PowerSouth Energy Cooperative

Charles R. Lowman Power Plant
Leroy, AL

Inflow Design Control Plan
Scrubber Waste Pond

Issued October 2016

CDG Engineers and Associates, Inc.
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| cdge.com

POWERSOUTH
ENERGY COOPERATIVE

REPORT
Inflow Design Control Plan
Scrubber Waste Pond
Charles R. Lowman Power Plant

October 2016

CDG
Engineering. Environmental. Answers.

10/15/16

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APPENDIXES

1.0 SCOPE OF SERVICES

PowerSouth Energy Cooperative (PowerSouth) requested CDG Engineers and Associates, Inc. (CDG) to perform analysis of Inflow Design Flood Controls in accordance with 257.82 of EPA's Disposal of Coal Combustion Residuals from Electric Utilities (CCR rule). In association with this scope of services, CDG performed Hydrologic and Hydraulic Capacity modeling of the plants CCR impoundments and downstream hydraulic structures.

This report is the summary of the modeling efforts intended to meet the requirements of the "Inflow Design Flood Control System Plan" for the Scrubber Waste Pond. The Charles R. Lowman Power Plant in Leroy, AL has three CCR impoundments that were investigated: Unit 1 Bottom Ash Pond, Unit 2/3 Bottom Ash Pond, and the Scrubber Waste Pond. As per the Rule CCR surface impoundments must:

1. "Adequately manage flow into the CCR surface impoundment during and following the peak discharge of the inflow design flood" (257.82(a)(1))

2. "Adequately manage flow from the CCR unit to collect and control the peak discharge resulting from the inflow design flood" (257.82(a)(2))

3. "Discharge from the CCR unit must be handled in accordance with the surface water requirements under 257.3-3." (257.82(b))

2.0 PROJECT DESCRIPTION

The Charles R. Lowman Power Plant in Leroy, AL has three CCR impoundments that were analyzed: Unit 1 Bottom Ash Pond, Unit 2/3 Bottom Ash Pond, and Scrubber Waste Pond. Although not subject to the CCR rule, the Process Waste Pond is included in this analysis as a downstream hydraulic structure due to its involvement in the Plant's water balance. The plant has several valving mechanisms that can direct process flows into and out of the individual impoundments. For the purpose of this analysis, flow from each impoundment goes to a single other impoundment. Scenarios were created to represent normal and abnormal operating conditions. The flow order to each pond is shown in Figure 2.1 below.

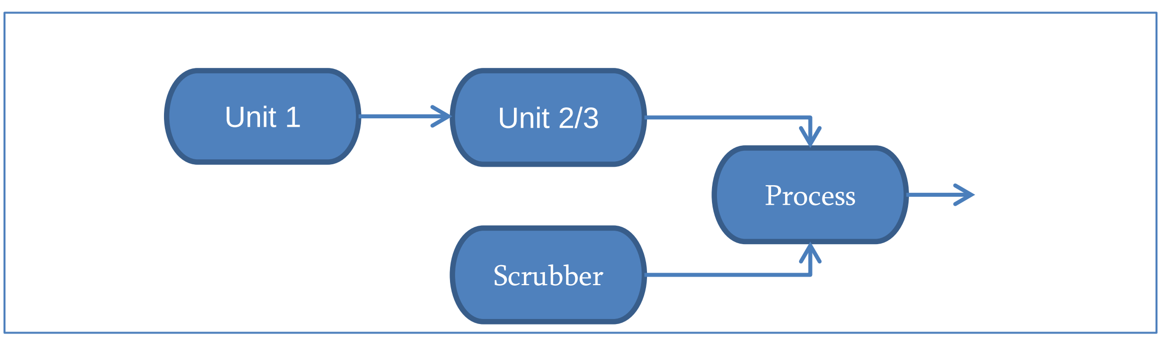


Figure 2.1-Impoundments Flow Order

3.0 MODEL VARIABLES AND ASSUMPTIONS

3.1 Identification of Design Storm Inflow

As per the "Hazard Potential Classification Assessment" each of the impoundments has a hazard classification of "Significant," requiring that the impoundments be analyzed for the 1000-yr flood.

Based on a review of topographic information provided by PowerSouth, it is evident that each impoundment has a contributing drainage shed that is primarily the impoundment itself. Therefore, the rainfall inflow for each impoundment is the volume of rainfall that accumulates in each drainage shed during the inflow design flood event. These rainfall inflows are tied to a specific impoundment and storm duration and therefore do not change between model scenarios. The 72hr-1000yr flood event was modeled for the rainfall event. Per the NOAA Atlas 14 the total rainfall for this event is 21.2 inches. An SCS Type III distribution was used to model this total rainfall depth over a 72 hour period. Figure 3.1 shows the cumulative rainfall depth curve. A copy of the NOAA Atlas 14 data can be seen in Appendix C.

