Prepared for

Santee Cooper
One Riverwood Drive
Moncks Corner, SC 29461

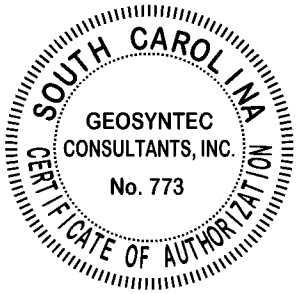
RUN-ON AND RUN-OFF CONTROL SYSTEM PLAN LANDFILL AREA 2

WINYAH GENERATING STATION

Prepared by

1300 South Mint Street, Suite 300
Charlotte, NC 28203





Project No. 26009458

November 2026

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1. INTRODUCTION

This Run-On and Run-Off Control System (ROROCS) Plan was prepared for the coal combustion residuals (CCR) Landfill Area 2 at Winyah Generating Station Class 3 Landfill (Winyah) as a periodic update to document how the run-on and run-off control systems have been designed and constructed to meet the regulatory requirements of 40 Code of Federal Regulations (CFR) 257.81 (run-on and run-off controls for CCR landfills). The supporting calculations for the run-on and run-off controls systems are provided as appendices to this ROROCS Plan.

The initial ROROCS Plan was prepared and certified in 2021 when the CCR Landfill Area 2 was newly built and was placed into the facility operating record prior to the date of initial receipt of CCR. This ROROCS Plan is the first subsequent plan (i.e., the first periodic update, being completed within the required five-year timeframe), and will be placed in Winyah's operating record, as required by 40 CFR 257.105(g)(3).

This periodic update has been refined to limit the scope of design, analysis, and control measure construction to be applicable to the operational conditions. Various calculations, such as leachate generation assessments, pump and pipe capacities, and stability of the landfill have been excluded from this update.

2. REGULATORY REQUIREMENTS

2.1 Federal CCR Rule

As required by 40 CFR 257.53 and 40 CFR 257.81, the owner or operator of a CCR landfill must design, construct, operate, and maintain:

- a run-on control system to prevent flow onto the active portion of the CCR unit during the peak discharge from a 24-hour, 25-year storm; and
- a run-off control system from the active portion of the CCR unit to collect and control at least the water volume resulting from a 24-hour, 25-year storm.

In the context of the CCR Rule, "active portion" is defined in 40 CFR 257.53 as that part of a CCR unit that has received or is receiving CCR or non-CCR wastes and that has not completed closure in accordance with Section 257.102.

2.2 Preamble to the Federal CCR Rule

Further clarification on the intent of this requirement of the CCR Rule is provided in the Preamble for the CCR Rule:

> *The owner or operator must design, construct, operate, and maintain the CCR landfill in such a way that any run-off generated from at least a 24-hour, 25-year storm must be collected through hydraulic structures, such as drainage ditches, toe drains, swales, or other means, and controlled so as to not adversely affect the condition of the CCR landfill. EPA has promulgated these requirements to minimize the detention time of run-off on the CCR landfill*

and minimize infiltration into the CCR landfill, to dissipate stormwater run-off velocity, and to minimize erosion of CCR landfill slopes. An additional concern with run-off from CCR landfills is the water quality of the run-off, which may collect suspended solids from the landfill slopes.

A description of run-on and run-off controls systems for Landfill Area 2 is included in subsequent sections of this ROROCS Plan.

3. DESIGN METHODOLOGY

3.1 Design Storm

Run-on and run-off controls systems were designed and constructed for hydraulic capacity for the 25-year, 24-hour storm event required by local and state regulations. Site-specific precipitation estimates were obtained from the National Oceanic and Atmospheric Administration (NOAA) Atlas 14, Volume 2, Version 3 for Georgetown, South Carolina, which indicates that the 25-year, 24-hour storm event generates 8.28 inches of precipitation at Winyah as presented in Table 1. Design calculations that support run-on and run-off control features against the assumed design storm are included in Appendix I of this ROROCS Plan. Interim and final cover stormwater features consist of perimeter and diversion berms to prevent stormwater run-on to the active face, attenuation basins and decant pipes to manage contact water run-off from the active face, and downdrains to convey stormwater run-off from the cap to the perimeter channel; these features were designed and constructed considering the 25-year, 24-hour storm event published for Georgetown County as described within the approved landfill permit application and in the landfill operations fill plan.

3.2 Run-Off and Routing Methodology

HydroCAD Version 10.20-3h and *Hydrologic Modeling System (HEC-HMS) Version 4.1* were used to apply the Soil Conservation Services (SCS) Technical Release 20 (TR-20) method to estimate run-off for interim and post-development conditions. Modeling was applied to calculate surface water run-off volumes, peak flow rates, routing of rainfall event hydrographs through perimeter channels and active face attenuation basins, and run-off discharge quantities supporting the design and operation of Landfill Area 2. Appendices I-A though I-C present detailed drainage calculations and results, including a detailed discussion of the parameters used in the analyses.

3.3 Design Drawings

Final conditions and construction details for run-on and run-off control system features are presented within the approved Permit Drawings of the Winyah Generating Station Class 3 Landfill Permit Application approved by the former South Carolina Department of Health and Environmental Control (DHEC) on 15 September 2017 (Permit #LF3-00042). Topographic information used in this evaluation was obtained from the December 2025 survey provided by Santee Cooper.

4. RUN-ON CONTROL

Run-on is defined as water that may flow towards any portion of a landfill. This section summarizes the proposed surface water management system design and describes the drainage features and components of the facility to divert stormwater run-on from reaching an active portion of Landfill Area 2.

Landfill Area 2 is located within the footprint of Ash Pond A and is bounded by a perimeter berm providing access to the landfill. The perimeter berm surrounding the landfill limits run-on from the surrounding areas; therefore, run-on potential is limited to stormwater flows from the perimeter berm around the landfill footprint.

Design calculations for run-on control are provided in Appendices I-B and I-C.

5. RUN-OFF CONTROL

Run-off is defined as stormwater, leachate, or liquid flows generated from a project area (landfill and associated features). Stormwater run-off management encompasses two classifications of run-off:

- Contact water (run-off that has contacted CCR) and
- Stormwater (run-off that has not contacted CCR).

Run-off controls for contact water and stormwater at Landfill Area 2 are described below.

As part of this periodic update, run-off control will be confirmed for the landfill in accordance to the methods prescribed in the original 2021 plan and within 40 CFR 257.3-3.

5.1 Contact Water Run-Off

Contact water is managed using decant structures located within the active landfill footprint. Each decant structure consists of a perforated vertical concrete riser pipe surrounded by an attenuation basin. The attenuation basin is a depressed area designed to temporarily detain contact water prior to discharge through the decant structure. The active disposal area, including the attenuation basin, is graded to drain toward the decant structure to facilitate collection and management of contact water.

At the time of this analysis, Landfill Area 2 included active Phase 2 and Phase 3 disposal areas. Contact water generated within each active disposal area is directed to a dedicated attenuation basin and decant structure. The attenuation basins provide temporary storage of contact water prior to discharge through the decant structures and serve as the primary contact water management features during active filling operations. The active disposal areas are graded to direct contact water toward the attenuation basin and decant structure associated with each phase.

The attenuation basins and decant structures were originally designed to provide temporary storage and controlled release of contact water generated within the active disposal areas. This update evaluates the continued performance of the existing contact water management system under current landfill conditions. Design calculations for contact water run-off control are provided in Appendix I-A.

5.2 Stormwater Run-Off

During operations, exterior side slopes of the landfill may be covered with interim soil cover or approved alternative cover as CCR placement progresses to prevent stormwater from contacting CCR. Stormwater run-off controls for non-contact water during CCR placement were designed and built based on the final cover system design; the interim features are constructed based on the final cover feature dimensions until final cover is constructed. The landfill has side slopes graded at 3 horizontal to 1 vertical (3H:1V) between drainage benches, and top deck slopes graded at five percent to maximize the removal of run-off. Drainage swales are constructed on the interim and final cover system to collect and divert surface water run-off into down drains to a perimeter channel at the toe of the landfill and then to the stormwater management areas. Stormwater run-off controls are capable of conveying flow from the 25-year, 24-hour storm event. Design calculations for stormwater run-off control are provided in Appendix I-B. Some of the stormwater management features were sized to convey non-contact water run-off from the final cover installation which results in a conservative analysis for interim conditions.

6. CONCLUSIONS

A review of the current conditions of the landfill from survey information, as well as a visual inspection, indicates that the landfill is being operated in accordance with the approved lift plans and permit documents to comply with federal regulations related to run-off control prevention measures.

As required by 40 CFR 257.81, the run-on control system at Landfill Area 2 was designed and built and is being maintained to prevent flow onto the active portion of the CCR unit during peak discharge from the 25-year, 24-hour storm event, and the run-off control system at Landfill Area 2 was designed and built and is being maintained to collect and control at least the water volume from the 25-year, 24-hour storm event.

TABLES

Table 1. NOAA Atlas 14 Precipitation Data

NOAA Atlas 14, Volume 2, Version 3
Location name: Georgetown, South Carolina, USA*
Latitude: 33.3343°, Longitude: -79.3551°
Elevation: 18.82 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

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

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.502 (0.468-0.543)	0.586 (0.545-0.638)	0.668 (0.619-0.722)	0.761 (0.703-0.823)	0.857 (0.789-0.927)	0.942 (0.863-1.02)	1.02 (0.929-1.10)	1.10 (0.993-1.19)	1.19 (1.07-1.29)	1.28 (1.14-1.39)
10-min	0.803 (0.748-0.868)	0.938 (0.872-1.02)	1.07 (0.992-1.16)	1.22 (1.13-1.32)	1.37 (1.26-1.48)	1.50 (1.38-1.62)	1.62 (1.48-1.75)	1.74 (1.57-1.88)	1.89 (1.69-2.04)	2.02 (1.79-2.19)
15-min	1.00 (0.935-1.09)	1.18 (1.10-1.28)	1.35 (1.25-1.46)	1.54 (1.42-1.67)	1.73 (1.59-1.87)	1.90 (1.74-2.05)	2.05 (1.87-2.22)	2.19 (1.99-2.37)	2.37 (2.13-2.57)	2.53 (2.25-2.75)
30-min	1.38 (1.28-1.49)	1.63 (1.51-1.77)	1.92 (1.78-2.08)	2.23 (2.06-2.41)	2.57 (2.36-2.77)	2.86 (2.62-3.09)	3.14 (2.86-3.39)	3.42 (3.09-3.69)	3.78 (3.38-4.09)	4.10 (3.64-4.45)
60-min	1.72 (1.60-1.85)	2.04 (1.90-2.22)	2.46 (2.29-2.67)	2.90 (2.68-3.14)	3.42 (3.14-3.69)	3.88 (3.55-4.19)	4.32 (3.94-4.67)	4.79 (4.34-5.18)	5.42 (4.86-5.87)	5.98 (5.32-6.50)
2-hr	2.08 (1.92-2.24)	2.49 (2.33-2.69)	3.07 (2.83-3.31)	3.66 (3.37-3.96)	4.37 (4.00-4.72)	5.01 (4.56-5.40)	5.63 (5.10-6.07)	6.27 (5.64-6.76)	7.10 (6.33-7.68)	7.85 (6.93-8.51)
3-hr	2.23 (2.06-2.42)	2.66 (2.45-2.91)	3.30 (3.03-3.59)	3.97 (3.64-4.33)	4.79 (4.37-5.21)	5.55 (5.02-6.03)	6.31 (5.66-6.84)	7.10 (6.33-7.71)	8.19 (7.20-8.91)	9.18 (7.98-10.0)
6-hr	2.66 (2.44-2.91)	3.19 (2.91-3.49)	3.94 (3.60-4.32)	4.75 (4.33-5.20)	5.76 (5.21-6.30)	6.69 (6.01-7.31)	7.61 (6.79-8.32)	8.62 (7.62-9.40)	9.97 (8.71-10.9)	11.2 (9.69-12.3)
12-hr	3.11 (2.84-3.44)	3.72 (3.39-4.11)	4.63 (4.21-5.12)	5.62 (5.10-6.20)	6.85 (6.17-7.54)	8.00 (7.15-8.78)	9.17 (8.12-10.0)	10.4 (9.15-11.4)	12.2 (10.5-13.4)	13.8 (11.8-15.2)
24-hr	3.64 (3.33-3.99)	4.42 (4.06-4.85)	5.71 (5.22-6.26)	6.77 (6.17-7.41)	8.28 (7.50-9.05)	9.53 (8.59-10.4)	10.9 (9.74-11.9)	12.3 (11.0-13.5)	14.4 (12.7-15.8)	16.1 (14.1-17.7)
2-day	4.30 (3.94-4.70)	5.21 (4.78-5.70)	6.66 (6.10-7.27)	7.85 (7.18-8.57)	9.56 (8.68-10.4)	11.0 (9.90-12.0)	12.5 (11.2-13.6)	14.1 (12.6-15.4)	16.4 (14.5-18.1)	18.3 (16.0-20.2)
3-day	4.55 (4.18-4.98)	5.50 (5.06-6.03)	7.00 (6.41-7.65)	8.21 (7.50-8.97)	9.93 (9.03-10.8)	11.3 (10.3-12.4)	12.9 (11.6-14.1)	14.5 (12.9-15.8)	16.7 (14.8-18.4)	18.6 (16.4-20.5)
4-day	4.81 (4.42-5.27)	5.80 (5.33-6.36)	7.33 (6.72-8.02)	8.57 (7.83-9.37)	10.3 (9.37-11.3)	11.7 (10.6-12.8)	13.2 (11.9-14.5)	14.8 (13.3-16.2)	17.1 (15.2-18.8)	18.9 (16.7-20.9)
7-day	5.61 (5.19-6.10)	6.76 (6.25-7.35)	8.44 (7.78-9.16)	9.78 (9.00-10.6)	11.6 (10.7-12.6)	13.1 (12.0-14.2)	14.7 (13.3-16.0)	16.3 (14.8-17.8)	18.6 (16.7-20.3)	20.5 (18.3-22.4)
10-day	6.36 (5.91-6.87)	7.63 (7.08-8.23)	9.36 (8.68-10.1)	10.7 (9.91-11.5)	12.5 (11.6-13.5)	14.0 (12.9-15.1)	15.5 (14.2-16.7)	17.0 (15.5-18.4)	19.1 (17.3-20.7)	20.9 (18.8-22.6)
20-day	8.60 (8.05-9.20)	10.2 (9.59-11.0)	12.4 (11.6-13.2)	14.0 (13.1-15.0)	16.3 (15.2-17.4)	18.0 (16.7-19.3)	19.8 (18.3-21.2)	21.7 (20.0-23.2)	24.2 (22.1-26.0)	26.2 (23.8-28.2)
30-day	10.6 (9.98-11.2)	12.6 (11.8-13.3)	14.9 (14.0-15.8)	16.7 (15.7-17.7)	19.0 (17.8-20.1)	20.8 (19.5-22.1)	22.6 (21.1-24.0)	24.4 (22.7-26.0)	26.9 (24.8-28.6)	28.8 (26.5-30.7)
45-day	13.4 (12.7-14.2)	15.8 (15.0-16.8)	18.5 (17.5-19.6)	20.5 (19.3-21.7)	23.1 (21.8-24.5)	25.1 (23.6-26.6)	27.1 (25.4-28.7)	29.0 (27.1-30.9)	31.6 (29.4-33.7)	33.6 (31.1-35.9)
60-day	16.0 (15.1-16.9)	18.8 (17.8-19.9)	21.8 (20.6-23.0)	24.1 (22.7-25.4)	26.9 (25.3-28.4)	29.1 (27.3-30.7)	31.2 (29.3-33.0)	33.3 (31.1-35.3)	36.0 (33.6-38.3)	38.1 (35.4-40.6)

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

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

Please refer to NOAA Atlas 14 document for more information.

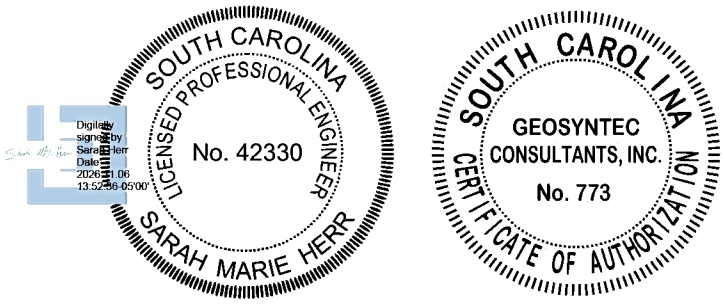
APPENDICES

APPENDIX I-A

Active Area Run-Off Control Calculations

Written by:	**A. Brand**	Date:	**10/16/2026**	Reviewed by:	**S. Herr**	Date:	**11/6/2026**
Client:	**Santee Cooper**	Project:	**Winyah Generating Station**	Project No.:	**26009458**	Task No.:	**005**

ACTIVE AREA RUN-OFF CONTROL



SEALED FOR

CALCULATION PAGES 1 THROUGH 9

1. PURPOSE

The purpose of this calculation package is to evaluate the active area run-off control design for Landfill Area 2 at Winyah Generating Station (WGS) located in Georgetown County, South Carolina. The calculations are used to:

- estimate contact water generation from the 25-year, 24-hour and 100-year, 24-hour storm events and
- evaluate the hydraulic performance of the contact water attenuation basins and decant structures used to manage and convey contact water from the active areas.

2. METHOD OF ANALYSIS

Contact water, or stormwater run-off that has been in contact with exposed waste in the active areas, is managed and conveyed with attenuation basins and decant structures. The decant structures consist of perforated vertical concrete riser pipes and are surrounded by attenuation basins. The attenuation basins are depressed areas around the decant structures intended to temporarily detain contact water. The entire active areas, including the attenuation basins, are graded to drain towards the decant structures.

At the time of this analysis, Landfill Area 2 included active Phase 2 and Phase 3 disposal areas. The phases are served by dedicated attenuation basins and decant structures, which were evaluated as part of the run-off control system analysis.

The contact water drainage areas, attenuation basins, and decant structures were modeled using *HydroCAD Version 10.20-3h* [HydroCAD, 2024]. The original attenuation basins and decant structures were sized to drain contact water generated from the 25-year, 24-hour storm event within approximately 3 days and to manage contact water generated from the 100-year, 24-hour storm event. This update to the original 2016 calculation provided in the 2021 Initial Run-On and Run-Off Control System (ROROCS) Plan does not include an analysis for the temporary and permanent leachate storage ponds. The assumptions and analyses performed within the 2016 evaluation are assumed to be the same at the time of the writing of this updated calculation.

Construction details are presented within the approved Permit Drawings of the Winyah Generating Station Class 3 Landfill Permit Application approved by the former South Carolina Department of Health and Environmental Control (DHEC) on 15 September 2017 (Permit #LF3-00042). Topographic information used in this evaluation was obtained from the December 2025 survey provided by Santee Cooper. All elevations presented herein are referenced to the North American Vertical Datum of 1988 (NAVD 88).

3. DESIGN PARAMETERS

Rainfall Event

The rainfall depths corresponding to the 25-year, 24-hour and 100-year, 24-hour storm events were selected based on information from the National Oceanic and Atmospheric Administration (NOAA) Atlas 14, Volume 2, Version 3 Point Precipitation Frequency Estimates [NOAA, 2026]. The 25-year, 24-hour rainfall depth is 8.28 inches, and the 100-year, 24-hour rainfall depth is 10.9 inches, as shown in Table 1. The rainfall intensity used in the analysis was the Soil Conservation Service (SCS) Type III distribution.

Contact Water Catchment Area

The hydrologic analysis was based on the recent survey. As Landfill Area 2 reaches final grades, cover soil will be placed on the fill side slopes, and the active areas will decrease. The surface conditions of the catchment areas were assumed to be bare (i.e., without vegetation) and graded to drain towards the decant structures. The run-off curve number of the surface material was assumed to be 97 based on the Hydrologic Evaluation of Landfill Performance (HELP) model provided in the 2021 Initial ROROCS Plan. The time of concentration for contact water to drain from the catchment areas to the decant structures of the attenuation basins was assumed to be 6 minutes.

Contact Water Attenuation Basins and Decant Structures

The attenuation basins are depressed areas surrounding the decant structures that attenuate contact water inflow by temporarily detaining it while it flows into the decant structures. The attenuation basins are constructed with minimum depths of 4 feet and sideslopes of approximately 5H:1V. The decant structures are extended vertically upward as Landfill Area 2 is filled. Since the active areas and corresponding contact water generation rates will decrease as Landfill Area 2 is filled, the size of the attenuation basins required to manage contact water also decreases. For the purposes of this calculation package, the attenuation basins are sized assuming the largest active areas and corresponding approximate waste elevations. Table 2 presents the Phase 2 and Phase 3 surface areas and storage volumes derived from the most recent survey. For Phase 2, the attenuation basin sizing includes a proposed berm that will be added along the access road to provide containment up to an elevation of 70 feet NAVD 88, as shown in Table 2.

The decant structures include vertical 36-inch diameter perforated reinforced concrete pipes. The pipes are installed in 4-foot segments, and the perforations are 2 inches in diameter, spaced at 30-degree intervals around the pipes (i.e., 12 perforations per row), and staggered vertically at 12-inch spacing for a total of 4 rows. The Phase 2 and Phase 3 decant structures discharge through separate 18-inch diameter high-density polyethylene (HDPE) pipes that converge at a common junction box. The combined flow is then conveyed approximately 608 feet through a 30-inch diameter corrugated HDPE pipe to a single outfall. Details of the Phase 2 and Phase 3 pipe networks are provided in Table 3.

The attenuation basins and decant structures for Phase 2 and Phase 3 were modeled under the following four scenarios:

1. The Phase 2 and Phase 3 decant structures are operating normally.
2. The Phase 2 decant structure is operating normally, and the Phase 3 decant structure is clogged and does not discharge from its attenuation basin.
3. The Phase 2 decant structure is clogged and does not discharge from its attenuation basin, and the Phase 3 decant structure is operating normally.
4. The Phase 2 and Phase 3 decant structures are clogged and do not discharge water from their respective attenuation basins.

4. RESULTS

Model outputs for Scenarios 1 through 4 for the Phase 2 and Phase 3 attenuation basins are presented in Table 4. The peak water surface elevations within the attenuation basins, assuming

the decant structures are clogged (i.e., Scenario 4), were 67.58 feet NAVD 88 for the 25-year, 24-hour storm event and 68.50 feet NAVD 88 for the 100-year, 24-hour storm event within the Phase 2 attenuation basin and 69.23 feet NAVD 88 for the 25-year, 24-hour storm event and 70.20 feet NAVD 88 for the 100-year, 24-hour storm event within the Phase 3 attenuation basin. With the addition of the proposed berm that will be added along the access road to provide containment up to an elevation of 70 feet NAVD 88 for the Phase 2 attenuation basin, the Phase 2 and Phase 3 attenuation basins provide at least 1 foot of freeboard for the 25-year, 24-hour and 100-year, 24-hour storm events.

5. CONCLUSIONS

Based on the calculations presented herein, the Phase 2 and Phase 3 attenuation basins located within Landfill Area 2 will contain contact water within the working area for the 25-year, 24-hour and 100-year, 24-hour storm events, even under the worst-case hypothetical scenario with both decant structures non-operational.

6. REFERENCES

HydroCAD (2024). *HydroCAD Stormwater Modeling System.* Version 10.20-3h.

NOAA (2026). *Precipitation-Frequency Atlas of the United States.* Atlas 14, Volume 2, Version 3.0, National Oceanic and Atmospheric Administration.

TABLE 1 – NOAA Point Precipitation Data

NOAA Atlas 14, Volume 2, Version 3
Location name: Georgetown, South Carolina, USA*
Latitude: 33.3343°, Longitude: -79.3551°
Elevation: 18.82 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

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

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
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10-min	0.803 (0.748-0.868)	0.938 (0.872-1.02)	1.07 (0.992-1.16)	1.22 (1.13-1.32)	1.37 (1.26-1.48)	1.50 (1.38-1.62)	1.62 (1.48-1.75)	1.74 (1.57-1.88)	1.89 (1.69-2.04)	2.02 (1.79-2.18)
15-min	1.00 (0.935-1.09)	1.18 (1.10-1.28)	1.35 (1.25-1.46)	1.54 (1.42-1.67)	1.73 (1.59-1.87)	1.90 (1.74-2.05)	2.05 (1.87-2.22)	2.19 (1.99-2.37)	2.37 (2.13-2.57)	2.53 (2.25-2.75)
30-min	1.38 (1.28-1.49)	1.63 (1.51-1.77)	1.92 (1.78-2.08)	2.23 (2.06-2.41)	2.57 (2.36-2.77)	2.86 (2.62-3.09)	3.14 (2.88-3.39)	3.42 (3.09-3.69)	3.78 (3.38-4.09)	4.10 (3.64-4.45)
60-min	1.72 (1.60-1.85)	2.04 (1.90-2.22)	2.46 (2.29-2.67)	2.90 (2.68-3.14)	3.42 (3.14-3.69)	3.88 (3.55-4.19)	4.32 (3.94-4.67)	4.79 (4.34-5.18)	5.42 (4.86-5.87)	5.98 (5.32-6.50)
2-hr	2.08 (1.92-2.24)	2.49 (2.30-2.69)	3.07 (2.83-3.31)	3.66 (3.37-3.96)	4.37 (4.00-4.72)	5.01 (4.58-5.40)	5.63 (5.10-6.07)	6.27 (5.64-6.76)	7.10 (6.33-7.65)	7.85 (6.93-8.51)
3-hr	2.23 (2.06-2.42)	2.66 (2.45-2.91)	3.30 (3.03-3.59)	3.97 (3.64-4.33)	4.79 (4.37-5.21)	5.55 (5.02-6.03)	6.31 (5.66-6.84)	7.10 (6.33-7.71)	8.19 (7.20-8.91)	9.18 (7.98-10.0)
6-hr	2.66 (2.44-2.91)	3.19 (2.91-3.49)	3.94 (3.60-4.32)	4.75 (4.33-5.20)	5.76 (5.21-6.30)	6.69 (6.01-7.31)	7.61 (6.79-8.32)	8.62 (7.62-9.40)	9.97 (8.71-10.9)	11.2 (9.69-12.3)
12-hr	3.11 (2.84-3.44)	3.72 (3.39-4.11)	4.63 (4.21-5.12)	5.62 (5.10-6.20)	6.85 (6.17-7.54)	8.00 (7.15-8.78)	9.17 (8.12-10.0)	10.4 (9.15-11.4)	12.2 (10.5-13.4)	13.8 (11.8-15.2)
24-hr	3.64 (3.33-3.99)	4.42 (4.06-4.85)	5.71 (5.22-6.26)	6.77 (6.17-7.41)	8.28 (7.50-9.06)	9.53 (8.59-10.4)	10.9 (9.74-11.9)	12.3 (11.0-13.6)	14.4 (12.7-15.8)	16.1 (14.1-17.7)
2-day	4.30 (3.94-4.70)	5.21 (4.78-5.70)	6.66 (6.10-7.27)	7.85 (7.18-8.57)	9.56 (8.68-10.4)	11.0 (9.90-12.0)	12.5 (11.2-13.6)	14.1 (12.6-15.4)	16.4 (14.5-18.1)	18.3 (16.0-20.2)
3-day	4.55 (4.18-4.98)	5.50 (5.06-6.03)	7.00 (6.41-7.65)	8.21 (7.50-8.97)	9.93 (9.03-10.8)	11.3 (10.3-12.4)	12.9 (11.5-14.1)	14.5 (12.9-15.8)	16.7 (14.8-18.4)	18.6 (16.4-20.5)
4-day	4.81 (4.42-5.27)	5.80 (5.33-6.36)	7.33 (6.72-8.02)	8.57 (7.83-9.37)	10.3 (9.37-11.3)	11.7 (10.6-12.8)	13.2 (11.8-14.5)	14.8 (13.3-16.2)	17.1 (15.2-18.8)	18.9 (16.7-20.9)
7-day	5.61 (5.19-6.10)	6.76 (6.25-7.35)	8.44 (7.78-9.16)	9.78 (9.00-10.6)	11.6 (10.7-12.6)	13.1 (12.0-14.2)	14.7 (13.3-16.0)	16.3 (14.8-17.8)	18.6 (16.7-20.3)	20.5 (18.3-22.4)
10-day	6.36 (5.91-6.87)	7.63 (7.08-8.23)	9.36 (8.68-10.1)	10.7 (9.91-11.5)	12.5 (11.6-13.5)	14.0 (12.9-15.1)	15.5 (14.2-16.7)	17.0 (15.5-18.4)	19.1 (17.3-20.7)	20.9 (18.8-22.6)
20-day	8.60 (8.05-9.20)	10.2 (9.59-11.0)	12.4 (11.6-13.2)	14.0 (13.1-15.0)	16.3 (15.2-17.4)	18.0 (16.7-19.3)	19.8 (18.3-21.2)	21.7 (20.0-23.2)	24.2 (22.1-26.0)	26.2 (23.8-28.2)
30-day	10.6 (9.98-11.2)	12.6 (11.8-13.3)	14.9 (14.0-15.8)	16.7 (15.7-17.7)	19.0 (17.8-20.1)	20.8 (19.5-22.1)	22.6 (21.1-24.0)	24.4 (22.7-26.0)	26.9 (24.8-28.6)	28.8 (26.5-30.7)
45-day	13.4 (12.7-14.2)	15.8 (15.0-16.8)	18.5 (17.5-19.6)	20.5 (19.3-21.7)	23.1 (21.8-24.5)	25.1 (23.6-26.6)	27.1 (25.4-28.7)	29.0 (27.1-30.9)	31.6 (29.4-33.7)	33.6 (31.1-35.9)
60-day	16.0 (15.1-16.9)	18.8 (17.8-19.9)	21.8 (20.6-23.0)	24.1 (22.7-25.4)	26.9 (25.3-28.4)	29.1 (27.3-30.7)	31.2 (29.3-33.0)	33.3 (31.1-35.3)	36.0 (33.6-38.3)	38.1 (35.4-40.6)

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

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

Please refer to NOAA Atlas 14 document for more information.

TABLE 2 – Construction Phase Area and Volume

Construction Phase	Attenuation Basin Top Elevation (ft)	Attenuation Basin Bottom Elevation (ft)	Area of Top of Attenuation Basin (ac)	Area of Bottom of Attenuation Basin (ac)	Approximate Basin Volume (ac-ft)
Phase 2	70	56	4.67	0.001	22.4
Phase 3	73	58	4.52	0.001	24.3

TABLE 3 – Construction Phase Pipe Network

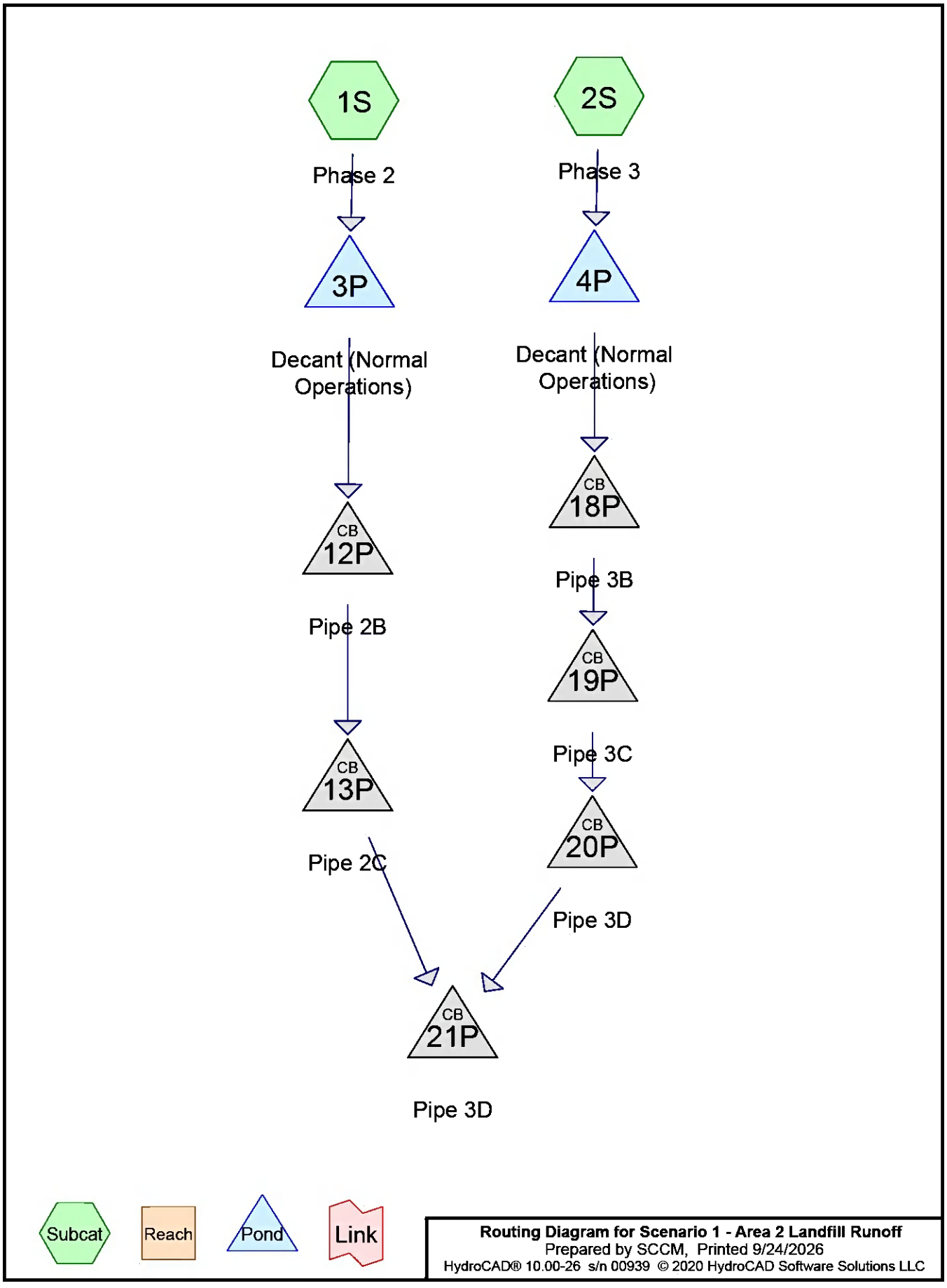
Construction Phase	Pipe ID	Type	Length	Inlet Invert Elevation (ft NAVD 88)	Outlet Invert Elevation (ft NAVD 88)	Slope (%)
Phase 2	Pipe 2A	18" HDPE	664	46.74	43.44	0.5
	Pipe 2B	18" HDPE	23	43.44	41.24	9.6
	Pipe 2C	18" HDPE	25	41.24	38.67	10.3
Phase 3	Pipe 3A	18" HDPE	848	47.06	42.82	0.5
	Pipe 3B	18" HDPE	45	42.82	36.74	13.5
	Pipe 3C	18" HDPE	43	36.74	31.88	11.3
	Pipe 3D	18" HDPE	438	31.88	29.67	0.5
Outlet Pipe	Outlet Pipe	30" Corrugated HDPE	608	29.67	24.02	0.9

TABLE 4 – Summary of Construction Phase Results

Scenario	HydroCAD Scenario	Peak Inflow (cfs)		Peak Outflow (cfs)		Fill Plan Berm Elevation (ft)	Peak Water Surface Elevation (ft)		Freeboard (ft)	
		25-yr, 24-hr storm	100-yr, 24-hr storm	25-yr, 24-hr storm	100-yr, 24-hr storm		25-yr, 24-hr storm	100-yr, 24-hr storm	25-yr, 24-hr storm	100-yr, 24-hr storm
Scenario 1	Phase 2 – Normal Operations	141.08	186.11	36.45	39.46	70	65.71	66.27	4.29	3.73
	Phase 3 – Normal Operations	117.73	155.30			73	66.85	67.62	6.15	5.38
Scenario 2	Phase 2 - Normal Operations	141.08	186.11	23.26	23.57	70	65.71	66.27	4.29	3.73
	Phase 3 - Clogged Decant Pipe	117.73	155.30			73	69.23	70.20	3.77	2.80
Scenario 3	Phase 2 - Clogged Decant Pipe	141.08	186.11	13.20	15.90	70	67.58	68.50	2.42	1.50
	Phase 3 - Normal Operations	117.73	155.30			73	66.85	67.62	6.15	5.38
Scenario 4	Phase 2 - Clogged Decant Pipe	141.08	186.11	0	0	70	67.58	68.50	2.42	1.50
	Phase 3 - Clogged Decant Pipe	117.73	155.30			73	69.23	70.20	3.77	2.80

APPENDIX A

HYDROCAD REPORTS



Routing Diagram for Scenario 1 - Area 2 Landfill Runoff
Prepared by SCCM, Printed 9/24/2026
HydroCAD® 10.00-26 s/n 00939 © 2020 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
32.690	97	(1S, 2S)
32.690	**97**	**TOTAL AREA**

Pipe Listing (all 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	3P	46.74	43.44	664.0	0.0050	0.009	18.0	0.0	0.0
2	4P	47.06	42.82	848.0	0.0050	0.009	18.0	0.0	0.0
3	12P	43.44	41.24	23.0	0.0957	0.009	18.0	0.0	0.0
4	13P	41.24	38.67	25.0	0.1028	0.009	18.0	0.0	0.0
5	18P	42.82	36.74	45.0	0.1351	0.009	18.0	0.0	0.0
6	19P	36.74	31.88	43.0	0.1130	0.009	18.0	0.0	0.0
7	20P	31.88	29.67	438.0	0.0050	0.009	18.0	0.0	0.0
8	21P	29.67	24.02	608.0	0.0093	0.020	30.0	0.0	0.0

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Phase 2 Runoff Area=17.820 ac 0.00% Impervious Runoff Depth=7.92"
Tc=6.0 min CN=97 Runoff=141.08 cfs 11.761 af

Subcatchment 2S: Phase 3 Runoff Area=14.870 ac 0.00% Impervious Runoff Depth=7.92"
Tc=6.0 min CN=97 Runoff=117.73 cfs 9.814 af

Pond 3P: Decant (Normal Operations) Peak Elev=65.71' Storage=4.659 af Inflow=141.08 cfs 11.761 af
Outflow=23.26 cfs 11.748 af

Pond 4P: Decant (Normal Operations) Peak Elev=66.85' Storage=3.859 af Inflow=117.73 cfs 9.814 af
Outflow=13.20 cfs 9.807 af

Pond 12P: Pipe 2B Peak Elev=56.18' Inflow=23.26 cfs 11.748 af
18.0" Round Culvert n=0.009 L=23.0' S=0.0957 '/' Outflow=23.26 cfs 11.748 af

Pond 13P: Pipe 2C Peak Elev=53.98' Inflow=23.26 cfs 11.748 af
18.0" Round Culvert n=0.009 L=25.0' S=0.1028 '/' Outflow=23.26 cfs 11.748 af

Pond 18P: Pipe 3B Peak Elev=47.43' Inflow=13.20 cfs 9.807 af
18.0" Round Culvert n=0.009 L=45.0' S=0.1351 '/' Outflow=13.20 cfs 9.807 af

Pond 19P: Pipe 3C Peak Elev=41.35' Inflow=13.20 cfs 9.807 af
18.0" Round Culvert n=0.009 L=43.0' S=0.1130 '/' Outflow=13.20 cfs 9.807 af

Pond 20P: Pipe 3D Peak Elev=36.49' Inflow=13.20 cfs 9.807 af
18.0" Round Culvert n=0.009 L=438.0' S=0.0050 '/' Outflow=13.20 cfs 9.807 af

Pond 21P: Pipe 3D Peak Elev=39.55' Inflow=36.45 cfs 21.555 af
30.0" Round Culvert n=0.020 L=608.0' S=0.0093 '/' Outflow=36.45 cfs 21.555 af

Total Runoff Area = 32.690 ac Runoff Volume = 21.576 af Average Runoff Depth = 7.92"
100.00% Pervious = 32.690 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: Phase 2

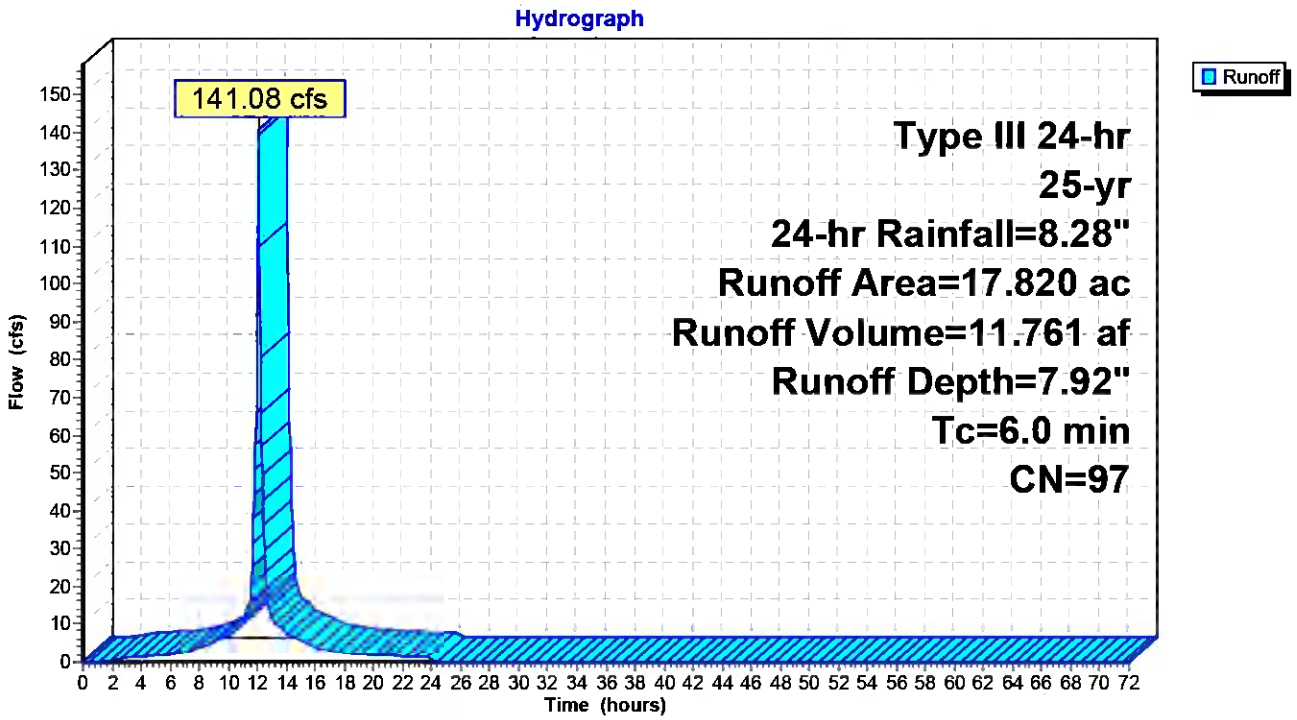
Runoff = 141.08 cfs @ 12.09 hrs, Volume= 11.761 af, Depth= 7.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr, 24-hr Rainfall=8.28"

	Area (ac)	CN	Description
*	17.820	97	
	17.820		100.00% Pervious Area

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

Subcatchment 1S: Phase 2



Summary for Subcatchment 2S: Phase 3

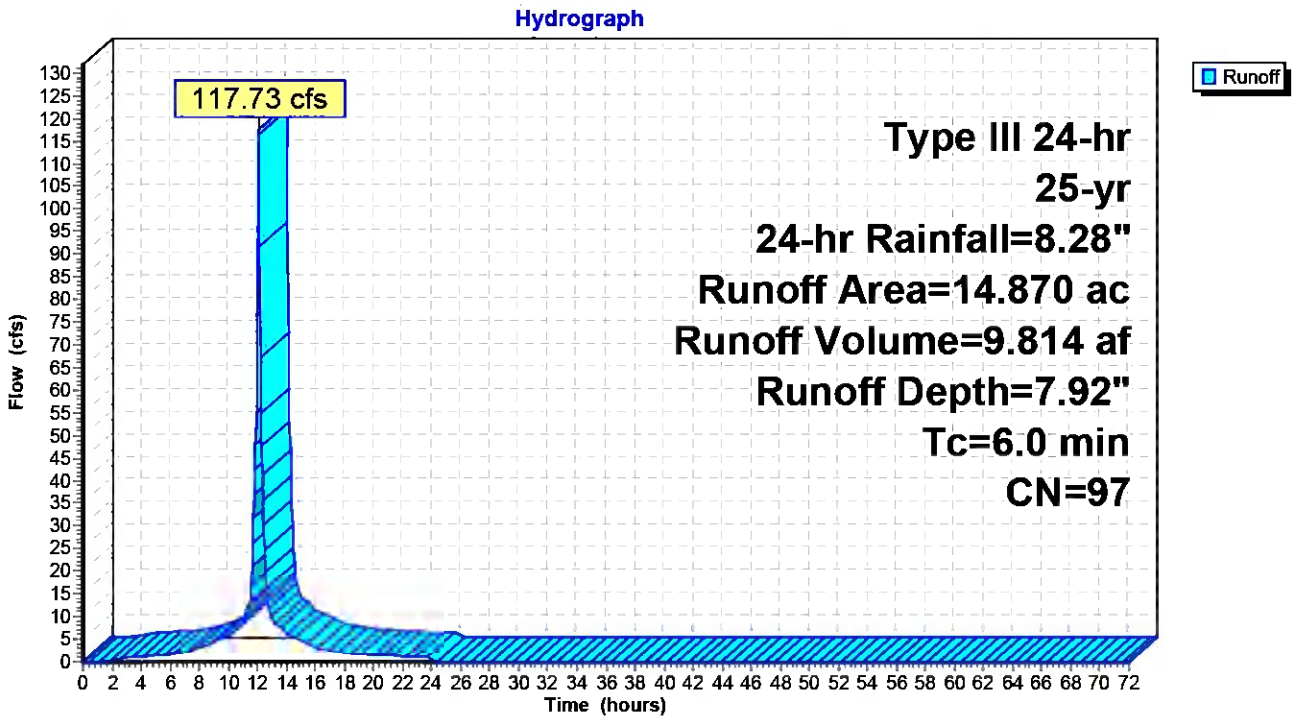
Runoff = 117.73 cfs @ 12.09 hrs, Volume= 9.814 af, Depth= 7.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr, 24-hr Rainfall=8.28"

	Area (ac)	CN	Description
*	14.870	97	
	14.870		100.00% Pervious Area

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

Subcatchment 2S: Phase 3



Summary for Pond 3P: Decant (Normal Operations)

Inflow Area = 17.820 ac, 0.00% Impervious, Inflow Depth = 7.92" for 25-yr, 24-hr event
Inflow = 141.08 cfs @ 12.09 hrs, Volume= 11.761 af
Outflow = 23.26 cfs @ 12.56 hrs, Volume= 11.748 af, Atten= 84%, Lag= 28.3 min
Primary = 23.26 cfs @ 12.56 hrs, Volume= 11.748 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 65.71' @ 12.56 hrs Surf.Area= 3.195 ac Storage= 4.659 af

Plug-Flow detention time= 127.0 min calculated for 11.748 af (100% of inflow)
Center-of-Mass det. time= 126.2 min (872.8 - 746.6)

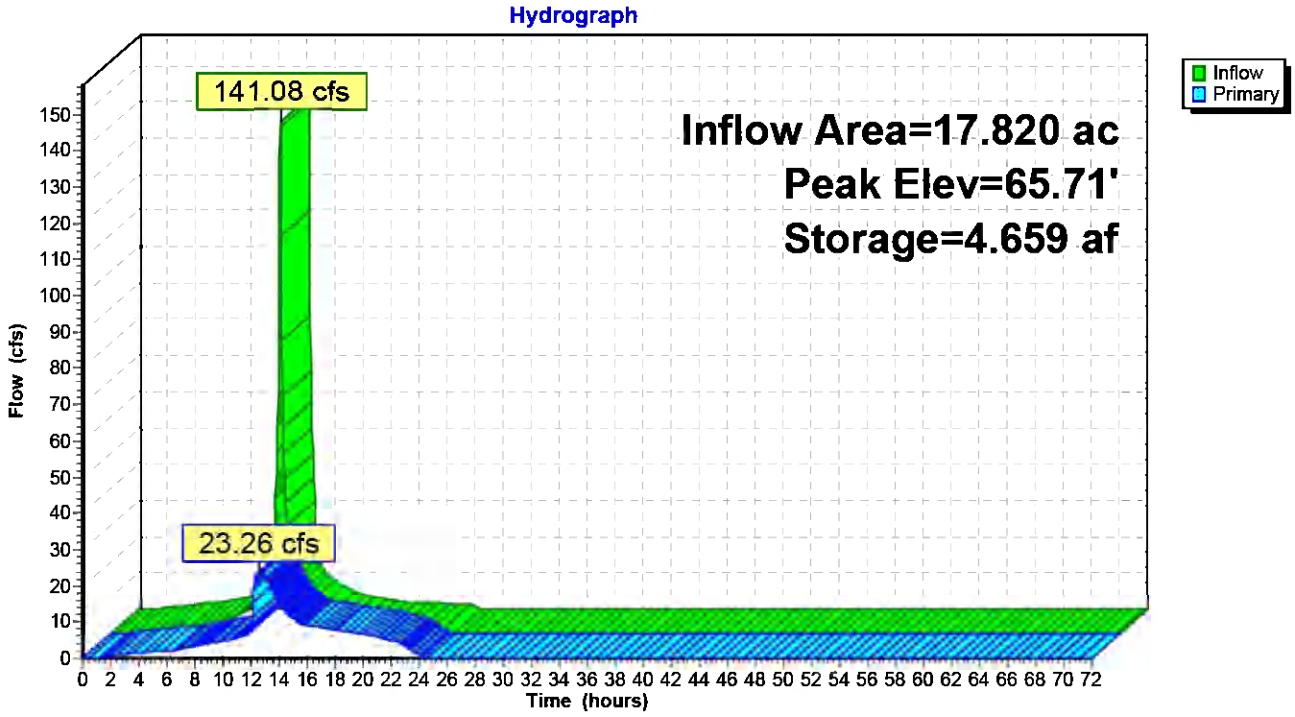
Volume	Invert	Avail.Storage	Storage Description
#1	56.00'	22.401 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
56.00	0.000	0.000	0.000
57.00	0.001	0.001	0.001
58.00	0.002	0.002	0.002
59.00	0.003	0.003	0.005
60.00	0.004	0.004	0.008
61.00	0.006	0.005	0.013
62.00	0.007	0.006	0.019
63.00	0.193	0.100	0.119
64.00	1.180	0.687	0.806
65.00	2.486	1.833	2.639
66.00	3.484	2.985	5.624
67.00	4.022	3.753	9.377
68.00	4.235	4.129	13.506
69.00	4.444	4.339	17.845
70.00	4.668	4.556	22.401

Device	Routin	Invert	Outlet Devices
#1	Primary	46.74'	**18.0" Round Culvert** L= 664.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 46.74' / 43.44' S= 0.0050 '/' Cc= 0.900 n= 0.009 PVC, smooth interior, Flow Area= 1.77 sf
#2	Device 1	65.05'	**36.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	64.55'	**2.0" Vert. Orifice/Grate X 12.00** C= 0.600
#4	Device 1	63.55'	**2.0" Vert. Orifice/Grate X 12.00** C= 0.600
#5	Device 1	62.55'	**2.0" Horiz. Orifice/Grate X 12.00** C= 0.600 Limited to weir flow at low heads
#6	Device 1	61.55'	**2.0" Horiz. Orifice/Grate X 12.00** C= 0.600 Limited to weir flow at low heads
#7	Device 1	61.05'	**2.0" Vert. Orifice/Grate X 12.00** C= 0.600

Primary OutFlow Max=23.26 cfs @ 12.56 hrs HW=65.71' (Free Discharge)
└─**1=Culvert** (Barrel Controls 23.26 cfs @ 13.16 fps)
  ├─**2=Orifice/Grate** (Passes < 16.54 cfs potential flow)
  ├─**3=Orifice/Grate** (Passes < 1.31 cfs potential flow)
  ├─**4=Orifice/Grate** (Passes < 1.82 cfs potential flow)
  ├─**5=Orifice/Grate** (Passes < 2.24 cfs potential flow)
  ├─**6=Orifice/Grate** (Passes < 2.57 cfs potential flow)
  └─**7=Orifice/Grate** (Passes < 2.70 cfs potential flow)

Pond 3P: Decant (Normal Operations)



Summary for Pond 4P: Decant (Normal Operations)

Inflow Area = 14.870 ac, 0.00% Impervious, Inflow Depth = 7.92" for 25-yr, 24-hr event
Inflow = 117.73 cfs @ 12.09 hrs, Volume= 9.814 af
Outflow = 13.20 cfs @ 12.73 hrs, Volume= 9.807 af, Atten= 89%, Lag= 38.8 min
Primary = 13.20 cfs @ 12.73 hrs, Volume= 9.807 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 66.85' @ 12.73 hrs Surf.Area= 1.840 ac Storage= 3.859 af

Plug-Flow detention time= 116.7 min calculated for 9.807 af (100% of inflow)
Center-of-Mass det. time= 116.1 min (862.7 - 746.6)

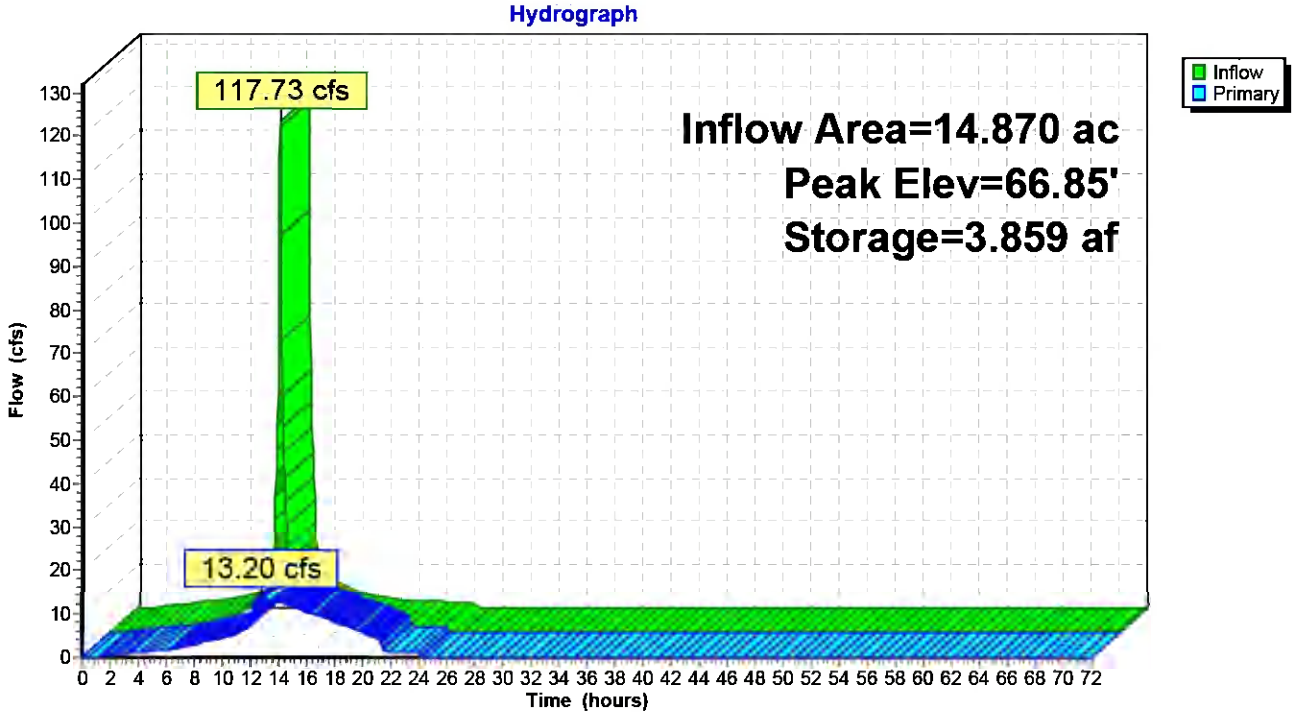
Volume	Invert	Avail.Storage	Storage Description
#1	58.00'	24.341 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
58.00	0.000	0.000	0.000
59.00	0.001	0.001	0.001
60.00	0.003	0.002	0.003
61.00	0.004	0.004	0.006
62.00	0.005	0.005	0.010
63.00	0.007	0.006	0.016
64.00	0.536	0.271	0.288
65.00	1.160	0.848	1.136
66.00	1.478	1.319	2.455
67.00	1.905	1.692	4.146
68.00	2.503	2.204	6.350
69.00	3.014	2.758	9.109
70.00	3.477	3.245	12.354
71.00	3.823	3.650	16.004
72.00	4.166	3.994	19.999
73.00	4.519	4.342	24.341

Device	Routing	Invert	Outlet Devices
#1	Primary	47.06'	**18.0" Round Culvert** L= 848.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 47.06' / 42.82' S= 0.0050 '/' Cc= 0.900 n= 0.009 PVC, smooth interior, Flow Area= 1.77 sf
#2	Device 1	69.40'	**48.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	68.90'	**2.0" Vert. Orifice/Grate X 12.00** C= 0.600
#4	Device 1	67.90'	**2.0" Vert. Orifice/Grate X 12.00** C= 0.600
#5	Device 1	66.90'	**2.0" Vert. Orifice/Grate X 12.00** C= 0.600
#6	Device 1	65.90'	**2.0" Vert. Orifice/Grate X 12.00** C= 0.600
#7	Device 1	64.90'	**2.0" Vert. Orifice/Grate X 12.00** C= 0.600
#8	Device 1	63.90'	**2.0" Vert. Orifice/Grate X 12.00** C= 0.600
#9	Device 1	62.90'	**2.0" Vert. Orifice/Grate X 12.00** C= 0.600
#10	Device 1	61.90'	**2.0" Vert. Orifice/Grate X 12.00** C= 0.600
#11	Device 1	61.40'	**2.0" Vert. Orifice/Grate X 12.00** C= 0.600

Primary OutFlow Max=13.20 cfs @ 12.73 hrs HW=66.85' (Free Discharge)
└─**1=Culvert** (Passes 13.20 cfs of 22.03 cfs potential flow)
  ├─**2=Orifice/Grate** (Controls 0.00 cfs)
  ├─**3=Orifice/Grate** (Controls 0.00 cfs)
  ├─**4=Orifice/Grate** (Controls 0.00 cfs)
  ├─**5=Orifice/Grate** (Controls 0.00 cfs)
  ├─**6=Orifice/Grate** (Orifice Controls 1.17 cfs @ 4.47 fps)
  ├─**7=Orifice/Grate** (Orifice Controls 1.72 cfs @ 6.57 fps)
  ├─**8=Orifice/Grate** (Orifice Controls 2.13 cfs @ 8.15 fps)
  ├─**9=Orifice/Grate** (Orifice Controls 2.48 cfs @ 9.46 fps)
  ├─**10=Orifice/Grate** (Orifice Controls 2.78 cfs @ 10.62 fps)
  └─**11=Orifice/Grate** (Orifice Controls 2.92 cfs @ 11.15 fps)

Pond 4P: Decant (Normal Operations)



Summary for Pond 12P: Pipe 2B

[57] Hint: Peaked at 56.18' (Flood elevation advised)
[79] Warning: Submerged Pond 3P Primary device # 1 INLET by 9.44'

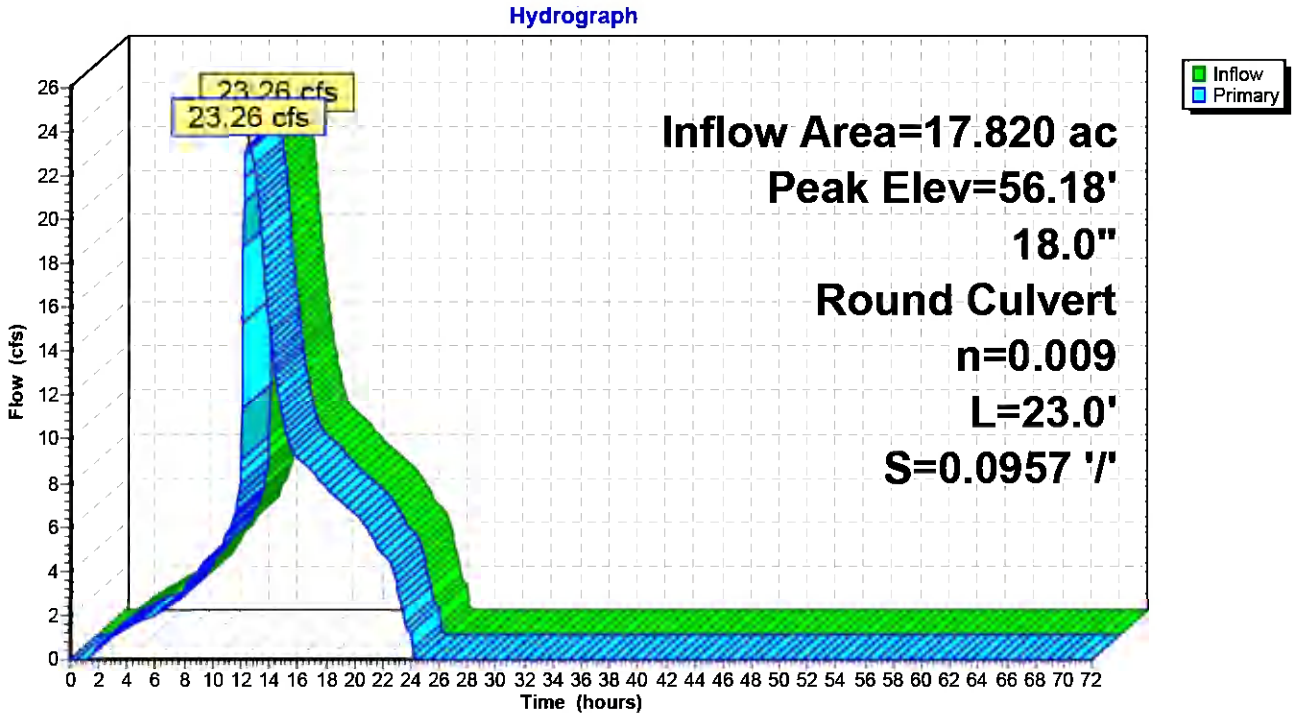
Inflow Area = 17.820 ac, 0.00% Impervious, Inflow Depth = 7.91" for 25-yr, 24-hr event
Inflow = 23.26 cfs @ 12.56 hrs, Volume= 11.748 af
Outflow = 23.26 cfs @ 12.56 hrs, Volume= 11.748 af, Atten= 0%, Lag= 0.0 min
Primary = 23.26 cfs @ 12.56 hrs, Volume= 11.748 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 56.18' @ 12.56 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	43.44'	**18.0" Round RCP_Round 18"** L= 23.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 43.44' / 41.24' S= 0.0957 '/' Cc= 0.900 n= 0.009 PVC, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=23.26 cfs @ 12.56 hrs HW=56.18' (Free Discharge)
↑**1=RCP_Round 18"** (Inlet Controls 23.26 cfs @ 13.16 fps)

Pond 12P: Pipe 2B



Summary for Pond 13P: Pipe 2C

[57] Hint: Peaked at 53.98' (Flood elevation advised)
[79] Warning: Submerged Pond 12P Primary device # 1 INLET by 10.54'

