MEMORANDUM

16 October 2016
File No. 128064-003

SUBJECT: Inflow Design Flood Control System Plan
Pond 001 - Cell 003
Associated Electric Cooperative, Inc.
Thomas Hill Energy Center
Clifton Hill, Missouri

Haley & Aldrich, Inc. (Haley & Aldrich) has developed this Inflow Design Flood (IDF) Control System Plan (Plan) on behalf of Associated Electric Cooperative, Inc. (AECI) for the existing coal combustion residuals (CCR) surface impoundment referred to as Pond 1 - Cell 003 (Cell 003) at the Thomas Hill Energy Center (THEC) in Clifton Hill, Missouri. This has been completed based on requirements of the Environmental Protection Agency (EPA) 40 CFR Parts 257 and 261, “Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities” (CCR Rule), specifically section §257.82. The Cell 003 existing conditions and supporting documentation has been reviewed and associated stormwater modeling and analysis performed to satisfy the Inflow Design Flood Control System Plan requirements of CCR Rule section §257.82 as described below.

§257.82(a): 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 (a)(2) of this section.

§257.82(a)(1): The inflow design flood control system must adequately manage flow into the CCR unit during and following the peak discharge of the inflow design flood specified in paragraph (a)(3) of this section.

Cell 003 is used for wet storage of fly ash, bottom ash, boiler slag and sediments from the coal pile runoff. Cell 003 receives decant water and suspended CCR from Cell 001 via an earthen bypass channel which flows from Cell 001 and around inactive/closed Cell 002, discharging into the northwest corner of Cell 003. In addition, stormwater from Cell 002 eastern basin flows to Cell 003, discharging from a submerged pipe in the northeast corner of the impoundment. Water and suspended CCR enter a rectangular concrete decant structure equipped with 60-inch wide concrete stop logs, and flow via a 48-in. diameter concrete outlet pipe which discharges into Cell 004. Water can also discharge to Pond 001 – Cell 004 via the 2-ft. deep trapezoidal emergency spillway.

Hydrologic and hydraulic modeling for this Cell 003 IDF Control System Plan was performed using HydroCAD Stormwater Modeling System, version 10.00-12 (HydroCAD) in conjunction with
the appropriate IDF as determined per the Hazard Potential Classification Assessment performed under separate cover.

When Cell 003 is maintained at its normal water surface elevation (WSEL) (El. 739.0), the results of the HydroCAD analysis confirm the IDF control system for Cell 003 adequately manage flow into the impoundment during and following the IDF peak discharge. Table 1 summarizes the effects of the IDF peak discharge during normal operation of the impoundment. The output from the two HydroCAD model simulations is provided as Appendix 1. See Figure 1 for the Pond Cell 003 existing site plan.

Table 1: HydroCAD Output Summary

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak flood level (ft)</td>
<td>714.5</td>
</tr>
<tr>
<td>Minimum Dike Elevation</td>
<td>716.0</td>
</tr>
<tr>
<td>Minimum freeboard (ft)</td>
<td>1.5</td>
</tr>
<tr>
<td>Peak inflow (cfs)</td>
<td>570.3</td>
</tr>
</tbody>
</table>

§257.82(a)(2): The inflow design flood control system must adequately manage flow from the CCR unit to collect and control the peak discharge resulting from the inflow design flood specified in paragraph (a)(3) of this section.

The outlet control structure is detailed in the Burns & McDonnell Ash Grading Plan Area No. 1 dated 06 June 1984 and the GEI Specific Site Assessment for Coal Combustion Waste – Impoundments at Thomas Hill Energy Center dated June 2011. Pertinent pages providing the required information have been provided as Appendix 2. Based on the HydroCAD analysis, the IDF control system for Cell 003 was determined to adequately manage flow from the impoundment by collecting and controlling the IDF peak discharge. The peak level and resulting freeboard in Cell 003 during the 100-year flood is noted in Table 1 (above). The HydroCAD model simulation output is provided as Appendix 1.

§257.82(a)(3): The inflow design flood is:

i. For a high hazard potential CCR surface impoundment, as determined under § 257.73(a)(2) or § 257.74(a)(2), the probable maximum flood;

ii. For a significant hazard potential CCR surface impoundment, as determined under § 257.73(a)(2) or § 257.74(a)(2), the 1,000-year flood;

iii. For a low hazard potential CCR surface impoundment, as determined under § 257.73(a)(2) or § 257.74(a)(2), the 100-year flood; or

iv. For an incised CCR surface impoundment, the 25-year flood.

Cell 003 was determined to be low hazard potential; therefore, the inflow design flood is the 100-year storm. The basis of the determination is discussed in Initial Hazard Potential Classification.
Assessment, Cell 003 dated October 2016. The 100-year storm characteristics were detailed in the NOAA Atlas 14 Point Precipitation Frequency Estimates: MO dated 27 August 2014 and prepared by the National Weather Service. Pertinent pages providing the required information have been provided as Appendix 3.

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

§257.3-3(a): For purposes of section 4004(a) of the Act, a facility shall not cause a discharge of pollutants into waters of the United States that is in violation of the requirements of the National Pollutant Discharge Elimination System (NPDES) under section 402 of the Clean Water Act, as amended.

§257.3-3(b): For purposes of section 4004(a) of the Act, a facility shall not cause a discharge of dredged material or fill material to waters of the United States that is in violation of the requirements under section 404 of the Clean Water Act, as amended.

§257.3-3(c): A facility or practice shall not cause non-point source pollution of waters of the United States that violates applicable legal requirements implementing an areawide or Statewide water quality management plan that has been approved by the Administrator under section 208 of the Clean Water Act, as amended.

Discharge from the Cell 003 is managed through plant National Pollution Discharge Elimination System permit which was prepared by the Missouri Department of Natural Resources. Pertinent pages providing the required information have been provided as Appendix 4.

§257.82(c)(1): Content of the plan. The owner or operator must prepare initial and periodic inflow design flood control system plans for the CCR unit according to the timeframes specified in paragraphs (c)(3) and (4) of this section. These plans must document how the inflow design flood control system has been designed and constructed to meet the requirements of this section. Each plan must be supported by appropriate engineering calculations. The owner or operator of the CCR unit has completed the inflow design flood control system plan when the plan has been placed in the facility’s operating record as required by § 257.105(g)(4).

This document and all attachments serve as the initial IDF Plan. Periodic inflow design flood control system plans will be prepared and placed in the facility operating record at 5-year increments or whenever there is a change in conditions that would affect the Plan.

