STORMWATER MANAGEMENT REPORT

FOR

235 MAIN STREET
OXFORD, MA 01540

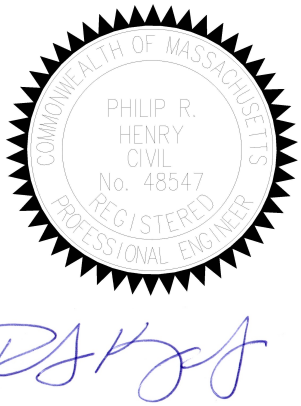
PREPARED FOR:

CUMBERLAND FARMS, INC.
165 FLANDERS ROAD
WESTBOROUGH, MA 01581

PREPARED BY:

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

DATE: SEPTEMBER 06, 2022



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1.0 SITE LOCATION AND DESCRIPTION

Civil Design Group, LLC (CDG) has been retained by Cumberland Farms, Inc. to prepare this Stormwater Management Report for the construction of a Cumberland Farms convenience store and gas station located at 235 Main Street and 5 Fairlawn Avenue, Oxford, Massachusetts (refer to Figure-1). The redevelopment program includes demolishing the existing structures and includes constructing a new 4,464 square foot Cumberland Farms convenience store with 4 pumps and 30 parking spaces on a 0.97± acre site. The site is bounded to the south by an American Legion building, to the west by residences, to the north by Fairlawn Avenue and to the east by Main Street.

According to FEMA flood insurance rate maps community panel number 25027C0976E, effective date 07/04/2011, the site lies within Zone X, which is defined as areas determined to be outside the 0.2% (500-year) annual chance floodplain. Based on available MassGIS information, the does not include a wetland resource area and does not appear to lie within an Area of Critical Environmental Concern (ACEC), or an area mapped for rare and endangered species or certified vernal pools. The site does lie within a groundwater protection area.

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 the municipal and the Massachusetts Department of Environmental Protection (DEP's) requirements. The proposed best management practices (BMPs) as outlined in this report include a subsurface infiltration system to provide recharge and mitigation of the peak flow rates for the 2, 10, and 100-year storm events and treatment devices to pretreat stormwater to the maximum extent practicable prior to discharging off site.

2.0 METHODOLOGY

Northeast Regional Climate Center (Cornell Rates) was utilized to source the precipitation values and 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 (Tc's) 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 Web Soil Survey, underlying soils on the site are classified as Merrimac fine sandy loam, which includes an associated hydrologic soil group [HSG] rating of A. Onsite subsurface testing conducted in March 2022 also yielded results indicating that the site is predominantly underlain by sand and gravel, therefore, for the purposes of generating peak flow rates, this stormwater report utilizes an HSG rating of A for both the existing and proposed conditions. Furthermore, an infiltration rate of 8.27 in/hour (HSG-A rate) is used for the proposed subsurface infiltration systems (SIS), which is consistent with the findings from the geotechnical report and onsite test pits.

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4.0 POINTS OF ANALYSIS

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

TABLE-1: POINTS OF ANALYSIS

POINT OF ANALYSIS	DESCRIPTION
POA-1	A comparison line along the Main Street right of way, which contributes to the municipal drainage system.
POA-2	A comparison line along the rear property line, which conveys runoff toward the abutting residential properties.
POA-3	A comparison point (drain manhole) within Fairlawn that conveys the onsite drainage system thereby contributing to the municipal drainage system. This drainage system appears to be traversing away from Main Street, therefore, it is being analyzed as not contributing to POA-1.

5.0 EXISTING DRAINAGE WATERSHEDS

The existing watersheds are delineated based on topography, physical characteristics and drainage networks within the site limits and collect and direct stormwater towards the POAs. The total study area for this project is 0.97± acres. Three (3) pre-development watersheds are described as follows:

Subcatchment EX-1: The 0.71-acre watershed is comprised of pavement, rooftop and grass areas. Runoff sheet flows via overland onto Main Street (POA-1) and is eventually collected within the municipal drainage system.

Subcatchment EX-2: The 0.13-acre watershed is comprised of pavement, rooftop and grass areas. Runoff sheet flows via overland in a westerly direction towards the abutting properties (POA-2).

Subcatchment EX-3: The 0.13-acre watershed is comprised of rooftop, pavement and grass areas. Runoff sheet flows via overland onto Fairlawn Avenue and is eventually collected within the municipal drainage system (POA-3).

6.0 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. The four (4) post-development watersheds are described as follows:

Subcatchment PR-1: The 0.16-acre watershed is comprised of grass areas. Runoff sheet flows via overland onto Main Street (POA-1) and is eventually collected within the municipal drainage system.

Subcatchment PR-2: The 0.07-acre watershed is comprised of pavement and grass areas. Runoff sheet flows via overland in a westerly direction towards the abutting properties (POA-2).

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Subcatchment PR-3A: The 0.68-acre watershed is comprised of rooftop, pavement and grass areas. Runoff is collected via the new onsite drainage system and conveyed through the subsurface infiltration system. The system has been design to collect up to the 100-year storm. Larger storms will utilize the overflow yard drain, whereby runoff will sheet flow into Fairlawn as it does in the current condition (POA-3).

Subcatchment PR-3B: The 0.05-acre watershed is comprised of grass areas. Runoff sheet flows via overland onto Fairlawn Avenue and is eventually collected within the municipal drainage system (POA-3).

7.0 PEAK FLOW RATE MITIGATION

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 storm events. Peak flow rates for the pre-development and post-development conditions are illustrated below:

TABLE 2: PEAK FLOW RATE COMPARISON

POINT OF ANALYIS	2-YEAR STORM EVENT (3.22"/24-HR)		10-YEAR STORM EVENT (4.83"/24-HR)		100-YEAR STORM EVENT (8.64"/24-HR)	
	PRE (CFS)	POST (CFS)	PRE (CFS)	POST (CFS)	PRE (CFS)	POST (CFS)
POA-1	*1.76*	**0.00**	*2.66*	**0.00**	*4.87*	**0.20**
POA-2	*0.09*	**0.02**	*0.14*	**0.03**	*0.36*	**0.13**
POA-3	*0.34*	**0.00**	*0.52*	**0.00**	*0.93*	**0.92**

8.0 WATER QUALITY

The redevelopment program includes measures to treat runoff from impervious areas prior to discharging offsite. New stormwater controls have been incorporated into the design that result in a reduction in annual stormwater pollutant loads from the site. Through the use of structural and non-structural BMPs, the water quality volume from the watersheds contributing to the proposed drainage system will undergo treatment. Currently, the limit of work contains approximately 0.78 acres of impervious area or 81% of the disturbed area. The redevelopment program includes approximately 0.63 acres of impervious or 65% of the site, resulting in a 0.15 acre reduction in impervious area. Therefore, this project qualifies as a redevelopment and standards 1, 8, 9, & 10 have been met. As depicted in Figure-5, subcatchments 1 through 5 corresponding to catch basins CB-1 through CB-5 of the proposed drainage system, collect 0.46± acres of non-rooftop impervious area and will be treated to the redevelopment standards (see below). The runoff from the remaining 0.01± acres of non-rooftop impervious area is associated with the concrete sidewalk around the rear and right side of the building, which will not be exposed to vehicular traffic and/or pollutants. The following BMPs were selected to treat the average annual TSS load from stormwater runoff under the post-development condition. Refer to the TSS Removal Calculation Worksheet below.

- 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 will trap and remove sediment and larger particles from the stormwater and will improve the performance of subsequent BMP's. The sumps will be a minimum of 4' in depth and a regular inspection and cleaning schedule has been proposed to ensure optimal effectiveness. When properly designed and maintained, catch basin sumps are effective in reducing the sediment and pollutant load in runoff.

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- Hydrodome (HD4 Unit)
  HydroDomes 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. See below for additional information about the TSS rates utilized for these proprietary BMPs.

- Subsurface Infiltration System (SIS)
  The subsurface infiltration systems have been designed to capture roof runoff and allow infiltration to occur via the perforations of the plastic arches and void space of the crushed stone.

TABLE 3: TSS REMOVAL CALCULATION WORKSHEET[1]

TREATMENT TRAIN-1 (TT#1): SC-1 - SC5- (0.46Ac)

BMP (A)	TSS Removal Rate (B)	Starting TSS Load (C)	Amount Removed (BxC) (D)	Remaining Load (C-D) (E)
Deep sump hooded catch basins	0.25	1.0	0.25	0.75
Infiltration w/ pre-treatment*	0.80[1]	0.75	0.60	0.15
Total TSS Removal = Summation of (D) =			**85%**	

*** Calculated using the Hydroworks software (minimum of 44% TSS Removal prior to infiltration)**
[1] 80% TSS removal credit when combined with adequate pretreatment

CUMULATIVE TSS REMOVAL: (0.46Acres x 0.85) + (0.01 Acres x 0.00) = 84%
0.47 Acres

Since the Hydroworks units are designed to treat the required flow without overflow, bypass, surcharge, or scouring, and since they include a built-in bypass mechanism to accommodate high flow storm events, they are considered "offline" units under the DEP policy as proposed.

9.0 GROUNDWATER RECHARGE

The DEP Stormwater Management Policy addresses the importance of recharging groundwater and reducing surface runoff. For a redevelopment project, any net increase in site impervious area must be infiltrated to approximate the annual recharge from pre-development conditions. On this site, there is a net reduction of 0.15 acres in impervious area. As a result of the proposed reduction in impervious area, the annual recharge for the post-development condition will exceed the annual recharge for existing site. Therefore, no additional infiltration is required to meet this standard, however, in an effort to further promote recharge to groundwater, a subsurface infiltration system (SIS) has been proposed to infiltrate runoff from the building rooftop. The system has been designed to accommodate up to the 100-year, 24-hour storm event utilizing a Rawls infiltration rate of 8.27in/hour, which is consistent with HSG-A soils. The available storage was used below in determining the drawdown time to ensure that the system drains within 72 hours.

[1] TSS Removal Rate calculation includes non-rooftop impervious surfaces.

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$$\textit{Drawdown calculation} = \frac{\textit{Depth}}{K}$$

Where k = 8.27 in/hour ("Rawls" Rate for HSG-A)

$$\textit{Drawdown calculation} = \frac{48\ in}{8.27\ in/hr} = 5.8\ hours < 72\ hours = \textbf{OK}$$

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 six (6) deep sump hooded catch basins, two (2) water quality units, one (1) subsurface infiltration system and associated piping. Using the rational method to determine peak runoff flows, the proposed conveyance system is designed for the 25-year storm event.

11.0 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 any new *untreated* discharges. The overland and subsurface drainage connection points will remain consistent with the existing condition.

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.

There is a net reduction of impervious area, however, additional recharge best management practices have been incorporated into the design to further promote groundwater recharge.

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

To aid in removal of total suspended solids, water quality unit(s) are proposed. Collected onsite impervious areas will be treated to the maximum extent practicable consistent with the redevelopment standards, which represents a vast improvement over the existing condition.

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.

Source control such as rooftop capture and direct connection into the proposed drainage system have been implemented to reduce the discharge of stormwater from the site. In addition, installation of a water quality unit will increase TSS removal for the site from existing conditions.

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.

Source control such as rooftop capture and direct connection into the proposed drainage system have been implemented to reduce the discharge of stormwater from the site. In addition, the installation of a water quality units will increase TSS removal for the site from existing conditions.

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.

Applicable standards are met.

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.

Sheet C006.0, 'Site Erosion and Sedimentation Control Plan' outlines and depicts measures to control construction related impacts including 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.

An Operation and Maintenance Plan (O&M) has been developed that outlines maintenance requirements to ensure longevity of BMP's. See Appendix A.

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

The proposed stormwater management system does not include any illicit discharges.

12.0 SUMMARY

The stormwater management system for the proposed redevelopment includes measures for collecting, conveying, treating and controlling stormwater runoff from the site. The site results in a net zero change in impervious area and post-development peak runoff rates have been attenuated for the 2, 10 and 100-year storm events. The collection system has been designed to convey runoff for the 25-year storm event and the stormwater management system incorporates both structural and non-structural BMP's to adequately treat runoff from the proposed redevelopment area in accordance with the DEP Stormwater Management Policy to the maximum extent practicable. Comprehensive computations and calculations with supporting figures and plans are attached.

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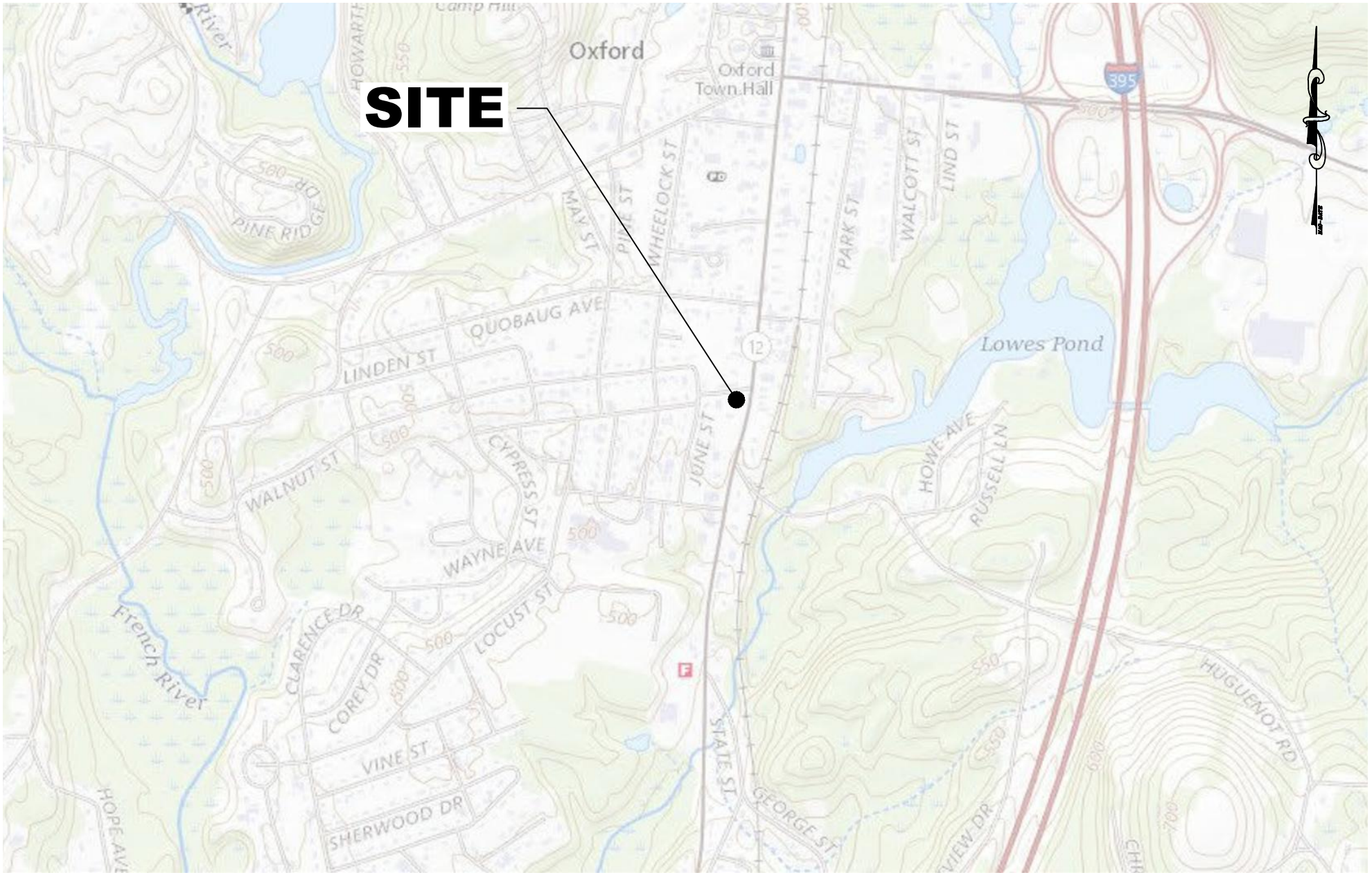

1000 0 500 1000 2000

GRAPHIC SCALE IN FEET

SOURCE: USGS TOPO 2022

CLIENT:

Cumberland FARMS

235 MAIN STREET & 5 FAIRLAWN AVENUE
OXFORD, MA

CIVIL DESIGN GROUP, LLC

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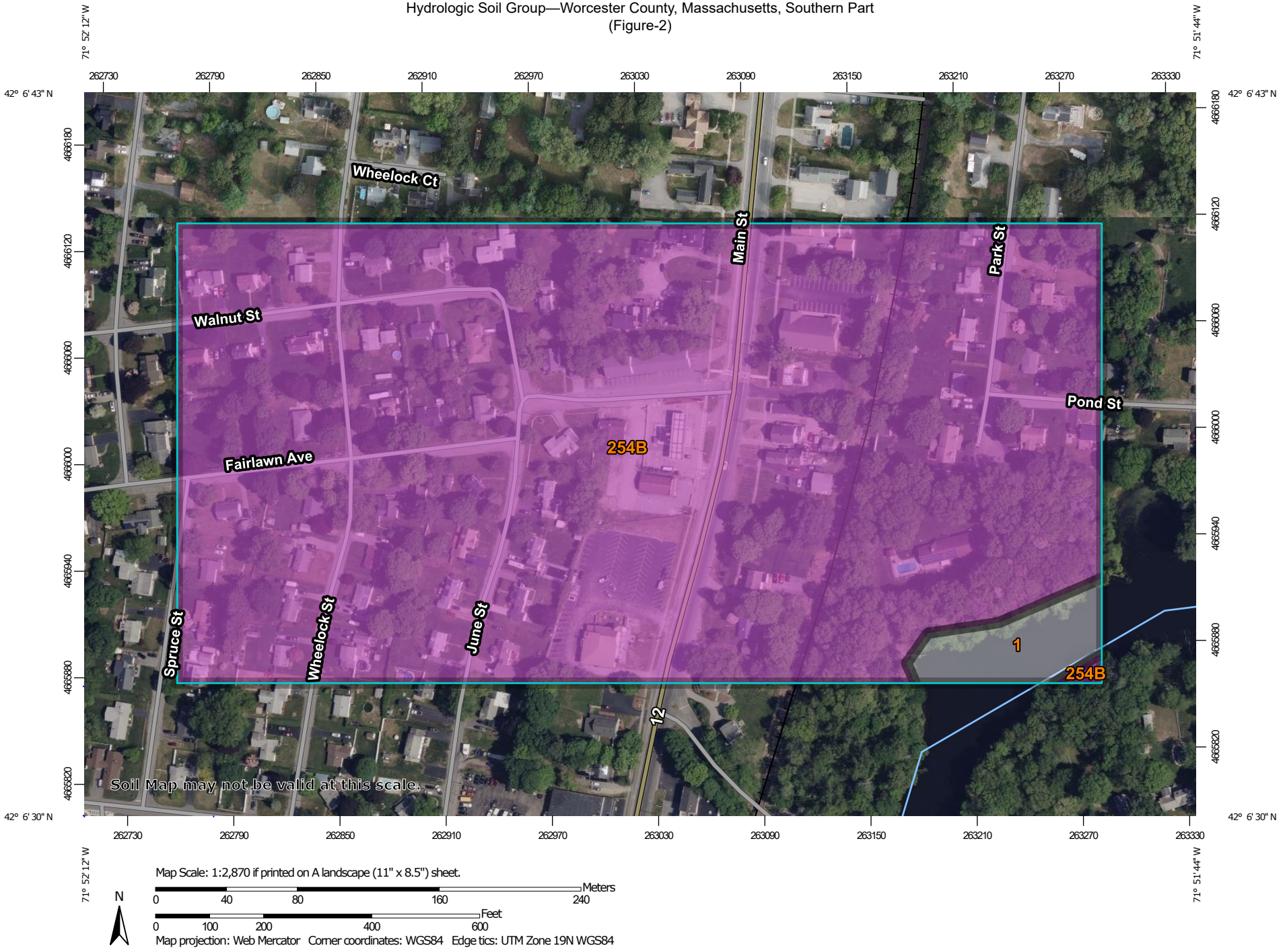
FIGURE-1
USGS PLAN

09/2022

Hydrologic Soil Group—Worcester County, Massachusetts, Southern Part
(Figure-2)



Map Scale: 1:2,870 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 40 80 160 240

Feet: 0 100 200 400 600

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 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: Worcester County, Massachusetts, Southern Part
Survey Area Data: Version 14, Sep 3, 2021

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

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

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
1	Water		1.0	2.9%
254B	Merrimac fine sandy loam, 3 to 8 percent slopes	A	32.6	97.1%
Totals for Area of Interest			**33.6**	**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.

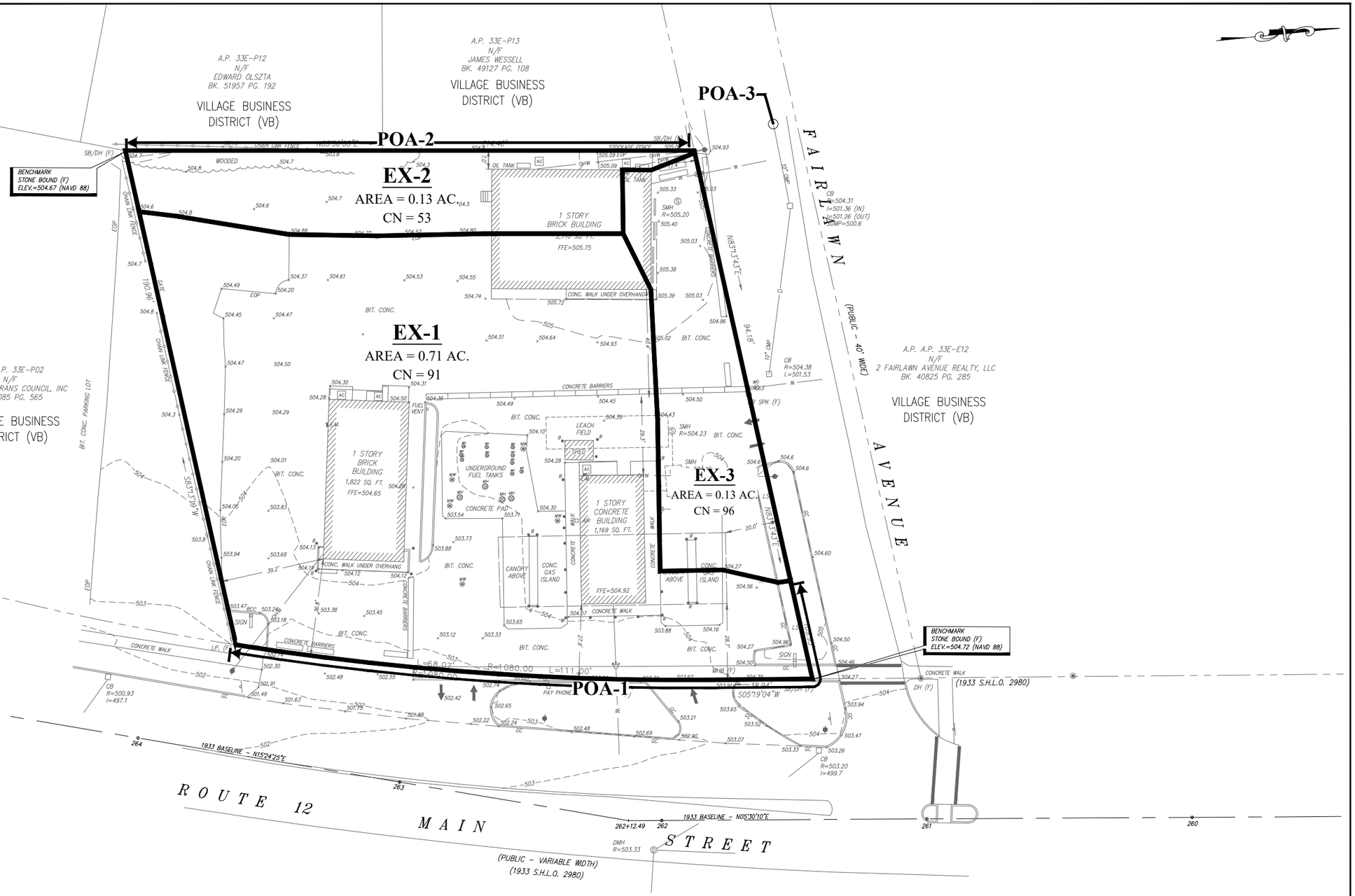
If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

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. 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.

4. ROOFTOP WATERSHEDS WERE DELINEATED BASED ON AERIALS AND ROOF LEADER LOCATIONS.

40 0 20 40 80

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OXFORD, MA 01540

NOT FOR CONSTRUCTION

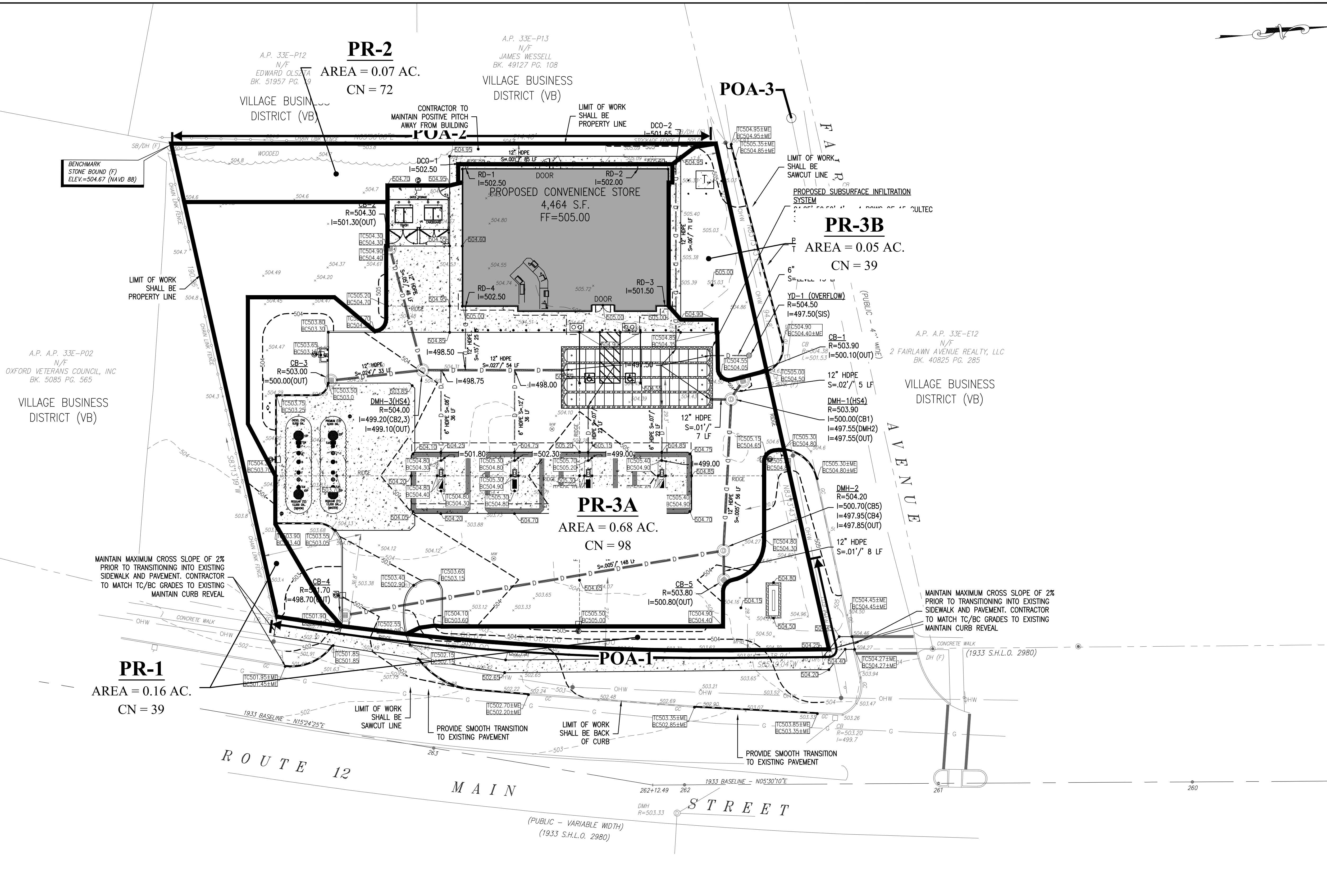
SHEET

PRE-DEVELOPMENT WATERSHEDS

FIG-3

DATE: 09/05/2022

CDG# 21033



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Cumberland Farms

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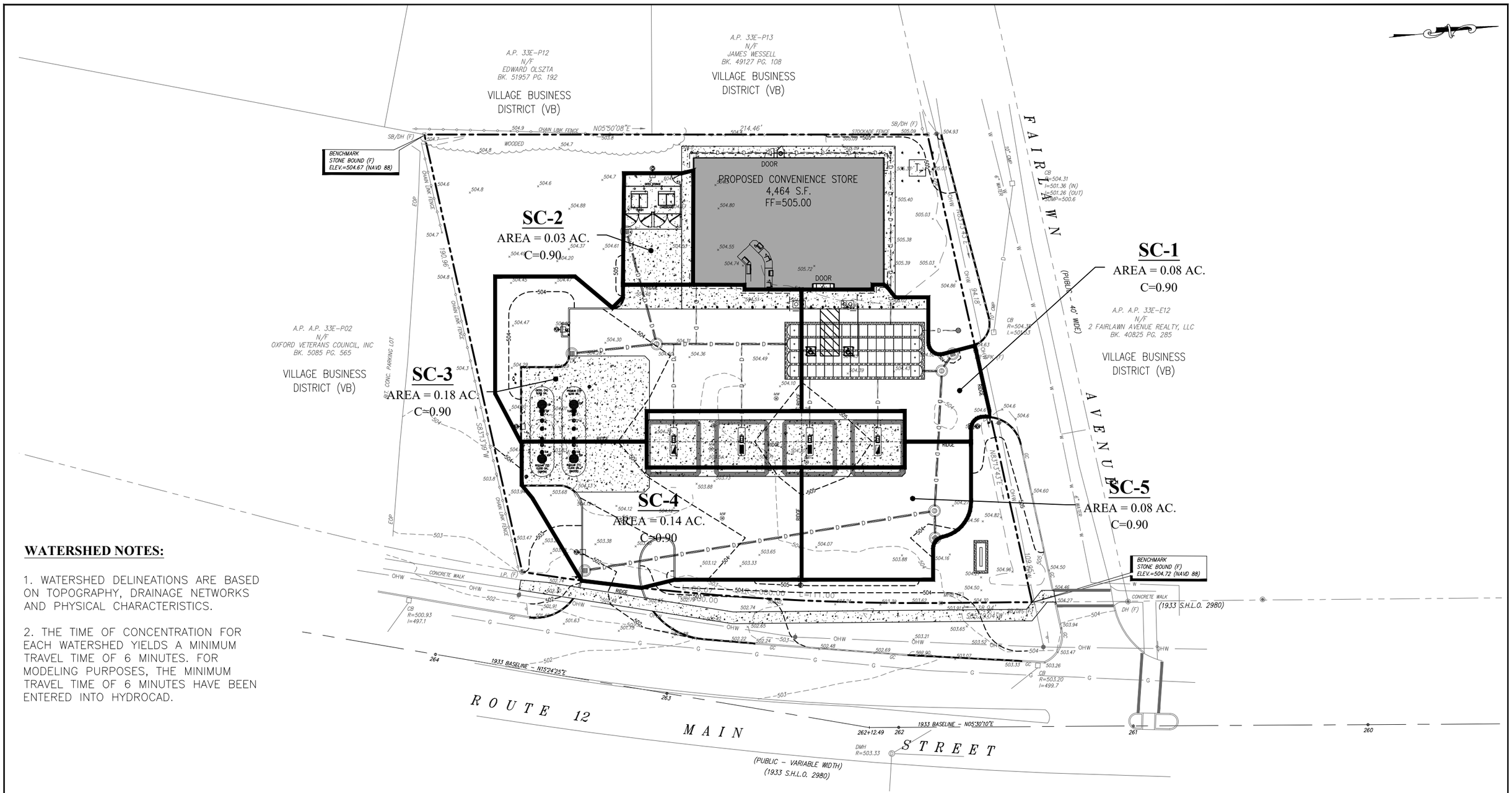
SHEET

POST-DEVELOPMENT WATERSHEDS

FIG-4

DATE: 09/05/2022

CDG# 21033



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NOT FOR CONSTRUCTION

SHEET

POST-DEVELOPMENT SUBCATCHMENTS

FIG-5

DATE: 09/05/2022

CDG# 21033

Hydroworks Sizing Summary

Cumberland Farms

Oxford, Ma DMH-1

08-31-2022

Recommended Size: HydroDome HD 4

A HydroDome HD 4 is recommended to provide 99 % annual TSS removal based on a drainage area of .3 (ac) with an imperviousness of 100 % and Worcester Wso Ap, Massachusetts rainfall for the Hydroworks standard particle size distribution.

The recommended HydroDome HD 4 treats 100 % of the annual runoff and provides 99 % annual TSS removal for the Worcester Wso Ap rainfall records and Hydroworks standard particle size distribution.

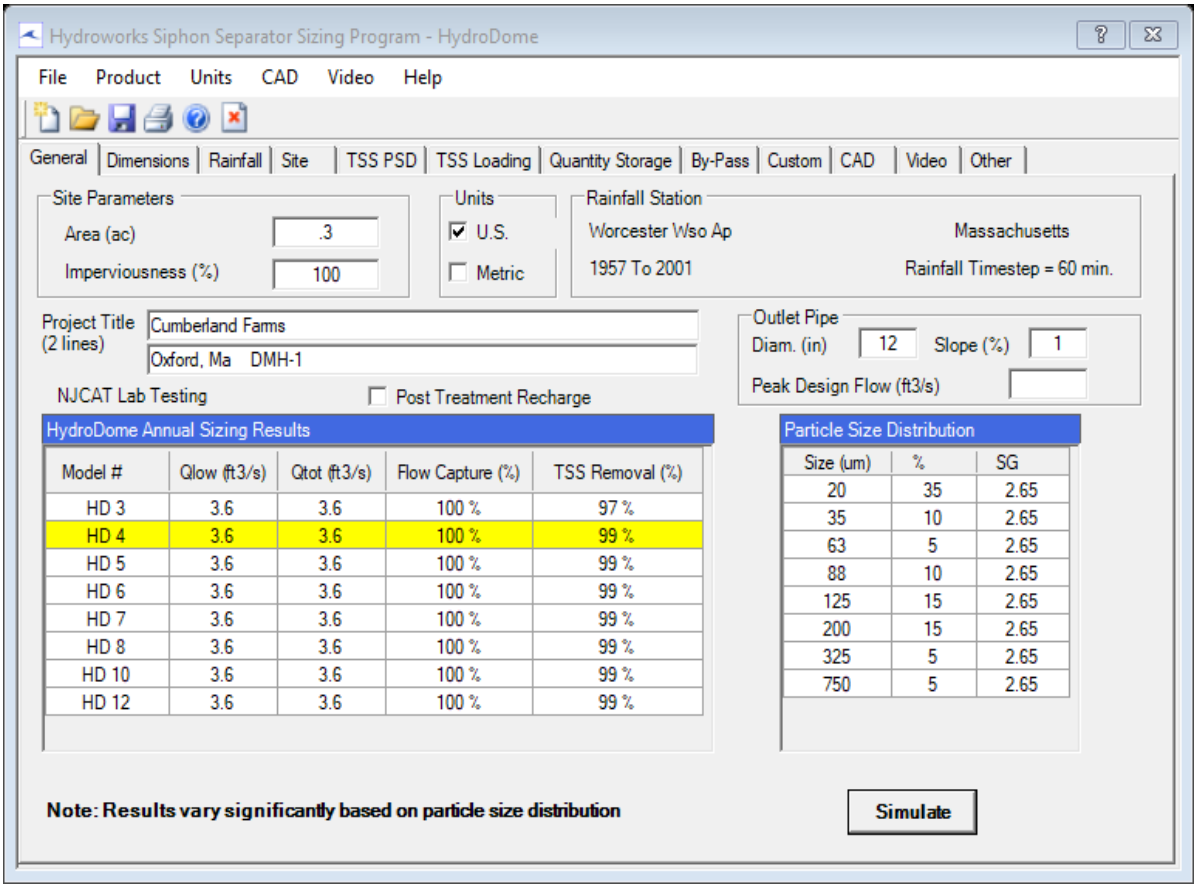
The HydroDome has a siphon which creates a discontinuity in headloss. Since a peak flow was not specified, headloss was calculated using the full pipe flow of 3.56 (ft3/s) for the given 12 (in) pipe diameter at 1% slope. The headloss was calculated to be 12 (in) above the crown of the 12 (in) outlet pipe.

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

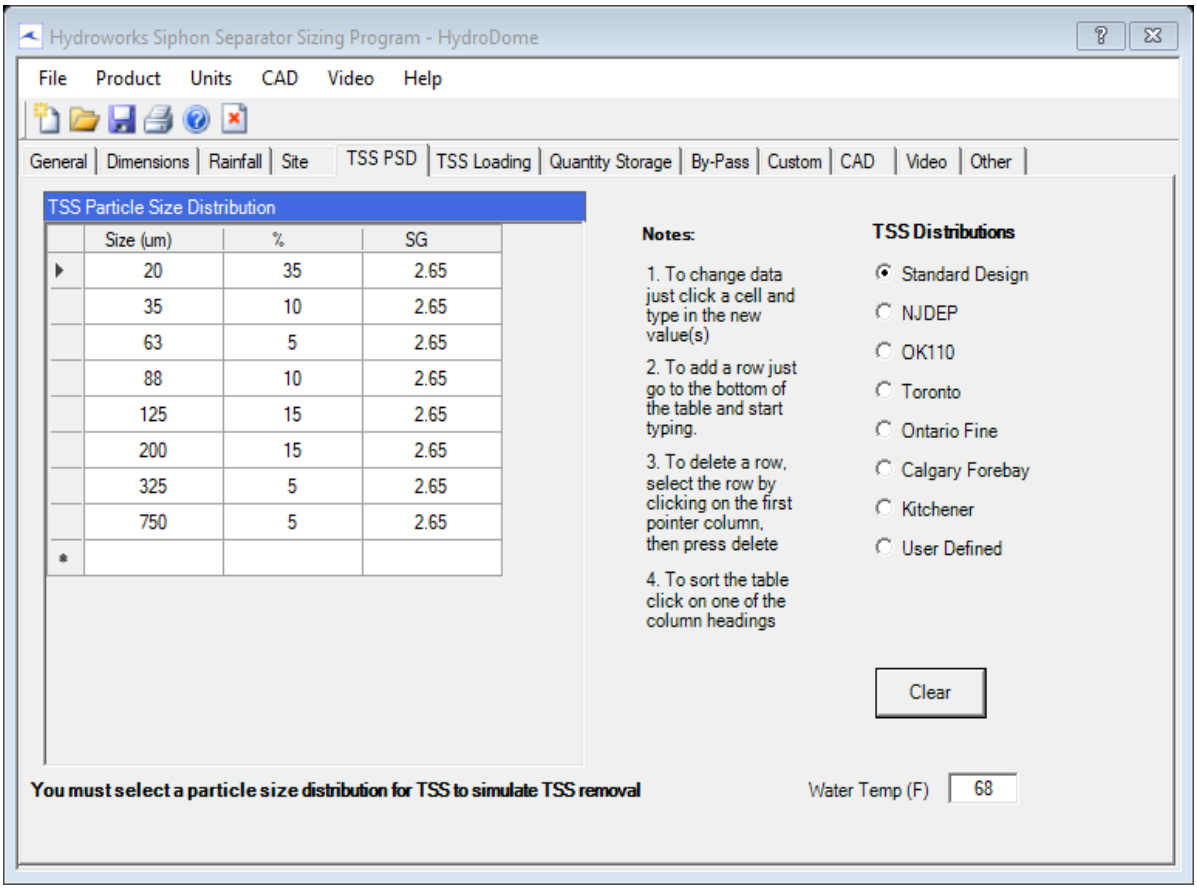
If you have any questions regarding this sizing summary please do not hesitate to contact Hydroworks at 888-290-7900 or email us at support@hydroworks.com.

