TM RIPPEY
CONSULTING ENGINEERS

7650 SW Beveland Street, Suite 100
Tigard, Oregon 97223

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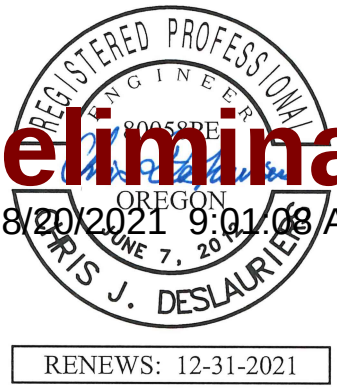
Preliminary Storm Drainage Calculations

FOR

SW Manhasset Warehouse
10500 SW Manhasset Drive
Tualatin, OR 97062

August 19, 2021



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Griffith Polymers
10500 SW Manhasset Dr
Tualatin, OR 97062

08/18/2021

RE: 10500 SW Manhasset Warehouse "Storm Drainage Narrative"

Dear Mr. Luu,

At your request, TM Rippey Consulting Engineers has completed the following storm drainage design calculations for the SW Manhasset Warehouse. The purpose of this report is to provide the analysis of stormwater treatment and mitigation of the proposed construction through the use of existing and new stormwater facilities. The intent of this report is to demonstrate that the proposed development will cause no increase in discharge flow to the current drainageways and provide water quality. Storm drainage design in accordance with Clean Water Services (CWS).

Site Existing Conditions

The existing 218,107 sf site is comprised of a warehouse building and parking lot to remain on the western half of the property. The eastern half of the property is where the new construction is proposed and consists of an open, grassy lot with large trees along the north and eastern property lines. Existing utilities and storm facilities that service the existing warehouse building are located along the northern property line. The existing storm facilities consist of two storm swales that are connected via a ditch inlet and a feature a flow control manhole. The western swale is located north of the existing warehouse and will not be disturbed. The eastern swale will be located north of the new development (see following two pages for proposed improvements).

The existing storm swales treat runoff from the existing warehouse (50,635 sf) and parking lots & walkways (36,858 sf). The total pervious area is approximately 12,011 sf. The runoff from these areas is collected via roof drains and catch basins and enters the existing stormwater facility at the western end of the existing western swale. Per the as built drawings and stormwater design documents (1986) provided to the Engineer of Record (EOR)- it can be assumed that the existing western swale provides treatment for water quality for the existing development, but the full extent to which the whole system was designed to provide detention is unclear. After running an analysis of the existing of the existing system, the swales do not detain runoff flows to release at rates that are in accordance with current CWS standards. The existing flow control manhole was not installed properly and does not function as it was likely designed to. Following a site visit, an overflow riser was found in the existing flow control manhole with no orifices. The existing system has been analyzed to show the potential detention capacity had the overflow riser been installed with orifices. See next page for a summary table of release rates.

Existing West Swale and Flow Control Manhole Design

Storm Event	Pre-Developed (cfs)	Post-Developed (cfs)	Target (cfs)	Mitigated (cfs)	WS Elevation (ft)	Depth Check, Bottom Elev=132.23 (<4')
2-year	0.32	1.30	0.32	0.31	134.77	2.54' OK
5-year	0.59	1.77	0.59	0.78	135.00	2.77' OK
10-year	0.77	2.06	0.77	1.14	135.05	2.82' OK
25-year	1.02	2.43	1.02	1.80	135.11	2.88' OK
100-year	1.63	3.29	Not Required	3.11	136.17	

The analysis of the existing system demonstrates that the detention capacity only supports peak flow matching of the 2-year post-developed to that of the 2-year pre-developed. The existing system was designed in 1986 and there is very limited information provided for what detention requirements were at this time. This analysis was performed with a measured overflow riser elevation inside the flow control manhole being 26.5" below the rim. The system was then designed to include two other orifices. See HydroCAD printouts on STM-18 to STM-35 for the analysis of the existing system.

Along the western property line is a 15,207 sf Public Access Easement (PAE) with a thru-street to the neighboring lots to the south from the Manhasset Drive cul-de-sac. There is a ditch in this PAE that provides a drainageway for many of the lots to the south. This storm network is independent of both the existing and proposed developments' storm utilities. The impervious area of 11,405 sf and the runoff it produces is not included in the analysis provided in this report as it will not be disturbed and its discharge flow will not be affected by the proposed developments. There is an additional 1,701 sf of parking area that is not within the PAE, but slopes to the catch basins within it. This area will also not be included in the following analysis. The total area that is within the site property line, but is not tributary to the site's storm facilities is 16,908 sf.

Existing Water Quality and Detention Swale:

- Water Quality Volume and Flow calculated per CWS 4.08.5 (Total impervious area =89,250 sf)
- Existing swale (West)= 126' long with 0.5% (min) bottom slope
  - WQV= 2,677.5 cu. ft
  - WQF= 0.186 cfs
    - Maximum depth of WQ swale= 0.5'
    - Bottom width= approximately 5.9' on average
    - Swale side slopes approximately 4H:1V
      - Side slope= approximately 3H:1V above treatment area
    - WQF Depth= 0.2'
    - WQF Velocity= 0.14 fps
    - Residence time= 900 seconds= 15.0 minutes

Proposed New Site Development:

The proposed developments include a new 44,648 sf warehouse building and 37,369 sf of ac paved parking and concrete walkways for a total impervious area is 82,055 sf. The total pervious area is 17,678 sf. No disturbance is proposed on the western half of the site. The proposed storm water system will utilize the existing storm swales as a combination of vegetated water quality swales and detention to meet the CWS standards. CWS section 4.09.2 allows for detention to be constructed and co-mingled with a vegetated water quality swale. The detention will meet the requirements of section 4.09.2 for detention and water quality. The water quality swale will meet the criteria of section 4.09.4.

Per CWS section 4.03 and with the use of the Hydromodification mapping tool, the project site point of discharge is into the Hedges Creek Marsh west of SW Teton Ave, which is classified as a Low-Risk area. The project site is not within the expansion area or current urban reserve- it can be classified as developed area as it was added prior to 2002. The site is larger than 80,000 sf and falls into the large project size category. The reach specific risk level is considered to be Low/Moderate following site investigations. The hydromodification assessment places the project site in Category 2.

Summary of Hydromodification Assessment (CWS 4.03.3)

- Low Risk [Mapping Tool- CWS 4.03.3.(a)(4)(A)]
  - Discharges to Hedges Creek Marsh
- Developed area [CWS 4.03.3.(b)(1)(B)]
  - Not within the expansion area or within the urban reserve
  - Added prior to 2002
- Large project size [CWS 4.03.3.(c)(2)(C)]
  - Greater than 80,000 sf in size
- Reach Specific Risk Level: Low/Moderate [CWS table 4-1]
- Hydromodification Approach Category: Category 2 [CWS 4.03.5 Table 4-2]
  - Hydromodification Approach is Peak-Flow Matching Detention, using design criteria described in 4.08.6 tables 4-6 and 4-7
    - The proposed storm mitigation plan is to detain the post-developed 2-year flow to 1/2 of the pre-developed. Furthermore, the proposed system will detain the post-developed 5-, 10- and 25-year flows to their respective pre-developed flows

The project will maintain the existing size and function of the existing western swale. The eastern swale is proposed to be reconfigured and enlarged to accommodate the increase in impervious runoff from the new development. The two swales will work independently to manage and treat runoff for water quality for their respective East and West developments. However, the two swales will operate as one system to manage and detain the post developed storm water runoff flows to their respective pre-developed target runoff flows. The project will utilize the SBUH SCS Type 1A analysis distribution to show how the design meets detention criteria. More specifically the 2-year 24 hour post developed flow is shown to be detained to 1/2 of the 2-year 24-hour pre developed flow and the 10-year and 25-year post post-developed runoff flows will be detained to their respective pre-developed flows per CWS Table 4-7. All onsite runoff from the new development will be collected via roof drains, catch basin and area drains and discharges at the western end of the eastern swale. A new flow control manhole along with 550 LF of 4' diameter HDPE detention pipe will be installed and any other necessary modifications will be performed in order to ensure that the existing system is reconfigured to function as designed. As the existing storm swales are intended to service the entire site, both

swales are analyzed as a single facility that mitigates stormwater from both the existing warehouse development as well as the proposed developments.

Proposed Water Quality and Detention Swale: CWS Section 4.09.2 and 4.09.4:

- Water Quality Volume and Flow calculated per CWS 4.08.5 (Total impervious area =82,055 sf)
  - WQV= 2,461.65 cu. ft
  - WQF= 0.171 cfs
- Enlarged New Swale (East)= 106' long with 0.5% (min) bottom slope
    - Maximum depth of WQ swale= 0.5'
    - Bottom width= 4' (2' minimum)
    - Swale side slopes= 4H:1V
      - Side slope= 3H:1V above treatment area
    - WQF depth= 0.23'
    - WQF velocity= .15 fps
    - Residence time= 706.7 seconds= 11.8 minutes
- Total ponding and storage depth for the swale and detention pond for the 25-year event is 4.5 feet (including WQ swale Depth) which is less than the maximum allowed depth of 5.0' for vegetated swales that are utilized as detention ponds

The vegetative water quality and detention swales meet all the criteria of CWS Sections 4.09.2 and 4.09.4. The 25-year outlet pipe velocity into the swale is 1.45 fps, from CWS table 5-5, Velocities of less than 5 fps shall have a minimum of ODT class 50 Rip-Rap, the plans call for 1.0-foot-deep class 100 Rip-Rap. The swale and detention pond will be will be planted per CWS standards. The swale will provide treatment for 65 percent phosphorus removal as it is understood that if the design engineer follows these design standards these criteria can be met. The conveyance system will also have a water quality manhole prior to discharging into the vegetative swale and detention pond.

Water Quality Manhole:

- 25-year inflow= 3.74 cfs
  - CWS requires 20 cf of sump per 1.0 cfs of flow for a minimum of 74.8 cf
- A 60" manhole provides 78.54 cf of sump with a 4.0' deep sump

New East Swale and Flow Control Manhole Design

Storm Event	Pre-Developed (cfs)	Post-Developed (cfs)	Target (cfs)	Mitigated (cfs)	WS Elevation (ft)	Depth Check, Bottom Elev=132.0 (<4')
2-year	**0.32**	**2.19**	****0.24**	**0.24**	**135.46**	**3.46' OK**
5-year	**0.59**	**2.86**	**0.59**	**0.44**	**135.84**	**3.84' OK**
10-year	**0.77**	**3.25**	**0.77**	**0.62**	**135.94**	**3.94' OK**
25-year	**1.02**	**3.74**	**1.02**	**0.98**	**136.00**	**4.00' OK**
100-year	**1.63**	**4.89**	**Not Required**	**2.69**	**136.17**	

**The 2-year target rate is an average of the full 2-year pre-developed target for the existing site to remain and the 1/2 of the 2-year pre-developed target for the new development. See STM-19 to STM-53 for HydroCAD Printouts

Downstream Conveyance Analysis:

The proposed project site currently discharges to a conveyance system that flows to the Hedges Creek Marsh. The system includes a series of open channel ditches with ditch inlets and several lengths of CMP (or other) storm pipe. Preliminary analysis of the total tributary basin to this system indicates that approximately 35.9 acres surrounding the project site discharges here.

Of this 35.9 acres, 23.7 acres includes area within the right of way of SW Tualatin-Sherwood Rd and several lots south of there. This area is referred to as Area 1 on the Conveyance maps found on STM-8 thru STM-11. The runoff from Area 1 flows to a bypass manhole in the right of way where it can be assumed to split the high flow events in half. One half of the flow continues in the conveyance system within the right of way, while the other half flows into the system that the proposed project site will discharge to. It can be assumed that 85% of this tributary area is impervious while the remaining 15% is pervious area. The total 25-year post developed peak flow rate from Area 1 is approximately 11.10 cfs. It is assumed that approximately 5.55 cfs flows to the project site conveyance system. Area 2 (Conveyance Maps) is approximately 12.2 acres and includes the project site, two lots to the south and one to the north. The total 25-year peak flow rate from Area 2 is approximately 5.71 cfs.

Refer to downstream conveyance maps for approximate tributary basin areas to the conveyance system.
Area 1 + Area 2= 23.7 acres + 12.2 acres = 35.9 acres

Flow (Area 1) + Flow (Area 2) = 5.55 cfs + 5.71 cfs = **Q_{25} = *11.26 cfs**

*This flowrate includes zero detention of post-developed flows and uses a time of concentration (T_c) of 61 minutes

The most-downstream section of the conveyance system for this basin area consists of a 21" diameter CMP pipe at 1.0% slope connected to a 36" CMP pipe at 0.1% slope.

Q_{max} (21") = 15.84 cfs
Q_{max} (36" dia) = 21.09 cfs

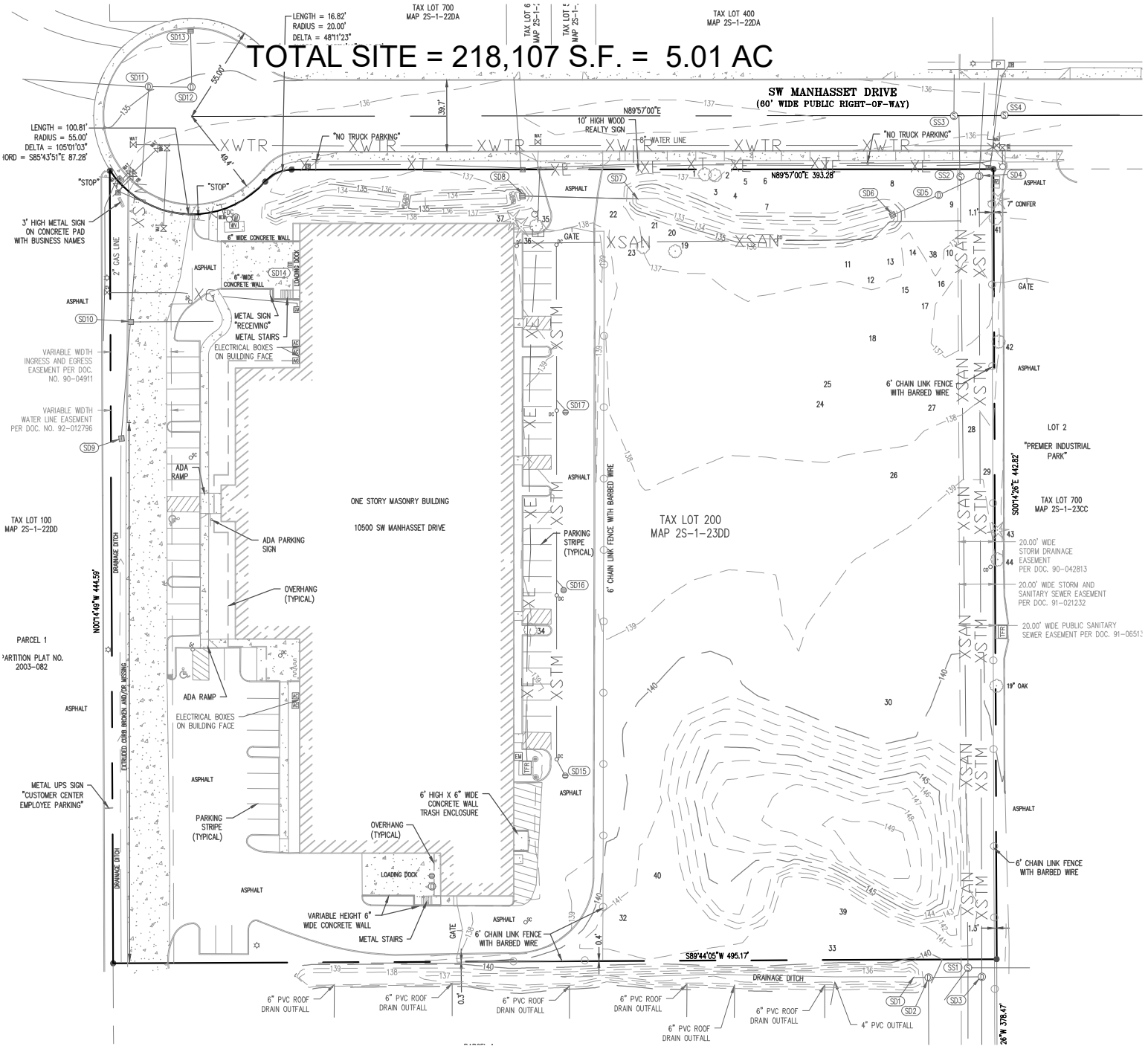
11.26 cfs < 15.84 cfs OK

The assumptions made in this preliminary conveyance analysis are very conservative as they assume zero detention from any of the sites that are includes. The proposed project site's stormwater mitigation system includes detention and actually reduces peak discharge rates from the site. Therefore, it can be reasonably stated that there will be no deficiency in downstream conveyance caused by this project.

Conclusions:

Conveyance calculations have been provided for a 12" diameter storm pipe at full flow for the total new impervious area using the 25-yr, 24-hour storm event. HydroCAD version 10.00 was used to analyze all stormwater runoff quantities. The simulation uses a Santa Barbra Urban Hydrograph in conjunction with the SCS Type 1A 24-hour model storm to design a storm system that meets the City of Tualatin and CWS requirements. See the enclosed area maps, detailed calculations, and HydroCAD printouts for supporting information.

Sincerely, Chris DesLauriers, P.E.



