INFLOW DESIGN FLOOD CONTROL SYSTEM PLAN
PLANT SMITH ASH POND
GULF POWER COMPANY

EPA's "Disposal of Coal Combustion Residuals from Electric Utilities" Final Rule (40 C.F.R. Part 257 and Part 261), §257.82, 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 Smith Ash Pond, is located at Gulf Power Company's Plant Smith. The facility consists of a three celled, 165-acre ash pond and a 13-acre recycle canal. The inflow design flood consists of the rainfall that falls within the limits of the surface impoundment as well as run-off from approximately 57 acres of adjoining watershed. Stormwater is temporarily stored within the limits of the surface impoundment and discharged through an overflow weir into the recycle canal.

The inflow design flood has been calculated using the National Resources Conservations Service method (also known as the Soil Conservation Service (SCS) method) using the 100-yr storm event required for a Low 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 "A" should be used to best reflect the characteristics of the soils on site for the adjacent watershed. This information was placed into Storm and Sanitary Sewer Analysis (StormNet) and used to generate appropriate precipitation curves, storm basin routing information, and resulting rating curves to evaluate surface impoundment capacity.

The Ash Pond was constructed to subdivide it into three primary basins by a series of interior berms. Flow from each basin is controlled by culverts set at differing elevations to allow for temporary, intermittent storage before final discharge over the stop log weir outlet structure. The combination of the individual basin storage and the capacity of the outlet structure allows the facility to safely store and pass the inflow design storm. A calculation summary is attached to this plan.

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.

10/17/16

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Inflow Design Control System Plan:
Hydrologic and Hydraulic Calculation Summary

for

Plant Smith Ash Pond

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 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 Smith Ash Pond to determine the hydraulic capacity of the impoundment. The design storm for the Plant Smith Ash Pond is a 100-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 100-year, 24-hour rainfall event through the impoundment are presented in Table 1 below:

Table 1-Flood Routing Results for Plant Smith Ash Pond

Plant Smith 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)
Northwest Cell (NWC)	17.9	23.0	N/A	21.9	1.1	273	114
Southwest Cell (SWC)	17.6	23.0	20.7	20.8	2.2	268	28
East Cell (EC)	15.3	20.0	N/A	18.9	1.1	803	257

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

3.0 Methodology

3.1 HYDROLOGIC ANALYSES

The Plant Smith Ash Pond is classified as a low hazard structure. The design storm for a low hazard structure is a 100-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 Smith Ash Pond Storm Distribution

Hazard Classification	Return Frequency (years)	Storm Duration (hours)	Rainfall Total (Inches)	Rainfall Source	Storm Distribution
Low	100	24	13.8	NOAA Atlas 14	SCS Type III

The drainage area for the Plant Smith Ash Pond was delineated based on LiDAR data and surveys acquired for the Plant 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 Tables 3(a) thru 3(e).

Table 3(a) — Ash Pond Northwest Basin Hydrologic Information

Drainage Basin Area (acres)	34.0
Hydrologic Curve Number, CN	90
Hydrologic Methodology	SCS Method
Time of Concentration (minutes)	50.3
Hydrologic Software	Storm and Sanitary Sewer Analysis, 2013 Autodesk, Inc.

Table 3(b) — Ash Pond Southwest Basin Hydrologic Information

Drainage Basin Area (acres)	53.0
Hydrologic Curve Number, CN	91
Hydrologic Methodology	SCS Method
Time of Concentration (minutes)	71.1
Hydrologic Software	Storm and Sanitary Sewer Analysis, 2013 Autodesk, Inc.

Table 3(c) — Ash Pond East Basin Hydrologic Information

Drainage Basin Area (acres)	78.3
Hydrologic Curve Number, CN	93
Hydrologic Methodology	SCS Method
Time of Concentration (minutes)	33.6
Hydrologic Software	Storm and Sanitary Sewer Analysis, 2013 Autodesk, Inc.

Table 3(d) — Dry Ash Storage Hydrologic Information

Drainage Basin Area (acres)	57.2
Hydrologic Curve Number, CN	49
Hydrologic Methodology	SCS Method
Time of Concentration (minutes)	62.2
Hydrologic Software	Storm and Sanitary Sewer Analysis, 2013 Autodesk, Inc.

Table 3(e) — Recycle Canal Hydrologic Information

Drainage Basin Area (acres)	13.0
Hydrologic Curve Number, CN	91
Hydrologic Methodology	SCS Method
Time of Concentration (minutes)	14.5
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 Smith were considered in this analysis. Based on normal plant operations, the Ash Pond receives an additional 48.11 MGD (74.4 cfs) of inflow from the Plant. The Southwest Cell receives 1.31 MGD (2.0 cfs), the Northwest Cell receives 43.34 MGD (67.1 cfs) and the East Cell receives 4.46 MGD (5.35 cfs).

3.2 HYDRAULIC ANALYSES

Storage values for the Ash Pond were determined by developing a stage-storage relationship utilizing contour data for the three ash pond sub-basins: Northwest Cell (NWC), Southwest Cell (SWC), East Cell (EC) and for the outlet channel (Recycle Canal - RC). All four of these areas maintain normal pool elevations separate from one another due to their outlet structure inverts. An arrangement of the basins is shown in the attached ash pond map in Section 4.5. Stormwater runoff and some additional Plant process flows pass thru 24" diameter HDPE pipes from the Northwest and Southwest Cells into the East Cell where it combines with runoff from the East Cell and Dry Ash Storage area along with stormwater sump flows from the stormwater runoff "cat tail" pond. The flow then passes over a stop log weir outlet structure located in a 20 feet flat bottom trapezoidal channel leaving the Ash Pond. This outlet structure consists of three sections of stop logs approximately 7 to 8 feet long and two 14" diameter pipe orifices with gate valves. Concrete walls extend from the stop log weirs to the channel walls on each side. A summary of spillway information for Ash Pond structures is presented below in Table 4. In addition to the outlet pipes from the Southwest Cell as noted above, an auxiliary concrete trapezoidal spillway is located on the south end of the NWC/EC dike. Also note that for this analysis, additional spillways and other structures downstream of the East Cell outlet weir as well as upstream in the Dry Ash Storage area were modeled to evaluate the ponds performance but are not listed in Table 4.

