STORMWATER MANAGEMENT REPORT

FOR

ROOKERY LANE SUBDIVISION

48Y FITCHBURG TURNPIKE
CONCORD, MASSACHUSETTS

PREPARED FOR:

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NAPLES, FL 34109

PREPARED BY:

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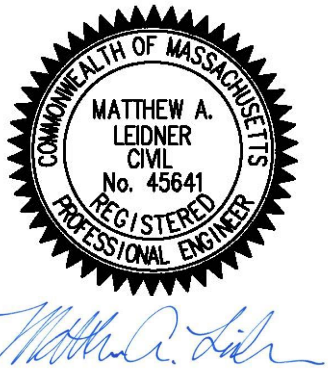

DATE: SEPTEMBER 4, 2020

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1.0 SITE LOCATION AND DESCRIPTION

Civil Design Group, LLC (CDG) has been retained by Quarry North Road, LLC to prepare this Stormwater Management Report for the construction of the *Rookery Lane* subdivision.

The project site is bordered by the *Cold Brook Crossing* project in the Town of Sudbury to the south, conservation land to the west and north, and a wetland system to the north and east. Much of the project site has been significantly disturbed as part of a former sand and gravel operation.

Vegetation cover types vary across the site ranging from patches of open field vegetation within the sand and gravel pit, undeveloped forested uplands flanking the sand and gravel pit to the north and east, and scrub-shrub/emergent marsh wetlands located along the northern and eastern property boundaries. A perennial stream flows within the emergent marsh along the northern property boundary before turning south and flowing along the eastern property boundary. The forested uplands occur along a topographic ridge located within the northern and eastern portions of the site, which descends towards the sand and gravel pit to the south and west, and to towards the scrub-shrub/emergent wetlands to the north and east.

This study presents a comparative analysis of the pre-development and post-development hydrologic characteristics of the site, and outlines the proposed measures to mitigate flow, provide groundwater recharge, and improve water quality from the site in accordance with applicable town and state requirements.

2.0 METHODOLOGY

Technical Release 55 (TR-55) methodology was utilized to determine weighted curve numbers (CNs) for each pre and post-development subcatchment area. Weighted CNs are based on ground cover type and hydrologic soil groups (HSGs). The times of concentration (Tcs) for each of the existing and proposed watersheds have been calculated. The areas that do not show a Tc travel path resulted in travel times of less than 6 minutes. CN and Tc values were then utilized to generate hydrographs using HydroCad 10.0, an industry standard software package that develops a hydrologic model based on the SCS method and computes peak discharges from rainfall runoff for urban and rural watersheds.

3.0 SOILS

According to the Natural Resources Conservation Service (NRCS) Web Soil Survey for Middlesex County, the upland portions of the site contain Pits, Gravel and Hinckley Loamy Sand, with a minor component of Merrimac Fine Sandy Loam soils. These soils are excessively drained soils that are typically associated with glacial outwash plains, stream terraces, kames, and eskers. The wetland portions of the site contain Freetown Muck, which consist of very deep, very poorly drained soils in depressions or low-lying areas like swamps, marshes, and bogs.

In addition to the NRCS data, subsurface testing was conducted by Civil Design Group, LLC in April 2020, results of which were utilized in the design of the infiltration system as further discussed herein.

4.0 POINTS OF ANALYSIS

Points of Analysis (POAs) are discharge points or lines toward which runoff from the study area is conveyed via overland flow or through drain pipes. The pre-development and post-development areas of disturbance drain to two (2) POAs listed and described below and shown on Figures 3 and 4.

TABLE-1: POINTS OF ANALYSIS

POINT OF ANALYSIS	DESCRIPTION
POA-C1	An analysis point representing the large wetland complex that wraps the northern and eastern portions of the site. This analysis point receives runoff via overland flow and ultimately discharges toward Cold Brook.
POA-C2	An analysis point off the southeast corner of the site representing an existing access driveway for the cell tower. This analysis point receives runoff via overland flow and ultimately discharges toward the large wetland complex noted above (POA-C1). It was studied separately from POA-C1 as it flows through an existing stormwater basin to the east of the cell tower prior to discharging to the wetlands.

5.0 WATERSHED DELINEATION

5.1 EXISTING DRAINAGE WATERSHEDS

The existing watersheds are delineated based on topography and physical characteristics and collect and direct stormwater towards the POAs. This report analyzes the site watersheds and also analyzes offsite watersheds that will ultimately flow through the proposed drainage features.

The total existing conditions study area includes 16.84 acres consisting of onsite and offsite areas which run into the study area, divided into two (2) pre-development watersheds as described below:

Subcatchment EX-C1: The 11.80-acre watershed is comprised of woods, brush areas, and wetlands. Runoff travels in a northerly and easterly direction toward POA-C1.

Subcatchment EX-C2: The 5.04-acre watershed is comprised of brush. Runoff travels in an easterly and southerly direction, crossing into the Sudbury section of the property and ultimately discharging toward POA-C2.

5.2 PROPOSED DRAINAGE WATERSHEDS

Similar to the existing watersheds, the proposed watersheds are delineated based on topography, physical characteristics and drainage networks within the site limits and collect and direct stormwater towards the POAs. This report analyzes the site watersheds and also analyzes offsite watersheds that flow through the proposed drainage features.

The total proposed conditions study area includes 17.10 acres consisting of onsite and offsite areas which run into the study area. The proposed study area is slightly larger than the existing study area due to differences in the areas which run onto the site in the proposed condition, which for the purposes of this report represents the full build-out of the adjacent *Cold Brook Crossing* project in Sudbury. The proposed study area is divided into seven (7) post-development watersheds as described below:

Subcatchment PR-C1: The 11.56-acre watershed is comprised of woods, brush areas, and wetlands. Runoff travels in a northerly and easterly direction toward POA-C1.

Subcatchment PR-C2a: The 0.97-acre watershed is comprised of brush. Runoff travels via overland flow into Depression C2a, an existing graded depression in the floor of the former gravel pit area, where it is fully infiltrated in all of the design storms. It was modeled as part of the POA-C2 watershed based on its theoretical overflow point, which would ultimately discharge toward POA-C2, though in reality the runoff will be infiltrated and not actually get to POA-2.

Subcatchment PR-C2b: The 1.77-acre watershed is comprised of brush. Runoff travels via overland flow into Depression C2b, an existing graded depression in the floor of the former gravel pit area, where it is fully infiltrated in all of the design storms. It was modeled as part of the POA-C2 watershed based on its theoretical overflow point, which would ultimately discharge toward POA-C2, though in reality the runoff will be infiltrated and not actually get to POA-2.

Subcatchment PR-C2c: The 0.44-acre watershed is comprised of brush. Runoff travels via overland flow into Depression C2c, an existing graded depression in the floor of the former gravel pit area, where it is fully infiltrated in all of the design storms. It was modeled as part of the POA-C2 watershed based on its theoretical overflow point, which would ultimately discharge toward POA-C2, though in reality the runoff will be infiltrated and not actually get to POA-2.

Subcatchment PR-C2d: The 2.26-acre watershed is comprised of lawn areas and pavement. Runoff from this subcatchment flows to SIS-C1, a subsurface infiltration basin which provides water quality treatment, infiltration, and flow mitigation. While this subcatchment is included in POA-C2, the SIS is designed to manage up to and including the 100-year storm event solely by way of infiltration and therefore this watershed contributes no flow to POA-C2 in any of the design storms.

Subcatchment PR-C2e: The 0.01-acre watershed is comprised of lawn area. Runoff from this area is de minimis and contributes to the *Cold Brook Crossing* stormwater management system, where it is conveyed to an infiltration system that has been designed to manage up to and including the 100-year storm event solely by way of infiltration. As such, this watershed contributes no flow to POA-C2 in any of the design storms

Subcatchment PR-C2f: The 0.09-acre watershed is comprised of brush. Runoff travels in a southerly and easterly direction toward POA-C2.

6.0 CURVE NUMBERS

For purposes of generating the weighted Curve Numbers (CNs), the following values were utilized:

- pavement was classified as "paved roads"
- brush areas were classified as "brush, fair"
- wooded upland areas were classified as "woods, good"
- wetland areas were assigned a CN of 77
- proposed lawn areas were classified as ">75% grass cover, good"
- the graded depressions was classified as "Stormwater Depression" with an assigned CN of 98

7.0 PEAK FLOW MITIGATION

In accordance with state and municipal standards, the stormwater management system is designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates for the 2-year, 10-year, and 100-year, 24-hour Type III storm events. The rainfall values used for each of these storms were obtained from the Cornell University Northeast Regional Climate Center *Atlas of Precipitation Extremes for the Northeastern United States and Southeastern Canada*. Peak flow rates for the pre-development and post-development conditions are illustrated below:

TABLE 2: PEAK FLOW RATE COMPARISON

POINT OF ANALYSIS	2-YEAR STORM EVENT (3.20"/24-HR)		10-YEAR STORM EVENT (4.80"/24-HR)		100-YEAR STORM EVENT (8.60"/24-HR)	
	PRE (CFS)	POST (CFS)	PRE (CFS)	POST (CFS)	PRE (CFS)	POST (CFS)
POA-C1	*1.12*	**1.12**	*2.33*	**2.33**	*5.86*	**5.85**
POA-C2	*0.00*	**0.00**	*0.04*	**0.00**	*1.67*	**0.07**

Peak flow has been mitigated as shown above through the use of an infiltration best management practice (BMP). The design methodology for the BMP is provided below. Pre- and post-development HydroCad output for the various storm events is included in Section 3. Section 3 also includes soil logs for the referenced test pits.

SIS-C1:

- Groundwater: Test pits TP-SIS-10A and TP-SIS-10B were evaluated in relation to this BMP. These test pits were terminated at elevations 120.5 and 121.5, respectively, with no redoximorphic features observed. At elevation 129.50, the bottom of the SIS is designed to be well above seasonal high groundwater.

- Infiltration Rate: Soil texture within the C horizon of test pits TP-SIS-10A and TP-SIS-10B ranged from coarse sand to sand. Since the bottom of this BMP is proposed within the C horizon, a "Rawls" infiltration rate of 8.27 inches/hour was used in the modeling of this system.

- Drawdown Time: Utilizing the "Rawls" infiltration rate of 8.27 inches/hour, the drawdown time is 75 inches ÷ 8.27 inches/hour = 9 hours thereby meeting the DEP drawdown requirement of <72 hours.

8.0 WATER QUALITY

The proposed development includes 0.59± acres of pavement. Runoff from the pavement is proposed to be infiltrated after having undergone pretreatment via deep-sump hooded catch basins and proprietary water quality units (Treatment Train #1).

- Deep Sump Hooded Catch Basins
  Stormwater runoff from proposed pavement areas will be directed via curbing and site grading to catch basins with deep sumps and hooded outlets. The catch basins are intended trap and remove sediment and larger particles from the stormwater and improve the performance of subsequent BMPs. The sumps will be a minimum of 4’ in depth and a regular inspection and cleaning schedule has been proposed to ensure optimal effectiveness.

- Proprietary Water Quality Units
  The proposed proprietary water quality units (WQUs) are designed to remove heavy particles, floating debris and hydrocarbons from stormwater. Stormwater enters the system where floatables and oils are separated prior to the clarified stormwater runoff discharging to an outlet pipe.

- Infiltration System
  Stormwater from pavement will be discharged to the proposed subsurface infiltration system for further treatment after undergoing treatment from the BMPs listed above.

TABLE 4: TSS REMOVAL CALCULATION WORKSHEET

TREATMENT TRAIN #1
PAVEMENT AREAS

BMP (A)	TSS Removal Rate (B)	Starting TSS Load (C)	Amount Removed (BxC) (D)	Remaining Load (C-D) (E)
Deep Sump CBs(1)	0.25	1.0	0.25	0.75
WQU Unit	0.80(2)	0.75	0.60	0.15
Total TSS Removal = Summation of (D) =			**85%**	

(1) Per "Table TSS" in the Massachusetts Stormwater Handbook, Volume 1 Chapter 1.
(2) Refer to attached Contech report demonstrating at least 80% TSS removal for all proposed water quality units

9.0 GROUNDWATER RECHARGE

The DEP Stormwater Management Policy addresses the importance of recharging groundwater and reducing surface runoff. For a new development project, the site's impervious area must be used to calculate the required infiltration in order to approximate the annual recharge from pre-development conditions. For this project, the total proposed impervious area is 0.59± acres. The required recharge equals a depth of runoff corresponding to the underlying soil type multiplied by the in impervious area for each soil type in the post development condition. The following values were used for this project:

TABLE 5: IMPERVIOUS AREA BY SOIL GROUP

HSG	RUNOFF DEPTH TO INFILTRATE (in)	EXISTING IMPERVIOUS AREA (ac)	PROPOSED IMPERVIOUS AREA (ac)	NET CHANGE IMPERVIOUS AREA (ac)
A	0.60	0.00	0.59	0.59
B	0.35	0.00	0.00	0.00
C	0.25	0.00	0.00	0.00
D	0.10	0.00	0.00	0.00

Recharge Volume (Rv) = (required runoff depth) x (newly created impervious area)

= [0.60 inch x 0.59 acres x (43,560 ft^2/acre) x (1 ft/12 inch)]
+ [0.35 inch x 0 acres x (43,560 ft^2/acre) x (1 ft/12 inch)]
+ [0.25 inch x 0 acres x (43,560 ft^2/acre) x (1 ft/12 inch)]
+ [0.10 inch x 0 acres x (43,560 ft^2/acre) x (1 ft/12 inch)]
= **1,285 cubic feet**

The static recharge volume provided in SIS-C1 is 10,300± cubic feet far exceeding DEP's recharge requirement.

10.0 DRAINAGE CONVEYANCE SYSTEM

The proposed stormwater conveyance system was designed to collect and convey runoff from developed areas to the associated stormwater management system BMP's described in this report. The drainage system consists of deep-sump hooded catch basins, manholes, water quality units, and pipes. Using the rational method to determine peak runoff flows, the proposed conveyance system is designed for the 25-year storm event. Hydraflow Storm Sewers output for the 25-year storm event is included in Section 4

11.0 CONSTRUCTION PERIOD EROSION & SEDIMENTATION CONTROL

The project is subject to the National Pollutant Discharge Elimination System (NPDES) program of the United States Environmental Protection Agency, which will require construction operations to comply with the NPDES General Permit For Stormwater Discharges From Construction Activities and will require the implementation of a site-specific a Stormwater Pollution Prevention Plan (SWPPP) addressing erosion and sedimentation control practices to be used throughout the construction period. Proposed erosion and sedimentation control measures will include compost filter socks or hay bales, silt fence, crushed stone, riprap, hydroseeding, mulching, erosion control matting, diversion berms, and sedimentation basin(s). Compost filter sock or hay bales and siltation fence will be used for the perimeter erosion control barrier and elsewhere as conditions warrant. Sedimentation basin(s) will be used within the site to treat runoff and diversion berms will be utilized as needed to divert untreated stormwater to the sedimentation basins. Sedimentation basins and diversion berms will be added, removed, and adjusted as the site evolves throughout the construction process. Hydroseeding or sod will be also be used as a stabilization measure for areas disturbed as part of this project. Mulching may be used to reinforce seeded areas where some protection is warranted. Mulching may also be used to stabilize areas where construction activities will temporarily cease for more than 14 days. Silt sacks will be used to protect catch basins prior to binder and elsewhere as conditions warrant. The contractor will be required to keep a reasonable stock of erosion controls on site to be able to supplement or make repairs as necessary.

12.0 COMPLIANCE WITH THE MASSACHUSETTS DEP STORMWATER HANDBOOK

This study presents a comparative analysis of the pre-development and post-development hydrologic characteristics of the site, and outlines the proposed measures to mitigate flow, provide groundwater recharge, and improve water quality from the site. The best management practices (BMPs) outlined in this report include measures to meet the municipal and the Massachusetts Department of Environmental Protection (DEP) requirements. Below is a summary of how the design complies with each applicable DEP standard.

Standard 1: No new stormwater conveyances may discharge untreated directly to or cause erosion in wetlands or waters of the Commonwealth.

The proposed stormwater conveyance system does not include new *untreated* discharges.

Standard 2: Stormwater management systems shall be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates.

As indicated above and within the supporting HydroCad calculations, the stormwater management system is designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates.

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

As indicated above and within the supporting HydroCad calculations, the recharge volume provided for this project exceeds the requirements of this standard.

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

Runoff from proposed impervious surface area is treated to at least an 80% TSS removal rate as described in this report.

Standard 5: For land uses with higher potential pollutant loads, source control and pollution prevention shall be implemented in accordance with the Massachusetts Stormwater Handbook to eliminate or reduce the discharge of stormwater runoff from such land uses to the maximum extent practicable.

Not applicable.

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

This project is in a Zone II and as such has been designed to achieve at least 44% TSS pretreatment prior to infiltration and has been designed utilizing the 1” water quality volume.

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

Not applicable.

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

The project design plans include erosion and sedimentation measures to control construction related impacts including erosion, sedimentation and other pollutant sources during construction and land disturbance activities. The project requires coverage under the National Pollutant Discharge Elimination System (NPDES) Construction General Permit. This will require the preparation of a Stormwater Pollution Prevention Plan (SWPPP), which will also include provisions for controlling erosion, sedimentation and other pollutant sources during construction and land disturbance activities.

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

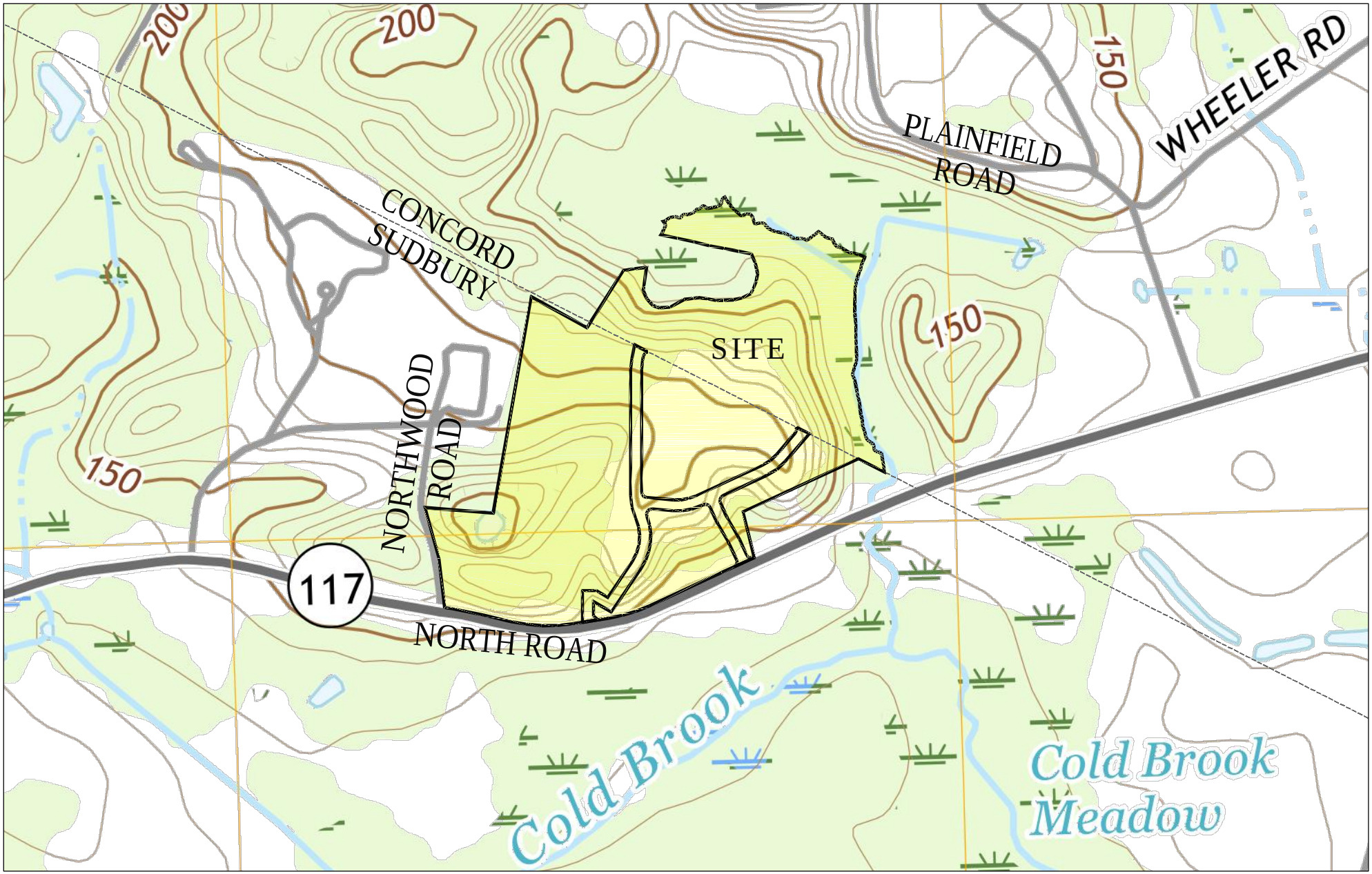
A post-construction Operation and Maintenance Plan (O&M) is attached.

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

The proposed stormwater management system does not include any illicit discharges. An illicit discharge statement is attached.

13.0 SUMMARY

The stormwater management system for the proposed development includes measures for collecting, conveying, treating and controlling stormwater runoff from the site. Stormwater controls have been designed such that the post-development peak discharge rates do not exceed pre-development peak discharge rates for the 2-year, 10-year, and 100-year, 24-hour Type III storm events. BMPs have been designed to treat the required water quality volume to 80% TSS removal and to exceed the infiltration volume required by DEP. The piped collection system has been designed to convey runoff for the 25-year storm event Rational Method storm event. Comprehensive computations and calculations with supporting figures and plans are attached.



600 0 300 600 1200

GRAPHIC SCALE IN FEET

SOURCE: USGS TOPO 2018
QUADRANGLE: MAYNARD, MA

PROJECT:

ROOKERY LANE SUBDIVISION

48Y FITCHBURG TURNPIKE
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PREPARED FOR:

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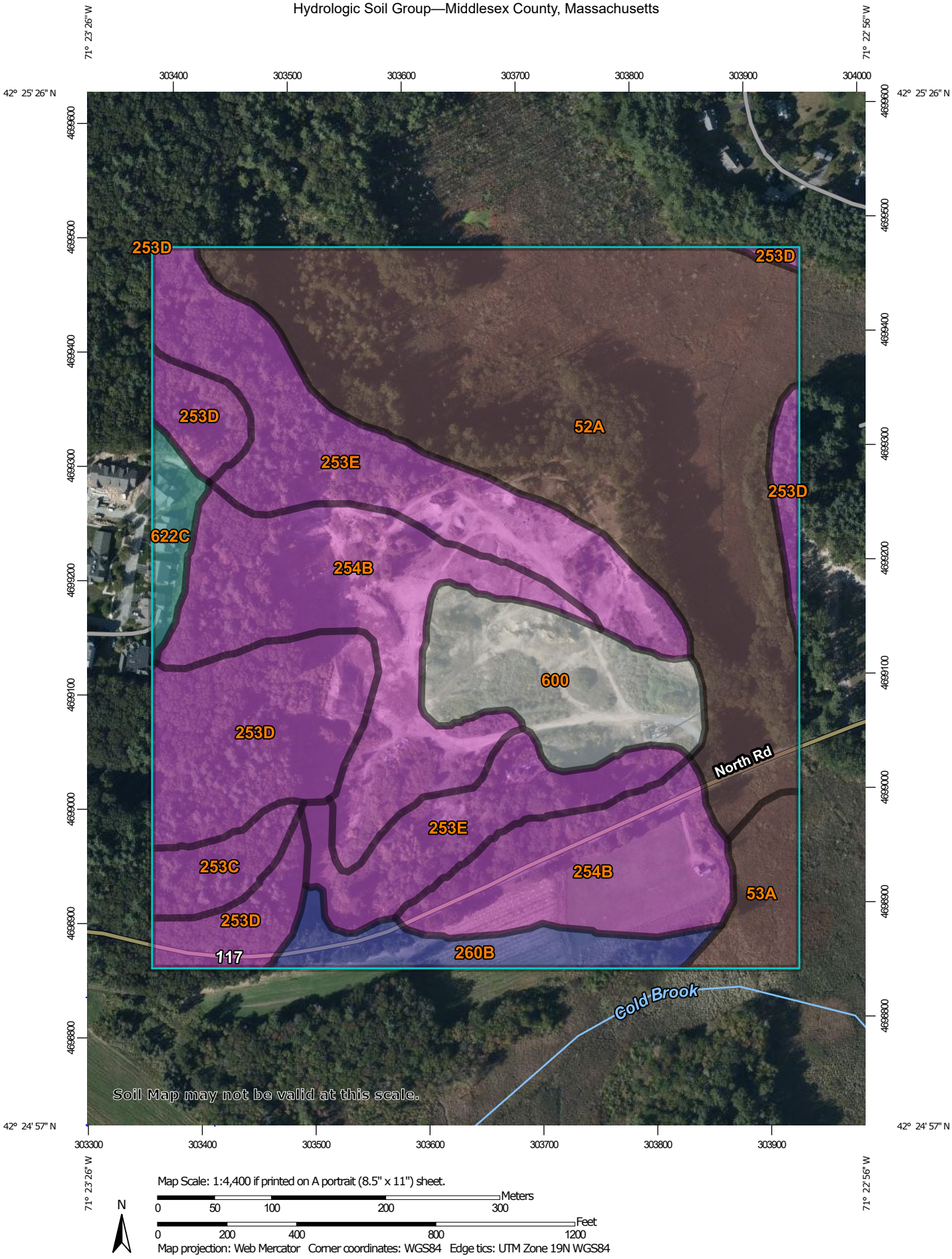
FIGURE 1
USGS PLAN

SEPTEMBER 4, 2020

Hydrologic Soil Group—Middlesex County, Massachusetts



Map Scale: 1:4,400 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 200 400 800 1200

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

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

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

Soil Rating Lines

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

Soil Rating Points

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

Water Features

Streams and Canals

Transportation

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

Background

Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Middlesex County, Massachusetts
Survey Area Data: Version 19, Sep 12, 2019

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

Date(s) aerial images were photographed: Aug 9, 2019—Sep 28, 2019

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
52A	Freetown muck, 0 to 1 percent slopes	B/D	29.4	33.1%
53A	Freetown muck, ponded, 0 to 1 percent slopes	B/D	2.4	2.7%
253C	Hinckley loamy sand, 8 to 15 percent slopes	A	1.8	2.0%
253D	Hinckley loamy sand, 15 to 25 percent slopes	A	11.6	13.1%
253E	Hinckley loamy sand, 25 to 35 percent slopes	A	14.9	16.7%
254B	Merrimac fine sandy loam, 3 to 8 percent slopes	A	17.8	20.0%
260B	Sudbury fine sandy loam, 3 to 8 percent slopes	B	3.2	3.5%
600	Pits, gravel		6.5	7.3%
622C	Paxton-Urban land complex, 3 to 15 percent slopes	C	1.5	1.6%
Totals for Area of Interest			**89.0**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

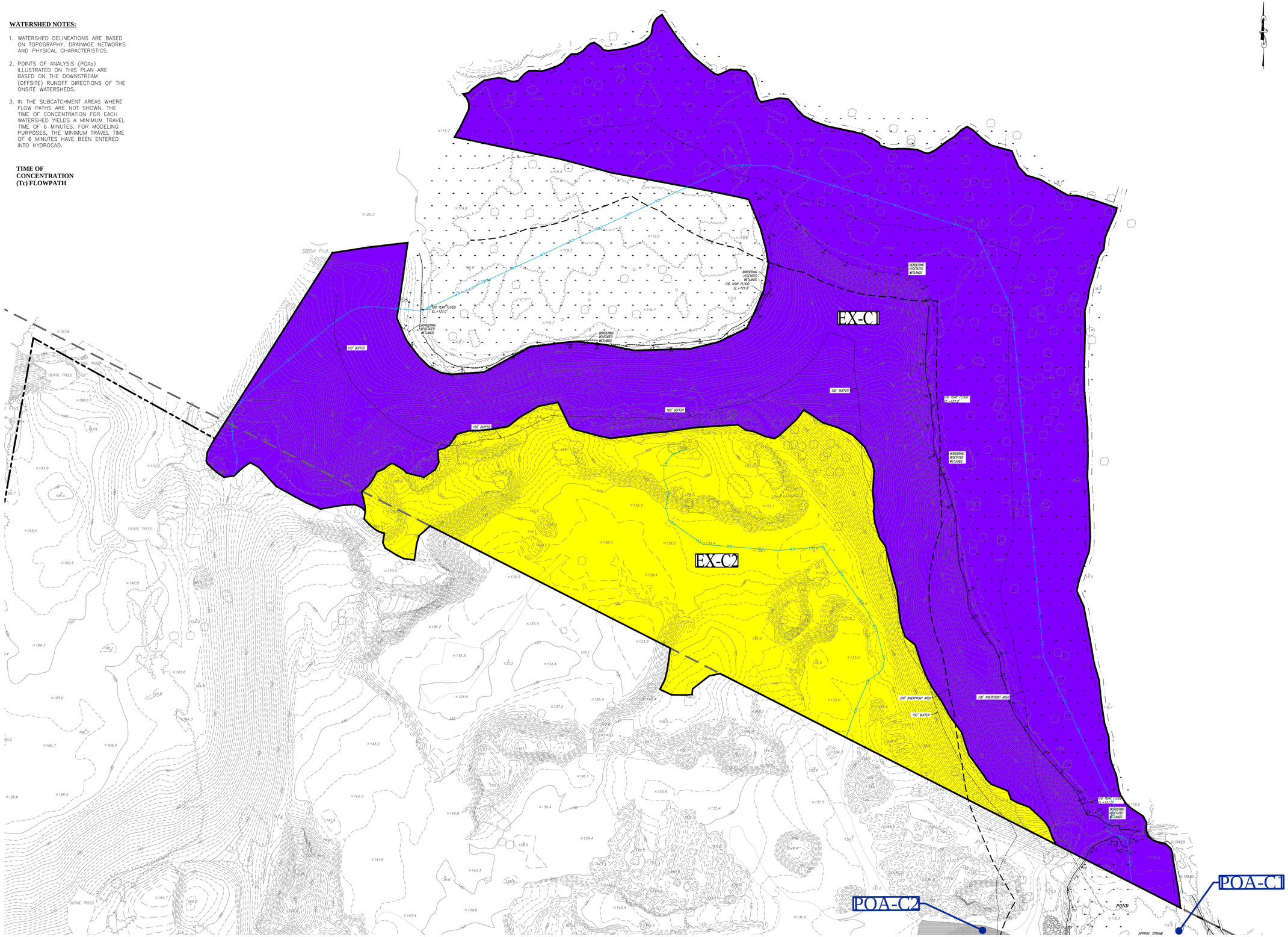
Component Percent Cutoff: None Specified

Tie-break Rule: Higher

WATERSHED NOTES:

1. WATERSHED DELINEATIONS ARE BASED ON TOPOGRAPHY, DRAINAGE NETWORKS AND PHYSICAL CHARACTERISTICS.
2. POINTS OF ANALYSIS (POAs) ILLUSTRATED ON THIS PLAN ARE BASED ON THE DOWNSTREAM (OFFSITE) RUNOFF DIRECTIONS OF THE ONSITE WATERSHEDS.
3. IN THE SUBCATCHMENT AREAS WHERE FLOW PATHS ARE NOT SHOWN, THE TIME OF CONCENTRATION FOR EACH WATERSHED YIELDS A MINIMUM TRAVEL TIME OF 6 MINUTES. FOR MODELING PURPOSES, THE MINIMUM TRAVEL TIME OF 6 MINUTES HAVE BEEN ENTERED INTO HYDROCAD.

TIME OF CONCENTRATION (Tc) FLOWPATH



NOT FOR CONSTRUCTION

CDG PROJECT #: 20022

REVISIONS:

REV	DATE	COMMENT
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

PLANNING BOARD:

SEAL:

MATTHEW A. LEIDNER, P.E.

PREPARED BY:

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NORTH ANDOVER, MA 01845
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PREPARED FOR:

QUARRY NORTH ROAD LLC

2134 SEVILLA WAY
NAPLES, FL 34109

PROJECT:

SUBDIVISION PLAN

MAP 15E, PARCEL 3419
48Y FITCHBURG TURNPIKE
CONCORD, MASSACHUSETTS

SCALE:

60 0 30 60 120

GRAPHIC SCALE IN FEET

SHEET:

PRE-DEVELOPMENT WATERSHEDS

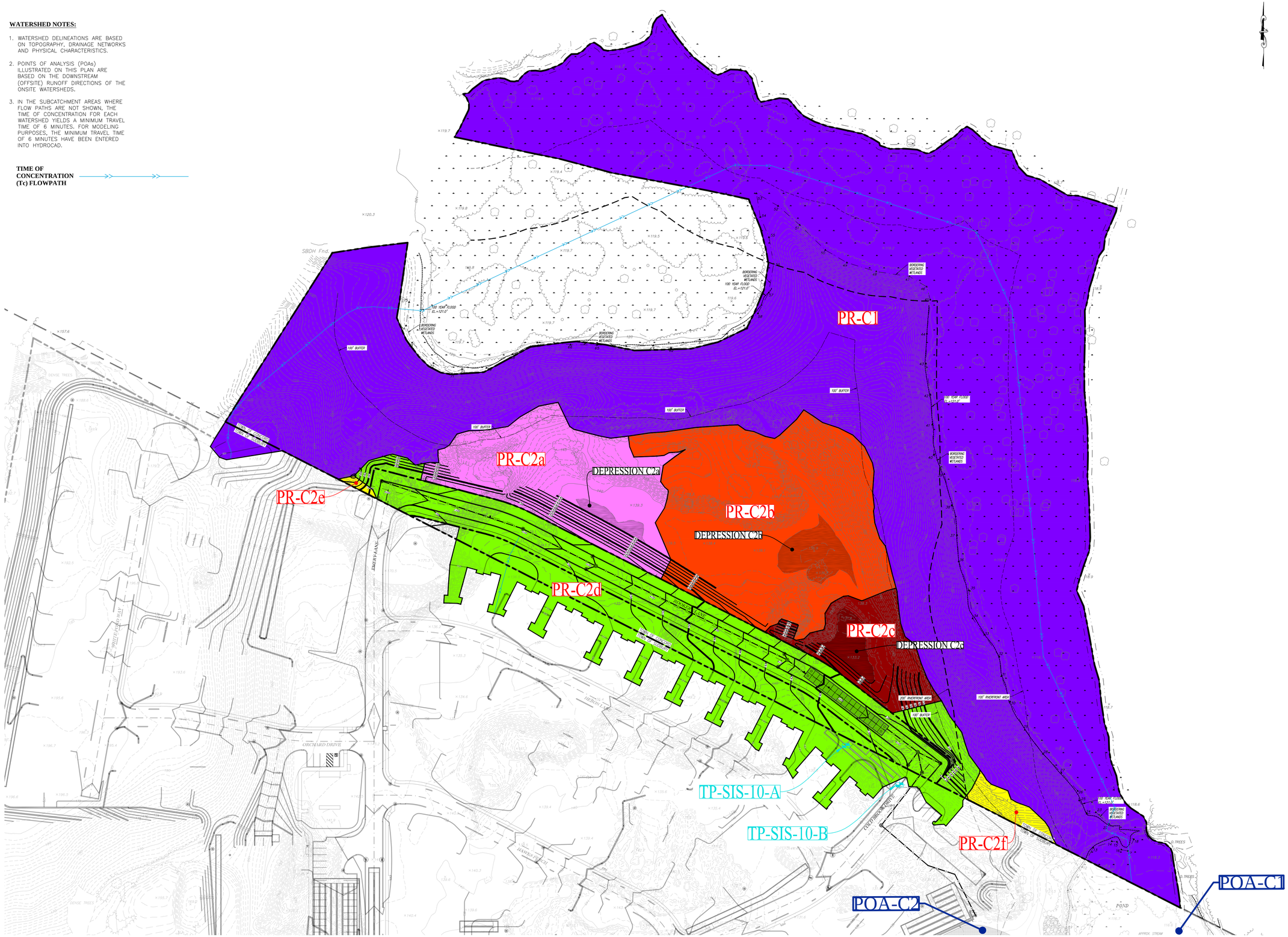
FIGURE 3

DATE: 09/04/2020

WATERSHED NOTES:

1. WATERSHED DELINEATIONS ARE BASED ON TOPOGRAPHY, DRAINAGE NETWORKS AND PHYSICAL CHARACTERISTICS.
2. POINTS OF ANALYSIS (POAs) ILLUSTRATED ON THIS PLAN ARE BASED ON THE DOWNSTREAM (OFFSITE) RUNOFF DIRECTIONS OF THE ONSITE WATERSHEDS.
3. IN THE SUBCATCHMENT AREAS WHERE FLOW PATHS ARE NOT SHOWN, THE TIME OF CONCENTRATION FOR EACH WATERSHED YIELDS A MINIMUM TRAVEL TIME OF 6 MINUTES. FOR MODELING PURPOSES, THE MINIMUM TRAVEL TIME OF 6 MINUTES HAVE BEEN ENTERED INTO HYDROCAD.

