STORMWATER MANAGEMENT REPORT

For

NORTH BLOOMFIELD COMMERCE CENTER
BLOOMFIELD, CONNECTICUT

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EXECUTIVE SUMMARY

This stormwater management report has been prepared in support of the proposed warehouse development located at 116 West Dudley Town Road in the Town of Bloomfield, Connecticut. The proposed development includes a ±522,000 square foot (SF) warehouse with site improvements including landscaping, hardscaping, employee parking lots, trailer parking lots, driveways, utility improvements, and drainage improvements.

Hydrologically, the site is located within the North Branch Park River sub-regional drainage basin. The site, which is approximately 56 acres, is bound by West Dudley Town Road to the south and west, industrial properties to the north and northeast, and a wooded lot to the east (see Figure 1). The site occupies a nominal portion of the roughly 30 square mile sub-regional drainage basin. Based on wetland delineation provided by All-Points Technology in September 2022, there are currently three wetland areas on-site:

- Wetlands 1 & 2, located at the southern boundary of the property, which ultimately drains underneath West Dudley Town Road.
- Wetlands 3 & 4, located to the southeast, which drains off-site to the east.
- Wetlands 5 & 6, located to the northeast, which also includes a perennial stream and drains off-site to the east.

Currently, the site is used for construction operations and office space for Butler Construction, a site contractor. The majority of the property is used for material storage and is covered with compacted gravel and temporary stockpiles. The property also includes one office building with associated utility and site improvements. Topography varies greatly throughout the site, ranging from elevation 157 at the northwestern corner of the site to elevation 130 located at the bottom of the perennial stream. The temporary stockpiles also rise to a max height of approximately 30 feet (maximum elevation 180), and vary throughout the site. Regarding existing drainage facilities, the site has a minimal closed pipe network along with three stormwater basins that each discharge to the aforementioned wetland systems via an outlet control structure. These stormwater ponds are currently classified as the aforementioned wetlands 2,3, and 6.

In the spring of 2017, Butler Construction submitted an application for permit to the Inland Wetlands and Watercourses Commission for the construction of an office building, parking, and equipment storage areas. REMA Ecological Services delineated the wetlands and provided a wetland assessment and recommendations for the project along with Alford Associates, who provided site design services and construction documents. Butler received approval for this application in March of 2017 and Planning & Zoning approval in April of 2017. Based on

correspondence with the town and observations of the property, it appears the work proposed in the application was partially complete. Due to this fact, the hydrologic analysis in this report compares the proposed condition to the condition of the site prior to the construction of the Butler facility (referred to herein as the "pre-existing condition").

The site in its pre-existing condition was comprised of mostly meadow and woods, with topography ranging from elevation 157 to 130, and included one office building with its associated utility and site improvements. The property also included four wetland systems, as delineated by REMA Ecological Services back in 2017. Information on the pre-existing condition was taken from the planning & zoning application prepared by Alford Associates, Inc. dated 04/13/2021. Please refer to Drawing EXC-1, Existing Conditions Plan, prepared by Alford Associates, Inc. for more information on this condition and its delineated wetlands. Nearmap aerial photography dated prior to the construction of the Butler storage facility was also used to supplement this information. It is the opinion of this office that this is a conservative approach for this analysis.

The proposed stormwater management system has been designed in general compliance with the Town of Bloomfield Zoning Regulations, the 2002 State of Connecticut Guidelines for Soil Erosion and Sediment Control, and the 2004 Connecticut Stormwater Quality Manual. This report demonstrates that the proposed stormwater system will effectively manage the quality and quantity of stormwater runoff for the proposed development. A comparative analysis is provided of the calculated pre-existing and post-development site runoff conditions, in which the overall peak flow rates leaving the project in the two, ten, 25, and 100 year storm events generally do not exceed those in the pre-existing condition. In addition, stormwater quality improvements and the installation of erosion and sedimentation controls during demolition and construction periods is specified, as well as long-term stabilization and pollution prevention on the site. Water quality Best Management Practices (BMPs) have also been incorporated to promote treatment and include sumped catch basins, rain gardens, landscaped areas, underground detention systems, micropool extended detention basins, and multiple water quality units.

It is the opinion of this office and the findings of this report that the proposed stormwater system, as designed, will effectively manage the stormwater runoff quality and quantity for the proposed warehouse development. The design in this report is further supported by the "116 West Dudley Town Road" permit application drawings prepared by Langan dated December 6th, 2022.

1.0 INTRODUCTION

1.1 General

This stormwater management report has been prepared in support of the proposed warehouse to be located at 116 West Dudley Town Road in the Town of Bloomfield, Connecticut and addresses the engineering design of the proposed stormwater conveyance and management systems.

1.2 Site Location

The site, which is approximately 56 acres, is located at 116 West Dudley Town Road, and is bound by West Dudley Town Road to the south and west, industrial properties to the north and northeast, and a wooded lot to the east (see Figure 1).The project site is located in the industrial zone (IND-2) and does not directly abut any residential zones (see Figure 5). Hydrologically, the project site is located within the North Branch Park River sub-regional drainage basin. The project site occupies a nominal portion of the North Branch Park River Sub-Regional Basin, which is approximately 30 square miles.

1.3 Pre-Existing Conditions

Due to the work from the previous application not being complete, the hydrologic analysis in this report compares the proposed condition to the condition of the site prior to the construction of the Butler facility (referred to herein as the "pre-existing condition"). The initial planning & zoning application for the construction of the Butler facility was approved on April 6th, 2017, and the conditions described below capture the state of the site prior to this application. Information on the pre-existing condition was taken from the "Existing Conditions Plan" from the planning & zoning application prepared by Alford Associates, Inc. dated 04/13/2021, and was supplemented by historical Nearmap aerial photography.

The site in its pre-existing condition was comprised of mostly meadow and woods, with topography ranging from elevation 157 at the northwestern corner of the site to elevation 130 at the bottom of the existing perennial stream located at the northeastern corner of the property. In this condition, there were four wetland systems on site, as delineated by REMA Ecological Services in 2017.

- Wetlands System A: Located at the northeastern portion of the site, it

also includes a perennial stream that flows to the east of the site. The total area of this wetland system was 1.39 acres.

- Wetlands System B: Located on the eastern portion of the site, which flows east of the site. The total area of this wetland system was 1.58 acres.
- Wetlands System C: Located approximately at the center of the site and surrounded by woods. The total area of this wetland system was 0.14 acres.
- Wetlands System D: Located at the south of the site, these wetlands ultimately flow through an existing 15" RCP pipe that flows under West Dudley Town Road. The total area of this wetland system was 0.60 acres.

1.4 Project Description

The proposed development includes a ±522,000 square foot (SF) warehouse with site improvements including landscaping, hardscaping, parking lots, trailer parking lots, sidewalks, driveways, site lighting, utility improvements, and stormwater management facilities. Existing site grades will be modified to accommodate the proposed development and the operational needs of the facility.

All-Points Technology delineated on-site wetlands in September of 2022. A detailed description of the on-site wetlands and proposed mitigation and enhancements can be found in the an accompanying report prepared by All-Points Technology. There are six wetlands on-site:

- Wetland 1: Located at the south of the site adjacent to West Dudley Town Road. Previously noted as Wetland D in pre-existing condition.
- Wetland 2: Located at the south of the site and was constructed as a stormwater pond as part of the Butler facility.
- Wetland 3: Located at the southeast corner of the site and was constructed as a stormwater pond as part of the Butler facility.
- Wetland 4: Located on the eastern portion of the site. Previously noted as Wetland B in pre-existing condition
- Wetland 5: Located at the northeastern corner of the site and includes a perennial stream. Previously noted as Wetland A in the pre-existing condition.
- Wetland 6: Located at the northeastern corner of the site and was constructed as a stormwater pond as part of the Butler facility.

The proposed development aims to limit the amount of disturbance to these existing wetland systems. The previously approved application to construct the Butler facility included the construction of three stormwater management basins. These basins were flagged as wetlands per the wetland delineation provided by All Points Technology (Wetland 2, Wetland 3, and Wetland 6), and were not present during the pre-existing condition. As part of this project, these existing basins are being renovated and expanded to manage and treat the anticipated stormwater runoff from the proposed development. Information on anticipated impacts in the upland review and wetland areas are described in an accompanying report prepared by All-Points Technology.

Further information on specific proposed watersheds can be found in Section 2.4 of this report.

1.5 FEMA

According to the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM), map numbers 09003C0351F and 09003C0352F, both effective September 26, 2008, the site is located entirely within Zone X (unshaded) (See Figure 3).

Zone X (unshaded) is considered a Low Risk Area and described by FEMA as areas determined to be outside the 0.2% annual chance (or 500-year) floodplain. No base flood elevations or base flood depths are shown within this zone.

1.6 Soil Conditions

According to the USDA Natural Resources Conservation Service (NRCS) Web Soil Survey, the main soil types onsite are Windsor Loamy Sand, Agawam Fine Sandy Loam, Elmridge Fine Sandy Loam, and Scitico, Shaker, and Maybid Soils. The Web Soil Survey has classified the hydrologic soil groups for each of these soils. See Table 1 for all soil types onsite and their corresponding hydrologic soil group per Web Soil Survey (see Figure 4).

Table 1: NRCS Soil Survey

Hydrologic Soil Group - Summary by Map Unit- State of Connecticut

Map Unit Symbol	Map Unit Name	HSG
9	Scitico, Shaker, and Maybid Soils	C/D
13	Walpole Sandy Loam, 0-3% Slopes	B/D
28A	Elmridge Fine Sandy Loam, 0-3% Slopes	C
29A	Agawam Fine Sandy Loam, 0-3% Slopes	B
36A	Windsor Loamy Sand, 0-3% Slopes	A
36B	Windsor Loamy Sand, 3-8% Slopes	A
103	Rippowam Fine Sandy Loam	B/D
306	Udorthents-Urban Land Complex	B
307	Urban Land	D

Soils are classified into hydrologic soil groups (HSG) to indicate the minimum rate of infiltration obtained for bare soil after prolonged wetting. The HSGs, which are A, B, C and D, are one element used to determine runoff curve numbers and analyzing stormwater characteristics of a site.

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.

A limited geotechnical investigation was prepared by Whitestone Associates, Inc. on September 28, 2022. Based on borings and test pits from this investigation, the site soils generally consisted of fine to medium sand with silt. Groundwater depths were found to be between 2' and 15' below grade, with shallower groundwater readings likely being the result of a perched water table. No credit for infiltration was included in our analysis, but open bottom systems are provided to promote infiltration.

2.0 STORMWATER MANAGEMENT

2.1 Design Criteria

Proposed peak flow rates at all points of discharge from the site were analyzed to compare proposed discharge rates with the pre-existing condition.

The storms analyzed include the following:

- A 2-year, 24-hour storm consisting of 3.22 inches of rainfall
- A 10-year, 24-hour storm consisting of 5.16 inches of rainfall
- A 25-year, 24-hour storm consisting of 6.36 inches of rainfall
- A 100-year, 24-hour storm consisting of 8.22 inches of rainfall

These events are based on the "NOAA Atlas 14 Point Precipitation Frequency Estimates: CT" as presented in Appendix E of this report. Hartford Bradley AP Station is the closest station in proximity to the site.

2.2 Design Methodology

The peak runoff discharges for existing and proposed conditions were analyzed using the Soil Conservation Service (SCS) methodology, which outlines procedures for calculating peak rates of runoff resulting from precipitation events, and procedures for developing runoff hydrographs. Values for area, curve number and time of concentration were calculated for existing and proposed conditions.

The curve number "CN" is a land-sensitive coefficient that dictates the relationship between total rainfall depth and direct stormwater runoff for

watersheds. The soils within the watersheds are divided into hydrologic soil groups (A, B, C and D) as previously described.

The time of concentration, Tc, is defined as the time for runoff to travel from the hydraulically most distant point in the watershed to a point of interest. Values of time of concentration were determined for existing and proposed conditions based on land cover and slope of the flow path, using methods outlined in the SCS methodology.

For this study, a 24-hour SCS Type III standard rainfall was used to determine the peak flow rate to all points of discharge from the site.

2.3 Pre-Existing Runoff Discharges (See Appendix A for Calculations)

The pre-existing drainage conditions were delineated into five watershed areas. Watersheds A, B, C, D, & E discharge to five different design points:

- Design Point A: Wetland System A
- Design Point B: Wetland System B
- Design Point C: Off-Site Wetlands System
- Design Point D: Wetland System D
- Design Point E: West Dudley Town Road

Refer to the attached Existing Conditions Watershed Map for a depiction of the pre-existing watersheds, flow paths, and design points for the site. Each watershed is described as follows.

Watershed A, consisting of 6.76 acres, is located at the northeastern corner of the site. The watershed is entirely pervious and consists of mostly meadow and woods. Runoff from this watershed sheet flows to the northeast and into the Wetland A system and perennial stream.

Watershed B, consisting of 26.67 acres, is located at the center of the parcel and occupies the majority of the site. The watershed is mostly pervious, consisting of meadow and woods. It also includes the existing building, which discharges its roof area via downspouts to the ground surface. Runoff from this watershed sheet flows to the south to Wetland System B.

Watershed C, consisting of 2.24 acres, is located on the eastern edge of the site. This watershed is entirely pervious and consists of mostly meadow area. Runoff from this watershed sheet flows off-site to wetlands off the property.

Watershed D, consisting of 11.75 acres, is located on the southern portion of the site. The watershed is mostly pervious, consisting of mostly of meadow and woods. A small portion of this watershed is comprised of area outside of the property along West Dudley Town Road, which sheet flows onto the site. Runoff from this watershed sheet flows to the south and into wetland system D, which ultimately discharges under West Dudley Town Road via a 15" reinforced concrete pipe.

Watershed E, consisting of 0.37 acres, is located along the western edge of the property along West Dudley Town Road. The watershed is mostly impervious, consisting of the existing buildings front-parking field. Runoff from this watershed sheet flows off-site into West Dudley Town Road.

2.4 Proposed Runoff Discharges (See Appendix B for Calculations)

The proposed conditions drainage patterns maintains the same five pre-existing design points and is broken into twelve watersheds. Watershed A-1, A-2, B-1, B-2, B-3, B-4, D-1, D-2, D-2.1, D-3, D-4 and E. These watersheds can be reviewed on the "Proposed Watershed Map (PR-WS)" accompanying this report.

Watershed A-1, consisting of 13.17 acres, is located on the eastern side of the property. This watershed includes the eastern truck court, the northern employee parking lot and driveway, and pervious areas located outside of the limit of disturbance. Runoff from a majority of this watershed is collected in a closed pipe network and routed to Existing Dry Detention Basin A-1. Peak flows are then attenuated via an outlet control structure in the basin, before discharging to Wetland 5 located at the northeast corner of the site via an existing 24" HDPE pipe.

Watershed A-2, consisting of 1.81 acres, is located at the northeastern corner of the site. The watershed is entirely pervious, consists of mostly woods and is outside the proposed limit of disturbance. Runoff from this watershed sheet flows to the northeast and into Wetland 5 and the perennial stream.

Watershed B-1, consisting of 5.90 acres, includes the eastern half of the proposed warehouse roof. Runoff from this watershed is collected into a number of roof drains which is conveyed via a closed pipe network into an underground detention system (Underground Detention Basin B-1). Peak flows are then attenuated via an outlet control structure, before discharging to Micropool Extended Detention Basin B. Peak flows are then attenuated via another outlet control structure before discharging to Wetland 4 via an existing 15" HDPE pipe.

Watershed B-2, consisting of 6.10 acres, includes the western half of the proposed warehouse roof. Runoff from this watershed is collected into a number of roof drains which is conveyed via a closed pipe network into an underground detention system (Underground Detention Basin B-2). Peak flows are then attenuated via an outlet control structure, before discharging to Micropool Extended Detention Basin B. Peak flows are then attenuated via another outlet control structure before discharging to Wetland 4 via an existing 15" HDPE pipe.

Watershed B-3, consisting of 3.96 acres, includes the southern employee parking lot and portions of the site driveways and landscaped areas. Runoff from this watershed is collected in catch basins and routed directly to Micropool Extended Detention Basin B via a closed pipe network. Peak flows are then attenuated via another outlet control structure before discharging to Wetland 4 via an existing 15" HDPE pipe.

Watershed B-4, consisting of 3.25 acres, includes wooded areas east of the proposed development. A majority of this area is outside the proposed limit of disturbance and is entirely pervious. Runoff from this watershed sheet flows into Wetland 4.

Watershed D-1, consisting of 8.44 acres, includes the western truck court, part of the access drives, and landscaped area. A portion of this watershed also includes parts of West Dudley Town Road per request of town staff. Runoff from this watershed is collected into a number of catch basins and is routed to an underground detention system (Underground Detention Basin D-1). Peak flows are then attenuated via an outlet control structure, before discharging to Micropool Extended Detention Basin D. Peak flows are then attenuated via another outlet control structure before discharging to Wetland 1 via an existing 18" HDPE pipe.

Watershed D-2, consisting of 2.46 acres, includes the southern access drives and landscaped areas. Runoff from this watershed is collected via catch basins and routed directly to Micropool Extended Detention Basin D via a closed pipe network. Peak flows are then attenuated via another outlet control structure before discharging to Wetland 1 via an existing 18" HDPE pipe.
Watershed D-2.1, consisting of 1.26 acres, includes landscaped area along West Dudley Town Road. Runoff from this watershed is collected via a yard drain and connected to closed pipe network that is routed to Micropool Extended Detention Basin D. Peak flows are then attenuated via another outlet control structure before discharging to Wetland 1 via an existing 18" HDPE pipe.

Watershed D-3, consisting of 0.83 acres, includes a portion of the southern access drive and landscaped area. Runoff from this watershed flows into a rain garden at the southwestern corner of the site, which overflows into Micropool Extended Detention Basin D via a raised yard drain. Peak flows are then attenuated via another outlet control structure before discharging to Wetland 1 via an existing 18" HDPE pipe.

Watershed E, consisting of 0.31 acres, includes a portion of landscaping along the western property line and a portion of the driveway at the southern edge of the property. Runoff from this watershed sheet flows off-site into West Dudley Town Road.

Table 2: Peak Runoff Rate Comparison (cubic-feet per second)

PEAK FLOW (cubic feet per second)					
Design Point		**2-year**	**10-year**	**25-year**	**100-year**
A (Wetland 5)	Pre	0.000	0.070	0.340	2.220
	Post	1.88	2.35	2.70	3.69
	Delta	**--**	**3257.14%**	**694.12%**	**66.22%**
B (Wetland 4)	Pre	3.630	19.870	33.450	57.490
	Post	2.57	7.27	11.34	17.24
	Delta	**-29.20%**	**-63.41%**	**-66.10%**	**-70.01%**
C (Off-Site Wetlands System)	Pre	0.040	0.800	1.650	3.300
	Post	0.00	0.00	0.00	0.00
	Delta	**-100.00%**	**-100.00%**	**-100.00%**	**-100.00%**
D (Wetland 1)	Pre	5.170	16.370	24.550	38.130
	Post	1.15	3.45	8.20	15.22
	Delta	**-77.76%**	**-78.92%**	**-66.60%**	**-60.08%**
E (West Dudley Town Road)	Pre	1.120	1.840	2.280	2.970
	Post	0.14	0.37	0.53	0.80
	Delta	**-87.50%**	**-79.89%**	**-76.75%**	**-73.06%**
TOTAL	Pre	9.960	38.950	62.270	104.110
	Post	5.740	13.440	22.770	36.950
	Delta	**-42.37%**	**-65.49%**	**-63.43%**	**-64.51%**

The project has been designed to the greatest extent feasible to maintain existing site hydrology. Through the implementation of the proposed stormwater management system, peak runoff rates in the proposed condition have been reduced at a majority of the design points for each design storm.

One exception is at Design Point A, located at Wetland 5, where the proposed flows exceed pre-existing peak flows. This is the result of installing an underdrain in the bottom of the Existing Detention Basin A-1 to ensure that the pond drains over time. The basin as constructed currently includes an existing 6" underdrain, and this application is intended to mimic that existing condition. To match pre-existing flows for all storms, an underdrain smaller than 2" would be required, which would have a high risk of clogging and would prevent the pond from draining. Section 7.61 of the Connecticut Stormwater Quality Manual guidelines cites this clogging as a potential practical limitation regarding outlet sizing and stream channel protection. In addition, the riser structure within the pond is not engaged for all storms.

At Design Point C, proposed off-site flows have been reduced to zero. This is the result of grades being adjusted as work from the previous application. A majority

of the watershed that previously flowed to Design Point C now flows into Existing Drainage Basin A-1, which allows for the potential of water quality treatment.

3.0 STORMWATER QUALITY (SEE APPENDIX C FOR CALCULATIONS)

3.1 Stormwater Quality Improvements

The proposed drainage systems have been designed to accommodate and treat the Water Quality Volume (WQV) for each contributing drainage area. The WQV is defined in CTDEP's Stormwater Quality Manual as follows:

"The water quality volume (WQV) is the amount of stormwater runoff from any given storm that should be captured and treated in order to remove a majority of stormwater pollutants on an average annual basis. The recommended WQV, which results in the capture and treatment of the entire runoff volume for 90 percent of the average annual storm events, is equivalent to the runoff associated with the first one-inch of rainfall."

This project incorporates a number of stormwater quality measures, including primary treatment practices, secondary treatment practices, and innovative/emerging technologies as defined by the 2004 Connecticut Stormwater Quality Manual. The proposed system will treat the Water Quality Volume (WQV) primarily through the wet pond systems and hydrodynamic separators designed in accordance with the 2004 Connecticut Stormwater Quality Manual. Additional treatment measures include sumped catch basins, rain gardens, landscaped areas, and sediment forebays to treat the WQV.

Groundwater recharge volume is defined within CTDEEP's Stormwater Quality Manual as follows:

"The groundwater recharge criterion is intended to maintain pre-development annual groundwater recharge volumes by capturing and infiltrating stormwater runoff. The objective of the groundwater recharge criterion is to maintain water table levels, stream baseflow, and wetland moisture levels. The groundwater recharge volume is the post-development design recharge volume required to minimize the loss of annual pre-development groundwater recharge."

Due to potentially high groundwater conditions and site soil conditions, infiltration was not assumed for the underground detention systems. However, opportunity for groundwater recharge is provided through the each of the surface ponds and landscaped areas on site. Below is a description of each best management practice provided in the proposed stormwater system.

Sumped Catch Basins

All catch basin structures will include a minimum of a 2 foot deep sump. This allows for the settlement of suspended particulates as the run off flows through the closed pipe conveyance line and to the discharge locations. Captured materials in the sump locations can be removed by vacuuming, avoiding degradation of downstream treatment features.

Rain Gardens

A rain garden is being proposed to be constructed at the southwestern corner of the property. This is designed to facilitate treatment of the collected stormwater and attenuate flows. Perforated underdrains and overflow yard drains are installed in each rain garden to prevent flooding.

Water Quality Units (Hydrodynamic separators)

Water quality units are proposed in locations where limiting factors such as separation to groundwater or proximity to site feature would not allow for other treatment BMPs such as infiltration features. Each water quality unit is sized to provide the full water quality treatment for the watershed based on the water quality flow (WQF) and have a suitable bypass flow rate to convey the 10 year design storm.

Underground Detention Systems

Underground detention systems B-1, B-2, and D-1 have been designed in accordance with the 2004 Connecticut Stormwater Quality Manual. Each system is primarily used for stormwater attenuation only has been sized to handle the 100- year storm without over topping.

Underground Detention System B-1

System B-1 will be constructed with 450 4-foot tall Retain-it concrete chambers (or equivalent) in five parallel rows. The system has a footprint of approximately 29,000 SF and a storage capacity 2.35 acre-ft. This system takes runoff from the eastern half of the warehouse roof.

Underground Detention System B-2
Similar to Underground Detention System B-1, system B-2 will be constructed with 450 4-foot tall Retain-it concrete chambers (or equivalent) in four parallel rows. The system has a footprint of approximately 29,000 SF and a storage capacity 2.35 acre-ft. This system takes runoff from the western half of the warehouse roof.

Underground Detention System D-1
System B-1 will be constructed with 328 4-foot tall Retain-it concrete chambers (or equivalent) in four parallel rows. The system has a footprint of approximately 21,000 SF and a storage capacity 1.71 acre-ft. This system takes runoff from the western truck court and landscaped area.

Dry Detention Pond
The proposed site intends to re-use the existing dry detention basin located at the northeast corner of the site. While the proposed dry detention basin will not provide water quality treatment, it does provide peak flow attenuation. To provide a form of pre-treatment, the pond is designed to be retrofitted with a sediment forebay. In addition, the outlet control structure is being replaced in order to attenuate the 100-year design storm, and an underdrain is being installed to prevent stagnant water from sitting in the pond.

Micropool Extended Detention Pond
Two micropool extended detention ponds are proposed on site. These ponds are a form of wet ponds and are designed to provide treatment of the WQV via a permanent wet micropool. The micropool in conjunction with the sediment forebay are designed to accommodate the WQV of the pond's contributing watershed area. Each of these ponds are designed to attenuate up to the 100-year storm using an outlet control structure without engaging the rip-rap emergency spillway. These ponds have been designed in general accordance of the 2004 Connecticut Stormwater Quality Manual.

Micropool Extended Detention Pond B
This pond is designed with a permanent wet pool sized to accommodate the WQV, with a wet pool storage volume of 1.58 acre-ft and total pond storage volume of 3.59 acre-ft.

Micropool Extended Detention Pond D
This pond is designed with a permanent wet pool sized to accommodate the WQV, with a wet pool storage volume of 1.08 acre-ft and total pond storage volume of 2.88 acre-ft.

The combination of the aforementioned treatment facilities have been designed with the objective of removing a minimum of 80% of total suspended solids (TSS).

4.0 STORM DRAINAGE COLLECTION SYSTEM DESIGN (SEE APPENDIX D FOR CALCULATIONS)

4.1 Design Criteria

The proposed subsurface storm drainage collection system is designed to convey the 10-year design storm event throughout the site with a foot of freeboard at each structure per CTDOT Drainage standards.

4.2 Design Methodology

The storm drainage system components were analyzed using the Rational Method for estimating runoff for a 10-year design storm event. The site was divided into subareas, each contributing runoff to an individual catch basin inlet or roof drain. A value for area, time of concentration, and runoff coefficient was calculated for each contributing subarea.

Values of time of concentration were selected based on land cover and flow path slope from the hydraulically most distant point in the subarea to the appropriate inlet. The average runoff coefficient, which is the ratio of peak runoff rate to the average rainfall rate for the period known as the time of concentration, was chosen using the following values:

CONDITION	C
Grass/Landscaping	0.30
Paved/Impervious/Roof Areas	0.90

Rainfall intensities were selected from the intensity-duration-frequency curve for Connecticut as presented in the "NOAA Atlas 14 Point Precipitation Frequency Estimates: CT" data as presented in Appendix E of this report. Hartford Bradley AP Station is the closest station in proximity to the site.

Storm drainage pipes were then sized based on calculated design flows using the Rational Method, and verified by solving for the hydraulic grade line throughout the pipe networks using the manning equation. Starting downstream tailwater elevations used for calculating hydraulic grade lines for each pipe network were set equal to the calculated maximum 10-year water surface elevations for each downstream BMP.

4.3 Storm Drainage Collection Summary

The runoff from the development will be collected using a conventional roof drain, catch basin, and manhole system. The collection system was designed to convey the 10-year storm and providing one foot of freeboard at each structure. In the event of larger storms, excess overland flows will be directed away from proposed structures and other sensitive site features.

5.0 CONCLUSION

The proposed stormwater management system has been designed in general accordance with the Town of Bloomfield requirements, the 2004 CTDEEP Stormwater Quality Manual, and the 2000 CTDOT Drainage Manual. The system incorporates stormwater quality measures to minimize passage of pollutants to downstream receiving waters. It has also been designed to provide peak runoff rate attenuation to significantly reduce the peak rate of stormwater runoff leaving the site under proposed conditions.

It is the opinion of this office and the findings of this report that the proposed stormwater system, as proposed, will effectively manage the quality and quantity of stormwater runoff for the proposed development.

6.0 REFERENCES

1. Town of Bloomfield Zoning Regulations

2. Official Map of Inland Wetlands & Watercourses, Grid 300 & 373, Town of Bloomfield Connecticut, July 21, 2014.

3. Connecticut Guidelines for Soil Erosion and Sediment Control, The Connecticut Council on Soil and Water Conservation, 2002.

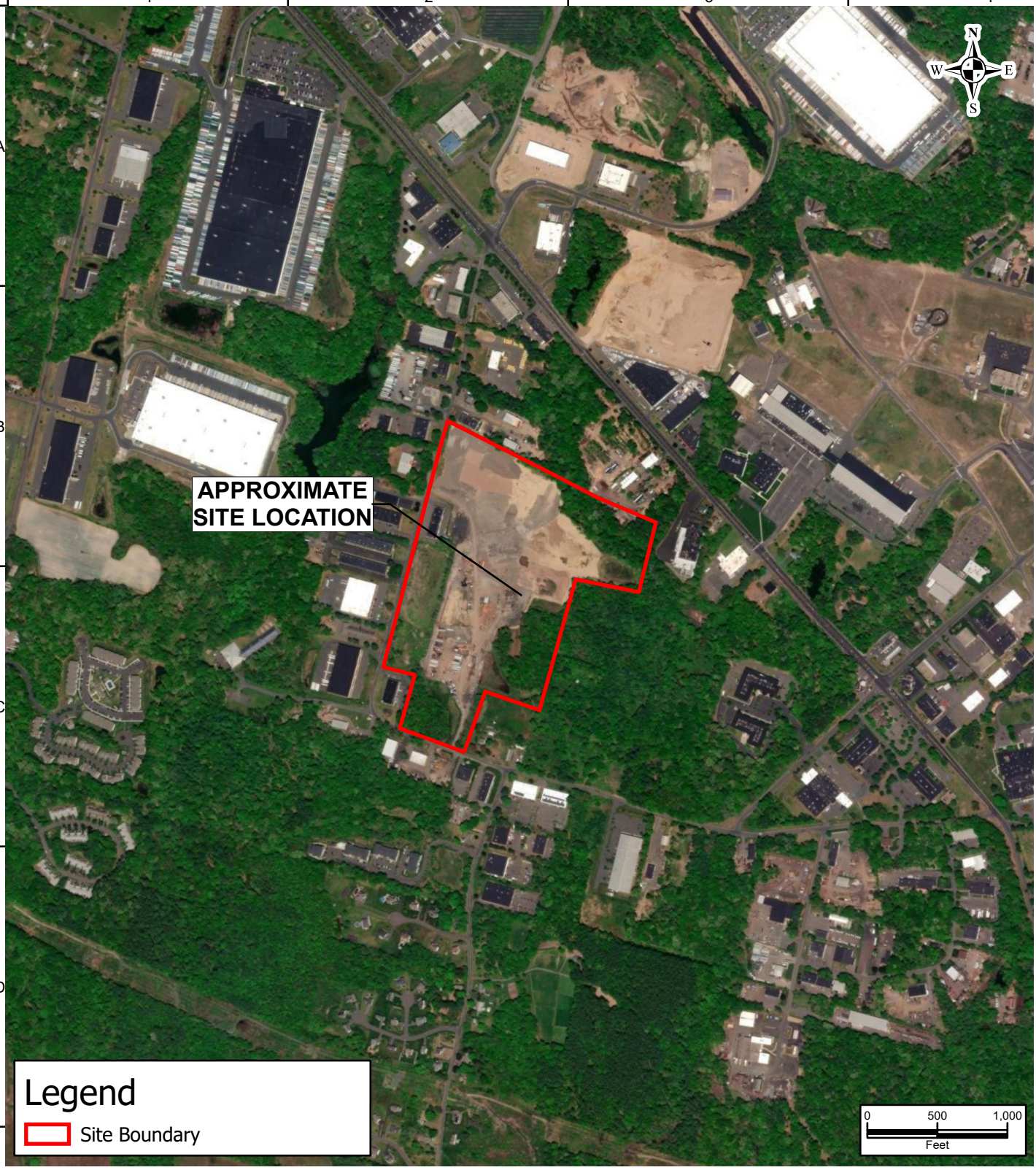
4. Web Soil Survey of Middlesex County, Connecticut, United States Department of Agriculture, 1958.

5. Urban Hydrology for Small Watersheds, Technical Release 55, United States Department of Agriculture, Soil Conservation Service, June 1986.

6. Connecticut Stormwater Quality Manual, Connecticut Department of Environmental Protection, 2004.

7. ConnDOT Drainage Manual, Connecticut Department of Transportation, 2000.

8. NOAA Atlas 14 Rainfall Depths & Intensities, https://hdsc.nws.noaa.gov/hdsc/pfds/



State of Connecticut, Maxar; Esri, DigitalGlobe, Earthstar Geographics, CNES/Airbus DS, GeoEye, USDA FSA, USGS, Aerogrid, IGN, IGP, and the GIS User Community

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Project	NORTH BLOOMFIELD COMMERCE CENTER BLOOMFIELD COUNTY HARTFORD CONNECTICUT
Drawing Title	AERIAL
Project No.	140255601
Date	10/17/2022
Scale	1:1,000
Drawn By	Site Analyzer
Submission Date	10/17/2022
Figure	1
	Sheet 1 of 5

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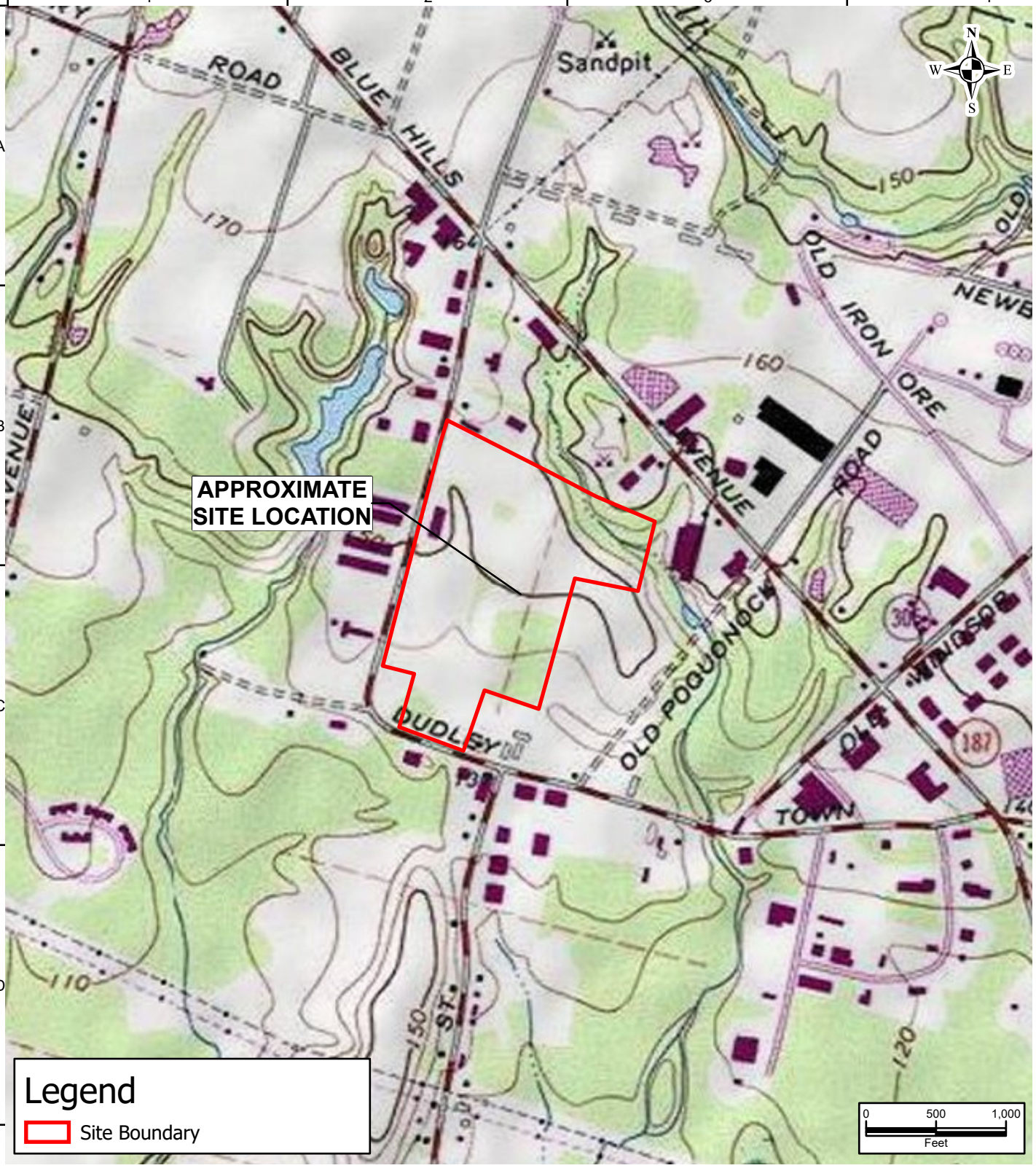
Spatial Reference: NAD 1983 StatePlane Connecticut FIPS 0600 Feet



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Project	NORTH BLOOMFIELD COMMERCE CENTER BLOOMFIELD COUNTY HARTFORD CONNECTICUT
Drawing Title	SITE LOCATION
Project No.	140255601
Date	10/17/2022
Scale	1:1,000
Drawn By	Site Analyzer
Submission Date	10/17/2022
Figure	2
	Sheet 2 of 5

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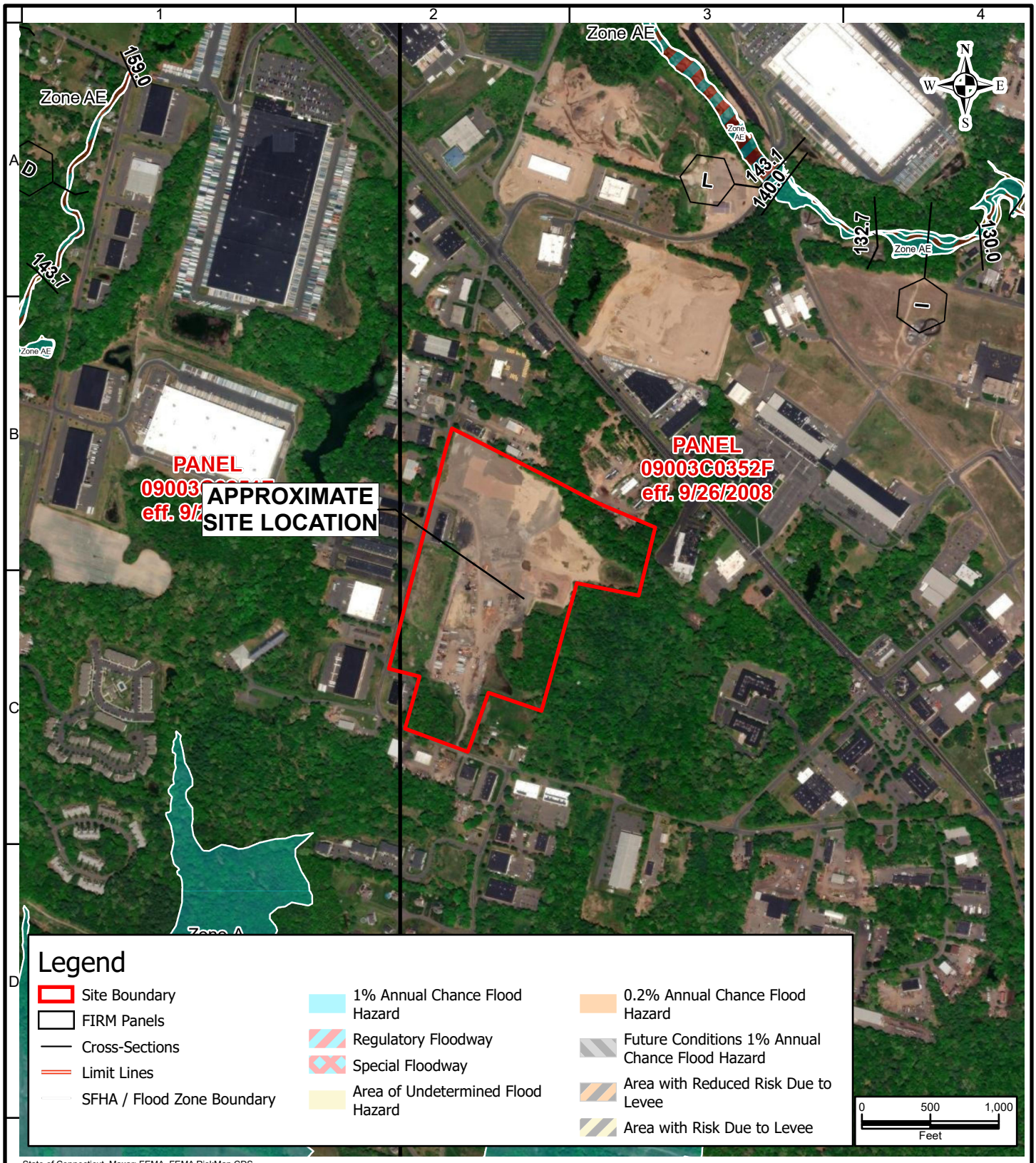

State of Connecticut, Maxar; FEMA, FEMA RiskMap CDS

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Project
NORTH BLOOMFIELD COMMERCE CENTER
BLOOMFIELD
COUNTY HARTFORD CONNECTICUT

Drawing Title
EFFECTIVE FEMA FIRM

Project No.	140255601
Date	10/17/2022
Scale	1:1,000
Drawn By	Site Analyzer
Submission Date	10/17/2022
Figure	3
	Sheet 3 of 5

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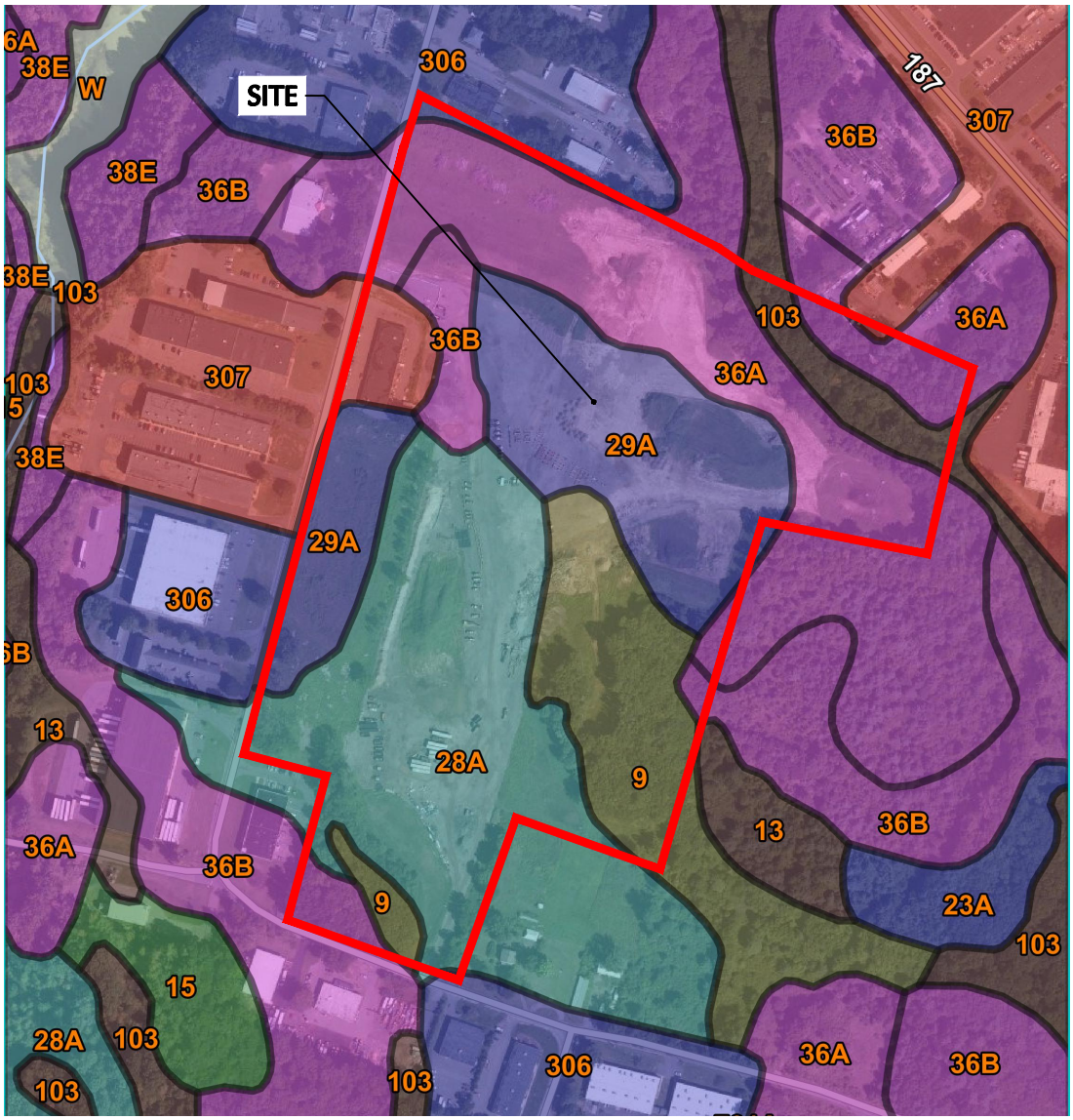

SOIL TYPE LEGEND

SYMBOL	NAME	RATING
9	SCITICO, SHAKER, AND MAYBID SOILS	C/D
13	WALPOLE SANDY LOAM, 0–3% SLOPES	B/D
28A	ELMRIDGE FINE SANDY LOAM, 0–3% SLOPES	C
29A	AGAWAM FINE SANDY LOAM, 0–3% SLOPES	B
36A	WINDSOR LOAMY SAND, 0–3% SLOPES	A
36B	WINDSOR LOAMY SAND, 3–8% SLOPES	A
103	RIPPOWAM FINE SANDY LOAM	B/D
306	UDORTHENTS–URBAN LAND COMPLEX	B
307	URBAN LAND	D

NOTES:
1. BASEMAP OBTAINED FROM USDA NATURAL RESOURCES CONSERVATION SERVICE (NRCS) WEB SOIL SURVEY MAP SERVICE ACCESSED 14 OCTOBER 2022.

500 0 250 500
SCALE IN FEET

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Project
NORTH BLOOMFIELD COMMERCE CENTER
116 WEST DUDLEY TOWN ROAD
BLOOMFIELD CONNECTICUT

Drawing Title
SOIL SURVEY MAP

Project No. 140255601
Date 10/14/2022
Drawn By CMD
Checked By DTG

FG04

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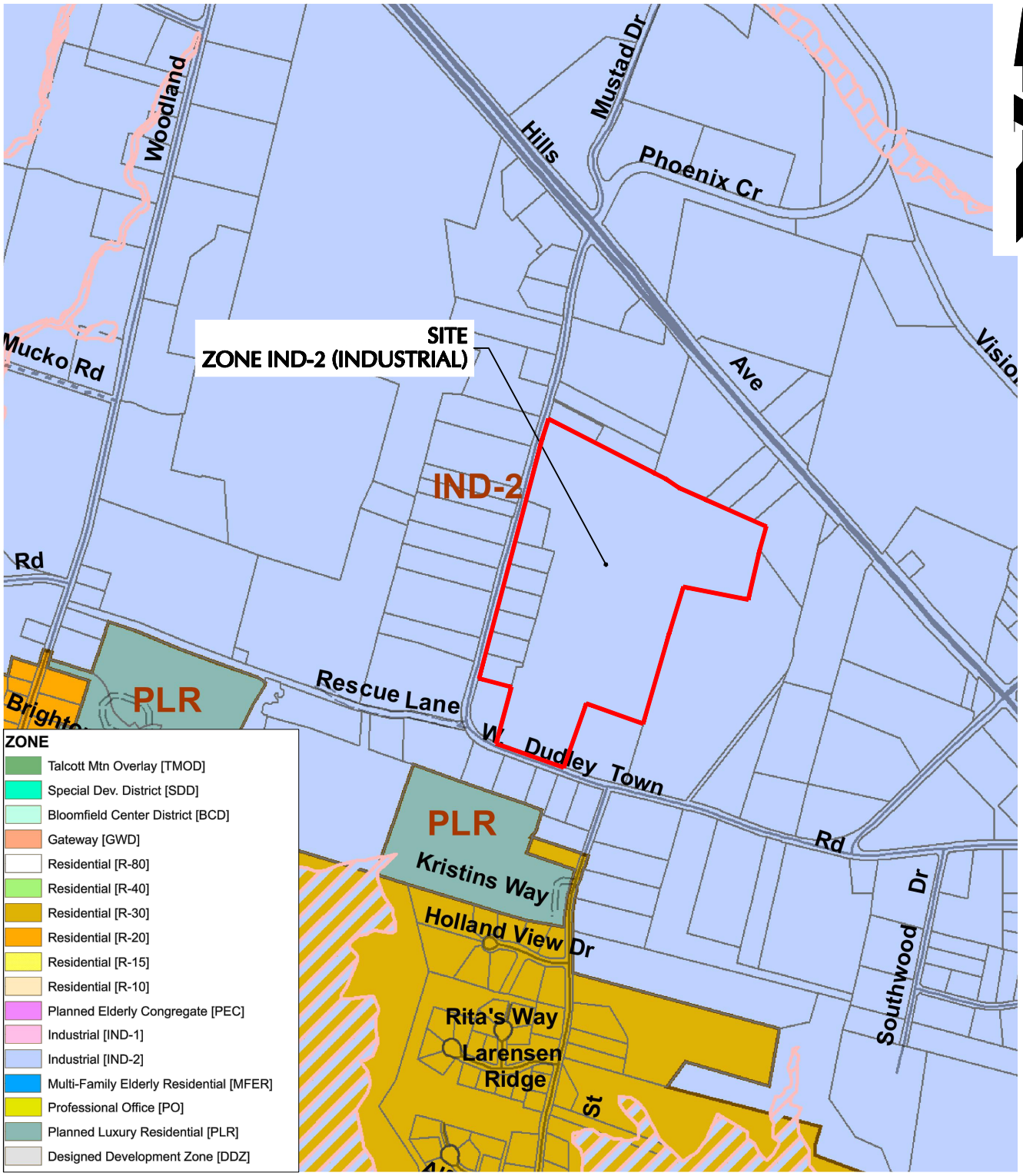

BASEMAP NOTES:

1. OFFICIAL ZONING MAP EFFECTIVE 2022. MAP OBTAINED FROM TOWN OF BLOOMFIELD WEBSITE, ACCESSED 14 OCTOBER 2022.

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SCALE: 1 INCH = 1000 FEET

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Project

NORTH BLOOMFIELD COMMERCE CENTER

116 WEST DUDLEY TOWN ROAD
BLOOMFIELD CONNECTICUT

Drawing Title

ZONING MAP

Project No.	140255601
Date	10/14/2022
Drawn By	CMD
Checked By	DTG

FG05

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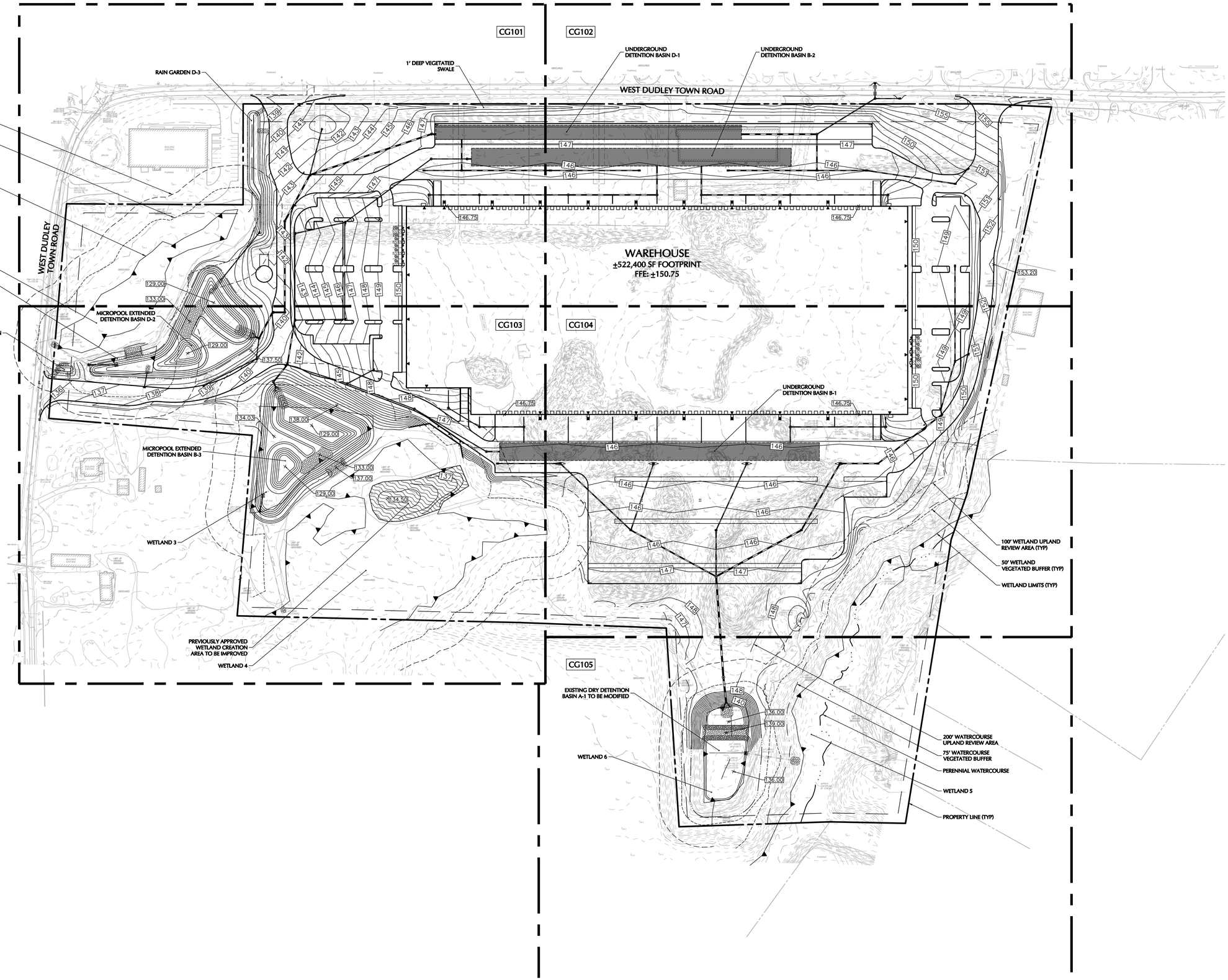

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Revisions		

Signature Date

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Project

NORTH BLOOMFIELD COMMERCE CENTER

116 WEST DUDLEY TOWN ROAD
MAP 16, LOT 43

BLOOMFIELD CONNECTICUT

APPLICANT/DEVELOPER:
NORTHPOINT DEVELOPMENT
3315 NORTH OAK TRAFFICWAY
KANSAS CITY, MO 64116

SUBMISSION PURPOSE: INLAND WETLANDS AND WATERCOURSES COMMISSION PERMIT APPLICATION

Drawing Title

OVERALL GRADING & DRAINAGE PLAN

Project No. 140255601

Date 12/08/2022

Drawn By ALF

Checked By DTG

Drawing No. CG100

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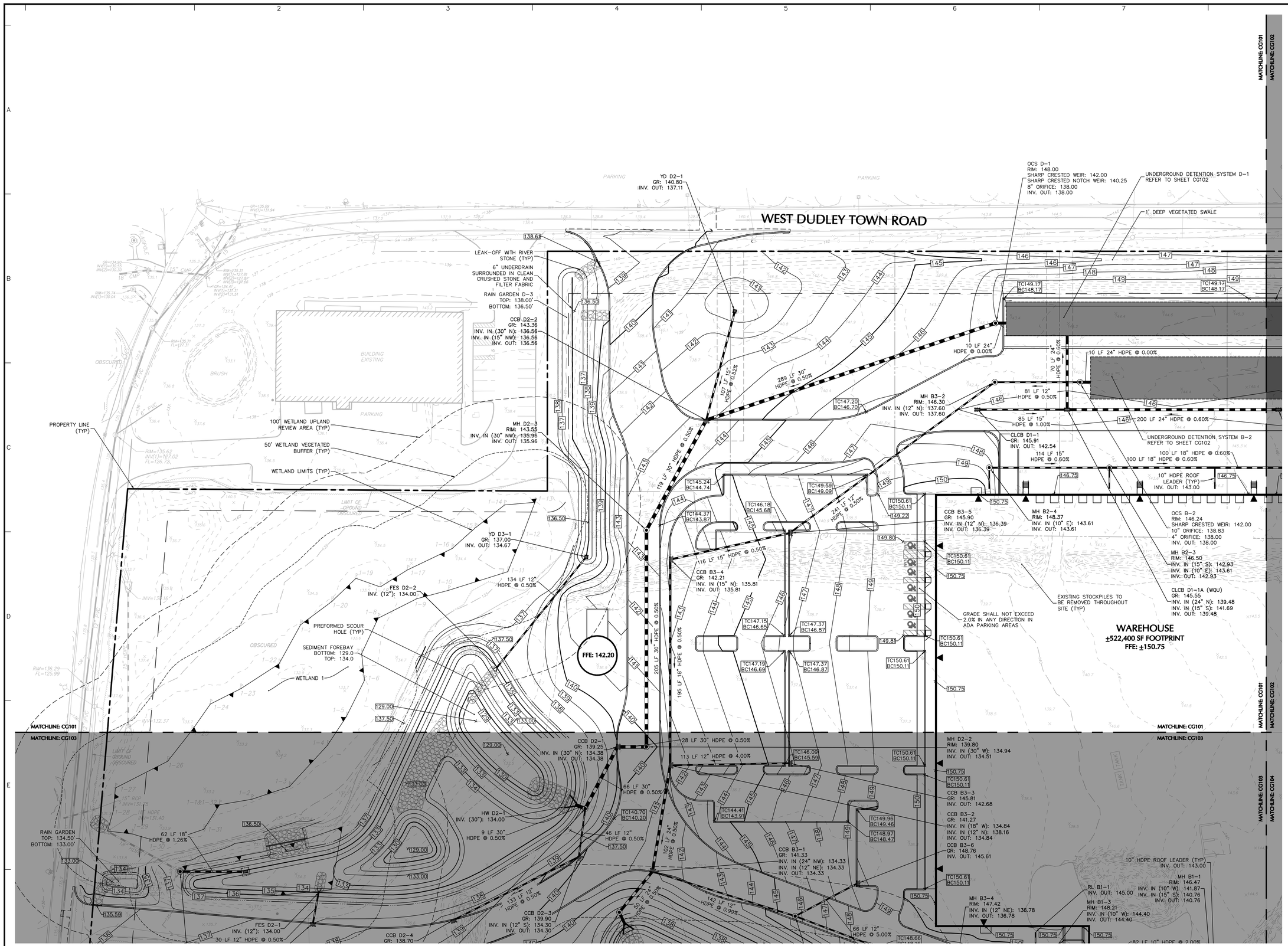

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CT NAD 83

SHEET LEGEND

1" = 1,000'

CG101 CG102 CG103 CG104 CG105

Date	Description	No.
Revisions		

Signature Date

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Project

NORTH BLOOMFIELD COMMERCE CENTER
116 WEST DUDLEY TOWN ROAD
MAP 16, LOT 43

BLOOMFIELD CONNECTICUT

APPLICANT/DEVELOPER:
NORTHPOINT DEVELOPMENT
3315 NORTH OAK TRAFFICWAY
KANSAS CITY, MO 64116

SUBMISSION PURPOSE: INLAND WETLANDS AND WATERCOURSES COMMISSION PERMIT APPLICATION

Drawing Title

GRADING & DRAINAGE PLAN I

Project No. 140255601

Date 12/08/2022

Drawn By ALF

Checked By DTG

Drawing No. CG101

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Project No. 140255601

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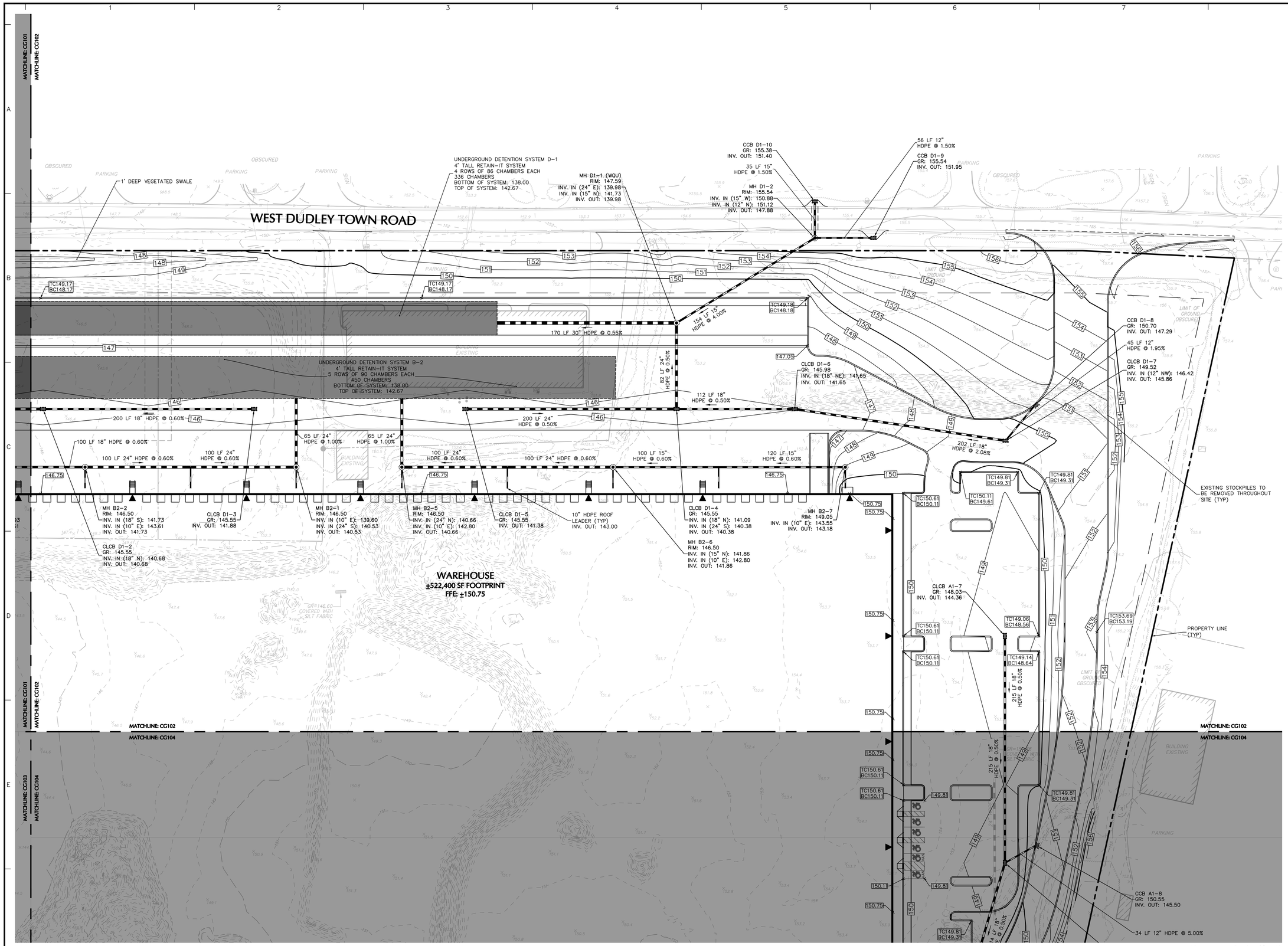

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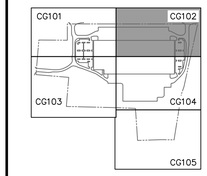

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Project

NORTH BLOOMFIELD COMMERCE CENTER

116 WEST DUDLEY TOWN ROAD
MAP 16, LOT 43

BLOOMFIELD CONNECTICUT

APPLICANT/DEVELOPER:
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3315 NORTH OAK TRAFFICWAY
KANSAS CITY, MO 64116

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Drawing Title

GRADING & DRAINAGE PLAN II

Project No.	Drawing No.
140255601	CG102
Date: 12/08/2022	
Drawn By: ALF	
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Project No. 140255601

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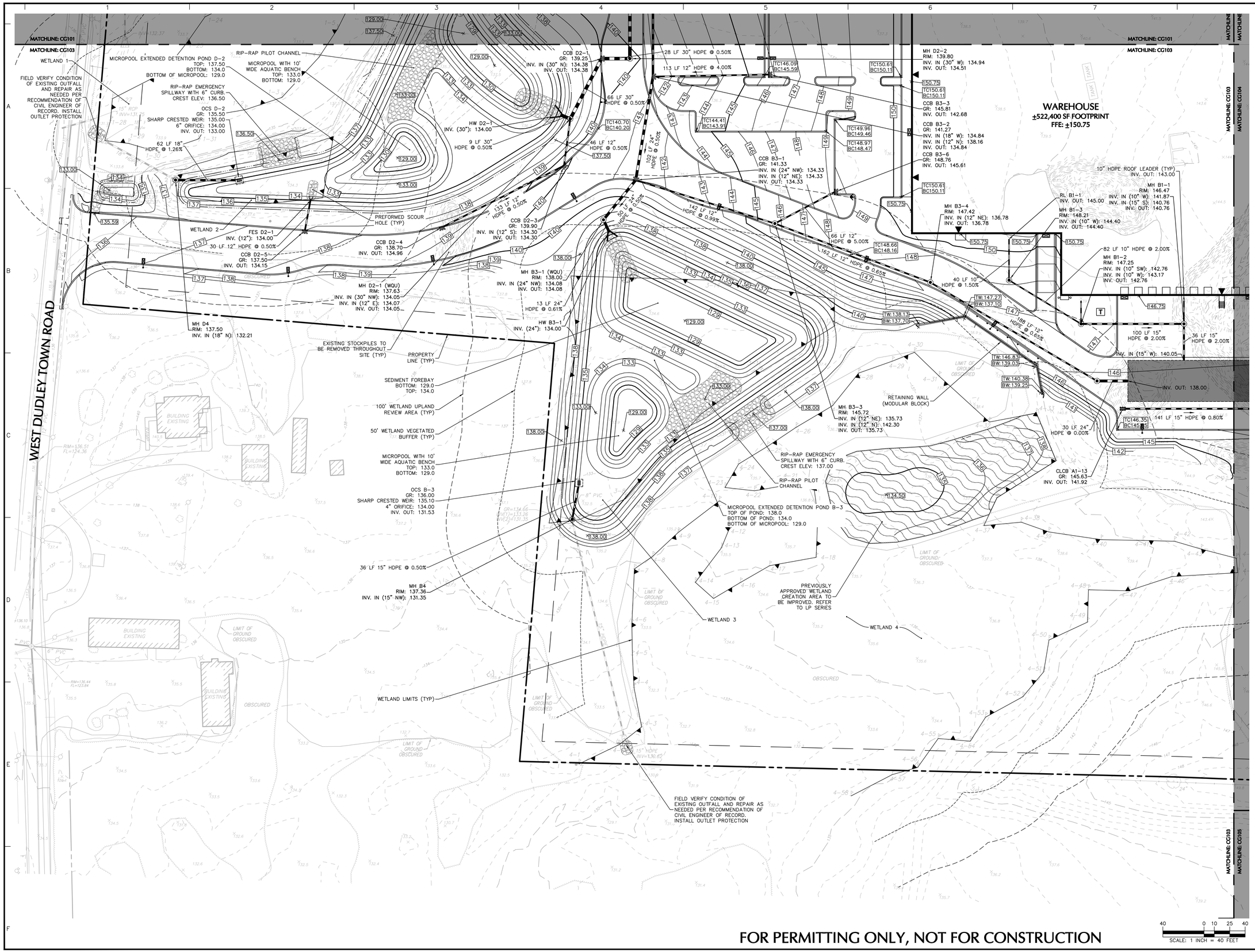

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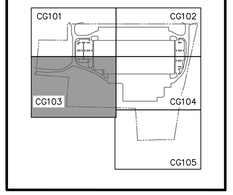
SHEET LEGEND

1" = 1,000'



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Revisions

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Project

NORTH BLOOMFIELD COMMERCE CENTER

116 WEST DUDLEY TOWN ROAD
MAP 16, LOT 43

BLOOMFIELD CONNECTICUT

APPLICANT/DEVELOPER:
NORTHPOINT DEVELOPMENT
3315 NORTH OAK TRAFFICWAY
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SUBMISSION PURPOSE: INLAND WETLANDS AND WATERCOURSES COMMISSION PERMIT APPLICATION

Drawing Title

GRADING & DRAINAGE PLAN III

Project No. 140255601

Date 12/08/2022

Drawing No. CG103

Drawn By ALF

Checked By DTG

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Project No. 140255601

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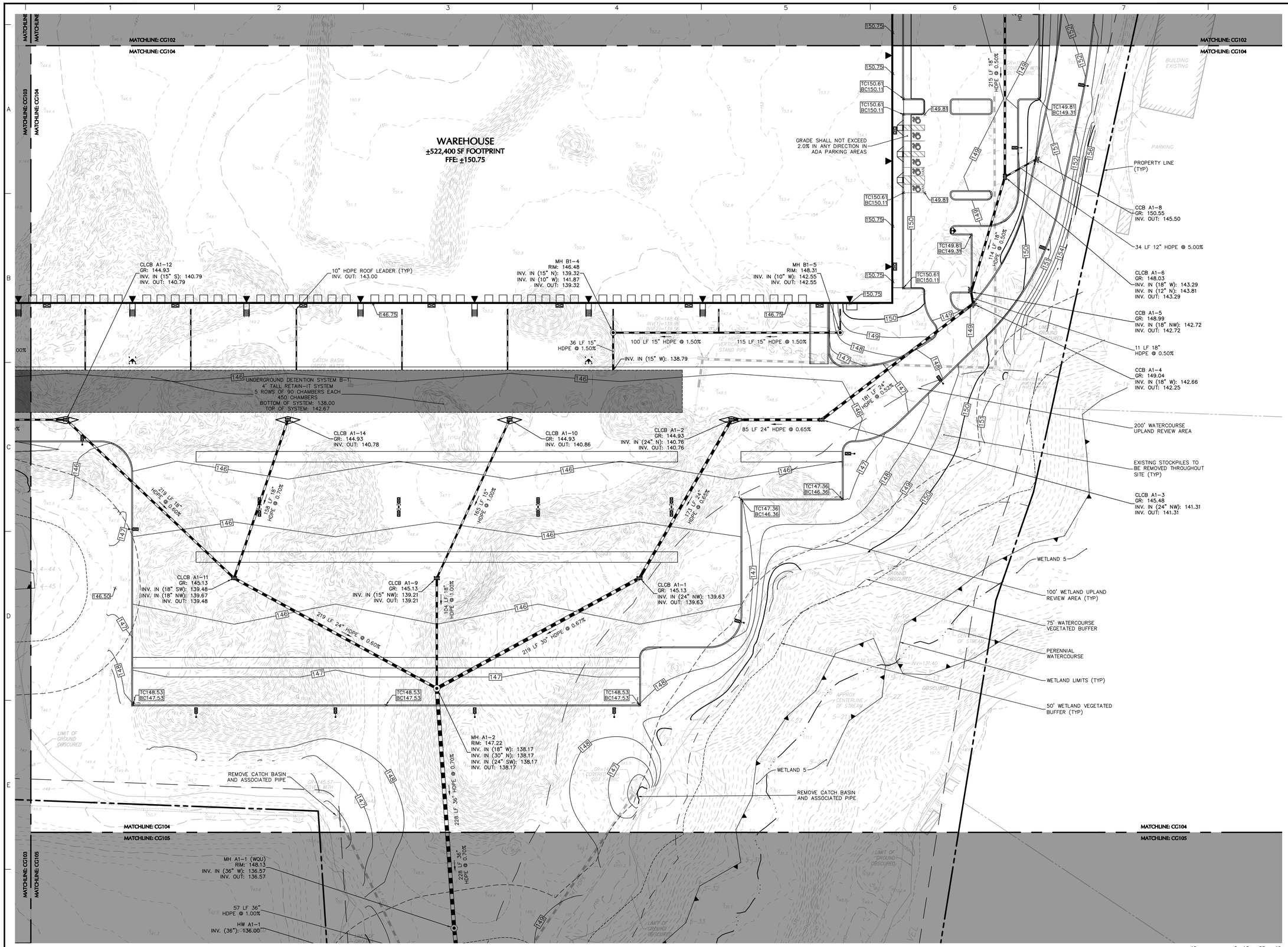

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Project
NORTH BLOOMFIELD COMMERCE CENTER
116 WEST DUDLEY TOWN ROAD
MAP 16, LOT 43
BLOOMFIELD CONNECTICUT

APPLICANT/DEVELOPER:
NORTHPOINT DEVELOPMENT
3315 NORTH OAK TRAFFICWAY
KANSAS CITY, MO 64116

SUBMISSION PURPOSE: INLAND WETLANDS AND WATERCOURSES COMMISSION PERMIT APPLICATION

Drawing Title
GRADING & DRAINAGE PLAN IV

Project No.	Drawing No.
140255601	CG104
Date: 12/08/2022	
Drawn By: ALF	
Checked By: DTG	

Project No. 140255601

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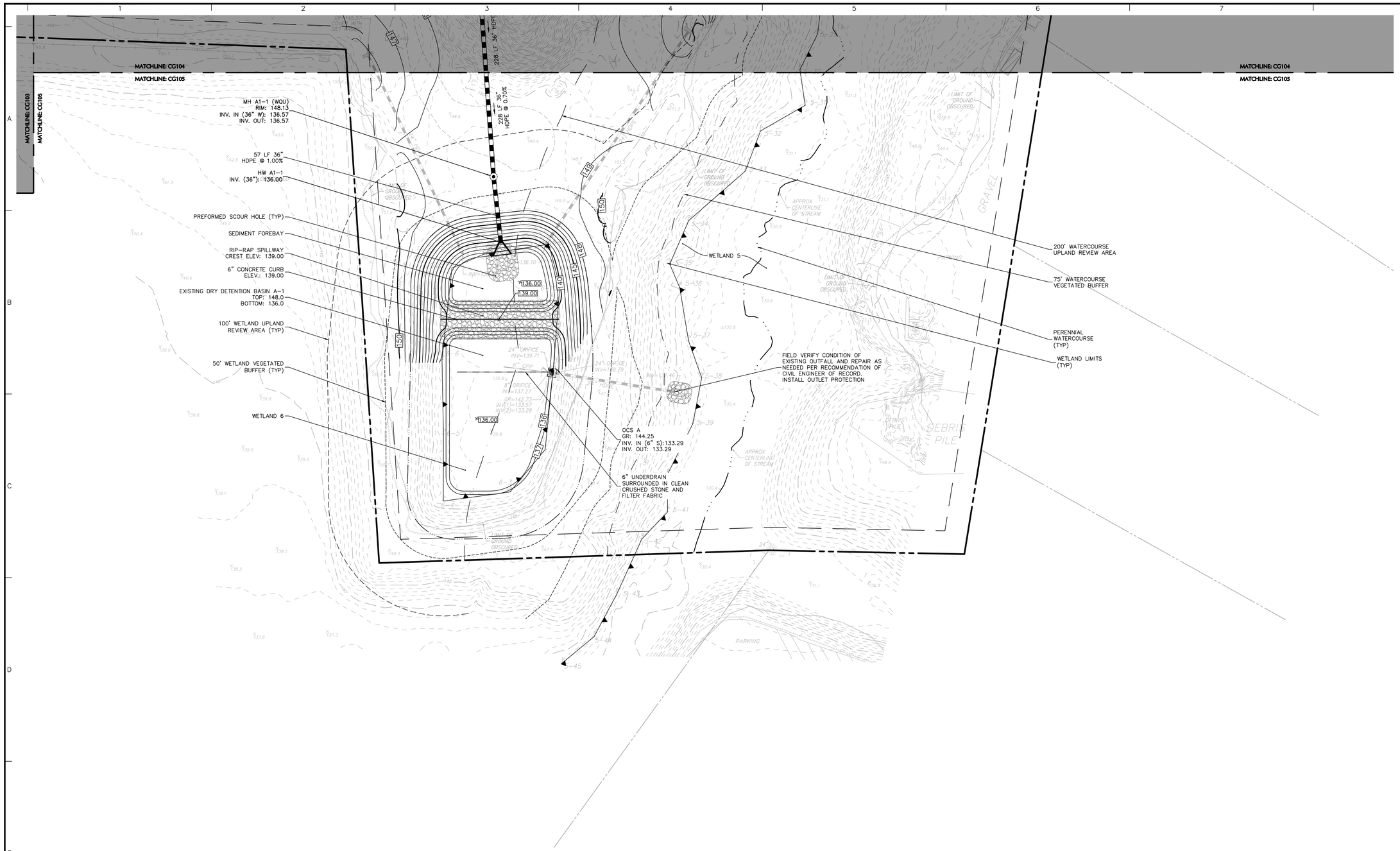

CT NAD 83

SHEET LEGEND

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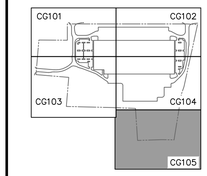

Date	Description	No.
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Project

NORTH BLOOMFIELD COMMERCE CENTER

116 WEST DUDLEY TOWN ROAD
MAP 16, LOT 43

BLOOMFIELD CONNECTICUT

APPLICANT/DEVELOPER:
NORTHPOINT DEVELOPMENT
3315 NORTH OAK TRAFFICWAY
KANSAS CITY, MO 64116

SUBMISSION PURPOSE: INLAND WETLANDS AND WATERCOURSES COMMISSION PERMIT APPLICATION

Drawing Title

GRADING & DRAINAGE PLAN V

Project No. 140255601

Date 12/08/2022

Drawn By ALF

Checked By DTG

Drawing No. CG105

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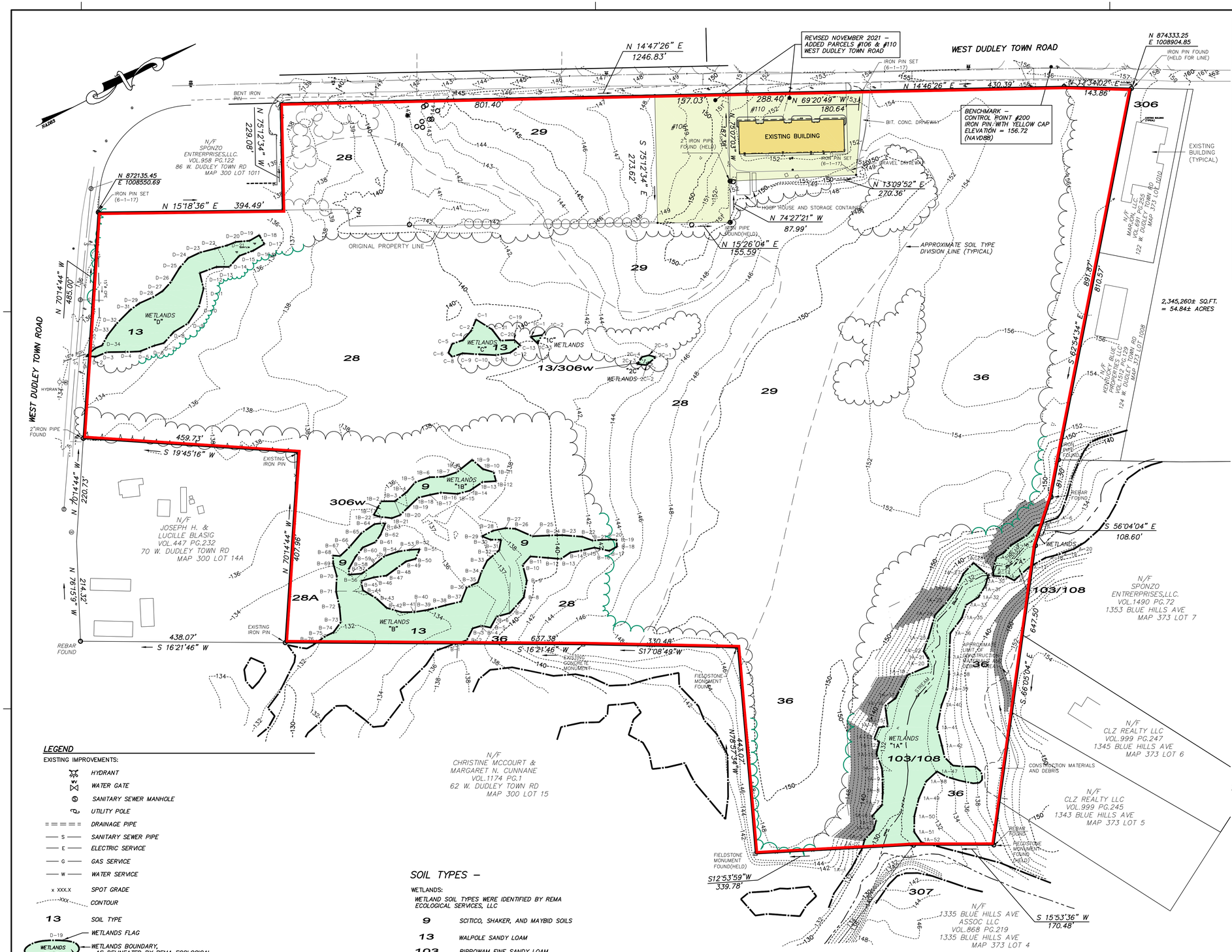
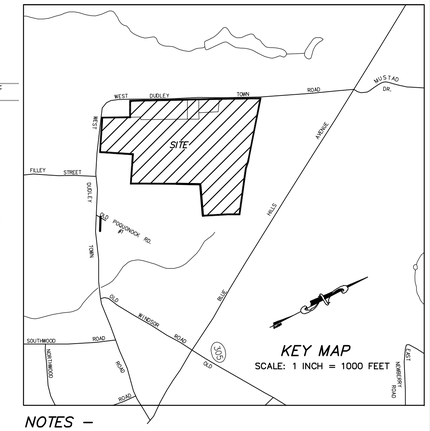




NOTES –

1. THIS SURVEY AND MAP HAS BEEN PREPARED IN ACCORDANCE WITH SECTIONS 20–300b–1 THROUGH 20–300b20 OF THE REGULATIONS OF CONNECTICUT STATE AGENCIES – "MINIMUM STANDARDS FOR SURVEYS AND MAPS IN THE STATE OF CONNECTICUT" AS ENDORSED BY THE CONNECTICUT ASSOCIATION OF LAND SURVEYORS, INC. IT IS A PROPERTY SURVEY CONFORMING TO HORIZONTAL ACCURACY CLASS A–2.

PERIMETER INFORMATION HAS BEEN TAKEN FROM REFERENCE PLAN 1.

2. THE COORDINATES (NORTH ORIENTATION) SHOWN ARE "NAD83".

3. FLAGGED WETLANDS AND EXISTING TOPOGRAPHY WITHIN THE AREA OF THE PROPOSED BUILDING AND IMPROVEMENTS HAS BEEN FIELD VERIFIED BY ALFORD ASSOCIATES, INC. IN DECEMBER, 2016 AND CONFORMS TO CLASS T–2 ACCURACY STANDARDS. OTHER TOPOGRAPHY HAS BEEN TAKEN FROM REFERENCE PLAN 1. ELEVATIONS ARE BASED ON "NAVD88".

4. WETLANDS WERE DELINEATED BY GEORGE LOGAN OF REMA ECOLOGICAL SERVICES, LLC IN DECEMBER, 2016.

5. SUBJECT PROPERTY IS ZONED "I–2", AS SHOWN "2014 TOWN OF BLOOMFIELD ZONING MAP PLAN AND ZONING COMMISSION WITH FEMA FLOOD ZONE".

6. PARCELS ARE SHOWN ON THE NOTED BLOOMFIELD ASSESSOR'S MAPS:
   116; MAP 373/300, LOT 14
   90–106; MAP 300, LOT 1012
   110; MAP 373, LOT 1013

7. PARCEL AREA = 2,345,260± SQ.FT. = 53.84± ACRES (PRIOR TO NOV, 2021)
   "106 WEST DUDLEY TOWN ROAD" = 0.987 ACRES
   "110 WEST DUDLEY TOWN ROAD" = 1.176 ACRES
   COMBINED AREA = 53.84± + 0.987 + 1.176 = 56.003 ACRES

8. DEEDS OF PARCELS:
   116; VOLUME 1911, PAGE 278
   90–104; VOLUME 1998, PAGE 101
   106; VOLUME 1992, PAGE 29
   110; VOLUME 1476, PAGE 115

9. THE SUBJECT PROPERTIES ARE WITHIN ZONE "X", WHICH IS OUTSIDE OF A 1% AND 0.2% ANNUAL CHANCE FLOOD AREA, AS SHOWN ON A PLAN ENTITLED – "FIRM FLOOD INSURANCE RATE MAP HARTFORD COUNTY, CONNECTICUT (ALL JURISDICTIONS) PANEL 352 OF 675 MAP NUMBER 09003C0352F EFFECTIVE DATE: SEPTEMBER 26, 2008 FEDERAL EMERGENCY MANAGEMENT AGENCY NATIONAL FLOOD INSURANCE PROGRAM".

10. TOTAL AREA OR WETLANDS BY REMA ECOLOGICAL SERVICES = 3.72 ACRES

AREA	SQ. FT.	ACRES
A	6,035	0.14
1A	54,665	1.25
B	59,280	1.36
1B	9,665	0.22
C	5,970	0.14
1C	195	0.004
2C	475	0.01
D	25,957	0.60
TOTAL	162,242	3.72

11. WETLANDS, AS SHOWN ON PROPERTY "N/F CHRISTINE MCCOURT & MARGARET N. CUNNANE", HAS BEEN TAKEN FROM A PLAN ENTITLED – "WETLANDS MAP BOUNDARY AMENDMENT PLAN PREPARED FOR MARGARET CUNNANE 62 WEST DUDLEY TOWN ROAD BLOOMFIELD, CONNECTICUT SHEETS 1 & 2 OF 2 SCALE: 1 IN. = 40 FT. DATE: DEC. 20, 2014", PREPARED BY ALFORD ASSOCIATES, INC..

12. PERCENT OF EXISTING IMPERVIOUS COVERAGE LOCATED ON THE COMBINED SUBJECT PROPERTY = 1.9%

REFERENCE PLANS –

1. "PROPERTY,LIMITED TOPOGRAPHIC SURVEY PROPERTY OF WEST DUDLEY TOWN ROAD, LLC WEST DUDLEY TOWN ROAD BLOOMFIELD, CONNECTICUT DATE: 05–01–2014 SCALE: 1"=100' SHEET NO. 1 OF 1 F.A. HESKETH & ASSOCIATES, INC."

2. "PROPERTY OF ASSOCIATED REALTY DUDLEY TOWN ROAD BLOOMFIELD CONNECTICUT SCALE: 1"= 50' SEPTEMBER, 1968 OFFICE OF HAROLD R. SANDERSON C.E. & L.S. BLOOMFIELD, CONNECTICUT"

3. "100 WEST DUDLEY TOWN ROAD INDUSTRIAL SUBDIVISION SUBDIVISION PLAN PREPARED FOR ADVANCED GAS CO., INC. LOT 1012 100 WEST DUDLEY TOWN ROAD BLOOMFIELD, CONNECTICUT SHEET 1 OF 3 SCALE: 1 IN. = 40 FT. DATE: APRIL 1, 2019 REVISION DATE 6–10–2019 ALFORD ASSOCIATES, INC. CIVIL ENGINEERS WINDSOR, CONNECTICUT"
PLAN IS RECORDED IN THE BLOOMFIELD LAND RECORDS AS MAP NO. 1885.

LEGEND

EXISTING IMPROVEMENTS:

- HYDRANT
- WATER GATE
- SANITARY SEWER MANHOLE
- UTILITY POLE
- DRAINAGE PIPE
- S — SANITARY SEWER PIPE
- E — ELECTRIC SERVICE
- G — GAS SERVICE
- W — WATER SERVICE
- x XXX.X — SPOT GRADE
- XXX — CONTOUR
- 13 — SOIL TYPE
- D–19 — WETLANDS FLAG
- WETLANDS — WETLANDS BOUNDARY, AS DELINEATED BY REMA ECOLOGICAL SERVICES, LLC
- WETLANDS
- WETLANDS BOUNDARY, PER OFFICIAL MAP (SHEETS 300 AND 373)
- EDGE OF WOODS
- SLOPES IN EXCESS OF 25%

SOIL TYPES –

WETLANDS:

WETLAND SOIL TYPES WERE IDENTIFIED BY REMA ECOLOGICAL SERVICES, LLC

9	SCITICO, SHAKER, AND MAYBID SOILS
13	WALPOLE SANDY LOAM
103	RIPPOWAM FINE SANDY LOAM
108	SACO SILT LOAM
306w	AQUENTS

UPLAND SOILS:

UPLAND SOIL TYPES ARE TAKEN FROM THE WEB SOIL SURVEY BY THE NATURAL RESOURCES CONSERVATION SERVICE (NRCS)

28	ELMRIDGE FINE SANDY LOAM
29	AGAWAM FINE SANDY LOAM
36	WINDSOR LOAMY SAND

GRAPHIC SCALE

100 0 50 100 200 400

(IN FEET)
1 inch = 100ft.

THE LOCATIONS OF UNDERGROUND UTILITIES ARE APPROXIMATE AND ALL UTILITIES MAY NOT BE SHOWN. PRIOR TO CONSTRUCTION, CONTRACTOR SHALL CALL 1–800–922–4455 AND HAVE UTILITIES MARKED ON THE GROUND.

WETLANDS FLAGS WERE SET BY REMA ECOLOGICAL SERVICES AND ARE SUBSTANTIALLY CORRECT AS DEPICTED HEREON.

REMA ECOLOGICAL SERVICES, LLC

George T. Logan, MS
Registered Soil Scientist
Certified Professional Wetland Scientist (No. 581)

APPLICANT:
BCI, Inc. d.b.a. Butler Company
c/o Timothy J. Butler
848 Marshall Phelps Road
Windsor, CT 06095
Tel. No. 860–688–8024
email: tjbutler@thebutlerco.com

OWNER:
CT Valley Properties III, LLC
c/o Timothy J. Butler
848 Marshall Phelps Road
Windsor, CT 06095
Tel. No. 860–688–8024
email: tjbutler@thebutlerco.com

DATE	REVISION
11–9–21	ADDED PARCELS #106 & #110 ALONG WITH PROPOSED IMPROVEMENTS. REVISED PROPOSED OFFICE/MAINTENANCE/SALES BUILDING AND ASSOCIATED WORK AREAS. REVISED WETLANDS.
4–15–21	ADDED PARCEL & PROPOSED IMPROVEMENTS ON "90, 92, 98, 100 & 104 WEST DUDLEY TOWN RD" & REVISED PREVIOUSLY APPROVED IMPROVEMENTS
6–27–17	STAFF COMMENTS
5–16–17	INCORPORATED CONDITIONS OF APPROVALS
3–3–17	MISC. REVISIONS

STATE OF CONNECTICUT WILSON H. ALFORD, JR. No. 9344 LICENSED PROFESSIONAL ENGINEER

STATE OF CONNECTICUT WILSON H. ALFORD, JR. No. 9344 LICENSED LAND SURVEYOR

TO THE BEST OF MY KNOWLEDGE AND BELIEF THIS MAP IS SUBSTANTIALLY CORRECT AS NOTED HEREON.

