MCKENZIE ENGINEERING GROUP

Professional Civil Engineering • Professional Land Surveying • Land Planning

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May 16, 2018

Ms. Emily Wentworth, Senior Planner/Zoning Administrator
Hingham Zoning Board of Appeals
Town Hall
210 Central Street
Hingham, MA 02043

Re: Engineering Peer Review
Comprehensive Permit Plan known as "River Stone"
Viking Lane and Ward Street, Hingham MA
Assessors Map 124, Lots 70-75 & Lot 26
Applicant: River Stone, LLC

Dear Ms. Wentworth:

This letter is in response to questions and comments in a review letter dated April 26, 2018 from Patrick G. Brennan, P.E. of Amory Engineers, P.C

Enclosed herewith are the following:

- Four (4) copies of the revised pre and post development HydroCAD analysis for Design Point 3.
- Eight (8) copies of revised sheets C-2 and C-3 prepared by McKenzie Engineering Group, Inc. (MEG) with the latest revision date of May 1, 2018.
- Eight (8) copies of memo prepared by McKenzie Engineering Group, Inc. dated May 1, 2018.

Responses by McKenzie Engineering Group, Inc. (MEG) correspond to the outline of the review letters and are in *italics*. Text in gray represents peer review comments.

Amory Engineers Comments

Incomplete or Missing Information:

1. The revised list of requested waivers, dated February 12, 2018 is not complete and needs to be revised to reflect the current plan. Again, we note that the waivers should explain the exact regulation from which relief is being requested so that the Board fully understands the implications of each requested waiver. We believe that it is extremely important to identify where the project will not comply with Planning Board Rules and Regulations (R&R) Section 4 – Design Standards and Section 5 – Specifications for Construction of Required Improvements. This is required to determine if the design complies with generally accepted public safety requirements and good engineering practice. **The Applicant has submitted a revised list of requested waivers, dated April 17, 2018. We understand that the waiver requests will be discussed in the public hearing. We note that the revised list may not accurately reflect the most recent plans.**

   MEG 5/16/18 response: A revised list of requested waivers will be submitted under separate cover.

2. The Board asked for a photometric plan at the February 6, 2018 public hearing. No lighting plan has been received to date. **The Applicant's engineer has advised that he does not believe a photometric plan is required and if the Board requires one it will be submitted with the final plans. Should the Board approve the project, we suggest submission of a photometric plan be a condition of approval.**

   MEG 5/16/18 response: No response required.

3. Soil information/test pits at all proposed infiltration systems. MEG has stated that "additional location specific soil testing will be performed in conjunction with the development of final construction plans." We have maintained that testing at this point would be a safer course of action for the developer but the required testing could be included as a condition of approval should the Board approve the project. Our suggested condition would be:

   Prior to the submission of final site development plans, a minimum of one test pit shall be excavated at each proposed infiltration system to verify soil textural analysis and depth to seasonal high groundwater. Test pits shall be excavated to a minimum depth of four feet below the proposed bottom of each infiltration system and shall be witnessed by an agent of the Town. Test pit logs shall be submitted to the Zoning Board of Appeals. The following actions shall be required based on test pit results:

   a. *If the test pits confirm assumed soil textural analysis and depth to seasonal high groundwater then no further action is required.*
   b. *If the test pits indicate more-restrictive soil texture, then the design of the infiltration system(s) shall be reevaluated. Results of the reevaluation shall be submitted to the ZBA for review.*
   c. *If the seasonal high groundwater is found to be less than four feet from the bottom of any infiltration system a mounding analysis shall be performed and results submitted to the ZBA for review.*
   d. *If the seasonal high groundwater is found to be less than two feet from the bottom of any infiltration system the system shall be redesigned to provide a minimum of two feet of separation.*
   e. *Any modifications to an infiltration system design shall be submitted to the ZBA for review.* **No comment required.**

   MEG 5/16/18 response: No response required.

4. Documentation to demonstrate that adequate water supply is available for domestic use and fire protection. The revised plan shows only one proposed fire hydrant. Additional hydrants are needed and we suggest the Applicant consult with the Fire Department about the location and number of hydrants. **We understand that a hydrant flow test was scheduled for April 25, 2018. The Applicant's engineer indicated that the results of the flow test will be reviewed by Aquarion and if the results are favorable, a will- serve letter, as well as the test results, will be provided to the Board. In the event that the information is not provided, and should the Board approve the project, we suggest submission of the will-serve letter and hydrant flow test results be a condition of approval.**

   MEG 5/16/18 response: No response required.

5. Full septic system design information to verify compliance with Title 5 (310 CMR 15) and to determine where the project will not comply with the Hingham Board of Health Supplementary Rules and Regulations for the Disposal of Sanitary Sewage. MEG has stated that "full septic system design plans will be submitted in conjunction with thedevelopment of final construction plans." Without the full design we cannot determine where the project will not comply with state and local regulations. **The Applicant's engineer has stated that this will be completed with preparation of final plans. Should the Board approve the project, we suggest submission of final septic design plans be a condition of approval.**

   MEG 5/16/18 response: No response required.

6. Information to document that the proposed septic system components (tanks and the soil absorption system) shown under proposed roadways are designed for loading as required by the Fire Department apparatus. **The revised plans show that no tanks will be located under the proposed roadway, only leaching system piping. Load calculations were included as an attachment to the April 25, 2018 response letter. We don't believe that the calculation of the load in pounds per square inch**

(9.97 psi) is accurate. We also note that Lt. DiNapoli forwarded information on the Town's new platform ladder truck which is heavier than the vehicle the calculations have been based on. We have calculated the loads and maximum deflection of the PVC pipe in the leaching field. Based on our calculations (see attached), Schedule 40 PVC will not support the load. The piping in the leaching system should be specified to be Schedule 80 PVC which will adequately support the load. Should the Board approve the project, we suggest requiring Schedule 80 pipe in the septic leaching system as a condition of approval.

MEG 5/16/18 response: No response required.

7. Updated pipe sizing calculations should be provided to reflect the revised drainage design. **Addressed – revised pipe sizing calculations have been provided.**

MEG 5/16/18 response: No response required.

Technical Comments

General/Roadway Comments

1. The proposed retaining wall between Units 23-25 on the subject site and 64 Ward Street will be up to nineteen feet high (previously fifteen feet). **The design has been revised to reflect a fifteen foot high wall.**
   a. We question whether this wall can be constructed without disturbing the 64 Ward Street property. **It is stated in the response letter that the Applicant's engineer has "been in contact with a representative from the wall supplier, Redi-Rock, and they have represented that the wall can be built as shown on the plan without disturbing the 64 Ward Street property." The Applicant should provide the methods of construction that will be employed to insure that there will be no disturbance to the 64 Ward Street property during construction of the wall. Should the Board approve the project, we suggest submission of this information be a condition of approval.**

      MEG 5/16/18 response: No response required.

   b. A portion of Unit 23 is only two feet off the wall and there is a roof drain pipe shown between the unit and the wall. Access to the roof drain pipe for maintenance would be limited. Also, proximity of the wall would block natural light and essentially render Unit 23 undesirable. **This unit has been moved such that the closest point is now proposed to be seven feet off the wall and there is no roof drain pipe located between the unit and the wall. We understand that the Fire Department has requested a minimum clearance of ten feet around structures.**

      MEG 5/16/18 response: No response required.

   c. The proposed decks/patios of Units 24 and 25 abut the wall. This will cause similar issues regarding natural light and visual impacts. **The proposed decks/patios are now shown about a foot off the wall. Maintenance of the decks/patios would be difficult.**

      MEG 5/16/18 response: No response required.

   d. A fence is proposed along the top of the wall but we have safety concerns with a wall of this height. **No response from the Applicant, safety concerns remain.**

      MEG 5/16/18 response: No walking surface is proposed on the upper side of the retaining wall and a 6-foot high fence is proposed along the top of the wall; therefore a wall of this height should not be a safety concern.

2. There also appears to be a six foot high retaining wall behind units 13-17, at the sediment forebay, yet this is not labeled on the plan. **Addressed – the retaining wall is labeled on Sheet C-1.**

MEG 5/16/18 response: No response required.

3. We concur with Mr. Dirk's comment that the roadway widths should be a minimum of 24-feet. **An attachment to the April 25, 2018 response letter is an April 24, 2018 letter from the Applicant's traffic engineer expressing his opinion that the 20-foot wide roadway is sufficient for a development of this size. We defer to Mr. Dirk.**

MEG 5/16/18 response: No response required.

4. In Mr. Dirk's April 3, 2018 letter to Ms. Wentworth, he notes that Road C has a grade of approximately 8 percent approaching Ward Street and recommends "a leveling area with a grade of 2 percent or less should be provided for a minimum distance of 50- feet approaching Ward Street." We agree that a leveling area should be provided and note that the R&R require a grade of not greater than three percent for a distance of 100 feet. **Addressed – Road C has been redesigned to provide a leveling area with a grade less than 2 percent for a minimum of 50-feet.**

   MEG 5/16/18 response: No response required.

5. Roadway slopes are not shown on the Road C profile and between Sta. 2+00 and 3+00 on the Viking Lane profile (Sheet C-3). **Addressed – roadway slopes are now shown.**

   MEG 5/16/18 response: No response required.

6. The proposed trench drain at about Sta. 2+81 on Road C should be shown on the profile on Sheet C-3. **Addressed – the trench drain is now shown.**

   MEG 5/16/18 response: No response required.

7. As noted in Mr. Dirk's April 3, 2018 letter, the sidewalk in front of Units 28 and 29 would be blocked if a vehicle were parked in either driveway. **Addressed – Units 28 and 29 have been moved to provide 21 feet from the back edge of sidewalk to the garages.**

   MEG 5/16/18 response: No response required.

<u>Drainage and Utilities</u>

1. The infiltration rates used for depression D-4 should be modeled in inches per hour (in/hr) to be consistent with the modeling of the other three depressions. **Addressed – infiltration rates have been revised accordingly.**

   MEG 5/16/18 response: No response required.

2. The post development HydroCAD results show that volume of stormwater runoff will be increased to the wetland area at the east side of the development. The calculations show that the rate of runoff will be decreased and the level of flooding in the wetland will not be increased. In our February 6, 2018 letter to the Board we questioned how the outlet from the wetland was modeled and asked for MEG to verify the outlet configuration and that the increase in runoff volume will not impact adjacent properties. In the March 9, 2018 response letter, MEG states that "additional information will be forwarded under separate cover." The revised calculations model the outlet from the wetland differently but no information has been provided to verify the outlet modeling (i.e. topography around the entire wetland to clearly show the outlet(s). We **reserve further comment until revised calculations have been provided. Please see the attached email we sent to the Applicant's engineer this morning.**

   MEG 5/16/18 response: Please refer to attached memo from MEG to Patrick G. Brennan, P.E., dated 5/1/18, resulting in minor revisions to Sheets C-2 and C-3 and revisions to the pre and post HydroCAD analysis for Design Point 3.

<u>Board of Health Letter dated March 6, 2018:</u>

1. The Board of Health (BOH) has indicated that the subject project is located within a nitrogen sensitive area (NSA) because there are nearby private drinking water wells. The Applicant has not responded to the BOH's letter. We believe that the BOH's letter raises valid health concerns and a response from the applicant is required. An attachment to the April 25, 2018 response letter is an April 24, 2018 letter from Mr. Peter Dillon, PG of Geoscience. Mr. Dillon states that nitrogen loading limits do not apply under 310 CMR 15, 'l'he State Environmental Code, Title S. While we agree with Mr. Dillon's interpretation of Title 5, we believe that the private wells down gradient from the proposed soil absorption system may be adversely impacted by the proposed system and protection of these wells from contamination should be afforded. Compliance with the Town of Hingham Board of Realth Supplementary Rules and Regulations for the Disposal of Sanitary Sewage (BOH Regulations) would afford such protection of public health. The Applicant has requested waivers from the BOH Regulations which would not afford that protection. Should the Board grant those waivers, we believe that an advanced treatment, denitrifying system

public health. The Applicant has requested waivers from the BOH Regulations which would not afford that protection. Should the Board grant those waivers, we believe that an advanced treatment, denitrifying system should be considered to provide protection of the wells and public health.

MEG 5/16/18 response: It is our understanding that an advance treatment, denitrifying system is not required under State Title 5 Regulations for systems proposed in areas not designated as nitrogen sensitive. We defer to Mr. Peter Dillion's letter dated April 24, 2018 regarding this subject.

We believe that the revisions to the plans and the additional information as noted above adequately address the comments from Amory Engineers, P.C.

Please contact me at your convenience if you have any questions or require additional information.

MCKENZIE ENGINEERING GROUP, INC.

Susan B. Spratt, P.E.
Project Manager

Bradley C. McKenzie, P.E.
President

Enclosures

cc: River Stone, LLC

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Professional Civil Engineering and Land Surveying • Land Planning • Project Management

Date: May 1, 2018

To: Patrick G. Brennan, P.E., Amory Engineers

From: Susan B. Spratt, P.E., McKenzie Engineering Group

Regarding: River Stone MEG Project No.: 27-135

Below are responses to your e-mail dated April 26, 2018 regarding your comments relative to the project design.

1. The outlet from the existing basin is missing the five foot weir at El. 58.71. The attached photo shows the outlet structure with the 5 foot weir inside the trash rack. It is clear that the weir elevation is slightly above the outlet culvert invert of 58.12, but not as high as your lowest modeled weir which is 59.38 (above the pipe). Please modify your existing conditions model to reflect the outlet with the 5 foot weir.

   The pre-development HydroCAD analysis for Design Point 3 has been modified to reflect the 5-foot wide x 1-foot high rectangular weir and is attached. Pre-development conditions for Design Point 3 did not change with the addition of the rectangular weir.

2. Post Development subcat 3A-17R is labeled as Roofs 19-21 FB, it is actually Roofs 16-18 FB and 22-23 FB. The area of roofs is correct, just the label is wrong. This isn't a big deal because it doesn't change the calculations but I wanted to put it out there.

   The label for post-development subcat 3A-17R has been revised and the HydroCAD analysis for Design Point 3 is attached.

3. CB's 8 and 11 appear to be drawn with double grates but aren't labeled as double grates. These are the only two with more than 2 cfs of flow so they should have and be labeled with double grates.

   The labels for CBs 8 & 11 have been revised to double grates and revised Plans C-2 and C-3 are attached.

4. You need additional treatment for the roadway runoff that discharges to infiltration system P-9. I suggest a treatment unit in place of DMH D-1.

   Labels for all treatment units have been added to the plans and revised Plans C-2 and C-3 are attached.

5. One septic question: Is the bump-out' on Unit 1 an elevated feature or part of the foundation? If part of the foundation, the nearby septic tank is not ten feet away from it.

   The plans have been revised and the septic tank is located 10 feet away from the foundation for Unit 1.

Please contact me if you have any questions.

LEGEND

SURVEY SYMBOLS

- REBAR
- ANGLE IRON
- CB/DH — CONCRETE BOUND WITH DRILL HOLE
- SB — STONE BOUND
- SB/DH — STONE BOUND

UTILITY SYMBOLS

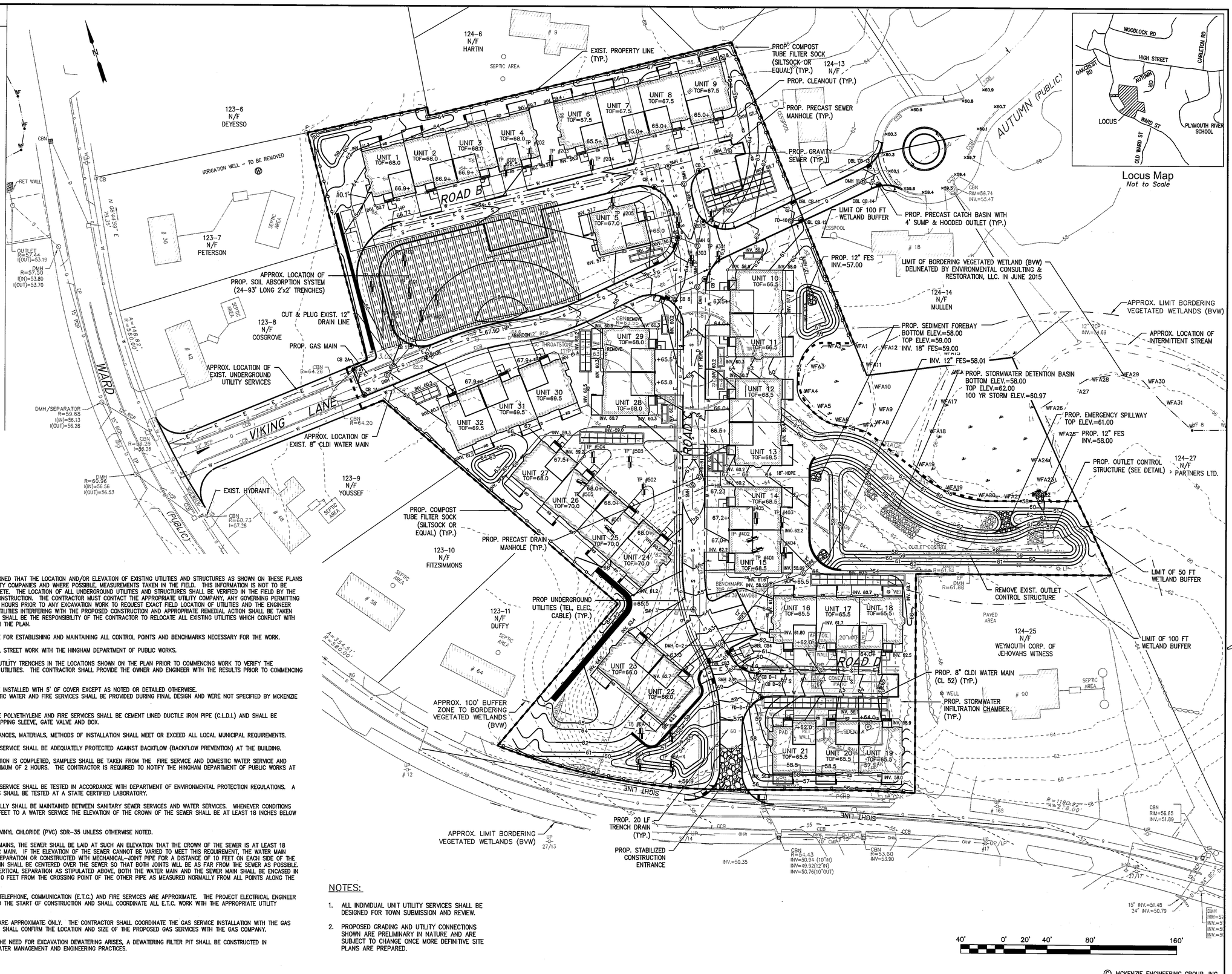
- ELECTRIC HAND HOLE
- GUY POLE
- GW — GUY WIRE
- HVAC UNIT
- BUILDING LIGHT
- TRANSFORMER
- WATER GATE
- EXH — EXHAUST VENT
- AIR VENT
- DRAINAGE SUMP
- EMH — ELECTRIC MANHOLE
- SMH — SEWER MANHOLE
- DMH — DRAIN MANHOLE
- TMH — TELEPHONE MANHOLE
- CBN — DRAINAGE CATCH BASIN
- DOOR WAY THRESHOLD
- HYDRANT
- POST INDICATER VALVE
- UTILITY POLE
- YARD LIGHT
- RIP RAP
- B — BOLLARD
- SIGN
- FA — FIRE ALARM

LINE DESIGNATORS

- W — WATER MAIN
- GUARD RAIL
- OHW — OVERHEAD WIRES
- G — GAS LINE
- WS — WATER SERVICE
- E — UNDERGROUND ELECTRIC
- D — STORM DRAIN LINE
- S — SANITARY SEWER LINE
- DRAINAGE SWALE
- X — CHAIN LINK FENCE

ABBREVIATIONS

FFE	FIRST FLOOR ELEVATION
BIT CONC.	BITUMINOUS CONCRETE PAVEMENT
CCB	CAPE COD BERM
EP	EDGE OF PAVEMENT
BC	BITUMINOUS CONCRETE CURB
(AM)	AS MEASURED
RET WALL	RETAINING WALL
CONC.	CONCRETE
RCP	REINFORCED CONCRETE PIPE
VGC	VERTICAL GRANITE CURB
ETW	EDGE OF TRAVEL WAY
MTL	METAL BERM
VCC	VERTICAL CONCRETE CURB
CMP	CORRUGATED METAL PIPE



Locus Map
Not to Scale

GENERAL UTILITY NOTES:

1. THE CONTRACTOR IS SPECIFICALLY CAUTIONED THAT THE LOCATION AND/OR ELEVATION OF EXISTING UTILITIES AND STRUCTURES AS SHOWN ON THESE PLANS IS BASED ON RECORDS OF VARIOUS UTILITY COMPANIES AND WHERE POSSIBLE, MEASUREMENTS TAKEN IN THE FIELD. THIS INFORMATION IS NOT TO BE RELIED UPON AS BEING EXACT OR COMPLETE. THE LOCATION OF ALL UNDERGROUND UTILITIES AND STRUCTURES SHALL BE VERIFIED IN THE FIELD BY THE CONTRACTOR PRIOR TO THE START OF CONSTRUCTION. THE CONTRACTOR MUST CONTACT THE APPROPRIATE UTILITY COMPANY, ANY GOVERNING PERMITTING AUTHORITY, AND "DIGSAFE" AT LEAST 72 HOURS PRIOR TO ANY EXCAVATION WORK TO REQUEST EXACT FIELD LOCATION OF UTILITIES AND THE ENGINEER SHALL BE NOTIFIED IN WRITING OF ANY UTILITIES INTERFERING WITH THE PROPOSED CONSTRUCTION AND APPROPRIATE REMEDIAL ACTION SHALL BE TAKEN BEFORE PROCEEDING WITH THE WORK. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO RELOCATE ALL EXISTING UTILITIES WHICH CONFLICT WITH THE PROPOSED IMPROVEMENTS SHOWN ON THE PLAN.
2. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ESTABLISHING AND MAINTAINING ALL CONTROL POINTS AND BENCHMARKS NECESSARY FOR THE WORK.
3. THE CONTRACTOR SHALL COORDINATE ALL STREET WORK WITH THE HINGHAM DEPARTMENT OF PUBLIC WORKS.
4. THE CONTRACTOR SHALL EXCAVATE THE UTILITY TRENCHES IN THE LOCATIONS SHOWN ON THE PLAN PRIOR TO COMMENCING WORK TO VERIFY THE ELEVATIONS AND LOCATIONS OF EXISTING UTILITIES. THE CONTRACTOR SHALL PROVIDE THE OWNER AND ENGINEER WITH THE RESULTS PRIOR TO COMMENCING ANY WORK.
5. ALL WATER AND FIRE SERVICES SHALL BE INSTALLED WITH 5' OF COVER EXCEPT AS NOTED OR DETAILED OTHERWISE.
6. THE LOCATION AND SIZES OF THE DOMESTIC WATER AND FIRE SERVICES SHALL BE PROVIDED DURING FINAL DESIGN AND WERE NOT SPECIFIED BY MCKENZIE ENGINEERING GROUP, INC.
7. THE DOMESTIC WATER SERVICES SHALL BE POLYETHYLENE AND FIRE SERVICES SHALL BE CEMENT LINED DUCTILE IRON PIPE (C.L.D.I.) AND SHALL BE INSTALLED WITH APPROPRIATELY SIZED TAPPING SLEEVE, GATE VALVE AND BOX.
8. ALL WATER AND FIRE SERVICE APPURTENANCES, MATERIALS, METHODS OF INSTALLATION SHALL MEET OR EXCEED ALL LOCAL MUNICIPAL REQUIREMENTS.
9. THE FIRE SERVICE AND DOMESTIC WATER SERVICE SHALL BE ADEQUATELY PROTECTED AGAINST BACKFLOW (BACKFLOW PREVENTION) AT THE BUILDING.
10. AFTER PRESSURE TESTING AND CHLORINATION IS COMPLETED, SAMPLES SHALL BE TAKEN FROM THE FIRE SERVICE AND DOMESTIC WATER SERVICE AND SHALL BE TESTED AT 200 PSI FOR A MINIMUM OF 2 HOURS. THE CONTRACTOR IS REQUIRED TO NOTIFY THE HINGHAM DEPARTMENT OF PUBLIC WORKS AT LEAST 24 HOURS PRIOR TO THE TESTING.
11. THE FIRE SERVICE AND DOMESTIC WATER SERVICE SHALL BE TESTED IN ACCORDANCE WITH DEPARTMENT OF ENVIRONMENTAL PROTECTION REGULATIONS. A MINIMUM OF 2 SEPARATE WATER SAMPLES SHALL BE TESTED AT A STATE CERTIFIED LABORATORY.
12. A MINIMUM OF 10 FEET CLEAR HORIZONTALLY SHALL BE MAINTAINED BETWEEN SANITARY SEWER SERVICES AND WATER SERVICES. WHENEVER CONDITIONS PREVENT A LATERAL SEPARATION OF 10 FEET TO A WATER SERVICE THE ELEVATION OF THE CROWN OF THE SEWER SHALL BE AT LEAST 18 INCHES BELOW THE INVERT OF THE WATER SERVICE.
13. ALL GRAVITY SEWER PIPE SHALL BE POLYVINYL CHLORIDE (PVC) SDR-35 UNLESS OTHERWISE NOTED.
14. WHERE SANITARY SEWERS CROSS WATER MAINS, THE SEWER SHALL BE LAID AT SUCH AN ELEVATION THAT THE CROWN OF THE SEWER IS AT LEAST 18 INCHES BELOW THE INVERT OF THE WATER MAIN. IF THE ELEVATION OF THE SEWER CANNOT BE VARIED TO MEET THIS REQUIREMENT, THE WATER MAIN SHALL BE RELOCATED TO PROVIDE THIS SEPARATION OR CONSTRUCTED WITH MECHANICAL-JOINT PIPE FOR A DISTANCE OF 10 FEET ON EACH SIDE OF THE SEWER. ONE FULL LENGTH OF WATER MAIN SHALL BE CENTERED OVER THE SEWER SO THAT BOTH JOINTS WILL BE AS FAR FROM THE SEWER AS POSSIBLE. WHENEVER IT IS IMPOSSIBLE TO OBTAIN VERTICAL SEPARATION AS STIPULATED ABOVE, BOTH THE WATER MAIN AND THE SEWER MAIN SHALL BE ENCASED IN CONCRETE FOR A MINIMUM DISTANCE OF 10 FEET FROM THE CROSSING POINT OF THE OTHER PIPE AS MEASURED NORMALLY FROM ALL POINTS ALONG THE PIPE.
15. THE LOCATIONS OF PROPOSED ELECTRIC, TELEPHONE, COMMUNICATION (E.T.C.) AND FIRE SERVICES ARE APPROXIMATE. THE PROJECT ELECTRICAL ENGINEER SHALL VERIFY THESE LOCATIONS PRIOR TO THE START OF CONSTRUCTION AND SHALL COORDINATE ALL E.T.C. WORK WITH THE APPROPRIATE UTILITY COMPANIES.
16. THE PROPOSED GAS SERVICE LOCATIONS ARE APPROXIMATE ONLY. THE CONTRACTOR SHALL COORDINATE THE GAS SERVICE INSTALLATION WITH THE GAS COMPANY. THE CLIENT AND CONTRACTOR SHALL CONFIRM THE LOCATION AND SIZE OF THE PROPOSED GAS SERVICES WITH THE GAS COMPANY.
17. IF DURING THE CONSTRUCTION PROCESS THE NEED FOR EXCAVATION DEWATERING ARISES, A DEWATERING FILTER PIT SHALL BE CONSTRUCTED IN ACCORDANCE WITH APPROPRIATE STORMWATER MANAGEMENT AND ENGINEERING PRACTICES.

NOTES:

1. ALL INDIVIDUAL UNIT UTILITY SERVICES SHALL BE DESIGNED FOR TOWN SUBMISSION AND REVIEW.
2. PROPOSED GRADING AND UTILITY CONNECTIONS SHOWN ARE PRELIMINARY IN NATURE AND ARE SUBJECT TO CHANGE ONCE MORE DEFINITIVE SITE PLANS ARE PREPARED.