Table 4—Ash Pond Spillway Attribute Table

Spillway Component	US Invert El (feet)	DS Invert El (feet)	Dimension	Slope (ft/ft)	Length (ft)	Spillway Capacity (cfs)
NWC Primary 1	18.2	17.8	24” diameter CPP	0.0100	36.9	24.5
NWC Primary 2	19.0	17.7	24” diameter CPP	0.0436	29.8	51.2
NWC Primary 3	17.9	16.6	24” diameter CPP	0.0291	44.6	41.8
SWC Primary 1	18.7	18.6	24” diameter CPP	0.0025	40.8	12.2
SWC Primary 2	18.8	18.7	24” diameter CPP	0.0025	40.1	12.2
SWC Primary 3	17.6	17.2	24” diameter CPP	0.0099	40.5	24.4
SWC Auxiliary Spillway	20.75	20.67	Trapezoidal 25-feet crest 7:1 s.s.	0.0039	20.7	N/A*
EC Primary 1	15.30	N/A*	Stop log weir section	N/A*	8.1	N/A*
EC Primary 2	15.30	N/A*	Stop log weir section	N/A*	7.1	N/A*
EC Primary 3	15.30	N/A*	Stop log weir section	N/A*	8.0	N/A*
EC Primary 3	17.8	N/A*	Concrete abutment walls 36.7 feet	N/A*	8.0	N/A*
EC Primary 3	17.8	N/A*	Trapezoidal Overflow section above Primary 1-4	N/A*	60.0	N/A*
EC Auxiliary 1	14.53	N/A*	14” steel pipe orifice & gate valve	N/A*	N/A*	0**
EC Auxiliary 2	14.54	N/A*	14” steel pipe orifice & gate valve	N/A*	N/A*	0**

*N/A = Not available or not applicable.
**EC Auxiliary pipe orifices to remain closed for required water quality volume per NPDES permit.

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 1.

4.0 Supporting Information

4.1 CURVE NUMBERS

Northwest Cell Basin

Subbasin Northwest Cell Basin

Soil/Surface Description	Area (acres)	Soil Group	CN
Ash with brush and grass cover	31.29	-	90.00
Water surface at normal pool	0.90	-	98.00
Aggregate roads	1.85	B	85.00
Composite Area & Weighted CN	34.04		89.94

Southwest Cell Basin

Subbasin Southwest Cell Basin

Soil/Surface Description	Area (acres)	Soil Group	CN
Assume no ash surface above normal pool.	8.87	-	98.00
Aggregate surfaced perimeter roads	1.90	B	85.00
Ash with grass and brush cover	42.29	-	90.00
Composite Area & Weighted CN	53.06		91.16

East Cell Basin

Subbasin East Cell Basin

Soil/Surface Description	Area (acres)	Soil Group	CN
Aggregate surfaced perimeter roads	2.91	B	85.00
Grassed Areas, Slopes	1.16	B	69.00
Ash with grass/brush cover	36.96	-	90.00
Water Surface	37.30	-	98.00
Composite Area & Weighted CN	78.33		93.31

Dry Ash Storage Basin

Subbasin Dry Ash Storage Basin

Soil/Surface Description	Area (acres)	Soil Group	CN
> 75% grass cover, Good	57.21	-	49.00
Composite Area & Weighted CN	57.21		49.00

