PERIODIC RUN-ON AND RUN-OFF CONTROL PLAN REVISION 2
391-3-4-.10(5) and 40 C.F.R. PART 257.81
PLANT BOWEN PRIVATE INDUSTRY SOLID WASTE DISPOSAL FACILITY
(ASH LANDFILL)
GEORGIA POWER COMPANY

The Federal CCR Rule, and, for Existing CCR Landfills where applicable, the Georgia CCR Rule (391-3-4-.10) require the owner or operator of an existing or new CCR landfill or any lateral expansion of a CCR landfill to prepare a run-on and run-off control system plan to document how these control systems have been designed and constructed to meet the applicable requirements of this section of the Rule. *See* 40 C.F.R. § 257.81; Ga. Comp. R. & Regs. r. 391.3-4-.10(5)(a). In addition, the Rules require periodic run-on and run-off control system plans every five years. *See* 40 C.F.R. § 257.81(c)(4); Ga. Comp. R. & Regs. r. 391.3-4-.10(5)(a).

The CCR Landfill known as the Plant Bowen CCR Landfill is located in Bartow County, just west of Cartersville, Georgia on Plant Bowen property. Active Cells 1 & 2 and 9 & 10 were permitted and constructed with a minimum 2-ft. compacted clay liner with a maximum hydraulic conductivity of 1×10^{-7} cm/sec, underlain with a structural fill layer with a maximum hydraulic conductivity of 1×10^{-6} cm/sec. Cells 9 & 10 were subsequently retrofitted with a composite liner and leachate collection system. Active Cells 3 & 4 were permitted and constructed with a composite liner system consisting of a HDPE geomembrane and a minimum 2-ft. compacted clay layer with a maximum hydraulic conductivity of 1×10^{-7} cm/sec. The composite liner is underlain with a structural fill layer with a maximum hydraulic conductivity of 1×10^{-6} cm/sec. The facility consists of the CCR storage cells, leachate ponds for Cell 3 and 4, and separate sedimentation ponds and clear pools. Future Cells 5-8 will be constructed in the same manner as Cells 3 & 4.

The storm water flows have been calculated using the Natural Resources Conservation Service (NRCS) method (also known as the Soil Conservation Service (SCS) method) using the 25-yr, 24-hr storm event. The storm water detention system has been designed in accordance with the Georgia Soil and Water Conservation Commission requirements and Technical Release 55 (TR-55) as well as other local, city, and government codes. The post developed storm water discharge was designed to be less than the pre-developed storm water discharge in accordance with the requirements of the State of Georgia.

Run-off curve number data was determined using Table 2.1.5-1 from the Georgia Stormwater Management Manual. Run-off coefficient data was determined by utilizing Table 2.1.5-2. The rainfall distribution for Plant Bowen (Type II) was determined from Technical Release 55 (TR-55). National Oceanic and Atmospheric Administration (NOAA) Atlas 14 was used to determine the 24-hr precipitation for the design storm event of 25-yr for Plant Bowen.

The NRCS provides information on soil characteristics and hydrologic groups present at the site. It was determined that the hydrological group “C” for Cells 1 & 2 and “B” for Cells 3 through 8 and Cells 9 & 10 should be used to best reflect the characteristics of the soils on site. This information was placed into Hydraflow Hydrographs 2019 and used to generate appropriate precipitation curves, runoff curve numbers and storm basin run-off values. This methodology has also been utilized for future cells within the unit.

The Plant Bowen CCR Landfill Cells are designed and constructed with perimeter berms and drainage ditches around the cells that prevent stormwater run-on during the peak discharge of a 24-hr, 25-yr storm from flowing onto the active portion of the landfill. The leachate from the Cells 3 & 4 and future Cells 5 through 8 leachate collection and removal system is routed to the leachate ponds where it is collected and controlled. The ponds are designed to hold the anticipated amount of leachate generated from the leachate collection system over a period of 6 days as well as the quantity of rainfall from a 24-hr, 100-yr storm event that falls directly into the leachate pond. For the purposes of the run-off calculations, the drainage area for the leachate pond is not included. Storm water run-off from Cells 1 & 2, Cells 9 & 10 and Cells 3 through 8, is routed through a system of sedimentation pond designed to handle the run-off from a 24-hr, 25-yr storm. This plan is supported by appropriate engineering calculations (attached) and was reviewed to reflect current conditions.

The facility is operated subject to and in accordance with § 257.3-3 of EPA's regulations.

I hereby certify that the run-on and run-off control system plan meets the requirements of 40 C.F.R. Part 257.81.

10/20/22

James C. Pegues, P.E.
Licensed State of Georgia, PE No. 17419

Southern Company

Technical and Project Solutions Calculation

Calculation Number: DC-BN-735210-004

Project/Plant: Bowen	**Unit(s):** 1 - 4	**Discipline/Area:** Civil
Title/Subject: Run-on and Run-off Study for Bowen Cells 1 & 2		
Purpose/Objective: To determine if the Cell's stormwater management can safely manage and pass the design storm event.		
System or Equipment Tag Numbers: N/A	**Originator:** Jeremy Brown	

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Revision Record

Rev. No.	Description	Originator Initial / Date	Reviewer Initial / Date	Approver Initial / Date
0	Issued for Review	JKB 2/9/21	AOG 3/1/21	JWM 6/7/21

Notes:

Design Calculations

Project	Prepared by	Date
Plant Bowen Run-on Run-off Control	Jeremy Brown	2/9/21
Subject/Title Provide run-on and run-off system calculations for the peak discharge from a 24-hr 25-year storm Cells 1 & 2	Reviewed by Ashley Grissom	Date 3/1/21
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Purpose of Calculation

The purpose of this calculation is to determine if the existing sedimentation ponds and clear pools can sufficiently handle run-on/run-off during a minimum 25-yr, 24-hr storm event per federal stormwater requirements Title 40 CFR Part 257.81 and the Georgia Environmental Protection Division's (EPD) Georgia CCR Rule (391-3-4-.10).

Summary of Conclusions

Based on our analysis, the detention pond system is adequate to collect and control the volume of water resulting from a 24-hour 25-year storm, as required.

Storage Pond Name	Normal Pool Elevation (feet, NAVD 88)	Maximum 25 year pool elevation (feet, NAVD 88)	Spillway/Top of Dike Elevation (feet, NAVD 88)	Freeboard to Spillway (feet, NAVD 88)
Clear Pool	691.00	693.88	696.00/700.00	2.12/6.12
Sedimentation Pond	691.00	693.88	696.00/700.00	2.12/6.12

Project Narrative

The Plant Bowen CCB Disposal Facility Cells 1 & 2 site is located in Bartow County and is approximately 1.5 miles East of Euharlee, Georgia and 6 miles southwest of Cartersville, Georgia. The plant is bordered on the north and east by the Etowah River and on the south and west by farmland.

Cells 1 & 2 cover 34.88 acres and the two disposal cells are not divided by any means. (See Image 1).

Cells 1 & 2 are comprised of a 31.12 acres storage cell, 2.53 acres sedimentation pond, 1.23 acres clear pool, berms, access roads and ditches. (See Image 2) Cells 1& 2 include a perimeter dike to control surface rainfall run-off. There is no stormwater run-on for these cells. Run-off from this area is directed through interior perimeter ditches and through 3 – 36" diameter HDEP pipes into a sedimentation pond that is connected to a clear pool via two 72" diameter risers and two 48" diameter pipes. Stormwater from the clear pool is discharged through a 72" diameter riser and 48" diameter pipe.

The clear pool has an auxiliary spillway that is a grassed trapezoidal weir. The auxiliary spillway is 8' wide with 6:1 side slopes and sloped at 1% in the direction of flow with a 3:1 slope on the discharge channel at the downstream end. Following pages will show the analysis for Cells 1 & 2.

Methodology

The stormwater flows were calculated using the National Resources Conservation Service method (also known as the Soil Conservation Service (SCS) method) using a 25-yr, 24-hr design storm event.

Storm basin calculation information was gathered from a number of sources to include the Georgia Stormwater Manual and Technical Release 55.

The National Resources Conservation Service (NCRS) provided information on the soil characteristics and hydrologic groups. The soil types found on the site are Urban Land, Wax Silt Loam and Waynesboro Clay Loam. (See Images 3 & 4). Almost the entire site (99.9%) is considered Urban Land because the cells currently have some waste stacked in it. The soils in Cells 9 & 10 that are adjacent to the North and Cells 3 & 4 that are in the vicinity to the Northwest both consist of hydrological group "B". Therefore, hydrological group "B" should be used to best reflect the characteristics of the soils on site.

Run-off curve number data was determined using Table 2.1.5-1 from the Georgia Stormwater Management Manual. Run-off coefficient data was determined by utilizing Table 2.1.5-2 from the Georgia Stormwater Management Manual and Manning's n for Channels (Chow, 1959).

Appendix B from the TR-55 was used to determine the rain distribution for Plant Bowen is Type II. (See Image 5)

NOAA Atlas 14 was used to determine the 24-hour precipitation for the design storm event of 25-yr for Plant Bowen is 6.07 in. (See Image 6)

Assumptions/Criteria

- Refer to Title 40 CFR Part 257.81 Hydrologic and hydraulic capacity requirements for the run-on and run-off controls for CCR landfills.
- Other assumptions are listed on attached calculation sheets.

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Design Inputs/References

- AutoCad Civil 3D 2019, Autodesk, Inc.
- Hydraflow Hydrographs Extension for AutoCad Civil 3D 2019, Autodesk, Inc.
- Hydraflow Express Extension for AutoCad Civil 3D 2019, Autodesk, Inc.
- NOAA Atlas 14, Volume 9, Version 2 for Taylorsville, GA.
- Georgia Stormwater Manual
- TR-55 – Urban Hydrology for Small Watersheds, Appendix B, National Resources Conservation Service, Conservation Engineering Division, 1986.
- Georgia Power Company – Plant Bowen – CCB Disposal Facility Design and Operation Plans H15061 - H15097, H15296 - H15315 and H52258 - H52260.

Design Calculations

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Image 1

Design Calculations

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Image 2

Design Calculations

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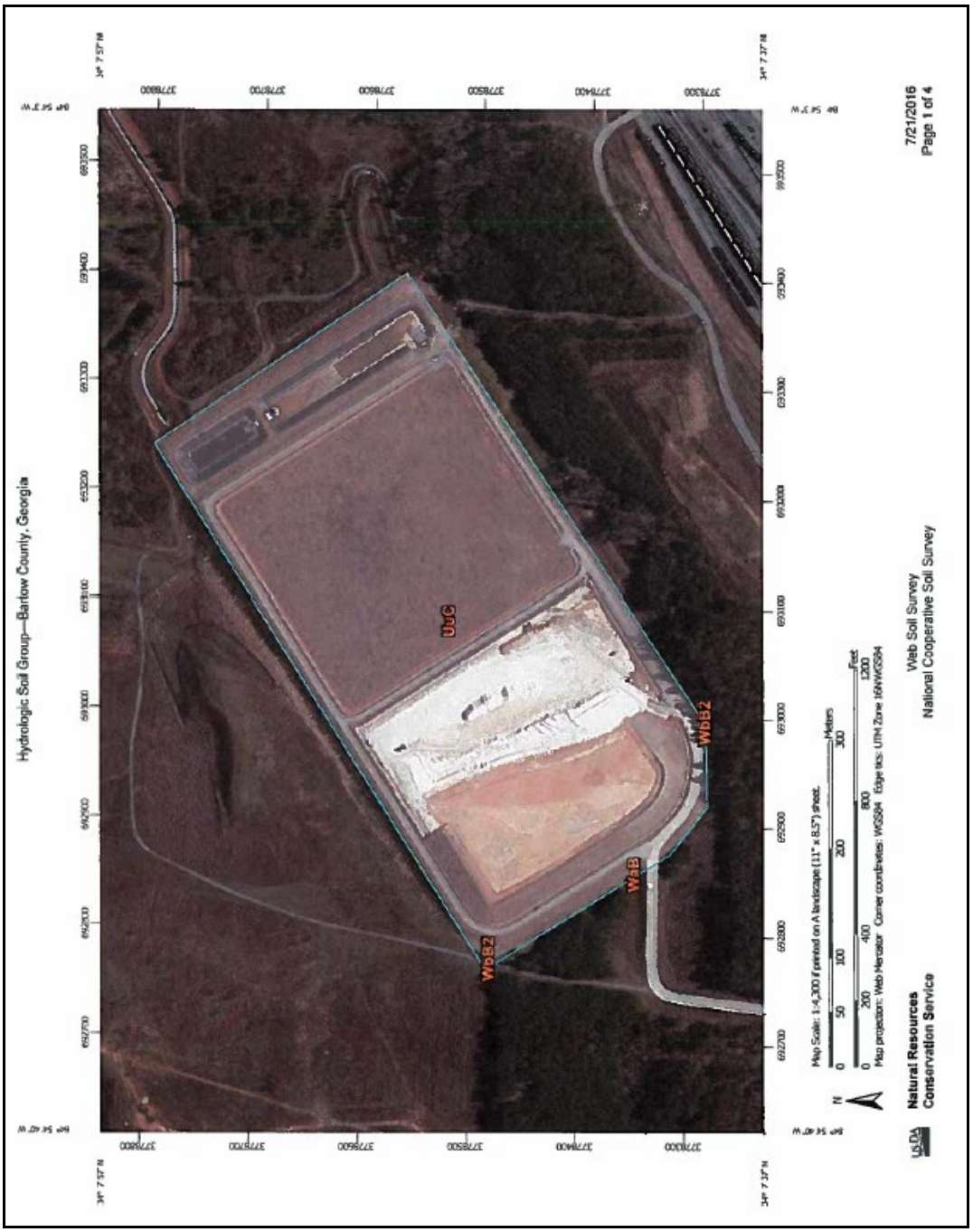

Image 3

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Bartow County, Georgia (GA015)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
UuC	Urban land-Udorthents complex, 0 to 10 percent slopes		40.2	99.9 %
WaB	Wax silt loam, 2 to 6 percent slopes, rarely flooded	D	0.0	0.0 %
WbB2	Waynesboro clay loam, 2 to 6 percent slopes, moderately eroded	B	0.1	0.1 %
Totals for Area of Interest			40.2	100.0%

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

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

Image 4

Design Calculations

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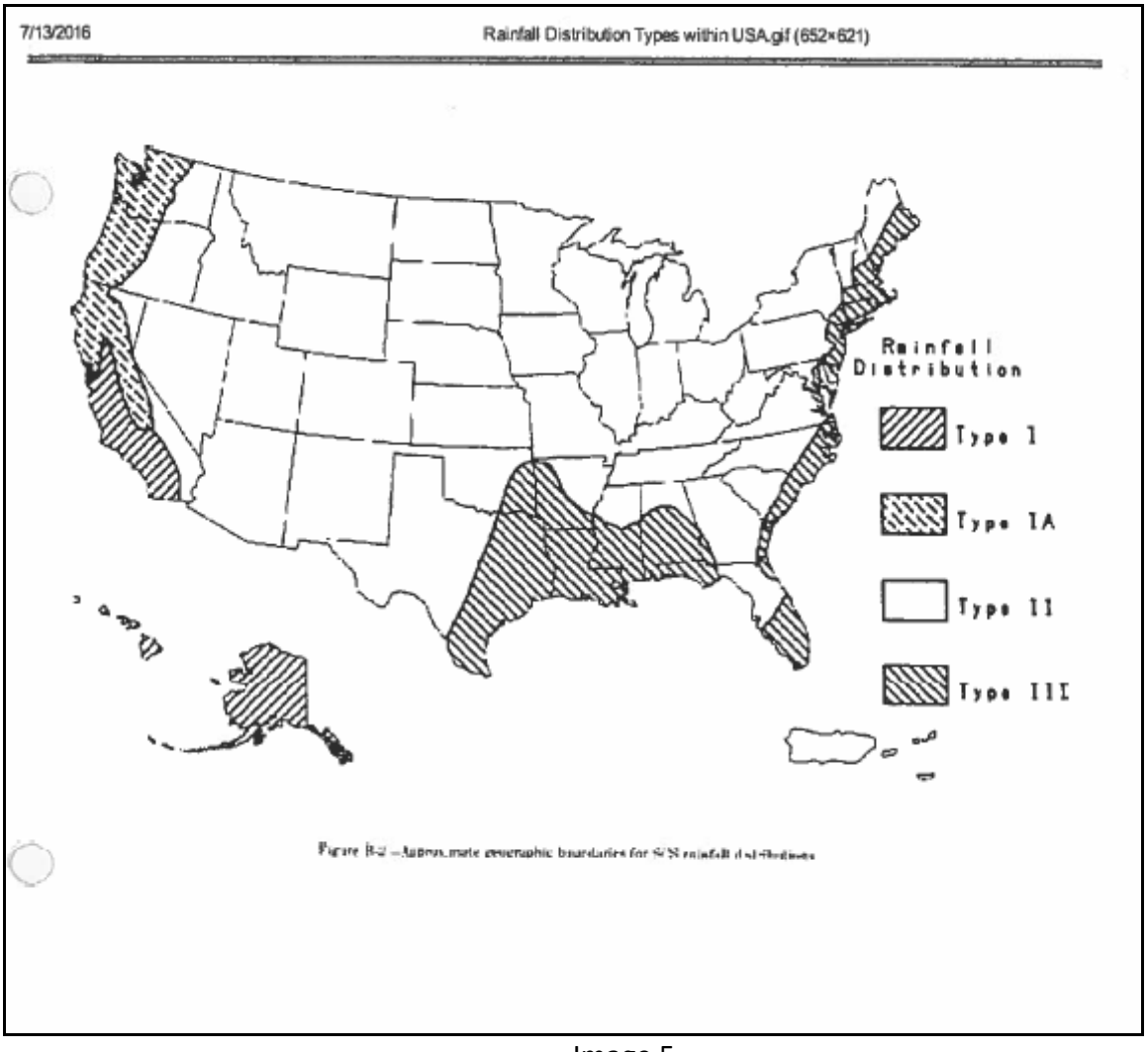

Image 5

Project	Prepared by	Date
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Precipitation Frequency Data Server — Page 1 of 4

NOAA Atlas 14, Volume 9, Version 2
TAYLORSVILLE
Station ID: 09-8600
Location name: Taylorsville, Georgia, US*
Latitude: 34.0861°, Longitude: -84.9828°
Elevation:
Elevation (station metadata): 721 ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Deborah Martin, Sandra Pavlovic, Ishani Roy, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Michael Yekta, Geoffery Bonnin

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	0.406 (0.321-0.518)	0.464 (0.367-0.593)	0.568 (0.448-0.726)	0.662 (0.520-0.849)	0.804 (0.619-1.06)	0.924 (0.695-1.23)	1.05 (0.768-1.42)	1.19 (0.838-1.62)	1.39 (0.943-1.92)	1.55 (1.02-2.14)
10-min	0.594 (0.471-0.759)	0.679 (0.537-0.868)	0.831 (0.655-1.06)	0.969 (0.761-1.24)	1.18 (0.907-1.56)	1.35 (1.02-1.80)	1.54 (1.12-2.07)	1.75 (1.23-2.38)	2.03 (1.38-2.81)	2.27 (1.50-3.14)
15-min	0.725 (0.574-0.926)	0.828 (0.655-1.06)	1.01 (0.799-1.30)	1.18 (0.928-1.52)	1.44 (1.11-1.90)	1.65 (1.24-2.19)	1.88 (1.37-2.53)	2.13 (1.50-2.90)	2.48 (1.68-3.43)	2.77 (1.83-3.83)
30-min	1.02 (0.811-1.31)	1.17 (0.924-1.49)	1.43 (1.13-1.83)	1.66 (1.31-2.13)	2.02 (1.56-2.68)	2.33 (1.75-3.09)	2.65 (1.94-3.57)	3.01 (2.12-4.11)	3.52 (2.39-4.86)	3.93 (2.60-5.44)
60-min	1.33 (1.05-1.70)	1.52 (1.20-1.94)	1.85 (1.46-2.36)	2.15 (1.69-2.76)	2.61 (2.01-3.45)	3.00 (2.25-3.98)	3.41 (2.49-4.58)	3.86 (2.71-5.26)	4.49 (3.05-6.21)	5.01 (3.31-6.93)
2-hr	1.64 (1.31-2.06)	1.86 (1.49-2.35)	2.27 (1.81-2.86)	2.64 (2.10-3.34)	3.20 (2.49-4.17)	3.66 (2.79-4.79)	4.16 (3.08-5.52)	4.70 (3.36-6.33)	5.47 (3.77-7.46)	6.09 (4.09-8.32)
3-hr	1.84 (1.49-2.30)	2.10 (1.69-2.62)	2.55 (2.05-3.19)	2.96 (2.37-3.71)	3.56 (2.80-4.60)	4.07 (3.12-5.28)	4.60 (3.43-6.05)	5.18 (3.73-6.91)	6.00 (4.17-8.12)	6.66 (4.51-9.04)
6-hr	2.27 (1.86-2.79)	2.57 (2.10-3.17)	3.10 (2.53-3.83)	3.57 (2.90-4.41)	4.26 (3.38-5.41)	4.82 (3.75-6.16)	5.42 (4.10-7.02)	6.05 (4.42-7.96)	6.94 (4.90-9.27)	7.65 (5.27-10.3)
12-hr	2.79 (2.32-3.39)	3.15 (2.61-3.83)	3.77 (3.12-4.58)	4.31 (3.54-5.25)	5.08 (4.06-6.34)	5.70 (4.48-7.17)	6.36 (4.87-8.10)	7.04 (5.21-9.11)	7.99 (5.72-10.5)	8.73 (6.11-11.6)
24-hr	3.34 (2.81-3.99)	3.79 (3.18-4.53)	4.54 (3.80-5.44)	5.18 (4.32-6.21)	6.07 (4.93-7.43)	6.77 (5.40-8.36)	7.48 (5.81-9.38)	8.22 (6.17-10.5)	9.21 (6.70-11.9)	9.98 (7.10-13.0)
2-day	3.87 (3.29-4.55)	4.43 (3.77-5.21)	5.34 (4.54-6.30)	6.10 (5.16-7.22)	7.14 (5.88-8.60)	7.95 (6.42-9.65)	8.75 (6.85-10.8)	9.56 (7.27-12.0)	10.6 (7.84-13.6)	11.4 (8.27-14.8)
3-day	4.24 (3.64-4.95)	4.81 (4.13-5.62)	5.76 (4.93-6.73)	6.56 (5.59-7.68)	7.66 (6.37-9.16)	8.53 (6.95-10.3)	9.40 (7.47-11.5)	10.3 (7.92-12.6)	11.5 (8.57-14.5)	12.4 (9.06-15.9)
4-day	4.56 (3.94-5.28)	5.14 (4.43-5.96)	6.10 (5.25-7.08)	6.92 (5.93-8.06)	8.07 (6.76-9.61)	8.98 (7.38-10.8)	9.92 (7.94-12.1)	10.9 (8.43-13.5)	12.2 (9.16-15.4)	13.2 (9.72-16.8)
7-day	5.37 (4.69-6.14)	5.99 (5.22-6.86)	7.04 (6.13-8.07)	7.94 (6.88-9.14)	9.24 (7.84-10.9)	10.3 (8.56-12.2)	11.3 (9.21-13.7)	12.5 (9.80-15.3)	14.0 (10.7-17.5)	15.2 (11.3-19.2)
10-day	6.07 (5.34-6.89)	6.74 (5.92-7.66)	7.88 (6.91-8.97)	8.87 (7.74-10.1)	10.3 (8.79-12.0)	11.4 (9.58-13.5)	12.6 (10.3-15.1)	13.8 (11.0-16.8)	15.5 (11.9-19.3)	16.8 (12.7-21.1)
20-day	8.08 (7.21-9.03)	8.91 (7.95-9.96)	10.3 (9.17-11.5)	11.5 (10.2-12.9)	13.2 (11.5-15.2)	14.6 (12.4-16.9)	16.0 (13.3-18.8)	17.4 (14.0-20.9)	19.4 (15.2-23.7)	21.0 (16.1-25.9)
30-day	9.86 (8.87-10.9)	10.8 (9.75-12.0)	12.5 (11.2-13.8)	13.9 (12.4-15.4)	15.8 (13.8-17.9)	17.3 (14.9-19.8)	18.8 (15.8-22.0)	20.4 (16.6-24.2)	22.5 (17.8-27.3)	24.1 (18.7-29.5)
45-day	12.2 (11.1-13.4)	13.5 (12.2-14.8)	15.4 (14.0-17.0)	17.1 (15.4-18.8)	19.3 (16.9-21.6)	20.9 (18.1-23.7)	22.6 (19.1-26.1)	24.3 (19.9-28.5)	26.4 (21.1-31.7)	28.1 (22.0-34.1)
60-day	14.4 (13.1-15.6)	15.8 (14.4-17.2)	18.1 (16.5-19.8)	19.9 (18.1-21.8)	22.4 (19.8-24.9)	24.2 (21.0-27.2)	25.9 (22.0-29.7)	27.7 (22.8-32.2)	29.8 (23.9-35.5)	31.4 (24.8-37.9)

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

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

Please refer to NOAA Atlas 14 document for more information.

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PF graphical

Image 6

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Body of Calculation

See detailed calculations and software output.

Drainage Area = 34.88 AC (See Map 1)

Curve Number = 64 (See Attached Table 1)

- 31.17 AC @ CN 61 (Grass)
- 2.56 AC @ CN 85 (Gravel)
- 1.15 AC @ CN 98 (Impervious – Liner in Sediment Pond and Clear Pool)
- ((31.17*61)+(2.56*85)+(1.15*98))/34.88 = 63.98 = 64

Time of Concentration = 20.49 Min (See Attached TR55 Worksheet and Map 2)

- Sheet Flow
  - Manning's n-Value = 0.15 (Short Grass) (See Table 2)
  - Flow Length = 300 LF
  - Land Slope = (806.50-784.00)/300 = 0.075 = 7.50%
- Shallow Concentrated
  - Flow Length = 202 LF
  - Watercourse Slope = (784.00-746.50)/202 = 0.1856 = 18.56%
  - Surface is Unpaved
- Channel Flow (See Channel Report 1)
  - Grass Lined 4' Wide Ditch with 2:1 Side Slopes and 4' Deep
  - Cross Sectional Area = 6.00 SF
  - Wetted Perimeter = 8.47 LF
  - Channel Slope = (746.50-700.01)/2387 = 0.0195 = 1.95%
  - Manning's n-Value = 0.030 (Vegetal Lining) (See Table 3)
  - Flow Length = 2387 LF
- Channel Flow (See Channel Report 2)
  - 3 – 36" Dia. HDPE Pipes @ 2.75%
  - Cross Section Area = 2.079 SF
  - Wetted Perimeter = 3.70 LF
  - Channel Slope = (700.01-698.00)/74 = 0.0272 = 2.72%
  - Manning's n-Value = 0.013 (HDPE Pipes) (See Table 4)
  - Flow Length = 74 LF

Time Interval = 3 Min

- Tc*0.1333 = 20.49*0.1333 = 2.73 = 3

Storm Distribution = Type II

Q_{25} = 78.47 CFS (See Hydrograph Report 1)

To Evaluate for Storage Capacity, Treat The Sediment Pond and Clear Pool As One Pond Since They Are Interconnected.

Elevation (FT)	Sed. Pond Area (SF)	Clear Pool Area (SF)	Total Area (SF)	Volume (CF)
689	0	15,324	15,324	0*
690	39,353	16,778	56,131	33,591*
691	42,351	18,271	60,622	91,947
692	45,389	19,804	65,193	154,835
693	48,465	21,375	69,840	222,331
694	51,581	22,986	74,567	294,515
695	54,737	24,637	79,374	371,465
696	57,931	26,326	84,257	453,260

Note: Stage storage is based on topographic information from 2020.
*Dead Storage

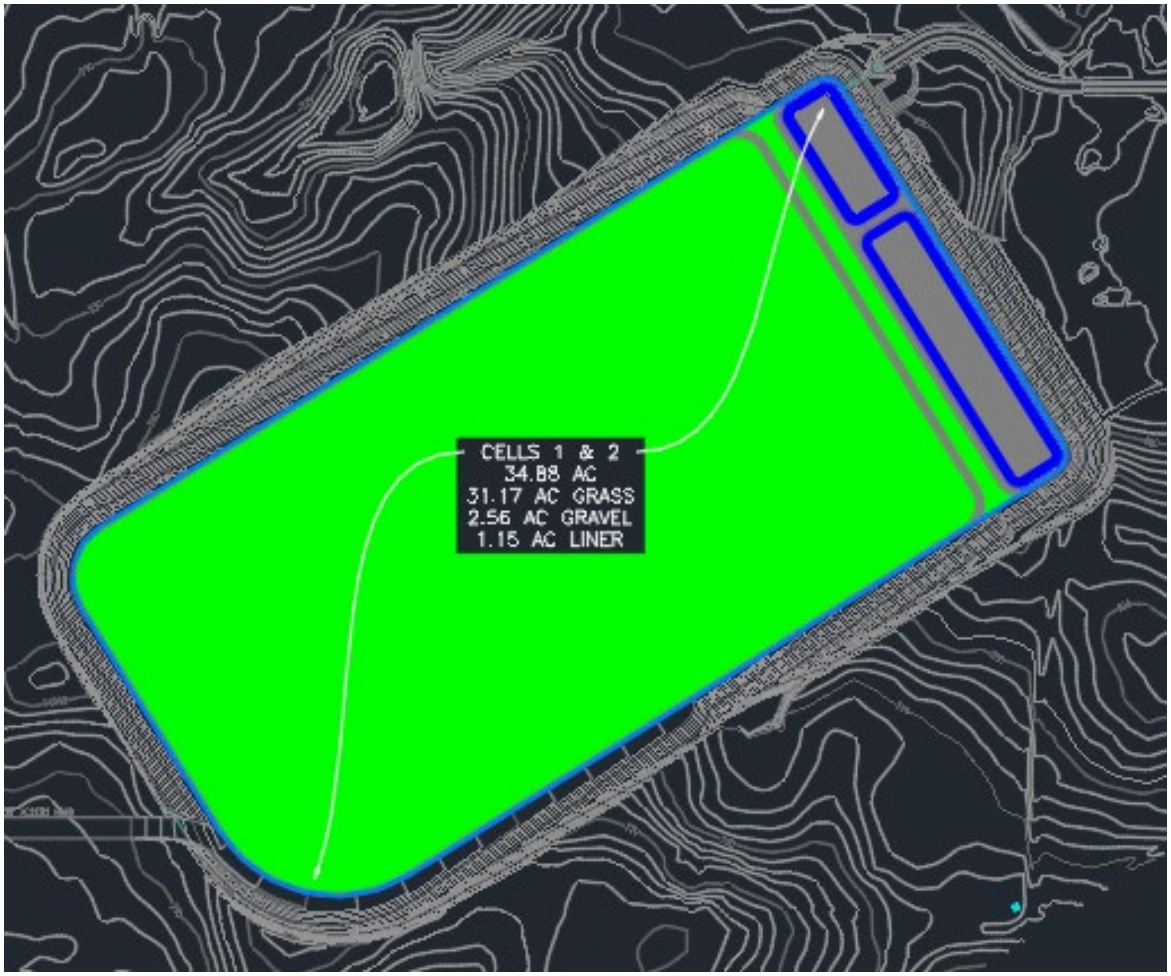
Spillways

- Principal Spillway consists of a 72” Dia. Riser with a 48” Dia. CMP.
- Auxiliary Spillway consist of a grass lined trapezoidal weir that is 8’ wide with 6:1 side slopes and sloped at 1% in the direction of flow with a 3:1 slope on the discharge channel at the downstream end.

High Water Elevation is 693.88 (See Pond Reports 1 & 2)

Design Calculations

Project	Prepared by	Date
Plant Bowen Run-on Run-off Control	Jeremy Brown	2/9/21
Subject/Title Provide run-on and run-off system calculations for the peak discharge from a 24-hr 25-year storm Cells 1 & 2	Reviewed by Ashley Grissom	Date 3/1/21
	Calculation Number DC-BN- 735210-004	Sheet 12 of 23



Map 1

Project	Prepared by	Date
Plant Bowen Run-on Run-off Control	Jeremy Brown	2/9/21
Subject/Title Provide run-on and run-off system calculations for the peak discharge from a 24-hr 25-year storm Cells 1 & 2	Reviewed by Ashley Grissom	Date 3/1/21
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Table 2.1.5-1 Runoff Curve Numbers[1]

Cover description: *Cover type and hydrologic condition*	*Average percent impervious area*[2]	Curve numbers for hydrologic soil groups: A	B	C	D
Cultivated land: without conservation treatment		72	81	88	91
with conservation treatment		62	71	78	81
Pasture or range land: poor condition		68	79	86	89
good condition		39	61	74	80
Meadow: good condition		30	58	71	78
Wood or forest land: thin stand, poor cover		45	66	77	83
good cover		25	55	70	77
Open space (lawns, parks, golf courses, cemeteries, etc.)[3]					
Poor condition (grass cover <50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm drains (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 Newly graded areas (pervious areas only, no vegetation)		77	86	91	94

[1] Average runoff condition, and $I_a = 0.2S$

[2] The average percent impervious area shown was used to develop the composite CNs. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. If the impervious area is not connected, the SCS method has an adjustment to reduce the effect.

[3] CNs shown are equivalent to those of pasture. Composite CNs may be computed for other combinations of open space cover type.

