HALEY & ALDRICH, INC.
6500 Rockside Road
Suite 200
Cleveland, OH 44131
216.739.0555

MEMORANDUM

15 October 2021
File No. 128064-022

SUBJECT: Inflow Design Flood Control System Plan – Periodic Update
Associated Electric Cooperative, Inc.
Thomas Hill Energy Center – Cell 001
Clifton Hill, Missouri

Haley & Aldrich, Inc. (Haley & Aldrich) has developed this Periodic 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 001 (Cell 001) at the Thomas Hill Energy Center (THEC) in Clifton Hill, Missouri. This has been completed based on requirements of the US Environmental Protection Agency's (EPA's) Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities, 40 CFR Part 257 effective 19 October 2015 including subsequent revisions, specifically related to §257.82. The Cell 001 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. This Plan has been updated to account for system modifications and meets the requirements to complete a periodic update every five years in accordance with §257.82(c)(4).

§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 001 is an existing CCR surface impoundment used for settling and temporary wet storage of bottom ash and boiler slag sluiced from Thomas Hill Units 1 and 2. CCR slurry is pumped from the power plant to the newly constructed Concrete Dewatering Tank (CDT), which is located directly east of Cell 001. The CDT receives sluice water from Unit 1 and 2, submerged flight conveyor via bottom ash sump pumps from Unit 3, and boiler wash from Units 1, 2, and 3. Currently, the CDT serves as a flow-through for plant waters (inflow is equal to outflow) and

discharges to Cell 001[1] through a 10-in. diameter HDPE pipe which discharges into the northeast corner of the impoundment. Decant water from the Cell 001 impoundment discharges via a rectangular concrete decant structure equipped with 60-inch wide concrete stop logs, and principal spillway via a 30-in. diameter concrete outlet pipe to a drainage channel which discharges into Cell 003.

Hydrologic and hydraulic modeling for this Cell 001 Plan was performed using HydroCAD Stormwater Modeling System, version 10.00-12 (HydroCAD) in conjunction with the appropriate inflow design flood (IDF) as determined per the 2021 Initial Hazard Potential Classification Assessment. The Periodic Hazard Potential Classification Assessment is being completed under separate cover. As stated below in *§257.82(a)(3)*, the IDF is the 100-yr storm.

When Cell 001 is maintained at its normal water surface elevation[2] (WSEL) (El. 739.0), the results of the HydroCAD analysis confirm the IDF control system for Cell 001 adequately manage flow into the impoundment during and following the IDF peak discharge. **Table I1** 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 A1**. See **Figure 1** for the Cell 001 existing site plan.

Table I: HydroCAD Output Summary

Peak flood level (ft)	740.7
Minimum Dike Elevation	744.0
Minimum freeboard (ft)	3.0
Peak inflow (cfs)	74.8

§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. The model also analyzes the downstream discharge channel to assess any apparent tail water effects at the discharge point. Pertinent pages of these documents referenced above providing the relevant information have been provided as **Appendix B**. Based on the HydroCAD analysis, the IDF control system for Cell 001 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 001 during the

[1] The CDT is progressing through operational start-up at this time. The eventual plan for the CDT discharge will be to recirculate the sluice water, minus blowdown, back to the power plant. During start-up, the CDT is fully discharging into Cell 001

[2] AECI maintains normal water at the noted elevation, but AECI is capable of removing/adding stop logs on the outlet structure and modifying the associated normal water surface elevation if necessary.

100-year flood is noted in Table 1 (above). The HydroCAD model simulation output is provided as **Appendix A**.

§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

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

Cell 001 was determined to be a low hazard potential classification. Therefore, the IDF is the 100-year storm. The basis of the determination is discussed in Periodic Hazard Potential Classification Assessment, Cell 001 dated October 2021. The 100-year storm characteristics were detailed in the NOAA Atlas 14 Point Precipitation Frequency Estimates: MO dated 16 August 2021 and prepared by the National Weather Service. In addition, since plant process water is pumped into the CDT and discharged into this impoundment, conservatively, the maximum process water flows into the pond from the plant NPDES permit along with the inflow storm event were modeled. The model is set up to start at the normal operating water surface elevation. Pertinent pages providing the required information have been provided as **Appendix C**.

§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 purposed 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 purposed 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 001 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 D**.

§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 Periodic 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 Inflow Design Flood Control System 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 flood control 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. The version date is based on the date the document is finalized, which is different than the completion/compliance date when the version is placed in the CCR Operating Record and subsequent notifications and placement on the CCR website.

Version	Date	Description of Changes Made
1	16 October 2016	Initial Issuance
2	15 October 2021	Periodic Update

§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.

The Initial IDF Plan was 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.

Not applicable, Cell 001 is an existing 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 or approval from the Participating State Director or approval from the EPA where EPA is the permitting authority stating that the initial and periodic inflow design flood control system plans meet the requirements of this section.

I certify that the Periodic Inflow Design Flood Control System Plan addressed in this document for AECI's Pond 001 - Cell 001 surface impoundment at the Thomas Hill Energy Center meets the USEPA's CCR Rule requirements of §257.82.

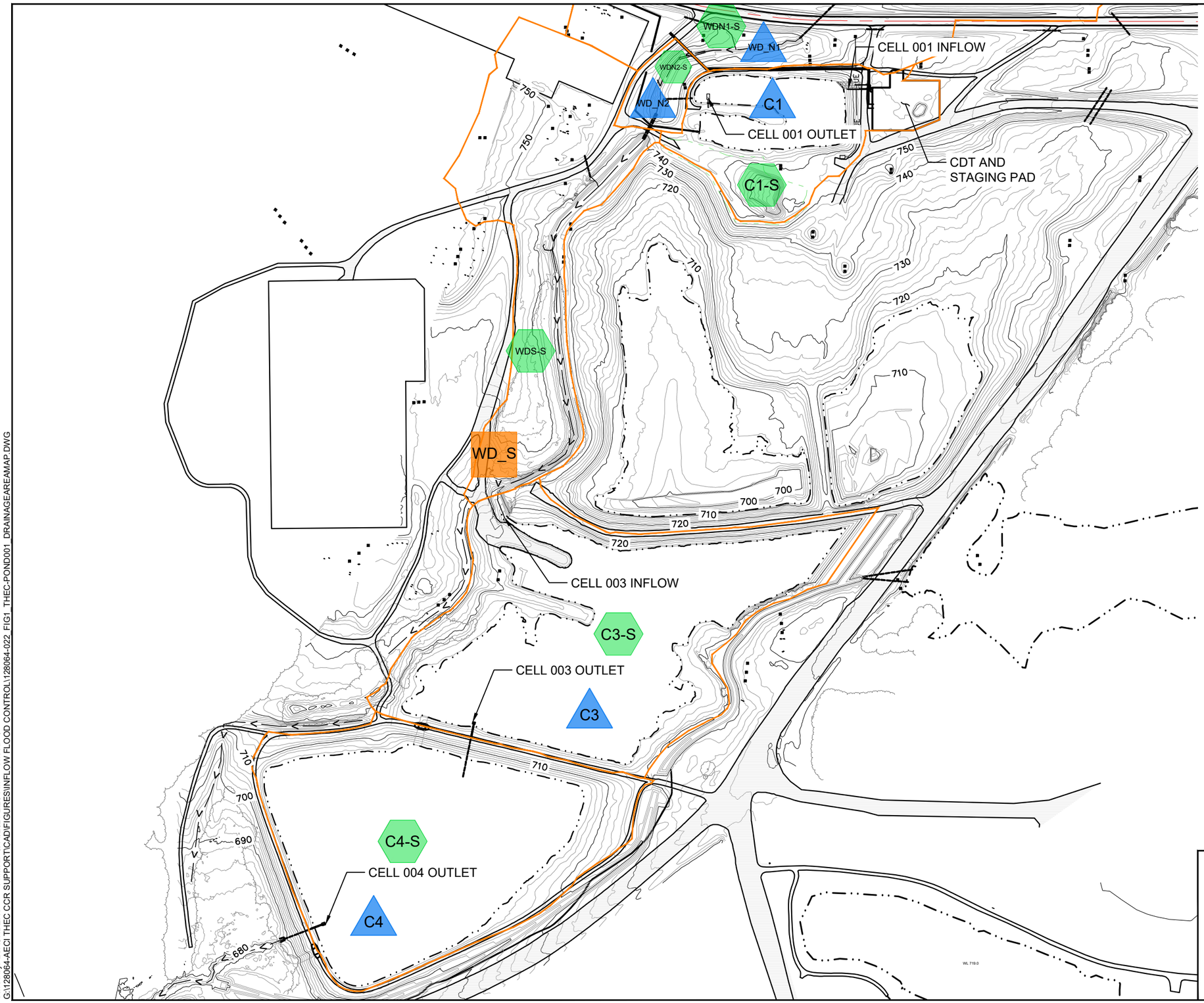
Signed:_____
Certifying Engineer

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

Professional Engineer's Seal and date:

Steven F. Putrich
Digitally signed by Steven F. Putrich
Date: 2021.10.15 14:18:08 -04'00'

Cc: Jenny Jones-AECI; Jason Pokorny-Haley & Aldrich



LEGEND

- SUBCATCHMENT
- WATER
- DITCH
- 10-FT. MAJOR CONTOUR
- 2-FT. MINOR CONTOUR

NOTES

1. EXISTING TOPOGRAPHY FROM ASSOCIATED ELECTRIC COOPERATIVE, INC. DATED AUGUST 2016. HORIZONTAL CONTROL IS BASED ON NAD83 ZONE 15N. VERTICAL CONTROL IS BASED ON NAVD88.

N

0 300 600
SCALE IN FEET

HALEY ALDRICH

ASSOCIATED ELECTRIC COOPERATIVE, INC.
THOMAS HILL ENERGY CENTER
CILFTON HILL, MISSOURI

ASH POND 001
DRAINAGE AREA MAP

SCALE: AS SHOWN
SEPTEMBER 2021

FIGURE 1

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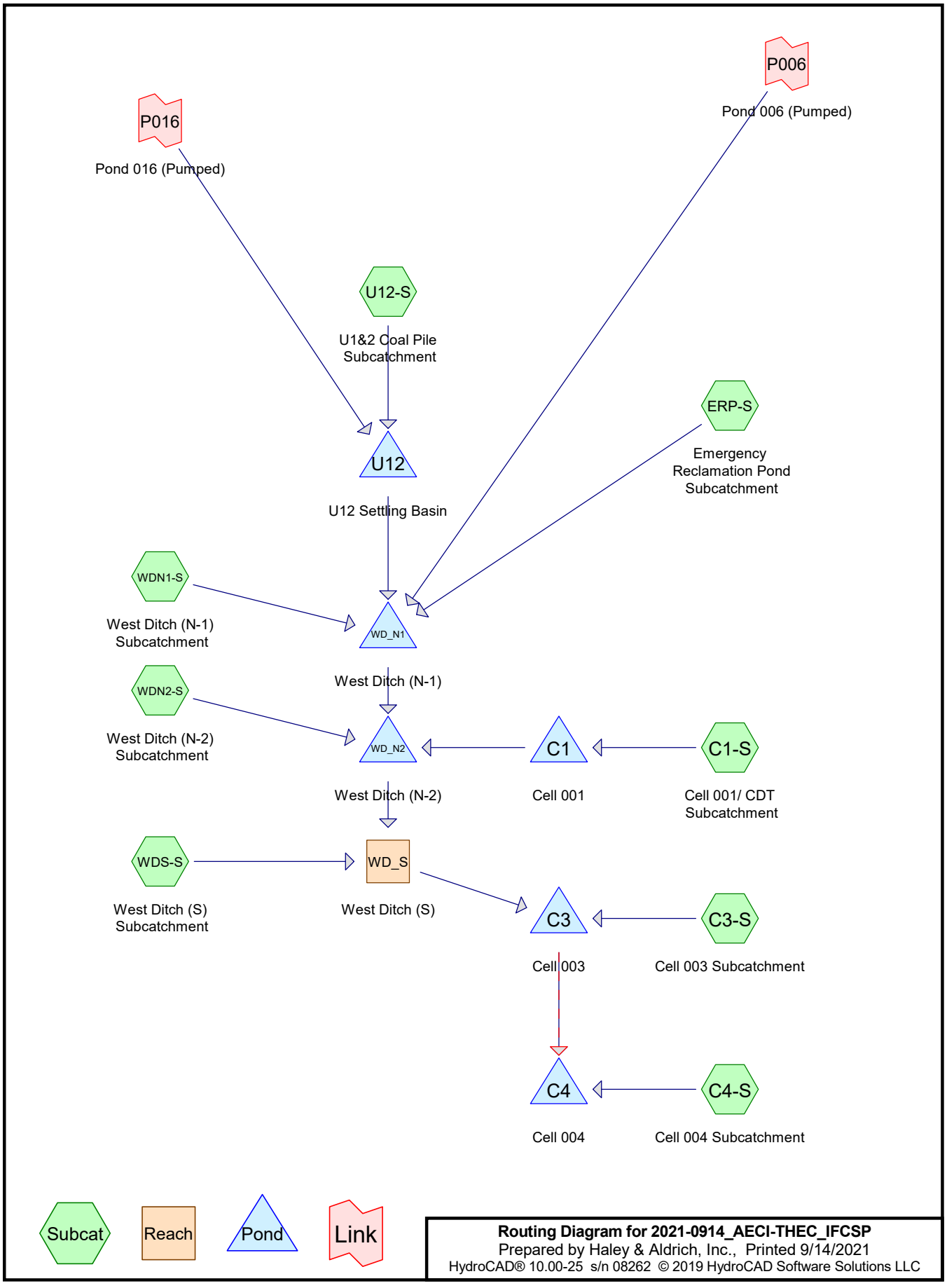
G:\128064-AEC\ THEC CCR SUPPORT\CAD\FIGURES\INFLOW FLOOD CONTROL\128064-022_FIG1_THEC-POND001_DRAINAGEAREAMAP.DWG

Appendix A



Routing Diagram for 2021-0914_AECI-THEC_IFCSP
Prepared by Haley & Aldrich, Inc., Printed 9/14/2021

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment C1-S: Cell 001/ CDT Runoff Area=5.857 ac 36.49% Impervious Runoff Depth=6.61"
Flow Length=228' Tc=9.5 min CN=89 Runoff=55.89 cfs 3.225 af

Subcatchment C3-S: Cell 003 Runoff Area=16.390 ac 62.59% Impervious Runoff Depth=7.08"
Flow Length=66' Slope=0.3182 '/' Tc=2.6 min CN=93 Runoff=201.67 cfs 9.675 af

Subcatchment C4-S: Cell 004 Runoff Area=14.380 ac 73.80% Impervious Runoff Depth=7.20"
Flow Length=149' Tc=5.9 min CN=94 Runoff=160.44 cfs 8.631 af

Subcatchment ERP-S: Emergency Runoff Area=17.080 ac 72.00% Impervious Runoff Depth=6.49"
Flow Length=2,980' Tc=11.4 min CN=88 Runoff=151.69 cfs 9.237 af

Subcatchment U12-S: U1&2 Coal Pile Runoff Area=38.810 ac 72.00% Impervious Runoff Depth=6.49"
Flow Length=2,090' Tc=14.5 min CN=88 Runoff=312.64 cfs 20.990 af