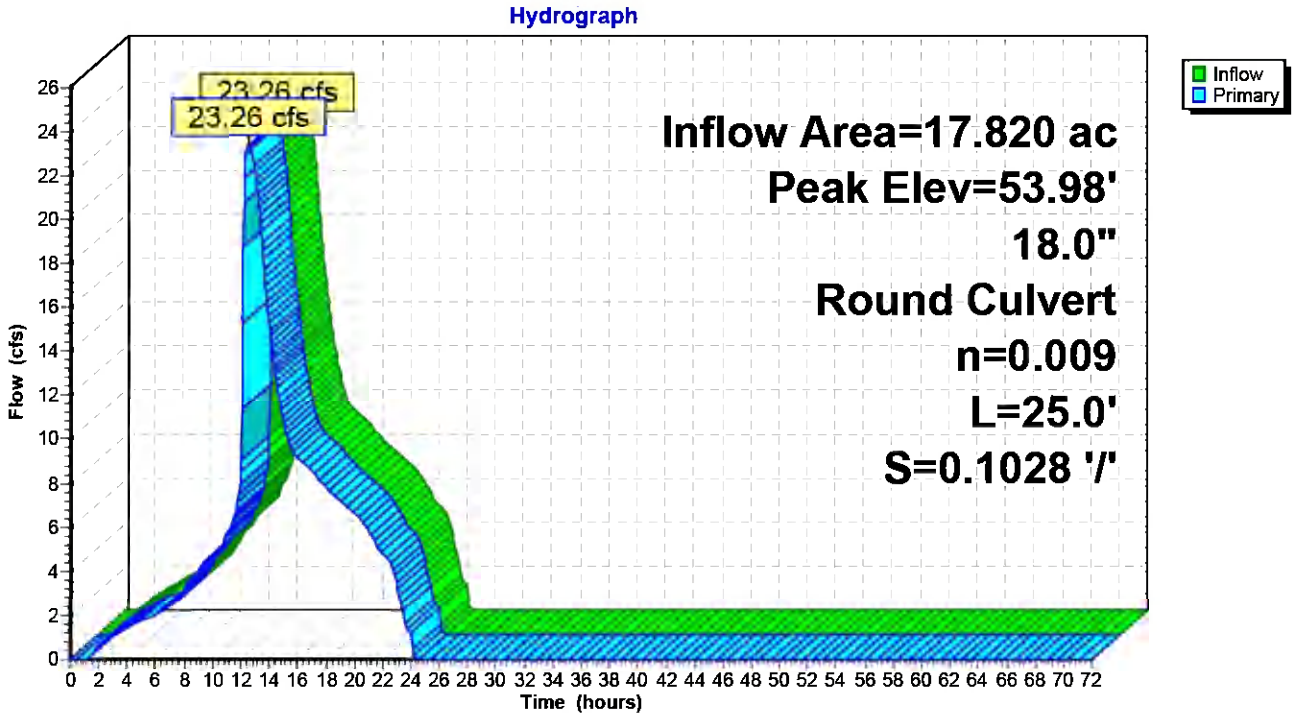
Inflow Area = 17.820 ac, 0.00% Impervious, Inflow Depth = 7.91" for 25-yr, 24-hr event
Inflow = 23.26 cfs @ 12.56 hrs, Volume= 11.748 af
Outflow = 23.26 cfs @ 12.56 hrs, Volume= 11.748 af, Atten= 0%, Lag= 0.0 min
Primary = 23.26 cfs @ 12.56 hrs, Volume= 11.748 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 53.98' @ 12.56 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	41.24'	**18.0" Round RCP_Round 18"** L= 25.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 41.24' / 38.67' S= 0.1028 '/' Cc= 0.900 n= 0.009 PVC, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=23.26 cfs @ 12.56 hrs HW=53.98' (Free Discharge)
↑**1=RCP_Round 18"** (Inlet Controls 23.26 cfs @ 13.16 fps)

Pond 13P: Pipe 2C



Summary for Pond 18P: Pipe 3B

[57] Hint: Peaked at 47.43' (Flood elevation advised)
[79] Warning: Submerged Pond 4P Primary device # 1 INLET by 0.37'

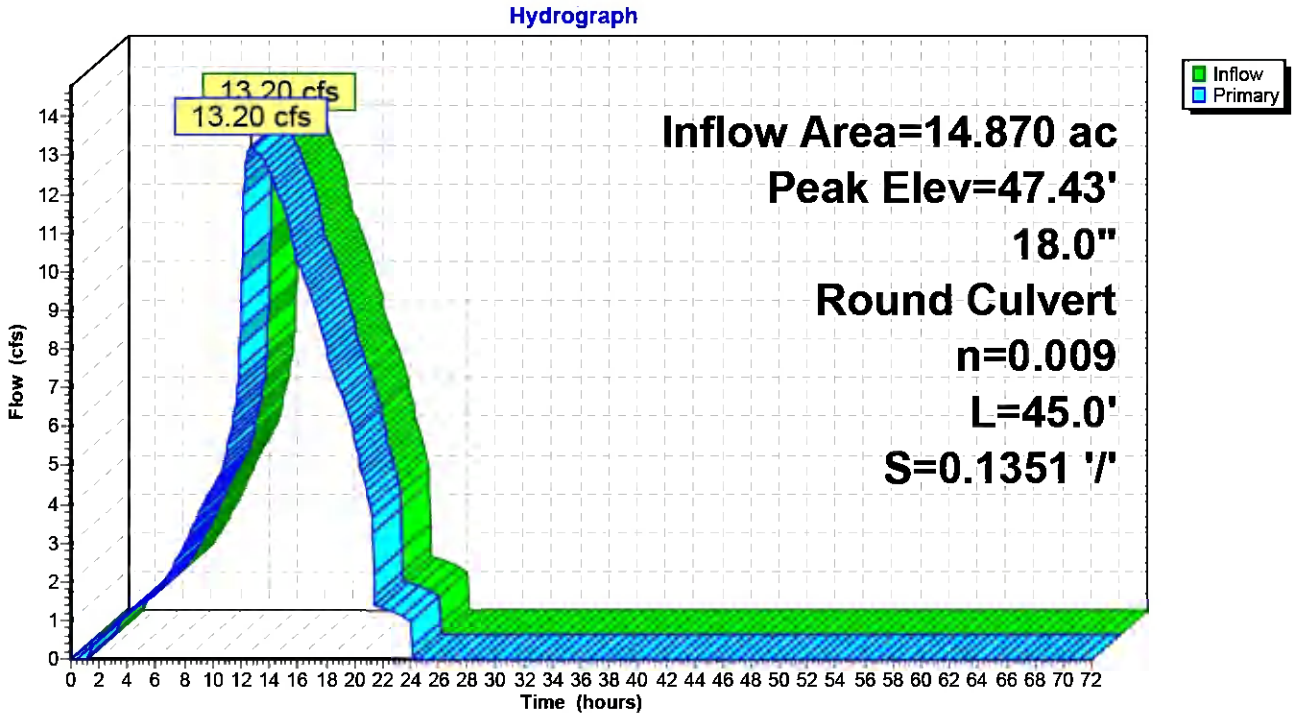
Inflow Area = 14.870 ac, 0.00% Impervious, Inflow Depth = 7.91" for 25-yr, 24-hr event
Inflow = 13.20 cfs @ 12.73 hrs, Volume= 9.807 af
Outflow = 13.20 cfs @ 12.73 hrs, Volume= 9.807 af, Atten= 0%, Lag= 0.0 min
Primary = 13.20 cfs @ 12.73 hrs, Volume= 9.807 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 47.43' @ 12.73 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	42.82'	**18.0" Round RCP_Round 18"** L= 45.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 42.82' / 36.74' S= 0.1351 '/' Cc= 0.900 n= 0.009 PVC, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=13.20 cfs @ 12.73 hrs HW=47.43' (Free Discharge)
1=RCP_Round 18" (Inlet Controls 13.20 cfs @ 7.47 fps)

Pond 18P: Pipe 3B



Summary for Pond 19P: Pipe 3C

[57] Hint: Peaked at 41.35' (Flood elevation advised)
[79] Warning: Submerged Pond 18P Primary device # 1 OUTLET by 4.61'

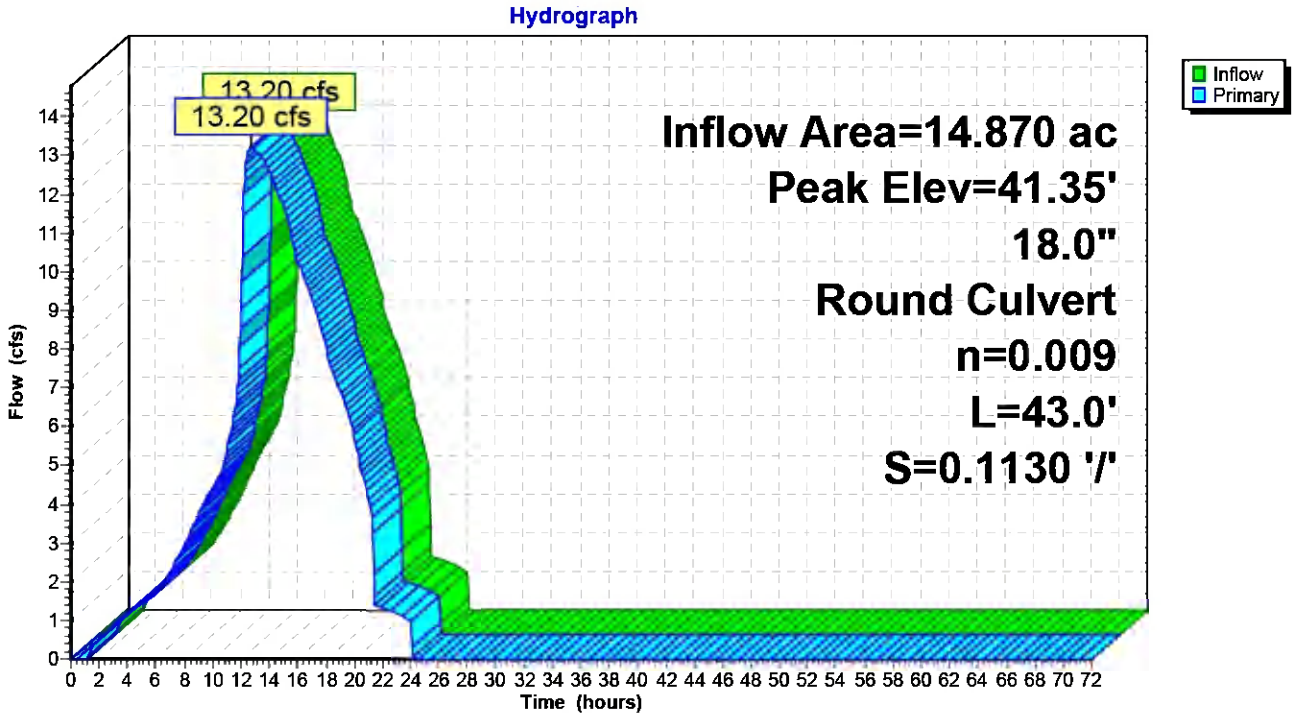
Inflow Area = 14.870 ac, 0.00% Impervious, Inflow Depth = 7.91" for 25-yr, 24-hr event
Inflow = 13.20 cfs @ 12.73 hrs, Volume= 9.807 af
Outflow = 13.20 cfs @ 12.73 hrs, Volume= 9.807 af, Atten= 0%, Lag= 0.0 min
Primary = 13.20 cfs @ 12.73 hrs, Volume= 9.807 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 41.35' @ 12.73 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	36.74'	**18.0" Round RCP_Round 18"** L= 43.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 36.74' / 31.88' S= 0.1130 '/' Cc= 0.900 n= 0.009 PVC, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=13.20 cfs @ 12.73 hrs HW=41.35' (Free Discharge)
↑**1=RCP_Round 18"** (Inlet Controls 13.20 cfs @ 7.47 fps)

Pond 19P: Pipe 3C



Summary for Pond 20P: Pipe 3D

[57] Hint: Peaked at 36.49' (Flood elevation advised)
[79] Warning: Submerged Pond 19P Primary device # 1 OUTLET by 4.61'

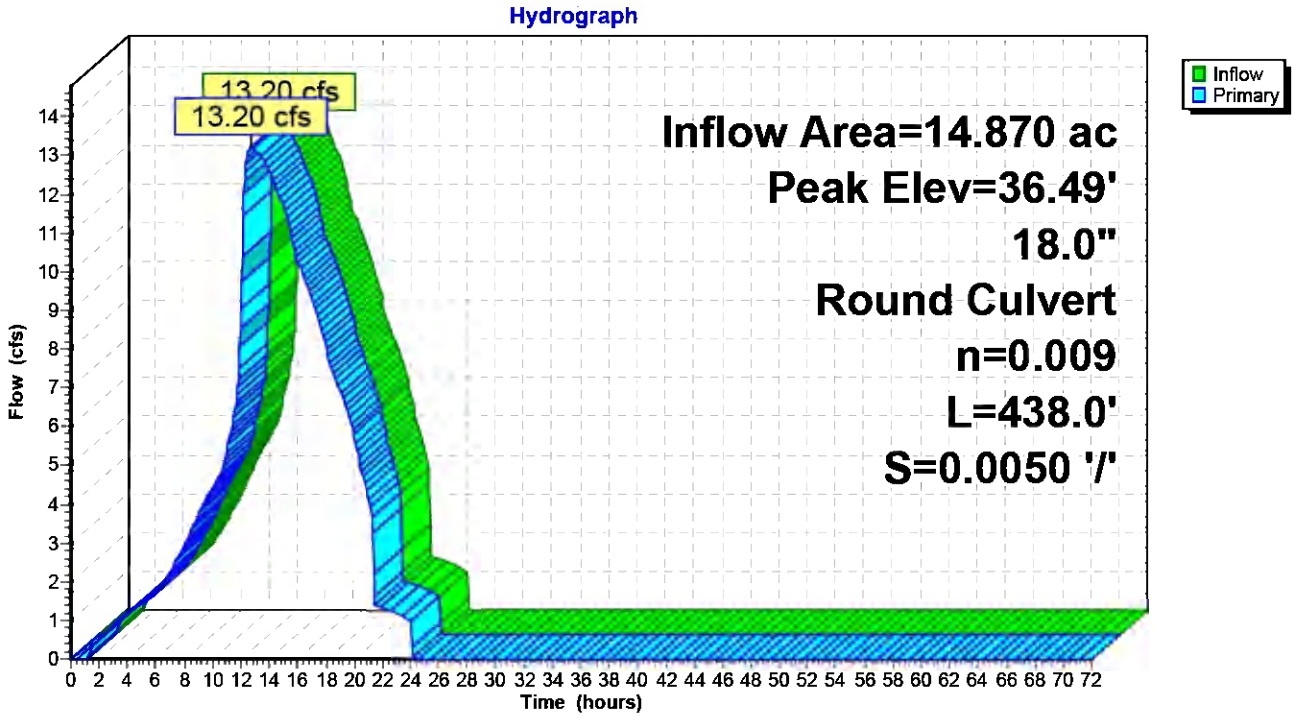
Inflow Area = 14.870 ac, 0.00% Impervious, Inflow Depth = 7.91" for 25-yr, 24-hr event
Inflow = 13.20 cfs @ 12.73 hrs, Volume= 9.807 af
Outflow = 13.20 cfs @ 12.73 hrs, Volume= 9.807 af, Atten= 0%, Lag= 0.0 min
Primary = 13.20 cfs @ 12.73 hrs, Volume= 9.807 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 36.49' @ 12.73 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	31.88'	**18.0" Round RCP_Round 18"** L= 438.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 31.88' / 29.67' S= 0.0050 '/' Cc= 0.900 n= 0.009 PVC, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=13.20 cfs @ 12.73 hrs HW=36.49' (Free Discharge)
↑**1=RCP_Round 18"** (Inlet Controls 13.20 cfs @ 7.47 fps)

Pond 20P: Pipe 3D



Summary for Pond 21P: Pipe 3D

[57] Hint: Peaked at 39.55' (Flood elevation advised)
[79] Warning: Submerged Pond 13P Primary device # 1 OUTLET by 0.88'
[81] Warning: Exceeded Pond 20P by 3.07' @ 12.60 hrs

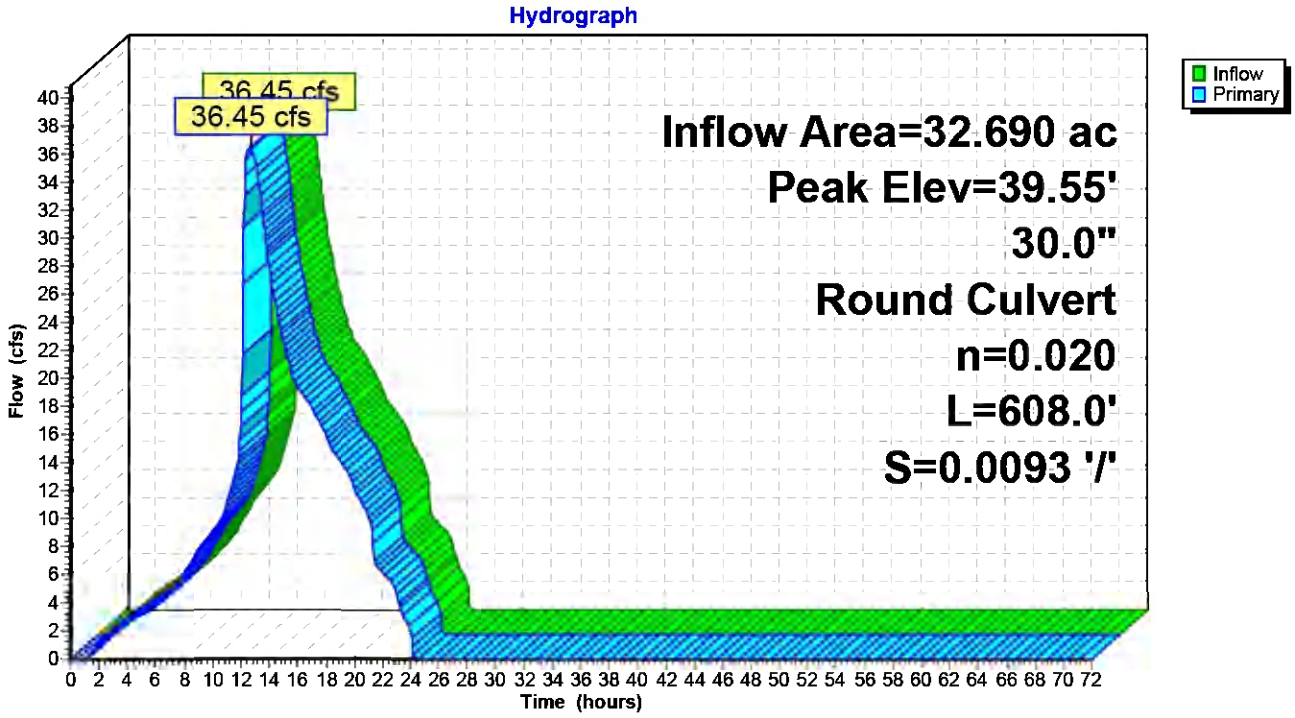
Inflow Area = 32.690 ac, 0.00% Impervious, Inflow Depth = 7.91" for 25-yr, 24-hr event
Inflow = 36.45 cfs @ 12.68 hrs, Volume= 21.555 af
Outflow = 36.45 cfs @ 12.68 hrs, Volume= 21.555 af, Atten= 0%, Lag= 0.0 min
Primary = 36.45 cfs @ 12.68 hrs, Volume= 21.555 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 39.55' @ 12.68 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	29.67'	**30.0" Round Culvert** L= 608.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 29.67' / 24.02' S= 0.0093 '/' Cc= 0.900 n= 0.020 Corrugated PE, corrugated interior, Flow Area= 4.91 sf

Primary OutFlow Max=36.45 cfs @ 12.68 hrs HW=39.55' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 36.45 cfs @ 7.43 fps)

Pond 21P: Pipe 3D



Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Phase 2 Runoff Area=17.820 ac 0.00% Impervious Runoff Depth=10.54"
Tc=6.0 min CN=97 Runoff=186.11 cfs 15.648 af

Subcatchment 2S: Phase 3 Runoff Area=14.870 ac 0.00% Impervious Runoff Depth=10.54"
Tc=6.0 min CN=97 Runoff=155.30 cfs 13.058 af

Pond 3P: Decant (Normal Operations) Peak Elev=66.27' Storage=6.589 af Inflow=186.11 cfs 15.648 af
Outflow=23.57 cfs 15.635 af

Pond 4P: Decant (Normal Operations) Peak Elev=67.62' Storage=5.442 af Inflow=155.30 cfs 13.058 af
Outflow=15.90 cfs 13.050 af

Pond 12P: Pipe 2B Peak Elev=56.50' Inflow=23.57 cfs 15.635 af
18.0" Round Culvert n=0.009 L=23.0' S=0.0957 '/' Outflow=23.57 cfs 15.635 af

Pond 13P: Pipe 2C Peak Elev=54.30' Inflow=23.57 cfs 15.635 af
18.0" Round Culvert n=0.009 L=25.0' S=0.1028 '/' Outflow=23.57 cfs 15.635 af

Pond 18P: Pipe 3B Peak Elev=49.17' Inflow=15.90 cfs 13.050 af
18.0" Round Culvert n=0.009 L=45.0' S=0.1351 '/' Outflow=15.90 cfs 13.050 af

Pond 19P: Pipe 3C Peak Elev=43.09' Inflow=15.90 cfs 13.050 af
18.0" Round Culvert n=0.009 L=43.0' S=0.1130 '/' Outflow=15.90 cfs 13.050 af

Pond 20P: Pipe 3D Peak Elev=38.38' Inflow=15.90 cfs 13.050 af
18.0" Round Culvert n=0.009 L=438.0' S=0.0050 '/' Outflow=15.90 cfs 13.050 af

Pond 21P: Pipe 3D Peak Elev=41.80' Inflow=39.46 cfs 28.685 af
30.0" Round Culvert n=0.020 L=608.0' S=0.0093 '/' Outflow=39.46 cfs 28.685 af

Total Runoff Area = 32.690 ac Runoff Volume = 28.706 af Average Runoff Depth = 10.54"
100.00% Pervious = 32.690 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: Phase 2

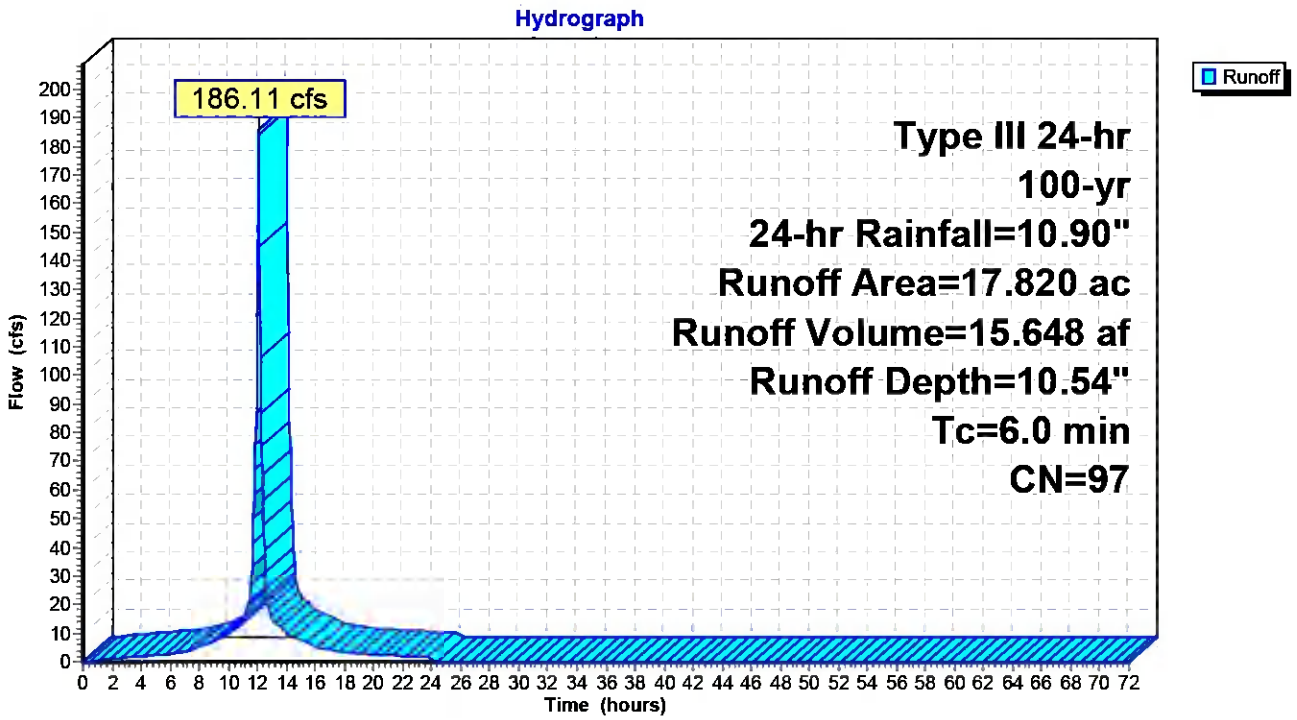
Runoff = 186.11 cfs @ 12.09 hrs, Volume= 15.648 af, Depth=10.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr, 24-hr Rainfall=10.90"

	Area (ac)	CN	Description
*	17.820	97	
	17.820		100.00% Pervious Area

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

Subcatchment 1S: Phase 2



Summary for Subcatchment 2S: Phase 3

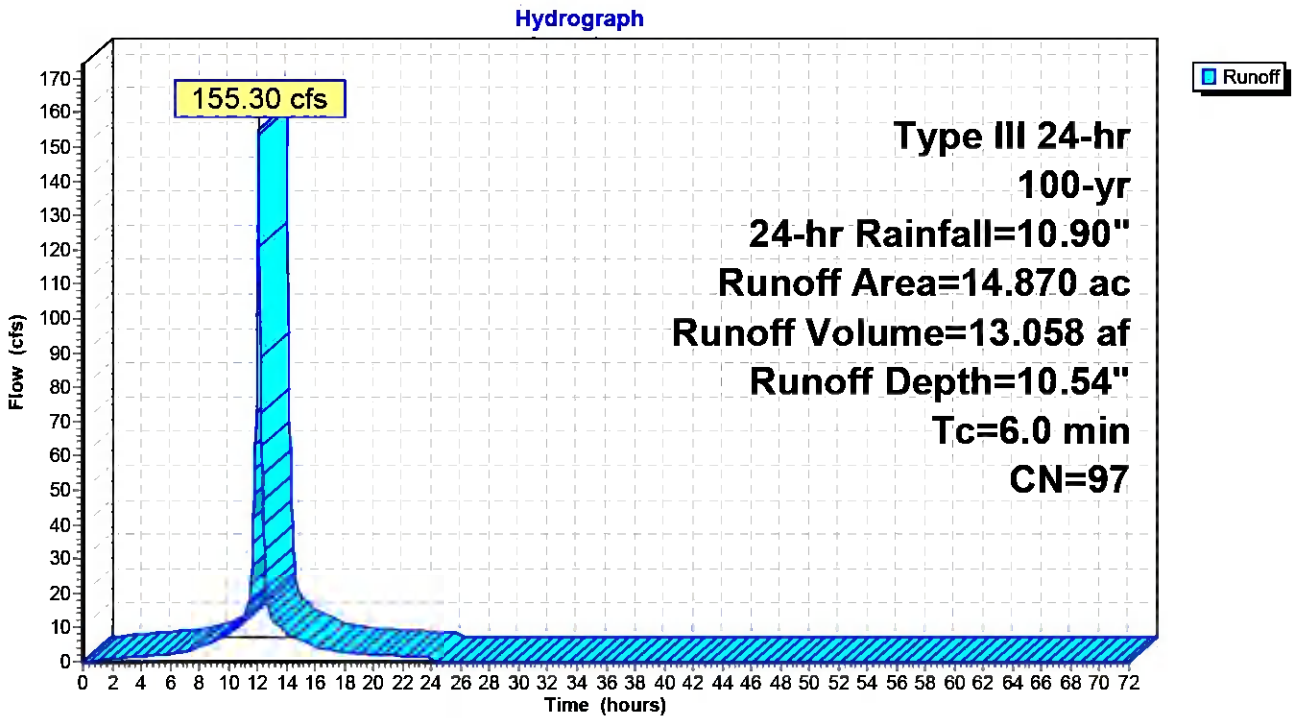
Runoff = 155.30 cfs @ 12.09 hrs, Volume= 13.058 af, Depth=10.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr, 24-hr Rainfall=10.90"

	Area (ac)	CN	Description
*	14.870	97	
	14.870		100.00% Pervious Area

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

Subcatchment 2S: Phase 3



Summary for Pond 3P: Decant (Normal Operations)

Inflow Area = 17.820 ac, 0.00% Impervious, Inflow Depth = 10.54" for 100-yr, 24-hr event
Inflow = 186.11 cfs @ 12.09 hrs, Volume= 15.648 af
Outflow = 23.57 cfs @ 12.64 hrs, Volume= 15.635 af, Atten= 87%, Lag= 33.2 min
Primary = 23.57 cfs @ 12.64 hrs, Volume= 15.635 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 66.27' @ 12.64 hrs Surf.Area= 3.630 ac Storage= 6.589 af

Plug-Flow detention time= 141.9 min calculated for 15.635 af (100% of inflow)
Center-of-Mass det. time= 141.3 min (883.9 - 742.6)

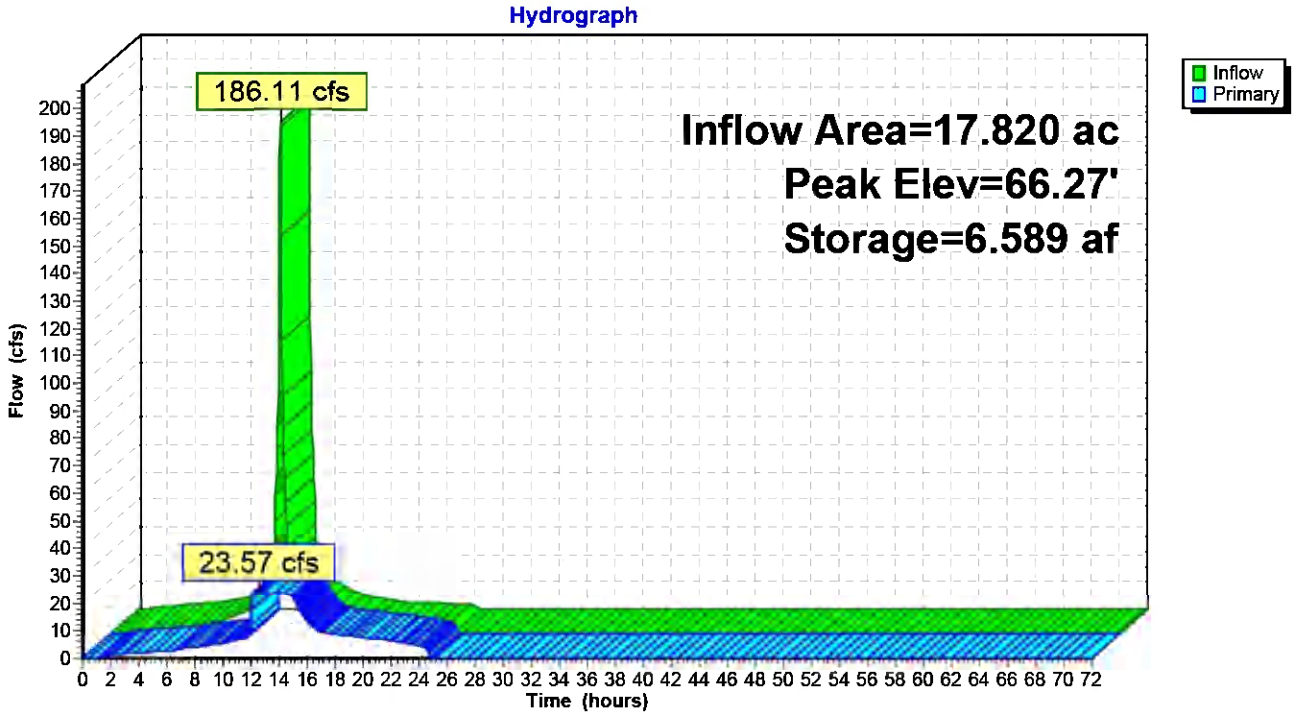
Volume	Invert	Avail.Storage	Storage Description
#1	56.00'	22.401 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
56.00	0.000	0.000	0.000
57.00	0.001	0.001	0.001
58.00	0.002	0.002	0.002
59.00	0.003	0.003	0.005
60.00	0.004	0.004	0.008
61.00	0.006	0.005	0.013
62.00	0.007	0.006	0.019
63.00	0.193	0.100	0.119
64.00	1.180	0.687	0.806
65.00	2.486	1.833	2.639
66.00	3.484	2.985	5.624
67.00	4.022	3.753	9.377
68.00	4.235	4.129	13.506
69.00	4.444	4.339	17.845
70.00	4.668	4.556	22.401

Device	Routin	Invert	Outlet Devices
#1	Primary	46.74'	**18.0" Round Culvert** L= 664.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 46.74' / 43.44' S= 0.0050 '/' Cc= 0.900 n= 0.009 PVC, smooth interior, Flow Area= 1.77 sf
#2	Device 1	65.05'	**36.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	64.55'	**2.0" Vert. Orifice/Grate X 12.00** C= 0.600
#4	Device 1	63.55'	**2.0" Vert. Orifice/Grate X 12.00** C= 0.600
#5	Device 1	62.55'	**2.0" Horiz. Orifice/Grate X 12.00** C= 0.600 Limited to weir flow at low heads
#6	Device 1	61.55'	**2.0" Horiz. Orifice/Grate X 12.00** C= 0.600 Limited to weir flow at low heads
#7	Device 1	61.05'	**2.0" Vert. Orifice/Grate X 12.00** C= 0.600

Primary OutFlow Max=23.57 cfs @ 12.64 hrs HW=66.27' (Free Discharge)
└─**1=Culvert** (Barrel Controls 23.57 cfs @ 13.34 fps)
  ├─**2=Orifice/Grate** (Passes < 37.61 cfs potential flow)
  ├─**3=Orifice/Grate** (Passes < 1.61 cfs potential flow)
  ├─**4=Orifice/Grate** (Passes < 2.05 cfs potential flow)
  ├─**5=Orifice/Grate** (Passes < 2.43 cfs potential flow)
  ├─**6=Orifice/Grate** (Passes < 2.74 cfs potential flow)
  └─**7=Orifice/Grate** (Passes < 2.86 cfs potential flow)

Pond 3P: Decant (Normal Operations)



Summary for Pond 4P: Decant (Normal Operations)

Inflow Area = 14.870 ac, 0.00% Impervious, Inflow Depth = 10.54" for 100-yr, 24-hr event
Inflow = 155.30 cfs @ 12.09 hrs, Volume= 13.058 af
Outflow = 15.90 cfs @ 12.83 hrs, Volume= 13.050 af, Atten= 90%, Lag= 44.5 min
Primary = 15.90 cfs @ 12.83 hrs, Volume= 13.050 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 67.62' @ 12.83 hrs Surf.Area= 2.276 ac Storage= 5.442 af

Plug-Flow detention time= 146.3 min calculated for 13.050 af (100% of inflow)
Center-of-Mass det. time= 145.9 min (888.5 - 742.6)

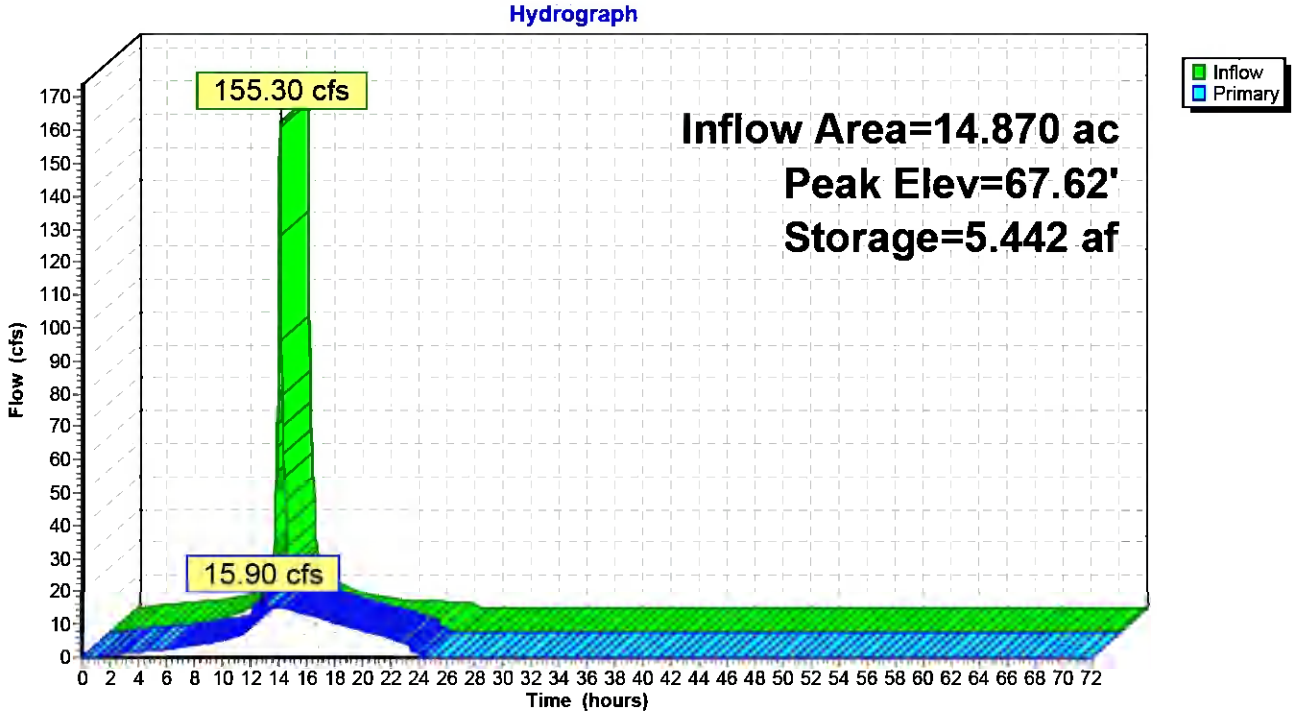
Volume	Invert	Avail.Storage	Storage Description
#1	58.00'	24.341 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
58.00	0.000	0.000	0.000
59.00	0.001	0.001	0.001
60.00	0.003	0.002	0.003
61.00	0.004	0.004	0.006
62.00	0.005	0.005	0.010
63.00	0.007	0.006	0.016
64.00	0.536	0.271	0.288
65.00	1.160	0.848	1.136
66.00	1.478	1.319	2.455
67.00	1.905	1.692	4.146
68.00	2.503	2.204	6.350
69.00	3.014	2.758	9.109
70.00	3.477	3.245	12.354
71.00	3.823	3.650	16.004
72.00	4.166	3.994	19.999
73.00	4.519	4.342	24.341

Device	Routing	Invert	Outlet Devices
#1	Primary	47.06'	**18.0" Round Culvert** L= 848.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 47.06' / 42.82' S= 0.0050 '/' Cc= 0.900 n= 0.009 PVC, smooth interior, Flow Area= 1.77 sf
#2	Device 1	69.40'	**48.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	68.90'	**2.0" Vert. Orifice/Grate X 12.00** C= 0.600
#4	Device 1	67.90'	**2.0" Vert. Orifice/Grate X 12.00** C= 0.600
#5	Device 1	66.90'	**2.0" Vert. Orifice/Grate X 12.00** C= 0.600
#6	Device 1	65.90'	**2.0" Vert. Orifice/Grate X 12.00** C= 0.600
#7	Device 1	64.90'	**2.0" Vert. Orifice/Grate X 12.00** C= 0.600
#8	Device 1	63.90'	**2.0" Vert. Orifice/Grate X 12.00** C= 0.600
#9	Device 1	62.90'	**2.0" Vert. Orifice/Grate X 12.00** C= 0.600
#10	Device 1	61.90'	**2.0" Vert. Orifice/Grate X 12.00** C= 0.600
#11	Device 1	61.40'	**2.0" Vert. Orifice/Grate X 12.00** C= 0.600

Primary OutFlow Max=15.90 cfs @ 12.83 hrs HW=67.62' (Free Discharge)
└─**1=Culvert** (Passes 15.90 cfs of 22.41 cfs potential flow)
  ├─**2=Orifice/Grate** (Controls 0.00 cfs)
  ├─**3=Orifice/Grate** (Controls 0.00 cfs)
  ├─**4=Orifice/Grate** (Controls 0.00 cfs)
  ├─**5=Orifice/Grate** (Orifice Controls 1.01 cfs @ 3.84 fps)
  ├─**6=Orifice/Grate** (Orifice Controls 1.61 cfs @ 6.16 fps)
  ├─**7=Orifice/Grate** (Orifice Controls 2.05 cfs @ 7.82 fps)
  ├─**8=Orifice/Grate** (Orifice Controls 2.40 cfs @ 9.18 fps)
  ├─**9=Orifice/Grate** (Orifice Controls 2.71 cfs @ 10.37 fps)
  ├─**10=Orifice/Grate** (Orifice Controls 2.99 cfs @ 11.43 fps)
  └─**11=Orifice/Grate** (Orifice Controls 3.12 cfs @ 11.93 fps)

Pond 4P: Decant (Normal Operations)



Summary for Pond 12P: Pipe 2B

[57] Hint: Peaked at 56.50' (Flood elevation advised)
[79] Warning: Submerged Pond 3P Primary device # 1 INLET by 9.76'

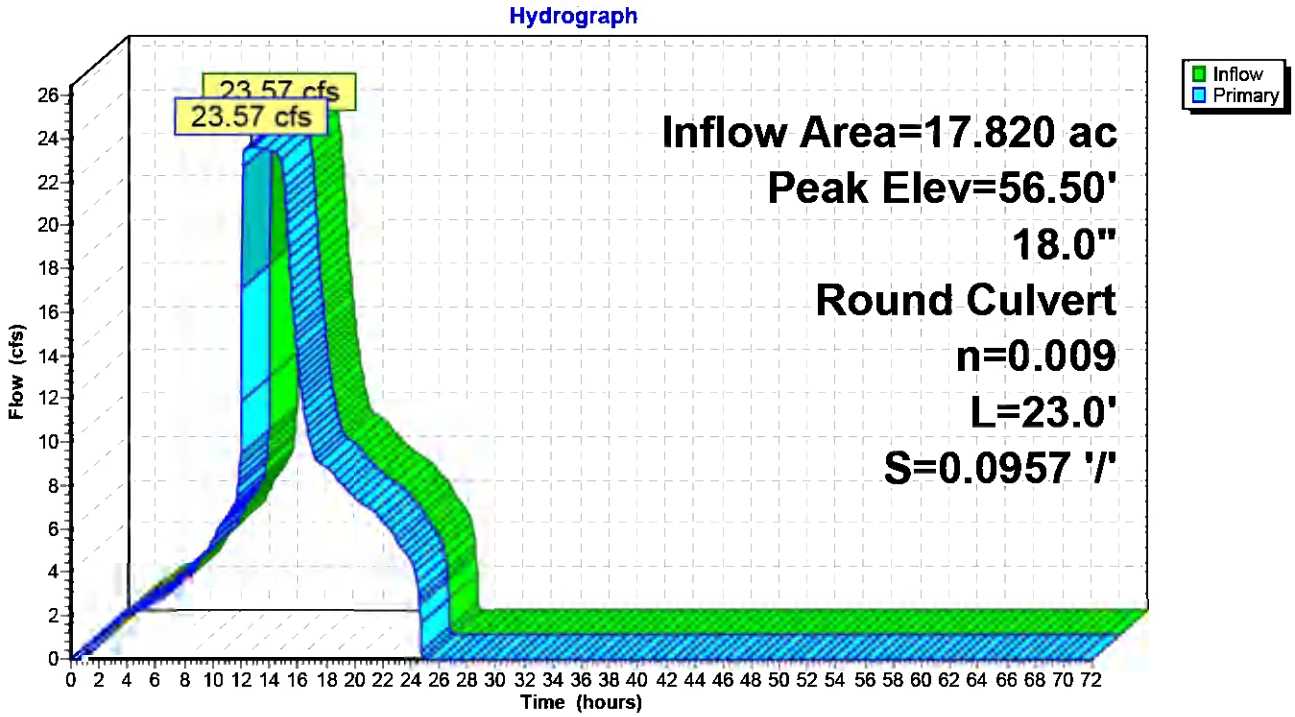
Inflow Area = 17.820 ac, 0.00% Impervious, Inflow Depth = 10.53" for 100-yr, 24-hr event
Inflow = 23.57 cfs @ 12.64 hrs, Volume= 15.635 af
Outflow = 23.57 cfs @ 12.64 hrs, Volume= 15.635 af, Atten= 0%, Lag= 0.0 min
Primary = 23.57 cfs @ 12.64 hrs, Volume= 15.635 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 56.50' @ 12.64 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	43.44'	**18.0" Round RCP_Round 18"** L= 23.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 43.44' / 41.24' S= 0.0957 '/' Cc= 0.900 n= 0.009 PVC, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=23.57 cfs @ 12.64 hrs HW=56.50' (Free Discharge)
↑**1=RCP_Round 18"** (Inlet Controls 23.57 cfs @ 13.34 fps)

Pond 12P: Pipe 2B



Summary for Pond 13P: Pipe 2C

[57] Hint: Peaked at 54.30' (Flood elevation advised)
[79] Warning: Submerged Pond 12P Primary device # 1 INLET by 10.86'

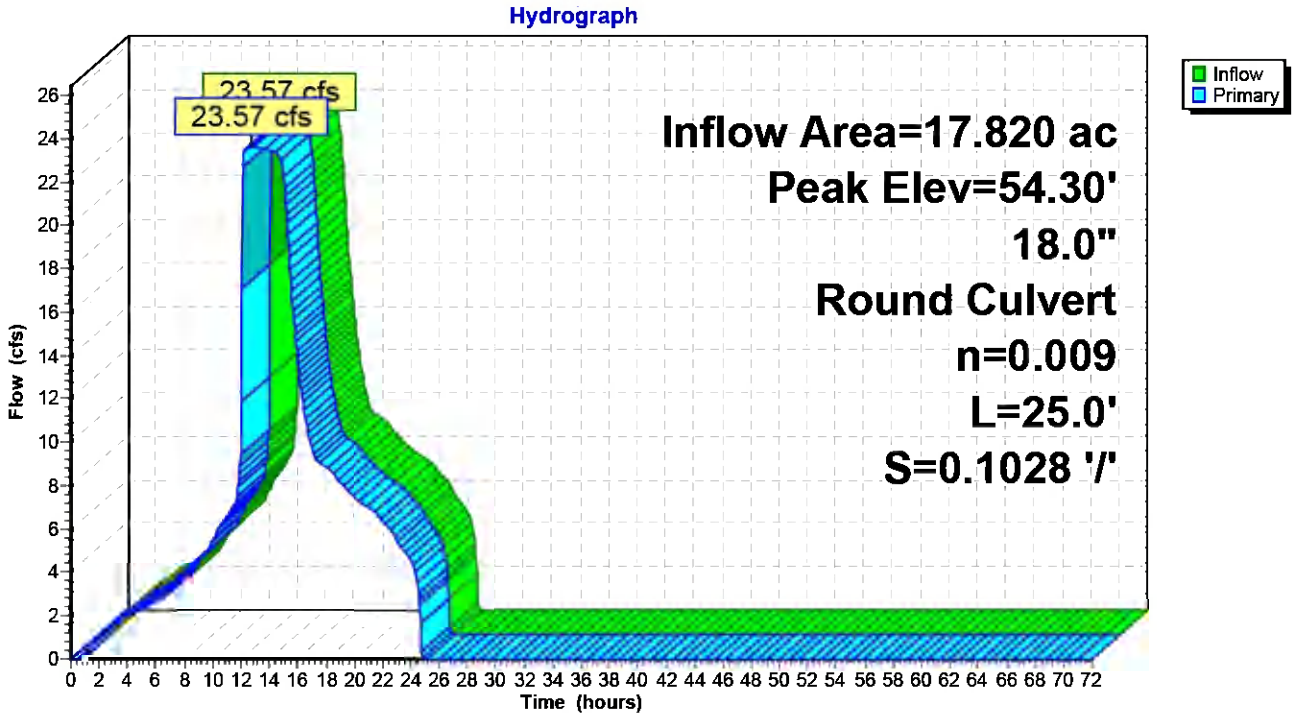
Inflow Area = 17.820 ac, 0.00% Impervious, Inflow Depth = 10.53" for 100-yr, 24-hr event
Inflow = 23.57 cfs @ 12.64 hrs, Volume= 15.635 af
Outflow = 23.57 cfs @ 12.64 hrs, Volume= 15.635 af, Atten= 0%, Lag= 0.0 min
Primary = 23.57 cfs @ 12.64 hrs, Volume= 15.635 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 54.30' @ 12.64 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	41.24'	**18.0" Round RCP_Round 18"** L= 25.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 41.24' / 38.67' S= 0.1028 '/' Cc= 0.900 n= 0.009 PVC, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=23.57 cfs @ 12.64 hrs HW=54.30' (Free Discharge)
↑**1=RCP_Round 18"** (Inlet Controls 23.57 cfs @ 13.34 fps)

Pond 13P: Pipe 2C



Summary for Pond 18P: Pipe 3B

[57] Hint: Peaked at 49.17' (Flood elevation advised)
[79] Warning: Submerged Pond 4P Primary device # 1 INLET by 2.11'

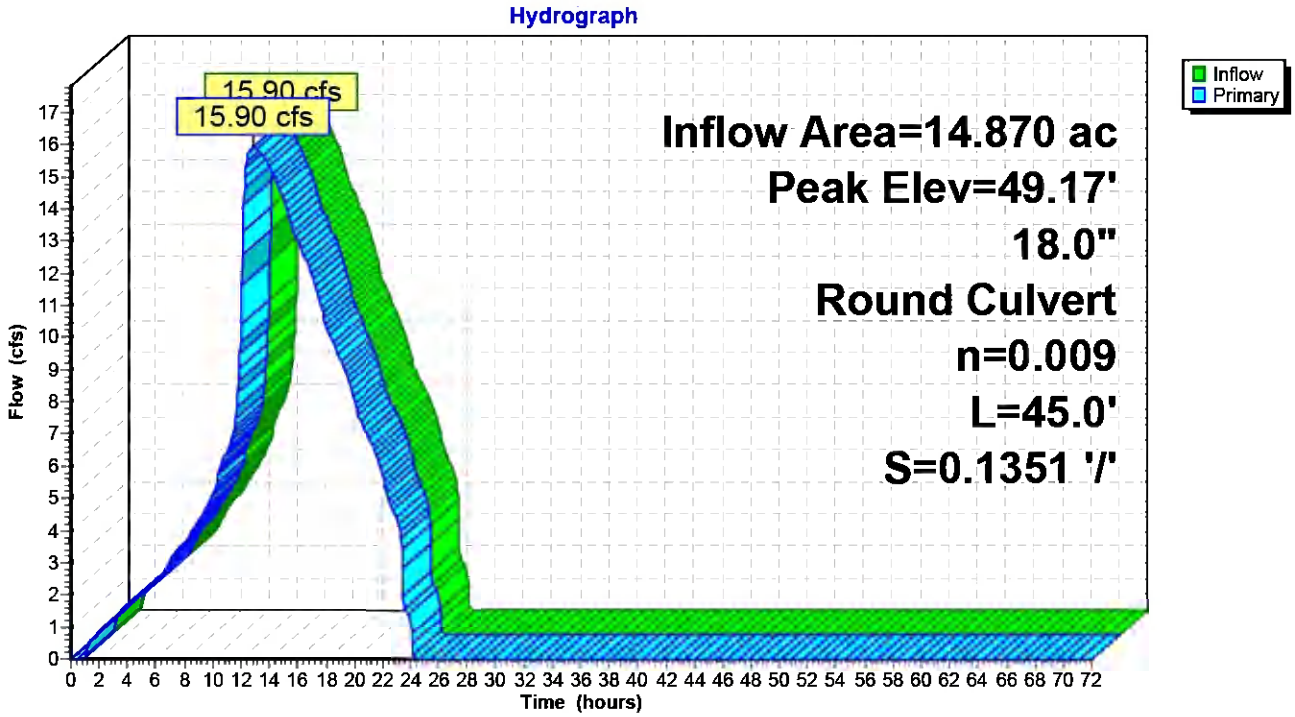
Inflow Area = 14.870 ac, 0.00% Impervious, Inflow Depth = 10.53" for 100-yr, 24-hr event
Inflow = 15.90 cfs @ 12.83 hrs, Volume= 13.050 af
Outflow = 15.90 cfs @ 12.83 hrs, Volume= 13.050 af, Atten= 0%, Lag= 0.0 min
Primary = 15.90 cfs @ 12.83 hrs, Volume= 13.050 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 49.17' @ 12.83 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	42.82'	**18.0" Round RCP_Round 18"** L= 45.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 42.82' / 36.74' S= 0.1351 '/' Cc= 0.900 n= 0.009 PVC, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=15.90 cfs @ 12.83 hrs HW=49.17' (Free Discharge)
1=RCP_Round 18" (Inlet Controls 15.90 cfs @ 9.00 fps)

Pond 18P: Pipe 3B



Summary for Pond 19P: Pipe 3C

[57] Hint: Peaked at 43.09' (Flood elevation advised)
[79] Warning: Submerged Pond 18P Primary device # 1 INLET by 0.27'

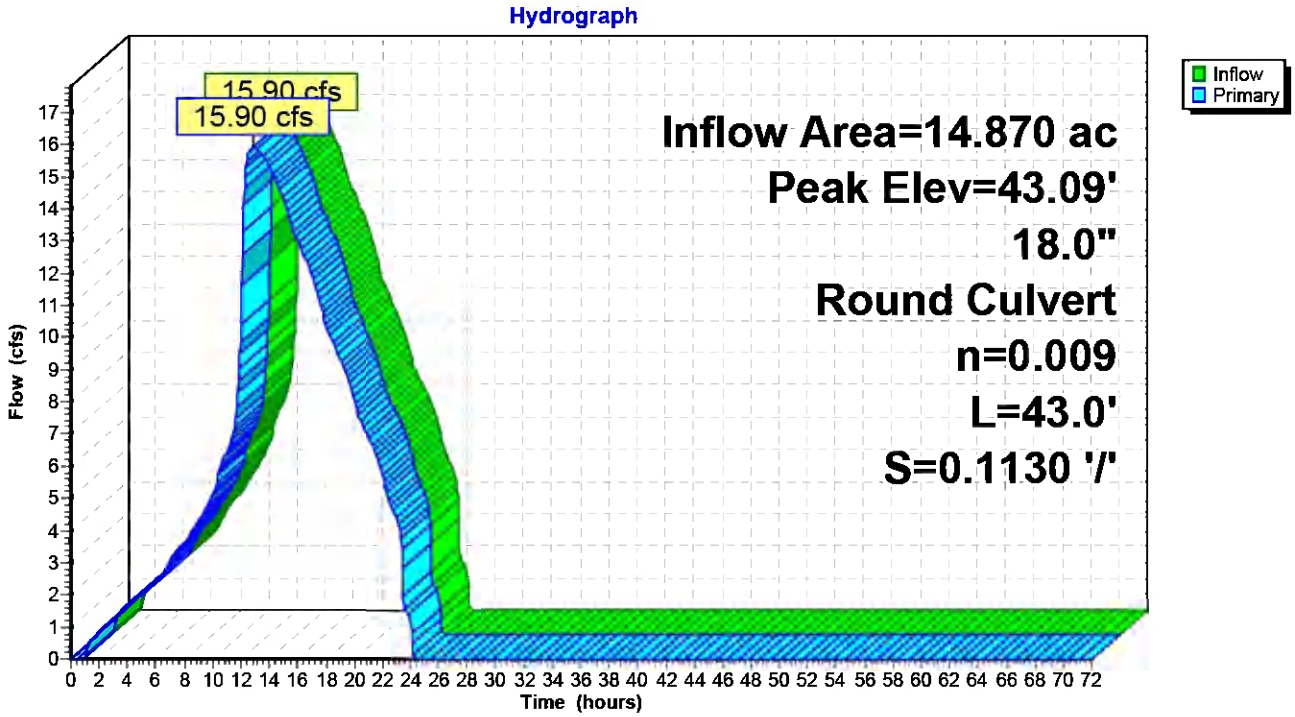
Inflow Area = 14.870 ac, 0.00% Impervious, Inflow Depth = 10.53" for 100-yr, 24-hr event
Inflow = 15.90 cfs @ 12.83 hrs, Volume= 13.050 af
Outflow = 15.90 cfs @ 12.83 hrs, Volume= 13.050 af, Atten= 0%, Lag= 0.0 min
Primary = 15.90 cfs @ 12.83 hrs, Volume= 13.050 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 43.09' @ 12.83 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	36.74'	**18.0" Round RCP_Round 18"** L= 43.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 36.74' / 31.88' S= 0.1130 '/' Cc= 0.900 n= 0.009 PVC, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=15.90 cfs @ 12.83 hrs HW=43.09' (Free Discharge)
↑**1=RCP_Round 18"** (Inlet Controls 15.90 cfs @ 9.00 fps)

Pond 19P: Pipe 3C



Summary for Pond 20P: Pipe 3D

[57] Hint: Peaked at 38.38' (Flood elevation advised)
[79] Warning: Submerged Pond 19P Primary device # 1 INLET by 1.64'

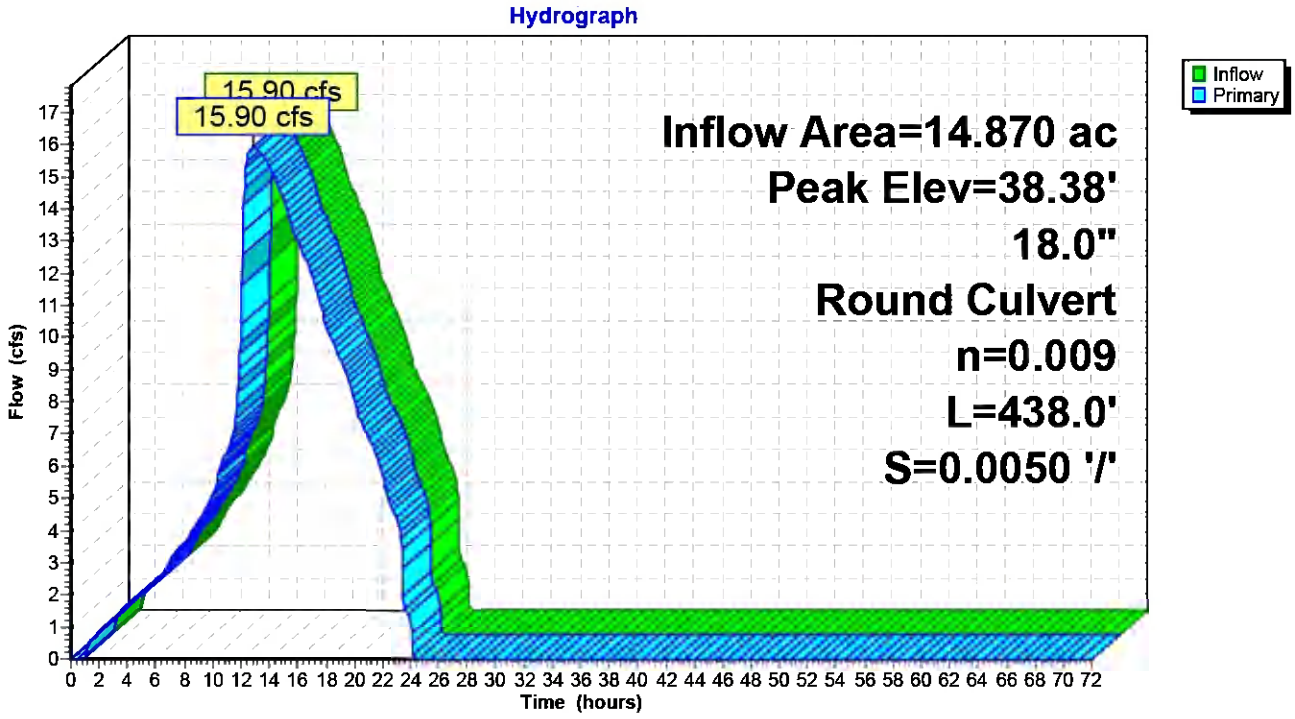
Inflow Area = 14.870 ac, 0.00% Impervious, Inflow Depth = 10.53" for 100-yr, 24-hr event
Inflow = 15.90 cfs @ 12.83 hrs, Volume= 13.050 af
Outflow = 15.90 cfs @ 12.83 hrs, Volume= 13.050 af, Atten= 0%, Lag= 0.0 min
Primary = 15.90 cfs @ 12.83 hrs, Volume= 13.050 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 38.38' @ 12.83 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	31.88'	**18.0" Round RCP_Round 18"** L= 438.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 31.88' / 29.67' S= 0.0050 '/' Cc= 0.900 n= 0.009 PVC, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=15.90 cfs @ 12.83 hrs HW=38.38' (Free Discharge)
1=RCP_Round 18" (Barrel Controls 15.90 cfs @ 9.00 fps)

Pond 20P: Pipe 3D



Summary for Pond 21P: Pipe 3D

[57] Hint: Peaked at 41.80' (Flood elevation advised)
[79] Warning: Submerged Pond 13P Primary device # 1 INLET by 0.56'
[81] Warning: Exceeded Pond 20P by 3.45' @ 12.35 hrs

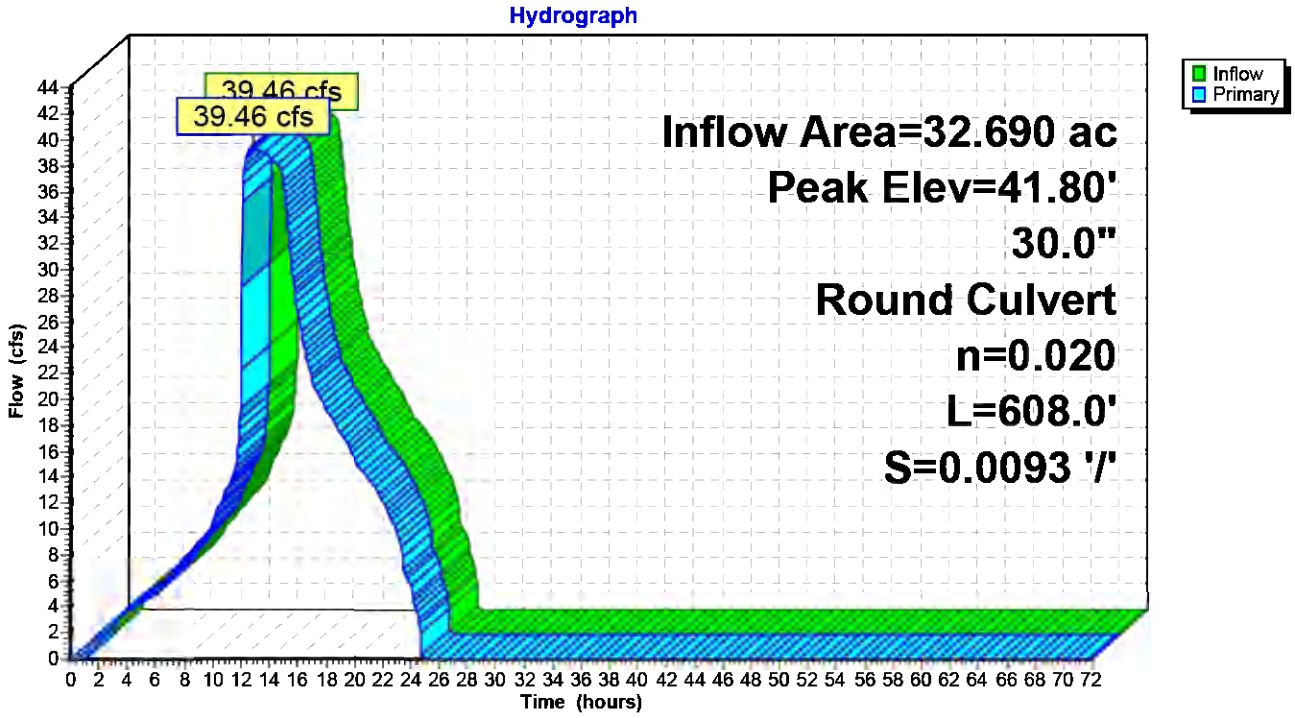
Inflow Area = 32.690 ac, 0.00% Impervious, Inflow Depth = 10.53" for 100-yr, 24-hr event
Inflow = 39.46 cfs @ 12.80 hrs, Volume= 28.685 af
Outflow = 39.46 cfs @ 12.80 hrs, Volume= 28.685 af, Atten= 0%, Lag= 0.0 min
Primary = 39.46 cfs @ 12.80 hrs, Volume= 28.685 af