Table 1

TR55 Tc Worksheet

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v12

Hyd. No. 2

Ditch

Description	A	B	C	Totals
Sheet Flow				
Manning's n-value	= 0.150	0.011	0.011	
Flow length (ft)	= 300.0	0.0	0.0	
Two-year 24-hr precip. (in)	= 3.79	0.00	0.00	
Land slope (%)	= 7.50	0.00	0.00	
Travel Time (min)	= 12.78 +	0.00 +	0.00 =	12.78
Shallow Concentrated Flow				
Flow length (ft)	= 202.00	0.00	0.00	
Watercourse slope (%)	= 18.56	0.00	0.00	
Surface description	= Unpaved	Paved	Paved	
Average velocity (ft/s)	=6.95	0.00	0.00	
Travel Time (min)	= 0.48 +	0.00 +	0.00 =	0.48
Channel Flow				
X sectional flow area (sqft)	= 6.00	0.00	0.00	
Wetted perimeter (ft)	= 8.47	0.00	0.00	
Channel slope (%)	= 1.95	0.00	0.00	
Manning's n-value	= 0.030	0.015	0.015	
Velocity (ft/s)	=5.51			
		0.00		
			0.00	
Flow length (ft)	({0})2387.0	0.0	0.0	
Travel Time (min)	= 7.23 +	0.00 +	0.00 =	7.23
Total Travel Time, Tc				**20.49 min**

TR55 Worksheet

Design Calculations

Project	Prepared by	Date
Plant Bowen Run-on Run-off Control	Jeremy Brown	2/9/21
Subject/Title Provide run-on and run-off system calculations for the peak discharge from a 24-hr 25-year storm Cells 1 & 2	Reviewed by Ashley Grissom	Date 3/1/21
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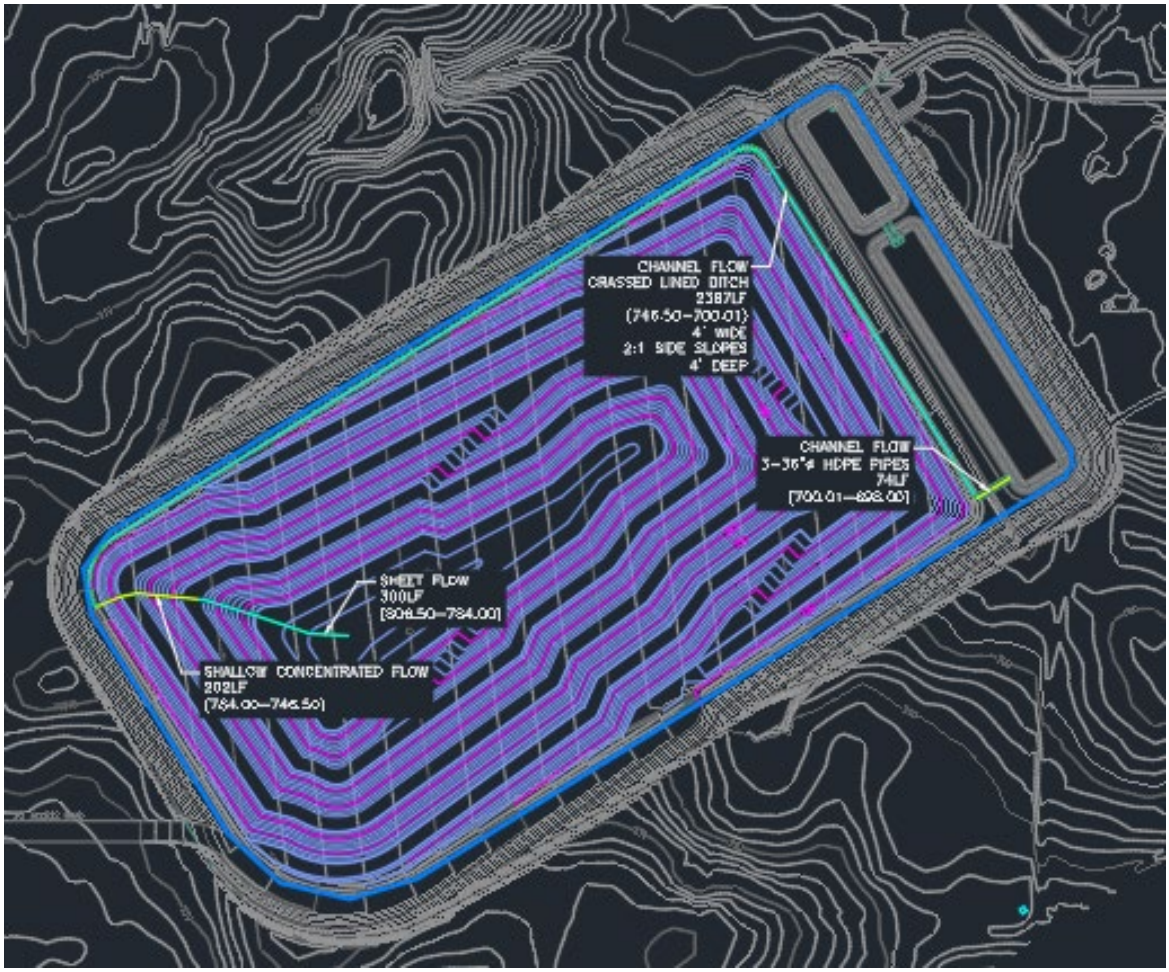


Map 2

Table 2.1.5-2 Roughness Coefficients (Manning's n) for Sheet Flow[1]

Surface Description	n
Smooth surfaces (concrete, asphalt, gravel, or bare soil)	0.011
Fallow (no residue)	0.05
Cultivated soils:	
Residue cover < 20%	0.06
Residue cover > 20%	0.17
Grass:	
Short grass prairie	0.15
Dense grasses[2]	0.24
Bermuda grass	0.41
Range (natural)	0.13
Woods[3]	
Light underbrush	0.40
Dense underbrush	0.80

[1] The n values are a composite of information by Engman (1986).

[2] Includes species such as weeping lovegrass, bluegrass, buffalo grass, blue grama grass, and native grass mixtures.

[3] When selecting n, consider cover to a height of about 0.1 ft. This is the only part of the plant cover that will obstruct sheet flow.

Source: SCS, TR-55, Second Edition, June 1986

Table 2

Design Calculations

Project	Prepared by	Date
Plant Bowen Run-on Run-off Control	Jeremy Brown	2/9/21
Subject/Title Provide run-on and run-off system calculations for the peak discharge from a 24-hr 25-year storm Cells 1 & 2	Reviewed by Ashley Grissom	Date 3/1/21
	Calculation Number DC-BN- 735210-004	Sheet 17 of 23

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Feb 4 2021

Cells 1 & 2 Ditch

Trapezoidal

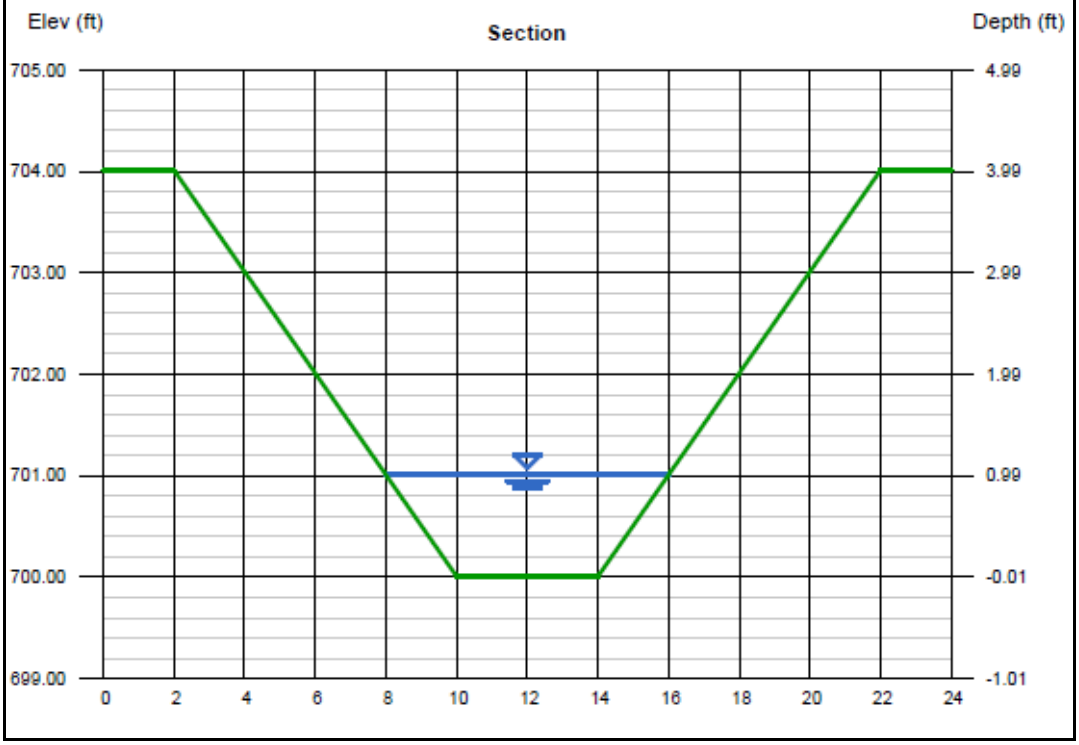
Bottom Width (ft)	= 4.00
Side Slopes (z:1)	= 2.00, 2.00
Total Depth (ft)	= 4.00
Invert Elev (ft)	= 700.01
Slope (%)	= 1.95
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 32.62

Highlighted

Depth (ft)	= 1.00
Q (cfs)	= 32.62
Area (sqft)	= 6.00
Velocity (ft/s)	= 5.44
Wetted Perim (ft)	= 8.47
Crit Depth, Yc (ft)	= 1.06
Top Width (ft)	= 8.00
EGL (ft)	= 1.46



Channel Report 1

Project	Prepared by	Date
Plant Bowen Run-on Run-off Control	Jeremy Brown	2/9/21
Subject/Title Provide run-on and run-off system calculations for the peak discharge from a 24-hr 25-year storm Cells 1 & 2	Reviewed by Ashley Grissom	Date 3/1/21
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Manning's n Values

3. finished, with gravel on bottom	0.015	0.017	0.020
4. unfinished	0.014	0.017	0.020
5. gunite, good section	0.016	0.019	0.023
6. gunite, wavy section	0.018	0.022	0.025
7. on good excavated rock	0.017	0.020	
8. on irregular excavated rock	0.022	0.027	
d. Concrete bottom float finish with sides of:			
1. dressed stone in mortar	0.015	0.017	0.020
2. random stone in mortar	0.017	0.020	0.024
3. cement rubble masonry, plastered	0.016	0.020	0.024
4. cement rubble masonry	0.020	0.025	0.030
5. dry rubble or riprap	0.020	0.030	0.035
e. Gravel bottom with sides of:			
1. formed concrete	0.017	0.020	0.025
2. random stone mortar	0.020	0.023	0.026
3. dry rubble or riprap	0.023	0.033	0.036
f. Brick			
1. glazed	0.011	0.013	0.015
2. in cement mortar	0.012	0.015	0.018
g. Masonry			
1. cemented rubble	0.017	0.025	0.030
2. dry rubble	0.023	0.032	0.035
h. Dressed ashlar/stone paving	0.013	0.015	0.017
i. Asphalt			
1. smooth	0.013	0.013	
2. rough	0.016	0.016	
j. Vegetal lining	0.030		0.500

Table 3

Project	Prepared by	Date
Plant Bowen Run-on Run-off Control	Jeremy Brown	2/9/21
Subject/Title Provide run-on and run-off system calculations for the peak discharge from a 24-hr 25-year storm Cells 1 & 2	Reviewed by Ashley Grissom	Date 3/1/21
	Calculation Number DC-BN- 735210-004	Sheet 19 of 23

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Feb 4 2021

Cells 1 & 2 Pipe

Circular

Diameter (ft)	= 3.00
Invert Elev (ft)	= 698.00
Slope (%)	= 2.72
N-Value	= 0.013

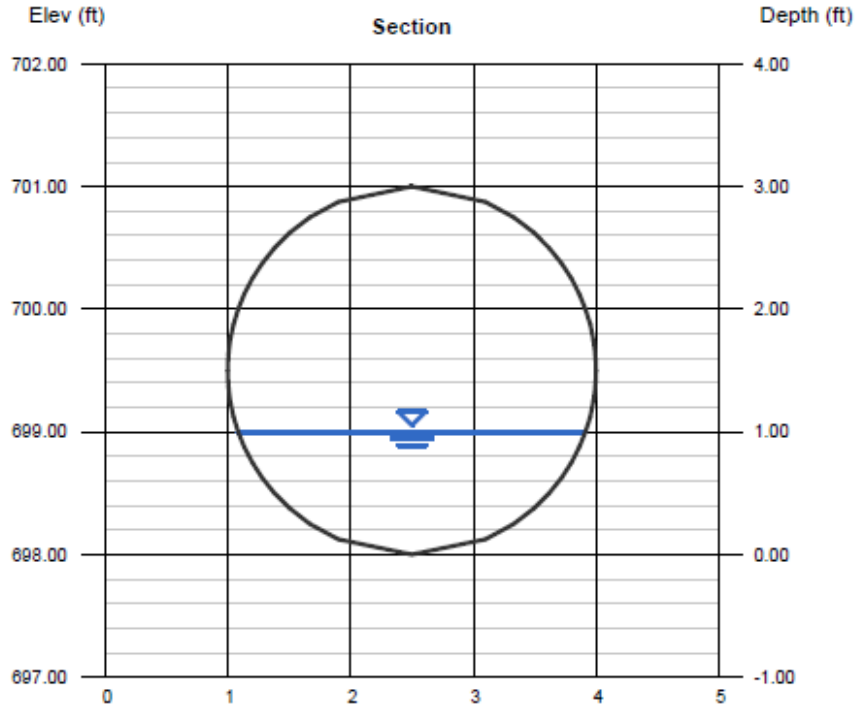
Calculations

Compute by:	Known Q
Known Q (cfs)	= 26.16

Full Flow = 78.47
Pipes = 3
Flow Per Pipe = 78.47/3 = 26.16

Highlighted

Depth (ft)	= 1.00
Q (cfs)	= 26.16
Area (sqft)	= 2.08
Velocity (ft/s)	= 12.58
Wetted Perim (ft)	= 3.70
Crit Depth, Yc (ft)	= 1.65
Top Width (ft)	= 2.83
EGL (ft)	= 3.46



Channel Report 2

Design Calculations

Project	Prepared by	Date
Plant Bowen Run-on Run-off Control	Jeremy Brown	2/9/21
Subject/Title Provide run-on and run-off system calculations for the peak discharge from a 24-hr 25-year storm Cells 1 & 2	Reviewed by Ashley Grissom	Date 3/1/21
	Calculation Number DC-BN- 735210-004	Sheet 20 of 23

Manning's n Values

Page 4 of 5

7. Concrete:			
Culvert, straight and free of debris	0.010	0.011	0.013
Culvert with bends, connections, and some debris	0.011	0.013	0.014
Finished	0.011	0.012	0.014
Sewer with manholes, inlet, etc., straight	0.013	0.015	0.017
Unfinished, steel form	0.012	0.013	0.014
Unfinished, smooth wood form	0.012	0.014	0.016
Unfinished, rough wood form	0.015	0.017	0.020
8. Wood:			
Stave	0.010	0.012	0.014
Laminated, treated	0.015	0.017	0.020
9. Clay:			
Common drainage tile	0.011	0.013	0.017
Vitrified sewer	0.011	0.014	0.017
Vitrified sewer with manholes, inlet, etc.	0.013	0.015	0.017
Vitrified Subdrain with open joint	0.014	0.016	0.018
10. Brickwork:			
Glazed	0.011	0.013	0.015
Lined with cement mortar	0.012	0.015	0.017
Sanitary sewers coated with sewage slime with bends and connections	0.012	0.013	0.016
Paved invert, sewer, smooth bottom	0.016	0.019	0.020
Rubble masonry, cemented	0.018	0.025	0.030

Table 4

Hydrograph Report

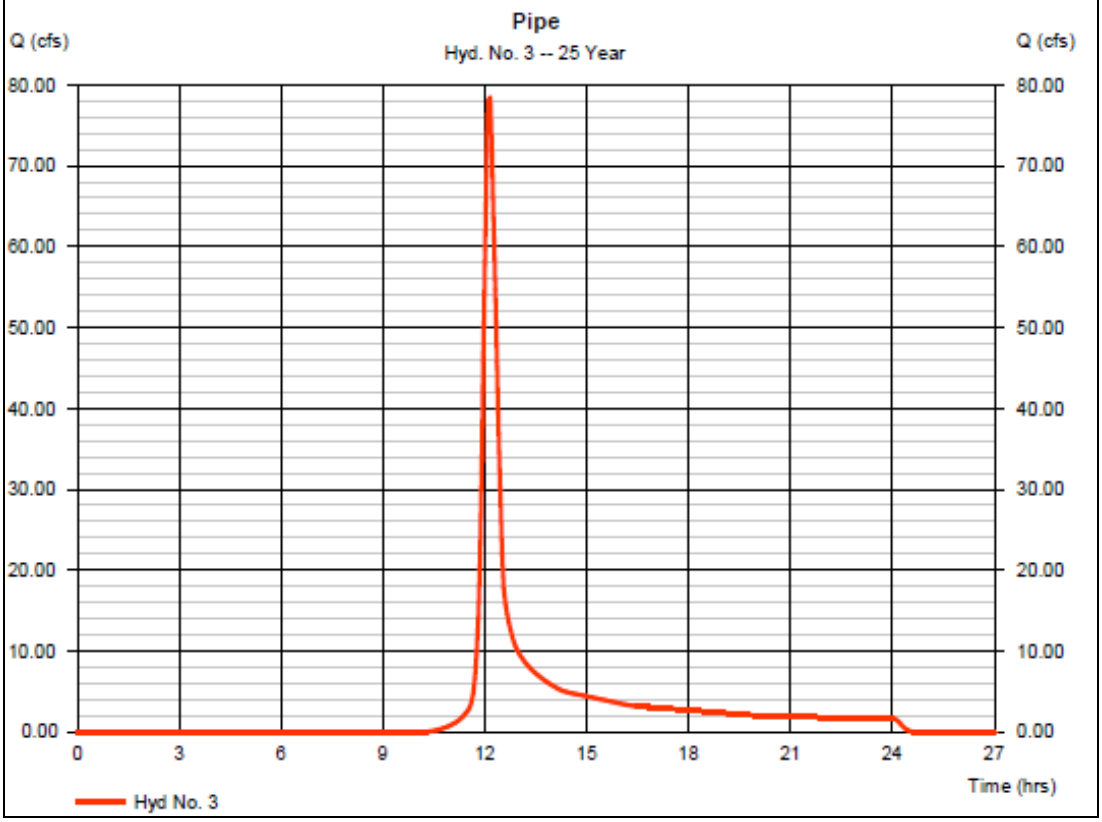
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v12 — Thursday, 02 / 4 / 2021

Hyd. No. 3

Pipe

Hydrograph type	= SCS Runoff	Peak discharge	= 78.47 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.15 hrs
Time interval	= 3 min	Hyd. volume	= 285,591 cuft
Drainage area	= 34.880 ac	Curve number	= 64*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 20.60 min
Total precip.	= 6.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(31.170 x 61) + (2.560 x 85) + (1.150 x 98)] / 34.880



Hydrograph Report 1

Design Calculations

Project	Prepared by	Date
Plant Bowen Run-on Run-off Control	Jeremy Brown	2/9/21
Subject/Title Provide run-on and run-off system calculations for the peak discharge from a 24-hr 25-year storm Cells 1 & 2	Reviewed by Ashley Grissom	Date 3/1/21
	Calculation Number DC-BN- 735210-004	Sheet 22 of 23

Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v12 — Friday, 02 / 5 / 2021

Pond No. 1 - Cell 1&2 Sed Pond/Clear Pool

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 689.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	689.00	15,324	0	0
1.00	690.00	56,131	33,591	33,591
2.00	691.00	60,622	58,356	91,947
3.00	692.00	65,193	62,887	154,835
4.00	693.00	69,840	67,496	222,331
5.00	694.00	74,567	72,183	294,515
6.00	695.00	79,374	76,950	371,465
7.00	696.00	84,257	81,795	453,260

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	48.00	0.00	0.00	0.00
Span (in)	48.00	0.00	0.00	0.00
No. Barrels	1	0	0	0
Invert El. (ft)	673.50	0.00	0.00	0.00
Length (ft)	128.00	0.00	0.00	0.00
Slope (%)	0.40	0.00	0.00	n/a
N-Value	.024	.013	.013	n/a
Orifice Coeff.	0.60	0.60	0.60	0.60
Multi-Stage	n/a	No	No	No

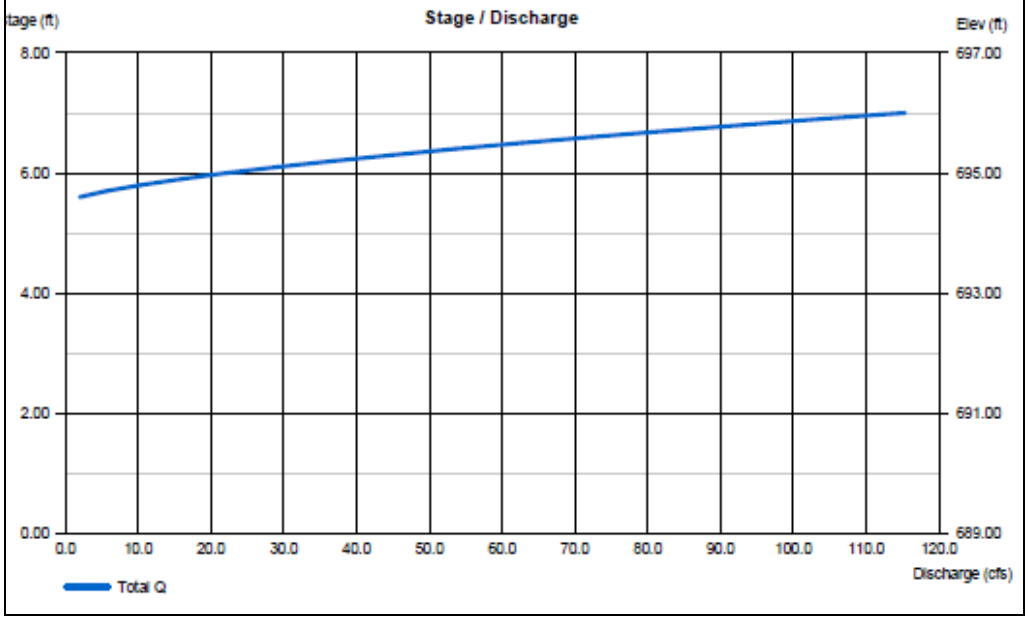
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	18.85	0.00	0.00	0.00
Crest El. (ft)	694.50	0.00	0.00	0.00
Weir Coeff.	3.33	3.33	3.33	3.33
Weir Type	1	—	—	—
Multi-Stage	Yes	No	No	No

Exfil.(in/hr) = 0.000 (by Contour)

TW Elev. (ft) = 0.00

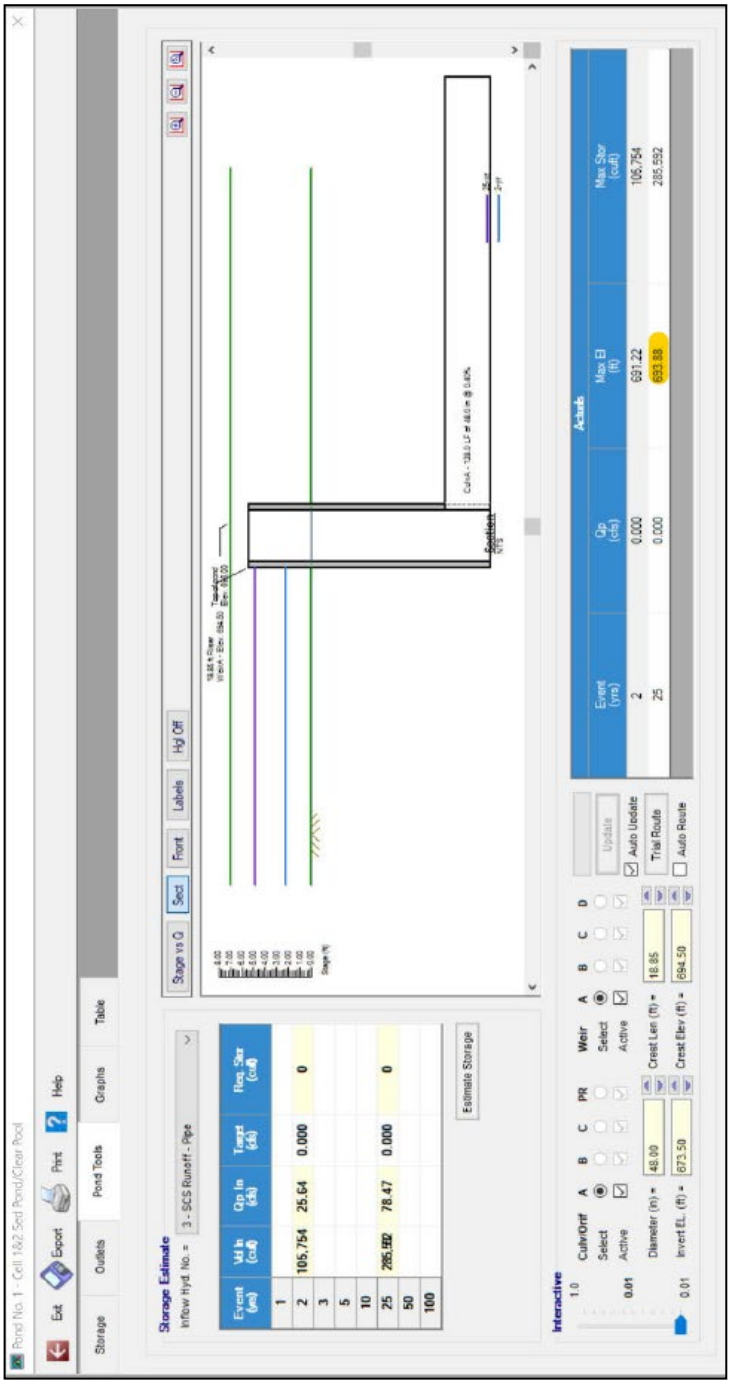
Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).



Pond Report 1

Design Calculations

Project	Prepared by	Date
Plant Bowen Run-on Run-off Control	Jeremy Brown	2/9/21
Subject/Title Provide run-on and run-off system calculations for the peak discharge from a 24-hr 25-year storm Cells 1 & 2	Reviewed by Ashley Grissom	Date 3/1/21
	Calculation Number DC-BN- 735210-004	Sheet 23 of 23



Pond Report 2

Southern Company

Technical and Project Solutions Calculation

Calculation Number: DC-BN-735210-002

Project/Plant: Bowen	**Unit(s):** 1 - 4	**Discipline/Area:** Civil
Title/Subject: Run-on and Run-off Study for Bowen Cells 3-8		
Purpose/Objective: To determine if the Cell's stormwater management can safely manage and pass the design storm event.		
System or Equipment Tag Numbers: N/A	**Originator:** Jeremy Brown	

Contents

Revision Record

Rev. No.	Description	Originator Initial / Date	Reviewer Initial / Date	Approver Initial / Date
0	Issued for Review	JKB 3/19/21	AOG 4/1/21	JWM 4/6/21

Notes:

Design Calculations

Project	Prepared by	Date
Plant Bowen Run-on Run-off Control	Jeremy Brown	3/19/21
Subject/Title Provide run-on and run-off system calculations for the peak discharge from a 24-hr 25-year storm Cells 3-8	Reviewed by Ashley Grissom	Date 4/1/21
	Calculation Number DC-BN- 735210-002	Sheet 1 of 58

Purpose of Calculation

The purpose of this calculation is to determine if the existing sedimentation ponds and clear pools can sufficiently handle run-on/run-off during a minimum 25-yr, 24-hr storm event per federal stormwater requirements Title 40 CFR Part 257.81 and the Georgia Environmental Protection Division's (EPD) Georgia CCR Rule (391-3-4-.10).

Summary of Conclusions

Based on our analysis, the detention pond system is adequate to collect and control the volume of water resulting from a 24-hour 25-year storm, as required.

Storage Pond Name	Normal Pool Elevation (feet, NAVD 88)	Maximum 25 year pool elevation (feet, NAVD 88)	Spillway/Top of Dike Elevation (feet, NAVD 88)	Freeboard to Spillway (feet, NAVD 88)
Cells 3, 5 & 7 Clear Pool	685.5	688.73	690.50/694.00	1.77/5.27
Cells 3, 5 & 7 Sediment Pond	685.5	688.73	690.50/694.00	1.77/5.27
Cell 4 Clear Pool	698.50	701.03	702.00/704.00	0.97/2.97
Cell 4 Sediment Pond	698.50	701.03	702.00/704.00	0.97/2.97
Cell 6 Clear Pool	686	688.40	689.50/692.00	1.10/3.60
Cell 6 Sediment Pond	686	688.40	689.50/692.00	1.10/3.60
Cell 8 Clear Pool	686	688.03	689.50/692.00	1.47/3.97
Cell 8 Sediment Pond	686	688.03	689.50/692.00	1.47/3.97

Project Narrative

The Plant Bowen CCB Disposal Facility Cells 3-8 site is located in Bartow County and is approximately 1.5 miles East of Euharlee, Georgia and 6 miles southwest of Cartersville, Georgia. The plant is bordered on the north and east by the Etowah River and on the south and west by farmland.

Since Cells 3-8 share an interconnected cap the storage area information below is based on the drainage area for each cells' sedimentation and clear pool. It should be noted that Cells 3, 5 & 7 share a sedimentation pond and clear pool.

Cells 3, 5 & 7

Cells 3, 5 & 7 cover 41.47 acres and their cap is not divided by any means. (See Image 1).

Cells 3, 5 & 7 are comprised of a 43.27 acres storage cell, 2.25 acres sedimentation pond, 0.73 acres clear pool, berms, access roads and ditches. (See Image 2) Cells 3, 5 & 7 include a perimeter dike to control surface rainfall run-off. There is no stormwater run-on for these cells. Run-off from this area is directed through a down drain system into an interior perimeter ditch into a sedimentation pond that is connected to a clear pool via two 48" diameter risers and two 30" diameter pipes. Stormwater from the clear pool is discharged through two 54" diameter risers and two 36" diameter pipes.

The sediment pond and clear pool both have an auxiliary spillway that is a concrete trapezoidal weir. The auxiliary spillway is 20' wide with 6:1 side slopes and sloped at 1% in the direction of flow with a 3:1 slope on the discharge channel at the downstream end. Following pages will show the analysis for Cells 3, 5 & 7.

Cell 4

Cell 4 covers 12.59 acres and its cap is not divided by any means. (See Image 1).

Cell 4 is comprised of a 12.24 acres storage cell, 1.13 acres sedimentation pond, 0.45 acres clear pool, berms, access roads and ditches. (See Image 2) Cell 4 includes a perimeter dike to control surface rainfall run-off. There is no stormwater run-on for this cell. Run-off from this area is directed through a down drain system into an interior perimeter ditch into a sedimentation pond that is connected to a clear pool via two 48" diameter risers and two 30" diameter pipes. Stormwater from the clear pool is discharged through a 66" diameter riser and 42" diameter pipe.

The sediment pond and clear pool both have an auxiliary spillway that is a concrete trapezoidal weir. The auxiliary spillway is 18' wide with 6:1 side slopes and sloped at 1% in the direction of flow with a 3:1 slope on the discharge channel at the downstream end. Following pages will show the analysis for Cell 4.

Cell 6

Cell 6 covers 28.14 acres and its cap is not divided by any means. (See Image 1).

Cell 6 is comprised of a 16.37 acres storage cell, 1.20 acres sedimentation pond, 0.38 acres clear pool, berms, access roads and ditches. (See Image 2) Cell 6 includes a perimeter dike to control surface rainfall run-off. There is no stormwater run-on for these cells. Run-off from this area is directed through a down drain system into an interior perimeter ditch into a sedimentation pond that is connected to a clear pool via a 36" diameter riser and six 24" diameter pipes. Stormwater from the clear pool is discharged through a 36" diameter riser and two 24" diameter pipes.

The sediment pond and clear pool both have an auxiliary spillway that is a grassed trapezoidal weir. The auxiliary spillway is 8' wide with 3:1 side slopes and sloped at 1% in the direction of flow with a 3:1 slope on the discharge channel at the downstream end. Following pages will show the analysis for Cell 6.

Cell 8

Cell 8 cover 10.41 acres and its cap is not divided by any means. (See Image 1).

Cell 8 is comprised of a 13.51 acres storage cell, 0.74 acres sedimentation pond, 0.34 acres clear pool, berms, access roads and ditches. (See Image 2) Cell 8 includes a perimeter dike to control surface rainfall run-off. There is no stormwater run-on for this cell. Run-off from this area is directed through a down drain system into an interior perimeter ditch into a sedimentation pond that is connected to a clear pool via a 36" diameter riser and five 24" diameter pipes. Stormwater from the clear pool is discharged through a 36" diameter riser and two 24" diameter pipes.

The sediment pond and clear pool both have an auxiliary spillway that is a grassed trapezoidal weir. The auxiliary spillway is 8' wide with 3:1 side slopes and sloped at 1% in the direction of flow with a 3:1 slope on the discharge channel at the downstream end. Following pages will show the analysis for Cell 8.

Methodology

The stormwater flows were calculated using the National Resources Conservation Service method (also known as the Soil Conservation Service (SCS) method) using a 25-yr, 24-hr design storm event.

Storm basin calculation information was gathered from a number of sources to include the Georgia Stormwater Manual and Technical Release 55.

The National Resources Conservation Service (NCRS) provided information on the soil characteristics and hydrologic groups. The soil types found on the site are Etowah Loam (17.1%), Waynesboro Clay Loam (81.8%) and Whitwell Silt Loam (1.1%) (See Images 3 & 4). Therefore, hydrological group "B" should be used to best reflect the characteristics of the soils on site.

Run-off curve number data was determined using Table 2.1.5-1 from the Georgia Stormwater Management Manual. Run-off coefficient data was determined by utilizing Table 2.1.5-2 from the Georgia Stormwater Management Manual and Manning's n for Channels (Chow, 1959).

Appendix B from the TR-55 was used to determine the rain distribution for Plant Bowen is Type II. (See Image 5)

NOAA Atlas 14 was used to determine the 24-hour precipitation for the design storm event of 25-yr for Plant Bowen is 6.07 in. (See Image 6)

Assumptions/Criteria

- Refer to Title 40 CFR Part 257.81 Hydrologic and hydraulic capacity requirements for the run-on and run-off controls for CCR landfills.
- Other assumptions are listed on attached calculation sheets.