L.S. NO. 9344

NOT VALID WITHOUT A LIVE SIGNATURE AND EMBOSSED SEAL

Alford ASSOCIATES, INC.
CIVIL ENGINEERS
WINDSOR, CONNECTICUT
WILSON H. ALFORD,JR.,P.E.& L.S.

DATE: DECEMBER 30, 2016

SCALE: 1 IN. = 100 FT.

INLAND WETLANDS & WATERCOURSES COMMISSION AND T.P. & Z. COMMISSION PERMIT APPLICATION PLANS

EXISTING CONDITIONS PLAN

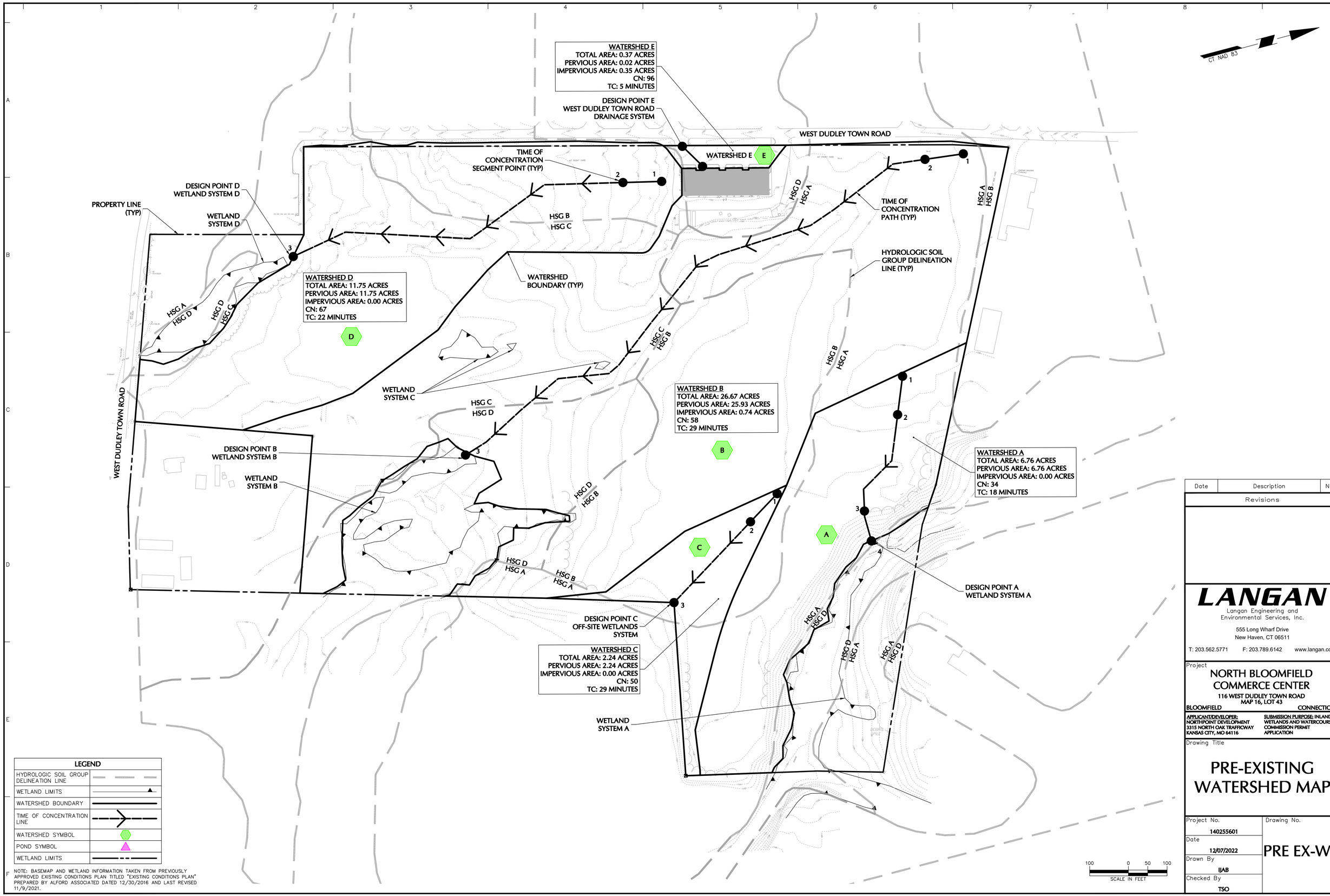
PREPARED FOR

BCI, INC. dba BUTLER COMPANY

LOT 14 – 116 WEST DUDLEY TOWN ROAD

BLOOMFIELD, CONNECTICUT

Sheet
EXC 1



LEGEND	
HYDROLOGIC SOIL GROUP DELINEATION LINE	
WETLAND LIMITS	
WATERSHED BOUNDARY	
TIME OF CONCENTRATION LINE	
WATERSHED SYMBOL	
POND SYMBOL	
WETLAND LIMITS	

NOTE: BASEMAP AND WETLAND INFORMATION TAKEN FROM PREVIOUSLY APPROVED EXISTING CONDITIONS PLAN TITLED "EXISTING CONDITIONS PLAN" PREPARED BY ALFORD ASSOCIATED DATED 12/30/2016 AND LAST REVISED 11/9/2021.

Date	Description	No.
Revisions		

LANGAN
Langan Engineering and Environmental Services, Inc.
555 Long Wharf Drive
New Haven, CT 06511
T: 203.562.5771 F: 203.789.6142 www.langan.com

Project
NORTH BLOOMFIELD COMMERCE CENTER
116 WEST DUDLEY TOWN ROAD
MAP 16, LOT 43
BLOOMFIELD CONNECTICUT

APPLICANT/DEVELOPER:
NORTHPOINT DEVELOPMENT
3315 NORTH OAK TRAFFICWAY
KANSAS CITY, MO 64116

SUBMISSION PURPOSE: INLAND WETLANDS AND WATERCOURSES COMMISSION PERMIT APPLICATION

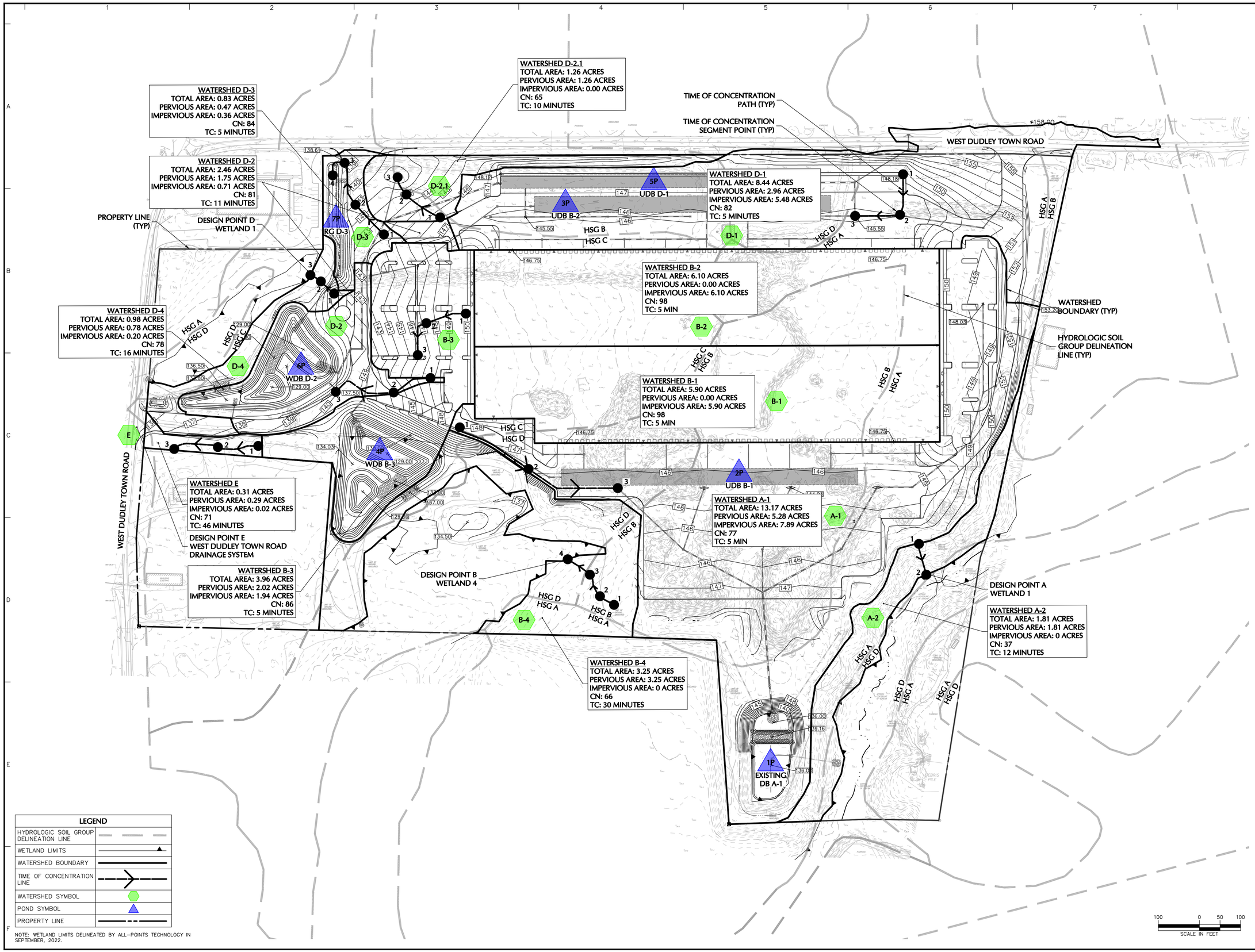
Drawing Title
PRE-EXISTING WATERSHED MAP

Project No.	Drawing No.
140255601	PRE EX-WS
Date: 12/07/2022	
Drawn By: IJAB	
Checked By: TSO	

LANGAN

Project No. 140255601

© 2022 Langan



LEGEND	
HYDROLOGIC SOIL GROUP DELINEATION LINE	
WETLAND LIMITS	
WATERSHED BOUNDARY	
TIME OF CONCENTRATION LINE	
WATERSHED SYMBOL	
POND SYMBOL	
PROPERTY LINE	

NOTE: WETLAND LIMITS DELINEATED BY ALL-POINTS TECHNOLOGY IN SEPTEMBER, 2022.

Date	Description	No.
Revisions		

LANGAN
Langan Engineering and Environmental Services, Inc.
555 Long Wharf Drive
New Haven, CT 06511
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Project
NORTH BLOOMFIELD COMMERCE CENTER
116 WEST DUDLEY TOWN ROAD
MAP 16, LOT 43
BLOOMFIELD CONNECTICUT

APPLICANT/DEVELOPER:
NORTHPOINT DEVELOPMENT
3315 NORTH OAK TRAFFICWAY
KANSAS CITY, MO 64116

SUBMISSION PURPOSE: INLAND WETLANDS AND WATERCOURSES COMMISSION PERMIT APPLICATION

Drawing Title
PROPOSED WATERSHED MAP

Project No. 140255601
Date 12/07/2022
Drawn By IJAB
Checked By TSO
Drawing No. PR-WS

Project No. 140255601

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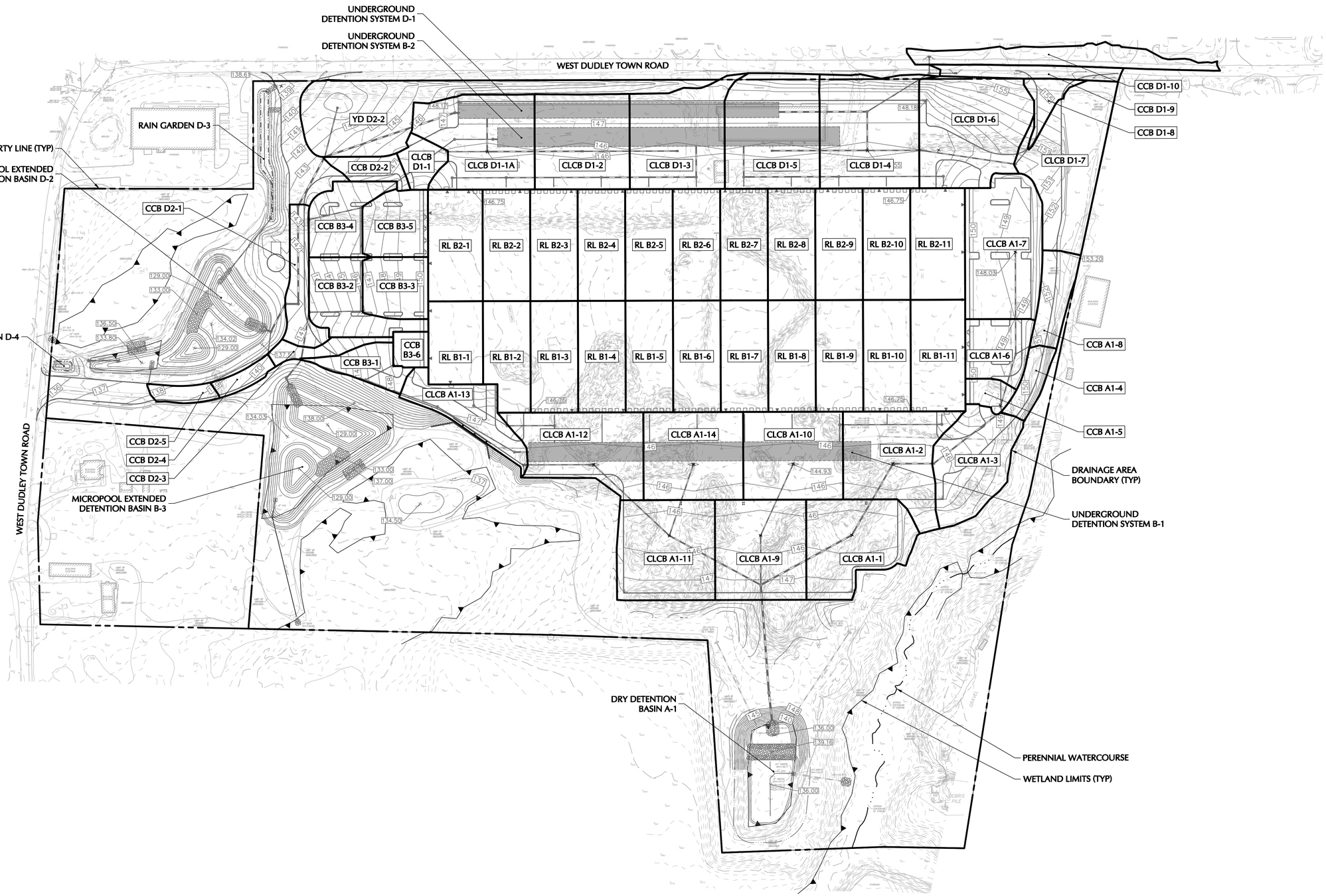

Date	Description	No.
Revisions		

Signature Date

LANGAN

Langan Engineering and Environmental Services, Inc.

555 Long Wharf Drive
New Haven, CT 06511

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Project

NORTH BLOOMFIELD COMMERCE CENTER

116 WEST DUDLEY TOWN ROAD
MAP 16, LOT 43

BLOOMFIELD CONNECTICUT

APPLICANT/DEVELOPER:
NORTHPOINT DEVELOPMENT
3315 NORTH OAK TRAFFICWAY
KANSAS CITY, MO 64116

SUBMISSION PURPOSE: INLAND WETLANDS AND WATERCOURSES COMMISSION PERMIT APPLICATION

Drawing Title

DRAINAGE AREA MAP

Project No. 140255601

Date 12/09/2022

Drawn By JMGM

Checked By TSO

Drawing No. DACB

LANGAN

Project No. 140255601

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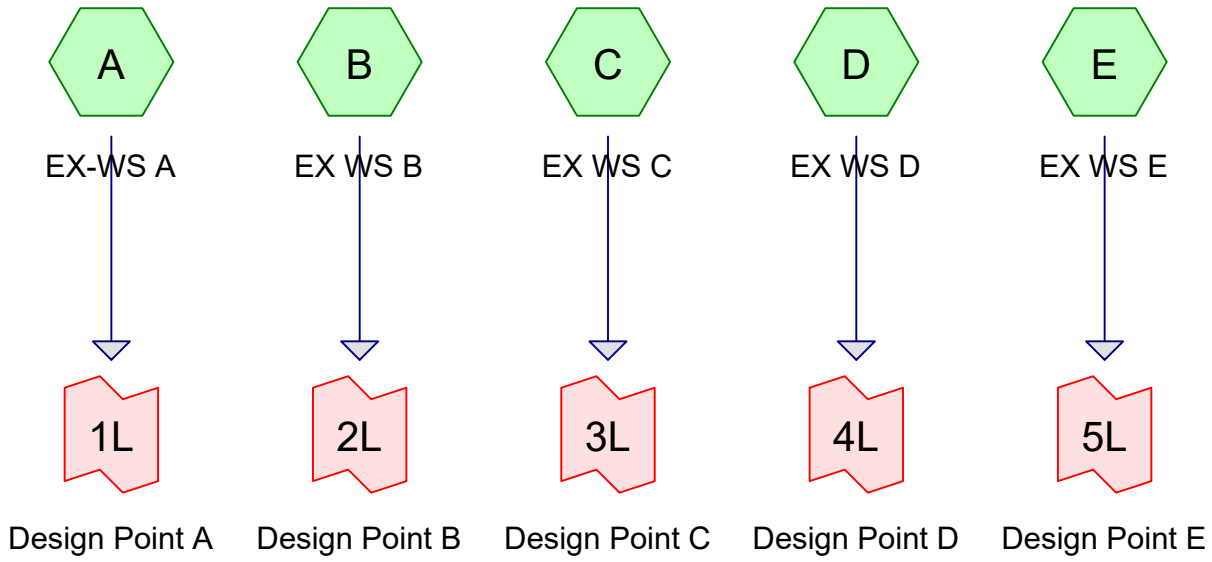
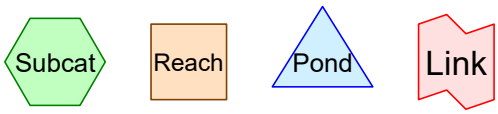
APPENDIX A

Existing Stormwater Discharge Calculations

LANGAN





Routing Diagram for 116 West Dudley Town Road Existing Hydrology
Prepared by Langan Engineering, Printed 12/7/2022
HydroCAD® 10.20-2f s/n 08223 © 2022 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.203	74	>75% Grass cover, Good, HSG C (D)
8.641	30	Meadow, non-grazed, HSG A (A, B, C)
11.006	58	Meadow, non-grazed, HSG B (A, B, C, D)
9.391	71	Meadow, non-grazed, HSG C (B, D)
1.996	78	Meadow, non-grazed, HSG D (B)
0.738	98	Paved parking, HSG A (B)
0.346	98	Paved parking, HSG D (E)
4.784	30	Woods, Good, HSG A (A, B, C)
2.487	55	Woods, Good, HSG B (B, C, D, E)
5.780	70	Woods, Good, HSG C (B, D)
2.405	77	Woods, Good, HSG D (A, B, D, E)
47.777	**57**	**TOTAL AREA**

Time span=5.00-26.00 hrs, dt=0.05 hrs, 421 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentA: EX-WS A Runoff Area=6.758 ac 0.00% Impervious Runoff Depth=0.00"
Flow Length=475' Tc=18.5 min CN=34 Runoff=0.00 cfs 0.000 af

SubcatchmentB: EX WS B Runoff Area=26.671 ac 2.77% Impervious Runoff Depth=0.35"
Flow Length=1,560' Tc=28.8 min CN=58 Runoff=3.63 cfs 0.774 af

SubcatchmentC: EX WS C Runoff Area=2.235 ac 0.00% Impervious Runoff Depth=0.13"
Flow Length=388' Slope=0.0050 '/' Tc=29.0 min CN=50 Runoff=0.04 cfs 0.025 af

SubcatchmentD: EX WS D Runoff Area=11.745 ac 0.00% Impervious Runoff Depth=0.70"
Flow Length=1,011' Tc=22.2 min CN=67 Runoff=5.17 cfs 0.683 af

SubcatchmentE: EX WS E Runoff Area=0.368 ac 94.02% Impervious Runoff Depth>2.75"
Flow Length=73' Slope=0.0200 '/' Tc=5.0 min CN=96 Runoff=1.12 cfs 0.084 af

Link 1L: Design Point A Inflow=0.00 cfs 0.000 af
Primary=0.00 cfs 0.000 af

Link 2L: Design Point B Inflow=3.63 cfs 0.774 af
Primary=3.63 cfs 0.774 af

Link 3L: Design Point C Inflow=0.04 cfs 0.025 af
Primary=0.04 cfs 0.025 af

Link 4L: Design Point D Inflow=5.17 cfs 0.683 af
Primary=5.17 cfs 0.683 af

Link 5L: Design Point E Inflow=1.12 cfs 0.084 af
Primary=1.12 cfs 0.084 af

Total Runoff Area = 47.777 ac Runoff Volume = 1.566 af Average Runoff Depth = 0.39"
97.73% Pervious = 46.693 ac 2.27% Impervious = 1.084 ac

Time span=5.00-26.00 hrs, dt=0.05 hrs, 421 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentA: EX-WS A Runoff Area=6.758 ac 0.00% Impervious Runoff Depth=0.08"
Flow Length=475' Tc=18.5 min CN=34 Runoff=0.07 cfs 0.044 af

SubcatchmentB: EX WS B Runoff Area=26.671 ac 2.77% Impervious Runoff Depth=1.26"
Flow Length=1,560' Tc=28.8 min CN=58 Runoff=19.87 cfs 2.796 af

SubcatchmentC: EX WS C Runoff Area=2.235 ac 0.00% Impervious Runoff Depth=0.76"
Flow Length=388' Slope=0.0050 '/' Tc=29.0 min CN=50 Runoff=0.80 cfs 0.141 af

SubcatchmentD: EX WS D Runoff Area=11.745 ac 0.00% Impervious Runoff Depth=1.92"
Flow Length=1,011' Tc=22.2 min CN=67 Runoff=16.37 cfs 1.875 af

SubcatchmentE: EX WS E Runoff Area=0.368 ac 94.02% Impervious Runoff Depth>4.63"
Flow Length=73' Slope=0.0200 '/' Tc=5.0 min CN=96 Runoff=1.84 cfs 0.142 af

Link 1L: Design Point A Inflow=0.07 cfs 0.044 af
Primary=0.07 cfs 0.044 af

Link 2L: Design Point B Inflow=19.87 cfs 2.796 af
Primary=19.87 cfs 2.796 af

Link 3L: Design Point C Inflow=0.80 cfs 0.141 af
Primary=0.80 cfs 0.141 af

Link 4L: Design Point D Inflow=16.37 cfs 1.875 af
Primary=16.37 cfs 1.875 af

Link 5L: Design Point E Inflow=1.84 cfs 0.142 af
Primary=1.84 cfs 0.142 af

Total Runoff Area = 47.777 ac Runoff Volume = 4.998 af Average Runoff Depth = 1.26"
97.73% Pervious = 46.693 ac 2.27% Impervious = 1.084 ac

Time span=5.00-26.00 hrs, dt=0.05 hrs, 421 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentA: EX-WS A Runoff Area=6.758 ac 0.00% Impervious Runoff Depth=0.28"
Flow Length=475' Tc=18.5 min CN=34 Runoff=0.34 cfs 0.158 af

SubcatchmentB: EX WS B Runoff Area=26.671 ac 2.77% Impervious Runoff Depth=1.99"
Flow Length=1,560' Tc=28.8 min CN=58 Runoff=33.45 cfs 4.412 af

SubcatchmentC: EX WS C Runoff Area=2.235 ac 0.00% Impervious Runoff Depth=1.32"
Flow Length=388' Slope=0.0050 '/' Tc=29.0 min CN=50 Runoff=1.65 cfs 0.247 af

SubcatchmentD: EX WS D Runoff Area=11.745 ac 0.00% Impervious Runoff Depth=2.80"
Flow Length=1,011' Tc=22.2 min CN=67 Runoff=24.55 cfs 2.745 af

SubcatchmentE: EX WS E Runoff Area=0.368 ac 94.02% Impervious Runoff Depth>5.78"
Flow Length=73' Slope=0.0200 '/' Tc=5.0 min CN=96 Runoff=2.28 cfs 0.177 af

Link 1L: Design Point A Inflow=0.34 cfs 0.158 af
Primary=0.34 cfs 0.158 af

Link 2L: Design Point B Inflow=33.45 cfs 4.412 af
Primary=33.45 cfs 4.412 af

Link 3L: Design Point C Inflow=1.65 cfs 0.247 af
Primary=1.65 cfs 0.247 af

Link 4L: Design Point D Inflow=24.55 cfs 2.745 af
Primary=24.55 cfs 2.745 af

Link 5L: Design Point E Inflow=2.28 cfs 0.177 af
Primary=2.28 cfs 0.177 af

Total Runoff Area = 47.777 ac Runoff Volume = 7.739 af Average Runoff Depth = 1.94"
97.73% Pervious = 46.693 ac 2.27% Impervious = 1.084 ac

Time span=5.00-26.00 hrs, dt=0.05 hrs, 421 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentA: EX-WS A Runoff Area=6.758 ac 0.00% Impervious Runoff Depth=0.79"
Flow Length=475' Tc=18.5 min CN=34 Runoff=2.22 cfs 0.446 af

SubcatchmentB: EX WS B Runoff Area=26.671 ac 2.77% Impervious Runoff Depth=3.27"
Flow Length=1,560' Tc=28.8 min CN=58 Runoff=57.49 cfs 7.273 af

SubcatchmentC: EX WS C Runoff Area=2.235 ac 0.00% Impervious Runoff Depth=2.39"
Flow Length=388' Slope=0.0050 '/' Tc=29.0 min CN=50 Runoff=3.30 cfs 0.444 af

SubcatchmentD: EX WS D Runoff Area=11.745 ac 0.00% Impervious Runoff Depth=4.30"
Flow Length=1,011' Tc=22.2 min CN=67 Runoff=38.13 cfs 4.213 af

SubcatchmentE: EX WS E Runoff Area=0.368 ac 94.02% Impervious Runoff Depth>7.57"
Flow Length=73' Slope=0.0200 '/' Tc=5.0 min CN=96 Runoff=2.97 cfs 0.232 af

Link 1L: Design Point A Inflow=2.22 cfs 0.446 af
Primary=2.22 cfs 0.446 af

Link 2L: Design Point B Inflow=57.49 cfs 7.273 af
Primary=57.49 cfs 7.273 af

Link 3L: Design Point C Inflow=3.30 cfs 0.444 af
Primary=3.30 cfs 0.444 af

Link 4L: Design Point D Inflow=38.13 cfs 4.213 af
Primary=38.13 cfs 4.213 af

Link 5L: Design Point E Inflow=2.97 cfs 0.232 af
Primary=2.97 cfs 0.232 af

Total Runoff Area = 47.777 ac Runoff Volume = 12.609 af Average Runoff Depth = 3.17"
97.73% Pervious = 46.693 ac 2.27% Impervious = 1.084 ac

Summary for Subcatchment A: EX-WS A

Runoff = 2.22 cfs @ 12.48 hrs, Volume= 0.446 af, Depth= 0.79"
Routed to Link 1L : Design Point A

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-26.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=8.22"

Area (ac)	CN	Description
0.249	77	Woods, Good, HSG D
0.611	58	Meadow, non-grazed, HSG B
3.449	30	Meadow, non-grazed, HSG A
2.449	30	Woods, Good, HSG A
6.758	34	Weighted Average
6.758		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.0	100	0.0150	0.10		**Sheet Flow, 1** Grass: Dense n= 0.240 P2= 3.22"
2.2	280	0.0180	2.16		**Shallow Concentrated Flow, 2** Unpaved Kv= 16.1 fps
0.3	95	0.1500	6.24		**Shallow Concentrated Flow, 3** Unpaved Kv= 16.1 fps
18.5	475	Total			

Summary for Subcatchment B: EX WS B

Runoff = 57.49 cfs @ 12.42 hrs, Volume= 7.273 af, Depth= 3.27"
Routed to Link 2L : Design Point B

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-26.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=8.22"

Area (ac)	CN	Description
0.738	98	Paved parking, HSG A
2.037	77	Woods, Good, HSG D
1.996	78	Meadow, non-grazed, HSG D
2.834	70	Woods, Good, HSG C
4.226	71	Meadow, non-grazed, HSG C
1.488	55	Woods, Good, HSG B
6.431	58	Meadow, non-grazed, HSG B
1.993	30	Woods, Good, HSG A
4.928	30	Meadow, non-grazed, HSG A
26.671	58	Weighted Average
25.933		97.23% Pervious Area
0.738		2.77% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.5	100	0.0120	0.10		**Sheet Flow, 1** Grass: Dense n= 0.240 P2= 3.22"
11.3	1,460	0.0180	2.16		**Shallow Concentrated Flow, 2** Unpaved Kv= 16.1 fps
28.8	1,560	Total			

Summary for Subcatchment C: EX WS C

Runoff = 3.30 cfs @ 12.45 hrs, Volume= 0.444 af, Depth= 2.39"
Routed to Link 3L : Design Point C

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-26.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=8.22"

Area (ac)	CN	Description
0.247	55	Woods, Good, HSG B
1.382	58	Meadow, non-grazed, HSG B
0.342	30	Woods, Good, HSG A
0.264	30	Meadow, non-grazed, HSG A
2.235	50	Weighted Average
2.235		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.8	100	0.0050	0.07		**Sheet Flow, 1** Grass: Dense n= 0.240 P2= 3.22"
4.2	288	0.0050	1.14		**Shallow Concentrated Flow, 2** Unpaved Kv= 16.1 fps
29.0	388	Total			

Summary for Subcatchment D: EX WS D

Runoff = 38.13 cfs @ 12.31 hrs, Volume= 4.213 af, Depth= 4.30"
Routed to Link 4L : Design Point D

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-26.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=8.22"

Area (ac)	CN	Description
0.113	77	Woods, Good, HSG D
0.203	74	>75% Grass cover, Good, HSG C
2.946	70	Woods, Good, HSG C
5.165	71	Meadow, non-grazed, HSG C
0.736	55	Woods, Good, HSG B
2.582	58	Meadow, non-grazed, HSG B
11.745	67	Weighted Average
11.745		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.2	100	0.0200	0.12		**Sheet Flow, A** Grass: Dense n= 0.240 P2= 3.22"
8.0	911	0.0140	1.90		**Shallow Concentrated Flow, B** Unpaved Kv= 16.1 fps
22.2	1,011	Total			

Summary for Subcatchment E: EX WS E

[49] Hint: Tc<2dt may require smaller dt

Runoff = 2.97 cfs @ 12.07 hrs, Volume= 0.232 af, Depth> 7.57"
Routed to Link 5L : Design Point E

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-26.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=8.22"

Area (ac)	CN	Description
0.346	98	Paved parking, HSG D
0.006	77	Woods, Good, HSG D
0.016	55	Woods, Good, HSG B
0.368	96	Weighted Average
0.022		5.98% Pervious Area
0.346		94.02% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	73	0.0200	1.30		**Sheet Flow, 1** Smooth surfaces n= 0.011 P2= 3.22"
0.9	73	Total, Increased to minimum Tc = 5.0 min			

Summary for Link 1L: Design Point A

Inflow Area = 6.758 ac, 0.00% Impervious, Inflow Depth = 0.79" for 100-yr event
Inflow = 2.22 cfs @ 12.48 hrs, Volume= 0.446 af
Primary = 2.22 cfs @ 12.48 hrs, Volume= 0.446 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-26.00 hrs, dt= 0.05 hrs

Summary for Link 2L: Design Point B

Inflow Area = 26.671 ac, 2.77% Impervious, Inflow Depth = 3.27" for 100-yr event
Inflow = 57.49 cfs @ 12.42 hrs, Volume= 7.273 af
Primary = 57.49 cfs @ 12.42 hrs, Volume= 7.273 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-26.00 hrs, dt= 0.05 hrs

Summary for Link 3L: Design Point C

Inflow Area = 2.235 ac, 0.00% Impervious, Inflow Depth = 2.39" for 100-yr event
Inflow = 3.30 cfs @ 12.45 hrs, Volume= 0.444 af
Primary = 3.30 cfs @ 12.45 hrs, Volume= 0.444 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-26.00 hrs, dt= 0.05 hrs

Summary for Link 4L: Design Point D

Inflow Area = 11.745 ac, 0.00% Impervious, Inflow Depth = 4.30" for 100-yr event
Inflow = 38.13 cfs @ 12.31 hrs, Volume= 4.213 af
Primary = 38.13 cfs @ 12.31 hrs, Volume= 4.213 af, Atten= 0%, Lag= 0.0 min

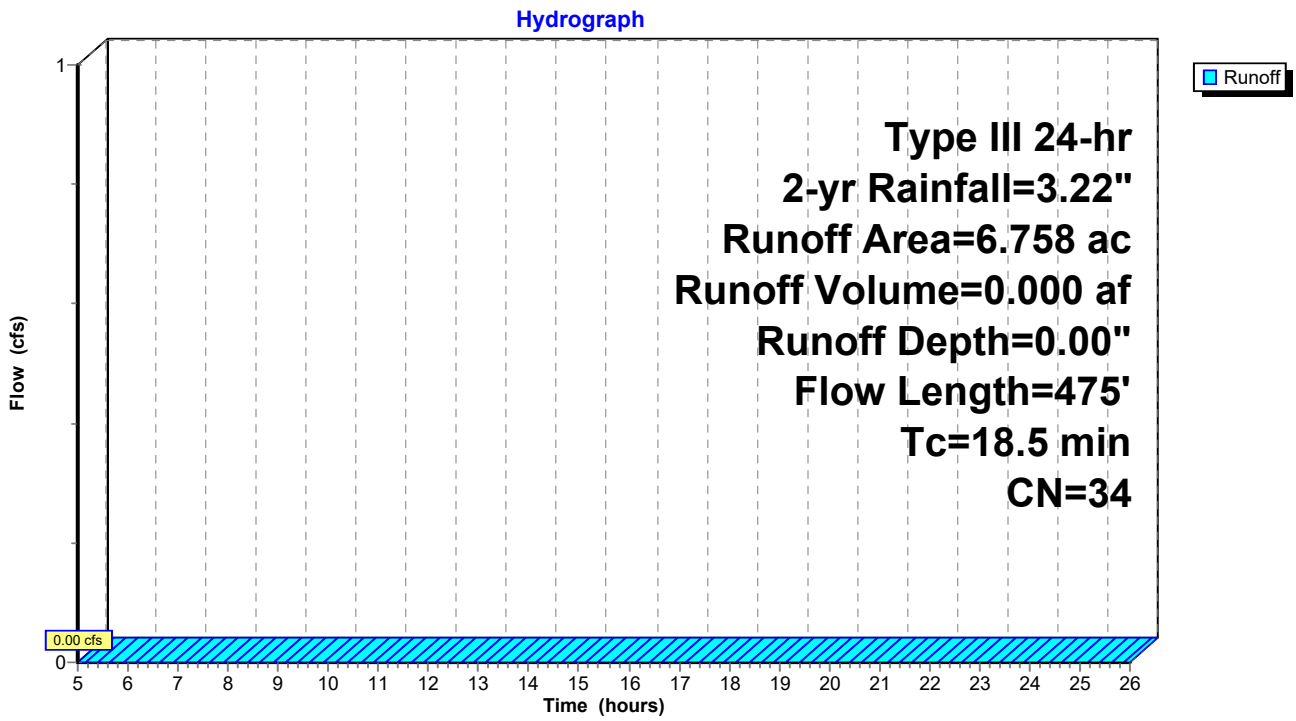
Primary outflow = Inflow, Time Span= 5.00-26.00 hrs, dt= 0.05 hrs

Summary for Link 5L: Design Point E

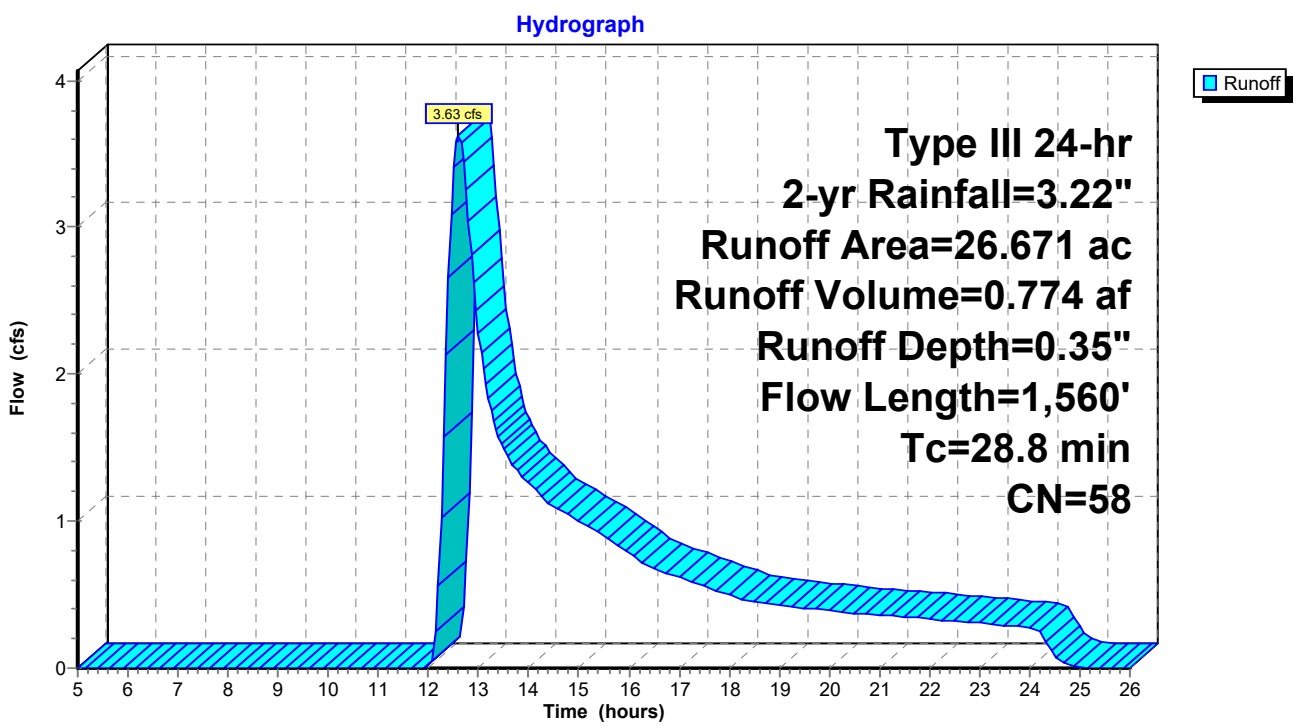
Inflow Area = 0.368 ac, 94.02% Impervious, Inflow Depth > 7.57" for 100-yr event
Inflow = 2.97 cfs @ 12.07 hrs, Volume= 0.232 af
Primary = 2.97 cfs @ 12.07 hrs, Volume= 0.232 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-26.00 hrs, dt= 0.05 hrs

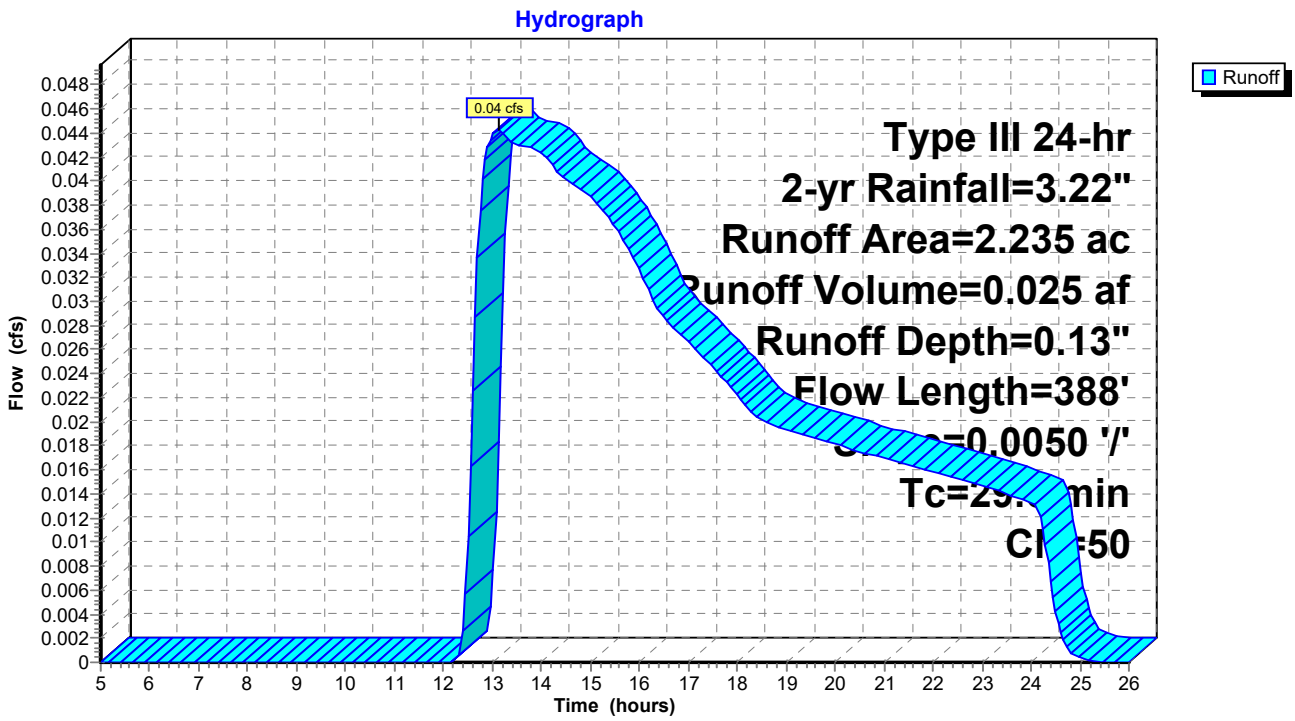
Subcatchment A: EX-WS A



Subcatchment B: EX WS B



Subcatchment C: EX WS C



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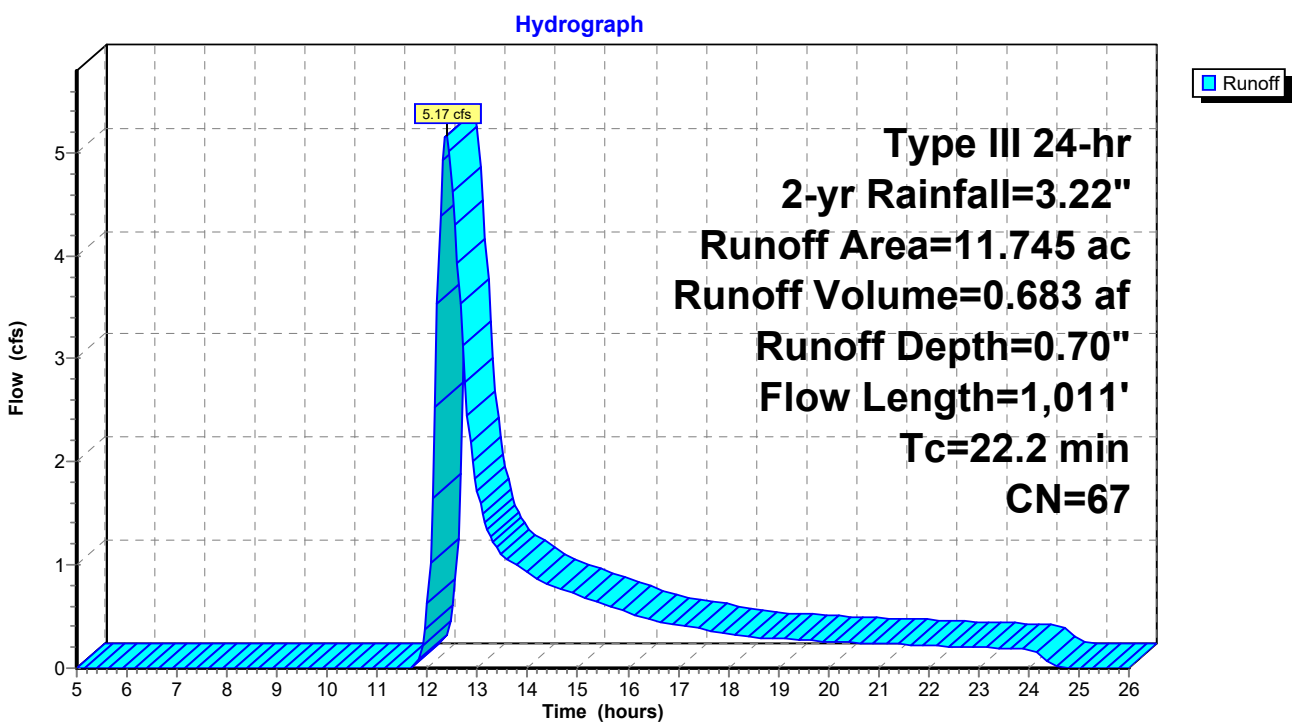

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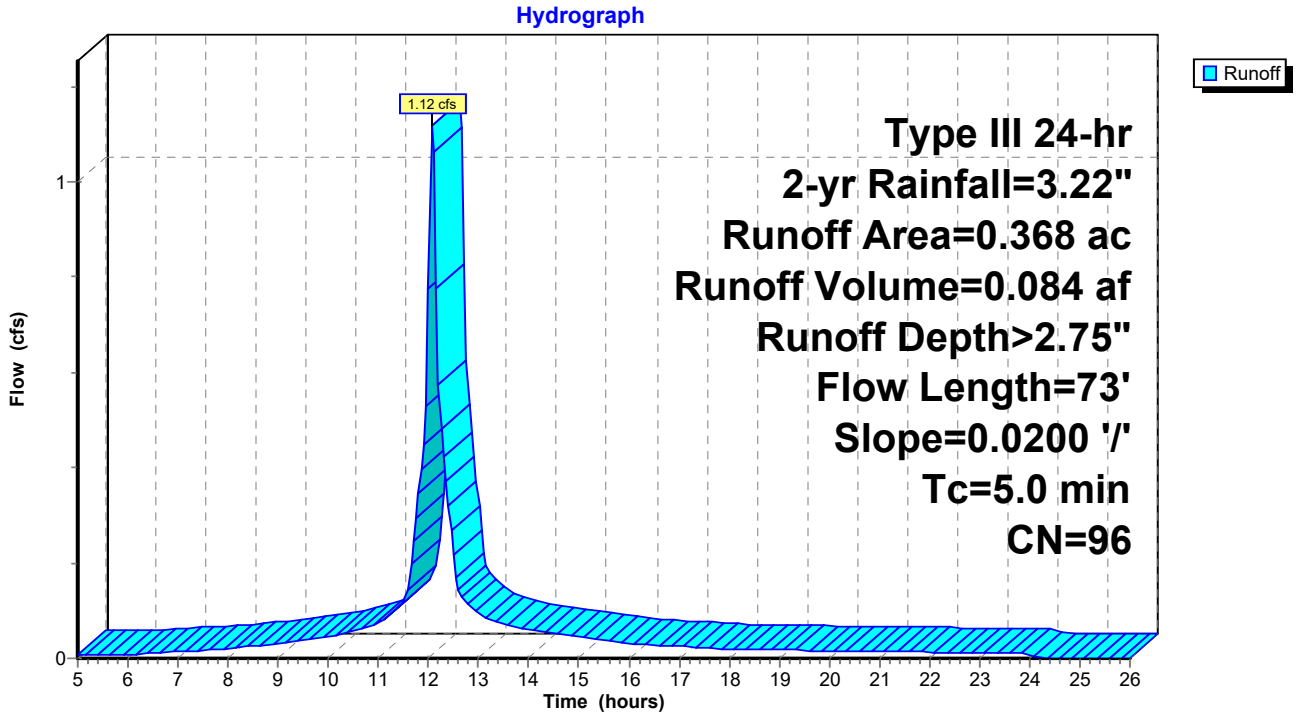
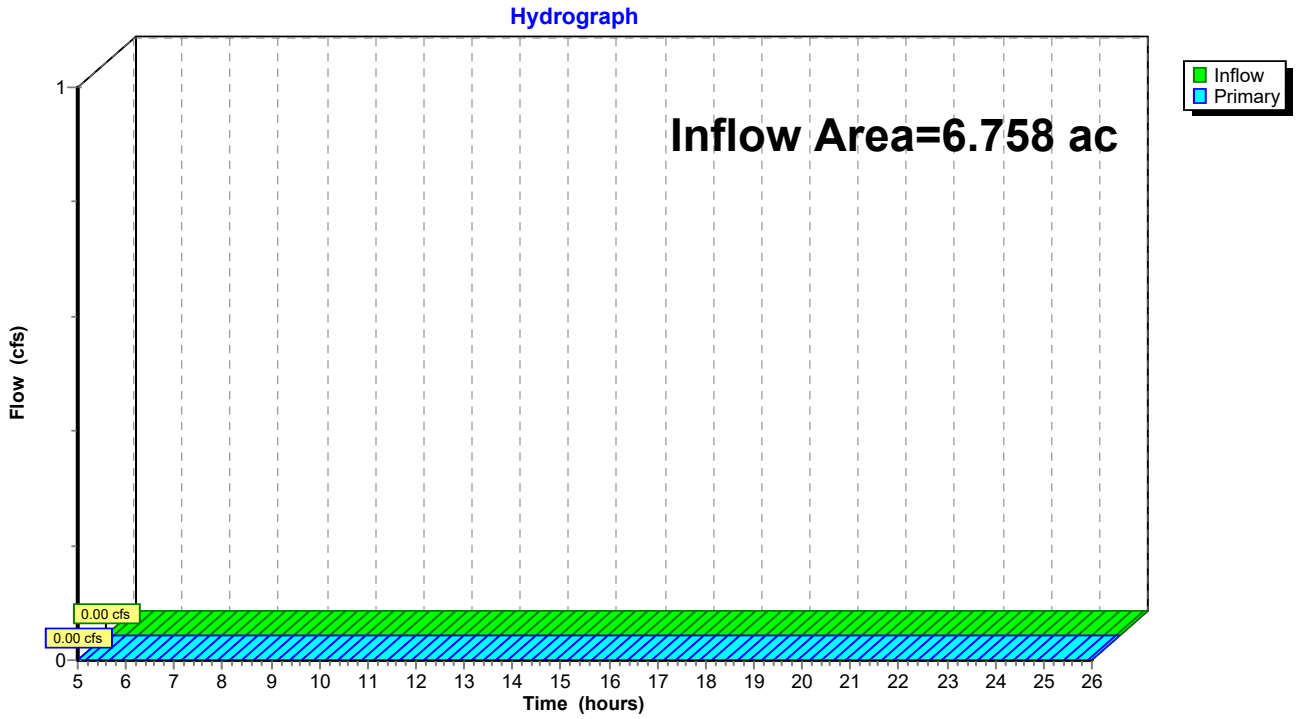


Link 1L: Design Point A



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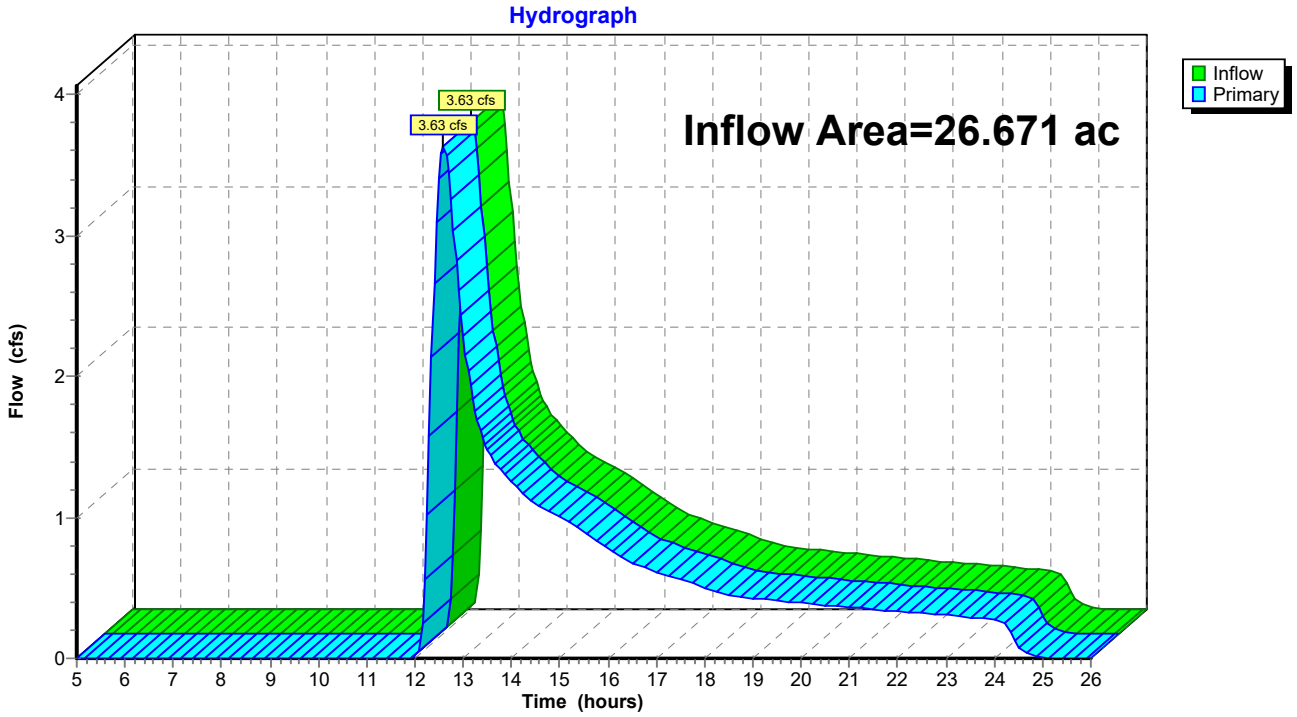
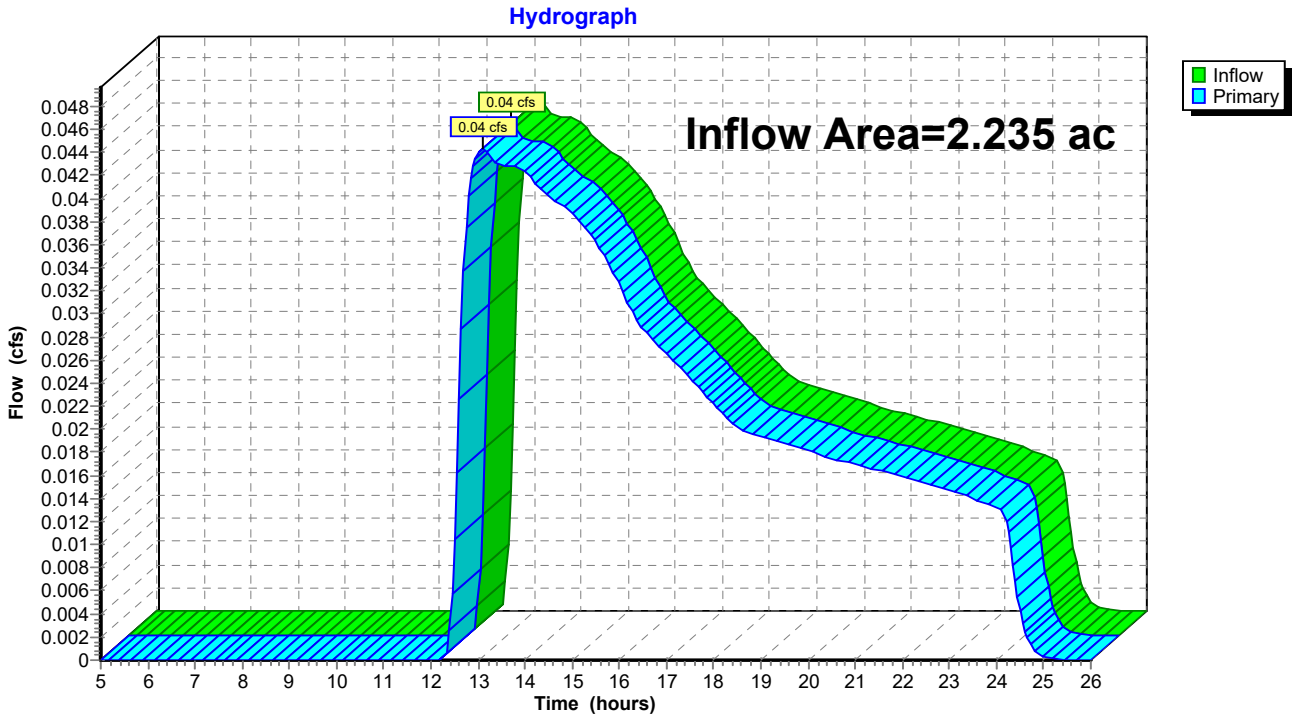


Link 3L: Design Point C



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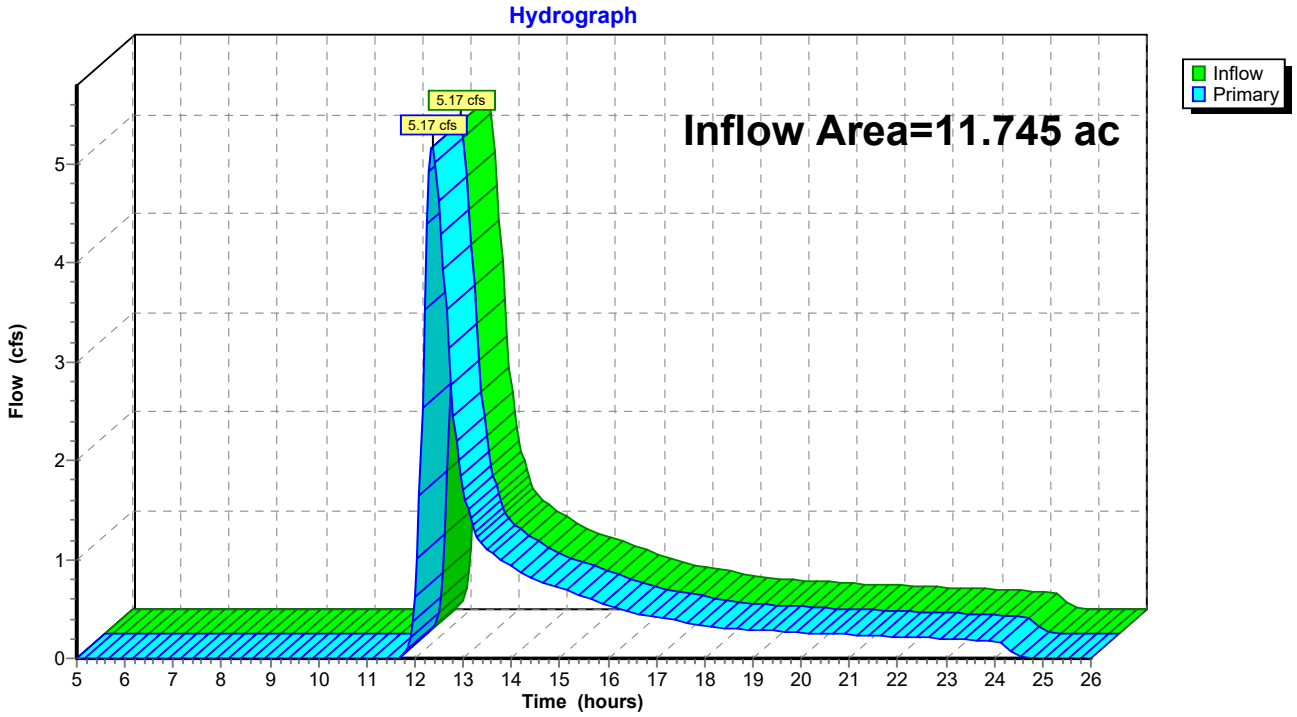

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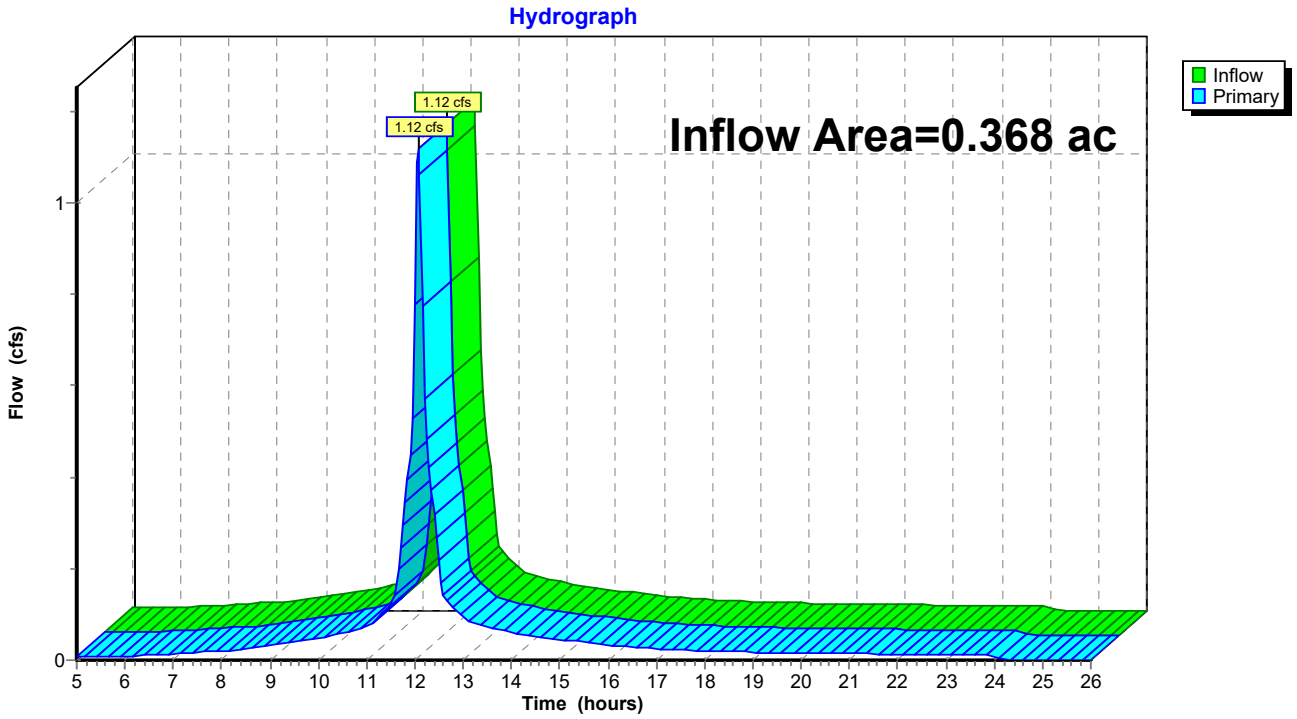
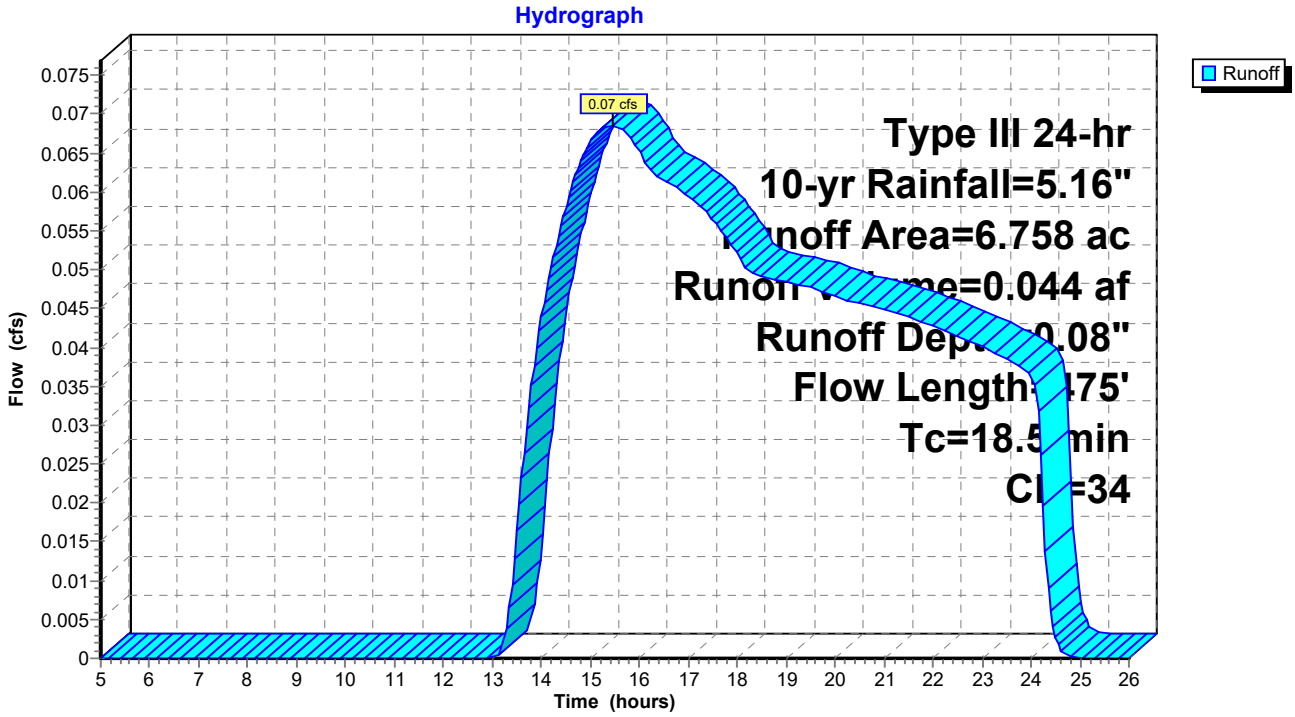


Subcatchment A: EX-WS A



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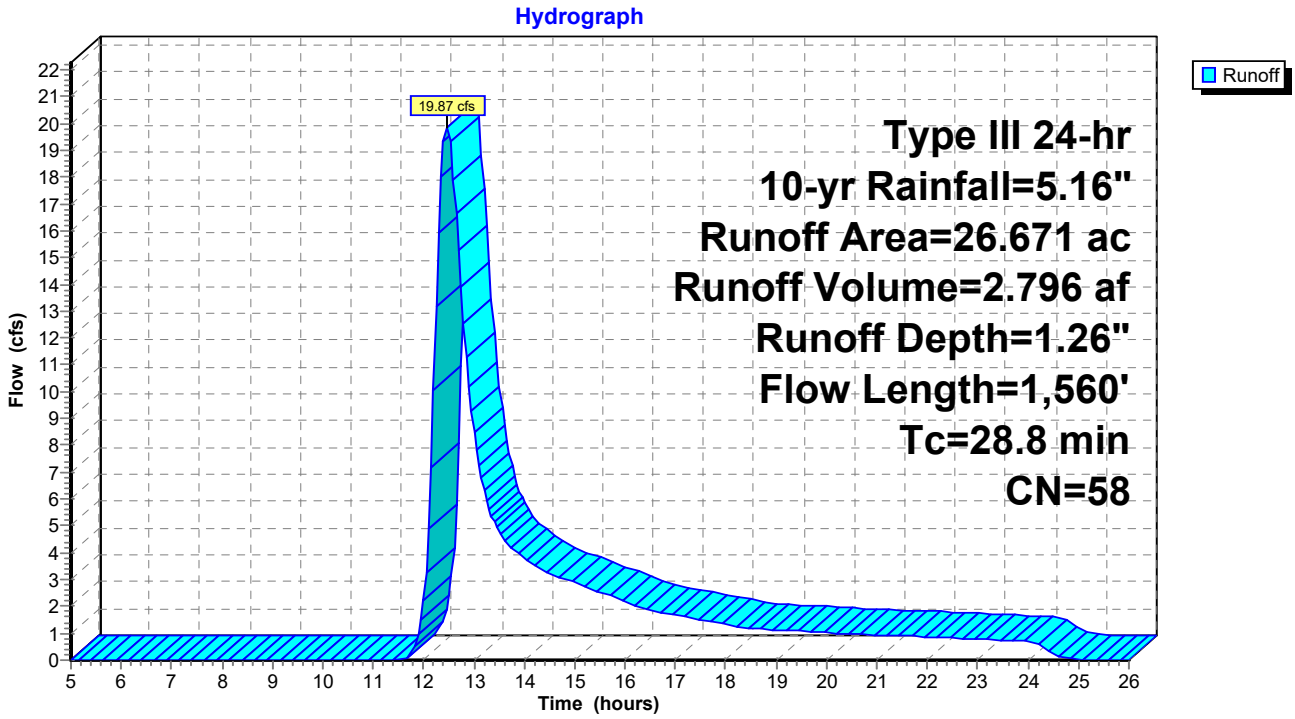
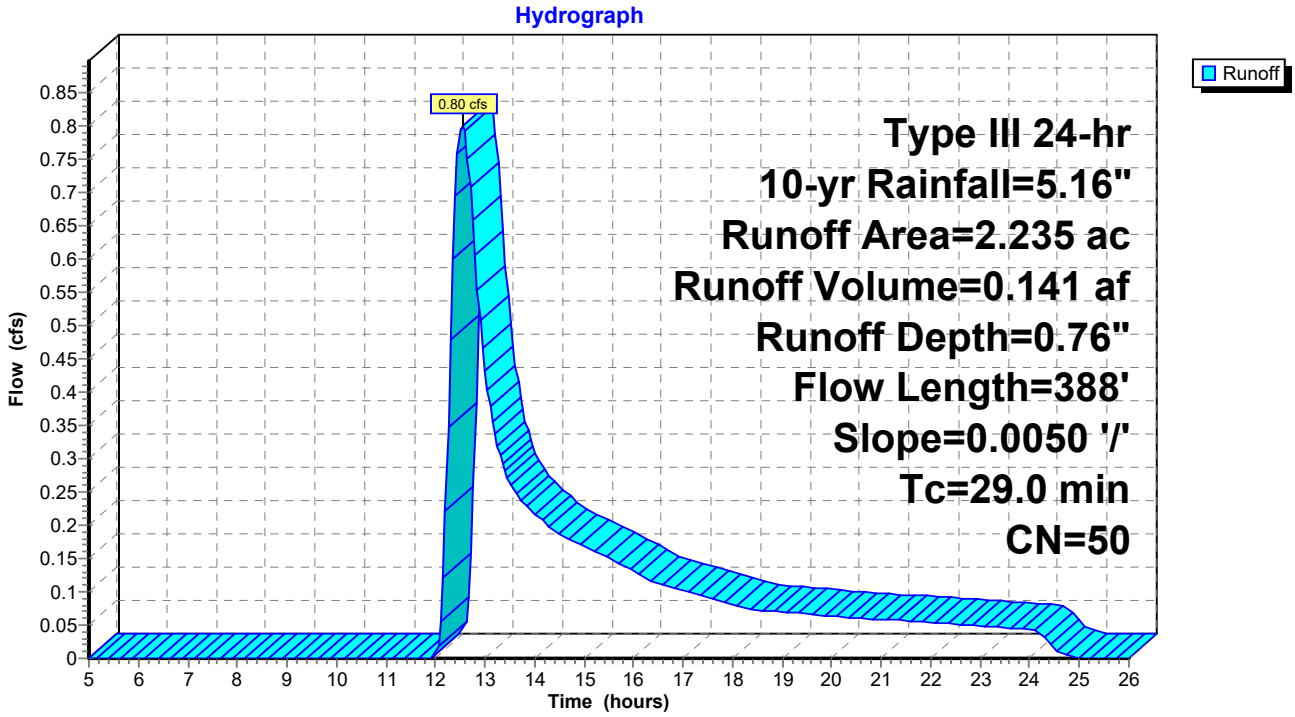
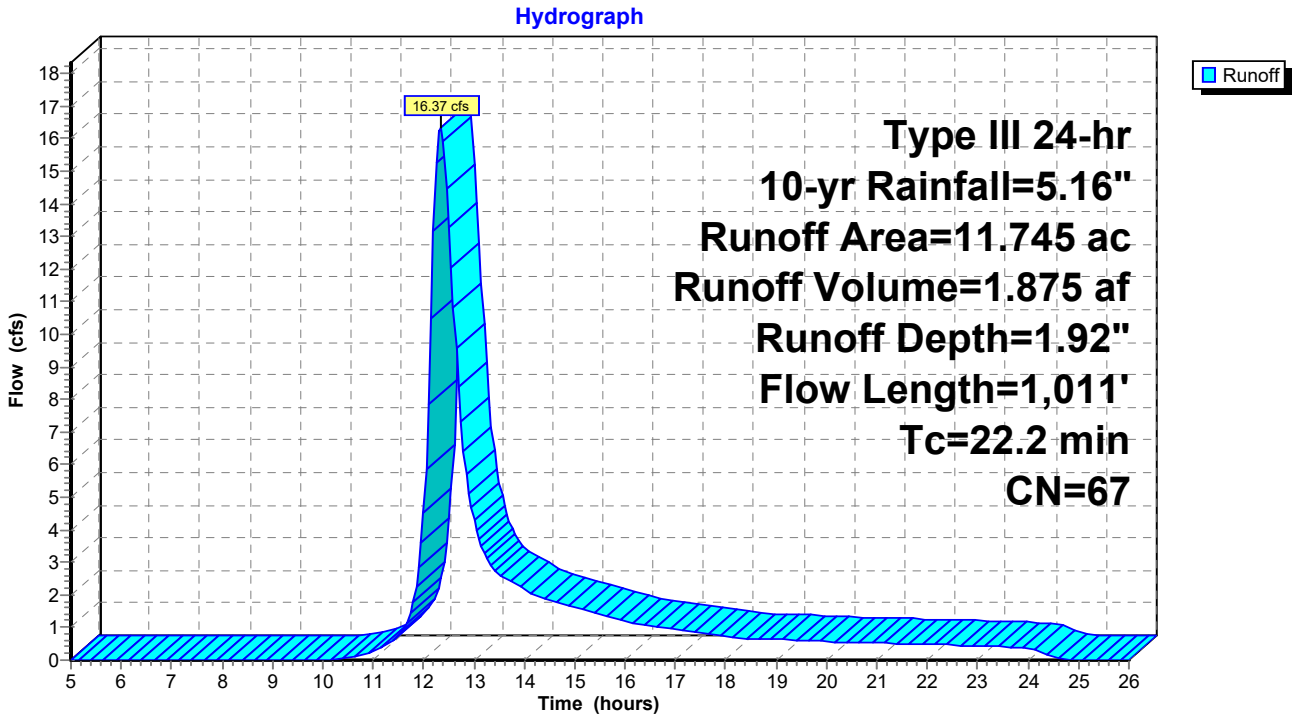


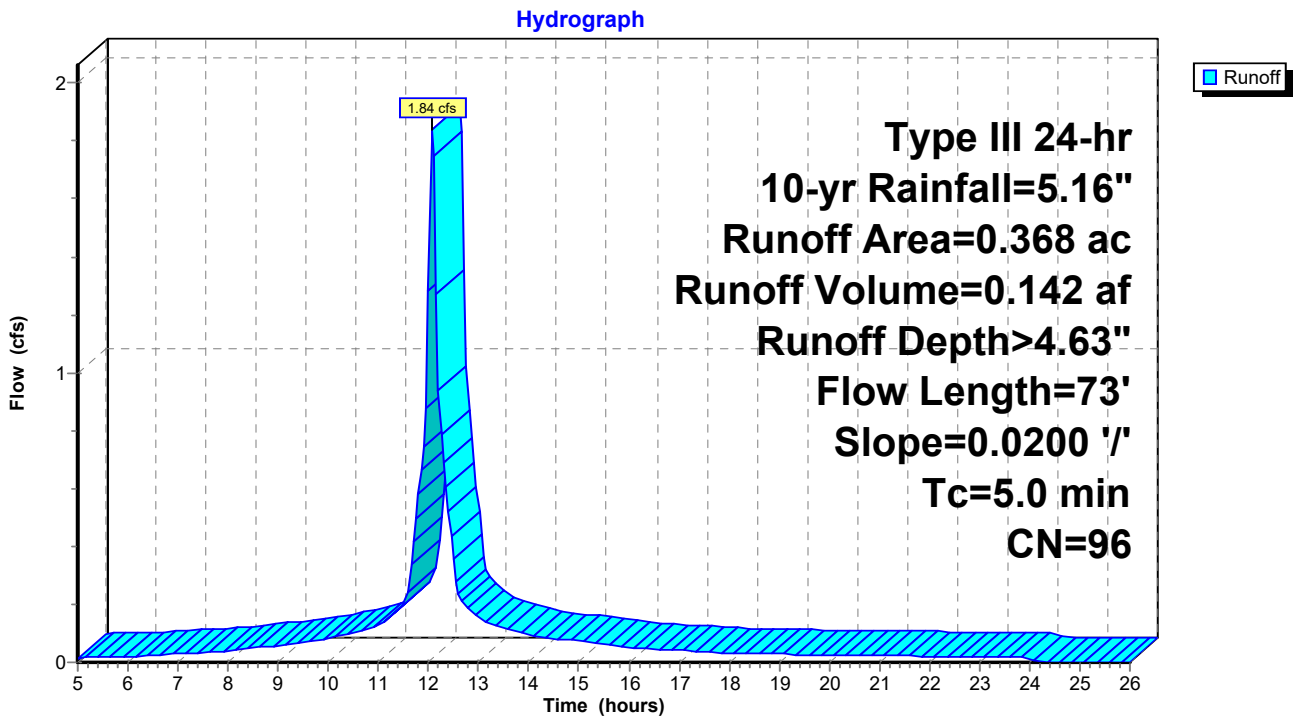
Subcatchment C: EX WS C



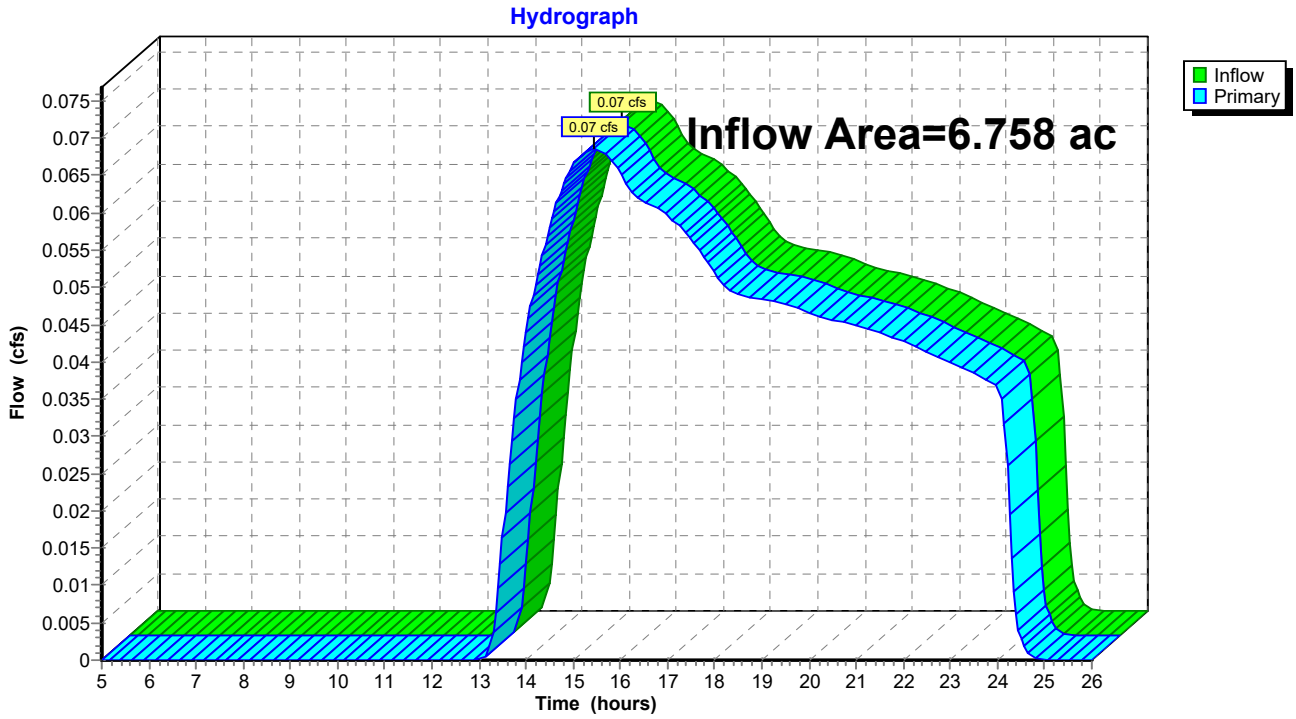
Subcatchment D: EX WS D



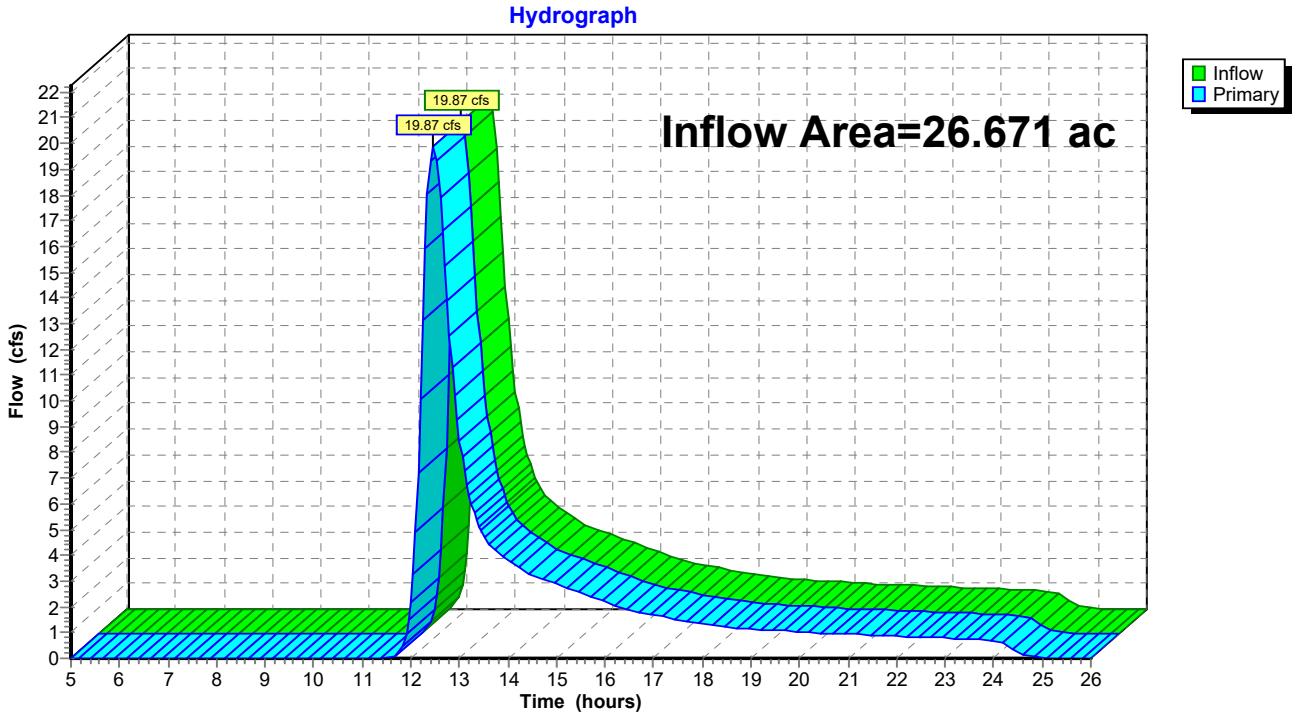
Subcatchment E: EX WS E



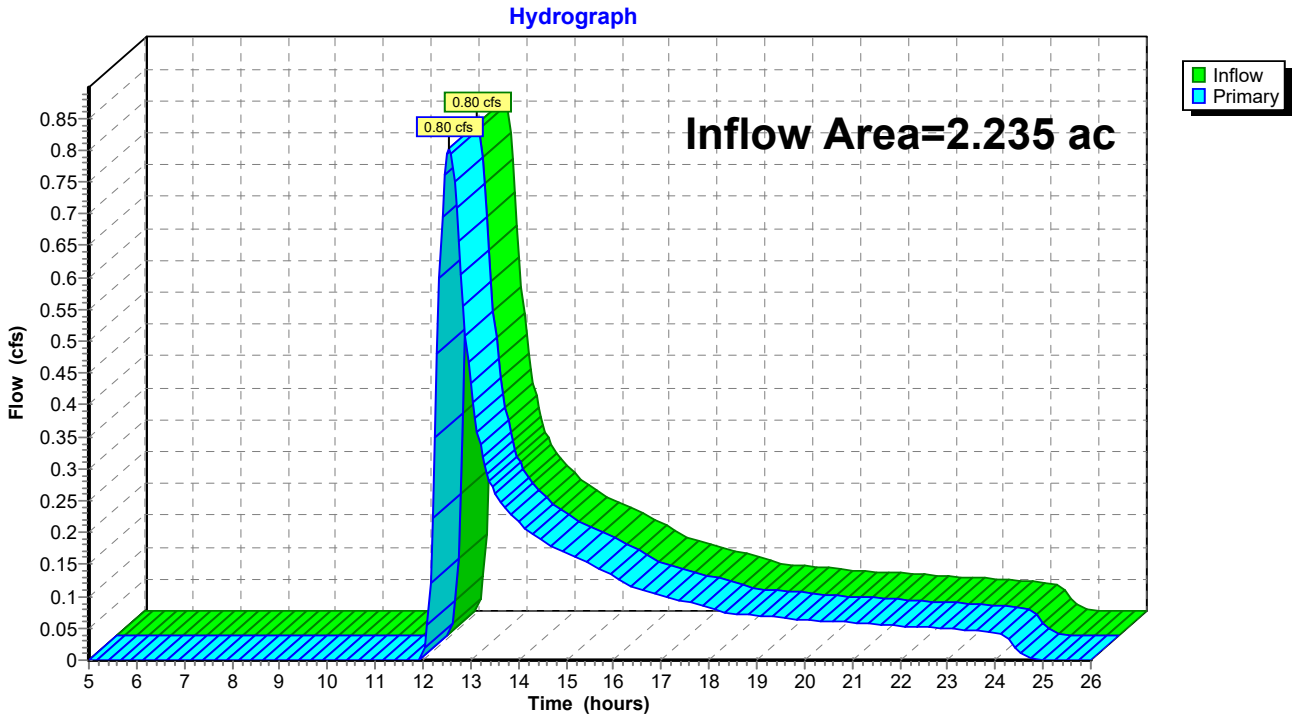
Link 1L: Design Point A



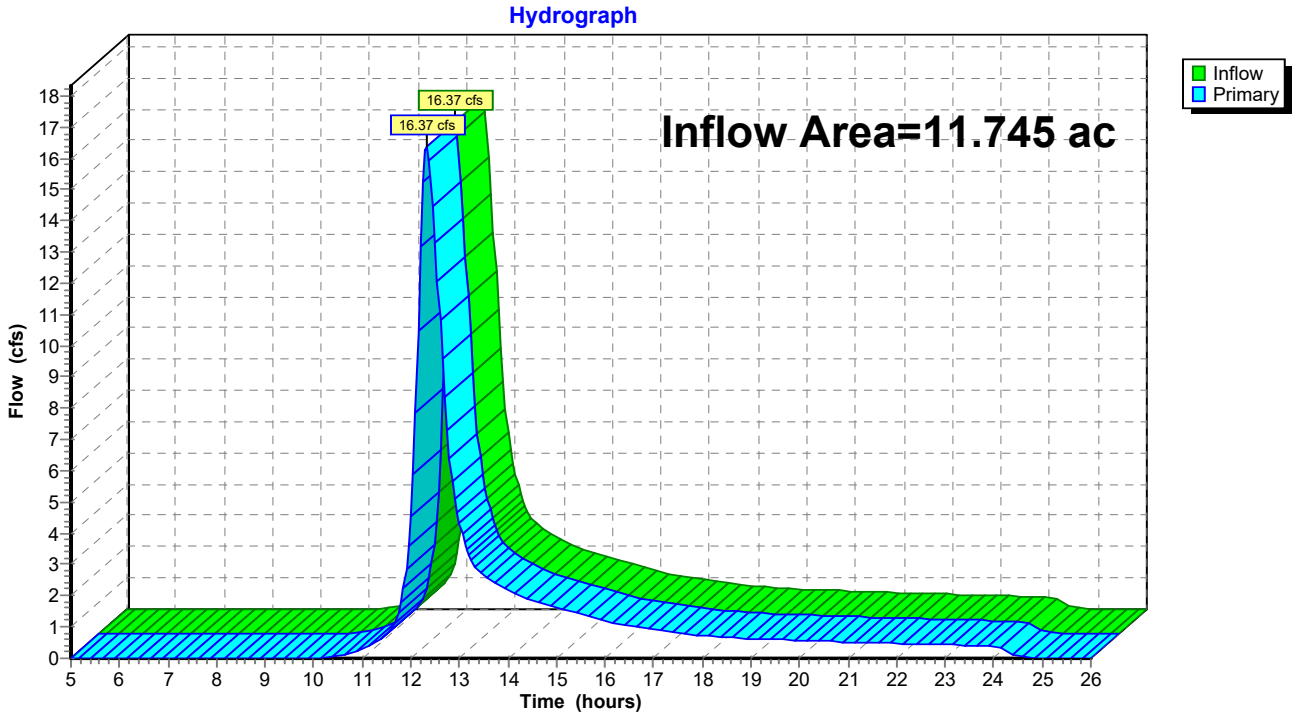
Link 2L: Design Point B



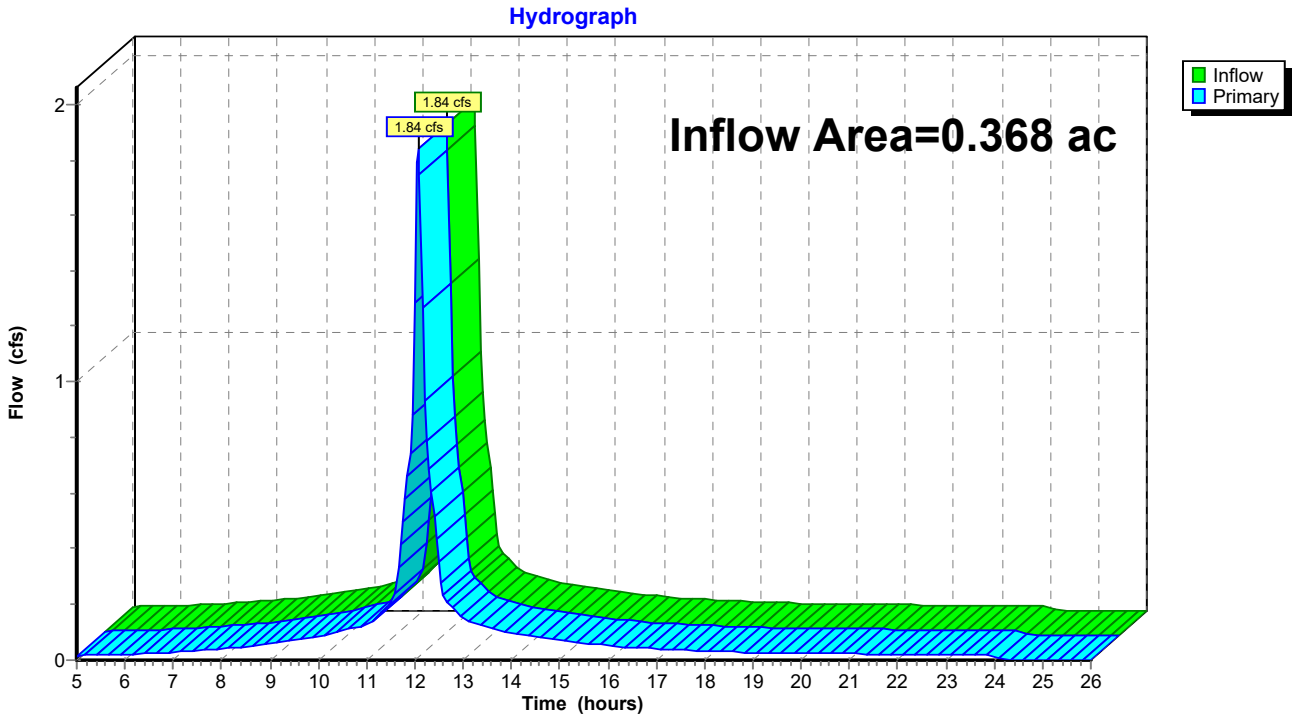
Link 3L: Design Point C



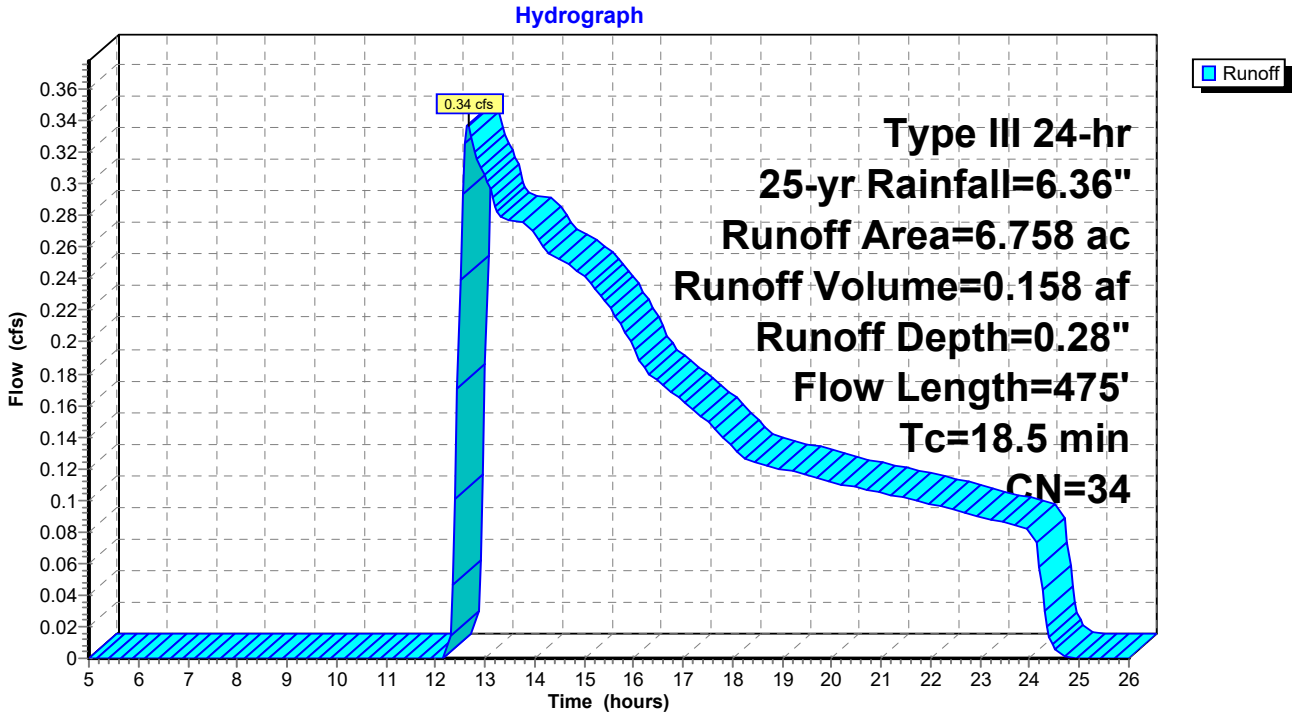
Link 4L: Design Point D



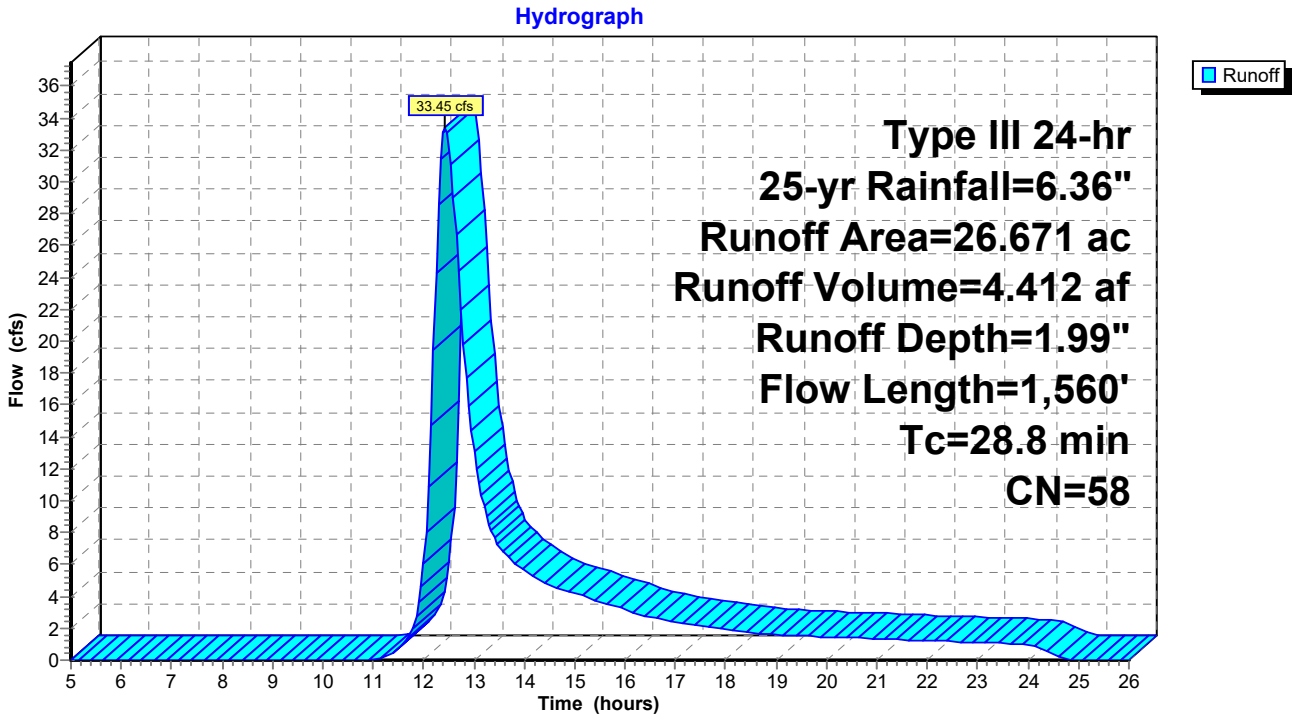
Link 5L: Design Point E



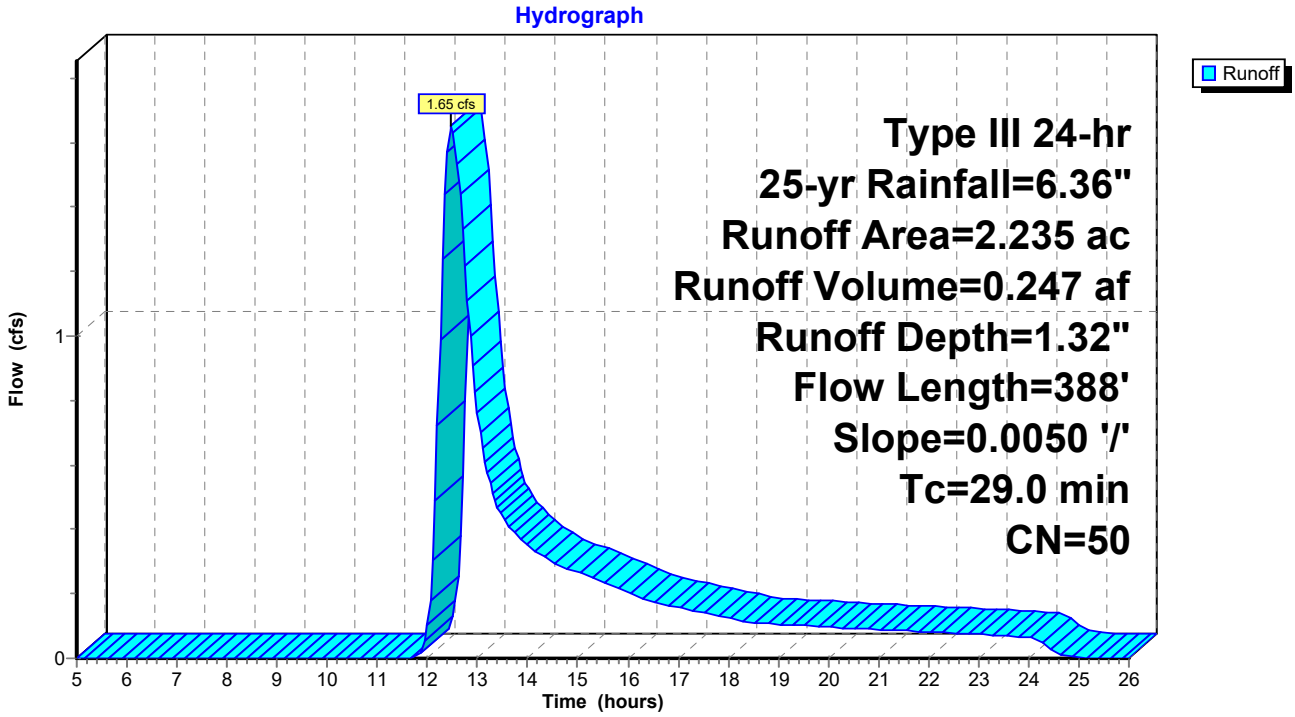
Subcatchment A: EX-WS A



Subcatchment B: EX WS B



Subcatchment C: EX WS C



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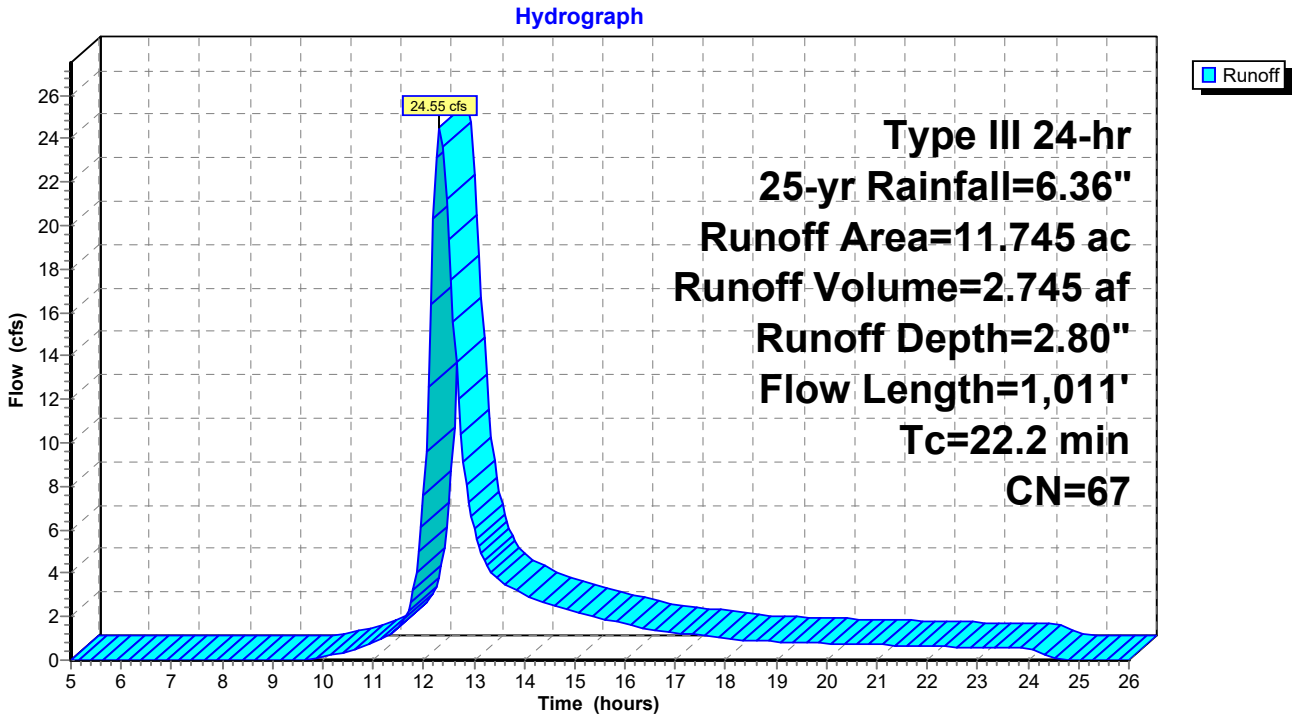