TIME OF CONCENTRATION (Tc) FLOWPATH



NOT FOR CONSTRUCTION

CDG PROJECT #: 20022

REVISIONS:

REV	DATE	COMMENT
1		
2		
3		
4		
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8		
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10		

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48Y FITCHBURG TURNPIKE
CONCORD, MASSACHUSETTS

SCALE:

60 0 30 60 120

GRAPHIC SCALE IN FEET

SHEET:

POST-DEVELOPMENT WATERSHEDS

FIGURE 4

DATE: 09/04/2020

NOT FOR CONSTRUCTION

CDG PROJECT #: 20022

REVISIONS:

REV	DATE	COMMENT
1		
2		
3		
4		
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7		
8		
9		
10		

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NAPLES, FL 34109

PROJECT:

SUBDIVISION PLAN

MAP 15E, PARCEL 3419
48Y FITCHBURG TURNPIKE
CONCORD, MASSACHUSETTS

SCALE:

60 0 30 60 120

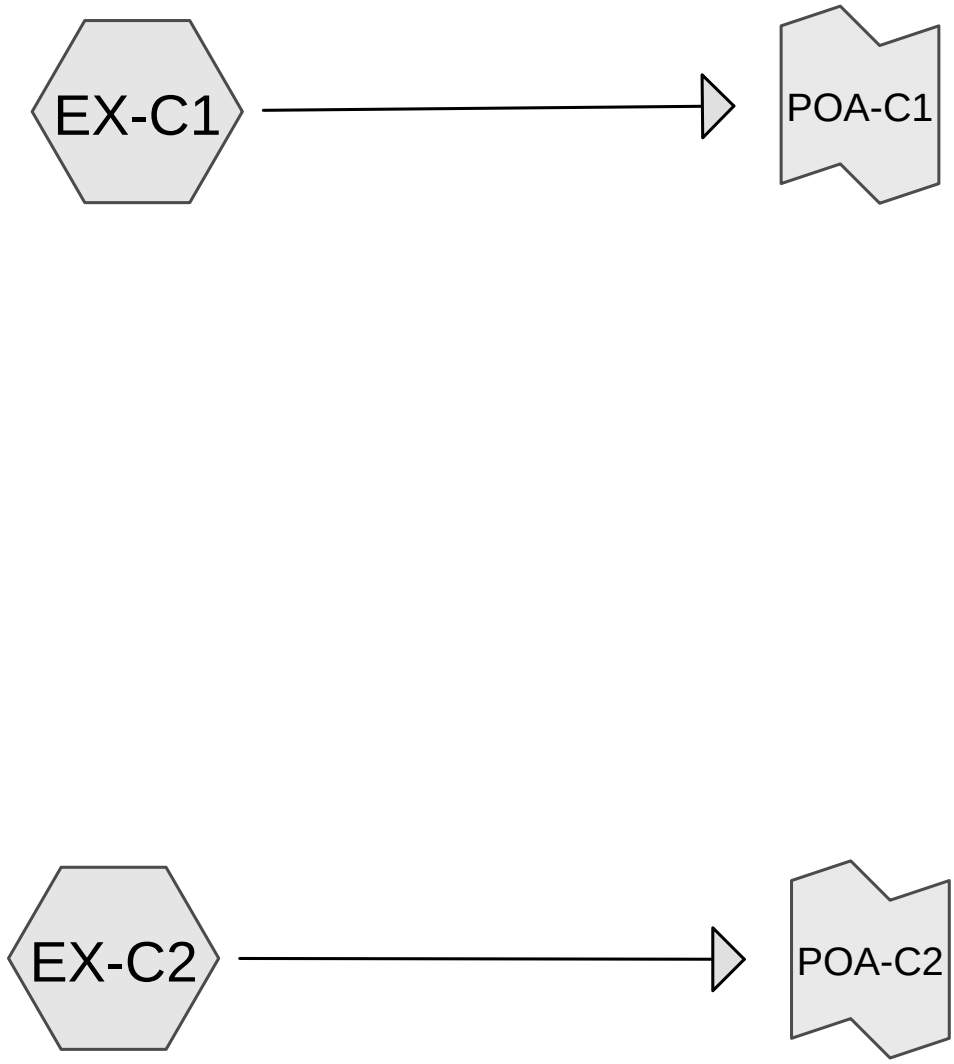
GRAPHIC SCALE IN FEET

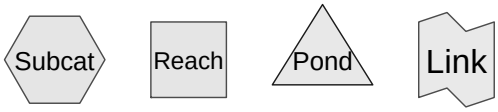
SHEET:

CATCH BASIN WATERSHEDS

FIGURE 5

DATE: 09/04/2020





Routing Diagram for Concord Pre-Development
Prepared by Microsoft, Printed 9/2/2020
HydroCAD® 10.00-22 s/n 07576 © 2018 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
5.340	35	Brush, Fair, HSG A (EX-C1, EX-C2)
6.230	77	Wetland, HSG D (EX-C1)
5.270	30	Woods, Good, HSG A (EX-C1)
16.840	**49**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
10.610	HSG A	EX-C1, EX-C2
0.000	HSG B	
0.000	HSG C	
6.230	HSG D	EX-C1
0.000	Other	
16.840		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
5.340	0.000	0.000	0.000	0.000	5.340	Brush, Fair	EX-C1, EX-C2
0.000	0.000	0.000	6.230	0.000	6.230	Wetland	EX-C1
5.270	0.000	0.000	0.000	0.000	5.270	Woods, Good	EX-C1
10.610	**0.000**	**0.000**	**6.230**	**0.000**	**16.840**	**TOTAL AREA**	

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment EX-C1: Runoff Area=11.800 ac 0.00% Impervious Runoff Depth>0.57"
Flow Length=2,197' Tc=297.6 min CN=WQ Runoff=1.12 cfs 0.560 af

Subcatchment EX-C2: Runoff Area=5.040 ac 0.00% Impervious Runoff Depth=0.00"
Flow Length=635' Tc=47.9 min CN=35 Runoff=0.00 cfs 0.000 af

Link POA-C1: Inflow=1.12 cfs 0.560 af
Primary=1.12 cfs 0.560 af

Link POA-C2: Inflow=0.00 cfs 0.000 af
Primary=0.00 cfs 0.000 af

Total Runoff Area = 16.840 ac Runoff Volume = 0.560 af Average Runoff Depth = 0.40"
100.00% Pervious = 16.840 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment EX-C1:

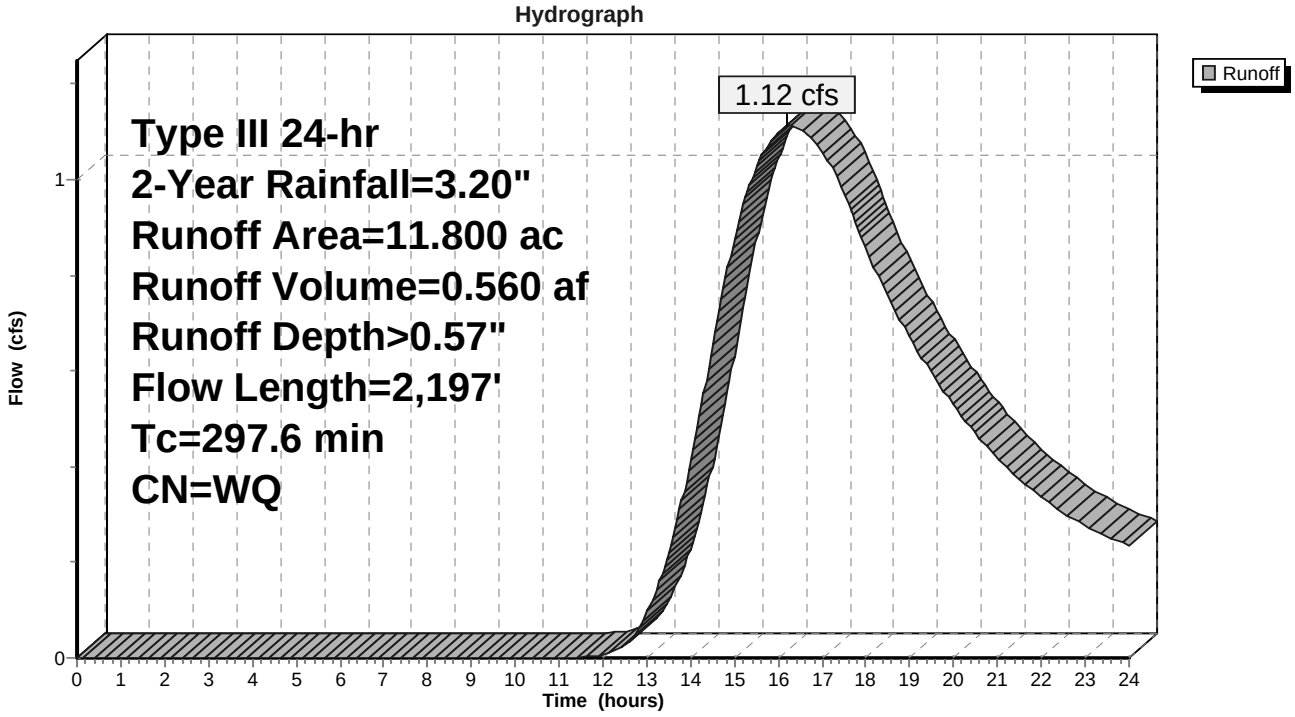
Runoff = 1.12 cfs @ 16.22 hrs, Volume= 0.560 af, Depth> 0.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.20"

	Area (ac)	CN	Description
	0.300	35	Brush, Fair, HSG A
	5.270	30	Woods, Good, HSG A
*	6.230	77	Wetland, HSG D
	11.800		Weighted Average
	11.800		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.1	50	0.0800	0.12		**Sheet Flow, Sheet-Woods** Woods: Light underbrush n= 0.400 P2= 3.20"
3.2	370	0.1500	1.94		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
287.3	1,777	0.0017	0.10		**Shallow Concentrated Flow, Wetland** Forest w/Heavy Litter Kv= 2.5 fps
297.6	2,197	Total			

Subcatchment EX-C1:



Summary for Subcatchment EX-C2:

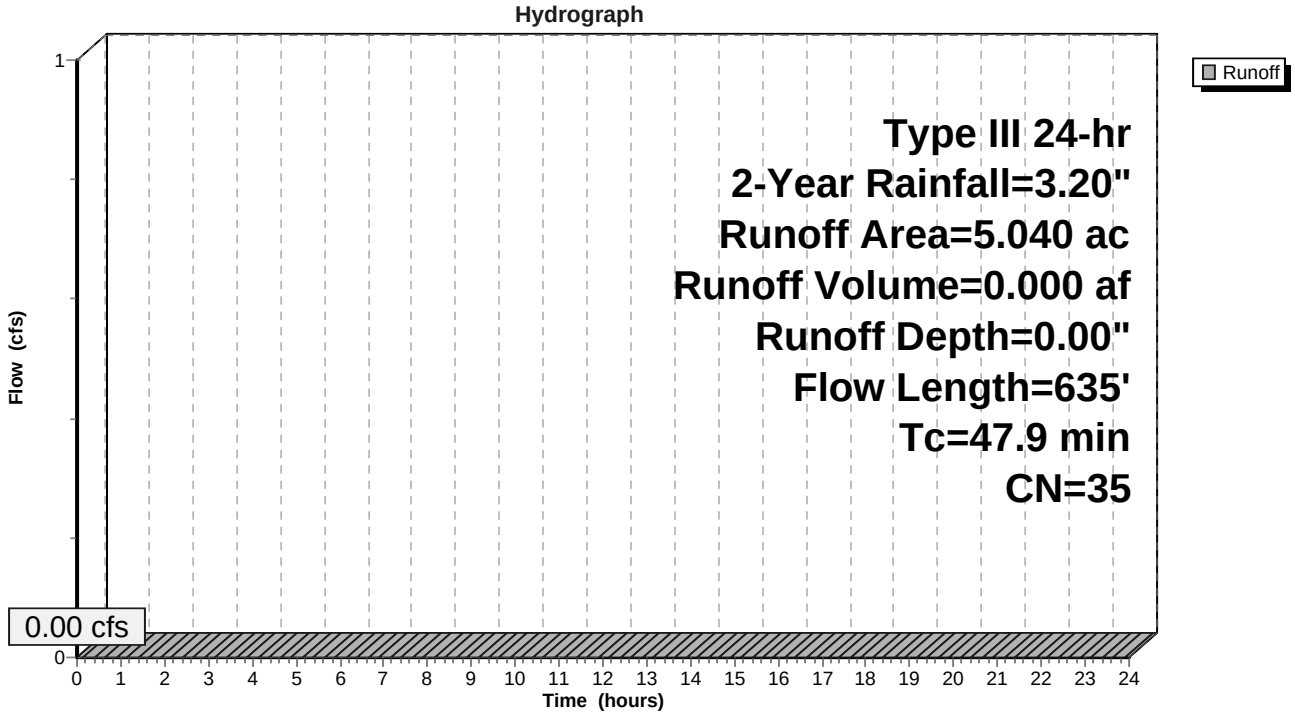
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.20"

Area (ac)	CN	Description
5.040	35	Brush, Fair, HSG A
5.040		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	50	0.1000	0.13		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
0.1	35	0.4000	6.32		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps
37.5	225	0.0001	0.10		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps
3.8	325	0.0200	1.41		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps
47.9	635	Total			

Subcatchment EX-C2:

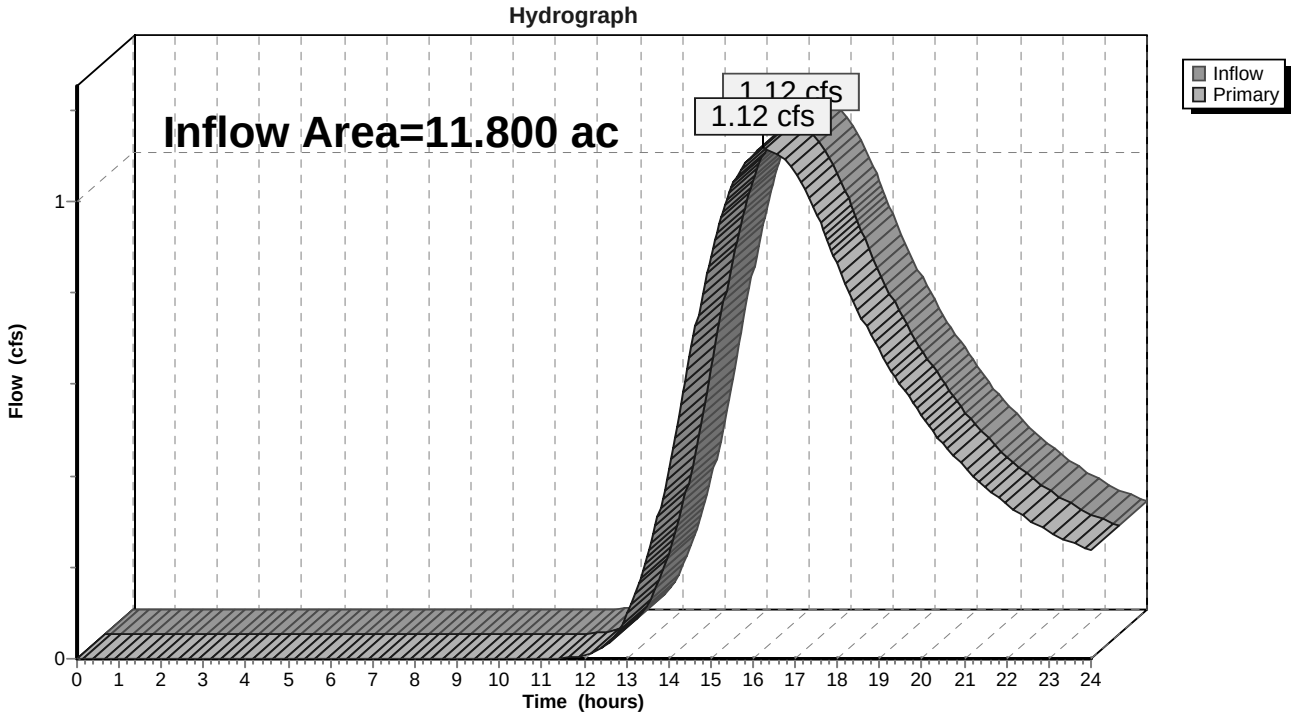


Summary for Link POA-C1:

Inflow Area = 11.800 ac, 0.00% Impervious, Inflow Depth > 0.57" for 2-Year event
Inflow = 1.12 cfs @ 16.22 hrs, Volume= 0.560 af
Primary = 1.12 cfs @ 16.22 hrs, Volume= 0.560 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link POA-C1:

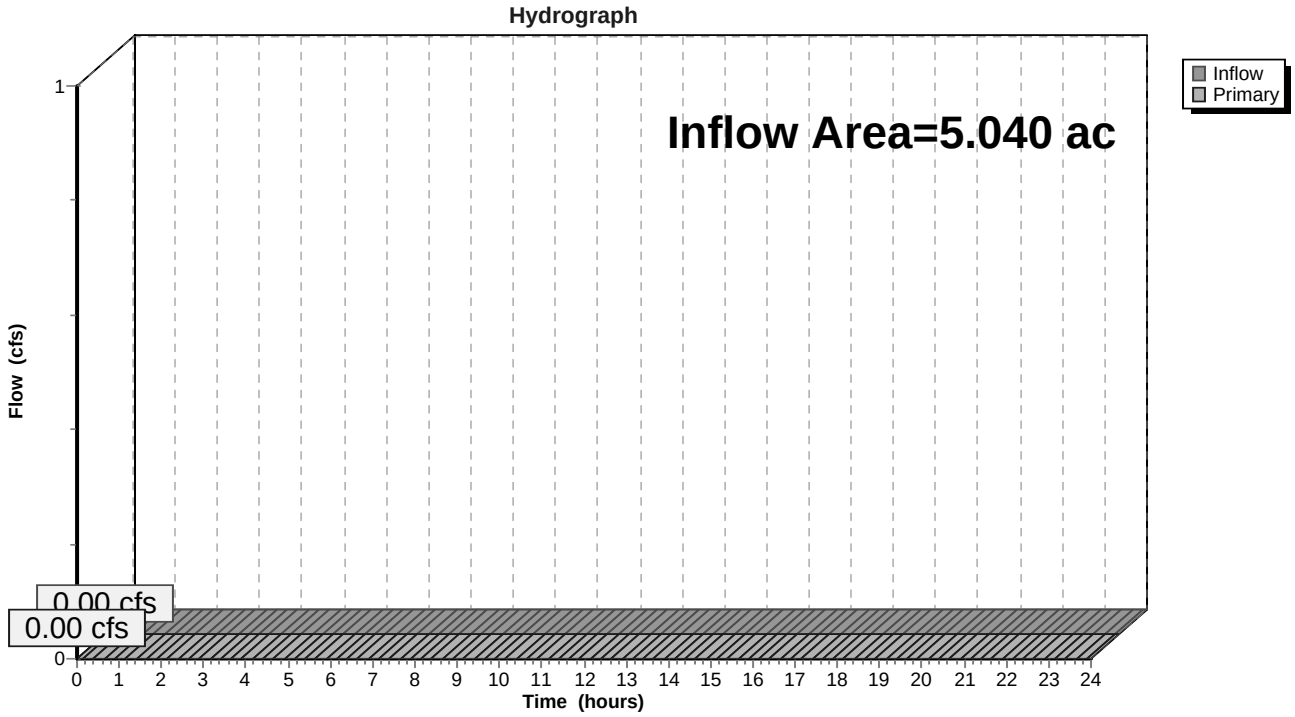


Summary for Link POA-C2:

Inflow Area = 5.040 ac, 0.00% Impervious, Inflow Depth = 0.00" for 2-Year event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link POA-C2:



Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment EX-C1: Runoff Area=11.800 ac 0.00% Impervious Runoff Depth>1.17"
Flow Length=2,197' Tc=297.6 min CN=WQ Runoff=2.33 cfs 1.154 af

Subcatchment EX-C2: Runoff Area=5.040 ac 0.00% Impervious Runoff Depth>0.06"
Flow Length=635' Tc=47.9 min CN=35 Runoff=0.04 cfs 0.024 af

Link POA-C1: Inflow=2.33 cfs 1.154 af
Primary=2.33 cfs 1.154 af

Link POA-C2: Inflow=0.04 cfs 0.024 af
Primary=0.04 cfs 0.024 af

Total Runoff Area = 16.840 ac Runoff Volume = 1.177 af Average Runoff Depth = 0.84"
100.00% Pervious = 16.840 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment EX-C1:

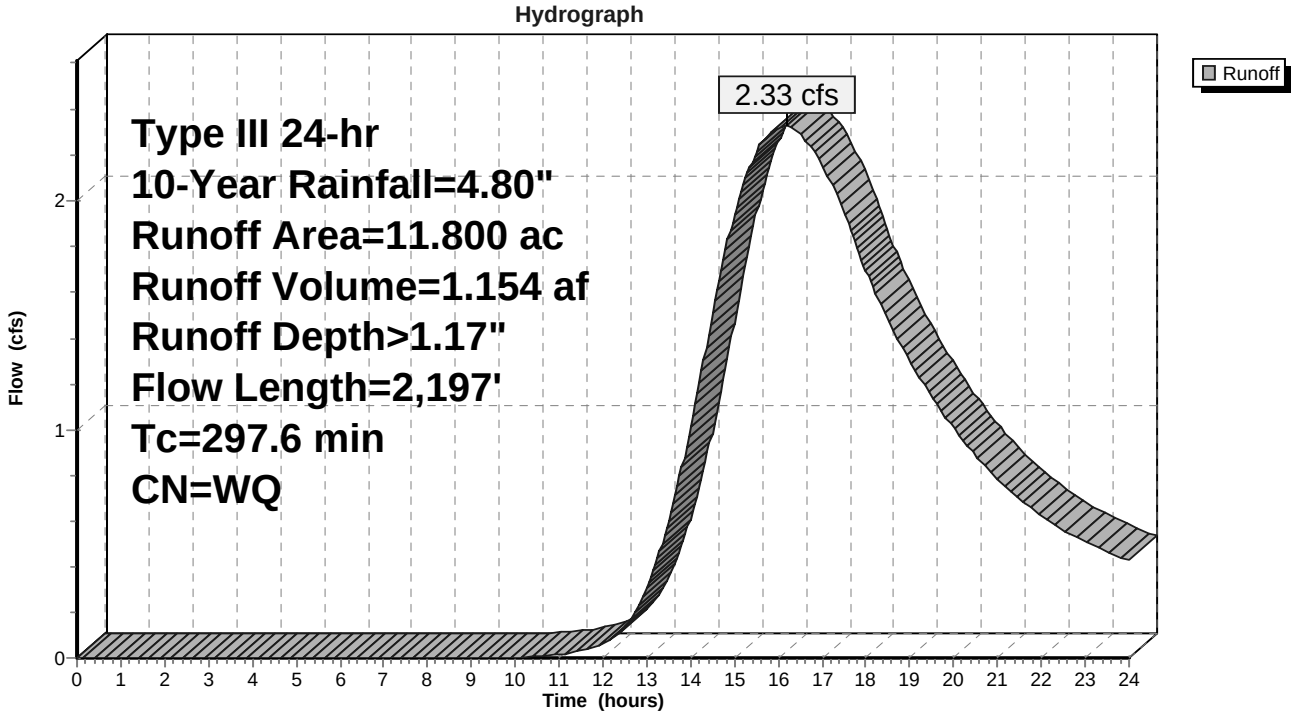
Runoff = 2.33 cfs @ 16.19 hrs, Volume= 1.154 af, Depth> 1.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (ac)	CN	Description
	0.300	35	Brush, Fair, HSG A
	5.270	30	Woods, Good, HSG A
*	6.230	77	Wetland, HSG D
	11.800		Weighted Average
	11.800		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.1	50	0.0800	0.12		**Sheet Flow, Sheet-Woods** Woods: Light underbrush n= 0.400 P2= 3.20"
3.2	370	0.1500	1.94		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
287.3	1,777	0.0017	0.10		**Shallow Concentrated Flow, Wetland** Forest w/Heavy Litter Kv= 2.5 fps
297.6	2,197	Total			

Subcatchment EX-C1:



Summary for Subcatchment EX-C2:

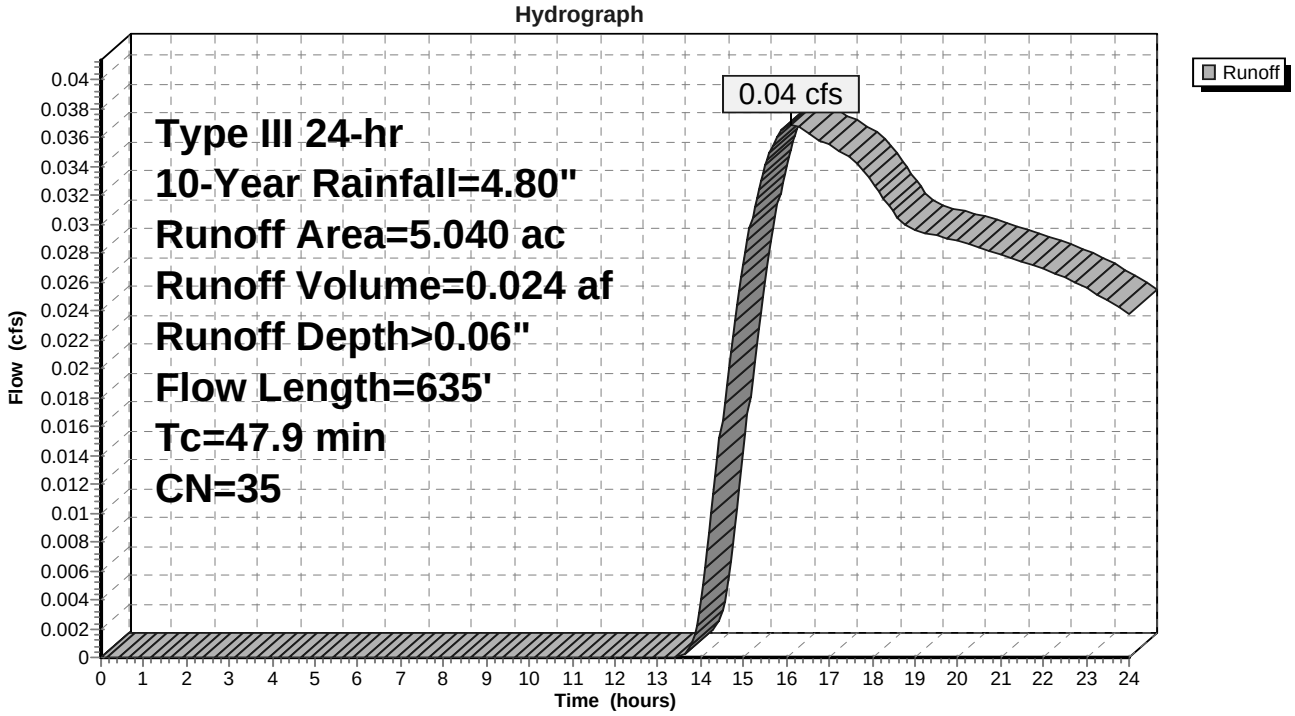
Runoff = 0.04 cfs @ 16.13 hrs, Volume= 0.024 af, Depth> 0.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description
5.040	35	Brush, Fair, HSG A
5.040		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	50	0.1000	0.13		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
0.1	35	0.4000	6.32		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps
37.5	225	0.0001	0.10		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps
3.8	325	0.0200	1.41		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps
47.9	635	Total			

Subcatchment EX-C2:

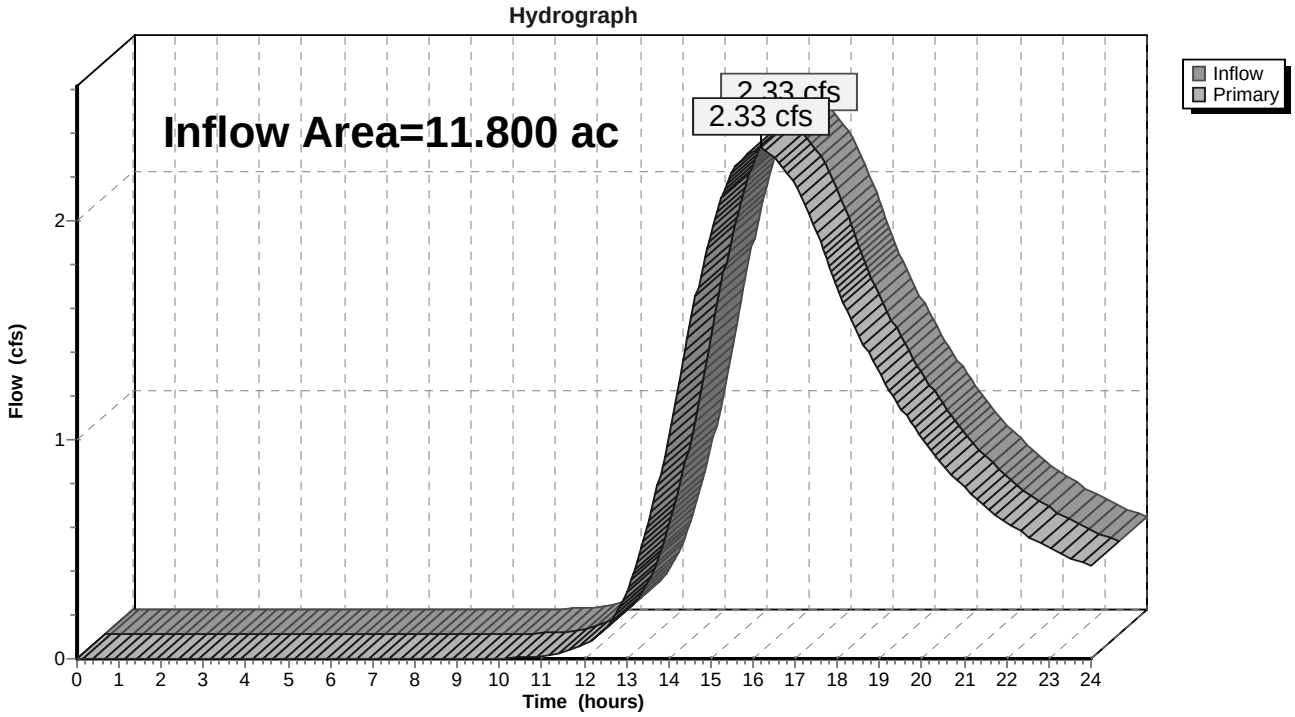


Summary for Link POA-C1:

Inflow Area = 11.800 ac, 0.00% Impervious, Inflow Depth > 1.17" for 10-Year event
Inflow = 2.33 cfs @ 16.19 hrs, Volume= 1.154 af
Primary = 2.33 cfs @ 16.19 hrs, Volume= 1.154 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link POA-C1:

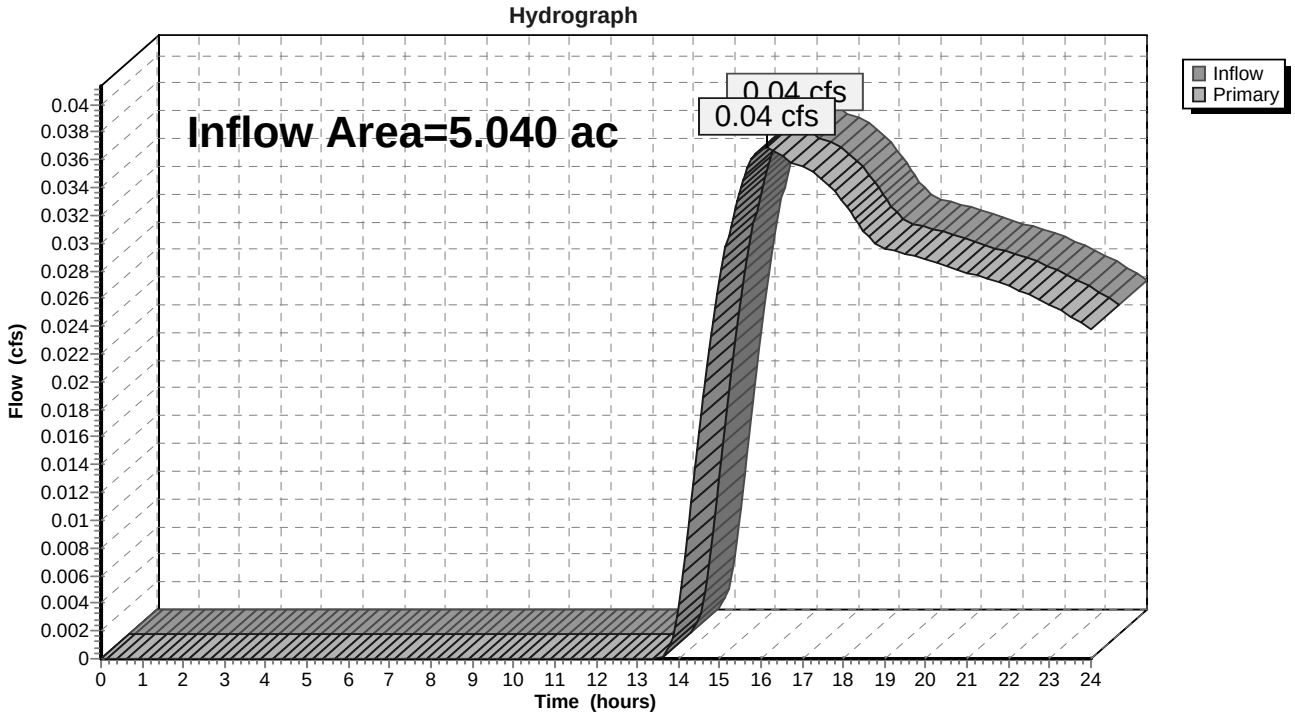


Summary for Link POA-C2:

Inflow Area = 5.040 ac, 0.00% Impervious, Inflow Depth > 0.06" for 10-Year event
Inflow = 0.04 cfs @ 16.13 hrs, Volume= 0.024 af
Primary = 0.04 cfs @ 16.13 hrs, Volume= 0.024 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link POA-C2:



Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment EX-C1: Runoff Area=11.800 ac 0.00% Impervious Runoff Depth>3.04"
Flow Length=2,197' Tc=297.6 min CN=WQ Runoff=5.86 cfs 2.992 af

Subcatchment EX-C2: Runoff Area=5.040 ac 0.00% Impervious Runoff Depth>1.00"
Flow Length=635' Tc=47.9 min CN=35 Runoff=1.67 cfs 0.419 af

Link POA-C1: Inflow=5.86 cfs 2.992 af
Primary=5.86 cfs 2.992 af

Link POA-C2: Inflow=1.67 cfs 0.419 af
Primary=1.67 cfs 0.419 af

Total Runoff Area = 16.840 ac Runoff Volume = 3.410 af Average Runoff Depth = 2.43"
100.00% Pervious = 16.840 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment EX-C1:

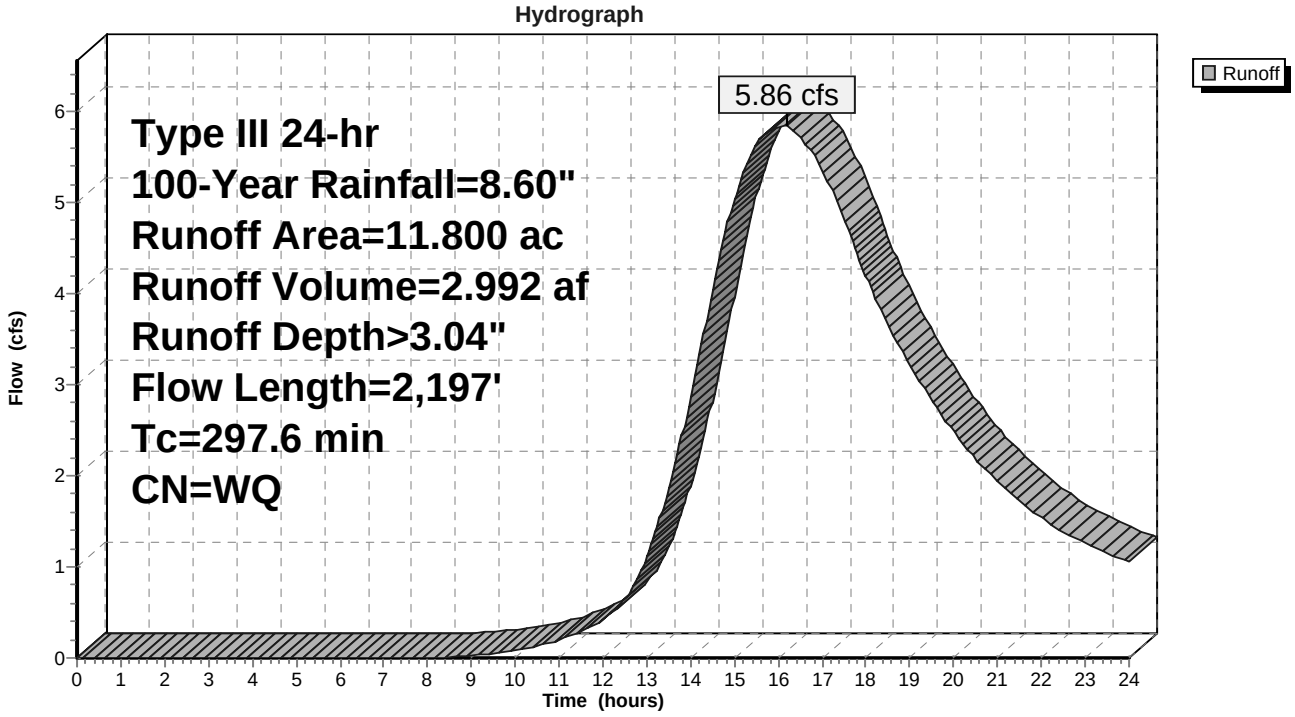
Runoff = 5.86 cfs @ 16.18 hrs, Volume= 2.992 af, Depth> 3.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.60"

	Area (ac)	CN	Description
	0.300	35	Brush, Fair, HSG A
	5.270	30	Woods, Good, HSG A
*	6.230	77	Wetland, HSG D
	11.800		Weighted Average
	11.800		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.1	50	0.0800	0.12		**Sheet Flow, Sheet-Woods** Woods: Light underbrush n= 0.400 P2= 3.20"
3.2	370	0.1500	1.94		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
287.3	1,777	0.0017	0.10		**Shallow Concentrated Flow, Wetland** Forest w/Heavy Litter Kv= 2.5 fps
297.6	2,197	Total			

Subcatchment EX-C1:



Summary for Subcatchment EX-C2:

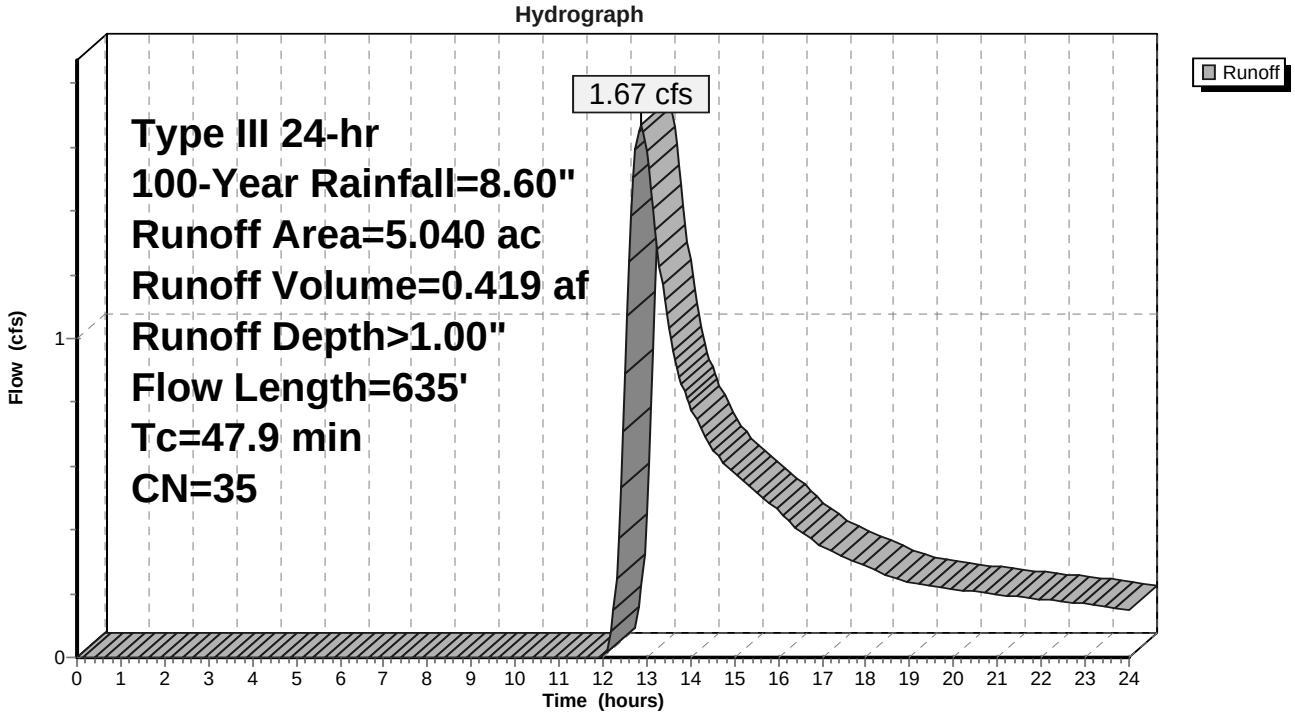
Runoff = 1.67 cfs @ 12.86 hrs, Volume= 0.419 af, Depth> 1.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.60"

Area (ac)	CN	Description
5.040	35	Brush, Fair, HSG A
5.040		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	50	0.1000	0.13		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
0.1	35	0.4000	6.32		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps
37.5	225	0.0001	0.10		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps
3.8	325	0.0200	1.41		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps
47.9	635	Total			

Subcatchment EX-C2:

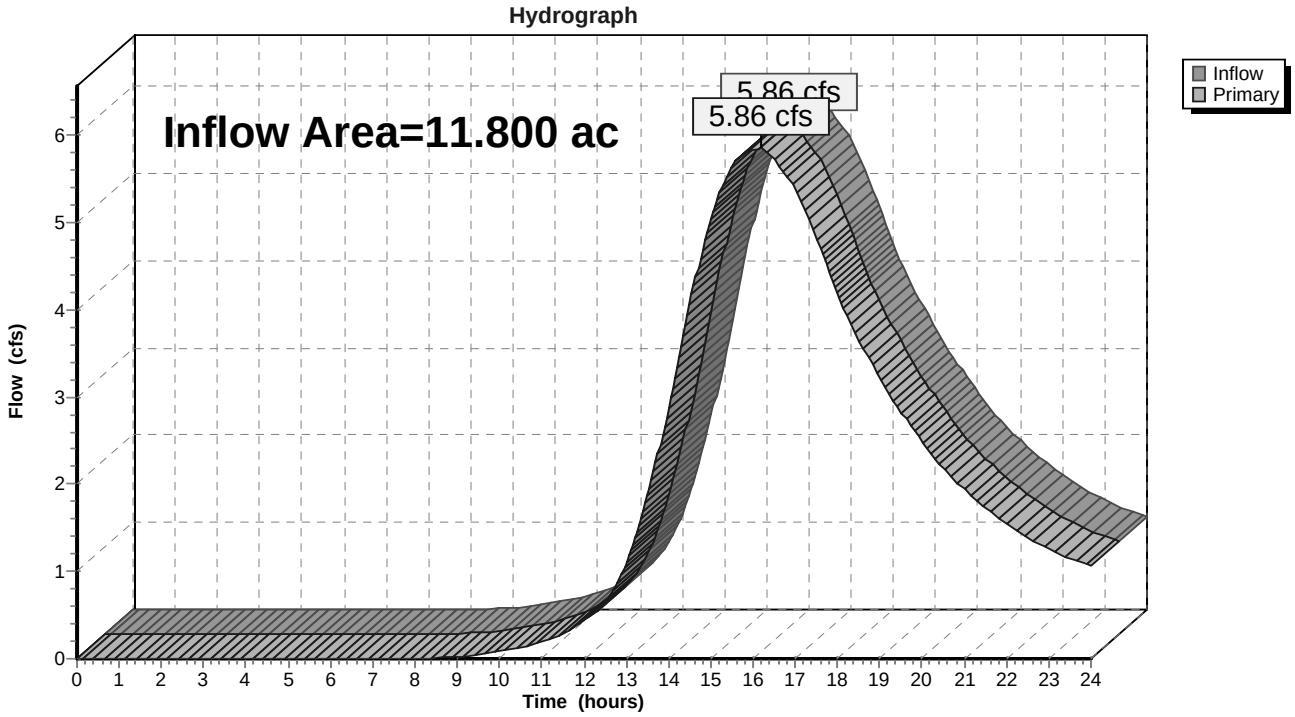


Summary for Link POA-C1:

Inflow Area = 11.800 ac, 0.00% Impervious, Inflow Depth > 3.04" for 100-Year event
Inflow = 5.86 cfs @ 16.18 hrs, Volume= 2.992 af
Primary = 5.86 cfs @ 16.18 hrs, Volume= 2.992 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link POA-C1:

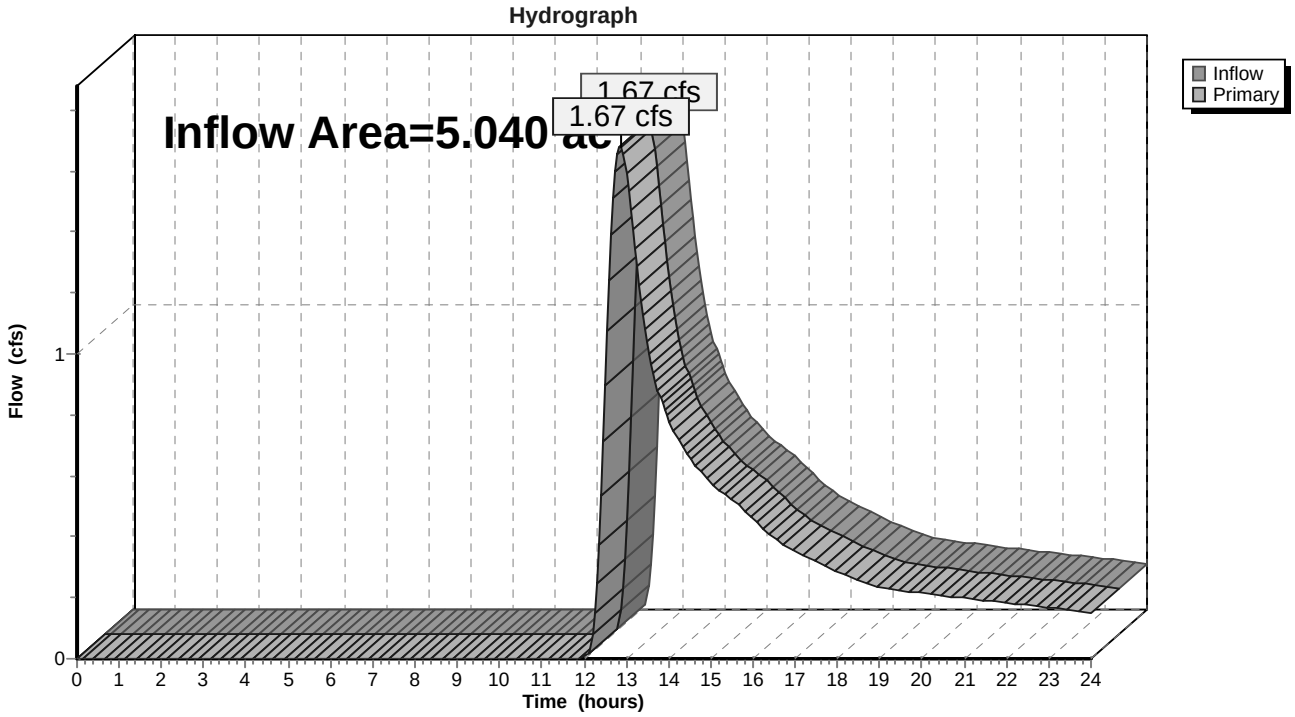


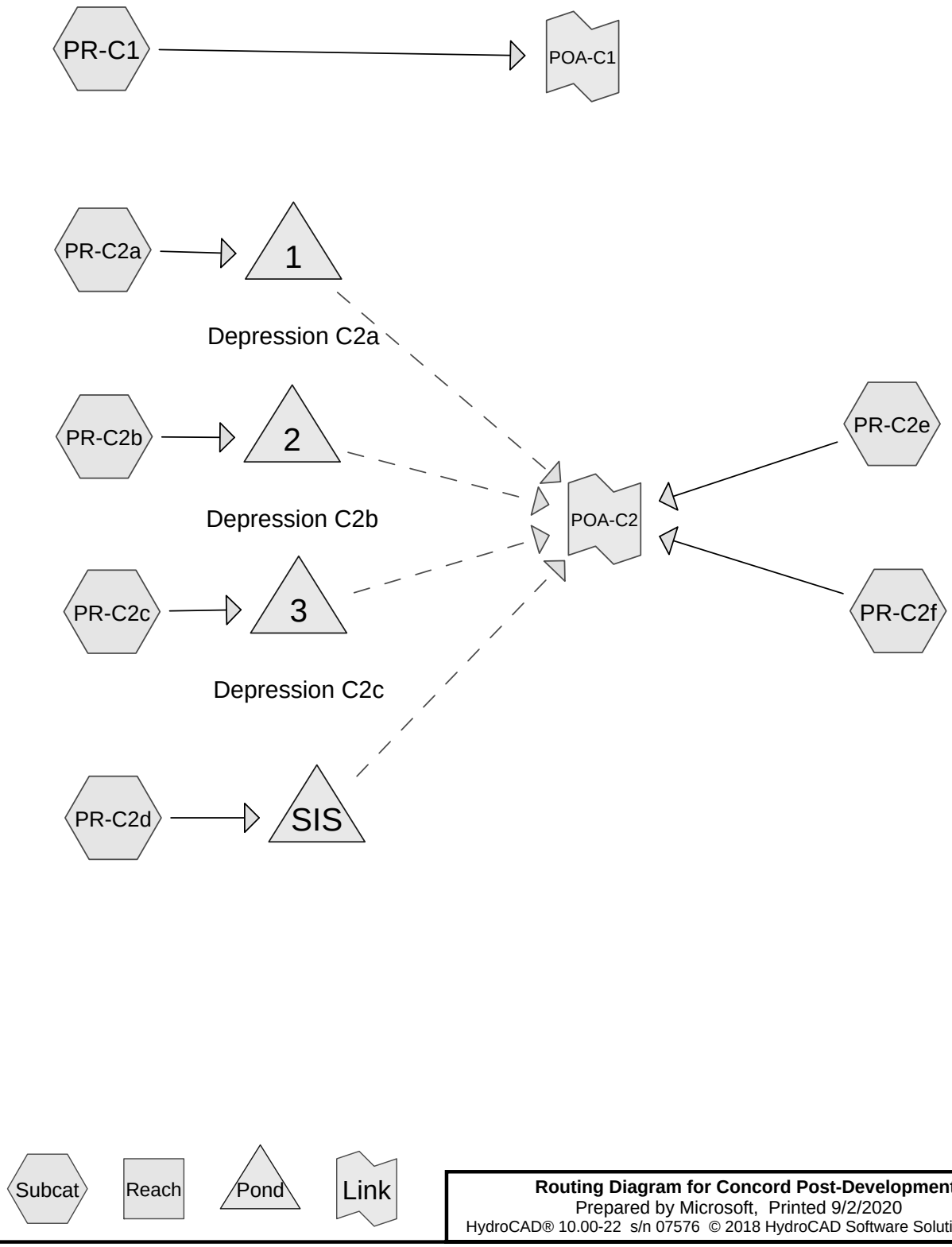
Summary for Link POA-C2:

Inflow Area = 5.040 ac, 0.00% Impervious, Inflow Depth > 1.00" for 100-Year event
Inflow = 1.67 cfs @ 12.86 hrs, Volume= 0.419 af
Primary = 1.67 cfs @ 12.86 hrs, Volume= 0.419 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link POA-C2:





Routing Diagram for Concord Post-Development
Prepared by Microsoft, Printed 9/2/2020
HydroCAD® 10.00-22 s/n 07576 © 2018 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
1.680	39	>75% Grass cover, Good, HSG A (PR-C2d, PR-C2e)
3.300	35	Brush, Fair, HSG A (PR-C1, PR-C2a, PR-C2b, PR-C2c, PR-C2f)
0.590	98	Paved roads w/curbs & sewers, HSG A (PR-C2d)
0.270	98	Stormwater Depression, HSG A (PR-C2a, PR-C2b, PR-C2c)
6.230	77	Wetland, HSG D (PR-C1)
5.030	30	Woods, Good, HSG A (PR-C1)
17.100	**52**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
10.870	HSG A	PR-C1, PR-C2a, PR-C2b, PR-C2c, PR-C2d, PR-C2e, PR-C2f
0.000	HSG B	
0.000	HSG C	
6.230	HSG D	PR-C1
0.000	Other	
17.100		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
1.680	0.000	0.000	0.000	0.000	1.680	>75% Grass cover, Good	PR-C2d, PR-C2e
3.300	0.000	0.000	0.000	0.000	3.300	Brush, Fair	PR-C1, PR-C2a, PR-C2b, PR-C2c, PR-C2f
0.590	0.000	0.000	0.000	0.000	0.590	Paved roads w/curbs & sewers	PR-C2d
0.270	0.000	0.000	0.000	0.000	0.270	Stormwater Depression	PR-C2a, PR-C2b, PR-C2c
0.000	0.000	0.000	6.230	0.000	6.230	Wetland	PR-C1
5.030	0.000	0.000	0.000	0.000	5.030	Woods, Good	PR-C1
10.870	**0.000**	**0.000**	**6.230**	**0.000**	**17.100**	**TOTAL AREA**	

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment PR-C1: Runoff Area=11.560 ac 0.00% Impervious Runoff Depth>0.58"
Flow Length=2,180' Tc=297.4 min CN=WQ Runoff=1.12 cfs 0.560 af

Subcatchment PR-C2a: Runoff Area=0.970 ac 4.12% Impervious Runoff Depth>0.12"
Tc=6.0 min CN=WQ Runoff=0.12 cfs 0.010 af

Subcatchment PR-C2b: Runoff Area=1.770 ac 7.91% Impervious Runoff Depth>0.23"
Tc=6.0 min CN=WQ Runoff=0.42 cfs 0.035 af

Subcatchment PR-C2c: Runoff Area=0.440 ac 20.45% Impervious Runoff Depth>0.61"
Tc=6.0 min CN=WQ Runoff=0.27 cfs 0.022 af

Subcatchment PR-C2d: Runoff Area=2.260 ac 26.11% Impervious Runoff Depth>0.77"
Flow Length=113' Slope=0.0200 '/' Tc=6.7 min CN=WQ Runoff=1.76 cfs 0.146 af

Subcatchment PR-C2e: Runoff Area=0.010 ac 0.00% Impervious Runoff Depth>0.00"
Tc=6.0 min CN=39 Runoff=0.00 cfs 0.000 af

Subcatchment PR-C2f: Runoff Area=0.090 ac 0.00% Impervious Runoff Depth=0.00"
Tc=6.0 min CN=35 Runoff=0.00 cfs 0.000 af

Pond 1: Depression C2a Peak Elev=138.57' Storage=19 cf Inflow=0.12 cfs 0.010 af
Discarded=0.10 cfs 0.010 af Secondary=0.00 cfs 0.000 af Outflow=0.10 cfs 0.010 af

Pond 2: Depression C2b Peak Elev=137.14' Storage=157 cf Inflow=0.42 cfs 0.035 af
Discarded=0.25 cfs 0.035 af Secondary=0.00 cfs 0.000 af Outflow=0.25 cfs 0.035 af

Pond 3: Depression C2c Peak Elev=132.42' Storage=185 cf Inflow=0.27 cfs 0.022 af
Discarded=0.12 cfs 0.022 af Secondary=0.00 cfs 0.000 af Outflow=0.12 cfs 0.022 af

Pond SIS: Peak Elev=130.49' Storage=1,257 cf Inflow=1.76 cfs 0.146 af
Discarded=0.45 cfs 0.146 af Secondary=0.00 cfs 0.000 af Outflow=0.45 cfs 0.146 af

Link POA-C1: Inflow=1.12 cfs 0.560 af
Primary=1.12 cfs 0.560 af

Link POA-C2: Inflow=0.00 cfs 0.000 af
Primary=0.00 cfs 0.000 af

Total Runoff Area = 17.100 ac Runoff Volume = 0.772 af Average Runoff Depth = 0.54"
94.97% Pervious = 16.240 ac 5.03% Impervious = 0.860 ac

Summary for Subcatchment PR-C1:

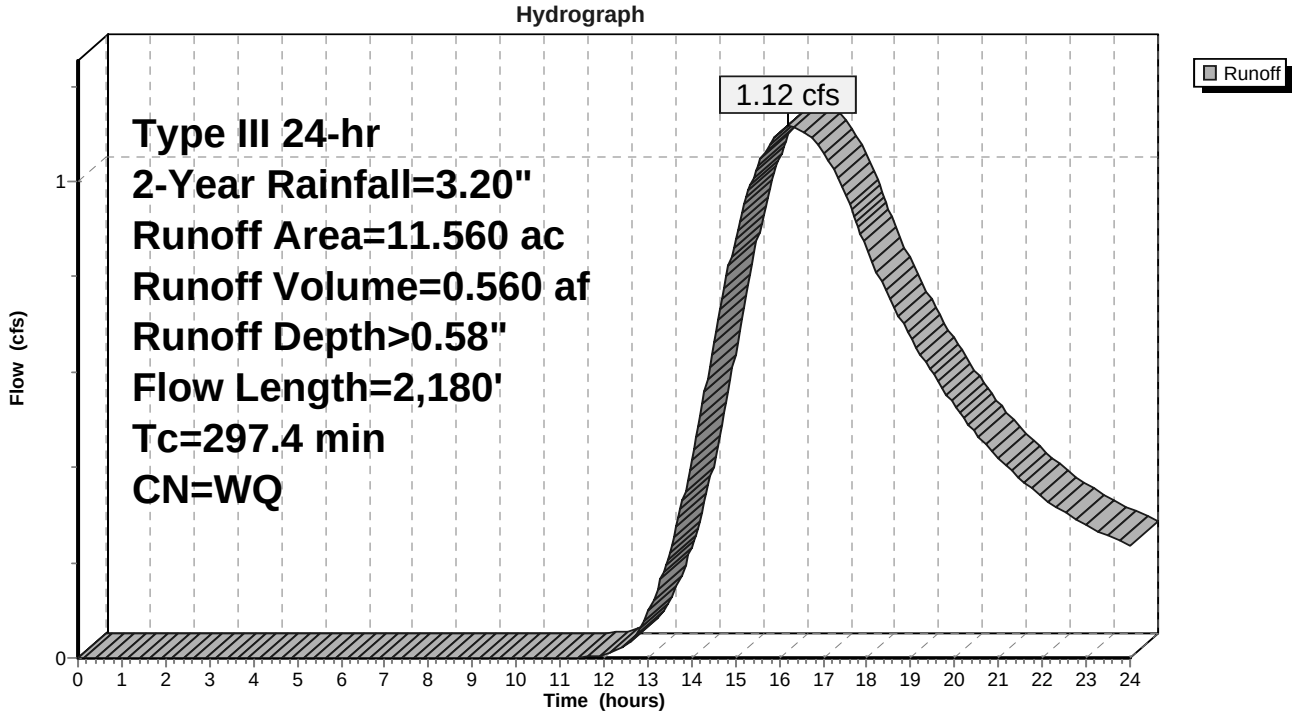
Runoff = 1.12 cfs @ 16.21 hrs, Volume= 0.560 af, Depth> 0.58"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.20"

	Area (ac)	CN	Description
	0.300	35	Brush, Fair, HSG A
	5.030	30	Woods, Good, HSG A
*	6.230	77	Wetland, HSG D
	11.560		Weighted Average
	11.560		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.1	50	0.0800	0.12		**Sheet Flow, Sheet-Woods** Woods: Light underbrush n= 0.400 P2= 3.20"
3.0	353	0.1500	1.94		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
287.3	1,777	0.0017	0.10		**Shallow Concentrated Flow, Wetland** Forest w/Heavy Litter Kv= 2.5 fps
297.4	2,180	Total			

Subcatchment PR-C1:



Summary for Subcatchment PR-C2a:

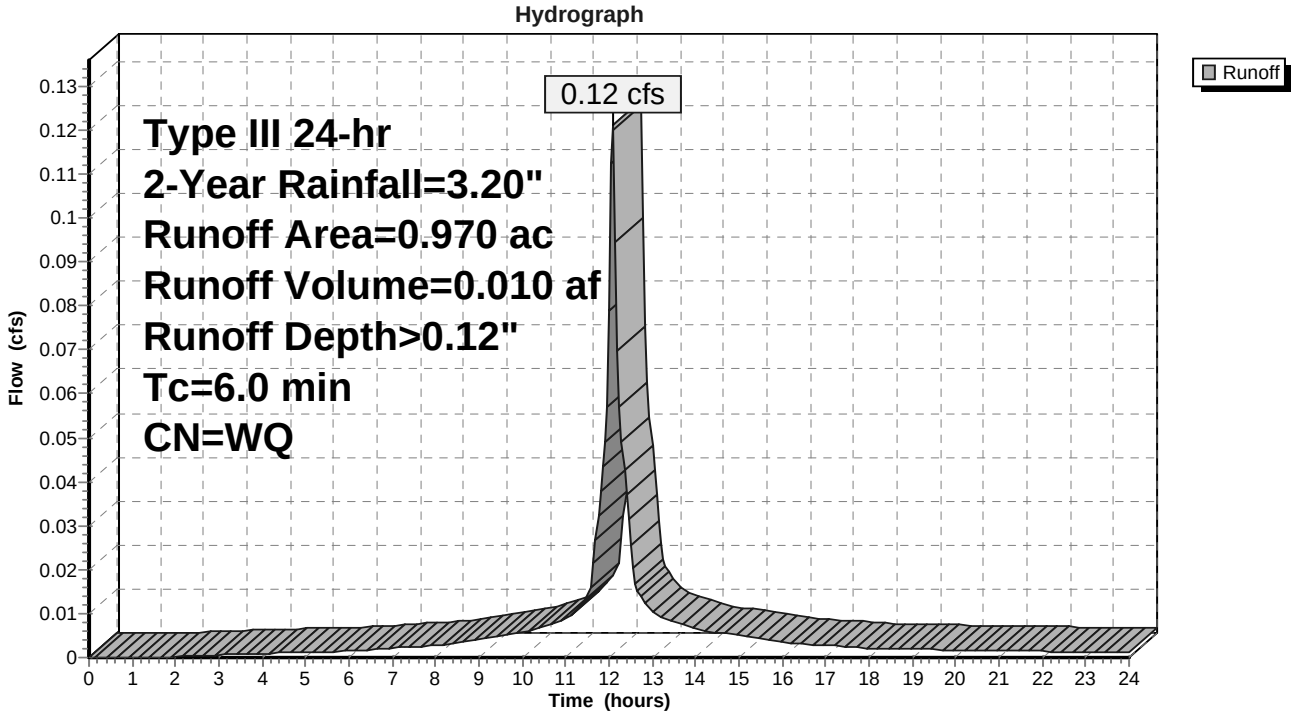
Runoff = 0.12 cfs @ 12.09 hrs, Volume= 0.010 af, Depth> 0.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.20"

	Area (ac)	CN	Description
	0.930	35	Brush, Fair, HSG A
*	0.040	98	Stormwater Depression, HSG A
	0.970		Weighted Average
	0.930		95.88% Pervious Area
	0.040		4.12% Impervious Area

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

Subcatchment PR-C2a:



Summary for Subcatchment PR-C2b:

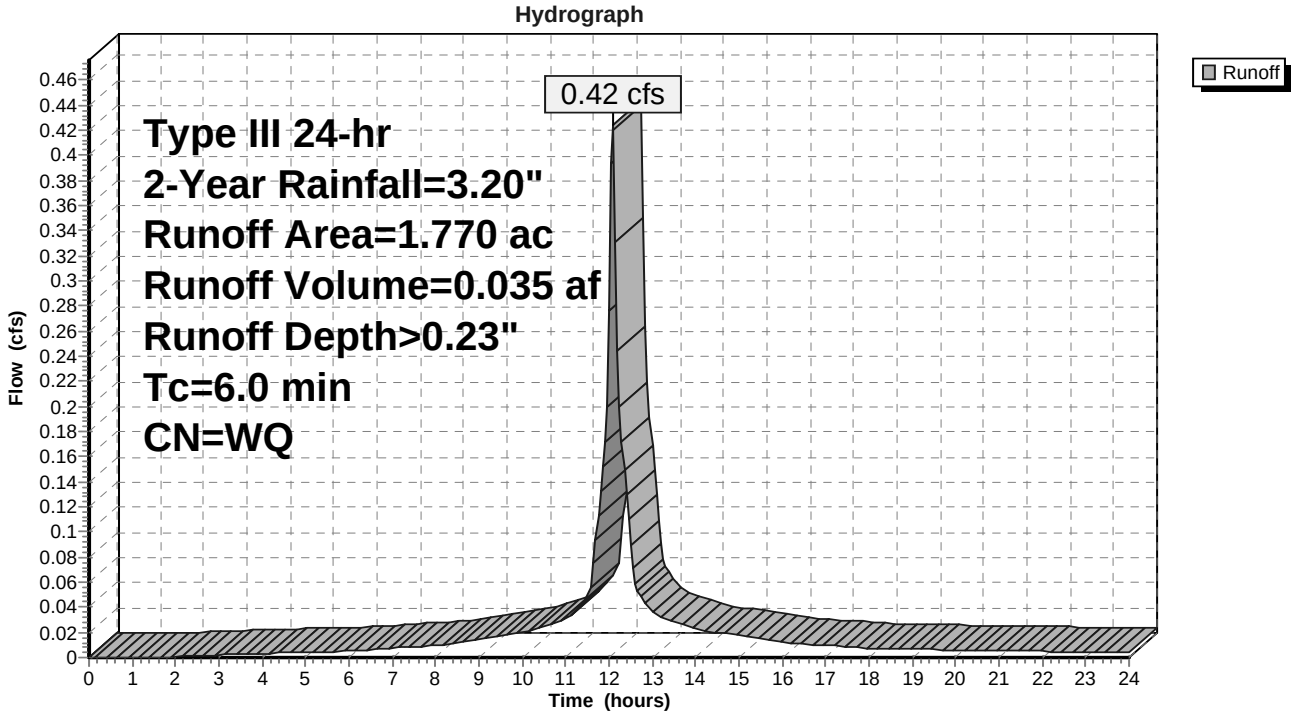
Runoff = 0.42 cfs @ 12.09 hrs, Volume= 0.035 af, Depth> 0.23"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.20"

	Area (ac)	CN	Description
	1.630	35	Brush, Fair, HSG A
*	0.140	98	Stormwater Depression, HSG A
	1.770		Weighted Average
	1.630		92.09% Pervious Area
	0.140		7.91% Impervious Area

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

Subcatchment PR-C2b:



Summary for Subcatchment PR-C2c:

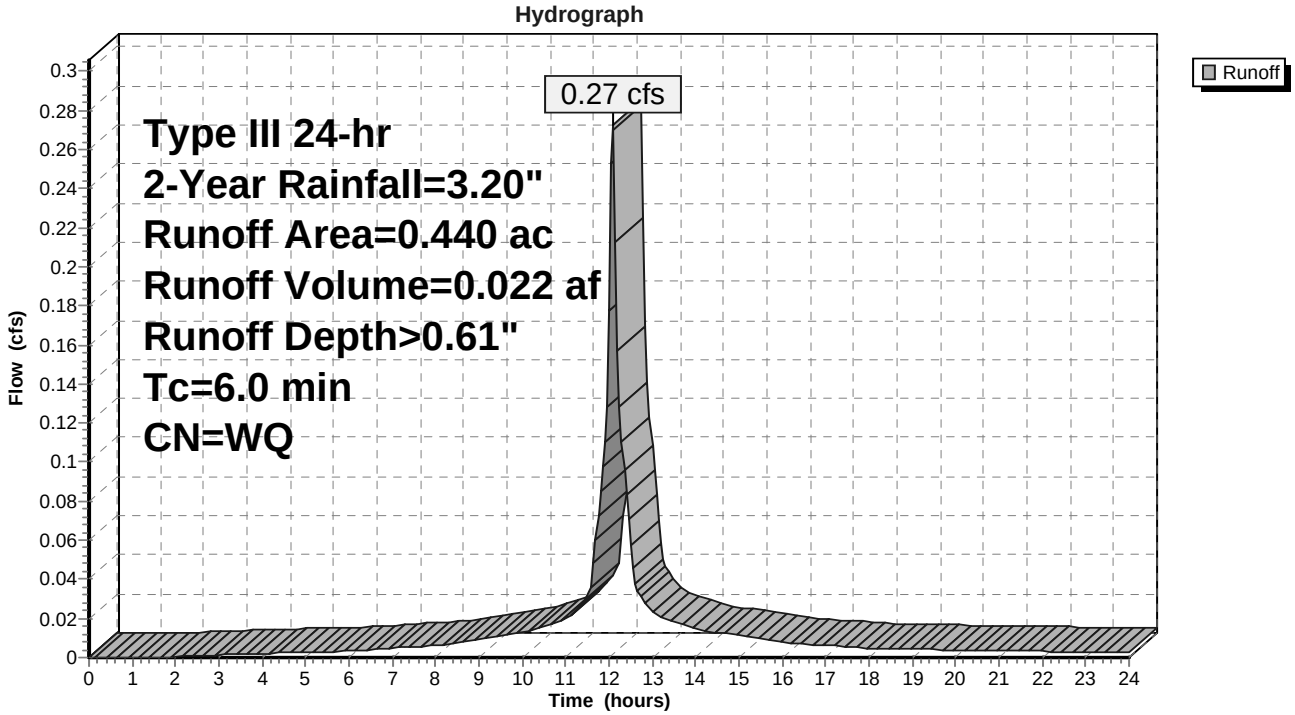
Runoff = 0.27 cfs @ 12.09 hrs, Volume= 0.022 af, Depth> 0.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.20"

	Area (ac)	CN	Description
	0.350	35	Brush, Fair, HSG A
*	0.090	98	Stormwater Depression, HSG A
	0.440		Weighted Average
	0.350		79.55% Pervious Area
	0.090		20.45% Impervious Area

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

Subcatchment PR-C2c:



Summary for Subcatchment PR-C2d:

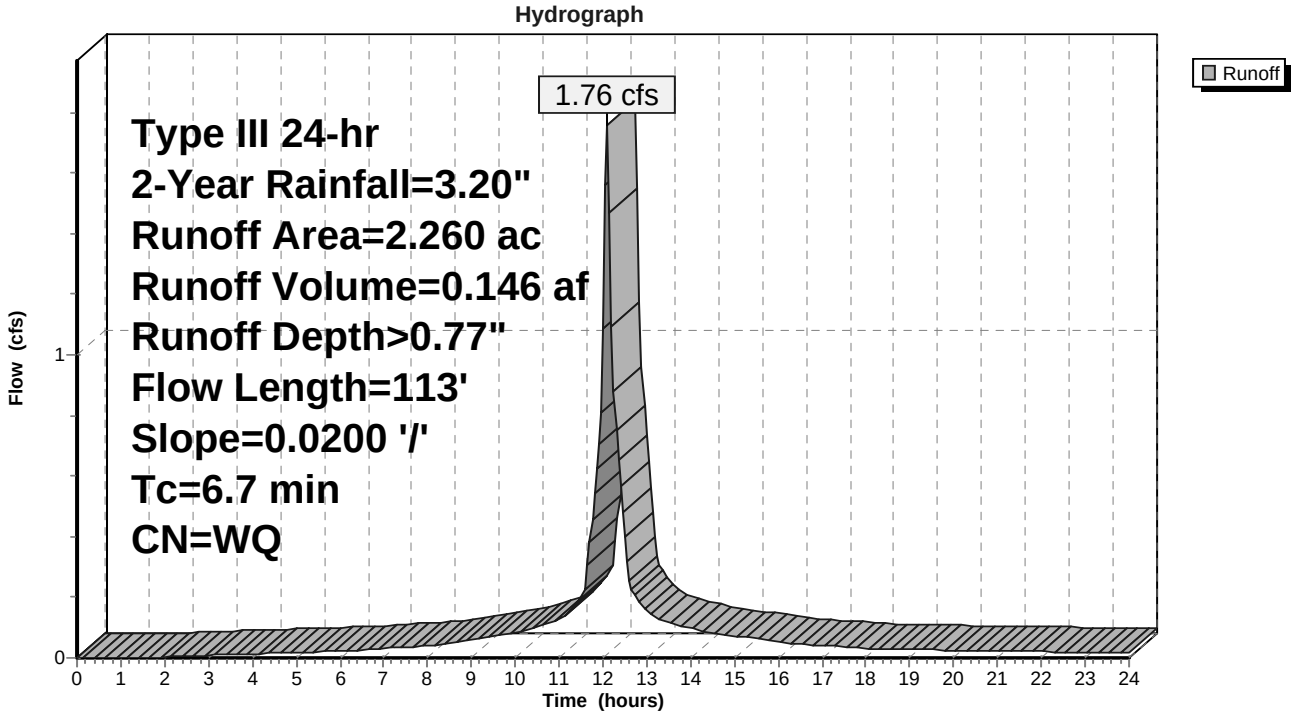
Runoff = 1.76 cfs @ 12.10 hrs, Volume= 0.146 af, Depth> 0.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.20"

Area (ac)	CN	Description
1.670	39	>75% Grass cover, Good, HSG A
0.590	98	Paved roads w/curbs & sewers, HSG A
2.260		Weighted Average
1.670		73.89% Pervious Area
0.590		26.11% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.0200	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
1.1	63	0.0200	0.99		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
6.7	113	Total			

Subcatchment PR-C2d:



Summary for Subcatchment PR-C2e:

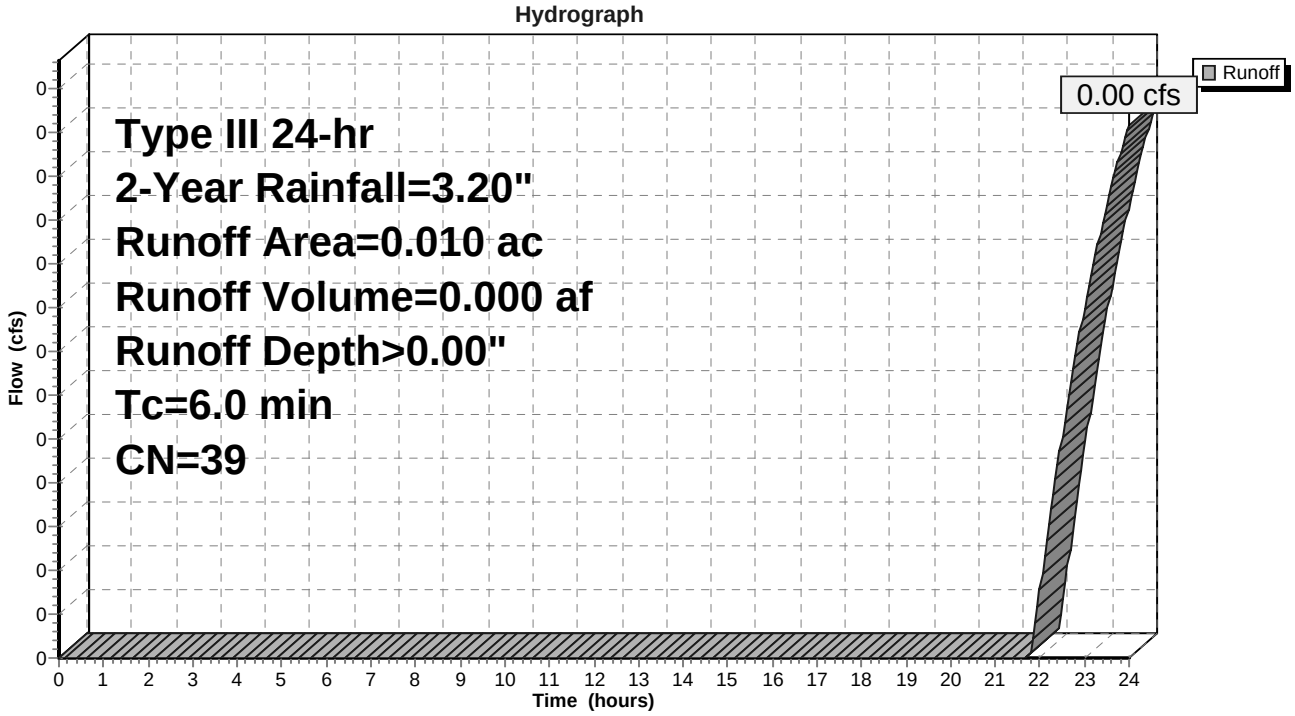
Runoff = 0.00 cfs @ 24.00 hrs, Volume= 0.000 af, Depth> 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.20"

Area (ac)	CN	Description
0.010	39	>75% Grass cover, Good, HSG A
0.010		100.00% Pervious Area

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

Subcatchment PR-C2e:



Summary for Subcatchment PR-C2f:

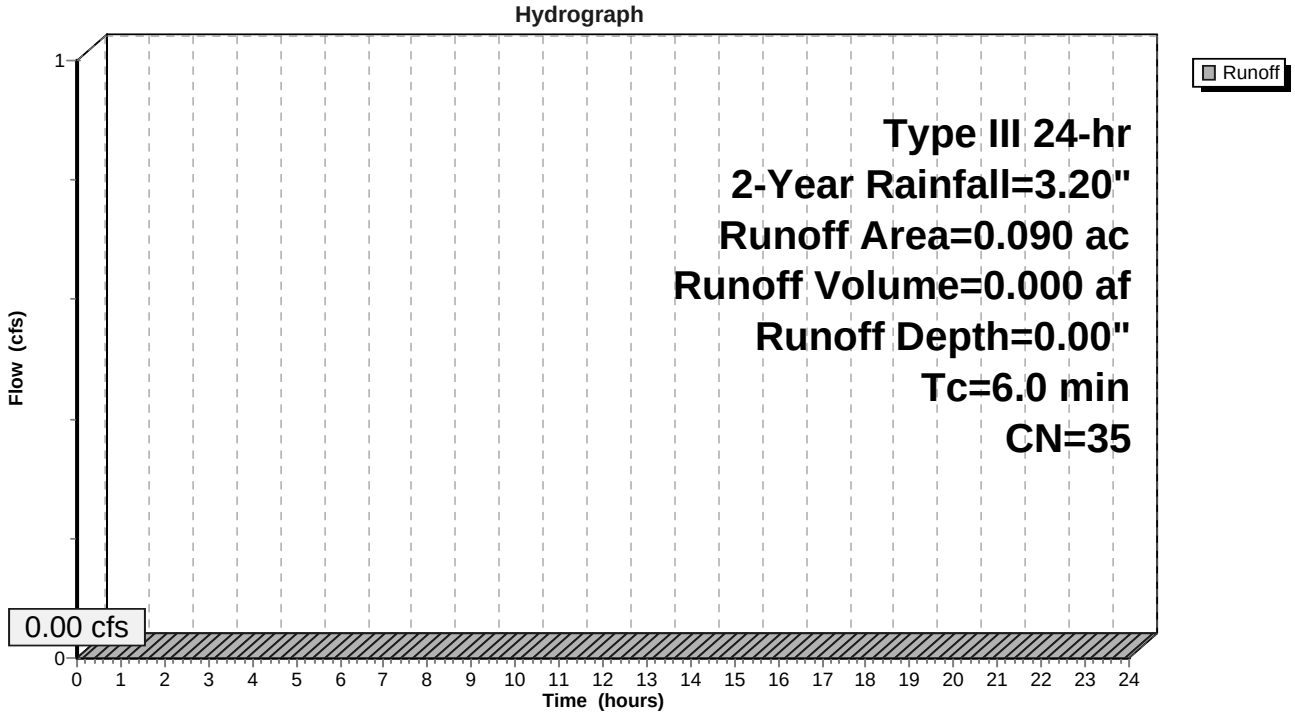
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.20"

Area (ac)	CN	Description
0.090	35	Brush, Fair, HSG A
0.090		100.00% Pervious Area

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

Subcatchment PR-C2f:



Summary for Pond 1: Depression C2a

Inflow Area =	0.970 ac,	4.12% Impervious,	Inflow Depth >	0.12"	for 2-Year event
Inflow =	0.12 cfs @	12.09 hrs,	Volume=	0.010 af	
Outflow =	0.10 cfs @	12.15 hrs,	Volume=	0.010 af,	Atten= 18%, Lag= 3.6 min
Discarded =	0.10 cfs @	12.15 hrs,	Volume=	0.010 af	
Secondary =	0.00 cfs @	0.00 hrs,	Volume=	0.000 af	

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 138.57' @ 12.15 hrs Surf.Area= 518 sf Storage= 19 cf

Plug-Flow detention time= 1.2 min calculated for 0.010 af (100% of inflow)
Center-of-Mass det. time= 1.1 min (757.1 - 756.0)

Volume	Invert	Avail.Storage	Storage Description
#1	138.50'	3,468 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

