Prepared for

Santee Cooper
One Riverwood Drive
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INFLOW DESIGN FLOOD CONTROL SYSTEM PLAN – SOUTH ASH POND

WINYAH GENERATING STATION

Prepared by

Geosyntec consultants

engineers | scientists | innovators

104 South Main Street, Suite 115
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Project Number: GSC5242

October 2016

INTRODUCTION

Winyah Generating Station (WGS or the Site) is a 1,260 megawatt coal-fired steam electric generating facility owned and operated by South Carolina Public Service Authority (Santee Cooper). The Site is situated between Pennyroyal and Turkey Creeks and is located at 661 Steam Plant Drive in Georgetown, South Carolina. Coal combustion residuals (CCR) generated at WGS have been historically managed in existing CCR surface impoundments.

In response to the recently published CCR Rule (40 Code of Federal Regulations (CFR) Part 257), South Carolina Public Service Authority (Santee Cooper) retained Geosyntec Consultants, Inc. (Geosyntec) to prepare documentation for existing surface impoundments (SIs) at WGS. Pursuant to Section 257.82(c) of the CCR Rule, Geosyntec Consultants (Geosyntec) prepared this Inflow Design Flood Control System Plan for the South Ash Pond at WGS.

Section § 257.82(a) of the Rule states that "*The owner or operator of an existing or new CCR surface impoundment or any lateral expansion of a CCR surface impoundment must design, construct, operate, and maintain an inflow design flood control system as specified in paragraphs (a)(1) and (2) of this section.*" The Preamble to the CCR Rule provides guidance on the documentation that should be provided for the Inflow Design Flood Control System Plan.

The inflow design flood control system for the South Ash Pond at the Site consists of maintaining minimum operating freeboards for the SI. Justification and documentation of the adequacy of the inflow design flood control systems are presented in the sections below.

The work presented in this report was performed under the direction of Mr. C. Fabian Benavente, P.E., of Geosyntec in accordance with §257.82(c).

SURFACE IMPOUNDMENT DESCRIPTION

The South Ash Pond, encompassing approximately 75 acres (ac), is situated immediately south of the Coal Pile and power block and is encircled by a railroad that loops around the pond (Thomas and Hutton, 2012). The northern extent of the South Ash Pond is bounded by the rail line and Coal Pile, while the southern extent is bounded by a forested area. To the west, the South Ash Pond is bounded by Pennyroyal Creek and is bordered to the east by an access road and the Discharge Channel. The maximum height of the South Ash Pond perimeter dike is 22 feet (ft) (Thomas and Hutton, 2012). The minimum crest elevation of the South Ash Pond perimeter dikes is 36.9 ft National Geodetic Vertical Datum of 1929 (NGVD 29) (Thomas and Hutton, 2016). A Site Map including the surface impoundment and hydraulic features associated with the South Ash Pond is provided in **Figure 1**.

The South Ash Pond historically received fly ash, boiler slag, bottom ash, low volume wastewater, and stormwater. Currently, the South Ash Pond receives low volume wastewater from Units 3 and 4, Unit 3 and 4 fly ash sluice (when fly ash is not handled dry), and blowdown and stormwater from the SEFA Star Facility. The purpose of the South Ash Pond is to contain CCR and treat process wastewater and stormwater to remove solids by gravity settling. Decanted water is discharged through a riser structure to the Discharge Canal. **Table 1** presents flow rates of process water conveyed to the South Ash Pond (Santee Cooper, 2015). The South Ash Pond also receives stormwater from the Coal Pile.

Table 1. Flow rates of process water conveyed to the South Ash Pond (Santee Cooper, 2015)

Process Water	Flow Rate (GPM)
Units 3 and 4 Hydroveyor Water	2,180
Units 3 and 4 Low Volume Wastewater	540
SEFA Star II Scrubber Blowdown	20

The normal operating level in the South Ash Pond is maintained by a rectangular concrete riser structure with 4 ft-long stoplogs on a single face. The top stoplog elevation is 28.73 ft NGVD 29 (Thomas and Hutton, 2016). A 36 in. diameter reinforced concrete pipe with an upstream invert elevation of 16.93 ft NGVD 29 conveys water from the riser structure to the Discharge Canal (Lockwood Greene, 1978; Thomas and Hutton, 2016).

CATCHMENT AREAS AND DESIGN STORM EVENT

The contributing watershed area for the South Ash Pond is 75.6 ac (Thomas and Hutton, 2012). The area was delineated using the dike crests to correspond to the pond's direct drainage area. Since the South Ash Pond is classified as a low hazard potential surface impoundment (Geosyntec, 2016), the inflow design flood is the 100-year storm event.

STORAGE CAPACITIES

The available stormwater storage volume of the South Ash Pond between elevations 12.0 ft and 36.9 ft NGVD 29 was calculated by developing an area-volume curve based on topographic and bathymetric data (Thomas and Hutton, 2012; Thomas and Hutton, 2016). The lowest contour within the South Ash Pond is 12.0 ft NGVD 29. The minimum crest elevation of the South Ash Pond perimeter dikes is 36.9 ft NGVD 29. The surface area of each contour was measured and tabulated at each elevation. The available surface water volume in each depth increment was calculated by averaging the surface area of the upper and lower contour and multiplying by the change in elevation between each contour. The cumulative storage volume of the South Ash Pond between these elevations is 296.6 acre-feet (ac-ft). Area-Capacity information is presented in Appendix A.

HYDROLOGIC AND HYDRAULIC ANALYSIS

A hydrologic and hydraulic analysis of the South Ash Pond was performed using *HydroCAD Version 10.0* software (HydroCAD, 2011). Process water and stormwater inflows, and outflows from the South Ash Pond to the Cooling Pond via the Discharge Canal were used to compute maximum water elevation during the design storm event. The base inflow of stormwater during the design event is 2,450 gpm (Santee Cooper, 2014). Tailwater effects associated with discharge from the South Ash Pond to the Discharge Channel were modeled using a fixed water surface elevation within the Discharge Channel and Cooling Pond. Appendix A presents the Hydrologic and

Hydraulic analysis report and documents assumptions, rainfall abstractions, drainage areas, and model results.

ROUTING RESULTS

The resulting peak water surface elevation for the 100-yr storm event based on the hydraulic and hydrologic analysis (Appendix A) is shown in **Table 2**. The South Ash Pond will effectively contain the 100-yr storm event assuming the SI is maintained at a normal operating elevation of 28.73 ft NGVD 29. With full containment of the design event, the South Ash Pond maintain a freeboard of 5 feet. Detailed results are presented in Appendix A.

Table 2 – Peak Elevations and Freeboard

Event	***Elevation (NGVD 29) (ft)***	***Free Board (ft)***
Normal Operating Condition	28.73	8.17
100-Yr, 72-Hr	31.81	5.09

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CERTIFICATION

This inflow design flood control system plan meets the requirements of this section (§257.82 Hydrologic and hydraulic capacity requirements for CCR impoundments.) of the Code of Federal Regulations Title 40, Part 257, Subpart D, and was prepared in accordance with current practices and the standard of care exercised by scientists and engineers performing similar tasks in the field of civil engineering, and no other warranty is provided in connection therewith. The contents of this report are based solely on the observations of the conditions observed by Geosyntec personnel and information provided to Geosyntec by Santee Cooper. Consistent with applicable professional standards of care, our opinions and recommendations were based in part on data furnished by others. Although we were not able to independently verify such data, we did evaluate it to determine whether it was consistent with other information that we developed in the course of our performance of the scope of services.