Design Inputs/References

- AutoCad Civil 3D 2019, Autodesk, Inc.
- Hydraflow Hydrographs Extension for AutoCad Civil 3D 2019, Autodesk, Inc.
- Hydraflow Express Extension for AutoCad Civil 3D 2019, Autodesk, Inc.
- NOAA Atlas 14, Volume 9, Version 2 for Taylorsville, GA.
- TR-55 – Urban Hydrology for Small Watersheds, Appendix B, National Resources Conservation Service, Conservation Engineering Division, 1986.
- Georgia Power Company – Plant Bowen – CCB Disposal Facility Design and Operation Plans H15061 - H15097, H15296 - H15315 and H52258 - H52260.

Design Calculations

Project	Prepared by	Date
Plant Bowen Run-on Run-off Control	Jeremy Brown	3/19/21
Subject/Title Provide run-on and run-off system calculations for the peak discharge from a 24-hr 25-year storm Cells 3-8	Reviewed by Ashley Grissom	Date 4/1/21
	Calculation Number DC-BN- 735210-002	Sheet 5 of 58

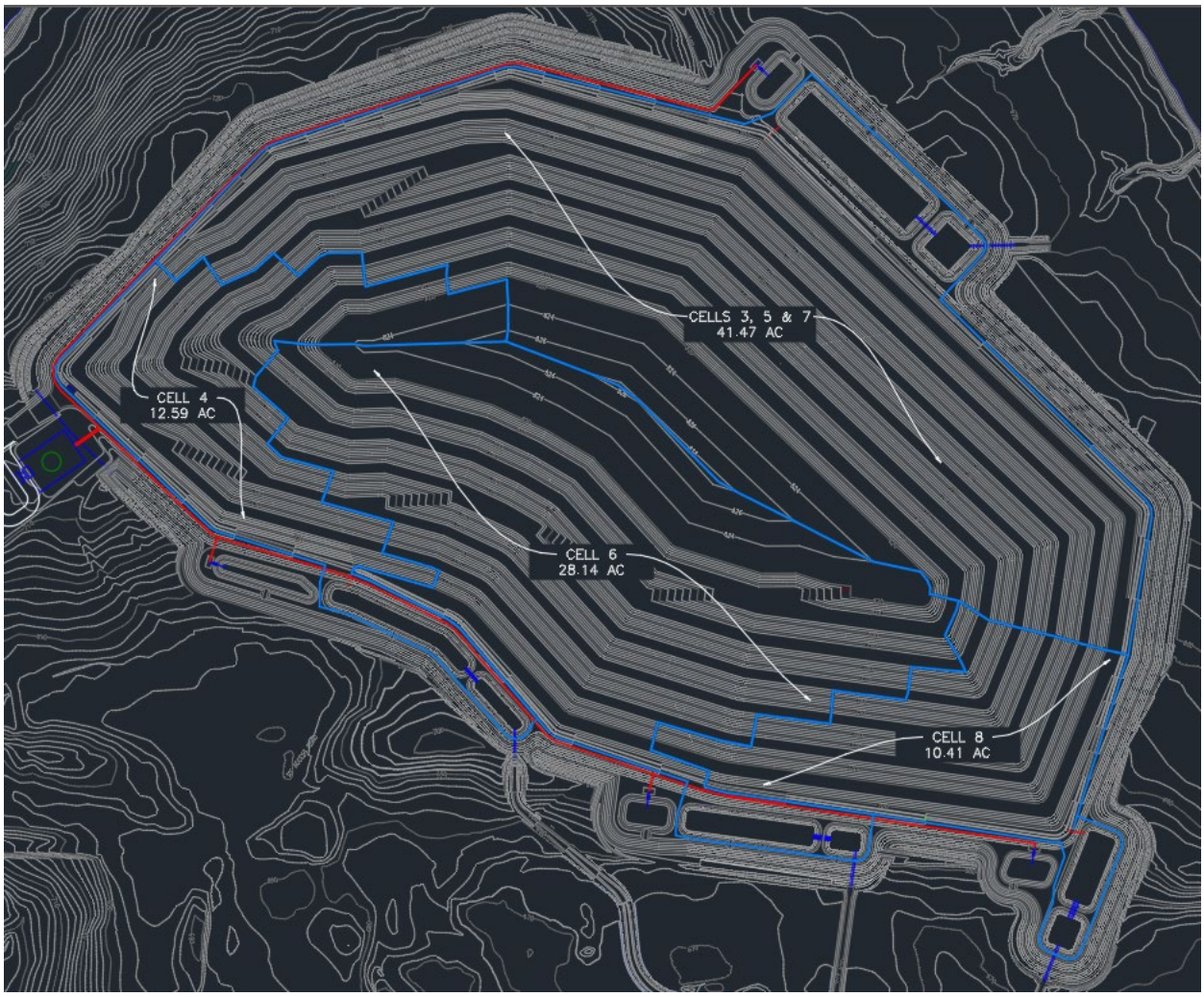


Image 1

Design Calculations

Project	Prepared by	Date
Plant Bowen Run-on Run-off Control	Jeremy Brown	3/19/21
Subject/Title Provide run-on and run-off system calculations for the peak discharge from a 24-hr 25-year storm Cells 3-8	Reviewed by Ashley Grissom	Date 4/1/21
	Calculation Number DC-BN- 735210-002	Sheet 6 of 58

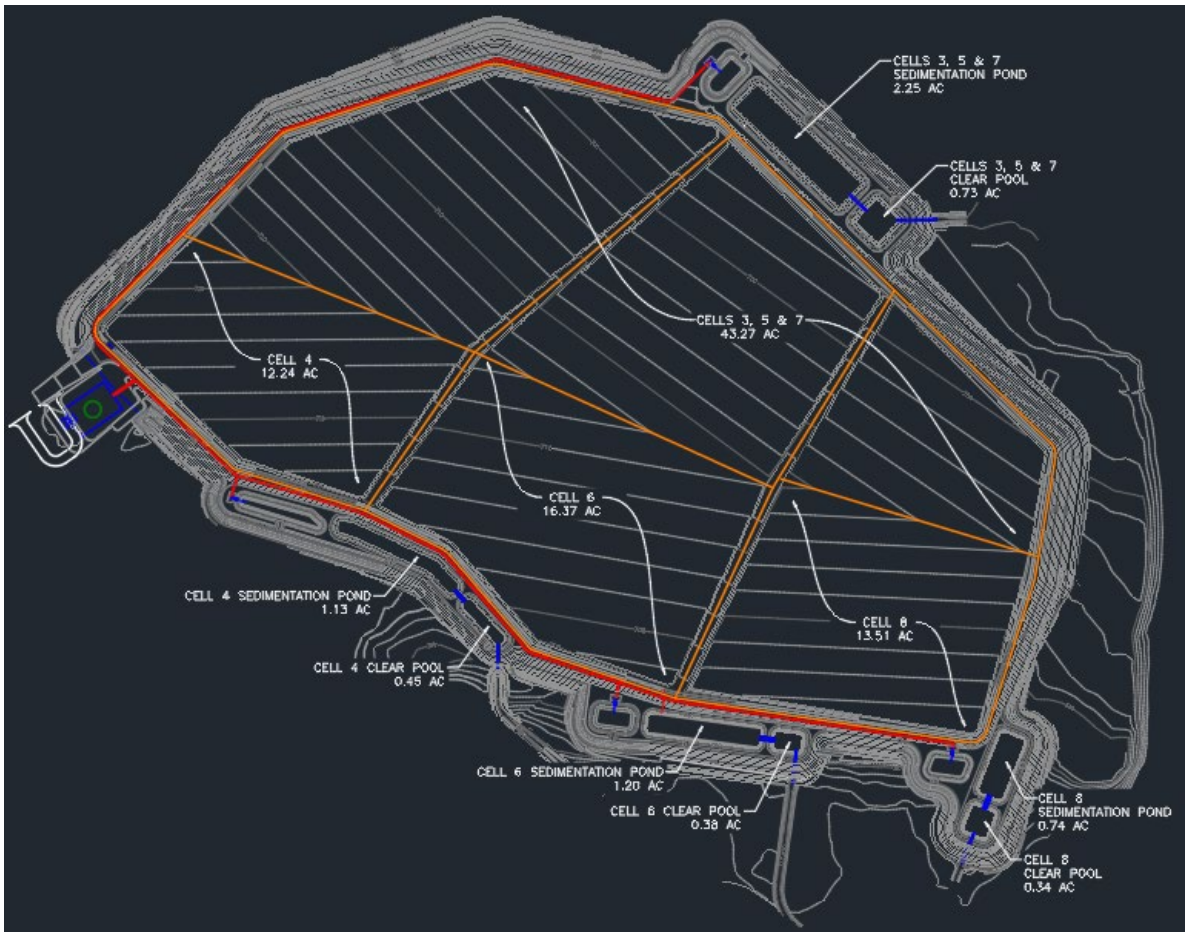


Image 2

Design Calculations

Project	Prepared by	Date
Plant Bowen Run-on Run-off Control	Jeremy Brown	3/19/21
Subject/Title Provide run-on and run-off system calculations for the peak discharge from a 24-hr 25-year storm Cells 3-8	Reviewed by Ashley Grissom	Date 4/1/21
	Calculation Number DC-BN- 735210-002	Sheet 7 of 58

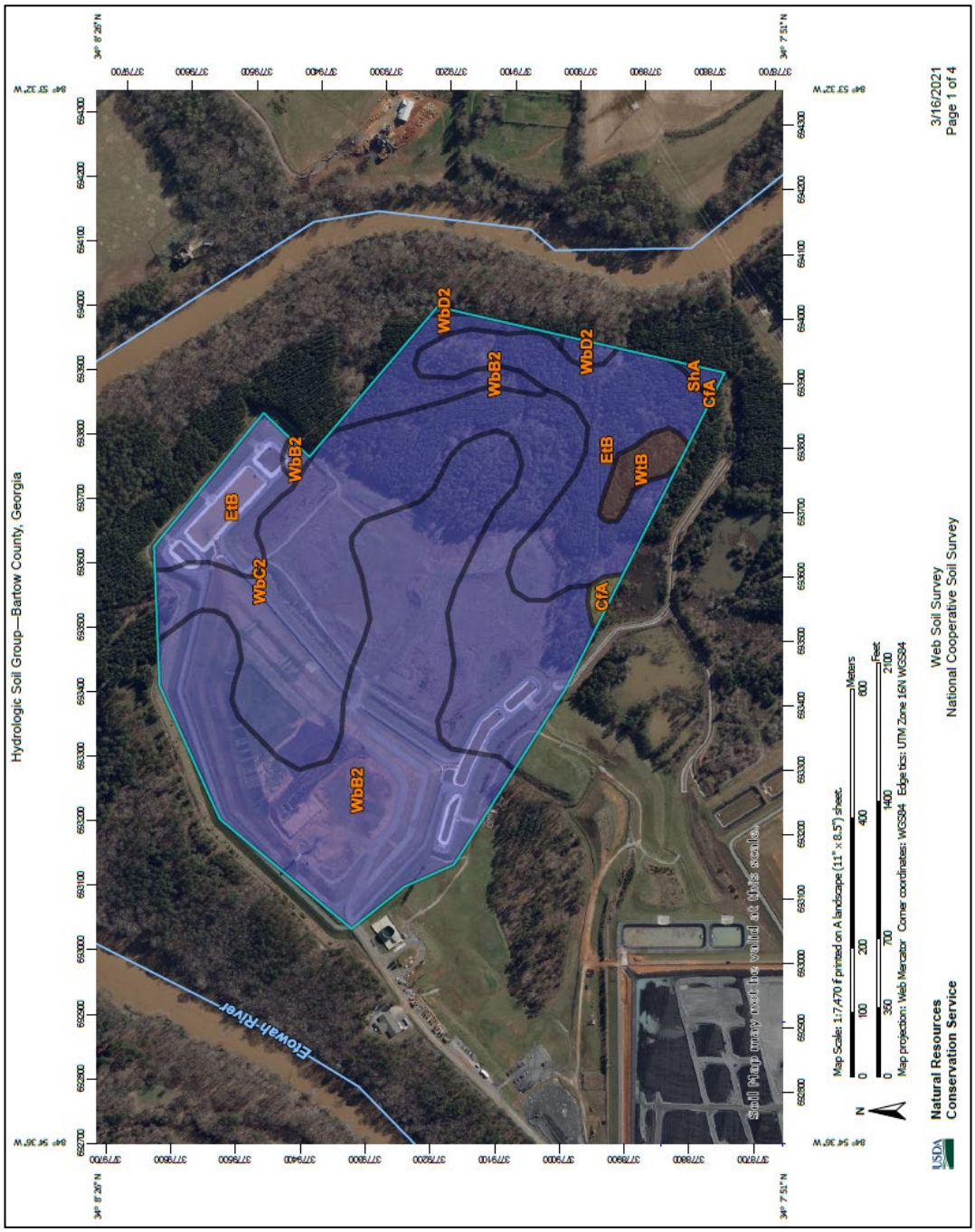


Image 3

Hydrologic Soil Group—Bartow County, Georgia

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
CfA	Cedarbluff loam, 0 to 2 percent slopes, occasionally flooded	C/D	0.0	0.0%
EtB	Etowah loam, 2 to 6 percent slopes	B	19.9	17.1%
WbB2	Waynesboro clay loam, 2 to 6 percent slopes, moderately eroded	B	50.0	42.9%
WbC2	Waynesboro clay loam, 6 to 10 percent slopes, moderately eroded	B	45.0	38.6%
WbD2	Waynesboro clay loam, 10 to 15 percent slopes, moderately eroded	B	0.3	0.3%
WtB	Whitwell silt loam, 1 to 5 percent slopes, rarely flooded	B/D	1.3	1.1%
Totals for Area of Interest			**116.5**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Image 4

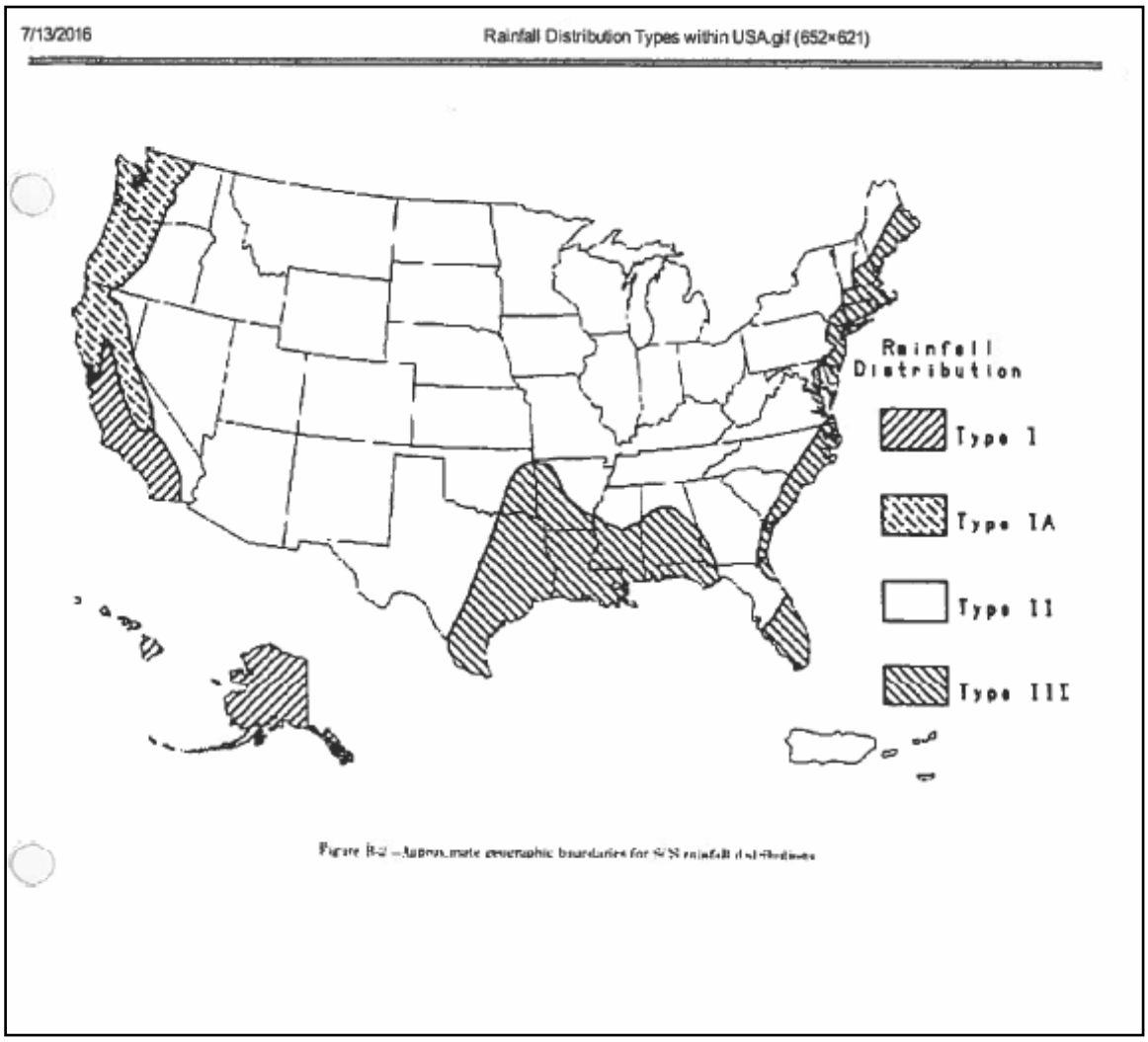

7/13/2016
Rainfall Distribution Types within USA.gif (652×621)
Rainfall Distribution
Type I
Type IA
Type II
Type III

Image 5

Precipitation Frequency Data Server — Page 1 of 4

NOAA Atlas 14, Volume 9, Version 2
TAYLORSVILLE
Station ID: 09-8600
Location name: Taylorsville, Georgia, US*
Latitude: 34.0861°, Longitude: -84.9828°
Elevation:
Elevation (station metadata): 721 ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Deborah Martin, Sandra Pavlovic, Ishani Roy, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Michael Yekta, Geoffery Bonnin

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	0.406 (0.321-0.518)	0.464 (0.367-0.593)	0.568 (0.448-0.726)	0.662 (0.520-0.849)	0.804 (0.619-1.06)	0.924 (0.695-1.23)	1.05 (0.768-1.42)	1.19 (0.838-1.62)	1.39 (0.943-1.92)	1.55 (1.02-2.14)
10-min	0.594 (0.471-0.759)	0.679 (0.537-0.868)	0.831 (0.655-1.06)	0.969 (0.761-1.24)	1.18 (0.907-1.56)	1.35 (1.02-1.80)	1.54 (1.12-2.07)	1.75 (1.23-2.38)	2.03 (1.38-2.81)	2.27 (1.50-3.14)
15-min	0.725 (0.574-0.926)	0.828 (0.655-1.06)	1.01 (0.799-1.30)	1.18 (0.928-1.52)	1.44 (1.11-1.90)	1.65 (1.24-2.19)	1.88 (1.37-2.53)	2.13 (1.50-2.90)	2.48 (1.68-3.43)	2.77 (1.83-3.83)
30-min	1.02 (0.811-1.31)	1.17 (0.924-1.49)	1.43 (1.13-1.83)	1.66 (1.31-2.13)	2.02 (1.56-2.68)	2.33 (1.75-3.09)	2.65 (1.94-3.57)	3.01 (2.12-4.11)	3.52 (2.39-4.86)	3.93 (2.60-5.44)
60-min	1.33 (1.05-1.70)	1.52 (1.20-1.94)	1.85 (1.46-2.36)	2.15 (1.69-2.76)	2.61 (2.01-3.45)	3.00 (2.25-3.98)	3.41 (2.49-4.58)	3.86 (2.71-5.26)	4.49 (3.05-6.21)	5.01 (3.31-6.93)
2-hr	1.64 (1.31-2.06)	1.86 (1.49-2.35)	2.27 (1.81-2.86)	2.64 (2.10-3.34)	3.20 (2.49-4.17)	3.66 (2.79-4.79)	4.16 (3.08-5.52)	4.70 (3.36-6.33)	5.47 (3.77-7.46)	6.09 (4.09-8.32)
3-hr	1.84 (1.49-2.30)	2.10 (1.69-2.62)	2.55 (2.05-3.19)	2.96 (2.37-3.71)	3.56 (2.80-4.60)	4.07 (3.12-5.28)	4.60 (3.43-6.05)	5.18 (3.73-6.91)	6.00 (4.17-8.12)	6.66 (4.51-9.04)
6-hr	2.27 (1.86-2.79)	2.57 (2.10-3.17)	3.10 (2.53-3.83)	3.57 (2.90-4.41)	4.26 (3.38-5.41)	4.82 (3.75-6.16)	5.42 (4.10-7.02)	6.05 (4.42-7.96)	6.94 (4.90-9.27)	7.65 (5.27-10.3)
12-hr	2.79 (2.32-3.39)	3.15 (2.61-3.83)	3.77 (3.12-4.58)	4.31 (3.54-5.25)	5.08 (4.06-6.34)	5.70 (4.49-7.17)	6.36 (4.87-8.10)	7.04 (5.21-9.11)	7.99 (5.72-10.5)	8.73 (6.11-11.6)
24-hr	3.34 (2.81-3.99)	3.79 (3.18-4.53)	4.54 (3.80-5.44)	5.18 (4.32-6.21)	6.07 (4.93-7.43)	6.77 (5.40-8.36)	7.48 (5.81-9.38)	8.22 (6.17-10.5)	9.21 (6.70-11.9)	9.98 (7.10-13.0)
2-day	3.87 (3.29-4.55)	4.43 (3.77-5.21)	5.34 (4.54-6.30)	6.10 (5.16-7.22)	7.14 (5.88-8.60)	7.95 (6.42-9.65)	8.75 (6.86-10.8)	9.56 (7.27-12.0)	10.6 (7.84-13.6)	11.4 (8.27-14.6)
3-day	4.24 (3.64-4.95)	4.81 (4.13-5.62)	5.76 (4.93-6.73)	6.56 (5.59-7.68)	7.66 (6.37-9.16)	8.53 (6.95-10.3)	9.40 (7.47-11.5)	10.3 (7.92-12.8)	11.5 (8.57-14.5)	12.4 (9.06-15.9)
4-day	4.56 (3.94-5.28)	5.14 (4.43-5.96)	6.10 (5.25-7.08)	6.92 (5.93-8.06)	8.07 (6.76-9.61)	8.98 (7.38-10.8)	9.92 (7.94-12.1)	10.9 (8.43-13.5)	12.2 (9.16-15.4)	13.2 (9.72-16.5)
7-day	5.37 (4.69-6.14)	5.99 (5.22-6.86)	7.04 (6.13-8.07)	7.94 (6.88-9.14)	9.24 (7.84-10.9)	10.3 (8.56-12.2)	11.3 (9.21-13.7)	12.5 (9.80-15.3)	14.0 (10.7-17.5)	15.2 (11.3-19.2)
10-day	6.07 (5.34-6.89)	6.74 (5.92-7.66)	7.88 (6.91-8.97)	8.87 (7.74-10.1)	10.3 (8.79-12.0)	11.4 (9.58-13.5)	12.6 (10.3-15.1)	13.8 (11.0-16.8)	15.5 (11.9-19.3)	16.8 (12.7-21.1)
20-day	8.08 (7.21-9.03)	8.91 (7.95-9.96)	10.3 (9.17-11.5)	11.5 (10.2-12.9)	13.2 (11.5-15.2)	14.6 (12.4-16.9)	16.0 (13.3-18.8)	17.4 (14.0-20.9)	19.4 (15.2-23.7)	21.0 (16.1-25.9)
30-day	9.86 (8.87-10.9)	10.8 (9.75-12.0)	12.5 (11.2-13.8)	13.9 (12.4-15.4)	15.8 (13.8-17.9)	17.3 (14.9-19.8)	18.8 (15.8-22.0)	20.4 (16.6-24.2)	22.5 (17.8-27.3)	24.1 (18.7-29.5)
45-day	12.2 (11.1-13.4)	13.5 (12.2-14.8)	15.4 (14.0-17.0)	17.1 (15.4-18.8)	19.3 (16.9-21.6)	20.9 (18.1-23.7)	22.6 (19.1-26.1)	24.3 (19.9-28.5)	26.4 (21.1-31.7)	28.1 (22.0-34.1)
60-day	14.4 (13.1-15.6)	15.8 (14.4-17.2)	18.1 (16.5-19.6)	19.9 (18.1-21.6)	22.4 (19.8-24.9)	24.2 (21.0-27.2)	25.9 (22.0-29.7)	27.7 (22.8-32.2)	29.8 (23.9-35.5)	31.4 (24.8-37.9)

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

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

Please refer to NOAA Atlas 14 document for more information.

Back to Top

PF graphical

Image 6

Body of Calculation

See detailed calculations and software output.

Cells 3, 5 & 7

Drainage Area = 41.47 AC (See Map 1)

Curve Number = 64 (See Table 1)

37.94 AC @ CN 61 (Grass)
2.58 AC @ CN 85 (Gravel)
0.95 AC @ CN 98 (Impervious – Liner in Sediment Pond and Clear Pool)
((37.94*61)+(2.58*85)+(0.95*98))/41.47 = 63.34 = 63

Time of Concentration = 34.46 Min (See TR55 Worksheet 1 and Map 2)

Sheet Flow

Manning's n-Value = 0.15 (Short Grass) (See Table 2)
Flow Length = 300 LF
Land Slope = (828.50-824.95)/300 = 0.0118 = 1.18%

Shallow Concentrated

Flow Length = 92 LF
Watercourse Slope = (824.95-822.00)/92 = 0.0321 = 3.21%
Surface is Unpaved

Channel Flow (See Channel Report 1)

15" Dia. HDPE Downdrain Pipes
Cross Sectional Area = 0.70 SF
Wetted Perimeter = 2.09 LF
Channel Slope = (722.00-705.75)/1957 = 0.0594 = 5.94%
Manning's n-Value = 0.13 (HDPE Pipe)(See Table 3)
Flow Length = 1957 LF

Channel Flow (See Channel Report 2)

Grass Lined 4' Wide Ditch with 2:1 Side Slopes and 4' Deep
Cross Sectional Area = 7.33 SF
Wetted Perimeter = 9.19 LF
Channel Slope = (705.75-693.25)/1181 = 0.0106 = 1.06%
Manning's n-Value = 0.030 (Vegetal Lining) (See Table 3)
Flow Length = 1181 LF

Channel Flow (See Channel Report 3)

Concrete Lined 18' Wide Ditch with 2:1 Side Slopes and 3.5' Deep
Cross Sectional Area = 10.51 SF
Wetted Perimeter = 20.46 LF
Channel Slope = (693.25-692.85)/77 = 0.0052 = 0.52%
Manning's n-Value = 0.013 (Concrete Lining) (See Table 3)
Flow Length = 77 LF

Time Interval = 3 Min
Tc*0.1333 = 34.50*0.1333 = 4.60 = 5

Storm Distribution = Type II

Q_{25} = 63.20 CFS (See Hydrograph Report 1)

To Evaluate for Storage Capacity, Treat The Sediment Pond and Clear Pool As One Pond Since They Are Interconnected.

Elevation (FT)	Sed. Pond Area (SF)	Clear Pool Area (SF)	Total Area (SF)	Volume (CF)
683	0	9,025	9,025	0*
684	43,996	9,996	53,992	28,361*
685	46,707	11,007	57,714	84,198*
685.5	48,077	11,527	59,604	113,523*
686	49,457	12,057	61,514	143,799
687	52,247	13,147	65,394	207,236
688	55,076	14,276	69,352	274,593
689	57,944	15,444	73,388	345,946
690	60,851	16,651	77,502	421,374
690.5	62,320	17,270	79,590	460,642

*Dead Storage

Spillways

- Principal Spillway consists of two 54” Dia. Risers with two 36” Dia. HDPE Pipes.
- Auxiliary Spillway consist of a concrete lined trapezoidal weir that is 20’ wide with 6:1 side slopes and sloped at 1% in the direction of flow with a 3:1 slope on the discharge channel at the downstream end.

High Water Elevation is 688.73 (See Pond Reports 1 & 2)

Design Calculations

Project	Prepared by	Date
Plant Bowen Run-on Run-off Control	Jeremy Brown	3/19/21
Subject/Title Provide run-on and run-off system calculations for the peak discharge from a 24-hr 25-year storm Cells 3-8	Reviewed by Ashley Grissom	Date 4/1/21
	Calculation Number DC-BN- 735210-002	Sheet 14 of 58

Map 1

Project	Prepared by	Date
Plant Bowen Run-on Run-off Control	Jeremy Brown	3/19/21
Subject/Title Provide run-on and run-off system calculations for the peak discharge from a 24-hr 25-year storm Cells 3-8	Reviewed by Ashley Grissom	Date 4/1/21
	Calculation Number DC-BN- 735210-002	Sheet 15 of 58

TR55 Tc Worksheet

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v12

Hyd. No. 4

Cell 3, 5 & 7 Ditch 2

Description	A	B	C	Totals
Sheet Flow				
Manning's n-value	= 0.150	0.011	0.011	
Flow length (ft)	= 300.0	0.0	0.0	
Two-year 24-hr precip. (in)	= 3.79	0.00	0.00	
Land slope (%)	= 1.18	0.00	0.00	
Travel Time (min)	**= 26.78 +**	**0.00 +**	**0.00 =**	**26.78**
Shallow Concentrated Flow				
Flow length (ft)	= 92.00	0.00	0.00	
Watercourse slope (%)	= 3.21	0.00	0.00	
Surface description	= Unpaved	Paved	Paved	
Average velocity (ft/s)	=2.89	0.00	0.00	
Travel Time (min)	**= 0.53 +**	**0.00 +**	**0.00 =**	**0.53**
Channel Flow				
X sectional flow area (sqft)	= 0.70	7.33	10.51	
Wetted perimeter (ft)	= 2.09	9.19	20.46	
Channel slope (%)	= 5.94	1.06	0.52	
Manning's n-value	= 0.013	0.030	0.013	
Velocity (ft/s)	=13.42			
		4.39		
			5.29	
Flow length (ft)	({0})1957.0	1181.0	77.0	
Travel Time (min)	**= 2.43 +**	**4.48 +**	**0.24 =**	**7.15**
Total Travel Time, Tc				**34.46 min**

TR55 Worksheet 1

Design Calculations

Project	Prepared by	Date
Plant Bowen Run-on Run-off Control	Jeremy Brown	3/19/21
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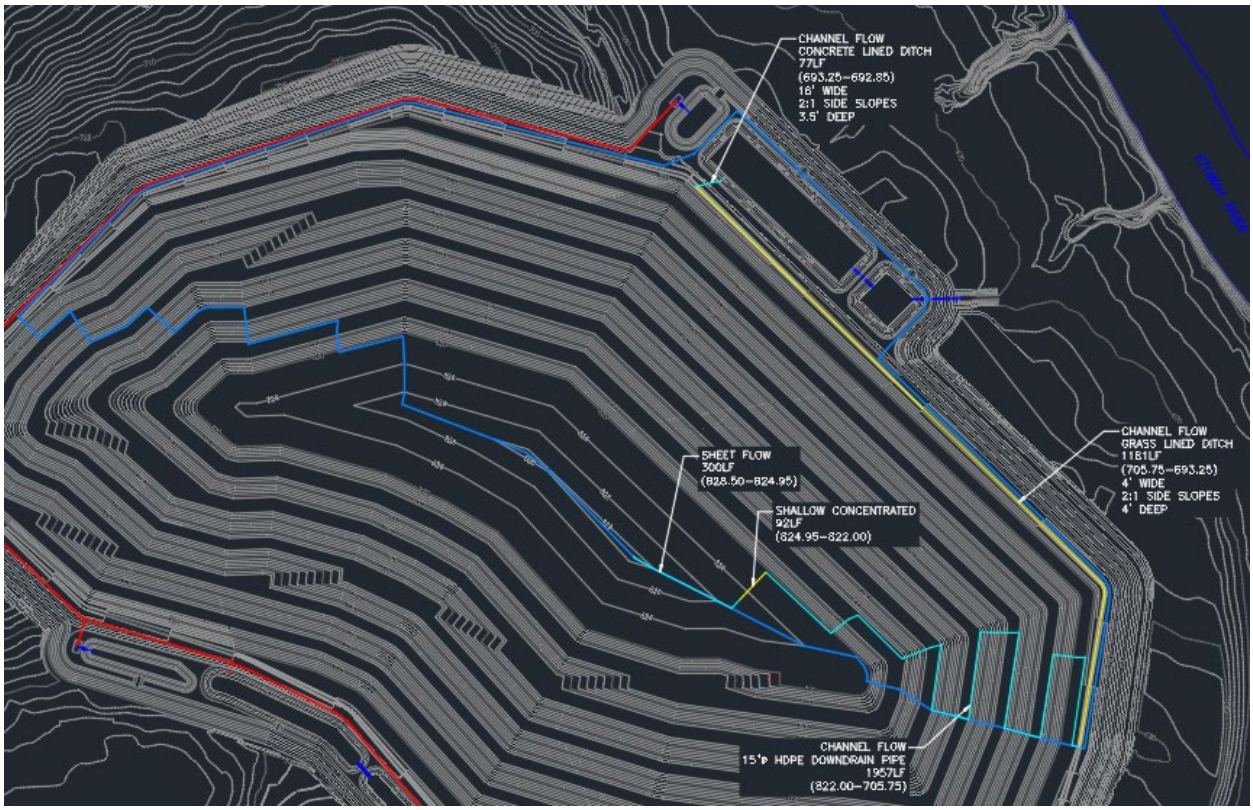
	Calculation Number DC-BN- 735210-002	Sheet 16 of 58



