

INFLOW DESIGN FLOOD CONTROL SYSTEM PLAN
PLANT GASTON GYPSUM 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 Gypsum Pond is located at Alabama Power Company's Plant Gaston. The facility consists of a CCR storage area (Cell 1) and a sedimentation pond. The inflow design flood consists of the rainfall that falls within the limits of the surface impoundment, runoff from approximately 14 acres of adjoining watershed, and a nominal amount (relative to the rainfall) of process flows. Stormwater is temporarily stored within the limits of the surface impoundment and discharged through a stop log riser system connected to a 36-inch discharge pipe that routes discharges to the sedimentation pond.

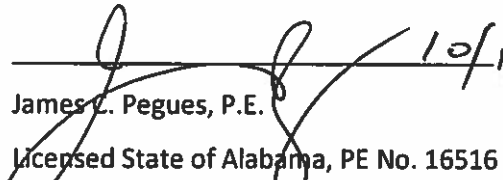
The inflow design flood has been calculated using the Natural Resources Conservation Service method (also known as the Soil Conservation Service (SCS) method) using the 1000-yr storm event required for a Significant hazard potential facility. Runoff curve number data was determined using Table 2-2A from 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 "D" 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 can safely store and pass the inflow design storm.

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.


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 Gypsum Storage Cell

Prepared by:

Southern Company Services
Technical Services

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

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

Approval: James C. Pegues 10/12/16
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 Gypsum Storage Cell to determine the hydraulic capacity of the impoundment. The design storm for the Plant Gaston Gypsum Storage Cell 1 is a 1000-year rainfall event. Southern Company has selected a storm length of 24-hours for all inflow design flood control plans. The results of routing a 1000 year, 24-hour rainfall event through the impoundment are presented in Table 1 below:

Table 1-Flood Routing Results for Plant Gaston Gypsum Storage Cell

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)
Gypsum Cell	414 to 416**	Varies – low point @ 419.7	N/A	417.2	2.5	438	12

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

**Assumed the higher normal pool elevation of 416.0 in calculations for conservative approach.

3.0 Methodology

3.1 HYDROLOGIC ANALYSES

Plant Gaston Gypsum Storage Cell is classified as a significant hazard structure. The design storm for a significant hazard structure is the 1000-year rainfall event. A summary of the design storm parameters and rainfall distribution methodology for these calculations is summarized below in Table 2.

Table 2. Plant Gaston Gypsum Storage Cell Storm Distribution

Hazard Classification	Return Frequency (years)	Storm Duration (hours)	Rainfall Total (Inches)	Rainfall Source	Storm Distribution
Significant	1000	24	14.0	NOAA Atlas 14	SCS Type III

The drainage area for Plant Gaston Gypsum Storage Cell was delineated based on LiDAR data acquired for the Plant in 2013. 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. 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 Gypsum Cell and Sedimentation Pond is provided below in Tables 3(a) and 3(b).

Table 3(a) Plant Gaston Gypsum Storage Cell Hydrologic Information

Drainage Basin Area (acres)	43.2
Hydrologic Curve Number, CN	87
Hydrologic Methodology	SCS Method
Time of Concentration (minutes)	13.9
Hydrologic Software	Storm and Sanitary Sewer Analysis, 2013 Autodesk, Inc.

Table 3(b) Plant Gaston Gypsum Storage Cell Sediment Pond Hydrologic Information

Drainage Basin Area (acres)	11.2
Hydrologic Curve Number, CN	98
Hydrologic Methodology	SCS Method
Time of Concentration (minutes)	5.0
Hydrologic Software	Storm and Sanitary Sewer Analysis, 2013 Autodesk, Inc.

Runoff values were determined by importing the characteristics developed above into a hydrologic model in Storm and Sanitary Sewer Analysis (StormNet) by AutoCad Civil 3D, 2013.

Process flows from Plant Gaston were considered in this analysis. Based on normal plant operations, the gypsum cell receives an additional 3.3 MGD (5.2 cfs) of inflow from the Plant. The gypsum cell receives 1.30 MGD (2.0 cfs) and the Sediment Pond receives 2.0 MGD (3.2 cfs).