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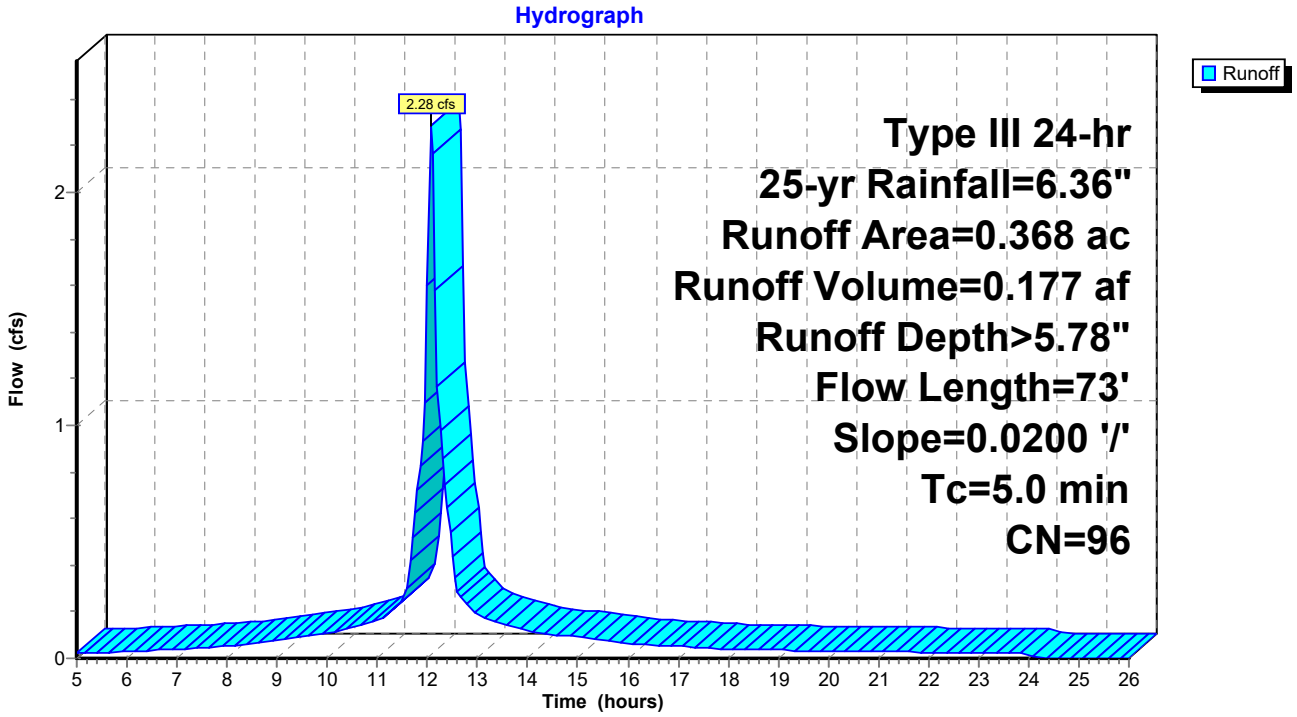
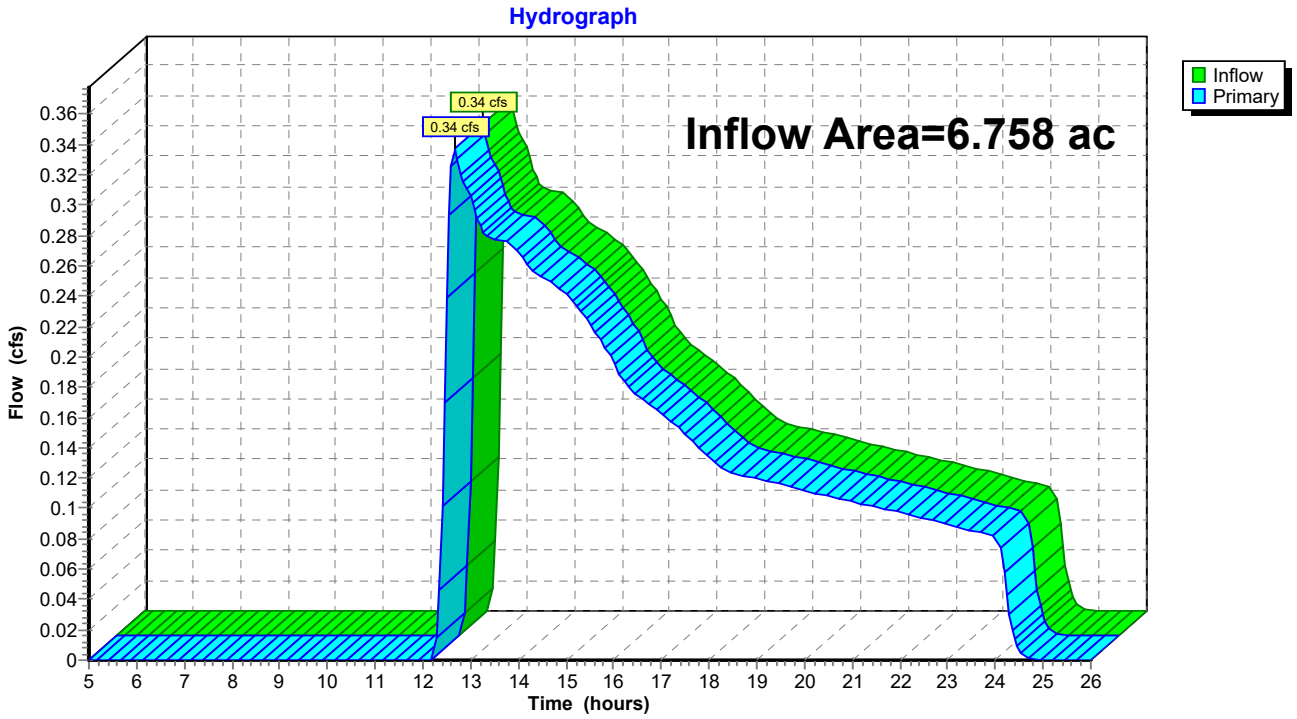


Link 1L: Design Point A



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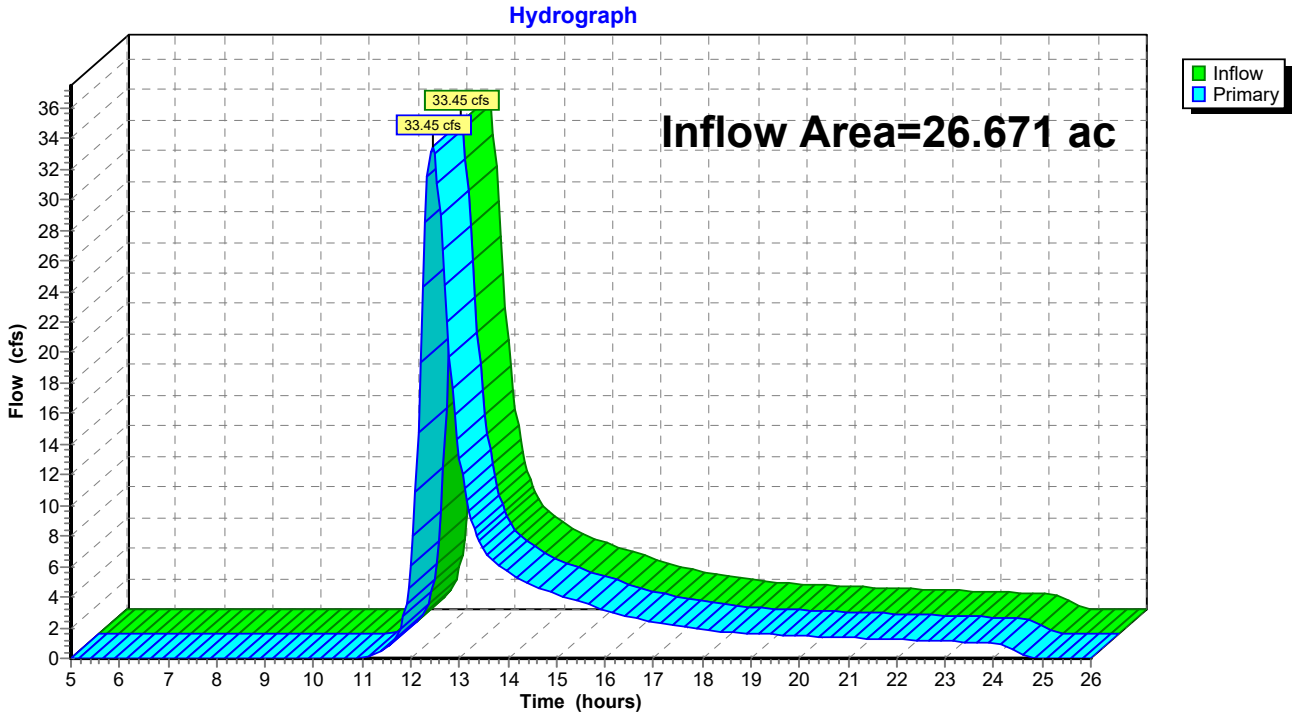
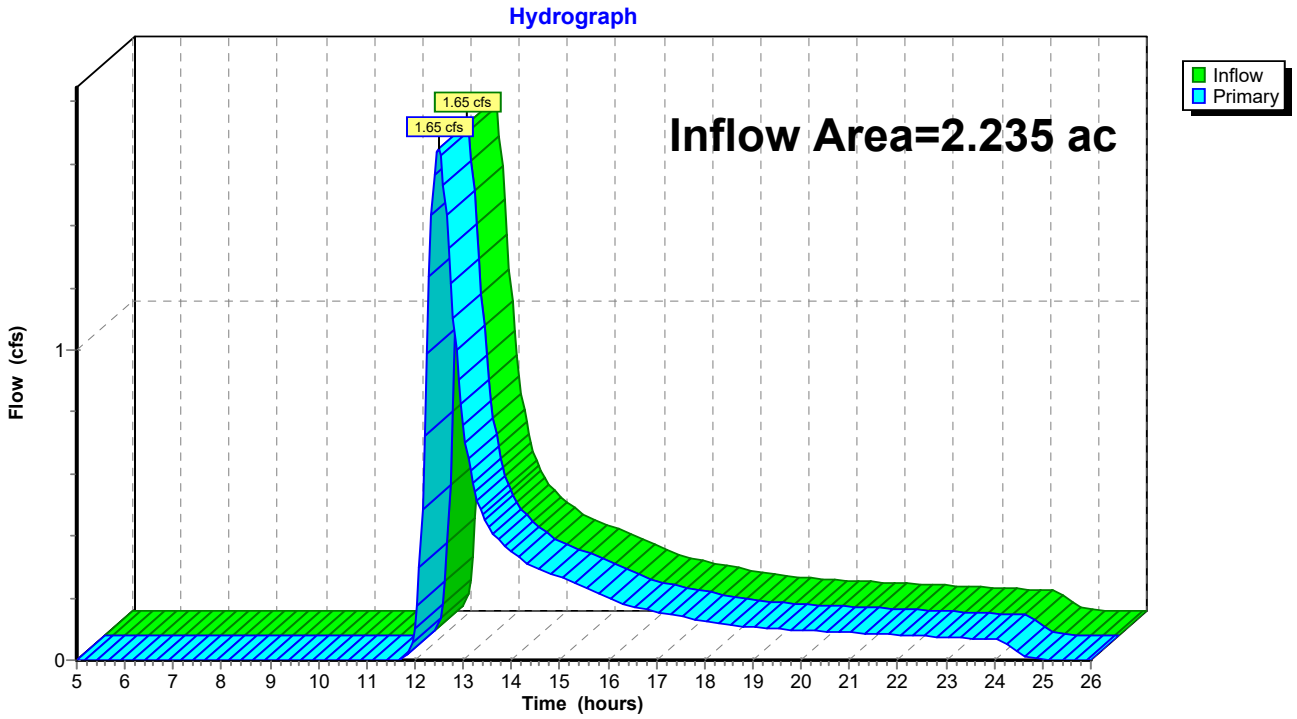
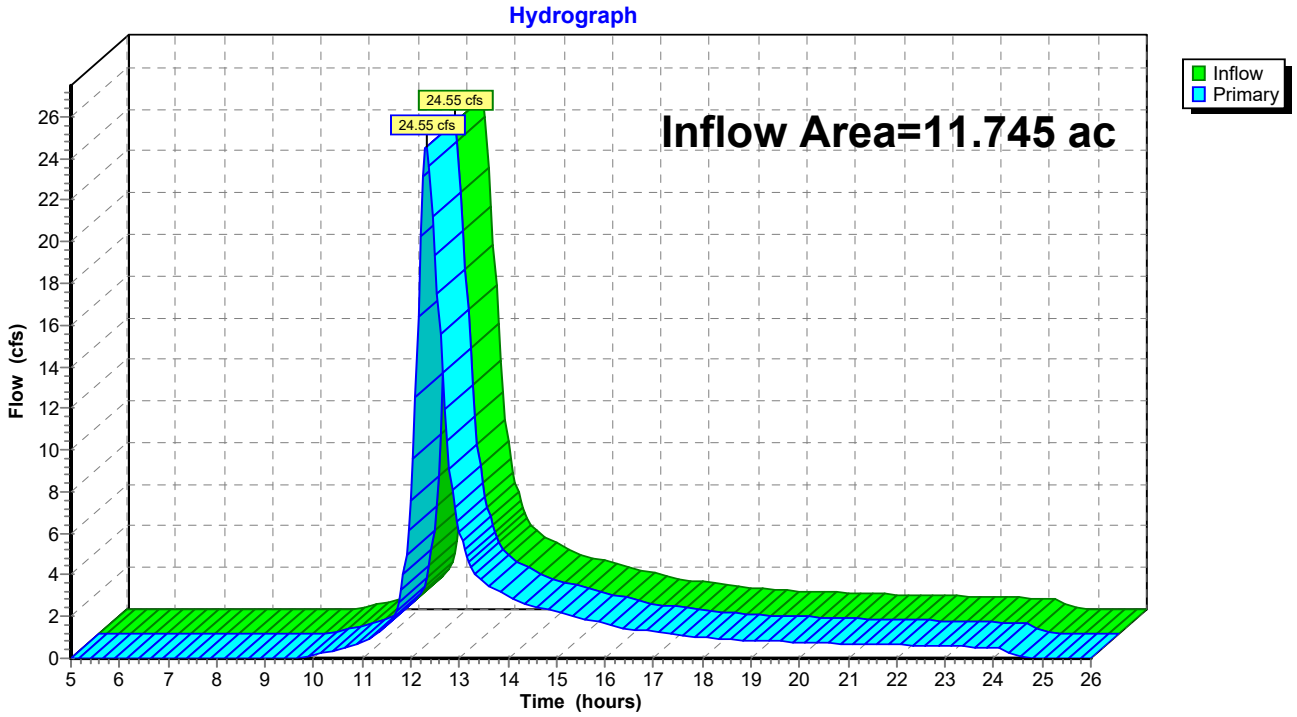


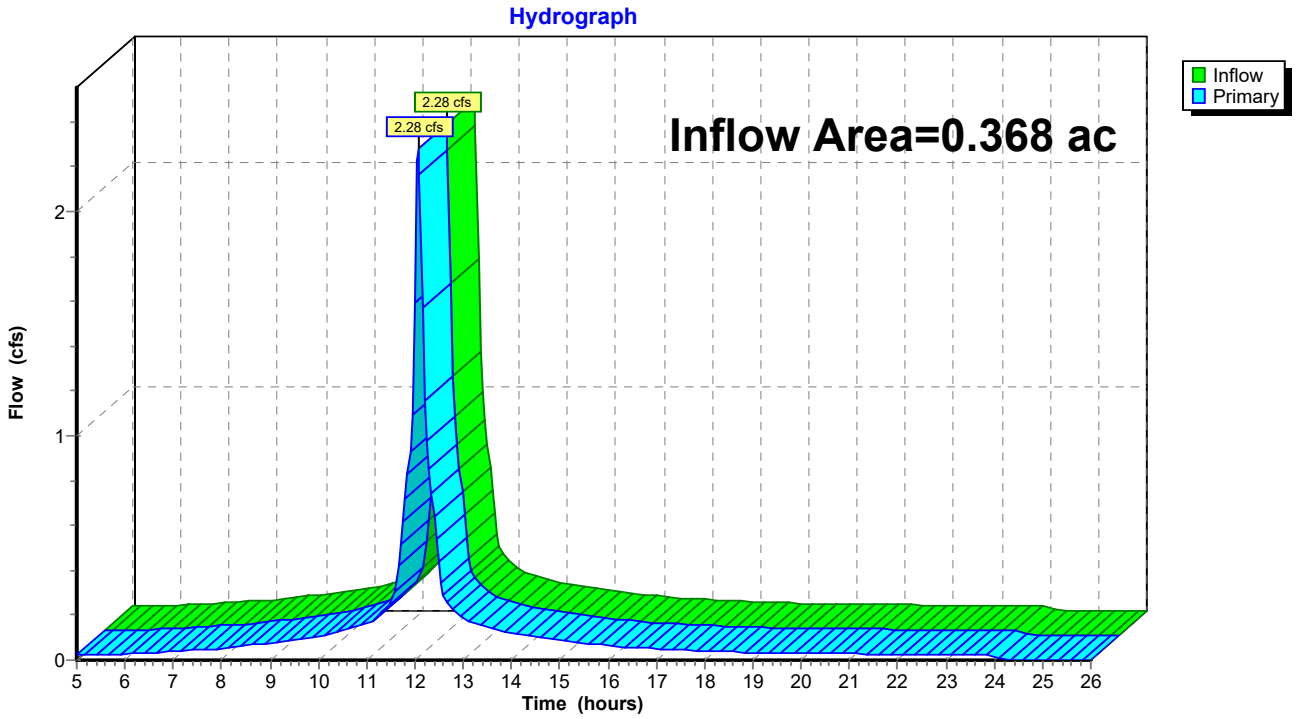
Link 3L: Design Point C



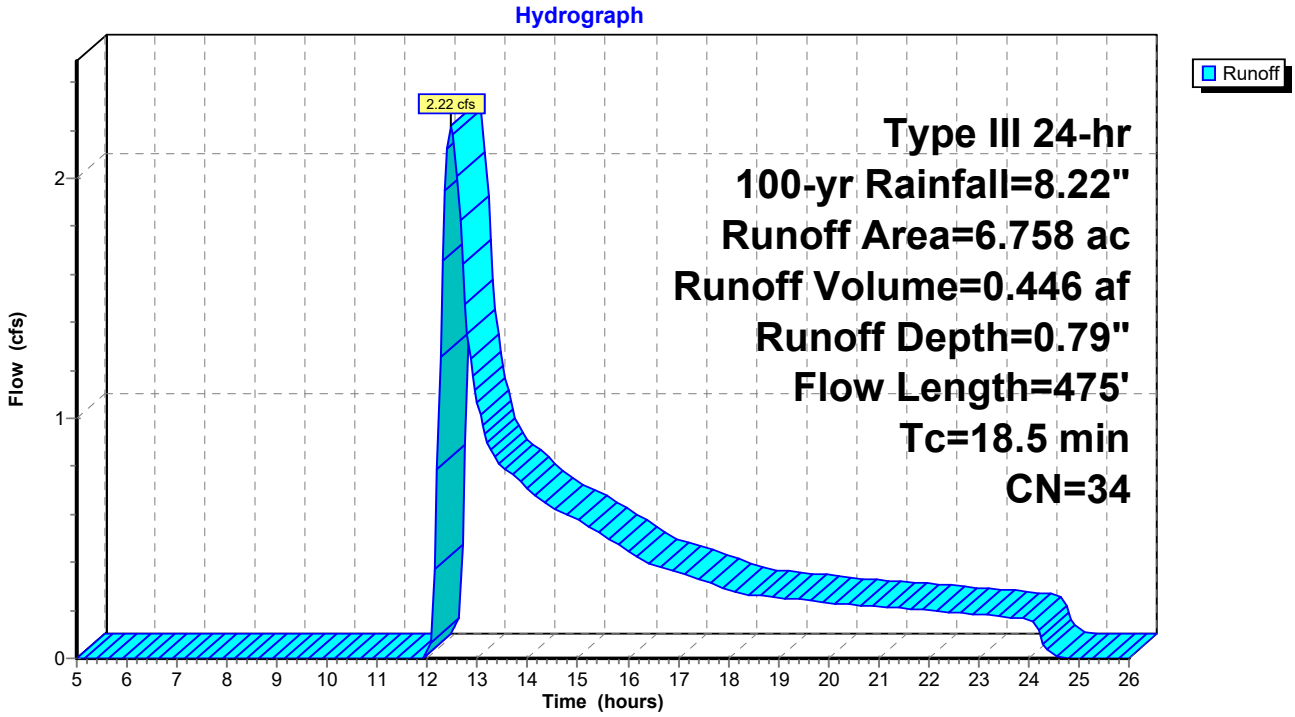
Link 4L: Design Point D



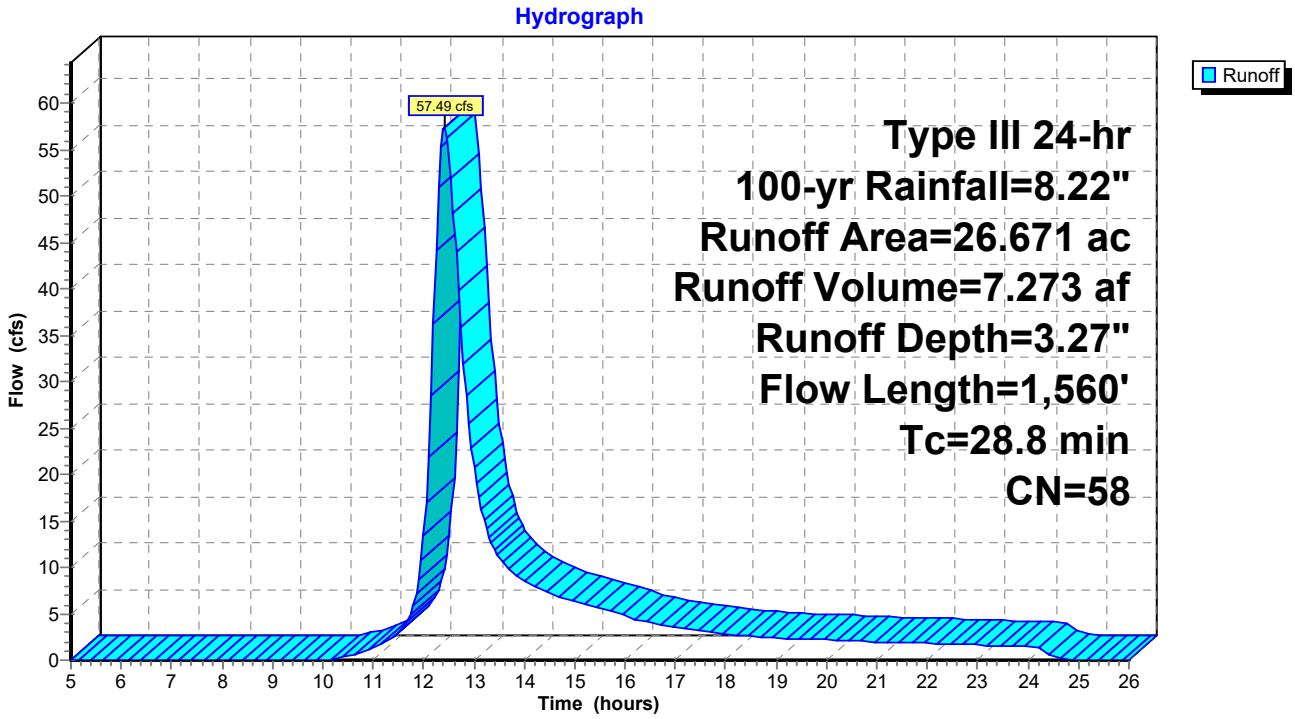
Link 5L: Design Point E



Subcatchment A: EX-WS A



Subcatchment B: EX WS B



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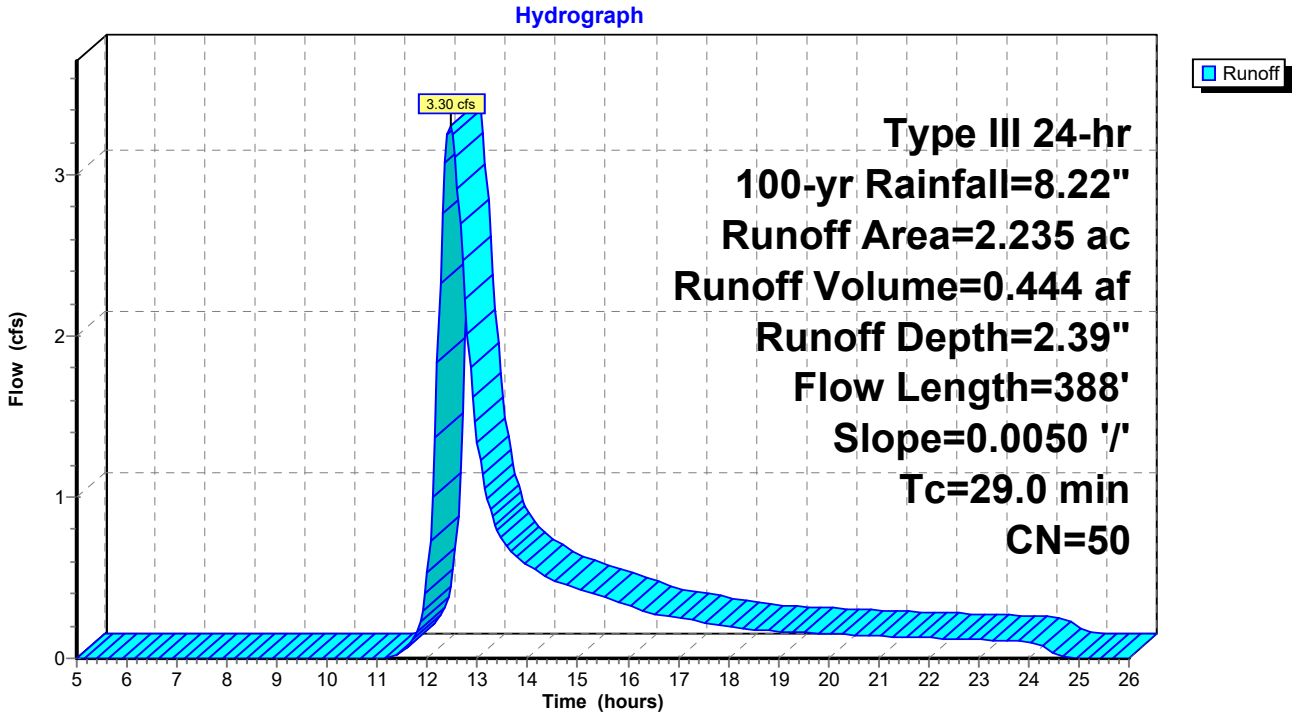

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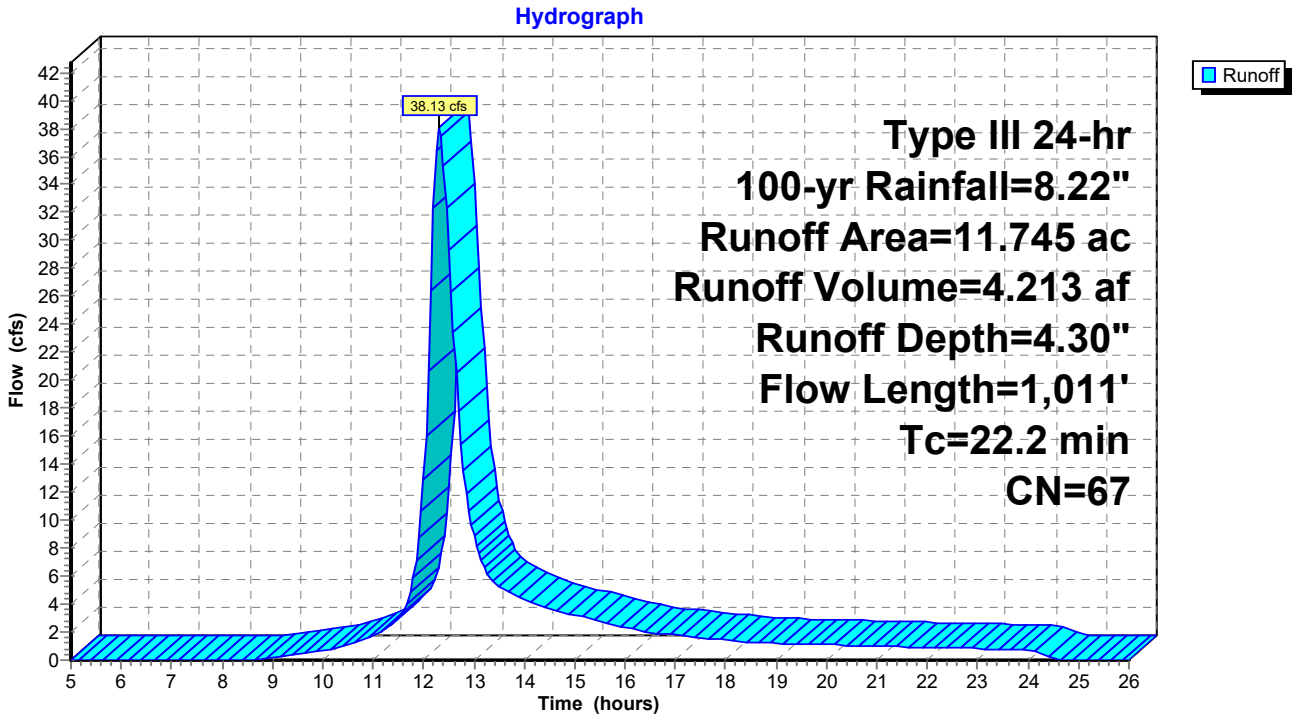
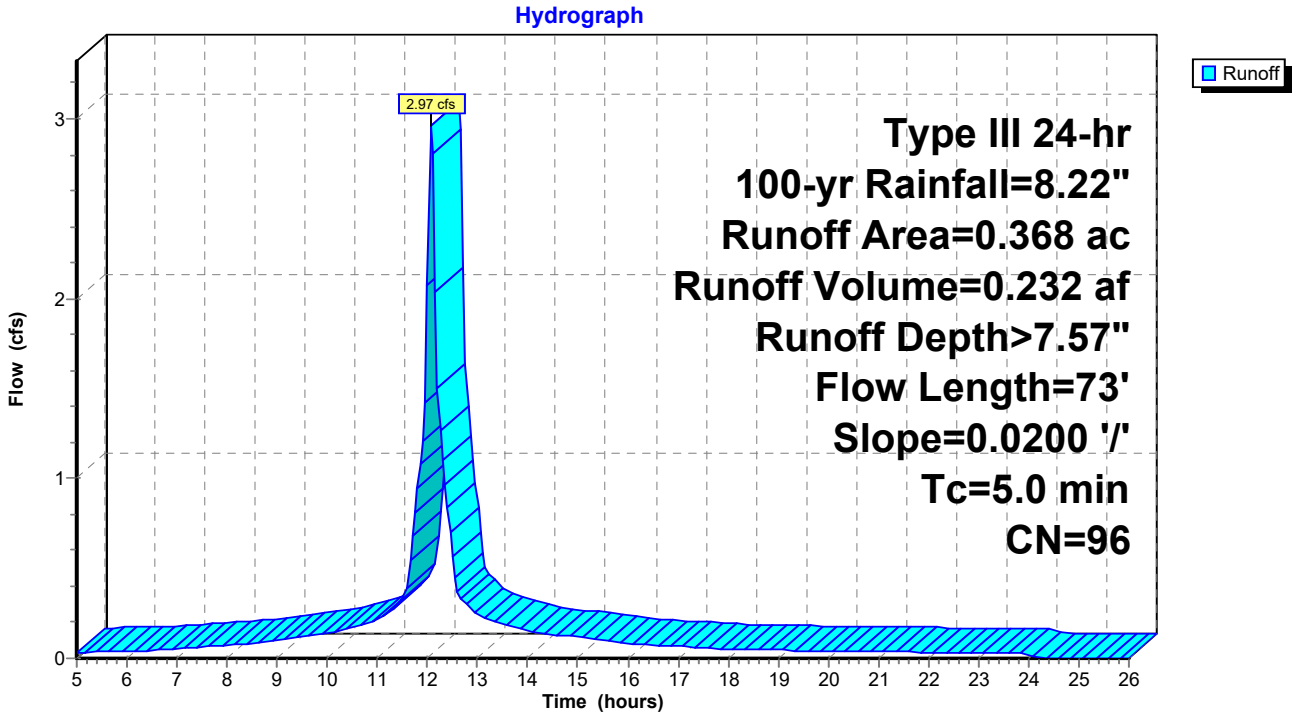
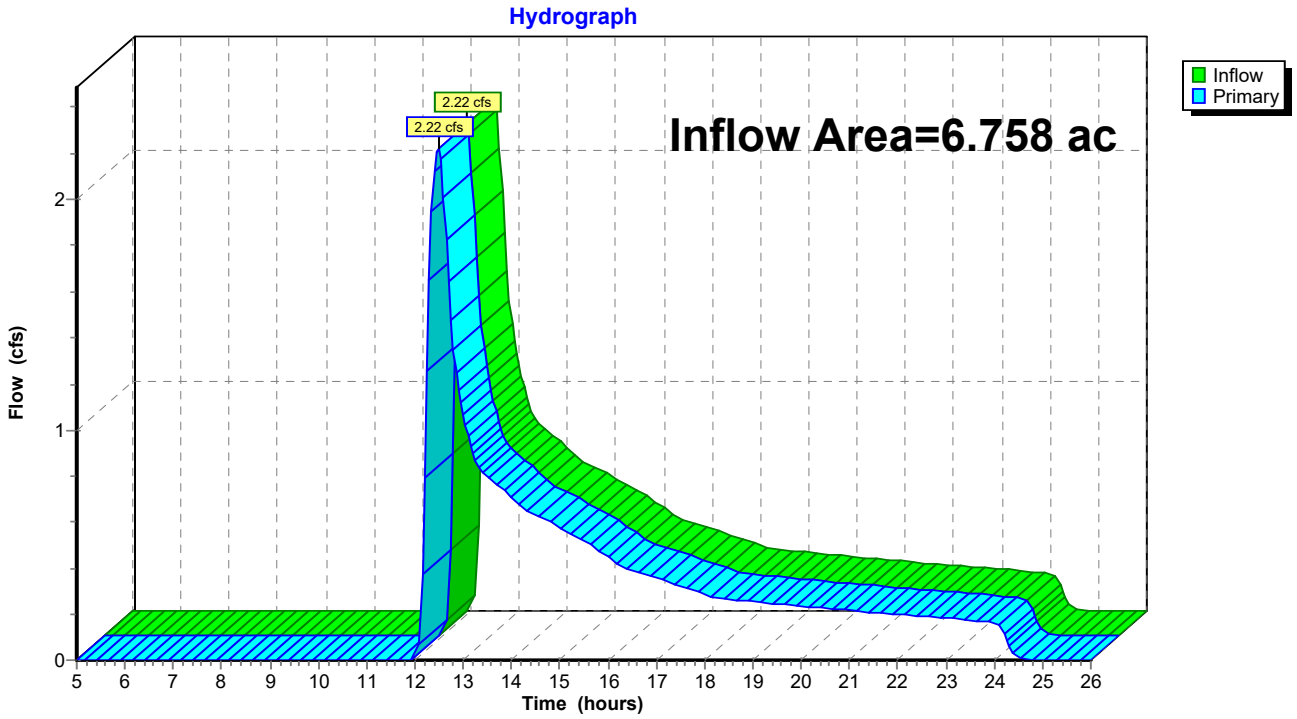


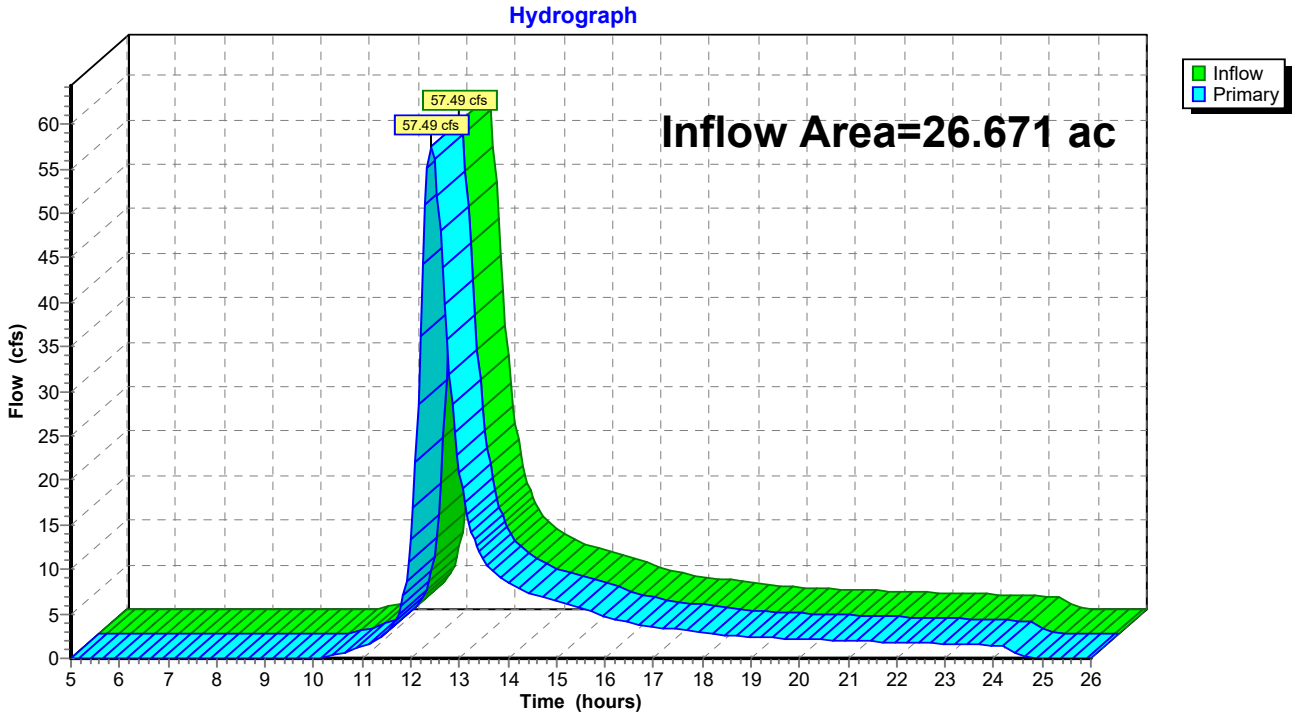
Subcatchment E: EX WS E



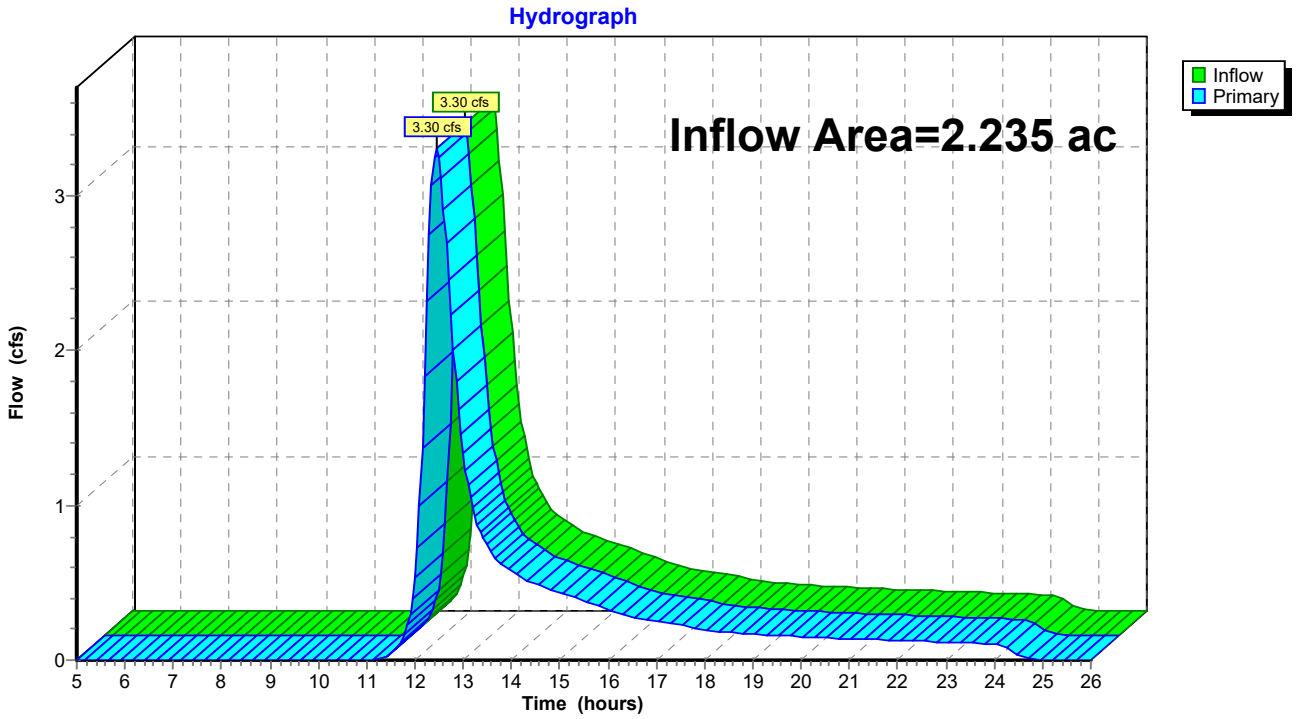
Link 1L: Design Point A



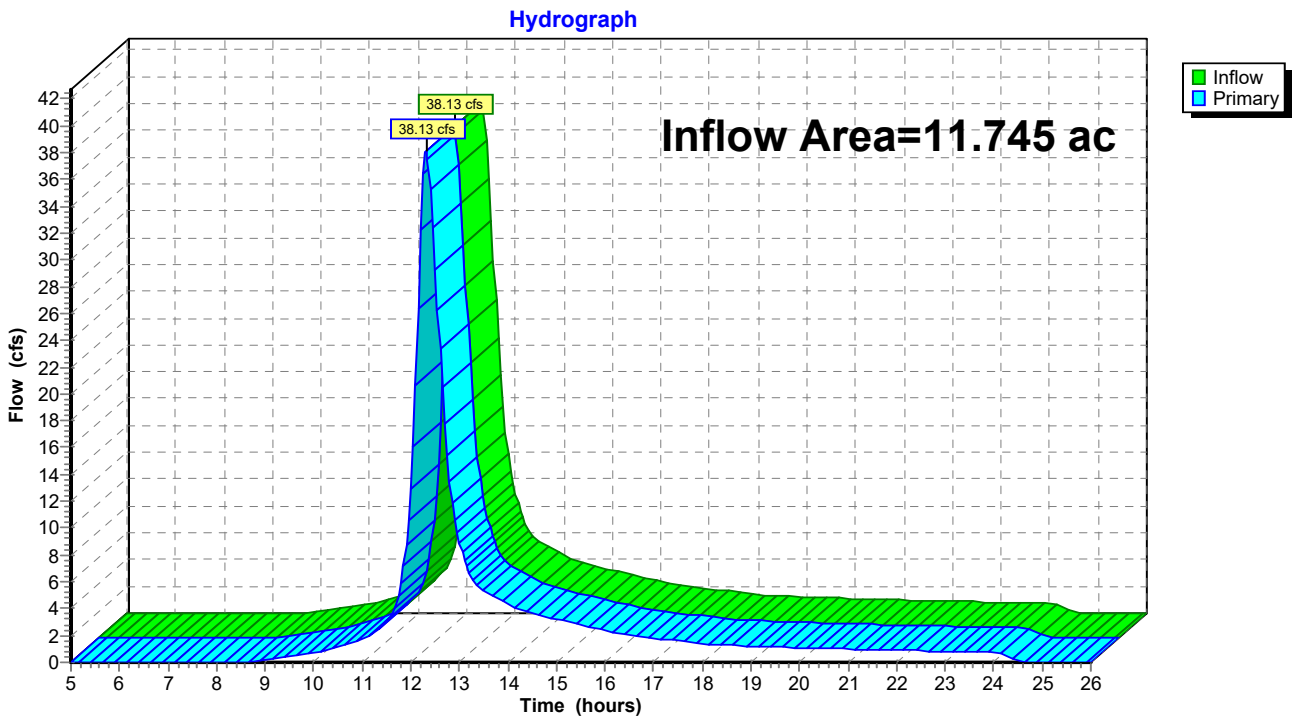
Link 2L: Design Point B



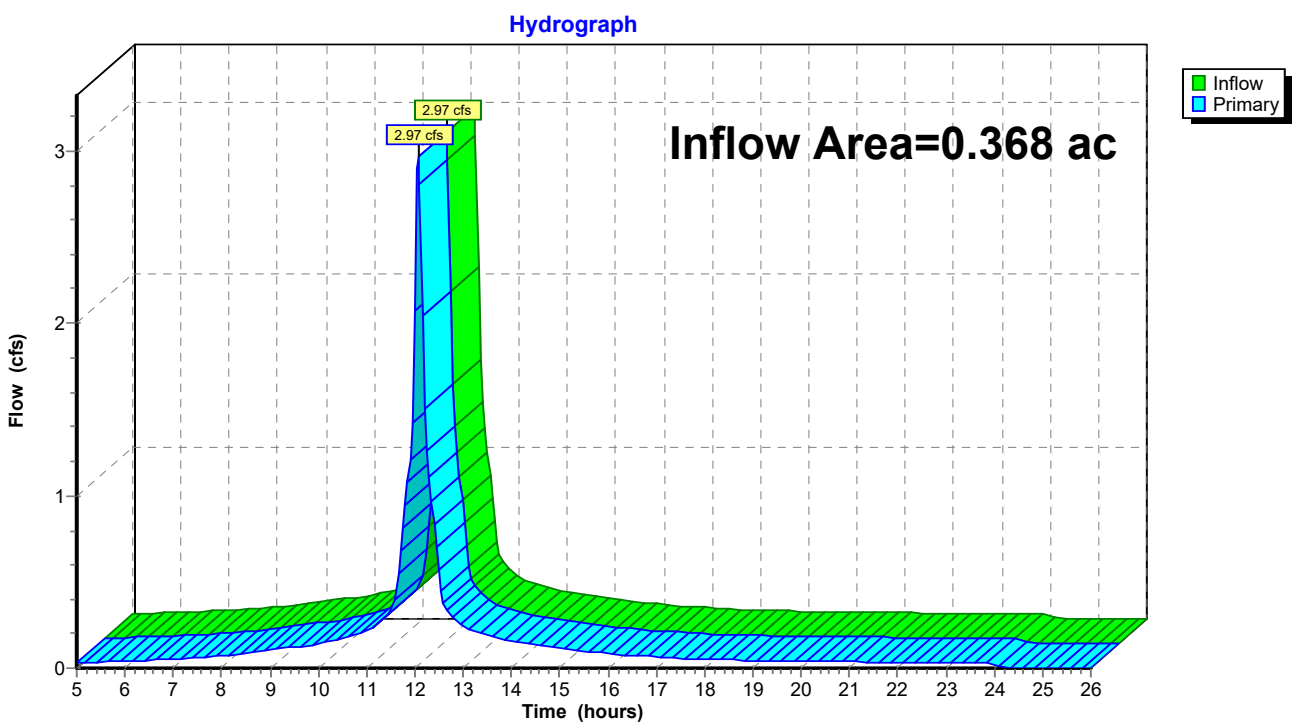
Link 3L: Design Point C



Link 4L: Design Point D



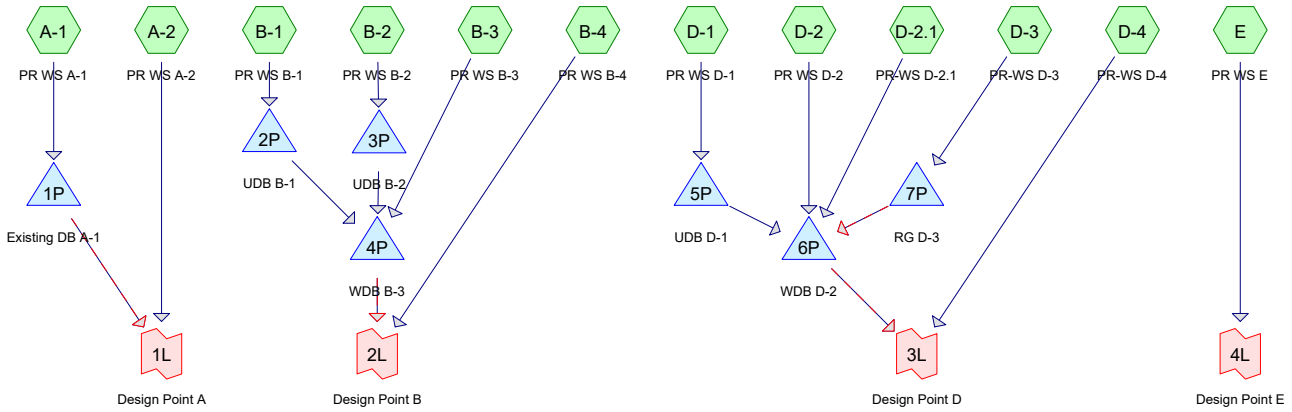
Link 5L: Design Point E

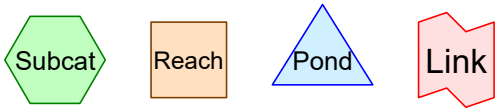


APPENDIX B

Proposed Stormwater Discharge Calculations

LANGAN





Routing Diagram for 116 West Dudley Town Road Proposed Hydrology
Prepared by Langan Engineering, Printed 12/7/2022
HydroCAD® 10.20-2f s/n 08223 © 2022 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.070	79	<50% Grass cover, Poor, HSG B (D-1)
4.830	39	>75% Grass cover, Good, HSG A (A-1, D-1)
2.660	61	>75% Grass cover, Good, HSG B (A-1, D-1, D-2.1)
5.490	74	>75% Grass cover, Good, HSG C (A-1, B-3, B-4, D-1, D-2, D-2.1, D-3, D-4, E)
0.960	80	>75% Grass cover, Good, HSG D (A-1, B-4, D-1, D-2.1, D-4)
0.460	58	Meadow, non-grazed, HSG B (B-4)
0.090	78	Meadow, non-grazed, HSG D (B-4)
26.660	98	Paved parking, HSG A (A-1, B-1, B-2, D-1, D-2, D-3, D-4, E)
1.940	98	Paved parking, HSG C (B-3)
2.320	30	Woods, Good, HSG A (A-1, A-2, B-4, E)
0.520	55	Woods, Good, HSG B (A-1, A-2, B-4, D-1)
0.860	70	Woods, Good, HSG C (B-3, B-4, D-4, E)
1.580	77	Woods, Good, HSG D (A-2, B-4, D-4)
48.440	**82**	**TOTAL AREA**

Time span=2.00-48.00 hrs, dt=0.05 hrs, 921 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentA-1: PR WS A-1 Runoff Area=13.170 ac 59.91% Impervious Runoff Depth=1.23"
Flow Length=431' Tc=5.0 min CN=77 Runoff=18.52 cfs 1.346 af

SubcatchmentA-2: PR WS A-2 Runoff Area=1.810 ac 0.00% Impervious Runoff Depth=0.00"
Flow Length=77' Slope=0.2180 '/' Tc=11.6 min CN=37 Runoff=0.00 cfs 0.000 af

SubcatchmentB-1: PR WS B-1 Runoff Area=5.900 ac 100.00% Impervious Runoff Depth>2.99"
Flow Length=100' Slope=1.0000 '/' Tc=5.0 min CN=98 Runoff=18.56 cfs 1.468 af

SubcatchmentB-2: PR WS B-2 Runoff Area=6.100 ac 100.00% Impervious Runoff Depth>2.99"
Flow Length=100' Slope=1.0000 '/' Tc=5.0 min CN=98 Runoff=19.19 cfs 1.518 af

SubcatchmentB-3: PR WS B-3 Runoff Area=3.960 ac 48.99% Impervious Runoff Depth=1.85"
Flow Length=192' Tc=5.0 min CN=86 Runoff=8.60 cfs 0.611 af

SubcatchmentB-4: PR WS B-4 Runoff Area=3.250 ac 0.00% Impervious Runoff Depth=0.65"
Flow Length=173' Tc=30.0 min CN=66 Runoff=1.16 cfs 0.177 af

SubcatchmentD-1: PR WS D-1 Runoff Area=8.440 ac 64.93% Impervious Runoff Depth=1.55"
Flow Length=210' Tc=5.0 min CN=82 Runoff=15.35 cfs 1.093 af

SubcatchmentD-2: PR WS D-2 Runoff Area=2.460 ac 28.86% Impervious Runoff Depth=1.48"
Flow Length=259' Tc=10.9 min CN=81 Runoff=3.58 cfs 0.304 af

SubcatchmentD-2.1: PR-WS D-2.1 Runoff Area=1.260 ac 0.00% Impervious Runoff Depth=0.61"
Flow Length=148' Tc=9.8 min CN=65 Runoff=0.61 cfs 0.064 af

SubcatchmentD-3: PR-WS D-3 Runoff Area=0.830 ac 43.37% Impervious Runoff Depth=1.70"
Flow Length=265' Tc=5.0 min CN=84 Runoff=1.65 cfs 0.118 af

SubcatchmentD-4: PR-WS D-4 Runoff Area=0.950 ac 21.05% Impervious Runoff Depth=1.29"
Flow Length=74' Tc=16.1 min CN=78 Runoff=1.02 cfs 0.102 af

SubcatchmentE: PR WS E Runoff Area=0.310 ac 6.45% Impervious Runoff Depth=0.89"
Flow Length=211' Tc=45.6 min CN=71 Runoff=0.14 cfs 0.023 af

Pond 1P: Existing DB A-1 Peak Elev=137.50' Storage=22,402 cf Inflow=18.52 cfs 1.346 af
Outflow=1.88 cfs 1.346 af

Pond 2P: UDB B-1 Peak Elev=139.50' Storage=0.884 af Inflow=18.56 cfs 1.468 af
Outflow=1.81 cfs 1.359 af

Pond 3P: UDB B-2 Peak Elev=139.59' Storage=0.937 af Inflow=19.19 cfs 1.518 af
Outflow=1.59 cfs 1.389 af

Pond 4P: WDB B-3 Peak Elev=135.44' Storage=50,106 cf Inflow=9.67 cfs 3.359 af
Primary=2.42 cfs 2.577 af Secondary=0.00 cfs 0.000 af Outflow=2.42 cfs 2.577 af

Pond 5P: UDB D-1 Peak Elev=139.19' Storage=0.523 af Inflow=15.35 cfs 1.093 af
Outflow=1.56 cfs 1.071 af

Pond 6P: WDB D-2 Peak Elev=135.04' Storage=32,421 cf Inflow=5.44 cfs 1.552 af
Primary=0.93 cfs 1.445 af Secondary=0.00 cfs 0.000 af Outflow=0.93 cfs 1.445 af

Pond 7P: RG D-3 Peak Elev=136.54' Storage=2,599 cf Inflow=1.65 cfs 0.118 af
Primary=0.15 cfs 0.113 af Secondary=0.00 cfs 0.000 af Outflow=0.15 cfs 0.113 af

Link 1L: Design Point A Inflow=1.88 cfs 1.346 af
Primary=1.88 cfs 1.346 af

Link 2L: Design Point B Inflow=2.57 cfs 2.753 af
Primary=2.57 cfs 2.753 af

Link 3L: Design Point D Inflow=1.15 cfs 1.547 af
Primary=1.15 cfs 1.547 af

Link 4L: Design Point E Inflow=0.14 cfs 0.023 af
Primary=0.14 cfs 0.023 af

Total Runoff Area = 48.440 ac Runoff Volume = 6.823 af Average Runoff Depth = 1.69"
40.96% Pervious = 19.840 ac 59.04% Impervious = 28.600 ac

Time span=2.00-48.00 hrs, dt=0.05 hrs, 921 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentA-1: PR WS A-1 Runoff Area=13.170 ac 59.91% Impervious Runoff Depth=2.76"
Flow Length=431' Tc=5.0 min CN=77 Runoff=42.62 cfs 3.026 af

SubcatchmentA-2: PR WS A-2 Runoff Area=1.810 ac 0.00% Impervious Runoff Depth=0.16"
Flow Length=77' Slope=0.2180 '/' Tc=11.6 min CN=37 Runoff=0.04 cfs 0.025 af

SubcatchmentB-1: PR WS B-1 Runoff Area=5.900 ac 100.00% Impervious Runoff Depth>4.91"
Flow Length=100' Slope=1.0000 '/' Tc=5.0 min CN=98 Runoff=29.99 cfs 2.414 af

SubcatchmentB-2: PR WS B-2 Runoff Area=6.100 ac 100.00% Impervious Runoff Depth>4.91"
Flow Length=100' Slope=1.0000 '/' Tc=5.0 min CN=98 Runoff=31.00 cfs 2.496 af

SubcatchmentB-3: PR WS B-3 Runoff Area=3.960 ac 48.99% Impervious Runoff Depth=3.62"
Flow Length=192' Tc=5.0 min CN=86 Runoff=16.63 cfs 1.193 af

SubcatchmentB-4: PR WS B-4 Runoff Area=3.250 ac 0.00% Impervious Runoff Depth=1.84"
Flow Length=173' Tc=30.0 min CN=66 Runoff=3.80 cfs 0.498 af

SubcatchmentD-1: PR WS D-1 Runoff Area=8.440 ac 64.93% Impervious Runoff Depth=3.22"
Flow Length=210' Tc=5.0 min CN=82 Runoff=31.76 cfs 2.267 af

SubcatchmentD-2: PR WS D-2 Runoff Area=2.460 ac 28.86% Impervious Runoff Depth=3.13"
Flow Length=259' Tc=10.9 min CN=81 Runoff=7.59 cfs 0.641 af

SubcatchmentD-2.1: PR-WS D-2.1 Runoff Area=1.260 ac 0.00% Impervious Runoff Depth=1.76"
Flow Length=148' Tc=9.8 min CN=65 Runoff=2.16 cfs 0.185 af

SubcatchmentD-3: PR-WS D-3 Runoff Area=0.830 ac 43.37% Impervious Runoff Depth=3.42"
Flow Length=265' Tc=5.0 min CN=84 Runoff=3.32 cfs 0.236 af

SubcatchmentD-4: PR-WS D-4 Runoff Area=0.950 ac 21.05% Impervious Runoff Depth=2.85"
Flow Length=74' Tc=16.1 min CN=78 Runoff=2.33 cfs 0.225 af

SubcatchmentE: PR WS E Runoff Area=0.310 ac 6.45% Impervious Runoff Depth=2.24"
Flow Length=211' Tc=45.6 min CN=71 Runoff=0.37 cfs 0.058 af

Pond 1P: Existing DB A-1 Peak Elev=139.53' Storage=66,804 cf Inflow=42.62 cfs 3.026 af
Outflow=2.31 cfs 3.026 af

Pond 2P: UDB B-1 Peak Elev=140.38' Storage=1.397 af Inflow=29.99 cfs 2.414 af
Outflow=3.41 cfs 2.293 af

Pond 3P: UDB B-2 Peak Elev=140.49' Storage=1.464 af Inflow=31.00 cfs 2.496 af
Outflow=3.36 cfs 2.350 af

Pond 4P: WDB B-3 Peak Elev=135.84' Storage=65,080 cf Inflow=21.07 cfs 5.837 af
Primary=6.74 cfs 5.023 af Secondary=0.00 cfs 0.000 af Outflow=6.74 cfs 5.023 af

Pond 5P: UDB D-1 Peak Elev=140.56' Storage=1.120 af Inflow=31.76 cfs 2.267 af
Outflow=4.19 cfs 2.242 af

Pond 6P: WDB D-2 Peak Elev=135.38' Storage=43,675 cf Inflow=12.01 cfs 3.299 af
Primary=3.27 cfs 3.173 af Secondary=0.00 cfs 0.000 af Outflow=3.27 cfs 3.173 af

Pond 7P: RG D-3 Peak Elev=137.15' Storage=4,968 cf Inflow=3.32 cfs 0.236 af
Primary=0.55 cfs 0.231 af Secondary=0.00 cfs 0.000 af Outflow=0.55 cfs 0.231 af

Link 1L: Design Point A Inflow=2.35 cfs 3.051 af
Primary=2.35 cfs 3.051 af

Link 2L: Design Point B Inflow=7.27 cfs 5.521 af
Primary=7.27 cfs 5.521 af

Link 3L: Design Point D Inflow=3.45 cfs 3.398 af
Primary=3.45 cfs 3.398 af

Link 4L: Design Point E Inflow=0.37 cfs 0.058 af
Primary=0.37 cfs 0.058 af

Total Runoff Area = 48.440 ac Runoff Volume = 13.265 af Average Runoff Depth = 3.29"
40.96% Pervious = 19.840 ac 59.04% Impervious = 28.600 ac

Time span=2.00-48.00 hrs, dt=0.05 hrs, 921 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentA-1: PR WS A-1 Runoff Area=13.170 ac 59.91% Impervious Runoff Depth=3.80"
Flow Length=431' Tc=5.0 min CN=77 Runoff=58.53 cfs 4.165 af

SubcatchmentA-2: PR WS A-2 Runoff Area=1.810 ac 0.00% Impervious Runoff Depth=0.44"
Flow Length=77' Slope=0.2180 '/' Tc=11.6 min CN=37 Runoff=0.28 cfs 0.066 af

SubcatchmentB-1: PR WS B-1 Runoff Area=5.900 ac 100.00% Impervious Runoff Depth>6.10"
Flow Length=100' Slope=1.0000 '/' Tc=5.0 min CN=98 Runoff=37.03 cfs 2.999 af

SubcatchmentB-2: PR WS B-2 Runoff Area=6.100 ac 100.00% Impervious Runoff Depth>6.10"
Flow Length=100' Slope=1.0000 '/' Tc=5.0 min CN=98 Runoff=38.29 cfs 3.100 af

SubcatchmentB-3: PR WS B-3 Runoff Area=3.960 ac 48.99% Impervious Runoff Depth=4.75"
Flow Length=192' Tc=5.0 min CN=86 Runoff=21.60 cfs 1.568 af

SubcatchmentB-4: PR WS B-4 Runoff Area=3.250 ac 0.00% Impervious Runoff Depth=2.71"
Flow Length=173' Tc=30.0 min CN=66 Runoff=5.74 cfs 0.734 af

SubcatchmentD-1: PR WS D-1 Runoff Area=8.440 ac 64.93% Impervious Runoff Depth=4.32"
Flow Length=210' Tc=5.0 min CN=82 Runoff=42.50 cfs 3.038 af

SubcatchmentD-2: PR WS D-2 Runoff Area=2.460 ac 28.86% Impervious Runoff Depth=4.21"
Flow Length=259' Tc=10.9 min CN=81 Runoff=10.17 cfs 0.864 af

SubcatchmentD-2.1: PR-WS D-2.1 Runoff Area=1.260 ac 0.00% Impervious Runoff Depth=2.62"
Flow Length=148' Tc=9.8 min CN=65 Runoff=3.30 cfs 0.275 af

SubcatchmentD-3: PR-WS D-3 Runoff Area=0.830 ac 43.37% Impervious Runoff Depth=4.53"
Flow Length=265' Tc=5.0 min CN=84 Runoff=4.36 cfs 0.314 af

SubcatchmentD-4: PR-WS D-4 Runoff Area=0.950 ac 21.05% Impervious Runoff Depth=3.90"
Flow Length=74' Tc=16.1 min CN=78 Runoff=3.18 cfs 0.309 af

SubcatchmentE: PR WS E Runoff Area=0.310 ac 6.45% Impervious Runoff Depth=3.19"
Flow Length=211' Tc=45.6 min CN=71 Runoff=0.53 cfs 0.082 af

Pond 1P: Existing DB A-1 Peak Elev=140.89' Storage=100,598 cf Inflow=58.53 cfs 4.165 af
Outflow=2.56 cfs 4.165 af

Pond 2P: UDB B-1 Peak Elev=140.92' Storage=1.718 af Inflow=37.03 cfs 2.999 af
Outflow=4.09 cfs 2.871 af

Pond 3P: UDB B-2 Peak Elev=141.07' Storage=1.803 af Inflow=38.29 cfs 3.100 af
Outflow=4.09 cfs 2.946 af

Pond 4P: WDB B-3 Peak Elev=136.07' Storage=74,390 cf Inflow=27.43 cfs 7.386 af
Primary=8.13 cfs 6.561 af Secondary=0.00 cfs 0.000 af Outflow=8.13 cfs 6.561 af

Pond 5P: UDB D-1 Peak Elev=141.11' Storage=1.360 af Inflow=42.50 cfs 3.038 af
Outflow=10.60 cfs 3.013 af

Pond 6P: WDB D-2 Peak Elev=135.70' Storage=54,993 cf Inflow=19.76 cfs 4.460 af
Primary=7.76 cfs 4.327 af Secondary=0.00 cfs 0.000 af Outflow=7.76 cfs 4.327 af

Pond 7P: RG D-3 Peak Elev=137.32' Storage=5,792 cf Inflow=4.36 cfs 0.314 af
Primary=1.36 cfs 0.309 af Secondary=0.00 cfs 0.000 af Outflow=1.36 cfs 0.309 af

Link 1L: Design Point A Inflow=2.70 cfs 4.231 af
Primary=2.70 cfs 4.231 af

Link 2L: Design Point B Inflow=11.34 cfs 7.295 af
Primary=11.34 cfs 7.295 af

Link 3L: Design Point D Inflow=8.20 cfs 4.636 af
Primary=8.20 cfs 4.636 af

Link 4L: Design Point E Inflow=0.53 cfs 0.082 af
Primary=0.53 cfs 0.082 af

Total Runoff Area = 48.440 ac Runoff Volume = 17.514 af Average Runoff Depth = 4.34"
40.96% Pervious = 19.840 ac 59.04% Impervious = 28.600 ac

Time span=2.00-48.00 hrs, dt=0.05 hrs, 921 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentA-1: PR WS A-1 Runoff Area=13.170 ac 59.91% Impervious Runoff Depth=5.48"
Flow Length=431' Tc=5.0 min CN=77 Runoff=84.26 cfs 6.011 af

SubcatchmentA-2: PR WS A-2 Runoff Area=1.810 ac 0.00% Impervious Runoff Depth=1.06"
Flow Length=77' Slope=0.2180 '/' Tc=11.6 min CN=37 Runoff=1.08 cfs 0.160 af

SubcatchmentB-1: PR WS B-1 Runoff Area=5.900 ac 100.00% Impervious Runoff Depth>7.94"
Flow Length=100' Slope=1.0000 '/' Tc=5.0 min CN=98 Runoff=47.93 cfs 3.903 af

SubcatchmentB-2: PR WS B-2 Runoff Area=6.100 ac 100.00% Impervious Runoff Depth>7.94"
Flow Length=100' Slope=1.0000 '/' Tc=5.0 min CN=98 Runoff=49.56 cfs 4.035 af

SubcatchmentB-3: PR WS B-3 Runoff Area=3.960 ac 48.99% Impervious Runoff Depth=6.54"
Flow Length=192' Tc=5.0 min CN=86 Runoff=29.27 cfs 2.160 af

SubcatchmentB-4: PR WS B-4 Runoff Area=3.250 ac 0.00% Impervious Runoff Depth=4.19"
Flow Length=173' Tc=30.0 min CN=66 Runoff=8.98 cfs 1.134 af

SubcatchmentD-1: PR WS D-1 Runoff Area=8.440 ac 64.93% Impervious Runoff Depth=6.07"
Flow Length=210' Tc=5.0 min CN=82 Runoff=58.93 cfs 4.268 af

SubcatchmentD-2: PR WS D-2 Runoff Area=2.460 ac 28.86% Impervious Runoff Depth=5.95"
Flow Length=259' Tc=10.9 min CN=81 Runoff=14.20 cfs 1.220 af

SubcatchmentD-2.1: PR-WS D-2.1 Runoff Area=1.260 ac 0.00% Impervious Runoff Depth=4.07"
Flow Length=148' Tc=9.8 min CN=65 Runoff=5.21 cfs 0.428 af

SubcatchmentD-3: PR-WS D-3 Runoff Area=0.830 ac 43.37% Impervious Runoff Depth=6.31"
Flow Length=265' Tc=5.0 min CN=84 Runoff=5.97 cfs 0.436 af

SubcatchmentD-4: PR-WS D-4 Runoff Area=0.950 ac 21.05% Impervious Runoff Depth=5.59"
Flow Length=74' Tc=16.1 min CN=78 Runoff=4.54 cfs 0.443 af

SubcatchmentE: PR WS E Runoff Area=0.310 ac 6.45% Impervious Runoff Depth=4.77"
Flow Length=211' Tc=45.6 min CN=71 Runoff=0.80 cfs 0.123 af

Pond 1P: Existing DB A-1 Peak Elev=142.98' Storage=158,721 cf Inflow=84.26 cfs 6.011 af
Outflow=2.90 cfs 6.011 af

Pond 2P: UDB B-1 Peak Elev=141.75' Storage=2.205 af Inflow=47.93 cfs 3.903 af
Outflow=4.95 cfs 3.768 af

Pond 3P: UDB B-2 Peak Elev=141.94' Storage=2.320 af Inflow=49.56 cfs 4.035 af
Outflow=4.99 cfs 3.870 af

Pond 4P: WDB B-3 Peak Elev=136.94' Storage=109,509 cf Inflow=36.62 cfs 9.798 af
Primary=8.92 cfs 8.959 af Secondary=0.00 cfs 0.000 af Outflow=8.92 cfs 8.959 af

Pond 5P: UDB D-1 Peak Elev=141.82' Storage=1.671 af Inflow=58.93 cfs 4.268 af
Outflow=22.42 cfs 4.242 af

Pond 6P: WDB D-2 Peak Elev=136.49' Storage=84,539 cf Inflow=41.10 cfs 6.321 af
Primary=12.63 cfs 6.181 af Secondary=0.00 cfs 0.000 af Outflow=12.63 cfs 6.181 af

Pond 7P: RG D-3 Peak Elev=137.55' Storage=7,003 cf Inflow=5.97 cfs 0.436 af
Primary=2.84 cfs 0.431 af Secondary=0.00 cfs 0.000 af Outflow=2.84 cfs 0.431 af

Link 1L: Design Point A Inflow=3.69 cfs 6.171 af
Primary=3.69 cfs 6.171 af

Link 2L: Design Point B Inflow=17.24 cfs 10.094 af
Primary=17.24 cfs 10.094 af

Link 3L: Design Point D Inflow=15.22 cfs 6.624 af
Primary=15.22 cfs 6.624 af

Link 4L: Design Point E Inflow=0.80 cfs 0.123 af
Primary=0.80 cfs 0.123 af

Total Runoff Area = 48.440 ac Runoff Volume = 24.322 af Average Runoff Depth = 6.03"
40.96% Pervious = 19.840 ac 59.04% Impervious = 28.600 ac

Summary for Subcatchment A-1: PR WS A-1

Runoff = 84.26 cfs @ 12.07 hrs, Volume= 6.011 af, Depth= 5.48"
Routed to Pond 1P : Existing DB A-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=8.22"

Area (ac)	CN	Description
3.240	39	>75% Grass cover, Good, HSG A
1.340	61	>75% Grass cover, Good, HSG B
0.130	74	>75% Grass cover, Good, HSG C
0.200	80	>75% Grass cover, Good, HSG D
0.300	30	Woods, Good, HSG A
0.070	55	Woods, Good, HSG B
7.890	98	Paved parking, HSG A
13.170	77	Weighted Average
5.280		40.09% Pervious Area
7.890		59.91% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.5	100	0.0110	1.09		**Sheet Flow, 1** Smooth surfaces n= 0.011 P2= 3.22"
3.5	331	0.0060	1.57		**Shallow Concentrated Flow, 2** Paved Kv= 20.3 fps
5.0	431	Total			

Summary for Subcatchment A-2: PR WS A-2

Runoff = 1.08 cfs @ 12.25 hrs, Volume= 0.160 af, Depth= 1.06"
Routed to Link 1L : Design Point A

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=8.22"

Area (ac)	CN	Description
1.520	30	Woods, Good, HSG A
0.040	55	Woods, Good, HSG B
0.250	77	Woods, Good, HSG D
1.810	37	Weighted Average
1.810		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.6	77	0.2180	0.11		**Sheet Flow, 1** Woods: Dense underbrush n= 0.800 P2= 3.22"

Summary for Subcatchment B-1: PR WS B-1

Runoff = 47.93 cfs @ 12.07 hrs, Volume= 3.903 af, Depth> 7.94"
Routed to Pond 2P : UDB B-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=8.22"

Area (ac)	CN	Description
5.900	98	Paved parking, HSG A
5.900		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.3	100	1.0000	6.60		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.22"
0.3	100	Total, Increased to minimum Tc = 5.0 min			

Summary for Subcatchment B-2: PR WS B-2

Runoff = 49.56 cfs @ 12.07 hrs, Volume= 4.035 af, Depth> 7.94"
Routed to Pond 3P : UDB B-2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=8.22"

Area (ac)	CN	Description
6.100	98	Paved parking, HSG A
6.100		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.3	100	1.0000	6.60		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.22"
0.3	100	Total, Increased to minimum Tc = 5.0 min			

Summary for Subcatchment B-3: PR WS B-3

Runoff = 29.27 cfs @ 12.07 hrs, Volume= 2.160 af, Depth= 6.54"
Routed to Pond 4P : WDB B-3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=8.22"

Area (ac)	CN	Description
1.940	98	Paved parking, HSG C
1.890	74	>75% Grass cover, Good, HSG C
0.130	70	Woods, Good, HSG C
3.960	86	Weighted Average
2.020		51.01% Pervious Area
1.940		48.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	100	0.0270	1.56		**Sheet Flow, 1** Smooth surfaces n= 0.011 P2= 3.22"
0.6	92	0.0140	2.40		**Shallow Concentrated Flow, 2** Paved Kv= 20.3 fps
1.7	192	Total, Increased to minimum Tc = 5.0 min			

Summary for Subcatchment B-4: PR WS B-4

Runoff = 8.98 cfs @ 12.43 hrs, Volume= 1.134 af, Depth= 4.19"
Routed to Link 2L : Design Point B

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=8.22"

Area (ac)	CN	Description
0.490	30	Woods, Good, HSG A
0.140	55	Woods, Good, HSG B
0.300	70	Woods, Good, HSG C
1.270	77	Woods, Good, HSG D
0.460	58	Meadow, non-grazed, HSG B
0.090	78	Meadow, non-grazed, HSG D
0.200	74	>75% Grass cover, Good, HSG C
0.300	80	>75% Grass cover, Good, HSG D
3.250	66	Weighted Average
3.250		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	40	0.0350	0.12		**Sheet Flow, 1** Grass: Dense n= 0.240 P2= 3.22"
23.4	60	0.0230	0.04		**Sheet Flow, 2** Woods: Dense underbrush n= 0.800 P2= 3.22"
1.1	73	0.0490	1.11		**Shallow Concentrated Flow, 3** Woodland Kv= 5.0 fps
30.0	173	Total			

Summary for Subcatchment D-1: PR WS D-1

Runoff = 58.93 cfs @ 12.07 hrs, Volume= 4.268 af, Depth= 6.07"
Routed to Pond 5P : UDB D-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=8.22"

Area (ac)	CN	Description
1.590	39	>75% Grass cover, Good, HSG A
0.490	61	>75% Grass cover, Good, HSG B
0.110	74	>75% Grass cover, Good, HSG C
0.430	80	>75% Grass cover, Good, HSG D
0.070	79	<50% Grass cover, Poor, HSG B
0.270	55	Woods, Good, HSG B
5.480	98	Paved parking, HSG A
8.440	82	Weighted Average
2.960		35.07% Pervious Area
5.480		64.93% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0210	1.41		**Sheet Flow, 1** Smooth surfaces n= 0.011 P2= 3.22"
1.3	110	0.0050	1.44		**Shallow Concentrated Flow, 2** Paved Kv= 20.3 fps
2.5	210	Total, Increased to minimum Tc = 5.0 min			

Summary for Subcatchment D-2: PR WS D-2

Runoff = 14.20 cfs @ 12.15 hrs, Volume= 1.220 af, Depth= 5.95"
Routed to Pond 6P : WDB D-2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=8.22"

Area (ac)	CN	Description
1.750	74	>75% Grass cover, Good, HSG C
0.710	98	Paved parking, HSG A
2.460	81	Weighted Average
1.750		71.14% Pervious Area
0.710		28.86% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0	100	0.0480	0.17		**Sheet Flow, 1** Grass: Dense n= 0.240 P2= 3.22"
0.9	159	0.0210	2.94		**Shallow Concentrated Flow, 2** Paved Kv= 20.3 fps
10.9	259	Total			

Summary for Subcatchment D-2.1: PR-WS D-2.1

Runoff = 5.21 cfs @ 12.14 hrs, Volume= 0.428 af, Depth= 4.07"
Routed to Pond 6P : WDB D-2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=8.22"

Area (ac)	CN	Description
0.830	61	>75% Grass cover, Good, HSG B
0.420	74	>75% Grass cover, Good, HSG C
0.010	80	>75% Grass cover, Good, HSG D
0.000	98	Paved parking, HSG A
1.260	65	Weighted Average
1.260		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.6	100	0.0530	0.17		**Sheet Flow, 1** Grass: Dense n= 0.240 P2= 3.22"
0.2	48	0.0770	4.47		**Shallow Concentrated Flow, 2** Unpaved Kv= 16.1 fps
9.8	148	Total			

Summary for Subcatchment D-3: PR-WS D-3

Runoff = 5.97 cfs @ 12.07 hrs, Volume= 0.436 af, Depth= 6.31"
Routed to Pond 7P : RG D-3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=8.22"

Area (ac)	CN	Description
0.470	74	>75% Grass cover, Good, HSG C
0.360	98	Paved parking, HSG A
0.830	84	Weighted Average
0.470		56.63% Pervious Area
0.360		43.37% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0	100	0.0300	1.62		**Sheet Flow, 1** Smooth surfaces n= 0.011 P2= 3.22"
0.6	110	0.0210	2.94		**Shallow Concentrated Flow, 2** Paved Kv= 20.3 fps
0.3	55	0.0400	3.00		**Shallow Concentrated Flow, 3** Grassed Waterway Kv= 15.0 fps
1.9	265	Total, Increased to minimum Tc = 5.0 min			

Summary for Subcatchment D-4: PR-WS D-4

Runoff = 4.54 cfs @ 12.22 hrs, Volume= 0.443 af, Depth= 5.59"
Routed to Link 3L : Design Point D

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=8.22"