Subcatchment WDN1-S: West Ditch (N-1) Runoff Area=8.319 ac 0.00% Impervious Runoff Depth=6.02"
Flow Length=331' Tc=10.7 min CN=84 Runoff=71.82 cfs 4.172 af

Subcatchment WDN2-S: West Ditch (N-2) Runoff Area=1.020 ac 0.00% Impervious Runoff Depth=6.02"
Flow Length=95' Tc=9.7 min CN=84 Runoff=9.09 cfs 0.512 af

Subcatchment WDS-S: West Ditch (S) Runoff Area=9.510 ac 0.00% Impervious Runoff Depth=6.02"
Flow Length=398' Tc=13.4 min CN=84 Runoff=75.23 cfs 4.770 af

Reach WD_S: West Ditch (S) Avg. Flow Depth=3.23' Max Vel=8.84 fps Inflow=279.46 cfs 124.567 af
n=0.025 L=1,350.0' S=0.0125 '/' Capacity=1,442.47 cfs Outflow=276.29 cfs 124.438 af

Pond C1: Cell 001 Peak Elev=740.74' Storage=465,405 cf Inflow=74.83 cfs 78.375 af
Outflow=34.39 cfs 78.368 af

Pond C3: Cell 003 Peak Elev=713.51' Storage=1,633,120 cf Inflow=399.75 cfs 134.112 af
Primary=113.71 cfs 123.622 af Secondary=0.00 cfs 0.000 af Outflow=113.71 cfs 123.622 af

Pond C4: Cell 004 Peak Elev=702.04' Storage=22.007 af Inflow=216.84 cfs 132.253 af
Primary=87.77 cfs 124.626 af Secondary=0.00 cfs 0.000 af Outflow=87.77 cfs 124.626 af

Pond U12: U12 Settling Basin Peak Elev=751.87' Storage=202,936 cf Inflow=314.79 cfs 24.367 af
Outflow=121.69 cfs 24.367 af

Pond WD_N1: West Ditch (N-1) Peak Elev=743.47' Storage=140,704 cf Inflow=347.13 cfs 40.918 af
48.0" Round Culvert x 2.00 n=0.025 L=80.0' S=0.0079 '/' Outflow=194.61 cfs 40.918 af

Pond WD_N2: West Ditch (N-2) Peak Elev=739.47' Storage=38,560 cf Inflow=233.82 cfs 119.797 af
48.0" Round Culvert x 2.00 n=0.025 L=83.0' S=0.0106 '/' Outflow=223.18 cfs 119.798 af

Link P006: Pond 006 (Pumped) Manual Hydrograph Inflow=2.00 cfs 3.141 af
Primary=2.00 cfs 3.141 af

Link P016: Pond 016 (Pumped)

Manual Hydrograph Inflow=2.15 cfs 3.377 af
Primary=2.15 cfs 3.377 af

Summary for Subcatchment C1-S: Cell 001/ CDT Subcatchment

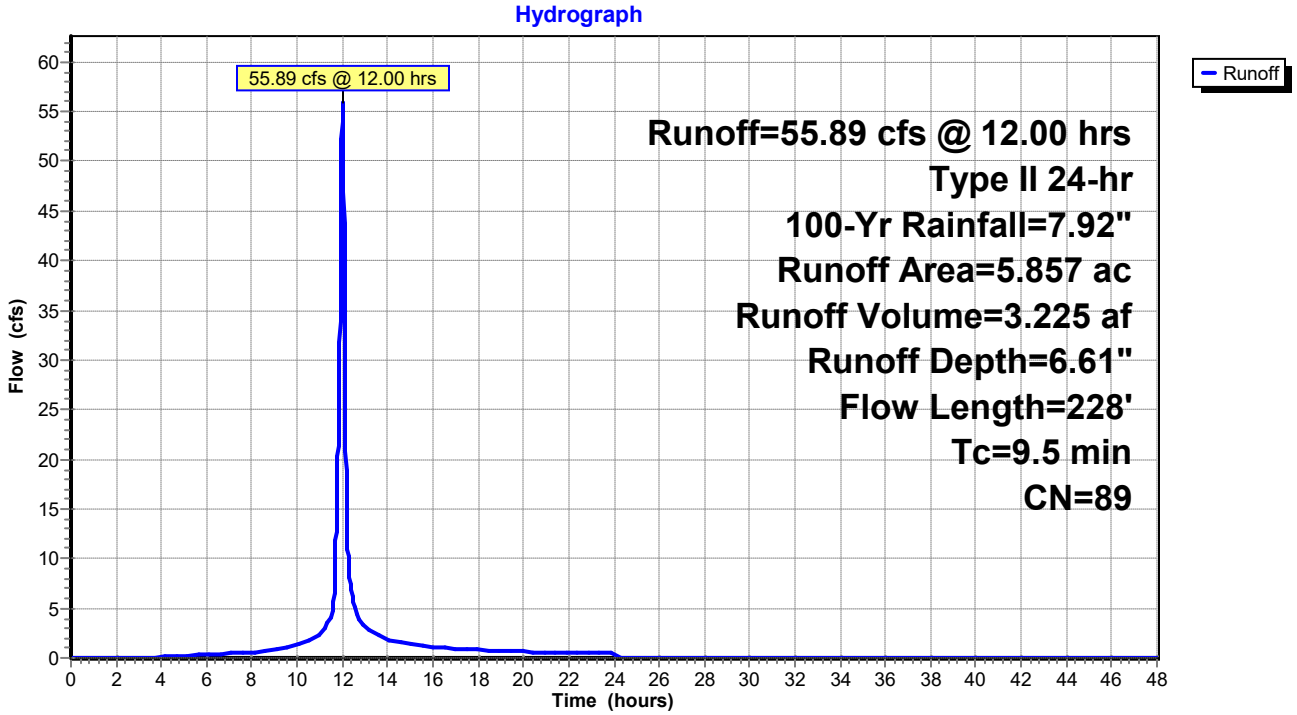
Runoff = 55.89 cfs @ 12.00 hrs, Volume= 3.225 af, Depth= 6.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Yr Rainfall=7.92"

	Area (ac)	CN	Description
	1.506	98	Water Surface, HSG D
	3.720	84	50-75% Grass cover, Fair, HSG D
*	0.631	98	CDT Area
	5.857	89	Weighted Average
	3.720		63.51% Pervious Area
	2.137		36.49% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	100	0.0400	0.20		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.56"
1.2	128	0.0625	1.75		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.5	228	Total			

Subcatchment C1-S: Cell 001/ CDT Subcatchment



Summary for Subcatchment C3-S: Cell 003 Subcatchment

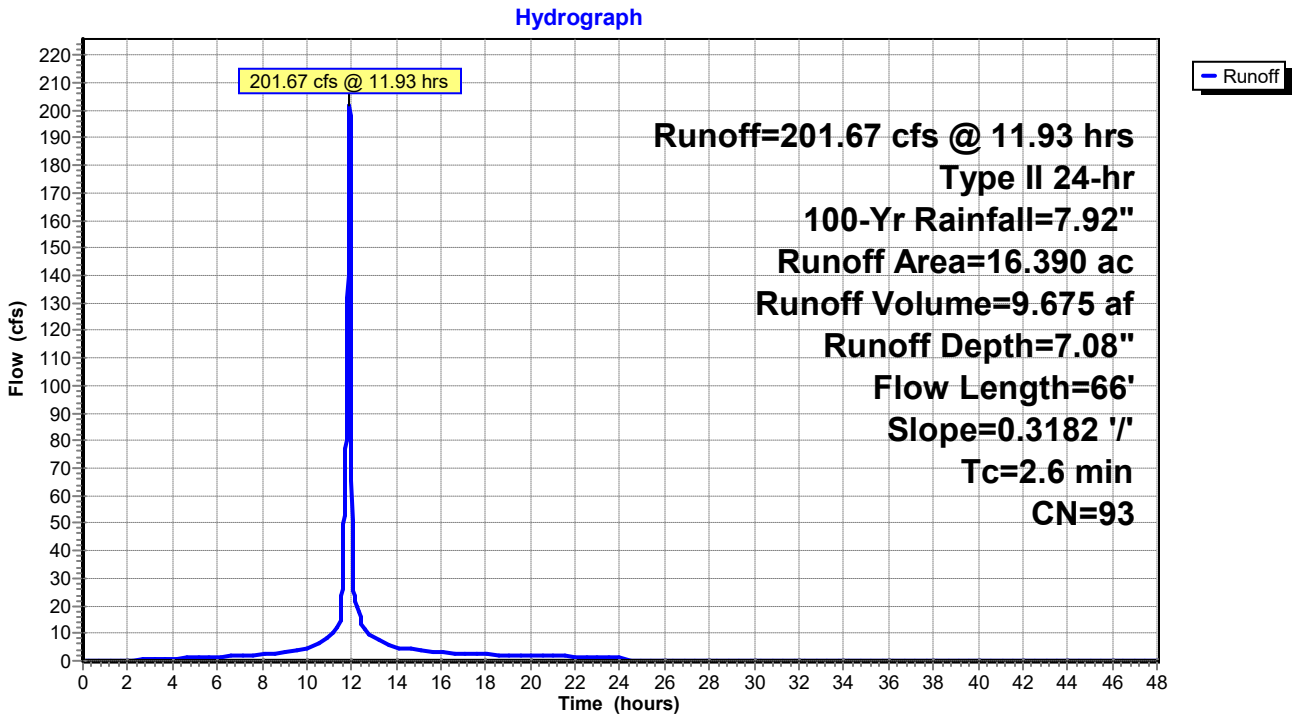
Runoff = 201.67 cfs @ 11.93 hrs, Volume= 9.675 af, Depth= 7.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Yr Rainfall=7.92"

Area (ac)	CN	Description
10.259	98	Water Surface, HSG A
6.131	84	50-75% Grass cover, Fair, HSG D
16.390	93	Weighted Average
6.131		37.41% Pervious Area
10.259		62.59% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.6	66	0.3182	0.42		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.56"

Subcatchment C3-S: Cell 003 Subcatchment



Summary for Subcatchment C4-S: Cell 004 Subcatchment

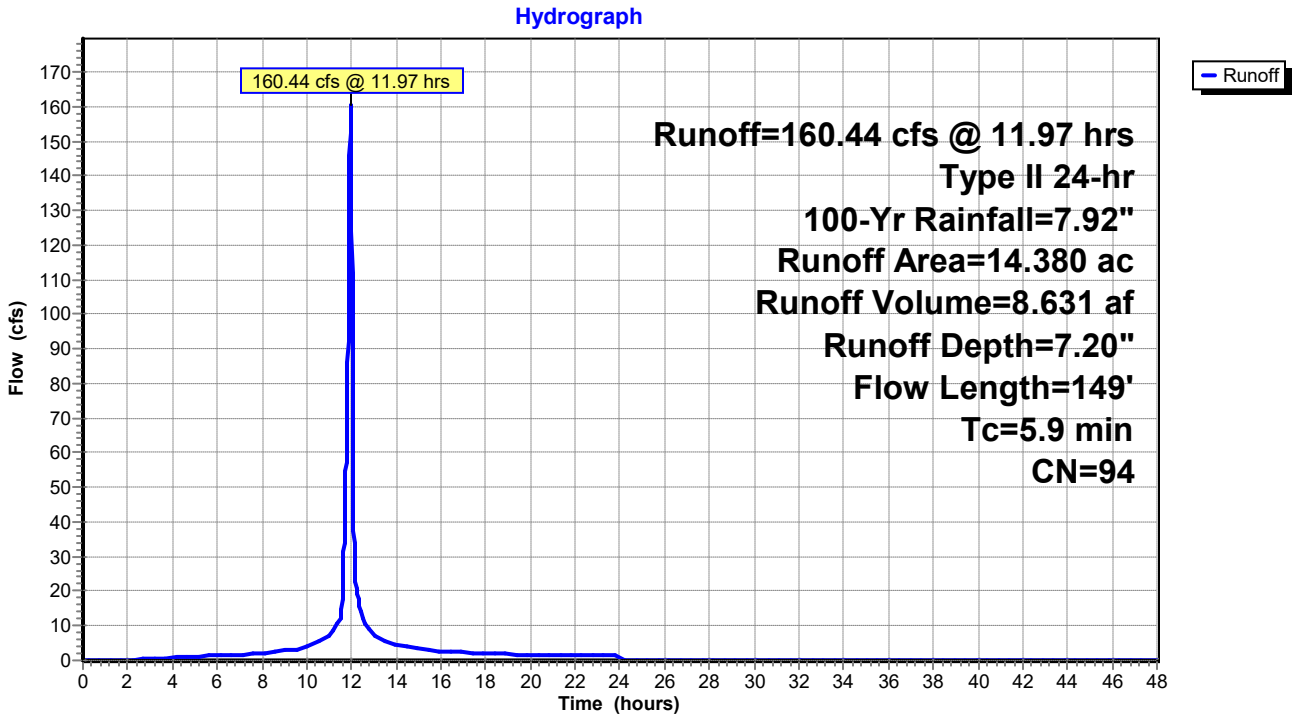
Runoff = 160.44 cfs @ 11.97 hrs, Volume= 8.631 af, Depth= 7.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Yr Rainfall=7.92"

Area (ac)	CN	Description
10.613	98	Water Surface, HSG A
3.767	84	50-75% Grass cover, Fair, HSG D
14.380	94	Weighted Average
3.767		26.20% Pervious Area
10.613		73.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.3	60	0.0450	0.19		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.56"
0.6	89	0.1404	2.62		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
5.9	149	Total			

