur at least twice annually, once in the fall and then in the spring after the snow melts. Ideally the unit should be checked frequently throughout the first year, and that will dictate the schedule going forward. All sediment and hydrocarbons should be properly handled and disposed of in accordance with local, state, and federal guidelines and regulations. Cleaning will take place at the completion of construction and as deemed necessary based on the inspections and manufacturer's requirements.

Oil/Grit Separators

At a minimum, oil grit separators should be inspected quarterly, and sediment, trash and pollutants shall be cleaned out at least twice per year. The oil/grit separators shall be cleaned using a vacuum pump. All sediments and hydrocarbons should be properly handled and disposed of in accordance with local, state, and federal guidelines and regulations.

Porous Pavement

The project includes a porous pavement parking lot at the rear of the development. This parking lot was selected as it is likely to receive the least number of daily trips in and out of the lot and will have no through-traffic since it is a dead-end lot with a gate for emergency access only out the back of the lot.

Included in this O&M is a copy of the Porous Asphalt Pavement for Stormwater Management guidelines which includes UNH's "Winter Maintenance Guidelines for Porous Pavement" which shall be implemented and followed as part of the required O&M of the Porous Pavement. In general, the following O&M criteria shall be performed at a minimum:

- Vacuum porous pavement quarterly (4 times per year). This is most critical after winter and fall seasons when debris accumulation and deposition is the greatest.

- If ponding water is observed during precipitation cleaning is recommended.

- See Snow Removal Section below for how to address snow removal and to address icing conditions on Porous Pavement.

NON-STRUCTURAL BMPs

Pavement Sweeping

As street sweeping is a BMP under DEP guidelines, this non-structural BMP is an effective removal of Total Suspended Solids (TSS) in a comprehensive stormwater management program. Litter and debris are to be regularly picked up and removed from the pavement. Paved areas are to be swept a minimum of quarterly per year.

Pervious Areas and Slopes

Runoff from pervious areas and slopes shall be directed over vegetated areas to promote settlement of suspended solids before entering a wetland or resource area. Steep pervious slopes will be permanently vegetated to dissipate energy and reduce potential erosion. No constructed vegetated slopes should exceed 2H:1V. Slopes exceeding 2:1 shall be stabilized with riprap, jute netting or other similar measures to minimize the potential for future erosion.

Drainage Control Structures, Flared End Sections, Trash Racks, Riprap Pads, Swales, and Level Spreader Splash Pads

Basin control structures, flared end sections, trash racks, riprap pads and level spreader splash pads shall be inspected and any debris or growth surrounding or within these structures shall be removed. Any/all debris or vegetation encroaching on the control structures or outfall components shall be removed or appropriately trimmed back to maintain the designed control elevation and flow patterns/cross section without impediment. Inspection should occur twice annually, once in the fall and then in the spring after the snow melts. Cleaning will take place at the completion of construction and as deemed necessary based on the inspections and manufacturer's requirements.

Herbicides and Pesticides

The use of traditional herbicides and pesticides within 100-feet of wetland resource areas shall be avoided to the maximum extent practical. In the event their short-term use cann porous pavemented through the Organic Materials Review Institute (OMRI) should be utilized.

Waste Management

Solid waste and recycling will be contained in dumpsters/compactors within the designated trash handling facility (shown on the plans) for routine and regular trash pickup. All residents and maintenance staff are directed to place their trash and recyclables in the appropriate bins at the trash/recycling facility provided on site.

Snow Removal

Snow removal is managed and overseen by Hanover's Facility Maintenance Personnel own in-house facility maintenance personnel. Snow removal will occur throughout the facility during every snow event to ensure safe pedestrian and vehicular access for the residents. In the event of deep snow accumulation that is greater than can be handled on site, Hanover Co. will contract to have the snow hauled from the site.

For standard pavement and sidewalks, the use of rock salt (sodium chloride) or other deicing chemicals within 100' of wetlands shall be avoided to the extent feasible. Rather, the use of organic options is preferred, such as magnesium chloride given the sensitivity of the surrounding and downstream wetland systems. Any/all de-icing chemicals shall be stored indoors and shall not be left out in the weather.

Snow on porous asphalt can be plowed the same as standard pavement, however, sunshine acts quickly to melt snow and ice sooner than on frozen standard pavement, and the melting snow infiltrates from the surface directly through the open graded porous asphalt to the stone subbase, which significantly reduces the potential for surface and black icing conditions. UNH (the region's experts on permeable pavement specifications and maintenance) advises to use an anti-icing (rather than de-icing treatments) on the permeable pavement surface (typically a brine solution which reduces the freezing point of water) prior to storms, rather than de-icing chemicals. Salt brine is typically a 23% salt/water mixture that can be applied to the surface which prevents snow and ice from bonding, and accumulated snow can be easily removed down to the pavement. Sand and other de-icing chemical applications are not recommended and should be avoided to the extent possible.

The On-Site Property Manager who will be responsible for implementing the Stormwater Management Operations and Maintenance Plan and posted signage will ensure that snowplow operators on this property apply the proper anti-icing treatment and do not apply sand as part of the winter maintenance.

Hazardous Waste and Spill Control Containment

In the event of a discharge or spill of oil or another hazardous material, outlets to stormwater management facilities immediately downstream of the spill shall be plugged so that hazardous materials do not enter the system. In the event of a discharge of oil or other hazardous material, responsible facility personnel shall notify the appropriate state agencies, the Town of Weymouth DPW and the EPA National Response Center 1-800-424-8802 shall be notified. All hazardous waste materials will be disposed of in a manner specified by local, state and/or federal regulations and by the manufacturer of such products.

Stormwater BMP Inspection and Maintenance Log

Facility Name	
Address	
Begin Date	End Date

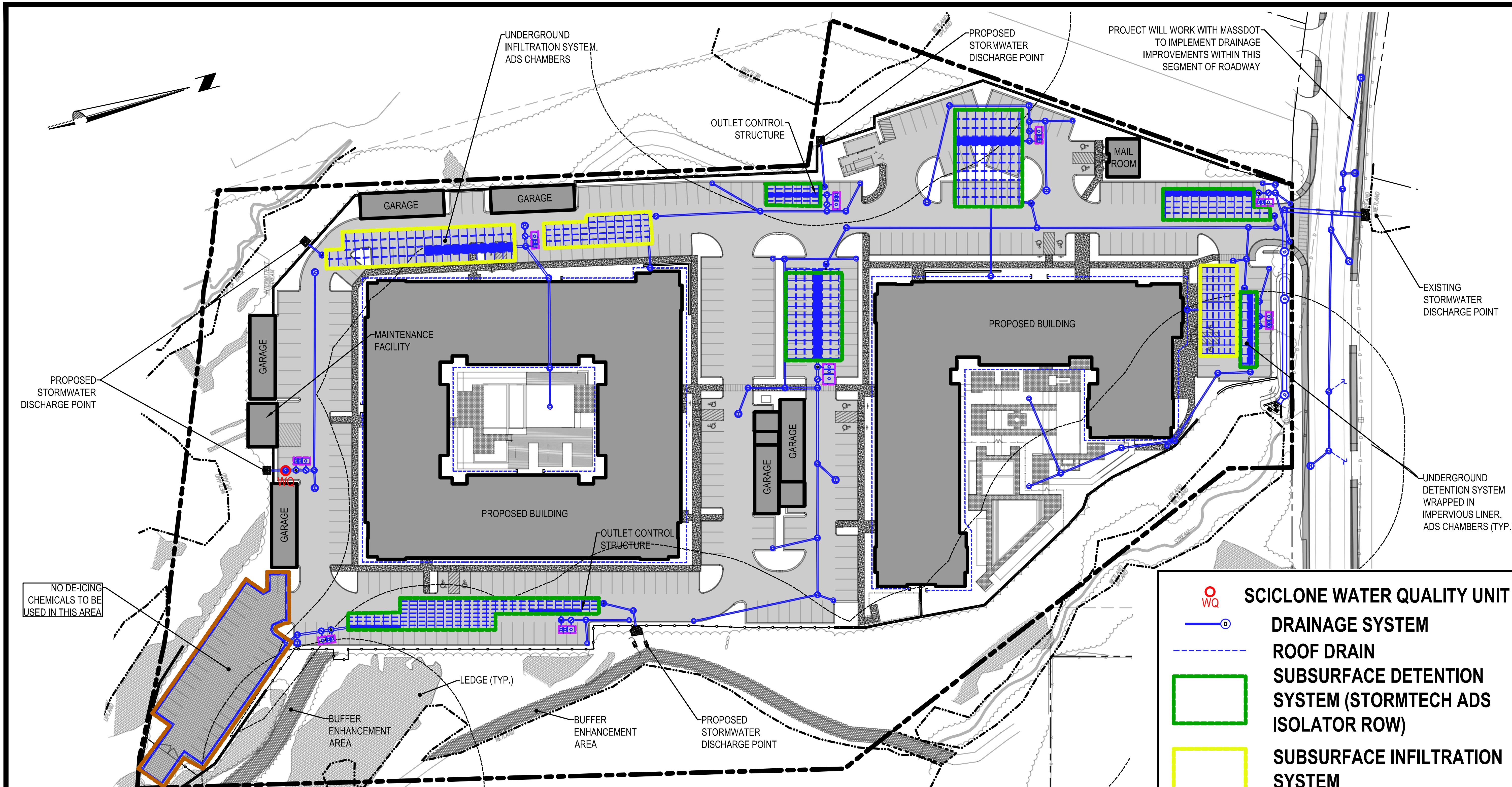
Date	BMP ID#	BMP Description	Inspected by:	Cause for Inspection	Exceptions Noted	Comments and Actions Taken

Instructions: Record all inspections and maintenance for all treatment BMPs on this form. Use additional log sheets and/or attach extended comments or documentation, as necessary. Submit a copy of the completed log with the annual independent inspectors' report to the municipality and start a new log at that time.

BMP ID# — Always use ID# from the Operation and Maintenance Manual.
Inspected by — Note all inspections and maintenance on this form, including the required independent annual inspection.
Cause for inspection — Note if the inspection is routine, pre-rainy-season, post-storm, annual, or in response to a noted problem or complaint.
Exceptions noted — Note any condition that requires correction or indicates a need for maintenance.
Comments and actions taken — Describe any maintenance done and need for follow-up.

Stormwater BMP Inspection Matrix

Conventional & LID Best Management Practices	Inspection & Maint. Frequency	Erosion& Scour	Obstructions	Trash & Debris	Sediment Build-Up Removal	Vegetation Cover	Remove/Reset Filter Fabric & Stone as Required	Vac Truck Sediment & Contaminants	Remove/Reset Riprap as Required
Pavement Sweeping	Four times per year								
Catch Basins/Area & Yard Drains	Four times per year								
Oil/Grit Separator Tanks	Four times per year								
Outlets (FES, Rip Rap Pad, Level Spreaders, vegetated swale)	Four times per year								
Proprietary Separator Water Quality Units	Four times per year								
Subsurface Infiltration Structures	Twice-Annually (Spring and Fall)								
Subsurface Detention Structures	Twice-Annually (Spring and Fall)								



OPERATION AND MAINTENANCE BMP MAP

HANOVER WEYMOUTH RESIDENTIAL DEVELOPMENT

1325 WASHINGTON STREET
WEYMOUTH, MA

80 40 0 80 160

WQ SCICLONE WATER QUALITY UNIT
DRAINAGE SYSTEM
ROOF DRAIN
SUBSURFACE DETENTION SYSTEM (STORMTECH ADS ISOLATOR ROW)
SUBSURFACE INFILTRATION SYSTEM
OIL GRIT SEPARATOR
POROUS PAVEMENT

SNOW STORAGE:

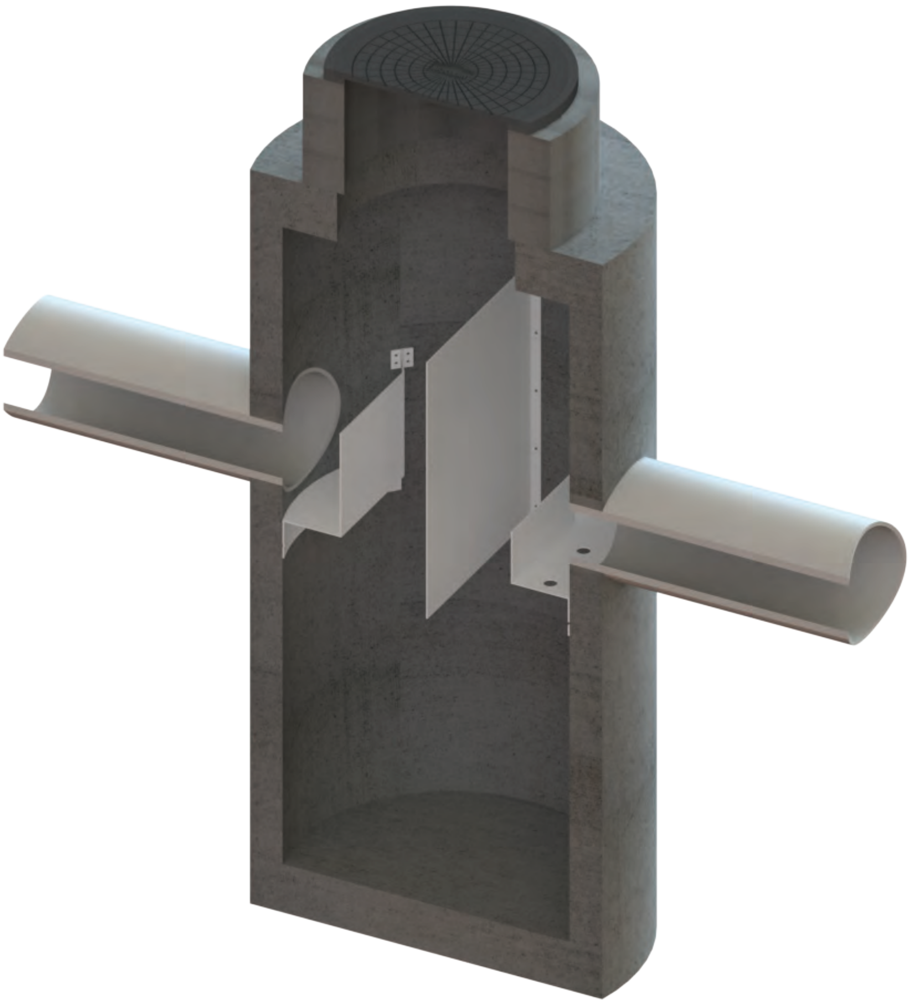
1. DRIVE AISLE TO BE PLOWED TO EACH EDGE OF PAVEMENT MAINTAINING MIN 20' WIDE ACCESS AT ALL TIMES
2. NO SNOW STORAGE SHALL OCCUR WITHIN WETLAND RESOURCE AREAS.
3. SNOW TO BE HAULED FROM SITE TO A TO-BE-DETERMINED LOCATION BY OWNER FOR REMOVAL PROCESS.

SciCLONE™

Hydrodynamic Separation

Bio Clean
A Forterra Company

OPERATION & MAINTENANCE



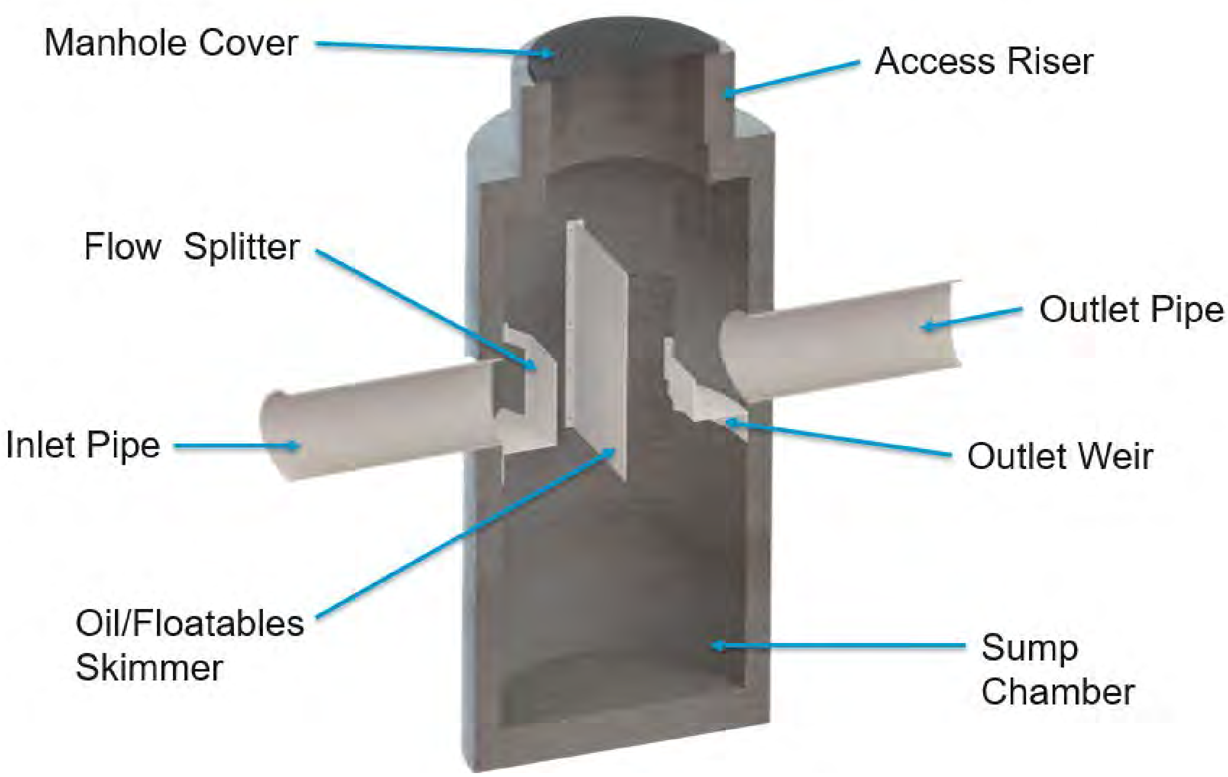
Bio Clean Environmental Services, Inc.
398 Via El Centro
Oceanside, CA 92058

www.BioCleanEnvironmental.com
p: 760.433.7640
f: 760.433.3176

OPERATION & MAINTENANCE

The SciCLONE™ Hydrodynamic Separator is designed to remove high levels of trash, debris, sediments and hydrocarbons. Its efficient design and construction maximize longevity and minimize maintenance requirements. The simple design of the system allows for unimpeded access for quick and easy maintenance. The SciCLONE™ is able to effectively capture and store sediment with no maintenance or loss of treatment capacity for a several years based on annual average loading in most regions.

Yet, as with all stormwater BMPs inspection and maintenance on the SciCLONE™ Hydrodynamic Separator is necessary. Stormwater regulations require that all BMPs be inspected and maintained to ensure they are operating as designed to allow for effective pollutant removal and provide protection to receiving water bodies. It is recommended that inspections be performed multiple times during the first year to assess site-specific loading conditions. This is recommended because pollutant loading can vary greatly from site to site. Variables such as nearby soil erosion or construction sites, winter sanding of roads, amount of daily traffic and land use can increase pollutant loading on the system. The first year of inspections can be used to set inspection and maintenance intervals for subsequent years. Without appropriate maintenance a BMP can exceed its storage capacity which can negatively affect its continued performance in removing and retaining captured pollutants.

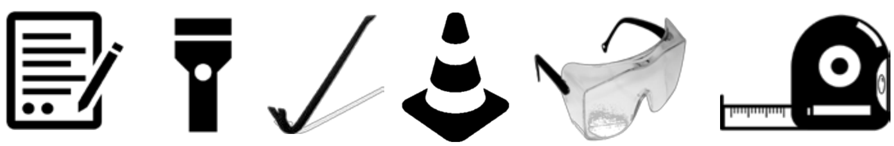


System Diagram:

Inspection Equipment

Following is a list of equipment to allow for simple and effective inspection of the SciCLONE™ Separator:

- Bio Clean Environmental Inspection Form (contained within this manual).
- Flashlight.
- Manhole hook or appropriate tools to remove access hatches and covers.
- Appropriate traffic control signage and procedures.
- Measuring pole and/or tape measure.
- Protective clothing and eye protection.
- Note: entering a confined space requires appropriate safety and certification. It is generally not required for routine inspections or maintenance of the system.



Inspection Steps

The core to any successful stormwater BMP maintenance program is routine inspections. The inspection steps required on the SciCLONE™ Separator are quick and easy. As mentioned above the first year should be seen as the maintenance interval establishment phase. During the first year more frequent inspections should occur in order to gather loading data and maintenance requirements for that specific site. This information can be used to establish a base for long-term inspection and maintenance interval requirements.

The SciCLONE™ Separator can be inspected though visual observation without entry into the system. All necessary pre-inspection steps must be carried out before inspection occurs, especially traffic control and other safety measures to protect the inspector and near-by pedestrians from any dangers associated with an open access hatch or manhole. Once these access covers have been safely opened the inspection process can proceed:

- Prepare the inspection form by writing in the necessary information including project name, location, date & time, unit number and other info (see inspection form).
- Observe the inside of the system through the access hatches. If minimal light is available and vision into the unit is impaired utilize a flashlight to see inside the system.
- Look for any out of the ordinary obstructions in the inflow pipe, sump chamber, or outflow pipe. Write down any observations on the inspection form.
- Through observation and/or digital photographs estimate the amount of floatable debris accumulated on the influent side of the oil/floatables skimmer. Record this information on the inspection form. Next utilizing a tape measure or measuring stick estimate the amount of sediment accumulated in the sump. Record this depth on the inspection form.

- Finalize inspection report for analysis by the maintenance manager to determine if maintenance is required.

Maintenance Indicators

Based upon observations made during inspection, maintenance of the system may be required based on the following indicators:

- Missing or damaged internal components.
- Obstructions in the system or its inlet or outlet.
- Excessive accumulation of floatable in the sump chambers in which the length and width of the chambers behind oil/floatables skimmer is fully impacted extending down more than 9".
- Excessive accumulation of sediment in the sump chamber of more than 18" in depth.

Maintenance Equipment

It is recommended that a vacuum truck be utilized to minimize the time required to maintain the SciCLONE™ Separator:

- Bio Clean Environmental Maintenance Form (contained in O&M Manual).
- Flashlight.
- Manhole hook or appropriate tools to access hatches and covers.
- Appropriate traffic control signage and procedures.
- Protective clothing and eye protection.
- Note: entering a confined space requires appropriate safety and certification. It is generally not required for routine maintenance of the system.
- Vacuum truck (with pressure washer attachment preferred).

Maintenance Procedures

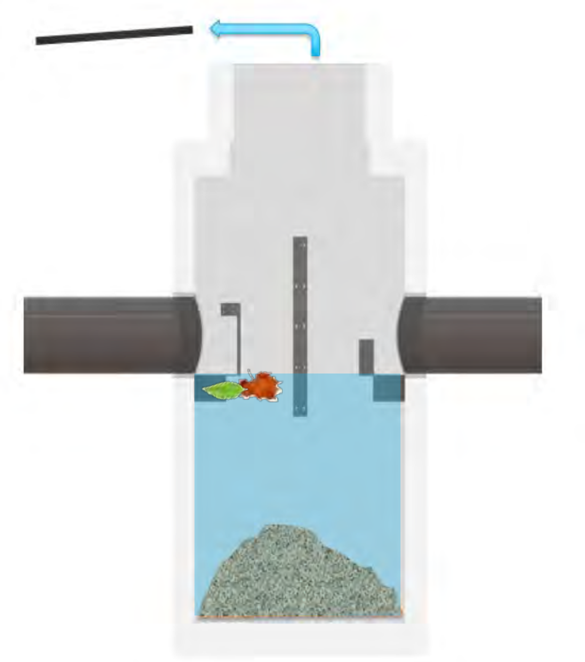
It is recommended that maintenance occurs at least three days after the most recent rain event to allow for drain down of any associated upstream detention systems. Maintaining the system while flows are still entering it will increase the time and complexity required for maintenance. Cleaning of the sump chamber can be performed from finish surface without entry into the vault utilizing a vacuum truck. Once all safety measures have been set up cleaning of the sump chamber can proceed as followed:

- Remove all access hatches (requires traffic control and safety measures to be completed prior).
- Using an extension on a vacuum truck position the hose over the opened access hatch and lower into the center of the sump chamber on the inlet side of the oil/floatables skimmer.

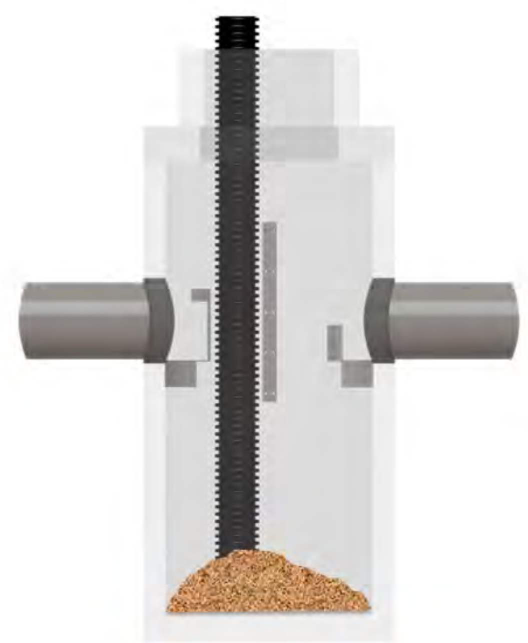
Remove all floating debris, standing water and sediment from the sump chamber. Access to the bottom of the sump chamber is unimpeded. The vac hose can be moved from side-to-side to fully remove sediments at the corners. A power washer can be used to assist if sediments have become hardened and stuck to the walls or the floor of the chamber. Repeat the same procedure on the effluent side of the oil/floatables skimmer to remove any remaining sediment. This completes the maintenance procedure required on the sump chamber and the SciCLONE™ Separator.

- The last step is to close up and replace all access hatches and remove all traffic control.
- All removed debris and pollutants shall be disposed of following local and state requirements.
- Disposal requirements for recovered pollutants may vary depending on local guidelines. In most areas the sediment, once dewatered, can be disposed of in a sanitary landfill. It is not anticipated that the sediment would be classified as hazardous waste.
- In the case of damaged components, replacement parts can be ordered by the manufacture.

Maintenance Sequence

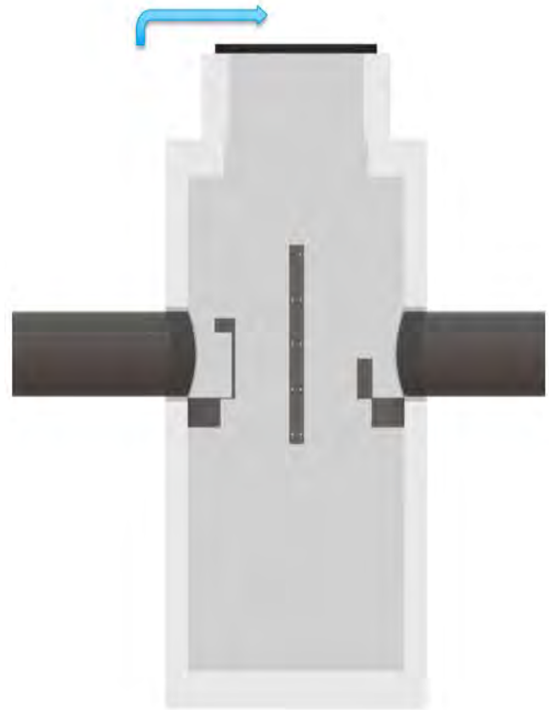


Remove Access Hatches Set Up Vacuum Truck to Clean the Sump Chamber.



Insert Vacuum Hose On the Inlet Side of the Oil/Floatables Skimmer and Vacuum Out All Trash, Sediment and Standing Water.

Insert Vacuum Hose On the Outlet Side of the Oil/Floatables Skimmer and Vacuum Out Any Remaining Sediment.



Replace Access Hatches and Remove Traffic Control and Safety Equipment.

For Maintenance Services or Information Please Contact Us At:
760-433-7640
Or Email: info@biocleanenvironmental.com

Inspection and Maintenance Report
Bio Clean SciCLONE™ Separator

Project Name ____________________

Project Address ____________________
(city) (Zip Code)

Owner / Management Company ____________________

Contact ____________________ Phone ( ) –

Inspector Name ____________________ Date ___/___/_____ Time ________ AM / PM

Type of Inspection ☐ Routine ☐ Follow Up ☐ Complaint ☐ Stor Storm Event in Last 72-hours? ☐ No ☐ Yes

Weather Condition ____________________ Additional Notes ____________________

For Office Use Only

(Reviewed By)

(Date)

Office personnel to complete section to the left.

Site Map #	GPS Coordinates of Vault	Model #	Oils and Floatables Accumilation on Inlet Side of Oil/Floatables Skimmers (lbs)	Sediment Accumulation In Sump Chamber (lbs) & Depth (inches)	Structural Notes	Operational Per Manufactures' Specifications (If not, why?)
	Lat: Long:					
	Lat: Long:					
	Lat: Long:					

Comments:

StormTech®
Detention • Retention • Water Quality
An ADS company

Isolator® Row O&M Manual

THE MOST **ADVANCED** NAME IN WATER MANAGEMENT SOLUTIONS™

THE ISOLATOR® ROW

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

THE ISOLATOR ROW
The Isolator Row is a row of StormTech chambers, either SC-160LP, SC-310, SC-310-3, SC-740, DC-780, MC-3500 or MC-4500 models, that is surrounded with filter fabric and connected to a closely located manhole for easy access. The fabric-wrapped chambers provide for settling and filtration of sediment as storm water rises in the Isolator Row and ultimately passes through the filter fabric. The open bottom chambers and perforated sidewalls (SC-310, SC- 310-3 and SC-740 models) allow storm water to flow both vertically and horizontally out of the chambers. Sediments are captured in the Isolator Row protecting the storage areas of the adjacent stone and chambers from sediment accumulation.

Two different fabrics are used for the Isolator Row. A woven geotextile fabric is placed between the stone and the Isolator Row chambers. The tough geotextile provides a media for storm water filtration and provides a durable surface for maintenance operations. It is also designed to prevent scour of the underlying stone and remain intact during high pressure jetting. A non-woven fabric is placed over the chambers to provide a filter media for flows passing through the perforations in the sidewall of the chamber. The non-woven fabric is not required over the SC-160LP, DC-780, MC-3500 or MC-4500 models as these chambers do not have perforated side walls.

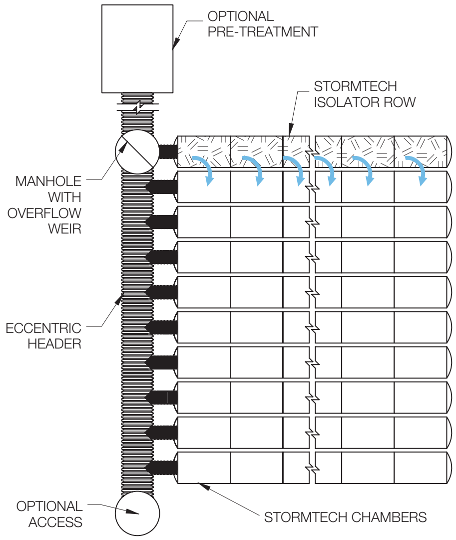
The Isolator Row is typically designed to capture the “first flush” and offers the versatility to be sized on a volume basis or flow rate basis. An upstream manhole not only provides access to the Isolator Row but typically includes a high flow weir such that storm water flowrates or volumes that exceed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

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

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

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

StormTech Isolator Row with Overflow Spillway (not to scale)



ISOLATOR ROW INSPECTION/MAINTENANCE

INSPECTION

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

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

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

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

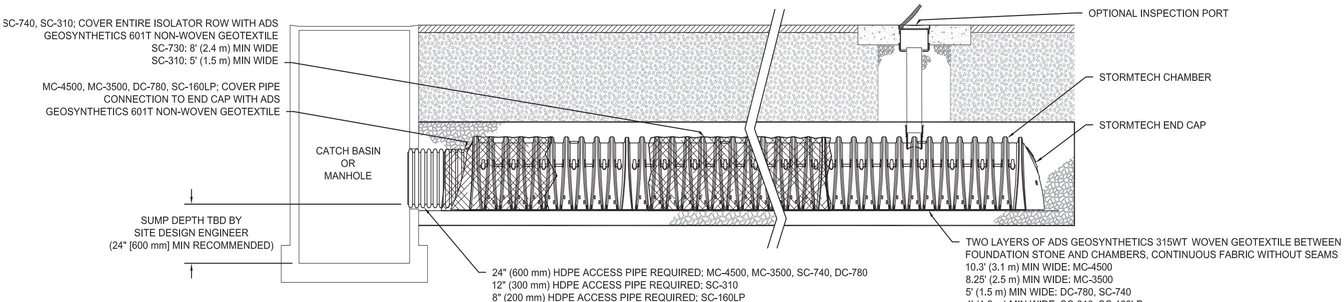
MAINTENANCE

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

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

StormTech Isolator Row (not to scale)

Note: Non-woven fabric is only required over the inlet pipe connection into the end cap for SC-160LP, DC-780, MC-3500 and MC-4500 chamber models and is not required over the entire Isolator Row.



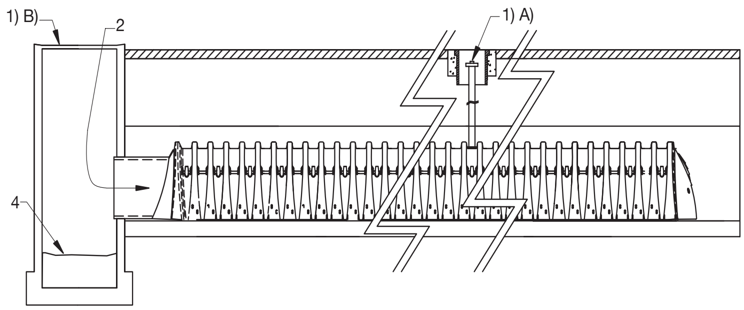
ISOLATOR ROW STEP BY STEP MAINTENANCE PROCEDURES

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

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

STEP 3
Replace all caps, lids and covers, record observations and actions.

STEP 4
Inspect & clean catch basins and manholes upstream of the StormTech system.



SAMPLE MAINTENANCE LOG

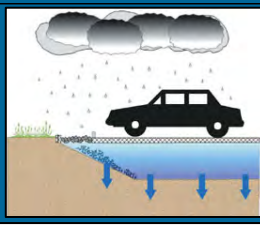
Date	Stadia Rod Readings: Fixed point to chamber bottom (1)	Stadia Rod Readings: Fixed point to top of sediment (2)	Sediment Depth (1)–(2)	Observations/Actions	Inspector
3/15/11	6.3 ft	none		New installation. Fixed point is CI frame at grade	DJM
9/24/11		6.2	0.1 ft	Some grit felt	SM
6/20/13		5.8	0.5 ft	Mucky feel, debris visible in manhole and in Isolator Row, maintenance due	NV
7/7/13	6.3 ft		0	System jetted and vacuumed	DJM

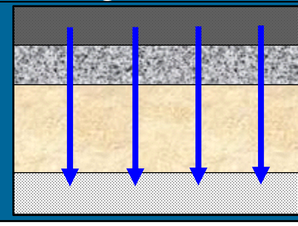
StormTech® Detention • Retention • Water Quality
A division of ADS

Advanced Drainage Systems, Inc.
4640 Trueman Blvd., Hilliard, OH 43026
1-800-821-6710 www.ads-pipe.com

Porous Asphalt Pavement for Stormwater Management

The UNH Stormwater Center — Web: www.unh.edu/erg/cstev/





Benefits and Uses

Porous Asphalt can be used in replace of traditional stormwater management measures given the proper conditions. Porous Asphalt's primary advantages are:

1. Quantity and Flood Control
2. Water Quality Treatment
3. Recharges Groundwater to Underlying Aquifers
4. Allows for Reduction of Stormwater Infrastructure (Piping, Catch-Basins, Retention Ponds, Curbing, etc.)
5. Suitable for Cold-Climate Applications, Maintains Recharge Capacity When Frozen
6. Allows for Reduced Salt and Sand Usage Due to Low/No Black Ice Development
7. Maintains Traction While Wet
8. Reduced Spray from Traveling Vehicles, Reduced Roadway Noise
9. Extended Pavement Life Due to Well Drained Base and Reduced Freeze-Thaw

Disadvantages

- Requires Routine (Quarterly) Vacuum Sweeping (Vac-Assisted Dry Sweeper Only)
- Proper Construction Stabilization and Erosion Control are Required to Prevent Clogging
- Quality Control for Material Production and Installation are Essential for Success
- Accidental Seal-Coating or Similar Surface Treatment Will Cause Failure

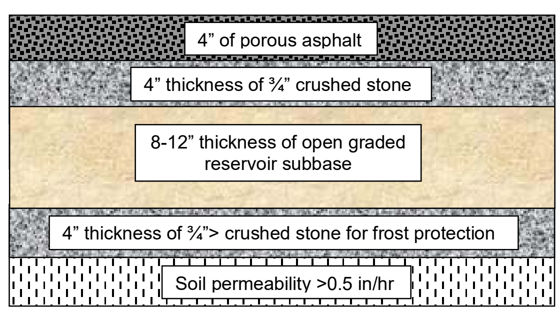
Cost & Maintenance

- Total Project Cost is Comparable for Porous Asphalt with Reduced Stormwater Infrastructure VS. Standard Pavement Applications where Stormwater Infrastructure is Required
- Materials Cost is ~20-25% More Than Traditional Asphalt
- Long-term Maintenance is Required by Routine Quarterly Vacuum Sweeping
- Sweeping Cost May Be Off-set by Reduced Deicing Costs
- Repairs Can be Made with Standard Asphalt Not to Exceed 10% of Surface Area

Design Criteria

- Soil Permeability is Recommended Between 0.25-3.0 Inches Per Hour
- Recommended Drainage Time of 24-48 Hours
- Sub-Drains Should be Used Where Proper Drainage May be an Issue to Minimize Frost Damage
- Most Appropriate for use with Low-Use Roadways and Parking Lots—Without a Modified Asphalt Binder
- 3-5 Feet of Vertical Separation is Needed from Seasonal High Groundwater

TYPICAL POROUS ASPHALT CROSS-SECTION



Additional Resources

- The UNH Stormwater Center, Porous Asphalt Specs - General Porous Bituminous Paving and Groundwater Infiltration Beds, http://www.unh.edu/erg/cstev/
- Federal Highway Administration (2006) Porous Pavement Fact Sheet http://www.fhwa.dot.gov/environment/ultraurb/3fs15.htm
- Ferguson, B. (2005), Porous Pavements, CRC Press.
- Porous Asphalt Pavements (2004) Information Series 131. The National Asphalt Pavement Association, Lanham, MD.

Winter Maintenance Guidelines for Porous Pavements





Maintenance Guidelines

- Road surfaces, porous and non-porous, are commonly not treated and plowed until 2 or more inches of snow accumulation.
- Plow after every storm. If possible plow with a slightly raised blade, while not necessary, this will help prevent pavement scarring.
- Up to ~75% salt reduction for porous asphalt can be achieved. Salt reduction amounts are site specific and are affected by degree of shading.

  USE SALT REDUCTION NUMBERS WITH CAUTION!!!
- Pervious concrete salt reduction will vary and is heavily dependent upon shading. For shaded areas, pervious concrete may not achieve salt reduction.
- Apply anti-icing treatments prior to storms. Anti-icing has the potential to provide the benefit of increased traffic safety at the lowest cost and with less environmental impact.
- Deicing is NOT required for black ice development. Meltwater readily drains through porous surfaces thereby preventing black ice.
- Apply deicing treatments during, and after storms as necessary to control compact snow and ice not removed by plowing.
- Sand application should be limited since its use will increase the need for vacuuming
- Vacuum porous areas a minimum of 2-4 times per year, especially after winter and fall seasons when debris accumulation and deposition is greatest.
- If ponding water is observed during precipitation cleaning is recommended.

Winter Maintenance Challenges

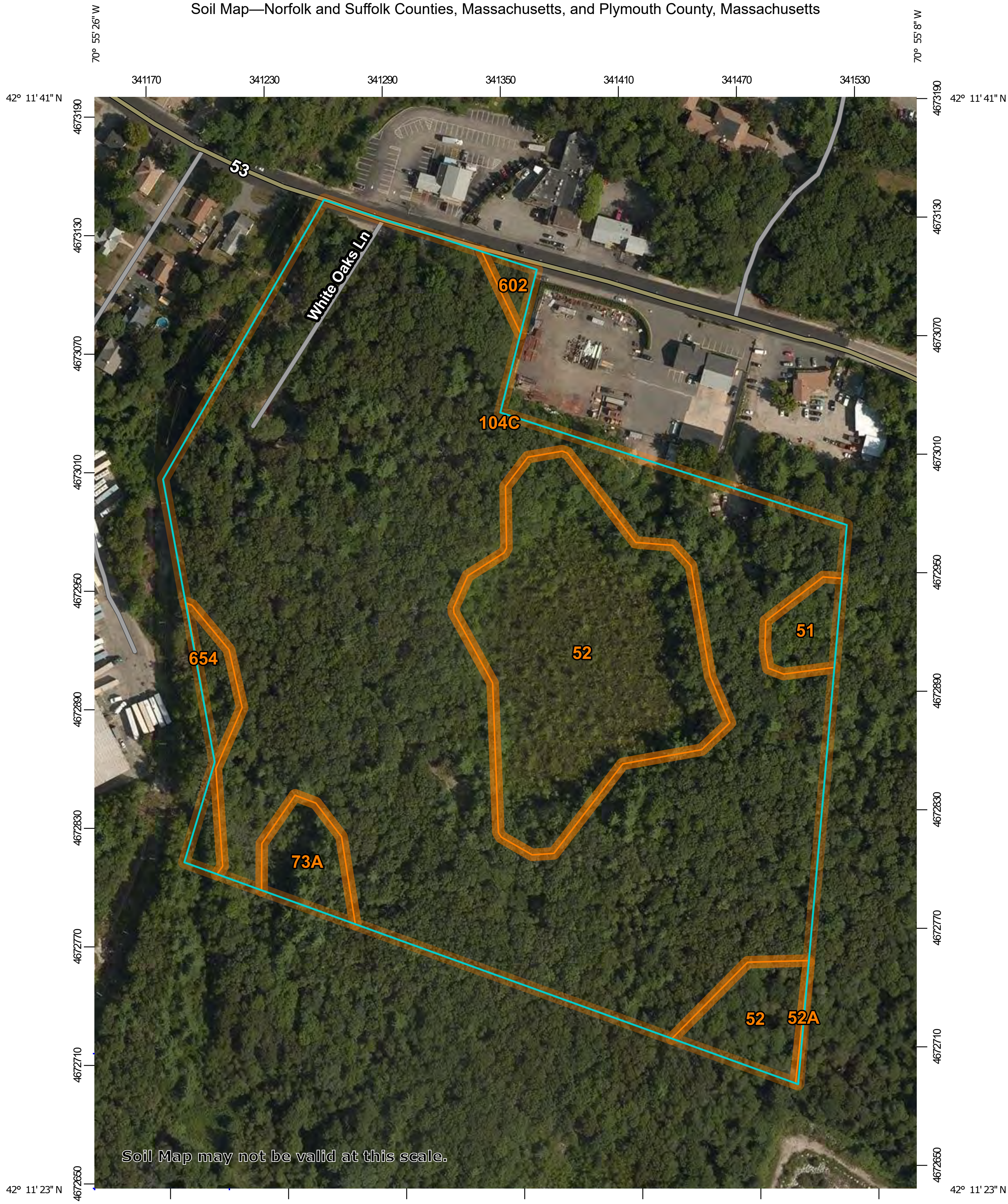
- Mixed precipitation and compact snow or ice is problematic for all paved surfaces, but is particularly problematic for porous surfaces. This is corrected by application of excess deicing chemicals.
- De-icing chemicals work by lowering the freezing point of water. Generally, the longer a de-icing chemical has to react, the greater the amount of melting. Meltwater readily drains through porous surfaces thereby reducing chemical contact time. This is corrected by excess salt application.
- Excess salt application in these instances is offset by the overall reduced salt during routine winter maintenance and salt reduction.

Additional Resources

- The UNH Stormwater Center: http://www.unh.edu/erg/cstev/
- Pennsylvania Asphalt Pavement Association (PAPA) Porous Asphalt Pavements Guide: http://www.pahotmix.org/PDF/porous1.pdf
- National Asphalt Pavement Association (NAPA) Porous Asphalt Pavements for Stormwater Management Revised 11/2008, Information Series 131

SECTION 6 – SOILS TESTING DATA

Soil Map—Norfolk and Suffolk Counties, Massachusetts, and Plymouth County, Massachusetts



Map Scale: 1:2,690 if printed on A portrait (8.5" x 11") sheet.

Meters: 0, 35, 70, 140, 210

Feet: 0, 100, 200, 400, 600

N

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

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Unit Polygons

Soil Map Unit Lines

Soil Map Unit Points

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at scales ranging from 1:12,000 to 1:25,000.