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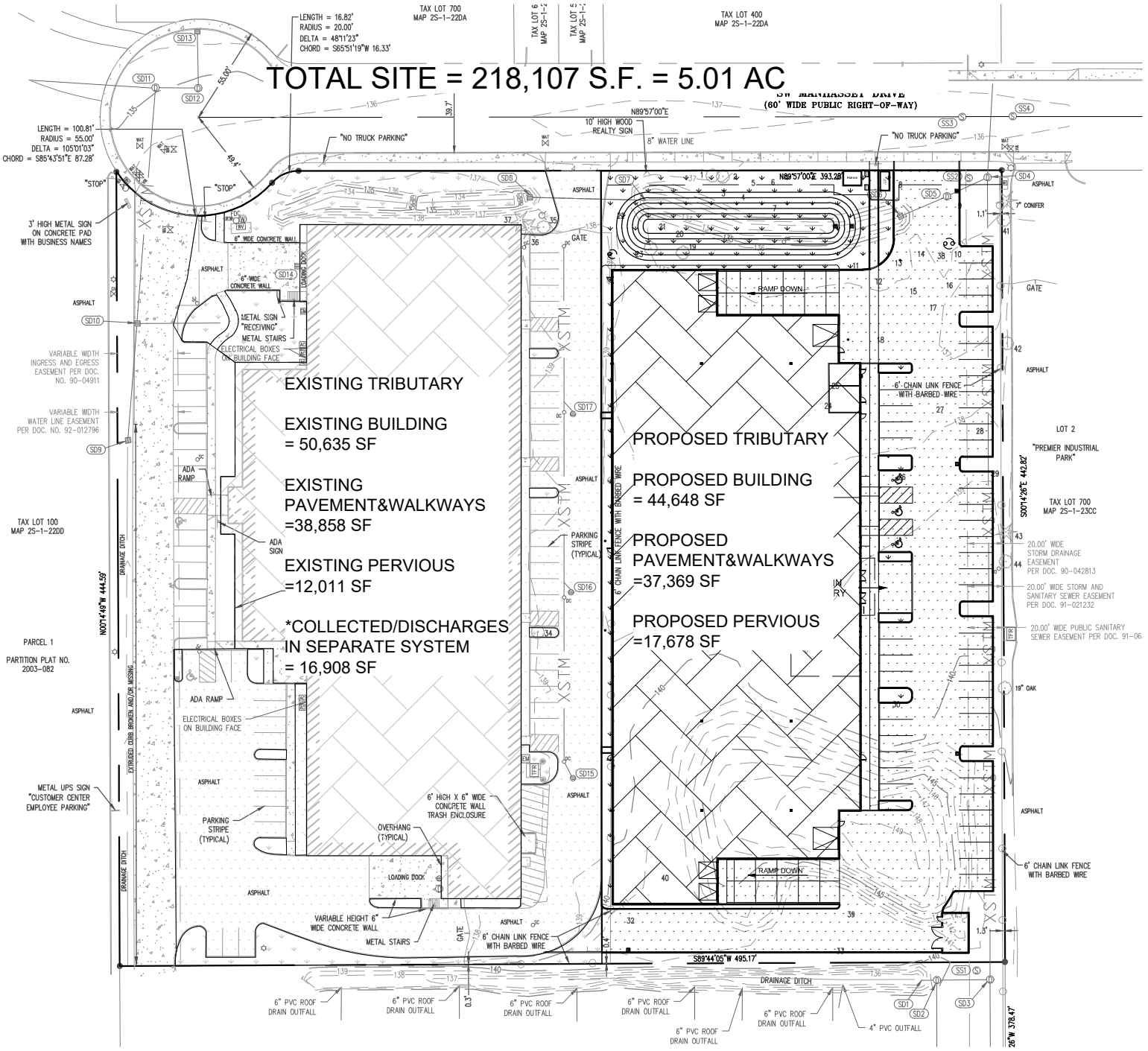
DETAIL: STORMWATER EXISTING TRIBUTARY AREA MAP
SCALE: 1" = 80'-0"

Job Name: 10500 SW MANHASSET		**Date:**	08/18/2021
Job No.:	21204	**Drawn:**	PRM
Client:	MDG CONSULTING	**Sheet:**	STM-6



PROPOSED AREA MAP

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DETAIL: STORMWATER PROPOSED TRIBUTARY AREA MAP
SCALE: 1" = 80'-0"

Job Name: 10500 SW MANHASSET **Date:** 08/18/2021

Job No.: 21204 **Drawn:** PRM

Client: MDG CONSULTING **Sheet:** STM-7

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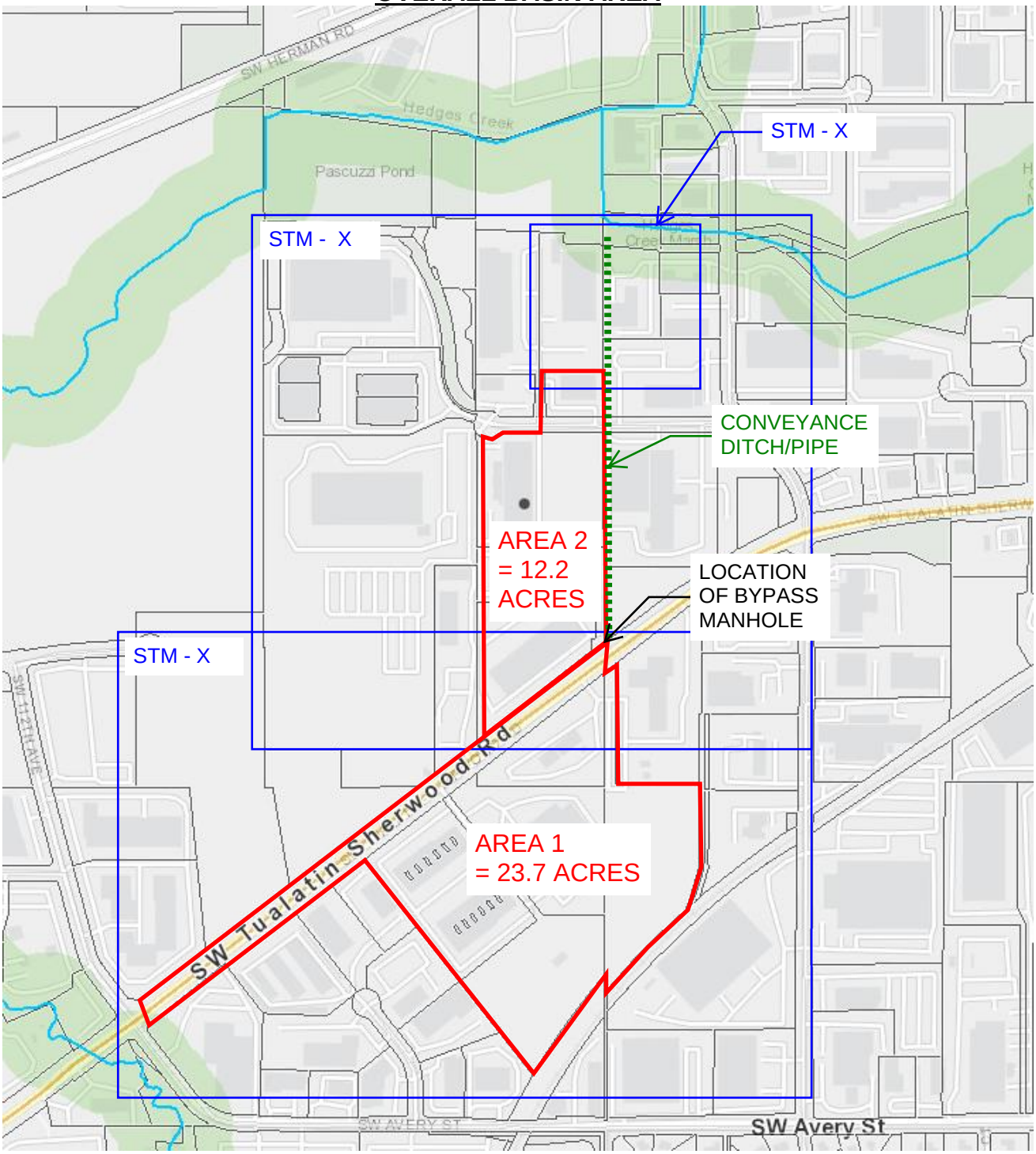
Job Name:	**10500 SW Manhasset Warehouse**	Job No: **21204**	Sheet No:
Client:	**MDG Consulting P.C.**	Date: **August 2021**	By: PRM

OVERALL BASIN AREA



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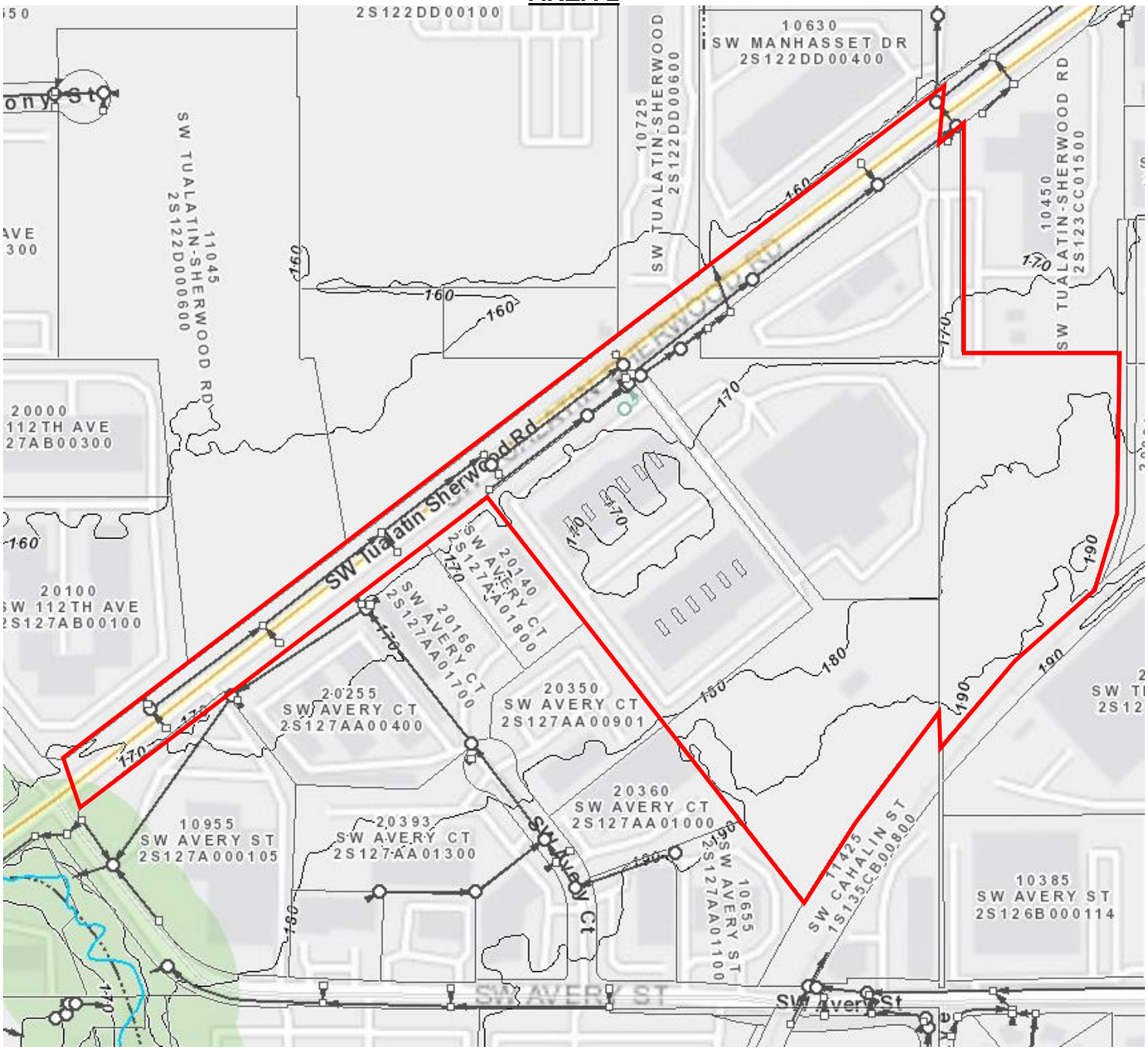
AREA 1



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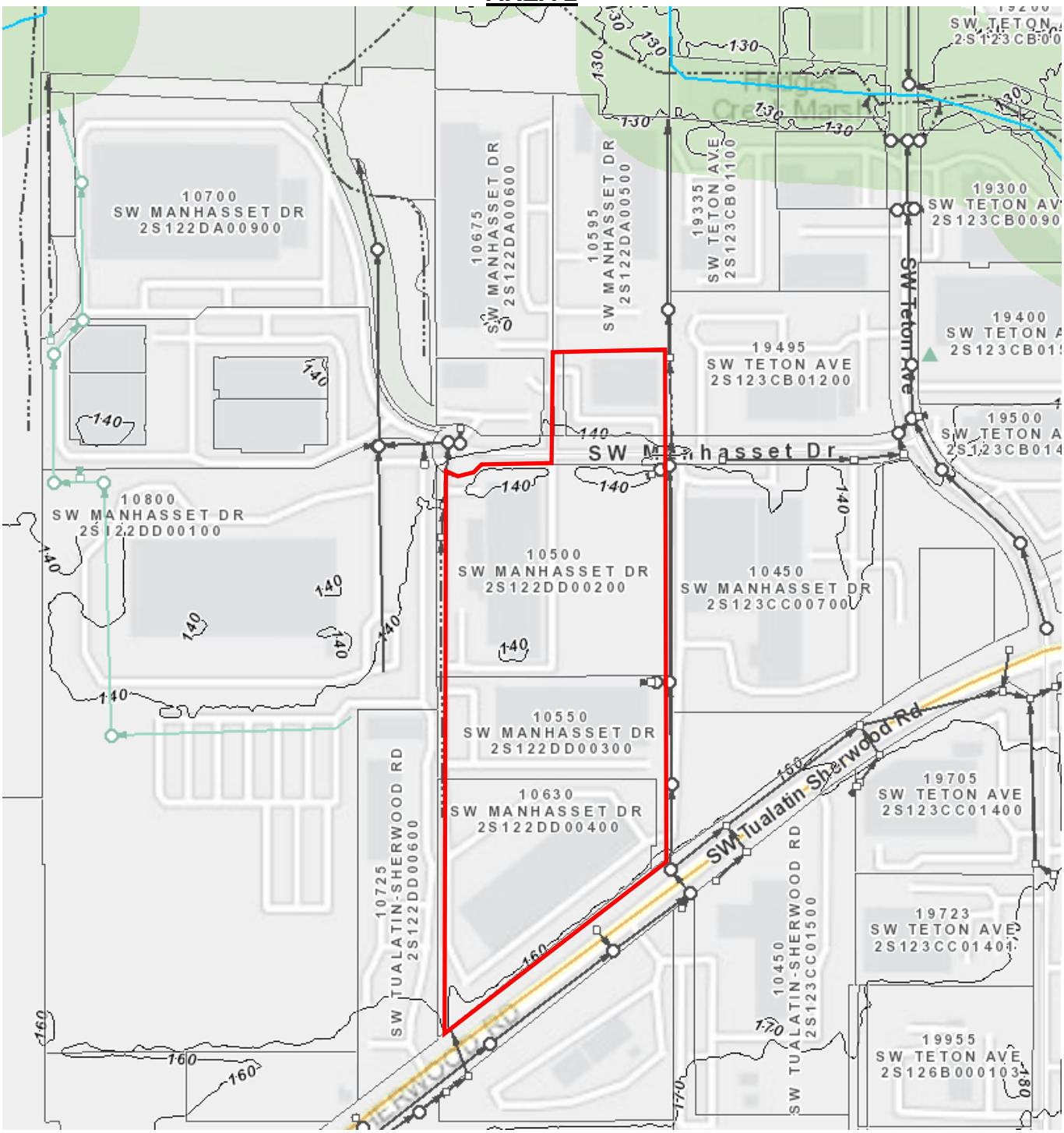
AREA 2



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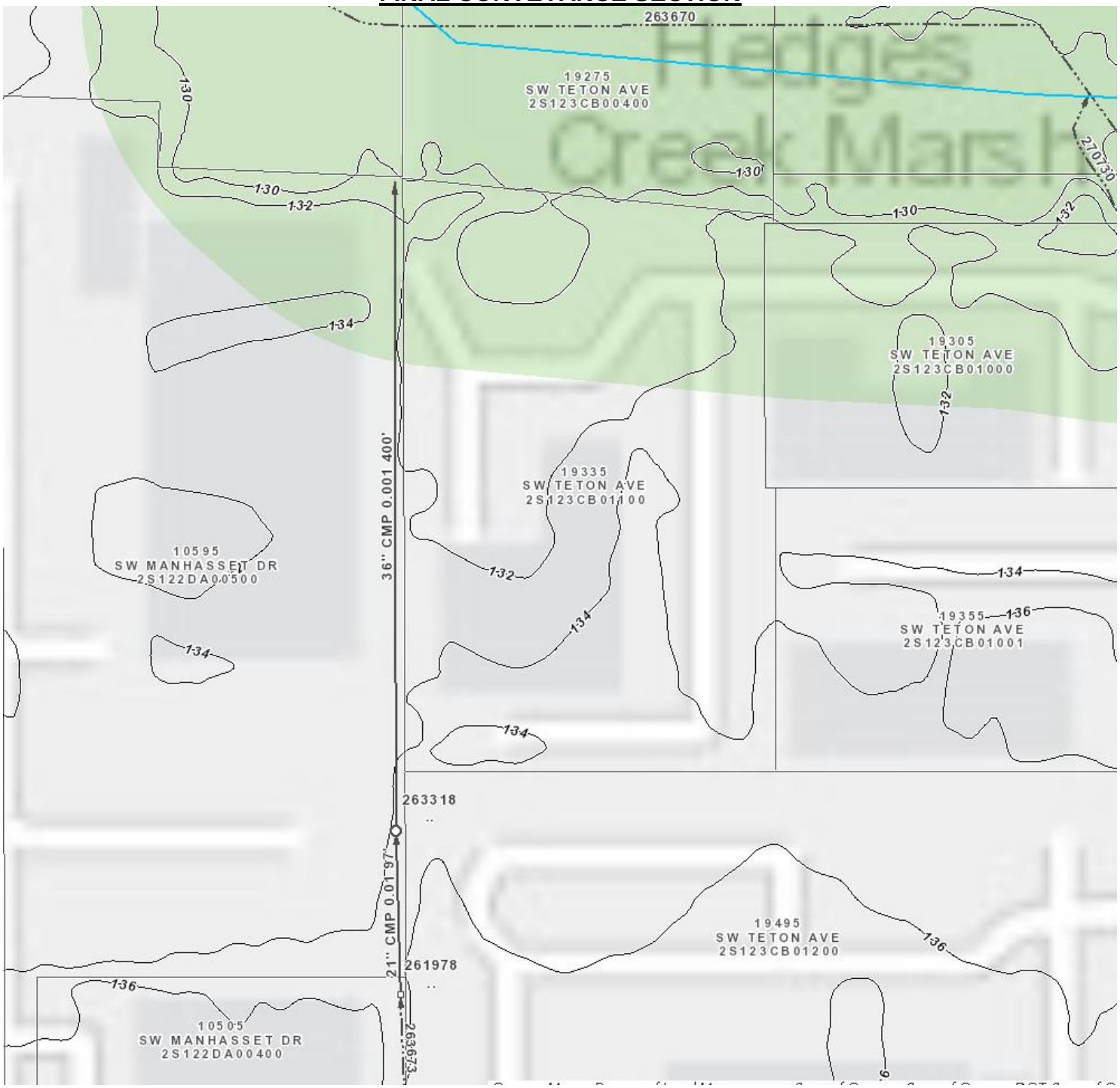
FINAL CONVEYANCE SECTION



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Onsite Storm Drainage Design Criteria & Summary

- Clean Water Services 2019 Design and Construction Standards R&O 19-22 was followed for the swale design and flow control device design.

- Rainfall Depths Per CWS 2019: Table 4-4

Storm Event	Rainfall Depth
2-yr	2.50 in
5 yr	3.10 in
10 yr	3.45 in
25 yr	3.90 in
WQ yr	*0.36 in

*In first 4 hours with an average storm return period of 96 hours

- HydroCAD version 10.00 was used to analyze the storm water runoff to the WQ and Detention Swale following the Clean Water Services Design and Construction Standards R&O 19-22. See the enclosed printouts for the planters and conveyance supporting information.

  Stormwater Quality Design Criteria:
  - Design per City of Tualatin and CWS Design standards
  - Remove 80% of TSS
  - Remove 65% of phosphorous from the new impervious area
  - Predetermined volume of 0.36 inches over 4 hours
  - Water quality design depth for a swale must be less than 0.5 feet
  - Minimum length must be at least 100 feet
  - Minimum bottom width must be 2.0 feet
  - Maximum velocity is 2.0 fps for 25-year storm event

  Stormwater Detention Design Criteria:
  - 2-year post-developed to 1/2 of the 2-year pre-developed design storm
    - The existing site still conforms to meeting the 2-year pre-developed target while the new development conforms to current standards of meeting 1/2 of the pre-developed 2-year storm. As both the existing and new developments are approximately equivalent in size, this equates to a weighted average of 3/4 of the 2-year pre-developed target rate for the entire site
  - 5,10 & 25-year post-developed to their respective pre-developed

- Impervious roof area is analyzed with a runoff curve number (CN) of 98.