Map 2

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Mar 17 2021

Cell 357 Downdrain

Circular

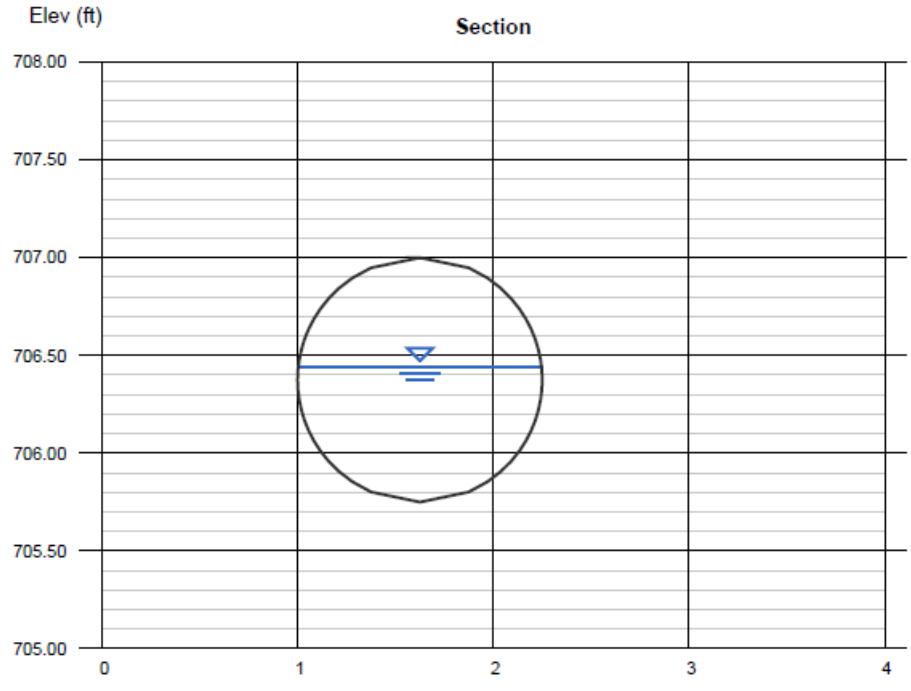
Diameter (ft)	= 1.25
Invert Elev (ft)	= 705.75
Slope (%)	= 5.94
N-Value	= 0.013

Calculations

Compute by:	Known Q
Known Q (cfs)	= 9.11

Highlighted

Depth (ft)	= 0.69
Q (cfs)	= 9.110
Area (sqft)	= 0.69
Velocity (ft/s)	= 13.11
Wetted Perim (ft)	= 2.09
Crit Depth, Yc (ft)	= 1.16
Top Width (ft)	= 1.24
EGL (ft)	= 3.36



Channel Report 1

Design Calculations

Project	Prepared by	Date
Plant Bowen Run-on Run-off Control	Jeremy Brown	3/19/21
Subject/Title Provide run-on and run-off system calculations for the peak discharge from a 24-hr 25-year storm Cells 3-8	Reviewed by Ashley Grissom	Date 4/1/21
	Calculation Number DC-BN- 735210-002	Sheet 18 of 58

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Mar 17 2021

Cell 3 Ditch 1

Trapezoidal

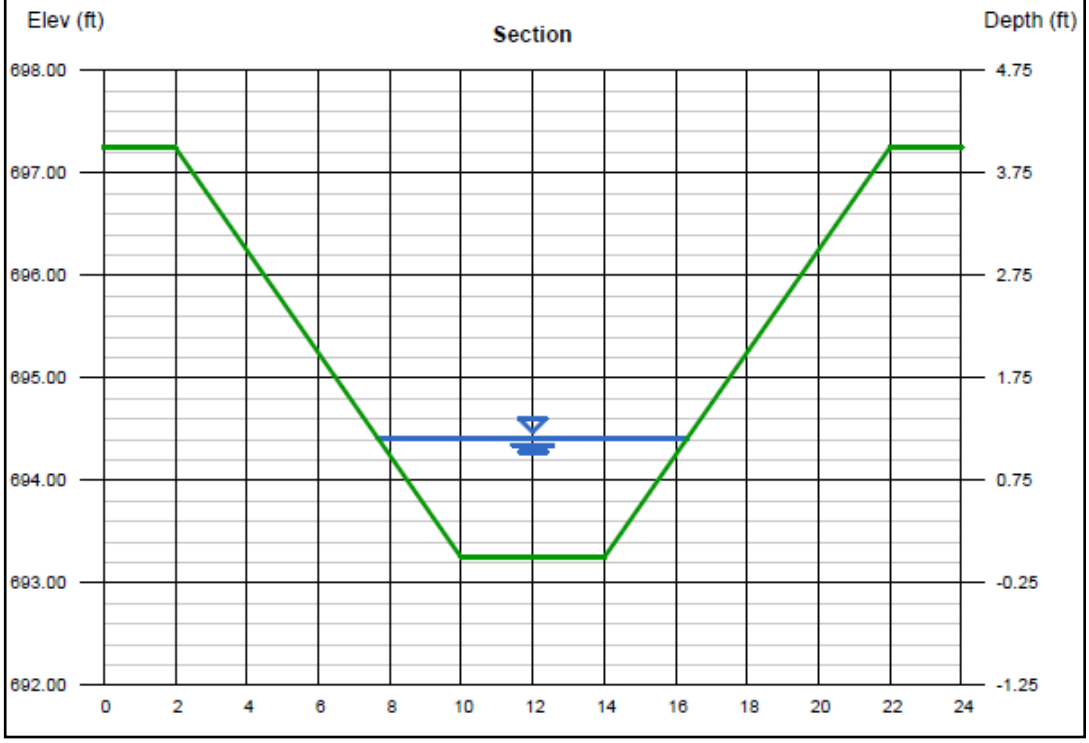
Bottom Width (ft)	= 4.00
Side Slopes (z:1)	= 2.00, 2.00
Total Depth (ft)	= 4.00
Invert Elev (ft)	= 693.25
Slope (%)	= 1.06
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 32.02

Highlighted

Depth (ft)	= 1.16
Q (cfs)	= 32.02
Area (sqft)	= 7.33
Velocity (ft/s)	= 4.37
Wetted Perim (ft)	= 9.19
Crit Depth, Yc (ft)	= 1.05
Top Width (ft)	= 8.64
EGL (ft)	= 1.46



Channel Report 2

Design Calculations

Project	Prepared by	Date
Plant Bowen Run-on Run-off Control	Jeremy Brown	3/19/21
Subject/Title Provide run-on and run-off system calculations for the peak discharge from a 24-hr 25-year storm Cells 3-8	Reviewed by Ashley Grissom	Date 4/1/21
	Calculation Number DC-BN- 735210-002	Sheet 19 of 58

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Mar 17 2021

Cell 3 Ditch 2

Trapezoidal

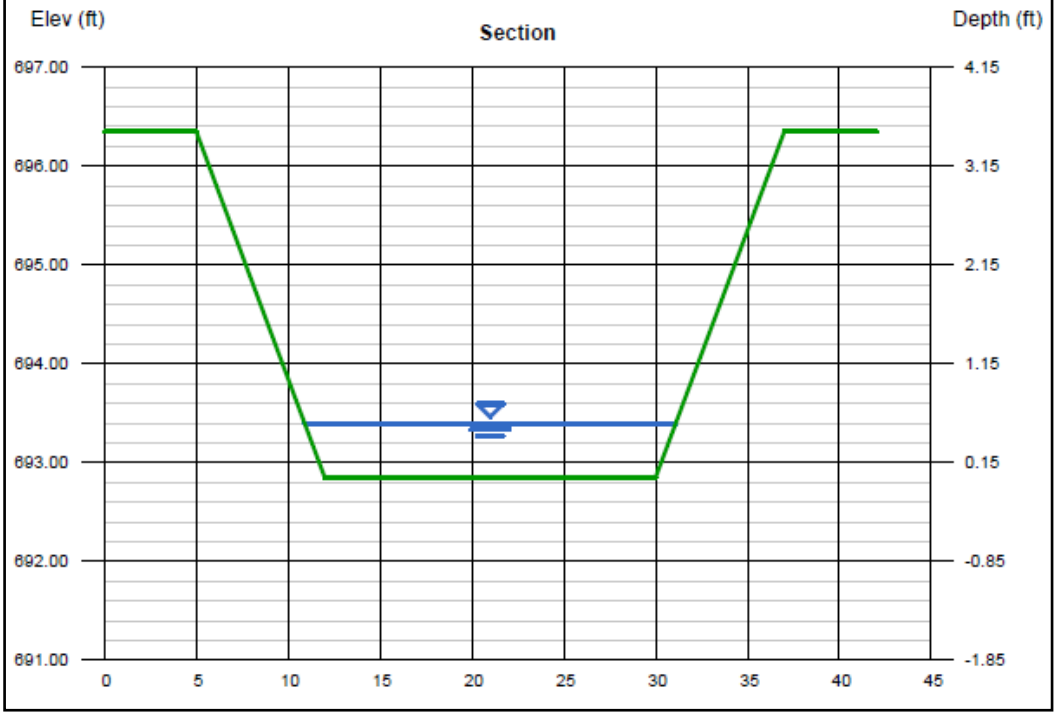
Bottom Width (ft)	= 18.00
Side Slopes (z:1)	= 2.00, 2.00
Total Depth (ft)	= 3.50
Invert Elev (ft)	= 692.85
Slope (%)	= 0.50
N-Value	= 0.013

Calculations

Compute by:	Known Q
Known Q (cfs)	= 53.05

Highlighted

Depth (ft)	= 0.55
Q (cfs)	= 53.05
Area (sqft)	= 10.51
Velocity (ft/s)	= 5.05
Wetted Perim (ft)	= 20.46
Crit Depth, Yc (ft)	= 0.64
Top Width (ft)	= 20.20
EGL (ft)	= 0.95



Channel Report 3

Design Calculations

Project	Prepared by	Date
Plant Bowen Run-on Run-off Control	Jeremy Brown	3/19/21
Subject/Title Provide run-on and run-off system calculations for the peak discharge from a 24-hr 25-year storm Cells 3-8	Reviewed by Ashley Grissom	Date 4/1/21
	Calculation Number DC-BN- 735210-002	Sheet 20 of 58

Hydrograph Report

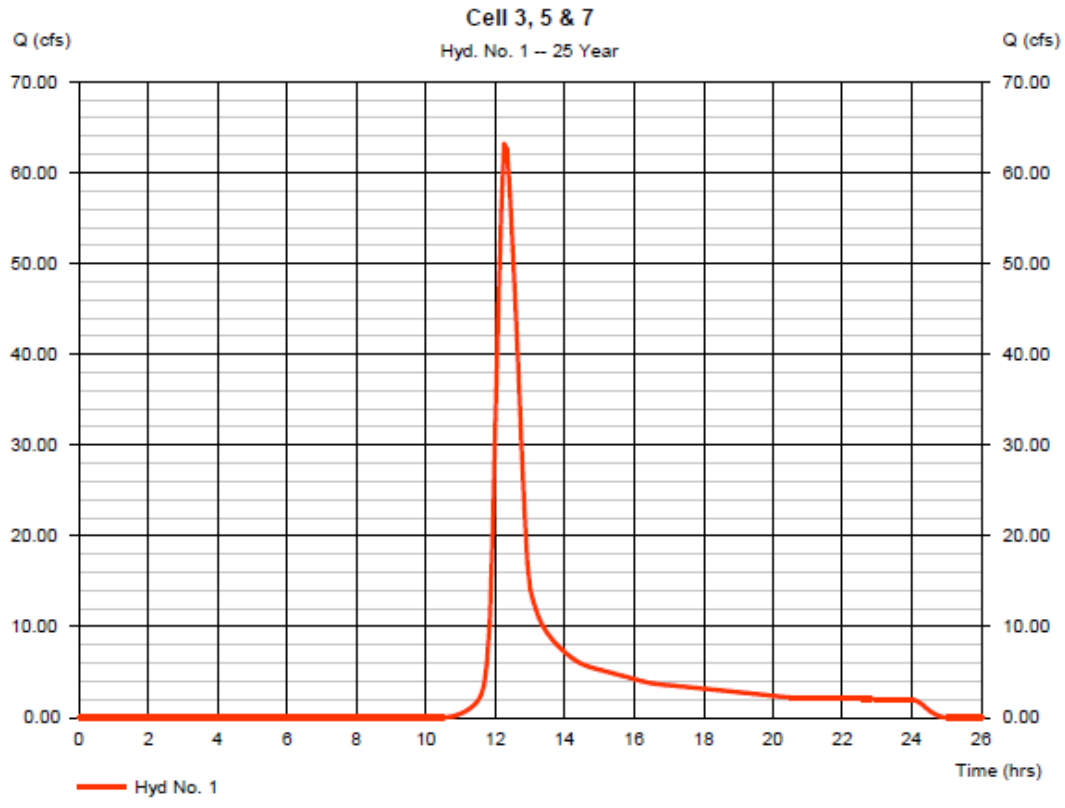
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v12 — Wednesday, 03 / 17 / 2021

Hyd. No. 1

Cell 3, 5 & 7

Hydrograph type	= SCS Runoff	Peak discharge	= 63.20 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.25 hrs
Time interval	= 5 min	Hyd. volume	= 326,637 cuft
Drainage area	= 41.470 ac	Curve number	= 63*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 34.50 min
Total precip.	= 6.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(37.940 x 61) + (2.580 x 85) + (0.950 x 98)] / 41.470



Hydrograph Report 1

Design Calculations

Project	Prepared by	Date
Plant Bowen Run-on Run-off Control	Jeremy Brown	3/19/21
Subject/Title Provide run-on and run-off system calculations for the peak discharge from a 24-hr 25-year storm Cells 3-8	Reviewed by Ashley Grissom	Date 4/1/21
	Calculation Number DC-BN- 735210-002	Sheet 21 of 58

Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v12 — Monday, 04 / 12 / 2021

Pond No. 1 - Cell 3 Sed Pond/Clear Pool

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 683.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	683.00	9,025	0	0
1.00	684.00	53,992	28,361	28,361
2.00	685.00	57,714	55,837	84,198
2.50	685.50	59,604	29,325	113,523
3.00	686.00	61,514	30,275	143,799
4.00	687.00	65,394	63,438	207,236
5.00	688.00	69,352	67,357	274,593
6.00	689.00	73,388	71,353	345,946
7.00	690.00	77,502	75,428	421,374
7.50	690.50	79,590	39,268	460,642

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 36.00	0.00	0.00	0.00
Span (in)	= 36.00	0.00	0.00	0.00
No. Barrels	= 2	0	0	0
Invert El. (ft)	= 670.00	0.00	0.00	0.00
Length (ft)	= 117.00	0.00	0.00	0.00
Slope (%)	= 0.25	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

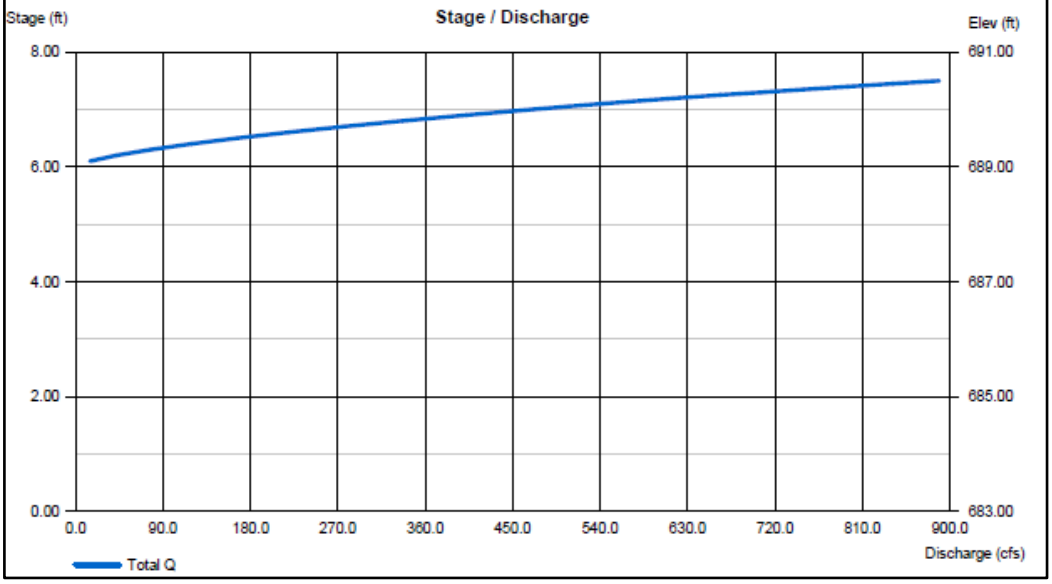
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 28.28	0.00	0.00	0.00
Crest El. (ft)	= 690.10	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	---	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 0.000 (by Contour)

TW Elev. (ft) = 0.00

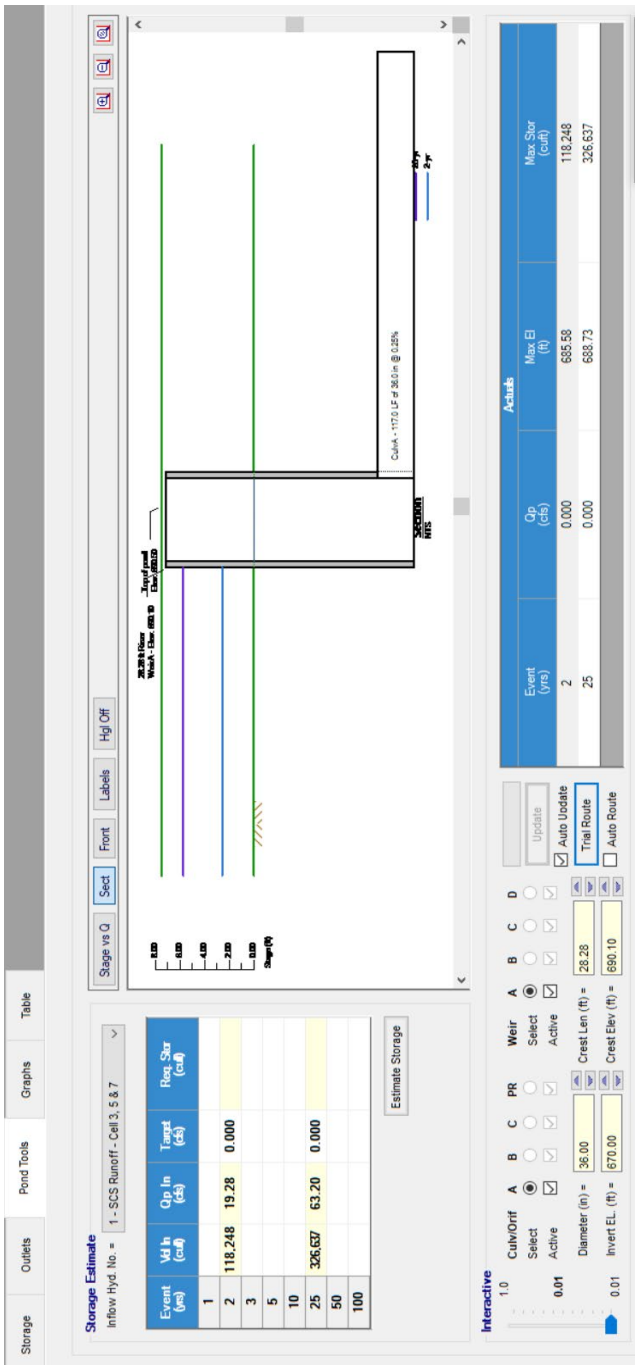
Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).



Pond Report 1

Design Calculations

Project	Prepared by	Date
Plant Bowen Run-on Run-off Control	Jeremy Brown	3/19/21
Subject/Title Provide run-on and run-off system calculations for the peak discharge from a 24-hr 25-year storm Cells 3-8	Reviewed by Ashley Grissom	Date 4/1/21
	Calculation Number DC-BN- 735210-002	Sheet 22 of 58



Pond Report 2

Cell 4

Drainage Area = 12.59 AC (See Map 3)

Curve Number = 64 (See Table 1)

10.79 AC @ CN 61 (Grass)
1.30 AC @ CN 85 (Gravel)
0.50 AC @ CN 98 (Impervious – Liner in Sediment Pond and Clear Pool)
((10.79*61)+(1.30*85)+(0.50*98))/12.59 = 64.95 = 65

Time of Concentration = 20.69 Min (See TR55 Worksheet 2 and Map 4)

Sheet Flow

Manning's n-Value = 0.15 (Short Grass) (See Table 2)
Flow Length = 167 LF
Land Slope = (826.66-822.00)/167 = 0.0279 = 2.79%

Shallow Concentrated

Flow Length = 161 LF
Watercourse Slope = (822.00-820.90)/161 = 0.0068 = 0.68%
Surface is Unpaved

Channel Flow (See Channel Report 4)

12" Dia. HDPE Downdrain Pipes
Cross Sectional Area = 0.624 SF
Wetted Perimeter = 2.08 LF
Channel Slope = (820.90-723.50)/1089 = 0.0894 = 8.94%
Manning's n-Value = 0.13 (HDPE Pipe)(See Table 3)
Flow Length = 1089 LF

Channel Flow (See Channel Report 5)

Grass Lined 4' Wide Ditch with 2:1 Side Slopes and 4' Deep
Cross Sectional Area = 5.07 SF
Wetted Perimeter = 7.94 LF
Channel Slope = (723.50-704.73)/1379 = 0.0136 = 1.36%
Manning's n-Value = 0.030 (Vegetal Lining) (See Table 3)
Flow Length = 1379 LF

Channel Flow (See Channel Report 6)

Concrete Lined 18' Wide Ditch with 2:1 Side Slopes and 3.5' Deep
Cross Sectional Area = 4.53 SF
Wetted Perimeter = 15.84 LF

Channel Slope = (704.73-704.00)/74 = 0.0099 = 0.99%
Manning's n-Value = 0.013 (Concrete Lining) (See Table 3)
Flow Length = 74 LF

Time Interval = 3 Min
Tc*0.1333 = 20.69*0.1333 = 2.76 = 3

Storm Distribution = Type II

Q_{25} = 29.54 CFS (See Hydrograph Report 2)

To Evaluate for Storage Capacity, Treat The Sediment Pond and Clear Pool As One Pond Since They Are Interconnected.

Elevation (FT)	Sed. Pond Area (SF)	Clear Pool Area (SF)	Total Area (SF)	Volume (CF)
697	740	5,913	6,653	0*
698	16,648	6,917	23,565	14,245*
698.5	17,772	7,435	25,207	26,434*
699	18,906	7,962	26,868	39,450
700	21,203	9,045	30,248	67,988
701	23,539	10,168	33,707	99,947
702	25,915	11,330	37,215	135,390

*Dead Storage

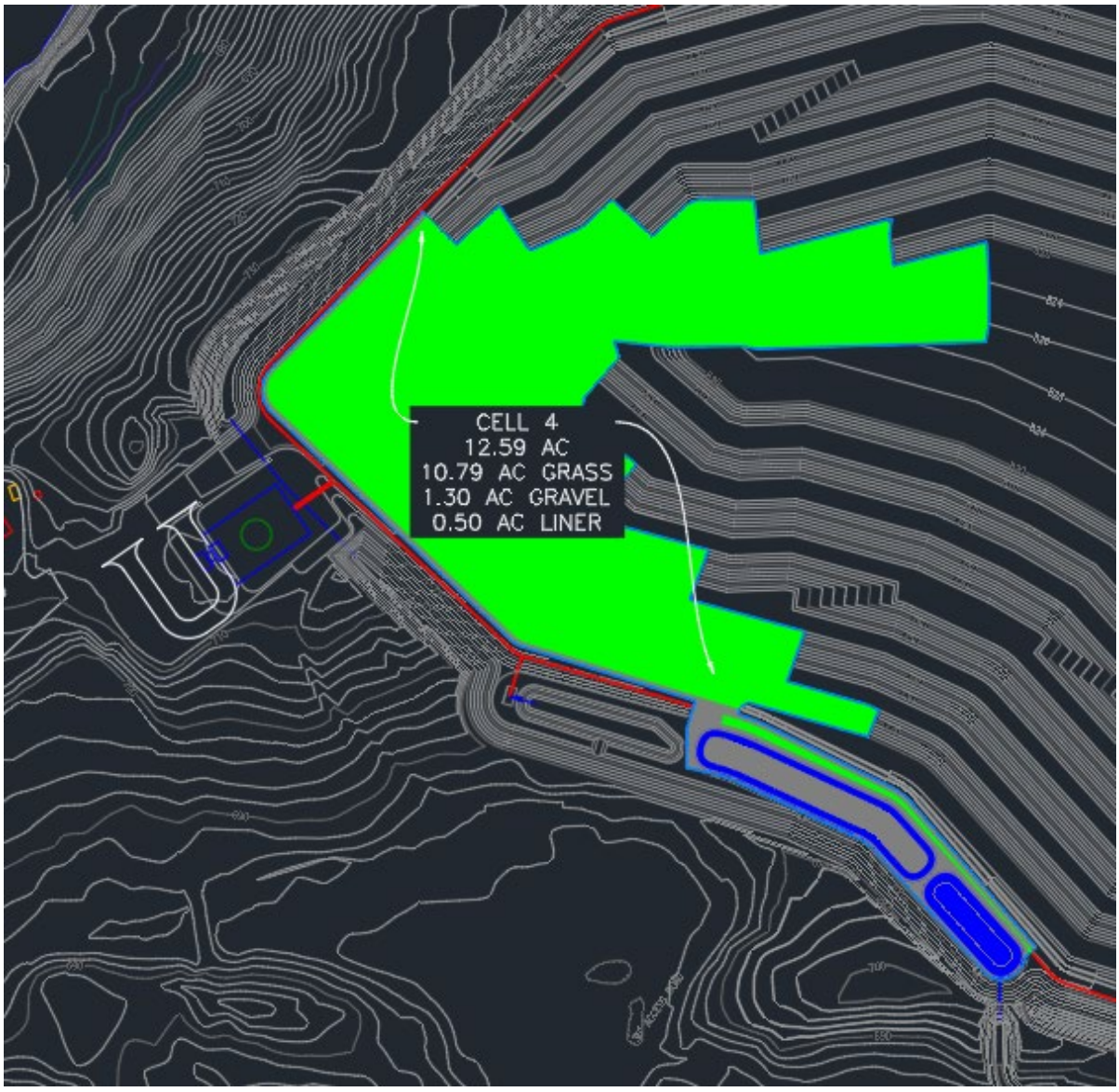
Spillways

- Principal Spillway consists of a 66" Dia. Riser with a 42" Dia. HDPE Pipe.
- Auxiliary Spillway consist of a concrete lined trapezoidal weir that is 18' wide with 6:1 side slopes and sloped at 1% in the direction of flow with a 3:1 slope on the discharge channel at the downstream end.

High Water Elevation is 701.03 (See Pond Reports 3 & 4)

Design Calculations

Project	Prepared by	Date
Plant Bowen Run-on Run-off Control	Jeremy Brown	3/19/21
Subject/Title Provide run-on and run-off system calculations for the peak discharge from a 24-hr 25-year storm Cells 3-8	Reviewed by Ashley Grissom	Date 4/1/21
	Calculation Number DC-BN- 735210-002	Sheet 25 of 58



Map 3

Project	Prepared by	Date
Plant Bowen Run-on Run-off Control	Jeremy Brown	3/19/21
Subject/Title Provide run-on and run-off system calculations for the peak discharge from a 24-hr 25-year storm Cells 3-8	Reviewed by Ashley Grissom	Date 4/1/21
	Calculation Number DC-BN- 735210-002	Sheet 26 of 58

TR55 Tc Worksheet

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v12

Hyd. No. 7

Cell 4

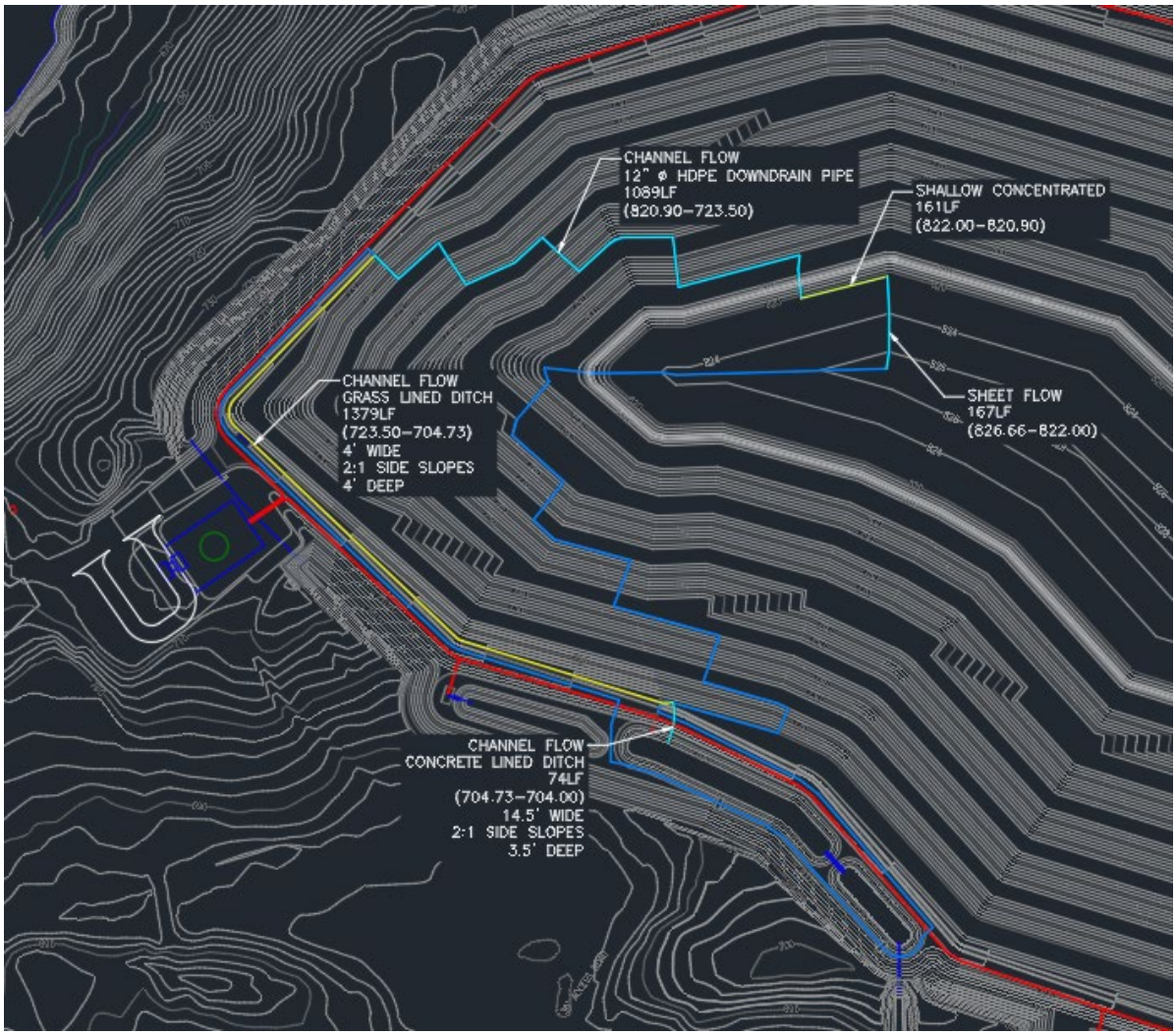
Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 167.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.79		0.00		0.00		
Land slope (%)	= 2.79		0.00		0.00		
Travel Time (min)	**= 11.88**	**+**	**0.00**	**+**	**0.00**	**=**	**11.88**
Shallow Concentrated Flow							
Flow length (ft)	= 161.00		0.00		0.00		
Watercourse slope (%)	= 0.68		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=1.33		0.00		0.00		
Travel Time (min)	**= 2.02**	**+**	**0.00**	**+**	**0.00**	**=**	**2.02**
Channel Flow							
X sectional flow area (sqft)	= 0.62		5.07		4.53		
Wetted perimeter (ft)	= 2.08		7.94		15.84		
Channel slope (%)	= 8.94		1.36		0.99		
Manning's n-value	= 0.013		0.030		0.013		
Velocity (ft/s)	=15.30						
			4.29				
					4.93		
Flow length (ft)	({0})1089.0		1379.0		74.0		
Travel Time (min)	**= 1.19**	**+**	**5.36**	**+**	**0.25**	**=**	**6.80**

Total Travel Time, Tc ..... **20.69 min**

TR55 Worksheet 2

Design Calculations

Project	Prepared by	Date
Plant Bowen Run-on Run-off Control	Jeremy Brown	3/19/21
Subject/Title Provide run-on and run-off system calculations for the peak discharge from a 24-hr 25-year storm Cells 3-8	Reviewed by Ashley Grissom	Date 4/1/21
	Calculation Number DC-BN- 735210-002	Sheet 27 of 58



Map 4

Project	Prepared by	Date
Plant Bowen Run-on Run-off Control	Jeremy Brown	3/19/21
Subject/Title Provide run-on and run-off system calculations for the peak discharge from a 24-hr 25-year storm Cells 3-8	Reviewed by Ashley Grissom	Date 4/1/21
	Calculation Number DC-BN- 735210-002	Sheet 28 of 58

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Mar 17 2021

Cell 4 Downdrain

Circular

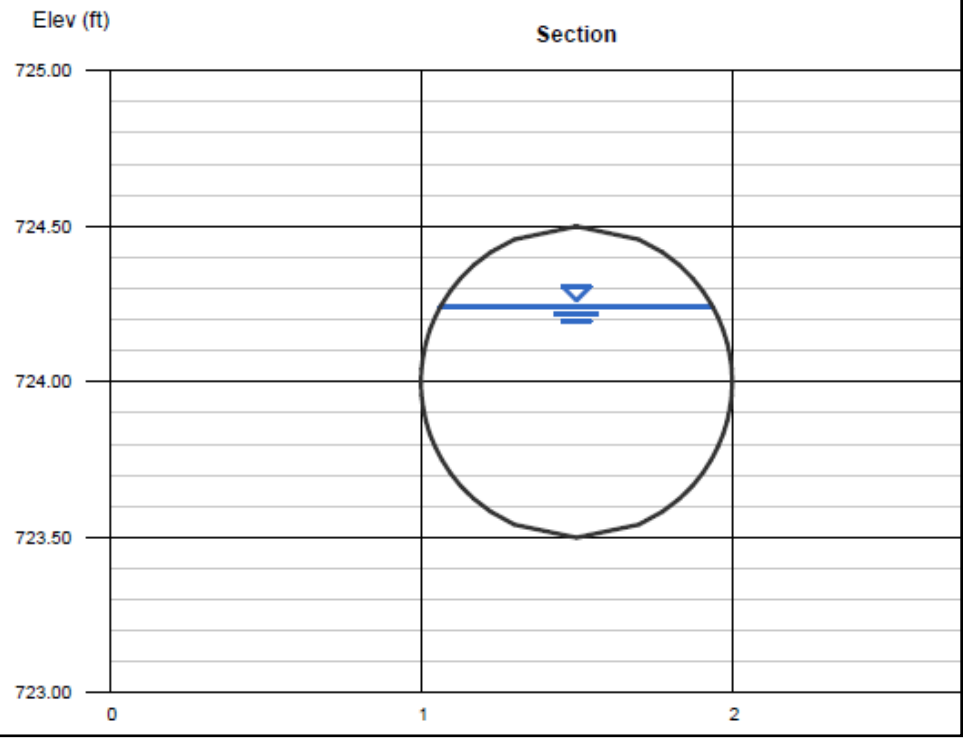
Diameter (ft)	= 1.00
Invert Elev (ft)	= 723.50
Slope (%)	= 8.94
N-Value	= 0.013

