INFLOW DESIGN FLOOD CONTROL SYSTEM PLAN
PLANT GASTON ASH POND
ALABAMA POWER COMPANY

Section 257.82 of EPA's regulations requires the owner or operator of an existing or new CCR surface impoundment or any lateral expansion of a CCR surface impoundment to design, construct, operate and maintain an inflow design flood control system capable of safely managing flow during and following the peak discharge of the specified inflow design flood. The owner or operator also has to prepare a written plan documenting how the inflow flood control system has been designed and constructed to meet the requirements of this section of the rule.

The existing CCR surface impoundment referred to as the Plant Gaston Ash Pond is located at Alabama Power Company's Plant Gaston. The inflow design flood consists of the rainfall that falls within the limits of the surface impoundment, runoff from approximately 47 acres of adjoining watershed, and a nominal amount (relative to rainfall) of process flows. Stormwater is temporarily stored within the limits of the surface impoundment and discharged through an outlet structure consisting of an 8-foot concrete riser connected to a 36-inch diameter concrete spillway pipe.

The inflow design flood has been calculated using the Natural Resources Conservation Service method (also known as the Soil Conservation Service (SCS) method) using the PMF storm event required for a High hazard potential facility. Runoff curve number data was determined using Table 2-2A from the Urban Hydrology for Small Watersheds (TR-55). Appendix A and B from the TR-55 were used to determine the rainfall distribution methodology. Precipitation values were determined from NOAA's Precipitation Frequency Data Server (Atlas-14).

The NRCS provided information on the soil characteristics and hydrologic groups present at the site. It was determined that the hydrological group "B" should be used to best reflect the characteristics of the soils on site. This information was placed into Hydraflow Hydrographs 2013 and used to generate appropriate precipitation curves, storm basin routing information, and resulting rating curves to evaluate surface impoundment capacity.

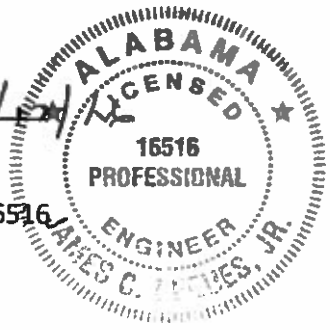
Calculations indicate the unit has a risk of overtopping a portion of the embankment located along the southeastern section of the surface impoundment near the primary spillway structure during the inflow

design storm. As addressed in the Structural Stability Assessment for the unit, plans are being prepared to armor this section of the embankment to allow it to safely operate as an auxiliary spillway.

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

I hereby certify that the inflow design flood control system plan meets the requirements of 40 C.F.R. Part 257.82.

10/[illegible]



James C. Pegues, P.E.

Licensed State of Alabama, PE No. 16516

Inflow Design Control System Plan:
Hydrologic and Hydraulic Calculation Summary

for

Plant Gaston Ash Pond

Prepared by:

Southern Company Services
Technical Services

Originator: _____ 10/13/16
Curtis R. Upchurch Date

Reviewer: _____ 10/13/16
Jason S. Wilson Date

Approval: _____ 10/13/16
James C. Pegues Date

1.0 Purpose of Calculation

The purpose of this report is to demonstrate the hydraulic capacity of the subject CCR impoundment in order to prepare an inflow design flood control plan as required by the United States Environmental Protection Agency's (EPA) final rule for Disposal of CCR from Electric Utilities (EPA 40 CFR 257).

2.0 Summary of Conclusions

A hydrologic and hydraulic model was developed for the Plant Gaston Ash Pond to determine the hydraulic capacity of the impoundment. The design storm for the Plant Gaston Ash Pond is the PMP rainfall event. Southern Company has selected a storm length of 24-hours for all inflow design flood control plans. The results of routing a PMP, 24-hour rainfall event through the impoundment are presented in Table 1 below:

Table 1-Flood Routing Results for Plant Smith Ash Pond

Plant Gaston Area	Normal Pool El (ft)	Top of embankment El (ft)	Emergency Spillway Crest El (ft)	Peak Water Surface Elevation (ft)	Freeboard* (ft)	Peak Inflow (cfs)	Peak Outflow (cfs)
Ash Pond	431.0 to 432.0**	Varies – low point @ 444.0	N/A	445.0	Overtops	6560	5070

*Freeboard is measured from the top of embankment to the peak water surface elevation
**Assumed the higher normal pool elevation of 432.0 in calculations for conservative approach.

3.0 Methodology

3.1 HYDROLOGIC ANALYSES

The Plant Gaston Ash Pond is classified as a high hazard structure. The design storm for a high hazard structure is the PMP rainfall event. A summary of the design storm parameters and rainfall distribution methodology for these calculations is summarized below in Tables 2(a) and 2(b).