Subcatchment C4-S: Cell 004 Subcatchment



Summary for Subcatchment ERP-S: Emergency Reclamation Pond Subcatchment

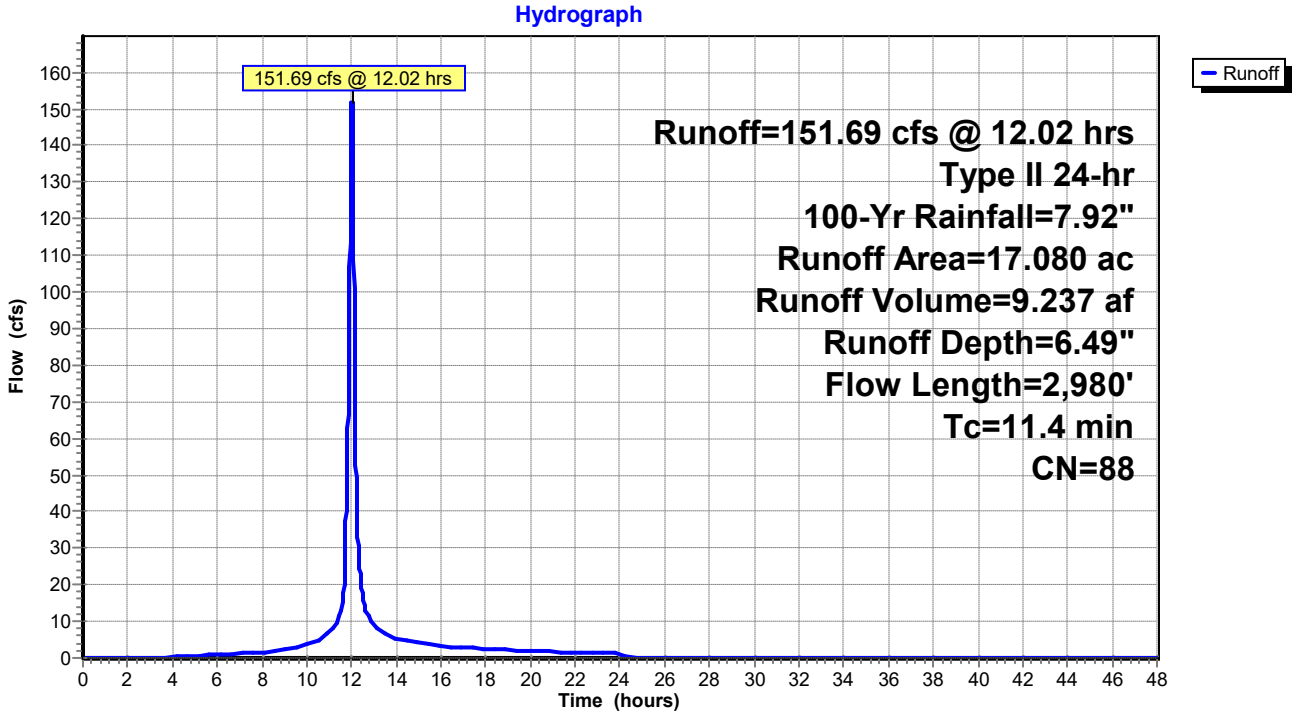
Runoff = 151.69 cfs @ 12.02 hrs, Volume= 9.237 af, Depth= 6.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Yr Rainfall=7.92"

Area (ac)	CN	Description
17.080	88	Urban industrial, 72% imp, HSG B
4.782		28.00% Pervious Area
12.298		72.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.6	300	0.3300	1.40		**Sheet Flow, off coal pile** Fallow n= 0.050 P2= 2.56"
1.2	400	0.3300	5.74		**Shallow Concentrated Flow, off coal pile** Nearly Bare & Untilled Kv= 10.0 fps
2.1	880	0.0100	6.93	55.47	**Trap/Vee/Rect Channel Flow, drainage ditch to ER Pond** Bot.W=5.00' D=1.00' Z= 3.0 '/' Top.W=11.00' n= 0.017 Concrete, unfinished
0.6	485		12.69		**Lake or Reservoir, ER Pond** Mean Depth= 5.00'
3.9	915	0.0100	3.93	31.43	**Trap/Vee/Rect Channel Flow, ER Pond discharge ditch to catch ba** Bot.W=5.00' D=1.00' Z= 3.0 '/' Top.W=11.00' n= 0.030 Earth, grassed & winding
11.4	2,980	Total			

Subcatchment ERP-S: Emergency Reclamation Pond Subcatchment



Summary for Subcatchment U12-S: U1&2 Coal Pile Subcatchment

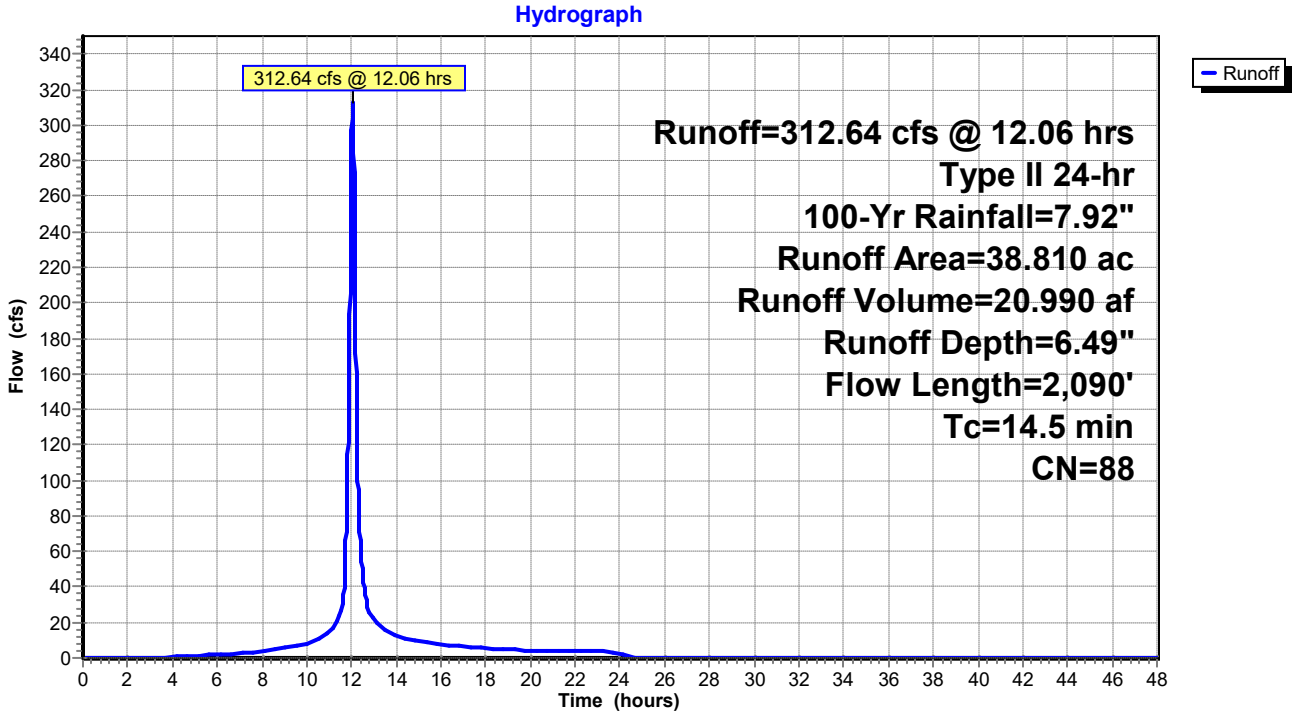
Runoff = 312.64 cfs @ 12.06 hrs, Volume= 20.990 af, Depth= 6.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Yr Rainfall=7.92"

Area (ac)	CN	Description
38.810	88	Urban industrial, 72% imp, HSG B
10.867		28.00% Pervious Area
27.943		72.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.3	300	0.0100	1.16		**Sheet Flow, fly ash building parking lot** Smooth surfaces n= 0.011 P2= 2.56"
8.2	790	0.0100	1.61		**Shallow Concentrated Flow, fly ash building parking lot** Unpaved Kv= 16.1 fps
2.0	1,000	0.0200	8.33	66.68	**Trap/Vee/Rect Channel Flow,** Bot.W=5.00' D=1.00' Z= 3.0 '/' Top.W=11.00' n= 0.020 Concrete, unfinished
14.5	2,090	Total			

Subcatchment U12-S: U1&2 Coal Pile Subcatchment



Summary for Subcatchment WDN1-S: West Ditch (N-1) Subcatchment

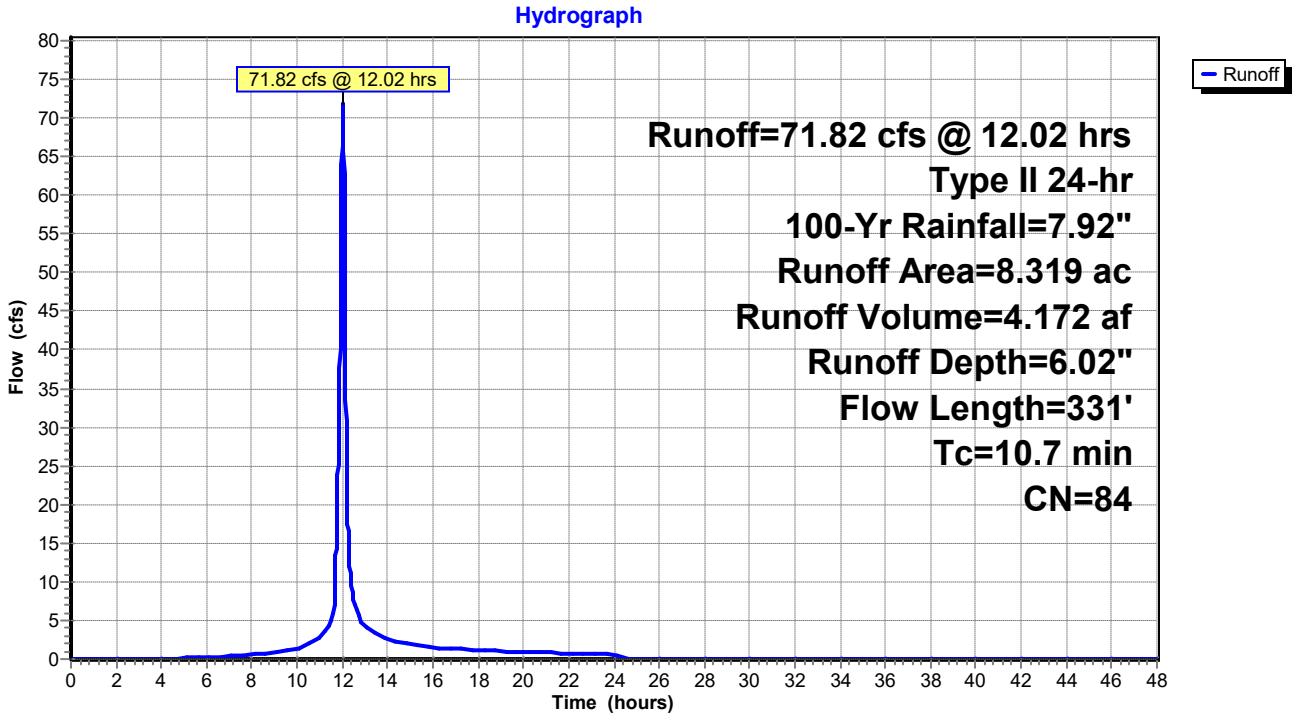
Runoff = 71.82 cfs @ 12.02 hrs, Volume= 4.172 af, Depth= 6.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Yr Rainfall=7.92"

Area (ac)	CN	Description
8.319	84	50-75% Grass cover, Fair, HSG D
8.319		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
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
10.7	331	Total			

Subcatchment WDN1-S: West Ditch (N-1) Subcatchment



Summary for Subcatchment WDN2-S: West Ditch (N-2) Subcatchment

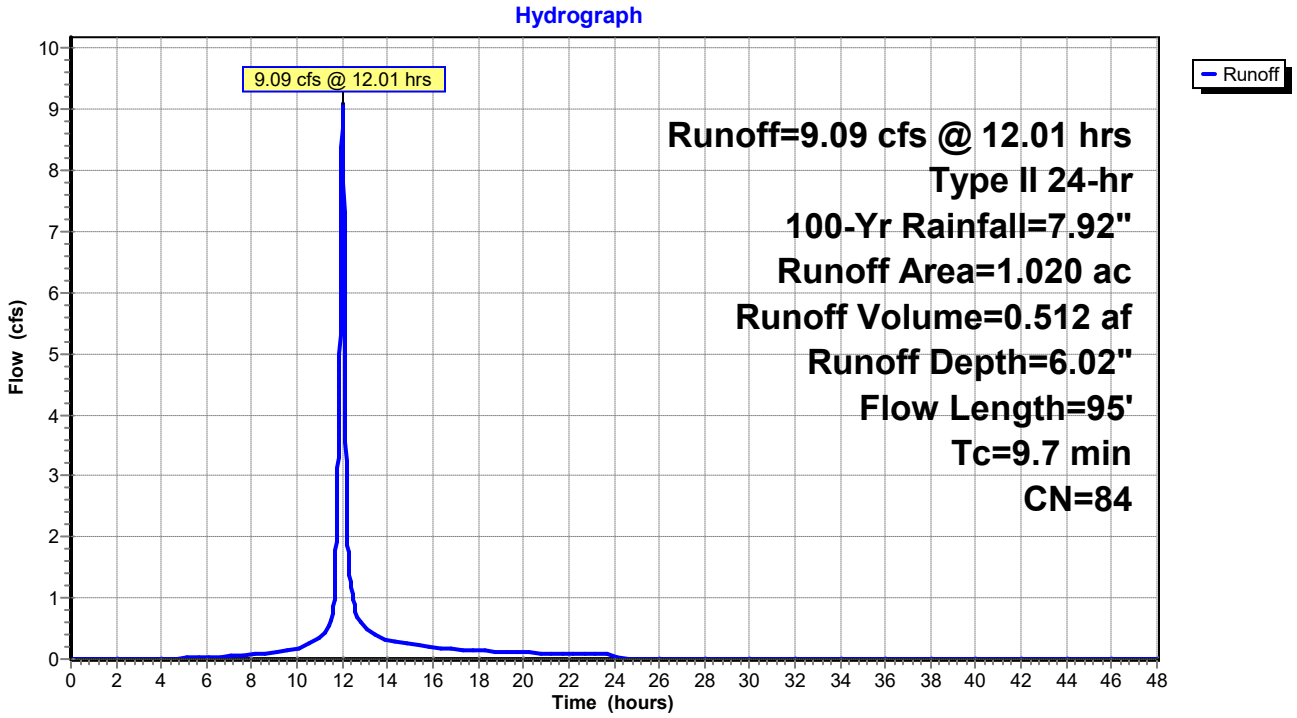
Runoff = 9.09 cfs @ 12.01 hrs, Volume= 0.512 af, Depth= 6.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Yr Rainfall=7.92"

Area (ac)	CN	Description
1.020	84	50-75% Grass cover, Fair, HSG D
1.020		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.6	60	0.0100	0.10		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.56"
0.1	35	0.3300	4.02		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.7	95	Total			