3.2 HYDRAULIC ANALYSES

Storage values for the Gypsum Cell were determined by developing a stage-storage relationship utilizing contour data for the Gypsum Cell and Sediment Pond. An arrangement of the Gypsum Cell and the Sediment Pond is shown in the attached drainage map in Section 4.5. Gypsum slurry is sluiced into the gypsum cell at the northwest corner into dewatering basins allowing for the settlement of gypsum. Flow from the dewatering basins along with runoff from the cell area during a storm event, flows to the stop log riser located

at the east side near the midpoint of the cell. After passing over the stop log weir in the riser it flows thru a 36 inch diameter hdpe pipe to the east into a lined canal which runs to south leading to the sediment basin. Process (sump) flows are added to the Sediment Pond at its northeast corner. The Sediment Pond does have an emergency discharge spillway at the west dike for an extreme storm event, but water levels are managed in the pond to prevent release as the site is a zero discharge system. The outfall from the emergency spillway is to a channel which runs south and discharges in to the Coosa River.

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

Table 4(a)— Plant Gaston Gypsum Cell Spillway Attribute Table

Spillway Component	US Invert El (feet)	DS Invert El (feet)	Dimension	Slope (ft/ft)	Length (ft)	Spillway Capacity (cfs)
Primary Spillway Stop log riser 6 foot square	413.0	409.8	Weir L = 3.0 ft., Weir EL 432.0 Outlet pipe = 36" diameter, HDPE	0.0050	207	N/A*

*N/A = Not available

Table 4(b)— Plant Gaston Gypsum Cell Sediment Pond Spillway Attribute Table

Spillway Component	US Invert El (feet)	DS Invert El (feet)	Dimension	Slope (ft/ft)	Length (ft)	Spillway Capacity (cfs)
Primary Spillway	414.5	414.11	Weir L = 3.0 ft., Weir EL 432.0 Outlet pipe = 36" diameter, HDPE	0.0200	19.4	N/A*

*N/A = Not available

Based on the spillway attributes listed above, rating curves were developed using Storm and Sanitary Sewer Analysis to determine the pond performance during the design storm. Results are shown in Table 2.

4.0 SUPPORTING INFORMATION

4.1 CURVE NUMBERS

4.1.1 GYPSUM CELL 1

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Subbasin Cell 1
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Soil/Surface Description	Area (acres)	Soil Group	CN
Gypsum & Agg. Roads	38.90	-	86.00
Water in Cell	4.30	-	98.00
Composite Area & Weighted CN	43.20		87.19

4.1.2 SEDIMENTATION POND

----- Subbasin Cell 1 -----			
Soil/Surface Description	Area (acres)	Soil Group	CN
Gypsum & Agg. Roads	38.90	-	86.00
Water in Cell	4.30	-	98.00
Composite Area & Weighted CN	43.20		87.19

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

4.3.1 GYPSUM CELL 1

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Subbasin Cell 1
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Shallow Concentrated Flow Computations
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	Subarea A	Subarea B	Subarea C
Flow Length (ft):	790.00	0.00	0.00
Slope (%):	0.50	0.00	0.00
Surface Type:	Paved	Unpaved	Unpaved
Velocity (ft/sec):	1.44	0.00	0.00
Computed Flow Time (minutes):	9.14	0.00	0.00

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Channel Flow Computations
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	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.02	0.00	0.00
Flow Length (ft):	1500.00	0.00	0.00
Channel Slope (%):	0.58	0.00	0.00
Cross Section Area (ft ²):	22.00	0.00	0.00
Wetted Perimeter (ft):	24.47	0.00	0.00
Velocity (ft/sec):	5.29	0.00	0.00
Computed Flow Time (minutes):	4.73	0.00	0.00

Total TOC (minutes):	13.87		
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4.3.2 SEDIMENTATION POND