Area (ac)	CN	Description
0.460	74	>75% Grass cover, Good, HSG C
0.020	80	>75% Grass cover, Good, HSG D
0.210	70	Woods, Good, HSG C
0.060	77	Woods, Good, HSG D
0.200	98	Paved parking, HSG A
0.950	78	Weighted Average
0.750		78.95% Pervious Area
0.200		21.05% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.5	44	0.1300	0.21		**Sheet Flow, 1** Grass: Dense n= 0.240 P2= 3.22"
12.6	30	0.0270	0.04		**Sheet Flow, 2** Woods: Dense underbrush n= 0.800 P2= 3.22"
16.1	74	Total			

Summary for Subcatchment E: PR WS E

Runoff = 0.80 cfs @ 12.62 hrs, Volume= 0.123 af, Depth= 4.77"
Routed to Link 4L : Design Point E

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=8.22"

Area (ac)	CN	Description
0.000	39	>75% Grass cover, Good, HSG A
0.060	74	>75% Grass cover, Good, HSG C
0.010	30	Woods, Good, HSG A
0.220	70	Woods, Good, HSG C
0.020	98	Paved parking, HSG A
0.310	71	Weighted Average
0.290		93.55% Pervious Area
0.020		6.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
40.8	100	0.0160	0.04		**Sheet Flow, 1** Woods: Dense underbrush n= 0.800 P2= 3.22"
4.8	111	0.0060	0.39		**Shallow Concentrated Flow, 2** Woodland Kv= 5.0 fps
45.6	211	Total			

Summary for Pond 1P: Existing DB A-1

Inflow Area = 13.170 ac, 59.91% Impervious, Inflow Depth = 5.48" for 100-yr event
Inflow = 84.26 cfs @ 12.07 hrs, Volume= 6.011 af
Outflow = 2.90 cfs @ 15.78 hrs, Volume= 6.011 af, Atten= 97%, Lag= 222.1 min
Primary = 2.90 cfs @ 15.78 hrs, Volume= 6.011 af
Routed to Link 1L : Design Point A

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 142.98' @ 15.78 hrs Surf.Area= 29,573 sf Storage= 158,721 cf

Plug-Flow detention time= 588.9 min calculated for 6.004 af (100% of inflow)
Center-of-Mass det. time= 589.3 min (1,397.0 - 807.7)

Volume	Invert	Avail.Storage	Storage Description
#1	136.00'	333,379 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
136.00	8,989	0	0
137.00	17,519	13,254	13,254
138.00	20,964	19,242	32,496
139.00	22,882	21,923	54,419
140.00	24,600	23,741	78,160
141.00	26,188	25,394	103,554
142.00	27,928	27,058	130,612
143.00	29,611	28,770	159,381
144.00	31,348	30,480	189,861
145.00	33,154	32,251	222,112
146.00	35,377	34,266	256,377
147.00	38,141	36,759	293,136
148.00	42,344	40,243	333,379

Device	Routing	Invert	Outlet Devices
#1	Primary	133.29'	**24.0" Round Culvert** L= 106.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 133.29' / 132.46' S= 0.0078 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf
#2	Device 1	133.29'	**6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	144.25'	**24.0" W x 36.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=2.90 cfs @ 15.78 hrs HW=142.98' (Free Discharge)
└─**1=Culvert** (Passes 2.90 cfs of 35.20 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 2.90 cfs @ 14.79 fps)
  └─**3=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond 2P: UDB B-1

Inflow Area = 5.900 ac,100.00% Impervious, Inflow Depth > 7.94" for 100-yr event
Inflow = 47.93 cfs @ 12.07 hrs, Volume= 3.903 af
Outflow = 4.95 cfs @ 12.77 hrs, Volume= 3.768 af, Atten= 90%, Lag= 42.0 min
Primary = 4.95 cfs @ 12.77 hrs, Volume= 3.768 af
Routed to Pond 4P : WDB B-3

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 141.75' @ 12.77 hrs Surf.Area= 0.661 ac Storage= 2.205 af

Plug-Flow detention time= 377.2 min calculated for 3.763 af (96% of inflow)
Center-of-Mass det. time= 356.8 min (1,100.2 - 743.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	138.00'	0.000 af	**40.00'W x 720.00'L x 4.67'H Field A** 3.085 af Overall - 3.085 af Embedded = 0.000 af x 40.0% Voids
#2A	138.00'	2.353 af	**retain_it retain_it 4.0'** x 450 Inside #1 Inside= 84.0"W x 48.0"H => 28.87 sf x 8.00'L = 230.9 cf Outside= 96.0"W x 56.0"H => 37.33 sf x 8.00'L = 298.7 cf 5 Rows adjusted for 1,434.4 cf perimeter wall
		2.353 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	138.00'	**12.0" Round Culvert** L= 100.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 138.00' / 137.00' S= 0.0100 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf
#2	Device 1	138.00'	**4.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	138.83'	**10.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 1	142.00'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=4.95 cfs @ 12.77 hrs HW=141.75' (Free Discharge)
└─**1=Culvert** (Passes 4.95 cfs of 5.38 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.80 cfs @ 9.11 fps)
  ├─**3=Orifice/Grate** (Orifice Controls 4.15 cfs @ 7.61 fps)
  └─**4=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 3P: UDB B-2

Inflow Area = 6.100 ac,100.00% Impervious, Inflow Depth > 7.94" for 100-yr event
Inflow = 49.56 cfs @ 12.07 hrs, Volume= 4.035 af
Outflow = 4.99 cfs @ 12.80 hrs, Volume= 3.870 af, Atten= 90%, Lag= 43.6 min
Primary = 4.99 cfs @ 12.80 hrs, Volume= 3.870 af
Routed to Pond 4P : WDB B-3

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 141.94' @ 12.80 hrs Surf.Area= 0.661 ac Storage= 2.320 af

Plug-Flow detention time= 403.5 min calculated for 3.870 af (96% of inflow)
Center-of-Mass det. time= 378.5 min (1,121.9 - 743.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	138.00'	0.000 af	**40.00'W x 720.00'L x 4.67'H Field A** 3.085 af Overall - 3.085 af Embedded = 0.000 af x 40.0% Voids
#2A	138.00'	2.353 af	**retain_it retain_it 4.0'** x 450 Inside #1 Inside= 84.0"W x 48.0"H => 28.87 sf x 8.00'L = 230.9 cf Outside= 96.0"W x 56.0"H => 37.33 sf x 8.00'L = 298.7 cf 5 Rows adjusted for 1,434.4 cf perimeter wall
		2.353 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	138.00'	**24.0" Round Culvert** L= 100.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 138.00' / 137.50' S= 0.0050 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf
#2	Device 1	138.00'	**4.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	139.00'	**10.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 1	142.00'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=4.99 cfs @ 12.80 hrs HW=141.94' (Free Discharge)
└─**1=Culvert** (Passes 4.99 cfs of 20.49 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.82 cfs @ 9.36 fps)
  ├─**3=Orifice/Grate** (Orifice Controls 4.17 cfs @ 7.65 fps)
  └─**4=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 4P: WDB B-3

Inflow Area = 15.960 ac, 87.34% Impervious, Inflow Depth > 7.37" for 100-yr event
Inflow = 36.62 cfs @ 12.08 hrs, Volume= 9.798 af
Outflow = 8.92 cfs @ 15.91 hrs, Volume= 8.959 af, Atten= 76%, Lag= 229.9 min
Primary = 8.92 cfs @ 15.91 hrs, Volume= 8.959 af
Routed to Link 2L : Design Point B
Secondary = 0.00 cfs @ 2.00 hrs, Volume= 0.000 af
Routed to Link 2L : Design Point B

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs

Peak Elev= 136.94' @ 15.91 hrs Surf.Area= 42,188 sf Storage= 109,509 cf

Plug-Flow detention time= 252.9 min calculated for 8.950 af (91% of inflow)
Center-of-Mass det. time= 148.3 min (1,187.8 - 1,039.5)

Volume	Invert	Avail.Storage	Storage Description
#1	134.00'	156,323 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
134.00	32,514	0	0
135.00	35,709	34,112	34,112
136.00	39,005	37,357	71,469
137.00	42,402	40,704	112,172
138.00	45,900	44,151	156,323

Device	Routing	Invert	Outlet Devices
#1	Primary	131.35'	**15.0" Round Culvert** L= 215.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 131.35' / 130.62' S= 0.0034 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 1.23 sf
#2	Device 1	134.00'	**4.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	135.10'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 0.89 0.89 Width (feet) 3.00 3.00 4.00
#4	Device 1	135.99'	**4.0' long Sharp-Crested Vee/Trap Weir** Cv= 2.62 (C= 3.28)
#5	Device 1	136.00'	**24.0" W x 36.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#6	Secondary	137.00'	**20.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=8.92 cfs @ 15.91 hrs HW=136.94' (Free Discharge)
└─**1=Culvert** (Barrel Controls 8.92 cfs @ 7.27 fps)
  ├─**2=Orifice/Grate** (Passes < 0.70 cfs potential flow)
  ├─**3=Custom Weir/Orifice** (Passes < 15.41 cfs potential flow)
  ├─**4=Sharp-Crested Vee/Trap Weir** (Passes < 12.07 cfs potential flow)
  └─**5=Orifice/Grate** (Passes < 5.82 cfs potential flow)

Secondary OutFlow Max=0.00 cfs @ 2.00 hrs HW=134.00' (Free Discharge)
└─**6=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 5P: UDB D-1

Inflow Area = 8.440 ac, 64.93% Impervious, Inflow Depth = 6.07" for 100-yr event
Inflow = 58.93 cfs @ 12.07 hrs, Volume= 4.268 af
Outflow = 22.42 cfs @ 12.31 hrs, Volume= 4.242 af, Atten= 62%, Lag= 14.4 min
Primary = 22.42 cfs @ 12.31 hrs, Volume= 4.242 af
Routed to Pond 6P : WDB D-2

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 141.82' @ 12.31 hrs Surf.Area= 0.494 ac Storage= 1.671 af

Plug-Flow detention time= 184.7 min calculated for 4.242 af (99% of inflow)
Center-of-Mass det. time= 180.9 min (977.1 - 796.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	138.00'	0.000 af	**32.00'W x 672.00'L x 4.67'H Field A** 2.304 af Overall - 2.304 af Embedded = 0.000 af x 40.0% Voids
#2A	138.00'	1.751 af	**retain_it retain_it 4.0'** x 336 Inside #1 Inside= 84.0"W x 48.0"H => 28.87 sf x 8.00'L = 230.9 cf Outside= 96.0"W x 56.0"H => 37.33 sf x 8.00'L = 298.7 cf 4 Rows adjusted for 1,328.7 cf perimeter wall
		1.751 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	138.00'	**30.0" Round Culvert** L= 700.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 138.00' / 134.00' S= 0.0057 '/' Cc= 0.900 n= 0.012, Flow Area= 4.91 sf
#2	Device 1	138.00'	**8.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	140.25'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 1.74 1.74 Width (feet) 3.00 3.00 4.00
#4	Device 1	142.00'	**4.0' long Sharp-Crested Vee/Trap Weir** Cv= 2.62 (C= 3.28)

Primary OutFlow Max=22.36 cfs @ 12.31 hrs HW=141.81' (Free Discharge)
└─**1=Culvert** (Passes 22.36 cfs of 29.88 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 3.14 cfs @ 8.98 fps)
  ├─**3=Custom Weir/Orifice** (Weir Controls 19.23 cfs @ 4.10 fps)
  └─**4=Sharp-Crested Vee/Trap Weir** (Controls 0.00 cfs)

Summary for Pond 6P: WDB D-2

Inflow Area = 12.990 ac, 50.42% Impervious, Inflow Depth > 5.84" for 100-yr event
Inflow = 41.10 cfs @ 12.20 hrs, Volume= 6.321 af
Outflow = 12.63 cfs @ 13.01 hrs, Volume= 6.181 af, Atten= 69%, Lag= 48.7 min
Primary = 12.63 cfs @ 13.01 hrs, Volume= 6.181 af
Routed to Link 3L : Design Point D
Secondary = 0.00 cfs @ 2.00 hrs, Volume= 0.000 af
Routed to Link 3L : Design Point D

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 136.49' @ 13.01 hrs Surf.Area= 38,792 sf Storage= 84,539 cf

Plug-Flow detention time= 218.7 min calculated for 6.174 af (98% of inflow)
Center-of-Mass det. time= 196.2 min (1,131.3 - 935.1)

Volume	Invert	Avail.Storage	Storage Description
#1	134.00'	125,647 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
134.00	29,100	0	0
135.00	32,946	31,023	31,023
136.00	36,830	34,888	65,911
137.00	40,813	38,822	104,733
137.50	42,843	20,914	125,647

Device	Routing	Invert	Outlet Devices
#1	Primary	132.21'	**18.0" Round Culvert** L= 75.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 132.21' / 131.40' S= 0.0108 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 1.77 sf
#2	Device 1	134.00'	**6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	135.00'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 0.49 0.49 Width (feet) 3.00 3.00 4.00
#4	Device 1	135.49'	**4.0' long Sharp-Crested Vee/Trap Weir** Cv= 2.62 (C= 3.28)
#5	Device 1	135.50'	**24.0" W x 36.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#6	Secondary	136.50'	**50.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=12.63 cfs @ 13.01 hrs HW=136.49' (Free Discharge)
└─**1=Culvert** (Inlet Controls 12.63 cfs @ 7.14 fps)
  ├─**2=Orifice/Grate** (Passes < 1.42 cfs potential flow)
  ├─**3=Custom Weir/Orifice** (Passes < 8.05 cfs potential flow)
  ├─**4=Sharp-Crested Vee/Trap Weir** (Passes < 13.15 cfs potential flow)
  └─**5=Orifice/Grate** (Passes < 6.35 cfs potential flow)

Secondary OutFlow Max=0.00 cfs @ 2.00 hrs HW=134.00' (Free Discharge)
└─**6=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 7P: RG D-3

Inflow Area = 0.830 ac, 43.37% Impervious, Inflow Depth = 6.31" for 100-yr event
Inflow = 5.97 cfs @ 12.07 hrs, Volume= 0.436 af
Outflow = 2.84 cfs @ 12.23 hrs, Volume= 0.431 af, Atten= 52%, Lag= 9.5 min
Primary = 2.84 cfs @ 12.23 hrs, Volume= 0.431 af
  Routed to Pond 6P : WDB D-2
Secondary = 0.00 cfs @ 2.00 hrs, Volume= 0.000 af
  Routed to Pond 6P : WDB D-2

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs

Peak Elev= 137.55' @ 12.23 hrs Surf.Area= 8,629 sf Storage= 7,003 cf

Plug-Flow detention time= 205.2 min calculated for 0.431 af (99% of inflow)
Center-of-Mass det. time= 197.9 min (989.1 - 791.2)

Volume	Invert	Avail.Storage	Storage Description
#1	134.50'	2,471 cf	**Bio-retention mix (Prismatic)** Listed below (Recalc) 6,177 cf Overall x 40.0% Voids
#2	136.50'	7,237 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)
		9,708 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
134.50	3,104	0	0
135.50	3,104	3,104	3,104
136.49	3,104	3,073	6,177

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
136.50	3,104	0	0
137.00	4,235	1,835	1,835
138.00	6,569	5,402	7,237

Device	Routing	Invert	Outlet Devices
#1	Primary	134.67'	**12.0" Round Culvert** L= 134.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 134.67' / 134.00' S= 0.0050 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf
#2	Device 1	137.00'	**24.0" W x 24.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	134.50'	**1.000 in/hr Exfiltration over Surface area**
#4	Secondary	137.99'	**24.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=2.83 cfs @ 12.23 hrs HW=137.55' (Free Discharge)
└─**1=Culvert** (Passes 2.83 cfs of 4.30 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 2.63 cfs @ 2.38 fps)
  └─**3=Exfiltration** (Exfiltration Controls 0.20 cfs)

Secondary OutFlow Max=0.00 cfs @ 2.00 hrs HW=134.50' (Free Discharge)
└─**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Link 1L: Design Point A

Inflow Area = 14.980 ac, 52.67% Impervious, Inflow Depth = 4.94" for 100-yr event
Inflow = 3.69 cfs @ 12.32 hrs, Volume= 6.171 af
Primary = 3.69 cfs @ 12.32 hrs, Volume= 6.171 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs

Summary for Link 2L: Design Point B

Inflow Area = 19.210 ac, 72.57% Impervious, Inflow Depth > 6.31" for 100-yr event
Inflow = 17.24 cfs @ 12.43 hrs, Volume= 10.094 af
Primary = 17.24 cfs @ 12.43 hrs, Volume= 10.094 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs

Summary for Link 3L: Design Point D

Inflow Area = 13.940 ac, 48.42% Impervious, Inflow Depth > 5.70" for 100-yr event
Inflow = 15.22 cfs @ 12.37 hrs, Volume= 6.624 af
Primary = 15.22 cfs @ 12.37 hrs, Volume= 6.624 af, Atten= 0%, Lag= 0.0 min

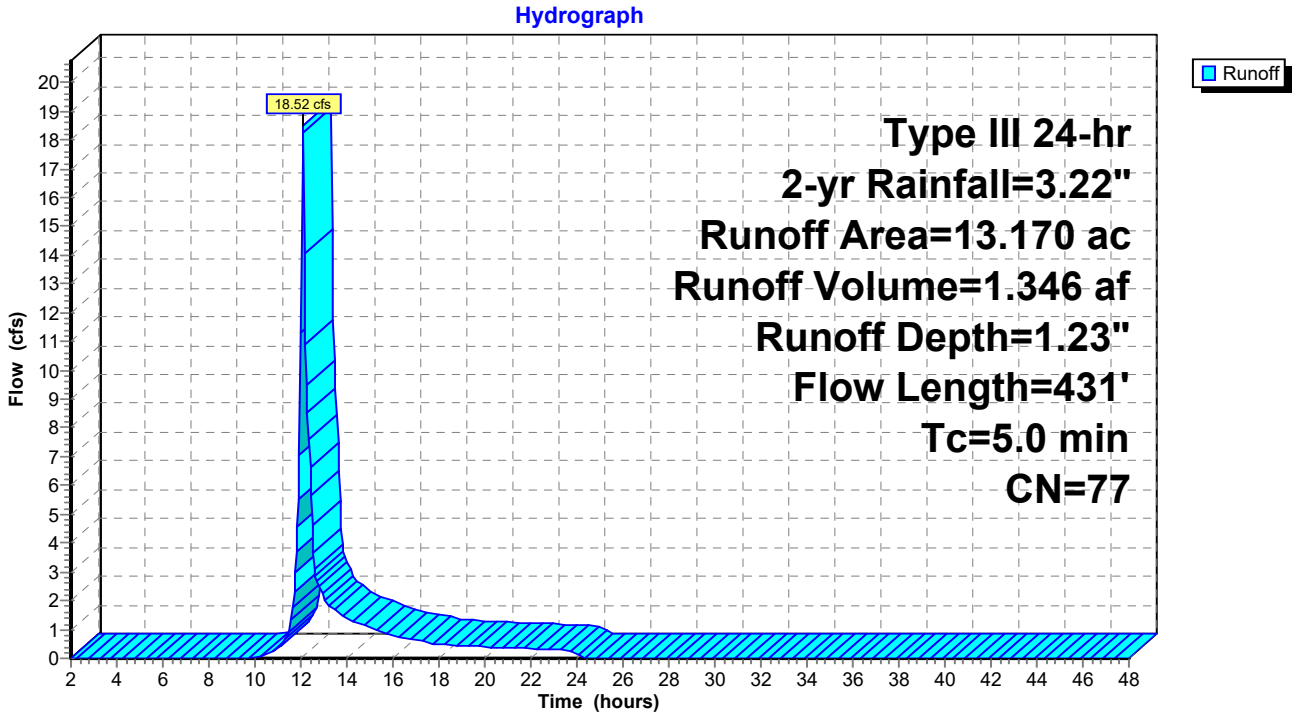
Primary outflow = Inflow, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs

Summary for Link 4L: Design Point E

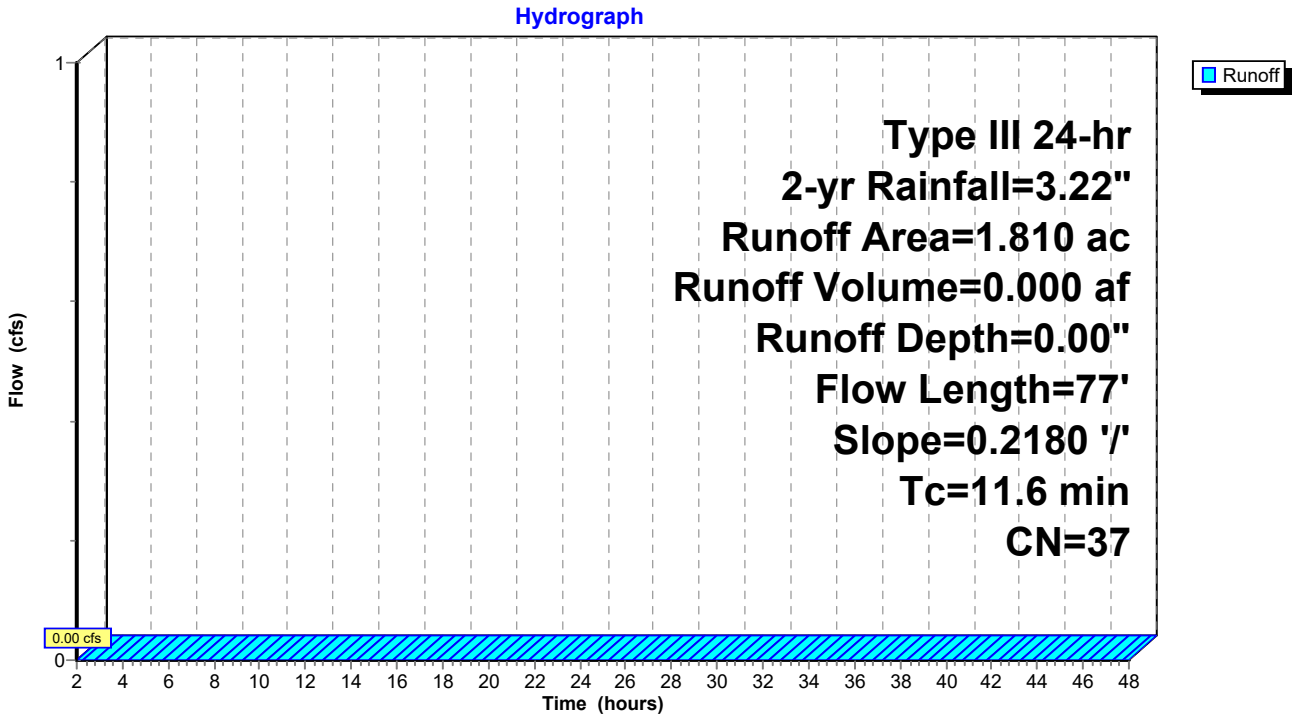
Inflow Area = 0.310 ac, 6.45% Impervious, Inflow Depth = 4.77" for 100-yr event
Inflow = 0.80 cfs @ 12.62 hrs, Volume= 0.123 af
Primary = 0.80 cfs @ 12.62 hrs, Volume= 0.123 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 2.00-48.00 hrs, dt= 0.05 hrs