Subcatchment WDN2-S: West Ditch (N-2) Subcatchment



Summary for Subcatchment WDS-S: West Ditch (S) Subcatchment

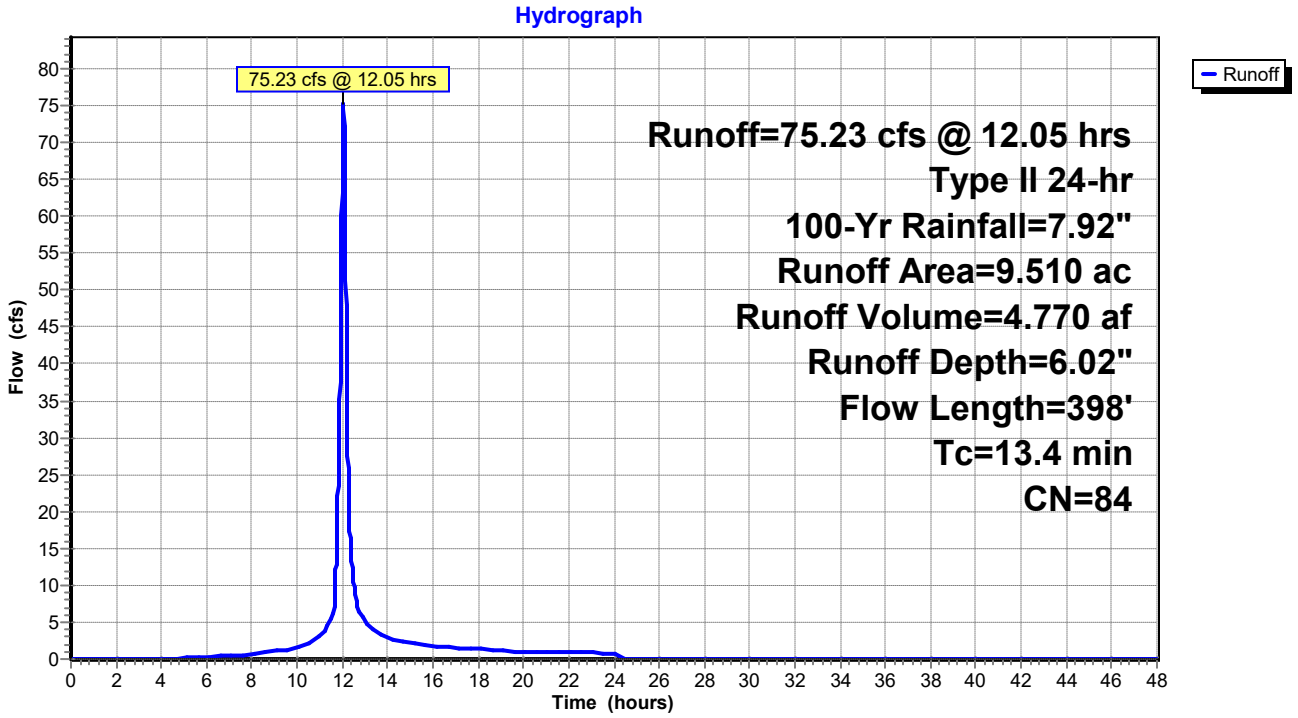
Runoff = 75.23 cfs @ 12.05 hrs, Volume= 4.770 af, Depth= 6.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Yr Rainfall=7.92"

Area (ac)	CN	Description
9.510	84	50-75% Grass cover, Fair, HSG D
9.510		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.0	100	0.0200	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.56"
2.4	298	0.0872	2.07		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
13.4	398	Total			

Subcatchment WDS-S: West Ditch (S) Subcatchment



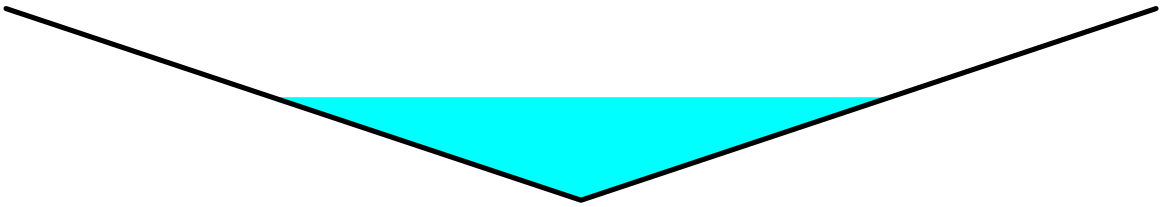
Summary for Reach WD_S: West Ditch (S)

Inflow Area = 80.596 ac, 52.58% Impervious, Inflow Depth > 18.55" for 100-Yr event
Inflow = 279.46 cfs @ 12.08 hrs, Volume= 124.567 af
Outflow = 276.29 cfs @ 12.11 hrs, Volume= 124.438 af, Atten= 1%, Lag= 2.1 min

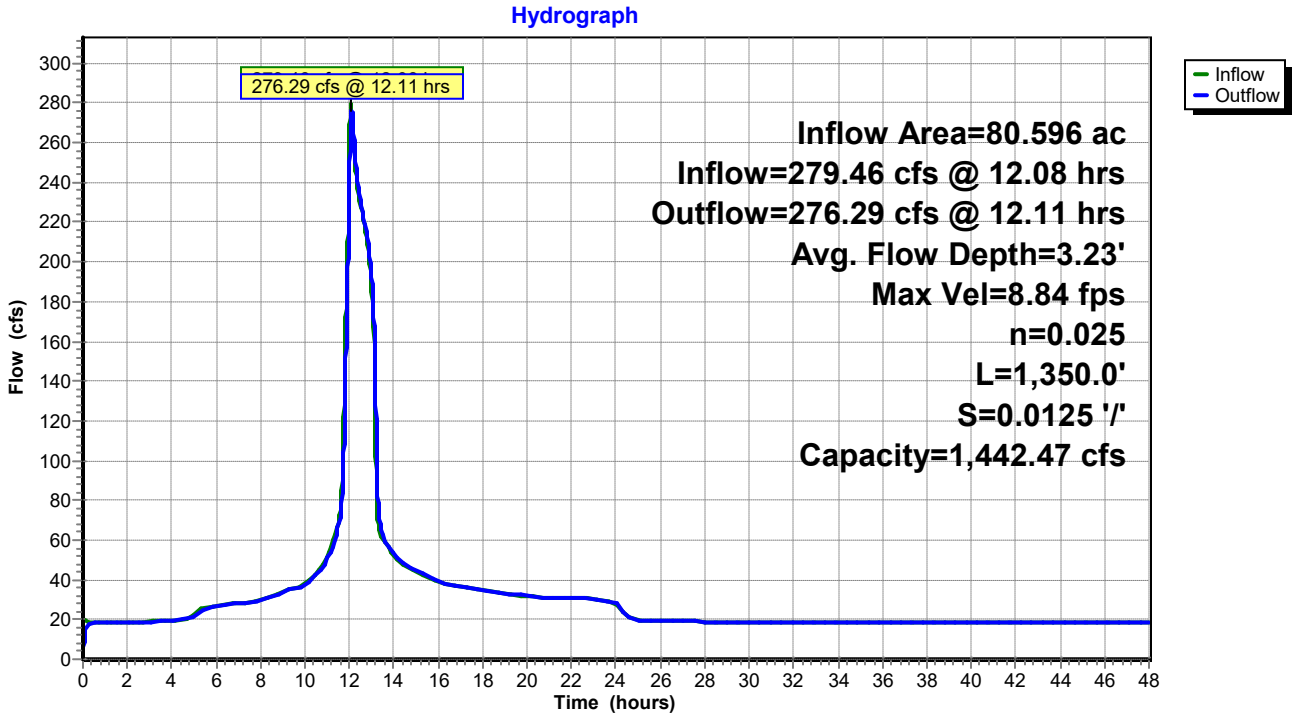
Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 8.84 fps, Min. Travel Time= 2.5 min
Avg. Velocity = 4.92 fps, Avg. Travel Time= 4.6 min

Peak Storage= 42,212 cf @ 12.11 hrs
Average Depth at Peak Storage= 3.23'
Bank-Full Depth= 6.00' Flow Area= 108.0 sf, Capacity= 1,442.47 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= 0.0125 '/'
Inlet Invert= 730.90', Outlet Invert= 714.00'



Reach WD_S: West Ditch (S)



Summary for Pond C1: Cell 001

Weir length and outlet pipe diameter per GEI Specific Site Assessment for CCW Impoundments at THEC (6/2011).

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

Pipe length, material, downstream invert, and slope per Burns & McDonnell Ash Pond Modifications Drawing Y2 (6/4/1984).

Base flow associated with full CDT flow-through.

Inflow Area = 5.857 ac, 36.49% Impervious, Inflow Depth >160.58" for 100-Yr event
Inflow = 74.83 cfs @ 12.00 hrs, Volume= 78.375 af, Incl. 18.94 cfs Base Flow
Outflow = 34.39 cfs @ 12.12 hrs, Volume= 78.368 af, Atten= 54%, Lag= 7.0 min
Primary = 34.39 cfs @ 12.12 hrs, Volume= 78.368 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Starting Elev= 740.13' Surf.Area= 83,869 sf Storage= 413,473 cf
Peak Elev= 740.74' @ 12.21 hrs Surf.Area= 86,225 sf Storage= 465,405 cf (51,932 cf above start)

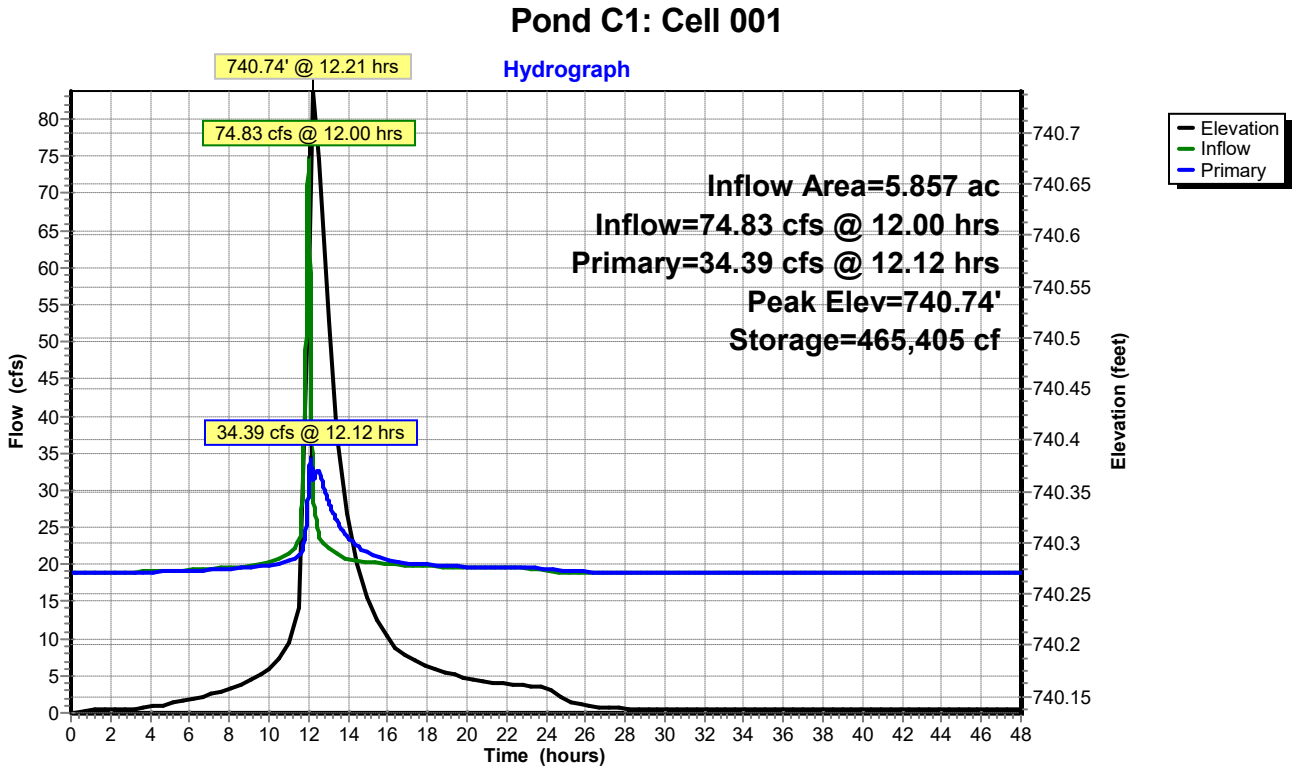
Plug-Flow detention time= 350.0 min calculated for 68.868 af (88% of inflow)
Center-of-Mass det. time= 2.5 min (1,415.3 - 1,412.8)

Volume	Invert	Avail.Storage	Storage Description
#1	733.60'	767,014 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
733.60	0	0	0
734.00	506	101	101
735.00	64,324	32,415	32,516
736.00	68,613	66,469	98,985
737.00	72,199	70,406	169,391
738.00	75,853	74,026	243,417
739.00	79,576	77,715	321,131
740.00	83,367	81,472	402,603
741.00	87,226	85,297	487,899
742.00	91,153	89,190	577,089
743.00	95,148	93,151	670,239
744.00	98,402	96,775	767,014

Device	Routing	Invert	Outlet Devices
#1	Primary	733.50'	**30.0" Round Culvert** L= 134.0' RCP, rounded edge headwall, Ke= 0.100 Inlet / Outlet Invert= 733.50' / 732.16' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 4.91 sf
#2	Device 1	739.00'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=34.20 cfs @ 12.12 hrs HW=740.72' TW=739.13' (Dynamic Tailwater)
└─**1=Culvert** (Passes 34.20 cfs of 35.28 cfs potential flow)
└─**2=Sharp-Crested Rectangular Weir** (Weir Controls 34.20 cfs @ 4.26 fps)



Summary for Pond C3: Cell 003

Weir length, pipe size, slope, material, and upstream invert elevation per Burns & McDonnell Ash Pond Modifications Drawing Y8 (6/4/1984).

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 Area = 96.986 ac, 54.27% Impervious, Inflow Depth > 16.59" for 100-Yr event
Inflow = 399.75 cfs @ 11.94 hrs, Volume= 134.112 af
Outflow = 113.71 cfs @ 13.22 hrs, Volume= 123.622 af, Atten= 72%, Lag= 77.3 min
Primary = 113.71 cfs @ 13.22 hrs, Volume= 123.622 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 713.51' @ 13.22 hrs Surf.Area= 496,675 sf Storage= 1,633,120 cf

Plug-Flow detention time= 308.5 min calculated for 123.596 af (92% of inflow)
Center-of-Mass det. time= 179.8 min (1,341.8 - 1,162.1)

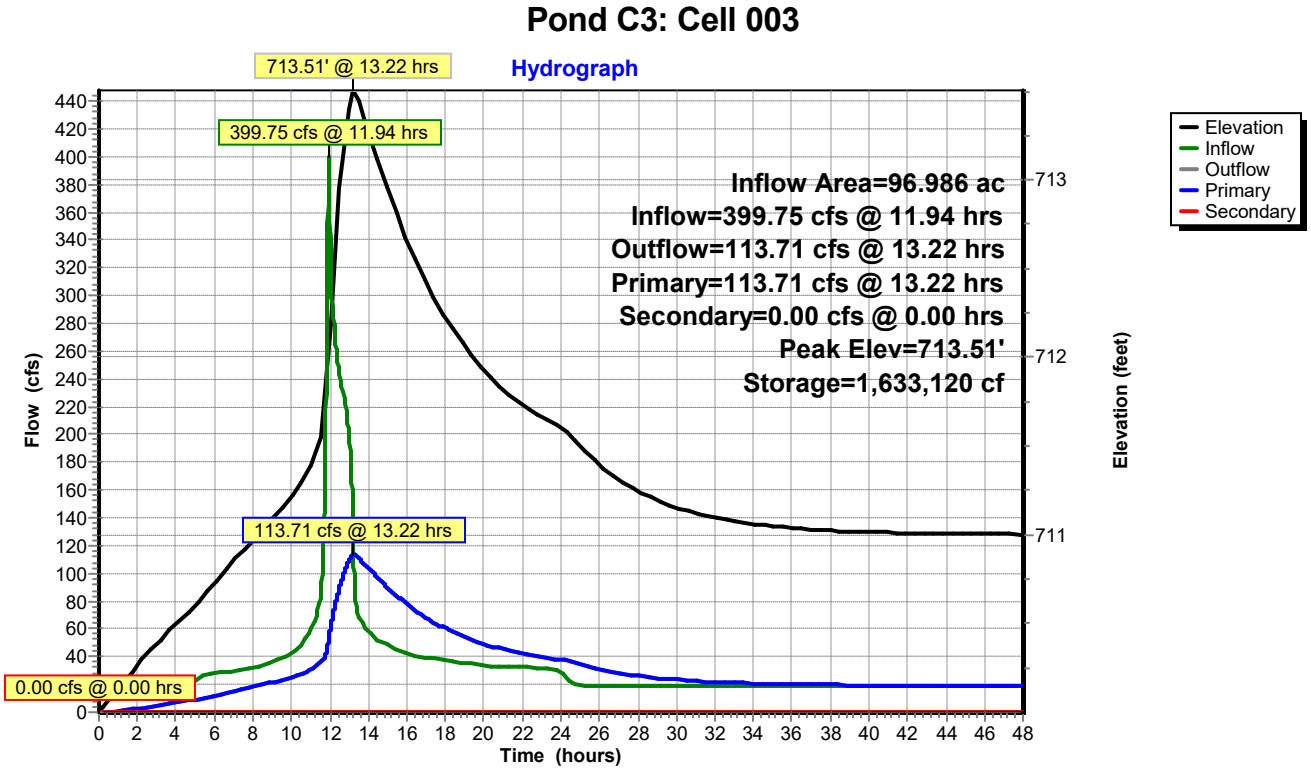
Volume	Invert	Avail.Storage	Storage Description
#1	710.00'	2,944,319 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
710.00	465,439	0	0
711.00	446,896	456,168	456,168
712.00	464,598	455,747	911,915
713.00	482,905	473,752	1,385,666
714.00	510,161	496,533	1,882,199
715.00	532,407	521,284	2,403,483
716.00	549,264	540,836	2,944,319