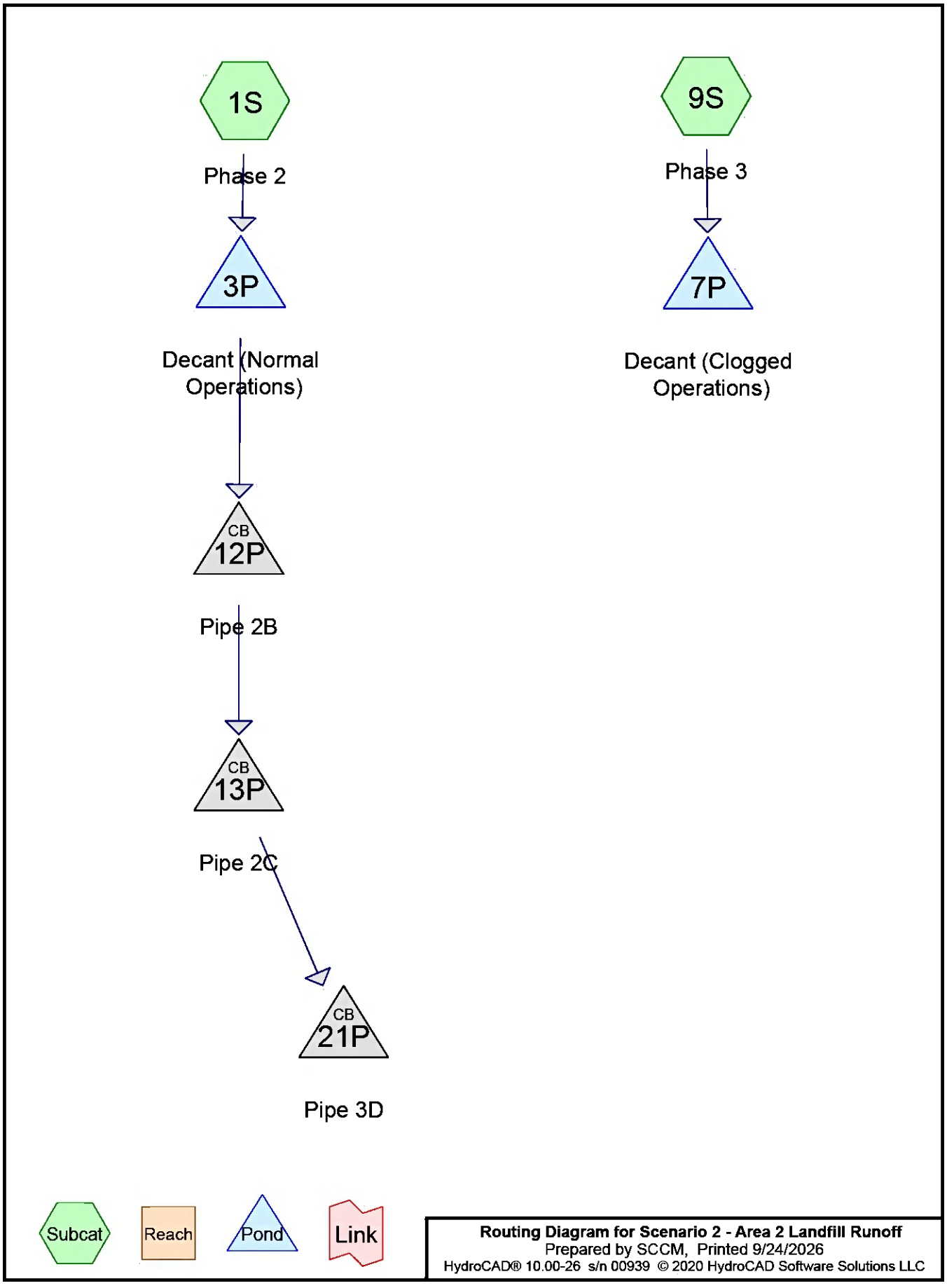
Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 41.80' @ 12.80 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	29.67'	**30.0" Round Culvert** L= 608.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 29.67' / 24.02' S= 0.0093 '/' Cc= 0.900 n= 0.020 Corrugated PE, corrugated interior, Flow Area= 4.91 sf

Primary OutFlow Max=39.46 cfs @ 12.80 hrs HW=41.80' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 39.46 cfs @ 8.04 fps)

Pond 21P: Pipe 3D





Routing Diagram for Scenario 2 - Area 2 Landfill Runoff
Prepared by SCCM, Printed 9/24/2026
HydroCAD® 10.00-26 s/n 00939 © 2020 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
32.690	97	(1S, 9S)
32.690	**97**	**TOTAL AREA**

Pipe Listing (all 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	3P	46.74	43.44	664.0	0.0050	0.009	18.0	0.0	0.0
2	12P	43.44	41.24	23.0	0.0957	0.009	18.0	0.0	0.0
3	13P	41.24	38.67	25.0	0.1028	0.009	18.0	0.0	0.0
4	21P	29.67	24.02	608.0	0.0093	0.020	30.0	0.0	0.0

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Phase 2 Runoff Area=17.820 ac 0.00% Impervious Runoff Depth=7.92"
Tc=6.0 min CN=97 Runoff=141.08 cfs 11.761 af

Subcatchment 9S: Phase 3 Runoff Area=14.870 ac 0.00% Impervious Runoff Depth=7.92"
Tc=6.0 min CN=97 Runoff=117.73 cfs 9.814 af

Pond 3P: Decant (Normal Operations) Peak Elev=65.71' Storage=4.659 af Inflow=141.08 cfs 11.761 af
Outflow=23.26 cfs 11.748 af

Pond 7P: Decant (Clogged Operations) Peak Elev=69.23' Storage=9.814 af Inflow=117.73 cfs 9.814 af
Outflow=0.00 cfs 0.000 af

Pond 12P: Pipe 2B Peak Elev=56.18' Inflow=23.26 cfs 11.748 af
18.0" Round Culvert n=0.009 L=23.0' S=0.0957 '/' Outflow=23.26 cfs 11.748 af

Pond 13P: Pipe 2C Peak Elev=53.98' Inflow=23.26 cfs 11.748 af
18.0" Round Culvert n=0.009 L=25.0' S=0.1028 '/' Outflow=23.26 cfs 11.748 af

Pond 21P: Pipe 3D Peak Elev=32.47' Inflow=23.26 cfs 11.748 af
30.0" Round Culvert n=0.020 L=608.0' S=0.0093 '/' Outflow=23.26 cfs 11.748 af

Total Runoff Area = 32.690 ac Runoff Volume = 21.576 af Average Runoff Depth = 7.92"
100.00% Pervious = 32.690 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: Phase 2

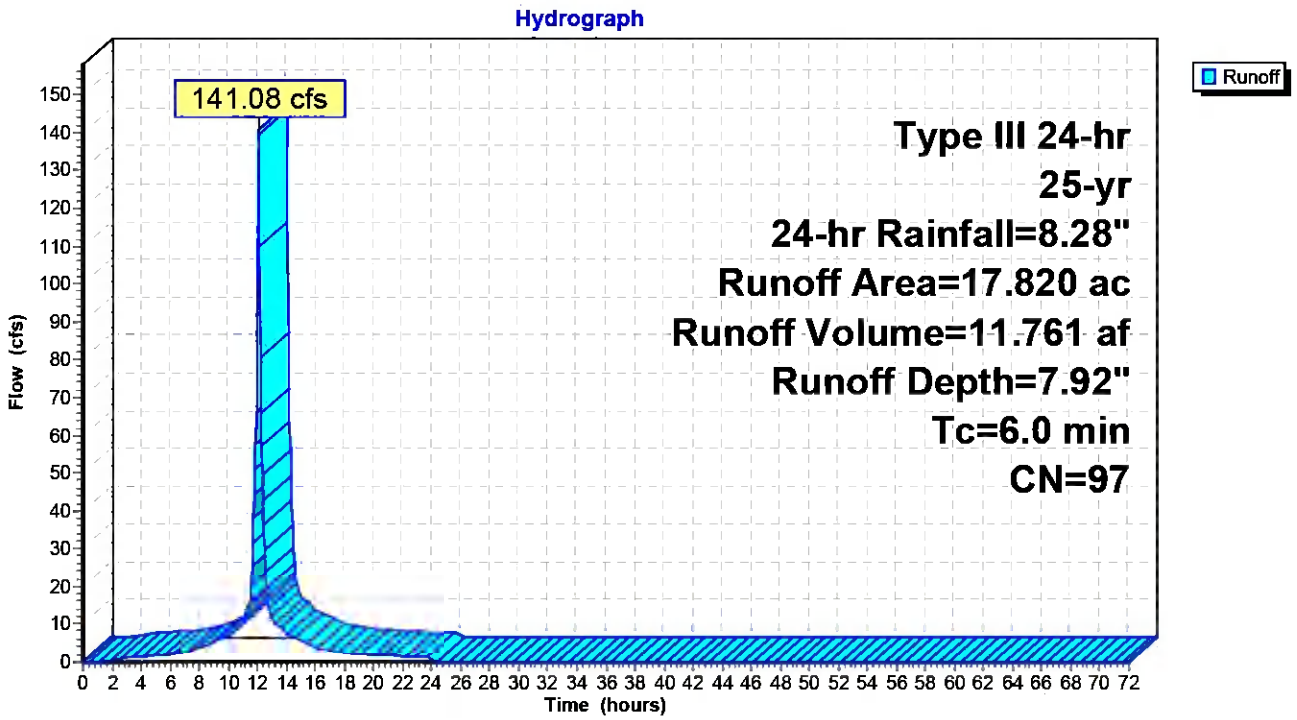
Runoff = 141.08 cfs @ 12.09 hrs, Volume= 11.761 af, Depth= 7.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr, 24-hr Rainfall=8.28"

	Area (ac)	CN	Description
*	17.820	97	
	17.820		100.00% Pervious Area

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

Subcatchment 1S: Phase 2



Summary for Subcatchment 9S: Phase 3

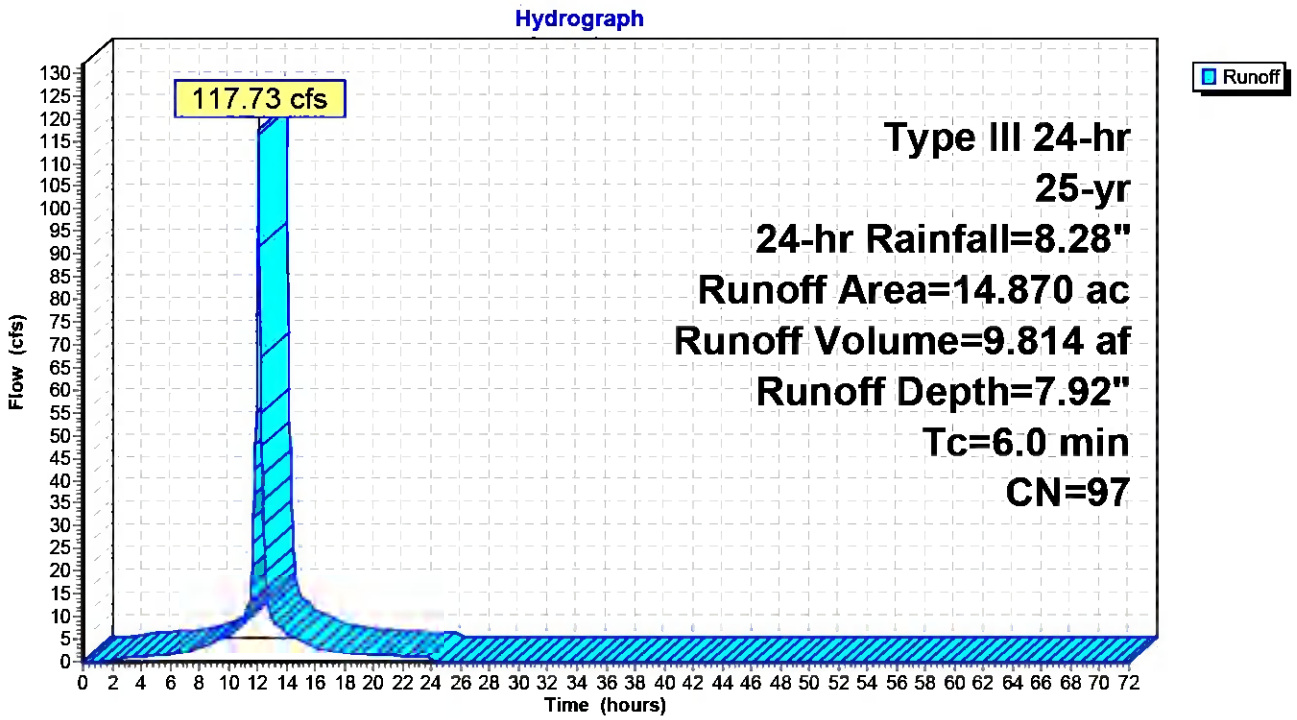
Runoff = 117.73 cfs @ 12.09 hrs, Volume= 9.814 af, Depth= 7.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr, 24-hr Rainfall=8.28"

	Area (ac)	CN	Description
*	14.870	97	
	14.870		100.00% Pervious Area

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

Subcatchment 9S: Phase 3



Summary for Pond 3P: Decant (Normal Operations)

Inflow Area = 17.820 ac, 0.00% Impervious, Inflow Depth = 7.92" for 25-yr, 24-hr event
Inflow = 141.08 cfs @ 12.09 hrs, Volume= 11.761 af
Outflow = 23.26 cfs @ 12.56 hrs, Volume= 11.748 af, Atten= 84%, Lag= 28.3 min
Primary = 23.26 cfs @ 12.56 hrs, Volume= 11.748 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 65.71' @ 12.56 hrs Surf.Area= 3.195 ac Storage= 4.659 af

Plug-Flow detention time= 127.0 min calculated for 11.748 af (100% of inflow)
Center-of-Mass det. time= 126.2 min (872.8 - 746.6)

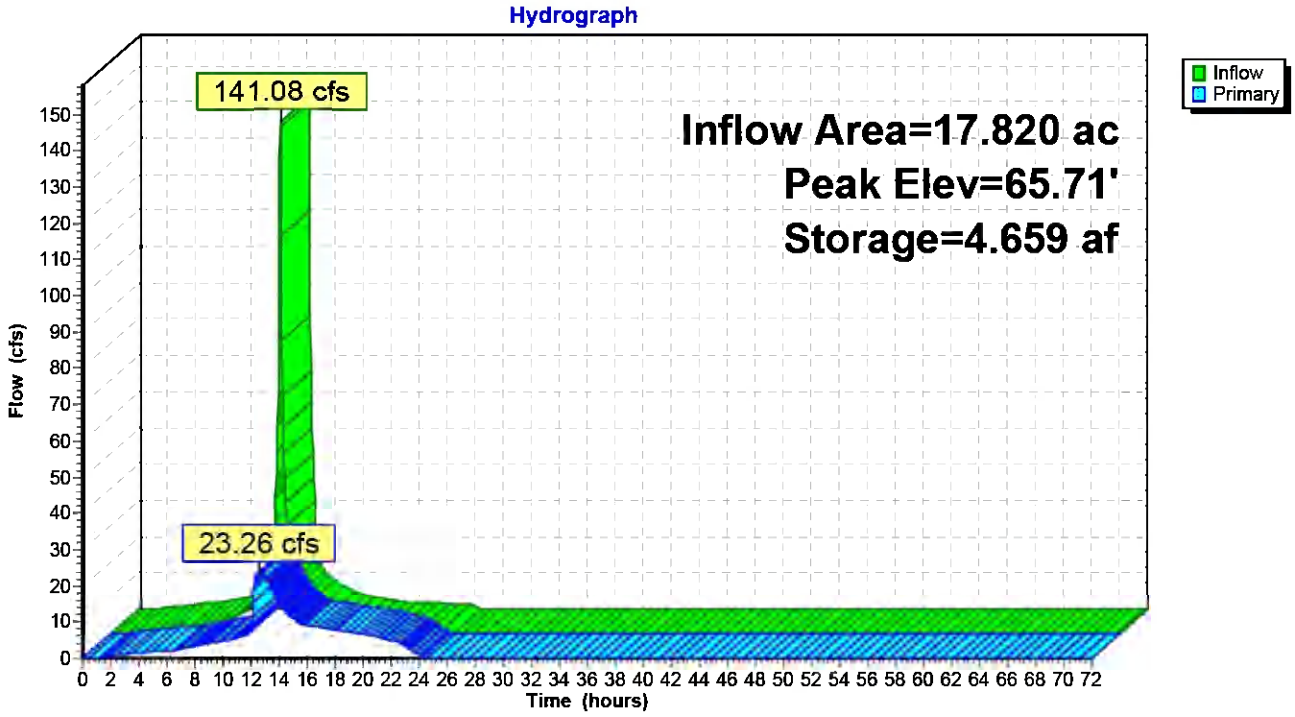
Volume	Invert	Avail.Storage	Storage Description
#1	56.00'	22.401 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
56.00	0.000	0.000	0.000
57.00	0.001	0.001	0.001
58.00	0.002	0.002	0.002
59.00	0.003	0.003	0.005
60.00	0.004	0.004	0.008
61.00	0.006	0.005	0.013
62.00	0.007	0.006	0.019
63.00	0.193	0.100	0.119
64.00	1.180	0.687	0.806
65.00	2.486	1.833	2.639
66.00	3.484	2.985	5.624
67.00	4.022	3.753	9.377
68.00	4.235	4.129	13.506
69.00	4.444	4.339	17.845
70.00	4.668	4.556	22.401

Device	Routin	Invert	Outlet Devices
#1	Primary	46.74'	**18.0" Round Culvert** L= 664.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 46.74' / 43.44' S= 0.0050 '/' Cc= 0.900 n= 0.009 PVC, smooth interior, Flow Area= 1.77 sf
#2	Device 1	65.05'	**36.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	64.55'	**2.0" Vert. Orifice/Grate X 12.00** C= 0.600
#4	Device 1	63.55'	**2.0" Vert. Orifice/Grate X 12.00** C= 0.600
#5	Device 1	62.55'	**2.0" Horiz. Orifice/Grate X 12.00** C= 0.600 Limited to weir flow at low heads
#6	Device 1	61.55'	**2.0" Horiz. Orifice/Grate X 12.00** C= 0.600 Limited to weir flow at low heads
#7	Device 1	61.05'	**2.0" Vert. Orifice/Grate X 12.00** C= 0.600

Primary OutFlow Max=23.26 cfs @ 12.56 hrs HW=65.71' (Free Discharge)
└─**1=Culvert** (Barrel Controls 23.26 cfs @ 13.16 fps)
  ├─**2=Orifice/Grate** (Passes < 16.54 cfs potential flow)
  ├─**3=Orifice/Grate** (Passes < 1.31 cfs potential flow)
  ├─**4=Orifice/Grate** (Passes < 1.82 cfs potential flow)
  ├─**5=Orifice/Grate** (Passes < 2.24 cfs potential flow)
  ├─**6=Orifice/Grate** (Passes < 2.57 cfs potential flow)
  └─**7=Orifice/Grate** (Passes < 2.70 cfs potential flow)

Pond 3P: Decant (Normal Operations)



Summary for Pond 7P: Decant (Clogged Operations)

Inflow Area = 14.870 ac, 0.00% Impervious, Inflow Depth = 7.92" for 25-yr, 24-hr event
Inflow = 117.73 cfs @ 12.09 hrs, Volume= 9.814 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

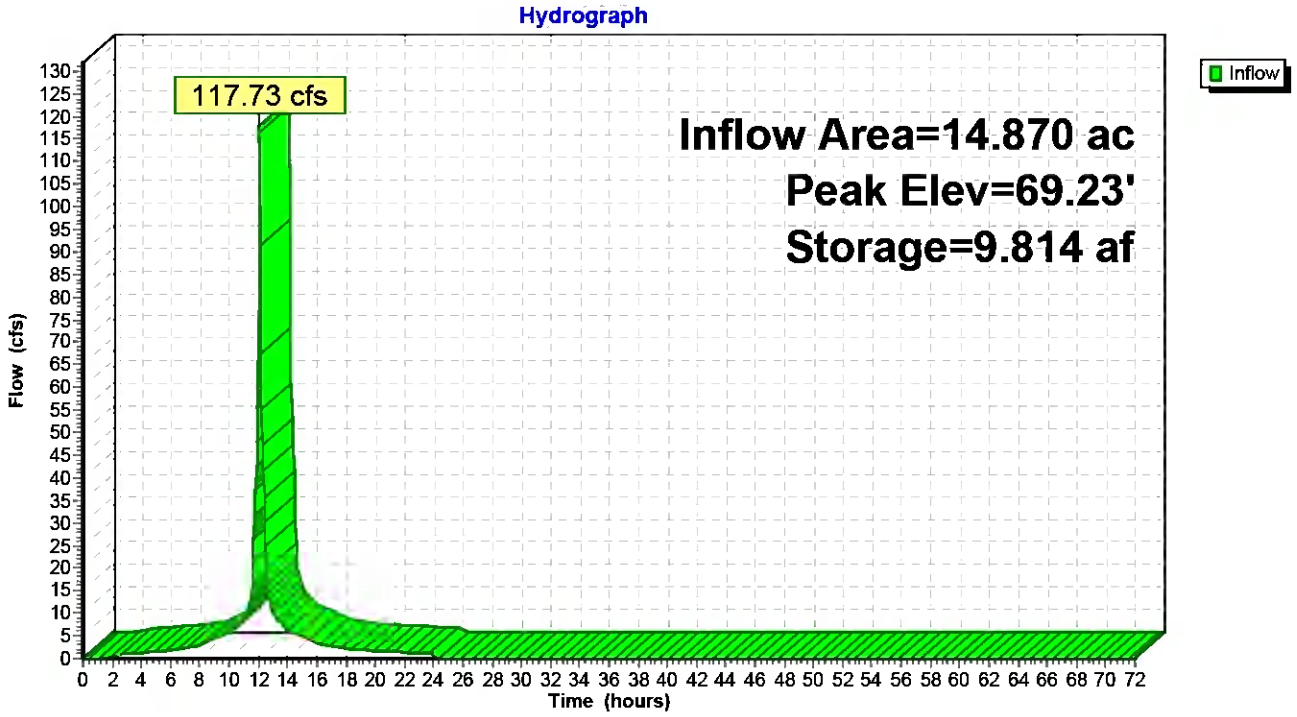
Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 69.23' @ 24.40 hrs Surf.Area= 3.120 ac Storage= 9.814 af

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'	24.341 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
58.00	0.000	0.000	0.000
59.00	0.001	0.001	0.001
60.00	0.003	0.002	0.003
61.00	0.004	0.004	0.006
62.00	0.005	0.005	0.010
63.00	0.007	0.006	0.016
64.00	0.536	0.271	0.288
65.00	1.160	0.848	1.136
66.00	1.478	1.319	2.455
67.00	1.905	1.692	4.146
68.00	2.503	2.204	6.350
69.00	3.014	2.758	9.109
70.00	3.477	3.245	12.354
71.00	3.823	3.650	16.004
72.00	4.166	3.994	19.999
73.00	4.519	4.342	24.341

Pond 7P: Decant (Clogged Operations)



Summary for Pond 12P: Pipe 2B

[57] Hint: Peaked at 56.18' (Flood elevation advised)
[79] Warning: Submerged Pond 3P Primary device # 1 INLET by 9.44'

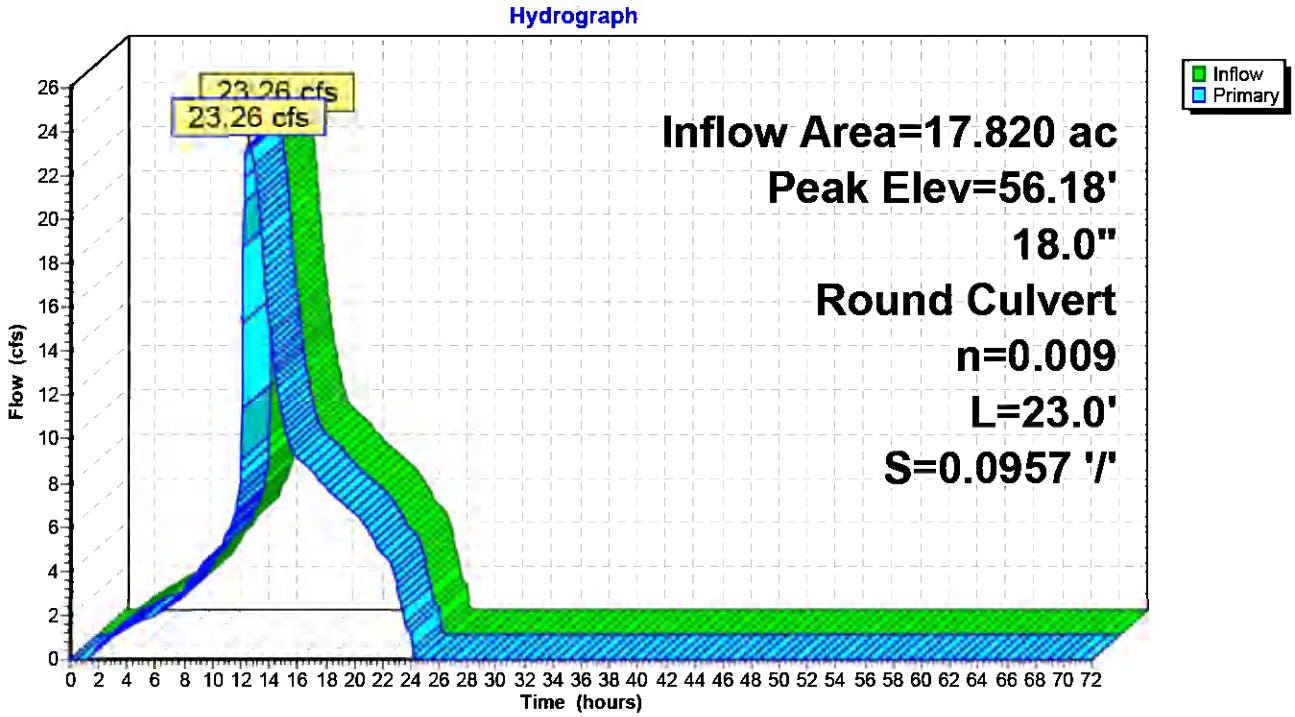
Inflow Area = 17.820 ac, 0.00% Impervious, Inflow Depth = 7.91" for 25-yr, 24-hr event
Inflow = 23.26 cfs @ 12.56 hrs, Volume= 11.748 af
Outflow = 23.26 cfs @ 12.56 hrs, Volume= 11.748 af, Atten= 0%, Lag= 0.0 min
Primary = 23.26 cfs @ 12.56 hrs, Volume= 11.748 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 56.18' @ 12.56 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	43.44'	**18.0" Round RCP_Round 18"** L= 23.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 43.44' / 41.24' S= 0.0957 '/' Cc= 0.900 n= 0.009 PVC, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=23.26 cfs @ 12.56 hrs HW=56.18' (Free Discharge)
1=RCP_Round 18" (Inlet Controls 23.26 cfs @ 13.16 fps)

Pond 12P: Pipe 2B



Summary for Pond 13P: Pipe 2C

[57] Hint: Peaked at 53.98' (Flood elevation advised)
[79] Warning: Submerged Pond 12P Primary device # 1 INLET by 10.54'

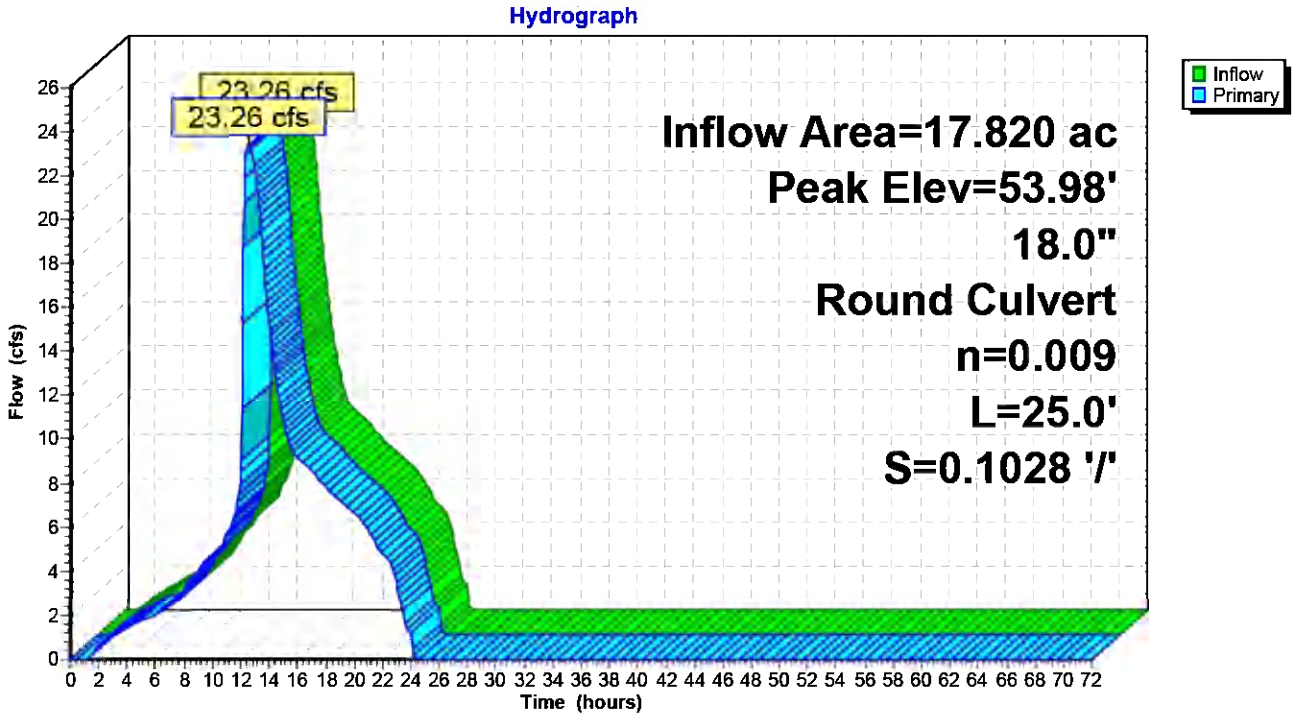
Inflow Area = 17.820 ac, 0.00% Impervious, Inflow Depth = 7.91" for 25-yr, 24-hr event
Inflow = 23.26 cfs @ 12.56 hrs, Volume= 11.748 af
Outflow = 23.26 cfs @ 12.56 hrs, Volume= 11.748 af, Atten= 0%, Lag= 0.0 min
Primary = 23.26 cfs @ 12.56 hrs, Volume= 11.748 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 53.98' @ 12.56 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	41.24'	**18.0" Round RCP_Round 18"** L= 25.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 41.24' / 38.67' S= 0.1028 '/' Cc= 0.900 n= 0.009 PVC, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=23.26 cfs @ 12.56 hrs HW=53.98' (Free Discharge)
1=RCP_Round 18" (Inlet Controls 23.26 cfs @ 13.16 fps)

Pond 13P: Pipe 2C



Summary for Pond 21P: Pipe 3D

[57] Hint: Peaked at 32.47' (Flood elevation advised)

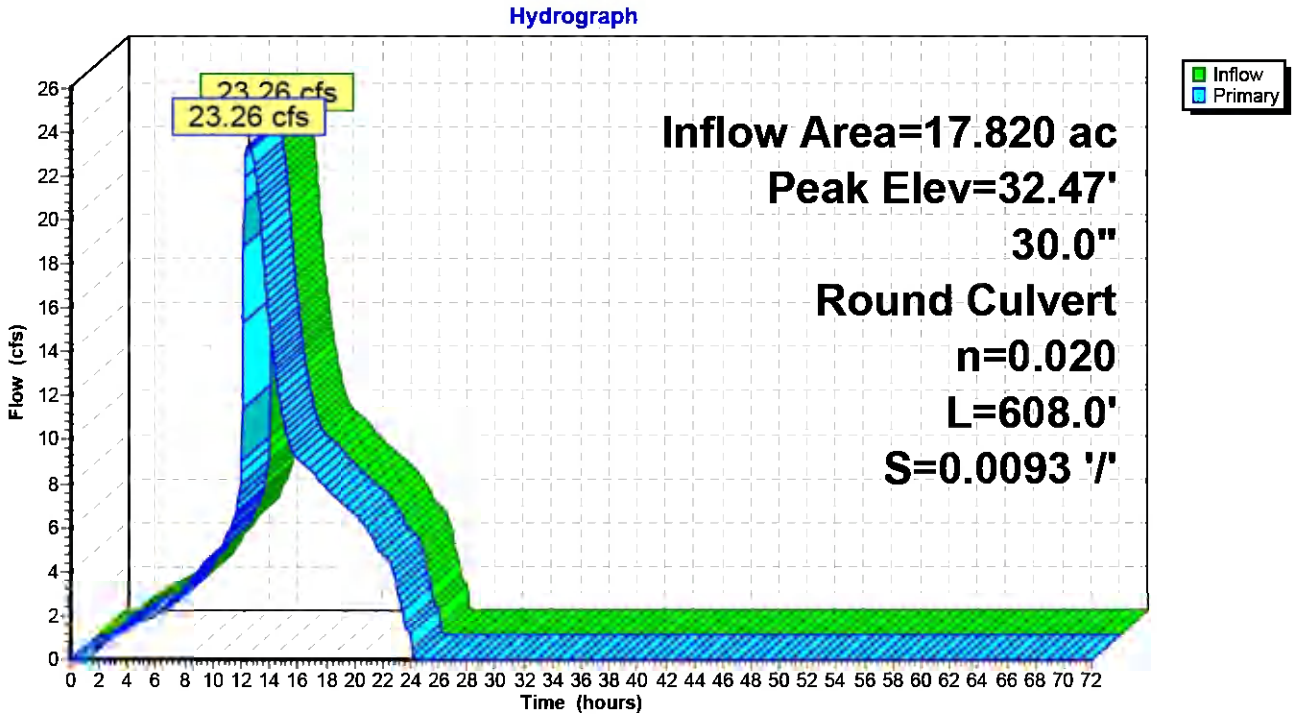
Inflow Area = 17.820 ac, 0.00% Impervious, Inflow Depth = 7.91" for 25-yr, 24-hr event
Inflow = 23.26 cfs @ 12.56 hrs, Volume= 11.748 af
Outflow = 23.26 cfs @ 12.56 hrs, Volume= 11.748 af, Atten= 0%, Lag= 0.0 min
Primary = 23.26 cfs @ 12.56 hrs, Volume= 11.748 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 32.47' @ 12.56 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	29.67'	**30.0" Round Culvert** L= 608.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 29.67' / 24.02' S= 0.0093 '/' Cc= 0.900 n= 0.020 Corrugated PE, corrugated interior, Flow Area= 4.91 sf

Primary OutFlow Max=23.26 cfs @ 12.56 hrs HW=32.47' (Free Discharge)
1=Culvert (Inlet Controls 23.26 cfs @ 4.74 fps)

Pond 21P: Pipe 3D



Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Phase 2 Runoff Area=17.820 ac 0.00% Impervious Runoff Depth=10.54"
Tc=6.0 min CN=97 Runoff=186.11 cfs 15.648 af

Subcatchment 9S: Phase 3 Runoff Area=14.870 ac 0.00% Impervious Runoff Depth=10.54"
Tc=6.0 min CN=97 Runoff=155.30 cfs 13.058 af

Pond 3P: Decant (Normal Operations) Peak Elev=66.27' Storage=6.589 af Inflow=186.11 cfs 15.648 af
Outflow=23.57 cfs 15.635 af

Pond 7P: Decant (Clogged Operations) Peak Elev=70.20' Storage=13.057 af Inflow=155.30 cfs 13.058 af
Outflow=0.00 cfs 0.000 af

Pond 12P: Pipe 2B Peak Elev=56.50' Inflow=23.57 cfs 15.635 af
18.0" Round Culvert n=0.009 L=23.0' S=0.0957 '/' Outflow=23.57 cfs 15.635 af

Pond 13P: Pipe 2C Peak Elev=54.30' Inflow=23.57 cfs 15.635 af
18.0" Round Culvert n=0.009 L=25.0' S=0.1028 '/' Outflow=23.57 cfs 15.635 af

Pond 21P: Pipe 3D Peak Elev=32.52' Inflow=23.57 cfs 15.635 af
30.0" Round Culvert n=0.020 L=608.0' S=0.0093 '/' Outflow=23.57 cfs 15.635 af

Total Runoff Area = 32.690 ac Runoff Volume = 28.706 af Average Runoff Depth = 10.54"
100.00% Pervious = 32.690 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: Phase 2

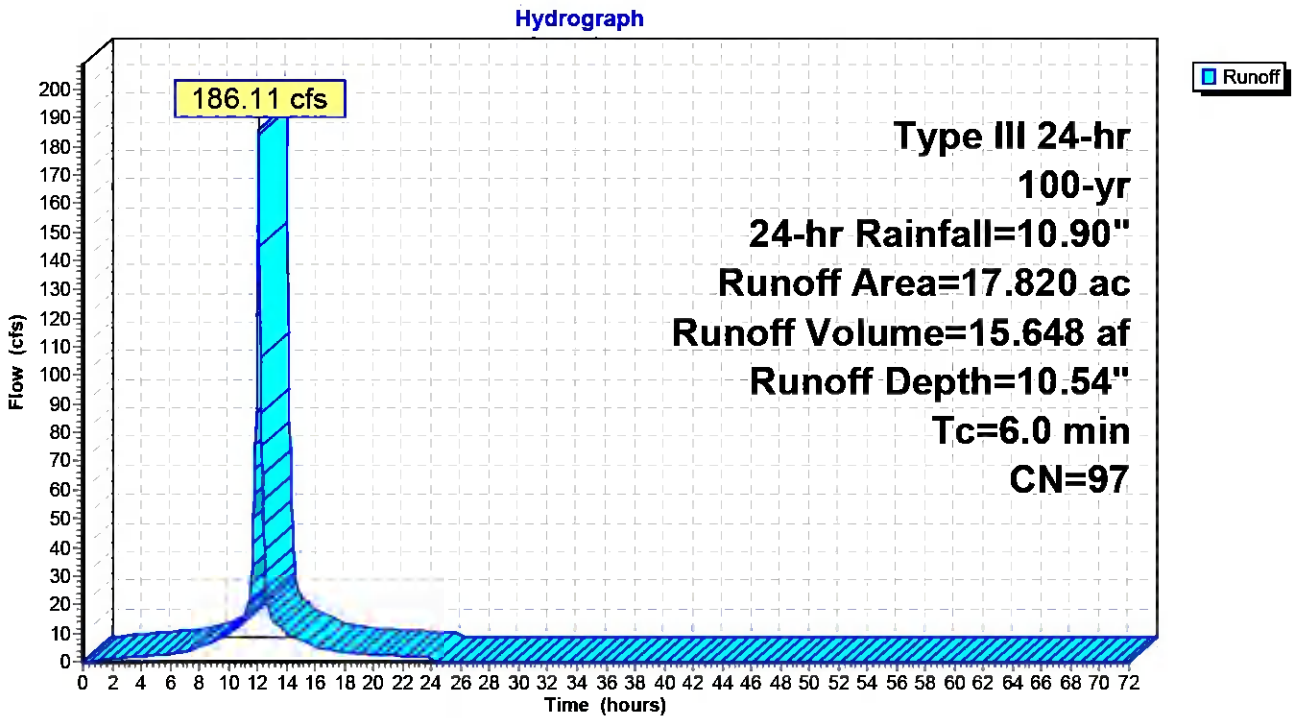
Runoff = 186.11 cfs @ 12.09 hrs, Volume= 15.648 af, Depth=10.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr, 24-hr Rainfall=10.90"

	Area (ac)	CN	Description
*	17.820	97	
	17.820		100.00% Pervious Area

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

Subcatchment 1S: Phase 2



Summary for Subcatchment 9S: Phase 3

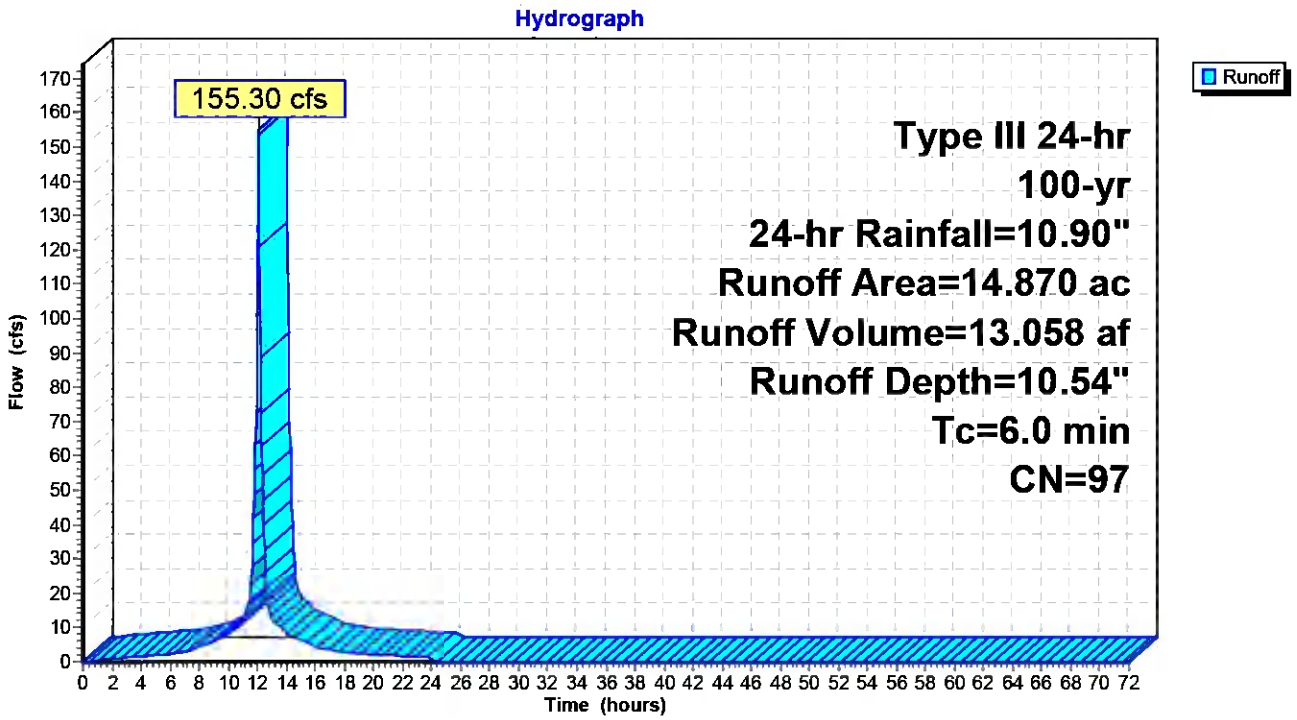
Runoff = 155.30 cfs @ 12.09 hrs, Volume= 13.058 af, Depth=10.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr, 24-hr Rainfall=10.90"

	Area (ac)	CN	Description
*	14.870	97	
	14.870		100.00% Pervious Area

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

Subcatchment 9S: Phase 3



Summary for Pond 3P: Decant (Normal Operations)

Inflow Area = 17.820 ac, 0.00% Impervious, Inflow Depth = 10.54" for 100-yr, 24-hr event
Inflow = 186.11 cfs @ 12.09 hrs, Volume= 15.648 af
Outflow = 23.57 cfs @ 12.64 hrs, Volume= 15.635 af, Atten= 87%, Lag= 33.2 min
Primary = 23.57 cfs @ 12.64 hrs, Volume= 15.635 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 66.27' @ 12.64 hrs Surf.Area= 3.630 ac Storage= 6.589 af

Plug-Flow detention time= 141.9 min calculated for 15.635 af (100% of inflow)
Center-of-Mass det. time= 141.3 min (883.9 - 742.6)

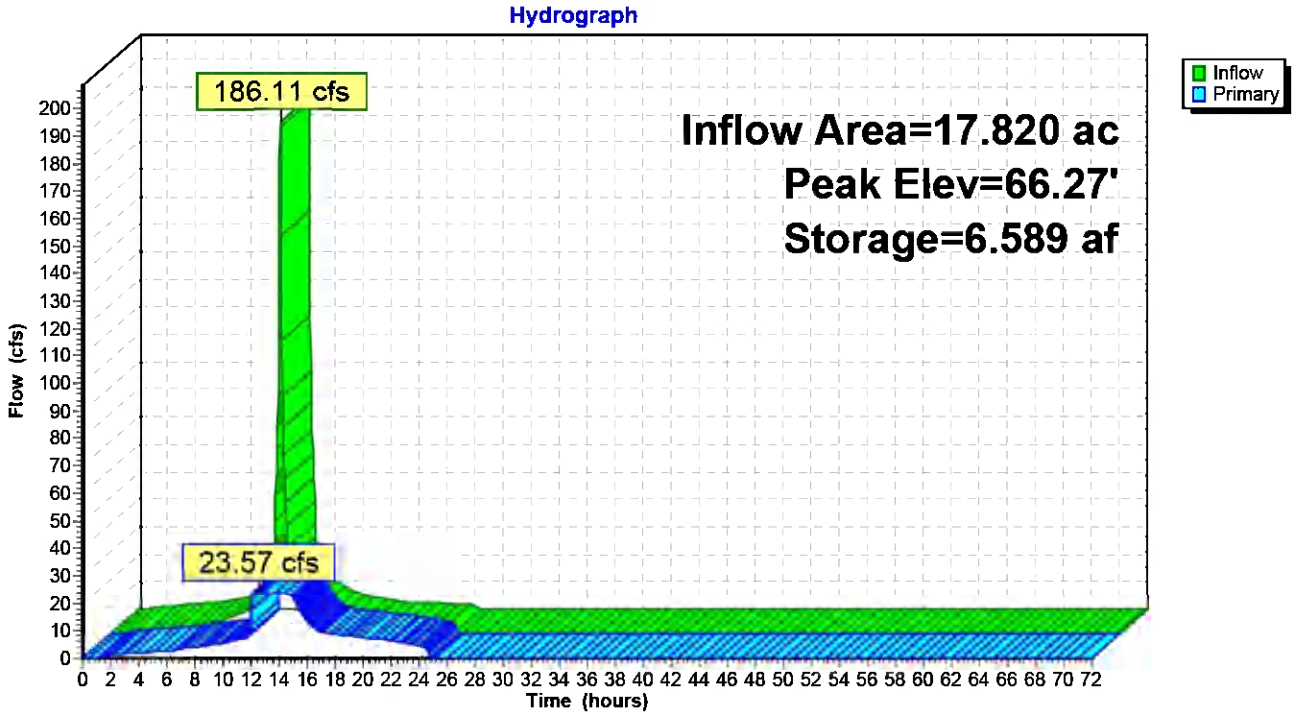
Volume	Invert	Avail.Storage	Storage Description
#1	56.00'	22.401 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
56.00	0.000	0.000	0.000
57.00	0.001	0.001	0.001
58.00	0.002	0.002	0.002
59.00	0.003	0.003	0.005
60.00	0.004	0.004	0.008
61.00	0.006	0.005	0.013
62.00	0.007	0.006	0.019
63.00	0.193	0.100	0.119
64.00	1.180	0.687	0.806
65.00	2.486	1.833	2.639
66.00	3.484	2.985	5.624
67.00	4.022	3.753	9.377
68.00	4.235	4.129	13.506
69.00	4.444	4.339	17.845
70.00	4.668	4.556	22.401

Device	Routin	Invert	Outlet Devices
#1	Primary	46.74'	**18.0" Round Culvert** L= 664.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 46.74' / 43.44' S= 0.0050 '/' Cc= 0.900 n= 0.009 PVC, smooth interior, Flow Area= 1.77 sf
#2	Device 1	65.05'	**36.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	64.55'	**2.0" Vert. Orifice/Grate X 12.00** C= 0.600
#4	Device 1	63.55'	**2.0" Vert. Orifice/Grate X 12.00** C= 0.600
#5	Device 1	62.55'	**2.0" Horiz. Orifice/Grate X 12.00** C= 0.600 Limited to weir flow at low heads
#6	Device 1	61.55'	**2.0" Horiz. Orifice/Grate X 12.00** C= 0.600 Limited to weir flow at low heads
#7	Device 1	61.05'	**2.0" Vert. Orifice/Grate X 12.00** C= 0.600

Primary OutFlow Max=23.57 cfs @ 12.64 hrs HW=66.27' (Free Discharge)
└─**1=Culvert** (Barrel Controls 23.57 cfs @ 13.34 fps)
  ├─**2=Orifice/Grate** (Passes < 37.61 cfs potential flow)
  ├─**3=Orifice/Grate** (Passes < 1.61 cfs potential flow)
  ├─**4=Orifice/Grate** (Passes < 2.05 cfs potential flow)
  ├─**5=Orifice/Grate** (Passes < 2.43 cfs potential flow)
  ├─**6=Orifice/Grate** (Passes < 2.74 cfs potential flow)
  └─**7=Orifice/Grate** (Passes < 2.86 cfs potential flow)

Pond 3P: Decant (Normal Operations)



Summary for Pond 7P: Decant (Clogged Operations)

Inflow Area = 14.870 ac, 0.00% Impervious, Inflow Depth = 10.54" for 100-yr, 24-hr event
Inflow = 155.30 cfs @ 12.09 hrs, Volume= 13.058 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

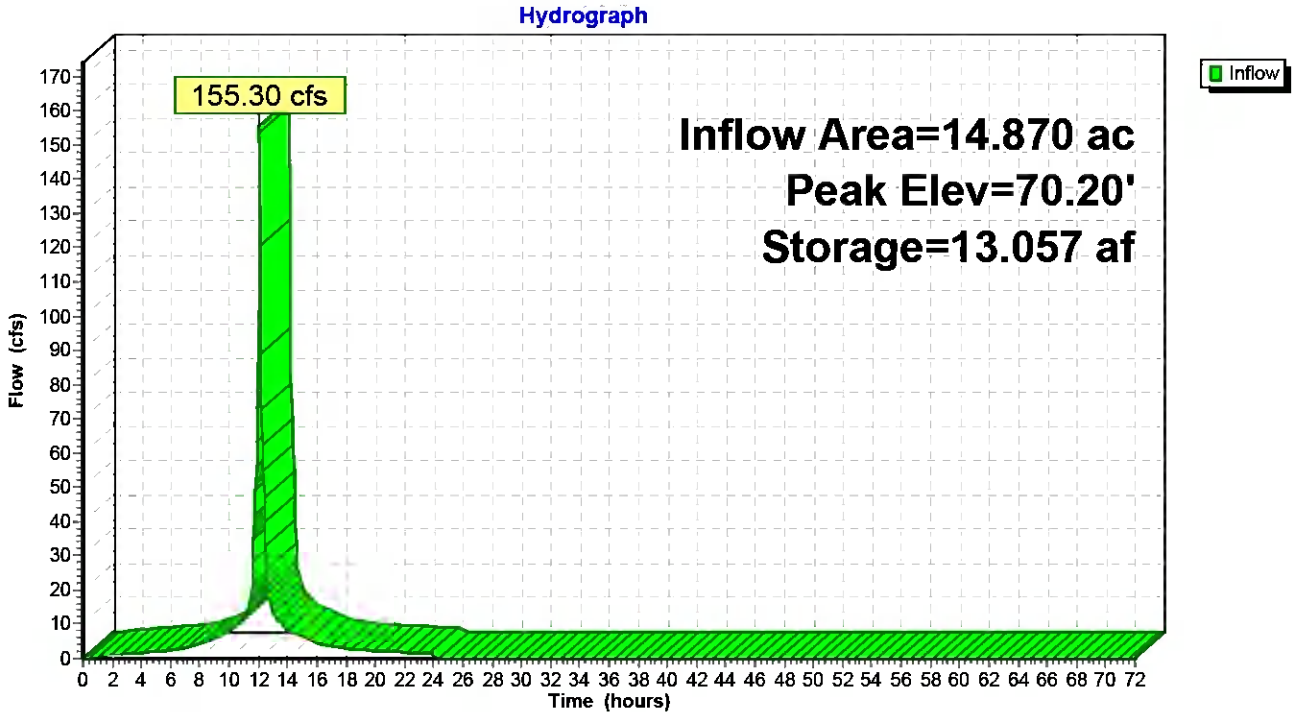
Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 70.20' @ 24.40 hrs Surf.Area= 3.546 ac Storage= 13.057 af

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'	24.341 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
58.00	0.000	0.000	0.000
59.00	0.001	0.001	0.001
60.00	0.003	0.002	0.003
61.00	0.004	0.004	0.006
62.00	0.005	0.005	0.010
63.00	0.007	0.006	0.016
64.00	0.536	0.271	0.288
65.00	1.160	0.848	1.136
66.00	1.478	1.319	2.455
67.00	1.905	1.692	4.146
68.00	2.503	2.204	6.350
69.00	3.014	2.758	9.109
70.00	3.477	3.245	12.354
71.00	3.823	3.650	16.004
72.00	4.166	3.994	19.999
73.00	4.519	4.342	24.341

Pond 7P: Decant (Clogged Operations)



Summary for Pond 12P: Pipe 2B

[57] Hint: Peaked at 56.50' (Flood elevation advised)
[79] Warning: Submerged Pond 3P Primary device # 1 INLET by 9.76'

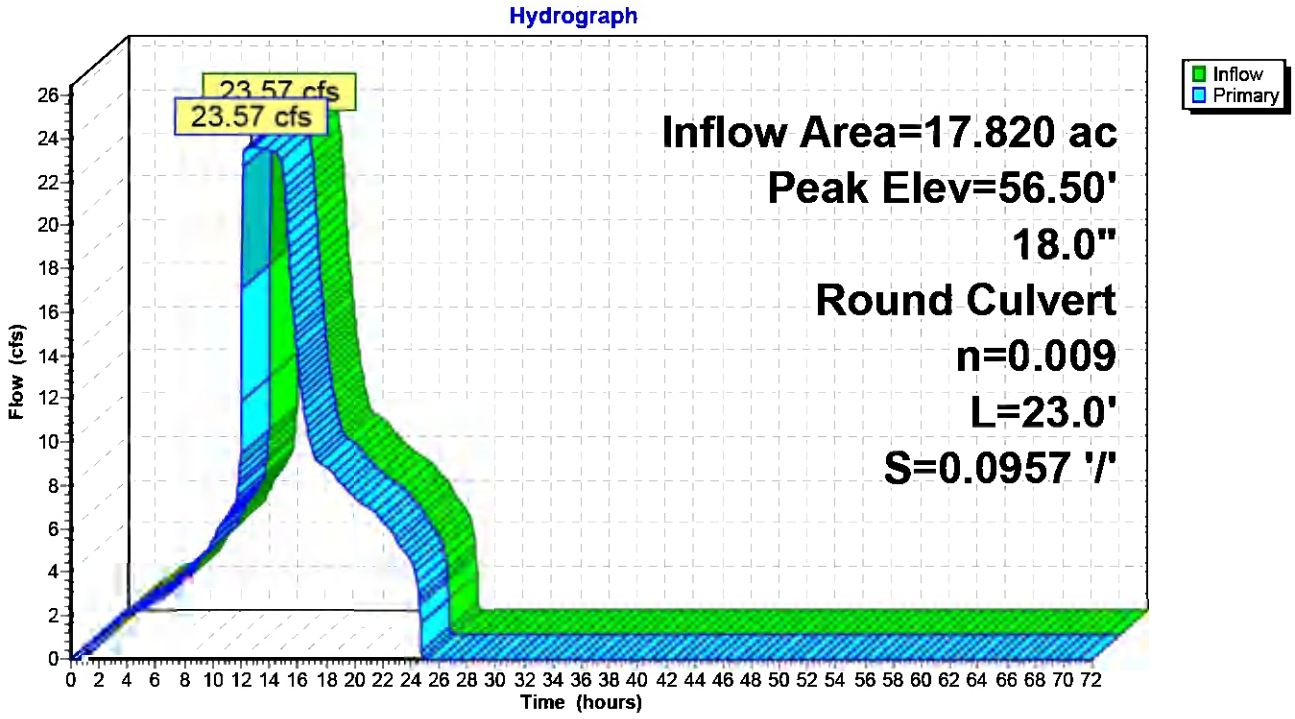
Inflow Area = 17.820 ac, 0.00% Impervious, Inflow Depth = 10.53" for 100-yr, 24-hr event
Inflow = 23.57 cfs @ 12.64 hrs, Volume= 15.635 af
Outflow = 23.57 cfs @ 12.64 hrs, Volume= 15.635 af, Atten= 0%, Lag= 0.0 min
Primary = 23.57 cfs @ 12.64 hrs, Volume= 15.635 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 56.50' @ 12.64 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	43.44'	**18.0" Round RCP_Round 18"** L= 23.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 43.44' / 41.24' S= 0.0957 '/' Cc= 0.900 n= 0.009 PVC, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=23.57 cfs @ 12.64 hrs HW=56.50' (Free Discharge)
↑**1=RCP_Round 18"** (Inlet Controls 23.57 cfs @ 13.34 fps)

Pond 12P: Pipe 2B



Summary for Pond 13P: Pipe 2C

[57] Hint: Peaked at 54.30' (Flood elevation advised)
[79] Warning: Submerged Pond 12P Primary device # 1 INLET by 10.86'

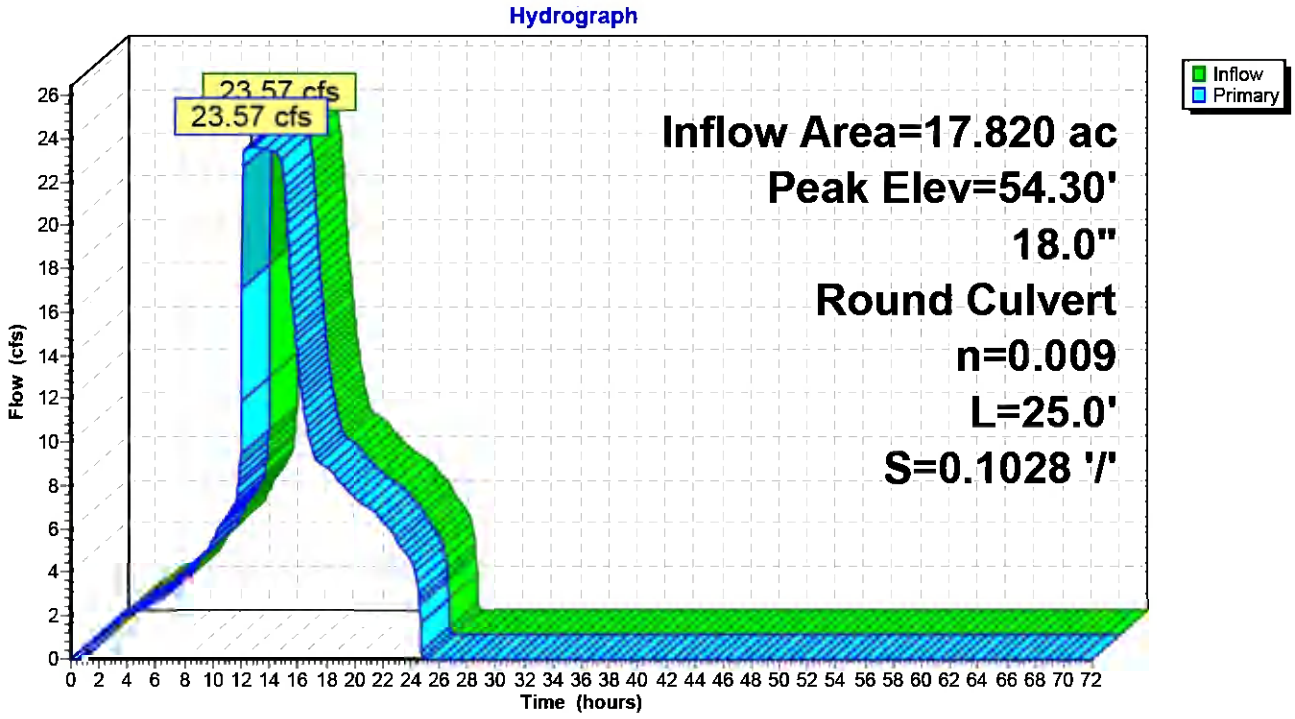
Inflow Area =	17.820 ac,	0.00% Impervious,	Inflow Depth = 10.53"	for 100-yr, 24-hr event	
Inflow =	23.57 cfs @	12.64 hrs,	Volume=	15.635 af	
Outflow =	23.57 cfs @	12.64 hrs,	Volume=	15.635 af,	Atten= 0%, Lag= 0.0 min
Primary =	23.57 cfs @	12.64 hrs,	Volume=	15.635 af	

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 54.30' @ 12.64 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	41.24'	**18.0" Round RCP_Round 18"** L= 25.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 41.24' / 38.67' S= 0.1028 '/' Cc= 0.900 n= 0.009 PVC, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=23.57 cfs @ 12.64 hrs HW=54.30' (Free Discharge)
↑**1=RCP_Round 18"** (Inlet Controls 23.57 cfs @ 13.34 fps)

Pond 13P: Pipe 2C



Summary for Pond 21P: Pipe 3D

[57] Hint: Peaked at 32.52' (Flood elevation advised)

