RUN-ON AND RUN-OFF CONTROL PLAN
PLANT GORGAS GYPSUM LANDFILL
ALABAMA POWER COMPANY

Section 257.81 of EPA's regulations requires 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. Each plan is to be supported by appropriate engineering calculations.

The Gypsum Landfill is located at Alabama Power Company's Plant Gorgas within the permitted boundaries of the Plant's overall landfill facility. While permitted for a variety of CCR, this facility will primarily store dry gypsum. The Gypsum Landfill covers approximately 15 acres.

The storm water flows have been calculated using the Natural Resources Conservation Service method (also known as the Soil Conservation Service (SCS)) method using 24 hour storm events. The storm water detention system has been designed in accordance with the Alabama Soil and Water Conservation Committee requirements 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 Alabama.

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 site contains areas with hydrological soil groups "A" and "D". A composite curve number was created based on the land use and soil type of the entire drainage area. This information was placed into Hydraflow Hydrographs and used to generate appropriate precipitation curves and storm basin runoff values.

The Plant Gorgas Gypsum Landfill is designed and constructed with perimeter berms and drainage ditches around the cell that prevent stormwater run-on from surrounding areas during the peak discharge of a 24-hr, 25-yr storm from flowing onto the active portion of the landfill.

The leachate/runoff pond collects and controls the calculated amount of leachate generated from the leachate collection system of the disposal cell as well as the quantity of rainfall from a 24-hr, 100-yr storm event that falls directly into the leachate/runoff pond. The water collected in the leachate/runoff pond is pumped back to the plant for reuse.

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.

10/17

James C. Pegues, P.E.

Licensed State of Alabama, PE No. 16516

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

for

Plant Gorgas Dry Gypsum Storage Facility

Prepared by:

Southern Company Services
Technical Services

Originator: _____ 10/6/16
Curtis R. Upchurch Date

Reviewer: _____ 10/11/16
Jason S. Wilson Date

Approval: _____ 10/12/16
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 CFR 257).

2.0 Summary of Conclusions

2.1 Site Overview

The Plant Gorgas Dry Gypsum Storage Facility is located approximately 9 miles west of Birmingham, Alabama on Plant Gorgas property northeast of the plant. The total area occupied by the landfill is approximately 48.6 acres. The landfill has one storage cell with a drainage area of approximately 30.3 acres and a Sedimentation Pond with a drainage area of approximately 18.3 acres. There is a single concrete stop log riser in the low point of the cell which conveys water to a sediment basin downstream via a 36 inch diameter HDPE pipe. Water collected in the Sedimentation Pond is pumped back to the Plant for reuse and is not released. The sediment pond does have a spillway with an outfall to the Black Warrior River basin south of the site, however this structure is only to maintain dam integrity in the unlikely case of an overflow condition. The Sedimentation Pond drainage area is approximately 18.3 acres and receives only runoff from the gypsum storage cell and the sloped areas around the pond up to the surrounding ridge lines.

An overview of the Cell and Sedimentation Pond is provided in Table 1 below.

Table 1 - Landfill site characteristics

Pond Description	Cell	Sedimentation Pond
Size (Acres)	20.7	3.4
Outlet Type	Concrete stop log riser 6'x6', Ht=25', Crest L=3.0' with 36" HDPE pipe	16" suction line to pump
Outlets To	Sedimentation Pond	Pumped to Plant for reuse

2.2 Run-on Control System Plan

There is no stormwater run-on into the Cell or Sedimentation Pond other than flow from surrounding slopes at the perimeter of the cell and pond. Run-off from these areas has been included in these calculations. Note that any others areas where run-off was directed to the landfill area was diverted by the initial design which now prevents any water encroachment. For further information on this hydraulic design, see SCS Calculation No. DC-GOR-ECS18932-001, Plant Gorgas Dry Gypsum Storage Facility Plans, Stormwater Management Calculations, 12/26/12

2.3 Run-off Control System Plan

A hydrologic and hydraulic model was developed for the Plant Gorgas Dry Gypsum Storage Facility Sedimentation Pond to determine the hydraulic capacity of the Cell and Sedimentation Pond. 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 Gorgas Dry Gypsum Storage Facility Sedimentation Pond

Plant Gorgas	Normal Pool El (ft)	Top of embankment El (ft)	Peak Water Surface Elevation (ft)	Freeboard* (ft)	Peak Inflow (cfs)	Peak Outflow (cfs)
Cell	359.0	385.0	360.7	24.3	N/A	4
Sedimentation Pond	335.0	355.0	345.8	9.2	65	0

