PERIODIC RUN-ON AND RUN-OFF CONTROL PLAN
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(4)(b).

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 structural fill layers varied in thickness from 5 ft. (minimum) to 13 ft. 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 and was reviewed under current conditions, summaries of which are attached.

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.

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

Run-on and Run-off Control System Plan for Landfills:
Calculation Summary

for

Plant Bowen Ash Landfill Cells 1 & 2

Prepared by:

Southern Company Services
T&PS Environmental Solutions

Originator: Jeremy Brown 10/6/21
Jeremy K. Brown Date

Reviewer: Joshua K Myers 10/8/21
Joshua K. Myers Date

Approval: 10/8/21
James C. Pegues Date

1.0 Purpose of Calculation

The purpose of this report is to demonstrate the run-on and run-off controls of the Plant Bowen Ash Landfill Cells 1 and 2 in order to prepare a run-on and run-off control system plan as required by the United States Environmental Protection Agency's (EPA) final rule for Disposal of Coal Combustion Residuals (CCR) from Electric Utilities (EPA 40 C.F.R. Part 257) and the Georgia Environmental Protection Division's (EPD) Georgia CCR Rule (391-3-4-.10).

2.0 Summary of Conclusions

2.1 Site Overview

The Plant Bowen Ash Landfill Cells 1 and 2 are located on Plant Bowen property approximately 1.5 miles east of Euharlee, Georgia and 6 miles southwest of Cartersville, Georgia. The total area occupied by the Ash landfill Cells 1 and 2 is 34.88 acres. Run-off from this area is directed through perimeter ditches that are inside the cells' perimeter dike. Flow from the perimeter ditches discharge into a sedimentation pond via three 36" diameter pipes. The sedimentation pond 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. Discharge from the clear pool goes into a stone lined ditch that flows to the east towards the Etowah River.

An overview of the Plant Bowen Ash Landfill Cells 1 & 2 is provided in Table 1 below.

Table 1 – Ash Landfill Cells 1 and 2 Site Characteristics

Pond Description	Storage Cells	Sedimentation Pond	Clear Pool
Size (Acres)	31.12	2.53	1.23
Outlet Type	Three 36" pipes	Two 72" risers connected to two 48" pipes	72" riser connected to a 48" pipe
Outlets To	Sedimentation Pond	Clear Pool	Ditch

2.2 Run-on Control System Plan

There is no stormwater run-on into the facility because it is contained within earthen berms that prevent stormwater from the surrounding area to enter the CCR facility.

2.3 Run-off Control System Plan

A hydrologic and hydraulic model was developed for the Plant Bowen Ash Landfill to determine the hydraulic capacity of Cells 1 and 2. The design storm for the purposes of run-off control system plans is the 24-hour, 25-year rainfall event. The results of routing the design storm event through the landfill are presented in Table 2 below:

Table 2 - Flood Routing Results for Plant Bowen Ash Landfill Cells 1 and 2

Plant Bowen	Normal Pool El (ft)	Top of Embankment El (ft)	Peak Water Surface El (ft)	Freeboard* (ft)	Peak Inflow (cfs)	Peak Outflow (cfs)
Cells 1 & 2	691.00	700.00	693.88	6.12	78.47	0.00**

*Freeboard is measured from the top of embankment to the peak water surface elevation

**The peak outflow is negligible because the riser is perforated with 0.5" holes that are covered by filter stone which drains the clear pool slowly. The elevation of the clear pool does not reach the elevation of the principal spillway during the design storm.

3.0 Methodology

3.1 HYDROLOGIC ANALYSES

The design storm for all run-on/run-off analyses is a 24-hour, 25-year rainfall event. A summary of the design storm parameters and rainfall distribution methodology for these calculations is summarized below in Table 3.

Table 3 - Plant Bowen Ash Landfill Cells 1 and 2 Design Storm Distribution

Return Frequency (years)	Storm Duration (hours)	Rainfall Total (Inches)	Rainfall Source	Storm Distribution
25	24	6.07	NOAA Atlas 14	SCS Type II

The drainage area for the Plant Bowen Ash Landfill Cells 1 and 2 was delineated based on LiDAR data acquired for the Plant in 2020. Run-off characteristics were developed based on the Soil Conservation Service (SCS) methodologies as outlined in TR-55. An overall SCS curve number for the drainage area was developed based on methods prescribed in TR-55. Soil types were obtained from the Natural Resources Conservation Service. Land use areas were delineated based on aerial photography. Time of Concentration and Lag Time calculations were also developed based on methodologies prescribed in TR-55.

A table of the pertinent basin characteristics of the landfill is provided below in Table 4.

Table 4 - Landfill Hydrologic Information (Cells 1 & 2)

Drainage Basin Area (acres)	34.88
Hydrologic Curve Number, CN	64
Hydrologic Methodology	SCS Method
Time of Concentration (minutes)	20.49
Hydrologic Software	Hydraflow Hydrographs

Run-off values were determined by importing the characteristics developed above into a hydrologic model with the Hydraflow Hydrographs Extension for AutoCAD Civil 3D 2019.