Table 2(a) Plant Gaston Ash Pond Storm Precipitation

Hazard Classification	Return Frequency (years)	Storm Duration (hours)	Rainfall Total (Inches)	Rainfall Source	Storm Distribution
High	PMP	24	42.3	HMR - 51	HRM-52 24 hr.

Table 2(b) Plant Gaston Ash Pond Storm Distribution (HMR-52 Input)

Area, (Sq. Miles)	Duration (hours)				
	6	12	24	48	72
10	33.2	37.0	42.9	47.3	50.1
200	22.9	27.7	34.1	38.0	41.3
1000	16.9	22.2	27.6	31.8	34.5
5000	9.7	14.0	18.5	22.9	26.1
10000	7.4	11.1	15.3	19.5	22.6
20000	5.4	8.8	12.3	16.1	19.0

The drainage area for the Plant Gaston Ash Pond was delineated based on LiDAR data and acquired for the Plant in 2013 and additional surveys in 2016. Runoff 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 the National Engineering Handbook Part 630, Chapter 9 which provides a breakdown of curve numbers for each soil type and land use combination. Soil types were obtained from the USGS online soils database. Land use areas were delineated based on aerial photography. Time of Concentration calculations were developed based on the overland flow method as described in the National Engineering Handbook Part 630, Chapter 15.

A table of the pertinent basin characteristics of the Ash Pond is provided below in Table 3.

Table 3— Plant Smith Ash Pond Hydrologic Information

Drainage Basin Area (acres)	317.6
Hydrologic Curve Number, CN	82
Hydrologic Methodology	SCS Method
Time of Concentration (minutes)	47.8
Hydrologic Software	Autodesk Hydraflow Hydrographs

Rainfall distribution was derived by HMR-52 software using precipitation depth-area-duration values from HMR-51 maps as noted in Table 2(b). Runoff values were determined by importing the characteristics developed above into a hydrologic model with the Autodesk Hydraflow Hydrographs program.

Process flows from Plant Gaston were considered in this analysis. Based on normal plant operations, the Ash Pond receives an additional 60.1 MGD (93 cfs) of inflow from the Plant.

3.2 HYDRAULIC ANALYSES

Storage values for the Ash Pond were determined by developing a stage-storage relationship utilizing contour data for the ash pond and outlet canal. An arrangement of the ash pond and outlet canal is shown in the attached ash pond map in Section 4.5. Stormwater runoff and Plant process flows are collected from the ash sluicing areas and the ash stack and conveyed via a perimeter channel which runs along the north perimeter of the site parallel to a rail yard, turns and runs along the west side of the ash pond and then runs east in a defined canal following the southern boundary of the ash pond to a discharge point for release to the Coosa River. The outfall point has a vertical stop log riser located in a clear pool at the termination of the canal.

A summary of spillway information is presented below in Table 4.

Table 4— Plant Gaston Ash Pond Spillway Attribute Table

Spillway Component	US Invert El (feet)	DS Invert El (feet)	Dimension	Slope (ft/ft)	Length (ft)	Spillway Capacity (cfs)
Primary Concrete stop log riser 8 foot square	413.0*	407.35	Weir L = 14.0 ft., Weir EL 432.0 Outlet pipe = 36" diameter, RCP	0.0120	270*	170

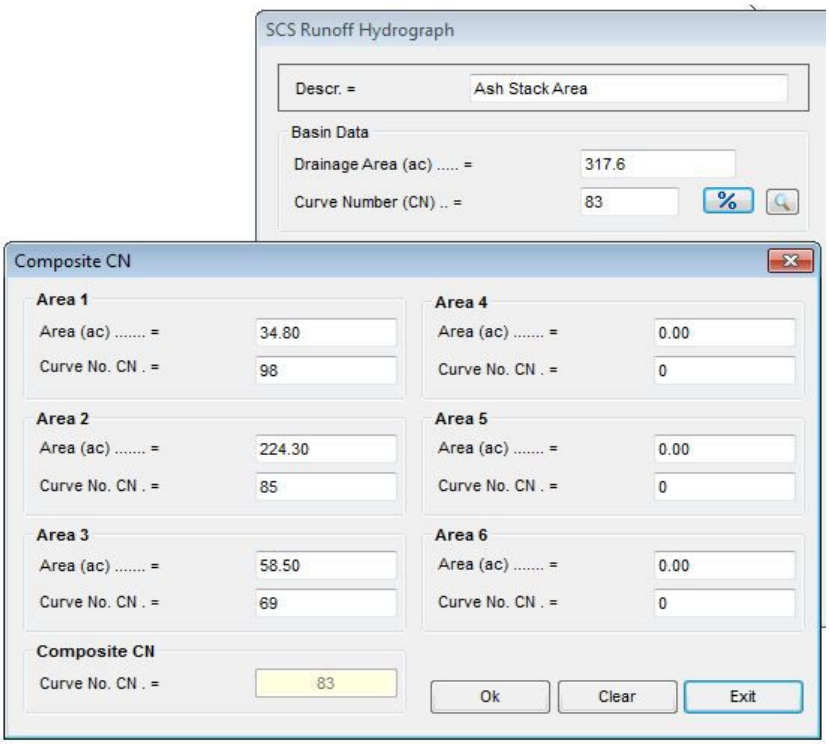
*Pipe system, riser, etc. has been retrofitted since initial construction. Some assumptions have been made for pipe lengths and inverts.