Calculations

Compute by:	Known Q
Known Q (cfs)	= 9.56

Highlighted

Depth (ft)	= 0.74
Q (cfs)	= 9.560
Area (sqft)	= 0.62
Velocity (ft/s)	= 15.31
Wetted Perim (ft)	= 2.08
Crit Depth, Yc (ft)	= 1.00
Top Width (ft)	= 0.88
EGL (ft)	= 4.38



Channel Report 4

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Mar 17 2021

Cell 4 Ditch 1

Trapezoidal

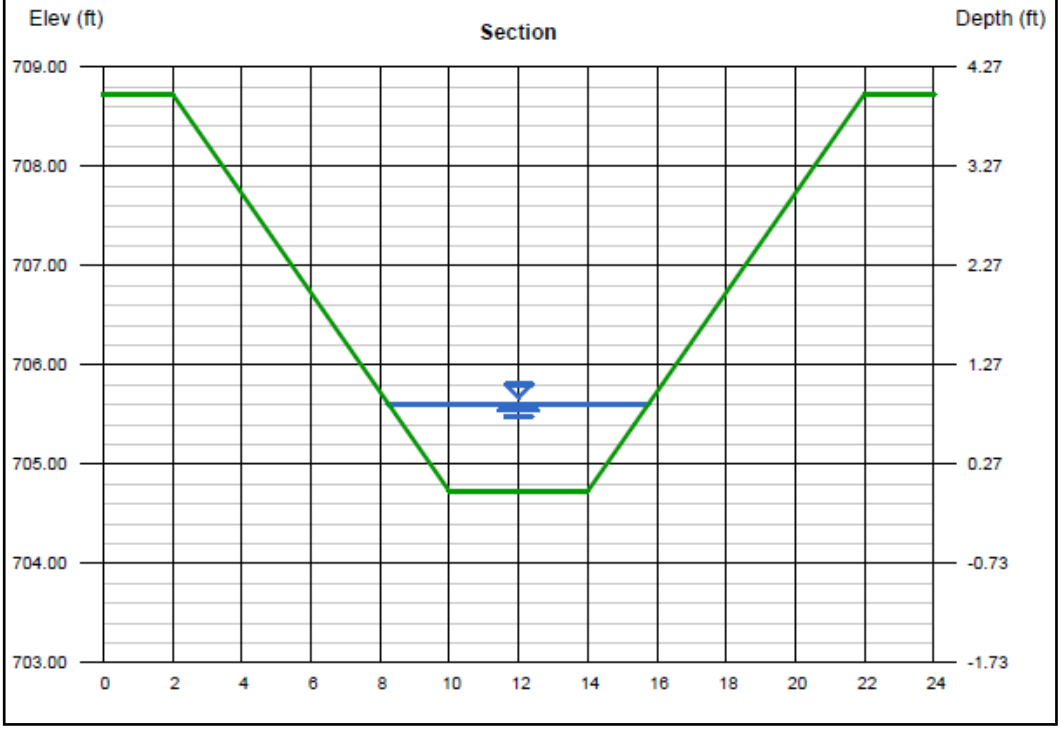
Bottom Width (ft)	= 4.00
Side Slopes (z:1)	= 2.00, 2.00
Total Depth (ft)	= 4.00
Invert Elev (ft)	= 704.73
Slope (%)	= 1.36
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 21.60

Highlighted

Depth (ft)	= 0.88
Q (cfs)	= 21.60
Area (sqft)	= 5.07
Velocity (ft/s)	= 4.26
Wetted Perim (ft)	= 7.94
Crit Depth, Yc (ft)	= 0.84
Top Width (ft)	= 7.52
EGL (ft)	= 1.16



Channel Report 5

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Mar 17 2021

Cell 4 Ditch 2

Trapezoidal

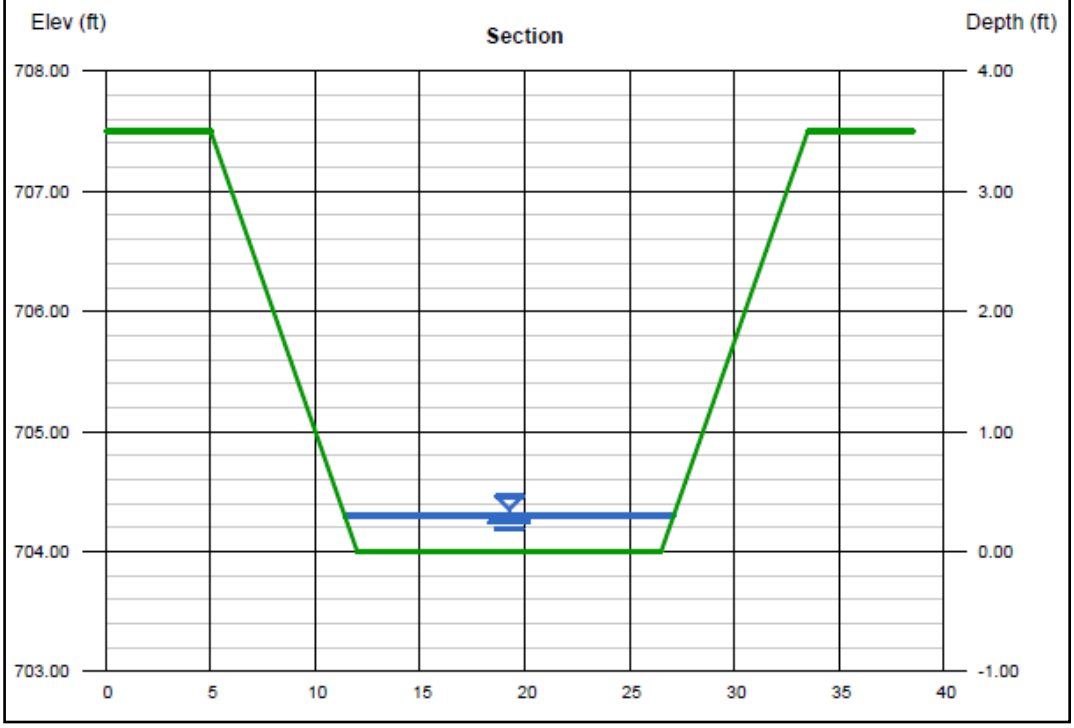
Bottom Width (ft)	= 14.50
Side Slopes (z:1)	= 2.00, 2.00
Total Depth (ft)	= 3.50
Invert Elev (ft)	= 704.00
Slope (%)	= 0.99
N-Value	= 0.013

Calculations

Compute by:	Known Q
Known Q (cfs)	= 21.60

Highlighted

Depth (ft)	= 0.30
Q (cfs)	= 21.60
Area (sqft)	= 4.53
Velocity (ft/s)	= 4.77
Wetted Perim (ft)	= 15.84
Crit Depth, Yc (ft)	= 0.41
Top Width (ft)	= 15.70
EGL (ft)	= 0.65



Channel Report 6

Hydrograph Report

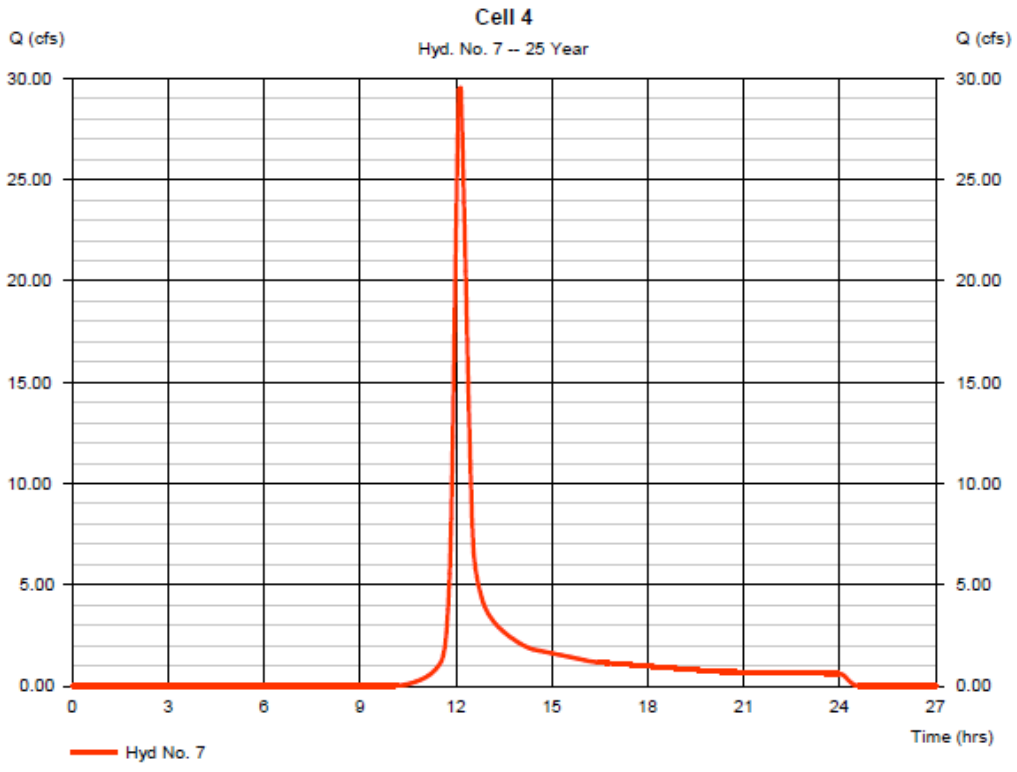
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v12 — Wednesday, 03 / 17 / 2021

Hyd. No. 7

Cell 4

Hydrograph type	= SCS Runoff	Peak discharge	= 29.54 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.15 hrs
Time interval	= 3 min	Hyd. volume	= 107,047 cuft
Drainage area	= 12.590 ac	Curve number	= 65*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 20.70 min
Total precip.	= 6.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(10.790 x 61) + (1.300 x 85) + (0.500 x 98)] / 12.590



Hydrograph Report 2

Project	Prepared by	Date
Plant Bowen Run-on Run-off Control	Jeremy Brown	3/19/21
Subject/Title Provide run-on and run-off system calculations for the peak discharge from a 24-hr 25-year storm Cells 3-8	Reviewed by Ashley Grissom	Date 4/1/21
	Calculation Number DC-BN- 735210-002	Sheet 32 of 58

Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v12 — Monday, 04 / 12 / 2021

Pond No. 2 - Cell 4 Sed Pond/Clear Pool

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 697.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	697.00	6,653	0	0
1.00	698.00	23,565	14,245	14,245
1.50	698.50	25,207	12,189	26,434
2.00	699.00	26,868	13,015	39,450
3.00	700.00	30,248	28,538	67,988
4.00	701.00	33,707	31,959	99,947
5.00	702.00	37,215	35,443	135,390

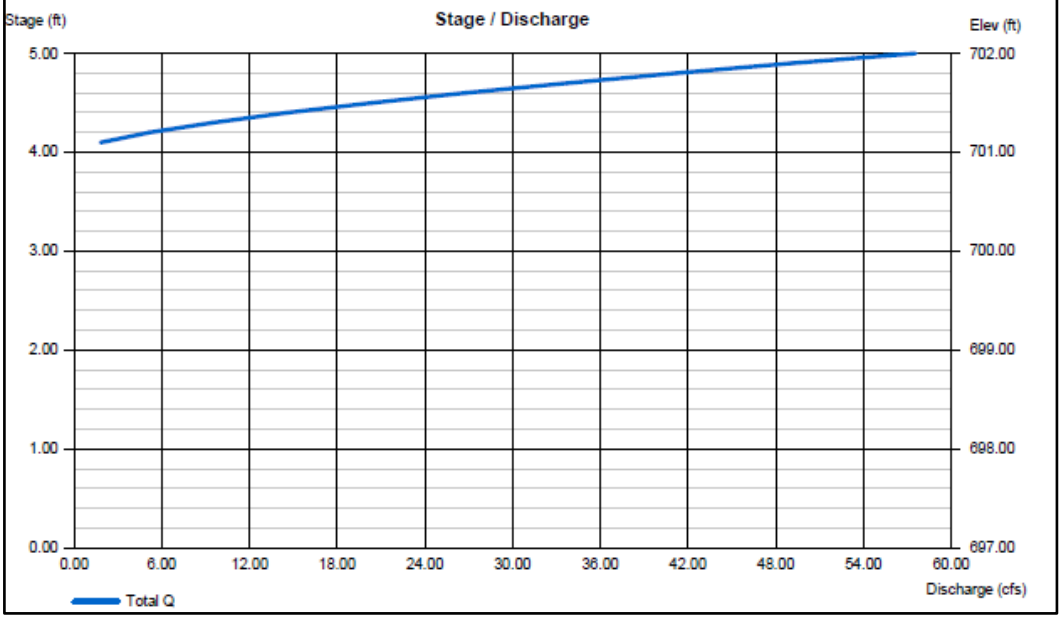
Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 42.00	0.00	0.00	0.00
Span (in)	= 42.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 681.60	0.00	0.00	0.00
Length (ft)	= 113.00	0.00	0.00	0.00
Slope (%)	= 0.80	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 17.28	0.00	0.00	0.00
Crest El. (ft)	= 702.43	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	---	---	---
Multi-Stage	= Yes	No	No	No
Exfil.(in/hr)	= 0.000 (by Wet area)			
TW Elev. (ft)	= 0.00			

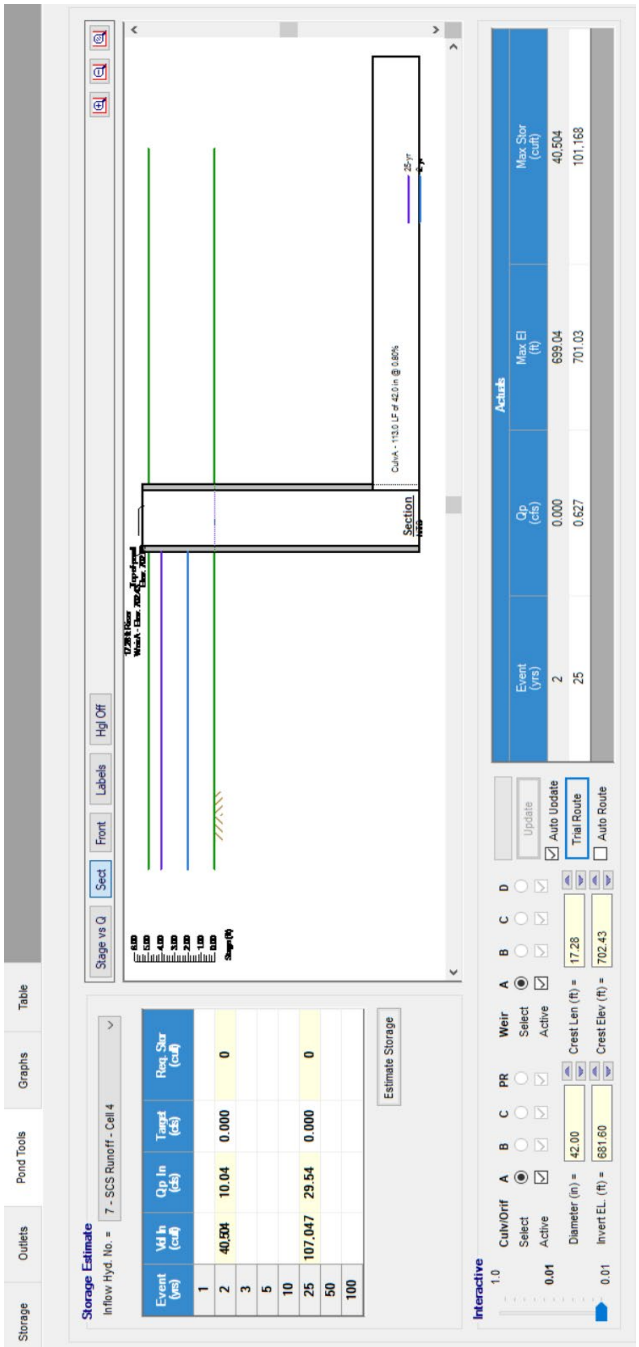
Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).



Pond Report 3

Design Calculations

Project	Prepared by	Date
Plant Bowen Run-on Run-off Control	Jeremy Brown	3/19/21
Subject/Title Provide run-on and run-off system calculations for the peak discharge from a 24-hr 25-year storm Cells 3-8	Reviewed by Ashley Grissom	Date 4/1/21
	Calculation Number DC-BN- 735210-002	Sheet 33 of 58



Pond Report 4

Cell 6

Drainage Area = 28.14 AC (See Map 5)

Curve Number = 64 (See Table 1)

26.66 AC @ CN 61 (Grass)
1.07 AC @ CN 85 (Gravel)
0.41 AC @ CN 98 (Impervious – Liner in Sediment Pond and Clear Pool)
((26.66*61)+(1.07*85)+(0.41*98))/28.14_ = 62.45 = 62

Time of Concentration = 46.98 Min (See TR55 Worksheet 3 and Map 6)

Sheet Flow

Manning's n-Value = 0.15 (Short Grass) (See Table 2)
Flow Length = 300 LF
Land Slope = (828.25-826.75)/300 = 0.0050 = 0.50%

Shallow Concentrated

Flow Length = 403 LF
Watercourse Slope = (826.75-822.00)/403 = 0.0118 = 1.18%
Surface is Unpaved

Channel Flow (See Channel Report 7)

18" Dia. HDPE Downdrain Pipes
Cross Sectional Area = 1.07 SF
Wetted Perimeter = 2.60 LF
Channel Slope = (822.00-703.63)/1778 = 0.0666 = 6.66%
Manning's n-Value = 0.13 (HDPE Pipe)(See Table 3)
Flow Length = 1778 LF

Channel Flow (See Channel Report 8)

Grass Lined 4' Wide Ditch with 2:1 Side Slopes and 4' Deep
Cross Sectional Area = 7.51 SF
Wetted Perimeter = 9.25 LF
Channel Slope = (703.63-697.00)/810 = 0.0082 = 0.82%
Manning's n-Value = 0.030 (Vegetal Lining) (See Table 3)
Flow Length = 810 LF

Channel Flow (See Channel Report 9)

Grass Lined 4' Wide Ditch with 2:1 Side Slopes and 2' Deep

Cross Sectional Area = 3.12 SF
Wetted Perimeter = 6.68 LF
Channel Slope = (697.00-690.00)/71 = 0.0986 = 9.86%
Manning's n-Value = 0.030 (Vegetal Lining) (See Table 3)
Flow Length = 71 LF

Time Interval = 3 Min
Tc*0.1333 = 46.98*0.1333 = 6.26 = 7

Storm Distribution = Type II

Q_{25} = 32.15 CFS (See Hydrograph Report 3)

To Evaluate for Storage Capacity, Treat The Sediment Pond and Clear Pool As One Pond Since They Are Interconnected.

Elevation (FT)	Sed. Pond Area (SF)	Clear Pool Area (SF)	Total Area (SF)	Volume (CF)
685	0	4,531	4,531	0*
686	20,795	5,195	25,990	13,790*
687	22,799	5,899	28,698	41,120
688	24,842	6,642	31,484	71,197
689	26,925	7,245	34,170	104,011
689.50	27,981	7,831	35,812	121,504

*Dead Storage

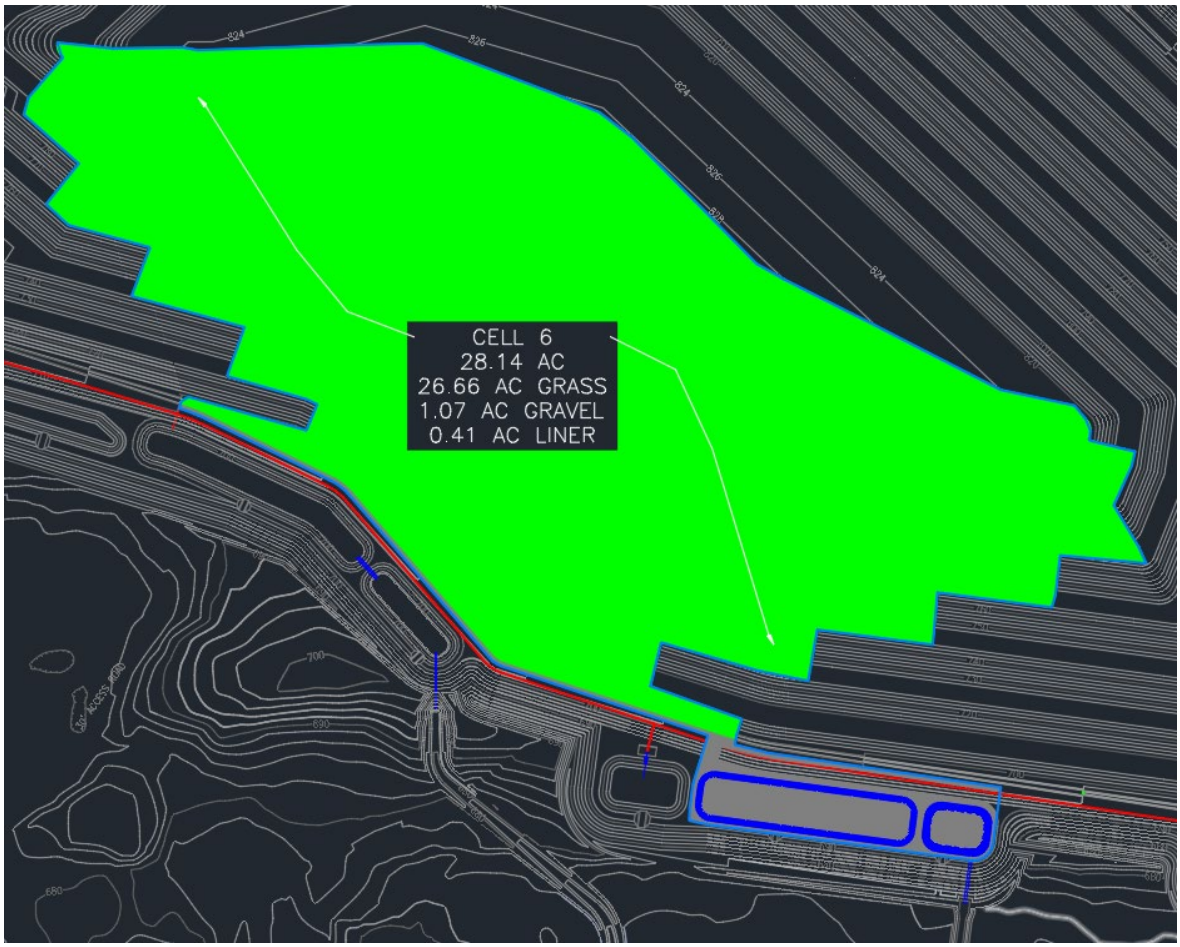
Spillways

- Principal Spillway consists of a 36" Dia. Riser with two 24" Dia. HDPE Pipes.
- Auxiliary Spillway consist of a grass lined trapezoidal weir that is 8' wide with 3:1 side slopes and sloped at 1% in the direction of flow with a 3:1 slope on the discharge channel at the downstream end.

High Water Elevation is 688.44 (See Pond Reports 5 & 6)

Design Calculations

Project	Prepared by	Date
Plant Bowen Run-on Run-off Control	Jeremy Brown	3/19/21
Subject/Title Provide run-on and run-off system calculations for the peak discharge from a 24-hr 25-year storm Cells 3-8	Reviewed by Ashley Grissom	Date 4/1/21
	Calculation Number DC-BN- 735210-002	Sheet 36 of 58



Map 5

TR55 Tc Worksheet

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v12

Hyd. No. 13

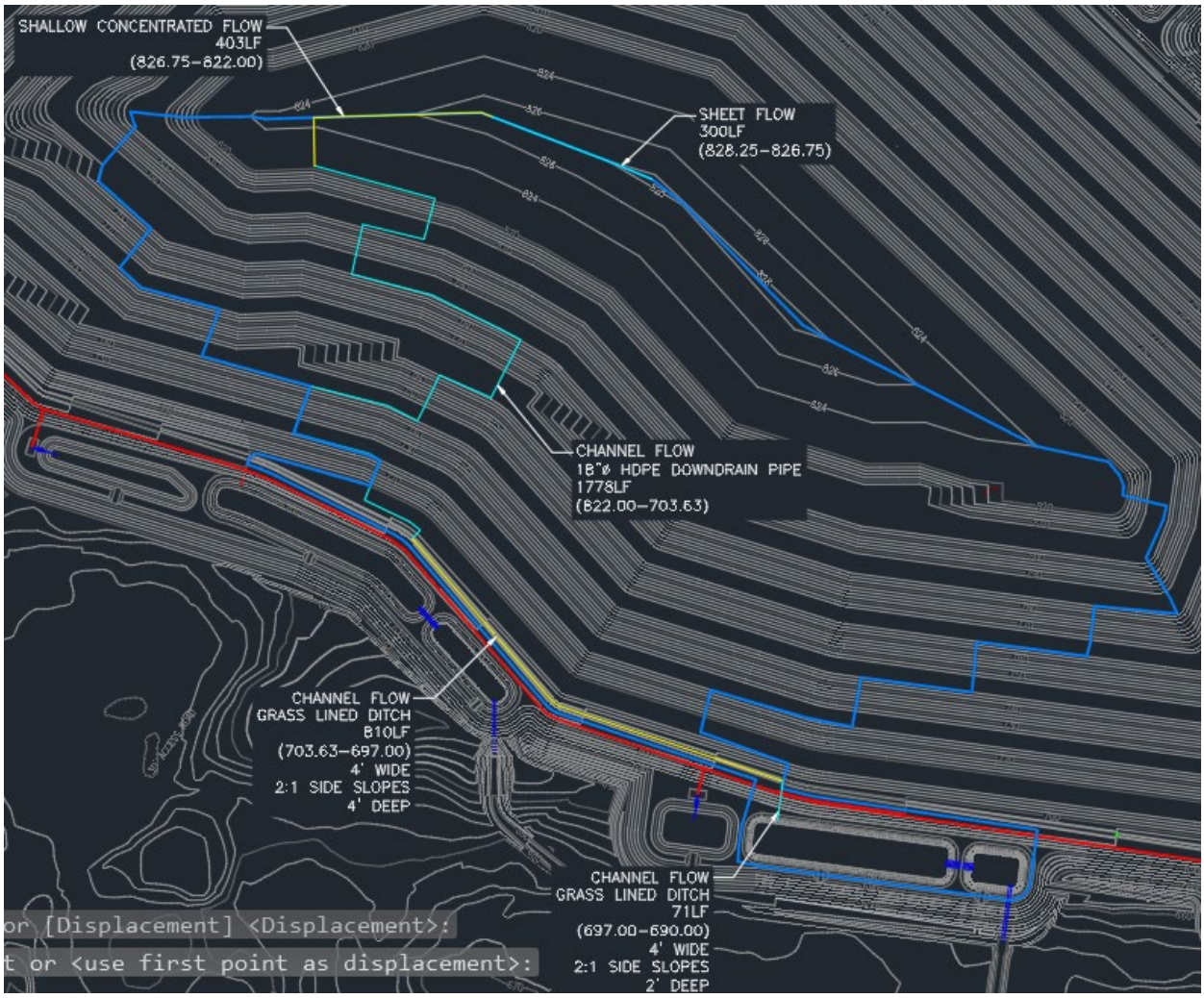
Cell 6

Description	A	B	C	Totals
Sheet Flow				
Manning's n-value	= 0.150	0.011	0.011	
Flow length (ft)	= 300.0	0.0	0.0	
Two-year 24-hr precip. (in)	= 3.79	0.00	0.00	
Land slope (%)	= 0.50	0.00	0.00	
Travel Time (min)	**= 37.75**	**+ 0.00**	**+ 0.00**	**= 37.75**
Shallow Concentrated Flow				
Flow length (ft)	= 403.00	0.00	0.00	
Watercourse slope (%)	= 1.18	0.00	0.00	
Surface description	= Unpaved	Paved	Paved	
Average velocity (ft/s)	=1.75	0.00	0.00	
Travel Time (min)	**= 3.83**	**+ 0.00**	**+ 0.00**	**= 3.83**
Channel Flow				
X sectional flow area (sqft)	= 1.07	7.51	3.12	
Wetted perimeter (ft)	= 2.60	9.28	6.68	
Channel slope (%)	= 6.66	0.82	9.86	
Manning's n-value	= 0.013	0.030	0.030	
Velocity (ft/s)	=16.32			
		3.90		
			9.36	
Flow length (ft)	({0})1778.0	810.0	71.0	
Travel Time (min)	**= 1.82**	**+ 3.46**	**+ 0.13**	**= 5.40**
Total Travel Time, Tc				**46.98 min**

TR55 Worksheet 3

Design Calculations

Project	Prepared by	Date
Plant Bowen Run-on Run-off Control	Jeremy Brown	3/19/21
Subject/Title Provide run-on and run-off system calculations for the peak discharge from a 24-hr 25-year storm Cells 3-8	Reviewed by Ashley Grissom	Date 4/1/21
	Calculation Number DC-BN- 735210-002	Sheet 38 of 58



Map 6

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Mar 18 2021

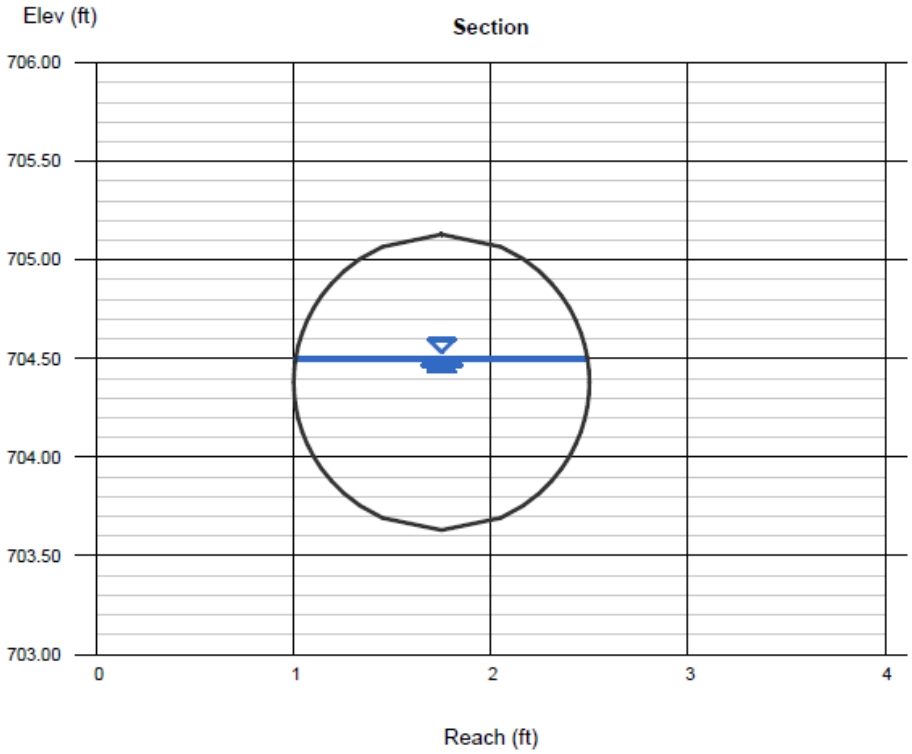
Cell 6 Downdrain

Circular
Diameter (ft) = 1.50

Invert Elev (ft) = 703.63
Slope (%) = 6.66
N-Value = 0.013

Calculations
Compute by: Known Q
Known Q (cfs) = 17.28

Highlighted
Depth (ft) = 0.87
Q (cfs) = 17.28
Area (sqft) = 1.07
Velocity (ft/s) = 16.20
Wetted Perim (ft) = 2.60
Crit Depth, Yc (ft) = 1.45
Top Width (ft) = 1.48
EGL (ft) = 4.95



Channel Report 7

Channel Report

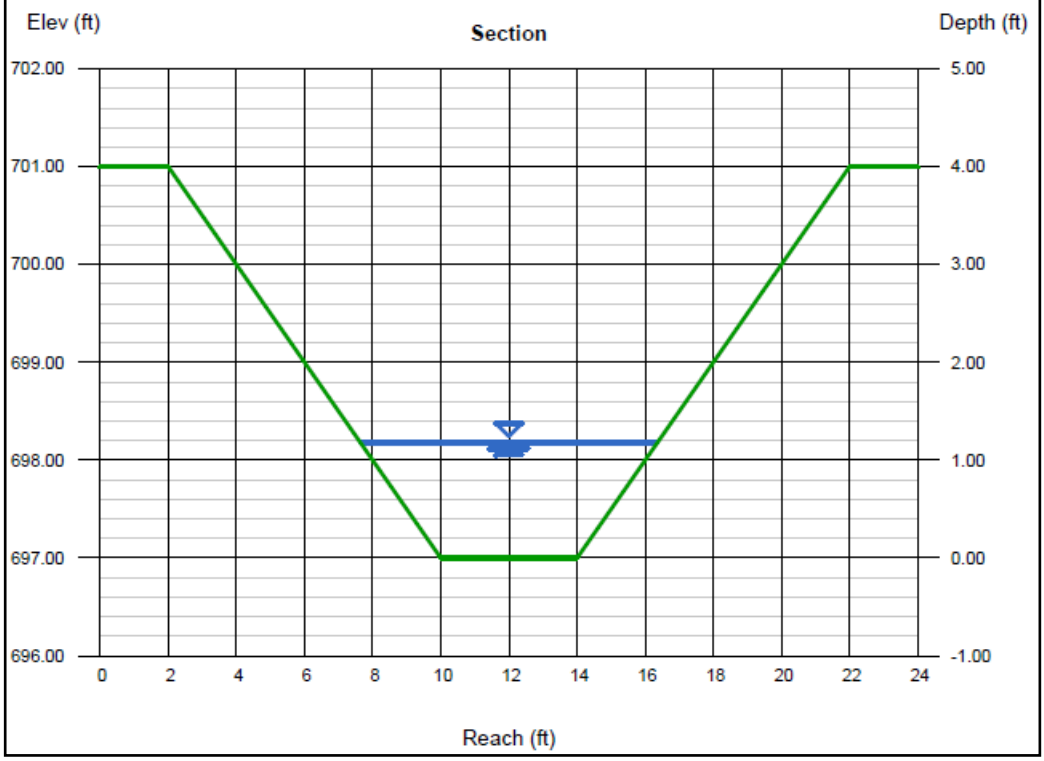
Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Mar 18 2021