3.2 HYDRAULIC ANALYSES

Storage values for the landfill were determined by developing a stage-storage relationship utilizing contour data. The spillway system at the Plant Bowen Ash Landfill Cells 1 and 2 consists of a principal spillway and an auxiliary spillway which are both located in the clear pool. The principal spillway consists of a sharp crested riser weir of 18.85 ft length which conveys flow to a corrugated metal pipe. The top of the riser weir is at elevation of 694.50 feet. The pipe is 48-inches in diameter and has a length of approximately 128 feet. The auxiliary spillway is a grassed trapezoidal weir that is 8' wide with 6:1 side slopes and sloped at 1% with a crest elevation of 696.00 and a discharge channel at 3:1 slope. A summary of spillway information is presented below in Table 5.

Table 5 - Spillway Attribute Table

Spillway Component	US Invert El (ft)	DS Invert El (ft)	Dimension (ft)	Slope (ft/ft)	Length (ft)	Spillway Capacity (cfs)
Principal	674.00	673.50	4' Diameter	0.40%	128	52.46
Auxiliary	696.00	695.65	8' span 4' rise	1.00%	35	1,296

Based on the spillway attributes listed above, the data was inserted into Hydraflow Hydrographs to determine the pond performance during the design storm. Results are shown in Table 2.

4.0 SUPPORTING INFORMATION

4.1 CURVE NUMBER

Terrain Type	**Area**	**Curve Number**
Grass	31.17	61
Gravel	2.56	85
HDPE	1.15	98