Based on the spillway attributes listed above, a rating curve was developed and inserted into Hydraflow Hydrographs software to analyze pond performance during the design storm. Results are shown in Table 1.

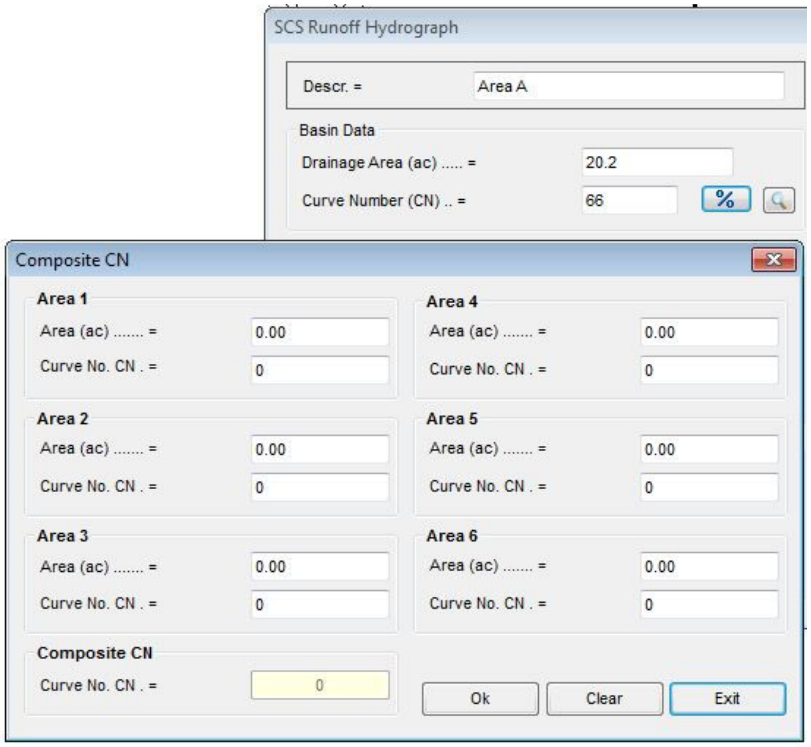
4.0 SUPPORTING INFORMATION

4.1 CURVE NUMBERS

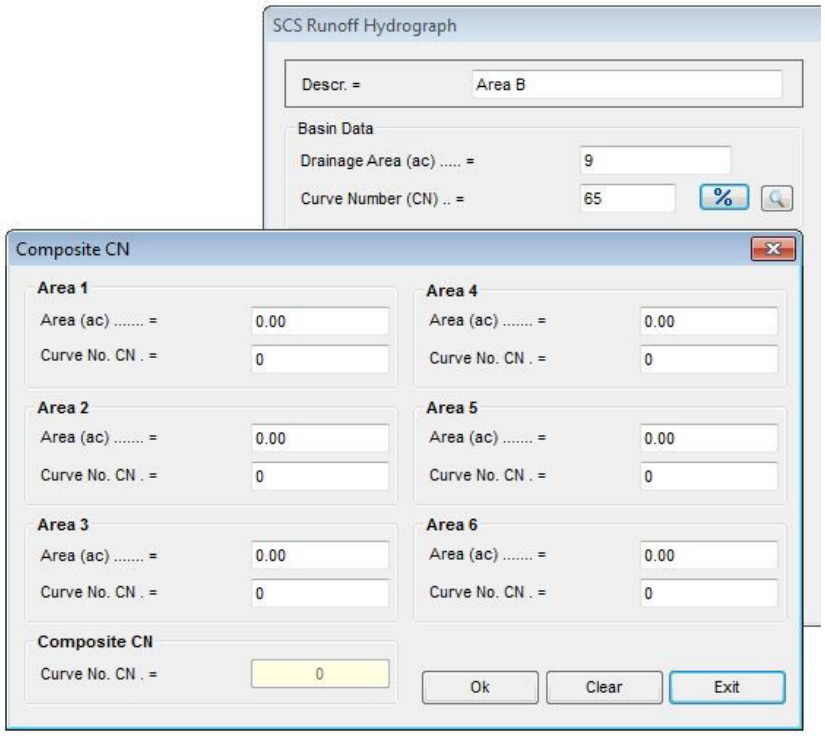
4.1.1 ASH STACK AREA



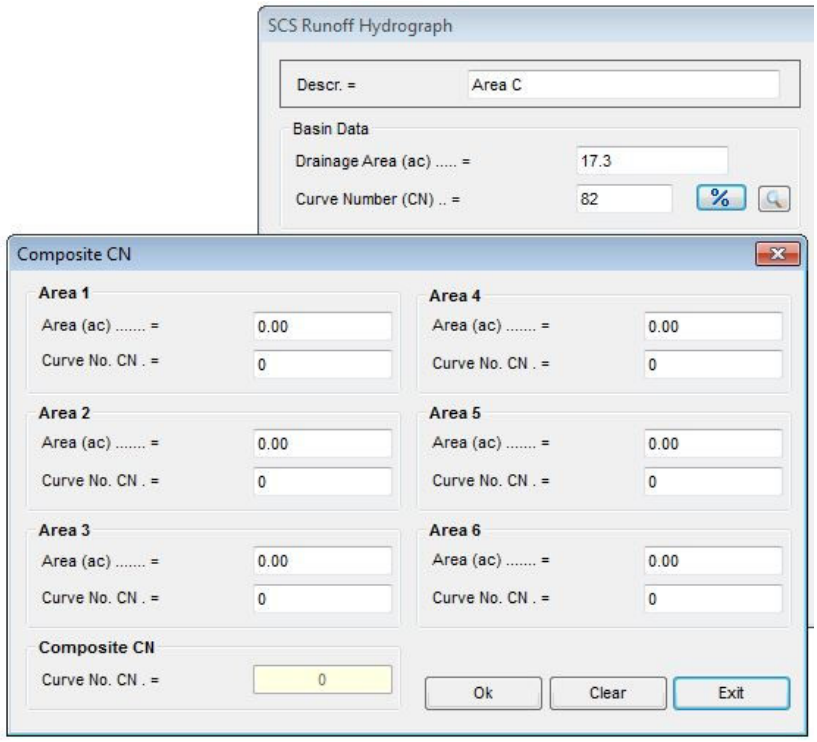
4.1.2 AREA A BASIN



4.1.3 AREA B BASIN



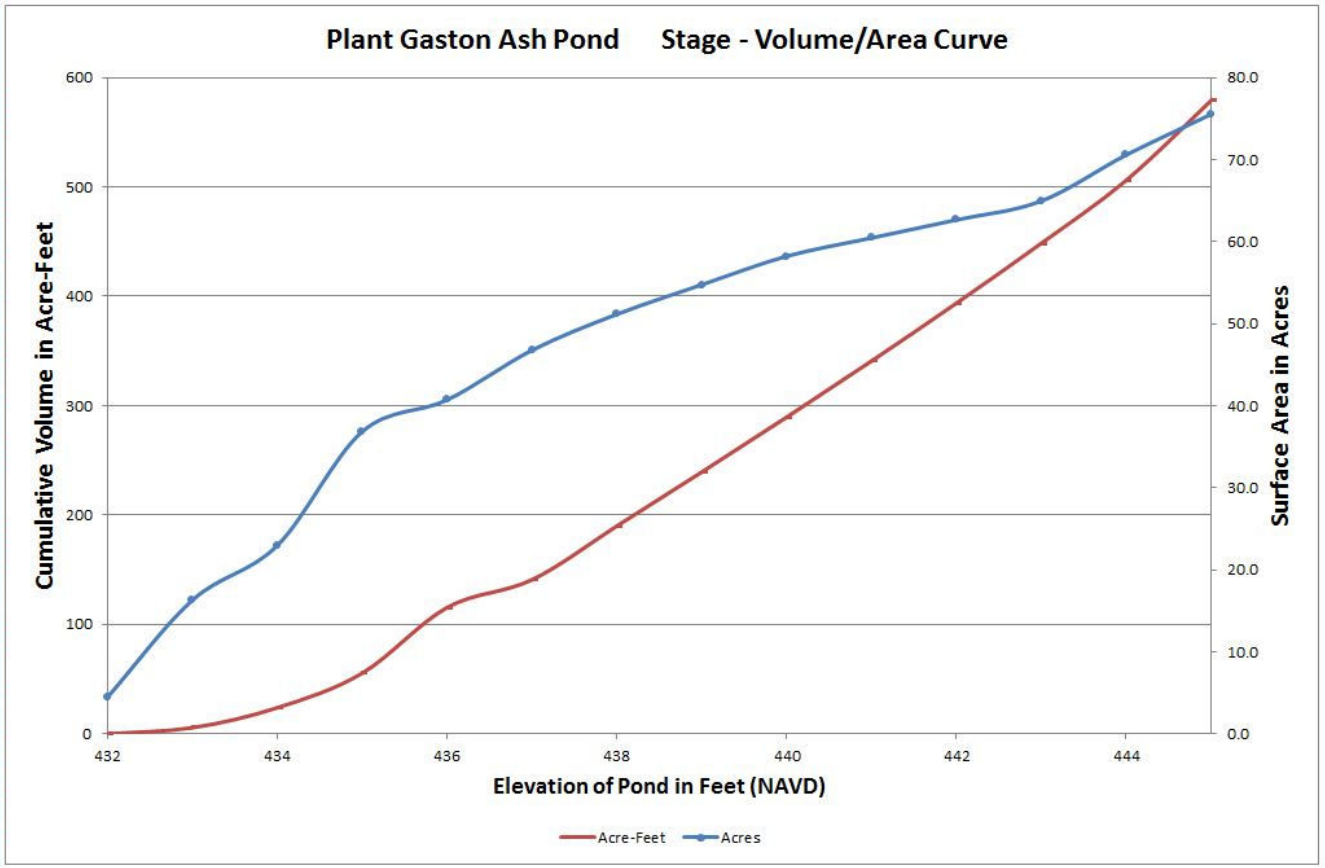
4.1.4 AREA C BASIN



4.2 STAGE-STORAGE TABLES & CURVES

ASH POND AND OUTLET CANAL

Contour Elevation	Surface Area Acres	Volume Acre-Feet
432	4.46	0.00
433	16.31	5.58
434	22.96	23.85
435	36.83	55.43
436	40.70	115.44
437	46.76	140.81
438	51.15	189.89
439	54.74	239.28
440	58.21	289.44
441	60.45	340.80
442	62.65	393.63
443	64.95	448.39
444	70.55	505.87
445	75.51	578.84



4.3 TIME OF CONCENTRATION

FORMULAS FOR SHEET FLOW, SHALLOW CONCENTRATED FLOW, CHANNEL FLOW, AND FLOW THRU WATER

SCS TR-55 Time of Concentration Computations Report	
==	
Sheet Flow Equation	Channel Flow Equation
-------------------	---------------------
Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))	V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