Certified by:

Carlos F. Benavente Date 10/12/2016

C. Fabian Benavente, P.E. South Carolina License Number 32067
Senior Engineer

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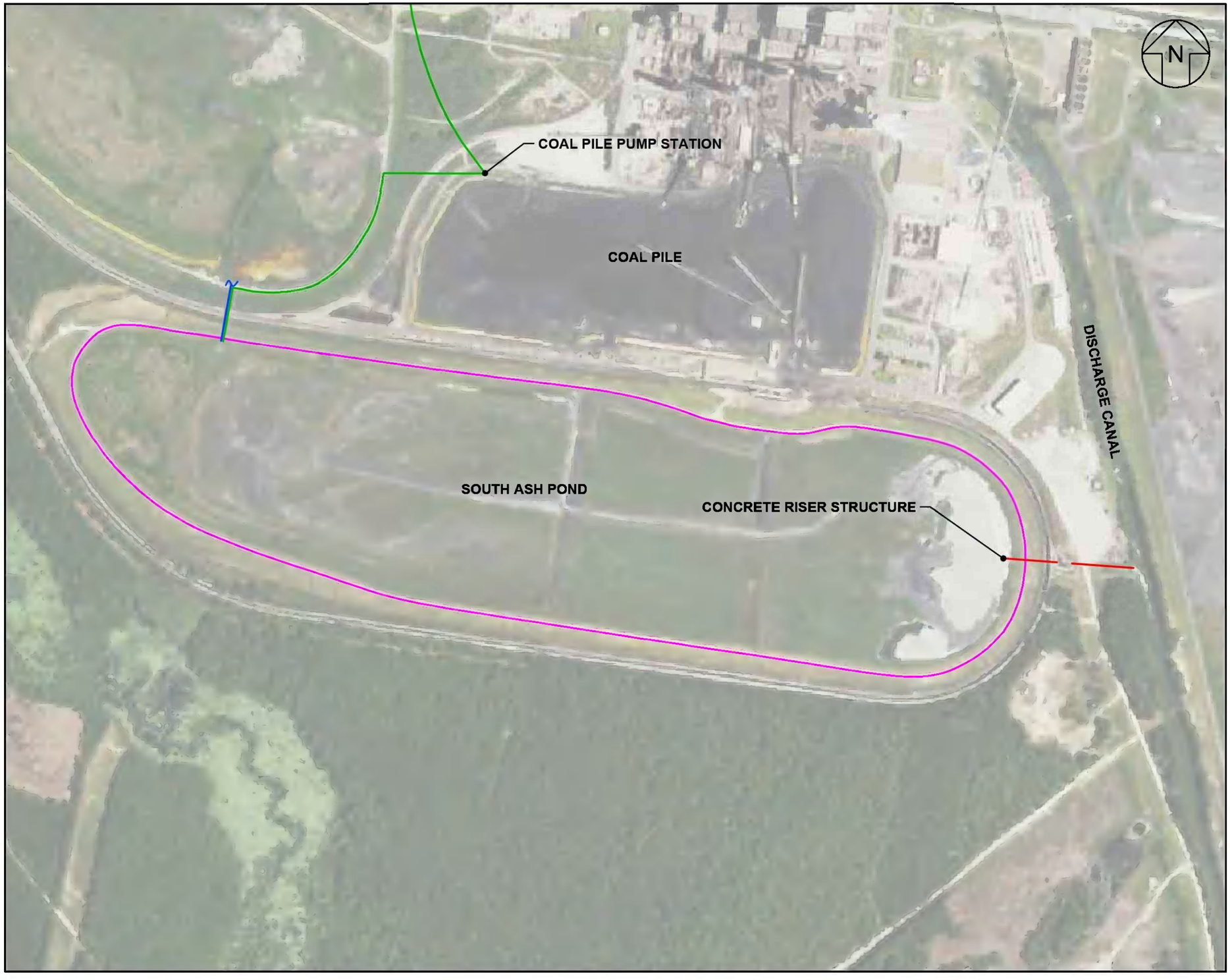
FIGURES



LEGEND

- POND BOUNDARY
- APPROXIMATE PIPE ALIGNMENT FROM COAL PILE PUMP STATION
- PIPE ALIGNMENT FOR ADDITIONAL PROCESS INFLOWS
- PIPE ALIGNMENT FROM DISCHARGE STRUCTURE TO DISCHARGE CANAL

0 400' 800'

SCALE IN FEET

WINYAH GENERATING STATION
SITE MAP

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FIGURE 1

M:\S\SANTEE COOPER\SANTEE COOPER-WINYAH\0028-WINYAH H&H ANALYSES\FIGURES\F-0-SC-585-00-F0028-020

APPENDIX A

Hydrologic and Hydraulic Analysis – South Ash Pond

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COMPUTATION COVER SHEET

Client:	Santee Cooper	Project:	Winyah Generating Station	Project/ Proposal No.:	GSC5242
				Task No.	01

Title of Computations: **Hydrologic and Hydraulic Analysis: South Ash Pond**

Computations by:	Signature	Sarah M. Herr	2/9/16
	Printed Name	Sarah Herr	Date
	Title	Senior Staff Engineer	
Assumptions and Procedures Checked by: (senior reviewer)	Signature	Brianna L. Wallace	10/11/16
	Printed Name	Brianna Wallace	Date
	Title	Senior Engineer	
Computations, Assumptions, and Procedures Checked by: (peer reviewer)	Signature		10/11/16
	Printed Name	Hari Parthasarathy	Date
	Title	Senior Staff Engineer	
Computations backchecked by: (originator)	Signature	Sarah M. Herr	10/11/16
	Printed Name	Sarah Herr	Date
	Title	Senior Staff Engineer	
Approved by: (pm or designate)	Signature	Brianna L. Wallace	10/11/16
	Printed Name	Brianna Wallace	Date
	Title	Senior Engineer	

Approval notes: _____

Revisions (number and initial all revisions)

No.	Sheet	Date	By	Checked by	Approval

Written by:	S. Herr	Date:	10/7/16	Reviewed by:	B. Wallace	Date:	10/7/16
Client:	Santee Cooper	Project:	Winyah Generating Station	Project/ Proposal No.:	GSC5242	Task No.:	01

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

PURPOSE AND BACKGROUND

Winyah Generating Station (WGS or the Site) is a coal-fired, electric generating facility located in Georgetown County, South Carolina. The Site is located between Pennyroyal and Turkey Creeks, tributaries to the Sampit River, and is approximately four miles southwest of Georgetown.

The purpose of this computation package is to evaluate the hydraulic capacity of the South Ash Pond to support spillway capacity assessment requirements, static factor of safety analyses, and hazard rankings required by the United States Environmental Protection Agency's (USEPA's) Coal Combustion Residuals (CCR) Rule. The South Ash Pond is regulated by the CCR Rule as an existing CCR surface impoundment. Under the CCR Rule, a low hazard ranking classification is associated with the 100 year (yr) precipitation event. Since the South Ash Pond is a low hazard surface impoundment, the 100 yr storm frequency is analyzed herein.