§257.82(c)(2): Amendment of the plan. The owner or operator of the CCR unit may amend the written inflow design flood control system plan at any time provided the revised plan is placed in the facility’s
operating record as required by § 257.105(g)(4). The owner or operator must amend the written inflow design flood control system plan whenever there is a change in conditions that would substantially affect the written plan in effect.

The IDF Plan will be amended at least 60 days prior to a planned change in the operation of the facility or the CCR impoundment, or no later than 60 days after an unanticipated event requires the need to revise the IDF Plan. If the Plan needs to be revised after closure activities have commenced, the Plan will be revised no later than 30 days following the triggering event.

Any amendments to the Plan will include written certification from a qualified professional engineer that the initial and any amendments to the IDF Plan meet the requirements of the CCR Rule.

A record of amendments to the Plan will be tracked below. The latest version of the IDF Plan will be noted on the front cover of the Plan.

<table>
<thead>
<tr>
<th>Version</th>
<th>Date</th>
<th>Description of Changes Made</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>16 October 2016</td>
<td>Initial Issuance</td>
</tr>
</tbody>
</table>

§257.82(c)(3): Timeframes for preparing the initial plan

i. Existing CCR surface impoundments. The owner or operator of the CCR unit must prepare the initial inflow design flood control system plan no later than October 17, 2016.

This IDF Plan has been prepared within the specified timeframe.

ii. New CCR surface impoundments and any lateral expansion of a CCR surface impoundment. The owner or operator must prepare the initial inflow design flood control system plan no later than the date of initial receipt of CCR in the CCR unit.

N/A – Cell 003 is an existing CCR impoundment.

§257.82(c)(4): Frequency for revising the plan. The owner or operator must prepare periodic inflow design flood control system plans required by paragraph (c)(1) of this section every five years. The date of completing the initial plan is the basis for establishing the deadline to complete the first periodic plan.
The owner or operator may complete any required plan prior to the required deadline provided the owner or operator places the completed plan into the facility’s operating record within a reasonable amount of time. In all cases, the deadline for completing a subsequent plan is based on the date of completing the previous plan. For purposes of this paragraph (c)(4), the owner or operator has completed an inflow design flood control system plan when the plan has been placed in the facility’s operating record as required by § 257.105(g)(4).

This IDF Plan or any subsequent IDF Plan will be assessed and amended whenever there is a change in operation of the CCR impoundment that would substantially affect the IDF Plan or when unanticipated events necessitate a revision of the Plan either before or after closure activities have commenced.

§257.82(c)(5): The owner or operator must obtain a certification from a qualified professional engineer stating that the initial and periodic inflow design flood control system plans meet the requirements of this section.

I certify that the design of the flood control system referenced in this Inflow Design Flood Control System Plan for AECI’s Pond 001 - Cell 003 at the Thomas Hill Energy Center meets the USEPA’s CCR Rule requirements of §257.82.

Signed: ____________________________

Consulting Engineer

Print Name: Steven F. Putrich
Missouri License No.: 2014035813
Title: Project Principal
Company: Haley & Aldrich, Inc.

Professional Engineer’s Seal

Cc: Kim Dickerson-AECI; Jason Pokorny-Haley & Aldrich
Appendix 1
### Area Listing (all nodes)

<table>
<thead>
<tr>
<th>Area (acres)</th>
<th>CN</th>
<th>Description</th>
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<tbody>
<tr>
<td>61.372</td>
<td>84</td>
<td>50-75% Grass cover, Fair, HSG D (1RS, 2RS, C2ES, C2WS, C3S, TPS)</td>
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<tr>
<td>67.122</td>
<td>93</td>
<td>Urban industrial, 72% imp, HSG D (CPS)</td>
</tr>
<tr>
<td>17.863</td>
<td>98</td>
<td>Water Surface, HSG A (C2ES, C2WS, C3S)</td>
</tr>
<tr>
<td><strong>146.357</strong></td>
<td>90</td>
<td><strong>TOTAL AREA</strong></td>
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### Soil Listing (all nodes)

<table>
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<tr>
<th>Area (acres)</th>
<th>Soil Group</th>
<th>Subcatchment Numbers</th>
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<tr>
<td>17.863</td>
<td>HSG A</td>
<td>C2ES, C2WS, C3S</td>
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<tr>
<td>0.000</td>
<td>HSG B</td>
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<tr>
<td>0.000</td>
<td>HSG C</td>
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<tr>
<td>128.494</td>
<td>HSG D</td>
<td>1RS, 2RS, C2ES, C2WS, C3S, CPS, TPS</td>
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<tr>
<td>0.000</td>
<td>Other</td>
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<tr>
<td><strong>146.357</strong></td>
<td>TOTAL AREA</td>
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<td>Subcatchment Numbers</td>
<td>Ground Covers (all nodes)</td>
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<td></td>
<td>HSG-A (acres)</td>
<td>HSG-B (acres)</td>
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<td>0.000</td>
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<tr>
<td></td>
<td>0.000</td>
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<td></td>
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## Pipe Listing (all nodes)

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<th>Node</th>
<th>In-Invert (feet)</th>
<th>Out-Invert (feet)</th>
<th>Length (feet)</th>
<th>Slope (ft/ft)</th>
<th>Diam/Width (inches)</th>
<th>Height (inches)</th>
<th>Inside-Fill (inches)</th>
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<td>733.00</td>
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<td>0.0100</td>
<td>48.0</td>
<td>0.0</td>
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</tr>
<tr>
<td>2</td>
<td>C2E</td>
<td>705.00</td>
<td>704.00</td>
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<td>3</td>
<td>C2W</td>
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<td>716.50</td>
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<td>0.0100</td>
<td>48.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>
Type II 24-hr 100-Yr Rainfall = 7.92".