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

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

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

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

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

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

Soil Survey Area: Norfolk and Suffolk Counties, Massachusetts
Survey Area Data: Version 16, Jun 11, 2020

Soil Survey Area: Plymouth County, Massachusetts
Survey Area Data: Version 13, Jun 9, 2020

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

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

Date(s) aerial images were photographed: Aug 26, 2014—Sep 4, 2014

MAP LEGEND

MAP INFORMATION

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
51	Swansea muck, 0 to 1 percent slopes	0.4	1.4%
52	Freetown muck, 0 to 1 percent slopes	4.8	19.2%
73A	Whitman fine sandy loam, 0 to 3 percent slopes, extremely stony	0.5	2.0%
104C	Hollis-Rock outcrop-Charlton complex, 0 to 15 percent slopes	18.7	75.2%
602	Urban land, 0 to 15 percent slopes	0.1	0.5%
654	Udorthents, loamy	0.4	1.6%
Subtotals for Soil Survey Area		**24.8**	**100.0%**
Totals for Area of Interest		**24.8**	**100.0%**

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
52A	Freetown muck, 0 to 1 percent slopes	0.0	0.0%
Subtotals for Soil Survey Area		**0.0**	**0.0%**
Totals for Area of Interest		**24.8**	**100.0%**

Norfolk and Suffolk Counties, Massachusetts

602—Urban land, 0 to 15 percent slopes

Map Unit Setting

National map unit symbol: vkyj
Mean annual precipitation: 32 to 50 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 120 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 99 percent
Minor components: 1 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Urban Land

Setting

Parent material: Excavated and filled land

Minor Components

Rock outcrops

Percent of map unit: 1 percent
Hydric soil rating: Unranked

Data Source Information

Soil Survey Area: Norfolk and Suffolk Counties, Massachusetts
Survey Area Data: Version 16, Jun 11, 2020

Soil Survey Area: Plymouth County, Massachusetts
Survey Area Data: Version 13, Jun 9, 2020

Norfolk and Suffolk Counties, Massachusetts

104C—Hollis-Rock outcrop-Charlton complex, 0 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2w69p
Elevation: 0 to 1,270 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

Hollis, extremely stony, and similar soils: 35 percent
Charlton, extremely stony, and similar soils: 25 percent
Rock outcrop: 25 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hollis, Extremely Stony

Setting

Landform: Hills, ridges
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Crest, side slope, nose slope
Down-slope shape: Convex
Across-slope shape: Linear, convex
Parent material: Coarse-loamy melt-out till derived from granite, gneiss, and/or schist

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
A - 2 to 7 inches: gravelly fine sandy loam
Bw - 7 to 16 inches: gravelly fine sandy loam
2R - 16 to 26 inches: bedrock

Properties and qualities

Slope: 0 to 15 percent
Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: 8 to 23 inches to lithic bedrock
Drainage class: Somewhat excessively drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water capacity: Very low (about 2.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Ecological site: F144AY033MA - Shallow Dry Till Uplands
Hydric soil rating: No

Description of Charlton, Extremely Stony

Setting

Landform: Ridges, hills
Landform position (two-dimensional): Summit, backslope, shoulder
Landform position (three-dimensional): Crest, side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Parent material: Coarse-loamy melt-out till derived from granite, gneiss, and/or schist

Typical profile

Oe - 0 to 2 inches: moderately decomposed plant material
A - 2 to 4 inches: fine sandy loam
Bw - 4 to 27 inches: gravelly fine sandy loam
C - 27 to 65 inches: gravelly fine sandy loam

Properties and qualities

Slope: 0 to 15 percent
Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water capacity: Moderate (about 8.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: B
Ecological site: F144AY034CT - Well Drained Till Uplands
Hydric soil rating: No

Description of Rock Outcrop

Setting

Landform: Hills, ridges
Parent material: Igneous and metamorphic rock

Typical profile

R - 0 to 79 inches: bedrock

Properties and qualities

Slope: 0 to 15 percent
Depth to restrictive feature: 0 inches to lithic bedrock
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Available water capacity: Very low (about 0.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Canton, extremely stony

Percent of map unit: 7 percent
Landform: Ridges, hills, moraines
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex, linear
Across-slope shape: Convex
Hydric soil rating: No

Chatfield, extremely stony

Percent of map unit: 6 percent
Landform: Hills, ridges
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Crest, side slope, nose slope
Down-slope shape: Convex
Across-slope shape: Linear, convex
Hydric soil rating: No

Montauk, extremely stony

Percent of map unit: 1 percent
Landform: Drumlins, ground moraines, recessionial moraines, hills
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Scituate, extremely stony

Percent of map unit: 1 percent
Landform: Ground moraines, drumlins, hills
Landform position (two-dimensional): Footslope, backslope, summit
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear, convex
Across-slope shape: Convex

Hydric soil rating: No

Data Source Information

Soil Survey Area: Norfolk and Suffolk Counties, Massachusetts
Survey Area Data: Version 16, Jun 11, 2020

Soil Survey Area: Plymouth County, Massachusetts
Survey Area Data: Version 13, Jun 9, 2020

Norfolk and Suffolk Counties, Massachusetts

51—Swansea muck, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2trl2
Elevation: 0 to 1,140 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

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

Description of Swansea

Setting

Landform: Bogs, swamps
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Highly decomposed organic material over loose sandy and gravelly glaciofluvial deposits

Typical profile

Oa1 - 0 to 24 inches: muck
Oa2 - 24 to 34 inches: muck
Cg - 34 to 79 inches: coarse sand

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: Rare
Frequency of ponding: Frequent
Available water capacity: Very high (about 16.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8w
Hydrologic Soil Group: B/D
Ecological site: F144AY043MA - Acidic Organic Wetlands
Hydric soil rating: Yes

Minor Components

Freetown

Percent of map unit: 10 percent
Landform: Swamps, bogs
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Whitman

Percent of map unit: 5 percent
Landform: Depressions, drainageways
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Scarboro

Percent of map unit: 5 percent
Landform: Depressions, drainageways
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: Norfolk and Suffolk Counties, Massachusetts
Survey Area Data: Version 16, Jun 11, 2020

Soil Survey Area: Plymouth County, Massachusetts
Survey Area Data: Version 13, Jun 9, 2020

Norfolk and Suffolk Counties, Massachusetts

52—Freetown muck, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2t2q9
Elevation: 0 to 1,110 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

Freetown and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Freetown

Setting

Landform: Marshes, kettles, swamps, depressions, depressions, bogs
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Highly decomposed organic material

Typical profile

Oe - 0 to 2 inches: mucky peat
Oa - 2 to 79 inches: muck

Properties and qualities

Slope: 0 to 1 percent
Surface area covered with cobbles, stones or boulders: 0.0 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: Rare
Frequency of ponding: Frequent
Available water capacity: Very high (about 19.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: B/D
Ecological site: F144AY043MA - Acidic Organic Wetlands
Hydric soil rating: Yes

Minor Components

Swansea

Percent of map unit: 5 percent
Landform: Marshes, swamps, bogs, kettles, depressions, depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Scarboro

Percent of map unit: 5 percent
Landform: Depressions, drainageways
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Whitman

Percent of map unit: 5 percent
Landform: Drainageways, depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: Norfolk and Suffolk Counties, Massachusetts
Survey Area Data: Version 16, Jun 11, 2020

Soil Survey Area: Plymouth County, Massachusetts
Survey Area Data: Version 13, Jun 9, 2020

Norfolk and Suffolk Counties, Massachusetts

73A—Whitman fine sandy loam, 0 to 3 percent slopes, extremely stony

Map Unit Setting

National map unit symbol: 2w695
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

Whitman, extremely stony, and similar soils: 81 percent
Minor components: 19 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Whitman, Extremely Stony

Setting

Landform: Drainageways, hills, ground moraines, drumlins, depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Oi - 0 to 1 inches: peat
A - 1 to 10 inches: fine sandy loam
Bg - 10 to 17 inches: gravelly fine sandy loam
Cdg - 17 to 61 inches: fine sandy loam

Properties and qualities

Slope: 0 to 3 percent
Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: 7 to 38 inches to densic material
Drainage class: Very poorly drained
Runoff class: Negligible
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 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water capacity: Low (about 3.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Ecological site: F144AY041MA - Very Wet Till Depressions
Hydric soil rating: Yes

Minor Components

Ridgebury, extremely stony

Percent of map unit: 10 percent
Landform: Drumlins, drainageways, hills, ground moraines, depressions
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Base slope, head slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Scarboro

Percent of map unit: 5 percent
Landform: Depressions, drainageways, outwash deltas, outwash terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Swansea

Percent of map unit: 3 percent
Landform: Marshes, swamps, bogs
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Woodbridge, extremely stony

Percent of map unit: 1 percent
Landform: Drumlins, hills, ground moraines
Landform position (two-dimensional): Backslope, footslope, summit
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Data Source Information

Soil Survey Area: Norfolk and Suffolk Counties, Massachusetts
Survey Area Data: Version 16, Jun 11, 2020

Soil Survey Area: Plymouth County, Massachusetts
Survey Area Data: Version 13, Jun 9, 2020

Norfolk and Suffolk Counties, Massachusetts

654—Udorthents, loamy

Map Unit Setting

National map unit symbol: vkyb
Elevation: 0 to 3,000 feet
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Udorthents

Setting

Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Tread, riser
Down-slope shape: Linear, convex
Across-slope shape: Linear, convex
Parent material: Excavated and filled coarse-loamy human transported material

Typical profile

H1 - 0 to 6 inches: variable
H2 - 6 to 60 inches: variable

Properties and qualities

Slope: 0 to 25 percent
Depth to restrictive feature: More than 80 inches
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to very high (0.06 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Hydric soil rating: Unranked

Minor Components

Udorthents,sandy

Percent of map unit: 8 percent
Hydric soil rating: Unranked

Udorthents,wet substr.

Percent of map unit: 8 percent
Hydric soil rating: Unranked

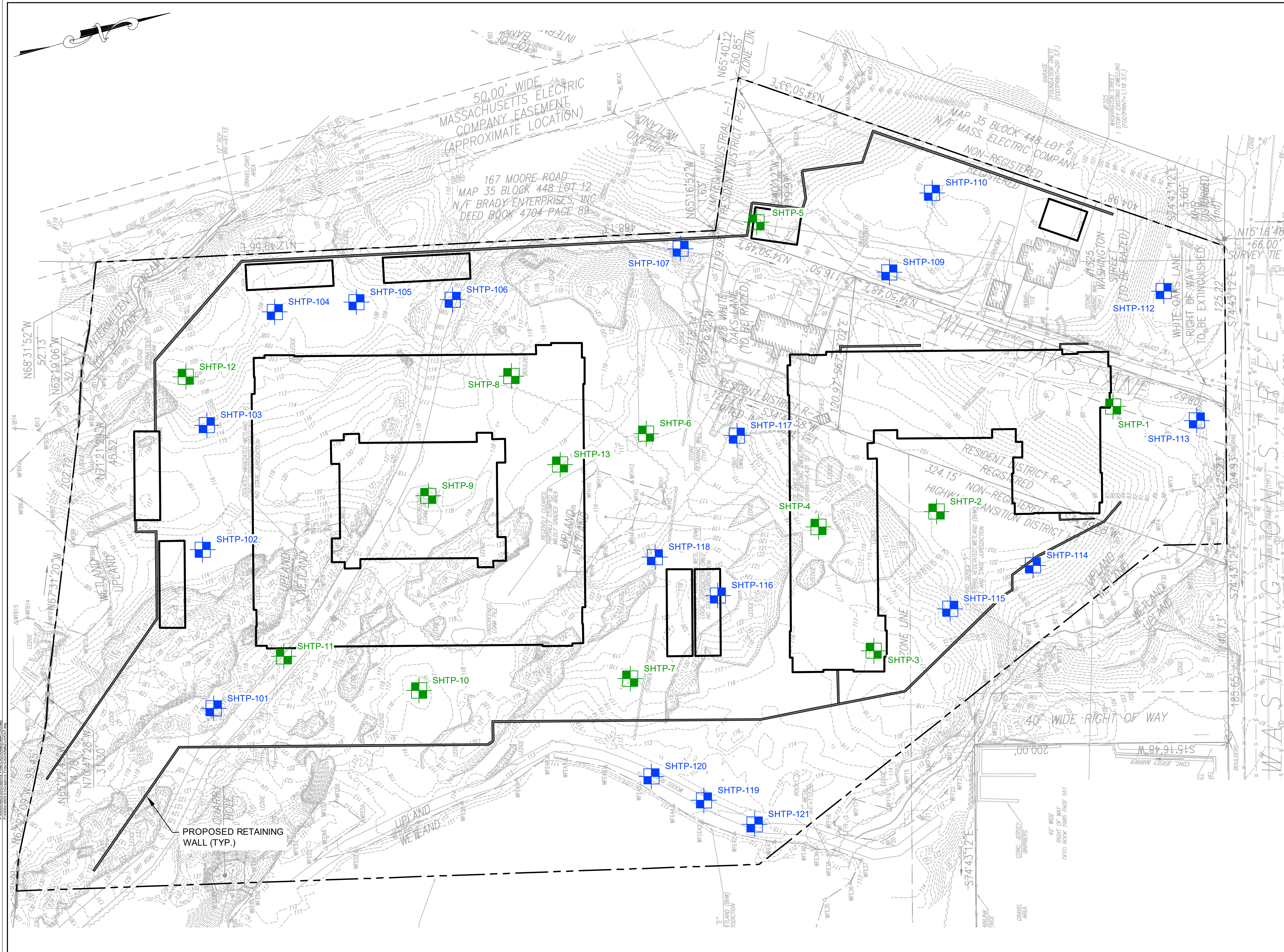
Urban land

Percent of map unit: 4 percent
Hydric soil rating: Unranked

Data Source Information

Soil Survey Area: Norfolk and Suffolk Counties, Massachusetts
Survey Area Data: Version 16, Jun 11, 2020

Soil Survey Area: Plymouth County, Massachusetts
Survey Area Data: Version 13, Jun 9, 2020



NOTES:

1. THE BASE TOPOGRAPHIC MAP WAS DRAWN FROM AN ELECTRONIC FILE ENTITLED, "EC 1-12-21.DWG", BY CROCKER DESIGN GROUP (CDG) OF HINGHAM, MA, PROVIDED ON FEBRUARY 10, 2021.
2. THE PROPOSED SITE FEATURES WERE DRAWN FROM A PLAN TITLED, "GRADING CONCEPT PLAN", SHEET GP-4, DATED JANUARY 12, 2021 AND RECEIVED FROM CDG ON FEBRUARY 10, 2021 WITH AN ORIGINAL SCALE OF 1" = 50'
3. TEST PITS DESIGNATED SHTP-1 THROUGH SHTP-13 WERE EXCAVATED BY J.F. PRICE CO., INC. (J.F. PRICE) OF HINGHAM, MA AND OBSERVED BY SANBORN HEAD ON NOVEMBER 12, 2020.
4. TEST PITS DESIGNATED SHTP-101 THROUGH SHTP-121 WERE EXCAVATED BY J.F. PRICE AND OBSERVED BY SANBORN HEAD BETWEEN FEBRUARY 24 AND 26, 2021. SHTP-108 AND SHTP-111 WERE NOT EXCAVATED DUE TO NEARBY ACTIVE UTILITIES.
5. APPROXIMATE LOCATIONS OF THE SHTP-1 SERIES EXPLORATIONS ARE BASED ON TAPED MEASUREMENTS MADE IN THE FIELD RELATIVE TO PROMINENT SITE FEATURES. TEST PITS DESIGNATED THE SHTP-100 SERIES EXPLORATIONS WERE SURVEYED IN THE FIELD BY CDG. THIS DATA SHOULD BE CONSIDERED ACCURATE ONLY TO THE DEGREE IMPLIED BY THE METHOD USED.

LEGEND:

APPROXIMATE SITE BOUNDARY

SHTP-101 APPROXIMATE LOCATION AND DESIGNATION OF TEST PIT OBSERVED BY SANBORN HEAD (FEBRUARY 2021)

SHTP-1 APPROXIMATE LOCATION AND DESIGNATION OF TEST PIT OBSERVED BY SANBORN HEAD (NOVEMBER 2020)

SANBORN HEAD

GRAPHICAL SCALE
40' 20' 0' 40' 80'

NO.	DATE	DESCRIPTION	BY

DRAWN BY: C.DIAS
DESIGNED BY: M.RUBERTI
REVIEWED BY: L.NORTON
PROJECT MGR: L.NORTON
PIC: V.KOKOSA
DATE: APRIL 2021

STORMWATER INFILTRATION DATA REPORT
HANOVER AT WEYMOUTH
WEYMOUTH, MASSACHUSETTS

EXPLORATION LOCATION PLAN

PROJECT NUMBER: 4905.01

SHEET NUMBER: 2

SANBORN | HEAD

Sanborn, Head & Associates, Inc.

Project: White Oaks Lane
Location: Weymouth, MA
Project No.: 4905.00

Test Pit No. SHTP-1

Ground Elevation: 88 ± feet Revised in March 2021
Datum: Project Datum

Date: 11/12/20
Time Started: 14:00
Time Finished: 14:20

Logged By: C. Disenhof
Checked By: V. Kokosa

Weather: Overcast, 50°F

Excavation Equipment

Contractor: J. F. Price, Co.
Operator: G. Fennessey
Reach: 20 ft

Make: CAT
Model: 315L
Bucket Capacity: 0.5 CY

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Test Pit	Stab. Time
11/12/20	14:12	7.8'	Ground Surface	8'	None

Depth (ft)	Field Testing Data	Strata Depth (ft)	Geologic Description	Strata Depth (ft)	Excv. Effort	Boulder Qty & Class	Remarks
0		0	Black, SILT and Sand, common Roots, common Leaves, few Organic particles. Moist. TOPSOIL with Leaf Mat.	0	E		
		0.5	Gray/brown, fine to coarse SAND, little Gravel, little Silt, common Roots, few Cobbles. Moist. SUBSOIL.	0.5			
2							
		3	Gray, fine to coarse SAND, numerous Cobbles, some Gravel, trace Silt. Moist.	3			
4		4.5	Gray, fine to coarse SAND, trace Gravel, trace Silt. Moist to wet.	4.5			
6							
8		8	Test pit terminated at 8 feet due to repeated collapse due to groundwater.	8			
10							
12							
14							
16							
18							
20							

Excavation Effort

E	Easy
M	Moderate
D	Difficult

Boulder Size Classification

12" - 24"	A
24" - 36"	B
36" and larger	C

Soil Description
Minor Component Proportions

trace	0 - 10%
little	10 - 20%
some	20 - 35%
and	35 - 50%

Test Pit Plan

4'
10'

North Arrow

Sheet: 1 of 1

SANBORN HEAD

Sanborn, Head & Associates, Inc.

Project: White Oaks Lane
Location: Weymouth, MA
Project No.: 4905.00

Test Pit No. SHTP-2

Ground Elevation: 104 ± feet Revised in March 2021
Datum: Project Datum

Date: 11/12/20
Time Started: 12:50
Time Finished: 13:15

Logged By: C. Disenhof
Checked By: V. Kokosa

Weather: Drizzle, 50°F

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Test Pit	Stab. Time
11/12/20	---	No Groundwater Observed			

Excavation Equipment

Contractor: J. F. Price, Co.
Operator: G. Fennessey
Reach: 20 ft

Make: CAT
Model: 315L
Bucket Capacity: 0.5 CY

Depth (ft)	Field Testing Data	Strata Depth (ft)	Geologic Description	Strata Depth (ft)	Excv. Effort	Boulder Qty & Class	Remarks
0		0	Forest Mat.	0	E		
		0.3	Brown, fine to coarse SAND, some Silt, trace Gravel. Moist. SUBSOIL.	0.3			
2		2	Gray, fine to coarse SAND, numerous Cobbles, some Gravel, trace Silt. Moist.	2			
4							
6							
		7.5	Gray, fine to coarse SAND, little Gravel, trace Silt, few Cobbles. Moist.	7.5			
8							
10							
		11.7	Test pit terminated at 11.7 feet due to repeated collapse.	11.7			
12							
14							
16							
18							
20							

Excavation Effort

E	Easy
M	Moderate
D	Difficult

Boulder Size Classification

12" - 24"	A
24" - 36"	B
36" and larger	C

Soil Description
Minor Component Proportions

trace	0 - 10%
little	10 - 20%
some	20 - 35%
and	35 - 50%

Test Pit Plan

5'
12'

North Arrow

SANBORN HEAD

Sanborn, Head & Associates, Inc.

Project: White Oaks Lane
Location: Weymouth, MA
Project No.: 4905.00

Test Pit No. SHTP-3

Ground Elevation: 117 ± feet Revised in March 2021
Datum: Project Datum

Date: 11/12/20
Time Started: 13:35
Time Finished: 13:45

Logged By: C. Disenhof
Checked By: V. Kokosa

Weather: Overcast, 50°F

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Test Pit	Stab. Time
11/12/20	---	No Groundwater Observed			

Excavation Equipment

Contractor: J. F. Price, Co.
Operator: G. Fennessey
Reach: 20 ft

Make: CAT
Model: 315L
Bucket Capacity: 0.5 CY

Depth (ft)	Field Testing Data	Strata Depth (ft)	Geologic Description	Strata Depth (ft)	Excv. Effort	Boulder Qty & Class	Remarks
0		0 0.4	Black, SILT and Sand, common Roots, common Leaves, few Organic particles. Moist. TOPSOIL with Leaf Mat.	0 0.4			
			Brown, SILT and Sand, little Cobbles, trace Gravel, few Roots. Moist. SUBSOIL.				
2		2.3	Gray/brown, fine to coarse SAND, little Silt, little Gravel. Moist. GLACIAL TILL.	2.3	E	1A 1B	Redoximorphic mottling observed in the till.
4		4 4.5	Test pit terminated between 4 to 4.5 feet due to refusal on bedrock.	4 4.5			
6							
8							
10							
12							
14							
16							
18							
20							

TEST PIT P:\4900S\4905.00\WORK\LOGS\4905.00 LOGS.GPJ 2017 SANBORN HEAD V1.GLB 2010 SANBORN HEAD V2.GDT 3/12/21

Excavation Effort

E	Easy
M	Moderate
D	Difficult

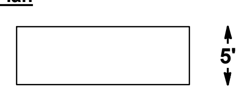
Boulder Size Classification

12" - 24"	A
24" - 36"	B
36" and larger	C

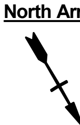
Soil Description Minor Component Proportions

trace	0 - 10%
little	10 - 20%
some	20 - 35%
and	35 - 50%

Test Pit Plan



North Arrow



SANBORN HEAD

Sanborn, Head & Associates, Inc.

Project: White Oaks Lane
Location: Weymouth, MA
Project No.: 4905.00

Test Pit No. SHTP-4

Ground Elevation: 115 ± feet Revised in March 2021
Datum: Project Datum

Date: 11/12/20
Time Started: 11:48
Time Finished: 12:00

Logged By: C. Disenhof
Checked By: V. Kokosa

Weather: Drizzle, 60°F

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Test Pit	Stab. Time
11/12/20	---	No Groundwater Observed			

Excavation Equipment

Contractor: J. F. Price, Co.
Operator: G. Fennessey
Reach: 20 ft

Make: CAT
Model: 315L
Bucket Capacity: 0.5 CY

Depth (ft)	Field Testing Data	Strata Depth (ft)	Geologic Description	Strata Depth (ft)	Excv. Effort	Boulder Qty & Class	Remarks
0		0 – 0.3	Forest Mat.	0 – 0.3			
		0.3 – 3	Brown, SILT and Sand, trace Gravel, few Roots. Moist. SUBSOIL.	0.3 – 3	E (0 – 3.5)	2A (0 – 3.5)	
		3 – 3.5	Gray/brown, fine to coarse SAND, some Silt, some Gravel. Moist. GLACIAL TILL.	3 – 3.5			
			Test pit terminated between 3 to 3.5 feet due to refusal on bedrock.				

Depth scale (ft): 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20

Excavation Effort

E	Easy
M	Moderate
D	Difficult

Boulder Size Classification

12" - 24"	A
24" - 36"	B
36" and larger	C

Soil Description
Minor Component Proportions

trace	0 - 10%
little	10 - 20%
some	20 - 35%
and	35 - 50%

Test Pit Plan

4'

8'

North Arrow

Sheet: 1 of 1

TEST PIT P:\4900S\4905.00\WORK\LOGS\4905.00 LOGS.GPJ 2017 SANBORN HEAD V1.GLB 2010 SANBORN HEAD V2.GDT 3/12/21

SANBORN | HEAD

Sanborn, Head & Associates, Inc.

Project: White Oaks Lane
Location: Weymouth, MA
Project No.: 4905.00

Test Pit No. SHTP-5

Ground Elevation: 98 ± feet Revised in March 2021
Datum: Project Datum

Date: 11/12/20
Time Started: 14:30
Time Finished: 15:00

Logged By: C. Disenhof
Checked By: V. Kokosa

Weather: Overcast, 50°F

Excavation Equipment

Contractor: J. F. Price, Co.
Operator: G. Fennessey
Reach: 20 ft

Make: CAT
Model: 315L
Bucket Capacity: 0.5 CY

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Test Pit	Stab. Time
11/12/20	---	No Groundwater Observed			

Depth (ft)	Field Testing Data	Strata Depth (ft)	Geologic Description	Strata Depth (ft)	Excv. Effort	Boulder Qty & Class	Remarks
0		0	Black, SILT and Sand, common Roots, common Leaves, few Organic particles. Moist. TOPSOIL with Leaf Mat.	0 / 0.5	E		
		1.5	Gray, COBBLES, and Sand, some Gravel, trace Silt, very few Roots. Moist. FILL.	2			
2		3	Black, SILT, and Sand, frequent Roots, few Organic particles. Moist. BURIED TOPSOIL.	2.3			
4		4	Brown, fine to coarse SAND, some Gravel, little Silt, very few Cobbles, very few Roots. Moist. BURIED SUBSOIL.	4			
		5	Gray, fine to coarse GRAVEL and Sand, little Cobbles, trace Silt. Moist.				
6							
8		8	Test pit terminated at 8 feet due to refusal on probable bedrock.	8			
10							
12							
14							
16							
18							
20							

TEST PIT P:\4900S\4905.00\WORK\LOGS\4905.00 LOGS.GPJ 2017 SANBORN HEAD V1.GLB 2010 SANBORN HEAD V2.GDT 3/12/21

Excavation Effort

E	Easy
M	Moderate
D	Difficult

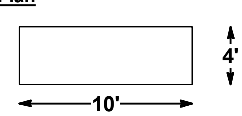
Boulder Size Classification

12" - 24"	A
24" - 36"	B
36" and larger	C

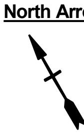
Soil Description Minor Component Proportions

trace	0 - 10%
little	10 - 20%
some	20 - 35%
and	35 - 50%

Test Pit Plan



North Arrow



Sheet: 1 of 1

SANBORN HEAD

Sanborn, Head & Associates, Inc.

Project: White Oaks Lane
Location: Weymouth, MA
Project No.: 4905.00

Test Pit No. SHTP-6

Ground Elevation: 116 ± feet Revised in March 2021
Datum: Project Datum

Date: 11/12/20
Time Started: 10:35
Time Finished: 10:50

Logged By: C. Disenhof
Checked By: V. Kokosa

Weather: Drizzle, 60°F

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Test Pit	Stab. Time
11/12/20	10:45	2'	Ground Surface	3'	None

Excavation Equipment

Contractor: J. F. Price, Co.
Operator: G. Fennessey
Reach: 20 ft

Make: CAT
Model: 315L
Bucket Capacity: 0.5 CY

Depth (ft)	Field Testing Data	Strata Depth (ft)	Geologic Description	Strata Depth (ft)	Excv. Effort	Boulder Qty & Class	Remarks
0		0	Black, SILT and Sand, common Roots, common Leaves, few Organic particles. Moist. TOPSOIL with Leaf Mat.	0	E		The topsoil was observed to vary from approximately 3 to 18" thick, but more typically approximately 6-inches thick.
		0.5	Gray, fine to coarse SAND, some Silt, trace Gravel, few Roots. Moist. SUBSOIL.	0.5			
2		2	Brown/gray, fine to coarse SAND, little Gravel, little Silt. Wet. GLACIAL TILL.	2			Redoximorphic mottling observed in the till. Groundwater observed to be perched on top of the till.
		3	Test pit terminated at 3 feet due to refusal on bedrock.	3			
4							
6							
8							
10							
12							
14							
16							
18							
20							

Excavation Effort

E	Easy
M	Moderate
D	Difficult

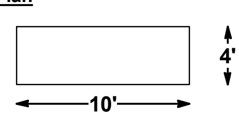
Boulder Size Classification

12" - 24"	A
24" - 36"	B
36" and larger	C

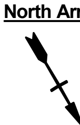
Soil Description
Minor Component Proportions

trace	0 - 10%
little	10 - 20%
some	20 - 35%
and	35 - 50%

Test Pit Plan



North Arrow



Sheet: 1 of 1

TEST PIT P:\4900S\4905.00\WORK\LOGS\4905.00 LOGS.GPJ 2017 SANBORN HEAD V1.GLB 2010 SANBORN HEAD V2.GDT 3/12/21

SANBORN | HEAD

Sanborn, Head & Associates, Inc.

Project: White Oaks Lane
Location: Weymouth, MA
Project No.: 4905.00

Test Pit No. SHTP-7

Ground Elevation: 118 ± feet Revised in March 2021
Datum: Project Datum

Date: 11/12/20
Time Started: 12:14
Time Finished: 12:30

Logged By: C. Disenhof
Checked By: V. Kokosa

Weather: Drizzle, 50°F

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Test Pit	Stab. Time
11/12/20	---	No Groundwater Observed			

Excavation Equipment

Contractor: J. F. Price, Co.
Operator: G. Fennessey
Reach: 20 ft

Make: CAT
Model: 315L
Bucket Capacity: 0.5 CY

Depth (ft)	Field Testing Data	Strata Depth (ft)	Geologic Description	Strata Depth (ft)	Excv. Effort	Boulder Qty & Class	Remarks
0		0 / 0.3	Forest Mat.	0 / 0.3			The forest mat with topsoil was observed to vary from approximately 3 to 6-inches thick.
		0.3	Brown, SILT and Sand, trace Gravel, few Roots, very few Cobbles. Moist. SUBSOIL.		E	2A	
2		2	Gray/pink, COBBLES, little Gravel, little Sand, trace Silt. Moist. WEATHERED ROCK.	2	D		The weathered rock is observed to fracture into approximately 1 to 6-inch angular blocks. It is observed to be a slightly weathered, moderately fractured GRANITE.
4		3	Test pit terminated between 3 to 4.3 feet due to refusal on bedrock.	4.3			
6							
8							
10							
12							
14							
16							
18							
20							

Excavation Effort

E	Easy
M	Moderate
D	Difficult

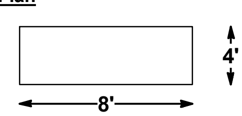
Boulder Size Classification

12" - 24"	A
24" - 36"	B
36" and larger	C

Soil Description Minor Component Proportions

trace	0 - 10%
little	10 - 20%
some	20 - 35%
and	35 - 50%

Test Pit Plan



North Arrow

Sheet: 1 of 1

SANBORN HEAD

Sanborn, Head & Associates, Inc.

Project: White Oaks Lane
Location: Weymouth, MA
Project No.: 4905.00

Test Pit No. SHTP-8

Ground Elevation: 119 ± feet Revised in March 2021
Datum: Project Datum

Date: 11/12/20
Time Started: 09:35
Time Finished: 09:45

Logged By: C. Disenhof
Checked By: V. Kokosa

Weather: Drizzle, 60°F

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Test Pit	Stab. Time
11/12/20	---	No Groundwater Observed			

Excavation Equipment

Contractor: J. F. Price, Co.
Operator: G. Fennessey
Reach: 20 ft

Make: CAT
Model: 315L
Bucket Capacity: 0.5 CY

Depth (ft)	Field Testing Data	Strata Depth (ft)	Geologic Description	Strata Depth (ft)	Excv. Effort	Boulder Qty & Class	Remarks
0		0	Ground Surface	0	E		A C-Class boulder larger than 6' in size was observed on the surface near the test pit. Due to irregular fill, the ground sloped approximately 1 foot downwards from NE to SW. In comparison, the bedrock surface was observed to be relatively level with a very slight slope to the SW.
		0.2	Forest Mat	1			
			Brown/black, WOOD CHIPS, very few Roots, very few Leaves. Moist. FILL.	1.3			
2		2.1		2.2			
		2.3	Brown, SILT, and Sand, trace Gravel, very few Cobbles, very few Roots. Moist. SUBSOIL.	2.6			
			Test pit terminated between 2.3 and 2.6 feet due to refusal on bedrock.				
4							
6							
8							
10							
12							
14							
16							
18							
20							

Excavation Effort

E	Easy
M	Moderate
D	Difficult

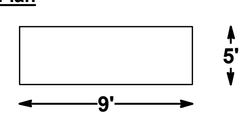
Boulder Size Classification

12" - 24"	A
24" - 36"	B
36" and larger	C

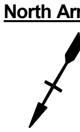
Soil Description
Minor Component Proportions

trace	0 - 10%
little	10 - 20%
some	20 - 35%
and	35 - 50%

Test Pit Plan



North Arrow



SANBORN | HEAD

Sanborn, Head & Associates, Inc.

Project: White Oaks Lane
Location: Weymouth, MA
Project No.: 4905.00

Test Pit No. SHTP-9

Ground Elevation: 118 ± feet Revised in March 2021
Datum: Project Datum

Date: 11/12/20
Time Started: 09:05
Time Finished: 09:25

Logged By: C. Disenhof
Checked By: V. Kokosa

Weather: Drizzle, 60°F

Excavation Equipment

Contractor: J. F. Price, Co.
Operator: G. Fennessey
Reach: 20 ft

Make: CAT
Model: 315L
Bucket Capacity: 0.5 CY

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Test Pit	Stab. Time
11/12/20	09:20	3.2'	Ground Surface	3.2'	None

Depth (ft)	Field Testing Data	Strata Depth (ft)	Geologic Description	Strata Depth (ft)	Excv. Effort	Boulder Qty & Class	Remarks
0		0	Black, fine to coarse GRAVEL, some Sand, few Cobbles, trace Silt, very few Roots, very few Organic particles. Moist. FILL.	0	E		
2		1.3	Brown, fine to coarse SAND and Silt, trace Gravel, very few Roots. Moist. SUBSOIL.	1.8			
		2.6	Gray, fine to coarse SAND, some Gravel, little Silt. Moist to wet.	2.4			Bedrock sloping irregularly downwards from west to east.
4		3.2	Test pit terminated between 2.8 to 3.2 feet due to refusal on bedrock.	2.8			
6							
8							
10							
12							
14							
16							
18							
20							

Excavation Effort

E	Easy
M	Moderate
D	Difficult

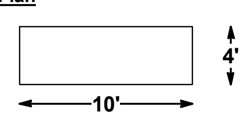
Boulder Size Classification

12" - 24"	A
24" - 36"	B
36" and larger	C

Soil Description
Minor Component Proportions

trace	0 - 10%
little	10 - 20%
some	20 - 35%
and	35 - 50%

Test Pit Plan



North Arrow

TEST PIT P:\4900S\4905.00\WORK\LOGS\4905.00 LOGS.GPJ 2017 SANBORN HEAD V1.GLB 2010 SANBORN HEAD V2.GDT 3/12/21

SANBORN HEAD

Sanborn, Head & Associates, Inc.

Project: White Oaks Lane
Location: Weymouth, MA
Project No.: 4905.00

Test Pit No. SHTP-10

Ground Elevation: 116 ± feet Revised in March 2021
Datum: Project Datum

Date: 11/12/20
Time Started: 10:10
Time Finished: 10:25

Logged By: C. Disenhof
Checked By: V. Kokosa

Weather: Drizzle, 60°F

Excavation Equipment

Contractor: J. F. Price, Co.
Operator: G. Fennessey
Reach: 20 ft

Make: CAT
Model: 315L
Bucket Capacity: 0.5 CY

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Test Pit	Stab. Time
11/12/20	10:20	2.5'	Ground Surface	4'	None

Depth (ft)	Field Testing Data	Strata Depth (ft)	Geologic Description	Strata Depth (ft)	Excv. Effort	Boulder Qty & Class	Remarks
0		0 – 0.5	Black, SILT and Sand, frequent Roots, common Leaves, trace Gravel, few Cobbles. Moist. TOPSOIL with Leaf Mat.	0 – 0.5	E	7A 1B	Topsoil varies from approximately 0.3" to 1' thick.
		0.5 – 2	Brown, SILT and Sand, common Roots, trace Gravel, few Cobbles. Moist. SUBSOIL.	0.5 – 2			The subsoil layer was observed to vary from approximately 2' thick to nonexistent. Redoximorphic mottling observed in the till.
2		2 – 4	Gray, fine to coarse SAND, some Gravel, little Silt. Wet. GLACIAL TILL.	2 – 4			
4		4	Test pit terminated between 3 to 4 feet due to refusal on bedrock.	4			
6							
8							
10							
12							
14							
16							
18							
20							

Excavation Effort

E	Easy
M	Moderate
D	Difficult

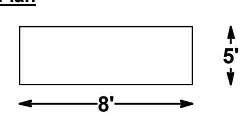
Boulder Size Classification

12" - 24"	A
24" - 36"	B
36" and larger	C

Soil Description Minor Component Proportions

trace	0 - 10%
little	10 - 20%
some	20 - 35%
and	35 - 50%

Test Pit Plan



North Arrow

SANBORN HEAD

Sanborn, Head & Associates, Inc.

Project: White Oaks Lane
Location: Weymouth, MA
Project No.: 4905.00

Test Pit No. SHTP-11

Ground Elevation: 116 ± feet Revised in March 2021
Datum: Project Datum

Date: 11/12/20
Time Started: 08:25
Time Finished: 08:55

Logged By: C. Disenhof
Checked By: V. Kokosa

Weather: Drizzle, 70°F

Excavation Equipment

Contractor: J. F. Price, Co.
Operator: G. Fennessey
Reach: 20 ft

Make: CAT
Model: 315L
Bucket Capacity: 0.5 CY

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Test Pit	Stab. Time
11/12/20	08:30	3'	Ground Surface	9.8'	None

Depth (ft)	Field Testing Data	Strata Depth (ft)	Geologic Description	Strata Depth (ft)	Excv. Effort	Boulder Qty & Class	Remarks
0		0	Forest Mat.	0	E	2A	
		0.3	Gray/orange, fine to coarse SAND, little Silt, trace Gravel. Moist. FILL.	0.3			The fill is observed to be reworked glacial till.
2		2.6	Black, SILT and Sand, frequent Roots. Moist. BURIED TOPSOIL.	2.6			
		3	Gray/brown, fine to coarse SAND, little Silt, little Gravel, few Cobbles. Moist. GLACIAL TILL.	3			Redoximorphic mottling observed at the top of the till. Groundwater is interpreted to be perched on top of the till.
10		9.8	Test pit terminated at 9.8' due to refusal on bedrock or boulders.	9.8			

Depth scale: 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20

Excavation Effort	
E	Easy
M	Moderate
D	Difficult

Boulder Size Classification	
12" - 24"	A
24" - 36"	B
36" and larger	C

Soil Description Minor Component Proportions	
trace	0 - 10%
little	10 - 20%
some	20 - 35%
and	35 - 50%

Test Pit Plan

4'

12'

North Arrow

TEST PIT P:\4900S\4905.00\WORK\LOGS\4905.00 LOGS.GPJ 2017 SANBORN HEAD V1.GLB 2010 SANBORN HEAD V2.GDT 3/12/21

SANBORN HEAD

Sanborn, Head & Associates, Inc.

Project: White Oaks Lane
Location: Weymouth, MA
Project No.: 4905.00

Test Pit No. SHTP-12

Ground Elevation: 106 ± feet Revised in March 2021
Datum: Project Datum

Date: 11/12/20
Time Started: 08:00
Time Finished: 08:15

Logged By: C. Disenhof
Checked By: V. Kokosa

Weather: Drizzle, 70°F

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Test Pit	Stab. Time
11/12/20	---	No Groundwater Observed			

Excavation Equipment

Contractor: J. F. Price, Co.
Operator: G. Fennessey
Reach: 20 ft

Make: CAT
Model: 315L
Bucket Capacity: 0.5 CY

Depth (ft)	Field Testing Data	Strata Depth (ft)	Geologic Description	Strata Depth (ft)	Excv. Effort	Boulder Qty & Class	Remarks
0		0 0.4	Black, SILT and Sand, common Roots, common Leaves, few Organic particles. Moist. TOPSOIL with Leaf Mat.	0 0.4	E		
			Brown, SILT and Sand, common Roots, trace Gravel. Moist. SUBSOIL.				
2		2.6	Gray, fine to coarse SAND, some Gravel, trace Silt, very few Cobbles. Moist. GLACIAL TILL.	2.8			The slope of the bedrock appears to follow the slope of the ground surface at a slightly steeper angle.
4			Test pit terminated between 2.7 and 4.5 feet due to refusal on sloping bedrock.	4.5			
6							
8							
10							
12							
14							
16							
18							
20							

Excavation Effort

E	Easy
M	Moderate
D	Difficult

Boulder Size Classification

12" - 24"	A
24" - 36"	B
36" and larger	C

Soil Description Minor Component Proportions

trace	0 - 10%
little	10 - 20%
some	20 - 35%
and	35 - 50%

Test Pit Plan

5'

10'

North Arrow

SANBORN HEAD

Sanborn, Head & Associates, Inc.

Project: White Oaks Lane
Location: Weymouth, MA
Project No.: 4905.00

Test Pit No. SHTP-13

Ground Elevation: 117 ± feet Revised in March 2021
Datum: Project Datum

Date: 11/12/20
Time Started: 09:50
Time Finished: 10:05

Logged By: C. Disenhof
Checked By: V. Kokosa

Weather: Drizzle, 60°F

Excavation Equipment

Contractor: J. F. Price, Co.
Operator: G. Fennessey
Reach: 20 ft

Make: CAT
Model: 315L
Bucket Capacity: 0.5 CY

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Test Pit	Stab. Time
11/12/20	10:00	3'	Ground Surface	3'	None

Depth (ft)	Field Testing Data	Strata Depth (ft)	Geologic Description	Strata Depth (ft)	Excv. Effort	Boulder Qty & Class	Remarks
0		0 – 0.5	Black, fine to coarse GRAVEL and Sand, trace Silt, very few Wood pieces, very few Trash particles, very few Roots, very few Organic particles. Moist. FILL.	0 – 0.5	E	2A	
			Brown, SILT and Sand, little Cobbles, trace Gravel, few Roots. Moist. SUBSOIL.	1.5			
2		2.5	Gray, fine to coarse SAND, some Gravel, little Silt. Wet. GLACIAL TILL.		D		
		3	Test pit terminated between 1.5 and 3 feet due to refusal on bedrock.				
4							
6							
8							
10							
12							
14							
16							
18							
20							

Excavation Effort

E	Easy
M	Moderate
D	Difficult

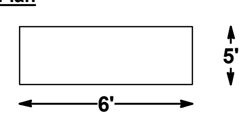
Boulder Size Classification

12" - 24"	A
24" - 36"	B
36" and larger	C

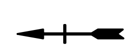
Soil Description
Minor Component Proportions

trace	0 - 10%
little	10 - 20%
some	20 - 35%
and	35 - 50%

Test Pit Plan



North Arrow



TEST PIT P:\4900S\4905.00\WORK\LOGS\4905.00 LOGS.GPJ 2017 SANBORN HEAD V1.GLB 2010 SANBORN HEAD V2.GDT 3/12/21

Test Pit Log

Site Name:	Weymouth, MA	Date:	2/25/2021
Site Address:	White Oaks Lane	Time:	7:30
Project No.:	4905.01		
Ground Surface Elev. (ft.):	117±	Weather :	Clear, 40's
		Logged by:	M. Ruberti
Test Pit Number:	SHTP-101	Soil Evaluator #:	SE 14152

Depth (inches)	Soil Horizon or Layer	Soil Matrix Color (Moist)	Redoximorphic Features			Soil Texture (NRCS)	Coarse Fragments (% by Volume)		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles			
0 - 2	O	-	-	-	-	-	-	-	-	-	Note 1
2 - 4	A	10YR 4/1	-	-	-	Bouldery Loamy Sand	10	15	Granular	Very Friable	Note 2
4 - 48	C_D	2.5Y 5/4	-	-	-	Bouldery Loamy Sand	20	10	Single Grain	Very Friable	
48 -	R	-	-	-	-	-	-	-	-	-	Note 3
-											
-											
-											

Test Pit Termination Depth (in.): 48 **Reason for Termination:** Bedrock refusal

Groundwater Observations:				**In-Situ Testing:**		
Depth to water weeping from pit face (in.):	24			Percolation Test:	No	Depth (in.):
Depth to standing water in hole (in.):	44	Stabilization Time:	<30 Minutes	Permeameter Test:	No	Depth (in.):
Depth to estimated seasonal high groundwater [ESHGW] (in.):	24	Basis for ESHGW:	Groundwater observed	Falling Head Test:	No	Depth (in.):
				Other Test:	No	Depth (in.):

Additional Notes:

1. Numerous Boulders ranging from 24-48" in diameter encountered within C layer.
2. Organic horizon consists of woodland leaf litter.
3. Bedrock encountered at refusal depth of 48".

Test Pit Log

Site Name:	Weymouth, MA	Date:	2/25/2021
Site Address:	White Oaks Lane	Time:	8:15
Project No.:	4905.01		
Ground Surface Elev. (ft.):	113±	Weather :	Clear, 40's
		Logged by:	M. Ruberti
Test Pit Number:	SHTP-102	Soil Evaluator #:	SE 14152

SANBORN HEAD

Depth (inches)	Soil Horizon or Layer	Soil Matrix Color (Moist)	Redoximorphic Features			Soil Texture (NRCS)	Coarse Fragments (% by Volume)		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles			
0 - 2	O	-	-	-	-	-	-	-	-	-	Note 1
2 - 4	A	10YR 4/1	-	-	-	Loamy Sand	10	5	Granular	Very Friable	
4 - 36	C_D	2.5Y 6/2	-	-	-	Very Gravelly Sand	30	0	Single Grain	Very Friable	
-											
-											
-											
-											

Test Pit Termination Depth (in.): 36 **Reason for Termination:** Repeated collapse

Groundwater Observations:				**In-Situ Testing:**		
Depth to water weeping from pit face (in.):	6			Percolation Test:	No	Depth (in.):
Depth to standing water in hole (in.):	27	Stabilization Time:	<30 Minutes	Permeameter Test:	No	Depth (in.):
Depth to estimated seasonal high groundwater [ESHGW] (in.):	6	Basis for ESHGW:	Groundwater observed	Falling Head Test:	No	Depth (in.):
				Other Test:	No	Depth (in.):

Additional Notes:

1. Organic horizon consists of woodland leaf litter.

Test Pit Log

Site Name:	Weymouth, MA	Date:	2/25/2021
Site Address:	White Oaks Lane	Time:	8:30
Project No.:	4905.01		
Ground Surface Elev. (ft.):	112±	Weather :	Sunny, 40's

Test Pit Number: SHTP-103

Logged by: M. Ruberti

Soil Evaluator #: SE 14152

Depth (inches)	Soil Horizon or Layer	Soil Matrix Color (Moist)	Redoximorphic Features			Soil Texture (NRCS)	Coarse Fragments (% by Volume)		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles			
0 - 2	O	-	-	-	-	-	-	-	-	-	Note 1
2 - 4	A	10YR 4/1	-	-	-	Loamy Sand	10	5	Granular	Very Friable	
4 - 24	B_W	2.5 YR 6/6	-	-	-	Gravelly Loamy Sand	15	5	Single Grain	Very Friable	
24 - 60	C_D	2.5 Y 5/3	-	-	-	Extremely Gravelly Loamy Sand	69	10	Single Grain	Very Friable	
-											
-											
-											

Test Pit Termination Depth (in.): 60 **Reason for Termination:** Target depth achieved

Groundwater Observations:				**In-Situ Testing:**		
Depth to water weeping from pit face (in.):	60			Percolation Test:	No	Depth (in.):
Depth to standing water in hole (in.):	60	Stabilization Time:	<30 Minutes	Permeameter Test:	No	Depth (in.):
Depth to estimated seasonal high groundwater [ESHGW] (in.):	60	Basis for ESHGW:	Groundwater observed	Falling Head Test:	No	Depth (in.):
				Other Test:	No	Depth (in.):

Additional Notes:

1. Organic horizon consists of woodland leaf litter.

Test Pit Log

Site Name:	Weymouth, MA	Date:	2/25/2021
Site Address:	White Oaks Lane	Time:	9:00
Project No.:	4905.01		
Ground Surface Elev. (ft.):	107±	Weather :	Sunny, 40's
		Logged by:	M. Ruberti
Test Pit Number:	SHTP-104	Soil Evaluator #:	SE 14152

Depth (inches)	Soil Horizon or Layer	Soil Matrix Color (Moist)	Redoximorphic Features			Soil Texture (NRCS)	Coarse Fragments (% by Volume)		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles			
0 - 2	O	-	-	-	-	-	-	-	-	-	Note 1
2 - 4	A	10YR 4/1	-	-	-	Loamy Sand	10	5	Granular	Very Friable	
4 - 30	B_W	2.5YR 6/6	-	-	-	Gravelly Loamy Sand	15	5	Single Grain	Very Friable	
30 - 36	C_D	2.5Y 5/3	-	-	-	Very Gravelly Loamy Sand	25	5	Single Grain	Very Friable	
36 -	R	-	-	-	-	-	-	-	-	-	Note 2
-											
-											

Test Pit Termination Depth (in.): 36 **Reason for Termination:** Bedrock refusal

Groundwater Observations:				**In-Situ Testing:**		
Depth to water weeping from pit face (in.):	N/A			Percolation Test:	No	Depth (in.):
Depth to standing water in hole (in.):	N/A	Stabilization Time:	<30 Minutes	Permeameter Test:	No	Depth (in.):
Depth to estimated seasonal high groundwater [ESHGW] (in.):	N/A	Basis for ESHGW:	N/A	Falling Head Test:	No	Depth (in.):
				Other Test:	No	Depth (in.):

Additional Notes:
1. Organic horizon consists of woodland leaf litter.
2. Bedrock encountered at refusal depth of 36".
3. N/A denotes "not observed".

