Run-On and Run-Off Control Systems Plan – CCR Landfills

Prepared for Interstate Power and Light Company
Prairie Creek Generating Station
Cedar Rapids, IA

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Prepared by:	M. Turner	10/11/2016 Date
Reviewed by:	D. Packard	10/11 /2016 Date
Approved by:	J. Staehlin	10/11 /2016 Date

Sargent & Lundy LLC

55 East Monroe Street
Chicago, IL 60603-5780 USA
Project No. 13391-017

Report No. SL-013528
Revision: 0

Certification and Seal:

I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa:

LICENSED PROFESSIONAL ENGINEER JAMES H. STAEHLIN 16860 IOWA

10-11-2016

James H. Staehlin

My license renewal date is December 31, 2016

Pages covered by this seal: All

10/11/2016
Sargent & Lundy, L.L.C.

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1. INTRODUCTION & PURPOSE

Interstate Power and Light Company (IPL) – a wholly owned subsidiary of Alliant Energy – operates four units at the Prairie Creek Generating Station (PCS), located in Cedar Rapids, Iowa. This coal-burning facility has two existing CCR landfills on site: the PCS Bottom Ash Pile and the PCS Beneficial Use Storage Area.

Pursuant to 40 CFR § 257.81(c), this document serves as the initial written run-on and run-off control system plan for the Prairie Creek Generating Station CCR landfills. Based on the applicability criteria of the Federal CCR Rule, § 257.81 applies to the following CCR units at the site:

- PCS Bottom Ash Pile
- PCS Beneficial Use Storage Area

Both of these CCR units are CCR piles that are regulated as existing CCR landfills, per 40 CFR § 257.53. Throughout this plan, the term “CCR landfill” refers to one of the CCR piles listed above.

The location of these CCR landfills is shown in Figure 1.

The facility also has a hydrated fly ash pile (i.e., Agpave) that has not received CCR on or after October 19, 2015 and is, therefore, not subject to the requirements of § 257.81. The agpave pile is shown in the drawings but is not discussed further herein.