Recycle Canal Basin

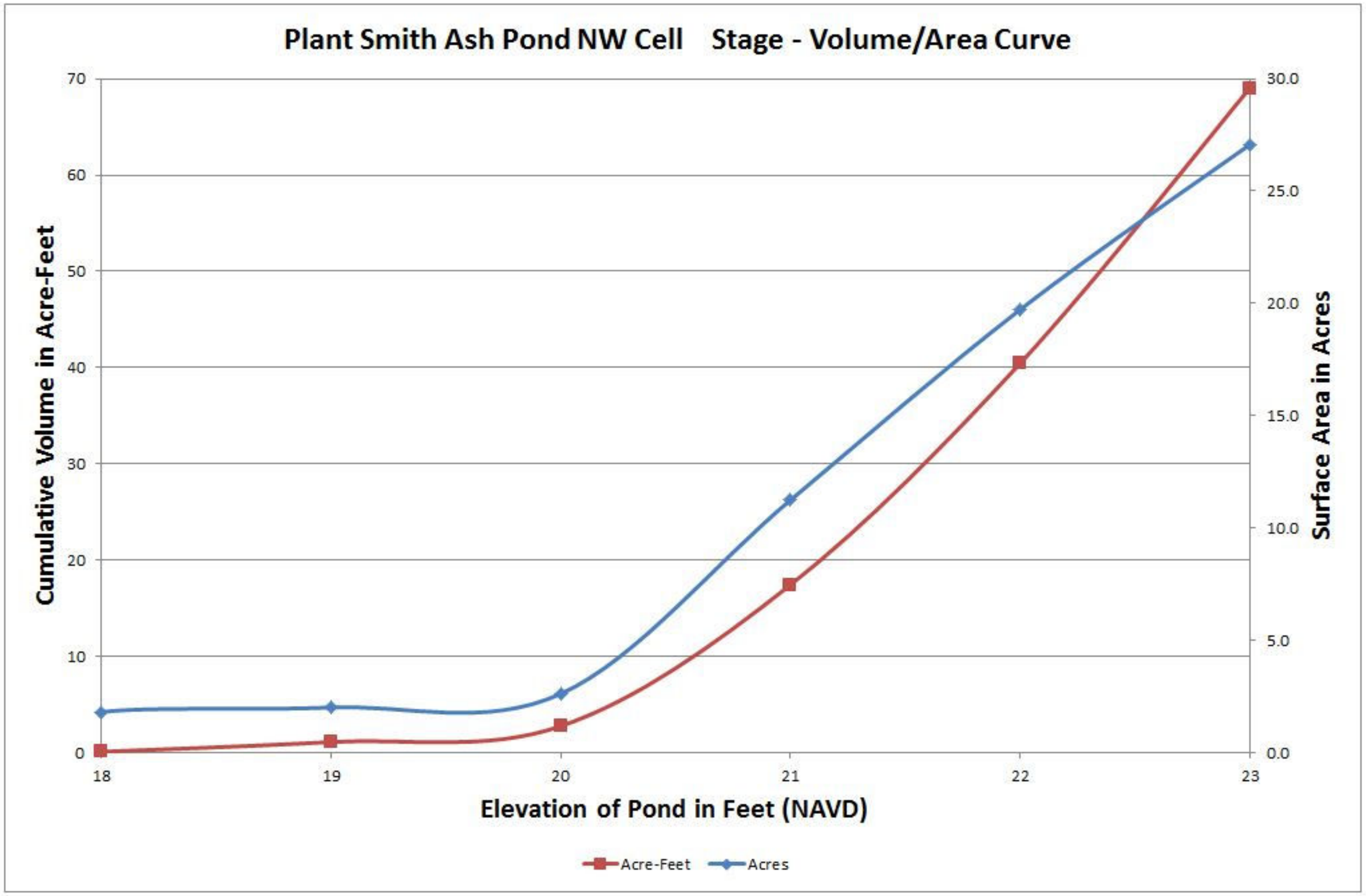
Subbasin Recycle Canal Basin

Soil/Surface Description	Area (acres)	Soil Group	CN
Water Surface (EL. 9.0)	6.31	-	98.00
Aggregate Surfaced Roads	1.73	B	85.00
Grassed Areas, Slopes	5.00	B	69.00
Composite Area & Weighted CN	13.04		85.16