Test Pit Log

Site Name:	Weymouth, MA	Date:	2/25/2021
Site Address:	White Oaks Lane	Time:	9:15
Project No.:	4905.01		
Ground Surface Elev. (ft.):	108±	Weather :	Sunny, 40's

SANBORN HEAD

Test Pit Number:	SHTP-105	Logged by:	M. Ruberti
		Soil Evaluator #:	SE 14152

Depth (inches)	Soil Horizon or Layer	Soil Matrix Color (Moist)	Redoximorphic Features			Soil Texture (NRCS)	Coarse Fragments (% by Volume)		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles			
0 - 2	O	-	-	-	-	-	-	-	-	-	Note 1
2 - 3	A	10YR 4/1	-	-	-	Loamy Sand	10	5	Granular	Very Friable	
3 - 18	B_W	2.5YR 6/6	-	-	-	Gravelly Loamy Sand	15	5	Single Grain	Very Friable	
18 - 54	C_D	2.5Y 5/3	24	2.5 Y 5/8	15	Very Gravelly Loamy Sand	33.1	10	Single Grain	Very Friable	
-											
-											
-											

Test Pit Termination Depth (in.): 54 **Reason for Termination:** Target depth achieved

Groundwater Observations:				**In-Situ Testing:**		
Depth to water weeping from pit face (in.):	30			Percolation Test:	No	Depth (in.):
Depth to standing water in hole (in.):	52	Stabilization Time:	<30 Minutes	Permeameter Test:	No	Depth (in.):
Depth to estimated seasonal high groundwater [ESHGW] (in.):	24	Basis for ESHGW:	Soil Mottling	Falling Head Test:	No	Depth (in.):
				Other Test:	No	Depth (in.):

Additional Notes:

1. Organic horizon consists of woodland leaf litter.

Test Pit Log

Site Name:	Weymouth, MA	Date:	2/25/2021
Site Address:	White Oaks Lane	Time:	11:00
Project No.:	4905.01		
Ground Surface Elev. (ft.):	107±	Weather :	Sunny, 40's
		Logged by:	M. Ruberti
Test Pit Number:	SHTP-106	Soil Evaluator #:	SE 14152

SANBORN HEAD

Depth (inches)	Soil Horizon or Layer	Soil Matrix Color (Moist)	Redoximorphic Features			Soil Texture (NRCS)	Coarse Fragments (% by Volume)		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles			
0 - 24	Fill	10 YR 4/1	-	-	-	Extremely Gravelly Loamy Sand	75	5	Structureless	Very Friable	Note 1
24 - 42	C	2.5 Y 6/2	-	-	-	Gravelly Loamy Sand	20	5	Single Grain	Very Friable	
-											
-											
-											
-											
-											

Test Pit Termination Depth (in.): 42 **Reason for Termination:** Target depth achieved

Groundwater Observations:				**In-Situ Testing:**		
Depth to water weeping from pit face (in.):	24			Percolation Test:	No	Depth (in.):
Depth to standing water in hole (in.):	40	Stabilization Time:	<30 Minutes	Permeameter Test:	No	Depth (in.):
Depth to estimated seasonal high groundwater [ESHGW] (in.):	24	Basis for ESHGW:	Groundwater observed	Falling Head Test:	No	Depth (in.):
				Other Test:	No	Depth (in.):

Additional Notes:

1. Few Brick fragments observed within the Fill layer.

Test Pit Log

Site Name:	Weymouth, MA	Date:	2/25/2021
Site Address:	White Oaks Lane	Time:	11:15
Project No.:	4905.01		
Ground Surface Elev. (ft.):	100±	Weather :	Sunny, 40's

SANBORN HEAD

Logged by: M. Ruberti

Test Pit Number: SHTP-107

Soil Evaluator #: SE 14152

Depth (inches)	Soil Horizon or Layer	Soil Matrix Color (Moist)	Redoximorphic Features			Soil Texture (NRCS)	Coarse Fragments (% by Volume)		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles			
0 - 2	O	-	-	-	-	-	-	-	-	-	Note 1
2 - 4	A	10YR 4/1	-	-	-	Sandy Loam	10	5	Granular	Very Friable	
4 - 36	B_W	2.5YR 6/6	-	-	-	Gravelly Loamy Sand	15	5	Single Grain	Very Friable	
36 - 48	C	2.5Y 5/3	-	-	-	Very Gravelly Sandy Loam	38.6	10	Massive	Very Friable	
36 - 48	R	-	-	-	-	-	-	-	-		Notes 2, 3
-											
-											

Test Pit Termination Depth (in.): 48 **Reason for Termination:** Bedrock refusal

Groundwater Observations:				**In-Situ Testing:**		
Depth to water weeping from pit face (in.):	N/A			Percolation Test:	No	Depth (in.):
Depth to standing water in hole (in.):	N/A	Stabilization Time:	<30 Minutes	Permeameter Test:	No	Depth (in.):
Depth to estimated seasonal high groundwater [ESHGW] (in.):	N/A	Basis for ESHGW:	N/A	Falling Head Test:	No	Depth (in.):
				Other Test:	No	Depth (in.):

Additional Notes:
1. Organic horizon consists of woodland leaf litter.
2. Bedrock observed between 3 feet and 4 feet bgs.
3. Test pit offset approximately 25 feet towards dirt road.
4. N/A denotes "not observed".

Test Pit Log

Site Name:	Weymouth, MA	Date:	2/26/2021
Site Address:	White Oaks Lane	Time:	10:30
Project No.:	4905.01		
Ground Surface Elev. (ft.):	98±	Weather :	Sunny, 40's
Test Pit Number:	SHTP-109	Logged by:	M. Ruberti
		Soil Evaluator #:	SE 14152

Depth (inches)	Soil Horizon or Layer	Soil Matrix Color (Moist)	Redoximorphic Features			Soil Texture (NRCS)	Coarse Fragments (% by Volume)		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles			
0 - 6	A	10YR 4/1	-	-	-	Loamy Sand	5	0	Granular	Very Friable	
6 - 24	B_W	2.5YR 6/6	-	-	-	Sandy Loam	10	5	Granular	Very Friable	
24 - 114	C	2.5Y 5/3	-	-	-	Gravelly Sand	28.6	5	Single Grain	Very Friable	
-											
-											
-											
-											

Test Pit Termination Depth (in.): 114 **Reason for Termination:** Target depth achieved

Groundwater Observations:				**In-Situ Testing:**		
Depth to water weeping from pit face (in.):	N/A			Percolation Test:	No	Depth (in.):
Depth to standing water in hole (in.):	N/A	Stabilization Time:	<30 Minutes	Permeameter Test:	No	Depth (in.):
Depth to estimated seasonal high groundwater [ESHGW] (in.):	N/A	Basis for ESHGW:	N/A	Falling Head Test:	No	Depth (in.):
				Other Test:	No	Depth (in.):

Additional Notes:

1. N/A denotes "not observed".

Test Pit Log

Site Name:	Weymouth, MA	Date:	2/26/2021
Site Address:	White Oaks Lane	Time:	9:30
Project No.:	4905.01		
Ground Surface Elev. (ft.):	103±	Weather :	Sunny, 40's
Test Pit Number:	SHTP-110	Logged by:	M. Ruberti
		Soil Evaluator #:	SE 14152

Depth (inches)	Soil Horizon or Layer	Soil Matrix Color (Moist)	Redoximorphic Features			Soil Texture (NRCS)	Coarse Fragments (% by Volume)		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles			
0 - 6	A	10 YR 4/1	-	-	-	Loamy Sand	5	0	Granular	Very Friable	
6 - 24	B_w	2.5YR 6/6	-	-	-	Sandy Loam	10	5	Granular	Very Friable	
24 - 156	C	2.5 Y 5/3	-	-	-	Very Gravelly Sand	30	5	Single Grain	Very Friable	
-											
-											
-											
-											

Test Pit Termination Depth (in.): 156 **Reason for Termination:** Target depth achieved

Groundwater Observations:				**In-Situ Testing:**		
Depth to water weeping from pit face (in.):	N/A			Percolation Test:	No	Depth (in.):
Depth to standing water in hole (in.):	N/A	Stabilization Time:	<30 Minutes	Permeameter Test:	No	Depth (in.):
Depth to estimated seasonal high groundwater [ESHGW] (in.):	N/A	Basis for ESHGW:	N/A	Falling Head Test:	No	Depth (in.):
				Other Test:	No	Depth (in.):

Additional Notes:

1. N/A denotes "not observed".

Test Pit Log

Site Name:	Weymouth, MA	Date:	2/25/2021
Site Address:	White Oaks Lane	Time:	12:00
Project No.:	4905.01		
Ground Surface Elev. (ft.):	86.5±	Weather :	Sunny, 40's
Test Pit Number:	SHTP-112	Logged by:	M. Ruberti
		Soil Evaluator #:	SE 14152

SANBORN HEAD

Depth (inches)	Soil Horizon or Layer	Soil Matrix Color (Moist)	Redoximorphic Features			Soil Texture (NRCS)	Coarse Fragments (% by Volume)		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles			
0 - 2	O	-	-	-	-	-	-	-	-	-	Note 1
2 - 4	A	10YR 4/1	-	-	-	Sandy Loam	10	5	Granular	Very Friable	
4 - 66	C	2.5 Y 6/2	-	-	-	Very Gravelly Sand	38.3	5	Single Grain	Very Friable	
-											
-											
-											
-											

Test Pit Termination Depth (in.): 66 **Reason for Termination:** Target depth achieved

Groundwater Observations:				**In-Situ Testing:**		
Depth to water weeping from pit face (in.):	60			Percolation Test:	No	Depth (in.):
Depth to standing water in hole (in.):	62	Stabilization Time:	<30 Minutes	Permeameter Test:	No	Depth (in.):
Depth to estimated seasonal high groundwater [ESHGW] (in.):	60	Basis for ESHGW:	Groundwater observed	Falling Head Test:	No	Depth (in.):
				Other Test:	No	Depth (in.):

Additional Notes:

1. Organic horizon consists of woodland leaf litter.

Test Pit Log

Site Name:	Weymouth, MA	Date:	2/25/2021
Site Address:	White Oaks Lane	Time:	11:45
Project No.:	4905.01		
Ground Surface Elev. (ft.):	86±	Weather :	Sunny, 40's
Test Pit Number:	SHTP-113	Logged by:	M. Ruberti
		Soil Evaluator #:	SE 14152

Depth (inches)	Soil Horizon or Layer	Soil Matrix Color (Moist)	Redoximorphic Features			Soil Texture (NRCS)	Coarse Fragments (% by Volume)		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles			
0 - 12	A	10YR 4/1	-	-	-	Loamy Sand	5	0	Granular	Very Friable	
12 - 24	B_w	2.5YR 6/6	-	-	-	Sandy Loam	10	5	Granular	Very Friable	
24 - 48	C	2.5Y 5/2	-	-	-	Very Gravelly Sand	25	5	Single Grain	Very Friable	
48 -	R										Note 1
-											
-											
-											

Test Pit Termination Depth (in.):	48	**Reason for Termination:**	Bedrock refusal

Groundwater Observations:				**In-Situ Testing:**		
Depth to water weeping from pit face (in.):	42			Percolation Test:	No	Depth (in.):
Depth to standing water in hole (in.):	46	Stabilization Time:	<30 Minutes	Permeameter Test:	No	Depth (in.):
Depth to estimated seasonal high groundwater [ESHGW] (in.):	42	Basis for ESHGW:	Groundwater observed	Falling Head Test:	No	Depth (in.):
				Other Test:	No	Depth (in.):

Additional Notes:

1. Bedrock encountered at refusal depth of 48".

Test Pit Log

Site Name:	Weymouth, MA	Date:	2/25/2021
Site Address:	White Oaks Lane	Time:	10:30
Project No.:	4905.01		
Ground Surface Elev. (ft.):	101±	Weather :	Sunny, 40's

SANBORN HEAD

Test Pit Number:	SHTP-114	Logged by:	M. Ruberti
		Soil Evaluator #:	SE 14152

Depth (inches)	Soil Horizon or Layer	Soil Matrix Color (Moist)	Redoximorphic Features			Soil Texture (NRCS)	Coarse Fragments (% by Volume)		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles			
0 - 2	O	-	-	-	-	-	-	-	-	-	Note 1
2 - 4	A	10YR 4/1	-	-	-	Sandy Loam	10	5	Granular	Very Friable	
4 - 156	C	2.5Y 5/3	-	-	-	Extremely Gravelly Sand	45.3	10	Single Grain	Very Friable	
-											
-											
-											
-											

Test Pit Termination Depth (in.): 156 **Reason for Termination:** Target depth achieved

Groundwater Observations:				**In-Situ Testing:**		
Depth to water weeping from pit face (in.):	N/A			Percolation Test:	No	Depth (in.):
Depth to standing water in hole (in.):	N/A	Stabilization Time:	<30 Minutes	Permeameter Test:	No	Depth (in.):
Depth to estimated seasonal high groundwater [ESHGW] (in.):	N/A	Basis for ESHGW:	N/A	Falling Head Test:	No	Depth (in.):
				Other Test:	No	Depth (in.):

Additional Notes:
1. Organic horizon consists of woodland leaf litter.
2. N/A denotes "not observed".

Test Pit Log

Site Name:	Weymouth, MA	Date:	2/25/2021
Site Address:	White Oaks Lane	Time:	10:30
Project No.:	4905.01		
Ground Surface Elev. (ft.):	110±	Weather :	Sunny, 40's
Test Pit Number:	SHTP-115	Logged by:	M. Ruberti
		Soil Evaluator #:	SE 14152

Depth (inches)	Soil Horizon or Layer	Soil Matrix Color (Moist)	Redoximorphic Features			Soil Texture (NRCS)	Coarse Fragments (% by Volume)		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles			
0 - 4	O	-	-	-	-	-	-	-	-	-	Note 1
4 -	R	-	-	-	-	-	-	-	-	-	Note 2
-											
-											
-											
-											
-											

Test Pit Termination Depth (in.): 4 **Reason for Termination:** Bedrock refusal

Groundwater Observations:				In-Situ Testing:		
Depth to water weeping from pit face (in.):	N/A			Percolation Test:	No	Depth (in.):
Depth to standing water in hole (in.):	N/A	Stabilization Time:	N/A	Permeameter Test:	No	Depth (in.):
Depth to estimated seasonal high groundwater [ESHGW] (in.):	N/A	Basis for ESHGW:	N/A	Falling Head Test:	No	Depth (in.):
				Other Test:	No	Depth (in.):

Additional Notes:
1. Organic horizon consists of woodland leaf litter.
2. Bedrock encountered at refusal depth of 4".

Test Pit Log

Site Name:	Weymouth, MA	Date:	2/25/2021
Site Address:	White Oaks Lane	Time:	9:45
Project No.:	4905.01		
Ground Surface Elev. (ft.):	122±	Weather :	Sunny, 40's

SANBORN HEAD

Logged by: M. Ruberti

Test Pit Number: SHTP-116

Soil Evaluator #: SE 14152

Depth (inches)	Soil Horizon or Layer	Soil Matrix Color (Moist)	Redoximorphic Features			Soil Texture (NRCS)	Coarse Fragments (% by Volume)		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles			
0 - 2	O	-	-	-	-	-	-	-	-	-	Note 1
2 - 4	A	10YR 4/1	-	-	-	Sandy Loam	10	5	Granular	Very Friable	
4 - 24	B_w	2.5YR 6/6	-	-	-	Gravelly Loamy Sand	15	5	Single Grain	Very Friable	Note 2
24 -	R	-	-	-	-	-	-	-	-	-	
-											
-											
-											

Test Pit Termination Depth (in.): 24 **Reason for Termination:** Bedrock refusal

Groundwater Observations:				**In-Situ Testing:**		
Depth to water weeping from pit face (in.):	20			Percolation Test:	No	Depth (in.):
Depth to standing water in hole (in.):	23	Stabilization Time:	<30 Minutes	Permeameter Test:	No	Depth (in.):
Depth to estimated seasonal high groundwater [ESHGW] (in.):	20	Basis for ESHGW:	Groundwater observed	Falling Head Test:	No	Depth (in.):
				Other Test:	No	Depth (in.):

Additional Notes:

1. Organic horizon consists of woodland leaf litter.
2. Bedrock encountered at refusal depth of 24".

Test Pit Log

Site Name:	Weymouth, MA	Date:	2/25/2021
Site Address:	White Oaks Lane	Time:	10:00
Project No.:	4905.01		
Ground Surface Elev. (ft.):	113±	Weather :	Sunny, 40's

SANBORN HEAD

Test Pit Number:	SHTP-117	Logged by:	M. Ruberti
		Soil Evaluator #:	SE 14152

Depth (inches)	Soil Horizon or Layer	Soil Matrix Color (Moist)	Redoximorphic Features			Soil Texture (NRCS)	Coarse Fragments (% by Volume)		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles			
0 - 30	A	10YR 4/1	-	-	-	Sandy Loam	10	0	Granular	Very Friable	Note 1
30 -	R	-	-	-	-	-	-	-	-	-	Note 2
-											
-											
-											
-											
-											

Test Pit Termination Depth (in.): 30 **Reason for Termination:** Bedrock refusal

Groundwater Observations:				**In-Situ Testing:**		
Depth to water weeping from pit face (in.):	12			Percolation Test:	No	Depth (in.):
Depth to standing water in hole (in.):	29	Stabilization Time:	<30 Minutes	Permeameter Test:	No	Depth (in.):
Depth to estimated seasonal high groundwater [ESHGW] (in.):	12	Basis for ESHGW:	Groundwater observed	Falling Head Test:	No	Depth (in.):
				Other Test:	No	Depth (in.):

Additional Notes:
1. Common Root pieces observed.
2. Bedrock encountered at refusal depth of 30".

Test Pit Log

Site Name:	Weymouth, MA	Date:	2/25/2021
Site Address:	White Oaks Lane	Time:	9:35
Project No.:	4905.01		
Ground Surface Elev. (ft.):	120±	Weather :	Sunny, 40's
Test Pit Number:	SH-TP118	Logged by:	M. Ruberti
		Soil Evaluator #:	SE 14152

Depth (inches)	Soil Horizon or Layer	Soil Matrix Color (Moist)	Redoximorphic Features			Soil Texture (NRCS)	Coarse Fragments (% by Volume)		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles			
0 - 2	O	-	-	-	-	-	-	-	-	-	Note 1
2 -	R	-	-	-	-	-	-	-	-	-	Note 2
-											
-											
-											
-											
-											

Test Pit Termination Depth (in.): 2 **Reason for Termination:** Bedrock refusal

Groundwater Observations:				**In-Situ Testing:**		
Depth to water weeping from pit face (in.):	N/A			Percolation Test:	No	Depth (in.):
Depth to standing water in hole (in.):	N/A	Stabilization Time:	<30 Minutes	Permeameter Test:	No	Depth (in.):
Depth to estimated seasonal high groundwater [ESHGW] (in.):	N/A	Basis for ESHGW:	N/A	Falling Head Test:	No	Depth (in.):
				Other Test:	No	Depth (in.):

Additional Notes:
1. Organic horizon consists of woodland leaf litter.
2. Bedrock encountered at refusal depth of 2".
3. N/A denotes "not observed".

Test Pit Log

Site Name:	Weymouth, MA	Date:	2/24/2021
Site Address:	White Oaks Lane	Time:	9:40
Project No.:	4905.01		
Ground Surface Elev. (ft.):	113.5±	Weather :	Sunny, 40's
		Logged by:	M. Ruberti
Test Pit Number:	SHTP-119	Soil Evaluator #:	SE 14152

Depth (inches)	Soil Horizon or Layer	Soil Matrix Color (Moist)	Redoximorphic Features			Soil Texture (NRCS)	Coarse Fragments (% by Volume)		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles			
0 - 2	O	-	-	-	-	-	-	-	-	-	Note 1
2 - 42	Fill	10YR 4/4	-	-	-	Very Gravelly Sand	30	10	Structureless	Very Friable	
-											
-											
-											
-											
-											

Test Pit Termination Depth (in.): 42 **Reason for Termination:** Repeated collapse

Groundwater Observations:				**In-Situ Testing:**		
Depth to water weeping from pit face (in.):	36			Percolation Test:	No	Depth (in.):
Depth to standing water in hole (in.):	36	Stabilization Time:	<30 Minutes	Permeameter Test:	No	Depth (in.):
Depth to estimated seasonal high groundwater [ESHGW] (in.):	36	Basis for ESHGW:	Groundwater observed	Falling Head Test:	No	Depth (in.):
				Other Test:	No	Depth (in.):

Additional Notes:

1. Organic horizon consists of woodland leaf litter.

Test Pit Log

Site Name:	Weymouth, MA	Date:	2/24/2021
Site Address:	White Oaks Lane	Time:	10:30
Project No.:	4905.01		
Ground Surface Elev. (ft.):	113±	Weather :	Sunny, 40's
		Logged by:	M. Ruberti
Test Pit Number:	SHTP-120	Soil Evaluator #:	SE 14152

Depth (inches)	Soil Horizon or Layer	Soil Matrix Color (Moist)	Redoximorphic Features			Soil Texture (NRCS)	Coarse Fragments (% by Volume)		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles			
0 - 2	O	-	-	-	-	-	-	-	-	-	Note 1
2 - 36	Fill	10YR 4/4	-	-	-	Very Gravelly Sand	30	10	Structureless	Very Friable	Notes 2, 3
-											
-											
-											
-											
-											

Test Pit Termination Depth (in.): 36 **Reason for Termination:** Repeated collpase

Groundwater Observations:				**In-Situ Testing:**		
Depth to water weeping from pit face (in.):	30			Percolation Test:	No	Depth (in.):
Depth to standing water in hole (in.):	33	Stabilization Time:	<30 Minutes	Permeameter Test:	No	Depth (in.):
Depth to estimated seasonal high groundwater [ESHGW] (in.):	30	Basis for ESHGW:	Groundwater observed	Falling Head Test:	No	Depth (in.):
				Other Test:	No	Depth (in.):

Additional Notes:

1. Organic horizon consists of woodland leaf litter.
2. Redoximorphic features caused by textural change observed at appriximately 2 feet bgs and not indicative of EHSGW.
3. Pockets of re-worked Glacial Till and Topsoil observed at approximately 2 feet bgs.

Test Pit Log

Site Name:	Weymouth, MA	Date:	2/24/2021
Site Address:	White Oaks Lane	Time:	9:00
Project No.:	4905.01		
Ground Surface Elev. (ft.):	115±	Weather :	Sunny, 40's
Test Pit Number:	SHTP-121	Logged by:	M. Ruberti
		Soil Evaluator #:	SE 14152

Depth (inches)	Soil Horizon or Layer	Soil Matrix Color (Moist)	Redoximorphic Features			Soil Texture (NRCS)	Coarse Fragments (% by Volume)		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles			
0 - 2	O	-	-	-	-	-	1	-	-	-	Note 1
2 - 54	Fill	10YR 4/1	-	-	-	Very Gravelly Sand	30	5	Structureless	Very Friable	
54 - 60	C_D	2.5Y 5/1	-	-	-	Gravelly Loamy Sand	15	10	Massive	Firm in place, Friable in hand	
-											
-											
-											
-											

Test Pit Termination Depth (in.): 60 **Reason for Termination:** Target depth achieved

Groundwater Observations:				**In-Situ Testing:**		
Depth to water weeping from pit face (in.):	54			Percolation Test:	No	Depth (in.):
Depth to standing water in hole (in.):	58	Stabilization Time:	<30 Minutes	Permeameter Test:	No	Depth (in.):
Depth to estimated seasonal high groundwater [ESHGW] (in.):	54	Basis for ESHGW:	Groundwater observed	Falling Head Test:	No	Depth (in.):
				Other Test:	No	Depth (in.):

Additional Notes:

1. Organic horizon consists of woodland leaf litter.

SECTION 7

BUFFER ZONE RESTORATION AND ENHANCEMENT PLAN

Buffer Zone Restoration and Enhancement Plan

Hanover Weymouth Residential Development
Weymouth, MA

July 8, 2021

Epsilon ASSOCIATES INC.

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BUFFER ZONE ENHANCEMENT PLAN

1.0 Overview

This Buffer Zone Enhancement Plan (the "Plan") has been prepared for the Hanover Company in support of the proposed residential apartment development located off Washington Street at the intersection with White Oaks Lane in Weymouth, Massachusetts ("Project") [MassDEP File No. 81-1271]. The Project will result in approximately 4,437 s.f. of permanent impacts to two Isolated Vegetated Wetlands ("IVWs") that are regulated under the Weymouth Wetlands Protection Bylaw (the "Bylaw"), but not the Wetlands Protection Act. Further, the Project does not propose any alterations to Bordering Vegetated Wetlands ("BVW") regulated under the Bylaw and Massachusetts Wetlands Protection Act regulations (310 CMR 10.55).

The Applicant originally proposed the creation of 5,100 s.f. of new wetlands along an existing access road adjacent to a BVW system along the eastern part of the site. A site walk with the Weymouth Conservation Commission was held on May 3, 2021. During the site walk, it was suggested by the Commission that rather than excavating the quarry access road to create new wetlands, it may be more beneficial from an ecological perspective to instead focus on enhancing the habitat within the 100-foot buffer zone, rather than creating more wetland. Additionally, because one of the IVWs to be filled by the Project is generally degraded and most of its functions altered, replacing the surface area of the lost IVWs may be less beneficial than enhancing the upland habitat areas.

Following this feedback from the Conservation Commission, the Applicant revised its proposed mitigation plan to focus solely on buffer zone enhancement. Specifically, the Project proposes to enhance and restore approximately 9,500 s.f. of the 100-foot buffer zone, including upland area habitat associated with a vernal pool, with native plantings like those found in the surrounding area. Due to the degraded nature of one of the IVWs to be filled, the Project aims to enhance the buffer zone area that adjoins a large BVW adjacent to the site, to enhance the habitat adjoining this higher quality wetland, as well as the habitat adjoining the vernal pool on site.

Additional information describing the proposed Plan is provided in the balance of this report. Refer to the Buffer Enhancement Drawings in Attachment C for additional detail.

2.0 Existing Conditions at Buffer Zone Enhancement Sites

Two existing quarry access roads located within the 100-foot buffer zone are proposed for restoration. These areas are depicted on Figures 1 and 2 in Attachment A; photographs are provided in Attachment B.

The first existing quarry access road is approximately 20 feet wide and borders the reference wetland along its western edge. Approximately 5,487 s.f. of this access road are proposed to be restored. The access road is relatively open and contains limited herbaceous vegetation and small saplings and shrubs. Scattered greenbrier (*Smilax rotundifolia*), white pine (*Pinus strobus*), red oak (*Quercus rubra*), black huckleberry (*Gaylussacia baccata*), and sheep laurel (*Kalmia* *angustifolia*) are present along the access road. Photos 7 through 9 depict the existing access road where one of the buffer enhancement areas is proposed to be constructed.

The second existing quarry access road that is proposed for restoration is located along the southeast corner of the site. This quarry road is located south of the vernal pool. The access road in this area is sparsely vegetated, particularly at the northern end. The northern end of the proposed buffer enhancement area is covered in small cobbles. Topography within the access road varies, and slopes upward to the south. The quarry access road is approximately 20 to 25 feet wide in this area. This area contains sparse herbaceous vegetation, but some saplings and shrubs were noted. Vegetation within the access road included white pine seedlings, honeysuckle (*Lonicera tatarica*), glossy buckthorn (*Frangula alnus*) seedlings, raspberry (*Rubus ideaus*), red maple seedlings, and autumn olive (*Elaeagnus umbellata*).

According to NRCS Soil Survey soils, soils within both of the buffer enhancement sites are characterized as Hollis-Rock outcrop-Charlton complex, 0 to 15 percent slopes.

3.0 Buffer Zone Restoration and Enhancement Plan

To enhance wildlife habitat value within the 100-foot buffer zone adjacent to the Project, portions of two existing quarry roads in the eastern and southeastern part of the site will be restored and planted. Construction of the "Buffer Zone Restoration and Enhancement Areas" will consist of: (1) removal of fill material and replacement with a suitable planting medium; (2) installation of woody plantings and a conservation seed mix; and (3) placement of coarse woody debris and installation of nest boxes.

The location of the buffer zone restoration and enhancement areas are depicted on the plan in Attachment C. As previously noted, the restoration areas are proposed in two locations: one will be approximately 5,487 s.f. in size and will extend along the access road adjacent to Wetland Series E, from a point adjacent to Wetland Flag E-37 to Wetland Flag E-53; and the second area will be 4,022 s.f. in size and will be located between the proposed development and the quarry hole/ IVW (vernal pool) located upgradient from the access road. The goal of the restoration areas is not to replicate wetlands, but rather to enhance the value of these areas for wildlife, particularly species likely to use the upland forest edge habitat. Further, a vernal pool is located between the two restoration areas. Thus, the goal is to enhance the value of this buffer zone strip, which is currently a relatively sparse access road. Planted shrubs and coarse woody debris will provide food, cover, and perching habitat for a variety of wildlife species.

The topsoil in each area will be rototilled, supplemented with loam, and planted with native plant species. In the southeast quarry road, where cobbles cover part of the access road, they will be removed prior to tilling and prepping the soil for planting. The native plants will be installed in clusters to mimic a natural environment. A qualified wetland scientist will oversee the restoration work and will provide direction on where to install the plantings based on field conditions. A planting table for the buffer zone restoration and enhancement areas is provided below.

Table 3-1 Buffer Zone Restoration and Enhancement Area Plantings

Plant Name	Plant Height	Plant Quantity[1]	Wetland Indicator Status	Planting Notes
Red maple (*Acer rubrum*)	6-8’	22	FAC	Red maples flower early in the spring. The leaves and shoots are browsed by deer. Rodents feed on the fruits. Adds important leaf litter.
Red oak (*Quercus rubra*)	6-8’	22	FACU	Red oak provides good cover for mammal and bird species and nesting sites for songbirds. Deer browse the leaves, and acorns are eaten by a variety of mammals. Adds important leaf litter.
Black huckleberry (*Gaylussacia baccata*)	3-4’	16	FACU	Berries provide a food source for wildlife.
Sweet pepperbush (*Clethra alnifolia*)	3-4’	16	FAC	A medium-sized salt tolerant shrub found in coastal and inland wetlands. Sweet-smelling white flowers in July. Provides food and cover for birds.
	TOTAL	**76**		
New England Conservation/Wildlife Mix[2]	1 lb/ 1,750 s.f.	~5.5 lbs	Varied	The New England Conservation/Wildlife Mix™ (or equivalent) contains a variety of grasses, wildflowers, and legumes. This seed mix enhances wildlife habitat value.

Only plant materials native and indigenous to the region should be used. The two restoration areas should be sown with a conservation seed mix (see Table 3-1 above) and covered with a light mulch of weed free straw, particularly if planted during the summer months. The woody plants should be surrounded with an approximately 3-foot diameter ring of woody mulch to a depth of approximately 2-inches or biodegradable plastic or fiber (which should be stapled or staked to the ground), to reduce the threat of competition from herbaceous species during the first growing season.

Miscellaneous Planting Requirements:

---

1 Assumes an average plant spacing of roughly 12-feet on center, accounting for existing plants in the buffer zone enhancement areas.

2 New England Conservation/Wildlife Mix - Virginia Wild Rye (*Elymus virginicus*), Little Bluestem (*Schizachyrium scoparium*), Big Bluestem (*Andropogon gerardii*), Red Fescue (*Festuca rubra*), Switch Grass (*Panicum virgatum*), Partridge Pea (*Chamaecrista fasciculata*), Panicledleaf Tick Trefoil (*Desmodium paniculatum*), Indian Grass (*Sorghastrum nutans*), Blue Vervain (*Verbena hastata*), Butterfly Milkweed (*Asclepias tuberosa*), Black Eyed Susan (*Rudbeckia hirta*), Common Sneezeweed (*Helenium autunale*), Heath Aster (*Asterpilosus/Symphyotrichum pilosum*), Early Goldenrod (*Solidago juncea*), Upland Bentgrass (*Agrostis perennans*). (Application Rate = 1 lb/ 1,750 s.f.). Source: New England Wetland Plants, Inc.

1. The wetland specialist ("WS") may propose substitutions relative to species, size, and quantities if there is limited availability of plant stock at the time of planting. All plant material shall be purchased from a New England nursery and guaranteed by the site contractor to be in vigorous growing condition.

2. Insofar as it is practicable, plant material shall be planted on the day of delivery. In the event this is not practicable, the site contractor shall protect, and water stock not planted in consultation with the WS and nursery. Plants shall not remain unplanted for longer than a 3-day period after delivery to the site. Any plants not installed during this 3-day period may be rejected by the WS.

3. Quality and size of plants, spread of roots, and size of balls shall be in accordance with ANSI 260 (REV.1980) "American Standard for Nursery Stock" as published by the American Association of Nurserymen, Inc.

4. All plants shall be planted in transported topsoil that is thoroughly watered and tamped as back filling progresses. Raise and replant any plant which settles more than 2 inches after planting and watering.

5. Plants shall not be bound with wire or rope at any time to damage the bark or break branches. Plants shall be handled from the bottom of the ball or container only.

6. Planting operations shall be performed during periods within the planting season when weather and soil conditions are suitable as determined by the supervising WS. This is typically between April 15 and June 15 and September 15 through November 15. Plants shall not be installed in topsoil that is in a muddy or frozen condition. The site contractor shall be responsible for re-setting any plants that become dislodged or uprooted because of frost heaves or other environmental factors during the first two growing seasons.

7. Set all plants plumb and straight. Locate plant in the center of the pit.

8. The conservation/wildlife seed mix shall be sown according to the manufacturer's recommendations and specifications.

9. Due to unpredictability of short term local hydrologic conditions and the need for additional care to establish new plantings the site contractor shall irrigate the plantings, as necessary, during the first growing season after planting.

Approximately 5% of the restoration area shall be covered in coarse woody debris consisting of tree branches or logs that will provide cover for amphibians, snakes, and small mammals. Three to five brush piles shall be placed within the restoration area for the same purpose. Lastly, six (6) nest boxes shall be installed within the restoration areas to encourage nesting songbirds such as chickadees, wrens, woodpeckers, and nuthatches. The nest boxes specifications will be tailored towards these types of songbirds.

4.0 Monitoring Plan

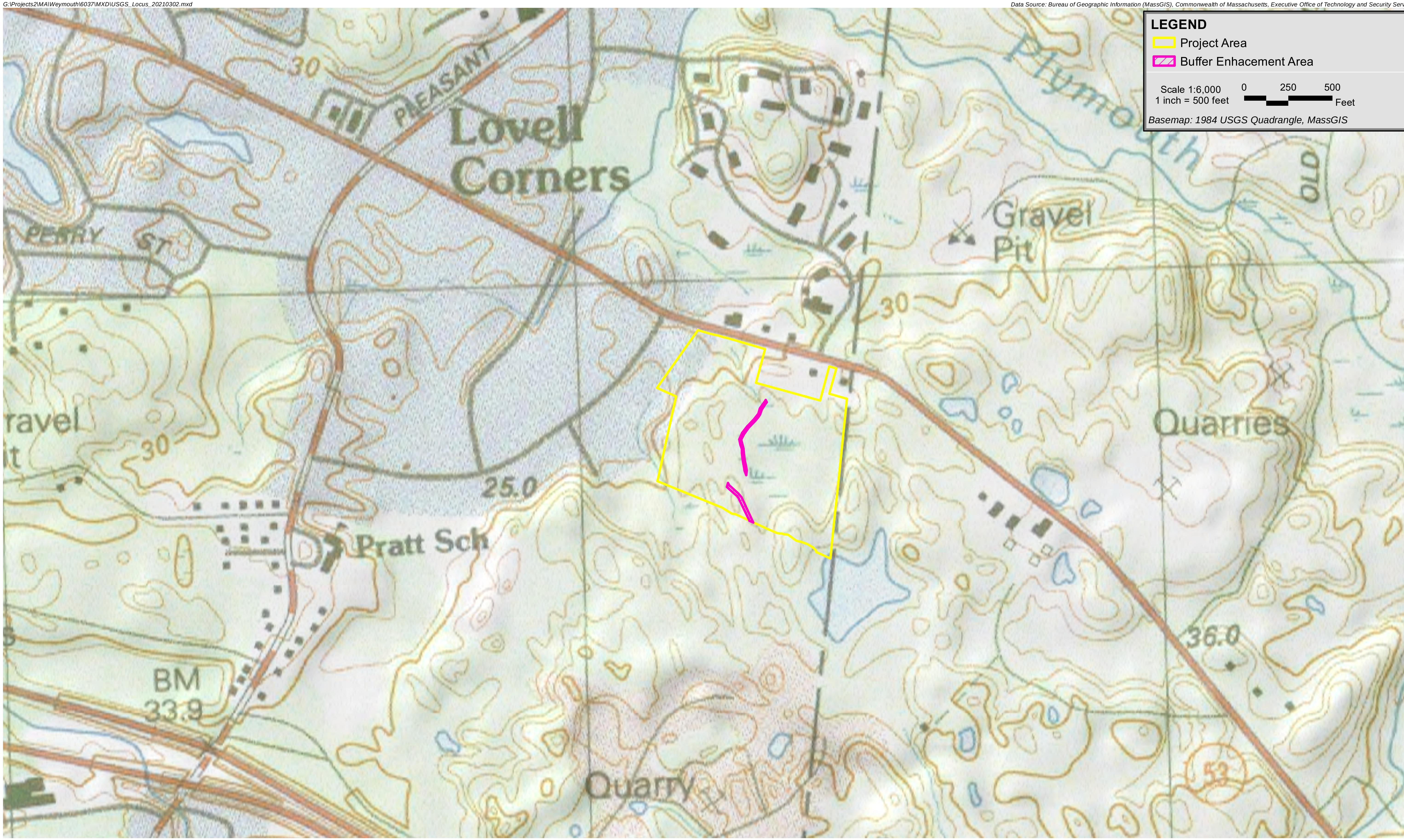
The buffer zone restoration and enhancement areas will be monitored twice per year (spring and fall) for two growing seasons by a qualified WS. The plantings will be monitored, the germination of the seed mix will be documented, and observed wildlife activity and usage will be documented. The annual reports will be submitted to the Commission no later than December 31 each year and will include results from the spring and fall inspections.

Attachment A

Figures

G:\Projects2\MA\Weymouth\6037\MXD\USGS_Locus_20210302.mxd

Data Source: Bureau of Geographic Information (MassGIS), Commonwealth of Massachusetts, Executive Office of Technology and Security Services

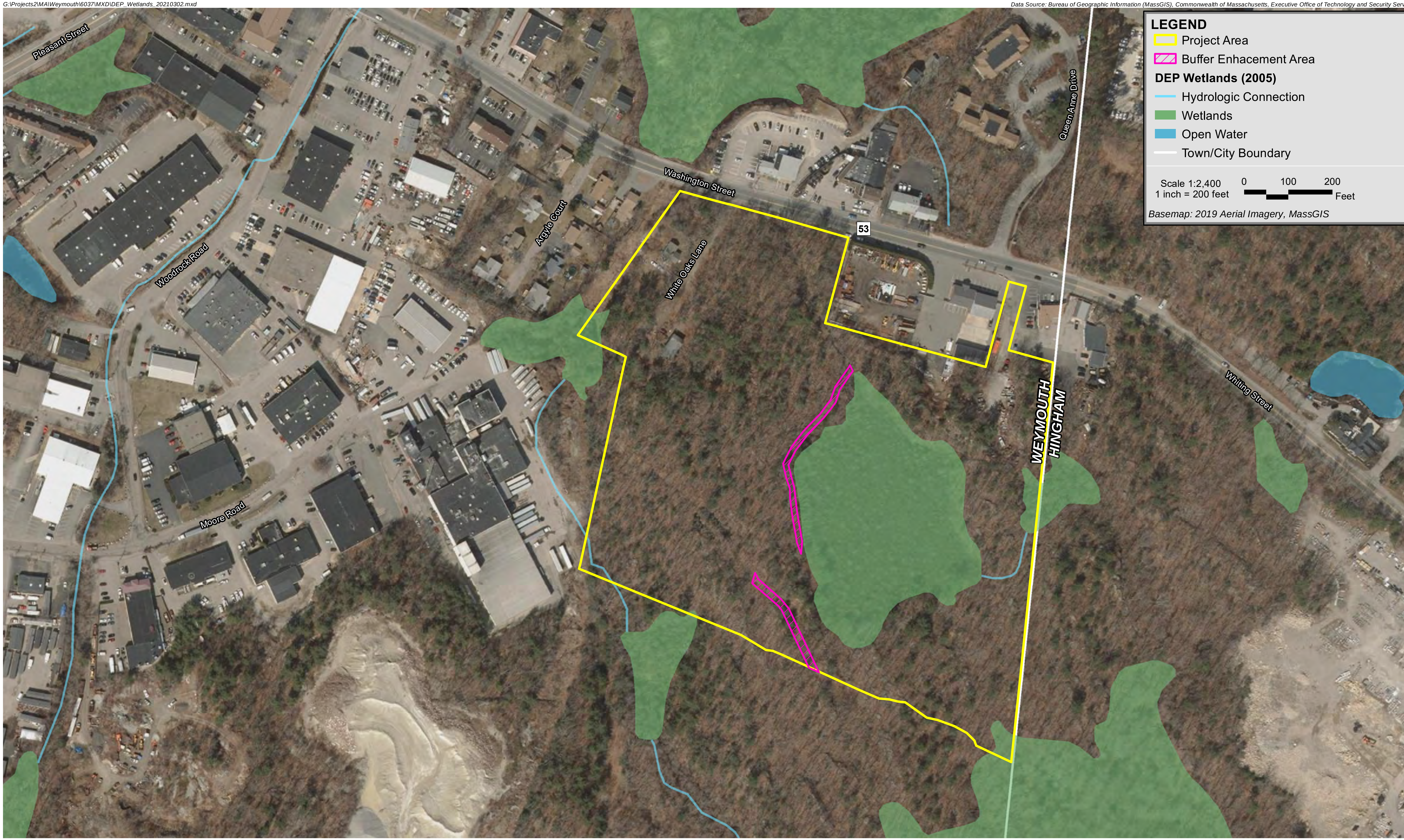


Washington Street Residential Apartments **Weymouth, Massachusetts**

Epsilon ASSOCIATES INC.

Figure 1

USGS Locus Map



Washington Street Residential Apartments **Weymouth, Massachusetts**

Epsilon
ASSOCIATES INC.

Figure 2
DEP Wetlands

Attachment B

Site Photographs

Photo 1: IVW Series H – Impact Area.

Photo 2: Another view of IVW Series H in the spring.

Photo 3: IVW Series G impact area.

Photo 4: Another view of IVW Series G.

Photo 5: View of BVW Series E, located adjacent to the historic access road proposed for restoration.

Photo 6: View of vernal pool upgradient of proposed buffer zone restoration area.

Photo 7: View of proposed buffer zone enhancement area / existing access road, looking north with BVW Series E to the east.

Photo 8: Another typical view of the proposed buffer enhancement area directly adjacent to Wetland Series E.

Photo 9: Typical view of the limited herbaceous cover within the existing access road adjacent to Wetland Series E.

Photo 10: View of the second proposed buffer enhancement location, an existing access road in the southeast corner of the site.

Photo 11: Cobbles within the southeast access road that is proposed for restoration.

Photo 12: Typical view of the southeast access road proposed for buffer enhancement.

Attachment C

Buffer Enhancement Drawings

NOTES:

1. CONSIDERATION WILL BE GIVEN TO LEAVING EXISTING MATURE UPLAND TREES ON HUMMOCKS WITHIN THE ENHANCEMENT AREA, AS THEY CAN PROVIDE SHADING AND REDUCE HEAT WITHIN THE SOIL STRATA AND RESULTANT EVAPORATION. TREES TO REMAIN IN PLACE ON MOUNDS WILL BE SELECTED AND FLAGGED BY A QUALIFIED WETLAND SCIENTIST PRIOR TO INITIATING CLEARING ACTIVITIES.
2. THE TRANSITION BETWEEN THE ENHANCEMENT AREA EDGE AND THE EXISTING WETLAND EDGE SHALL BE GRADED IN A MANNER THAT RESULTS IN A NATURAL SLOPE (NO ARTIFICIAL BERM. THIS REFINED GRADING SHALL BE CONDUCTED UNDER THE SUPERVISION OF A QUALIFIED WETLAND SCIENTIST
3. THE EXISTING ACCESS ROAD WILL BE TILLED AND SUPPLEMENTED WITH 6" OF LOAM TO CREATE A SUITABLE PLANTING MEDIUM FOR THE SUPPLEMENTAL BUFFER ZONE ENHANCEMENT PLANTING AND SOWN WITH A CONSERVATION SEED MIX

Date	Description	No.
	Revisions	

GABRIEL R. CROCKER
PROFESSIONAL ENGINEER, MA REGISTRATION #47917

Crocker Design Group
2 SHARP STREET, UNIT B
HINGHAM, MA 02043
P: 781-919-0808

Project
HANOVER WEYMOUTH RESIDENTIAL DEVELOPMENT
#1325 WASHINGTON STREET, WEYMOUTH, MA

Prepared for
HANOVER R.S. LIMITED PARTNERSHIP
ONE MARINE PARK DRIVE, SUITE 701, BOSTON, MA 02210
HANOVER COMPANY

Drawing Title
BUFFER ZONE RESTORATION AND ENHANCEMENT PLAN

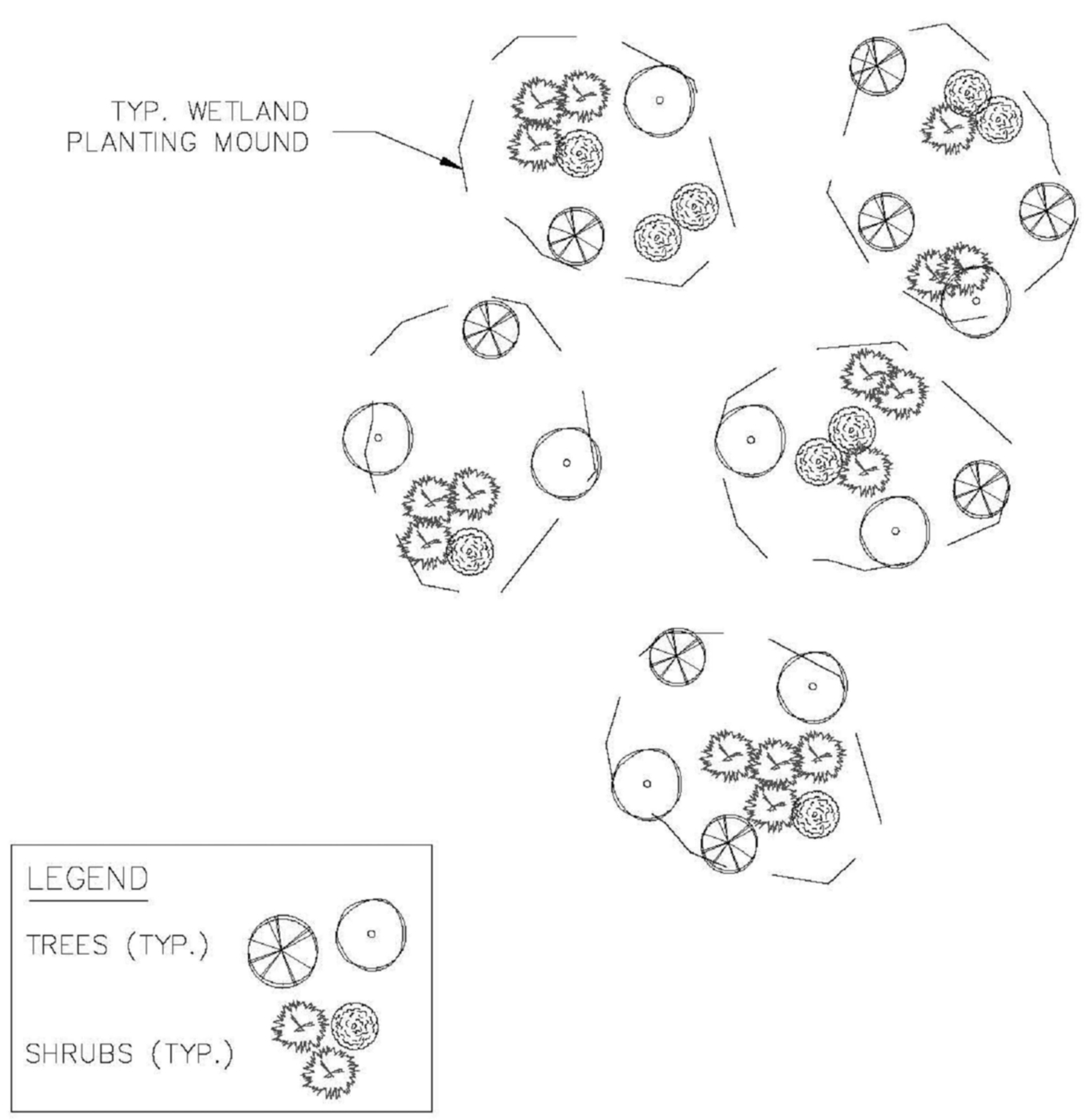
Project No.	100-124
Date	6.21.2021
Scale	1"=30'
Drawn By	AS
Approved By	GC

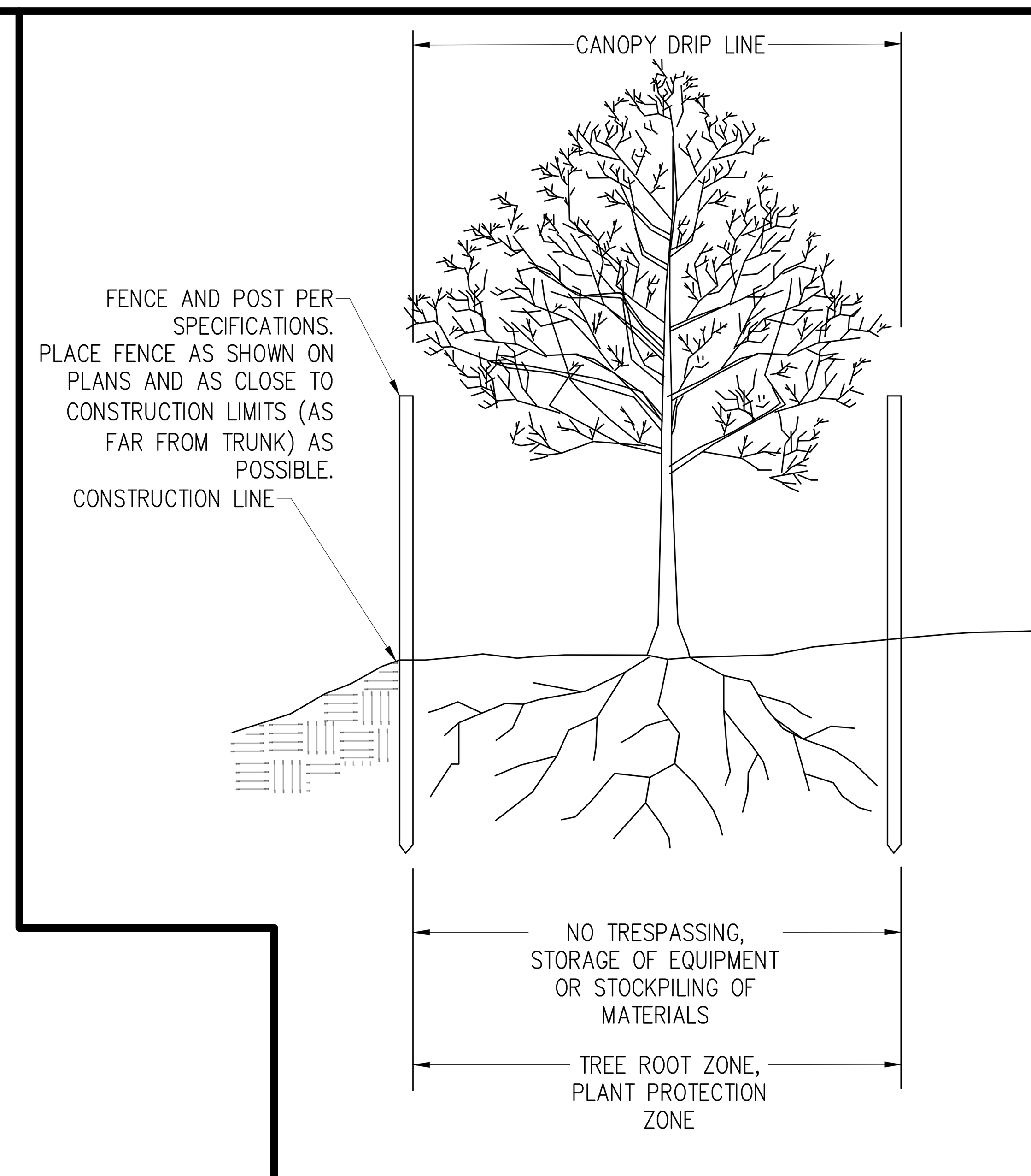
Drawing No.
W-1

PLANT SPACING DETAILS

NOT TO SCALE

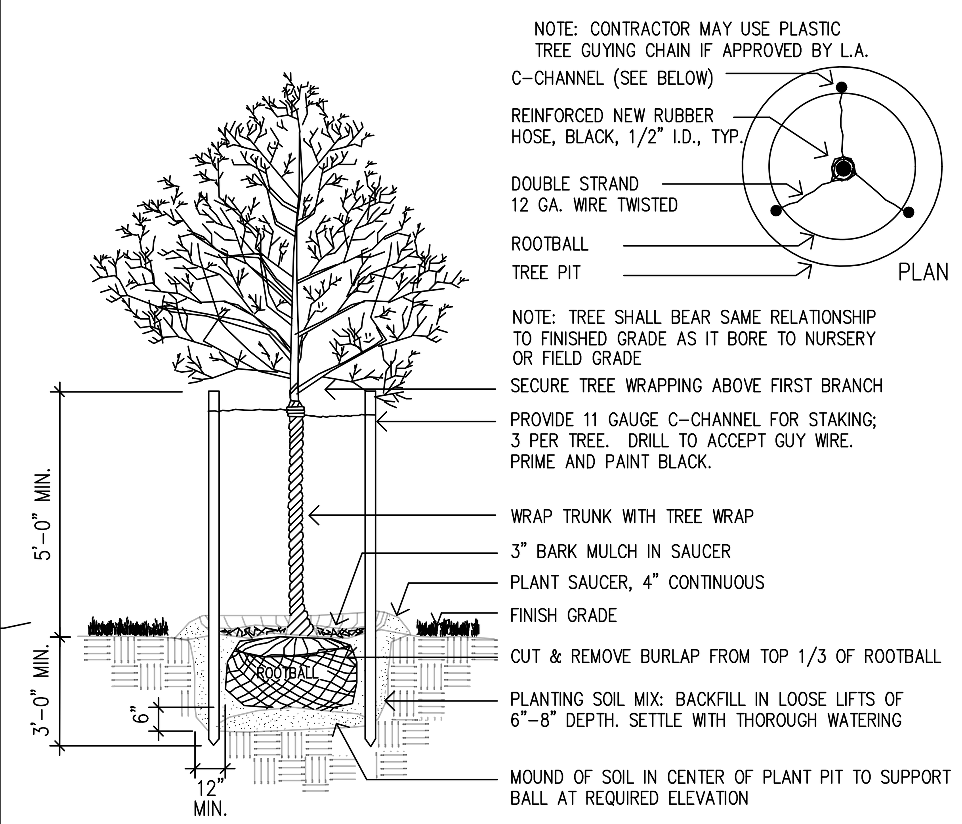
TYPICAL WETLAND PLANTING LAYOUT





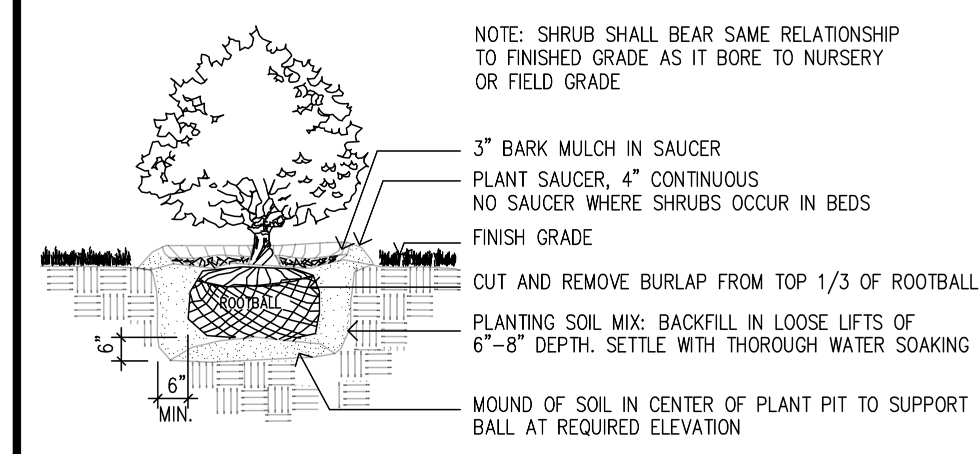
TREE PROTECTION- EXISTING TREE

NOT TO SCALE



DECIDUOUS TREE PLANTING AND STAKING

SCALE: N.T.S.