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)** Head (feet) 0.00 2.00 Width (feet) 12.00 18.00

Primary OutFlow Max=113.71 cfs @ 13.22 hrs HW=713.51' TW=701.68' (Dynamic Tailwater)
└─**1=Culvert** (Passes 113.71 cfs of 271.94 cfs potential flow)
└─**2=Sharp-Crested Rectangular Weir** (Weir Controls 113.71 cfs @ 6.12 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=710.00' TW=700.00' (Dynamic Tailwater)
└─**3=Custom Weir/Orifice** (Controls 0.00 cfs)



Summary for Pond C4: Cell 004

Pimary outlet pipe slope, upstream invert, downstream invert, size, and material per Burns & McDonnell Ash Pond Modifications Drawing Y12 (10/17/1985).

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

Weir length per 2016 H&A Hazard Potential Classification.

Emergency spillway elevation and bottom width per Ash Pond #001 Specs provided by AECI. Side slopes per Burns & McDonnell Dike Profile and Grading Section Drawing Y12 (5/10/1980).

Inflow Area = 111.366 ac, 56.79% Impervious, Inflow Depth > 14.25" for 100-Yr event
Inflow = 216.84 cfs @ 11.97 hrs, Volume= 132.253 af
Outflow = 87.77 cfs @ 15.39 hrs, Volume= 124.626 af, Atten= 60%, Lag= 205.4 min
Primary = 87.77 cfs @ 15.39 hrs, Volume= 124.626 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 702.04' @ 15.39 hrs Surf.Area= 10.890 ac Storage= 22.007 af

Plug-Flow detention time= 221.0 min calculated for 124.600 af (94% of inflow)
Center-of-Mass det. time= 133.4 min (1,437.1 - 1,303.7)

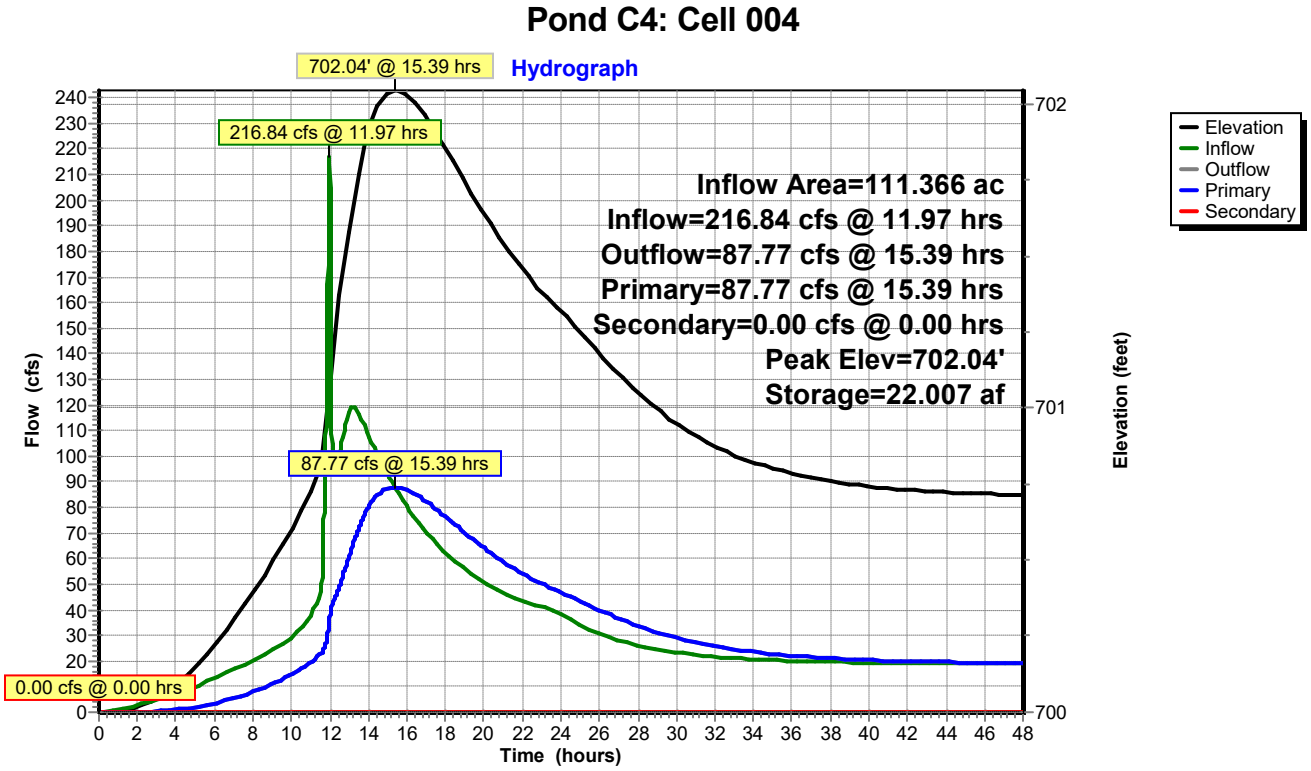
Volume	Invert	Avail.Storage	Storage Description
#1	700.00'	54.879 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
700.00	10.614	0.000	0.000
701.00	10.774	10.694	10.694
702.00	10.885	10.830	21.523
703.00	11.005	10.945	32.468
704.00	11.183	11.094	43.562
705.00	11.450	11.316	54.879

Device	Routing	Invert	Outlet Devices
#1	Primary	682.00'	**48.0" Round Culvert** L= 140.0' RCP, rounded edge headwall, Ke= 0.100 Inlet / Outlet Invert= 682.00' / 680.60' S= 0.0100 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 12.57 sf
#2	Device 1	700.00'	**5.0' long Sharp-Crested Rectangular Weir X 2.00** 2 End Contraction(s)
#3	Secondary	703.00'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 2.00 Width (feet) 10.00 16.00

Primary OutFlow Max=87.77 cfs @ 15.39 hrs HW=702.04' (Free Discharge)
└**1=Culvert** (Passes 87.77 cfs of 323.98 cfs potential flow)
└**2=Sharp-Crested Rectangular Weir** (Weir Controls 87.77 cfs @ 4.68 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=700.00' (Free Discharge)
└**3=Custom Weir/Orifice** (Controls 0.00 cfs)



Summary for Pond U12: U12 Settling Basin

Conservatively assumed no detention time in the U1 & U2 Coal Pile Runoff Settling Basin (i.e., also no wedge wire screen overtop wedge wire screen)

Inflow Area = 38.810 ac, 72.00% Impervious, Inflow Depth = 7.53" for 100-Yr event
Inflow = 314.79 cfs @ 12.06 hrs, Volume= 24.367 af
Outflow = 121.69 cfs @ 12.02 hrs, Volume= 24.367 af, Atten= 61%, Lag= 0.0 min
Primary = 121.69 cfs @ 12.02 hrs, Volume= 24.367 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Starting Elev= 746.27' Surf.Area= 8,235 sf Storage= 16,921 cf
Peak Elev= 751.87' @ 12.26 hrs Surf.Area= 86,769 sf Storage= 202,936 cf (186,015 cf above start)

Plug-Flow detention time= 28.3 min calculated for 23.978 af (98% of inflow)
Center-of-Mass det. time= 10.1 min (808.6 - 798.5)

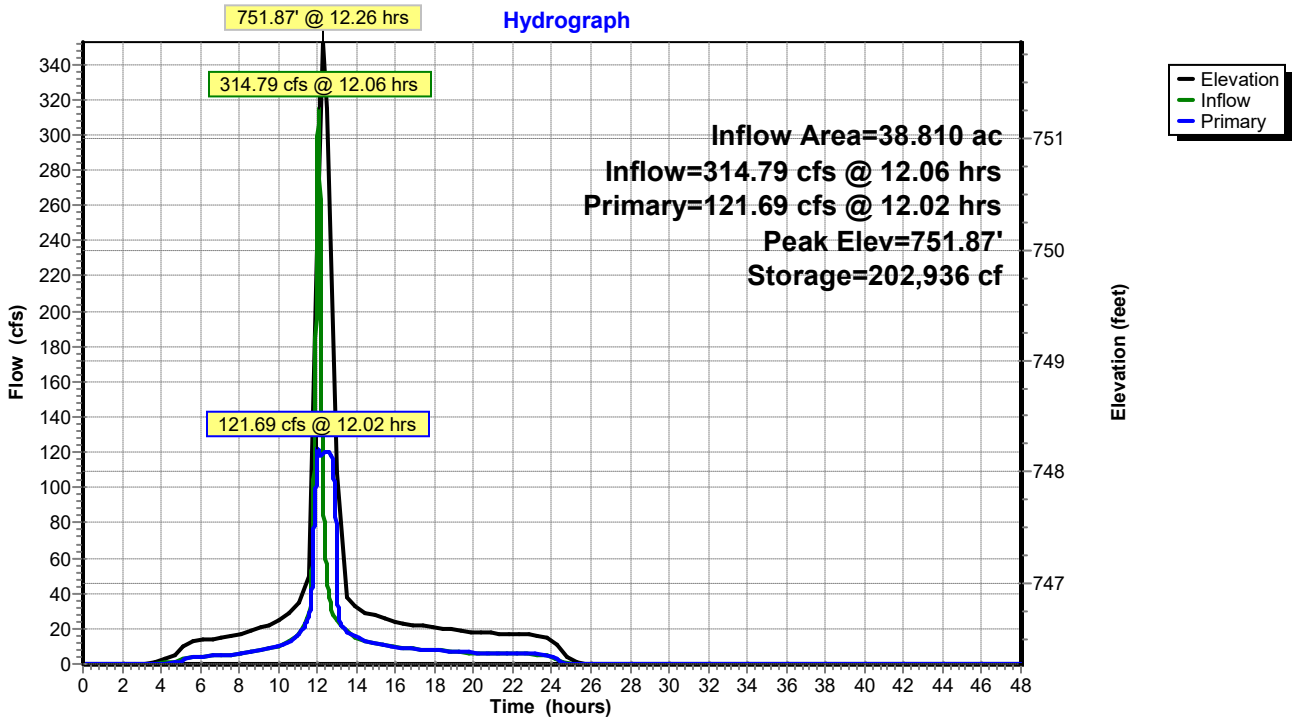
Volume	Invert	Avail.Storage	Storage Description
#1	742.80'	214,289 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
742.80	0	0	0
743.00	2,309	231	231
744.00	3,920	3,115	3,345
745.00	5,663	4,792	8,137
746.00	7,623	6,643	14,780
747.00	9,888	8,756	23,535
748.00	12,284	11,086	34,621
750.00	38,657	50,941	85,562
752.00	90,070	128,727	214,289

Device	Routing	Invert	Outlet Devices
#1	Primary	741.27'	**48.0" Round Storm Sewer** L= 251.3' CMP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 741.27' / 734.39' S= 0.0274 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 12.57 sf
#2	Device 1	746.27'	**48.0" Horiz. Drop Inlet Structure** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=119.94 cfs @ 12.02 hrs HW=750.37' TW=741.74' (Dynamic Tailwater)
↑—**1=Storm Sewer** (Outlet Controls 119.94 cfs @ 9.54 fps)
↑—**2=Drop Inlet Structure** (Passes 119.94 cfs of 122.45 cfs potential flow)

Pond U12: U12 Settling Basin



Summary for Pond WD_N1: West Ditch (N-1)

Inflow Area = 64.209 ac, 62.67% Impervious, Inflow Depth = 7.65" for 100-Yr event
Inflow = 347.13 cfs @ 12.02 hrs, Volume= 40.918 af
Outflow = 194.61 cfs @ 12.13 hrs, Volume= 40.918 af, Atten= 44%, Lag= 6.4 min
Primary = 194.61 cfs @ 12.13 hrs, Volume= 40.918 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Starting Elev= 733.00' Surf.Area= 6 sf Storage= 3 cf
Peak Elev= 743.47' @ 12.21 hrs Surf.Area= 34,276 sf Storage= 140,704 cf (140,701 cf above start)

Plug-Flow detention time= 4.3 min calculated for 40.918 af (100% of inflow)
Center-of-Mass det. time= 4.2 min (810.6 - 806.4)