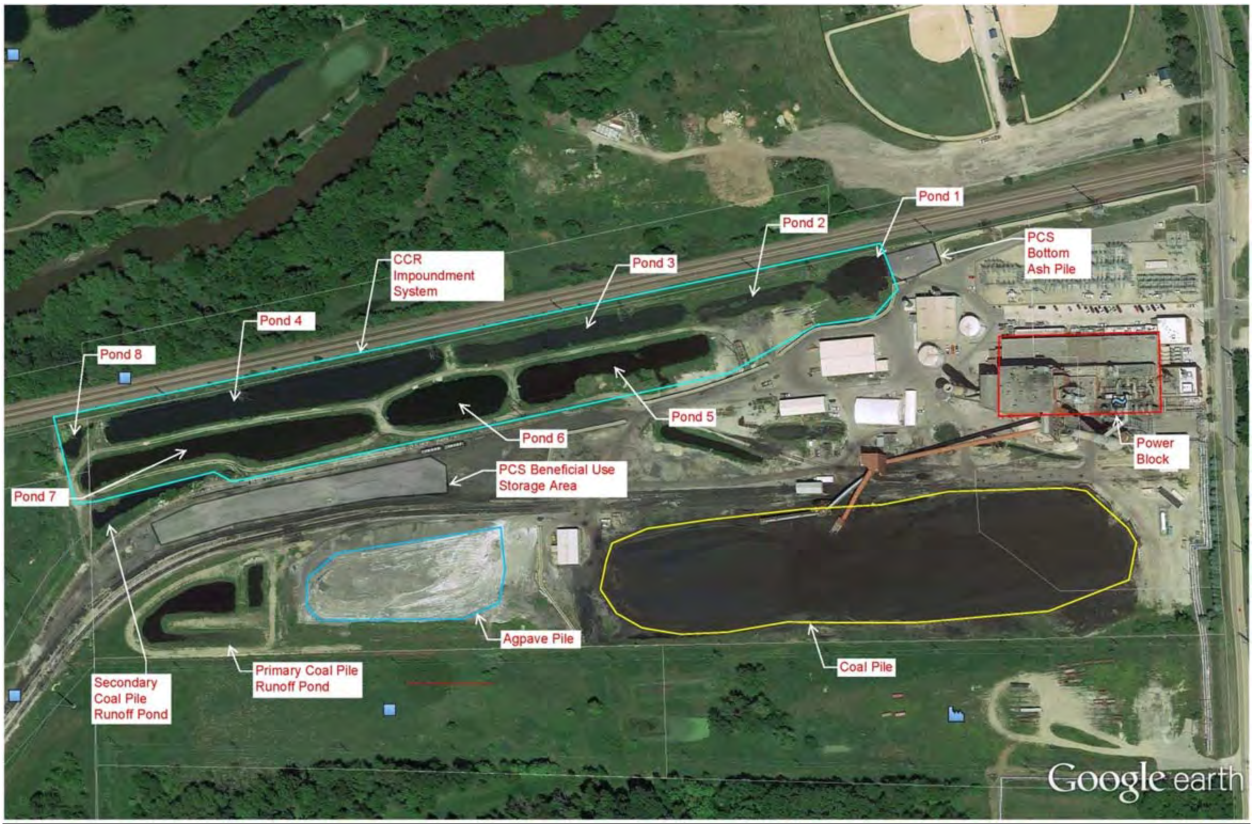

Figure 1: Existing CCR Landfill locations at Prairie Creek Generating Station

2. RESULTS AND CONCLUSIONS

The run-on and run-off control systems for each CCR landfill were analyzed to assess how the landfill control systems manage the storm water run-on and run-off during the design storm event. The full analysis is shown in Appendix A. Due to site grade elevations and physical barriers, run-on does not reach either of the landfills. The PCS Bottom Ash Pile is surrounded on the south and east sides by flood walls and grade slopes away from the pile on the north and west sides. The PCS Beneficial Use Storage Area is at a local high point between two rails and receives no run-on.

Storm water run-off from the PCS Bottom Ash Pile drains by sheet flow directly into Pond 1 which is connected by either ditches or culverts to a series of ponds on the site, Ponds 2 through 4 and Pond 8. Ponds 5 through 7 are connected to this series of ponds by an overflow culvert located approximately 9” above the normal water level of Pond 2. For the purpose of storm water modeling, it is assumed that the water level of Pond 2 will not rise above the overflow culvert invert elevation for a 25-year, 24- hour storm event and all storm water runoff from the PCS Bottom Ash Pile and contributing drainage area will be contained in Ponds 1 through 4. The runoff volume from the drainage area, including direct rainfall on the ponds and runoff from the PCS Bottom Ash Pile and a small portion of the site to the south and east of Pond 1, is 0.74 ac-ft. When drained to Ponds 1 through 4, this results in a nominal pond water level rise of approximately 9.5 inches. Ponds 1 through 4 have sufficient capacity to contain run-off from the PCS Bottom Ash Pile and other contributing plant runoff, without overtopping, as presented in Table 1.

TABLE 1: PCS BOTTOM ASH PILE RUN-OFF

PCS Beneficial Use Storage Area Runoff Collection Point	Design Storm Event	Existing Water Surface Elevation (1) (ft)	Final Water Surface Elevation (2) (ft)	Top of Berm Elevation (ft)	Freeboard (ft)
Pond 1	25-year, 24-hour	713.85	714.64	716.03	1.39
Pond 2	25-year, 24-hour	713.71	714.50	716.43	1.93
Pond 3	25-year, 24-hour	713.46	714.25	714.44	0.19
Pond 4	25-year, 24-hour	713.26	714.05	714.46	0.41

(1) Normal operating water level, prior to a design storm event
(2) Water level in pond after a design storm event

Storm water run-off from the PCS Beneficial Use Storage Area drains by sheet flow to retention areas on the north and south sides of the pile which are bounded by existing railroad tracks as shown in Appendix A. The retention areas have sufficient capacity to contain the runoff from the PCS Beneficial Use Storage Area without overtopping the top of rail, as presented in Table 2.

TABLE 2: PCS BENEFICIAL USE STORAGE AREA RUN-OFF

PCS Bottom Ash Pile Collection Point	Design Storm Event	Landfill Runoff (ft^3)	Available Storage (ft^3)	Reserve Capacity (ft^3)
Retention Area to North	25-year, 24-hour	1000	1800	800
Retention Area to South	25-year, 24-hour	1350	4800	3450

Storm water runoff from both CCR landfills either infiltrates into the ground or is directed through the existing on site ponds to the PCS Discharge Pond (Pond 8). The discharge from this pond is regulated by a National Pollutant Discharge Elimination System (NPDES) permit issued by the Iowa Department of Natural Resources; therefore, the ponds meet the requirements of § 257.81(b).