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REV	DATE	DESCRIPTION	BY	APP
1	1/8/18	RECONFIGURATION	SBS	BCM
2	1/19/18	REVIEW COMMENTS	SBS	BCM
3	2/2/18	REVIEW COMMENTS	SBS	BCM
4	3/9/18	REVIEW COMMENTS	SBS	BCM
5	4/25/18	REVIEW COMMENTS	SBS	BCM
6	5/1/18	REVIEW COMMENTS	SBS	BCM

MCKENZIE ENGINEERING GROUP
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Norwell, MA 02061
Ph: 781-792-3900
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COMPREHENSIVE PERMIT PLAN

KNOWN AS

RIVER STONE

(ASSESSORS MAP 124, LOTS 70-75 & LOT 26)
VIKING LANE & WARD STREET
HINGHAM, MASSACHUSETTS

PROFESSIONAL ENGINEER:
COMMONWEALTH OF MASSACHUSETTS
BRADLEY C. MCKENZIE
CIVIL
No. 38917
REGISTERED PROFESSIONAL ENGINEER

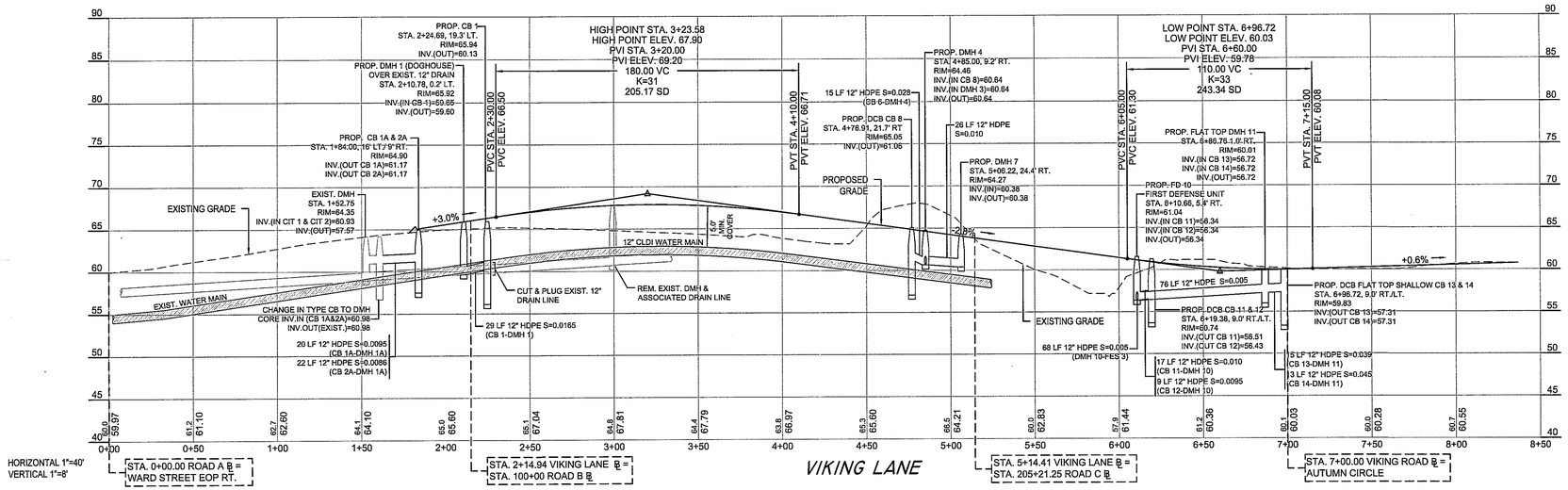
ZBA PERMIT PLAN

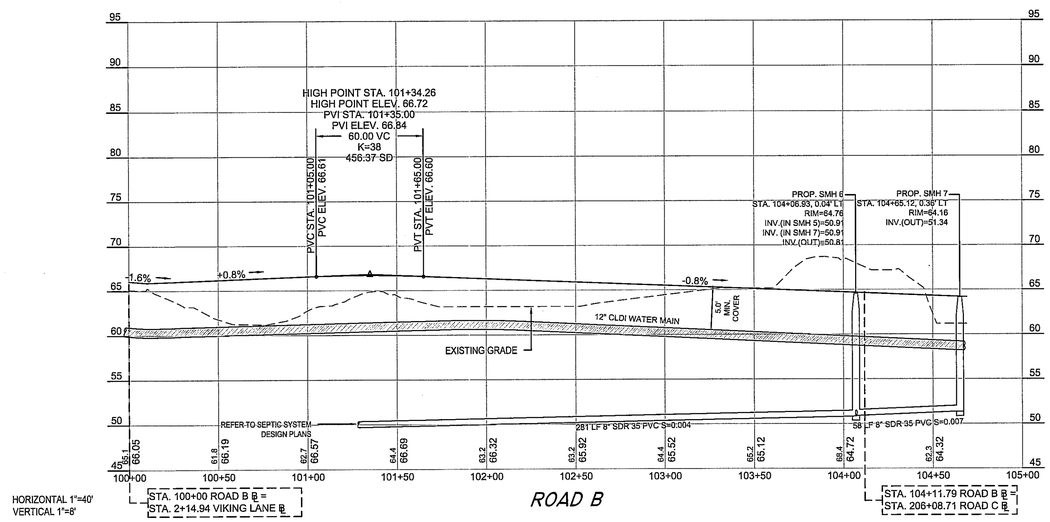
APPLICANT:
RIVER STONE, LLC
293R WASHINGTON STREET
NORWELL, MASSACHUSETTS 02061

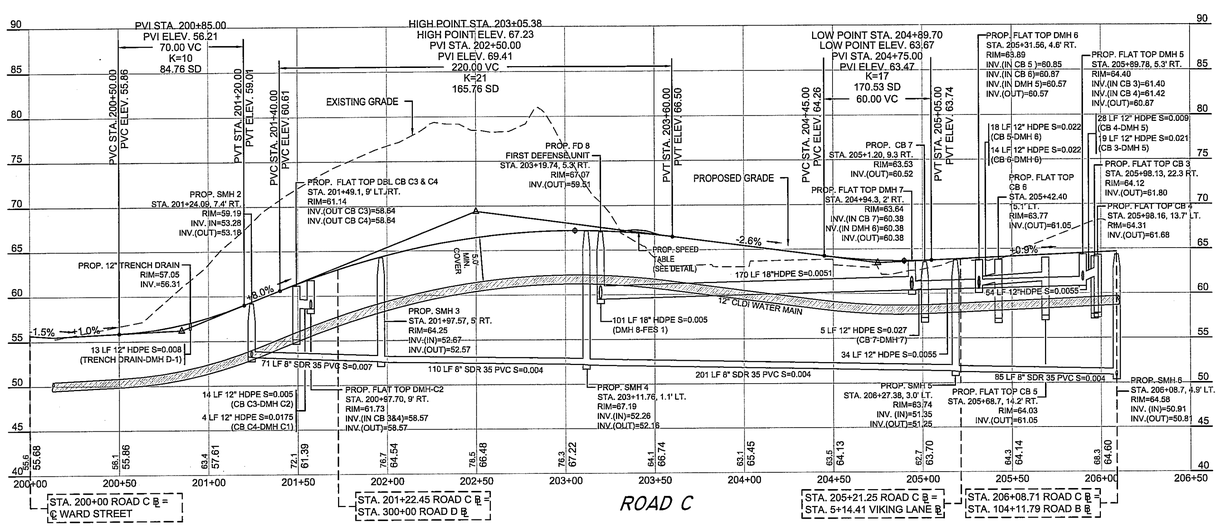
DRAWN BY:	JLS
DESIGNED BY:	- - -
CHECKED BY:	- - -
APPROVED BY:	- - -
DATE:	10/7/2015
SCALE:	1"=40'
PROJECT NO.:	27-135

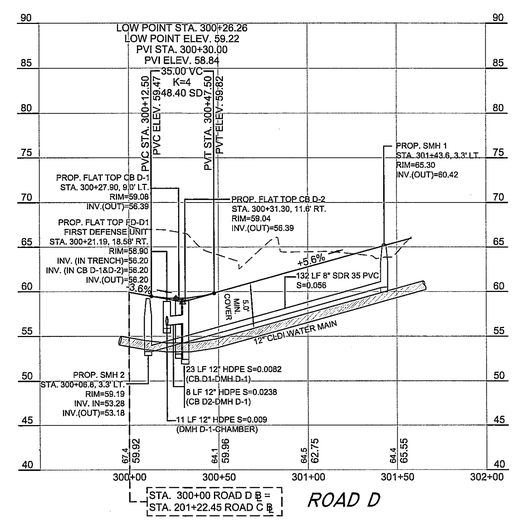
DWG. TITLE:
Grading & Utility Plan

DWG. NO:
C-2









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2	1/19/18	NO CHANGES	SBS	BCM
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3	3/9/18	REVIEW COMMENTS	SBS	BCM
4	4/25/18	REVIEW COMMENTS	SBS	BCM
5	5/1/18	REVIEW COMMENTS	SBS	BCM

MCKENZIE ENGINEERING GROUP
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Ph: 781-792-3900
www.mckeng.com

COMPREHENSIVE PERMIT PLAN

KNOWN AS

RIVER STONE

(ASSESSORS MAP 124, LOTS 70-75 & LOT 26)
VIKING LANE & WARD STREET
HINGHAM, MASSACHUSETTS

PROFESSIONAL ENGINEER:

COMMONWEALTH OF MASSACHUSETTS
BRADLEY C. McKENZIE
CIVIL
No. 39917
REGISTERED PROFESSIONAL ENGINEER

ZBA PERMIT PLAN

APPLICANT:
RIVER STONE, LLC
293R WASHINGTON STREET
NORWELL, MASSACHUSETTS 02061

DRAWN BY:	JLS
DESIGNED BY:	- -
CHECKED BY:	- -
APPROVED BY:	- -
DATE:	10/7/2015
SCALE:	1"=40'
PROJECT NO.:	27-135

DWG. TITLE:
Roadway Profiles

DWG. NO:
C-3

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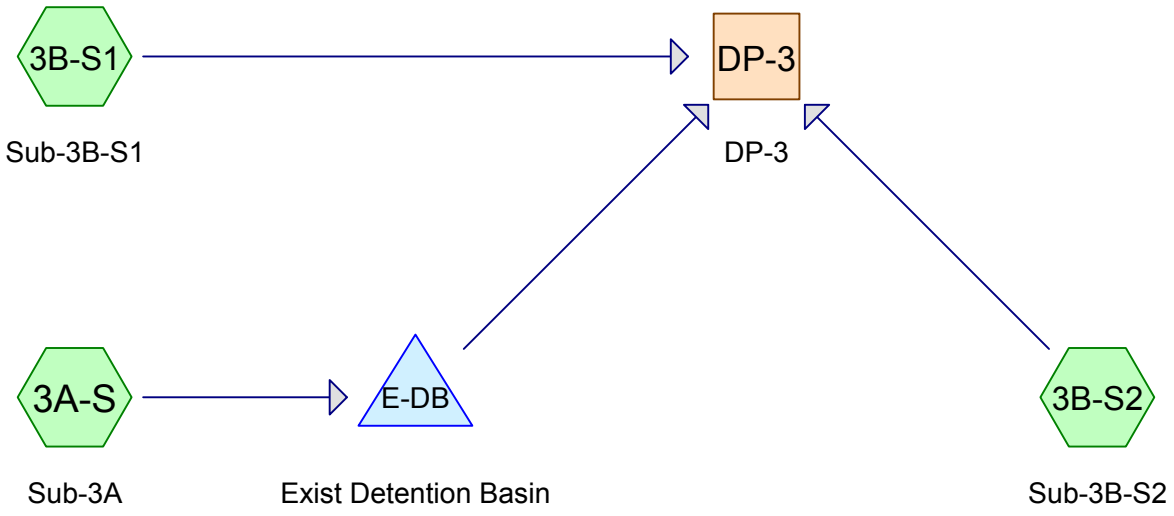

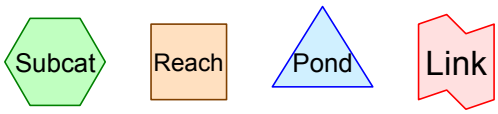

Routing Diagram for 27-135 Pre-Development (R6) Final-rev
Prepared by McKenzie Engineering Group, Inc.
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Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.199	39	>75% Grass cover, Good, HSG A (3A-S, 3B-S2)
0.116	39	>75% Grass cover, Good, HSG A - offsite (3A-S, 3B-S1)
0.338	61	>75% Grass cover, Good, HSG B (3A-S, 3B-S1, 3B-S2)
0.022	61	>75% Grass cover, Good, HSG B - offsite (3B-S1)
0.062	98	Existing Detention Basin, HSG A (3A-S)
0.029	98	Existing Detention Basin, HSG B (3A-S)
0.007	98	Paved drive, HSG A - offsite (3B-S1)
0.369	98	Paved parking, HSG A - offsite (3A-S)
0.055	98	Paved roads w/curbs & sewers, HSG A (3A-S)
0.075	98	Paved roads w/curbs & sewers, HSG B (3A-S)
0.025	98	Riprap, HSG A (3A-S, 3B-S1, 3B-S2)
0.024	98	Riprap, HSG B (3A-S, 3B-S1, 3B-S2)
0.032	98	Roofs, HSG A - offsite (3A-S)
0.784	30	Woods, Good, HSG A (3A-S, 3B-S1, 3B-S2)
0.138	30	Woods, Good, HSG A - offsite (3A-S, 3B-S1)
0.771	55	Woods, Good, HSG B (3A-S, 3B-S1, 3B-S2)
0.040	55	Woods, Good, HSG B - offsite (3B-S1)
3.085	**56**	**TOTAL AREA**

Soil Listing (selected nodes)

Area (acres)	Soil Group	Subcatchment Numbers
1.786	HSG A	3A-S, 3B-S1, 3B-S2
1.299	HSG B	3A-S, 3B-S1, 3B-S2
0.000	HSG C	
0.000	HSG D	
0.000	Other	
3.085		**TOTAL AREA**

Ground Covers (selected nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.315	0.360	0.000	0.000	0.000	0.675	>75% Grass cover, Good	3A-S, 3B-S1, 3B-S2
0.062	0.029	0.000	0.000	0.000	0.092	Existing Detention Basin	3A-S
0.007	0.000	0.000	0.000	0.000	0.007	Paved drive	3B-S1
0.369	0.000	0.000	0.000	0.000	0.369	Paved parking	3A-S
0.055	0.075	0.000	0.000	0.000	0.130	Paved roads w/curbs & sewers	3A-S
0.025	0.024	0.000	0.000	0.000	0.049	Riprap	3A-S, 3B-S1, 3B-S2
0.032	0.000	0.000	0.000	0.000	0.032	Roofs	3A-S
0.922	0.811	0.000	0.000	0.000	1.732	Woods, Good	3A-S, 3B-S1, 3B-S2
1.786	**1.299**	**0.000**	**0.000**	**0.000**	**3.085**	**TOTAL AREA**	

Pipe Listing (selected nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	3A-S	0.00	0.00	157.0	0.0030	0.013	15.0	0.0	0.0
2	E-DB	58.12	58.05	25.0	0.0028	0.013	12.0	0.0	0.0

Time span=0.00-48.00 hrs, dt=0.02 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment3A-S: Sub-3A Runoff Area=72,040 sf 40.04% Impervious Runoff Depth=0.66"
Flow Length=534' Tc=9.4 min CN=62 Runoff=0.87 cfs 0.091 af

Subcatchment3B-S1: Sub-3B-S1 Runoff Area=51,536 sf 1.07% Impervious Runoff Depth=0.19"
Flow Length=345' Tc=8.5 min CN=49 Runoff=0.07 cfs 0.019 af

Subcatchment3B-S2: Sub-3B-S2 Runoff Area=10,796 sf 1.36% Impervious Runoff Depth=0.22"
Flow Length=345' Tc=8.5 min CN=50 Runoff=0.02 cfs 0.005 af

Reach DP-3: DP-3 Inflow=0.18 cfs 0.079 af
Outflow=0.18 cfs 0.079 af

Pond E-DB: Exist Detention Basin Peak Elev=59.46' Storage=1,718 cf Inflow=0.87 cfs 0.091 af
Outflow=0.13 cfs 0.056 af

Total Runoff Area = 3.085 ac Runoff Volume = 0.115 af Average Runoff Depth = 0.45"
78.02% Pervious = 2.407 ac 21.98% Impervious = 0.678 ac

Summary for Subcatchment 3A-S: Sub-3A

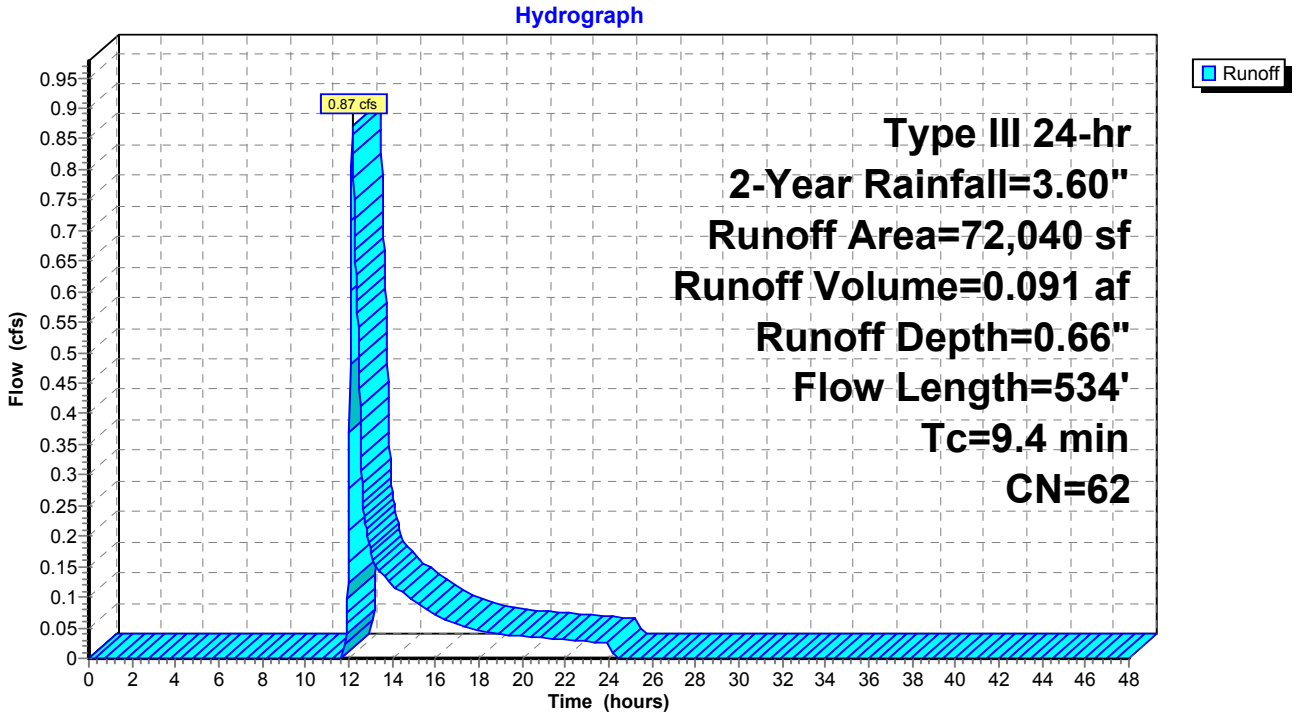
Runoff = 0.87 cfs @ 12.16 hrs, Volume= 0.091 af, Depth= 0.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-Year Rainfall=3.60"

	Area (sf)	CN	Description
*	1,384	98	Roofs, HSG A - offsite
*	16,069	98	Paved parking, HSG A - offsite
*	1,682	30	Woods, Good, HSG A - offsite
*	914	39	>75% Grass cover, Good, HSG A - offsite
	24,471	30	Woods, Good, HSG A
	6,905	39	>75% Grass cover, Good, HSG A
	2,407	98	Paved roads w/curbs & sewers, HSG A
*	2,712	98	Existing Detention Basin, HSG A
*	810	98	Riprap, HSG A
	3,247	98	Paved roads w/curbs & sewers, HSG B
	2,784	55	Woods, Good, HSG B
*	938	98	Riprap, HSG B
	6,442	61	>75% Grass cover, Good, HSG B
*	1,275	98	Existing Detention Basin, HSG B
	72,040	62	Weighted Average
	43,198		59.96% Pervious Area
	28,842		40.04% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	50	0.0160	0.14		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.60"
1.8	225	0.0160	2.04		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.9	102	0.0090	1.93		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.9	157	0.0030	2.88	3.54	**Pipe Channel, RCP_Round 15"** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013
9.4	534	Total			

Subcatchment 3A-S: Sub-3A



Summary for Subcatchment 3B-S1: Sub-3B-S1

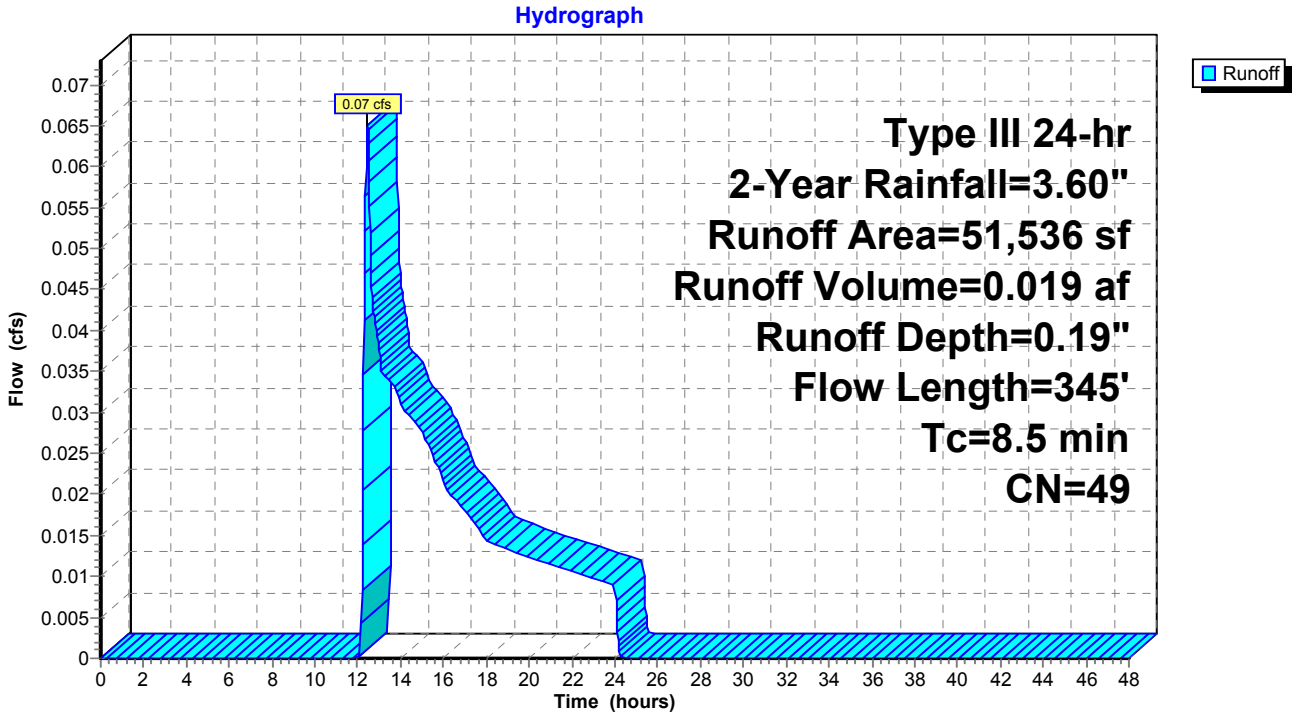
Runoff = 0.07 cfs @ 12.45 hrs, Volume= 0.019 af, Depth= 0.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-Year Rainfall=3.60"

	Area (sf)	CN	Description
*	255	98	Riprap, HSG A
*	4	98	Riprap, HSG B
	8,302	30	Woods, Good, HSG A
	24,250	55	Woods, Good, HSG B
	7,313	61	>75% Grass cover, Good, HSG B
*	4,310	30	Woods, Good, HSG A - offsite
*	4,121	39	>75% Grass cover, Good, HSG A - offsite
*	290	98	Paved drive, HSG A - offsite
*	957	61	>75% Grass cover, Good, HSG B - offsite
*	1,734	55	Woods, Good, HSG B - offsite
	51,536	49	Weighted Average
	50,987		98.93% Pervious Area
	549		1.07% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	50	0.0700	0.12		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.60"
1.5	295	0.0400	3.22		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
8.5	345	Total			

Subcatchment 3B-S1: Sub-3B-S1



Summary for Subcatchment 3B-S2: Sub-3B-S2

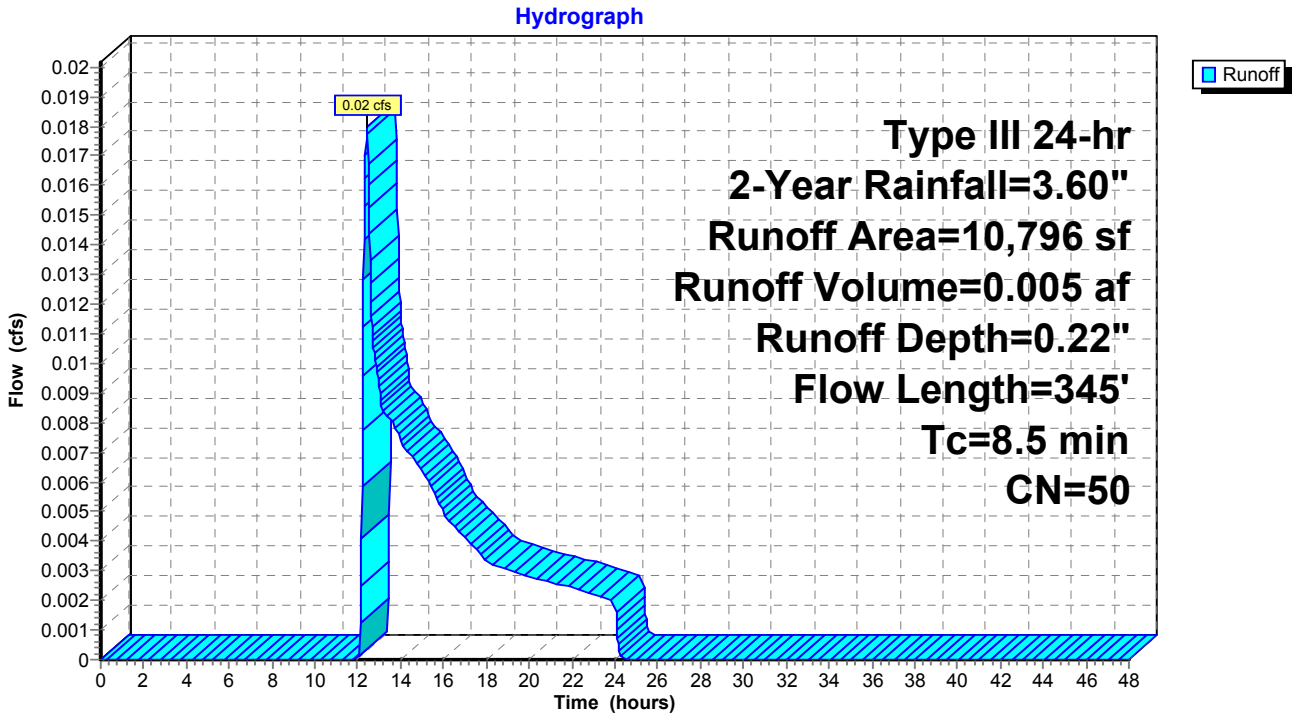
Runoff = 0.02 cfs @ 12.42 hrs, Volume= 0.005 af, Depth= 0.22"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-Year Rainfall=3.60"

	Area (sf)	CN	Description
*	30	98	Riprap, HSG A
*	117	98	Riprap, HSG B
	1,380	30	Woods, Good, HSG A
	6,538	55	Woods, Good, HSG B
	1,762	39	>75% Grass cover, Good, HSG A
	969	61	>75% Grass cover, Good, HSG B
	10,796	50	Weighted Average
	10,649		98.64% Pervious Area
	147		1.36% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	50	0.0700	0.12		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.60"
1.5	295	0.0400	3.22		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
8.5	345	Total			