4.2 STAGE-STORAGE TABLES & CURVES

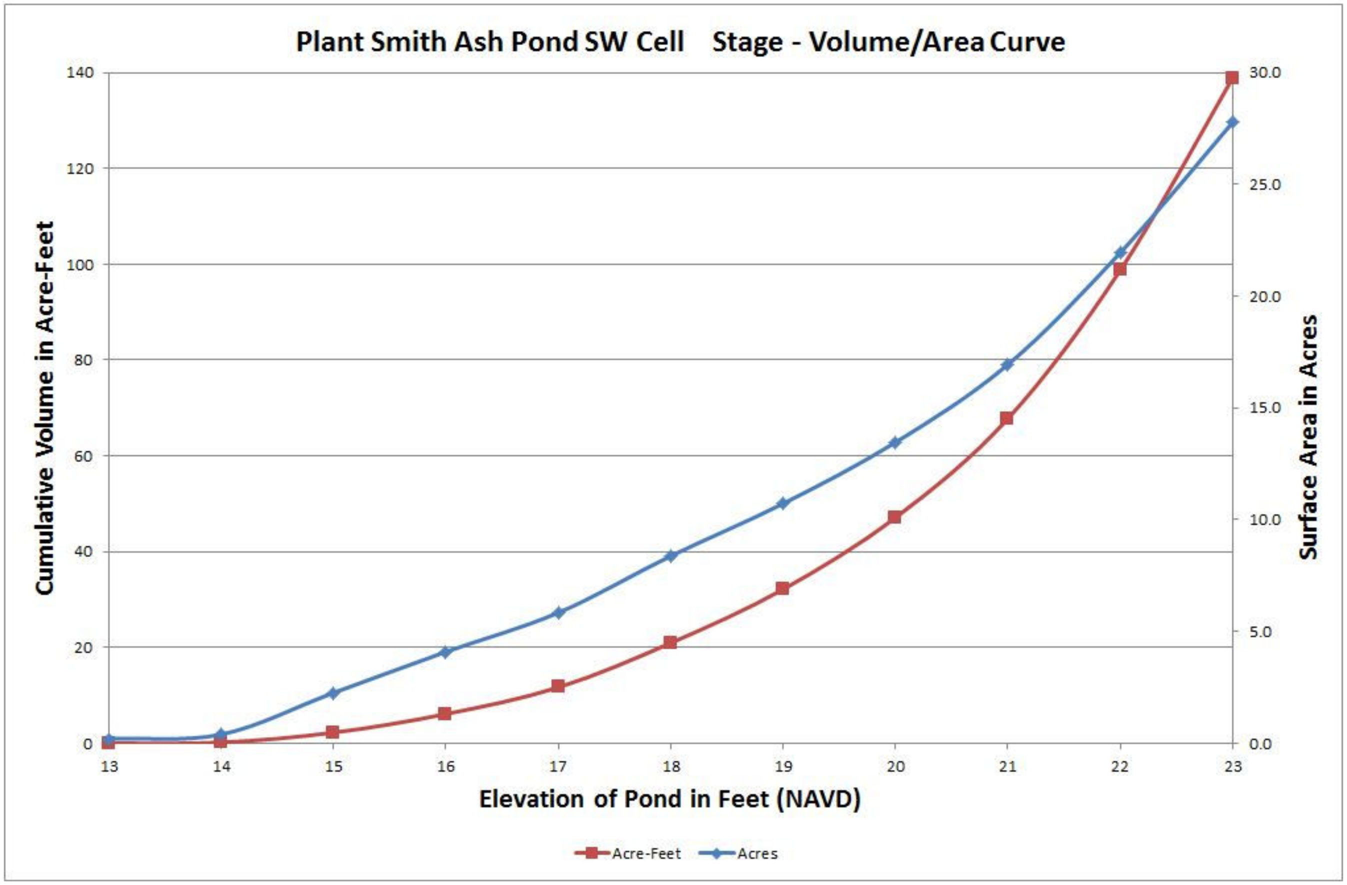
4.2.1 NORTHWEST CELL

Contour Elevation	Surface Area Acres	Volume Acre-Feet
17.9	0.50	0.00
18	1.81	0.09
19	2.01	1.11
20	2.62	2.75
21	11.24	17.43
22	19.72	40.43
23	27.07	69.03



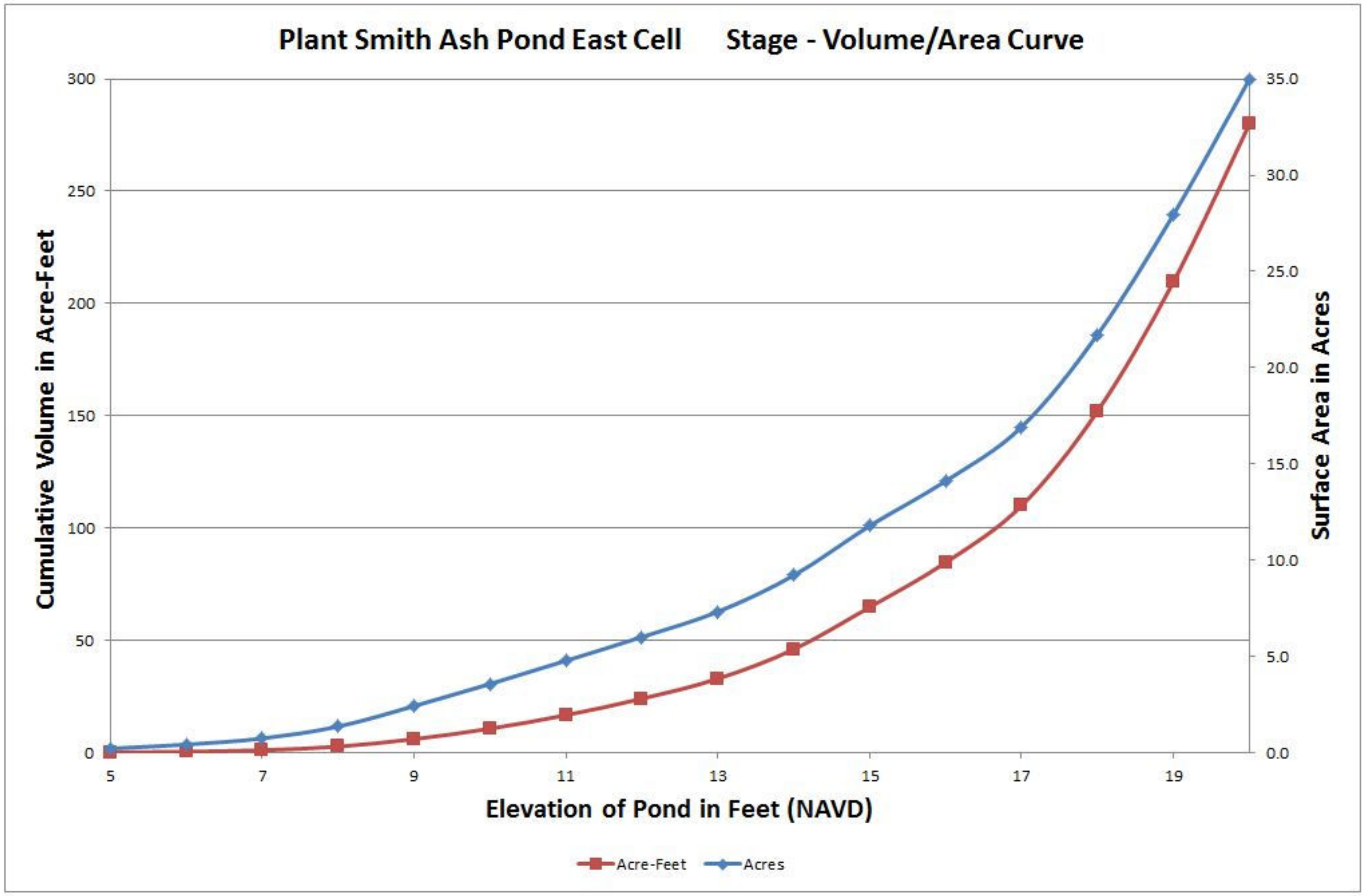
4.2.2 SOUTHWEST CELL

Contour Elevation	Surface Area Acres	Volume Acre-Feet
13	0.20	0.00
14	0.40	0.20
15	2.26	2.26
16	4.10	6.14
17	5.85	11.69
18	8.38	20.95
19	10.72	32.17
20	13.47	47.13
21	16.94	67.77
22	21.95	98.75
23	27.77	138.87