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

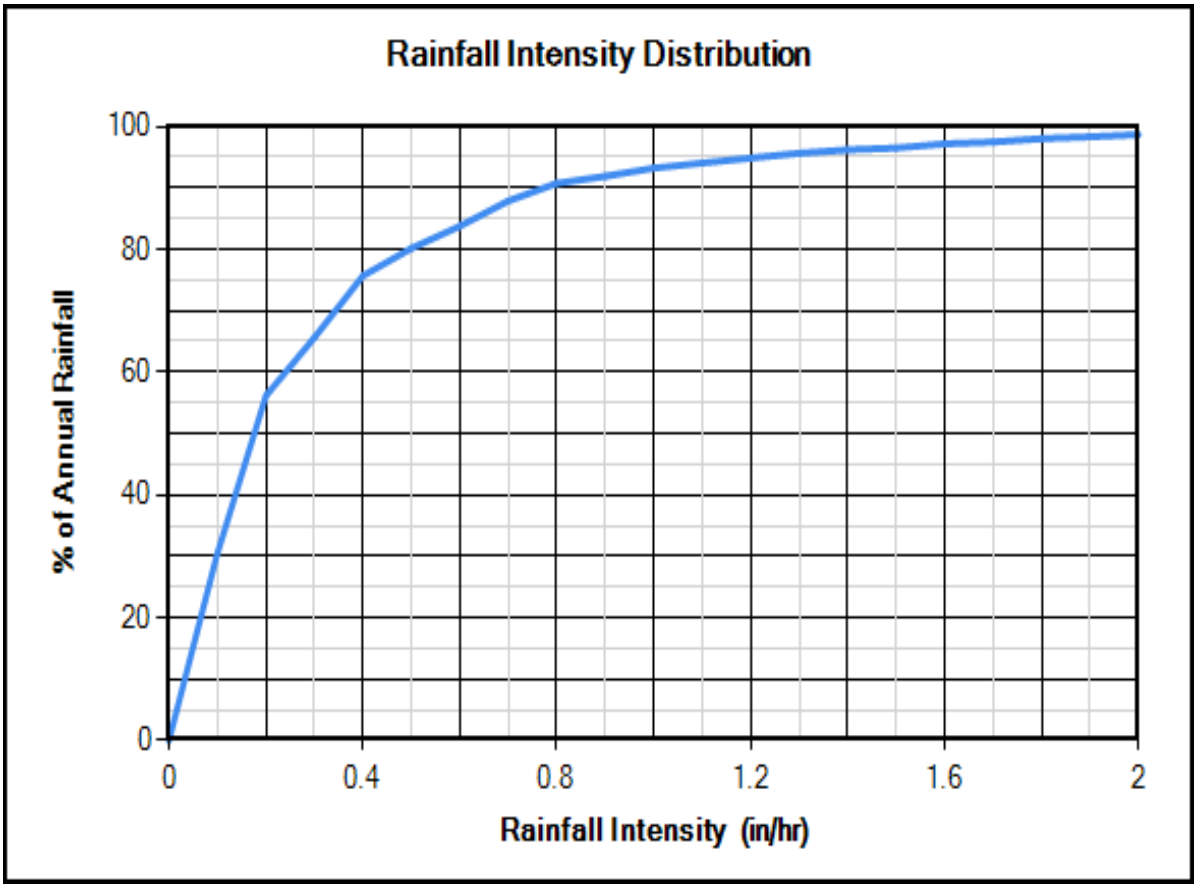
TSS Removal Sizing Summary



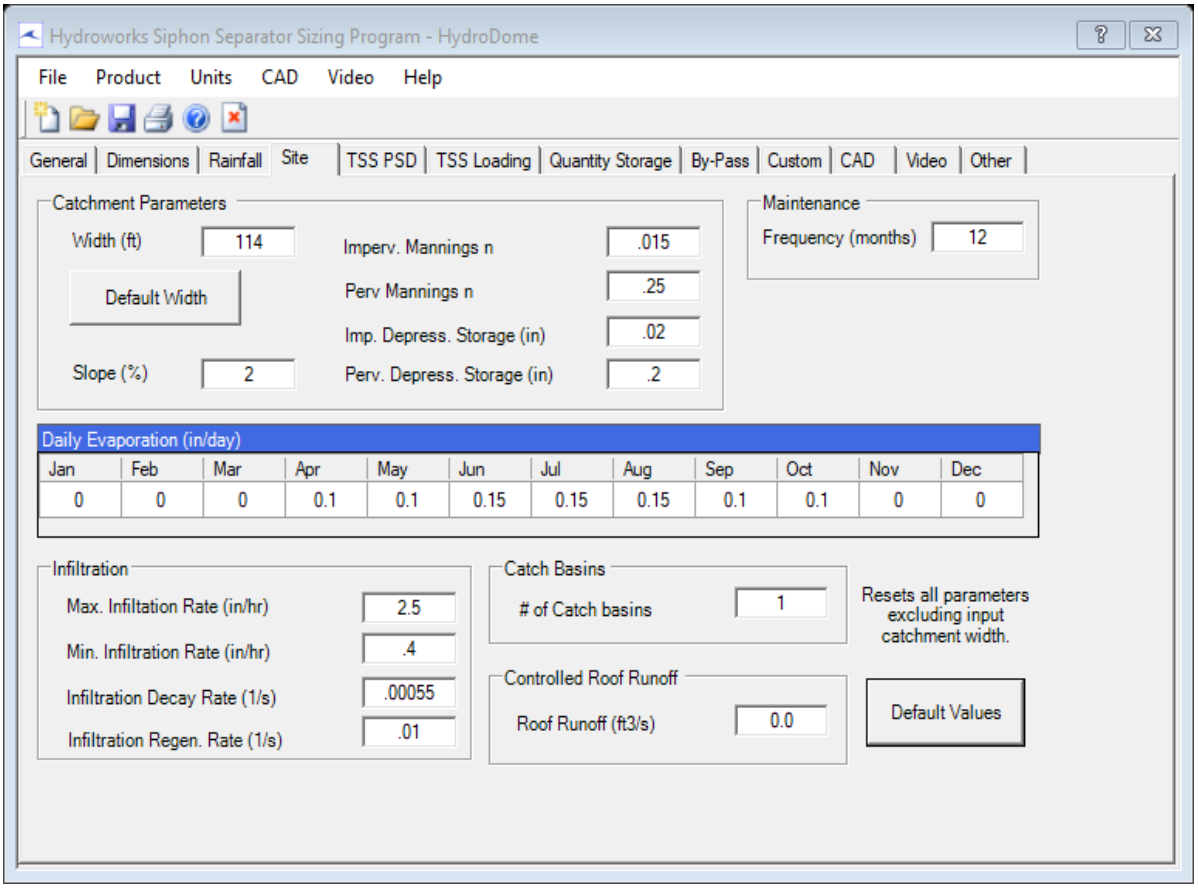
TSS Particle Size Distribution



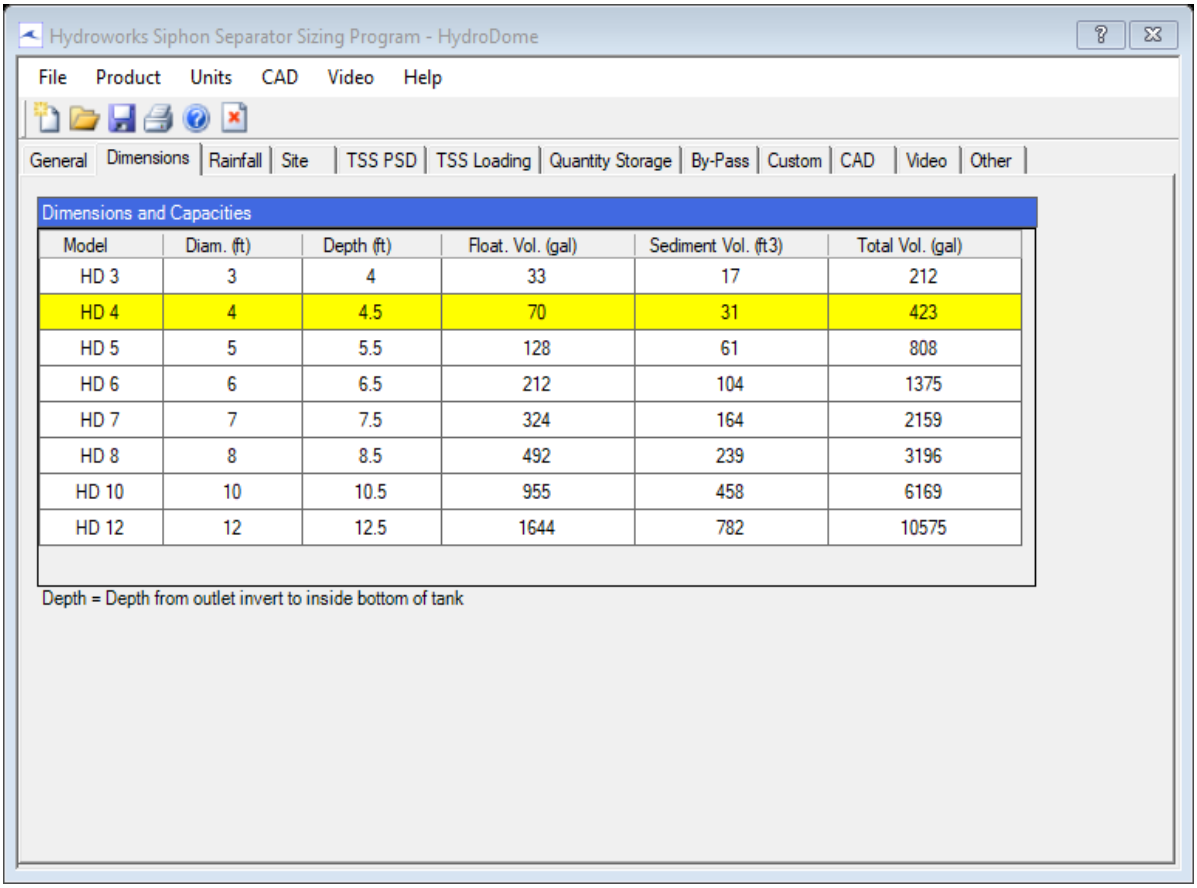
Rainfall Station - Worcester Wso Ap, Massachusetts(1957 To 2001)



Site Physical Characteristics



Dimensions And Capacities

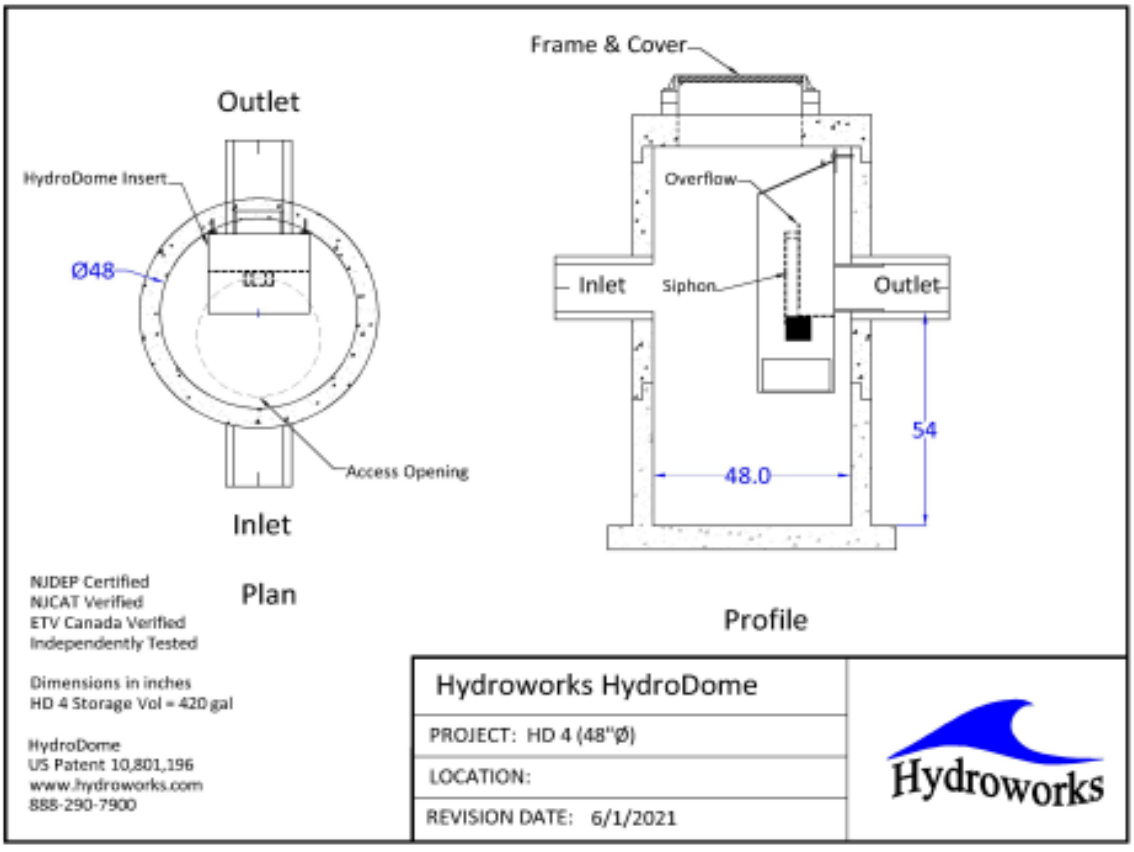


Dimensions and Capacities

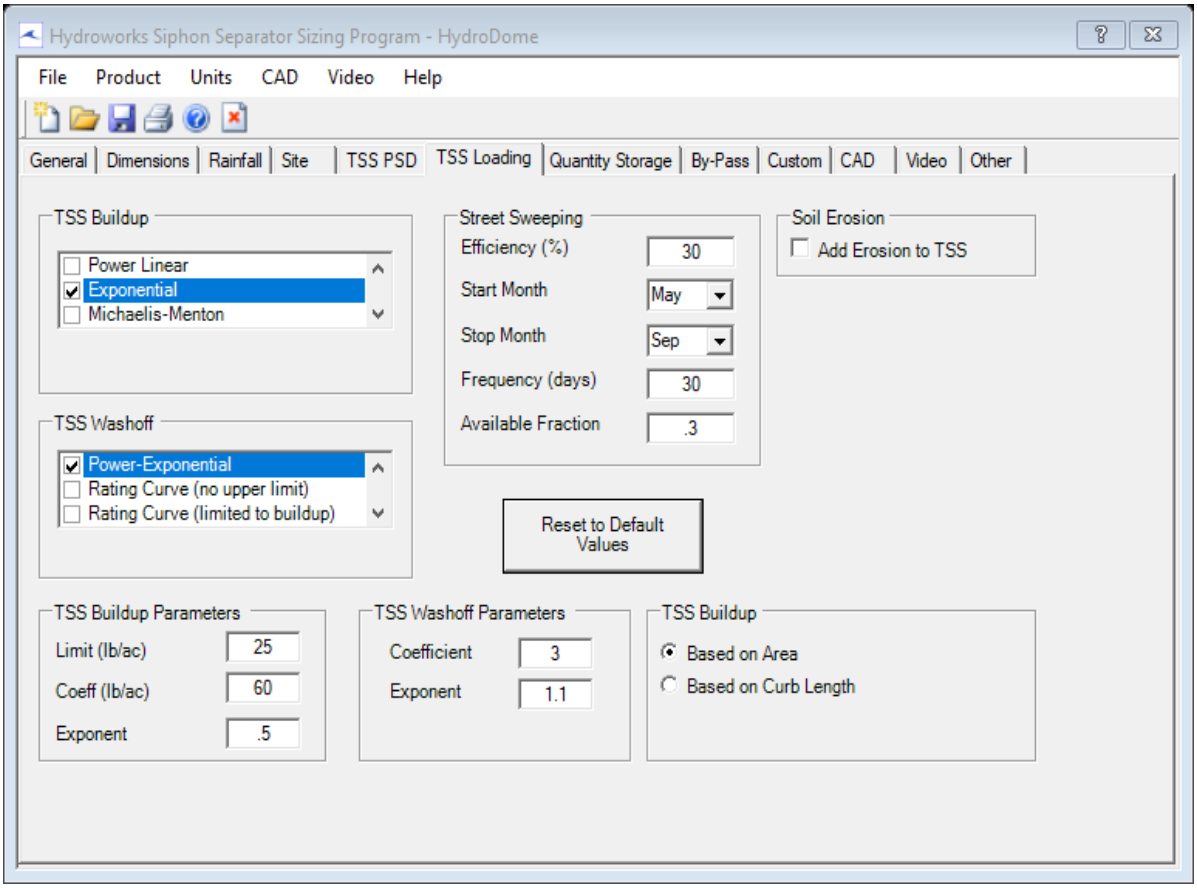
Model	Diam. (ft)	Depth (ft)	Float. Vol. (gal)	Sediment Vol. (ft3)	Total Vol. (gal)
HD 3	3	4	33	17	212
HD 4	4	4.5	70	31	423
HD 5	5	5.5	128	61	808
HD 6	6	6.5	212	104	1375
HD 7	7	7.5	324	164	2159
HD 8	8	8.5	492	239	3196
HD 10	10	10.5	955	458	6169
HD 12	12	12.5	1644	782	10575

Depth = Depth from outlet invert to inside bottom of tank

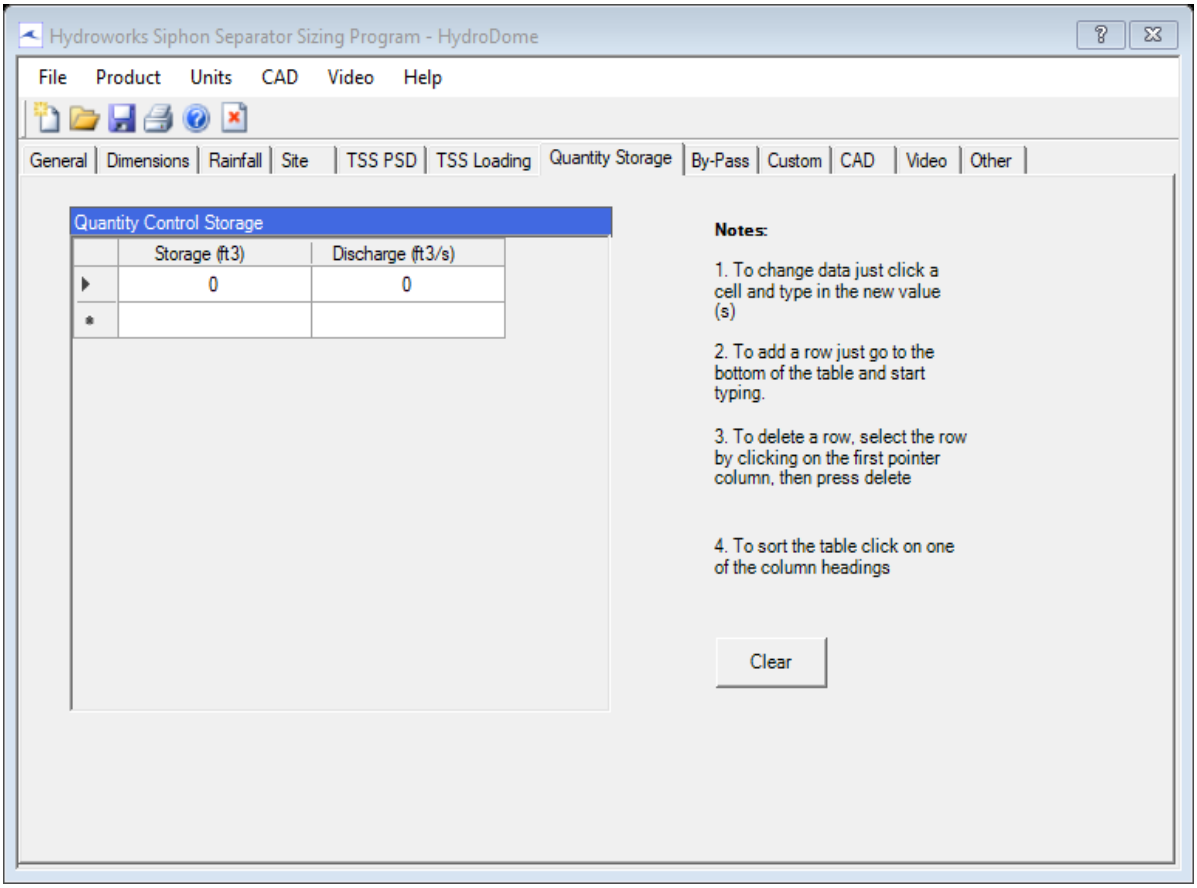
Generic HD 4 CAD Drawing



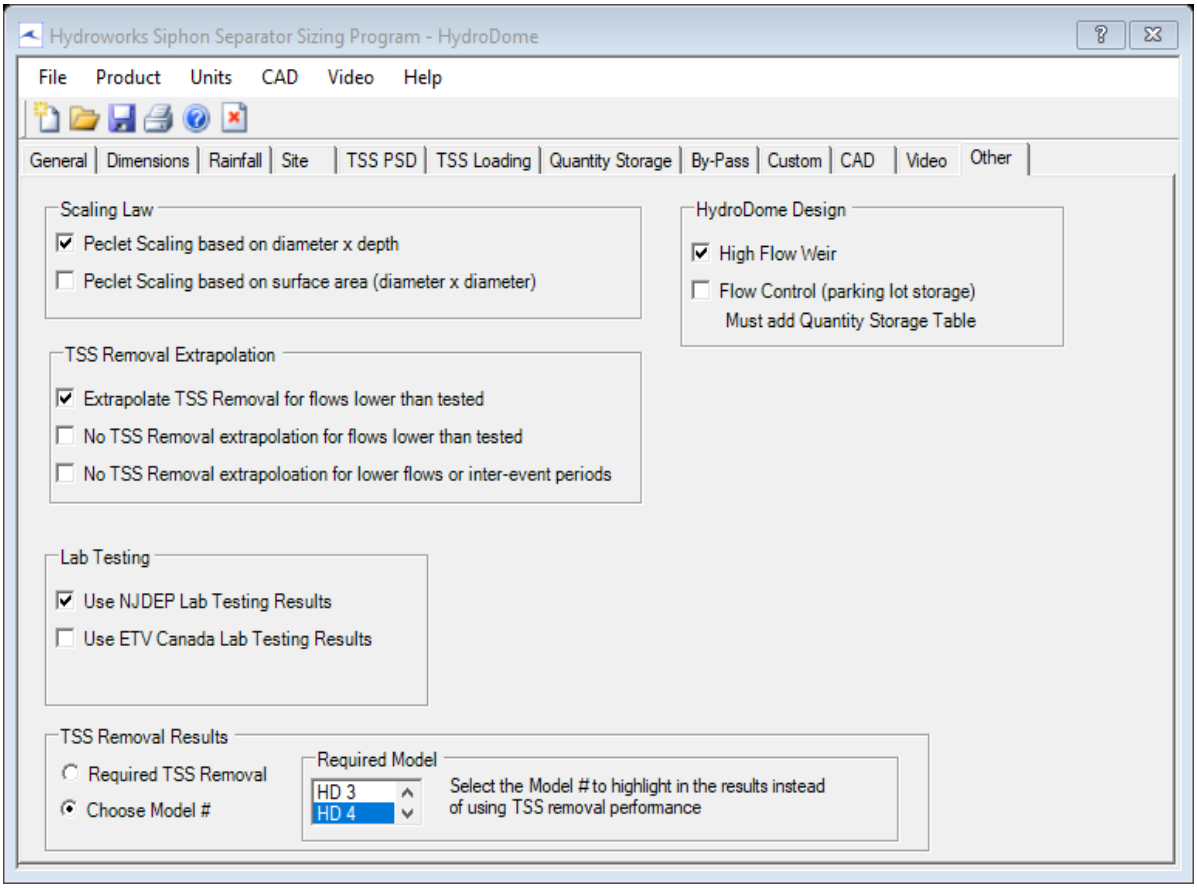
TSS Buildup And Washoff



Upstream Quantity Storage



Other Parameters



Flagged Issues

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

Hydroworks Sizing Program - Version 5.6

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

Hydroworks Sizing Summary

Cumberland Farms
Oxford, Ma DMH-3

08-31-2022

Recommended Size: HydroDome HD 4

A HydroDome HD 4 is recommended to provide 99 % annual TSS removal based on a drainage area of .21 (ac) with an imperviousness of 100 % and Worcester Wso Ap, Massachusetts rainfall for the Hydroworks standard particle size distribution.

The recommended HydroDome HD 4 treats 100 % of the annual runoff and provides 99 % annual TSS removal for the Worcester Wso Ap rainfall records and Hydroworks standard particle size distribution.

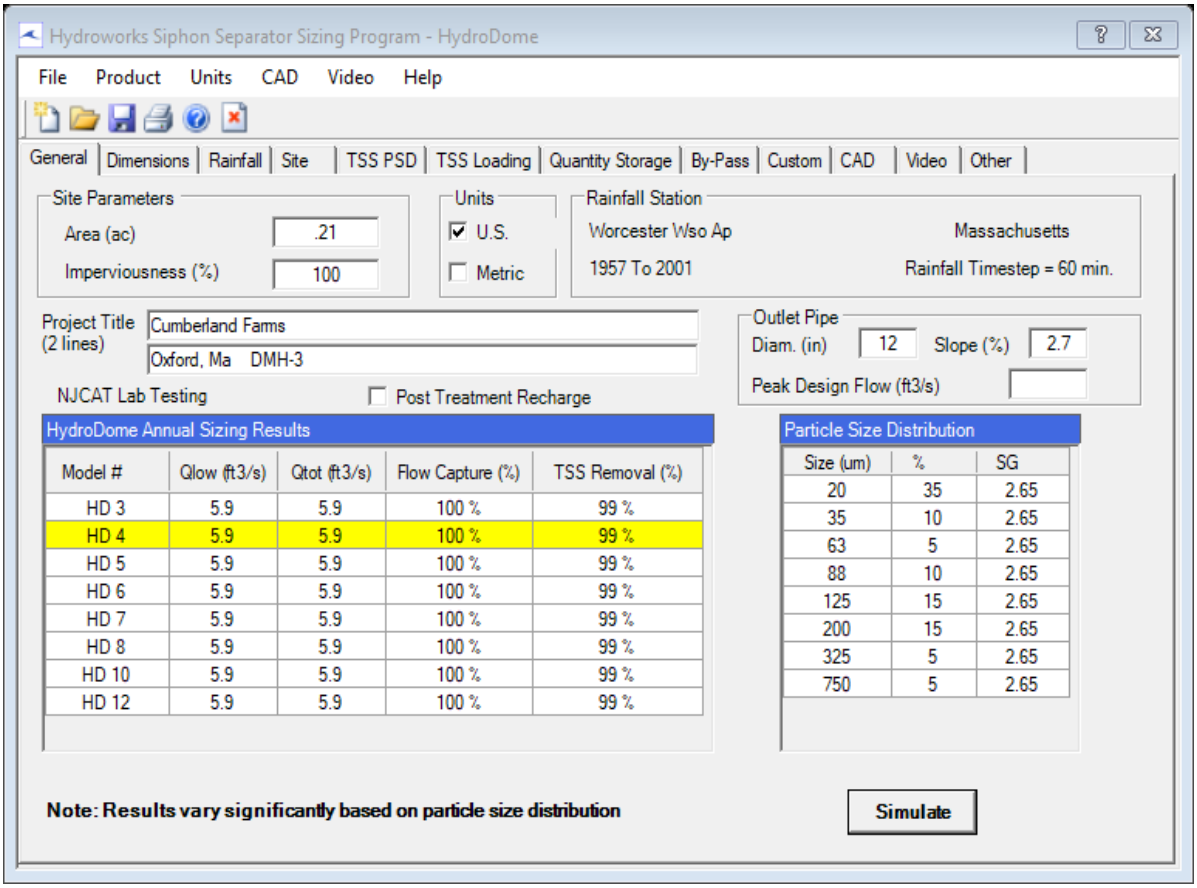
The HydroDome has a siphon which creates a discontinuity in headloss. Since a peak flow was not specified, headloss was calculated using the full pipe flow of 5.85 (ft3/s) for the given 12 (in) pipe diameter at 2.7% slope. The headloss was calculated to be 15 (in) above the crown of the 12 (in) outlet pipe.

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

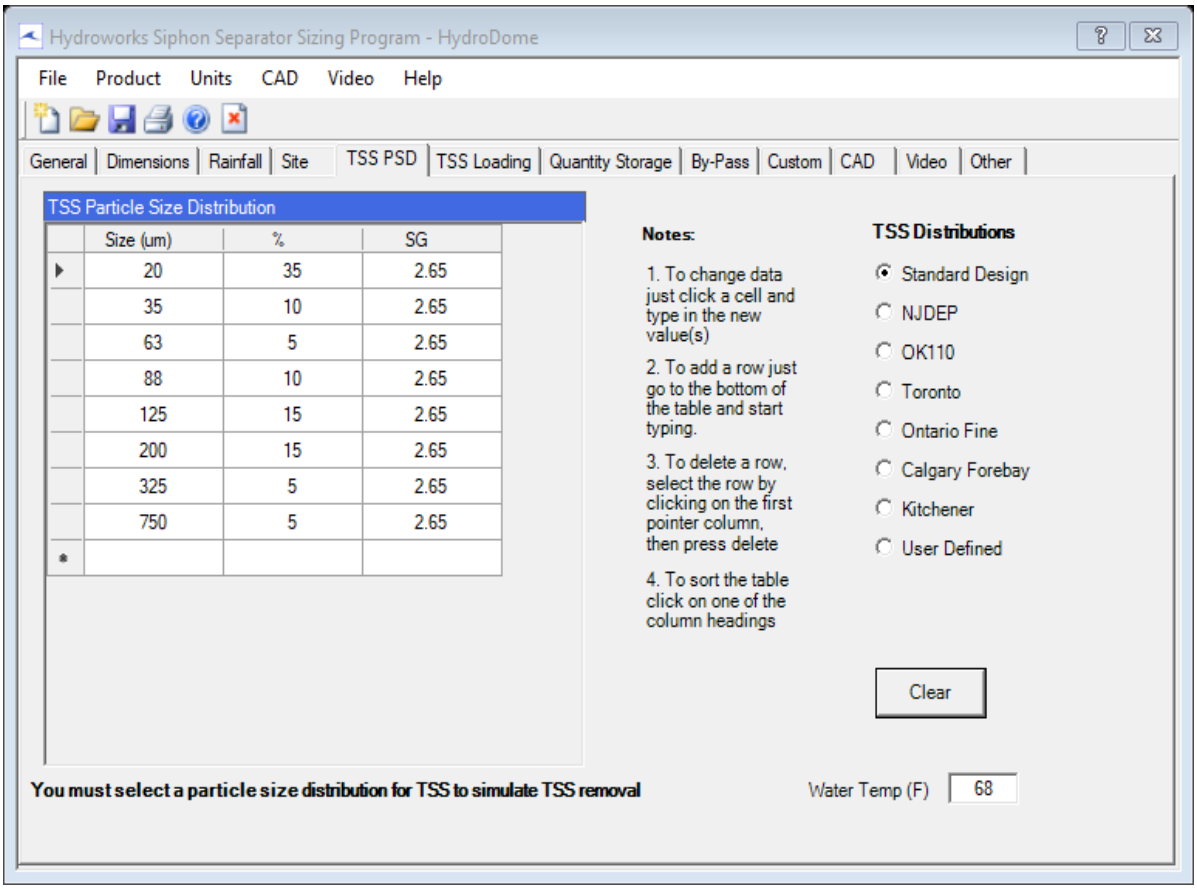
If you have any questions regarding this sizing summary please do not hesitate to contact Hydroworks at 888-290-7900 or email us at support@hydroworks.com.

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

TSS Removal Sizing Summary



TSS Particle Size Distribution



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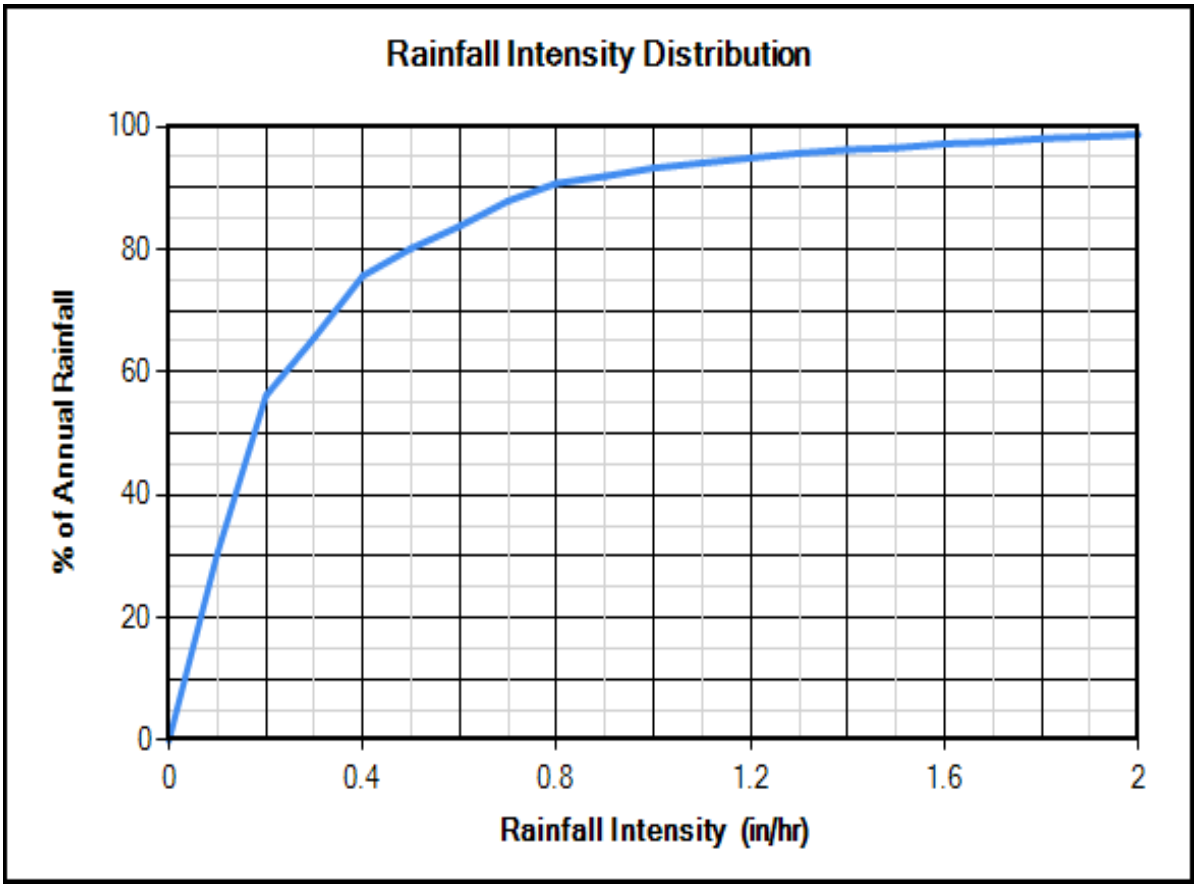
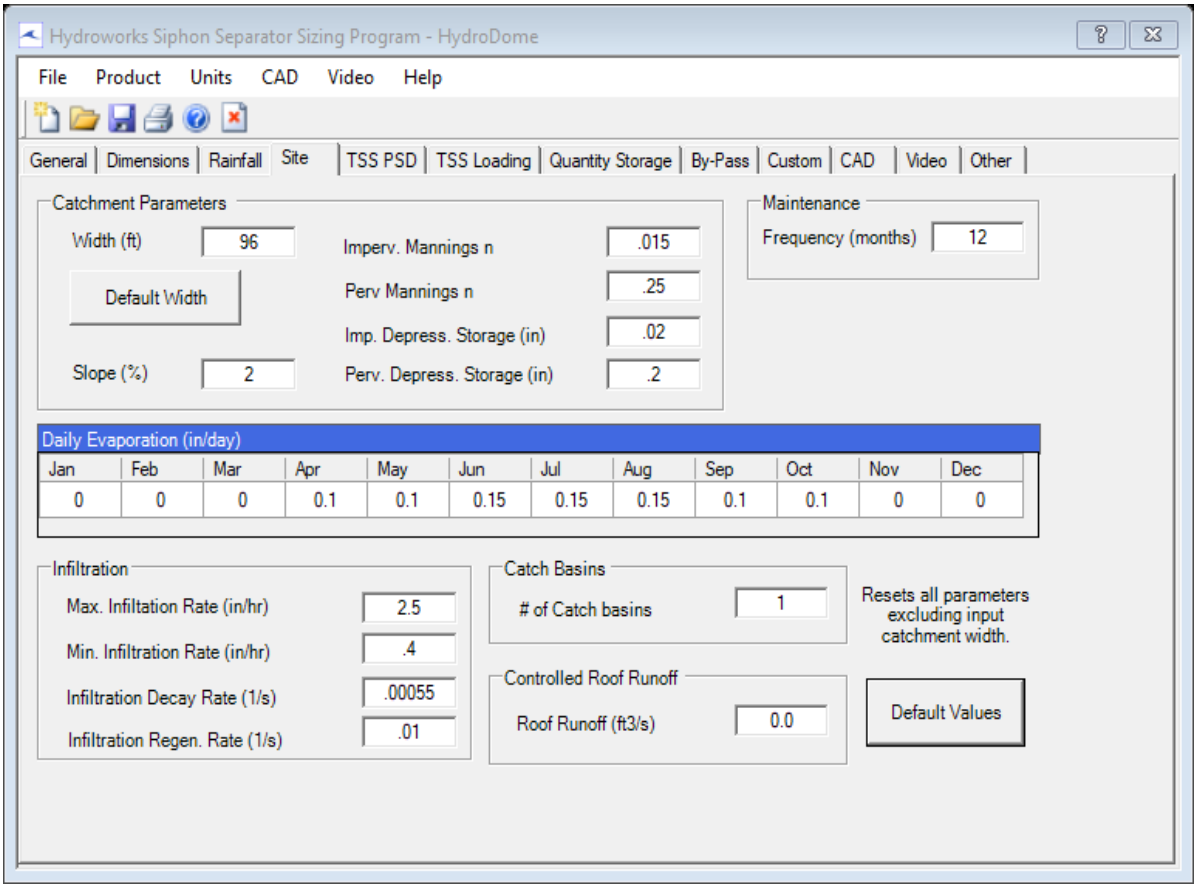
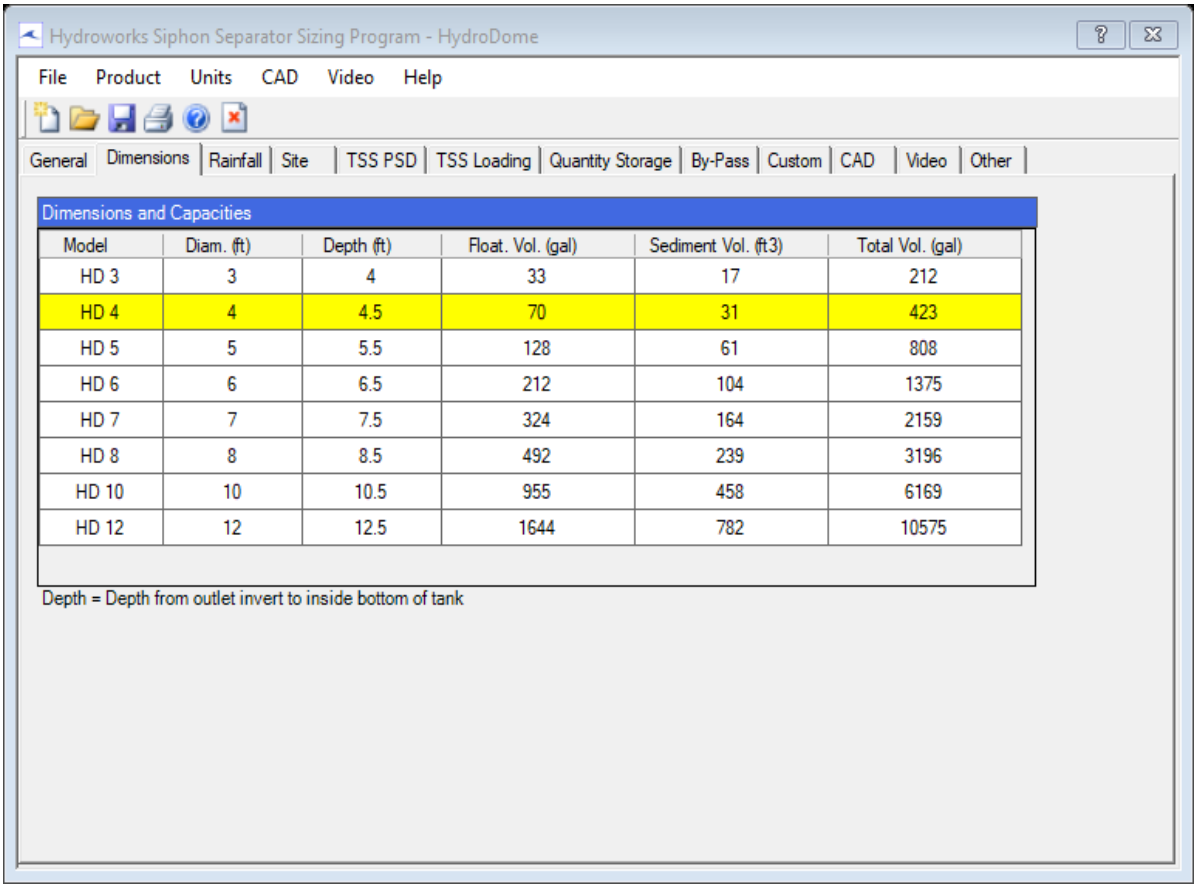


Site Physical Characteristics



Dimensions And Capacities



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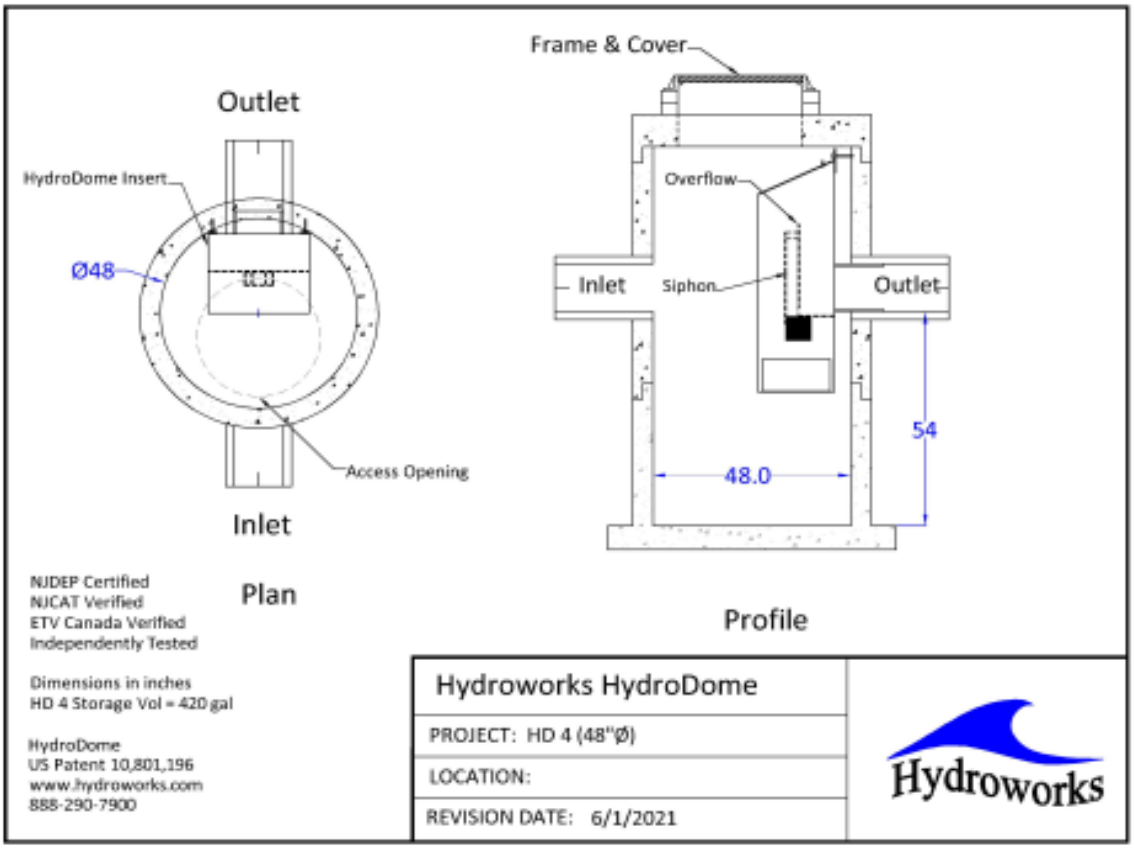
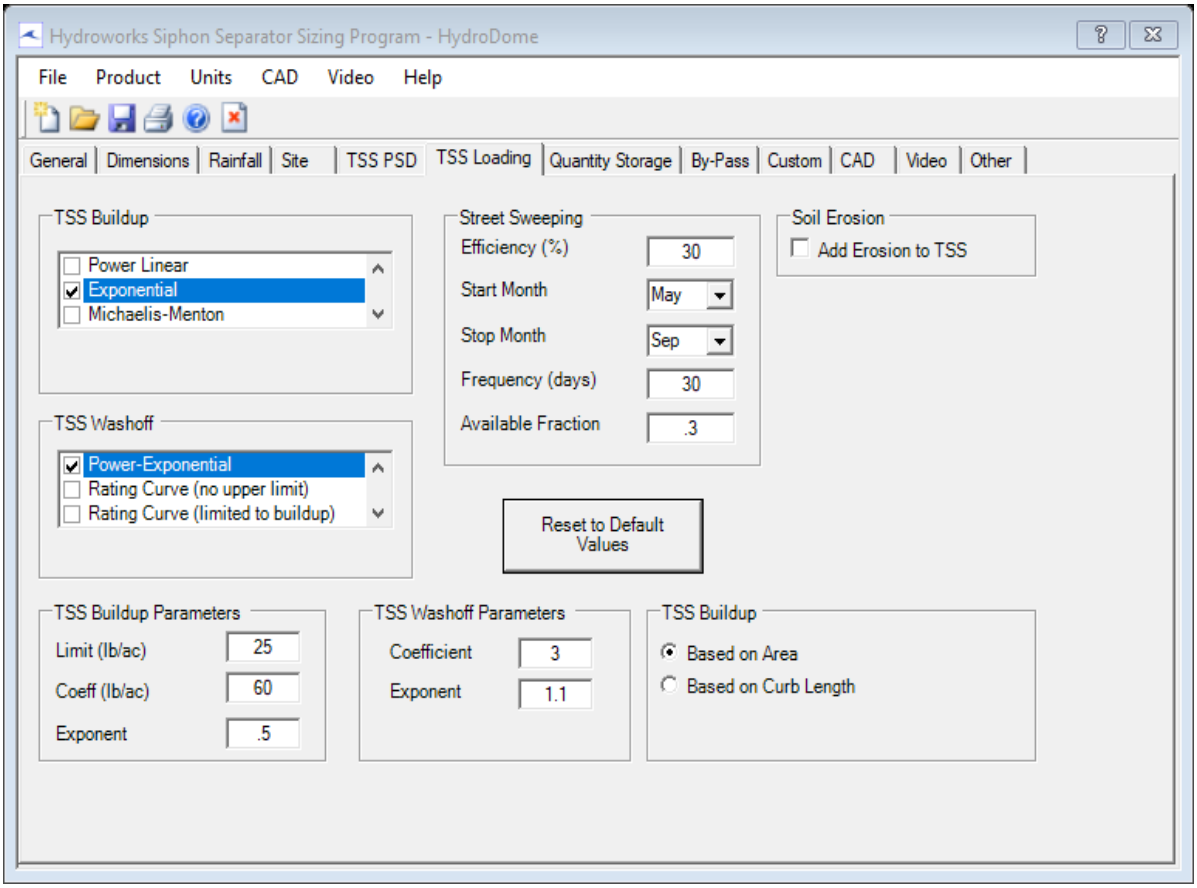
HD 8	8	8.5	492	239	3196
HD 10	10	10.5	955	458	6169
HD 12	12	12.5	1644	782	10575

Depth = Depth from outlet invert to inside bottom of tank

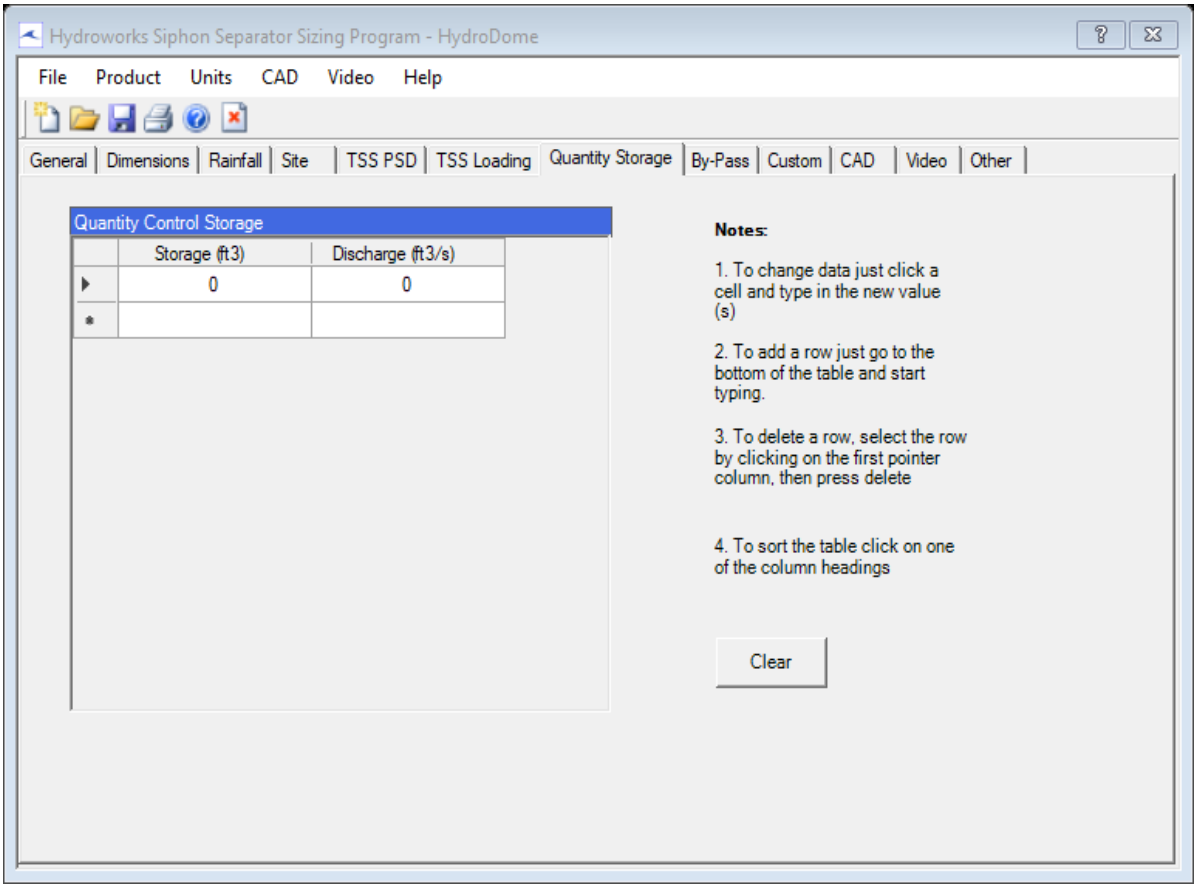
Generic HD 4 CAD Drawing



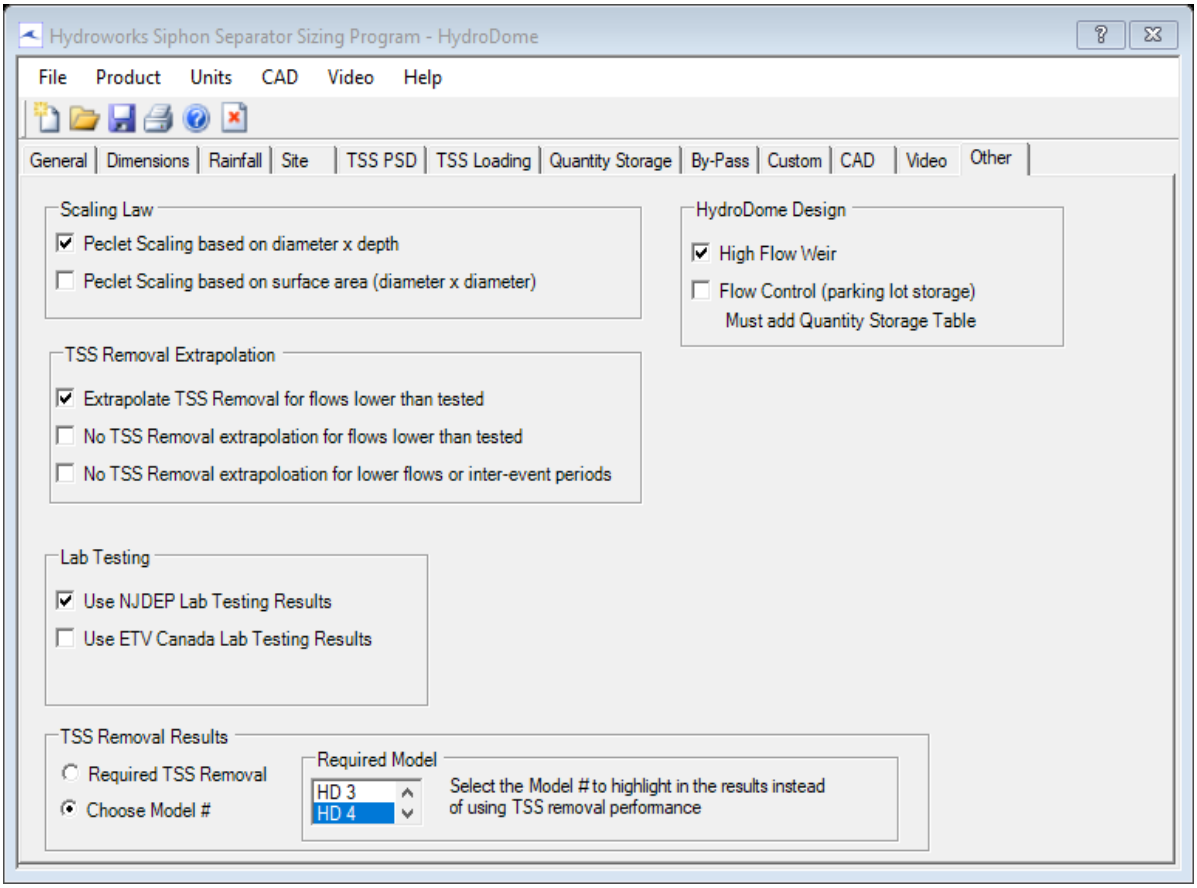
TSS Buildup And Washoff



Upstream Quantity Storage



Other Parameters



Flagged Issues

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

Hydroworks Sizing Program - Version 5.6

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

LEGEND:

● SB-# INDICATES APPROXIMATE LOCATION OF BORINGS PERFORMED BY DRILEX OF AUBURN, MA ON MARCH 2022.