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- Pre-Developed Time of Concentration = 44 minutes (see calculation below)
- Post-Developed Time of Concentration = 10 minutes

Onsite Areas

- **Total Onsite Area = 218,107 sf = 5.01 acres**
  - Existing Western = 118,412 sf = 2.72 acres
    - Roof: 50,635 sf impervious (CN=98)
    - Parking & Walkways: 38,858 sf impervious (CN=98)
    - Landscaping/Swale: 12,011 sf pervious (CN=77)
    - *Not tributary to system: 16, 908 sf pervious & impervious
  - Proposed Eastern = 99,695 sf = 2.29 acres
    - Roof: 44,648 sf impervious (CN=98)
    - Parking & Walkways: 37,369 sf impervious (CN=98)
    - Landscaping/Swale: 17,678 sf pervious (CN=77)

T_c Calculations

Time of Concentration T_c Calculations for Pre-Developed Condition:

- Pre-Developed Sheet Flow 1:

  L = 150' P = 1.58 in S = 0.72% n = 0.24

  $T_1 = \frac{0.42\ (0.24 \times 150)^{0.8}}{(1.58) \times (0.0072)^{0.4}} = 34.3$ MIN

- Pre-Developed Shallow Flow 1:

  L = 372'

  V = 16.1345 $(S)^{0.5}$= 0.6 ft/s

  S = 0.72%

  $T_2 = \frac{372}{60 \times 0.60} = 10.33$ MIN

Pre-Developed Tc = 34.3 + 10.33 = 44.63 min; Use 44 min

Time of Concentration T_c Calcualtions for Post-Developed Condition:

Post-Developed Tc = Use 10 min:

Stormwater Quality Calculations

Existing West Swale

- Total Impervious area= 89,205 sf

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- Water Quality Volume (WQV)
  - WQV (cu. ft.) = 0.36 (in.) x Area (sq. ft.)= 2,677.5 cu.ft.
    12 (in/ft)

- Water Quality Flow (WQF)
  - WQF (cfs) = WQV = 0.186 cfs
    14,400 secs

- Water Quality Depth: Manning's equation for determining flow depth
  - $Q=VA= \frac{1.486}{n} \times A \times R^{2/3} \times S^{1/2}$
    - Where n = 0.24 for open channel flow
    - A = Flow area
    - R = Hydraulic Radius
    - S = Slope = 0.5%
  - WQ Flow Depth= 0.2' < 0.5 ft **OK**

- Max Velocity for 25-year storm = 2.0 fps
  - Q_{25}= 3.74 cfs
  - $A_{\text{bottom swale cross section}}$= 3.95 sf
  - V= 0.95 fps < 2.0 fps **OK**

- Minimum Swale length:
  - Residence Time= 900 seconds
    - Min residence time = 540 seconds
  - Q_{WQ}= 0.186 cfs
  - At WQ depth of 0.20 ft, A= 1.46 sf
  - Q=VA, V= 0.14 fps
  - L=VT= 75.6 ft
  - Minimum length of swale bottom is 100 ft, 126' provided

New East Swale

- Total Impervious area= 82,055 sf
- Water Quality Volume (WQV)
  - WQV (cu. ft.) = 0.36 (in.) x Area (sq. ft.)= 2,461.65 cu.ft.
    12 (in/ft)

- Water Quality Flow (WQF)
  - WQF (cfs) = WQV = 0.171 cfs
    14,400 secs

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- Water Quality Depth: Manning's equation for determining flow depth
  - $Q=VA= \frac{1.486}{n} \times A \times R^{2/3} \times S^{1/2}$
    - Where n = 0.24 for open channel flow
    - A = Flow area
    - R = Hydraulic Radius
    - S = Slope = 0.5%
  - WQ Flow Depth= 0.23' < 0.5 ft **OK**

- Max Velocity for 25-year storm = 2.0 fps
  - Q_{25}= 3.74 cfs
  - $A_{\text{bottom swale cross section}}$= 3.0 sf
  - V= 1.24 fps < 2.0 fps **OK**

- Minimum Swale length:
  - Residence Time= 706.7 seconds
    - Min residence time = 540 seconds
  - Q_{WQ}= 0.171 cfs
  - At WQ depth of 0.23 ft, A= 1.13 sf
  - Q=VA, V= 0.15 fps
  - L=VT= 81 ft
  - Minimum length of swale bottom is 100 ft, 106' provided

Water Quality Manhole Sizing Calculations

- Per CWS requirements, the sump volume of a water quality manhole must be 20 cubic feet per 1 cfs of runoff flow into the manhole for the 25-year storm event
- $V_{cylinder}= \pi r^2 h$
- 25-year non-detained runoff flow for entire system= 3.74 cfs
- Minimum sump volume required = 74.8 cubic feet
- Per CWS detail 250, 60" diameter manhole requires 78.5 cubic feet with 4' sump depth
  - 3' (min) sump depth
  - 5' (max) sump depth
- IE out= xxx
- Sump= xxx - 4.0'
- h= 4.0'
- **V_{sump}= 74.8 cubic feet < 78.5 cubic feet OK**

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Job Name:	**10500 SW Manhasset Warehouse**	Job No:	**21204**
Client:	**MDG Consulting P.C.**	Date:	**August 2021** By: PRM

New East Swale and Flow Control Manhole Design

Storm Event	Pre-Developed (cfs)	Post-Developed (cfs)	Target (cfs)	Mitigated (cfs)	WS Elevation (ft)	Depth Check, Bottom Elev=132.0 (<4')
2-year	**0.32**	**2.19**	****0.24**	**0.24**	**135.46**	**3.46' OK**
5-year	**0.59**	**2.86**	**0.59**	**0.44**	**135.84**	**3.84' OK**
10-year	**0.77**	**3.25**	**0.77**	**0.62**	**135.94**	**3.94' OK**
25-year	**1.02**	**3.74**	**1.02**	**0.98**	**136.00**	**4.00' OK**
100-year	**1.63**	**4.89**	**Not Required**	**2.69**	**136.17**	

**The 2-year target rate is an average of the full 2-year pre-developed target for the existing site to remain and the 1/2 of the 2-year pre-developed target for the new development.

Downstream Conveyance Calculations

21" diameter pipe at 1.0% slope

$$Q_{max} = \frac{1.486}{n} \times A \times R^{2/3} \times S^{1/2}$$

- n= 0.013
- A= 2.41 sq ft
- R= 0.437 feet
- S= 0.01

Q_{max} (21")= 15.84 cfs

36" diameter pipe at 0.1% slope

$$Q_{max} = \frac{1.486}{n} \times A \times R^{2/3} \times S^{1/2}$$

- n= 0.013
- A= 7.07 sq ft
- R= 0.750 feet
- S= 0.001

Q_{max} (36")= 21.09 cfs

TM RIPPEY
CONSULTING ENGINEERS

7650 SW Beveland Street, Suite 100
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Client:	**MDG Consulting P.C.**	Date:	**August 2021**	By: PRM

Conveyance Calculations

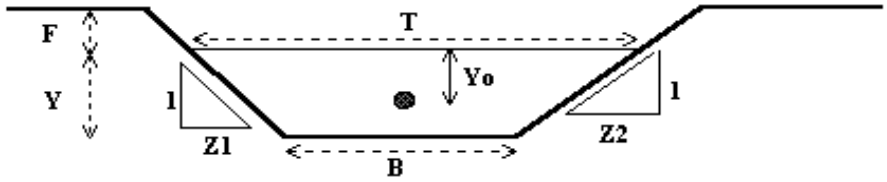
- Pipe Capacity Equation
  - $Q_{max} = \frac{1.486 \times A \times R^{2/3} \times S^{1/2}}{n}$
  - A = Area; R = Hydraulic Radius; S = Slope; n = Manning's Roughness Coefficient

- 12" dia. where n = 0.013, A = 0.78 sf, R = 0.25 ft, S = 0.02
  - **Q_{full} = 5.04 cfs > $Q_{25\text{-}yr}$ = 3.74 cfs → OK.**

Normal Flow Analysis - Trapezoidal Channel

Project: Existing West Swale

Channel ID: WQF Depth and Velocity

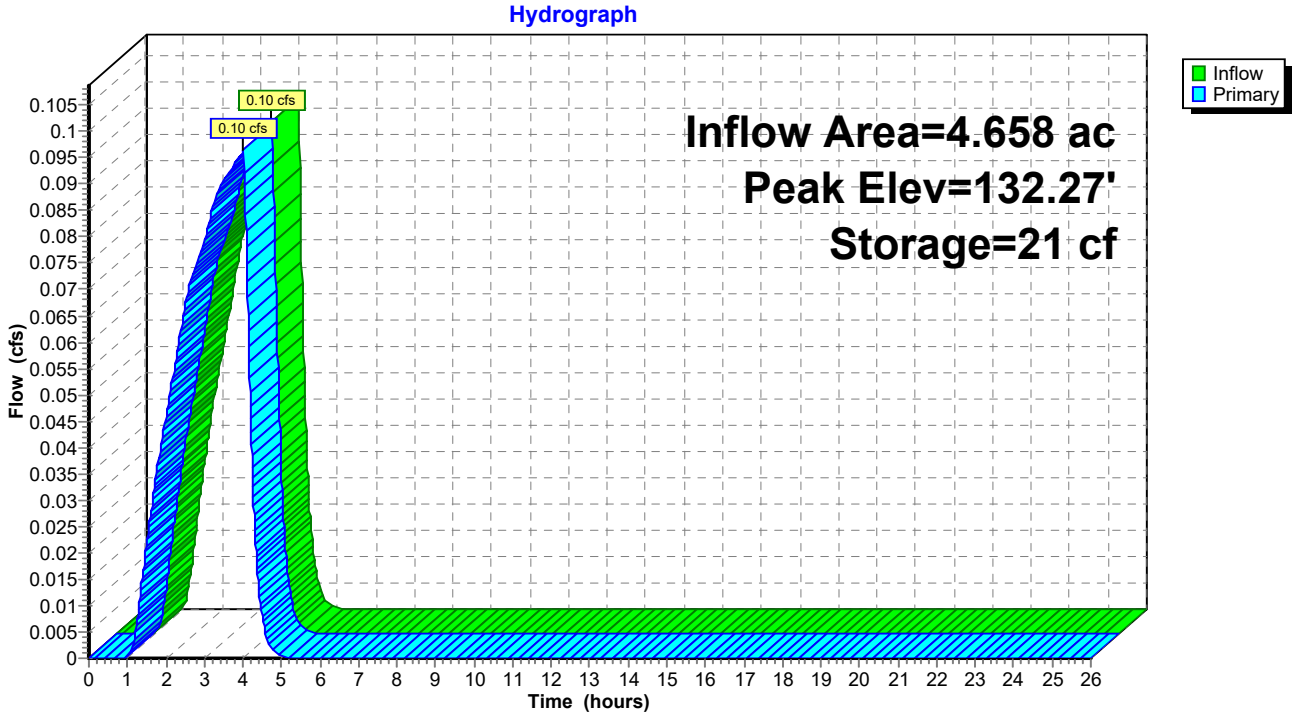


Design Information (Input)			
Channel Invert Slope	So =	0.0050	ft/ft
Manning's n	n =	0.240	
Bottom Width	B =	5.90	ft
Left Side Slope	Z1 =	4.00	ft/ft
Right Side Slope	Z2 =	4.00	ft/ft
Freeboard Height	F =	1.00	ft
Design Water Depth	Y =	**0.20**	ft

Normal Flow Condtion (Calculated)			
Discharge	**Q =**	**0.19**	cfs
Froude Number	**Fr =**	**0.06**	
Flow Velocity	**V =**	**0.14**	fps
Flow Area	A =	1.34	sq ft
Top Width	T =	7.50	ft
Wetted Perimeter	P =	7.55	ft
Hydraulic Radius	R =	0.18	ft
Hydraulic Depth	D =	0.18	ft
Specific Energy	Es =	0.20	ft
Centroid of Flow Area	Yo =	0.10	ft
Specific Force	Fs =	0.01	kip

Primary OutFlow Max=0.17 cfs @ 4.00 hrs HW=132.27' (Free Discharge)
└**1=Culvert** (Passes 0.17 cfs of 2.71 cfs potential flow)
└**2=2yr** (Orifice Controls 0.17 cfs @ 4.97 fps)
└**3=Orifice/Grate** (Controls 0.00 cfs)
└**4=Orifice/Grate** (Controls 0.00 cfs)

Pond 6P: Existing FC MH 2, 5 10



Summary for Pond 6P: Existing FC MH 2, 5 10

[44] Hint: Outlet device #2 is below defined storage

Inflow Area = 4.658 ac, 43.99% Impervious, Inflow Depth = 0.04" for WQ event
Inflow = 0.10 cfs @ 4.00 hrs, Volume= 0.016 af
Outflow = 0.10 cfs @ 4.00 hrs, Volume= 0.016 af, Atten= 1%, Lag= 0.1 min
Primary = 0.10 cfs @ 4.00 hrs, Volume= 0.016 af

Routing by Stor-Ind method, Time Span= 0.00-26.00 hrs, dt= 0.01 hrs
Peak Elev= 132.27' @ 4.00 hrs Surf.Area= 573 sf Storage= 21 cf

Plug-Flow detention time= 3.7 min calculated for 0.016 af (100% of inflow)
Center-of-Mass det. time= 3.7 min (184.7 - 181.0)

Volume	Invert	Avail.Storage	Storage Description
#1	132.23'	6,726 cf	**East Swale (Prismatic)**Listed below (Recalc)
#2	133.28'	5,240 cf	**West Swale (Prismatic)**Listed below (Recalc)
#3	132.30'	80 cf	**15.0" Round 15" pipe** L= 65.0' S= 0.0100 '/'
#4	133.28'	262 cf	**10.0" Round 10" Pipe** L= 480.0' S= 0.0100 '/'
#5	133.28'	77 cf	**8.0" Round 8" Pipe** L= 220.0' S= 0.0100 '/'
		12,384 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
132.23	550	0	0
133.00	1,023	606	606
134.00	1,694	1,359	1,964
135.00	2,379	2,037	4,001
136.00	3,072	2,726	6,726

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
133.28	265	0	0
134.00	747	364	364
135.00	1,303	1,025	1,389
136.00	1,807	1,555	2,944
137.00	2,784	2,296	5,240

Device	Routing	Invert	Outlet Devices
#1	Primary	131.20'	**18.0" Round Culvert** L= 45.0' Ke= 0.700 Inlet / Outlet Invert= 131.20' / 131.16' S= 0.0009 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#2	Device 1	131.20'	**2.5" Horiz. 2yr** C= 0.600 Limited to weir flow at low heads
#3	Device 1	134.80'	**2.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 1	134.91'	**18.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Summary for Subcatchment 12S: Total Undeveloped Pre

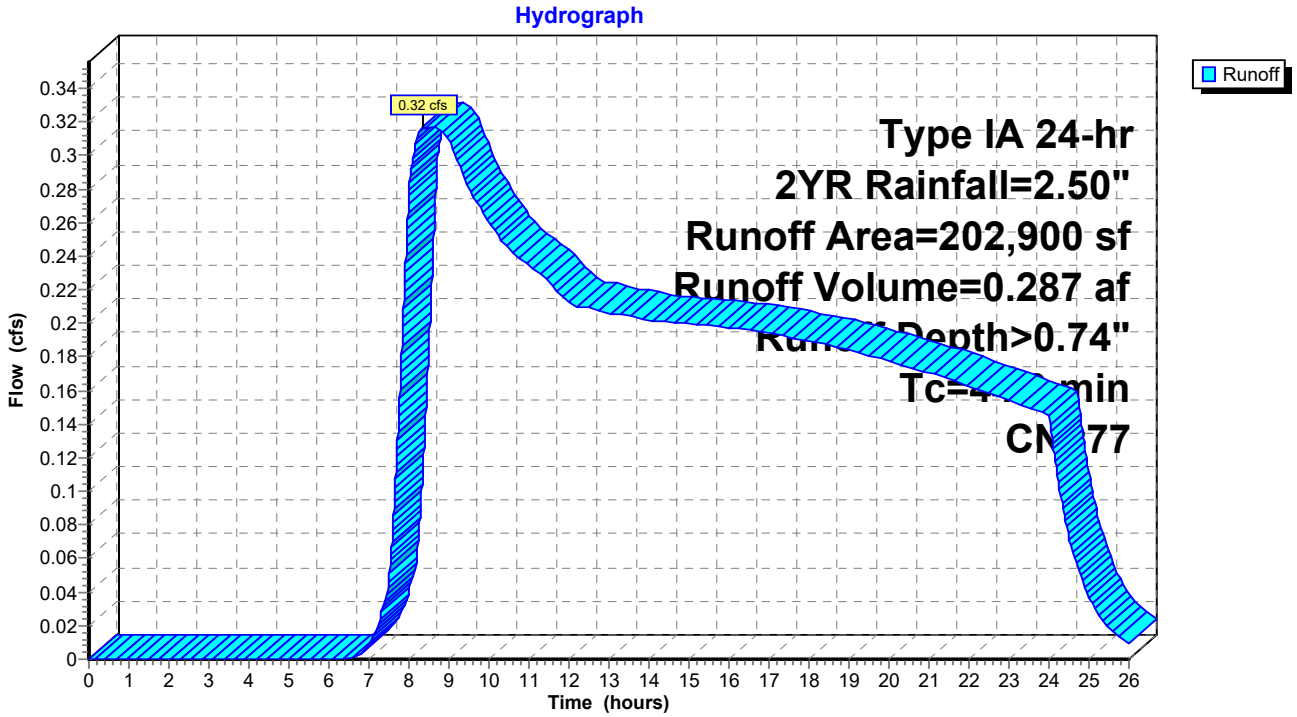
Runoff = 0.32 cfs @ 8.37 hrs, Volume= 0.287 af, Depth> 0.74"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-26.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2YR Rainfall=2.50"