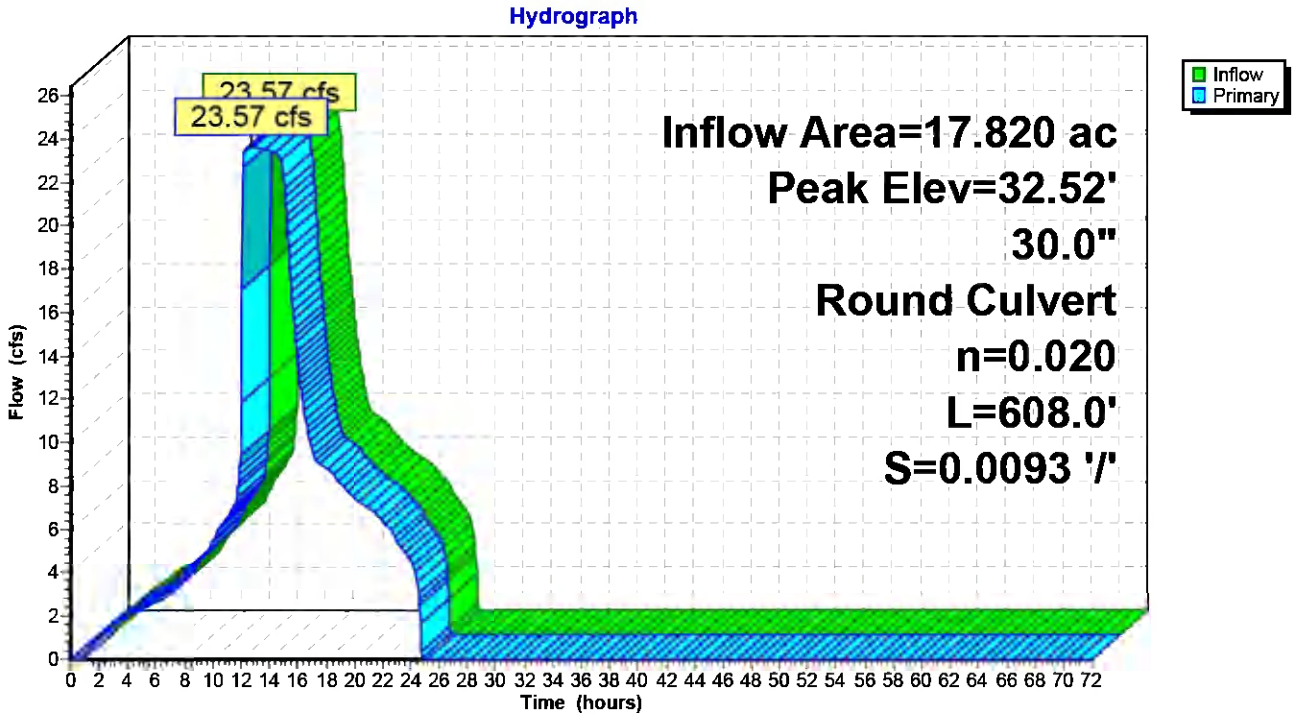
Inflow Area = 17.820 ac, 0.00% Impervious, Inflow Depth = 10.53" for 100-yr, 24-hr event
Inflow = 23.57 cfs @ 12.64 hrs, Volume= 15.635 af
Outflow = 23.57 cfs @ 12.64 hrs, Volume= 15.635 af, Atten= 0%, Lag= 0.0 min
Primary = 23.57 cfs @ 12.64 hrs, Volume= 15.635 af

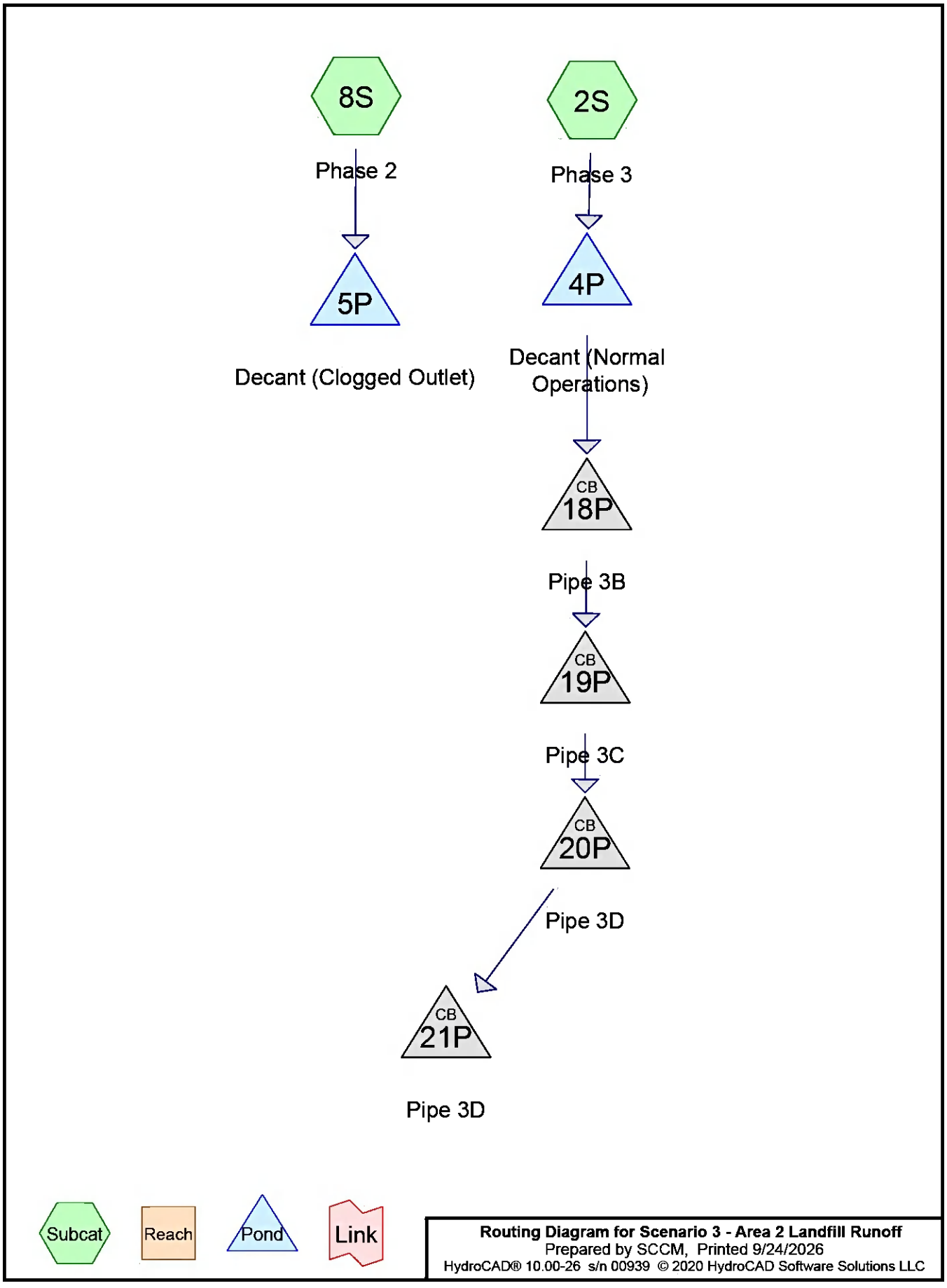
Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 32.52' @ 12.64 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	29.67'	**30.0" Round Culvert** L= 608.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 29.67' / 24.02' S= 0.0093 '/' Cc= 0.900 n= 0.020 Corrugated PE, corrugated interior, Flow Area= 4.91 sf

Primary OutFlow Max=23.57 cfs @ 12.64 hrs HW=32.52' (Free Discharge)
1=Culvert (Inlet Controls 23.57 cfs @ 4.80 fps)

Pond 21P: Pipe 3D




8S
2S
Phase 2
Phase 3
5P
4P
Decant (Clogged Outlet)
Decant (Normal Operations)
CB 18P
Pipe 3B
CB 19P
Pipe 3C
CB 20P
Pipe 3D
CB 21P
Pipe 3D
Subcat
Reach
Pond
Link
Routing Diagram for Scenario 3 - Area 2 Landfill Runoff
Prepared by SCCM, Printed 9/24/2026
HydroCAD® 10.00-26 s/n 00939 © 2020 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
32.690	97	(2S, 8S)
32.690	**97**	**TOTAL AREA**

Pipe Listing (all 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	4P	47.06	42.82	848.0	0.0050	0.009	18.0	0.0	0.0
2	18P	42.82	36.74	45.0	0.1351	0.009	18.0	0.0	0.0
3	19P	36.74	31.88	43.0	0.1130	0.009	18.0	0.0	0.0
4	20P	31.88	29.67	438.0	0.0050	0.009	18.0	0.0	0.0
5	21P	29.67	24.02	608.0	0.0093	0.020	30.0	0.0	0.0

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 2S: Phase 3 Runoff Area=14.870 ac 0.00% Impervious Runoff Depth=7.92"
Tc=6.0 min CN=97 Runoff=117.73 cfs 9.814 af

Subcatchment 8S: Phase 2 Runoff Area=17.820 ac 0.00% Impervious Runoff Depth=7.92"
Tc=6.0 min CN=97 Runoff=141.08 cfs 11.761 af

Pond 4P: Decant (Normal Operations) Peak Elev=66.85' Storage=3.859 af Inflow=117.73 cfs 9.814 af
Outflow=13.20 cfs 9.807 af

Pond 5P: Decant (Clogged Outlet) Peak Elev=67.58' Storage=11.761 af Inflow=141.08 cfs 11.761 af
Outflow=0.00 cfs 0.000 af

Pond 18P: Pipe 3B Peak Elev=47.43' Inflow=13.20 cfs 9.807 af
18.0" Round Culvert n=0.009 L=45.0' S=0.1351 '/' Outflow=13.20 cfs 9.807 af

Pond 19P: Pipe 3C Peak Elev=41.35' Inflow=13.20 cfs 9.807 af
18.0" Round Culvert n=0.009 L=43.0' S=0.1130 '/' Outflow=13.20 cfs 9.807 af

Pond 20P: Pipe 3D Peak Elev=36.49' Inflow=13.20 cfs 9.807 af
18.0" Round Culvert n=0.009 L=438.0' S=0.0050 '/' Outflow=13.20 cfs 9.807 af

Pond 21P: Pipe 3D Peak Elev=31.43' Inflow=13.20 cfs 9.807 af
30.0" Round Culvert n=0.020 L=608.0' S=0.0093 '/' Outflow=13.20 cfs 9.807 af

Total Runoff Area = 32.690 ac Runoff Volume = 21.576 af Average Runoff Depth = 7.92"
100.00% Pervious = 32.690 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 2S: Phase 3

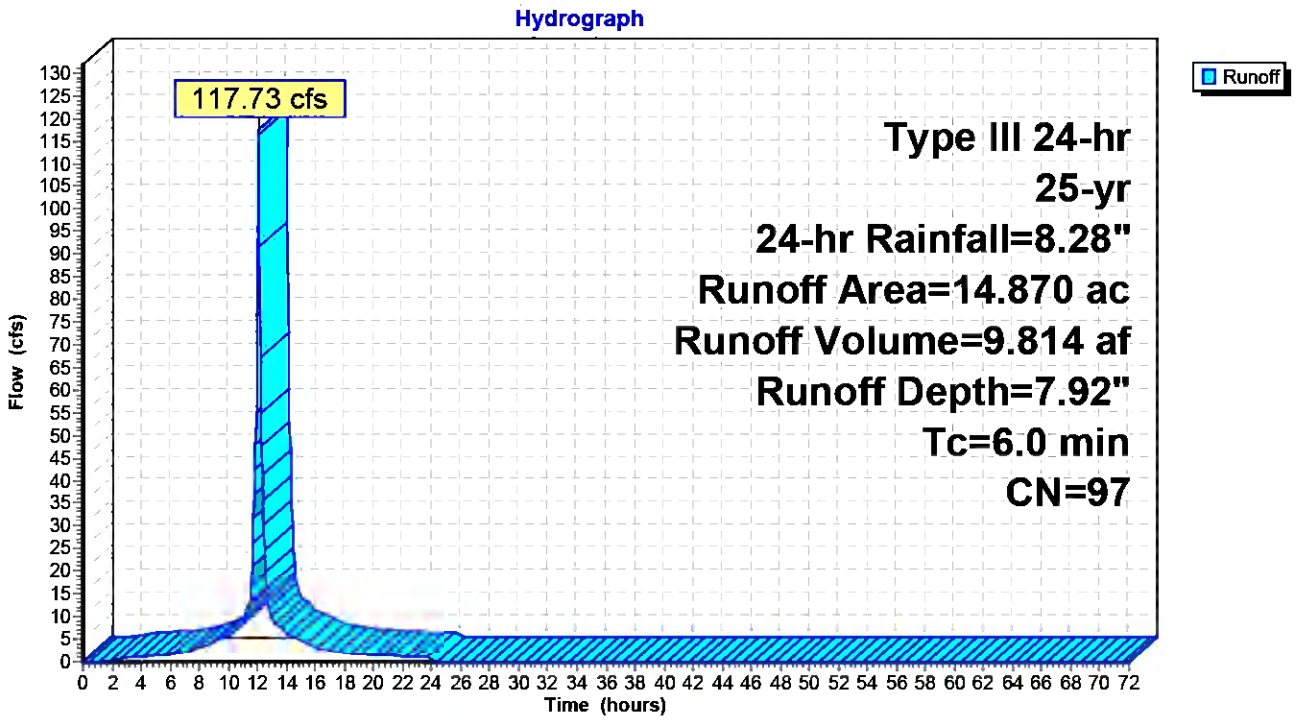
Runoff = 117.73 cfs @ 12.09 hrs, Volume= 9.814 af, Depth= 7.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr, 24-hr Rainfall=8.28"

	Area (ac)	CN	Description
*	14.870	97	
	14.870		100.00% Pervious Area

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

Subcatchment 2S: Phase 3



Summary for Subcatchment 8S: Phase 2

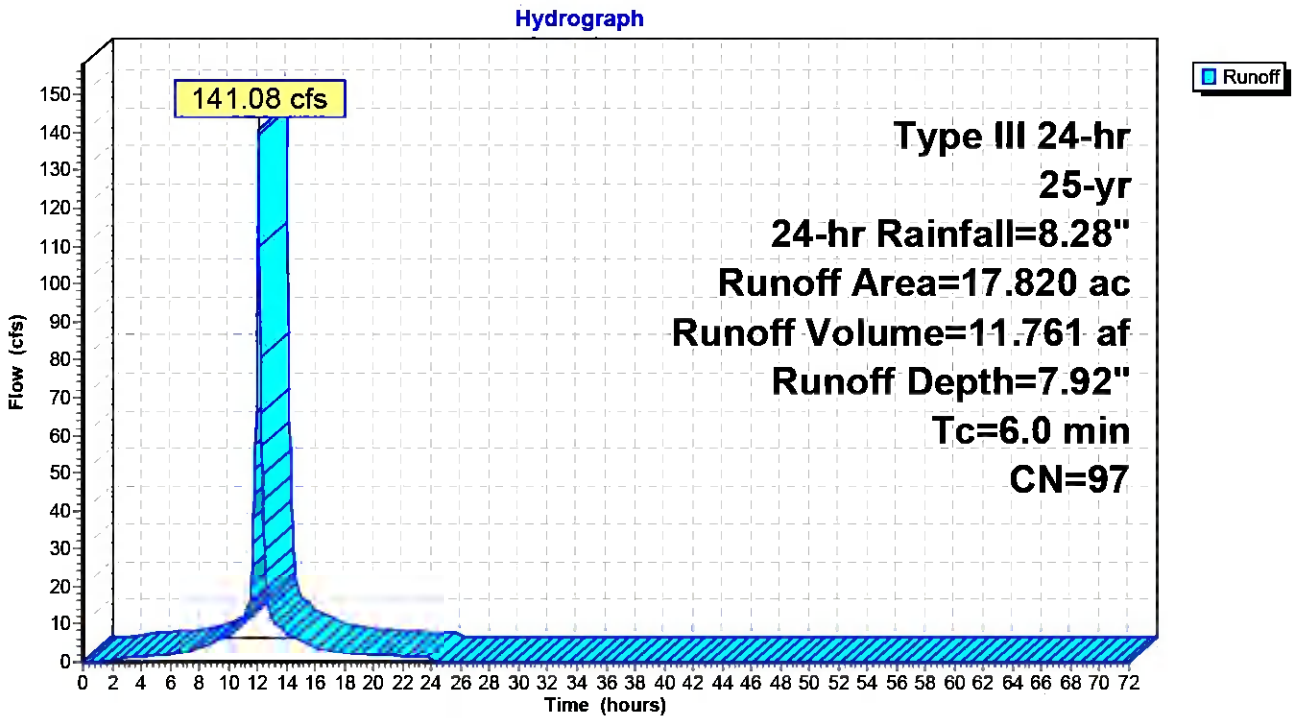
Runoff = 141.08 cfs @ 12.09 hrs, Volume= 11.761 af, Depth= 7.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr, 24-hr Rainfall=8.28"

	Area (ac)	CN	Description
*	17.820	97	
	17.820		100.00% Pervious Area

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

Subcatchment 8S: Phase 2



Summary for Pond 4P: Decant (Normal Operations)

Inflow Area = 14.870 ac, 0.00% Impervious, Inflow Depth = 7.92" for 25-yr, 24-hr event
Inflow = 117.73 cfs @ 12.09 hrs, Volume= 9.814 af
Outflow = 13.20 cfs @ 12.73 hrs, Volume= 9.807 af, Atten= 89%, Lag= 38.8 min
Primary = 13.20 cfs @ 12.73 hrs, Volume= 9.807 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 66.85' @ 12.73 hrs Surf.Area= 1.840 ac Storage= 3.859 af

Plug-Flow detention time= 116.7 min calculated for 9.807 af (100% of inflow)
Center-of-Mass det. time= 116.1 min (862.7 - 746.6)

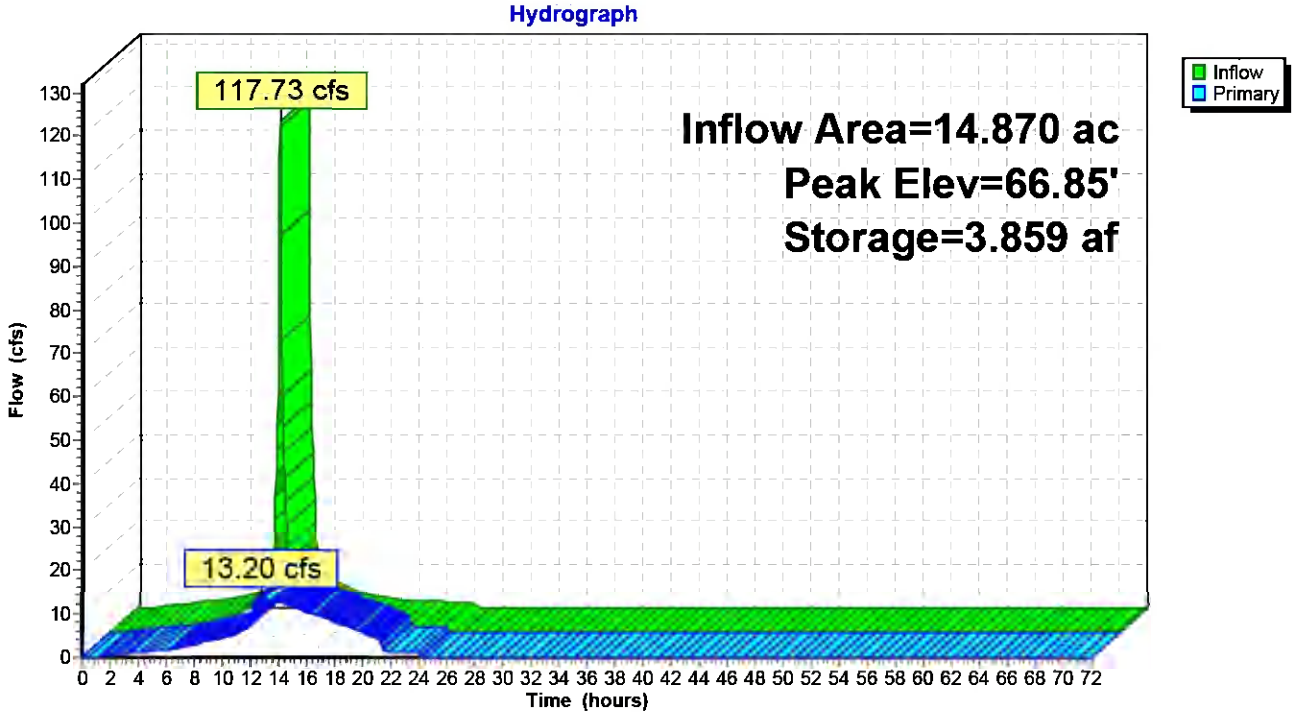
Volume	Invert	Avail.Storage	Storage Description
#1	58.00'	24.341 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
58.00	0.000	0.000	0.000
59.00	0.001	0.001	0.001
60.00	0.003	0.002	0.003
61.00	0.004	0.004	0.006
62.00	0.005	0.005	0.010
63.00	0.007	0.006	0.016
64.00	0.536	0.271	0.288
65.00	1.160	0.848	1.136
66.00	1.478	1.319	2.455
67.00	1.905	1.692	4.146
68.00	2.503	2.204	6.350
69.00	3.014	2.758	9.109
70.00	3.477	3.245	12.354
71.00	3.823	3.650	16.004
72.00	4.166	3.994	19.999
73.00	4.519	4.342	24.341

Device	Routing	Invert	Outlet Devices
#1	Primary	47.06'	**18.0" Round Culvert** L= 848.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 47.06' / 42.82' S= 0.0050 '/' Cc= 0.900 n= 0.009 PVC, smooth interior, Flow Area= 1.77 sf
#2	Device 1	69.40'	**48.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	68.90'	**2.0" Vert. Orifice/Grate X 12.00** C= 0.600
#4	Device 1	67.90'	**2.0" Vert. Orifice/Grate X 12.00** C= 0.600
#5	Device 1	66.90'	**2.0" Vert. Orifice/Grate X 12.00** C= 0.600
#6	Device 1	65.90'	**2.0" Vert. Orifice/Grate X 12.00** C= 0.600
#7	Device 1	64.90'	**2.0" Vert. Orifice/Grate X 12.00** C= 0.600
#8	Device 1	63.90'	**2.0" Vert. Orifice/Grate X 12.00** C= 0.600
#9	Device 1	62.90'	**2.0" Vert. Orifice/Grate X 12.00** C= 0.600
#10	Device 1	61.90'	**2.0" Vert. Orifice/Grate X 12.00** C= 0.600
#11	Device 1	61.40'	**2.0" Vert. Orifice/Grate X 12.00** C= 0.600

Primary OutFlow Max=13.20 cfs @ 12.73 hrs HW=66.85' (Free Discharge)
└─**1=Culvert** (Passes 13.20 cfs of 22.03 cfs potential flow)
  ├─**2=Orifice/Grate** (Controls 0.00 cfs)
  ├─**3=Orifice/Grate** (Controls 0.00 cfs)
  ├─**4=Orifice/Grate** (Controls 0.00 cfs)
  ├─**5=Orifice/Grate** (Controls 0.00 cfs)
  ├─**6=Orifice/Grate** (Orifice Controls 1.17 cfs @ 4.47 fps)
  ├─**7=Orifice/Grate** (Orifice Controls 1.72 cfs @ 6.57 fps)
  ├─**8=Orifice/Grate** (Orifice Controls 2.13 cfs @ 8.15 fps)
  ├─**9=Orifice/Grate** (Orifice Controls 2.48 cfs @ 9.46 fps)
  ├─**10=Orifice/Grate** (Orifice Controls 2.78 cfs @ 10.62 fps)
  └─**11=Orifice/Grate** (Orifice Controls 2.92 cfs @ 11.15 fps)

Pond 4P: Decant (Normal Operations)



Summary for Pond 5P: Decant (Clogged Outlet)

Inflow Area = 17.820 ac, 0.00% Impervious, Inflow Depth = 7.92" for 25-yr, 24-hr event
Inflow = 141.08 cfs @ 12.09 hrs, Volume= 11.761 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

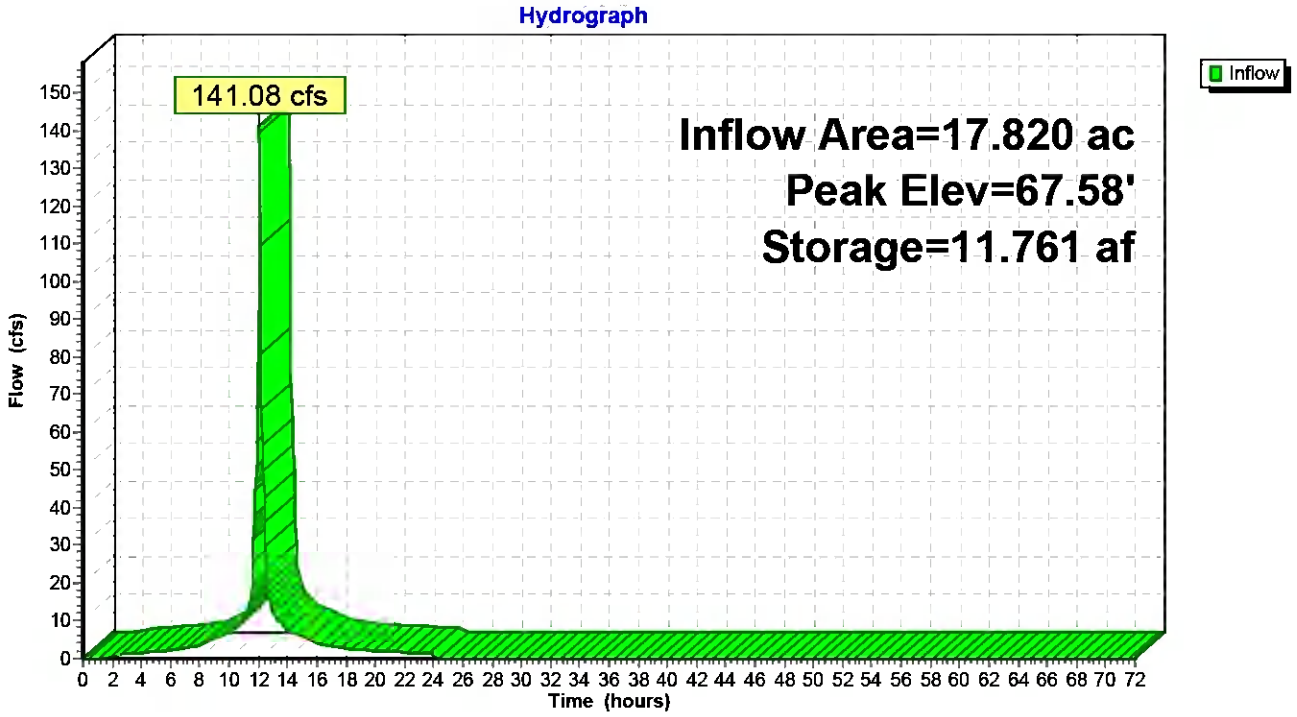
Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 67.58' @ 24.40 hrs Surf.Area= 4.146 ac Storage= 11.761 af

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	56.00'	22.401 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
56.00	0.000	0.000	0.000
57.00	0.001	0.001	0.001
58.00	0.002	0.002	0.002
59.00	0.003	0.003	0.005
60.00	0.004	0.004	0.008
61.00	0.006	0.005	0.013
62.00	0.007	0.006	0.019
63.00	0.193	0.100	0.119
64.00	1.180	0.687	0.806
65.00	2.486	1.833	2.639
66.00	3.484	2.985	5.624
67.00	4.022	3.753	9.377
68.00	4.235	4.129	13.506
69.00	4.444	4.339	17.845
70.00	4.668	4.556	22.401

Pond 5P: Decant (Clogged Outlet)



Summary for Pond 18P: Pipe 3B

[57] Hint: Peaked at 47.43' (Flood elevation advised)
[79] Warning: Submerged Pond 4P Primary device # 1 INLET by 0.37'

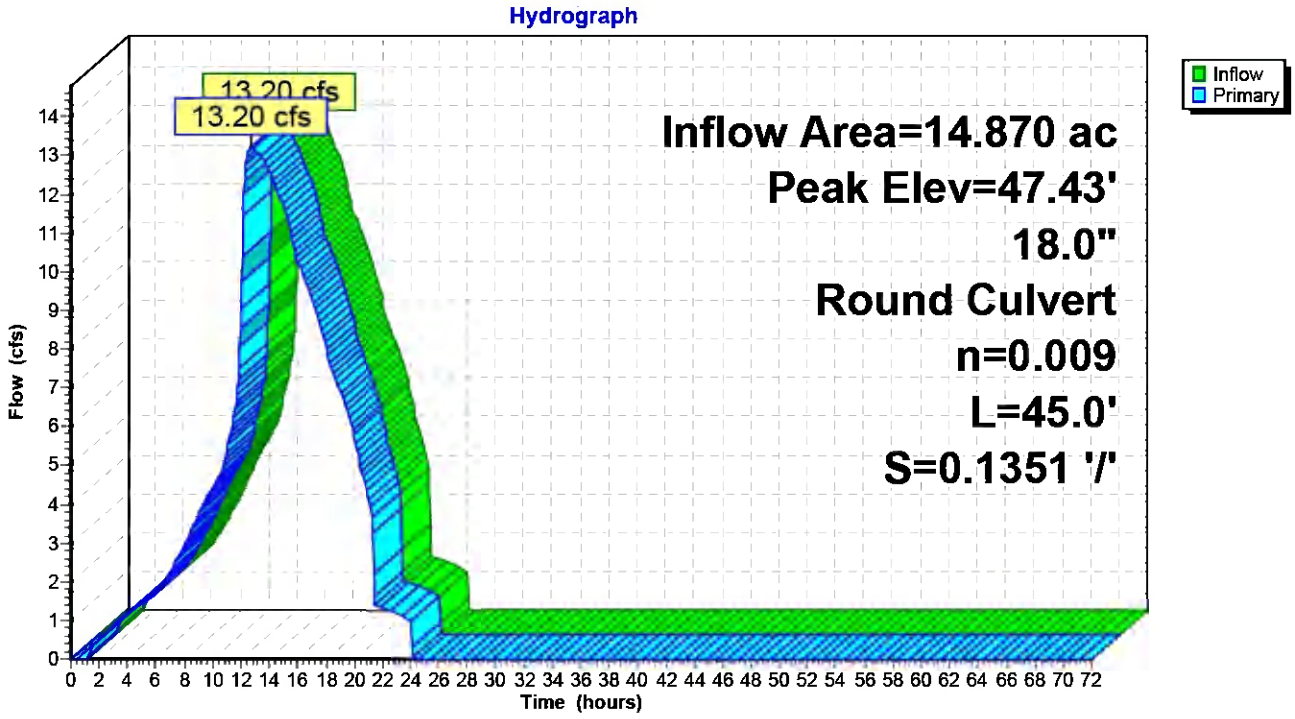
Inflow Area = 14.870 ac, 0.00% Impervious, Inflow Depth = 7.91" for 25-yr, 24-hr event
Inflow = 13.20 cfs @ 12.73 hrs, Volume= 9.807 af
Outflow = 13.20 cfs @ 12.73 hrs, Volume= 9.807 af, Atten= 0%, Lag= 0.0 min
Primary = 13.20 cfs @ 12.73 hrs, Volume= 9.807 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 47.43' @ 12.73 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	42.82'	**18.0" Round RCP_Round 18"** L= 45.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 42.82' / 36.74' S= 0.1351 '/' Cc= 0.900 n= 0.009 PVC, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=13.20 cfs @ 12.73 hrs HW=47.43' (Free Discharge)
↑**1=RCP_Round 18"** (Inlet Controls 13.20 cfs @ 7.47 fps)

Pond 18P: Pipe 3B



Summary for Pond 19P: Pipe 3C

[57] Hint: Peaked at 41.35' (Flood elevation advised)
[79] Warning: Submerged Pond 18P Primary device # 1 OUTLET by 4.61'

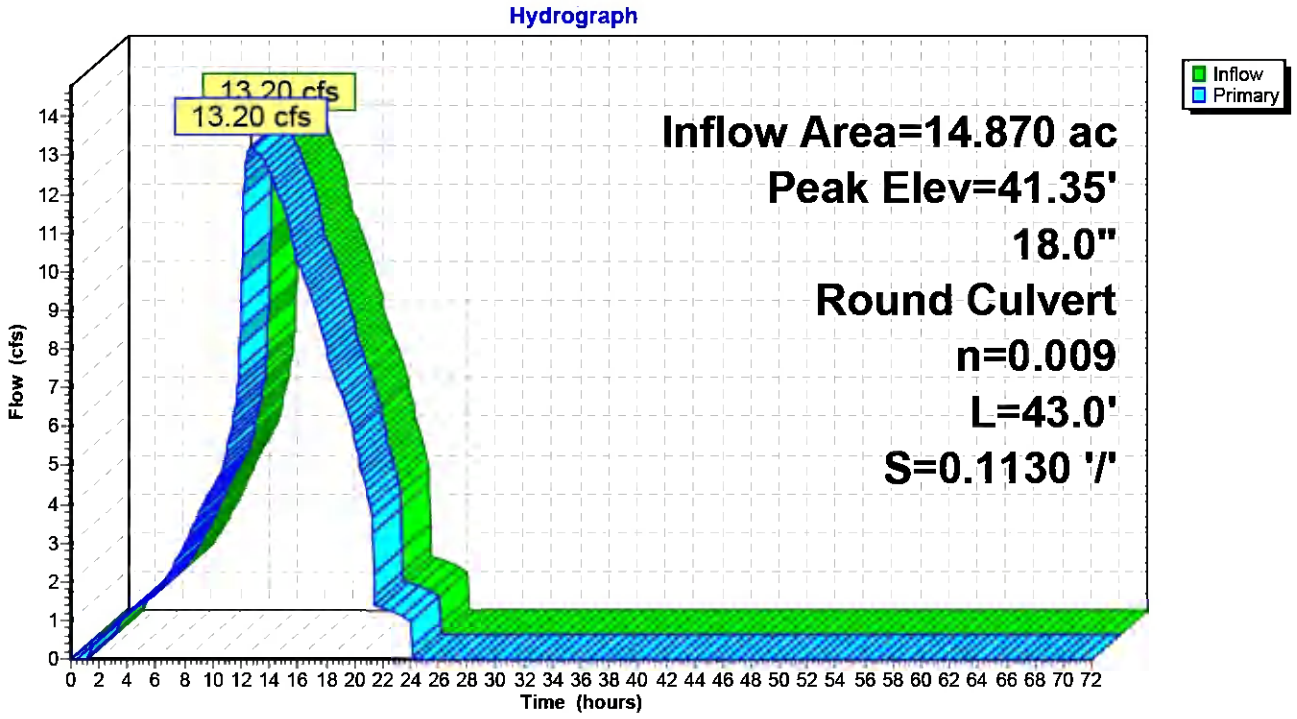
Inflow Area = 14.870 ac, 0.00% Impervious, Inflow Depth = 7.91" for 25-yr, 24-hr event
Inflow = 13.20 cfs @ 12.73 hrs, Volume= 9.807 af
Outflow = 13.20 cfs @ 12.73 hrs, Volume= 9.807 af, Atten= 0%, Lag= 0.0 min
Primary = 13.20 cfs @ 12.73 hrs, Volume= 9.807 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 41.35' @ 12.73 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	36.74'	**18.0" Round RCP_Round 18"** L= 43.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 36.74' / 31.88' S= 0.1130 '/' Cc= 0.900 n= 0.009 PVC, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=13.20 cfs @ 12.73 hrs HW=41.35' (Free Discharge)
↑**1=RCP_Round 18"** (Inlet Controls 13.20 cfs @ 7.47 fps)

Pond 19P: Pipe 3C



Summary for Pond 20P: Pipe 3D

[57] Hint: Peaked at 36.49' (Flood elevation advised)
[79] Warning: Submerged Pond 19P Primary device # 1 OUTLET by 4.61'

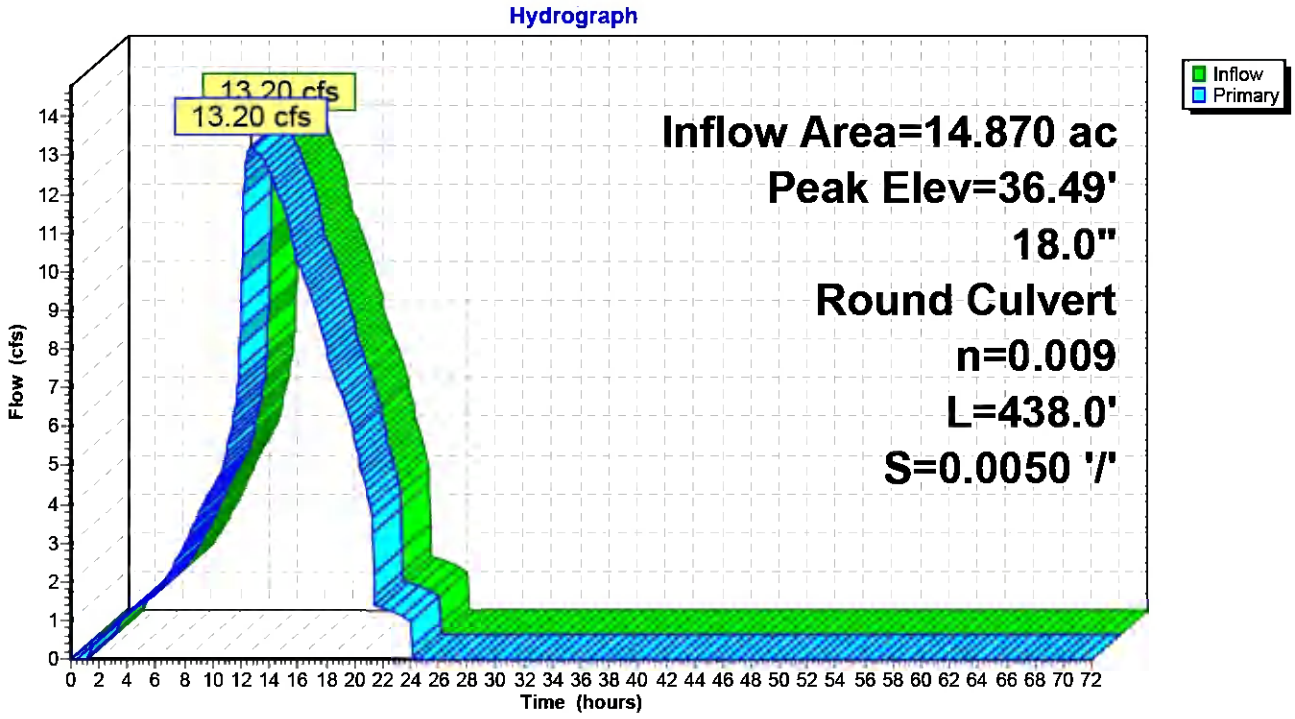
Inflow Area = 14.870 ac, 0.00% Impervious, Inflow Depth = 7.91" for 25-yr, 24-hr event
Inflow = 13.20 cfs @ 12.73 hrs, Volume= 9.807 af
Outflow = 13.20 cfs @ 12.73 hrs, Volume= 9.807 af, Atten= 0%, Lag= 0.0 min
Primary = 13.20 cfs @ 12.73 hrs, Volume= 9.807 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 36.49' @ 12.73 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	31.88'	**18.0" Round RCP_Round 18"** L= 438.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 31.88' / 29.67' S= 0.0050 '/' Cc= 0.900 n= 0.009 PVC, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=13.20 cfs @ 12.73 hrs HW=36.49' (Free Discharge)
↑**1=RCP_Round 18"** (Inlet Controls 13.20 cfs @ 7.47 fps)

Pond 20P: Pipe 3D



Summary for Pond 21P: Pipe 3D

[57] Hint: Peaked at 31.43' (Flood elevation advised)
[79] Warning: Submerged Pond 20P Primary device # 1 OUTLET by 1.76'

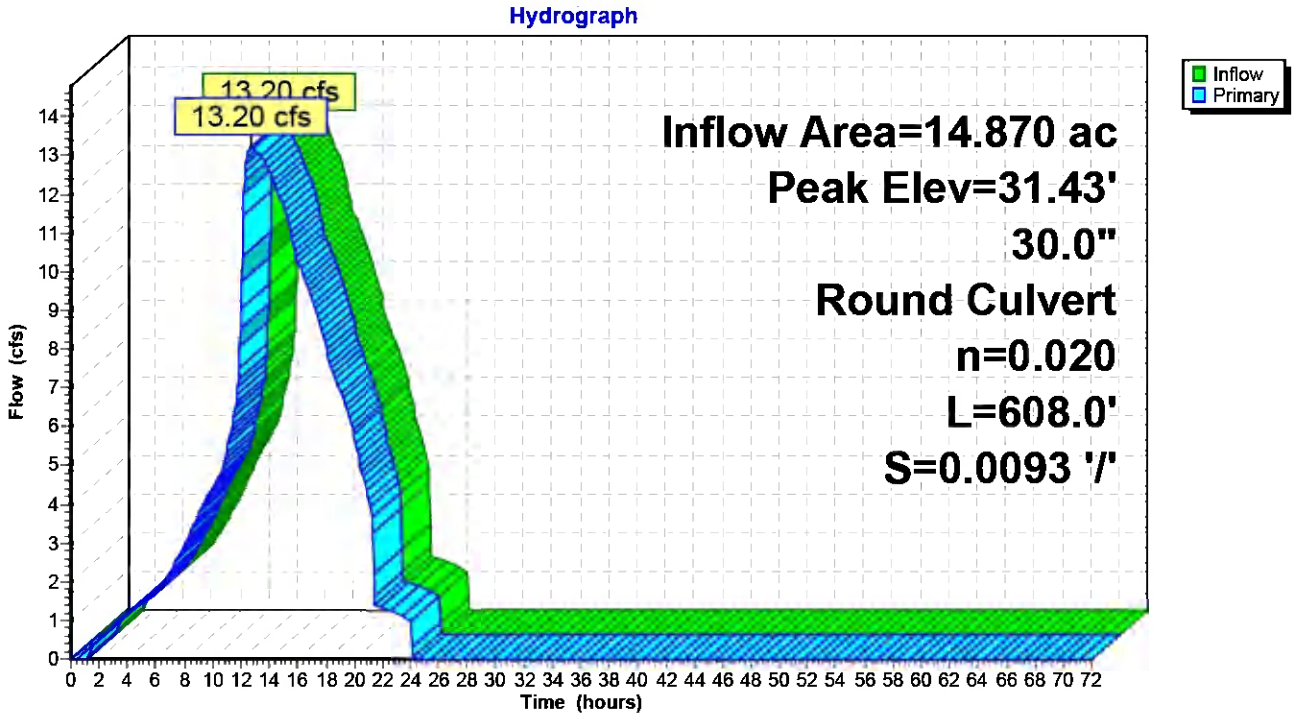
Inflow Area = 14.870 ac, 0.00% Impervious, Inflow Depth = 7.91" for 25-yr, 24-hr event
Inflow = 13.20 cfs @ 12.73 hrs, Volume= 9.807 af
Outflow = 13.20 cfs @ 12.73 hrs, Volume= 9.807 af, Atten= 0%, Lag= 0.0 min
Primary = 13.20 cfs @ 12.73 hrs, Volume= 9.807 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 31.43' @ 12.73 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	29.67'	**30.0" Round Culvert** L= 608.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 29.67' / 24.02' S= 0.0093 '/' Cc= 0.900 n= 0.020 Corrugated PE, corrugated interior, Flow Area= 4.91 sf

Primary OutFlow Max=13.20 cfs @ 12.73 hrs HW=31.43' (Free Discharge)
↑**1=Culvert** (Inlet Controls 13.20 cfs @ 3.57 fps)

Pond 21P: Pipe 3D



Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 2S: Phase 3 Runoff Area=14.870 ac 0.00% Impervious Runoff Depth=10.54"
Tc=6.0 min CN=97 Runoff=155.30 cfs 13.058 af

Subcatchment 8S: Phase 2 Runoff Area=17.820 ac 0.00% Impervious Runoff Depth=10.54"
Tc=6.0 min CN=97 Runoff=186.11 cfs 15.648 af

Pond 4P: Decant (Normal Operations) Peak Elev=67.62' Storage=5.442 af Inflow=155.30 cfs 13.058 af
Outflow=15.90 cfs 13.050 af

Pond 5P: Decant (Clogged Outlet) Peak Elev=68.50' Storage=15.648 af Inflow=186.11 cfs 15.648 af
Outflow=0.00 cfs 0.000 af

Pond 18P: Pipe 3B Peak Elev=49.17' Inflow=15.90 cfs 13.050 af
18.0" Round Culvert n=0.009 L=45.0' S=0.1351 '/' Outflow=15.90 cfs 13.050 af

Pond 19P: Pipe 3C Peak Elev=43.09' Inflow=15.90 cfs 13.050 af
18.0" Round Culvert n=0.009 L=43.0' S=0.1130 '/' Outflow=15.90 cfs 13.050 af

Pond 20P: Pipe 3D Peak Elev=38.38' Inflow=15.90 cfs 13.050 af
18.0" Round Culvert n=0.009 L=438.0' S=0.0050 '/' Outflow=15.90 cfs 13.050 af

Pond 21P: Pipe 3D Peak Elev=31.66' Inflow=15.90 cfs 13.050 af
30.0" Round Culvert n=0.020 L=608.0' S=0.0093 '/' Outflow=15.90 cfs 13.050 af

Total Runoff Area = 32.690 ac Runoff Volume = 28.706 af Average Runoff Depth = 10.54"
100.00% Pervious = 32.690 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 2S: Phase 3

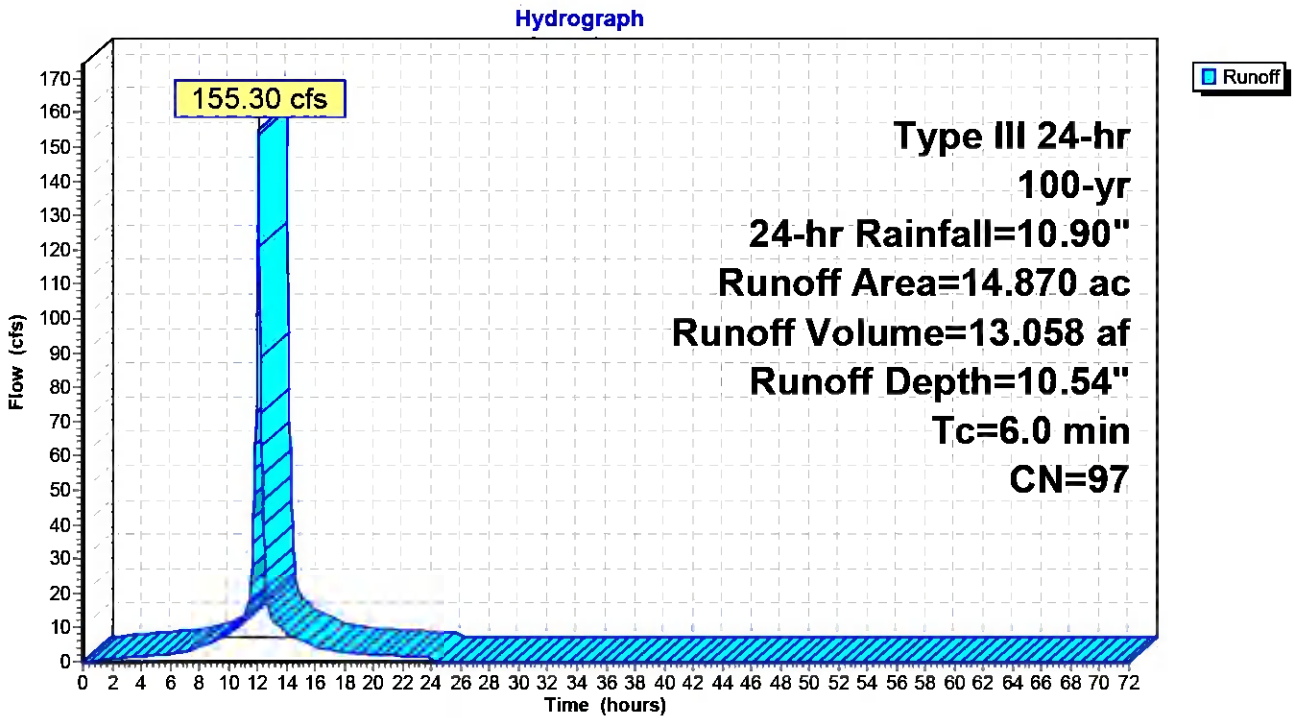
Runoff = 155.30 cfs @ 12.09 hrs, Volume= 13.058 af, Depth=10.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr, 24-hr Rainfall=10.90"

	Area (ac)	CN	Description
*	14.870	97	
	14.870		100.00% Pervious Area

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

Subcatchment 2S: Phase 3



Summary for Subcatchment 8S: Phase 2

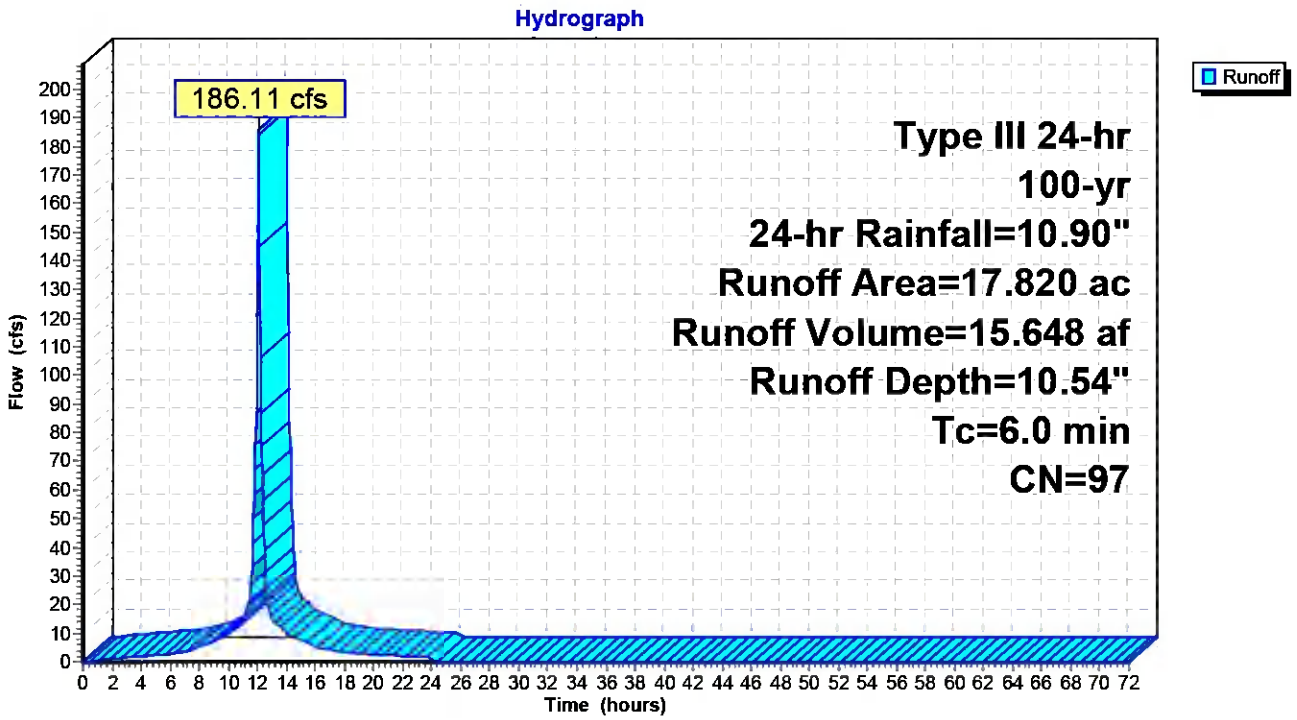
Runoff = 186.11 cfs @ 12.09 hrs, Volume= 15.648 af, Depth=10.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr, 24-hr Rainfall=10.90"

	Area (ac)	CN	Description
*	17.820	97	
	17.820		100.00% Pervious Area

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

Subcatchment 8S: Phase 2



Summary for Pond 4P: Decant (Normal Operations)

Inflow Area = 14.870 ac, 0.00% Impervious, Inflow Depth = 10.54" for 100-yr, 24-hr event
Inflow = 155.30 cfs @ 12.09 hrs, Volume= 13.058 af
Outflow = 15.90 cfs @ 12.83 hrs, Volume= 13.050 af, Atten= 90%, Lag= 44.5 min
Primary = 15.90 cfs @ 12.83 hrs, Volume= 13.050 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 67.62' @ 12.83 hrs Surf.Area= 2.276 ac Storage= 5.442 af

Plug-Flow detention time= 146.3 min calculated for 13.050 af (100% of inflow)
Center-of-Mass det. time= 145.9 min (888.5 - 742.6)

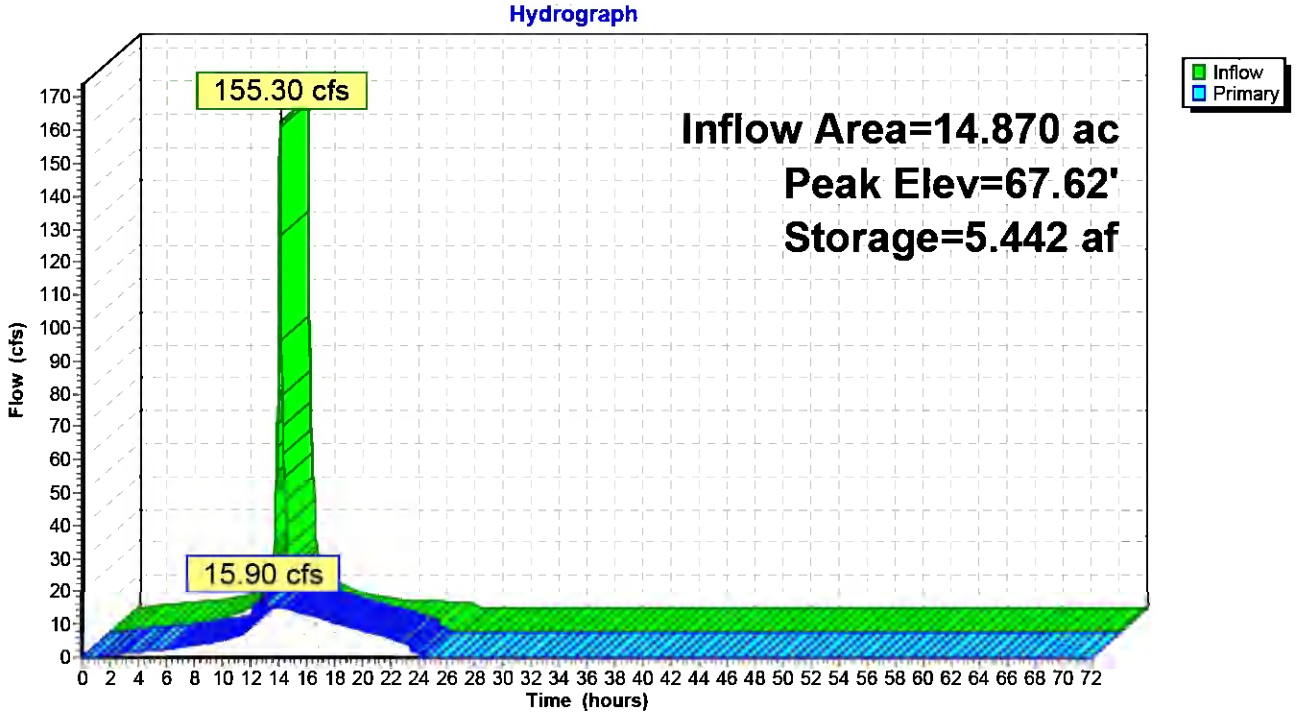
Volume	Invert	Avail.Storage	Storage Description
#1	58.00'	24.341 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
58.00	0.000	0.000	0.000
59.00	0.001	0.001	0.001
60.00	0.003	0.002	0.003
61.00	0.004	0.004	0.006
62.00	0.005	0.005	0.010
63.00	0.007	0.006	0.016
64.00	0.536	0.271	0.288
65.00	1.160	0.848	1.136
66.00	1.478	1.319	2.455
67.00	1.905	1.692	4.146
68.00	2.503	2.204	6.350
69.00	3.014	2.758	9.109
70.00	3.477	3.245	12.354
71.00	3.823	3.650	16.004
72.00	4.166	3.994	19.999
73.00	4.519	4.342	24.341

Device	Routing	Invert	Outlet Devices
#1	Primary	47.06'	**18.0" Round Culvert** L= 848.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 47.06' / 42.82' S= 0.0050 '/' Cc= 0.900 n= 0.009 PVC, smooth interior, Flow Area= 1.77 sf
#2	Device 1	69.40'	**48.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	68.90'	**2.0" Vert. Orifice/Grate X 12.00** C= 0.600
#4	Device 1	67.90'	**2.0" Vert. Orifice/Grate X 12.00** C= 0.600
#5	Device 1	66.90'	**2.0" Vert. Orifice/Grate X 12.00** C= 0.600
#6	Device 1	65.90'	**2.0" Vert. Orifice/Grate X 12.00** C= 0.600
#7	Device 1	64.90'	**2.0" Vert. Orifice/Grate X 12.00** C= 0.600
#8	Device 1	63.90'	**2.0" Vert. Orifice/Grate X 12.00** C= 0.600
#9	Device 1	62.90'	**2.0" Vert. Orifice/Grate X 12.00** C= 0.600
#10	Device 1	61.90'	**2.0" Vert. Orifice/Grate X 12.00** C= 0.600
#11	Device 1	61.40'	**2.0" Vert. Orifice/Grate X 12.00** C= 0.600

Primary OutFlow Max=15.90 cfs @ 12.83 hrs HW=67.62' (Free Discharge)
└─**1=Culvert** (Passes 15.90 cfs of 22.41 cfs potential flow)
  ├─**2=Orifice/Grate** (Controls 0.00 cfs)
  ├─**3=Orifice/Grate** (Controls 0.00 cfs)
  ├─**4=Orifice/Grate** (Controls 0.00 cfs)
  ├─**5=Orifice/Grate** (Orifice Controls 1.01 cfs @ 3.84 fps)
  ├─**6=Orifice/Grate** (Orifice Controls 1.61 cfs @ 6.16 fps)
  ├─**7=Orifice/Grate** (Orifice Controls 2.05 cfs @ 7.82 fps)
  ├─**8=Orifice/Grate** (Orifice Controls 2.40 cfs @ 9.18 fps)
  ├─**9=Orifice/Grate** (Orifice Controls 2.71 cfs @ 10.37 fps)
  ├─**10=Orifice/Grate** (Orifice Controls 2.99 cfs @ 11.43 fps)
  └─**11=Orifice/Grate** (Orifice Controls 3.12 cfs @ 11.93 fps)

Pond 4P: Decant (Normal Operations)



Summary for Pond 5P: Decant (Clogged Outlet)

Inflow Area = 17.820 ac, 0.00% Impervious, Inflow Depth = 10.54" for 100-yr, 24-hr event
Inflow = 186.11 cfs @ 12.09 hrs, Volume= 15.648 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

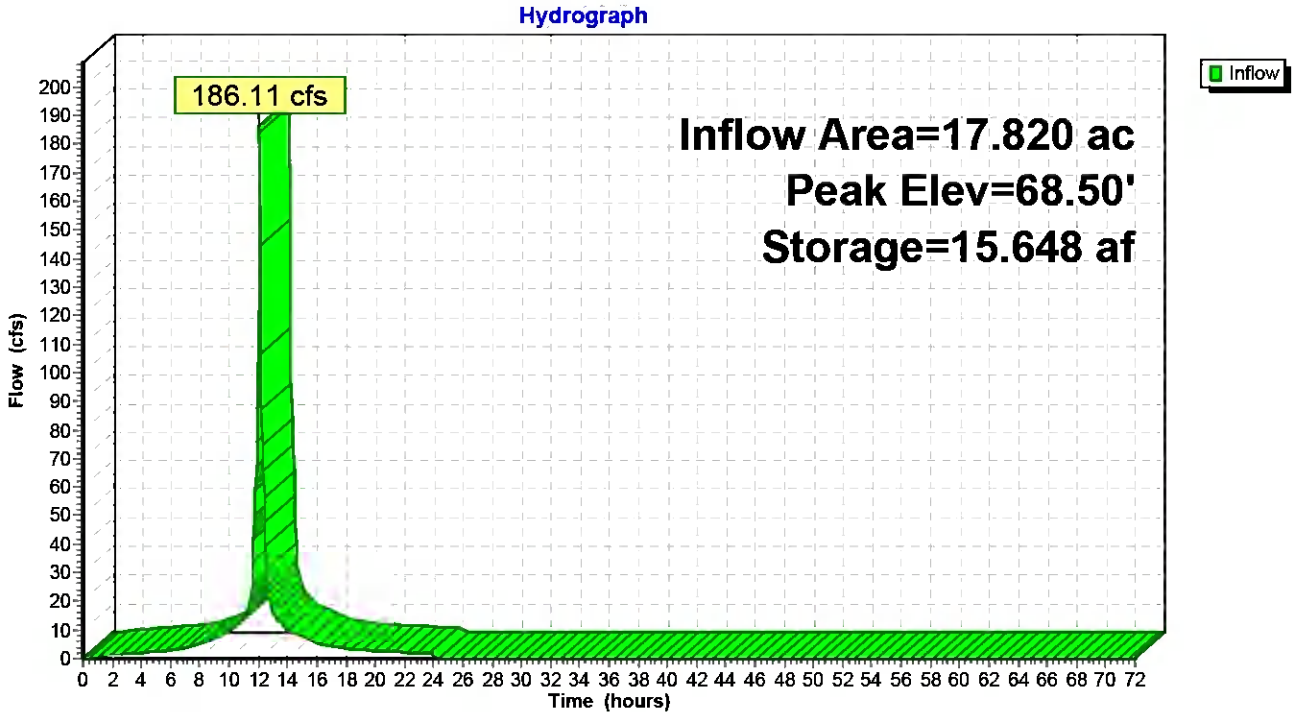
Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 68.50' @ 24.40 hrs Surf.Area= 4.339 ac Storage= 15.648 af

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	56.00'	22.401 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
56.00	0.000	0.000	0.000
57.00	0.001	0.001	0.001
58.00	0.002	0.002	0.002
59.00	0.003	0.003	0.005
60.00	0.004	0.004	0.008
61.00	0.006	0.005	0.013
62.00	0.007	0.006	0.019
63.00	0.193	0.100	0.119
64.00	1.180	0.687	0.806
65.00	2.486	1.833	2.639
66.00	3.484	2.985	5.624
67.00	4.022	3.753	9.377
68.00	4.235	4.129	13.506
69.00	4.444	4.339	17.845
70.00	4.668	4.556	22.401

Pond 5P: Decant (Clogged Outlet)



Summary for Pond 18P: Pipe 3B

[57] Hint: Peaked at 49.17' (Flood elevation advised)
[79] Warning: Submerged Pond 4P Primary device # 1 INLET by 2.11'