*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 Gorgas Dry Gypsum Sedimentation Pond Design Storm Distribution

Return Frequency (years)	Storm Duration (hours)	Rainfall Total (Inches)	Rainfall Source	Storm Distribution
25	24	7.15	NOAA Atlas 14	SCS Type III

The drainage area for the Plant Gorgas Dry Gypsum Sedimentation Pond was determined based on a composite of Aerial Topo from March 2003, Field Topo August 2008 and Lidar Topo December 2011. 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. Times of Concentration 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 4(a) and 4(b):

Table 4(a)—Landfill Hydrologic Information (Gypsum Cell)

Drainage Basin Area (acres)	30.32
Hydrologic Curve Number, CN	94
Hydrologic Methodology	SCS Method
Time of Concentration (minutes)	17.7
Hydrologic Software	Hydraflow Hydrographs

Table 4(b)—Landfill Hydrologic Information (Sedimentation Pond)

Drainage Basin Area (acres)	18.25
Hydrologic Curve Number, CN	74
Hydrologic Methodology	SCS Method
Time of Concentration (minutes)	22.3
Hydrologic Software	Hydraflow Hydrographs

Run-off values were determined by importing the characteristics developed above into a hydrologic model in Hydraflow Hydrographs Extension of AutoCad Civil 3D, 2013.

3.2 HYDRAULIC ANALYSES

Storage values for the Sedimentation Pond were determined by developing a stage-storage relationship utilizing contour data. The spillway system at the Plant Gorgas Dry Gypsum Sedimentation Pond consists of one primary spillway in the cell and in the sedimentation pond. The primary spillway in the cell is a 6 foot square stop log riser with a 3 foot crest section. In the Sedimentation Pond, the primary spillway is a trapezoidal weir located on the west dike. It is a reinforced concrete spillway with a 2-foot wide crest with a depth of 1-foot deep with 6:1 slopes on either end providing access along the perimeter dike. The spillway conveys flow to an existing downstream drainage channel. A summary of spillway information is presented below in Tables 5(a) and (b).

Table 5(a) – Cell Spillway Attribute Table

Spillway Component	US Invert El (feet)	DS Invert El (feet)	Dimension (ft)	Slope (ft/ft)	Length (ft)	Spillway Capacity (cfs)
Primary Spillway Stop log riser 8 foot square	356.0	354.0	Weir L = 3.0 ft., Weir EL 359.0 Outlet pipe = 36" diameter, HDPE	0.078	258	N/A*

Table 5(b) – Sedimentation Pond Spillway Attribute Table

Spillway Component	US Invert El (feet)	DS Invert El (feet)	Dimension (ft)	Slope (ft/ft)	Length (ft)	Spillway Capacity (cfs)
Primary Spillway	354.0	353.8	Trapezoidal (Concrete), Crest L=20', 6:1 S.S.	0.010	26.0	N/A*