The South Ash Pond, encompassing approximately 76 acres (ac), is situated immediately south of the Coal Pile and power block and is encircled by a railroad that loops around the pond (Thomas and Hutton, 2012). (Note that 76 ac is the area contained within the dike crest boundary. The area of the limits of CCR is slightly less at approximately 75 ac.) The northern extent of the South Ash Pond is bounded by the rail line and Coal Pile, while the southern extent is bounded by a forested area. To the west, the South Ash Pond is bounded by Pennyroyal Creek and is bordered to the east by an access road and the Discharge Channel. The maximum height of the South Ash Pond perimeter dike is 22 feet (ft) (Thomas and Hutton, 2012). The minimum crest elevation of the South Ash Pond perimeter dikes is 36.9 ft National Geodetic Vertical Datum of 1929 (NGVD 29) (Thomas and Hutton, 2016). A Site Map including the surface impoundment and hydraulic features associated with the South Ash Pond is provided in **Figure 1**.

The South Ash Pond impounds CCRs in the form of fly ash, boiler slag, and bottom ash. The South Ash Pond also receives low volume wastewater and other process water inflows described herein. Additionally, the South Ash Pond receives contact stormwater from the Coal Pile. Decanted water is discharged through a riser structure and outlet pipe approximately 350 ft in length to the Discharge Canal (Lockwood Greene, 1978).

METHODOLOGY

Stormwater runoff volumes and associated discharges to the South Ash Pond were modeled using *HydroCAD Version 10.0* software (HydroCAD, 2011). *HydroCAD* utilizes frequency-based precipitation events, in conjunction with watershed properties, to calculate peak runoff by several accepted methods. The Soil Conservation Service (SCS) Technical Release 20 (TR-20) method was applied in *HydroCAD* to calculate stormwater runoff volumes (SCS, 1982).

The following parameters and assumptions were selected for calculating stormwater runoff volumes to the South Ash Pond.

Rainfall

The 72 hour (hr) duration precipitation event was used in this analysis. The rainfall depth corresponding to the 72 hr duration precipitation event for the 100 yr frequency return period for the Site is 12.8 inches (in.) (NOAA, 2006). The design storm hyetograph was developed using SCS Type III rainfall distribution and was directly input to the *HydroCAD* model.

Drainage Areas and Curve Numbers

The contributing watershed area for the South Ash Pond is 75.6 ac (Thomas and Hutton, 2012). The area was delineated using the dike crests to correspond to the pond's direct drainage area. The pond was assigned a curve number (CN) based on guidance provided in Technical Release 55 (TR-55) (SCS, 1986) representing the type of ground cover in that area. The South Ash Pond was assumed to be approximately 82% ash (CN = 87), 7% sparse vegetation (CN = 68), and 11% water (CN = 100) (Weighted CN = 87). The contributing watershed area and CN is summarized in **Table 1** and was directly input into the *HydroCAD* model.

Times of Concentration Calculations

The time of concentration represents the time required for runoff to flow from the most hydraulically remote point of the drainage area to the point under investigation. The flow path from the most remote point within the South Ash Pond is characterized by sheet flow and shallow concentrated flow (shown in **Figure 2**).

HydroCAD applied the Overton and Meadows formulation to calculate travel time for sheet flow for distances less than 300 ft (NRCS, 2010):

$$T_t = \frac{0.007(nL)^{0.8}}{P_{2-24}^{0.5} S^{0.4}}$$

where:

T_t = travel time for overland sheet flow (hr);

n = Manning's roughness coefficient for sheet flow (--);

L = flow length (ft);

$P_{2\text{-}24}$ = 2 yr, 24 hr rainfall (in.); and

S = slope of hydraulic grade line (or land slope) (feet per feet [ft/ft]).

A Manning's roughness coefficient of 0.020 was used to represent sheet flow in the South Ash Pond. The sheet flow length was limited to 100 ft, because sheet flow beyond 100 ft typically transitions to shallow concentrated flow. The rainfall depth for the 2 yr, 24 hr frequency storm event is 4.38 in. (NOAA, 2006). The parameters used to model sheet flow within the South Ash Pond are shown in **Table 2**.

Shallow concentrated flow travel time was computed using the Upland Method (NRCS, 2010).

$$T_t = \frac{L}{V}$$

where:

T_t = travel time (seconds [s]);

L = flow length (ft); and

V = average velocity (feet per second [ft/s]).

The average velocity was computed using the following equation (NRCS, 2010).

$$V = K_v S^{0.5}$$

where: V = average velocity (ft/s);

K_v = velocity factor (ft/s); and

S = slope of hydraulic grade line (or land slope) (ft/ft).

A velocity factor of 16.1 ft/s, representing flow across an unpaved surface, was used to calculate shallow concentrated flow travel time within the South Ash Pond. The parameters used to describe shallow concentrated flow within the South Ash Pond are presented in **Table 2**. The computed times of concentration for the South Ash Pond are summarized in **Table 3**.

Inflows

In the *HydroCAD* model, stormwater inflow associated with the South Ash Pond is represented by Sub-Catchment 2S. Pond 1P represents the South Ash Pond. In addition to stormwater inflow, process water is discharged to the South Ash Pond. The process water flows corresponding to Units 3 and 4 hydroveyor water, Units 3 and 4 low volume wastewater, and SEFA Star II Scrubber blowdowns are represented by Nodes 3L, 4L, and 5L, respectively. The base inflows are modeled as 2,180 gallons per minute (gpm) (4.86 cubic feet per second [cfs]) from the Units 3 and 4 hydroveyor water, 540 gpm (1.20 cfs) from the Units 3 and 4 low volume wastewater, and 20 gpm (4.46E-02 cfs) from the SEFA Star II Scrubber blowdowns (Santee Cooper, 2015). During storm events, the South Ash Pond receives contact stormwater from the Coal Pile, represented by Node 6L in the *HydroCAD* model. This base inflow is modeled as 2,450 gpm (5.46 cfs) (Santee Cooper, 2014). The *HydroCAD* model routing diagram is provided in **Appendix A**.

Storage Capacities

The available stormwater storage volume of the South Ash Pond between elevations 12.0 ft and 36.9 ft NGVD 29 was calculated by developing an area-volume curve based on topographic and bathymetric data (Thomas and Hutton, 2012; Thomas and Hutton, 2016). The lowest contour within the South Ash Pond is 12.0 ft NGVD 29. The minimum crest elevation of the South Ash Pond perimeter dikes is 36.9 ft NGVD 29. The surface area of each contour was measured and tabulated at each elevation. The available surface water

volume in each depth increment was calculated by averaging the surface area of the upper and lower contour and multiplying by the change in elevation between each contour. The cumulative storage volume of the South Ash Pond between these elevations is 295.6 acre-feet (ac-ft). The South Ash Pond is maintained at a normal operational pool elevation of 28.73 ft NGVD 29 (Thomas and Hutton, 2016). As a result, the starting elevation of Pond 1P is set to 28.73 ft NGVD 29. The area-volume data are presented in **Table 4**.

Outlet Structures

The normal operating level in the South Ash Pond is maintained by a rectangular concrete riser structure with 4 ft long stop logs on a single face. The top stop log elevation is 28.73 ft NGVD 29 (Thomas and Hutton, 2016). A 36 in. diameter reinforced concrete pipe with an upstream invert elevation of 16.93 ft NGVD 29 conveys water from the riser structure to the Discharge Canal (Lockwood Greene, 1978; Thomas and Hutton, 2016).