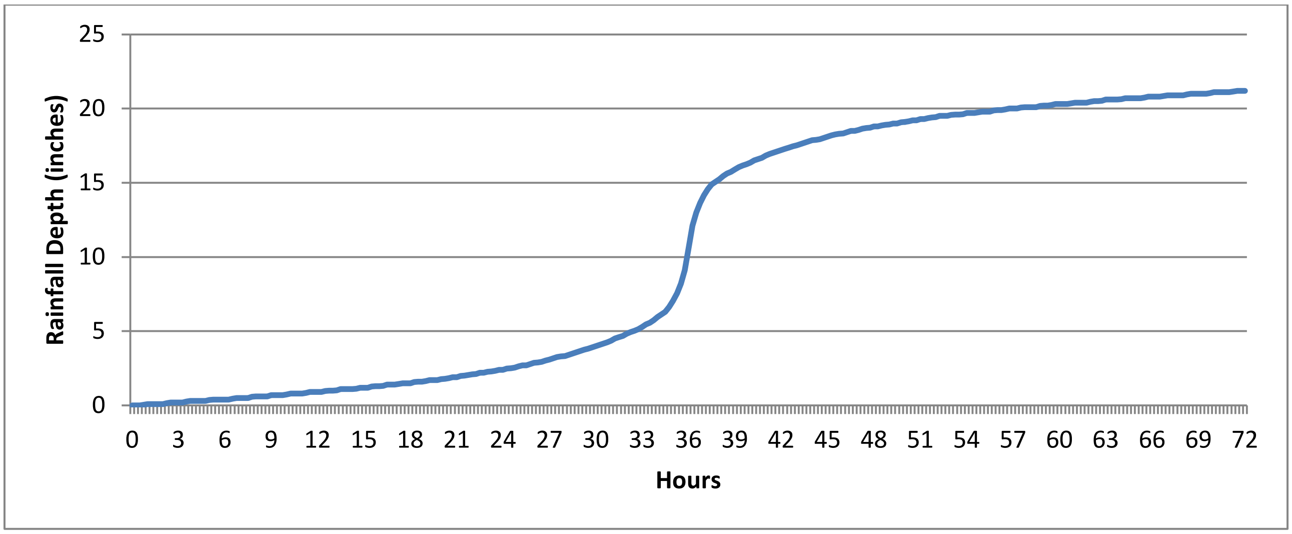


Figure 3.1- 72hr-1000yr Cumulative Rainfall Depth Curve

3.1.1 Additional Inflows

Scrubber Waste Pond inflows consists of several plant operation flows. During operations the flow is a continuous 1,078 gpm into the Scrubber Waste Pond.

3.2 Characterization of Rainfall Abstractions

In developing the geometric modeling parameters for this project, CDG relied topographic information in conjunction with construction plans prepared by Burns & McDonnell circa 1979, for work at the plant. Table 3.1 shows the stage-storage information used for modeling.

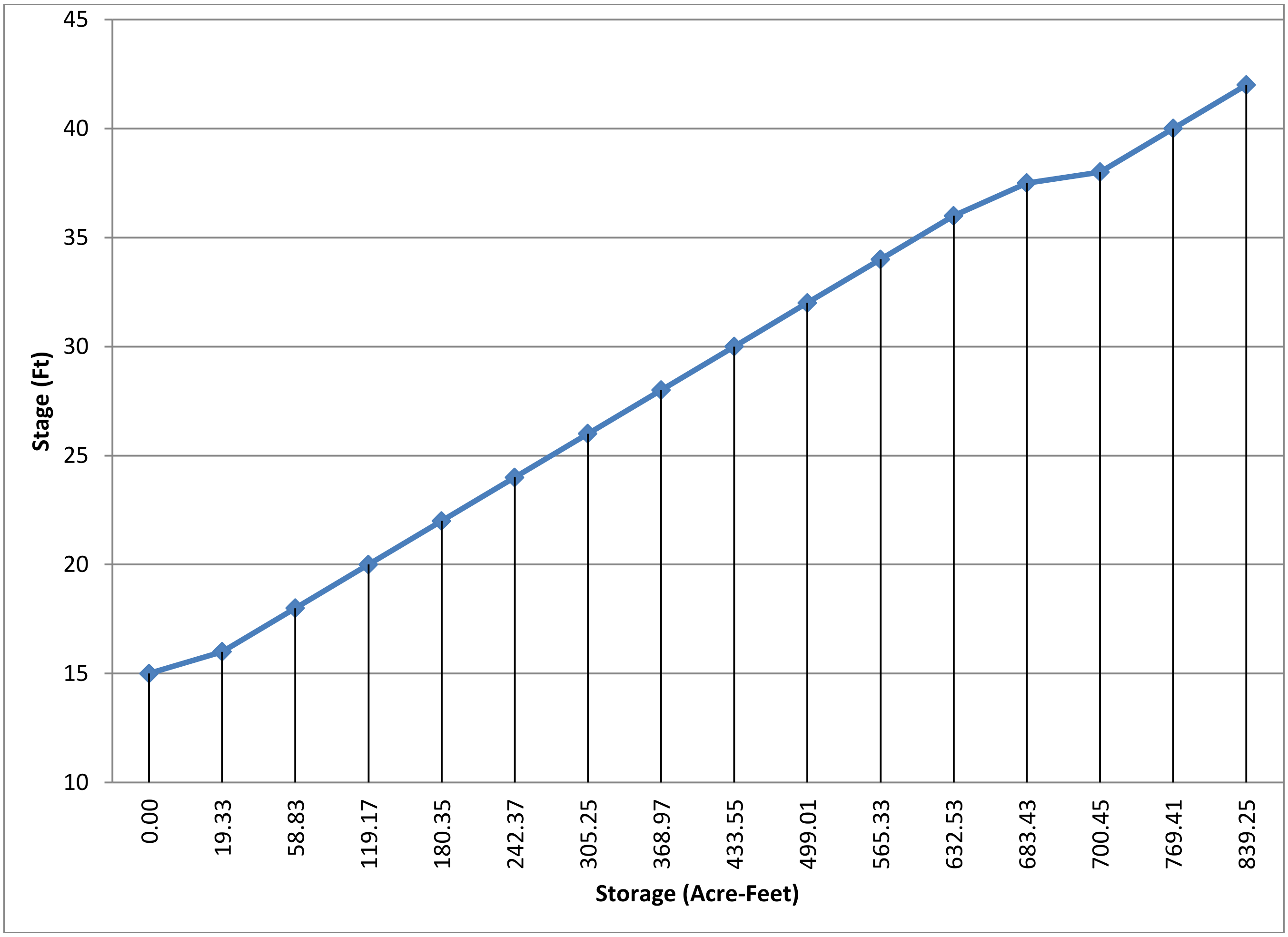


Figure 3.2- Scrubber Waste Pond Stage-Storage Curve

The normal pool elevation for the Scrubber Waste Pond is 37.50. For the purposes of this model no infiltration was considered for the ponds.