	R = Aq / Wp
Where:	Tc = (Lf / V) / (3600 sec/hr)
Tc = Time of Concentration (hrs)	
n = Manning's Roughness	Where:
Lf = Flow Length (ft)	Tc = Time of Concentration (hrs)
P = 2 yr, 24 hr Rainfall (inches)	Lf = Flow Length (ft)
Sf = Slope (ft/ft)	R = Hydraulic Radius (ft)
	Aq = Flow Area (ft^2)
Shallow Concentrated Flow Equation	Wp = Wetted Perimeter (ft)
----------------------------------	V = Velocity (ft/sec)
V = 16.1345 * (Sf^0.5) (unpaved surface)	Sf = Slope (ft/ft)
V = 20.3282 * (Sf^0.5) (paved surface)	n = Manning's Roughness
V = 15.0 * (Sf^0.5) (grassed waterway surface)	
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)	Water Travel Velocity Equation
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)	---------------------
V = 7.0 * (Sf^0.5) (short grass pasture surface)	V = (g*D)^0.5
V = 5.0 * (Sf^0.5) (woodland surface)	Tc = ((Lf / V) /60sec/min)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)	
Tc = (Lf / V) / (3600 sec/hr)	Where:
	Tc = Time of Concentration (hrs)
Where:	D = Mean Depth (ft)
Tc = Time of Concentration (hrs)	g = Gravitational Constant (32.2 ft/sec)
Lf = Flow Length (ft)	Lf = Flow Length (ft)
V = Velocity (ft/sec)	R = Hydraulic Radius (ft)
Sf = Slope (ft/ft)	V = Velocity (ft/sec)