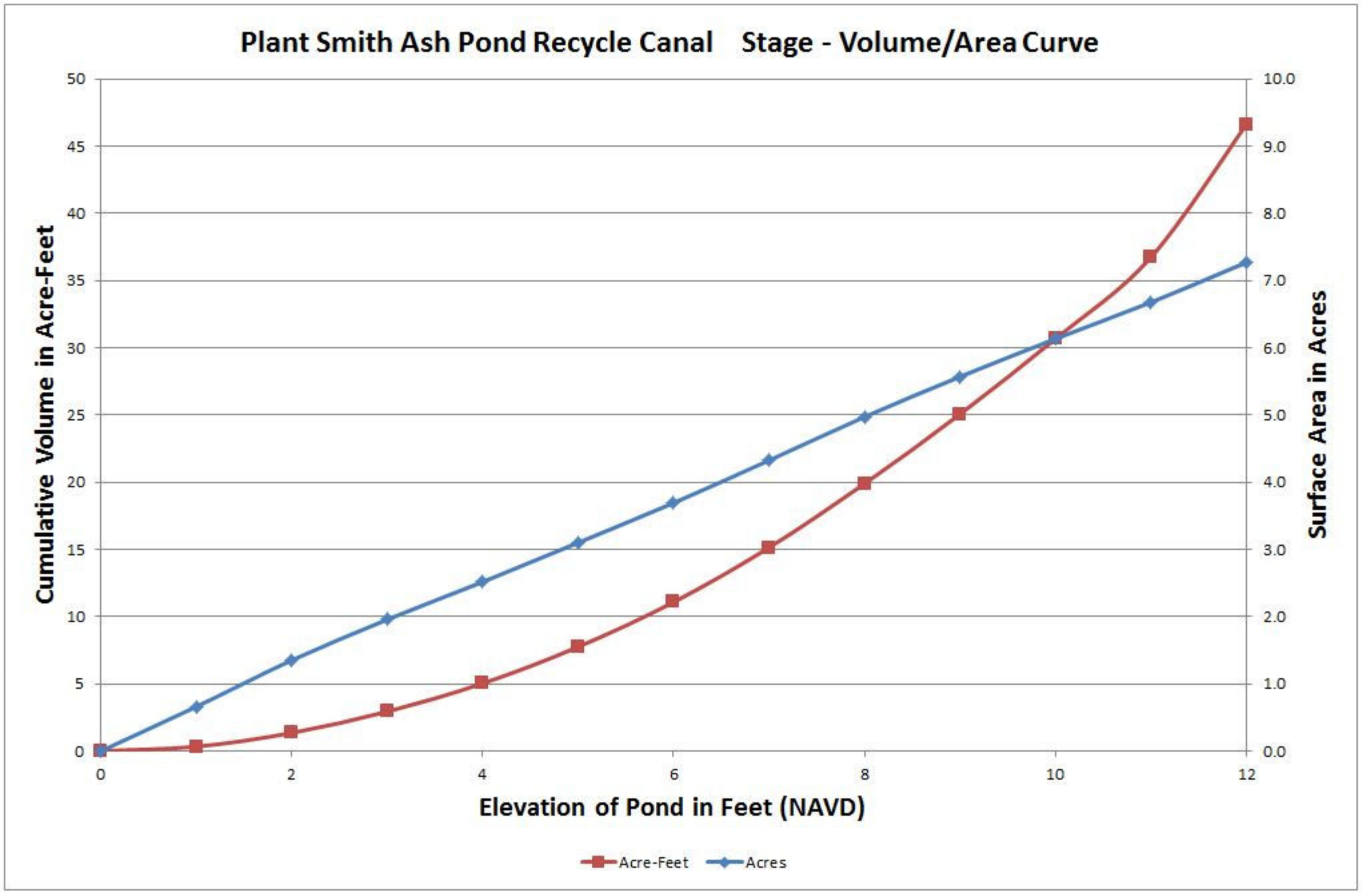
4.2.3 EAST CELL

Contour Elevation	Surface Area Acres	Volume Acre-Feet
5	0.21	0.11
6	0.42	0.42
7	0.74	1.11
8	1.36	2.72
9	2.42	6.06
10	3.57	10.71
11	4.78	16.72
12	6.01	24.04
13	7.32	32.95
14	9.21	46.06
15	11.78	64.81
16	14.11	84.66
17	16.92	109.99
18	21.72	152.01
19	27.95	209.60
20	34.98	279.85



4.2.4 RECYCLE CANAL

Contour Elevation	Surface Area Acres	Volume Acre-Feet
0	0.00	0.00
1	0.66	0.33
2	1.35	1.35
3	1.96	2.93
4	2.52	5.03
5	3.10	7.75
6	3.69	11.07
7	4.32	15.14
8	4.97	19.88
9	5.57	25.06
10	6.13	30.66
11	6.68	36.72
12	7.27	46.61



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	
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Sheet Flow Equation	Channel Flow Equation
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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 NORTHWEST CELL

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Subbasin Northwest Cell Basin			
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Sheet Flow Computations			

-	Subarea A	Subarea B	
Manning's Roughness:	0.015	0.3	
Flow Length (ft):	24	12	
Slope (%):	4.2	25	
2 yr, 24 hr Rainfall (in):	5.4	5.4	
Velocity (ft/sec):	1.41	0.23	
Computed Flow Time (minutes):	0.28	0.88	
Shallow Concentrated Flow Computations			