3.3 Selection of Run-off Model

The US Army Corps of Engineers Hydrologic Modeling System 4.2 (HEC-HMS) was chosen for use in this modeling effort. HEC-HMS is a widely known, used, and trusted modeling software for complete processing of dendritic watershed systems. This software is also compatible with other associated studies at the site and is used for large scale hydrologic and hydraulic modeling of the Tombigbee River.

3.4 Identification and Characterization of Intake or Decant Structures

3.4.1 Scrubber Waste Pond Intake/Decant Structures

As stated earlier, each pond is drained and flow is conveyed via pumping systems. The pumping rates, “pump on” elevations, and “pump off” elevations were provided by PowerSouth. For this analysis, a “pump on” elevation of normal pool was used.

The Scrubber Waste Intake consists of two suction lift pumps with a normal operating flow of 1395 gpm (3.11 cfs). The pumps are fed by two floating intake hoses that allow for the removal of liquids from the laminar portion of the impounded waters. Ponds are drained by pumping systems and do not have identified gravity spillways.

3.4.2 Supplemental Intake Structures

During high rainfall events, mobile suction lift pumps are utilized at the site to supplement permanent intake structures. These pumps are used in instances of existing pump or pond maintenance.

3.4.3 Downstream Hydraulic Structures

The Scrubber Waste Pond is drained solely by pumping. As shown in Figure 2.1 all liquids extracted from the Scrubber Waste Pond is discharged to the Process Waste Pond. The Owner has informed us that all liquids which are pumped to downstream hydraulic structures are handled in accordance with the surface water requirements under 257.3-3.

4.0 SCENARIOS AND RESULTS

4.1 Scenario 1-Normal Operations

4.1.1 Scenario 1 Flow Diagram

Scenario 1 assumes that all the pond pumps are fully operational and that each pond has its contributing rainfall inflow. It also assumes that the plant inflows go to the Scrubber Waste Pond. The figure below illustrates the flows for this scenario.

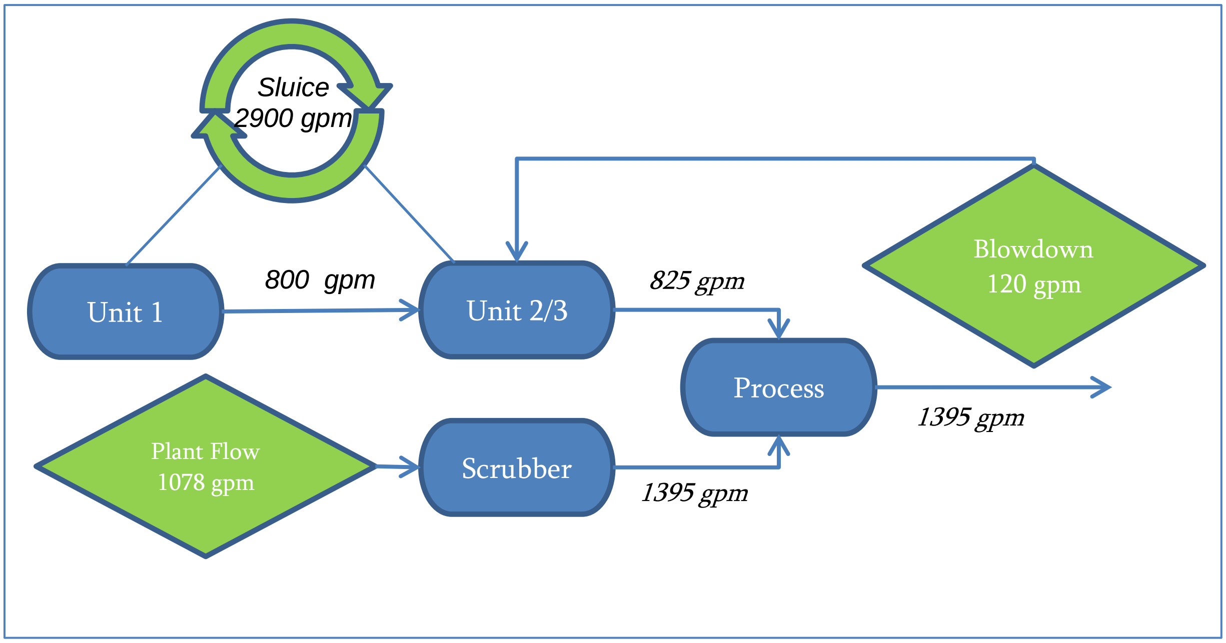


Figure 4.1-Scenario 1 Flow Diagram

4.1.2 Scenario 1 Results

This scenario was modeled using HEC-HMS 4.2 with the above listed variables. The table below shows the results from the hydraulic model.

Table 4.1-Scenario 1-Scrubber Waste Pond Maximum Hydraulic Grades

Impoundment Name	Pound Overtopping Elevation.	Max HGL	Time to Max HGL	Total Drawdown Time	Pass/Fail
	(feet)	(feet)	(hours)	(days)	
Scrubber Waste	42.0	39.2	80	10.0	Pass

The total drawdown time shown in Table 4.1 is defined as the time from the beginning of the model to the time where the impoundment returns to the normal pool elevation.