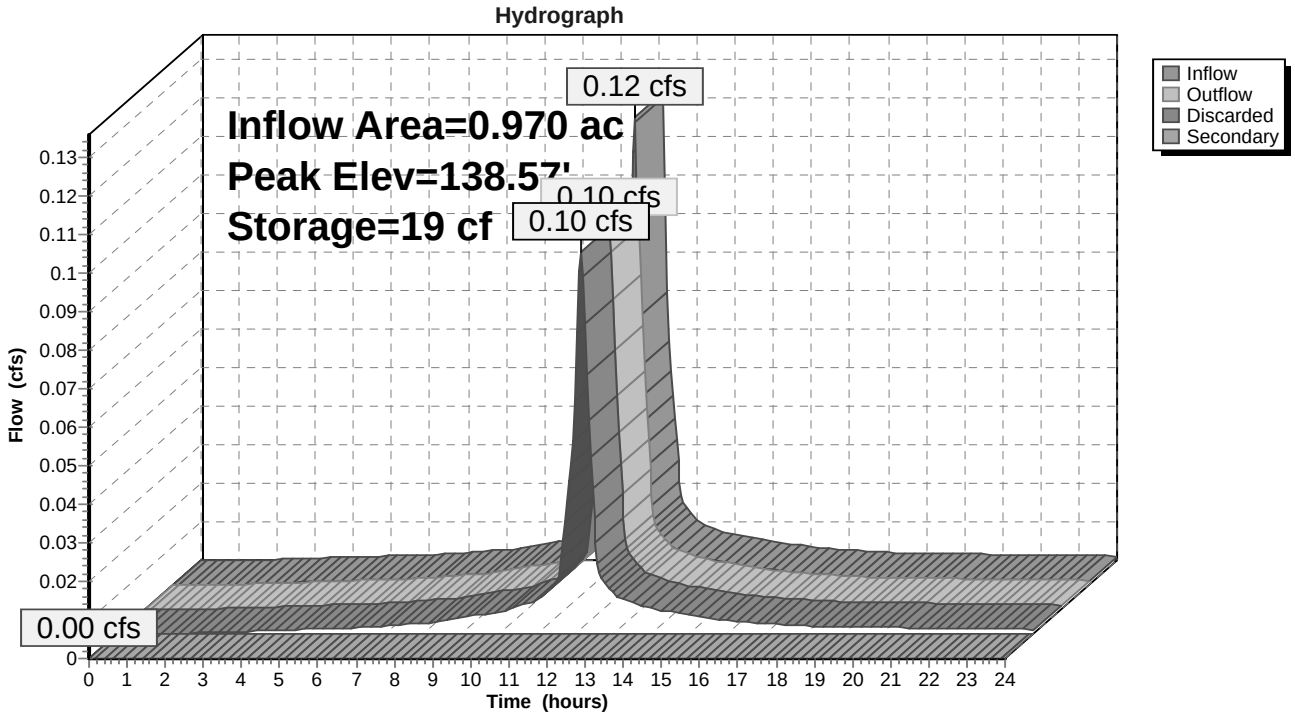
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
138.50	1	0	0
139.50	6,935	3,468	3,468

Device	Routing	Invert	Outlet Devices
#1	Discarded	138.50'	**8.270 in/hr Exfiltration over Horizontal area**
#2	Secondary	139.25'	**75.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Discarded OutFlow Max=0.10 cfs @ 12.15 hrs HW=138.57' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.10 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=138.50' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1: Depression C2a



Summary for Pond 2: Depression C2b

Inflow Area =	1.770 ac,	7.91% Impervious,	Inflow Depth >	0.23"	for 2-Year event
Inflow =	0.42 cfs @	12.09 hrs,	Volume=	0.035 af	
Outflow =	0.25 cfs @	12.20 hrs,	Volume=	0.035 af,	Atten= 40%, Lag= 6.9 min
Discarded =	0.25 cfs @	12.20 hrs,	Volume=	0.035 af	
Secondary =	0.00 cfs @	0.00 hrs,	Volume=	0.000 af	

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 137.14' @ 12.20 hrs Surf.Area= 1,332 sf Storage= 157 cf

Plug-Flow detention time= 3.9 min calculated for 0.035 af (100% of inflow)
Center-of-Mass det. time= 3.8 min (759.8 - 756.0)

Volume	Invert	Avail.Storage	Storage Description
#1	136.90'	7,221 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

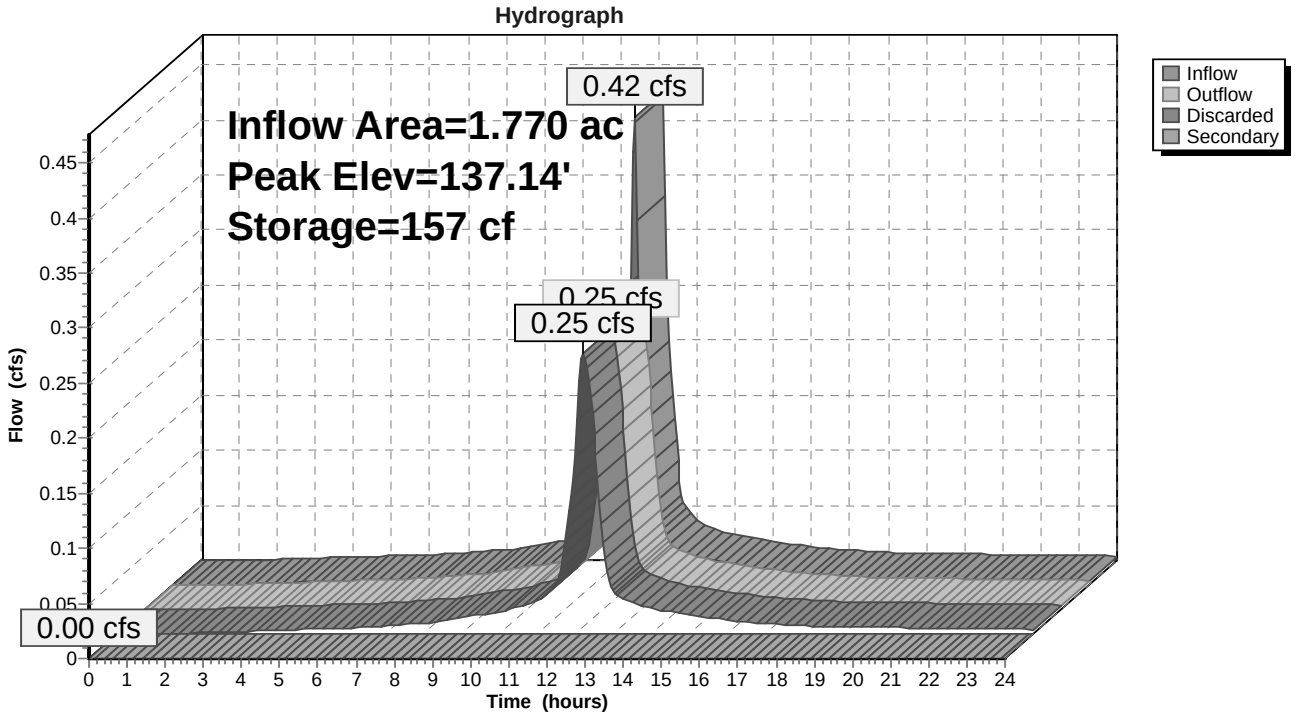
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
136.90	1	0	0
138.50	9,025	7,221	7,221

Device	Routing	Invert	Outlet Devices
#1	Discarded	136.90'	**8.270 in/hr Exfiltration over Horizontal area**
#2	Secondary	138.30'	**15.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Discarded OutFlow Max=0.25 cfs @ 12.20 hrs HW=137.14' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.25 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=136.90' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2: Depression C2b



Summary for Pond 3: Depression C2c

Inflow Area = 0.440 ac, 20.45% Impervious, Inflow Depth > 0.61" for 2-Year event
Inflow = 0.27 cfs @ 12.09 hrs, Volume= 0.022 af
Outflow = 0.12 cfs @ 12.27 hrs, Volume= 0.022 af, Atten= 56%, Lag= 11.1 min
Discarded = 0.12 cfs @ 12.27 hrs, Volume= 0.022 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 132.42' @ 12.27 hrs Surf.Area= 633 sf Storage= 185 cf

Plug-Flow detention time= 18.1 min calculated for 0.022 af (100% of inflow)
Center-of-Mass det. time= 17.7 min (773.7 - 756.0)

Volume	Invert	Avail.Storage	Storage Description
#1	131.40'	25,709 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

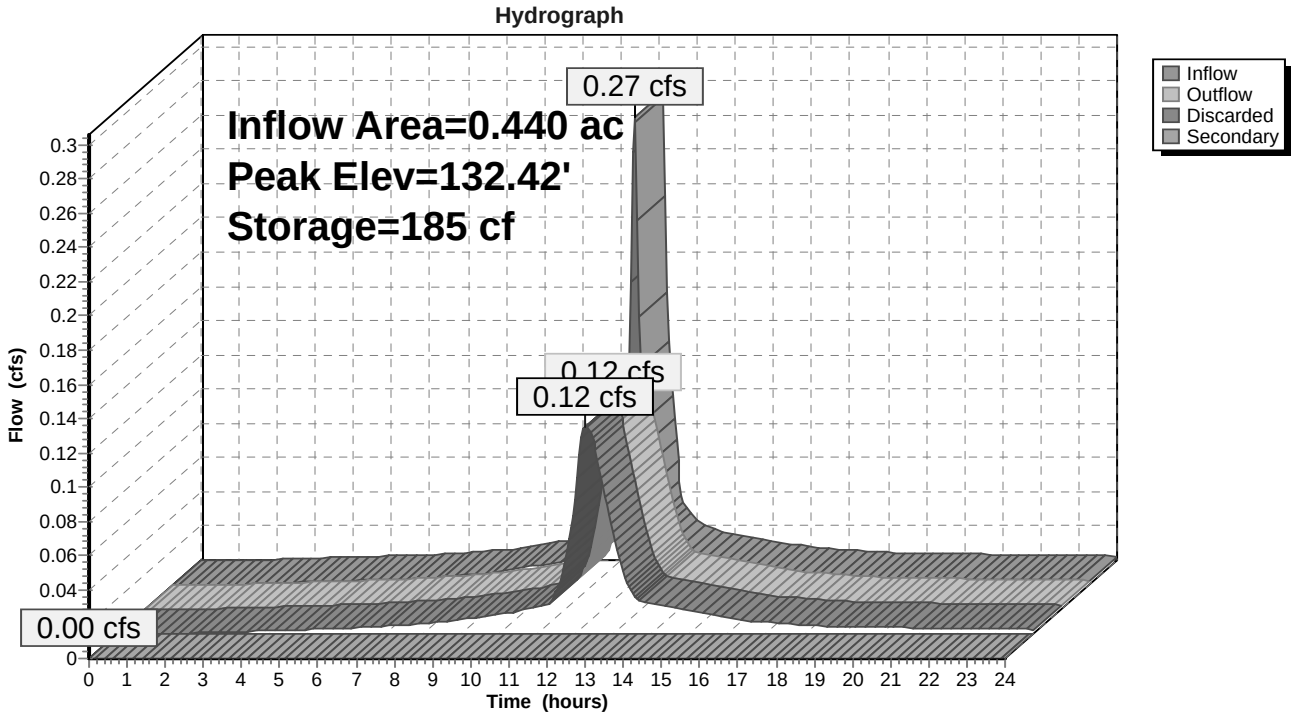
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
131.40	1	0	0
132.00	99	30	30
138.30	8,053	25,679	25,709

Device	Routing	Invert	Outlet Devices
#1	Discarded	131.40'	**8.270 in/hr Exfiltration over Horizontal area**
#2	Secondary	138.10'	**25.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Discarded OutFlow Max=0.12 cfs @ 12.27 hrs HW=132.42' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.12 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=131.40' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 3: Depression C2c



Summary for Pond SIS:

Inflow Area = 2.260 ac, 26.11% Impervious, Inflow Depth > 0.77" for 2-Year event
Inflow = 1.76 cfs @ 12.10 hrs, Volume= 0.146 af
Outflow = 0.45 cfs @ 11.80 hrs, Volume= 0.146 af, Atten= 75%, Lag= 0.0 min
Discarded = 0.45 cfs @ 11.80 hrs, Volume= 0.146 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 130.49' @ 12.47 hrs Surf.Area= 2,329 sf Storage= 1,257 cf

Plug-Flow detention time= 13.8 min calculated for 0.145 af (100% of inflow)
Center-of-Mass det. time= 13.6 min (770.4 - 756.7)

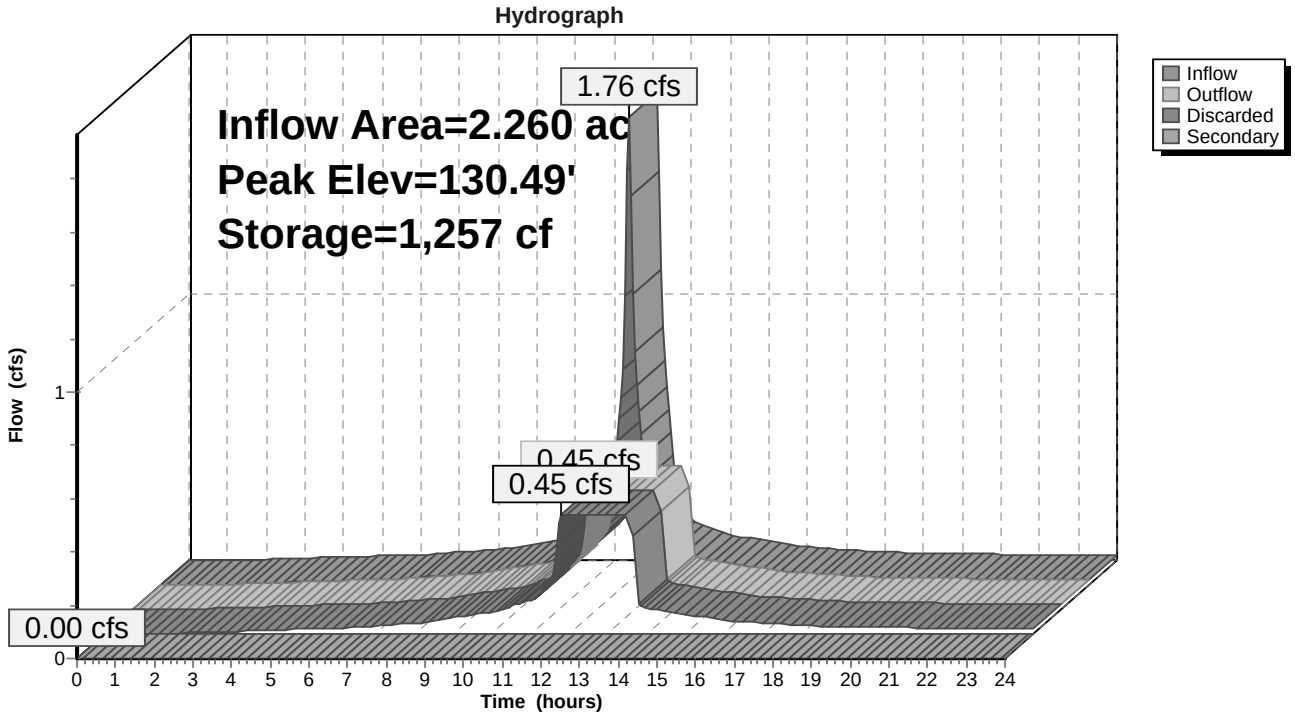
Volume	Invert	Avail.Storage	Storage Description
#1	129.50'	2,043 cf	**17.00'W x 137.00'L x 6.50'H Prismatoid**
			15,139 cf Overall - 8,330 cf Embedded = 6,809 cf x 30.0% Voids
#2	130.00'	8,330 cf	**7.00'W x 7.00'L x 5.00'H Prismatoid** x 34 Inside #1
		10,373 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	129.50'	**8.270 in/hr Exfiltration over Horizontal area**
#2	Secondary	135.95'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=0.45 cfs @ 11.80 hrs HW=129.58' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.45 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=129.50' (Free Discharge)
└**2=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond SIS:

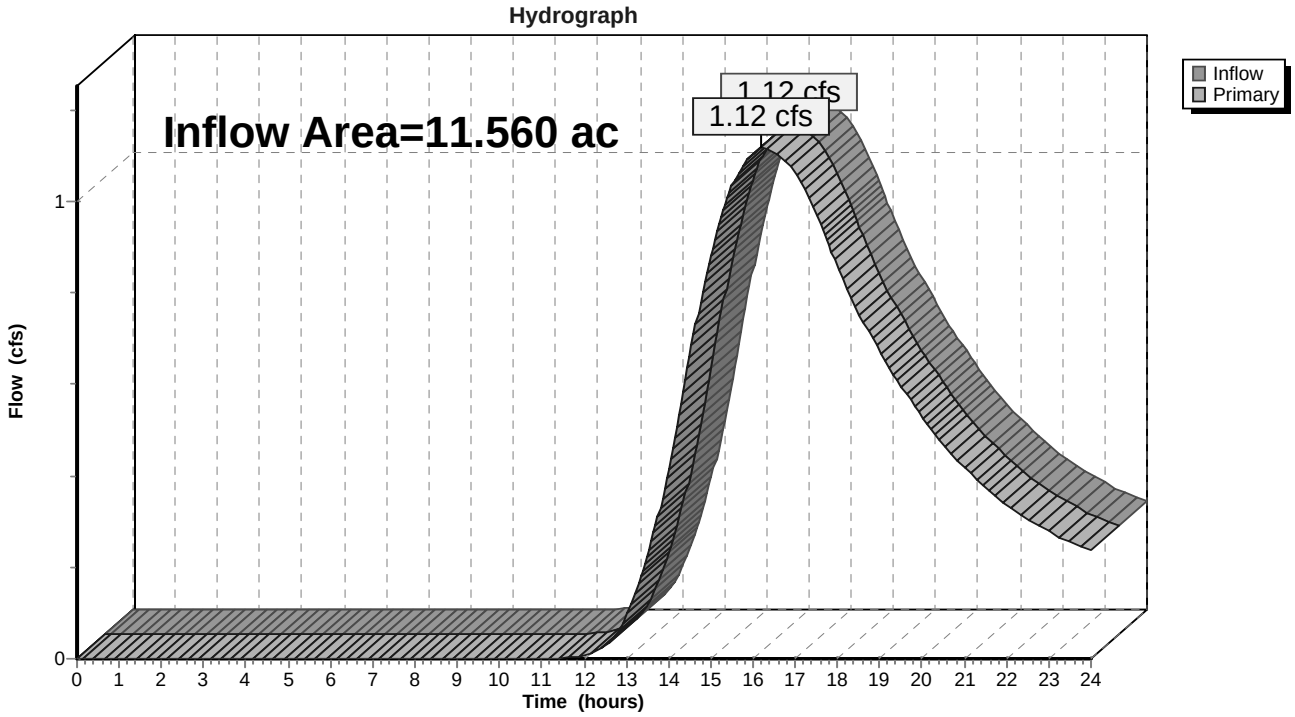

Hydrograph
Inflow Area=2.260 ac
Peak Elev=130.49'
Storage=1,257 cf
1.76 cfs
0.45 cfs
0.45 cfs
0.00 cfs
Inflow
Outflow
Discarded
Secondary
Flow (cfs)
1
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Time (hours)

Summary for Link POA-C1:

Inflow Area = 11.560 ac, 0.00% Impervious, Inflow Depth > 0.58" for 2-Year event
Inflow = 1.12 cfs @ 16.21 hrs, Volume= 0.560 af
Primary = 1.12 cfs @ 16.21 hrs, Volume= 0.560 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link POA-C1:

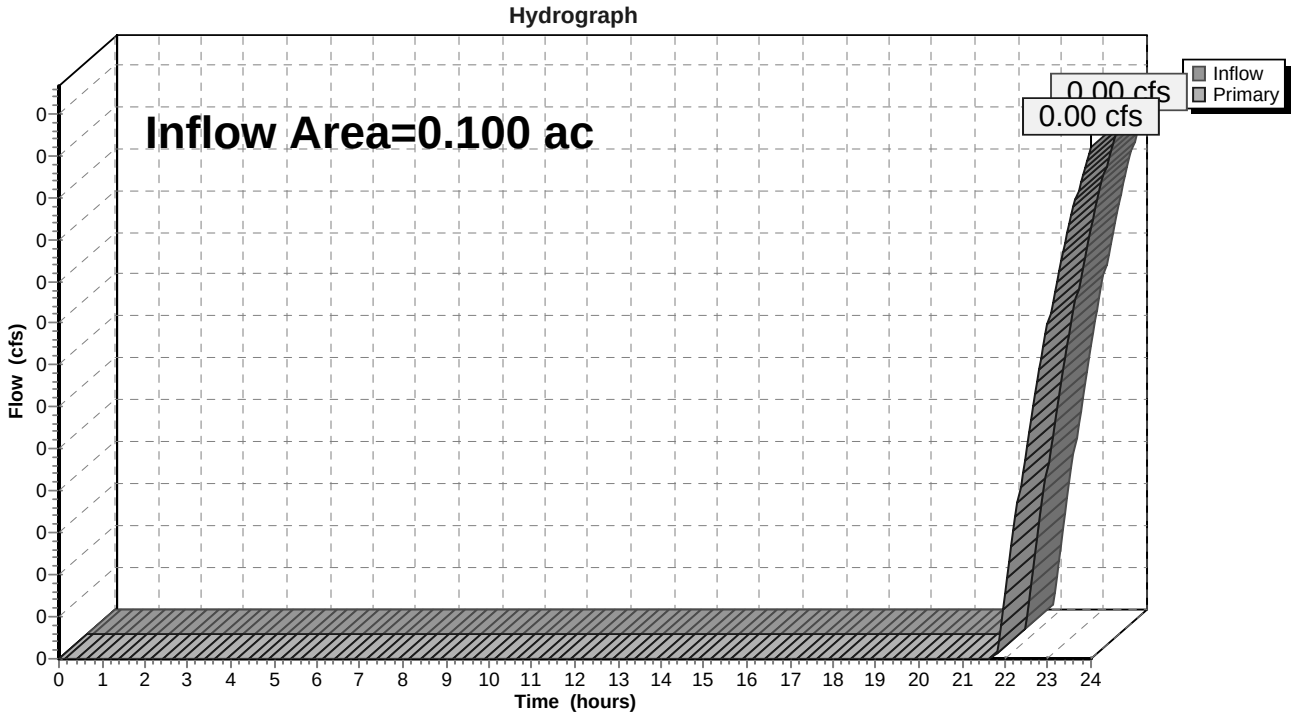


Summary for Link POA-C2:

Inflow Area = 0.100 ac, 0.00% Impervious, Inflow Depth > 0.00" for 2-Year event
Inflow = 0.00 cfs @ 24.00 hrs, Volume= 0.000 af
Primary = 0.00 cfs @ 24.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link POA-C2:



Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment PR-C1: Runoff Area=11.560 ac 0.00% Impervious Runoff Depth>1.20"
Flow Length=2,180' Tc=297.4 min CN=WQ Runoff=2.33 cfs 1.154 af

Subcatchment PR-C2a: Runoff Area=0.970 ac 4.12% Impervious Runoff Depth>0.25"
Tc=6.0 min CN=WQ Runoff=0.18 cfs 0.020 af

Subcatchment PR-C2b: Runoff Area=1.770 ac 7.91% Impervious Runoff Depth>0.42"
Tc=6.0 min CN=WQ Runoff=0.64 cfs 0.061 af

Subcatchment PR-C2c: Runoff Area=0.440 ac 20.45% Impervious Runoff Depth>0.98"
Tc=6.0 min CN=WQ Runoff=0.41 cfs 0.036 af

Subcatchment PR-C2d: Runoff Area=2.260 ac 26.11% Impervious Runoff Depth>1.31"
Flow Length=113' Slope=0.0200 '/' Tc=6.7 min CN=WQ Runoff=2.66 cfs 0.247 af

Subcatchment PR-C2e: Runoff Area=0.010 ac 0.00% Impervious Runoff Depth>0.16"
Tc=6.0 min CN=39 Runoff=0.00 cfs 0.000 af

Subcatchment PR-C2f: Runoff Area=0.090 ac 0.00% Impervious Runoff Depth>0.06"
Tc=6.0 min CN=35 Runoff=0.00 cfs 0.000 af

Pond 1: Depression C2a Peak Elev=138.60' Storage=38 cf Inflow=0.18 cfs 0.020 af
Discarded=0.14 cfs 0.020 af Secondary=0.00 cfs 0.000 af Outflow=0.14 cfs 0.020 af

Pond 2: Depression C2b Peak Elev=137.22' Storage=288 cf Inflow=0.64 cfs 0.061 af
Discarded=0.35 cfs 0.061 af Secondary=0.00 cfs 0.000 af Outflow=0.35 cfs 0.061 af

Pond 3: Depression C2c Peak Elev=132.59' Storage=305 cf Inflow=0.41 cfs 0.036 af
Discarded=0.16 cfs 0.036 af Secondary=0.00 cfs 0.000 af Outflow=0.16 cfs 0.036 af

Pond SIS: Peak Elev=131.19' Storage=2,574 cf Inflow=2.66 cfs 0.247 af
Discarded=0.45 cfs 0.247 af Secondary=0.00 cfs 0.000 af Outflow=0.45 cfs 0.247 af

Link POA-C1: Inflow=2.33 cfs 1.154 af
Primary=2.33 cfs 1.154 af

Link POA-C2: Inflow=0.00 cfs 0.001 af
Primary=0.00 cfs 0.001 af

Total Runoff Area = 17.100 ac Runoff Volume = 1.518 af Average Runoff Depth = 1.07"
94.97% Pervious = 16.240 ac 5.03% Impervious = 0.860 ac

Summary for Subcatchment PR-C1:

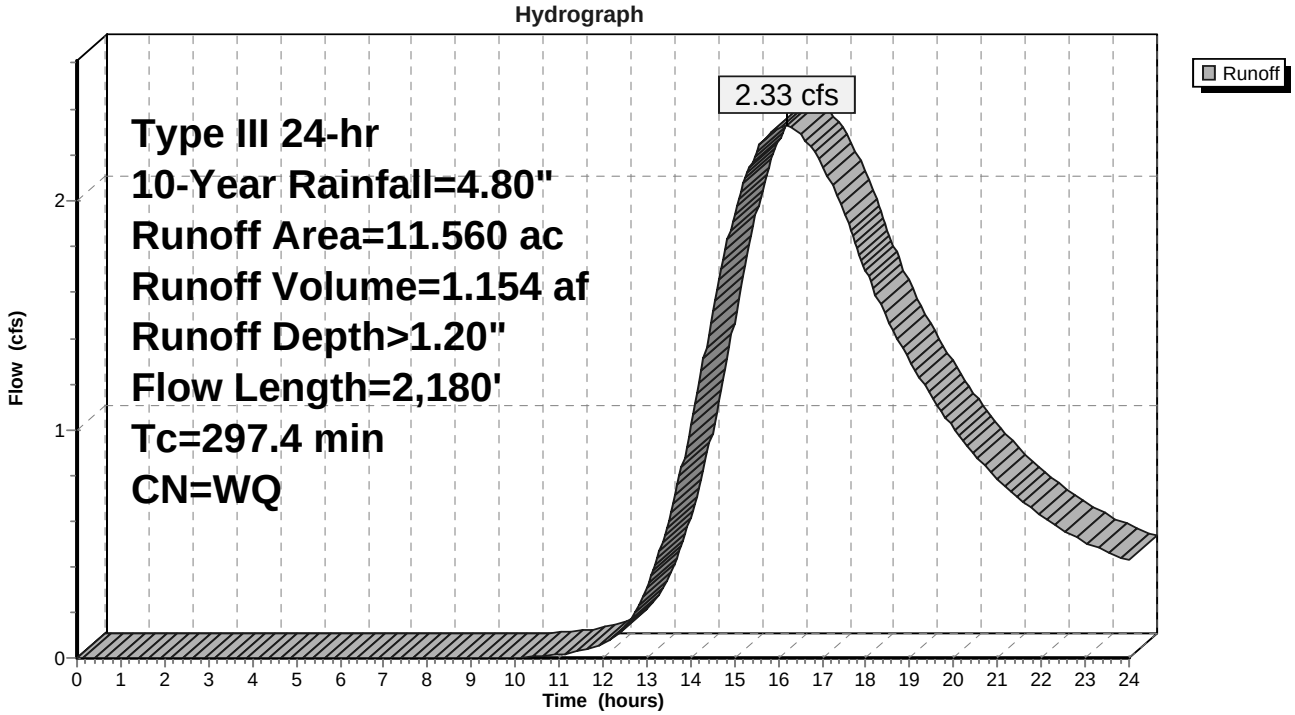
Runoff = 2.33 cfs @ 16.19 hrs, Volume= 1.154 af, Depth> 1.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (ac)	CN	Description
	0.300	35	Brush, Fair, HSG A
	5.030	30	Woods, Good, HSG A
*	6.230	77	Wetland, HSG D
	11.560		Weighted Average
	11.560		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.1	50	0.0800	0.12		**Sheet Flow, Sheet-Woods** Woods: Light underbrush n= 0.400 P2= 3.20"
3.0	353	0.1500	1.94		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
287.3	1,777	0.0017	0.10		**Shallow Concentrated Flow, Wetland** Forest w/Heavy Litter Kv= 2.5 fps
297.4	2,180	Total			

Subcatchment PR-C1:



Summary for Subcatchment PR-C2a:

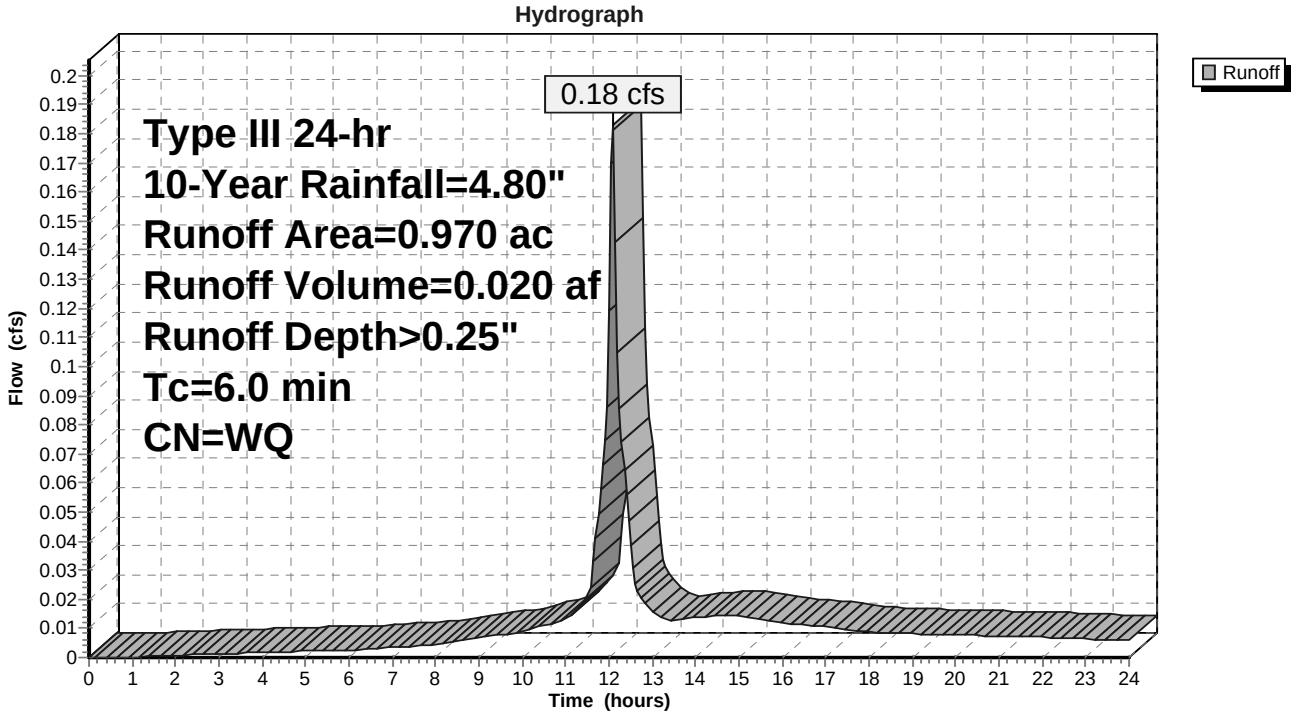
Runoff = 0.18 cfs @ 12.09 hrs, Volume= 0.020 af, Depth> 0.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (ac)	CN	Description
	0.930	35	Brush, Fair, HSG A
*	0.040	98	Stormwater Depression, HSG A
	0.970		Weighted Average
	0.930		95.88% Pervious Area
	0.040		4.12% Impervious Area

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

Subcatchment PR-C2a:



Summary for Subcatchment PR-C2b:

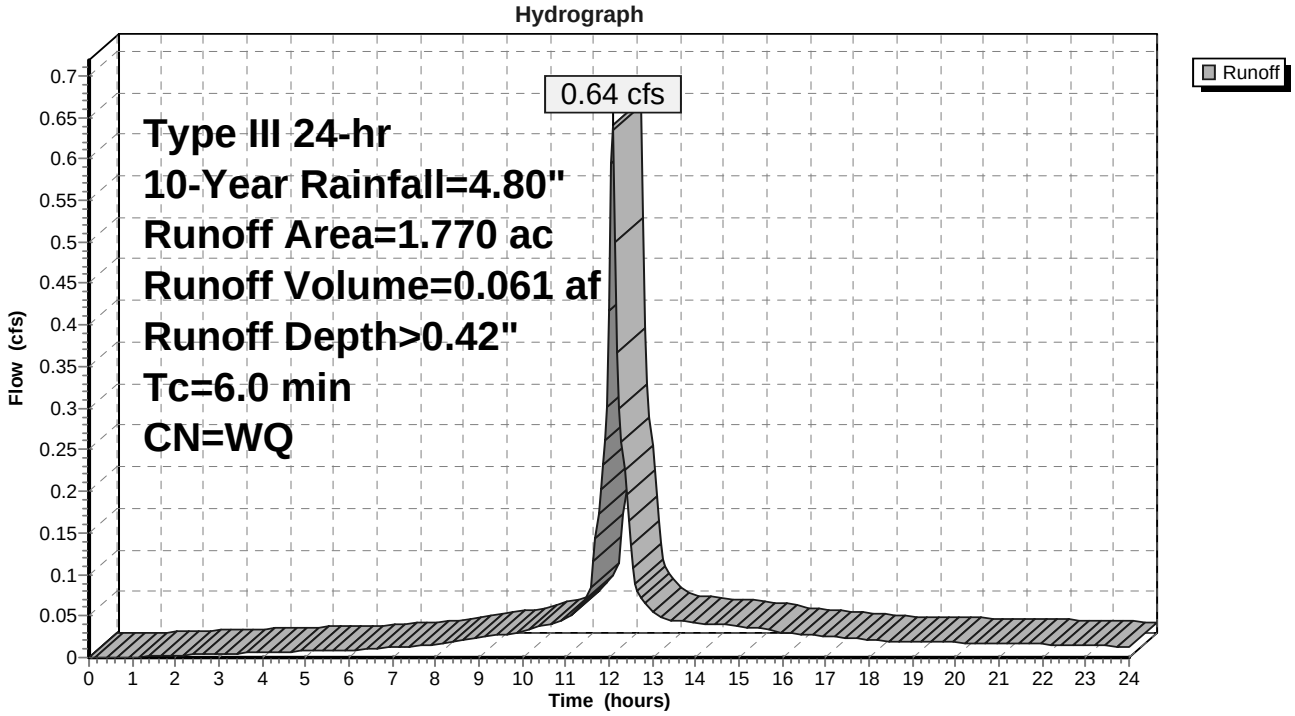
Runoff = 0.64 cfs @ 12.09 hrs, Volume= 0.061 af, Depth> 0.42"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (ac)	CN	Description
	1.630	35	Brush, Fair, HSG A
*	0.140	98	Stormwater Depression, HSG A
	1.770		Weighted Average
	1.630		92.09% Pervious Area
	0.140		7.91% Impervious Area

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

Subcatchment PR-C2b:



Summary for Subcatchment PR-C2c:

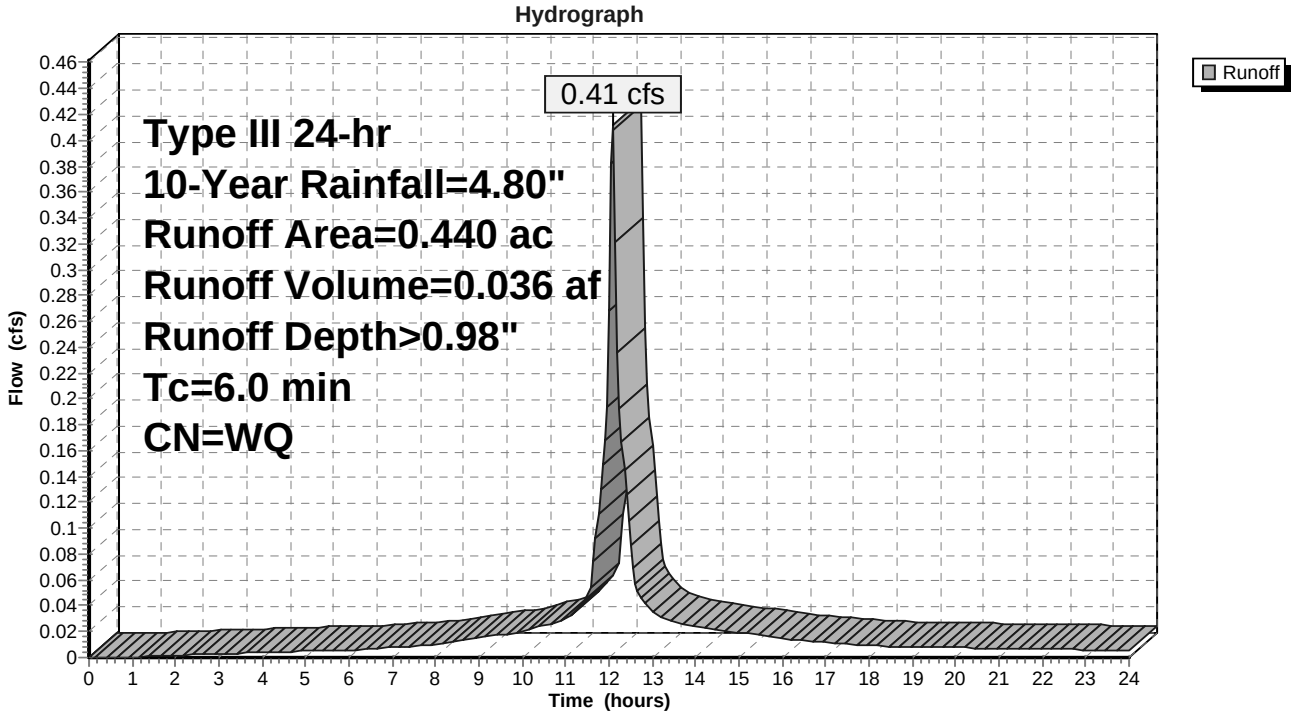
Runoff = 0.41 cfs @ 12.09 hrs, Volume= 0.036 af, Depth> 0.98"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (ac)	CN	Description
	0.350	35	Brush, Fair, HSG A
*	0.090	98	Stormwater Depression, HSG A
	0.440		Weighted Average
	0.350		79.55% Pervious Area
	0.090		20.45% Impervious Area

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

Subcatchment PR-C2c:



Summary for Subcatchment PR-C2d:

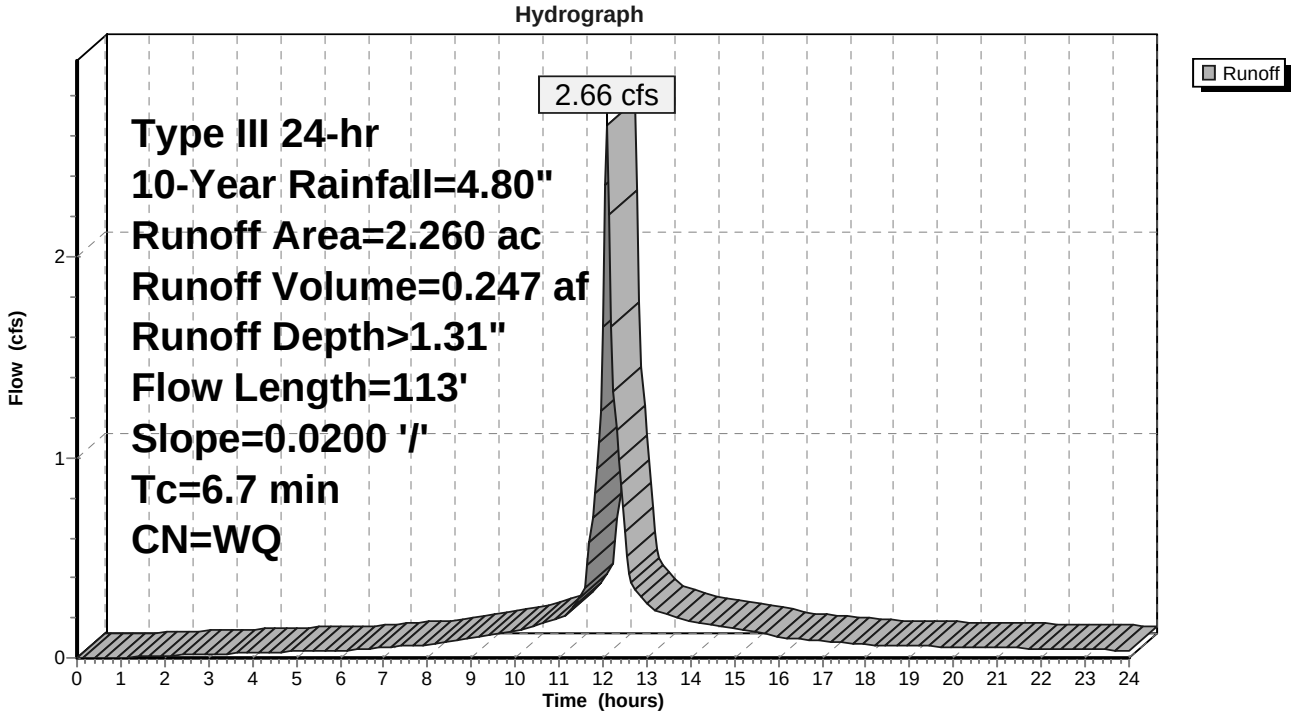
Runoff = 2.66 cfs @ 12.10 hrs, Volume= 0.247 af, Depth> 1.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description
1.670	39	>75% Grass cover, Good, HSG A
0.590	98	Paved roads w/curbs & sewers, HSG A
2.260		Weighted Average
1.670		73.89% Pervious Area
0.590		26.11% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.0200	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
1.1	63	0.0200	0.99		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
6.7	113	Total			

Subcatchment PR-C2d:



Summary for Subcatchment PR-C2e:

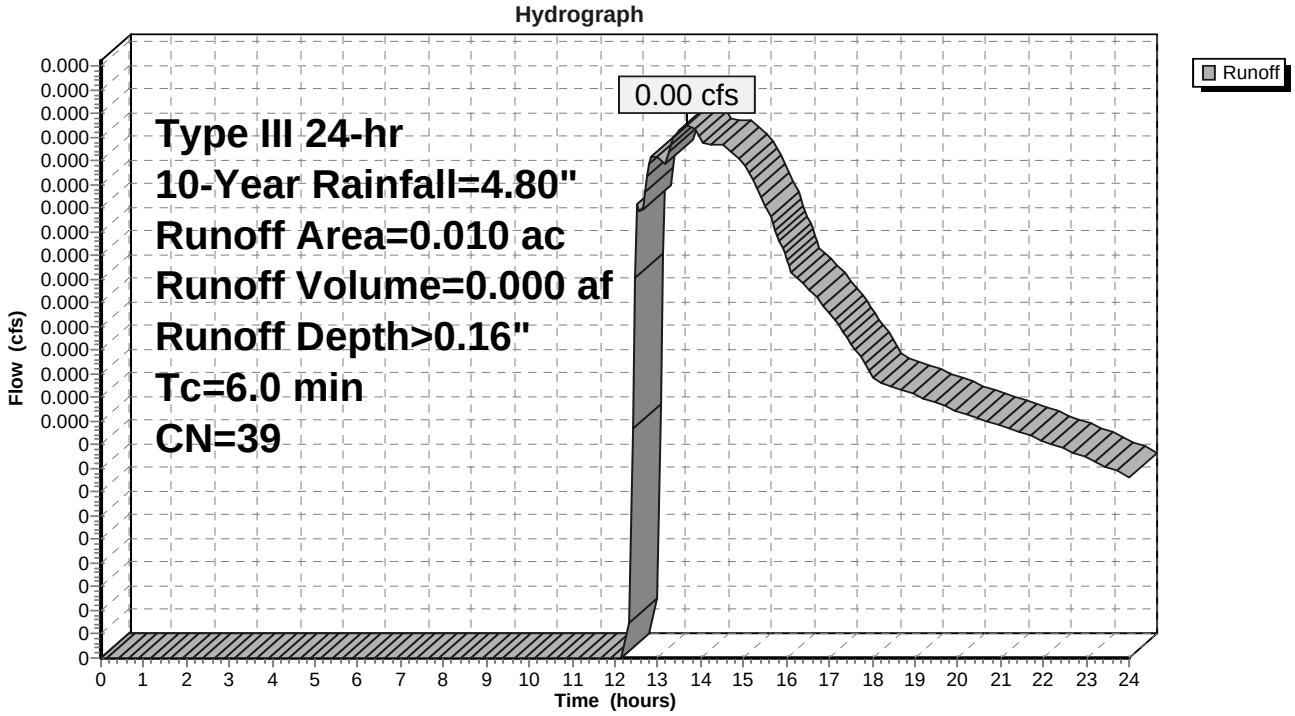
Runoff = 0.00 cfs @ 13.67 hrs, Volume= 0.000 af, Depth> 0.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description
0.010	39	>75% Grass cover, Good, HSG A
0.010		100.00% Pervious Area

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

Subcatchment PR-C2e:



Summary for Subcatchment PR-C2f:

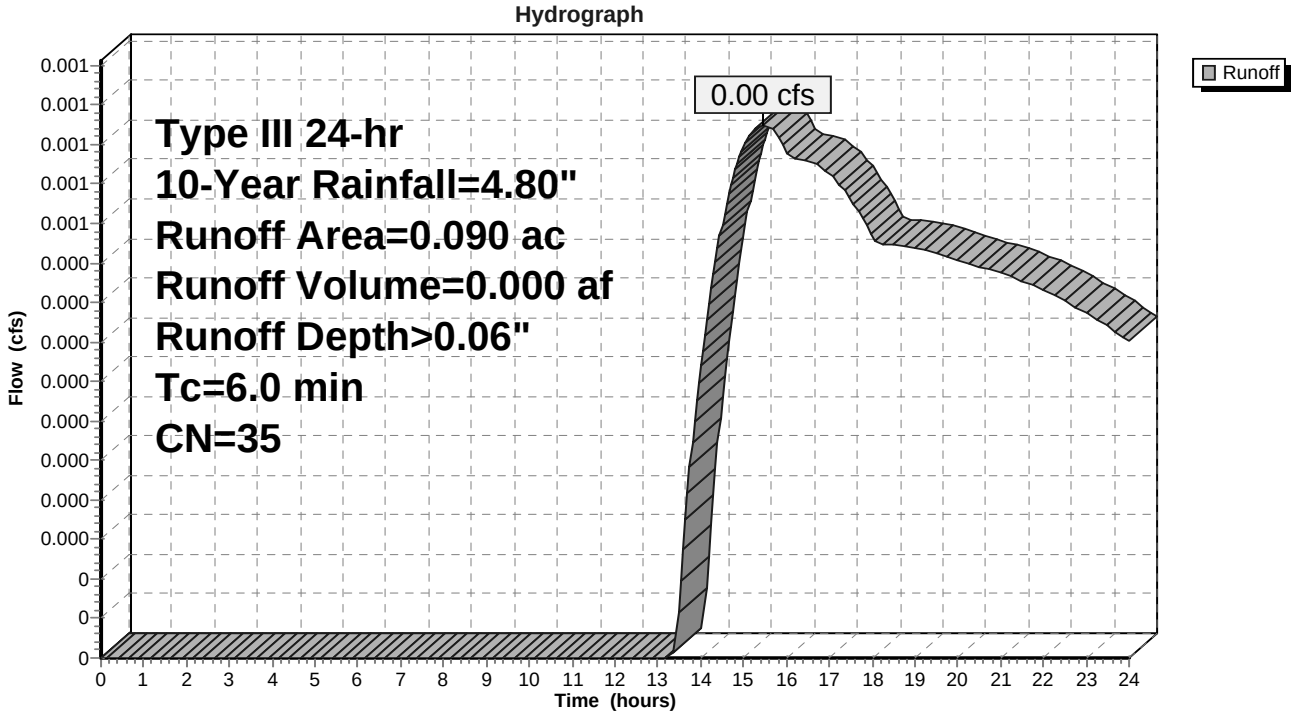
Runoff = 0.00 cfs @ 15.45 hrs, Volume= 0.000 af, Depth> 0.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description
0.090	35	Brush, Fair, HSG A
0.090		100.00% Pervious Area

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

Subcatchment PR-C2f:



Summary for Pond 1: Depression C2a

Inflow Area =	0.970 ac,	4.12% Impervious,	Inflow Depth >	0.25"	for 10-Year event
Inflow =	0.18 cfs @	12.09 hrs,	Volume=	0.020 af	
Outflow =	0.14 cfs @	12.16 hrs,	Volume=	0.020 af,	Atten= 24%, Lag= 4.4 min
Discarded =	0.14 cfs @	12.16 hrs,	Volume=	0.020 af	
Secondary =	0.00 cfs @	0.00 hrs,	Volume=	0.000 af	

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 138.60' @ 12.16 hrs Surf.Area= 729 sf Storage= 38 cf

Plug-Flow detention time= 1.3 min calculated for 0.020 af (100% of inflow)
Center-of-Mass det. time= 1.2 min (834.8 - 833.6)

Volume	Invert	Avail.Storage	Storage Description
#1	138.50'	3,468 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

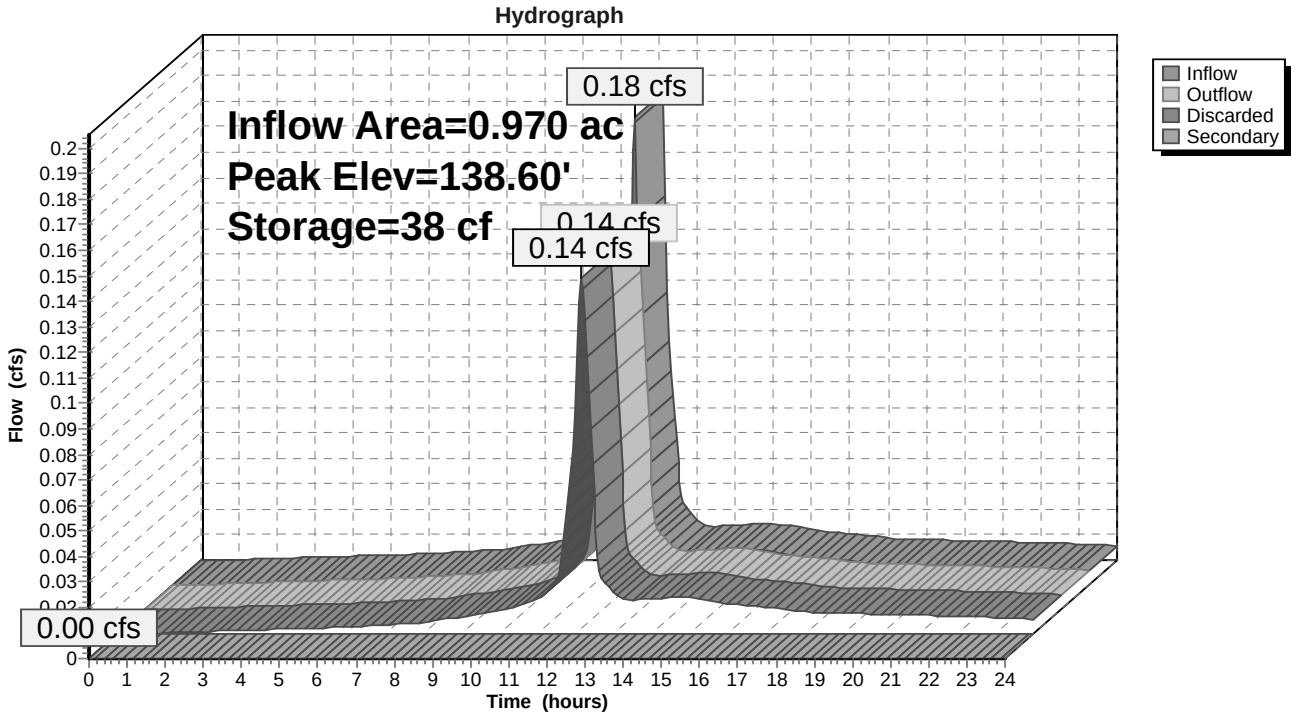
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
138.50	1	0	0
139.50	6,935	3,468	3,468

Device	Routing	Invert	Outlet Devices
#1	Discarded	138.50'	**8.270 in/hr Exfiltration over Horizontal area**
#2	Secondary	139.25'	**75.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Discarded OutFlow Max=0.14 cfs @ 12.16 hrs HW=138.60' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.14 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=138.50' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1: Depression C2a



Summary for Pond 2: Depression C2b

Inflow Area =	1.770 ac,	7.91% Impervious,	Inflow Depth >	0.42"	for 10-Year event
Inflow =	0.64 cfs @	12.09 hrs,	Volume=	0.061 af	
Outflow =	0.35 cfs @	12.22 hrs,	Volume=	0.061 af,	Atten= 46%, Lag= 8.0 min
Discarded =	0.35 cfs @	12.22 hrs,	Volume=	0.061 af	
Secondary =	0.00 cfs @	0.00 hrs,	Volume=	0.000 af	

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 137.22' @ 12.22 hrs Surf.Area= 1,803 sf Storage= 288 cf

Plug-Flow detention time= 4.8 min calculated for 0.061 af (100% of inflow)
Center-of-Mass det. time= 4.7 min (801.3 - 796.6)

Volume	Invert	Avail.Storage	Storage Description
#1	136.90'	7,221 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

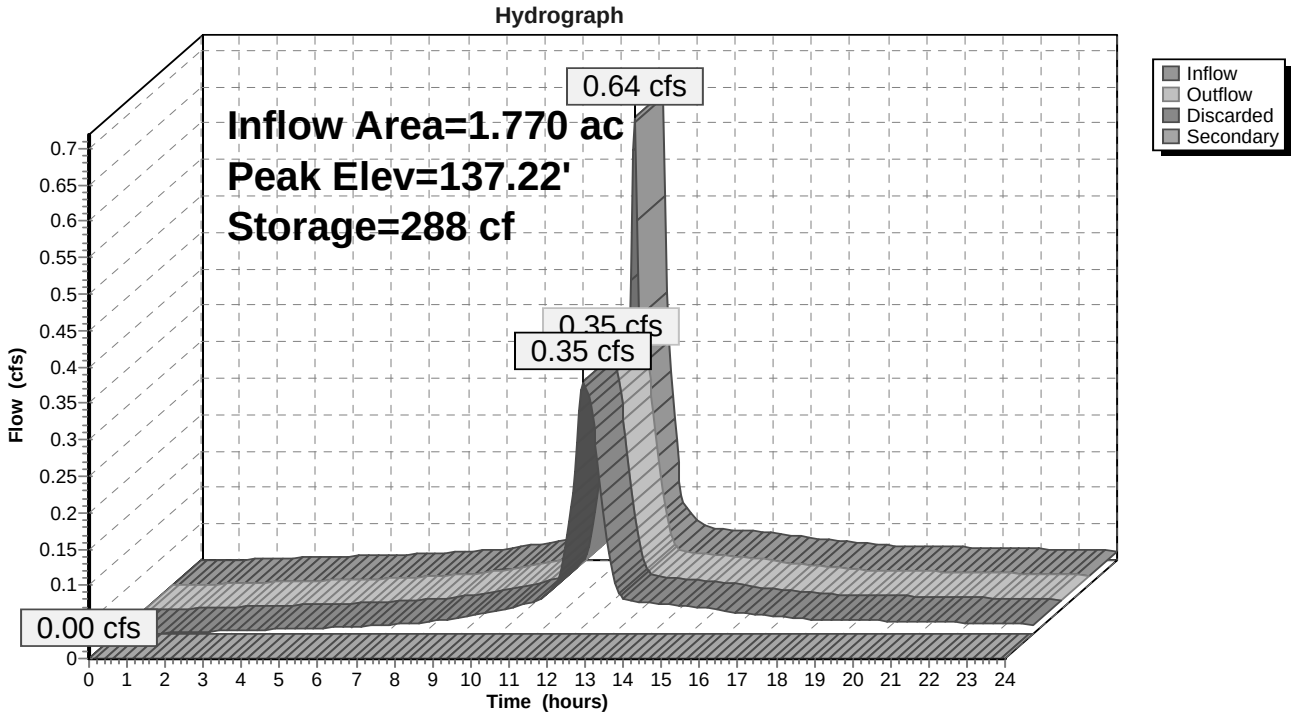
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
136.90	1	0	0
138.50	9,025	7,221	7,221

Device	Routing	Invert	Outlet Devices
#1	Discarded	136.90'	**8.270 in/hr Exfiltration over Horizontal area**
#2	Secondary	138.30'	**15.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Discarded OutFlow Max=0.34 cfs @ 12.22 hrs HW=137.22' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.34 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=136.90' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2: Depression C2b



Summary for Pond 3: Depression C2c

Inflow Area = 0.440 ac, 20.45% Impervious, Inflow Depth > 0.98" for 10-Year event
Inflow = 0.41 cfs @ 12.09 hrs, Volume= 0.036 af
Outflow = 0.16 cfs @ 12.32 hrs, Volume= 0.036 af, Atten= 61%, Lag= 13.7 min
Discarded = 0.16 cfs @ 12.32 hrs, Volume= 0.036 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 132.59' @ 12.32 hrs Surf.Area= 839 sf Storage= 305 cf

Plug-Flow detention time= 21.3 min calculated for 0.036 af (100% of inflow)
Center-of-Mass det. time= 20.2 min (786.2 - 766.0)

Volume	Invert	Avail.Storage	Storage Description
#1	131.40'	25,709 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

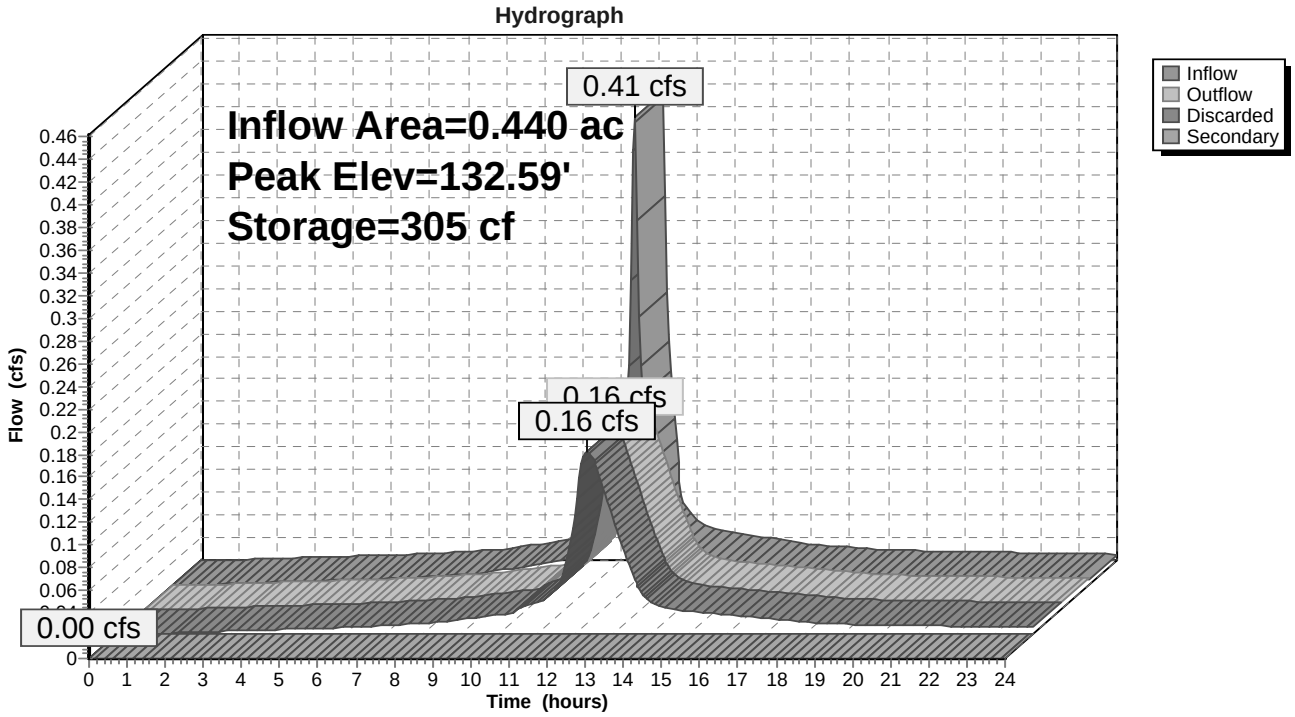
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
131.40	1	0	0
132.00	99	30	30
138.30	8,053	25,679	25,709

Device	Routing	Invert	Outlet Devices
#1	Discarded	131.40'	**8.270 in/hr Exfiltration over Horizontal area**
#2	Secondary	138.10'	**25.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Discarded OutFlow Max=0.16 cfs @ 12.32 hrs HW=132.59' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.16 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=131.40' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 3: Depression C2c



Summary for Pond SIS:

Inflow Area = 2.260 ac, 26.11% Impervious, Inflow Depth > 1.31" for 10-Year event
Inflow = 2.66 cfs @ 12.10 hrs, Volume= 0.247 af
Outflow = 0.45 cfs @ 11.70 hrs, Volume= 0.247 af, Atten= 83%, Lag= 0.0 min
Discarded = 0.45 cfs @ 11.70 hrs, Volume= 0.247 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 131.19' @ 12.59 hrs Surf.Area= 2,329 sf Storage= 2,574 cf

Plug-Flow detention time= 31.7 min calculated for 0.246 af (100% of inflow)
Center-of-Mass det. time= 31.4 min (805.3 - 773.9)

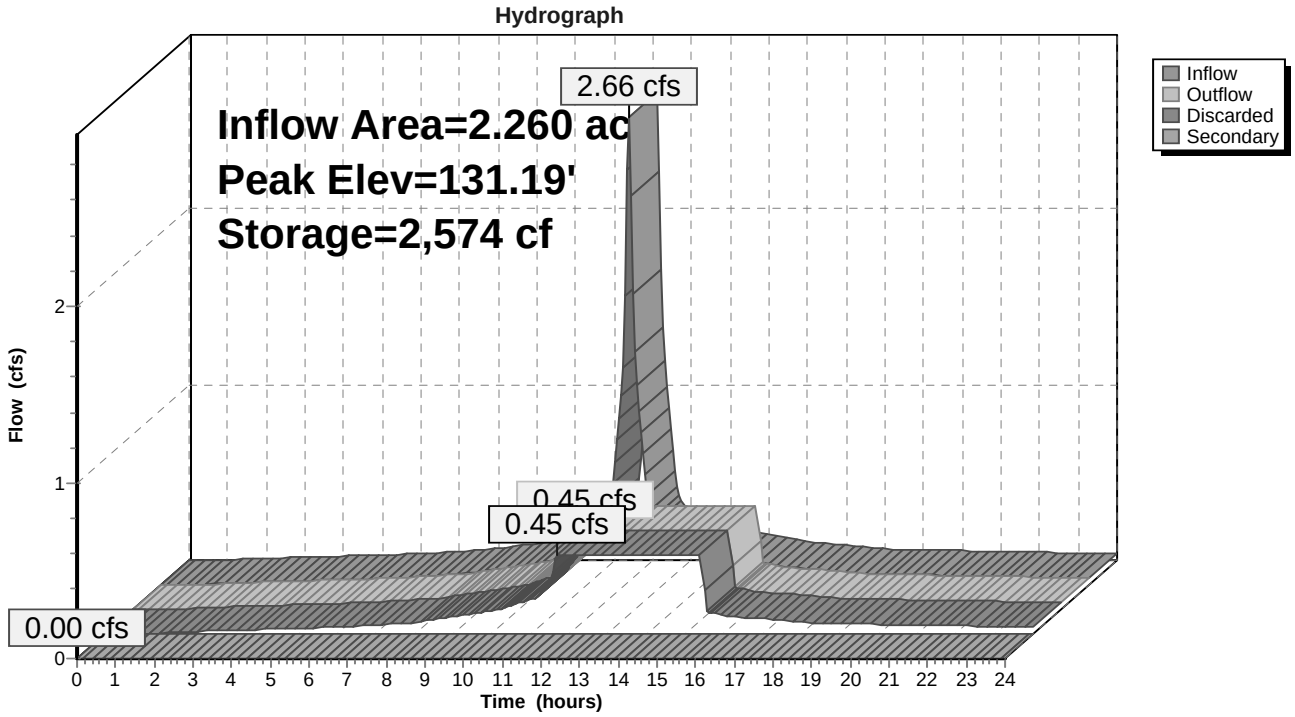
Volume	Invert	Avail.Storage	Storage Description
#1	129.50'	2,043 cf	**17.00'W x 137.00'L x 6.50'H Prismatoid**
			15,139 cf Overall - 8,330 cf Embedded = 6,809 cf x 30.0% Voids
#2	130.00'	8,330 cf	**7.00'W x 7.00'L x 5.00'H Prismatoid** x 34 Inside #1
		10,373 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	129.50'	**8.270 in/hr Exfiltration over Horizontal area**
#2	Secondary	135.95'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=0.45 cfs @ 11.70 hrs HW=129.58' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.45 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=129.50' (Free Discharge)
└**2=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond SIS:

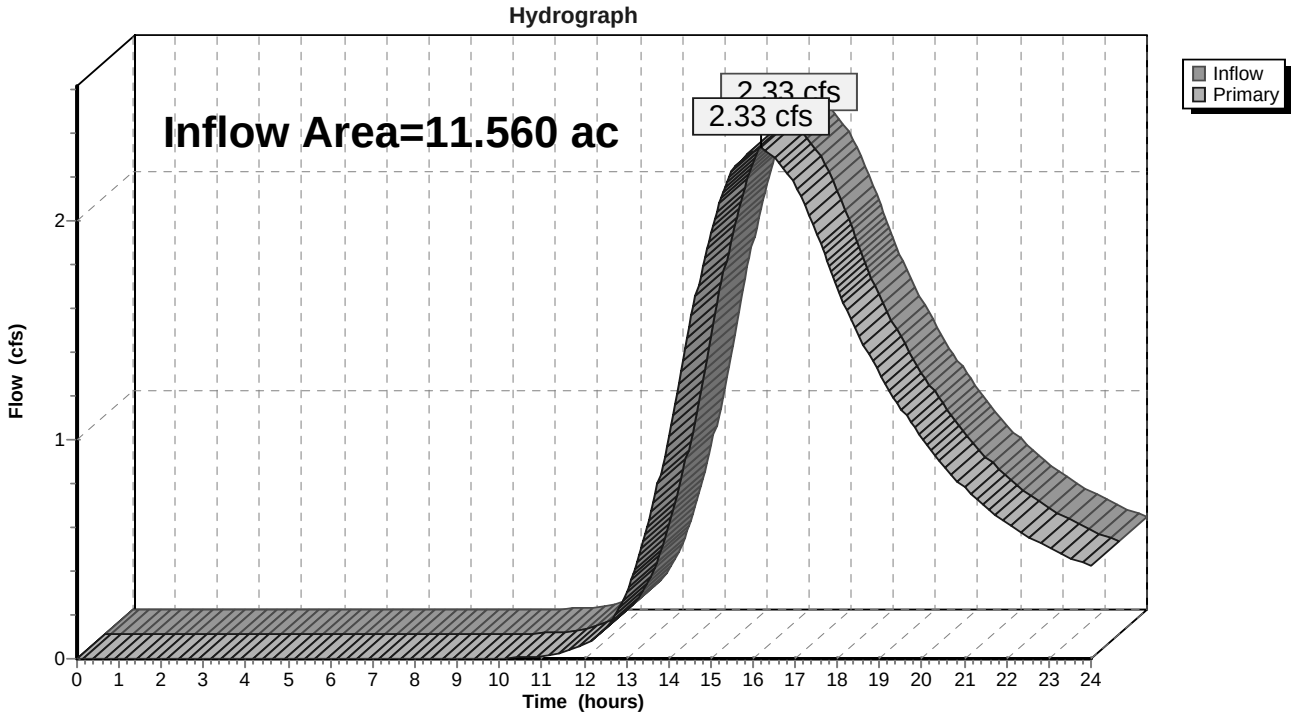

Hydrograph
Inflow Area=2.260 ac
Peak Elev=131.19'
Storage=2,574 cf
2.66 cfs
0.45 cfs
0.45 cfs
0.00 cfs
Inflow
Outflow
Discarded
Secondary
Flow (cfs)
Time (hours)

Summary for Link POA-C1:

Inflow Area = 11.560 ac, 0.00% Impervious, Inflow Depth > 1.20" for 10-Year event
Inflow = 2.33 cfs @ 16.19 hrs, Volume= 1.154 af
Primary = 2.33 cfs @ 16.19 hrs, Volume= 1.154 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link POA-C1:

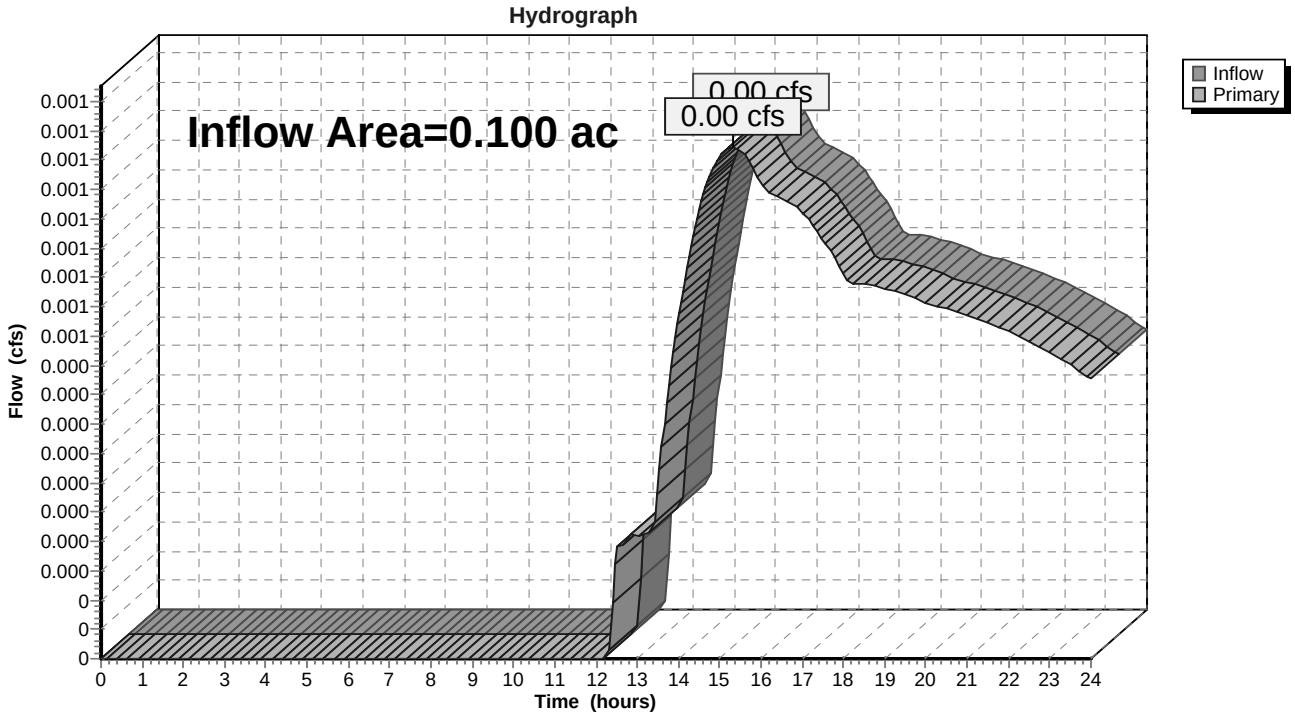


Summary for Link POA-C2:

Inflow Area = 0.100 ac, 0.00% Impervious, Inflow Depth > 0.07" for 10-Year event
Inflow = 0.00 cfs @ 15.32 hrs, Volume= 0.001 af
Primary = 0.00 cfs @ 15.32 hrs, Volume= 0.001 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link POA-C2:



Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment PR-C1: Runoff Area=11.560 ac 0.00% Impervious Runoff Depth>3.10"
Flow Length=2,180' Tc=297.4 min CN=WQ Runoff=5.85 cfs 2.983 af

Subcatchment PR-C2a: Runoff Area=0.970 ac 4.12% Impervious Runoff Depth>1.32"
Tc=6.0 min CN=WQ Runoff=0.87 cfs 0.107 af

Subcatchment PR-C2b: Runoff Area=1.770 ac 7.91% Impervious Runoff Depth>1.60"
Tc=6.0 min CN=WQ Runoff=2.08 cfs 0.235 af

Subcatchment PR-C2c: Runoff Area=0.440 ac 20.45% Impervious Runoff Depth>2.52"
Tc=6.0 min CN=WQ Runoff=0.93 cfs 0.092 af

Subcatchment PR-C2d: Runoff Area=2.260 ac 26.11% Impervious Runoff Depth>3.23"
Flow Length=113' Slope=0.0200 '/' Tc=6.7 min CN=WQ Runoff=6.63 cfs 0.608 af

Subcatchment PR-C2e: Runoff Area=0.010 ac 0.00% Impervious Runoff Depth>1.42"
Tc=6.0 min CN=39 Runoff=0.01 cfs 0.001 af

Subcatchment PR-C2f: Runoff Area=0.090 ac 0.00% Impervious Runoff Depth>1.02"
Tc=6.0 min CN=35 Runoff=0.06 cfs 0.008 af

Pond 1: Depression C2a Peak Elev=138.86' Storage=450 cf Inflow=0.87 cfs 0.107 af
Discarded=0.48 cfs 0.107 af Secondary=0.00 cfs 0.000 af Outflow=0.48 cfs 0.107 af

Pond 2: Depression C2b Peak Elev=137.65' Storage=1,578 cf Inflow=2.08 cfs 0.235 af
Discarded=0.81 cfs 0.235 af Secondary=0.00 cfs 0.000 af Outflow=0.81 cfs 0.235 af

Pond 3: Depression C2c Peak Elev=133.08' Storage=868 cf Inflow=0.93 cfs 0.092 af
Discarded=0.28 cfs 0.092 af Secondary=0.00 cfs 0.000 af Outflow=0.28 cfs 0.092 af

Pond SIS: Peak Elev=135.78' Storage=10,216 cf Inflow=6.63 cfs 0.608 af
Discarded=0.45 cfs 0.569 af Secondary=0.00 cfs 0.000 af Outflow=0.45 cfs 0.569 af

Link POA-C1: Inflow=5.85 cfs 2.983 af
Primary=5.85 cfs 2.983 af

Link POA-C2: Inflow=0.07 cfs 0.009 af
Primary=0.07 cfs 0.009 af

Total Runoff Area = 17.100 ac Runoff Volume = 4.034 af Average Runoff Depth = 2.83"
94.97% Pervious = 16.240 ac 5.03% Impervious = 0.860 ac

Summary for Subcatchment PR-C1:

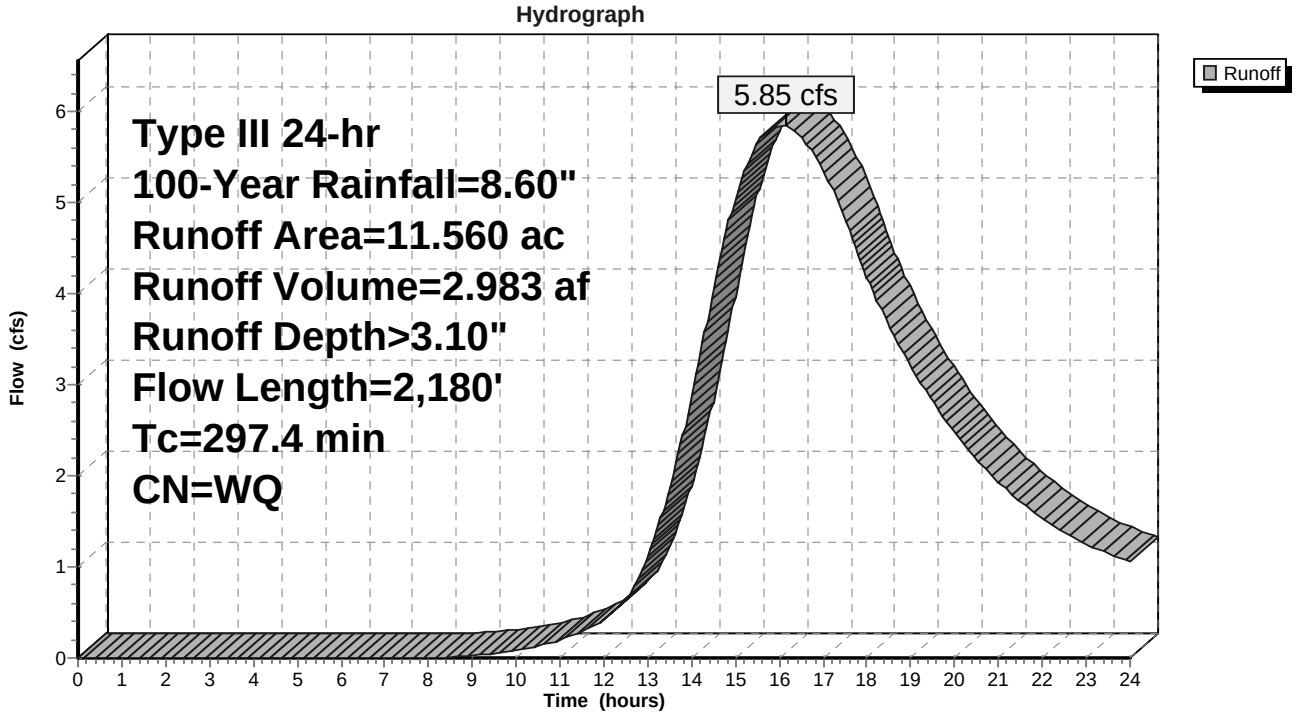
Runoff = 5.85 cfs @ 16.17 hrs, Volume= 2.983 af, Depth> 3.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.60"

	Area (ac)	CN	Description
	0.300	35	Brush, Fair, HSG A
	5.030	30	Woods, Good, HSG A
*	6.230	77	Wetland, HSG D
	11.560		Weighted Average
	11.560		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.1	50	0.0800	0.12		**Sheet Flow, Sheet-Woods** Woods: Light underbrush n= 0.400 P2= 3.20"
3.0	353	0.1500	1.94		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
287.3	1,777	0.0017	0.10		**Shallow Concentrated Flow, Wetland** Forest w/Heavy Litter Kv= 2.5 fps
297.4	2,180	Total			

Subcatchment PR-C1:



Summary for Subcatchment PR-C2a:

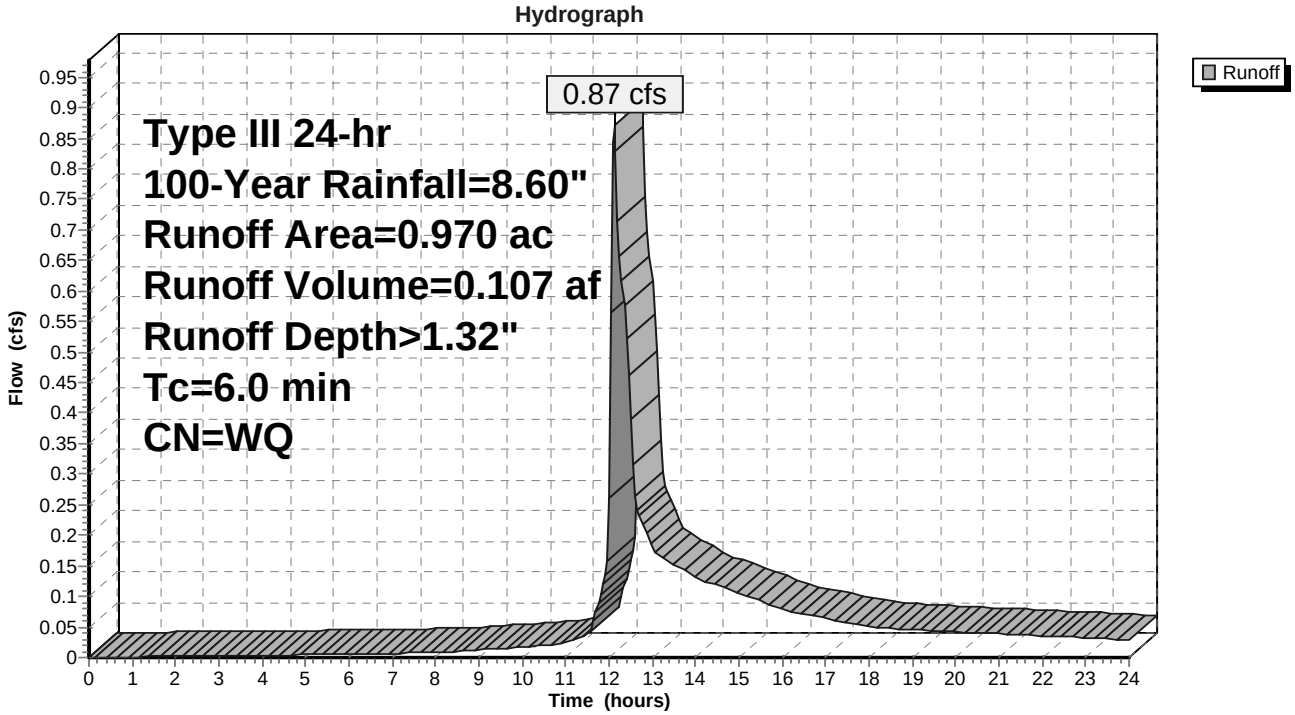
Runoff = 0.87 cfs @ 12.12 hrs, Volume= 0.107 af, Depth> 1.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.60"

	Area (ac)	CN	Description
	0.930	35	Brush, Fair, HSG A
*	0.040	98	Stormwater Depression, HSG A
	0.970		Weighted Average
	0.930		95.88% Pervious Area
	0.040		4.12% Impervious Area

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

Subcatchment PR-C2a:



Summary for Subcatchment PR-C2b:

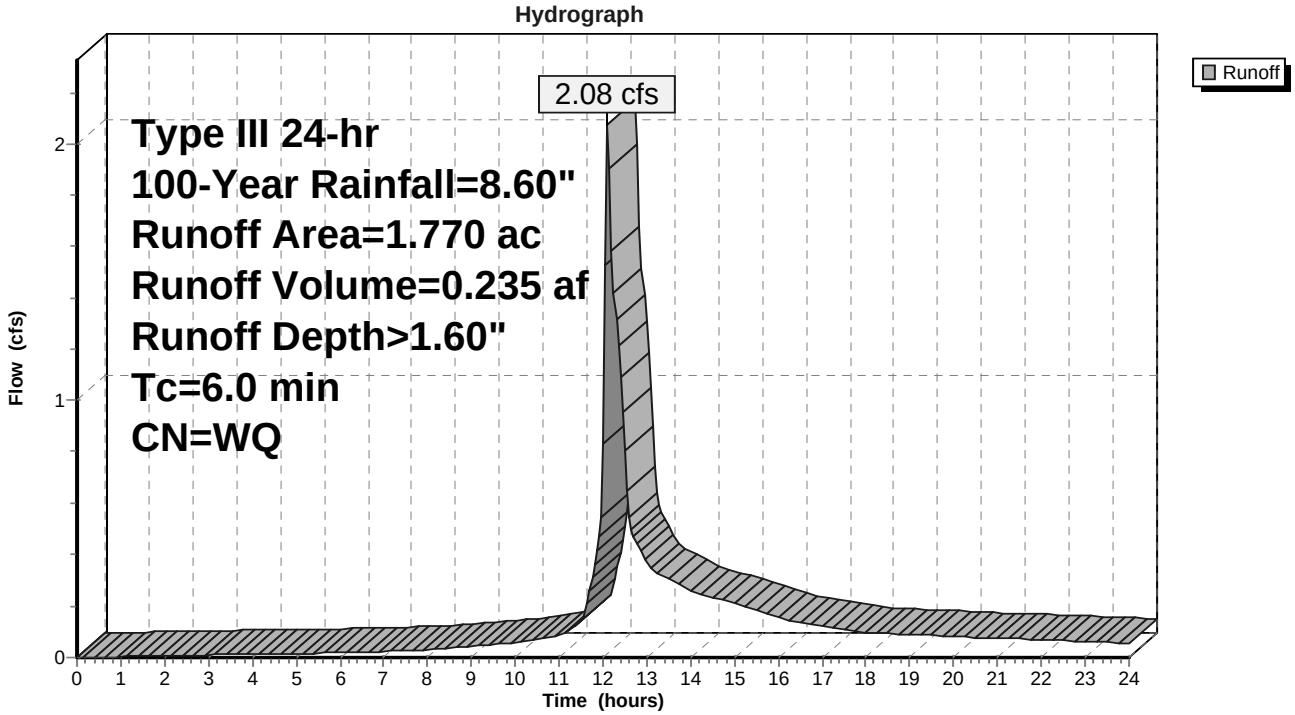
Runoff = 2.08 cfs @ 12.11 hrs, Volume= 0.235 af, Depth> 1.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.60"

	Area (ac)	CN	Description
	1.630	35	Brush, Fair, HSG A
*	0.140	98	Stormwater Depression, HSG A
	1.770		Weighted Average
	1.630		92.09% Pervious Area
	0.140		7.91% Impervious Area

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

Subcatchment PR-C2b:



Summary for Subcatchment PR-C2c:

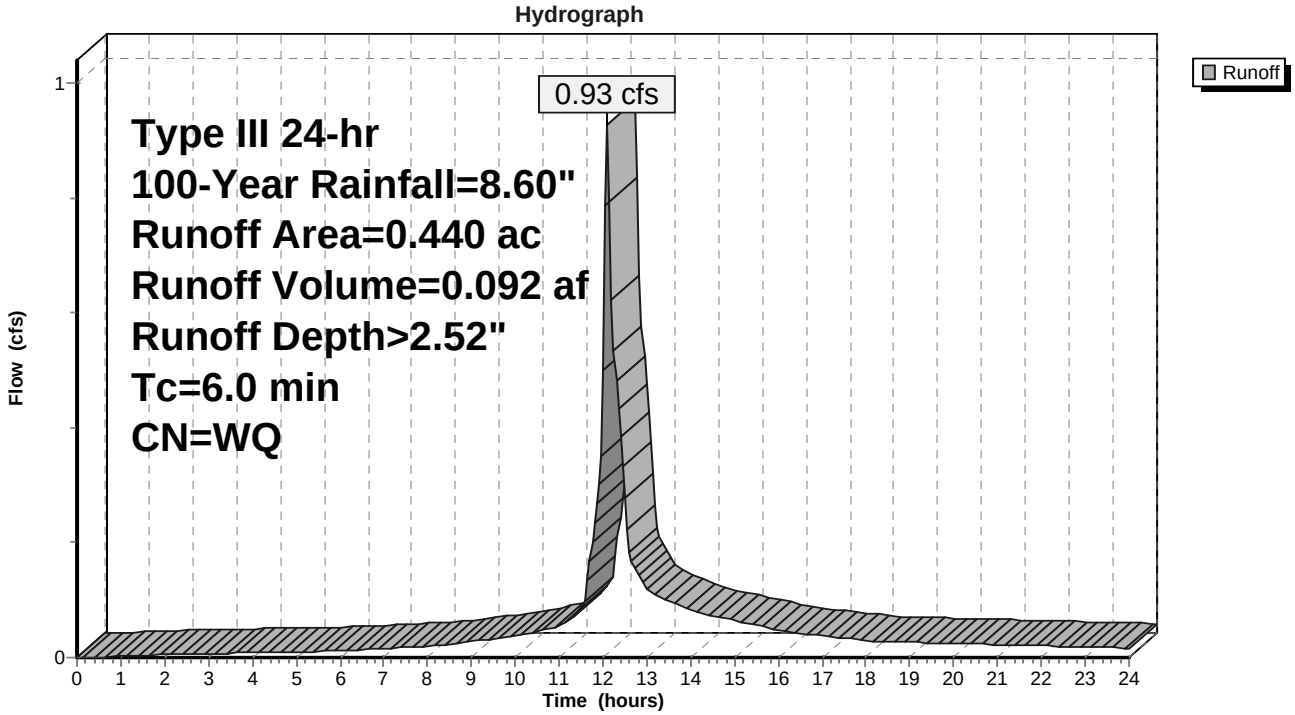
Runoff = 0.93 cfs @ 12.10 hrs, Volume= 0.092 af, Depth> 2.52"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.60"

	Area (ac)	CN	Description
	0.350	35	Brush, Fair, HSG A
*	0.090	98	Stormwater Depression, HSG A
	0.440		Weighted Average
	0.350		79.55% Pervious Area
	0.090		20.45% Impervious Area

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

Subcatchment PR-C2c:



Summary for Subcatchment PR-C2d:

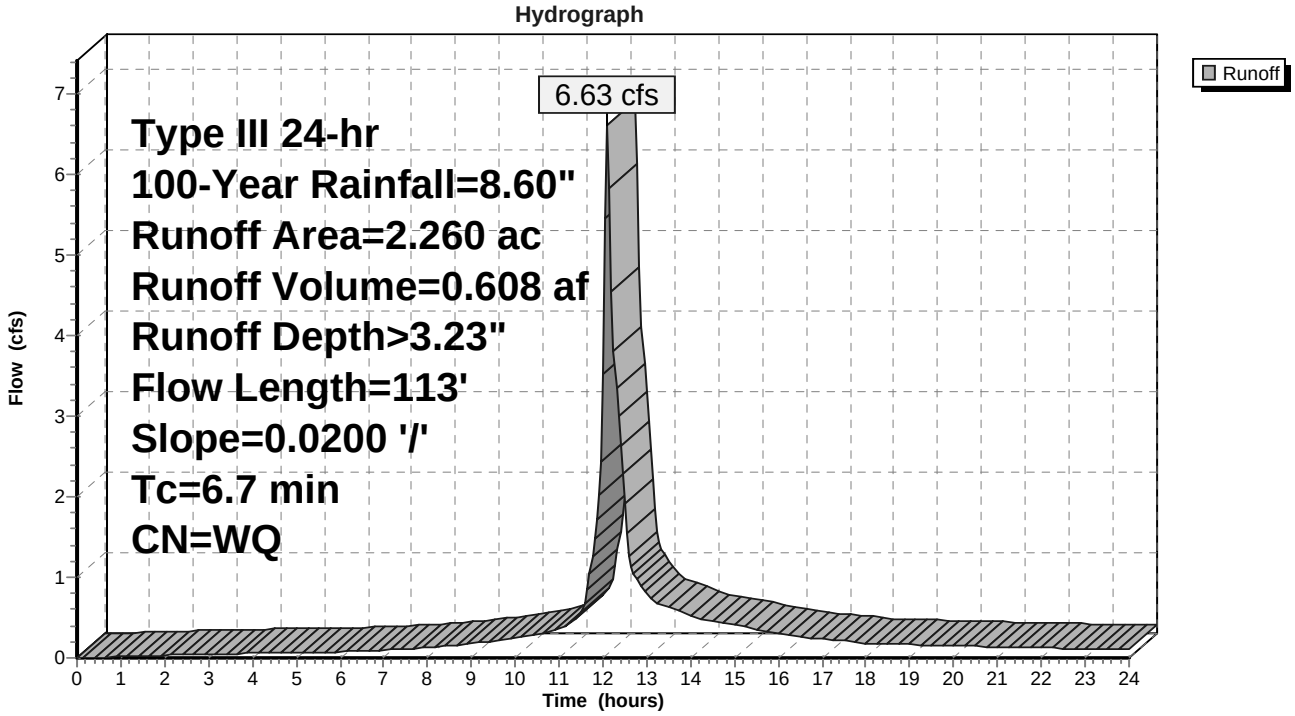
Runoff = 6.63 cfs @ 12.10 hrs, Volume= 0.608 af, Depth> 3.23"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.60"

Area (ac)	CN	Description
1.670	39	>75% Grass cover, Good, HSG A
0.590	98	Paved roads w/curbs & sewers, HSG A
2.260		Weighted Average
1.670		73.89% Pervious Area
0.590		26.11% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.0200	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
1.1	63	0.0200	0.99		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
6.7	113	Total			

Subcatchment PR-C2d:



Summary for Subcatchment PR-C2e:

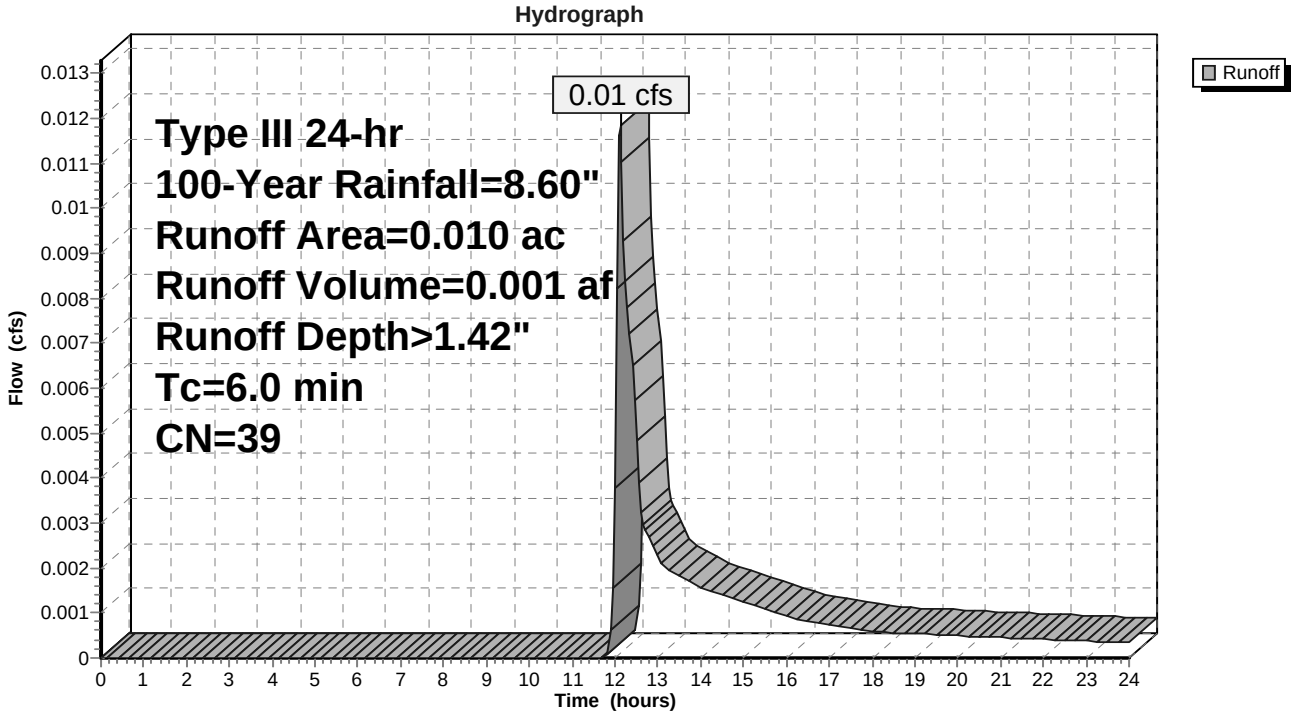
Runoff = 0.01 cfs @ 12.12 hrs, Volume= 0.001 af, Depth> 1.42"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.60"

Area (ac)	CN	Description
0.010	39	>75% Grass cover, Good, HSG A
0.010		100.00% Pervious Area

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

Subcatchment PR-C2e:



Summary for Subcatchment PR-C2f:

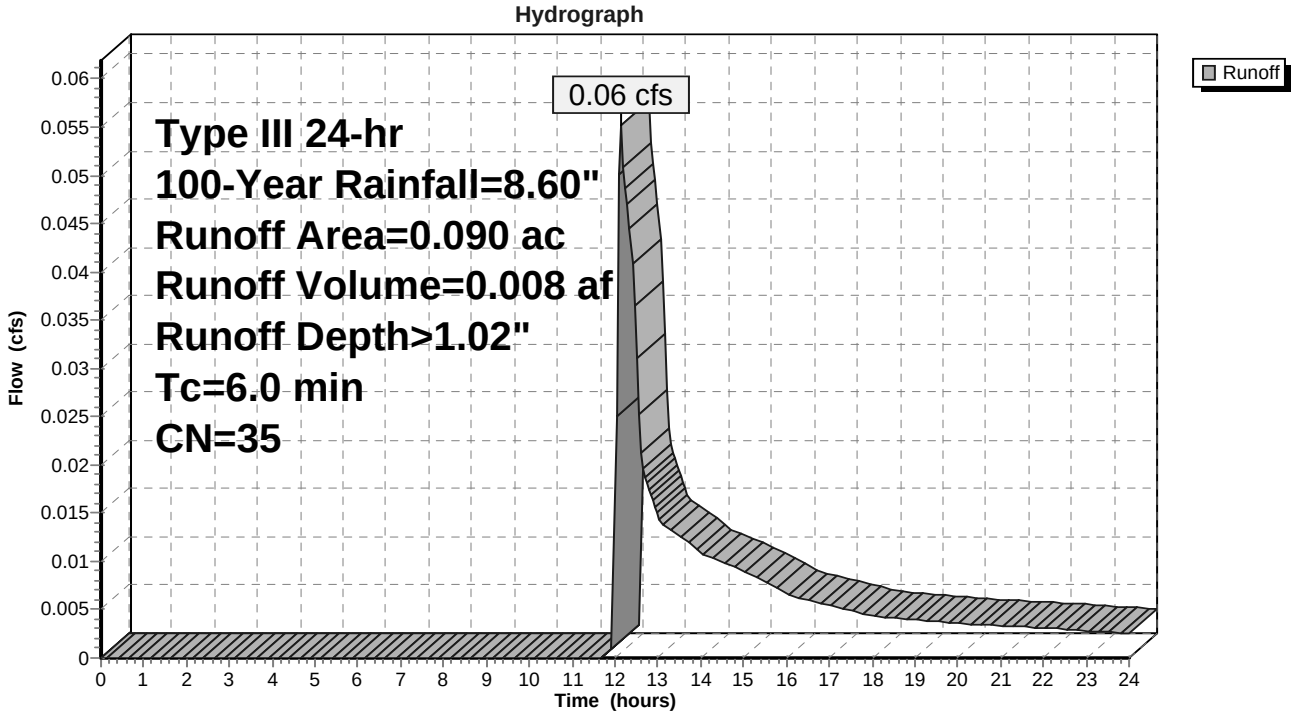
Runoff = 0.06 cfs @ 12.15 hrs, Volume= 0.008 af, Depth> 1.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.60"

Area (ac)	CN	Description
0.090	35	Brush, Fair, HSG A
0.090		100.00% Pervious Area

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

Subcatchment PR-C2f:



Summary for Pond 1: Depression C2a

Inflow Area =	0.970 ac,	4.12% Impervious,	Inflow Depth >	1.32"	for 100-Year event
Inflow =	0.87 cfs @	12.12 hrs,	Volume=	0.107 af	
Outflow =	0.48 cfs @	12.44 hrs,	Volume=	0.107 af,	Atten= 45%, Lag= 18.8 min
Discarded =	0.48 cfs @	12.44 hrs,	Volume=	0.107 af	
Secondary =	0.00 cfs @	0.00 hrs,	Volume=	0.000 af	

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 138.86' @ 12.44 hrs Surf.Area= 2,498 sf Storage= 450 cf

Plug-Flow detention time= 6.2 min calculated for 0.107 af (100% of inflow)
Center-of-Mass det. time= 6.0 min (882.3 - 876.3)

Volume	Invert	Avail.Storage	Storage Description
#1	138.50'	3,468 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

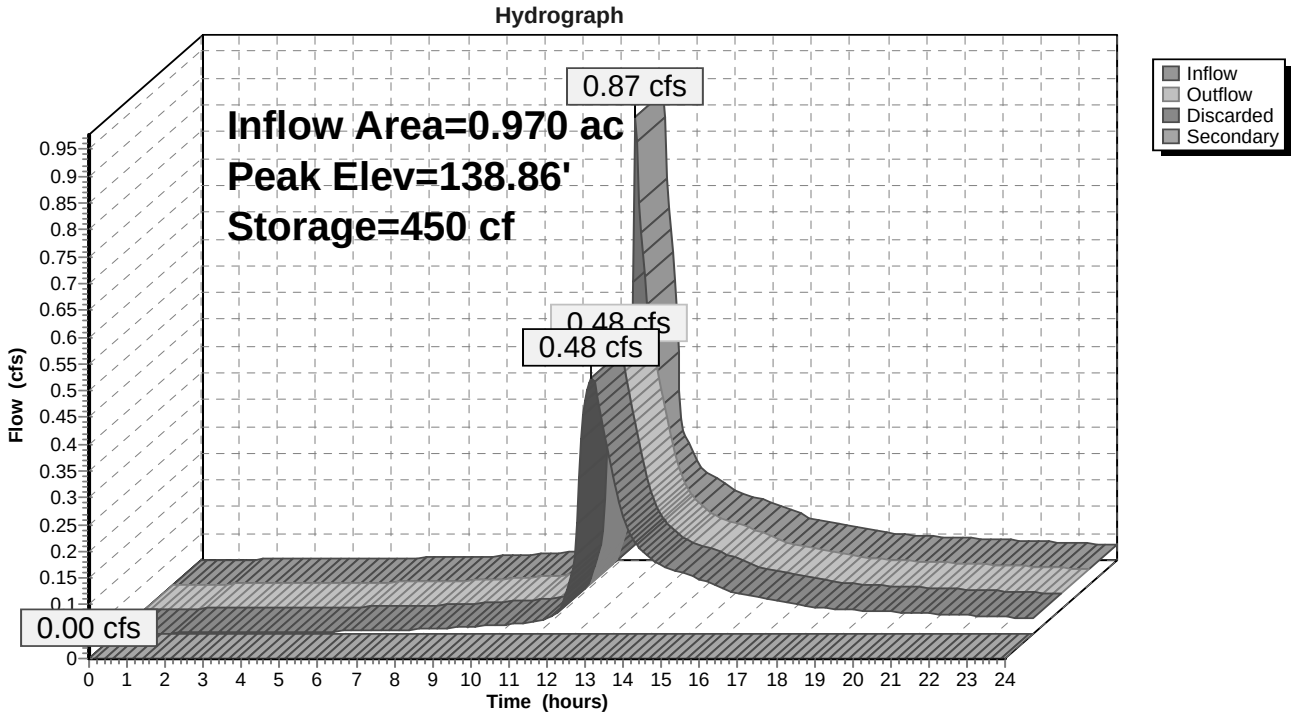
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
138.50	1	0	0
139.50	6,935	3,468	3,468

Device	Routing	Invert	Outlet Devices
#1	Discarded	138.50'	**8.270 in/hr Exfiltration over Horizontal area**
#2	Secondary	139.25'	**75.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Discarded OutFlow Max=0.48 cfs @ 12.44 hrs HW=138.86' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.48 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=138.50' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1: Depression C2a



Summary for Pond 2: Depression C2b

Inflow Area =	1.770 ac,	7.91% Impervious,	Inflow Depth >	1.60"	for 100-Year event
Inflow =	2.08 cfs @	12.11 hrs,	Volume=	0.235 af	
Outflow =	0.81 cfs @	12.50 hrs,	Volume=	0.235 af,	Atten= 61%, Lag= 23.1 min
Discarded =	0.81 cfs @	12.50 hrs,	Volume=	0.235 af	
Secondary =	0.00 cfs @	0.00 hrs,	Volume=	0.000 af	

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 137.65' @ 12.50 hrs Surf.Area= 4,219 sf Storage= 1,578 cf

Plug-Flow detention time= 14.5 min calculated for 0.235 af (100% of inflow)
Center-of-Mass det. time= 14.1 min (862.2 - 848.1)

Volume	Invert	Avail.Storage	Storage Description
#1	136.90'	7,221 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

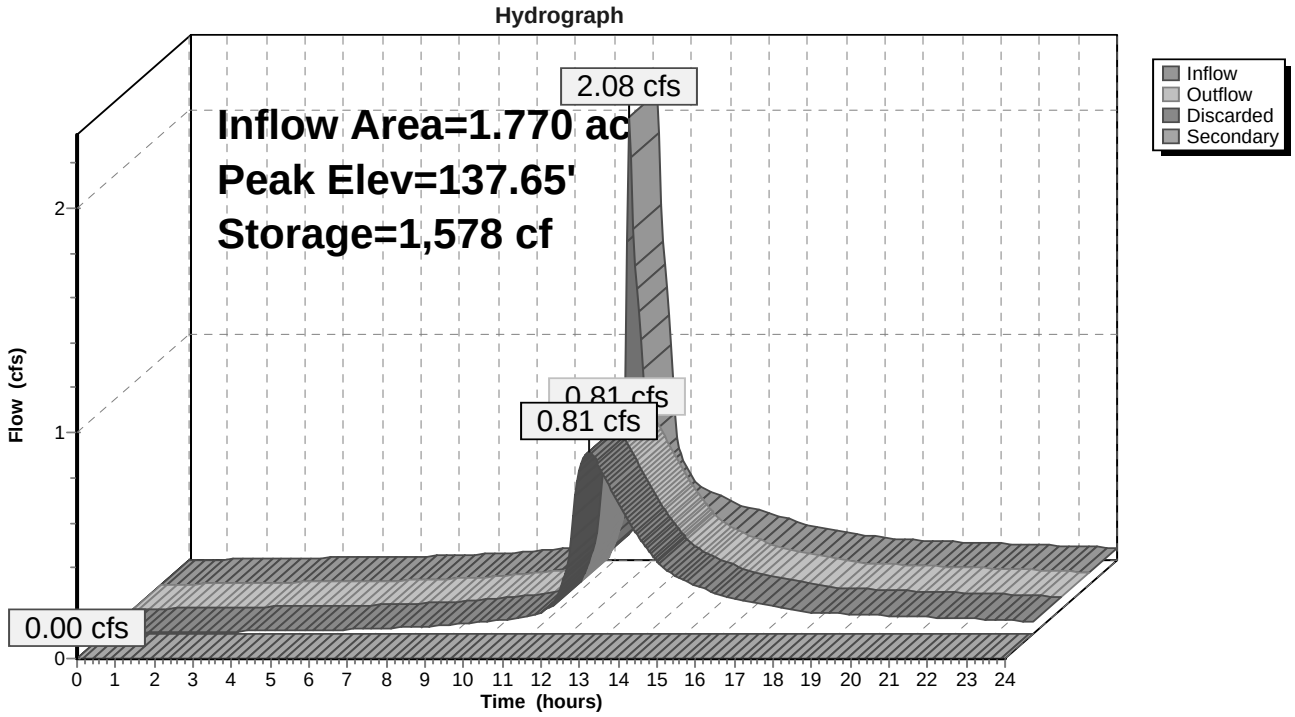
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
136.90	1	0	0
138.50	9,025	7,221	7,221

Device	Routing	Invert	Outlet Devices
#1	Discarded	136.90'	**8.270 in/hr Exfiltration over Horizontal area**
#2	Secondary	138.30'	**15.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Discarded OutFlow Max=0.81 cfs @ 12.50 hrs HW=137.65' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.81 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=136.90' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2: Depression C2b



Summary for Pond 3: Depression C2c

Inflow Area =	0.440 ac, 20.45% Impervious, Inflow Depth > 2.52" for 100-Year event				
Inflow =	0.93 cfs @	12.10 hrs,	Volume=	0.092 af	
Outflow =	0.28 cfs @	12.50 hrs,	Volume=	0.092 af,	Atten= 70%, Lag= 23.9 min
Discarded =	0.28 cfs @	12.50 hrs,	Volume=	0.092 af	
Secondary =	0.00 cfs @	0.00 hrs,	Volume=	0.000 af	

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 133.08' @ 12.50 hrs Surf.Area= 1,458 sf Storage= 868 cf

Plug-Flow detention time= 30.7 min calculated for 0.092 af (99% of inflow)
Center-of-Mass det. time= 26.6 min (825.8 - 799.2)

Volume	Invert	Avail.Storage	Storage Description
#1	131.40'	25,709 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

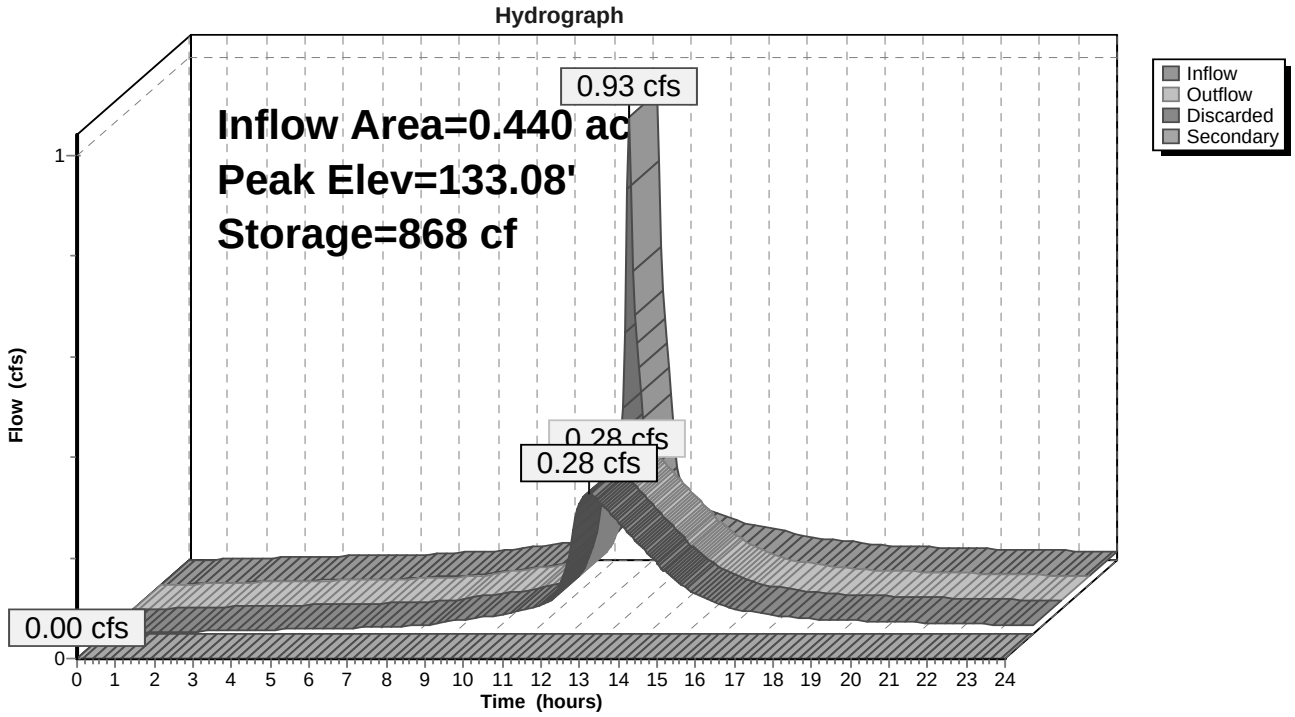
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
131.40	1	0	0
132.00	99	30	30
138.30	8,053	25,679	25,709

Device	Routing	Invert	Outlet Devices
#1	Discarded	131.40'	**8.270 in/hr Exfiltration over Horizontal area**
#2	Secondary	138.10'	**25.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Discarded OutFlow Max=0.28 cfs @ 12.50 hrs HW=133.08' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.28 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=131.40' (Free Discharge)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 3: Depression C2c



Summary for Pond SIS:

Inflow Area = 2.260 ac, 26.11% Impervious, Inflow Depth > 3.23" for 100-Year event
Inflow = 6.63 cfs @ 12.10 hrs, Volume= 0.608 af
Outflow = 0.45 cfs @ 11.30 hrs, Volume= 0.569 af, Atten= 93%, Lag= 0.0 min
Discarded = 0.45 cfs @ 11.30 hrs, Volume= 0.569 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 135.78' @ 14.66 hrs Surf.Area= 2,329 sf Storage= 10,216 cf

Plug-Flow detention time= 203.0 min calculated for 0.568 af (93% of inflow)
Center-of-Mass det. time= 167.4 min (960.6 - 793.2)

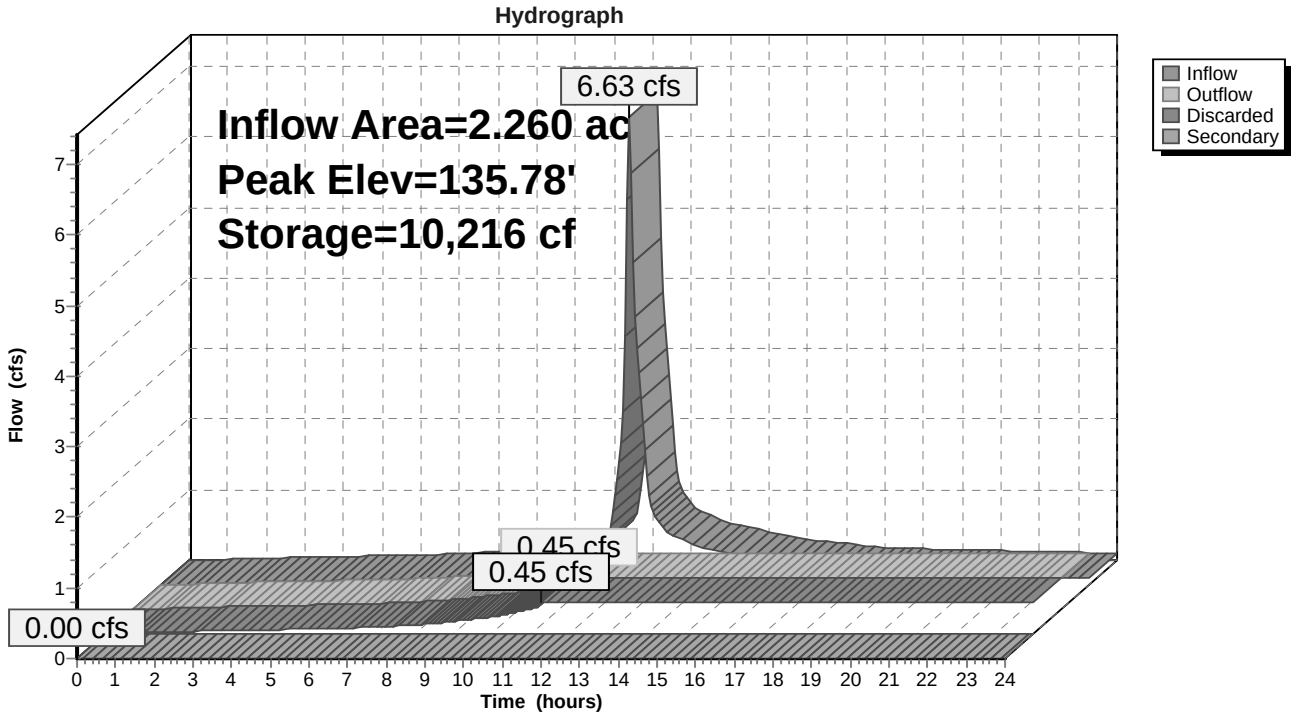
Volume	Invert	Avail.Storage	Storage Description
#1	129.50'	2,043 cf	**17.00'W x 137.00'L x 6.50'H Prismatoid**
			15,139 cf Overall - 8,330 cf Embedded = 6,809 cf x 30.0% Voids
#2	130.00'	8,330 cf	**7.00'W x 7.00'L x 5.00'H Prismatoid** x 34 Inside #1
		10,373 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	129.50'	**8.270 in/hr Exfiltration over Horizontal area**
#2	Secondary	135.95'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=0.45 cfs @ 11.30 hrs HW=129.57' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.45 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=129.50' (Free Discharge)
└**2=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond SIS:

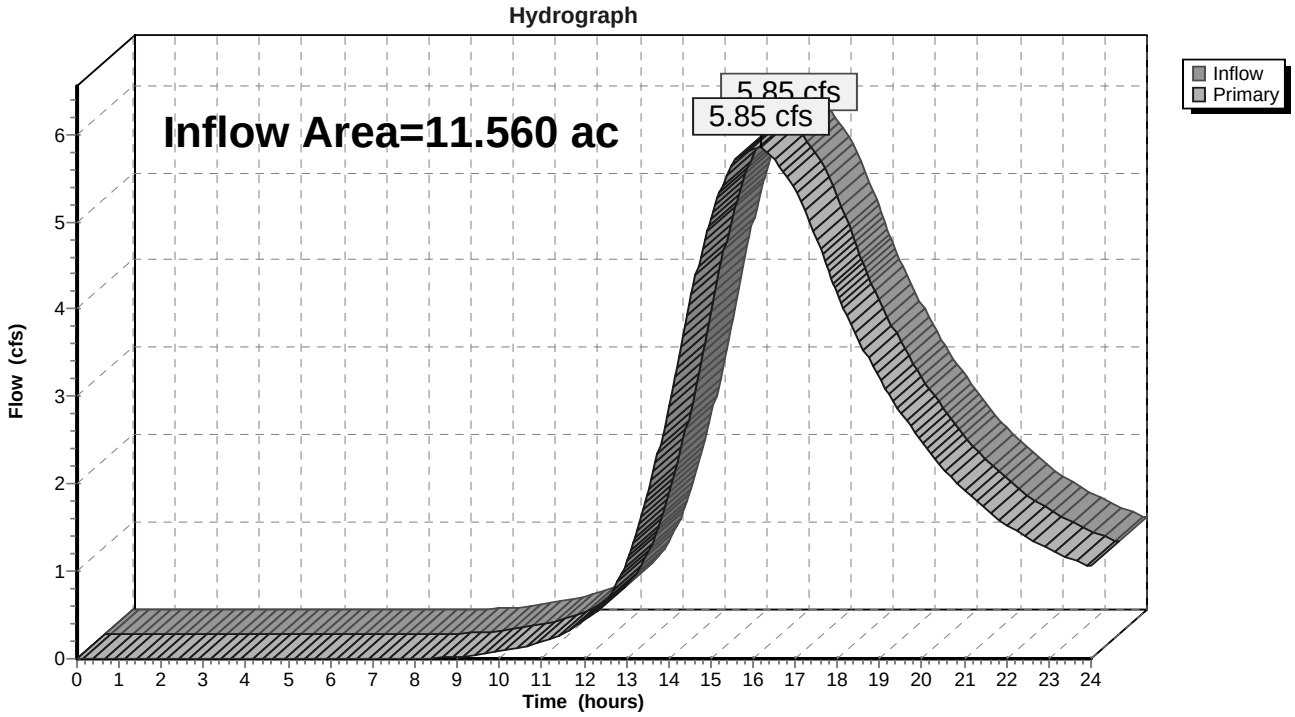

Hydrograph
Inflow Area=2.260 ac
Peak Elev=135.78'
Storage=10,216 cf
6.63 cfs
0.45 cfs
0.45 cfs
0.00 cfs
Inflow
Outflow
Discarded
Secondary
Flow (cfs)
Time (hours)

Summary for Link POA-C1:

Inflow Area = 11.560 ac, 0.00% Impervious, Inflow Depth > 3.10" for 100-Year event
Inflow = 5.85 cfs @ 16.17 hrs, Volume= 2.983 af
Primary = 5.85 cfs @ 16.17 hrs, Volume= 2.983 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link POA-C1:

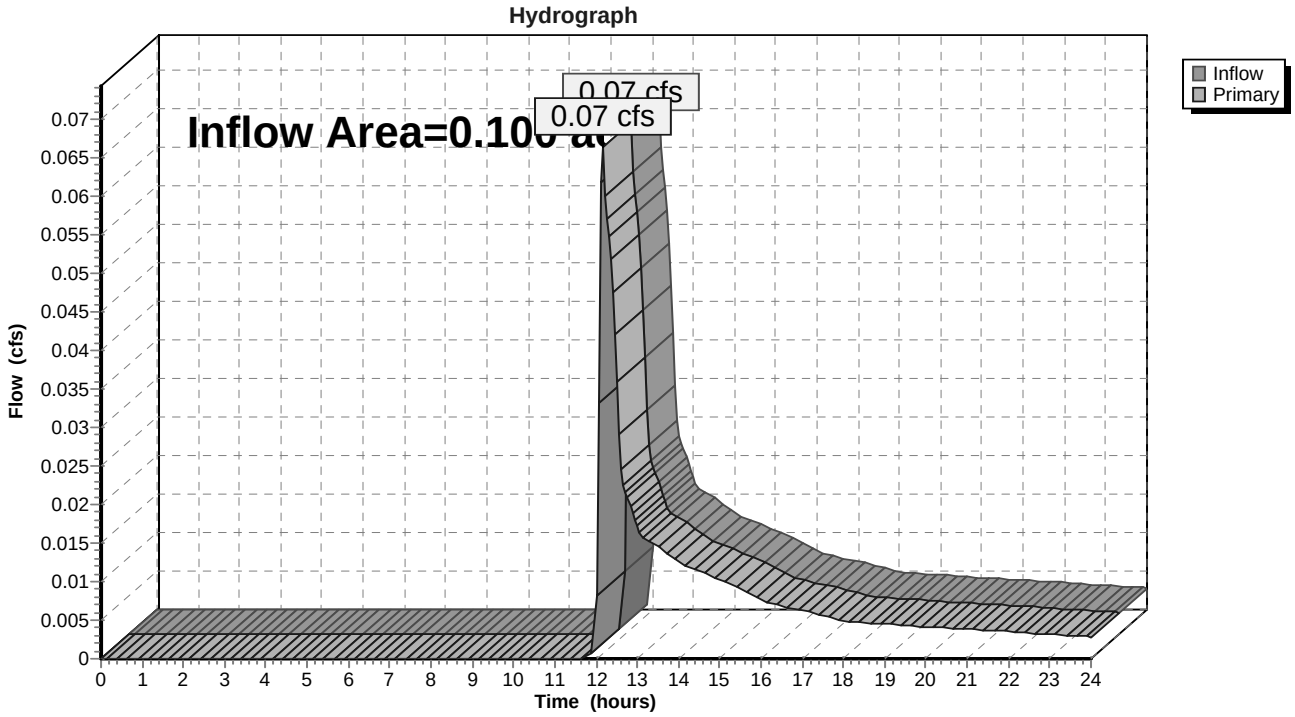


Summary for Link POA-C2:

Inflow Area = 0.100 ac, 0.00% Impervious, Inflow Depth > 1.06" for 100-Year event
Inflow = 0.07 cfs @ 12.15 hrs, Volume= 0.009 af
Primary = 0.07 cfs @ 12.15 hrs, Volume= 0.009 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link POA-C2:



TEST PIT LOG

Site: Melone Quarry, North Road, Sudbury, MA
Logged By: Matthew Leidner, P.E., Civil Design Group, LLC
Excavator: Maurer

Test Pit Number: TP-SIS-10A (Hole #) | 04-28-2020 (Date) | 0830 (Time) | Cloudy, 50 deg. F (Weather) | _____ (Latitude) | _____ (Longitude:)

Land Use: Former Sand & Gravel Pit (e.g., woodland, agricultural field, vacant lot, etc.) | Bare ground w/some brush (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | <5 (Slope (%))

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

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-36	C1	COS	10YR 5/4	X	X	X	25	0	GRANULAR	LOOSE	X
36-132	C2	S	10YR 5/4	X	X	X	5	0	GRANULAR	LOOSE	X

Additional Notes:
No ledge encountered.