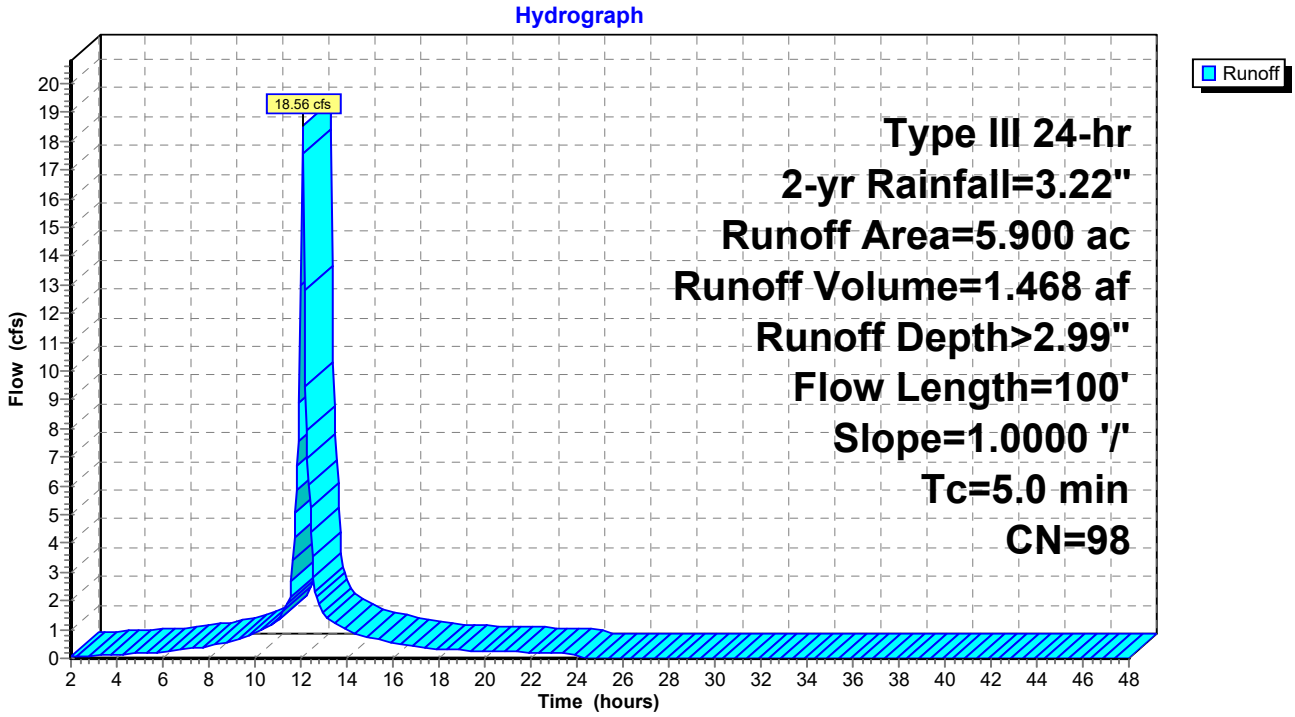
Subcatchment A-1: PR WS A-1



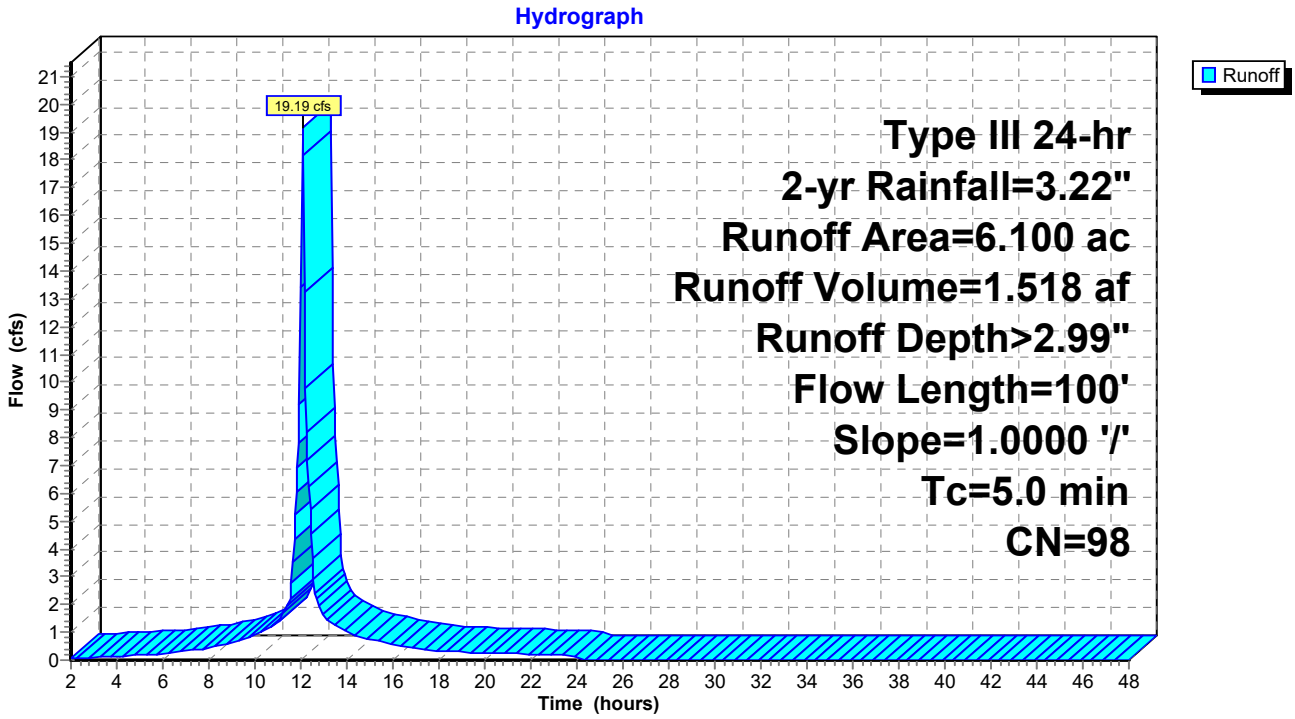
Subcatchment A-2: PR WS A-2



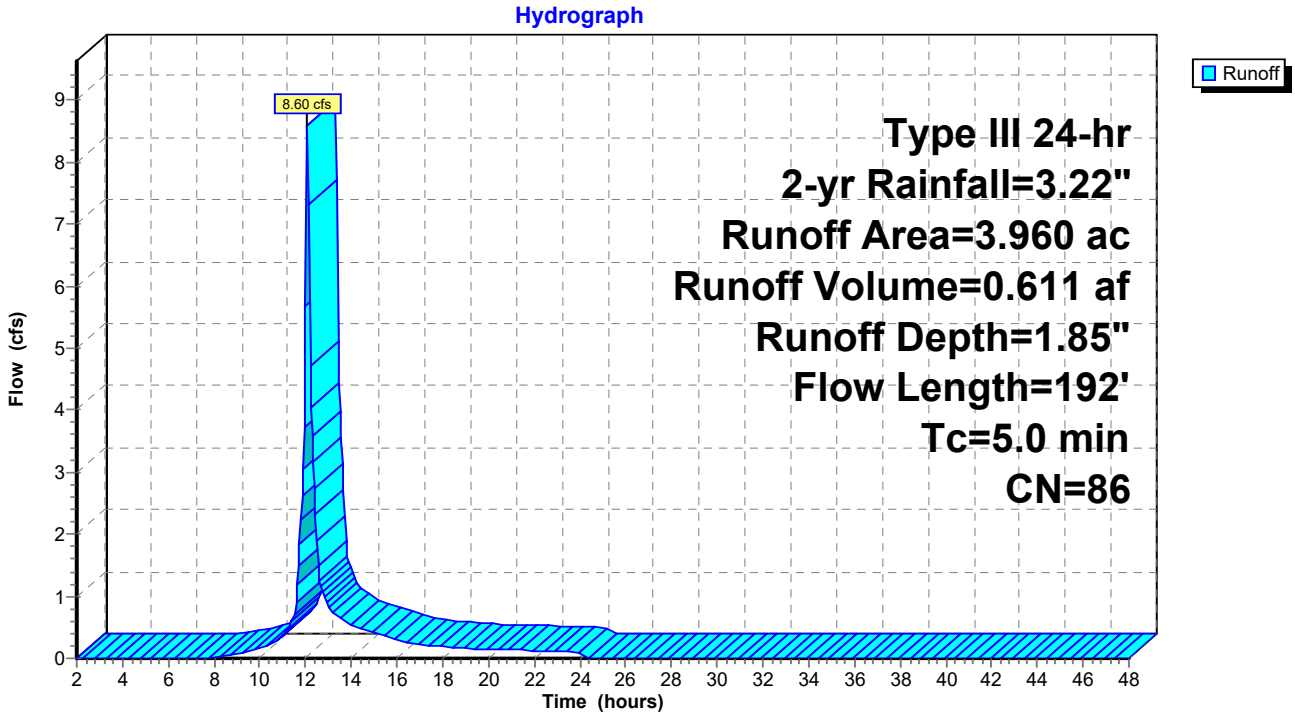
Subcatchment B-1: PR WS B-1



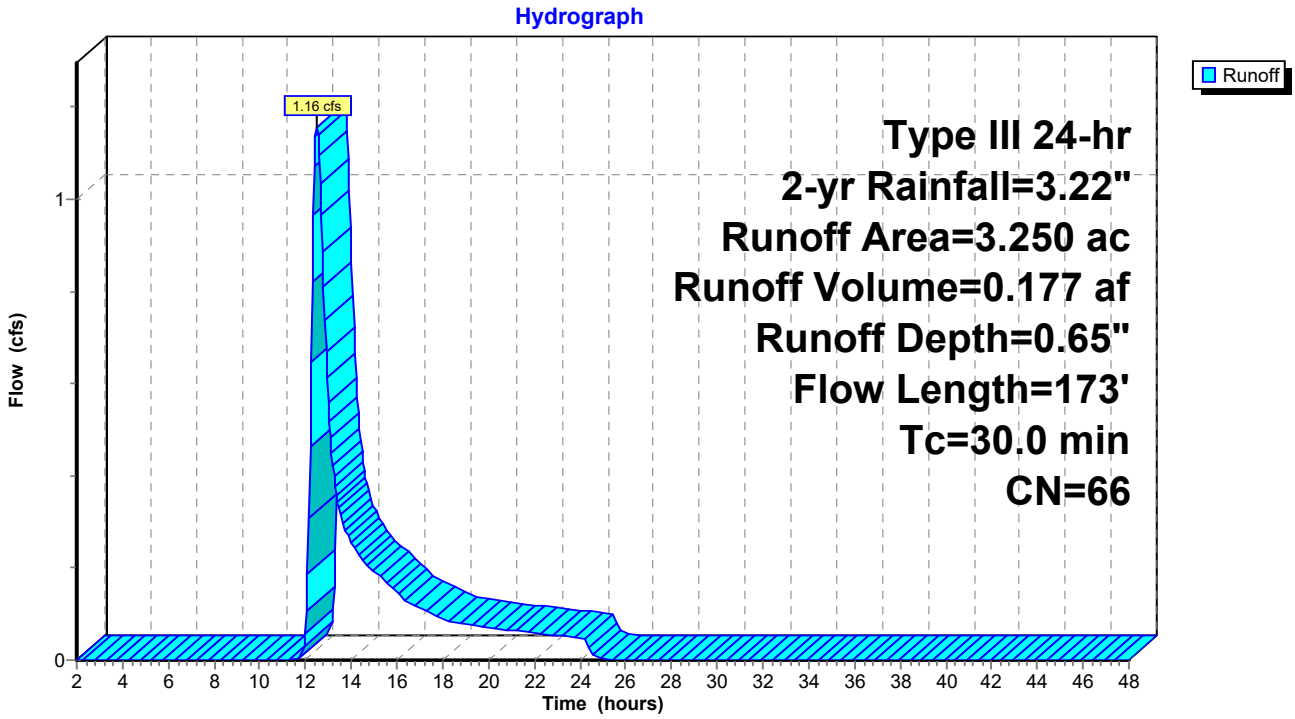
Subcatchment B-2: PR WS B-2



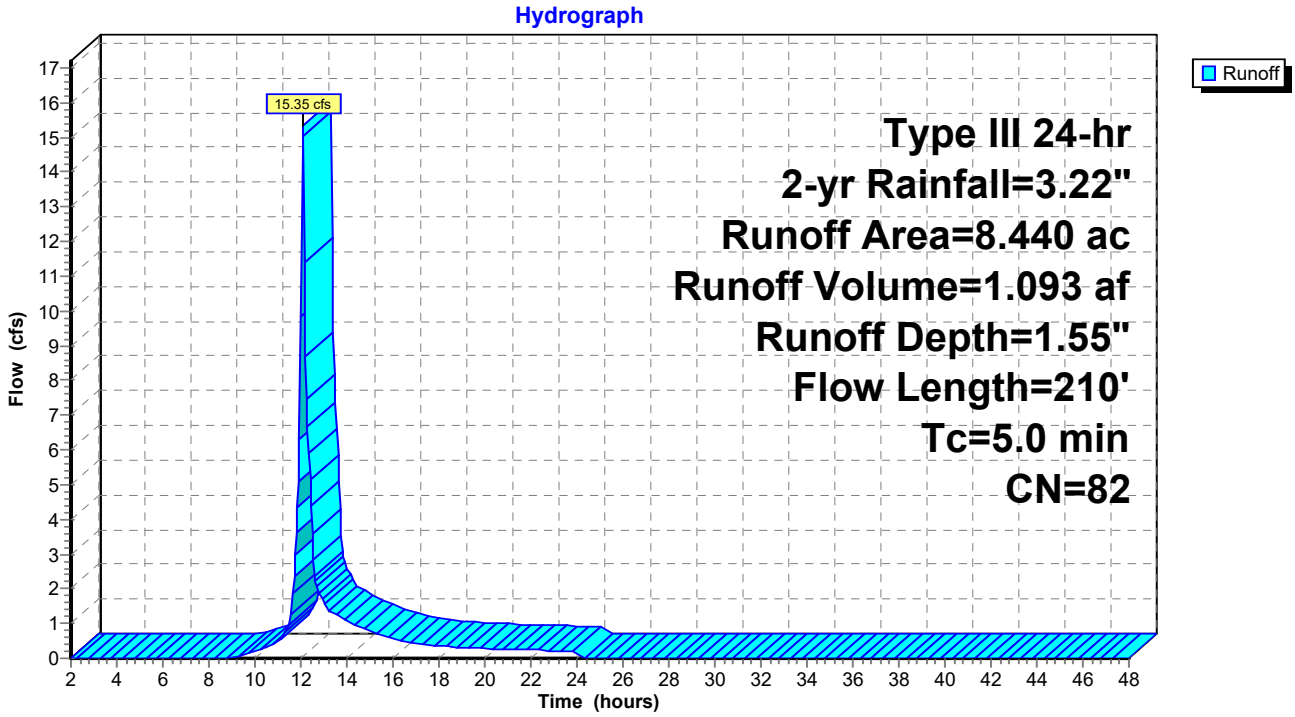
Subcatchment B-3: PR WS B-3



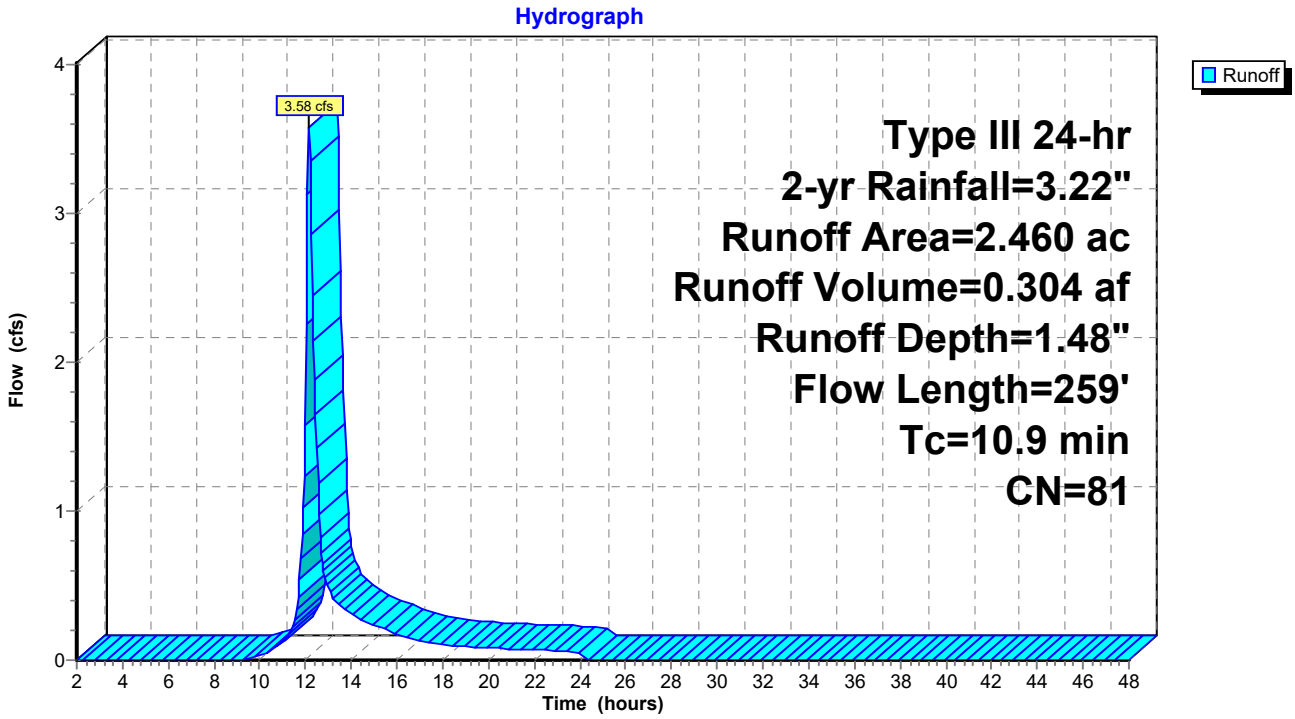
Subcatchment B-4: PR WS B-4



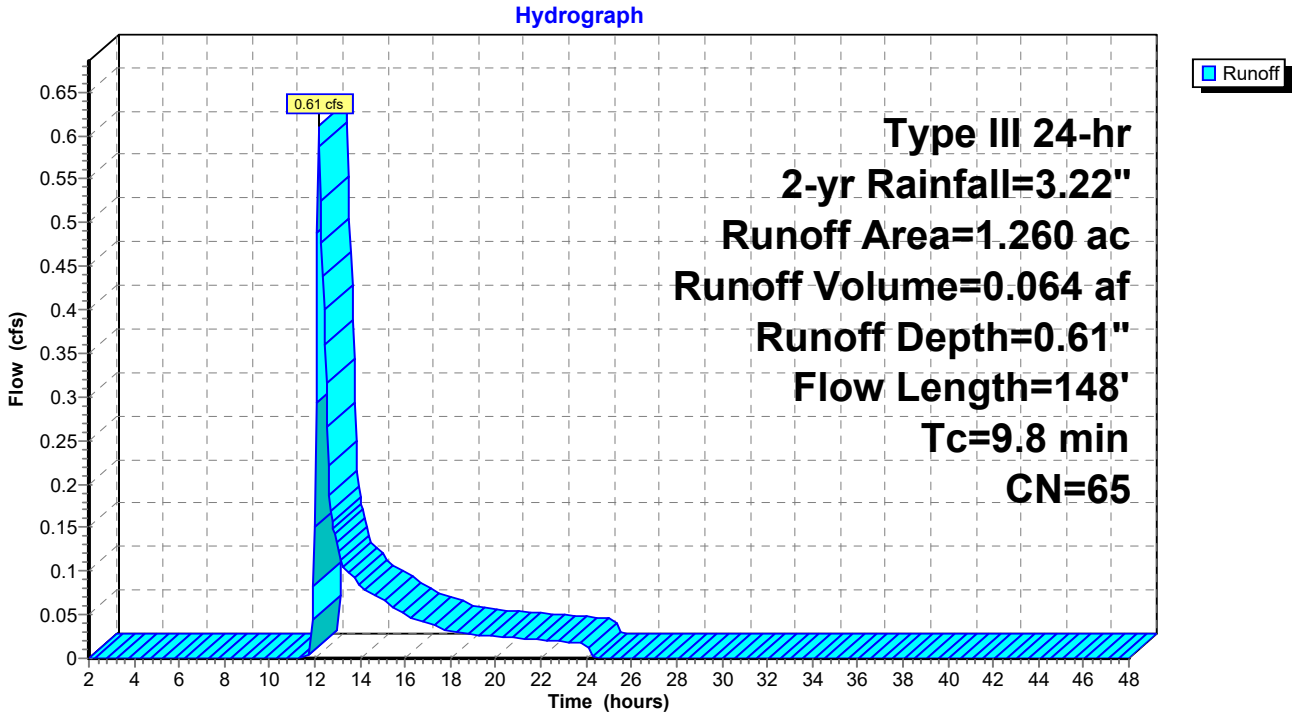
Subcatchment D-1: PR WS D-1



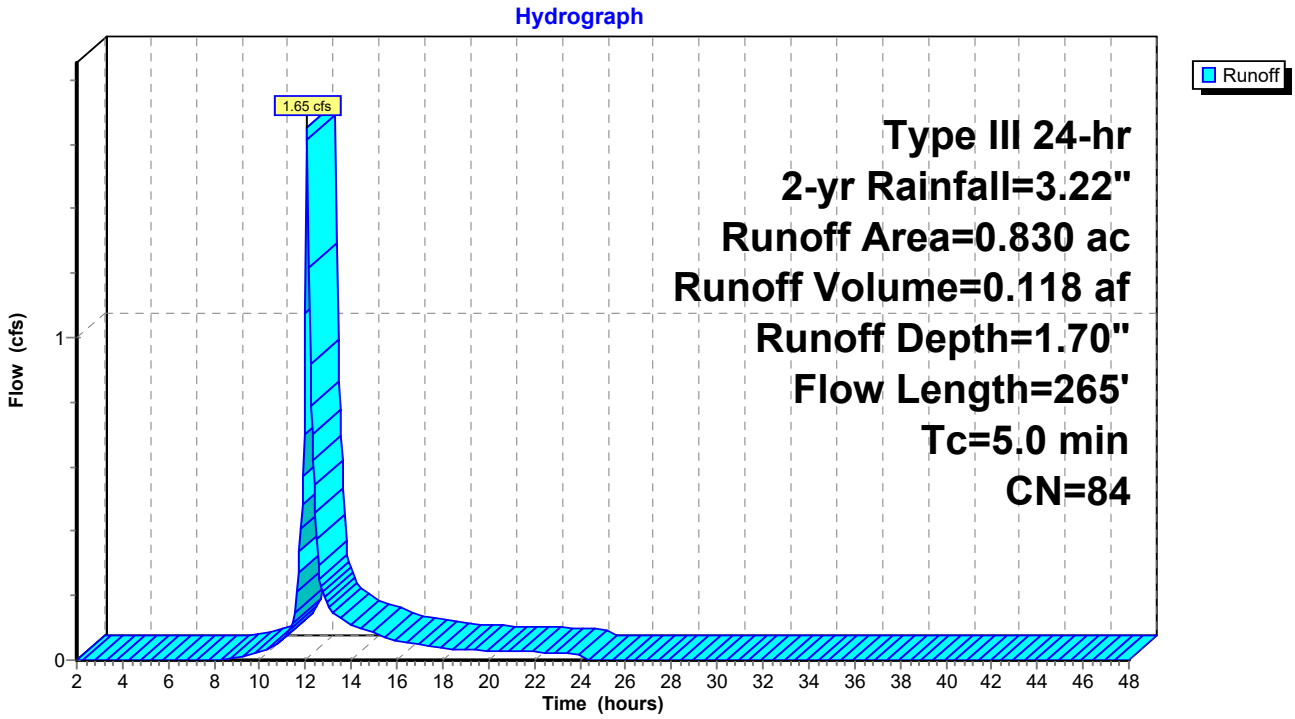
Subcatchment D-2: PR WS D-2



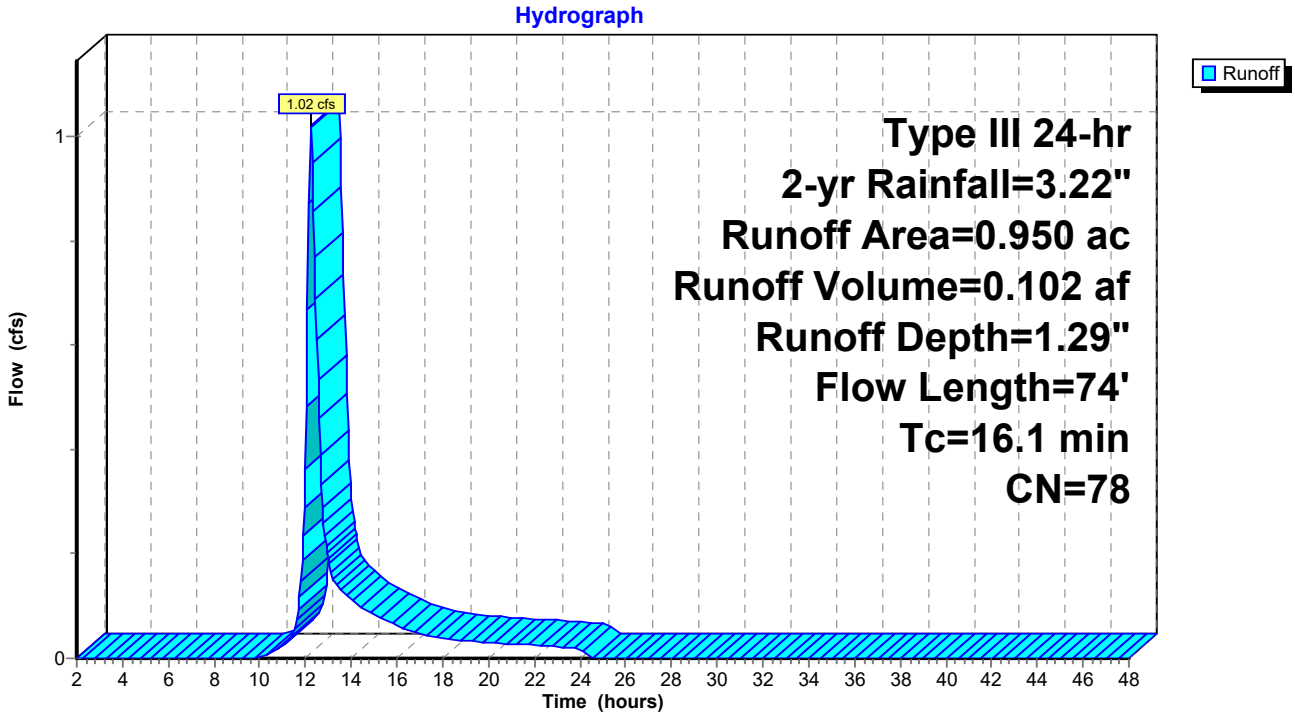
Subcatchment D-2.1: PR-WS D-2.1



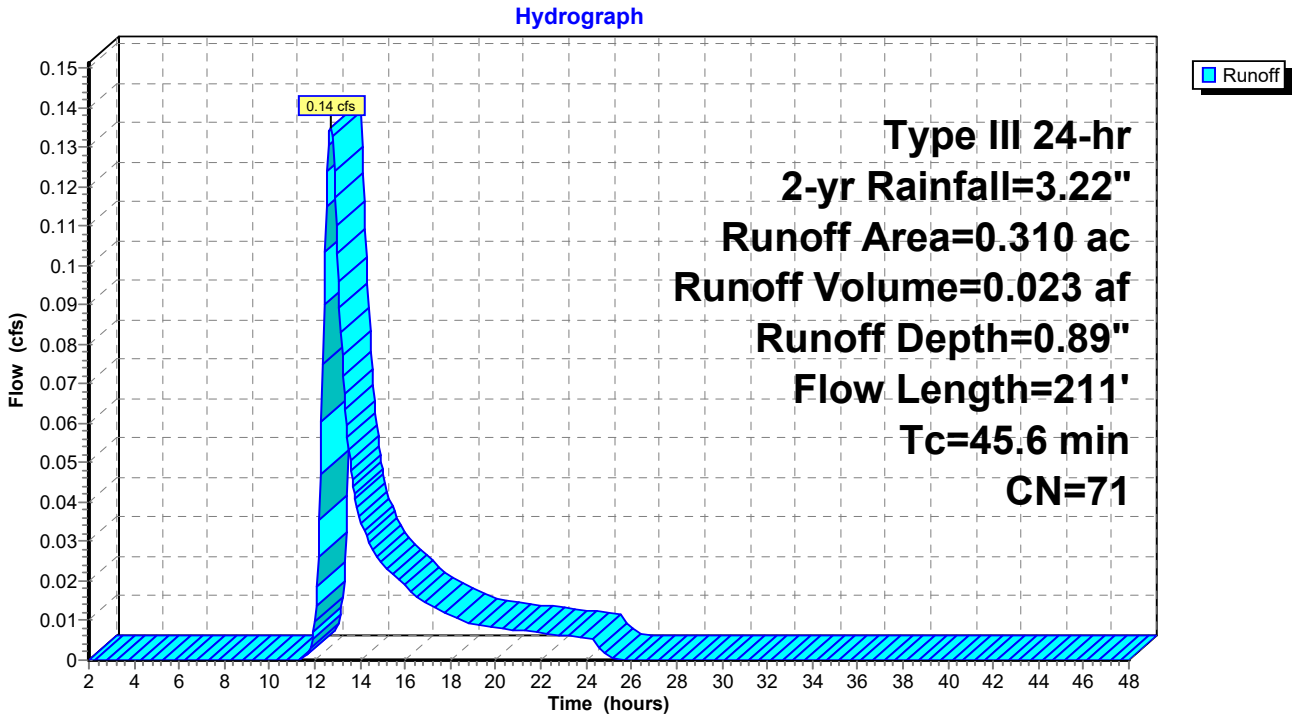
Subcatchment D-3: PR-WS D-3



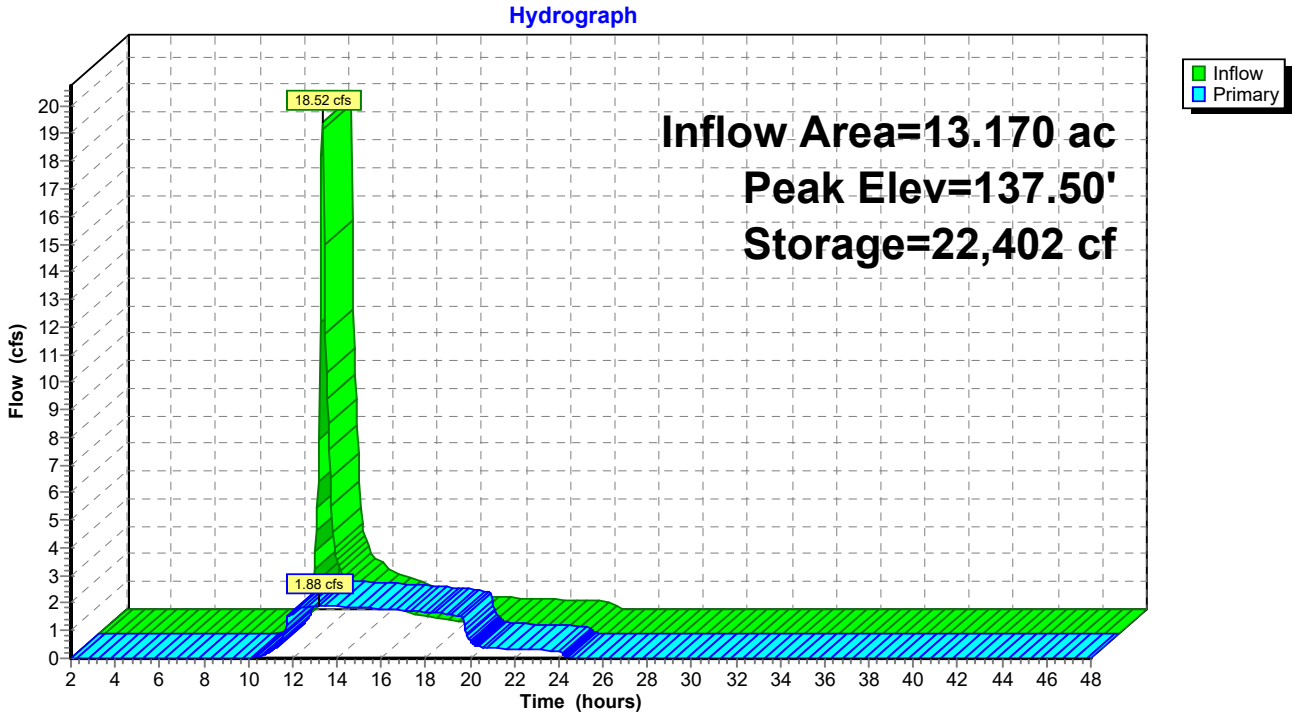
Subcatchment D-4: PR-WS D-4



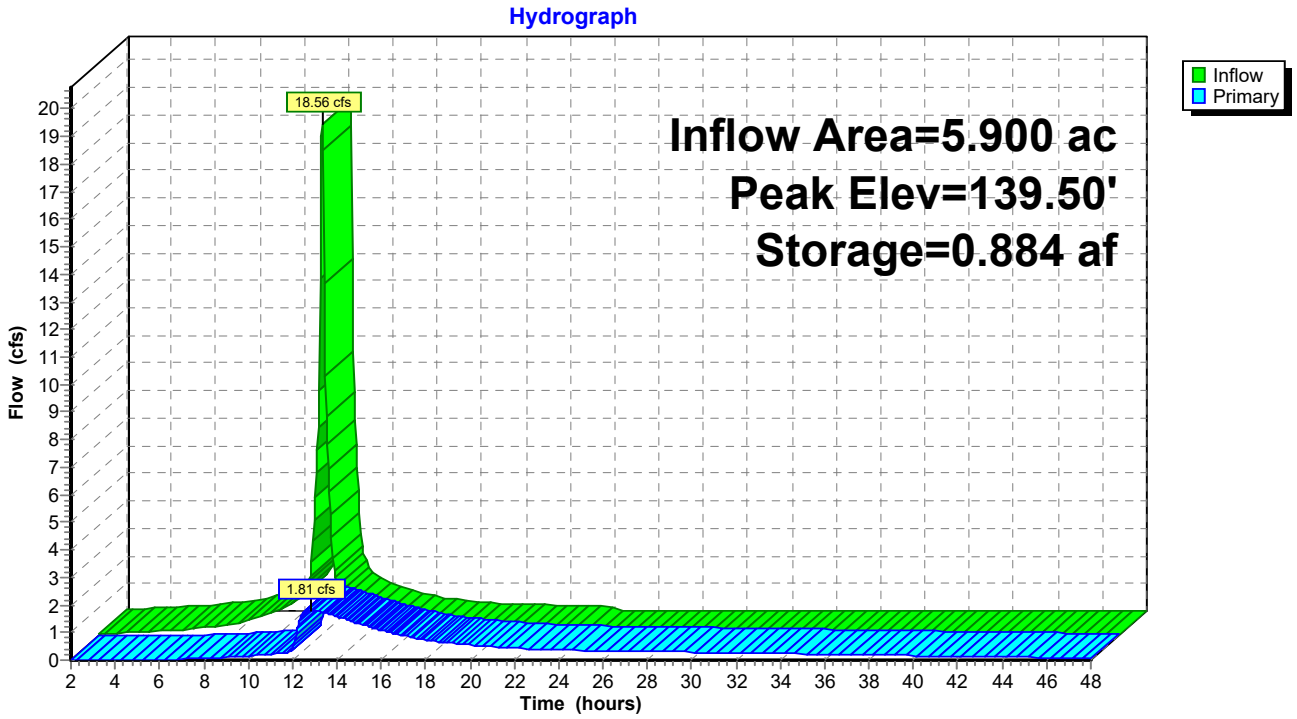
Subcatchment E: PR WS E



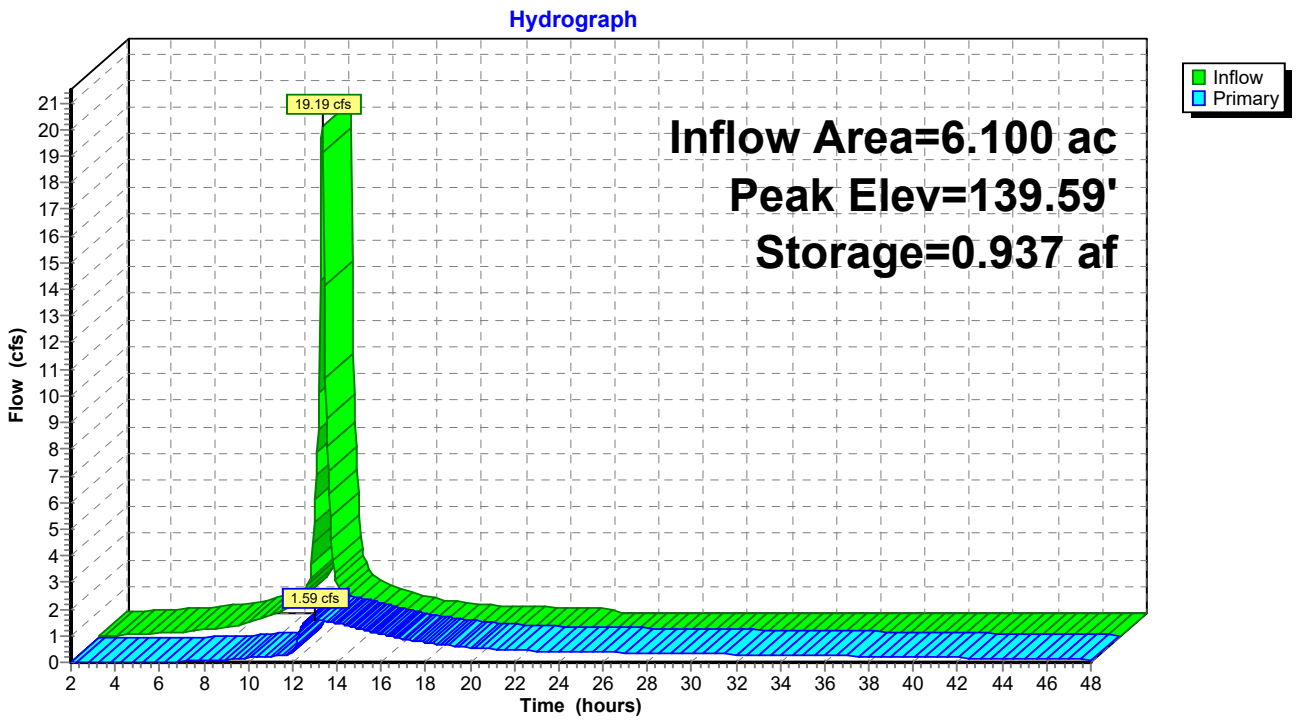
Pond 1P: Existing DB A-1



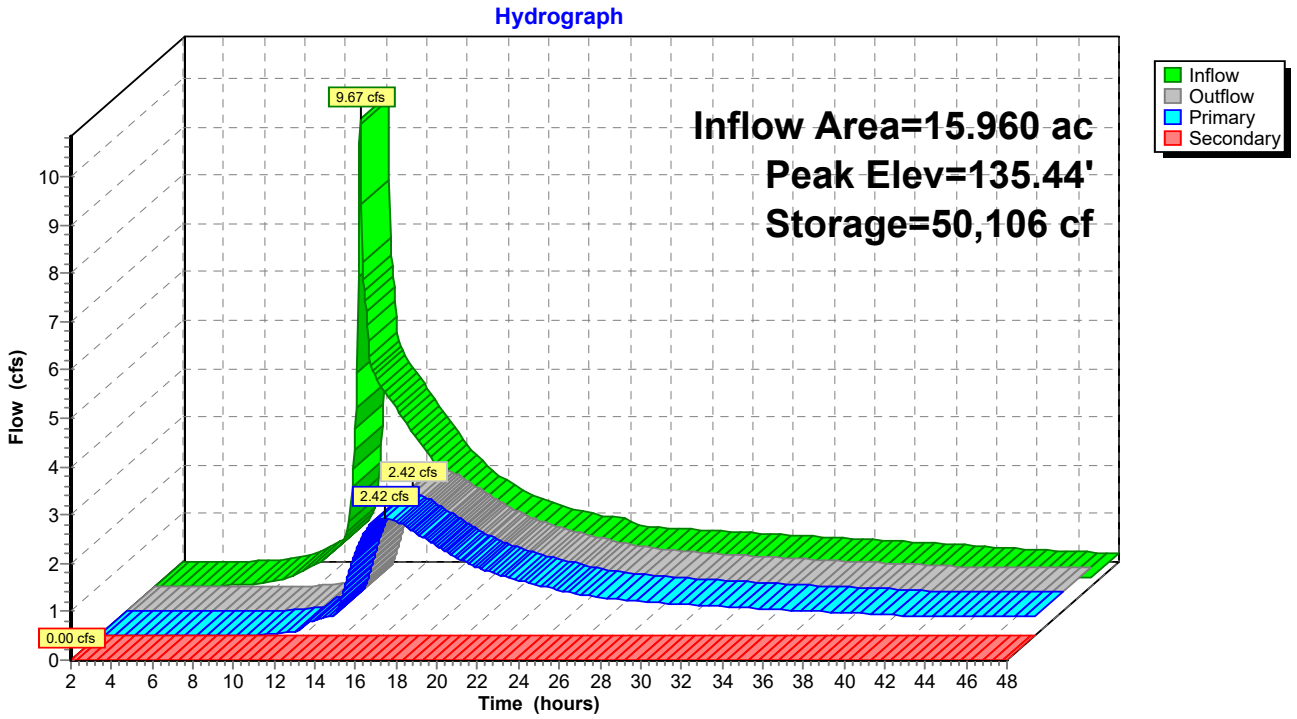
Pond 2P: UDB B-1



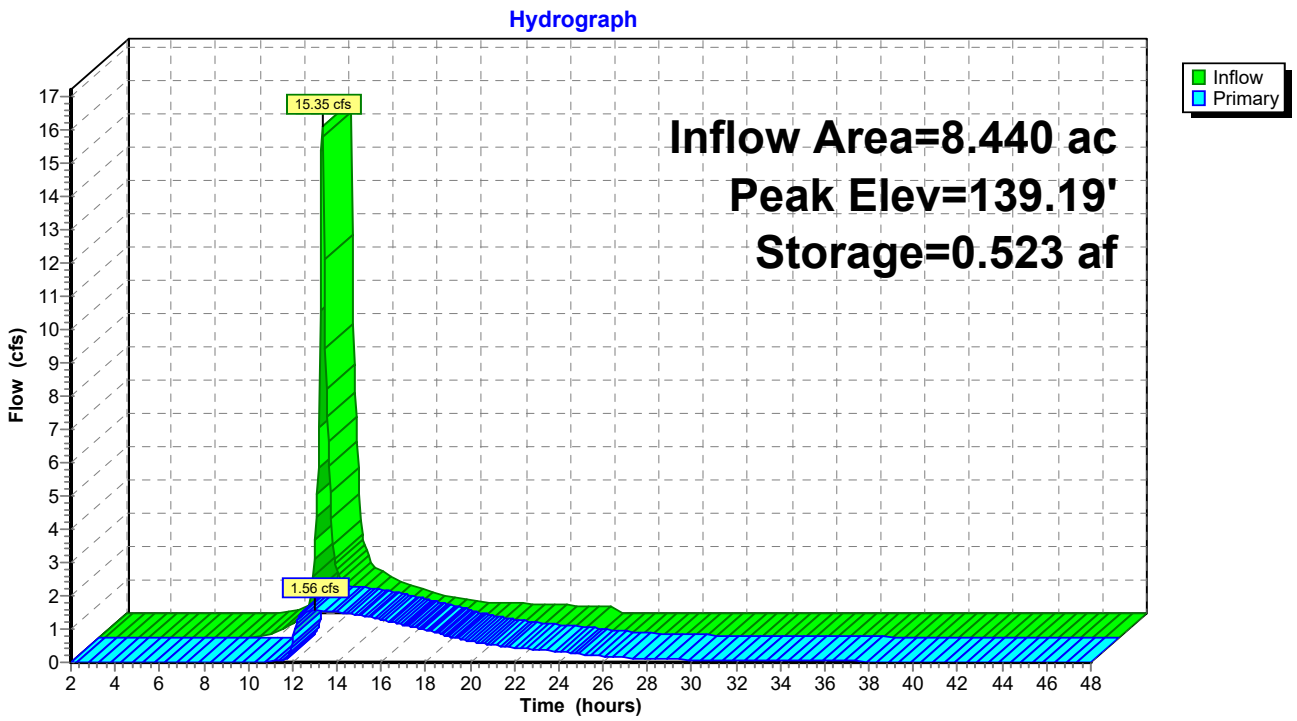
Pond 3P: UDB B-2



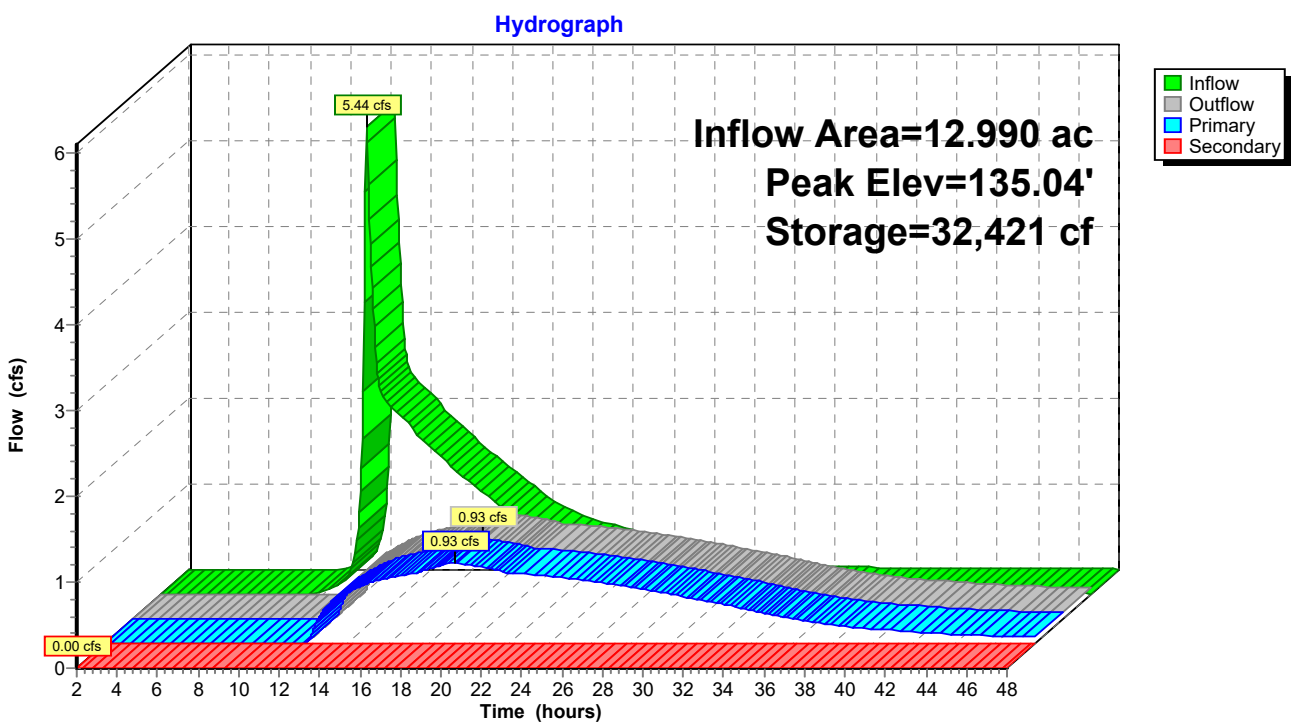
Pond 4P: WDB B-3



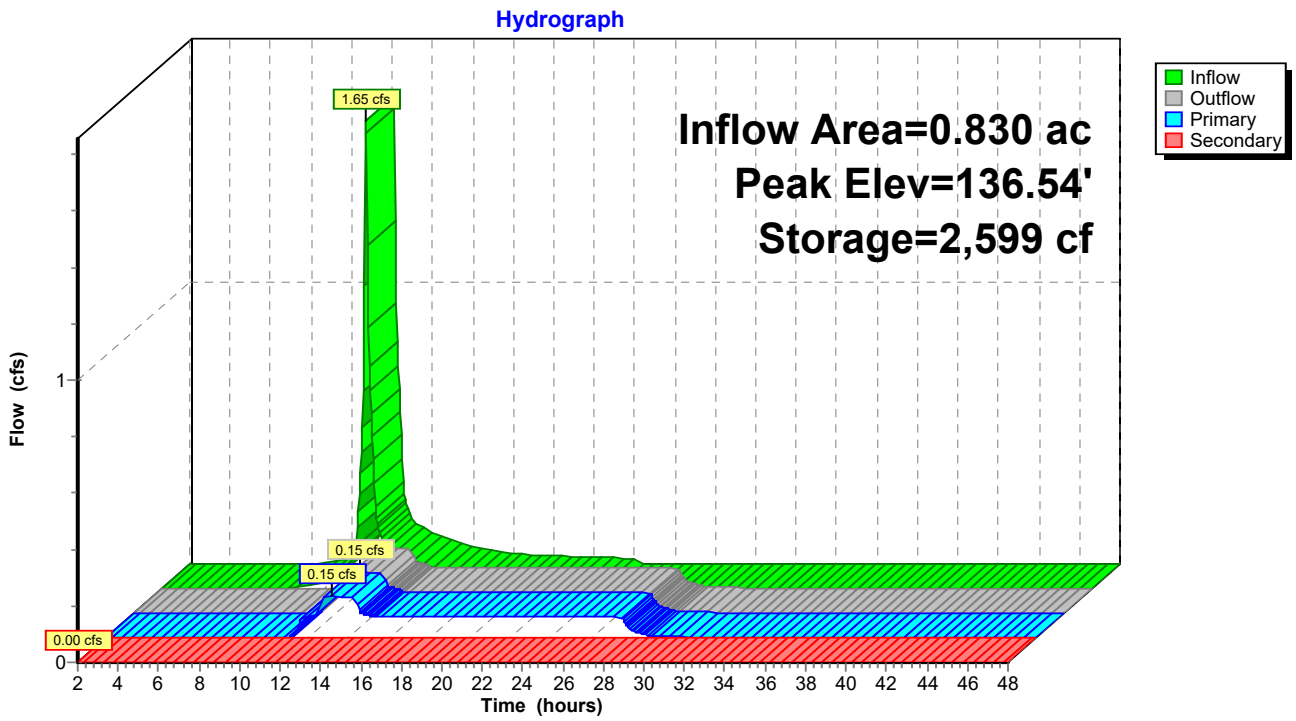
Pond 5P: UDB D-1



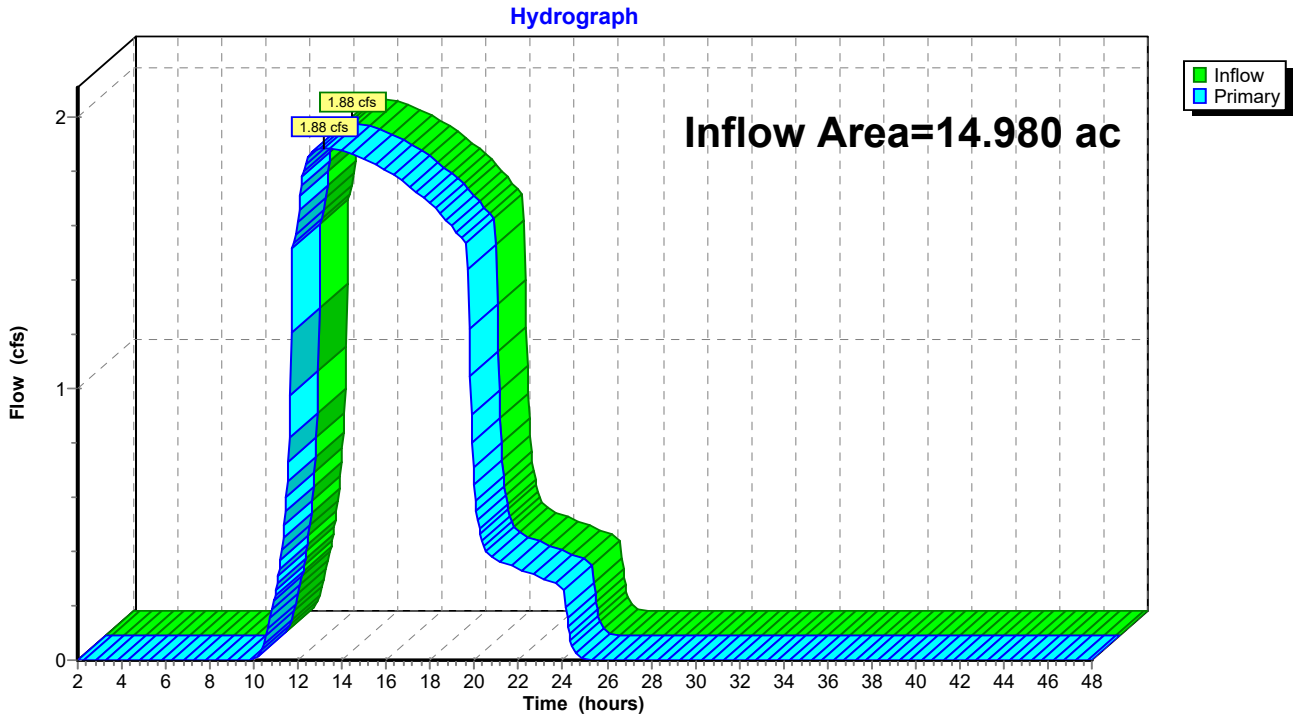
Pond 6P: WDB D-2



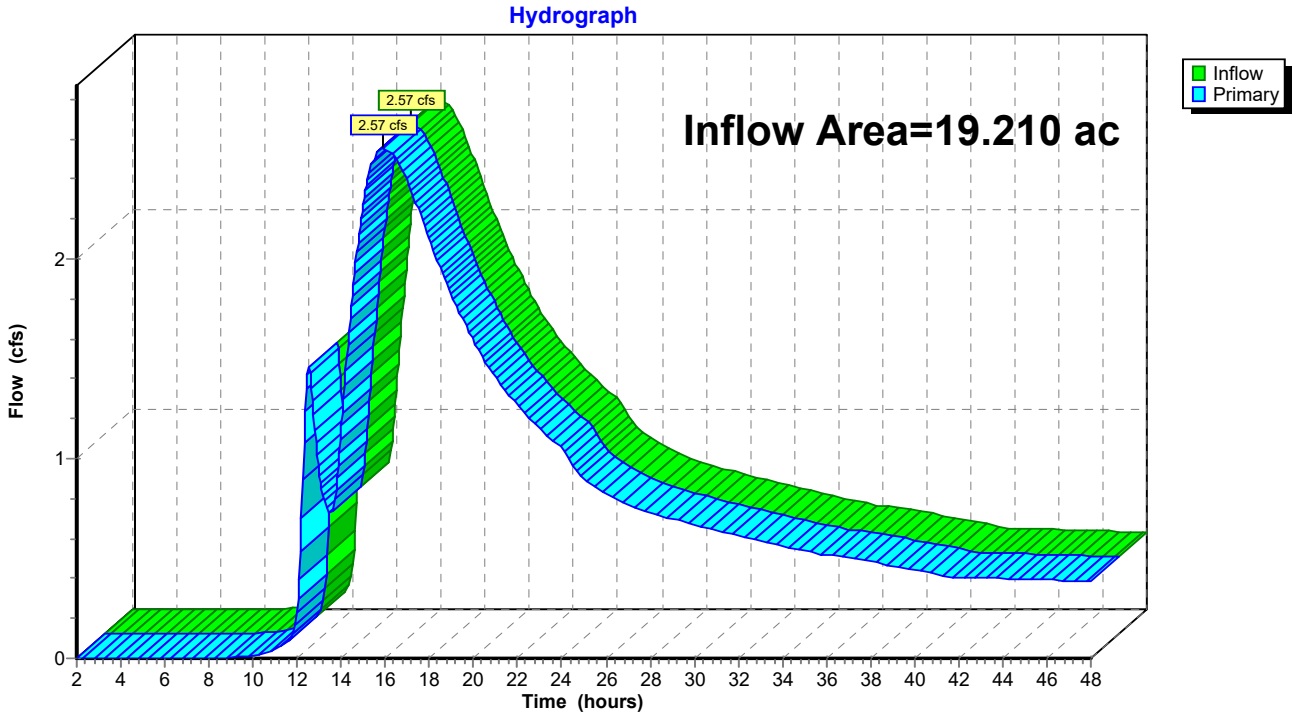
Pond 7P: RG D-3



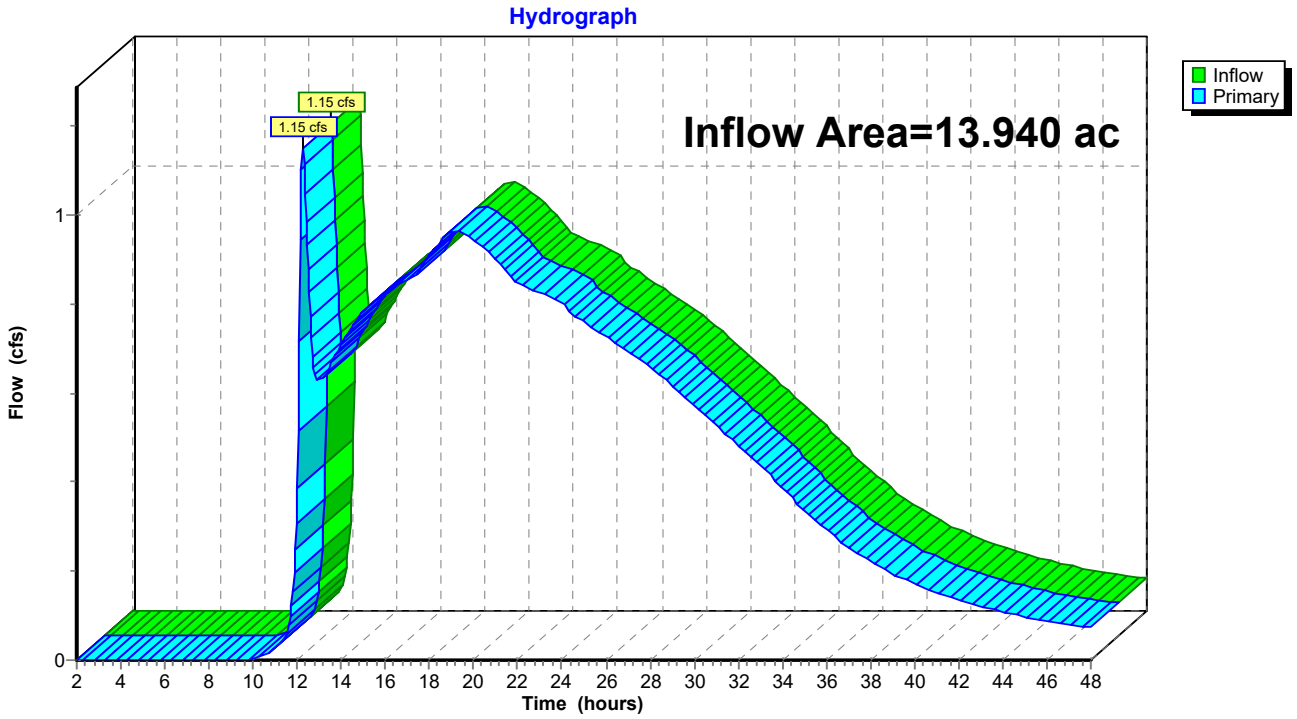
Link 1L: Design Point A



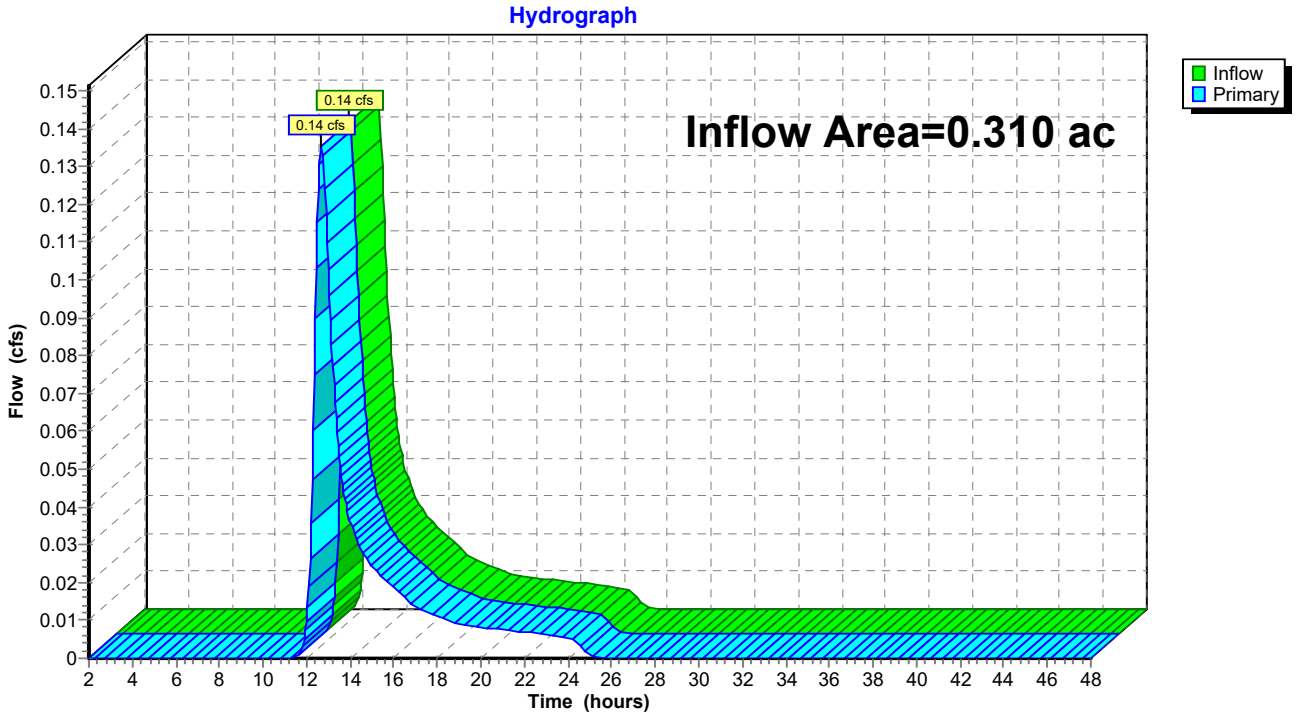
Link 2L: Design Point B



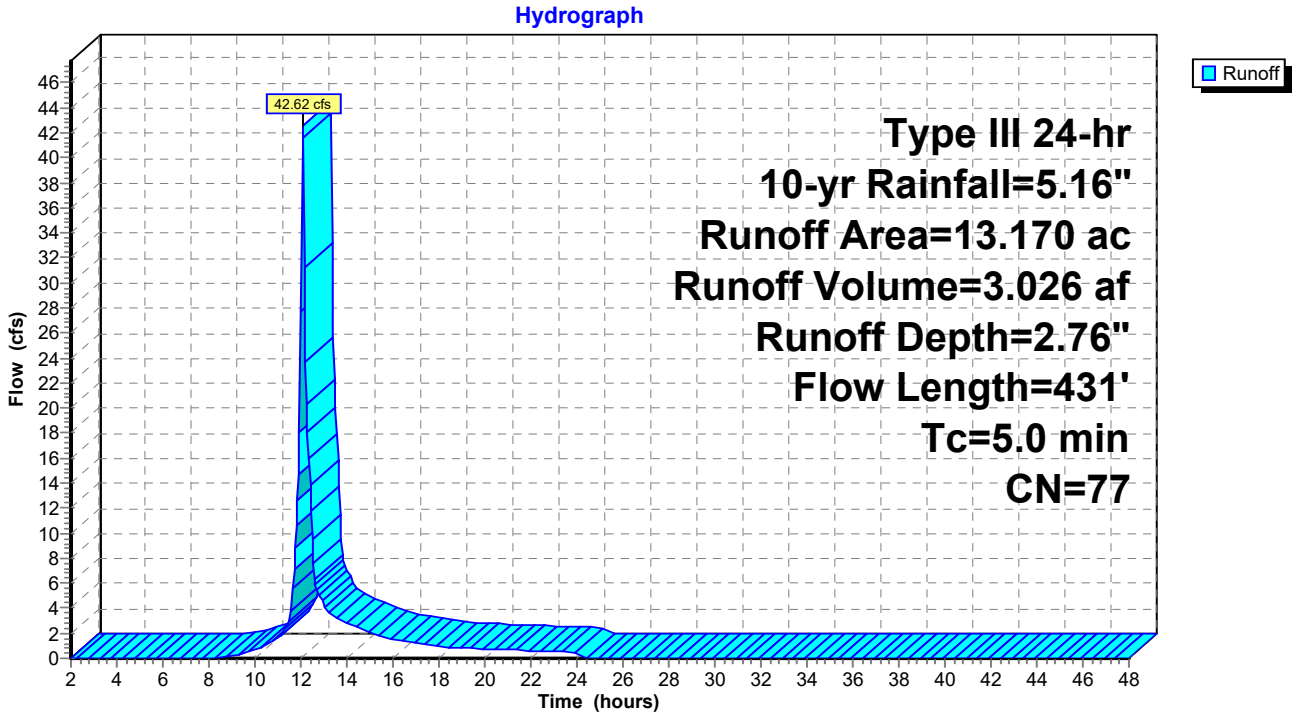
Link 3L: Design Point D



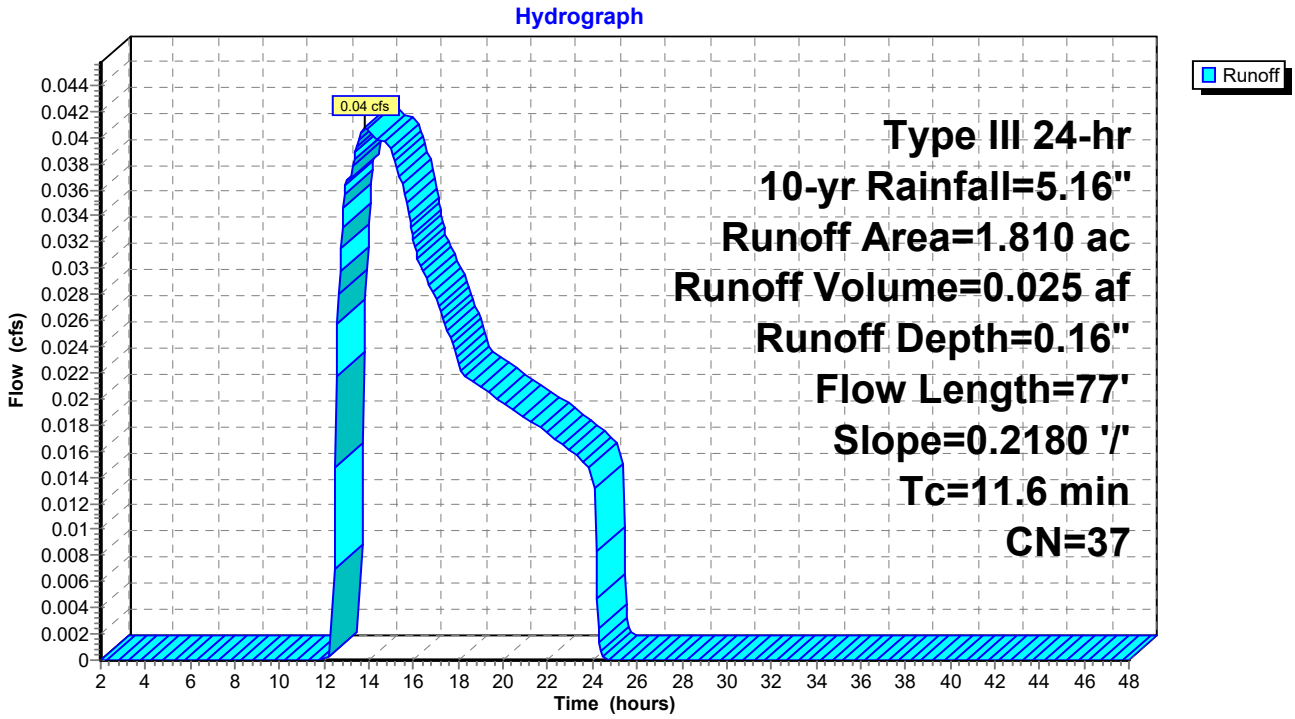
Link 4L: Design Point E



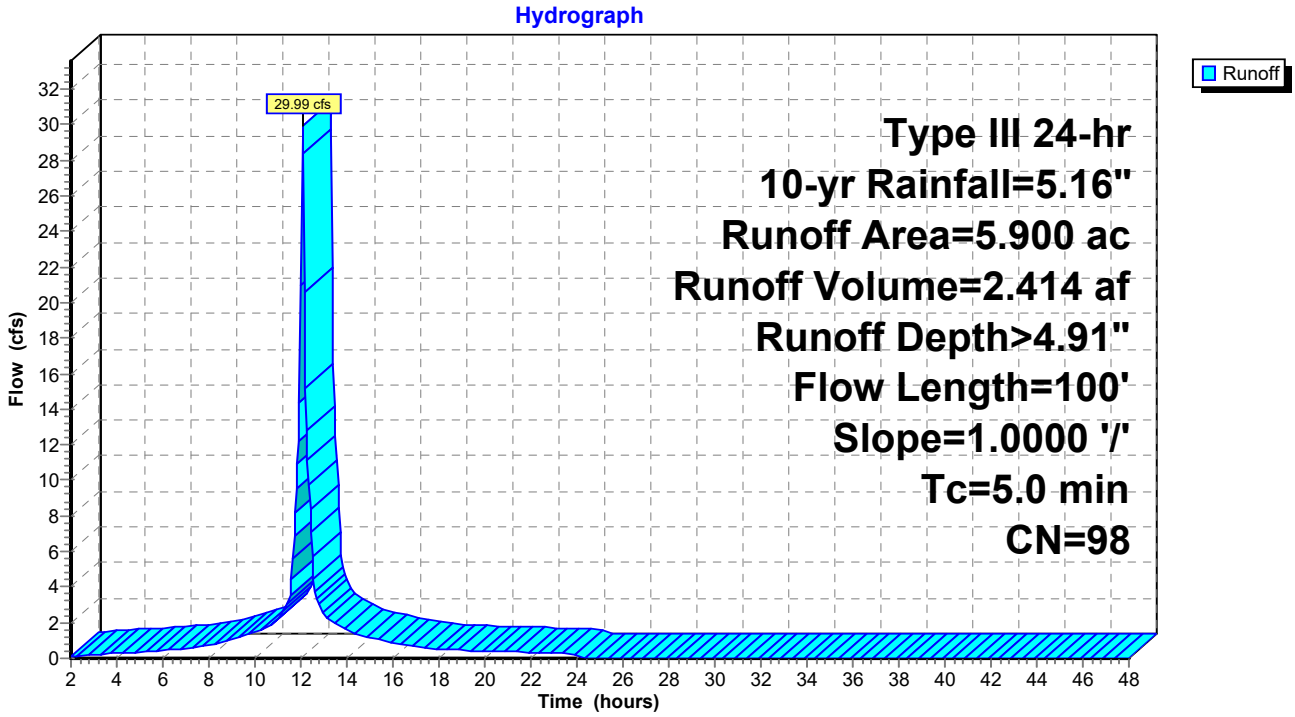
Subcatchment A-1: PR WS A-1



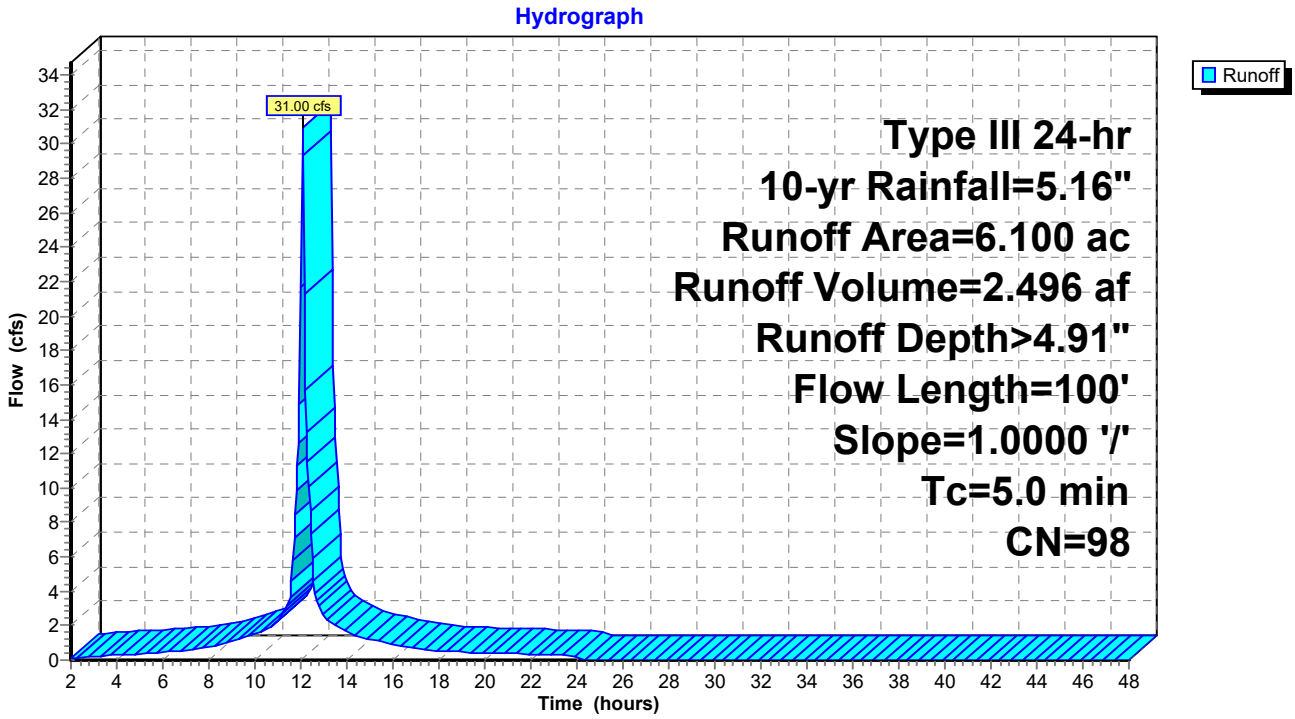
Subcatchment A-2: PR WS A-2



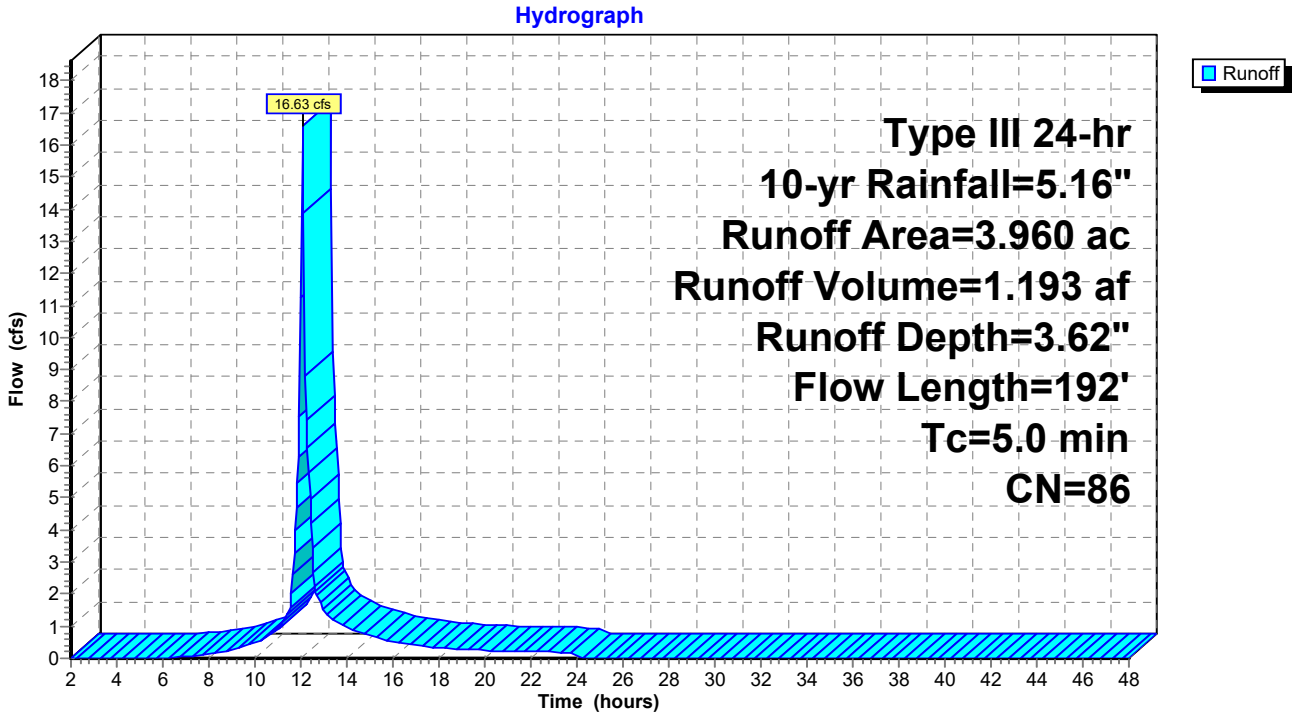
Subcatchment B-1: PR WS B-1



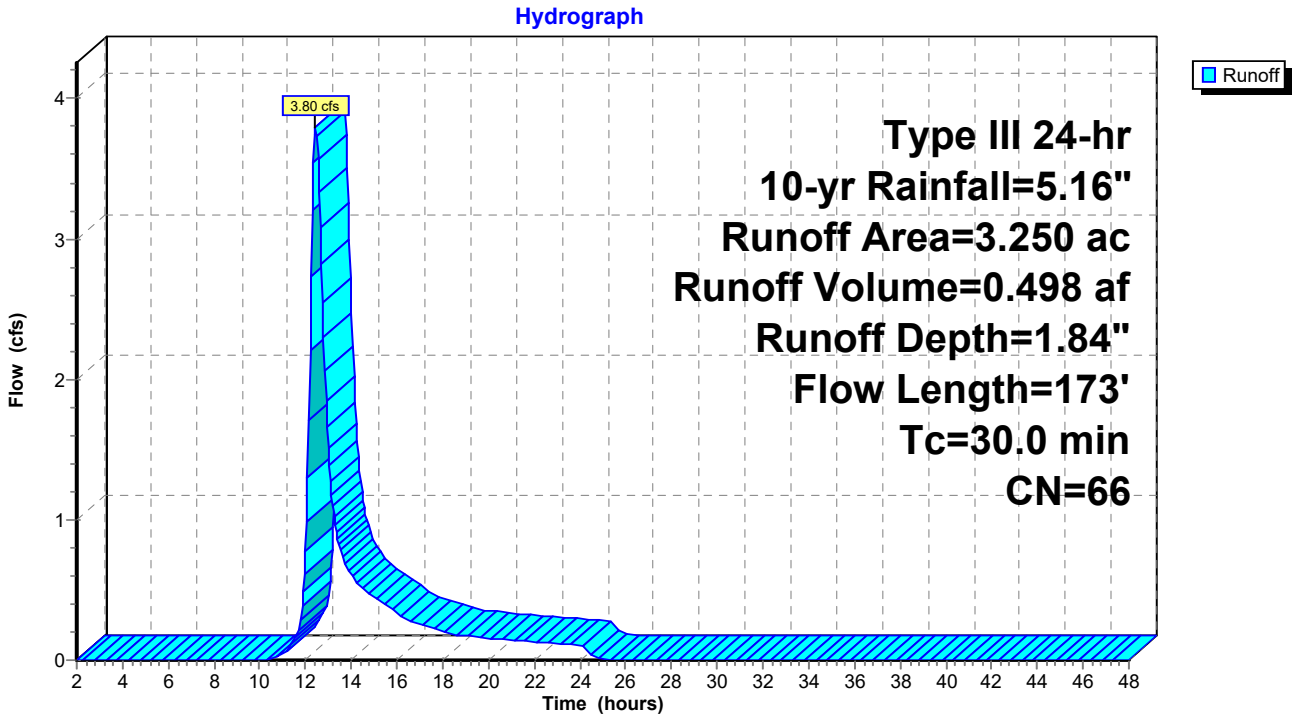
Subcatchment B-2: PR WS B-2



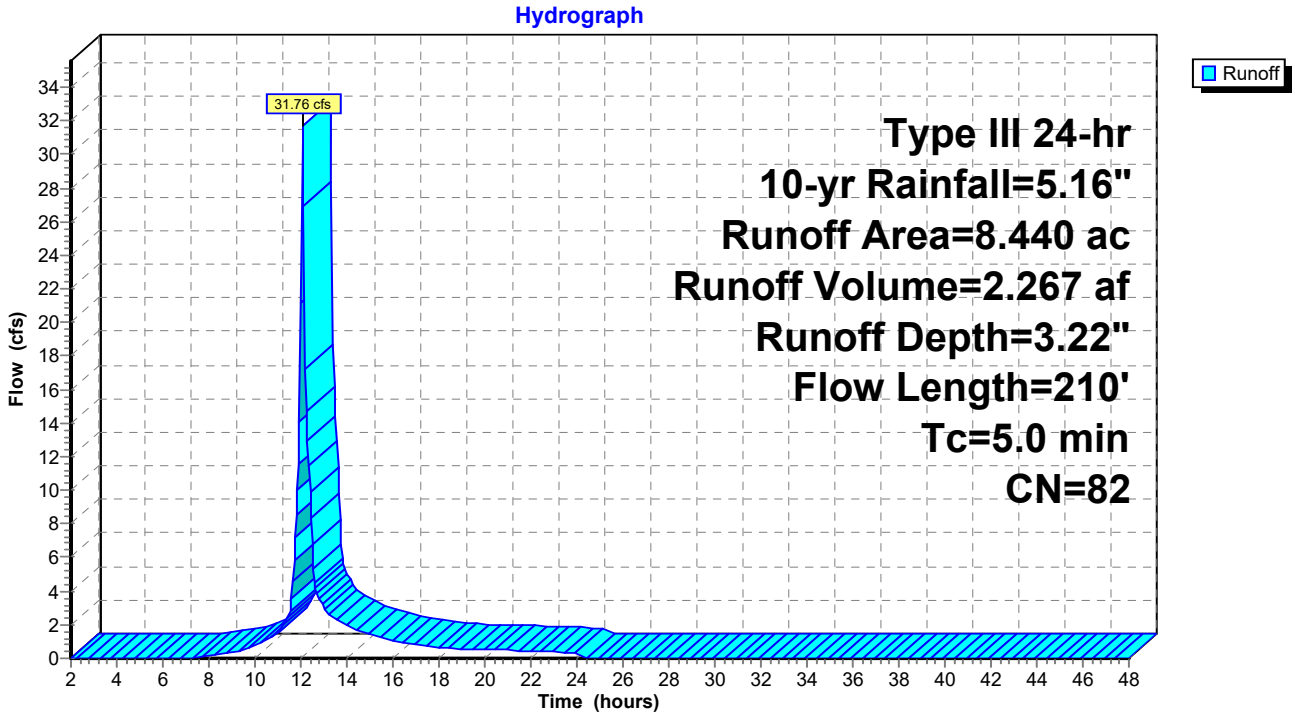
Subcatchment B-3: PR WS B-3



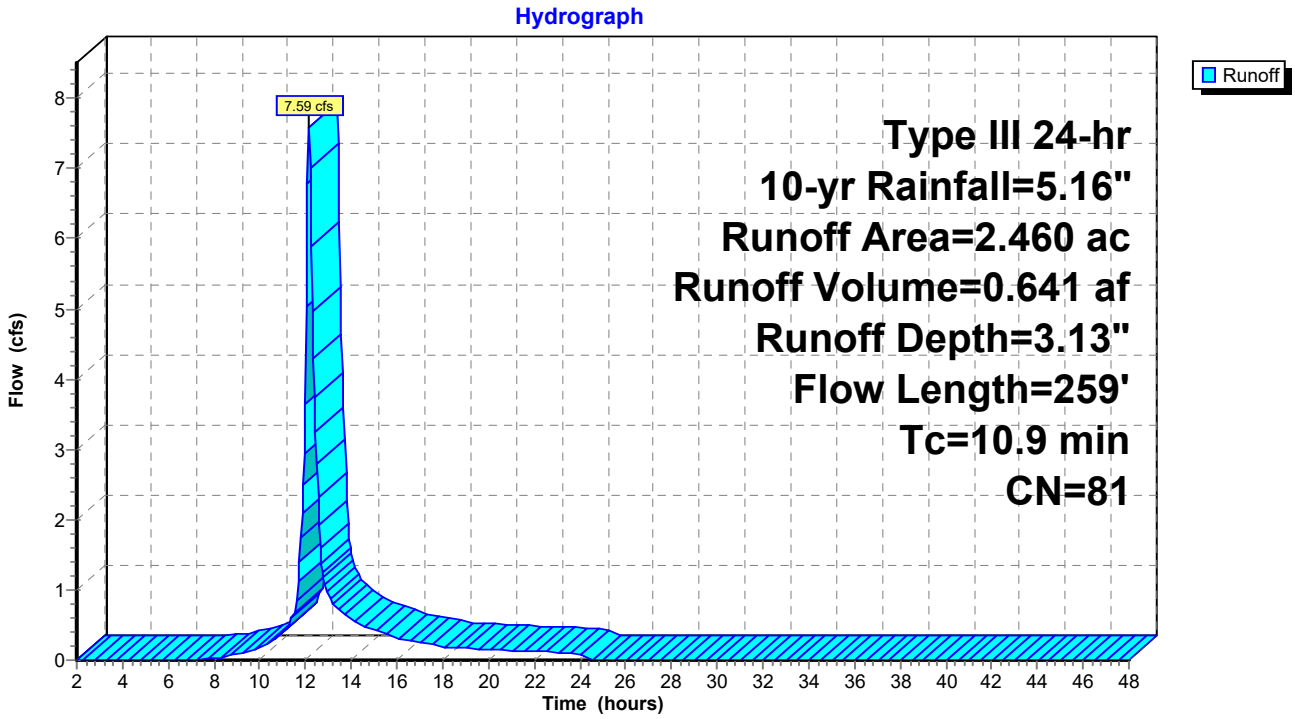
Subcatchment B-4: PR WS B-4



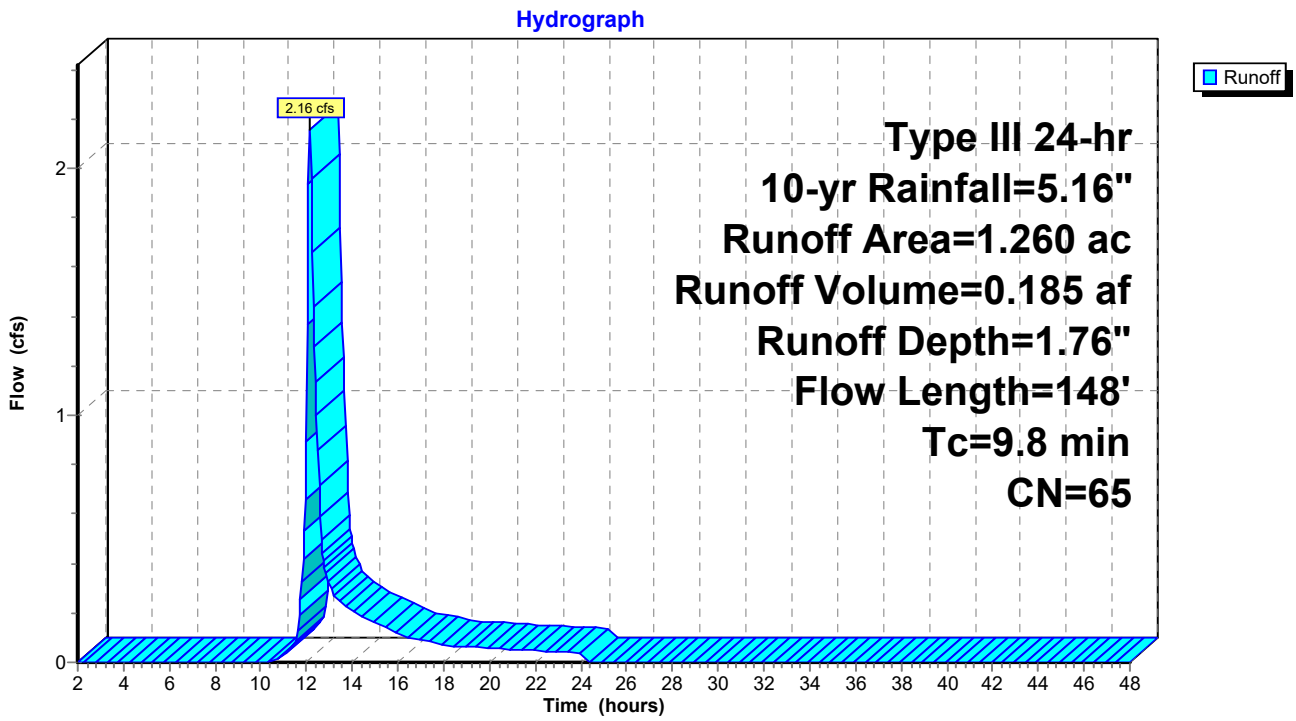
Subcatchment D-1: PR WS D-1



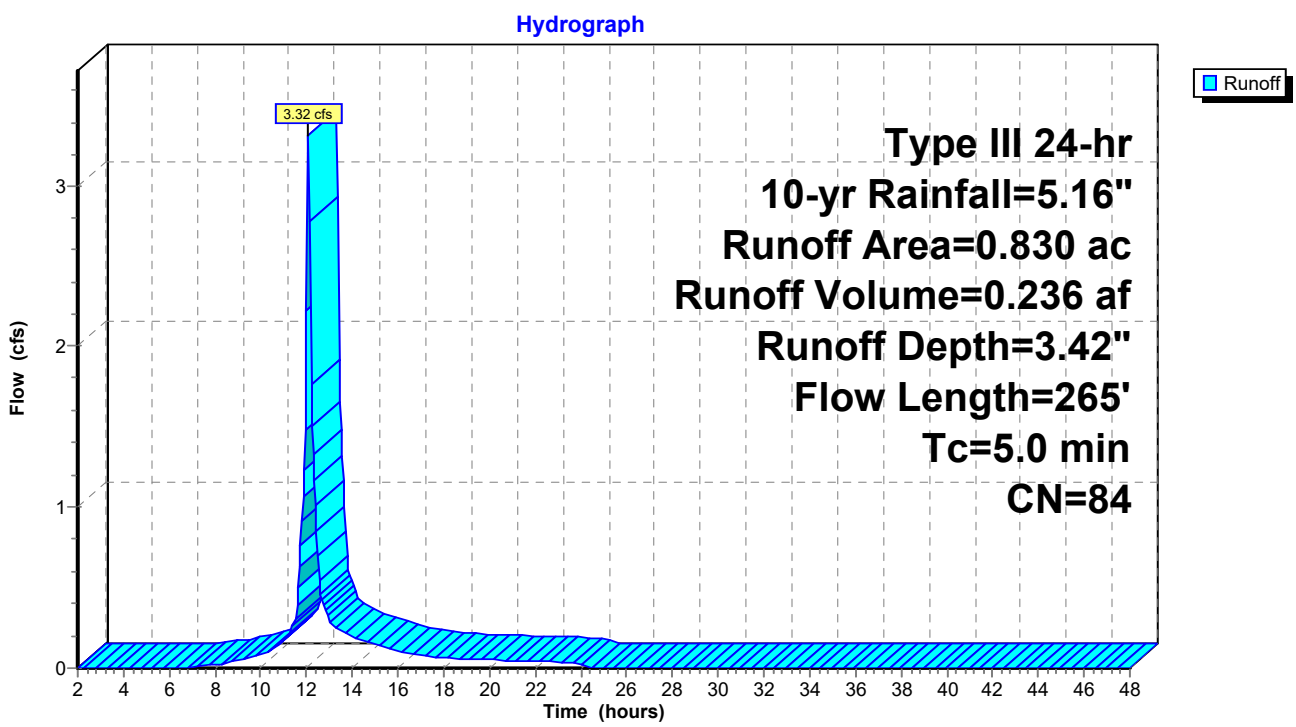
Subcatchment D-2: PR WS D-2



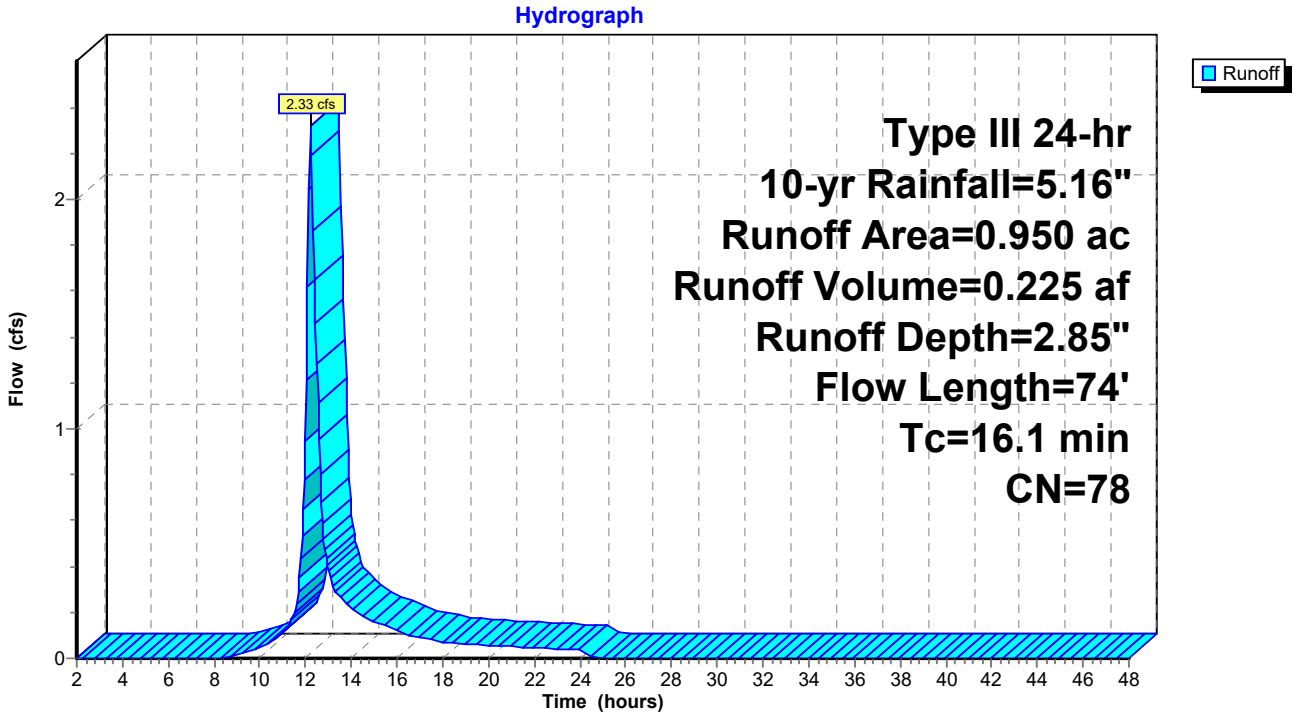
Subcatchment D-2.1: PR-WS D-2.1



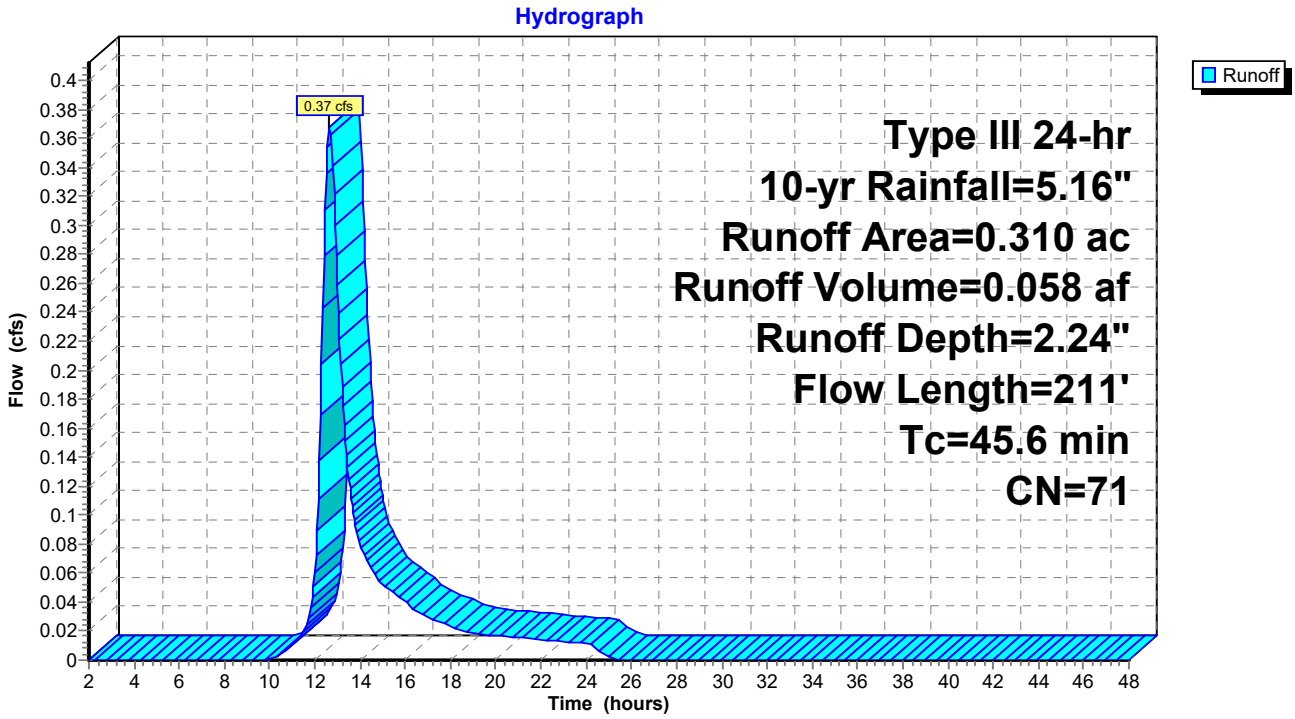
Subcatchment D-3: PR-WS D-3



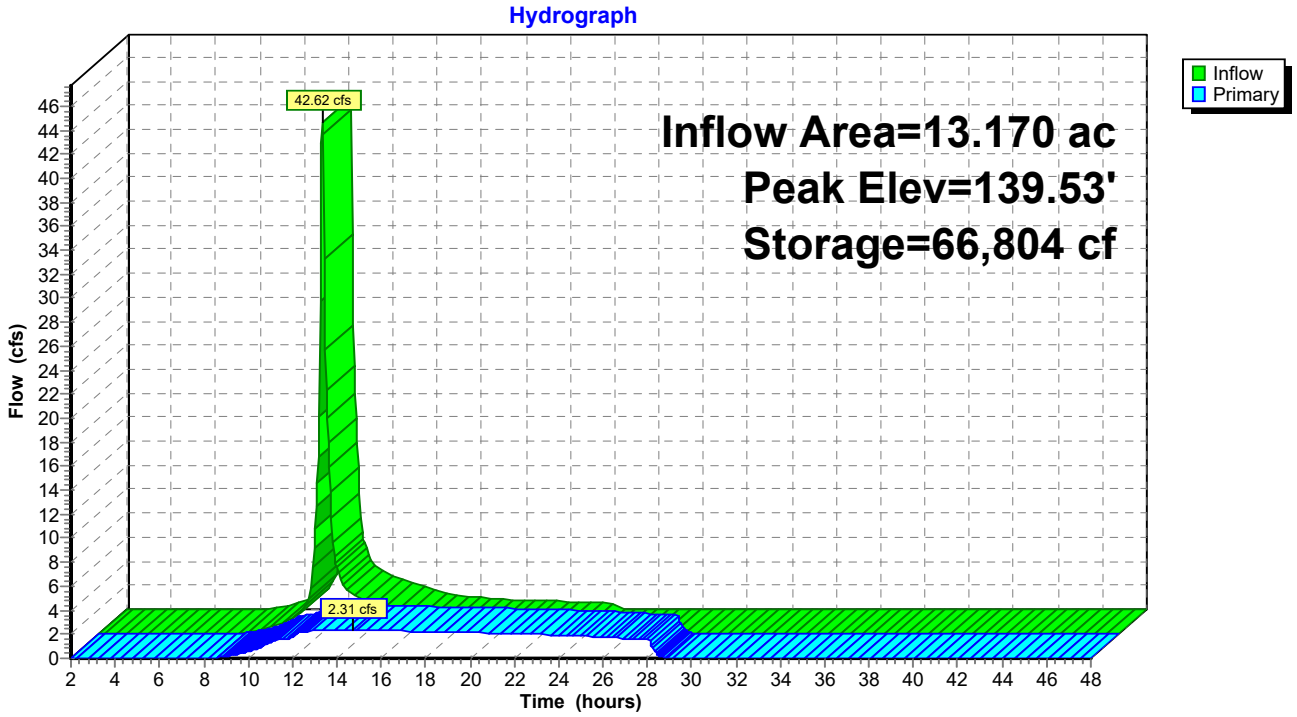
Subcatchment D-4: PR-WS D-4



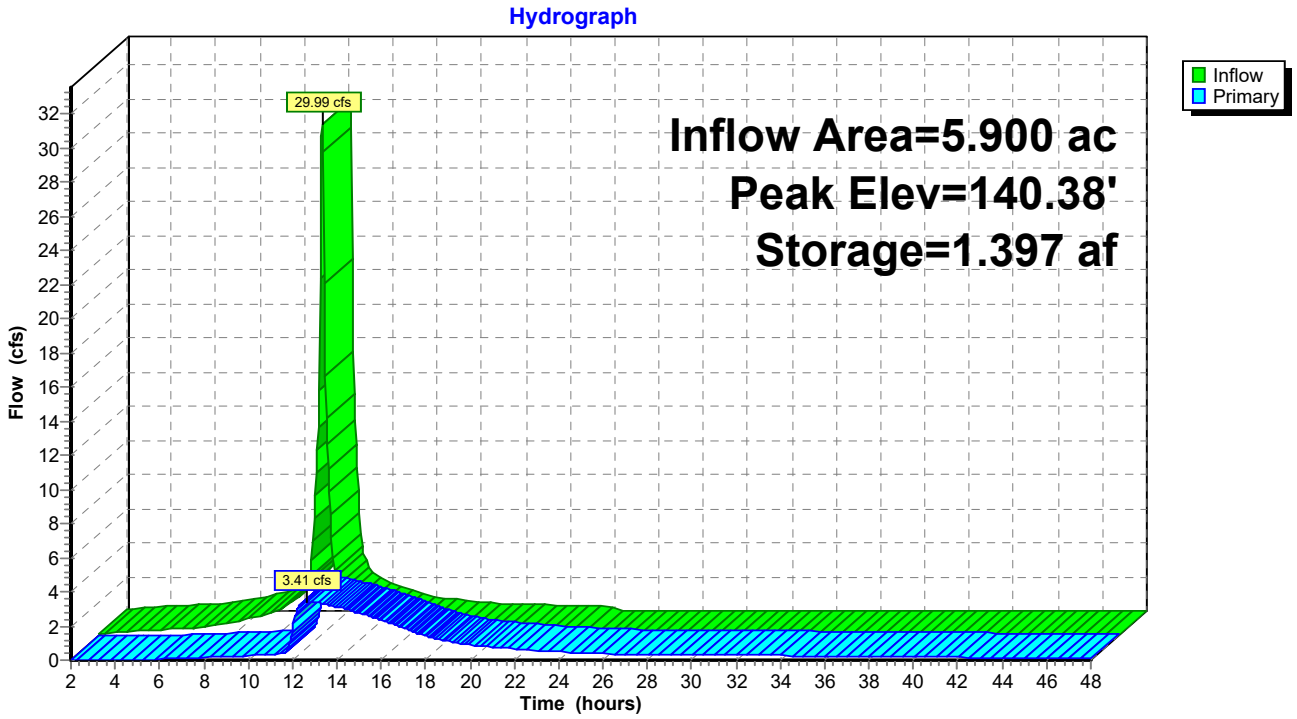
Subcatchment E: PR WS E



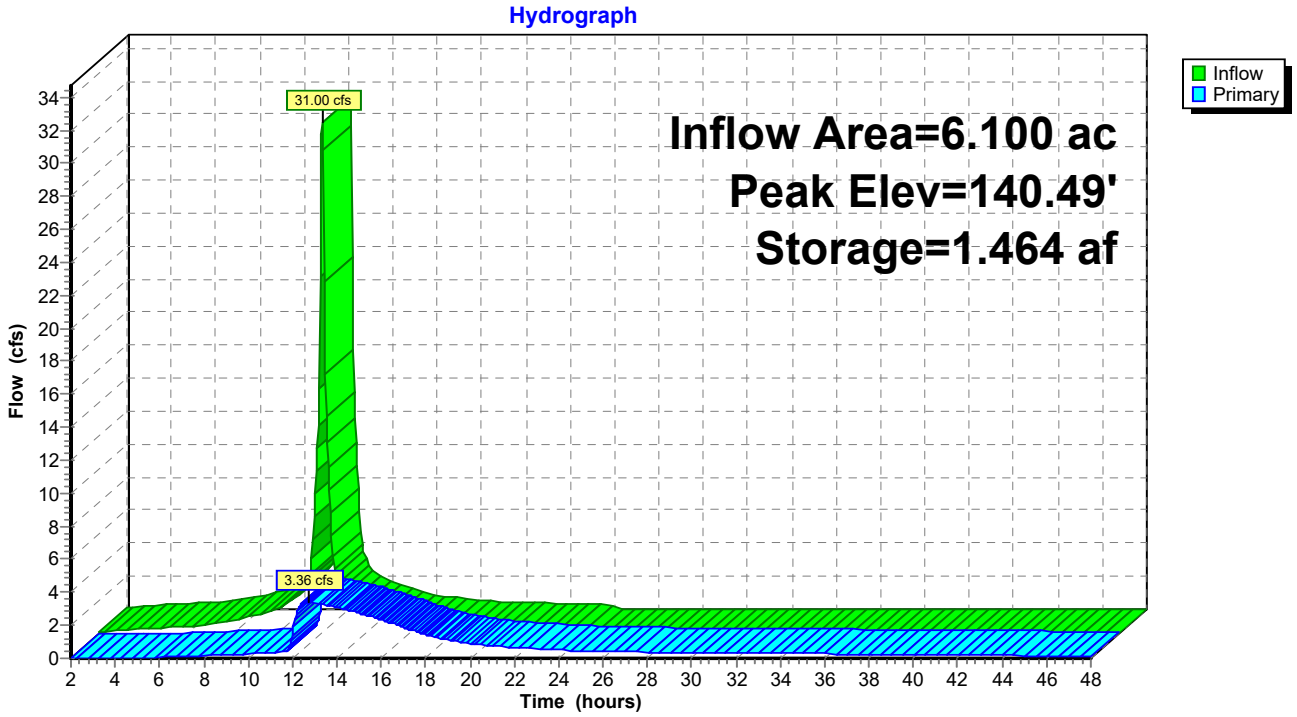
Pond 1P: Existing DB A-1



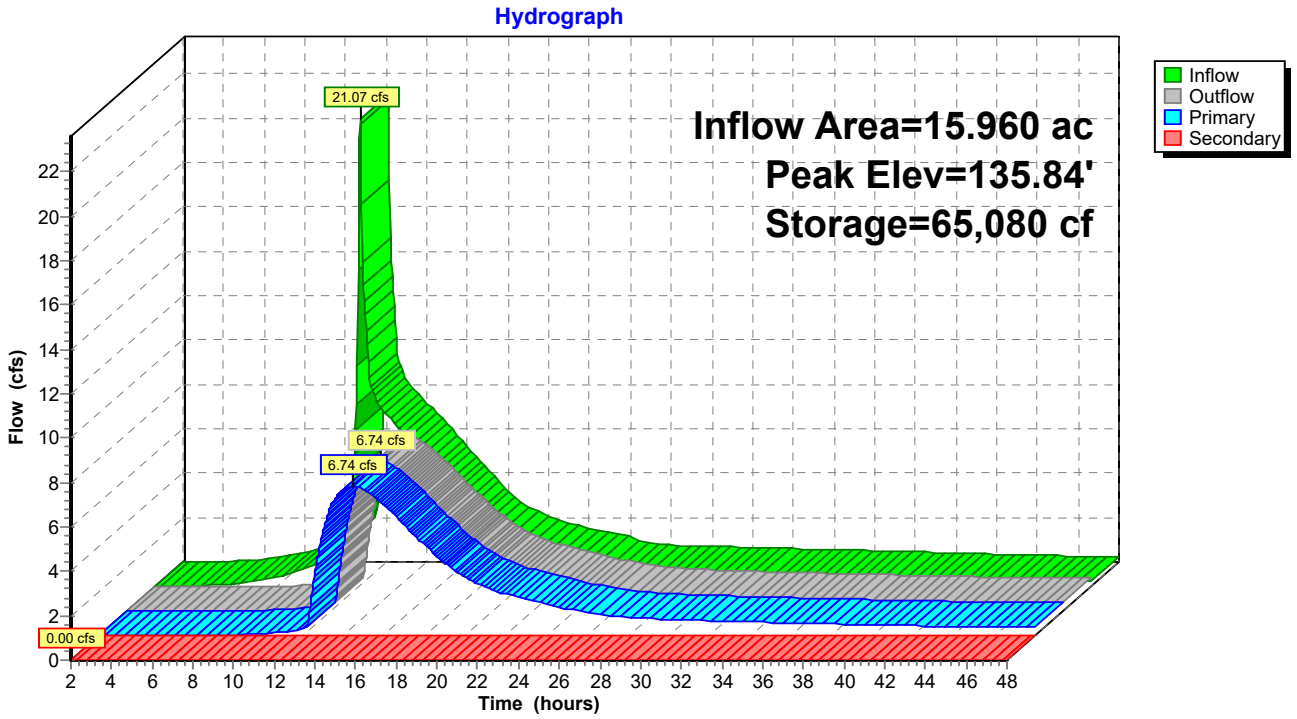
Pond 2P: UDB B-1



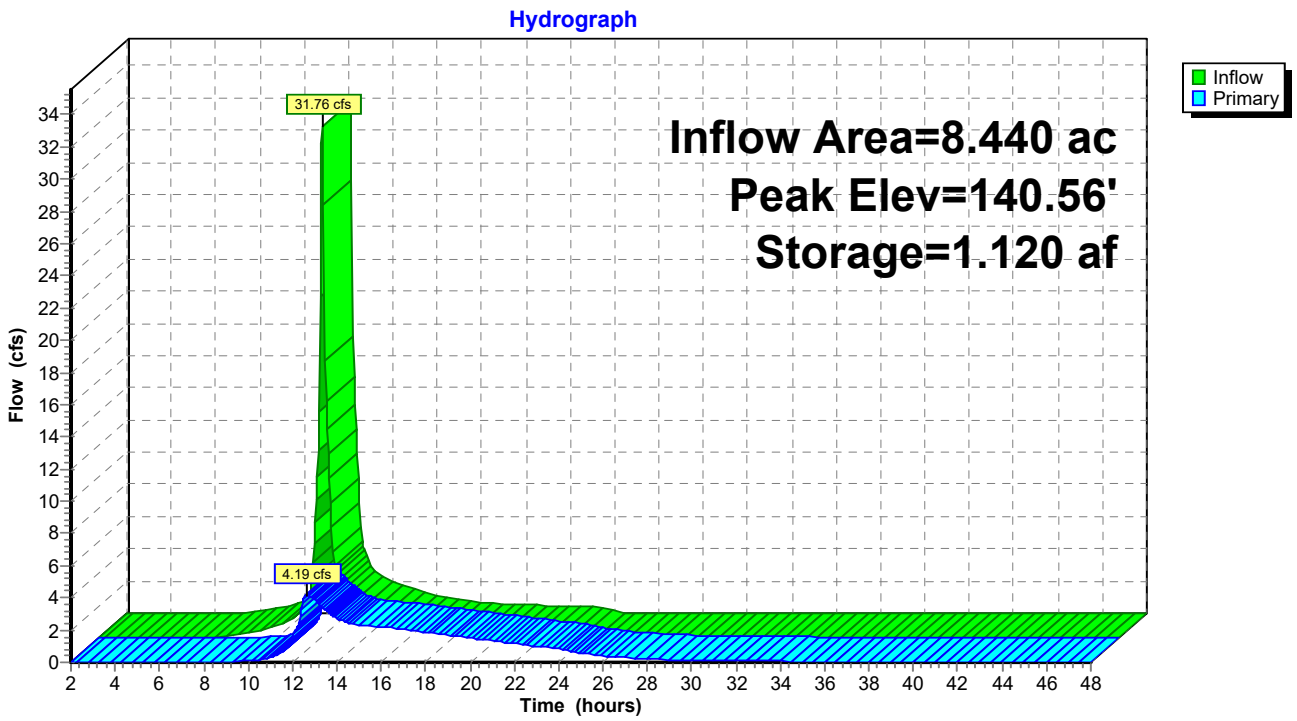
Pond 3P: UDB B-2



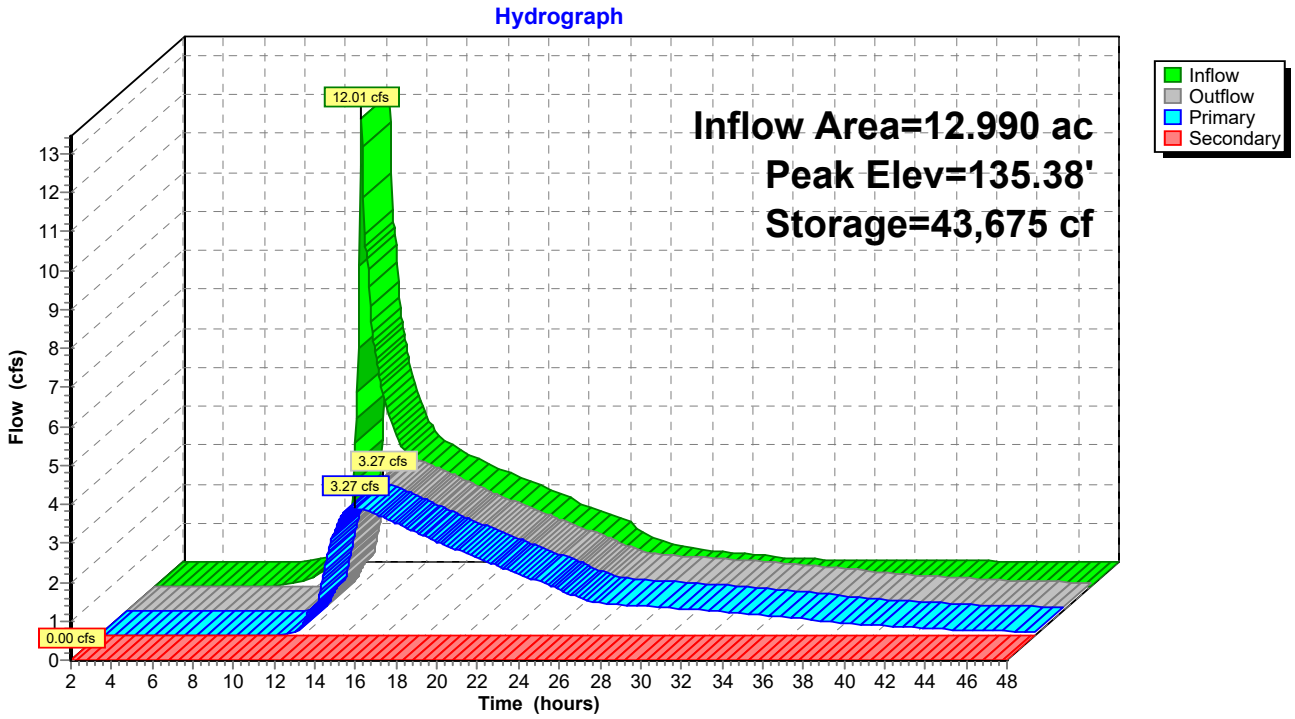
Pond 4P: WDB B-3



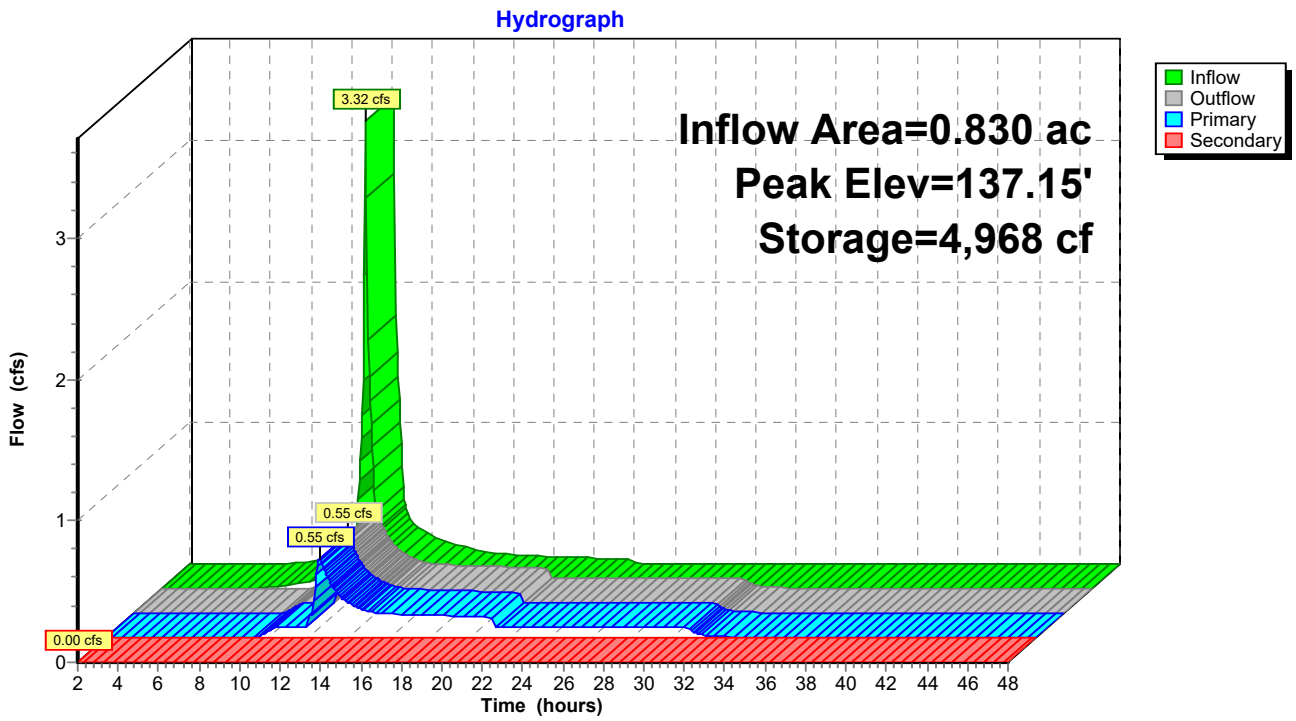
Pond 5P: UDB D-1



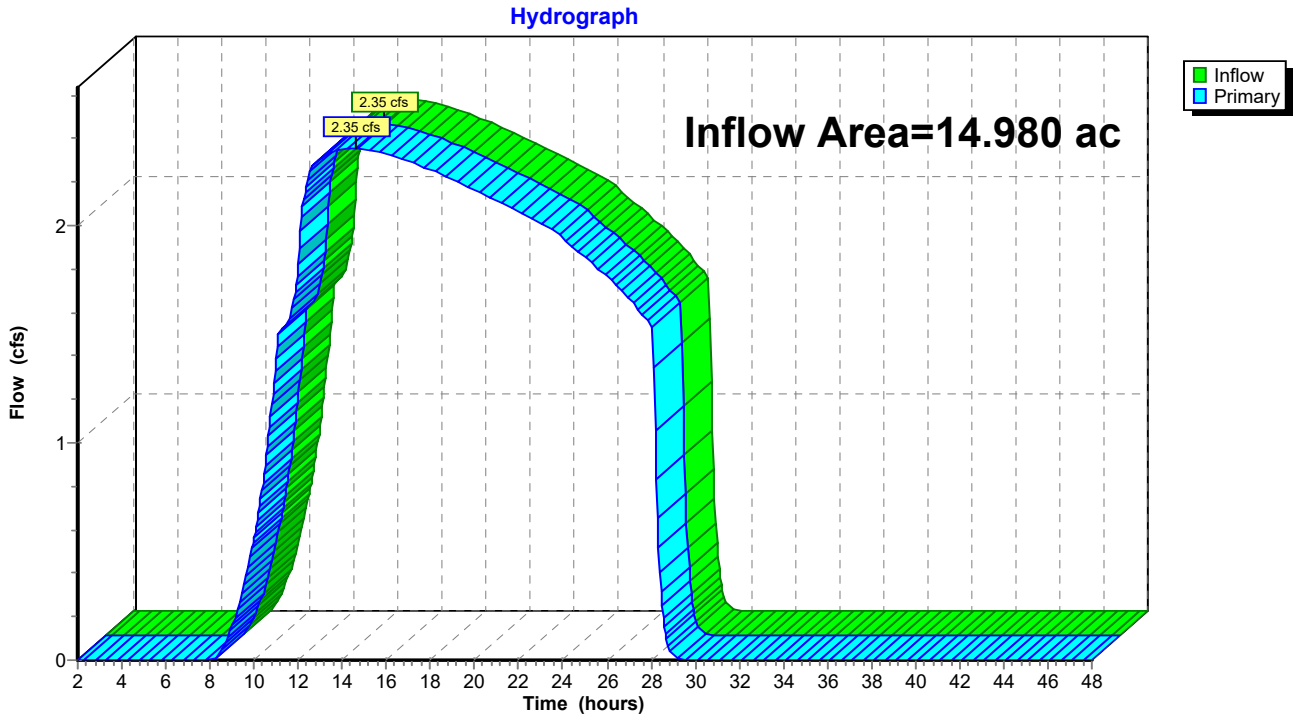
Pond 6P: WDB D-2



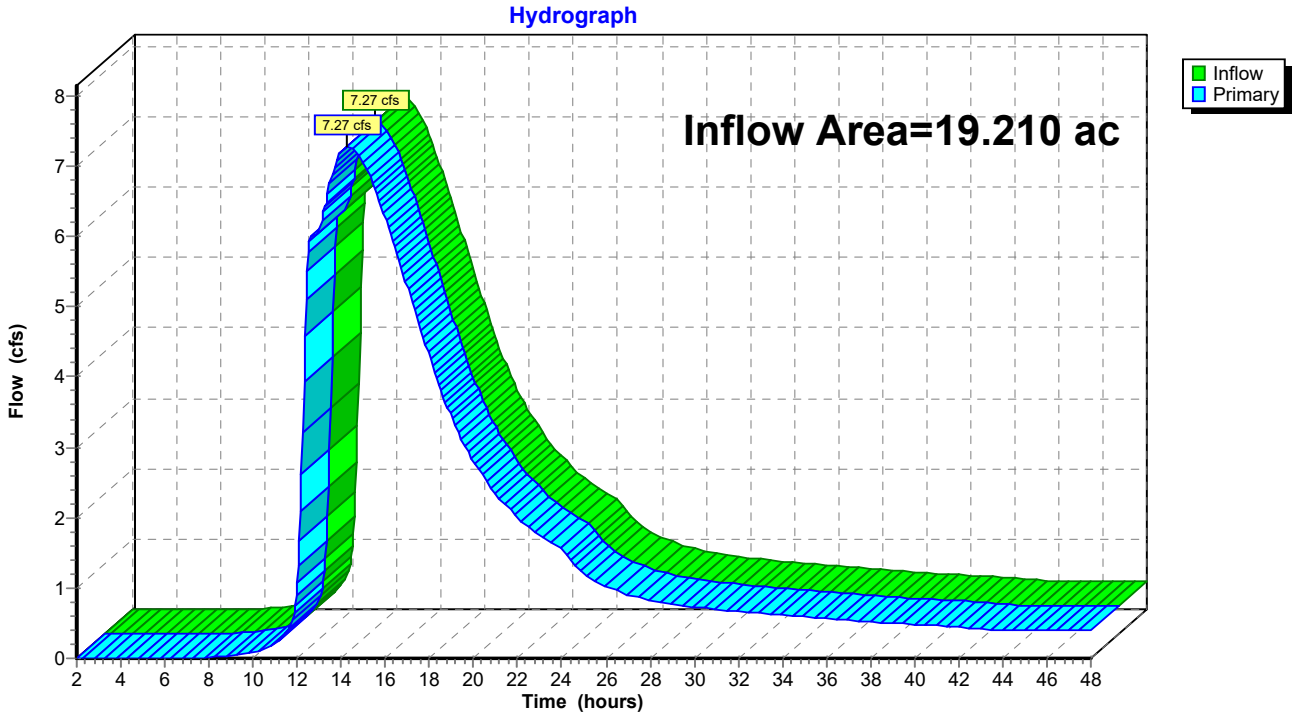
Pond 7P: RG D-3



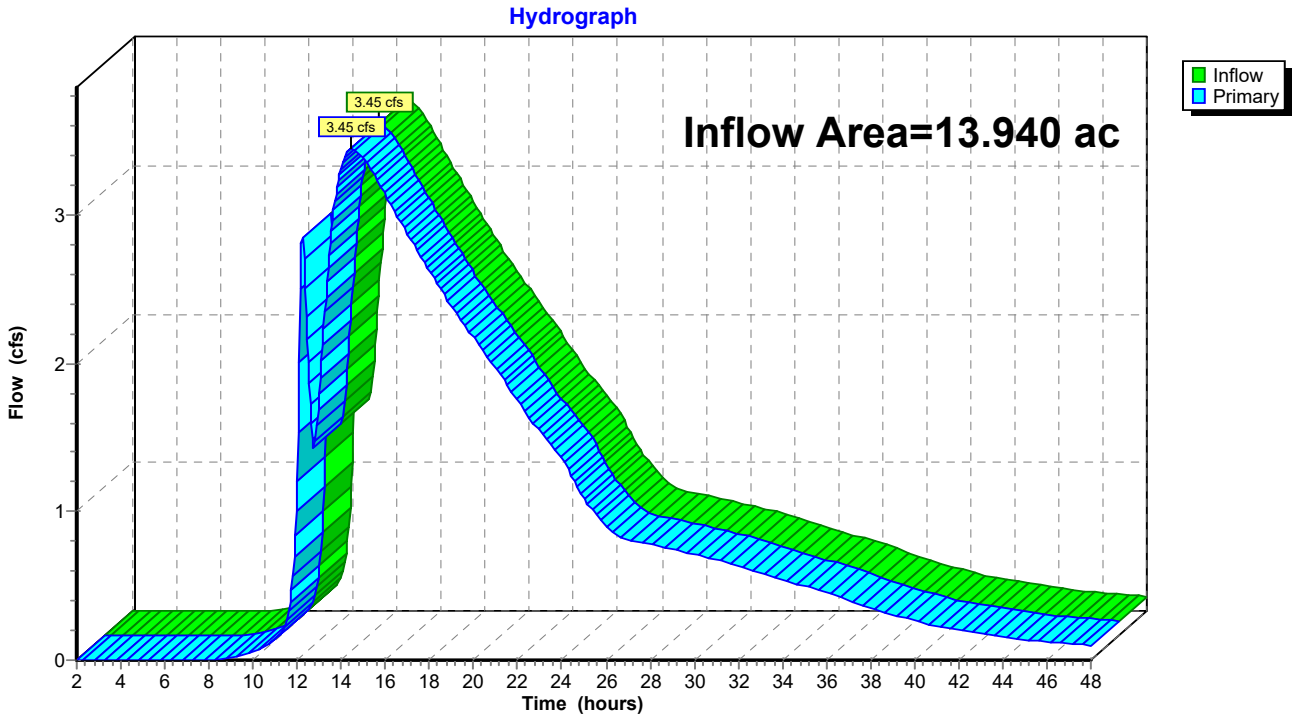
Link 1L: Design Point A



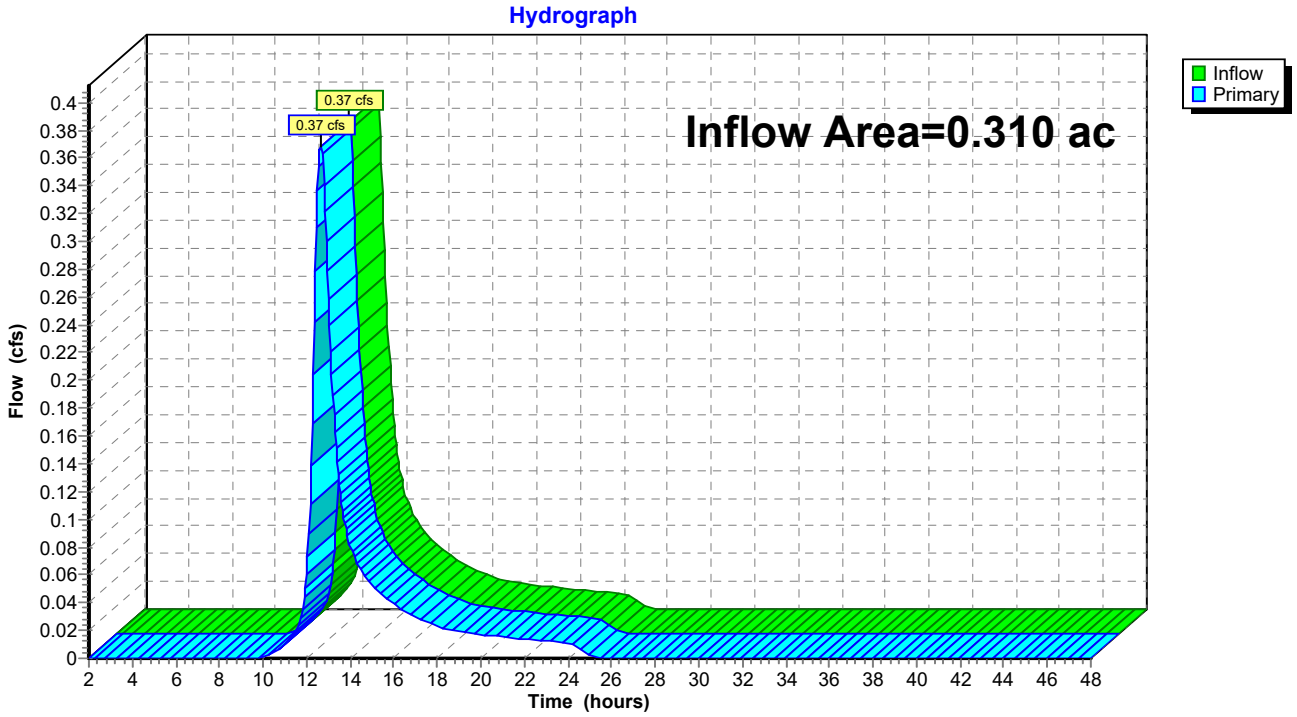
Link 2L: Design Point B