Extraction:

Subcatchment 1RS: Channel 1
- Runoff Area = 3.169 ac
- Impervious: 0.00%
- Runoff Depth = 6.02"
- Flow Length = 331'
- Tc = 10.7 min
- CN = 84
- Runoff = 27.36 cfs
- 1.589 af

Subcatchment 2RS: Channel 2
- Runoff Area = 5.195 ac
- Impervious: 0.00%
- Runoff Depth = 6.02"
- Flow Length = 398'
- Tc = 13.4 min
- CN = 84
- Runoff = 41.10 cfs
- 2.605 af

Subcatchment C2ES: Cell 2 East
- Runoff Area = 22.599 ac
- Impervious: 19.87%
- Runoff Depth = 6.37"
- Flow Length = 880'
- Tc = 10.4 min
- CN = 87
- Runoff = 204.75 cfs
- 12.000 af

Subcatchment C2WS: Cell 2 West
- Runoff Area = 22.599 ac
- Impervious: 16.39%
- Runoff Depth = 6.25"
- Flow Length = 2301'
- Tc = 12.7 min
- CN = 86
- Runoff = 136.37 cfs
- 8.544 af

Subcatchment C3S: Cell 3 Subcatchment
- Runoff Area = 21.567 ac
- Impervious: 49.54%
- Runoff Depth = 6.85"
- Flow Length = 66'
- Slope = 0.3182 '/'
- Tc = 2.6 min
- CN = 91
- Runoff = 261.61 cfs
- 12.303 af

Subcatchment CPS: Coal Pile
- Runoff Area = 67.122 ac
- Impervious: 72.00%
- Runoff Depth = 7.18"
- Tc = 10.0 min
- CN = 93
- Runoff = 653.22 cfs
- 39.620 af

Subcatchment TPS: Triangular Pond
- Runoff Area = 10.310 ac
- Impervious: 0.00%
- Runoff Depth = 6.02"
- Tc = 5.0 min
- CN = 84
- Runoff = 107.48 cfs
- 5.171 af

Reach 1R: Channel 1
- Avg. Flow Depth = 5.28'
- Max Vel = 8.10 fps
- Inflow = 680.43 cfs
- 41.210 af

Reach 2R: Channel 2
- Avg. Flow Depth = 3.83'
- Max Vel = 9.93 fps
- Inflow = 439.43 cfs
- 555.512 af

Pond 1P: 48" Culverts
- Peak Elev = 744.08'
- Storage = 6.981 af
- Inflow = 731.83 cfs
- 553.095 af

Pond C2E: Cell 2 East
- Peak Elev = 718.70'
- Storage = 22.914 af
- Inflow = 295.26 cfs
- 19.908 af

Pond C2W: Cell 2 West
- Peak Elev = 712.80'
- Storage = 52.114 af
- Inflow = 136.37 cfs
- 8.544 af

Pond C3: Cell 3
- Peak Elev = 714.49'
- Storage = 59.2354 af
- Inflow = 570.27 cfs
- 592.354 af

Total Runoff Area = 146.357 ac
Runoff Volume = 81.833 af
Average Runoff Depth = 6.71"

54.77% Pervious = 80.166 ac
45.23% Impervious = 66.191 ac
Summary for Subcatchment 1RS: Channel 1 Subcatchment

Runoff = 27.36 cfs @ 12.02 hrs, Volume = 1.589 af, Depth = 6.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span = 0.00-144.00 hrs, dt = 0.01 hrs
Type II 24-hr 100-Yr Rainfall = 7.92"

Area (ac)  CN  Description
3.169  84  50-75% Grass cover, Fair, HSG D
3.169  100  100.00% Pervious Area

Tc  Length  Slope  Velocity  Capacity  Description
(min)  (feet) (ft/ft) (ft/sec) (cfs)  
8.7  100  0.0360  0.19  Sheet Flow, Grass: Short  n = 0.150  P2 = 2.56"
2.0  231  0.0753  1.92  Shallow Concentrated Flow, Short Grass Pasture  Kv = 7.0 fps

Subcatchment 1RS: Channel 1 Subcatchment

Hydrograph

Type II 24-hr
100-Yr Rainfall = 7.92"
Runoff Area = 3.169 ac
Runoff Volume = 1.589 af
Runoff Depth = 6.02"
Flow Length = 331'
Tc = 10.7 min
CN = 84
Summary for Subcatchment 2RS: Channel 2 Subcatchment

Runoff = 41.10 cfs @ 12.05 hrs, Volume = 2.605 af, Depth = 6.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span = 0.00-144.00 hrs, dt = 0.01 hrs
Type II 24-hr 100-Yr Rainfall=7.92"

<table>
<thead>
<tr>
<th>Area (ac)</th>
<th>CN</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.195</td>
<td>84</td>
<td>50-75% Grass cover, Fair, HSG D</td>
</tr>
<tr>
<td>5.195</td>
<td>100</td>
<td>100.00% Pervious Area</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tc (min)</th>
<th>Length (feet)</th>
<th>Slope (ft/ft)</th>
<th>Velocity (ft/sec)</th>
<th>Capacity (cfs)</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>11.0</td>
<td>100</td>
<td>0.0200</td>
<td>0.15</td>
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<td>Sheet Flow, Grass: Short n = 0.150 P2 = 2.56&quot;</td>
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<tr>
<td>2.4</td>
<td>298</td>
<td>0.0872</td>
<td>2.07</td>
<td></td>
<td>Shallow Concentrated Flow, Short Grass Pasture Kv = 7.0 fps</td>
</tr>
</tbody>
</table>

Subcatchment 2RS: Channel 2 Subcatchment

Hydrograph

Type II 24-hr 100-Yr Rainfall=7.92"
Runoff Area=5.195 ac
Runoff Volume=2.605 af
Runoff Depth=6.02"
Flow Length=398'
Tc=13.4 min
CN=84
Summary for Subcatchment C2ES: Cell 2 East Subcatchment

Runoff = 204.75 cfs @ 12.01 hrs, Volume= 12.000 af, Depth= 6.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Yr Rainfall=7.92"

<table>
<thead>
<tr>
<th>Area (ac)</th>
<th>CN</th>
<th>Description</th>
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<tbody>
<tr>
<td>4.491</td>
<td>98</td>
<td>Water Surface, HSG A</td>
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<tr>
<td>18.108</td>
<td>84</td>
<td>50-75% Grass cover, Fair, HSG D</td>
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<tr>
<td>22.599</td>
<td>87</td>
<td>Weighted Average</td>
</tr>
<tr>
<td>18.108</td>
<td>80.13% Pervious Area</td>
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<tr>
<td>4.491</td>
<td>19.87% Impervious Area</td>
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</table>