TEST PIT LOG

Site: Melone Quarry, North Road, Sudbury, MA
Logged By: Matthew Leidner, P.E., Civil Design Group, LLC
Excavator: Maurer

Test Pit Number: TP-SIS-10B (Hole #) | 04-28-2020 (Date) | 0830 (Time) | Cloudy, 50 deg. F (Weather) | _____ (Latitude) | _____ (Longitude:)

Land Use: Former Sand & Gravel Pit (e.g., woodland, agricultural field, vacant lot, etc.) | Bare ground w/some brush (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | <5 (Slope (%))

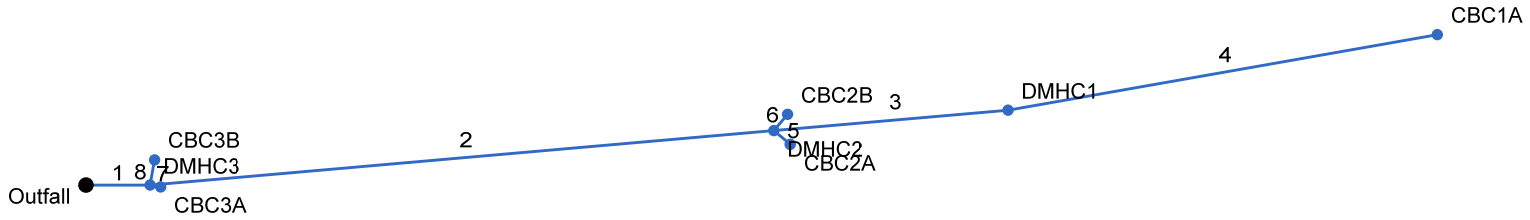
Groundwater Observed: ☐ Yes ☒ No If yes: _____ Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-132	C	COS	10YR 5/4	X	X	X	20	0	GRANULAR	LOOSE	X

Additional Notes:
No ledge encountered.

Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan



Project File: System-1.stm	Number of lines: 8	Date: 8/31/2020

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr Line No.	Line Length (ft)	Defl angle (deg)	Junc Type	Known Q (cfs)	Drng Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Invert El Dn (ft)	Line Slope (%)	Invert El Up (ft)	Line Size (in)	Line Shape	N Value (n)	J-Loss Coeff (K)	Inlet/ Rim El (ft)	
1	End	30.000	0.000	MH	0.00	0.00	0.00	6.0	132.00	6.67	134.00	12	Cir	0.011	0.99	142.55	DMHC3-SIS
2	1	293.000	-5.000	MH	0.00	0.00	0.00	6.0	137.50	4.33	150.20	12	Cir	0.011	0.75	155.37	DMHC2-DMHC3
3	2	110.000	0.000	MH	0.00	0.00	0.00	6.0	151.30	1.09	152.50	12	Cir	0.011	0.15	156.62	DMHC1-DMHC2
4	3	204.000	-5.000	Grate	0.00	0.04	0.90	6.0	152.60	0.93	154.50	12	Cir	0.011	1.00	158.20	CB1A-DMHC1
5	2	10.000	45.000	Grate	0.00	0.21	0.90	6.0	151.30	3.00	151.60	12	Cir	0.011	1.00	155.35	CB2A-DMHC2
6	2	10.000	-45.000	Grate	0.00	0.39	0.90	6.0	151.30	3.00	151.60	12	Cir	0.011	1.00	155.35	CB2B-DMHC2
7	1	5.000	10.000	Grate	0.00	0.17	0.90	6.0	138.50	4.00	138.70	12	Cir	0.011	1.00	142.79	CB3A-DMHC3
8	1	12.000	-80.000	Grate	0.00	0.52	0.90	6.0	138.50	1.67	138.70	12	Cir	0.011	1.00	142.79	CB3B-DMHC3

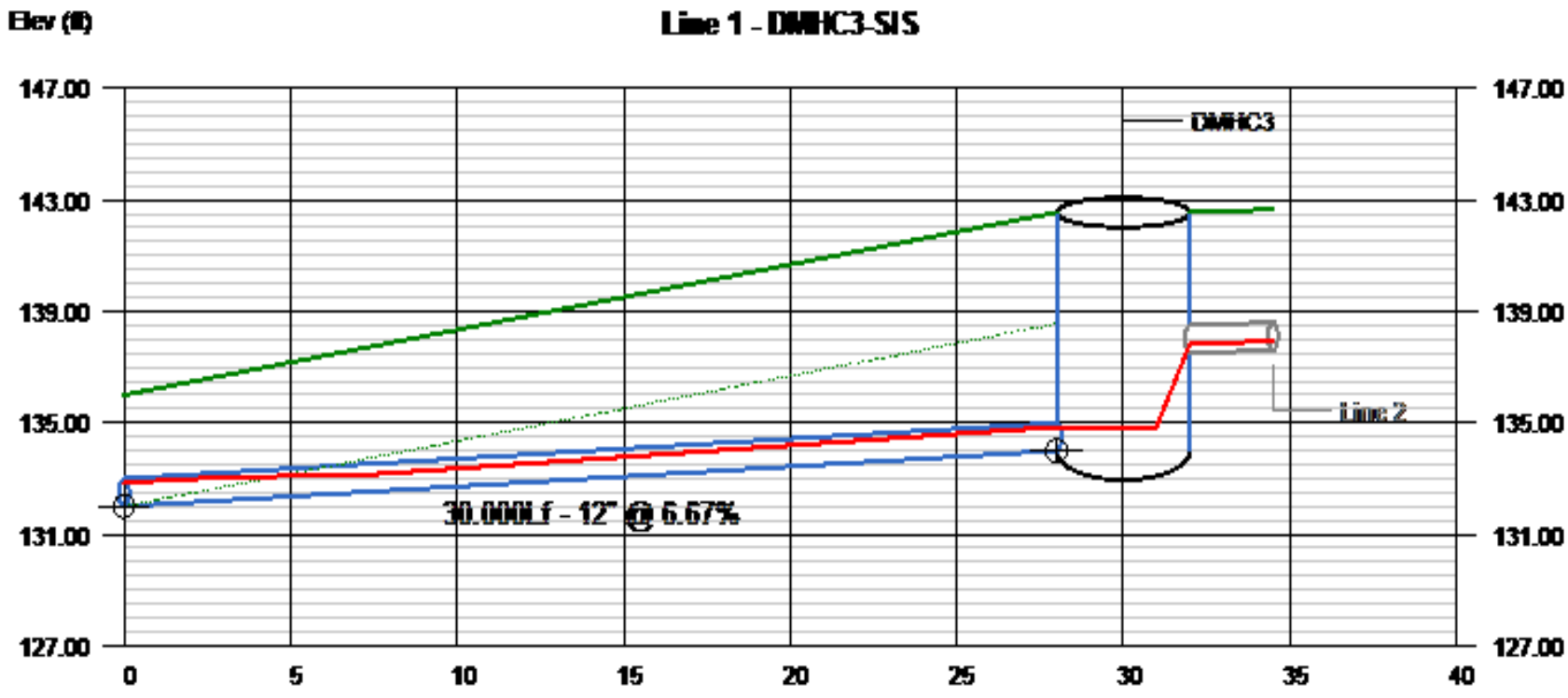
Project File: System-1.stm | Number of lines: 8 | Date: 8/31/2020

Storm Sewer Summary Report

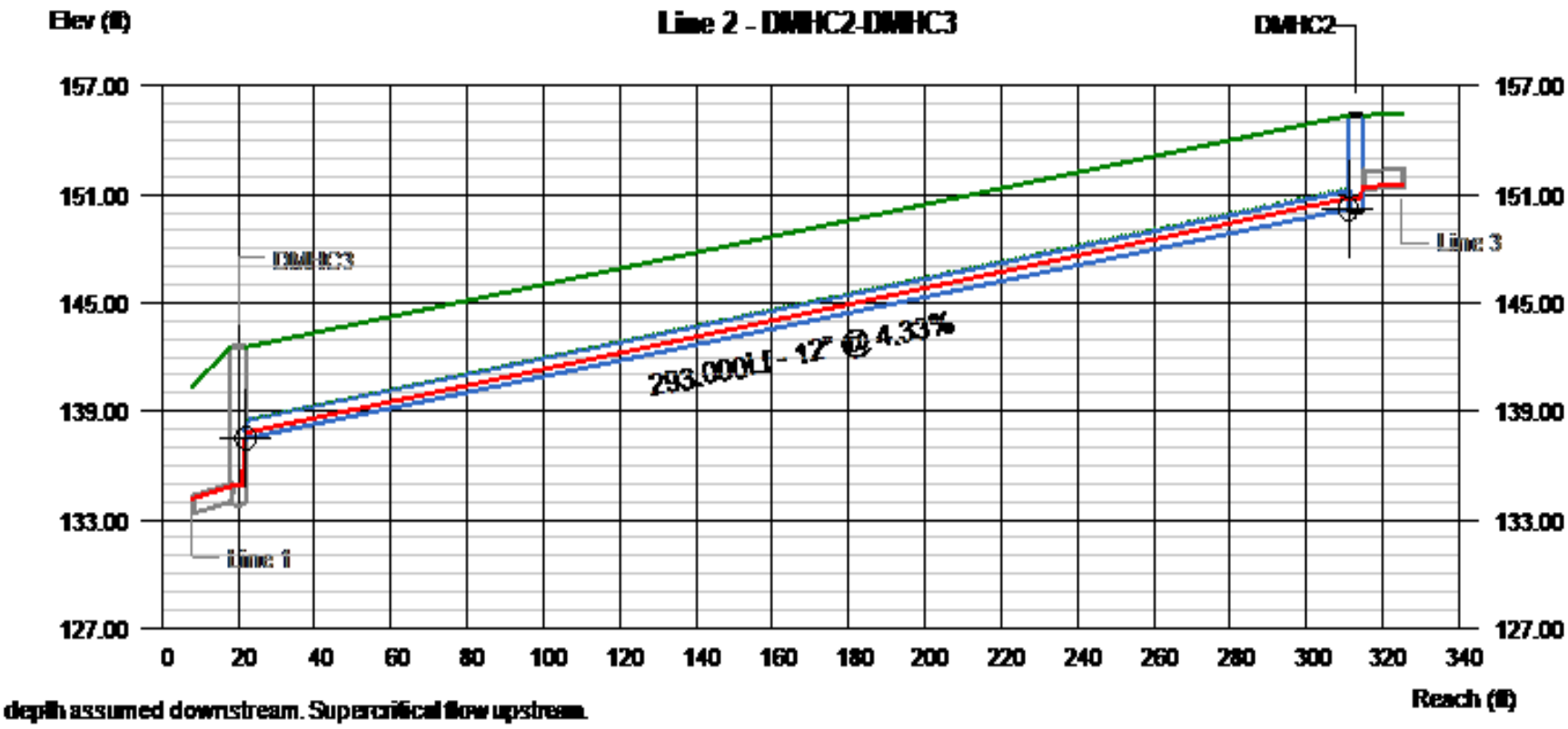
Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line Slope (%)	HGL Down (ft)	HGL Up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns Line No.	Junction Type
1	DMHC3-SIS	4.02	12	Cir	30.000	132.00	134.00	6.667	132.85	134.85	n/a	134.85 j	End	Manhole
2	DMHC2-DMHC3	1.98	12	Cir	293.000	137.50	150.20	4.334	137.82	150.80	n/a	150.80	1	Manhole
3	DMHC1-DMHC2	0.15	12	Cir	110.000	151.30	152.50	1.091	151.43	152.66	n/a	152.66	2	Manhole
4	CB1A-DMHC1	0.22	12	Cir	204.000	152.60	154.50	0.931	152.76	154.69	n/a	154.69	3	Grate
5	CB2A-DMHC2	1.16	12	Cir	10.000	151.30	151.60	3.000	151.57	152.05	n/a	152.05	2	Grate
6	CB2B-DMHC2	2.16	12	Cir	10.000	151.30	151.60	3.000	151.67	152.23	0.27	152.23	2	Grate
7	CB3A-DMHC3	0.94	12	Cir	5.000	138.50	138.70	4.000	138.73	139.11	n/a	139.11	1	Grate
8	CB3B-DMHC3	2.88	12	Cir	12.000	138.50	138.70	1.667	139.02	139.43	n/a	139.43	1	Grate

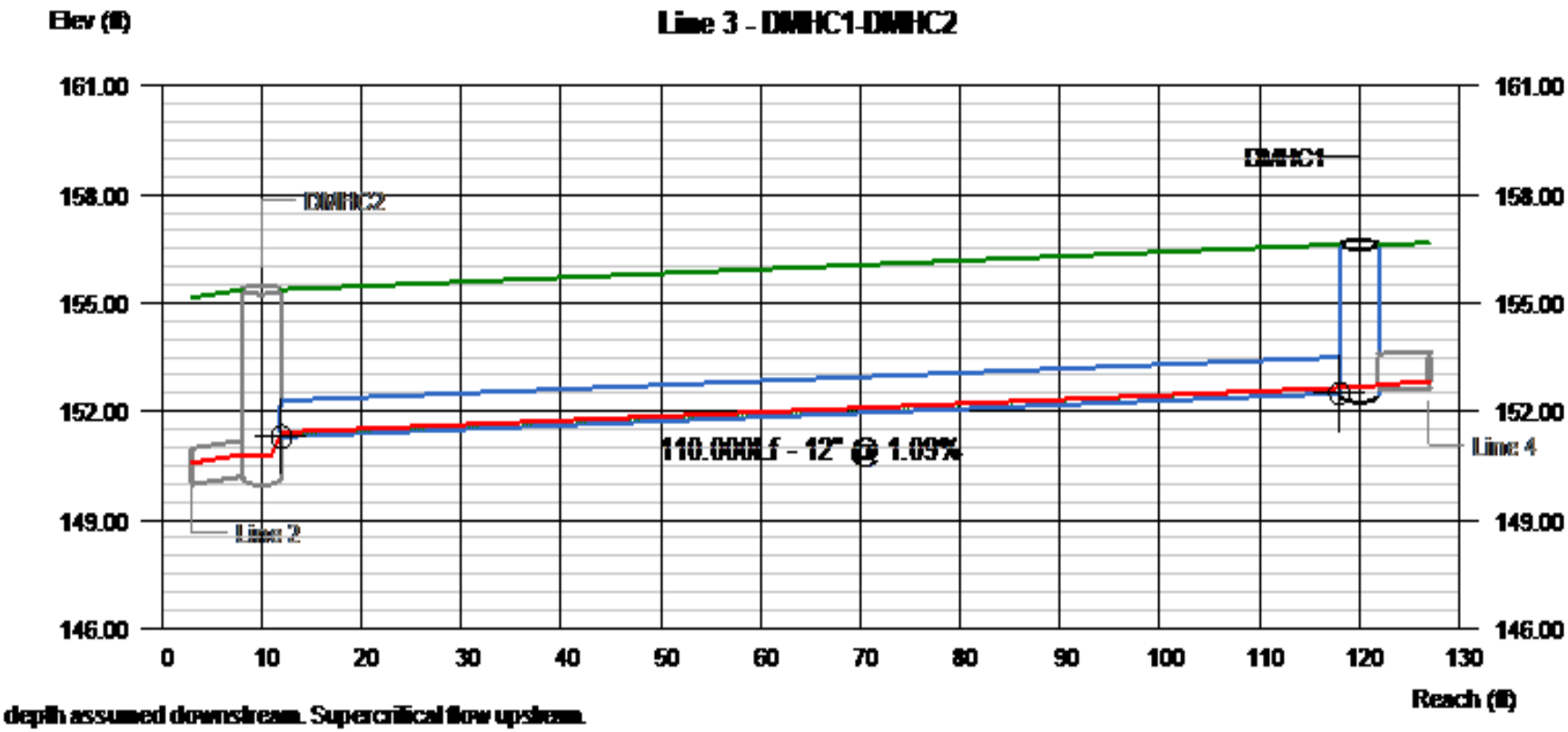
Project File: System-1.stm | Number of lines: 8 | Run Date: 8/31/2020

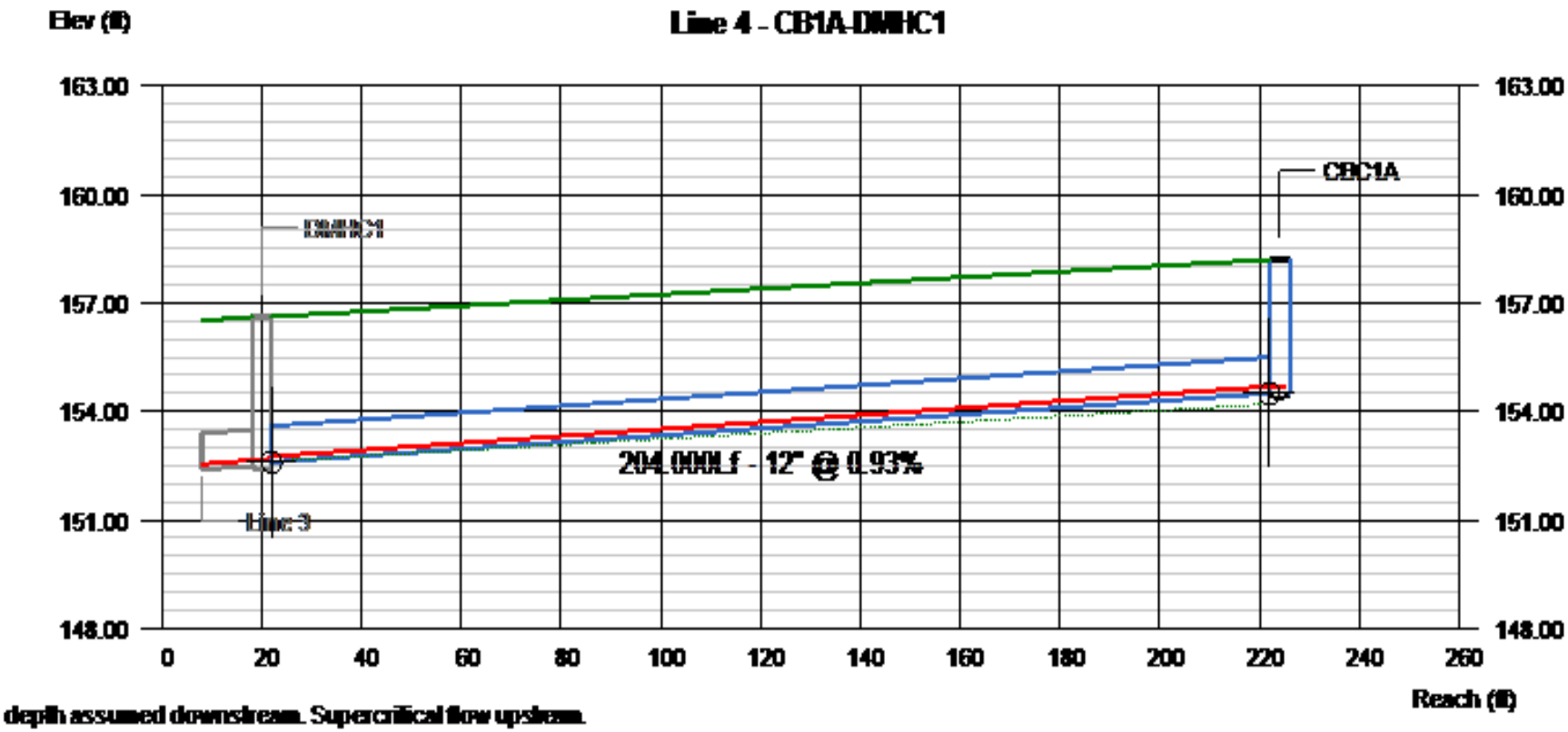
NOTES: Return period = 25 Yrs. ; j - Line contains hyd. jump.

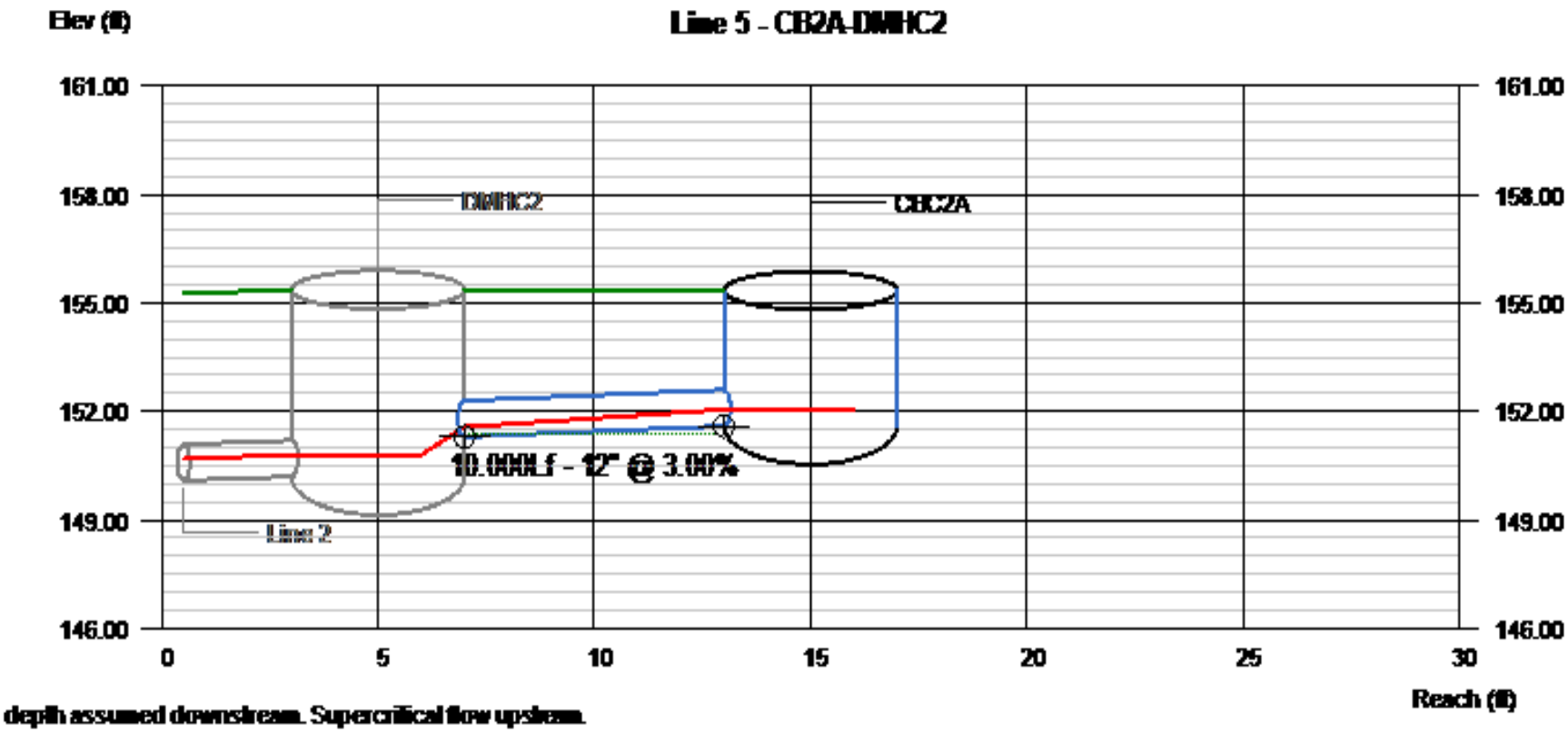


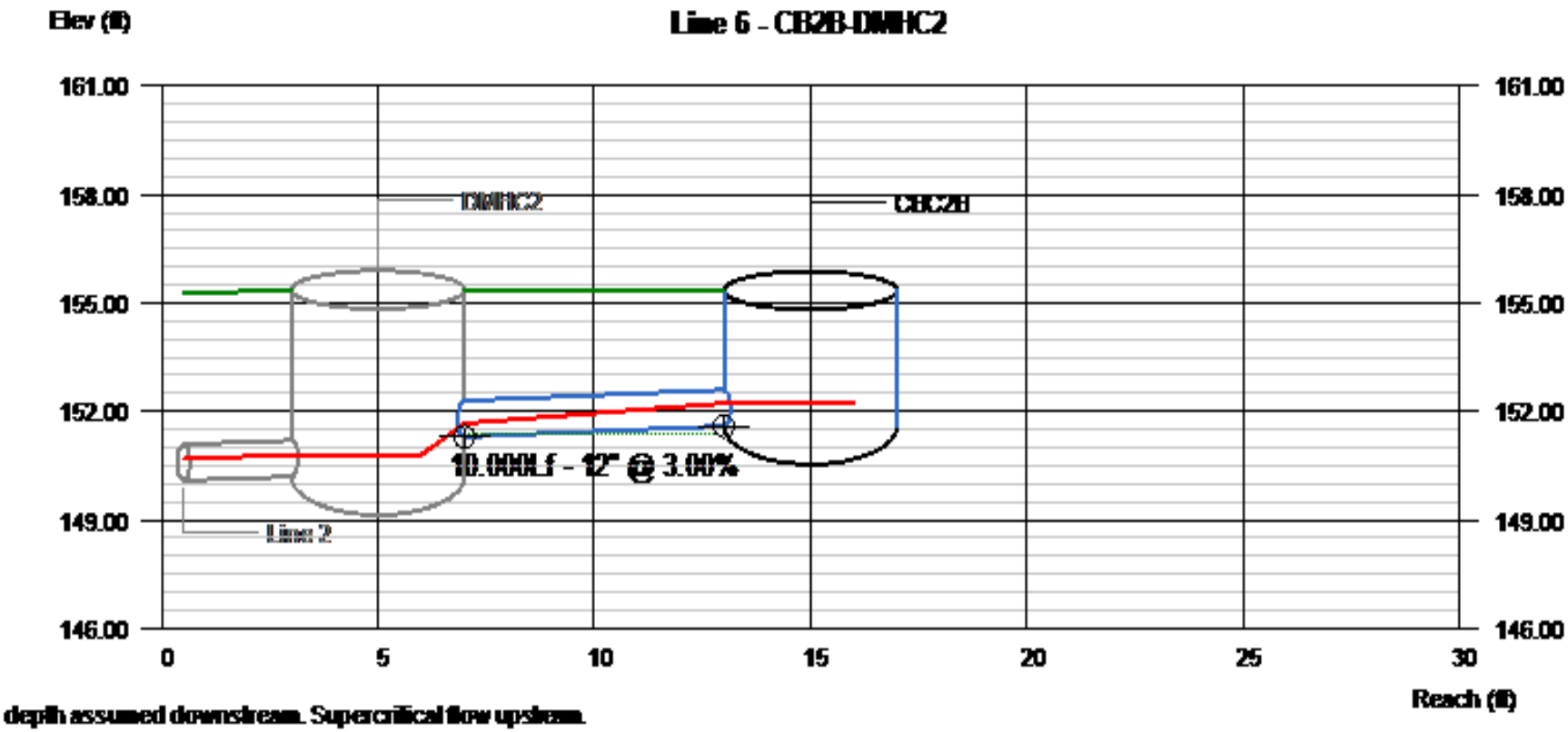
Starting HGL = 132.85. Supercritical flow upstream.

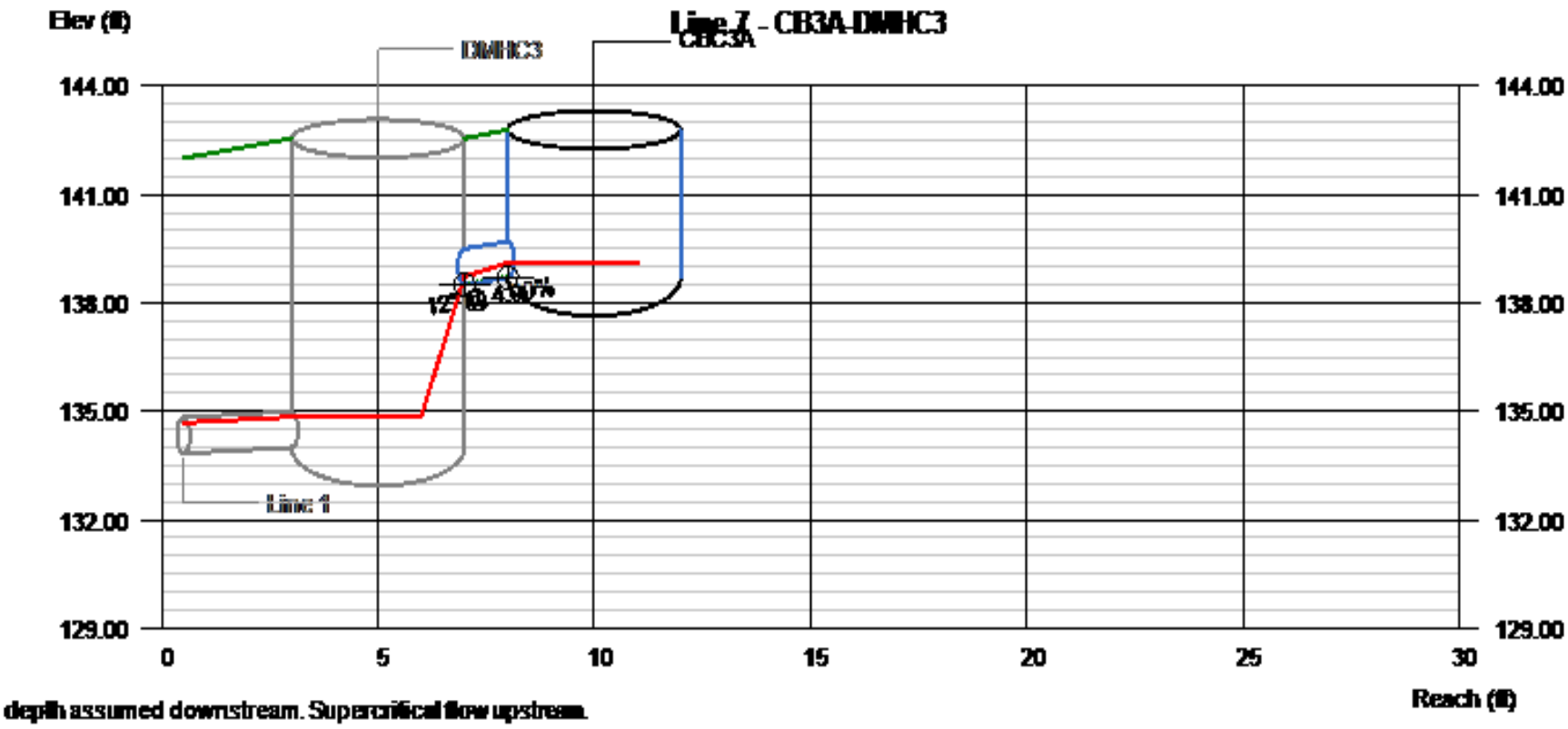

Elev (ft)
Line 2 - DMHC2-DMHC3
DMHC2
DMHC3
Line 3
Line 1
293.000LF - 12" @ 4.33%
157.00
151.00
145.00
139.00
133.00
127.00
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340
Reach (ft)
depth assumed downstream. Supercritical flow upstream.

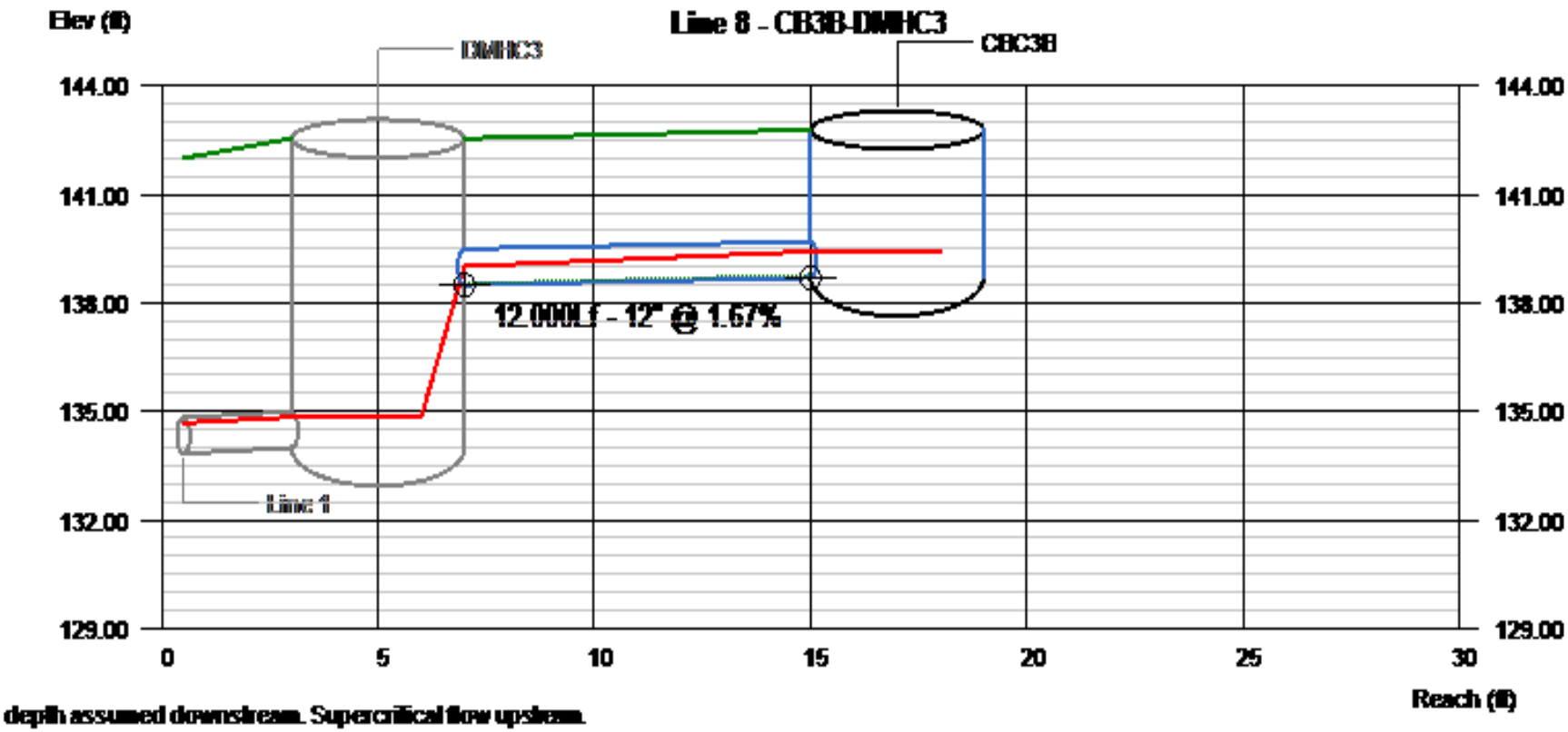

Elev (ft)
Line 3 - DMHC1-DMHC2
161.00
158.00
155.00
152.00
149.00
146.00
DMHC2
DMHC1
110.000LF - 12" @ 1.09%
Line 2
Line 4
0
10
20
30
40
50
60
70
80
90
100
110
120
130
Reach (ft)
depth assumed downstream. Supercritical flow upstream.