TYPICAL SHRUB PLANTING

SCALE: N.T.S.

BUFFER ZONE RESTORATION AND ENHANCEMENT AREA PLANTING TABLE

Plant Name	Plant Height	Plant Quantity (1)	Wetland Indicator Status	Planting Notes
Red maple (*Acer rubrum*)	6-8'	22	FAC	Red maples flower early in the spring. The leaves and shoots are browsed by deer. Rodents feed on the fruits. Adds important leaf litter.
Red oak (*Quercus rubra*)	6-8'	22	FACU	Red oak provides good cover for mammal and bird species and nesting sites for songbirds. Deer browse the leaves, and acorns are eaten by a variety of mammals. Adds important leaf litter.
Black huckleberry (*Gaylussacia baccata*)	3-4'	16	FACU	Berries provide a food source for wildlife.
Sweet pepperbush (*Clethra alnifolia*)	3-4'	16	FAC	A medium-sized salt tolerant shrub found in coastal and inland wetlands. Sweet-smelling white flowers in July. Provides food and cover for birds.
	TOTAL	**76**		
New England Conservation/Wildlife Mix	1 lb/ 1,750 s.f.	~5.5 lbs	Varied	The New England Conservation/Wildlife Mix™ (or equivalent) contains a variety of grasses, wildflowers, and legumes. This seed mix enhances wildlife habitat value.

(1) Assumes an average plant spacing of roughly 12-feet on center, accounting for existing plants in the buffer zone enhancement area.

CONSERVATION SEED MIX SPECS FOR RESTORATION AND BUFFER ENHANCEMENT AREA

Botanical Name	Common Name	Indicator
Elymus virginicus	Virginia Wild Rye	FACW-
Schizachyrium scoparium	Little Bluestem	FACU
Andropogon gerardii	Big Bluestem	FAC
Festuca rubra	Red Fescue	FACU
Sorghastrum nutans	Indian Grass	UPL
Panicum virgatum	Switch Grass	FAC
Chamaecrista fasciculata	Partridge Pea	FACU
Desmodium canadense	Showy Tick Trefoil	FAC
Asclepias tuberosa	Butterfly Milkweed	NI
Bidens frondosa	Beggar Ticks	FACW
Eupatorium purpureum (Eutrochium maculatum)	Purple Joe Pye Weed	FAC
Rudbeckia hirta	Black Eyed Susan	FACU-
Aster pilosus (Symphyotrichum pilosum)	Heath (or Hairy) Aster	UPL
Solidago juncea	Early Goldenrod	

Date	Description	No.
	Revisions	

GABRIEL R. CROCKER
PROFESSIONAL ENGINEER, MA REGISTRATION #47917

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P: 781-919-0808

Project: HANOVER WEYMOUTH RESIDENTIAL DEVELOPMENT
#1325 WASHINGTON STREET, WEYMOUTH, MA

Prepared for: HANOVER R.S. LIMITED PARTNERSHIP
ONE MARINE PARK DRIVE, SUITE 701, BOSTON, MA 02210
HANOVER COMPANY

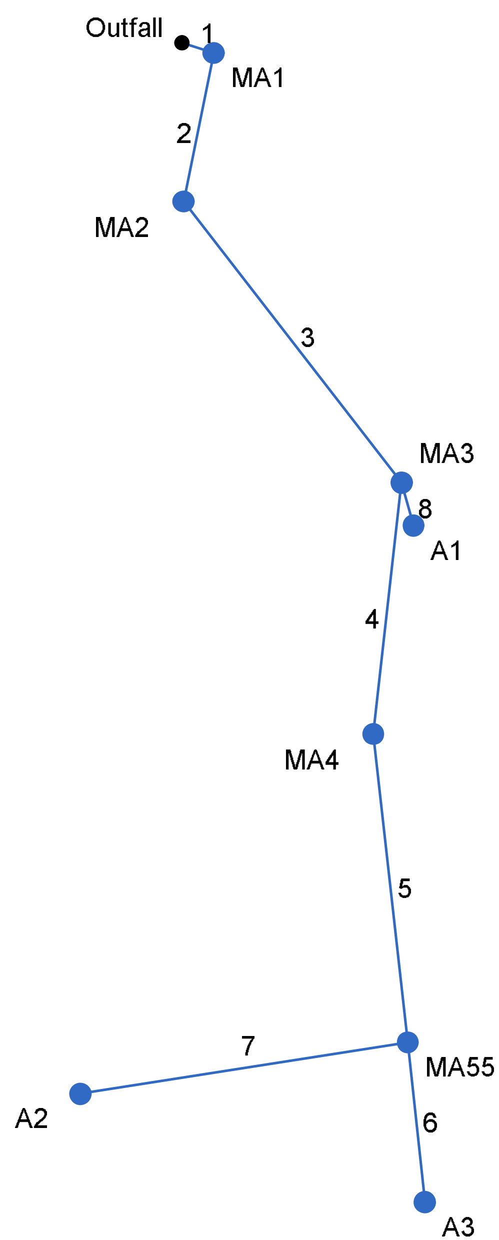
Drawing Title: BUFFER ZONE RESTORATION AND ENHANCEMENT DETAILS

Project No.	100-124
Date	4.8.2021
Scale	AS NOTED
Drawn By	AS
Approved By	GC

Drawing No. W-2

SECTION 7 – HYDRAULIC PIPE SIZING

Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: Network A.stm	Number of lines: 8	Date: 7/14/2021

Storm Sewers v12.00

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Dn	Up	Dn	Up	Dn	Up	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
1	End	6.727	0.00	0.49	0.00	0.00	0.12	0.0	7.2	5.3	0.63	4.25	0.58	15	0.43	83.59	83.62	84.64	84.64	0.00	89.68	Pipe - (427) (3) (3)
2	1	26.914	0.00	0.49	0.00	0.00	0.12	0.0	6.8	5.4	0.64	2.52	1.29	12	0.50	83.97	84.10	84.65	84.65	89.68	90.48	Pipe - (427) (3) (2)
3	2	66.274	0.00	0.49	0.00	0.00	0.12	0.0	6.3	5.5	0.65	2.55	2.27	12	0.51	84.20	84.54	84.68	84.88	90.48	90.72	Pipe - (427) (3) (1)
4	3	44.382	0.00	0.39	0.00	0.00	0.07	0.0	6.0	5.6	0.42	10.07	2.12	12	8.00	84.64	88.19	84.98	88.45	90.72	92.77	Pipe - (427) (3) (5)
5	4	54.289	0.00	0.39	0.00	0.00	0.07	0.0	5.8	5.6	0.42	8.18	3.98	12	5.27	89.60	92.46	89.75	92.73	92.77	96.06	Pipe - (426) (4) (1)
6	5	28.370	0.21	0.21	0.27	0.06	0.06	5.0	5.0	5.8	0.33	2.50	2.21	12	0.49	92.75	92.89	93.00	93.14	96.06	96.06	Pipe - (426) (4) (4)
7	5	67.190	0.18	0.18	0.10	0.02	0.02	5.0	5.0	5.8	0.11	2.50	1.45	12	0.49	92.56	92.89	92.73	93.02	96.06	96.06	Pipe - (426) (4) (1)
8	3	7.743	0.10	0.10	0.44	0.04	0.04	5.0	5.0	5.8	0.26	2.56	2.08	12	0.52	88.03	88.07	88.24	88.28	90.72	90.73	Pipe - (426) (4) (4)

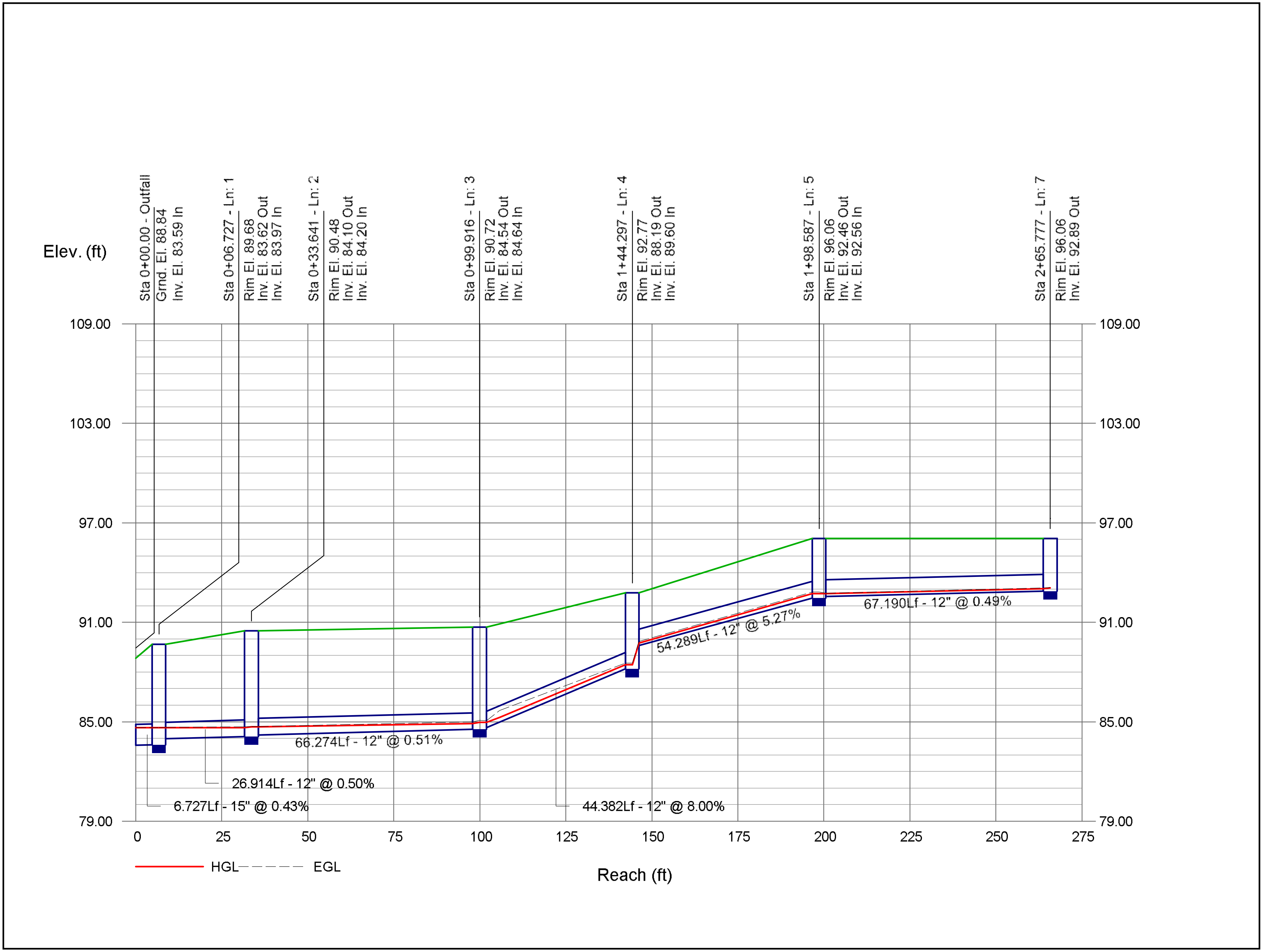
Project File: Network A.stm | Number of lines: 8 | Run Date: 7/14/2021

NOTES:Intensity = 59.21 / (Inlet time + 12.50) ^ 0.81 ; Return period =Yrs. 10 ; c = cir e = ellip b = box

Storm Sewers v12.00

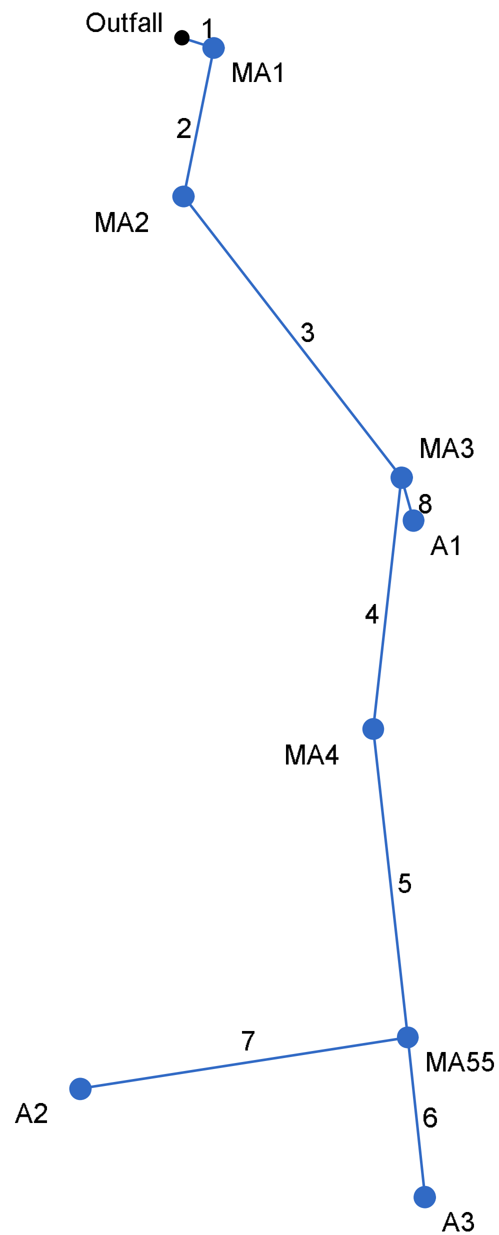
Storm Sewer Profile

Proj. file: Network A.stm



Storm Sewers

Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: Network A.stm	Number of lines: 8	Date: 7/14/2021

Storm Sewers v12.00

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Dn	Up	Dn	Up	Dn	Up	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
1	End	6.727	0.00	0.49	0.00	0.00	0.12	0.0	7.8	7.1	0.84	4.25	0.69	15	0.43	83.59	83.62	86.46	86.46	0.00	89.68	Pipe - (427) (3) (3)
2	1	26.914	0.00	0.49	0.00	0.00	0.12	0.0	7.4	7.2	0.85	2.52	1.09	12	0.50	83.97	84.10	86.47	86.48	89.68	90.48	Pipe - (427) (3) (2)
3	2	66.274	0.00	0.49	0.00	0.00	0.12	0.0	6.4	7.4	0.88	2.55	1.12	12	0.51	84.20	84.54	86.50	86.54	90.48	90.72	Pipe - (427) (3) (1)
4	3	44.382	0.00	0.39	0.00	0.00	0.07	0.0	6.0	7.5	0.56	10.07	1.71	12	8.00	84.64	88.19	86.56	88.50	90.72	92.77	Pipe - (427) (3) (5)
5	4	54.289	0.00	0.39	0.00	0.00	0.07	0.0	5.7	7.6	0.57	8.18	4.34	12	5.27	89.60	92.46	89.78	92.77	92.77	96.06	Pipe - (426) (4) (1)
6	5	28.370	0.21	0.21	0.27	0.06	0.06	5.0	5.0	7.8	0.44	2.50	2.40	12	0.49	92.75	92.89	93.03	93.17	96.06	96.06	Pipe - (426) (4) (4)
7	5	67.190	0.18	0.18	0.10	0.02	0.02	5.0	5.0	7.8	0.14	2.50	1.51	12	0.49	92.56	92.89	92.77	93.04	96.06	96.06	Pipe - (426) (4) (1)
8	3	7.743	0.10	0.10	0.44	0.04	0.04	5.0	5.0	7.8	0.34	2.56	2.26	12	0.52	88.03	88.07	88.28	88.32	90.72	90.73	Pipe - (426) (4) (4)

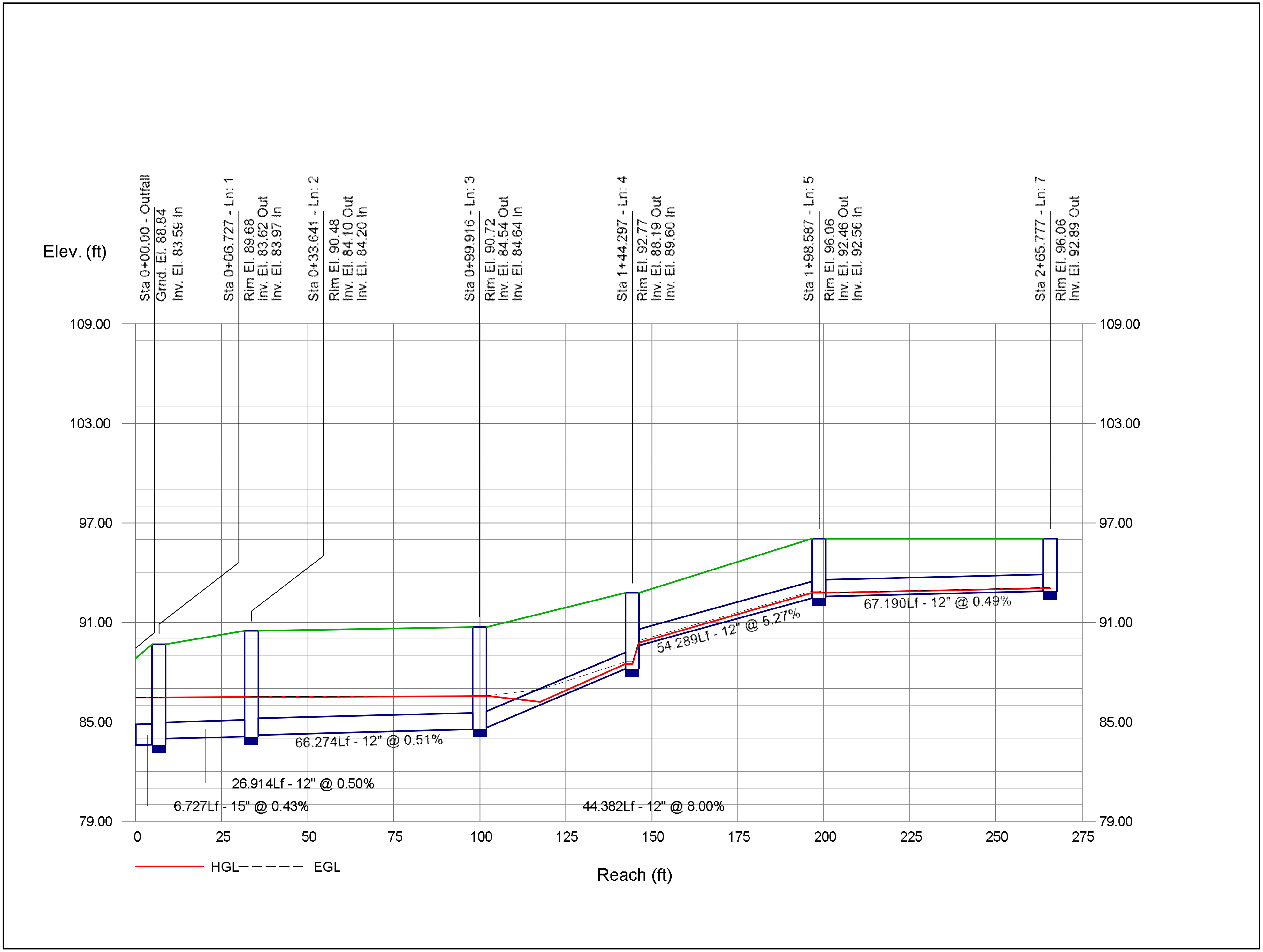
Project File: Network A.stm | Number of lines: 8 | Run Date: 7/14/2021

NOTES:Intensity = 197.93 / (Inlet time + 22.50) ^ 0.98 ; Return period =Yrs. 100 ; c = cir e = ellip b = box

Storm Sewers v12.00

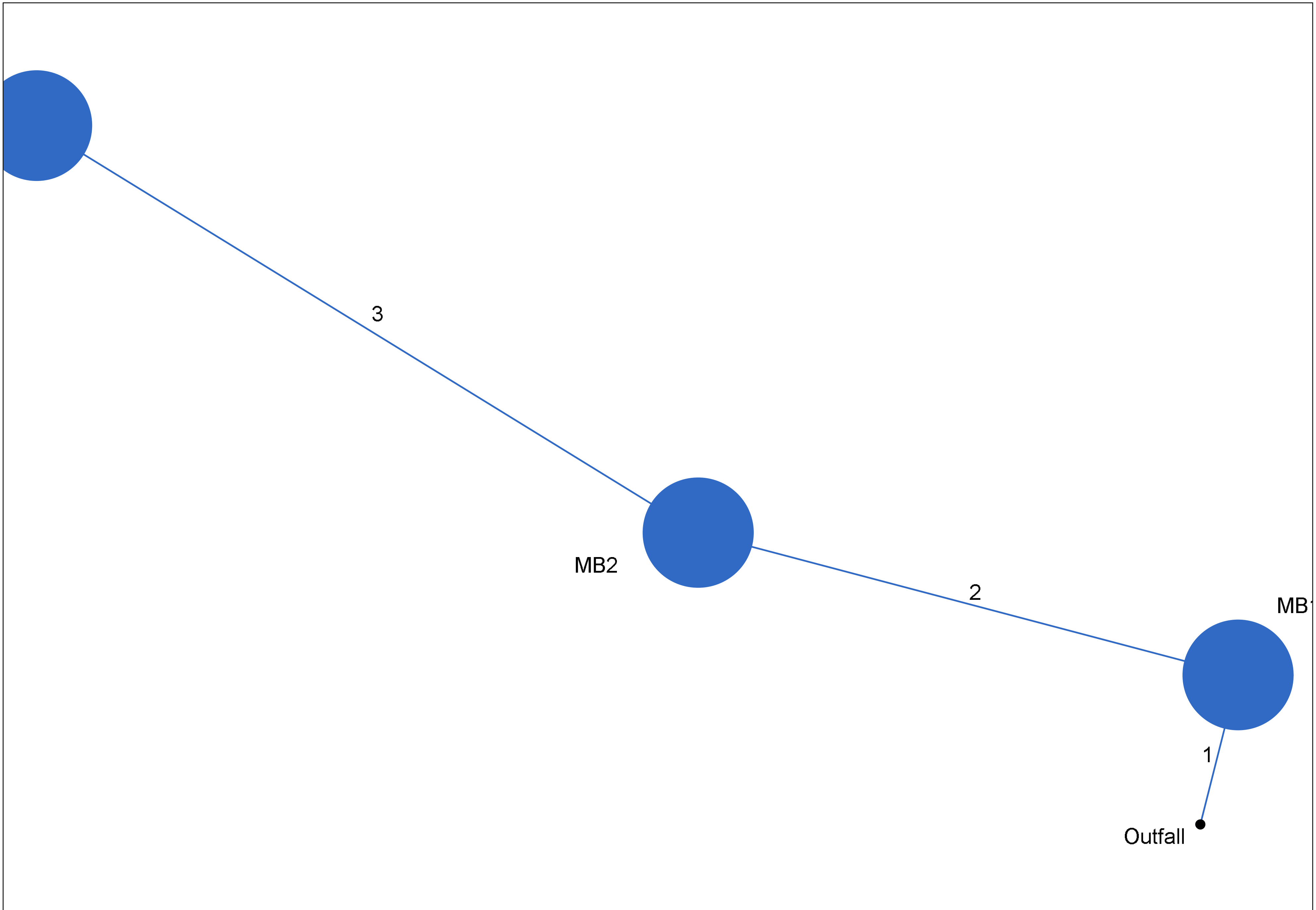
Storm Sewer Profile

Proj. file: Network A.stm



Storm Sewers

Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: Network B.stm	Number of lines: 3	Date: 7/14/2021

Storm Sewers v12.00

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Dn	Up	Dn	Up	Dn	Up	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
1	End	5.436	0.00	0.17	0.00	0.00	0.14	0.0	5.3	5.8	0.82	2.30	2.44	12	0.42	84.19	84.21	84.64	84.65	0.00	89.22	Pipe - (427) (5)
2	1	20.483	0.00	0.17	0.00	0.00	0.14	0.0	5.2	5.8	0.83	2.52	2.74	12	0.50	84.31	84.42	84.75	84.80	89.22	88.71	Pipe - (426) (5) (1)
3	2	28.352	0.17	0.17	0.84	0.14	0.14	5.0	5.0	5.8	0.83	2.50	2.87	12	0.49	84.52	84.66	84.92	85.06	88.71	87.82	Pipe - (426) (5)

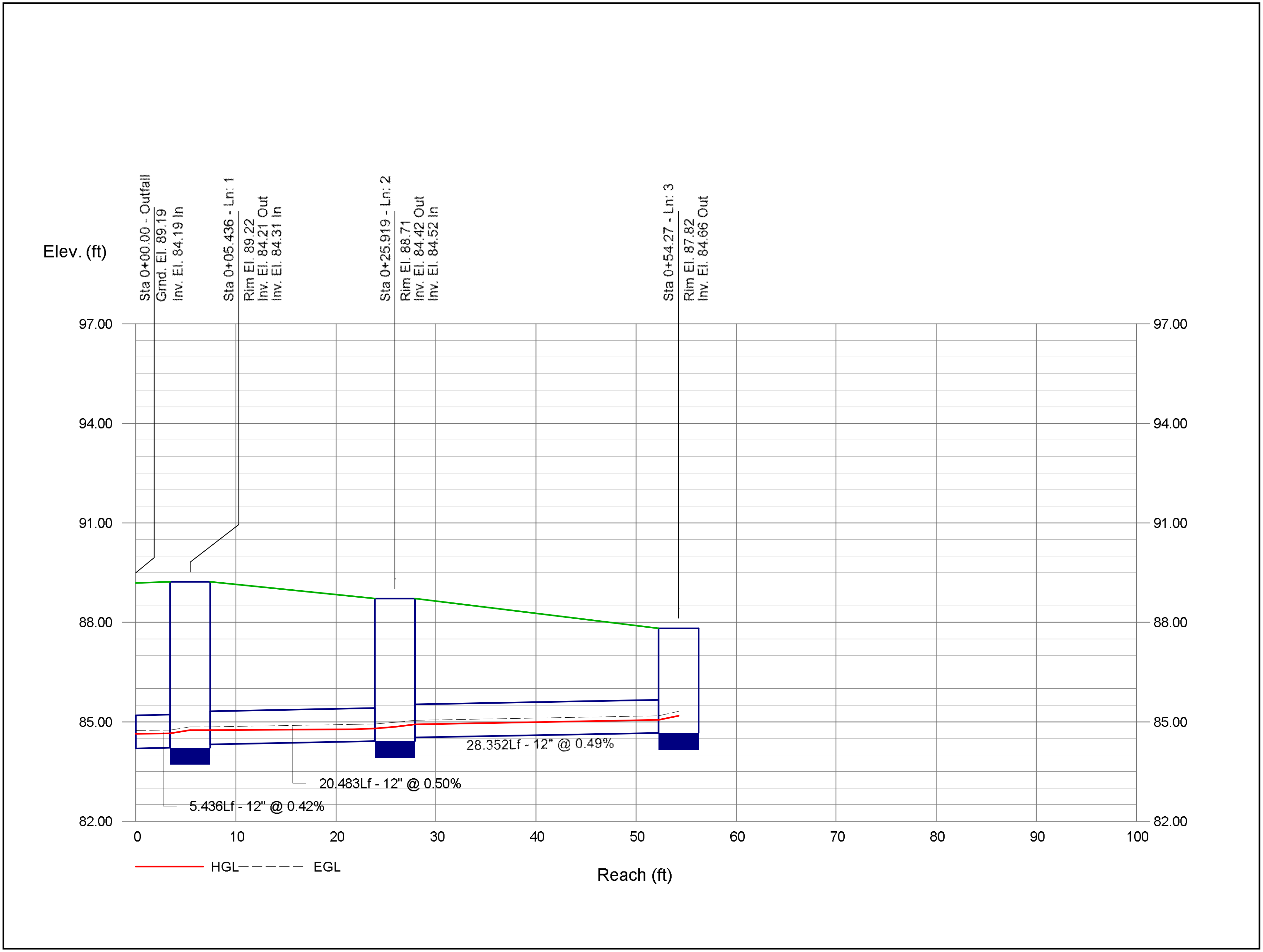
Project File: Network B.stm | Number of lines: 3 | Run Date: 7/14/2021

NOTES:Intensity = 59.21 / (Inlet time + 12.50) ^ 0.81 ; Return period =Yrs. 10 ; c = cir e = ellip b = box

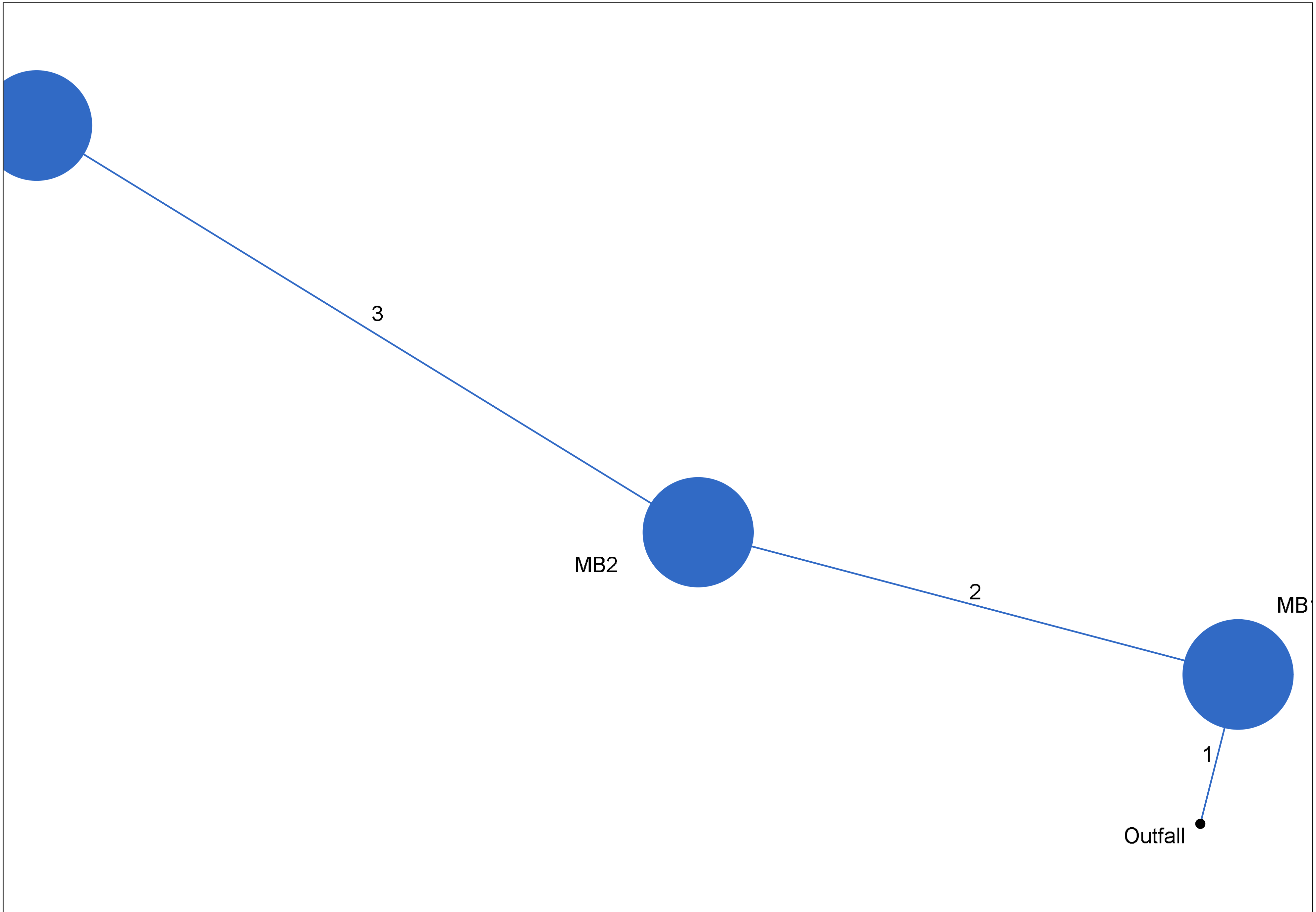
Storm Sewers v12.00

Storm Sewer Profile

Proj. file: Network B.stm



Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: Network B.stm	Number of lines: 3	Date: 7/14/2021

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Dn	Up	Dn	Up	Dn	Up	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
1	End	5.436	0.00	0.17	0.00	0.00	0.14	0.0	5.6	7.6	1.09	2.30	1.39	12	0.42	84.19	84.21	86.46	86.47	0.00	89.22	Pipe - (427) (5)
2	1	20.483	0.00	0.17	0.00	0.00	0.14	0.0	5.3	7.7	1.10	2.52	1.40	12	0.50	84.31	84.42	86.50	86.51	89.22	88.71	Pipe - (426) (5) (1)
3	2	28.352	0.17	0.17	0.84	0.14	0.14	5.0	5.0	7.8	1.11	2.50	1.42	12	0.49	84.52	84.66	86.52	86.55	88.71	87.82	Pipe - (426) (5)

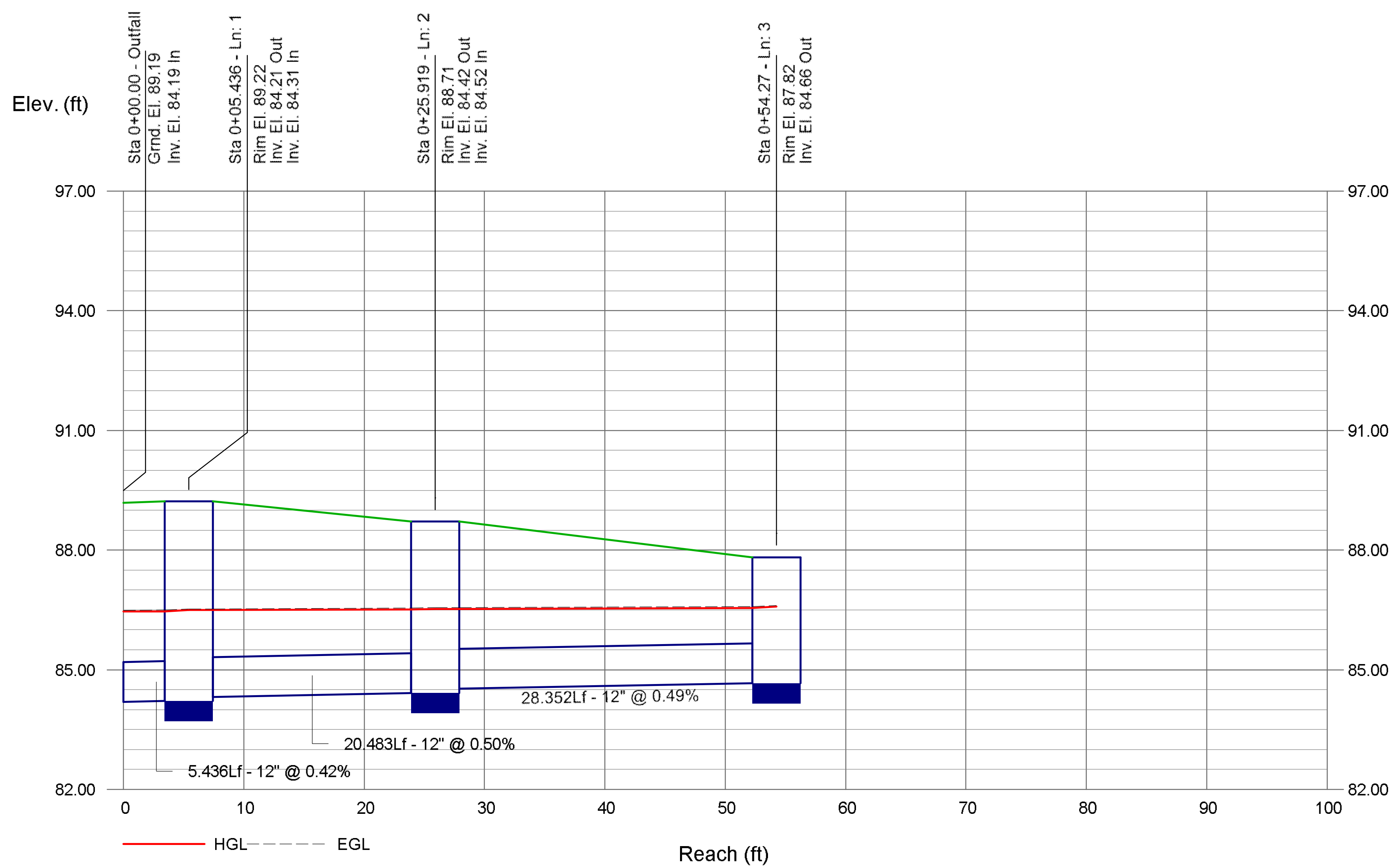
Project File: Network B.stm	Number of lines: 3	Run Date: 7/14/2021

NOTES:Intensity = 197.93 / (Inlet time + 22.50) ^ 0.98 ; Return period =Yrs. 100 ; c = cir e = ellip b = box

Storm Sewers v12.00

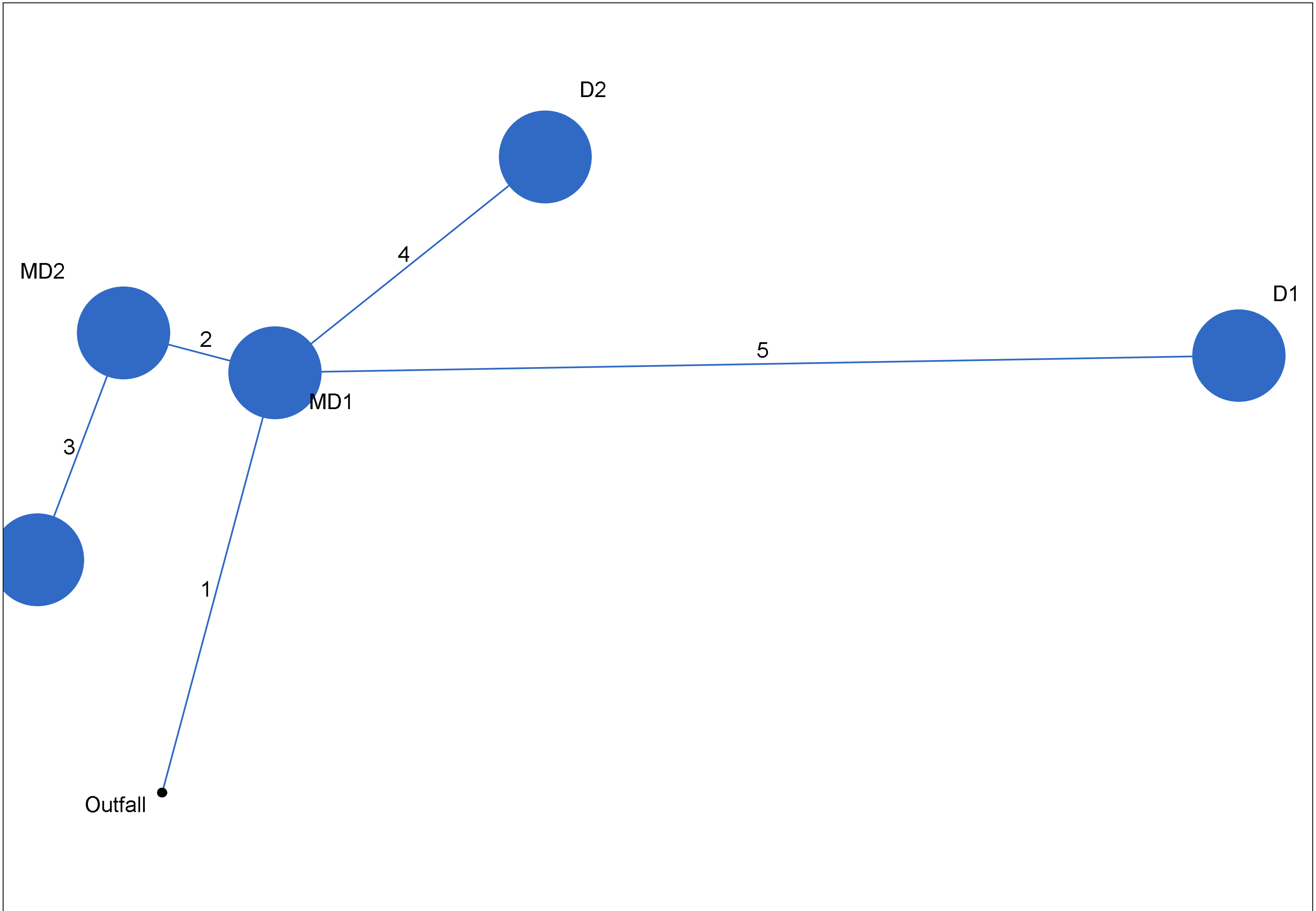
Storm Sewer Profile

Proj. file: Network B.stm



Storm Sewers

Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: Network D.stm	Number of lines: 5	Date: 7/14/2021

Storm Sewers v12.00

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Dn	Up	Dn	Up	Dn	Up	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
1	End	19.111	0.00	0.39	0.00	0.00	0.26	0.0	5.4	5.7	1.50	2.54	3.38	12	0.51	83.23	83.33	83.78	83.88	0.00	86.85	Pipe - (427) (3) (4)
2	1	6.856	0.00	0.22	0.00	0.00	0.13	0.0	5.1	5.8	0.78	2.52	1.76	12	0.50	83.49	83.52	84.06	84.06	86.85	86.84	Pipe - (426) (4) (1)
3	2	10.606	0.22	0.22	0.61	0.13	0.13	5.0	5.0	5.8	0.78	3.09	2.51	12	0.75	83.62	83.70	84.11	84.07	86.84	86.87	Pipe - (426) (4) (1)
4	1	15.223	0.07	0.07	0.89	0.06	0.06	5.0	5.0	5.8	0.36	2.58	1.23	12	0.53	83.61	83.69	84.06	84.06	86.85	86.86	Pipe - (426) (4) (1)
5	1	42.106	0.10	0.10	0.65	0.07	0.07	5.0	5.0	5.8	0.38	4.14	1.77	12	1.35	83.61	84.18	84.06	84.43	86.85	86.85	Pipe - (426) (4) (3)