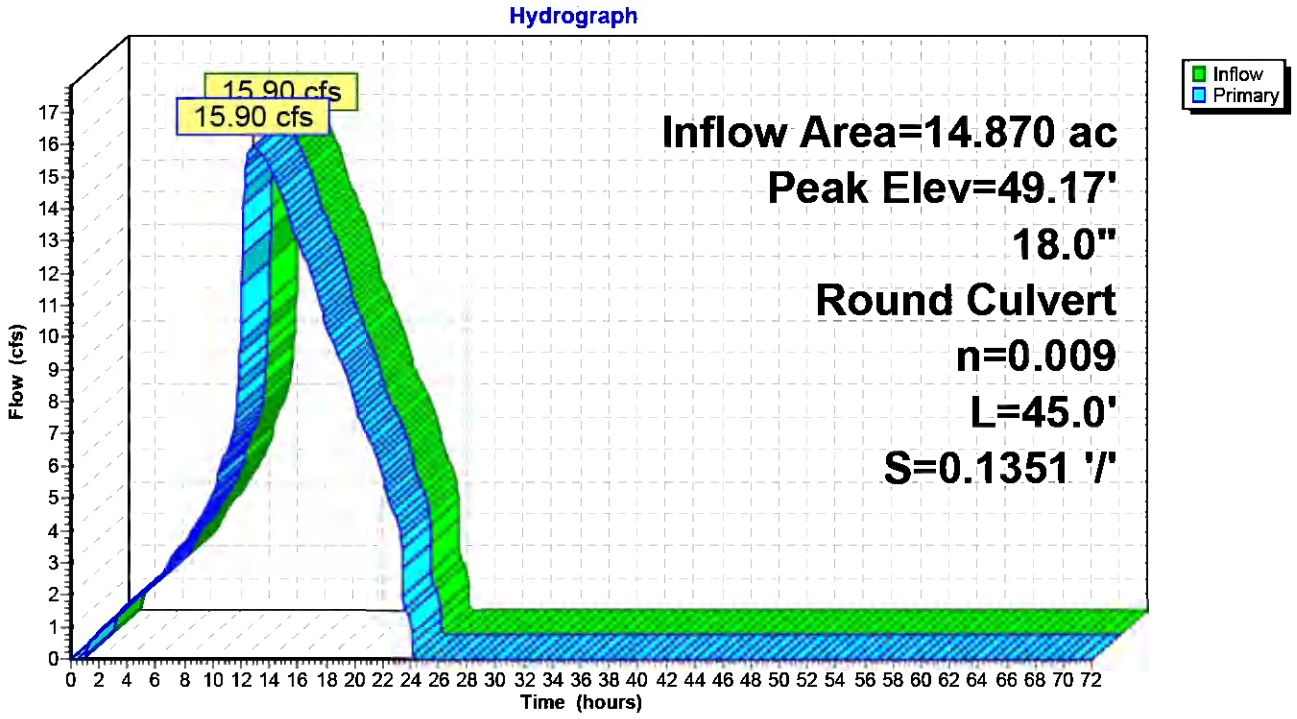
Inflow Area = 14.870 ac, 0.00% Impervious, Inflow Depth = 10.53" for 100-yr, 24-hr event
Inflow = 15.90 cfs @ 12.83 hrs, Volume= 13.050 af
Outflow = 15.90 cfs @ 12.83 hrs, Volume= 13.050 af, Atten= 0%, Lag= 0.0 min
Primary = 15.90 cfs @ 12.83 hrs, Volume= 13.050 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 49.17' @ 12.83 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	42.82'	**18.0" Round RCP_Round 18"** L= 45.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 42.82' / 36.74' S= 0.1351 '/' Cc= 0.900 n= 0.009 PVC, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=15.90 cfs @ 12.83 hrs HW=49.17' (Free Discharge)
↑**1=RCP_Round 18"** (Inlet Controls 15.90 cfs @ 9.00 fps)

Pond 18P: Pipe 3B



Summary for Pond 19P: Pipe 3C

[57] Hint: Peaked at 43.09' (Flood elevation advised)
[79] Warning: Submerged Pond 18P Primary device # 1 INLET by 0.27'

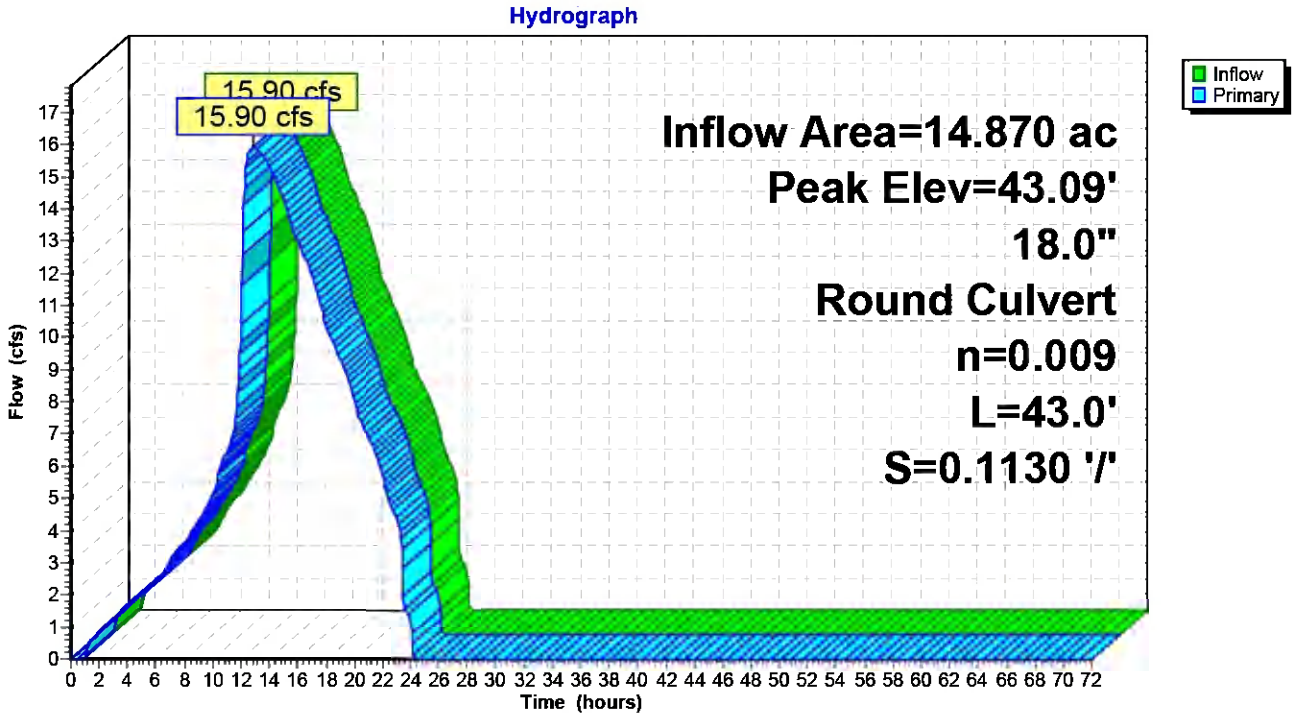
Inflow Area = 14.870 ac, 0.00% Impervious, Inflow Depth = 10.53" for 100-yr, 24-hr event
Inflow = 15.90 cfs @ 12.83 hrs, Volume= 13.050 af
Outflow = 15.90 cfs @ 12.83 hrs, Volume= 13.050 af, Atten= 0%, Lag= 0.0 min
Primary = 15.90 cfs @ 12.83 hrs, Volume= 13.050 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 43.09' @ 12.83 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	36.74'	**18.0" Round RCP_Round 18"** L= 43.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 36.74' / 31.88' S= 0.1130 '/' Cc= 0.900 n= 0.009 PVC, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=15.90 cfs @ 12.83 hrs HW=43.09' (Free Discharge)
1=RCP_Round 18" (Inlet Controls 15.90 cfs @ 9.00 fps)

Pond 19P: Pipe 3C



Summary for Pond 20P: Pipe 3D

[57] Hint: Peaked at 38.38' (Flood elevation advised)
[79] Warning: Submerged Pond 19P Primary device # 1 INLET by 1.64'

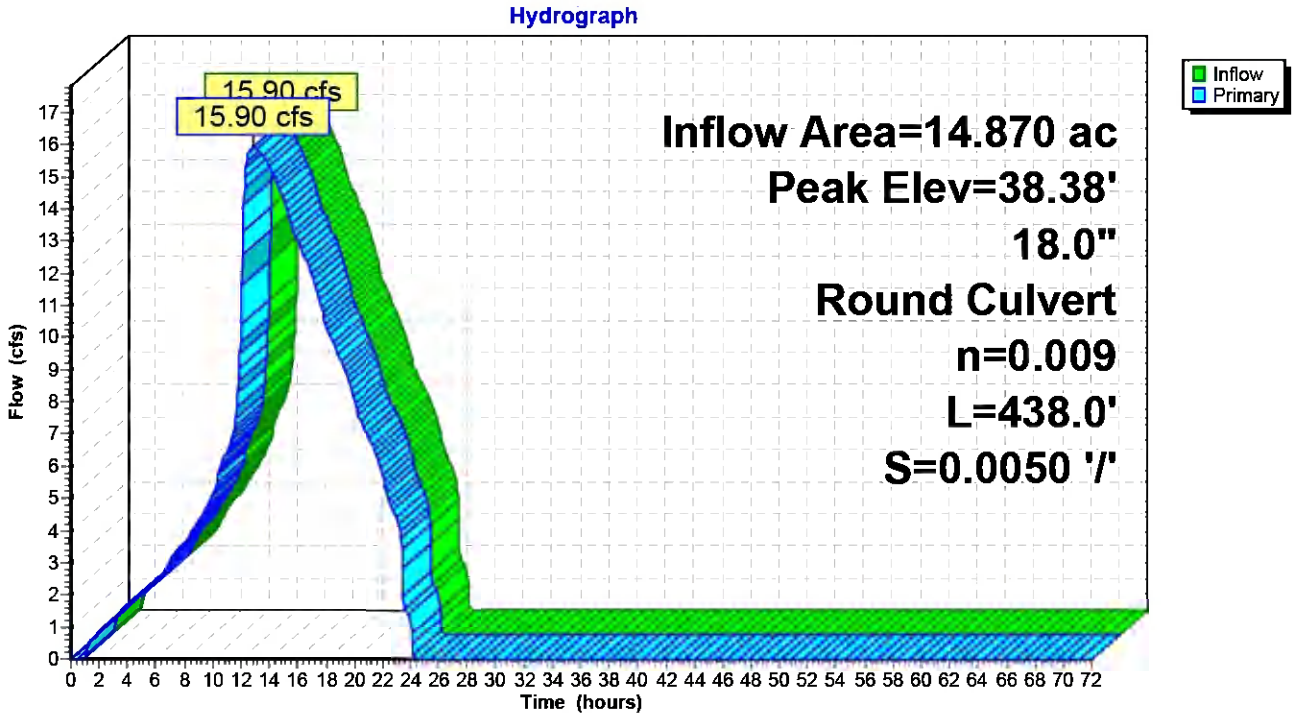
Inflow Area = 14.870 ac, 0.00% Impervious, Inflow Depth = 10.53" for 100-yr, 24-hr event
Inflow = 15.90 cfs @ 12.83 hrs, Volume= 13.050 af
Outflow = 15.90 cfs @ 12.83 hrs, Volume= 13.050 af, Atten= 0%, Lag= 0.0 min
Primary = 15.90 cfs @ 12.83 hrs, Volume= 13.050 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 38.38' @ 12.83 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	31.88'	**18.0" Round RCP_Round 18"** L= 438.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 31.88' / 29.67' S= 0.0050 '/' Cc= 0.900 n= 0.009 PVC, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=15.90 cfs @ 12.83 hrs HW=38.38' (Free Discharge)
1=RCP_Round 18" (Barrel Controls 15.90 cfs @ 9.00 fps)

Pond 20P: Pipe 3D



Summary for Pond 21P: Pipe 3D

[57] Hint: Peaked at 31.66' (Flood elevation advised)
[79] Warning: Submerged Pond 20P Primary device # 1 OUTLET by 1.99'

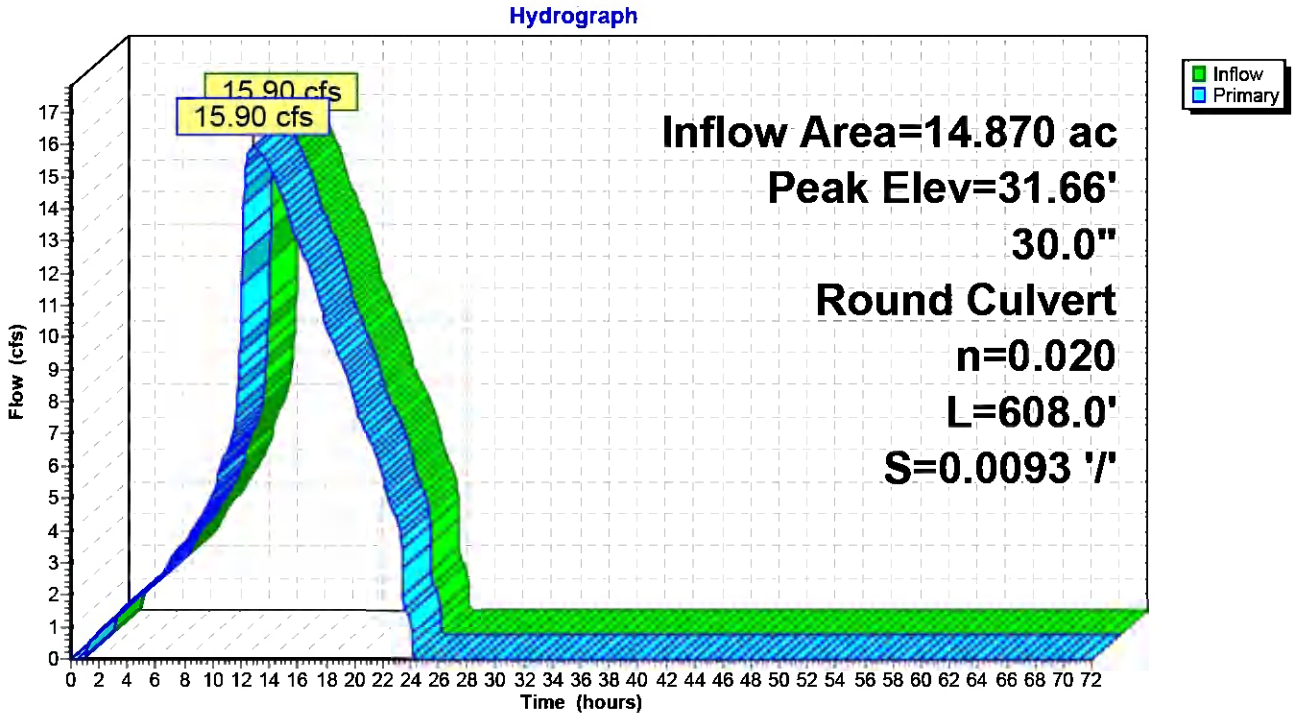
Inflow Area = 14.870 ac, 0.00% Impervious, Inflow Depth = 10.53" for 100-yr, 24-hr event
Inflow = 15.90 cfs @ 12.83 hrs, Volume= 13.050 af
Outflow = 15.90 cfs @ 12.83 hrs, Volume= 13.050 af, Atten= 0%, Lag= 0.0 min
Primary = 15.90 cfs @ 12.83 hrs, Volume= 13.050 af

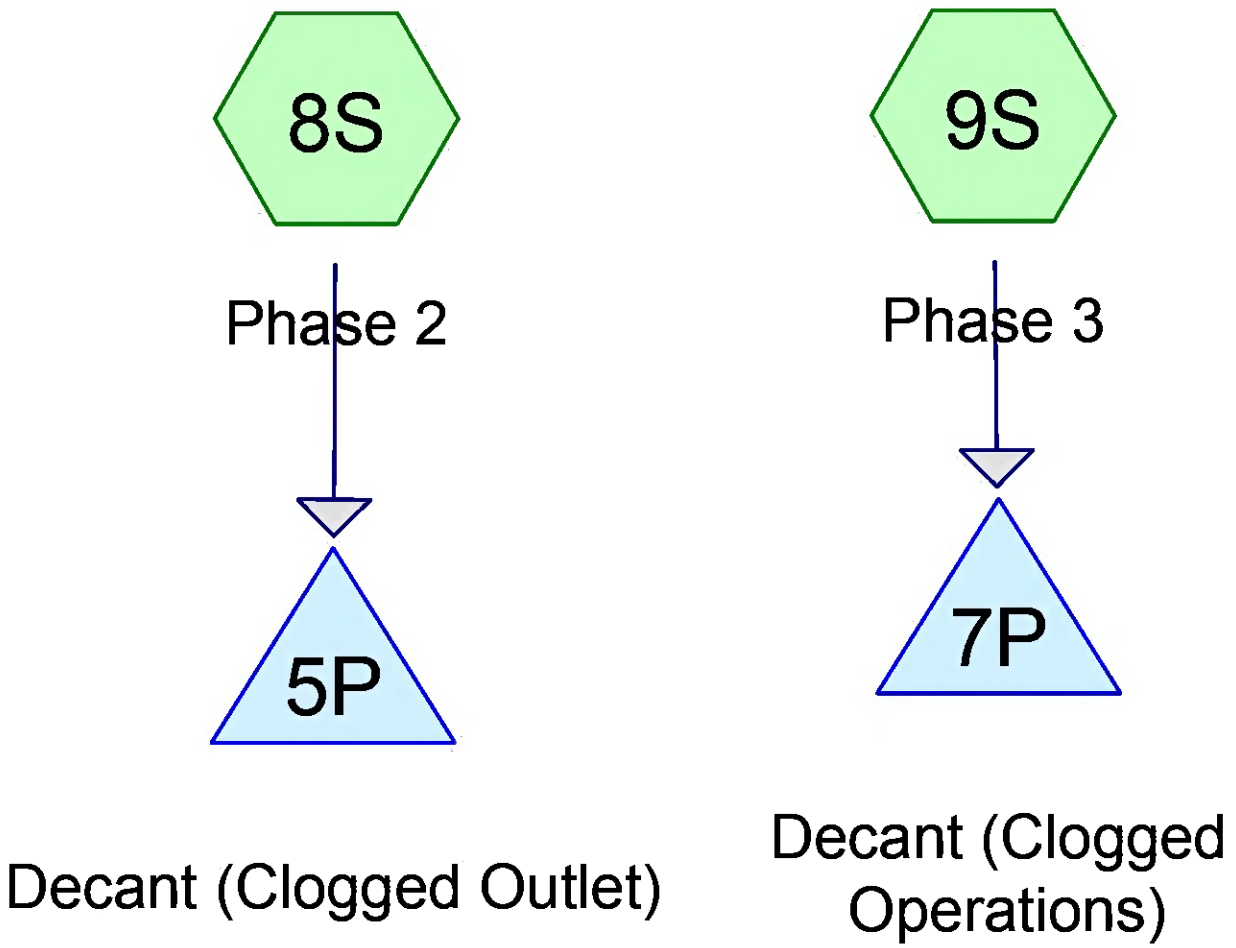
Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 31.66' @ 12.83 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	29.67'	**30.0" Round Culvert** L= 608.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 29.67' / 24.02' S= 0.0093 '/' Cc= 0.900 n= 0.020 Corrugated PE, corrugated interior, Flow Area= 4.91 sf

Primary OutFlow Max=15.90 cfs @ 12.83 hrs HW=31.66' (Free Discharge)
↑**1=Culvert** (Inlet Controls 15.90 cfs @ 3.79 fps)

Pond 21P: Pipe 3D





Subcat Reach Pond Link

Routing Diagram for Scenario 4 - Area 2 Landfill Runoff
Prepared by SCCM, Printed 9/24/2026
HydroCAD® 10.00-26 s/n 00939 © 2020 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
32.690	97	(8S, 9S)
32.690	**97**	**TOTAL AREA**

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 8S: Phase 2 Runoff Area=17.820 ac 0.00% Impervious Runoff Depth=7.92"
Tc=6.0 min CN=97 Runoff=141.08 cfs 11.761 af

Subcatchment 9S: Phase 3 Runoff Area=14.870 ac 0.00% Impervious Runoff Depth=7.92"
Tc=6.0 min CN=97 Runoff=117.73 cfs 9.814 af

Pond 5P: Decant (Clogged Outlet) Peak Elev=67.58' Storage=11.761 af Inflow=141.08 cfs 11.761 af
Outflow=0.00 cfs 0.000 af

Pond 7P: Decant (Clogged Operations) Peak Elev=69.23' Storage=9.814 af Inflow=117.73 cfs 9.814 af
Outflow=0.00 cfs 0.000 af

Total Runoff Area = 32.690 ac Runoff Volume = 21.576 af Average Runoff Depth = 7.92"
100.00% Pervious = 32.690 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 8S: Phase 2

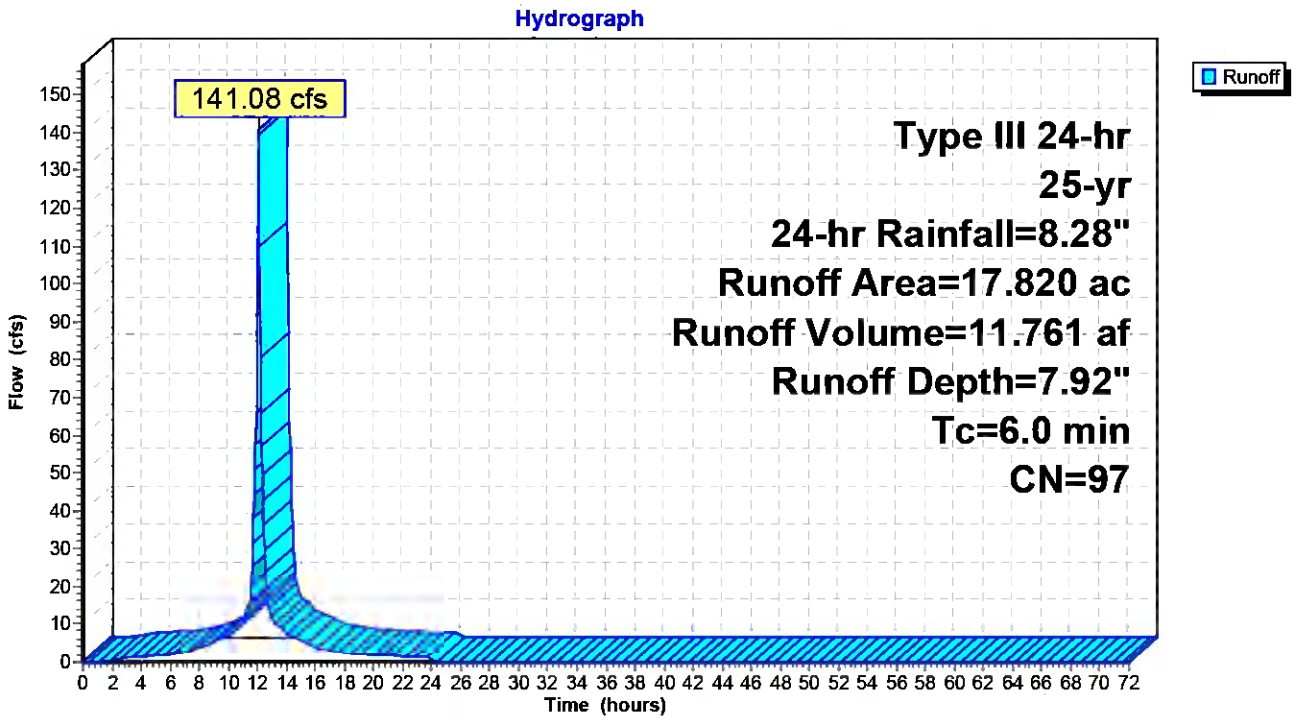
Runoff = 141.08 cfs @ 12.09 hrs, Volume= 11.761 af, Depth= 7.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr, 24-hr Rainfall=8.28"

	Area (ac)	CN	Description
*	17.820	97	
	17.820		100.00% Pervious Area

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

Subcatchment 8S: Phase 2



Summary for Subcatchment 9S: Phase 3

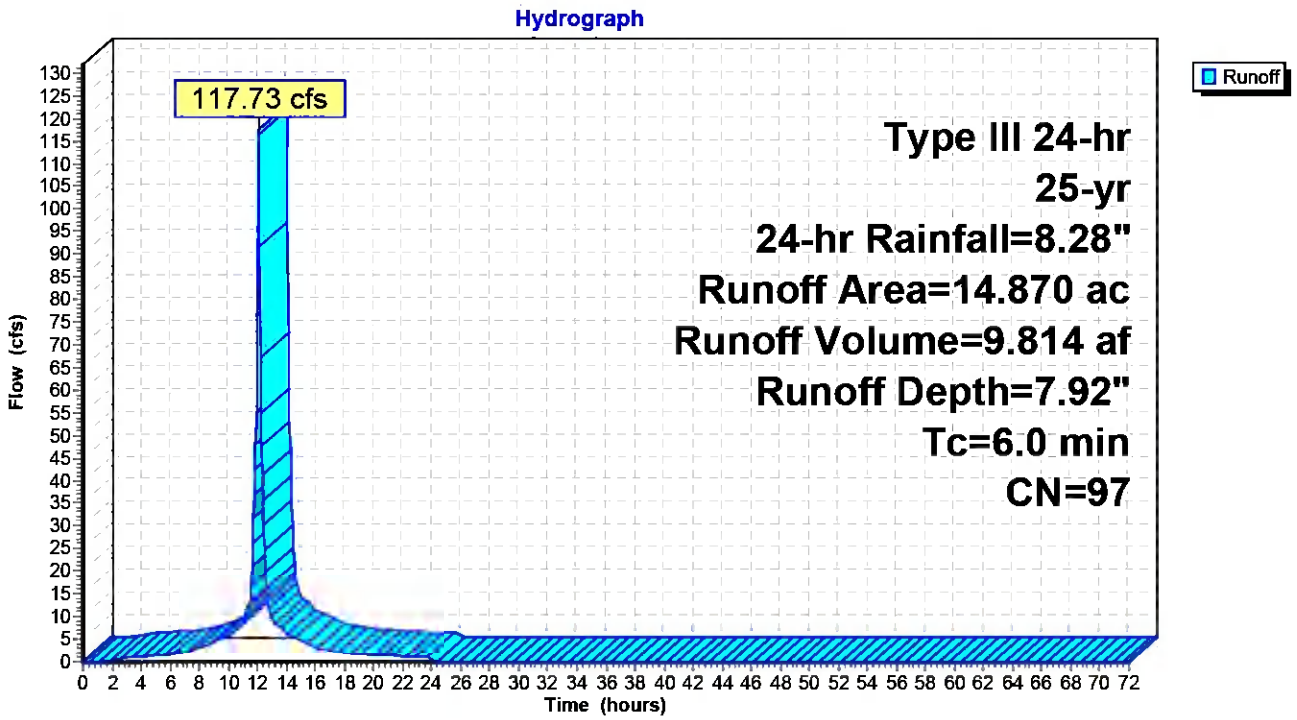
Runoff = 117.73 cfs @ 12.09 hrs, Volume= 9.814 af, Depth= 7.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr, 24-hr Rainfall=8.28"

	Area (ac)	CN	Description
*	14.870	97	
	14.870		100.00% Pervious Area

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

Subcatchment 9S: Phase 3



Summary for Pond 5P: Decant (Clogged Outlet)

Inflow Area = 17.820 ac, 0.00% Impervious, Inflow Depth = 7.92" for 25-yr, 24-hr event
Inflow = 141.08 cfs @ 12.09 hrs, Volume= 11.761 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

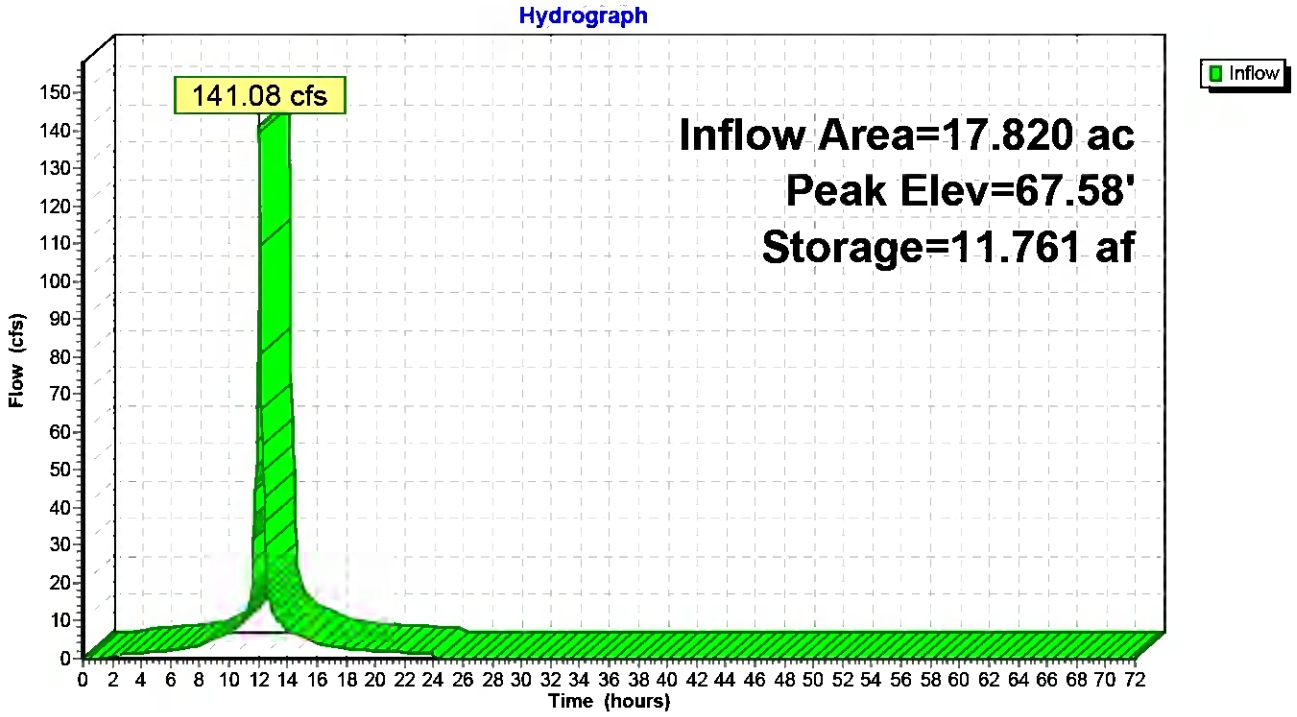
Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 67.58' @ 24.40 hrs Surf.Area= 4.146 ac Storage= 11.761 af

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	56.00'	22.401 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
56.00	0.000	0.000	0.000
57.00	0.001	0.001	0.001
58.00	0.002	0.002	0.002
59.00	0.003	0.003	0.005
60.00	0.004	0.004	0.008
61.00	0.006	0.005	0.013
62.00	0.007	0.006	0.019
63.00	0.193	0.100	0.119
64.00	1.180	0.687	0.806
65.00	2.486	1.833	2.639
66.00	3.484	2.985	5.624
67.00	4.022	3.753	9.377
68.00	4.235	4.129	13.506
69.00	4.444	4.339	17.845
70.00	4.668	4.556	22.401

Pond 5P: Decant (Clogged Outlet)



Summary for Pond 7P: Decant (Clogged Operations)

Inflow Area = 14.870 ac, 0.00% Impervious, Inflow Depth = 7.92" for 25-yr, 24-hr event
Inflow = 117.73 cfs @ 12.09 hrs, Volume= 9.814 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

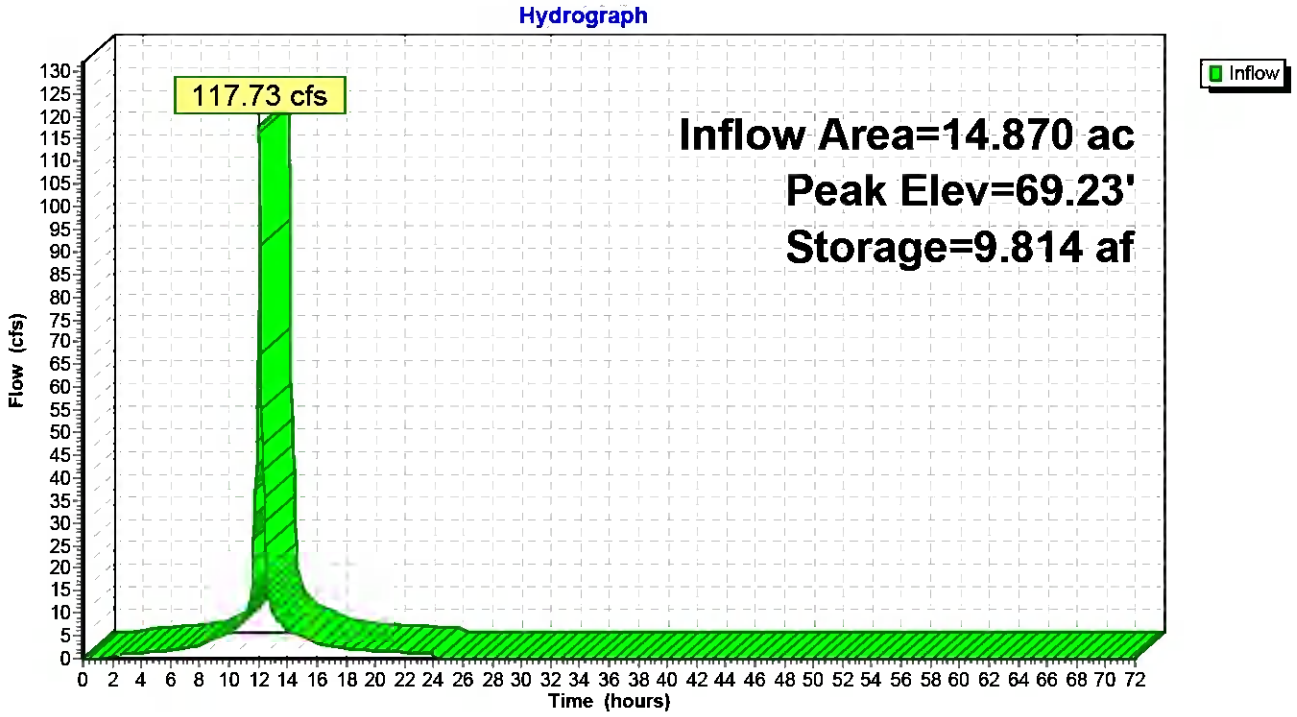
Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 69.23' @ 24.40 hrs Surf.Area= 3.120 ac Storage= 9.814 af

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'	24.341 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
58.00	0.000	0.000	0.000
59.00	0.001	0.001	0.001
60.00	0.003	0.002	0.003
61.00	0.004	0.004	0.006
62.00	0.005	0.005	0.010
63.00	0.007	0.006	0.016
64.00	0.536	0.271	0.288
65.00	1.160	0.848	1.136
66.00	1.478	1.319	2.455
67.00	1.905	1.692	4.146
68.00	2.503	2.204	6.350
69.00	3.014	2.758	9.109
70.00	3.477	3.245	12.354
71.00	3.823	3.650	16.004
72.00	4.166	3.994	19.999
73.00	4.519	4.342	24.341

Pond 7P: Decant (Clogged Operations)



Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 8S: Phase 2 Runoff Area=17.820 ac 0.00% Impervious Runoff Depth=10.54"
Tc=6.0 min CN=97 Runoff=186.11 cfs 15.648 af

Subcatchment 9S: Phase 3 Runoff Area=14.870 ac 0.00% Impervious Runoff Depth=10.54"
Tc=6.0 min CN=97 Runoff=155.30 cfs 13.058 af

Pond 5P: Decant (Clogged Outlet) Peak Elev=68.50' Storage=15.648 af Inflow=186.11 cfs 15.648 af
Outflow=0.00 cfs 0.000 af

Pond 7P: Decant (Clogged Operations) Peak Elev=70.20' Storage=13.057 af Inflow=155.30 cfs 13.058 af
Outflow=0.00 cfs 0.000 af

Total Runoff Area = 32.690 ac Runoff Volume = 28.706 af Average Runoff Depth = 10.54"
100.00% Pervious = 32.690 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 8S: Phase 2

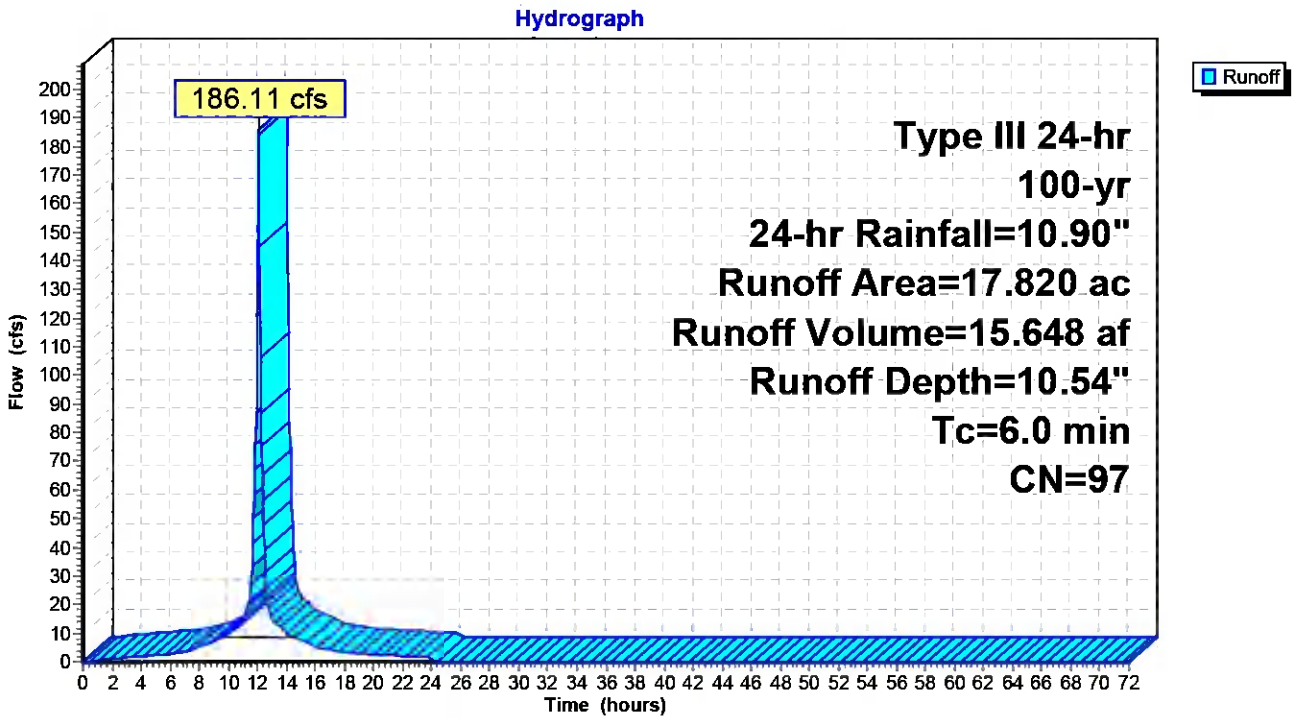
Runoff = 186.11 cfs @ 12.09 hrs, Volume= 15.648 af, Depth=10.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr, 24-hr Rainfall=10.90"

	Area (ac)	CN	Description
*	17.820	97	
	17.820		100.00% Pervious Area

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

Subcatchment 8S: Phase 2



Summary for Subcatchment 9S: Phase 3

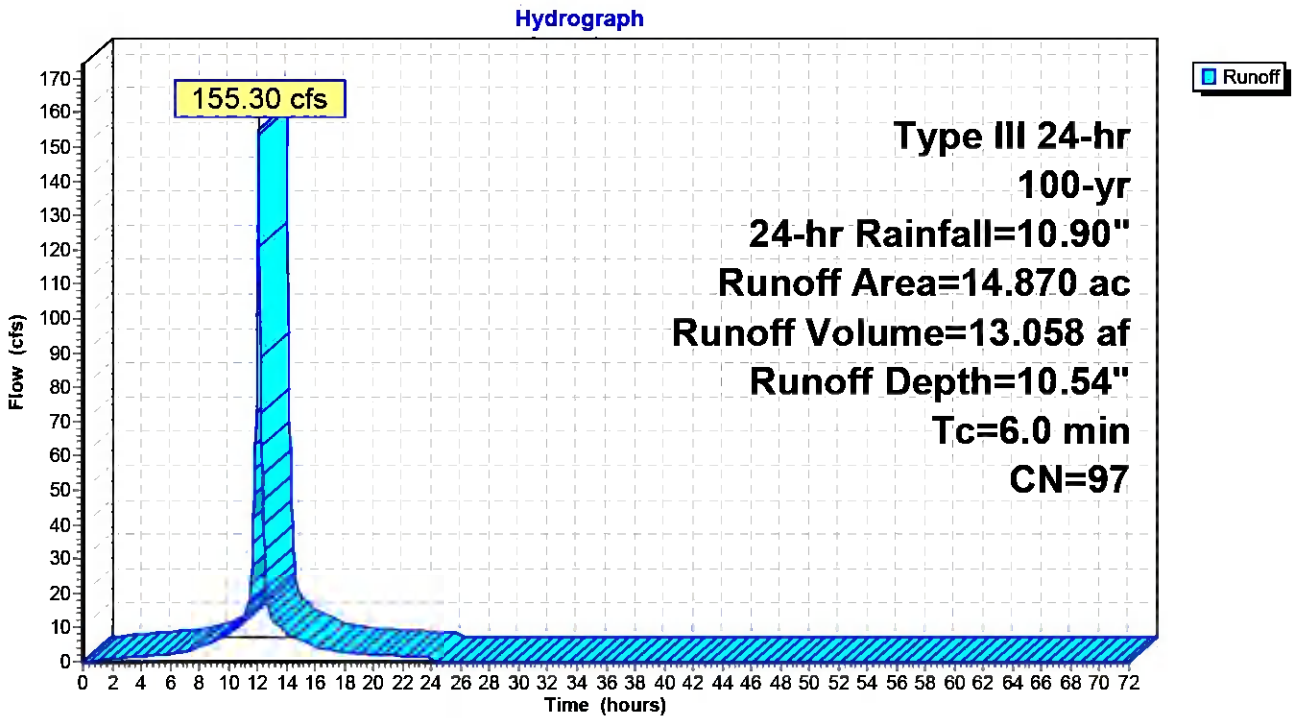
Runoff = 155.30 cfs @ 12.09 hrs, Volume= 13.058 af, Depth=10.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr, 24-hr Rainfall=10.90"

	Area (ac)	CN	Description
*	14.870	97	
	14.870		100.00% Pervious Area

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

Subcatchment 9S: Phase 3



Summary for Pond 5P: Decant (Clogged Outlet)

Inflow Area = 17.820 ac, 0.00% Impervious, Inflow Depth = 10.54" for 100-yr, 24-hr event
Inflow = 186.11 cfs @ 12.09 hrs, Volume= 15.648 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

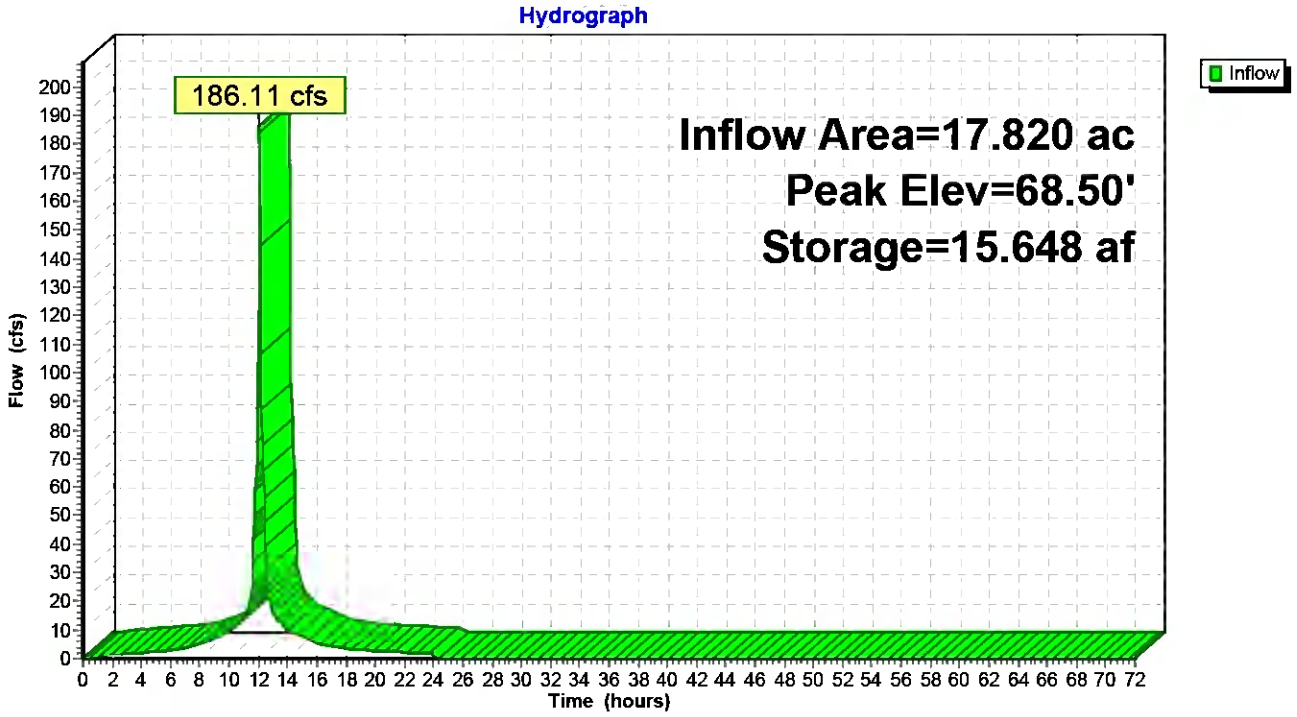
Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 68.50' @ 24.40 hrs Surf.Area= 4.339 ac Storage= 15.648 af

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	56.00'	22.401 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
56.00	0.000	0.000	0.000
57.00	0.001	0.001	0.001
58.00	0.002	0.002	0.002
59.00	0.003	0.003	0.005
60.00	0.004	0.004	0.008
61.00	0.006	0.005	0.013
62.00	0.007	0.006	0.019
63.00	0.193	0.100	0.119
64.00	1.180	0.687	0.806
65.00	2.486	1.833	2.639
66.00	3.484	2.985	5.624
67.00	4.022	3.753	9.377
68.00	4.235	4.129	13.506
69.00	4.444	4.339	17.845
70.00	4.668	4.556	22.401

Pond 5P: Decant (Clogged Outlet)



Summary for Pond 7P: Decant (Clogged Operations)

Inflow Area = 14.870 ac, 0.00% Impervious, Inflow Depth = 10.54" for 100-yr, 24-hr event
Inflow = 155.30 cfs @ 12.09 hrs, Volume= 13.058 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

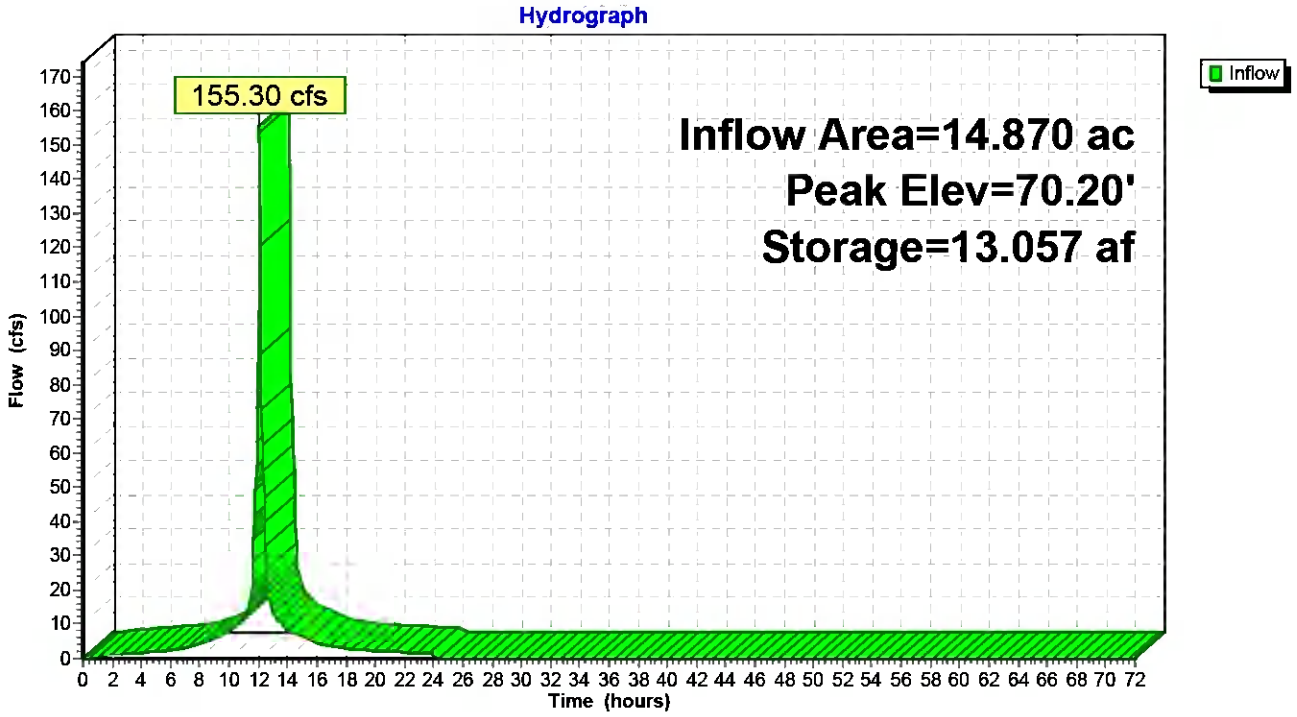
Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 70.20' @ 24.40 hrs Surf.Area= 3.546 ac Storage= 13.057 af

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'	24.341 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
58.00	0.000	0.000	0.000
59.00	0.001	0.001	0.001
60.00	0.003	0.002	0.003
61.00	0.004	0.004	0.006
62.00	0.005	0.005	0.010
63.00	0.007	0.006	0.016
64.00	0.536	0.271	0.288
65.00	1.160	0.848	1.136
66.00	1.478	1.319	2.455
67.00	1.905	1.692	4.146
68.00	2.503	2.204	6.350
69.00	3.014	2.758	9.109
70.00	3.477	3.245	12.354
71.00	3.823	3.650	16.004
72.00	4.166	3.994	19.999
73.00	4.519	4.342	24.341

Pond 7P: Decant (Clogged Operations)



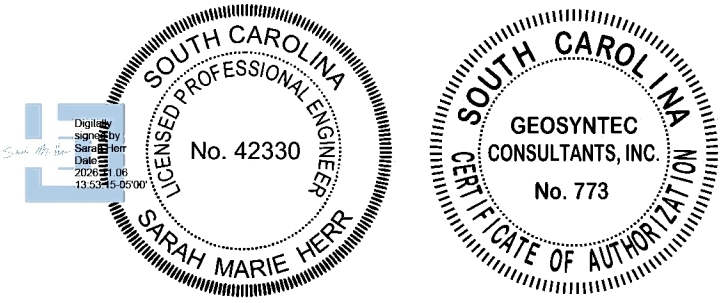
APPENDIX I-B

Run-On and Run-Off Perimeter Control Calculations

Written by: **A. Brand** Date: **11/1/2026** Reviewed by: **S. Herr** Date: **11/6/2026**

Client: **Santee Cooper** Project: **Winyah Generating Station** Project No.: **26009458** Phase No.: **005**

SURFACE WATER MANAGEMENT SYSTEM DESIGN
CLOSURE TURF® FINAL COVER SYSTEM



SEALED FOR

CALCULATION PAGES 1 THROUGH 81

1. INTRODUCTION

1.1 Purpose

The purpose of this calculation package is to present the analysis for the estimation of surface water run-off and evaluation of the proposed final surface water management system hydraulic capacity at Landfill Area 2 at Winyah Generating Station (WGS) in Georgetown County, South Carolina. Because the proposed alternative geomembrane/artificial turf system known as the ClosureTurf® final cover system will generate higher run-off volume as compared to the currently-permitted final cover system with a vegetated (grass) surface, Geosyntec evaluated the capacities of the proposed stormwater structures to determine whether they can adequately convey the increased run-off generated by the proposed final cover system. The hydrologic analysis includes calculation of peak discharges and total run-off volumes from the landfill area during final conditions (i.e., post-development conditions after closure), when the final cover system for the landfill is in-place, as are the permanent surface water management system conveyance features. The results of the hydrologic calculations are used to evaluate the capacity of the hydraulic components of the landfill surface water management system.

1.2 Surface Water Management System – Overview

The Engineering Drawings that accompany the Engineering Report in the approved permit application shows the final grading plan of the landfill area and includes a series of drawings that show the surface water management system features. Key features of the surface water management system at Landfill Area 2 are as follows:

- The final cover system ground surface will have sideslopes inclined at three horizontal to one vertical (3H:1V) in-between drainage terraces and top surface slopes (top deck areas) are inclined at a nominal 3 to 5 percent slope. The sideslope drainage terraces are spaced approximately every 30 feet vertically, and with typical drainage profile slopes at 2 percent. Sheet flow run-off upgradient from each sideslope drainage terrace will be captured in the terraces, where the water will be conveyed to downdrain pipes spaced periodically around the landfill area.

- Downdrain pipes will outlet into either perimeter drainage reaches, or into existing site drainage features (i.e., the discharge canal or cooling pond). At each location where downdrain pipes outlet to the perimeter drainage channel, a concrete outlet apron will be used. At each location where downdrain pipes outlet directly to existing drainage features (discharge canal or cooling pond), riprap aprons will be used to dissipate energy.

- Perimeter drainage reaches will convey water to outlets into existing site drainage features (i.e., the intake canal, discharge canal, or cooling pond). Periodic or extensive drainage culverts are located along the drainage channels as necessary.

- The landfill area will include a final cover access road, with an adjacent drainage channel ("access road drainage terrace") located on the inside edge of the road. The access road drainage terraces will receive sheet flow run-off from the road along with some sheet flow from adjacent landfill sideslopes and will convey water to either a culvert beneath the access road or to downdrain pipes spaced periodically around the landfill area. Culverts will convey flow beneath roads where the landfill perimeter access road crosses the perimeter reaches. The hydraulic capacity of the roadway culverts was also evaluated.

Figure 1 of this calculation package shows the layout of the final cover grading of Landfill Area 2, along with a delineation of drainage areas.

2. METHODOLOGY

2.1 HEC-HMS Computer Model

Surface water discharges are estimated using *Hydrologic Modeling System (HEC-HMS), Version 4.1* developed through the Hydraulic Engineering Center (HEC) of the United States Army Corps of Engineers (USACE) (USACE, 2000). The program simulates natural and controlled precipitation-run-off and routing processes of a watershed. For precipitation-run-off-routing simulation, HEC-HMS provides the following components:

- Precipitation-specification options can describe a frequency-based hypothetical precipitation event (i.e., design rainfall or storm event). For this analysis, the following hypothetical precipitation events were evaluated: the 25-year (4% annual chance), 24-hour duration event (herein referred to as the 25-year, 24-hour event); and the 100-year (1% annual chance), 24-hour duration event (herein referred to as the 100-year, 24-hour event).

- Water loss models can estimate the volume of run-off given the precipitation and properties of the watershed. For this analysis, the National Resource Conservation Service (NRCS) Curve Number Loss Model was used (USDA, 1986).

- Direct run-off transform models can account for overland flow, storage, and energy losses as surface water runs off a watershed and into the drainage channels. For this analysis, the NRCS Unit Hydrograph Model was selected.

- Hydraulic routing models account for storage and energy flux as surface water flows through drainage channels. The Kinematic Wave Model was selected for these analyses.

HEC-HMS modeling calculates surface water run-off volumes, peak flow rates, and flow characteristics from landfill run-off that drains to and is routed through the perimeter channels under final closure conditions. The results are used to evaluate the capacity of the hydraulic design of the surface water management conveyances (i.e., top deck drainage terraces, sideslope drainage terraces, downdrain pipes, and perimeter drainage channels and pipes).

2.1.1 Estimation of Time of Concentration for HEC-HMS NRCS Curve Number Method

The method to estimate the sheet flow travel time was obtained from the U.S. Department of Agriculture (USDA) document *Urban Hydrology for Small Watersheds, Technical Release 55 (TR-55)* (USDA, 1986). Manning's kinematic solution is used for estimating travel time for sheet flow for flow distances less than 100 feet (USDA, 1986):

$$T_t = \frac{0.007(nL)^{0.8}}{P_{2-24}^{0.5} S^{0.4}}$$

where: T_t = travel time for overland sheet flow (hr)

n = roughness coefficient for sheet flow

L = flow length (ft)

$P_{2\text{-}24}$ = 2-year, 24-hour rainfall (in.)

S = slope of hydraulic grade line (or land slope) (ft/ft)

The slope of the hydraulic grade line, or land slope (S), for all subcatchment areas of the final cover system is shown in Appendix 1 of this calculation package. To estimate sheet flow travel time (T_t), a roughness coefficient of 0.11 for ClosureTurf® was selected for the final cover system (WatershedGeo, 2019). Maximum flow lengths (L) were measured draining to each stormwater feature. As shown in Table 1, the rainfall depth for the 2-year, 24-hour frequency ($P_{2\text{-}24}$) at the site is 4.42 inches (NOAA, 2026).

Based on the designed conveyance system, run-off will be converted from sheet flow to open channel flow relatively quickly, and therefore shallow concentrated flow should be negligible. Surface water run-off within each subcatchment area will sheet flow along the top deck or sideslopes of the final cover system until the water reaches either a drainage terrace or the perimeter drainage channel, at which point the flow will be classified as open channel flow. The method selected to estimate the open channel flow travel time is based on guidance provided in TR-55 (USDA, 1986). Travel time for open channel flow is estimated by dividing the longest drainage path by the velocity of run-off:

$$T_t = \frac{L}{V}\left(\frac{1}{60}\right)$$

where: T_t = travel time (min)

L = flow length (ft)

V = average velocity (ft/sec)

Open channel flow velocities were estimated using Manning's equation based on guidance provided in TR-55 (USDA, 1986). The average flow velocities were determined for bank-full elevation as:

$$V = \frac{1.49}{n} R_h^{2/3} S^{1/2}$$

where: V = average velocity (ft/s)

n = Manning's roughness coefficient

R_h = hydraulic radius (ft) = A/P

A = cross sectional area (ft^2)

P = wetted perimeter (ft)

S = slope of hydraulic grade line (or longitudinal channel slope for normal flow conditions) (ft/ft)

To estimate open channel flow travel time (T_t), a Manning's roughness coefficient (n) of 0.027 was selected for open channels lined with vegetation as shown in Table 2 (Chow, 1959).

The velocities and times of concentration used in the analysis are presented in Appendix 1 of this calculation package. A minimum time of concentration of six minutes was used as recommended by TR-55 (USDA, 1986) because small areas with exceedingly short times of concentration could result in design rainfall intensities that are unrealistically high. The lag times calculated for each drainage area are presented in Appendix 1 for use in the NRCS Curve Number Method and HEC-HMS software. The lag time is estimated as 0.6 times the time of concentration (USDA, 1986).

2.2 Drainage Terraces and Downdrains

The hydraulic capacity of the drainage terraces (top deck, sideslope, and access road) and each downdrain pipe is calculated by solving Manning's equation for the depth of flow within each feature. Manning's equation (Chow, 1959) is expressed as:

$$Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

where: Q = discharge (cfs)

n = Manning's roughness coefficient

A = area of cross-section of flow (ft^2)

P = wetted perimeter (ft)

R = hydraulic radius = A/P (ft)

S = slope of hydraulic grade line (or longitudinal slope for normal flow conditions) (ft/ft)

The average tractive stresses in the drainage terraces for various flows from the design events are estimated by the following equation (Chow, 1959):

$$\tau_o = \gamma_w RS$$

where: τ_o = average tractive stress (lb/ft^2)

γ_w = unit weight of water (lb/ft^3)

R = hydraulic radius = A/P (ft)

S = channel slope (ft/ft)

Manning's equation was used to calculate the resulting flow depths and velocities to confirm that the drainage features are appropriately sized. The tractive stress equation was also used to evaluate the channel lining. The calculated 25-year average velocity was used as the basis for design of the channel lining system for each drainage feature.

The flow rates (i.e., peak discharge rates, Q) from the HEC-HMS modeling results relate to the contributing drainage areas for each downdrain pipe feature. Each individual sideslope drainage terrace and top-deck drainage terraces constitute a portion of the total contributing area to a downdrain pipe feature. Therefore, the total flow rate within the downdrain pipe feature was scaled based on area to estimate the expected flow rate to each drainage terrace within the overall contributing area. For example, the subcatchment contributing to downdrain pipe feature 2A1 has a total area of 11.54 acres. The subcatchment can be divided into nine separate subareas corresponding to each sideslope drainage terraces within this subcatchment. The farthest downgradient sideslope drainage terrace on the west side of the downdrain pipe feature 2A1 (i.e., one of the nine drainage terraces for this downdrain pipe) has an area of 0.25 acres. The expected flow rate within that drainage terrace is estimated as 0.25 acres divided by the total area (11.54 acres) times the peak flow rate (80.42 cfs for a 25-year event). This calculation results in an expected peak flow rate of 1.74 cfs for this specific sideslope drainage terrace. Similar calculations were conducted for every drainage terrace, and the largest subarea contributing to a drainage terrace (i.e., the largest expected flow rate within all the drainage terraces) was used to calculate the critical peak flow rate required for designing adequate capacity within the drainage terrace.

2.3 Perimeter Drainage Reaches and Roadway Culverts

2.3.1 Perimeter Drainage Reaches

Final cover areas contributing to each perimeter drainage reach are modeled in HEC-HMS. Each reach is designed to convey the peak surface water run-off rate corresponding to the 100-year (i.e., one percent annual chance of occurrence), 24-hour duration rainfall event flowing to the channel reach. The hydraulic capacity of each perimeter drainage channel or perimeter culvert is calculated and assessed by solving Manning's equation from Section 2.2. The peak velocity for the perimeter drainage channels calculated from Manning's equation was used to evaluate the channel lining.

In perimeter reach culverts that were flowing full during the 100-year, 24-hour event, the cumulative energy losses (friction losses, minor losses, and exit losses) were calculated to estimate the hydraulic grade line (HGL) along the system. Friction losses and minor losses were estimated and the 100-year, 24-hour HGL elevation was calculated at each junction box. Friction loss, or the energy required to overcome the roughness of the pipe, is expressed as (FHWA, 2013):

$$H_f = S_f L$$

where: H_f = friction loss (ft)

S_f = friction slope (ft/ft)

L = length of pipe (ft)

The equation for calculating the friction slope along each pipe segment is provided below (FHWA, 2013):

$$S_f = \frac{(Q\ n)}{(K_Q\ D^{2.67})}^2$$

where: Q = flow (ft^3/s)

n = roughness coefficient

K_Q = 0.46 for English units

D = pipe diameter (ft)

Minor losses due to the presence of junction boxes were calculated using the following equation (UDFCD, 2001):

$$H = K(\frac{V^2}{2g})$$

where: H = minor loss (ft)

K = bend loss coefficient = 0.025 from Figure 2 (UDFCD, 2001)

V = pipe velocity (ft/s)

g = acceleration due to gravity (ft/s^2) = 32.2 ft/s^2

Exit loss from the storm drain outfall was calculated using the following equation (FHWA, 2013):

$$H_o = K[\frac{V_o^2}{2g} - \frac{V_d^2}{2g}]$$

where: H_o = exit loss (ft)

K = exit loss coefficient

V_o = average outlet velocity (ft/s)

V_d = channel velocity downstream of outlet (ft/s)

g = acceleration due to gravity (ft/s^2) = 32.2 ft/s^2

An exit loss coefficient (K) of 1.0 is usually recommended by FHWA (2009); however, a loss coefficient of 0.5 was selected for this analysis because the pipe segment at the outlet is flowing at a depth approximately 50% of the pipe diameter. The downstream channel velocity (V_d) represents the open channel velocity between the pipe outlet headwall and the intake channel. A downstream velocity of two feet per second was selected to represent non-erosive velocities in this section of channel. This is assumed to be a conservative assumption since the actual downstream velocity will likely be greater prior to reaching the intake channel.

2.3.2 Roadway Culverts

The hydraulic capacity of the roadway culverts was assessed by utilizing the HY-8 Culvert Analysis Program v.7.5 (HY-8) from FHWA (2012). The performance of the culverts is modeled and evaluated based on boundary conditions, culvert characteristics, and design flow rates for the 100-year, 24-hour rainfall event. Tailwater conditions were assumed to correspond to the calculated flow depth in the downstream channel.