The tailwater effects associated with discharge from the South Ash Pond to the Discharge Canal were modeled using a fixed water surface elevation within the Discharge Canal and Cooling Pond. This tailwater surface elevation was estimated by conservatively assuming 2.5 ft depth of water over the Cooling Pond emergency spillway during the 100 yr storm event. The top of the stop log bolted to the top of the concrete spillway of the Cooling Pond is at elevation 21.65 ft NGVD 29 (Thomas and Hutton, 2015). The water surface of the Discharge Canal and Cooling Pond was assumed to be at 24.15 ft NGVD 29 (21.65 ft NGVD 29 plus an additional 2.5 ft of water). The tailwater effects associated with the Discharge Canal and Cooling Pond are represented by Node 7L in the *HydroCAD* model.

RESULTS

The resulting peak water surface elevation and storage volume for the 100 yr storm event is shown in **Table 5**. The South Ash Pond will effectively contain the 100 yr storm event. This hydrologic and hydraulic analysis demonstrates that the South Ash Pond contains the 72 hr duration precipitation event for the 100 yr frequency return period assuming the South Ash Pond is maintained at a normal operating elevation of 28.73 ft NGVD 29.

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TABLES

Table 1 – Watershed Area and Curve Number

Drainage Basin	Area (ac)	Weighted Curve Number (--)
South Ash Pond	75.614	87

Table 2 – Input Parameters Describing Sheet Flow and Shallow Concentrated Flow

Flow Path	Sheet Flow				Shallow Concentrated Flow		
	Land Slope (ft/ft)	*Manning's Roughness Coefficient (--)*	*Flow Length (ft)*	*2 Yr, 24 Hr Rainfall (in.)*	*Flow Length (ft)*	*Land Slope (ft/ft)*	*Velocity Factor (ft/s)*
South Ash Pond							
Sheet	0.0525	0.020	100	4.38	--	--	--
Shallow Concentrated	--	--	--	--	2,200	0.0036	16.1

Table 3 – Times of Concentration

Flow Path	Time of Concentration (minutes [min])
South Ash Pond	
Sheet	1.1
Shallow Concentrated	38.0

Table 4 – Stage Storage Table (Thomas and Hutton, 2012; Thomas and Hutton, 2016)

South Ash Pond			
Elevation (NGVD 29) (ft)	*Area (ac)*	*Volume (ac-ft)*	*Cumulative Volume (ac-ft)*
36.9	60.2	52.4	295.6
36	56.3	97.3	243.2
34	41.0	61.8	145.9
32	20.8	31.1	84.0
30	10.3	16.7	53.0
28	6.5	11.7	36.2
26	5.2	9.4	24.5
24	4.2	7.2	15.2
22	3.1	5.2	7.9
20	2.1	2.4	2.8
18	0.31	0.35	0.40
16	0.033	0.040	0.048
14	0.007	0.008	0.008
12	0.001	0.000	0.000

Table 5 – Peak Elevations and Volumes

Storm Event	South Ash Pond		
	Elevation (NGVD 29) (ft)	*Volume (ac-ft)*	*Time (hr)*
100-Yr, 72-Hr	31.81	80.191	38.08

FIGURES

LEGEND

- POND BOUNDARY
- APPROXIMATE PIPE ALIGNMENT FROM COAL PILE PUMP STATION
- PIPE ALIGNMENT FOR ADDITIONAL PROCESS INFLOWS
- PIPE ALIGNMENT FROM DISCHARGE STRUCTURE TO DISCHARGE CANAL

0 400' 800'

SCALE IN FEET

WINYAH GENERATING STATION
SITE MAP

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FIGURE 1

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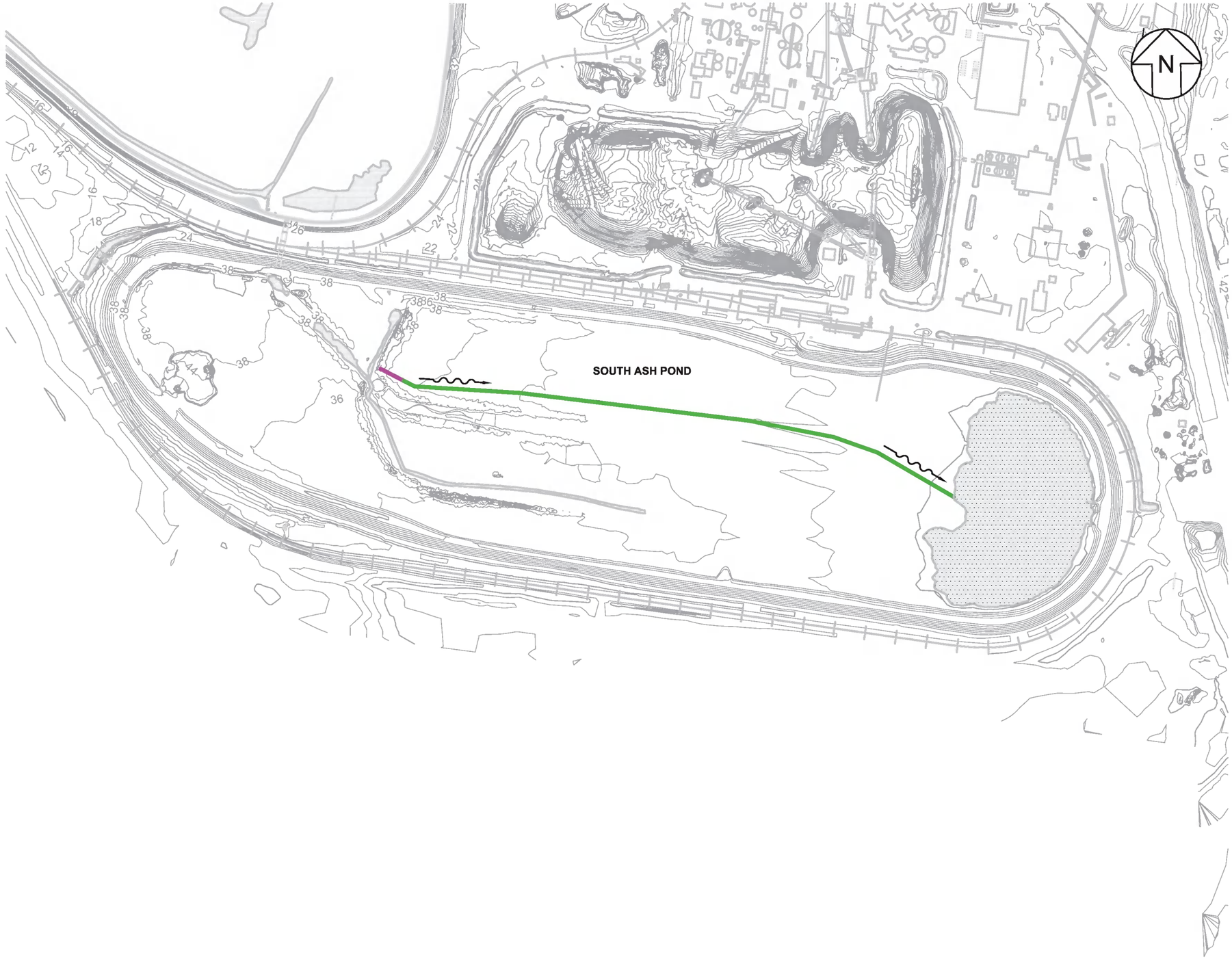

LEGEND

- SHEET FLOW
- SHALLOW CONCENTRATED FLOW
- GENERAL FLOW DIRECTION

0 400' 800'