Project File: Network D.stm

Number of lines: 5

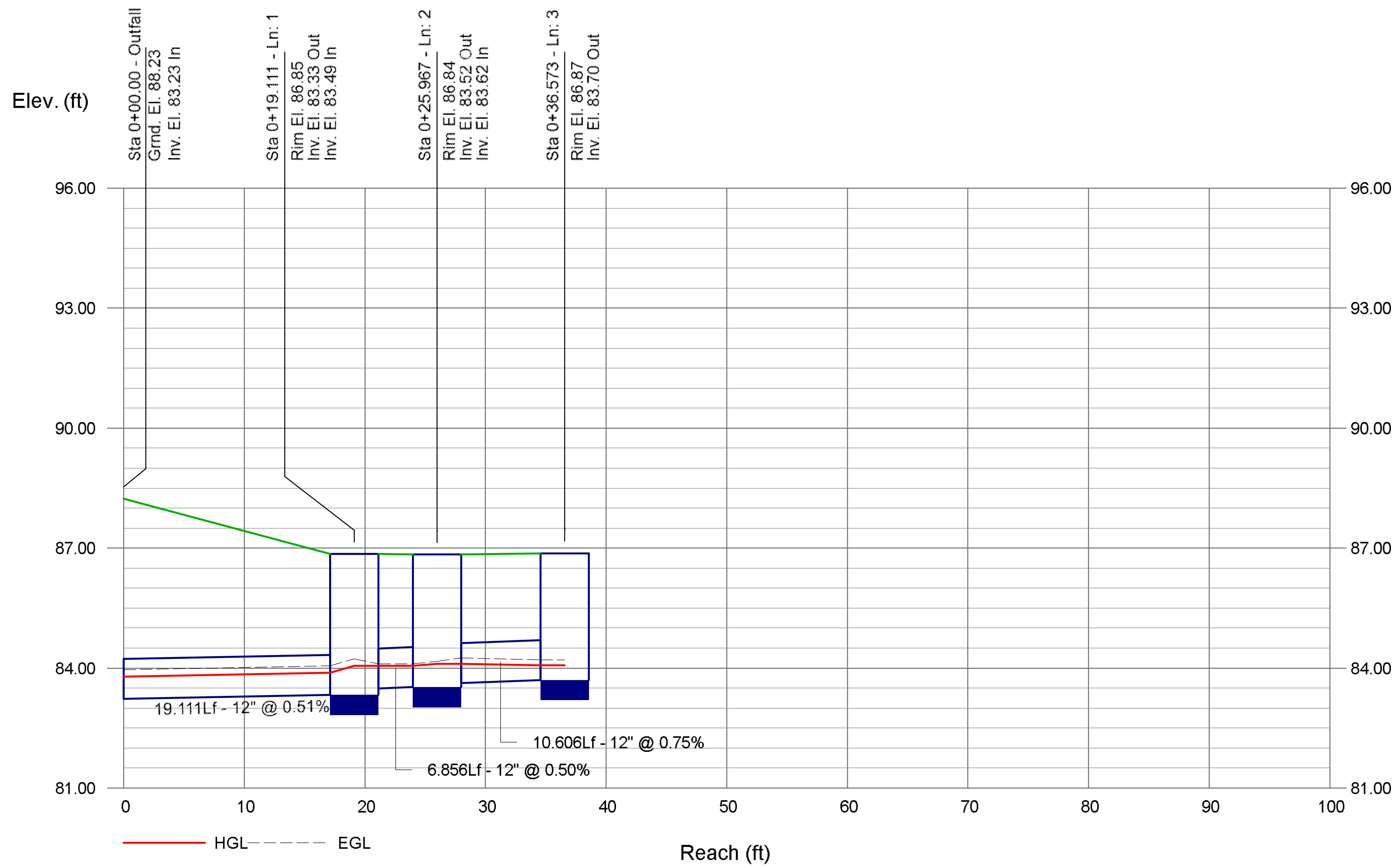
Run Date: 7/14/2021

NOTES:Intensity = 59.21 / (Inlet time + 12.50) ^ 0.81 ; Return period =Yrs. 10 ; c = cir e = ellip b = box

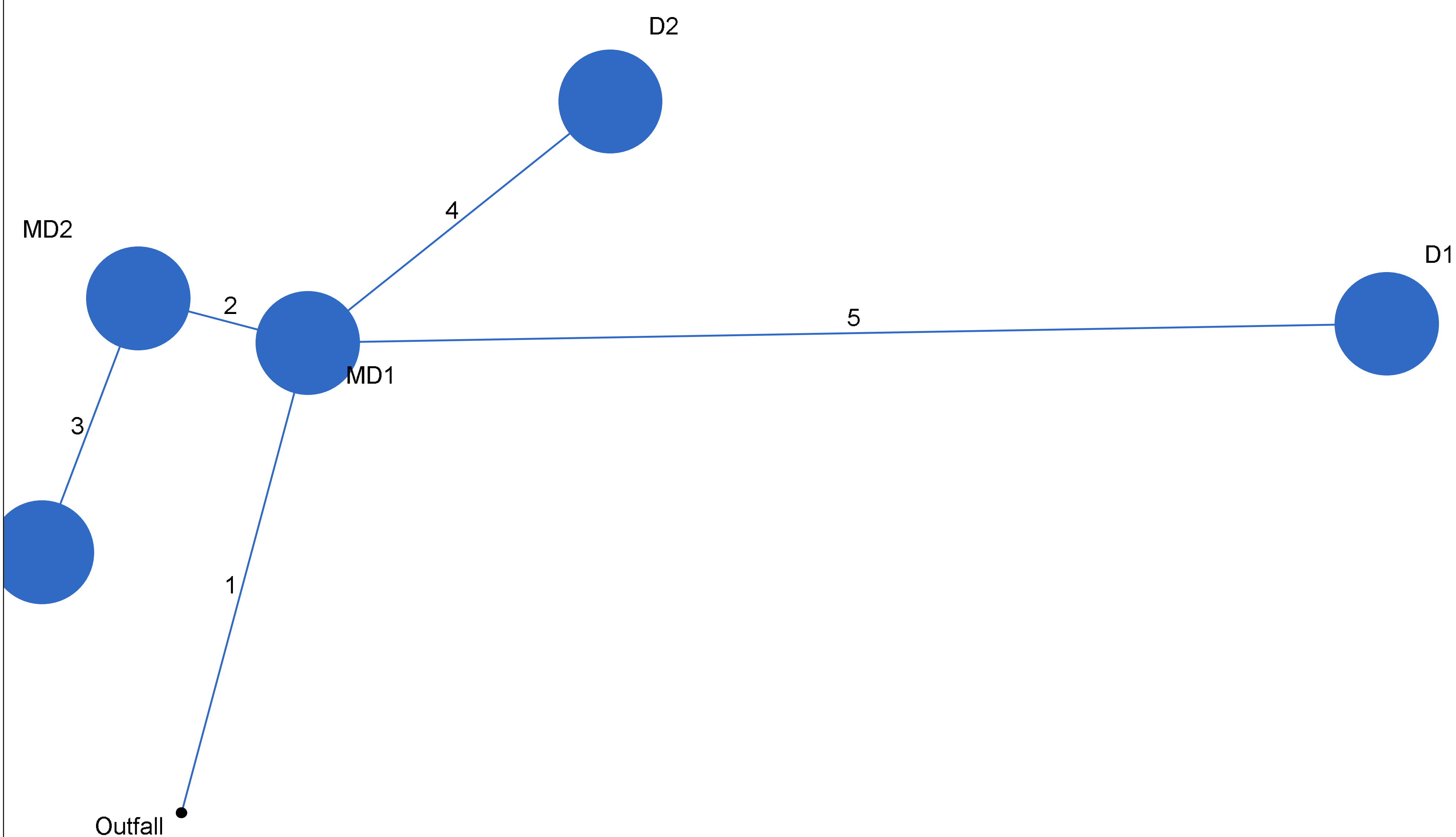
Storm Sewers v12.00

Storm Sewer Profile

Proj. file: Network D.stm



Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: Network D.stm	Number of lines: 5	Date: 7/14/2021

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Dn	Up	Dn	Up	Dn	Up	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
1	End	19.111	0.00	0.39	0.00	0.00	0.26	0.0	6.1	7.5	1.96	2.54	2.50	12	0.51	83.23	83.33	85.44	85.50	0.00	86.85	Pipe - (427) (3) (4)
2	1	6.856	0.00	0.22	0.00	0.00	0.13	0.0	5.1	7.8	1.04	2.52	1.33	12	0.50	83.49	83.52	85.60	85.60	86.85	86.84	Pipe - (426) (4) (1)
3	2	10.606	0.22	0.22	0.61	0.13	0.13	5.0	5.0	7.8	1.05	3.09	1.33	12	0.75	83.62	83.70	85.63	85.64	86.84	86.87	Pipe - (426) (4) (1)
4	1	15.223	0.07	0.07	0.89	0.06	0.06	5.0	5.0	7.8	0.49	2.58	0.62	12	0.53	83.61	83.69	85.60	85.60	86.85	86.86	Pipe - (426) (4) (1)
5	1	42.106	0.10	0.10	0.65	0.07	0.07	5.0	5.0	7.8	0.51	4.14	0.65	12	1.35	83.61	84.18	85.60	85.60	86.85	86.85	Pipe - (426) (4) (3)

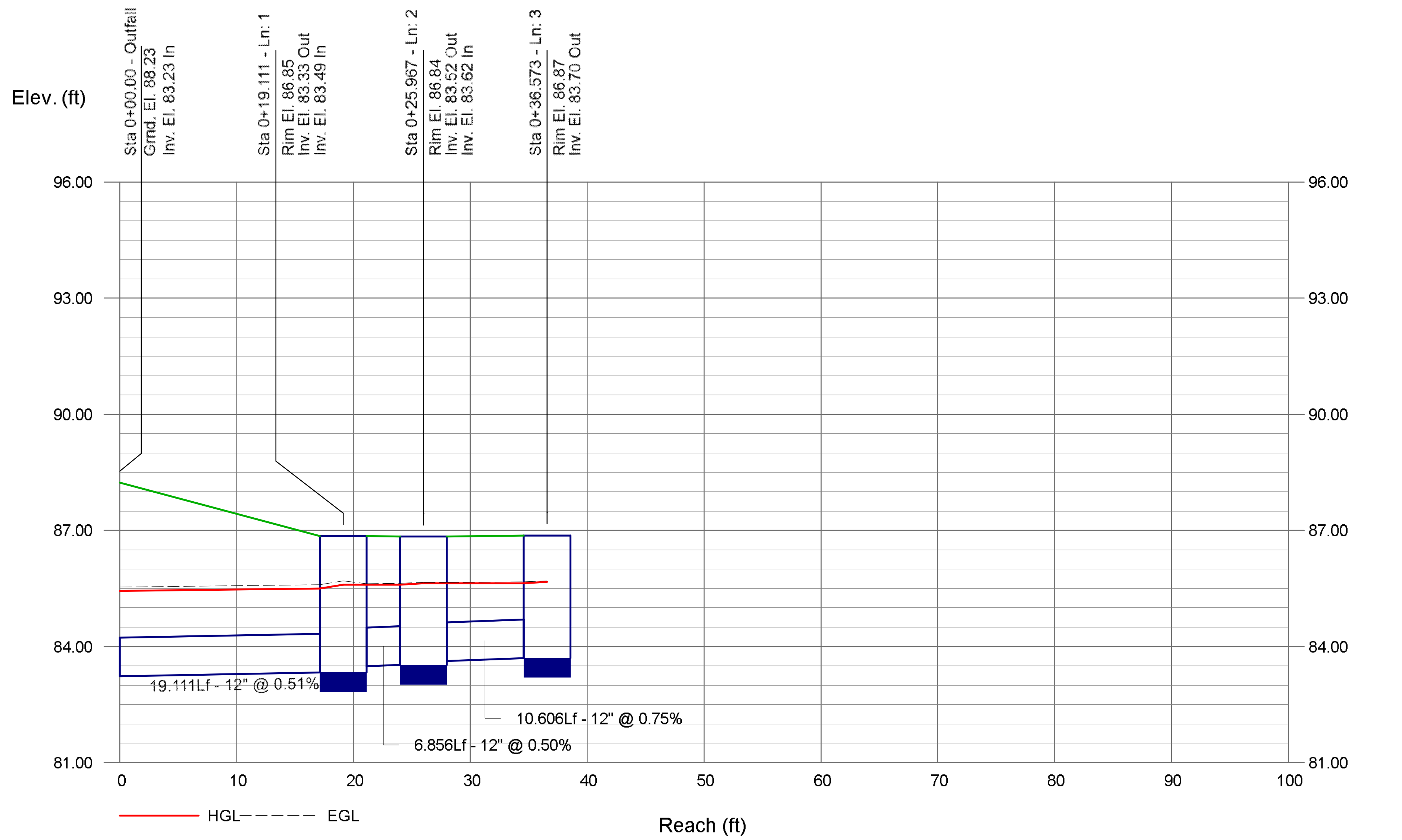
Project File: Network D.stm | Number of lines: 5 | Run Date: 7/14/2021

NOTES:Intensity = 197.93 / (Inlet time + 22.50) ^ 0.98 ; Return period =Yrs. 100 ; c = cir e = ellip b = box

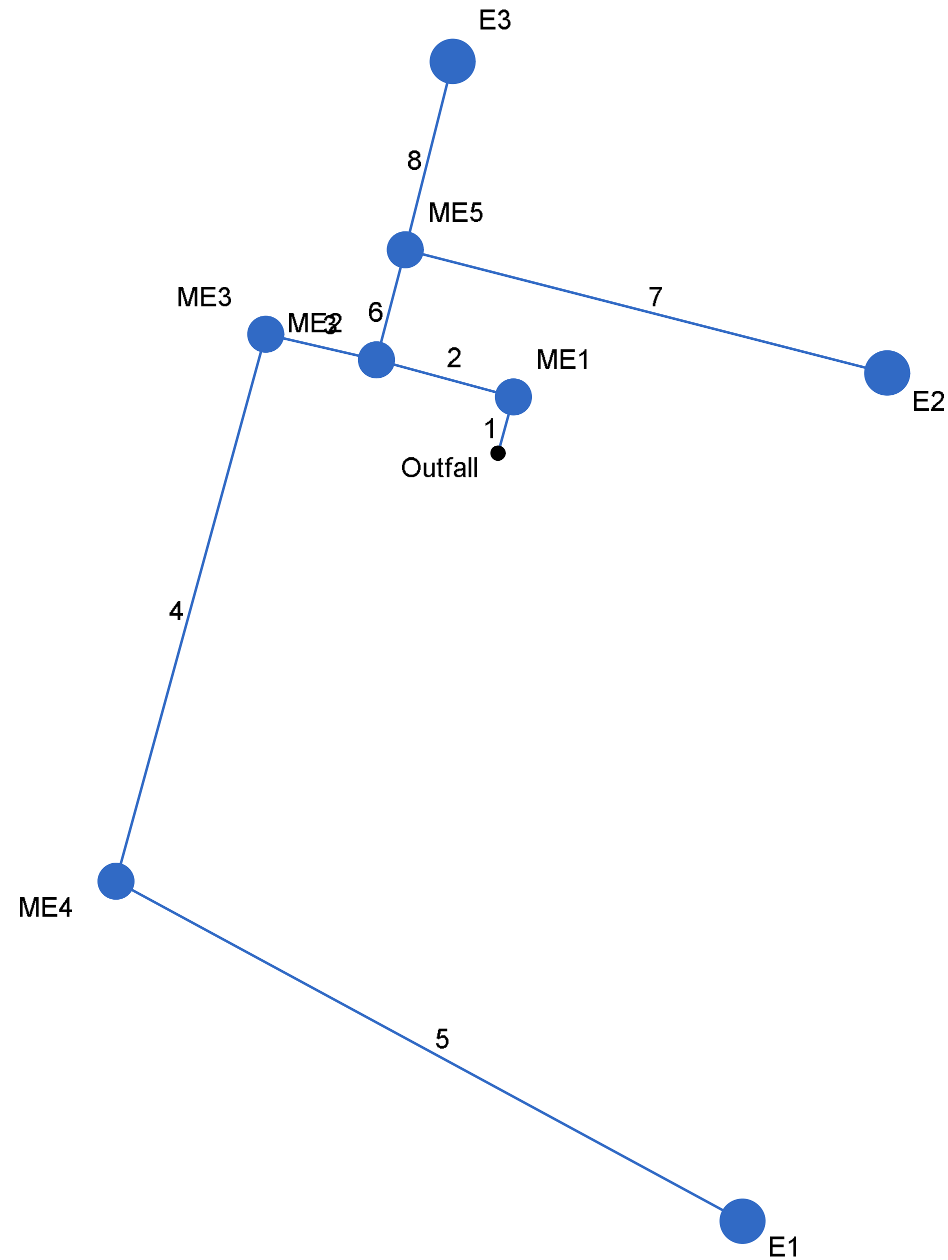
Storm Sewers v12.00

Storm Sewer Profile

Proj. file: Network D.stm



Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: Network E.stm	Number of lines: 8	Date: 7/14/2021

Storm Sewers v12.00

Storm Sewer Tabulation

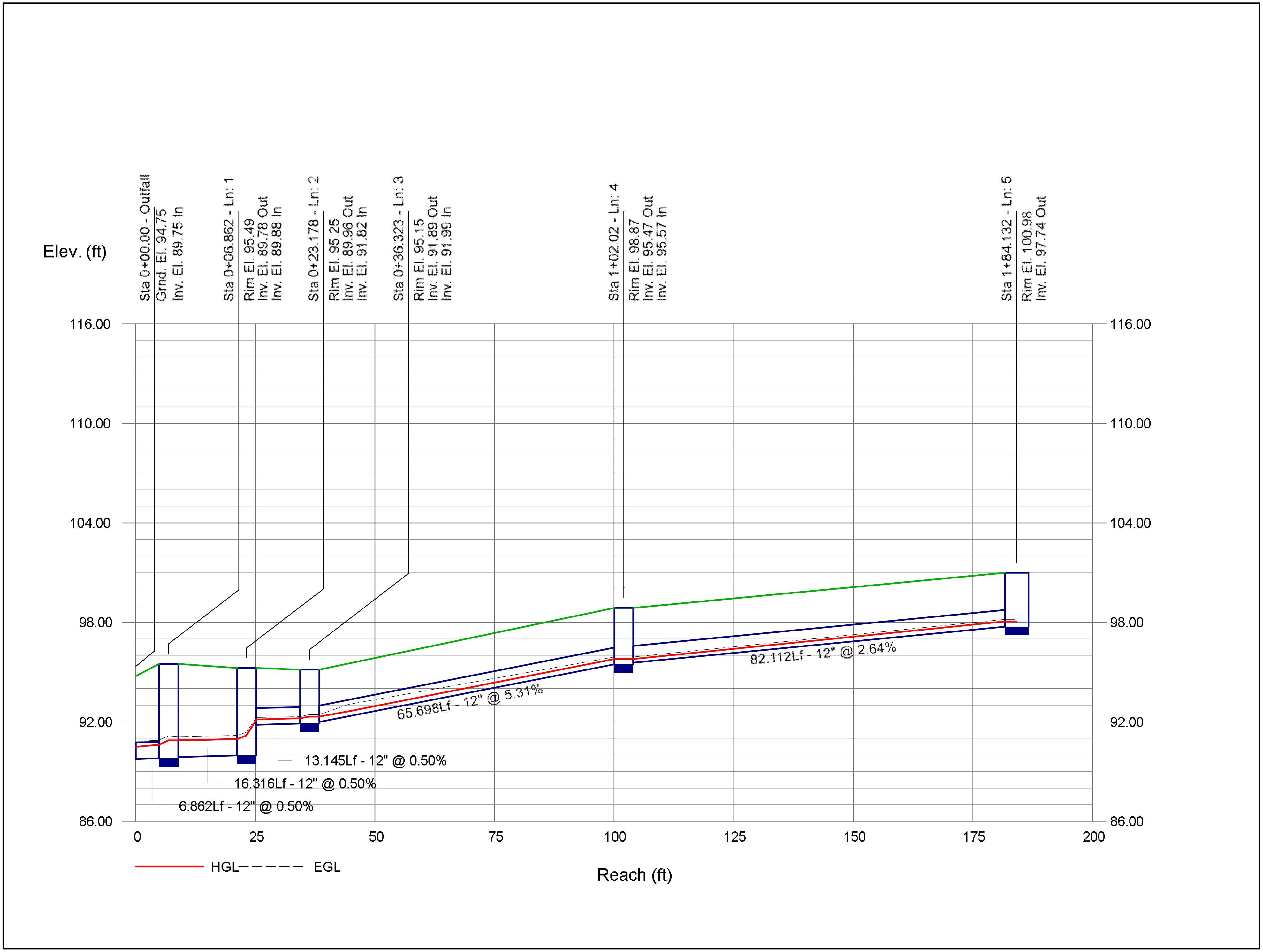
Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Dn	Up	Dn	Up	Dn	Up	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
1	End	6.862	0.00	0.80	0.00	0.00	0.51	0.0	5.9	5.6	2.88	2.52	4.46	12	0.50	89.75	89.78	90.48	90.60	0.00	95.49	Pipe - (521)
2	1	16.316	0.00	0.80	0.00	0.00	0.51	0.0	5.9	5.6	2.89	2.52	3.68	12	0.50	89.88	89.96	90.88	90.96	95.49	95.25	Pipe - (520) (1)
3	2	13.145	0.00	0.12	0.00	0.00	0.10	0.0	5.8	5.6	0.58	2.52	2.61	12	0.50	91.82	91.89	92.15	92.21	95.25	95.15	Pipe - (520)
4	3	65.698	0.00	0.12	0.00	0.00	0.10	0.0	5.4	5.7	0.59	8.21	2.67	12	5.31	91.99	95.47	92.32	95.79	95.15	98.87	Pipe - (519)
5	4	82.112	0.12	0.12	0.86	0.10	0.10	5.0	5.0	5.8	0.60	5.79	3.67	12	2.64	95.57	97.74	95.79	98.06	98.87	100.98	Pipe - (426) (3)
6	2	13.257	0.00	0.68	0.00	0.00	0.41	0.0	5.6	5.7	2.34	2.52	3.64	12	0.50	91.06	91.13	91.82	91.89	95.25	94.51	Pipe - (426) (1) (1)
7	6	57.395	0.26	0.26	0.63	0.16	0.16	5.0	5.0	5.8	0.96	2.53	1.62	12	0.51	91.23	91.52	92.10	92.13	94.51	94.90	Pipe - (426) (2)
8	6	22.511	0.42	0.42	0.59	0.25	0.25	5.0	5.0	5.8	1.45	2.49	1.92	12	0.49	91.13	91.24	92.10	92.12	94.51	93.21	Pipe - (426) (1)

Project File: Network E.stm | Number of lines: 8 | Run Date: 7/14/2021

NOTES:Intensity = 59.21 / (Inlet time + 12.50) ^ 0.81 ; Return period =Yrs. 10 ; c = cir e = ellip b = box

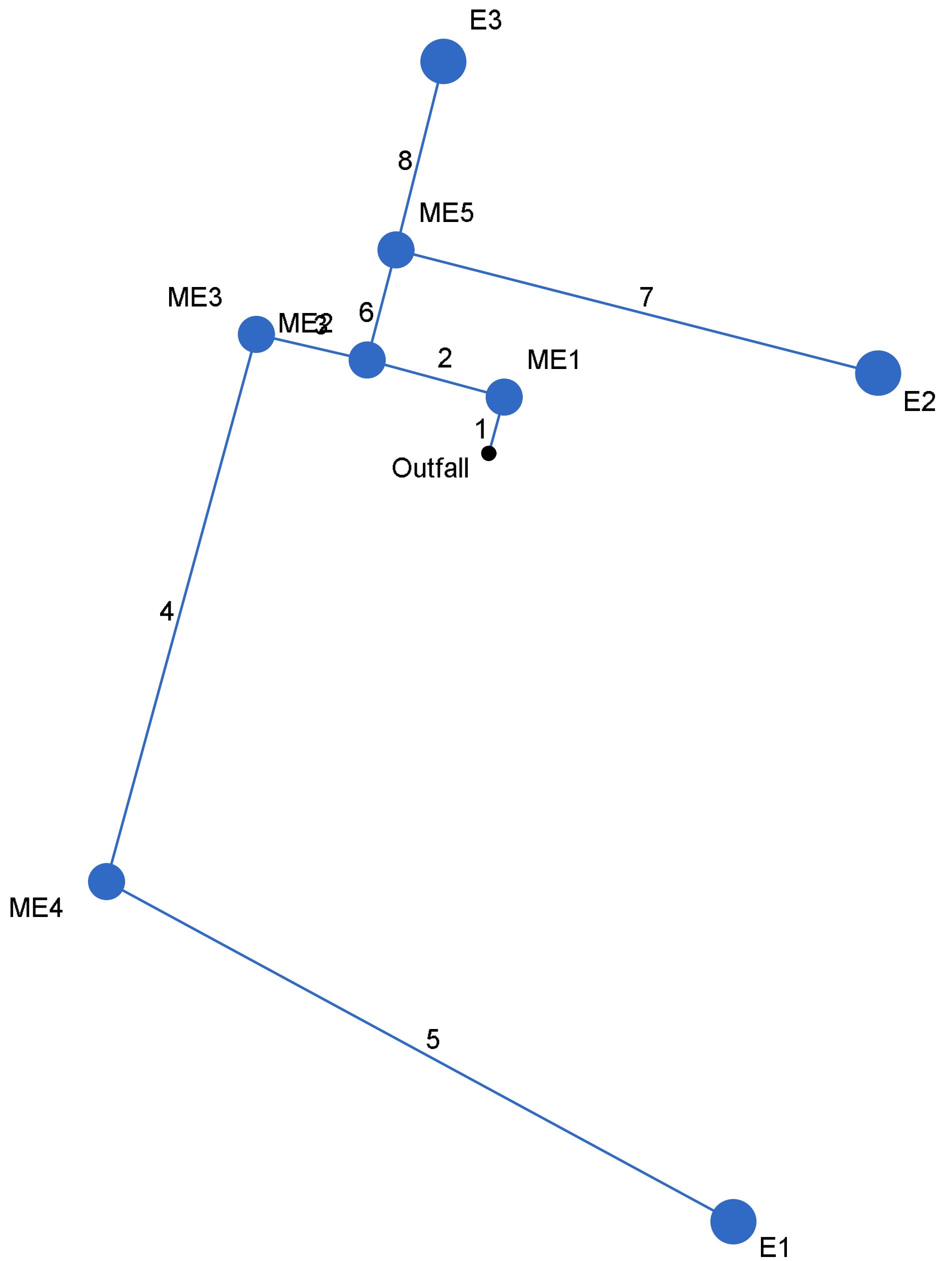
Storm Sewer Profile

Proj. file: Network E.stm



Storm Sewers

Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: Network E.stm	Number of lines: 8	Date: 7/14/2021

Storm Sewers v12.00

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Dn	Up	Dn	Up	Dn	Up	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
1	End	6.862	0.00	0.80	0.00	0.00	0.51	0.0	6.2	7.5	3.85	2.52	4.91	12	0.50	89.75	89.78	92.59	92.67	0.00	95.49	Pipe - (521)
2	1	16.316	0.00	0.80	0.00	0.00	0.51	0.0	6.1	7.5	3.86	2.52	4.92	12	0.50	89.88	89.96	93.04	93.24	95.49	95.25	Pipe - (520) (1)
3	2	13.145	0.00	0.12	0.00	0.00	0.10	0.0	5.9	7.6	0.78	2.52	0.99	12	0.50	91.82	91.89	93.61	93.62	95.25	95.15	Pipe - (520)
4	3	65.698	0.00	0.12	0.00	0.00	0.10	0.0	5.4	7.7	0.79	8.21	2.00	12	5.31	91.99	95.47	93.63	95.85	95.15	98.87	Pipe - (519)
5	4	82.112	0.12	0.12	0.86	0.10	0.10	5.0	5.0	7.8	0.80	5.79	3.77	12	2.64	95.57	97.74	95.85	98.11	98.87	100.98	Pipe - (426) (3)
6	2	13.257	0.00	0.68	0.00	0.00	0.41	0.0	5.6	7.6	3.14	2.52	4.00	12	0.50	91.06	91.13	93.61	93.72	95.25	94.51	Pipe - (426) (1) (1)
7	6	57.395	0.26	0.26	0.63	0.16	0.16	5.0	5.0	7.8	1.28	2.53	1.63	12	0.51	91.23	91.52	93.96	94.04	94.51	94.90	Pipe - (426) (2)
8	6	22.511	0.42	0.42	0.59	0.25	0.25	5.0	5.0	7.8	1.93	2.49	2.46	12	0.49	91.13	91.24	93.96	94.03	94.51	93.21	Pipe - (426) (1)

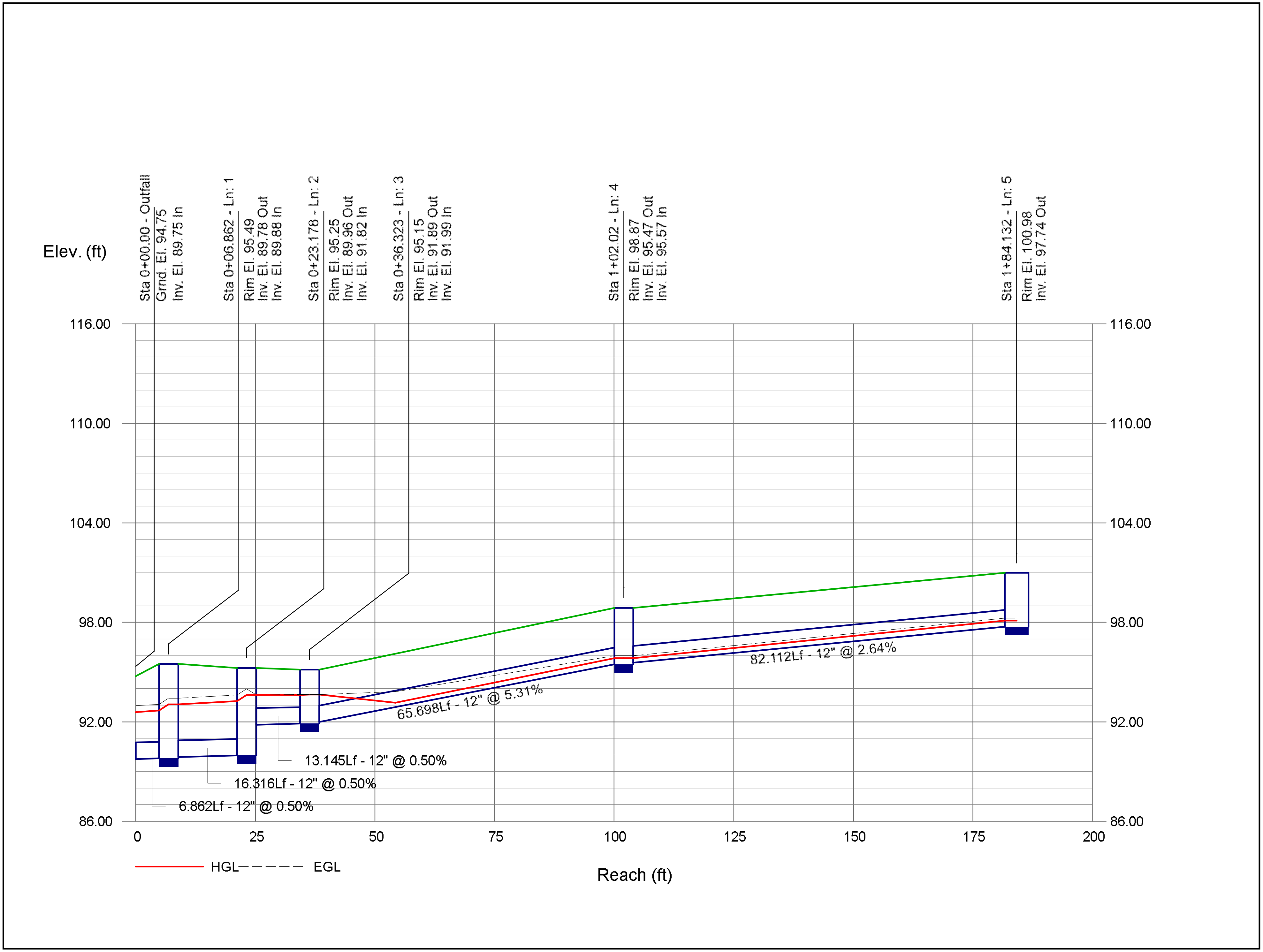
Project File: Network E.stm | Number of lines: 8 | Run Date: 7/14/2021

NOTES:Intensity = 197.93 / (Inlet time + 22.50) ^ 0.98 ; Return period =Yrs. 100 ; c = cir e = ellip b = box

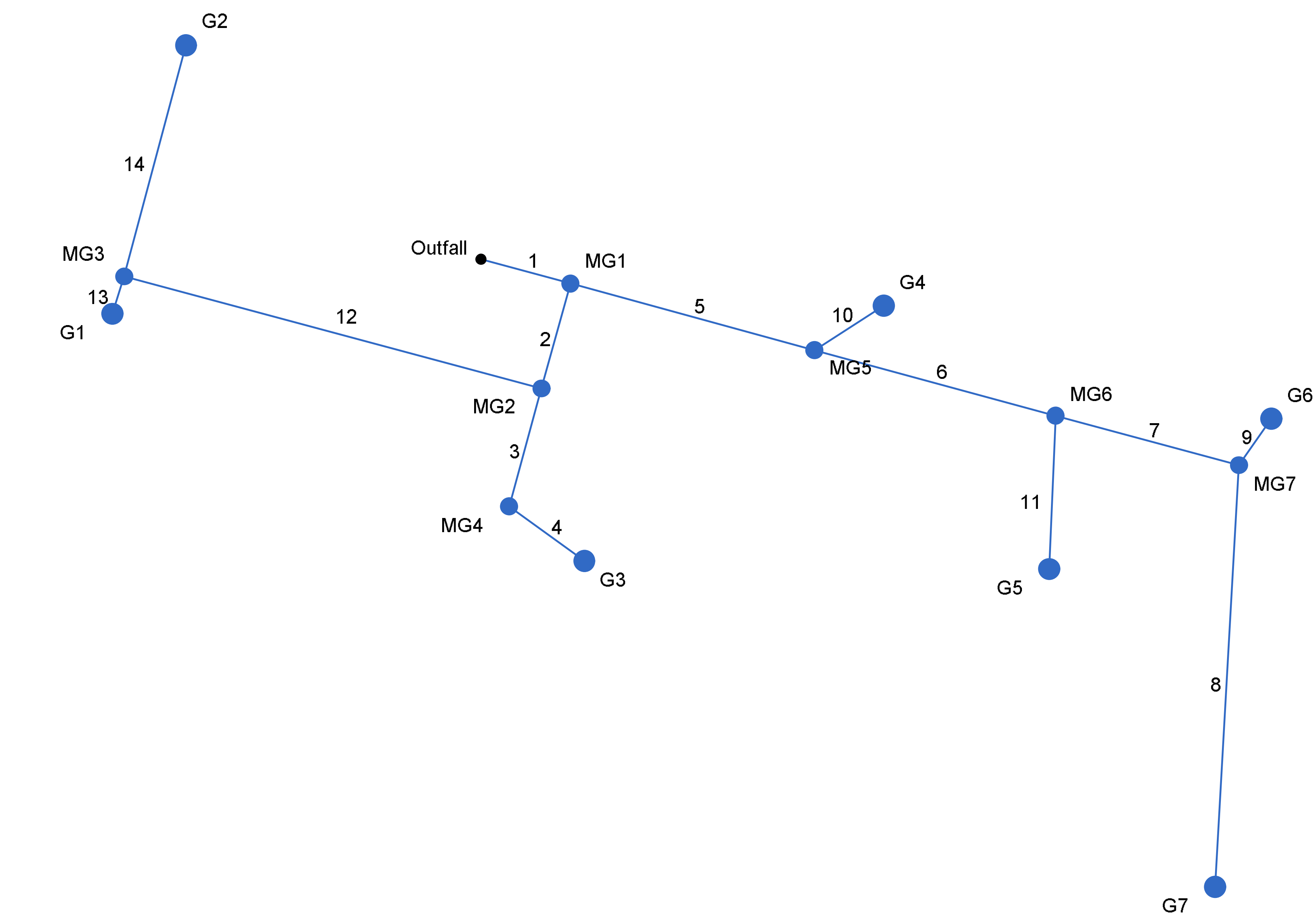
Storm Sewers v12.00

Storm Sewer Profile

Proj. file: Network E.stm



Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: Network G.stm	Number of lines: 14	Date: 7/14/2021

Storm Sewers v12.00

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	22.833	0.00	1.16	0.00	0.00	0.91	0.0	6.3	5.5	5.01	16.14	4.44	24	0.51	100.54	100.66	101.30	101.44	0.00	110.87	Pipe - (427) (3) (3)
2	1	26.942	0.00	0.51	0.00	0.00	0.42	0.0	6.1	5.6	2.33	7.43	3.32	18	0.50	100.76	100.89	101.44	101.47	110.87	111.85	Pipe - (427) (4) (1)
3	2	30.505	0.00	0.18	0.00	0.00	0.15	0.0	5.1	5.8	0.88	7.86	4.84	12	4.87	107.73	109.21	107.95	109.60	111.85	113.30	Pipe - (427) (4)
4	3	22.884	0.18	0.18	0.84	0.15	0.15	5.0	5.0	5.8	0.88	7.02	4.59	12	3.89	109.66	110.55	109.90	110.94	113.30	113.72	Pipe - (426) (4) (1)
5	1	62.483	0.00	0.65	0.00	0.00	0.49	0.0	6.1	5.6	2.73	7.43	3.88	18	0.50	104.35	104.66	104.98	105.29	110.87	110.17	Pipe - (427) (3) (2)
6	5	61.711	0.00	0.41	0.00	0.00	0.29	0.0	5.7	5.7	1.62	2.52	3.07	12	0.50	104.76	105.07	105.48	105.65	110.17	110.65	Pipe - (427) (3) (1)
7	6	46.862	0.00	0.37	0.00	0.00	0.25	0.0	5.5	5.7	1.44	2.52	3.31	12	0.50	105.90	106.13	106.44	106.68	110.65	110.28	Pipe - (427) (3)
8	7	104.611	0.06	0.06	0.83	0.05	0.05	5.0	5.0	5.8	0.29	8.14	3.56	12	5.22	107.08	112.54	107.21	112.76	110.28	115.72	Pipe - (426) (4) (1)
9	7	14.002	0.31	0.31	0.65	0.20	0.20	5.0	5.0	5.8	1.18	2.52	2.47	12	0.50	106.23	106.30	106.84	106.86	110.28	109.47	Pipe - (426) (4)
10	5	20.304	0.24	0.24	0.85	0.20	0.20	5.0	5.0	5.8	1.19	2.50	3.14	12	0.49	106.19	106.29	106.68	106.78	110.17	109.46	Pipe - (426) (4) (2)
11	6	37.978	0.04	0.04	0.89	0.04	0.04	5.0	5.0	5.8	0.21	10.08	1.21	12	8.00	105.17	108.21	105.83	108.40	110.65	113.32	Pipe - (426) (4) (1)
12	2	106.680	0.00	0.33	0.00	0.00	0.27	0.0	5.5	5.7	1.53	2.52	3.12	12	0.50	100.99	101.52	101.68	102.06	111.85	107.78	Pipe - (427) (3) (4)
13	12	9.714	0.17	0.17	0.81	0.14	0.14	5.0	5.0	5.8	0.80	10.03	5.32	12	7.93	103.44	104.21	103.63	104.58	107.78	108.38	Pipe - (426) (4) (1)
14	12	59.298	0.16	0.16	0.81	0.13	0.13	5.0	5.0	5.8	0.76	2.53	1.98	12	0.51	101.62	101.92	102.26	102.33	107.78	105.09	Pipe - (426) (4) (3)

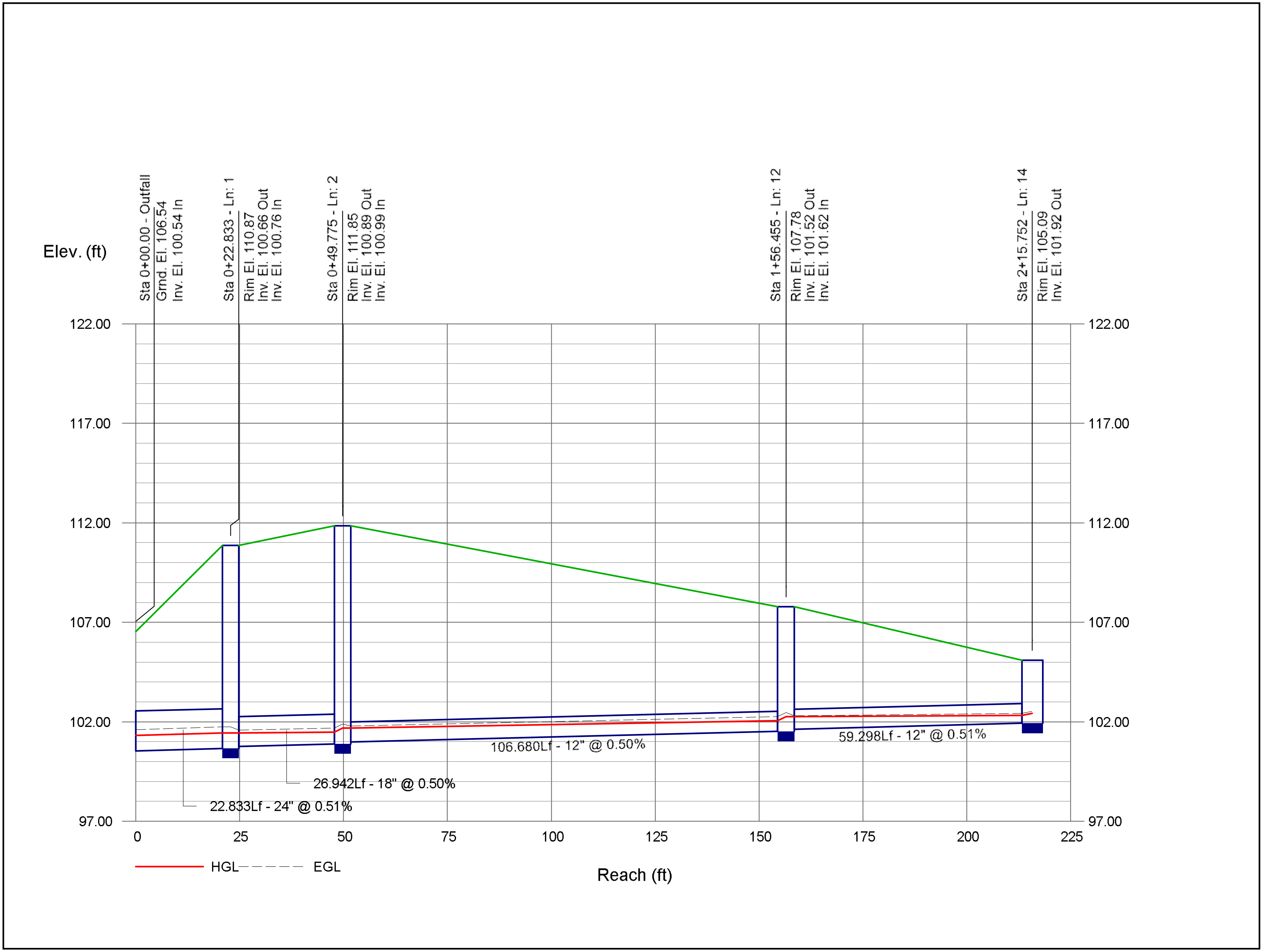
Project File: Network G.stm | Number of lines: 14 | Run Date: 7/14/2021

NOTES:Intensity = 59.21 / (Inlet time + 12.50) ^ 0.81 ; Return period =Yrs. 10 ; c = cir e = ellip b = box

Storm Sewers v12.00

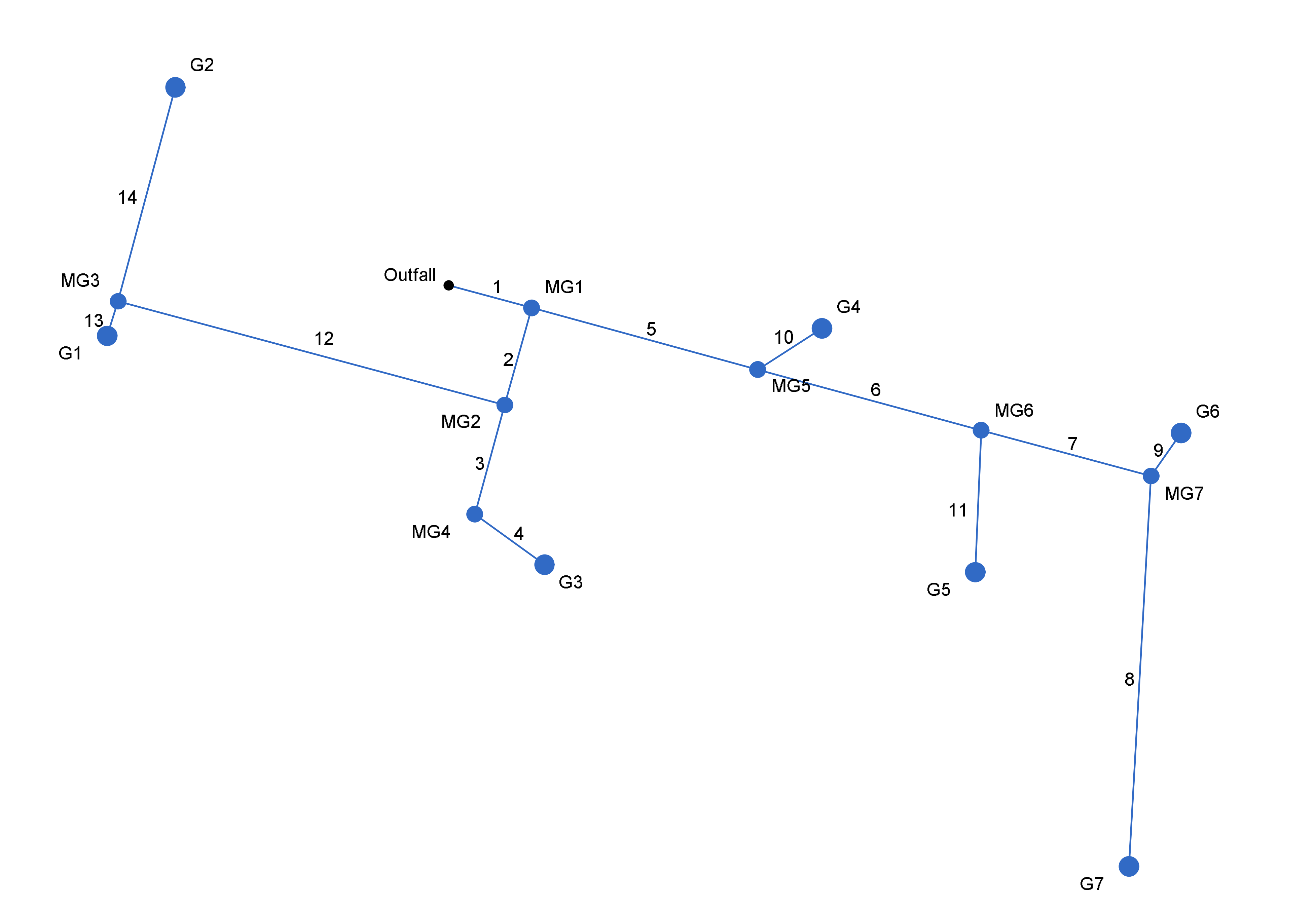
Storm Sewer Profile

Proj. file: Network G.stm



Storm Sewers

Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: Network G.stm	Number of lines: 14	Date: 7/14/2021

Storm Sewers v12.00

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Dn	Up	Dn	Up	Dn	Up	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
1	End	22.833	0.00	1.16	0.00	0.00	0.91	0.0	6.7	7.4	6.69	16.14	2.13	24	0.51	100.54	100.66	103.65	103.67	0.00	110.87	Pipe - (427) (3) (3)
2	1	26.942	0.00	0.51	0.00	0.00	0.42	0.0	6.5	7.4	3.10	7.43	1.76	18	0.50	100.76	100.89	103.74	103.76	110.87	111.85	Pipe - (427) (4) (1)
3	2	30.505	0.00	0.18	0.00	0.00	0.15	0.0	5.1	7.8	1.18	7.86	5.27	12	4.87	107.73	109.21	107.99	109.67	111.85	113.30	Pipe - (427) (4)
4	3	22.884	0.18	0.18	0.84	0.15	0.15	5.0	5.0	7.8	1.18	7.02	5.00	12	3.89	109.66	110.55	109.94	111.01	113.30	113.72	Pipe - (426) (4) (1)
5	1	62.483	0.00	0.65	0.00	0.00	0.49	0.0	6.0	7.5	3.70	7.43	4.19	18	0.50	104.35	104.66	105.10	105.41	110.87	110.17	Pipe - (427) (3) (2)
6	5	61.711	0.00	0.41	0.00	0.00	0.29	0.0	5.7	7.6	2.19	2.52	3.23	12	0.50	104.76	105.07	105.63	105.83	110.17	110.65	Pipe - (427) (3) (1)
7	6	46.862	0.00	0.37	0.00	0.00	0.25	0.0	5.5	7.7	1.93	2.52	3.54	12	0.50	105.90	106.13	106.56	106.79	110.65	110.28	Pipe - (427) (3)
8	7	104.611	0.06	0.06	0.83	0.05	0.05	5.0	5.0	7.8	0.39	8.14	3.87	12	5.22	107.08	112.54	107.23	112.80	110.28	115.72	Pipe - (426) (4) (1)
9	7	14.002	0.31	0.31	0.65	0.20	0.20	5.0	5.0	7.8	1.57	2.52	2.58	12	0.50	106.23	106.30	106.98	107.00	110.28	109.47	Pipe - (426) (4)
10	5	20.304	0.24	0.24	0.85	0.20	0.20	5.0	5.0	7.8	1.59	2.50	3.37	12	0.49	106.19	106.29	106.77	106.87	110.17	109.46	Pipe - (426) (4) (2)
11	6	37.978	0.04	0.04	0.89	0.04	0.04	5.0	5.0	7.8	0.28	10.08	1.30	12	8.00	105.17	108.21	106.01	108.43	110.65	113.32	Pipe - (426) (4) (1)
12	2	106.680	0.00	0.33	0.00	0.00	0.27	0.0	5.8	7.6	2.03	2.52	2.58	12	0.50	100.99	101.52	103.81	104.16	111.85	107.78	Pipe - (427) (3) (4)
13	12	9.714	0.17	0.17	0.81	0.14	0.14	5.0	5.0	7.8	1.07	10.03	2.41	12	7.93	103.44	104.21	104.26	104.65	107.78	108.38	Pipe - (426) (4) (1)
14	12	59.298	0.16	0.16	0.81	0.13	0.13	5.0	5.0	7.8	1.01	2.53	1.29	12	0.51	101.62	101.92	104.26	104.31	107.78	105.09	Pipe - (426) (4) (3)