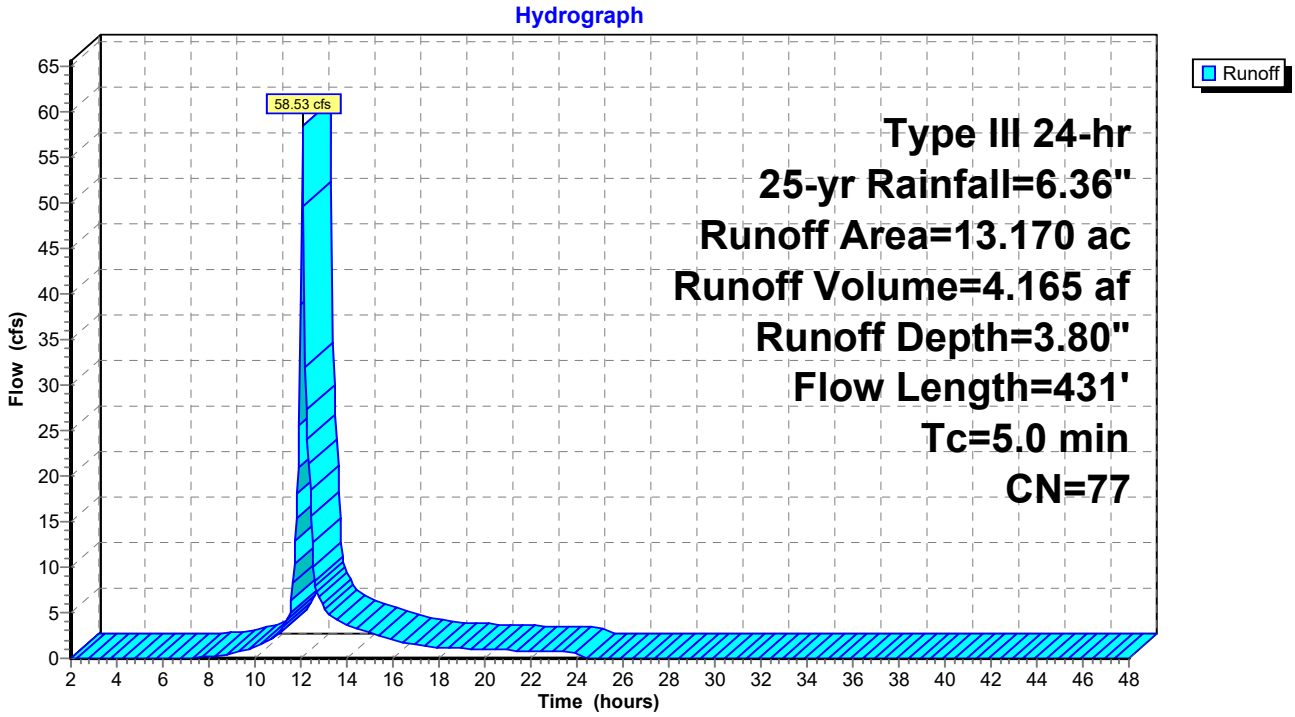
Link 3L: Design Point D



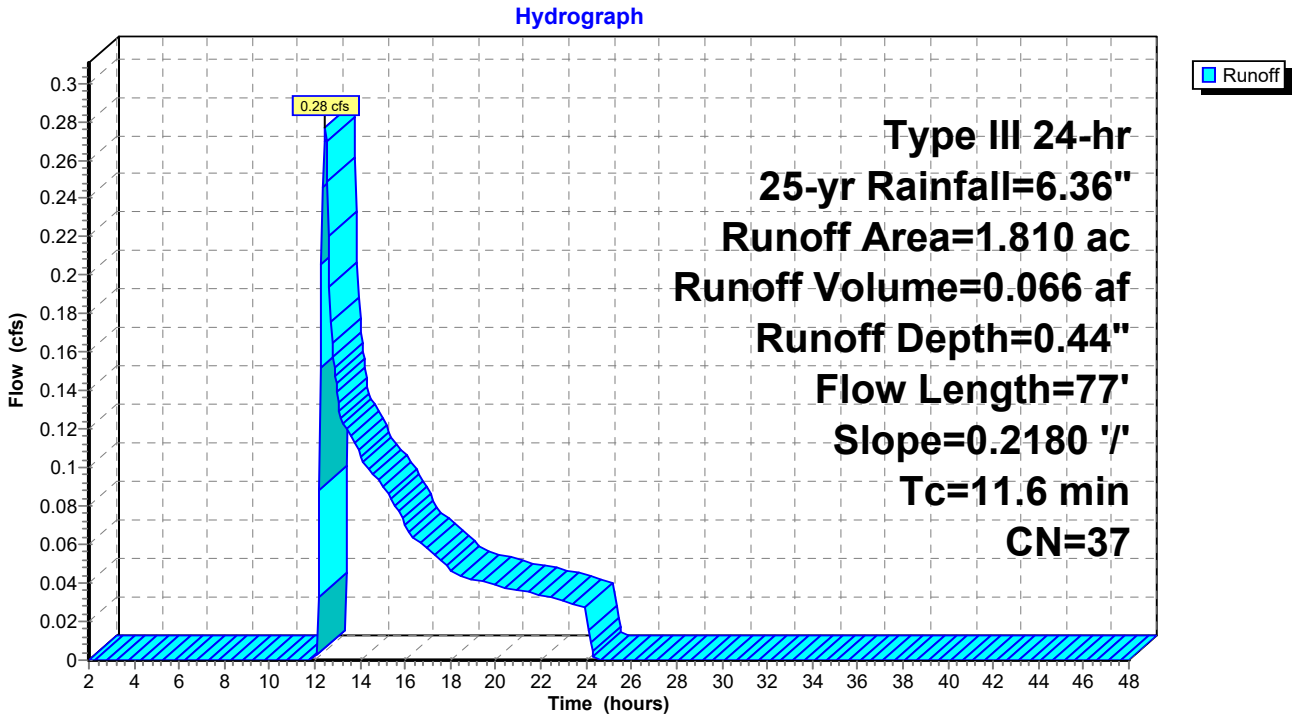
Link 4L: Design Point E



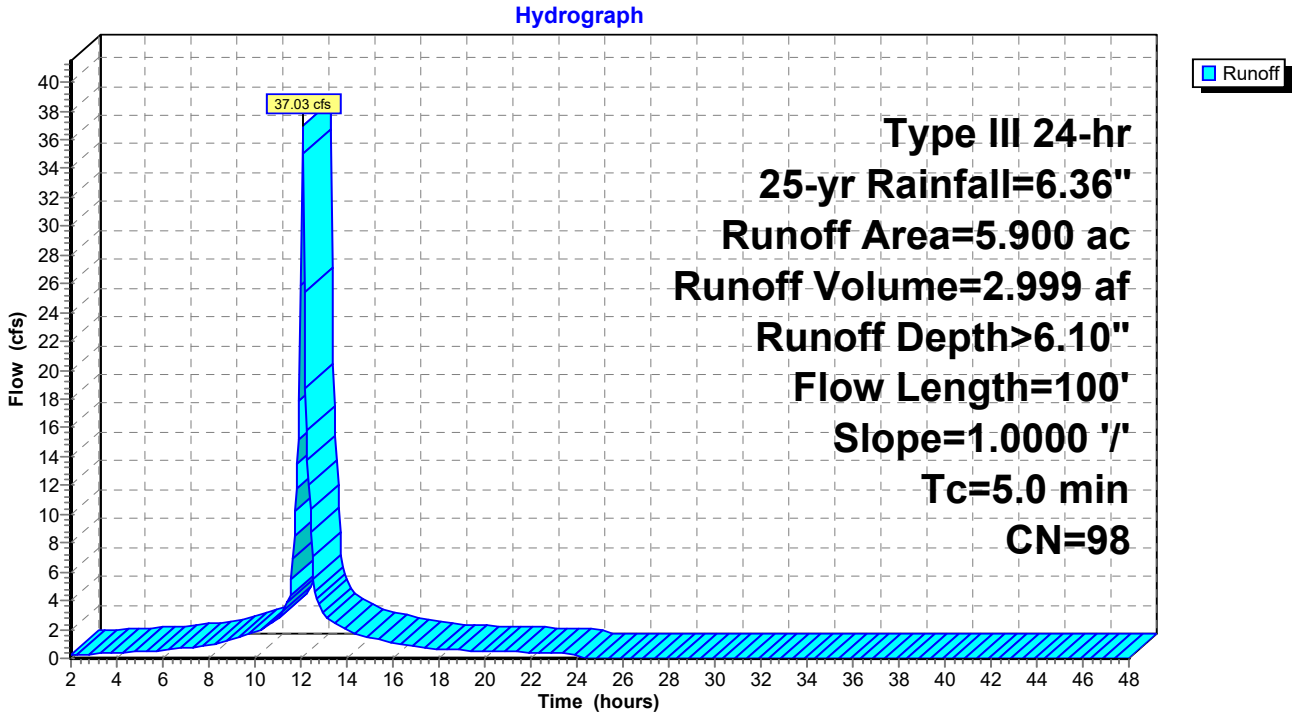
Subcatchment A-1: PR WS A-1



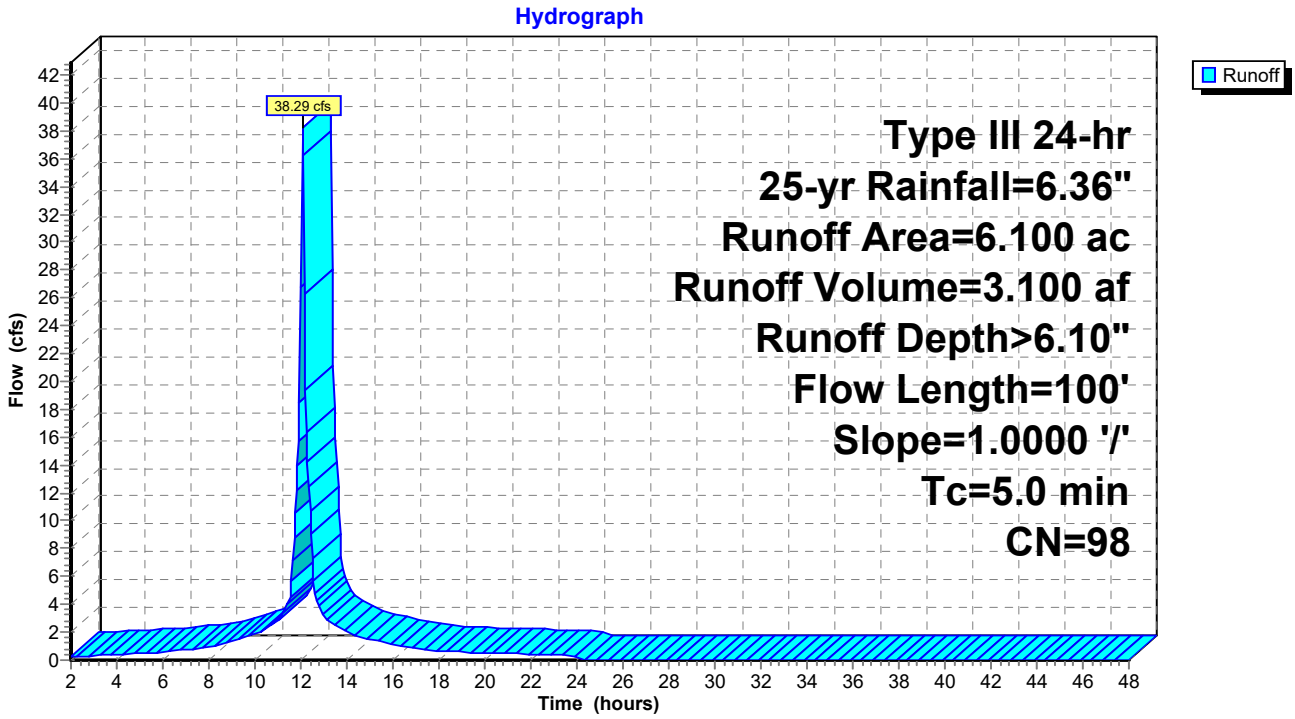
Subcatchment A-2: PR WS A-2



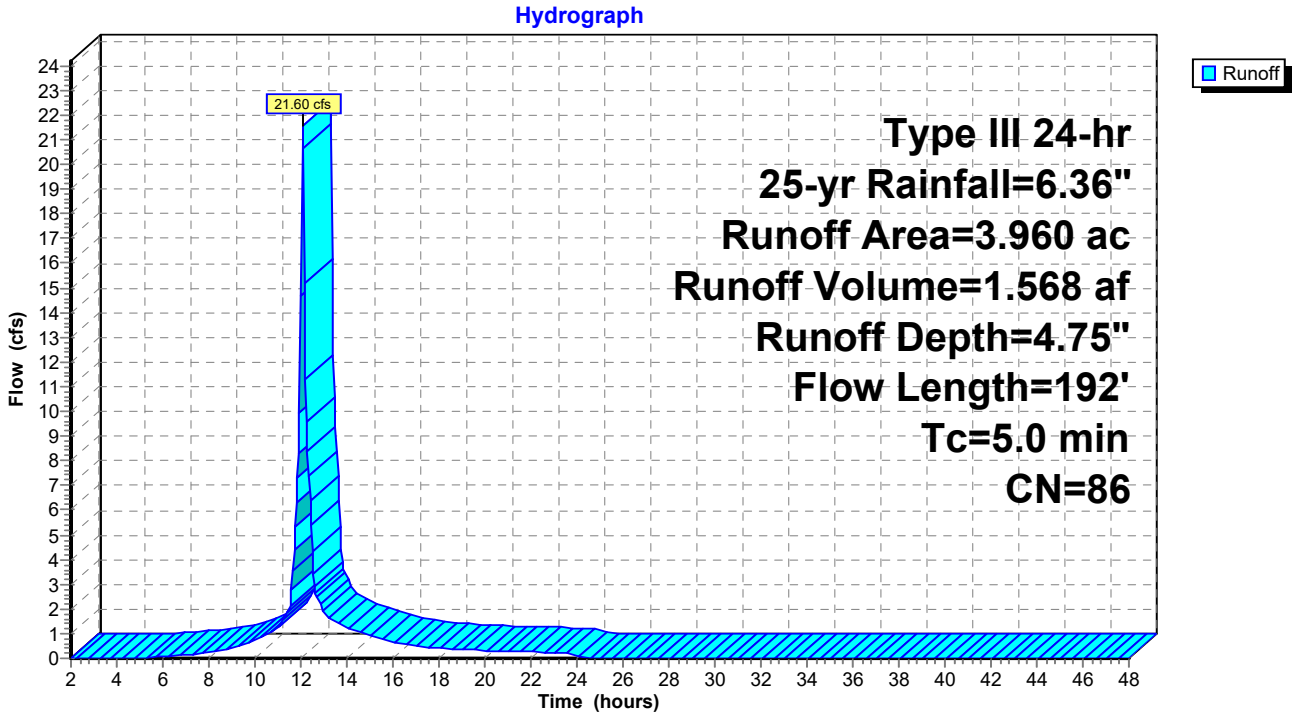
Subcatchment B-1: PR WS B-1



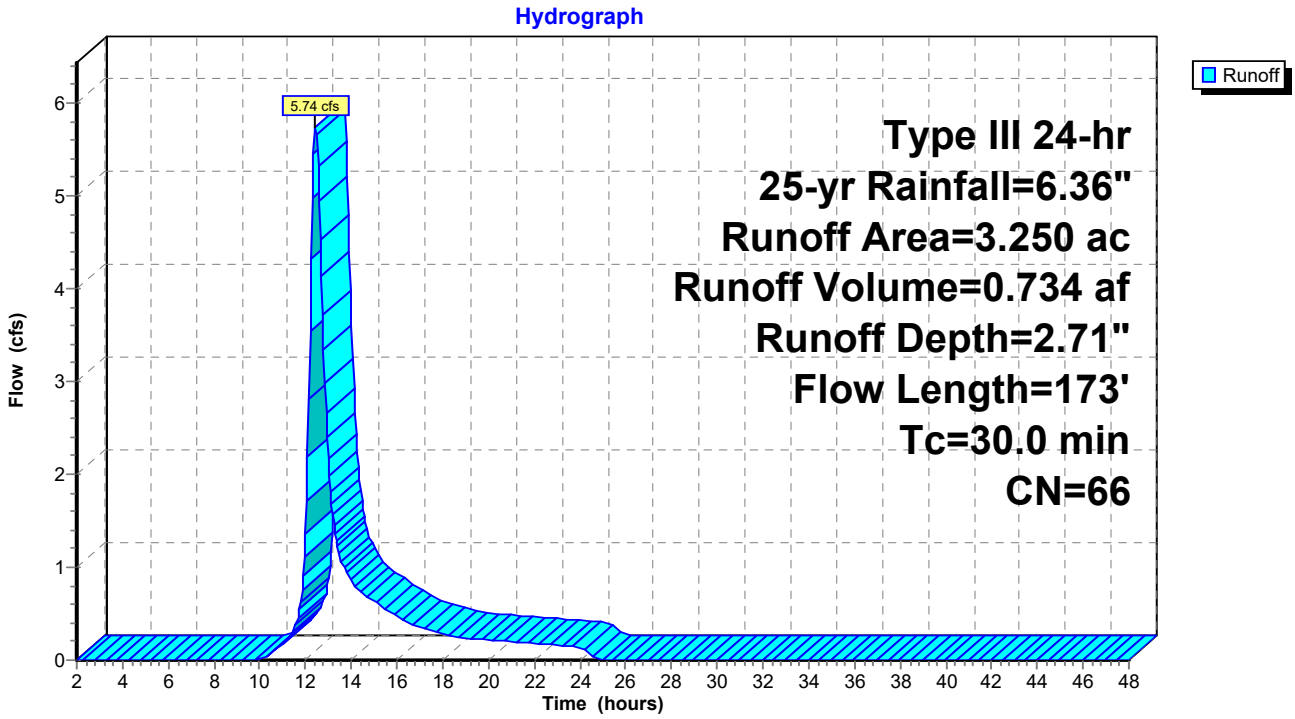
Subcatchment B-2: PR WS B-2



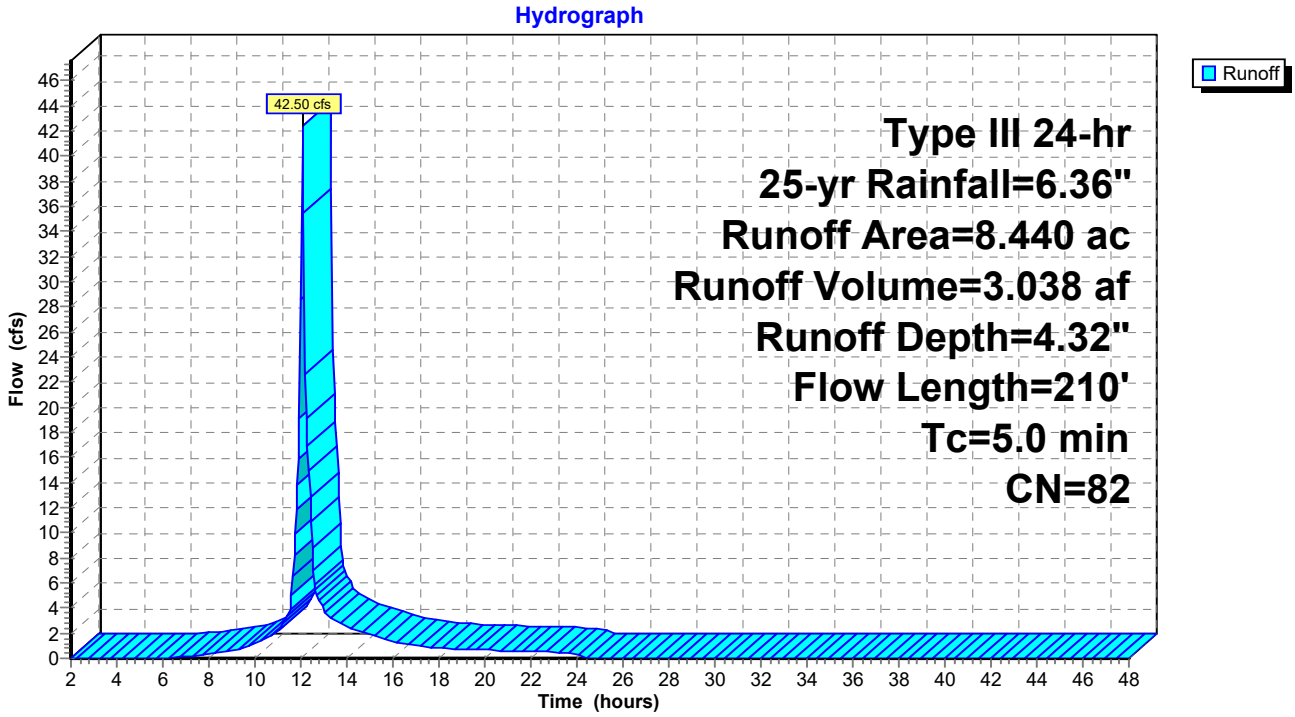
Subcatchment B-3: PR WS B-3



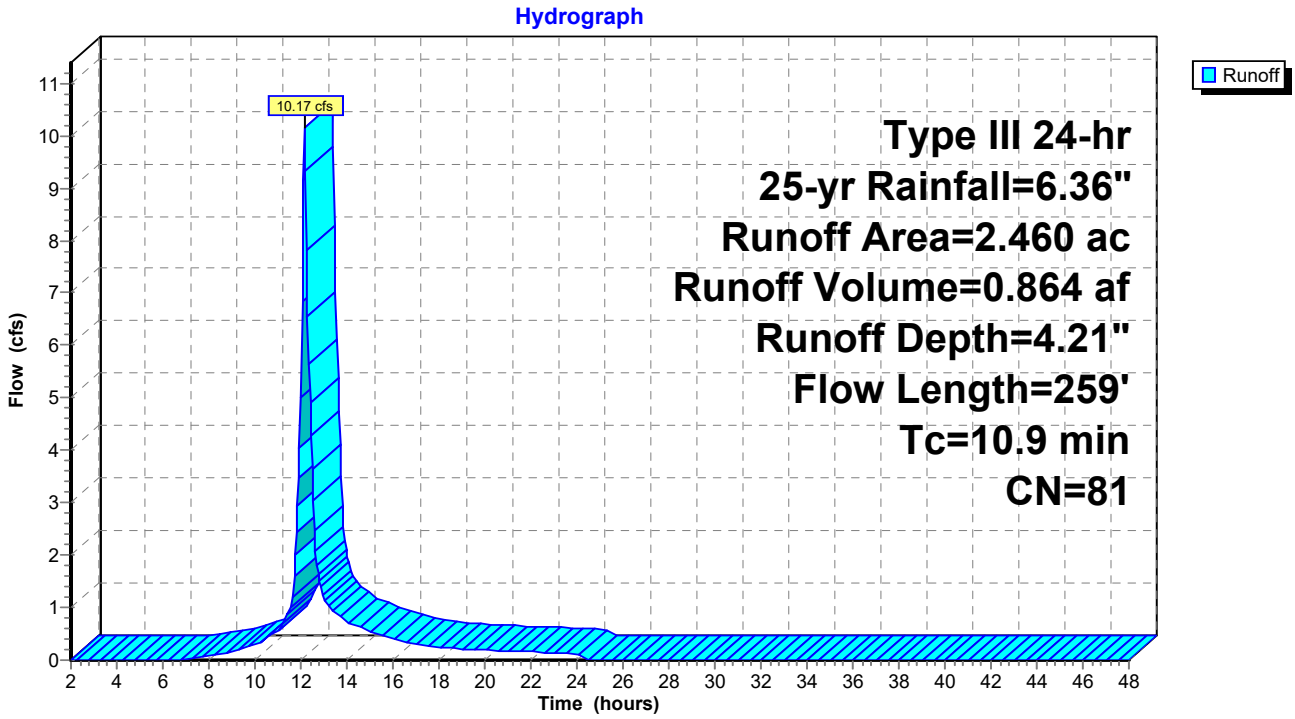
Subcatchment B-4: PR WS B-4



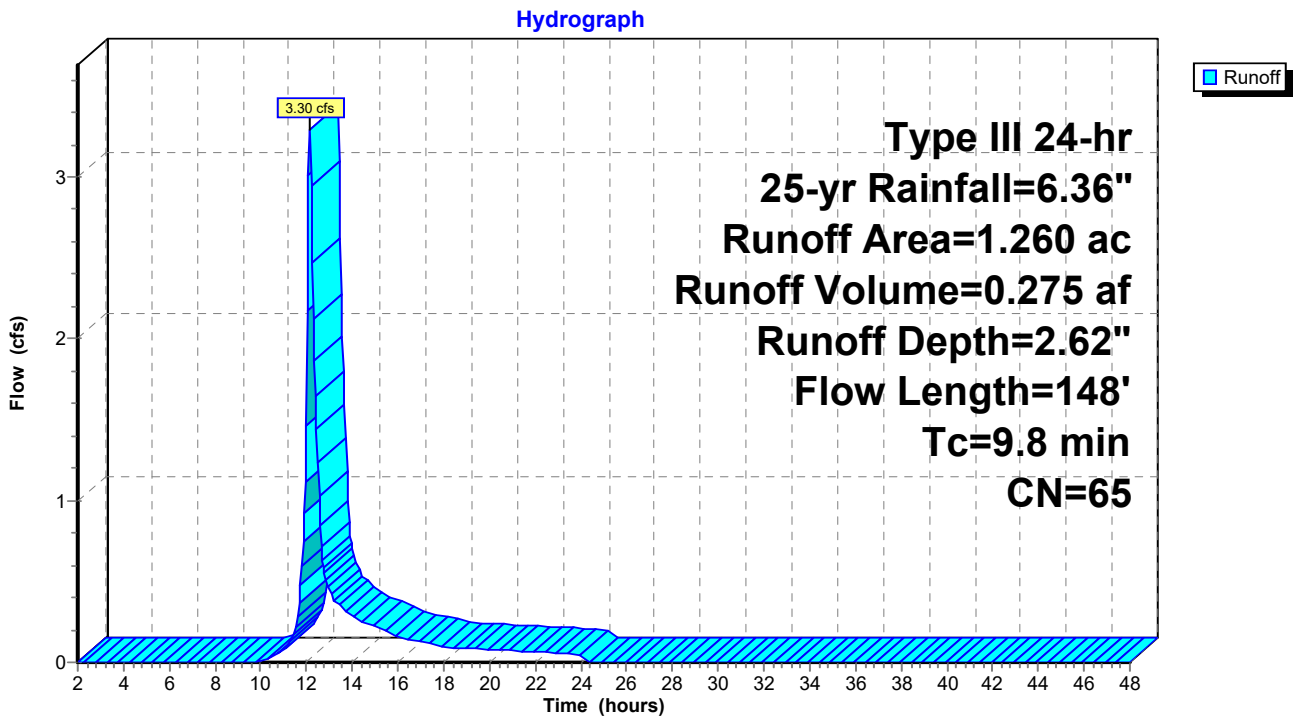
Subcatchment D-1: PR WS D-1



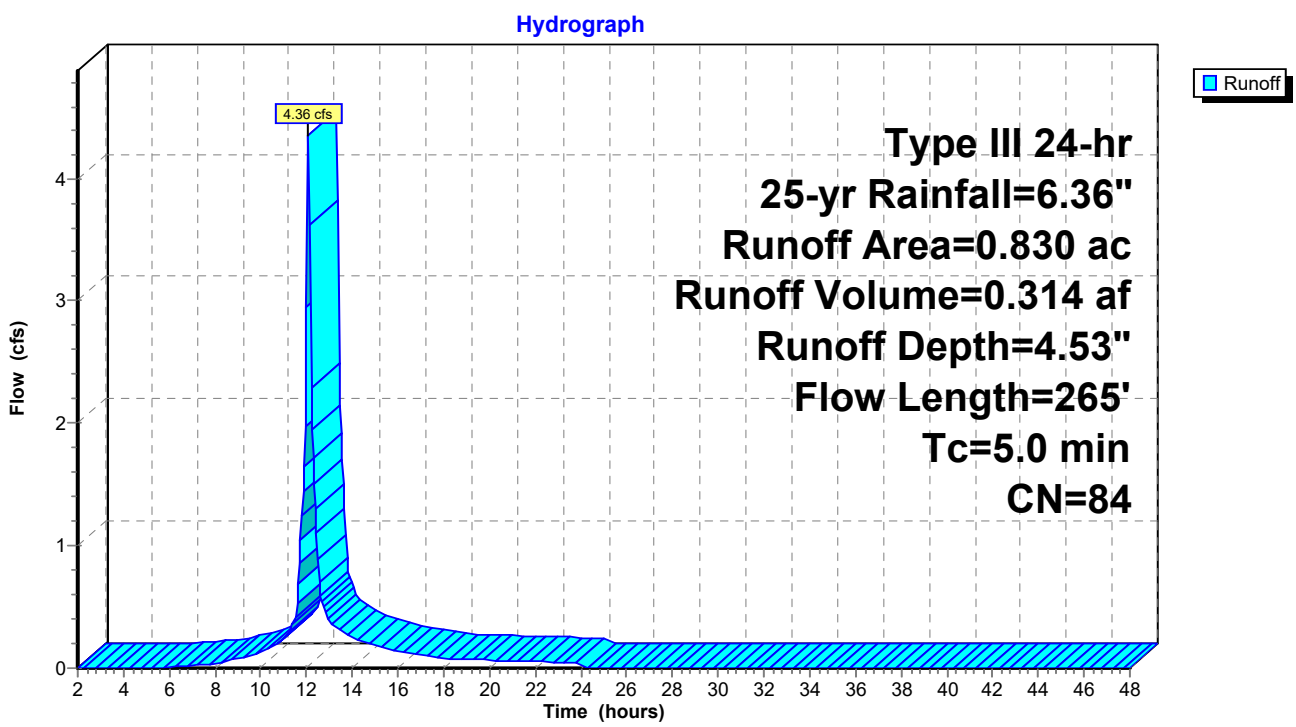
Subcatchment D-2: PR WS D-2



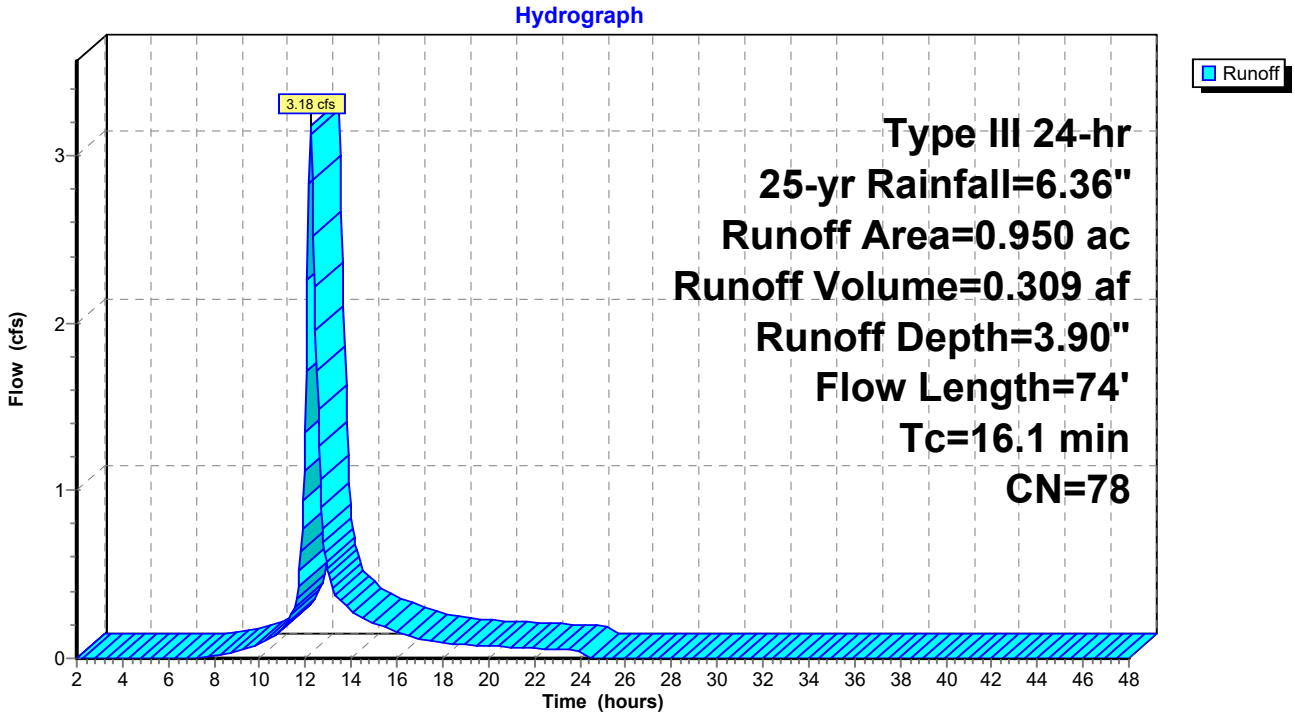
Subcatchment D-2.1: PR-WS D-2.1



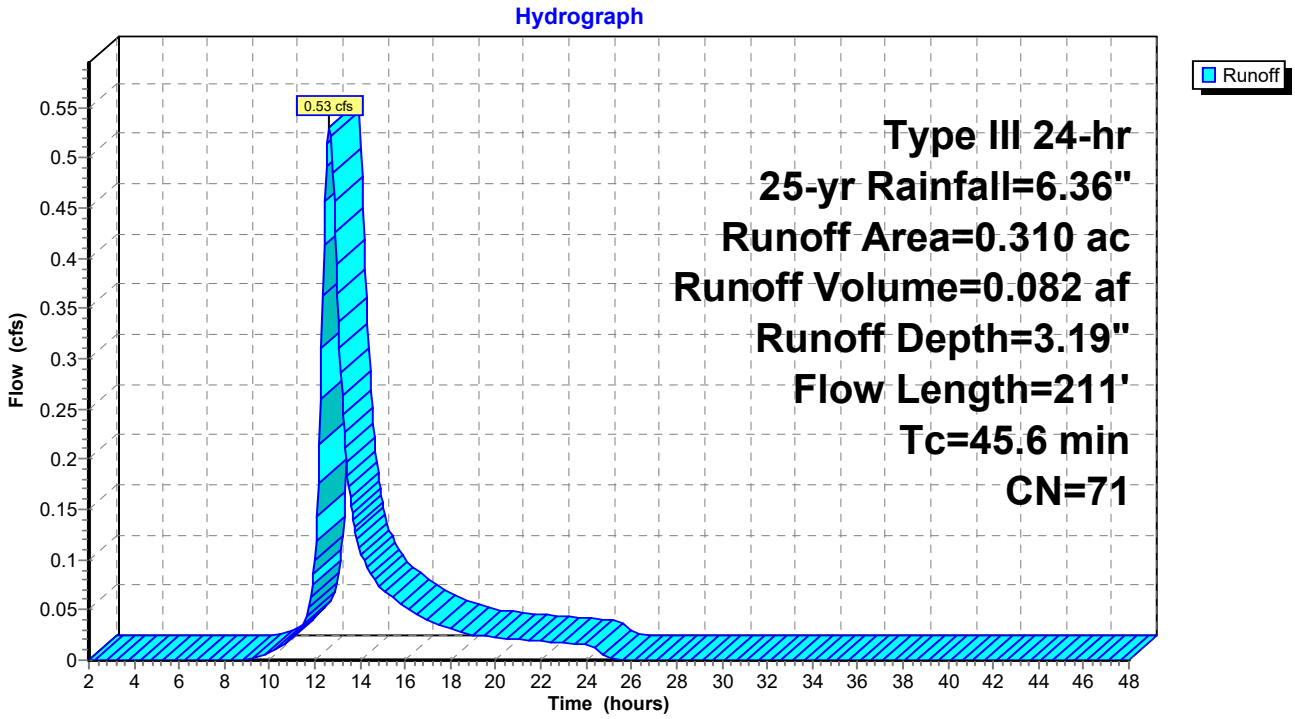
Subcatchment D-3: PR-WS D-3



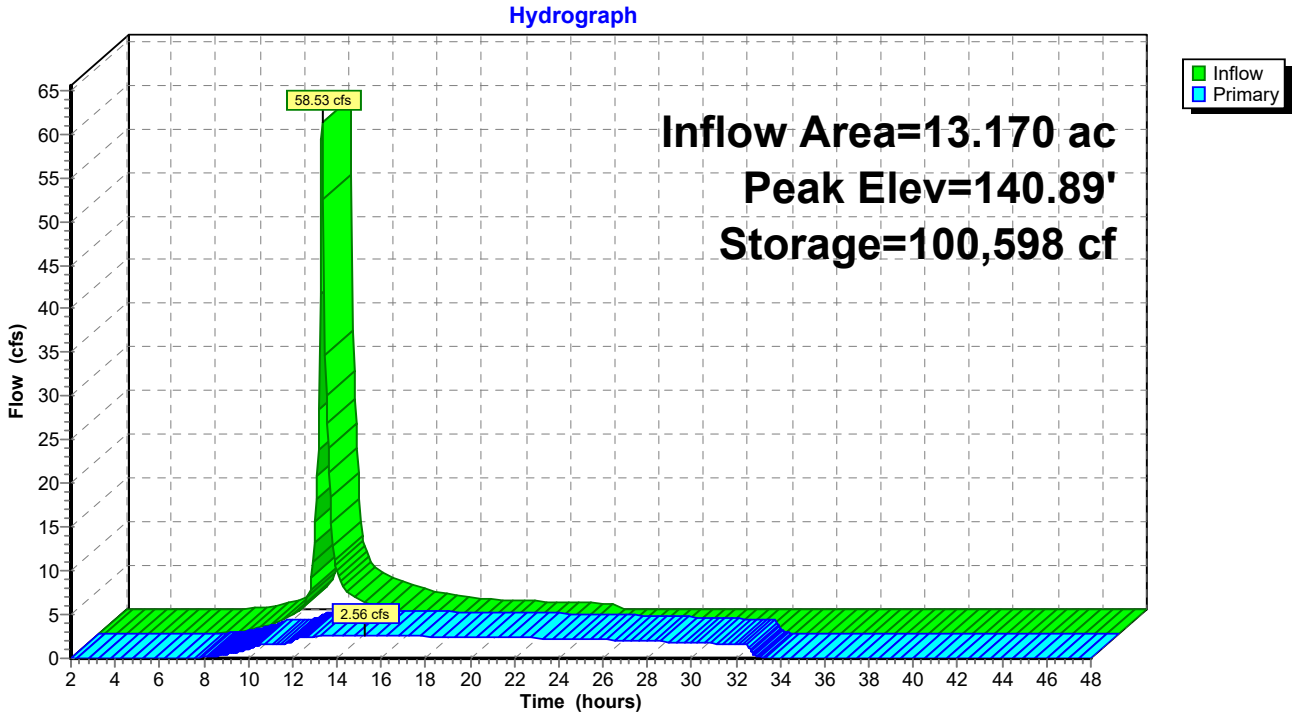
Subcatchment D-4: PR-WS D-4



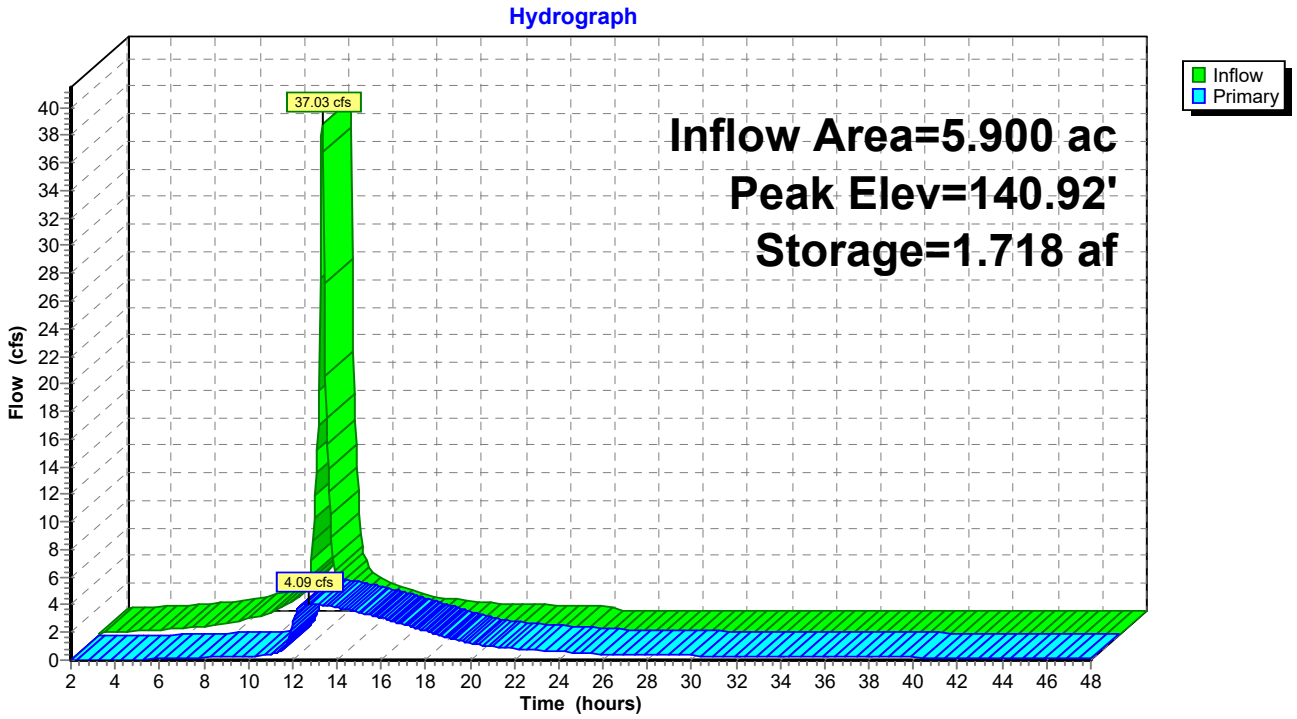
Subcatchment E: PR WS E



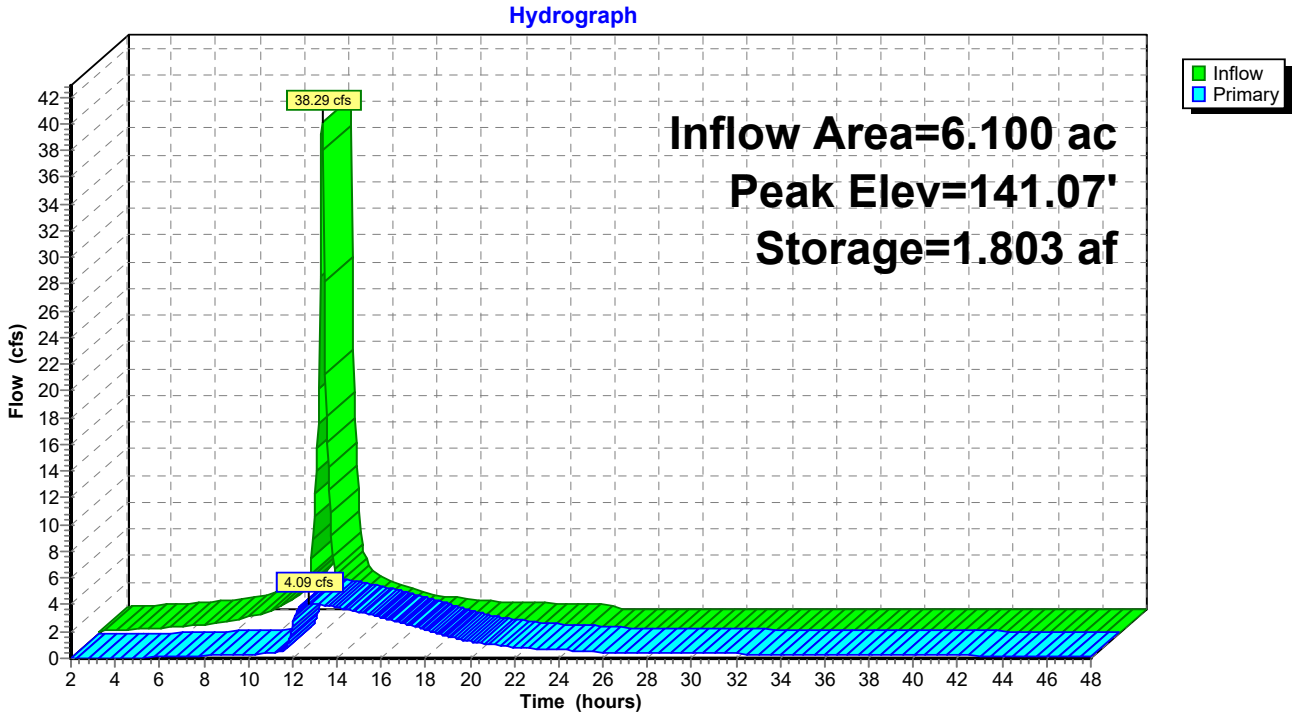
Pond 1P: Existing DB A-1



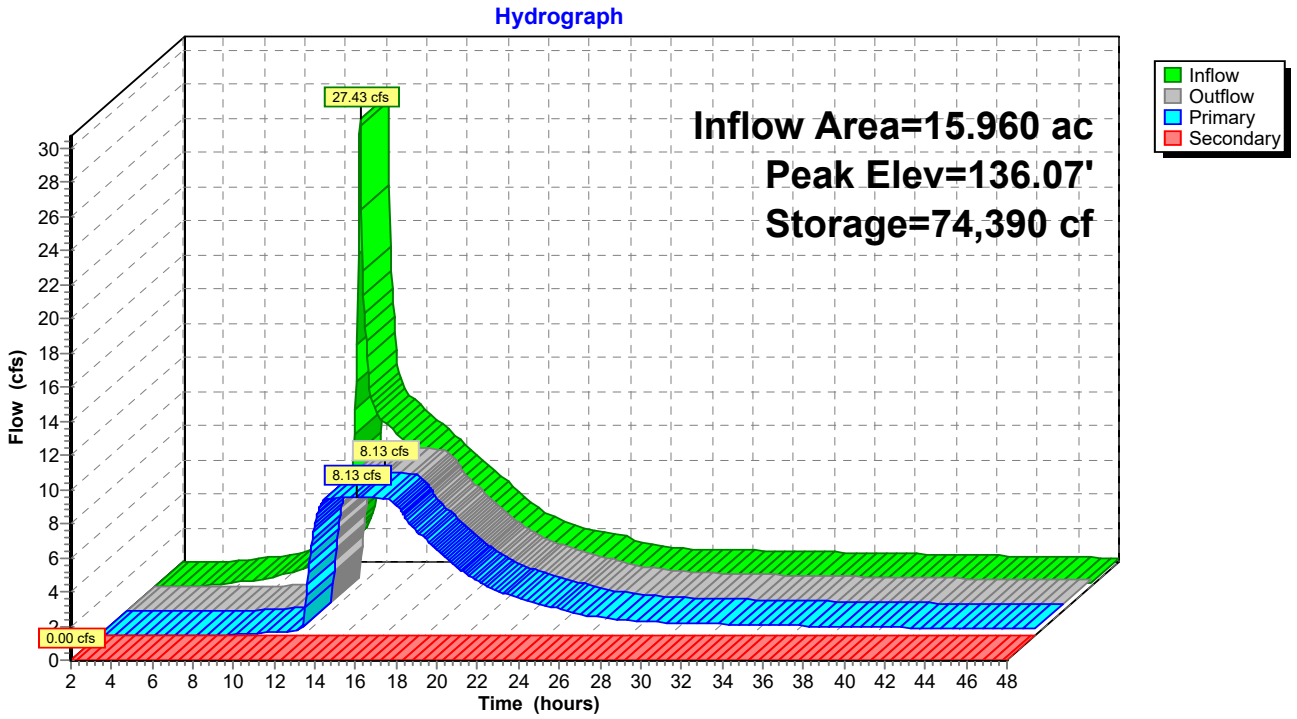
Pond 2P: UDB B-1



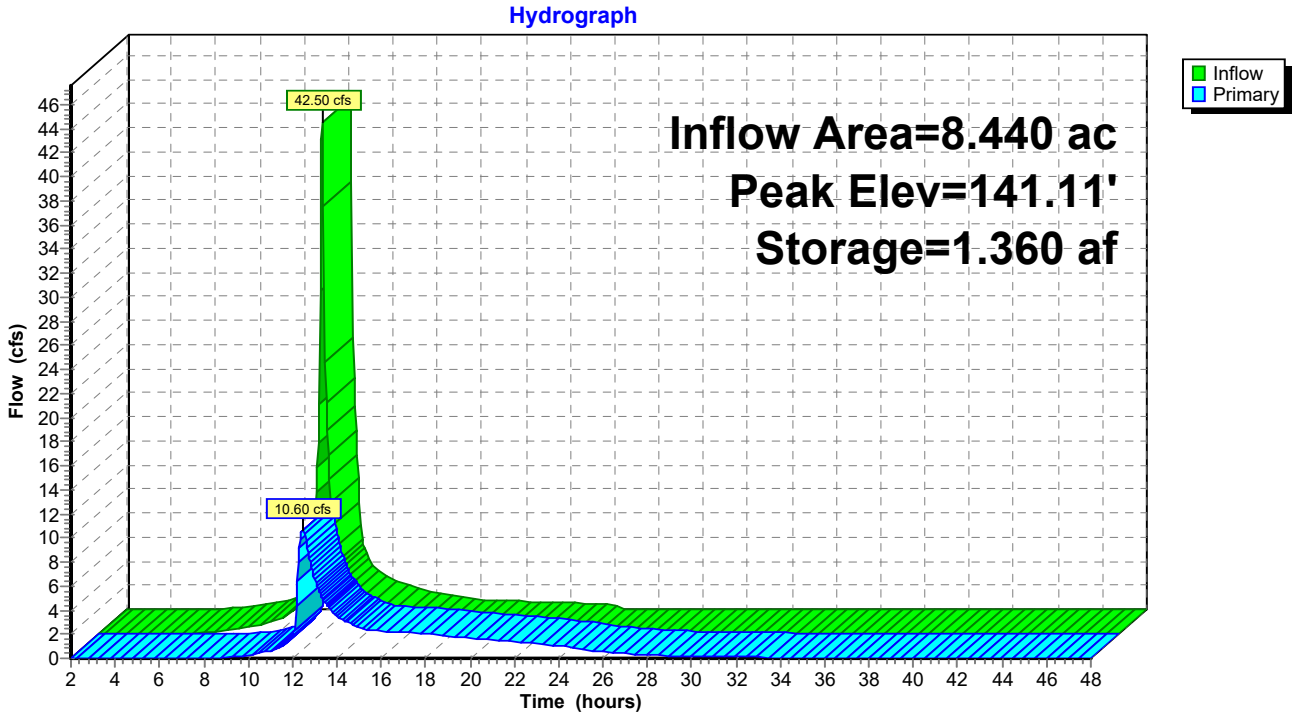
Pond 3P: UDB B-2



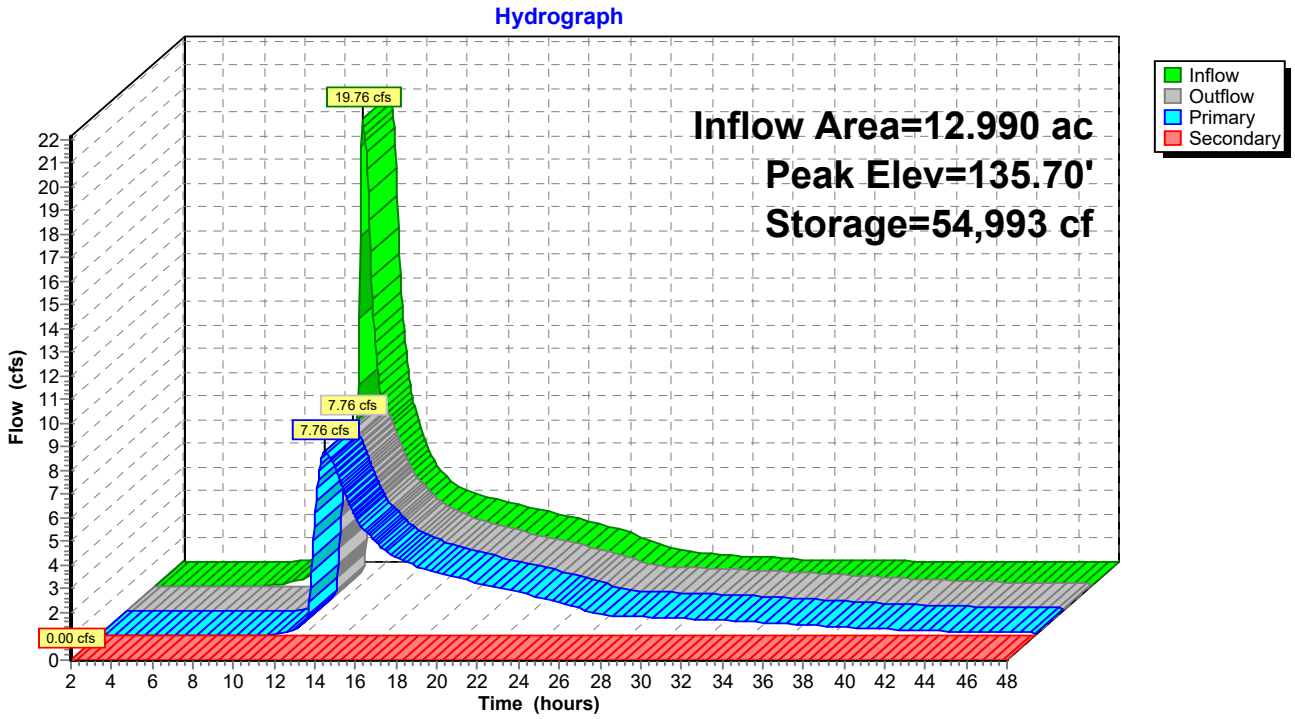
Pond 4P: WDB B-3



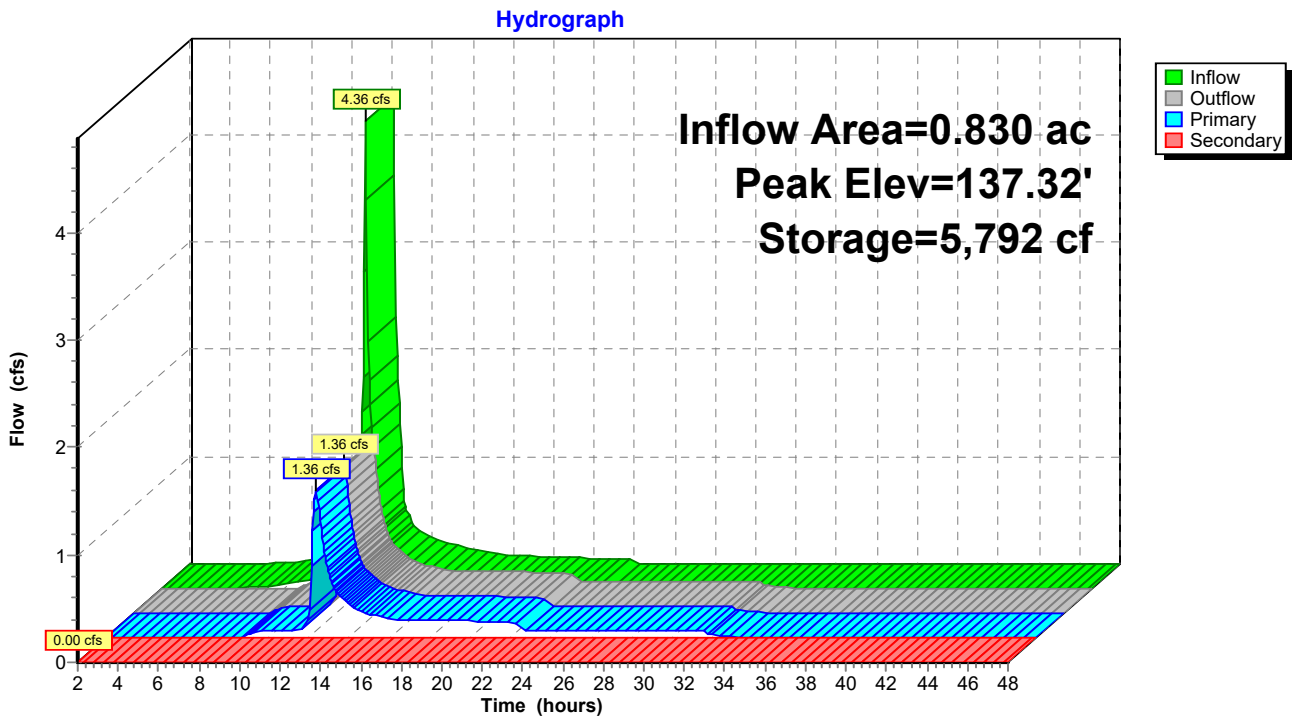
Pond 5P: UDB D-1



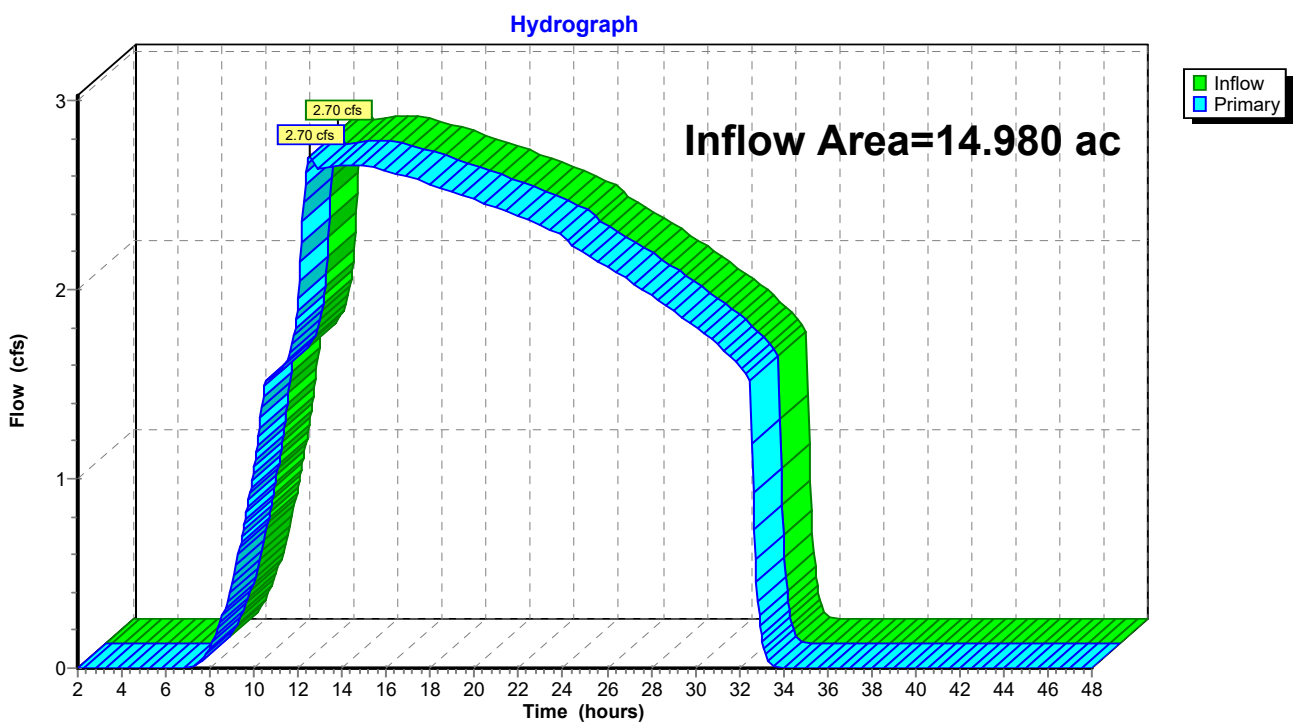
Pond 6P: WDB D-2



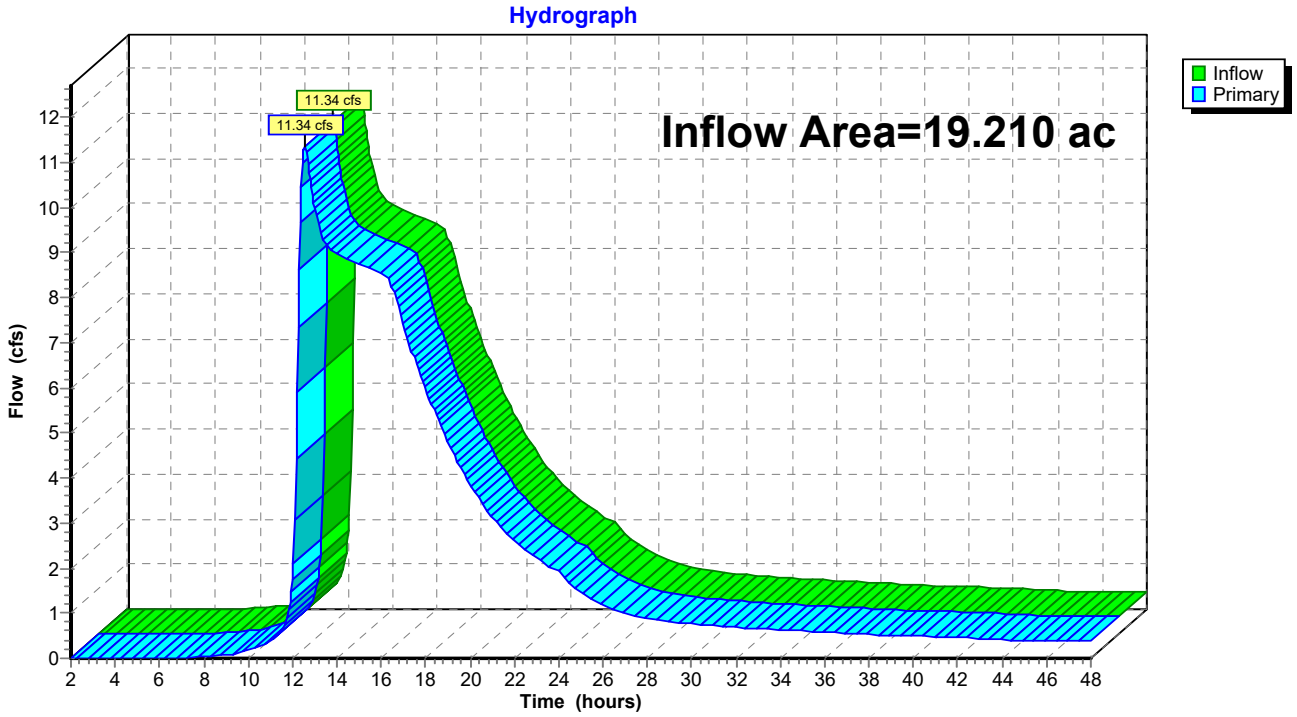
Pond 7P: RG D-3



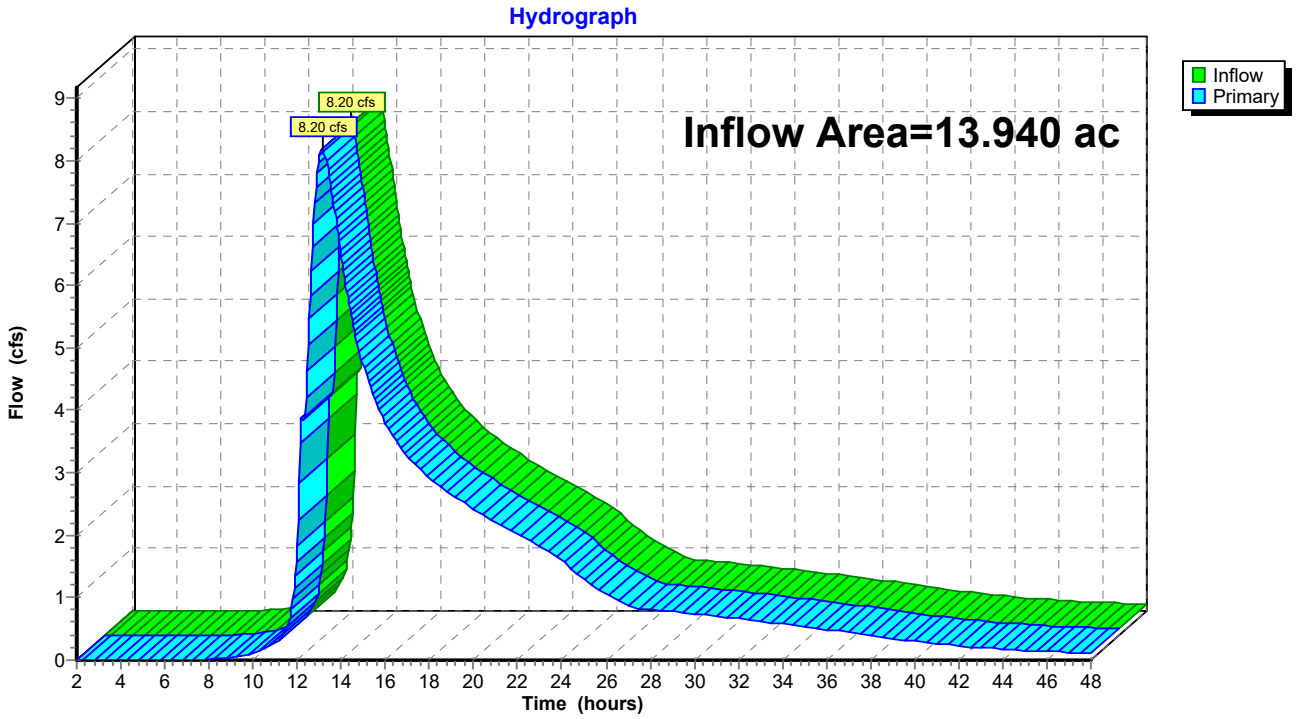
Link 1L: Design Point A



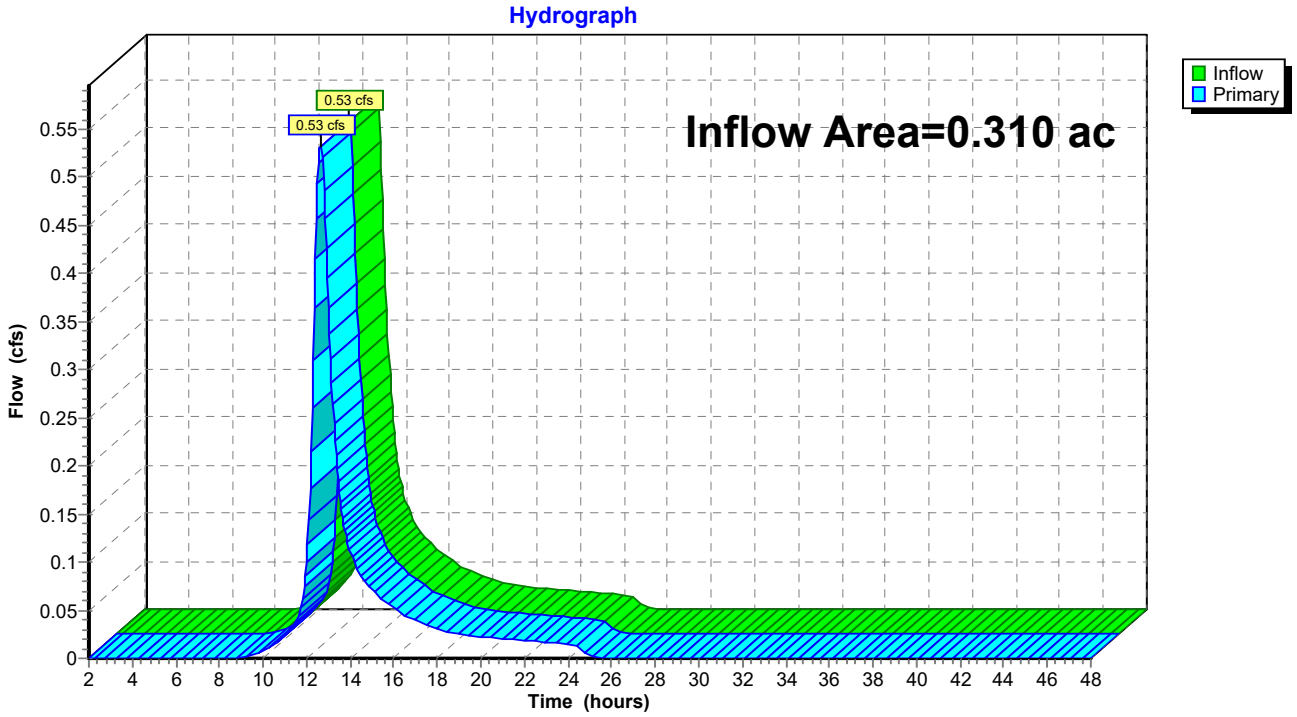
Link 2L: Design Point B



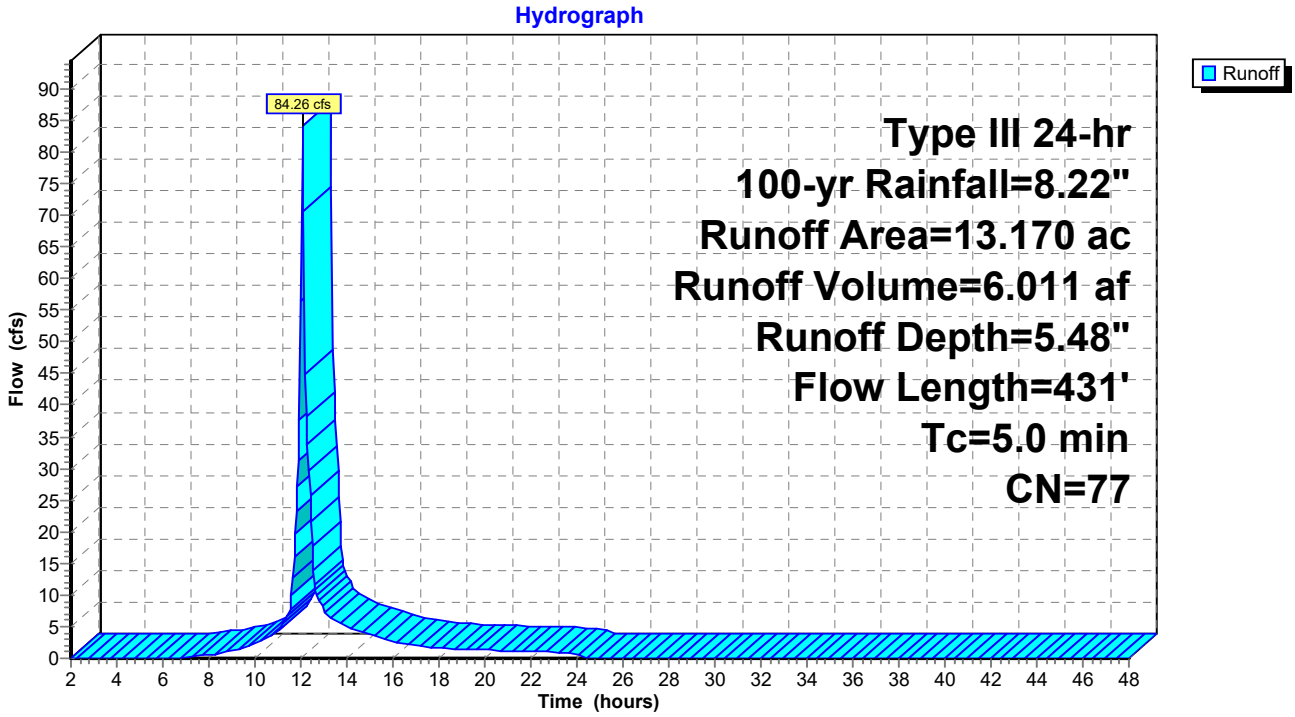
Link 3L: Design Point D



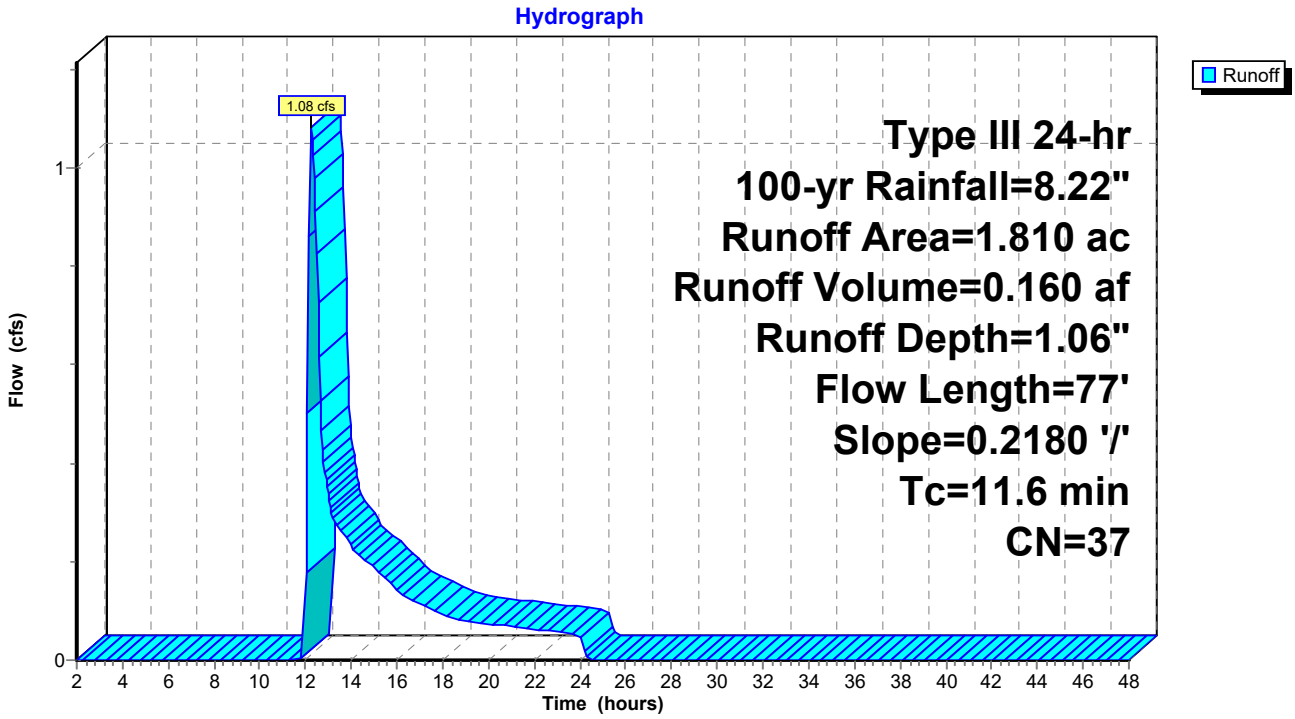
Link 4L: Design Point E



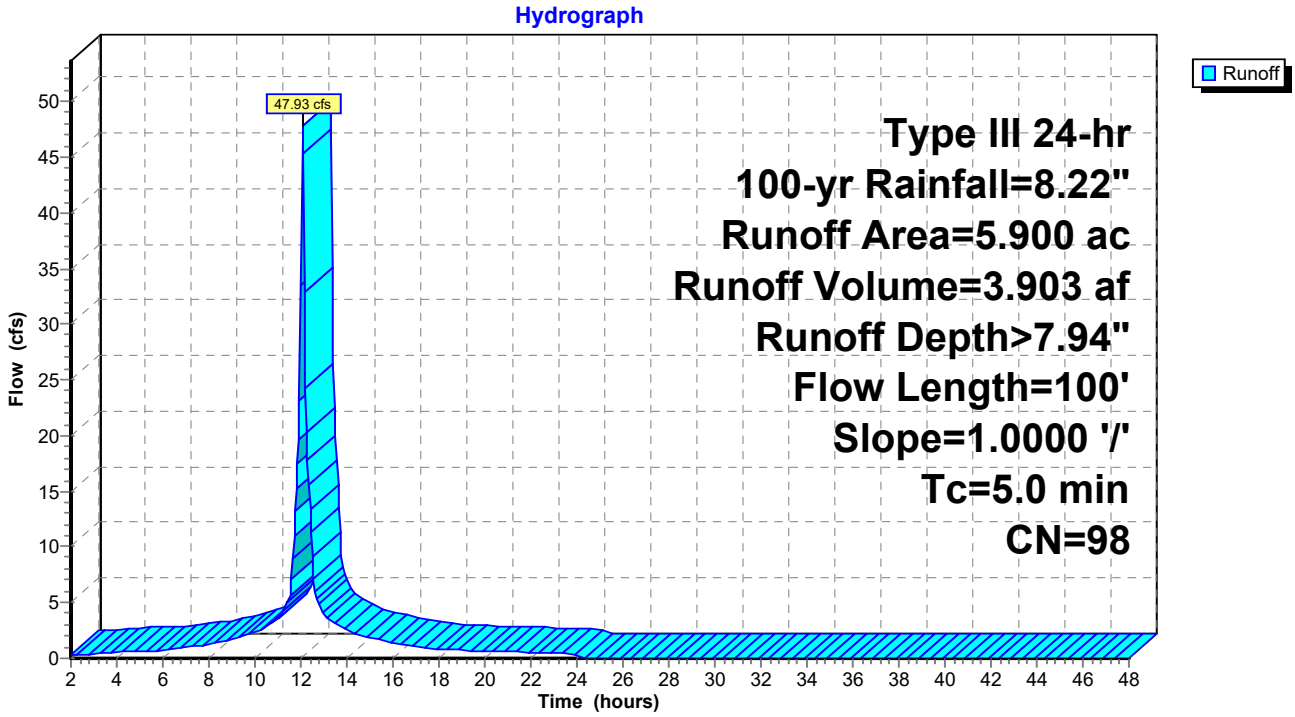
Subcatchment A-1: PR WS A-1



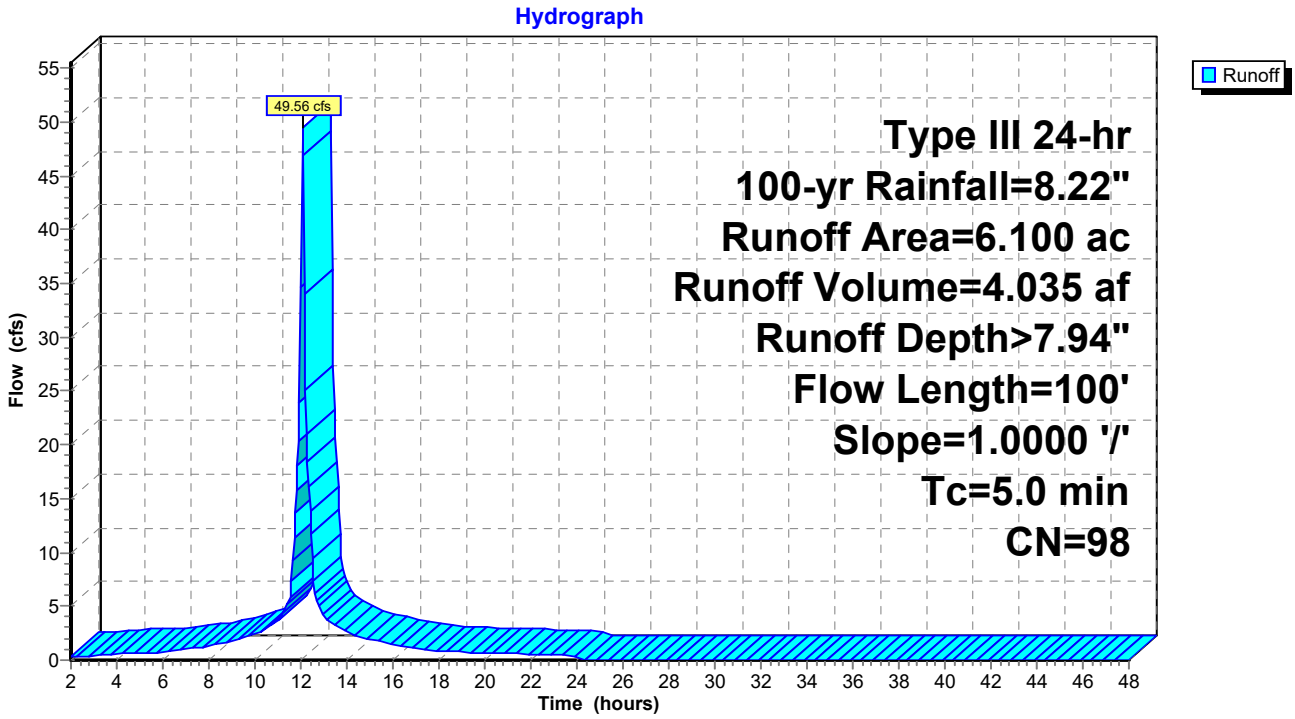
Subcatchment A-2: PR WS A-2



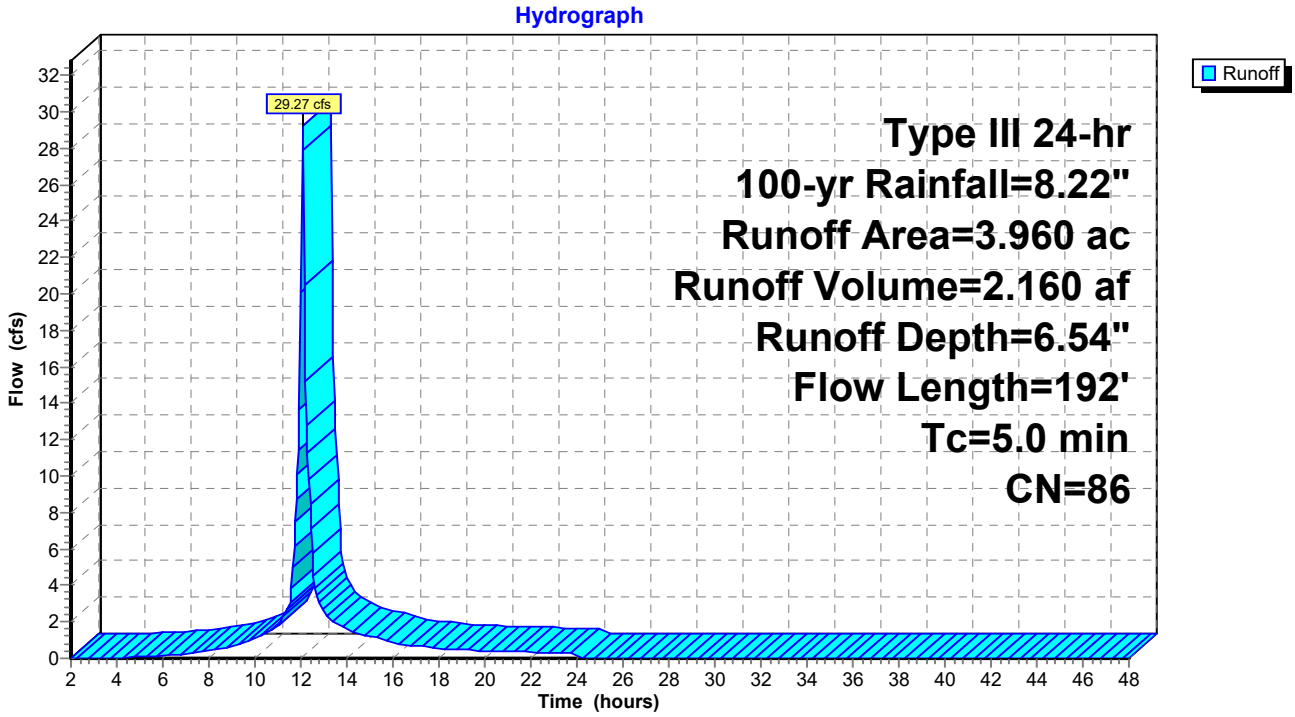
Subcatchment B-1: PR WS B-1



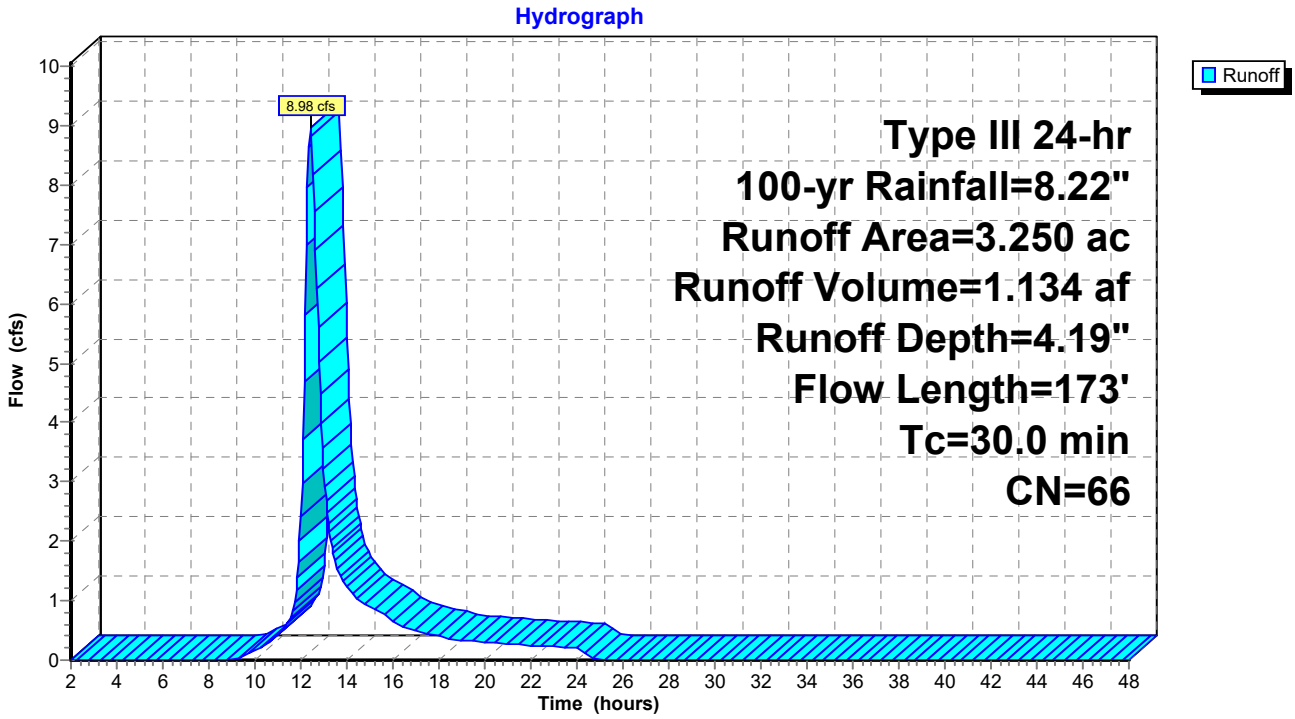
Subcatchment B-2: PR WS B-2



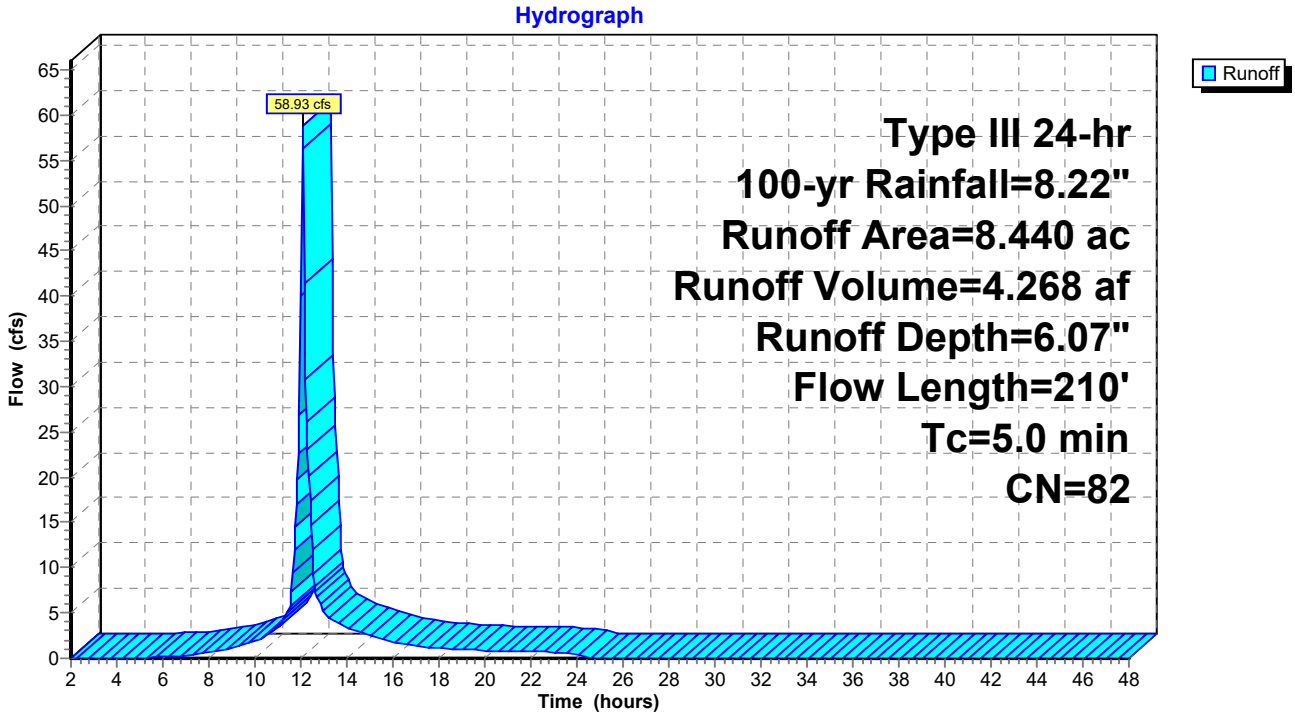
Subcatchment B-3: PR WS B-3



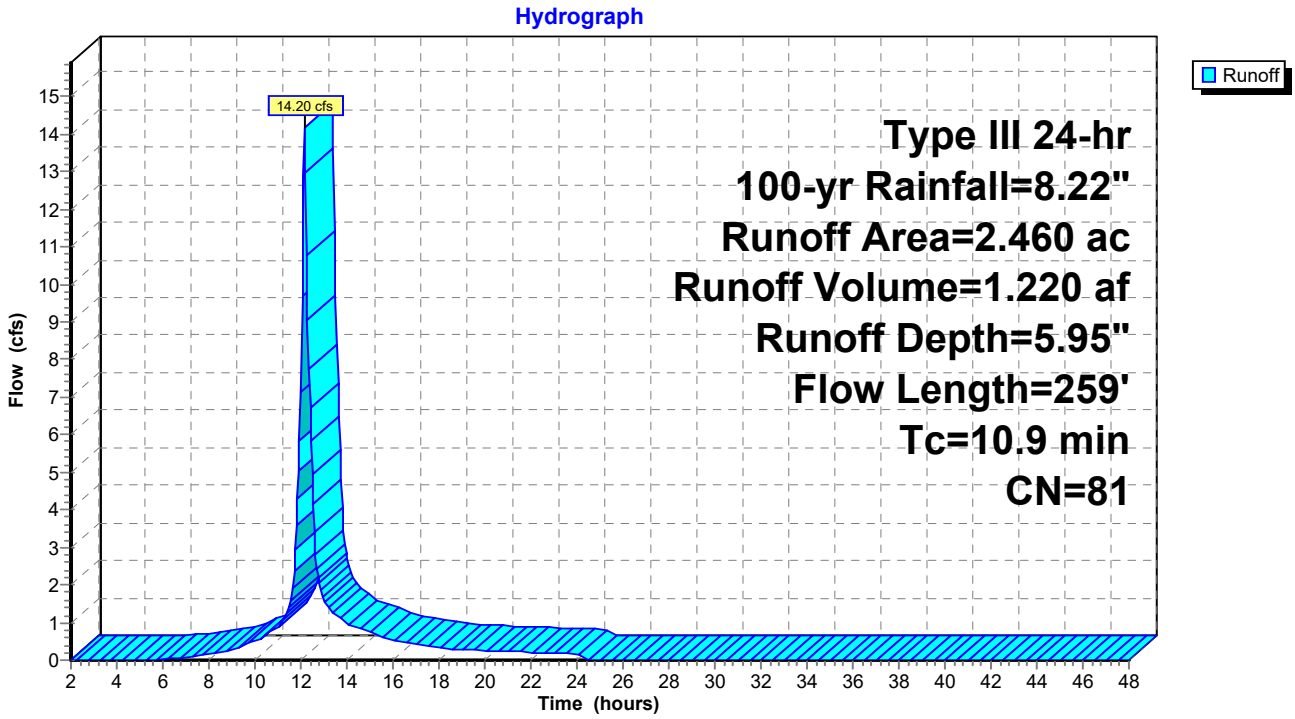
Subcatchment B-4: PR WS B-4



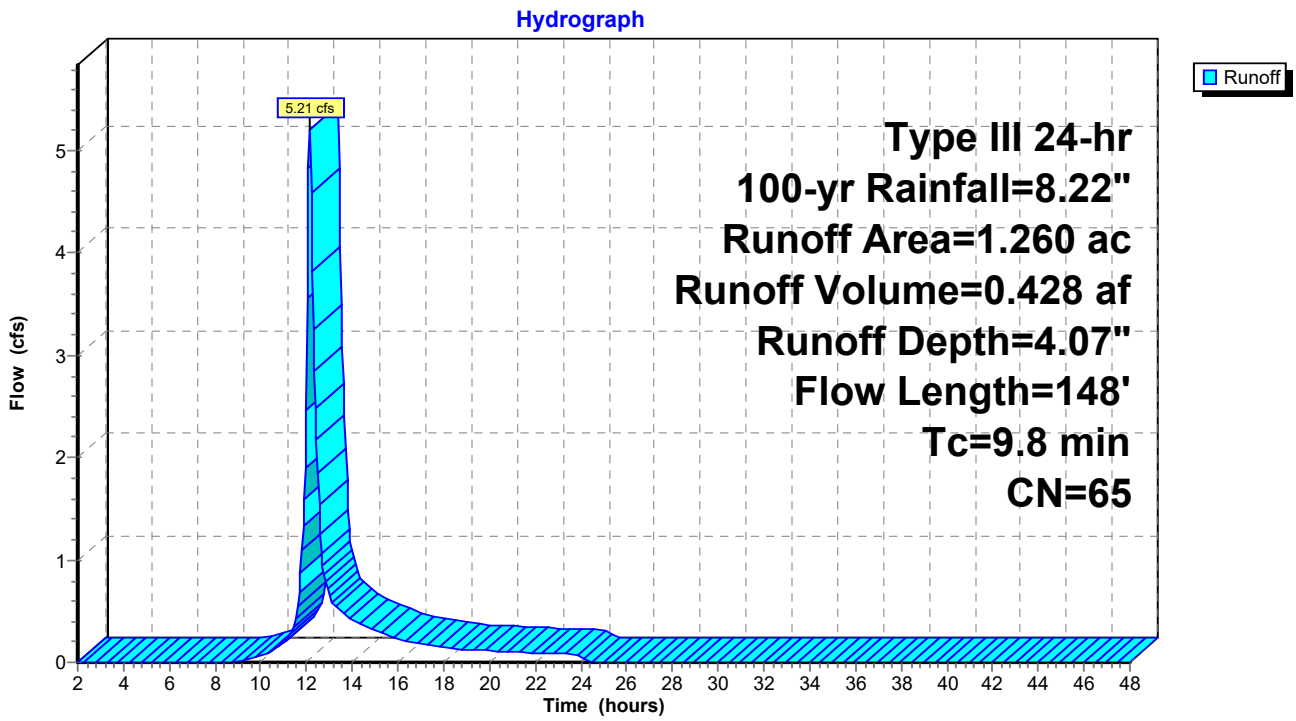
Subcatchment D-1: PR WS D-1



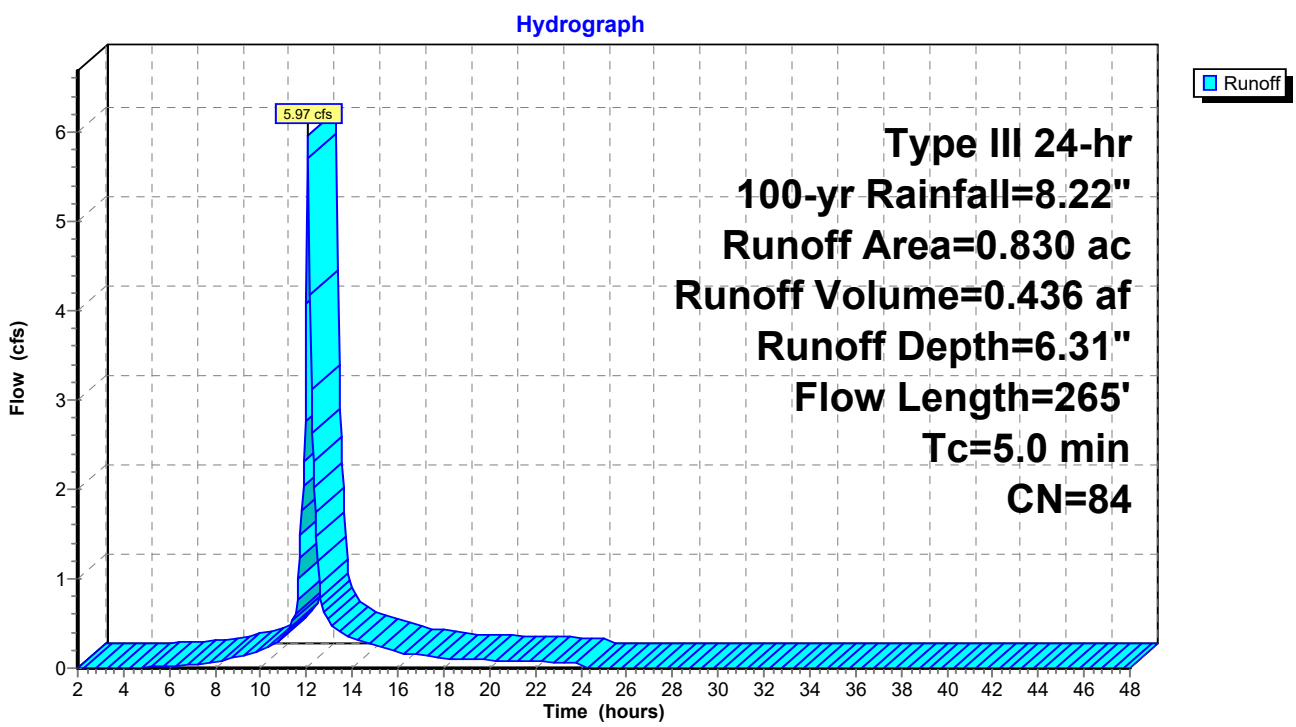
Subcatchment D-2: PR WS D-2



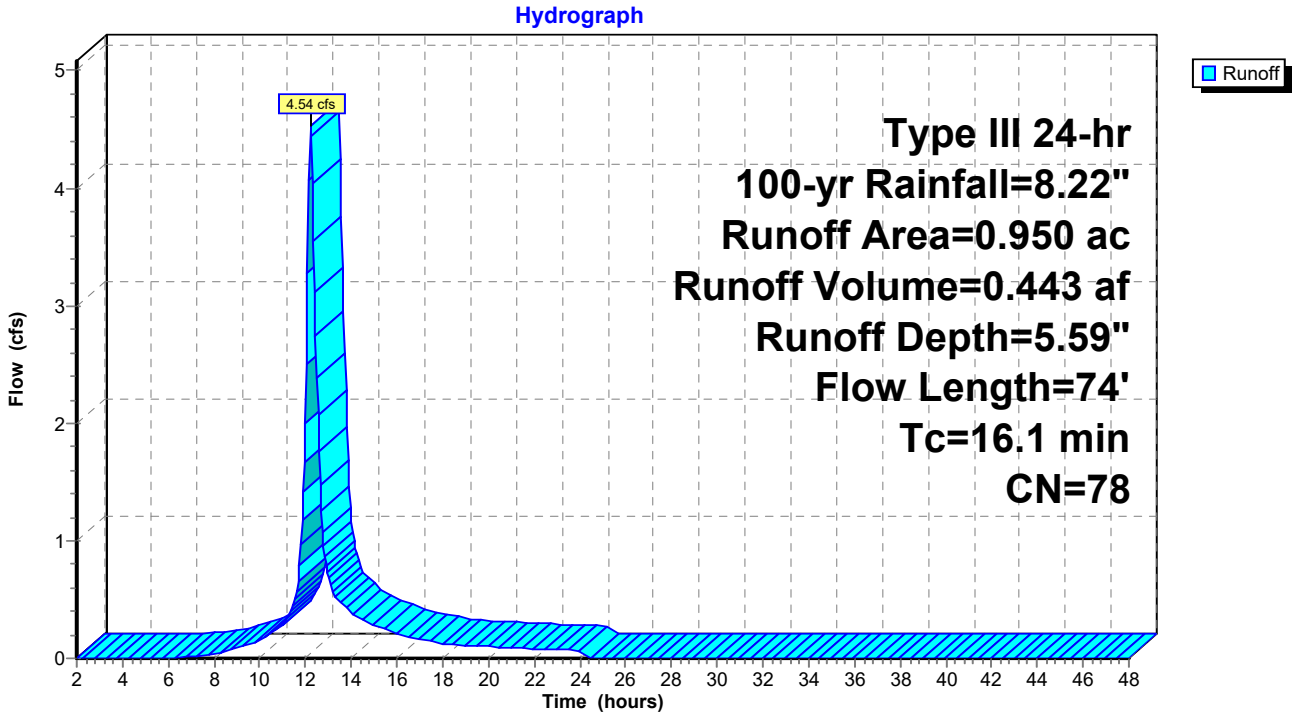
Subcatchment D-2.1: PR-WS D-2.1



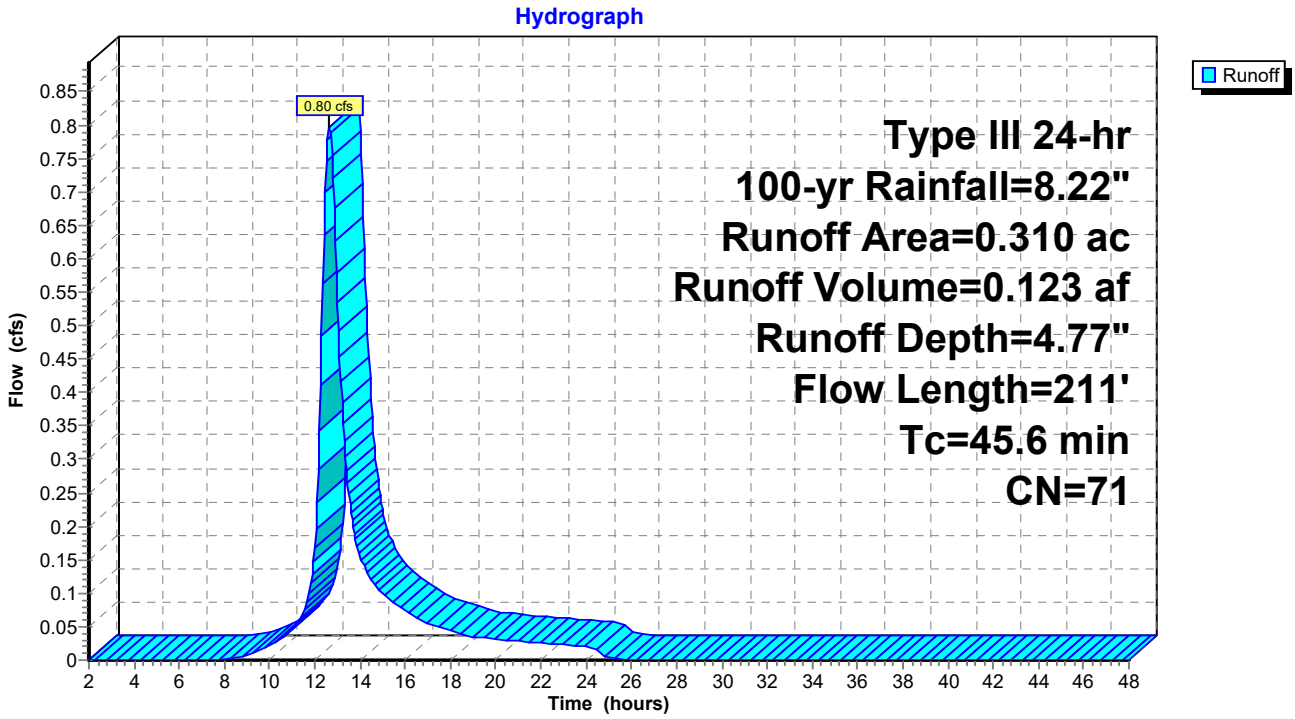
Subcatchment D-3: PR-WS D-3



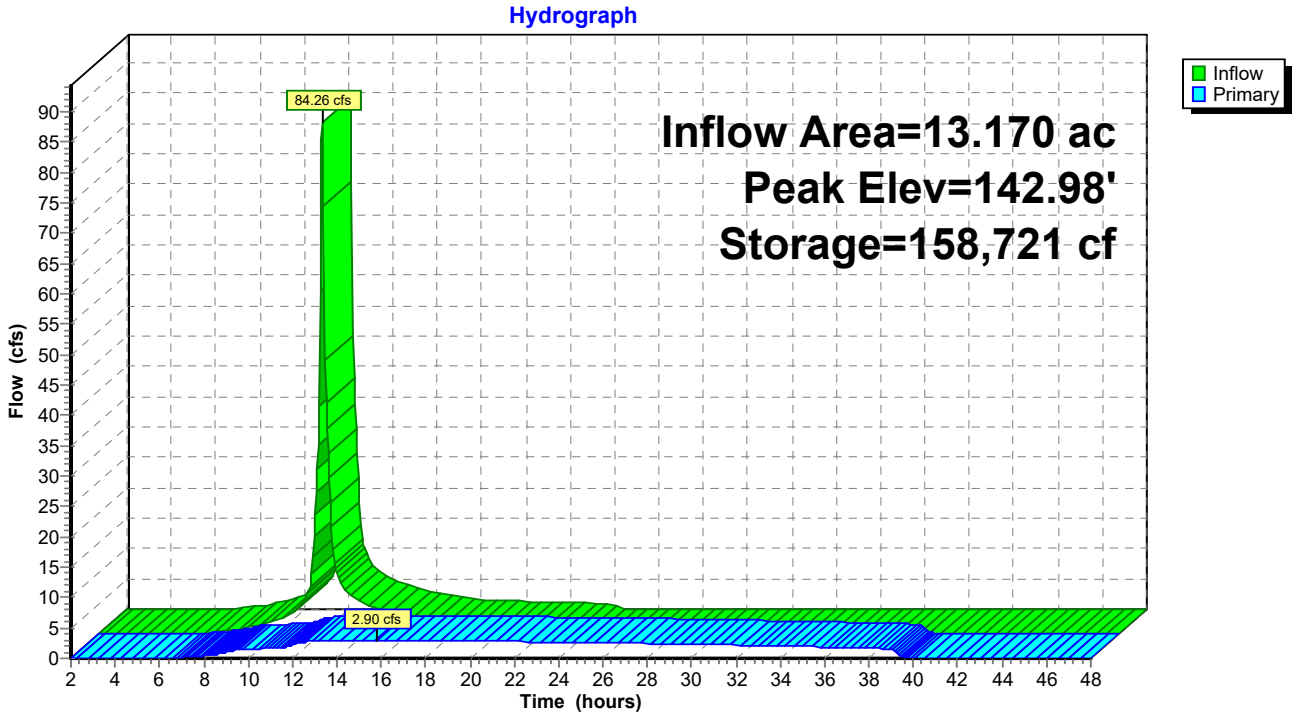
Subcatchment D-4: PR-WS D-4



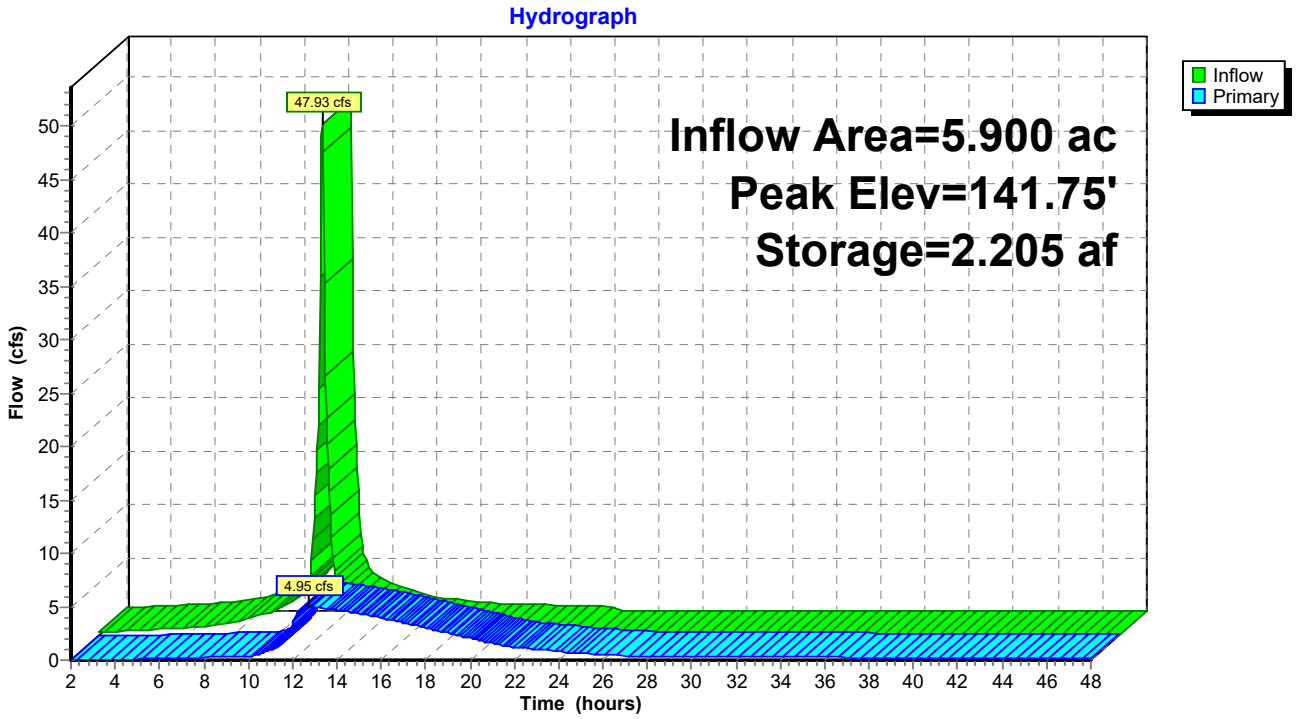
Subcatchment E: PR WS E



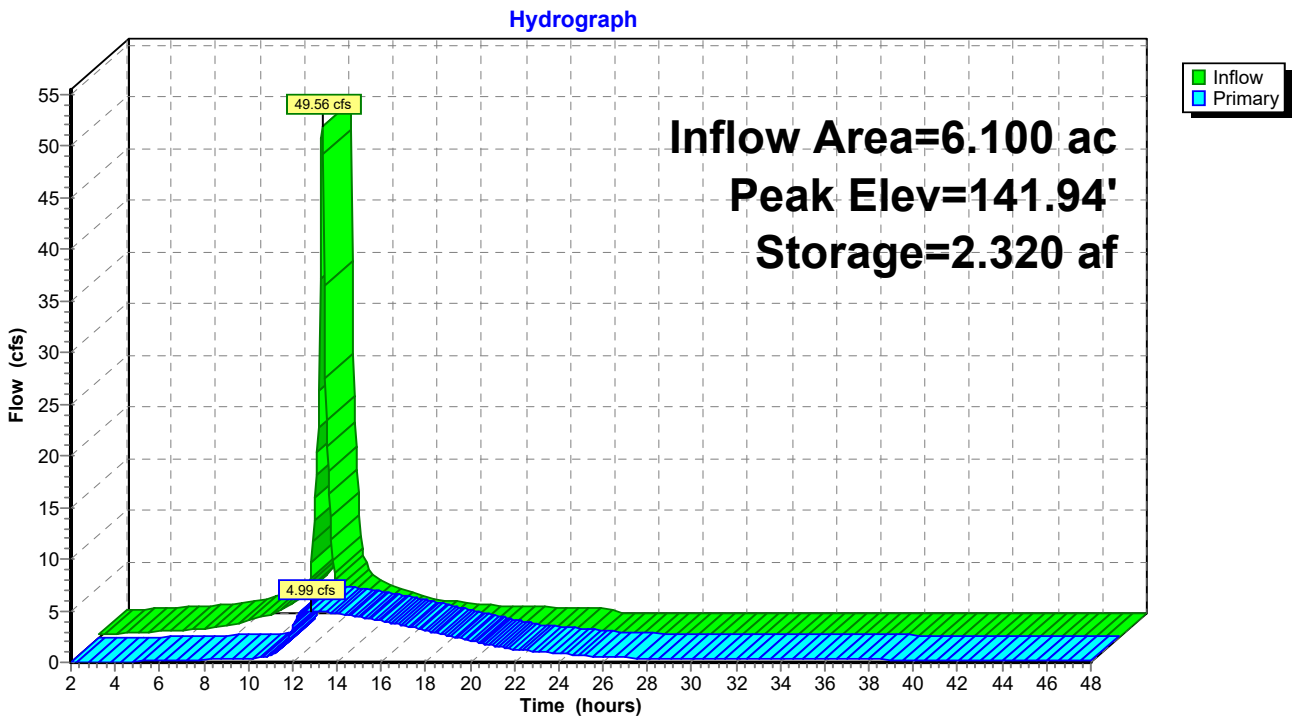
Pond 1P: Existing DB A-1



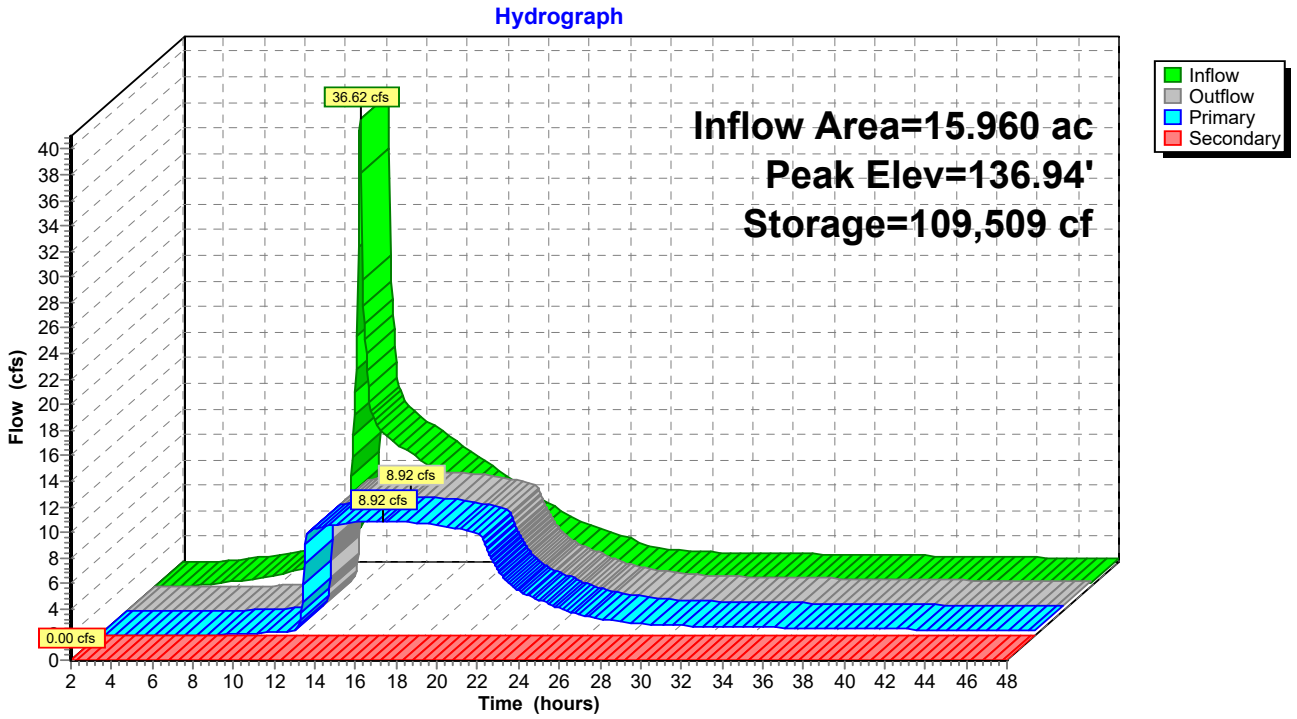
Pond 2P: UDB B-1



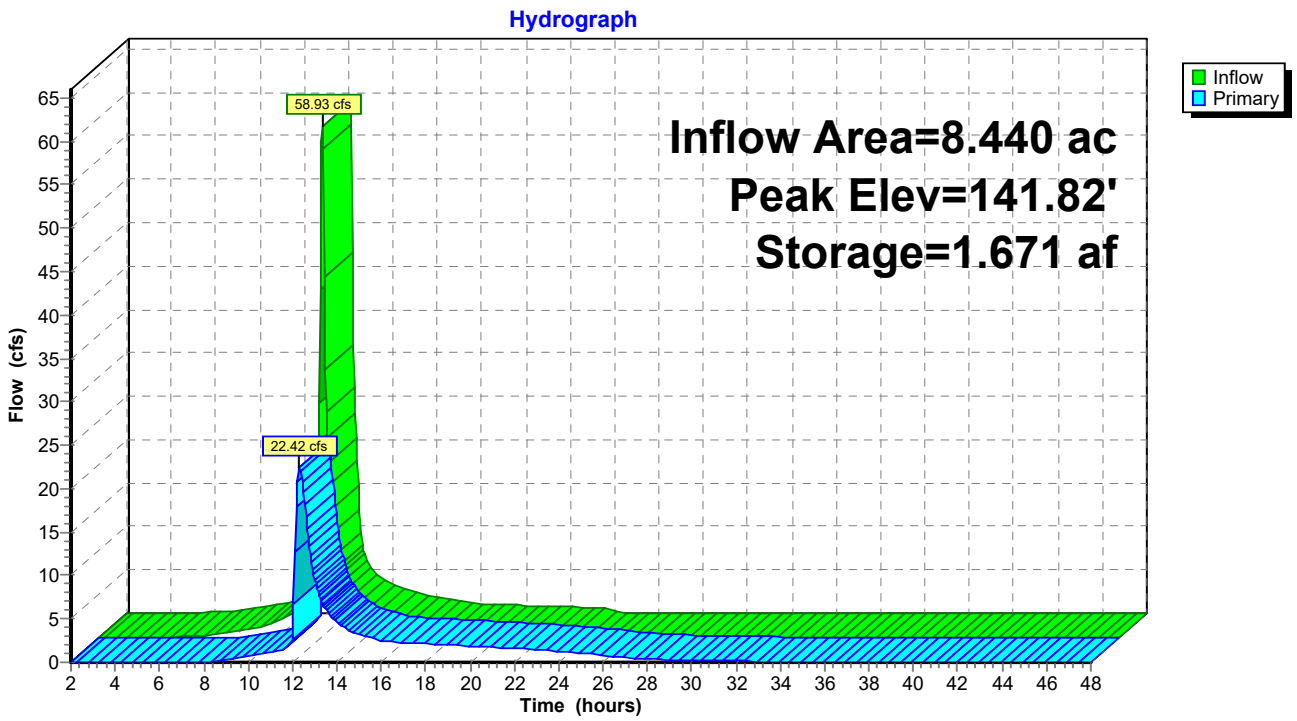
Pond 3P: UDB B-2



Pond 4P: WDB B-3



Pond 5P: UDB D-1



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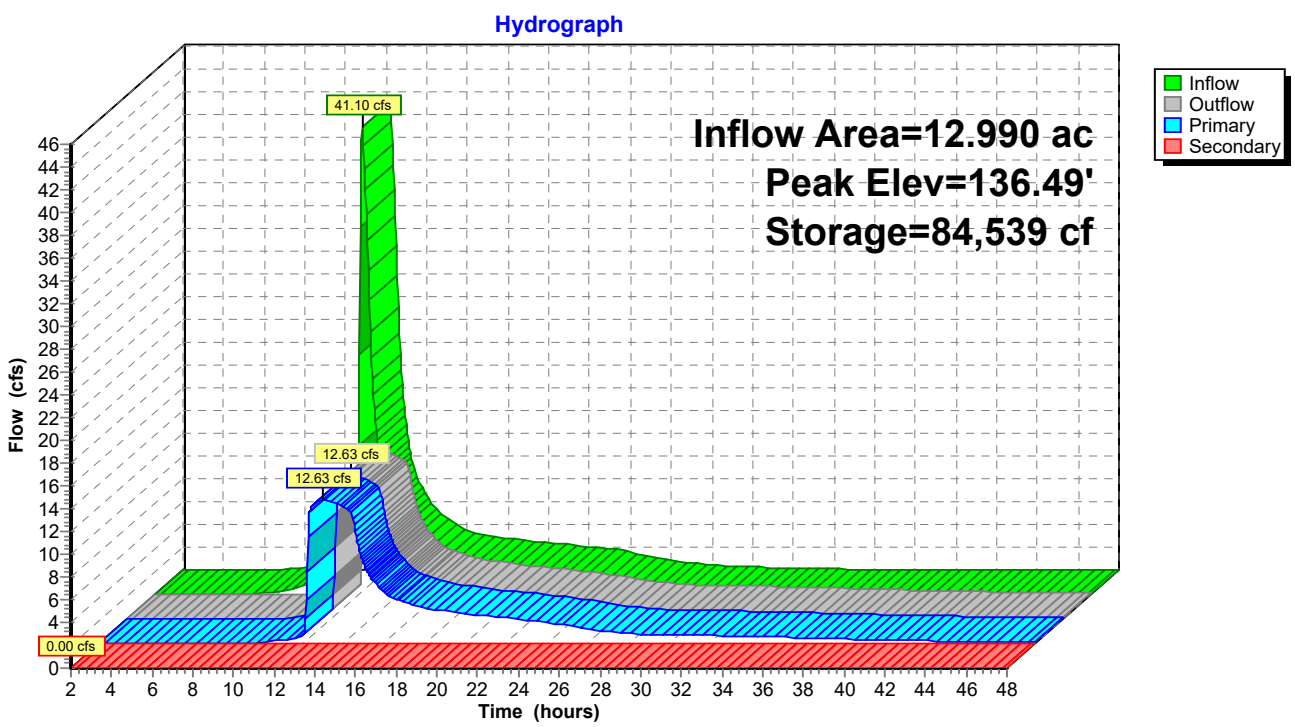
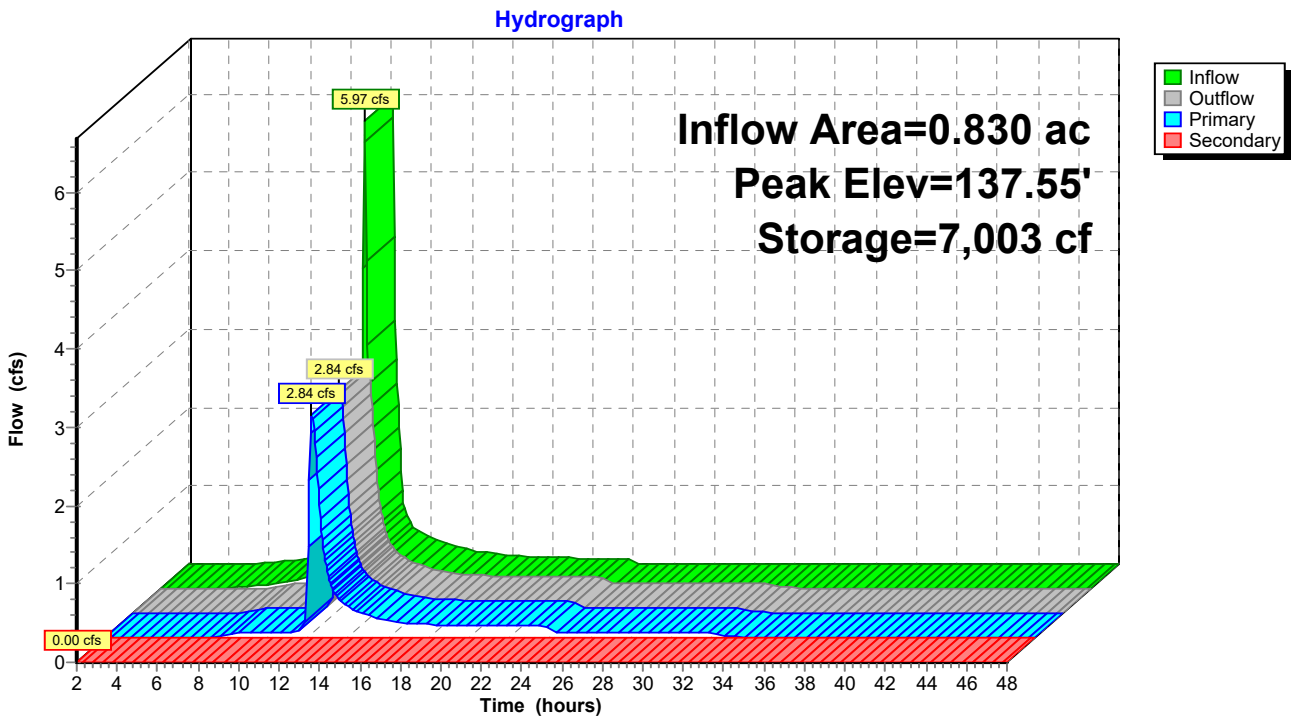
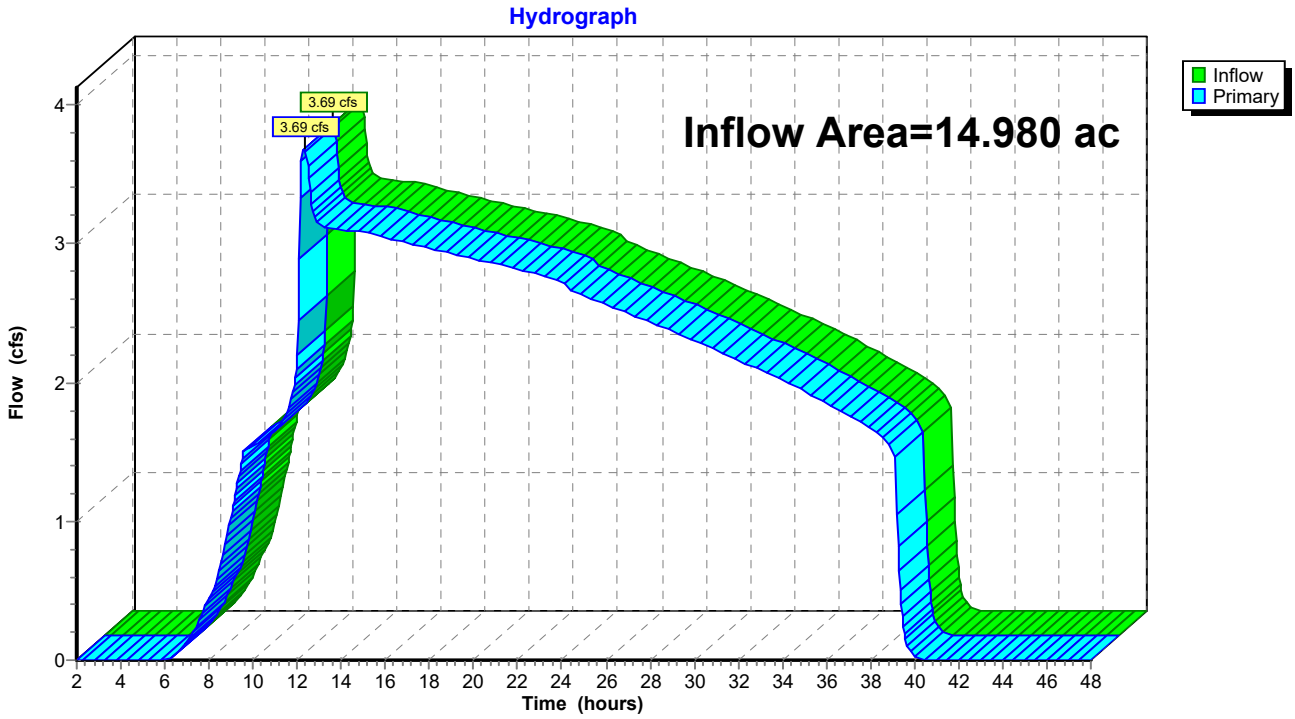