4.3.1 ASH STACK AREA

TR55 Tc Worksheet

Hyd. No. 1

Ash Stack Area

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.020		0.011		0.011		
Flow length (ft)	= 300.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 4.11		0.00		0.00		
Land slope (%)	= 1.00		0.00		0.00		
Travel Time (min)	**= 5.48**	**+**	**0.00**	**+**	**0.00**	**=**	**5.48**
Shallow Concentrated Flow							
Flow length (ft)	= 2770.00		0.00		0.00		
Watercourse slope (%)	= 3.80		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	= 3.15		0.00		0.00		
Travel Time (min)	**= 14.68**	**+**	**0.00**	**+**	**0.00**	**=**	**14.68**
Channel Flow							
X sectional flow area (sqft)	= 67.13		0.00		0.00		
Wetted perimeter (ft)	= 27.04		0.00		0.00		
Channel slope (%)	= 0.27		0.00		0.00		
Manning's n-value	= 0.030		0.015		0.015		
Velocity (ft/s)	= 4.75						
			0.00				
					0.00		
Flow length (ft)	({0})6210.0		0.0		0.0		
Travel Time (min)	**= 21.81**	**+**	**0.00**	**+**	**0.00**	**=**	**21.81**
Total Travel Time, Tc							**42.00 min**

Flow thru Water Computations	

-	Subarea A
Flow Length (ft):	4400
Average Depth (ft):	5
Velocity (ft/sec):	12.7
Computed Flow Time (minutes):	5.8
==========	
Total TOC (minutes):	47.8
==========	