Subcatchment 3B-S2: Sub-3B-S2

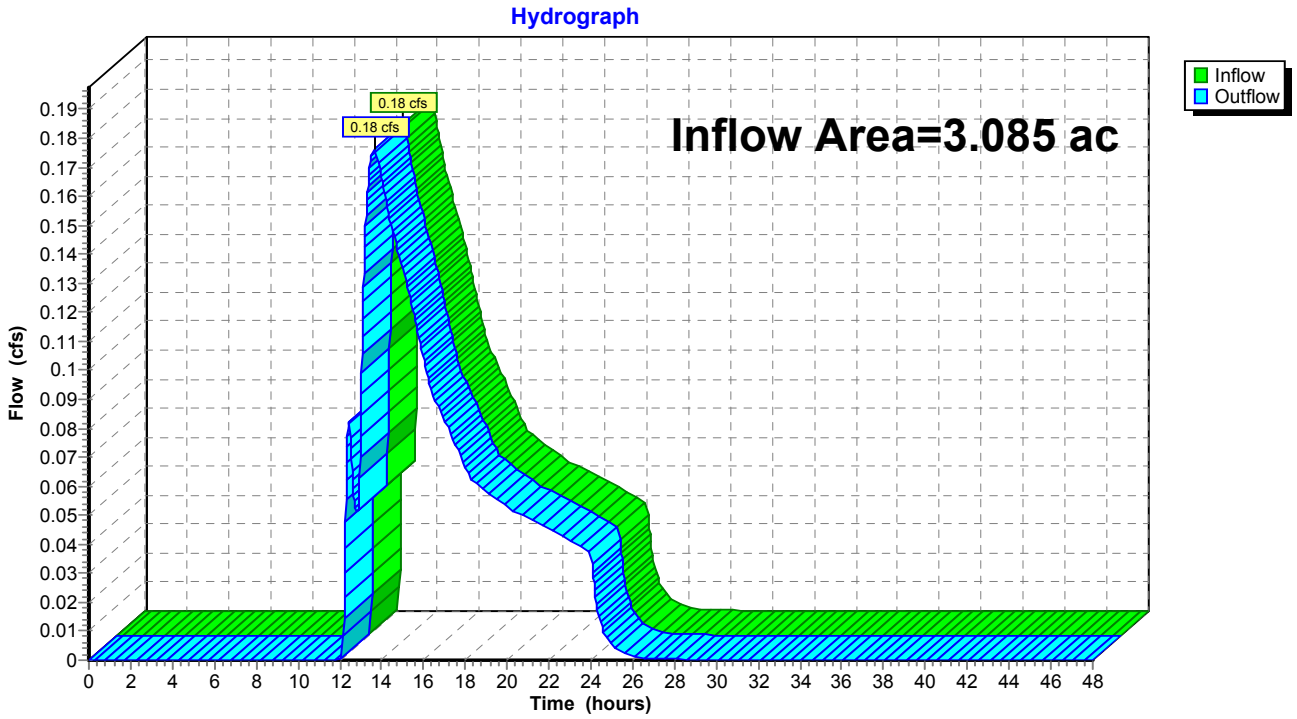


Summary for Reach DP-3: DP-3

Inflow Area = 3.085 ac, 21.98% Impervious, Inflow Depth = 0.31" for 2-Year event
Inflow = 0.18 cfs @ 13.63 hrs, Volume= 0.079 af
Outflow = 0.18 cfs @ 13.63 hrs, Volume= 0.079 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs

Reach DP-3: DP-3



Summary for Pond E-DB: Exist Detention Basin

Inflow Area = 1.654 ac, 40.04% Impervious, Inflow Depth = 0.66" for 2-Year event
Inflow = 0.87 cfs @ 12.16 hrs, Volume= 0.091 af
Outflow = 0.13 cfs @ 13.66 hrs, Volume= 0.056 af, Atten= 85%, Lag= 90.2 min
Primary = 0.13 cfs @ 13.66 hrs, Volume= 0.056 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 59.46' @ 13.66 hrs Surf.Area= 2,295 sf Storage= 1,718 cf

Plug-Flow detention time= 258.4 min calculated for 0.056 af (61% of inflow)
Center-of-Mass det. time= 128.8 min (1,028.5 - 899.7)

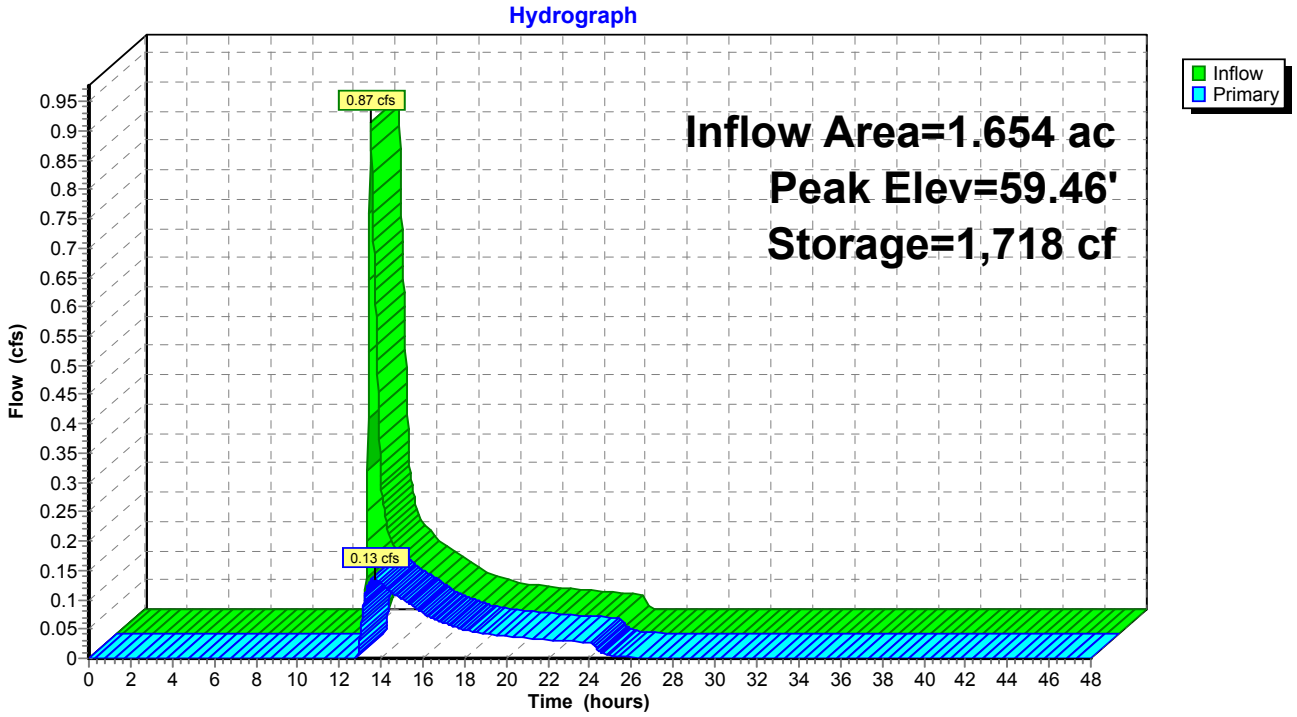
Volume	Invert	Avail.Storage	Storage Description
#1	58.00'	6,834 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
58.00	192	0	0
59.00	1,511	852	852
60.00	3,233	2,372	3,224
61.00	3,987	3,610	6,834

Device	Routing	Invert	Outlet Devices
#1	Primary	58.12'	**12.0" Round RCP_Round 12"** L= 25.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 58.12' / 58.05' S= 0.0028 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	59.38'	**2.0' long x 1.00' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s) 2.0' Crest Height
#3	Device 1	60.63'	**7.0' long x 0.59' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#4	Device 2	58.71'	**5.0' long x 1.00' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=0.13 cfs @ 13.66 hrs HW=59.46' TW=0.00' (Dynamic Tailwater)
└─**1=RCP_Round 12"** (Passes 0.13 cfs of 2.65 cfs potential flow)
  ├─**2=Sharp-Crested Rectangular Weir** (Weir Controls 0.13 cfs @ 0.90 fps)
  │ └─**4=Sharp-Crested Rectangular Weir** (Passes 0.13 cfs of 4.70 cfs potential flow)
  └─**3=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond E-DB: Exist Detention Basin



Time span=0.00-48.00 hrs, dt=0.02 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment3A-S: Sub-3A Runoff Area=72,040 sf 40.04% Impervious Runoff Depth=1.32"
Flow Length=534' Tc=9.4 min CN=62 Runoff=2.05 cfs 0.181 af

Subcatchment3B-S1: Sub-3B-S1 Runoff Area=51,536 sf 1.07% Impervious Runoff Depth=0.56"
Flow Length=345' Tc=8.5 min CN=49 Runoff=0.37 cfs 0.056 af

Subcatchment3B-S2: Sub-3B-S2 Runoff Area=10,796 sf 1.36% Impervious Runoff Depth=0.61"
Flow Length=345' Tc=8.5 min CN=50 Runoff=0.09 cfs 0.013 af

Reach DP-3: DP-3 Inflow=1.32 cfs 0.214 af
Outflow=1.32 cfs 0.214 af

Pond E-DB: Exist Detention Basin Peak Elev=59.66' Storage=2,226 cf Inflow=2.05 cfs 0.181 af
Outflow=0.96 cfs 0.146 af

Total Runoff Area = 3.085 ac Runoff Volume = 0.250 af Average Runoff Depth = 0.97"
78.02% Pervious = 2.407 ac 21.98% Impervious = 0.678 ac

Summary for Subcatchment 3A-S: Sub-3A

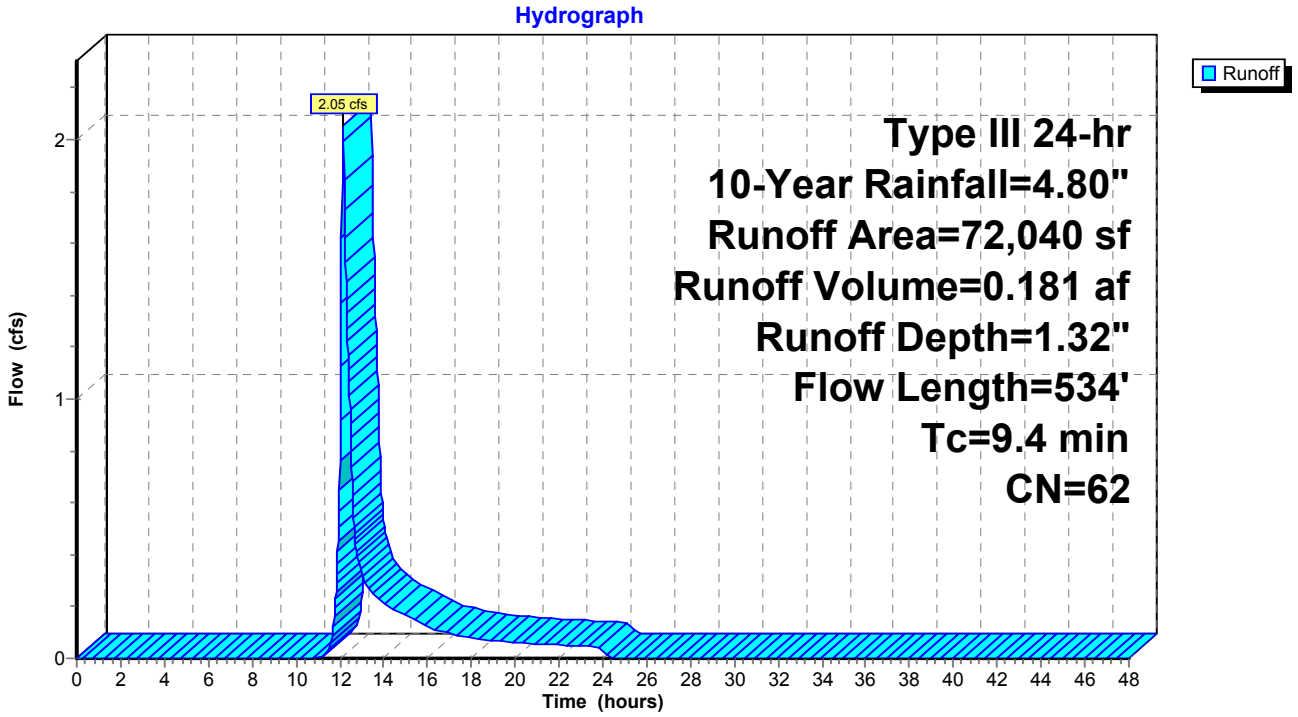
Runoff = 2.05 cfs @ 12.15 hrs, Volume= 0.181 af, Depth= 1.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (sf)	CN	Description
*	1,384	98	Roofs, HSG A - offsite
*	16,069	98	Paved parking, HSG A - offsite
*	1,682	30	Woods, Good, HSG A - offsite
*	914	39	>75% Grass cover, Good, HSG A - offsite
	24,471	30	Woods, Good, HSG A
	6,905	39	>75% Grass cover, Good, HSG A
	2,407	98	Paved roads w/curbs & sewers, HSG A
*	2,712	98	Existing Detention Basin, HSG A
*	810	98	Riprap, HSG A
	3,247	98	Paved roads w/curbs & sewers, HSG B
	2,784	55	Woods, Good, HSG B
*	938	98	Riprap, HSG B
	6,442	61	>75% Grass cover, Good, HSG B
*	1,275	98	Existing Detention Basin, HSG B
	72,040	62	Weighted Average
	43,198		59.96% Pervious Area
	28,842		40.04% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	50	0.0160	0.14		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.60"
1.8	225	0.0160	2.04		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.9	102	0.0090	1.93		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.9	157	0.0030	2.88	3.54	**Pipe Channel, RCP_Round 15"** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013
9.4	534	Total			

Subcatchment 3A-S: Sub-3A



Summary for Subcatchment 3B-S1: Sub-3B-S1

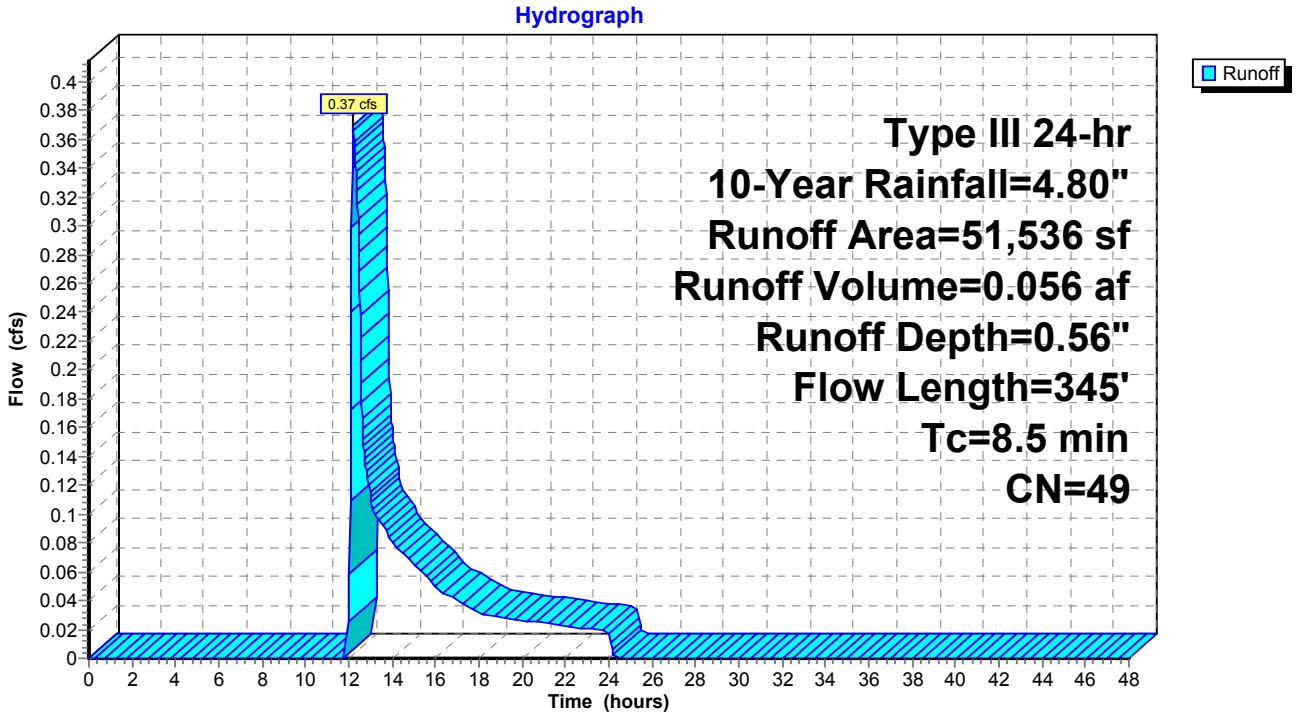
Runoff = 0.37 cfs @ 12.19 hrs, Volume= 0.056 af, Depth= 0.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (sf)	CN	Description
*	255	98	Riprap, HSG A
*	4	98	Riprap, HSG B
	8,302	30	Woods, Good, HSG A
	24,250	55	Woods, Good, HSG B
	7,313	61	>75% Grass cover, Good, HSG B
*	4,310	30	Woods, Good, HSG A - offsite
*	4,121	39	>75% Grass cover, Good, HSG A - offsite
*	290	98	Paved drive, HSG A - offsite
*	957	61	>75% Grass cover, Good, HSG B - offsite
*	1,734	55	Woods, Good, HSG B - offsite
	51,536	49	Weighted Average
	50,987		98.93% Pervious Area
	549		1.07% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	50	0.0700	0.12		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.60"
1.5	295	0.0400	3.22		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
8.5	345	Total			

Subcatchment 3B-S1: Sub-3B-S1



Summary for Subcatchment 3B-S2: Sub-3B-S2

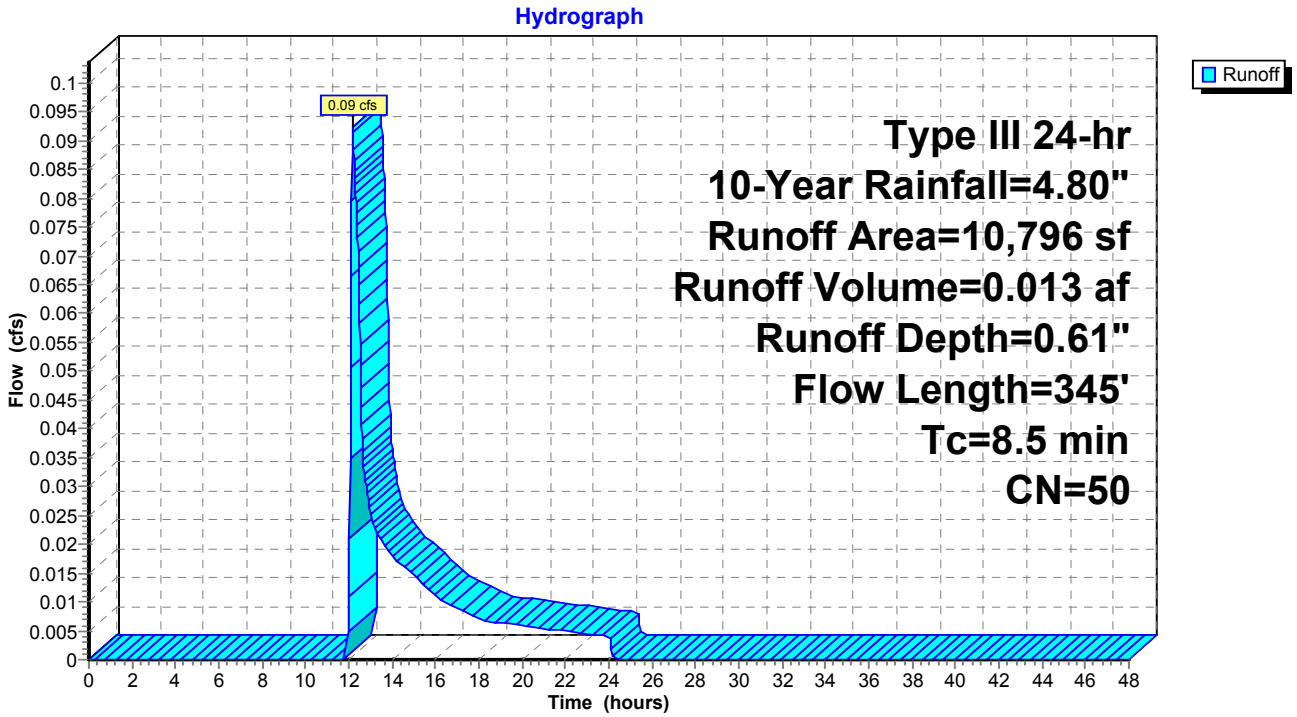
Runoff = 0.09 cfs @ 12.17 hrs, Volume= 0.013 af, Depth= 0.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (sf)	CN	Description
*	30	98	Riprap, HSG A
*	117	98	Riprap, HSG B
	1,380	30	Woods, Good, HSG A
	6,538	55	Woods, Good, HSG B
	1,762	39	>75% Grass cover, Good, HSG A
	969	61	>75% Grass cover, Good, HSG B
	10,796	50	Weighted Average
	10,649		98.64% Pervious Area
	147		1.36% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	50	0.0700	0.12		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.60"
1.5	295	0.0400	3.22		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
8.5	345	Total			

Subcatchment 3B-S2: Sub-3B-S2

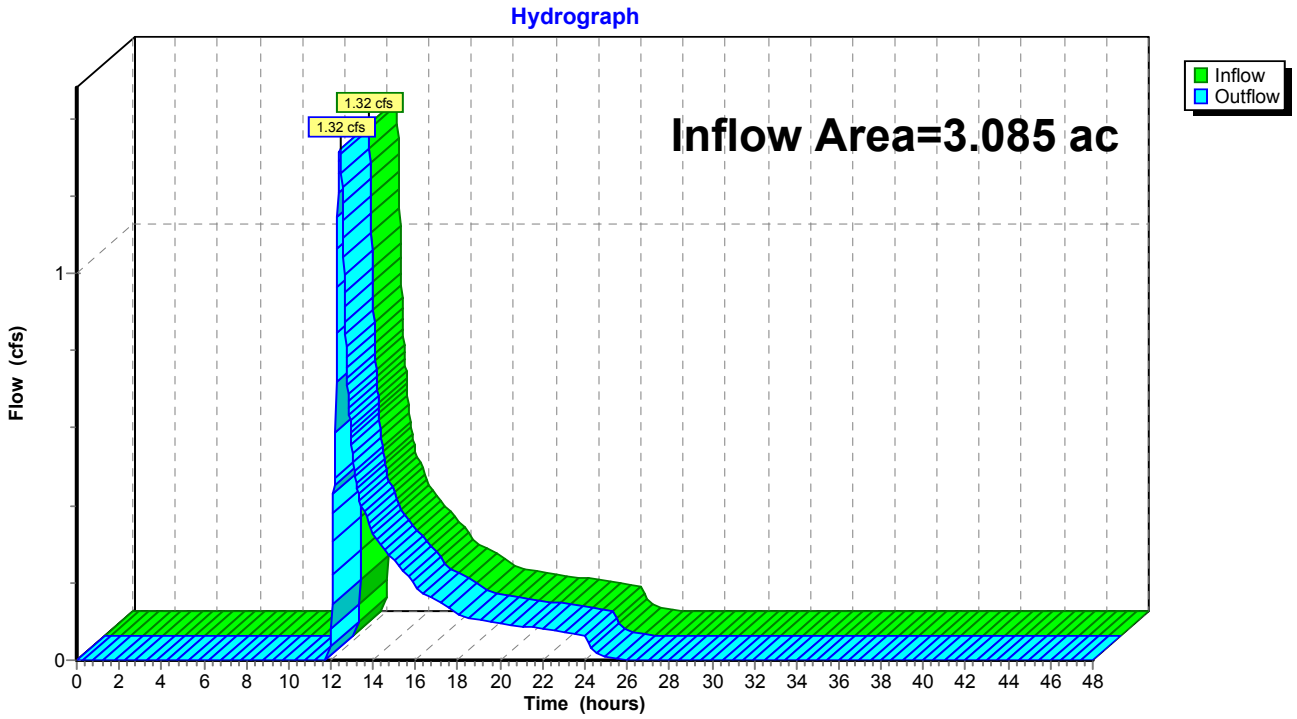


Summary for Reach DP-3: DP-3

Inflow Area = 3.085 ac, 21.98% Impervious, Inflow Depth = 0.83" for 10-Year event
Inflow = 1.32 cfs @ 12.43 hrs, Volume= 0.214 af
Outflow = 1.32 cfs @ 12.43 hrs, Volume= 0.214 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs

Reach DP-3: DP-3



Summary for Pond E-DB: Exist Detention Basin

Inflow Area = 1.654 ac, 40.04% Impervious, Inflow Depth = 1.32" for 10-Year event
Inflow = 2.05 cfs @ 12.15 hrs, Volume= 0.181 af
Outflow = 0.96 cfs @ 12.46 hrs, Volume= 0.146 af, Atten= 53%, Lag= 18.9 min
Primary = 0.96 cfs @ 12.46 hrs, Volume= 0.146 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 59.66' @ 12.46 hrs Surf.Area= 2,649 sf Storage= 2,226 cf

Plug-Flow detention time= 137.7 min calculated for 0.146 af (80% of inflow)
Center-of-Mass det. time= 56.5 min (931.9 - 875.4)

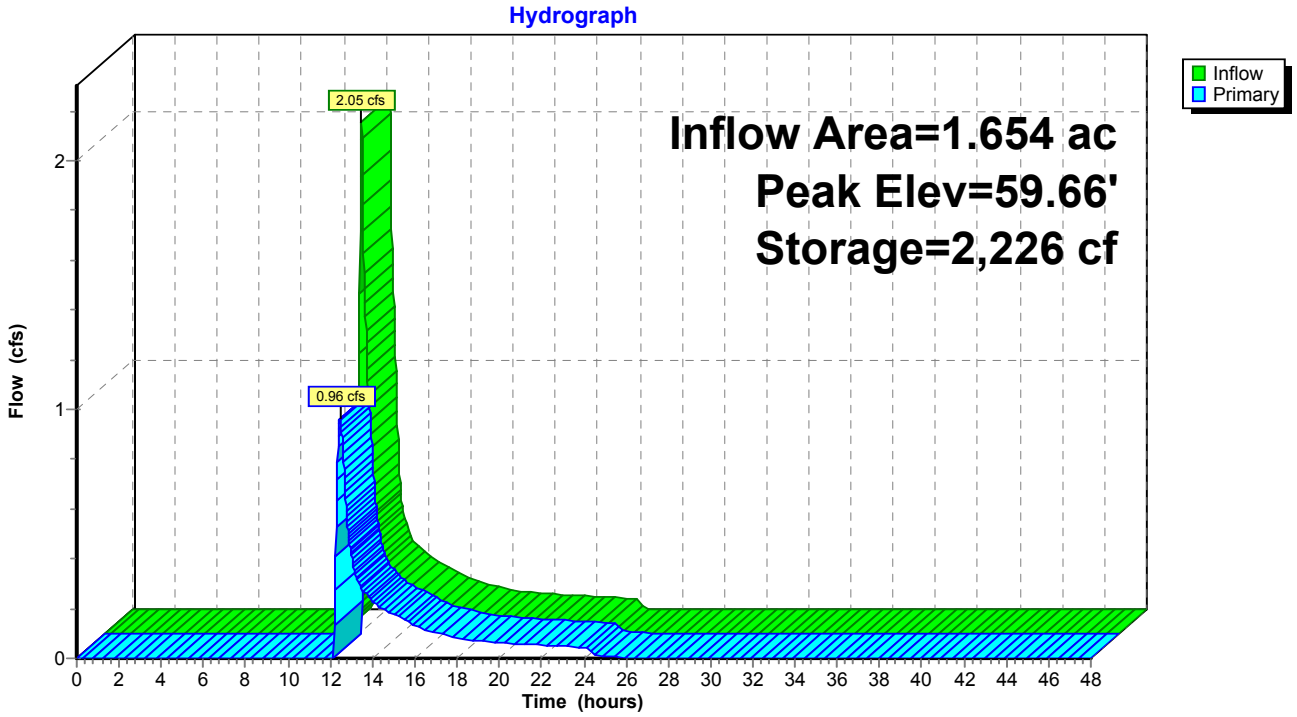
Volume	Invert	Avail.Storage	Storage Description
#1	58.00'	6,834 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
58.00	192	0	0
59.00	1,511	852	852
60.00	3,233	2,372	3,224
61.00	3,987	3,610	6,834

Device	Routing	Invert	Outlet Devices
#1	Primary	58.12'	**12.0" Round RCP_Round 12"** L= 25.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 58.12' / 58.05' S= 0.0028 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	59.38'	**2.0' long x 1.00' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s) 2.0' Crest Height
#3	Device 1	60.63'	**7.0' long x 0.59' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#4	Device 2	58.71'	**5.0' long x 1.00' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=0.96 cfs @ 12.46 hrs HW=59.66' TW=0.00' (Dynamic Tailwater)
└─**1=RCP_Round 12"** (Passes 0.96 cfs of 3.26 cfs potential flow)
  ├─**2=Sharp-Crested Rectangular Weir** (Weir Controls 0.96 cfs @ 1.76 fps)
  │ └─**4=Sharp-Crested Rectangular Weir** (Passes 0.96 cfs of 10.71 cfs potential flow)
  └─**3=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond E-DB: Exist Detention Basin



Time span=0.00-48.00 hrs, dt=0.02 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment3A-S: Sub-3A Runoff Area=72,040 sf 40.04% Impervious Runoff Depth=1.89"
Flow Length=534' Tc=9.4 min CN=62 Runoff=3.09 cfs 0.260 af

Subcatchment3B-S1: Sub-3B-S1 Runoff Area=51,536 sf 1.07% Impervious Runoff Depth=0.93"
Flow Length=345' Tc=8.5 min CN=49 Runoff=0.84 cfs 0.092 af

Subcatchment3B-S2: Sub-3B-S2 Runoff Area=10,796 sf 1.36% Impervious Runoff Depth=1.00"
Flow Length=345' Tc=8.5 min CN=50 Runoff=0.20 cfs 0.021 af

Reach DP-3: DP-3 Inflow=2.66 cfs 0.337 af
Outflow=2.66 cfs 0.337 af

Pond E-DB: Exist Detention Basin Peak Elev=59.82' Storage=2,671 cf Inflow=3.09 cfs 0.260 af
Outflow=1.88 cfs 0.225 af