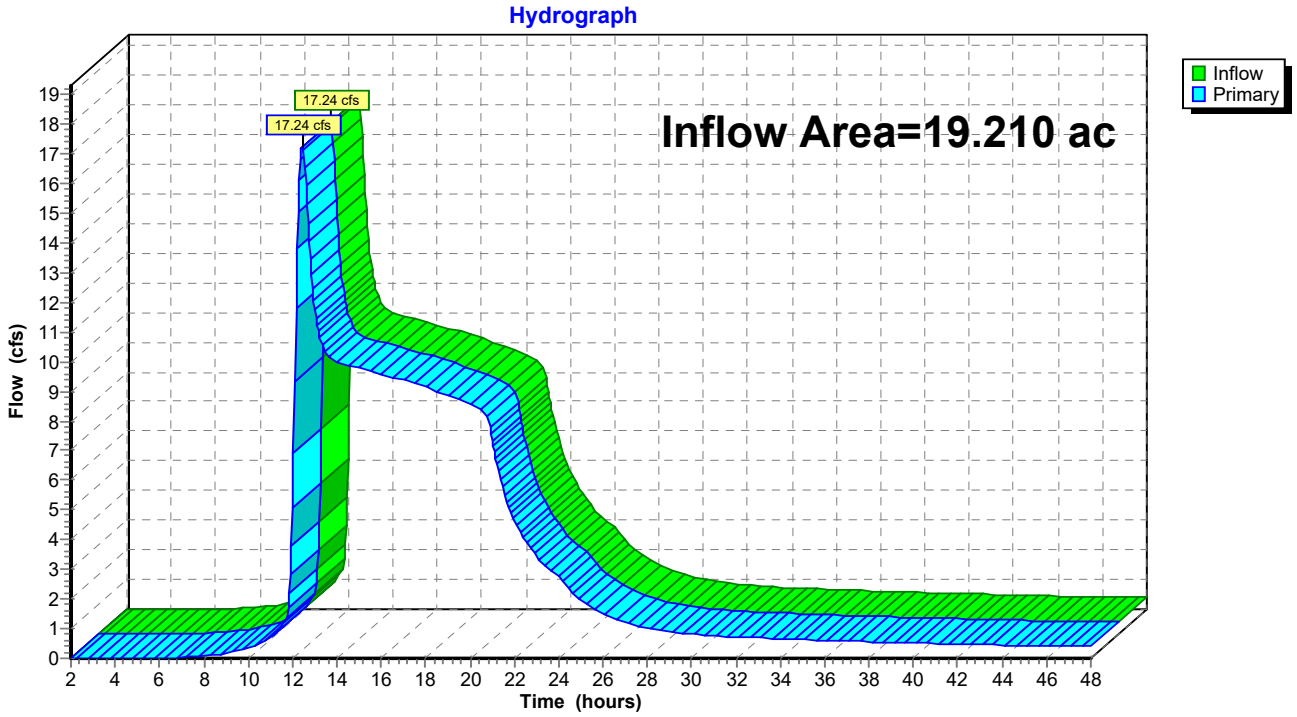
Pond 7P: RG D-3



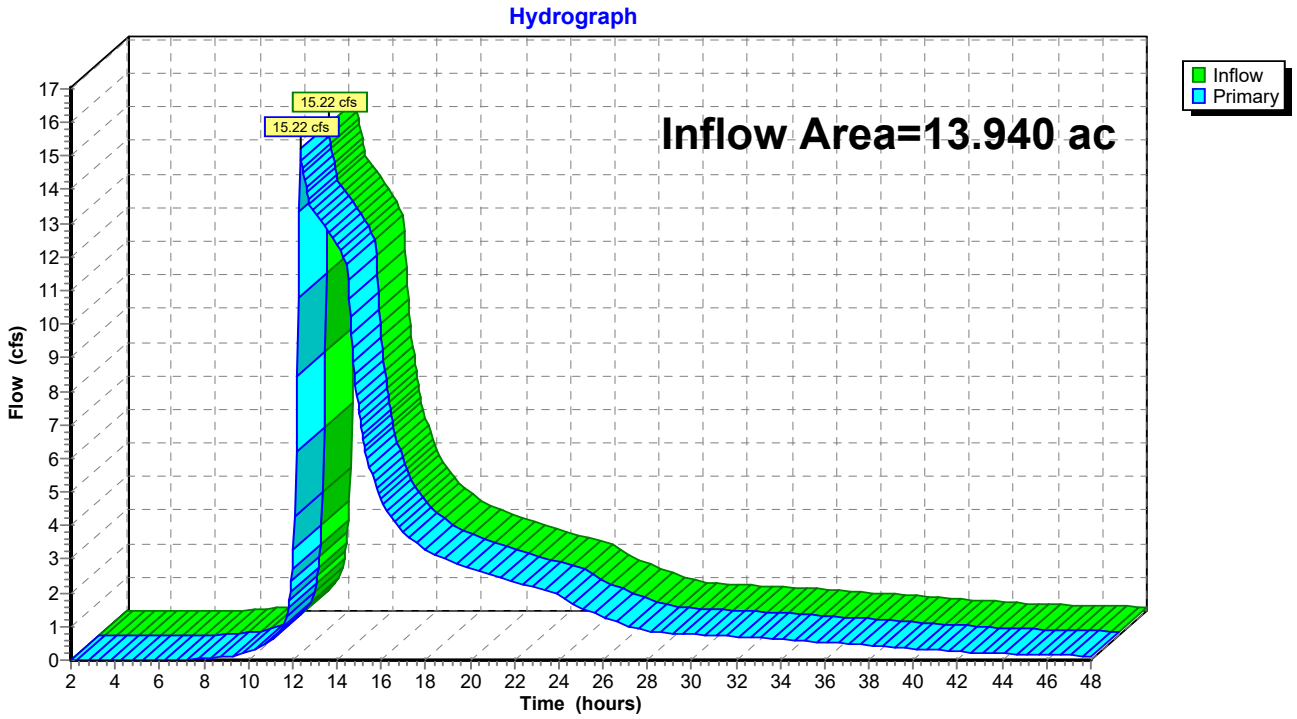
Link 1L: Design Point A



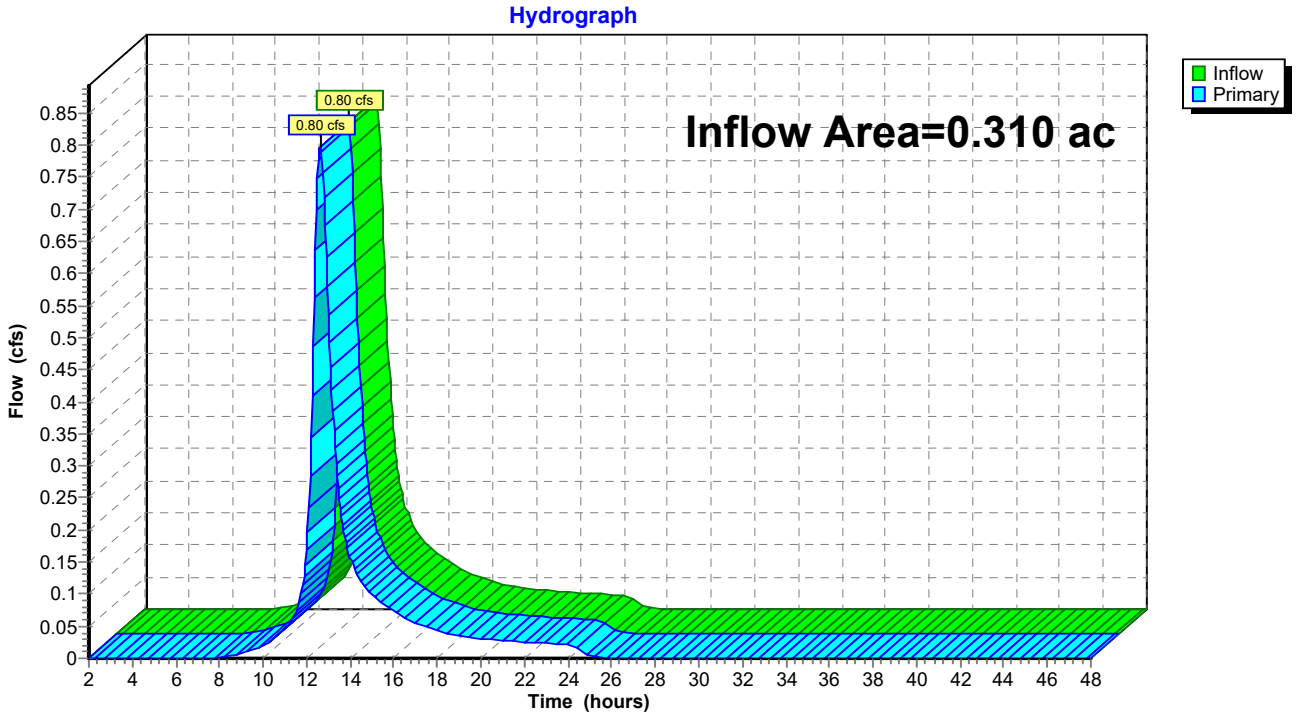
Link 2L: Design Point B



Link 3L: Design Point D



Link 4L: Design Point E



APPENDIX C

Stormwater Quality Calculations

LANGAN

STORMWATER QUALITY CALCULATIONS

Methodology: Water Quality Volume and Flow

Reference: 2004 Stormwater Quality Manual

$$WQV = \frac{(1")(R)(A)}{12}$$

WQV = water quality volume (acre-feet)
R = volumetric runoff coefficient
I = percent impervious cover
A = site area (acres)

$$WQF = (q_u)(A)(Q)$$

WQF = water quality flow (cfs)
q_u = unit peak discharge (cfs/mi^2/inch)
A = drainage area (mi^2)
Q = runoff depth (watershed inches)
= [WQV (acre-feet)]x[12 (inches/foot)] / Drainage area (acres)

Site Characteristics

Description	**Existing DB A-1**	Drainage Area to feature	**Watershed A-1**	
Area		13.17 acres	0.020578	mi^2
Impervious Area		7.89 acres		
Tc		0.08 hr		
I		59.9 %		
R = 0.05+ 0.009(I) =		0.589		
WQV =		**0.65 acre-ft**	28,167	cf
Q = WQV x 12/A =		0.59 inches		

determine qu using NRCS Runoff Curve Number

P = 1.0 inch

$$CN = \frac{1000}{[10 + 5P + 10Q - 10(Q^2 + 1.25QP)^{1/2}]}$$

CN = 95

Determine I_a, table 4-1 Chapter 4 TR-55

I_a = 0.151

Determine q_u, Exhibit 4-III Chapter 4 TR-55

q_u = 640 csm/in

WQF = 7.76 cfs

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STORMWATER QUALITY CALCULATIONS

Methodology: Water Quality Volume and Flow

Reference: 2004 Stormwater Quality Manual

$$WQV = \frac{(1")(R)(A)}{12}$$

WQV = water quality volume (acre-feet)
R = volumetric runoff coefficient
I = percent impervious cover
A = site area (acres)

$$WQF = (q_u)(A)(Q)$$

WQF = water quality flow (cfs)
q_u = unit peak discharge (cfs/mi^2/inch)
A = drainage area (mi^2)
Q = runoff depth (watershed inches)
= [WQV (acre-feet)]x[12 (inches/foot)] / Drainage area (acres)

Site Characteristics

Description	**MH A1-1 (WQU)**	Drainage Area to feature		**Watershed A-1**	
Area		9.79	acres	0.015297	mi^2
Impervious Area		7.89	acres		
Tc		0.08	hr		
I		80.6	%		
R = 0.05+ 0.009(I) =		0.775			
WQV =		**0.63**	**acre-ft**	27,554	cf
Q = WQV x 12/A =		0.78	inches		

determine qu using NRCS Runoff Curve Number

P = 1.0 inch

$$CN = \frac{1000}{[10 + 5P + 10Q - 10(Q^2 + 1.25QP)^{1/2}]}$$

CN = 98

Determine I_a, table 4-1 Chapter 4 TR-55

I_a = 0.151

Determine q_u, Exhibit 4-III Chapter 4 TR-55

q_u = 640 csm/in

WQF = 7.59 cfs

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STORMWATER QUALITY CALCULATIONS

Methodology: Water Quality Volume and Flow

Reference: 2004 Stormwater Quality Manual

$$WQV = \frac{(1")(R)(A)}{12}$$

WQV = water quality volume (acre-feet)
R = volumetric runoff coefficient
I = percent impervious cover
A = site area (acres)

$$WQF = (q_u)(A)(Q)$$

WQF = water quality flow (cfs)
q_u = unit peak discharge (cfs/mi^2/inch)
A = drainage area (mi^2)
Q = runoff depth (watershed inches)
= [WQV (acre-feet)]x[12 (inches/foot)] / Drainage area (acres)

Site Characteristics

Description	**WDB B-3**	Drainage Area to feature		**Watershed B**	
Area		15.96	acres	0.024938	mi^2
Impervious Area		13.94	acres		
Tc		0.08	hr		
I		87.3	%		
R = 0.05+ 0.009(I) =		0.836			
WQV =		**1.11**	**acre-ft**	48,439	cf
Q = WQV x 12/A =		0.84	inches		

determine qu using NRCS Runoff Curve Number

P = 1.0 inch

$$CN = \frac{1000}{[10 + 5P + 10Q - 10(Q^2 + 1.25QP)^{1/2}]}$$

CN = 98

Determine I_a, table 4-1 Chapter 4 TR-55

I_a = 0.151

Determine q_u, Exhibit 4-III Chapter 4 TR-55

q_u = 640 csm/in

WQF = 13.34 cfs

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STORMWATER QUALITY CALCULATIONS

Methodology: Water Quality Volume and Flow

Reference: 2004 Stormwater Quality Manual

$$WQV = \frac{(1")(R)(A)}{12}$$

WQV = water quality volume (acre-feet)
R = volumetric runoff coefficient
I = percent impervious cover
A = site area (acres)

$$WQF = (q_u)(A)(Q)$$

WQF = water quality flow (cfs)
q_u = unit peak discharge (cfs/mi^2/inch)
A = drainage area (mi^2)
Q = runoff depth (watershed inches)
= [WQV (acre-feet)]x[12 (inches/foot)] / Drainage area (acres)

Site Characteristics

Description	**MH B3-1 (WQU)**	Drainage Area to feature		**Watershed B-3**	
Area		2.18	acres	0.003406	mi^2
Impervious Area		1.94	acres		
Tc		0.08	hr		
I		89.0	%		
R = 0.05+ 0.009(I) =		0.851			
WQV =		**0.15**	**acre-ft**	6,734	cf
Q = WQV x 12/A =		0.85	inches		

determine qu using NRCS Runoff Curve Number

P = 1.0 inch

$$CN = \frac{1000}{[10 + 5P + 10Q - 10(Q^2 + 1.25QP)^{1/2}]}$$

CN = 99

Determine I_a, table 4-1 Chapter 4 TR-55

I_a = 0.151

Determine q_u, Exhibit 4-III Chapter 4 TR-55

q_u = 640 csm/in

WQF = 1.86 cfs

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STORMWATER QUALITY CALCULATIONS

Methodology: Water Quality Volume and Flow

Reference: 2004 Stormwater Quality Manual

$$WQV = \frac{(1")(R)(A)}{12}$$

WQV = water quality volume (acre-feet)
R = volumetric runoff coefficient
I = percent impervious cover
A = site area (acres)

$$WQF = (q_u)(A)(Q)$$

WQF = water quality flow (cfs)
q_u = unit peak discharge (cfs/mi^2/inch)
A = drainage area (mi^2)
Q = runoff depth (watershed inches)
= [WQV (acre-feet)]x[12 (inches/foot)] / Drainage area (acres)

Site Characteristics

Description	**UDB B-1**	Drainage Area to feature		**Watershed D**	
Area		12.99	acres	0.020297	mi^2
Impervious Area		6.55	acres		
Tc		0.08	hr		
I		50.4	%		
R = 0.05+ 0.009(I) =		0.504			
WQV =		**0.55**	**acre-ft**	23,757	cf
Q = WQV x 12/A =		0.50	inches		

determine qu using NRCS Runoff Curve Number

P = 1.0 inch

$$CN = \frac{1000}{[10 + 5P + 10Q - 10(Q^2 + 1.25QP)^{1/2}]}$$

CN = 94

Determine I_a, table 4-1 Chapter 4 TR-55

I_a = 0.151

Determine q_u, Exhibit 4-III Chapter 4 TR-55

q_u = 640 csm/in

WQF = 6.54 cfs

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STORMWATER QUALITY CALCULATIONS

Methodology: Water Quality Volume and Flow

Reference: 2004 Stormwater Quality Manual

$$WQV = \frac{(1")(R)(A)}{12}$$

WQV = water quality volume (acre-feet)
R = volumetric runoff coefficient
I = percent impervious cover
A = site area (acres)

$$WQF = (q_u)(A)(Q)$$

WQF = water quality flow (cfs)
q_u = unit peak discharge (cfs/mi^2/inch)
A = drainage area (mi^2)
Q = runoff depth (watershed inches)
= [WQV (acre-feet)]x[12 (inches/foot)] / Drainage area (acres)

Site Characteristics

Description	**CLCB D1-1A (WQU)**	Drainage Area to feature		**Watershed D-1**	
Area		4.97	acres	0.007766	mi^2
Impervious Area		4.17	acres		
Tc		0.08	hr		
I		83.9	%		
R = 0.05+ 0.009(I) =		0.805			
WQV =		**0.33**	**acre-ft**	14,525	cf
Q = WQV x 12/A =		0.81	inches		

determine qu using NRCS Runoff Curve Number

P = 1.0 inch

$$CN = \frac{1000}{[10 + 5P + 10Q - 10(Q^2 + 1.25QP)^{1/2}]}$$

CN = 98

Determine I_a, table 4-1 Chapter 4 TR-55

I_a = 0.151

Determine q_u, Exhibit 4-III Chapter 4 TR-55

q_u = 640 csm/in

WQF = 4.00 cfs

STORMWATER QUALITY CALCULATIONS

Methodology: Water Quality Volume and Flow

Reference: 2004 Stormwater Quality Manual

$$WQV = \frac{(1")(R)(A)}{12}$$

WQV = water quality volume (acre-feet)
R = volumetric runoff coefficient
I = percent impervious cover
A = site area (acres)

$$WQF = (q_u)(A)(Q)$$

WQF = water quality flow (cfs)
q_u = unit peak discharge (cfs/mi^2/inch)
A = drainage area (mi^2)
Q = runoff depth (watershed inches)
= [WQV (acre-feet)]x[12 (inches/foot)] / Drainage area (acres)

Site Characteristics

Description	**MH D1-1 (WQU)**	Drainage Area to feature		**Watershed D-1**	
Area	4.19	acres		0.006547	mi^2
Impervious Area	2.03	acres			
Tc	0.08	hr			
I	48.4	%			
R = 0.05+ 0.009(I) =	0.486				
WQV =	**0.17**	**acre-ft**		7,392	cf
Q = WQV x 12/A =	0.49	inches			

determine qu using NRCS Runoff Curve Number

P = 1.0 inch

$$CN = \frac{1000}{[10 + 5P + 10Q - 10(Q^2 + 1.25QP)^{1/2}]}$$

CN = 94

Determine I_a, table 4-1 Chapter 4 TR-55

I_a = 0.151

Determine q_u, Exhibit 4-III Chapter 4 TR-55

q_u = 640 csm/in

WQF = **2.04** cfs

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STORMWATER QUALITY CALCULATIONS

Methodology: Water Quality Volume and Flow

Reference: 2004 Stormwater Quality Manual

WQV = water quality volume (acre-feet)
R = volumetric runoff coefficient
I = percent impervious cover
A = site area (acres)

WQF = water quality flow (cfs)
q_u = unit peak discharge (cfs/mi^2/inch)
A = drainage area (mi^2)
Q = runoff depth (watershed inches)
= [WQV (acre-feet)]x[12 (inches/foot)] / Drainage area (acres)

Site Characteristics

Description	**MH D2-1 (WQU)**	Drainage Area to feature		**Watershed D-1**	
Area		2.15	acres	0.003359	mi^2
Impervious Area		0.67	acres		
Tc		0.08	hr		
I		31.2	%		
R = 0.05+ 0.009(I) =		0.330			
WQV =		**0.06**	**acre-ft**	2,579	cf
Q = WQV x 12/A =		0.33	inches		

determine qu using NRCS Runoff Curve Number

P = 1.0 inch

$$CN = \frac{1000}{[10 + 5P + 10Q - 10(Q^2 + 1.25QP)^{1/2}]}$$

CN = 90

Determine I_a, table 4-1 Chapter 4 TR-55

I_a = 0.151

Determine q_u, Exhibit 4-III Chapter 4 TR-55

q_u = 640 csm/in

WQF = 0.71 cfs

		BY	IJAB	DATE	12/6/2022	PROJ NO.	140255601
		CKD	IJAB	DATE	12/6/2022	SHEET	8 8

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APPENDIX D

Stormwater Collection System Calculations

LANGAN

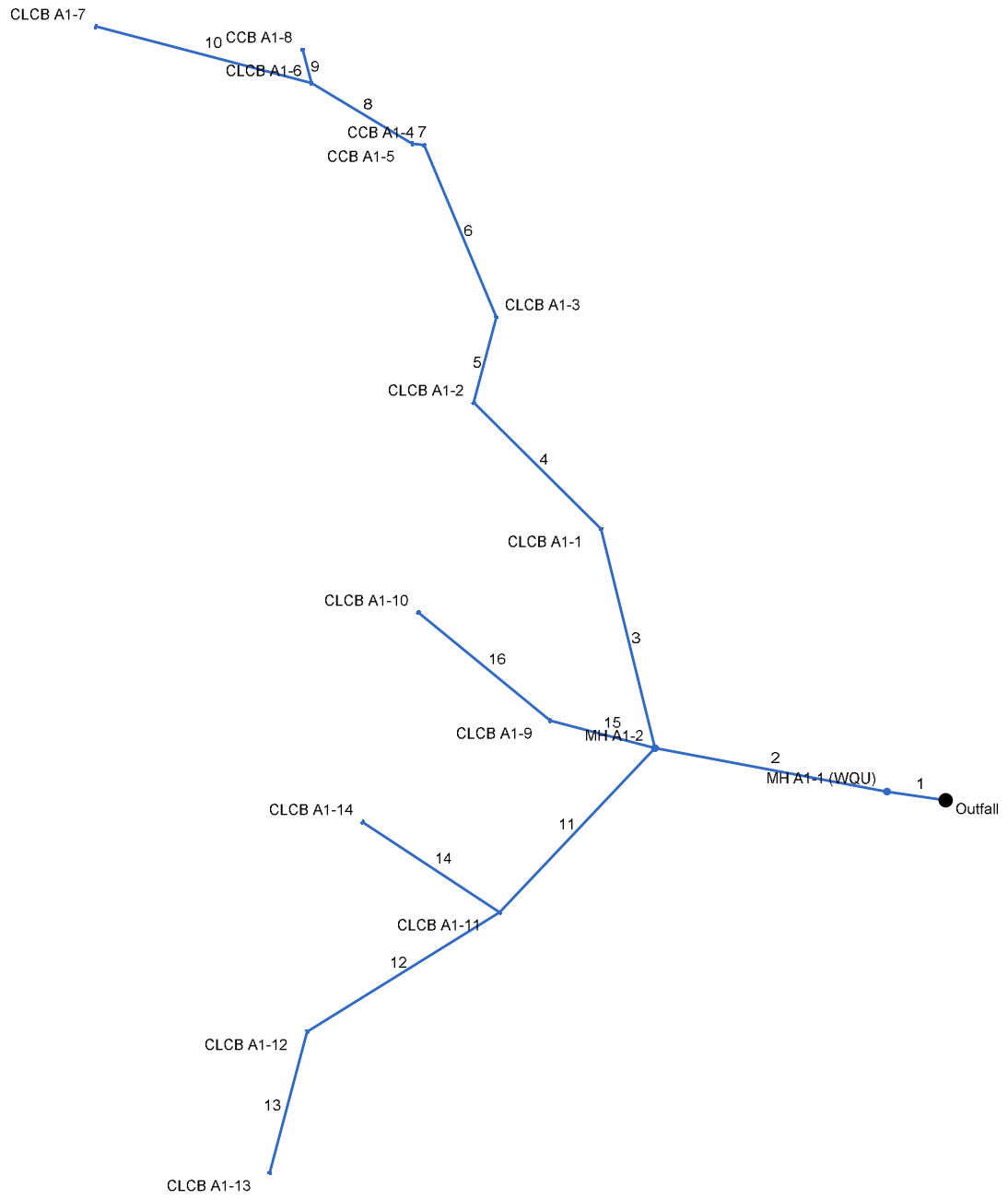
Project	116 West Dudley Town Rd	By	JMGM	Date	12/5/2022
Location	116 West Dudley Town Rd, Bloomfield, CT	Checked	IJAB	Date	12/6/2022
Circle one:	Present (Developed)	Job No.	140255601		

1. Rational 'C' Runoff Coefficient & Area Calculations

Catchment Area	Total Area		Impervious (C=.9)		Pervious (C=0.3)		Percent Impervious	C
	SF	AC	SF	AC	SF	AC		
CLCB A1-1	38,714	0.889	31,988	0.734	6,726	0.154	83%	0.80
CLCB A1-2	41,562	0.954	35,823	0.822	5,739	0.132	86%	0.82
CLCB A1-3	32,970	0.757	10,748	0.247	22,222	0.510	33%	0.50
CCB A1-4	7,961	0.183	4,748	0.109	3,213	0.074	60%	0.66
CCB A1-5	5,638	0.129	4,094	0.094	1,544	0.035	73%	0.74
CLCB A1-6	17,435	0.400	13,405	0.308	4,030	0.093	77%	0.76
CLCB A1-7	46,601	1.070	37,881	0.870	8,720	0.200	81%	0.79
CCB A1-8	13,255	0.304	6,124	0.141	7,131	0.164	46%	0.58
CLCB A1-9	40,498	0.930	37,440	0.860	3,058	0.070	92%	0.85
CLCB A1-10	38,850	0.892	38,850	0.892	0	0.000	100%	0.90
CLCB A1-11	43,231	0.992	37,413	0.859	5,818	0.134	87%	0.82
CLCB A1-12	39,402	0.905	34,882	0.801	4,520	0.104	89%	0.83
CLCB A1-13	21,301	0.489	11,270	0.259	10,031	0.230	53%	0.62
CLCB A1-14	38,850	0.892	38,850	0.892	0	0.000	100%	0.90
RL B1-1	20,125	0.462	20,125	0.462	0	0.000	100%	0.90
RL B1-2	21,700	0.498	21,700	0.498	0	0.000	100%	0.90
RL B1-3	23,500	0.539	23,500	0.539	0	0.000	100%	0.90
RL B1-4	23,500	0.539	23,500	0.539	0	0.000	100%	0.90
RL B1-5	23,500	0.539	23,500	0.539	0	0.000	100%	0.90
RL B1-6	23,500	0.539	23,500	0.539	0	0.000	100%	0.90
RL B1-7	23,500	0.539	23,500	0.539	0	0.000	100%	0.90
RL B1-8	23,500	0.539	23,500	0.539	0	0.000	100%	0.90
RL B1-9	23,500	0.539	23,500	0.539	0	0.000	100%	0.90
RL B1-10	23,500	0.539	23,500	0.539	0	0.000	100%	0.90
RL B1-11	27,025	0.620	27,025	0.620	0	0.000	100%	0.90
RL B2-1	27,025	0.620	27,025	0.620	0	0.000	100%	0.90
RL B2-2	23,500	0.539	23,500	0.539	0	0.000	100%	0.90
RL B2-3	23,500	0.539	23,500	0.539	0	0.000	100%	0.90
RL B2-4	23,500	0.539	23,500	0.539	0	0.000	100%	0.90
RL B2-5	23,500	0.539	23,500	0.539	0	0.000	100%	0.90
RL B2-6	23,500	0.539	23,500	0.539	0	0.000	100%	0.90
RL B2-7	23,500	0.539	23,500	0.539	0	0.000	100%	0.90
RL B2-8	23,500	0.539	23,500	0.539	0	0.000	100%	0.90
RL B2-9	23,500	0.539	23,500	0.539	0	0.000	100%	0.90
RL B2-10	23,500	0.539	23,500	0.539	0	0.000	100%	0.90
RL B2-11	27,025	0.620	27,025	0.620	0	0.000	100%	0.90
CCB B3-1	11,646	0.267	6,341	0.146	5,305	0.122	54%	0.63
CCB B3-2	22,915	0.526	21,239	0.488	1,676	0.038	93%	0.86
CCB B3-3	17,548	0.403	16,855	0.387	693	0.016	96%	0.88
CCB B3-4	18,949	0.435	16,999	0.390	1,950	0.045	90%	0.84
CCB B3-5	18,407	0.423	17,445	0.400	962	0.022	95%	0.87
CCB B3-6	5,496	0.126	5,496	0.126	0	0.000	100%	0.90
CLCB D1-1	39,582	0.909	36,258	0.832	3,324	0.076	92%	0.85
CLCB D1-1A (WQU)	44,210	1.015	32,770	0.752	11,440	0.263	74%	0.74

CLCB D1-2	40,019	0.919	37,000	0.849	3,019	0.069	92%	0.85
CLCB D1-3	42,782	0.982	37,000	0.849	5,782	0.133	86%	0.82
CLCB D1-4	49,995	1.148	38,727	0.889	11,268	0.259	77%	0.76
CLCB D1-5	47,519	1.091	37,000	0.849	10,519	0.241	78%	0.77
CLCB D1-6	49,836	1.144	14,395	0.330	35,441	0.814	29%	0.47
CLCB D1-7	45,437	1.043	15,366	0.353	30,071	0.690	34%	0.50
CCB D1-8	6,557	0.151	4,523	0.104	2,034	0.047	69%	0.71
CCB D1-9	10,530	0.242	6,787	0.156	3,743	0.086	64%	0.69
CCB D1-10	22,644	0.520	10,552	0.242	12,092	0.278	47%	0.58
CCB D2-1	14,686	0.337	11,098	0.255	3,588	0.082	76%	0.75
CCB D2-2	7,889	0.181	6,259	0.144	1,630	0.037	79%	0.78
CCB D2-3	6,862	0.158	3,808	0.087	3,054	0.070	55%	0.63
CCB D2-4	4,788	0.110	4,070	0.093	718	0.016	85%	0.81
CCB D2-5	4,915	0.113	4,146	0.095	769	0.018	84%	0.81
YD D2-1	54,573	1.253	0	0.000	54,573	1.253	0%	0.30

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



Project File: Network A-1.stm	Number of lines: 16	Date: 12/7/2022

Storm Sewers v2022.00

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	PIPE-45 (1)	42.03	36	Cir	57.363	136.00	136.57	1.000	139.53*	139.72*	0.08	139.81	End	Manhole
2	PIPE-45	43.32	36	Cir	227.640	136.57	138.17	0.700	139.81	140.38	0.87	141.25	1	Manhole
3	PIPE-41	20.20	30	Cir	218.534	138.17	139.63	0.670	141.25	141.62	0.31	141.93	2	Grate
4	PIPE-44	16.54	24	Cir	173.404	139.63	140.76	0.650	141.93	142.65	0.60	143.25	3	Grate
5	PIPE-57	12.04	24	Cir	85.463	140.76	141.31	0.650	143.25*	143.45*	0.23	143.68	4	Grate
6	PIPE-43	10.26	24	Cir	180.629	141.31	142.25	0.521	143.68	143.95	0.27	144.22	5	Grate
7	PIPE-29	9.48	18	Cir	11.364	142.66	142.72	0.500	144.22*	144.30*	0.33	144.63	6	Grate
8	PIPE-3	9.08	18	Cir	113.600	142.72	143.29	0.500	144.63*	145.36*	0.46	145.82	7	Grate
9	PIPE-4	1.31	12	Cir	33.896	143.81	145.50	5.000	145.82	145.98	n/a	145.98 j	8	Grate
10	PIPE-2	6.26	18	Cir	215.000	143.29	144.36	0.500	145.82*	146.47*	0.19	146.66	8	Grate
11	PIPE-39	16.84	24	Cir	218.534	138.17	139.48	0.600	141.25*	142.28*	0.66	142.94	2	Grate
12	PIPE-5	7.08	18	Cir	218.589	139.48	140.79	0.600	142.94*	143.79*	0.27	144.06	11	Grate
13	PIPE-70	2.24	15	Cir	141.469	140.79	141.92	0.800	144.06*	144.21*	0.05	144.26	12	Grate
14	PIPE-6	5.94	18	Cir	158.433	139.67	140.78	0.700	142.94*	143.37*	0.18	143.55	11	Grate
15	PIPE-42	11.29	18	Cir	104.370	138.17	139.21	1.000	141.25*	142.28*	0.45	142.73	2	Grate
16	PIPE-7	5.94	15	Cir	165.109	139.21	140.86	1.000	142.73*	143.92*	0.36	144.28	15	Grate

Project File: Network A-1.stm | Number of lines: 16 | Run Date: 12/7/2022

NOTES: Return period = 10 Yrs. ; *Surcharged (HGL above crown). ; j - Line contains hyd. jump.

Storm Sewer Tabulation

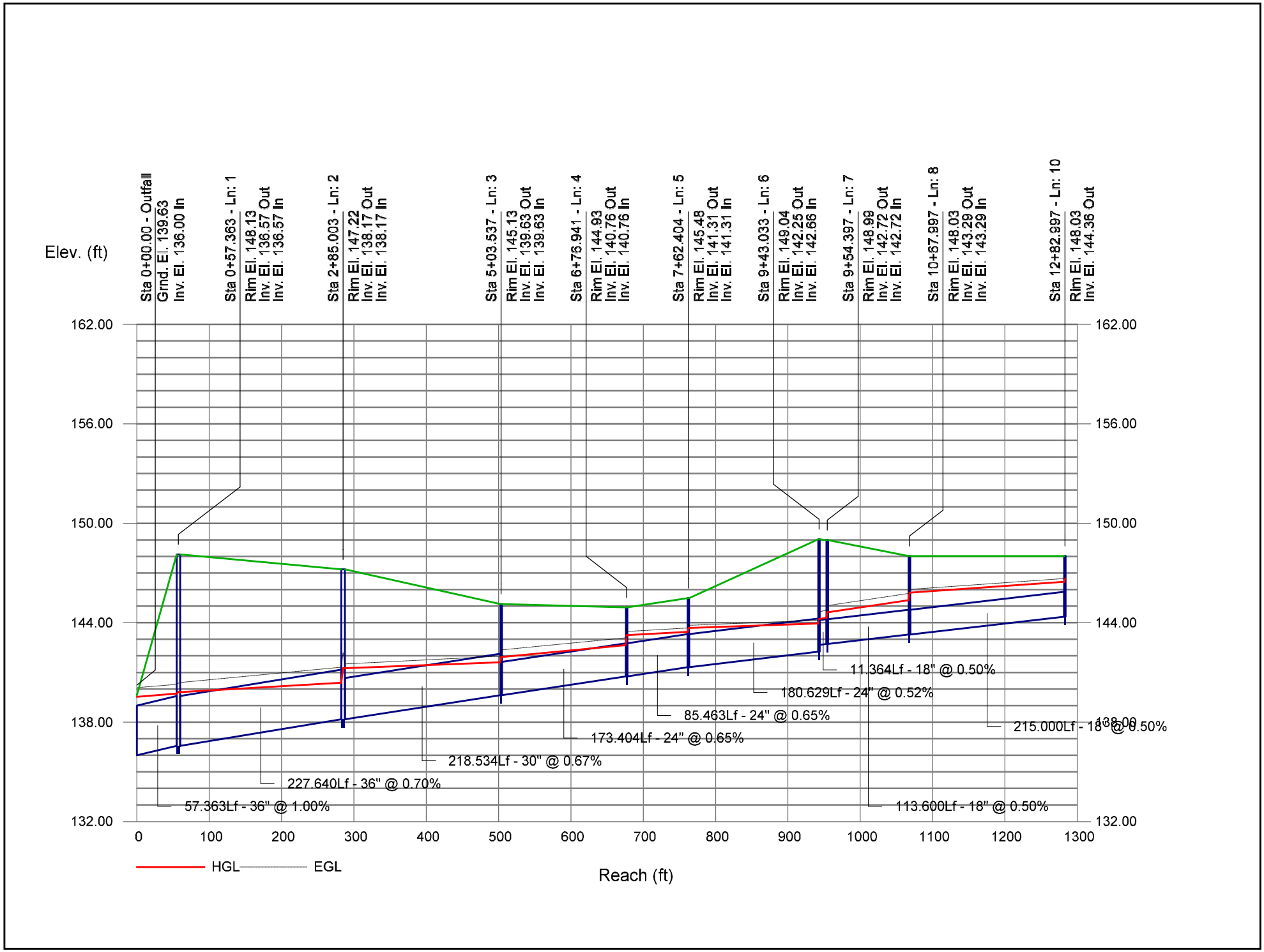
Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	57.363	0.00	9.79	0.00	0.00	7.68	0.0	9.5	5.5	42.03	72.25	5.95	36	1.00	136.00	136.57	139.53	139.72	139.63	148.13	PIPE-45 (1)
2	1	227.640	0.00	9.79	0.00	0.00	7.68	0.0	9.0	5.6	43.32	60.45	6.95	36	0.70	136.57	138.17	139.81	140.38	148.13	147.22	PIPE-45
3	2	218.534	0.89	4.69	0.80	0.71	3.41	5.0	8.2	5.9	20.20	36.38	4.48	30	0.67	138.17	139.63	141.25	141.62	147.22	145.13	PIPE-41
4	3	173.404	0.95	3.80	0.82	0.78	2.70	5.0	7.6	6.1	16.54	19.75	5.33	24	0.65	139.63	140.76	141.93	142.65	145.13	144.93	PIPE-44
5	4	85.463	0.76	2.84	0.50	0.38	1.92	5.0	7.3	6.3	12.04	19.75	3.83	24	0.65	140.76	141.31	143.25	143.45	144.93	145.48	PIPE-57
6	5	180.629	0.18	2.09	0.66	0.12	1.54	5.0	6.4	6.7	10.26	17.68	3.44	24	0.52	141.31	142.25	143.68	143.95	145.48	149.04	PIPE-43
7	6	11.364	0.13	1.90	0.74	0.10	1.42	5.0	6.4	6.7	9.48	8.04	5.37	18	0.50	142.66	142.72	144.22	144.30	149.04	148.99	PIPE-29
8	7	113.600	0.40	1.77	0.76	0.30	1.33	5.0	6.0	6.9	9.08	8.04	5.14	18	0.50	142.72	143.29	144.63	145.36	148.99	148.03	PIPE-3
9	8	33.896	0.30	0.30	0.58	0.18	0.18	5.0	5.0	7.4	1.31	8.63	2.57	12	5.00	143.81	145.50	145.82	145.98	148.03	150.55	PIPE-4
10	8	215.000	1.07	1.07	0.79	0.85	0.85	5.0	5.0	7.4	6.26	8.04	3.54	18	0.50	143.29	144.36	145.82	146.47	148.03	148.03	PIPE-2
11	2	218.534	0.99	3.28	0.82	0.81	2.67	5.0	7.2	6.3	16.84	18.98	5.36	24	0.60	138.17	139.48	141.25	142.28	147.22	145.13	PIPE-39
12	11	218.589	0.90	1.39	0.83	0.75	1.05	5.0	6.3	6.7	7.08	8.81	4.01	18	0.60	139.48	140.79	142.94	143.79	145.13	144.93	PIPE-5
13	12	141.469	0.49	0.49	0.62	0.30	0.30	5.0	5.0	7.4	2.24	6.26	1.83	15	0.80	140.79	141.92	144.06	144.21	144.93	145.63	PIPE-70
14	11	158.433	0.89	0.89	0.90	0.80	0.80	5.0	5.0	7.4	5.94	9.52	3.36	18	0.70	139.67	140.78	142.94	143.37	145.13	144.93	PIPE-6
15	2	104.370	0.93	1.82	0.85	0.79	1.59	5.0	5.5	7.1	11.29	11.38	6.39	18	1.00	138.17	139.21	141.25	142.28	147.22	145.13	PIPE-42
16	15	165.109	0.89	0.89	0.90	0.80	0.80	5.0	5.0	7.4	5.94	7.00	4.84	15	1.00	139.21	140.86	142.73	143.92	145.13	144.93	PIPE-7

Project File: Network A-1.stm | Number of lines: 16 | Run Date: 12/7/2022

NOTES:Intensity = 35.84 / (Inlet time + 3.80) ^ 0.73; Return period =Yrs. 10 ; c = cir e = ellip b = box

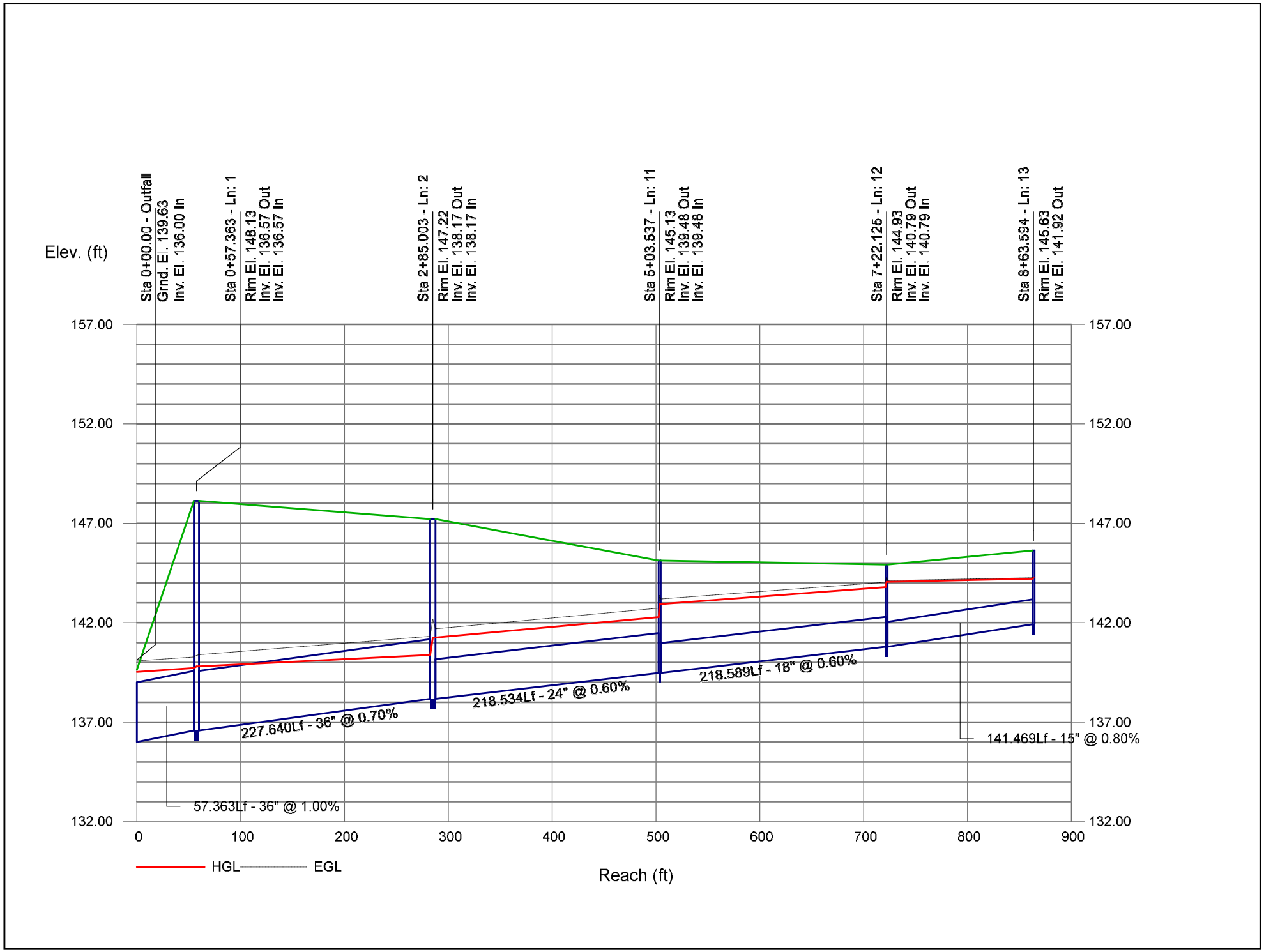
Storm Sewer Profile

Proj. file: Network A-1.stm

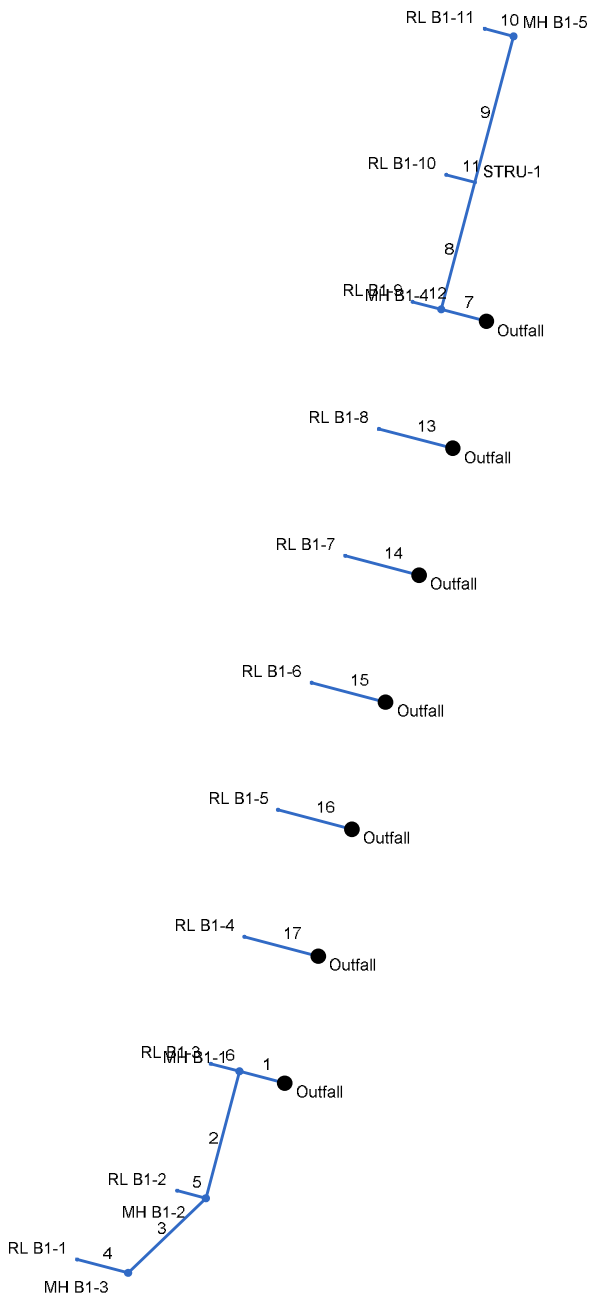


Storm Sewer Profile

Proj. file: Network A-1.stm



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



Project File: Network B-1.stm	Number of lines: 17	Date: 12/7/2022

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	PIPE-82 (1)	9.50	15	Cir	35.500	140.05	140.76	2.006	141.03	141.93	0.98	141.93	End	Manhole
2	PIPE-85	6.23	15	Cir	100.000	140.76	142.76	2.000	141.93	143.77	n/a	143.77 j	1	Manhole
3	PIPE-84	3.06	10	Cir	81.892	142.76	144.40	2.000	143.77	145.16	n/a	145.16 j	2	Manhole
4	PIPE-83	3.08	10	Cir	40.000	144.40	145.00	1.500	145.16	145.76	0.54	145.76	3	Grate
5	PIPE-87	3.32	10	Cir	22.500	143.17	143.62	2.000	143.85	144.39	0.61	144.39	2	Grate
6	PIPE-88	3.59	10	Cir	22.500	141.88	143.00	5.000	142.38	143.79	0.71	143.79	1	Grate
7	PIPE-77	10.57	15	Cir	35.500	138.79	139.33	1.507	140.38*	141.19*	1.15	142.34	End	Manhole
8	PIPE-91	7.37	15	Cir	100.000	139.33	140.83	1.500	142.34*	143.45*	0.56	144.01	7	Manhole
9	PIPE-90	4.12	15	Cir	115.000	140.83	142.55	1.500	144.01*	144.41*	0.18	144.59	8	Manhole
10	PIPE-89	4.13	10	Cir	22.500	142.55	143.00	2.000	144.59*	145.27*	0.89	146.17	9	Grate
11	PIPE-92	3.59	10	Cir	22.500	141.88	143.00	5.000	144.01*	144.53*	0.68	145.21	8	Grate
12	PIPE-120	3.59	10	Cir	22.500	141.88	143.00	5.000	142.38	143.79	0.71	143.79	7	Grate
13	PIPE-78	3.59	10	Cir	58.000	140.10	143.00	5.000	140.60	143.79	0.71	143.79	End	Grate
14	PIPE-79	3.59	10	Cir	58.000	140.10	143.00	5.000	140.60	143.79	0.71	143.79	End	Grate
15	PIPE-80	3.59	10	Cir	58.000	140.10	143.00	5.000	140.60	143.79	0.71	143.79	End	Grate
16	PIPE-81	3.59	10	Cir	58.000	140.10	143.00	5.000	140.60	143.79	0.71	143.79	End	Grate
17	PIPE-82	3.59	10	Cir	58.000	140.10	143.00	5.000	140.60	143.79	0.71	143.79	End	Grate

Project File: Network B-1.stm | Number of lines: 17 | Run Date: 12/7/2022

NOTES: Return period = 10 Yrs. ; *Surcharged (HGL above crown). ; j - Line contains hyd. jump.

Storm Sewer Tabulation

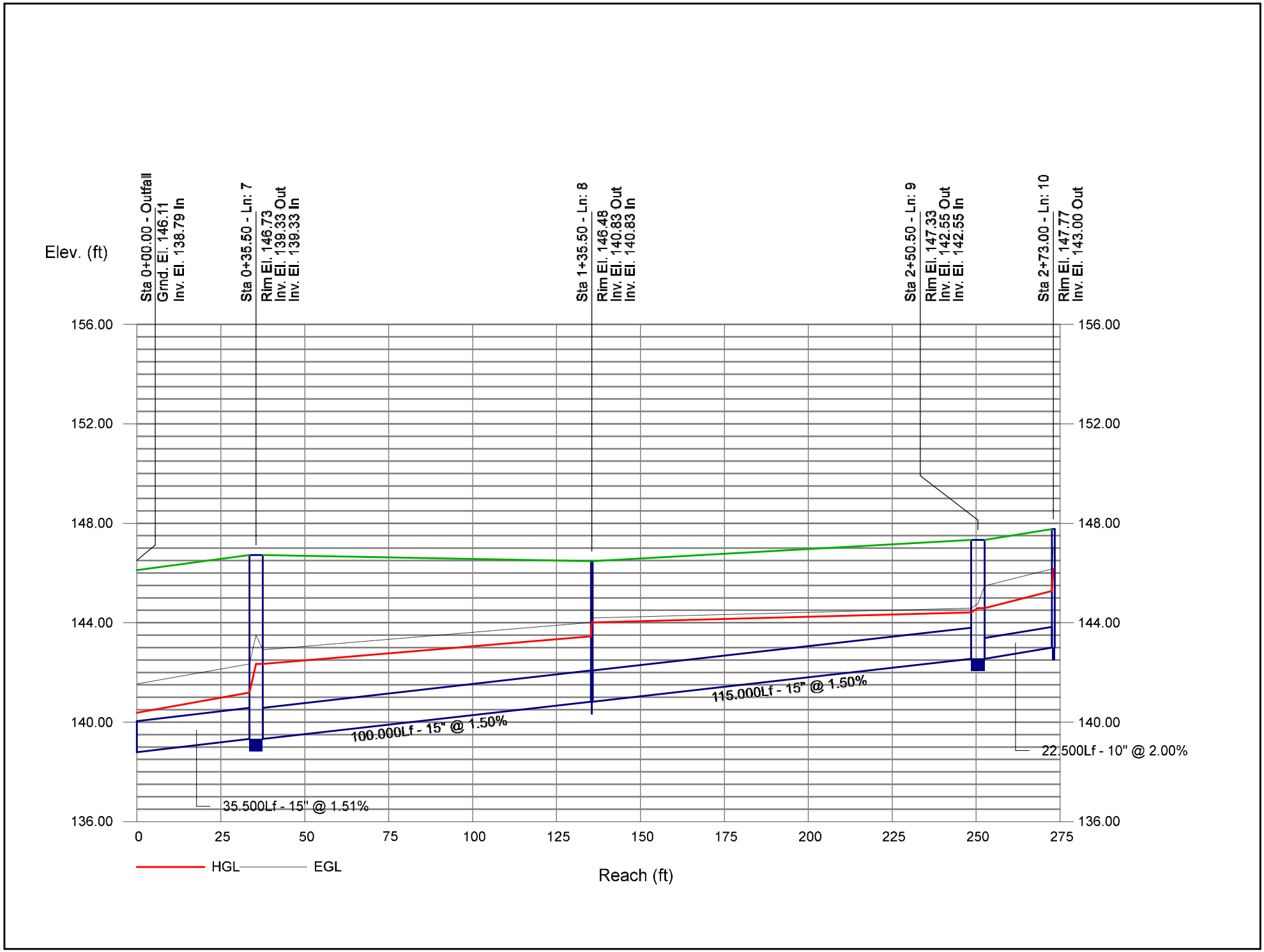
Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	35.500	0.00	1.50	0.00	0.00	1.35	0.0	5.6	7.0	9.50	9.91	8.57	15	2.01	140.05	140.76	141.03	141.93	146.11	146.48	PIPE-82 (1)
2	1	100.000	0.00	0.96	0.00	0.00	0.86	0.0	5.3	7.2	6.23	9.89	5.55	15	2.00	140.76	142.76	141.93	143.77	146.48	147.38	PIPE-85
3	2	81.892	0.00	0.46	0.00	0.00	0.42	0.0	5.1	7.3	3.06	3.36	5.74	10	2.00	142.76	144.40	143.77	145.16	147.38	148.21	PIPE-84
4	3	40.000	0.46	0.46	0.90	0.42	0.42	5.0	5.0	7.4	3.08	2.91	5.92	10	1.50	144.40	145.00	145.16	145.76	148.21	150.73	PIPE-83
5	2	22.500	0.50	0.50	0.90	0.45	0.45	5.0	5.0	7.4	3.32	3.36	6.65	10	2.00	143.17	143.62	143.85	144.39	147.38	147.54	PIPE-87
6	1	22.500	0.54	0.54	0.90	0.49	0.49	5.0	5.0	7.4	3.59	5.30	8.59	10	5.00	141.88	143.00	142.38	143.79	146.48	146.70	PIPE-88
7	End	35.500	0.00	1.70	0.00	0.00	1.53	0.0	5.9	6.9	10.57	8.59	8.61	15	1.51	138.79	139.33	140.38	141.19	146.11	146.73	PIPE-77
8	7	100.000	0.00	1.16	0.00	0.00	1.04	0.0	5.6	7.1	7.37	8.57	6.00	15	1.50	139.33	140.83	142.34	143.45	146.73	146.48	PIPE-91
9	8	115.000	0.00	0.62	0.00	0.00	0.56	0.0	5.0	7.4	4.12	8.57	3.36	15	1.50	140.83	142.55	144.01	144.41	146.48	147.33	PIPE-90
10	9	22.500	0.62	0.62	0.90	0.56	0.56	5.0	5.0	7.4	4.13	3.36	7.58	10	2.00	142.55	143.00	144.59	145.27	147.33	147.77	PIPE-89
11	8	22.500	0.54	0.54	0.90	0.49	0.49	5.0	5.0	7.4	3.59	5.30	6.59	10	5.00	141.88	143.00	144.01	144.53	146.48	146.70	PIPE-92
12	7	22.500	0.54	0.54	0.90	0.49	0.49	5.0	5.0	7.4	3.59	5.30	8.59	10	5.00	141.88	143.00	142.38	143.79	146.73	146.70	PIPE-120
13	End	58.000	0.54	0.54	0.90	0.49	0.49	5.0	5.0	7.4	3.59	5.30	8.59	10	5.00	140.10	143.00	140.60	143.79	146.08	146.70	PIPE-78
14	End	58.000	0.54	0.54	0.90	0.49	0.49	5.0	5.0	7.4	3.59	5.30	8.59	10	5.00	140.10	143.00	140.60	143.79	146.12	146.70	PIPE-79
15	End	58.000	0.54	0.54	0.90	0.49	0.49	5.0	5.0	7.4	3.59	5.30	8.59	10	5.00	140.10	143.00	140.60	143.79	146.09	146.70	PIPE-80
16	End	58.000	0.54	0.54	0.90	0.49	0.49	5.0	5.0	7.4	3.59	5.30	8.59	10	5.00	140.10	143.00	140.60	143.79	146.11	146.70	PIPE-81
17	End	58.000	0.54	0.54	0.90	0.49	0.49	5.0	5.0	7.4	3.59	5.30	8.59	10	5.00	140.10	143.00	140.60	143.79	141.04	146.70	PIPE-82

Project File: Network B-1.stm | Number of lines: 17 | Run Date: 12/7/2022

NOTES:Intensity = 35.84 / (Inlet time + 3.80) ^ 0.73; Return period =Yrs. 10 ; c = cir e = ellip b = box

Storm Sewer Profile

Proj. file: Network B-1.stm



Storm Sewer Profile

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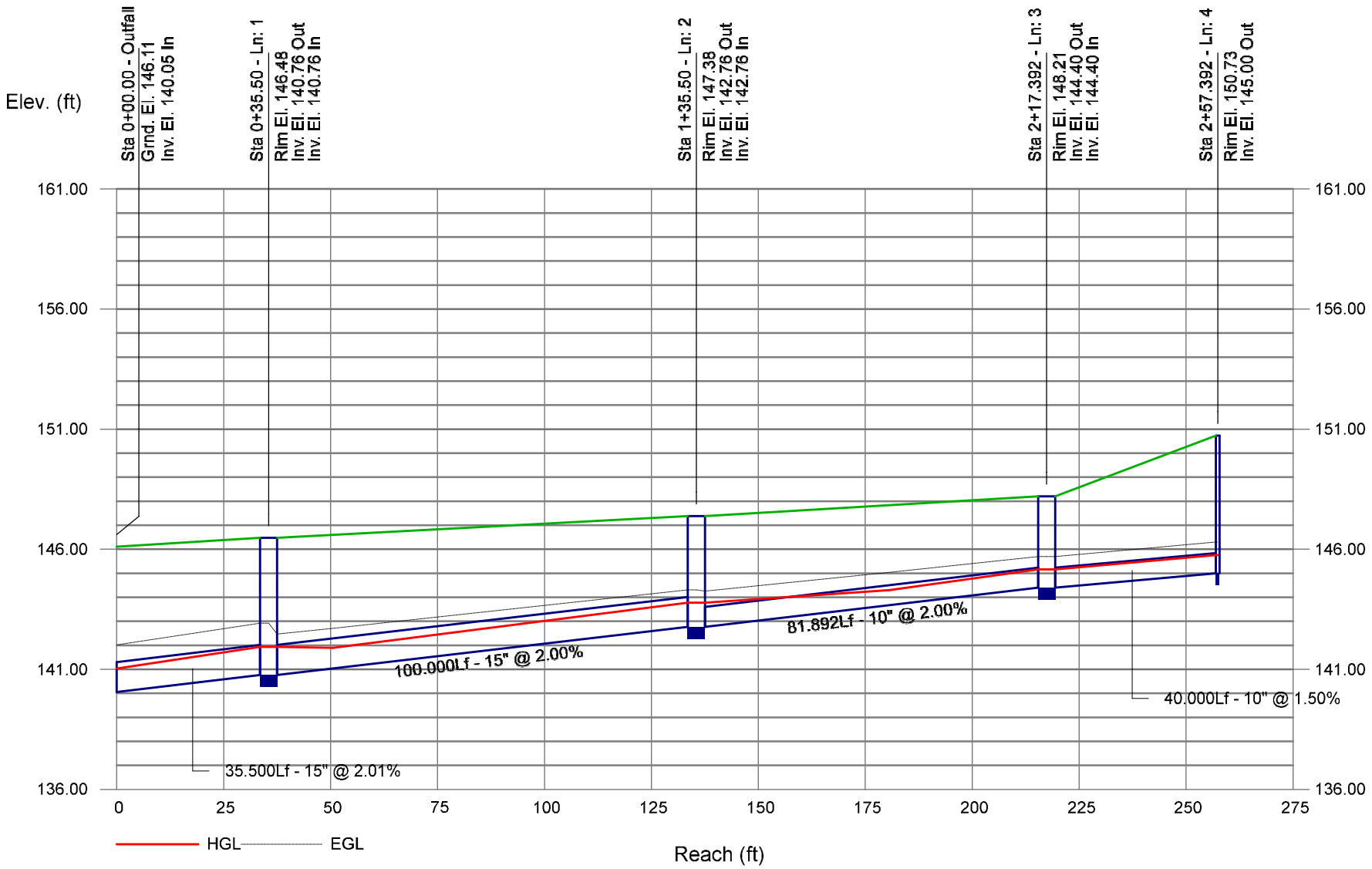
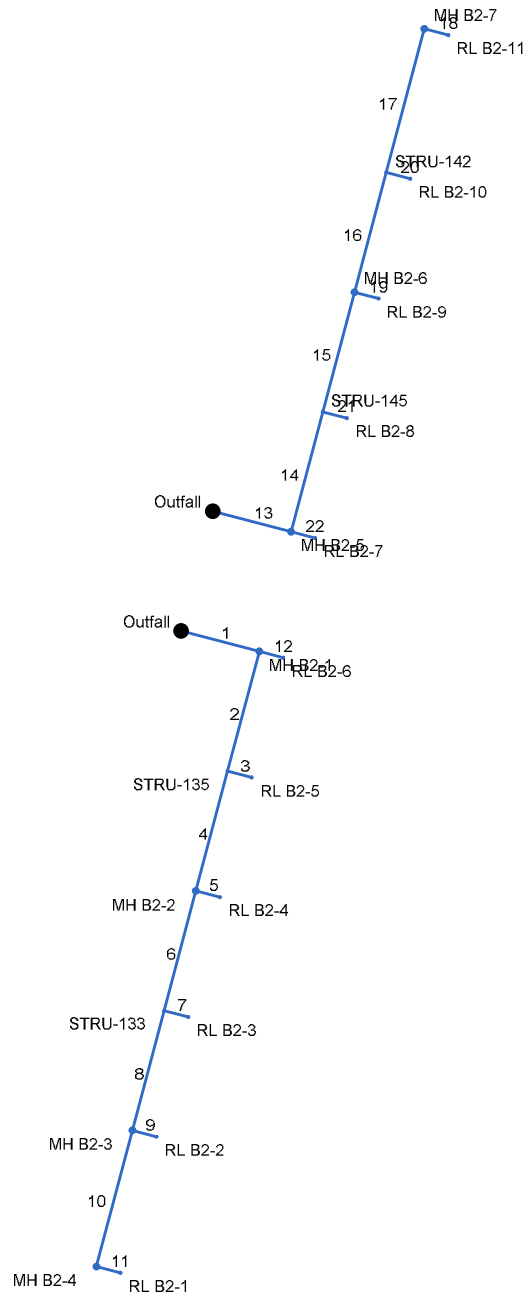


Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: Network B-2.stm	Number of lines: 22	Date: 12/7/2022

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	PIPE-94 (1)	19.28	24	Cir	65.043	139.88	140.53	0.999	141.22	142.11	n/a	142.11	End	Manhole
2	PIPE-101	16.44	24	Cir	100.000	140.53	141.13	0.600	142.11	142.59	n/a	142.59 j	1	Manhole
3	PIPE-105	3.60	10	Cir	20.000	143.61	143.81	1.000	144.44*	144.90*	0.68	145.58	2	Grate
4	PIPE-100	13.52	24	Cir	100.000	141.13	141.73	0.600	142.59	143.05	n/a	143.05 j	2	Manhole
5	PIPE-104	3.60	10	Cir	20.000	143.61	143.81	1.000	144.44*	144.90*	0.68	145.58	4	Grate
6	PIPE-99	10.47	18	Cir	100.000	141.73	142.33	0.600	143.23*	144.08*	0.55	144.62	4	Manhole
7	PIPE-103	3.60	10	Cir	20.000	143.61	143.81	1.000	144.62*	145.08*	0.68	145.76	6	Grate
8	PIPE-98	7.36	18	Cir	100.000	142.33	142.93	0.600	144.62*	145.04*	0.27	145.31	6	Manhole
9	PIPE-102	3.60	10	Cir	20.000	143.61	143.81	1.000	145.31*	145.77*	0.68	146.45	8	Grate
10	PIPE-97	4.12	15	Cir	113.728	142.93	143.61	0.598	145.31*	145.71*	0.17	145.88	8	Manhole
11	PIPE-96	4.13	10	Cir	20.000	143.61	143.81	1.000	145.88*	146.49*	0.89	147.38	10	Grate
12	PIPE-94	3.60	10	Cir	20.000	139.60	140.00	2.000	142.11*	142.57*	0.68	143.25	1	Grate
13	PIPE-111	16.49	24	Cir	65.051	140.01	140.66	0.999	141.21	142.12	0.70	142.12	End	Manhole
14	PIPE-110	13.56	24	Cir	100.000	140.66	141.26	0.600	142.12	142.58	n/a	142.58 j	13	Manhole
15	PIPE-109	10.54	24	Cir	100.000	141.26	141.86	0.600	142.58	143.02	n/a	143.02 j	14	Manhole
16	PIPE-108	7.35	15	Cir	100.000	141.86	142.46	0.600	143.11*	144.21*	0.56	144.77	15	Manhole
17	PIPE-107	4.12	15	Cir	120.000	142.46	143.18	0.600	144.77*	145.19*	0.17	145.36	16	Manhole
18	PIPE-106	4.13	10	Cir	20.002	143.55	143.75	1.000	145.36*	145.97*	0.89	146.86	17	Grate
19	PIPE-113	3.60	10	Cir	20.000	142.80	143.00	1.000	143.63*	144.09*	0.68	144.77	15	Grate
20	PIPE-112	3.60	10	Cir	20.000	142.80	143.00	1.000	144.77*	145.23*	0.68	145.91	16	Grate
21	PIPE-114	3.60	10	Cir	20.000	142.80	143.00	1.000	143.63*	144.09*	0.68	144.77	14	Grate
22	PIPE-115	3.60	10	Cir	20.000	142.80	143.00	1.000	143.63*	144.09*	0.68	144.77	13	Grate

Project File: Network B-2.stm | Number of lines: 22 | Run Date: 12/7/2022

NOTES: Return period = 10 Yrs. ; *Surcharged (HGL above crown). ; j - Line contains hyd. jump.

Storm Sewer Tabulation

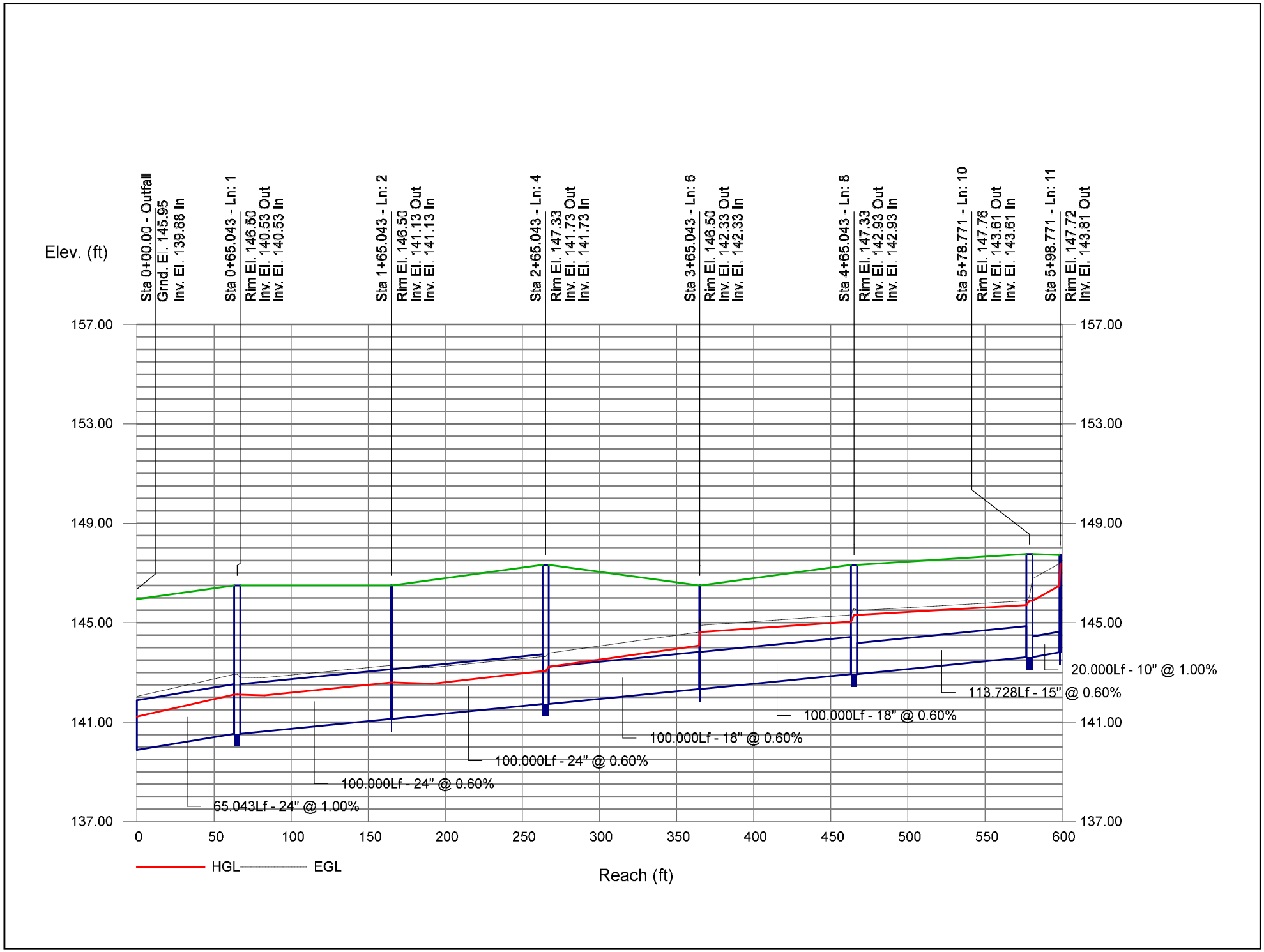
Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	65.043	0.00	3.32	0.00	0.00	2.99	0.0	6.8	6.5	19.28	24.49	7.94	24	1.00	139.88	140.53	141.22	142.11	145.95	146.50	PIPE-94 (1)
2	1	100.000	0.00	2.78	0.00	0.00	2.50	0.0	6.6	6.6	16.44	18.98	6.43	24	0.60	140.53	141.13	142.11	142.59	146.50	146.50	PIPE-101
3	2	20.000	0.54	0.54	0.90	0.49	0.49	5.0	5.0	7.4	3.60	2.37	6.60	10	1.00	143.61	143.81	144.44	144.90	146.50	146.70	PIPE-105
4	2	100.000	0.00	2.24	0.00	0.00	2.02	0.0	6.3	6.7	13.52	18.98	5.82	24	0.60	141.13	141.73	142.59	143.05	146.50	147.33	PIPE-100
5	4	20.000	0.54	0.54	0.90	0.49	0.49	5.0	5.0	7.4	3.60	2.37	6.60	10	1.00	143.61	143.81	144.44	144.90	147.33	146.70	PIPE-104
6	4	100.000	0.00	1.70	0.00	0.00	1.53	0.0	6.0	6.8	10.47	8.81	5.93	18	0.60	141.73	142.33	143.23	144.08	147.33	146.50	PIPE-99
7	6	20.000	0.54	0.54	0.90	0.49	0.49	5.0	5.0	7.4	3.60	2.37	6.60	10	1.00	143.61	143.81	144.62	145.08	146.50	146.70	PIPE-103
8	6	100.000	0.00	1.16	0.00	0.00	1.04	0.0	5.6	7.1	7.36	8.81	4.17	18	0.60	142.33	142.93	144.62	145.04	146.50	147.33	PIPE-98
9	8	20.000	0.54	0.54	0.90	0.49	0.49	5.0	5.0	7.4	3.60	2.37	6.60	10	1.00	143.61	143.81	145.31	145.77	147.33	146.70	PIPE-102
10	8	113.728	0.00	0.62	0.00	0.00	0.56	0.0	5.0	7.4	4.12	5.41	3.35	15	0.60	142.93	143.61	145.31	145.71	147.33	147.76	PIPE-97
11	10	20.000	0.62	0.62	0.90	0.56	0.56	5.0	5.0	7.4	4.13	2.37	7.58	10	1.00	143.61	143.81	145.88	146.49	147.76	147.72	PIPE-96
12	1	20.000	0.54	0.54	0.90	0.49	0.49	5.0	5.0	7.4	3.60	3.36	6.60	10	2.00	139.60	140.00	142.11	142.57	146.50	146.70	PIPE-94
13	End	65.051	0.00	2.78	0.00	0.00	2.50	0.0	6.5	6.6	16.49	24.49	7.53	24	1.00	140.01	140.66	141.21	142.12	146.02	146.53	PIPE-111
14	13	100.000	0.00	2.24	0.00	0.00	2.02	0.0	6.2	6.7	13.56	18.98	5.83	24	0.60	140.66	141.26	142.12	142.58	146.53	146.50	PIPE-110
15	14	100.000	0.00	1.70	0.00	0.00	1.53	0.0	5.9	6.9	10.54	18.98	5.17	24	0.60	141.26	141.86	142.58	143.02	146.50	146.58	PIPE-109
16	15	100.000	0.00	1.16	0.00	0.00	1.04	0.0	5.6	7.0	7.35	5.42	5.99	15	0.60	141.86	142.46	143.11	144.21	146.58	146.50	PIPE-108
17	16	120.000	0.00	0.62	0.00	0.00	0.56	0.0	5.0	7.4	4.12	5.42	3.35	15	0.60	142.46	143.18	144.77	145.19	146.50	147.69	PIPE-107
18	17	20.002	0.62	0.62	0.90	0.56	0.56	5.0	5.0	7.4	4.13	2.37	7.58	10	1.00	143.55	143.75	145.36	145.97	147.69	148.05	PIPE-106
19	15	20.000	0.54	0.54	0.90	0.49	0.49	5.0	5.0	7.4	3.60	2.37	6.60	10	1.00	142.80	143.00	143.63	144.09	146.58	146.70	PIPE-113
20	16	20.000	0.54	0.54	0.90	0.49	0.49	5.0	5.0	7.4	3.60	2.37	6.60	10	1.00	142.80	143.00	144.77	145.23	146.50	146.70	PIPE-112
21	14	20.000	0.54	0.54	0.90	0.49	0.49	5.0	5.0	7.4	3.60	2.37	6.60	10	1.00	142.80	143.00	143.63	144.09	146.50	146.70	PIPE-114
22	13	20.000	0.54	0.54	0.90	0.49	0.49	5.0	5.0	7.4	3.60	2.37	6.60	10	1.00	142.80	143.00	143.63	144.09	146.53	146.70	PIPE-115

Project File: Network B-2.stm | Number of lines: 22 | Run Date: 12/7/2022

NOTES:Intensity = 35.84 / (Inlet time + 3.80) ^ 0.73; Return period =Yrs. 10 ; c = cir e = ellip b = box

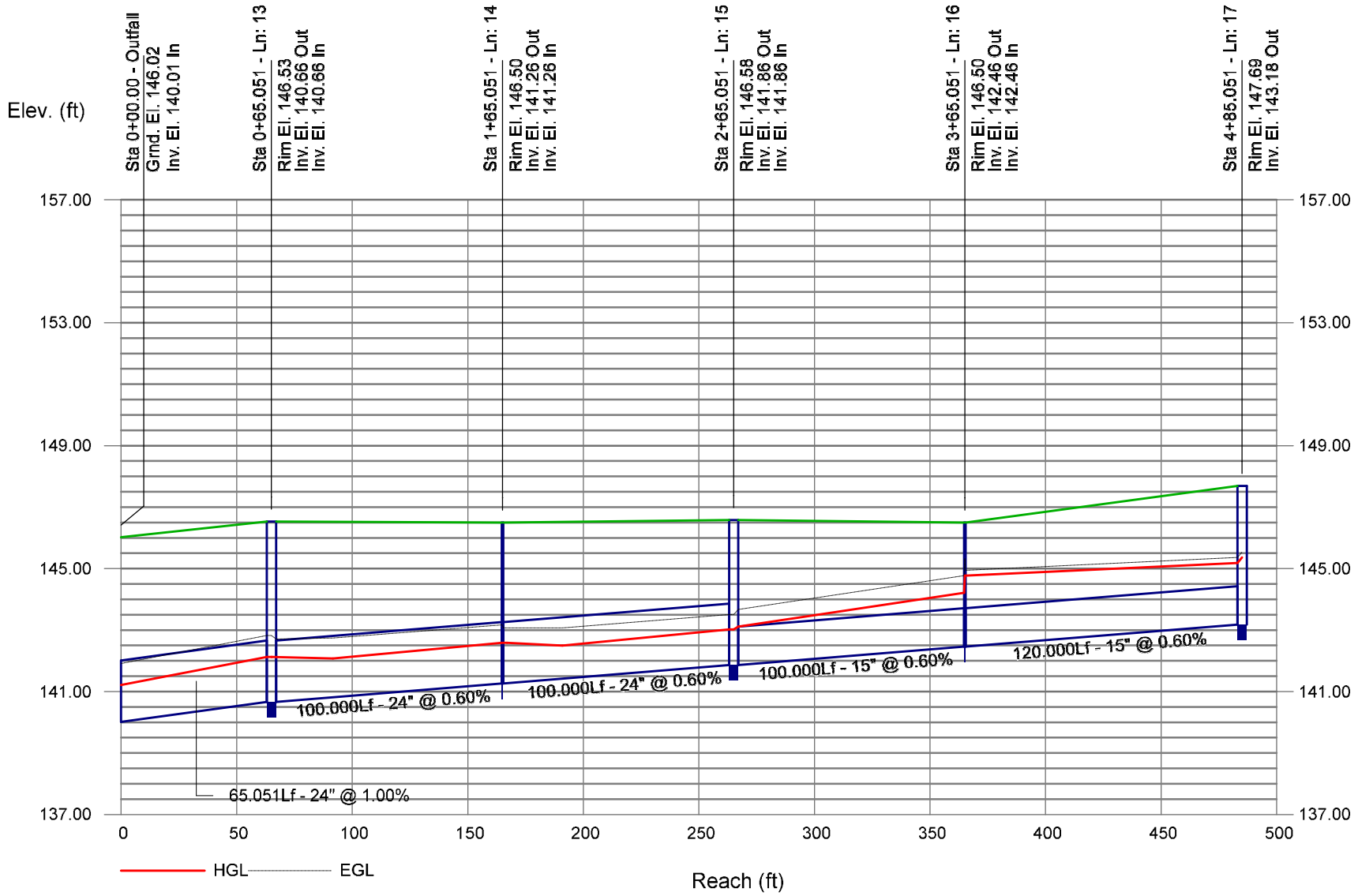
Storm Sewer Profile

Proj. file: Network B-2.stm

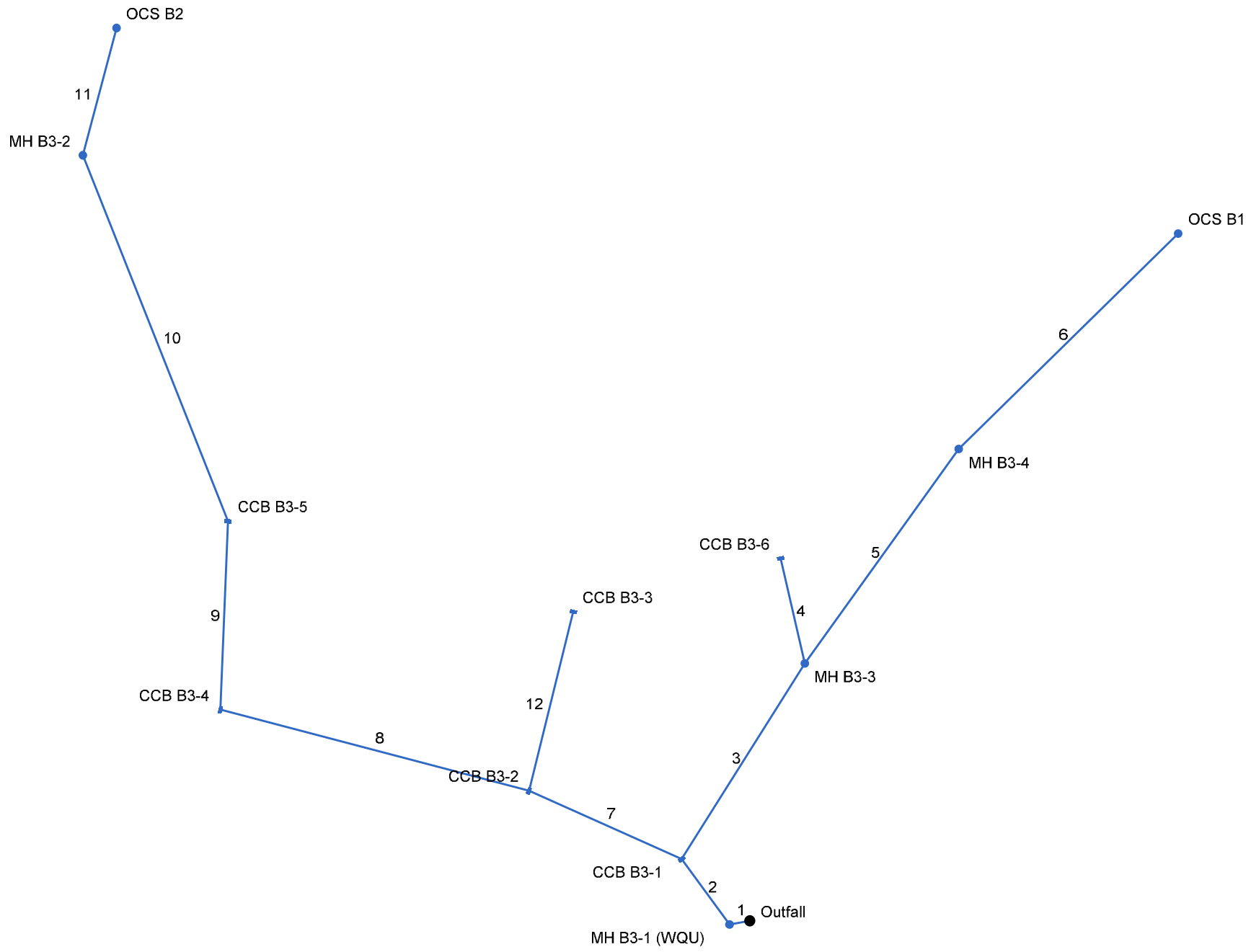


Storm Sewer Profile

Proj. file: Network B-2.stm



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



Project File: Network B-3.stm	Number of lines: 12	Date: 12/7/2022

Storm Sewers v2022.00

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	PIPE-25	18.88	24	Cir	12.549	134.00	134.08	0.638	135.56	135.67	0.71	136.38	End	Manhole
2	PIPE-34	19.00	24	Cir	49.745	134.08	134.33	0.503	136.38*	136.68*	1.06	137.74	1	Grate
3	PIPE-67 (1)	4.26	12	Cir	141.633	134.33	135.73	0.988	137.74*	139.47*	0.34	139.81	2	Manhole
4	PIPE-26	0.87	12	Cir	66.253	142.30	145.61	4.996	142.51	146.00	n/a	146.00	3	Grate
5	PIPE-67	3.41	12	Cir	161.646	135.73	136.78	0.650	139.81*	141.07*	0.06	141.13	3	Manhole
6	PIPE-66	3.41	12	Cir	188.202	136.78	138.00	0.648	141.13*	142.60*	0.29	142.90	5	Manhole
7	PIPE-24	13.96	24	Cir	102.029	134.33	134.84	0.500	137.74*	138.07*	0.45	138.52	2	Grate
8	PIPE-22	8.71	18	Cir	195.000	134.84	135.81	0.497	138.52*	139.67*	0.55	140.22	7	Grate
9	PIPE-21	6.20	15	Cir	115.733	135.81	136.39	0.501	140.22*	141.13*	0.27	141.40	8	Grate
10	PIPE-69	3.49	12	Cir	241.286	136.39	137.60	0.501	141.40*	143.38*	0.20	143.57	9	Manhole
11	PIPE-72	3.49	12	Cir	80.723	137.60	138.00	0.496	143.57*	144.23*	0.31	144.54	10	Manhole
12	PIPE-23	2.61	12	Cir	113.018	138.16	142.68	3.999	138.56	143.37	n/a	143.37	7	Grate

Project File: Network B-3.stm | Number of lines: 12 | Run Date: 12/7/2022

NOTES: Return period = 10 Yrs. ; *Surcharged (HGL above crown).