4.2 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

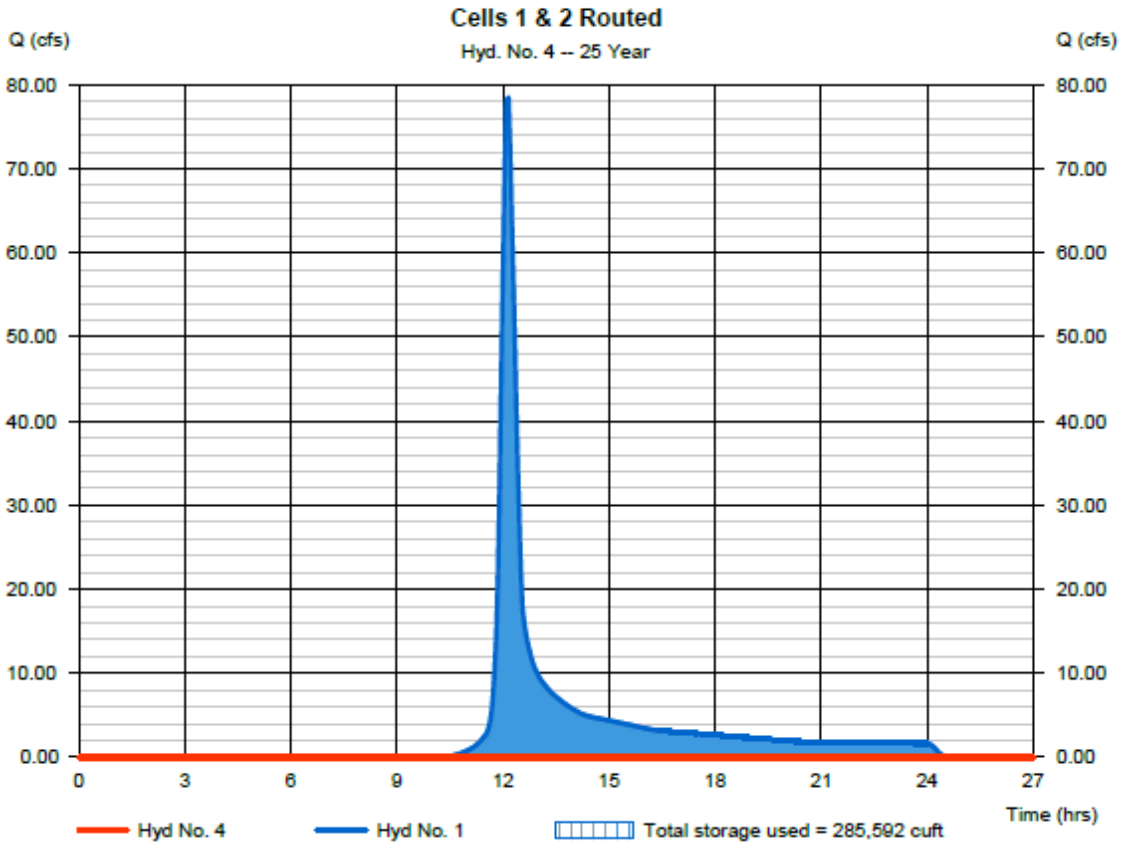
4.3 TIME OF CONCENTRATION

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**

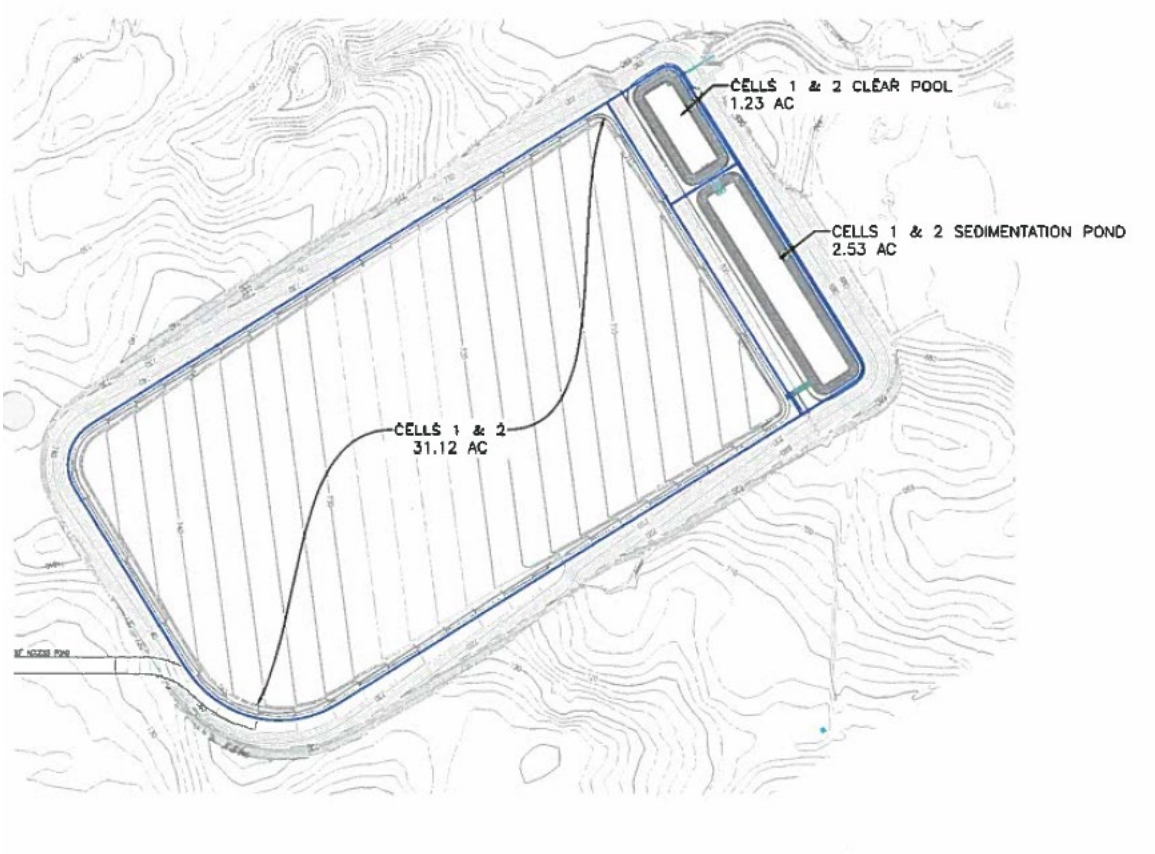
4.4 RESULTS

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 25 yrs	Time to peak	= n/a
Time interval	= 3 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 1 - Cells 1 & 2	Max. Elevation	= 693.88 ft
Reservoir name	= Cell 1&2 Sed Pond/Clear Pool	Max. Storage	= 285,592 cuft

Storage Indication method used.



4.5 DRAINAGE BASIN



Run-on and Run-off Control System Plan for Landfills:
Calculation Summary

for

Plant Bowen CCR Landfill Cells 3 & 4

Prepared by:

Southern Company Services
T&PS Environmental Services

Originator: Jeremy Brown 10/6/21
Jeremy K. Brown Date

Reviewer: Joshua K Myers 10/8/21
Joshua K. Myers Date

Approval: 10/8/21
James C. Pegues Date

1.0 Purpose of Calculation

The purpose of this report is to demonstrate the run-on and run-off controls of the subject CCR landfill in order to prepare a run-on and run-off control system plan as required by the United States Environmental Protection Agency's (EPA) final rule for Disposal of CCR from Electric Utilities (EPA 40 C.F.R. Part 257) and the Georgia Environmental Protection Division's (EPD) Georgia CCR Rule (391-3-4-.10).

2.0 Summary of Conclusions

2.1 Site Overview

The Plant Bowen CCR Landfill Cells 3 & 4 are located on Plant Bowen property approximately 1.5 miles east of Euharlee, Georgia and 6 miles southwest of Cartersville, Georgia. The total area occupied by the CCR landfill is 36.45 acres.

Run-off from Cell 3 is directed through perimeter ditches that are inside the cell perimeter dike. Flow from the perimeter ditches discharge into a sedimentation pond via a concrete channel. The Cell 3 sedimentation pond is connected to a clear pool via two 48" diameter risers and two 30" diameter pipes. Stormwater from the Cell 3 clear pool is discharged through two 54" diameter risers and two 36" diameter pipes. Discharge from the clear pool goes into a ditch that flows to the east into the Etowah River.

Run-off from Cell 4 is directed through perimeter ditches that are inside the cell perimeter dike. Flow from the perimeter ditches discharge into a sedimentation pond via a concrete channel. The Cell 4 sedimentation pond is connected to a clear pool via two 48" diameter risers and two 30" diameter pipes. Stormwater from the Cell 4 clear pool is discharged through a 66" diameter riser and a 42" diameter pipe. Discharge from the clear pool goes into a ditch that flows to the north towards the Etowah River.

An overview of Cells 3 & 4 is provided in Table 1 below. It should be noted that Cells 3-8 share an interconnected cap. The information below is based on the drainage area for each cells' sedimentation pond and clear pool. Also, Cells 3, 5 & 7 share a sedimentation pond and clear pool. Currently Cells 3 & 4 are the only cells that are built and therefore only information for these cells are shown in this run-on run-off calculation summary.