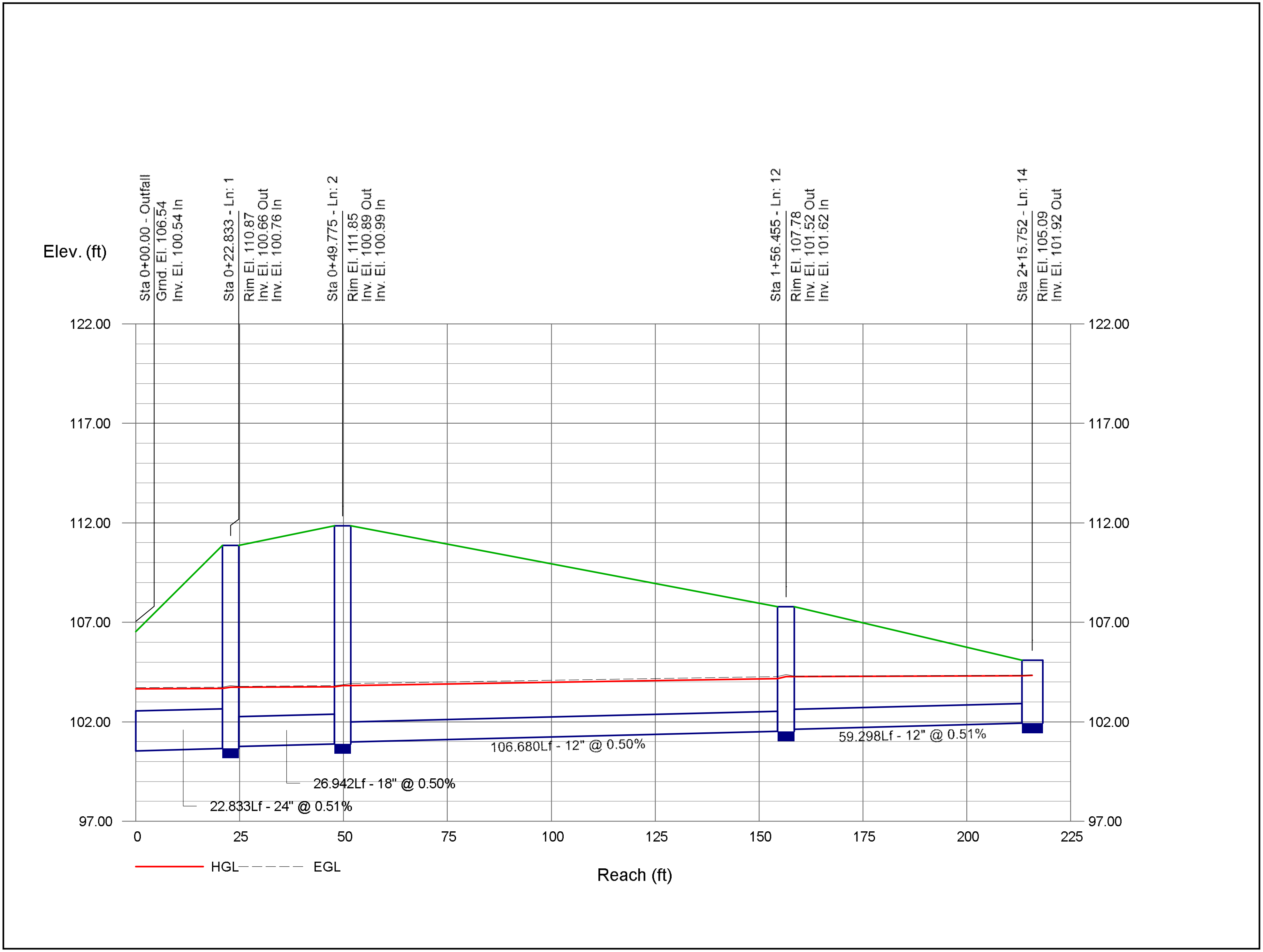
Project File: Network G.stm | Number of lines: 14 | Run Date: 7/14/2021

NOTES:Intensity = 197.93 / (Inlet time + 22.50) ^ 0.98 ; Return period =Yrs. 100 ; c = cir e = ellip b = box

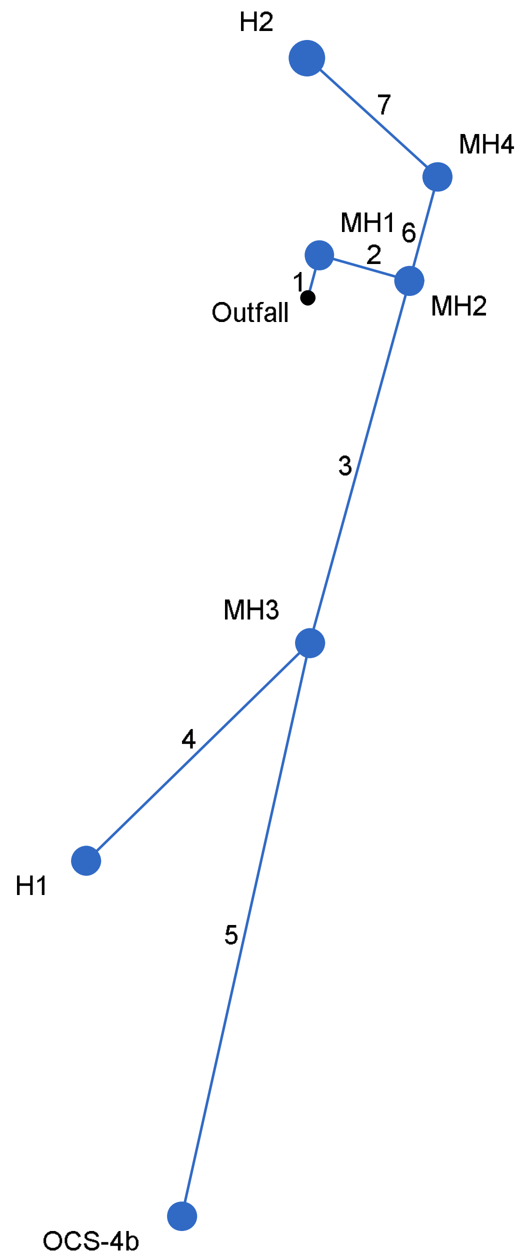
Storm Sewers v12.00

Storm Sewer Profile

Proj. file: Network G.stm



Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: Network H.stm	Number of lines: 7	Date: 7/14/2021

Storm Sewers v12.00

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Dn	Up	Dn	Up	Dn	Up	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
1	End	6.329	0.00	0.39	0.00	0.00	0.32	0.0	5.5	5.7	1.91	2.52	3.78	12	0.50	100.00	100.03	100.59	100.67	0.00	104.62	Pipe - (518)
2	1	13.682	0.00	0.39	0.00	0.00	0.32	0.0	5.4	5.7	1.91	2.52	3.13	12	0.50	100.13	100.20	100.87	100.91	104.62	104.90	Pipe - (517)
3	2	55.200	0.00	0.14	0.00	0.00	0.12	0.0	5.2	5.8	0.77	7.74	4.62	12	4.73	101.70	104.31	101.91	104.68	104.90	107.65	Pipe - (427)
4	3	45.838	0.14	0.14	0.85	0.12	0.12	5.0	5.0	5.8	0.70	6.46	4.12	12	3.29	104.48	105.99	104.70	106.34	107.65	109.16	Pipe - (450)
5	3	86.283	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.08	6.17	1.03	12	3.00	104.41	107.00	104.68	107.12	107.65	111.73	Pipe - (481)
6	2	15.758	0.00	0.25	0.00	0.00	0.20	0.0	5.2	5.8	1.16	2.52	1.88	12	0.50	100.30	100.38	101.07	101.08	104.90	104.11	Pipe - (516)
7	6	25.928	0.25	0.25	0.80	0.20	0.20	5.0	5.0	5.8	1.17	2.52	2.39	12	0.50	100.48	100.61	101.13	101.16	104.11	103.05	Pipe - (426)

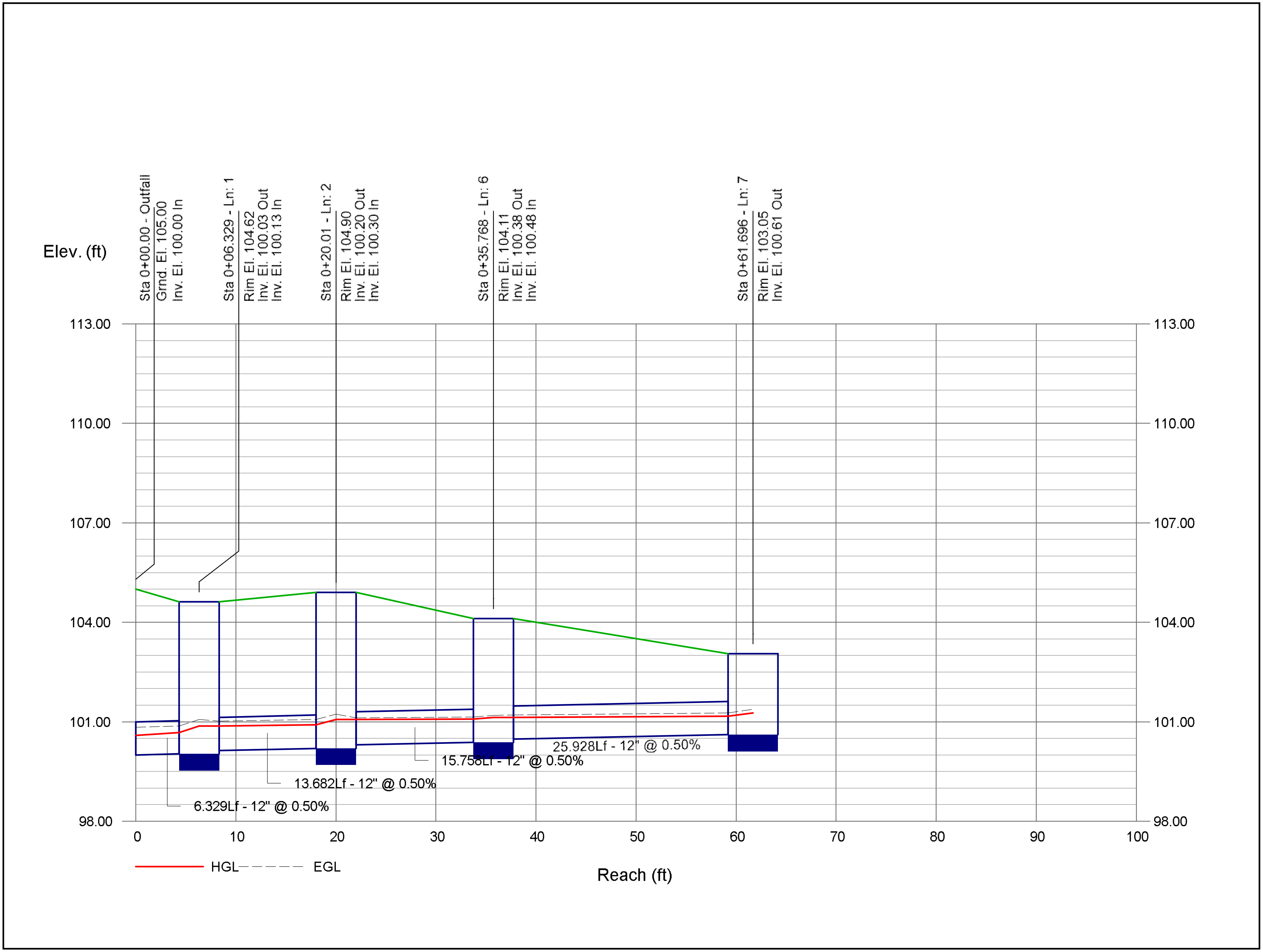
Project File: Network H.stm | Number of lines: 7 | Run Date: 7/14/2021

NOTES:Intensity = 59.21 / (Inlet time + 12.50) ^ 0.81 ; Return period =Yrs. 10 ; c = cir e = ellip b = box

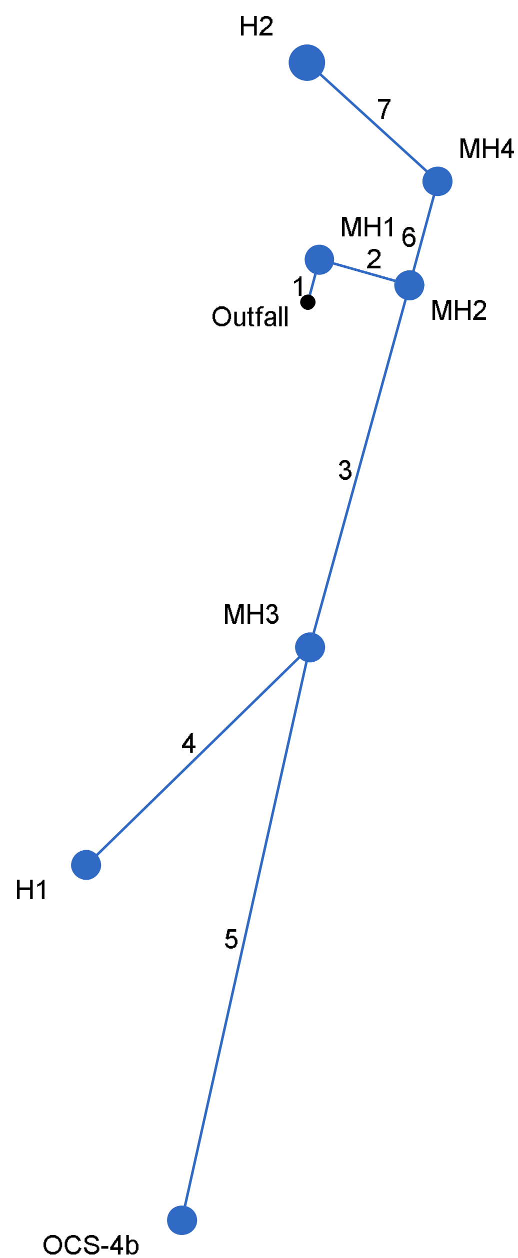
Storm Sewers v12.00

Storm Sewer Profile

Proj. file: Network H.stm



Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: Network H.stm	Number of lines: 7	Date: 7/14/2021

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Dn	Up	Dn	Up	Dn	Up	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
1	End	6.329	0.00	0.39	0.00	0.00	0.32	0.0	5.5	7.7	4.40	2.52	5.61	12	0.50	100.00	100.03	101.11	101.21	0.00	104.62	Pipe - (518)
2	1	13.682	0.00	0.39	0.00	0.00	0.32	0.0	5.5	7.7	4.41	2.52	5.61	12	0.50	100.13	100.20	101.70	101.91	104.62	104.90	Pipe - (517)
3	2	55.200	0.00	0.14	0.00	0.00	0.12	0.0	5.3	7.7	2.88	7.74	4.83	12	4.73	101.70	104.31	102.39	105.04	104.90	107.65	Pipe - (427)
4	3	45.838	0.14	0.14	0.85	0.12	0.12	5.0	5.0	7.8	0.93	6.46	2.60	12	3.29	104.48	105.99	105.04	106.39	107.65	109.16	Pipe - (450)
5	3	86.283	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.96	6.17	3.90	12	3.00	104.41	107.00	105.04	107.60	107.65	111.73	Pipe - (481)
6	2	15.758	0.00	0.25	0.00	0.00	0.20	0.0	5.2	7.7	1.55	2.52	1.97	12	0.50	100.30	100.38	102.39	102.42	104.90	104.11	Pipe - (516)
7	6	25.928	0.25	0.25	0.80	0.20	0.20	5.0	5.0	7.8	1.56	2.52	1.99	12	0.50	100.48	100.61	102.48	102.53	104.11	103.05	Pipe - (426)

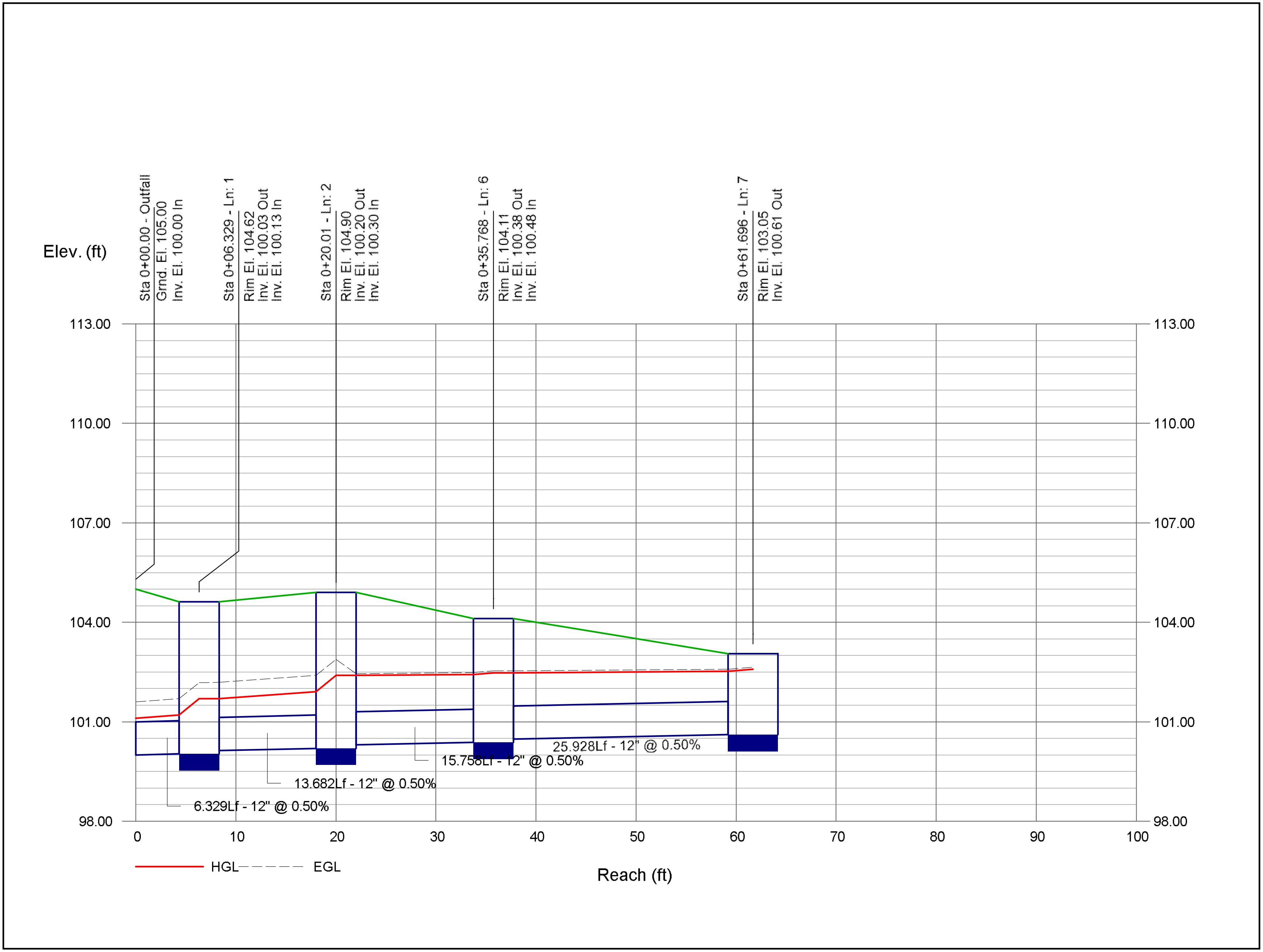
Project File: Network H.stm | Number of lines: 7 | Run Date: 7/14/2021

NOTES:Intensity = 197.93 / (Inlet time + 22.50) ^ 0.98 ; Return period =Yrs. 100 ; c = cir e = ellip b = box

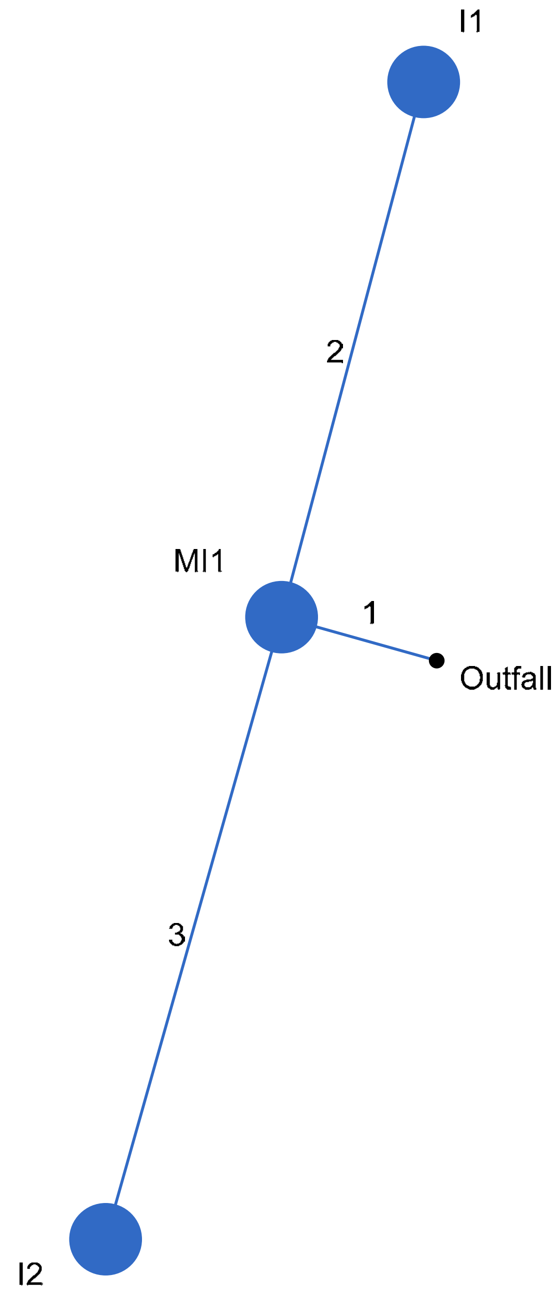
Storm Sewers v12.00

Storm Sewer Profile

Proj. file: Network H.stm



Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: Network I.stm	Number of lines: 3	Date: 4/6/2021

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Dn	Up	Dn	Up	Dn	Up	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
1	End	9.202	0.00	0.35	0.00	0.00	0.28	0.0	6.3	5.5	1.56	2.52	3.53	12	0.50	101.10	101.15	101.63	101.72	0.00	106.42	Pipe - (427) (3) (4)
2	1	31.978	0.18	0.18	0.81	0.15	0.15	6.0	6.0	5.6	0.81	2.52	2.86	12	0.50	101.76	101.92	102.15	102.31	106.42	105.09	Pipe - (426) (4) (3)
3	1	37.028	0.17	0.17	0.81	0.14	0.14	6.0	6.0	5.6	0.77	10.07	2.20	12	7.99	101.25	104.21	101.89	104.58	106.42	108.38	Pipe - (426) (4) (1)

Project File: Network I.stm

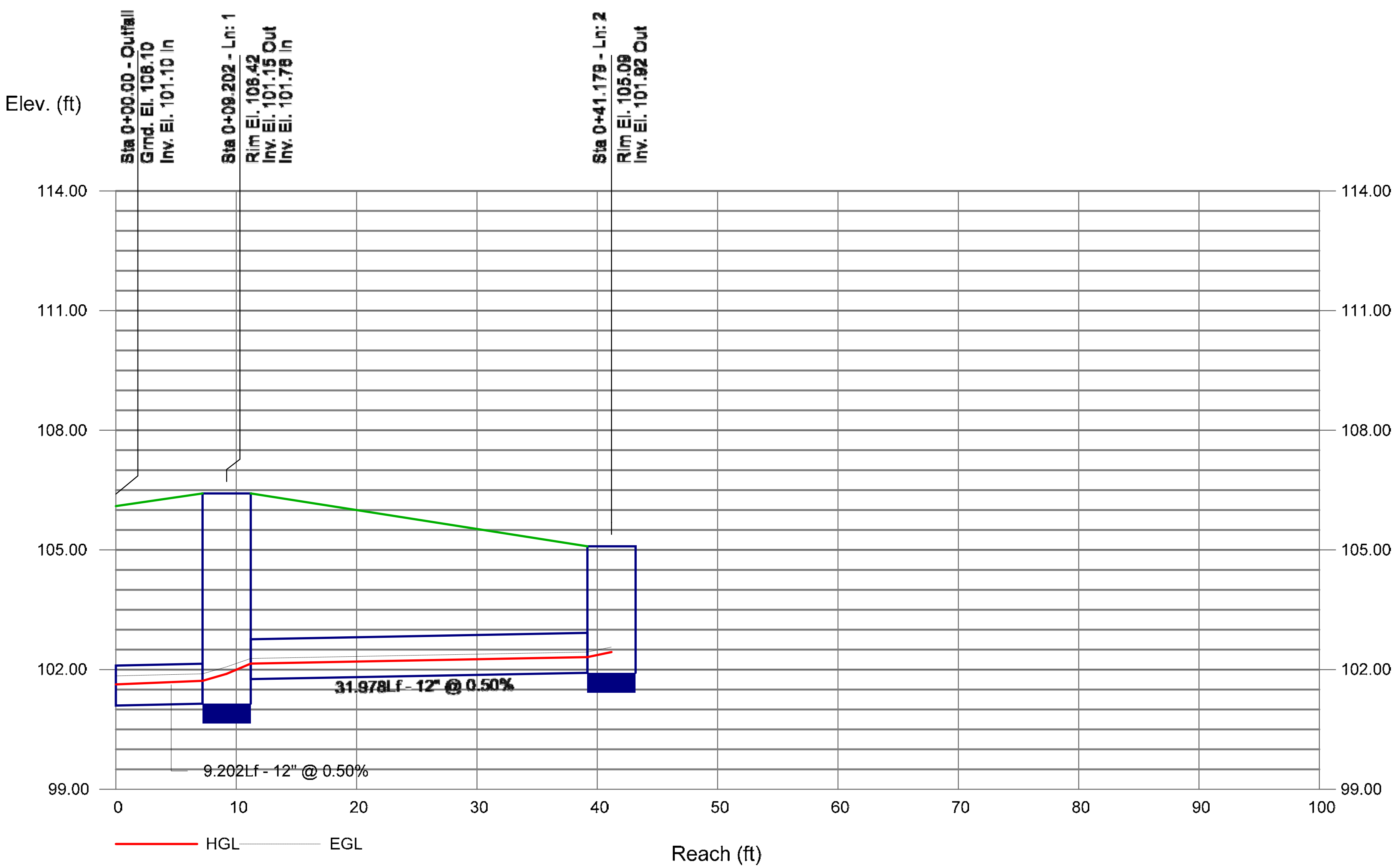
Number of lines: 3

Run Date: 4/6/2021

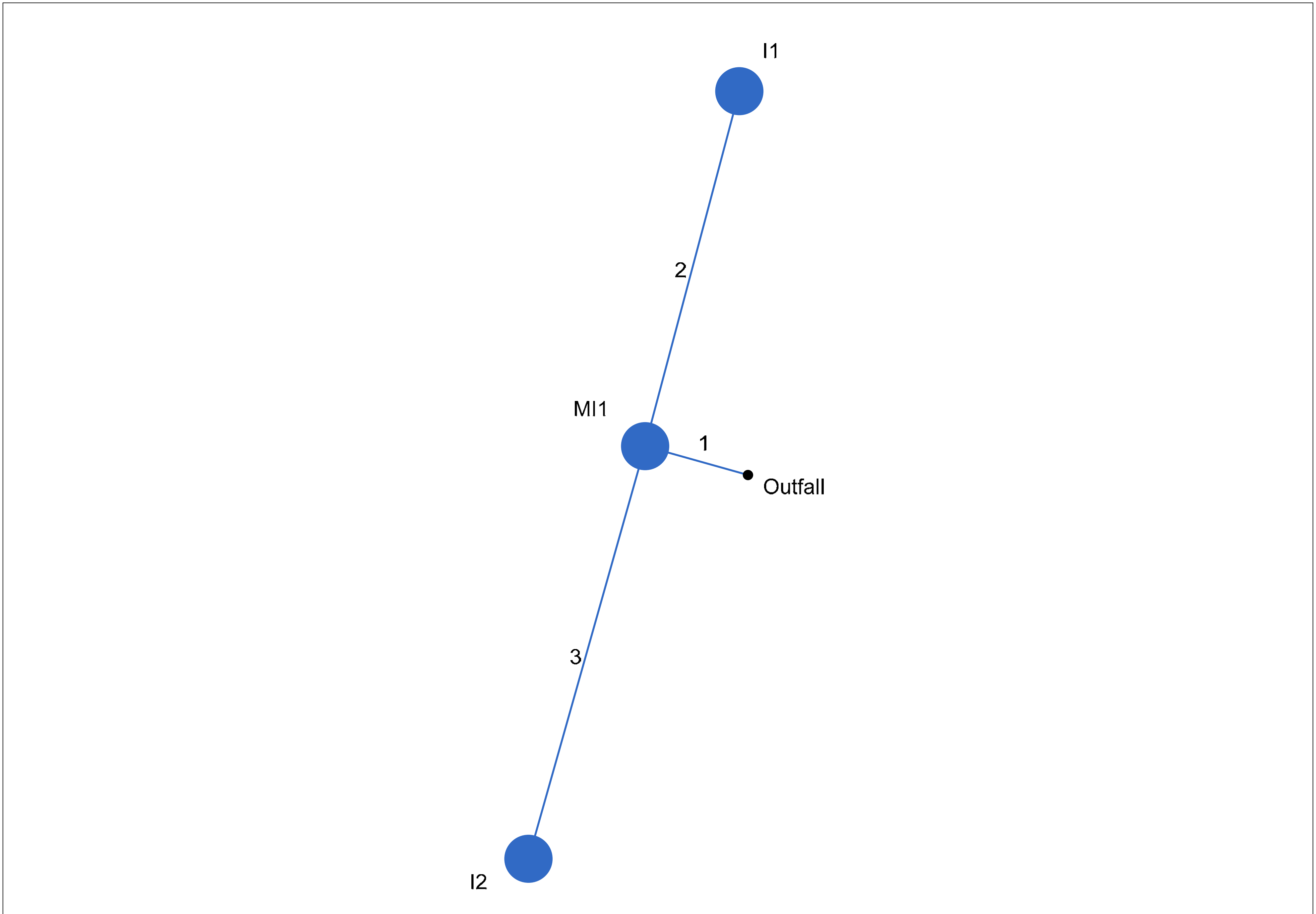
NOTES:Intensity = 59.21 / (Inlet time + 12.50) ^ 0.81; Return period =Yrs. 10 ; c = cir e = ellip b = box

Storm Sewer Profile

Proj. file: Network I.stm



Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: Network I.stm	Number of lines: 3	Date: 4/6/2021

Storm Sewer Tabulation

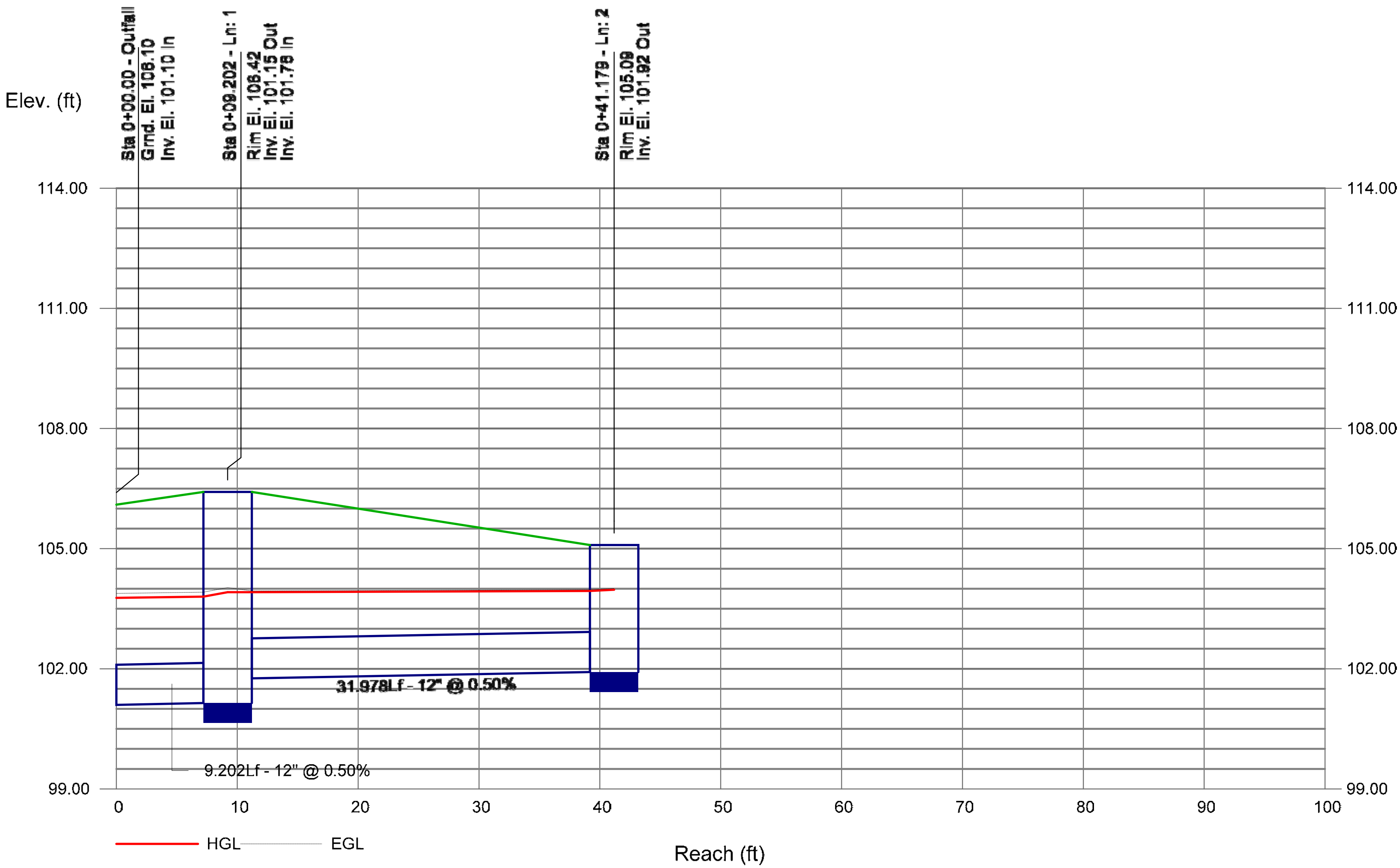
Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	9.202	0.00	0.35	0.00	0.00	0.28	0.0	6.4	7.4	2.11	2.52	2.68	12	0.50	101.10	101.15	103.77	103.80	0.00	106.42	Pipe - (427) (3) (4)
2	1	31.978	0.18	0.18	0.81	0.15	0.15	6.0	6.0	7.5	1.10	2.52	1.40	12	0.50	101.76	101.92	103.91	103.94	106.42	105.09	Pipe - (426) (4) (3)
3	1	37.028	0.17	0.17	0.81	0.14	0.14	6.0	6.0	7.5	1.04	10.07	2.28	12	7.99	101.25	104.21	103.91	104.64	106.42	108.38	Pipe - (426) (4) (1)

Project File: Network I.stm	Number of lines: 3	Run Date: 4/6/2021

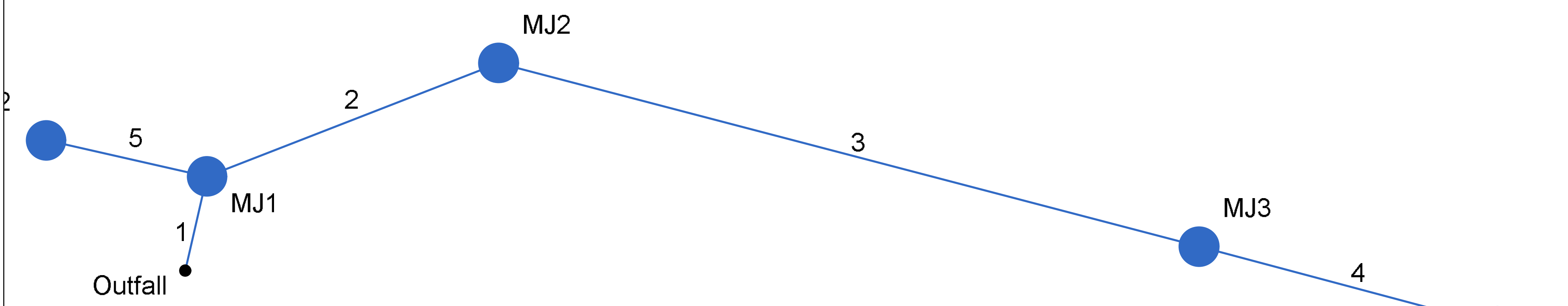
NOTES:Intensity = 197.93 / (Inlet time + 22.50) ^ 0.98; Return period =Yrs. 100 ; c = cir e = ellip b = box

Storm Sewer Profile

Proj. file: Network I.stm



Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: Network J.stm	Number of lines: 5	Date: 7/14/2021

Storm Sewers v12.00

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Dn	Up	Dn	Up	Dn	Up	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
1	End	10.171	0.00	1.19	0.00	0.00	0.80	0.0	6.1	5.6	4.47	22.33	3.78	18	4.52	109.74	110.20	110.93	111.01	0.00	115.40	Pipe - (450) (1) (1)
2	1	32.300	0.60	0.88	0.90	0.54	0.57	5.0	5.9	5.6	3.18	7.39	3.96	18	0.50	110.30	110.46	111.01	111.14	115.40	116.78	Pipe - (450) (1) (1)
3	2	74.845	0.00	0.28	0.00	0.00	0.03	0.0	5.3	5.8	0.16	9.84	1.94	18	0.88	111.92	112.57	112.05	112.72	116.78	116.00	Pipe - (450) (1) (1)
4	3	31.847	0.28	0.28	0.10	0.03	0.03	5.0	5.0	5.8	0.16	2.52	1.81	12	0.50	112.67	112.83	112.84	113.00	116.00	116.00	Pipe - (450) (1) (1)
5	1	17.068	0.31	0.31	0.76	0.24	0.24	5.0	5.0	5.8	1.38	2.59	3.35	12	0.53	111.62	111.71	112.14	112.23	115.40	114.88	Pipe - (450) (1) (1)

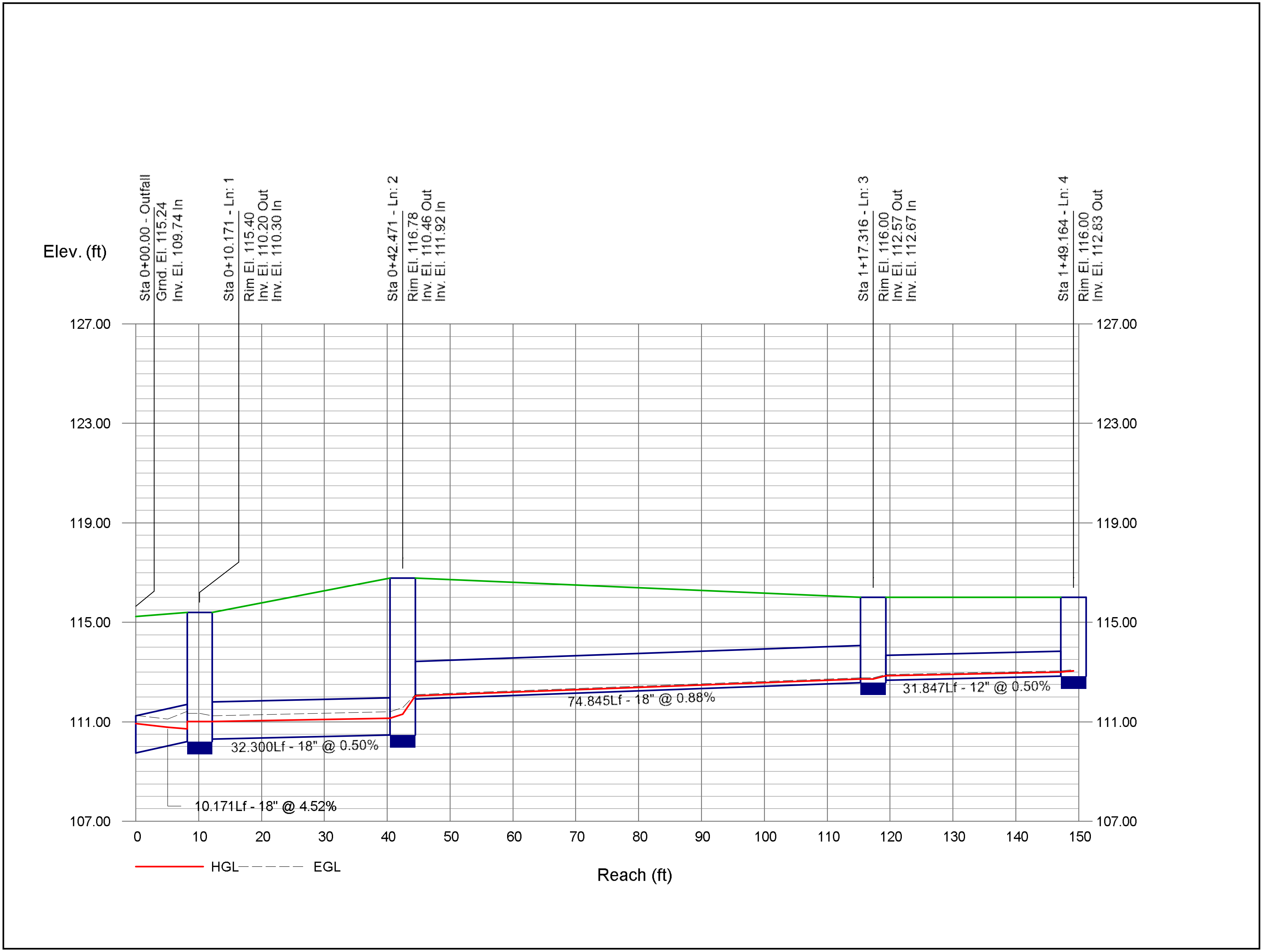
Project File: Network J.stm | Number of lines: 5 | Run Date: 7/14/2021

NOTES:Intensity = 59.21 / (Inlet time + 12.50) ^ 0.81 ; Return period =Yrs. 10 ; c = cir e = ellip b = box

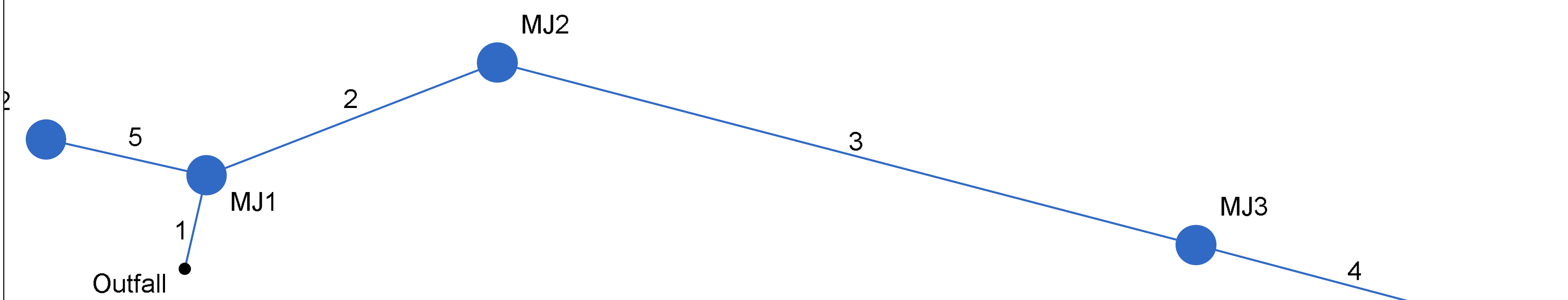
Storm Sewers v12.00

Storm Sewer Profile

Proj. file: Network J.stm



Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: Network J.stm	Number of lines: 5	Date: 7/14/2021

Storm Sewers v12.00

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Dn	Up	Dn	Up	Dn	Up	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
1	End	10.171	0.00	1.19	0.00	0.00	0.80	0.0	16.5	5.5	4.46	22.33	2.52	18	4.52	109.74	110.20	113.48	113.50	0.00	115.40	Pipe - (450) (1) (1)
2	1	32.300	0.60	0.88	0.90	0.54	0.57	5.0	16.2	5.6	3.18	7.39	1.80	18	0.50	110.30	110.46	113.60	113.63	115.40	116.78	Pipe - (450) (1) (1)
3	2	74.845	0.00	0.28	0.00	0.00	0.03	0.0	6.8	7.3	0.21	9.84	0.13	18	0.88	111.92	112.57	113.66	113.66	116.78	116.00	Pipe - (450) (1) (1)
4	3	31.847	0.28	0.28	0.10	0.03	0.03	5.0	5.0	7.8	0.22	2.52	0.30	12	0.50	112.67	112.83	113.66	113.66	116.00	116.00	Pipe - (450) (1) (1)
5	1	17.068	0.31	0.31	0.76	0.24	0.24	5.0	5.0	7.8	1.84	2.59	2.34	12	0.53	111.62	111.71	113.60	113.64	115.40	114.88	Pipe - (450) (1) (1)

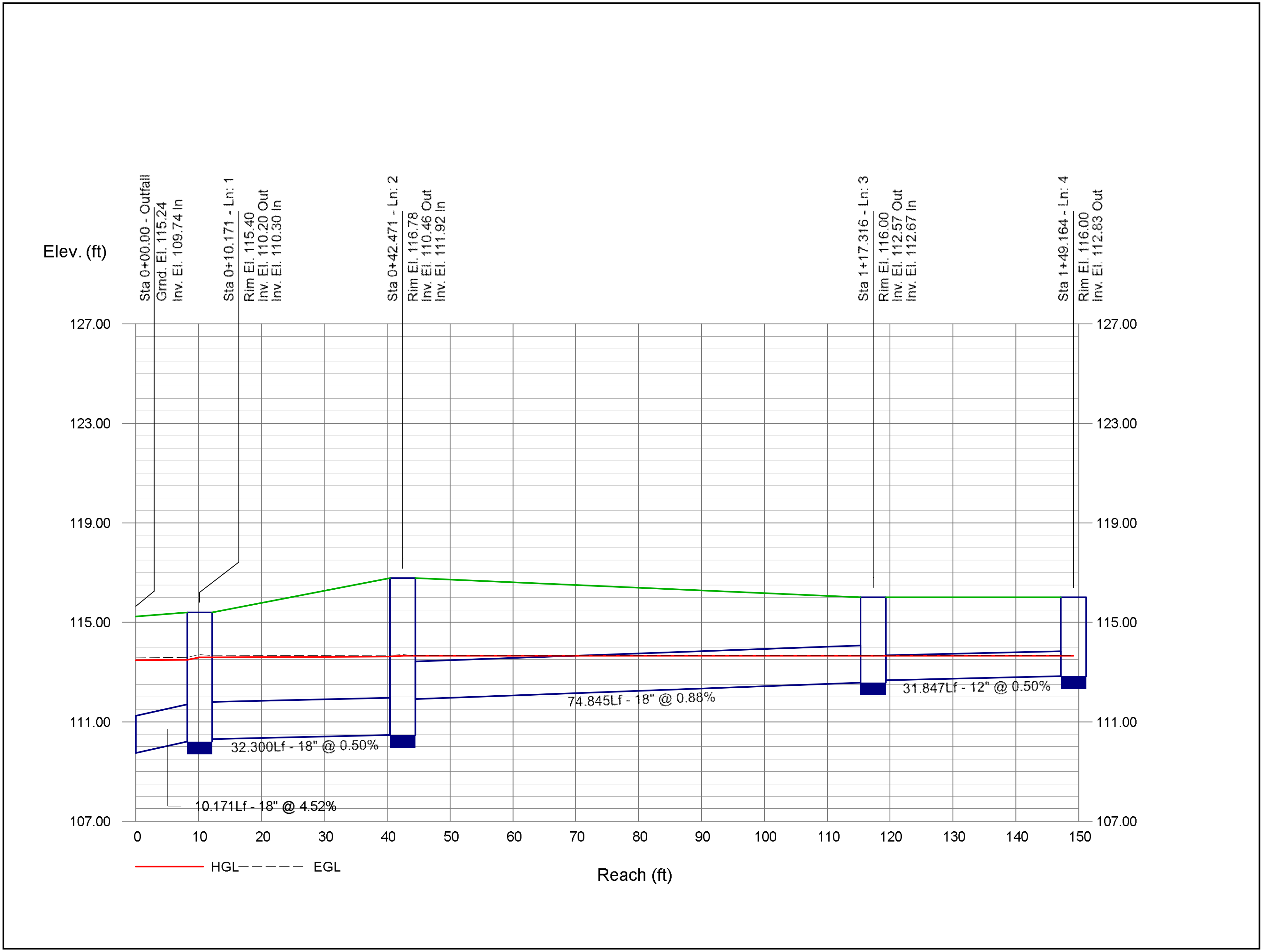
Project File: Network J.stm | Number of lines: 5 | Run Date: 7/14/2021