Cell 6 Ditch 1

Trapezoidal	
Bottom Width (ft)	= 4.00
Side Slopes (z:1)	= 2.00, 2.00
Total Depth (ft)	= 4.00
Invert Elev (ft)	= 697.00
Slope (%)	= 0.82
N-Value	= 0.030

Calculations	
Compute by:	Known Q
Known Q (cfs)	= 28.88

Highlighted	
Depth (ft)	= 1.18
Q (cfs)	= 28.88
Area (sqft)	= 7.50
Velocity (ft/s)	= 3.85
Wetted Perim (ft)	= 9.28
Crit Depth, Yc (ft)	= 0.99
Top Width (ft)	= 8.72
EGL (ft)	= 1.41



Channel Report 8

Project	Prepared by	Date
Plant Bowen Run-on Run-off Control	Jeremy Brown	3/19/21
Subject/Title Provide run-on and run-off system calculations for the peak discharge from a 24-hr 25-year storm Cells 3-8	Reviewed by Ashley Grissom	Date 4/1/21
	Calculation Number DC-BN- 735210-002	Sheet 41 of 58

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Mar 18 2021

Cell 6 Ditch 2

Trapezoidal

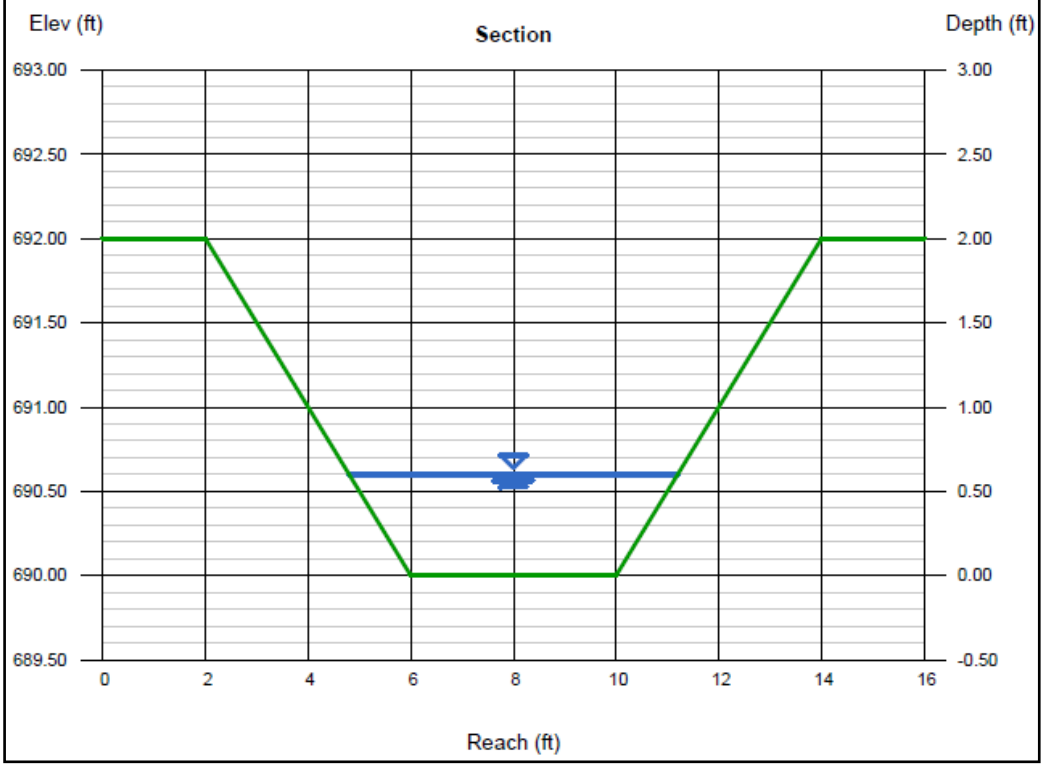
Bottom Width (ft)	= 4.00
Side Slopes (z:1)	= 2.00, 2.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 690.00
Slope (%)	= 9.86
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 28.88

Highlighted

Depth (ft)	= 0.60
Q (cfs)	= 28.88
Area (sqft)	= 3.12
Velocity (ft/s)	= 9.26
Wetted Perim (ft)	= 6.68
Crit Depth, Yc (ft)	= 0.99
Top Width (ft)	= 6.40
EGL (ft)	= 1.93



Channel Report 9

Hydrograph Report

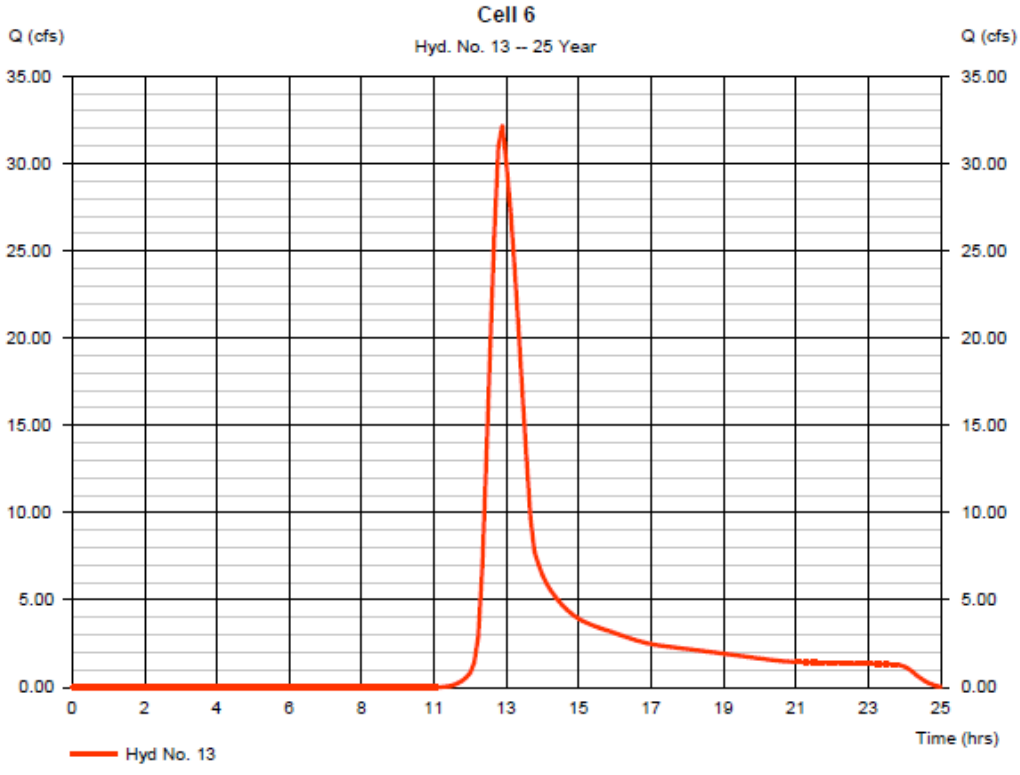
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v12 — Thursday, 03 / 18 / 2021

Hyd. No. 13

Cell 6

Hydrograph type	= SCS Runoff	Peak discharge	= 32.15 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.48 hrs
Time interval	= 7 min	Hyd. volume	= 212,598 cuft
Drainage area	= 28.140 ac	Curve number	= 62*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 47.00 min
Total precip.	= 6.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(26.660 x 61) + (1.070 x 85) + (0.410 x 98)] / 28.140



Hydrograph Report 3

Project	Prepared by	Date
Plant Bowen Run-on Run-off Control	Jeremy Brown	3/19/21
Subject/Title Provide run-on and run-off system calculations for the peak discharge from a 24-hr 25-year storm Cells 3-8	Reviewed by Ashley Grissom	Date 4/1/21
	Calculation Number DC-BN- 735210-002	Sheet 43 of 58

Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v12 — Thursday, 03 / 18 / 2021

Pond No. 3 - Cell 6 Sed Pond/Clear Pool

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 685.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	685.00	4,531	0	0
1.00	686.00	25,990	13,790	13,790
2.00	687.00	28,698	27,330	41,120
3.00	688.00	31,484	30,077	71,197
4.00	689.00	34,170	32,815	104,011
4.50	689.50	35,812	17,492	121,504

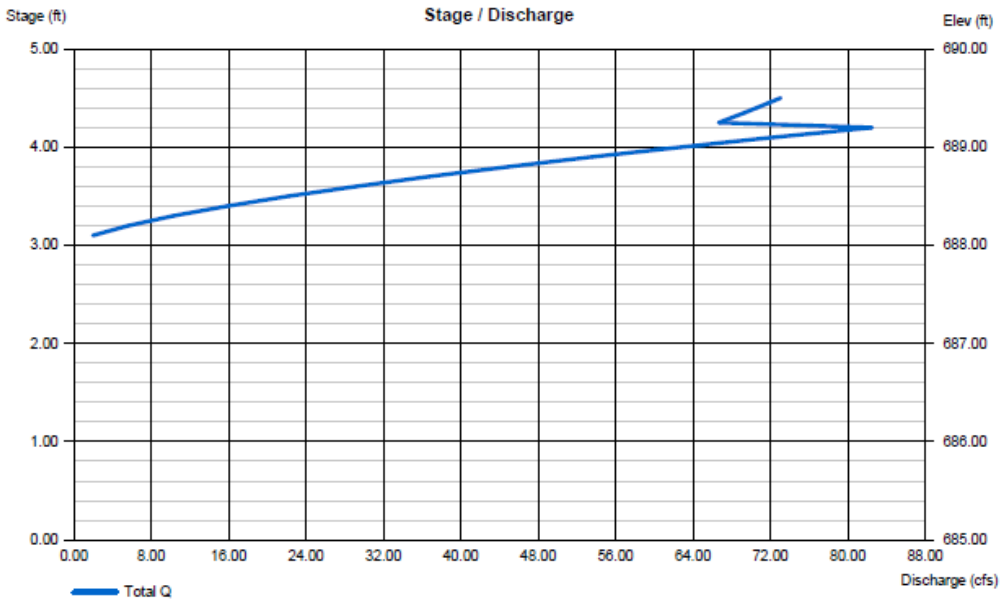
Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	0.00	0.00	0.00
Span (in)	= 24.00	0.00	0.00	0.00
No. Barrels	= 2	0	0	0
Invert El. (ft)	= 670.00	0.00	0.00	0.00
Length (ft)	= 102.00	0.00	0.00	0.00
Slope (%)	= 0.59	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 9.42	0.00	0.00	0.00
Crest El. (ft)	= 688.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	---	---	---
Multi-Stage	= Yes	No	No	No
Exfil.(in/hr)	= 0.000 (by Wet area)			
TW Elev. (ft)	= 0.00			

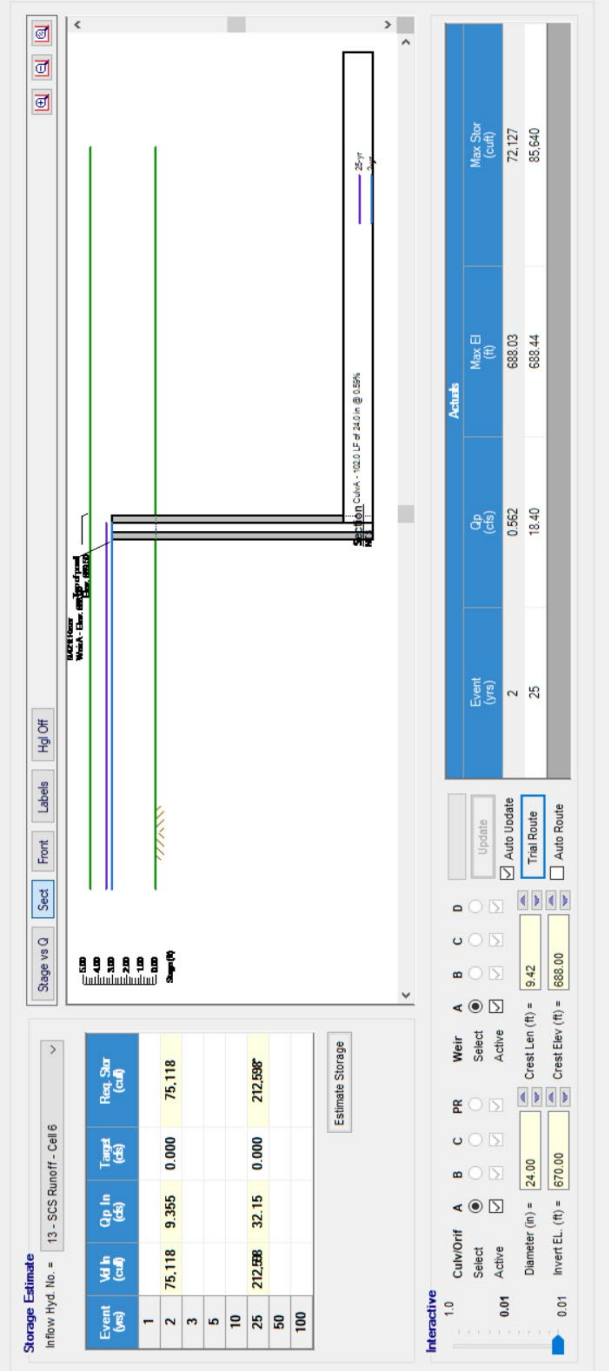
Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).



Pond Report 5

Design Calculations

Project	Prepared by	Date
Plant Bowen Run-on Run-off Control	Jeremy Brown	3/19/21
Subject/Title Provide run-on and run-off system calculations for the peak discharge from a 24-hr 25-year storm Cells 3-8	Reviewed by Ashley Grissom	Date 4/1/21
	Calculation Number DC-BN- 735210-002	Sheet 44 of 58



Pond Report 6

Cell 8

Drainage Area = 10.41 AC (See Map 7)

Curve Number = 64 (See Table 1)

9.10 AC @ CN 61 (Grass)
0.97 AC @ CN 85 (Gravel)
0.34 AC @ CN 98 (Impervious – Liner in Sediment Pond and Clear Pool)
((9.10*61)+(0.97*85)+(0.34*98))/10.41 = 64.44 = 64

Time of Concentration = 19.48 Min (See TR55 Worksheet 4 and Map 8)

Sheet Flow

Manning's n-Value = 0.15 (Short Grass) (See Table 2)
Flow Length = 99 LF
Land Slope = (806.00-805.10)/99 = 0.0091 = 0.91%

Channel Flow (See Channel Report 10)

15" Dia. HDPE Downdrain Pipes
Cross Sectional Area = 0.66 SF
Wetted Perimeter = 2.04 LF
Channel Slope = (805.10-696.77)/1541 = 0.0703 = 7.03%
Manning's n-Value = 0.13 (HDPE Pipe)(See Table 3)
Flow Length = 1541 LF

Channel Flow (See Channel Report 11)

Grass Lined 4' Wide Ditch with 2:1 Side Slopes and 4' Deep
Cross Sectional Area = 5.76 SF
Wetted Perimeter = 8.34 LF
Channel Slope = (696.77-692.14)/895 = 0.0052 = 0.52%
Manning's n-Value = 0.030 (Vegetal Lining) (See Table 3)
Flow Length = 895 LF

Channel Flow (See Channel Report 12)

Grass Lined 4' Wide Ditch with 2:1 Side Slopes and 2' Deep
Cross Sectional Area = 2.87 SF
Wetted Perimeter = 6.50 LF
Channel Slope = (692.14-688.00)/52 = 0.0796 = 7.96%
Manning's n-Value = 0.030 (Vegetal Lining) (See Table 3)
Flow Length = 52 LF

Time Interval = 3 Min

Tc*0.1333 = 19.48*0.1333 = 2.60 = 3

Storm Distribution = Type II

Q_{25} = 27.43 CFS (See Hydrograph Report 4)

To Evaluate for Storage Capacity, Treat The Sediment Pond and Clear Pool As One Pond Since They Are Interconnected.

Elevation (FT)	Sed. Pond Area (SF)	Clear Pool Area (SF)	Total Area (SF)	Volume (CF)
685	0	6,230	6,230	0*
686	15,795	6,995	22,790	13,644*
687	17,149	7,789	24,948	37,502
688	18,542	8,642	27,184	63,558
689	19,975	9,525	29,500	91,889
689.50	20,706	9,981	30,687	106,933

*Dead Storage

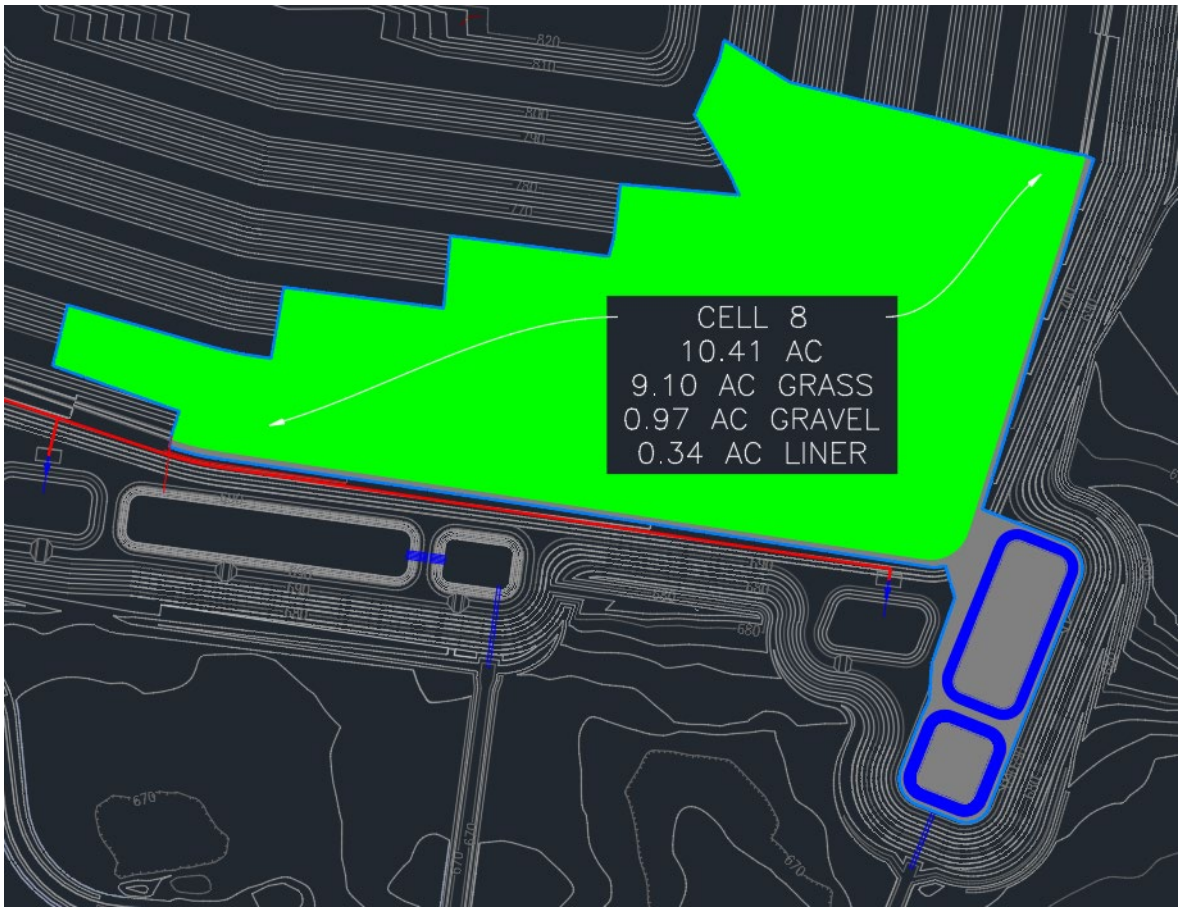
Spillways

- Principal Spillway consists of a 36” Dia. Riser with two 24” Dia. HDPE Pipes.
- Auxiliary Spillway consist of a grass lined trapezoidal weir that is 8’ wide with 3:1 side slopes and sloped at 1% in the direction of flow with a 3:1 slope on the discharge channel at the downstream end.

High Water Elevation is 688.03 (See Pond Reports 7 & 8)

Design Calculations

Project	Prepared by	Date
Plant Bowen Run-on Run-off Control	Jeremy Brown	3/19/21
Subject/Title Provide run-on and run-off system calculations for the peak discharge from a 24-hr 25-year storm Cells 3-8	Reviewed by Ashley Grissom	Date 4/1/21
	Calculation Number DC-BN- 735210-002	Sheet 47 of 58



Map 7

TR55 Tc Worksheet

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v12

Hyd. No. 19

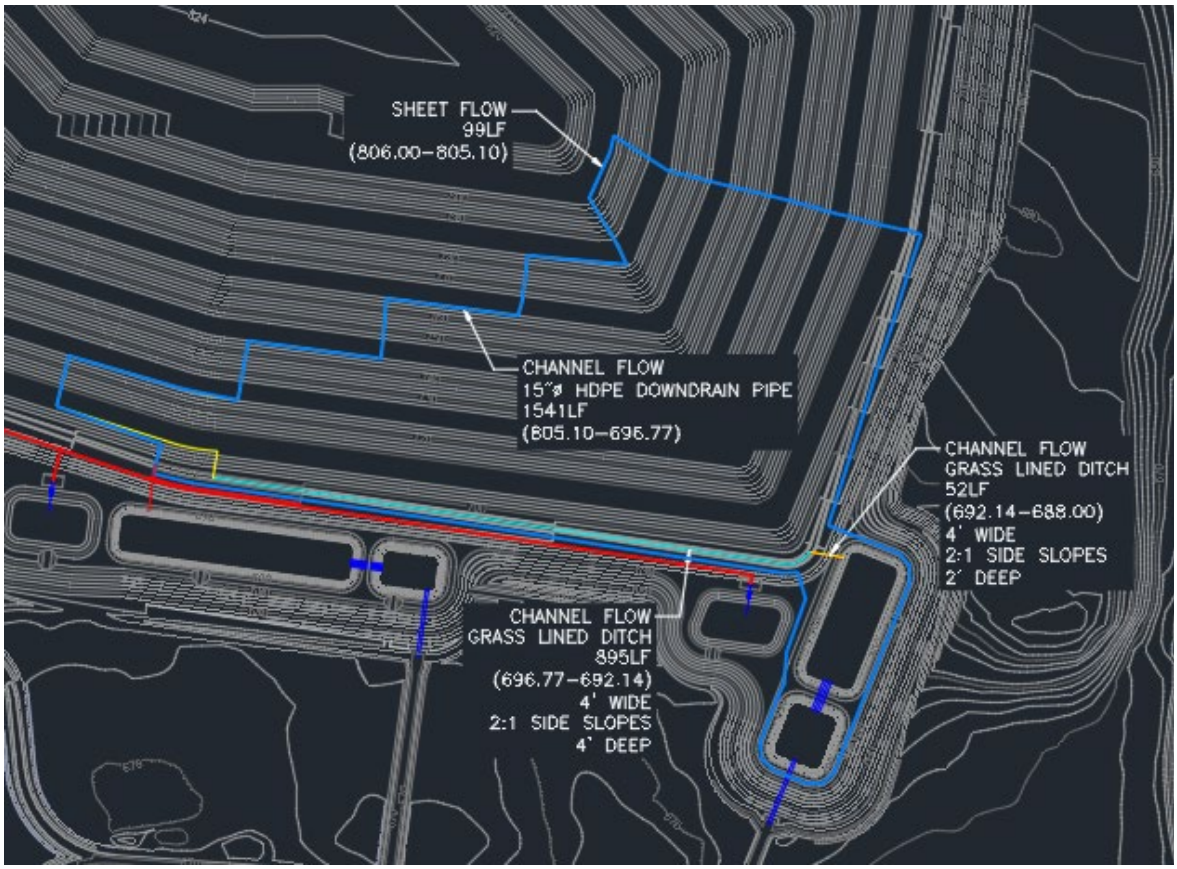
Cell 8

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 99.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.79		0.00		0.00		
Land slope (%)	= 0.91		0.00		0.00		
Travel Time (min)	**= 12.24**	**+**	**0.00**	**+**	**0.00**	**=**	**12.24**
Shallow Concentrated Flow							
Flow length (ft)	= 0.00		0.00		0.00		
Watercourse slope (%)	= 0.00		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=0.00		0.00		0.00		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**
Channel Flow							
X sectional flow area (sqft)	= 0.66		5.76		2.87		
Wetted perimeter (ft)	= 2.04		8.34		6.50		
Channel slope (%)	= 7.03		0.52		7.96		
Manning's n-value	= 0.013		0.030		0.030		
Velocity (ft/s)	=14.27						
			2.79				
					8.10		
Flow length (ft)	({0})1541.0		895.0		52.0		
Travel Time (min)	**= 1.80**	**+**	**5.34**	**+**	**0.11**	**=**	**7.24**
Total Travel Time, Tc							**19.48 min**

TR55 Worksheet 3

Design Calculations

Project	Prepared by	Date
Plant Bowen Run-on Run-off Control	Jeremy Brown	3/19/21
Subject/Title Provide run-on and run-off system calculations for the peak discharge from a 24-hr 25-year storm Cells 3-8	Reviewed by Ashley Grissom	Date 4/1/21
	Calculation Number DC-BN- 735210-002	Sheet 49 of 58



Map 8

Project	Prepared by	Date
Plant Bowen Run-on Run-off Control	Jeremy Brown	3/19/21
Subject/Title Provide run-on and run-off system calculations for the peak discharge from a 24-hr 25-year storm Cells 3-8	Reviewed by Ashley Grissom	Date 4/1/21
	Calculation Number DC-BN- 735210-002	Sheet 50 of 58

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Mar 18 2021

Cell 8 Downdrain

Circular

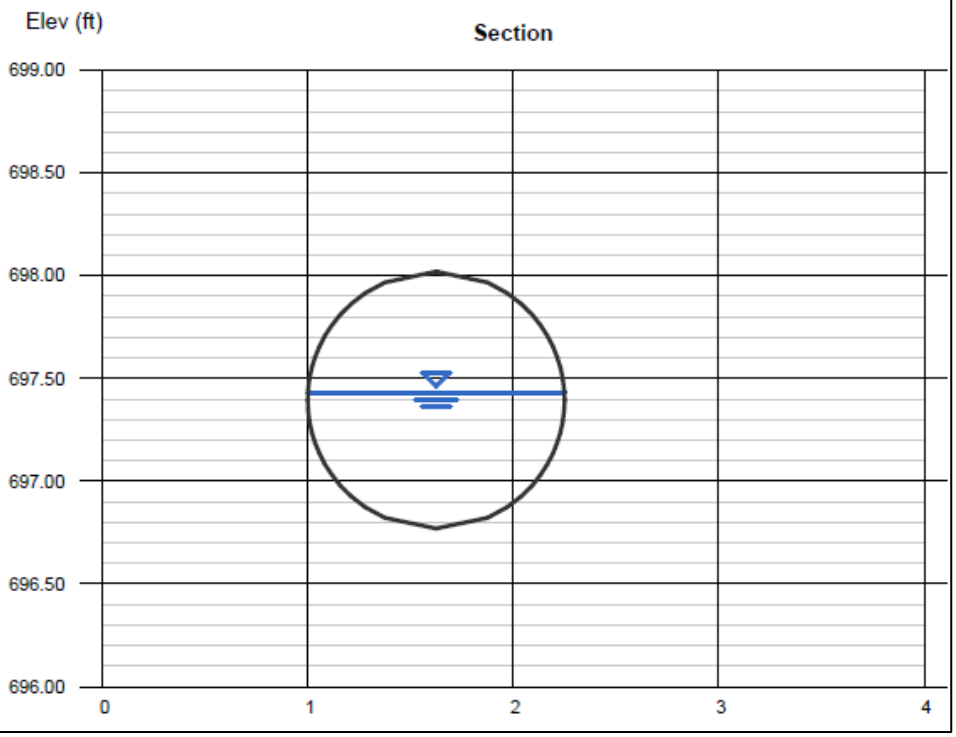
Diameter (ft)	= 1.25
Invert Elev (ft)	= 696.77
Slope (%)	= 7.03
N-Value	= 0.013

Calculations

Compute by:	Known Q
Known Q (cfs)	= 9.38

Highlighted

Depth (ft)	= 0.66
Q (cfs)	= 9.380
Area (sqft)	= 0.66
Velocity (ft/s)	= 14.22
Wetted Perim (ft)	= 2.04
Crit Depth, Yc (ft)	= 1.17
Top Width (ft)	= 1.25
EGL (ft)	= 3.80



Channel Report 10

Design Calculations

Project	Prepared by	Date
Plant Bowen Run-on Run-off Control	Jeremy Brown	3/19/21
Subject/Title Provide run-on and run-off system calculations for the peak discharge from a 24-hr 25-year storm Cells 3-8	Reviewed by Ashley Grissom	Date 4/1/21
	Calculation Number DC-BN- 735210-002	Sheet 51 of 58

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Mar 18 2021

Cell 8 Ditch 1

Trapezoidal

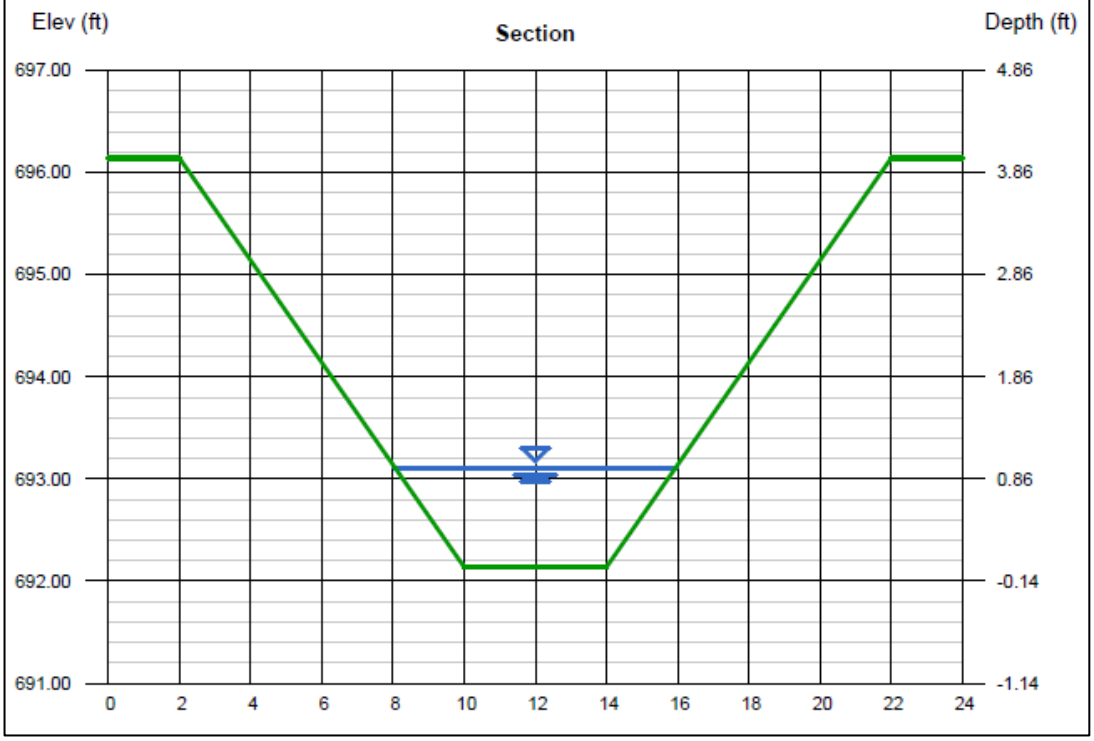
Bottom Width (ft)	= 4.00
Side Slopes (z:1)	= 2.00, 2.00
Total Depth (ft)	= 4.00
Invert Elev (ft)	= 692.14
Slope (%)	= 0.52
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 15.81

Highlighted

Depth (ft)	= 0.97
Q (cfs)	= 15.81
Area (sqft)	= 5.76
Velocity (ft/s)	= 2.74
Wetted Perim (ft)	= 8.34
Crit Depth, Yc (ft)	= 0.70
Top Width (ft)	= 7.88
EGL (ft)	= 1.09



Channel Report 11

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Mar 18 2021

Cell 8 Ditch 2

Trapezoidal

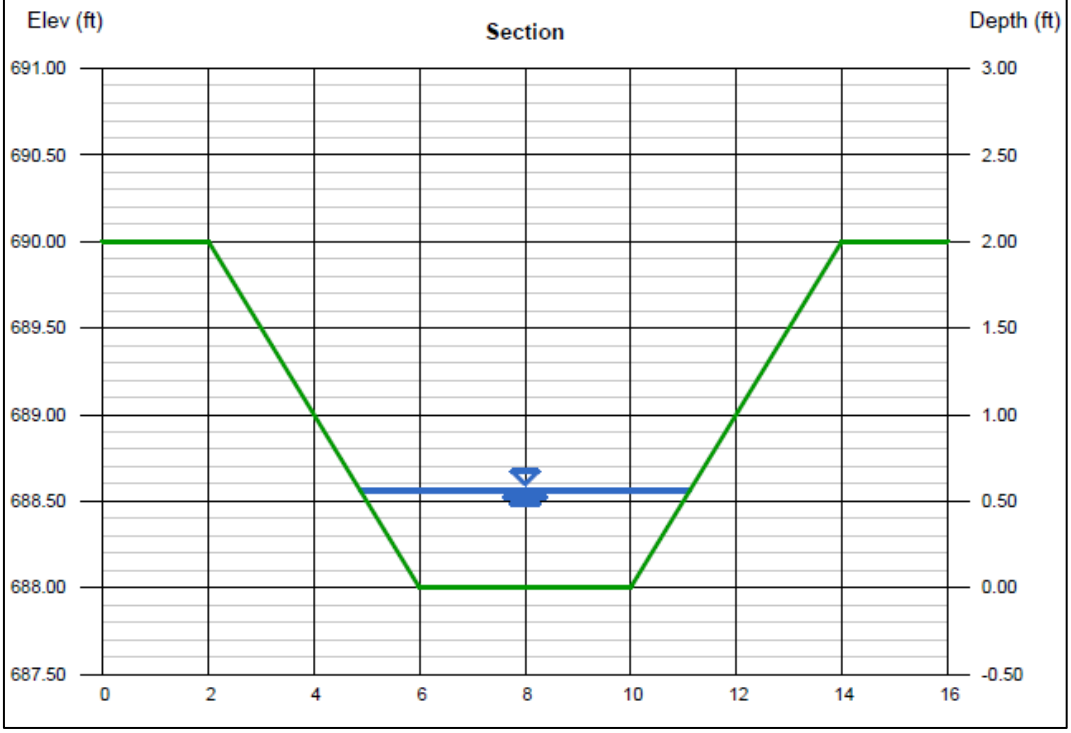
Bottom Width (ft)	= 4.00
Side Slopes (z:1)	= 2.00, 2.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 688.00
Slope (%)	= 7.96
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 22.51