4.2 Scenario 2-Abnormal Operations

4.2.1 Scenario 2 Flow Diagram

Scenario 2 is intended to represent abnormal operations at the facility such as a loss of power, pumping failure, or other similar conditions. For this scenario a pumping failure is assumed. Since all the ponds rely on pumping systems for outflow a failure would mean that the impoundments could not discharge inflows. It also means that the plant would not be producing an inflow because its operations would be ceased. Therefore, the only impoundment inflows are from the 72hr inflow design flood event itself. The figure below illustrates the flows for this scenario.

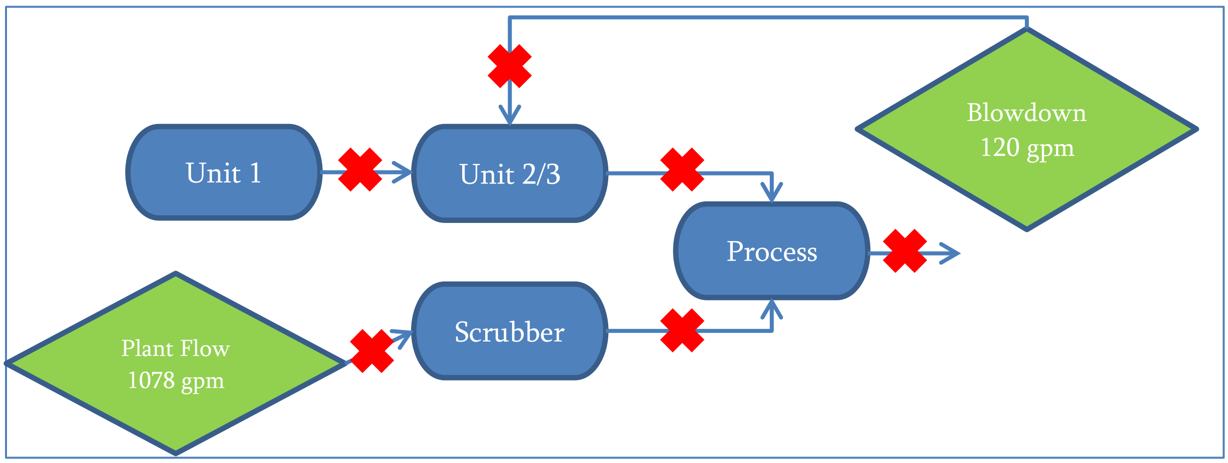


Figure 4.4-Scenario 2 Flow Diagram

4.2.2 Scenario 2 Results

This scenario was modeled using HEC-HMS 4.2 with the above listed variables. The model determined that the Scrubber Waste Pond does not overtop during this scenario. The maximum hydraulic grade can be found in the following table.

Table 4.2-Scenario 2 Maximum Hydraulic Grades

Impoundment Name	Max HGL	Pond Overtopping Elevation.	Pass/Fail
Scrubber Waste	39.3	42.0	Pass

5.0 SUMMARY AND CONCLUSIONS

The conclusions presented in this report are based upon currently accepted engineering principles, practices, and standards in the area where the services were provided. No other warranty, expressed or implied, is made. The findings in this report were developed from engineering calculations performed to meet the standards of the CCR Rule. Plant operation information was provided by the owner.

In conclusion, as per this report and supporting documents Scrubber Waste Pond at the Charles R. Lowman Power Plant meets the requirements for inflow design flood controls as per the CCR Rule. This document and its Attachments are intended to meet the requirements of the Initial Inflow Design Flood Control System Plan as per 257.82.