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Subbasin Sediment Pond Basin
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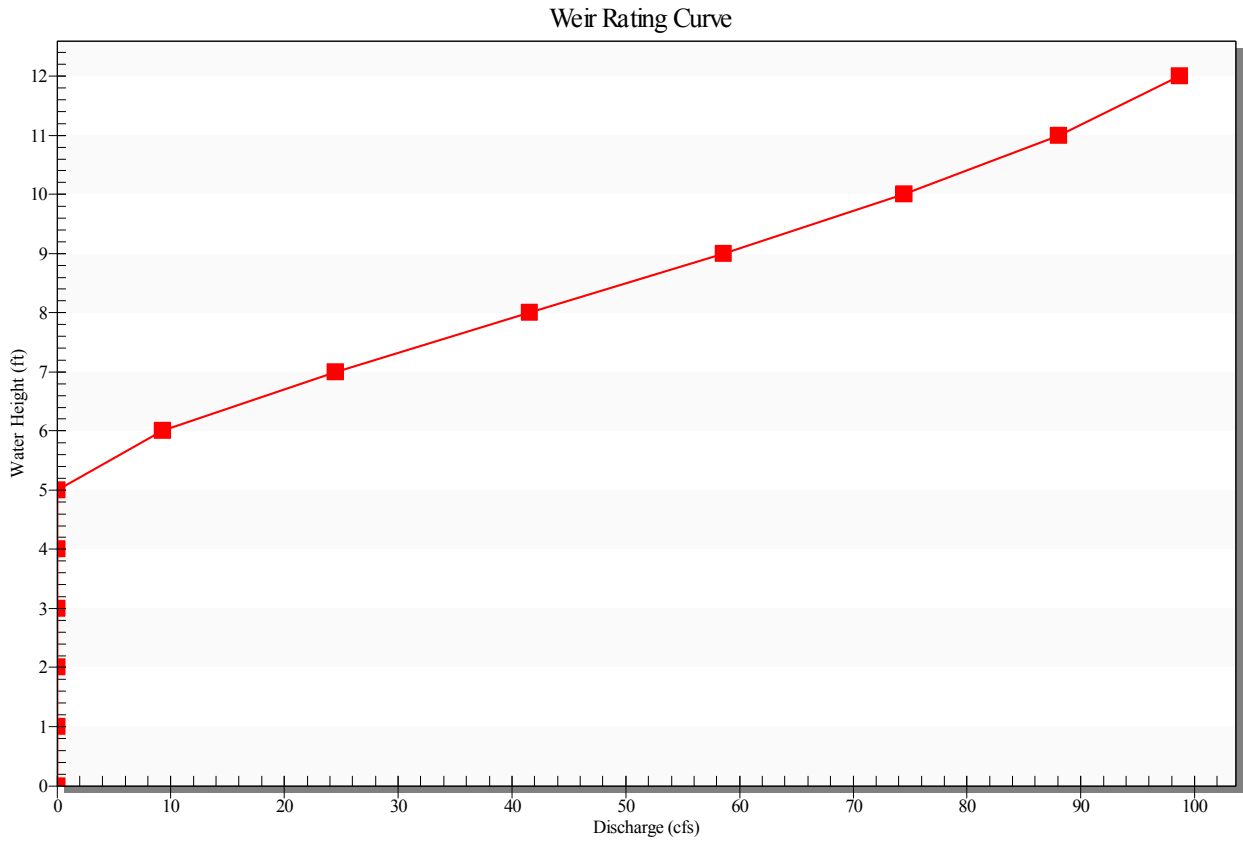
User-Defined TOC override (minutes):      5.00