<table>
<thead>
<tr>
<th>Tc (min)</th>
<th>Length (feet)</th>
<th>Slope (ft/ft)</th>
<th>Velocity (ft/sec)</th>
<th>Capacity (cfs)</th>
<th>Description</th>
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<td>5.9</td>
<td>100</td>
<td>0.0930</td>
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<td>Sheet Flow, Grass: Short  n= 0.150  P2= 2.56&quot;</td>
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<tr>
<td>2.6</td>
<td>215</td>
<td>0.0377</td>
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<td>Shallow Concentrated Flow, Short Grass Pasture  Kv= 7.0 fps</td>
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<tr>
<td>1.9</td>
<td>565</td>
<td>0.0265</td>
<td>5.05</td>
<td>57.03</td>
<td>Channel Flow, Area= 11.3 sf  Perim= 30.0'  r= 0.38'  n= 0.025  Earth, clean &amp; winding</td>
</tr>
</tbody>
</table>

10.4 880 Total

Subcatchment C2ES: Cell 2 East Subcatchment

Hydrograph

Type II 24-hr 100-Yr Rainfall=7.92"
Runoff Area=22.599 ac
Runoff Volume=12.000 af
Runoff Depth=6.37"
Flow Length=880'
Tc=10.4 min
CN=87
Summary for Subcatchment C2WS: Cell 2 West Subcatchment

Runoff = 136.37 cfs @ 12.04 hrs, Volume= 8.544 af, Depth= 6.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Yr Rainfall=7.92"

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<th>CN</th>
<th>Description</th>
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<tr>
<td>2.687</td>
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<td>Water Surface, HSG A</td>
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<td>13.708</td>
<td>84</td>
<td>50-75% Grass cover, Fair, HSG D</td>
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<tr>
<td>16.395</td>
<td>86</td>
<td>Weighted Average</td>
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<tr>
<td>13.708</td>
<td>83.61% Pervious Area</td>
<td></td>
</tr>
<tr>
<td>2.687</td>
<td>16.39% Impervious Area</td>
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<table>
<thead>
<tr>
<th>Tc (min)</th>
<th>Length (feet)</th>
<th>Slope (ft/ft)</th>
<th>Velocity (ft/sec)</th>
<th>Capacity (cfs)</th>
<th>Description</th>
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<td>Sheet Flow, Grass: Short n= 0.150 P2= 2.56&quot;</td>
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<td>1.8</td>
<td>158</td>
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<td>Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps</td>
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<td>2,043</td>
<td>0.0020</td>
<td>4.80</td>
<td>240.05</td>
<td>Channel Flow, Area= 50.0 sf Perim= 20.6' r= 2.43' n= 0.025 Earth, clean &amp; winding</td>
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<tr>
<td>12.7</td>
<td>2,301</td>
<td>Total</td>
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<td></td>
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</tbody>
</table>

Subcatchment C2WS: Cell 2 West Subcatchment

Hydrograph

Type II 24-hr
100-Yr Rainfall=7.92"
Runoff Area=16.395 ac
Runoff Volume=8.544 af
Runoff Depth=6.25"
Flow Length=2,301'
Tc=12.7 min
CN=86
Summary for Subcatchment C3S: Cell 3 Subcatchment

Runoff = 261.61 cfs @ 11.93 hrs, Volume = 12.303 af, Depth = 6.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Yr Rainfall=7.92"

<table>
<thead>
<tr>
<th>Area (ac)</th>
<th>CN</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.685</td>
<td>98</td>
<td>Water Surface, HSG A</td>
</tr>
<tr>
<td>10.882</td>
<td>84</td>
<td>50-75% Grass cover, Fair, HSG D</td>
</tr>
<tr>
<td>21.567</td>
<td>91</td>
<td>Weighted Average</td>
</tr>
<tr>
<td>10.882</td>
<td>50.46% Pervious Area</td>
<td></td>
</tr>
<tr>
<td>10.685</td>
<td>49.54% Impervious Area</td>
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</table>

<table>
<thead>
<tr>
<th>Tc (min)</th>
<th>Length (feet)</th>
<th>Slope (ft/ft)</th>
<th>Velocity (ft/sec)</th>
<th>Capacity (cfs)</th>
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</tr>
</thead>
<tbody>
<tr>
<td>2.6</td>
<td>66</td>
<td>0.3182</td>
<td>0.42</td>
<td></td>
<td>Sheet Flow, Grass: Short n= 0.150 P2= 2.56&quot;</td>
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</tbody>
</table>

Subcatchment C3S: Cell 3 Subcatchment

Hydrograph

Type II 24-hr 100-Yr Rainfall=7.92"
Runoff Area=21.567 ac
Runoff Volume=12.303 af
Runoff Depth=6.85"
Flow Length=66'
Slope=0.3182 '/'
Tc=2.6 min
CN=91
Summary for Subcatchment CPS: Coal Pile Subcatchment

Runoff = 653.22 cfs @ 12.01 hrs, Volume= 39.620 af, Depth= 7.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Yr Rainfall=7.92"

<table>
<thead>
<tr>
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<tr>
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<td>93</td>
<td>Urban industrial, 72% imp, HSG D</td>
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<td>18.794</td>
<td>28.00% Pervious Area</td>
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<tr>
<td>48.328</td>
<td>72.00% Impervious Area</td>
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<th>Tc (min)</th>
<th>Length (feet)</th>
<th>Slope (ft/ft)</th>
<th>Velocity (ft/sec)</th>
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<tr>
<td>10.0</td>
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<td></td>
<td></td>
<td>Direct Entry,</td>
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</table>

Subcatchment CPS: Coal Pile Subcatchment

Hydrograph

Type II 24-hr 100-Yr Rainfall=7.92"
Runoff Area=67.122 ac
Runoff Volume=39.620 af
Runoff Depth=7.08"
Tc=10.0 min
CN=93
Summary for Subcatchment TPS: Triangular Pond Subcatchment

Runoff = 107.48 cfs @ 11.96 hrs, Volume = 5.171 af, Depth = 6.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span = 0.00-144.00 hrs, dt = 0.01 hrs
Type II 24-hr 100-Yr Rainfall = 7.92"

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<th>Description</th>
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</thead>
<tbody>
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<td>84</td>
<td>50-75% Grass cover, Fair, HSG D</td>
</tr>
<tr>
<td>10.310</td>
<td>100.00% Pervious Area</td>
<td></td>
</tr>
</tbody>
</table>

Tc = 5.0 min

Direct Entry,

Subcatchment TPS: Triangular Pond Subcatchment

Hydrograph

Type II 24-hr 100-Yr Rainfall = 7.92"
Runoff Area = 10.310 ac
Runoff Volume = 5.171 af
Runoff Depth = 6.02"
Tc = 5.0 min
CN = 84
Summary for Reach 1R: Channel 1