Appendix A

Scenario 1 Results

Figure A.1-Scrubber Waste Pond HGL and Inflow Graph

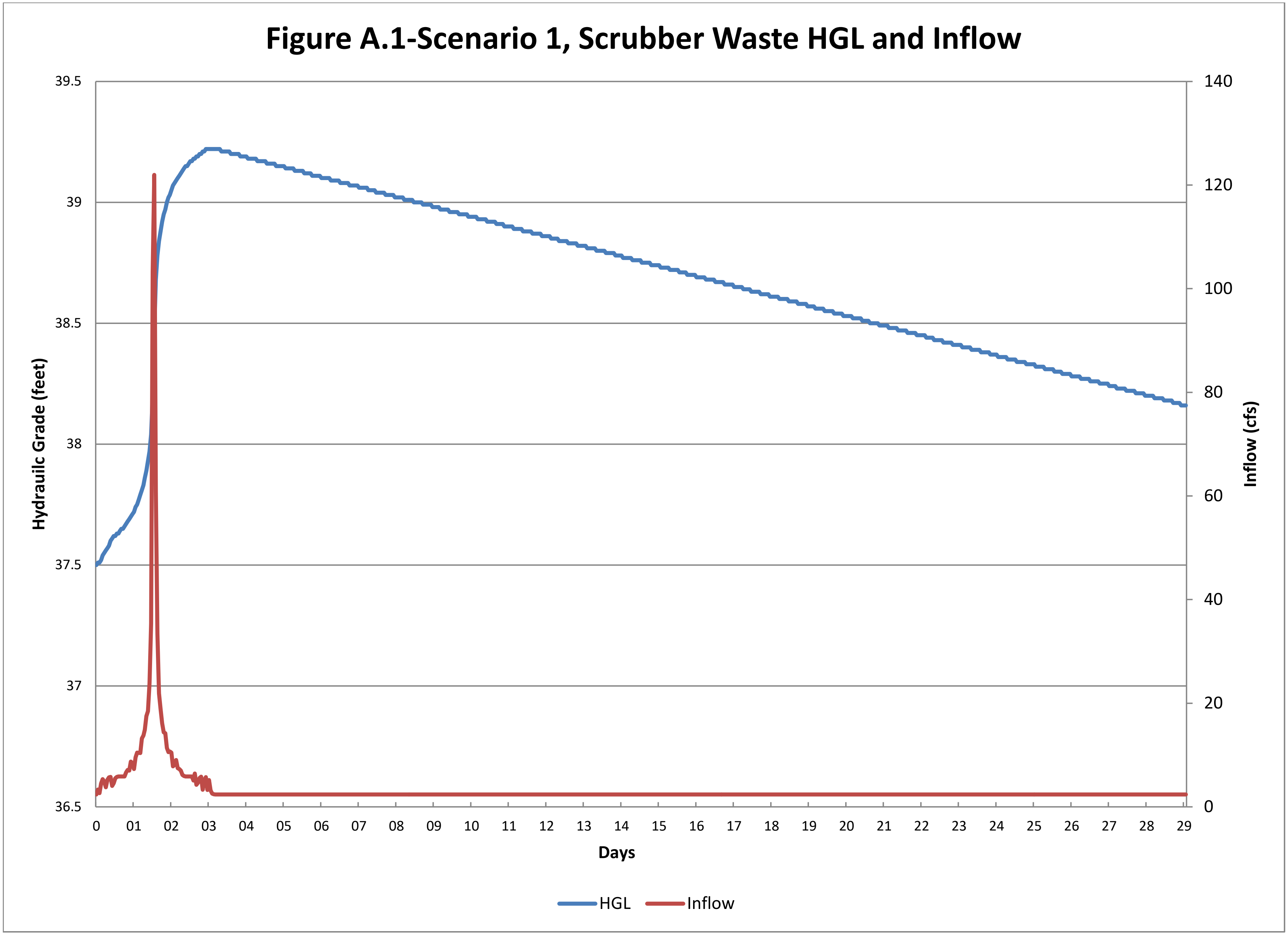


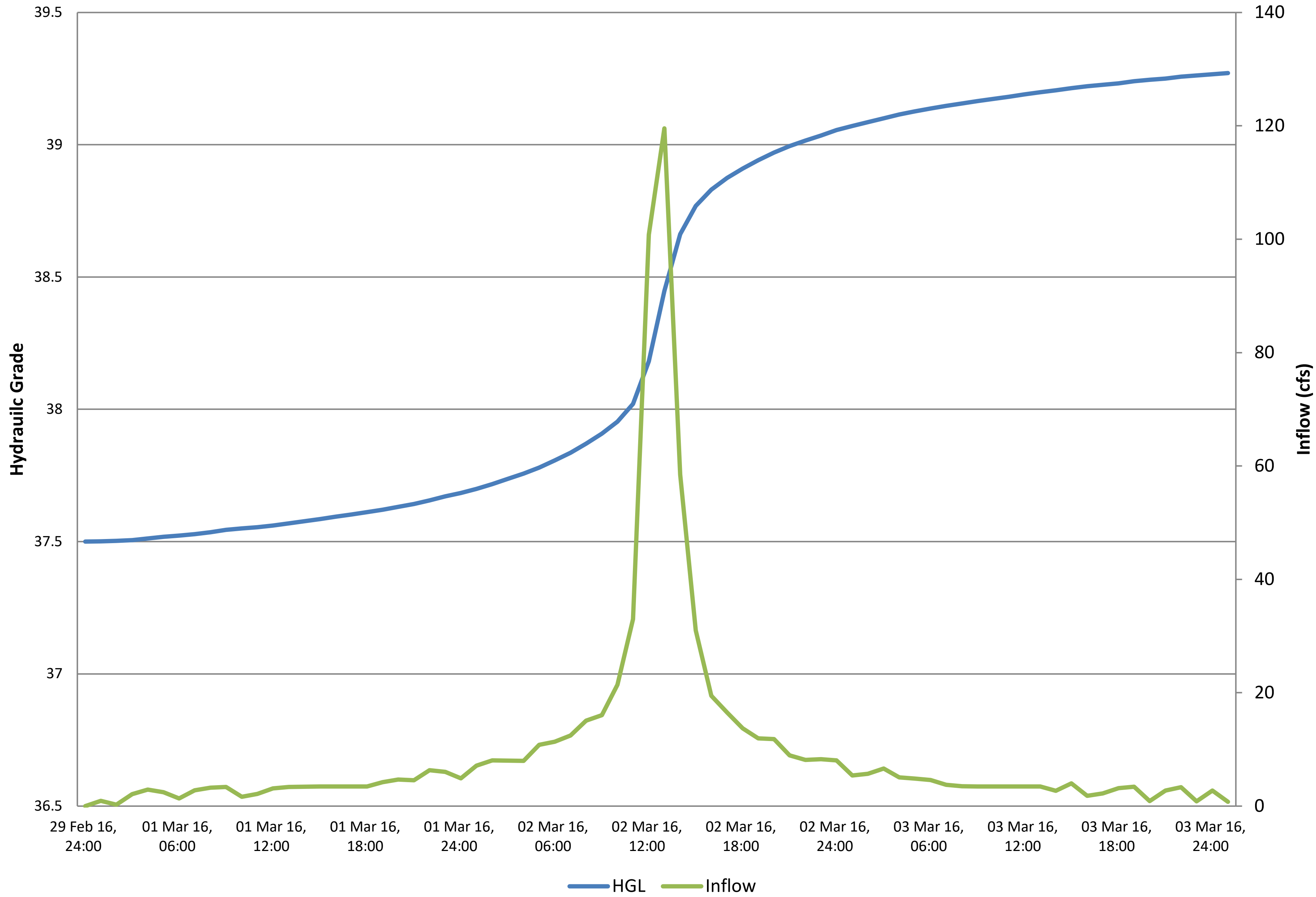
Figure A.1-Scenario 1, Scrubber Waste HGL and Inflow
Hydrauilc Grade (feet)
39.5
39
38.5
38
37.5
37
36.5
Inflow (cfs)
140
120
100
80
60
40
20
0
0 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29
Days
HGL
Inflow