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Subbasin Runoff Summary
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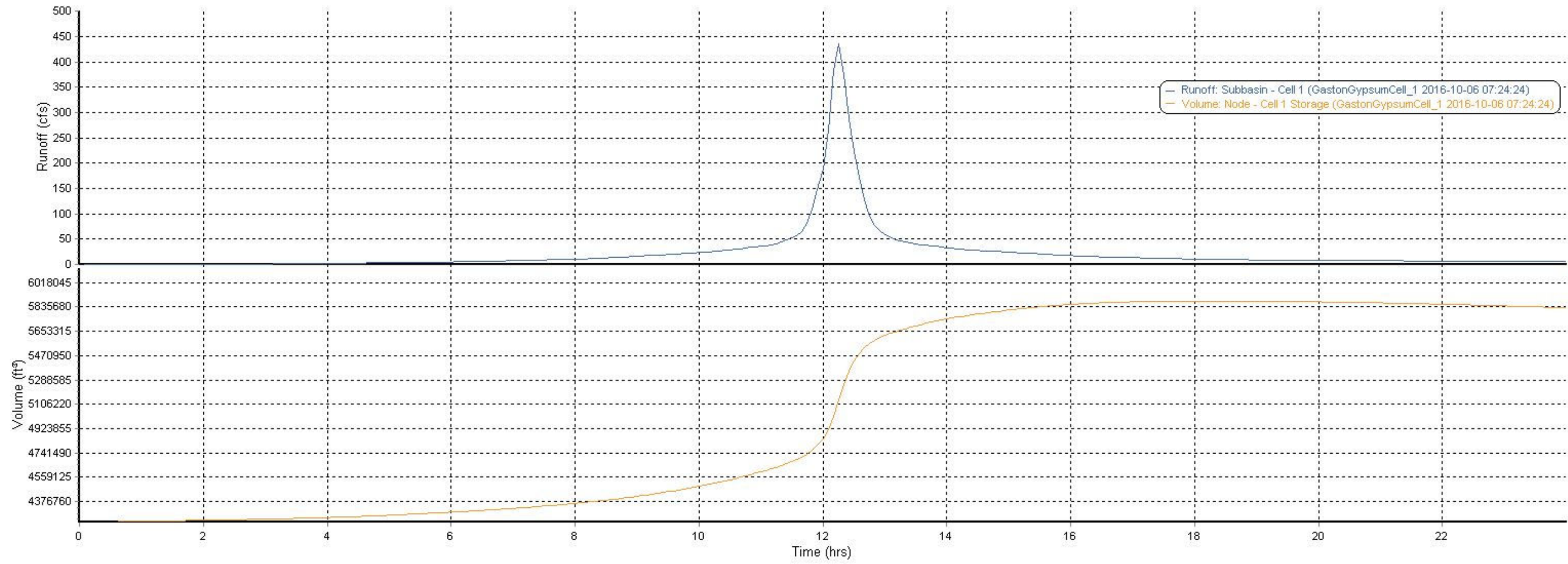
Subbasin ID	Total Precip in	Total Runoff in	Peak Runoff cfs	Weighted Curve Number	Time of Concentration days hh:mm:ss
Cell 1	14.00	12.38	437.13	87.190	0 00:13:52
Sediment Pond Basin	14.00	13.76	132.49	98.000	0 00:05:00