-	Subarea A	Subarea B	Subarea C
Flow Length (ft):	240	175	700
Slope (%):	0.83	0.6	0.15
Surface Type:	Woodland	Bare & untilled Bare & untilled	
Velocity (ft/sec):	0.46	0.77	0.39
Computed Flow Time (minutes):	8.7	3.79	29.91
Channel Flow Computations			

-	Subarea A	Subarea B	
Manning's Roughness:	0.03	0	
Flow Length (ft):	1250	0	
Channel Slope (%):	0.16	0	
Cross Section Area (ft²):	64.6	0	
Wetted Perimeter (ft):	33.27	0	
Velocity (ft/sec):	3.09	0	
Computed Flow Time (minutes):	6.74	0	
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Total TOC (minutes):	50.3		
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4.3.2 SOUTHWEST CELL

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Subbasin Southwest Cell Basin		
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Sheet Flow Computations		

-	Subarea A	Subarea B
Manning's Roughness:	0.015	0.3
Flow Length (ft):	17	28
Slope (%):	4.1	14
2 yr, 24 hr Rainfall (in):	5.4	5.4
Velocity (ft/sec):	1.3	0.21
Computed Flow Time (minutes):	0.22	2.18
Shallow Concentrated Flow Computations		

-	Subarea A	Subarea B
Flow Length (ft):	1317	505
Slope (%):	0.23	0.2
Surface Type:	Bare & untilled Bare & untilled Unpaved	
Velocity (ft/sec):	0.48	0.45
Computed Flow Time (minutes):	45.73	18.7
Flow thru Water Computations		

-	Subarea A	Subarea B
Flow Length (ft):	1065	1385
Average Depth (ft):	2	4
Velocity (ft/sec):	8	11.3
Computed Flow Time (minutes):	2.21	2.03
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Total TOC (minutes):	71.07	
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4.3.3 DRY ASH STORAGE

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Subbasin Dry Ash Storage Basin			
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Sheet Flow Computations			

-	Subarea A		
Manning's Roughness:	0.3		
Flow Length (ft):	100		
Slope (%):	0.23		
2 yr, 24 hr Rainfall (in):	6		
Velocity (ft/sec):	0.06		
Computed Flow Time (minutes):	29.59		
Shallow Concentrated Flow Computations			

-	Subarea A		
Flow Length (ft):	455		
Slope (%):	0.23		
Surface Type:	Grassed waterway Unpaved		
Velocity (ft/sec):	0.72		
Computed Flow Time (minutes):	10.53		
Channel Flow Computations			

-	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.03	0.03	0.03
Flow Length (ft):	1279	877	330
Channel Slope (%):	0.11	0.43	1.09
Cross Section Area (ft^2):	43.15	18.55	13.46
Wetted Perimeter (ft):	59.66	20.23	18
Velocity (ft/sec):	1.33	3.07	4.27
Computed Flow Time (minutes):	16.06	4.75	1.29
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Total TOC (minutes):	62.23		
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4.3.4 EAST CELL

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Subbasin East Cell Basin		
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Sheet Flow Computations		

-	Subarea A	Subarea B
Manning's Roughness:	0.015	0.3
Flow Length (ft):	25	24
Slope (%):	4.1	45
2 yr, 24 hr Rainfall (in):	5.4	5.4
Velocity (ft/sec):	1.41	0.33
Computed Flow Time (minutes):	0.3	1.21
Shallow Concentrated Flow Computations		

-	Subarea A	Subarea B
Flow Length (ft):	1426	0
Slope (%):	0.28	0
Surface Type:	Grassed waterway Unpaved	Unpaved
Velocity (ft/sec):	0.79	0
Computed Flow Time (minutes):	30.08	0
Flow thru Water Computations		

-	Subarea A	
Flow Length (ft):	1680	
Average Depth (ft):	6.3	
Velocity (ft/sec):	14.2	
Computed Flow Time (minutes):	1.97	
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Total TOC (minutes):	33.6	
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4.3.5 RECYCLE CANAL

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Subbasin Recycle Canal Basin		
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Sheet Flow Computations		