Highlighted

Depth (ft)	= 0.56
Q (cfs)	= 22.51
Area (sqft)	= 2.87
Velocity (ft/s)	= 7.85
Wetted Perim (ft)	= 6.50
Crit Depth, Yc (ft)	= 0.86
Top Width (ft)	= 6.24
EGL (ft)	= 1.52



Channel Report 12

Design Calculations

Project	Prepared by	Date
Plant Bowen Run-on Run-off Control	Jeremy Brown	3/19/21
Subject/Title Provide run-on and run-off system calculations for the peak discharge from a 24-hr 25-year storm Cells 3-8	Reviewed by Ashley Grissom	Date 4/1/21
	Calculation Number DC-BN- 735210-002	Sheet 53 of 58

Hydrograph Report

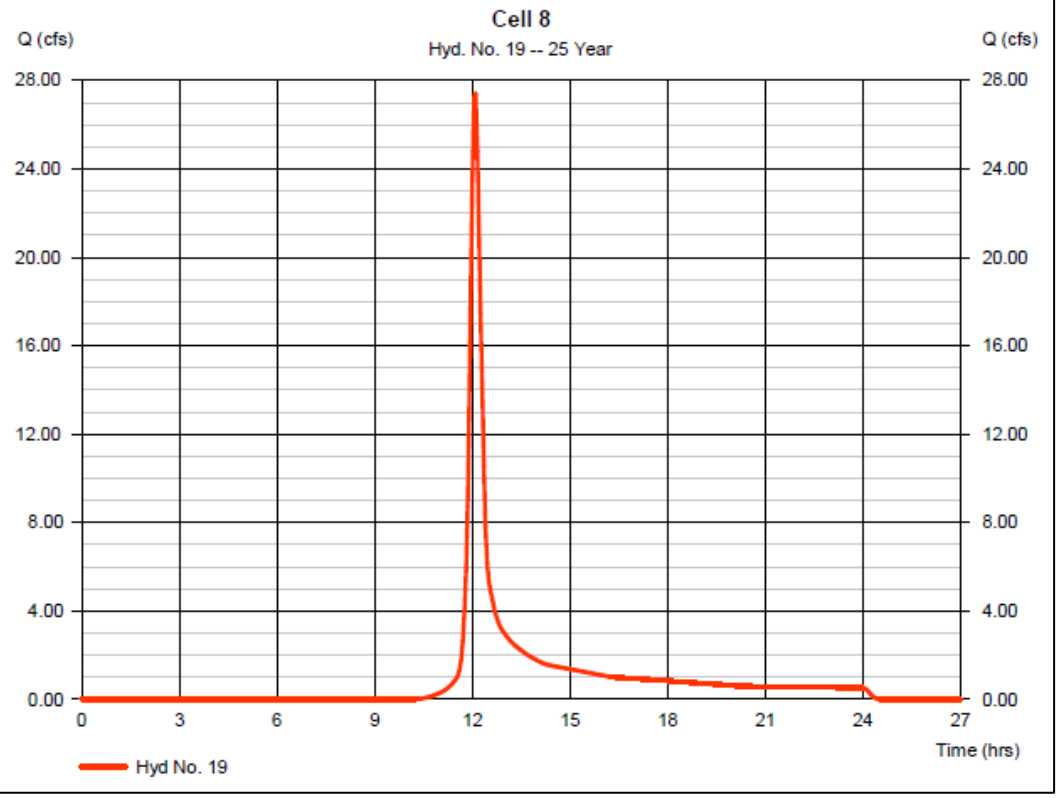
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v12 — Thursday, 03 / 18 / 2021

Hyd. No. 19

Cell 8

Hydrograph type	= SCS Runoff	Peak discharge	= 27.43 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.10 hrs
Time interval	= 3 min	Hyd. volume	= 90,153 cuft
Drainage area	= 10.410 ac	Curve number	= 64*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 19.50 min
Total precip.	= 6.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(9.100 x 61) + (0.970 x 85) + (0.340 x 98)] / 10.410



Hydrograph Report 4

Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v12 — Thursday, 03 / 18 / 2021

Pond No. 4 - Cell 8 Sed Pond/Clear Pool

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 685.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	685.00	6,230	0	0
1.00	686.00	22,790	13,644	13,644
2.00	687.00	24,948	23,858	37,502
3.00	688.00	27,184	26,055	63,558
4.00	689.00	29,500	28,331	91,889
4.50	689.50	30,687	15,044	106,933

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	0.00	0.00	0.00
Span (in)	= 24.00	0.00	0.00	0.00
No. Barrels	= 2	0	0	0
Invert El. (ft)	= 670.00	0.00	0.00	0.00
Length (ft)	= 103.00	0.00	0.00	0.00
Slope (%)	= 1.07	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

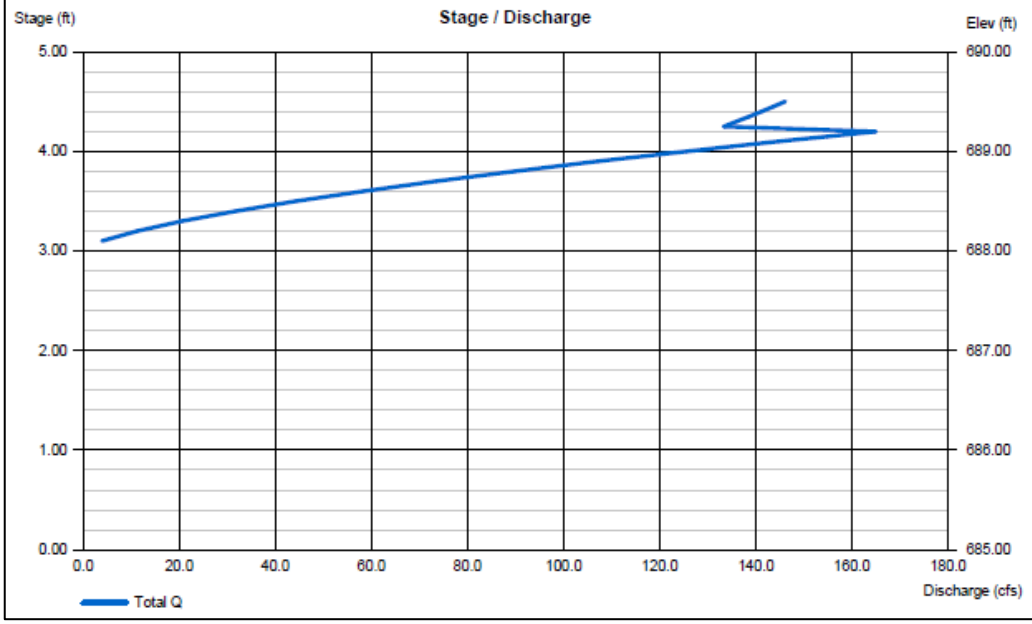
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 9.42	0.00	0.00	0.00
Crest El. (ft)	= 688.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	---	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)

TW Elev. (ft) = 0.00

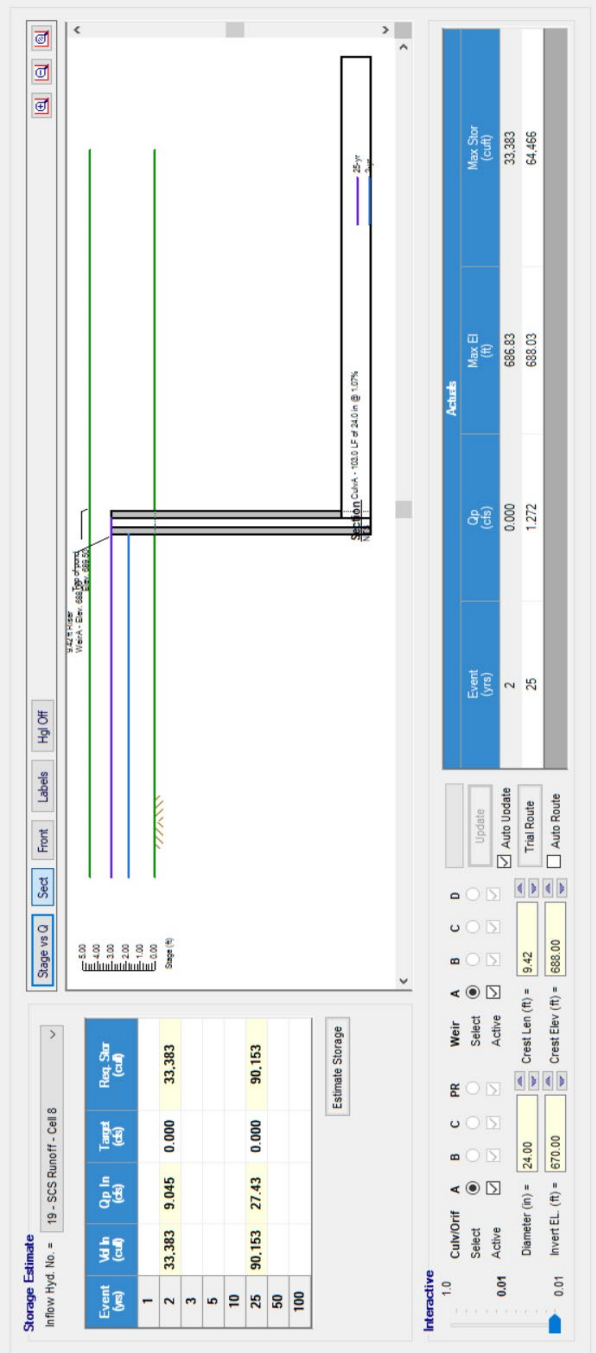
Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).



Pond Report 7

Design Calculations

Project	Prepared by	Date
Plant Bowen Run-on Run-off Control	Jeremy Brown	3/19/21
Subject/Title Provide run-on and run-off system calculations for the peak discharge from a 24-hr 25-year storm Cells 3-8	Reviewed by Ashley Grissom	Date 4/1/21
	Calculation Number DC-BN- 735210-002	Sheet 55 of 58



Pond Report 8

Table 2.1.5-1 Runoff Curve Numbers[1]

Cover description: Cover type and hydrologic condition	Average percent impervious area[2]	Curve numbers for hydrologic soil groups: A	B	C	D
Cultivated land: without conservation treatment		72	81	88	91
with conservation treatment		62	71	78	81
Pasture or range land: poor condition		68	79	86	89
good condition		39	61	74	80
Meadow: good condition		30	58	71	78
Wood or forest land: thin stand, poor cover		45	66	77	83
good cover		25	55	70	77
Open space (lawns, parks, golf courses, cemeteries, etc.)[3]					
Poor condition (grass cover <50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm drains (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 Newly graded areas (pervious areas only, no vegetation)		77	86	91	94

[1] Average runoff condition, and $I_a = 0.2S$

[2] The average percent impervious area shown was used to develop the composite CNs. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. If the impervious area is not connected, the SCS method has an adjustment to reduce the effect.

[3] CNs shown are equivalent to those of pasture. Composite CNs may be computed for other combinations of open space cover type.

Table 1

Table 2.1.5-2 Roughness Coefficients (Manning's n) for Sheet Flow[1]

Surface Description	n
Smooth surfaces (concrete, asphalt, gravel, or bare soil)	0.011
Fallow (no residue)	0.05
Cultivated soils:	
Residue cover < 20%	0.06
Residue cover > 20%	0.17
Grass:	
Short grass prairie	0.15
Dense grasses[2]	0.24
Bermuda grass	0.41
Range (natural)	0.13
Woods[3]	
Light underbrush	0.40
Dense underbrush	0.80

[1] The n values are a composite of information by Engman (1986).
[2] Includes species such as weeping lovegrass, bluegrass, buffalo grass, blue grama grass, and native grass mixtures.
[3] When selecting n, consider cover to a height of about 0.1 ft. This is the only part of the plant cover that will obstruct sheet flow.

Source: SCS, TR-55, Second Edition, June 1986

Table 2

Manning's n Values

3. finished, with gravel on bottom	0.015	0.017	0.020
4. unfinished	0.014	0.017	0.020
5. gunite, good section	0.016	0.019	0.023
6. gunite, wavy section	0.018	0.022	0.025
7. on good excavated rock	0.017	0.020	
8. on irregular excavated rock	0.022	0.027	
d. Concrete bottom float finish with sides of:			
1. dressed stone in mortar	0.015	0.017	0.020
2. random stone in mortar	0.017	0.020	0.024
3. cement rubble masonry, plastered	0.016	0.020	0.024
4. cement rubble masonry	0.020	0.025	0.030
5. dry rubble or riprap	0.020	0.030	0.035
e. Gravel bottom with sides of:			
1. formed concrete	0.017	0.020	0.025
2. random stone mortar	0.020	0.023	0.026
3. dry rubble or riprap	0.023	0.033	0.036
f. Brick			
1. glazed	0.011	0.013	0.015
2. in cement mortar	0.012	0.015	0.018
g. Masonry			
1. cemented rubble	0.017	0.025	0.030
2. dry rubble	0.023	0.032	0.035
h. Dressed ashlar/stone paving	0.013	0.015	0.017
i. Asphalt			
1. smooth	0.013	0.013	
2. rough	0.016	0.016	
j. Vegetal lining	0.030		0.500

Table 3

Southern Company

Technical and Project Solutions Calculation

Calculation Number: DC-BN-735210-003

Project/Plant: Bowen	**Unit(s):** 1 - 4	**Discipline/Area:** Civil
Title/Subject: Run-on and Run-off Study for Bowen Cells 9 & 10		
Purpose/Objective: To determine if the Cell's stormwater management can safely manage and pass the design storm event.		
System or Equipment Tag Numbers: N/A	**Originator:** Jeremy Brown	

Contents

Topic	Page	Attachments (Computer Printouts, Tech. Papers, Sketches, Correspondence)	# of Pages
Purpose of Calculation	1		1
Summary of Conclusions	1		1
Project Narrative	1-2		2
Methodology	2		1
Assumptions/Criteria	2		1
Design Inputs/References	3-9		7
Body of Calculation	10-23		14
Total # of pages including cover sheet & attachments:	24		

Revision Record

Rev. No.	Description	Originator Initial / Date	Reviewer Initial / Date	Approver Initial / Date
0	Issued for Review	JKB 2/12/21	AOG 3/1/21	JWM 6/7/21
1	Revised per as-builts	JKB 2/10/22	AOG 2/11/22	JWM 2/11/22

Notes:

Design Calculations

Project	Prepared by	Date
Plant Bowen Run-on Run-off Control	Jeremy Brown	2/10/22
Subject/Title Provide run-on and run-off system calculations for the peak discharge from a 24-hr 25-year storm Cells 9 & 10	Reviewed by Ashley Grissom	Date 2/11/22
	Calculation Number DC-BN- 735210-003 (Rev1)	Sheet 1 of 23

Purpose of Calculation

The purpose of this calculation is to determine if the existing sedimentation ponds and clear pools can sufficiently handle run-on/run-off during a minimum 25-yr, 24-hr storm event per federal stormwater requirements Title 40 CFR Part 257.81 and the Georgia Environmental Protection Division's (EPD) Georgia CCR Rule (391-3-4-.10).

Summary of Conclusions

Based on our analysis, the detention pond system is adequate to collect and control the volume of water resulting from a 24-hour 25-year storm, as required.

Storage Pond Name	Normal Pool Elevation (feet, NAVD 88)	Maximum 25 year pool elevation (feet, NAVD 88)	Spillway/Top of Dike Elevation (feet, NAVD 88)	Freeboard to Spillway (feet, NAVD 88)
Clear Pool	697.00	701.44	703.50/706.00	2.06/4.56
Sedimentation Pond	697.00	701.44	703.50/706.00	2.06/4.56

Project Narrative

The Plant Bowen CCB Disposal Facility Cells 9 & 10 site is located in Bartow County and is approximately 1.5 miles East of Euharlee, Georgia and 6 miles southwest of Cartersville, Georgia. The plant is bordered on the north and east by the Etowah River and on the south and west by farmland.

Cells 9 & 10 cover 34.71 acres and are not divided by any means. (See Image 1).

Cells 9 & 10 are comprised of a 31.67 acres storage cell, 2.12 acres sedimentation pond, 0.92 acres clear pool, berms, access roads and ditches. (See Image 2) Cells 9 & 10 include a perimeter dike to control surface rainfall run-off. There is no stormwater run-on for these cells. Run-off from this area is directed through interior perimeter ditches and through 4 – 42" diameter HDPE pipes into a sedimentation pond that is connected to a clear pool via two 54" diameter risers and two 36" diameter pipes. Stormwater from the clear pool is discharged through a 54" diameter riser and 42" diameter pipe.

The sediment pond and clear pool have identical auxiliary spillways that are concrete trapezoidal weirs. The auxiliary spillways are 24' wide with 6:1 side slopes and sloped at 1% in

the direction of flow with a 3:1 slope on the discharge channel at the downstream end. Following pages will show the analysis for Cells 9 & 10.

Leachate is collected separately from stormwater run-off in a sump. From there leachate is pumped to a 592,000 gallon leachate storage tank and then sent to the Low Volume Waste Treatment System.

Methodology

The stormwater flows were calculated using the National Resources Conservation Service method (also known as the Soil Conservation Service (SCS) method) using a 25-yr, 24-hr design storm event.

Storm basin calculation information was gathered from a number of sources to include the Georgia Stormwater Manual and Technical Release 55.

The National Resources Conservation Service (NCRS) provided information on the soil characteristics and hydrologic groups. The soil types found on the site are Etowah Loam and Waynesboro Clay Loam. (See Images 3 & 4). It was determined that the hydrological group "B" should be used to best reflect the characteristics of the soils on site.

Run-off curve number data was determined using Table 2.1.5-1 from the Georgia Stormwater Management Manual. Run-off coefficient data was determined by utilizing Table 2.1.5-2 from the Georgia Stormwater Management Manual and Manning's n for Channels (Chow, 1959).

Appendix B from the TR-55 was used to determine the rain distribution for Plant Bowen is Type II. (See Image 5)

NOAA Atlas 14 was used to determine the 24-hour precipitation for the design storm event of 25-yr for Plant Bowen is 6.07 in. (See Image 6)

Assumptions/Criteria

- Refer to Title 40 CFR Part 257.81 Hydrologic and hydraulic capacity requirements for the run-on and run-off controls for CCR landfills.
- Other assumptions are listed on attached calculation sheets.

Design Inputs/References

- AutoCad Civil 3D 2019, Autodesk, Inc.
- Hydraflow Hydrographs Extension for AutoCad Civil 3D 2019, Autodesk, Inc.
- Hydraflow Express Extension for AutoCad Civil 3D 2019, Autodesk, Inc.
- NOAA Atlas 14, Volume 9, Version 2 for Taylorsville, GA.
- Georgia SW Manual
- TR-55 – Urban Hydrology for Small Watersheds, Appendix B, National Resources Conservation Service, Conservation Engineering Division, 1986.
- Georgia Power Company – Plant Bowen – CCB Disposal Facility Design and Operation Plans H15061 - H15097, H15296 - H15315 and H52258 - H52260.
- Cells 9&10 As-built drawing from 2014 titled “13471-Plant Bowen-CCB Facility CELL9_10 2014.dwg”

Project	Prepared by	Date
Plant Bowen Run-on Run-off Control	Jeremy Brown	2/10/22
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Image 1

Design Calculations

Project	Prepared by	Date
Plant Bowen Run-on Run-off Control	Jeremy Brown	2/10/22
Subject/Title Provide run-on and run-off system calculations for the peak discharge from a 24-hr 25-year storm Cells 9 & 10	Reviewed by Ashley Grissom	Date 2/11/22
	Calculation Number DC-BN- 735210-003 (Rev1)	Sheet 5 of 23

Image 2

Design Calculations

Project	Prepared by	Date
Plant Bowen Run-on Run-off Control	Jeremy Brown	2/10/22
Subject/Title Provide run-on and run-off system calculations for the peak discharge from a 24-hr 25-year storm Cells 9 & 10	Reviewed by Ashley Grissom	Date 2/11/22
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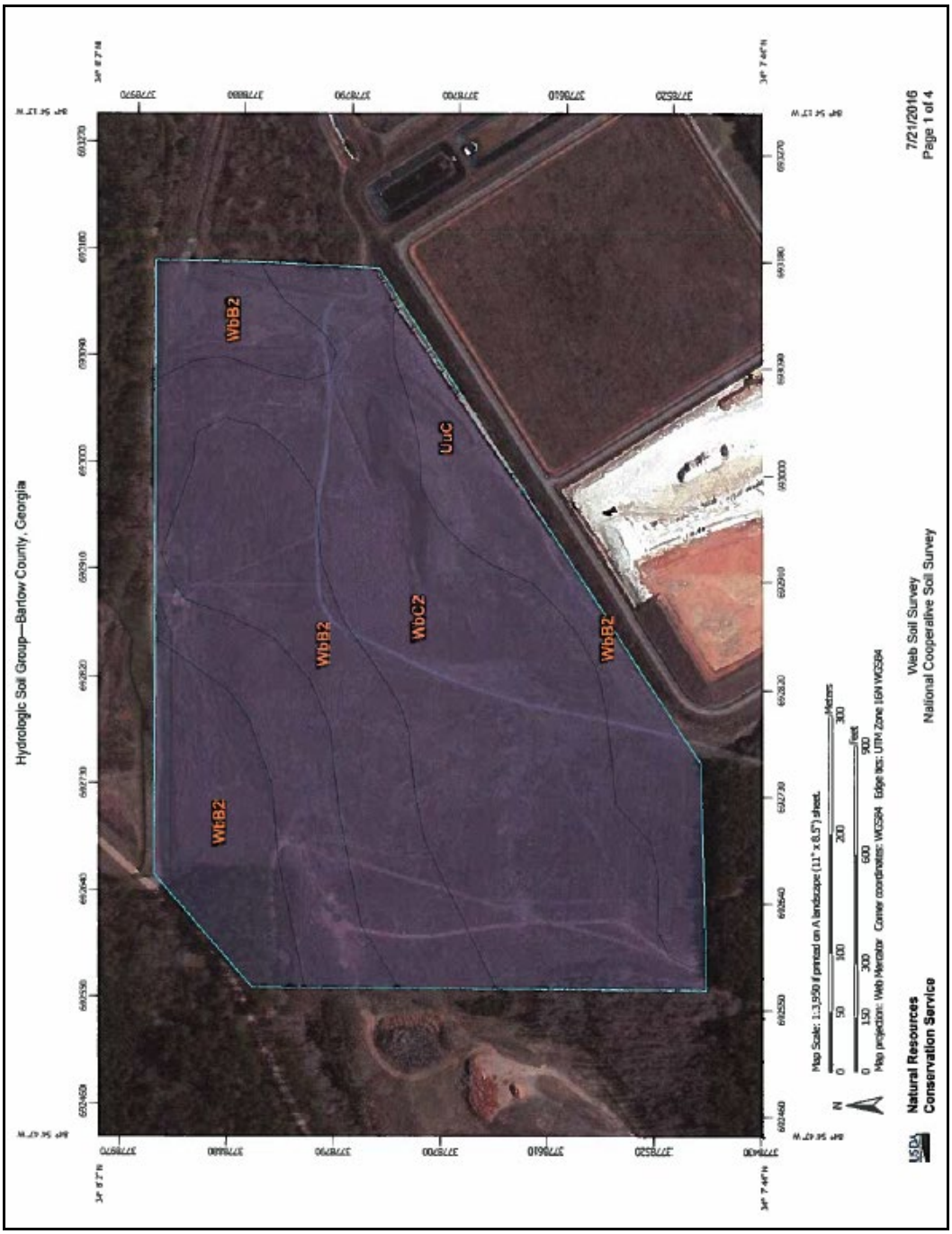


Image 3

Hydrologic Soil Group—Bartow County, Georgia

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Bartow County, Georgia (GA015)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
UuC	Urban land-Udorthents complex, 0 to 10 percent slopes		0.3	0.5%
WbB2	Waynesboro clay loam, 2 to 6 percent slopes, moderately eroded	B	25.4	46.6%
WbC2	Waynesboro clay loam, 6 to 10 percent slopes, moderately eroded	B	28.8	52.9%
Totals for Area of Interest			54.5	100.0%

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

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

Image 4

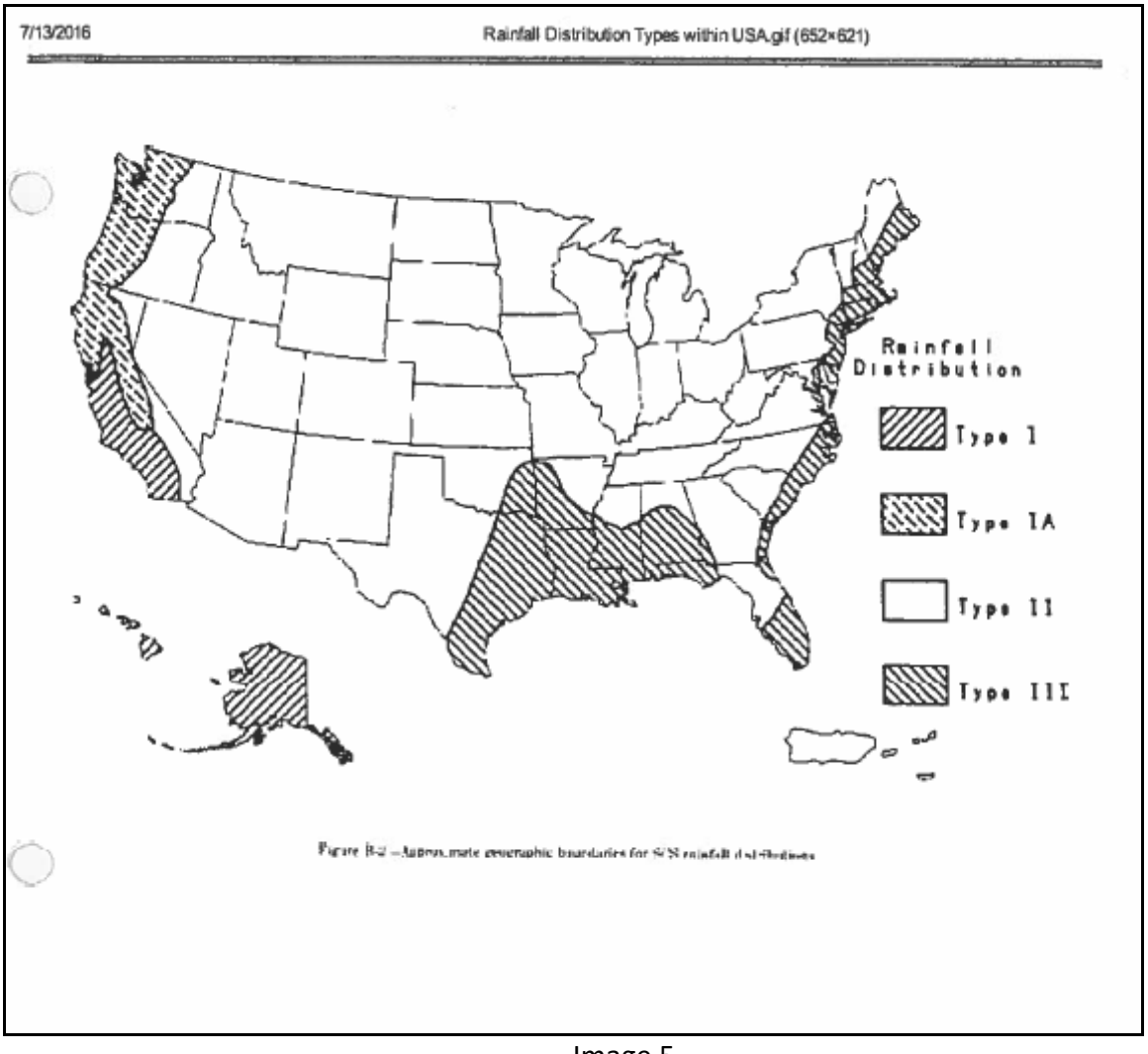

7/13/2016
Rainfall Distribution Types within USA.gif (652×621)
Rainfall Distribution
Type I
Type IA
Type II
Type III

Image 5

Project	Prepared by	Date
Plant Bowen Run-on Run-off Control	Jeremy Brown	2/10/22
Subject/Title Provide run-on and run-off system calculations for the peak discharge from a 24-hr 25-year storm Cells 9 & 10	Reviewed by Ashley Grissom	Date 2/11/22
	Calculation Number DC-BN- 735210-003 (Rev1)	Sheet 9 of 23

Precipitation Frequency Data Server — Page 1 of 4

NOAA Atlas 14, Volume 9, Version 2
TAYLORSVILLE
Station ID: 09-8600
Location name: Taylorsville, Georgia, US*
Latitude: 34.0861°, Longitude: -84.9828°
Elevation:
Elevation (station metadata): 721 ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Deborah Martin, Sandra Pavlovic, Ishani Roy, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Michael Yekta, Geoffery Bonnin

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	0.406 (0.321-0.518)	0.464 (0.367-0.593)	0.568 (0.448-0.726)	0.662 (0.520-0.849)	0.804 (0.619-1.06)	0.924 (0.695-1.23)	1.05 (0.768-1.42)	1.19 (0.838-1.62)	1.39 (0.943-1.92)	1.55 (1.02-2.14)
10-min	0.594 (0.471-0.759)	0.679 (0.537-0.868)	0.831 (0.655-1.06)	0.969 (0.761-1.24)	1.18 (0.907-1.56)	1.35 (1.02-1.80)	1.54 (1.12-2.07)	1.75 (1.23-2.38)	2.03 (1.38-2.81)	2.27 (1.50-3.14)
15-min	0.725 (0.574-0.926)	0.828 (0.655-1.06)	1.01 (0.799-1.30)	1.18 (0.928-1.52)	1.44 (1.11-1.90)	1.65 (1.24-2.19)	1.88 (1.37-2.53)	2.13 (1.50-2.90)	2.48 (1.68-3.43)	2.77 (1.83-3.83)
30-min	1.02 (0.811-1.31)	1.17 (0.924-1.49)	1.43 (1.13-1.83)	1.66 (1.31-2.13)	2.02 (1.56-2.68)	2.33 (1.75-3.09)	2.65 (1.94-3.57)	3.01 (2.12-4.11)	3.52 (2.39-4.86)	3.93 (2.60-5.44)
60-min	1.33 (1.05-1.70)	1.52 (1.20-1.94)	1.85 (1.46-2.36)	2.15 (1.69-2.76)	2.61 (2.01-3.45)	3.00 (2.25-3.98)	3.41 (2.49-4.58)	3.86 (2.71-5.26)	4.49 (3.05-6.21)	5.01 (3.31-6.93)
2-hr	1.64 (1.31-2.06)	1.86 (1.49-2.35)	2.27 (1.81-2.86)	2.64 (2.10-3.34)	3.20 (2.49-4.17)	3.66 (2.79-4.79)	4.16 (3.08-5.52)	4.70 (3.36-6.33)	5.47 (3.77-7.46)	6.09 (4.09-8.32)
3-hr	1.84 (1.49-2.30)	2.10 (1.69-2.62)	2.55 (2.05-3.19)	2.96 (2.37-3.71)	3.56 (2.80-4.60)	4.07 (3.12-5.28)	4.60 (3.43-6.05)	5.18 (3.73-6.91)	6.00 (4.17-8.12)	6.66 (4.51-9.04)
6-hr	2.27 (1.86-2.79)	2.57 (2.10-3.17)	3.10 (2.53-3.83)	3.57 (2.90-4.41)	4.26 (3.38-5.41)	4.82 (3.75-6.16)	5.42 (4.10-7.02)	6.05 (4.42-7.96)	6.94 (4.90-9.27)	7.65 (5.27-10.3)
12-hr	2.79 (2.32-3.39)	3.15 (2.61-3.83)	3.77 (3.12-4.58)	4.31 (3.54-5.25)	5.08 (4.06-6.34)	5.70 (4.48-7.17)	6.36 (4.87-8.10)	7.04 (5.21-9.11)	7.99 (5.72-10.5)	8.73 (6.11-11.6)
24-hr	3.34 (2.81-3.99)	3.79 (3.18-4.53)	4.54 (3.80-5.44)	5.18 (4.32-6.21)	6.07 (4.93-7.43)	6.77 (5.40-8.36)	7.48 (5.81-9.38)	8.22 (6.17-10.5)	9.21 (6.70-11.9)	9.98 (7.10-13.0)
2-day	3.87 (3.29-4.55)	4.43 (3.77-5.21)	5.34 (4.54-6.30)	6.10 (5.16-7.22)	7.14 (5.88-8.60)	7.95 (6.42-9.65)	8.75 (6.85-10.8)	9.56 (7.27-12.0)	10.6 (7.84-13.6)	11.4 (8.27-14.8)
3-day	4.24 (3.64-4.95)	4.81 (4.13-5.62)	5.76 (4.93-6.73)	6.56 (5.59-7.68)	7.66 (6.37-9.16)	8.53 (6.95-10.3)	9.40 (7.47-11.5)	10.3 (7.92-12.6)	11.5 (8.57-14.5)	12.4 (9.06-15.9)
4-day	4.56 (3.94-5.28)	5.14 (4.43-5.96)	6.10 (5.25-7.08)	6.92 (5.93-8.06)	8.07 (6.76-9.61)	8.98 (7.38-10.8)	9.92 (7.94-12.1)	10.9 (8.43-13.5)	12.2 (9.16-15.4)	13.2 (9.72-16.8)
7-day	5.37 (4.69-6.14)	5.99 (5.22-6.86)	7.04 (6.13-8.07)	7.94 (6.88-9.14)	9.24 (7.84-10.9)	10.3 (8.56-12.2)	11.3 (9.21-13.7)	12.5 (9.80-15.3)	14.0 (10.7-17.5)	15.2 (11.3-19.2)
10-day	6.07 (5.34-6.89)	6.74 (5.92-7.66)	7.88 (6.91-8.97)	8.87 (7.74-10.1)	10.3 (8.79-12.0)	11.4 (9.58-13.5)	12.6 (10.3-15.1)	13.8 (11.0-16.8)	15.5 (11.9-19.3)	16.8 (12.7-21.1)
20-day	8.08 (7.21-9.03)	8.91 (7.95-9.96)	10.3 (9.17-11.5)	11.5 (10.2-12.9)	13.2 (11.5-15.2)	14.6 (12.4-16.9)	16.0 (13.3-18.8)	17.4 (14.0-20.9)	19.4 (15.2-23.7)	21.0 (16.1-25.9)
30-day	9.86 (8.87-10.9)	10.8 (9.75-12.0)	12.5 (11.2-13.8)	13.9 (12.4-15.4)	15.8 (13.8-17.9)	17.3 (14.9-19.8)	18.8 (15.8-22.0)	20.4 (16.6-24.2)	22.5 (17.8-27.3)	24.1 (18.7-29.5)
45-day	12.2 (11.1-13.4)	13.5 (12.2-14.8)	15.4 (14.0-17.0)	17.1 (15.4-18.8)	19.3 (16.9-21.6)	20.9 (18.1-23.7)	22.6 (19.1-26.1)	24.3 (19.9-28.5)	26.4 (21.1-31.7)	28.1 (22.0-34.1)
60-day	14.4 (13.1-15.6)	15.8 (14.4-17.2)	18.1 (16.5-19.8)	19.9 (18.1-21.8)	22.4 (19.8-24.9)	24.2 (21.0-27.2)	25.9 (22.0-29.7)	27.7 (22.8-32.2)	29.8 (23.9-35.5)	31.4 (24.8-37.9)

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

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

Please refer to NOAA Atlas 14 document for more information.