4.3.2 AREA A

TR55 Tc Worksheet

Hyd. No. 5

Area A

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.400		0.011		0.011		
Flow length (ft)	= 150.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 4.11		0.00		0.00		
Land slope (%)	= 7.40		0.00		0.00		
Travel Time (min)	**= 15.53**	**+**	**0.00**	**+**	**0.00**	**=**	**15.53**
Shallow Concentrated Flow							
Flow length (ft)	= 940.00		0.00		0.00		
Watercourse slope (%)	= 7.40		0.00		0.00		
Surface description	= Paved		Paved		Paved		
Average velocity (ft/s)	= 5.53		0.00		0.00		
Travel Time (min)	**= 2.83**	**+**	**0.00**	**+**	**0.00**	**=**	**2.83**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.018		0.015		0.015		
Velocity (ft/s)	= 0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**
Total Travel Time, Tc							**18.36 min**

4.3.3 AREA B

TR55 Tc Worksheet

Hyd. No. 7

Area B

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.400		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 4.11		0.00		0.00		
Land slope (%)	= 10.60		0.00		0.00		
Travel Time (min)	**= 9.72**	**+**	**0.00**	**+**	**0.00**	**=**	**9.72**
Shallow Concentrated Flow							
Flow length (ft)	= 626.00		0.00		0.00		
Watercourse slope (%)	= 10.60		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	= 5.25		0.00		0.00		
Travel Time (min)	**= 1.99**	**+**	**0.00**	**+**	**0.00**	**=**	**1.99**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.018		0.015		0.015		
Velocity (ft/s)	= 0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 11.71 min

4.3.4 AREA C

TR55 Tc Worksheet

Hyd. No. 10

Area C

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.240		0.011		0.011		
Flow length (ft)	= 50.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 4.11		0.00		0.00		
Land slope (%)	= 5.00		0.00		0.00		
Travel Time (min)	**= 5.01**	**+**	**0.00**	**+**	**0.00**	**=**	**5.01**
Shallow Concentrated Flow							
Flow length (ft)	= 1300.00		0.00		0.00		
Watercourse slope (%)	= 5.60		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	= 3.82		0.00		0.00		
Travel Time (min)	**= 5.67**	**+**	**0.00**	**+**	**0.00**	**=**	**5.67**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.018		0.015		0.015		
Velocity (ft/s)	= 0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 10.70 min

4.4 RATING CURVES

4.4.1 ASH POND & OUTLET CANAL RATING CURVE

Pond Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2013 by Autodesk, Inc. v10 — Thursday, 10 / 6 / 2016

Pond No. 1 - Ash Pond Pool & Canal

Pond Data

Pond storage is based on user-defined values.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	432.00	n/a	0	0
1.00	433.00	n/a	243,063	243,063
2.00	434.00	n/a	795,784	1,038,847
3.00	435.00	n/a	1,375,547	2,414,394
4.00	436.00	n/a	2,614,109	5,028,503
5.00	437.00	n/a	1,105,094	6,133,597
6.00	438.00	n/a	2,137,871	8,271,468
7.00	439.00	n/a	2,151,782	10,423,250
8.00	440.00	n/a	2,184,900	12,608,150
9.00	441.00	n/a	2,237,210	14,845,360
10.00	442.00	n/a	2,301,370	17,146,730
11.00	443.00	n/a	2,185,010	19,331,740
12.00	444.00	n/a	2,704,070	22,035,810
13.00	445.00	n/a	3,178,560	25,214,370

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 36.00	Inactive	Inactive	Inactive
Span (in)	= 36.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 413.00	0.00	0.00	0.00
Length (ft)	= 270.00	0.00	0.00	0.00
Slope (%)	= 1.12	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)	= 14.00	1500.00	Inactive	Inactive
Crest El. (ft)	= 432.00	444.00	440.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	Rect	Cipti	—
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).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	432.00	0.00	—	—	—	0.00	0.00	—	—	—	—	0.000
1.00	243,063	433.00	133.37 oc	—	—	—	46.62	0.00	—	—	—	—	46.62
2.00	1,038,847	434.00	133.37 oc	—	—	—	93.15 ic	0.00	—	—	—	—	93.15
3.00	2,414,394	435.00	133.37 oc	—	—	—	114.08 ic	0.00	—	—	—	—	114.08
4.00	5,028,503	436.00	133.37 oc	—	—	—	131.73 ic	0.00	—	—	—	—	131.73
5.00	6,133,597	437.00	149.47 oc	—	—	—	149.45 s	0.00	—	—	—	—	149.45
6.00	8,271,468	438.00	152.72 oc	—	—	—	152.68 s	0.00	—	—	—	—	152.68
7.00	10,423,250	439.00	155.83 oc	—	—	—	155.77 s	0.00	—	—	—	—	155.77
8.00	12,608,150	440.00	158.85 oc	—	—	—	158.80 s	0.00	—	—	—	—	158.80
9.00	14,845,360	441.00	161.79 oc	—	—	—	161.76 s	0.00	—	—	—	—	161.76
10.00	17,146,730	442.00	164.68 oc	—	—	—	164.50 s	0.00	—	—	—	—	164.50
11.00	19,331,740	443.00	167.50 oc	—	—	—	167.48 s	0.00	—	—	—	—	167.48
12.00	22,035,810	444.00	170.28 oc	—	—	—	170.18 s	0.00	—	—	—	—	170.18
13.00	25,214,370	445.00	173.01 oc	—	—	—	172.46 s	4995.00	—	—	—	—	5167.46