NOTES:

1) BORING LOCATION PLAN OBTAINED FROM A DRAWING TITLED "AERIAL PLAN AP-1" PREPARED BY CIVIL DESIGN GROUP, LLC DATED NOVEMBER 02, 2021.

2) BORING LOCATIONS WERE DETERMINED BY TAPING AND LINE-OF-SIGHT FROM SITE FEATURES. BORING LOCATIONS SHOULD BE CONSIDERED APPROXIMATE.

3) THE RECENT BORINGS WERE OBSERVED BY A KLEINFELDER REPRESENTATIVE ON A FULL-TIME BASIS.

SITE PLAN APPROVAL

CIVIL DESIGN GROUP, LLC 11/02/21 PREPARED BY DATE	OXFORD, MA CITY & STATE
SENIOR MGR. OF NEW DEV. & CONST. SERVICES DATE	TBD STORE# STATION# PROPERTY#
VP OF MARKETING DATE	SITE PLAN REV# & DATE
LAND PLANNING MANAGER DATE	4,464 SF BUILDING GROSS SQ. FOOTAGE
SENIOR VICE PRESIDENT OF STORE OPERATIONS DATE	2 – 20K GAL IN GROUND TANK SIZES
PRESIDENT/CHIEF OPERATING OFFICER DATE	O/S APPRL LOW DIRECTOR OF CONST ☐YES ☐NO / O/S APPRL LOW LND PLAN MGR ☐YES ☐NO
	NPV REQ'D VP, SR. VP'S ☐YES ☐NO / NPV REQ'D REGIONAL ☐YES ☐NO

THIS PLAN IS COMPILED FROM AVAILABLE EXISTING INFORMATION AND IS FOR CONCEPTUAL PLANNING ONLY, FURTHER RESEARCH MAY BE REQUIRED TO VERIFY DIMENSIONS, ZONING REQUIREMENTS, WETLAND LIMITS, FIRE CODES, STATE AND LOCAL PERMITTING, PHYSICAL RESTRAINTS ON SITE, AND TRAFFIC CIRCULATION.

30 0 15 30 60

GRAPHIC SCALE IN FEET

Cumberland FARMS

4,464 PROTO
4 FUEL DISPENSERS
STORE NUMBER: TBD

235 MAIN STREET
5 FAIRLAWN AVENUE
OXFORD, MA

PROJECT TYPE:
RAZE AND REBUILD

KLEINFELDER
Bright People. Right Solutions.

One Beacon Street, Suite 8100
Boston, MA 02108
Phone: 617-497-7800
www.kleinfelder.com

PREPARED BY:

CIVIL DESIGN GROUP, LLC

21 HIGH STREET, SUITE 207
NORTH ANDOVER, MA 01845
www.cdgengineering.com
p: 978-794-5400

REVISIONS:

FIGURE 2

BORING LOCATION PLAN

OXFORD, MA

Date Begin - End:	3/09/2022	**Drilling Company:**	Drilex Enviromental	**BORING LOG SB-1**	
Logged By:	M. Chea	**Drill Crew:**	E. Gravante		
Hor.-Vert. Datum:	WGS84 - NAVD88	**Drilling Equipment:**	CME-75	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Drive and wash with casing		
Weather:	Overcast, 30°F	**Bore Diameter:**	4.5 in. O.D.		

FIELD EXPLORATION

Latitude: 42.11000° N
Longitude: -71.86617° W
Ground Surface Elevation (ft.): 501.00
Surface Condition: Bituminous Pavement

Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)
500	0		**Asphalt** 500.5	G-1										
			G-1: Fill: **Poorly graded SAND with Gravel (SP)**: fine to medium-grained, fine grained subrounded gravel, olive yellow mottled dark bluish gray, moist, PID = 0.0											
			496.0											
495	5		S-1: **Poorly graded SAND with Gravel (SP)**: fine to medium-grained, fine grained subrounded gravel, light brown, moist, medium dense, PID = 0.0	S-1		BC=4 4 8 8	10"							
			S-2: **Poorly graded SAND (SP)**: fine to medium-grained, trace fine-grained angular gravel, light brown, moist, medium dense, PID = 0.0	S-2		BC=8 6 4 3	19"							
	10		490.0	S-3		BC=5 6 5 4	10"							
490 ▽			S-3: Similar to S-2, PID = 0.0											
			S-4: **Silty SAND (SM)**: fine to medium-grained, grayish brown, wet, loose, PID = 0.0	S-4		BC=3 2 2 3	16"							
			487.0											
	15		S-5: **Sandy Lean CLAY (CL)**: fine-grained sand, brown, wet, very stiff, PID = 0.0	S-5		BC=9 13 15 16	15"	CL			100	65		
485			482.0											
	20		S-6: **Silty SAND (SM)**: fine to medium-grained, grayish brown, wet, dense, PID = 1.1	S-6		BC=14 19 17 14	12"							
480			477.0											
	25		S-7: **Sandy Silt (ML)**: non plastic, fine-grained sand, grayish brown, wet, medium stiff, PID = 0.3	S-7		BC=4 2 3 4	16"							
475			S-8: Similar to S-7, PID = 0.2	S-8		BC=4 3 3 3	11"							
	30		470.0											
470														
465	35													

MONITORING WELL CONSTRUCTION*

Completion Method: Flush mount cap in concrete

- Concrete
- 20/40 Sand Pack
- 2" SCH 40 Solid PVC Riser
- Bentonite Chips
- 20/40 Sand Pack
- 2" SCH 40 Slotted 0.010 PVC Screen
- Soil Cuttings

The boring was terminated at approximately 31 ft. below ground surface. The boring was backfilled with soil cuttings, sand, bentonite chips and solid PVC riser on March 09, 2022. Drive and wash with casing started at a depth of 5 ft.

GROUNDWATER LEVEL INFORMATION:
▽ Groundwater was observed at approximately 11 ft below ground surface

GENERAL NOTES:
1. Ground surface elevation is based on MASSMAPPER
2. Borehole was vacuum excavated to 5 ft below ground surface.
3. A PID (ppmv) was used for environmental field screening of soil samples.
4. Monitoring Well installed to a depth of 25 ft.
5. Borings were located by taping and line-of-sight measurements from existing site features. Boring locations should be considered approximate.

KLEINFELDER
Bright People. Right Solutions.

PROJECT NO.:	20153215
DRAWN BY:	NJ
CHECKED BY:	HDF
DATE:	4/7/2022
REVISED:	-

BORING LOG SB-1

CFI-Oxford
235 Main Street
Oxford, MA

PLATE
1
PAGE: 1 of 1

Date Begin - End:	3/09/2022	**Drilling Company:**	Drilex Enviromental	**BORING LOG SB-2**	
Logged By:	M.Chea	**Drill Crew:**	E. Gravante		
Hor.-Vert. Datum:	WGS84 - NAVD88	**Drilling Equipment:**	CME-75	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Drive and wash with casing		
Weather:	Overcast, 30°F	**Bore Diameter:**	4.5 in. O.D.		

FIELD EXPLORATION

Latitude: 42.10998° N
Longitude: -71.86600° W
Ground Surface Elevation (ft.): 501.00
Surface Condition: Bituminous Pavement

Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
500			**Asphalt** 500.5	G-1											
			G-1: Fill: **Poorly graded SAND with Gravel (SP)**: fine to medium-grained, fine-grained subrounded gravel, olive yellow mottled dark bluish gray, dry to moist, PID = 0.0												
			496.0												
495	5		S-1: **Poorly graded SAND with Gravel (SP)**: fine to medium-grained, fine-grained subrounded gravel, light brown, moist, medium dense, PID = 0.0	S-1		BC=5 8 7 10	12"								
			S-2: **Poorly graded SAND (SP)**: fine to medium-grained, trace fine-grained subrounded gravel, light brown, moist, medium dense, PID = 0.2	S-2		BC=12 7 6 6	17"								
			492.0												
490	10		S-3: **Silty SAND (SM)**: fine-grained, grayish brown, moist to wet, loose, PID = 0.1	S-3		BC=4 3 3 2	18"								
			S-4: Similar to S-3, wet, PID = 0.1	S-4		BC=4 4 5 11	16"								
485	15		S-5: **Silty SAND (SM)**: fine-grained, brown, wet, medium dense, PID = 0.5	S-5		BC=11 12 13 13	12"	SM			100	38			
480	20		S-6: Similar to S-5, PID = 1.3	S-6		BC=6 7 4 5	13"								
			477.0												
475	25		S-7: **Sandy Silt (ML)**: Sandy silt, non plastic, fine-grained, grayish brown, wet, medium stiff, PID = 0.4	S-7		BC=5 3 3 4	14"								
470	30		S-8: Similar to S-7, 470.0	S-8		BC=3 4 5 5	NR								
465	35														

LABORATORY RESULTS

The boring was terminated at approximately 31 ft. below ground surface. The boring was backfilled with auger cuttings and patched at surface on March 09, 2022. Drive and wash with casing started at a depth of 5 ft.

GROUNDWATER LEVEL INFORMATION:
▽ Groundwater was observed at approximately 11 ft below ground surface

GENERAL NOTES:
1. Ground surface elevation is based on MASSMAPPER
2. Borehole was vacuum excavated to 5 ft below ground surface.
3. A PID (ppmv) was used for environmental field screening of soil samples.
4. Monitoring Well installed to a depth of 25 ft.
5. Borings were located by taping and line-of-sight measurements from existing site features. Boring locations should be considered approximate.

KLEINFELDER
Bright People. Right Solutions.

PROJECT NO.:	20153215
DRAWN BY:	NJ
CHECKED BY:	HDF
DATE:	4/7/2022
REVISED:	-

BORING LOG SB-2

CFI-Oxford
235 Main Street
Oxford, MA

PLATE
2
PAGE: 1 of 1

BORING LOG SB-3

Date Begin - End:	3/11/2022	**Drilling Company:**	Drilex Enviromental		
Logged By:	N. Jamba	**Drill Crew:**	E. Gravante		
Hor.-Vert. Datum:	WGS84 - NAVD88	**Drilling Equipment:**	CME-75	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Hollow Stem Auger		
Weather:	Overcast, 34°F	**Auger Diameter:**	4.5 in. O.D.		

FIELD EXPLORATION

Latitude: 42.11029° N
Longitude: -71.86601° W
Ground Surface Elevation (ft.): 501.00
Surface Condition: Bituminous Pavement

Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)
500	0		**Asphalt** 500.5	G-1			
			G-1: **Poorly graded SAND with Gravel (SP)**: fine to medium-grained, trace fine-grained subrounded gravel, dark brown sand at 2 to 4 ft., olive yellow, dry to moist, PID = 0.1				
	5		496.0				
495			S-1: **Poorly graded SAND with Silt (SP-SM)**: fine to medium-grained, trace fine-grained subrounded gravel, brown, moist, loose, PID = 0.1	S-1		BC=1 2 3 4	16"
			S-2: **Poorly graded SAND with Silt (SP-SM)**: fine to medium-grained, trace fine grained angular gravel, light brown, moist, loose, PID = 0.2	S-2		BC=6 5 4 4	15"
			S-3: Similar to S-2, PID = 0.0	S-3		BC=3 6 4 5	21"
	10		490.0				
490 ▽			S-4: **Silty SAND (SM)**: fine to medium-grained, grayish brown, wet, loose, PID = 0.0	S-4		BC=4 4 5 3	16"
	15		S-5: Similar to S-4, fine sand, PID = 0.3	S-5		BC=16 18 22 18	20"
485							
	20		S-6: **Silty SAND (SM)**: fine to medium-grained, brown, wet, loose, PID = 0.5	S-6		BC=4 4 2 6	21"
480			479.0				
	25						
475							

LABORATORY RESULTS

USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
SP-SM			100	6.3			

The boring was terminated at approximately 22 ft. below ground surface. The boring was backfilled with auger cuttings and patched at surface on March 11, 2022. Hollow Stem Auger started at a depth of 5 ft.

GROUNDWATER LEVEL INFORMATION:
▽ Groundwater was observed at approximately 11 ft below ground surface

GENERAL NOTES:
1. Ground surface elevation is based on MASSMAPPER
2. Borehole was vacuum excavated to 5 ft below ground surface.
3. A PID (ppmv) was used for environmental field screening of soil samples.
4. Monitoring Well installed to a depth of 25 ft.
5. Borings were located by taping and line-of-sight measurements from existing site features. Boring locations should be considered approximate.

KLEINFELDER
Bright People. Right Solutions.

PROJECT NO.:	20153215
DRAWN BY:	NJ
CHECKED BY:	HDF
DATE:	4/7/2022
REVISED:	-

BORING LOG SB-3

CFI-Oxford
235 Main Street
Oxford, MA

PLATE 3

PAGE: 1 of 1

PLOTTED: 04/11/2022 04:11 PM BY: NJamba

BORING LOG SB-4

Date Begin - End:	3/11/2022	**Drilling Company:**	Drilex Enviromental		
Logged By:	N. Jamba	**Drill Crew:**	E. Gravante		
Hor.-Vert. Datum:	WGS84 - NAVD88	**Drilling Equipment:**	CME-75	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Hollow Stem Auger		
Weather:	Overcast, 34°F	**Auger Diameter:**	4.5 in. O.D.		

FIELD EXPLORATION

Latitude: 42.11051° N
Longitude: -71.86583° W
Ground Surface Elevation (ft.): 501.00
Surface Condition: Bituminous Pavement

Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
			Asphalt 500.5	G-1											
500			G-1: Fill **Poorly graded SAND with Silt (SP)**: fine to medium-grained, fine-grained subrounded gravel, olive yellow, dry to moist, trace gravel, PID = 0.1 499.0	G-2											
			G-2: Fill **Poorly graded SAND with Gravel (SP)**: fine to medium-grained, fine-grained subrounded gravel, glass pieces between 2 to 3 ft, dry to moist, PID = 0.1 496.0												
	5		S-1: **Poorly graded SAND with Gravel (SP)**: fine to medium-grained, fine-grained subrounded gravel, grayish brown, moist, medium dense, PID = 0.0	S-1		BC=4 4 7 11	11"								
495			S-2: **Poorly graded SAND with Gravel (SP)**: fine to medium-grained, fine-grained subrounded gravel, brown, moist, medium dense, PID = 0.2 492.0	S-2		BC=12 8 8 6	16"								
	10		S-3: **Silty SAND with Gravel (SM)**: fine to medium-grained, fine-grained subrounded gravel, brown, moist, medium dense, PID = 0.1	S-3		BC=4 6 6 5	13"	SM			79	15			
490 ▽			S-4: **Silty SAND (SM)**: fine to medium-grained, grayish brown, wet, loose, PID = 0.1	S-4		BC=5 4 4 4	18"								
	15		S-5: Similar to S-4, PID = 0.5	S-5		BC=4 3 3 5	17"								
485															
	20		S-6: Similar to S-4, PID = 0.3	S-6		BC=3 2 3 4	18"								
480			479.0												
475	25														

The boring was terminated at approximately 22 ft. below ground surface. The boring was backfilled with auger cuttings and patched at surface on March 11, 2022. Hollow Stem Auger started at a depth of 5 ft.

GROUNDWATER LEVEL INFORMATION:
▽ Groundwater was observed at approximately 11 ft below ground surface

GENERAL NOTES:
1. Ground surface elevation is based on MASSMAPPER
2. Borehole was vacuum excavated to 5 ft below ground surface.
3. A PID (ppmv) was used for environmental field screening of soil samples.
4. Monitoring Well installed to a depth of 25 ft.
5. Borings were located by taping and line-of-sight measurements from existing site features. Boring locations should be considered approximate.

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PROJECT NO.:	20153215
DRAWN BY:	NJ
CHECKED BY:	HDF
DATE:	4/7/2022
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BORING LOG SB-4

CFI-Oxford
235 Main Street
Oxford, MA

PLATE
4
PAGE: 1 of 1

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Date Begin - End: 3/10/2022 **Drilling Company:** Drilex Enviromental

BORING LOG SB-5

Logged By: N. Jamba **Drill Crew:** E. Gravante

Hor.-Vert. Datum: WGS84 - NAVD88 **Drilling Equipment:** CME-75 **Hammer Type - Drop:** 140 lb. Auto - 30 in.

Plunge: -90 degrees **Drilling Method:** Hollow Stem Auger

Weather: Overcast, 31°F **Auger Diameter:** 4.5 in. O.D.

FIELD EXPLORATION

Latitude: 42.11042° N
Longitude: -71.86626° W
Ground Surface Elevation (ft.): 501.00
Surface Condition: Bituminous Pavement

Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)
500	0		**Asphalt** 500.5	G-1			
			G-1: **Poorly graded SAND with Silt and Gravel (SP-SM)**: fine to medium-grained, fine grained subrounded gravel, olive yellow, moist, PID = 0.0 499.0	G-2			
			G-2: **Poorly graded SAND with Silt (SP-SM)**: fine to medium-grained, fine-grained subrounded gravel, light brown, dry to moist, PID = 0.0 498.0	G-3			
495	5		G-3: **Poorly graded SAND (SP)**: fine to medium-grained, fine-grained subrounded gravel, olive yellow, dry to moist, PID = 0.0 496.0	S-1		BC=7 8 7 7	16"
			S-1: **Poorly graded SAND with Silt and Gravel (SP-SM)**: fine to medium-grained, fine-grained subrounded gravel, brown, moist, medium dense, PID = 0.2	S-2		BC=21 13 12 9	16"
490	10		S-2: **Poorly graded SAND with Silt and Gravel (SP-SM)**: fine to medium-grained, fine-grained subrounded gravel, grayish brown, moist, medium dense, PID = 0.0 490.0	S-3		BC=2 3 4 5	17"
			S-3: Similar to S-2, except loose, PID = 0.1	S-4		BC=8 7 5 3	20"
			S-4: **Silty SAND (SM)**: fine to medium-grained, grayish brown, wet, medium dense, PID = 0.0				
485	15		S-5: Similar to S-4, except loose, PID = 0.1	S-5		BC=3 3 4 4	21"
480	20		S-6: Similar to S-4, except PID = 0.3	S-6		BC=9 10 12 11	22"
475	25		479.0				

LABORATORY RESULTS

USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
SP-SM			69	5.8			

The boring was terminated at approximately 22 ft. below ground surface. The boring was backfilled with auger cuttings and patched at surface on March 10, 2022. Hollow Stem Auger started at a depth of 5 ft.

GROUNDWATER LEVEL INFORMATION:
▽ Groundwater was observed at approximately 11 ft below ground surface

GENERAL NOTES:
1. Ground surface elevation is based on MASSMAPPER
2. Borehole was vacuum excavated to 5 ft below ground surface.
3. A PID (ppmv) was used for environmental field screening of soil samples.
4. Monitoring Well installed to a depth of 25 ft.
5. Borings were located by taping and line-of-sight measurements from existing site features. Boring locations should be considered approximate.

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BORING LOG SB-5

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PLATE 5

PAGE: 1 of 1

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BORING LOG SB-6

Date Begin - End:	3/10/2022	**Drilling Company:**	Drilex Enviromental		
Logged By:	N. Jamba	**Drill Crew:**	E. Gravante		
Hor.-Vert. Datum:	WGS84 - NAVD88	**Drilling Equipment:**	CME-75	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Hollow Stem Auger		
Weather:	Overcast, 31°F	**Auger Diameter:**	4.5 in. O.D.		

FIELD EXPLORATION

Latitude: 42.11027° N
Longitude: -71.86651° W
Ground Surface Elevation (ft.): 501.00
Surface Condition: Bituminous Pavement

Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
500			**Asphalt** 500.5	G-1											
			G-1: Fill: **Poorly graded SAND with Gravel (SP-SM)**: fine to coarse-grained, fine-grained subrounded gravel, olive yellow, dry to moist, PID = 0.8 500.0	G-2											
			G-2: **Poorly graded SAND with Silt (SP-SM)**: fine to coarse-grained, fine-grained subrounded gravel, yellow, dry to moist, PID = 0.1 498.0	G-3											
495	5		G-3: **Poorly graded SAND (SP-SM)**: fine to coarse-grained, fine-grained subrounded gravel, olive yellow, dry to moist, PID = 0.1 496.0	S-1		BC=2 2 7 9	14"	SP-SM			61	5.4			
			S-1: **Poorly graded SAND with Silt and Gravel (SP-SM)**: fine to coarse-grained, fine-grained subrounded gravel, brown, moist, loose, PID = 0.1	S-2		BC=10 10 7 6	11"								
			S-2: **Poorly graded SAND with Silt and Gravel (SP-SM)**: fine to coarse-grained, fine-grained subrounded gravel, brown, moist, medium dense, PID = 0.3 490.0	S-3		BC=7 5 6 8	18"								
490	10		S-3: Similar to S-2, brown, moist, medium dense, PID = 0.2	S-4		BC=7 6 4 4	15"								
			S-4: **Silty SAND (SM)**: fine to medium-grained, brown, wet, medium dense, PID = 0.2												
485	15		S-5 **Silty SAND (SM)**: fine-grained, brown, wet, medium dense, PID = 0.5	S-5		BC=4 5 5 5	18"								
480	20		S-6: Similar to S-4, except loose, PID = 0.0	S-6		BC=5 4 5 4	24"								
			479.0												
475	25														

LABORATORY RESULTS

The boring was terminated at approximately 22 ft. below ground surface. The boring was backfilled with auger cuttings and patched at surface on March 10, 2022. Hollow Stem Auger started at a depth of 5 ft.

GROUNDWATER LEVEL INFORMATION:
▽ Groundwater was observed at approximately 11 ft below ground surface

GENERAL NOTES:
1. Ground surface elevation is based on MASSMAPPER
2. Borehole was vacuum excavated to 5 ft below ground surface.
3. A PID (ppmv) was used for environmental field screening of soil samples.
4. Monitoring Well installed to a depth of 25 ft.
5. Borings were located by taping and line-of-sight measurements from existing site features. Boring locations should be considered approximate.

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BORING LOG SB-6

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235 Main Street
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PLATE
6

PAGE: 1 of 1

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Date Begin - End:	3/10/2022	**Drilling Company:**	Drilex Enviromental	**BORING LOG SB-7**	
Logged By:	N. Jamba	**Drill Crew:**	E. Gravante		
Hor.-Vert. Datum:	WGS84 - NAVD88	**Drilling Equipment:**	CME-75	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Hollow Stem Auger		
Weather:	Overcast, 30°F	**Auger Diameter:**	4.5 in. O.D.		

FIELD EXPLORATION

Latitude: 42.11009° N
Longitude: -71.86638° W
Ground Surface Elevation (ft.): 501.00
Surface Condition: Bituminous Pavement

Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
500			**Asphalt** 500.5	G-1											
			G-1: Fill: **Poorly graded SAND with Gravel (SP-SM)**: fine to coarse-grained, grained, fine to coarse-grained subrounded gravel, dry to moist, PID = 0.0												
			496.0												
495	5		S-1: **Poorly graded SAND with Silt and Gravel (SP-SM)**: fine to coarse-grained, grained, fine to coarse-grained subrounded gravel, brown, moist, medium dense, PID = 0.1	S-1		BC=2 4 9 9	8"	SP-SM			63	12			
			S-2: **Poorly graded SAND with Silt and Gravel (SP-SM)**: fine to coarse-grained, grained, fine to coarse-grained subrounded gravel, grayish brown, moist, medium dense, PID = 0.3	S-2		BC=10 10 9 7	16"								
			492.0												
490	10		S-3: **Silty SAND (SM)**: fine to medium-grained, brown, wet, loose, PID = 0.0	S-3		BC=4 5 5 4	18"								
			S-4: Similar to S-3, PID = 0.0	S-4		BC=6 4 5 4	14"								
			488.0												
485	15														
480	20														
475	25														

The boring was terminated at approximately 13 ft. below ground surface. The boring was backfilled with auger cuttings and patched at surface on March 10, 2022. Hollow Stem Auger started at a depth of 5 ft.

GROUNDWATER LEVEL INFORMATION:
▽ Groundwater was observed at approximately 11 ft below ground surface

GENERAL NOTES:
1. Ground surface elevation is based on MASSMAPPER
2. Borehole was vacuum excavated to 5 ft below ground surface.
3. A PID (ppmv) was used for environmental field screening of soil samples.
4. Monitoring Well installed to a depth of 25 ft.
5. Borings were located by taping and line-of-sight measurements from existing site features. Boring locations should be considered approximate.

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PROJECT NO.:	20153215
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BORING LOG SB-7

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235 Main Street
Oxford, MA

PLATE
7
PAGE: 1 of 1

Date Begin - End:	3/10/2022	**Drilling Company:**	Drilex Enviromental	**BORING LOG SB-8**	
Logged By:	N. Jamba	**Drill Crew:**	E. Gravante		
Hor.-Vert. Datum:	WGS84 - NAVD88	**Drilling Equipment:**	CME-75	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Hollow Stem Auger		
Weather:	Overcast, 30°F	**Auger Diameter:**	4.5 in. O.D.		

Latitude: 42.11011° N
Longitude: -71.86585° W
Ground Surface Elevation (ft.): 501.00
Surface Condition: Bituminous Pavement

Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
500	0		**Asphalt** 500.5	G-1											
			G-1: **Poorly graded SAND with Silt (SP-SM)**: fine to medium-grained, light brown, dry to moist, PID = 0.0												
			497.0												
			G-2: **Poorly graded SAND (SP-SM)**: fine to medium-grained, olive yellow, dry to moist, PID = 0.1 496.0	G-2											
495	5		S-1: **Poorly graded SAND with Gravel (SP)**: fine to medium-grained, subrounded gravel, grayish brown, moist, medium dense, PID = 0.1	S-1		BC=4 6 8 8	12"								
			S-2: **Poorly graded SAND (SP)**: fine to medium-grained, angular, brown, moist, medium dense, PID = 0.0	S-2		BC=6 6 6 5	20"								
			S-3: **Poorly graded SAND (SP)**: fine to medium-graind, angular, brown, moist, loose, PID = 0.2 490.0	S-3		BC=3 5 3 3	24"								
490 ▽	10		S-4: **Sandy Silt (ML)**: fine-grained sand, brown, wet, loose, PID = 0.1	S-4		BC=3 4 4 9	23"								
			S-5: Similar to S-4, except **Sandy Silt (ML)**: fine-grained sand, medium dense, PID = 0.0	S-5		BC=9 7 8 7	16"	ML			100	53			
485	15														
	20		S-6: Similar to S-4 PID = 0.1	S-6		BC=4 5 6 6	24"								
480			479.0												
475	25														

The boring was terminated at approximately 22 ft. below ground surface. The boring was backfilled with auger cuttings and patched at surface on March 10, 2022. Hollow Stem Auger started at a depth of 5 ft.

GROUNDWATER LEVEL INFORMATION:
▽ Groundwater was observed at approximately 11 ft below ground surface

GENERAL NOTES:
1. Ground surface elevation is based on MASSMAPPER
2. Borehole was vacuum excavated to 5 ft below ground surface.
3. A PID (ppmv) was used for environmental field screening of soil samples.
4. Monitoring Well installed to a depth of 25 ft.
5. Borings were located by taping and line-of-sight measurements from existing site features. Boring locations should be considered approximate.

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BORING LOG SB-8

CFI-Oxford
235 Main Street
Oxford, MA

PLATE
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PAGE: 1 of 1

Date Begin - End:	3/07/2022	**Drilling Company:**	Drilex Enviromental
Logged By:	F Niazy	**Drill Crew:**	Enzo G.
Hor.-Vert. Datum:	WGS84 - NAVD88	**Drilling Equipment:**	Hand Auger
Plunge:	-90 degrees	**Drilling Method:**	VacTruck
Weather:	59°F Cloudy	**Exploration Diameter:**	

BORING LOG SB-9

FIELD EXPLORATION

Latitude: 42.11042° N
Longitude: -71.86575° E
Ground Surface Elevation (ft.): 501.00
Surface Condition: Bituminous Pavement

Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)
500	0		**Asphalt** 500.5	G-1			
			G-1: Fill: **Poorly graded SAND (SP)**: fine to medium-grained, fine grained subrounded gravel, olive yellow mottled dark bluish gray, dry to moist, PID = 0.0				
	5		496.0				
495			The boring was terminated at approximately 5 ft. below ground surface. The boring was backfilled with cuttings and patched at surface on March 07, 2022. VacTruck started at a depth of 0 ft.				
	10						
490							

LABORATORY RESULTS

USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during drilling or after completion.

GENERAL NOTES:
1. Ground surface elevation is based on MASSMAPPER
2. Borehole was vacuum excavated to 5 ft below ground surface.
3. A PID (ppmv) was used for environmental field screening of soil samples.
4. Monitoring Well installed to a depth of 25 ft.
5. Borings were located by taping and line-of-sight measurements from existing site features. Boring locations should be considered approximate.

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BORING LOG SB-9

CFI-Oxford
235 Main Street
Oxford, MA

PLATE
9
PAGE: 1 of 1

BORING LOG SB-10

Date Begin - End:	3/07/2022	**Drilling Company:**	Drilex Enviromental
Logged By:	F Niazy	**Drill Crew:**	Enzo G.
Hor.-Vert. Datum:	WGS84 - NAVD88	**Drilling Equipment:**	Hand Auger
Plunge:	-90 degrees	**Drilling Method:**	VacTruck
Weather:	61°F Light Rain	**Exploration Diameter:**	

FIELD EXPLORATION

Latitude: 42.11033° N
Longitude: -71.86610° W
Ground Surface Elevation (ft.): 501.00
Surface Condition: Bituminous Pavement

Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)
500	0		**Asphalt** 500.5	G-1			
			G-1: **Poorly graded SAND with Silt (SP)**: fine to medium-grained, fine-grained subrounded gravel, olive yellow, dry to moist, PID = 0.0 499.0				
	5		G-2: **Poorly graded SAND with Gravel (SP)**: fine to medium-grained, fine-grained subrounded gravel, olive yellow mottled pink, dry to moist, PID = 0.0 496.0	G-2			
495							
490	10						

LABORATORY RESULTS

USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks

The boring was terminated at approximately 5 ft. below ground surface. The boring was backfilled with cuttings and patched at surface on March 07, 2022. VacTruck started at a depth of 0 ft.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during drilling or after completion.

GENERAL NOTES:
1. Ground surface elevation is based on MASSMAPPER
2. Borehole was vacuum excavated to 5 ft below ground surface.
3. A PID (ppmv) was used for environmental field screening of soil samples.
4. Monitoring Well installed to a depth of 25 ft.
5. Borings were located by taping and line-of-sight measurements from existing site features. Boring locations should be considered approximate.

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BORING LOG SB-10

CFI-Oxford
235 Main Street
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PLATE
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BORING LOG SB-11

Date Begin - End:	3/07/2022	**Drilling Company:**	Drilex Enviromental
Logged By:	F Niazy	**Drill Crew:**	Enzo G.
Hor.-Vert. Datum:	WGS84 - NAVD88	**Drilling Equipment:**	Hand Auger
Plunge:	-90 degrees	**Drilling Method:**	VacTruck
Weather:	48°F Partly Cloudy	**Exploration Diameter:**	

FIELD EXPLORATION

Latitude: 42.11049° N
Longitude: -71.86660° W
Ground Surface Elevation (ft.): 501.00
Surface Condition: Bituminous Pavement

Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
500	0		**Asphalt** 500.5	G-1											
			G-1: Fill **Poorly graded SAND with Silt (SP)**: fine to medium-grained, trace fine-grained subrounded gravel, olive yellow, dry to moist, trace organics top 2 ft, PID = 0.0												
			497.0												
495	5														
490	10														

The boring was terminated at approximately 4 ft. below ground surface. The boring was backfilled with cuttings and patched at surface on March 07, 2022. VacTruck started at a depth of 0 ft.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during drilling or after completion.

GENERAL NOTES:
1. Ground surface elevation is based on MASSMAPPER
2. Borehole was vacuum excavated to 5 ft below ground surface.
3. A PID (ppmv) was used for environmental field screening of soil samples.
4. Monitoring Well installed to a depth of 25 ft.
5. Borings were located by taping and line-of-sight measurements from existing site features. Boring locations should be considered approximate.

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BORING LOG SB-11

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PLATE
11

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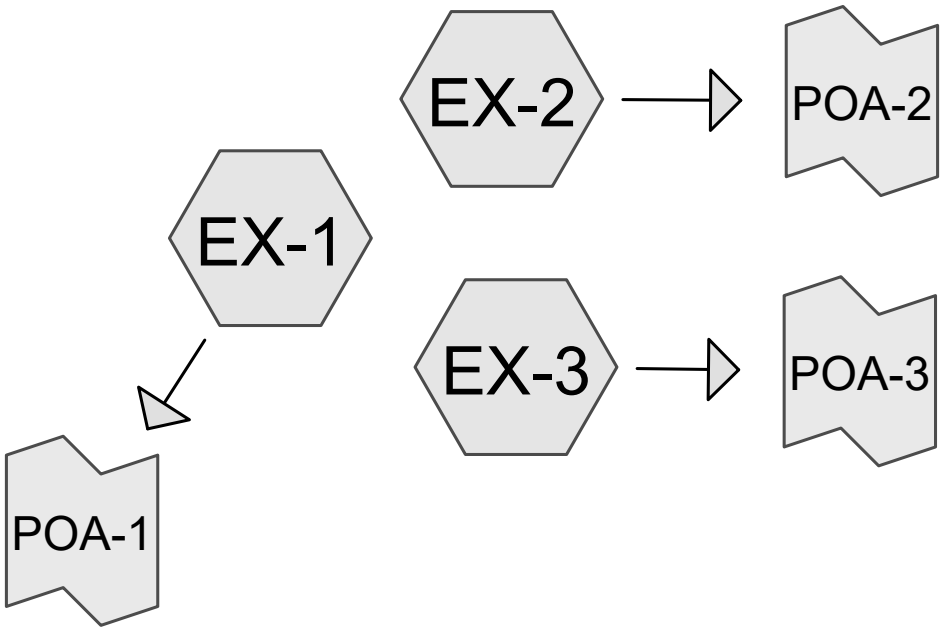


Subcat Reach Pond Link

Routing Diagram for Pre Development Conditions
Prepared by {enter your company name here}, Printed 9/1/2022

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.182	39	>75% Grass cover, Good, HSG A (EX-1, EX-2, EX-3)
0.653	98	Paved parking, HSG A (EX-1, EX-2, EX-3)
0.131	98	Roofs, HSG A (EX-1, EX-2, EX-3)
0.966	**87**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.966	HSG A	EX-1, EX-2, EX-3
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.000	Other	
0.966		**TOTAL AREA**

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment EX-1: Runoff Area=30,842 sf 88.94% Impervious Runoff Depth>2.65"
Tc=6.0 min CN=39/98 Runoff=1.76 cfs 0.157 af

Subcatchment EX-2: Runoff Area=5,710 sf 24.50% Impervious Runoff Depth>0.73"
Tc=6.0 min CN=39/98 Runoff=0.09 cfs 0.008 af

Subcatchment EX-3: Runoff Area=5,519 sf 96.59% Impervious Runoff Depth>2.88"
Tc=6.0 min CN=39/98 Runoff=0.34 cfs 0.030 af

Link POA-1: Inflow=1.76 cfs 0.157 af
Primary=1.76 cfs 0.157 af

Link POA-2: Inflow=0.09 cfs 0.008 af
Primary=0.09 cfs 0.008 af

Link POA-3: Inflow=0.34 cfs 0.030 af
Primary=0.34 cfs 0.030 af

Total Runoff Area = 0.966 ac Runoff Volume = 0.195 af Average Runoff Depth = 2.42"
18.80% Pervious = 0.182 ac 81.20% Impervious = 0.784 ac

Summary for Subcatchment EX-1:

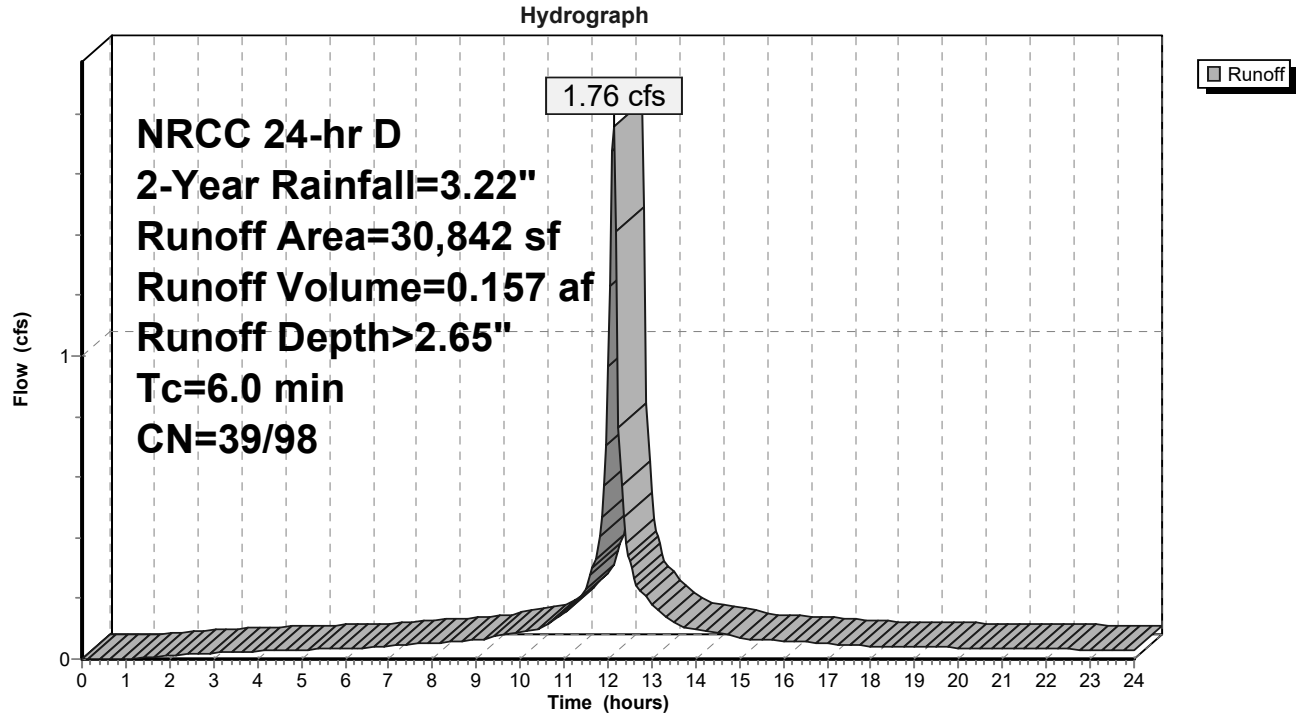
Runoff = 1.76 cfs @ 12.13 hrs, Volume= 0.157 af, Depth> 2.65"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 0.00-24.00 hrs, dt= 0.05
NRCC 24-hr D 2-Year Rainfall=3.22"

Area (sf)	CN	Description
4,140	98	Roofs, HSG A
3,412	39	>75% Grass cover, Good, HSG A
23,290	98	Paved parking, HSG A
30,842	91	Weighted Average
3,412	39	11.06% Pervious Area
27,430	98	88.94% Impervious Area

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

Subcatchment EX-1:



Summary for Subcatchment EX-2:

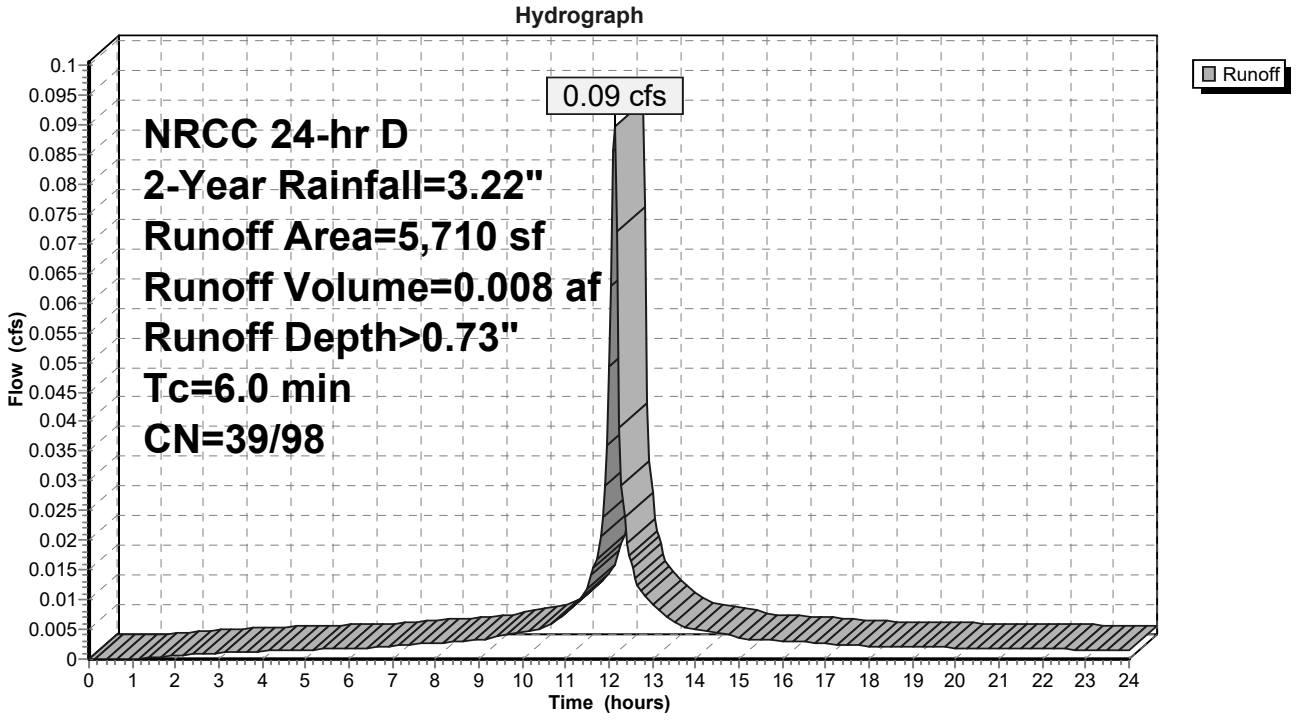
Runoff = 0.09 cfs @ 12.13 hrs, Volume= 0.008 af, Depth> 0.73"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 0.00-24.00 hrs, dt= 0.05
NRCC 24-hr D 2-Year Rainfall=3.22"