*N/A = Not available

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 2.
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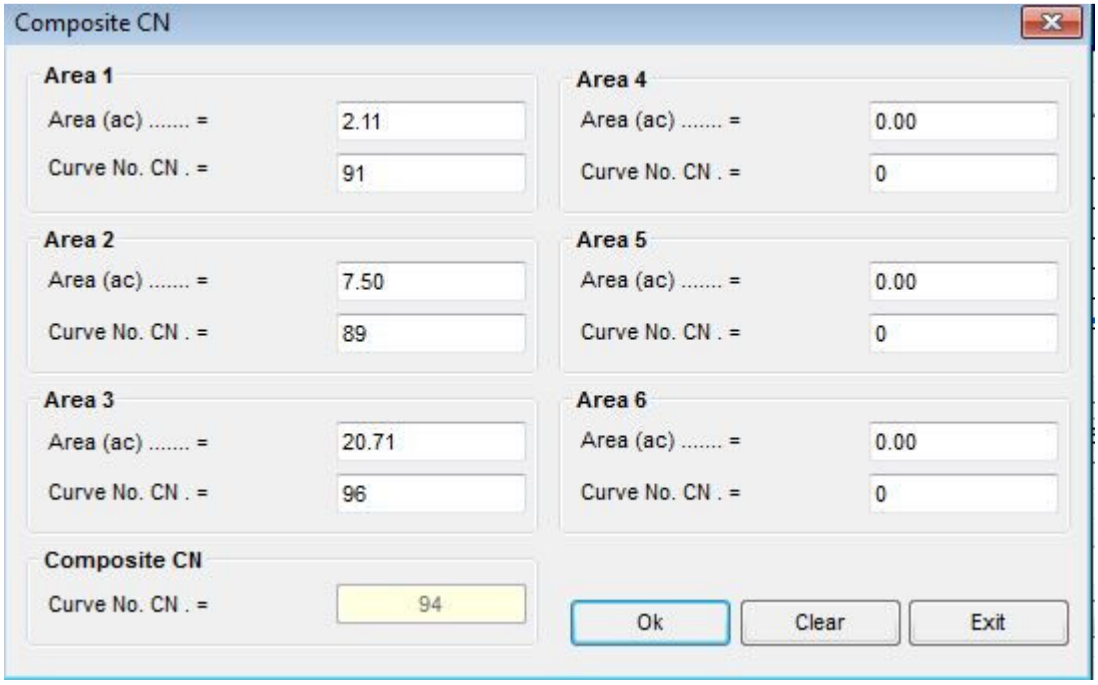
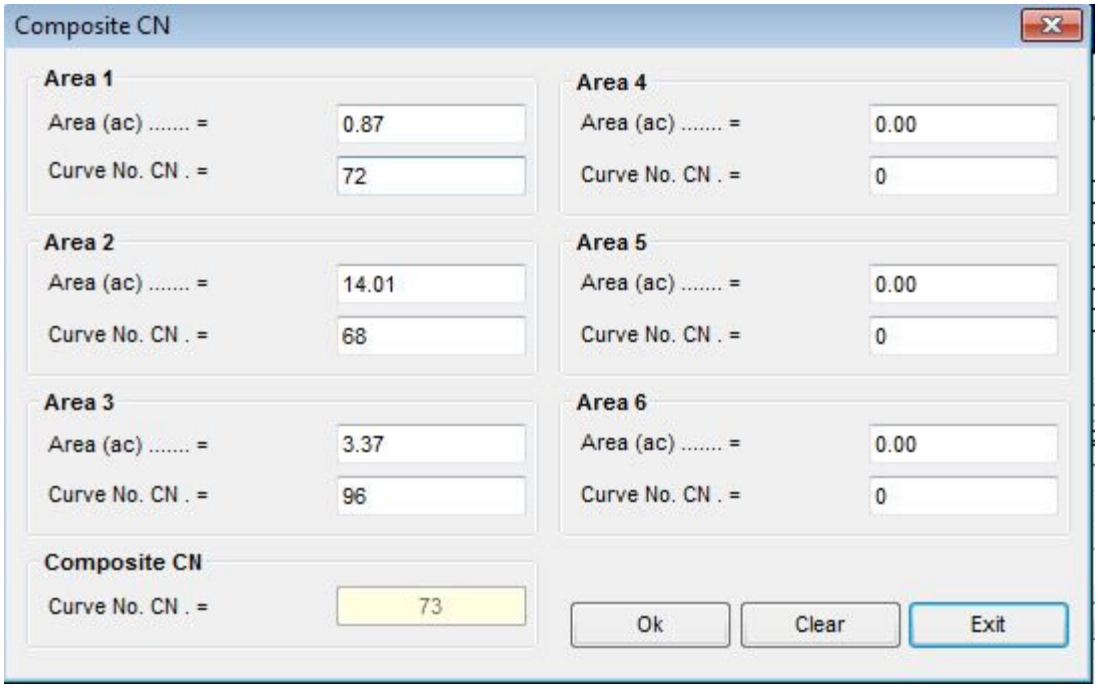
4.0 SUPPORTING INFORMATION

4.1 CURVE NUMBER

4.1.1 GYPSUM CELL



4.1.2 SEDIMENTATION POND AREA



4.2 STAGE-STORAGE TABLE

4.2.1 SEDIMENTATION POND

Pond Name: Sediment Pond

Row	Stage	Elevation	Contour Area	Incremental Storage	Total Storage	Total Discharge
	(ft)	(ft)	(sqft)	(cuft)	(cuft)	(cfs)
0	0.00	335.00	69,661	0.000	0.000	0.000
1	5.00	340.00	86,860	391,303	391,303	0.000
2	10.00	345.00	105,472	480,830	872,133	0.000
3	15.00	350.00	125,499	577,428	1,449,560	0.000
4	19.00	354.00	142,538	536,074	1,985,634	0.000
5	20.00	355.00	146,939	144,739	2,130,373	52.00
6						
7						
8						
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10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						