SCALE IN FEET

WINYAH GENERATING STATION
SOUTH ASH POND FLOW PATH

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FIGURE 2

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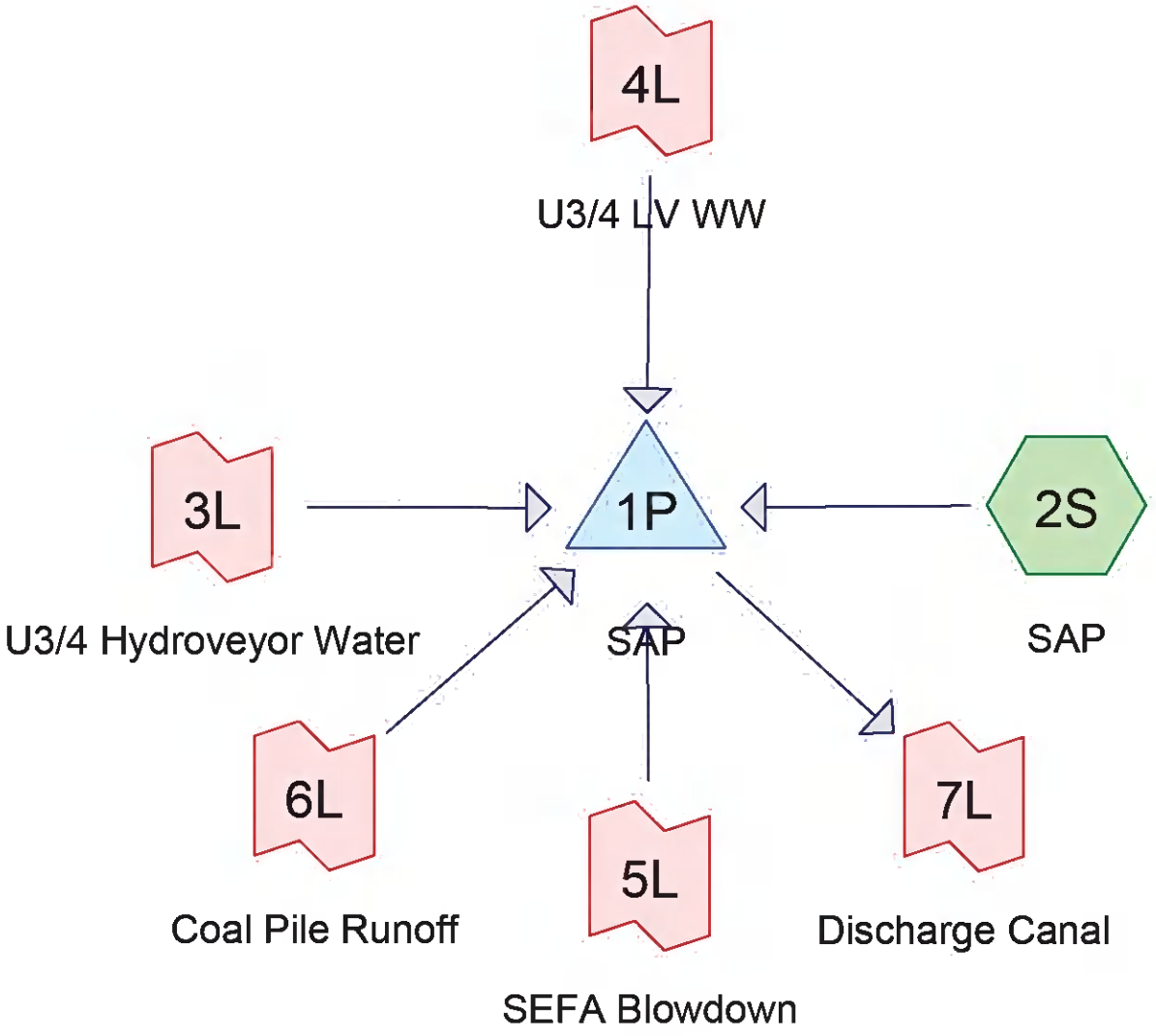
APPENDICES

APPENDIX A



Subcat Reach Pond Link

Routing Diagram for South Ash Pond
Prepared by Geosyntec Consultants, Printed 10/11/2016

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
75.614	87	11% water, 82% CCR, 7% shrubs (2S)

Time span=0.00-999.00 hrs, dt=0.01 hrs, 99901 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment2S: SAP Runoff Area=75.614 ac 0.00% Impervious Runoff Depth=11.17"
Flow Length=2,300' Tc=39.1 min CN=87 Runoff=245.16 cfs 70.362 af

Pond 1P: SAP Peak Elev=31.81' Storage=80.191 af Inflow=256.73 cfs 930.950 af
Outflow=59.83 cfs 930.936 af

Link 3L: U3/4 HydroveyorWater Manual Hydrograph Inflow=4.86 cfs 361.492 af
Primary=4.86 cfs 361.492 af

Link 4L: U3/4 LV WW Manual Hydrograph Inflow=1.20 cfs 89.257 af
Primary=1.20 cfs 89.257 af

Link 5L: SEFA Blowdown Manual Hydrograph Inflow=0.05 cfs 3.719 af
Primary=0.05 cfs 3.719 af

Link 6L: Coal Pile Runoff Manual Hydrograph Inflow=5.46 cfs 406.120 af
Primary=5.46 cfs 406.120 af

Link 7L: DischargeCanal Inflow=59.83 cfs 930.936 af
Primary=59.83 cfs 930.936 af

Summary for Subcatchment 2S: SAP

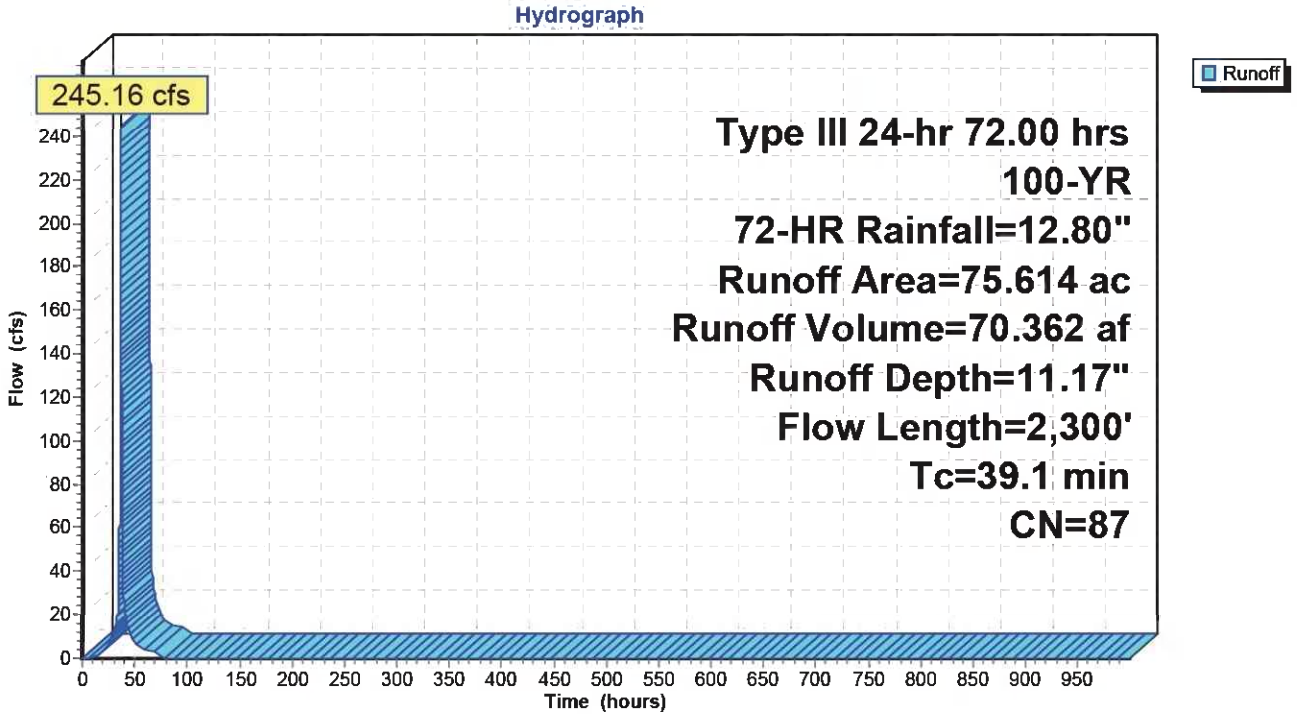
Runoff = 245.16 cfs @ 36.53 hrs, Volume= 70.362 af, Depth=11.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-999.00 hrs, dt= 0.01 hrs
Type III 24-hr 72.00 hrs 100-YR, 72-HR Rainfall=12.80"