-	Subarea A	Subarea B
Manning's Roughness:	0.3	0.3
Flow Length (ft):	55	35
Slope (%):	1	5.7
2 yr, 24 hr Rainfall (in):	5.4	5.4
Velocity (ft/sec):	0.09	0.16
Computed Flow Time (minutes):	10.74	3.73
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Total TOC (minutes):	14.47	
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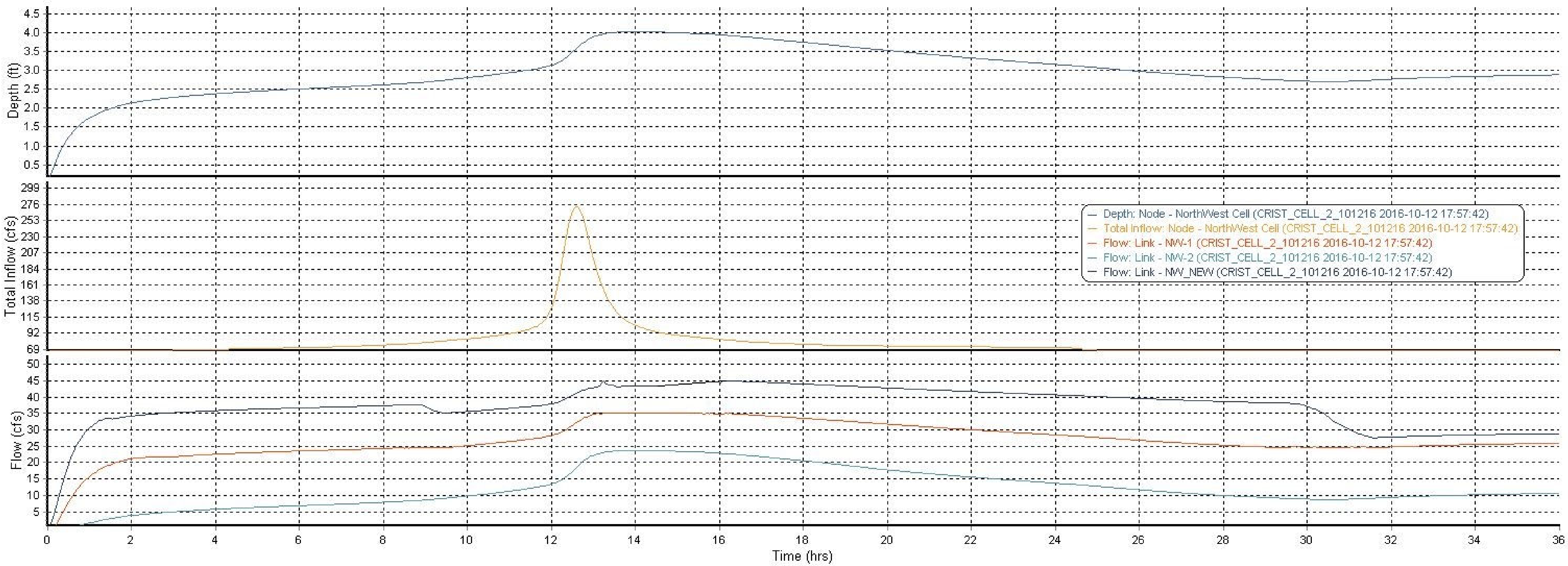
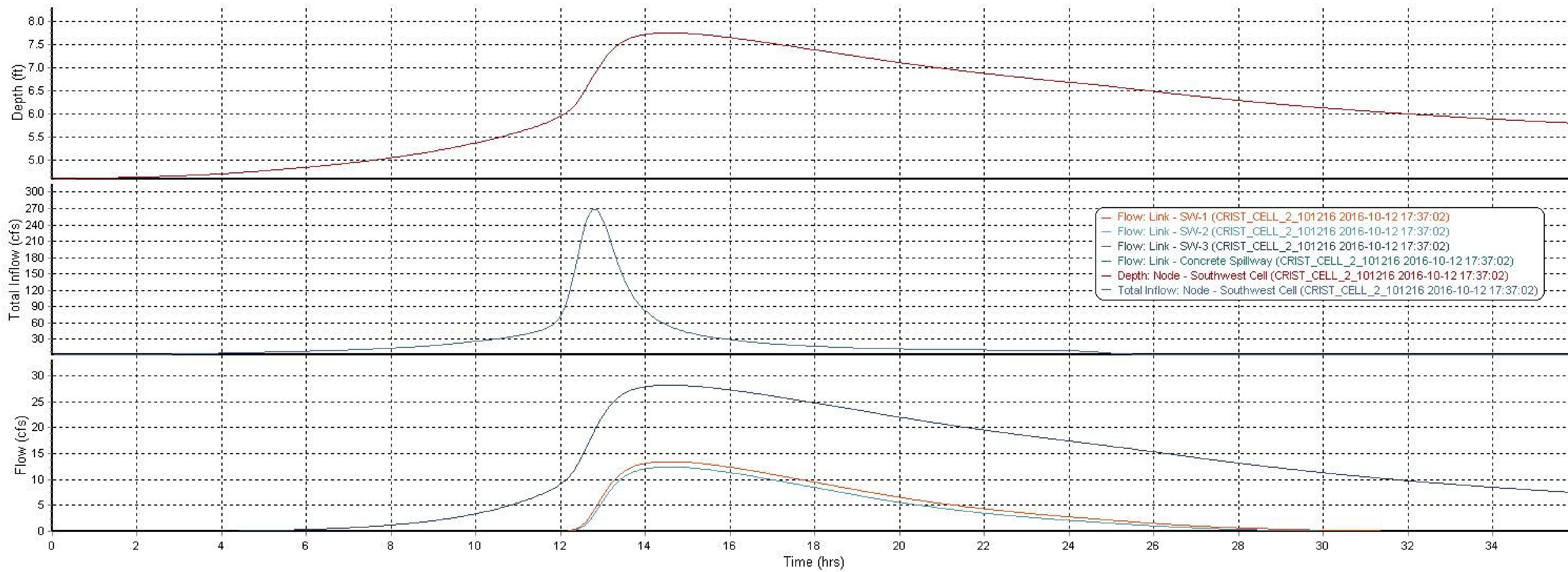
4.4 CELL RATING CURVES