2.3.3 Riprap Apron Design

The riprap aprons are designed to protect against erosion and scour from the peak outflow based on the 25-year, 24-hour rainfall event. The selected design guidance from the Federal Highway Administration (FHWA) provides a methodology for calculating the median riprap size (d_{50}) and required length of apron (L_a) based on the culvert diameter and design flow rate. The median riprap size is calculated using the following equation (FHWA, 2006):

$$d_{50} = 0.2D\left[\frac{Q}{\sqrt{g}D^{2.5}}\right]^{4/3}\frac{D}{TW}$$

where: d_{50} = median riprap size (ft)

Q = design discharge (cfs),

D = culvert diameter (ft)

TW = tailwater depth (ft)

g = gravitational constant (32.2 ft/s^2)

The tailwater depth should be limited to between 0.4D and D. FHWA (2006) recommends the use of a tailwater depth equal to 0.4D if the tailwater conditions are unknown. Once the median riprap size is calculated, the required length and depth (i.e., thickness) of the riprap apron can be estimated using Table 3 provided by the FHWA (2006). The width of the riprap apron is selected as three times the culvert diameter based on the riprap apron detail presented in Figure 3 from FHWA (2006) or the bottom width of the channel for culverts that discharge directly to channels.

3. DESIGN PARAMETERS

The following data and assumptions were utilized to select the relevant engineering parameters to estimate surface water run-off and hydraulic capacity.

3.1 HEC-HMS

3.1.1 Rainfall

The rainfall depths corresponding to 24-hour duration hypothetical precipitation event and 25- and 100-year frequency return periods for the site are 8.28 inches and 10.9 inches, respectively, as shown in Table 1 (NOAA, 2026). The design storm hyetograph is defined using a NRCS Type III rainfall distribution, which is selected based on Figure 4 (USDA, 1986).

3.1.2 Drainage Areas and Reaches

The drainage areas and reaches were modeled based on the following approach and related assumptions:

- Drainage Areas – The contributing watershed areas for each basin (drainage area) or reach (perimeter drainage channel or pipe) associated with the landfill area are divided into multiple subbasins (subareas). Subbasins are modeled based on the receiving surface water drainage feature and are delineated for the areas draining to perimeter drainage channel reaches. The NRCS Curve Number Loss Model was used to estimate the volume of run-off from a given subbasin. The NRCS Unit Hydrograph Model was used to estimate the direct run-off flow rates from each subbasin. Each subbasin is assigned a Curve Number representing the type of ground cover for a given soil for the area. The subbasin area, Curve Number, and NRCS Unit Hydrograph lag time input parameters are included in the HEC-HMS output in Appendix 1.

- Curve Number (CN) – Curve number for ClosureTurf® were obtained from the WatershedGeo Design Guidelines Manual (WatershedGeo, 2019). Proposed final cover of the CCR landfill will have a CN = 95, as shown in Table 5.

- Manning's Roughness Coefficients – Values of Manning's roughness coefficients used in the reach routing calculations were obtained from Chow (1959) and Barfuss and Tullis (1989). Table 2 and Figure 6 summarize the Manning's coefficients used in this calculation package. A Manning's roughness coefficient value of 0.036 was selected for the drainage

terraces which are proposed to be lined with ClosureTurf® overlain with riprap. A Manning's roughness coefficient value of 0.027 was selected for perimeter drainage channels which are proposed to be grass-lined. A Manning's roughness coefficient value of 0.009 was selected for HDPE downdrain pipes.

- Perimeter Channel Reaches – The Kinematic Wave Model is used to model the surface water flow in each of the reaches in the HEC-HMS program. The Kinematic Wave Model accounts for storage and energy flux as surface water moves through stream channels. Average geometric characteristics of the stream channel measured from the existing and proposed topography are input into HEC-HMS.

3.1.3 Nodal Network Diagrams

Figure 7 of this calculation package presents the nodal network diagrams for the final landfill conditions of Landfill Area 2. The nodal network diagram shows the subbasins, reaches, and discharge locations.

3.2 Drainage Terrace and Downdrain

The hydraulic capacity of the drainage terraces and downdrains were evaluated to meet or exceed the applicable requirements of the State of South Carolina Department of Environmental Services (SCDES) regulations for Class Three Landfills. The following design criteria have been adopted:

- The drainage terraces and downdrains are designed to control at least the water volume resulting from a 25-year, 24-hour storm.
- The drainage terraces:
    - are sized to convey run-off from the 25-year, 24-hour design rainfall event with a hydraulic head not more than 1 foot;
    - are sized to convey the 100-year, 24-hour design rainfall event without overtopping; and
    - have channel lining materials selected to resist the velocities and/or tractive stresses produced by the 25-year, 24-hour rainfall event.
- The downdrain pipes are designed to convey the 100-year, 24-hour rainfall event without flowing full (to avoid pressurized flow).

The design parameters used in these calculations, including channel geometry, Manning's roughness coefficient, and calculated peak flows for the 25-year and 100-year events are summarized for each drainage terrace type and downdrain pipe feature in Tables 6 and 7, respectively, of this calculation package. Further discussion of the design parameters for each feature is provided in the sections that follow.

3.2.1 Top-Deck Drainage Terraces

The top-deck drainage terraces are designed as v-shaped channels (i.e., trapezoidal channels with bottom width equal to zero). The top-deck drainage terraces will be formed by constructing tack-on berms near the edge of the top deck surface. As such, one side of the v-shaped channel will be inclined at 5% based on the top deck surface grades, and the other side of the v-shaped channel will be inclined at 3H:1V based on the constructed berm. The top deck drainage terraces will have a constant depth of 1.5 feet and a longitudinal slope of approximately 0.5%.

A Manning's roughness coefficient of 0.036 was selected for the top-deck terraces, based on recommendations for excavated earth channels with riprap (Chow, 1959) as shown in Table 2. A tractive stress approach was used to check the stability of the channel lining, and a permissible tractive stress of 2.4 pounds per square foot was used based on recommendations by FHWA (2005) as shown in Table 8.

The critical top-deck drainage terrace, used as the basis for design, is located in subcatchment 2F1 of Landfill Area 2 and was selected because it has the largest contributing drainage area of 1.36 acres. The resulting peak discharge rates from the 25-year and 100-year storm events are 9.51 cubic feet per second and 12.58 cubic feet per second, respectively.

3.2.2 Sideslope Drainage Terraces

The sideslope drainage terraces are designed as riprap-lined trapezoidal channels graded into the 3H:1V sideslopes of the final cover system. The sideslope drainage terraces have been modified to be trapezoidal in shape with 2H:1V sides on both the up-slope and down-slope sides of the terrace. The sideslope drainage terraces have a constant depth of 1.5 feet, bottom width of 6.0 feet, and a longitudinal slope of approximately 2%. As with the top-deck terraces, a Manning's roughness coefficient of 0.036 was used, and a tractive stress approach was used to check the stability of the channel lining, and a permissible tractive stress of 2.4 pounds per square foot was used based on recommendations by FHWA (2005) as shown in Table 8.

The critical sideslope drainage terrace, used as the basis for design, is located in subcatchment 2F2 of Landfill Area 2 as shown on the attached Figure 8. This location is critical because it has the largest contributing drainage area of 3.07 acres. The resulting peak discharge rates from the 25-year and 100-year storm events are 21.6 cubic feet per second and 28.6 cubic feet per second, respectively.

3.2.3 Access Road Drainage Terraces

The access road drainage terraces are designed as riprap-lined v-shaped channels. The sideslopes of the access road drainage terrace are 3H:1V on the up-slope side of the terrace. The down-slope side is inclined at a 2H:1V angle. The access road drainage terraces have a constant depth of 1.5 feet and a longitudinal slope of approximately 8%.

The channel lining material will be six-inch diameter (average) riprap stones. A Manning's roughness coefficient of 0.036 was selected for the access road drainage terraces, based on recommendations from Chow (1959), as shown in Table 2. A tractive stress approach was used to check the stability of the channel lining, and a permissible tractive stress of 2.4 pounds per square foot was used based on recommendations by FHWA (2005) as shown in Table 8.

The critical access road drainage terrace, used as the basis for design, is located in subcatchment 2A2A and was selected because it has the largest contributing drainage area of 2.15 acres. The resulting peak discharge rates from the 25-year and 100-year storm events are 15.7 cubic feet per second and 20.8 cubic feet per second, respectively.

3.2.4 Downdrains

The downdrains will be 18-inch diameter, smooth-interior, high-density polyethylene (HDPE) pipe. A Manning's roughness coefficient of 0.009 was selected for the downdrains, based on recommendations from Barfuss and Tullis (1989), as shown in Figure 6. In general, the downdrain pipes will follow the slope of the landfill sideslopes, and as such will generally be inclined at a longitudinal slope of 3H:1V. However, the slope will flatten to 4% at locations where downdrain pipes cross the sideslope drainage terraces, as well as at the landfill perimeter. This much flatter 4% slope governs the hydraulic sizing and is therefore used to size the downdrains.

Multiple pipes are used side-by-side to form a cluster of pipes at each downdrain feature location, based on the number of pipes needed to collect the run-off generated from each contributing drainage area.

3.3 Perimeter Drainage Reaches and Roadway Culverts

3.3.1 Perimeter Drainage Reaches

Perimeter drainage channels are designed to be grass-lined trapezoidal shaped channels. The design parameters for each perimeter drainage channel reach, including channel geometry and calculated peak flow rates for the 25-year and 100-year, 24-hour rainfall events, are summarized in Table 10. A Manning's roughness coefficient of 0.027 was selected for perimeter drainage channels with grass-lining (Chow, 1959) as shown in Table 2 of this calculation package. A maximum permissible velocity of 6.0 feet per second was selected, based on recommendations from Georgetown County (2006) for Bermuda grass-lined drainage channels, as shown in Table 9 of this calculation package. The perimeter drainage channels are designed to have a calculated average velocity less than the permissible velocity for a 25-year, 24-hour rainfall event. Perimeter drainage reach pipes/culverts at Landfill Area 2 were designed as reinforced concrete pipe (RCP). The design parameters for each perimeter drainage reach pipe/culvert, including geometry and calculated peak flow rates are also summarized in Table 10. A Manning's roughness coefficient of 0.012 was selected for concrete pipes as shown in Table 11 (Chow, 1959). A maximum permissible velocity for of 18 feet per second was selected, based on Table 12 (USDA, 2007).

3.3.2 Roadway Culverts

The roadway culverts near the landfill perimeter areas will be RCP. The design parameters for each roadway culvert, including inlet invert elevation, outlet invert elevation, slope, approximate length, and design flow rates for each culvert for the 25-year and 100-year, 24-hour rainfall events, are summarized in Table 13. A Manning's roughness coefficient of 0.012 was selected based on guidance from Chow (1959) as shown in Table 11. All culverts were designed using the following parameters to convey the peak flow rate for the 100-year, 24-hour rainfall event. The inflow structure into the culvert influences the conveyance of surface water through the culvert. The culvert inflow structures were modeled as a square edge with a headwall.

3.3.3 Riprap Apron Design

Riprap aprons were sized for the outflow of each proposed culvert, as well as for the downdrain pipe locations which discharge directly to the canals or cooling pond. The riprap apron design parameters including flow rates, culvert diameter, and riprap apron dimensions depth are presented in Table 14. For the purposes of riprap apron design only, proposed culvert crossings with multiple barrels were modeled with a flow rate evenly distributed to each culvert based on the number of barrels.

4. RESULTS

Table 15 of this calculation package presents a summary of the HEC-HMS hydrologic modeling results. Additional detailed backup, including screen-shots of the modeling output results, is provided in Appendix 1 of this calculation package. The summary of results in Table 15 shows the calculated peak discharges and total discharge run-off volumes at the landfill outfall locations (which refers to locations where run-off outlets to the existing on-site cooling pond) for Landfill Area 2. Results are provided for both the 25-year and 100-year storm events.

The depth of flow, velocity, and average tractive stress for the peak discharges into each representative top deck drainage terrace, sideslope drainage terrace, access road drainage terrace, and downdrain pipe feature were calculated using the methodology described above. These calculation results are summarized in Table 16 (for drainage terraces) and Table 17 (for downdrain pipe features). In addition, the downdrain pipe feature configurations and associated number of pipes to be utilized at each sideslope drainage terrace were tabulated in Table 18.

Appendix 2 of this calculation package provides spreadsheets used for calculating the results for the downdrain pipe features, access road drainage terraces, top deck drainage terrace, and sideslope drainage terrace with the greatest flow rates (i.e., the critical design cases). The set of Engineering Drawings that accompanies the Engineering Report shows the location and layout of the drainage structures discussed within this calculation package.

The calculation results presented herein demonstrate that:

- Each drainage terrace is designed with the capacity to convey the flows from the 25-year, 24-hour design rainfall event with a hydraulic head not more than 1 foot and to convey the 100-year, 24-hour design rainfall event without overtopping.

- The selected channel lining can adequately resist the velocities and/or tractive stresses produced by the 25-year, 24-hour rainfall event.

- Downdrain pipe features are designed to flow partially full (avoiding pressurized flow) during the 25-year, 24-hour design rainfall event and the 100-year, 24-hour rainfall event, and using multiple pipes side-by-side at locations where more than one pipe is needed to convey the flow from the contributing drainage area.

The depth of flow and velocity for the calculated discharge for each perimeter drainage reach channel/pipe during the design rainfall events were calculated using the methodology described

above. Calculations for each perimeter drainage reach were performed using spreadsheet-based computations, with results summarized in Table 19. Spreadsheet results for each perimeter drainage reach are presented in Appendix 3 of this calculation package. For perimeter reach pipes/culverts flowing full during the 100-year, 24-hour event, the HGL elevation was calculated at each junction box to ensure the elevation of the HGL was less than the top of junction box, as shown in Table 19.

The performance of each roadway culvert from HY-8 modeling during the design rainfall events is presented in Table 20. The riprap apron median size, apron depth, and apron length for each culvert and downdrain pipe feature are presented in Table 14. The calculation results presented herein demonstrate that:

- Each perimeter drainage channel reach is designed to be able to convey the 100-year, 24-hour rainfall event without overtopping.
- The selected channel lining can adequately resist the velocities or tractive stresses produced by the 25-year, 24-hour rainfall event.
- Perimeter drainage reach pipes are designed to convey the 25-year, 24-hour rainfall event without flowing full.
- The roadway culvert designs contain the capacity to convey the design flows without overtopping the downstream roadway for a 100-year, 24-hour rainfall event. Proposed modifications to roadway culvert design include updating Culvert 2BC from 2 barrels with 24-inch diameters to 2 barrels with 30-inch diameters.
- The minimum d_{50} size of the riprap apron was computed for the outflow of each necessary discharge structure. In addition, the selected riprap class, apron depths and lengths are provided within Table 14 for each riprap apron.

Note that FHWA (2006) recommends an apron width of three times the outlet diameter or one pipe width wider than the extent of the pipe barrels at the up gradient end of the apron near the culvert outlet and a 3:1 rate of expansion at each edge along the length of the apron. However, several structures are discharging into a stabilized trapezoidal channel and the dimensions of the riprap aprons are restricted by the channel dimensions. Therefore, the entire width of the channel should be lined with riprap in these cases.

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Table 1. Precipitation Frequency for Georgetown, South Carolina (from NOAA, 2026)

NOAA Atlas 14, Volume 2, Version 3
Location name: Georgetown, South Carolina, USA*
Latitude: 33.3343°, Longitude: -79.3551°
Elevation: 18.82 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

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

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.502 (0.468-0.543)	0.586 (0.545-0.636)	0.668 (0.619-0.722)	0.761 (0.703-0.823)	0.867 (0.789-0.927)	0.942 (0.863-1.02)	1.02 (0.929-1.10)	1.10 (0.993-1.19)	1.19 (1.07-1.29)	1.28 (1.14-1.39)
10-min	0.803 (0.748-0.868)	0.938 (0.872-1.02)	1.07 (0.992-1.16)	1.22 (1.13-1.32)	1.37 (1.26-1.48)	1.50 (1.38-1.62)	1.62 (1.48-1.75)	1.74 (1.57-1.88)	1.89 (1.69-2.04)	2.02 (1.79-2.19)
15-min	1.00 (0.936-1.09)	1.18 (1.10-1.28)	1.35 (1.25-1.46)	1.54 (1.42-1.67)	1.73 (1.59-1.87)	1.90 (1.74-2.05)	2.05 (1.87-2.22)	2.19 (1.99-2.37)	2.37 (2.13-2.57)	2.53 (2.25-2.75)
30-min	1.38 (1.28-1.49)	1.63 (1.51-1.77)	1.92 (1.78-2.08)	2.23 (2.06-2.41)	2.57 (2.36-2.77)	2.86 (2.62-3.09)	3.14 (2.86-3.39)	3.42 (3.09-3.69)	3.78 (3.38-4.09)	4.10 (3.64-4.45)
60-min	1.72 (1.60-1.85)	2.04 (1.90-2.22)	2.46 (2.29-2.67)	2.90 (2.68-3.14)	3.42 (3.14-3.69)	3.88 (3.55-4.19)	4.32 (3.94-4.67)	4.79 (4.34-5.18)	5.42 (4.86-5.87)	5.98 (5.32-6.50)
2-hr	2.08 (1.92-2.24)	2.49 (2.30-2.69)	3.07 (2.83-3.31)	3.66 (3.37-3.96)	4.37 (4.00-4.72)	5.01 (4.56-5.40)	5.63 (5.10-6.07)	6.27 (5.64-6.76)	7.10 (6.33-7.68)	7.85 (6.93-8.51)
3-hr	2.23 (2.06-2.42)	2.66 (2.45-2.91)	3.30 (3.03-3.59)	3.97 (3.64-4.33)	4.79 (4.37-5.21)	5.55 (5.02-6.03)	6.31 (5.66-6.84)	7.10 (6.33-7.71)	8.19 (7.20-8.91)	9.18 (7.98-10.0)
6-hr	2.66 (2.44-2.91)	3.19 (2.91-3.49)	3.94 (3.60-4.32)	4.75 (4.33-5.20)	5.76 (5.21-6.30)	6.69 (6.01-7.31)	7.61 (6.79-8.32)	8.62 (7.62-9.40)	9.97 (8.71-10.9)	11.2 (9.69-12.3)
12-hr	3.11 (2.84-3.44)	3.72 (3.39-4.11)	4.63 (4.21-5.12)	5.62 (5.10-6.20)	6.85 (6.17-7.54)	8.00 (7.15-8.78)	9.17 (8.12-10.0)	10.4 (9.15-11.4)	12.2 (10.5-13.4)	13.8 (11.8-15.2)
24-hr	3.64 (3.33-3.99)	4.42 (4.06-4.85)	5.71 (5.22-6.26)	6.77 (6.17-7.41)	8.28 (7.50-9.05)	9.53 (8.59-10.4)	10.9 (9.74-11.9)	12.3 (11.0-13.5)	14.4 (12.7-15.8)	16.1 (14.1-17.7)
2-day	4.30 (3.94-4.70)	5.21 (4.78-5.70)	6.66 (6.10-7.27)	7.85 (7.18-8.57)	9.56 (8.66-10.4)	11.0 (9.90-12.0)	12.5 (11.2-13.6)	14.1 (12.6-15.4)	16.4 (14.5-18.1)	18.3 (16.0-20.2)
3-day	4.55 (4.18-4.98)	5.50 (5.06-6.03)	7.00 (6.41-7.65)	8.21 (7.50-8.97)	9.93 (9.03-10.8)	11.3 (10.3-12.4)	12.9 (11.6-14.1)	14.5 (12.9-15.8)	16.7 (14.8-18.4)	18.6 (16.4-20.5)
4-day	4.81 (4.42-5.27)	5.80 (5.33-6.36)	7.33 (6.72-8.02)	8.57 (7.83-9.37)	10.3 (9.37-11.3)	11.7 (10.6-12.8)	13.2 (11.9-14.5)	14.8 (13.3-16.2)	17.1 (15.2-18.8)	18.9 (16.7-20.9)
7-day	5.61 (5.19-6.10)	6.76 (6.25-7.35)	8.44 (7.78-9.16)	9.78 (9.00-10.6)	11.6 (10.7-12.6)	13.1 (12.0-14.2)	14.7 (13.3-16.0)	16.3 (14.8-17.8)	18.6 (16.7-20.3)	20.5 (18.3-22.4)
10-day	6.36 (5.91-6.87)	7.63 (7.08-8.23)	9.36 (8.68-10.1)	10.7 (9.91-11.5)	12.5 (11.6-13.5)	14.0 (12.9-15.1)	15.5 (14.2-16.7)	17.0 (15.5-18.4)	19.1 (17.3-20.7)	20.9 (18.8-22.6)
20-day	8.60 (8.05-9.20)	10.2 (9.59-11.0)	12.4 (11.6-13.2)	14.0 (13.1-15.0)	16.3 (15.2-17.4)	18.0 (16.7-19.3)	19.8 (18.3-21.2)	21.7 (20.0-23.2)	24.2 (22.1-26.0)	26.2 (23.8-28.2)
30-day	10.6 (9.98-11.2)	12.6 (11.8-13.3)	14.9 (14.0-15.8)	16.7 (15.7-17.7)	19.0 (17.8-20.1)	20.8 (19.5-22.1)	22.6 (21.1-24.0)	24.4 (22.7-26.0)	26.9 (24.8-28.6)	28.8 (26.5-30.7)
45-day	13.4 (12.7-14.2)	15.8 (15.0-16.8)	18.5 (17.5-19.6)	20.5 (19.3-21.7)	23.1 (21.8-24.5)	25.1 (23.6-26.8)	27.1 (25.4-28.7)	29.0 (27.1-30.9)	31.6 (29.4-33.7)	33.6 (31.1-35.9)
60-day	16.0 (15.1-16.9)	18.8 (17.8-19.9)	21.8 (20.6-23.0)	24.1 (22.7-25.4)	26.9 (25.3-28.4)	29.1 (27.3-30.7)	31.2 (29.3-33.0)	33.3 (31.1-35.3)	36.0 (33.6-38.3)	38.1 (35.4-40.6)

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

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

Please refer to NOAA Atlas 14 document for more information.

Table 2. Manning's n Values for Open Channels
(from Chow, 1959)

Type of channel and description	Minimum	Normal	Maximum
B. LINED OR BUILT-UP CHANNELS			
B-1. Metal			
a. Smooth steel surface			
1. Unpainted	0.011	0.012	0.014
2. Painted	0.012	0.013	0.017
b. Corrugated	0.021	0.025	0.030
B-2. Nonmetal			
e. Gravel bottom with sides of			
1. Formed concrete	0.017	0.020	0.025
2. Random stone in mortar	0.020	0.023	0.026
3. Dry rubble or riprap	0.023	0.033	0.036
C. EXCAVATED OR DREDGED			
a. Earth, straight and uniform			
1. Clean, recently completed	0.016	0.018	0.020
2. Clean, after weathering	0.018	0.022	0.025
3. Gravel, uniform section, clean	0.022	0.025	0.030
4. With short grass, few weeds	0.022	0.027	0.033
b. Earth, winding and sluggish			
1. No vegetation	0.023	0.025	0.030
2. Grass, some weeds	0.025	0.030	0.033
3. Dense weeds or aquatic plants in deep channels	0.030	0.035	0.040
4. Earth bottom and rubble sides	0.028	0.030	0.035
5. Stony bottom and weedy banks	0.025	0.035	0.040
6. Cobble bottom and clean sides	0.030	0.040	0.050

Table 3. Riprap Classes and Apron Dimensions (from FHWA, 2006)

Class	D_{50} (mm)	D_{50} (in)	Apron Length[1]	Apron Depth
1	125	5	4D	$3.5D_{50}$
2	150	6	4D	$3.3D_{50}$
3	250	10	5D	$2.4D_{50}$
4	350	14	6D	$2.2D_{50}$
5	500	20	7D	$2.0D_{50}$
6	550	22	8D	$2.0D_{50}$

[1]D is the culvert rise.

Table 4. Hydrologic Soil Groups for On-Site Soils (from USDA, 2026)

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
10	Leon sand, 0 to 2 percent slopes	A/D	144.4	3.2%
12A	Yauhannah loamy fine sand, 0 to 2 percent slopes	B/D	742.5	16.3%
13	Bladen loam, 0 to 2 percent slopes	C/D	367.9	8.1%
18	Cape Fear loam	C/D	15.1	0.3%
20	Centenary fine sand	A	226.5	5.0%
24B	Chisolm sand, 0 to 4 percent slopes	A	55.0	1.2%
25A	Wakulla sand, 0 to 2 percent slopes	A	48.8	1.1%
26A	Eulonia loamy fine sand, 0 to 2 percent slopes	C/D	555.6	12.2%
27	Rutlege sand	A/D	109.4	2.4%
28	Echaw sand	A	388.0	8.5%
33	Hobonny muck	A/D	89.0	2.0%
34	Johnston loam	A/D	83.4	1.8%
50	Lynn Haven sand	A/D	36.2	0.8%
54A	Chipley fine sand, 0 to 2 percent slopes	A	2.4	0.1%
55	Witherbee fine sand	A/D	461.7	10.1%
57	Grifton loamy fine sand	B/D	45.3	1.0%
58	Udorthents, loamy	B/D	399.6	8.8%
59	Wahee fine sandy loam	C/D	510.6	11.2%
61	Yemassee loamy fine sand	B/D	81.9	1.8%
W	Water		191.5	4.2%
Totals for Area of Interest			**4,554.7**	**100.0%**

Table 5. ClosureTurf® Hydrology Parameters (from WatershedGeo, 2019)

ClosureTurf® Hydrology		
	TR-55 Data	
	Curve Number Depends on Rain Intensity	92[1] - 95
Sheet Flow	Manning's n	0.11
	Flow Length	100'
	2yr-24hr Rain	SCS
	Land Slope	design
	Flow Length	design
	Slope	design
Shallow Concentrated Flow	Surface (paved/unpaved)	Unpaved
	X-Sect Area	ft²
	Wetted Perimeter	Linear Feet
	Channel Slope	ft/ft
Channel Flow	Manning's n	0.02 - HydroBinder; 0.03 - Sand Infill
	Flow Length	design
	Flow Length	design

1. CN ranging from 92 in High Intensity Rainfalls to 95 in normal rainfall events.

Table 6. Design Parameter Summary for Drainage Terraces

Drainage Feature	Channel Shape	Longitudinal Channel Slope (%)	Manning's n	Bottom Width (ft)	Depth (ft)	Left Side Slope (H:V)	Right Side Slope (H:V)	25-year Flow Rate Q_{25} (cfs)	100-year Flow Rate Q_{100} (cfs)
Sideslope	V-shaped	2.0	0.036	6	1.5	2:1	2:1	21.6	28.6
Top Deck	V-shaped	0.50	0.036	0.0	1.5	20:1	3:1	9.51	12.58
Access Road	V-shaped	8.00	0.036	0.0	1.5	3:1	2:1	15.7	20.8

Table 7. Design Parameter Summary for Downdrain Pipe Features

Downdrain Feature[1]	No. of Pipes	Pipe Dimensions			25-year	100-year
		Pipe Diameter (ft)	Minimum Pipe Slope (%)	Manning's Roughness n	Peak Flow (cfs)	Peak Flow (cfs)
2A1	3	1.5	4.0	0.009	56.1	74.2
2A2	2	1.5	4.0	0.009	24.8	32.8
2C1	5	1.5	4.0	0.009	100.5	133.0
2E1	3	1.5	4.0	0.009	51.0	67.5
2F1	5	1.5	4.0	0.009	95.2	126.0
2F2	6	1.5	4.0	0.009	117.4	155.4

Note:

1. The downdrain pipe feature consists of multiple downdrain pipes with varying lengths.

Table 8. Typical Permissible Shear Stresses for Bare Soil and Stone Linings (FHWA, 2005)

		Permissible Shear Stress	
Lining Category	Lining Type	N/m^2	lb/ft^2
Bare Soil[1] Cohesive (PI = 10)	Clayey sands	1.8-4.5	0.037-0.095
	Inorganic silts	1.1-4.0	0.027-0.11
	Silty sands	1.1-3.4	0.024-0.072
Bare Soil[1] Cohesive (PI ≥ 20)	Clayey sands	4.5	0.094
	Inorganic silts	4.0	0.083
	Silty sands	3.5	0.072
	Inorganic clays	6.6	0.14
Bare Soil[2] Non-cohesive (PI < 10)	Finer than coarse sand D_{75}<1.3 mm (0.05 in)	1.0	0.02
	Fine gravel D_{75}=7.5 mm (0.3 in)	5.6	0.12
	Gravel D_{75}=15 mm (0.6 in)	11	0.24
Gravel Mulch[3]	Coarse gravel D_{50} = 25 mm (1 in)	19	0.4
	Very coarse gravel D_{50} = 50 mm (2 in)	38	0.8
Rock Riprap[3]	D_{50} = 0.15 m (0.5 ft)	113	2.4
	D_{50} = 0.30 m (1.0 ft)	227	4.8

[1]Based on Equation 4.6 assuming a soil void ratio of 0.5 (USDA, 1987).
[2]Based on Equation 4.5 derived from USDA (1987)
[3]Based on Equation 6.7 with Shield's parameter equal to 0.047.

Table 9. Maximum Velocities for Vegetative Channel Linings (from Georgetown County, 2006)

Vegetation Type	Slope Range (%)[1]	Maximum Velocity[2] (ft/s)
Bermuda Grass	0 - 5	6
	5 - 10	5
Bahia	All	4
Tall Fescue Grass	0 - 10	4
Mixtures[3]		
Kentucky Bluegrass	0 - 5	5
Buffalo Grass	5 - 10	4
	>10	3
Grass Mixture	0 - 5[1]	4
	5 - 10	3
Sericea Lespedeza,	0 - 5[4]	2.5
Weeping Lovegrass, Alfalfa	All	
Annuals[5]	0 - 5	2.5
Sod	All	4
Lapped Sod	All	5.5

[1] Do not use on slopes steeper than 10 percent except for side-slope in combination channels.
[2] Use velocities exceeding 5 feet per second only where good stands can be established and maintained.
[3] Mixtures of Tall Fescue, Bahia, and/or Bermuda.
[4] Do not use on slopes steeper than 5 percent except for side-slope in combination channels.
[5] Annuals - used on mild slopes or as temporary protection until permanent covers are established.

Table 10. Design Parameter Summary for Perimeter Drainage Reaches

Perimeter Reach	Shape	Longitudinal Slope (ft/ft)	Manning's n	Bottom Width (ft)	Diameter (in)	Depth (ft)	Side Slopes (H:V)	Lining	25-year Flow Rate Q_{25} (cfs)	100-year Flow Rate Q_{100} (cfs)
Perimeter Reach 2A1	Trapezoid	0.005	0.027	3.0	-	3.0	3:1	Vegetation	107.8	142.9
Perimeter Reach 2A2	Trapezoid	0.005	0.027	3.0	-	3.0	3:1	Vegetation	28.0	37.0
Perimeter Reach 2BA	Trapezoid	0.005	0.027	3.0	-	3.0	3:1	Vegetation	17.6	23.3
Perimeter Reach 2BB	Trapezoid	0.005	0.027	3.0	-	3.0	3:1	Vegetation	42.2	55.9
Perimeter Reach 2C1	Trapezoid	0.005	0.027	3.0	-	3.0	3:1	Vegetation	120.4	159.6
Perimeter Reach 2DA	Trapezoid	0.005	0.027	3.0	-	3.0	3:1	Vegetation	28.1	37.1

Table 11. Manning's n Values for Closed Conduits
(from Chow, 1959)

Type of channel and description	Minimum	Normal	Maximum
A-2. Nonmetal			
a. Lucite	0.008	0.009	0.010
b. Glass	0.009	0.010	0.013
c. Cement			
1. Neat, surface	0.010	0.011	0.013
2. Mortar	0.011	0.013	0.015
d. Concrete			
1. Culvert, straight and free of debris	0.010	0.011	0.013
2. Culvert with bends, connections, and some debris	0.011	0.013	0.014
3. Finished	0.011	0.012	0.014
4. Sewer with manholes, inlet, etc., straight	0.013	0.015	0.017
5. Unfinished, steel form	0.012	0.013	0.014
6. Unfinished, smooth wood form	0.012	0.014	0.016
7. Unfinished, rough wood form	0.015	0.017	0.020
e. Wood			
1. Stave	0.010	0.012	0.014
2. Laminated, treated	0.015	0.017	0.020
f. Clay			
1. Common drainage tile	0.011	0.013	0.017
2. Vitrified sewer	0.011	0.014	0.017
3. Vitrified sewer with manholes, inlet, etc.	0.013	0.015	0.017
4. Vitrified subdrain with open joint	0.014	0.016	0.018
g. Brickwork			
1. Glazed	0.011	0.013	0.015
2. Lined with cement mortar	0.012	0.015	0.017
h. Sanitary sewers coated with sewage slimes, with bends and connections	0.012	0.013	0.016
i. Paved invert, sewer, smooth bottom	0.016	0.019	0.020
j. Rubble masonry, cemented	0.018	0.025	0.030

Table 12. Allowable Velocity and Shear Stress for Selected Lining Materials (from USDA, 2007)

Boundary category	Boundary type	Allowable velocity (ft/s)	Allowable shear stress (lb/ft^2)
Temporary degradable reinforced erosion control products (RECP)	Jute net	1–2.5	0.45
	Straw with net	1–3	1.5–1.65
	Coconut fiber with net	3–4	2.25
	Fiberglass roving	2.5–7	2
Nondegradable RECP	Unvegetated	5–7	3
	Partially established	7.5–15	4–6
	Fully vegetated	8–21	8
Hard surface	Gabions	1–19	10
	Concrete	>18	12.5

Table 13. Design Parameter Summary for Roadway Culverts

Culvert Designation	25-year Flow Rate Q_{25} (cfs)	100-year Flow Rate Q_{100} (cfs)	Approx. Length (ft)	Slope (%)	Description	Inlet Elevation (ft)	Outlet Elevation (ft)	Roadway Elevation (ft)
Culvert 2BA	17.6	23.3	112	0.50	1 - 2-ft Diameter RCP	32.39	31.83	38.84
Culvert 2BB	13.6	18.0	107	5.61	1 - 2-ft Diameter RCP	39.00	33.00	42.24
Culvert 2BC	42.2	55.9	109	2.30	2 - 2.5-ft Diameter RCP	23.50	21.00	27.48
Culvert 2C	120.2	159.5	108	0.50	1 - 3.5-ft Diameter RCP	26.95	26.41	40.72
Culvert 2D	28.0	37.1	108	0.50	1 - 2-ft Diameter RCP	26.99	26.45	40.92

Table 14. Design Parameter and Results Summary for Riprap Aprons

Riprap Apron Feature	25-year Flow Rate Q_{25} (cfs)	Number of Barrels	Culvert Diameter (ft)	Median Riprap Size (in)	Riprap Class	Apron Depth (ft)	Apron Length (ft)
Culvert 2BA	17.6	1	2.0	5.4	1	1.6	8.0
Culvert 2BB	13.6	1	2.0	3.8	1	1.1	8.0
Culvert 2BC	42.2	2	2.5	4.1	1	1.2	10.0
Culvert 2C	120.2	1	3.5	18.9	5	3.2	24.5
Culvert 2D	28.0	1	2.0	10.0	3	2.0	10.0
2E1	51.0	3	1.5	10.1	3	2.0	7.5
2F1	95.2	5	1.5	11.7	4	2.1	9.0
2F2	117.4	6	1.5	12.1	4	2.2	9.0

Note: See Table 3 for the riprap size associated with each Riprap Class.

Table 15. Summary of Peak Flow Rates and Total Run-off Volumes at Landfill Outfall Locations

Outfall	Design Storm	Peak Flow (cfs)	Total Run-off (ac-ft)
2A	25-year	107.8	9.9
	100-year	107.8	13.2
2B	25-year	42.2	3.8
	100-year	42.2	5.1
2C	25-year	120.2	11.2
	100-year	120.2	15.0
2D	25-year	28.0	2.5
	100-year	28.0	3.3
2E	25-year	59.0	5.2
	100-year	59.0	6.9
2F	25-year	226.6	20.6
	100-year	226.6	27.7

Table 16. Summary of Calculated Results for Drainage Terraces

	25-year, 24-hour Design Event				100-year, 24-hour Design Event				
Drainage Feature	**Flow Rate Q_{25} (cfs)**	**Depth of Flow (ft)**	**Average Velocity (ft/s)**	**Average Tractive Stress (psf)**	**Flow Rate Q_{100} (cfs)**	**Depth of Flow (ft)**	**Average Velocity (ft/s)**	**Average Tractive Stress (psf)**	**Channel Lining**
Sideslope	21.6	0.72	4.06	0.72	28.6	0.84	4.44	0.82	Riprap
Top Deck	9.51	0.74	1.50	0.11	12.58	0.82	1.61	0.13	Riprap
Access Road 2A2A	15.7	0.96	6.81	2.22	20.8	1.07	7.31	2.46	Riprap
Access Road 2BB	13.6	0.91	6.57	2.10	18.0	1.01	7.05	2.33	Riprap

Table 17. Summary of Calculated Results for Downdrain Pipe Features

Drainage Feature[1]	25-year Flow Rate Q_{25} (cfs)	Depth of Flow (ft)	Average Velocity (ft/s)	100-year Flow Rate Q_{100} (cfs)	Depth of Flow (ft)	Average Velocity (ft/s)	No. of Pipes
2A1	56.1	0.9	18.1	74.2	1.03	19.2	3
2A2	24.8	0.7	16.3	32.8	0.78	17.5	2
2C1	100.5	0.9	18.4	133.0	1.09	19.4	5
2E1	51.0	0.8	17.7	67.5	0.96	18.8	3
2F1	95.2	0.9	18.2	126.0	1.04	19.3	5
2F2	117.4	0.9	18.3	155.4	1.06	19.3	6

Note:

1. "Drainage feature" refers to each downdrain location/designation, as shown on the surface water management system design drawings presented in the set of Engineering Drawings that accompanies the Engineering Report.

Table 18. Distribution of Downdrain Pipes at each Sideslope Drainage Terrace Location

Drainage Feature[1]	No. of Pipes	Number of Pipes Required at Sideslope Drainage Terraces (SSDTs)					
		SSDT 1	SSDT 2	SSDT 3	SSDT 4	SSDT 5	SSDT 6
2A1	3	3	2	1	1	1	N/A
2A2	2	2	1	1	N/A	N/A	N/A
2C1	5	5	4	3	2	1	1
2E1	3	3	2	1	1	1	N/A
2F1	5	5	4	3	2	2	1
2F2	6	6	5	4	3	2	1

Note:

1. "Drainage feature" refers to each downdrain location/designation, as shown on the surface water management system design drawings presented in the set of Engineering Drawings that accompanies the Engineering Report. The SSDTs at each downdrain location are numbered starting with "1" being the lowest drainage terrace, and in ascending order going up the slope. "N/A" (not applicable) means that SSDT number does not exist at that specific downdrain location.

Table 19. Perimeter Drainage Reach Capacity Calculation Results

Drainage Channel Reach	25-year, 24-hour Design Event				100-year, 24-hour Design Event			
	Peak Flow (cfs)	Peak Depth (ft)	Peak Velocity (ft/s)	Tractive Stress (psf)	Peak Flow (cfs)	Peak Depth (ft)	Peak Velocity (ft/s)	Tractive Stress (psf)
Perimeter Reach 2A1	107.8	2.32	4.66	0.41	142.9	2.62	5.01	0.45
Perimeter Reach 2A2	28.0	1.25	3.29	0.24	37.0	1.43	3.54	0.27
Perimeter Reach 2BA	17.6	1.00	2.91	0.20	23.3	1.15	3.14	0.22
Perimeter Reach 2BB	42.2	1.52	3.67	0.28	55.9	1.73	3.94	0.32
Perimeter Reach 2C1	120.4	2.43	4.80	0.43	159.6	2.75	5.15	0.47
Perimeter Reach 2DA	28.1	1.25	3.29	0.24	37.1	1.43	3.55	0.27

Table 20. Roadway Culvert Capacity Analysis Results

	25-year, 24-hour storm event				100-year, 24-hour storm event		
Culvert	**Peak Flow Rate (cfs)**	**Pipe Velocity (fps)**	**Headwater Elev (ft)**	**25-year Freeboard (ft)**	**Peak Flow Rate (cfs)**	**Pipe Velocity (fps)**	**Headwater Elev (ft)**
Culvert 2BA	17.6	6.92	34.98	3.86	23.3	8.13	35.97
Culvert 2BB	13.6	15.13	41.04	1.20	18.0	14.9	41.59
Culvert 2BC	42.2	11.84	25.88	1.60	55.9	11.09	26.45
Culvert 2C	120.2	12.9	35.47	5.25	159.5	16.58	40.40
Culvert 2D	28.0	9.3	31.63	9.29	37.1	11.91	34.14

FIGURES

Figure 1. Landfill Area 2 Drainage Plan

Figure 2. Bend Loss Coefficient (from UDFCD, 2001)

Figure 3. Typical Geometry of Riprap Aprons at Culverts (from FHWA, 2006)

Figure 4. NRCS Rainfall Distributions (from USDA, 1986)

Figure 5. Soil Survey Map (from USDA, 2026)

Figure 6. Manning's n for HDPE (from Barfuss and Tullis, 1989)

Figure 7. HEC-HMS Nodal Network

Figure 8. Landfill Area 2 Drainage Plan with Critical Terrace Areas



Figure 1. Landfill Area 2 Drainage Plan

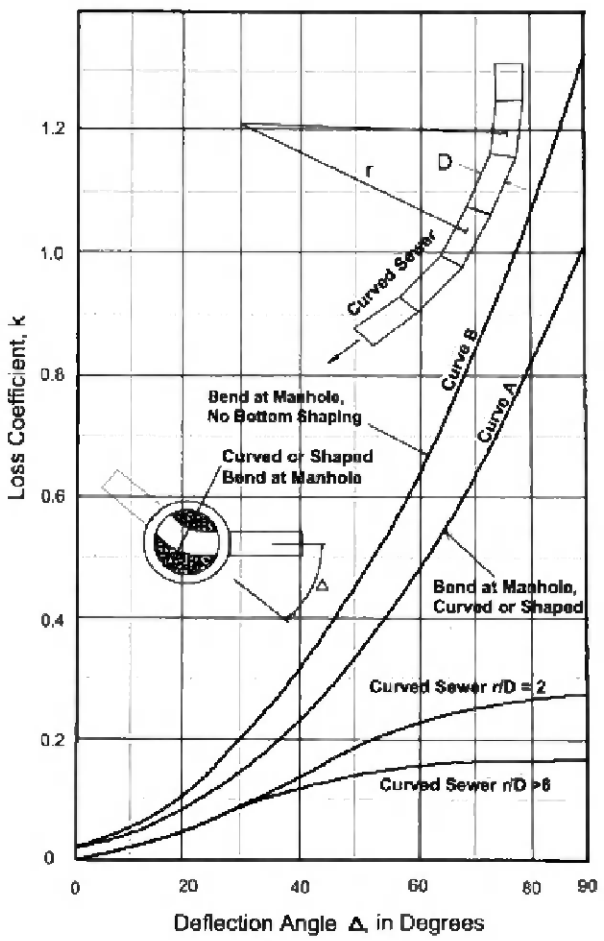


Figure 2. Bend Loss Coefficient (from UDFCD, 2001)

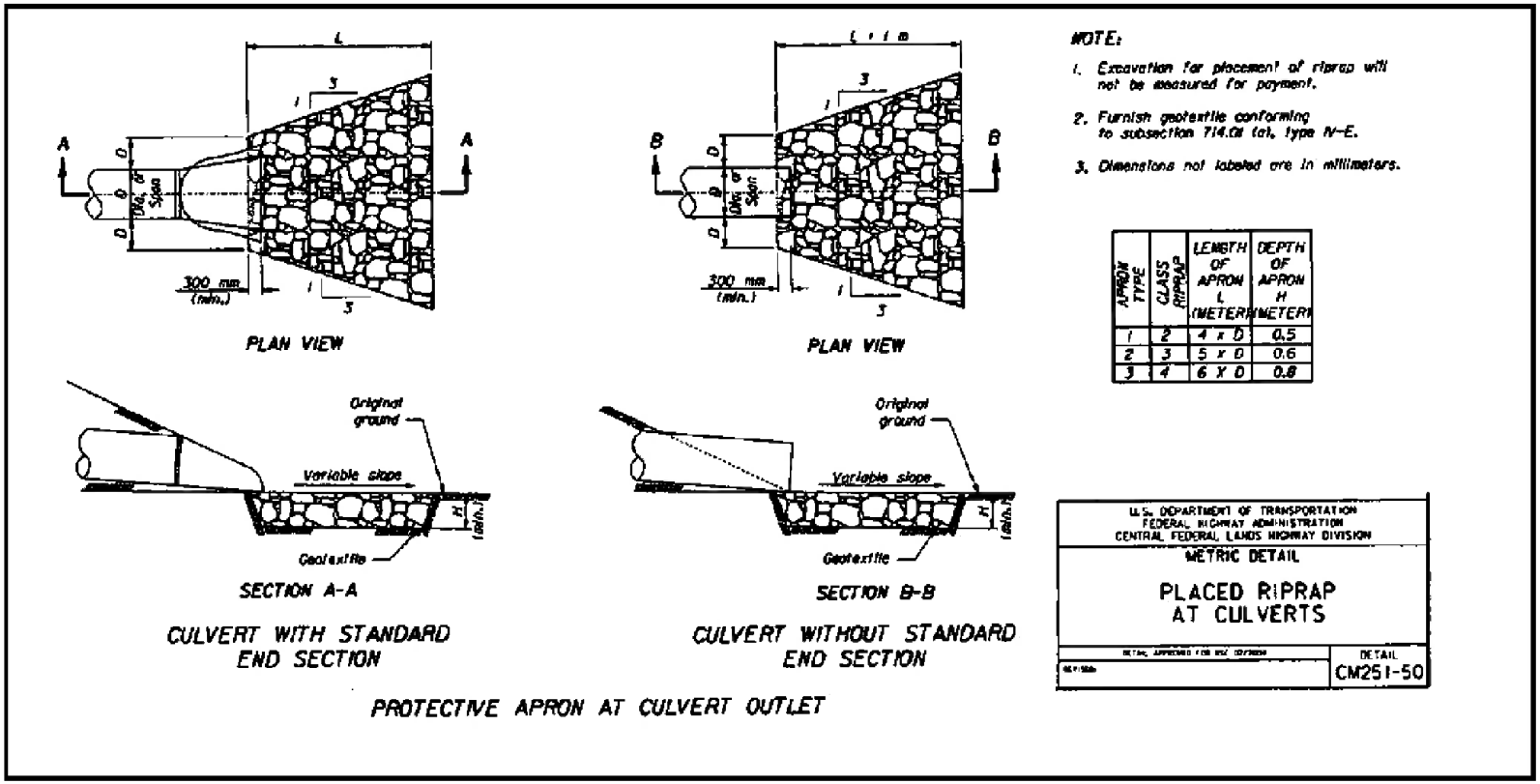


Figure 3. Typical Geometry of Riprap Aprons at Culverts

(from FHWA, 2006)

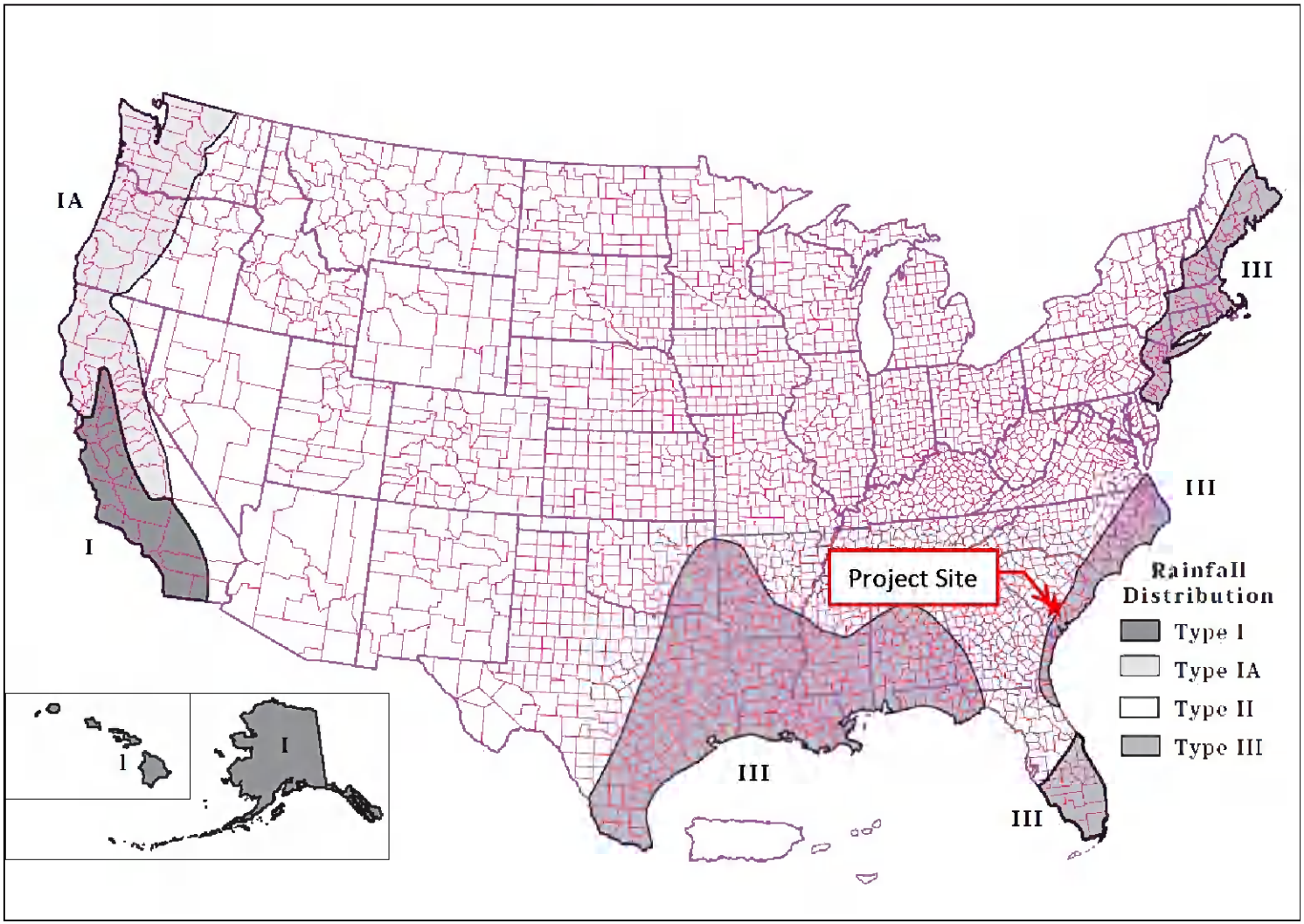


Figure 4. NRCS Rainfall Distributions (from USDA, 1986)

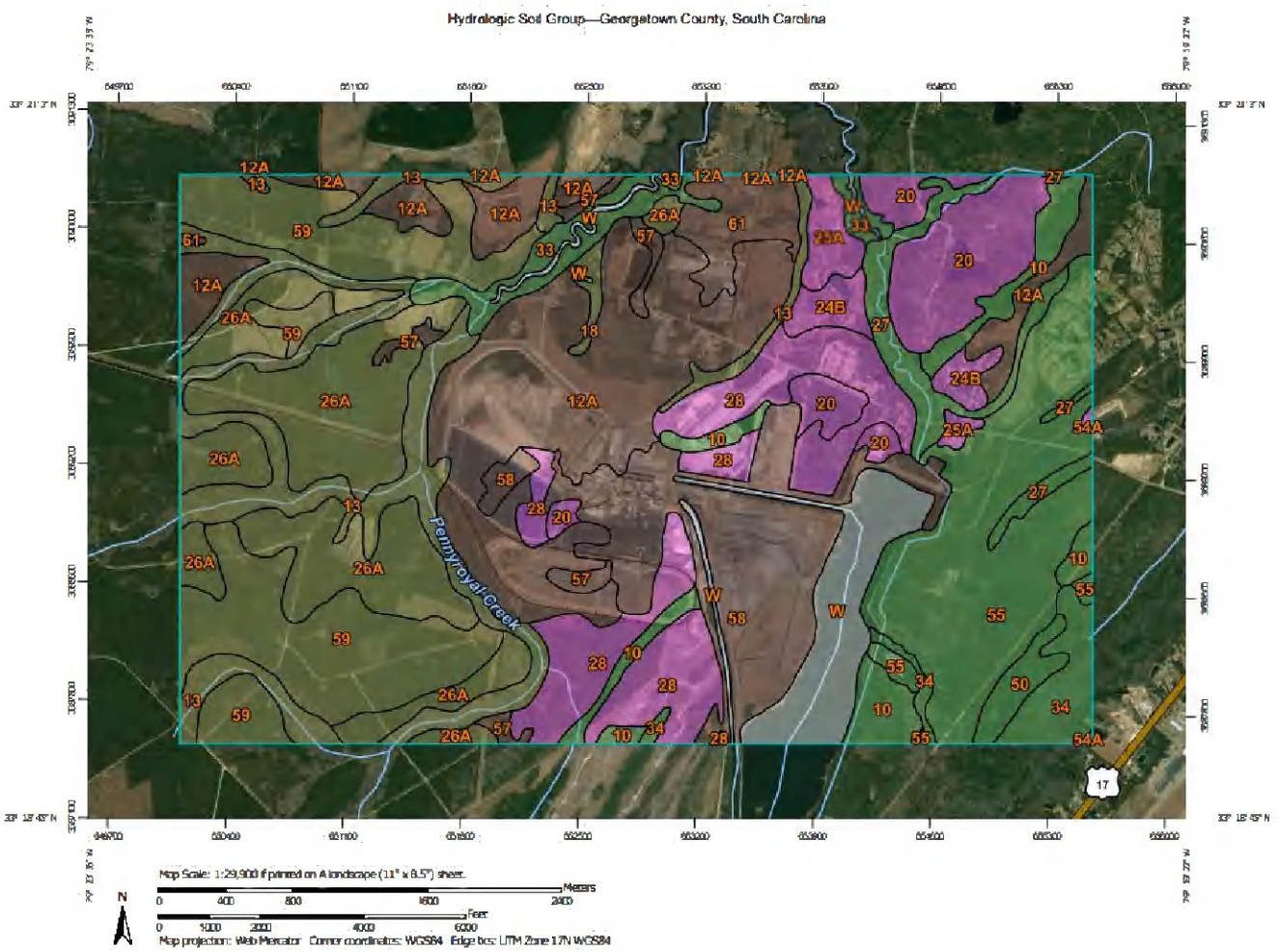


Figure 5. Soil Survey Map (from USDA, 2026)

Note: This map is provided for informational purposes only, but does not affect the analyses, which are based on the non-soil (ClosureTurf®) ground surface for this alternative final cover system option.