Total Runoff Area = 3.085 ac Runoff Volume = 0.373 af Average Runoff Depth = 1.45"
78.02% Pervious = 2.407 ac 21.98% Impervious = 0.678 ac

Summary for Subcatchment 3A-S: Sub-3A

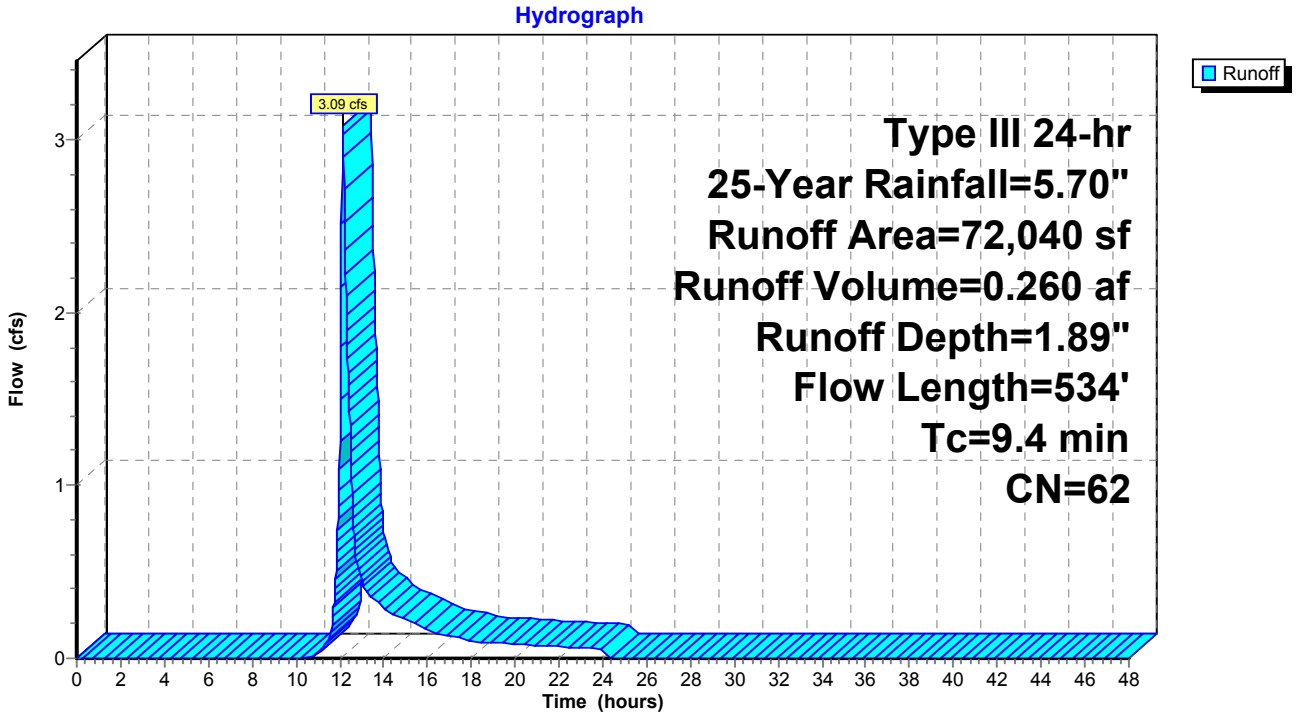
Runoff = 3.09 cfs @ 12.14 hrs, Volume= 0.260 af, Depth= 1.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-Year Rainfall=5.70"

	Area (sf)	CN	Description
*	1,384	98	Roofs, HSG A - offsite
*	16,069	98	Paved parking, HSG A - offsite
*	1,682	30	Woods, Good, HSG A - offsite
*	914	39	>75% Grass cover, Good, HSG A - offsite
	24,471	30	Woods, Good, HSG A
	6,905	39	>75% Grass cover, Good, HSG A
	2,407	98	Paved roads w/curbs & sewers, HSG A
*	2,712	98	Existing Detention Basin, HSG A
*	810	98	Riprap, HSG A
	3,247	98	Paved roads w/curbs & sewers, HSG B
	2,784	55	Woods, Good, HSG B
*	938	98	Riprap, HSG B
	6,442	61	>75% Grass cover, Good, HSG B
*	1,275	98	Existing Detention Basin, HSG B
	72,040	62	Weighted Average
	43,198		59.96% Pervious Area
	28,842		40.04% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	50	0.0160	0.14		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.60"
1.8	225	0.0160	2.04		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.9	102	0.0090	1.93		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.9	157	0.0030	2.88	3.54	**Pipe Channel, RCP_Round 15"** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013
9.4	534	Total			

Subcatchment 3A-S: Sub-3A



Summary for Subcatchment 3B-S1: Sub-3B-S1

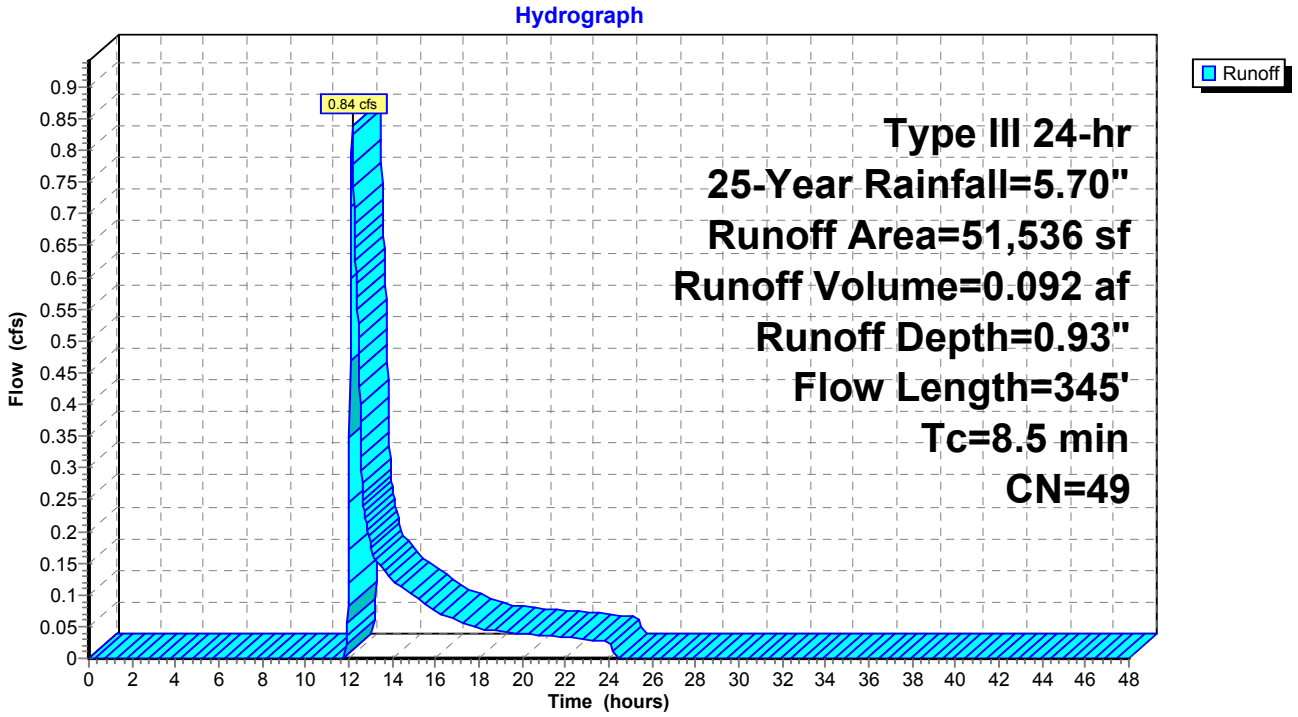
Runoff = 0.84 cfs @ 12.15 hrs, Volume= 0.092 af, Depth= 0.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-Year Rainfall=5.70"

	Area (sf)	CN	Description
*	255	98	Riprap, HSG A
*	4	98	Riprap, HSG B
	8,302	30	Woods, Good, HSG A
	24,250	55	Woods, Good, HSG B
	7,313	61	>75% Grass cover, Good, HSG B
*	4,310	30	Woods, Good, HSG A - offsite
*	4,121	39	>75% Grass cover, Good, HSG A - offsite
*	290	98	Paved drive, HSG A - offsite
*	957	61	>75% Grass cover, Good, HSG B - offsite
*	1,734	55	Woods, Good, HSG B - offsite
	51,536	49	Weighted Average
	50,987		98.93% Pervious Area
	549		1.07% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	50	0.0700	0.12		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.60"
1.5	295	0.0400	3.22		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
8.5	345	Total			

Subcatchment 3B-S1: Sub-3B-S1



Summary for Subcatchment 3B-S2: Sub-3B-S2

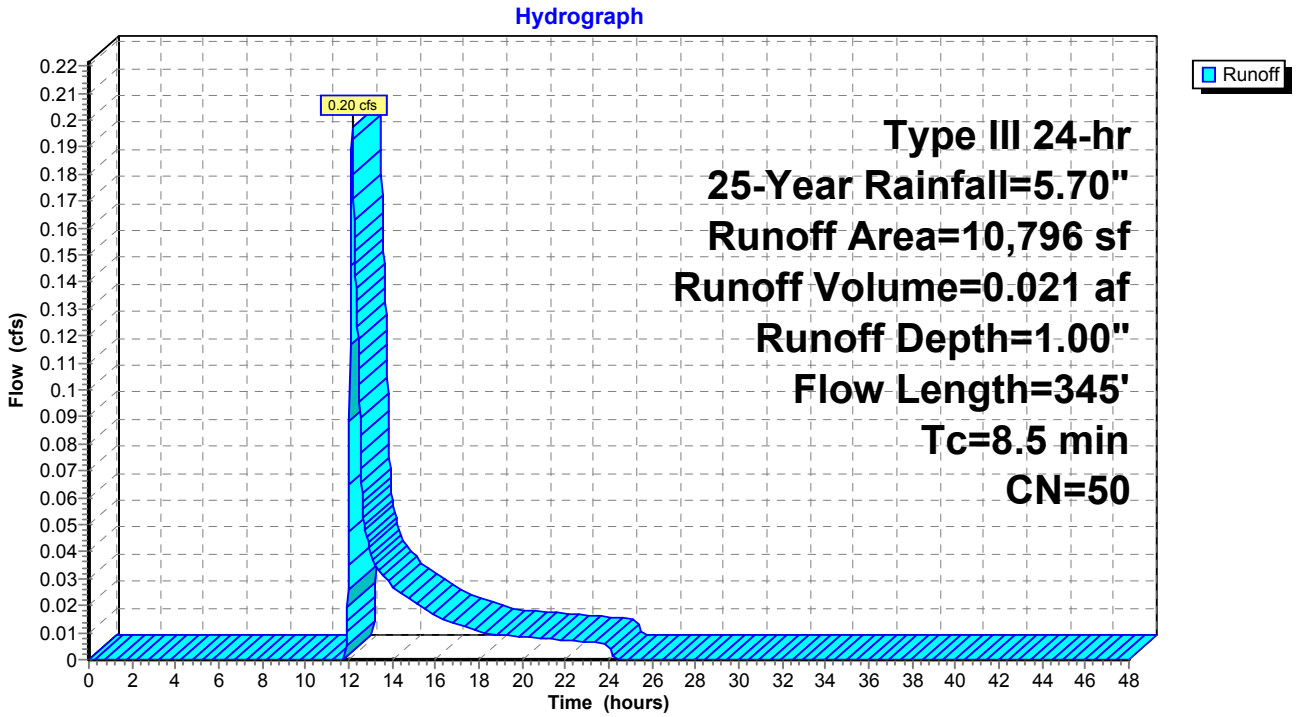
Runoff = 0.20 cfs @ 12.15 hrs, Volume= 0.021 af, Depth= 1.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-Year Rainfall=5.70"

	Area (sf)	CN	Description
*	30	98	Riprap, HSG A
*	117	98	Riprap, HSG B
	1,380	30	Woods, Good, HSG A
	6,538	55	Woods, Good, HSG B
	1,762	39	>75% Grass cover, Good, HSG A
	969	61	>75% Grass cover, Good, HSG B
	10,796	50	Weighted Average
	10,649		98.64% Pervious Area
	147		1.36% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	50	0.0700	0.12		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.60"
1.5	295	0.0400	3.22		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
8.5	345	Total			

Subcatchment 3B-S2: Sub-3B-S2

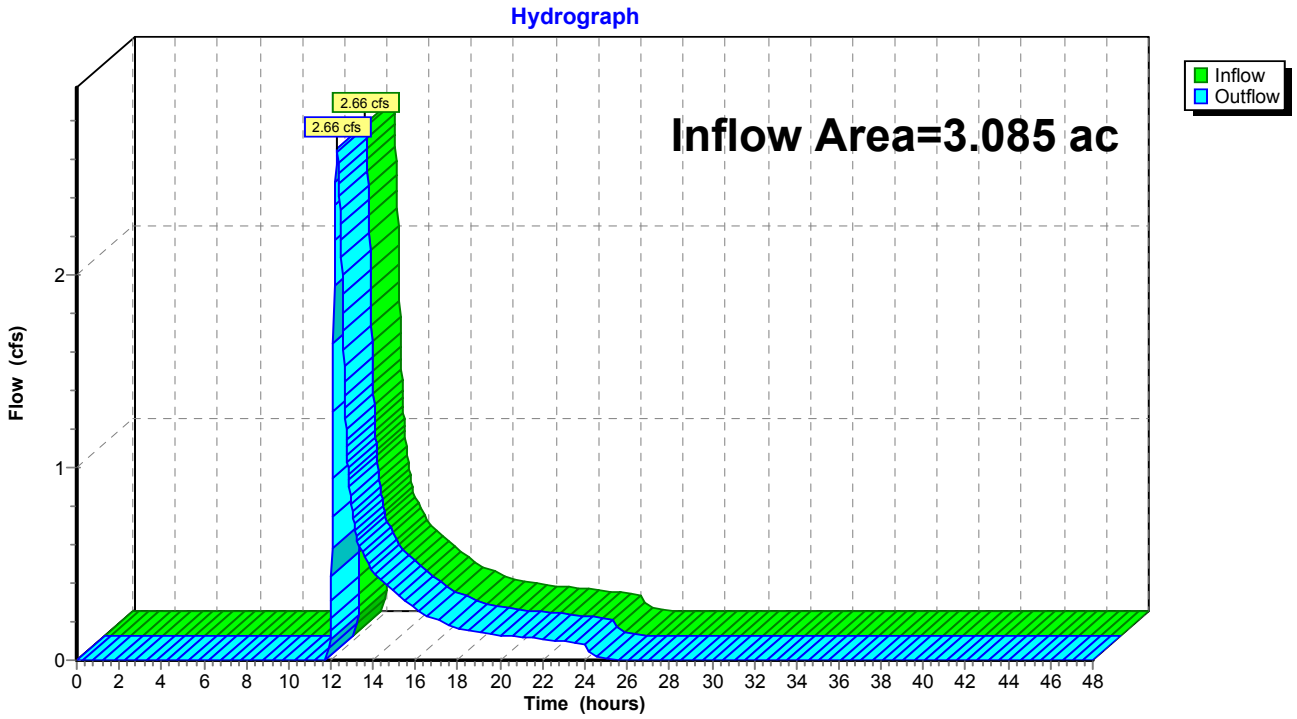


Summary for Reach DP-3: DP-3

Inflow Area = 3.085 ac, 21.98% Impervious, Inflow Depth = 1.31" for 25-Year event
Inflow = 2.66 cfs @ 12.30 hrs, Volume= 0.337 af
Outflow = 2.66 cfs @ 12.30 hrs, Volume= 0.337 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs

Reach DP-3: DP-3



Summary for Pond E-DB: Exist Detention Basin

Inflow Area = 1.654 ac, 40.04% Impervious, Inflow Depth = 1.89" for 25-Year event
Inflow = 3.09 cfs @ 12.14 hrs, Volume= 0.260 af
Outflow = 1.88 cfs @ 12.33 hrs, Volume= 0.225 af, Atten= 39%, Lag= 11.0 min
Primary = 1.88 cfs @ 12.33 hrs, Volume= 0.225 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 59.82' @ 12.33 hrs Surf.Area= 2,924 sf Storage= 2,671 cf

Plug-Flow detention time= 102.9 min calculated for 0.225 af (86% of inflow)
Center-of-Mass det. time= 40.4 min (904.3 - 863.9)

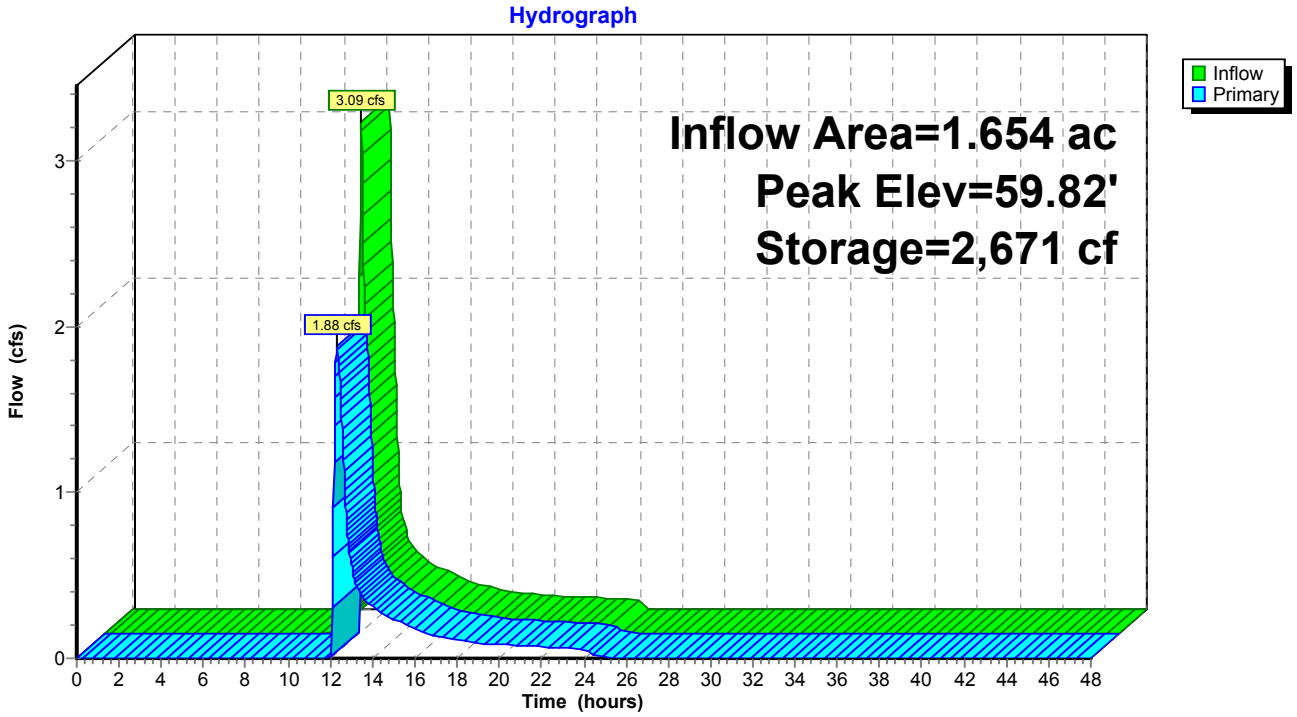
Volume	Invert	Avail.Storage	Storage Description
#1	58.00'	6,834 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
58.00	192	0	0
59.00	1,511	852	852
60.00	3,233	2,372	3,224
61.00	3,987	3,610	6,834

Device	Routing	Invert	Outlet Devices
#1	Primary	58.12'	**12.0" Round RCP_Round 12"** L= 25.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 58.12' / 58.05' S= 0.0028 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	59.38'	**2.0' long x 1.00' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s) 2.0' Crest Height
#3	Device 1	60.63'	**7.0' long x 0.59' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#4	Device 2	58.71'	**5.0' long x 1.00' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=1.87 cfs @ 12.33 hrs HW=59.82' TW=0.00' (Dynamic Tailwater)
└─**1=RCP_Round 12"** (Passes 1.87 cfs of 3.66 cfs potential flow)
  ├─**2=Sharp-Crested Rectangular Weir** (Weir Controls 1.87 cfs @ 2.23 fps)
  │ └─**4=Sharp-Crested Rectangular Weir** (Passes 1.87 cfs of 14.48 cfs potential flow)
  └─**3=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond E-DB: Exist Detention Basin



Time span=0.00-48.00 hrs, dt=0.02 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment3A-S: Sub-3A Runoff Area=72,040 sf 40.04% Impervious Runoff Depth=2.87"
Flow Length=534' Tc=9.4 min CN=62 Runoff=4.85 cfs 0.396 af

Subcatchment3B-S1: Sub-3B-S1 Runoff Area=51,536 sf 1.07% Impervious Runoff Depth=1.63"
Flow Length=345' Tc=8.5 min CN=49 Runoff=1.77 cfs 0.161 af

Subcatchment3B-S2: Sub-3B-S2 Runoff Area=10,796 sf 1.36% Impervious Runoff Depth=1.72"
Flow Length=345' Tc=8.5 min CN=50 Runoff=0.40 cfs 0.036 af

Reach DP-3: DP-3 Inflow=5.33 cfs 0.557 af
Outflow=5.33 cfs 0.557 af

Pond E-DB: Exist Detention Basin Peak Elev=60.06' Storage=3,427 cf Inflow=4.85 cfs 0.396 af
Outflow=3.58 cfs 0.361 af

Total Runoff Area = 3.085 ac Runoff Volume = 0.593 af Average Runoff Depth = 2.31"
78.02% Pervious = 2.407 ac 21.98% Impervious = 0.678 ac

Summary for Subcatchment 3A-S: Sub-3A

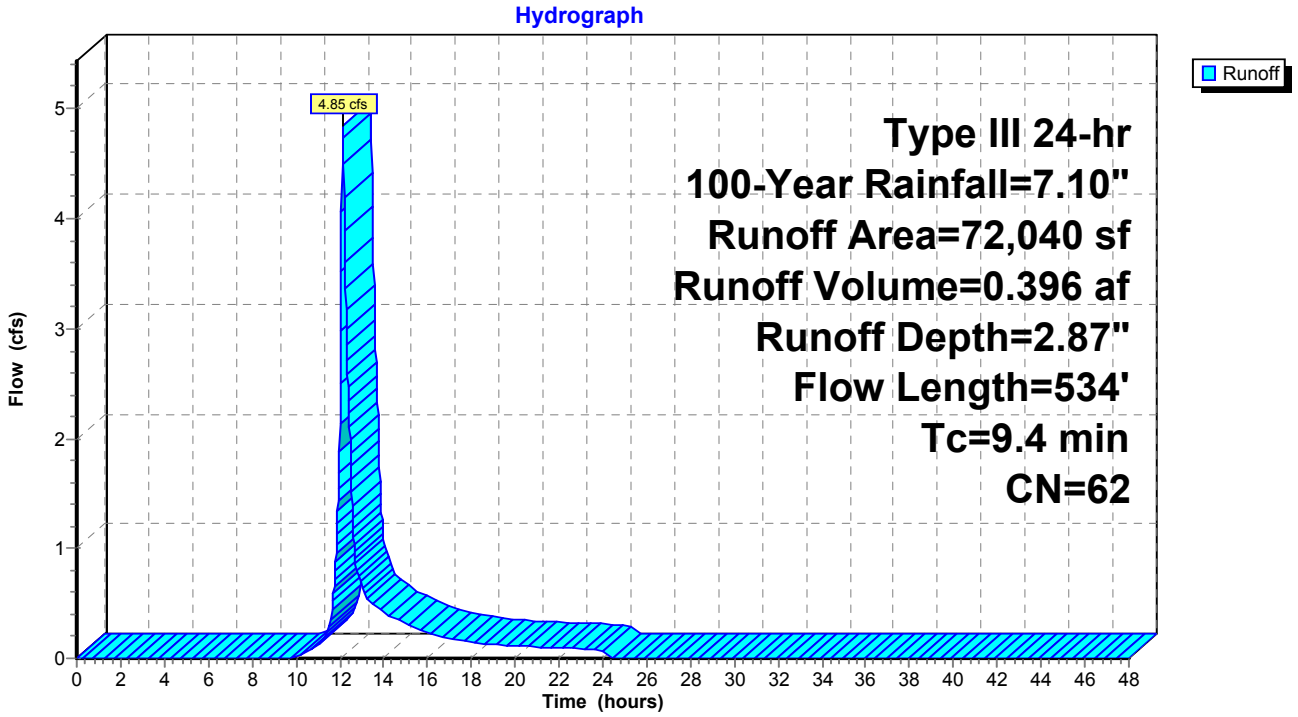
Runoff = 4.85 cfs @ 12.14 hrs, Volume= 0.396 af, Depth= 2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year Rainfall=7.10"

	Area (sf)	CN	Description
*	1,384	98	Roofs, HSG A - offsite
*	16,069	98	Paved parking, HSG A - offsite
*	1,682	30	Woods, Good, HSG A - offsite
*	914	39	>75% Grass cover, Good, HSG A - offsite
	24,471	30	Woods, Good, HSG A
	6,905	39	>75% Grass cover, Good, HSG A
	2,407	98	Paved roads w/curbs & sewers, HSG A
*	2,712	98	Existing Detention Basin, HSG A
*	810	98	Riprap, HSG A
	3,247	98	Paved roads w/curbs & sewers, HSG B
	2,784	55	Woods, Good, HSG B
*	938	98	Riprap, HSG B
	6,442	61	>75% Grass cover, Good, HSG B
*	1,275	98	Existing Detention Basin, HSG B
	72,040	62	Weighted Average
	43,198		59.96% Pervious Area
	28,842		40.04% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	50	0.0160	0.14		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.60"
1.8	225	0.0160	2.04		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.9	102	0.0090	1.93		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.9	157	0.0030	2.88	3.54	**Pipe Channel, RCP_Round 15"** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013
9.4	534	Total			

Subcatchment 3A-S: Sub-3A



Summary for Subcatchment 3B-S1: Sub-3B-S1

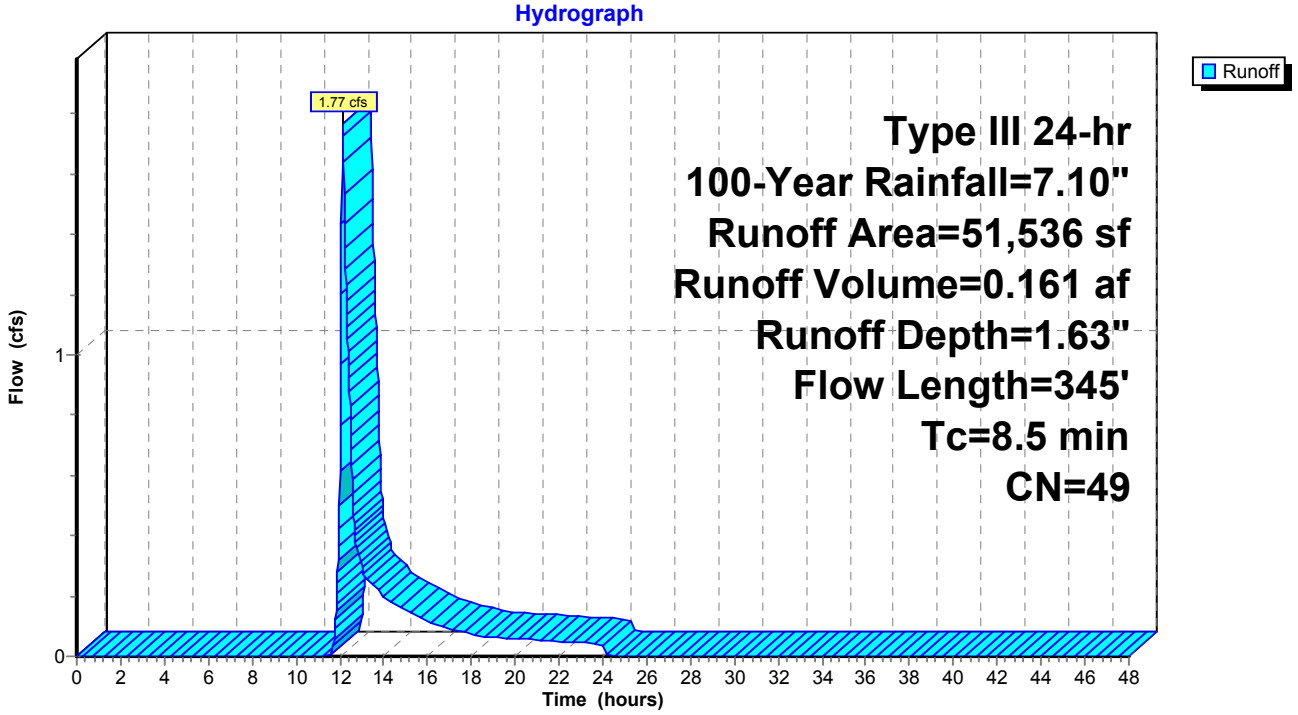
Runoff = 1.77 cfs @ 12.14 hrs, Volume= 0.161 af, Depth= 1.63"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year Rainfall=7.10"