Table 1 - Landfill site characteristics

Pond Description	Cell 3	Sedimentation Pond	Clear Pool
Size (Acres)	43.27	2.25	0.73
Outlet Type	Concrete channel	Two 48” risers connected to two 30” pipes	Two 54” risers connected to two 36” pipes
Outlets To	Sedimentation Pond	Clear Pool	Ditch

Pond Description	Cell 4	Sedimentation Pond	Clear Pool
Size (Acres)	12.24	1.13	0.45
Outlet Type	Concrete channel	Two 48” risers connected to two 30” pipes	A 66” riser connected to a 42” pipe
Outlets To	Sedimentation Pond	Clear Pool	Ditch

2.2 Run-on Control System Plan

There is no stormwater run-on into the facility because it is contained within earthen berms that prevent stormwater from the surrounding area to enter the CCR facility.

2.3 Run-off Control System Plan

A hydrologic and hydraulic model was developed for the Plant Bowen CCR Landfill to determine the hydraulic capacity of the Cell. The design storm for the purposes of run-off control system plans is the 24-hour, 25-year rainfall event. The results of routing the design storm event through the landfill are presented in Table 2 below:

Table 2 - Flood Routing Results for Plant Bowen CCR Landfill

Plant Bowen	Normal Pool El (ft)	Top of Embankment El (ft)	Peak Water Surface El (ft)	Freeboard* (ft)	Peak Inflow (cfs)	Peak Outflow (cfs)
Cell 3	685.50	694.00	688.73	5.27	63.20	0.00
Cell 4	698.50	704.00	701.03	2.97	29.54	0.63

*Freeboard is measured from the top of embankment to the peak water surface elevation

3.0 Methodology

3.1 HYDROLOGIC ANALYSES

The design storm for all run-on/run-off analyses is a 24-hour, 25-year rainfall event. A summary of the design storm parameters and rainfall distribution methodology for these calculations is summarized below in Table 3.

Table 3 - Plant McIntosh CCR Landfill Design Storm Distribution

Return Frequency (years)	Storm Duration (hours)	Rainfall Total (Inches)	Rainfall Source	Storm Distribution
25	24	6.07	NOAA Atlas 14	SCS Type II

The drainage area for the Plant Bowen CCR Landfill was delineated based on LiDAR data acquired for the Plant in 2020. Run-off characteristics were developed based on the Soil Conservation Service (SCS) methodologies as outlined in TR-55. An overall SCS curve number for the drainage area was developed based on methods prescribed in TR-55. Soil types were obtained from the Natural Resources Conservation Service. Land use areas were delineated based on aerial photography. Time of Concentration and Lag Time calculations were also developed based on methodologies prescribed in TR-55.

A table of the pertinent basin characteristics of the landfill is provided below in Tables 4a through 4b.

Table 4a - Landfill Hydrologic Information (Cell 3)

Drainage Basin Area (acres)	41.47
Hydrologic Curve Number, CN	64
Hydrologic Methodology	SCS Method
Time of Concentration (minutes)	34.46
Hydrologic Software	Hydraflow Hydrographs

Table 4b - Landfill Hydrologic Information (Cell 4)

Drainage Basin Area (acres)	12.59
Hydrologic Curve Number, CN	64
Hydrologic Methodology	SCS Method
Time of Concentration (minutes)	20.69
Hydrologic Software	Hydraflow Hydrographs

Run-off values were determined by importing the characteristics developed above into a hydrologic model with the Hydraflow Hydrographs Extension for AutoCAD Civil 3D 2019.

3.2 HYDRAULIC ANALYSES

Storage values for the landfill were determined by developing a stage-storage relationship utilizing contour data. The spillway systems at the Plant Bowen Cells 3 and 4 consist of a principal spillway and an auxiliary spillway. The Cell 3 principal spillway consists of two sharp crested riser weirs of 28.28 ft length which conveys flow to two HDPE pipes. The top of the riser weirs is at elevation of 689.00 feet. The pipes are 36-inches in diameter and have a length of approximately 117 feet each. The Cell 3 auxiliary spillway is a concrete trapezoidal weir that is 20' wide with 6:1 side slopes and is sloped at 1% with a crest elevation of 690.50. The Cell 4 principal spillway consists of a sharp crested riser weir of 25.13 ft length which conveys flow to an HDPE pipe. The top of the riser weir is at elevation of 701.00 feet. The pipe is 42-inches in diameter and has a length of approximately 113 feet. The Cell 4 auxiliary spillway is a concrete trapezoidal weir that is 18' wide with 6:1 side slopes and is sloped at 1% with a crest elevation of 702.00.

A summary of spillway information is presented below in Tables 5a through 5b.

Table 5a - Spillway Attribute Table (Cell 3)

Spillway Component	US Invert El (feet)	DS Invert El (feet)	Dimension (ft)	Slope (ft/ft)	Length (ft)	Spillway Capacity (cfs)
Auxiliary	690.50	690.16	20' span 3.5' rise	1.0%	34.50	1,445

Table 5b - Spillway Attribute Table (Cell 4)

Spillway Component	US Invert El (feet)	DS Invert El (feet)	Dimension (ft)	Slope (ft/ft)	Length (ft)	Spillway Capacity (cfs)
Auxiliary	702.00	701.71	18' span 2' rise	1.0%	29	235.5

Based on the spillway attributes listed above, the data was inserted into Hydraflow Hydrographs to determine the pond performance during the design storm. Results are shown in Table 2.