	Area (ac)	CN	Description
*	75.614	87	11% water, 82% CCR, 7% shrubs
	75.614		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	100	0.0525	1.47		**Sheet Flow, Sheet Flow** n= 0.020 P2= 4.38"
38.0	2,200	0.0036	0.97		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
39.1	2,300	Total			

Subcatchment 2S: SAP



Summary for Pond 1P: SAP

Inflow Area = 75.614 ac, 0.00% Impervious, Inflow Depth = 147.74" for 100-YR, 72-HR event
Inflow = 256.73 cfs @ 36.53 hrs, Volume= 930.950 af
Outflow = 59.83 cfs @ 38.08 hrs, Volume= 930.936 af, Atten= 77%, Lag= 93.3 min
Primary = 59.83 cfs @ 38.08 hrs, Volume= 930.936 af

Routing by Stor-Ind method, Time Span= 0.00-999.00 hrs, dt= 0.01 hrs
Starting Elev= 28.73' Surf.Area= 7.854 ac Storage= 41.444 af
Peak Elev= 31.81' @ 38.08 hrs Surf.Area= 19.797 ac Storage= 80.191 af (38.747 af above start)

Plug-Flow detention time= 2,926.1 min calculated for 889.478 af (96% of inflow)
Center-of-Mass det. time= 517.5 min (25,653.1 - 25,135.6)

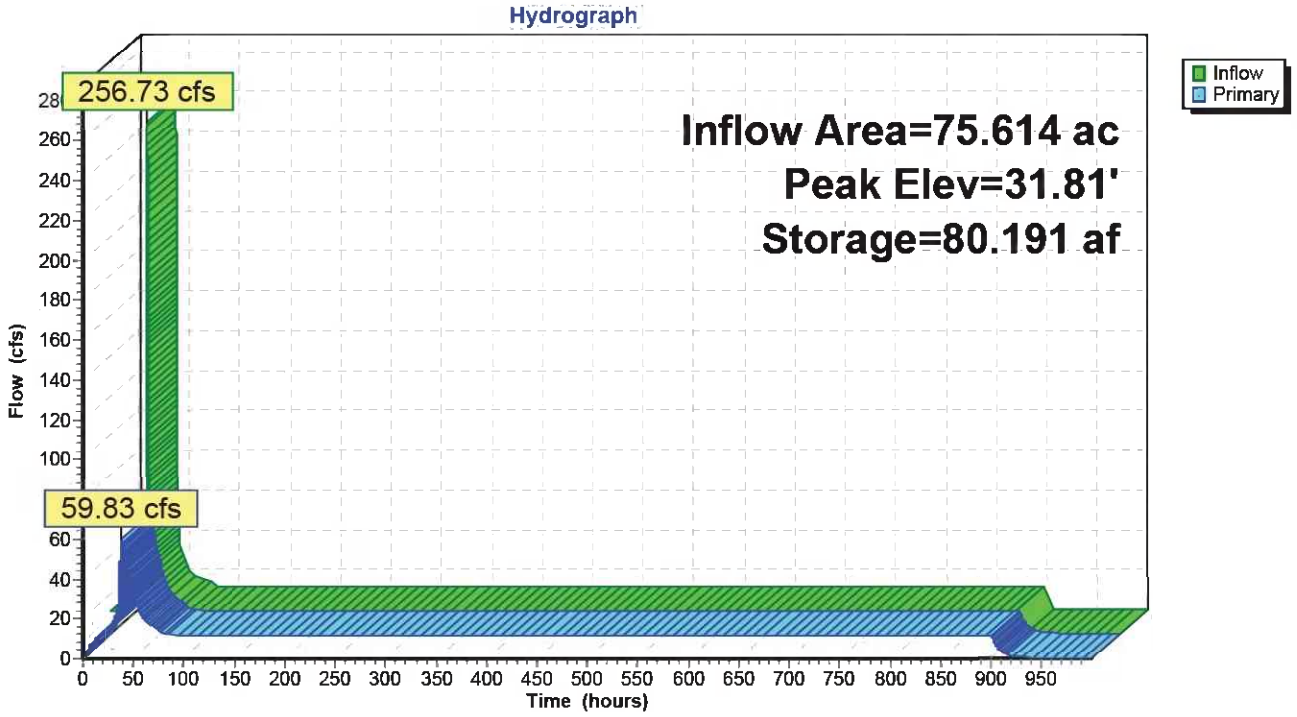
Volume	Invert	Avail.Storage	Storage Description
#1	12.00'	295.584 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
12.00	0.001	0.000	0.000
14.00	0.007	0.008	0.008
16.00	0.033	0.040	0.048
18.00	0.314	0.347	0.395
20.00	2.071	2.385	2.780
22.00	3.080	5.151	7.931
24.00	4.152	7.232	15.163
26.00	5.225	9.377	24.540
28.00	6.456	11.681	36.221
30.00	10.286	16.742	52.963
32.00	20.794	31.080	84.043
34.00	41.028	61.822	145.865
36.00	56.283	97.311	243.176
36.90	60.180	52.408	295.584

Device	Routing	Invert	Outlet Devices
#1	Primary	16.93'	**36.0" Round Culvert** L= 350.0' RCP, groove end w/headwall, Ke= 0.200 Inlet / Outlet Invert= 16.93' / 16.93' S= 0.0000 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 7.07 sf
#2	Device 1	28.73'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=59.82 cfs @ 38.08 hrs HW=31.81' (Free Discharge)
↑—**1=Culvert** (Passes 59.82 cfs of 101.09 cfs potential flow)
↑—**2=Sharp-Crested Rectangular Weir** (Weir Controls 59.82 cfs @ 5.74 fps)

Pond 1P: SAP


Hydrograph
256.73 cfs
59.83 cfs
Inflow Area=75.614 ac
Peak Elev=31.81'
Storage=80.191 af
Inflow
Primary
Flow (cfs)
Time (hours)
0 20 40 60 100 120 140 160 180 200 220 240 260 28
0 50 100 150 200 250 300 350 400 450 500 550 600 650 700 750 800 850 900 950