Back to Top

PF graphical

Image 6

Body of Calculation

See detailed calculations and software output.

Drainage Area = 34.71 AC (See Map 1)

Curve Number = 64 (See Attached Table 1)

31.47 AC @ CN 61 (Grass)
2.48 AC @ CN 85 (Gravel)
0.76 AC @ CN 98 (Impervious – Liner in Sediment Pond and Clear Pool)
((31.47*61)+(2.48*85)+(0.76*98))/34.88 = 63.52 = 64

Time of Concentration = 31.49 Min (See Attached TR55 Worksheet and Map 2)

Sheet Flow

Manning's n-Value = 0.15 (Short Grass) (See Table 2)
Flow Length = 300 LF
Land Slope = (805.50-799.00)/300 = 0.0217 = 2.17%

Shallow Concentrated

Flow Length = 353 LF
Watercourse Slope = (799.00-744.54)/353 = 0.1543 = 15.43%
Surface is Unpaved

Channel Flow (See Channel Report 1)

Grass Lined 4' Wide Ditch with 2:1 Side Slopes and 4' Deep
Cross Sectional Area = 6.57 SF
Wetted Perimeter = 8.79 LF
Channel Slope = (744.54-704.46)/2773 = 0.0145= 1.45%
Manning's n-Value = 0.030 (Vegetal Lining) (See Table 3)
Flow Length = 2773 LF

Channel Flow (See Channel Report 2)

4 – 42" Dia. HDPE Pipes @ 1.51%
Cross Section Area = 1.85 SF
Wetted Perimeter = 3.64 LF
Channel Slope = (704.46-702.92)/102 = 0.0151 = 1.51%
Manning's n-Value = 0.013 (HDPE Pipes) (See Table 4)
Flow Length = 102 LF

Time Interval = 3 Min

Tc*0.1333 = 31.49*0.1333 = 4.20 = 5

Storm Distribution = Type II

Q_{25} = 65.64 CFS (See Hydrograph Report 1)

To Evaluate for Storage Capacity, Treat The Sediment Pond and Clear Pool As One Pond Since They Are Interconnected.

Elevation (FT)	Sed. Pond Area (SF)	Clear Pool Area (SF)	Total Area (SF)	Volume (CF)
695	0	9369	9369	0*
696	30,498	10,378	40,876	23,269*
697	32,804	11,426	44,230	65,807
698	35,149	12,514	47,663	111,738
699	37,533	13,640	51,173	161,141
700	39,956	14,806	54,762	214,093
701	42,419	16,012	58,431	270,674
702	44,921	17,256	62,177	330,962
703	47,462	18,540	66,002	395,036
703.5	48,748	19,197	67,945	428,518

Note: Stage storage is based on topographic information from 2020.
*Dead Storage

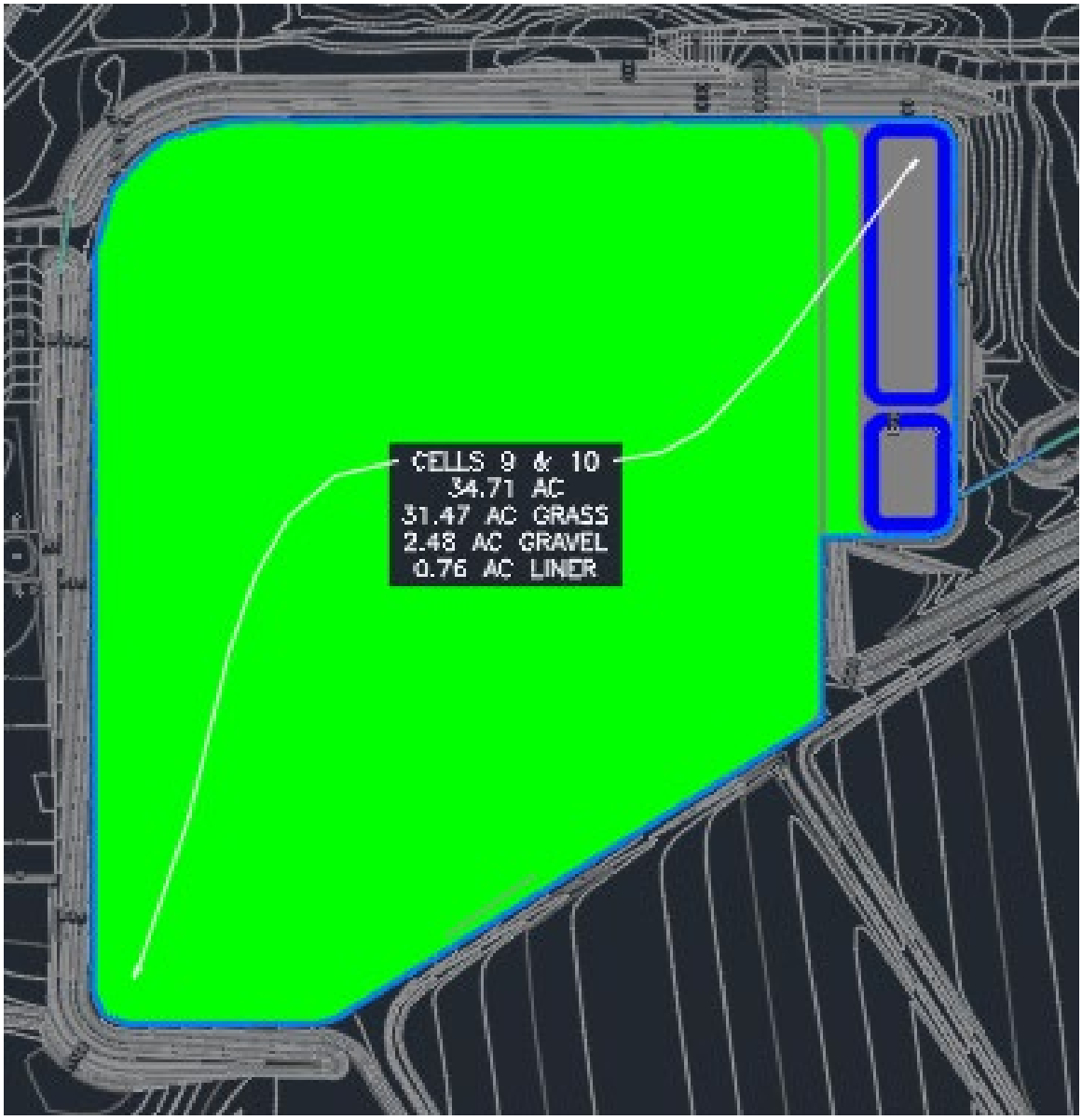
Spillways

- Principal Spillway consists of a 54” Dia. Riser with a 42” Dia. HDPE Pipe.
- Auxiliary Spillways in the Clear Pool and Sediment Pond consist of a concrete trapezoidal weir that is 24’ wide with 6:1 side slopes and sloped at 1% in the direction of flow with a 3:1 slope on the discharge channel at the downstream end.

High Water Elevation is 701.44 (See Pond Reports 1 & 2)

Design Calculations

Project	Prepared by	Date
Plant Bowen Run-on Run-off Control	Jeremy Brown	2/10/22
Subject/Title Provide run-on and run-off system calculations for the peak discharge from a 24-hr 25-year storm Cells 9 & 10	Reviewed by Ashley Grissom	Date 2/11/22
	Calculation Number DC-BN- 735210-003 (Rev1)	Sheet 12 of 23



Map 1

Table 2.1.5-1 Runoff Curve Numbers[1]

Cover description: Cover type and hydrologic condition	Average percent impervious area[2]	Curve numbers for hydrologic soil groups: A	B	C	D
Cultivated land: without conservation treatment		72	81	88	91
with conservation treatment		62	71	78	81
Pasture or range land: poor condition		68	79	86	89
good condition		39	61	74	80
Meadow: good condition		30	58	71	78
Wood or forest land: thin stand, poor cover		45	66	77	83
good cover		25	55	70	77
Open space (lawns, parks, golf courses, cemeteries, etc.)[3]					
Poor condition (grass cover <50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm drains (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 Newly graded areas (pervious areas only, no vegetation)		77	86	91	94

[1] Average runoff condition, and $I_a = 0.2S$

[2] The average percent impervious area shown was used to develop the composite CNs. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. If the impervious area is not connected, the SCS method has an adjustment to reduce the effect.

[3] CNs shown are equivalent to those of pasture. Composite CNs may be computed for other combinations of open space cover type.

Table 1

TR55 Tc Worksheet

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v12

Hyd. No. 1

Cells 9 & 10

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 300.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.79		0.00		0.00		
Land slope (%)	= 2.17		0.00		0.00		
Travel Time (min)	= 20.99	+	0.00	+	0.00	=	20.99
Shallow Concentrated Flow							
Flow length (ft)	= 353.00		0.00		0.00		
Watercourse slope (%)	= 15.43		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=6.34		0.00		0.00		
Travel Time (min)	= 0.93	+	0.00	+	0.00	=	0.93
Channel Flow							
X sectional flow area (sqft)	= 6.57		1.79		0.00		
Wetted perimeter (ft)	= 8.79		3.39		0.00		
Channel slope (%)	= 1.45		1.51		0.00		
Manning's n-value	= 0.030		0.013		0.015		
Velocity (ft/s)	=4.92						
			9.18				
					0.00		
Flow length (ft)	({0})2773.0		102.0		0.0		
Travel Time (min)	= 9.39	+	0.19	+	0.00	=	9.58

Total Travel Time, Tc ..... **31.49 min**

TR55 Worksheet

Design Calculations

Project	Prepared by	Date
Plant Bowen Run-on Run-off Control	Jeremy Brown	2/10/22
Subject/Title Provide run-on and run-off system calculations for the peak discharge from a 24-hr 25-year storm Cells 9 & 10	Reviewed by Ashley Grissom	Date 2/11/22
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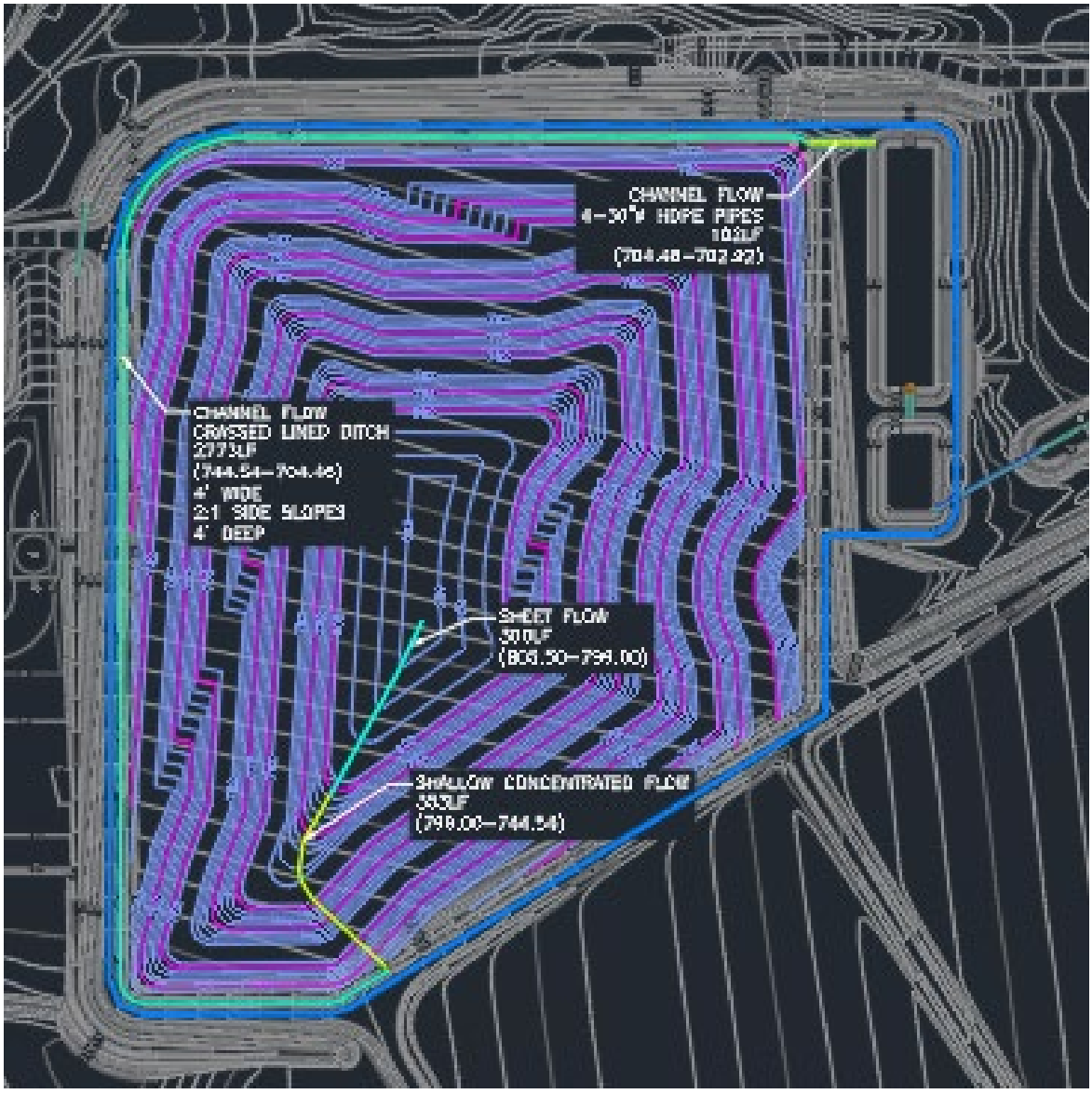

Map 2

Table 2.1.5-2 Roughness Coefficients (Manning's n) for Sheet Flow[1]

Surface Description	n
Smooth surfaces (concrete, asphalt, gravel, or bare soil)	0.011
Fallow (no residue)	0.05
Cultivated soils:	
Residue cover < 20%	0.06
Residue cover > 20%	0.17
Grass:	
Short grass prairie	0.15
Dense grasses[2]	0.24
Bermuda grass	0.41
Range (natural)	0.13
Woods[3]	
Light underbrush	0.40
Dense underbrush	0.80

[1] The n values are a composite of information by Engman (1986).

[2] Includes species such as weeping lovegrass, bluegrass, buffalo grass, blue grama grass, and native grass mixtures.

[3] When selecting n, consider cover to a height of about 0.1 ft. This is the only part of the plant cover that will obstruct sheet flow.

Source: SCS, TR-55, Second Edition, June 1986

Table 2

Project	Prepared by	Date
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Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Feb 11 2021

Cells 9 & 10 Ditch

Trapezoidal

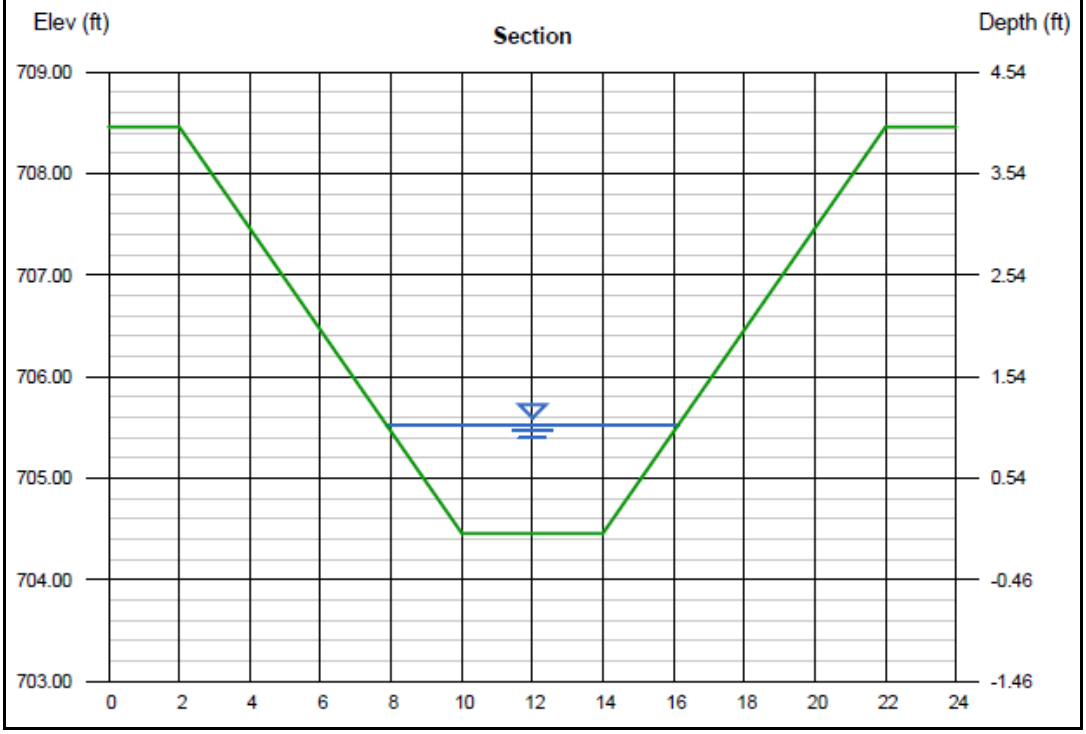
Bottom Width (ft)	= 4.00
Side Slopes (z:1)	= 2.00, 2.00
Total Depth (ft)	= 4.00
Invert Elev (ft)	= 704.46
Slope (%)	= 1.45
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 31.97

Highlighted

Depth (ft)	= 1.07
Q (cfs)	= 31.97
Area (sqft)	= 6.57
Velocity (ft/s)	= 4.87
Wetted Perim (ft)	= 8.79
Crit Depth, Yc (ft)	= 1.05
Top Width (ft)	= 8.28
EGL (ft)	= 1.44



Channel Report 1

Manning's n Values

3. finished, with gravel on bottom	0.015	0.017	0.020
4. unfinished	0.014	0.017	0.020
5. gunite, good section	0.016	0.019	0.023
6. gunite, wavy section	0.018	0.022	0.025
7. on good excavated rock	0.017	0.020	
8. on irregular excavated rock	0.022	0.027	
d. Concrete bottom float finish with sides of:			
1. dressed stone in mortar	0.015	0.017	0.020
2. random stone in mortar	0.017	0.020	0.024
3. cement rubble masonry, plastered	0.016	0.020	0.024
4. cement rubble masonry	0.020	0.025	0.030
5. dry rubble or riprap	0.020	0.030	0.035
e. Gravel bottom with sides of:			
1. formed concrete	0.017	0.020	0.025
2. random stone mortar	0.020	0.023	0.026
3. dry rubble or riprap	0.023	0.033	0.036
f. Brick			
1. glazed	0.011	0.013	0.015
2. in cement mortar	0.012	0.015	0.018
g. Masonry			
1. cemented rubble	0.017	0.025	0.030
2. dry rubble	0.023	0.032	0.035
h. Dressed ashlar/stone paving	0.013	0.015	0.017
i. Asphalt			
1. smooth	0.013	0.013	
2. rough	0.016	0.016	
j. Vegetal lining	0.030		0.500

Table 3

Design Calculations

Project	Prepared by	Date
Plant Bowen Run-on Run-off Control	Jeremy Brown	2/10/22
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Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Feb 10 2022

Cells 9 & 10 Pipe

Circular

Diameter (ft)	= 3.50
Invert Elev (ft)	= 702.92
Slope (%)	= 1.51
N-Value	= 0.013

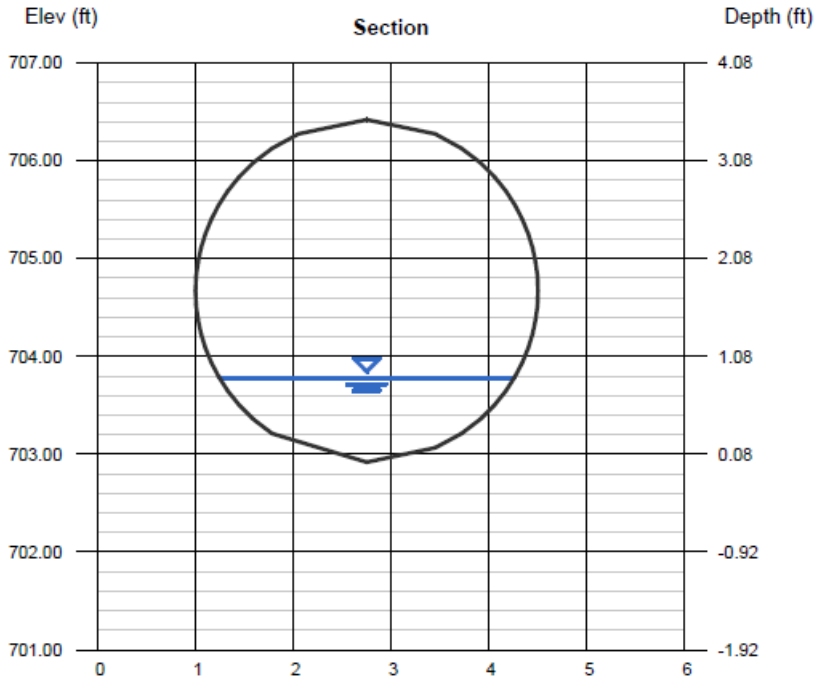
Calculations

Compute by:	Known Q
Known Q (cfs)	= 16.41

Full Flow = 65.64
Pipes = 4
Flow Per Pipe =
65.64/4 = 16.41

Highlighted

Depth (ft)	= 0.86
Q (cfs)	= 16.41
Area (sqft)	= 1.85
Velocity (ft/s)	= 8.88
Wetted Perim (ft)	= 3.64
Crit Depth, Yc (ft)	= 1.24
Top Width (ft)	= 3.02
EGL (ft)	= 2.09



Channel Report 2

Project	Prepared by	Date
Plant Bowen Run-on Run-off Control	Jeremy Brown	2/10/22
Subject/Title Provide run-on and run-off system calculations for the peak discharge from a 24-hr 25-year storm Cells 9 & 10	Reviewed by Ashley Grissom	Date 2/11/22
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Manning's n Values

7. Concrete:			
Culvert, straight and free of debris	0.010	0.011	0.013
Culvert with bends, connections, and some debris	0.011	0.013	0.014
Finished	0.011	0.012	0.014
Sewer with manholes, inlet, etc., straight	0.013	0.015	0.017
Unfinished, steel form	0.012	0.013	0.014
Unfinished, smooth wood form	0.012	0.014	0.016
Unfinished, rough wood form	0.015	0.017	0.020
8. Wood:			
Stave	0.010	0.012	0.014
Laminated, treated	0.015	0.017	0.020
9. Clay:			
Common drainage tile	0.011	0.013	0.017
Vitrified sewer	0.011	0.014	0.017
Vitrified sewer with manholes, inlet, etc.	0.013	0.015	0.017
Vitrified Subdrain with open joint	0.014	0.016	0.018
10. Brickwork:			
Glazed	0.011	0.013	0.015
Lined with cement mortar	0.012	0.015	0.017
Sanitary sewers coated with sewage slime with bends and connections	0.012	0.013	0.016
Paved invert, sewer, smooth bottom	0.016	0.019	0.020
Rubble masonry, cemented	0.018	0.025	0.030

Table 4

Hydrograph Report

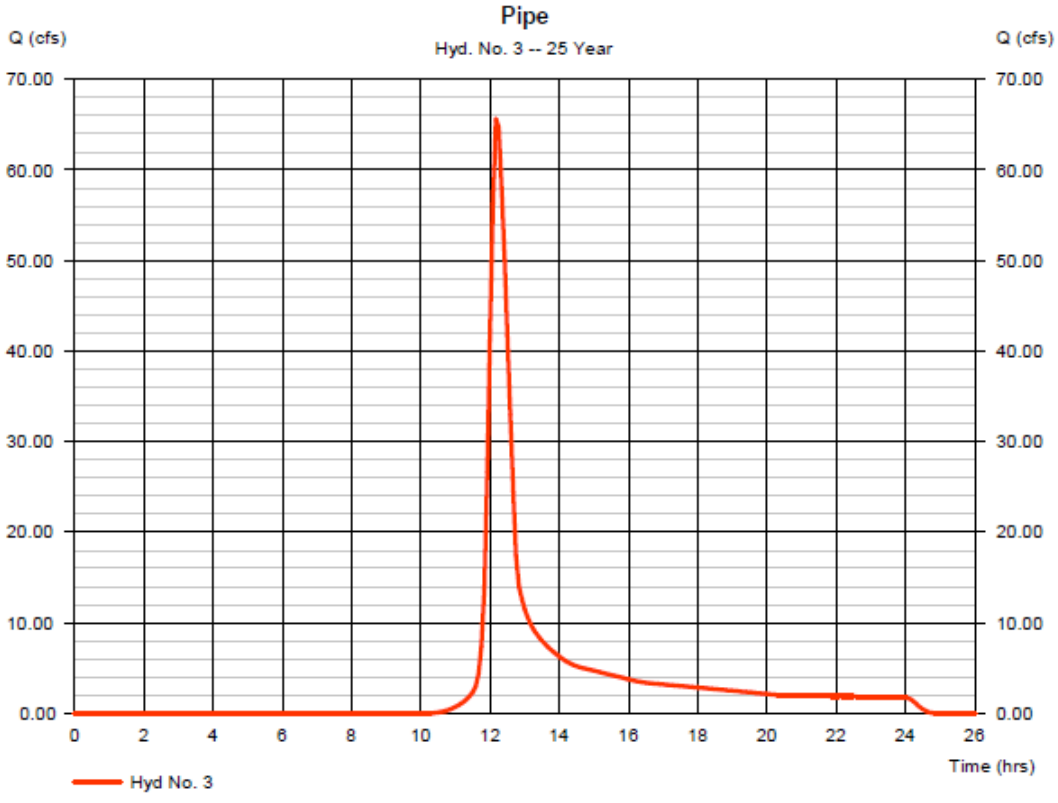
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v12 — Thursday, 02 / 11 / 2021

Hyd. No. 3

Pipe

Hydrograph type	= SCS Runoff	Peak discharge	= 65.64 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.17 hrs
Time interval	= 5 min	Hyd. volume	= 300,595 cuft
Drainage area	= 34.710 ac	Curve number	= 64*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 31.50 min
Total precip.	= 6.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(31.470 x 61) + (2.480 x 85) + (0.760 x 98)] / 34.710



Hydrograph Report 1

Project	Prepared by	Date
Plant Bowen Run-on Run-off Control	Jeremy Brown	2/10/22
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Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v12 — Monday, 01 / 31 / 2022

Pond No. 1 - Cell 9&10 Sed Pond/Clear Pool

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 695.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	695.00	9,369	0	0
1.00	696.00	40,876	23,269	23,269
2.00	697.00	44,230	42,538	65,807
3.00	698.00	47,663	45,931	111,738
4.00	699.00	51,173	49,403	161,141
5.00	700.00	54,762	52,952	214,093
6.00	701.00	58,431	56,581	270,674
7.00	702.00	62,177	60,288	330,962
8.00	703.00	66,002	64,074	395,036
8.50	703.50	67,945	33,482	428,518

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 42.00	0.00	0.00	0.00
Span (in)	= 42.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 679.90	0.00	0.00	0.00
Length (ft)	= 200.00	0.00	0.00	0.00
Slope (%)	= 2.45	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

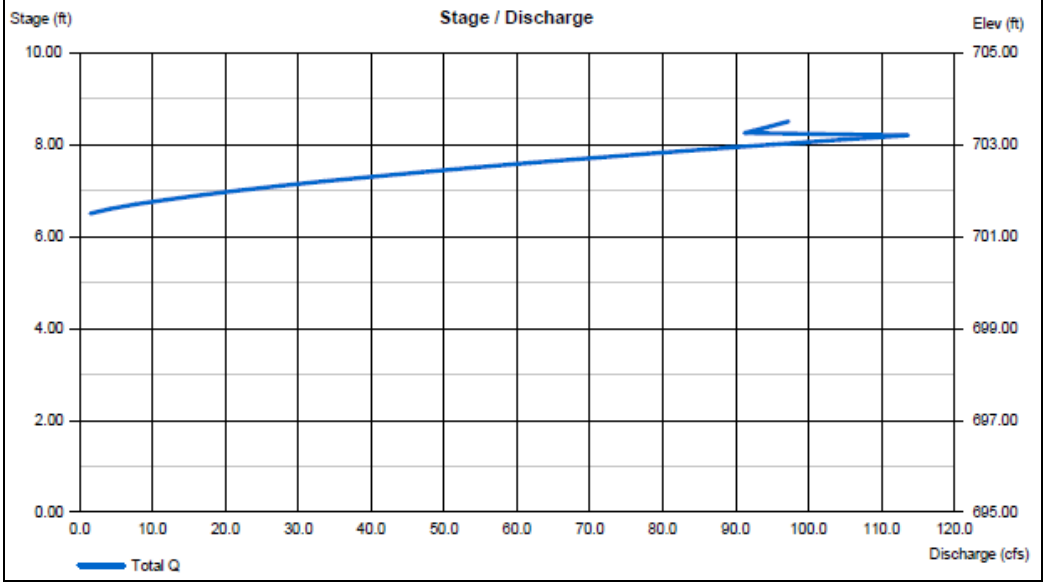
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 14.13	0.00	0.00	0.00
Crest El. (ft)	= 701.40	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	---	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 0.000 (by Contour)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).



Pond Report 1

Design Calculations

Project	Prepared by	Date
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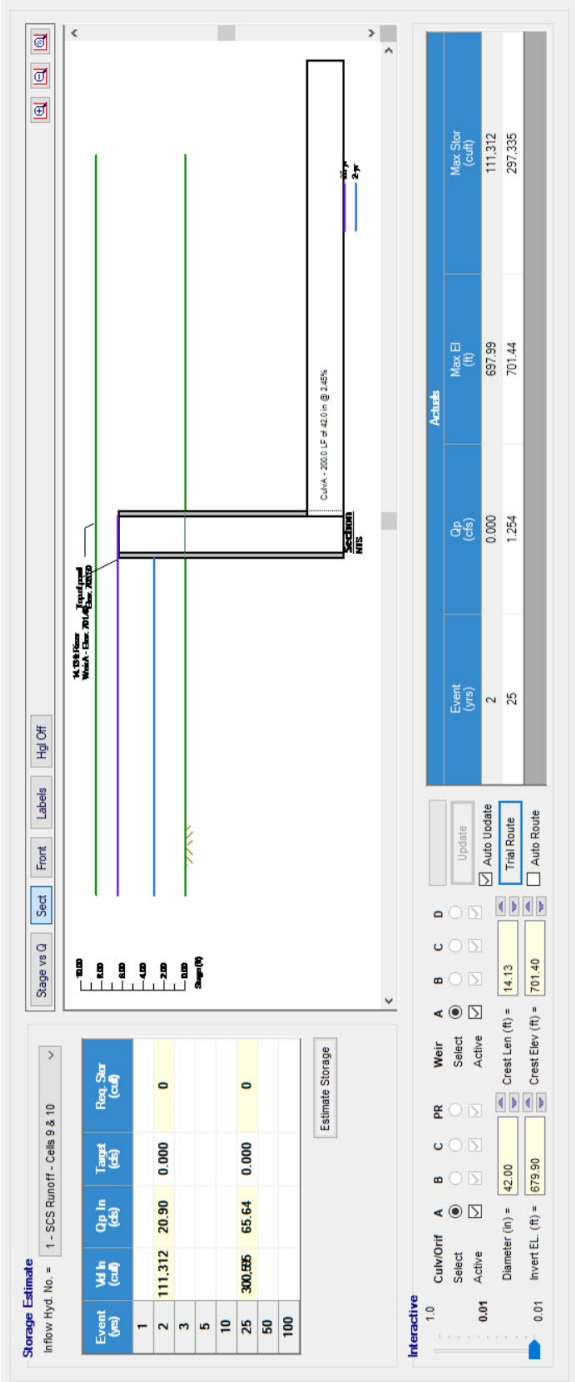

Pond Report 2