4.3 TIME OF CONCENTRATION

4.3.1 GYPSUM CELL AREA

TR55 Tc Worksheet

Hyd. No. 1

Gyp. Stack Area

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)	= 4.00		0.00		0.00		
Land slope (%)	= 1.80		0.00		0.00		
Travel Time (min)	**= 22.01**	**+**	**0.00**	**+**	**0.00**	**=**	**22.01**
Shallow Concentrated Flow							
Flow length (ft)	= 130.00		0.00		0.00		
Watercourse slope (%)	= 20.00		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	= 7.22		0.00		0.00		
Travel Time (min)	**= 0.30**	**+**	**0.00**	**+**	**0.00**	**=**	**0.30**
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	= 0.015		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							**22.30 min**

4.3.2 SEDIMENTATION POND AREA

TR55 Tc Worksheet

Hyd. No. 4

Sediment Pond Area

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 190.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 4.00		0.00		0.00		
Land slope (%)	= 1.80		0.00		0.00		
Travel Time (min)	**= 15.28**	**+**	**0.00**	**+**	**0.00**	**=**	**15.28**
Shallow Concentrated Flow							
Flow length (ft)	= 500.00		210.00		0.00		
Watercourse slope (%)	= 6.25		33.33		0.00		
Surface description	= Unpaved		Unpaved		Paved		
Average velocity (ft/s)	= 4.03		9.32		0.00		
Travel Time (min)	**= 2.07**	**+**	**0.38**	**+**	**0.00**	**=**	**2.44**
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	= 0.015		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							**17.70 min**

4.4 RESULTS

4.4.1 GYPSUM CELL AREA

Hydrograph Report

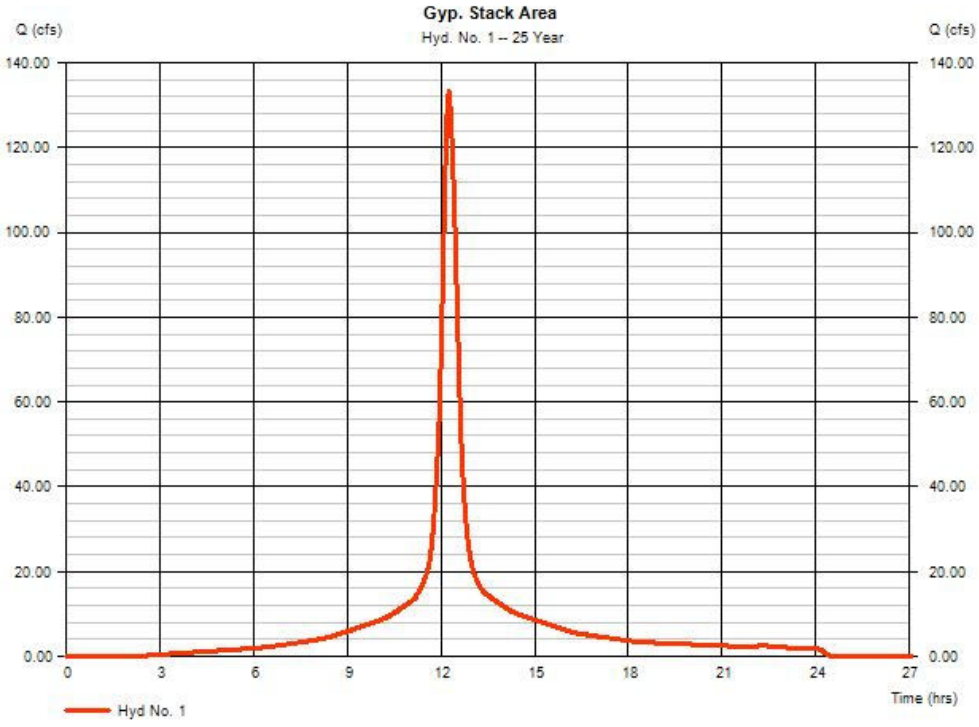
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2013 by Autodesk, Inc. v10 — Saturday, 10 / 1 / 2016

Hyd. No. 1

Gyp. Stack Area

Hydrograph type	= SCS Runoff	Peak discharge	= 133.20 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.25 hrs
Time interval	= 3 min	Hyd. volume	= 690,779 cuft
Drainage area	= 30.320 ac	Curve number	= 94*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 22.30 min
Total precip.	= 7.15 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(2.110 x 91) + (7.500 x 89) + (20.710 x 96)] / 30.320