Inflow Area = 70.291 ac, 68.75% Impervious, Inflow Depth = 7.04” for 100-Yr event
Inflow = 680.43 cfs @ 12.01 hrs, Volume= 41.210 af
Outflow = 678.10 cfs @ 12.02 hrs, Volume= 41.210 af, Atten= 0%, Lag= 0.8 min

Routing by Sim-Route method, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs
Max. Velocity= 8.10 fps, Min. Travel Time= 1.1 min
Avg. Velocity = 1.97 fps, Avg. Travel Time= 4.7 min

Peak Storage= 46,049 cf @ 12.02 hrs
Average Depth at Peak Storage= 5.28'
Bank-Full Depth= 6.00' Flow Area= 108.0 sf, Capacity= 952.16 cfs

0.00' x 6.00' deep channel, n= 0.025  Earth, clean & winding
Side Slope Z-value= 3.0 '/' Top Width= 36.00'
Length= 550.0'  Slope= 0.0055 '/'
Inlet Invert= 737.00', Outlet Invert= 734.00'

Reach 1R: Channel 1

Hydrograph

Inflow Area=70.291 ac
Avg. Flow Depth=5.28'
Max Vel=8.10 fps
n=0.025
L=550.0'
S=0.0055 '/'
Capacity=952.16 cfs
Summary for Reach 2R: Channel 2

Inflow Area = 75.486 ac, 64.02% Impervious, Inflow Depth > 88.31" for 100-Yr event
Inflow = 439.43 cfs @ 12.11 hrs, Volume= 555.512 af
Outflow = 437.42 cfs @ 12.14 hrs, Volume= 555.308 af, Atten= 0%, Lag= 1.9 min

Routing by Sim-Route method, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs
Max. Velocity= 9.93 fps, Min. Travel Time= 2.3 min
Avg. Velocity = 5.63 fps, Avg. Travel Time= 4.0 min

Peak Storage= 59.451 cf @ 12.14 hrs
Average Depth at Peak Storage= 3.83'
Bank-Full Depth= 6.00' Flow Area= 108.0 sf, Capacity= 1,446.73 cfs

0.00' x 6.00' deep channel, n= 0.025 Earth, clean & winding
Side Slope Z-value= 3.0 '/' Top Width= 36.00'
Length= 1,350.0' Slope= 0.0126 '/'
Inlet Invert= 733.00', Outlet Invert= 716.00'

Reach 2R: Channel 2

Hydrograph

Inflow Area=75.486 ac
Avg. Flow Depth=3.83'
Max Vel=9.93 fps
n=0.025
L=1,350.0'
S=0.0126 '/'
Capacity=1,446.73 cfs
Summary for Pond 1P: 48" Culverts


[63] Warning: Exceeded Reach 1R INLET depth by 3.47' @ 12.22 hrs

Inflow Area = 70.291 ac, 68.75% Impervious, Inflow Depth > 94.42" for 100-Yr event

Inflow = 731.83 cfs @ 12.02 hrs, Volume= 553.095 af, Incl. 24.00 cfs Base Flow

Outflow = 407.32 cfs @ 12.15 hrs, Volume= 552.942 af, Atten= 44%, Lag= 7.3 min

Routing by Sim-Route method, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs

Peak Elev= 744.08' @ 12.15 hrs Surf.Area= 1.463 ac Storage= 6.981 af

Plug-Flow detention time= 3.4 min calculated for 552.942 af (100% of inflow)

Center-of-Mass det. time= 2.1 min (4,054.6 - 4,052.4)

Volume Invert Avail.Storage Storage Description
#1 732.00' 7.008 af Custom Stage Data (Prismatic) Listed below (Recalc)

<table>
<thead>
<tr>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>732.00</td>
<td>0.002</td>
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<td>0.000</td>
</tr>
<tr>
<td>733.00</td>
<td>0.008</td>
<td>0.005</td>
<td>0.005</td>
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<tr>
<td>734.00</td>
<td>0.041</td>
<td>0.024</td>
<td>0.029</td>
</tr>
<tr>
<td>735.00</td>
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<td>0.069</td>
<td>0.099</td>
</tr>
<tr>
<td>736.00</td>
<td>0.179</td>
<td>0.138</td>
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<tr>
<td>737.00</td>
<td>0.308</td>
<td>0.244</td>
<td>0.481</td>
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<td>738.00</td>
<td>0.427</td>
<td>0.367</td>
<td>0.849</td>
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<tr>
<td>739.00</td>
<td>0.657</td>
<td>0.542</td>
<td>1.391</td>
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<tr>
<td>740.00</td>
<td>0.865</td>
<td>0.761</td>
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<td>741.00</td>
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<td>3.103</td>
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<td>743.00</td>
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<td>744.00</td>
<td>1.463</td>
<td>1.395</td>
<td>6.861</td>
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<td>744.10</td>
<td>1.463</td>
<td>0.146</td>
<td>7.008</td>
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</table>

Device Routing Invert Outlet Devices
#1 Primary 734.00' 48.0" Round Culvert X 2.00

L= 100.0' RCP, groove end projecting, Ke= 0.200
Inlet / Outlet Invert= 734.00' / 733.00' S= 0.0100 '/' Cc= 0.900
n= 0.012 Concrete pipe, finished, Flow Area= 12.57 sf

Primary OutFlow Max=407.25 cfs @ 12.15 hrs HW=744.08' TW=736.83' (Dynamic Tailwater)

1=Culvert (Inlet Controls 407.25 cfs @ 16.20 fps)
Pond 1P: 48" Culverts

Hydrograph

- **Inflow Area:** 70.291 ac
- **Peak Elev:** 744.08'
- **Storage:** 6.981 af
- **Round Culvert x 2.00**
  - **n:** 0.012
  - **L:** 100.0'
  - **S:** 0.0100 '/'

Flow (cfs) vs Time (hours)

- **731.83 cfs**
- **407.32 cfs**
Summary for Pond C2E: Cell 2 East

Cell 2 East and Cell 2 West combined into one unit at El. 721’.