	Area (sf)	CN	Description
*	202,900	77	
	202,900		100.00% Pervious Area

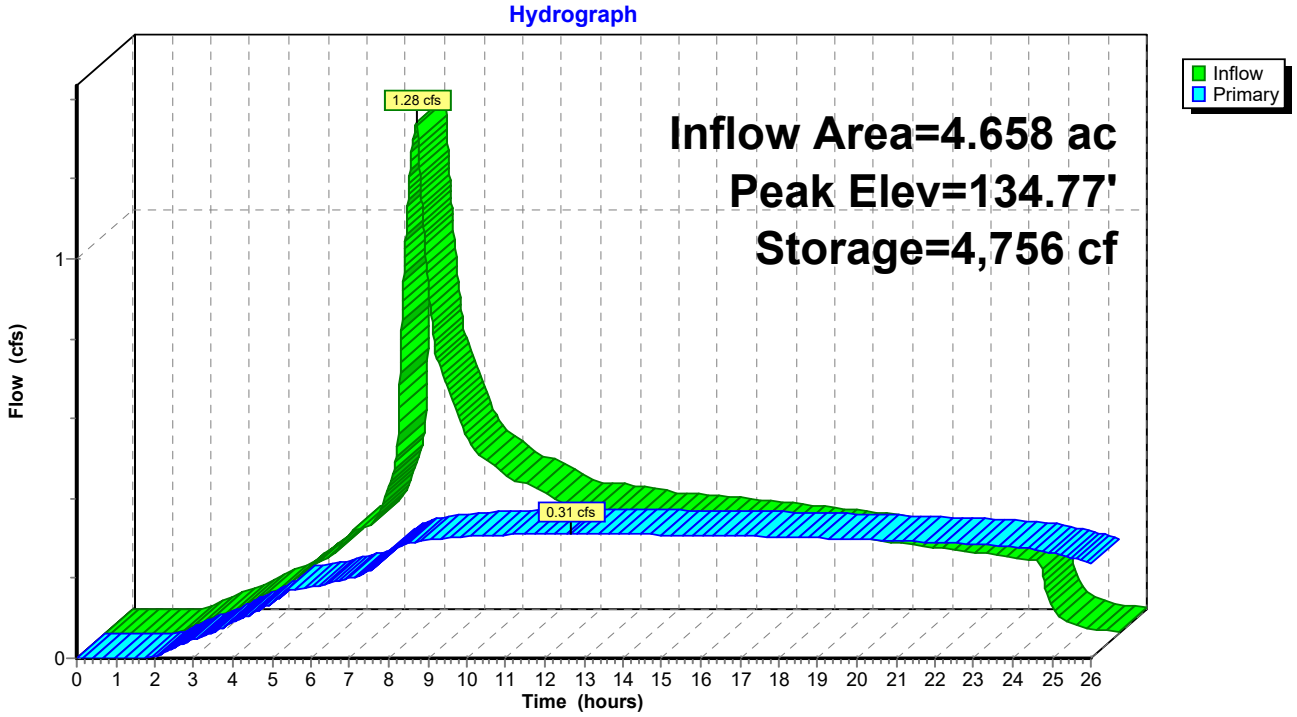
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
44.0					**Direct Entry,**

Subcatchment 12S: Total Undeveloped Pre



Primary OutFlow Max=0.31 cfs @ 12.68 hrs HW=134.77' (Free Discharge)
└**1=Culvert** (Passes 0.31 cfs of 12.61 cfs potential flow)
  └**2=2yr** (Orifice Controls 0.31 cfs @ 9.10 fps)
  └**3=Orifice/Grate** (Controls 0.00 cfs)
  └**4=Orifice/Grate** (Controls 0.00 cfs)

Pond 6P: Existing FC MH 2, 5 10



Summary for Pond 6P: Existing FC MH 2, 5 10

[44] Hint: Outlet device #2 is below defined storage

Inflow Area = 4.658 ac, 43.99% Impervious, Inflow Depth > 1.36" for 2YR event
Inflow = 1.28 cfs @ 8.00 hrs, Volume= 0.529 af
Outflow = 0.31 cfs @ 12.68 hrs, Volume= 0.506 af, Atten= 76%, Lag= 280.9 min
Primary = 0.31 cfs @ 12.68 hrs, Volume= 0.506 af

Routing by Stor-Ind method, Time Span= 0.00-26.00 hrs, dt= 0.01 hrs
Peak Elev= 134.77' @ 12.68 hrs Surf.Area= 3,487 sf Storage= 4,756 cf

Plug-Flow detention time= 184.0 min calculated for 0.505 af (96% of inflow)
Center-of-Mass det. time= 154.5 min (925.5 - 771.0)

Volume	Invert	Avail.Storage	Storage Description
#1	132.23'	6,726 cf	**East Swale (Prismatic)**Listed below (Recalc)
#2	133.28'	5,240 cf	**West Swale (Prismatic)**Listed below (Recalc)
#3	132.30'	80 cf	**15.0" Round 15" pipe** L= 65.0' S= 0.0100 '/'
#4	133.28'	262 cf	**10.0" Round 10" Pipe** L= 480.0' S= 0.0100 '/'
#5	133.28'	77 cf	**8.0" Round 8" Pipe** L= 220.0' S= 0.0100 '/'
		12,384 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
132.23	550	0	0
133.00	1,023	606	606
134.00	1,694	1,359	1,964
135.00	2,379	2,037	4,001
136.00	3,072	2,726	6,726

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
133.28	265	0	0
134.00	747	364	364
135.00	1,303	1,025	1,389
136.00	1,807	1,555	2,944
137.00	2,784	2,296	5,240

Device	Routing	Invert	Outlet Devices
#1	Primary	131.20'	**18.0" Round Culvert** L= 45.0' Ke= 0.700 Inlet / Outlet Invert= 131.20' / 131.16' S= 0.0009 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#2	Device 1	131.20'	**2.5" Horiz. 2yr** C= 0.600 Limited to weir flow at low heads
#3	Device 1	134.80'	**2.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 1	134.91'	**18.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Summary for Subcatchment 12S: Total Undeveloped Pre

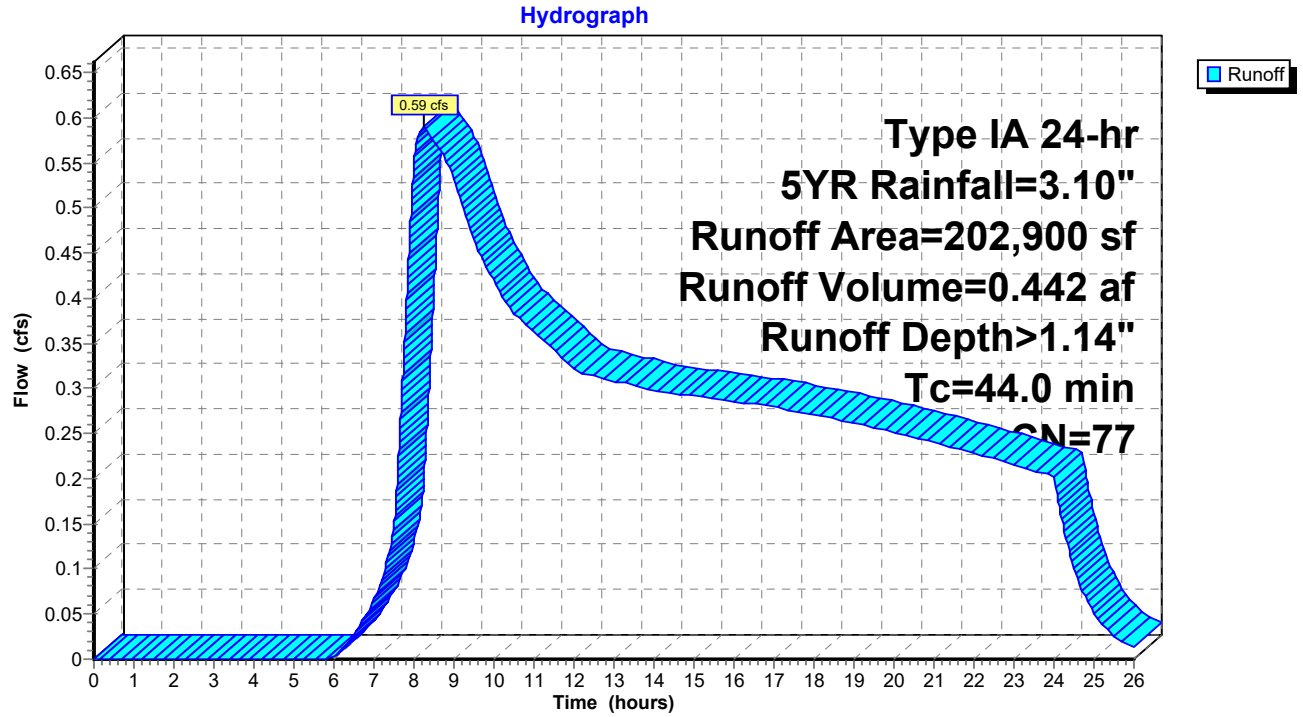
Runoff = 0.59 cfs @ 8.26 hrs, Volume= 0.442 af, Depth> 1.14"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-26.00 hrs, dt= 0.01 hrs
Type IA 24-hr 5YR Rainfall=3.10"

	Area (sf)	CN	Description
*	202,900	77	
	202,900		100.00% Pervious Area

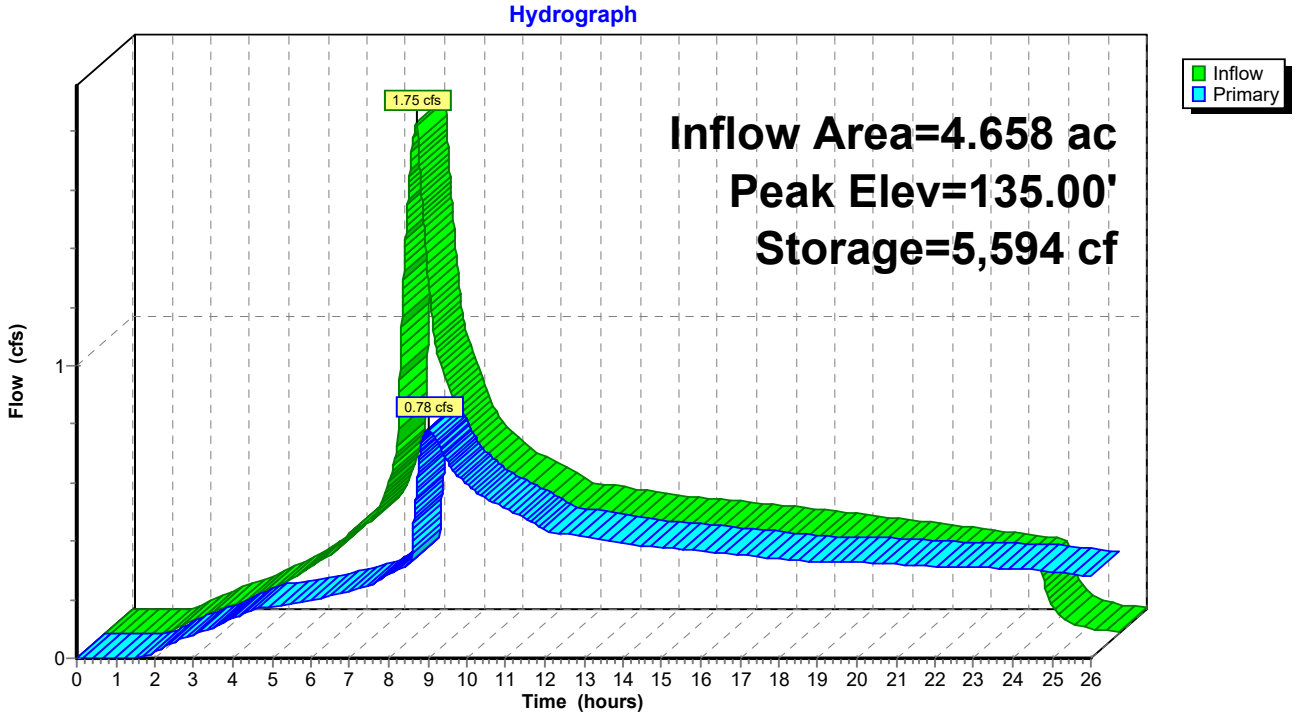
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
44.0					**Direct Entry,**

Subcatchment 12S: Total Undeveloped Pre



Primary OutFlow Max=0.78 cfs @ 9.01 hrs HW=135.00' (Free Discharge)
└**1=Culvert** (Passes 0.78 cfs of 13.11 cfs potential flow)
  └**2=2yr** (Orifice Controls 0.32 cfs @ 9.39 fps)
  └**3=Orifice/Grate** (Orifice Controls 0.04 cfs @ 1.65 fps)
  └**4=Orifice/Grate** (Weir Controls 0.43 cfs @ 0.99 fps)

Pond 6P: Existing FC MH 2, 5 10



Summary for Pond 6P: Existing FC MH 2, 5 10

[44] Hint: Outlet device #2 is below defined storage

Inflow Area = 4.658 ac, 43.99% Impervious, Inflow Depth > 1.86" for 5YR event
Inflow = 1.75 cfs @ 8.00 hrs, Volume= 0.720 af
Outflow = 0.78 cfs @ 9.01 hrs, Volume= 0.657 af, Atten= 55%, Lag= 60.6 min
Primary = 0.78 cfs @ 9.01 hrs, Volume= 0.657 af

Routing by Stor-Ind method, Time Span= 0.00-26.00 hrs, dt= 0.01 hrs
Peak Elev= 135.00' @ 9.01 hrs Surf.Area= 3,773 sf Storage= 5,594 cf

Plug-Flow detention time= 177.0 min calculated for 0.657 af (91% of inflow)
Center-of-Mass det. time= 118.3 min (879.0 - 760.8)

Volume	Invert	Avail.Storage	Storage Description
#1	132.23'	6,726 cf	**East Swale (Prismatic)**Listed below (Recalc)
#2	133.28'	5,240 cf	**West Swale (Prismatic)**Listed below (Recalc)
#3	132.30'	80 cf	**15.0" Round 15" pipe** L= 65.0' S= 0.0100 '/'
#4	133.28'	262 cf	**10.0" Round 10" Pipe** L= 480.0' S= 0.0100 '/'
#5	133.28'	77 cf	**8.0" Round 8" Pipe** L= 220.0' S= 0.0100 '/'
		12,384 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
132.23	550	0	0
133.00	1,023	606	606
134.00	1,694	1,359	1,964
135.00	2,379	2,037	4,001
136.00	3,072	2,726	6,726

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
133.28	265	0	0
134.00	747	364	364
135.00	1,303	1,025	1,389
136.00	1,807	1,555	2,944
137.00	2,784	2,296	5,240

Device	Routing	Invert	Outlet Devices
#1	Primary	131.20'	**18.0" Round Culvert** L= 45.0' Ke= 0.700 Inlet / Outlet Invert= 131.20' / 131.16' S= 0.0009 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#2	Device 1	131.20'	**2.5" Horiz. 2yr** C= 0.600 Limited to weir flow at low heads
#3	Device 1	134.80'	**2.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 1	134.91'	**18.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Summary for Subcatchment 12S: Total Undeveloped Pre

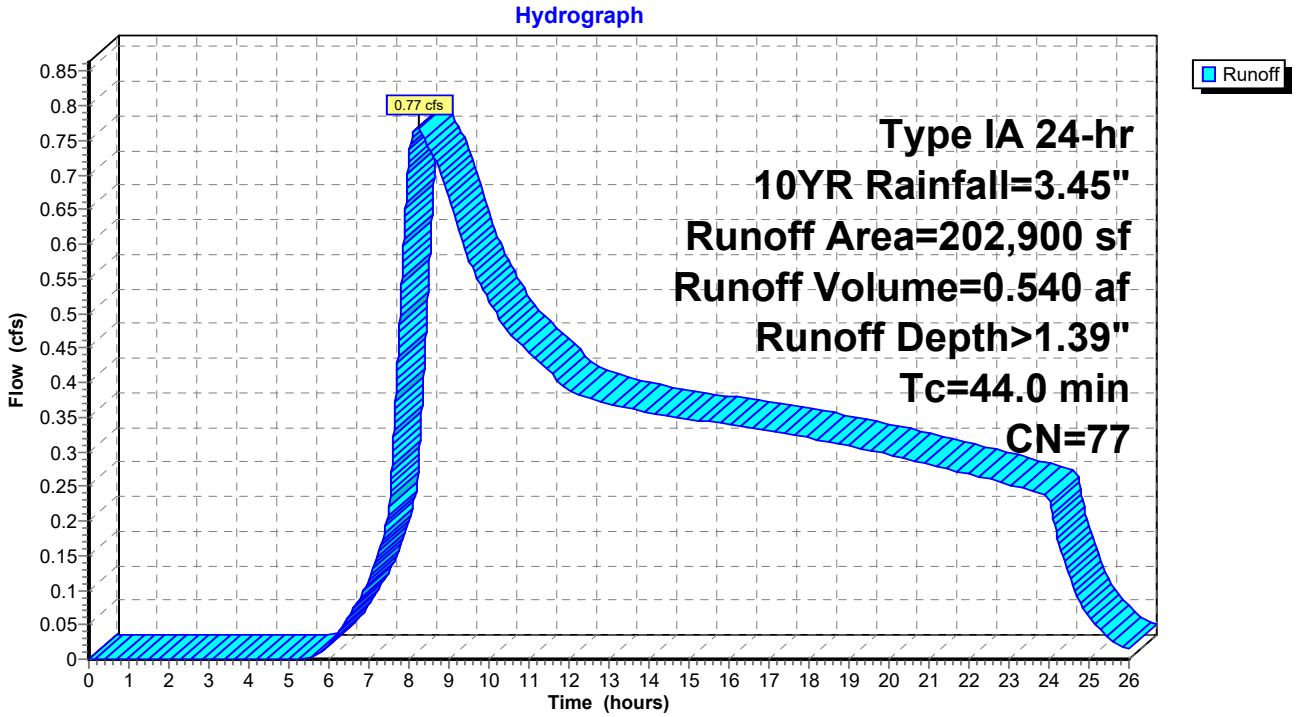
Runoff = 0.77 cfs @ 8.23 hrs, Volume= 0.540 af, Depth> 1.39"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-26.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10YR Rainfall=3.45"

	Area (sf)	CN	Description
*	202,900	77	
	202,900		100.00% Pervious Area

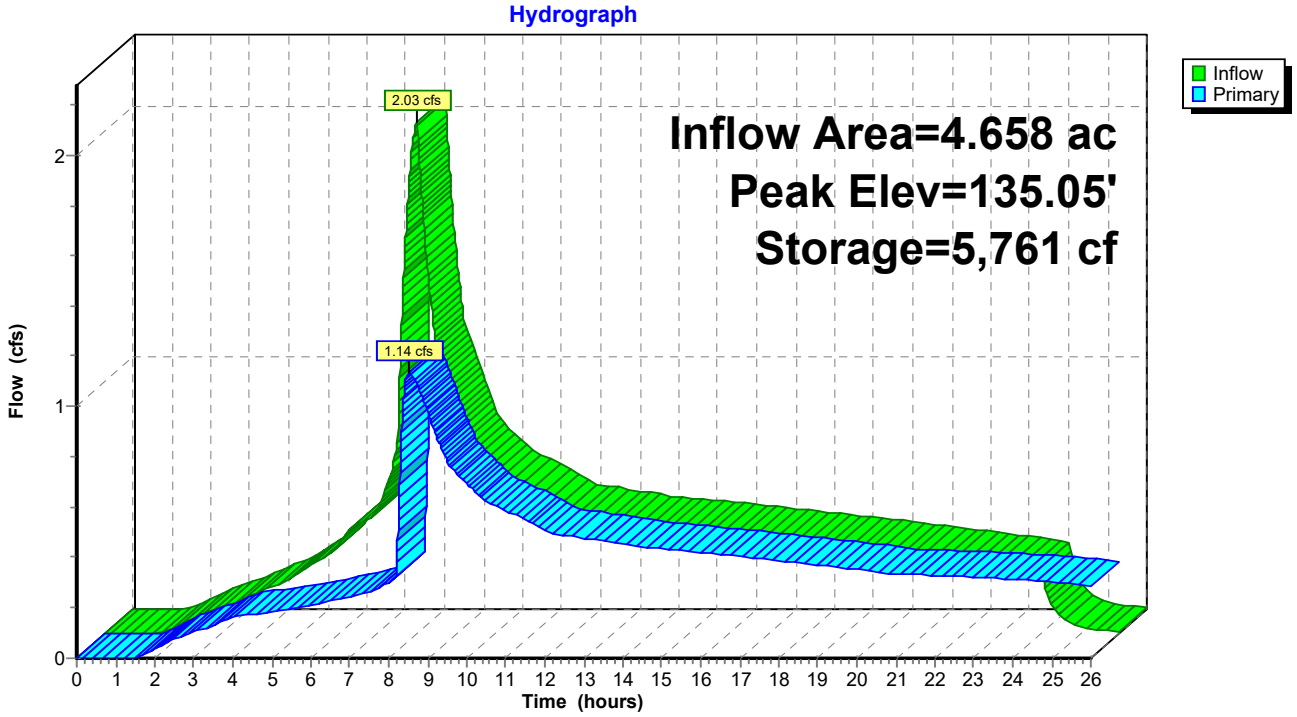
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
44.0					**Direct Entry,**