	Area (sf)	CN	Description
*	255	98	Riprap, HSG A
*	4	98	Riprap, HSG B
	8,302	30	Woods, Good, HSG A
	24,250	55	Woods, Good, HSG B
	7,313	61	>75% Grass cover, Good, HSG B
*	4,310	30	Woods, Good, HSG A - offsite
*	4,121	39	>75% Grass cover, Good, HSG A - offsite
*	290	98	Paved drive, HSG A - offsite
*	957	61	>75% Grass cover, Good, HSG B - offsite
*	1,734	55	Woods, Good, HSG B - offsite
	51,536	49	Weighted Average
	50,987		98.93% Pervious Area
	549		1.07% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	50	0.0700	0.12		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.60"
1.5	295	0.0400	3.22		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
8.5	345	Total			

Subcatchment 3B-S1: Sub-3B-S1



Summary for Subcatchment 3B-S2: Sub-3B-S2

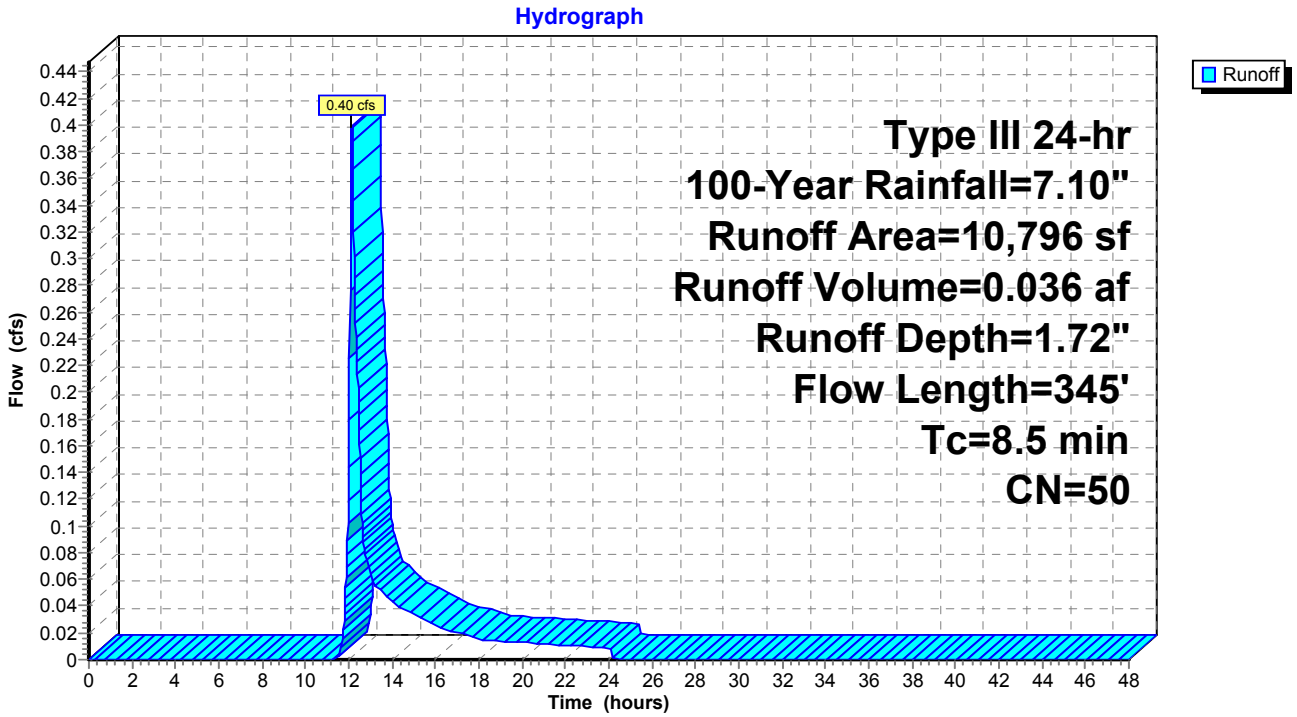
Runoff = 0.40 cfs @ 12.14 hrs, Volume= 0.036 af, Depth= 1.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year Rainfall=7.10"

	Area (sf)	CN	Description
*	30	98	Riprap, HSG A
*	117	98	Riprap, HSG B
	1,380	30	Woods, Good, HSG A
	6,538	55	Woods, Good, HSG B
	1,762	39	>75% Grass cover, Good, HSG A
	969	61	>75% Grass cover, Good, HSG B
	10,796	50	Weighted Average
	10,649		98.64% Pervious Area
	147		1.36% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	50	0.0700	0.12		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.60"
1.5	295	0.0400	3.22		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
8.5	345	Total			

Subcatchment 3B-S2: Sub-3B-S2

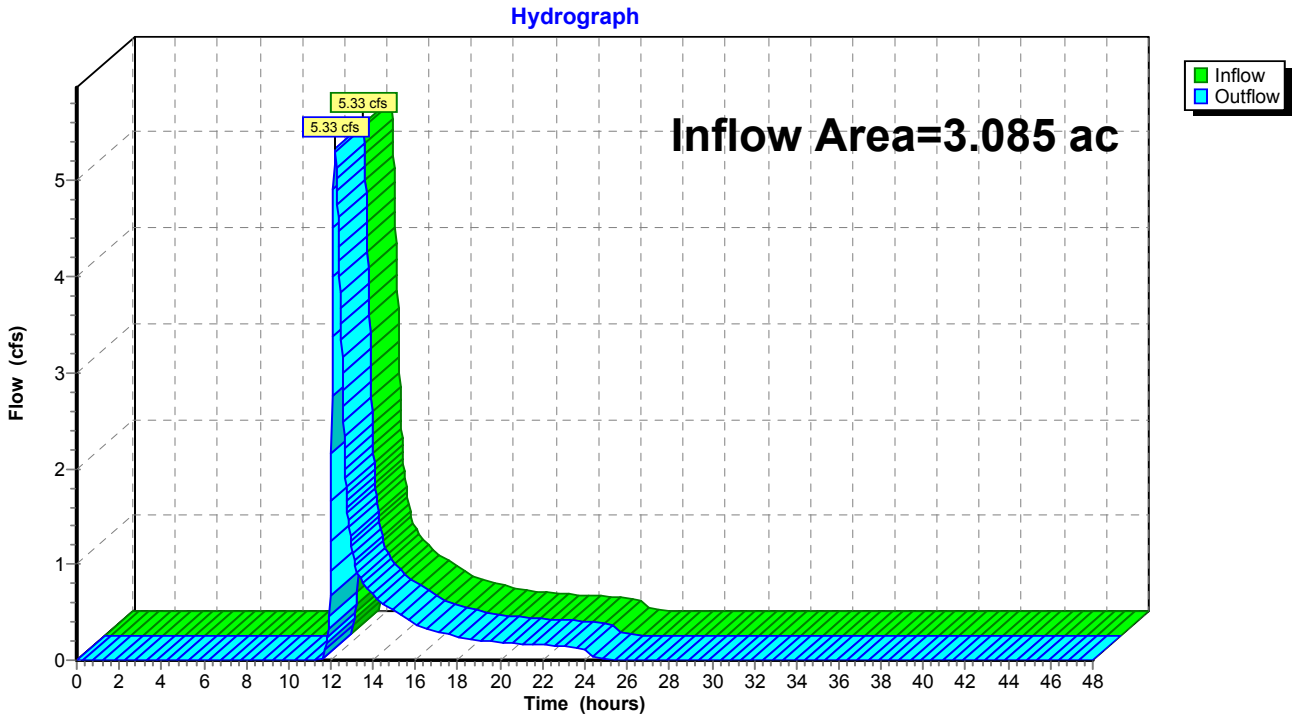


Summary for Reach DP-3: DP-3

Inflow Area = 3.085 ac, 21.98% Impervious, Inflow Depth = 2.17" for 100-Year event
Inflow = 5.33 cfs @ 12.20 hrs, Volume= 0.557 af
Outflow = 5.33 cfs @ 12.20 hrs, Volume= 0.557 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs

Reach DP-3: DP-3



Summary for Pond E-DB: Exist Detention Basin

Inflow Area = 1.654 ac, 40.04% Impervious, Inflow Depth = 2.87" for 100-Year event
Inflow = 4.85 cfs @ 12.14 hrs, Volume= 0.396 af
Outflow = 3.58 cfs @ 12.24 hrs, Volume= 0.361 af, Atten= 26%, Lag= 6.3 min
Primary = 3.58 cfs @ 12.24 hrs, Volume= 0.361 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 60.06' @ 12.24 hrs Surf.Area= 3,280 sf Storage= 3,427 cf

Plug-Flow detention time= 74.2 min calculated for 0.360 af (91% of inflow)
Center-of-Mass det. time= 29.8 min (881.0 - 851.2)

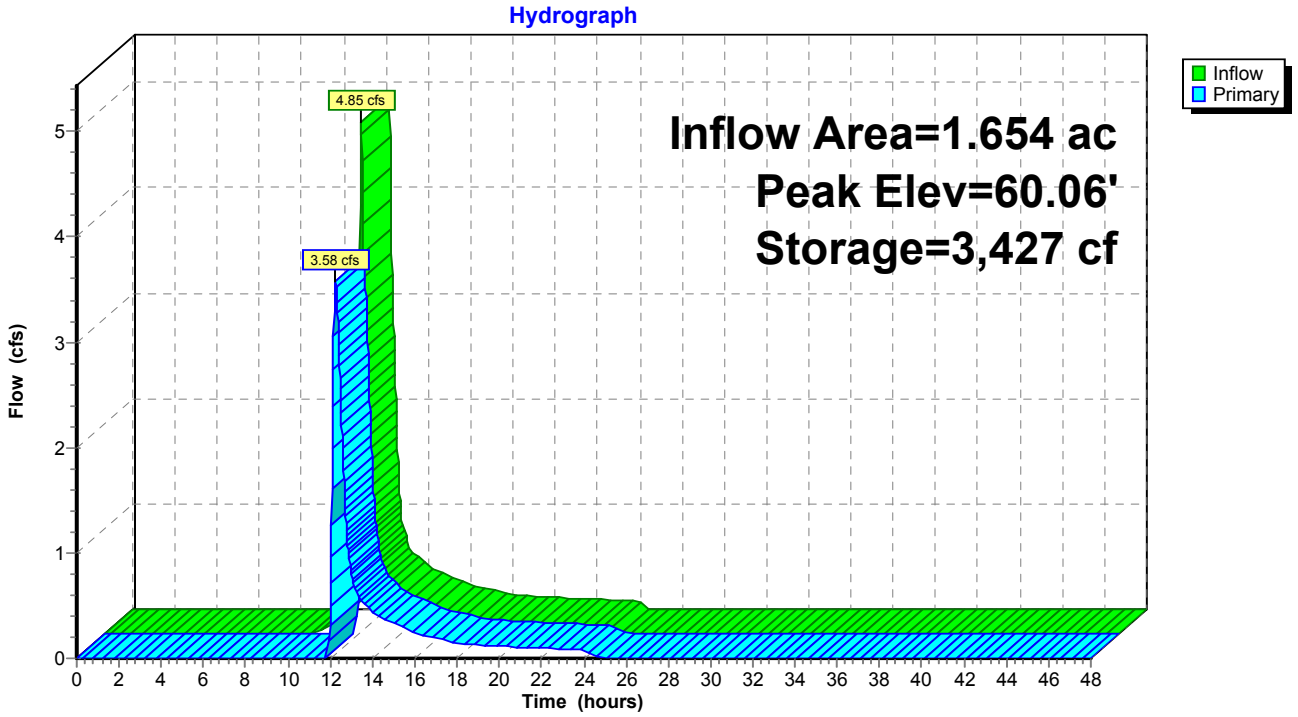
Volume	Invert	Avail.Storage	Storage Description
#1	58.00'	6,834 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

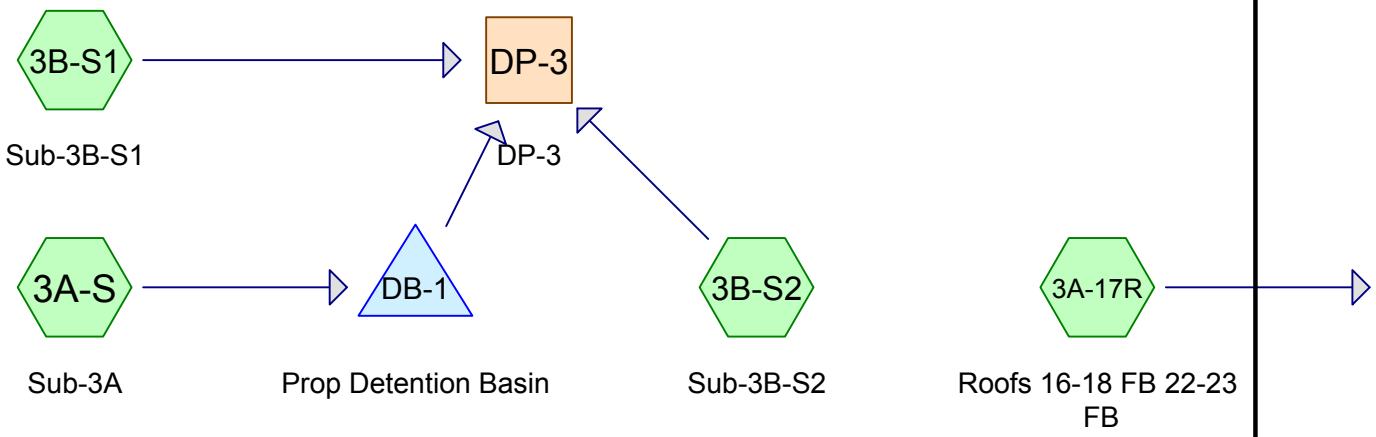
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
58.00	192	0	0
59.00	1,511	852	852
60.00	3,233	2,372	3,224
61.00	3,987	3,610	6,834

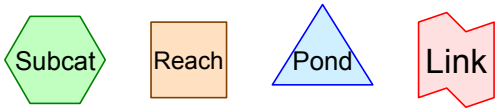
Device	Routing	Invert	Outlet Devices
#1	Primary	58.12'	**12.0" Round RCP_Round 12"** L= 25.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 58.12' / 58.05' S= 0.0028 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	59.38'	**2.0' long x 1.00' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s) 2.0' Crest Height
#3	Device 1	60.63'	**7.0' long x 0.59' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#4	Device 2	58.71'	**5.0' long x 1.00' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=3.58 cfs @ 12.24 hrs HW=60.06' TW=0.00' (Dynamic Tailwater)
└─**1=RCP_Round 12"** (Passes 3.58 cfs of 4.19 cfs potential flow)
  ├─**2=Sharp-Crested Rectangular Weir** (Weir Controls 3.58 cfs @ 2.81 fps)
  │ └─**4=Sharp-Crested Rectangular Weir** (Passes 3.58 cfs of 18.59 cfs potential flow)
  └─**3=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond E-DB: Exist Detention Basin







Routing Diagram for 27-135 Post-Development (R6)-rev
Prepared by McKenzie Engineering Group, Inc.
HydroCAD® 10.00-21 s/n 00452 © 2018 HydroCAD Software Solutions LLC

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.904	39	>75% Grass cover, Good, HSG A (3A-S, 3B-S2)
0.052	39	>75% Grass cover, Good, HSG A - offsite (3A-S, 3B-S1)
0.337	61	>75% Grass cover, Good, HSG B (3A-S, 3B-S1, 3B-S2)
0.022	61	>75% Grass cover, Good, HSG B - offsite (3B-S1)
0.062	98	Decks, HSG A (3A-S)
0.015	98	Decks, HSG B (3A-S, 3B-S1)
0.175	98	Detention Basin, HSG A (3A-S)
0.095	98	Detention Basin, HSG B (3A-S)
0.240	98	Paved drives, HSG A (3A-S)
0.058	98	Paved drives, HSG B (3A-S)
0.369	98	Paved parking, HSG A - offsite (3A-S)
0.331	98	Paved roads w/curbs & sewers, HSG A (3A-S)
0.203	98	Paved roads w/curbs & sewers, HSG B (3A-S)
0.075	98	Paved sidewalk, HSG A (3A-S)
0.028	98	Paved sidewalk, HSG B (3A-S)
0.004	98	Riprap, HSG B (3B-S2)
0.218	98	Roofs, HSG A (3A-17R)
0.032	98	Roofs, HSG A - offsite (3A-S)
0.020	98	Walks, HSG A (3A-S)
0.004	98	Walks, HSG B (3A-S)
0.033	30	Woods, Good, HSG A (3B-S1, 3B-S2)
0.040	30	Woods, Good, HSG A - offsite (3A-S, 3B-S1)
0.165	55	Woods, Good, HSG B (3B-S1, 3B-S2)
0.040	55	Woods, Good, HSG B - offsite (3B-S1)
3.521	**74**	**TOTAL AREA**

Soil Listing (selected nodes)

Area (acres)	Soil Group	Subcatchment Numbers
2.551	HSG A	3A-17R, 3A-S, 3B-S1, 3B-S2
0.970	HSG B	3A-S, 3B-S1, 3B-S2
0.000	HSG C	
0.000	HSG D	
0.000	Other	
3.521		**TOTAL AREA**

Ground Covers (selected nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.956	0.359	0.000	0.000	0.000	1.315	>75% Grass cover, Good	3A-S, 3B-S1, 3B-S2
0.062	0.015	0.000	0.000	0.000	0.077	Decks	3A-S, 3B-S1
0.175	0.095	0.000	0.000	0.000	0.270	Detention Basin	3A-S
0.240	0.058	0.000	0.000	0.000	0.298	Paved drives	3A-S
0.369	0.000	0.000	0.000	0.000	0.369	Paved parking	3A-S
0.331	0.203	0.000	0.000	0.000	0.534	Paved roads w/curbs & sewers	3A-S
0.075	0.028	0.000	0.000	0.000	0.103	Paved sidewalk	3A-S
0.000	0.004	0.000	0.000	0.000	0.004	Riprap	3B-S2
0.250	0.000	0.000	0.000	0.000	0.250	Roofs	3A-17R, 3A-S
0.020	0.004	0.000	0.000	0.000	0.024	Walks	3A-S
0.073	0.204	0.000	0.000	0.000	0.277	Woods, Good	3A-S, 3B-S1, 3B-S2
2.551	**0.970**	**0.000**	**0.000**	**0.000**	**3.521**	**TOTAL AREA**	

Pipe Listing (selected nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	DB-1	58.00	57.65	19.5	0.0179	0.013	12.0	0.0	0.0

Time span=0.00-48.00 hrs, dt=0.02 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment3A-17R: Roofs 16-18 FB Runoff Area=9,510 sf 100.00% Impervious Runoff Depth=3.37"
Tc=6.0 min CN=98 Runoff=0.76 cfs 0.061 af

Subcatchment3A-S: Sub-3A Runoff Area=122,378 sf 60.45% Impervious Runoff Depth=1.44"
Tc=6.0 min CN=76 Runoff=4.63 cfs 0.337 af

Subcatchment3B-S1: Sub-3B-S1 Runoff Area=13,033 sf 2.85% Impervious Runoff Depth=0.38"
Tc=6.0 min CN=55 Runoff=0.06 cfs 0.009 af

Subcatchment3B-S2: Sub-3B-S2 Runoff Area=8,474 sf 2.25% Impervious Runoff Depth=0.35"
Tc=6.0 min CN=54 Runoff=0.03 cfs 0.006 af

Reach DP-3: DP-3 Inflow=0.09 cfs 0.015 af
Outflow=0.09 cfs 0.015 af

Pond DB-1: Prop Detention Basin Peak Elev=59.70' Storage=14,668 cf Inflow=4.63 cfs 0.337 af
Outflow=0.00 cfs 0.000 af

Total Runoff Area = 3.521 ac Runoff Volume = 0.413 af Average Runoff Depth = 1.41"
45.21% Pervious = 1.592 ac 54.79% Impervious = 1.929 ac

Summary for Subcatchment 3A-17R: Roofs 16-18 FB 22-23 FB

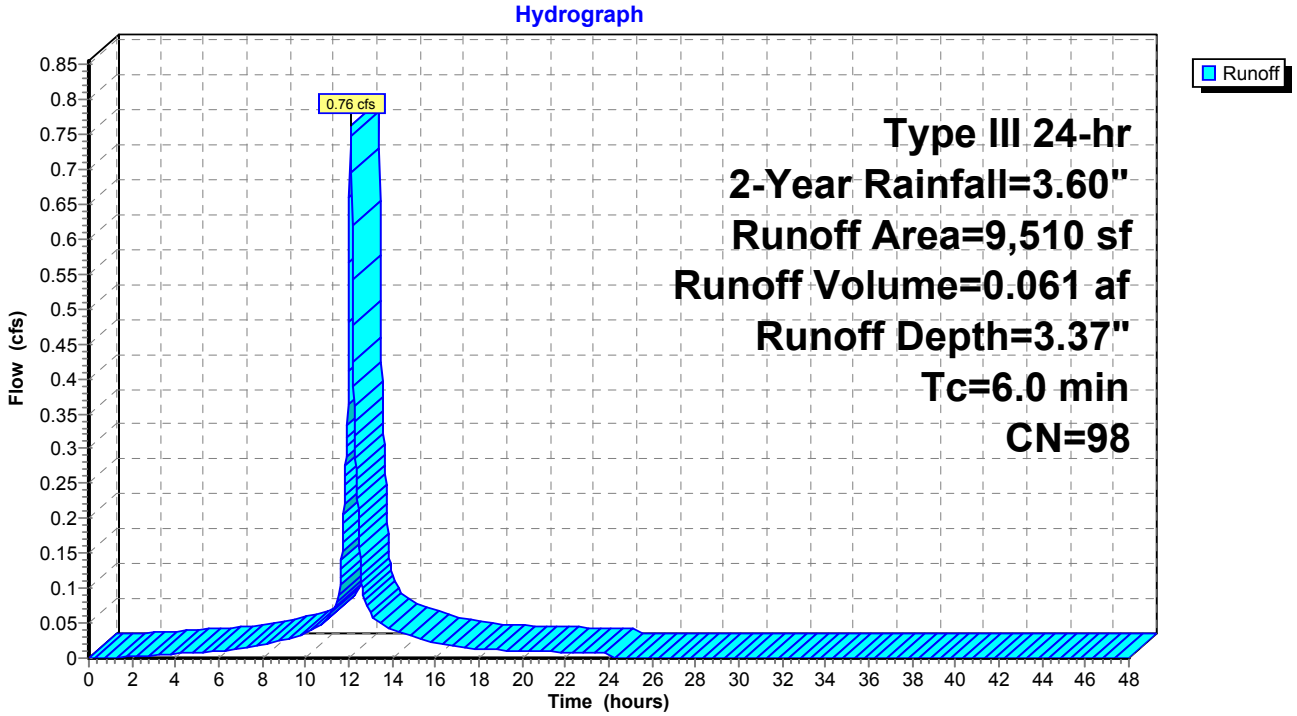
Runoff = 0.76 cfs @ 12.08 hrs, Volume= 0.061 af, Depth= 3.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-Year Rainfall=3.60"

Area (sf)	CN	Description
5,720	98	Roofs, HSG A
3,790	98	Roofs, HSG A
9,510	98	Weighted Average
9,510		100.00% Impervious Area

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

Subcatchment 3A-17R: Roofs 16-18 FB 22-23 FB



Summary for Subcatchment 3A-S: Sub-3A

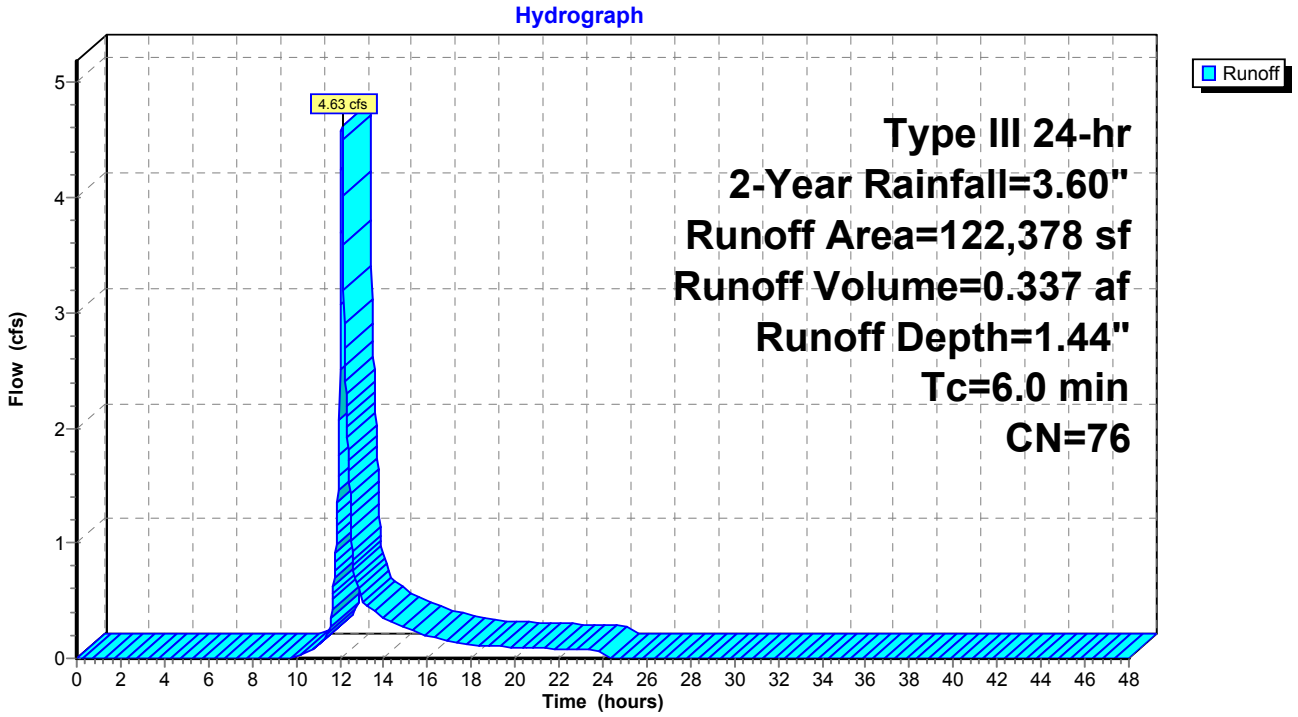
Runoff = 4.63 cfs @ 12.09 hrs, Volume= 0.337 af, Depth= 1.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-Year Rainfall=3.60"

	Area (sf)	CN	Description
*	10,470	98	Paved drives, HSG A
*	2,526	98	Paved drives, HSG B
*	14,412	98	Paved roads w/curbs & sewers, HSG A
	8,829	98	Paved roads w/curbs & sewers, HSG B
*	3,274	98	Paved sidewalk, HSG A
*	1,229	98	Paved sidewalk, HSG B
*	882	98	Walks, HSG A
*	168	98	Walks, HSG B
*	0	98	Roofs, HSG A
*	0	98	Roofs, HSG B
	0	98	Roofs, HSG A
	0	98	Roofs, HSG A
*	2,702	98	Decks, HSG A
*	262	98	Decks, HSG B
*	7,626	98	Detention Basin, HSG A
*	4,140	98	Detention Basin, HSG B
	38,127	39	>75% Grass cover, Good, HSG A
	7,682	61	>75% Grass cover, Good, HSG B
*	0	98	Walls, HSG A
*	1,384	98	Roofs, HSG A - offsite
*	16,069	98	Paved parking, HSG A - offsite
*	914	39	>75% Grass cover, Good, HSG A - offsite
*	1,682	30	Woods, Good, HSG A - offsite
*	0	30	Woods, Good, HSG A - offsite
	122,378	76	Weighted Average
	48,405		39.55% Pervious Area
	73,973		60.45% Impervious Area