Inflow = 295.26 cfs @ 11.99 hrs, Volume= 19.908 af, Incl. 0.23 cfs Base Flow
Outflow = 48.39 cfs @ 12.30 hrs, Volume= 24.778 af, Atten= 84%, Lag= 18.7 min
Primary = 48.39 cfs @ 12.30 hrs, Volume= 24.778 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Sim-Route method, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs
Starting Elev= 718.00’ Surf.Area= 5.225 ac Storage= 19.174 af
Peak Elev= 718.70’ @ 12.30 hrs Surf.Area= 5.418 ac Storage= 22.914 af (3.740 af above start)

Plug-Flow detention time = 2,306.9 min calculated for 5.604 af (28% of inflow)
Center-of-Mass det. time = (not calculated: outflow precedes inflow)

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<tr>
<th>Volume</th>
<th>Invert</th>
<th>Avail.Storage</th>
<th>Storage Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>714.00’</td>
<td>36.274 af</td>
<td>Custom Stage Data (Prismatic) Listed below (Recalc)</td>
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</table>

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
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<td>714.00</td>
<td>4.491</td>
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<td>715.00</td>
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<td>716.00</td>
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<tr>
<td>717.00</td>
<td>4.981</td>
<td>4.859</td>
<td>14.071</td>
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<tr>
<td>718.00</td>
<td>5.225</td>
<td>5.103</td>
<td>19.174</td>
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<tr>
<td>719.00</td>
<td>5.499</td>
<td>5.362</td>
<td>24.536</td>
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<tr>
<td>720.00</td>
<td>5.841</td>
<td>5.670</td>
<td>30.206</td>
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<tr>
<td>721.00</td>
<td>6.295</td>
<td>6.068</td>
<td>36.274</td>
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<table>
<thead>
<tr>
<th>Device</th>
<th>Routing</th>
<th>Invert</th>
<th>Outlet Devices</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>Primary</td>
<td>705.00’</td>
<td>48.0” Round Culvert</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>L= 100.0’ RCP, groove end projecting, Ke= 0.200</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Inlet / Outlet Invert= 705.00’ / 704.00’ S= 0.0100 ‘/’ Cc= 0.900</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>n= 0.012 Concrete pipe, finished, Flow Area= 12.57 sf</td>
</tr>
<tr>
<td>#2</td>
<td>Device 1</td>
<td>717.00’</td>
<td>7.0’ long Sharp-Crested Rectangular Weir</td>
</tr>
<tr>
<td>#3</td>
<td>Secondary</td>
<td>720.00’</td>
<td>700.0’ long x 10.0’ breadth Broad-Crested Rectangular Weir</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64</td>
</tr>
</tbody>
</table>
Primary OutFlow  Max=48.39 cfs @ 12.30 hrs  HW=718.70'  TW=713.89'  (Dynamic Tailwater)
  1=Culvert  (Passes 48.39 cfs of 165.88 cfs potential flow)
  2=Sharp-Crested Rectangular Weir  (Weir Controls 48.39 cfs @ 4.27 fps)

Secondary OutFlow  Max=0.00 cfs @ 0.00 hrs  HW=718.00'  TW=710.00'  (Dynamic Tailwater)
  3=Broad-Crested Rectangular Weir  (Controls 0.00 cfs)
**Summary for Pond C2W: Cell 2 West**

Cell 2 East and Cell 2 West combined into one unit at El. 721'.

Primary and secondary outlets per Gerdell Engineering Resources, Inc. Figure 1 (9/2015). Length estimated per Google Earth Pro.

Inflow = 136.37 cfs @ 12.04 hrs, Volume= 8.544 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Tertiary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Sim-Route method, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs
Peak Elev= 712.80' @ 24.73 hrs Surf.Area= 3.719 ac Storage= 8.542 af

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

<table>
<thead>
<tr>
<th>Volume</th>
<th>Invert</th>
<th>Avail.Storage</th>
<th>Storage Description</th>
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<tbody>
<tr>
<td>#1</td>
<td>710.00'</td>
<td>156.546 af</td>
<td>Custom Stage Data (Prismatic) Listed below (Recalc)</td>
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</table>

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<thead>
<tr>
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<tbody>
<tr>
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<td>2.687</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>711.00</td>
<td>2.822</td>
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<td>726.00</td>
<td>21.464</td>
<td>21.047</td>
<td>156.546</td>
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</table>

**Device Routing Invert Outlet Devices**

- **#1 Primary** 718.00' **15.0" Round Culvert**
  L= 100.0' RCP, groove end projecting, Ke= 0.200
  Inlet / Outlet Invert= 718.00' / 716.50' S= 0.0150 '/' Cc= 0.900
  n= 0.020 Corrugated PE, corrugated interior, Flow Area= 1.23 sf

- **#2 Secondary** 719.00' **15.0" Round Culvert**
  L= 100.0' RCP, groove end projecting, Ke= 0.200
  Inlet / Outlet Invert= 719.00' / 716.50' S= 0.0250 '/' Cc= 0.900
  n= 0.020 Corrugated PE, corrugated interior, Flow Area= 1.23 sf

- **#3 Tertiary** 720.00' **700.0' long x 10.0' breadth Broad-Crested Rectangular Weir**
Primary OutFlow  Max=0.00 cfs @ 0.00 hrs  HW=710.00'  TW=710.00'  (Dynamic Tailwater)
1=Culvert  (Controls 0.00 cfs)

Secondary OutFlow  Max=0.00 cfs @ 0.00 hrs  HW=710.00'  TW=710.00'  (Dynamic Tailwater)
2=Culvert  (Controls 0.00 cfs)

Tertiary OutFlow  Max=0.00 cfs @ 0.00 hrs  HW=710.00'  TW=718.00'  (Dynamic Tailwater)
3=Broad-Crested Rectangular Weir  (Controls 0.00 cfs)

Pond C2W: Cell 2 West

Peak Elev=712.80'
Storage=8.542 af
Summary for Pond C3: Cell 3


Weir overflow elevation based on water level at time of survey.

Emergency spillway - Ash Pond #001 Specs provided by AECI. Dimensions out spillway per GEI Specific Site Assessment for CCW Impoundments at THEC (6/2011).