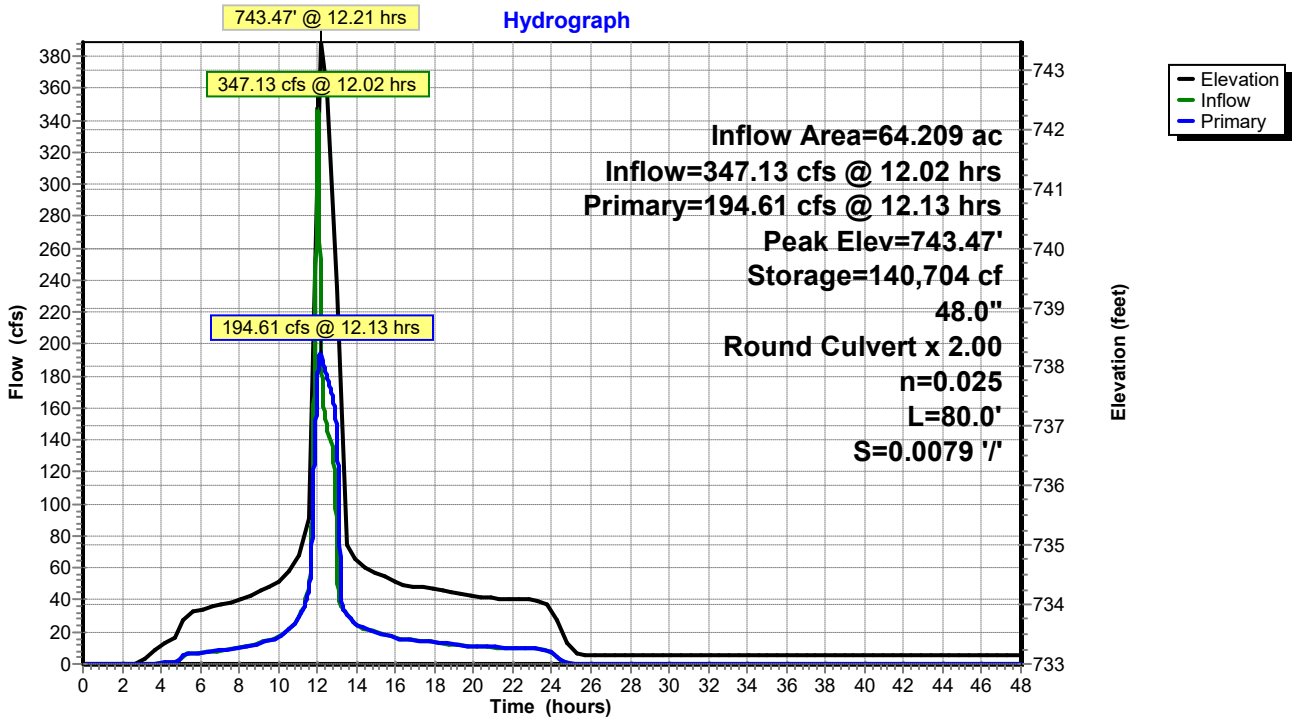
Volume	Invert	Avail.Storage	Storage Description
#1	732.00'	159,518 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
732.00	0	0	0
733.00	6	3	3
734.00	425	216	219
735.00	1,880	1,153	1,371
736.00	3,618	2,749	4,120
737.00	6,250	4,934	9,054
738.00	9,925	8,088	17,142
739.00	15,164	12,545	29,686
740.00	19,529	17,347	47,033
741.00	24,049	21,789	68,822
742.00	28,064	26,057	94,878
743.00	32,406	30,235	125,113
744.00	36,404	34,405	159,518

Device	Routing	Invert	Outlet Devices
#1	Primary	732.96'	**48.0" Round Culvert X 2.00** L= 80.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 732.96' / 732.33' S= 0.0079 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 12.57 sf

Primary OutFlow Max=193.16 cfs @ 12.13 hrs HW=743.26' TW=739.17' (Dynamic Tailwater)
↑**1=Culvert** (Inlet Controls 193.16 cfs @ 7.69 fps)

Pond WD_N1: West Ditch (N-1)



Summary for Pond WD_N2: West Ditch (N-2)

Dual 48" culverts and invert elevations per 2019 survey.

All pumped flows (process and stormwater related) assumed to pump directly into the upstream portion of the existing West Ditch

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Inflow Area = 71.086 ac, 59.61% Impervious, Inflow Depth > 20.22" for 100-Yr event
Inflow = 233.82 cfs @ 12.11 hrs, Volume= 119.797 af
Outflow = 223.18 cfs @ 12.29 hrs, Volume= 119.798 af, Atten= 5%, Lag= 11.1 min
Primary = 223.18 cfs @ 12.29 hrs, Volume= 119.798 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Starting Elev= 733.00' Surf.Area= 1,740 sf Storage= 1,573 cf
Peak Elev= 739.47' @ 12.26 hrs Surf.Area= 12,627 sf Storage= 38,560 cf (36,987 cf above start)

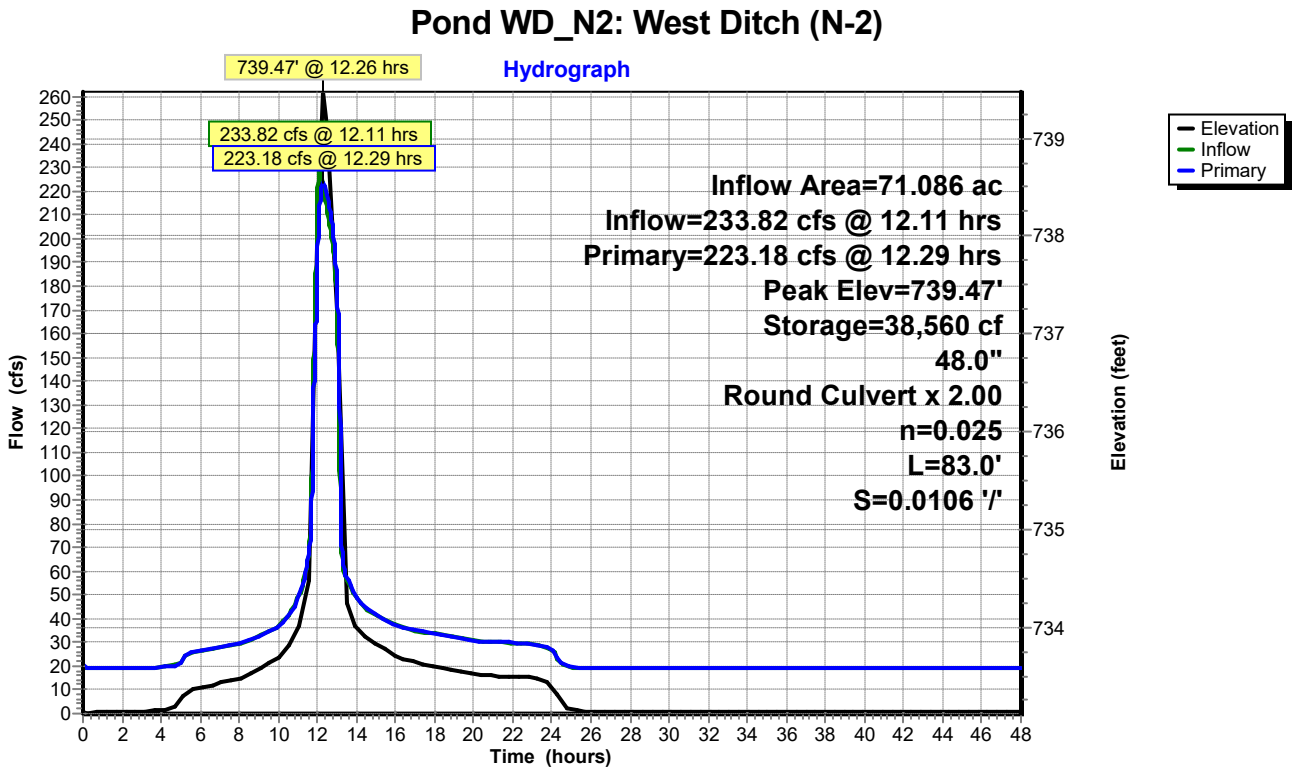
Plug-Flow detention time= 1.6 min calculated for 119.755 af (100% of inflow)
Center-of-Mass det. time= 0.6 min (1,206.7 - 1,206.1)

Volume	Invert	Avail.Storage	Storage Description
#1	730.00'	968,539 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
730.00	0	0	0
731.00	108	54	54
732.00	595	352	406
733.00	1,740	1,168	1,573
734.00	2,465	2,103	3,676
735.00	4,060	3,263	6,938
736.00	4,968	4,514	11,452
737.00	6,012	5,490	16,942
738.00	7,449	6,731	23,673
739.00	11,073	9,261	32,934
740.00	14,345	12,709	45,643
741.00	16,052	15,199	60,841
742.00	17,708	16,880	77,721
743.00	19,273	18,491	96,212
744.00	20,990	20,132	116,343
748.00	74,052	190,084	306,427
752.00	82,764	313,632	620,059
756.00	91,476	348,480	968,539

Device	Routing	Invert	Outlet Devices
#1	Primary	731.78'	**48.0" Round Culvert X 2.00** L= 83.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 731.78' / 730.90' S= 0.0106 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 12.57 sf

Primary OutFlow Max=223.30 cfs @ 12.29 hrs HW=739.46' TW=734.00' (Dynamic Tailwater)
1=Culvert (Inlet Controls 223.30 cfs @ 8.88 fps)



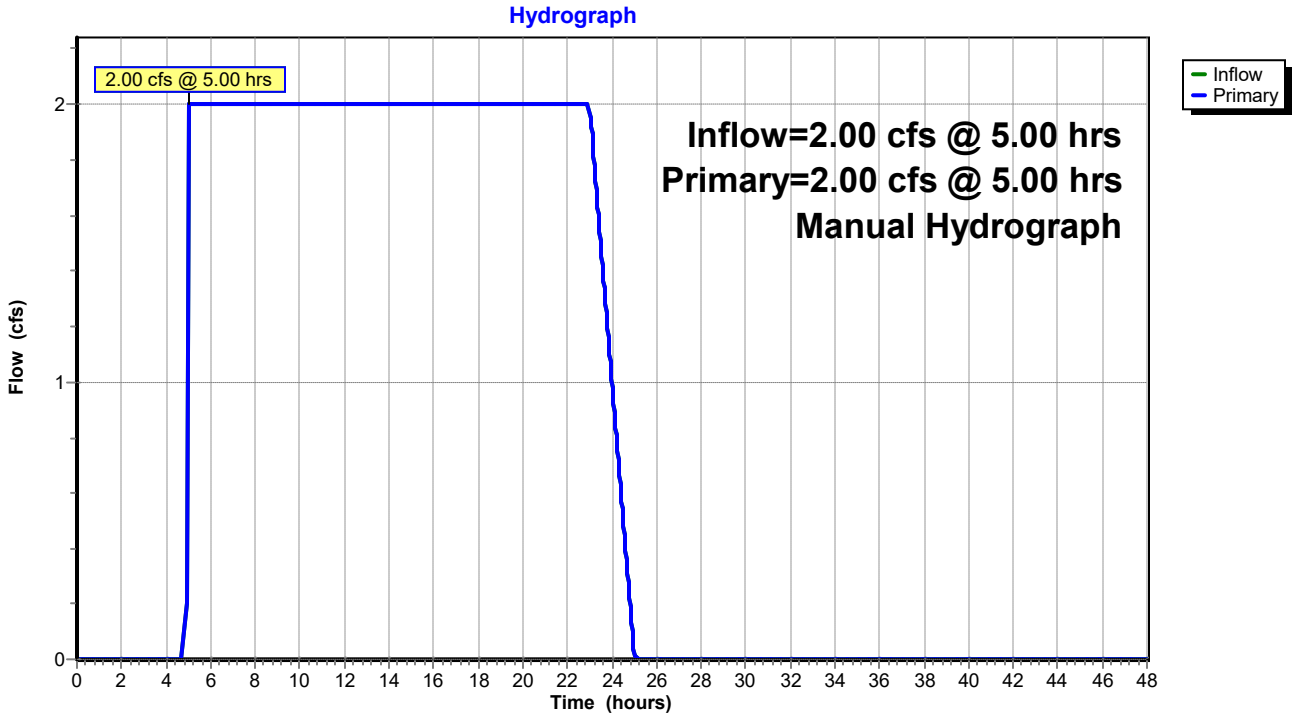
Summary for Link P006: Pond 006 (Pumped)

Inflow = 2.00 cfs @ 5.00 hrs, Volume= 3.141 af
Primary = 2.00 cfs @ 5.00 hrs, Volume= 3.141 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

11 Point manual hydrograph, To= 5.00 hrs, dt= 2.00 hrs, cfs =
2.00 2.00 2.00 2.00 2.00 2.00 2.00 2.00 2.00 2.00
0.00

Link P006: Pond 006 (Pumped)



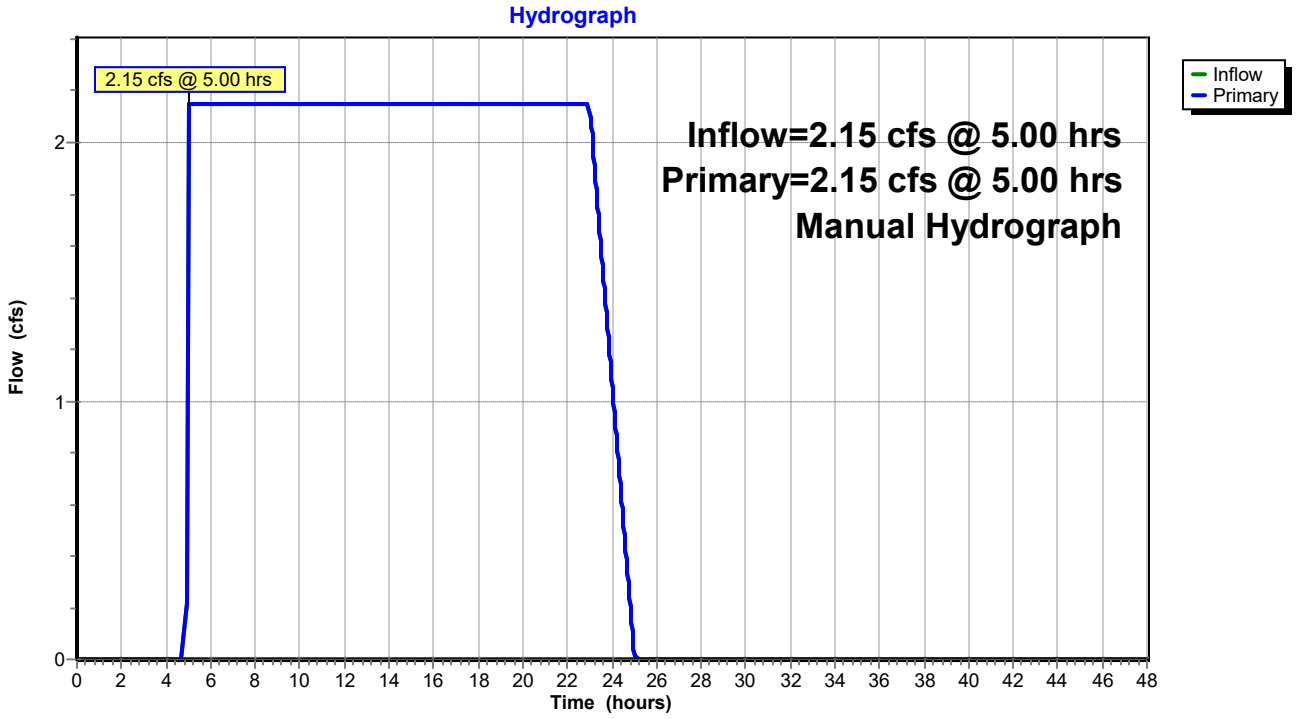
Summary for Link P016: Pond 016 (Pumped)

Inflow = 2.15 cfs @ 5.00 hrs, Volume= 3.377 af
Primary = 2.15 cfs @ 5.00 hrs, Volume= 3.377 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

11 Point manual hydrograph, To= 5.00 hrs, dt= 2.00 hrs, cfs =
2.15 2.15 2.15 2.15 2.15 2.15 2.15 2.15 2.15 2.15
0.00

Link P016: Pond 016 (Pumped)