Area (sf)	CN	Description
1,187	98	Roofs, HSG A
4,311	39	>75% Grass cover, Good, HSG A
212	98	Paved parking, HSG A
5,710	53	Weighted Average
4,311	39	75.50% Pervious Area
1,399	98	24.50% Impervious Area

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

Subcatchment EX-2:



Summary for Subcatchment EX-3:

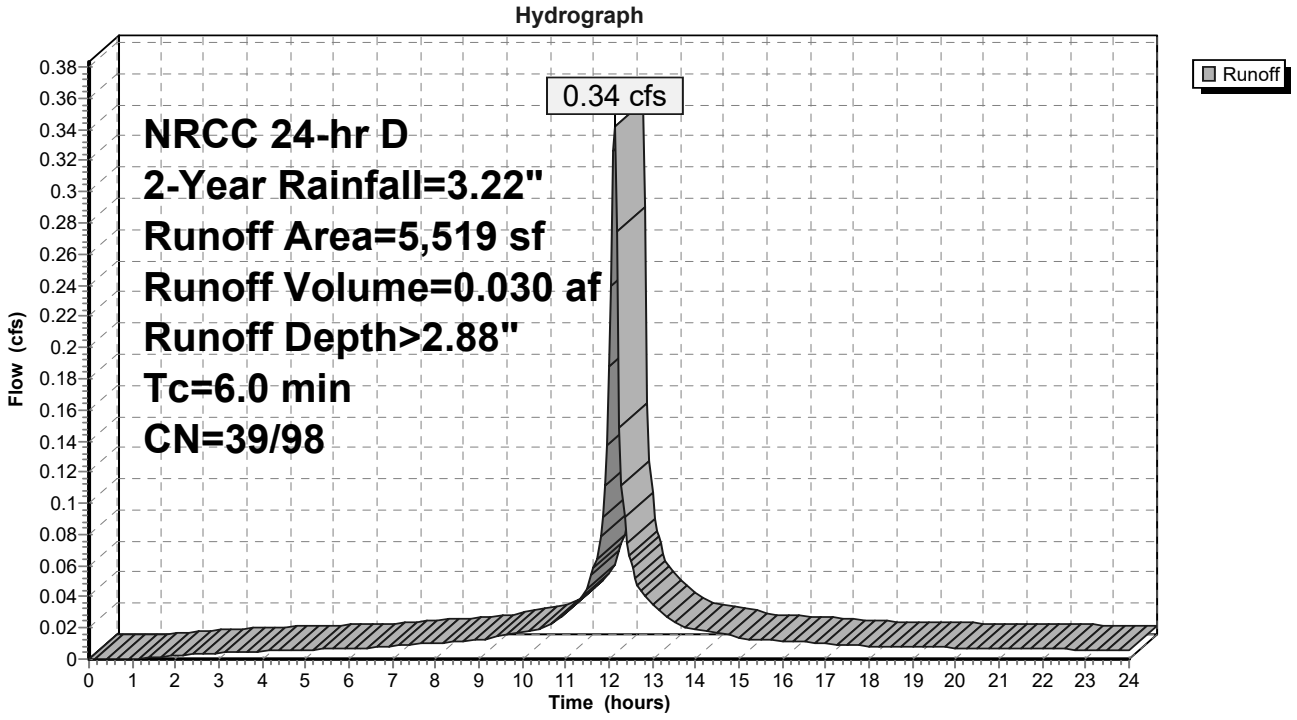
Runoff = 0.34 cfs @ 12.13 hrs, Volume= 0.030 af, Depth> 2.88"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 0.00-24.00 hrs, dt= 0.05
NRCC 24-hr D 2-Year Rainfall=3.22"

Area (sf)	CN	Description
393	98	Roofs, HSG A
188	39	>75% Grass cover, Good, HSG A
4,938	98	Paved parking, HSG A
5,519	96	Weighted Average
188	39	3.41% Pervious Area
5,331	98	96.59% Impervious Area

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

Subcatchment EX-3:

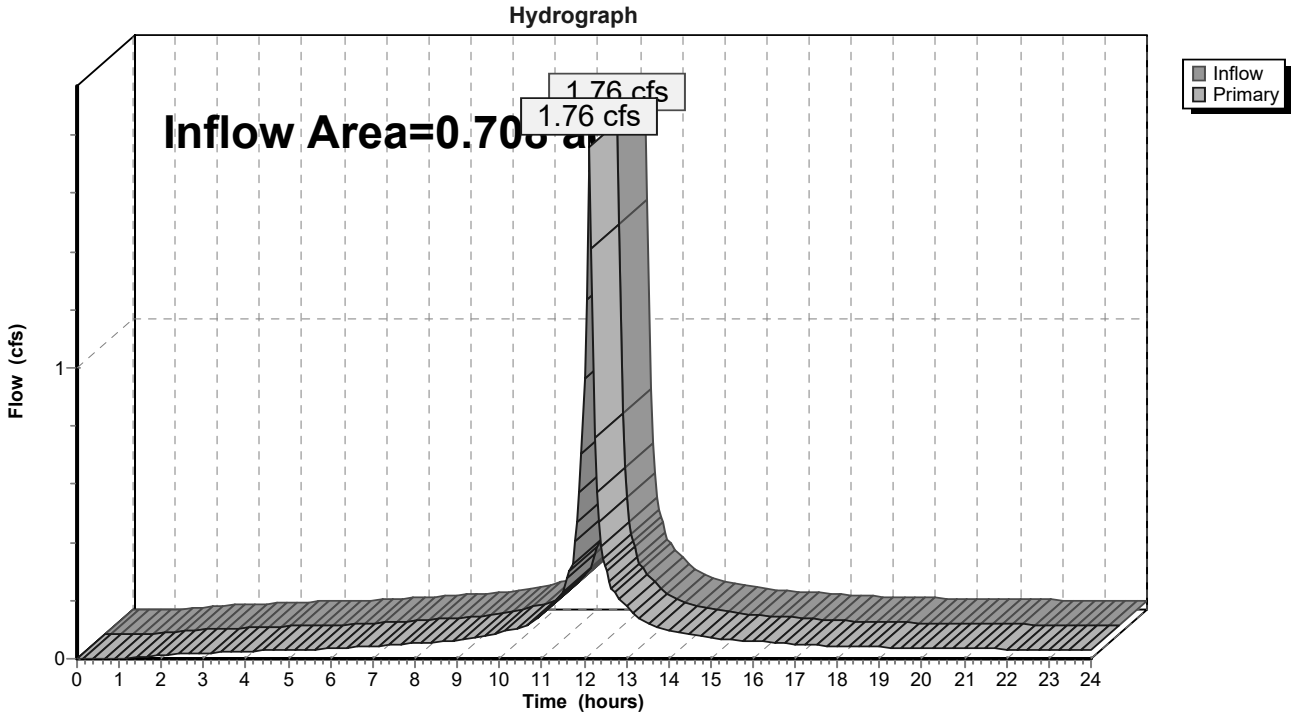


Summary for Link POA-1:

Inflow Area = 0.708 ac, 88.94% Impervious, Inflow Depth > 2.65" for 2-Year event
Inflow = 1.76 cfs @ 12.13 hrs, Volume= 0.157 af
Primary = 1.76 cfs @ 12.13 hrs, Volume= 0.157 af, Atten= 0%, Lag= 0.0 min

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

Link POA-1:

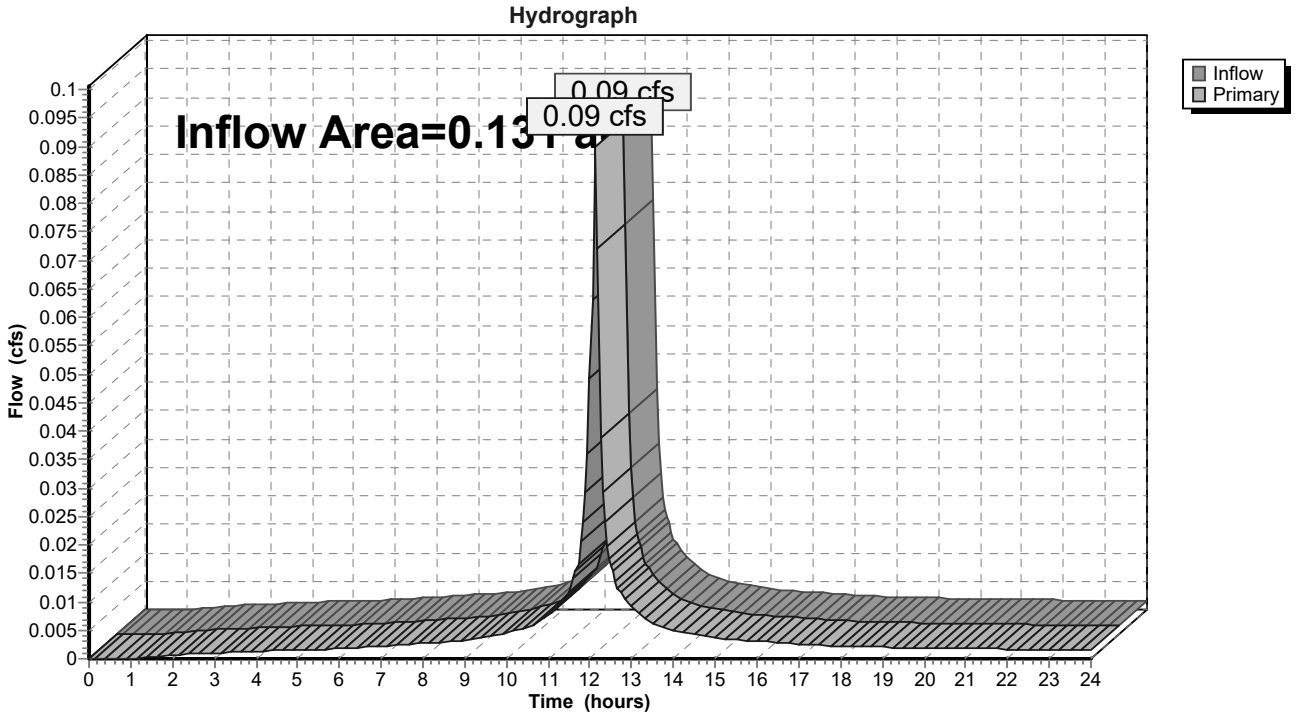


Summary for Link POA-2:

Inflow Area = 0.131 ac, 24.50% Impervious, Inflow Depth > 0.73" for 2-Year event
Inflow = 0.09 cfs @ 12.13 hrs, Volume= 0.008 af
Primary = 0.09 cfs @ 12.13 hrs, Volume= 0.008 af, Atten= 0%, Lag= 0.0 min

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

Link POA-2:

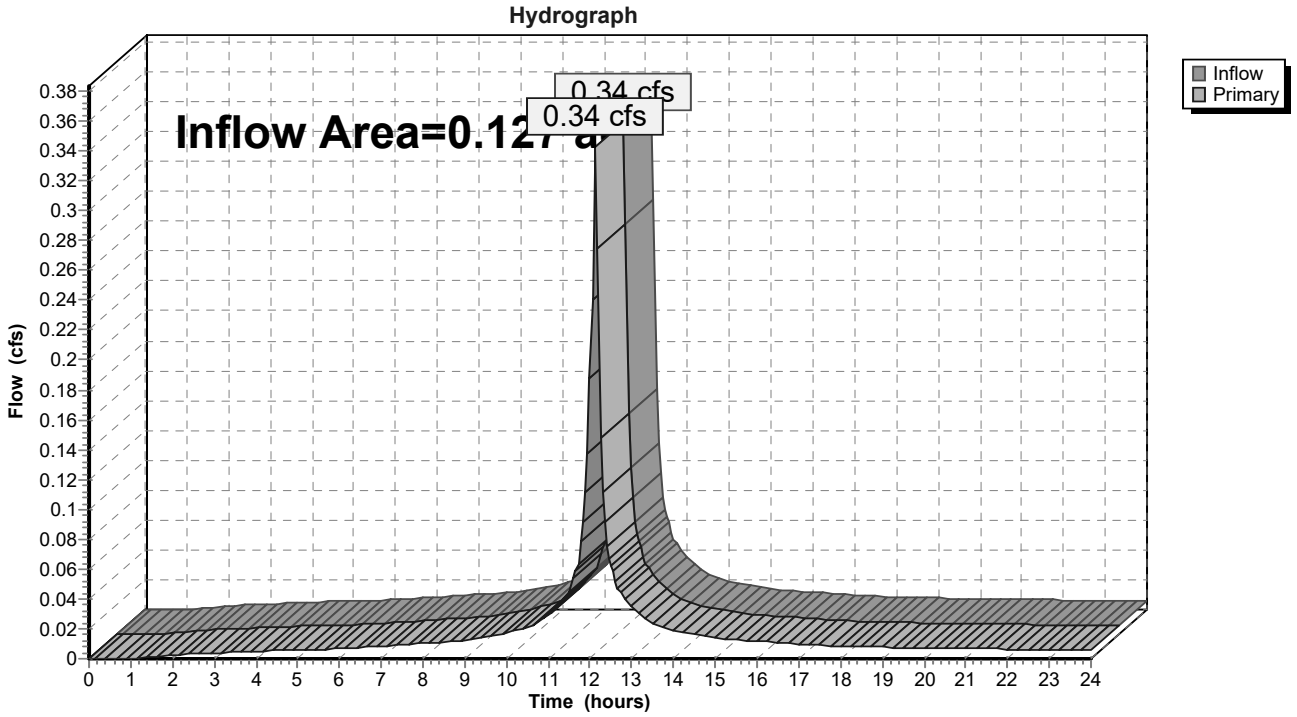


Summary for Link POA-3:

Inflow Area = 0.127 ac, 96.59% Impervious, Inflow Depth > 2.88" for 2-Year event
Inflow = 0.34 cfs @ 12.13 hrs, Volume= 0.030 af
Primary = 0.34 cfs @ 12.13 hrs, Volume= 0.030 af, Atten= 0%, Lag= 0.0 min

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

Link POA-3:



Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment EX-1: Runoff Area=30,842 sf 88.94% Impervious Runoff Depth>4.10"
Tc=6.0 min CN=39/98 Runoff=2.66 cfs 0.242 af

Subcatchment EX-2: Runoff Area=5,710 sf 24.50% Impervious Runoff Depth>1.25"
Tc=6.0 min CN=39/98 Runoff=0.14 cfs 0.014 af

Subcatchment EX-3: Runoff Area=5,519 sf 96.59% Impervious Runoff Depth>4.44"
Tc=6.0 min CN=39/98 Runoff=0.52 cfs 0.047 af

Link POA-1: Inflow=2.66 cfs 0.242 af
Primary=2.66 cfs 0.242 af

Link POA-2: Inflow=0.14 cfs 0.014 af
Primary=0.14 cfs 0.014 af

Link POA-3: Inflow=0.52 cfs 0.047 af
Primary=0.52 cfs 0.047 af

Total Runoff Area = 0.966 ac Runoff Volume = 0.302 af Average Runoff Depth = 3.76"
18.80% Pervious = 0.182 ac 81.20% Impervious = 0.784 ac

Summary for Subcatchment EX-1:

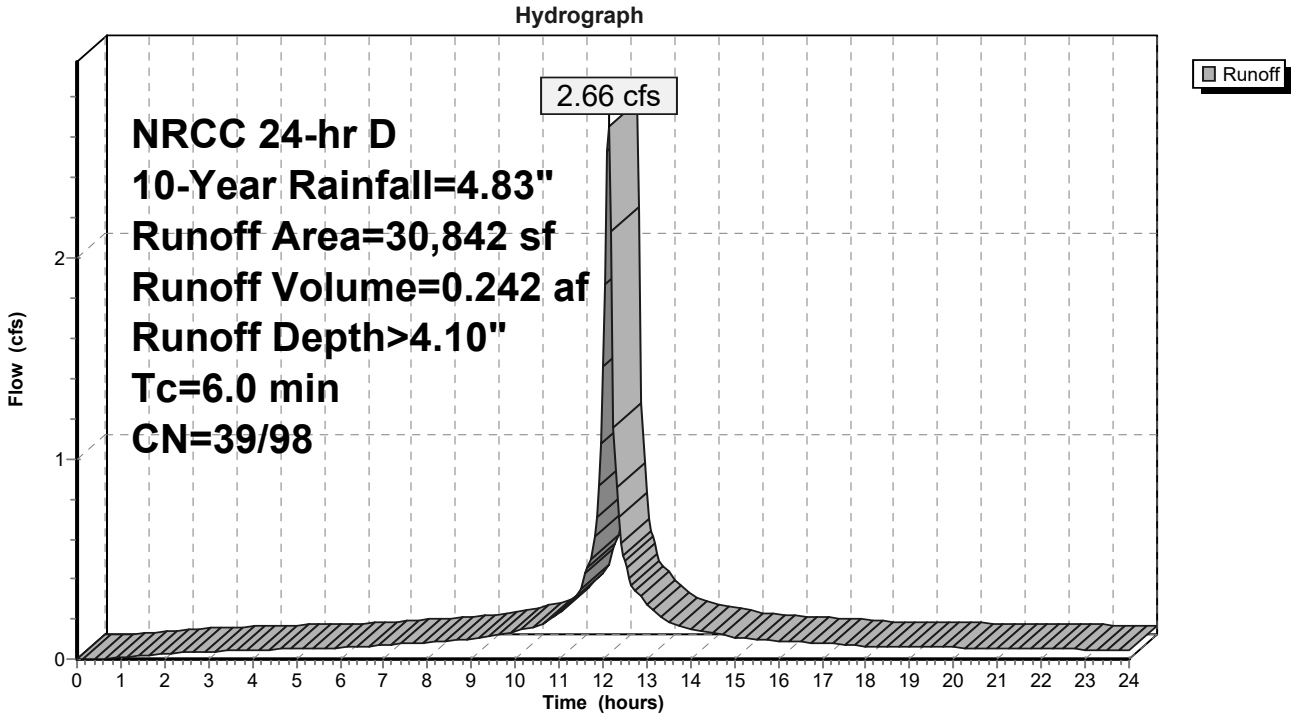
Runoff = 2.66 cfs @ 12.13 hrs, Volume= 0.242 af, Depth> 4.10"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 0.00-24.00 hrs, dt= 0.05
NRCC 24-hr D 10-Year Rainfall=4.83"

Area (sf)	CN	Description
4,140	98	Roofs, HSG A
3,412	39	>75% Grass cover, Good, HSG A
23,290	98	Paved parking, HSG A
30,842	91	Weighted Average
3,412	39	11.06% Pervious Area
27,430	98	88.94% Impervious Area

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

Subcatchment EX-1:



Summary for Subcatchment EX-2:

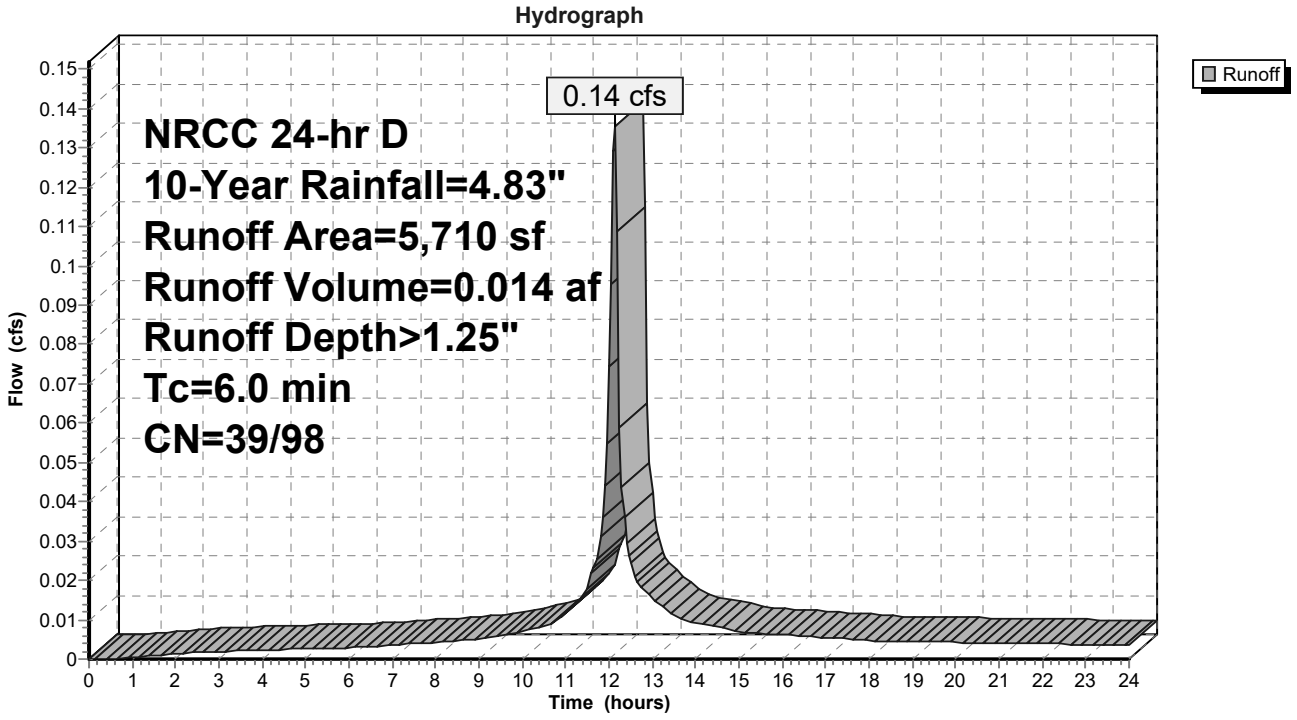
Runoff = 0.14 cfs @ 12.13 hrs, Volume= 0.014 af, Depth> 1.25"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 0.00-24.00 hrs, dt= 0.05
NRCC 24-hr D 10-Year Rainfall=4.83"

Area (sf)	CN	Description
1,187	98	Roofs, HSG A
4,311	39	>75% Grass cover, Good, HSG A
212	98	Paved parking, HSG A
5,710	53	Weighted Average
4,311	39	75.50% Pervious Area
1,399	98	24.50% Impervious Area

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

Subcatchment EX-2:



Summary for Subcatchment EX-3:

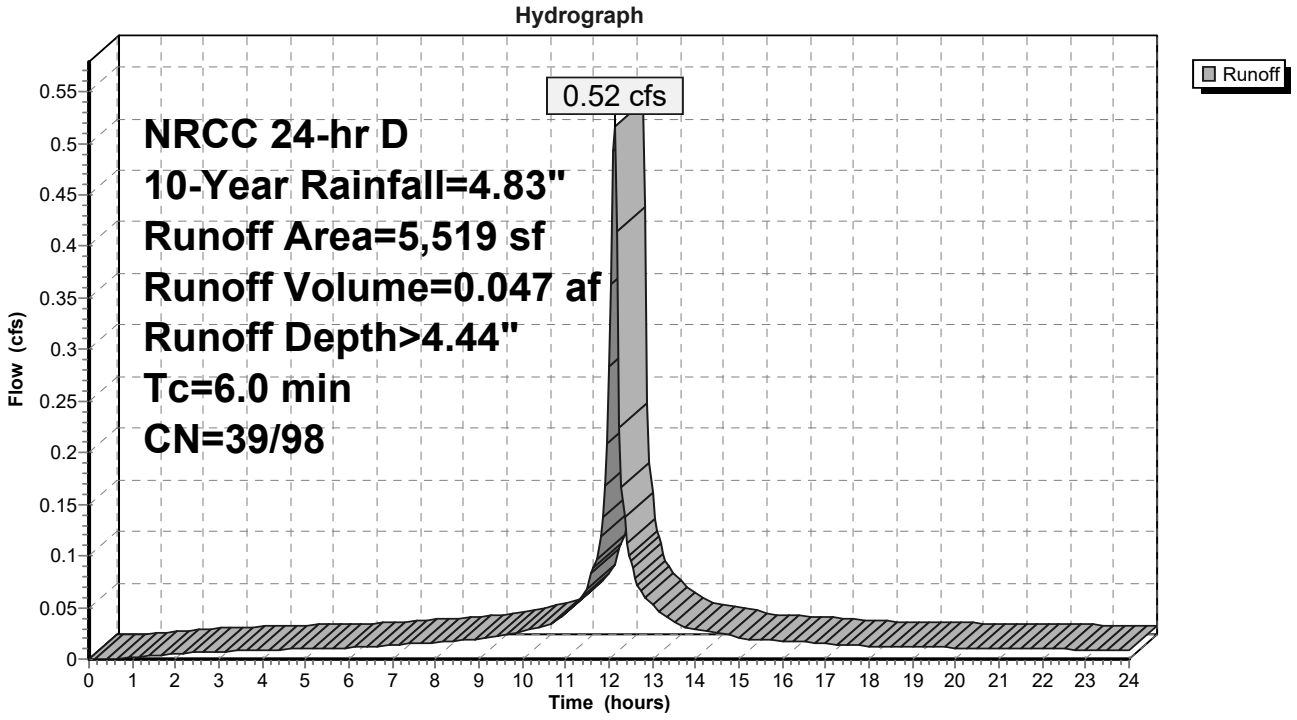
Runoff = 0.52 cfs @ 12.13 hrs, Volume= 0.047 af, Depth> 4.44"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 0.00-24.00 hrs, dt= 0.05
NRCC 24-hr D 10-Year Rainfall=4.83"

Area (sf)	CN	Description
393	98	Roofs, HSG A
188	39	>75% Grass cover, Good, HSG A
4,938	98	Paved parking, HSG A
5,519	96	Weighted Average
188	39	3.41% Pervious Area
5,331	98	96.59% Impervious Area

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

Subcatchment EX-3:

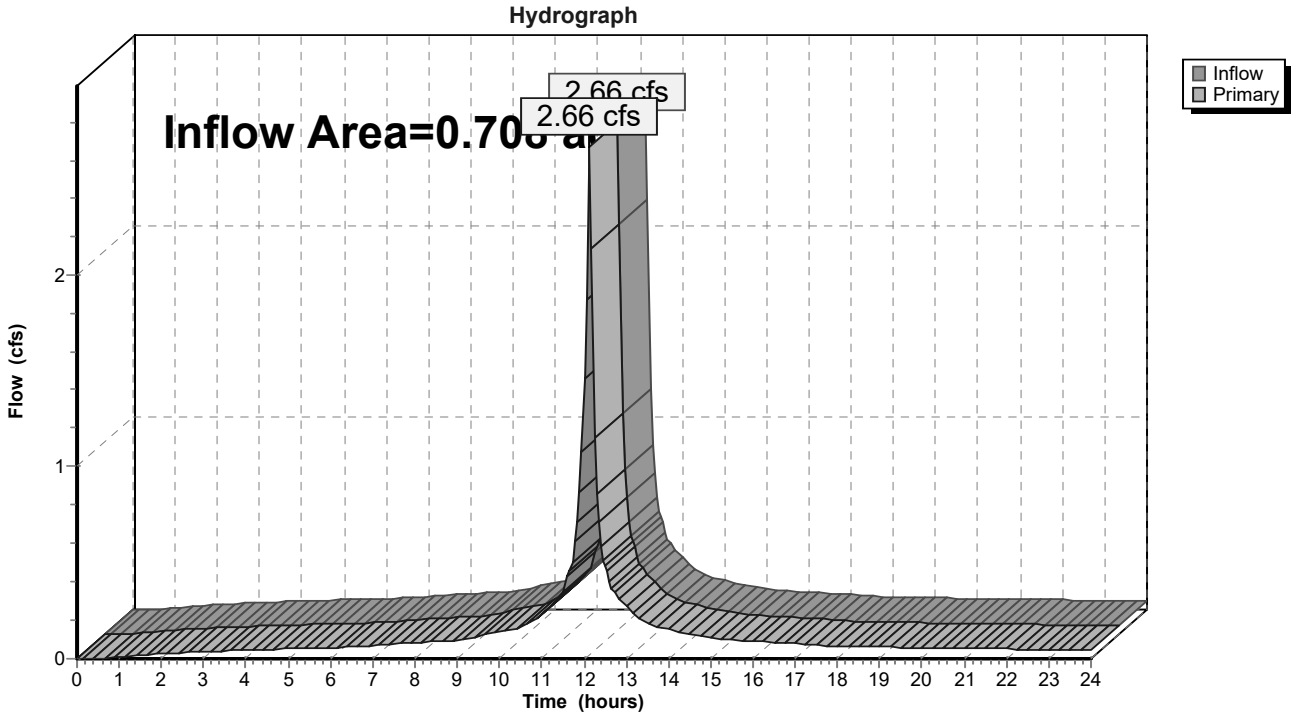


Summary for Link POA-1:

Inflow Area = 0.708 ac, 88.94% Impervious, Inflow Depth > 4.10" for 10-Year event
Inflow = 2.66 cfs @ 12.13 hrs, Volume= 0.242 af
Primary = 2.66 cfs @ 12.13 hrs, Volume= 0.242 af, Atten= 0%, Lag= 0.0 min

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

Link POA-1:

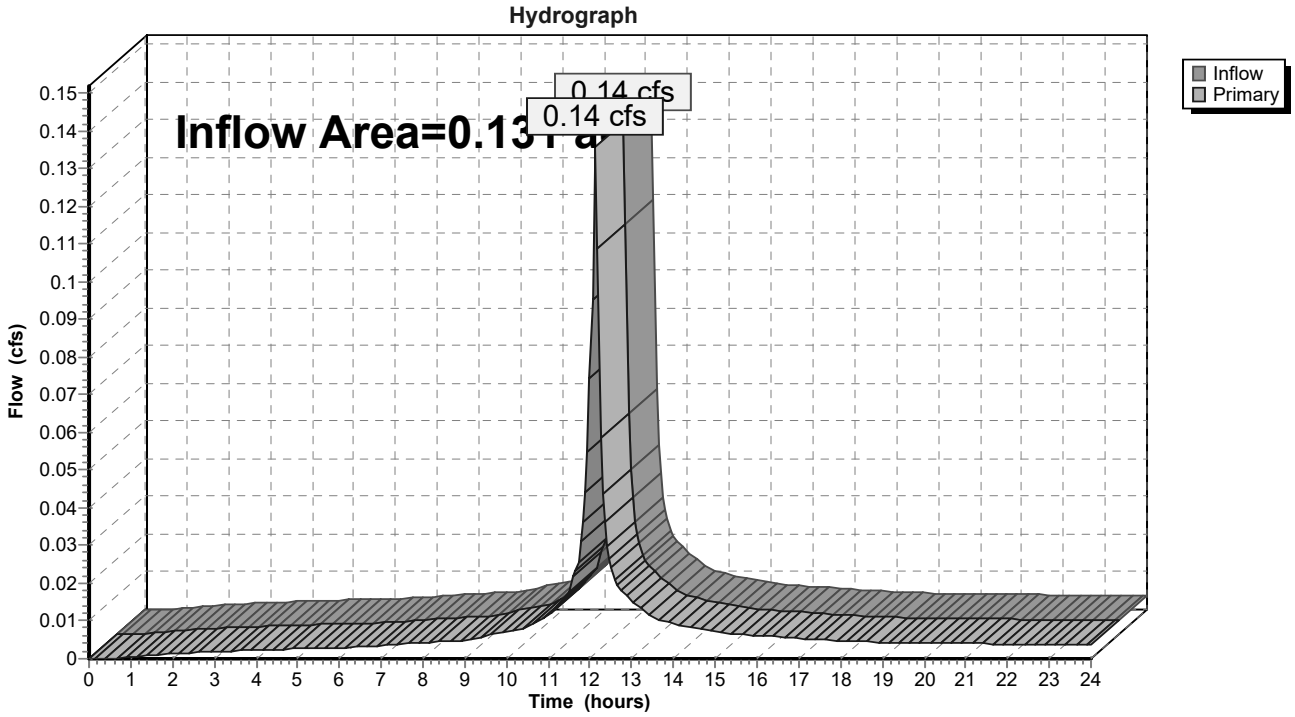


Summary for Link POA-2:

Inflow Area = 0.131 ac, 24.50% Impervious, Inflow Depth > 1.25" for 10-Year event
Inflow = 0.14 cfs @ 12.13 hrs, Volume= 0.014 af
Primary = 0.14 cfs @ 12.13 hrs, Volume= 0.014 af, Atten= 0%, Lag= 0.0 min

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

Link POA-2:

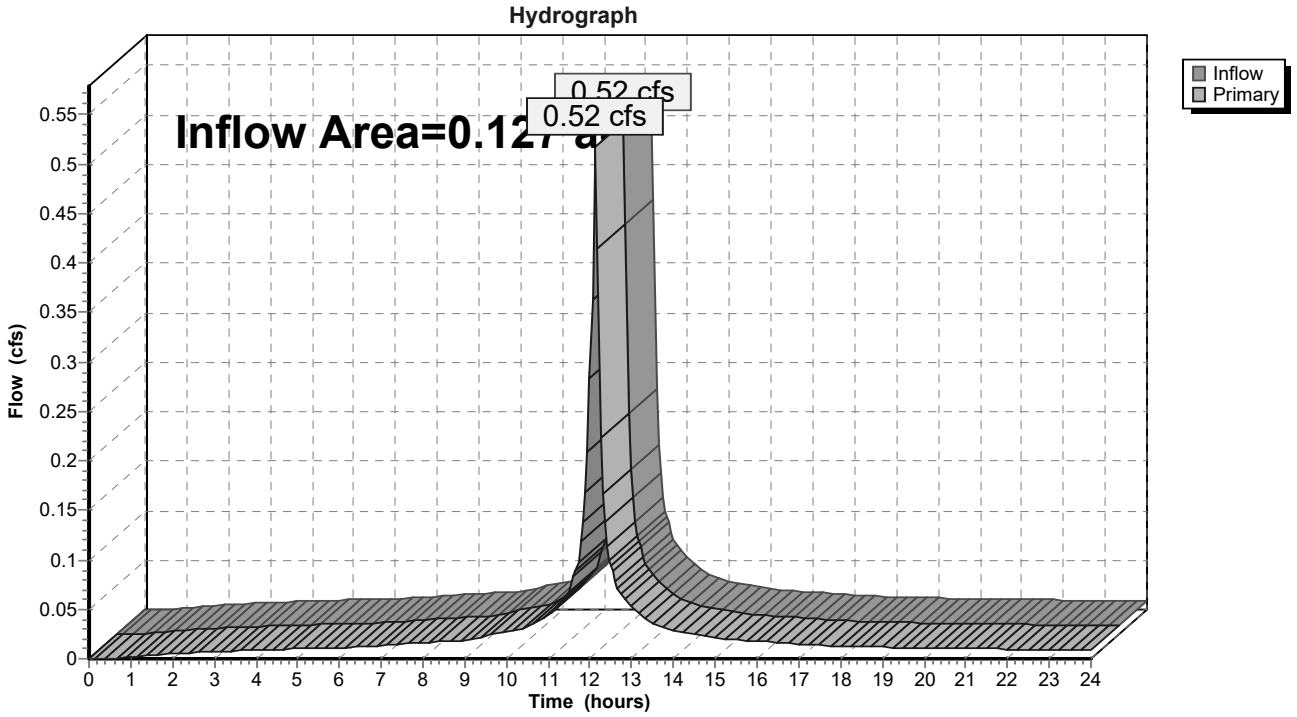


Summary for Link POA-3:

Inflow Area = 0.127 ac, 96.59% Impervious, Inflow Depth > 4.44" for 10-Year event
Inflow = 0.52 cfs @ 12.13 hrs, Volume= 0.047 af
Primary = 0.52 cfs @ 12.13 hrs, Volume= 0.047 af, Atten= 0%, Lag= 0.0 min

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

Link POA-3:



Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment EX-1: Runoff Area=30,842 sf 88.94% Impervious Runoff Depth>7.62"
Tc=6.0 min CN=39/98 Runoff=4.87 cfs 0.450 af

Subcatchment EX-2: Runoff Area=5,710 sf 24.50% Impervious Runoff Depth>3.14"
Tc=6.0 min CN=39/98 Runoff=0.36 cfs 0.034 af

Subcatchment EX-3: Runoff Area=5,519 sf 96.59% Impervious Runoff Depth>8.15"
Tc=6.0 min CN=39/98 Runoff=0.93 cfs 0.086 af

Link POA-1: Inflow=4.87 cfs 0.450 af
Primary=4.87 cfs 0.450 af

Link POA-2: Inflow=0.36 cfs 0.034 af
Primary=0.36 cfs 0.034 af

Link POA-3: Inflow=0.93 cfs 0.086 af
Primary=0.93 cfs 0.086 af

Total Runoff Area = 0.966 ac Runoff Volume = 0.570 af Average Runoff Depth = 7.08"
18.80% Pervious = 0.182 ac 81.20% Impervious = 0.784 ac

Summary for Subcatchment EX-1:

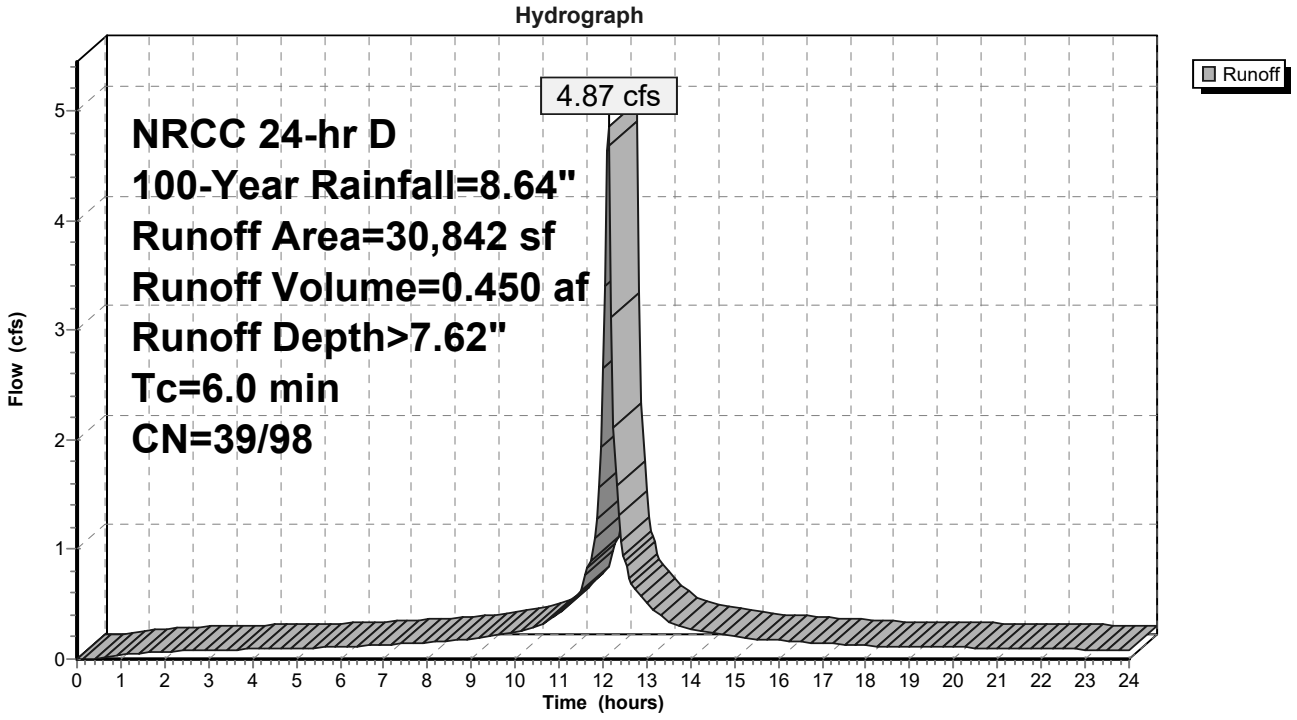
Runoff = 4.87 cfs @ 12.13 hrs, Volume= 0.450 af, Depth> 7.62"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 0.00-24.00 hrs, dt= 0.05
NRCC 24-hr D 100-Year Rainfall=8.64"

Area (sf)	CN	Description
4,140	98	Roofs, HSG A
3,412	39	>75% Grass cover, Good, HSG A
23,290	98	Paved parking, HSG A
30,842	91	Weighted Average
3,412	39	11.06% Pervious Area
27,430	98	88.94% Impervious Area

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

Subcatchment EX-1:



Summary for Subcatchment EX-2:

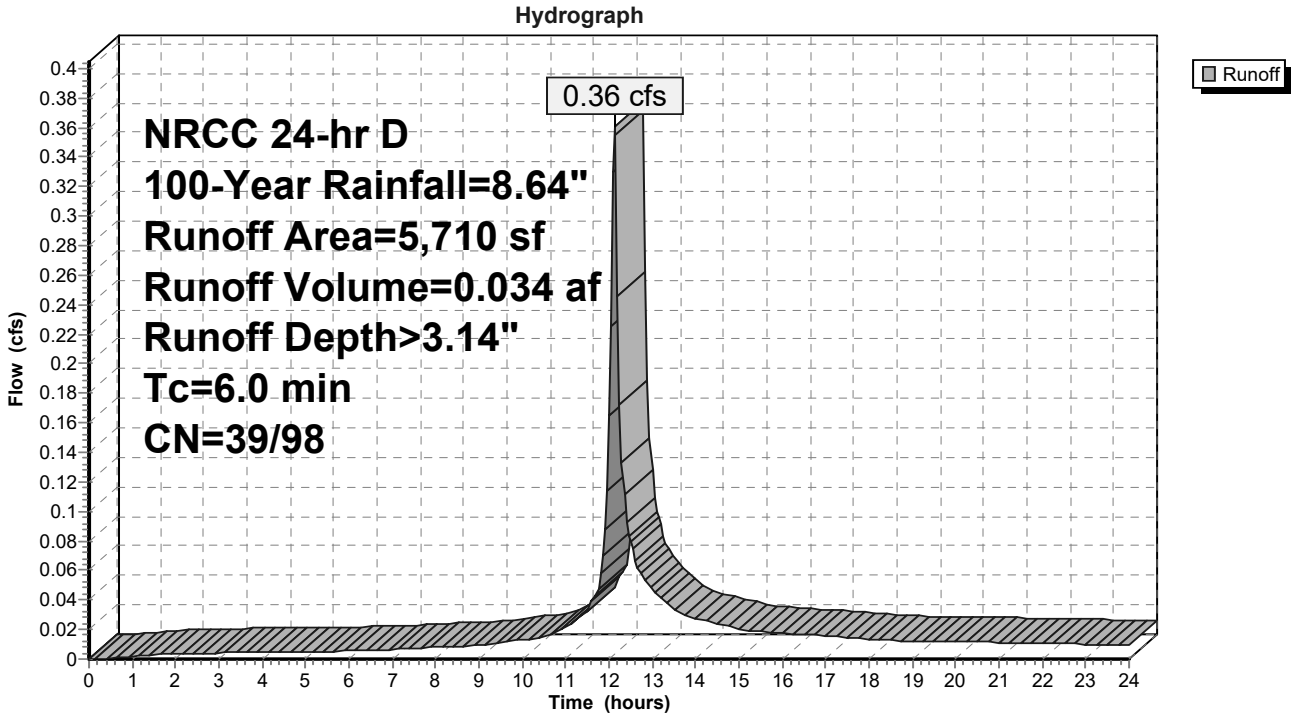
Runoff = 0.36 cfs @ 12.13 hrs, Volume= 0.034 af, Depth> 3.14"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 0.00-24.00 hrs, dt= 0.05
NRCC 24-hr D 100-Year Rainfall=8.64"

Area (sf)	CN	Description
1,187	98	Roofs, HSG A
4,311	39	>75% Grass cover, Good, HSG A
212	98	Paved parking, HSG A
5,710	53	Weighted Average
4,311	39	75.50% Pervious Area
1,399	98	24.50% Impervious Area

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

Subcatchment EX-2:



Summary for Subcatchment EX-3:

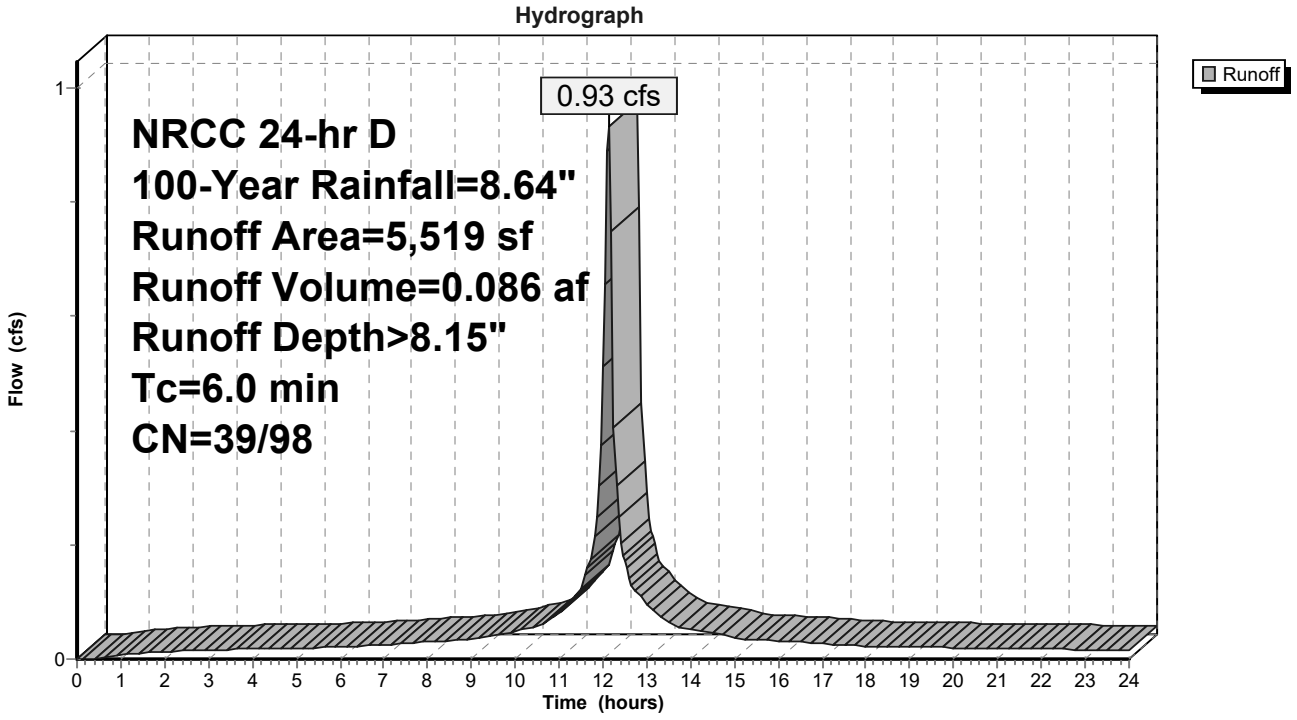
Runoff = 0.93 cfs @ 12.13 hrs, Volume= 0.086 af, Depth> 8.15"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 0.00-24.00 hrs, dt= 0.05
NRCC 24-hr D 100-Year Rainfall=8.64"

Area (sf)	CN	Description
393	98	Roofs, HSG A
188	39	>75% Grass cover, Good, HSG A
4,938	98	Paved parking, HSG A
5,519	96	Weighted Average
188	39	3.41% Pervious Area
5,331	98	96.59% Impervious Area

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

Subcatchment EX-3:

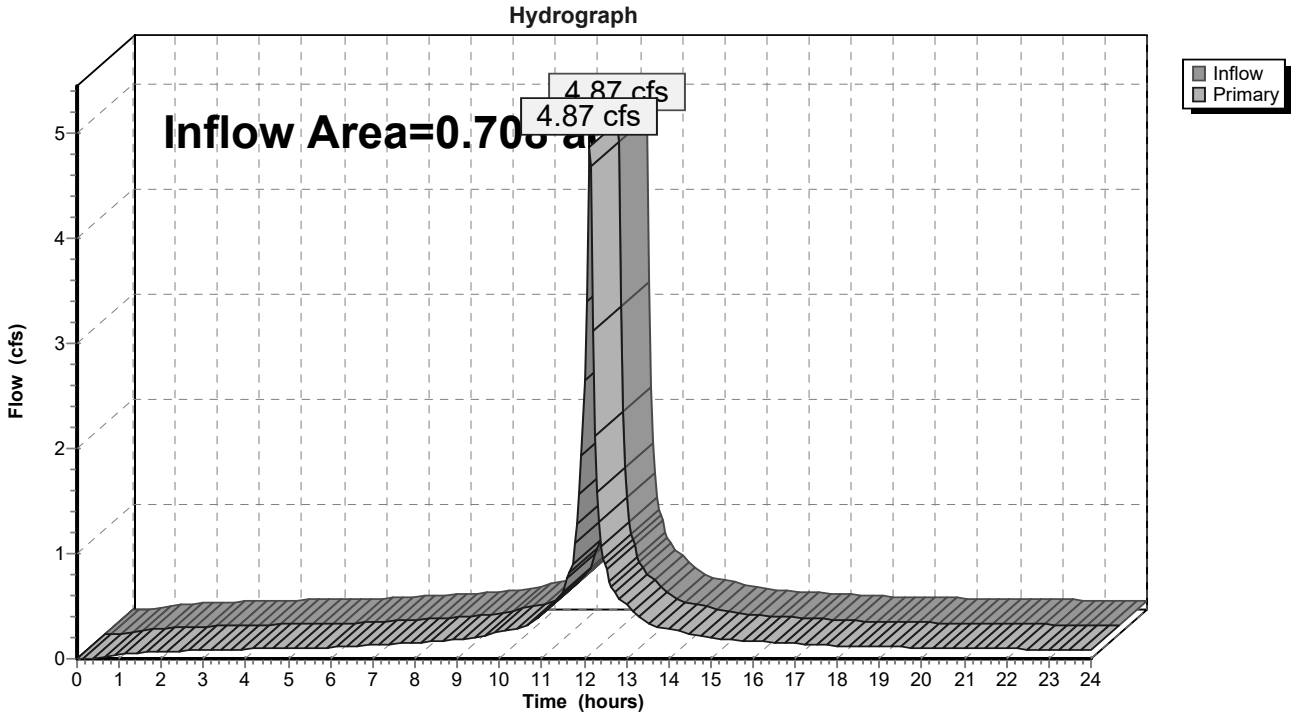


Summary for Link POA-1:

Inflow Area = 0.708 ac, 88.94% Impervious, Inflow Depth > 7.62" for 100-Year event
Inflow = 4.87 cfs @ 12.13 hrs, Volume= 0.450 af
Primary = 4.87 cfs @ 12.13 hrs, Volume= 0.450 af, Atten= 0%, Lag= 0.0 min

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

Link POA-1:

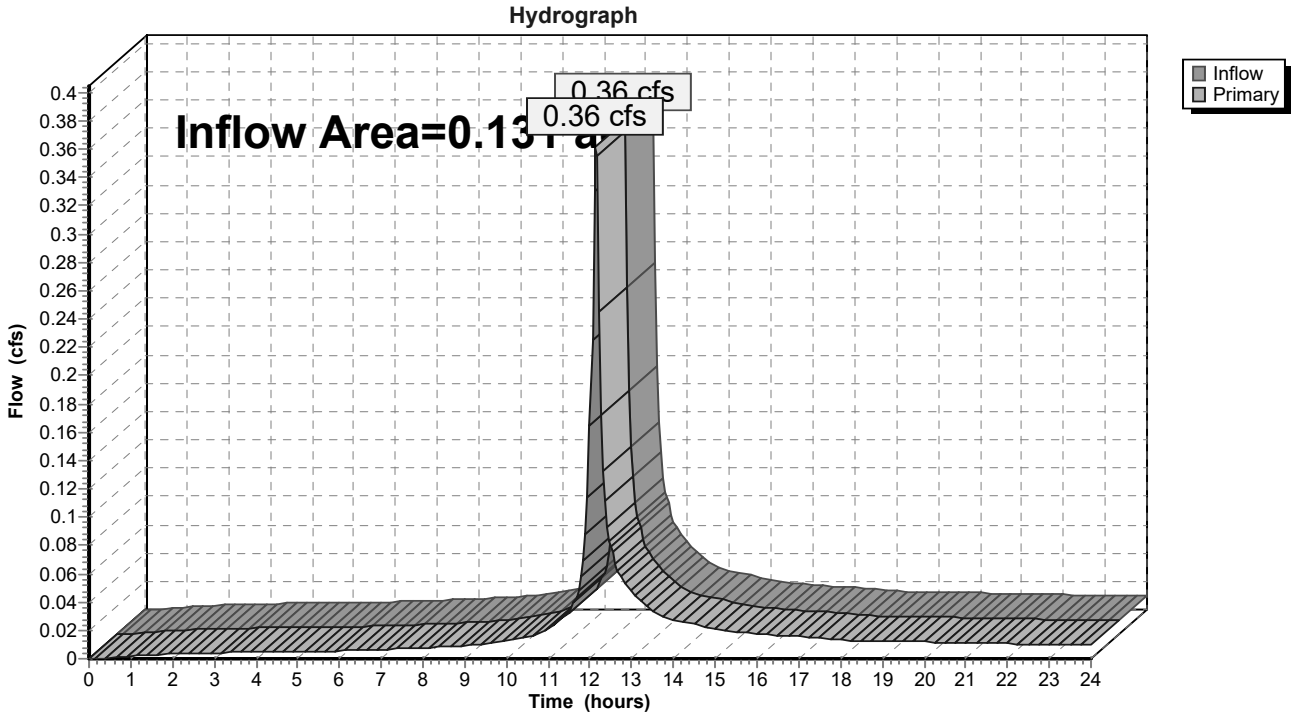


Summary for Link POA-2:

Inflow Area = 0.131 ac, 24.50% Impervious, Inflow Depth > 3.14" for 100-Year event
Inflow = 0.36 cfs @ 12.13 hrs, Volume= 0.034 af
Primary = 0.36 cfs @ 12.13 hrs, Volume= 0.034 af, Atten= 0%, Lag= 0.0 min

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

Link POA-2:

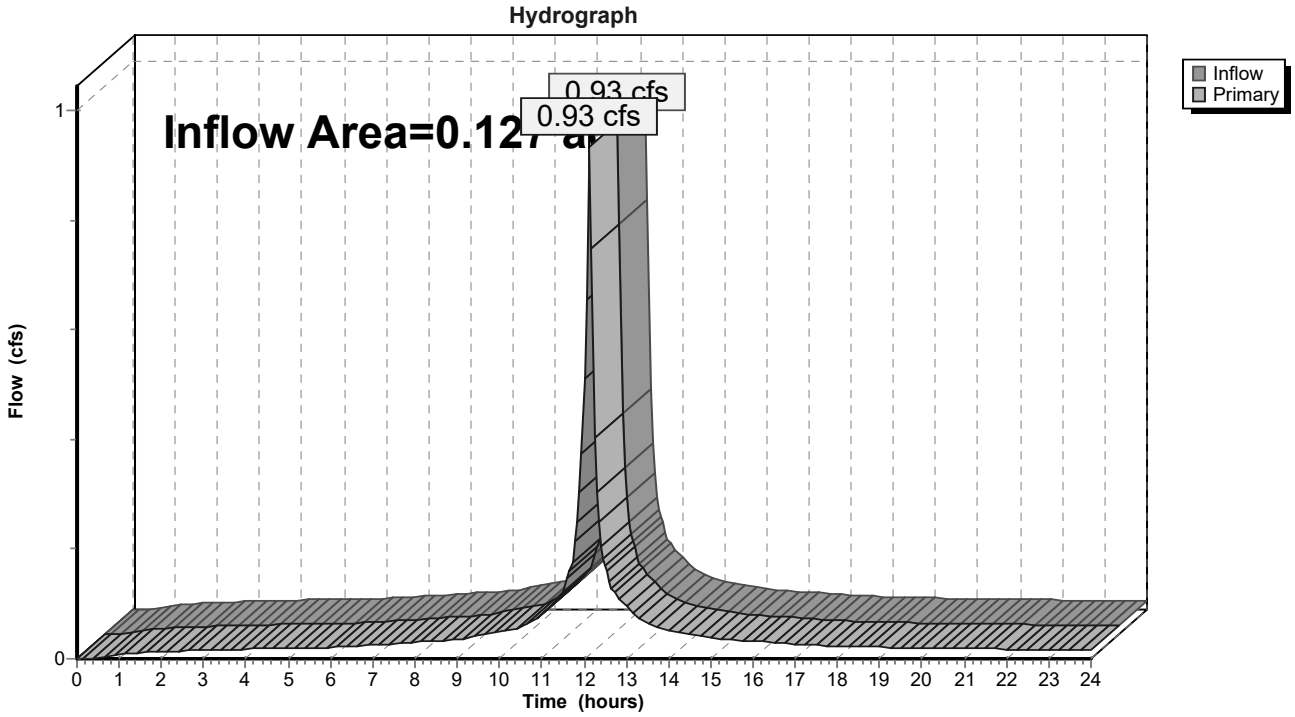


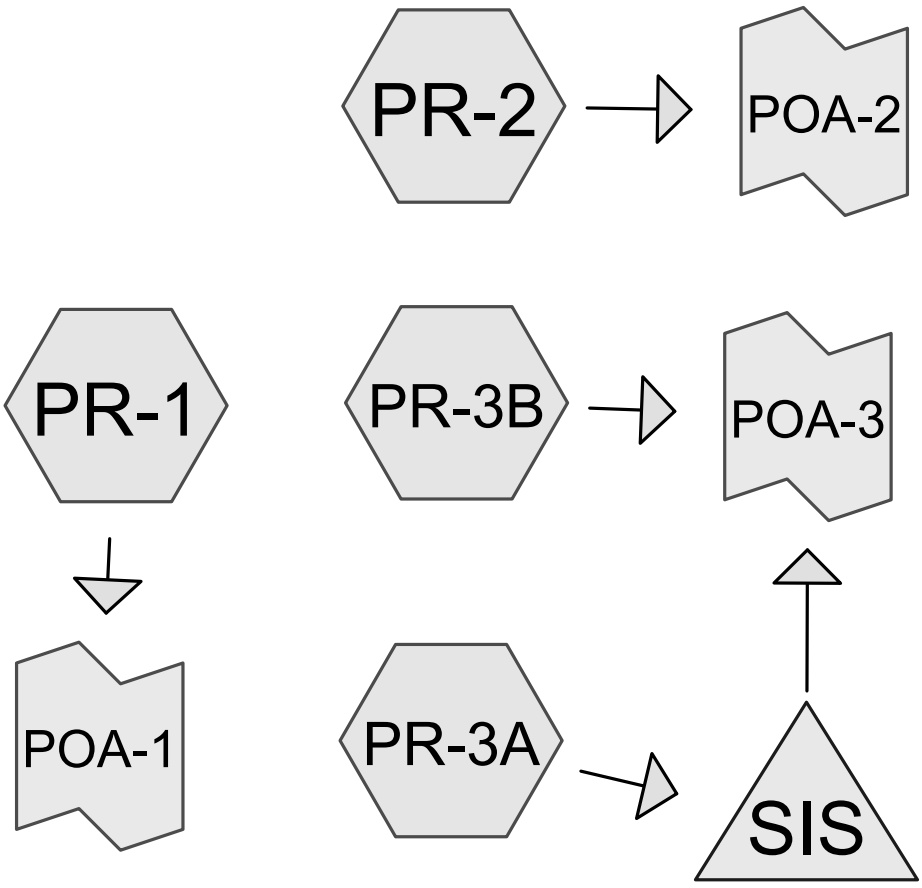
Summary for Link POA-3:

Inflow Area = 0.127 ac, 96.59% Impervious, Inflow Depth > 8.15" for 100-Year event
Inflow = 0.93 cfs @ 12.13 hrs, Volume= 0.086 af
Primary = 0.93 cfs @ 12.13 hrs, Volume= 0.086 af, Atten= 0%, Lag= 0.0 min

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

Link POA-3:





Subcat Reach Pond Link

Routing Diagram for Post Development Conditions
Prepared by {enter your company name here}, Printed 9/1/2022

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.331	39	>75% Grass cover, Good, HSG A (PR-1, PR-2, PR-3A, PR-3B)
0.471	98	Paved parking, HSG A (PR-2, PR-3A)
0.163	98	Roofs, HSG A (PR-3A)
0.966	**78**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.966	HSG A	PR-1, PR-2, PR-3A, PR-3B
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.000	Other	
0.966		**TOTAL AREA**

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment PR-1: Runoff Area=7,182 sf 0.00% Impervious Runoff Depth>0.00"
Tc=6.0 min CN=39/0 Runoff=0.00 cfs 0.000 af

Subcatchment PR-2: Runoff Area=3,087 sf 9.43% Impervious Runoff Depth>0.28"
Tc=6.0 min CN=39/98 Runoff=0.02 cfs 0.002 af

Subcatchment PR-3A: Runoff Area=29,671 sf 92.14% Impervious Runoff Depth>2.75"
Tc=6.0 min CN=39/98 Runoff=1.76 cfs 0.156 af

Subcatchment PR-3B: Runoff Area=2,127 sf 0.00% Impervious Runoff Depth>0.00"
Tc=6.0 min CN=39/0 Runoff=0.00 cfs 0.000 af

Pond SIS: Peak Elev=498.48' Storage=1,433 cf Inflow=1.76 cfs 0.156 af
Discarded=0.28 cfs 0.156 af Primary=0.00 cfs 0.000 af Outflow=0.28 cfs 0.156 af

Link POA-1: Inflow=0.00 cfs 0.000 af
Primary=0.00 cfs 0.000 af

Link POA-2: Inflow=0.02 cfs 0.002 af
Primary=0.02 cfs 0.002 af

Link POA-3: Inflow=0.00 cfs 0.000 af
Primary=0.00 cfs 0.000 af

Total Runoff Area = 0.966 ac Runoff Volume = 0.158 af Average Runoff Depth = 1.96"
34.32% Pervious = 0.331 ac 65.68% Impervious = 0.634 ac

Summary for Subcatchment PR-1:

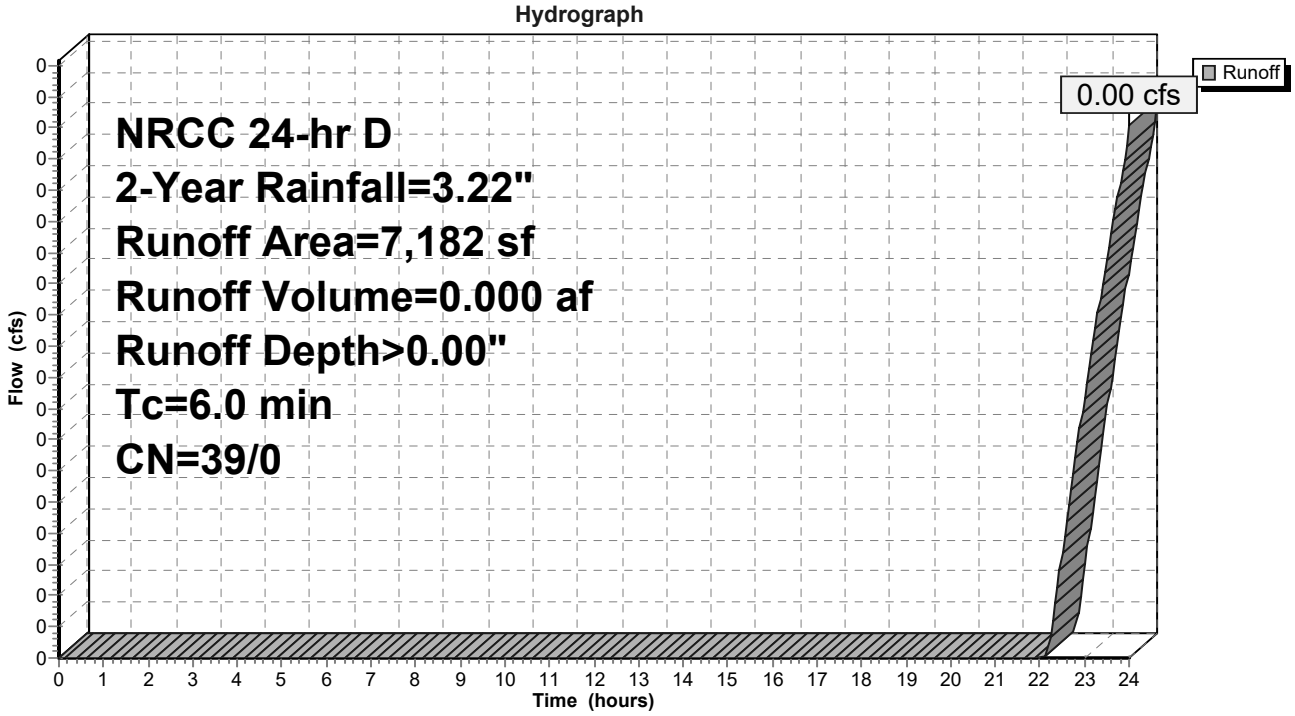
Runoff = 0.00 cfs @ 24.00 hrs, Volume= 0.000 af, Depth> 0.00"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 0.00-24.00 hrs, dt= 0.05
NRCC 24-hr D 2-Year Rainfall=3.22"

Area (sf)	CN	Description
7,182	39	>75% Grass cover, Good, HSG A
7,182	39	100.00% Pervious Area

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

Subcatchment PR-1:



Summary for Subcatchment PR-2:

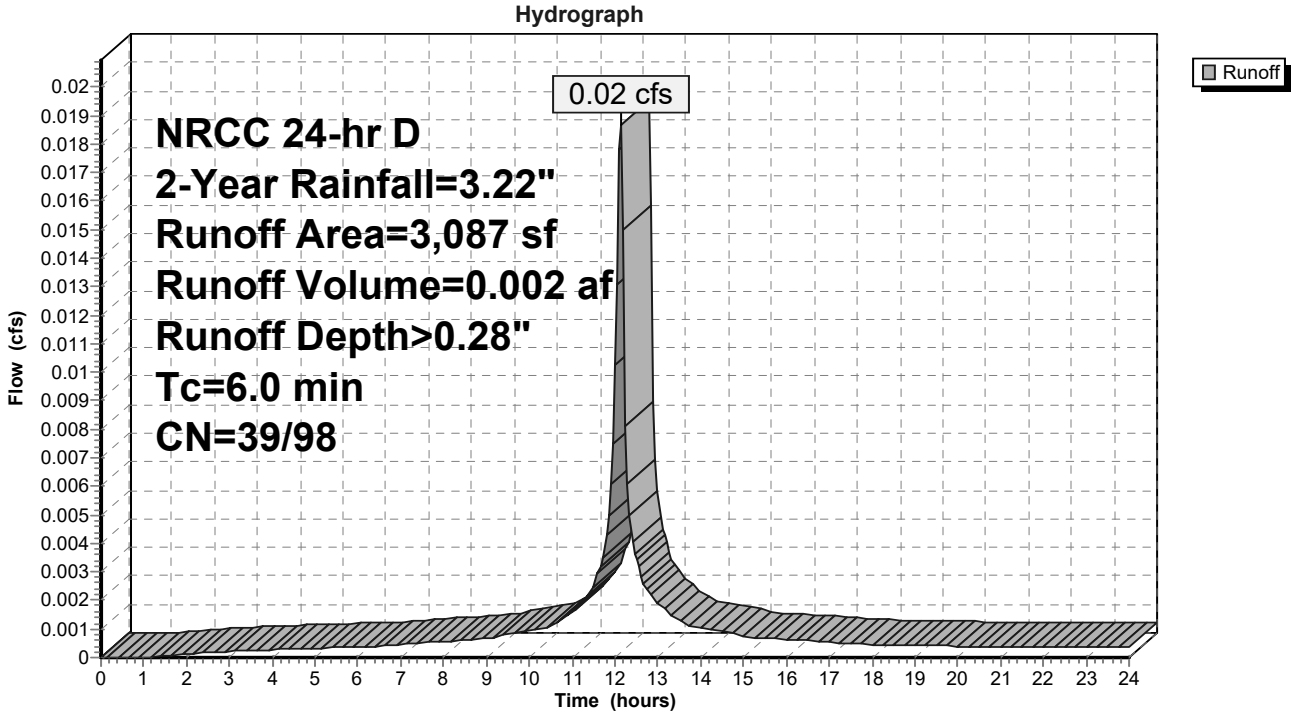
Runoff = 0.02 cfs @ 12.13 hrs, Volume= 0.002 af, Depth> 0.28"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 0.00-24.00 hrs, dt= 0.05
NRCC 24-hr D 2-Year Rainfall=3.22"

Area (sf)	CN	Description
2,796	39	>75% Grass cover, Good, HSG A
291	98	Paved parking, HSG A
3,087	45	Weighted Average
2,796	39	90.57% Pervious Area
291	98	9.43% Impervious Area

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

Subcatchment PR-2:



Summary for Subcatchment PR-3A:

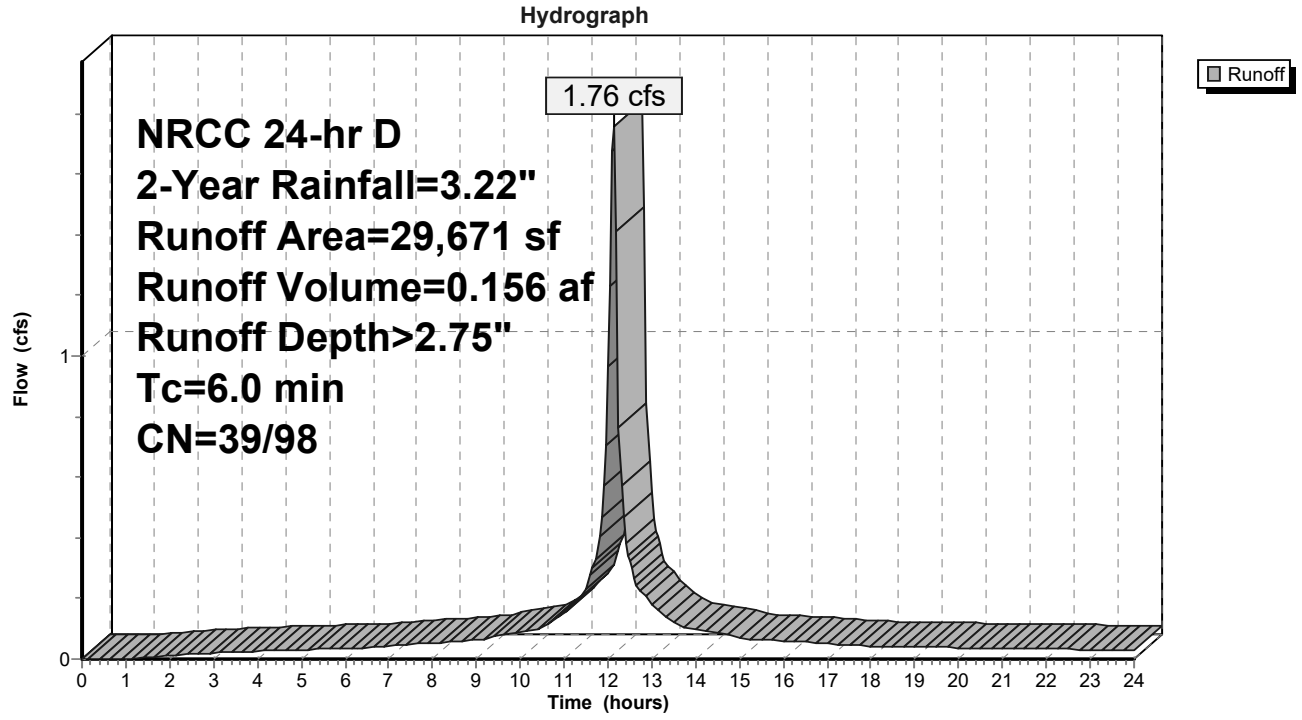
Runoff = 1.76 cfs @ 12.13 hrs, Volume= 0.156 af, Depth> 2.75"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 0.00-24.00 hrs, dt= 0.05
NRCC 24-hr D 2-Year Rainfall=3.22"

Area (sf)	CN	Description
7,104	98	Roofs, HSG A
2,332	39	>75% Grass cover, Good, HSG A
20,235	98	Paved parking, HSG A
29,671	93	Weighted Average
2,332	39	7.86% Pervious Area
27,339	98	92.14% Impervious Area

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

Subcatchment PR-3A:



Summary for Subcatchment PR-3B:

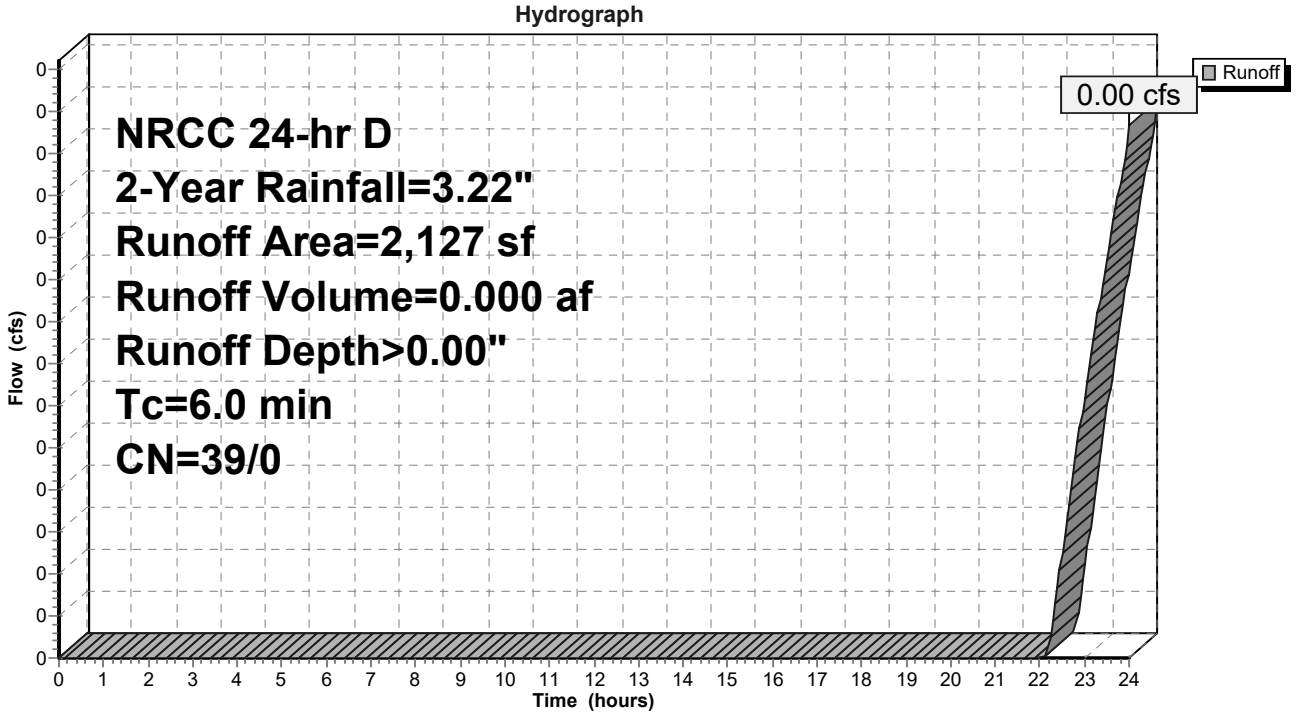
Runoff = 0.00 cfs @ 24.00 hrs, Volume= 0.000 af, Depth> 0.00"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 0.00-24.00 hrs, dt= 0.05
NRCC 24-hr D 2-Year Rainfall=3.22"

Area (sf)	CN	Description
2,127	39	>75% Grass cover, Good, HSG A
2,127	39	100.00% Pervious Area

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

Subcatchment PR-3B:



Summary for Pond SIS:

Inflow Area = 0.681 ac, 92.14% Impervious, Inflow Depth > 2.75" for 2-Year event
Inflow = 1.76 cfs @ 12.13 hrs, Volume= 0.156 af
Outflow = 0.28 cfs @ 11.70 hrs, Volume= 0.156 af, Atten= 84%, Lag= 0.0 min
Discarded = 0.28 cfs @ 11.70 hrs, Volume= 0.156 af
Primary = 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= 498.48' @ 12.59 hrs Surf.Area= 1,443 sf Storage= 1,433 cf

Plug-Flow detention time= 27.1 min calculated for 0.156 af (100% of inflow)
Center-of-Mass det. time= 26.5 min (786.1 - 759.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	497.00'	1,408 cf	**24.25'W x 59.50'L x 4.00'H Field A** 5,772 cf Overall - 2,250 cf Embedded = 3,521 cf x 40.0% Voids
#2A	497.50'	2,250 cf	**Cultec R-360HD** x 60 Inside #1 Effective Size= 54.9"W x 36.0"H => 9.99 sf x 3.67'L = 36.6 cf Overall Size= 60.0"W x 36.0"H x 4.17'L with 0.50' Overlap 60 Chambers in 4 Rows Cap Storage= +6.5 cf x 2 x 4 rows = 51.7 cf
#3	501.00'	2,508 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc) -Impervious
		6,166 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
501.00	2	0	0
504.50	2	7	7
505.00	10,000	2,501	2,508

Device	Routing	Invert	Outlet Devices
#1	Primary	504.50'	**24.0" Vert. Orifice/Grate** C= 0.600
#2	Discarded	497.00'	**8.270 in/hr Exfiltration over Horizontal area**

Discarded OutFlow Max=0.28 cfs @ 11.70 hrs HW=497.10' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.28 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=497.00' (Free Discharge)
↑—**1=Orifice/Grate** (Controls 0.00 cfs)

Pond SIS: - Chamber Wizard Field A

Chamber Model = Cultec R-360HD (Cultec Recharger® 360HD)
Effective Size= 54.9"W x 36.0"H => 9.99 sf x 3.67'L = 36.6 cf
Overall Size= 60.0"W x 36.0"H x 4.17'L with 0.50' Overlap
Cap Storage= +6.5 cf x 2 x 4 rows = 51.7 cf

60.0" Wide + 9.0" Spacing = 69.0" C-C Row Spacing

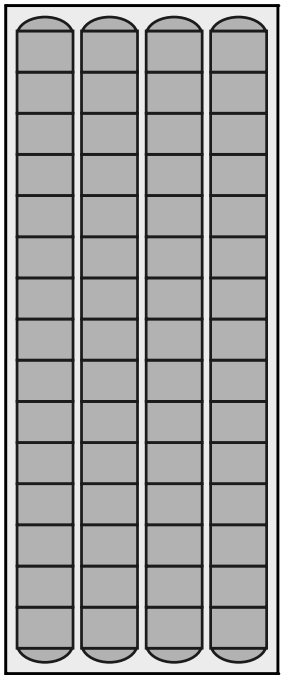
15 Chambers/Row x 3.67' Long +1.25' Cap Length x 2 = 57.50' Row Length +12.0" End Stone x 2 = 59.50' Base Length
4 Rows x 60.0" Wide + 9.0" Spacing x 3 + 12.0" Side Stone x 2 = 24.25' Base Width
6.0" Base + 36.0" Chamber Height + 6.0" Cover = 4.00' Field Height

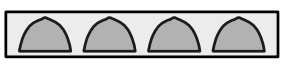
60 Chambers x 36.6 cf + 6.5 cf Cap Volume x 2 x 4 Rows = 2,250.4 cf Chamber Storage

5,771.5 cf Field - 2,250.4 cf Chambers = 3,521.1 cf Stone x 40.0% Voids = 1,408.5 cf Stone Storage

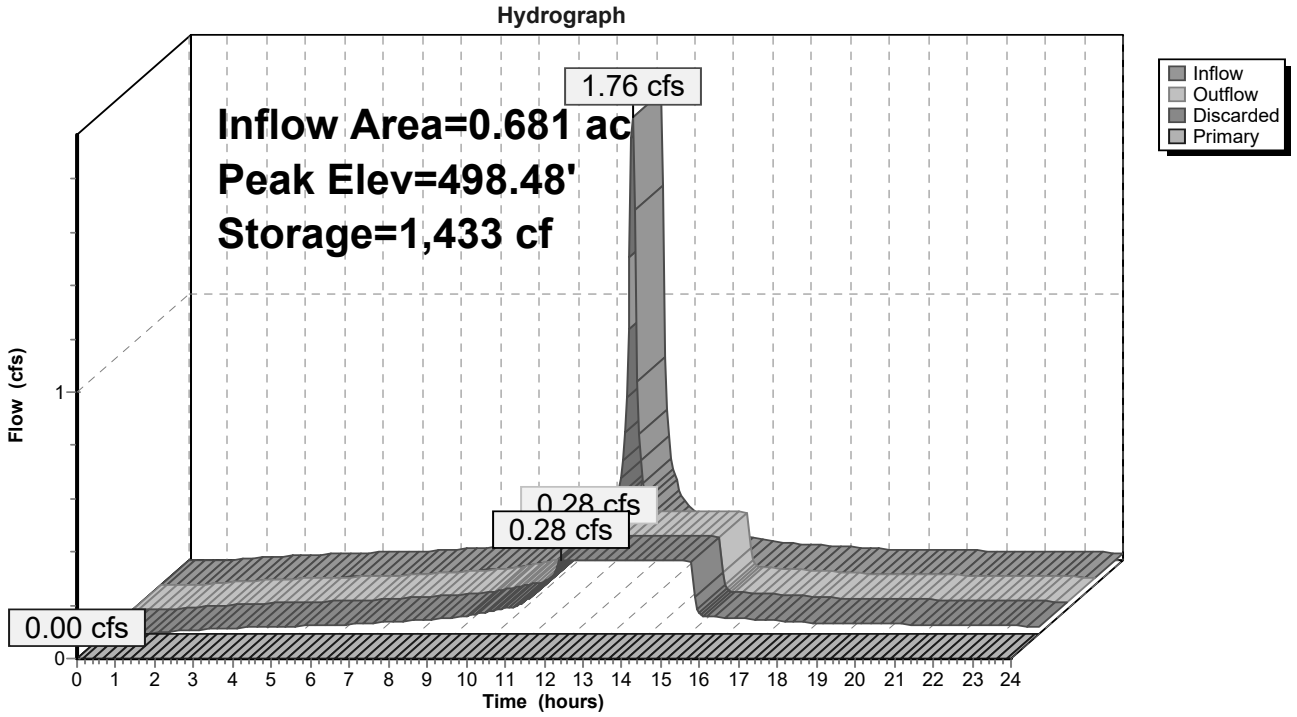
Chamber Storage + Stone Storage = 3,658.8 cf = 0.084 af
Overall Storage Efficiency = 63.4%
Overall System Size = 59.50' x 24.25' x 4.00'

60 Chambers
213.8 cy Field
130.4 cy Stone





Pond SIS:

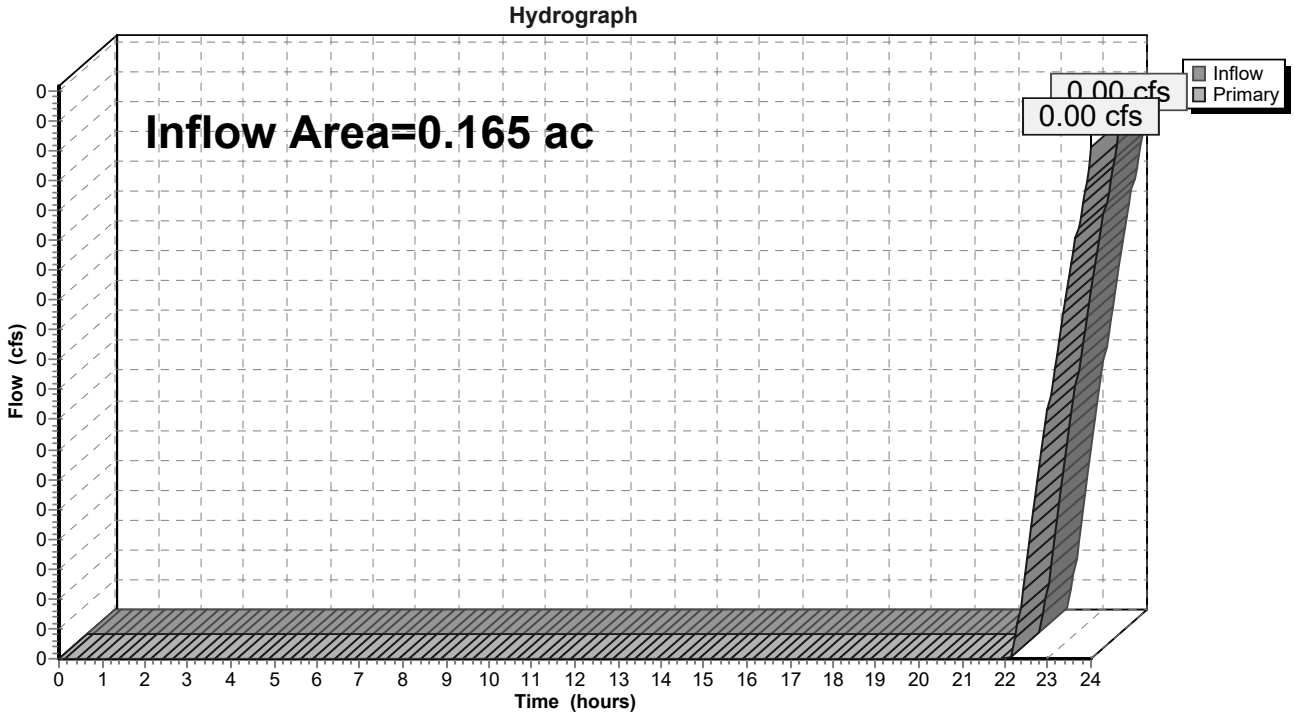

Hydrograph
Inflow Area=0.681 ac
Peak Elev=498.48'
Storage=1,433 cf
1.76 cfs
0.28 cfs
0.28 cfs
0.00 cfs
Inflow
Outflow
Discarded
Primary
Flow (cfs)
0
1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Time (hours)

Summary for Link POA-1:

Inflow Area = 0.165 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-1:

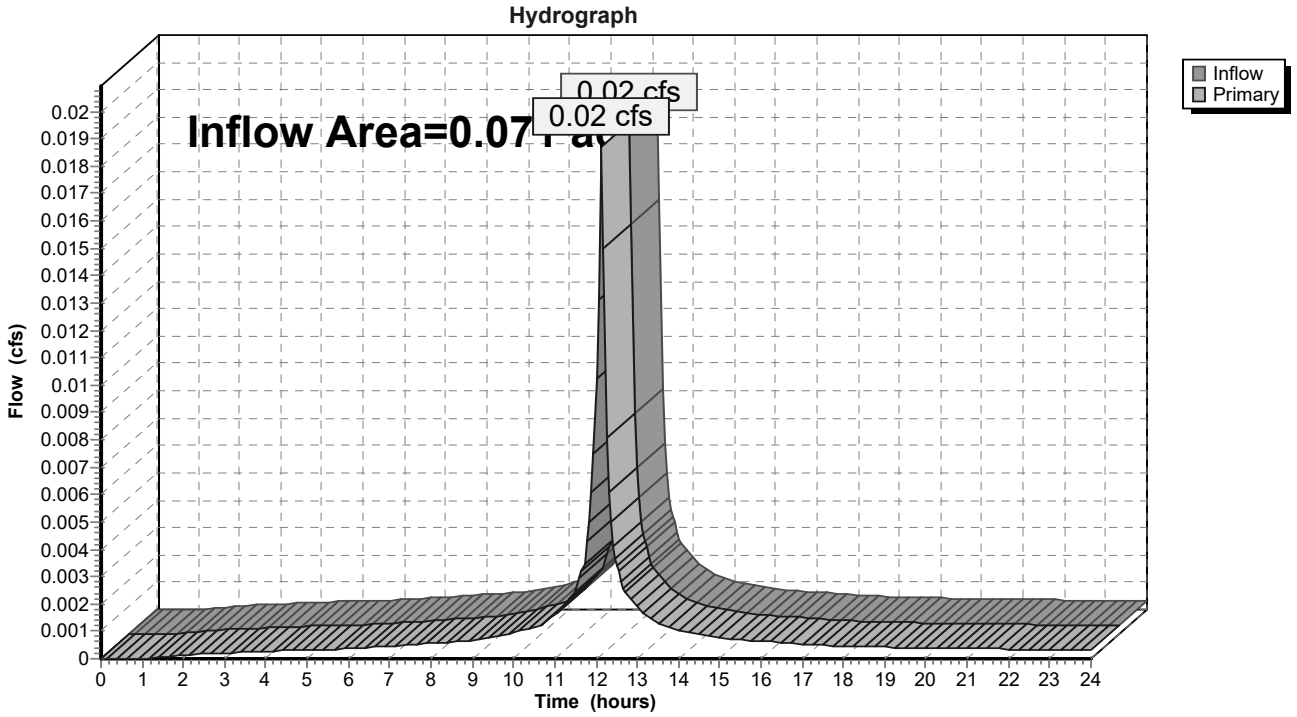


Summary for Link POA-2:

Inflow Area = 0.071 ac, 9.43% Impervious, Inflow Depth > 0.28" for 2-Year event
Inflow = 0.02 cfs @ 12.13 hrs, Volume= 0.002 af
Primary = 0.02 cfs @ 12.13 hrs, Volume= 0.002 af, Atten= 0%, Lag= 0.0 min

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

Link POA-2:

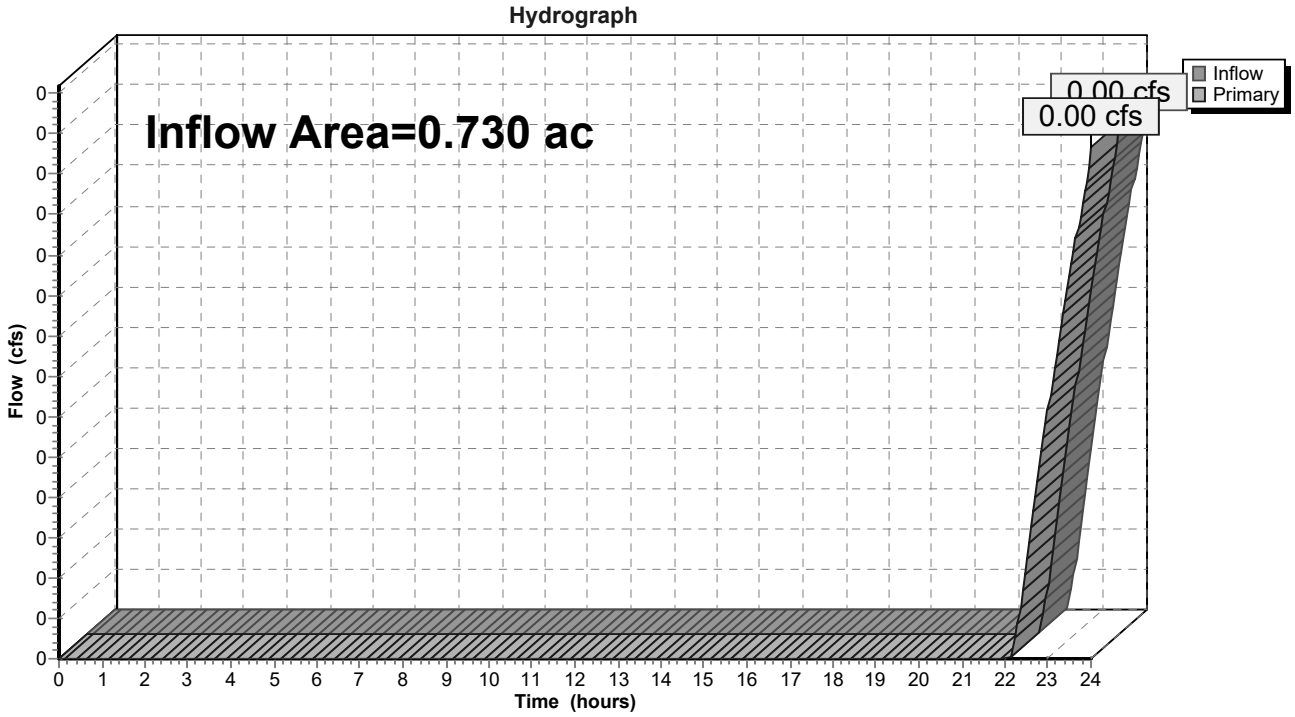


Summary for Link POA-3:

Inflow Area = 0.730 ac, 85.98% 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-3:



Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment PR-1: Runoff Area=7,182 sf 0.00% Impervious Runoff Depth>0.17"
Tc=6.0 min CN=39/0 Runoff=0.00 cfs 0.002 af

Subcatchment PR-2: Runoff Area=3,087 sf 9.43% Impervious Runoff Depth>0.58"
Tc=6.0 min CN=39/98 Runoff=0.03 cfs 0.003 af

Subcatchment PR-3A: Runoff Area=29,671 sf 92.14% Impervious Runoff Depth>4.24"
Tc=6.0 min CN=39/98 Runoff=2.65 cfs 0.241 af

Subcatchment PR-3B: Runoff Area=2,127 sf 0.00% Impervious Runoff Depth>0.17"
Tc=6.0 min CN=39/0 Runoff=0.00 cfs 0.001 af

Pond SIS: Peak Elev=499.76' Storage=2,791 cf Inflow=2.65 cfs 0.241 af
Discarded=0.28 cfs 0.241 af Primary=0.00 cfs 0.000 af Outflow=0.28 cfs 0.241 af

Link POA-1: Inflow=0.00 cfs 0.002 af
Primary=0.00 cfs 0.002 af

Link POA-2: Inflow=0.03 cfs 0.003 af
Primary=0.03 cfs 0.003 af

Link POA-3: Inflow=0.00 cfs 0.001 af
Primary=0.00 cfs 0.001 af

Total Runoff Area = 0.966 ac Runoff Volume = 0.247 af Average Runoff Depth = 3.07"
34.32% Pervious = 0.331 ac 65.68% Impervious = 0.634 ac

Summary for Subcatchment PR-1:

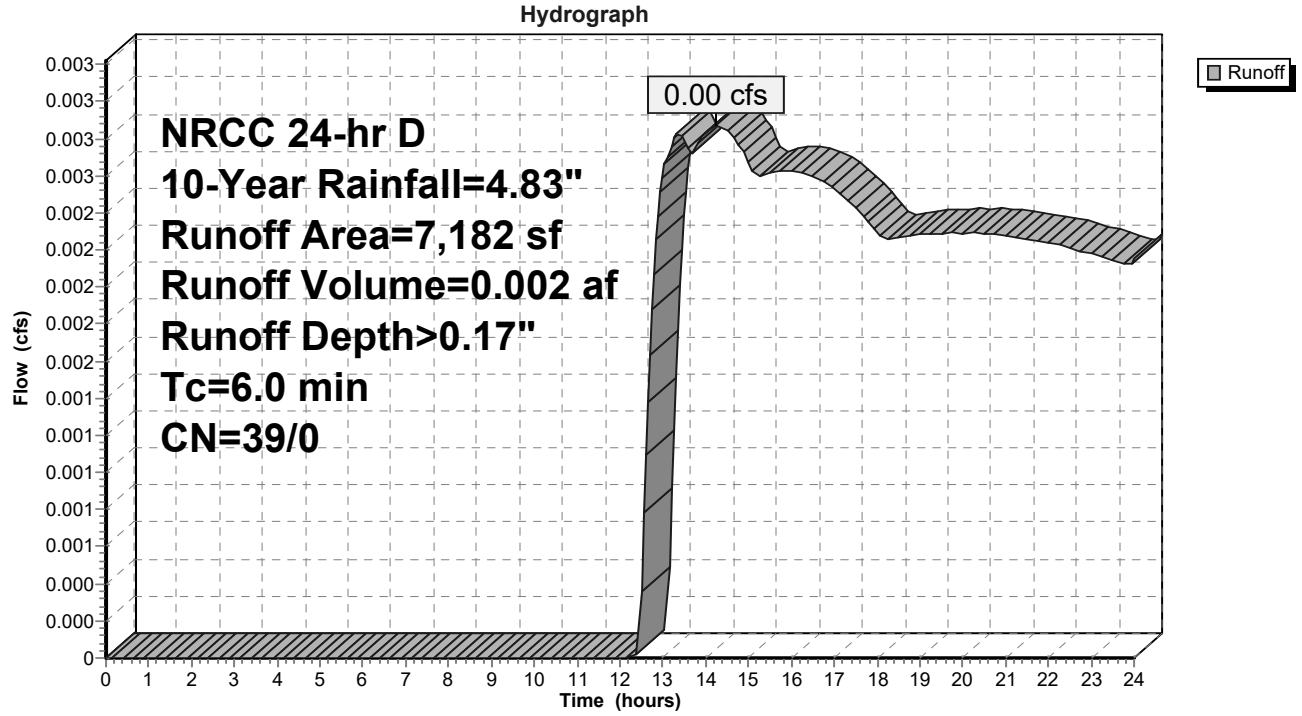
Runoff = 0.00 cfs @ 14.25 hrs, Volume= 0.002 af, Depth> 0.17"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 0.00-24.00 hrs, dt= 0.05
NRCC 24-hr D 10-Year Rainfall=4.83"

Area (sf)	CN	Description
7,182	39	>75% Grass cover, Good, HSG A
7,182	39	100.00% Pervious Area

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

Subcatchment PR-1:



Summary for Subcatchment PR-2:

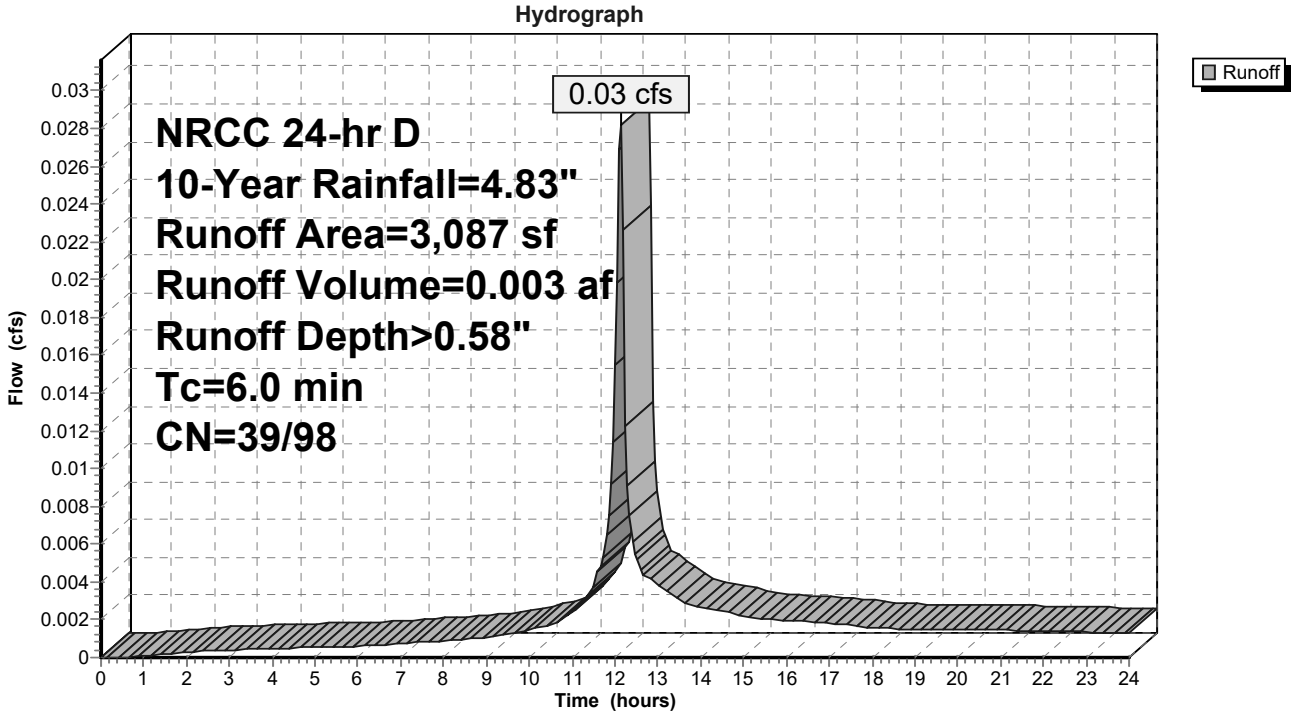
Runoff = 0.03 cfs @ 12.13 hrs, Volume= 0.003 af, Depth> 0.58"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 0.00-24.00 hrs, dt= 0.05
NRCC 24-hr D 10-Year Rainfall=4.83"

Area (sf)	CN	Description
2,796	39	>75% Grass cover, Good, HSG A
291	98	Paved parking, HSG A
3,087	45	Weighted Average
2,796	39	90.57% Pervious Area
291	98	9.43% Impervious Area

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

Subcatchment PR-2:



Summary for Subcatchment PR-3A:

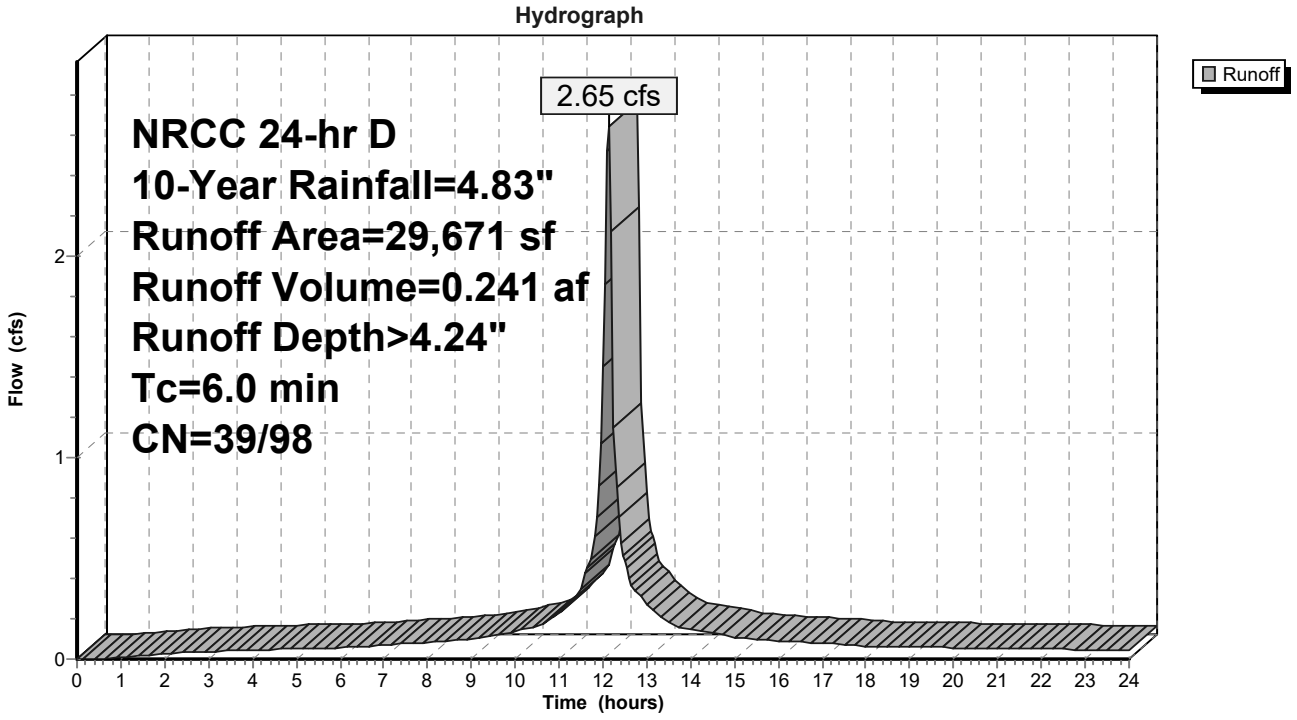
Runoff = 2.65 cfs @ 12.13 hrs, Volume= 0.241 af, Depth> 4.24"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 0.00-24.00 hrs, dt= 0.05
NRCC 24-hr D 10-Year Rainfall=4.83"

Area (sf)	CN	Description
7,104	98	Roofs, HSG A
2,332	39	>75% Grass cover, Good, HSG A
20,235	98	Paved parking, HSG A
29,671	93	Weighted Average
2,332	39	7.86% Pervious Area
27,339	98	92.14% Impervious Area

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

Subcatchment PR-3A:



Summary for Subcatchment PR-3B:

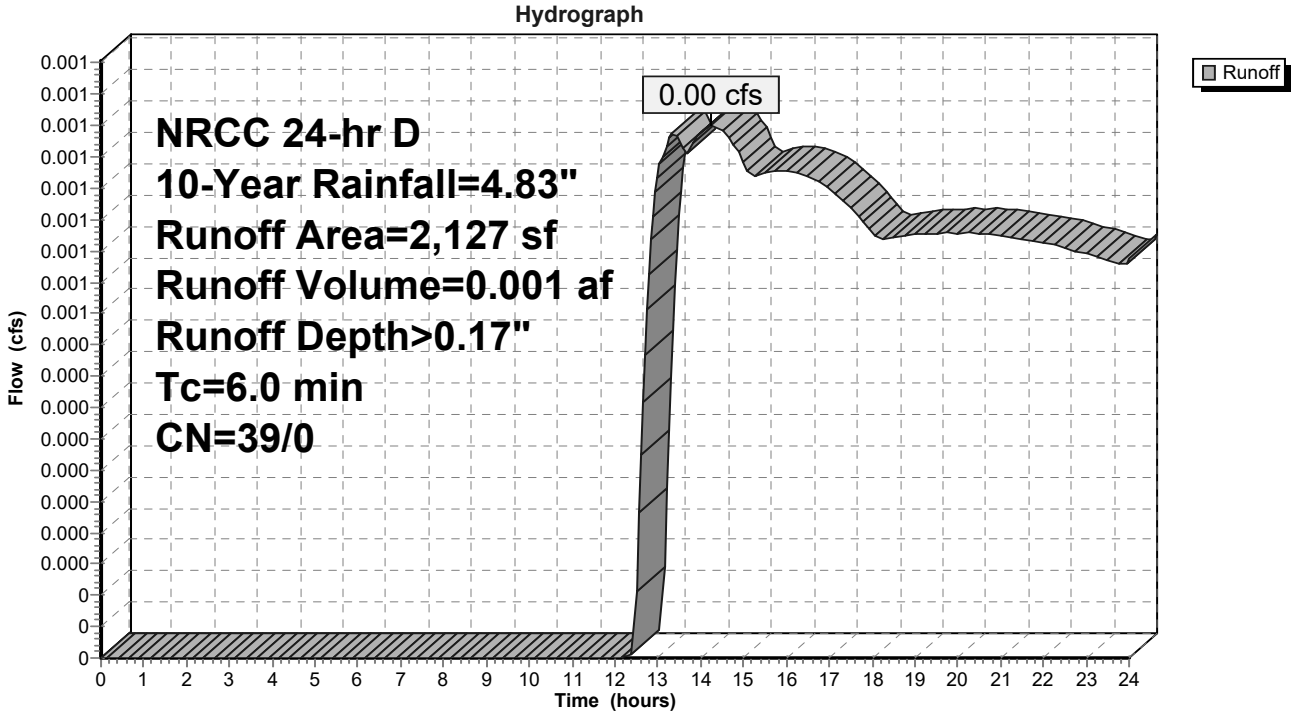
Runoff = 0.00 cfs @ 14.25 hrs, Volume= 0.001 af, Depth> 0.17"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 0.00-24.00 hrs, dt= 0.05
NRCC 24-hr D 10-Year Rainfall=4.83"

Area (sf)	CN	Description
2,127	39	>75% Grass cover, Good, HSG A
2,127	39	100.00% Pervious Area

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

Subcatchment PR-3B:



Summary for Pond SIS:

Inflow Area = 0.681 ac, 92.14% Impervious, Inflow Depth > 4.24" for 10-Year event
Inflow = 2.65 cfs @ 12.13 hrs, Volume= 0.241 af
Outflow = 0.28 cfs @ 11.30 hrs, Volume= 0.241 af, Atten= 90%, Lag= 0.0 min
Discarded = 0.28 cfs @ 11.30 hrs, Volume= 0.241 af
Primary = 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= 499.76' @ 12.99 hrs Surf.Area= 1,443 sf Storage= 2,791 cf

Plug-Flow detention time= 60.6 min calculated for 0.241 af (100% of inflow)
Center-of-Mass det. time= 60.0 min (811.5 - 751.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	497.00'	1,408 cf	**24.25'W x 59.50'L x 4.00'H Field A** 5,772 cf Overall - 2,250 cf Embedded = 3,521 cf x 40.0% Voids
#2A	497.50'	2,250 cf	**Cultec R-360HD** x 60 Inside #1 Effective Size= 54.9"W x 36.0"H => 9.99 sf x 3.67'L = 36.6 cf Overall Size= 60.0"W x 36.0"H x 4.17'L with 0.50' Overlap 60 Chambers in 4 Rows Cap Storage= +6.5 cf x 2 x 4 rows = 51.7 cf
#3	501.00'	2,508 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc) -Impervious
		6,166 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
501.00	2	0	0
504.50	2	7	7
505.00	10,000	2,501	2,508

Device	Routing	Invert	Outlet Devices
#1	Primary	504.50'	**24.0" Vert. Orifice/Grate** C= 0.600
#2	Discarded	497.00'	**8.270 in/hr Exfiltration over Horizontal area**

Discarded OutFlow Max=0.28 cfs @ 11.30 hrs HW=497.10' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.28 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=497.00' (Free Discharge)
↑—**1=Orifice/Grate** (Controls 0.00 cfs)

Pond SIS: - Chamber Wizard Field A

Chamber Model = Cultec R-360HD (Cultec Recharger® 360HD)
Effective Size= 54.9"W x 36.0"H => 9.99 sf x 3.67'L = 36.6 cf
Overall Size= 60.0"W x 36.0"H x 4.17'L with 0.50' Overlap
Cap Storage= +6.5 cf x 2 x 4 rows = 51.7 cf

60.0" Wide + 9.0" Spacing = 69.0" C-C Row Spacing

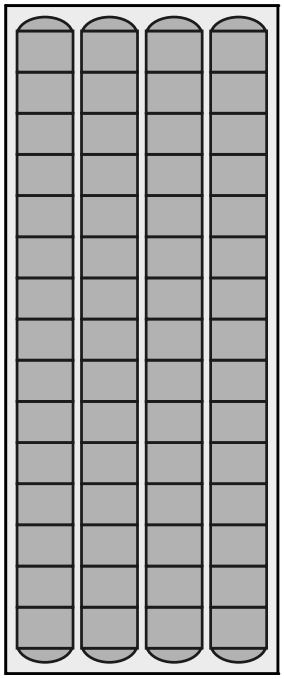
15 Chambers/Row x 3.67' Long +1.25' Cap Length x 2 = 57.50' Row Length +12.0" End Stone x 2 = 59.50' Base Length
4 Rows x 60.0" Wide + 9.0" Spacing x 3 + 12.0" Side Stone x 2 = 24.25' Base Width
6.0" Base + 36.0" Chamber Height + 6.0" Cover = 4.00' Field Height

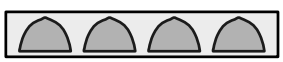
60 Chambers x 36.6 cf + 6.5 cf Cap Volume x 2 x 4 Rows = 2,250.4 cf Chamber Storage

5,771.5 cf Field - 2,250.4 cf Chambers = 3,521.1 cf Stone x 40.0% Voids = 1,408.5 cf Stone Storage

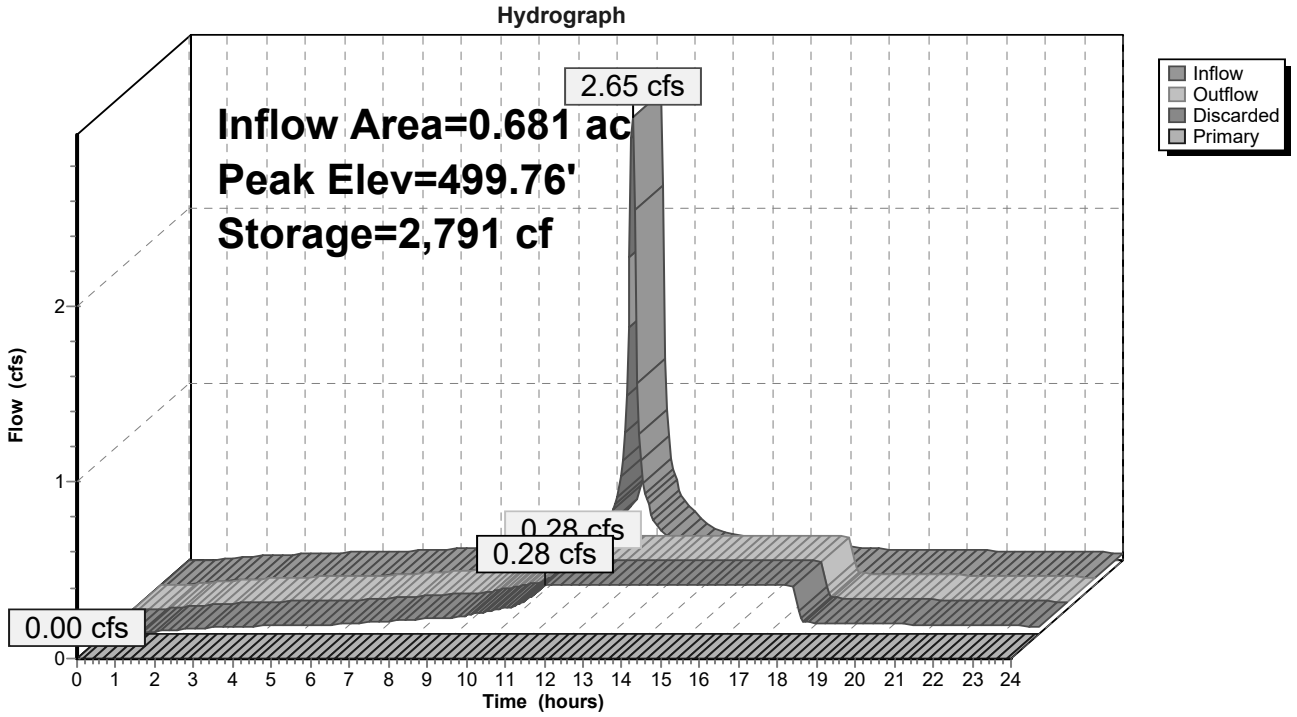
Chamber Storage + Stone Storage = 3,658.8 cf = 0.084 af
Overall Storage Efficiency = 63.4%
Overall System Size = 59.50' x 24.25' x 4.00'

60 Chambers
213.8 cy Field
130.4 cy Stone





Pond SIS:

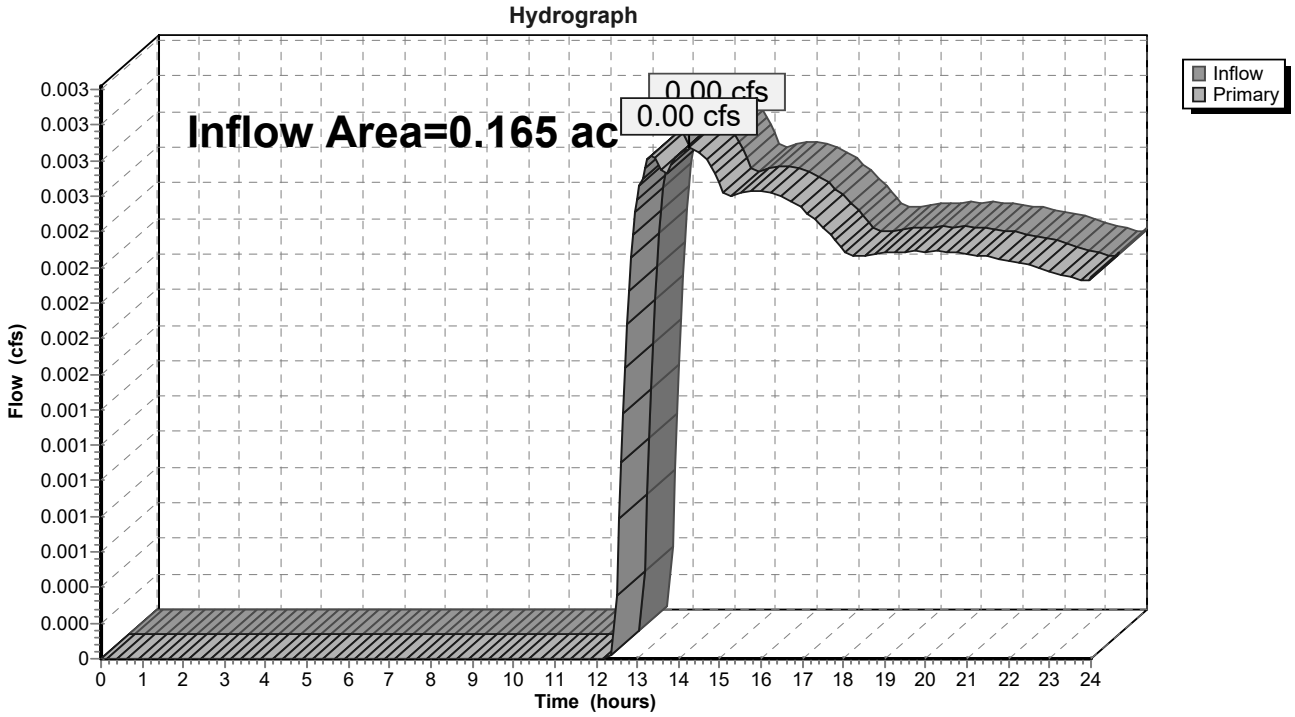

Hydrograph
Inflow Area=0.681 ac
Peak Elev=499.76'
Storage=2,791 cf
2.65 cfs
0.28 cfs
0.28 cfs
0.00 cfs
Inflow
Outflow
Discarded
Primary
Flow (cfs)
Time (hours)
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

Summary for Link POA-1:

Inflow Area = 0.165 ac, 0.00% Impervious, Inflow Depth > 0.17" for 10-Year event
Inflow = 0.00 cfs @ 14.25 hrs, Volume= 0.002 af
Primary = 0.00 cfs @ 14.25 hrs, Volume= 0.002 af, Atten= 0%, Lag= 0.0 min

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

Link POA-1:

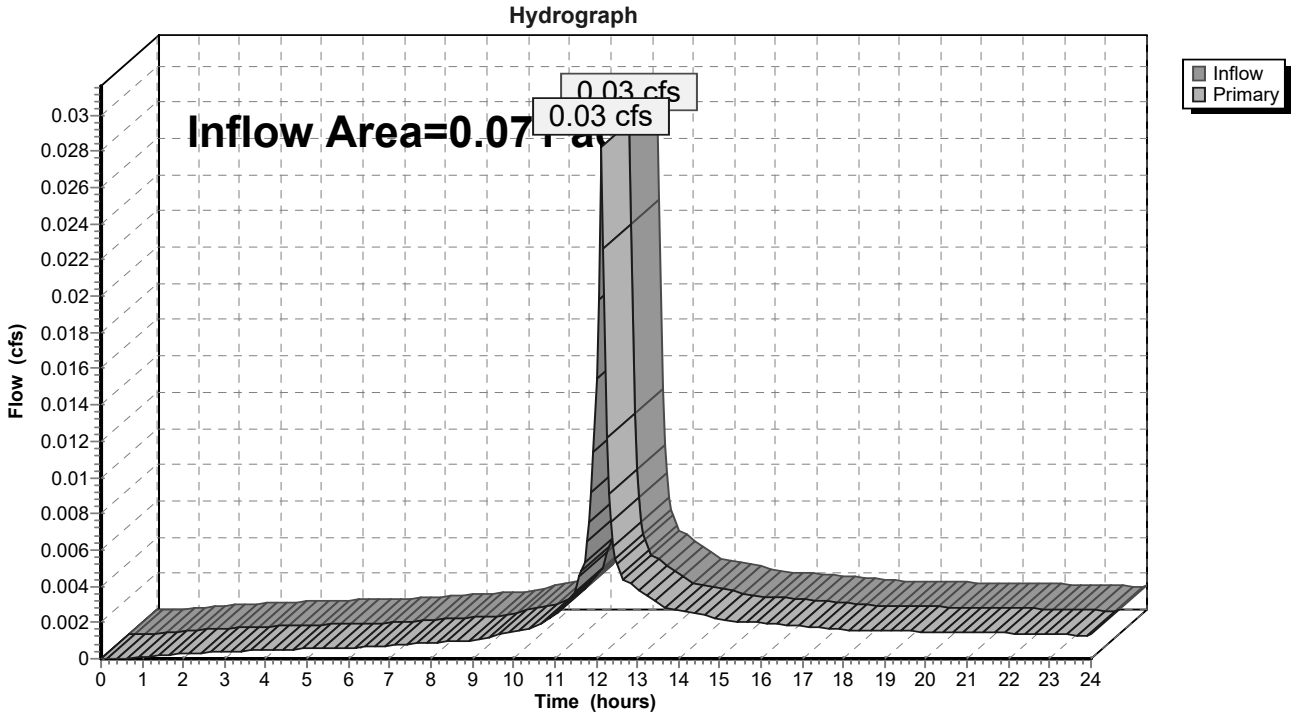


Summary for Link POA-2:

Inflow Area = 0.071 ac, 9.43% Impervious, Inflow Depth > 0.58" for 10-Year event
Inflow = 0.03 cfs @ 12.13 hrs, Volume= 0.003 af
Primary = 0.03 cfs @ 12.13 hrs, Volume= 0.003 af, Atten= 0%, Lag= 0.0 min

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

Link POA-2:

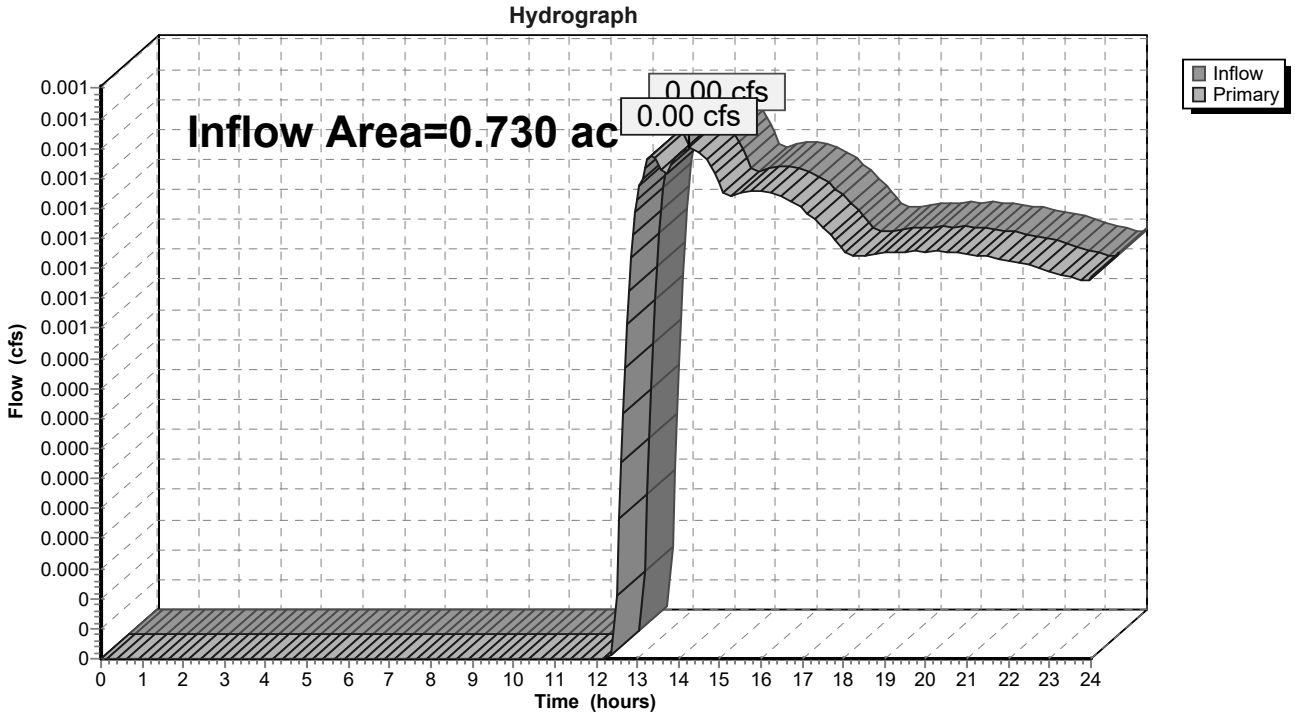


Summary for Link POA-3:

Inflow Area = 0.730 ac, 85.98% Impervious, Inflow Depth > 0.01" for 10-Year event
Inflow = 0.00 cfs @ 14.25 hrs, Volume= 0.001 af
Primary = 0.00 cfs @ 14.25 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-3:



Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment PR-1: Runoff Area=7,182 sf 0.00% Impervious Runoff Depth>1.43"
Tc=6.0 min CN=39/0 Runoff=0.20 cfs 0.020 af

Subcatchment PR-2: Runoff Area=3,087 sf 9.43% Impervious Runoff Depth>2.09"
Tc=6.0 min CN=39/98 Runoff=0.13 cfs 0.012 af

Subcatchment PR-3A: Runoff Area=29,671 sf 92.14% Impervious Runoff Depth>7.84"
Tc=6.0 min CN=39/98 Runoff=4.82 cfs 0.445 af

Subcatchment PR-3B: Runoff Area=2,127 sf 0.00% Impervious Runoff Depth>1.43"
Tc=6.0 min CN=39/0 Runoff=0.06 cfs 0.006 af

Pond SIS: Peak Elev=504.89' Storage=5,155 cf Inflow=4.82 cfs 0.445 af
Discarded=0.28 cfs 0.369 af Primary=0.90 cfs 0.076 af Outflow=1.17 cfs 0.445 af

Link POA-1: Inflow=0.20 cfs 0.020 af
Primary=0.20 cfs 0.020 af

Link POA-2: Inflow=0.13 cfs 0.012 af
Primary=0.13 cfs 0.012 af

Link POA-3: Inflow=0.92 cfs 0.082 af
Primary=0.92 cfs 0.082 af

Total Runoff Area = 0.966 ac Runoff Volume = 0.483 af Average Runoff Depth = 6.00"
34.32% Pervious = 0.331 ac 65.68% Impervious = 0.634 ac

Summary for Subcatchment PR-1:

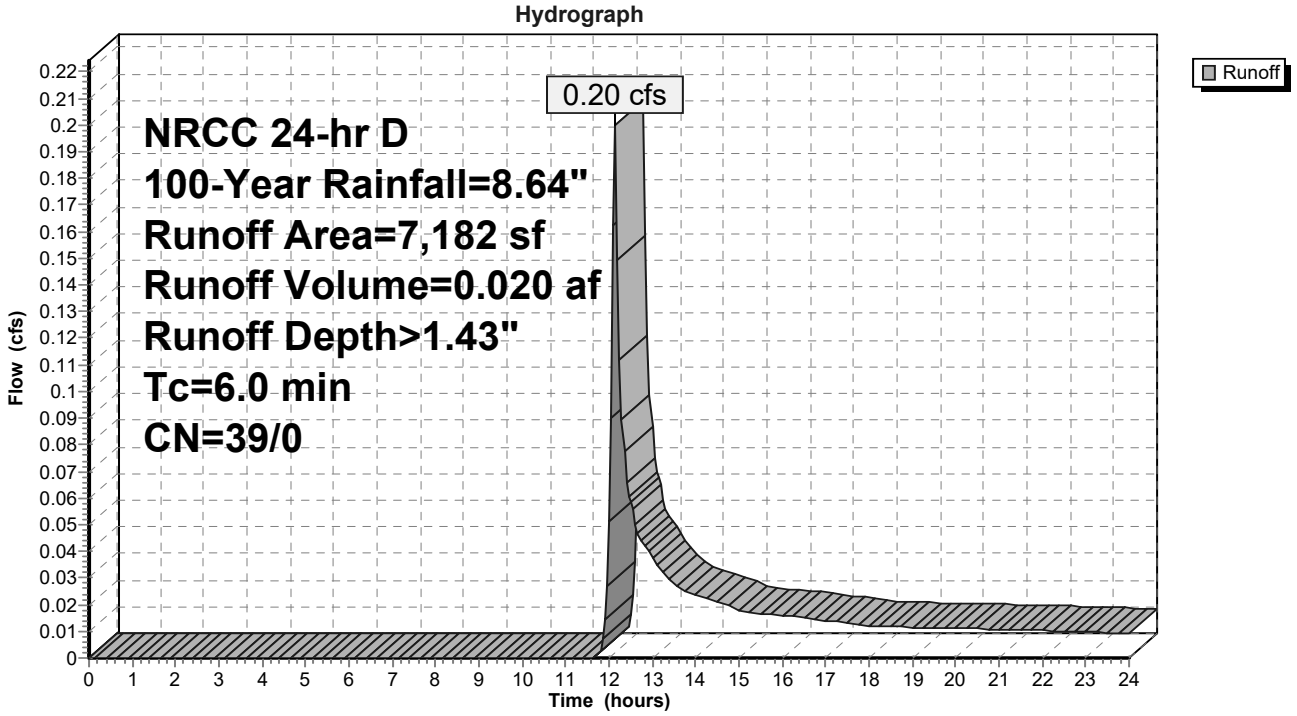
Runoff = 0.20 cfs @ 12.15 hrs, Volume= 0.020 af, Depth> 1.43"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 0.00-24.00 hrs, dt= 0.05
NRCC 24-hr D 100-Year Rainfall=8.64"

Area (sf)	CN	Description
7,182	39	>75% Grass cover, Good, HSG A
7,182	39	100.00% Pervious Area

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

Subcatchment PR-1:



Summary for Subcatchment PR-2:

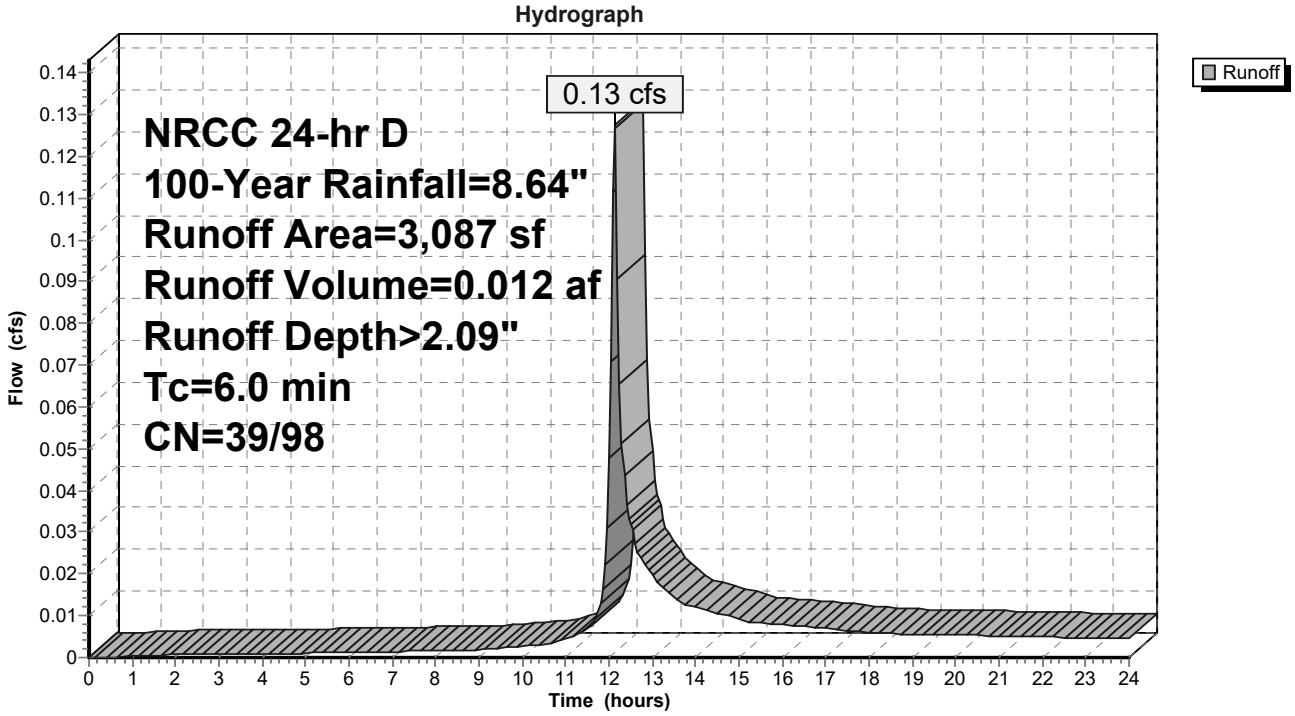
Runoff = 0.13 cfs @ 12.14 hrs, Volume= 0.012 af, Depth> 2.09"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 0.00-24.00 hrs, dt= 0.05
NRCC 24-hr D 100-Year Rainfall=8.64"

Area (sf)	CN	Description
2,796	39	>75% Grass cover, Good, HSG A
291	98	Paved parking, HSG A
3,087	45	Weighted Average
2,796	39	90.57% Pervious Area
291	98	9.43% Impervious Area

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

Subcatchment PR-2:



Summary for Subcatchment PR-3A:

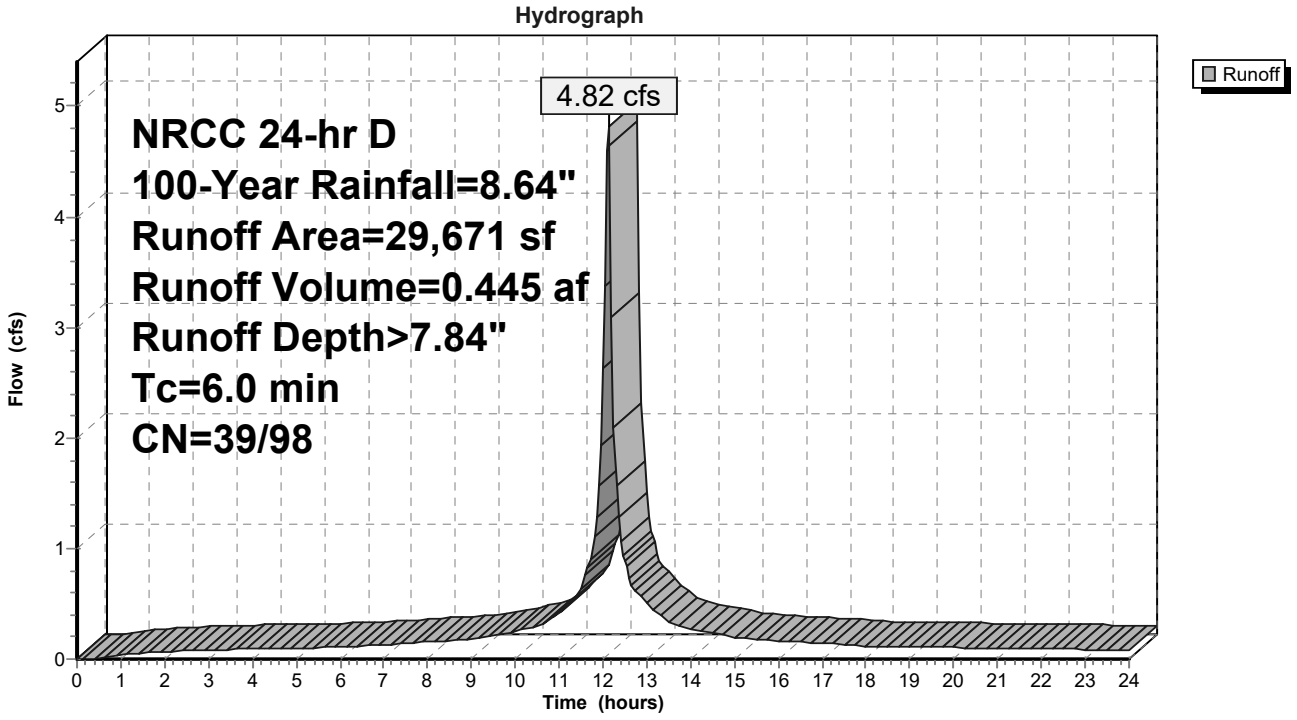
Runoff = 4.82 cfs @ 12.13 hrs, Volume= 0.445 af, Depth> 7.84"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 0.00-24.00 hrs, dt= 0.05
NRCC 24-hr D 100-Year Rainfall=8.64"