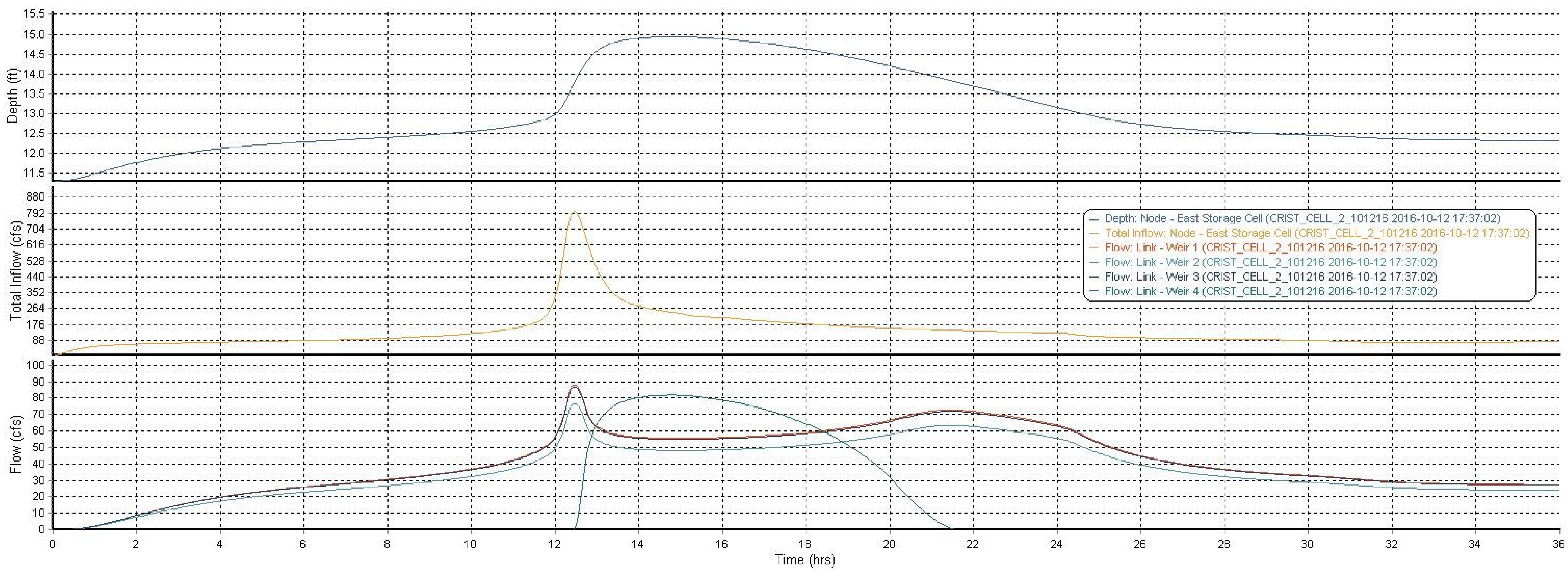
4.4.1 NORTHWEST CELL RATING CURVES



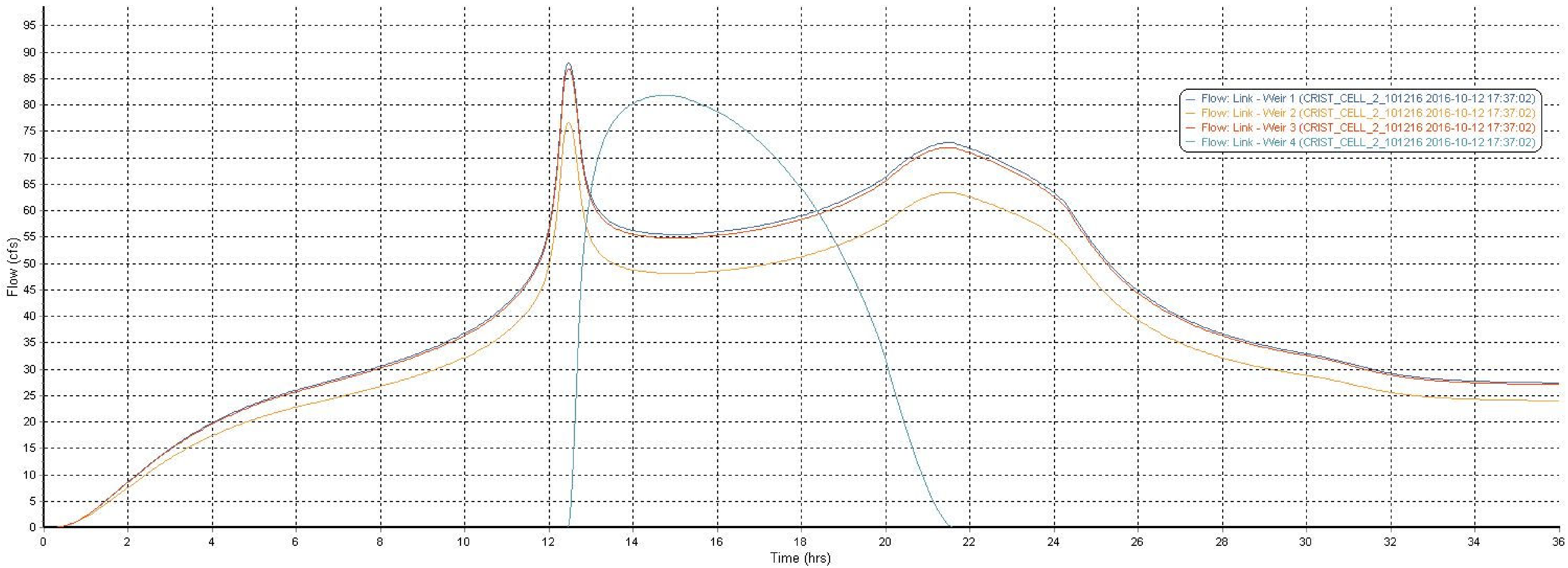
4.4.2 SOUTHWEST CELL RATING CURVES



4.4.3 EAST CELL RATING CURVES



4.4.4 EAST CELL STOP LOG WEIR RATING CURVES



4.5 DRAINAGE BASIN