Appendix B

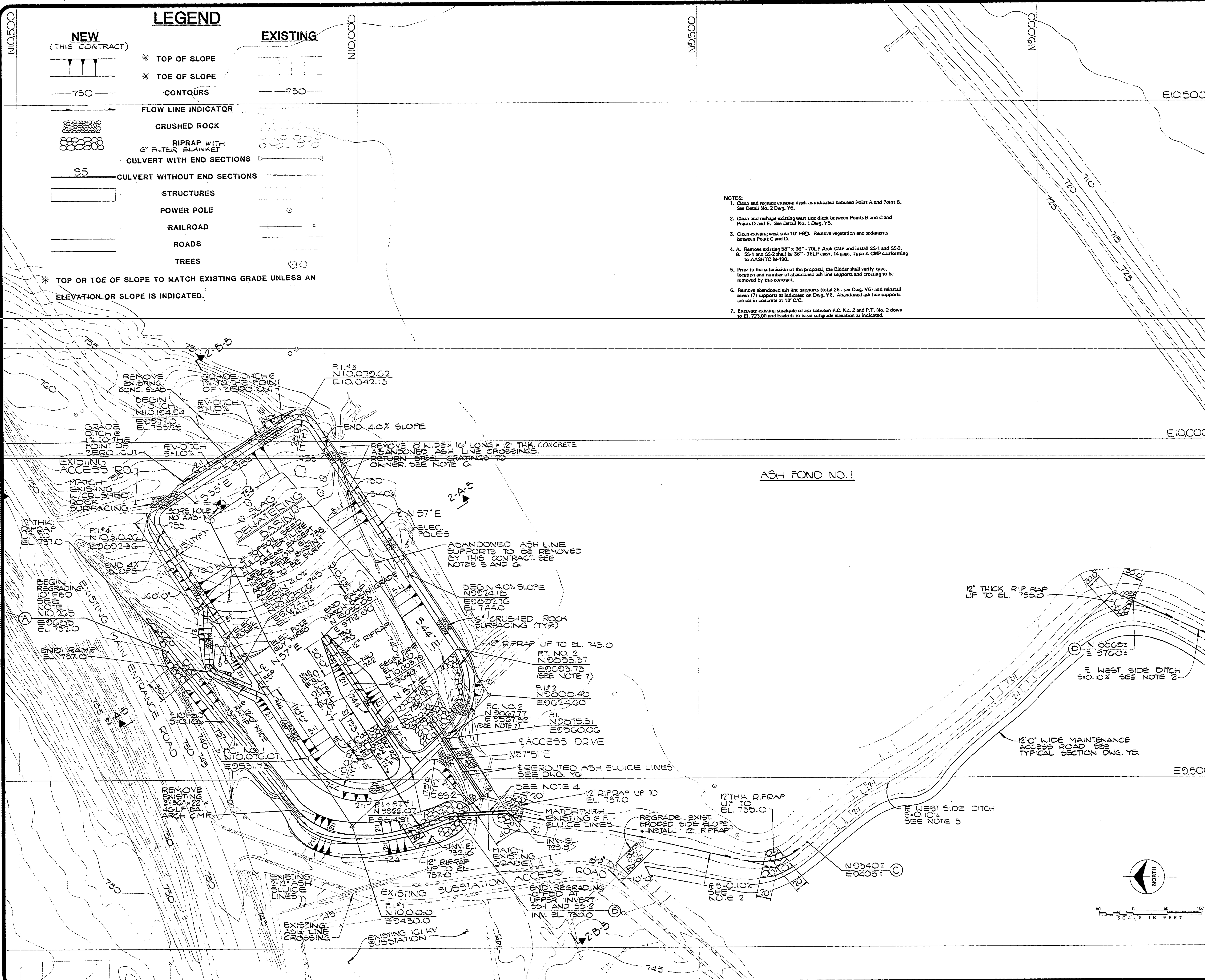
LEGEND

NEW (THIS CONTRACT)		EXISTING
	* TOP OF SLOPE	
	* TOE OF SLOPE	
750	CONTOURS	750
	FLOW LINE INDICATOR	
	CRUSHED ROCK	
	RIPRAP WITH 6" FILTER BLANKET	
	CULVERT WITH END SECTIONS	
SS	CULVERT WITHOUT END SECTIONS	
	STRUCTURES	
	POWER POLE	
	RAILROAD	
	ROADS	
	TREES	

* TOP OR TOE OF SLOPE TO MATCH EXISTING GRADE UNLESS AN ELEVATION OR SLOPE IS INDICATED.

NOTES:

1. Clean and regrade existing ditch as indicated between Point A and Point B. See Detail No. 2 Dwg. Y5.
2. Clean and reshape existing west side ditch between Points B and C and Points D and E. See Detail No. 1 Dwg. Y5.
3. Clean existing west side 10' FBD. Remove vegetation and sediments between Point C and D.
4. A. Remove existing 58" x 36" - 70LF Arch CMP and install SS-1 and SS-2.
   B. SS-1 and SS-2 shall be 36" - 76LF each, 14 gage, Type A CMP conforming to AASHTO M-190.
5. Prior to the submission of the proposal, the Bidder shall verify type, location and number of abandoned ash line supports and crossing to be removed by this contract.
6. Remove abandoned ash line supports (total 28 - see Dwg. Y6) and reinstall seven (7) supports as indicated on Dwg. Y6. Abandoned ash line supports are set in concrete at 18' C/C.
7. Excavate existing stockpile of ash between P.C. No. 2 and P.T. No. 2 down to El. 723.00 and backfill to basin subgrade elevation as indicated.



no.	date	by	revision
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	10-17-85	DLM	

date	6-4-84
designed	KUMTHEKAR
detailed	MADDOCK
checked	

STATE OF MISSOURI H. L. WONDERLY NUMBER E-20896 REGISTERED PROFESSIONAL ENGINEER

Burns & McDonnell
Engineers • Architects • Consultants
Kansas City, Missouri

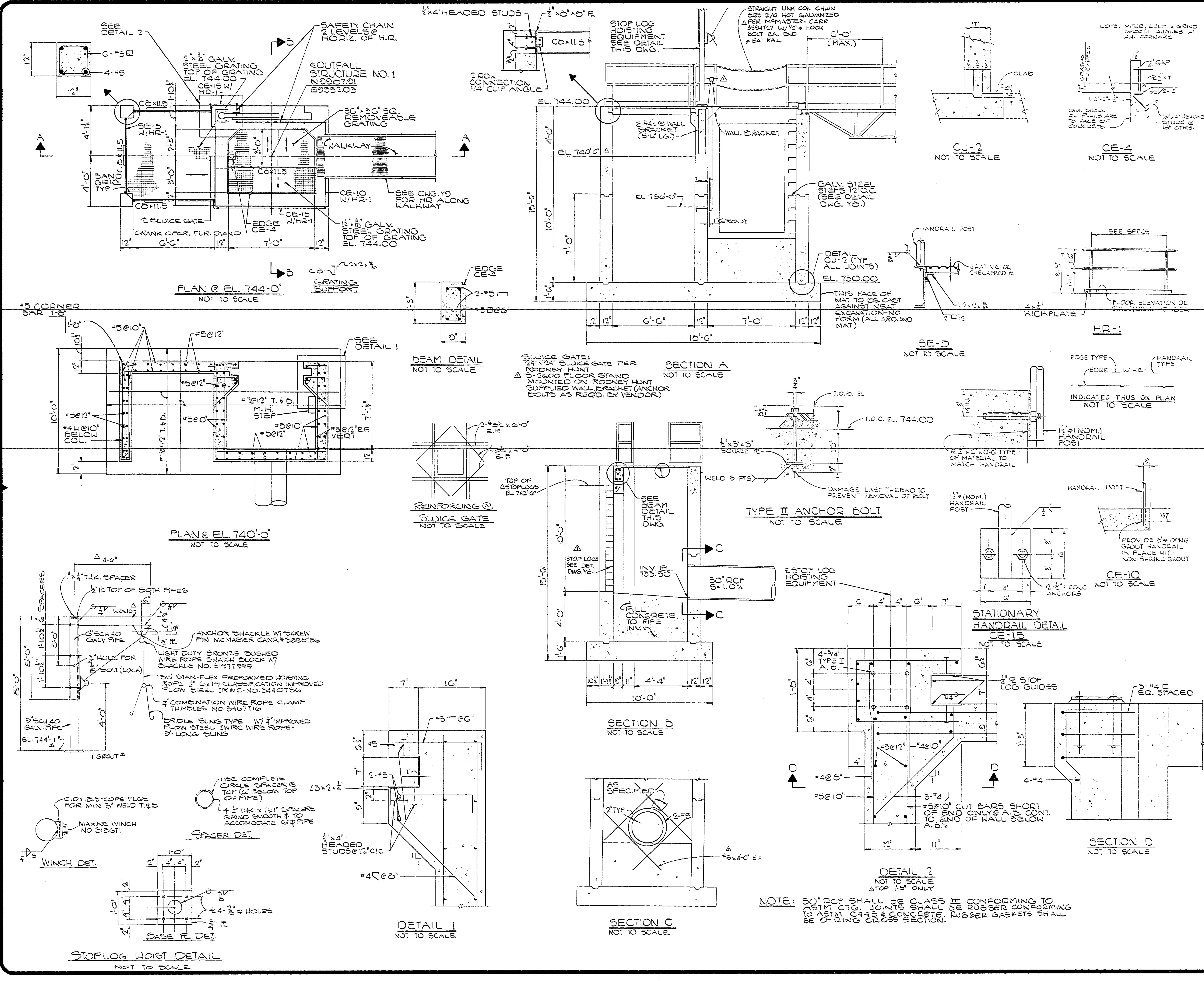
THOMAS HILL POWER PLANT
ASSOCIATED ELECTRIC COOPERATIVE
MISSOURI 73

ASH POND MODIFICATIONS

GRADING PLAN
AREA NO. 1

project	contract
83-210-1	EP. 10. 8301
drawing	rev.
Y2	—

EP.TO.8301 .TO.8301



no.	date	by	revision
△	6-26-84	AFF	REVISED PER ADDENDUM NO. 1
	6-29-84	JAK	ISSUED W/ ADD. NO. 1
	8-6-84	JAK	ISSUED FOR CONSTRUCTION
	10-17-85	CLM	CONFORMING TO CONSTRUCTION RECORDS

STATE OF MISSOURI — K. L. WONDERLY — NUMBER E-20656 — REGISTERED PROFESSIONAL ENGINEER

date JUNE 4, 1984
designed SEYB
detailed MADDOCK
checked

Burns & McDonnell
Engineers • Architects • Consultants
Kansas City, Missouri

THOMAS HILL POWER PLANT
ASSOCIATED ELECTRIC COOPERATIVE
MISSOURI 73

ASH POND MODIFICATIONS

OUTFALL STRUCTURE NO. 1

project 83-210-1
contract EP. TO. 8301
drawing Y7
rev. 1

EP. TO. 8301

Appendix C

NOAA Atlas 14, Volume 8, Version 2
Location name: Huntsville, Missouri, USA*
Latitude: 39.5435°, Longitude: -92.637°
Elevation: 713.62 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Deborah Martin, Sandra Pavlovic, Ishani Roy, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Michael Yekta, Geoffery Bonnin

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.405** (0.328-0.498)	**0.468** (0.378-0.576)	**0.570** (0.459-0.703)	**0.654** (0.524-0.810)	**0.769** (0.594-0.975)	**0.857** (0.647-1.10)	**0.944** (0.688-1.24)	**1.03** (0.721-1.39)	**1.15** (0.770-1.58)	**1.23** (0.808-1.72)
10-min	**0.593** (0.480-0.729)	**0.685** (0.554-0.843)	**0.834** (0.673-1.03)	**0.958** (0.767-1.19)	**1.13** (0.870-1.43)	**1.25** (0.947-1.61)	**1.38** (1.01-1.81)	**1.51** (1.06-2.03)	**1.68** (1.13-2.31)	**1.81** (1.18-2.52)
15-min	**0.723** (0.585-0.890)	**0.835** (0.676-1.03)	**1.02** (0.820-1.26)	**1.17** (0.936-1.45)	**1.37** (1.06-1.74)	**1.53** (1.16-1.96)	**1.69** (1.23-2.21)	**1.84** (1.29-2.47)	**2.05** (1.38-2.82)	**2.20** (1.44-3.08)
30-min	**1.02** (0.827-1.26)	**1.19** (0.965-1.47)	**1.47** (1.19-1.81)	**1.70** (1.36-2.10)	**2.00** (1.54-2.53)	**2.23** (1.68-2.86)	**2.45** (1.79-3.21)	**2.68** (1.87-3.59)	**2.97** (1.99-4.08)	**3.18** (2.08-4.44)
60-min	**1.30** (1.05-1.59)	**1.54** (1.25-1.90)	**1.96** (1.58-2.41)	**2.30** (1.85-2.85)	**2.79** (2.16-3.56)	**3.17** (2.40-4.09)	**3.56** (2.60-4.68)	**3.96** (2.77-5.33)	**4.49** (3.02-6.20)	**4.91** (3.21-6.85)
2-hr	**1.57** (1.28-1.92)	**1.89** (1.54-2.32)	**2.44** (1.98-2.99)	**2.91** (2.35-3.58)	**3.58** (2.79-4.55)	**4.11** (3.13-5.28)	**4.66** (3.43-6.11)	**5.24** (3.69-7.02)	**6.02** (4.08-8.26)	**6.63** (4.38-9.20)
3-hr	**1.73** (1.41-2.10)	**2.10** (1.72-2.56)	**2.75** (2.24-3.36)	**3.31** (2.68-4.06)	**4.14** (3.25-5.26)	**4.81** (3.68-6.17)	**5.51** (4.08-7.21)	**6.25** (4.43-8.37)	**7.28** (4.96-9.97)	**8.09** (5.36-11.2)
6-hr	**2.06** (1.70-2.49)	**2.50** (2.06-3.03)	**3.27** (2.68-3.97)	**3.96** (3.22-4.82)	**4.97** (3.95-6.31)	**5.81** (4.49-7.43)	**6.71** (5.00-8.74)	**7.66** (5.48-10.2)	**9.00** (6.19-12.3)	**10.1** (6.73-13.8)
12-hr	**2.49** (2.06-2.99)	**2.95** (2.44-3.55)	**3.77** (3.11-4.54)	**4.50** (3.69-5.44)	**5.57** (4.45-7.01)	**6.46** (5.03-8.20)	**7.41** (5.57-9.59)	**8.42** (6.06-11.1)	**9.83** (6.81-13.3)	**11.0** (7.38-14.9)
24-hr	**2.95** (2.46-3.52)	**3.42** (2.85-4.08)	**4.24** (3.52-5.08)	**4.97** (4.11-5.98)	**6.06** (4.88-7.57)	**6.97** (5.46-8.77)	**7.92** (6.00-10.2)	**8.95** (6.50-11.8)	**10.4** (7.25-14.0)	**11.5** (7.82-15.6)
2-day	**3.38** (2.84-4.01)	**3.88** (3.26-4.61)	**4.76** (3.98-5.66)	**5.54** (4.61-6.62)	**6.70** (5.43-8.30)	**7.66** (6.05-9.58)	**8.68** (6.61-11.1)	**9.77** (7.14-12.7)	**11.3** (7.94-15.0)	**12.5** (8.54-16.8)
3-day	**3.68** (3.10-4.34)	**4.22** (3.56-4.99)	**5.17** (4.34-6.13)	**6.02** (5.02-7.16)	**7.26** (5.89-8.94)	**8.28** (6.55-10.3)	**9.35** (7.15-11.9)	**10.5** (7.70-13.6)	**12.1** (8.54-16.0)	**13.4** (9.17-17.9)
4-day	**3.94** (3.33-4.64)	**4.52** (3.81-5.33)	**5.52** (4.65-6.53)	**6.41** (5.37-7.61)	**7.72** (6.28-9.48)	**8.79** (6.98-10.9)	**9.91** (7.60-12.5)	**11.1** (8.17-14.4)	**12.8** (9.04-16.9)	**14.1** (9.70-18.8)
7-day	**4.64** (3.94-5.44)	**5.28** (4.48-6.19)	**6.39** (5.40-7.50)	**7.37** (6.20-8.69)	**8.80** (7.21-10.7)	**9.98** (7.97-12.3)	**11.2** (8.66-14.1)	**12.5** (9.29-16.1)	**14.4** (10.2-18.9)	**15.9** (11.0-21.0)
10-day	**5.28** (4.50-6.16)	**5.97** (5.09-6.98)	**7.17** (6.09-8.40)	**8.23** (6.95-9.68)	**9.79** (8.04-11.9)	**11.1** (8.86-13.6)	**12.4** (9.60-15.5)	**13.8** (10.3-17.7)	**15.8** (11.3-20.7)	**17.4** (12.1-22.9)
20-day	**7.11** (6.10-8.24)	**8.02** (6.88-9.31)	**9.57** (8.18-11.1)	**10.9** (9.27-12.7)	**12.8** (10.6-15.4)	**14.4** (11.6-17.4)	**15.9** (12.4-19.7)	**17.6** (13.1-22.3)	**19.8** (14.3-25.7)	**21.6** (15.1-28.3)
30-day	**8.64** (7.45-9.98)	**9.78** (8.42-11.3)	**11.7** (10.0-13.5)	**13.2** (11.3-15.4)	**15.5** (12.8-18.4)	**17.2** (13.9-20.7)	**18.9** (14.8-23.3)	**20.8** (15.6-26.1)	**23.2** (16.7-29.9)	**25.1** (17.6-32.7)
45-day	**10.6** (9.17-12.2)	**12.0** (10.4-13.8)	**14.3** (12.4-16.5)	**16.2** (13.9-18.8)	**18.8** (15.6-22.3)	**20.8** (16.9-24.9)	**22.8** (17.8-27.9)	**24.8** (18.6-30.9)	**27.3** (19.8-35.0)	**29.3** (20.7-38.0)
60-day	**12.3** (10.6-14.1)	**14.0** (12.1-16.0)	**16.6** (14.4-19.2)	**18.8** (16.2-21.7)	**21.7** (18.0-25.6)	**23.9** (19.4-28.5)	**26.1** (20.4-31.7)	**28.1** (21.2-35.0)	**30.8** (22.4-39.2)	**32.8** (23.2-42.5)