Subcatchment 12S: Total Undeveloped Pre



Primary OutFlow Max=1.13 cfs @ 8.51 hrs HW=135.05' (Free Discharge)
└─**1=Culvert** (Passes 1.13 cfs of 13.21 cfs potential flow)
  ├─**2=2yr** (Orifice Controls 0.32 cfs @ 9.44 fps)
  ├─**3=Orifice/Grate** (Orifice Controls 0.04 cfs @ 1.94 fps)
  └─**4=Orifice/Grate** (Weir Controls 0.77 cfs @ 1.20 fps)

Pond 6P: Existing FC MH 2, 5 10



Summary for Pond 6P: Existing FC MH 2, 5 10

[44] Hint: Outlet device #2 is below defined storage

Inflow Area = 4.658 ac, 43.99% Impervious, Inflow Depth > 2.15" for 10YR event
Inflow = 2.03 cfs @ 8.00 hrs, Volume= 0.836 af
Outflow = 1.14 cfs @ 8.51 hrs, Volume= 0.763 af, Atten= 44%, Lag= 30.5 min
Primary = 1.14 cfs @ 8.51 hrs, Volume= 0.763 af

Routing by Stor-Ind method, Time Span= 0.00-26.00 hrs, dt= 0.01 hrs
Peak Elev= 135.05' @ 8.51 hrs Surf.Area= 3,826 sf Storage= 5,761 cf

Plug-Flow detention time= 157.5 min calculated for 0.763 af (91% of inflow)
Center-of-Mass det. time= 98.5 min (854.3 - 755.8)

Volume	Invert	Avail.Storage	Storage Description
#1	132.23'	6,726 cf	**East Swale (Prismatic)**Listed below (Recalc)
#2	133.28'	5,240 cf	**West Swale (Prismatic)**Listed below (Recalc)
#3	132.30'	80 cf	**15.0" Round 15" pipe** L= 65.0' S= 0.0100 '/'
#4	133.28'	262 cf	**10.0" Round 10" Pipe** L= 480.0' S= 0.0100 '/'
#5	133.28'	77 cf	**8.0" Round 8" Pipe** L= 220.0' S= 0.0100 '/'
		12,384 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
132.23	550	0	0
133.00	1,023	606	606
134.00	1,694	1,359	1,964
135.00	2,379	2,037	4,001
136.00	3,072	2,726	6,726

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
133.28	265	0	0
134.00	747	364	364
135.00	1,303	1,025	1,389
136.00	1,807	1,555	2,944
137.00	2,784	2,296	5,240

Device	Routing	Invert	Outlet Devices
#1	Primary	131.20'	**18.0" Round Culvert** L= 45.0' Ke= 0.700 Inlet / Outlet Invert= 131.20' / 131.16' S= 0.0009 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#2	Device 1	131.20'	**2.5" Horiz. 2yr** C= 0.600 Limited to weir flow at low heads
#3	Device 1	134.80'	**2.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 1	134.91'	**18.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Summary for Subcatchment 12S: Total Undeveloped Pre

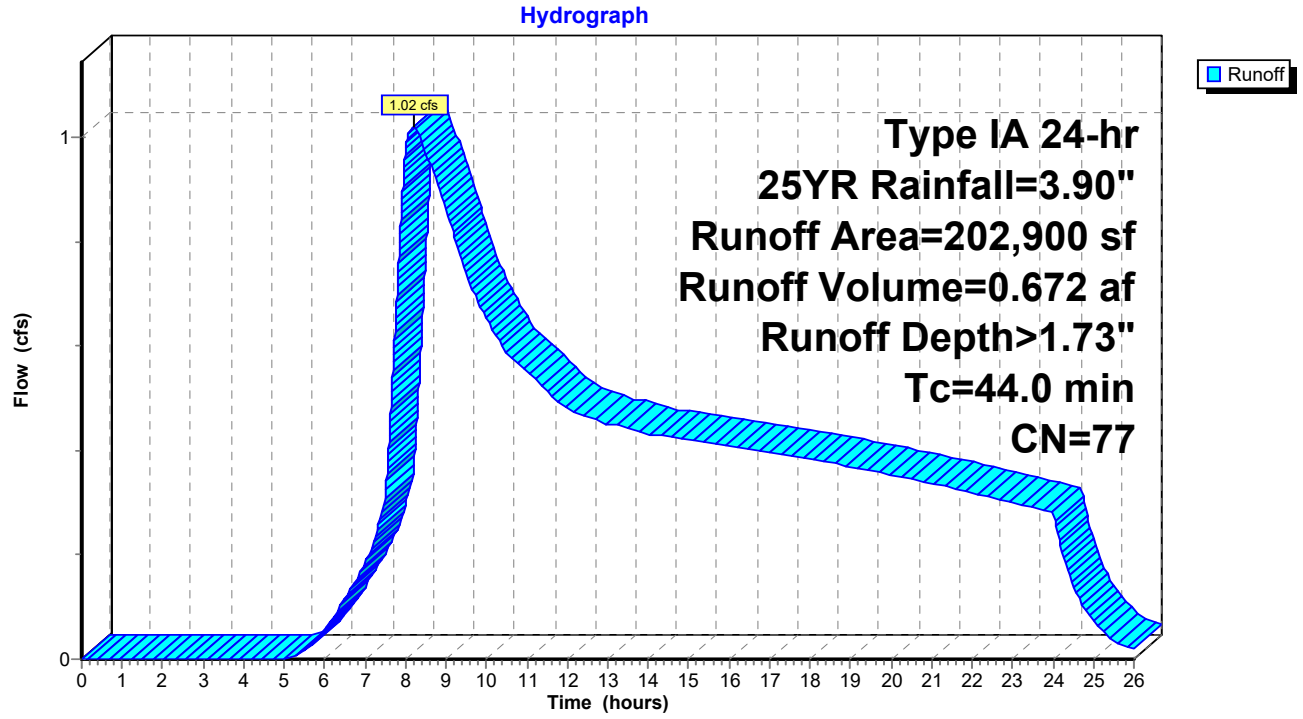
Runoff = 1.02 cfs @ 8.20 hrs, Volume= 0.672 af, Depth> 1.73"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-26.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25YR Rainfall=3.90"

	Area (sf)	CN	Description
*	202,900	77	
	202,900		100.00% Pervious Area

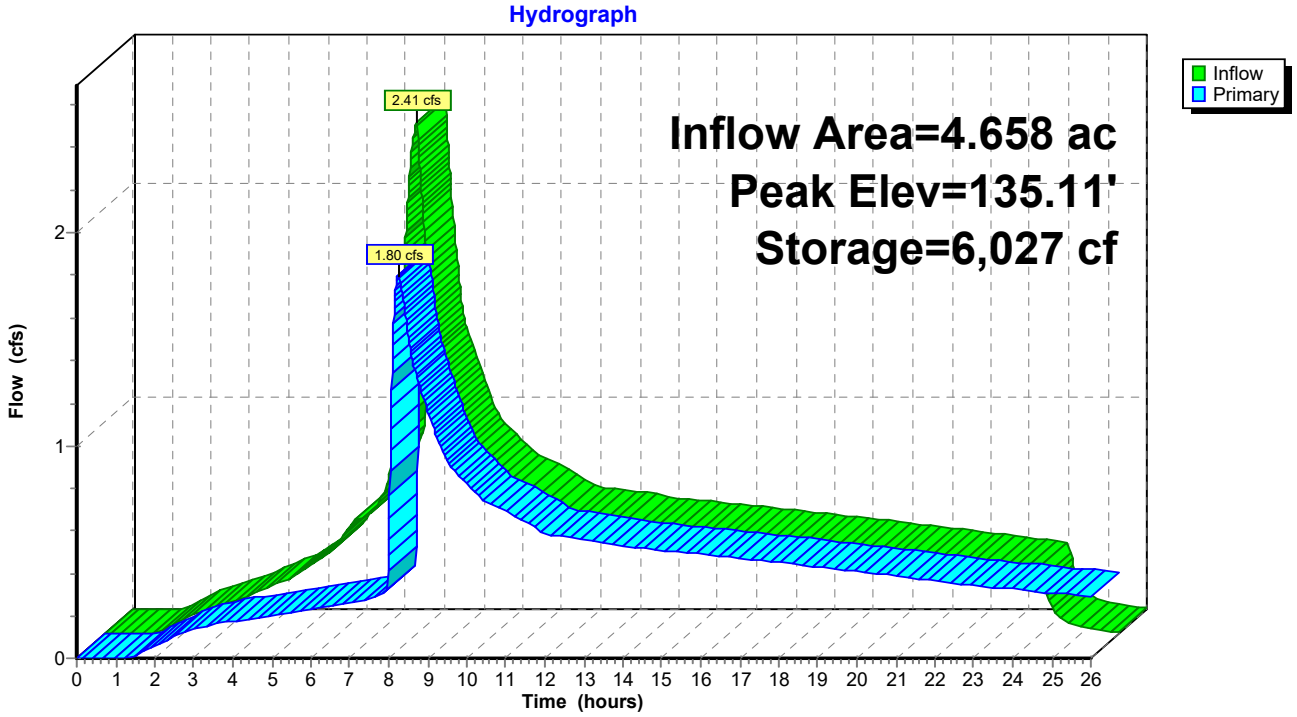
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
44.0					**Direct Entry,**

Subcatchment 12S: Total Undeveloped Pre



Primary OutFlow Max=1.79 cfs @ 8.24 hrs HW=135.11' (Free Discharge)
└─**1=Culvert** (Passes 1.79 cfs of 13.35 cfs potential flow)
  ├─**2=2yr** (Orifice Controls 0.32 cfs @ 9.53 fps)
  ├─**3=Orifice/Grate** (Orifice Controls 0.05 cfs @ 2.31 fps)
  └─**4=Orifice/Grate** (Weir Controls 1.42 cfs @ 1.48 fps)

Pond 6P: Existing FC MH 2, 5 10



Summary for Pond 6P: Existing FC MH 2, 5 10

[44] Hint: Outlet device #2 is below defined storage

Inflow Area = 4.658 ac, 43.99% Impervious, Inflow Depth > 2.55" for 25YR event
Inflow = 2.41 cfs @ 8.00 hrs, Volume= 0.988 af
Outflow = 1.80 cfs @ 8.24 hrs, Volume= 0.909 af, Atten= 25%, Lag= 14.5 min
Primary = 1.80 cfs @ 8.24 hrs, Volume= 0.909 af

Routing by Stor-Ind method, Time Span= 0.00-26.00 hrs, dt= 0.01 hrs
Peak Elev= 135.11' @ 8.24 hrs Surf.Area= 3,908 sf Storage= 6,027 cf

Plug-Flow detention time= 136.9 min calculated for 0.909 af (92% of inflow)
Center-of-Mass det. time= 82.1 min (832.3 - 750.2)

Volume	Invert	Avail.Storage	Storage Description
#1	132.23'	6,726 cf	**East Swale (Prismatic)**Listed below (Recalc)
#2	133.28'	5,240 cf	**West Swale (Prismatic)**Listed below (Recalc)
#3	132.30'	80 cf	**15.0" Round 15" pipe** L= 65.0' S= 0.0100 '/'
#4	133.28'	262 cf	**10.0" Round 10" Pipe** L= 480.0' S= 0.0100 '/'
#5	133.28'	77 cf	**8.0" Round 8" Pipe** L= 220.0' S= 0.0100 '/'
		12,384 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
132.23	550	0	0
133.00	1,023	606	606
134.00	1,694	1,359	1,964
135.00	2,379	2,037	4,001
136.00	3,072	2,726	6,726

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
133.28	265	0	0
134.00	747	364	364
135.00	1,303	1,025	1,389
136.00	1,807	1,555	2,944
137.00	2,784	2,296	5,240

Device	Routing	Invert	Outlet Devices
#1	Primary	131.20'	**18.0" Round Culvert** L= 45.0' Ke= 0.700 Inlet / Outlet Invert= 131.20' / 131.16' S= 0.0009 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#2	Device 1	131.20'	**2.5" Horiz. 2yr** C= 0.600 Limited to weir flow at low heads
#3	Device 1	134.80'	**2.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 1	134.91'	**18.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Summary for Subcatchment 12S: Total Undeveloped Pre

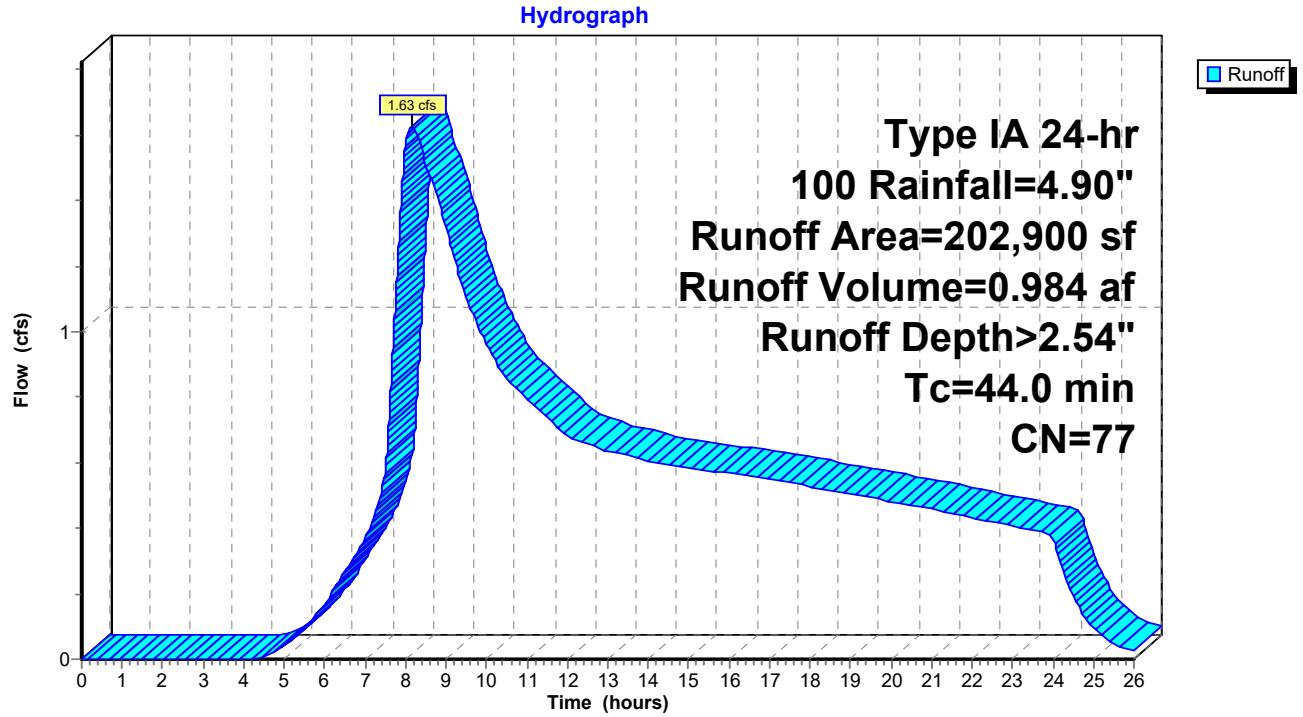
Runoff = 1.63 cfs @ 8.15 hrs, Volume= 0.984 af, Depth> 2.54"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-26.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100 Rainfall=4.90"

	Area (sf)	CN	Description
*	202,900	77	
	202,900		100.00% Pervious Area

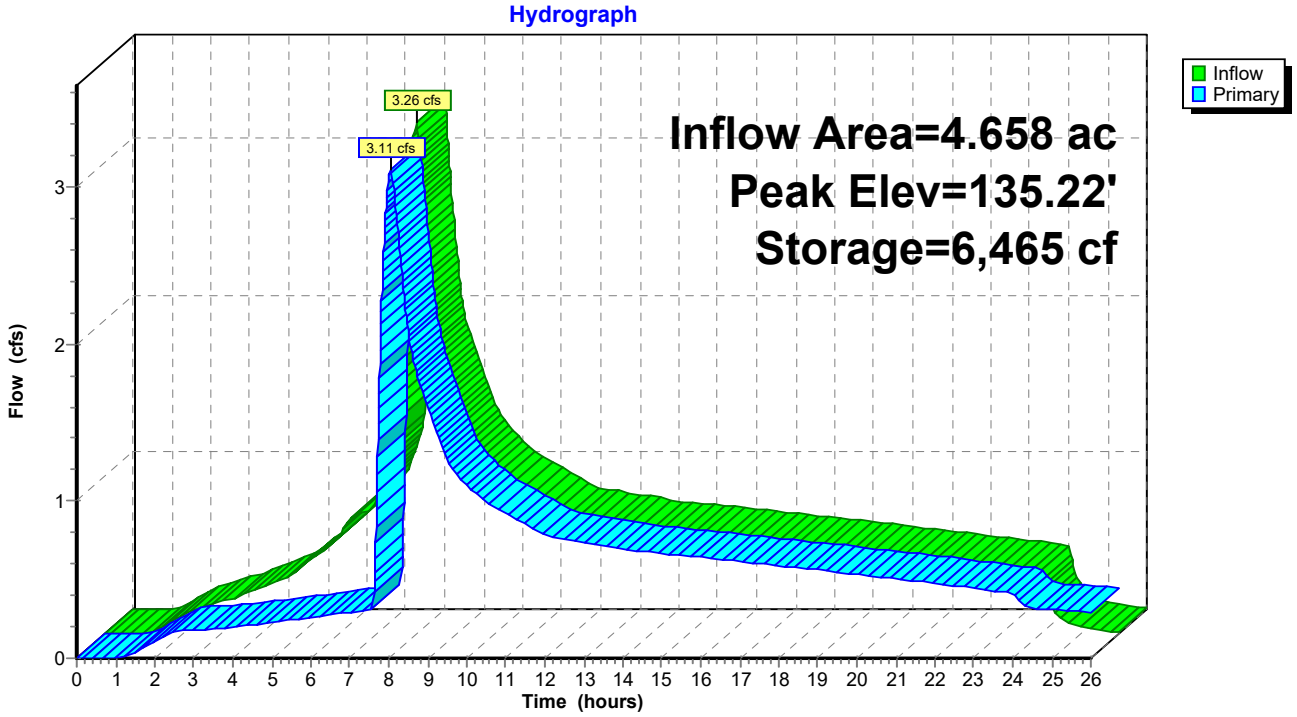
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
44.0					**Direct Entry,**