Appendix B

Scenario 2 Results

Figure B.1-Scrubber Waste Pond HGL and Inflow Graph

Figure B.1-Scenario 2, Scrubber Waste HGL and Inflow



Appendix C

NOAA Atlas 14 Information

NOAA Atlas 14, Volume 9, Version 2 JACKSON
Station ID: 01-4193
Location name: Jackson, Alabama, US*
Latitude: 31.5250°, Longitude: -87.9278°
Elevation:
Elevation (station metadata): 220 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	0.531 (0.449-0.629)	0.606 (0.512-0.719)	0.731 (0.615-0.869)	0.834 (0.697-0.997)	0.976 (0.783-1.21)	1.09 (0.849-1.37)	1.20 (0.897-1.55)	1.31 (0.934-1.75)	1.46 (0.993-2.01)	1.57 (1.04-2.21)
10-min	0.777 (0.658-0.920)	0.888 (0.750-1.05)	1.07 (0.900-1.27)	1.22 (1.02-1.46)	1.43 (1.15-1.77)	1.59 (1.24-2.00)	1.75 (1.31-2.27)	1.92 (1.37-2.56)	2.14 (1.46-2.95)	2.30 (1.52-3.24)
15-min	0.948 (0.802-1.12)	1.08 (0.915-1.28)	1.30 (1.10-1.55)	1.49 (1.25-1.78)	1.74 (1.40-2.16)	1.94 (1.51-2.44)	2.14 (1.60-2.77)	2.34 (1.67-3.13)	2.61 (1.77-3.60)	2.81 (1.85-3.95)
30-min	1.40 (1.18-1.66)	1.60 (1.36-1.90)	1.95 (1.64-2.31)	2.23 (1.86-2.67)	2.62 (2.10-3.24)	2.93 (2.29-3.68)	3.23 (2.42-4.18)	3.54 (2.52-4.74)	3.96 (2.69-5.46)	4.27 (2.82-6.01)
60-min	1.86 (1.57-2.20)	2.12 (1.79-2.51)	2.56 (2.15-3.04)	2.96 (2.47-3.53)	3.53 (2.85-4.42)	4.01 (3.14-5.08)	4.51 (3.39-5.88)	5.04 (3.61-6.78)	5.79 (3.95-8.03)	6.38 (4.21-8.97)
2-hr	2.32 (1.97-2.73)	2.63 (2.23-3.09)	3.18 (2.69-3.75)	3.68 (3.09-4.37)	4.45 (3.62-5.55)	5.09 (4.02-6.44)	5.79 (4.38-7.53)	6.54 (4.72-8.78)	7.61 (5.24-10.5)	8.48 (5.64-11.9)
3-hr	2.61 (2.23-3.06)	2.94 (2.50-3.44)	3.55 (3.01-4.17)	4.13 (3.48-4.88)	5.04 (4.14-6.31)	5.83 (4.64-7.39)	6.70 (5.11-8.73)	7.66 (5.56-10.3)	9.05 (6.27-12.5)	10.2 (6.80-14.2)
6-hr	3.15 (2.70-3.66)	3.53 (3.02-4.11)	4.27 (3.64-5.00)	5.00 (4.23-5.87)	6.16 (5.09-7.69)	7.18 (5.75-9.06)	8.31 (6.38-10.8)	9.57 (6.99-12.8)	11.4 (7.96-15.7)	12.9 (8.69-17.9)
12-hr	3.73 (3.21-4.31)	4.22 (3.63-4.89)	5.15 (4.42-5.99)	6.04 (5.14-7.05)	7.42 (6.16-9.17)	8.62 (6.92-10.8)	9.93 (7.66-12.8)	11.4 (8.35-15.1)	13.5 (9.45-18.4)	15.2 (10.3-20.9)
24-hr	4.30 (3.72-4.94)	4.95 (4.28-5.69)	6.12 (5.27-7.06)	7.19 (6.15-8.33)	8.81 (7.32-10.8)	10.2 (8.21-12.6)	11.7 (9.03-14.8)	13.3 (9.78-17.4)	15.6 (11.0-21.0)	17.4 (11.9-23.8)
2-day	4.86 (4.23-5.54)	5.64 (4.90-6.45)	7.04 (6.09-8.06)	8.30 (7.14-9.56)	10.2 (8.50-12.3)	11.8 (9.53-14.4)	13.5 (10.5-17.0)	15.3 (11.3-19.9)	17.9 (12.7-23.9)	19.9 (13.7-27.0)
3-day	5.26 (4.59-5.98)	6.07 (5.29-6.91)	7.52 (6.53-8.58)	8.84 (7.63-10.1)	10.8 (9.07-13.1)	12.5 (10.2-15.3)	14.3 (11.2-18.0)	16.2 (12.1-21.1)	19.0 (13.5-25.4)	21.2 (14.6-28.7)
4-day	5.62 (4.91-6.37)	6.44 (5.62-7.31)	7.91 (6.88-9.00)	9.26 (8.00-10.6)	11.3 (9.47-13.6)	13.0 (10.6-15.8)	14.8 (11.6-18.6)	16.8 (12.6-21.7)	19.6 (14.0-26.2)	21.9 (15.1-29.5)
7-day	6.59 (5.79-7.43)	7.46 (6.54-8.42)	8.99 (7.85-10.2)	10.4 (9.00-11.8)	12.4 (10.5-14.8)	14.1 (11.6-17.1)	16.0 (12.6-19.9)	17.9 (13.4-23.0)	20.7 (14.9-27.4)	22.9 (15.9-30.7)
10-day	7.45 (6.56-8.37)	8.36 (7.35-9.40)	9.94 (8.70-11.2)	11.3 (9.87-12.8)	13.4 (11.3-15.9)	15.1 (12.4-18.1)	16.9 (13.3-20.9)	18.8 (14.1-24.0)	21.5 (15.4-28.3)	23.6 (16.4-31.5)
20-day	9.83 (8.70-11.0)	10.9 (9.60-12.1)	12.6 (11.1-14.1)	14.1 (12.3-15.9)	16.3 (13.7-19.0)	18.0 (14.8-21.4)	19.7 (15.6-24.1)	21.6 (16.3-27.2)	24.1 (17.4-31.4)	26.1 (18.3-34.6)
30-day	11.8 (10.5-13.2)	13.0 (11.6-14.5)	15.0 (13.3-16.7)	16.7 (14.6-18.7)	19.0 (16.1-22.0)	20.8 (17.2-24.5)	22.6 (18.0-27.5)	24.5 (18.6-30.7)	27.0 (19.6-35.0)	29.0 (20.4-38.2)
45-day	14.5 (12.9-16.0)	15.9 (14.2-17.6)	18.3 (16.2-20.3)	20.2 (17.8-22.6)	22.9 (19.4-26.4)	24.9 (20.6-29.2)	26.9 (21.4-32.4)	28.9 (21.9-36.0)	31.5 (22.9-40.5)	33.4 (23.6-43.9)
60-day	16.7 (14.9-18.5)	18.5 (16.5-20.4)	21.3 (18.9-23.6)	23.5 (20.8-26.2)	26.5 (22.5-30.4)	28.8 (23.8-33.6)	30.9 (24.7-37.2)	33.1 (25.2-41.0)	35.8 (26.1-45.8)	37.7 (26.8-49.5)