4.4.2 GYPSUM CELL ROUTING

Hydrograph Report

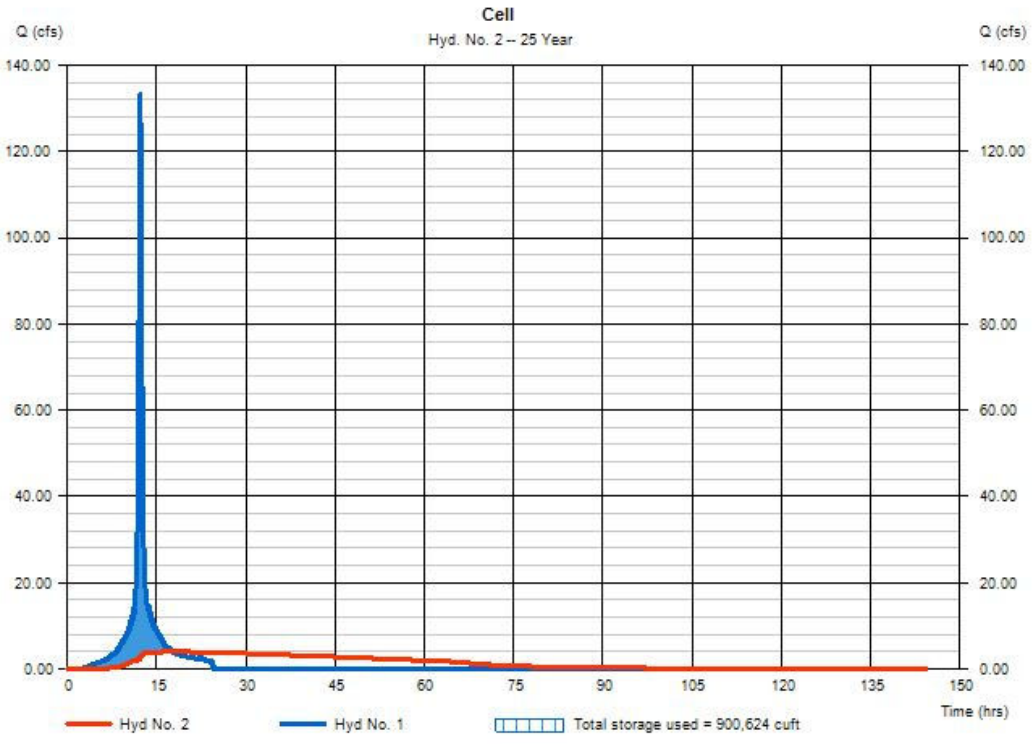
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2013 by Autodesk, Inc. v10 Saturday, 10 / 1 / 2016

Hyd. No. 2

Cell

Hydrograph type	= Reservoir	Peak discharge	= 3.984 cfs
Storm frequency	= 25 yrs	Time to peak	= 17.70 hrs
Time interval	= 3 min	Hyd. volume	= 687,808 cuft
Inflow hyd. No.	= 1 - Gyp. Stack Area	Max. Elevation	= 360.74 ft
Reservoir name	= Gypsum Cell	Max. Storage	= 900,624 cuft

Storage indication method used. Wet pond routing start elevation = 359.00 ft.