Subcatchment 12S: Total Undeveloped Pre



Primary OutFlow Max=3.11 cfs @ 8.04 hrs HW=135.22' (Free Discharge)
└─**1=Culvert** (Passes 3.11 cfs of 13.59 cfs potential flow)
  ├─**2=2yr** (Orifice Controls 0.33 cfs @ 9.66 fps)
  ├─**3=Orifice/Grate** (Orifice Controls 0.06 cfs @ 2.81 fps)
  └─**4=Orifice/Grate** (Weir Controls 2.71 cfs @ 1.83 fps)

Pond 6P: Existing FC MH 2, 5 10



Summary for Pond 6P: Existing FC MH 2, 5 10

[44] Hint: Outlet device #2 is below defined storage

Inflow Area = 4.658 ac, 43.99% Impervious, Inflow Depth > 3.44" for 100 event
Inflow = 3.26 cfs @ 8.00 hrs, Volume= 1.337 af
Outflow = 3.11 cfs @ 8.04 hrs, Volume= 1.253 af, Atten= 4%, Lag= 2.7 min
Primary = 3.11 cfs @ 8.04 hrs, Volume= 1.253 af

Routing by Stor-Ind method, Time Span= 0.00-26.00 hrs, dt= 0.01 hrs
Peak Elev= 135.22' @ 8.04 hrs Surf.Area= 4,040 sf Storage= 6,465 cf

Plug-Flow detention time= 107.3 min calculated for 1.253 af (94% of inflow)
Center-of-Mass det. time= 63.6 min (803.6 - 740.0)

Volume	Invert	Avail.Storage	Storage Description
#1	132.23'	6,726 cf	**East Swale (Prismatic)**Listed below (Recalc)
#2	133.28'	5,240 cf	**West Swale (Prismatic)**Listed below (Recalc)
#3	132.30'	80 cf	**15.0" Round 15" pipe** L= 65.0' S= 0.0100 '/'
#4	133.28'	262 cf	**10.0" Round 10" Pipe** L= 480.0' S= 0.0100 '/'
#5	133.28'	77 cf	**8.0" Round 8" Pipe** L= 220.0' S= 0.0100 '/'
		12,384 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
132.23	550	0	0
133.00	1,023	606	606
134.00	1,694	1,359	1,964
135.00	2,379	2,037	4,001
136.00	3,072	2,726	6,726

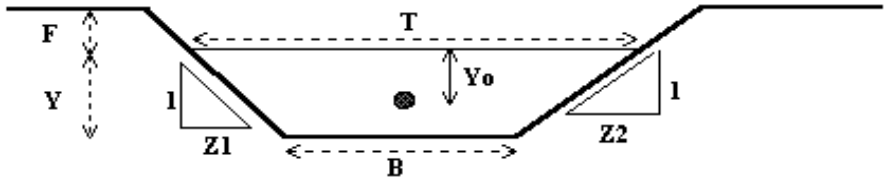
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
133.28	265	0	0
134.00	747	364	364
135.00	1,303	1,025	1,389
136.00	1,807	1,555	2,944
137.00	2,784	2,296	5,240

Device	Routing	Invert	Outlet Devices
#1	Primary	131.20'	**18.0" Round Culvert** L= 45.0' Ke= 0.700 Inlet / Outlet Invert= 131.20' / 131.16' S= 0.0009 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#2	Device 1	131.20'	**2.5" Horiz. 2yr** C= 0.600 Limited to weir flow at low heads
#3	Device 1	134.80'	**2.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 1	134.91'	**18.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Normal Flow Analysis - Trapezoidal Channel

Project: Proposed East Swale

Channel ID: WQF Depth and Velocity



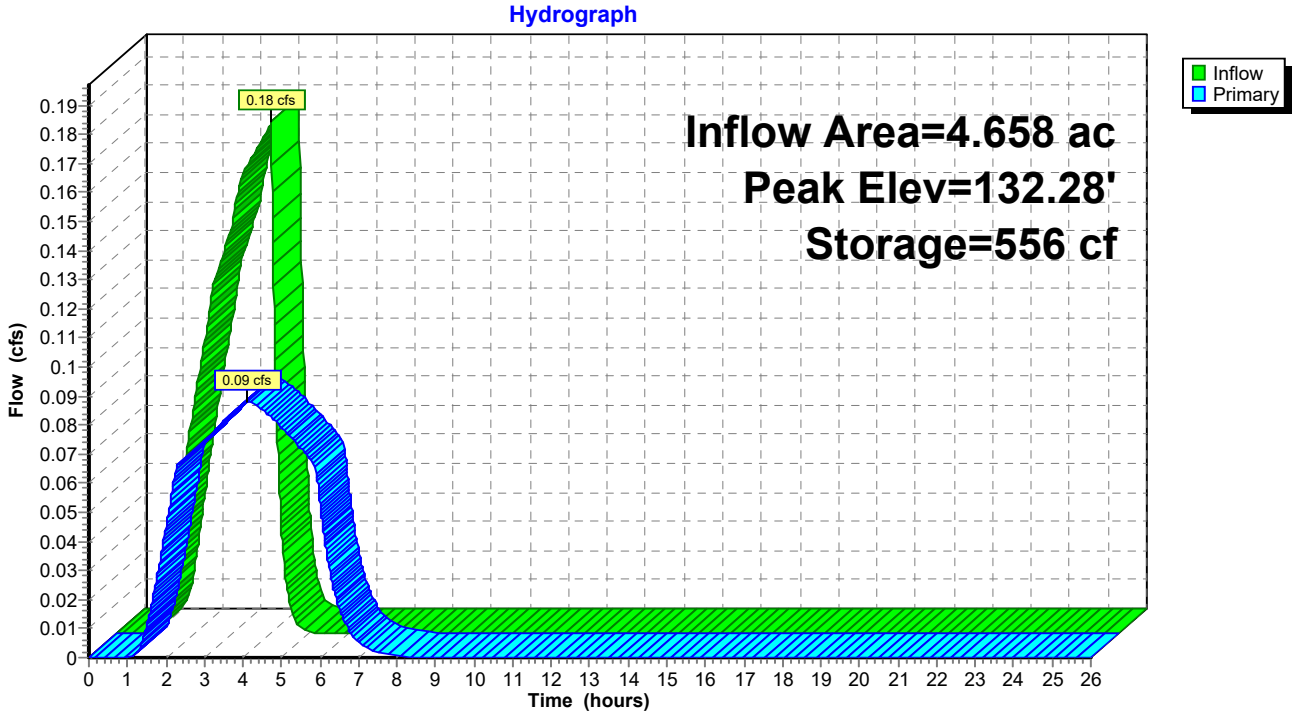
Design Information (Input)			
Channel Invert Slope	So =	0.0050	ft/ft
Manning's n	n =	0.240	
Bottom Width	B =	4.00	ft
Left Side Slope	Z1 =	4.00	ft/ft
Right Side Slope	Z2 =	4.00	ft/ft
Freeboard Height	F =	1.00	ft
Design Water Depth	Y =	**0.23**	ft

Normal Flow Condtion (Calculated)			
Discharge	**Q =**	**0.17**	cfs
Froude Number	**Fr =**	**0.06**	
Flow Velocity	**V =**	**0.15**	fps
Flow Area	A =	1.13	sq ft
Top Width	T =	5.84	ft
Wetted Perimeter	P =	5.90	ft
Hydraulic Radius	R =	0.19	ft
Hydraulic Depth	D =	0.19	ft
Specific Energy	Es =	0.23	ft
Centroid of Flow Area	Yo =	0.11	ft
Specific Force	Fs =	0.01	kip

#4 Device 1 135.90' **18.0" Horiz. 25 yr** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.09 cfs @ 4.12 hrs HW=132.28' (Free Discharge)
└**1=Culvert** (Passes 0.09 cfs of 0.92 cfs potential flow)
  ├**2=2yr** (Orifice Controls 0.09 cfs @ 3.34 fps)
  ├**3=5 & 10 yr** (Controls 0.00 cfs)
  └**4=25 yr** (Controls 0.00 cfs)

Pond 11P: FC MH 1/2 of 2, 10, 25



Summary for Pond 11P: FC MH 1/2 of 2, 10, 25

[44] Hint: Outlet device #2 is below defined storage

Inflow Area = 4.658 ac, 84.43% Impervious, Inflow Depth = 0.07" for WQ event
Inflow = 0.18 cfs @ 4.00 hrs, Volume= 0.028 af
Outflow = 0.09 cfs @ 4.12 hrs, Volume= 0.028 af, Atten= 50%, Lag= 7.2 min
Primary = 0.09 cfs @ 4.12 hrs, Volume= 0.028 af

Routing by Stor-Ind method, Time Span= 0.00-26.00 hrs, dt= 0.01 hrs
Peak Elev= 132.28' @ 4.12 hrs Surf.Area= 2,434 sf Storage= 556 cf

Plug-Flow detention time= 62.1 min calculated for 0.028 af (100% of inflow)
Center-of-Mass det. time= 62.1 min (246.0 - 183.9)

Volume	Invert	Avail.Storage	Storage Description
#1	132.00'	15,308 cf	**East Swale (Prismatic)**Listed below (Recalc)
#2	133.28'	5,240 cf	**West Swale (Prismatic)**Listed below (Recalc)
#3	132.00'	6,912 cf	**48.0" Round HDPE Pipe** L= 550.0'
#4	132.30'	80 cf	**15.0" Round 15" pipe** L= 65.0' S= 0.0100 '/'
#5	133.28'	262 cf	**10.0" Round 10" Pipe** L= 480.0' S= 0.0100 '/'
#6	133.28'	77 cf	**8.0" Round 8" Pipe** L= 220.0' S= 0.0100 '/'
		27,877 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
132.00	1,105	0	0
133.00	1,820	1,463	1,463
134.00	2,591	2,206	3,668
135.00	3,419	3,005	6,673
136.00	4,303	3,861	10,534
137.00	5,244	4,774	15,308

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
133.28	265	0	0
134.00	747	364	364
135.00	1,303	1,025	1,389
136.00	1,807	1,555	2,944
137.00	2,784	2,296	5,240

Device	Routing	Invert	Outlet Devices
#1	Primary	131.80'	**18.0" Round Culvert** L= 50.0' Ke= 0.900 Inlet / Outlet Invert= 131.80' / 131.30' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#2	Device 1	131.80'	**2.2" Horiz. 2yr** C= 0.600 Limited to weir flow at low heads
#3	Device 1	135.48'	**4.0" Vert. 5 & 10 yr** C= 0.600 Limited to weir flow at low heads

Summary for Subcatchment 12S: Total Undeveloped Pre

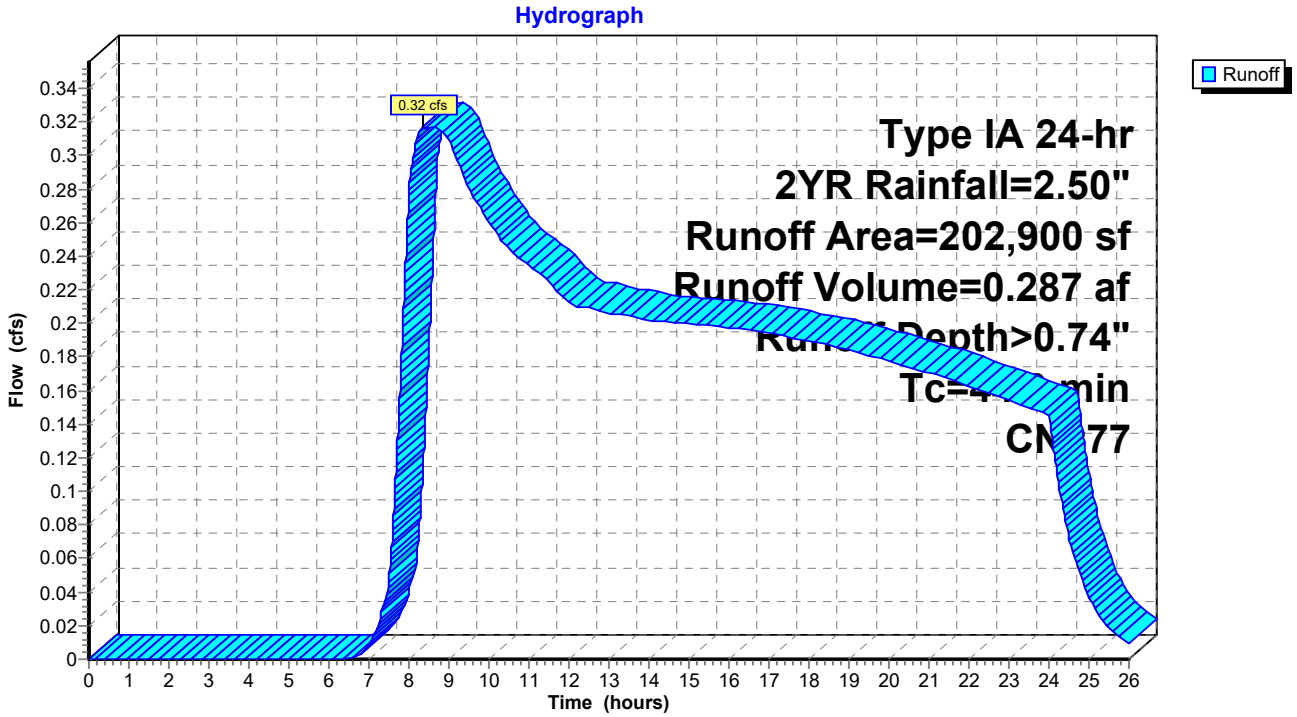
Runoff = 0.32 cfs @ 8.37 hrs, Volume= 0.287 af, Depth> 0.74"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-26.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2YR Rainfall=2.50"

	Area (sf)	CN	Description
*	202,900	77	
	202,900		100.00% Pervious Area

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

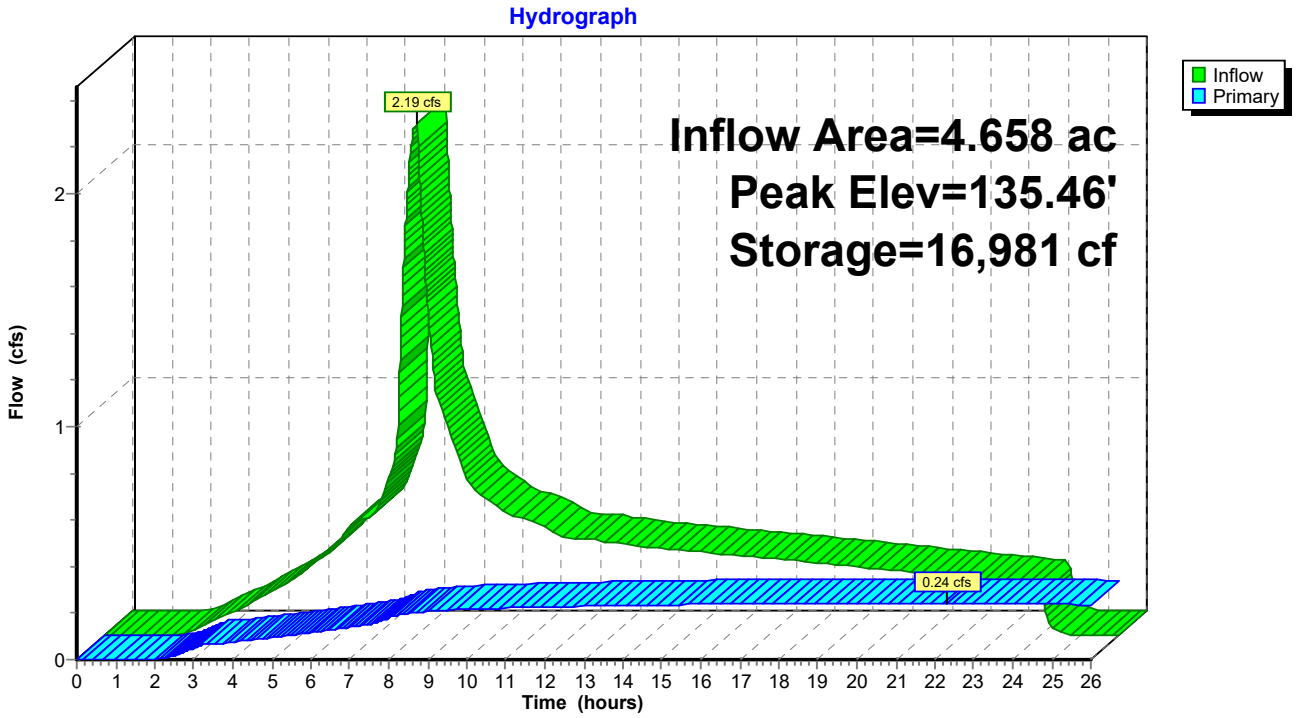
Subcatchment 12S: Total Undeveloped Pre



#4 Device 1 135.90' **18.0" Horiz. 25 yr** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.24 cfs @ 22.33 hrs HW=135.46' (Free Discharge)
└─**1=Culvert** (Passes 0.24 cfs of 11.46 cfs potential flow)
  ├─**2=2yr** (Orifice Controls 0.24 cfs @ 9.21 fps)
  ├─**3=5 & 10 yr** (Controls 0.00 cfs)
  └─**4=25 yr** (Controls 0.00 cfs)

Pond 11P: FC MH 1/2 of 2, 10, 25



Summary for Pond 11P: FC MH 1/2 of 2, 10, 25

[44] Hint: Outlet device #2 is below defined storage

Inflow Area = 4.658 ac, 84.43% Impervious, Inflow Depth = 1.92" for 2YR event
Inflow = 2.19 cfs @ 7.99 hrs, Volume= 0.744 af
Outflow = 0.24 cfs @ 22.33 hrs, Volume= 0.393 af, Atten= 89%, Lag= 860.6 min
Primary = 0.24 cfs @ 22.33 hrs, Volume= 0.393 af

Routing by Stor-Ind method, Time Span= 0.00-26.00 hrs, dt= 0.01 hrs
Peak Elev= 135.46' @ 22.33 hrs Surf.Area= 6,954 sf Storage= 16,981 cf

Plug-Flow detention time= 482.0 min calculated for 0.393 af (53% of inflow)
Center-of-Mass det. time= 228.3 min (953.3 - 725.0)

Volume	Invert	Avail.Storage	Storage Description
#1	132.00'	15,308 cf	**East Swale (Prismatic)**Listed below (Recalc)
#2	133.28'	5,240 cf	**West Swale (Prismatic)**Listed below (Recalc)
#3	132.00'	6,912 cf	**48.0" Round HDPE Pipe** L= 550.0'
#4	132.30'	80 cf	**15.0" Round 15" pipe** L= 65.0' S= 0.0100 '/'
#5	133.28'	262 cf	**10.0" Round 10" Pipe** L= 480.0' S= 0.0100 '/'
#6	133.28'	77 cf	**8.0" Round 8" Pipe** L= 220.0' S= 0.0100 '/'
		27,877 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
132.00	1,105	0	0
133.00	1,820	1,463	1,463
134.00	2,591	2,206	3,668
135.00	3,419	3,005	6,673
136.00	4,303	3,861	10,534
137.00	5,244	4,774	15,308