Storm Sewer Tabulation

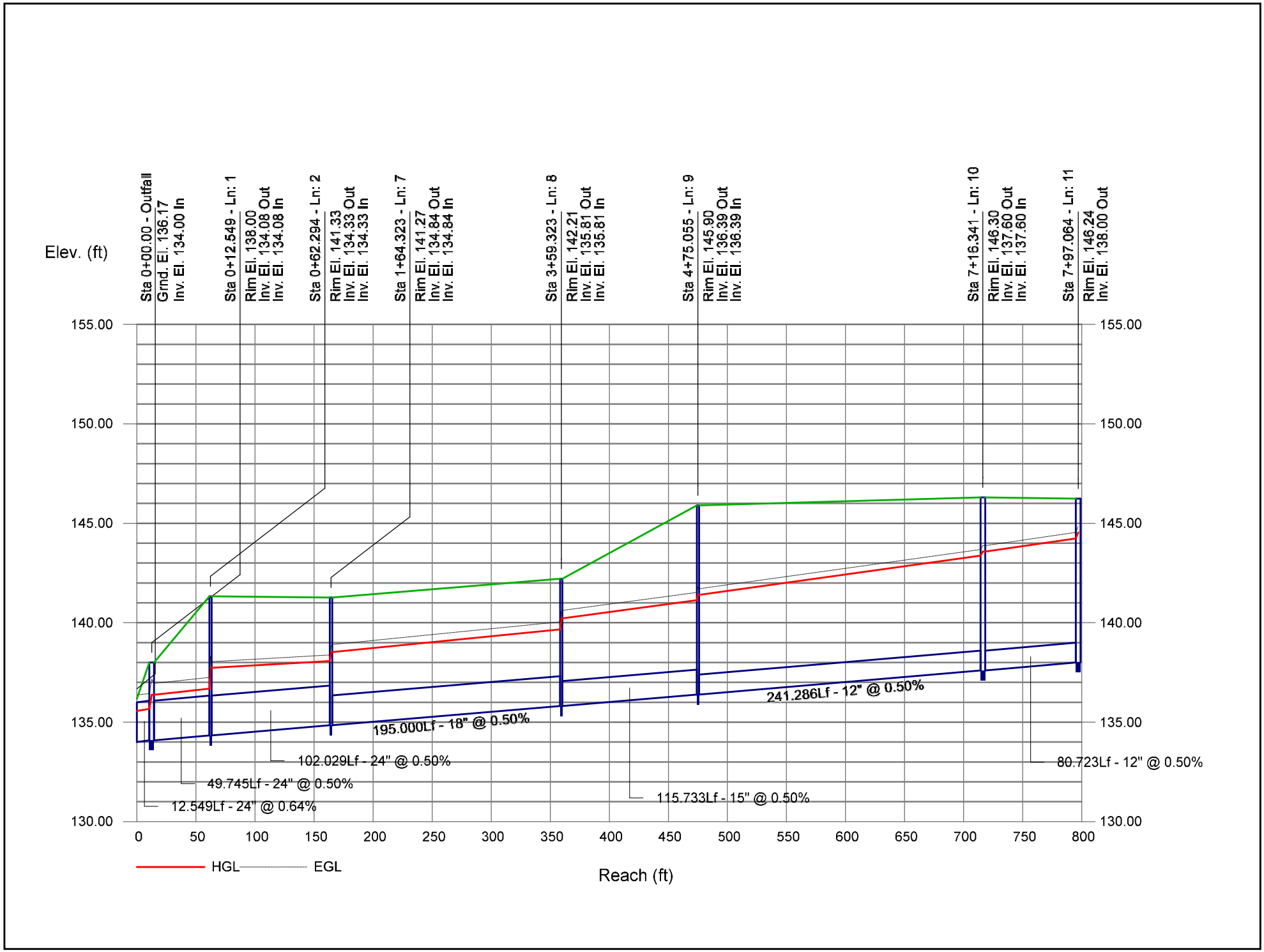
Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	12.549	0.00	2.18	0.00	0.00	1.82	0.0	6.6	6.6	18.88	19.56	7.12	24	0.64	134.00	134.08	135.56	135.67	136.17	138.00	PIPE-25
2	1	49.745	0.27	2.18	0.63	0.17	1.82	5.0	6.4	6.6	19.00	17.37	6.05	24	0.50	134.08	134.33	136.38	136.68	138.00	141.33	PIPE-34
3	2	141.633	0.00	0.13	0.00	0.00	0.12	0.0	5.2	7.3	4.26	3.84	5.43	12	0.99	134.33	135.73	137.74	139.47	141.33	145.72	PIPE-67 (1)
4	3	66.253	0.13	0.13	0.90	0.12	0.12	5.0	5.0	7.4	0.87	8.62	5.04	12	5.00	142.30	145.61	142.51	146.00	145.72	148.76	PIPE-26
5	3	161.646	0.00	0.00	0.00	0.00	0.00	0.0	0.7	0.0	3.41	3.11	4.34	12	0.65	135.73	136.78	139.81	141.07	145.72	147.42	PIPE-67
6	5	188.202	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	3.41	3.11	4.34	12	0.65	136.78	138.00	141.13	142.60	147.42	145.91	PIPE-66
7	2	102.029	0.53	1.78	0.86	0.46	1.53	5.0	6.0	6.8	13.96	17.32	4.45	24	0.50	134.33	134.84	137.74	138.07	141.33	141.27	PIPE-24
8	7	195.000	0.43	0.85	0.84	0.36	0.73	5.0	5.4	7.2	8.71	8.02	4.93	18	0.50	134.84	135.81	138.52	139.67	141.27	142.21	PIPE-22
9	8	115.733	0.42	0.42	0.87	0.37	0.37	5.0	5.0	7.4	6.20	4.95	5.05	15	0.50	135.81	136.39	140.22	141.13	142.21	145.90	PIPE-21
10	9	241.286	0.00	0.00	0.00	0.00	0.00	0.0	0.3	0.0	3.49	2.73	4.44	12	0.50	136.39	137.60	141.40	143.38	145.90	146.30	PIPE-69
11	10	80.723	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	3.49	2.72	4.44	12	0.50	137.60	138.00	143.57	144.23	146.30	146.24	PIPE-72
12	7	113.018	0.40	0.40	0.88	0.35	0.35	5.0	5.0	7.4	2.61	7.72	6.68	12	4.00	138.16	142.68	138.56	143.37	141.27	145.81	PIPE-23

Project File: Network B-3.stm | Number of lines: 12 | Run Date: 12/7/2022

NOTES:Intensity = 35.84 / (Inlet time + 3.80) ^ 0.73; Return period =Yrs. 10 ; c = cir e = ellip b = box

Storm Sewer Profile

Proj. file: Network B-3.stm



Storm Sewer Profile

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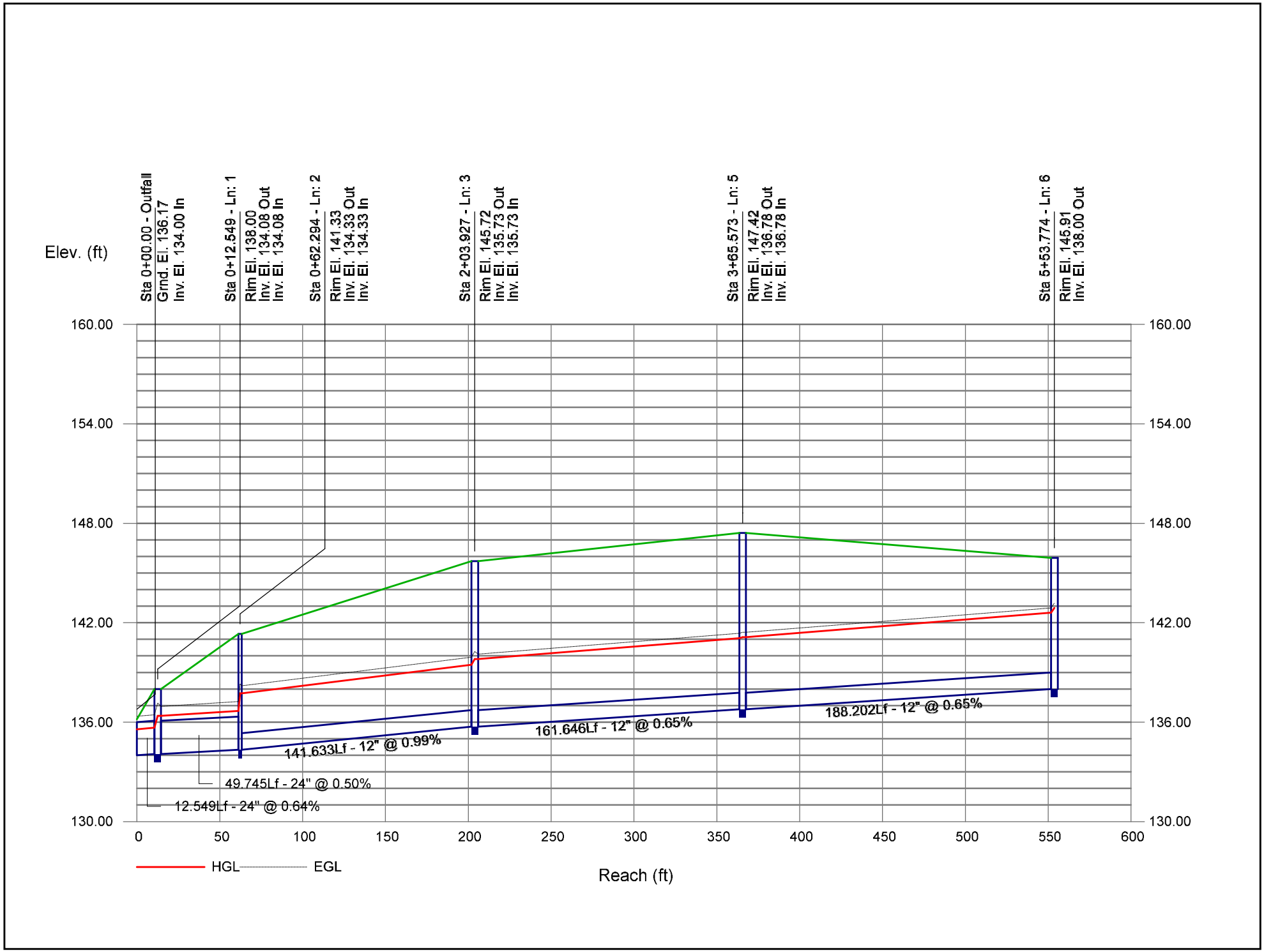
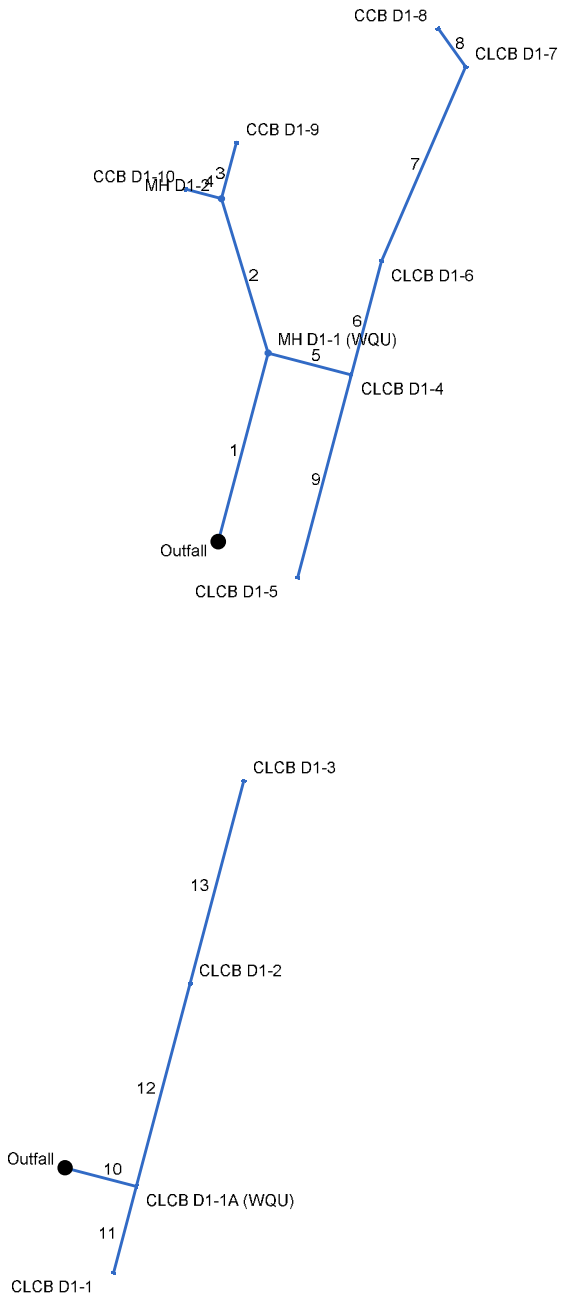


Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: Network D-1.stm	Number of lines: 13	Date: 12/7/2022

Storm Sewers v2022.00

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	PIPE-117	21.52	30	Cir	185.902	139.05	139.98	0.498	140.59	141.55	n/a	141.55	End	Manhole
2	PIPE-74	3.41	15	Cir	153.686	141.73	147.88	4.000	142.15	148.62	0.27	148.62	1	Manhole
3	PIPE-75	1.23	12	Cir	55.589	151.12	151.95	1.500	151.47	152.42	n/a	152.42	2	Grate
4	PIPE-73	2.23	15	Cir	34.740	150.88	151.40	1.500	151.31	152.00	0.23	152.00	2	Grate
5	PIPE-116	18.80	24	Cir	81.587	139.98	140.38	0.500	141.98*	142.46*	1.25	143.71	1	Grate
6	PIPE-13	7.93	18	Cir	112.000	141.09	141.65	0.500	143.71*	144.25*	0.16	144.41	5	Grate
7	PIPE-28	4.59	18	Cir	201.872	141.65	145.86	2.083	144.41	146.68	n/a	146.68 j	6	Grate
8	PIPE-27	0.79	12	Cir	44.562	146.42	147.29	1.951	146.68	147.66	n/a	147.66	7	Grate
9	PIPE-93	6.22	24	Cir	200.000	140.38	141.38	0.500	143.71*	143.84*	0.06	143.90	5	Grate
10	PIPE-49	16.61	24	Cir	70.000	139.06	139.48	0.604	140.59	140.95	1.58	140.95	End	Grate
11	PIPE-71	1.14	15	Cir	85.124	141.69	142.54	1.000	142.03	142.96	n/a	142.96	10	Grate
12	PIPE-20	11.10	24	Cir	200.000	139.48	140.68	0.600	140.95	141.88	n/a	141.88 j	10	Grate
13	PIPE-19	5.96	18	Cir	200.000	140.68	141.88	0.600	141.88	142.83	n/a	142.83 j	12	Grate

Project File: Network D-1.stm | Number of lines: 13 | Run Date: 12/7/2022

NOTES: Return period = 10 Yrs. ; *Surcharged (HGL above crown). ; j - Line contains hyd. jump.

Storm Sewer Tabulation

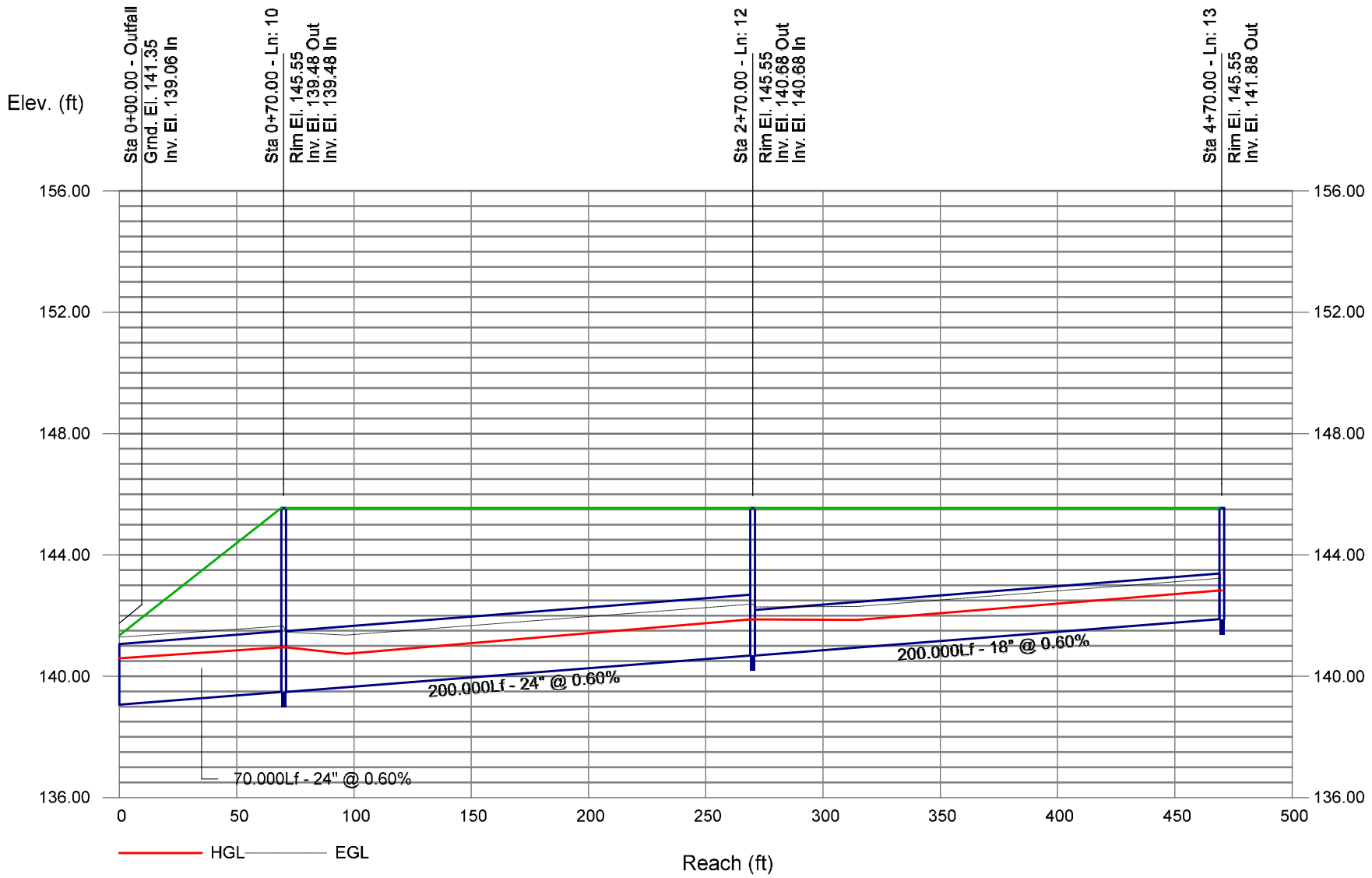
Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	185.902	0.00	5.34	0.00	0.00	3.35	0.0	6.9	6.4	21.52	31.34	6.69	30	0.50	139.05	139.98	140.59	141.55	0.00	147.59	PIPE-117
2	1	153.686	0.00	0.76	0.00	0.00	0.47	0.0	5.2	7.3	3.41	13.99	6.94	15	4.00	141.73	147.88	142.15	148.62	147.59	155.54	PIPE-74
3	2	55.589	0.24	0.24	0.69	0.17	0.17	5.0	5.0	7.4	1.23	4.72	4.24	12	1.50	151.12	151.95	151.47	152.42	155.54	155.54	PIPE-75
4	2	34.740	0.52	0.52	0.58	0.30	0.30	5.0	5.0	7.4	2.23	8.57	4.87	15	1.50	150.88	151.40	151.31	152.00	155.54	155.38	PIPE-73
5	1	81.587	1.15	4.58	0.76	0.87	2.88	5.0	6.7	6.5	18.80	17.33	5.98	24	0.50	139.98	140.38	141.98	142.46	147.59	145.55	PIPE-116
6	5	112.000	1.14	2.34	0.47	0.54	1.17	5.0	6.1	6.8	7.93	8.04	4.49	18	0.50	141.09	141.65	143.71	144.25	145.55	145.98	PIPE-13
7	6	201.872	1.04	1.19	0.50	0.52	0.63	5.0	5.2	7.3	4.59	16.42	3.61	18	2.08	141.65	145.86	144.41	146.68	145.98	149.52	PIPE-28
8	7	44.562	0.15	0.15	0.71	0.11	0.11	5.0	5.0	7.4	0.79	5.39	3.94	12	1.95	146.42	147.29	146.68	147.66	149.52	150.70	PIPE-27
9	5	200.000	1.09	1.09	0.77	0.84	0.84	5.0	5.0	7.4	6.22	17.33	1.98	24	0.50	140.38	141.38	143.71	143.84	145.55	145.55	PIPE-93
10	End	70.000	1.01	3.10	0.74	0.75	2.49	5.0	6.4	6.7	16.61	19.05	6.58	24	0.60	139.06	139.48	140.59	140.95	141.35	145.55	PIPE-49
11	10	85.124	0.18	0.18	0.85	0.15	0.15	5.0	5.0	7.4	1.14	7.00	3.67	15	1.00	141.69	142.54	142.03	142.96	145.55	145.91	PIPE-71
12	10	200.000	0.92	1.90	0.85	0.78	1.59	5.0	5.7	7.0	11.10	18.98	5.08	24	0.60	139.48	140.68	140.95	141.88	145.55	145.55	PIPE-20
13	12	200.000	0.98	0.98	0.82	0.81	0.81	5.0	5.0	7.4	5.96	8.81	4.53	18	0.60	140.68	141.88	141.88	142.83	145.55	145.55	PIPE-19

Project File: Network D-1.stm | Number of lines: 13 | Run Date: 12/7/2022

NOTES:Intensity = 35.84 / (Inlet time + 3.80) ^ 0.73; Return period =Yrs. 10 ; c = cir e = ellip b = box

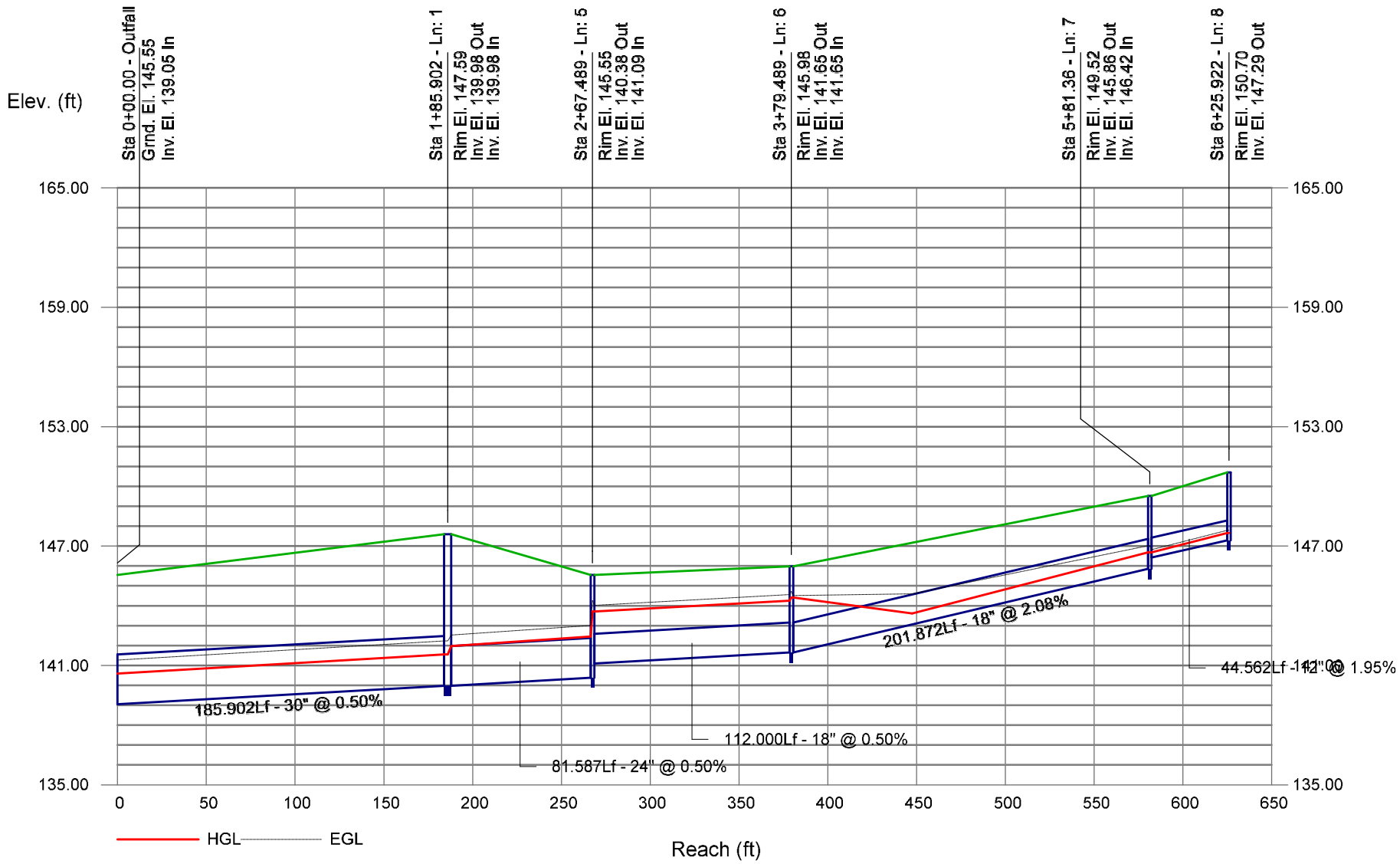
Storm Sewer Profile

Proj. file: Network D-1.stm

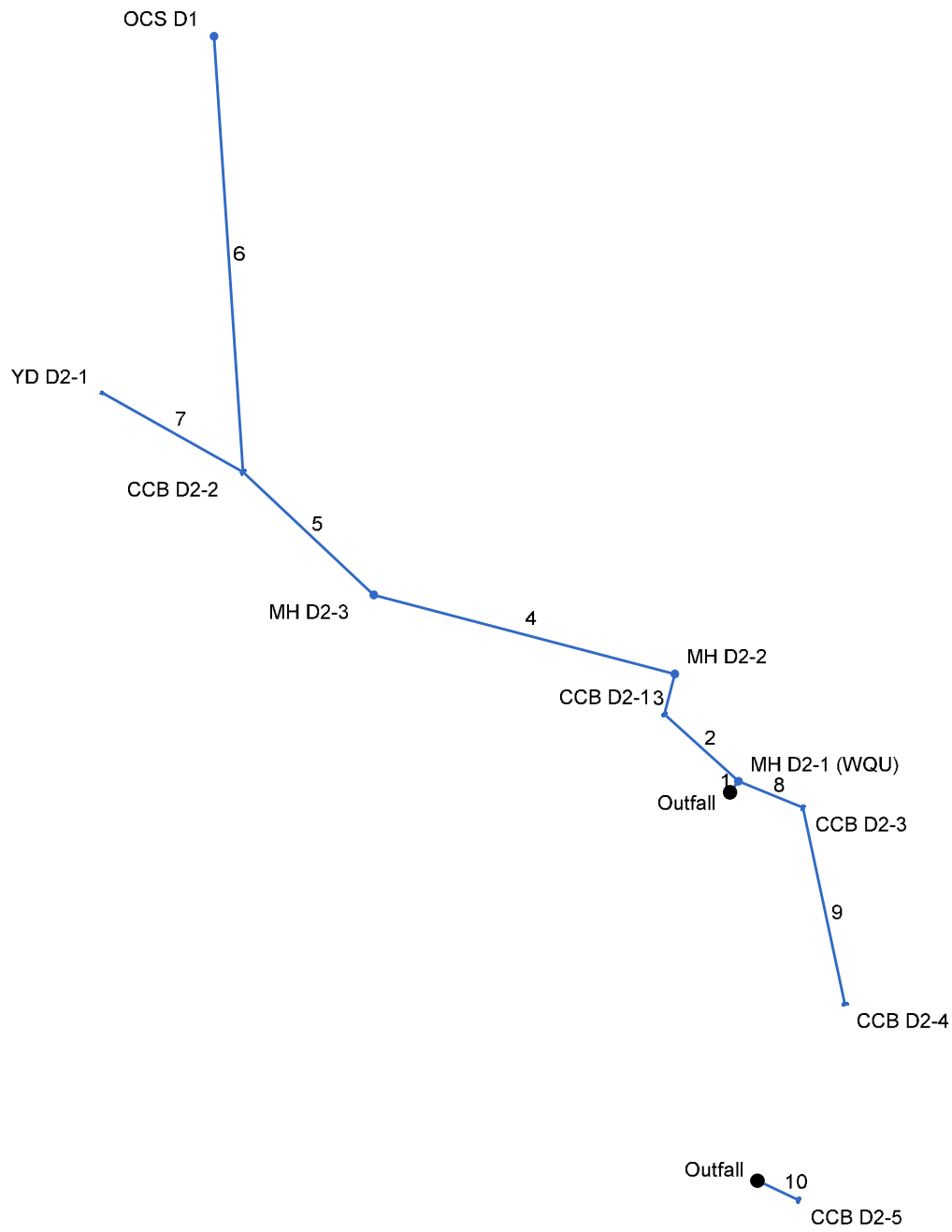


Storm Sewer Profile

Proj. file: Network D-1.stm



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



Project File: Network D-2.stm	Number of lines: 10	Date: 12/7/2022

Storm Sewers v2022.00

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	PIPE-63	10.66	30	Cir	9.257	134.00	134.05	0.540	135.26	135.14	0.42	135.14	End	Manhole
2	PIPE-38	9.52	30	Cir	66.026	134.05	134.38	0.500	135.14	135.41	n/a	135.41 j	1	Grate
3	PIPE-33	7.88	30	Cir	27.500	134.38	134.51	0.473	135.41	135.44	n/a	135.44 j	2	Manhole
4	PIPE-32	8.05	30	Cir	205.287	134.94	135.96	0.497	135.80	136.90	0.19	136.90	3	Manhole
5	PIPE-31	8.16	30	Cir	118.617	135.96	136.56	0.506	136.90	137.51	0.51	137.51	4	Grate
6	PIPE-47(0)	4.50	30	Cir	288.985	136.56	138.00	0.498	137.51	138.70	n/a	138.70 j	5	Manhole
7	PIPE-76	2.78	15	Cir	106.687	136.56	137.11	0.516	137.51	137.78	n/a	137.78	5	Grate
8	PIPE-62	1.28	12	Cir	45.925	134.07	134.30	0.501	135.14	135.18	0.06	135.24	1	Grate
9	PIPE-35	0.66	12	Cir	132.921	134.30	134.96	0.497	135.24	135.30	n/a	135.30	8	Grate
10	PIPE-36	0.66	12	Cir	29.805	134.00	134.15	0.503	135.26*	135.27*	0.01	135.28	End	Grate

Project File: Network D-2.stm | Number of lines: 10 | Run Date: 12/7/2022

NOTES: Return period = 10 Yrs. ; *Surcharged (HGL above crown). ; j - Line contains hyd. jump.

Storm Sewer Tabulation

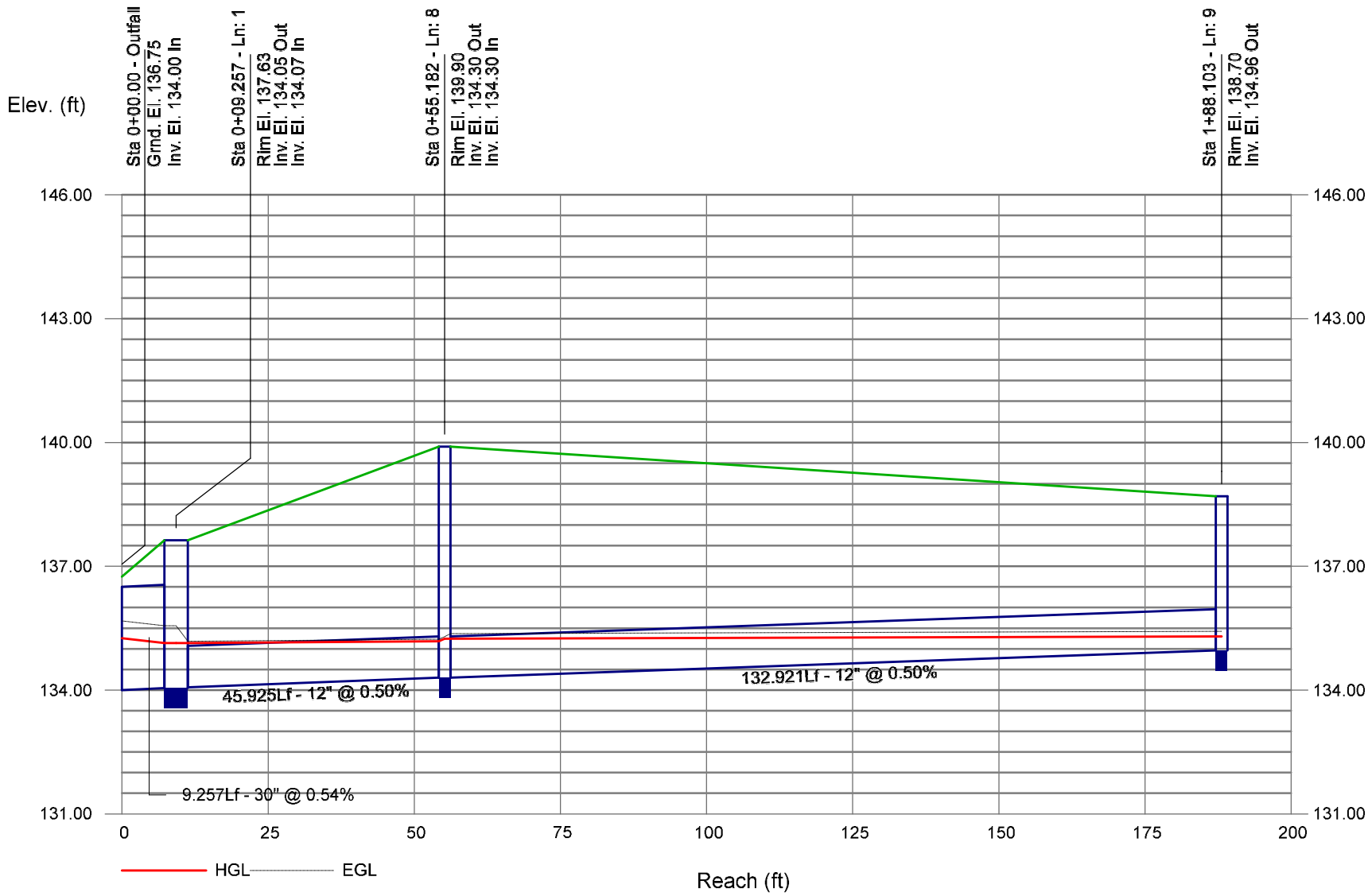
Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	9.257	0.00	2.04	0.00	0.00	0.96	0.0	6.9	6.4	10.66	32.65	4.74	30	0.54	134.00	134.05	135.26	135.14	136.75	137.63	PIPE-63
2	1	66.026	0.34	1.77	0.75	0.26	0.77	5.0	6.7	6.5	9.52	31.41	4.81	30	0.50	134.05	134.38	135.14	135.41	137.63	139.25	PIPE-38
3	2	27.500	0.00	1.43	0.00	0.00	0.52	0.0	6.6	6.6	7.88	30.55	4.43	30	0.47	134.38	134.51	135.41	135.44	139.25	139.80	PIPE-33
4	3	205.287	0.00	1.43	0.00	0.00	0.52	0.0	5.9	6.9	8.05	31.32	5.05	30	0.50	134.94	135.96	135.80	136.90	139.80	143.55	PIPE-32
5	4	118.617	0.18	1.43	0.78	0.14	0.52	5.0	5.5	7.1	8.16	31.60	4.80	30	0.51	135.96	136.56	136.90	137.51	143.55	143.36	PIPE-31
6	5	288.985	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	4.50	31.36	3.32	30	0.50	136.56	138.00	137.51	138.70	143.36	147.91	PIPE-47(0)
7	5	106.687	1.25	1.25	0.30	0.38	0.38	5.0	5.0	7.4	2.78	5.02	3.47	15	0.52	136.56	137.11	137.51	137.78	143.36	140.80	PIPE-76
8	1	45.925	0.16	0.27	0.63	0.10	0.19	5.0	6.2	6.7	1.28	2.73	1.69	12	0.50	134.07	134.30	135.14	135.18	137.63	139.90	PIPE-62
9	8	132.921	0.11	0.11	0.81	0.09	0.09	5.0	5.0	7.4	0.66	2.72	1.84	12	0.50	134.30	134.96	135.24	135.30	139.90	138.70	PIPE-35
10	End	29.805	0.11	0.11	0.81	0.09	0.09	5.0	5.0	7.4	0.66	2.74	0.84	12	0.50	134.00	134.15	135.26	135.27	135.25	137.50	PIPE-36

Project File: Network D-2.stm | Number of lines: 10 | Run Date: 12/7/2022

NOTES:Intensity = 35.84 / (Inlet time + 3.80) ^ 0.73; Return period =Yrs. 10 ; c = cir e = ellip b = box

Storm Sewer Profile

Proj. file: Network D-2.stm



Storm Sewer Profile

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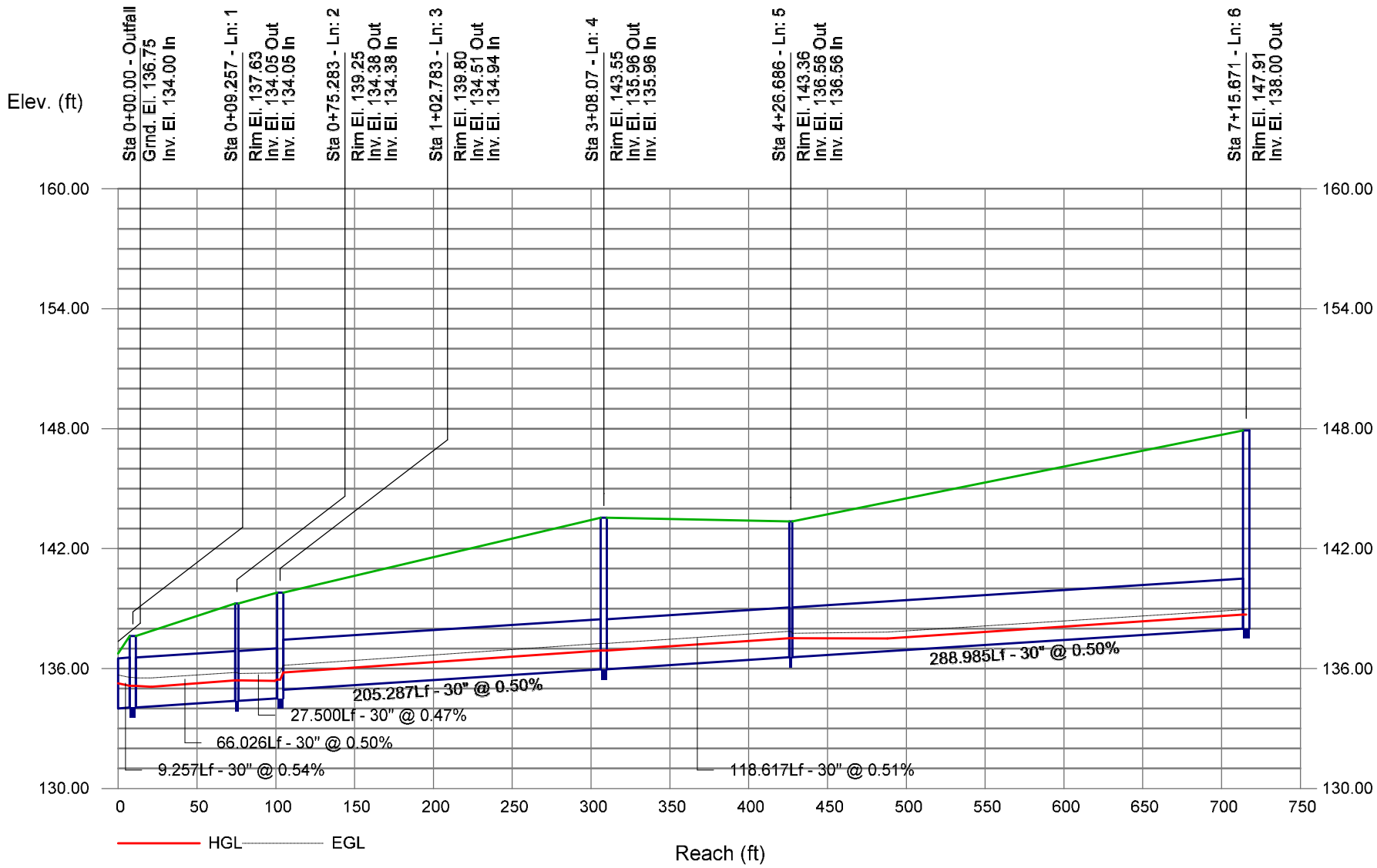

APPENDIX E

NOAA Atlas 14 Rainfall Depths & Intensities

LANGAN

NOAA Atlas 14, Volume 10, Version 3 HARTFORD BRADLEY AP
Station ID: 06-3456
Location name: Windsor Locks, Connecticut, USA*
Latitude: 41.9381°, Longitude: -72.6825°
Elevation:
Elevation (station metadata): 190 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sandra Pavlovic, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Orlan Wilhite

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.348 (0.266-0.454)	0.417 (0.318-0.545)	0.530 (0.403-0.695)	0.624 (0.472-0.823)	0.753 (0.554-1.04)	0.850 (0.614-1.20)	0.952 (0.670-1.39)	1.07 (0.714-1.60)	1.23 (0.795-1.90)	1.36 (0.862-2.15)
10-min	0.493 (0.376-0.643)	0.591 (0.451-0.772)	0.751 (0.571-0.985)	0.883 (0.669-1.17)	1.07 (0.784-1.47)	1.20 (0.870-1.70)	1.35 (0.949-1.97)	1.51 (1.01-2.26)	1.74 (1.13-2.70)	1.93 (1.22-3.05)
15-min	0.580 (0.443-0.757)	0.695 (0.530-0.908)	0.883 (0.672-1.16)	1.04 (0.787-1.37)	1.25 (0.923-1.73)	1.42 (1.02-2.00)	1.59 (1.12-2.32)	1.78 (1.19-2.66)	2.05 (1.32-3.17)	2.27 (1.44-3.59)
30-min	0.778 (0.594-1.02)	0.938 (0.716-1.23)	1.20 (0.913-1.57)	1.42 (1.07-1.87)	1.72 (1.26-2.37)	1.94 (1.40-2.73)	2.18 (1.53-3.18)	2.44 (1.63-3.65)	2.82 (1.82-4.36)	3.12 (1.98-4.93)
60-min	0.976 (0.745-1.27)	1.18 (0.901-1.54)	1.52 (1.15-1.99)	1.80 (1.36-2.37)	2.18 (1.60-3.00)	2.47 (1.78-3.47)	2.77 (1.95-4.04)	3.10 (2.08-4.64)	3.58 (2.32-5.54)	3.97 (2.51-6.27)
2-hr	1.26 (0.969-1.64)	1.52 (1.17-1.97)	1.94 (1.48-2.52)	2.28 (1.74-2.99)	2.76 (2.05-3.79)	3.12 (2.27-4.38)	3.50 (2.49-5.11)	3.94 (2.65-5.86)	4.60 (2.98-7.07)	5.14 (3.26-8.07)
3-hr	1.45 (1.12-1.88)	1.75 (1.35-2.26)	2.23 (1.71-2.90)	2.63 (2.01-3.44)	3.18 (2.37-4.36)	3.59 (2.63-5.03)	4.03 (2.88-5.89)	4.56 (3.07-6.75)	5.35 (3.47-8.20)	6.02 (3.83-9.41)
6-hr	1.82 (1.42-2.34)	2.21 (1.71-2.84)	2.84 (2.20-3.66)	3.36 (2.59-4.36)	4.08 (3.06-5.57)	4.61 (3.40-6.45)	5.19 (3.75-7.58)	5.91 (3.99-8.70)	7.01 (4.57-10.7)	7.96 (5.08-12.4)
12-hr	2.23 (1.74-2.84)	2.74 (2.14-3.49)	3.57 (2.78-4.58)	4.26 (3.30-5.49)	5.22 (3.94-7.08)	5.92 (4.39-8.24)	6.69 (4.86-9.74)	7.66 (5.19-11.2)	9.17 (6.00-13.9)	10.5 (6.71-16.2)
24-hr	2.58 (2.03-3.26)	3.22 (2.53-4.09)	4.28 (3.35-5.44)	5.16 (4.02-6.60)	6.36 (4.83-8.60)	7.24 (5.42-10.1)	8.22 (6.03-12.0)	9.48 (6.45-13.8)	11.5 (7.54-17.3)	13.3 (8.53-20.4)
2-day	2.86 (2.27-3.60)	3.63 (2.88-4.58)	4.89 (3.86-6.18)	5.94 (4.66-7.55)	7.38 (5.65-9.94)	8.42 (6.35-11.7)	9.59 (7.12-14.0)	11.2 (7.62-16.1)	13.7 (9.03-20.6)	16.1 (10.3-24.5)
3-day	3.12 (2.49-3.91)	3.97 (3.16-4.98)	5.36 (4.24-6.74)	6.51 (5.12-8.24)	8.09 (6.22-10.9)	9.24 (7.00-12.8)	10.5 (7.85-15.3)	12.3 (8.40-17.7)	15.2 (9.99-22.6)	17.8 (11.5-27.0)
4-day	3.37 (2.69-4.21)	4.28 (3.41-5.36)	5.77 (4.58-7.24)	7.00 (5.53-8.84)	8.70 (6.71-11.7)	9.93 (7.54-13.7)	11.3 (8.46-16.4)	13.2 (9.04-19.0)	16.3 (10.8-24.3)	19.1 (12.3-29.0)
7-day	4.06 (3.26-5.05)	5.11 (4.09-6.35)	6.81 (5.43-8.49)	8.22 (6.52-10.3)	10.2 (7.87-13.5)	11.6 (8.82-15.8)	13.2 (9.85-18.9)	15.3 (10.5-21.8)	18.8 (12.4-27.8)	21.9 (14.2-33.0)
10-day	4.75 (3.82-5.87)	5.85 (4.70-7.26)	7.67 (6.14-9.54)	9.17 (7.30-11.5)	11.2 (8.72-14.9)	12.7 (9.72-17.3)	14.4 (10.8-20.6)	16.7 (11.5-23.7)	20.3 (13.4-29.9)	23.5 (15.2-35.3)
20-day	6.86 (5.56-8.44)	8.03 (6.50-9.88)	9.94 (8.01-12.3)	11.5 (9.23-14.3)	13.7 (10.7-17.9)	15.3 (11.7-20.5)	17.1 (12.7-23.9)	19.3 (13.4-27.2)	22.7 (15.1-33.2)	25.7 (16.7-38.4)
30-day	8.66 (7.04-10.6)	9.85 (8.00-12.1)	11.8 (9.54-14.5)	13.4 (10.8-16.6)	15.6 (12.2-20.2)	17.3 (13.2-22.9)	19.0 (14.1-26.2)	21.1 (14.7-29.7)	24.2 (16.2-35.3)	26.8 (17.5-39.9)
45-day	10.9 (8.91-13.3)	12.1 (9.90-14.8)	14.2 (11.5-17.3)	15.8 (12.8-19.5)	18.1 (14.1-23.2)	19.9 (15.1-26.0)	21.6 (15.9-29.3)	23.5 (16.5-32.9)	26.2 (17.5-37.9)	28.2 (18.4-41.8)
60-day	12.8 (10.5-15.6)	14.1 (11.5-17.2)	16.2 (13.2-19.8)	17.9 (14.5-22.0)	20.3 (15.8-25.8)	22.2 (16.9-28.7)	24.0 (17.5-32.0)	25.7 (18.0-35.8)	27.9 (18.8-40.3)	29.5 (19.3-43.6)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

Back to Top

PF graphical

NOAA Atlas 14, Volume 10, Version 3
Location name: Windsor Locks, Connecticut, USA*
Latitude: 41.9381°, Longitude: -72.6825°
Elevation: 169.33 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sandra Pavlovic, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Orlan Wilhite

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	4.18 (3.19-5.45)	5.00 (3.82-6.54)	6.36 (4.84-8.34)	7.49 (5.66-9.88)	9.04 (6.65-12.5)	10.2 (7.37-14.4)	11.4 (8.04-16.7)	12.8 (8.57-19.1)	14.7 (9.54-22.8)	16.4 (10.3-25.8)
10-min	2.96 (2.26-3.86)	3.55 (2.71-4.63)	4.51 (3.43-5.91)	5.30 (4.01-6.99)	6.40 (4.70-8.82)	7.22 (5.22-10.2)	8.09 (5.69-11.8)	9.06 (6.07-13.5)	10.5 (6.76-16.2)	11.6 (7.33-18.3)
15-min	2.32 (1.77-3.03)	2.78 (2.12-3.63)	3.53 (2.69-4.64)	4.16 (3.15-5.48)	5.02 (3.69-6.92)	5.67 (4.10-7.98)	6.34 (4.46-9.27)	7.10 (4.76-10.6)	8.19 (5.30-12.7)	9.08 (5.75-14.4)
30-min	1.56 (1.19-2.03)	1.88 (1.43-2.45)	2.40 (1.83-3.15)	2.83 (2.15-3.74)	3.43 (2.52-4.73)	3.88 (2.80-5.47)	4.35 (3.06-6.36)	4.88 (3.27-7.29)	5.63 (3.64-8.72)	6.24 (3.95-9.86)
60-min	0.976 (0.745-1.27)	1.18 (0.901-1.54)	1.52 (1.15-1.99)	1.80 (1.36-2.37)	2.18 (1.60-3.00)	2.47 (1.78-3.47)	2.77 (1.95-4.04)	3.10 (2.08-4.64)	3.58 (2.32-5.54)	3.97 (2.51-6.27)
2-hr	0.630 (0.484-0.818)	0.758 (0.582-0.985)	0.968 (0.741-1.26)	1.14 (0.870-1.50)	1.38 (1.02-1.90)	1.56 (1.14-2.19)	1.75 (1.24-2.55)	1.97 (1.33-2.93)	2.30 (1.49-3.54)	2.57 (1.63-4.04)
3-hr	0.484 (0.373-0.625)	0.582 (0.449-0.753)	0.743 (0.571-0.964)	0.876 (0.669-1.14)	1.06 (0.788-1.45)	1.20 (0.874-1.68)	1.34 (0.959-1.96)	1.52 (1.02-2.25)	1.78 (1.16-2.73)	2.00 (1.27-3.14)
6-hr	0.304 (0.236-0.391)	0.369 (0.286-0.474)	0.474 (0.367-0.611)	0.562 (0.432-0.728)	0.682 (0.511-0.930)	0.771 (0.568-1.08)	0.867 (0.625-1.26)	0.986 (0.666-1.45)	1.17 (0.763-1.78)	1.33 (0.848-2.07)
12-hr	0.185 (0.144-0.236)	0.227 (0.177-0.290)	0.296 (0.231-0.380)	0.354 (0.274-0.456)	0.433 (0.327-0.588)	0.491 (0.365-0.684)	0.555 (0.404-0.808)	0.635 (0.431-0.930)	0.761 (0.498-1.15)	0.871 (0.557-1.35)
24-hr	0.107 (0.085-0.136)	0.134 (0.106-0.170)	0.178 (0.140-0.227)	0.215 (0.167-0.275)	0.265 (0.201-0.358)	0.302 (0.226-0.419)	0.342 (0.251-0.498)	0.395 (0.269-0.575)	0.479 (0.314-0.722)	0.554 (0.355-0.850)
2-day	0.060 (0.047-0.075)	0.076 (0.060-0.095)	0.102 (0.080-0.129)	0.124 (0.097-0.157)	0.154 (0.118-0.207)	0.175 (0.132-0.243)	0.200 (0.148-0.291)	0.232 (0.159-0.336)	0.286 (0.188-0.429)	0.334 (0.215-0.510)
3-day	0.043 (0.035-0.054)	0.055 (0.044-0.069)	0.074 (0.059-0.094)	0.090 (0.071-0.114)	0.112 (0.086-0.151)	0.128 (0.097-0.177)	0.146 (0.109-0.213)	0.170 (0.117-0.246)	0.211 (0.139-0.314)	0.247 (0.159-0.375)
4-day	0.035 (0.028-0.044)	0.045 (0.036-0.056)	0.060 (0.048-0.075)	0.073 (0.058-0.092)	0.091 (0.070-0.121)	0.103 (0.079-0.143)	0.118 (0.088-0.171)	0.137 (0.094-0.198)	0.170 (0.112-0.253)	0.199 (0.129-0.302)
7-day	0.024 (0.019-0.030)	0.030 (0.024-0.038)	0.041 (0.032-0.051)	0.049 (0.039-0.061)	0.060 (0.047-0.081)	0.069 (0.052-0.094)	0.078 (0.059-0.113)	0.091 (0.063-0.130)	0.112 (0.074-0.165)	0.130 (0.084-0.197)
10-day	0.020 (0.016-0.024)	0.024 (0.020-0.030)	0.032 (0.026-0.040)	0.038 (0.030-0.048)	0.047 (0.036-0.062)	0.053 (0.041-0.072)	0.060 (0.045-0.086)	0.069 (0.048-0.099)	0.085 (0.056-0.125)	0.098 (0.064-0.147)
20-day	0.014 (0.012-0.018)	0.017 (0.014-0.021)	0.021 (0.017-0.026)	0.024 (0.019-0.030)	0.029 (0.022-0.037)	0.032 (0.024-0.043)	0.036 (0.026-0.050)	0.040 (0.028-0.057)	0.047 (0.032-0.069)	0.054 (0.035-0.080)
30-day	0.012 (0.010-0.015)	0.014 (0.011-0.017)	0.016 (0.013-0.020)	0.019 (0.015-0.023)	0.022 (0.017-0.028)	0.024 (0.018-0.032)	0.026 (0.020-0.036)	0.029 (0.020-0.041)	0.034 (0.022-0.049)	0.037 (0.024-0.055)
45-day	0.010 (0.008-0.012)	0.011 (0.009-0.014)	0.013 (0.011-0.016)	0.015 (0.012-0.018)	0.017 (0.013-0.021)	0.018 (0.014-0.024)	0.020 (0.015-0.027)	0.022 (0.015-0.030)	0.024 (0.016-0.035)	0.026 (0.017-0.039)
60-day	0.009 (0.007-0.011)	0.010 (0.008-0.012)	0.011 (0.009-0.014)	0.012 (0.010-0.015)	0.014 (0.011-0.018)	0.015 (0.012-0.020)	0.017 (0.012-0.022)	0.018 (0.013-0.025)	0.019 (0.013-0.028)	0.020 (0.013-0.030)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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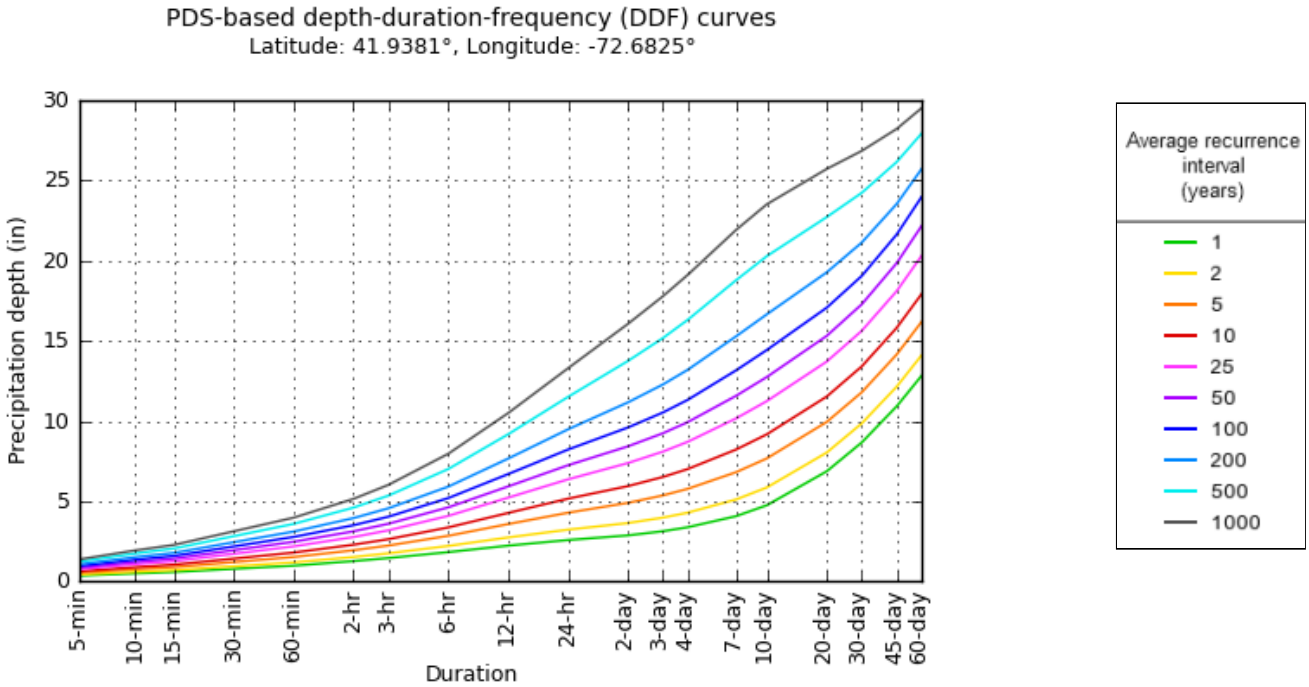
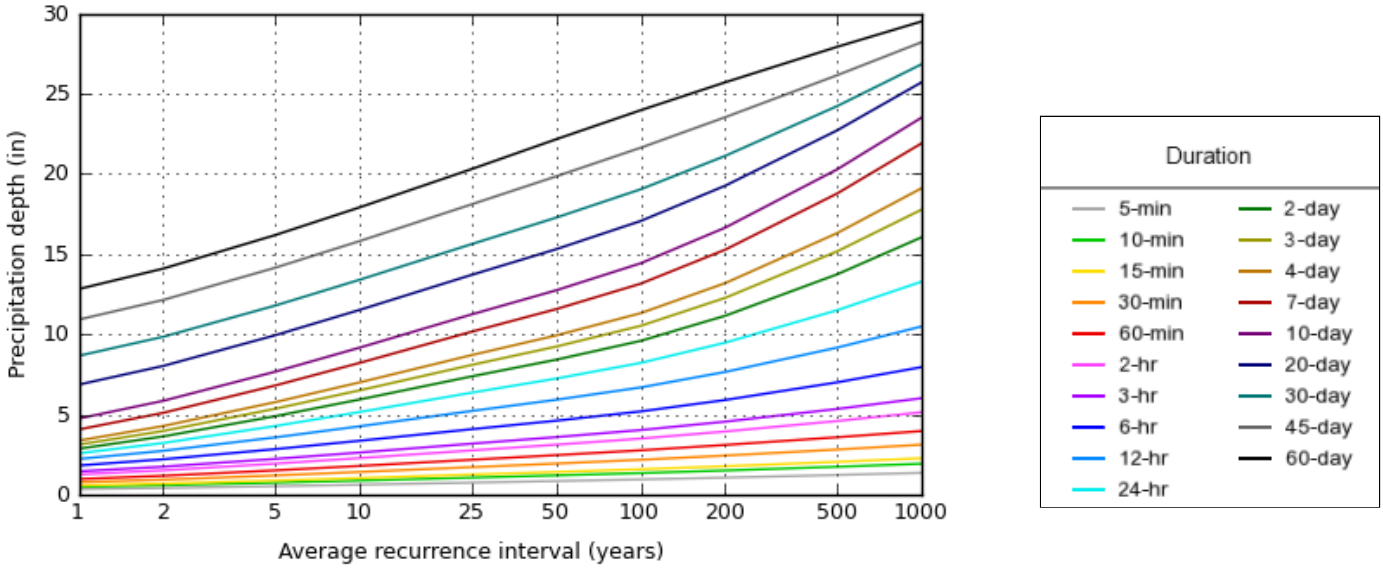
PF graphical





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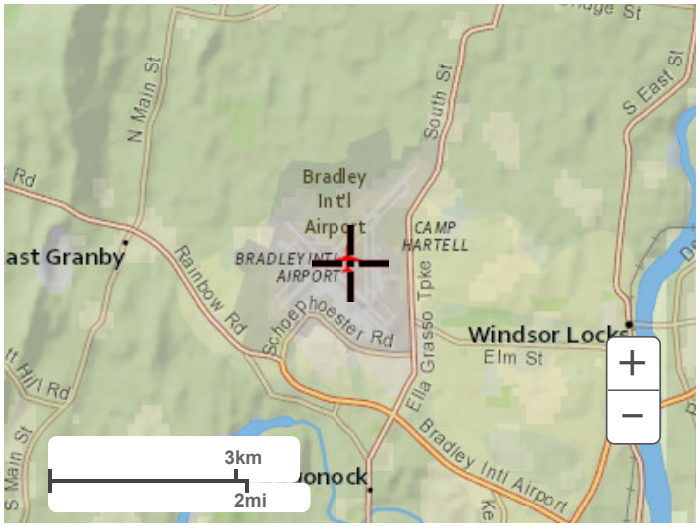
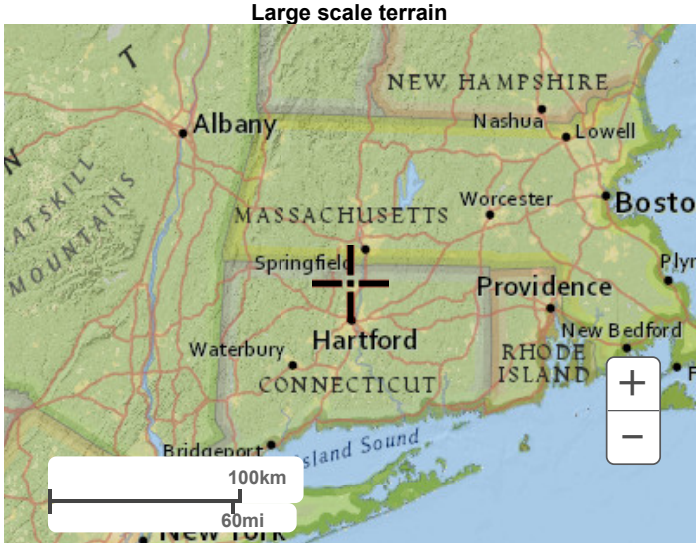
Maps & aerials

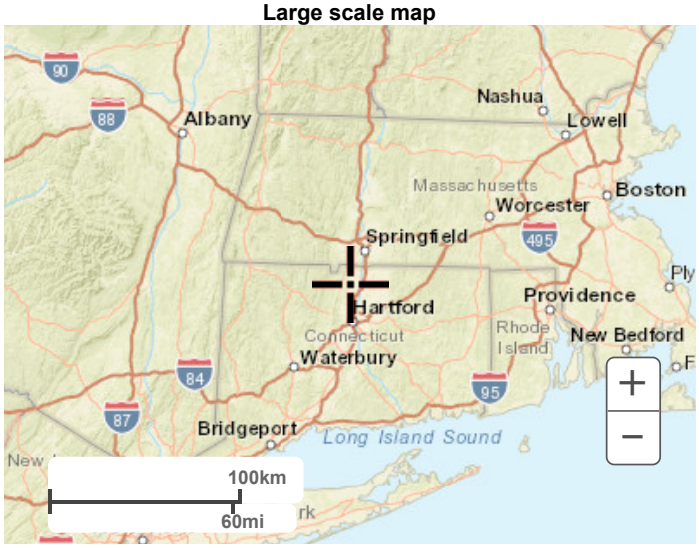
Small scale terrain



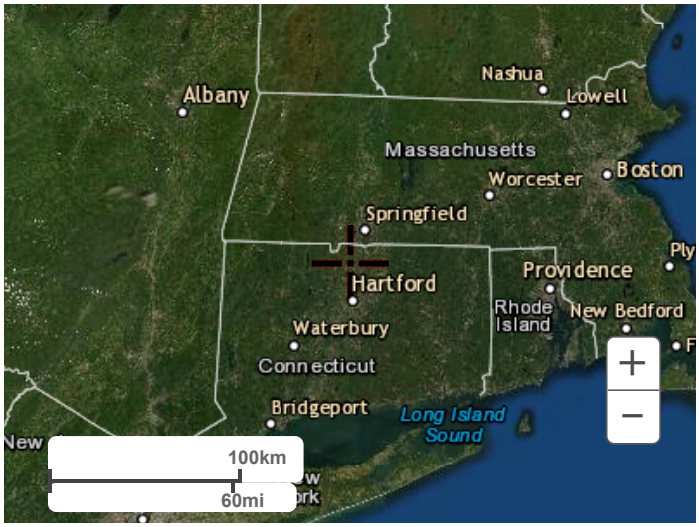
Large scale terrain



Large scale map



Large scale aerial



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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

APPENDIX F

Operations and Maintenance

LANGAN

Stormwater Management System Operation and Maintenance Plan
116 West Dudley Town Road

Regular inspection and maintenance of the stormwater management system and uphill areas is necessary to ensure proper operation. Inspections of the stormwater management system and pavement areas should be conducted monthly and should follow the schedule outlined in the sections below:

SITE AREAS:
General inspections shall be conducted monthly and after a storm event resulting in more than 2.5" of rain over a 24-hour period (approximately 1-year storm event).

Inspection and Maintenance

Check for:	***Corrective Measure:***
Erosion	Install erosion control measures and provide stabilization measures.
Spillage	Contain spill as close to source as possible with a dike of absorbent materials installed to protect drainage inlets, stormwater areas, or downstream wetlands and streams. All hazardous waste material, including absorbent materials must be disposed of by a licensed hazardous waste transporter and disposed of in an environmentally acceptable manner.
Sediment Accumulation	Stabilize any disturbed areas uphill of where the sedimentation is occurring. Use temporary erosion control measures (i.e. silt fence, straw bales) to filter stormwater runoff.
Trash	Pick up and dispose of trash and litter in an environmentally acceptable manner.

At a minimum the following maintenance measures shall be provided at the frequency listed in the following table:

Routine Maintenance

Maintenance Measure:	***Frequency:***
Pavement Sweeping	Minimum two times per year: during spring cleanup (after last snow event) and during fall cleanup (to remove fallen leaves).
Pavement De-icing	Apply anti-icing treatment prior to storms. Apply deicing treatments as needed during and after snow storms and mixed precipitation events to control ice and compact snow not removed during plowing

CATCH BASINS, YARD DRAINS, AND PIPES:
All catch basins shall be inspected annually.

Inspection and Maintenance

Check for:	***Corrective Measure:***
Trash, Sediment, and Debris at CB Grate	Remove trash, sediment, and debris and dispose of in an environmentally acceptable manner.

Sediment & Trash Accumulation in Sump	Remove sediment from sumps if depth of deposits is greater than one-half the depth from the bottom of the catch basin to the invert of the lowest pipe in the catch basin.
Pipe blockages	Flush pipes to remove blockages. TV inspect as required.

At a minimum the following maintenance measures shall be provided at the frequency listed in the following table:

Routine Maintenance

Maintenance Measure:	***Frequency:***
Sediment Removal	Minimum one time per year. Remove accumulated sediment and trash from catch basin sumps, grates and pipe inverts. Dispose of sediment and trash in an environmentally acceptable manner.

WATER QUALITY UNITS

Water Quality Units shall be inspected monthly.

Inspection and Maintenance

Check for:	***Corrective Measure:***
Sediment Accumulation	Remove sediment when accumulation exceeds 75% of capacity in the isolated sump or when an appreciable level of hydrocarbons and trash has accumulated per manufacturer's specifications.
Trash and Debris	Remove trash and debris and dispose of in an environmentally acceptable manner.
Hydrocarbons	Clean out water quality unit sump immediately following any recorded petroleum spill. May be performed using vacuum pump or absorbent pads.

At a minimum the following maintenance measures shall be provided at the frequency listed in the following table:

Routine Maintenance

Maintenance Measure:	***Frequency:***
Sediment Removal	Inspected at a minimum immediately after completion of the site's construction and twice a year afterwards. Remove sediment accumulation as required. Dispose of sediment in an environmentally acceptable manner.
Trash and Debris	Inspected at a minimum immediately after completion of the site's construction and twice a year afterwards. Dispose trash in an environmentally acceptable manner.

In addition to the above measures, water quality units are to be inspected and maintained per manufacturer's specifications. Product information is attached.

Stormwater Management System Operation and Maintenance Plan
116 West Dudley Town Road

OUTLET CONTROL STRUCTURES

Outlet control structures shall be inspected monthly.

Inspection and Maintenance

Check for:	***Corrective Measure:***
Sediment, Trash, and Debris Accumulation	Remove trash, sediment, and debris and dispose of in an environmentally acceptable manner.
Pipe Blockages	Flush pipes to remove blockages. TV inspect as required.

At a minimum the following maintenance measures shall be provided at the frequency listed in the following table:

Routine Maintenance

Maintenance Measure:	***Frequency:***
Sediment Removal	Inspected at a minimum immediately after completion of the site's construction and twice a year afterwards. Remove sediment accumulation as required. Dispose of sediment in an environmentally acceptable manner.
Trash and Debris	Inspected at a minimum immediately after completion of the site's construction and twice a year afterwards. Dispose trash in an environmentally acceptable manner.

UNDERGROUND DETENTION SYSTEMS

Underground Detention Systems shall be inspected monthly. Inspect after every major storm during the first three months of operation and monthly thereafter.

Inspection and Maintenance

Check for:	***Corrective Measure:***
Sediment Accumulation	Remove sediment when accumulation exceeds 3 inches throughout the system.
Trash and Debris	Remove trash and debris and dispose of in an environmentally acceptable manner.
Oil & Grease	Remove accumulation of oil when accumulation is more than a visible sheen. Remove oil in an environmentally acceptable manner.

At a minimum the following maintenance measures shall be provided at the frequency listed in the following table:

Routine Maintenance

Maintenance Measure:	***Frequency:***
Sediment Removal	Inspected at a minimum immediately after completion of the site's construction, every 6 months for the first year of operation and annually after the end of the first year. Remove sediment

	accumulation as required. Dispose of sediment in an environmentally acceptable manner.
Trash and Debris	Minimum once per year.

In addition to the above measures, underground detention systems are to be inspected and maintained per manufacturer's specifications. Product information is attached.

DETENTION BASIN

The detention basin shall be inspected monthly. Inspect after every major storm during the first three months of operation and monthly thereafter.

Inspection and Maintenance

Check for:	***Corrective Measure:***
Sediment Accumulation	Remove sediment from the basin as necessary. Wait until floor of the basin is thoroughly dry before removing sediment.
Erosion and cracking	Install erosion control measures and provide stabilization measures. Undercut or eroded areas shall be repaired within 30 days of documentation.
Trash and Debris	Remove trash and debris and dispose of in an environmentally acceptable manner.
Invasive and Excess Vegetation	Remove excess vegetation from basin. Revegetate as needed.
Condition of rip-rap	Area should be cleared of all sediment deposits and invasive plant species. Damage and deterioration of the area shall be repaired immediately.

At a minimum the following maintenance measures shall be provided at the frequency listed in the following table:

Routine Maintenance

Maintenance Measure:	***Frequency:***
Mowing	Twice a year: mow the buffer area, side slopes, and basin bottom. Remove trash and debris, grass clippings and accumulated organic matter.

MICROPOOL EXTENDED DETENTION PONDS

The ponds shall be inspected monthly. Inspect after every major storm during the first three months of operation and monthly thereafter.

Inspection and Maintenance

Check for:	***Corrective Measure:***
Sediment Accumulation	Remove sediment from the forebay and basin as necessary. Wait until floor of the basin is thoroughly dry before removing sediment. At a minimum remove sediment accumulation immediately after construction and every five years after that.

Erosion and cracking	Install erosion control measures and provide stabilization measures. Undercut or eroded areas shall be repaired within 30 days of documentation.
Trash and Debris	Remove trash and debris and dispose of in an environmentally acceptable manner. Inspect that inlets and outlets are free of debris.
Invasive Species and Excess Vegetation	Remove excess vegetation from basin. Revegetate as needed. Inspect for algal growth and remove as necessary.
Hydrocarbons	Inspect for signs of hydrocarbons and remove if detected.
Condition of rip-rap	Area should be cleared of all sediment deposits and invasive plant species. Damage and deterioration of the area shall be repaired immediately.

At a minimum the following maintenance measures shall be provided at the frequency listed in the following table:

Routine Maintenance

Maintenance Measure:	***Frequency:***
Mowing	Twice a year: mow the buffer area and side slopes. Remove trash and debris, grass clippings and accumulated organic matter.

RAIN GARDENS

Rain Gardens shall be inspected monthly. Inspect after every major storm during the first three months of operation and monthly thereafter.

Inspection and Maintenance

Check for:	***Corrective Measure:***
Sediment Accumulation	Remove sediment from the rain garden as necessary. Wait until floor of the garden is thoroughly dry before removing sediment.
Erosion and cracking	Install erosion control measures and provide stabilization measures. Undercut or eroded areas shall be repaired within 30 days of documentation.
Trash and Debris	Remove trash, dead branches, and debris from garden and dispose of in an environmentally acceptable manner.
Invasive and Excess Vegetation	Remove excess vegetation, weeds and invasive species from the rain garden. Revegetate as needed.
Condition of stone inlets	Area should be cleared of all sediment deposits and invasive plant species. Damage and deterioration of the area shall be repaired immediately.

At a minimum the following maintenance measures shall be provided at the frequency listed in the following table:

Routine Maintenance

Maintenance Measure:	***Frequency:***

Pruning	Once a year prune back native grasses and clip dead portions of shrubs to encourage new growth. Remove trash and debris, grass clippings and accumulated organic matter.
Mulching	If desired, add a thin layer of mulch to the rain garden annually.

OWNERS MAINTENANCE MANUAL

retain-it, LLC
560 Salmon Brook Street
Granby, CT 06035
(860) 413-3050

retain-it ®

Owners Maintenance Manual

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Description

Engineering Design Specifications

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- Periodic Inspection
- Visual Inspection Guide
  - Internal Flow Evaluation
    - Low, Medium and High Flow
  - Pollution Storage Capacities
    - Oil and Grease
    - Sediments
    - Trash and Debris
- Standard Maintenance
- Emergency Spill Conditions

Sample Maintenance Log

Description

retain-it ® is a subsurface Storm Water Management system constructed of precast concrete structures. They are installed in a side by side configuration creating a continuous internal flow channel integrated throughout the system. Systems are constructed with designated inlet and outlet modules, some with multiple inlets and outlets depending on the site storm water system layout. Infiltration systems typically have an inlet and sidewalls/ base constructed on a stone infiltration blanket with geofabric installed at the native soil interface. Other systems incorporate outlet flow control devices. Detention systems are typically lined with a watertight membrane and have inlet and outlet control devices.

The retain-it ® system can consist of multiple varying layouts, with no two the same. Given this, it should be noted that the operation and maintenance requirements are very similar regardless of the intended layout. It is important that the end user know the specific elements of each system so as to understand how best to optimize it's operation.

Installation per Design: Operation is simple to follow where the installation was performed in accordance with the design specifications, drawings and calculations. Specifics shall be identified in the design drawings. As-built drawings will benefit the locating of specific design modules where the system has been buried below a parking lot area. Optional access manholes or removable grates may be installed above every inlet/outlet pipe and at critical design elements designated by the design.

Daily Operation and Long Term Maintenance: In general, daily usage of the system is self sufficient and will operate without requiring any outside assistance, except for periodic inspection to verify optimal performance and maintenance for removal of collected pollutants. A longer term maintenance program should incorporate a more thorough inspection of the all elements of the system to verify proper operating condition. This is more important with the infiltration type of systems where the soil infiltration surface may become restricted due to fine particle build up. Long term maintenance should include provisions for cleaning and removal of collected solids, oils and debris from the system.

System Operation: The system operational function is initiated according to rainfall runoff flows entering the structure. Internally, the runoff flows in a set pattern or sequence throughout the module layout in accordance with the hydraulic design conditions. The flows primarily operate on system head derived from the changes in

elevation from the internal water surface and the outlet invert elevation. Some designs incorporate internal flow controls to satisfy hydraulic conditions that enhance water quality treatment or other intended purposes. Modified systems may incorporate a pump, but in general there are no mechanical apparatus required.

End user operations primarily consist of inspection and maintenance of the system over time.

Periodic Inspection: Important note - All storm water management systems react differently depending on the conditions that are characteristic to the contributing water shed. Variables such as storm intensity, runoff flow rates, site geology, surface stabilization and pollution load will affect the system operation. As does the inspection and maintenance frequency to ensure optimum effectiveness.

Inspections should be done periodically, with a greater number scheduled during the system start up and less frequently as the operator becomes familiar with the system performance characteristics. It is recommended that the end user keep records of the performance using the inspection log record sheet found in the back of this manual. These records shall identify the cycle of maintenance “system calibration” required for the specific applications based on the contributing water shed variables operating under “normal” conditions.

Please note that immediate maintenance may be required during “non-normal” events such as during adverse weather conditions or emergency fuel spills. See information on emergency spills in this manual.

Visual inspection of all assessable components shall be performed throughout the lifetime of the system. Access has been supplied at critical points to monitor hydraulic performance and removed pollutants buildup.

Standard Maintenance:

After construction has been completed and all disturbed surfaces have been stabilized by means of vegetation, asphalt or concrete surfaces, and all drainage system components have been constructed and are free of construction debris and sediments; then the storm water management system can be considered in an operational status.

Periodic visual inspections will help to identify issues of concern.The usual indicators are signs of slow flows, backed up water, visible oil, trash and debris or an excessive amount of sediment in the storage area.

Normal operational flows can be observed to flow freely at the predicted design elevations, from the inlet to the outlet module, following a serpintine path thru the storage and attenuation modules. Note that some modules are designed to permanently

retain water where others may hold water and slowly release it over a typical 24 hour period. During a storm water event, the flows and water surface elevations will fluctuate from a low flow to a high flow/ storage status. The storage modules should fill during the event and drain down within a 24 hour period after the event has stopped. All pipes, orifices, weirs and standpipes should pass flows freely and at optimum capacity.

Standard maintenance is performed using a vacuum truck to suction the accumulated sediments, oils and greases and trash and debris from the system. Whereas an on-site maintenance staff can remove these items by hand, it is preferred that the vacuum truck be used as dictated by specific system conditions. When a specialized module designed to have a permanent water level is used, the vacuum truck should pump the liquid level down to inspect the below water elevation structures and sump storage areas.

Oils and greases can be handled by on-site staff by utilizing absorbent products that soak up the oils (and not) converting the oils from a liquid into a manageable solid form. These oil soaked absorbent materials should be disposed of in an approved manner.

Sediments, trash and debris shall be removed and disposed of in an approved manner.

Any indications of hazardous material, determined by visual inspection, testing, smell or abnormality, should be reported and handled per appropriate regulations.

Flow Conditions

System operators should familiarize themselves with proper hydraulic flow condition indicators, acceptable depths of sedimentation, debris and trash build up, and concentrations of oils and greases.

Hydraulic flow conditions are those that are established by the design as either a flow/storage or as a water quality treatment function. Both have performance characteristics that can be visually identified so as to determine the effective and efficient operation of the system.

The engineering design drawings should note the various expected water surface level elevations that are achieved during different design storms within the various modules. Since it is difficult for a visual inspection to coincide with the exact time given water elevations are predicted, the following guidelines are given for evaluation.

Visual Inspection Guide:

<u>Internal Flow Evaluation</u>

Low flow: water should flow freely from the inlet to the outlet, travelling the intended attenuation path thru the system with the water surface elevation below the structure

beam height (12” deep), the system should drain completely 24 hours after a storm event,

Medium flow: the system should hold and maintain a water level during the 24 hour storm event and yet continually fill as the storm increases or drain downward as the event recedes. Flow within the system should occur freely from inlet to outlet only being restricted when a flow control structure has been integrally designed in place. Flow control devices may result in a water level backing up either temporarily or permanently; noting devices such as water quality modules may require a permanent water level to operate properly (see water quality treatment). Other system applications should drain completely 24 hours after a storm event.

High flow: the system should fill to the maximum design storm water level elevation (hydraulic grade line) per design. In most cases, that is the highest storage elevation available in the system, at the underside of the module top slab, or the invert of the overflow pipe. As the storm event recedes, the water level should begin to drain down via flow thru the system and discharge. The system should drain completely within 24 hours after a storm event.

Pollutant Storage Capacities

<u>Oil and Grease</u>

Oil and Grease Collection (with optional Oil water separator module specified) - Oil and grease accumulation is generally a function related to vehicle parking lot and drive areas, oil generating land uses or emergency spill conditions. It is important to maintain the system from accumulating excessive volumes of oils in that they may wash over into other sections of the system potentially clogging and reducing the infiltration capacity, blocking control devices and contaminating the overall system. The following standards apply.

Oil should not accumulate more than a visible sheen on the water surface in the oil water separation module only. A sheen is described as a fine, thin oil layer on the water surface identified by the glossy rainbow colors. A dipstick (dry wooden stick) can be used as a probe to determine the thickness of oil on the surface.

Accumulated oils could be associated with insufficient maintenance or a potential large volume oil resource. Any accumulation of oil should be promptly maintained by an experienced waste handler. Emergency spills such as those generated by an accidental spill shall be contained and removed immediately before the next storm event. Spills shall be handled in accordance with local environmental regulations. See spill and accumulated oil maintenance procedures.

Sediments

Sediments (with optional primary grit module or sedimentation modules specified) - Sediments shall be periodically removed from the system as they accumulate within the designated storage modules. The inlet modules are generally equipped with a sediment storage sump located in the base of the inlet structure. Inspection should be performed after major storm events or a minimum of annually, unless a different inspection cycle has been determined to be sufficient. Inspection shall consist of using a probe to determine the presence of and depth of the accumulated solids. Access is via the 24" manhole.

Note that excessive volumes of sediments will reduce the performance and efficiency of the system. Regional accumulations of solids such as those associated with ice and snow, may result in large springtime volumes of sand and gravels used for traction and ice control.

Trash and Debris

Trash and Debris (with optional trash and debris module specified) - Trash and debris accumulates in the inlet module in three forms; floating debris, neutrally buoyant, and heavy material. The floating debris is visible from the access manhole floating on the water surface in the form of but not limited to wood, paper, plastic, foam, bottles and cans. The neutrally buoyant material resides below the surface and combines with the natural flow regime of the system. It is hard to detect and can only be recognized when at a high concentration appears as a thickening of the water viscosity. Heavier material will simply settle to the sump base and combine with the sediments.

Note that trash and debris typically cause the most problems when they become lodged in a flow control device such as an outlet elbow, riser pipe, and orifice or weir structure. This can be detected visibly when the system is pumped down during maintenance. It can also be evaluated as a condition when flow is impeded and the water level backs up higher than the design elevations.

Emergency Spill Conditions (with optional emergency spill control module specified):

Emergency spill conditions are defined as an excessive accumulation of hydrocarbons such as oil, gasoline, diesel fuel, transmission oil or antifreeze usually resulting from an accidental discharge. Excessive accumulation is described as any amount larger than a thin "sheen" visible on the water surface.

Care should be given in handling these types of fluids. The incident should be reported to the appropriate authorities and should be mitigated by a hazardous waste consultant approved for such matters.

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Maintenance Log

Storm Water Management System

Location: ID #:

Date	Inspection Notes	Inspector

Note the following conditions:

Inlet Module

Outlet Module

Water Quality Module

Oil Elbow

Oil Accumulation

Sedimentation Accumulation

Trash and Debris Quantity

Flow Conditions

Flow Control Outlet Structure

Overflow Pipe

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Cascade Separator® Inspection and Maintenance Guide

CASCADE
separator®

Maintenance

The Cascade Separator® system should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects sediment and debris will depend upon on-site activities and site pollutant characteristics. For example, unstable soils or heavy winter sanding will cause the sediment storage sump to fill more quickly but regular sweeping of paved surfaces will slow accumulation.

Inspection

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

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

Access to the Cascade Separator unit is typically achieved through one manhole access cover. The opening allows for inspection and cleanout of the center chamber (cylinder) and sediment storage sump, as well as inspection of the inlet chamber and slanted skirt. For large units, multiple manhole covers allow access to the chambers and sump.

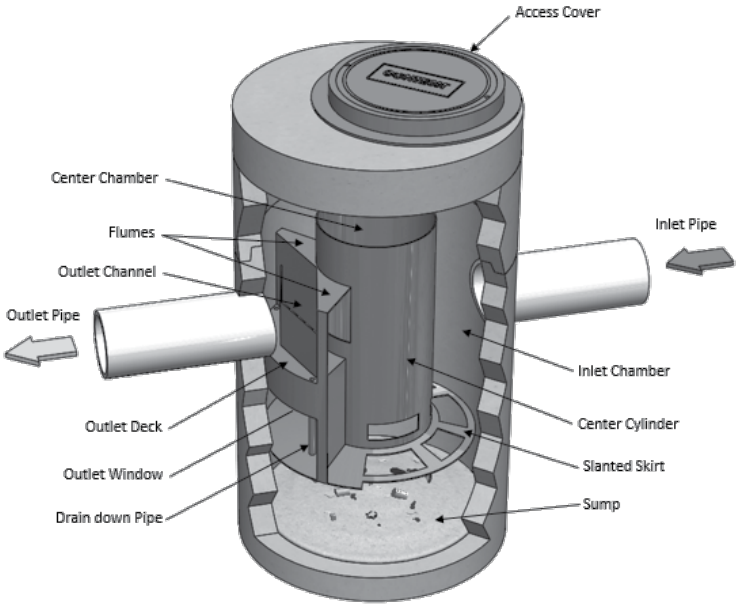
The Cascade Separator system should be cleaned before the level of sediment in the sump reaches the maximum sediment depth and/or when an appreciable level of hydrocarbons and trash has accumulated. If sorbent material is used, it must be replaced when significant discoloration has occurred. Performance may be impacted when maximum sediment storage capacity is exceeded. Contech recommends maintaining the system when sediment level reaches 50% of maximum storage volume. The level of sediment is easily determined by measuring the distance from the system outlet invert (standing water level) to the top of the sediment pile. To avoid underestimating the level of sediment in the chamber, the measuring device must be lowered to the top of the sediment pile carefully. Finer, silty particles at the top of the pile typically offer less resistance to the end of the rod than larger particles toward the bottom of the pile. Once this measurement is recorded, it should be compared to the chart in this document to determine if the height of the sediment pile off the bottom of the sump floor exceeds 50% of the maximum sediment storage.

Cleaning

Cleaning of a Cascade Separator system should be done during dry weather conditions when no flow is entering the system. The use of a vacuum truck is generally the most effective and convenient method of removing pollutants from the system. Simply remove the manhole cover and insert the vacuum tube down through the center chamber and into the sump. The system should be completely drained down and the sump fully evacuated of sediment. The areas outside the center chamber and the slanted skirt should also be washed off if pollutant build-up exists in these areas.

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

Manhole covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and to ensure proper safety precautions. Confined space entry procedures need to be followed if physical access is required. Disposal of all material removed from the Cascade Separator system must be done in accordance with local regulations. In many locations, disposal of evacuated sediments may be handled in the same manner as disposal of sediments removed from catch basins or deep sump manholes. Check your local regulations for specific requirements on disposal. If any components are damaged, replacement parts can be ordered from the manufacturer.



Cascade Separator® Maintenance Indicators and Sediment Storage Capacities

Model Number	Diameter		Distance from Water Surface to Top of Sediment Pile		Sediment Storage Capacity	
	ft	m	ft	m	y^3	m^3
CS-3	3	0.9	1.5	0.5	0.4	0.3
CS-4	4	1.2	2.5	0.8	0.7	0.5
CS-5	5	1.3	3	0.9	1.1	0.8
CS-6	6	1.8	3.5	1	1.6	1.2
CS-8	8	2.4	4.8	1.4	2.8	2.1
CS-10	10	3.0	6.2	1.9	4.4	3.3
CS-12	12	3.6	7.5	2.3	6.3	4.8

Note: The information in the chart is for standard units. Units may have been designed with non-standard sediment storage depth.

A Cascade Separator unit can be easily cleaned in less than 30 minutes.

A vacuum truck excavates pollutants from the systems.

Cascade Separator® Inspection & Maintenance Log

Cascade Model:			Location:		
Date	Depth Below Invert to Top of Sediment[1]	Floatable Layer Thickness[2]	Describe Maintenance Performed	Maintenance Personnel	Comments

1. The depth to sediment is determined by taking a measurement from the manhole outlet invert (standing water level) to the top of the sediment pile. Once this measurement is recorded, it should be compared to the chart in the maintenance guide to determine if the height of the sediment pile off the bottom of the sump floor exceeds 50% of the maximum sediment storage. Note: to avoid underestimating the volume of sediment in the chamber, the measuring device must be carefully lowered to the top of the sediment pile.
2. For optimum performance, the system should be cleaned out when the floating hydrocarbon layer accumulates to an appreciable thickness. In the event of an oil spill, the system should be cleaned immediately.

SUPPORT

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

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CDS® Inspection and Maintenance Guide

CDS TECHNOLOGIES

Maintenance

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

Inspection

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

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

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

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

Cleaning

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

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

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

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

Table 1: CDS Maintenance Indicators and Sediment Storage Capacities

Support

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

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CDS Inspection & Maintenance Log

CDS Model: _____ Location: _____

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

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

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