Elev (ft)
Line 4 - CB1A-DMHC1
163.00
160.00
157.00
154.00
151.00
148.00
0
20
40
60
80
100
120
140
160
180
200
220
240
260
Reach (ft)
CBC1A
204.000LF - 12" @ 0.93%
Line 3
depth assumed downstream. Supercritical flow upstream.

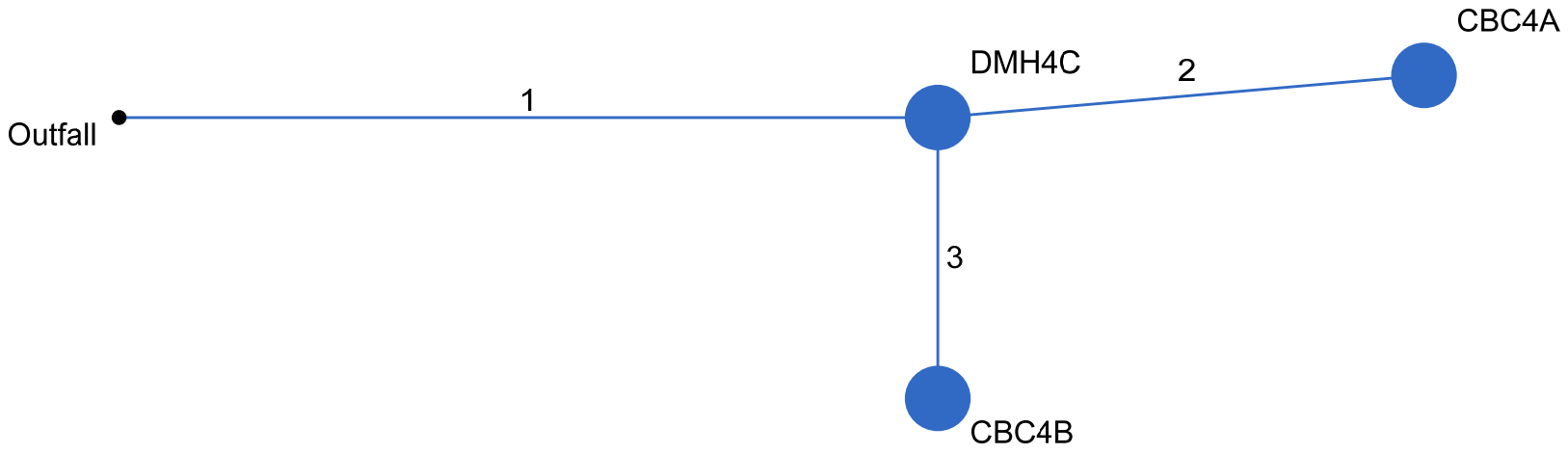

Elev (ft)
Line 5 - CB2A-DMHC2
161.00
158.00
155.00
152.00
149.00
146.00
DMHC2
CB2A
10.000 f - 12" @ 3.00%
Line 2
0
5
10
15
20
25
30
Reach (ft)
depth assumed downstream. Supercritical flow upstream.


Elev (ft)
Line 6 - CB2B-DMHC2
161.00
158.00
155.00
152.00
149.00
146.00
DMHC2
CB2B
10.0000 f - 12" @ 3.00%
Line 2
0
5
10
15
20
25
30
Reach (ft)
depth assumed downstream. Supercritical flow upstream.


Elev (ft)
Line 7 - CB3A-DMHC3
CB3A
DMHC3
144.00
141.00
138.00
135.00
132.00
129.00
12" @ 4.90%
Line 4
0
5
10
15
20
25
30
Reach (ft)
depth assumed downstream. Supercritical flow upstream.


Elev (ft)
Line 8 - CB3B-DMHC3
DMHC3
CBC3B
144.00
141.00
138.00
135.00
132.00
129.00
12.000 ft - 12" @ 1.67%
Line 4
0
5
10
15
20
25
30
Reach (ft)
depth assumed downstream. Supercritical flow upstream.

Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan



Project File: System-2.stm	Number of lines: 3	Date: 8/31/2020

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr Line No.	Line Length (ft)	Defl angle (deg)	Junc Type	Known Q (cfs)	Drng Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Invert El Dn (ft)	Line Slope (%)	Invert El Up (ft)	Line Size (in)	Line Shape	N Value (n)	J-Loss Coeff (K)	Inlet/ Rim El (ft)	
1	End	52.000	0.000	MH	0.00	0.00	0.00	6.0	132.00	1.44	132.75	12	Cir	0.011	1.00	137.03	DMHC4-SIS
2	1	31.000	-5.000	Grate	0.00	0.37	0.50	6.0	133.00	1.29	133.40	12	Cir	0.011	1.00	136.40	CB4A-DMH4C
3	1	18.000	90.000	Grate	0.00	0.57	0.50	6.0	133.00	1.67	133.30	12	Cir	0.011	1.00	136.70	CB4B-DMH4C

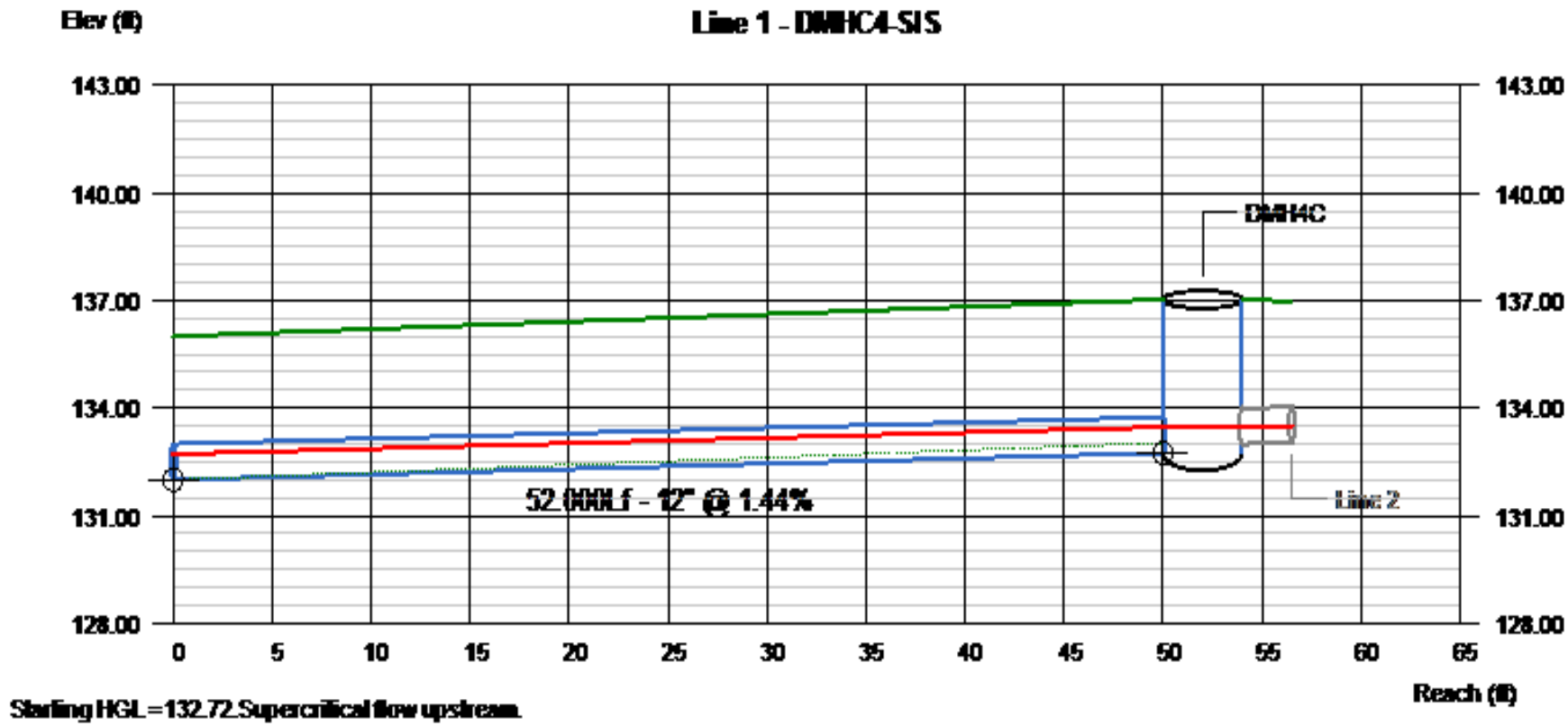
Project File: System-2.stm | Number of lines: 3 | Date: 8/31/2020

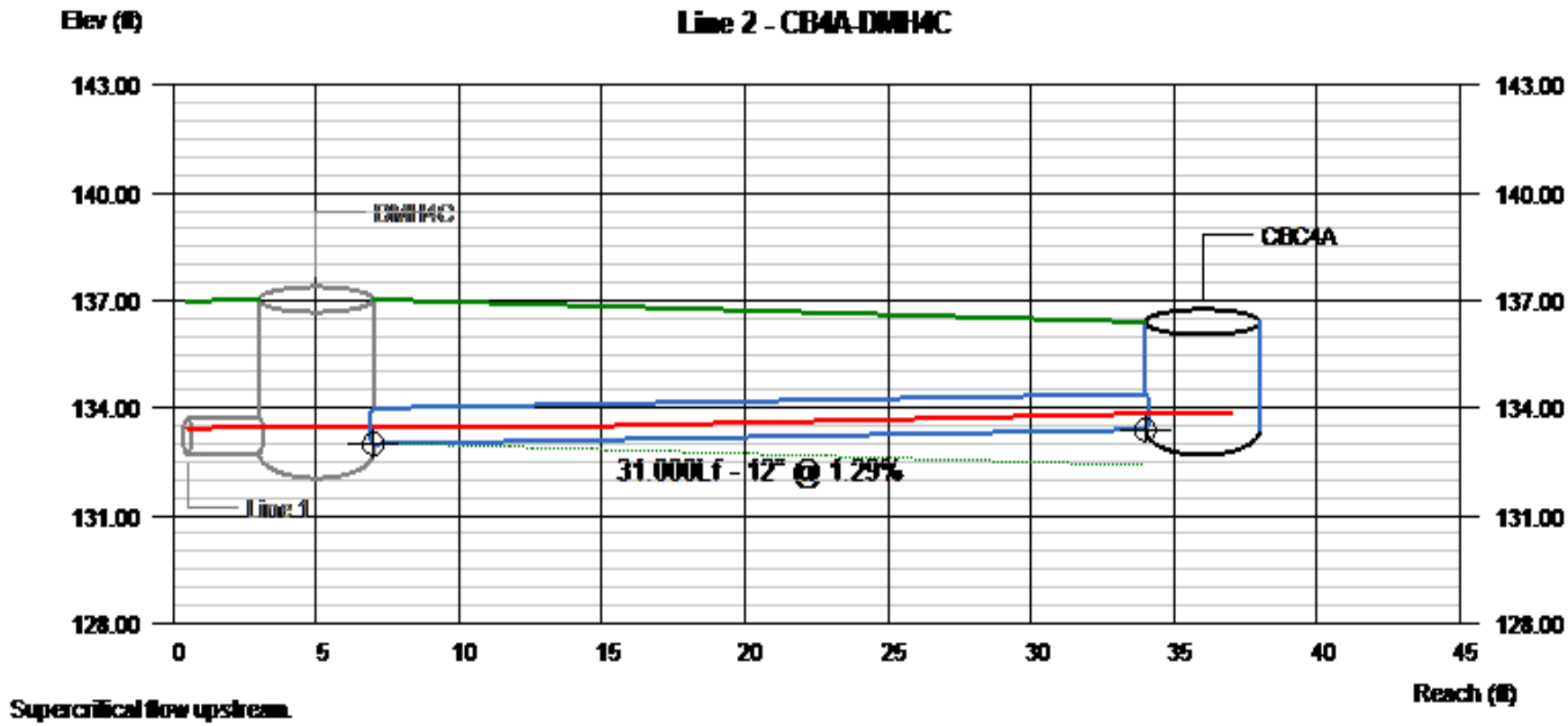
Storm Sewer Summary Report

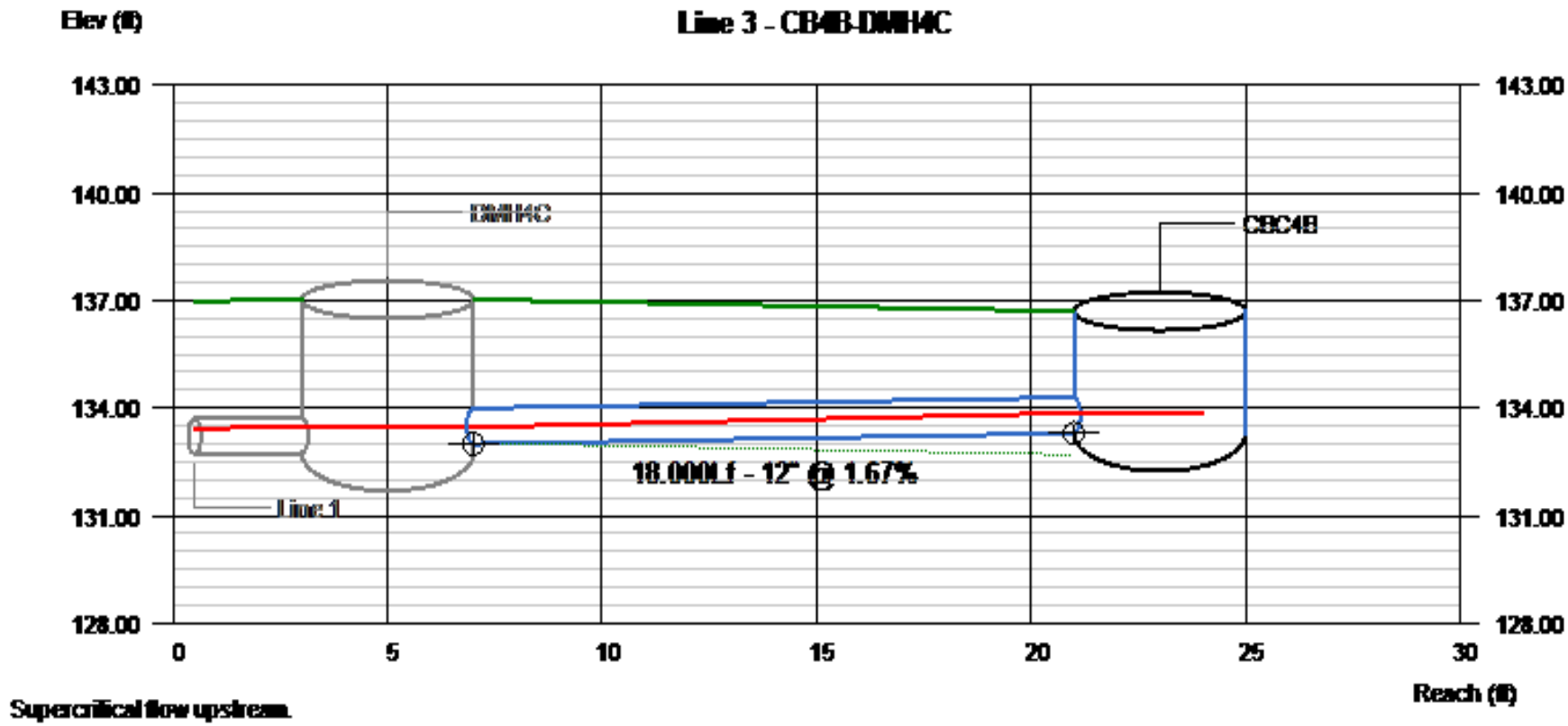
Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line Slope (%)	HGL Down (ft)	HGL Up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns Line No.	Junction Type
1	DMHC4-SIS	2.85	12	Cir	52.000	132.00	132.75	1.442	132.72	133.47	0.34	133.47	End	Manhole
2	CB4A-DMH4C	1.14	12	Cir	31.000	133.00	133.40	1.290	133.47	133.85	n/a	133.85 j	1	Grate
3	CB4B-DMH4C	1.75	12	Cir	18.000	133.00	133.30	1.667	133.47	133.86	n/a	133.86	1	Grate

Project File: System-2.stm | Number of lines: 3 | Run Date: 8/31/2020

NOTES: Return period = 25 Yrs. ; j - Line contains hyd. jump.


Elev (ft)
Line 1 - DMHC4-SIS
143.00
140.00
137.00
134.00
131.00
128.00
0
5
10
15
20
25
30
35
40
45
50
55
60
65
DMH4C
52.0000 f - 12" @ 1.44%
Line 2
Reach (ft)
Starting HGL = 132.72 Supercritical flow upstream.


Elev (ft)
Line 2 - CB4A-DMH4C
143.00
140.00
137.00
134.00
131.00
128.00
DMH4C
CBC4A
31.000 Lf - 12" @ 1.29%
Line 1
0
5
10
15
20
25
30
35
40
45
Reach (ft)
Supercritical flow upstream.


Elev (ft)
Line 3 - CB4B-DMH4C
143.00
140.00
137.00
134.00
131.00
128.00
DMH4C
CBC4B
18.000 lf - 12" @ 1.67%
Line 1
0
5
10
15
20
25
30
Reach (ft)
Supercritical flow upstream.

Project: Rookery Lane Subdivision
Location: Concord, MA
Prepared For: Civil Design Group

Purpose: To calculate the water quality flow rate (WQF) over a given site area. In this situation the WQF is derived from the first 1" of runoff from the contributing impervious surface.

Reference: Massachusetts Dept. of Environmental Protection Wetlands Program / United States Department of Agriculture Natural Resources Conservation Service TR-55 Manual

Procedure: Determine unit peak discharge using Figure 1 or 2. Figure 2 is in tabular form so is preferred. Using the tc, read the unit peak discharge (qu) from Figure 1 or Table in Figure 2. qu is expressed in the following units: cfs/mi^2/watershed inches (csm/in).

Compute Q Rate using the following equation:

$$Q = (qu)\ (A)\ (WQV)$$

where:

Q = flow rate associated with first 1" of runoff
qu = the unit peak discharge, in csm/in.
A = impervious surface drainage area (in square miles)
WQV = water quality volume in watershed inches (1" in this case)

Structure Name	Impv. (acres)	A (miles^2)	t_c (min)	t_c (hr)	WQV (in)	qu (csm/in.)	Q (cfs)
DMH-C3	0.40	0.0006250	6.0	0.100	1.00	774.00	0.48
DMH-C4	0.19	0.0002969	6.0	0.100	1.00	774.00	0.23

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION
BASED ON THE RATIONAL RAINFALL METHOD

ROOKERY LANE SUBDIVISION
CONCORD, MA

Area	**0.40 ac**	Unit Site Designation	**DMH-C3**
Weighted C	**0.9**	Rainfall Station #	**69**
t_c	**6 min**		
CDS Model	**2015-4**	CDS Treatment Capacity	**1.4 cfs**

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Incremental Removal (%)
0.02	10.2%	10.2%	0.01	0.01	9.9
0.04	9.6%	19.8%	0.01	0.01	9.3
0.06	9.4%	29.3%	0.02	0.02	9.1
0.08	7.7%	37.0%	0.03	0.03	7.4
0.10	8.6%	45.6%	0.04	0.04	8.2
0.12	6.3%	51.9%	0.04	0.04	6.0
0.14	4.7%	56.5%	0.05	0.05	4.4
0.16	4.6%	61.2%	0.06	0.06	4.4
0.18	3.5%	64.7%	0.06	0.06	3.3
0.20	4.3%	69.1%	0.07	0.07	4.1
0.25	8.0%	77.1%	0.09	0.09	7.4
0.30	5.6%	82.7%	0.11	0.11	5.1
0.35	4.4%	87.0%	0.13	0.13	4.0
0.40	2.5%	89.5%	0.14	0.14	2.3
0.45	2.5%	92.1%	0.16	0.16	2.3
0.50	1.4%	93.5%	0.18	0.18	1.2
0.75	5.0%	98.5%	0.27	0.27	4.2
1.00	1.0%	99.5%	0.36	0.36	0.8
1.50	0.0%	99.5%	0.54	0.54	0.0
2.00	0.0%	99.5%	0.72	0.72	0.0
3.00	0.5%	100.0%	1.08	1.08	0.2
					93.6
				Removal Efficiency Adjustment[2] =	6.5%
				Predicted % Annual Rainfall Treated =	93.5%
				Predicted Net Annual Load Removal Efficiency =	**87.2%**

1 - Based on 10 years of hourly precipitation data from NCDC Station 770, Boston WSFO AP, Suffolk County, MA
2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION
BASED ON THE RATIONAL RAINFALL METHOD

ROOKERY LANE SUBDIVISION
CONCORD, MA

Area	**0.19 ac**	Unit Site Designation	**DMH-C4**
Weighted C	**0.9**	Rainfall Station #	**69**
t_c	**6 min**		
CDS Model	**2015-5**	CDS Treatment Capacity	**1.4 cfs**

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Incremental Removal (%)
0.02	10.2%	10.2%	0.00	0.00	9.9
0.04	9.6%	19.8%	0.01	0.01	9.3
0.06	9.4%	29.3%	0.01	0.01	9.1
0.08	7.7%	37.0%	0.01	0.01	7.5
0.10	8.6%	45.6%	0.02	0.02	8.3
0.12	6.3%	51.9%	0.02	0.02	6.1
0.14	4.7%	56.5%	0.02	0.02	4.5
0.16	4.6%	61.2%	0.03	0.03	4.5
0.18	3.5%	64.7%	0.03	0.03	3.4
0.20	4.3%	69.1%	0.03	0.03	4.2
0.25	8.0%	77.1%	0.04	0.04	7.6
0.30	5.6%	82.7%	0.05	0.05	5.3
0.35	4.4%	87.0%	0.06	0.06	4.1
0.40	2.5%	89.5%	0.07	0.07	2.4
0.45	2.5%	92.1%	0.08	0.08	2.4
0.50	1.4%	93.5%	0.09	0.09	1.3
0.75	5.0%	98.5%	0.13	0.13	4.6
1.00	1.0%	99.5%	0.17	0.17	0.9
1.50	0.0%	99.5%	0.26	0.26	0.0
2.00	0.0%	99.5%	0.34	0.34	0.0
3.00	0.5%	100.0%	0.51	0.51	0.3
					95.5
				Removal Efficiency Adjustment[2] =	6.5%
				Predicted % Annual Rainfall Treated =	93.5%
				Predicted Net Annual Load Removal Efficiency =	**89.0%**

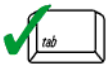
1 - Based on 10 years of hourly precipitation data from NCDC Station 770, Boston WSFO AP, Suffolk County, MA
2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

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

Checklist for Stormwater Report

A. Introduction

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



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

The Stormwater Report must include:

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

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

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

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

---

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

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

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

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

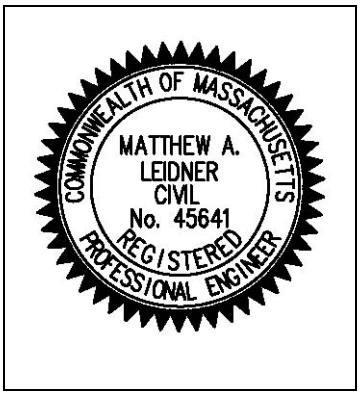
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature



09-04-2020

Signature and Date

Checklist

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

☒ New development

☐ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

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

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

Standard 1: No New Untreated Discharges

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

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

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

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

☐ Static ☒ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

Standard 9: Operation and Maintenance Plan

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

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

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

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

Standard 10: Prohibition of Illicit Discharges

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

☒ An Illicit Discharge Compliance Statement is attached;

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

ILLICIT DISCHARGE STATEMENT

FOR

ROOKERY LANE SUBDIVISION

48Y FITCHBURG TURNPIKE
CONCORD, MASSACHUSETTS

DATE: SEPTEMBER 4, 2020

Illicit discharges to the stormwater management system are discharges not entirely comprised of stormwater. Discharges to the stormwater management system from the following activities or facilities are permissible: firefighting, water line flushing, landscape irrigation, uncontaminated groundwater, potable water sources, foundation drains, air conditioning condensation, footing drains, individual resident car washing, flows from riparian habitats and wetlands, dechlorinated water from swimming pools, water used for street washing and water used to clean residential buildings without detergents.

There are no known illicit discharges currently at the site nor are any illicit discharges proposed as part of the project. The stormwater management system is *not* intended to convey any illicit discharges and/or pollutants and as such, control measures that are identified within this report shall be strictly adhered to in order to minimize the risk of contamination. Any unknown existing illicit discharges that are discovered as part of the development of the subject site shall be eliminated in accordance with local, state and federal regulations.

Quary Road North LLC
Manager

Signature

9/4/2020

Date

OPERATION AND MAINTENANCE PLAN

&

LONG-TERM POLLUTION PREVENTION PLAN

FOR

ROOKERY LANE SUBDIVISION

48Y FITCHBURG TURNPIKE
CONCORD, MASSACHUSETTS

PREPARED FOR:

QUARRY NORTH ROAD, LLC
2134 SEVILLA WAY
NAPLES, FL 34109

PREPARED BY:

CIVIL DESIGN GROUP, LLC
21 HIGH STREET, SUITE 207
NORTH ANDOVER, MA 01845

DATE: SEPTEMBER 4, 2020

1.0 OPERATION AND MAINTENANCE PLAN

1.1 INTRODUCTION

Civil Design Group, LLC has prepared the following Operation and Maintenance (O&M) Plan for *Rookery Lane Subdivision*.

CONTACT INFORMATION

PROJECT	LANDOWNER & STORMWATER MANAGEMENT SYSTEM OWNER
ROOKERY LANE SUBDIVISION	Owner: Quarry North Road, LLC, their successors and assigns
	Contact: TBD (interim contact Quarry North Road, LLC)
	Phone: TBD (interim phone 239-571-5500 – Chris Claussen)

The owner shall be responsible for the long-term operation and maintenance of the stormwater management system components and shall be responsible for record keeping of inspections, maintenance and repairs of the stormwater management system components. Any time that the ownership changes, the new property owner shall assume all responsibilities for their property as outlined in this O&M plan. The owner shall hire a qualified professional to conduct scheduled inspections and maintain records in accordance with the inspection schedule outline enclosed within this document.

Design Engineer: Civil Design Group, LLC
Address: 21 High Street, Suite 207, North Andover, MA 01845
Office Phone: 978-794-5400
Contact: Matthew Leidner, P.E.

The components of the stormwater management system shall be inspected, monitored and maintained in accordance with the following to ensure that the stormwater management/ best management practice facilities for the project function as intended. Routine inspection and proper maintenance of these individual components is essential to providing the long-term enhancement of both the quality and quantity of the runoff from the site.

The proposed stormwater management best management practices (BMPs) have been designed to collect and convey runoff from developed areas in accordance with the Massachusetts DEP's Stormwater Management Handbook. Using the rational method to determine peak runoff flows, the onsite drainage structures and pipes are designed for the 25-year storm event. The system consists of deep sump hooded catch basins, trench drains, manholes, water quality units, an infiltration basin, subsurface infiltration systems, and porous pavement.

Street Sweeping

Street sweeping shall be performed twice a year, once in the spring and once in the fall, to reduce the amount of sediment and debris entering the catch basins.

Deep Sump Hooded Catch Basins

Stormwater runoff from proposed pavement is directed via curbing and site grading to catch basins with deep sumps and hooded outlets. These structures are designed to trap and remove sediment and larger particles from the stormwater and improve the performance of subsequent BMP's. The sumps are a minimum of 4' in depth and a routine inspection and cleaning schedule shall be followed to ensure optimal effectiveness.

Inspection Frequency:	Quarterly
Inspection Tools:	Manhole hook; survey rod; sludge judge
Items to Inspect:	Measure sediment in sump using survey rod; visually check for floating debris or trash; visually check for oil and if more than a sheen is present, use sludge judge to measure thickness of layer; visually ensure that hood is in place; visually ensure that grate is in good condition; visually ensure that outlet pipe is unobstructed
Maintenance Threshold(s):	Annually or ≥24" sediment in sump (whichever comes first); discernible layer of oil/hydrocarbons on surface; floating trash
Maintenance Equipment:	Vactor or clamshell for sediment removal; vactor and/or oil sorbent pads for oil/hydrocarbon removal; net for floating debris or trash removal

Water Quality Units

Proprietary water quality units are designed to remove heavy particles, floating debris and hydrocarbons from stormwater. Stormwater enters the system where floatables and oils are separated prior to the clarified stormwater runoff discharging to an outlet pipe. The project design proposes to use the following Contech Engineered Solutions models: CDS 2015-4 and CDS 2015-5.

Inspection Frequency:	Quarterly
Inspection Tools:	Manhole hook; survey rod; sludge judge
Items to Inspect:	Measure sediment in sump using survey rod; use sludge judge to measure thickness of oil layer through oil port; visually ensure that insert and weir are in good condition; visually ensure that cover is in good condition
Maintenance Threshold(s):	≥8" sediment and/or a discernible layer of oil/hydrocarbons or as otherwise recommended by the manufacturer
Maintenance Equipment:	Vactor

Subsurface Infiltration Systems (SIS)

The subsurface infiltration system is designed to infiltrate runoff from the site. The system is comprised of open-bottom concrete chambers and stone and is equipped with inspection/cleanout ports to facilitate inspection for standing water and sediment accumulation.

Inspection Frequency:	Quarterly
Inspection Tools:	Ruler or survey rod to measure sediment

Items to Inspect:	Measure any accumulated sediment using a ruler or survey rod; inspect for standing water if more than 72 hours have elapsed since the previous rain event.
Maintenance Threshold(s):	≥1" sediment
Maintenance Equipment:	Water jet and vactor

1.2 ILLICIT DISCHARGE STATEMENT

Illicit discharges to the stormwater management system are discharges not entirely comprised of stormwater. Discharges to the stormwater management system from the following activities or facilities are permissible: firefighting, water line flushing, landscape irrigation, uncontaminated groundwater, potable water sources, foundation drains, air conditioning condensation, footing drains, individual resident car washing, flows from riparian habitats and wetlands, dechlorinated water from swimming pools, water used for street washing and water used to clean residential buildings without detergents.

There are no known illicit discharges currently at the site nor are any illicit discharges proposed as part of the project. The stormwater management system is not intended to convey any illicit discharges and or pollutants and as such, control measures that are identified within this report shall be strictly adhered to in order to minimize the risk of contamination. Any unknown existing illicit discharges that are discovered as part of the development of the subject site shall be eliminated in accordance with local, state and federal regulations.

2.0 LONG-TERM POLLUTION PREVENTION PLAN (LTPPP)

The Massachusetts DEP Stormwater Management Handbook requires that a Long-Term Pollution Prevention Plan (LTPPP) be prepared and incorporated as part of the Operation & Maintenance of the Stormwater Management System. The purpose of the LTPPP is to identify potential sources of pollution that may affect the quality of stormwater discharges, and to describe the implementation of practices to reduce the pollutants in stormwater discharges. The following items describe the source control and proper procedures for the LTPPP.

Street Sweeping

Sweeping of site drives and parking lots constructed of standard impervious asphalt pavement shall be performed twice a year, once in the spring and once in the fall, to reduce the amount of sediment and debris entering the catch basins. Swept materials shall be disposed of in accordance with applicable local and state requirements.

Deicing and Salt Storage

Deicing methods shall be used in conjunction with snow removal to maintain safe pedestrian and vehicular access. This development requires special consideration to deicing due to the use of porous pavement on the adjacent *Cold Brook Crossing* project and because the site is located in an environmentally sensitive Zone II area. In order to avoid the potential for inadvertently placing sand on adjacent porous pavement areas, sanding shall be avoided within this subdivision. Industry standard deicing products shall be used on paved surfaces unless specifically restricted by the municipality and shall be used at the minimum acceptable rate to ensure pedestrian and vehicular safety. Deicing products shall be stored off-site or in a covered location.

Snow Disposal

This development requires special attention to snow removal because the site is located in an environmentally sensitive Zone II area. To the extent practicable, snow shall be piled in areas where the snowmelt will receive maximum treatment through the proposed BMPs. Snow meltwater can filter into the soil, leaving behind sand and debris, which can be removed in the springtime, or run onto surfaces that undergo treatment through the proposed BMPs. Avoid disposing of snow on top of storm drain catch basins or in stormwater drainage swales or ditches. Snow combined with sand and debris may block a storm drainage system, causing localized flooding. In no case shall snow be disposed of or stored in wetlands, streams or other water bodies. If necessary to remove snow from the site, the snow shall be disposed of at an off-site location in accordance with applicable local, state and federal regulations. No snow may be brought into the Zone II from areas outside the Zone II.

Lawn, Garden, and Landscape Management

Lawn areas shall be maintained and mowed regularly throughout the growing season. Any bare areas of lawn shall be reseeded and plants shall be pruned on an as-needed basis. Trash and debris shall be removed from landscaped and planted areas as-needed. Fertilizers, herbicides and pesticides shall be used within the amounts recommended by the manufacturer. These products shall be stored in containers indoors. Pet waste shall be disposed of properly.

APPENDIX-A

EXAMPLE
OPERATION AND MAINTENANCE
REPORT FORM

CIVIL DESIGN GROUP, LLC
ENGINEERING. LAND USE. PLANNING. PERMITTING.

21 High Street, Suite 207
North Andover, MA 01845
Tel 978.794.5400
www.cdgengineering.com

QUARTERLY STORMWATER INSPECTION REPORT

Site:	Rookery Lane Subdivision	**Date:**	
Address:	48Y Fitchburg Turnpike, Concord, MA	**Time:**	
Inspector:		**Weather:**	

CATCH BASINS

Unit #	Sediment (inches)	Oil (inches)	Hood/ Pipes	Grate	Last Cleaned	Attention Recommended
CB-C1a						
CB-C2a						
CB-C2b						
CB-C3a						
CB-C3b						
CB-C4a						
CB-C5b						

WATER QUALITY UNITS

Unit #	Sediment (inches)	Oil (inches)	Trash	Cover	Last Cleaned	Attention Recommended
DMH-C3						
DMH-C4						

SUBSURFACE INFILTRATION SYSTEM

Unit #	Notes	Attention Recommended
SIS-C1		

APPENDIX-B

CONTECH WATER QUALITY UNIT MAINTENANCE GUIDELINES

CONTECH®
ENGINEERED SOLUTIONS

CDS® Inspection and Maintenance Guide

CDS TECHNOLOGIES

Maintenance

The CDS system should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects pollutants will depend more heavily on site activities than the size of the unit. For example, unstable soils or heavy winter sanding will cause the grit chamber to fill more quickly but regular sweeping of paved surfaces will slow accumulation.

Inspection

Inspection is the key to effective maintenance and is easily performed. Pollutant transport and deposition may vary from year to year and regular inspections will help ensure that the system is cleaned out at the appropriate time. At a minimum, inspections should be performed twice per year (e.g. spring and fall) however more frequent inspections may be necessary in climates where winter sanding operations may lead to rapid accumulations, or in equipment washdown areas. Installations should also be inspected more frequently where excessive amounts of trash are expected.

The visual inspection should ascertain that the system components are in working order and that there are no blockages or obstructions in the inlet and separation screen. The inspection should also quantify the accumulation of hydrocarbons, trash, and sediment in the system. Measuring pollutant accumulation can be done with a calibrated dipstick, tape measure or other measuring instrument. If absorbent material is used for enhanced removal of hydrocarbons, the level of discoloration of the sorbent material should also be identified during inspection. It is useful and often required as part of an operating permit to keep a record of each inspection. A simple form for doing so is provided.

Access to the CDS unit is typically achieved through two manhole access covers. One opening allows for inspection and cleanout of the separation chamber (cylinder and screen) and isolated sump. The other allows for inspection and cleanout of sediment captured and retained outside the screen. For deep units, a single manhole access point would allows both sump cleanout and access outside the screen.

The CDS system should be cleaned when the level of sediment has reached 75% of capacity in the isolated sump or when an appreciable level of hydrocarbons and trash has accumulated. If absorbent material is used, it should be replaced when significant discoloration has occurred. Performance will not be impacted until 100% of the sump capacity is exceeded however it is recommended that the system be cleaned prior to that for easier removal of sediment. The level of sediment is easily determined by measuring from finished grade down to the top of the sediment pile. To avoid underestimating the level of sediment in the chamber, the measuring device must be lowered to the top of the sediment pile carefully. Particles at the top of the pile typically offer less resistance to the end of the rod than consolidated particles toward the bottom of the pile. Once this measurement is recorded, it should be compared to the as-built drawing for the unit to determine weather the height of the sediment pile off the bottom of the sump floor exceeds 75% of the total height of isolated sump.

Cleaning

Cleaning of a CDS systems should be done during dry weather conditions when no flow is entering the system. The use of a vacuum truck is generally the most effective and convenient method of removing pollutants from the system. Simply remove the manhole covers and insert the vacuum hose into the sump. The system should be completely drained down and the sump fully evacuated of sediment. The area outside the screen should also be cleaned out if pollutant build-up exists in this area.

In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, the system should be cleaned out immediately in the event of an oil or gasoline spill should be cleaned out immediately. Motor oil and other hydrocarbons that accumulate on a more routine basis should be removed when an appreciable layer has been captured. To remove these pollutants, it may be preferable to use absorbent pads since they are usually less expensive to dispose than the oil/water emulsion that may be created by vacuuming the oily layer. Trash and debris can be netted out to separate it from the other pollutants. The screen should be power washed to ensure it is free of trash and debris.

Manhole covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and also to ensure that proper safety precautions have been followed. Confined space entry procedures need to be followed if physical access is required. Disposal of all material removed from the CDS system should be done in accordance with local regulations. In many jurisdictions, disposal of the sediments may be handled in the same manner as the disposal of sediments removed from catch basins or deep sump manholes.

CDS Model	Diameter		Distance from Water Surface to Top of Sediment Pile		Sediment Storage Capacity	
	ft	m	ft	m	y^3	m^3
CDS1515	3	0.9	3.0	0.9	0.5	0.4
CDS2015	4	1.2	3.0	0.9	0.9	0.7
CDS2015	5	1.5	3.0	0.9	1.3	1.0
CDS2020	5	1.5	3.5	1.1	1.3	1.0
CDS2025	5	1.5	4.0	1.2	1.3	1.0
CDS3020	6	1.8	4.0	1.2	2.1	1.6
CDS3025	6	1.8	4.0	1.2	2.1	1.6
CDS3030	6	1.8	4.6	1.4	2.1	1.6
CDS3035	6	1.8	5.0	1.5	2.1	1.6
CDS4030	8	2.4	4.6	1.4	5.6	4.3
CDS4040	8	2.4	5.7	1.7	5.6	4.3
CDS4045	8	2.4	6.2	1.9	5.6	4.3
CDS5640	10	3.0	6.3	1.9	8.7	6.7
CDS5653	10	3.0	7.7	2.3	8.7	6.7
CDS5668	10	3.0	9.3	2.8	8.7	6.7
CDS5678	10	3.0	10.3	3.1	8.7	6.7

Table 1: CDS Maintenance Indicators and Sediment Storage Capacities

Support

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

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CDS Inspection & Maintenance Log

CDS Model: _____ Location: _____

Date	Water depth to sediment[1]	Floatable Layer Thickness[2]	Describe Maintenance Performed	Maintenance Personnel	Comments

1. The water depth to sediment is determined by taking two measurements with a stadia rod: one measurement from the manhole opening to the top of the sediment pile and the other from the manhole opening to the water surface. If the difference between these measurements is less than the values listed in table 1 the system should be cleaned out. **Note: to avoid underestimating the volume of sediment in the chamber, the measuring device must be carefully lowered to the top of the sediment pile.**

2. For optimum performance, the system should be cleaned out when the floating hydrocarbon layer accumulates to an appreciable thickness. In the event of an oil spill, the system should be cleaned immediately.