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
133.28	265	0	0
134.00	747	364	364
135.00	1,303	1,025	1,389
136.00	1,807	1,555	2,944
137.00	2,784	2,296	5,240

Device	Routing	Invert	Outlet Devices
#1	Primary	131.80'	**18.0" Round Culvert** L= 50.0' Ke= 0.900 Inlet / Outlet Invert= 131.80' / 131.30' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#2	Device 1	131.80'	**2.2" Horiz. 2yr** C= 0.600 Limited to weir flow at low heads
#3	Device 1	135.48'	**4.0" Vert. 5 & 10 yr** C= 0.600 Limited to weir flow at low heads

Summary for Subcatchment 12S: Total Undeveloped Pre

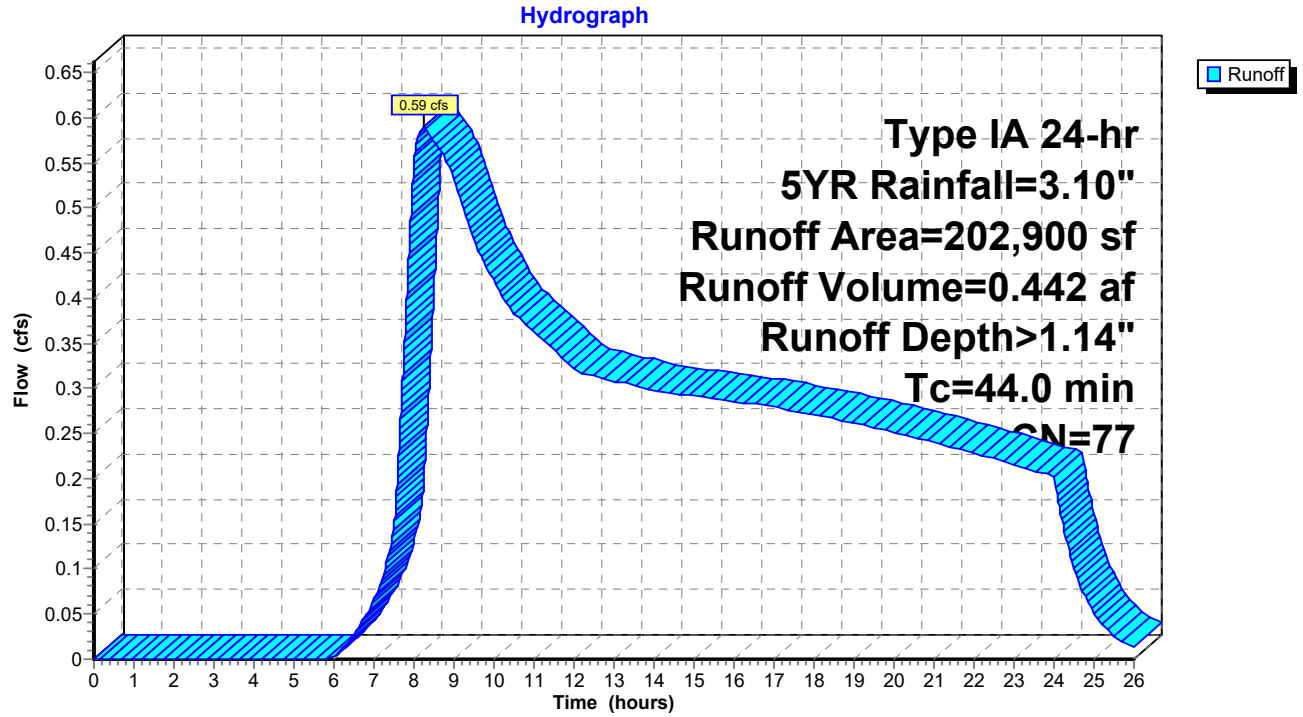
Runoff = 0.59 cfs @ 8.26 hrs, Volume= 0.442 af, Depth> 1.14"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-26.00 hrs, dt= 0.01 hrs
Type IA 24-hr 5YR Rainfall=3.10"

	Area (sf)	CN	Description
*	202,900	77	
	202,900		100.00% Pervious Area

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

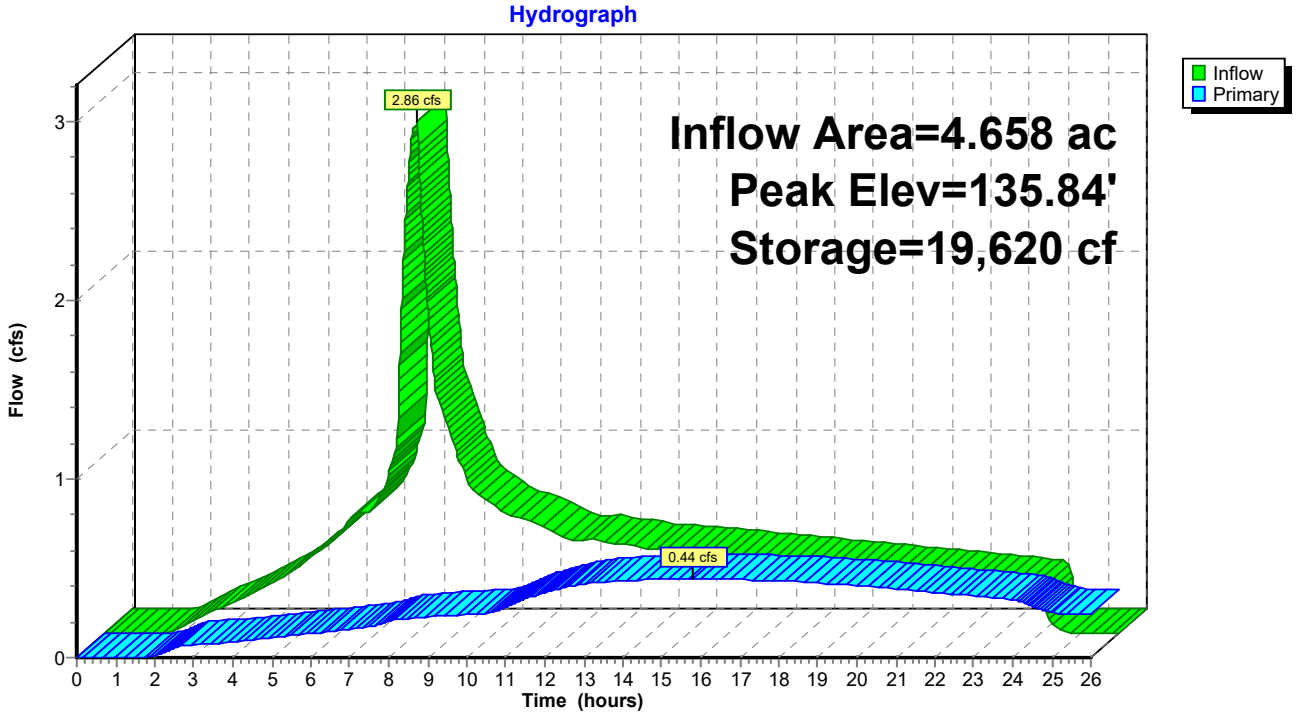
Subcatchment 12S: Total Undeveloped Pre



#4 Device 1 135.90' **18.0" Horiz. 25 yr** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.44 cfs @ 15.79 hrs HW=135.84' (Free Discharge)
└**1=Culvert** (Passes 0.44 cfs of 12.19 cfs potential flow)
  ├**2=2yr** (Orifice Controls 0.26 cfs @ 9.68 fps)
  ├**3=5 & 10 yr** (Orifice Controls 0.19 cfs @ 2.13 fps)
  └**4=25 yr** (Controls 0.00 cfs)

Pond 11P: FC MH 1/2 of 2, 10, 25



Summary for Pond 11P: FC MH 1/2 of 2, 10, 25

[44] Hint: Outlet device #2 is below defined storage

Inflow Area = 4.658 ac, 84.43% Impervious, Inflow Depth = 2.50" for 5YR event
Inflow = 2.86 cfs @ 7.98 hrs, Volume= 0.970 af
Outflow = 0.44 cfs @ 15.79 hrs, Volume= 0.587 af, Atten= 85%, Lag= 468.5 min
Primary = 0.44 cfs @ 15.79 hrs, Volume= 0.587 af

Routing by Stor-Ind method, Time Span= 0.00-26.00 hrs, dt= 0.01 hrs
Peak Elev= 135.84' @ 15.79 hrs Surf.Area= 6,818 sf Storage= 19,620 cf

Plug-Flow detention time= 475.5 min calculated for 0.587 af (61% of inflow)
Center-of-Mass det. time= 251.3 min (964.1 - 712.8)

Volume	Invert	Avail.Storage	Storage Description
#1	132.00'	15,308 cf	**East Swale (Prismatic)**Listed below (Recalc)
#2	133.28'	5,240 cf	**West Swale (Prismatic)**Listed below (Recalc)
#3	132.00'	6,912 cf	**48.0" Round HDPE Pipe** L= 550.0'
#4	132.30'	80 cf	**15.0" Round 15" pipe** L= 65.0' S= 0.0100 '/'
#5	133.28'	262 cf	**10.0" Round 10" Pipe** L= 480.0' S= 0.0100 '/'
#6	133.28'	77 cf	**8.0" Round 8" Pipe** L= 220.0' S= 0.0100 '/'
		27,877 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
132.00	1,105	0	0
133.00	1,820	1,463	1,463
134.00	2,591	2,206	3,668
135.00	3,419	3,005	6,673
136.00	4,303	3,861	10,534
137.00	5,244	4,774	15,308

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
133.28	265	0	0
134.00	747	364	364
135.00	1,303	1,025	1,389
136.00	1,807	1,555	2,944
137.00	2,784	2,296	5,240

Device	Routing	Invert	Outlet Devices
#1	Primary	131.80'	**18.0" Round Culvert** L= 50.0' Ke= 0.900 Inlet / Outlet Invert= 131.80' / 131.30' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#2	Device 1	131.80'	**2.2" Horiz. 2yr** C= 0.600 Limited to weir flow at low heads
#3	Device 1	135.48'	**4.0" Vert. 5 & 10 yr** C= 0.600 Limited to weir flow at low heads

Summary for Subcatchment 12S: Total Undeveloped Pre

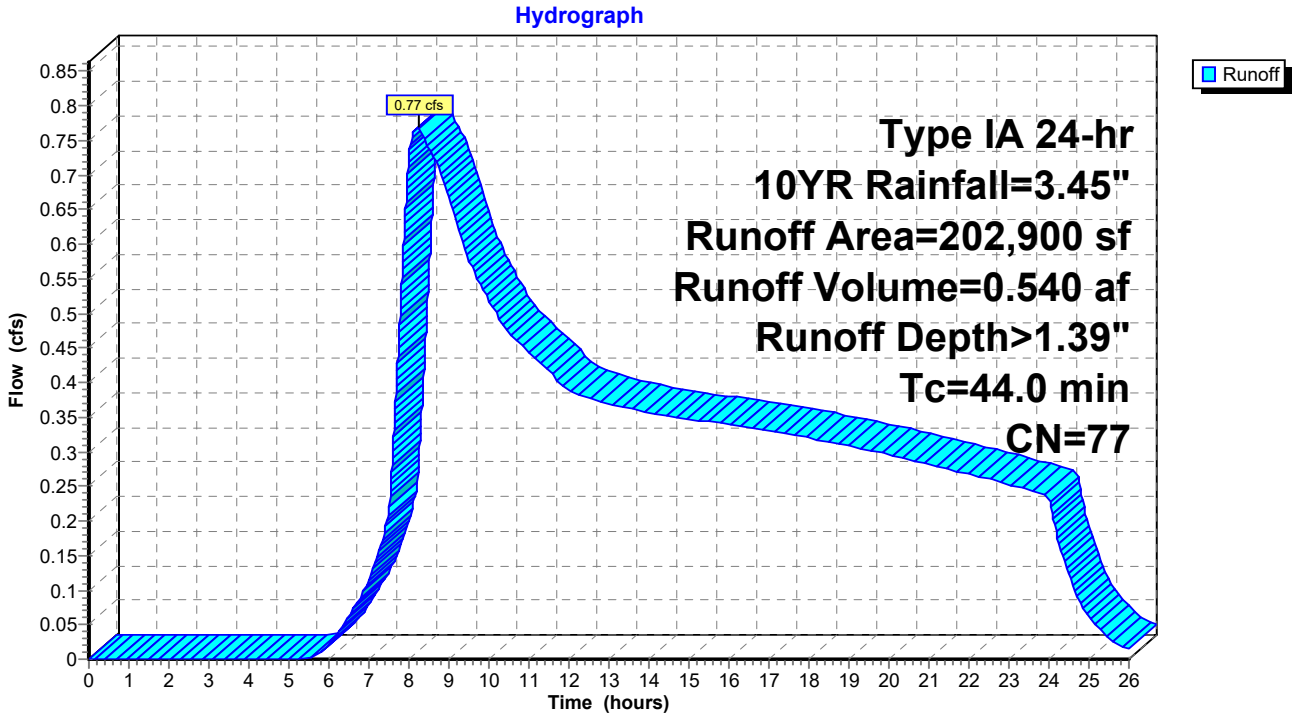
Runoff = 0.77 cfs @ 8.23 hrs, Volume= 0.540 af, Depth> 1.39"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-26.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10YR Rainfall=3.45"

	Area (sf)	CN	Description
*	202,900	77	
	202,900		100.00% Pervious Area

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

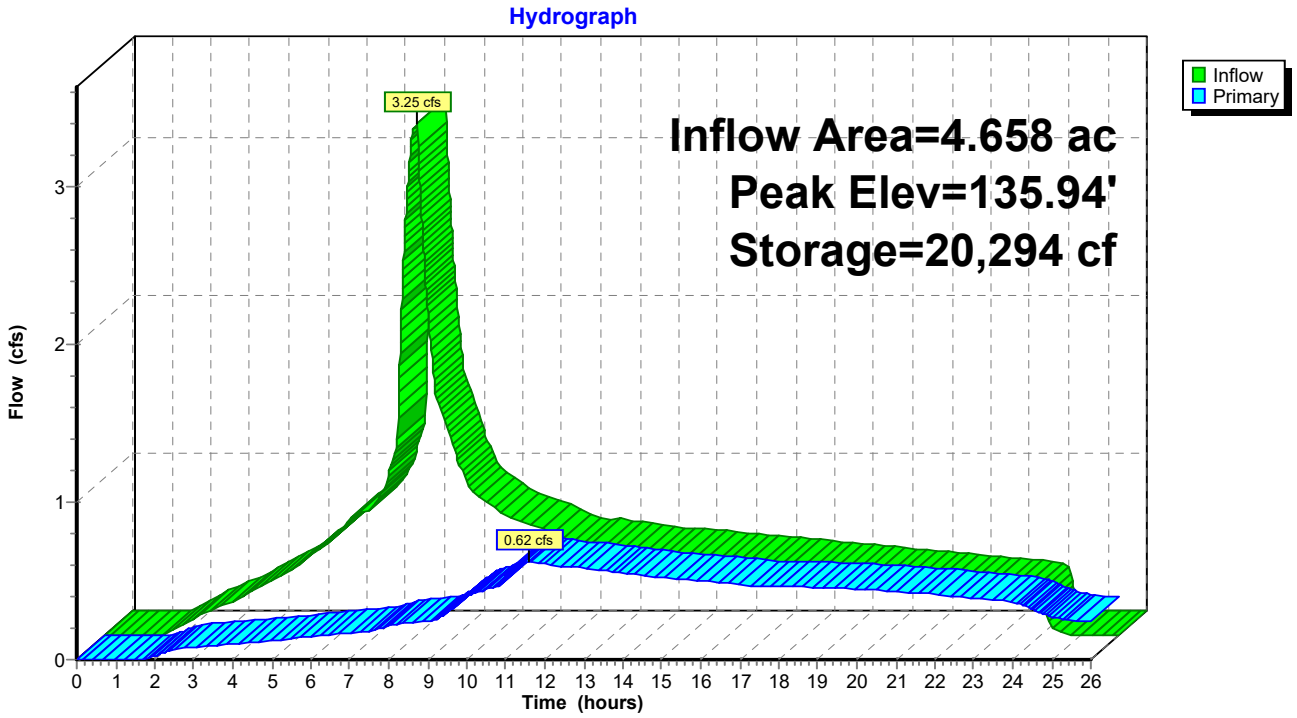
Subcatchment 12S: Total Undeveloped Pre



#4 Device 1 135.90' **18.0" Horiz. 25 yr** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.62 cfs @ 11.61 hrs HW=135.94' (Free Discharge)
└**1=Culvert** (Passes 0.62 cfs of 12.37 cfs potential flow)
  ├**2=2yr** (Orifice Controls 0.26 cfs @ 9.80 fps)
  ├**3=5 & 10 yr** (Orifice Controls 0.23 cfs @ 2.62 fps)
  └**4=25 yr** (Weir Controls 0.13 cfs @ 0.67 fps)

Pond 11P: FC MH 1/2 of 2, 10, 25



Summary for Pond 11P: FC MH 1/2 of 2, 10, 25

[44] Hint: Outlet device #2 is below defined storage

Inflow Area = 4.658 ac, 84.43% Impervious, Inflow Depth = 2.84" for 10YR event
Inflow = 3.25 cfs @ 7.98 hrs, Volume= 1.102 af
Outflow = 0.62 cfs @ 11.61 hrs, Volume= 0.714 af, Atten= 81%, Lag= 218.1 min
Primary = 0.62 cfs @ 11.61 hrs, Volume= 0.714 af

Routing by Stor-Ind method, Time Span= 0.00-26.00 hrs, dt= 0.01 hrs
Peak Elev= 135.94' @ 11.61 hrs Surf.Area= 6,620 sf Storage= 20,294 cf

Plug-Flow detention time= 441.8 min calculated for 0.713 af (65% of inflow)
Center-of-Mass det. time= 235.0 min (942.2 - 707.2)

Volume	Invert	Avail.Storage	Storage Description
#1	132.00'	15,308 cf	**East Swale (Prismatic)**Listed below (Recalc)
#2	133.28'	5,240 cf	**West Swale (Prismatic)**Listed below (Recalc)
#3	132.00'	6,912 cf	**48.0" Round HDPE Pipe** L= 550.0'
#4	132.30'	80 cf	**15.0" Round 15" pipe** L= 65.0' S= 0.0100 '/'
#5	133.28'	262 cf	**10.0" Round 10" Pipe** L= 480.0' S= 0.0100 '/'
#6	133.28'	77 cf	**8.0" Round 8" Pipe** L= 220.0' S= 0.0100 '/'
		27,877 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
132.00	1,105	0	0
133.00	1,820	1,463	1,463
134.00	2,591	2,206	3,668
135.00	3,419	3,005	6,673
136.00	4,303	3,861	10,534
137.00	5,244	4,774	15,308

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
133.28	265	0	0
134.00	747	364	364
135.00	1,303	1,025	1,389
136.00	1,807	1,555	2,944
137.00	2,784	2,296	5,240