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

Subcatchment 3A-S: Sub-3A



Summary for Subcatchment 3B-S1: Sub-3B-S1

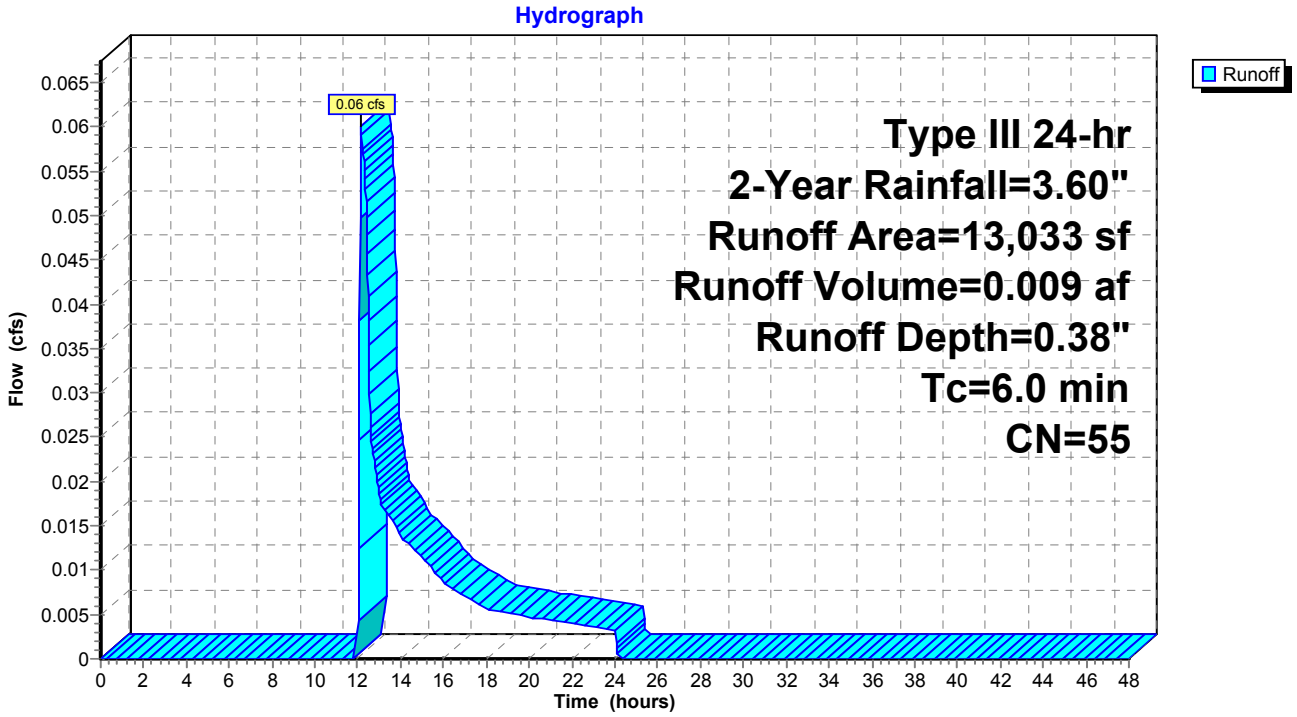
Runoff = 0.06 cfs @ 12.15 hrs, Volume= 0.009 af, Depth= 0.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-Year Rainfall=3.60"

	Area (sf)	CN	Description
	3,060	55	Woods, Good, HSG B
	927	30	Woods, Good, HSG A
	0	39	>75% Grass cover, Good, HSG A
	4,574	61	>75% Grass cover, Good, HSG B
*	371	98	Decks, HSG B
*	62	30	Woods, Good, HSG A - offsite
*	1,346	39	>75% Grass cover, Good, HSG A - offsite
*	959	61	>75% Grass cover, Good, HSG B - offsite
*	1,734	55	Woods, Good, HSG B - offsite
	13,033	55	Weighted Average
	12,662		97.15% Pervious Area
	371		2.85% Impervious Area

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

Subcatchment 3B-S1: Sub-3B-S1



Summary for Subcatchment 3B-S2: Sub-3B-S2

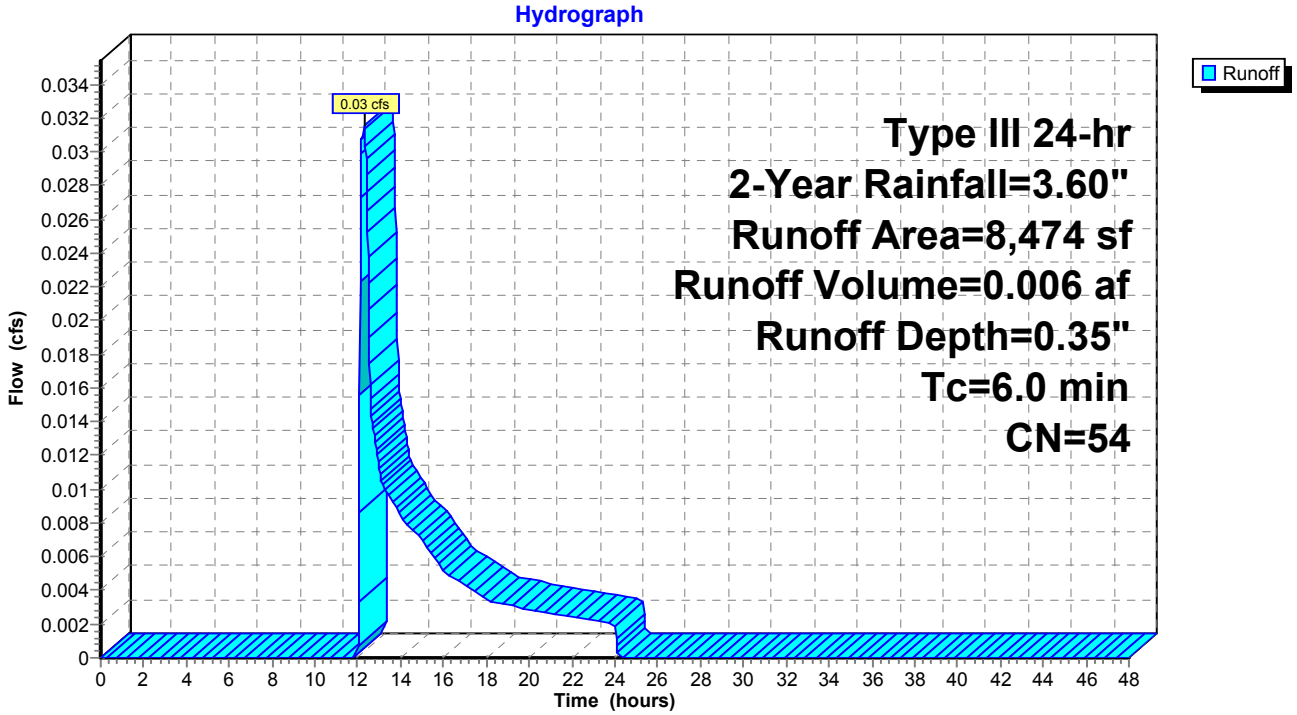
Runoff = 0.03 cfs @ 12.28 hrs, Volume= 0.006 af, Depth= 0.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-Year Rainfall=3.60"

	Area (sf)	CN	Description
*	191	98	Riprap, HSG B
	496	30	Woods, Good, HSG A
	4,111	55	Woods, Good, HSG B
	1,240	39	>75% Grass cover, Good, HSG A
	2,436	61	>75% Grass cover, Good, HSG B
	8,474	54	Weighted Average
	8,283		97.75% Pervious Area
	191		2.25% Impervious Area

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

Subcatchment 3B-S2: Sub-3B-S2

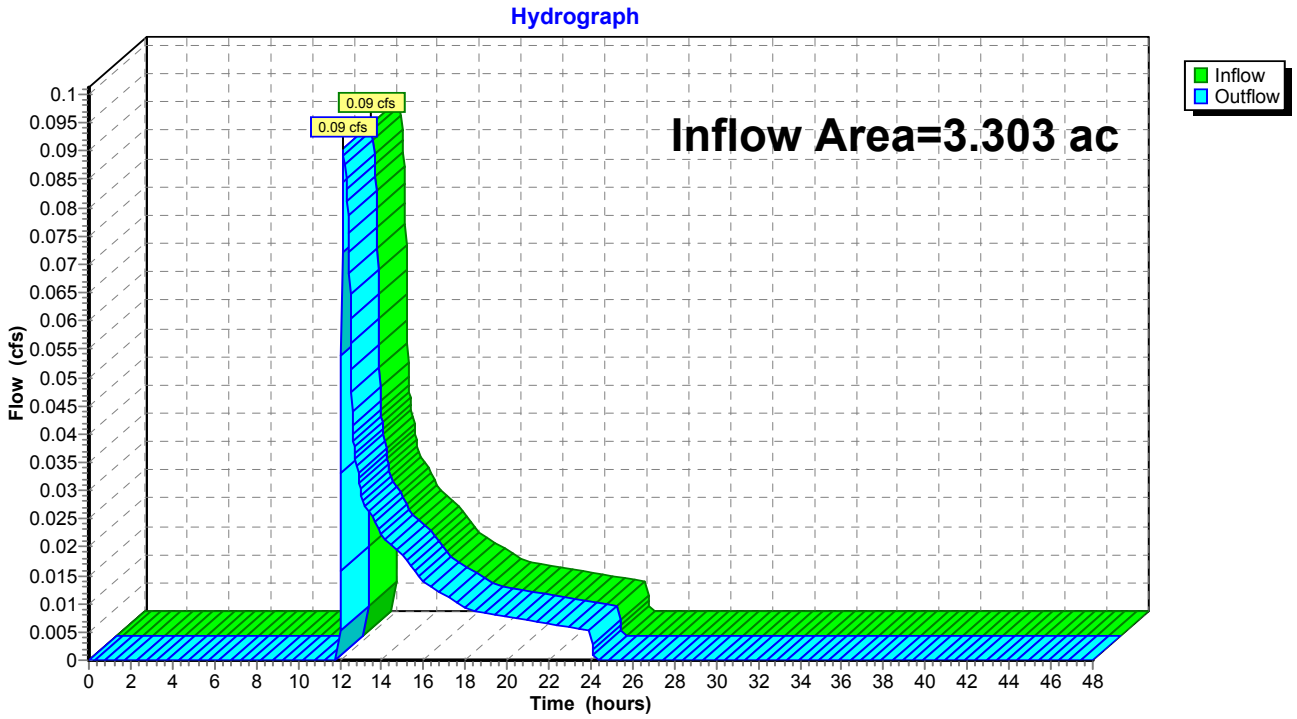


Summary for Reach DP-3: DP-3

Inflow Area = 3.303 ac, 51.80% Impervious, Inflow Depth = 0.05" for 2-Year event
Inflow = 0.09 cfs @ 12.16 hrs, Volume= 0.015 af
Outflow = 0.09 cfs @ 12.16 hrs, Volume= 0.015 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs

Reach DP-3: DP-3



Summary for Pond DB-1: Prop Detention Basin

Inflow Area = 2.809 ac, 60.45% Impervious, Inflow Depth = 1.44" for 2-Year event
Inflow = 4.63 cfs @ 12.09 hrs, Volume= 0.337 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 59.70' @ 24.36 hrs Surf.Area= 10,380 sf Storage= 14,668 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

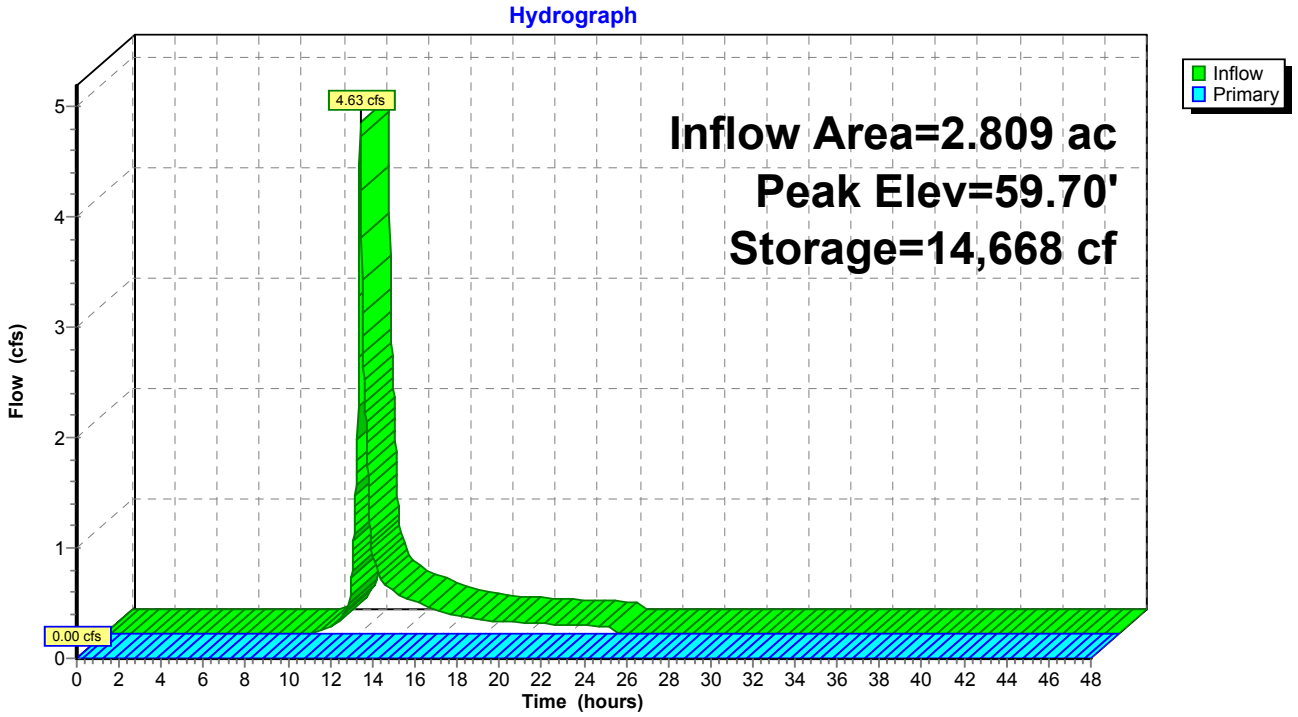
Volume	Invert	Avail.Storage	Storage Description
#1	58.00'	43,052 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
58.00	6,940	0	0
59.00	8,873	7,907	7,907
60.00	11,019	9,946	17,853
61.00	12,597	11,808	29,661
62.00	14,185	13,391	43,052

Device	Routing	Invert	Outlet Devices
#1	Primary	58.00'	**12.0" Round Culvert** L= 19.5' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 58.00' / 57.65' S= 0.0179 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	60.50'	**4.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	60.83'	**4.0' long x 0.50' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=58.00' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Controls 0.00 cfs)
  ├─**2=Orifice/Grate** (Controls 0.00 cfs)
  └─**3=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond DB-1: Prop Detention Basin



Time span=0.00-48.00 hrs, dt=0.02 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment3A-17R: Roofs 16-18 FB Runoff Area=9,510 sf 100.00% Impervious Runoff Depth=4.56"
Tc=6.0 min CN=98 Runoff=1.02 cfs 0.083 af

Subcatchment3A-S: Sub-3A Runoff Area=122,378 sf 60.45% Impervious Runoff Depth=2.37"
Tc=6.0 min CN=76 Runoff=7.77 cfs 0.555 af

Subcatchment3B-S1: Sub-3B-S1 Runoff Area=13,033 sf 2.85% Impervious Runoff Depth=0.88"
Tc=6.0 min CN=55 Runoff=0.24 cfs 0.022 af

Subcatchment3B-S2: Sub-3B-S2 Runoff Area=8,474 sf 2.25% Impervious Runoff Depth=0.83"
Tc=6.0 min CN=54 Runoff=0.14 cfs 0.013 af

Reach DP-3: DP-3 Inflow=0.38 cfs 0.043 af
Outflow=0.38 cfs 0.043 af

Pond DB-1: Prop Detention Basin Peak Elev=60.55' Storage=24,170 cf Inflow=7.77 cfs 0.555 af
Outflow=0.01 cfs 0.007 af

Total Runoff Area = 3.521 ac Runoff Volume = 0.674 af Average Runoff Depth = 2.30"
45.21% Pervious = 1.592 ac 54.79% Impervious = 1.929 ac

Summary for Subcatchment 3A-17R: Roofs 16-18 FB 22-23 FB

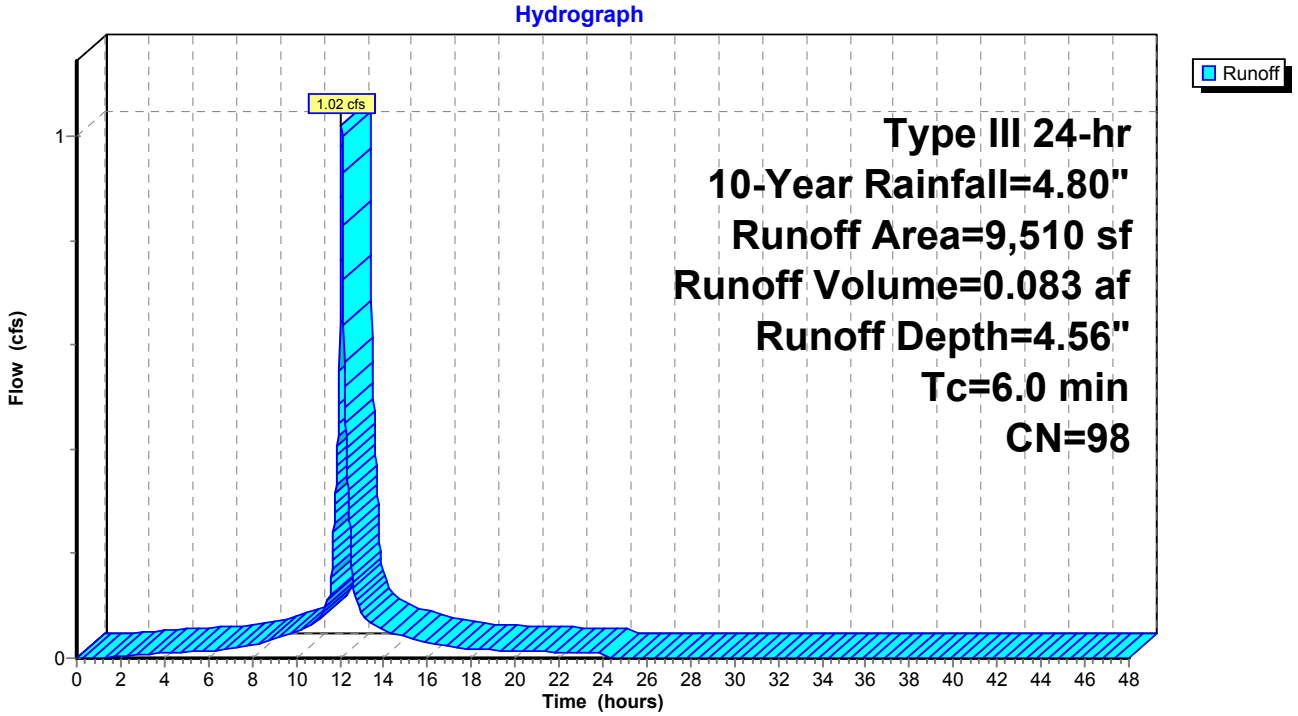
Runoff = 1.02 cfs @ 12.08 hrs, Volume= 0.083 af, Depth= 4.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (sf)	CN	Description
5,720	98	Roofs, HSG A
3,790	98	Roofs, HSG A
9,510	98	Weighted Average
9,510		100.00% Impervious Area

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

Subcatchment 3A-17R: Roofs 16-18 FB 22-23 FB



Summary for Subcatchment 3A-S: Sub-3A

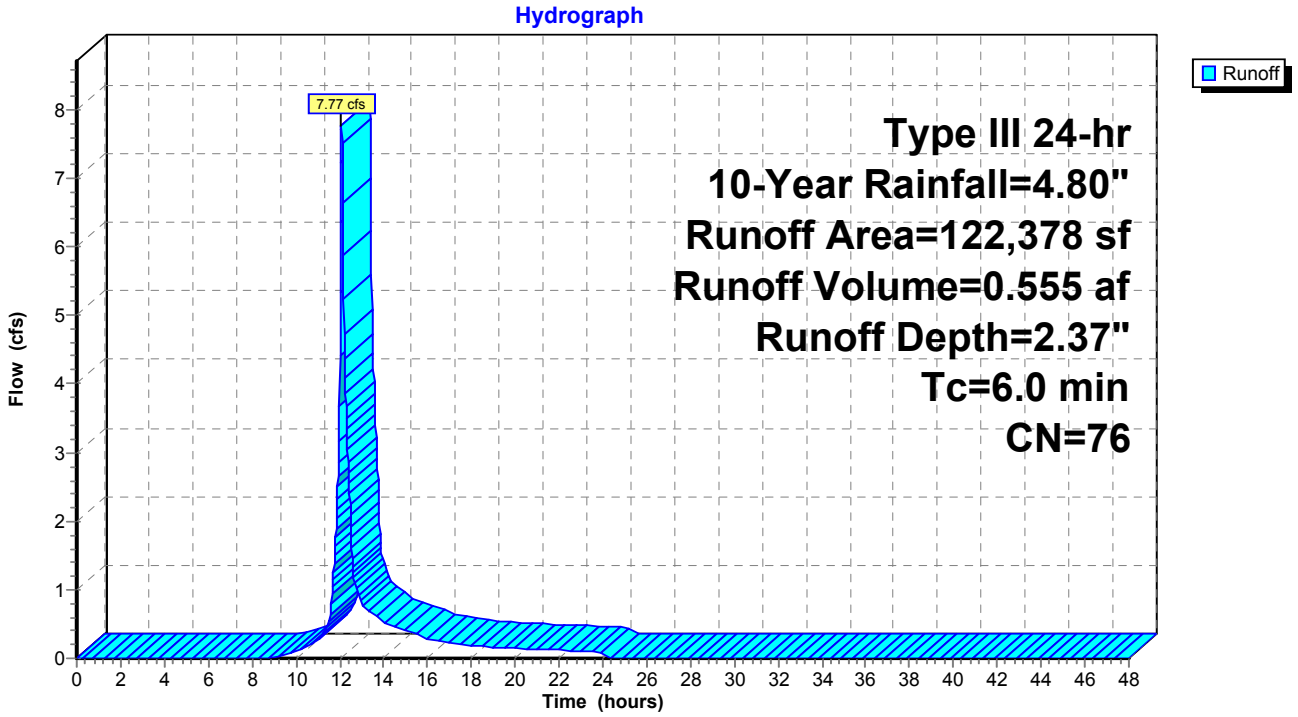
Runoff = 7.77 cfs @ 12.09 hrs, Volume= 0.555 af, Depth= 2.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (sf)	CN	Description
*	10,470	98	Paved drives, HSG A
*	2,526	98	Paved drives, HSG B
*	14,412	98	Paved roads w/curbs & sewers, HSG A
	8,829	98	Paved roads w/curbs & sewers, HSG B
*	3,274	98	Paved sidewalk, HSG A
*	1,229	98	Paved sidewalk, HSG B
*	882	98	Walks, HSG A
*	168	98	Walks, HSG B
*	0	98	Roofs, HSG A
*	0	98	Roofs, HSG B
	0	98	Roofs, HSG A
	0	98	Roofs, HSG A
*	2,702	98	Decks, HSG A
*	262	98	Decks, HSG B
*	7,626	98	Detention Basin, HSG A
*	4,140	98	Detention Basin, HSG B
	38,127	39	>75% Grass cover, Good, HSG A
	7,682	61	>75% Grass cover, Good, HSG B
*	0	98	Walls, HSG A
*	1,384	98	Roofs, HSG A - offsite
*	16,069	98	Paved parking, HSG A - offsite
*	914	39	>75% Grass cover, Good, HSG A - offsite
*	1,682	30	Woods, Good, HSG A - offsite
*	0	30	Woods, Good, HSG A - offsite
	122,378	76	Weighted Average
	48,405		39.55% Pervious Area
	73,973		60.45% Impervious Area

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

Subcatchment 3A-S: Sub-3A



Summary for Subcatchment 3B-S1: Sub-3B-S1

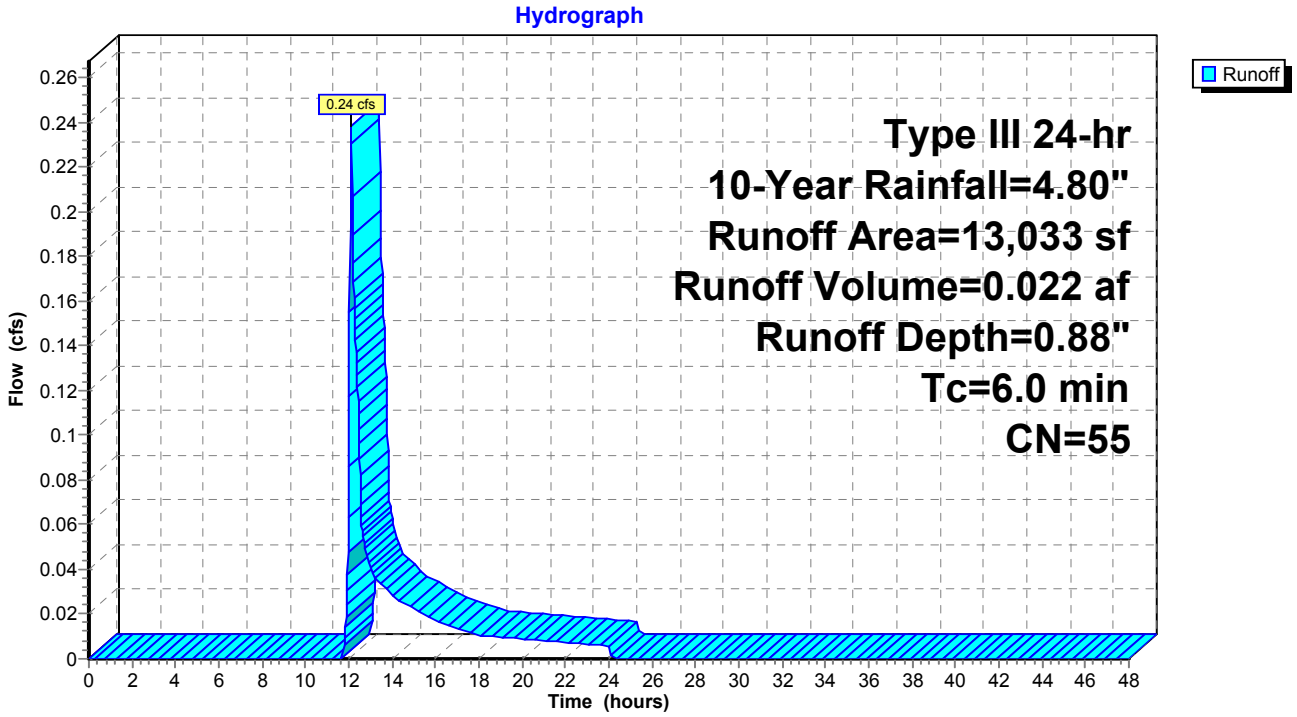
Runoff = 0.24 cfs @ 12.11 hrs, Volume= 0.022 af, Depth= 0.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (sf)	CN	Description
	3,060	55	Woods, Good, HSG B
	927	30	Woods, Good, HSG A
	0	39	>75% Grass cover, Good, HSG A
	4,574	61	>75% Grass cover, Good, HSG B
*	371	98	Decks, HSG B
*	62	30	Woods, Good, HSG A - offsite
*	1,346	39	>75% Grass cover, Good, HSG A - offsite
*	959	61	>75% Grass cover, Good, HSG B - offsite
*	1,734	55	Woods, Good, HSG B - offsite
	13,033	55	Weighted Average
	12,662		97.15% Pervious Area
	371		2.85% Impervious Area

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

Subcatchment 3B-S1: Sub-3B-S1



Summary for Subcatchment 3B-S2: Sub-3B-S2

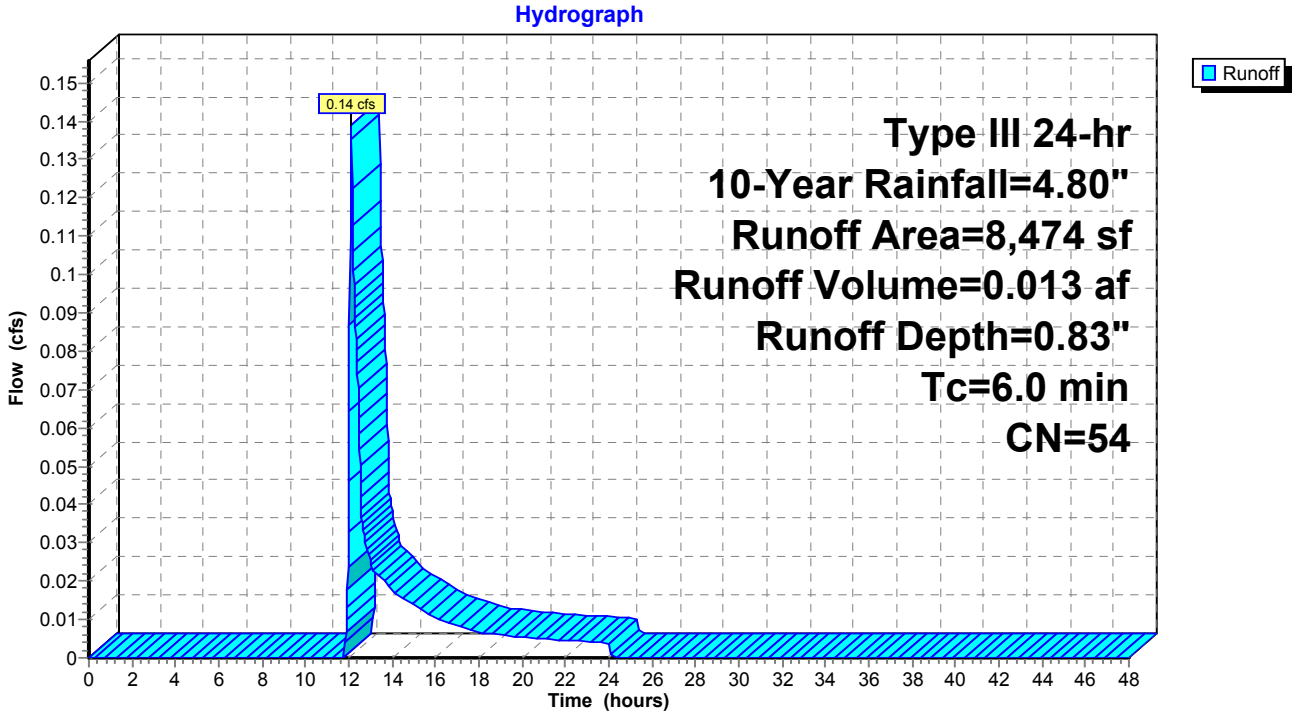
Runoff = 0.14 cfs @ 12.11 hrs, Volume= 0.013 af, Depth= 0.83"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (sf)	CN	Description
*	191	98	Riprap, HSG B
	496	30	Woods, Good, HSG A
	4,111	55	Woods, Good, HSG B
	1,240	39	>75% Grass cover, Good, HSG A
	2,436	61	>75% Grass cover, Good, HSG B
	8,474	54	Weighted Average
	8,283		97.75% Pervious Area
	191		2.25% Impervious Area