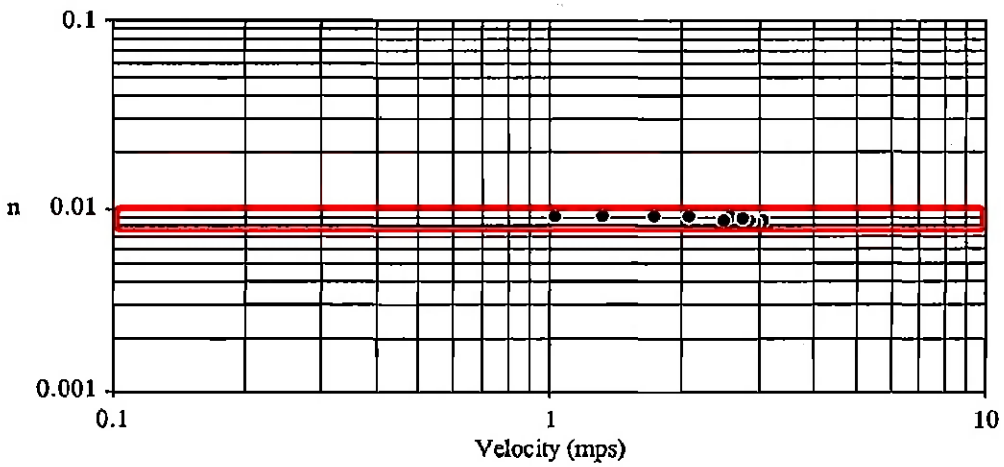


Figure 6. Manning's n for HDPE

(from Barfuss and Tullis, 1989)

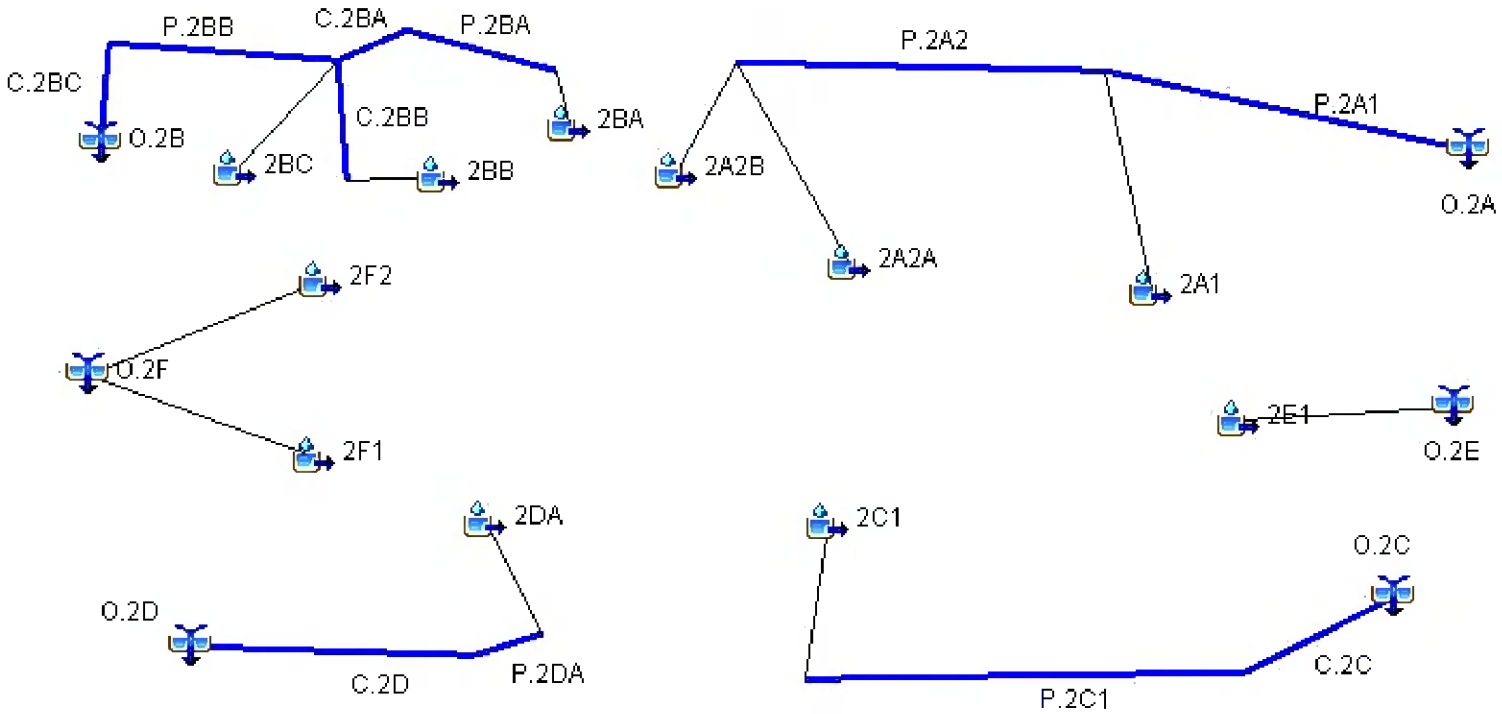


Figure 7. HEC-HMS Nodal Network

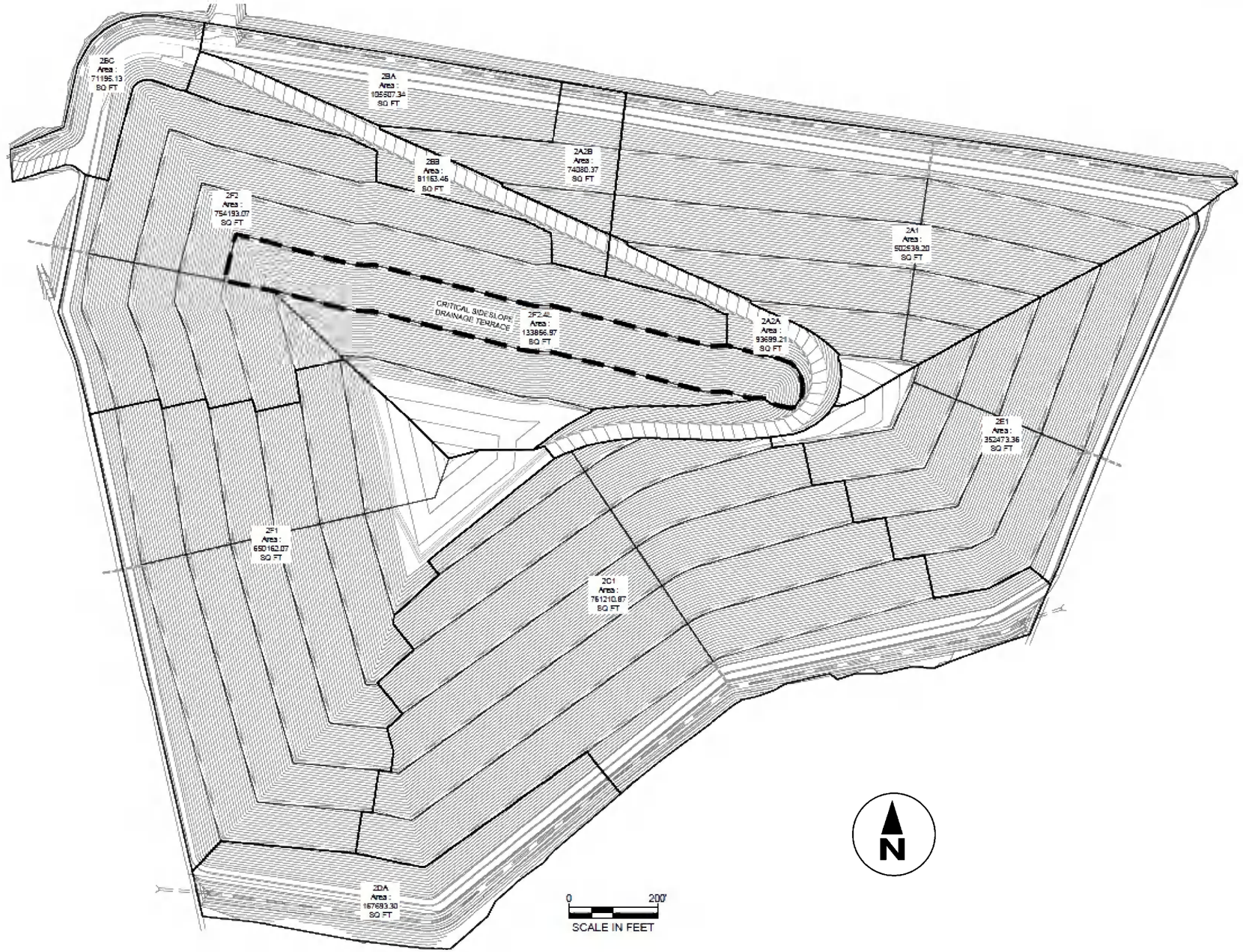


Figure 8. Landfill Area 2 Drainage Plan with Critical Terrace Areas

APPENDIX 1
HEC-HMS HYDROLOGIC MODEL PARAMETERS

Table 1-1. HEC-HMS Basin Input Parameters for Kinematic Wave Model

POST-DEVELOPMENT CONDITIONS			Watershed Characterization			Sheet Flow				Open Channel Flow - Top Deck or Side Slope Drainage Terrace								
Subcatchment Designation	Area A (mi^2)	Area A (acres)	Initial Abstraction (in)	Curve Number	Impervious Cover (%)	Flow Length (ft)	Manning's n	Slope (ft/ft)	Time T_t (min)	Flow Length (ft)	Depth d (ft)	Area A (ft^2)	Wetted P (ft)	Hydraulic Radius (ft)	Manning's n	Slope (ft/ft)	Velocity (ft/s)	Time T_t (min)
2A1	0.01803	11.54	0.11	95	0.00	126	0.11	0.05	5.42	80	1.0	4.00	8.26	0.48	0.036	0.020	3.61	0.37
2A2A	0.00336	2.15	0.11	95	0.00	34	0.11	0.02	2.74	1233	1.0	2.50	5.40	0.46	0.036	0.080	7.01	2.93
2A2B	0.00266	1.70	0.11	95	0.00	89	0.11	0.33	1.92	230	1.0	4.00	8.26	0.48	0.036	0.020	3.61	1.06
2BA	0.00378	2.42	0.11	95	0.00	163	0.11	0.33	3.12	0	1.0	4.00	8.26	0.48	0.036	0.020	3.61	0.00
2BB	0.00291	1.86	0.11	95	0.00	34	0.11	0.02	2.74	997	1.0	2.50	5.40	0.46	0.036	0.080	7.01	2.37
2BC	0.00255	1.63	0.11	95	0.00	92	0.11	0.33	5.71	0	1.0	4.00	8.26	0.48	0.036	0.020	3.61	0.00
2C1	0.02730	17.47	0.11	95	0.00	93	0.11	0.33	1.99	937	1.0	4.00	8.26	0.48	0.036	0.020	3.61	4.33
2DA	0.00602	3.85	0.11	95	0.00	84	0.11	0.33	1.84	0	1.0	4.00	8.26	0.48	0.036	0.020	3.61	0.00
2E1	0.01264	8.09	0.11	95	0.00	118	0.11	0.05	5.15	73	1.0	4.00	8.26	0.48	0.036	0.020	3.61	0.34
2F1	0.02332	14.93	0.11	95	0.00	121	0.11	0.05	5.25	305	1.0	4.00	8.26	0.48	0.036	0.005	1.80	2.82
2F2	0.02705	17.31	0.11	95	0.00	161	0.11	0.05	6.60	264	1.0	4.00	8.26	0.48	0.036	0.020	3.61	1.22

2-year, 24-hour Design Rainfall Depth = 4.42 inches

inage Terrace Left Side Slope =	20.0	H:V
Top Deck Drainage Terrace Right Side Slope =	3.0	H:V
Side Slope Drainage Terrace Left Side Slope =	5.0	H:V
Side Slope Drainage Terrace Right Side Slope =	3.0	H:V
Access Road Drainage Terrace Left Side Slope =	2.0	H:V
Access Road Drainage Terrace Right Side Slope =	3.0	H:V

Notes:

1) *Curve number = 95 represents ClosureTurf® (WatershedGeo, 2019).*
2) *Manning's roughness coefficient: n = 0.11 represents sheet flow for ClosureTurf® (WatershedGeo, 2019).*
3) *Manning's roughness coefficient: n = 0.027 represents an excavated earth channel that is straight and uniform with short grass and few weeds (Chow, 1959).*
4) *Manning's roughness coefficient: n = 0.009 represents HDPE (Barfuss, 1989).*
5) *Travel Time (T_t) is calculated using Manning's kinematic solutions for sheet flow (USDA, 1986).*

$$T_t = 0.007(nL)^{0.8} / (P_{2\text{-}24})^{0.5} S^{0.4}$$

6) *Open channel flow velocity is calculated using Manning's equation (USDA, 1986).*

$V = (1.49 r^{2/3} S^{1/2}) / n$ where: r = hydraulic radius (ft) and is equal to A/P [area (ft^2)/wetted perimeter (ft)]

7) *Design rainfall depth taken from NOAA Atlas 14, Volume 2, Version 3 for Georgetown, South Carolina.*

Table 1-1 (Continued). HEC-HMS Basin Input Parameters for Kinematic Wave Model

Down Drain Pipe Flow								Open Channel Flow - Perimeter Channel											
Flow Length (ft)	Area A (ft^2)	Wetted P (ft)	Hydraulic Radius (ft)	Manning's n	Slope (ft/ft)	Velocity (ft/s)	Time T_t (min)	Flow Length (ft)	Depth d (ft)	Area A (ft^2)	Wetted P (ft)	Hydraulic Radius (ft)	Manning's n	Slope (ft/ft)	Velocity (ft/s)	Time T_t (min)	Design T_c (min)	SCS Lag Time (min)	HMS 25-yr Flow (cfs)	HMS 100-yr Flow (cfs)
498	1.77	4.71	0.38	0.009	0.333	49.71	0.17	680	2.0	18.00	15.65	1.15	0.027	0.0050	4.28	2.65	8.61	5.16	80.42	106.46
0	1.77	4.71	0.38	0.009	0.333	49.71	0.00	0	2.0	18.00	15.65	1.15	0.027	0.0050	4.28	0.00	6.00	3.60	15.68	20.75
156	1.77	4.71	0.38	0.009	0.333	49.71	0.05	0	2.0	18.00	15.65	1.15	0.027	0.0050	4.28	0.00	6.00	3.60	12.41	16.43
0	1.77	4.71	0.38	0.009	0.333	49.71	0.00	423	2.0	18.00	15.65	1.15	0.027	0.0050	4.28	1.65	6.00	3.60	17.64	23.34
95	1.77	4.71	0.38	0.009	0.050	19.25	0.08	0	2.0	18.00	15.65	1.15	0.027	0.0050	4.28	0.00	6.00	3.60	13.58	17.97
0	1.77	4.71	0.38	0.009	0.333	49.71	0.00	729	2.0	18.00	15.65	1.15	0.027	0.0050	4.28	2.84	8.55	5.13	11.39	15.07
85	1.77	4.71	0.38	0.009	0.333	49.71	0.03	646	2.0	18.00	15.65	1.15	0.027	0.0050	4.28	2.51	8.86	5.32	121.04	160.22
0	1.77	4.71	0.38	0.009	0.333	49.71	0.00	981	2.0	18.00	15.65	1.15	0.027	0.0050	4.28	3.82	6.00	3.60	28.09	37.18
504	1.77	4.71	0.38	0.009	0.333	49.71	0.17	0	2.0	18.00	15.65	1.15	0.027	0.0050	4.28	0.00	6.00	3.60	58.98	78.06
668	1.77	4.71	0.38	0.009	0.333	49.71	0.22	0	2.0	18.00	15.65	1.15	0.027	0.0050	4.28	0.00	8.29	4.98	104.67	138.54
745	1.77	4.71	0.38	0.009	0.333	49.71	0.25	0	2.0	18.00	15.65	1.15	0.027	0.0050	4.28	0.00	8.07	4.84	121.94	161.40

Diameter= 1.5 ft

Perimeter Channel Left Side Slope = 3.0 H:V

Perimeter Channel Right Side Slope = 3.0 H:V

Perimeter Channel Base Width = 3.00 ft

Table 1-2. 25-year, 24-hour Precipitation Event Nodal Areas, Peak Flow Rates, and Run-off Volumes for Landfill Area 2

Global Summary Results for Run "Permit_Mod_25YR"

Project: Winyah_2020 Simulation Run: Permit_Mod_25YR

Start of Run: 01Jan2016, 00:00 Basin Model: Permit_Mod_Landfill Areas
End of Run: 05Feb2016, 00:00 Meteorologic Model: 25-Year_2016
Compute Time: 22Apr2020, 11:01:13 Control Specifications: Control 1

Show Elements: All Elements Volume Units: IN AC-FT Sorting: Alphabetic

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
C.1A	0.03378	143.0	01Jan2016, 12:09	13.8
C.1B	0.00414	19.3	01Jan2016, 12:05	1.7
C.1C	0.01677	72.1	01Jan2016, 12:09	6.9
C.2BA	0.00378	17.6	01Jan2016, 12:05	1.5
C.2BB	0.00291	13.6	01Jan2016, 12:05	1.2
C.2BC	0.00924	42.2	01Jan2016, 12:08	3.8
C.2C	0.02730	120.2	01Jan2016, 12:10	11.2
C.2D	0.00602	28.0	01Jan2016, 12:05	2.5
O.1A	0.04147	177.2	01Jan2016, 12:08	17.0
O.1C	0.01677	72.1	01Jan2016, 12:09	6.9
O.2A	0.02405	107.8	01Jan2016, 12:08	9.9
O.2B	0.00924	42.2	01Jan2016, 12:08	3.8
O.2C	0.02730	120.2	01Jan2016, 12:10	11.2
O.2D	0.00602	28.0	01Jan2016, 12:05	2.5
O.2E	0.01264	59.0	01Jan2016, 12:05	5.2
O.2F	0.05037	226.6	01Jan2016, 12:06	20.6
P.1A1	0.00769	34.5	01Jan2016, 12:08	3.2
P.1BA	0.03378	143.0	01Jan2016, 12:09	13.8
P.1B1	0.02964	126.6	01Jan2016, 12:09	12.1
P.1B2	0.02108	90.5	01Jan2016, 12:09	8.6
P.1B3	0.00838	36.7	01Jan2016, 12:10	3.4
P.1C1	0.01677	72.2	01Jan2016, 12:09	6.9
P.1C2	0.00533	24.0	01Jan2016, 12:08	2.2
P.2A1	0.02405	107.8	01Jan2016, 12:08	9.9
P.2A2	0.00602	28.0	01Jan2016, 12:07	2.5
P.2BA	0.00378	17.6	01Jan2016, 12:05	1.5
P.2BB	0.00924	42.2	01Jan2016, 12:08	3.8
P.2C1	0.02730	120.4	01Jan2016, 12:10	11.2
P.2DA	0.00602	28.1	01Jan2016, 12:05	2.5
1A1	0.00769	34.6	01Jan2016, 12:06	3.1
1BA	0.00346	16.1	01Jan2016, 12:05	1.4
1BB	0.00068	3.2	01Jan2016, 12:05	0.3
1B1	0.00856	38.2	01Jan2016, 12:06	3.5
1B2A	0.00200	9.3	01Jan2016, 12:05	0.8
1B2B	0.01070	49.9	01Jan2016, 12:05	4.4
1B3	0.00838	36.8	01Jan2016, 12:07	3.4
1C1	0.01144	48.4	01Jan2016, 12:08	4.7
1C2	0.00533	24.1	01Jan2016, 12:06	2.2
2A1	0.01803	80.4	01Jan2016, 12:06	7.4
2A2A	0.00336	15.7	01Jan2016, 12:05	1.4
2A2B	0.00266	12.4	01Jan2016, 12:05	1.1
2BA	0.00378	17.6	01Jan2016, 12:05	1.5
2BB	0.00291	13.6	01Jan2016, 12:05	1.2
2BC	0.00255	11.4	01Jan2016, 12:06	1.0
2C1	0.02730	121.0	01Jan2016, 12:06	11.2
2DA	0.00602	28.1	01Jan2016, 12:05	2.5
2E1	0.01264	59.0	01Jan2016, 12:05	5.2
2F1	0.02332	104.7	01Jan2016, 12:06	9.6
2F2	0.02705	121.9	01Jan2016, 12:06	11.1

Table 1-3. P 100-year, 24-hour Precipitation Event Nodal Areas, Peak Flow Rates, and Run-off Volumes for Landfill Area 2

Global Summary Results for Run "Permit_Mod_100YR"

Project: Winyah_2020 Simulation Run: Permit_Mod_100YR

Start of Run: 01Jan2016, 00:00 Basin Model: Permit_Mod_Landfill Areas
End of Run: 05Feb2016, 00:00 Meteorologic Model: 100-year_2016
Compute Time: 22Apr2020, 11:36:55 Control Specifications: Control 1

Show Elements: All Elements Volume Units: IN AC-FT Sorting: Alphabetic

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
C.1A	0.03378	190.6	01Jan2016, 12:08	18.5
C.1B	0.00414	25.5	01Jan2016, 12:05	2.3
C.1C	0.01677	95.5	01Jan2016, 12:09	9.2
C.2BA	0.00378	23.3	01Jan2016, 12:05	2.1
C.2BB	0.00291	18.0	01Jan2016, 12:05	1.6
C.2BC	0.00924	55.9	01Jan2016, 12:08	5.1
C.2C	0.02730	159.5	01Jan2016, 12:10	15.0
C.2D	0.00602	37.1	01Jan2016, 12:05	3.3
O.1A	0.04147	236.2	01Jan2016, 12:08	22.8
O.1C	0.01677	95.5	01Jan2016, 12:09	9.2
O.2A	0.02405	142.9	01Jan2016, 12:08	13.2
O.2B	0.00924	55.9	01Jan2016, 12:08	5.1
O.2C	0.02730	159.5	01Jan2016, 12:10	15.0
O.2D	0.00602	37.1	01Jan2016, 12:05	3.3
O.2E	0.01264	78.1	01Jan2016, 12:05	6.9
O.2F	0.05017	299.9	01Jan2016, 12:06	27.7
P.1A1	0.00769	45.6	01Jan2016, 12:08	4.2
P.1BA	0.03378	190.9	01Jan2016, 12:08	18.5
P.1B1	0.02964	168.4	01Jan2016, 12:09	16.3
P.1B2	0.02108	120.4	01Jan2016, 12:09	11.6
P.1B3	0.00838	48.2	01Jan2016, 12:10	4.6
P.1C1	0.01677	95.5	01Jan2016, 12:09	9.2
P.1C2	0.00513	31.8	01Jan2016, 12:07	2.9
P.2A1	0.02405	142.9	01Jan2016, 12:08	13.2
P.2A2	0.00602	37.0	01Jan2016, 12:07	3.3
P.2BA	0.00378	23.3	01Jan2016, 12:05	2.1
P.2BB	0.00924	55.9	01Jan2016, 12:08	5.1
P.2C1	0.02730	159.6	01Jan2016, 12:10	15.0
P.2DA	0.00602	37.1	01Jan2016, 12:05	3.3
1A1	0.00769	45.8	01Jan2016, 12:06	4.2
1BA	0.00346	21.4	01Jan2016, 12:05	1.9
1BB	0.00068	4.2	01Jan2016, 12:05	0.4
1B1	0.00856	50.6	01Jan2016, 12:06	4.7
1B2A	0.00200	12.4	01Jan2016, 12:05	1.1
1B2B	0.01070	66.0	01Jan2016, 12:05	5.9
1B3	0.00838	48.7	01Jan2016, 12:07	4.6
1C1	0.01144	64.1	01Jan2016, 12:08	6.3
1C2	0.00533	31.9	01Jan2016, 12:06	2.9
2A1	0.01803	106.5	01Jan2016, 12:06	9.9
2A2A	0.00336	20.7	01Jan2016, 12:05	1.8
2A2B	0.00266	16.4	01Jan2016, 12:05	1.5
2BA	0.00378	23.3	01Jan2016, 12:05	2.1
2BB	0.00291	18.0	01Jan2016, 12:05	1.6
2BC	0.00255	15.1	01Jan2016, 12:06	1.4
2C1	0.02730	160.2	01Jan2016, 12:06	15.0
2DA	0.00602	37.2	01Jan2016, 12:05	3.3
2E1	0.01264	78.1	01Jan2016, 12:05	6.9
2F1	0.02312	138.5	01Jan2016, 12:06	12.8
2F2	0.02705	161.4	01Jan2016, 12:06	14.8

HEC-HMS HYDROLOGIC MODEL INPUT PARAMETERS

Basin: Permit_Mod_Landfill Areas
Last Modified Date: 22 April 2020
Last Modified Time: 15:37:24
Version: 4.1
Filepath Separator: \
Unit System: English
Missing Flow To Zero: No
Enable Flow Ratio: No
Compute Local Flow At Junctions: No

Enable Sediment Routing: No

Enable Quality Routing: No
End:

Subbasin: 2BA
Last Modified Date: 9 March 2020
Last Modified Time: 20:21:38
Canvas X: 23003.054744325596
Canvas Y: -3949.942720958053
From Canvas X: 8895.376192653515
From Canvas Y: -18515.221528144317
Area: 0.00378
Downstream: P.2BA

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 95

Transform: SCS
Lag: 3.60
Unitgraph Type: STANDARD

Baseflow: None
End:

Reach: P.2BA
Last Modified Date: 31 March 2017
Last Modified Time: 16:23:03
Canvas X: 20677.44830580029
Canvas Y: -2228.9304895720807
From Canvas X: 23248.526410763978
From Canvas Y: -2737.548829362001
Downstream: C.2BA

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 100
Energy Slope: 0.005
Mannings n: 0.027
Shape: Trapezoid
Number of Subreaches: 2
Width: 3
Side Slope: 3
Channel Loss: None
End:

Reach: C.2BA
Last Modified Date: 31 March 2017
Last Modified Time: 16:23:01
Canvas X: 18997.809603640897
Canvas Y: -2621.8256741307214
From Canvas X: 20677.44830580029
From Canvas Y: -2228.9304895720807
Downstream: P.2BB

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 100
Energy Slope: 0.005
Mannings n: 0.012
Shape: Circular
Number of Subreaches: 2
Width: 2
Channel Loss: None
End:

Subbasin: 2BB
Last Modified Date: 9 March 2020
Last Modified Time: 20:21:38
Canvas X: 21508.415534496355
Canvas Y: -4834.058034482235
From Canvas X: 8895.376192653515
From Canvas Y: -18515.221528144317
Area: 0.00291
Downstream: C.2BB

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 95

Transform: SCS
Lag: 3.60
Unitgraph Type: STANDARD

Baseflow: None
End:

Reach: C.2BB
Last Modified Date: 31 March 2017
Last Modified Time: 16:22:17
Canvas X: 18997.809603640897
Canvas Y: -2621.8256741307214
From Canvas X: 19774.14504443189
From Canvas Y: -4404.683813152387
Downstream: P.2BB

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 100
Energy Slope: 0.005
Mannings n: 0.012
Shape: Circular
Number of Subreaches: 2
Width: 2
Channel Loss: None
End:

Subbasin: 2BC
  Last Modified Date: 10 March 2020
  Last Modified Time: 20:10:53
  Canvas X: 18678.88461280165
  Canvas Y: -4541.540694056375
  From Canvas X: 8895.376192653515
  From Canvas Y: -18515.221528144317
  Area: 0.00255
  Downstream: P.2BB

  Canopy: None
  Plant Uptake Method: None

  Surface: None

  LossRate: SCS
  Percent Impervious Area: 0.0
  Curve Number: 95

  Transform: SCS
  Lag: 5.13
  Unitgraph Type: STANDARD

  Baseflow: None
End:

Reach: P.2BB
  Last Modified Date: 31 March 2017
  Last Modified Time: 16:22:56
  Canvas X: 16654.197216235632
  Canvas Y: -2801.102645308636
  From Canvas X: 18997.809603640897
  From Canvas Y: -2621.8256741307214
  Downstream: C.2BC

  Route: Kinematic Wave
  Channel: Kinematic Wave
  Length: 700
  Energy Slope: 0.005
  Mannings n: 0.027
  Shape: Trapezoid
  Number of Subreaches: 2
  Width: 3
  Side Slope: 3
  Channel Loss: None
End:

Reach: C.2BC
  Last Modified Date: 31 March 2017
  Last Modified Time: 16:23:14
  Canvas X: 15761.847071912121
  Canvas Y: -5121.1839390362575
  From Canvas X: 16654.197216235632
  From Canvas Y: -2801.102645308636
  Label X: -59.0
  Label Y: 2.0
  Downstream: O.2B

  Route: Kinematic Wave
  Channel: Kinematic Wave
  Length: 100
  Energy Slope: 0.005
  Mannings n: 0.012
  Shape: Circular
  Number of Subreaches: 2
  Width: 4
  Channel Loss: None
End:

Junction: O.2B
  Last Modified Date: 22 April 2020
  Last Modified Time: 15:37:24
  Canvas X: 15761.847071912121
  Canvas Y: -5121.1839390362575
  From Canvas X: 8895.376192653515
  From Canvas Y: -18515.221528144317
End:

Subbasin: 2DA
  Last Modified Date: 10 March 2020
  Last Modified Time: 20:10:53
  Canvas X: 20320.84178915117
  Canvas Y: -8767.493860325882
  From Canvas X: 8895.376192653515
  From Canvas Y: -18515.221528144317
  Area: 0.00602
  Downstream: P.2DA

  Canopy: None
  Plant Uptake Method: None

  Surface: None

  LossRate: SCS
  Percent Impervious Area: 0.0
  Curve Number: 95

  Transform: SCS
  Lag: 3.6
  Unitgraph Type: STANDARD

  Baseflow: None
End:

Reach: P.2DA
  Last Modified Date: 31 March 2017
  Last Modified Time: 16:18:48
  Canvas X: 20006.750464226818
  Canvas Y: -10834.623116141
  From Canvas X: 22051.566279892017
  From Canvas Y: -10374.11653943865
  Downstream: C.2D

  Route: Kinematic Wave
  Channel: Kinematic Wave
  Length: 100
  Energy Slope: 0.005
  Mannings n: 0.027
  Shape: Trapezoid
  Number of Subreaches: 2
  Width: 3
  Side Slope: 3
  Channel Loss: None
End:

Reach: C.2D
  Last Modified Date: 31 March 2017
  Last Modified Time: 16:18:48

Canvas X: 16797.119428312264
Canvas Y: -10822.998570815244
From Canvas X: 20006.750464226818
From Canvas Y: -10834.623116141
Label X: -4.0
Label Y: -18.0
Downstream: O.2D

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 100
Energy Slope: 0.005
Mannings n: 0.012
Shape: Circular
Number of Subreaches: 2
Width: 2
Channel Loss: None
End:

Junction: O.2D
Last Modified Date: 22 April 2020
Last Modified Time: 15:37:24
Canvas X: 16797.119428312264
Canvas Y: -10822.998570815244
From Canvas X: 8895.376192653515
From Canvas Y: -18515.221528144317
Label X: -55.0
Label Y: 14.0
End:

Subbasin: 2F2
Last Modified Date: 9 March 2020
Last Modified Time: 20:21:38
Canvas X: 17165.83334587702
Canvas Y: -7700.389151252137
From Canvas X: 8895.376192653515
From Canvas Y: -18515.221528144317
Area: 0.02705
Downstream: O.2F

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 95

Transform: SCS
Lag: 4.84
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: 2F1
Last Modified Date: 9 March 2020
Last Modified Time: 20:21:38
Canvas X: 17972.40072371894
Canvas Y: -9537.570400780958
From Canvas X: 8895.376192653515
From Canvas Y: -18515.221528144317
Area: 0.02332
Downstream: O.2F

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 95

Transform: SCS
Lag: 4.98
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: O.2F
Last Modified Date: 22 April 2020
Last Modified Time: 15:37:24
Canvas X: 15328.6520963462
Canvas Y: -8955.049516784013
From Canvas X: 8895.376192653515
From Canvas Y: -18515.221528144317
End:

Subbasin: 1B2B
Last Modified Date: 9 March 2020
Last Modified Time: 20:21:38
Canvas X: 14263.186468365408
Canvas Y: -5060.234731025208
From Canvas X: 19389.249277992683
From Canvas Y: -18152.530062061167
Label X: 0.0
Label Y: 1.0
Area: 0.01070
Downstream: P.1B2

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 95

Transform: SCS
Lag: 3.66
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: 1B3
Last Modified Date: 10 March 2020
Last Modified Time: 20:10:53
Canvas X: 12730.526611120333
Canvas Y: -5691.329966361414
From Canvas X: 8895.376192653515
From Canvas Y: -18515.221528144317
Area: 0.00838
Downstream: P.1B3

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 95

Transform: SCS
Lag: 5.72
Unitgraph Type: STANDARD

Baseflow: None
End:

Reach: P.1B3
Last Modified Date: 31 March 2017
Last Modified Time: 16:17:13
Canvas X: 12375.961346364431
Canvas Y: -2555.952947269673
From Canvas X: 12871.815426171663
From Canvas Y: -4910.980340324205
Downstream: P.1B2

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 800
Energy Slope: 0.005
Mannings n: 0.027
Shape: Trapezoid
Number of Subreaches: 2
Width: 3
Side Slope: 3
Channel Loss: None
End:

Subbasin: 1B2A
Last Modified Date: 9 March 2020
Last Modified Time: 20:21:38
Canvas X: 10987.501675429858
Canvas Y: -5090.286885088837
From Canvas X: 8895.376192653515
From Canvas Y: -18515.221528144317
Area: 0.00200
Downstream: P.1B2

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 95

Transform: SCS
Lag: 3.60
Unitgraph Type: STANDARD

Baseflow: None
End:

Reach: P.1B2
Last Modified Date: 31 March 2017
Last Modified Time: 16:17:13
Canvas X: 8839.266923751873
Canvas Y: -2095.7621939451737
From Canvas X: 12375.961346364431
From Canvas Y: -2555.952947269673
Label X: -18.0
Label Y: 11.0
Downstream: P.1B1

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 953
Energy Slope: 0.005
Mannings n: 0.027
Shape: Trapezoid
Number of Subreaches: 2
Width: 3
Side Slope: 3
Channel Loss: None
End:

Subbasin: 1B1
Last Modified Date: 10 March 2020
Last Modified Time: 20:10:53
Canvas X: 9755.36335882107
Canvas Y: -5060.234731025208
From Canvas X: 8895.376192653515
From Canvas Y: -18515.221528144317
Area: 0.00856
Downstream: P.1B1

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 95

Transform: SCS
Lag: 5.15
Unitgraph Type: STANDARD

Baseflow: None
End:

Reach: P.1B1
Last Modified Date: 31 March 2017
Last Modified Time: 16:16:58
Canvas X: 5967.055620542664
Canvas Y: -1674.5485509712807
From Canvas X: 8839.266923751873
From Canvas Y: -2095.7621939451737
Label X: -12.0
Label Y: 12.0
Downstream: P.1BA

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 215
Energy Slope: 0.005

Mannings n: 0.027
Shape: Trapezoid
Number of Subreaches: 2
Width: 3
Side Slope: 3
Channel Loss: None
End:

Subbasin: 1BA
Last Modified Date: 9 March 2020
Last Modified Time: 20:21:38
Canvas X: 7681.764728430675
Canvas Y: -4849.869652579806
From Canvas X: 8895.376192653515
From Canvas Y: -18515.221528144317
Area: 0.00346
Downstream: C.1B

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 95

Transform: SCS
Lag: 3.60
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: 1BB
Last Modified Date: 9 March 2020
Last Modified Time: 20:21:38
Canvas X: 5397.801019594877
Canvas Y: -3798.0442603527936
From Canvas X: 8895.376192653515
From Canvas Y: -18515.221528144317
Area: 0.00068
Downstream: C.1B

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 95

Transform: SCS
Lag: 3.60
Unitgraph Type: STANDARD

Baseflow: None
End:

Reach: C.1B
Last Modified Date: 31 March 2017
Last Modified Time: 16:16:42
Canvas X: 5967.055620542664
Canvas Y: -1674.5485509712807
From Canvas X: 6075.668158437937
From Canvas Y: -2758.7492922041447
Downstream: P.1BA

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 100
Energy Slope: 0.005
Mannings n: 0.012
Shape: Circular
Number of Subreaches: 2
Width: 2
Channel Loss: None
End:

Reach: P.1BA
Last Modified Date: 31 March 2017
Last Modified Time: 16:16:45
Canvas X: 3644.8714328581973
Canvas Y: -2212.727072916364
From Canvas X: 5967.055620542664
From Canvas Y: -1674.5485509712807
Label X: -13.0
Label Y: 14.0
Downstream: C.1A

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 105
Energy Slope: 0.005
Mannings n: 0.027
Shape: Trapezoid
Number of Subreaches: 2
Width: 3
Side Slope: 3
Channel Loss: None
End:

Reach: C.1A
Last Modified Date: 31 March 2017
Last Modified Time: 16:16:35
Canvas X: 2302.4291510410985
Canvas Y: -3016.6882546984416
From Canvas X: 3644.8714328581973
From Canvas Y: -2212.727072916364
Label X: -3.0
Label Y: 18.0
Downstream: O.1A

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 100
Energy Slope: 0.005
Mannings n: 0.012
Shape: Circular
Number of Subreaches: 2
Width: 4
Channel Loss: None
End:

Subbasin: 1A1
Last Modified Date: 10 March 2020
Last Modified Time: 20:10:53

Canvas X: 5818.5311764856815
Canvas Y: -5360.7562716614975
From Canvas X: 8895.376192653515
From Canvas Y: -18515.221528144317
Area: 0.00769
Downstream: P.1A1

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 95

Transform: SCS
Lag: 4.92
Unitgraph Type: STANDARD

Baseflow: None
End:

Reach: P.1A1
Last Modified Date: 31 March 2017
Last Modified Time: 16:16:05
Canvas X: 2302.4291510410985
Canvas Y: -3016.6882546984416
From Canvas X: 4144.4312883434895
From Canvas Y: -5419.404425552808
Downstream: O.1A

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 525
Energy Slope: 0.005
Mannings n: 0.027
Shape: Trapezoid
Number of Subreaches: 2
Width: 3
Side Slope: 3
Channel Loss: None
End:

Junction: O.1A
Last Modified Date: 22 April 2020
Last Modified Time: 15:37:24
Canvas X: 2302.4291510410985
Canvas Y: -3016.6882546984416
From Canvas X: 8895.376192653515
From Canvas Y: -18515.221528144317
Label X: -64.0
Label Y: 12.0
End:

Subbasin: 2C1
Last Modified Date: 10 March 2020
Last Modified Time: 20:10:53
Canvas X: 23530.332367961128
Canvas Y: -8744.078342601737
From Canvas X: 8895.376192653515
From Canvas Y: -18515.221528144317
Area: 0.02730
Downstream: P.2C1

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 95

Transform: SCS
Lag: 5.32
Unitgraph Type: STANDARD

Baseflow: None
End:

Reach: P.2C1
Last Modified Date: 31 March 2017
Last Modified Time: 16:19:25
Canvas X: 25559.082510168057
Canvas Y: -10452.762155759388
From Canvas X: 23697.096578980454
From Canvas Y: -10382.476830461705
Label X: -6.0
Label Y: -14.0
Downstream: C.2C

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 1350
Energy Slope: 0.005
Mannings n: 0.027
Shape: Trapezoid
Number of Subreaches: 2
Width: 3
Side Slope: 3
Channel Loss: None
End:

Reach: C.2C
Last Modified Date: 31 March 2017
Last Modified Time: 16:19:27
Canvas X: 26713.83693786458
Canvas Y: -8852.916105675358
From Canvas X: 25559.082510168057
From Canvas Y: -10452.762155759388
Downstream: O.2C

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 100
Energy Slope: 0.005
Mannings n: 0.012
Shape: Circular
Number of Subreaches: 2
Width: 4
Channel Loss: None
End:

Junction: O.2C
Last Modified Date: 22 April 2020
Last Modified Time: 15:37:24
Canvas X: 26713.83693786458

Canvas Y: -8852.916105675358
From Canvas X: 8895.376192653515
From Canvas Y: -18515.221528144317
End:

Subbasin: 2A1
Last Modified Date: 10 March 2020
Last Modified Time: 20:10:53
Canvas X: 27961.051448809565
Canvas Y: -6152.391400207119
From Canvas X: 8895.376192653515
From Canvas Y: -18515.221528144317
Area: 0.01803
Downstream: P.2A1

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 95

Transform: SCS
Lag: 5.16
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: 2A2A
Last Modified Date: 9 March 2020
Last Modified Time: 20:21:38
Canvas X: 25914.170287235196
Canvas Y: -6173.101796981193
From Canvas X: 8895.376192653515
From Canvas Y: -18515.221528144317
Area: 0.00336
Downstream: P.2A2

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 95

Transform: SCS
Lag: 3.60
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: 2A2B
Last Modified Date: 9 March 2020
Last Modified Time: 20:21:38
Canvas X: 24615.649241001633
Canvas Y: -4915.1595334424255
From Canvas X: 8895.376192653515
From Canvas Y: -18515.221528144317
Area: 0.00266
Downstream: P.2A2

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 95

Transform: SCS
Lag: 3.60
Unitgraph Type: STANDARD

Baseflow: None
End:

Reach: P.2A2
Last Modified Date: 31 March 2017
Last Modified Time: 16:20:54
Canvas X: 28535.491595925763
Canvas Y: -4400.863806752261
From Canvas X: 26457.235003130787
From Canvas Y: -4087.875881557411
Downstream: P.2A1

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 690
Energy Slope: 0.005
Mannings n: 0.027
Shape: Trapezoid
Number of Subreaches: 2
Width: 3
Side Slope: 3
Channel Loss: None
End:

Reach: P.2A1
Last Modified Date: 31 March 2017
Last Modified Time: 16:20:54
Canvas X: 29768.736817670226
Canvas Y: -6207.169744718049
From Canvas X: 28535.491595925763
From Canvas Y: -4400.863806752261
Downstream: O.2A

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 600
Energy Slope: 0.005
Mannings n: 0.027
Shape: Trapezoid
Number of Subreaches: 2
Width: 3
Side Slope: 3
Channel Loss: None
End:

Junction: O.2A
Last Modified Date: 22 April 2020
Last Modified Time: 15:37:24

Canvas X: 29768.736817670226
Canvas Y: -6207.169744718049
From Canvas X: 8895.376192653515
From Canvas Y: -18515.221528144317
End:

Subbasin: 1C1
Last Modified Date: 10 March 2020
Last Modified Time: 20:10:53
Canvas X: 10481.609778654665
Canvas Y: -6541.04394021408
From Canvas X: 8895.376192653515
From Canvas Y: -18515.221528144317
Area: 0.01144
Downstream: P.1C1

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 95

Transform: SCS
Lag: 6.88
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: 1C2
Last Modified Date: 10 April 2020
Last Modified Time: 19:49:36
Canvas X: 13462.100862199468
Canvas Y: -6598.028605270678
From Canvas X: 8895.376192653515
From Canvas Y: -18515.221528144317
Area: 0.00533
Downstream: P.1C2

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 95

Transform: SCS
Lag: 4.74
Unitgraph Type: STANDARD

Baseflow: None
End:

Reach: P.1C2
Last Modified Date: 31 March 2017
Last Modified Time: 16:13:25
Canvas X: 10373.860234577145
Canvas Y: -8170.956850765629
From Canvas X: 13010.843942149506
From Canvas Y: -8483.555281082447
Label X: 2.0
Label Y: 14.0
Downstream: P.1C1

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 415
Energy Slope: 0.005
Mannings n: 0.027
Shape: Trapezoid
Number of Subreaches: 2
Width: 3
Side Slope: 3
Channel Loss: None
End:

Reach: P.1C1
Last Modified Date: 31 March 2017
Last Modified Time: 16:13:25
Canvas X: 7318.024026413357
Canvas Y: -7835.279612895717
From Canvas X: 10373.860234577145
From Canvas Y: -8170.956850765629
Downstream: C.1C

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 340
Energy Slope: 0.005
Mannings n: 0.027
Shape: Trapezoid
Number of Subreaches: 2
Width: 3
Side Slope: 3
Channel Loss: None
End:

Reach: C.1C
Last Modified Date: 31 March 2017
Last Modified Time: 16:13:28
Canvas X: 8694.584794293705
Canvas Y: -8912.913464911355
From Canvas X: 7318.024026413357
From Canvas Y: -7835.279612895717
Downstream: O.1C

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 100
Energy Slope: 0.005
Mannings n: 0.012
Shape: Circular
Number of Subreaches: 2
Width: 6
Channel Loss: None
End:

Junction: O.1C
Last Modified Date: 22 April 2020
Last Modified Time: 15:37:24
Canvas X: 8694.584794293705
Canvas Y: -8912.913464911355
From Canvas X: 8895.376192653515

```
  From Canvas Y: -18515.221528144317
End:

Subbasin: 2E1
  Last Modified Date: 9 March 2020
  Last Modified Time: 20:21:38
  Canvas X: 23713.64404493401
  Canvas Y: -7373.647496731782
  From Canvas X: 8895.376192653515
  From Canvas Y: -18515.221528144317
  Area: 0.01264
  Downstream: O.2E

  Canopy: None
  Plant Uptake Method: None

  Surface: None

  LossRate: SCS
  Percent Impervious Area: 0.0
  Curve Number: 95

  Transform: SCS
  Lag: 3.60
  Unitgraph Type: STANDARD

  Baseflow: None
End:

Junction: O.2E
  Last Modified Date: 22 April 2020
  Last Modified Time: 15:37:24
  Canvas X: 26232.502654473094
  Canvas Y: -7373.647496731782
  From Canvas X: 8895.376192653515
  From Canvas Y: -18515.221528144317
End:

Basin Schematic Properties:
  Last View N: -5886.038098238729
  Last View S: -23932.82626360068
  Last View W: 112.26896901012151
  Last View E: 22946.90592082476
  Maximum View N: 417.93047210596296
  Maximum View S: -24691.817804820963
  Maximum View W: -2237.445293676677
  Maximum View E: 41947.30928408436
  Extent Method: Elements
  Buffer: 20
  Draw Icons: Yes
  Draw Icon Labels: Name
  Draw Map Objects: No
  Draw Gridlines: No
  Draw Flow Direction: No
  Fix Element Locations: No
  Fix Hydrologic Order: No
End::
```

Appendix 2
Drainage Feature Calculations

Design/Check: Trapezoidal/Triangular Channel

Methodology: Manning's Equation

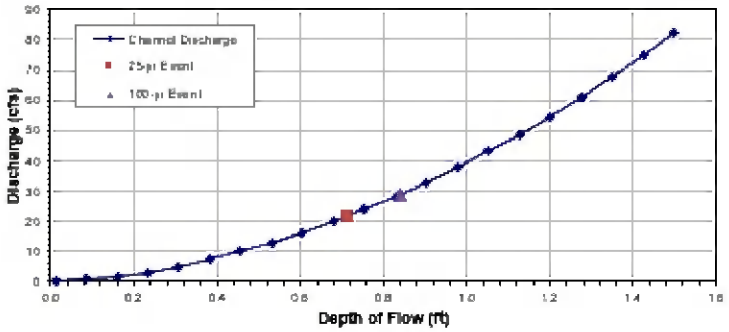
Project: Santee Cooper - Winyah Generating Station

Ditch ID: **Side Slope Drainage Terrace**

Peak Discharge, Q_{25} =	21.64	cfs (25-yr Event)
Peak Discharge, Q_{100} =	28.65	cfs (100-yr Event)
Bottom Width, B =	6.00	ft
Left Side Slope, Z_1 =	2.0	horizontal :1 vertical
Right Side Slope, Z_2 =	2.0	horizontal :1 vertical
Channel Depth, Y =	1.50	ft
Top Width, T =	12.0	ft
Manning's Roughness Coeff., n =	0.036	
Longitudinal Channel Slope, S_o =	0.0200	ft/ft

Depth of Flow Y ft	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R=A/P ft	Average Velocity V ft/s	Discharge (Flow Rate) Q=AV ft^3/s	Avg. Tractive Stress τ_0 lb/ft^2	Comments
0.01	0.06	6.04	0.01	0.27	0.0	0.01	
0.08	0.52	6.38	0.08	1.10	0.6	0.10	
0.16	1.00	6.71	0.15	1.65	1.7	0.19	
0.23	1.51	7.04	0.21	2.10	3.2	0.27	
0.31	2.04	7.38	0.28	2.48	5.1	0.34	
0.38	2.59	7.71	0.34	2.83	7.3	0.42	
0.46	3.16	8.04	0.39	3.14	9.9	0.49	
0.53	3.75	8.38	0.45	3.43	12.9	0.56	
0.61	4.37	8.71	0.50	3.70	16.1	0.63	
0.68	5.01	9.04	0.55	3.95	19.8	0.69	
0.76	5.67	9.38	0.60	4.18	23.7	0.75	
0.83	6.35	9.71	0.65	4.41	28.0	0.82	
0.90	7.06	10.04	0.70	4.63	32.7	0.88	
0.98	7.79	10.38	0.75	4.83	37.6	0.94	
1.05	8.54	10.71	0.80	5.03	42.9	0.99	
1.13	9.31	11.04	0.84	5.22	48.6	1.05	
1.20	10.10	11.38	0.89	5.41	54.6	1.11	
1.28	10.92	11.71	0.93	5.59	61.0	1.16	
1.35	11.76	12.04	0.98	5.76	67.7	1.22	
1.43	12.62	12.38	1.02	5.93	74.8	1.27	
1.50	13.50	12.71	1.06	6.09	82.3	1.33	
0.72	5.32	9.20	0.58	4.06	21.60	0.72	Q [25-yr Event]
0.84	6.45	9.75	0.66	4.44	28.63	0.82	Q [100-yr Event]

Discharge versus Depth Relationship



Design/Check: Trapezoidal/Triangular Channel

Methodology: Manning's Equation

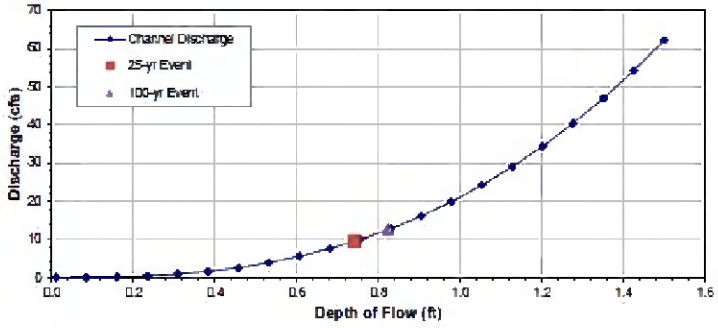
Project: Santee Cooper - Winyah Generating Station

Ditch ID: **Top Deck Drainage Terrace**

Peak Discharge, Q_{25} =	9.51	cfs (25-yr Event)
Peak Discharge, Q_{100} =	12.58	cfs (100-yr Event)
Bottom Width, B =	0.00	ft
Left Side Slope, Z_1 =	20.0	horizontal :1 vertical
Right Side Slope, Z_2 =	3.0	horizontal :1 vertical
Channel Depth, Y =	1.50	ft
Top Width, T =	34.5	ft
Manning's Roughness Coeff., n =	0.036	
Longitudinal Channel Slope, S_0 =	0.0050	ft/ft

Depth of Flow Y ft	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R=A/P ft	Average Velocity V ft/s	Discharge (Flow Rate) Q=AV ft^3/s	Ave. Tractive Stress τ_0 lb/ft^2	Comments
0.01	0.00	0.23	0.00	0.08	0.0	0.00	
0.08	0.08	1.96	0.04	0.35	0.0	0.01	
0.16	0.29	3.69	0.08	0.54	0.2	0.02	
0.23	0.63	5.41	0.12	0.69	0.4	0.04	
0.31	1.09	7.14	0.15	0.84	0.9	0.05	
0.38	1.68	8.87	0.19	0.97	1.6	0.06	
0.46	2.40	10.60	0.23	1.09	2.6	0.07	
0.53	3.25	12.32	0.26	1.20	3.9	0.08	
0.61	4.22	14.05	0.30	1.31	5.5	0.09	
0.68	5.33	15.78	0.34	1.42	7.6	0.11	
0.76	6.56	17.51	0.37	1.52	10.0	0.12	
0.83	7.91	19.23	0.41	1.62	12.8	0.13	
0.90	9.40	20.96	0.45	1.71	16.1	0.14	
0.98	11.01	22.69	0.49	1.81	19.9	0.15	
1.05	12.75	24.42	0.52	1.90	24.2	0.16	
1.13	14.62	26.14	0.56	1.99	29.0	0.17	
1.20	16.62	27.87	0.60	2.07	34.4	0.19	
1.28	18.74	29.60	0.63	2.16	40.4	0.20	
1.35	20.99	31.33	0.67	2.24	47.0	0.21	
1.43	23.37	33.05	0.71	2.32	54.3	0.22	
1.50	25.88	34.78	0.74	2.40	62.2	0.23	
0.74	6.31	17.18	0.37	1.50	9.47	0.11	Q (25-yr Event)
0.82	7.80	19.10	0.41	1.61	12.57	0.13	Q (100-yr Event)

Discharge versus Depth Relationship



Design/Check: Trapezoidal/Triangular Channel

Methodology: Manning's Equation

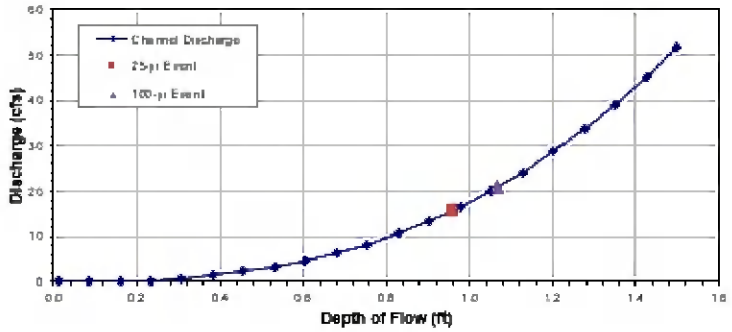
Project: Santee Cooper - Winyah Generating Station

Ditch ID: **2A2A Access Road Drainage Terrace**

Peak Discharge, Q_{25} =	15.68	cfs (25-yr Event)
Peak Discharge, Q_{100} =	20.75	cfs (100-yr Event)
Bottom Width, B =	0.00	ft
Left Side Slope, Z_1 =	3.0	horizontal :1 vertical
Right Side Slope, Z_2 =	2.0	horizontal :1 vertical
Channel Depth, Y =	1.50	ft
Top Width, T =	7.5	ft
Manning's Roughness Coeff., n =	0.036	
Longitudinal Channel Slope, S_o =	0.0800	ft/ft

Depth of Flow Y ft	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R=A/P ft	Average Velocity V ft/s	Discharge (Flow Rate) Q=AV ft^3/s	Avg. Tractive Stress τ_0 lb/ft^2	Comments
0.01	0.00	0.05	0.00	0.32	0.0	0.02	
0.08	0.02	0.46	0.04	1.35	0.0	0.20	
0.16	0.06	0.86	0.07	2.05	0.1	0.37	
0.23	0.14	1.26	0.11	2.66	0.4	0.54	
0.31	0.24	1.66	0.14	3.19	0.8	0.71	
0.38	0.37	2.06	0.18	3.69	1.3	0.88	
0.46	0.52	2.47	0.21	4.16	2.2	1.06	
0.53	0.71	2.87	0.25	4.60	3.2	1.23	
0.61	0.92	3.27	0.28	5.02	4.6	1.40	
0.68	1.16	3.67	0.32	5.42	6.3	1.57	
0.76	1.43	4.08	0.35	5.81	8.3	1.75	
0.83	1.72	4.48	0.38	6.18	10.6	1.92	
0.90	2.04	4.88	0.42	6.55	13.4	2.09	
0.98	2.39	5.28	0.45	6.90	16.5	2.26	
1.05	2.77	5.68	0.49	7.25	20.1	2.43	
1.13	3.18	6.09	0.52	7.59	24.1	2.61	
1.20	3.61	6.49	0.56	7.92	28.6	2.78	
1.28	4.07	6.89	0.59	8.24	33.6	2.95	
1.35	4.56	7.29	0.63	8.56	39.1	3.12	
1.43	5.08	7.70	0.66	8.87	45.1	3.30	
1.50	5.63	8.10	0.69	9.18	51.6	3.47	
0.96	2.30	5.17	0.44	6.81	15.64	2.22	Q [25-yr Event]
1.07	2.84	5.75	0.49	7.31	20.72	2.46	Q [100-yr Event]

Discharge versus Depth Relationship



Design/Check: Trapezoidal/Triangular Channel

Methodology: Manning's Equation

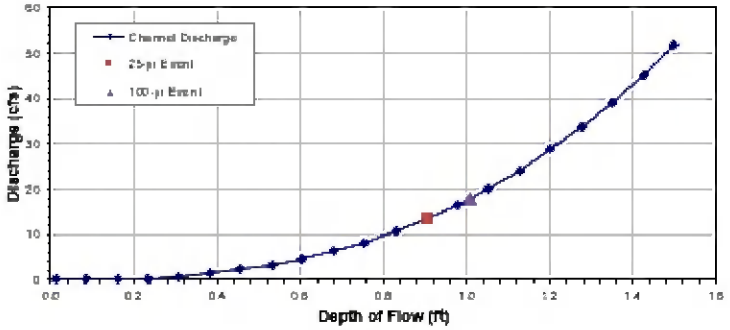
Project: Santee Cooper - Winyah Generating Station

Ditch ID: **2BB Access Road Drainage Terrace**

Peak Discharge, Q_{25} =	13.58	cfs (25-yr Event)
Peak Discharge, Q_{100} =	17.97	cfs (100-yr Event)
Bottom Width, B =	0.00	ft
Left Side Slope, Z_1 =	3.0	horizontal :1 vertical
Right Side Slope, Z_2 =	2.0	horizontal :1 vertical
Channel Depth, Y =	1.50	ft
Top Width, T =	7.5	ft
Manning's Roughness Coeff., n =	0.036	
Longitudinal Channel Slope, S_w =	0.0800	ft/ft

Depth of Flow Y ft	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R=A/P ft	Average Velocity V ft/s	Discharge (Flow Rate) Q=AV ft^3/s	Avg. Tractive Stress τ_0 lb/ft^2	Comments
0.01	0.00	0.05	0.00	0.32	0.0	0.02	
0.08	0.02	0.46	0.04	1.35	0.0	0.20	
0.16	0.06	0.86	0.07	2.05	0.1	0.37	
0.23	0.14	1.26	0.11	2.66	0.4	0.54	
0.31	0.24	1.66	0.14	3.19	0.8	0.71	
0.38	0.37	2.06	0.18	3.69	1.3	0.88	
0.46	0.52	2.47	0.21	4.16	2.2	1.06	
0.53	0.71	2.87	0.25	4.60	3.2	1.23	
0.61	0.92	3.27	0.28	5.02	4.6	1.40	
0.68	1.16	3.67	0.32	5.42	6.3	1.57	
0.76	1.43	4.08	0.35	5.81	8.3	1.75	
0.83	1.72	4.48	0.38	6.18	10.6	1.92	
0.90	2.04	4.88	0.42	6.55	13.4	2.09	
0.98	2.39	5.28	0.45	6.90	16.5	2.26	
1.05	2.77	5.68	0.49	7.25	20.1	2.43	
1.13	3.18	6.09	0.52	7.59	24.1	2.61	
1.20	3.61	6.49	0.56	7.92	28.6	2.78	
1.28	4.07	6.89	0.59	8.24	33.6	2.95	
1.35	4.56	7.29	0.63	8.56	39.1	3.12	
1.43	5.08	7.70	0.66	8.87	45.1	3.30	
1.50	5.63	8.10	0.69	9.18	51.6	3.47	
0.91	2.06	4.91	0.42	6.57	13.57	2.10	Q [25-yr Event]
1.01	2.54	5.44	0.47	7.05	17.92	2.33	Q [100-yr Event]

Discharge versus Depth Relationship



Down Drain Feature: 2A1

Flow Through Circular Pipe

Number of Pipes, N=	3	
Diameter of pipe, D=	18	inches
Longitudinal Slope, So=	0.040	ft/ft
Manning's n=	0.009	
Density of flowing liquid, rho=	1.94	slugs/ft^3
Peak Discharge, Q_{25}=	56.1	cfs
Peak Discharge, Q_{100}=	74.2	cfs

Theta radians	Theta degrees	Depth of Flow y inches	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R ft	Average Velocity V ft/s	Discharge Q=A*V cfs	Force F lbf
0.00	0	0.0	0.000	0.00		0.0	0.00	0.0
0.25	14	0.1	0.001	0.19	0.00	0.8	0.00	0.0
0.50	29	0.3	0.006	0.38	0.02	2.0	0.04	0.0
0.75	43	0.6	0.019	0.56	0.03	3.5	0.20	0.5
1.00	57	1.1	0.045	0.75	0.06	5.0	0.67	2.2
1.25	72	1.7	0.085	0.94	0.09	6.7	1.69	7.3
1.50	86	2.4	0.141	1.13	0.13	8.3	3.52	18.9
1.75	100	3.2	0.215	1.31	0.16	9.9	6.41	41.1
2.00	115	4.1	0.307	1.50	0.20	11.5	10.57	78.5
2.25	129	5.1	0.414	1.69	0.25	13.0	16.11	135.1
2.50	143	6.2	0.535	1.88	0.29	14.3	23.01	213.4
2.75	158	7.2	0.666	2.06	0.32	15.6	31.13	313.7
3.00	172	8.4	0.804	2.25	0.36	16.7	40.21	433.4
3.25	186	9.5	0.944	2.44	0.39	17.6	49.85	567.1
3.50	201	10.6	1.083	2.63	0.41	18.3	59.61	707.1
3.75	215	11.7	1.215	2.81	0.43	18.9	68.99	844.2
4.00	229	12.7	1.338	3.00	0.45	19.3	77.55	969.0
4.25	244	13.7	1.447	3.19	0.45	19.6	84.88	1073.2
4.50	258	14.7	1.541	3.38	0.46	19.6	90.70	1151.0
4.75	272	15.5	1.617	3.56	0.45	19.6	94.84	1199.0
5.00	286	16.2	1.676	3.75	0.45	19.3	97.29	1217.3
5.25	301	16.8	1.718	3.94	0.44	19.0	98.16	1208.8
5.50	315	17.3	1.745	4.13	0.42	18.7	97.68	1178.4
5.75	329	17.7	1.760	4.31	0.41	18.2	96.17	1132.7
6.00	344	17.9	1.766	4.50	0.39	17.7	94.01	1078.7
6.25	358	18.0	1.767	4.69	0.38	17.3	91.58	1022.9
3.41	195	10.2	1.033	2.56	0.40	18.1	56.11	656.7
3.90	224	12.3	1.292	2.93	0.44	19.2	74.38	923.1

Down Drain Feature: 2A2

Flow Through Circular Pipe

Number of Pipes, N=	2	
Diameter of pipe, D=	18	inches
Longitudinal Slope, So=	0.040	ft/ft
Manning's n=	0.009	
Density of flowing liquid, rho=	1.94	slugs/ft^3
Peak Discharge, Q_{25}=	24.8	cfs
Peak Discharge, Q_{100}=	32.8	cfs

Theta radians	Theta degrees	Depth of Flow y inches	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R ft	Average Velocity V ft/s	Discharge Q=A*V cfs	Force F lbf
0.00	0	0.0	0.000	0.00		0.0	0.00	0.0
0.25	14	0.1	0.001	0.19	0.00	0.8	0.00	0.0
0.50	29	0.3	0.006	0.38	0.02	2.0	0.02	0.0
0.75	43	0.6	0.019	0.56	0.03	3.5	0.13	0.5
1.00	57	1.1	0.045	0.75	0.06	5.0	0.45	2.2
1.25	72	1.7	0.085	0.94	0.09	6.7	1.13	7.3
1.50	86	2.4	0.141	1.13	0.13	8.3	2.35	18.9
1.75	100	3.2	0.215	1.31	0.16	9.9	4.27	41.1
2.00	115	4.1	0.307	1.50	0.20	11.5	7.05	78.5
2.25	129	5.1	0.414	1.69	0.25	13.0	10.74	135.1
2.50	143	6.2	0.535	1.88	0.29	14.3	15.34	213.4
2.75	158	7.2	0.666	2.06	0.32	15.6	20.76	313.7
3.00	172	8.4	0.804	2.25	0.36	16.7	26.80	433.4
3.25	186	9.5	0.944	2.44	0.39	17.6	33.23	567.1
3.50	201	10.6	1.083	2.63	0.41	18.3	39.74	707.1
3.75	215	11.7	1.215	2.81	0.43	18.9	45.99	844.2
4.00	229	12.7	1.338	3.00	0.45	19.3	51.70	969.0
4.25	244	13.7	1.447	3.19	0.45	19.6	56.59	1073.2
4.50	258	14.7	1.541	3.38	0.46	19.6	60.46	1151.0
4.75	272	15.5	1.617	3.56	0.45	19.6	63.23	1199.0
5.00	286	16.2	1.676	3.75	0.45	19.3	64.86	1217.3
5.25	301	16.8	1.718	3.94	0.44	19.0	65.44	1208.8
5.50	315	17.3	1.745	4.13	0.42	18.7	65.12	1178.4
5.75	329	17.7	1.760	4.31	0.41	18.2	64.12	1132.7
6.00	344	17.9	1.766	4.50	0.39	17.7	62.67	1078.7
6.25	358	18.0	1.767	4.69	0.38	17.3	61.05	1022.9
2.92	167	8.0	0.758	2.19	0.35	16.3	24.74	391.9
3.23	185	9.4	0.935	2.43	0.39	17.5	32.82	558.5

Down Drain Feature: 2C1
Flow Through Circular Pipe

Number of Pipes, N=	5	
Diameter of pipe, D=	18	inches
Longitudinal Slope, So=	0.040	ft/ft
Manning's n=	0.009	
Density of flowing liquid, rho=	1.94	slugs/ft^3
Peak Discharge, Q_{25}=	100.5	cfs
Peak Discharge, Q_{100}=	133.0	cfs

Theta radians	Theta degrees	Depth of Flow y inches	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R ft	Average Velocity V ft/s	Discharge Q=A*V cfs	Force F lbf
0.00	0	0.0	0.000	0.00		0.0	0.00	0.0
0.25	14	0.1	0.001	0.19	0.00	0.8	0.00	0.0
0.50	29	0.3	0.006	0.38	0.02	2.0	0.06	0.0
0.75	43	0.6	0.019	0.56	0.03	3.5	0.33	0.5
1.00	57	1.1	0.045	0.75	0.06	5.0	1.12	2.2
1.25	72	1.7	0.085	0.94	0.09	6.7	2.82	7.3
1.50	86	2.4	0.141	1.13	0.13	8.3	5.86	18.9
1.75	100	3.2	0.215	1.31	0.16	9.9	10.69	41.1
2.00	115	4.1	0.307	1.50	0.20	11.5	17.62	78.5
2.25	129	5.1	0.414	1.69	0.25	13.0	26.85	135.1
2.50	143	6.2	0.535	1.88	0.29	14.3	38.35	213.4
2.75	158	7.2	0.666	2.06	0.32	15.6	51.89	313.7
3.00	172	8.4	0.804	2.25	0.36	16.7	67.01	433.4
3.25	186	9.5	0.944	2.44	0.39	17.6	83.08	567.1
3.50	201	10.6	1.083	2.63	0.41	18.3	99.34	707.1
3.75	215	11.7	1.215	2.81	0.43	18.9	114.99	844.2
4.00	229	12.7	1.338	3.00	0.45	19.3	129.25	969.0
4.25	244	13.7	1.447	3.19	0.45	19.6	141.47	1073.2
4.50	258	14.7	1.541	3.38	0.46	19.6	151.16	1151.0
4.75	272	15.5	1.617	3.56	0.45	19.6	158.07	1199.0
5.00	286	16.2	1.676	3.75	0.45	19.3	162.15	1217.3
5.25	301	16.8	1.718	3.94	0.44	19.0	163.60	1208.8
5.50	315	17.3	1.745	4.13	0.42	18.7	162.80	1178.4
5.75	329	17.7	1.760	4.31	0.41	18.2	160.29	1132.7
6.00	344	17.9	1.766	4.50	0.39	17.7	156.68	1078.7
6.25	358	18.0	1.767	4.69	0.38	17.3	152.63	1022.9
3.52	202	10.7	1.093	2.64	0.41	18.4	100.53	717.7
4.08	234	13.1	1.373	3.06	0.45	19.4	133.28	1004.0

Down Drain Feature: 2E1

Flow Through Circular Pipe

Number of Pipes, N=	3	
Diameter of pipe, D=	18	inches
Longitudinal Slope, So=	0.040	ft/ft
Manning's n=	0.009	
Density of flowing liquid, rho=	1.94	slugs/ft^3
Peak Discharge, Q_{25}=	51.0	cfs
Peak Discharge, Q_{100}=	67.5	cfs

Theta radians	Theta degrees	Depth of Flow y inches	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R ft	Average Velocity V ft/s	Discharge Q=A*V cfs	Force F lbf
0.00	0	0.0	0.000	0.00		0.0	0.00	0.0
0.25	14	0.1	0.001	0.19	0.00	0.8	0.00	0.0
0.50	29	0.3	0.006	0.38	0.02	2.0	0.04	0.0
0.75	43	0.6	0.019	0.56	0.03	3.5	0.20	0.5
1.00	57	1.1	0.045	0.75	0.06	5.0	0.67	2.2
1.25	72	1.7	0.085	0.94	0.09	6.7	1.69	7.3
1.50	86	2.4	0.141	1.13	0.13	8.3	3.52	18.9
1.75	100	3.2	0.215	1.31	0.16	9.9	6.41	41.1
2.00	115	4.1	0.307	1.50	0.20	11.5	10.57	78.5
2.25	129	5.1	0.414	1.69	0.25	13.0	16.11	135.1
2.50	143	6.2	0.535	1.88	0.29	14.3	23.01	213.4
2.75	158	7.2	0.666	2.06	0.32	15.6	31.13	313.7
3.00	172	8.4	0.804	2.25	0.36	16.7	40.21	433.4
3.25	186	9.5	0.944	2.44	0.39	17.6	49.85	567.1
3.50	201	10.6	1.083	2.63	0.41	18.3	59.61	707.1
3.75	215	11.7	1.215	2.81	0.43	18.9	68.99	844.2
4.00	229	12.7	1.338	3.00	0.45	19.3	77.55	969.0
4.25	244	13.7	1.447	3.19	0.45	19.6	84.88	1073.2
4.50	258	14.7	1.541	3.38	0.46	19.6	90.70	1151.0
4.75	272	15.5	1.617	3.56	0.45	19.6	94.84	1199.0
5.00	286	16.2	1.676	3.75	0.45	19.3	97.29	1217.3
5.25	301	16.8	1.718	3.94	0.44	19.0	98.16	1208.8
5.50	315	17.3	1.745	4.13	0.42	18.7	97.68	1178.4
5.75	329	17.7	1.760	4.31	0.41	18.2	96.17	1132.7
6.00	344	17.9	1.766	4.50	0.39	17.7	94.01	1078.7
6.25	358	18.0	1.767	4.69	0.38	17.3	91.58	1022.9
3.28	188	9.6	0.961	2.46	0.39	17.7	51.04	584.2
3.71	213	11.5	1.195	2.78	0.43	18.8	67.59	823.8

Down Drain Feature: 2F1

Flow Through Circular Pipe

Number of Pipes, N=	5	
Diameter of pipe, D=	18	inches
Longitudinal Slope, So=	0.040	ft/ft
Manning's n=	0.009	
Density of flowing liquid, rho=	1.94	slugs/ft^3
Peak Discharge, Q_{25}=	95.2	cfs
Peak Discharge, Q_{100}=	126.0	cfs