Area (sf)	CN	Description
7,104	98	Roofs, HSG A
2,332	39	>75% Grass cover, Good, HSG A
20,235	98	Paved parking, HSG A
29,671	93	Weighted Average
2,332	39	7.86% Pervious Area
27,339	98	92.14% Impervious Area

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

Subcatchment PR-3A:



Summary for Subcatchment PR-3B:

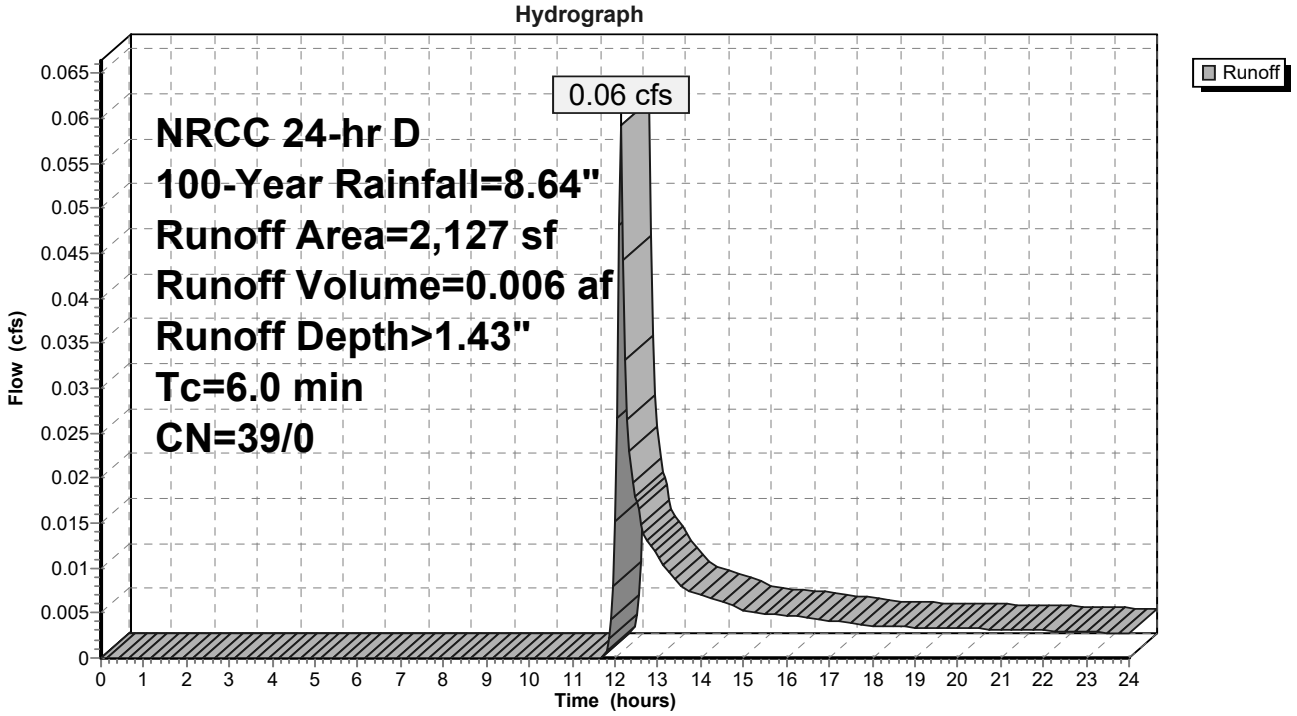
Runoff = 0.06 cfs @ 12.15 hrs, Volume= 0.006 af, Depth> 1.43"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv. UI as Pervious, Time Span= 0.00-24.00 hrs, dt= 0.05
NRCC 24-hr D 100-Year Rainfall=8.64"

Area (sf)	CN	Description
2,127	39	>75% Grass cover, Good, HSG A
2,127	39	100.00% Pervious Area

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

Subcatchment PR-3B:



Summary for Pond SIS:

Inflow Area = 0.681 ac, 92.14% Impervious, Inflow Depth > 7.84" for 100-Year event
Inflow = 4.82 cfs @ 12.13 hrs, Volume= 0.445 af
Outflow = 1.17 cfs @ 12.38 hrs, Volume= 0.445 af, Atten= 76%, Lag= 14.9 min
Discarded = 0.28 cfs @ 10.40 hrs, Volume= 0.369 af
Primary = 0.90 cfs @ 12.38 hrs, Volume= 0.076 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 504.89' @ 12.38 hrs Surf.Area= 1,443 sf Storage= 5,155 cf

Plug-Flow detention time= 82.7 min calculated for 0.444 af (100% of inflow)
Center-of-Mass det. time= 81.9 min (825.8 - 743.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	497.00'	1,408 cf	**24.25'W x 59.50'L x 4.00'H Field A** 5,772 cf Overall - 2,250 cf Embedded = 3,521 cf x 40.0% Voids
#2A	497.50'	2,250 cf	**Cultec R-360HD** x 60 Inside #1 Effective Size= 54.9"W x 36.0"H => 9.99 sf x 3.67'L = 36.6 cf Overall Size= 60.0"W x 36.0"H x 4.17'L with 0.50' Overlap 60 Chambers in 4 Rows Cap Storage= +6.5 cf x 2 x 4 rows = 51.7 cf
#3	501.00'	2,508 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc) -Impervious
		6,166 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
501.00	2	0	0
504.50	2	7	7
505.00	10,000	2,501	2,508

Device	Routing	Invert	Outlet Devices
#1	Primary	504.50'	**24.0" Vert. Orifice/Grate** C= 0.600
#2	Discarded	497.00'	**8.270 in/hr Exfiltration over Horizontal area**

Discarded OutFlow Max=0.28 cfs @ 10.40 hrs HW=497.10' (Free Discharge)
↑└**2=Exfiltration** (Exfiltration Controls 0.28 cfs)

Primary OutFlow Max=0.90 cfs @ 12.38 hrs HW=504.89' (Free Discharge)
↑└**1=Orifice/Grate** (Orifice Controls 0.90 cfs @ 2.11 fps)

Pond SIS: - Chamber Wizard Field A

Chamber Model = Cultec R-360HD (Cultec Recharger® 360HD)
Effective Size= 54.9"W x 36.0"H => 9.99 sf x 3.67'L = 36.6 cf
Overall Size= 60.0"W x 36.0"H x 4.17'L with 0.50' Overlap
Cap Storage= +6.5 cf x 2 x 4 rows = 51.7 cf

60.0" Wide + 9.0" Spacing = 69.0" C-C Row Spacing

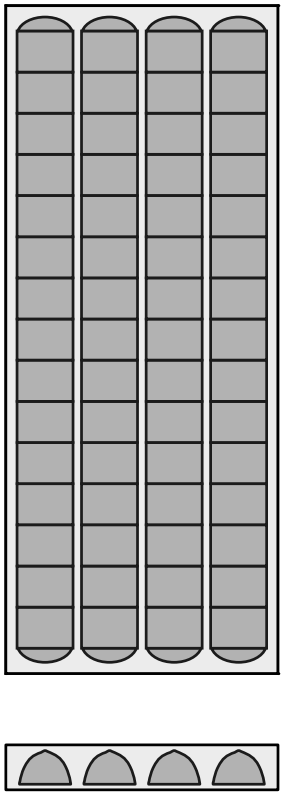
15 Chambers/Row x 3.67' Long +1.25' Cap Length x 2 = 57.50' Row Length +12.0" End Stone x 2 = 59.50' Base Length
4 Rows x 60.0" Wide + 9.0" Spacing x 3 + 12.0" Side Stone x 2 = 24.25' Base Width
6.0" Base + 36.0" Chamber Height + 6.0" Cover = 4.00' Field Height

60 Chambers x 36.6 cf + 6.5 cf Cap Volume x 2 x 4 Rows = 2,250.4 cf Chamber Storage

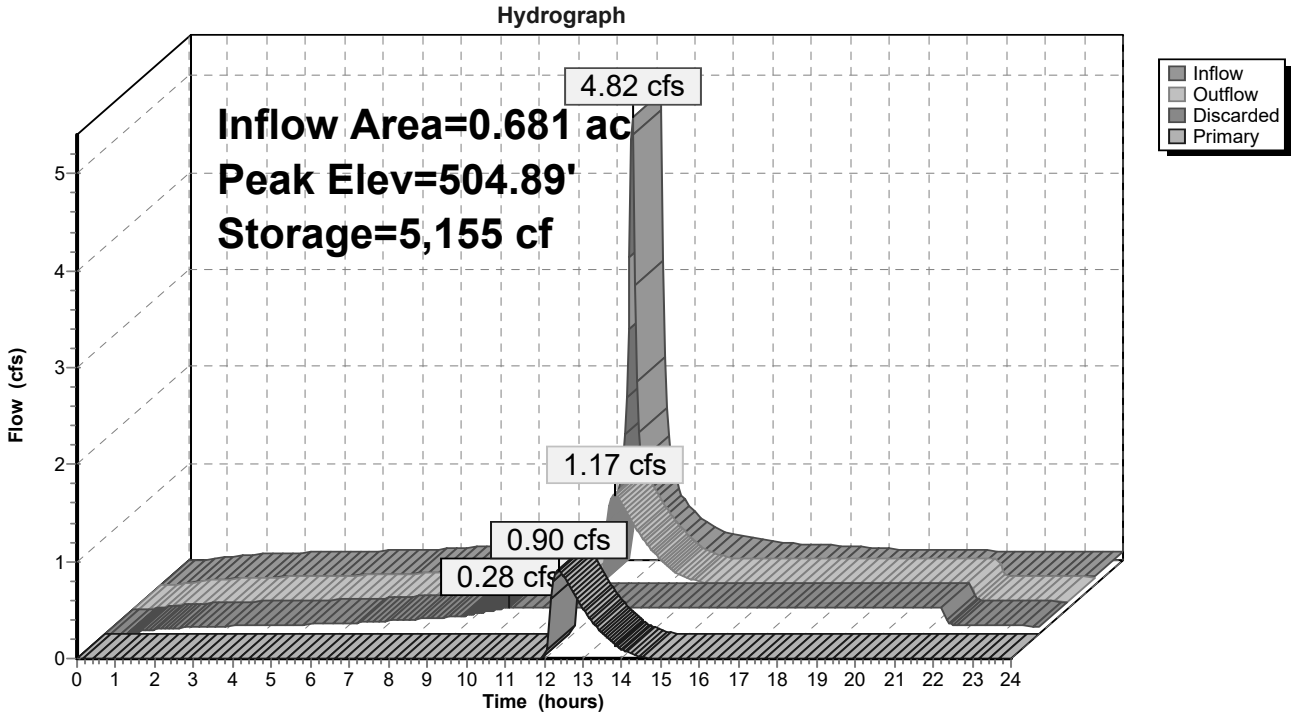
5,771.5 cf Field - 2,250.4 cf Chambers = 3,521.1 cf Stone x 40.0% Voids = 1,408.5 cf Stone Storage

Chamber Storage + Stone Storage = 3,658.8 cf = 0.084 af
Overall Storage Efficiency = 63.4%
Overall System Size = 59.50' x 24.25' x 4.00'

60 Chambers
213.8 cy Field
130.4 cy Stone



Pond SIS:

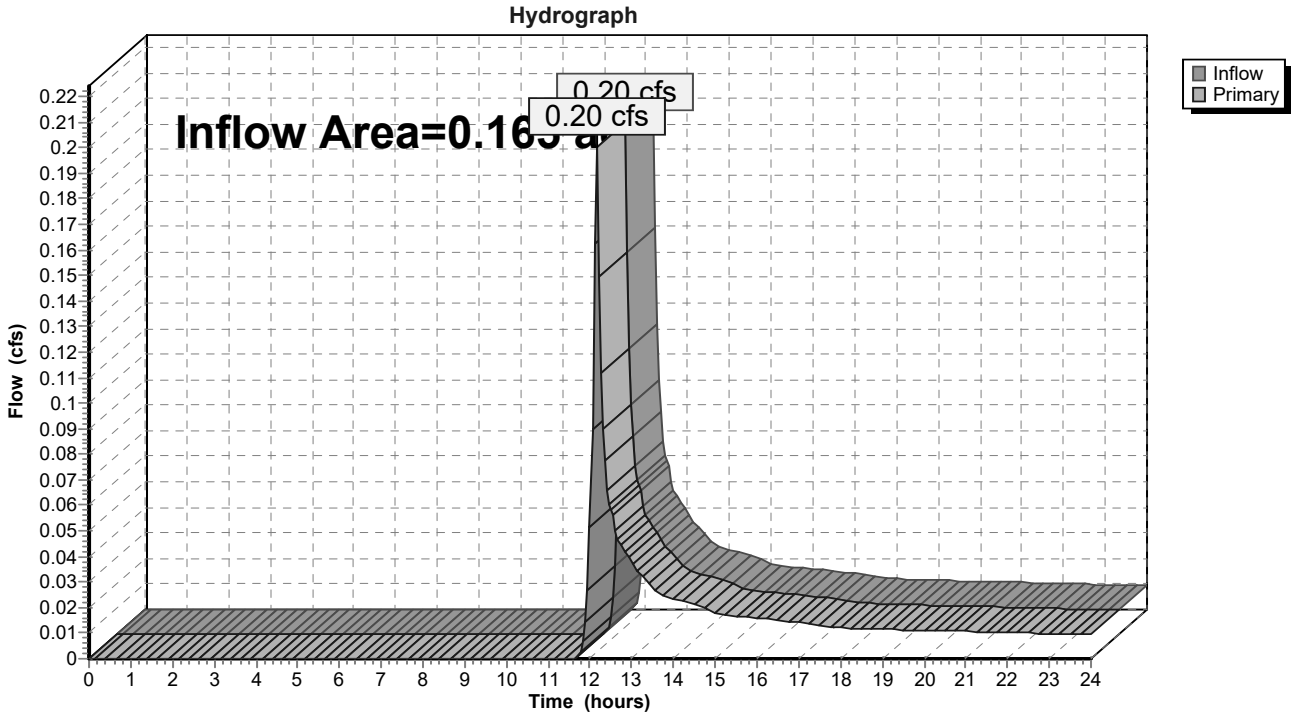

Hydrograph
Inflow Area=0.681 ac
Peak Elev=504.89'
Storage=5,155 cf
4.82 cfs
1.17 cfs
0.90 cfs
0.28 cfs
Inflow
Outflow
Discarded
Primary
Flow (cfs)
Time (hours)
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

Summary for Link POA-1:

Inflow Area = 0.165 ac, 0.00% Impervious, Inflow Depth > 1.43" for 100-Year event
Inflow = 0.20 cfs @ 12.15 hrs, Volume= 0.020 af
Primary = 0.20 cfs @ 12.15 hrs, Volume= 0.020 af, Atten= 0%, Lag= 0.0 min

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

Link POA-1:

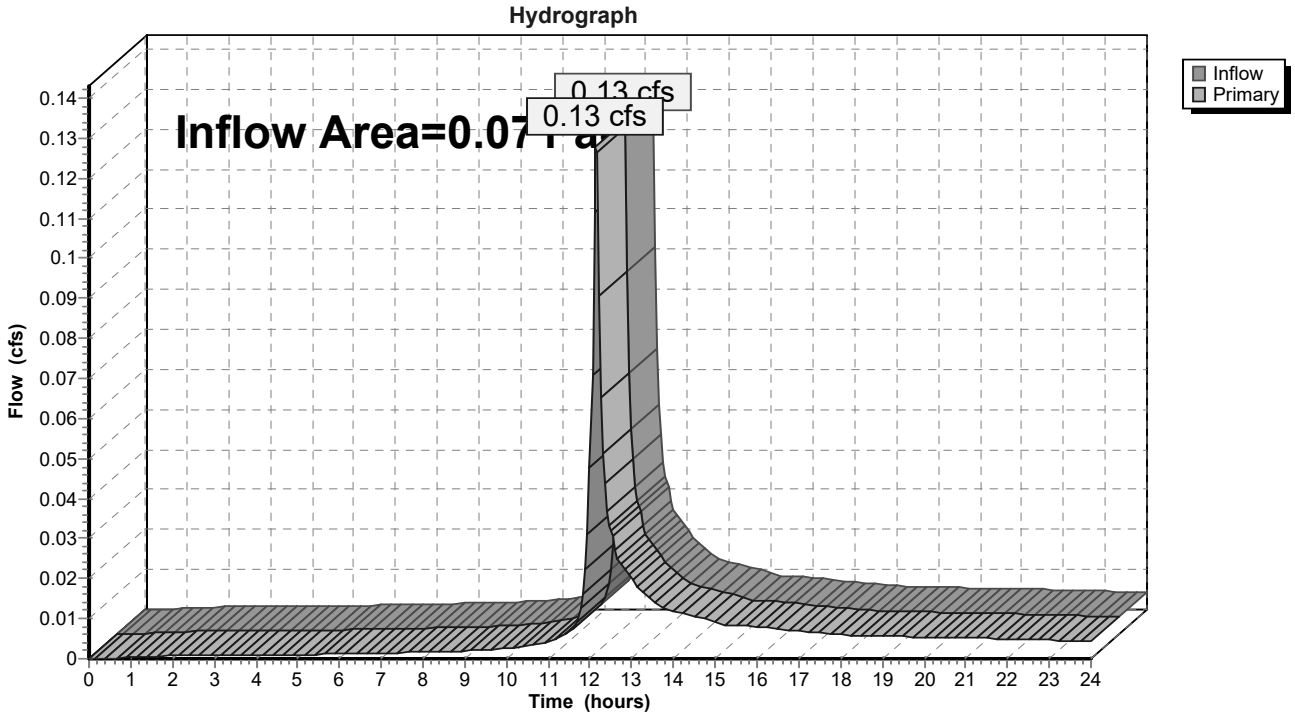


Summary for Link POA-2:

Inflow Area = 0.071 ac, 9.43% Impervious, Inflow Depth > 2.09" for 100-Year event
Inflow = 0.13 cfs @ 12.14 hrs, Volume= 0.012 af
Primary = 0.13 cfs @ 12.14 hrs, Volume= 0.012 af, Atten= 0%, Lag= 0.0 min

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

Link POA-2:

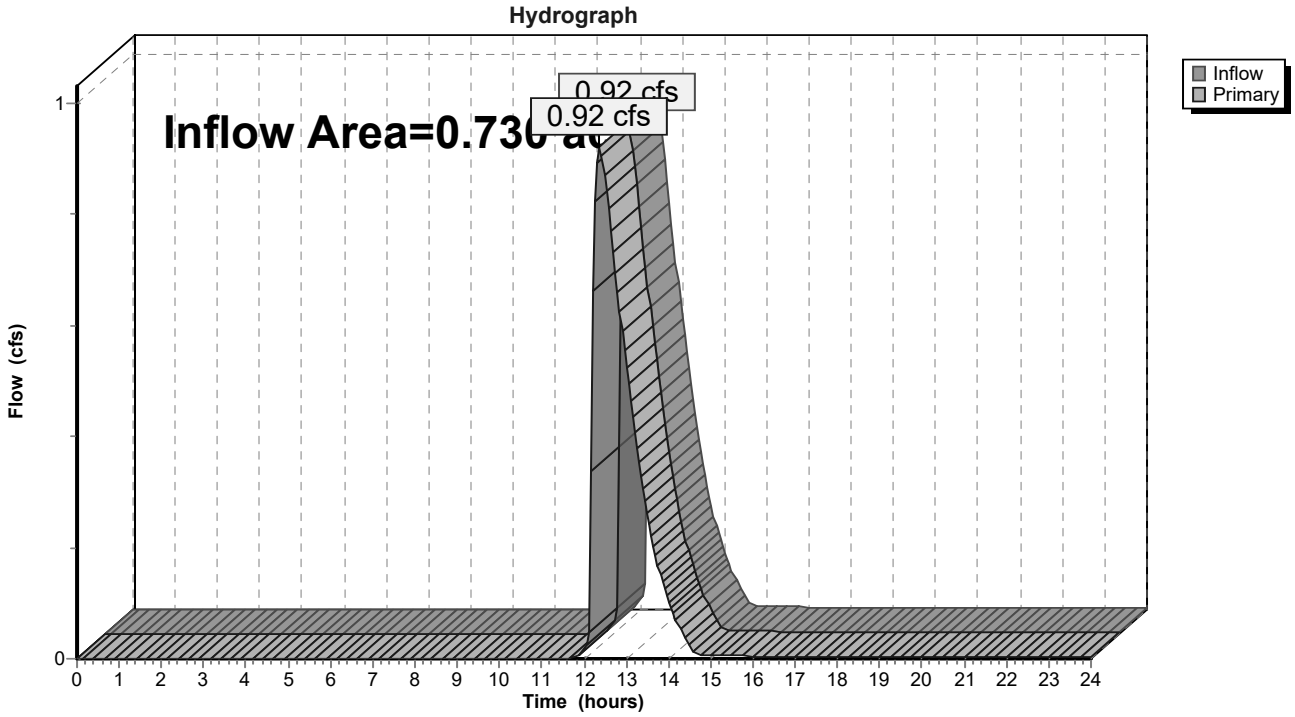


Summary for Link POA-3:

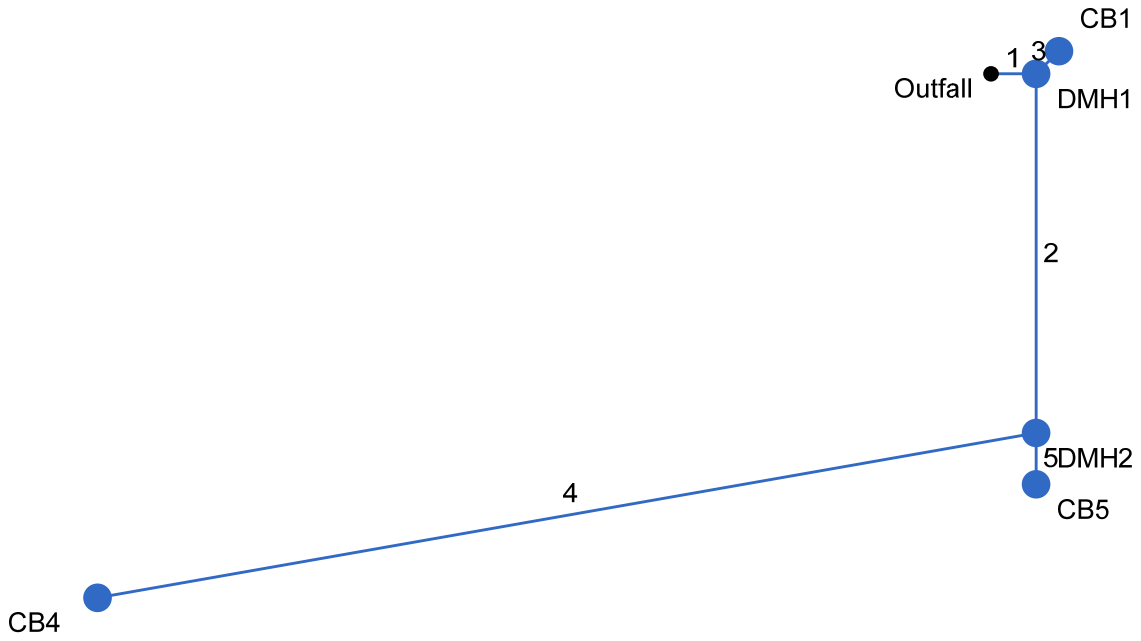
Inflow Area = 0.730 ac, 85.98% Impervious, Inflow Depth > 1.35" for 100-Year event
Inflow = 0.92 cfs @ 12.37 hrs, Volume= 0.082 af
Primary = 0.92 cfs @ 12.37 hrs, Volume= 0.082 af, Atten= 0%, Lag= 0.0 min

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

Link POA-3:



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



Project File: System-1.stm	Number of lines: 5	Date: 8/31/2022

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	7.000	0.000	MH	0.00	0.00	0.00	6.0	497.50	0.71	497.55	12	Cir	0.012	1.00	503.90	DMH1-SIS
2	1	56.000	90.000	MH	0.00	0.00	0.00	6.0	497.55	0.54	497.85	12	Cir	0.012	0.99	504.20	DMH2-DMH1
3	1	5.000	-45.000	Grate	0.00	0.08	0.90	6.0	500.00	2.00	500.10	12	Cir	0.012	1.00	503.90	CB1-DMH1
4	2	148.000	80.000	Grate	0.00	0.14	0.90	6.0	497.95	0.51	498.70	12	Cir	0.012	1.00	501.70	CB4-DMH2
5	2	8.000	0.000	Grate	0.00	0.08	0.90	6.0	500.70	1.25	500.80	12	Cir	0.012	1.00	503.80	CB5-DMH2

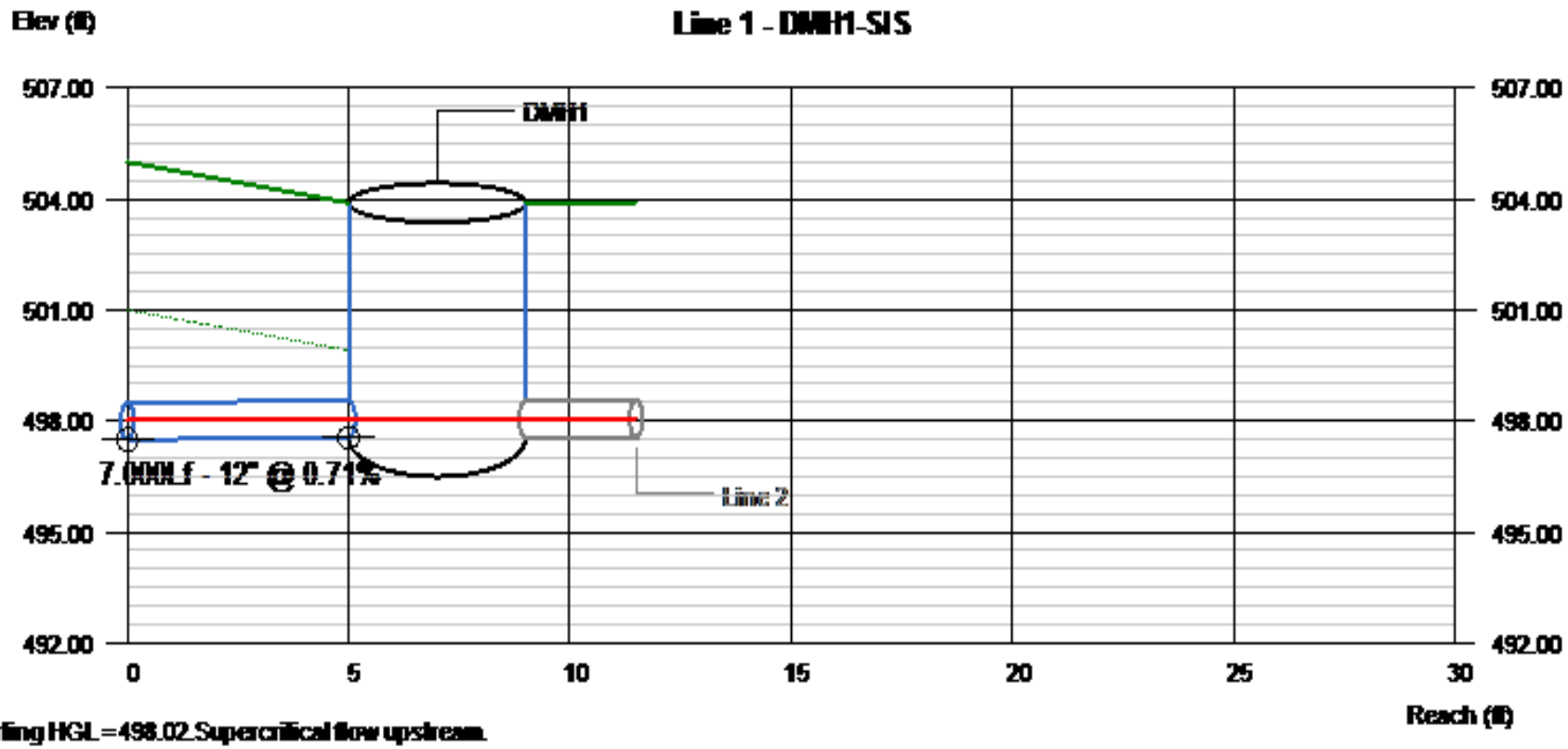
Project File: System-1.stm | Number of lines: 5 | Date: 8/31/2022

Storm Sewer Summary Report

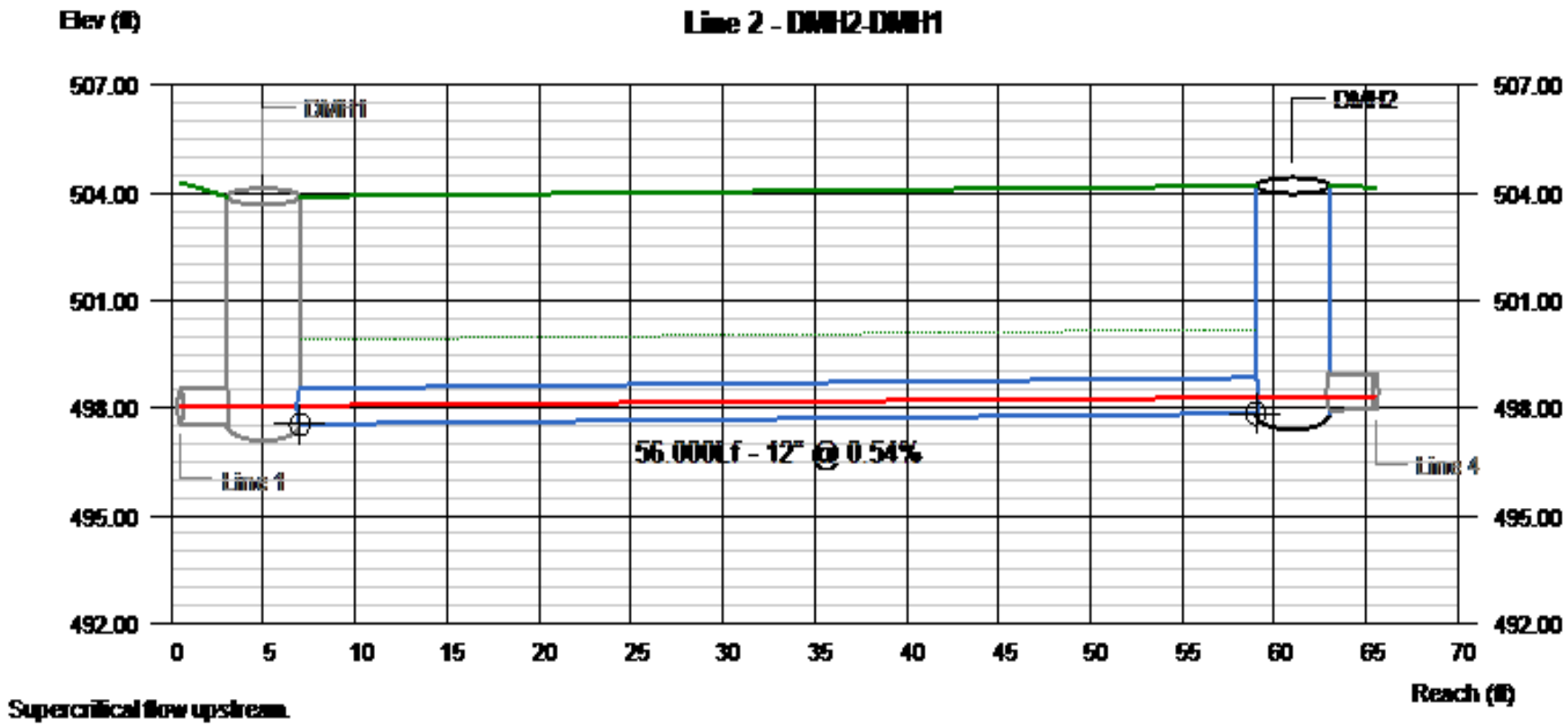
Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line Slope (%)	HGL Down (ft)	HGL Up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns Line No.	Junction Type
1	DMH1-SIS	1.50	12	Cir	7.000	497.50	497.55	0.714	498.02	498.07	n/a	498.07 j	End	Manhole
2	DMH2-DMH1	1.12	12	Cir	56.000	497.55	497.85	0.536	498.07	498.30	n/a	498.30	1	Manhole
3	CB1-DMH1	0.45	12	Cir	5.000	500.00	500.10	2.000	500.20	500.38	n/a	500.38	1	Grate
4	CB4-DMH2	0.79	12	Cir	148.000	497.95	498.70	0.507	498.32	499.07	0.14	499.07	2	Grate
5	CB5-DMH2	0.45	12	Cir	8.000	500.70	500.80	1.250	500.92	501.08	n/a	501.08	2	Grate

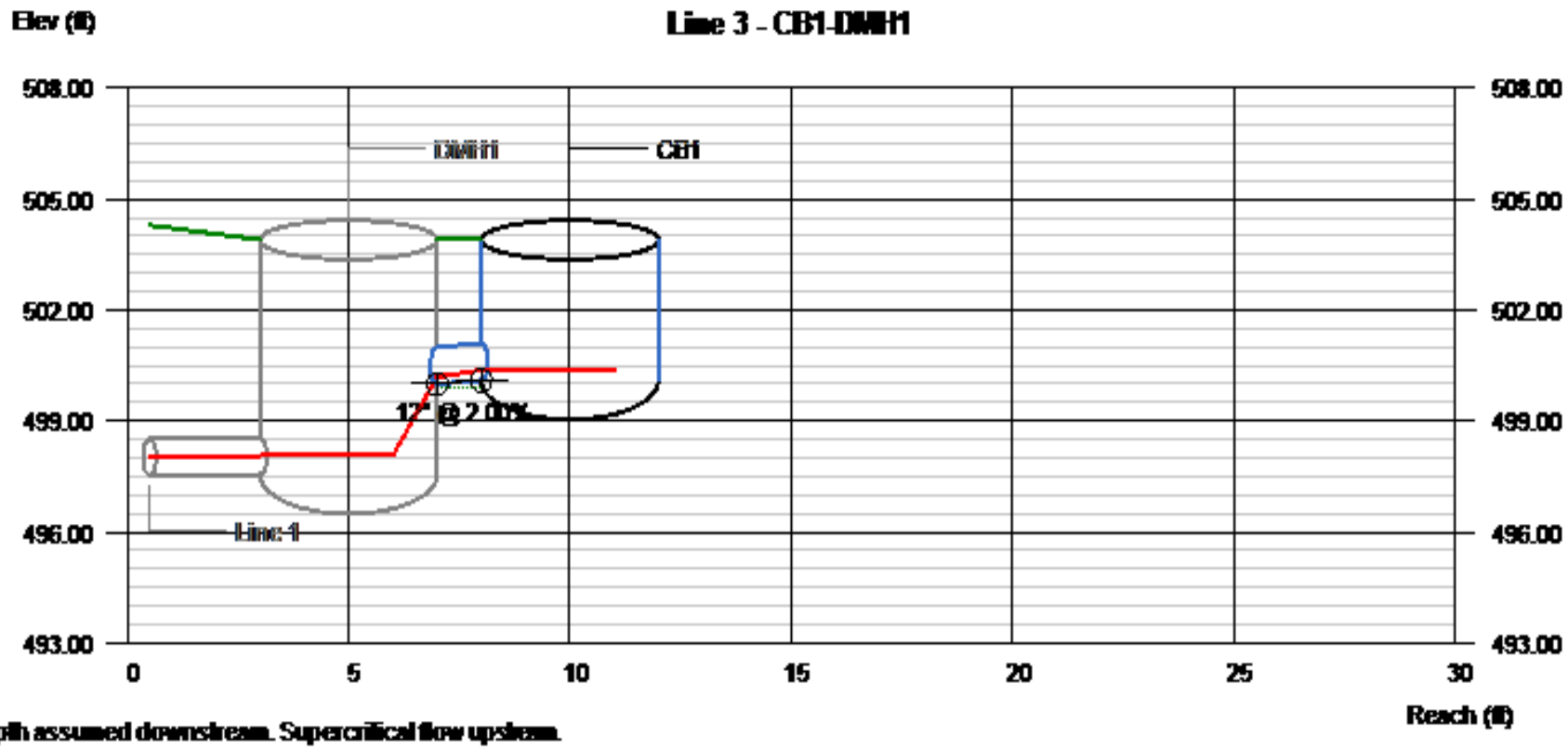
Project File: System-1.stm | Number of lines: 5 | Run Date: 8/31/2022

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

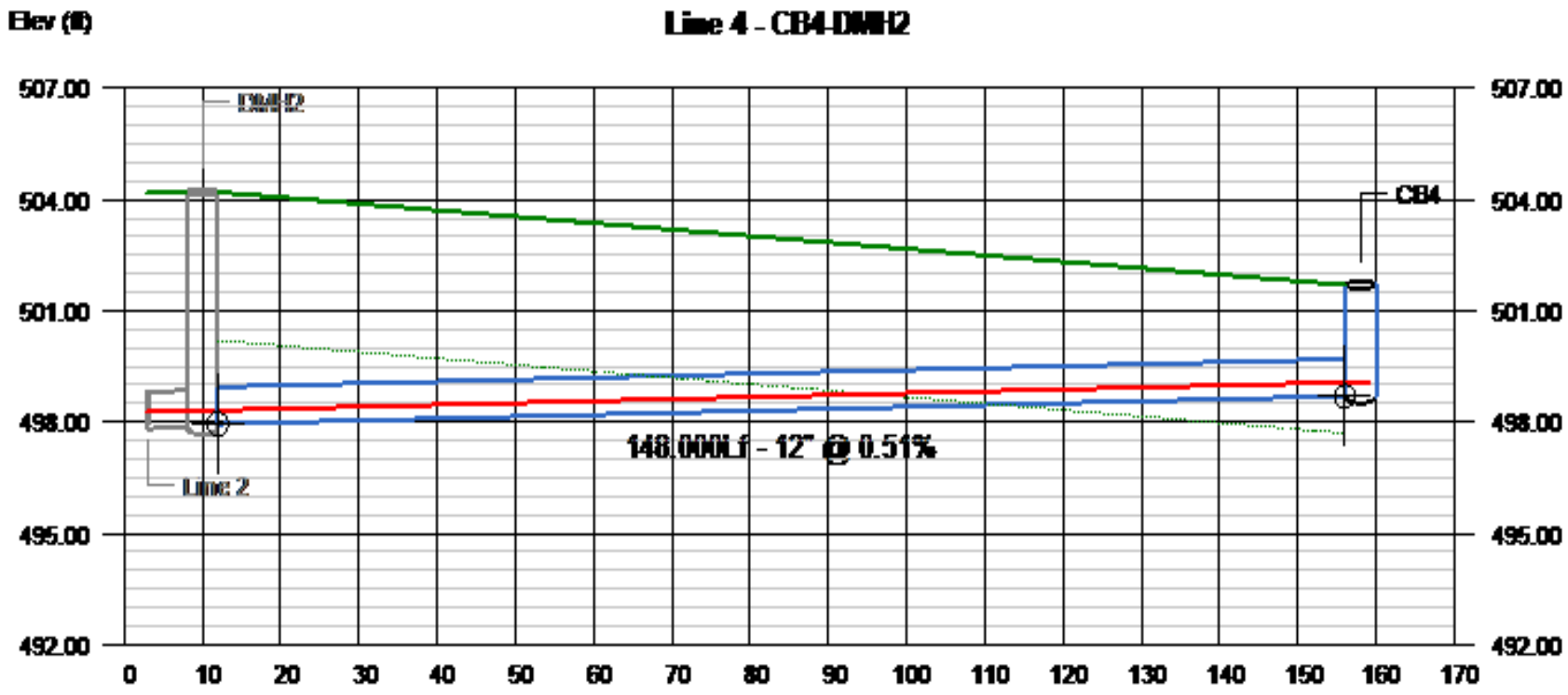


Starting HGL = 498.02 Supercritical flow upstream.

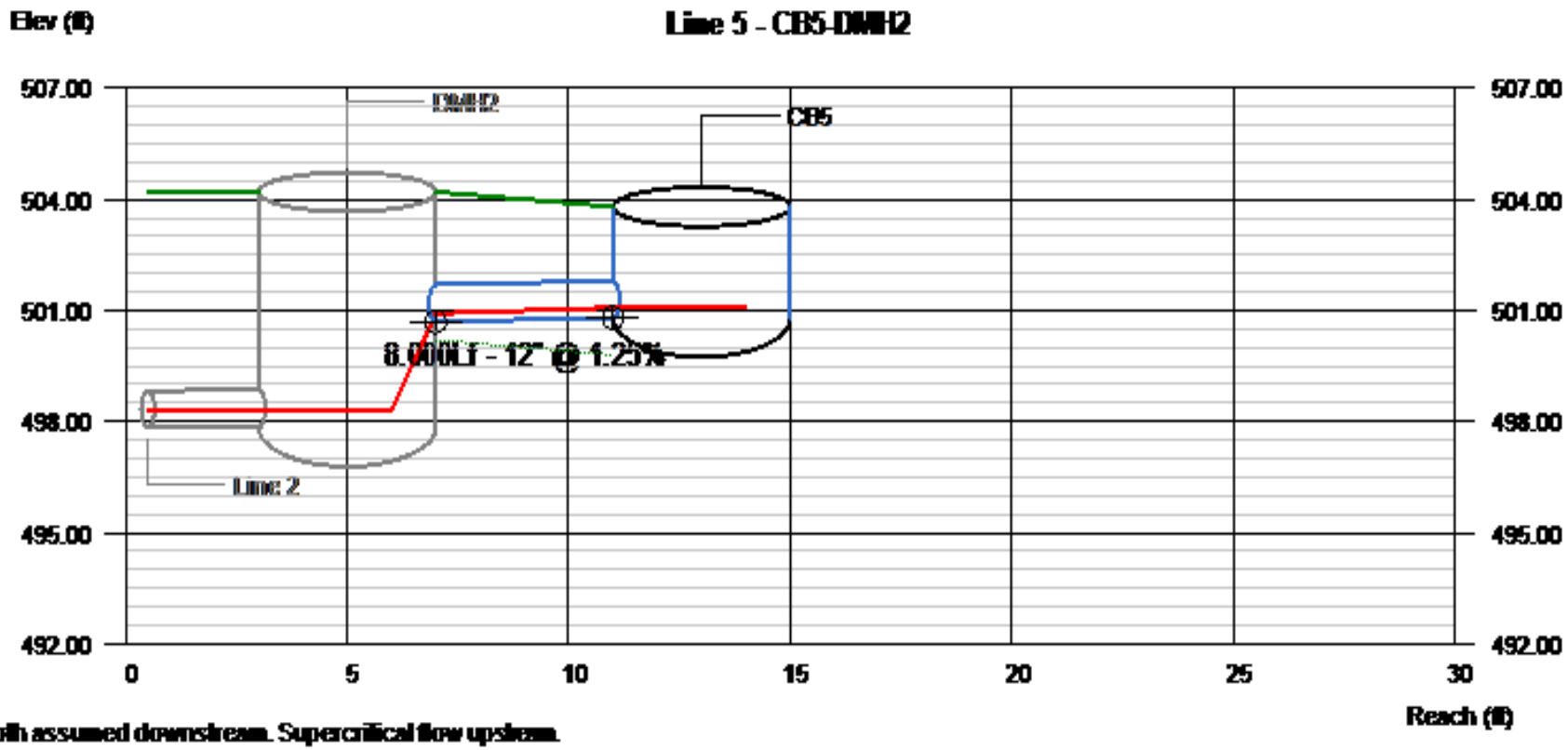

Elev (ft)
Line 2 - DMH2-DMH1
507.00
504.00
501.00
498.00
495.00
492.00
DMH1
DMH2
56.000 lf - 12" @ 0.54%
Line 1
Line 4
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
Reach (ft)
Supercritical flow upstream.



depth assumed downstream. Supercritical flow upstream.