[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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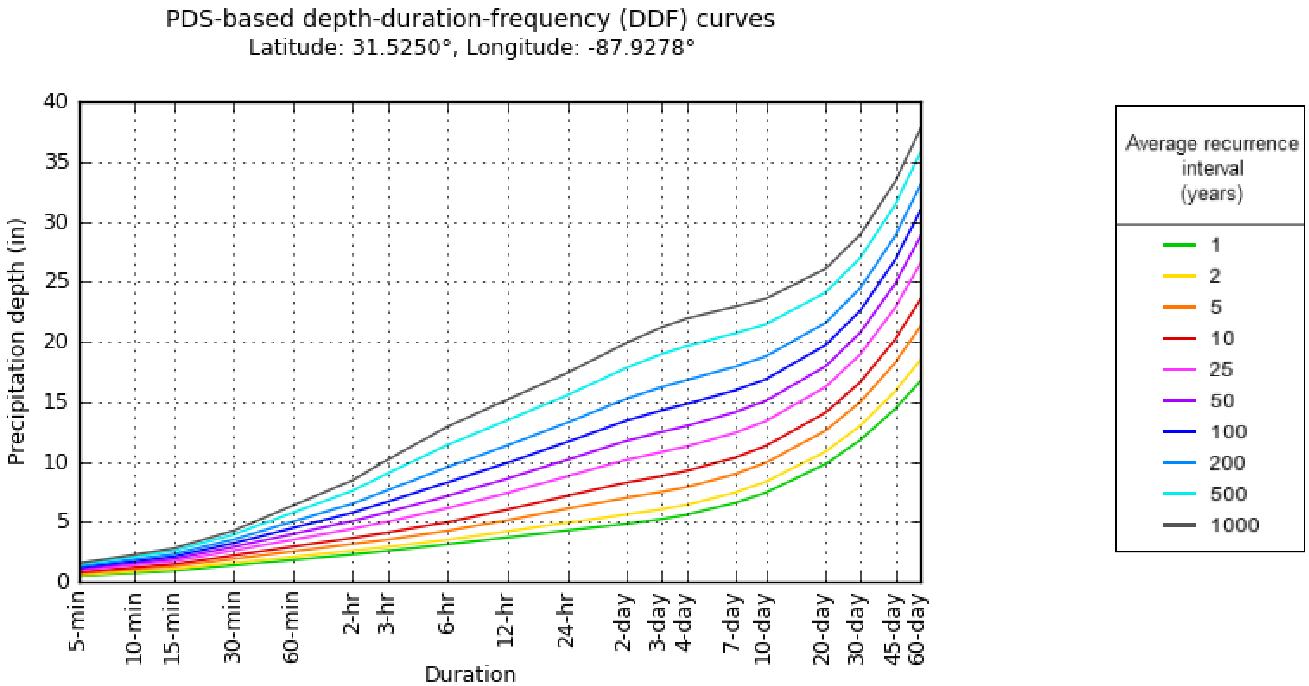
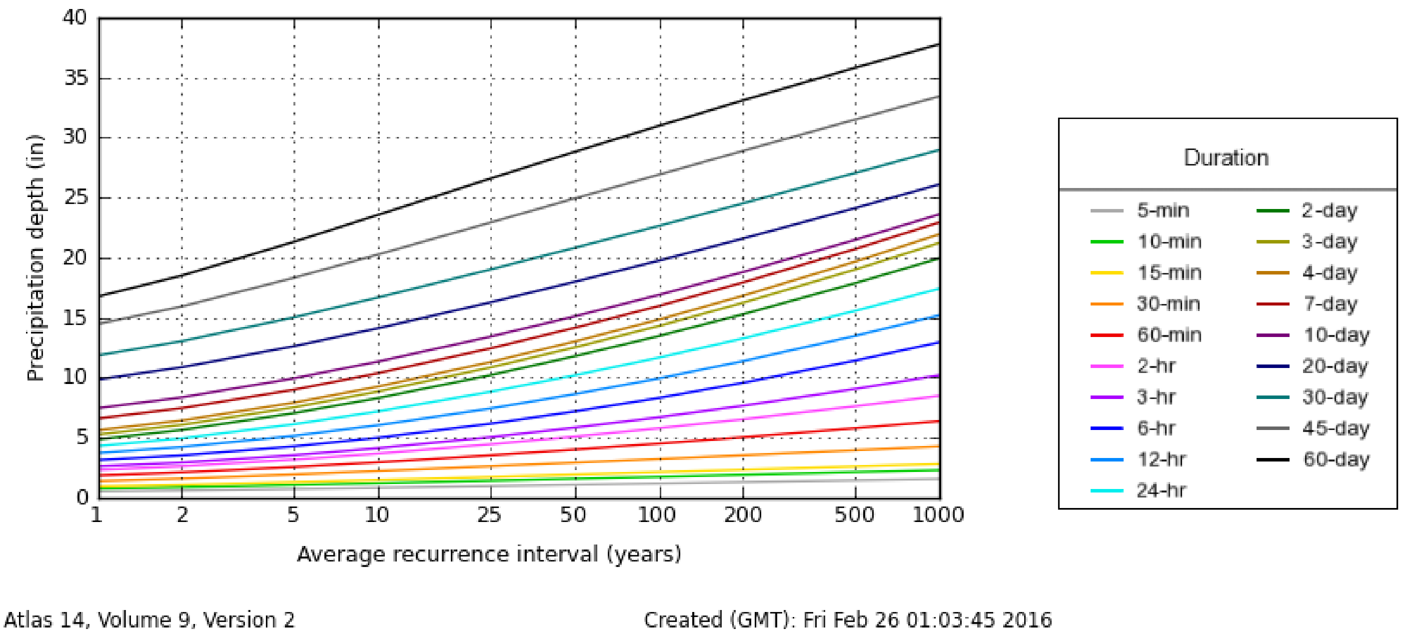
PF graphical