Summary for Link 3L: U3/4 Hydroveyor Water

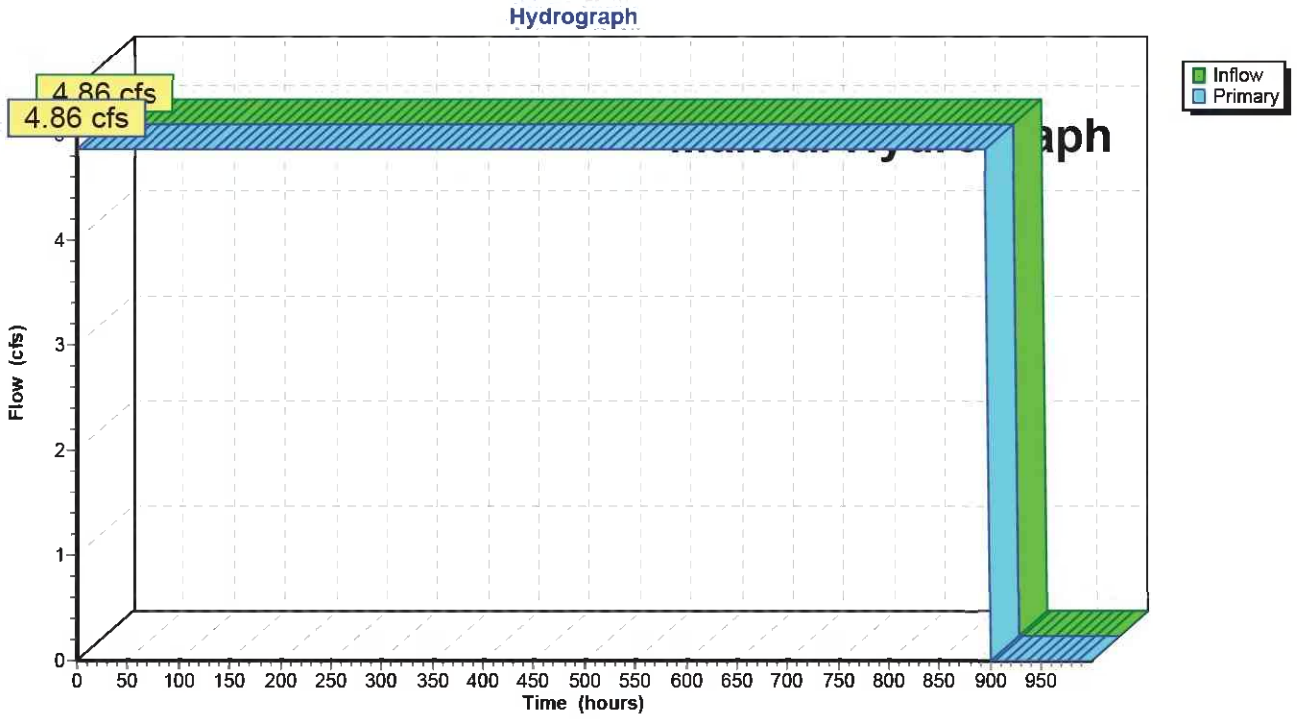
Inflow = 4.86 cfs @ 0.00 hrs, Volume= 361.492 af
Primary = 4.86 cfs @ 0.00 hrs, Volume= 361.492 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-999.00 hrs, dt= 0.01 hrs

19 Point manual hydrograph, To= 0.00 hrs, dt= 50.00 hrs, cfs =

4.86	4.86	4.86	4.86	4.86	4.86	4.86	4.86	4.86	4.86
4.86	4.86	4.86	4.86	4.86	4.86	4.86	4.86	4.86	

Link 3L: U3/4 Hydroveyor Water



Summary for Link 4L: U3/4 LV WW

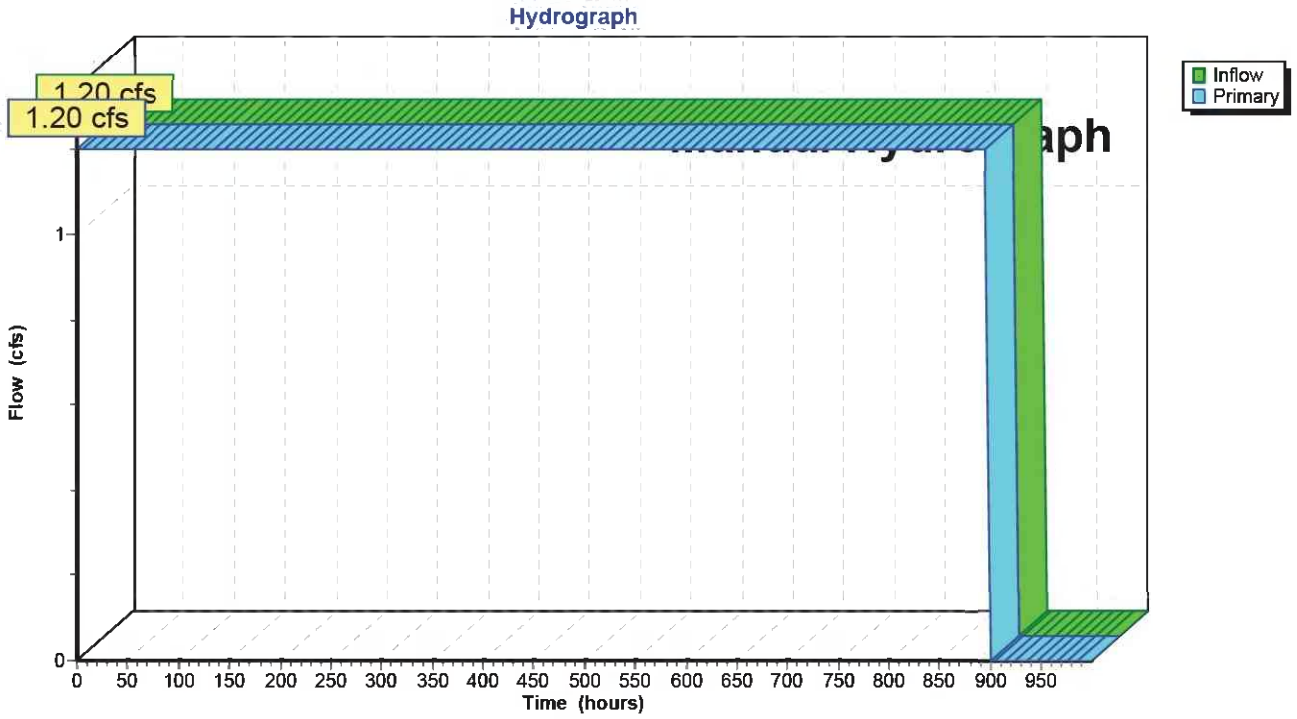
Inflow = 1.20 cfs @ 0.00 hrs, Volume= 89.257 af
Primary = 1.20 cfs @ 0.00 hrs, Volume= 89.257 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-999.00 hrs, dt= 0.01 hrs

19 Point manual hydrograph, To= 0.00 hrs, dt= 50.00 hrs, cfs =

1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20
1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	