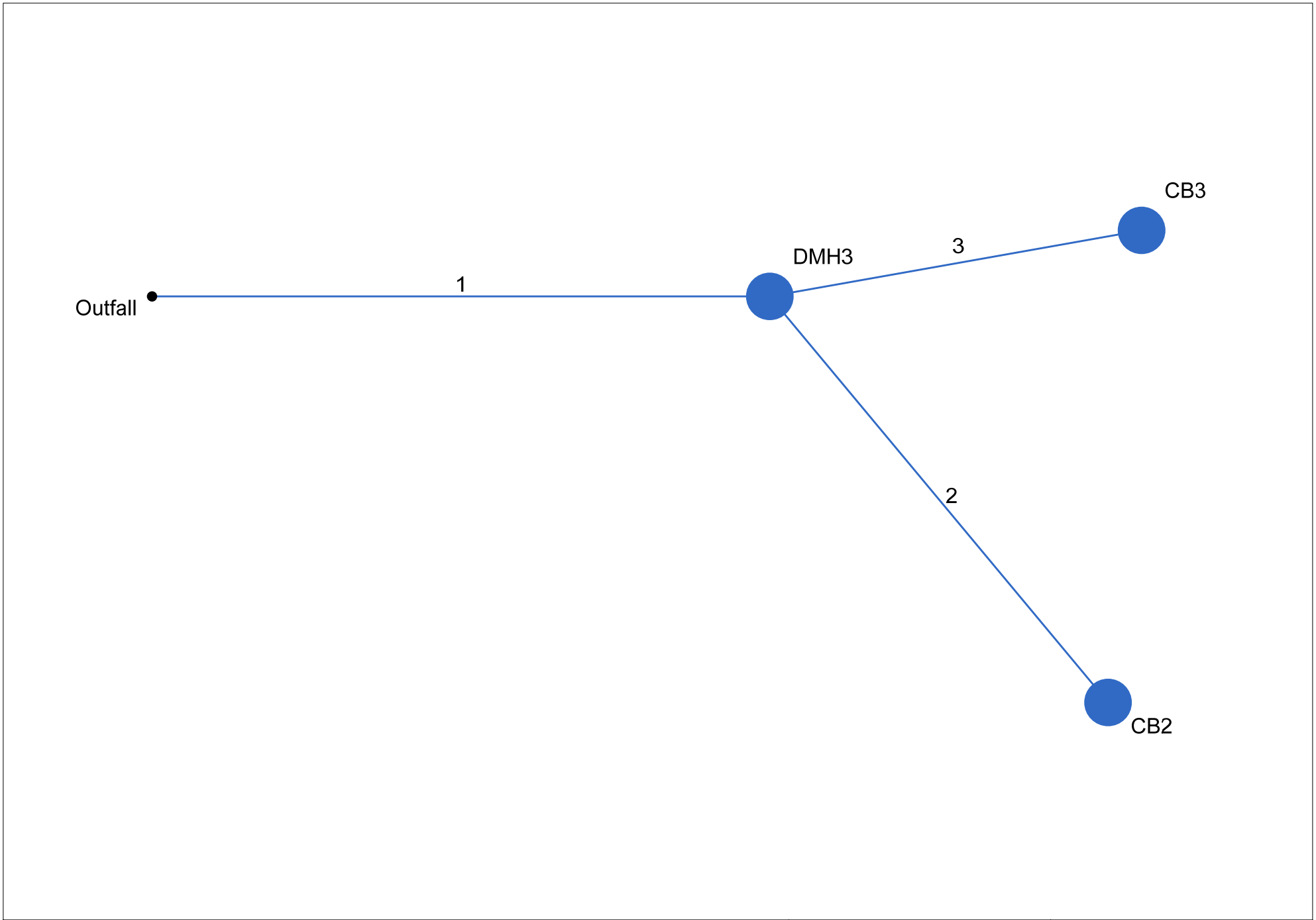


depth assumed downstream. Supercritical flow upstream.



depth assumed downstream. Supercritical flow upstream.

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



Project File: System0-2.stm	Number of lines: 3	Date: 8/31/2022

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	54.000	0.000	MH	0.00	0.00	0.00	6.0	497.50	2.96	499.10	12	Cir	0.012	0.80	504.00	DMH3-SIS
2	1	46.000	50.000	Grate	0.00	0.03	0.90	6.0	499.20	4.57	501.30	12	Cir	0.012	1.00	504.30	CB2-DMH3
3	1	33.000	-10.000	Grate	0.00	0.18	0.90	6.0	499.20	2.42	500.00	12	Cir	0.012	1.00	503.00	CB3-DMH3

Project File: System0-2.stm

Number of lines: 3

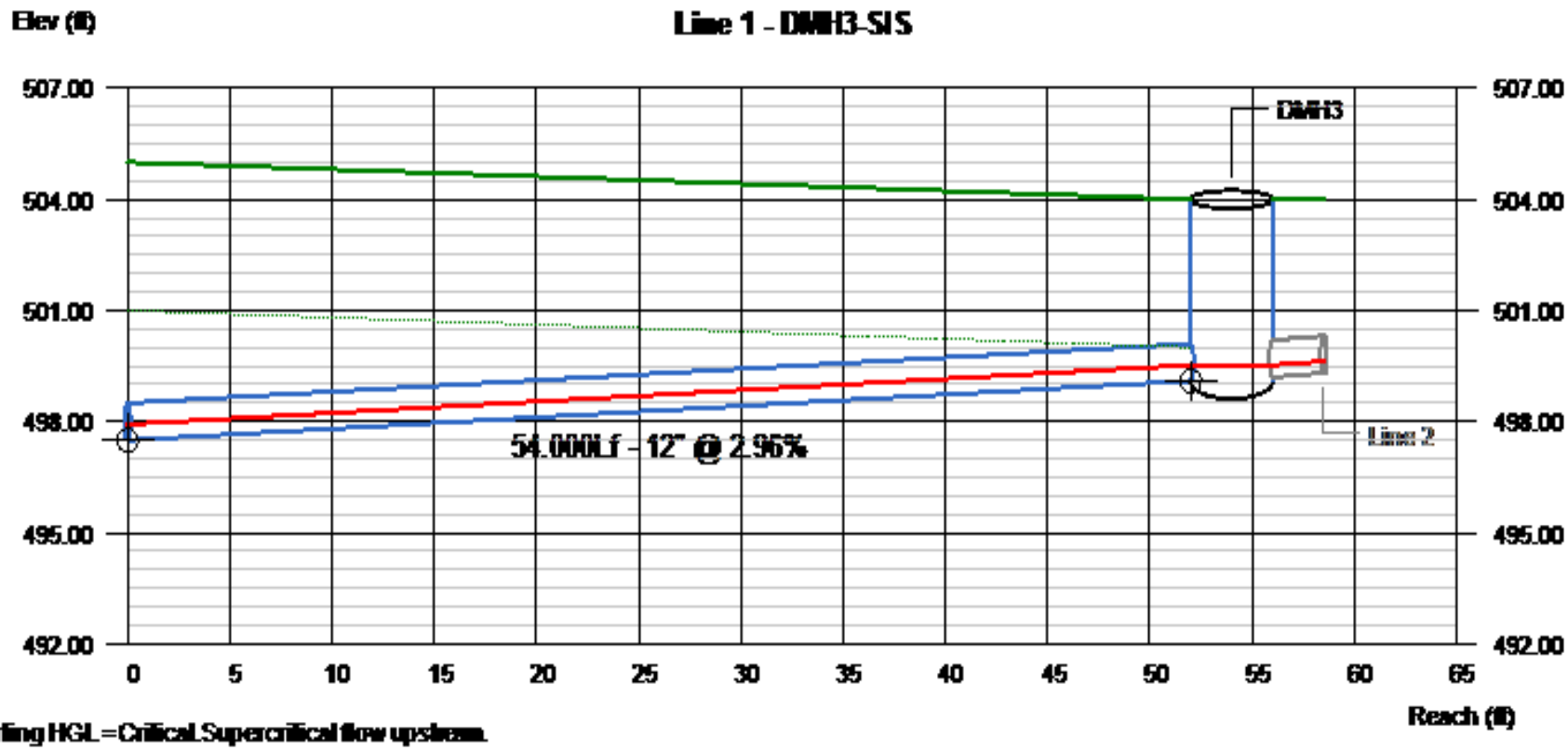
Date: 8/31/2022

Storm Sewer Summary Report

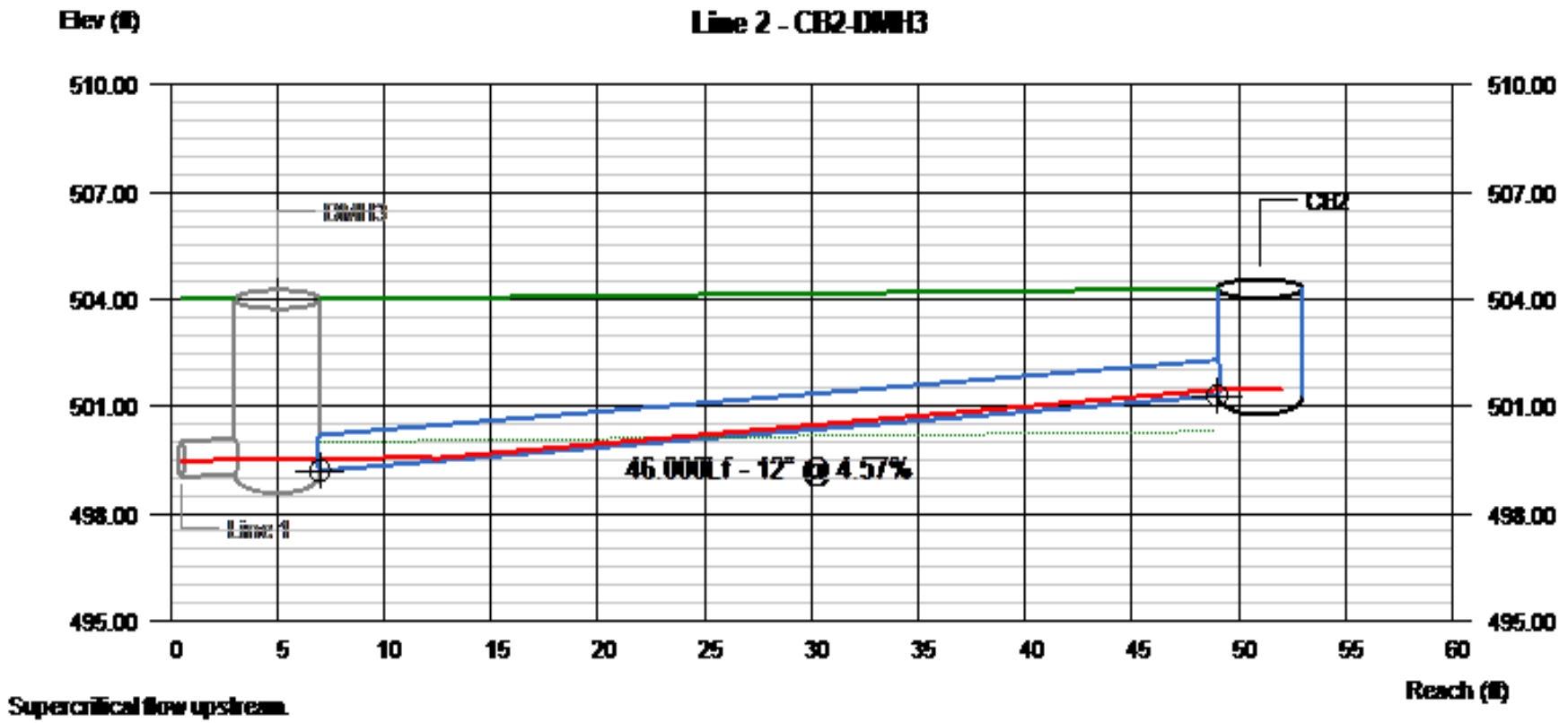
Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line Slope (%)	HGL Down (ft)	HGL Up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns Line No.	Junction Type
1	DMH3-SIS	1.03	12	Cir	54.000	497.50	499.10	2.963	497.93	499.53	0.13	499.53	End	Manhole
2	CB2-DMH3	0.17	12	Cir	46.000	499.20	501.30	4.565	499.53	501.47	n/a	501.47 j	1	Grate
3	CB3-DMH3	1.02	12	Cir	33.000	499.20	500.00	2.424	499.53	500.42	n/a	500.42	1	Grate

Project File: System0-2.stm | Number of lines: 3 | Run Date: 8/31/2022

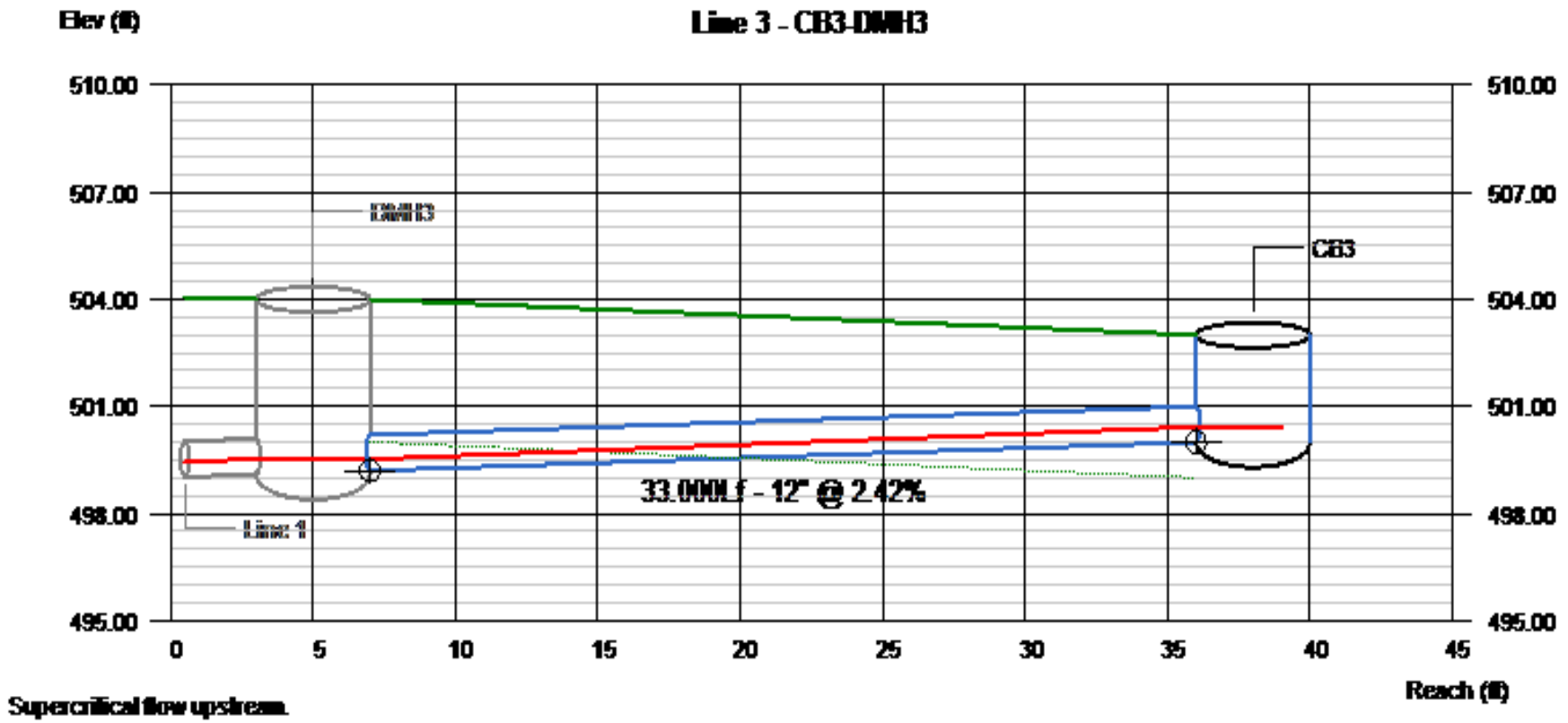
NOTES: Return period = 25 Yrs. ; j - Line contains hyd. jump.



Starting HGL = Critical Supercritical flow upstream.



Supercritical flow upstream.

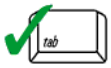

Elev (ft)
Line 3 - CB3-DMH3
510.00
507.00
504.00
501.00
498.00
495.00
DMH3
CB3
33.000Lf - 12" @ 2.42%
Line 1
0
5
10
15
20
25
30
35
40
45
Reach (ft)
Supercritical flow upstream.

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.

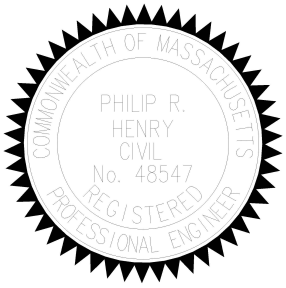
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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



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.

OPERATION AND MAINTENANCE PLAN

FOR

235 MAIN STREET
OXFORD, MA 01540

PREPARED FOR:

CUMBERLAND FARMS, INC.
165 FLANDERS ROAD
WESTBOROUGH, MA 01581

PREPARED BY:

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

DATE: SEPTEMBER 06, 2022

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OPERATION AND MAINTENANCE PLAN

1.0 INTRODUCTION

In accordance with the standards set forth by the Massachusetts Department of Environmental Protection (MADEP) Stormwater Management Policy, Civil Design Group, LLC has prepared the following Operations and Maintenance (O&M) Plan for the Cumberland Farms store located at the site below.

PROPERTY INFORMATION

PROPERTY ADDRESS	LANDOWNER & STORMWATER MANAGEMENT SYSTEM OWNER
235 MAIN STREET OXFORD, MA 01540	Owner: EG AMERICA
	Contact: TBD
	Phone: TBD
	Email: TBD

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

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

2.0 LONG TERM POLLUTION PREVENTION PLAN (LTPPP)

In accordance with Standard #4 from the MADEP Stormwater Management Policy, the following LTPPP has been prepared as part of this O&M Plan. The purpose of the LTPPP is to identify potential pollutant sources in stormwater discharges and implement prevention measures prior to affecting downstream resource areas.

Housekeeping:
The site shall be kept in a clean and working order. Substances and materials to be used on site that consistent with the nature of business shall be protected from the elements by storing indoors or in containers with appropriate lids. Proper disposal and care shall be followed when disposing of empty containers.

Solid Waste:
Solid waste materials shall be stored in the dumpsters provided on site. The dumpster enclosure shall be kept closed when not in use and the trash shall not be left outside of the enclosure. The owner shall contract with a waste management company to properly dispose of waste material. The dumpsters shall be emptied on a regular basis.

Pet Waste Management:
Pet waste is not anticipated based on the proposed use of the site.

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Petroleum Products:
Petroleum products shall be stored in sealed containers and clearly labeled. Petroleum storage tanks shall be located a minimum of 100 linear feet from wetland resource areas, drainage ways, inlets and surface waters unless stored within a building. Petroleum storage tanks shall be equipped with a secondary means of containment designed to provide a containment volume that is equal to 110% of the volume of the largest tank unless otherwise required. Drip pans or other form of containment shall be provided for all dispensers. Any asphalt substances used onsite will be applied according to the manufacturer's recommendations.

Fertilizers, Herbicides and Pesticides:
Fertilizers, herbicides and pesticides shall be used in the minimum amounts recommended by the manufacturer and applied to limit contact with stormwater. These products shall be stored in containers indoors.

Paints and Cleaning Solvents:
Paints and containers shall be properly stored in their original containers. Disposal of these products and their containers shall be in accordance with the manufacturer's recommendations.

Spill Prevention and Response:
In the event of a spill of a hazardous substance the following response action items shall be followed in order to prevent or minimize discharge to the stormwater management system.

1. Spills shall be immediately addressed.
2. Spills of hazardous substances shall be remediated using the manufacturers' protocol for cleanup.
3. Vehicular and fuel spills shall be remediated in accordance to local and state regulations.
4. The following equipment and materials shall be present on site and shall be clearly identifiable:
    a. Absorbent materials, brooms, dust pans, mops, rags, gloves, goggles, trash containers, etc.
5. Spills that are toxic or hazardous in nature shall be reported to the MA DEP and professional emergency contractor.
6. The owner shall designate individuals who will receive spill prevention and response training. These individuals will each become responsible for a particular phase of prevention and response. The names of these personnel shall be posted in the material storage area and in the management office.

3.0 STORMWATER MANAGEMENT SYSTEM

The components of the stormwater management system shall be inspected, monitored and maintained in accordance with the following to ensure that the on-site stormwater management/BMP 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 (BMP's) have been designed to collect and convey runoff from developed areas in accordance with the Massachusetts DEP's Stormwater Management Policy. Using the rational method to determine peak runoff flows, the onsite drainage system is designed for the 25-year storm event. The drainage system consists of five (5) four-foot deep sump hooded catch basins, two (2) Hydrodomes and a subsurface infiltration system (SIS), and associated piping.

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Street Sweeping
Sweeping shall be performed twice a year, once in the spring and once in the fall, within the parking lot and driveway areas to reduce the amount of sediment and trash entering the catch basins.

Deep Sump Hooded Catch Basins
Stormwater runoff from proposed pavement areas is directed via curbing and site grading to catch basins with deep sumps and hooded outlets and trench drains. These structures are designed to trap and remove sediment and larger particles from the stormwater and improve the performance of subsequent BMP's. The catch basin 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
- Cleaning Threshold(s): 18" sediment in sump; discernable layer of oil on surface; floating trash
- Equipment: Clamshell or vactor

HydroDome
HydroDome 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. See the attached product description sheets for additional information, including maintenance recommendations.

- Inspection Frequency: Quarterly
- Cleaning Threshold(s): Per manufacturer's recommendations
- Equipment: Vactor

Subsurface Infiltration System (SIS)
The SIS is designed to detain and infiltrate runoff from the C-Store rooftop and fueling canopy. The system is comprised of plastic chamber surrounded in stone and is equipped with inspection ports to facilitate inspection for standing water and sediment.

- Inspection Frequency: Semiannual
- Cleaning Threshold(s): 4" sediment or standing water for >48 hours following a rain event
- Equipment: Water jet and vactor

4.0 SNOW MANAGEMENT AND DEICING CONTROL

The Owner shall contract with a company to properly clear and remove snow. The contractor shall be responsible for maintaining all roads, driveways, parking lots, sidewalks and pedestrian access onsite as well as along the right-of-way frontage. Snow shall be piled in the designated areas snow storage areas to the extent practicable. Snow shall be removed from the site if the capacity of the designated areas is reached, and disposed of in accordance with applicable regulations and requirements.

Deicing chemicals shall be kept indoors in a safe location and shall be clearly labeled. Deicing solutions such as calcium chloride, rock salt and/or sand may be used unless otherwise restricted by the municipality. Deicing methods shall be used in conjunction with snow removal to maintain safe pedestrian and vehicular access.

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5.0 ILLICIT DISCHARGE STATEMENT

The proposed stormwater management system consists of deep sump hooded catch basins, manholes, a hydrodynamic separator, and associated piping which is intended to collect and convey stormwater discharges from the site. 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 redevelopment of the subject site shall be eliminated in accordance with local, state and federal regulations.

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APPENDIX-A

OPERATION AND MAINTENANCE REPORT FORM

STORMWATER DIVISION
OF CIVIL DESIGN GROUP, LLC

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

QUARTERLY STORMWATER INSPECTION REPORT

Site:	Cumberland Farms	**Date:**	
Address:	235 Main Street, Oxford, MA	**Time:**	
Inspector:		**Weather:**	

CATCH BASIN, YARD DRAIN, TRENCH DRAINS (QUARTERLY)

Unit #	Sediment (inches)	Oil (inches)	Hood/ Pipes	Grate	Last Cleaned	Attention Recommended
CB-1						
CB-2						
CB-3						
CB-4						
CB-5						

PROPRIETARY UNITS (QUARTERLY)

Unit #	Sediment (inches)	Oil (inches)	Trash	Cover	Last Cleaned	Attention Recommended
DMH-1 HD4						
DMH-3 HD4						

SUBSURFACE INFILTRATION SYSTEM (SEMIANNUALLY)

Unit #	Sediment (inches)	Oil (inches)	Trash	Cover	Last Cleaned	Attention Recommended
SIS						

Hydroworks® HydroDome

Operations & Maintenance Manual

Version 1.0

Please call Hydroworks at 888-290-7900 or email us at support@hydroworks.com if you have any questions regarding the Inspection Checklist. Please email a copy of the completed checklist to Hydroworks at support@hydroworks.com for our records.

Introduction

The HydroDome (Figure 1) is a state-of-the-art hydrodynamic separator. HydroDome can be used for water quality and quantity flow control if desired.

Hydrodynamic separators remove solids, debris and lighter than water (oil, trash, floating debris) pollutants from stormwater. Hydrodynamic separators and other water quality measures are mandated by regulatory agencies (Town/City, State, Federal Government) to protect storm water quality from pollution generated by urban development (traffic, people) as part of new development permitting requirements.

As storm water treatment structures fill up with pollutants they become less and less effective in removing new pollution. Therefore, it is important that storm water treatment structures be maintained on a regular basis to ensure that they are operating at optimum performance. The HydroDome is no different in this regard and this manual has been assembled to provide the owner/operator with the necessary information to inspect and coordinate maintenance of their HydroDome.

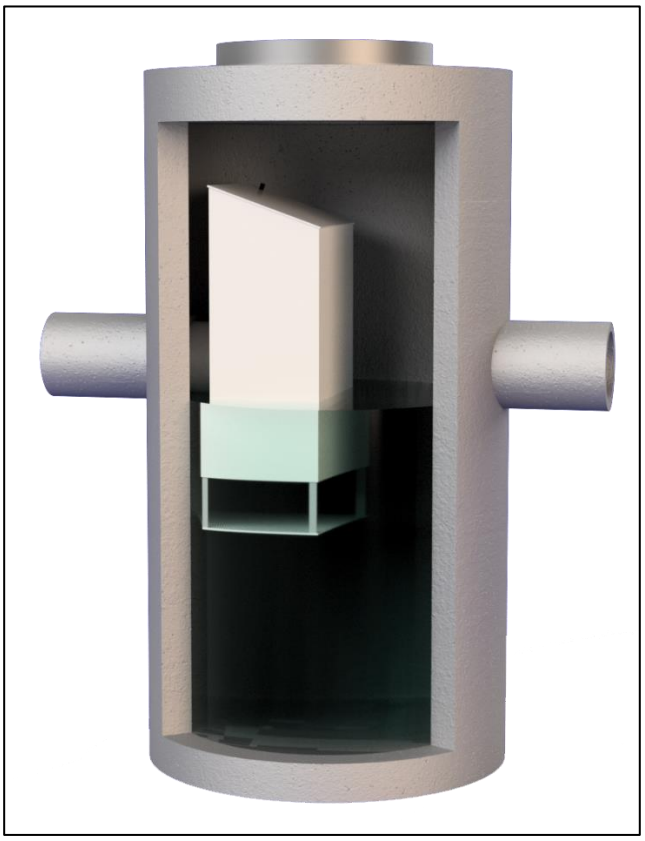


Figure 1. Hydroworks HydroDome

Hydroworks

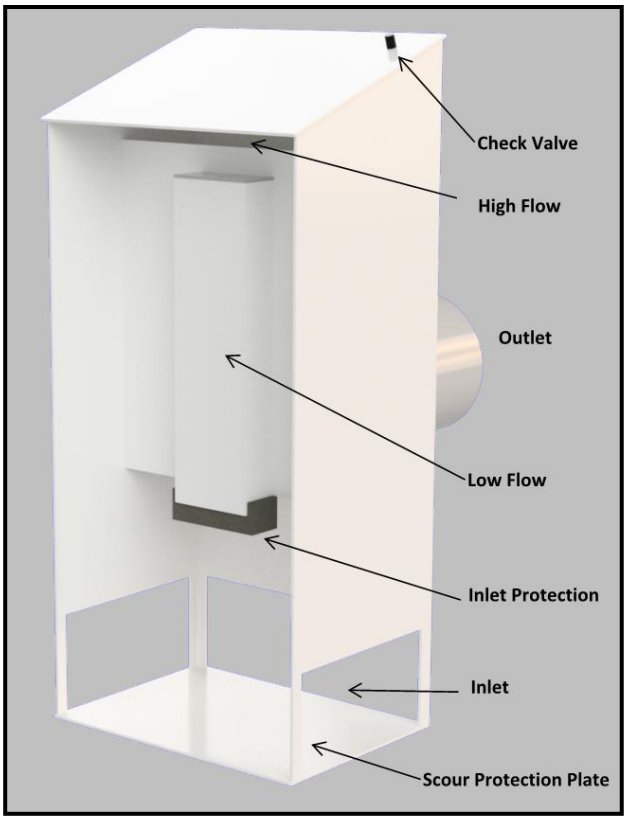


Figure 2 HydroDome Internal Components

Inspection

Procedure

Floatables

A visual inspection can be conducted for floatables by removing the cover/grate and looking down into the separator.

TSS/Sediment

Inspection for TSS build-up can be conducted using a Sludge Judge®, Core Pro®, AccuSludge® or equivalent sampling device that allows the measurement of the depth of TSS/sediment in the unit. These devices typically have a ball valve at the bottom of the tube that allows water and TSS to flow into the tube when lowering the tube into the unit. Once the unit touches the bottom of the device, it is quickly pulled upward such that the water and TSS in the tube forces the ball valve closed allowing the user to see a full core of water/TSS in the unit. Several readings (2 or 3) should be made at different locations of the structure to ensure that an accurate TSS depth measurement is recorded.

Operation

The water level during periods without rain should be near the outlet invert of the structure. If the water level remains near the top of the HydroDome this may suggest that there is an obstruction downstream of the HydroDome or that the inlet protection at the HydroDome may need to be cleaned.

Frequency

Construction Period

The HydroDome separator should be inspected every four weeks and after every large storm (over 0.5" (12.5 mm) of rain) during the construction period.

Post-Construction Period

The Hydroworks HydroDome separator should be inspected during the first year of operation for normal stabilized sites (grassed or paved areas). If the unit is subject to oil spills or runoff from unstabilized areas (storage piles, exposed soils), the HydroDome separator should be inspected more frequently (4 times per year). The initial annual inspection will indicate the required frequency of inspection and maintenance if the unit was maintained after the construction period.

Reporting

Reports should be prepared as part of each inspection and include the following information:

1. Date of inspection
2. GPS coordinates of Hydroworks unit
3. Time since last rainfall
4. Date of last inspection
5. Installation deficiencies (missing parts, incorrect installation of parts)
6. Structural deficiencies (concrete cracks, broken parts)
7. Operational deficiencies (leaks, elevated water level)
8. Presence of oil sheen or depth of oil layer
9. Estimate of depth/volume of floatables (trash, leaves) captured
10. Sediment depth measured
11. Recommendations for any repairs and/or maintenance for the unit
12. Estimation of time before maintenance is required if not required at time of inspection

A sample inspection checklist is provided at the end of this manual.

Maintenance

Procedure

The Hydroworks HydroDome unit is typically maintained using a vacuum truck. There are numerous companies that can maintain the HydroDome separator. Maintenance with a vacuum truck involves removing all of the water and sediment together. The water is then separated from the sediment on the truck or at the disposal facility.

The area around the HydroDome provides clear access to the bottom of the structure (Figure 3). This is the area where a vacuum hose would be lowered to clean the unit.

In instances where a vacuum truck is not available other maintenance methods (i.e. clamshell bucket) can be used, but they will be less effective. If a clamshell bucket is used the water must be decanted prior to cleaning since the sediment is under water and typically fine in nature.

The local municipality should be consulted for the allowable disposal options for both water and sediments prior to any maintenance operation. Once the water is decanted the sediment can be removed with the clamshell bucket.

Maintenance of a Hydroworks HydroDome unit will typically take 1 to 2 hours depending on size of unit and using a vacuum truck. Cleaning may take longer for other cleaning methods (i.e. clamshell bucket).

Inlet protection (Figure 2) is located at the inlet to the low flow opening in the HydroDome to ensure the opening does not become clogged. Although it is not anticipated that the inlet protection will have to be replaced on a regular (i.e. annual) basis since the inlet protection is protected by the submerged entrance to the HydroDome , the inlet protection should be checked each time the HydroDome is inspected or maintained. The inlet protection is removable and should be rinsed with water to ensure any debris caught on the protection is discarded. Unless damaged, the inlet protection can be reinstalled. A replacement piece can be bought through Hydroworks and/or retail stores. Hydroworks can provide information on the inlet protection and where it can be bought. A sign that the inlet protection needs cleaning/replacement would be a water level near the crown of the outlet pipe in the structure during periods with no flow (i.e. unit does not drain down to the pipe invert).

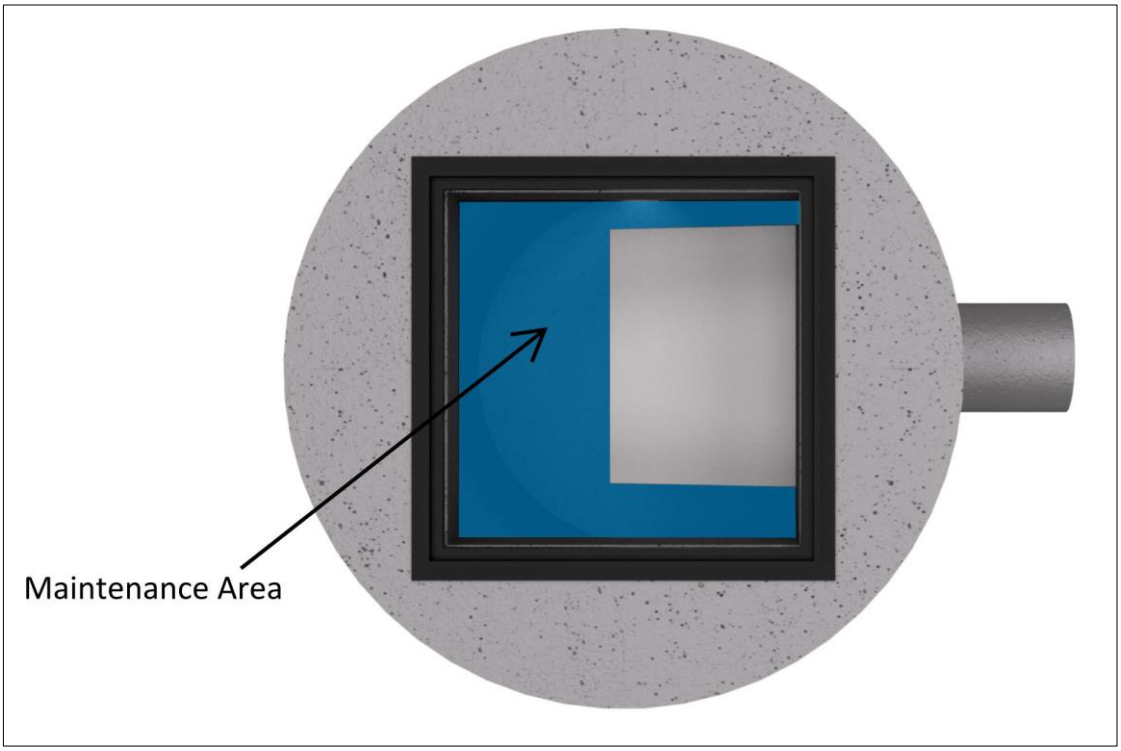


Figure 3. HydroDome Maintenance Access

Frequency

Construction Period

A HydroDome separator can fill with construction sediment quickly during the construction period. The HydroDome must be maintained during the construction period when the depth of TSS/sediment reaches 24” (600 mm). It must also be maintained during the construction period if there is an appreciable depth of oil in the unit (more than a sheen) or if floatables other than oil cover over 50% of the area of the separator

The HydroDome separator should be maintained at the end of the construction period, prior to operation for the post-construction period.

Post-Construction Period

The maintenance for sediment accumulation is required if the depth of sediment is 1 ft or greater in separators with standard water (sump) depths (Table 1).

There will be designs with increased sediment storage based on specifications or site-specific criteria. Please contact Hydroworks at 888-290-7900 to inquire whether your HydroDome was designed with extra sump depth to extend the frequency of maintenance.

The HydroDome separator must also be maintained if there is an appreciable depth of oil in the unit (more than a sheen) or if floatables other than oil cover over 75% of the water surface of the separator.

Table 1 Standard Dimensions for Hydroworks HydroDome Models

Model	Diameter ft (mm)	Maintenance Sediment Depth in (mm)
HD 3	3 (900)	12 (300)
HD 4	4 (1200)	12 (300)
HD 5	5 (1500)	12 (300)
HD 6	6 (1800)	12 (300)
HD 7	7 (2100)	12 (300)
HD 8	8 (2400)	12 (300)
HD 10	10 (3000)	12 (300)
HD 12	12 (3600)	12 (300)

HYDRODOME INSPECTION SHEET

Date _____
Date of Last Inspection _____

Site _____
City _____
State _____
Owner _____

GPS Coordinates _____

Date of last rainfall _____

Site Characteristics	**Yes**	**No**
Soil erosion evident	☐	☐
Exposed material storage on site	☐	☐
Large exposure to leaf litter (lots of trees)	☐	☐
High traffic (vehicle) area	☐	☐

HydroDome	**Yes**	**No**
Obstructions in the inlet	☐ *	☐
Damage to HydroDome (cracked, broken, loose pieces)	☐ **	☐
Improperly installed outlet pipe	☐ ***	☐
Internal component damage (cracked, broken, loose pieces)	☐ **	☐
Floating debris in the separator (oil, leaves, trash)	☐	☐
Large debris visible in the separator	☐ *	☐
Concrete cracks/deficiencies	☐ ***	☐
Exposed rebar	☐ **	☐
Raised water level (water level close to top of HydroDome)	☐ ***	☐
Water seepage (water level not at outlet pipe invert)	☐ ***	☐

Water level depth below outlet pipe invert _____“

Routine Measurements

Floating debris depth	**< 0.5” (13mm)**	☐	**>0.5” 13mm)**	☐ *
Floating debris coverage	**< 75% of surface area**	☐	**> 75% surface area**	☐ *
Sludge depth	**< 12” (300mm)**	☐	**> 12” (300mm)**	☐ *****

* Maintenance required
** Repairs required
*** Further investigation is required

Note: Inspections should not be made within 24 hours of a storm to allow the water to drain from the structure to assess a raised water level or water level seepage

Hydroworks

Other Comments:

Hydroworks

Hydroworks® HydroDome

One Year Limited Warranty

Hydroworks, LLC warrants, to the purchaser and subsequent owner(s) during the warranty period subject to the terms and conditions hereof, the Hydroworks HydroDome to be free from defects in material and workmanship under normal use and service, when properly installed, used, inspected and maintained in accordance with Hydroworks written instructions, for the period of the warranty. The standard warranty period is 1 year.

The warranty period begins once the separator has been manufactured and is available for delivery. Any components determined to be defective, either by failure or by inspection, in material and workmanship will be repaired, replaced or remanufactured at Hydroworks' option provided, however, that by doing so Hydroworks, LLC will not be obligated to replace an entire insert or concrete section, or the complete unit. This warranty does not cover shipping charges, damages, labor, any costs incurred to obtain access to the unit, any costs to repair/replace any surface treatment/cover after repair/replacement, or other charges that may occur due to product failure, repair or replacement.

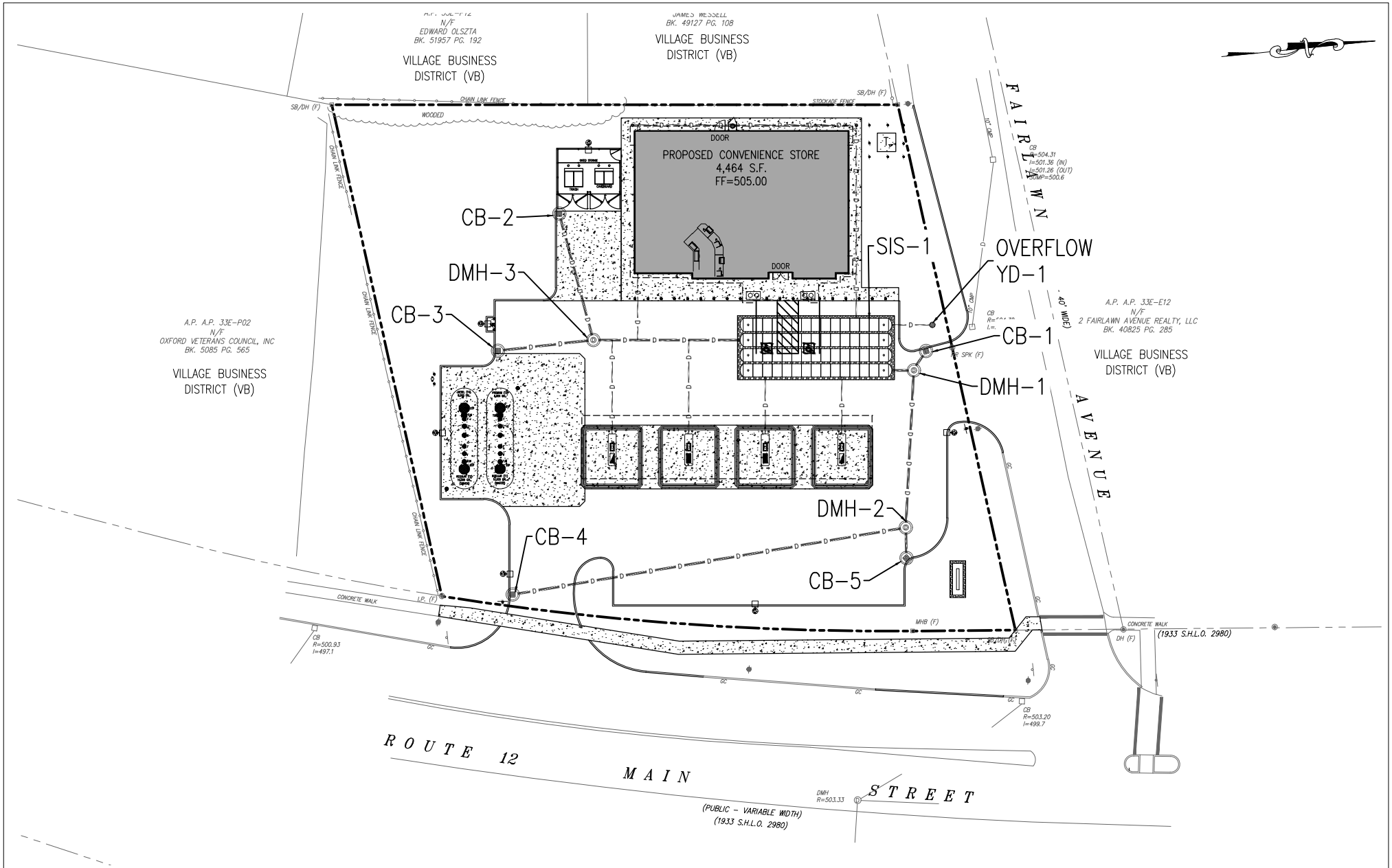
This warranty does not apply to any material that has been disassembled or modified without prior approval of Hydroworks, LLC, that has been subjected to misuse, misapplication, neglect, alteration, accident or act of God, or that has not been installed, inspected, operated or maintained in accordance with Hydroworks, LLC instructions and is in lieu of all other warranties expressed or implied. Hydroworks, LLC does not authorize any representative or other person to expand or otherwise modify this limited warranty.

The owner shall provide Hydroworks, LLC with written notice of any alleged defect in material or workmanship including a detailed description of the alleged defect upon discovery of the defect. Hydroworks, LLC should be contacted at 136 Central Ave., Clark, NJ 07066 or any other address as supplied by Hydroworks, LLC. (888-290-7900).

This limited warranty is exclusive. There are no other warranties, express or implied, or merchantability or fitness for a particular purpose and none shall be created whether under the uniform commercial code, custom or usage in the industry or the course of dealings between the parties. Hydroworks, LLC will replace any goods that are defective under this warranty as the sole and exclusive remedy for breach of this warranty.

Subject to the foregoing, all conditions, warranties, terms, undertakings or liabilities (including liability as to negligence), expressed or implied, and howsoever arising, as to the condition, suitability, fitness, safety, or title to the Hydroworks HydroDome are hereby negated and excluded and Hydroworks, LLC gives and makes no such representation, warranty or undertaking except as expressly set forth herein. Under no circumstances shall Hydroworks, LLC be liable to the Purchaser or to any third party for product liability claims; claims arising from the design, shipment, or installation of the HydroDome, or the cost of other goods or services related to the purchase and installation of the HydroDome. For this Limited Warranty to apply, the HydroDome must be installed in accordance with all site conditions required by state and local codes; all other applicable laws; and Hydroworks' written installation instructions.

Hydroworks, LLC expressly disclaims liability for special, consequential or incidental damages (even if it has been advised of the possibility of the same) or breach of expressed or implied warranty. Hydroworks, LLC shall not be liable for penalties or liquidated damages, including loss of production and profits; labor and materials; overhead costs; or other loss or expense incurred by the purchaser or any third party. Specifically excluded from limited warranty coverage are damages to the HydroDome arising from ordinary wear and tear; alteration, accident, misuse, abuse or neglect; improper maintenance, failure of the product due to improper installation of the concrete sections or improper sizing; or any other event not caused by Hydroworks, LLC. This limited warranty represents Hydroworks' sole liability to the purchaser for claims related to the HydroDome, whether the claim is based upon contract, tort, or other legal basis.



50 0 25 50 100

GRAPHIC SCALE IN FEET

CLIENT:

Cumberland FARMS

165 FLANDERS ROAD
WESTBOROUGH, MA 01581

SITE:

CUMBERLAND FARMS
235 MAIN STREET
OXFORD, MA

CIVIL DESIGN GROUP, LLC

21 HIGH STREET SUITE 207
NORTH ANDOVER, MA 01845
www.cdgengineering.com
p: 978-794-5400 f: 978-965-3971

BMP FIGURE

09/2022