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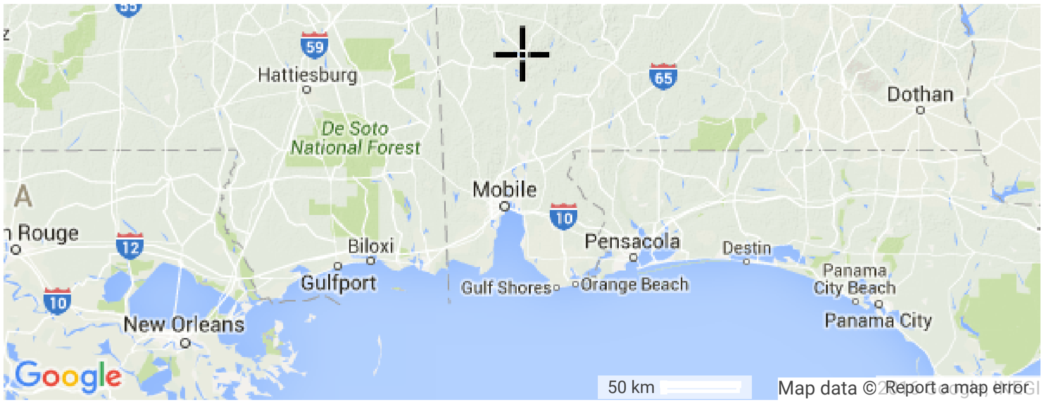
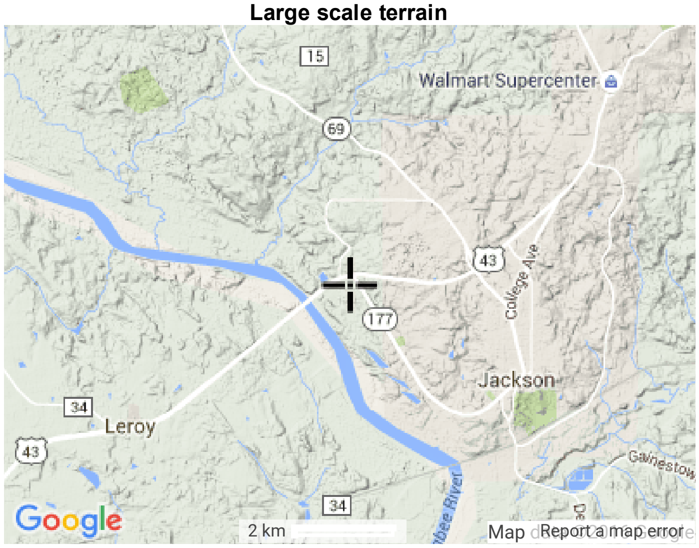
Maps & aerials

Small scale terrain

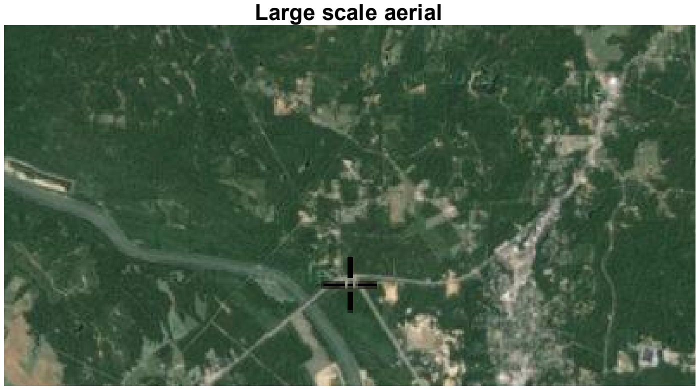


Large scale terrain



Large scale map

Large scale aerial



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