NOTES:Intensity = 197.93 / (Inlet time + 22.50) ^ 0.98 ; Return period =Yrs. 100 ; c = cir e = ellip b = box

Storm Sewers v12.00

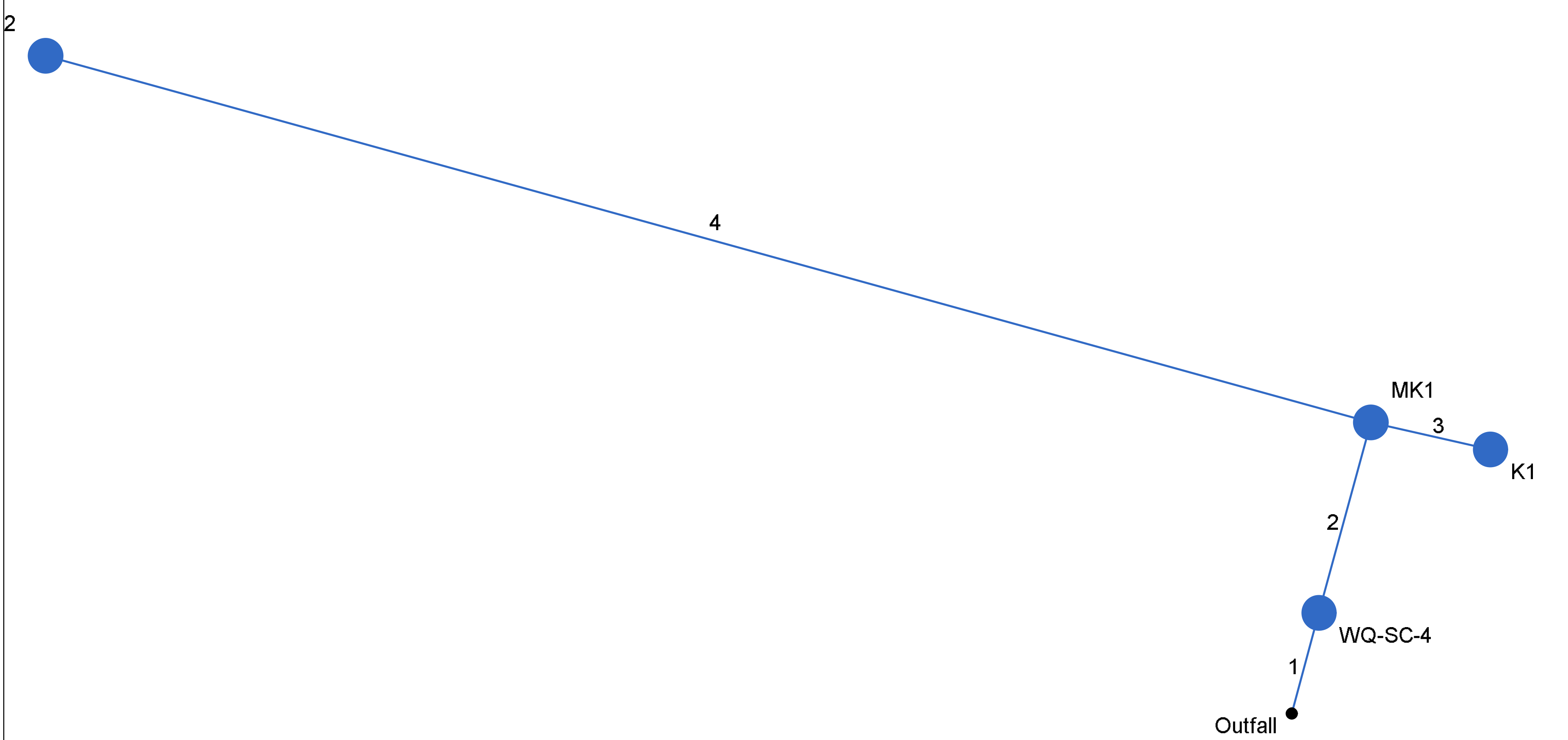
Storm Sewer Profile

Proj. file: Network J.stm



Storm Sewers

Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: Network K.stm	Number of lines: 4	Date: 7/14/2021

Storm Sewers v12.00

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	12.258	0.00	0.45	0.00	0.00	0.38	0.0	6.3	5.5	2.09	10.07	4.11	12	8.00	112.00	112.98	112.62	113.60	113.67	117.97	Pipe - (450) (1) (1)
2	1	23.677	0.00	0.45	0.00	0.00	0.38	0.0	6.2	5.5	2.11	1.56	2.68	12	0.19	112.98	113.03	113.98	114.03	117.97	117.42	Pipe - (450) (1) (1)
3	2	14.646	0.24	0.24	0.84	0.20	0.20	5.0	5.0	5.8	1.18	2.94	3.45	12	0.68	114.51	114.61	114.95	115.07	117.42	117.28	Pipe - (450) (1) (1)
4	2	163.929	0.21	0.21	0.85	0.18	0.18	5.0	5.0	5.8	1.04	2.52	2.31	12	0.50	113.27	114.09	114.14	114.53	117.42	116.76	Pipe - (450) (1)

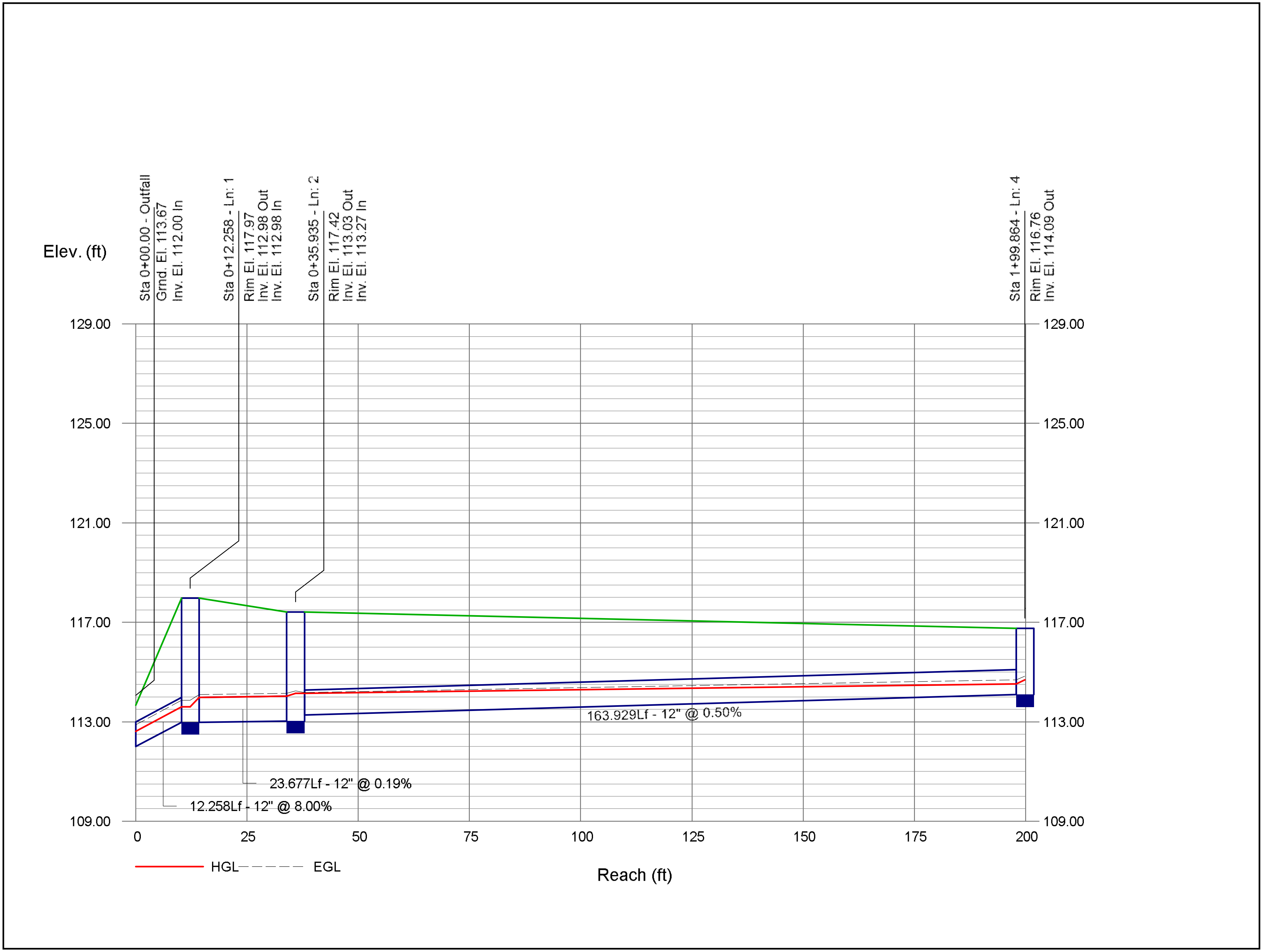
Project File: Network K.stm	Number of lines: 4	Run Date: 7/14/2021

NOTES:Intensity = 59.21 / (Inlet time + 12.50) ^ 0.81 ; Return period =Yrs. 10 ; c = cir e = ellip b = box

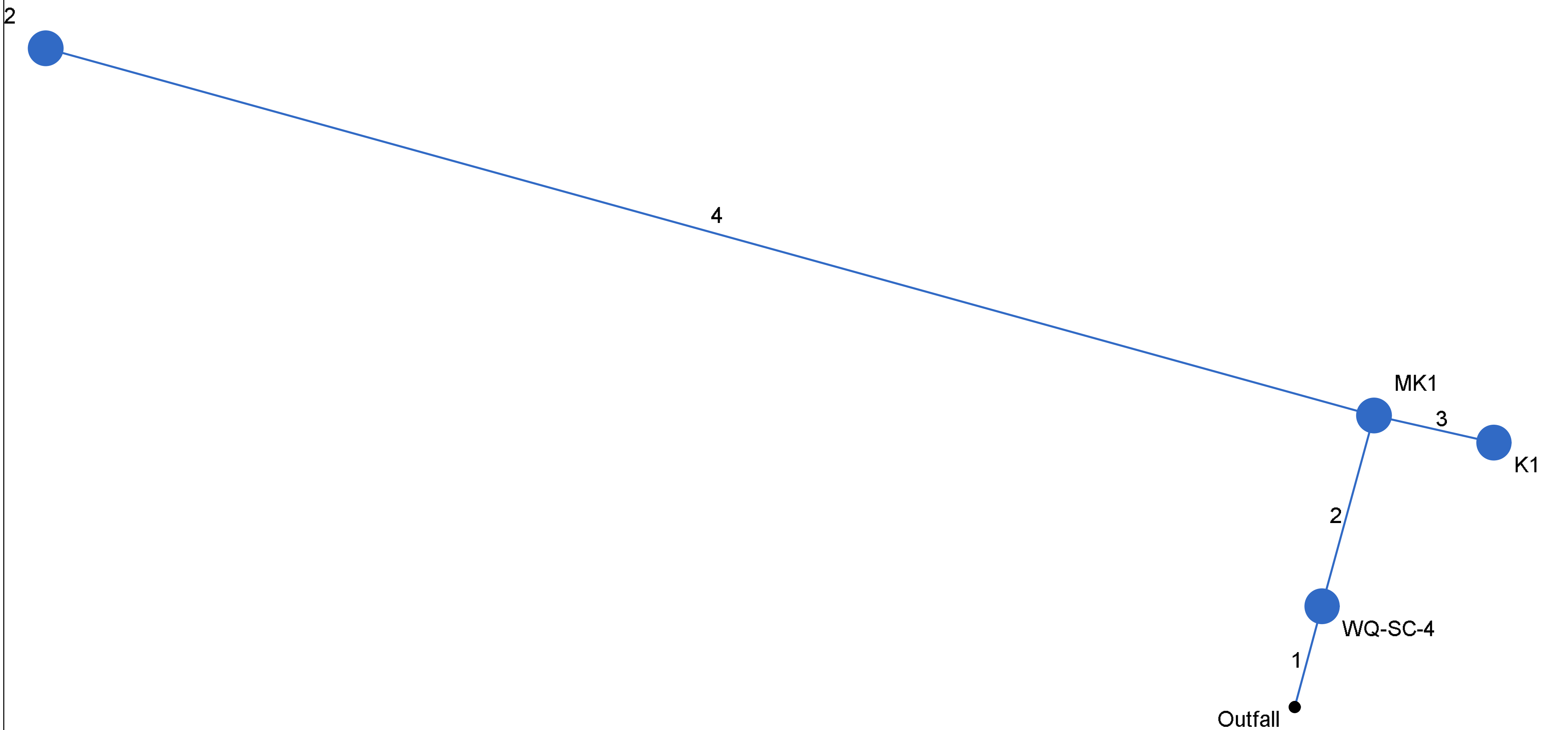
Storm Sewers v12.00

Storm Sewer Profile

Proj. file: Network K.stm



Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: Network K.stm	Number of lines: 4	Date: 7/14/2021

Storm Sewers v12.00

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Dn	Up	Dn	Up	Dn	Up	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
1	End	12.258	0.00	0.45	0.00	0.00	0.38	0.0	6.3	7.5	2.84	10.07	4.68	12	8.00	112.00	112.98	112.72	113.70	113.67	117.97	Pipe - (450) (1) (1)
2	1	23.677	0.00	0.45	0.00	0.00	0.38	0.0	6.2	7.5	2.85	1.56	3.63	12	0.19	112.98	113.03	113.98	114.13	117.97	117.42	Pipe - (450) (1) (1)
3	2	14.646	0.24	0.24	0.84	0.20	0.20	5.0	5.0	7.8	1.57	2.94	3.76	12	0.68	114.51	114.61	115.03	115.14	117.42	117.28	Pipe - (450) (1) (1)
4	2	163.929	0.21	0.21	0.85	0.18	0.18	5.0	5.0	7.8	1.39	2.52	2.34	12	0.50	113.27	114.09	114.34	114.68	117.42	116.76	Pipe - (450) (1)

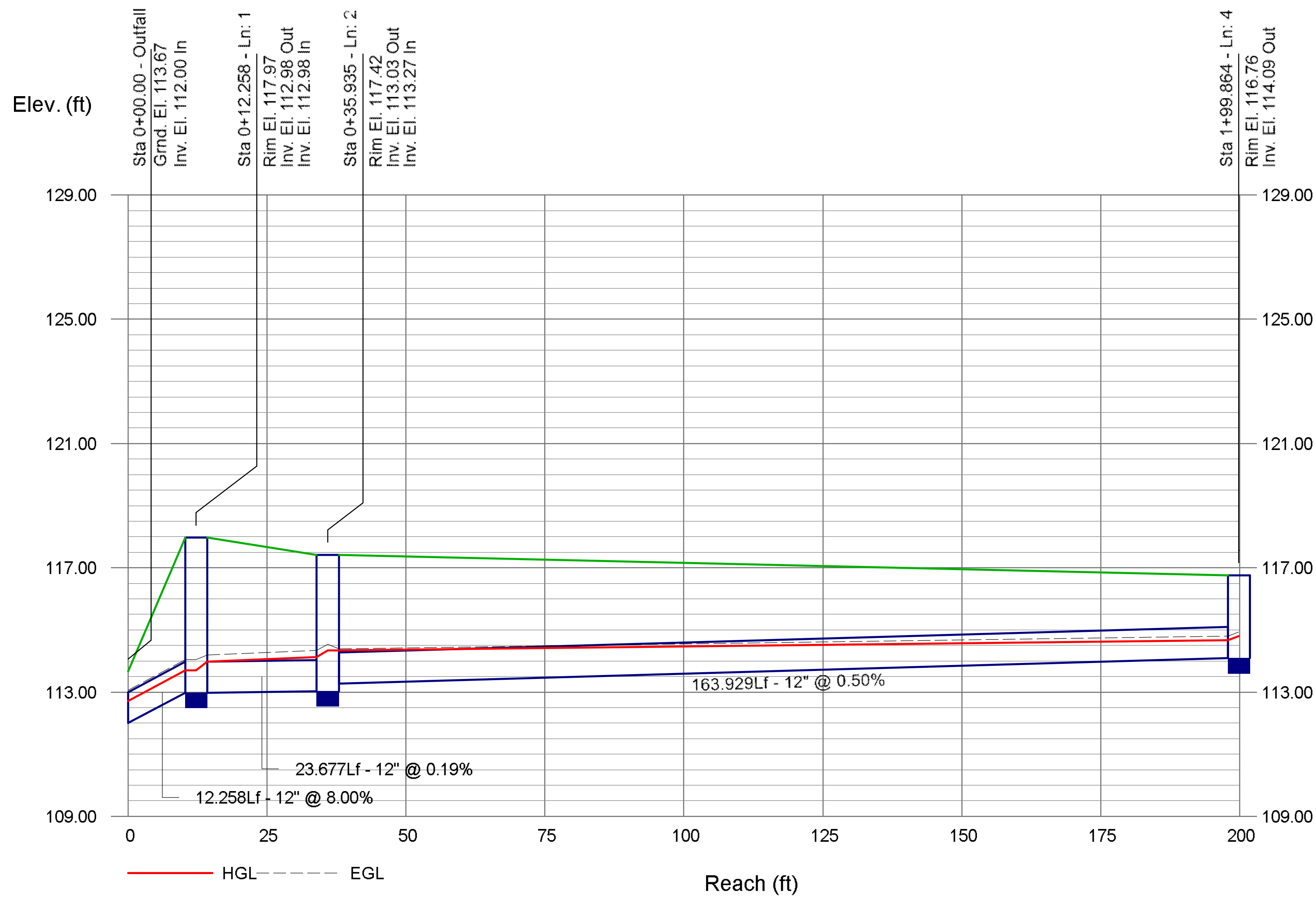
Project File: Network K.stm | Number of lines: 4 | Run Date: 7/14/2021

NOTES:Intensity = 197.93 / (Inlet time + 22.50) ^ 0.98 ; Return period =Yrs. 100 ; c = cir e = ellip b = box

Storm Sewers v12.00

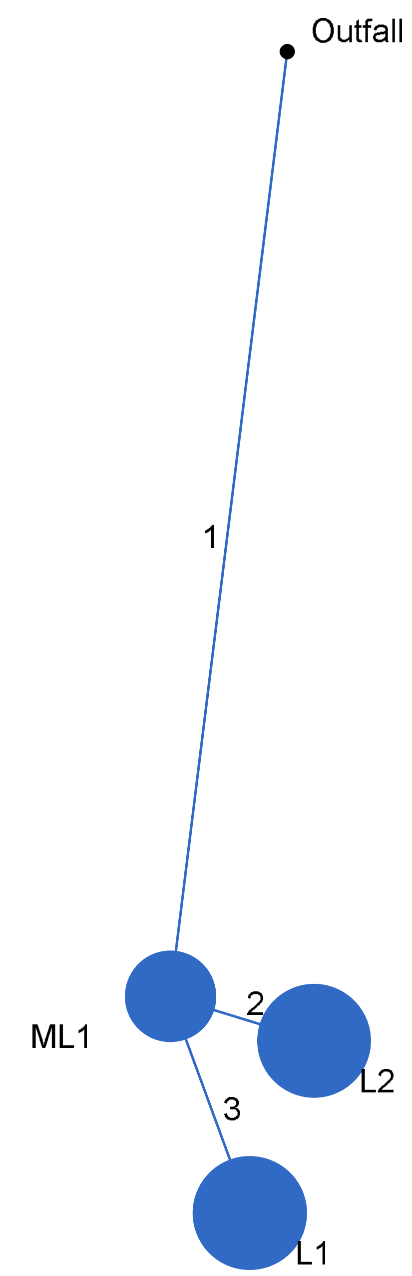
Storm Sewer Profile

Proj. file: Network K.stm



Storm Sewers

Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: Network L.stm	Number of lines: 3	Date: 7/14/2021

Storm Sewers v12.00

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Dn	Up	Dn	Up	Dn	Up	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
1	End	42.917	0.00	0.79	0.00	0.00	0.42	0.0	5.1	5.8	2.46	7.35	2.49	18	0.49	113.12	113.33	114.05	114.07	0.00	116.38	Pipe - (427) (3) (4)
2	1	6.731	0.47	0.47	0.47	0.22	0.22	5.0	5.0	5.8	1.29	2.38	2.34	12	0.45	113.52	113.55	114.19	114.20	116.38	116.24	Pipe - (426) (4) (3)
3	1	10.262	0.32	0.32	0.63	0.20	0.20	5.0	5.0	5.8	1.18	6.67	2.50	12	3.51	113.33	113.69	114.19	114.15	116.38	116.37	Pipe - (426) (4) (1)

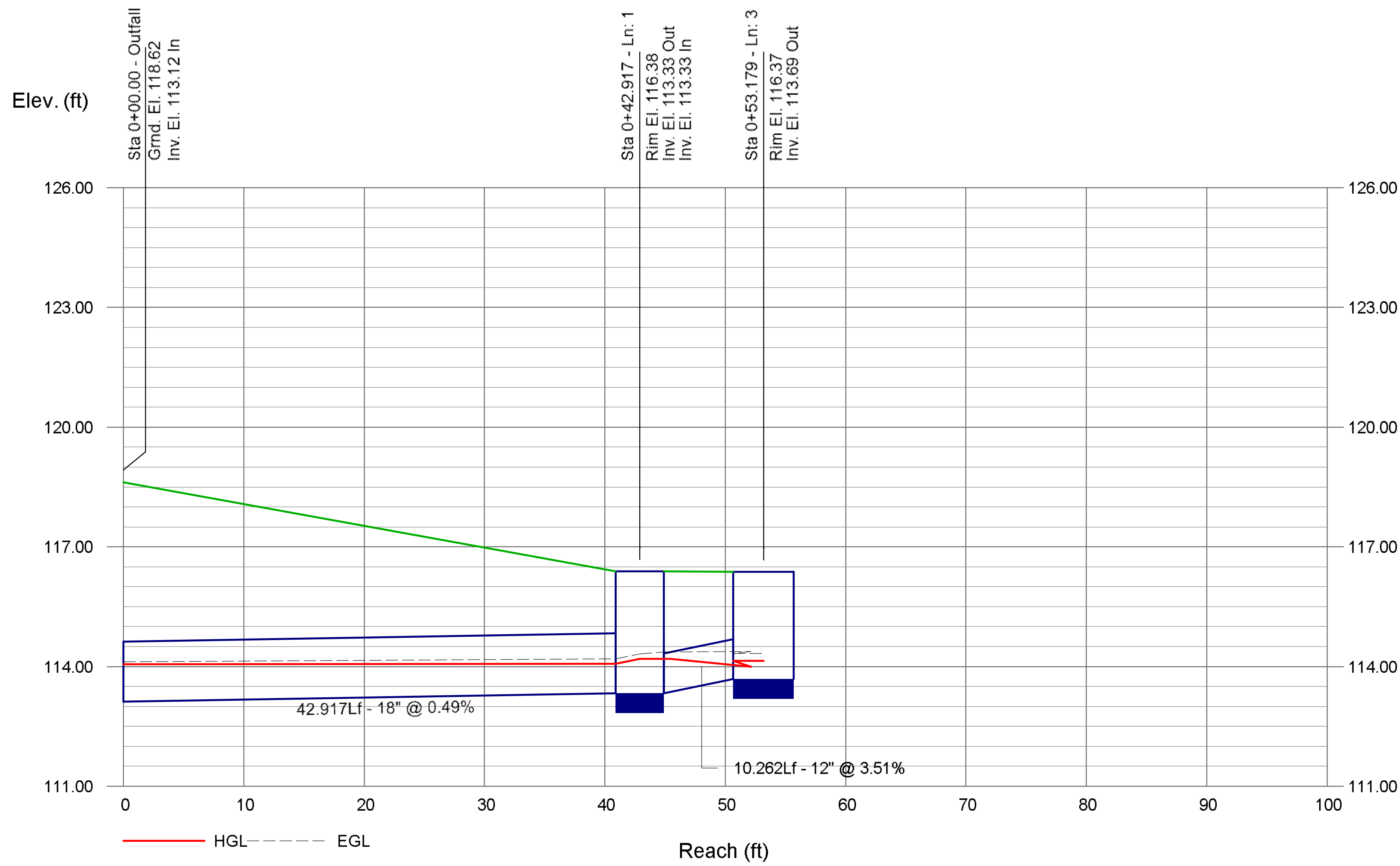
Project File: Network L.stm | Number of lines: 3 | Run Date: 7/14/2021

NOTES:Intensity = 59.21 / (Inlet time + 12.50) ^ 0.81 ; Return period =Yrs. 10 ; c = cir e = ellip b = box

Storm Sewers v12.00

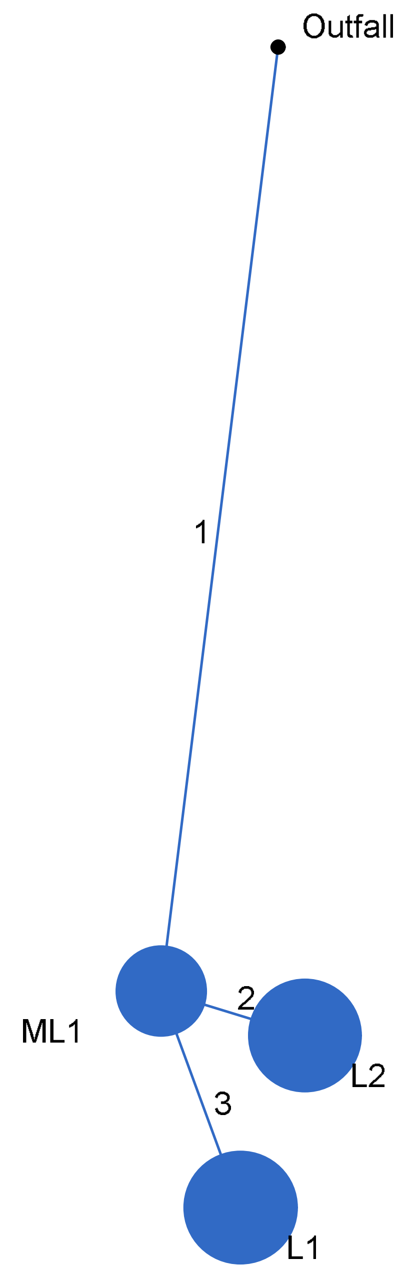
Storm Sewer Profile

Proj. file: Network L.stm



Storm Sewers

Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: Network L.stm	Number of lines: 3	Date: 7/14/2021

Storm Sewers v12.00

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Dn	Up	Dn	Up	Dn	Up	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
1	End	42.917	0.00	0.79	0.00	0.00	0.42	0.0	5.1	7.8	3.29	7.35	1.86	18	0.49	113.12	113.33	114.91	114.95	0.00	116.38	Pipe - (427) (3) (4)
2	1	6.731	0.47	0.47	0.47	0.22	0.22	5.0	5.0	7.8	1.72	2.38	2.19	12	0.45	113.52	113.55	115.01	115.02	116.38	116.24	Pipe - (426) (4) (3)
3	1	10.262	0.32	0.32	0.63	0.20	0.20	5.0	5.0	7.8	1.57	6.67	2.00	12	3.51	113.33	113.69	115.01	115.03	116.38	116.37	Pipe - (426) (4) (1)

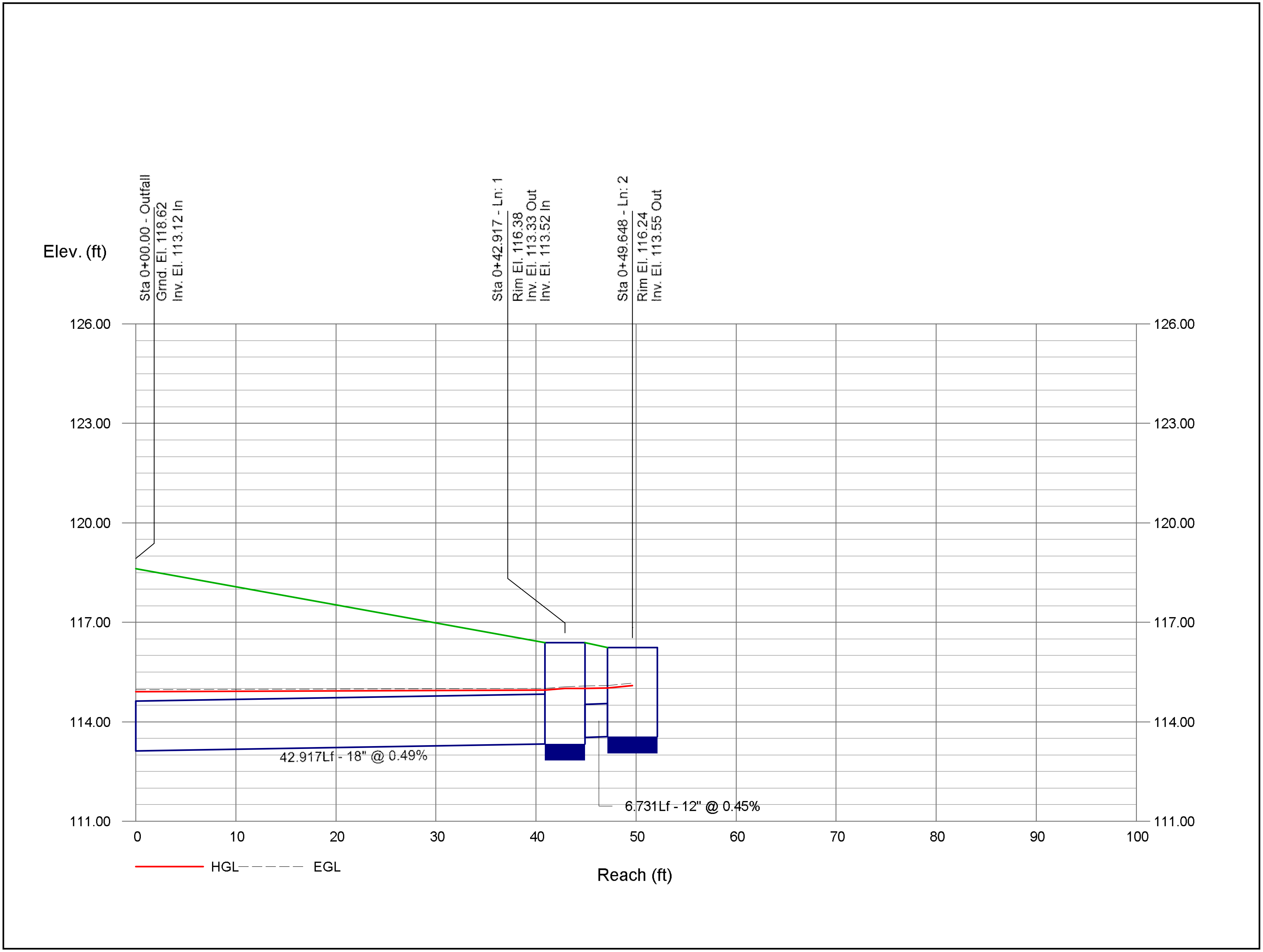
Project File: Network L.stm | Number of lines: 3 | Run Date: 7/14/2021

NOTES:Intensity = 197.93 / (Inlet time + 22.50) ^ 0.98 ; Return period =Yrs. 100 ; c = cir e = ellip b = box

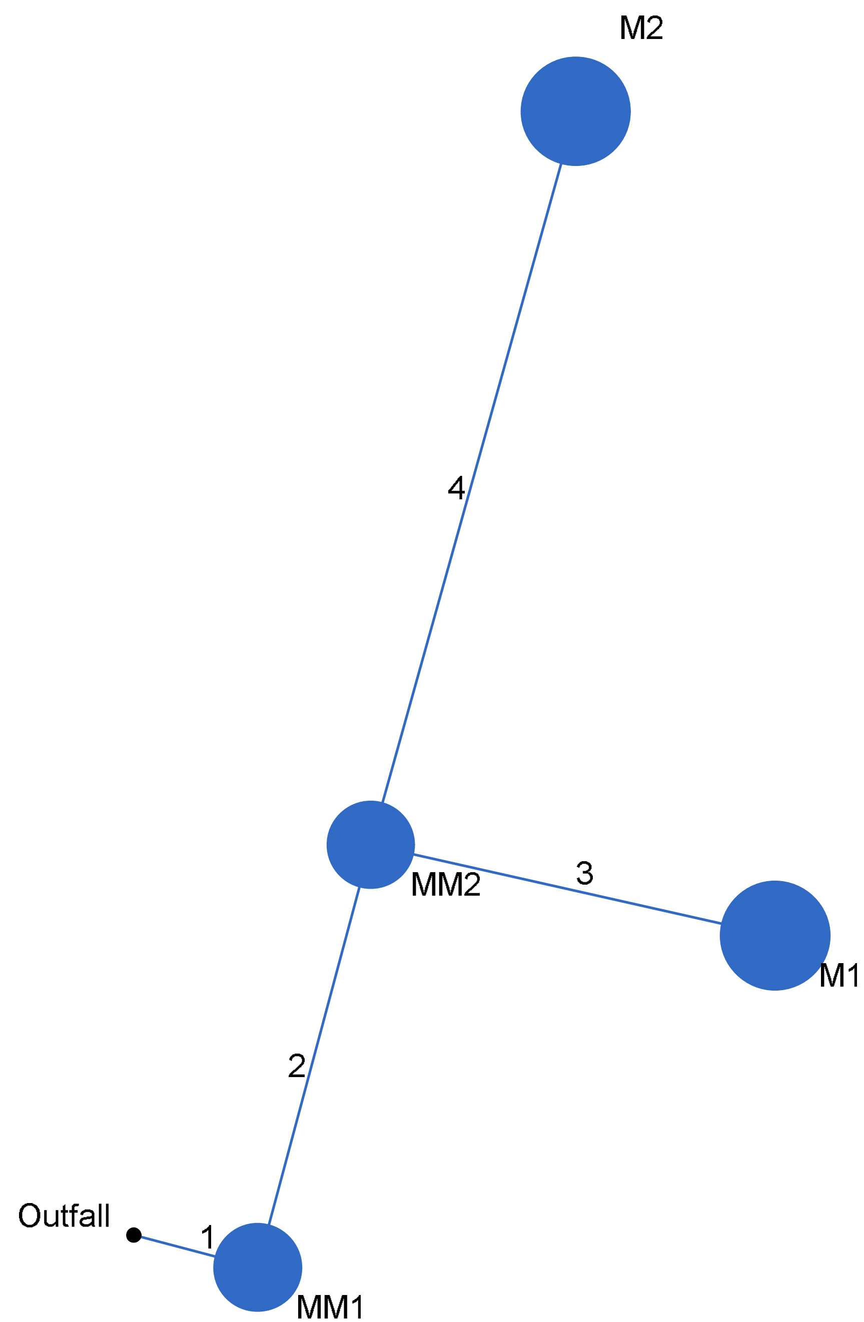
Storm Sewers v12.00

Storm Sewer Profile

Proj. file: Network L.stm



Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: Network M.stm	Number of lines: 4	Date: 7/14/2021

Storm Sewer Tabulation

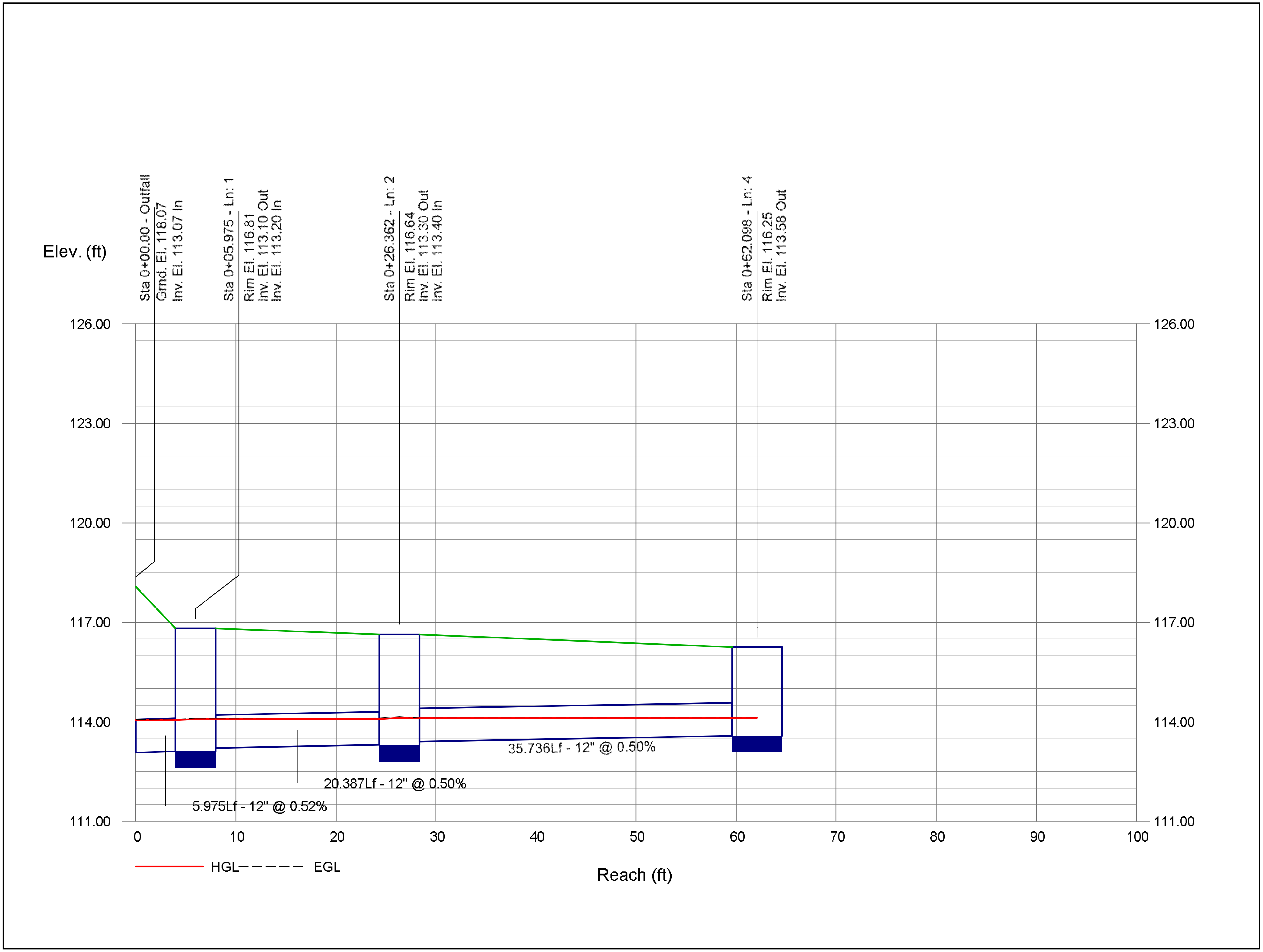
Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Dn	Up	Dn	Up	Dn	Up	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
1	End	5.975	0.00	0.21	0.00	0.00	0.18	0.0	7.2	5.3	0.94	2.58	1.22	12	0.52	113.07	113.10	114.05	114.05	0.00	116.81	Pipe - (523)
2	1	20.387	0.00	0.21	0.00	0.00	0.18	0.0	6.9	5.4	0.95	2.52	1.38	12	0.50	113.20	113.30	114.08	114.08	116.81	116.64	Pipe - (427) (3) (4)
3	2	19.120	0.18	0.18	0.84	0.15	0.15	5.0	5.0	5.8	0.88	2.44	1.89	12	0.47	113.50	113.59	114.12	114.13	116.64	116.26	Pipe - (426) (4) (1)
4	2	35.736	0.03	0.03	0.88	0.03	0.03	5.0	5.0	5.8	0.15	2.53	0.31	12	0.50	113.40	113.58	114.12	114.12	116.64	116.25	Pipe - (426) (4) (3)

Project File: Network M.stm | Number of lines: 4 | Run Date: 7/14/2021

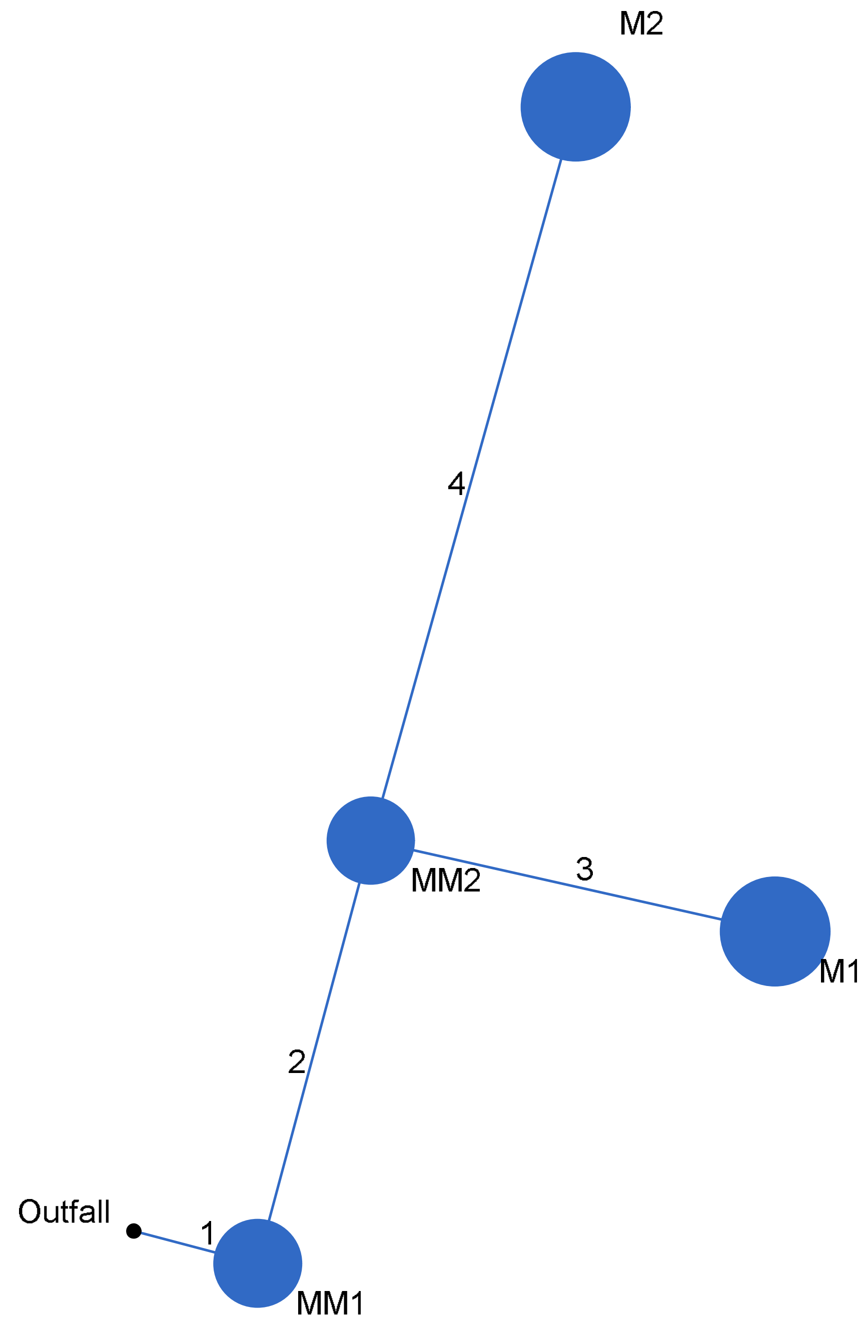
NOTES:Intensity = 59.21 / (Inlet time + 12.50) ^ 0.81 ; Return period =Yrs. 10 ; c = cir e = ellip b = box

Storm Sewers v12.00

Storm Sewer Profile



Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: Network M.stm	Number of lines: 4	Date: 7/14/2021

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	5.975	0.00	0.21	0.00	0.00	0.18	0.0	7.5	7.2	1.27	2.58	1.62	12	0.52	113.07	113.10	114.91	114.92	0.00	116.81	Pipe - (523)
2	1	20.387	0.00	0.21	0.00	0.00	0.18	0.0	7.3	7.2	1.28	2.52	1.63	12	0.50	113.20	113.30	114.96	114.99	116.81	116.64	Pipe - (427) (3) (4)
3	2	19.120	0.18	0.18	0.84	0.15	0.15	5.0	5.0	7.8	1.18	2.44	1.50	12	0.47	113.50	113.59	115.03	115.05	116.64	116.26	Pipe - (426) (4) (1)
4	2	35.736	0.03	0.03	0.88	0.03	0.03	5.0	5.0	7.8	0.21	2.53	0.26	12	0.50	113.40	113.58	115.03	115.03	116.64	116.25	Pipe - (426) (4) (3)

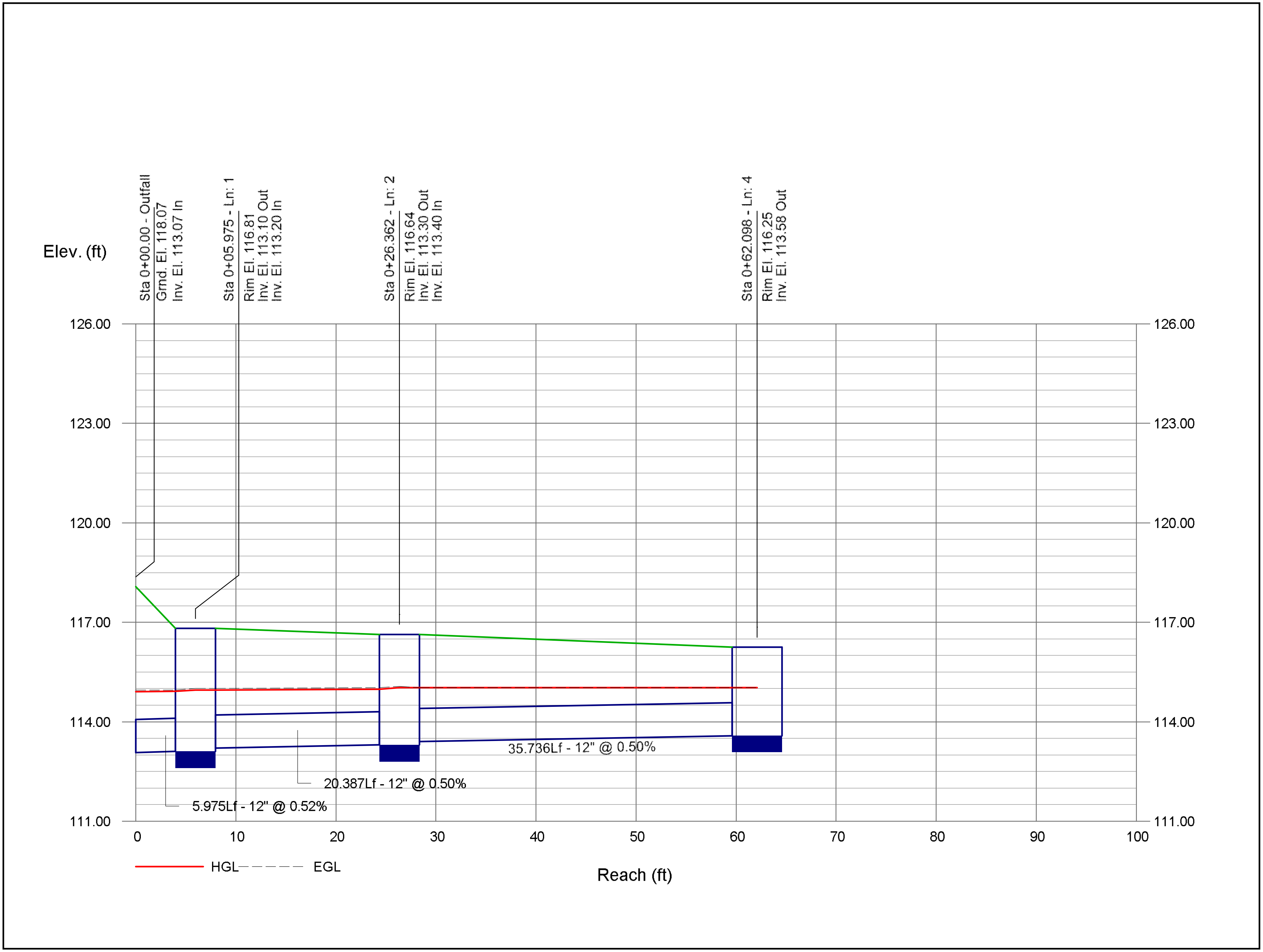
Project File: Network M.stm | Number of lines: 4 | Run Date: 7/14/2021