4.4.2 ASH POND & OUTLET CANAL INFLOW HYDROGRAPH

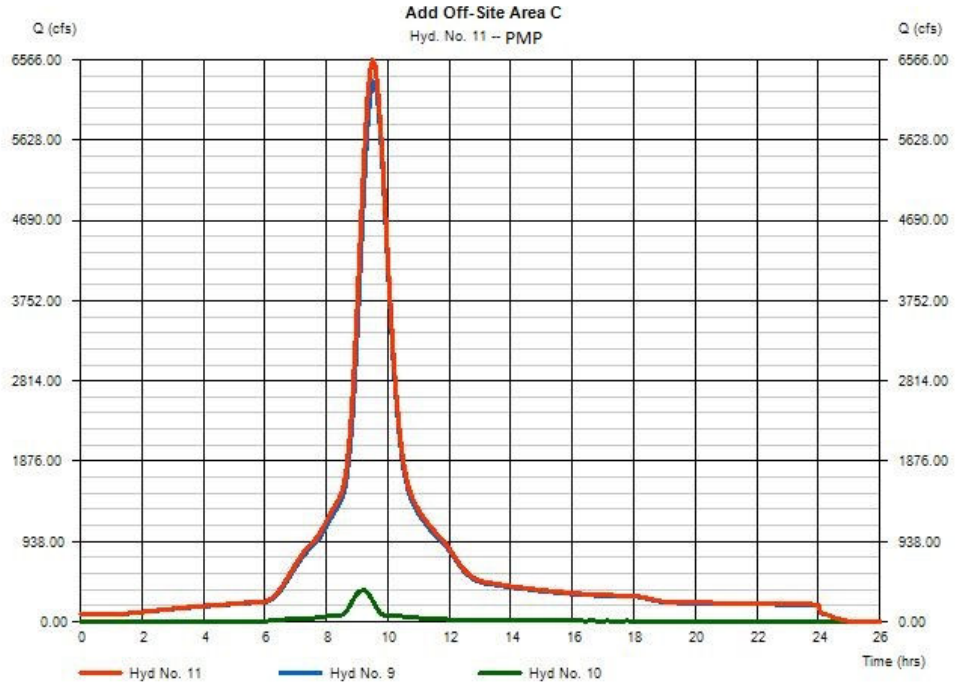
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2013 by Autodesk, Inc. v10 Thursday, 10 / 6 / 2016

Hyd. No. 11

Add Off-Site Area C

Hydrograph type	= Combine	Peak discharge	= 6563.66 cfs
Storm frequency	= PMP	Time to peak	= 9.50 hrs
Time interval	= 5 min	Hyd. volume	= 60,294,780 cuft
Inflow hyds.	= 9, 10	Contrib. drain. area	= 17.300 ac



4.4.3 ASH POND & OUTLET CANAL DISCHARGE HYDROGRAPH

Hydrograph Report

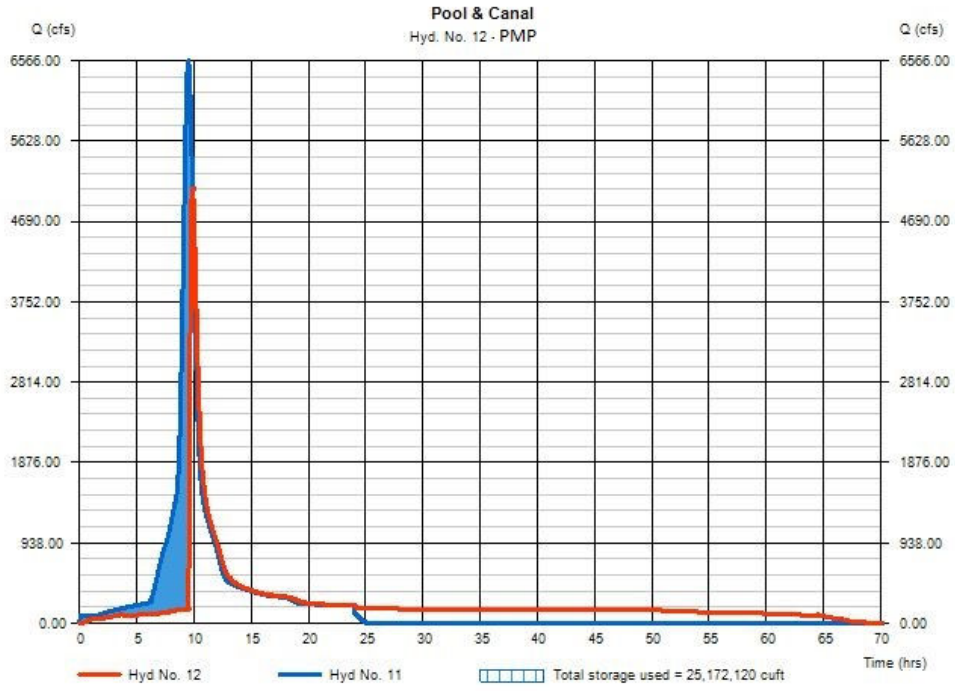
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2013 by Autodesk, Inc. v10 Thursday, 10 / 6 / 2016