Device	Routing	Invert	Outlet Devices
#1	Primary	131.80'	**18.0" Round Culvert** L= 50.0' Ke= 0.900 Inlet / Outlet Invert= 131.80' / 131.30' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#2	Device 1	131.80'	**2.2" Horiz. 2yr** C= 0.600 Limited to weir flow at low heads
#3	Device 1	135.48'	**4.0" Vert. 5 & 10 yr** C= 0.600 Limited to weir flow at low heads

Summary for Subcatchment 12S: Total Undeveloped Pre

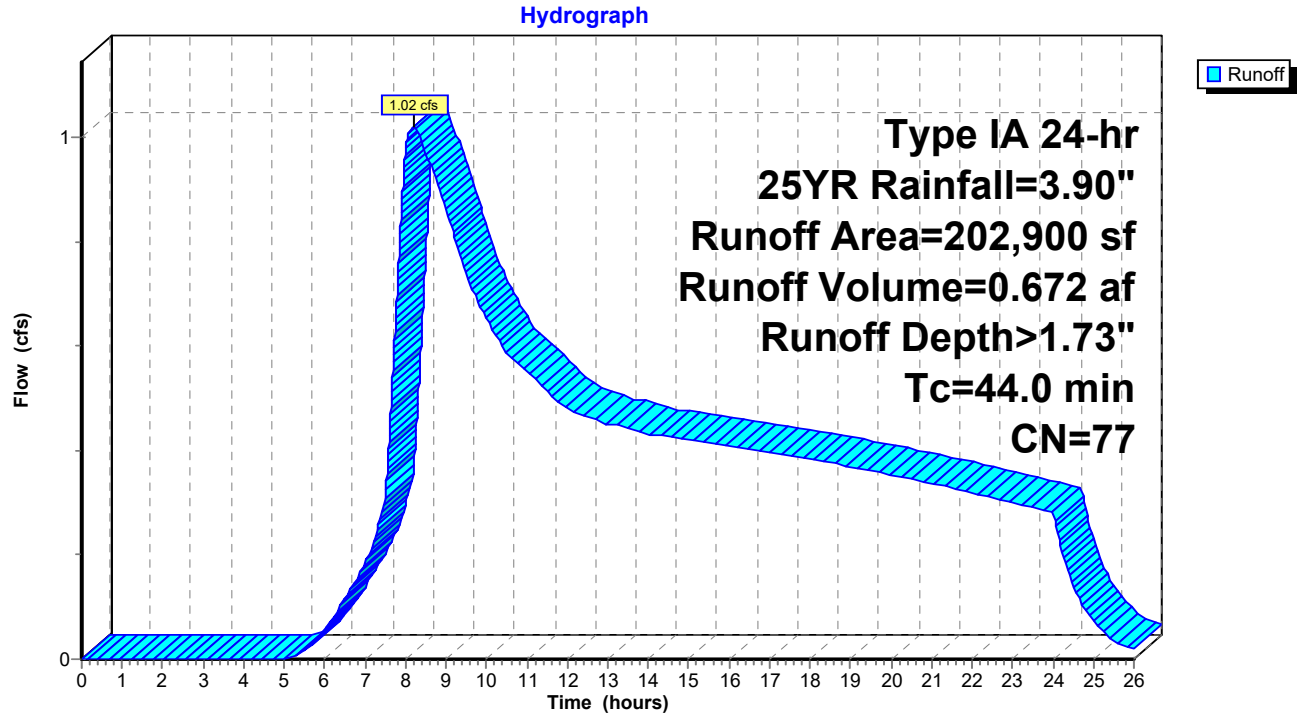
Runoff = 1.02 cfs @ 8.20 hrs, Volume= 0.672 af, Depth> 1.73"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-26.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25YR Rainfall=3.90"

	Area (sf)	CN	Description
*	202,900	77	
	202,900		100.00% Pervious Area

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

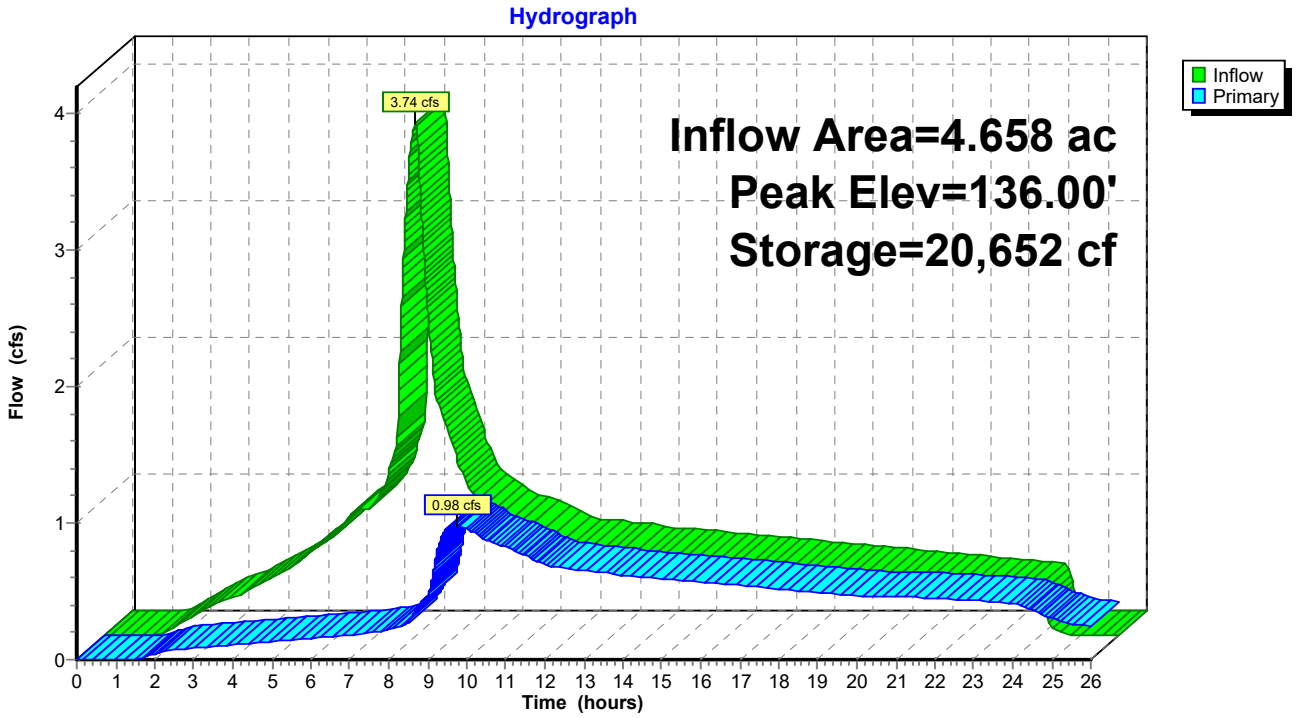
Subcatchment 12S: Total Undeveloped Pre



#4 Device 1 135.90' **18.0" Horiz. 25 yr** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.97 cfs @ 9.73 hrs HW=136.00' (Free Discharge)
└**1=Culvert** (Passes 0.97 cfs of 12.47 cfs potential flow)
  ├**2=2yr** (Orifice Controls 0.26 cfs @ 9.86 fps)
  ├**3=5 & 10 yr** (Orifice Controls 0.25 cfs @ 2.85 fps)
  └**4=25 yr** (Weir Controls 0.46 cfs @ 1.02 fps)

Pond 11P: FC MH 1/2 of 2, 10, 25



Summary for Pond 11P: FC MH 1/2 of 2, 10, 25

[44] Hint: Outlet device #2 is below defined storage

Inflow Area = 4.658 ac, 84.43% Impervious, Inflow Depth = 3.28" for 25YR event
Inflow = 3.74 cfs @ 7.97 hrs, Volume= 1.273 af
Outflow = 0.98 cfs @ 9.73 hrs, Volume= 0.878 af, Atten= 74%, Lag= 105.3 min
Primary = 0.98 cfs @ 9.73 hrs, Volume= 0.878 af

Routing by Stor-Ind method, Time Span= 0.00-26.00 hrs, dt= 0.01 hrs
Peak Elev= 136.00' @ 9.73 hrs Surf.Area= 6,290 sf Storage= 20,652 cf

Plug-Flow detention time= 392.5 min calculated for 0.878 af (69% of inflow)
Center-of-Mass det. time= 204.5 min (905.7 - 701.3)

Volume	Invert	Avail.Storage	Storage Description
#1	132.00'	15,308 cf	**East Swale (Prismatic)**Listed below (Recalc)
#2	133.28'	5,240 cf	**West Swale (Prismatic)**Listed below (Recalc)
#3	132.00'	6,912 cf	**48.0" Round HDPE Pipe** L= 550.0'
#4	132.30'	80 cf	**15.0" Round 15" pipe** L= 65.0' S= 0.0100 '/'
#5	133.28'	262 cf	**10.0" Round 10" Pipe** L= 480.0' S= 0.0100 '/'
#6	133.28'	77 cf	**8.0" Round 8" Pipe** L= 220.0' S= 0.0100 '/'
		27,877 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
132.00	1,105	0	0
133.00	1,820	1,463	1,463
134.00	2,591	2,206	3,668
135.00	3,419	3,005	6,673
136.00	4,303	3,861	10,534
137.00	5,244	4,774	15,308

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
133.28	265	0	0
134.00	747	364	364
135.00	1,303	1,025	1,389
136.00	1,807	1,555	2,944
137.00	2,784	2,296	5,240

Device	Routing	Invert	Outlet Devices
#1	Primary	131.80'	**18.0" Round Culvert** L= 50.0' Ke= 0.900 Inlet / Outlet Invert= 131.80' / 131.30' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#2	Device 1	131.80'	**2.2" Horiz. 2yr** C= 0.600 Limited to weir flow at low heads
#3	Device 1	135.48'	**4.0" Vert. 5 & 10 yr** C= 0.600 Limited to weir flow at low heads

Summary for Subcatchment 12S: Total Undeveloped Pre

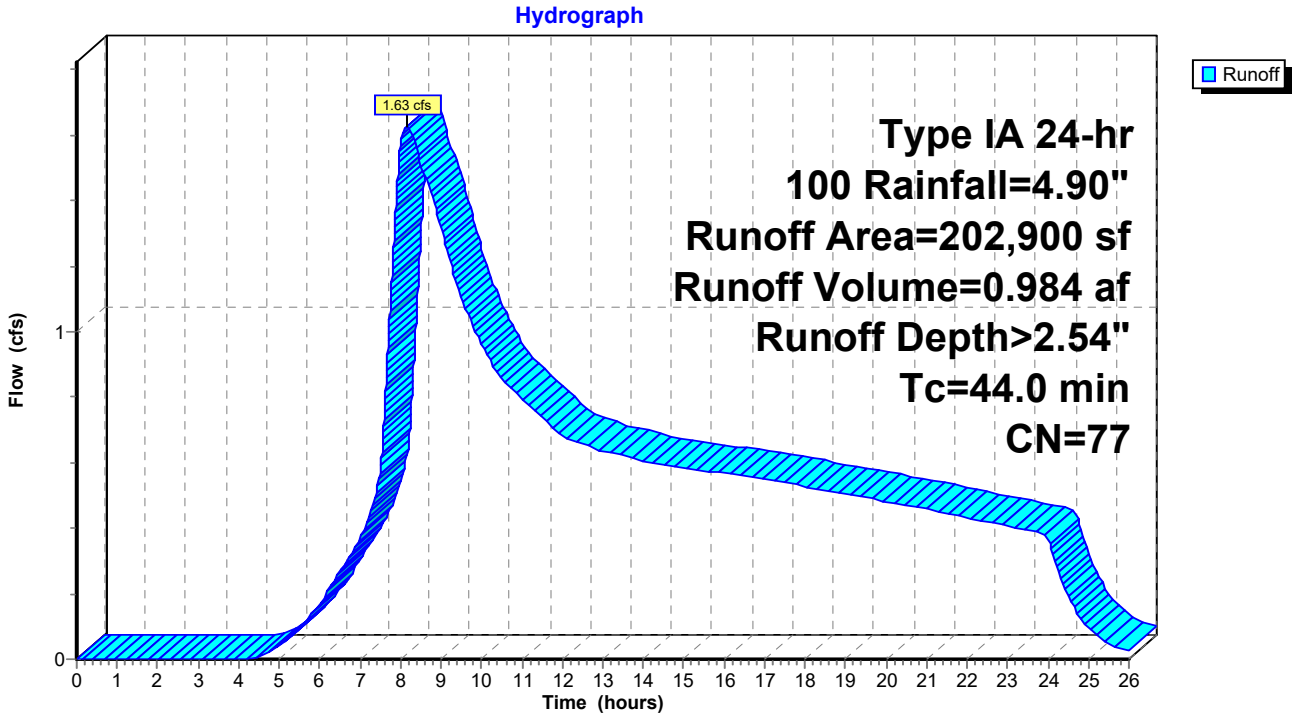
Runoff = 1.63 cfs @ 8.15 hrs, Volume= 0.984 af, Depth> 2.54"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-26.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100 Rainfall=4.90"

	Area (sf)	CN	Description
*	202,900	77	
	202,900		100.00% Pervious Area

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

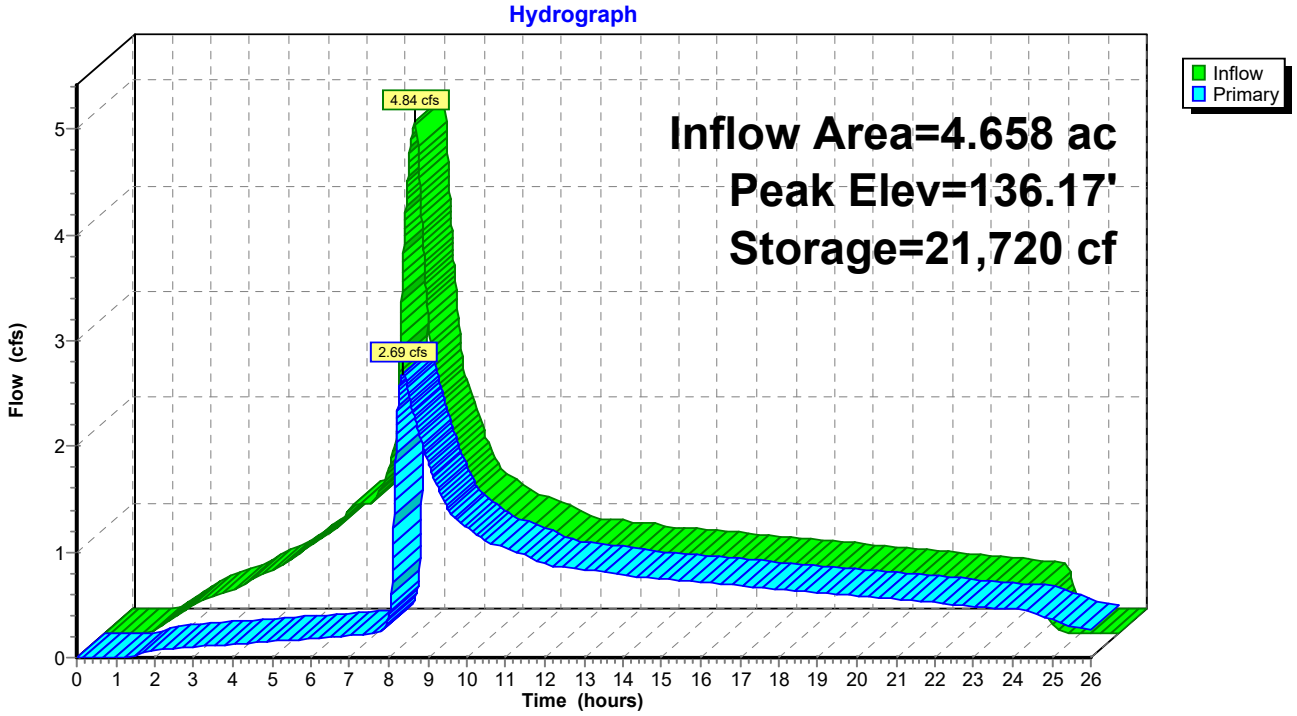
Subcatchment 12S: Total Undeveloped Pre



#4 Device 1 135.90' **18.0" Horiz. 25 yr** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=2.68 cfs @ 8.36 hrs HW=136.17' (Free Discharge)
└**1=Culvert** (Passes 2.68 cfs of 12.77 cfs potential flow)
  ├**2=2yr** (Orifice Controls 0.27 cfs @ 10.06 fps)
  ├**3=5 & 10 yr** (Orifice Controls 0.30 cfs @ 3.47 fps)
  └**4=25 yr** (Weir Controls 2.11 cfs @ 1.69 fps)

Pond 11P: FC MH 1/2 of 2, 10, 25



Summary for Pond 11P: FC MH 1/2 of 2, 10, 25

[44] Hint: Outlet device #2 is below defined storage

Inflow Area = 4.658 ac, 84.43% Impervious, Inflow Depth = 4.27" for 100 event
Inflow = 4.84 cfs @ 7.97 hrs, Volume= 1.656 af
Outflow = 2.69 cfs @ 8.36 hrs, Volume= 1.251 af, Atten= 44%, Lag= 23.6 min
Primary = 2.69 cfs @ 8.36 hrs, Volume= 1.251 af

Routing by Stor-Ind method, Time Span= 0.00-26.00 hrs, dt= 0.01 hrs
Peak Elev= 136.17' @ 8.36 hrs Surf.Area= 6,483 sf Storage= 21,720 cf

Plug-Flow detention time= 311.6 min calculated for 1.251 af (76% of inflow)
Center-of-Mass det. time= 156.0 min (847.2 - 691.2)

Volume	Invert	Avail.Storage	Storage Description
#1	132.00'	15,308 cf	**East Swale (Prismatic)**Listed below (Recalc)
#2	133.28'	5,240 cf	**West Swale (Prismatic)**Listed below (Recalc)
#3	132.00'	6,912 cf	**48.0" Round HDPE Pipe** L= 550.0'
#4	132.30'	80 cf	**15.0" Round 15" pipe** L= 65.0' S= 0.0100 '/'
#5	133.28'	262 cf	**10.0" Round 10" Pipe** L= 480.0' S= 0.0100 '/'
#6	133.28'	77 cf	**8.0" Round 8" Pipe** L= 220.0' S= 0.0100 '/'
		27,877 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
132.00	1,105	0	0
133.00	1,820	1,463	1,463
134.00	2,591	2,206	3,668
135.00	3,419	3,005	6,673
136.00	4,303	3,861	10,534
137.00	5,244	4,774	15,308

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
133.28	265	0	0
134.00	747	364	364
135.00	1,303	1,025	1,389
136.00	1,807	1,555	2,944
137.00	2,784	2,296	5,240

Device	Routing	Invert	Outlet Devices
#1	Primary	131.80'	**18.0" Round Culvert** L= 50.0' Ke= 0.900 Inlet / Outlet Invert= 131.80' / 131.30' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#2	Device 1	131.80'	**2.2" Horiz. 2yr** C= 0.600 Limited to weir flow at low heads
#3	Device 1	135.48'	**4.0" Vert. 5 & 10 yr** C= 0.600 Limited to weir flow at low heads