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

Subcatchment 3B-S2: Sub-3B-S2

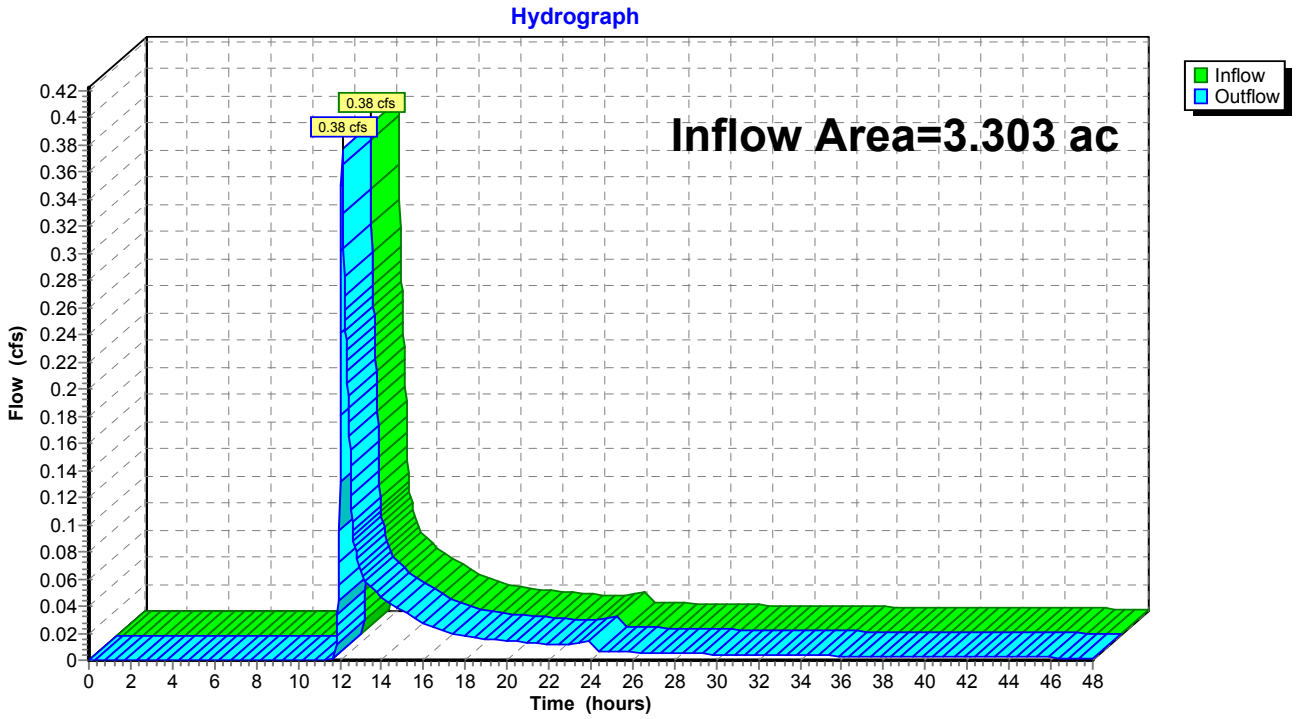


Summary for Reach DP-3: DP-3

Inflow Area = 3.303 ac, 51.80% Impervious, Inflow Depth > 0.15" for 10-Year event
Inflow = 0.38 cfs @ 12.11 hrs, Volume= 0.043 af
Outflow = 0.38 cfs @ 12.11 hrs, Volume= 0.043 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs

Reach DP-3: DP-3



Summary for Pond DB-1: Prop Detention Basin

Inflow Area = 2.809 ac, 60.45% Impervious, Inflow Depth = 2.37" for 10-Year event
Inflow = 7.77 cfs @ 12.09 hrs, Volume= 0.555 af
Outflow = 0.01 cfs @ 24.17 hrs, Volume= 0.007 af, Atten= 100%, Lag= 724.6 min
Primary = 0.01 cfs @ 24.17 hrs, Volume= 0.007 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 60.55' @ 24.17 hrs Surf.Area= 11,889 sf Storage= 24,170 cf

Plug-Flow detention time= 1,392.3 min calculated for 0.007 af (1% of inflow)
Center-of-Mass det. time= 1,146.9 min (1,981.1 - 834.2)

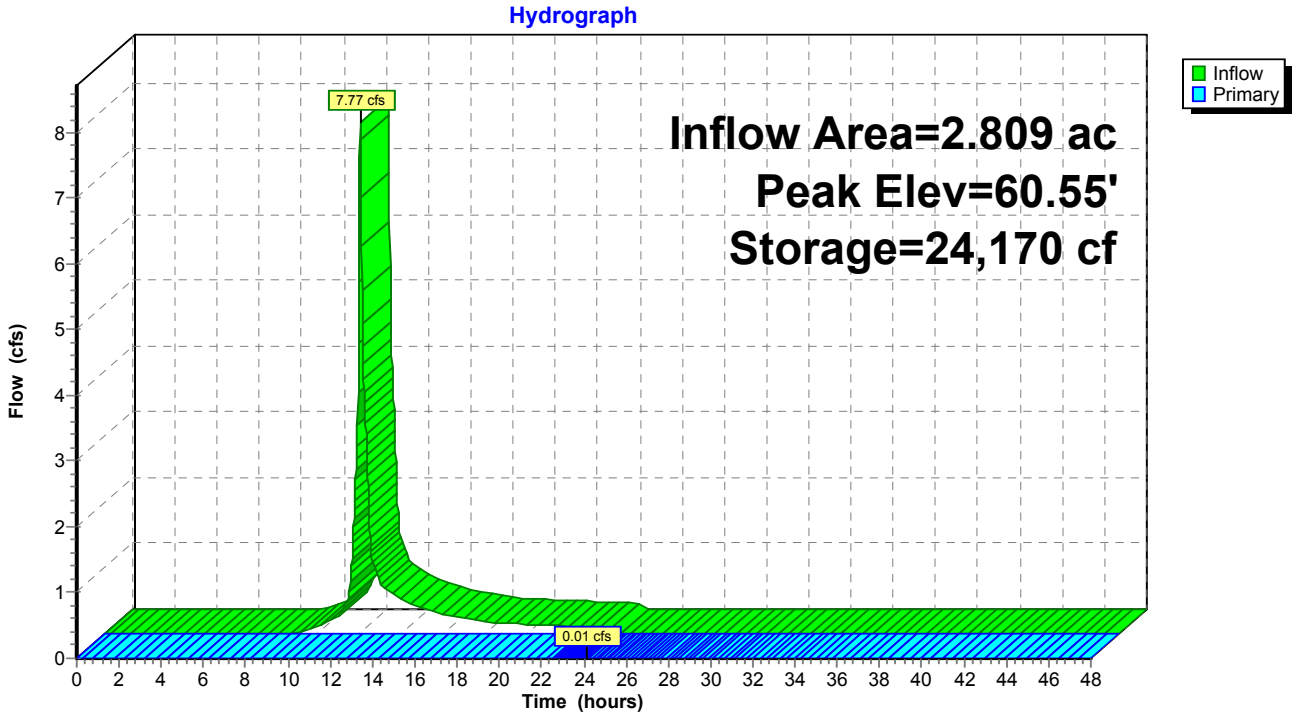
Volume	Invert	Avail.Storage	Storage Description
#1	58.00'	43,052 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
58.00	6,940	0	0
59.00	8,873	7,907	7,907
60.00	11,019	9,946	17,853
61.00	12,597	11,808	29,661
62.00	14,185	13,391	43,052

Device	Routing	Invert	Outlet Devices
#1	Primary	58.00'	**12.0" Round Culvert** L= 19.5' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 58.00' / 57.65' S= 0.0179 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	60.50'	**4.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	60.83'	**4.0' long x 0.50' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=0.01 cfs @ 24.17 hrs HW=60.55' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 0.01 cfs of 4.28 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.01 cfs @ 0.77 fps)
  └─**3=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond DB-1: Prop Detention Basin



Time span=0.00-48.00 hrs, dt=0.02 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment3A-17R: Roofs 16-18 FB Runoff Area=9,510 sf 100.00% Impervious Runoff Depth=5.46"
Tc=6.0 min CN=98 Runoff=1.22 cfs 0.099 af

Subcatchment3A-S: Sub-3A Runoff Area=122,378 sf 60.45% Impervious Runoff Depth=3.12"
Tc=6.0 min CN=76 Runoff=10.28 cfs 0.731 af

Subcatchment3B-S1: Sub-3B-S1 Runoff Area=13,033 sf 2.85% Impervious Runoff Depth=1.35"
Tc=6.0 min CN=55 Runoff=0.41 cfs 0.034 af

Subcatchment3B-S2: Sub-3B-S2 Runoff Area=8,474 sf 2.25% Impervious Runoff Depth=1.28"
Tc=6.0 min CN=54 Runoff=0.25 cfs 0.021 af

Reach DP-3: DP-3 Inflow=0.66 cfs 0.231 af
Outflow=0.66 cfs 0.231 af

Pond DB-1: Prop Detention Basin Peak Elev=60.82' Storage=27,428 cf Inflow=10.28 cfs 0.731 af
Outflow=0.17 cfs 0.177 af

Total Runoff Area = 3.521 ac Runoff Volume = 0.885 af Average Runoff Depth = 3.02"
45.21% Pervious = 1.592 ac 54.79% Impervious = 1.929 ac

Summary for Subcatchment 3A-17R: Roofs 16-18 FB 22-23 FB

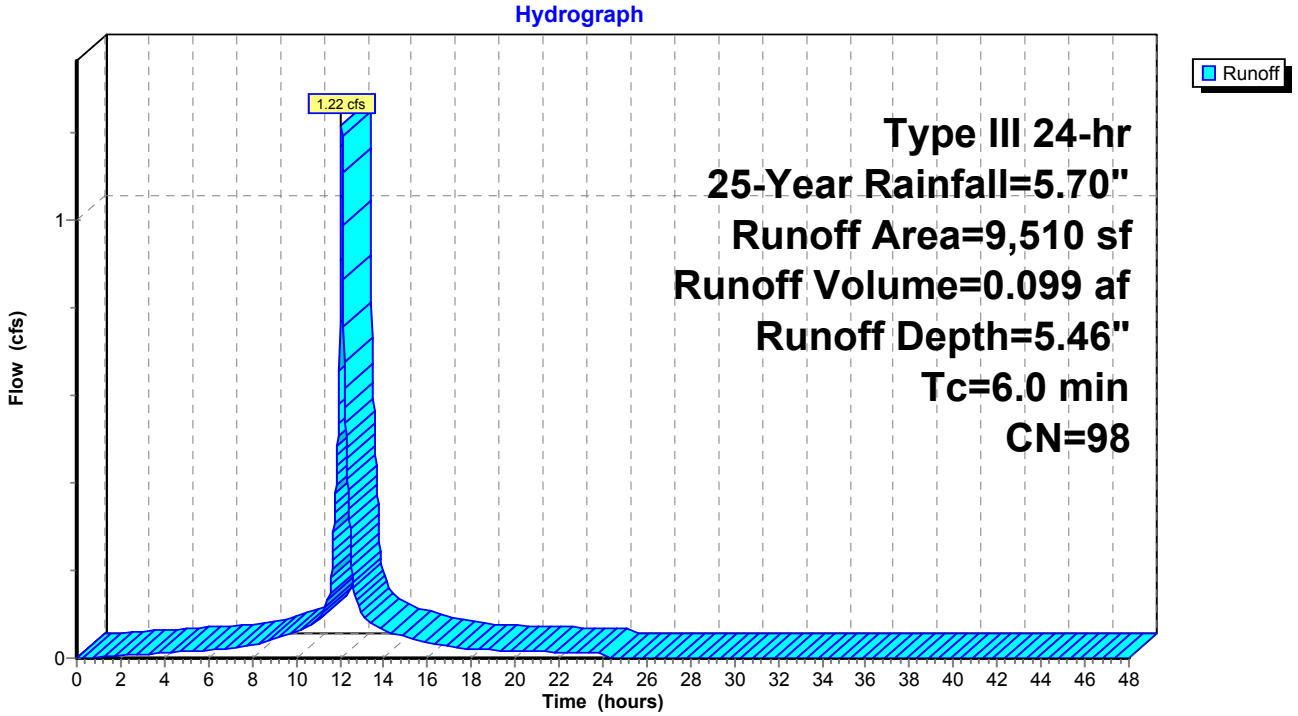
Runoff = 1.22 cfs @ 12.08 hrs, Volume= 0.099 af, Depth= 5.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-Year Rainfall=5.70"

Area (sf)	CN	Description
5,720	98	Roofs, HSG A
3,790	98	Roofs, HSG A
9,510	98	Weighted Average
9,510		100.00% Impervious Area

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

Subcatchment 3A-17R: Roofs 16-18 FB 22-23 FB



Summary for Subcatchment 3A-S: Sub-3A

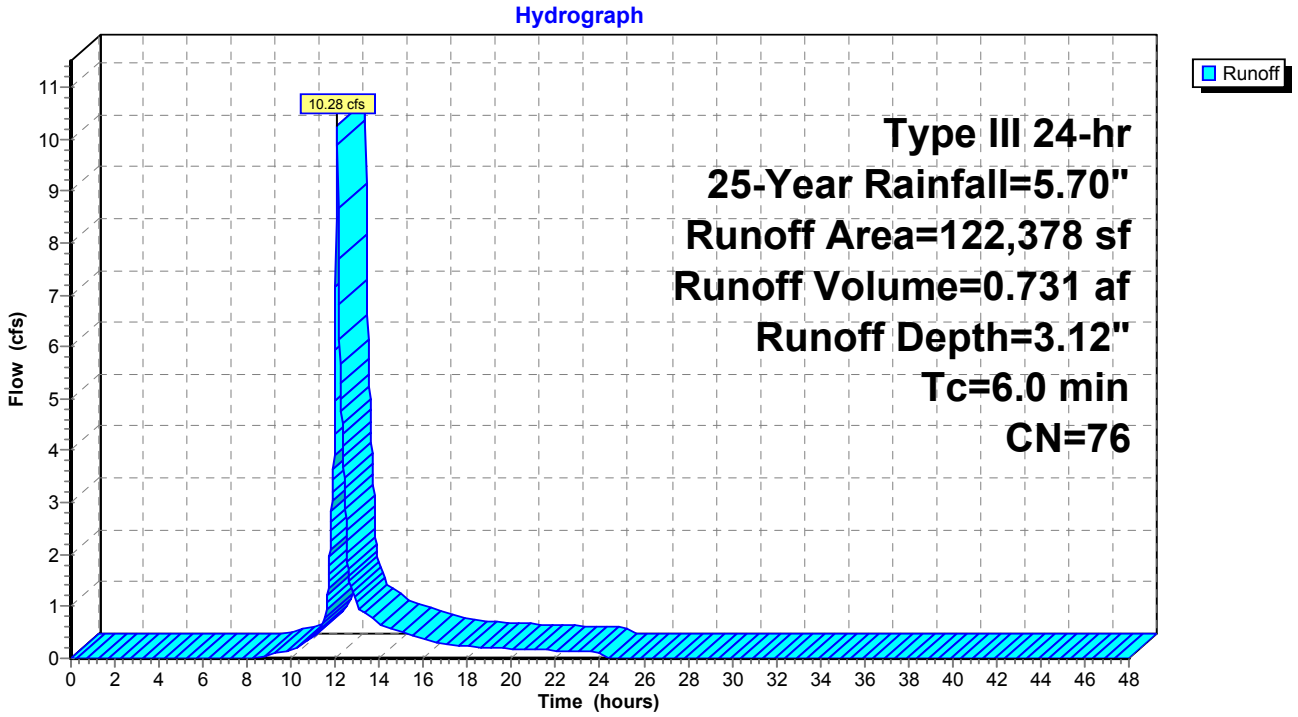
Runoff = 10.28 cfs @ 12.09 hrs, Volume= 0.731 af, Depth= 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-Year Rainfall=5.70"

	Area (sf)	CN	Description
*	10,470	98	Paved drives, HSG A
*	2,526	98	Paved drives, HSG B
*	14,412	98	Paved roads w/curbs & sewers, HSG A
	8,829	98	Paved roads w/curbs & sewers, HSG B
*	3,274	98	Paved sidewalk, HSG A
*	1,229	98	Paved sidewalk, HSG B
*	882	98	Walks, HSG A
*	168	98	Walks, HSG B
*	0	98	Roofs, HSG A
*	0	98	Roofs, HSG B
	0	98	Roofs, HSG A
	0	98	Roofs, HSG A
*	2,702	98	Decks, HSG A
*	262	98	Decks, HSG B
*	7,626	98	Detention Basin, HSG A
*	4,140	98	Detention Basin, HSG B
	38,127	39	>75% Grass cover, Good, HSG A
	7,682	61	>75% Grass cover, Good, HSG B
*	0	98	Walls, HSG A
*	1,384	98	Roofs, HSG A - offsite
*	16,069	98	Paved parking, HSG A - offsite
*	914	39	>75% Grass cover, Good, HSG A - offsite
*	1,682	30	Woods, Good, HSG A - offsite
*	0	30	Woods, Good, HSG A - offsite
	122,378	76	Weighted Average
	48,405		39.55% Pervious Area
	73,973		60.45% Impervious Area

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

Subcatchment 3A-S: Sub-3A



Summary for Subcatchment 3B-S1: Sub-3B-S1

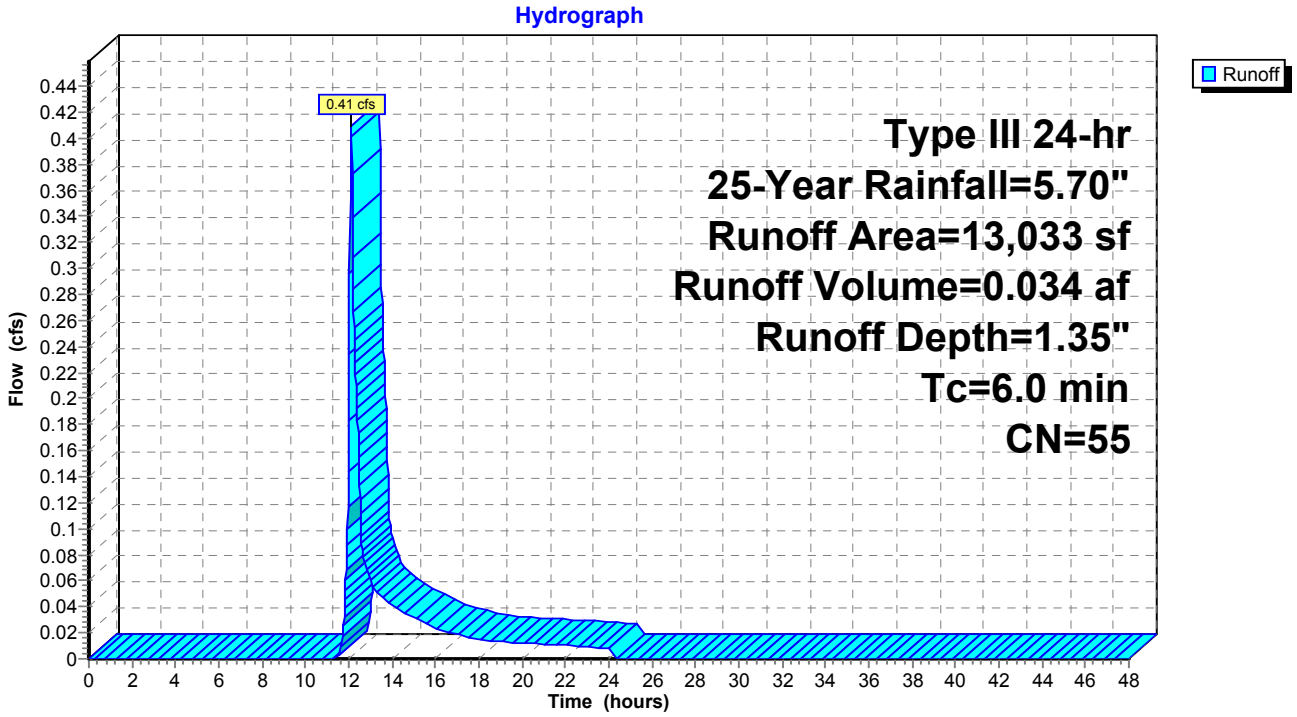
Runoff = 0.41 cfs @ 12.10 hrs, Volume= 0.034 af, Depth= 1.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-Year Rainfall=5.70"

	Area (sf)	CN	Description
	3,060	55	Woods, Good, HSG B
	927	30	Woods, Good, HSG A
	0	39	>75% Grass cover, Good, HSG A
	4,574	61	>75% Grass cover, Good, HSG B
*	371	98	Decks, HSG B
*	62	30	Woods, Good, HSG A - offsite
*	1,346	39	>75% Grass cover, Good, HSG A - offsite
*	959	61	>75% Grass cover, Good, HSG B - offsite
*	1,734	55	Woods, Good, HSG B - offsite
	13,033	55	Weighted Average
	12,662		97.15% Pervious Area
	371		2.85% Impervious Area

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

Subcatchment 3B-S1: Sub-3B-S1



Summary for Subcatchment 3B-S2: Sub-3B-S2

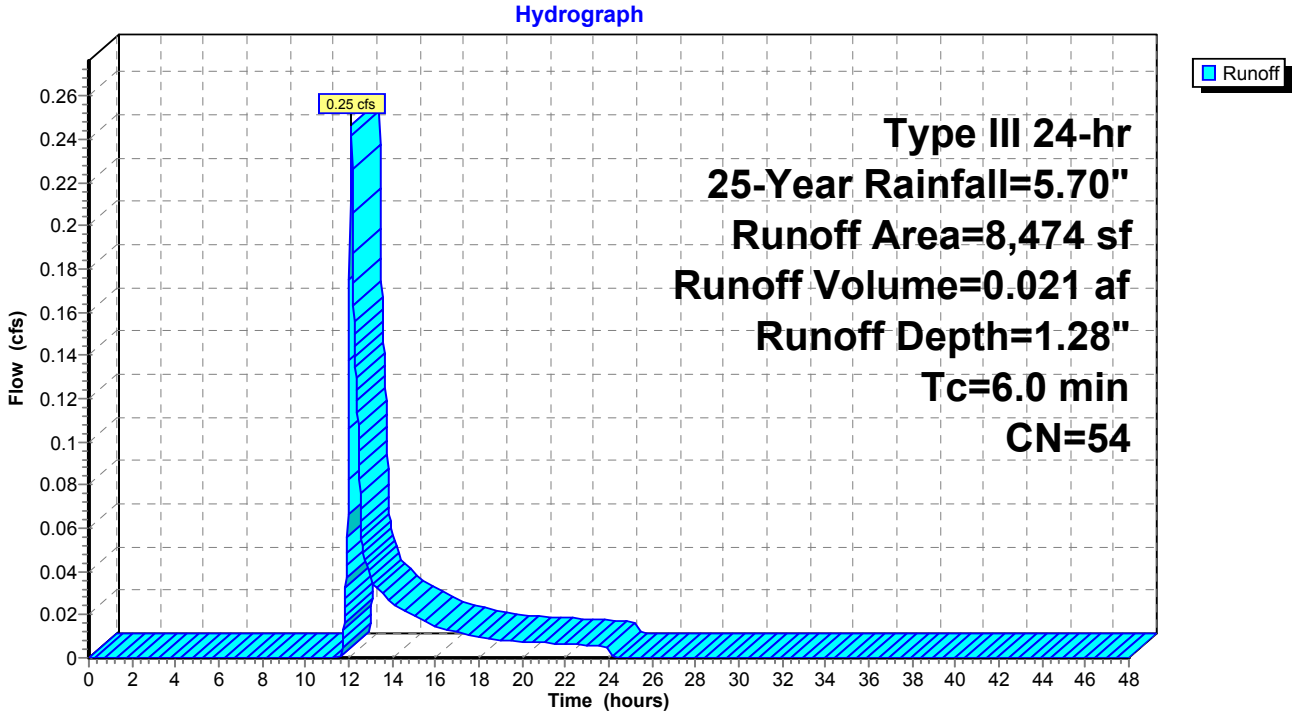
Runoff = 0.25 cfs @ 12.10 hrs, Volume= 0.021 af, Depth= 1.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-Year Rainfall=5.70"

	Area (sf)	CN	Description
*	191	98	Riprap, HSG B
	496	30	Woods, Good, HSG A
	4,111	55	Woods, Good, HSG B
	1,240	39	>75% Grass cover, Good, HSG A
	2,436	61	>75% Grass cover, Good, HSG B
	8,474	54	Weighted Average
	8,283		97.75% Pervious Area
	191		2.25% Impervious Area

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

Subcatchment 3B-S2: Sub-3B-S2

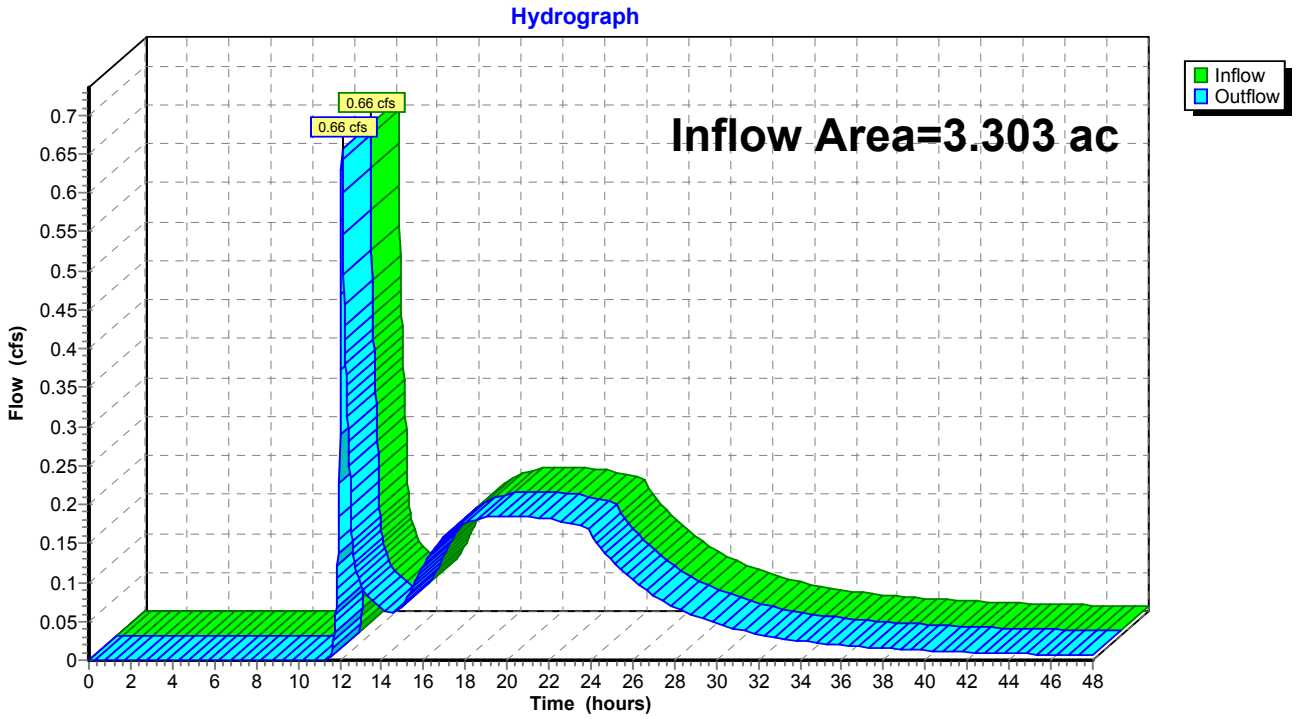


Summary for Reach DP-3: DP-3

Inflow Area = 3.303 ac, 51.80% Impervious, Inflow Depth > 0.84" for 25-Year event
Inflow = 0.66 cfs @ 12.10 hrs, Volume= 0.231 af
Outflow = 0.66 cfs @ 12.10 hrs, Volume= 0.231 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs

Reach DP-3: DP-3



Summary for Pond DB-1: Prop Detention Basin

Inflow Area = 2.809 ac, 60.45% Impervious, Inflow Depth = 3.12" for 25-Year event
Inflow = 10.28 cfs @ 12.09 hrs, Volume= 0.731 af
Outflow = 0.17 cfs @ 20.83 hrs, Volume= 0.177 af, Atten= 98%, Lag= 524.2 min
Primary = 0.17 cfs @ 20.83 hrs, Volume= 0.177 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 60.82' @ 20.83 hrs Surf.Area= 12,314 sf Storage= 27,428 cf

Plug-Flow detention time= 750.7 min calculated for 0.177 af (24% of inflow)
Center-of-Mass det. time= 613.1 min (1,439.4 - 826.3)

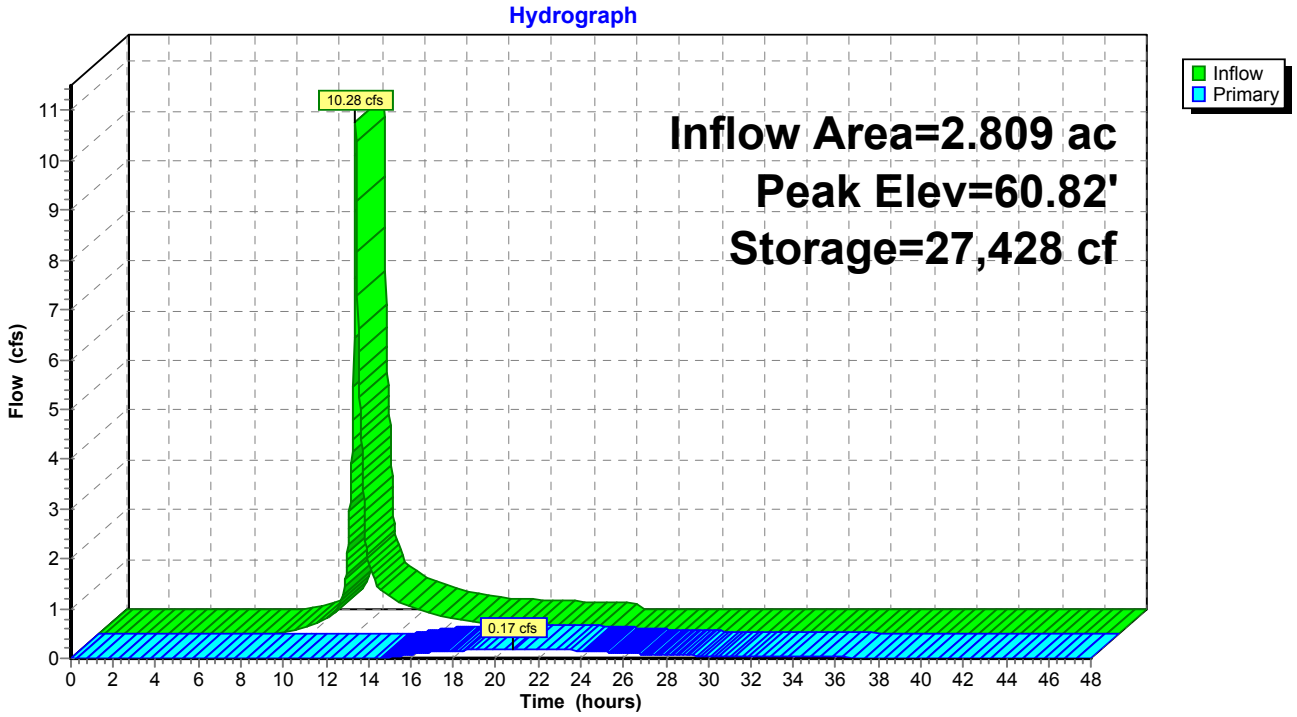
Volume	Invert	Avail.Storage	Storage Description
#1	58.00'	43,052 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
58.00	6,940	0	0
59.00	8,873	7,907	7,907
60.00	11,019	9,946	17,853
61.00	12,597	11,808	29,661
62.00	14,185	13,391	43,052

Device	Routing	Invert	Outlet Devices
#1	Primary	58.00'	**12.0" Round Culvert** L= 19.5' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 58.00' / 57.65' S= 0.0179 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	60.50'	**4.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	60.83'	**4.0' long x 0.50' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=0.17 cfs @ 20.83 hrs HW=60.82' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 0.17 cfs of 4.55 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.17 cfs @ 1.93 fps)
  └─**3=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond DB-1: Prop Detention Basin



Time span=0.00-48.00 hrs, dt=0.02 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment3A-17R: Roofs 16-18 FB Runoff Area=9,510 sf 100.00% Impervious Runoff Depth=6.86"
Tc=6.0 min CN=98 Runoff=1.52 cfs 0.125 af

Subcatchment3A-S: Sub-3A Runoff Area=122,378 sf 60.45% Impervious Runoff Depth=4.35"
Tc=6.0 min CN=76 Runoff=14.26 cfs 1.018 af

Subcatchment3B-S1: Sub-3B-S1 Runoff Area=13,033 sf 2.85% Impervious Runoff Depth=2.19"
Tc=6.0 min CN=55 Runoff=0.72 cfs 0.055 af

Subcatchment3B-S2: Sub-3B-S2 Runoff Area=8,474 sf 2.25% Impervious Runoff Depth=2.09"
Tc=6.0 min CN=54 Runoff=0.44 cfs 0.034 af

Reach DP-3: DP-3 Inflow=1.16 cfs 0.551 af
Outflow=1.16 cfs 0.551 af

Pond DB-1: Prop Detention Basin Peak Elev=60.97' Storage=29,267 cf Inflow=14.26 cfs 1.018 af
Outflow=0.90 cfs 0.463 af

Total Runoff Area = 3.521 ac Runoff Volume = 1.231 af Average Runoff Depth = 4.19"
45.21% Pervious = 1.592 ac 54.79% Impervious = 1.929 ac

Summary for Subcatchment 3A-17R: Roofs 16-18 FB 22-23 FB

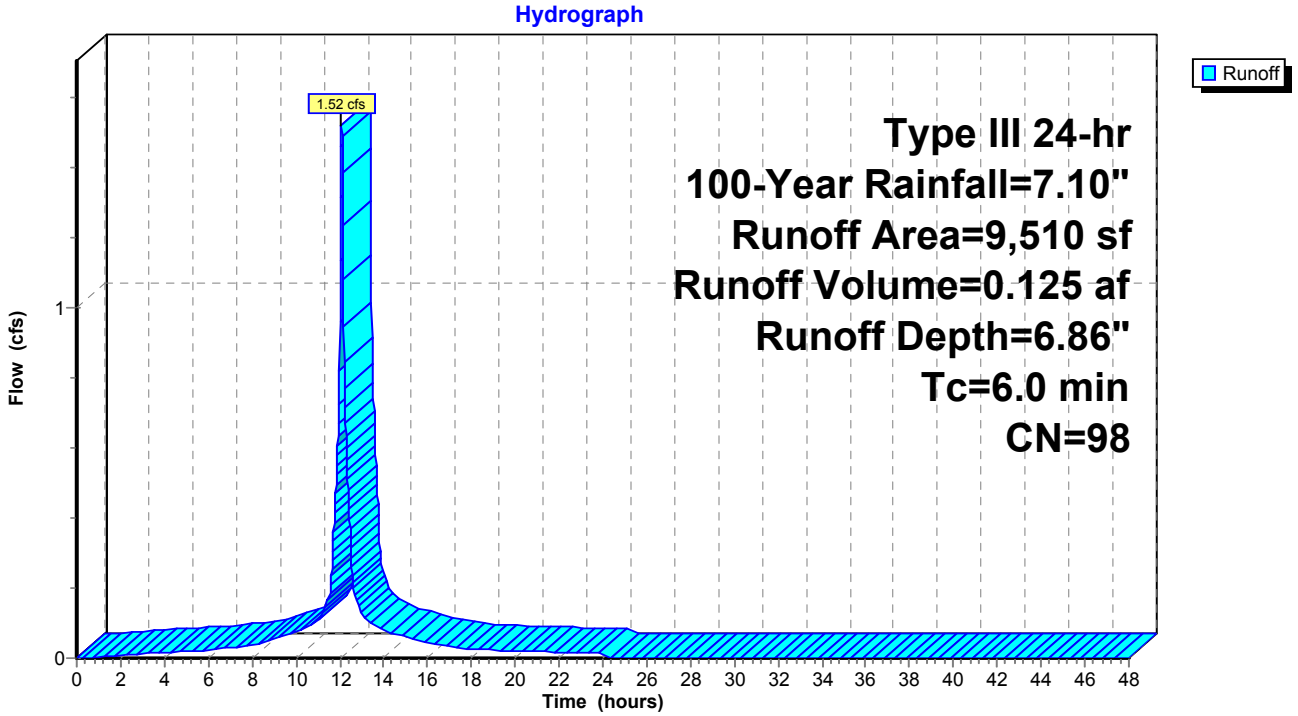
Runoff = 1.52 cfs @ 12.08 hrs, Volume= 0.125 af, Depth= 6.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year Rainfall=7.10"

Area (sf)	CN	Description
5,720	98	Roofs, HSG A
3,790	98	Roofs, HSG A
9,510	98	Weighted Average
9,510		100.00% Impervious Area

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

Subcatchment 3A-17R: Roofs 16-18 FB 22-23 FB



Summary for Subcatchment 3A-S: Sub-3A

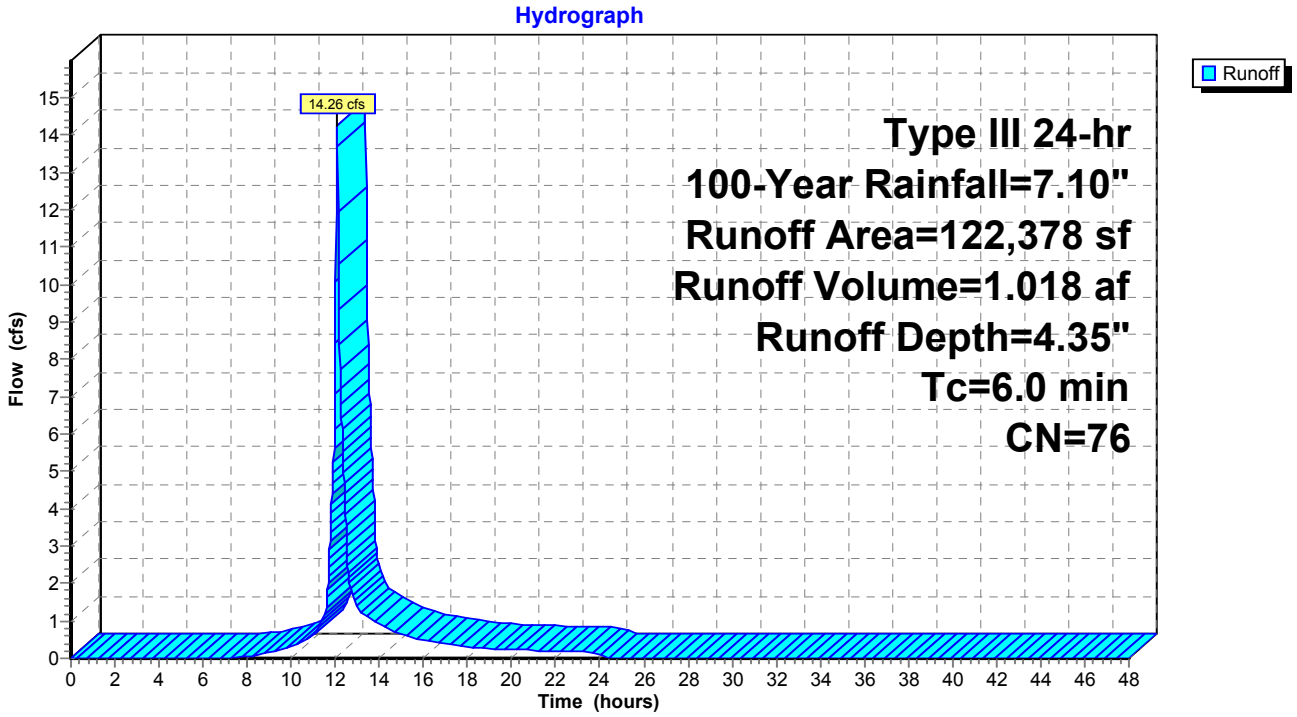
Runoff = 14.26 cfs @ 12.09 hrs, Volume= 1.018 af, Depth= 4.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year Rainfall=7.10"

	Area (sf)	CN	Description
*	10,470	98	Paved drives, HSG A
*	2,526	98	Paved drives, HSG B
*	14,412	98	Paved roads w/curbs & sewers, HSG A
	8,829	98	Paved roads w/curbs & sewers, HSG B
*	3,274	98	Paved sidewalk, HSG A
*	1,229	98	Paved sidewalk, HSG B
*	882	98	Walks, HSG A
*	168	98	Walks, HSG B
*	0	98	Roofs, HSG A
*	0	98	Roofs, HSG B
	0	98	Roofs, HSG A
	0	98	Roofs, HSG A
*	2,702	98	Decks, HSG A
*	262	98	Decks, HSG B
*	7,626	98	Detention Basin, HSG A
*	4,140	98	Detention Basin, HSG B
	38,127	39	>75% Grass cover, Good, HSG A
	7,682	61	>75% Grass cover, Good, HSG B
*	0	98	Walls, HSG A
*	1,384	98	Roofs, HSG A - offsite
*	16,069	98	Paved parking, HSG A - offsite
*	914	39	>75% Grass cover, Good, HSG A - offsite
*	1,682	30	Woods, Good, HSG A - offsite
*	0	30	Woods, Good, HSG A - offsite
	122,378	76	Weighted Average
	48,405		39.55% Pervious Area
	73,973		60.45% Impervious Area

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

Subcatchment 3A-S: Sub-3A



Summary for Subcatchment 3B-S1: Sub-3B-S1

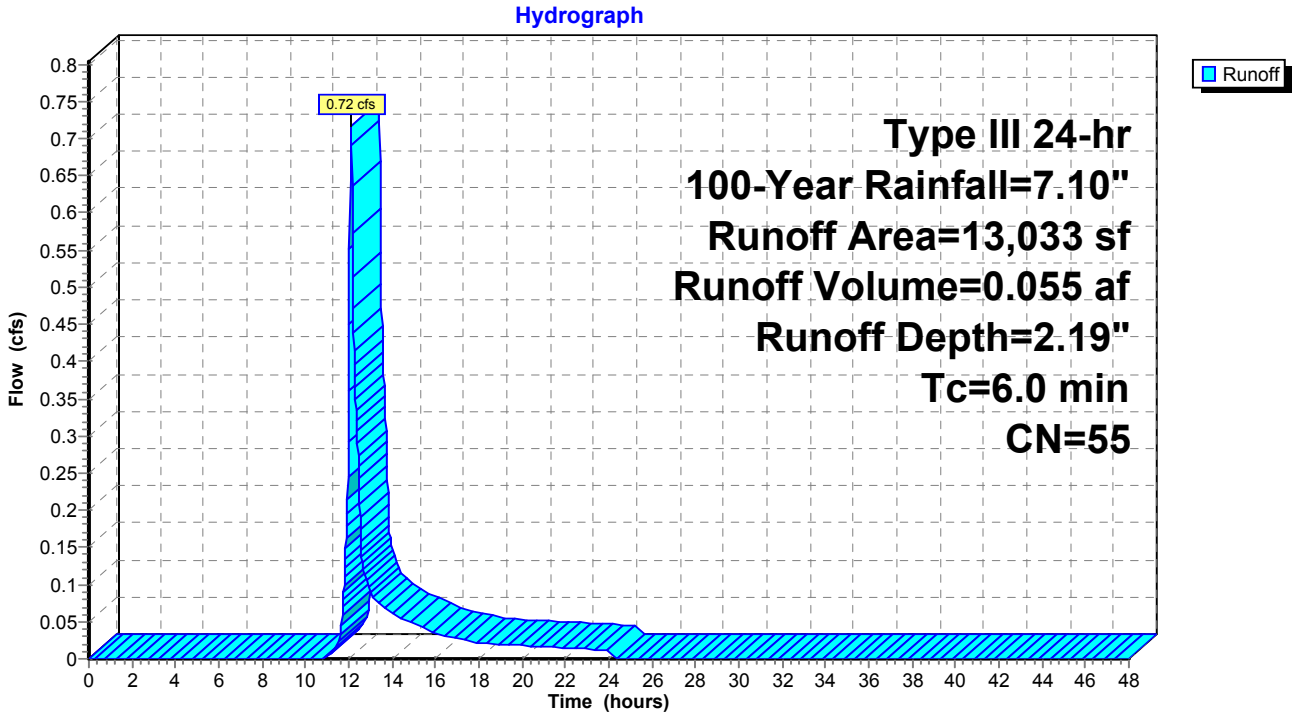
Runoff = 0.72 cfs @ 12.10 hrs, Volume= 0.055 af, Depth= 2.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year Rainfall=7.10"

	Area (sf)	CN	Description
	3,060	55	Woods, Good, HSG B
	927	30	Woods, Good, HSG A
	0	39	>75% Grass cover, Good, HSG A
	4,574	61	>75% Grass cover, Good, HSG B
*	371	98	Decks, HSG B
*	62	30	Woods, Good, HSG A - offsite
*	1,346	39	>75% Grass cover, Good, HSG A - offsite
*	959	61	>75% Grass cover, Good, HSG B - offsite
*	1,734	55	Woods, Good, HSG B - offsite
	13,033	55	Weighted Average
	12,662		97.15% Pervious Area
	371		2.85% Impervious Area

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

Subcatchment 3B-S1: Sub-3B-S1



Summary for Subcatchment 3B-S2: Sub-3B-S2

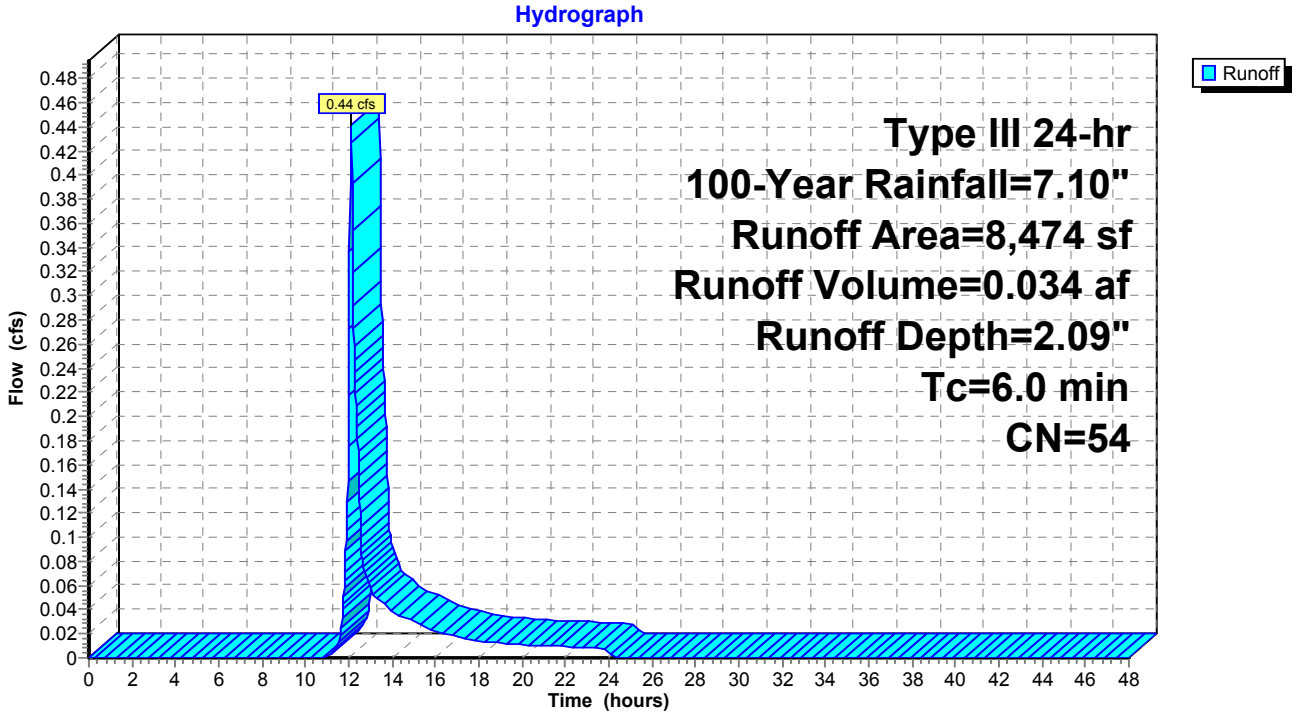
Runoff = 0.44 cfs @ 12.10 hrs, Volume= 0.034 af, Depth= 2.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year Rainfall=7.10"

	Area (sf)	CN	Description
*	191	98	Riprap, HSG B
	496	30	Woods, Good, HSG A
	4,111	55	Woods, Good, HSG B
	1,240	39	>75% Grass cover, Good, HSG A
	2,436	61	>75% Grass cover, Good, HSG B
	8,474	54	Weighted Average
	8,283		97.75% Pervious Area
	191		2.25% Impervious Area

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

Subcatchment 3B-S2: Sub-3B-S2

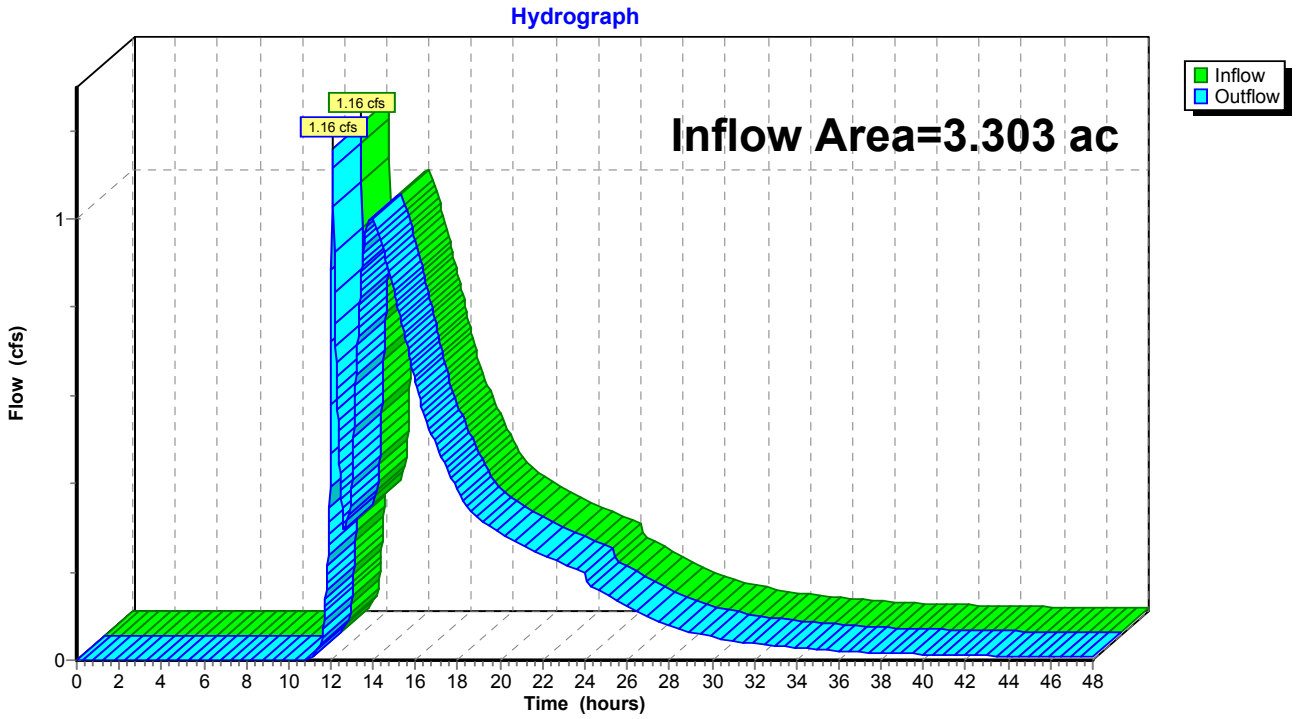


Summary for Reach DP-3: DP-3

Inflow Area = 3.303 ac, 51.80% Impervious, Inflow Depth > 2.00" for 100-Year event
Inflow = 1.16 cfs @ 12.10 hrs, Volume= 0.551 af
Outflow = 1.16 cfs @ 12.10 hrs, Volume= 0.551 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs

Reach DP-3: DP-3



Summary for Pond DB-1: Prop Detention Basin

Inflow Area = 2.809 ac, 60.45% Impervious, Inflow Depth = 4.35" for 100-Year event
Inflow = 14.26 cfs @ 12.09 hrs, Volume= 1.018 af
Outflow = 0.90 cfs @ 13.94 hrs, Volume= 0.463 af, Atten= 94%, Lag= 111.3 min
Primary = 0.90 cfs @ 13.94 hrs, Volume= 0.463 af

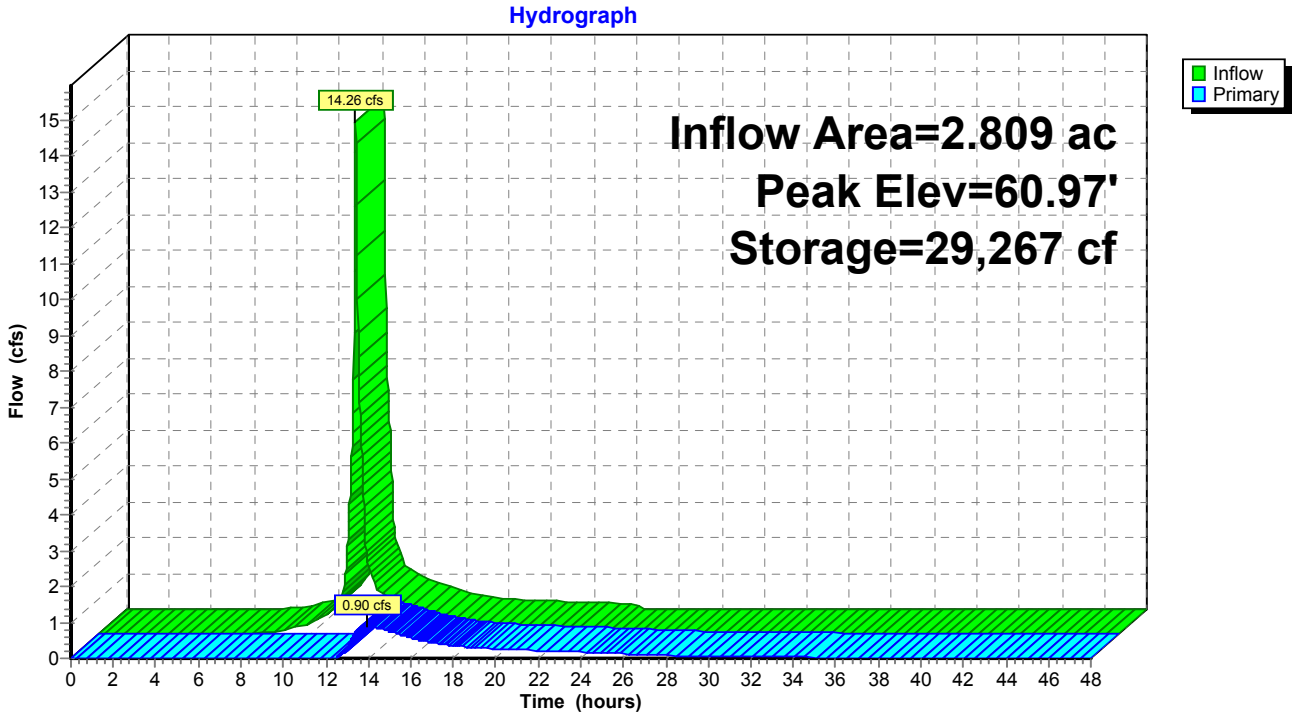
Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 60.97' @ 13.94 hrs Surf.Area= 12,548 sf Storage= 29,267 cf

Plug-Flow detention time= 448.2 min calculated for 0.463 af (45% of inflow)
Center-of-Mass det. time= 330.9 min (1,147.7 - 816.8)

Volume	Invert	Avail.Storage	Storage Description
#1	58.00'	43,052 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
58.00	6,940	0	0
59.00	8,873	7,907	7,907
60.00	11,019	9,946	17,853
61.00	12,597	11,808	29,661
62.00	14,185	13,391	43,052

Device	Routing	Invert	Outlet Devices
#1	Primary	58.00'	**12.0" Round Culvert** L= 19.5' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 58.00' / 57.65' S= 0.0179 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	60.50'	**4.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	60.83'	**4.0' long x 0.50' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=0.90 cfs @ 13.94 hrs HW=60.97' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 0.90 cfs of 4.69 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.23 cfs @ 2.65 fps)
  └─**3=Sharp-Crested Rectangular Weir** (Weir Controls 0.67 cfs @ 1.22 fps)

Pond DB-1: Prop Detention Basin