4.4 RATING CURVES
4.4.1 GYPSUM CELL STOP LOG RISER

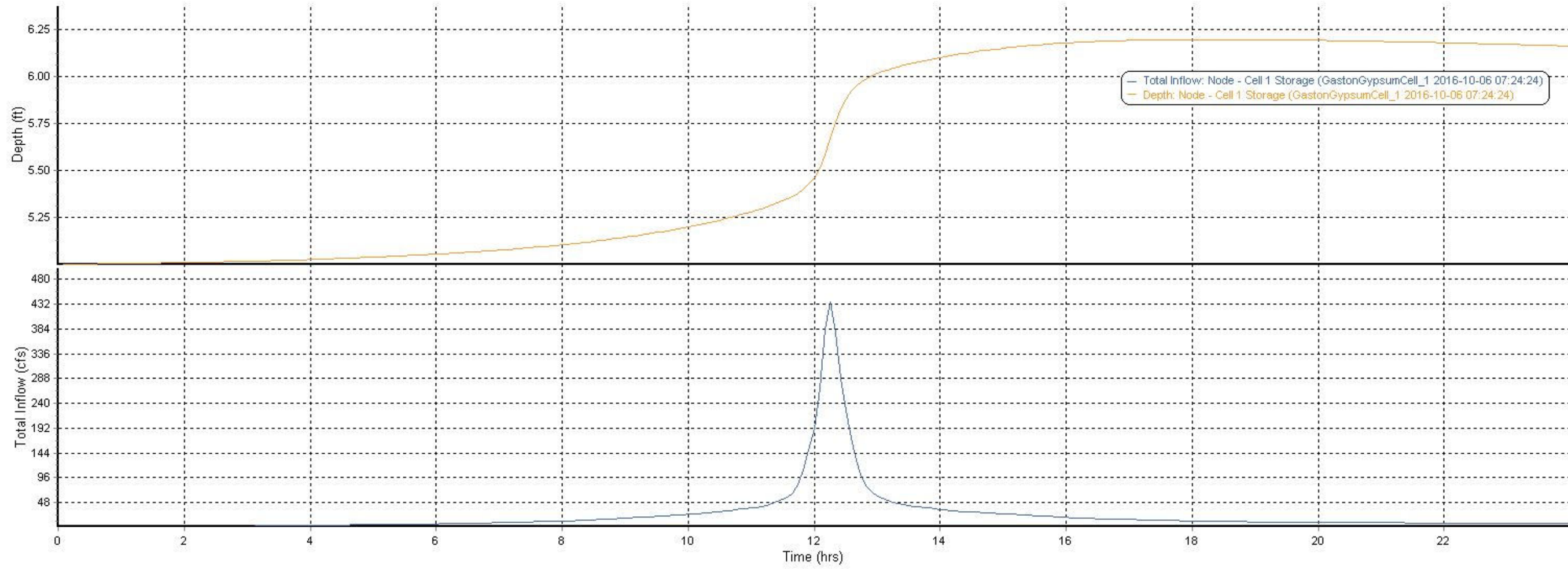


4.4.2 GYPSUM CELL RATING CURVES

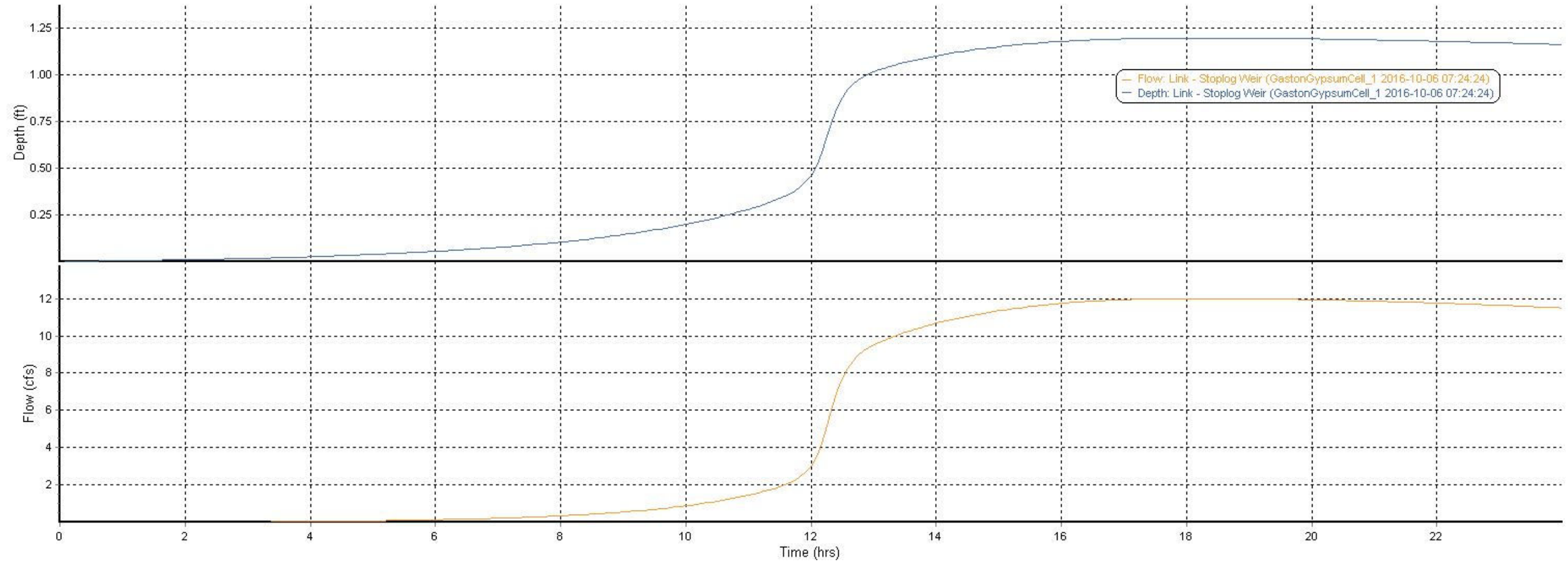
4.4.2.1 CELL 1 - RUNOFF AND VOLUME VS TIME



4.4.2.2 CELL 1 - INFLOW VS TIME
CELL 1 - DEPTH VS TIME



4.4.2.3 CELL 1 STOP LOG RISER - FLOW VS TIME
CELL 1 STOP LOG RISER - DEPTH VS TIME



4.5 DRAINAGE MAP