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

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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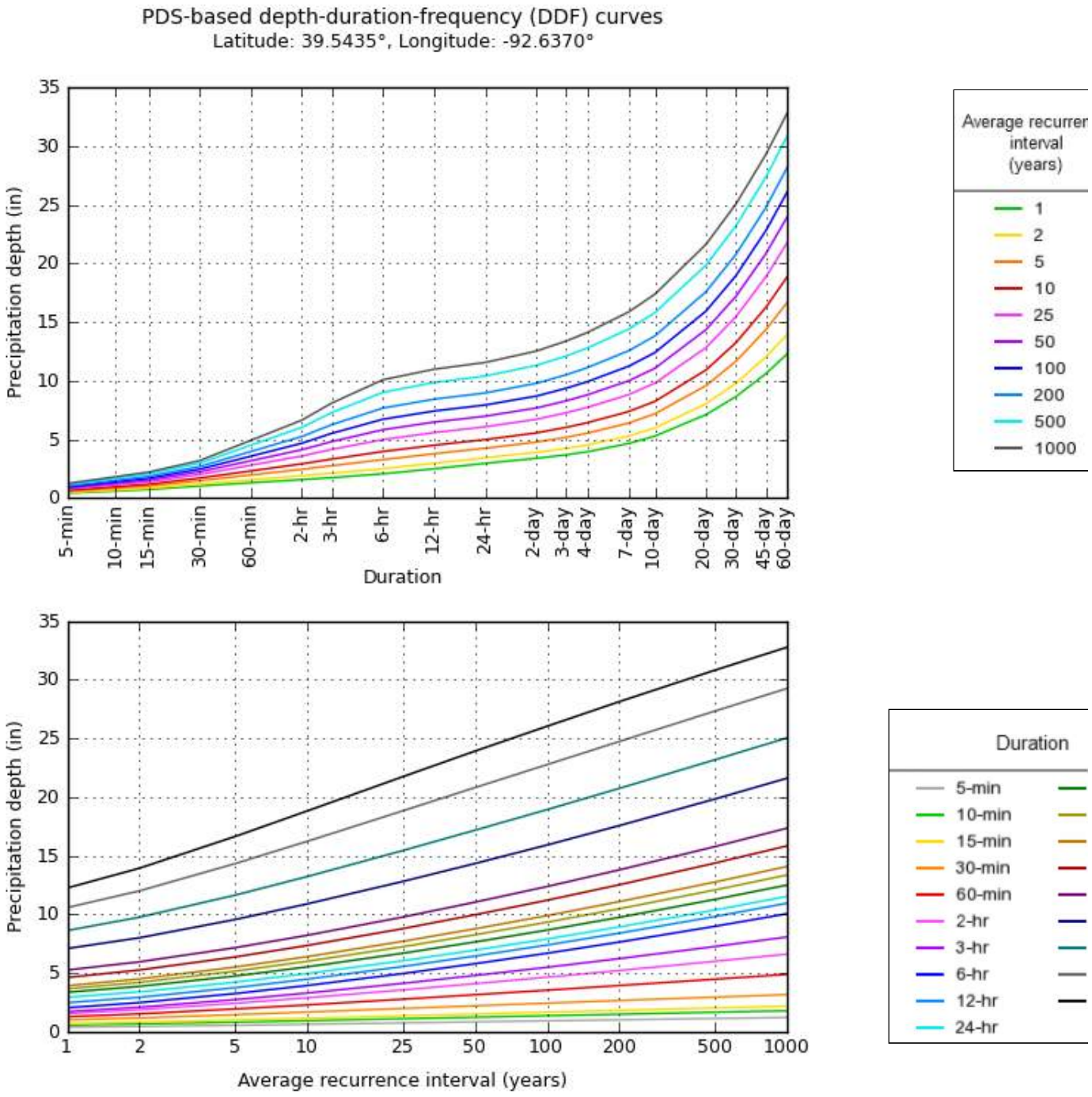
PF graphical



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Created (GMT): Mon Aug 16 15:37:07 2021

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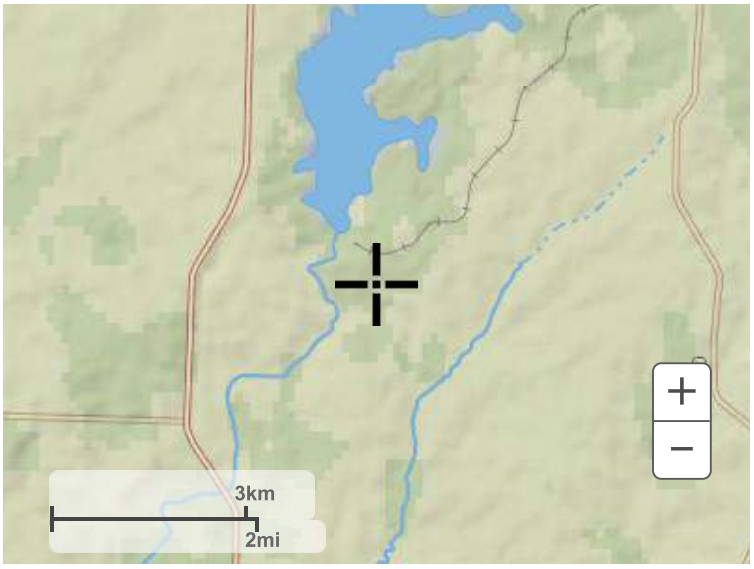
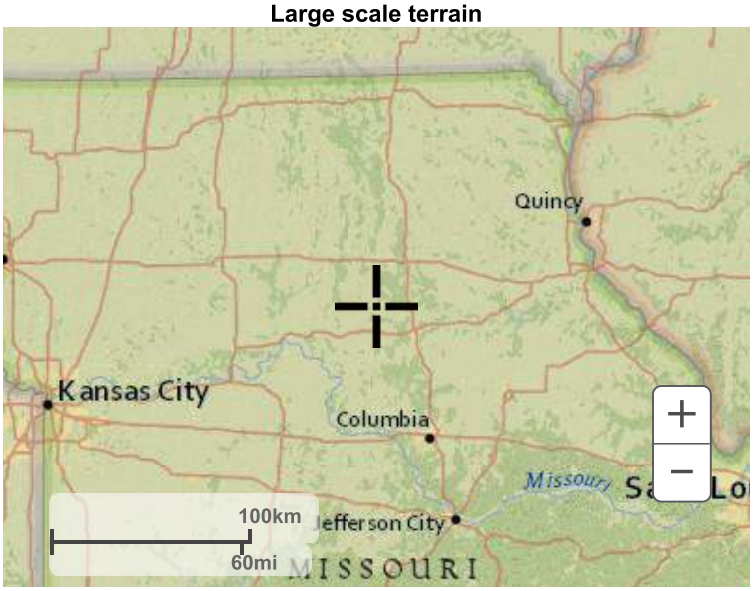
Maps & aerials

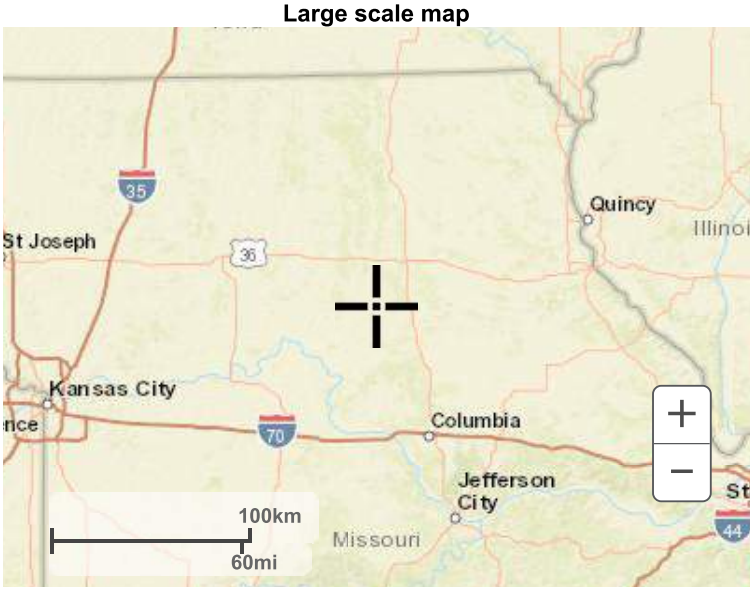
Small scale terrain



Large scale terrain



Large scale map



Large scale aerial

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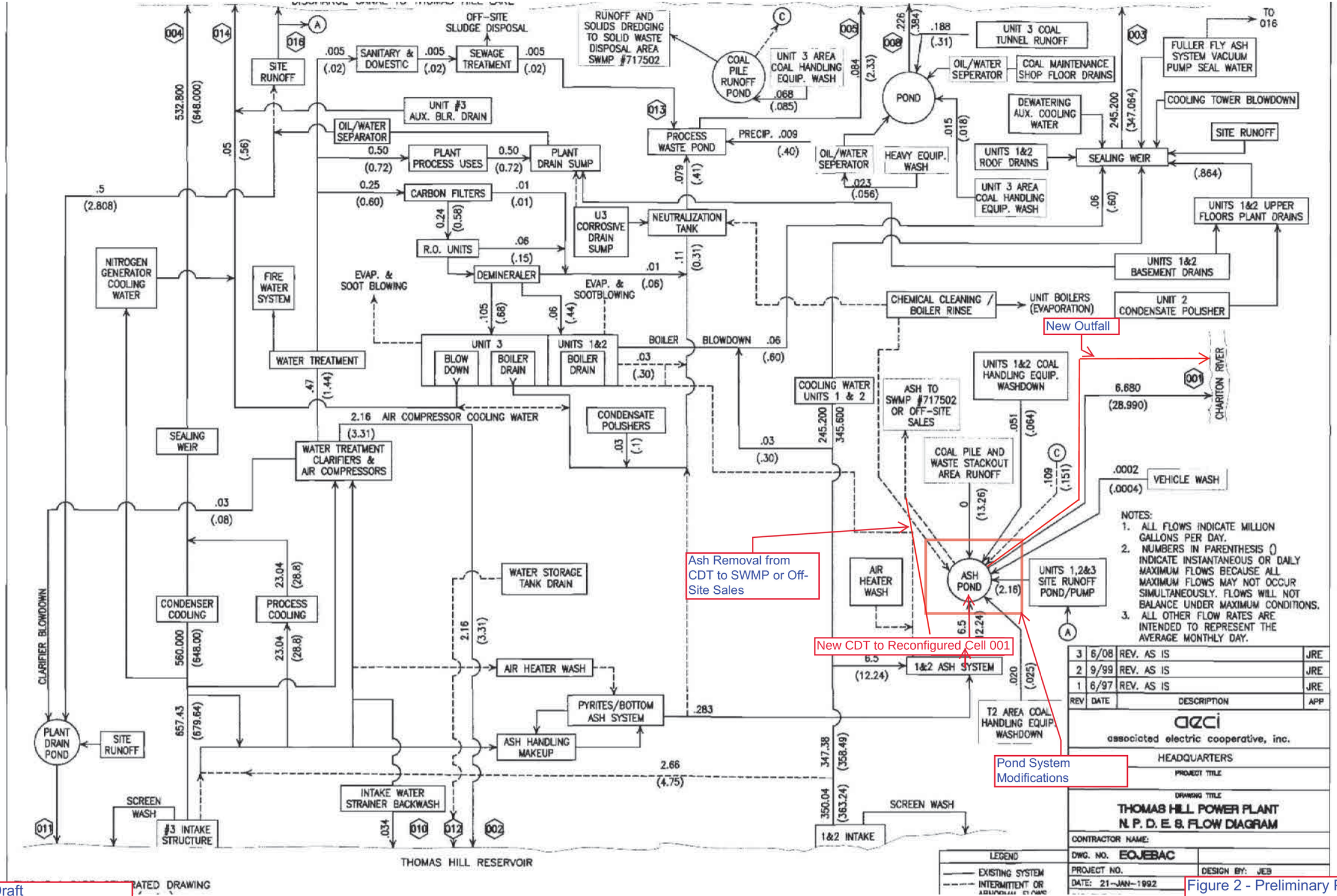
US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

Appendix D



Preliminary Draft
For Discussion Purposes Only

Figure 2 - Preliminary Proposed PFD Modifications