Inflow = 570.27 cfs @ 11.94 hrs, Volume= 592.354 af
Outflow = 158.50 cfs @ 12.89 hrs, Volume= 573.067 af, Atten= 72%, Lag= 56.7 min
Primary = 158.50 cfs @ 12.89 hrs, Volume= 573.067 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Sim-Route method, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs
Peak Elev= 714.49' @ 12.89 hrs Surf.Area= 12.866 ac Storage= 52.114 af
Plug-Flow detention time= 306.4 min calculated for 573.067 af (97% of inflow)
Center-of-Mass det. time= 150.8 min (4,004.6 - 3,853.8)

---

Volume | Invert | Avail.Storage | Storage Description
---|---|---|---
#1 710.00' | 72.090 af | Custom Stage Data (Prismatic) Listed below (Recalc)

---

Elevation | Surf.Area | Inc.Store | Cum.Store
---|---|---|---
710.00 | 10.685 | 0.000 | 0.000
711.00 | 11.024 | 10.855 | 10.855
712.00 | 11.282 | 11.153 | 22.007
713.00 | 11.968 | 11.625 | 33.632
714.00 | 12.627 | 12.297 | 45.930
715.00 | 13.119 | 12.873 | 58.803
716.00 | 13.456 | 13.287 | 72.090

Device | Routing | Invert | Outlet Devices
---|---|---|---
#1 Primary | 695.00' | 48.0" Round Culvert
L= 125.0' RCP, rounded edge headwall, Ke= 0.100
Inlet / Outlet Invert= 695.00' / 693.75' S= 0.0100 '/' Cc= 0.900
n= 0.012 Concrete pipe, finished, Flow Area= 12.57 sf

#2 Device 1 | 710.00' | 6.0' long Sharp-Crested Rectangular Weir 2 End Contraction(s)
#3 Secondary | 715.00' | Custom Weir/Orifice, Cv= 2.62 (C= 3.28)

---

Primary OutFlow Max=158.50 cfs @ 12.89 hrs HW=714.49' (Free Discharge)
\[\text{Max}=158.50 \text{ cfs} \times 12.89 \text{ hrs} \times 714.49' \text{ (Free Discharge)} \]

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=710.00' (Free Discharge)
\[\text{Max}=0.00 \text{ cfs} \times 0.00 \text{ hrs} \times 710.00' \text{ (Free Discharge)} \]
Summary for Link C1: Cell 1

Cell 001 Outflow

Inflow = 33.68 cfs @ 12.18 hrs, Volume= 226.297 af
Primary = 33.68 cfs @ 12.19 hrs, Volume= 226.281 af, Atten= 0%, Lag= 0.6 min

Primary outflow = Inflow, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs

100-Yr Primary Imported from AECI_Thomas Hill_Cell 1_Stormwater Link~Pond C1.csv

Link C1: Cell 1

Hydrograph

Inflow

Primary
Appendix 2
Specific Site Assessment for Coal Combustion Waste Impoundments at Thomas Hill Energy Center
Clifton Hill, Missouri

Submitted to:
U.S. Environmental Protection Agency
Office of Resource Conservation and Recovery
5304P
1200 Pennsylvania Avenue NW
Washington, DC 20460

Submitted by:
GEI Consultants, Inc.
4601 DTC Blvd, Suite 900
Denver, CO 80237

June 2011
Project Number: 092884

Steven R. Townsley, P.E.
Senior Project Engineer
The materials stored in each of the CCW impoundment dikes are summarized below:

- **Slag Dewatering Basin** – This basin is a wet storage area that is used to contain both bottom ash and boiler slag. The ash and slag is continuously dredged and is sold to a private contractor who uses the material as roofing granules.

- **Ash Pond – Cell No. 2** – This cell is a wet storage that is used to contain fly ash, bottom ash, boiler slag, and sediments from the coal pile runoff. The fly ash is collected and used as part of the mine reclamation activities on the power plant property.

Based on our observation and the soil boring information presented in the Global Stability Evaluation report prepared by Geotechnology, Inc. in May of 2010, the CCW impoundment dikes appear to have homogeneous construction using silty clayey fill soils. The dikes were designed without internal drains from the collection of seepage.

The dike for the Slag Dewatering Basin has an approximate crest width of 10 feet and design upstream and downstream side slopes of 3H:1V and 2H:1V, respectively. The perimeter dike for Ash Pond – Cell No. 2 has an approximate crest width of 18 feet and design upstream and downstream side slopes of 3H:1V.

The basic dimensions and geometry of each impoundment is summarized in Table 2-1.

**Table 2-1: Summary Information for Impoundment Dike Parameters**

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<th>Parameter</th>
<th>Slag Dewatering Basin</th>
<th>Ash Pond – Cell No. 2</th>
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<td>Approximate Surface Area (acres)*</td>
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*Storage capacity and area values provided by Associated Electric Cooperative, Inc.

### 2.3 Spillways

The Ash Pond – Cell No. 2 Impoundment has an emergency spillway (Photo 16) which, if utilized, would flow into Ash Pond – Cell No. 3. The emergency spillway is an Open Channel Spillway, trapezoidal in shape, with a top width of approximately 18 feet, an average bottom width of 12 feet, and a depth of 2 feet below the top of the dike crest. The emergency spillway crest is lined with 3- to 6-inch crushed rock.

The Slag Dewatering Pond does not have a spillway associated with the impoundment.
2.4 Intakes and Outlet Works

2.4.1 Slag Dewatering Basin

The coal ash slurry line at the Slag Dewatering Basin consists of an 18-inch steel pipe from the power plant. Photos 1 and 2 in Appendix B show the inlet structure to the Slag Dewatering Basin.

The outlet structure (Photos 3 and 7) consists of a 30-inch diameter concrete outlet pipe from the concrete decant tower with 60-inch wide, 6-inch square concrete stop logs. The outlet structure releases the decant water into a bypass channel (Photo 4) which bypasses Ash Pond – Cell No. 1 and discharges into the Ash Pond – Cell No. 2 (Photos 8 and 9). At the time of our visit to the site, there was active flow through the outlet structure.

2.4.2 Ash Pond – Cell No. 2

Decant water is received from the Slag Dewatering Basin through a bypass channel (Photos 8 and 9) and from a concrete decant tower with 60-inch wide, 6-inch square concrete stop logs in the Ash Pond – Cell No. 1. This decant water is collected from natural runoff around Ash Pond – Cell No. 1.

The outlet structure (Photo 12) consists of a 36-inch diameter concrete outlet pipe from the concrete decant tower with 72-inch wide, 6-inch square concrete stop logs. At the time of our visit to the site, there was active flow through the outlet structure into Ash Pond – Cell No. 3. Ash Pond – Cell No. 3 contains only decant water prior to its release to the Middle Fork of the Little Chariton River.