4.0 SUPPORTING INFORMATION

4.1 CURVE NUMBER

4.1.1 CELL 3

Terrain Type	Area	Curve Number
Grass	37.94	61
Gravel	2.58	85
HDPE/Concrete	0.95	98

4.1.2 CELL 4

Terrain Type	Area	Curve Number
Grass	10.79	61
Gravel	1.30	85
HDPE/Concrete	0.50	98

4.2 STAGE-STORAGE TABLE

4.2.1 CELL 3

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

4.2.2 CELL 4

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

4.3 TIME OF CONCENTRATION

4.3.1 CELL 3

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**

4.3.2 CELL 4

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**

4.4 RESULTS

4.4.1 CELL 3

Hydrograph Report

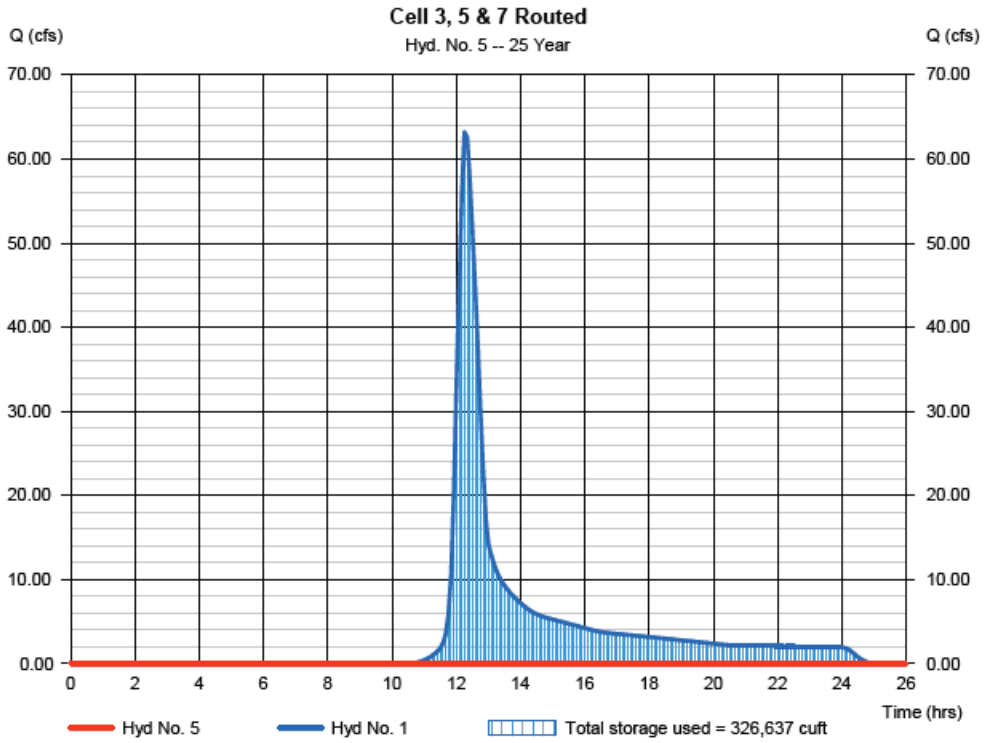
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v12 — Thursday, 04 / 22 / 2021

Hyd. No. 5

Cell 3, 5 & 7 Routed

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 25 yrs	Time to peak	= n/a
Time interval	= 5 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 1 - Cell 3, 5 & 7	Max. Elevation	= 688.73 ft
Reservoir name	= Cell 3 Sed Pond/Clear Pool	Max. Storage	= 326,637 cuft

Storage Indication method used.



Cell 3 shows an outflow of 0.00 cfs because the Peak Water Surface Elevation of 688.73 is lower than the top elevation of the riser structure which is 690.10. However, the riser structure is perforated to allow flow out of the sedimentation and clear pool. That flow is not modeled due to its very minimum.