Theta radians	Theta degrees	Depth of Flow y inches	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R ft	Average Velocity V ft/s	Discharge Q=A*V cfs	Force F lbf
0.00	0	0.0	0.000	0.00		0.0	0.00	0.0
0.25	14	0.1	0.001	0.19	0.00	0.8	0.00	0.0
0.50	29	0.3	0.006	0.38	0.02	2.0	0.06	0.0
0.75	43	0.6	0.019	0.56	0.03	3.5	0.33	0.5
1.00	57	1.1	0.045	0.75	0.06	5.0	1.12	2.2
1.25	72	1.7	0.085	0.94	0.09	6.7	2.82	7.3
1.50	86	2.4	0.141	1.13	0.13	8.3	5.86	18.9
1.75	100	3.2	0.215	1.31	0.16	9.9	10.69	41.1
2.00	115	4.1	0.307	1.50	0.20	11.5	17.62	78.5
2.25	129	5.1	0.414	1.69	0.25	13.0	26.85	135.1
2.50	143	6.2	0.535	1.88	0.29	14.3	38.35	213.4
2.75	158	7.2	0.666	2.06	0.32	15.6	51.89	313.7
3.00	172	8.4	0.804	2.25	0.36	16.7	67.01	433.4
3.25	186	9.5	0.944	2.44	0.39	17.6	83.08	567.1
3.50	201	10.6	1.083	2.63	0.41	18.3	99.34	707.1
3.75	215	11.7	1.215	2.81	0.43	18.9	114.99	844.2
4.00	229	12.7	1.338	3.00	0.45	19.3	129.25	969.0
4.25	244	13.7	1.447	3.19	0.45	19.6	141.47	1073.2
4.50	258	14.7	1.541	3.38	0.46	19.6	151.16	1151.0
4.75	272	15.5	1.617	3.56	0.45	19.6	158.07	1199.0
5.00	286	16.2	1.676	3.75	0.45	19.3	162.15	1217.3
5.25	301	16.8	1.718	3.94	0.44	19.0	163.60	1208.8
5.50	315	17.3	1.745	4.13	0.42	18.7	162.80	1178.4
5.75	329	17.7	1.760	4.31	0.41	18.2	160.29	1132.7
6.00	344	17.9	1.766	4.50	0.39	17.7	156.68	1078.7
6.25	358	18.0	1.767	4.69	0.38	17.3	152.63	1022.9
3.44	197	10.3	1.048	2.58	0.41	18.2	95.24	671.6
3.94	226	12.5	1.311	2.96	0.44	19.3	126.18	942.5

Down Drain Feature: 2F2

Flow Through Circular Pipe

Number of Pipes, N=	6	
Diameter of pipe, D=	18	inches
Longitudinal Slope, So=	0.040	ft/ft
Manning's n=	0.009	
Density of flowing liquid, rho=	1.94	slugs/ft^3
Peak Discharge, Q_{25}=	117.4	cfs
Peak Discharge, Q_{100}=	155.4	cfs

Theta radians	Theta degrees	Depth of Flow y inches	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R ft	Average Velocity V ft/s	Discharge Q=A*V cfs	Force F lbf
0.00	0	0.0	0.000	0.00		0.0	0.00	0.0
0.25	14	0.1	0.001	0.19	0.00	0.8	0.00	0.0
0.50	29	0.3	0.006	0.38	0.02	2.0	0.07	0.0
0.75	43	0.6	0.019	0.56	0.03	3.5	0.40	0.5
1.00	57	1.1	0.045	0.75	0.06	5.0	1.35	2.2
1.25	72	1.7	0.085	0.94	0.09	6.7	3.38	7.3
1.50	86	2.4	0.141	1.13	0.13	8.3	7.04	18.9
1.75	100	3.2	0.215	1.31	0.16	9.9	12.82	41.1
2.00	115	4.1	0.307	1.50	0.20	11.5	21.14	78.5
2.25	129	5.1	0.414	1.69	0.25	13.0	32.21	135.1
2.50	143	6.2	0.535	1.88	0.29	14.3	46.02	213.4
2.75	158	7.2	0.666	2.06	0.32	15.6	62.27	313.7
3.00	172	8.4	0.804	2.25	0.36	16.7	80.41	433.4
3.25	186	9.5	0.944	2.44	0.39	17.6	99.70	567.1
3.50	201	10.6	1.083	2.63	0.41	18.3	119.21	707.1
3.75	215	11.7	1.215	2.81	0.43	18.9	137.98	844.2
4.00	229	12.7	1.338	3.00	0.45	19.3	155.10	969.0
4.25	244	13.7	1.447	3.19	0.45	19.6	169.76	1073.2
4.50	258	14.7	1.541	3.38	0.46	19.6	181.39	1151.0
4.75	272	15.5	1.617	3.56	0.45	19.6	189.68	1199.0
5.00	286	16.2	1.676	3.75	0.45	19.3	194.58	1217.3
5.25	301	16.8	1.718	3.94	0.44	19.0	196.32	1208.8
5.50	315	17.3	1.745	4.13	0.42	18.7	195.36	1178.4
5.75	329	17.7	1.760	4.31	0.41	18.2	192.35	1132.7
6.00	344	17.9	1.766	4.50	0.39	17.7	188.02	1078.7
6.25	358	18.0	1.767	4.69	0.38	17.3	183.15	1022.9
3.48	199	10.5	1.071	2.61	0.41	18.3	117.49	694.8
4.01	230	12.8	1.341	3.00	0.45	19.3	155.52	972.2

Appendix 3
Perimeter Reach Calculation

Design/Check: Trapezoidal/Triangular Channel

Methodology: Manning's Equation

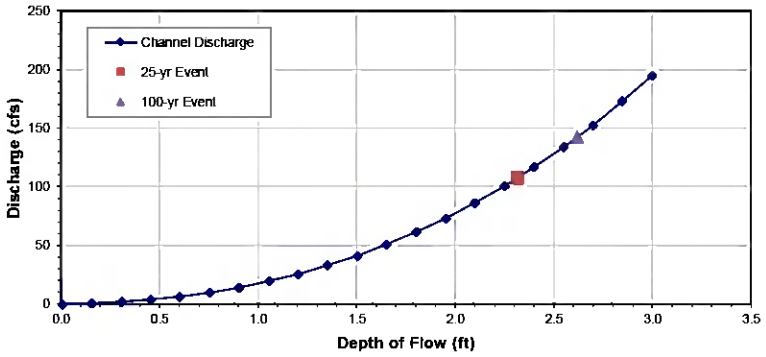
Project: Santee Cooper - Winyah Generating Station

Ditch ID: **Perimeter Reach 2A1** **Design**

Peak Discharge, Q_{25} =	107.76	cfs (25-yr Event)
Peak Discharge, Q_{100} =	142.91	cfs (100-yr Event)
Bottom Width, B =	3.00	ft
Left Side Slope, Z_1 =	3.00	horizontal :1 vertical
Right Side Slope, Z_2 =	3.00	horizontal :1 vertical
Channel Depth, Y =	3.00	ft
Top Width, T =	21.0	ft
Manning's Roughness Coeff., n =	0.027	
Longitudinal Channel Slope, S_o =	0.005	ft/ft

Depth, of Flow Y ft	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R=A/P ft	Average Velocity V ft/s	Discharge (Flow Rate) Q=AV ft^3/s	Avg. Tractive Stress τ_0 lb/ft^2	Comments
0.01	0.03	3.06	0.01	0.18	0.0	0.00	
0.16	0.55	4.01	0.14	1.04	0.6	0.04	
0.31	1.21	4.95	0.24	1.53	1.9	0.08	
0.46	2.01	5.90	0.34	1.90	3.8	0.11	
0.61	2.93	6.85	0.43	2.22	6.5	0.13	
0.76	3.99	7.79	0.51	2.50	10.0	0.16	
0.91	5.19	8.74	0.59	2.76	14.3	0.19	
1.06	6.52	9.68	0.67	3.00	19.5	0.21	
1.21	7.98	10.63	0.75	3.22	25.7	0.23	
1.36	9.58	11.57	0.83	3.44	32.9	0.26	
1.51	11.31	12.52	0.90	3.65	41.2	0.28	
1.65	13.18	13.46	0.98	3.85	50.7	0.31	
1.80	15.18	14.41	1.05	4.04	61.3	0.33	
1.95	17.31	15.36	1.13	4.23	73.2	0.35	
2.10	19.58	16.30	1.20	4.41	86.3	0.37	
2.25	21.98	17.25	1.27	4.59	100.8	0.40	
2.40	24.51	18.19	1.35	4.76	116.7	0.42	
2.55	27.18	19.14	1.42	4.93	134.1	0.44	
2.70	29.99	20.08	1.49	5.10	152.9	0.47	
2.85	32.93	21.03	1.57	5.26	173.3	0.49	
3.00	36.00	21.97	1.64	5.42	195.3	0.51	
2.32	23.07	17.66	1.31	4.66	107.59	0.41	Q (25-yr Event)
2.62	28.48	19.58	1.45	5.01	142.72	0.45	Q (100-yr Event)

Discharge versus Depth Relationship



Design/Check: Trapezoidal/Triangular Channel

Methodology: Manning's Equation

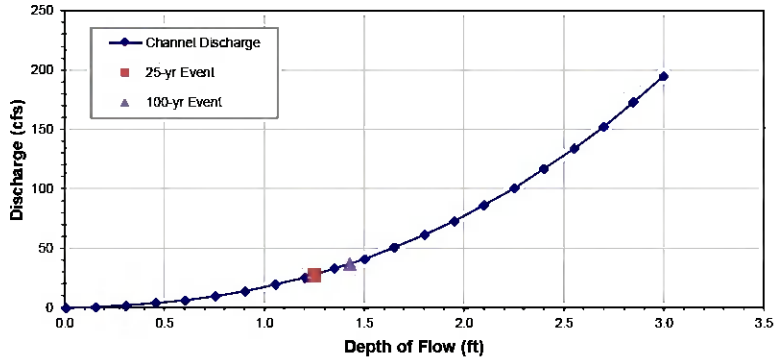
Project: Santee Cooper - Winyah Generating Station

Ditch ID: **Perimeter Reach 2A2** **Design**

Peak Discharge, Q_{25} =	27.98	cfs (25-yr Event)
Peak Discharge, Q_{100} =	37.02	cfs (100-yr Event)
Bottom Width, B =	3.00	ft
Left Side Slope, Z_1 =	3.00	horizontal :1 vertical
Right Side Slope, Z_2 =	3.00	horizontal :1 vertical
Channel Depth, Y =	3.00	ft
Top Width, T =	21.0	ft
Manning's Roughness Coeff., n =	0.027	
Longitudinal Channel Slope, S_o =	0.005	ft/ft

Depth of Flow Y ft	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R=A/P ft	Average Velocity V ft/s	Discharge (Flow Rate) Q=AV ft^3/s	Avg. Tractive Stress τ_0 lb/ft^2	Comments
0.01	0.03	3.06	0.01	0.18	0.0	0.00	
0.16	0.55	4.01	0.14	1.04	0.6	0.04	
0.31	1.21	4.95	0.24	1.53	1.9	0.08	
0.46	2.01	5.90	0.34	1.90	3.8	0.11	
0.61	2.93	6.85	0.43	2.22	6.5	0.13	
0.76	3.99	7.79	0.51	2.50	10.0	0.16	
0.91	5.19	8.74	0.59	2.76	14.3	0.19	
1.06	6.52	9.68	0.67	3.00	19.5	0.21	
1.21	7.98	10.63	0.75	3.22	25.7	0.23	
1.36	9.58	11.57	0.83	3.44	32.9	0.26	
1.51	11.31	12.52	0.90	3.65	41.2	0.28	
1.65	13.18	13.46	0.98	3.85	50.7	0.31	
1.80	15.18	14.41	1.05	4.04	61.3	0.33	
1.95	17.31	15.36	1.13	4.23	73.2	0.35	
2.10	19.58	16.30	1.20	4.41	86.3	0.37	
2.25	21.98	17.25	1.27	4.59	100.8	0.40	
2.40	24.51	18.19	1.35	4.76	116.7	0.42	
2.55	27.18	19.14	1.42	4.93	134.1	0.44	
2.70	29.99	20.08	1.49	5.10	152.9	0.47	
2.85	32.93	21.03	1.57	5.26	173.3	0.49	
3.00	36.00	21.97	1.64	5.42	195.3	0.51	
1.25	8.46	10.92	0.78	3.29	27.87	0.24	Q (25-yr Event)
1.43	10.41	12.04	0.86	3.54	36.88	0.27	Q (100-yr Event)

Discharge versus Depth Relationship



Design/Check: Trapezoidal/Triangular Channel

Methodology: Manning's Equation

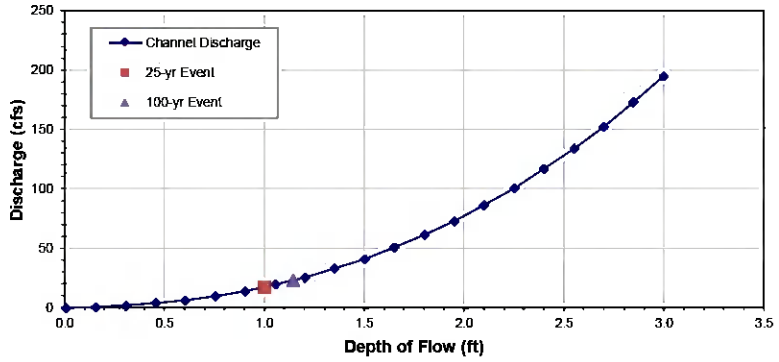
Project: Santee Cooper - Winyah Generating Station

Ditch ID: **Perimeter Reach 2BA** **Design**

Peak Discharge, Q_{25} =	17.62	cfs (25-yr Event)
Peak Discharge, Q_{100} =	23.32	cfs (100-yr Event)
Bottom Width, B =	3.00	ft
Left Side Slope, Z_1 =	3.00	horizontal :1 vertical
Right Side Slope, Z_2 =	3.00	horizontal :1 vertical
Channel Depth, Y =	3.00	ft
Top Width, T =	21.0	ft
Manning's Roughness Coeff., n =	0.027	
Longitudinal Channel Slope, S_o =	0.005	ft/ft

Depth of Flow Y ft	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R=A/P ft	Average Velocity V ft/s	Discharge (Flow Rate) Q=AV ft^3/s	Avg. Tractive Stress τ_0 lb/ft^2	Comments
0.01	0.03	3.06	0.01	0.18	0.0	0.00	
0.16	0.55	4.01	0.14	1.04	0.6	0.04	
0.31	1.21	4.95	0.24	1.53	1.9	0.08	
0.46	2.01	5.90	0.34	1.90	3.8	0.11	
0.61	2.93	6.85	0.43	2.22	6.5	0.13	
0.76	3.99	7.79	0.51	2.50	10.0	0.16	
0.91	5.19	8.74	0.59	2.76	14.3	0.19	
1.06	6.52	9.68	0.67	3.00	19.5	0.21	
1.21	7.98	10.63	0.75	3.22	25.7	0.23	
1.36	9.58	11.57	0.83	3.44	32.9	0.26	
1.51	11.31	12.52	0.90	3.65	41.2	0.28	
1.65	13.18	13.46	0.98	3.85	50.7	0.31	
1.80	15.18	14.41	1.05	4.04	61.3	0.33	
1.95	17.31	15.36	1.13	4.23	73.2	0.35	
2.10	19.58	16.30	1.20	4.41	86.3	0.37	
2.25	21.98	17.25	1.27	4.59	100.8	0.40	
2.40	24.51	18.19	1.35	4.76	116.7	0.42	
2.55	27.18	19.14	1.42	4.93	134.1	0.44	
2.70	29.99	20.08	1.49	5.10	152.9	0.47	
2.85	32.93	21.03	1.57	5.26	173.3	0.49	
3.00	36.00	21.97	1.64	5.42	195.3	0.51	
1.00	6.02	9.34	0.64	2.91	17.51	0.20	Q (25-yr Event)
1.15	7.40	10.26	0.72	3.14	23.20	0.22	Q (100-yr Event)

Discharge versus Depth Relationship



Design/Check: Trapezoidal/Triangular Channel

Methodology: Manning's Equation

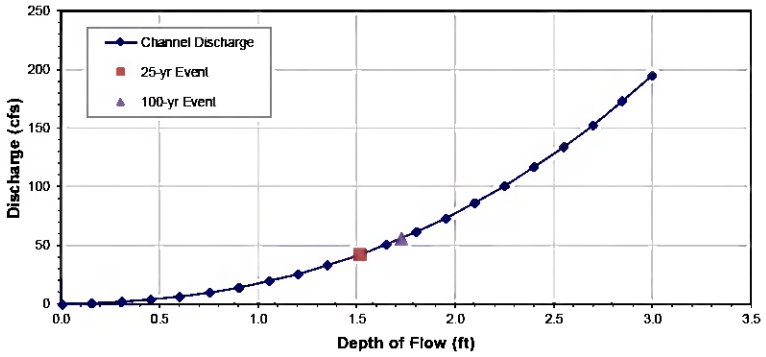
Project: Santee Cooper - Winyah Generating Station

Ditch ID: **Perimeter Reach 2BB** **Design**

Peak Discharge, Q_{25} =	42.20	cfs (25-yr Event)
Peak Discharge, Q_{100} =	55.89	cfs (100-yr Event)
Bottom Width, B =	3.00	ft
Left Side Slope, Z_1 =	3.00	horizontal :1 vertical
Right Side Slope, Z_2 =	3.00	horizontal :1 vertical
Channel Depth, Y =	3.00	ft
Top Width, T =	21.0	ft
Manning's Roughness Coeff., n =	0.027	
Longitudinal Channel Slope, S_o =	0.005	ft/ft

Depth, of Flow Y ft	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R=A/P ft	Average Velocity V ft/s	Discharge (Flow Rate) Q=AV ft^3/s	Avg. Tractive Stress τ_0 lb/ft^2	Comments
0.01	0.03	3.06	0.01	0.18	0.0	0.00	
0.16	0.55	4.01	0.14	1.04	0.6	0.04	
0.31	1.21	4.95	0.24	1.53	1.9	0.08	
0.46	2.01	5.90	0.34	1.90	3.8	0.11	
0.61	2.93	6.85	0.43	2.22	6.5	0.13	
0.76	3.99	7.79	0.51	2.50	10.0	0.16	
0.91	5.19	8.74	0.59	2.76	14.3	0.19	
1.06	6.52	9.68	0.67	3.00	19.5	0.21	
1.21	7.98	10.63	0.75	3.22	25.7	0.23	
1.36	9.58	11.57	0.83	3.44	32.9	0.26	
1.51	11.31	12.52	0.90	3.65	41.2	0.28	
1.65	13.18	13.46	0.98	3.85	50.7	0.31	
1.80	15.18	14.41	1.05	4.04	61.3	0.33	
1.95	17.31	15.36	1.13	4.23	73.2	0.35	
2.10	19.58	16.30	1.20	4.41	86.3	0.37	
2.25	21.98	17.25	1.27	4.59	100.8	0.40	
2.40	24.51	18.19	1.35	4.76	116.7	0.42	
2.55	27.18	19.14	1.42	4.93	134.1	0.44	
2.70	29.99	20.08	1.49	5.10	152.9	0.47	
2.85	32.93	21.03	1.57	5.26	173.3	0.49	
3.00	36.00	21.97	1.64	5.42	195.3	0.51	
1.52	11.49	12.61	0.91	3.67	42.15	0.28	Q (25-yr Event)
1.73	14.14	13.93	1.02	3.94	55.74	0.32	Q (100-yr Event)

Discharge versus Depth Relationship



Design/Check: Trapezoidal/Triangular Channel

Methodology: Manning's Equation

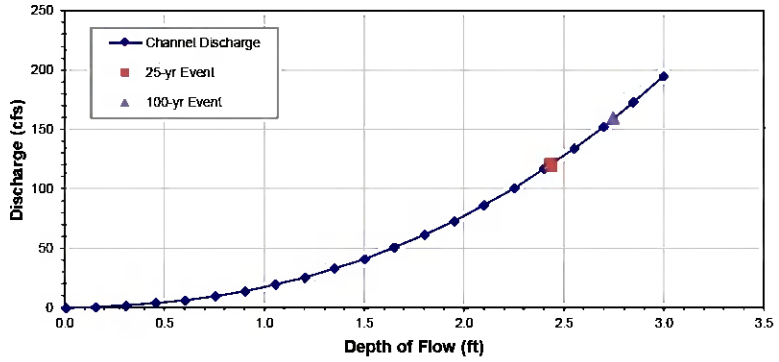
Project: Santee Cooper - Winyah Generating Station

Ditch ID: **Perimeter Reach 2C1** **Design**

Peak Discharge, Q_{25} =	120.38	cfs (25-yr Event)
Peak Discharge, Q_{100} =	159.56	cfs (100-yr Event)
Bottom Width, B =	3.00	ft
Left Side Slope, Z_1 =	3.00	horizontal :1 vertical
Right Side Slope, Z_2 =	3.00	horizontal :1 vertical
Channel Depth, Y =	3.00	ft
Top Width, T =	21.0	ft
Manning's Roughness Coeff., n =	0.027	
Longitudinal Channel Slope, S_o =	0.005	ft/ft

Depth of Flow Y ft	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R=A/P ft	Average Velocity V ft/s	Discharge (Flow Rate) Q=AV ft^3/s	Avg. Tractive Stress τ_0 lb/ft^2	Comments
0.01	0.03	3.06	0.01	0.18	0.0	0.00	
0.16	0.55	4.01	0.14	1.04	0.6	0.04	
0.31	1.21	4.95	0.24	1.53	1.9	0.08	
0.46	2.01	5.90	0.34	1.90	3.8	0.11	
0.61	2.93	6.85	0.43	2.22	6.5	0.13	
0.76	3.99	7.79	0.51	2.50	10.0	0.16	
0.91	5.19	8.74	0.59	2.76	14.3	0.19	
1.06	6.52	9.68	0.67	3.00	19.5	0.21	
1.21	7.98	10.63	0.75	3.22	25.7	0.23	
1.36	9.58	11.57	0.83	3.44	32.9	0.26	
1.51	11.31	12.52	0.90	3.65	41.2	0.28	
1.65	13.18	13.46	0.98	3.85	50.7	0.31	
1.80	15.18	14.41	1.05	4.04	61.3	0.33	
1.95	17.31	15.36	1.13	4.23	73.2	0.35	
2.10	19.58	16.30	1.20	4.41	86.3	0.37	
2.25	21.98	17.25	1.27	4.59	100.8	0.40	
2.40	24.51	18.19	1.35	4.76	116.7	0.42	
2.55	27.18	19.14	1.42	4.93	134.1	0.44	
2.70	29.99	20.08	1.49	5.10	152.9	0.47	
2.85	32.93	21.03	1.57	5.26	173.3	0.49	
3.00	36.00	21.97	1.64	5.42	195.3	0.51	
2.43	25.07	18.39	1.36	4.80	120.26	0.43	Q (25-yr Event)
2.75	30.93	20.39	1.52	5.15	159.39	0.47	Q (100-yr Event)

Discharge versus Depth Relationship



Design/Check: Trapezoidal/Triangular Channel

Methodology: Manning's Equation

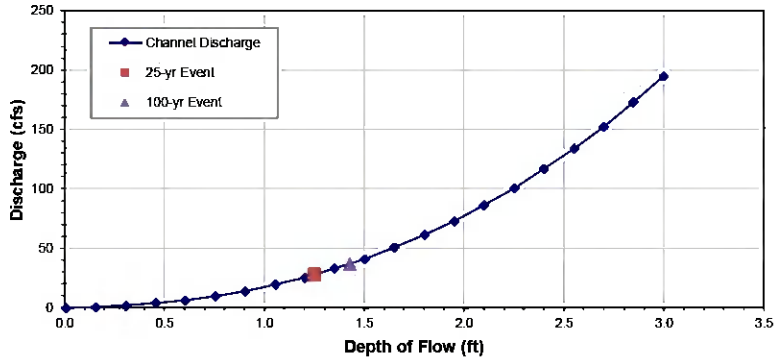
Project: Santee Cooper - Winyah Generating Station

Ditch ID: **Perimeter Reach 2DA** **Design**

Peak Discharge, Q_{25} =	28.06	cfs (25-yr Event)
Peak Discharge, Q_{100} =	37.14	cfs (100-yr Event)
Bottom Width, B =	3.00	ft
Left Side Slope, Z_1 =	3.00	horizontal :1 vertical
Right Side Slope, Z_2 =	3.00	horizontal :1 vertical
Channel Depth, Y =	3.00	ft
Top Width, T =	21.0	ft
Manning's Roughness Coeff., n =	0.027	
Longitudinal Channel Slope, S_o =	0.005	ft/ft

Depth of Flow Y ft	Area of Flow A ft^2	Wetted Perimeter P ft	Hydraulic Radius R=A/P ft	Average Velocity V ft/s	Discharge (Flow Rate) Q=AV ft^3/s	Avg. Tractive Stress τ_0 lb/ft^2	Comments
0.01	0.03	3.06	0.01	0.18	0.0	0.00	
0.16	0.55	4.01	0.14	1.04	0.6	0.04	
0.31	1.21	4.95	0.24	1.53	1.9	0.08	
0.46	2.01	5.90	0.34	1.90	3.8	0.11	
0.61	2.93	6.85	0.43	2.22	6.5	0.13	
0.76	3.99	7.79	0.51	2.50	10.0	0.16	
0.91	5.19	8.74	0.59	2.76	14.3	0.19	
1.06	6.52	9.68	0.67	3.00	19.5	0.21	
1.21	7.98	10.63	0.75	3.22	25.7	0.23	
1.36	9.58	11.57	0.83	3.44	32.9	0.26	
1.51	11.31	12.52	0.90	3.65	41.2	0.28	
1.65	13.18	13.46	0.98	3.85	50.7	0.31	
1.80	15.18	14.41	1.05	4.04	61.3	0.33	
1.95	17.31	15.36	1.13	4.23	73.2	0.35	
2.10	19.58	16.30	1.20	4.41	86.3	0.37	
2.25	21.98	17.25	1.27	4.59	100.8	0.40	
2.40	24.51	18.19	1.35	4.76	116.7	0.42	
2.55	27.18	19.14	1.42	4.93	134.1	0.44	
2.70	29.99	20.08	1.49	5.10	152.9	0.47	
2.85	32.93	21.03	1.57	5.26	173.3	0.49	
3.00	36.00	21.97	1.64	5.42	195.3	0.51	
1.25	8.48	10.93	0.78	3.29	27.95	0.24	Q (25-yr Event)
1.43	10.44	12.05	0.87	3.55	37.00	0.27	Q (100-yr Event)

Discharge versus Depth Relationship



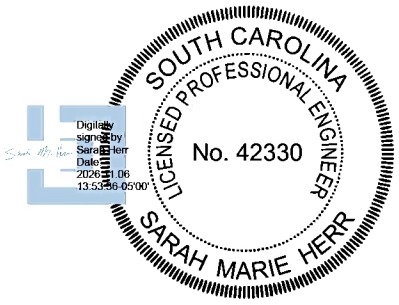
APPENDIX I-C

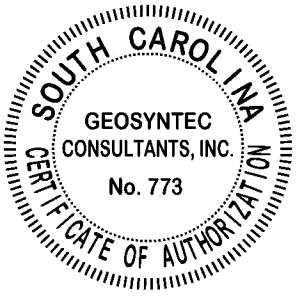
Active Area Run-On Control Calculations

Written by: **A. Brand** Date: **10/16/2026** Reviewed by: **S. Herr** Date: **11/6/2026**

Client: **Santee Cooper** Project: **Winyah Generating Station** Project No.: **26009458** Task No.: **005**

ACTIVE AREA RUN-ON CONTROL





SEALED FOR

CALCULATION PAGES 1 THROUGH 19

1 INTRODUCTION

The purpose of this calculation package is to:

- present an update to the originally permitted calculation from 2016 for compliance with the Federal CCR Rule;
- present the analysis for the sizing of the temporary diversion berms utilized as necessary at the active face (i.e., diversions around areas of exposed waste) during development of Landfill Area 2 at the Winyah Generating Station (WGS) in Georgetown County, South Carolina; and
- present the analysis for the sizing of the contact water management ditch located around the landfill perimeter, which receives contact water generated from exterior-facing waste slopes and conveys the contact water run-off to temporary internal low points for collection and removal.

Diversion berms are temporary soil berms constructed as necessary up-gradient from the active working face (exposed waste areas) to intercept stormwater run-off before it comes into contact with waste. These temporary diversion berms route the non-contact (clean) stormwater around active areas into the surface water management system and away from the active face. Contact water management ditches are temporary features along the landfill perimeter, which intercept and convey contact water from exterior-facing uncovered waste slopes (i.e., prior to installation of intermediate or final cover).

To provide operator flexibility to adapt to differing conditions, rather than provide just one required design berm and ditch size for run-on control, this calculation package provides the

sizing needed for a variety of cases. These are intended to capture the expected range of operational conditions, while providing operational flexibility to choose the appropriate minimum berm and ditch sizes based on the conditions that exist up-gradient from specific active areas at any point in time. As such, for these analyses, the maximum up-gradient drainage area which can be managed by the given diversion berm size and ditch size, and for the 25-year, 24-hour rainfall event, is calculated for run-on controls as required by the Federal CCR Rule.

2 ASSUMPTIONS AND PROCEDURES

The section discusses the assumptions and procedures for the design of the temporary diversion berms and contact water management ditch.

Active Face Run-On Diversion Berms

Temporary diversion berms are installed with flow line (longitudinal) slopes ranging from 0.5% to 2%. Temporary diversion berms are placed as needed up-gradient from the active working face. The temporary diversion berms are assumed to be "tack-on" berms with a 2.5H:1V side slope (see Figure 1 of this calculation package) to form a vee-shaped channel. A channel depth of 2.0 feet was assumed (i.e., this is a fixed parameter of these calculations).

The Soil Conservation Service (SCS) Technical Release 20 (TR-20) Method (SCS Method) [SCS, 1982] described in the Georgetown County *Stormwater Management Design Manual (2025 Edition)* [2025] is used to calculate the peak surface water discharge. This approach is considered appropriate given that drainage areas to diversion berms will be on the order of 2 acres or more. The channels were sized assuming they are flowing full, which is considered adequate since they are interior and temporary site features, and given other conservative selections of parameters as documented herein. The following steps were utilized to calculate the drainage areas that the diversion berms can accommodate.

1. Compute the discharge capacity of diversion berms with 0.5%, 1%, 1.5%, and 2% slopes using Manning's Equation for open channel flow.
2. Apply the SCS Method to compute the up-gradient drainage area that would produce the discharge capacity calculated in Step 1.

Manning's equation was used to estimate the peak discharge capacity of the vee-shaped channel created by a temporary diversion berm. Manning's equation [Chow, 1959] is expressed as:

$$Q = \frac{1.49}{n} A R^{2/3} S^{1/2} \quad (1)$$

where:

Q = discharge (cfs)
n = Manning's roughness coefficient
A = area of cross-section of flow (ft^2)
P = wetted perimeter (ft)
R = hydraulic radius = A/P (ft)
S = longitudinal slope (ft/ft)

The peak discharge from the contributing drainage area by the SCS Method [SCS, 1982; Georgetown County, 2006] can be computed by:

$$Q_p = q_u \times A \times Q \times F_p \quad (2)$$

where:

Q_p = peak design discharge (cfs)
q_u = unit peak discharge ($cfs/mi^2/in.$)
A = drainage area (mi^2)
Q = run-off (in.)
F_p = pond and swamp adjustment factor (unitless)

The pond and swamp adjustment factor is 1.00 using Table 1. Run-off was computed by:

$$Q = \frac{(P-0.2S)^2}{(P+0.8S)} \quad (3)$$

where:

Q = total run-off volume for the specified storm event (in.)
P = rainfall depth for the specified storm event (in.)
S = potential maximum retention after run-off begins (in.)

The rainfall depth corresponding to the 25-year, 24-hour storm event was selected based on information from the National Oceanic and Atmospheric Administration (NOAA) Atlas 14,

Volume 2, Version 3 Point Precipitation Frequency Estimates [NOAA, 2026]. The 25-year, 24-hour rainfall depth is 8.28 in., as shown in Table 2.

Potential maximum retention after run-off begins is computed by:

$$S = \frac{1000}{CN} - 10 \qquad (4)$$

where:

S = potential maximum retention after run-off begins (in.)
CN = SCS curve number

Unit peak discharge in Equation (2) was found using Figure 2. For a conservative design approach, a minimum time of concentration of 5 minutes was used. The ratio of initial abstraction (Ia) and rainfall volume for the specified storm event (P) was used, where:

$$I_a = 0.2S \qquad (5)$$

where:

I_a = initial abstraction (in.)
S = potential maximum retention after run-off begins (in.)

Equation (2) is rearranged, and the watershed drainage area was back-calculated for each potential flow line slope of a temporary diversion berm.

Contact Water Management Ditch

Contact water management ditches are installed with flow line (longitudinal) slopes ranging from 0.5% to 2%. A schematic (conceptual) layout of the contact water management ditch and contributing areas is presented in Figure 3 of this calculation package. As shown, for calculation purposes the ditch is modeled as a vee-shaped channel. A minimum channel depth of 2.0 feet was assumed (i.e., this is a fixed parameter of these calculations), and since this ditch is positioned near the landfill perimeter, it is designed to have 0.5 feet of freeboard (i.e., a flow depth of 1.5 feet). Note that to route the ditch towards low points, the ditch depth will by definition increase as the flow line drops in elevation along the ditch alignment. To be conservative, the ditch is modeled with a constant depth using the minimum flow depth. Thus, if

it is installed and operated according to the sizing and drainage area calculations presented herein, the run-on control system is expected to convey the design storm.

The SCS Method [SCS, 1982; Georgetown County, 2025] approach and methodology as described above for the diversion berms is used. The calculations are performed for ditches with 0.5%, 1%, 1.5%, and 2% slopes.

3 DESIGN PARAMETERS

This section discusses the justification behind the selected design parameters for the temporary diversion berms. Where applicable, design parameter values were obtained from the Georgetown County *Stormwater Design Manual (2006 Edition)* [2006], as these values are not provided in the 2025 Edition [Georgetown County, 2025].

The Manning's roughness coefficient (*n*) for the diversion berm was selected as 0.02 for unlined, bare soil channels with flow depths larger than 0.5 feet, as shown in Table 3 [Georgetown County, 2006]. This was also used for the ditch (considered an appropriate representation of a bare ground channel formed of exposed waste).

The peak discharge flowing to the channel is calculated using the SCS Method [SCS, 1982]. A curve number (CN) of 86 was selected to model the diversion berm scenario, as the type of ground cover in that area is assumed to be 100% CCR. A curve number of 94 was selected to model the contact water management ditch scenario as a newly graded area for hydrologic soil group (HSG) D as shown in Table 4 and Table 5. A soil survey map is provided in Figure 4. The CN was increased as compared to the diversion berm scenario to account for graded bare ground waste material, which is judged likely to allow less infiltration and produce more run-off (similar, but not quite as much run-off as from paved streets).

4 RESULTS

Diversion Berms

The results of the temporary diversion berm calculations are summarized in Table 6 for each assumed flow line slope. The calculated drainage areas represent the maximum drainage area that each temporary diversion berm configuration can accommodate for the 25-year, 24-hour storm event. It should be noted that if, during operations, a larger area than those calculated in Table 6 will be draining towards the active face, multiple diversion berms may be constructed to

comply with the drainage area requirements presented herein for the given berm height and the selected flow line slope.

Contact Water Management Ditch

The results of the contact water management ditch calculations are summarized in Table 7 for each assumed flow line slope. The calculated drainage areas represent the maximum drainage area that each contact water management ditch configuration can accommodate for the 25-year, 24-hour storm event. It should be noted that if, during operations, a larger area than those calculated in Table 7 will be draining towards the contact water management ditch, this indicates that either: (i) a new and separate contact water management ditch is needed (flowing to its own separate low area for collection and removal of contact water); (ii) up-gradient diversion berms/terraces on the exterior waste slopes can be used to divert contact water to other areas and thereby reduce the drainage area contributing to the contact water management ditch to be within acceptable area; or (iii) an enlarged ditch (e.g., with a trapezoidal bottom instead of the v-ditch assumed herein) is needed, which may be calculated using the methodology presented herein.

5 REFERENCES

Chow, V.T. (1959). *Open-Channel Hydraulics*, McGraw-Hill Book Company, Inc., New York, NY.

Georgetown County (2006). *Stormwater Management Design Manual*. Georgetown County, South Carolina.

Georgetown County (2025). *Stormwater Management Design Manual*. Georgetown County, South Carolina.

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SCS (1982). *Technical Release Number 20 (TR-20)*. National Technical Information Service.

USDA (2026). Web Soil Survey, Soil Survey Staff, Natural Resources Conservation Service (NRCS), United States Department of Agriculture, available online at http://websoilsurvey.nrcs.usda.gov, accessed June 2026.

TABLES

Table 1. Pond and Swamp Adjustment Factor (from Georgetown County, 2006)

Table 2. Precipitation Frequency for Georgetown, South Carolina (from NOAA, 2026)

Table 3. Manning's Roughness Coefficients for Artificial Channels (from Georgetown County, 2006)

Table 4. Hydrologic Soil Groups for On-Site Soils (from USDA, 2026)

Table 5. Run-off Curve Number for Urban Areas and Agricultural Lands NRCS (SCS) CN Method (from Georgetown County, 2006)

Table 6. Diversion Berm Drainage Area Sizing

Table 7. Contact Water Management Ditch Drainage Area Sizing

Table 1. Pond and Swamp Adjustment Factor

(from Georgetown County, 2006)

Pond and Swamp Areas (%)*	F_p
0.0	1.00
0.2	0.97
1.0	0.87
3.0	0.75
5.0	0.72
*Percent of entire drainage basin	

Table 2. Precipitation Frequency for Georgetown, South Carolina

(from NOAA, 2026)

NOAA Atlas 14, Volume 2, Version 3
Location name: Georgetown, South Carolina, USA*
Latitude: 33.3343°, Longitude: -79.3551°
Elevation: 18.82 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

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

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.502 (0.468-0.543)	0.586 (0.545-0.636)	0.668 (0.619-0.722)	0.761 (0.703-0.823)	0.857 (0.789-0.927)	0.942 (0.863-1.02)	1.02 (0.929-1.10)	1.10 (0.993-1.19)	1.19 (1.07-1.29)	1.28 (1.14-1.39)
10-min	0.803 (0.748-0.868)	0.938 (0.872-1.02)	1.07 (0.992-1.16)	1.22 (1.13-1.32)	1.37 (1.26-1.48)	1.50 (1.38-1.62)	1.62 (1.48-1.75)	1.74 (1.57-1.88)	1.89 (1.69-2.04)	2.02 (1.79-2.19)
15-min	1.00 (0.935-1.09)	1.18 (1.10-1.28)	1.35 (1.25-1.46)	1.54 (1.42-1.67)	1.73 (1.59-1.87)	1.90 (1.74-2.05)	2.05 (1.87-2.22)	2.19 (1.99-2.37)	2.37 (2.13-2.57)	2.53 (2.25-2.75)
30-min	1.38 (1.28-1.49)	1.63 (1.51-1.77)	1.92 (1.78-2.08)	2.23 (2.06-2.41)	2.57 (2.38-2.77)	2.86 (2.62-3.09)	3.14 (2.86-3.39)	3.42 (3.09-3.69)	3.78 (3.38-4.09)	4.10 (3.64-4.45)
60-min	1.72 (1.60-1.85)	2.04 (1.90-2.22)	2.46 (2.29-2.67)	2.90 (2.68-3.14)	3.42 (3.14-3.69)	3.88 (3.55-4.19)	4.32 (3.94-4.67)	4.79 (4.34-5.18)	5.42 (4.86-5.87)	5.98 (5.32-6.50)
2-hr	2.08 (1.92-2.24)	2.49 (2.30-2.69)	3.07 (2.83-3.31)	3.66 (3.37-3.96)	4.37 (4.00-4.72)	5.01 (4.56-5.40)	5.63 (5.10-6.07)	6.27 (5.64-6.76)	7.10 (6.33-7.68)	7.85 (6.93-8.51)
3-hr	2.23 (2.06-2.42)	2.66 (2.45-2.91)	3.30 (3.03-3.59)	3.97 (3.64-4.33)	4.79 (4.37-5.21)	5.55 (5.02-6.03)	6.31 (5.66-6.84)	7.10 (6.33-7.71)	8.19 (7.20-8.91)	9.18 (7.98-10.0)
6-hr	2.66 (2.44-2.91)	3.19 (2.91-3.49)	3.94 (3.60-4.32)	4.75 (4.33-5.20)	5.76 (5.21-6.30)	6.69 (6.01-7.31)	7.61 (6.79-8.32)	8.62 (7.62-9.40)	9.97 (8.71-10.9)	11.2 (9.69-12.3)
12-hr	3.11 (2.84-3.44)	3.72 (3.39-4.11)	4.63 (4.21-5.12)	5.62 (5.10-6.20)	6.85 (6.17-7.54)	8.00 (7.15-8.78)	9.17 (8.12-10.0)	10.4 (9.15-11.4)	12.2 (10.5-13.4)	13.8 (11.8-15.2)
24-hr	3.64 (3.33-3.99)	4.42 (4.06-4.85)	5.71 (5.22-6.26)	6.77 (6.17-7.41)	8.28 (7.50-9.05)	9.53 (8.59-10.4)	10.9 (9.74-11.9)	12.3 (11.0-13.5)	14.4 (12.7-15.8)	16.1 (14.1-17.7)
2-day	4.30 (3.94-4.70)	5.21 (4.78-5.70)	6.66 (6.10-7.27)	7.85 (7.18-8.57)	9.56 (8.68-10.4)	11.0 (9.90-12.0)	12.5 (11.2-13.6)	14.1 (12.6-15.4)	16.4 (14.5-18.1)	18.3 (16.0-20.2)
3-day	4.55 (4.18-4.98)	5.50 (5.06-6.03)	7.00 (6.41-7.65)	8.21 (7.50-8.97)	9.93 (9.03-10.8)	11.3 (10.3-12.4)	12.9 (11.6-14.1)	14.5 (12.9-15.8)	16.7 (14.8-18.4)	18.6 (16.4-20.5)
4-day	4.81 (4.42-5.27)	5.80 (5.33-6.36)	7.33 (6.72-8.02)	8.57 (7.83-9.37)	10.3 (9.37-11.3)	11.7 (10.6-12.8)	13.2 (11.9-14.5)	14.8 (13.3-16.2)	17.1 (15.2-18.8)	18.9 (16.7-20.9)
7-day	5.61 (5.19-6.10)	6.76 (6.25-7.35)	8.44 (7.78-9.16)	9.78 (9.00-10.6)	11.6 (10.7-12.6)	13.1 (12.0-14.2)	14.7 (13.3-16.0)	16.3 (14.8-17.8)	18.6 (16.7-20.3)	20.5 (18.3-22.4)
10-day	6.36 (5.91-6.87)	7.63 (7.08-8.23)	9.36 (8.68-10.1)	10.7 (9.91-11.5)	12.5 (11.6-13.5)	14.0 (12.9-15.1)	15.5 (14.2-16.7)	17.0 (15.5-18.4)	19.1 (17.3-20.7)	20.9 (18.8-22.6)
20-day	8.60 (8.05-9.20)	10.2 (9.59-11.0)	12.4 (11.6-13.2)	14.0 (13.1-15.0)	16.3 (15.2-17.4)	18.0 (16.7-19.3)	19.8 (18.3-21.2)	21.7 (20.0-23.2)	24.2 (22.1-26.0)	26.2 (23.8-28.2)
30-day	10.6 (9.98-11.2)	12.6 (11.8-13.3)	14.9 (14.0-15.8)	16.7 (15.7-17.7)	19.0 (17.8-20.1)	20.8 (19.5-22.1)	22.6 (21.1-24.0)	24.4 (22.7-26.0)	26.9 (24.8-28.6)	28.8 (26.5-30.7)
45-day	13.4 (12.7-14.2)	15.8 (15.0-16.8)	18.5 (17.5-19.6)	20.5 (19.3-21.7)	23.1 (21.8-24.5)	25.1 (23.6-26.6)	27.1 (25.4-28.7)	29.0 (27.1-30.9)	31.6 (29.4-33.7)	33.6 (31.1-35.9)
60-day	16.0 (15.1-16.9)	18.8 (17.8-19.9)	21.8 (20.6-23.0)	24.1 (22.7-25.4)	26.9 (25.3-28.4)	29.1 (27.3-30.7)	31.2 (29.3-33.0)	33.3 (31.1-35.3)	36.0 (33.6-38.3)	38.1 (35.4-40.6)

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

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

Please refer to NOAA Atlas 14 document for more information.

Table 3. Manning's Roughness Coefficients for Artificial Channels

(from Georgetown County, 2006)

Lining Category	Lining Type	"n" at various flow depths		
		0 - 0.5 ft	0.5 - 2.0 ft	>2.0 ft
Rigid	Concrete	0.015	0.013	0.013
	Grouted Riprap	0.040	0.030	0.028
	Stone Masonry	0.042	0.032	0.030
	Soil Cement	0.025	0.022	0.020
	Asphalt	0.018	0.016	0.016
Unlined	Bare Soil	0.023	0.020	0.020
	Rock Cut	0.045	0.035	0.025
Temporary[1]	Woven Paper Net	0.016	0.015	0.015
	Jute Net	0.028	0.022	0.019
	Fiberglass Roving	0.028	0.022	0.019
	Straw with Net	0.065	0.033	0.025
	Curled Wood Mat	0.066	0.035	0.028
	Synthetic Mat	0.036	0.025	0.021
Gravel	1-inch D_{50}	0.044	0.033	0.030
	2-inch D_{50}	0.066	0.041	0.034
Rock Riprap	6-inch D_{50}	0.104	0.069	0.035
	12-inch D_{50}	---	0.078	0.040

Source: Federal Highway Administration. Design of Roadside Channels with Flexible Linings. HEC-15, 1988.
Note: Values listed are representative values for the respective depth ranges. Manning's "n" varies with the flow depth.
[1]Some "temporary" linings become permanent when buried.

Table 4. Hydrologic Soil Groups for On-Site Soils

(from USDA, 2026)

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
10	Leon sand, 0 to 2 percent slopes	A/D	144.4	3.2%
12A	Yauhannah loamy fine sand, 0 to 2 percent slopes	B/D	742.5	16.3%
13	Bladen loam, 0 to 2 percent slopes	C/D	367.9	8.1%
18	Cape Fear loam	C/D	15.1	0.3%
20	Centenary fine sand	A	226.5	5.0%
24B	Chisolm sand, 0 to 4 percent slopes	A	55.0	1.2%
25A	Wakulla sand, 0 to 2 percent slopes	A	48.8	1.1%
26A	Eulonia loamy fine sand, 0 to 2 percent slopes	C/D	555.6	12.2%
27	Rutlege sand	A/D	109.4	2.4%
28	Echaw sand	A	388.0	8.5%
33	Hobonny muck	A/D	89.0	2.0%
34	Johnston loam	A/D	83.4	1.8%
50	Lynn Haven sand	A/D	36.2	0.8%
54A	Chipley fine sand, 0 to 2 percent slopes	A	2.4	0.1%
55	Witherbee fine sand	A/D	461.7	10.1%
57	Grifton loamy fine sand	B/D	45.3	1.0%
58	Udorthents, loamy	B/D	399.6	8.8%
59	Wahee fine sandy loam	C/D	510.6	11.2%
61	Yemassee loamy fine sand	B/D	81.9	1.8%
W	Water		191.5	4.2%
Totals for Area of Interest			**4,554.7**	**100.0%**

Table 5. Run-off Curve Number for Urban Areas and Agricultural Lands NRCS (SCS) CN Method

(from Georgetown County, 2006)

Cover Description Cover Type and Hydrologic Condition	Average Percent Impervious Area[2]	Curve Numbers for Hydrologic Soil Group			
		A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc)[3]		68	79	86	89
Poor Condition (grass cover<50%)		49	69	79	84
Fair Condition (grass cover 50% to 75%)		39	61	74	80
Good Condition (grass cover >75%)					
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas and agricultural land					
Newly graded areas (pervious areas only, no vegetation)		77	86	91	94
Pasture, grassland, or range: continuous forage for grazing[4]	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	61	74	80
Meadow: continuous grass, protected from grazing and generally mowed for hay	-	30	58	71	78
Brush-brush, weed, grass mixture with brush the major element[5]	Poor	48	67	77	83
	Fair	35	56	70	77
	Good	[7]30	48	65	73

Table 6. Diversion Berm Drainage Area Sizing

Depth of Channel (ft)	Diversion Berm Flow Line Slope (%)	Maximum Predicted Flow Velocity (ft/s)	Maximum Predicted Flow Rate (cfs)	Maximum Drainage Area (ac)
2.0	0.5%	5.05	55.58	8.3
	1.0%	7.15	78.60	11.7
	1.5%	8.75	96.27	14.4
	2.0%	10.11	111.16	16.6

Note: The back-calculated maximum allowable drainage area for the channel dimensions (geometry and slope) given above, as calculated by the NRCS/SCS Method, assumes that the channel created by the diversion berm is flowing full when conveying the peak discharge during the 25-year rainfall event and from the maximum contributing drainage area.

Table 7. Contact Water Management Ditch Drainage Area Sizing

Depth of Channel (ft)	Depth of Flow (ft)	Diversion Berm Flow Line Slope (%)	Maximum Predicted Flow Velocity (ft/s)	Maximum Predicted Flow Rate (cfs)	Maximum Drainage Area (ac)
2	1.5	0.5%	4.20	28.34	3.7
		1.0%	5.94	40.08	5.2
		1.5%	7.27	49.09	6.4
		2.0%	8.40	56.68	7.4

Note: As indicated in the above table, the contact water management ditch is designed to have 0.5-ft of freeboard. That is, the back-calculated maximum allowable drainage area for the channel dimensions (geometry and slope) given above, as calculated by the NRCS/SCS Method, assumes that the 2-ft deep channel created by the contact water management ditch has a depth of flow of 1.5-ft when conveying the peak discharge during the 25-year rainfall event and from the maximum contributing drainage area.

FIGURES

Figure 1. Typical/Schematic (Conceptual) of Phased Active Fill Area Section

Figure 2. NRCS (SCS) Type III Unit Peak Discharge Graph (from Georgetown County, 2006)

Figure 2. Typical/Schematic (Conceptual) of Exterior-Facing Waste Slope and Contact Water Management Ditch

Figure 4. Soil Survey Map (from USDA, 2026)

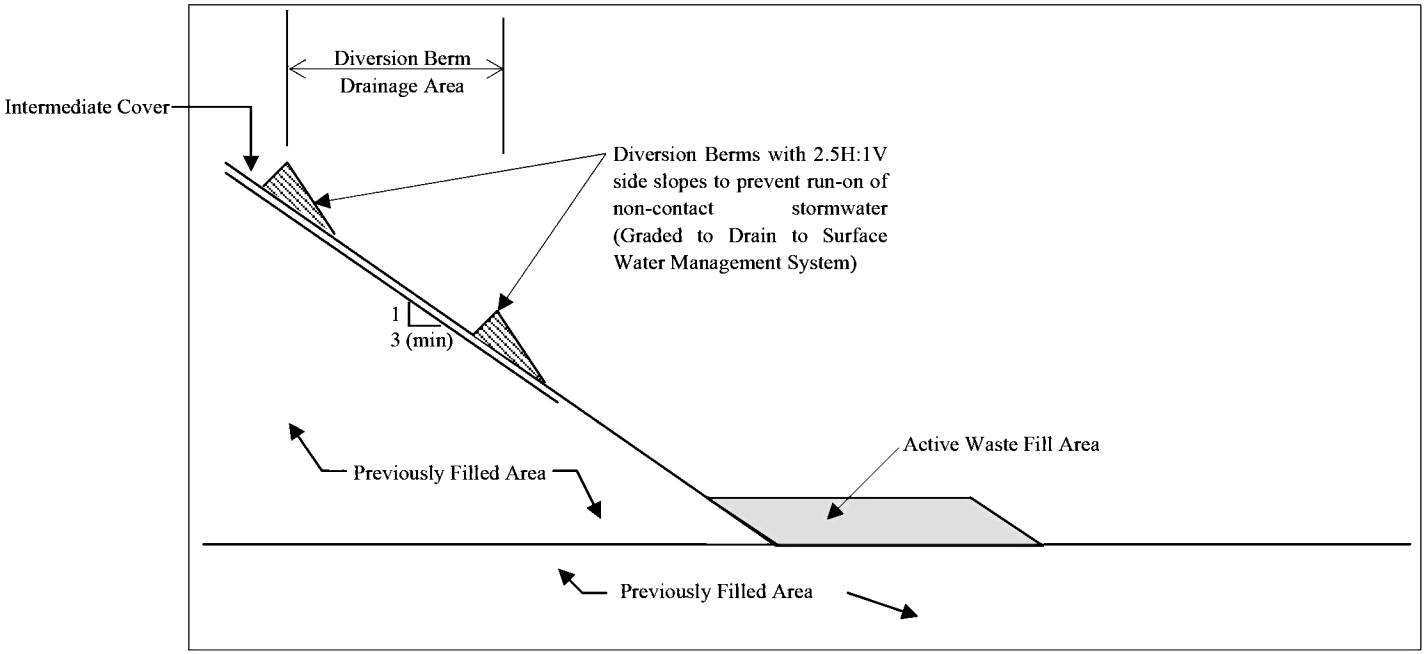


Figure 1. Typical/Schematic (Conceptual) of Phased Active Fill Area Section

(portraying possible conditions where diversion berms may be used) (Not to Scale (NTS))

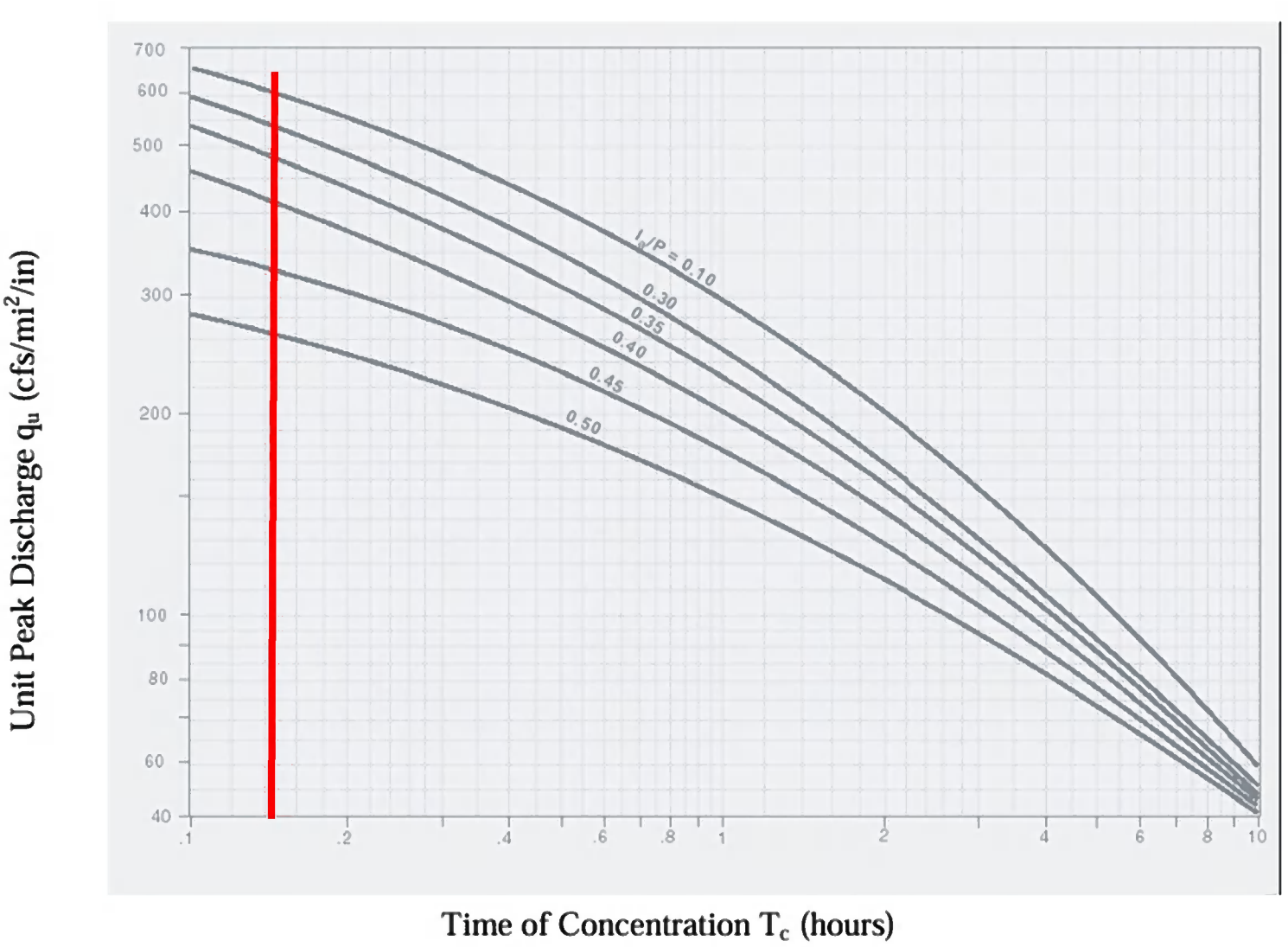


Figure 2. NRCS (SCS) Type III Unit Peak Discharge Graph

(from Georgetown County, 2006)

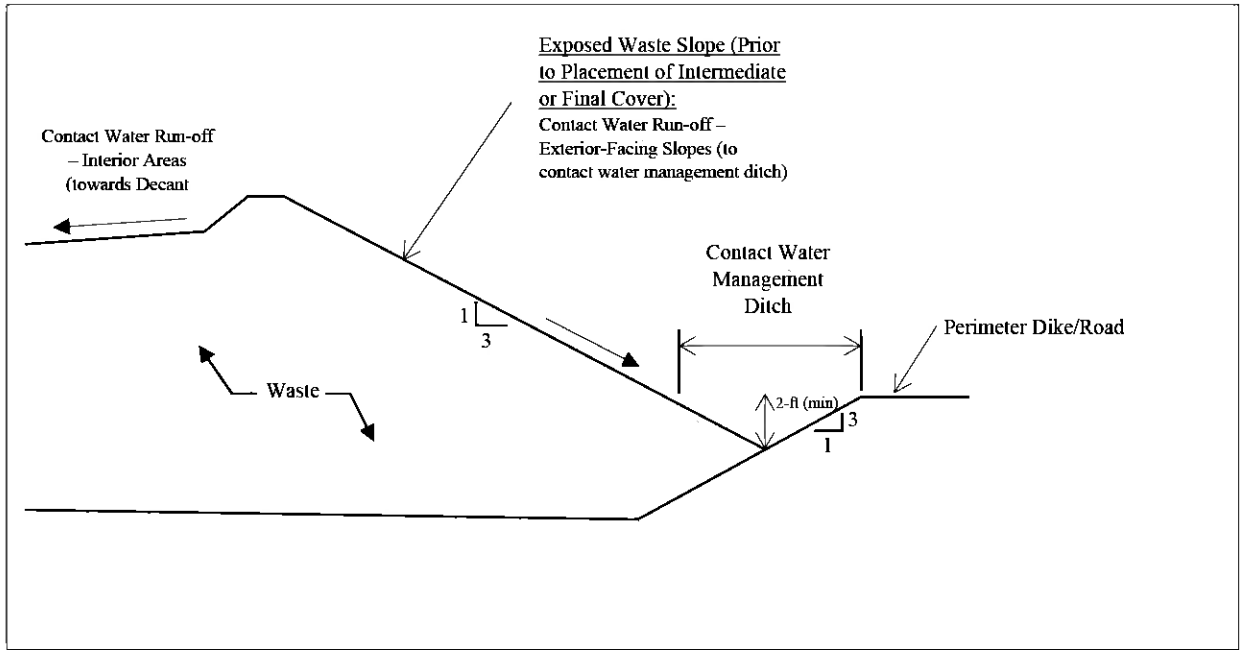


Figure 3. Typical/Schematic (Conceptual) of Exterior-Facing Waste Slope and Contact Water Management Ditch (Not to Scale (NTS))

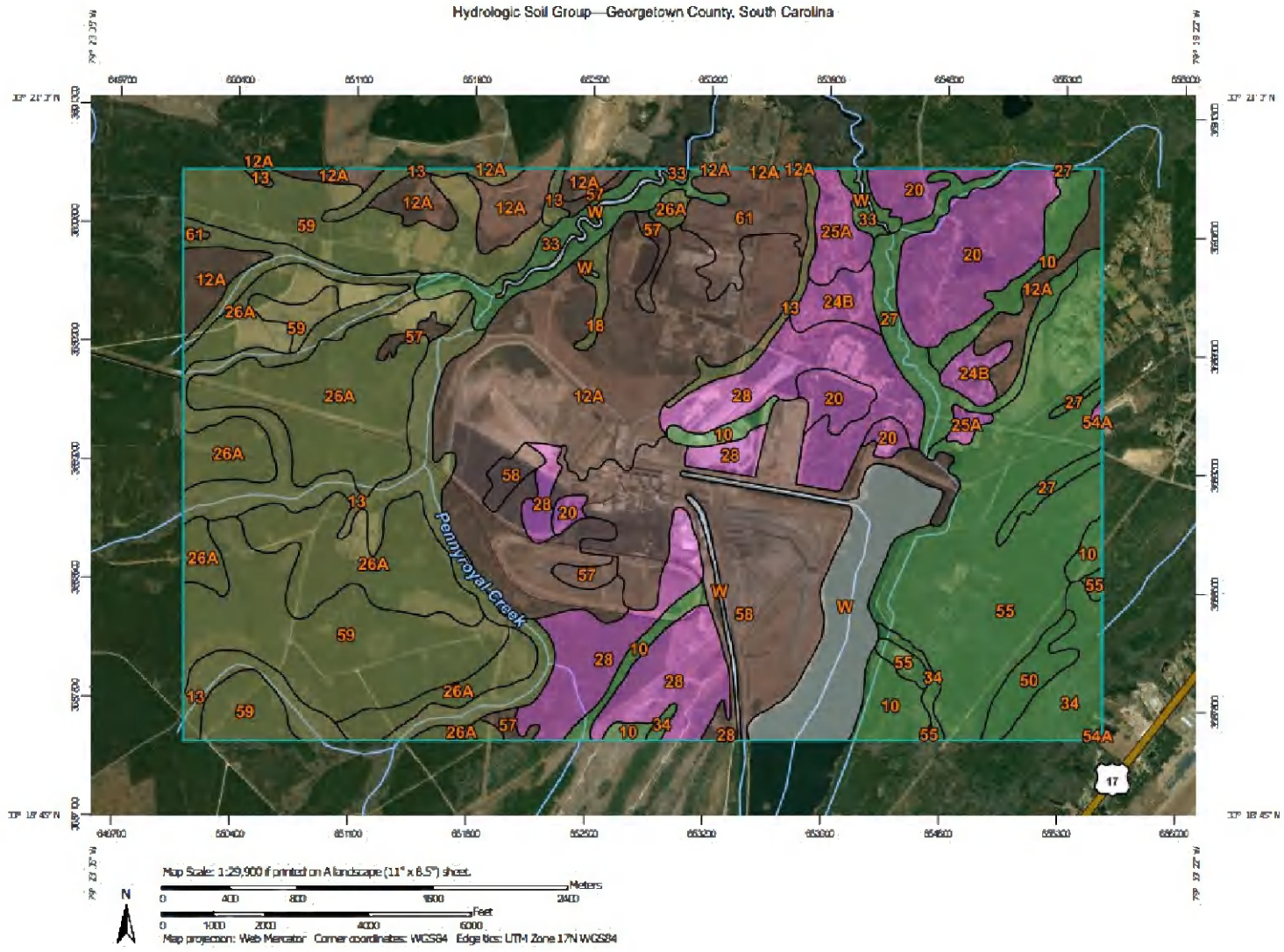


Figure 4. Soil Survey Map (from USDA, 2026)