2.5 Vicinity Map

Thomas Hill Energy Center is located in the town of Clifton Hill in Randolph County, Missouri, as shown on Figure 1. The specific latitude and longitude of the ponds is provided below:

Longitude: 92 Degrees, 38 Minutes, 17 Seconds
Latitude: 39 Degrees, 32 Minutes, 34 Seconds

2.6 Plan and Sectional Drawings

GEI was provided with two partial sets of design documents for this project and a geotechnical engineering report. These documents included:

- Engineering drawings for the “Ash Pond Facilities” project in 1978-79. These plans were prepared by Burns and McDonnell dated December 1, 1978 and March 23, 1979.
invert elevation is at about El. 731 feet. Based on the 24-hour 100-year precipitation event of 7.2 inches, the Slag Dewatering Basin would receive about 8.4 acre-feet of storm water. Without detailed hydraulic routing simulations, it is difficult to determine the resulting water surface elevation in Slag Dewatering Basin, however the available storage volume and discharge capacity of the decant structure is likely enough to maintain at least 1 foot of residual freeboard during the design event. Based on these results, the Slag Dewatering Basin meets the regulatory requirements for storing and passing the 24-hour 100-year inflow design flood without overtopping the dam.

5.2.2 Ash Pond – Cell No. 2

The contributing drainage area to the Ash Pond – Cell No. 2 includes the impoundment’s surface area (Table 2-1) and a considerable amount of surrounding surface drainage. Additionally, decant water from the Slag Dewatering Basin and Ash Pond – Cell No. 1 can be routed to Ash Pond – Cell No. 2 through the decant structures, producing a total contributing drainage area of about 148 acres. However, currently Ash Pond – Cell No. 1 does not store any water and has considerable available storage capacity to store the design storm precipitation that falls over the reservoir surface. Therefore, based on the current configuration, Ash Pond – Cell No. 1 does not contribute storm water runoff to Ash Pond – Cell No. 2, resulting in a total contributing drainage area to Ash Pond – Cell No. 2 of about 136 acres.

The water surface in Ash Pond – Cell No. 2 is regulated by a decant structure located through the south dike that discharges water into Ash Pond – Cell No. 3. Additionally, Ash Pond – Cell No. 2 has an 18-foot wide by 2-foot deep emergency spillway located over the south dike that can also discharge water into Ash Pond – Cell No. 3. Currently, the Ash Pond – Cell No. 2 water level is maintained at about El. 713 feet, providing about 4.0 feet of freeboard. Based on the current configuration and the 24-hour 100-year precipitation event of 7.2 inches, the Ash Pond – Cell No. 2 would receive about 83 acre-feet of storm water. Without detailed hydraulic routing simulations, it is difficult to determine the resulting water surface elevation in Ash Pond – Cell No. 2, however the combined discharge capacity of the decant structure and emergency spillway is likely enough to maintain at least 1 foot of residual freeboard during the design event. Based on these results, the Ash Pond – Cell No. 2 will likely meet the regulatory requirements for storing and passing the 24-hour 100-year inflow design flood without overtopping the dam.
8.3 Ash Pond – Cell No. 2

8.3.1 Impoundment Dike

8.3.1.1 Dike Crest

The crest of the dike at the Ash Pond – Cell No. 2 appeared to be in good condition. No signs of cracking, settlement, movement, erosion or deterioration were observed during the assessment. The crest appears to be well-drained and no standing water was observed. The dike crest surface is generally composed of gravel road base material that traverses the length of the dike for vehicle access.

8.3.1.2 Upstream Slope

The upstream slope (Photos 10, 14, 15 and 18) of the dike at the Ash Pond – Cell No. 2 is partially covered with small riprap near the toe and well established grass growth near the crest of the embankment. The remaining slope is unprotected. No scarps, sloughs, depressions or other indications of slope instability or signs of erosion were observed during the inspection of the impoundment.

8.3.1.3 Downstream Slope

The downstream slope (Photos 11 and 17) of the dike at the Ash Pond – Cell No. 2 (which is also the upstream slope of Ash Pond – Cell No. 3) has well-established grass growth, which provides some erosion protection. At the toe of the slope is Ash Pond – No. 3. The lower 10 feet of the slope is rip rap with small to medium size rock. No scarps, sloughs, depressions or other indications of slope instability or signs of erosion were observed during the inspection of the impoundment.

8.3.2 Seepage and Stability

We observed no signs of seepage or slope instability in the dike during our inspection of Ash Pond – Cell No. 2.

8.3.3 Appurtenant Structures

8.3.3.1 Outlet Structure

The outlet structure (Photo 12) consists of a 36-inch diameter concrete outlet pipe and a concrete decant tower with 72-inch wide, 6-inch square concrete stop logs. The outlet structure releases decant water into Ash Pond – Cell No. 3. At the time of our visit to the site, there was active flow through the outlet structure.
8.3.3.2 Pump Structures

No pumps are present at Ash Pond – Cell No. 2.

8.3.3.3 Emergency Spillway

Just west of the Ash Pond – Cell No. 2 spillway (decant outlet) is the emergency spillway (Photo 16). The emergency spillway is an Open Channel Spillway, trapezoidal in shape, with a top width of approximately 18 feet, an average bottom width of 12 feet, and a depth of 2 feet below the top of the dike crest. The emergency spillway crest is lined with 3- to 6-inch crushed rock.

8.3.3.4 Drains

No internal or toe drains are present in the dike at Ash Pond – Cell No. 2.

8.3.3.5 Water Surface Elevations and Reservoir Discharge

At the time of our inspection on November 9, 2010, the Ash Pond – Cell No. 2 water level was observed to be at an approximate elevation of 713 feet (Photo 13). The water surface of Ash Pond – Cell No. 2 is controlled by the outlet structure that discharges into the Ash Pond – Cell No. 3.
Appendix 3
### DATA DESCRIPTION

**Data type:** precipitation depth  
**Units:** english  
**Time series type:** partial duration

### SELECT LOCATION

1. Manually:
   - b) Select station (click here for a list of stations used in frequency analysis for MO): select station

2. Use map:
   - a) Select location (move crosshair or double click)
   - b) Click on station icon  
     (show stations on map)

### POINT PRECIPITATION FREQUENCY (PF) ESTIMATES

WITH 90% CONFIDENCE INTERVALS AND SUPPLEMENTARY INFORMATION  
NOAA Atlas 14, Volume 8, Version 2

#### PDS-based precipitation frequency estimates with 90% confidence intervals (in inches)

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</tr>
<tr>
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<td>21.7</td>
<td>23.9</td>
<td>26.1</td>
<td>28.1</td>
</tr>
</tbody>
</table>

1 Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parentheses 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) values and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

Estimates from the table in csv format: precipitation frequency estimates ✤ Submit