4.4.2 CELL 4

Hydrograph Report

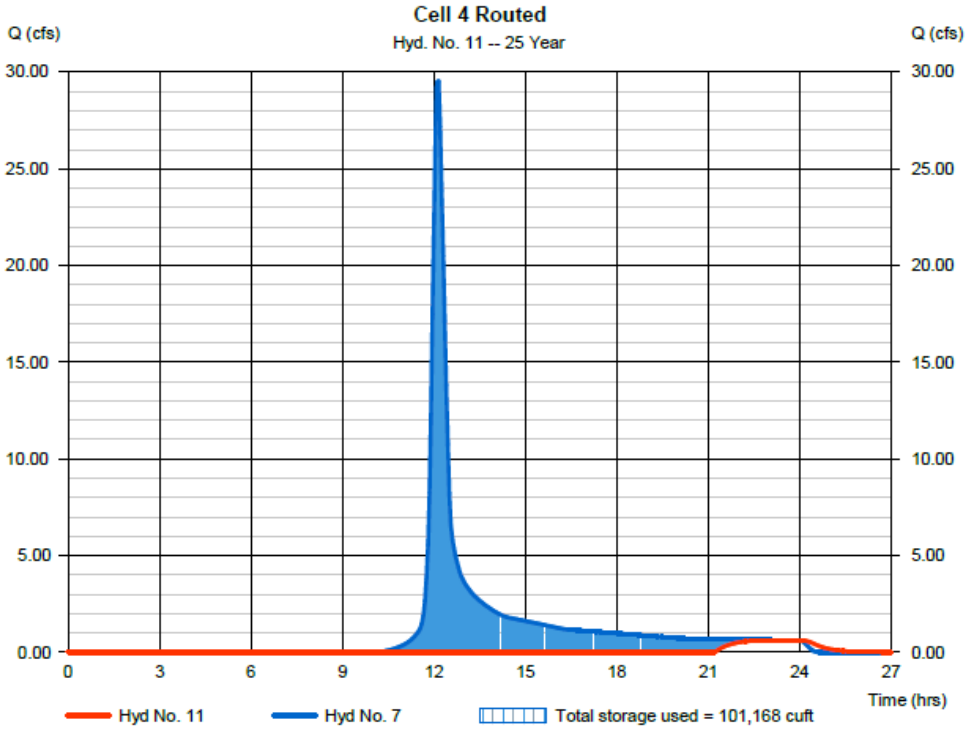
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v12 — Thursday, 04 / 22 / 2021

Hyd. No. 11

Cell 4 Routed

Hydrograph type	= Reservoir	Peak discharge	= 0.627 cfs
Storm frequency	= 25 yrs	Time to peak	= 23.35 hrs
Time interval	= 3 min	Hyd. volume	= 7,098 cuft
Inflow hyd. No.	= 7 - Cell 4	Max. Elevation	= 701.03 ft
Reservoir name	= Cell 4 Sed Pond/Clear Pool	Max. Storage	= 101,168 cuft

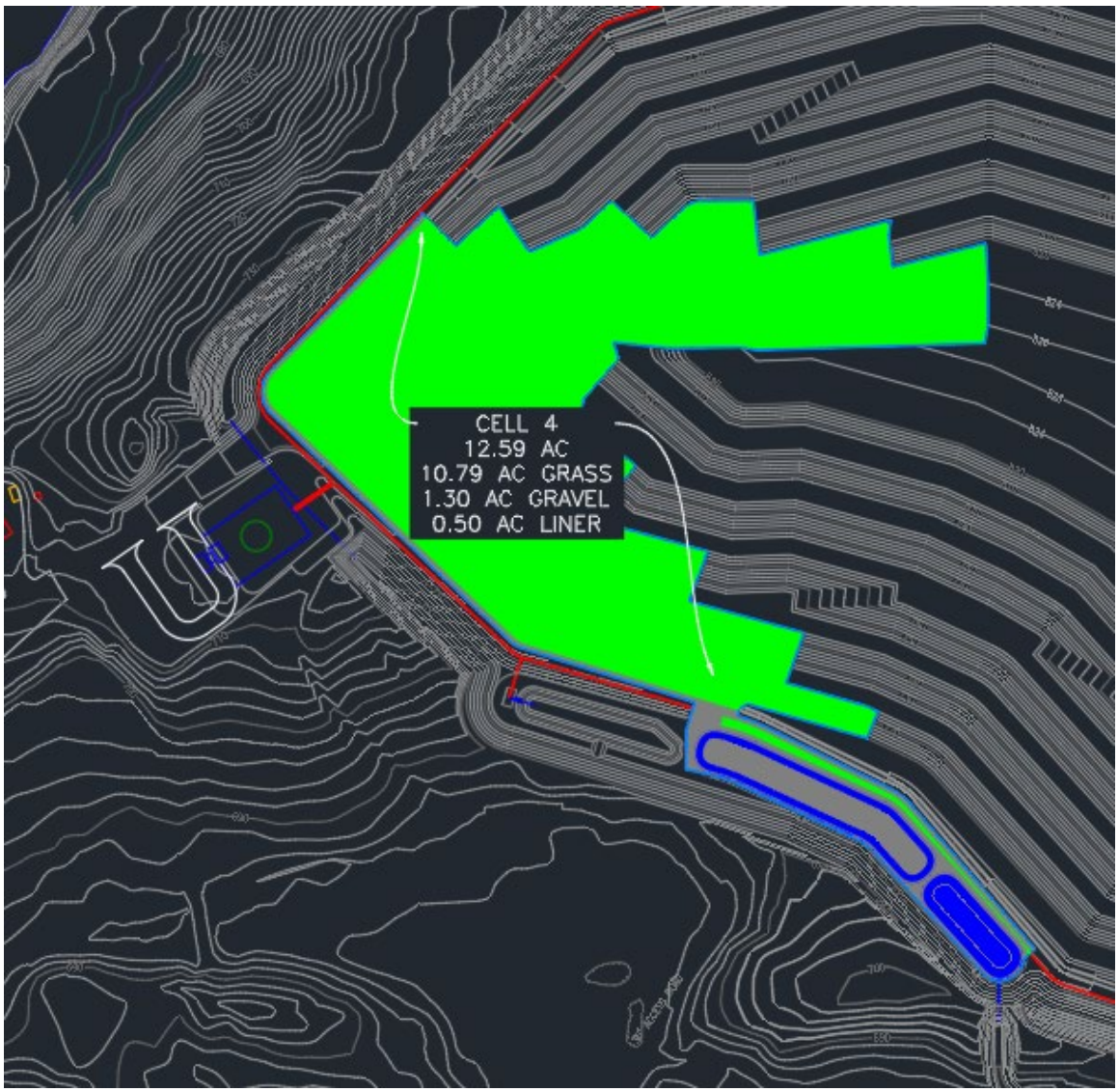
Storage Indication method used.