Link 4L: U3/4 LV WW



Summary for Link 5L: SEFA Blowdown

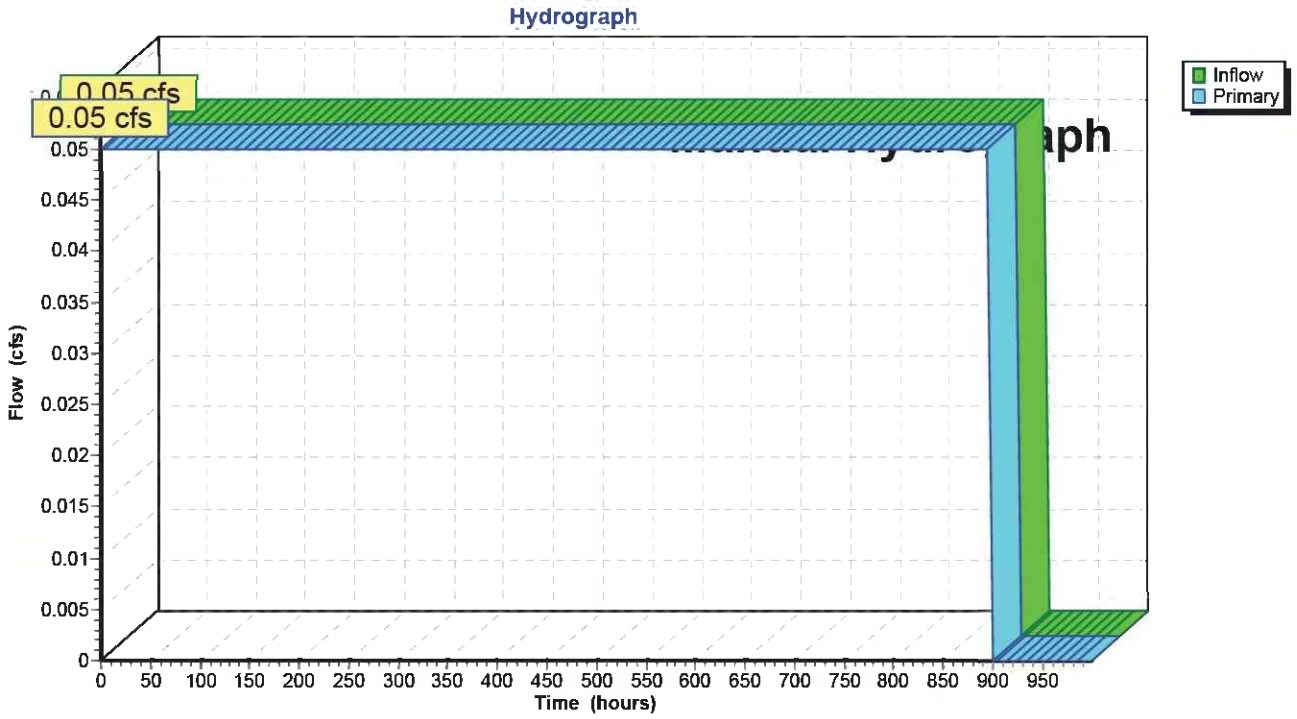
Inflow = 0.05 cfs @ 0.00 hrs, Volume= 3.719 af
Primary = 0.05 cfs @ 0.00 hrs, Volume= 3.719 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-999.00 hrs, dt= 0.01 hrs

19 Point manual hydrograph, To= 0.00 hrs, dt= 50.00 hrs, cfs =

0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	

Link 5L: SEFA Blowdown



Summary for Link 6L: Coal Pile Runoff

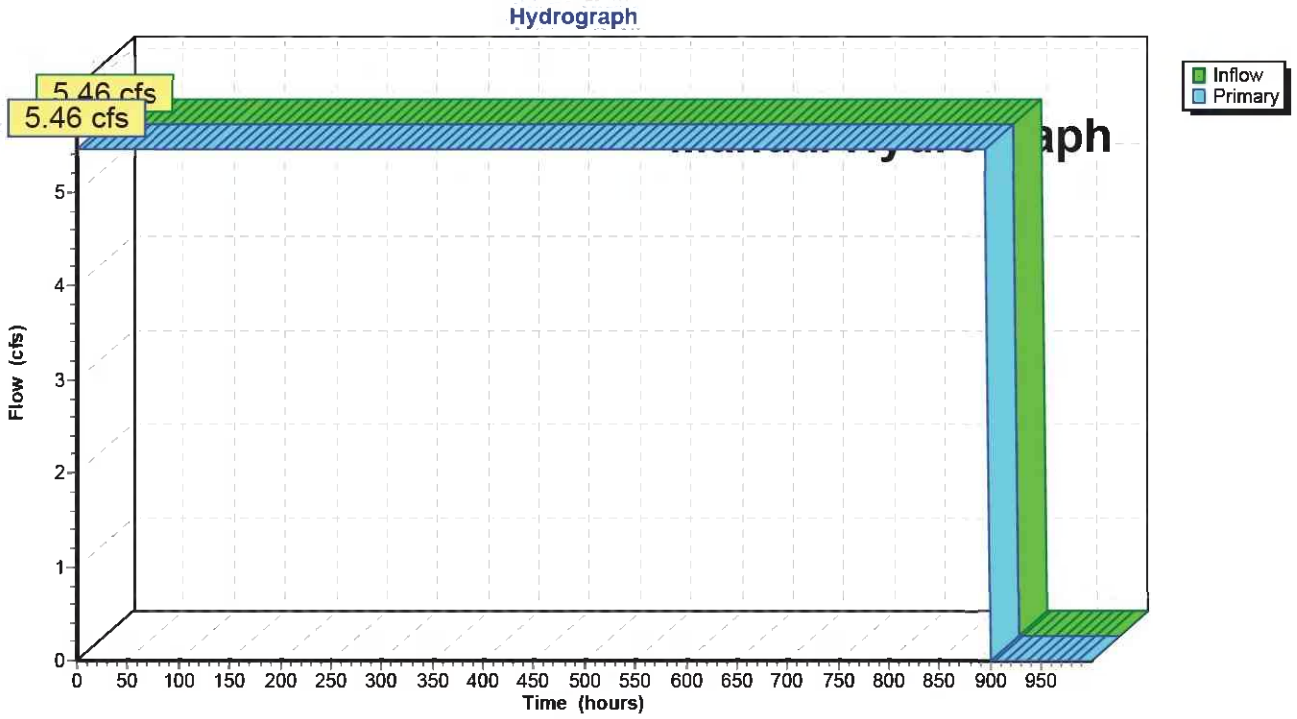
Inflow = 5.46 cfs @ 0.00 hrs, Volume= 406.120 af
Primary = 5.46 cfs @ 0.00 hrs, Volume= 406.120 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-999.00 hrs, dt= 0.01 hrs

19 Point manual hydrograph, To= 0.00 hrs, dt= 50.00 hrs, cfs =

5.46	5.46	5.46	5.46	5.46	5.46	5.46	5.46	5.46	5.46
5.46	5.46	5.46	5.46	5.46	5.46	5.46	5.46	5.46	

Link 6L: Coal Pile Runoff



Summary for Link 7L: Discharge Canal

[79] Warning: Submerged Pond 1P Primary device # 1 by 7.22'

Inflow Area = 75.614 ac, 0.00% Impervious, Inflow Depth > 147.74" for 100-YR, 72-HR event
Inflow = 59.83 cfs @ 38.08 hrs, Volume= 930.936 af
Primary = 59.83 cfs @ 38.08 hrs, Volume= 930.936 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-999.00 hrs, dt= 0.01 hrs

Fixed water surface Elevation= 24.15'

Link 7L: Discharge Canal