NOTES:Intensity = 197.93 / (Inlet time + 22.50) ^ 0.98 ; Return period =Yrs. 100 ; c = cir e = ellip b = box

Storm Sewers v12.00

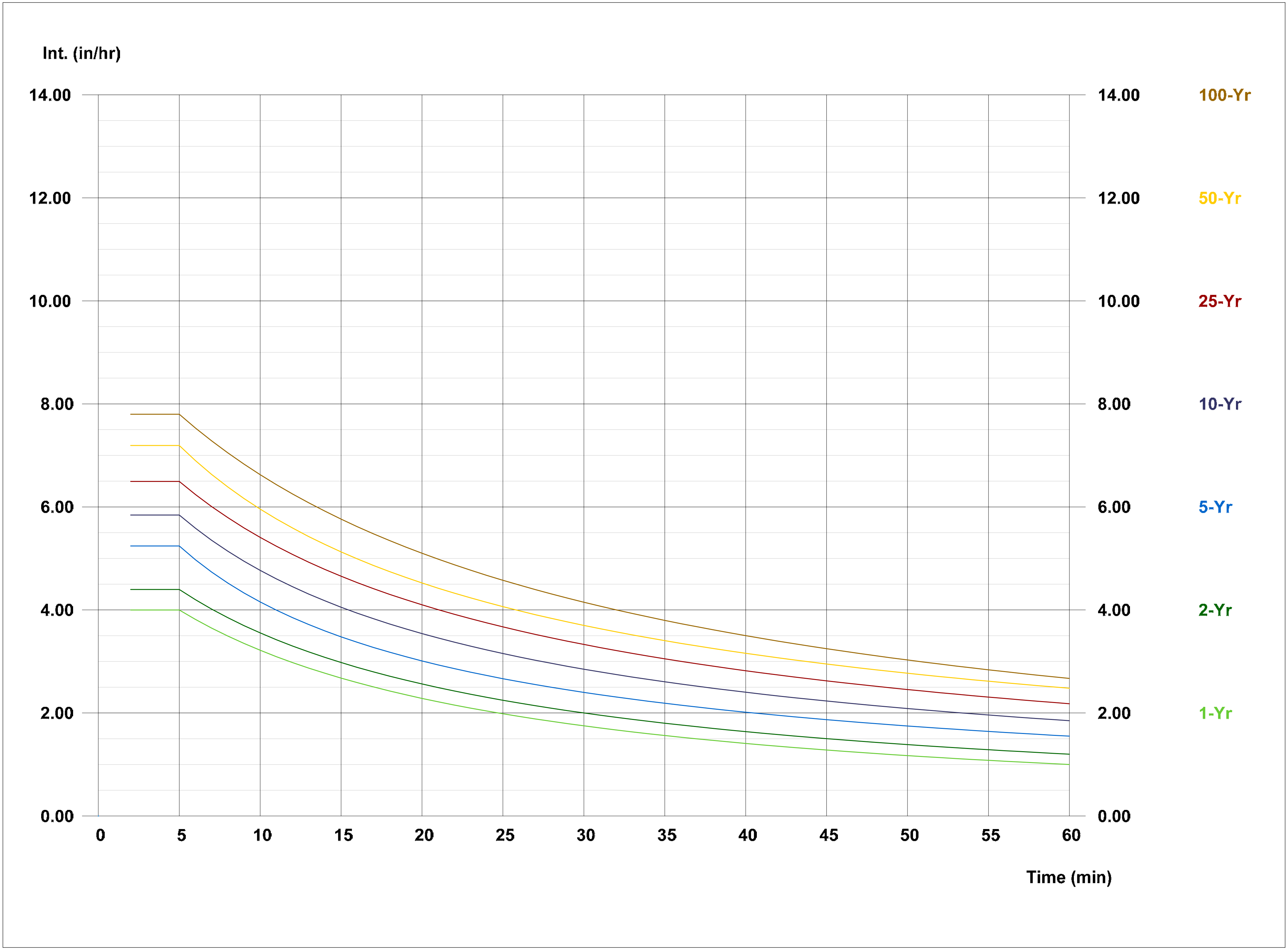
Storm Sewer Profile

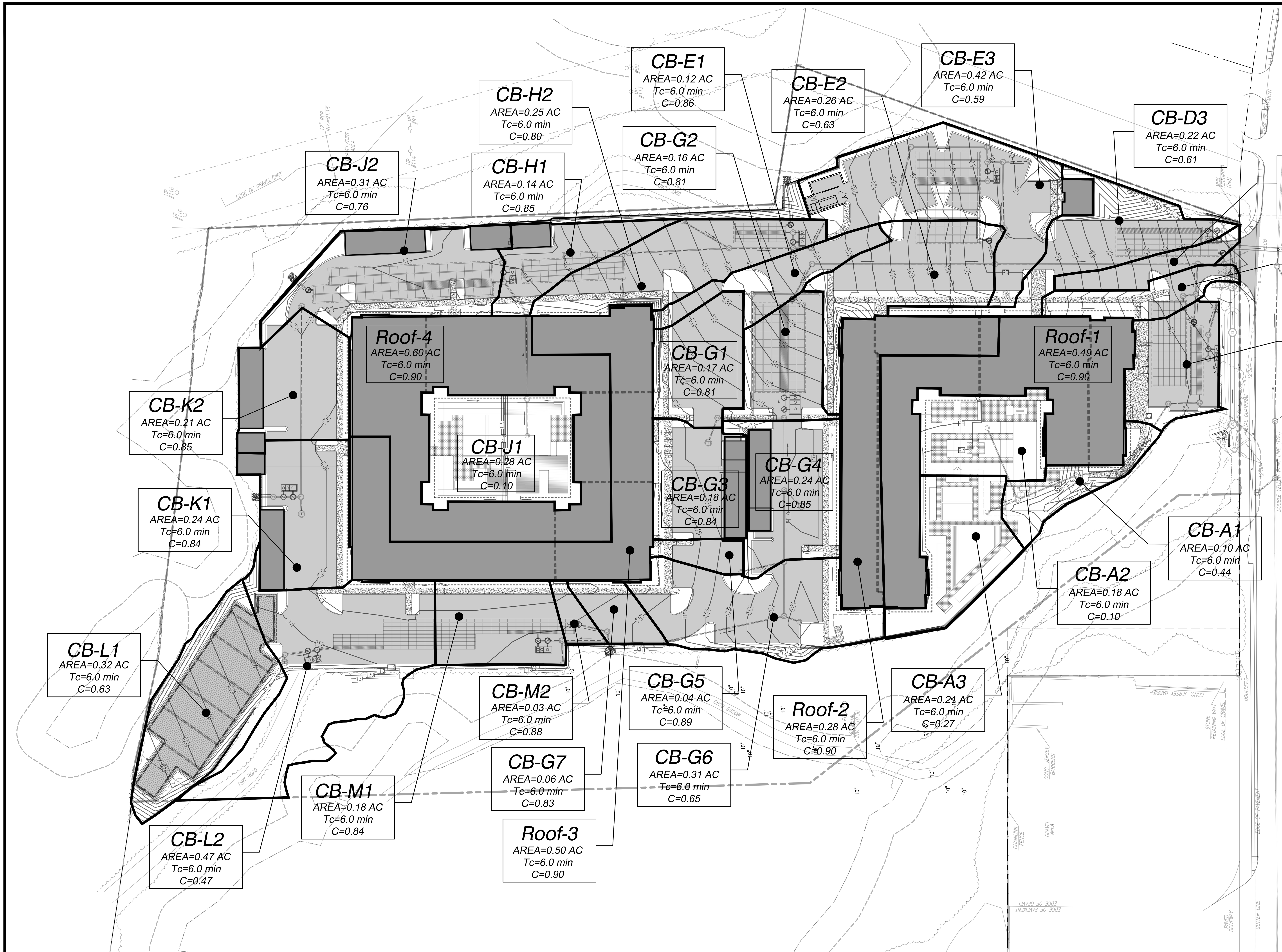
Proj. file: Network M.stm



Storm Sewer IDF Curves

IDF file: quincy idf curve.IDF





	TOTAL		GRASS AREA		PAVED AREA		TOTAL AREA	RUNOFF
CB	AREA (S.F.)	AREA (AC)	S.F.	AC	S.F.	ACRES	(ACRES)	COEFFICIENT
A1	4384.00	0.10	2500.00	0.06	1884.00	0.04	0.10	0.44
A2	7986.00	0.18	7986.00	0.18	0.00	0.00	0.18	0.10
A3	9098.00	0.21	7200.00	0.17	1898.00	0.04	0.21	0.27
B1	7188.00	0.17	500.00	0.01	6688.00	0.15	0.17	0.84
D1	4160.00	0.10	1300.00	0.03	2860.00	0.07	0.10	0.65
D2	3064.00	0.07	50.00	0.00	3014.00	0.07	0.07	0.89
D3	9495.00	0.22	3440.00	0.08	6055.00	0.14	0.22	0.61
E1	5326.00	0.12	250.00	0.01	5076.00	0.12	0.12	0.86
E2	11270.00	0.26	3800.00	0.09	7470.00	0.17	0.26	0.63
E3	18121.00	0.42	7050.00	0.16	11071.00	0.25	0.42	0.59
G2	7009.00	0.16	760.00	0.02	6249.00	0.14	0.16	0.81
G1	7467.00	0.17	820.00	0.02	6647.00	0.15	0.17	0.81
G3	7915.00	0.18	610.00	0.01	7305.00	0.17	0.18	0.84
G4	10344.00	0.24	630.00	0.01	9714.00	0.22	0.24	0.85
G5	1831.00	0.04	25.00	0.00	1806.00	0.04	0.04	0.89
G6	13447.00	0.31	4200.00	0.10	9247.00	0.21	0.31	0.65
G7	2795.00	0.06	260.00	0.01	2535.00	0.06	0.06	0.83
H2	11085.00	0.25	1400.00	0.03	9685.00	0.22	0.25	0.80
H1	6017.00	0.14	355.00	0.01	5662.00	0.13	0.14	0.85
J1	12312.00	0.28	12312.00	0.28	0.00	0.00	0.28	0.10
J2	13429.00	0.31	2350.00	0.05	11079.00	0.25	0.31	0.76
K1	10283.00	0.24	750.00	0.02	9533.00	0.22	0.24	0.84
K2	9360.00	0.21	580.00	0.01	8780.00	0.20	0.21	0.85
L1	13983.00	0.32	4760.00	0.11	9223.00	0.21	0.32	0.63
L2	20592.00	0.47	11035.00	0.25	9557.00	0.22	0.47	0.47
M1	7738.00	0.18	560.00	0.01	7178.00	0.16	0.18	0.84
M2	1360.00	0.03	38.00	0.00	1322.00	0.03	0.03	0.88
ROOF 1	21230.00	0.49	0.00	0.00	21230.00	0.49	0.49	0.90
ROOF 2	12267.00	0.28	0.00	0.00	12267.00	0.28	0.28	0.90
ROOF 3	21598.00	0.50	0.00	0.00	21598.00	0.50	0.50	0.90
ROOF 4	26069.00	0.60	0.00	0.00	26069.00	0.60	0.60	0.90

NOTE:

1. ALL SUB-CATCHMENTS AREAS WHICH EACH DRAIN TO A CATCH BASIN HAVE BEEN DESIGNED TO HAVE LESS THAN $\frac{1}{4}$ AC OF IMPERVIOUS AREA CONTRIBUTARY TO EACH CATCH BASIN

Date	Description	No.
7.14.2021	REVISED PER CONSERVATION COMMISSION	1.

Revisions

7-14-2021

GABRIEL R. CROCKER
PROFESSIONAL ENGINEER, MA REGISTRATION #47917

COMMONWEALTH OF MASSACHUSETTS
GABRIEL R. CROCKER
CIVIL
No.47917
REGISTERED
PROFESSIONAL ENGINEER

Crocker Design Group
2 SHARP STREET, UNIT B
HINGHAM, MA 02043
P: 781-919-0808

Project
HANOVER WEYMOUTH RESIDENTIAL DEVELOPMENT
#1325 WASHINGTON STREET, WEYMOUTH, MA

Prepared for
HANOVER R.S. LIMITED PARTNERSHIP
ONE MARINE PARK DRIVE, SUITE 701, BOSTON, MA 02210
HANOVER COMPANY

Drawing Title
PROPOSED CONDITIONS SUB-CATCHMENTS MAP

Project No.	100-124
Date	4.8.2021
Scale	1"=40'
Drawn By	AS
Approved By	GC

Drawing No.
PH-2

SECTION 9 – ORAD MA DEP #81-1253

For Registry of Deeds Use Only

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands

WPA Form 4B – Order of Resource Area Delineation

Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

Provided by MassDEP:
81-1253
MassDEP File Number

eDEP Transaction Number
Weymouth
City/Town

A. General Information

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

Note: Before completing this form consult your local Conservation Commission regarding any municipal bylaw or ordinance.

From: Weymouth
1. Conservation Commission

2. This Issuance is for (check one):

a. ☒ Order of Resource Area Delineation

b. ☐ Amended Order of Resource Area Delineation

3. Applicant:

James	Bristol, III
a. First Name	b. Last Name

1317 Washington RE Holdings LLC
c. Organization

190 Old Derby St, Suite 311
d. Mailing Address

Hingham	MA	02043
e. City/Town	f. State	g. Zip Code

4. Property Owner (if different from applicant):

See Attachment 1 (1 pg)	
a. First Name	b. Last Name

c. Organization

d. Mailing Address

e. City/Town	f. State	g. Zip Code

5. Project Location:

Washington St & White Oaks Lane (see Attachment 2, 1 pg)	Weymouth b. City/Town	02189 c. Zip Code
Map 35, Block 448 d. Assessors Map/Plat Number	Lots 7, 8, 9 and 25 e. Parcel/Lot Number	

Latitude and Longitude (in degrees, minutes, seconds): d m s f. Latitude; d m s g. Longitude

6. Dates:

05/04/2020	06/23/2020	07/28/2020
a. Date ANRAD filed	b. Date Public Hearing Closed	c. Date of Issuance

ATTACHMENT 1

Attachment to Order of Resource Area Delineation
DEP File #81-1235
Washington St. and White Oaks Lane, Weymouth MA

RECORD OWNER INFORMATION

Assessor's Reference: Map 35 Block 448 Lot 7
Land Court Certificate No. 201840

Owner: 1317 Bristol Holdings, LLC
190 Old Derby Street
Suite 311
Hingham, MA 02043

Assessor's Reference: Map 35 Block 448 Lot 8
Land Court Certificate No. 201841

Owner: 1317 Bristol Holdings, LLC
190 Old Derby Street
Suite 311
Hingham, MA 02043

Assessor's Reference: Map 35 Block 448 Lot 9
Deed Book 1955 – Page 560
Deed Book 3055 – Page 514

Owner: Bates Bros. Seam-Face Granite Co.
882 Pleasant Street
East Weymouth, MA 02189

Assessor's Reference: Map 35 Block 448 Lot 25
Land Court Certificate No. 182152

Owner: White Oaks Trust
190 Old Derby Street
Suite 311
Hingham, MA 02043

ATTACHMENT 2

Order of Resource Area Delineation
DEP File #81-1235
Washington St. and White Oaks Lane, Weymouth MA

PROPERTY LOCATION

Assessors Reference			Property Address
Map	Block	Lot	
35	448	7	1325 Washington St.
35	448	8	"0" Washington St. (undeveloped land)
35	448	9	"0" Washington St. (undeveloped land)
35	448	25	28 White Oaks Lane

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands

WPA Form 4B – Order of Resource Area Delineation

Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

Provided by MassDEP:
81-1253
MassDEP File Number

eDEP Transaction Number
Weymouth
City/Town

A. General Information (cont.)

7. Title and Date (or Revised Date if applicable) of Final Plans and Other Documents:

Wetland Location Plan, Assessors Map 35 Block 448, Lots 7, 8, 9, 25, Washington Street, Weymouth MA. Prepared by Crocker Design Group.

Rev. 6/18/2020
b. Date

c. Title

d. Date

B. Order of Delineation

1. The Conservation Commission has determined the following (check whichever is applicable):

a. ☒ **Accurate**: The boundaries described on the referenced plan(s) above and in the Abbreviated Notice of Resource Area Delineation are accurately drawn for the following resource area(s):

1. ☒ Bordering Vegetated Wetlands
2. ☒ Other resource area(s), specifically:

a. See ATTACHMENT 3 (1 pg) for list of all resource areas covered under this ORAD.

b. ☒ **Modified**: The boundaries described on the plan(s) referenced above, as modified by the Conservation Commission from the plans contained in the Abbreviated Notice of Resource Area Delineation, are accurately drawn from the following resource area(s):

1. ☐ Bordering Vegetated Wetlands
2. ☒ Other resource area(s), specifically:

a. Wetland series "D" is labeled on the ANRAD plan as "Isolated Vegetated Wetland (IVW), Local Jurisdiction Only." The Conservation Commission has not made a determination as to state jurisdiction. This ORAD rules only on the local jurisdiction of series "D."

c. ☐ **Inaccurate**: The boundaries described on the referenced plan(s) and in the Abbreviated Notice of Resource Area Delineation were found to be inaccurate and cannot be confirmed for the following resource area(s):

1. ☐ Bordering Vegetated Wetlands
2. ☐ Other resource area(s), specifically:

ATTACHMENT 3

Order of Resource Area Delineation
DEP File #81-1235
Washington St. and White Oaks Lane, Weymouth MA

WETLAND RESOURCE AREA DESCRIPTIONS
For areas jurisdictional under the Mass Wetlands Protection Act (MGL c. 131, sec. 40) and/or the Weymouth Wetlands Protection Ordinance (Weymouth Code of Ordinances, Chapter 7, sec. 301)

<u>BORDERING VEGETATED WETLAND – STATE AND LOCAL JURISDICTION</u>
Wetland Series "A"
Wetlands Series "B"
Wetland Series "E"
Wetland Series "F"

<u>ISOLATED VEGETATED WETLAND – LOCAL JURISDICTION ONLY</u>
Wetland Series "C"
Wetland Series "G", flags WFG1 – WFG11 (Note: this is one of two series labeled "WFG")
Wetland Series "H"

<u>ISOLATED VEGETATED WETLAND and VERNAL POOL – LOCAL JURISDICTION ONLY</u>
Quarry Hole "E" series
Quarry Hole "G" series, WFG1 – WFG8 (Note: this is one of two series labeled "WFG")

<u>WETLAND SERIES LOCAL JURISDICTION, STATE JURISDICTION NOT DETERMINED</u>
Wetland series "D" (wetland flags WFD 1 – 9).
NOTE: On the ANRAD plan, the WFD series is labeled as "Isolated Vegetated Wetland, Local Jurisdiction Only." The Weymouth Conservation Commission has not made a determination as to whether or not this wetland series is subject to state jurisdiction.

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands

WPA Form 4B – Order of Resource Area Delineation

Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

Provided by MassDEP:
81-1253
MassDEP File Number

eDEP Transaction Number
Weymouth
City/Town

B. Order of Delineation (cont.)

3. ☐ The boundaries were determined to be inaccurate because:

C. Findings

This Order of Resource Area Delineation determines that the boundaries of those resource areas noted above, have been delineated and approved by the Commission and are binding as to all decisions rendered pursuant to the Massachusetts Wetlands Protection Act (M.G.L. c.131, § 40) and its regulations (310 CMR 10.00). This Order does not, however, determine the boundaries of any resource area or Buffer Zone to any resource area not specifically noted above, regardless of whether such boundaries are contained on the plans attached to this Order or to the Abbreviated Notice of Resource Area Delineation.

This Order must be signed by a majority of the Conservation Commission. The Order must be sent by certified mail (return receipt requested) or hand delivered to the applicant. A copy also must be mailed or hand delivered at the same time to the appropriate DEP Regional Office (see https://www.mass.gov/service-details/massdep-regional-offices-by-community).

D. Appeals

The applicant, the owner, any person aggrieved by this Order, any owner of land abutting the land subject to this Order, or any ten residents of the city or town in which such land is located, are hereby notified of their right to request the appropriate DEP Regional Office to issue a Superseding Order of Resource Area Delineation. When requested to issue a Superseding Order of Resource Area Delineation, the Department's review is limited to the objections to the resource area delineation(s) stated in the appeal request. The request must be made by certified mail or hand delivery to the Department, with the appropriate filing fee and a completed Request for Departmental Action Fee Transmittal Form, as provided in 310 CMR 10.03(7) within ten business days from the date of issuance of this Order. A copy of the request shall at the same time be sent by certified mail or hand delivery to the Conservation Commission and to the applicant, if he/she is not the appellant.

Any appellants seeking to appeal the Department's Superseding Order of Resource Area Delineation will be required to demonstrate prior participation in the review of this project. Previous participation in the permit proceeding means the submission of written information to the Conservation Commission prior to the close of the public hearing, requesting a Superseding Order or Determination, or providing written information to the Department prior to issuance of a Superseding Order or Determination.

The request shall state clearly and concisely the objections to the Order which is being appealed and how the Order does not contribute to the protection of the interests identified in the Massachusetts Wetlands Protection Act, (M.G.L. c. 131, § 40) and is inconsistent with the wetlands regulations (310 CMR 10.00). To the extent that the Order is based on a municipal bylaw or ordinance, and not on the Massachusetts Wetlands Protection Act or regulations, the Department of Environmental Protection has no appellate jurisdiction.

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands

WPA Form 4B – Order of Resource Area Delineation

Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

Provided by MassDEP:
81-1253
MassDEP File Number

eDEP Transaction Number
Weymouth
City/Town

E. Signatures

07/28/2020
Date of Issuance

Please indicate the number of members who will sign this form.

3
1. Number of Signers

Signatures

Signature of Conservation Commission Member	Printed Name
Thomas E Tanner	Thomas Tanner, Chairman
	George Loring, Member
	Frank Singleton, Member

This Order is valid for three years from the date of issuance.

If this Order constitutes an Amended Order of Resource Area Delineation, this Order does not extend the issuance date of the original Final Order, which expires on unless extended in writing by the issuing authority.

This Order is issued to the applicant and the property owner (if different) as follows:

2. ☐ By hand delivery on

a. Date

3. ☒ By certified mail, return receipt requested on

07/28/2020
a. Date

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands

Request for Departmental Action Fee Transmittal Form

Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

DEP File Number:

81-1235
Provided by DEP

A. Request Information

1. Location of Project

a. Street Address | b. City/Town, Zip

c. Check number | d. Fee amount

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

2. Person or party making request (if appropriate, name the citizen group's representative):

Name

Mailing Address

City/Town | State | Zip Code

Phone Number | Fax Number (if applicable)

3. Applicant (as shown on Determination of Applicability (Form 2), Order of Resource Area Delineation (Form 4B), Order of Conditions (Form 5), Restoration Order of Conditions (Form 5A), or Notice of Non-Significance (Form 6)):

Name

Mailing Address

City/Town | State | Zip Code

Phone Number | Fax Number (if applicable)

4. DEP File Number:

B. Instructions

1. When the Departmental action request is for (check one):

☐ Superseding Order of Conditions – Fee: $120.00 (single family house projects) or $245 (all other projects)

☐ Superseding Determination of Applicability – Fee: $120

☐ Superseding Order of Resource Area Delineation – Fee: $120

Send this form and check or money order, payable to the *Commonwealth of Massachusetts,* to:

Department of Environmental Protection
Box 4062
Boston, MA 02211

Request for Departmental Action Fee Transmittal Form

Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

DEP File Number:

Provided by DEP

B. Instructions (cont.)

2. On a separate sheet attached to this form, state clearly and concisely the objections to the Determination or Order which is being appealed. To the extent that the Determination or Order is based on a municipal bylaw, and not on the Massachusetts Wetlands Protection Act or regulations, the Department has no appellate jurisdiction.

3. Send a **copy** of this form and a **copy** of the check or money order with the Request for a Superseding Determination or Order by certified mail or hand delivery to the appropriate DEP Regional Office (see https://www.mass.gov/service-details/massdep-regional-offices-by-community).

4. A copy of the request shall at the same time be sent by certified mail or hand delivery to the Conservation Commission and to the applicant, if he/she is not the appellant.

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands

WPA Form 4B – Order of Resource Area Delineation

Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

Provided by MassDEP:

MassDEP File Number

eDEP Transaction Number

City/Town

Recording Information

Prior to commencement of work, this Order of Resource Area Delineation must be recorded in the Registry of Deeds or the Land Court for the district in which the land is located, within the chain of title of the affected property. In the case of recorded land, the Final Order shall also be noted in the Registry's Grantor Index under the name of the owner of the land subject to the Order. In the case of registered land, this Order shall also be noted on the Land Court Certificate of Title of the owner of the land subject to the Order of Resource Area Delineation. The recording information on this page shall be submitted to the Conservation Commission listed below.

Conservation Commission

Detach on dotted line, have stamped by the Registry of Deeds and submit to the Conservation Commission.

To:

Conservation Commission

Please be advised that the Order of Resource Area Delineation for the Project at:

Project Location | MassDEP File Number

Has been recorded at the Registry of Deeds of:

County | Book | Page

For: Property Owner

and has been noted in the chain of title of the affected property in:

Book | Page

In accordance with the Order of Resource Area Delineation issued on:

Date

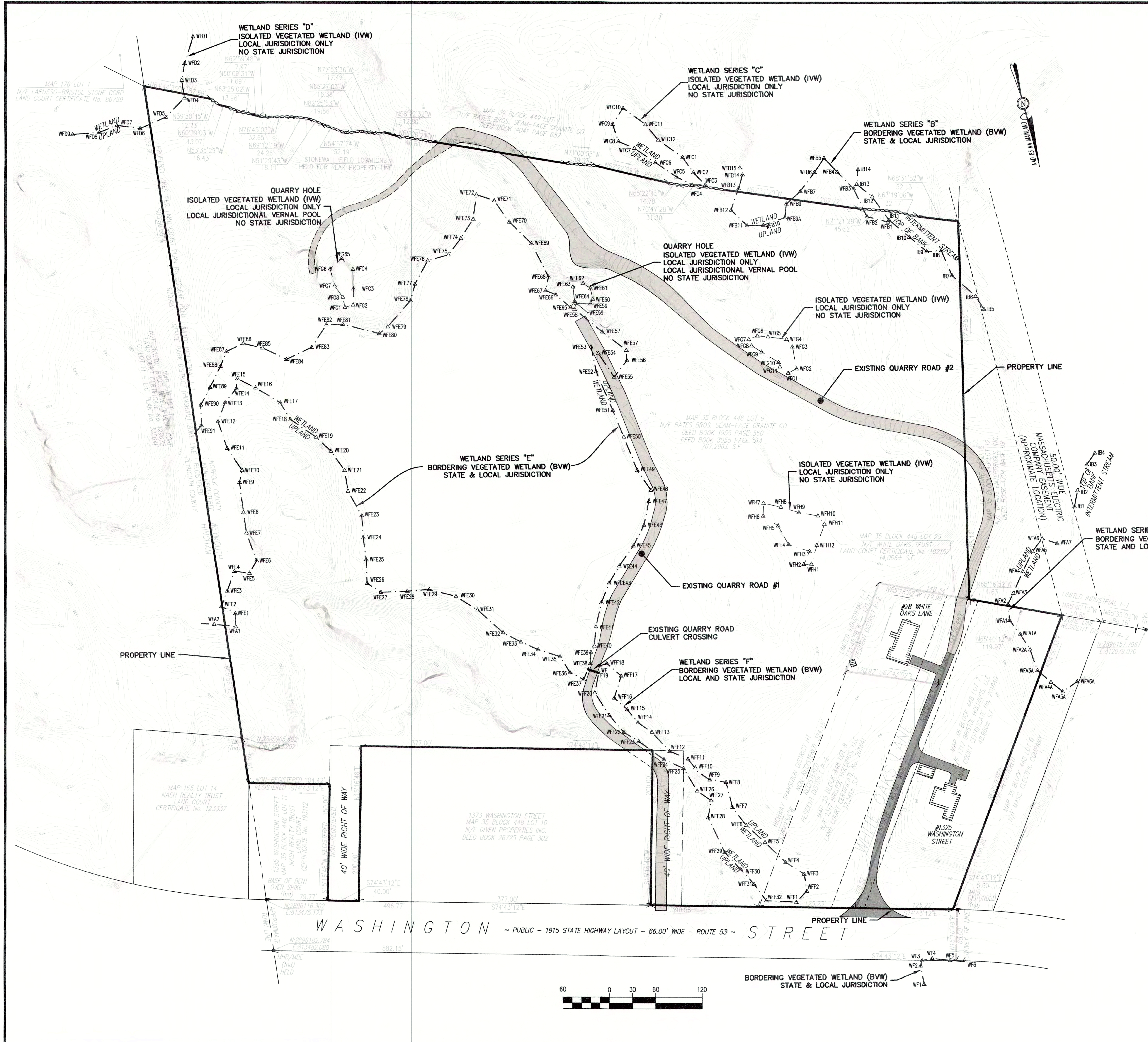
If recorded land, the instrument number identifying this transaction is:

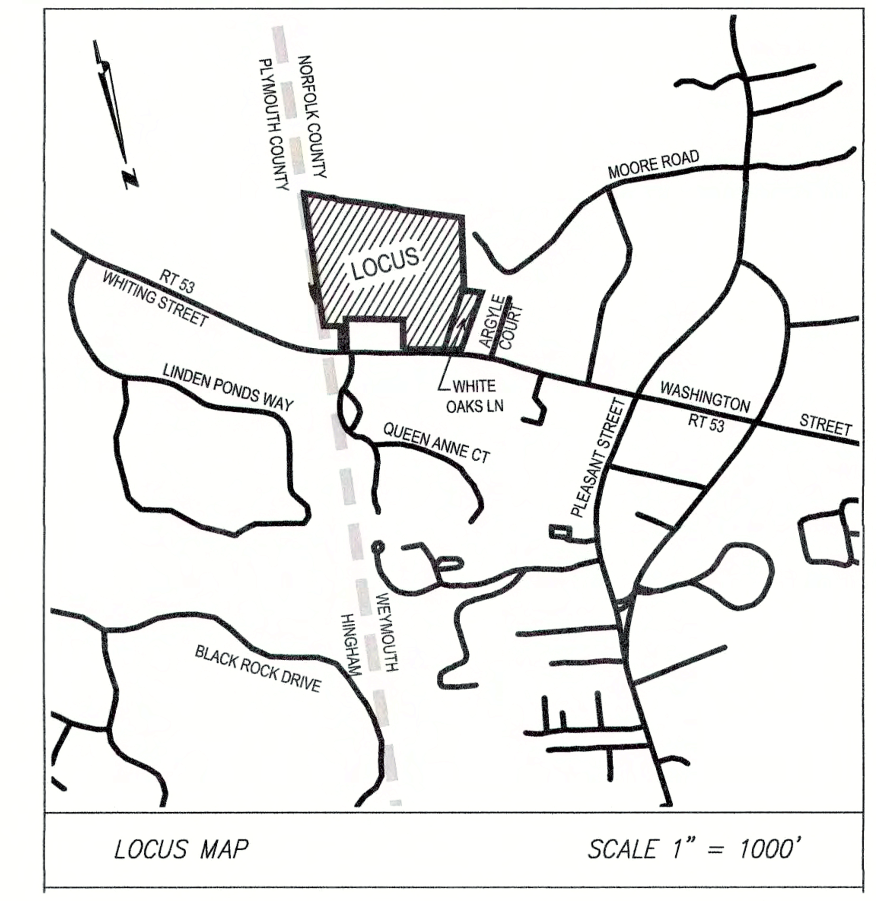
Instrument Number

If registered land, the document number identifying this transaction is:

Document Number

Signature of Applicant





RECORD OWNERS:

MAP 35 BLOCK 448 LOT 7
1317 BRISTOL HOLDINGS, LLC
LAND COURT CERTIFICATE No. 201840
LOT AREA = 48,960± S.F.

MAP 35 BLOCK 448 LOT 8
1317 BRISTOL HOLDINGS, LLC
LAND COURT CERTIFICATE No. 201841
LOT AREA = 37,341± S.F.

MAP 35 BLOCK 448 LOT 9
BATES BROS. SEAM-FACE GRANITE CO.
DEED BOOK 1955 PAGE 560
DEED BOOK 3055 PAGE 514
LOT AREA = 767,296± S.F.

MAP 35 BLOCK 448 LOT 25
WHITE OAKS TRUST
LAND COURT CERTIFICATE No. 182152
LOT AREA = 14,066± S.F.

PLAN REFERENCES:

1. WASHINGTON STREET – STATE HIGHWAY LAYOUT No. 1640 & 1846
2. PLAN No. 467 OF 1949 PLAN BOOK 2827 PAGE 455
3. PLAN No. 226 OF 1951 PLAN BOOK 2985 PAGE 551
4. PLAN No. 1087 OF 1961 PLAN BOOK 3934 PAGE 722
5. PLAN No. 420 OF 1966 PLAN BOOK 220
6. PLAN No. 376 OF 1968 PLAN BOOK 224
7. PLAN No. 933 OF 1970 PLAN BOOK 4704 PAGE 86
8. LAND COURT CASE No. 14364
9. LAND COURT CASE No. 20228
10. LAND COURT CASE No. 20905
11. LAND COURT CASE No. 31196
12. LAND COURT CASE No. 32564

NOTES:

1. WETLAND RESOURCE AREAS SHOWN HEREON DELINEATED BY SOUTH RIVER ENVIRONMENTAL ON JANUARY 7, 2020, MARCH 27, 2020 AND MAY 14, 2020.
2. SUBJECT PROPERTY FALLS WITHIN ZONE X OF THE FLOOD INSURANCE RATE MAP No. 25021C0233E, WITH AN EFFECTIVE DATE OF JULY 17, 2012, AND DOES NOT FALL WITHIN A SPECIAL FLOOD HAZARD AREA.
3. SUBJECT PROPERTY FALLS WITH PORTIONS OF THE RESIDENCE DISTICT R-2, LIMITED INDUSTRIAL I-1, HIGHWAY TRANSITION DISTICT HT AND THE COMMERCIAL COORIDOR OVERLAY DISTRICT CCOD.
4. COORDINATE POSITIONS SHOWN HEREON REFERENCED TO THE NORTH AMERICAN HORIZONTAL DATUM OF 1983 MASSACHUSETTS MAINLAND (NAD83).
5. RESOURCE AREA TYPES IDENTIFIED ON THE PLANS WERE DETERMINED BY SOUTH RIVER ENVIRONMENTAL.
6. TOPOGRAPHY SHOWN WAS GENERATED FROM AERIAL PHOTOGRAMMETRY PERFORMED CHA CONSULTING INC. (CHA). CONTOURS SHOWN ARE 1-FOOT CONTOUR INTERVALS.

Date	Description	No.
6/18/20	ADD NEW WETLAND FLAGS	2
5/20/20	ADD NEW WETLAND FLAGS	1

Revisions

COMMONWEALTH OF MASSACHUSETTS
SHANE M. BRENNER
No. 45917
REGISTERED
PROFESSIONAL LAND SURVEYOR

6/18/20

SHANE M. BRENNER
PROFESSIONAL LAND SURVEYOR, MA REGISTRATION #45917

Crocker Design Group
2 SHARP STREET, UNIT B
HINGHAM, MA 02043
P: 781-919-0808

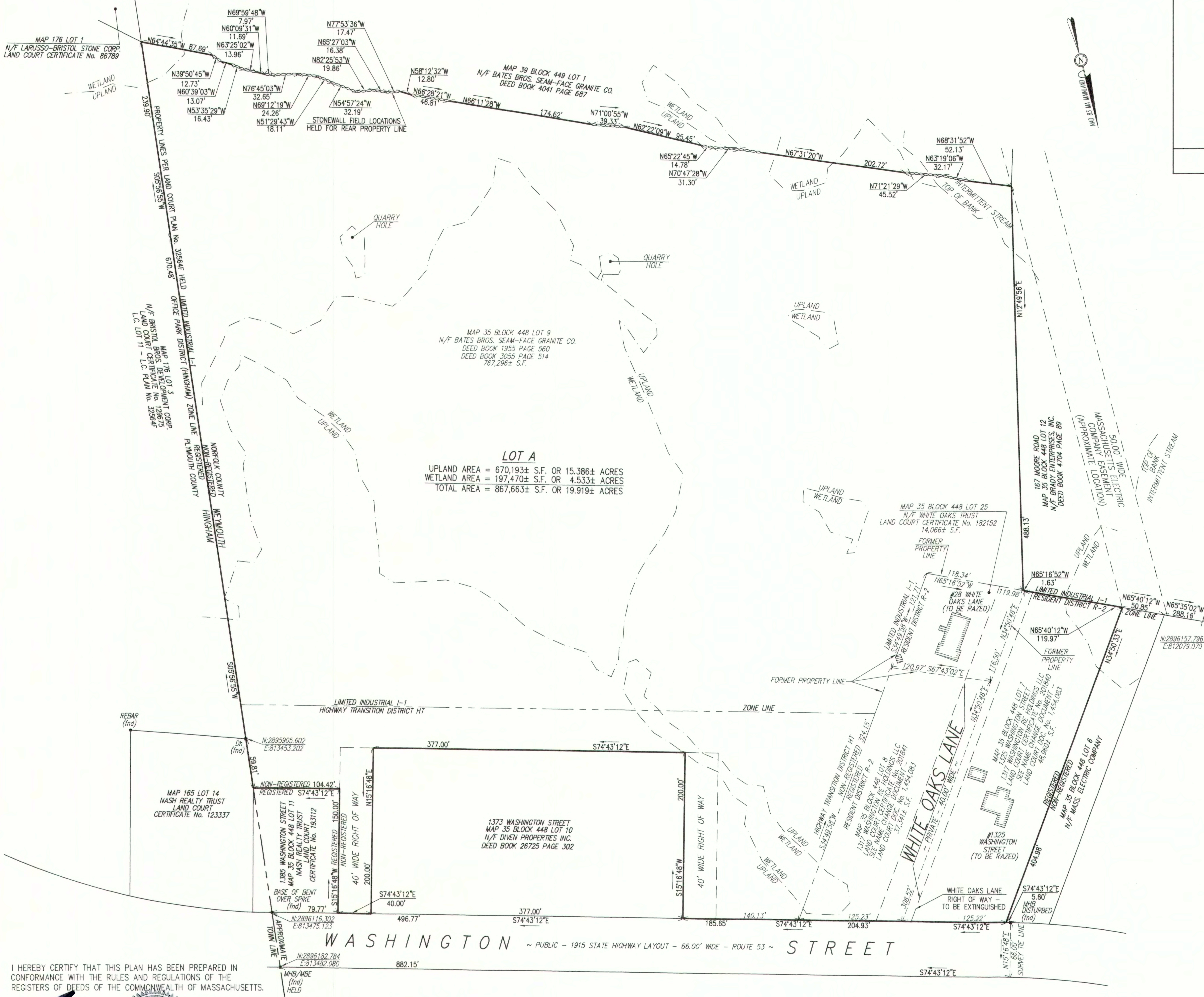
Project
ASSESSORS MAP 35 BLOCK 448
LOTS 7, 8, 9 & 25
WASHINGTON STREET
WEYMOUTH, MA

Prepared for
1317 WASHINGTON RE HOLDINGS LLC
190 OLD DERBY STREET, SUITE 311
HINGHAM, MA

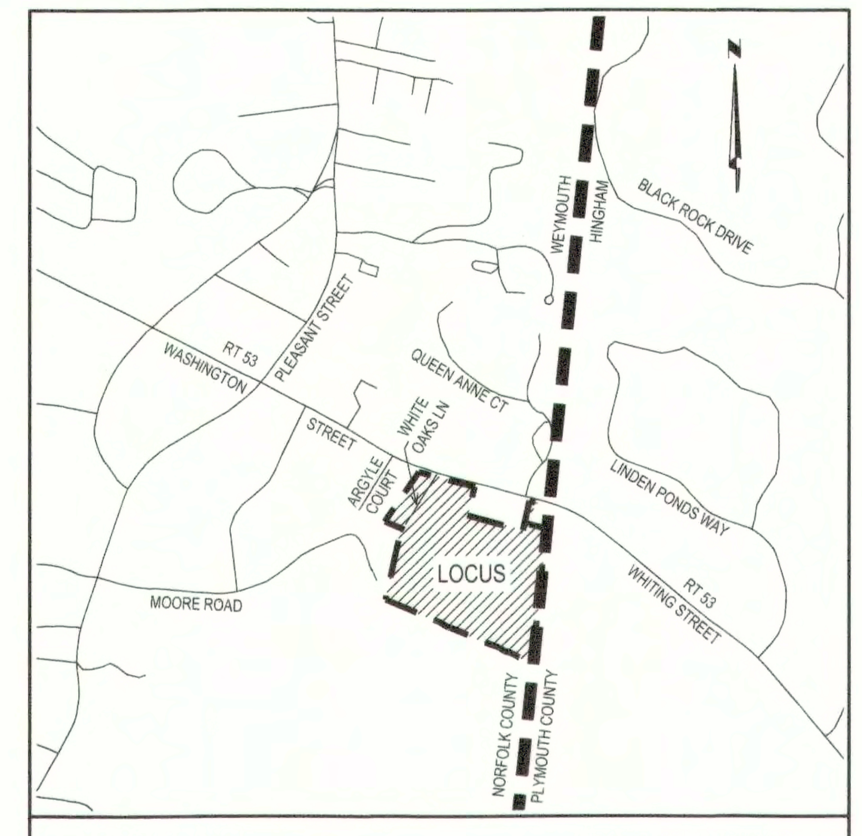
Drawing Title
WETLAND LOCATION PLAN

Project No.	100-081	Drawing No.
Date	5-21-2020	1 OF 1
Scale	1"=60'	
Drawn By	AS	
Approved By	SMB	

SECTION 10 – ENDORSED ANR PLAN



FOR REGISTRY USE ONLY



LOCUS MAP SCALE 1" = 1000'

WEYMOUTH PLANNING BOARD

APPROVAL UNDER THE SUBDIVISION CONTROL LAW NOT REQUIRED

Robert J. Luongo
Town of Weymouth Planning & Community Development Director

DATE: 9/30/2020

PLANNING BOARD ENDORSEMENT OF THIS PLAN INDICATES ONLY THAT THE PLAN IS NOT A SUBDIVISION UNDER M.G.L. CH. 41 SEC. 81L, AND DOES NOT INDICATE THAT THE LOT IS BUILDABLE, OR THAT IT MEETS ZONING, BOARD OF HEALTH, CONSERVATION OR GENERAL BY-LAW REQUIREMENTS.

RECORD OWNERS:

MAP 35 BLOCK 448 LOT 7
1325 WASHINGTON STREET
1317 WASHINGTON RE HOLDINGS LLC
LAND COURT CERTIFICATE No. 201840
SEE NAME CHANGE DOCUMENT – LAND COURT DOC. No. 1,454,083
LOT AREA = 48,960± S.F.

MAP 35 BLOCK 448 LOT 8
1317 WASHINGTON RE HOLDINGS LLC
LAND COURT CERTIFICATE No. 201841
SEE NAME CHANGE DOCUMENT – LAND COURT DOC. No. 1,454,083
LOT AREA = 37,341± S.F.

MAP 35 BLOCK 448 LOT 9
1317 WASHINGTON RE HOLDINGS LLC
DEED BOOK 38108 PAGE 591
LOT AREA = 767,296± S.F.

MAP 35 BLOCK 448 LOT 25
28 WHITE OAKS LANE
1317 WASHINGTON RE HOLDINGS LLC
LAND COURT CERTIFICATE No. 202960
LOT AREA = 14,066± S.F.

PLAN REFERENCES:

1. WASHINGTON STREET – STATE HIGHWAY LAYOUT No. 1640 & 1846
2. PLAN No. 467 OF 1949 PLAN BOOK 2827 PAGE 455
3. PLAN No. 226 OF 1951 PLAN BOOK 2985 PAGE 551
4. PLAN No. 1087 OF 1961 PLAN BOOK 3934 PAGE 722
5. PLAN No. 420 OF 1966 PLAN BOOK 220
6. PLAN No. 376 OF 1968 PLAN BOOK 224
7. PLAN No. 933 OF 1970 PLAN BOOK 4704 PAGE 86
8. LAND COURT CASE No. 14364
9. LAND COURT CASE No. 20228
10. LAND COURT CASE No. 20905
11. LAND COURT CASE No. 31196
12. LAND COURT CASE No. 32564

NOTES:

1. THE PURPOSE OF THIS PLAN IS TO CONSOLIDATE ASSESSORS MAP 35 BLOCK 448 LOTS 7, 8, 9 AND 25 INTO LOT A AS SHOWN HEREON.
2. PROPERTY LINE SURVEY PERFORMED BY CROCKER DESIGN GROUP BETWEEN FEBRUARY AND MAY OF 2020.
3. SUBJECT PROPERTY FALLS WITHIN ZONE X OF THE FLOOD INSURANCE RATE MAP No. 25021C0233E, WITH AN EFFECTIVE DATE OF JULY 17, 2012, AND DOES NOT FALL WITHIN A SPECIAL FLOOD HAZARD AREA.
4. SUBJECT PROPERTY FALLS WITH PORTIONS OF THE RESIDENCE DISTRICT R-2, LIMITED INDUSTRIAL I-1, HIGHWAY TRANSITION DISTICT HT. THE SUBJECT PROPERTY FALLS ENTIRELY WITHIN THE COMMERCIAL COORIDOR DISTRICT CCOD.
5. ZONING SETBACKS ARE NOT SHOWN HEREON AS THEY MAY DIFFER DEPENDING ON THE PROPOSED USE OF THE PROPERTY.
6. WETLAND RESOURCE AREAS SHOWN HEREON DELINEATED BY SOUTH RIVER ENVIRONMENTAL ON JANUARY 7, 2020 AND MARCH 27, 2020. FOR REFERENCE TO A SPECIFIC TYPE OF WETLAND RESOURCE AREA SHOWN AND LABELED AS WETLAND, SEE WETLAND LOCATION PLAN INCLUDED IN APPROVED ORDER OF RESOURCE AREA DELINEATION (ORAD) WITH AN ISSUANCE DATE FOR THIS PROJECT OF JULY 28, 2020. QUARRY HOLES EXCLUDED FROM UPLAND/WETLAND LAND AREA CALCULATIONS.
7. COORDINATE POSITIONS SHOWN HEREON REFERENCED TO THE NORTH AMERICAN HORIZONTAL DATUM OF 1983 MASSACHUSETTS MAINLAND (NAD83).

I HEREBY CERTIFY THAT THIS PLAN HAS BEEN PREPARED IN CONFORMANCE WITH THE RULES AND REGULATIONS OF THE REGISTERS OF DEEDS OF THE COMMONWEALTH OF MASSACHUSETTS.

SHANE M. BRENNER, P.L.S. 9/3/20 DATE

COMMONWEALTH OF MASSACHUSETTS
SHANE M BRENNER
No. 45917
REGISTERED PROFESSIONAL LAND SURVEYOR

Date	Description	No.
	Revisions	

COMMONWEALTH OF MASSACHUSETTS
SHANE M BRENNER
No. 45917
REGISTERED PROFESSIONAL LAND SURVEYOR

SHANE M. BRENNER
PROFESSIONAL LAND SURVEYOR, MA REGISTRATION #45917

Crocker Design Group
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HINGHAM, MA 02043
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Project
ASSESSORS MAP 35 BLOCK 448
LOTS 7, 8, 9 & 25
WASHINGTON STREET
WEYMOUTH, MA

Prepared for
1317 WASHINGTON RE HOLDINGS LLC
190 OLD DERBY STREET, SUITE 311
HINGHAM, MA

Drawing Title
APPROVAL NOT REQUIRED PLAN OF LAND

Project No.	100-081	Drawing No.
Date	08-10-2020	
Scale	1"=60'	1 OF 1
Drawn By	CRM	
Approved By	SMB	

SECTION 11 – PROJECT PLANS
(Under Separate Cover)