4.5 DRAINAGE BASIN

4.5.1 CELL 3

4.5.2 CELL 4



Run-on and Run-off Control System Plan for Landfills:
Calculation Summary

for

Plant Bowen CCR Landfill Cells 9 & 10

Prepared by:

Southern Company Services
T&PS Environmental Solutions

Originator: Jeremy Brown 10/6/21
Jeremy K. Brown Date

Reviewer: Joshua K Myers 10/8/21
Joshua K. Myers Date

Approval: 10/8/21
James C. Pegues Date

1.0 Purpose of Calculation

The purpose of this report is to demonstrate the run-on and run-off controls of the subject CCR landfill in order to prepare a run-on and run-off control system plan as required by the United States Environmental Protection Agency's (EPA) final rule for Disposal of CCR from Electric Utilities (EPA 40 C.F.R. Part 257) and the Georgia Environmental Protection Division's (EPD) Georgia CCR Rule (391-3-4-.10).

2.0 Summary of Conclusions

2.1 Site Overview

The Plant Bowen CCR Landfill Cells 9 and 10 are located on Plant Bowen property approximately 1.5 miles east of Euharlee, Georgia and 6 miles southwest of Cartersville, Georgia. The total area occupied by the CCR landfill Cells 9 and 10 is 31.67 acres. Run-off from this area is directed through perimeter ditches that are inside the cells' perimeter dike. Flow from the perimeter ditches discharge into a sedimentation pond via four 30" diameter pipes. The sedimentation pond 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. Discharge from the clear pool goes into a stone lined ditch that flows to the east into the Etowah River.

An overview of Cells 9 & 10 is provided in Table 1 below.

Table 1 - Landfill site characteristics

Pond Description	Cells 9 & 10	Sedimentation Pond	Clear Pool
Size (Acres)	31.67	2.12	0.92
Outlet Type	Four 30" pipes	Two 48" risers connected to two 30" pipes	66" riser connected to a 42" pipe
Outlets To	Sedimentation Pond	Clear Pool	Ditch

2.2 Run-on Control System Plan

There is no stormwater run-on into the facility because it is contained within earthen berms that prevent stormwater from the surrounding area to enter the CCR facility.

2.3 Run-off Control System Plan

A hydrologic and hydraulic model was developed for the Plant Bowen CCR Landfill to determine the hydraulic capacity of Cells 9 and 10. The design storm for the purposes

of run-off control system plans is the 24-hour, 25-year rainfall event. The results of routing the design storm event through the landfill are presented in Table 2 below:

Table 2 - Flood Routing Results for Plant Bowen CCR Landfill Cells 9 and 10

Plant Bowen	Normal Pool El (ft)	Top of Embankment El (ft)	Peak Water Surface El (ft)	Freeboard* (ft)	Peak Inflow (cfs)	Peak Outflow (cfs)
Cells 9 & 10	697.00	706.00	701.45	4.55	65.64	0.00**

*Freeboard is measured from the top of embankment to the peak water surface elevation

**The peak outflow is negligible because the riser is perforated with 0.5" holes that are covered by filter stone which drains the clear pool slowly. The elevation of the clear pool does not reach the elevation of the principal spillway during the design storm.

3.0 Methodology

3.1 HYDROLOGIC ANALYSES

The design storm for all run-on/run-off analyses is a 24-hour, 25-year rainfall event. A summary of the design storm parameters and rainfall distribution methodology for these calculations is summarized below in Table 3.

Table 3 - Plant Bowen CCR Landfill Cells 9 and 10 Design Storm Distribution

Return Frequency (years)	Storm Duration (hours)	Rainfall Total (Inches)	Rainfall Source	Storm Distribution
25	24	6.07	NOAA Atlas 14	SCS Type II

The drainage area for the Plant Bowen CCR Landfill Cells 9 and 10 was delineated based on LiDAR data acquired for the Plant in 2020. Run-off characteristics were developed based on the Soil Conservation Service (SCS) methodologies as outlined in TR-55. An overall SCS curve number for the drainage area was developed based on methods prescribed in TR-55. Soil types were obtained from the Natural Resources Conservation Service. Land use areas were delineated based on aerial photography. Time of Concentration and Lag Time calculations were also developed based on methodologies prescribed in TR-55.

A table of the pertinent basin characteristics of the landfill is provided below in Table 4.

Table 4 - Landfill Hydrologic Information (Cells 9 & 10)

Drainage Basin Area (acres)	34.71
Hydrologic Curve Number, CN	64
Hydrologic Methodology	SCS Method
Time of Concentration (minutes)	31.49
Hydrologic Software	Hydraflow Hydrographs

Run-off values were determined by importing the characteristics developed above into a hydrologic model with the Hydraflow Hydrographs Extension for AutoCAD Civil 3D 2019.