Hyd. No. 12

Pool & Canal

Hydrograph type	= Reservoir	Peak discharge	= 5070.51 cfs
Storm frequency	PMP	Time to peak	= 9.83 hrs
Time interval	= 5 min	Hyd. volume	= 60,266,836 cuft
Inflow hyd. No.	= 11 - Add Off-Site Area C	Max. Elevation	= 445.00 ft
Reservoir name	= Ash Pond Pool & Canal	Max. Storage	= 25,172,120 cuft

Storage indication method used.



4.4.4 ASH POND & OUTLET CANAL DEPTH VS TIME

Hydrograph Report

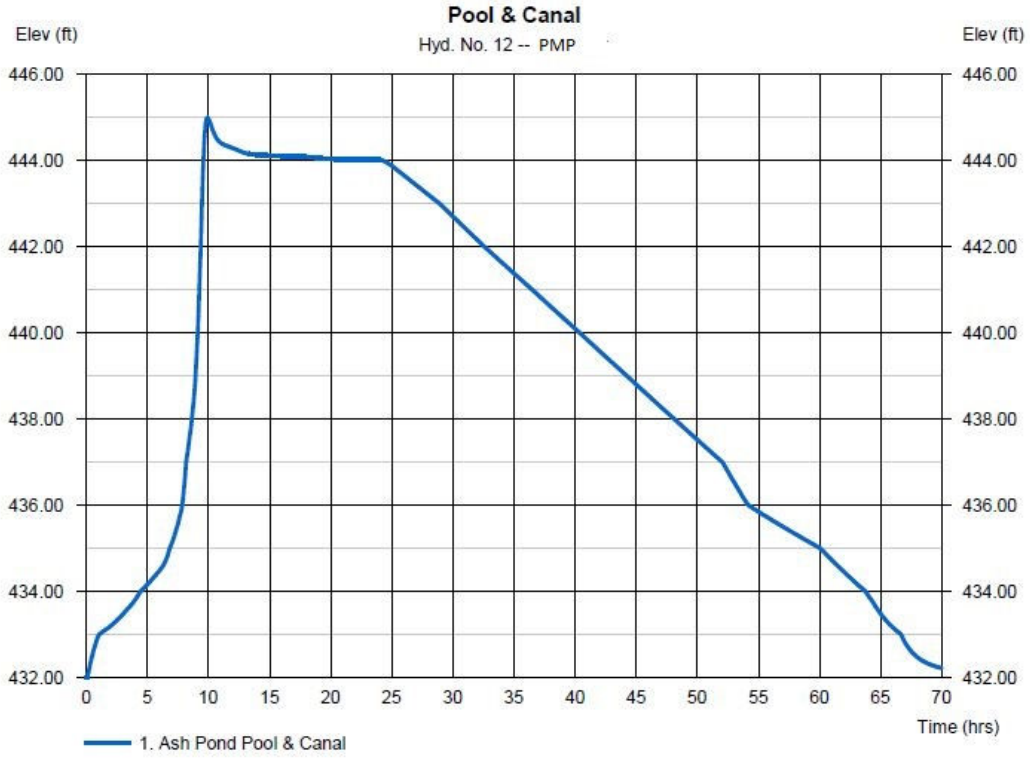
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2013 by Autodesk, Inc. v10 — Thursday, 10 / 6 / 2016

Hyd. No. 12

Pool & Canal

Hydrograph type	= Reservoir	Peak discharge	= 5070.51 cfs
Storm frequency	= PMP	Time to peak	= 9.83 hrs
Time interval	= 5 min	Hyd. volume	= 60,266,836 cuft
Inflow hyd. No.	= 11 - Add Off-Site Area C	Max. Elevation	= 445.00 ft
Reservoir name	= Ash Pond Pool & Canal	Max. Storage	= 25,172,120 cuft

Storage Indication method used.



4.5 DRAINAGE BASIN