4.4.3 SEDIMENTATION POND AREA

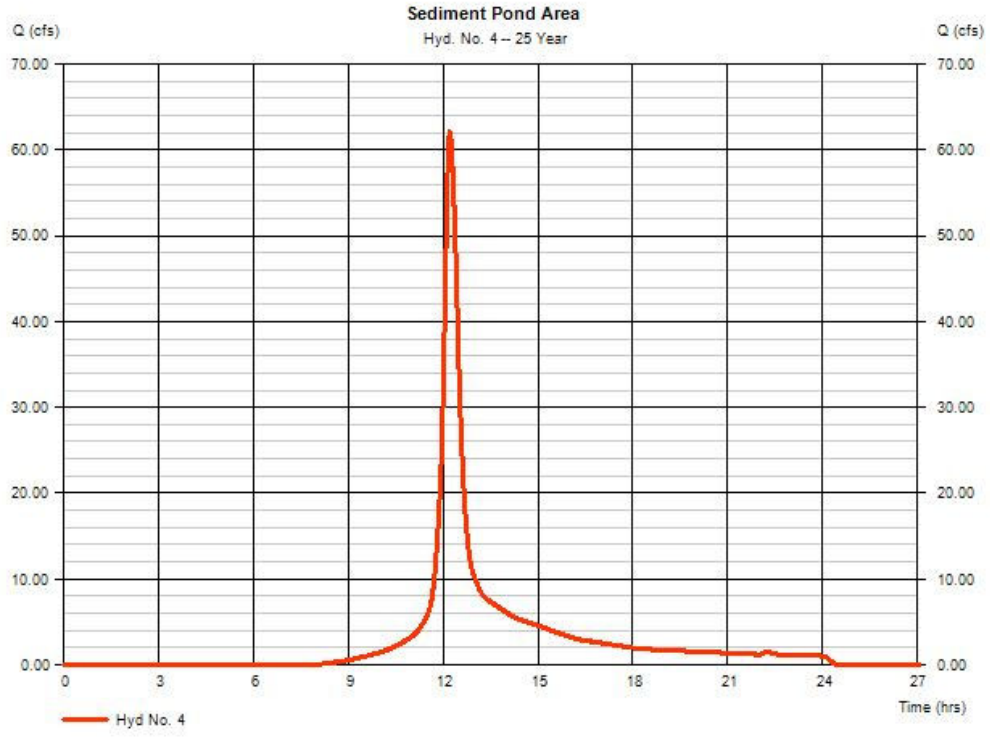
Hydrograph Report

Hyd. No. 4

Sediment Pond Area

Hydrograph type	= SCS Runoff	Peak discharge	= 62.16 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.20 hrs
Time interval	= 3 min	Hyd. volume	= 277,704 cuft
Drainage area	= 18.250 ac	Curve number	= 73*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 17.70 min
Total precip.	= 7.15 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.870 x 72) + (14.010 x 68) + (3.370 x 96)] / 18.250



4.4.4 SEDIMENTATION POND ROUTING (NO DISCHARGE)

Hydrograph Report

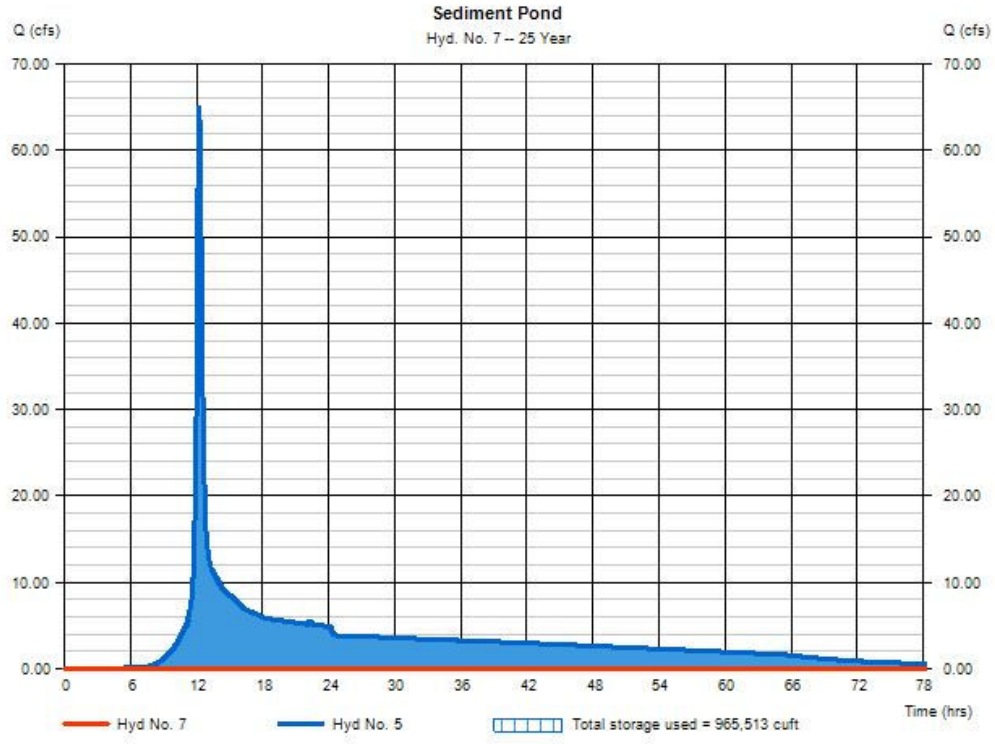
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2013 by Autodesk, Inc. v10 Saturday, 10 / 1 / 2016

Hyd. No. 7

Sediment Pond

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.	= 5 - Flow into Sediment Pond	Max. Elevation	= 345.81 ft
Reservoir name	= Sediment Pond	Max. Storage	= 965,513 cuft

Storage indication method used.



4.5 DRAINAGE BASIN