3.2 HYDRAULIC ANALYSES

Storage values for the landfill were determined by developing a stage-storage relationship utilizing contour data. The spillway system at the Plant Bowen CCR Landfill Cells 9 and 10 consists of a principal spillway located in the clear pool and identical auxiliary spillways in the clear pool and sediment pond. The principal spillway consists of a sharp crested riser weir of 17.28 ft length which conveys flow to an HDPE pipe. The top of the riser weir is at elevation of 701.50 feet. The pipe is 42-in in diameter and has a length of approximately 200 feet. The auxiliary spillways are concrete trapezoidal weirs that are 24 ft wide with 6:1 side slopes sloped at 1% with a crest elevation of 703.50. A summary of spillway information is presented below in Table 5.

Table 5 - Spillway Attribute Table

Spillway Component	US Invert El (ft)	DS Invert El (ft)	Dimension (ft)	Slope (ft/ft)	Length (ft)	Spillway Capacity (cfs)
Principal	679.00	678.00	3.5’	0.50%	200	75.84
Auxiliary	703.50	703.21	24’ span 2.5’ rise	1.0%	29.5	628.9

Based on the spillway attributes listed above, the data was inserted into Hydraflow Hydrographs to determine the pond performance during the design storm. Results are shown in Table 2.

4.0 SUPPORTING INFORMATION

4.1 CURVE NUMBER

Terrain Type	**Area**	**Curve Number**
Grass	31.47	61
Gravel	2.48	85
HDPE	0.76	98

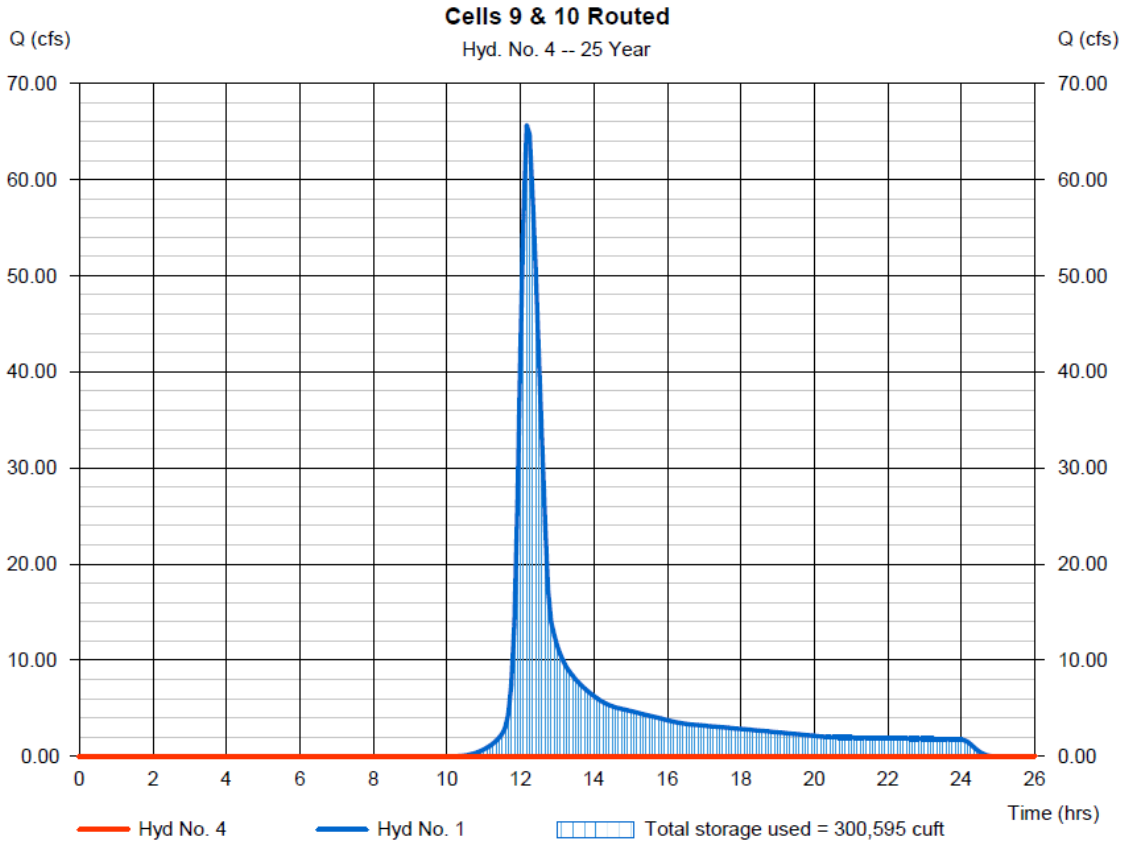
4.2 STAGE-STORAGE TABLE

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

4.3 TIME OF CONCENTRATION

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**

4.4 RESULTS


Cells 9 & 10 Routed
Hyd. No. 4 -- 25 Year
Q (cfs)
Q (cfs)
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
0
2
4
6
8
10
12
14
16
18
20
22
24
26
Time (hrs)
Hyd No. 4
Hyd No. 1
Total storage used = 300,595 cuft

4.5 DRAINAGE BASIN