The engineering calculations supporting these conclusions are presented in Appendix A.

3. CERTIFICATIONS

There is no storm water run-on to either landfill as a result of a 25-year, 24-hour design storm.

The run-off from a 25-year, 24-hour design storm is controlled and contained in the adjacent CCR ponds (PCS Bottom Ash Pile) or in the adjacent retention areas (PCS Beneficial Use Storage Area).

It is S&L's opinion that the run-on and run-off control systems for the PCS Bottom Ash Pile and PCS Beneficial Use Storage Area meet the requirements of 40 CFR § 257.81(a) and (b). Further, it is S&L's opinion that this plan meets the requirements of 40 CFR § 257.81(c).

4. REFERENCES

1. 40 CFR Part 257 – Environmental Protection Agency Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities; Final Rule, Federal Register, Vol. 80, No. 74.

Appendix A – Landfill Run-On and Run-Off Control System Analysis

Sargent & Lundy LLC

ISSUE SUMMARY

Form SOP-0402-07, Revision 11

DESIGN CONTROL SUMMARY			
CLIENT:	ALLIANT ENERGY	UNIT NO.: -	PAGE NO.: 1
PROJECT NAME:	WATER AND ASH PROGRAM- PRAIRIE CREEK GENERATING STATION		
PROJECT NO.:	13391-017	S&L NUCLEAR QA PROGRAM	
CALC. NO..:	PCS-C-CCR-001	APPLICABLE ☐ YES ☒ NO	
TITLE:	LANDFILL RUN-ON AND RUN-OFF CONTROL SYSTEM ANALYSIS		
EQUIPMENT NO.:	N/A		

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1. PURPOSE & SCOPE

The purpose of this calculation is to perform a storm water run-on and run-off control system evaluation for the PCS Beneficial Use Storage area and PCS Bottom Ash Piles at the Prairie Creek Generating Station in Cedar Rapids, Iowa (Linn County), in accordance with the requirements of the Federal CCR Rule (40 CFR Part 257; Environmental Protection Agency Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities; Final Rule) (Reference 7.2). Described in §257.81, the run-on and run-off control systems for each landfill are required to be analyzed for the design event of a 25-year, 24-hour storm.

This calculation is required for all "active landfills", defined as "that part of the CCR unit that has received or is receiving CCR or non-CCR waste and that has not completed closure in accordance with §257.102," (Reference 7.2). Thus, the applicable landfills included in this calculation are as follows: PCS Bottom Ash Piles and PCS Beneficial Use Storage area as highlighted in Attachment 8.1. This calculation addresses the capacity to collect and control run-off from the PCS Bottom Ash Piles and PCS Beneficial Use Storage area of the plant.

In order to accurately encapsulate any changes to the CCR landfills (i.e., closures, material, geometry), this calculation is to be reviewed, and if necessary, revised every 5 years as required by the Federal CCR Rule in §257.81(c)(4).

2. DESIGN INPUT

2.1 The layout showing the PCS Bottom Ash Piles and PCS Beneficial Use Storage area and the storm water conveyance system is shown in Attachment 8.1, Reference 7.1.

2.2 The 25-year, 24-hour storm event rainfall depth for Linn County is 5.57 inches (Attachment 8.2, Reference 7.3).

2.3 Curve Number CN for the adjoining catchment areas are shown in Table 1 (Attachment 8.5). The numbers are fairly conservative and are taken from Attachment 8.5, Reference 7.5 for Hydrologic Group soil B based on the soil survey data as described in Assumption 3.6, Reference 7.7.

Table 1

Land Use	Curve Number CN
Grassland	61
Roads	98
Gravel Pads	85
PCS Bottom Ash Piles	72
PCS Beneficial Use Storage area Piles	72

2.4 The individual drainage areas at the generating station are derived from Google Earth (Reference 7.1, Attachment 8.4).

3. DESIGN ASSUMPTIONS

3.1 It is assumed that ponds that receive run-off from PCS Bottom Ash Piles and adjoining plant areas are filled with average water level as shown in Table 2 below in the beginning of the design storm with water as shown in Attachment 8.1, Reference 7.1. However, it is assumed that storage area which receives the discharge from the PCS Beneficial Use Storage area Piles are dry at the beginning of storm event.

3.2 Based on the geometry of ponds and the presence of berms each pond and flood barriers around the south and east of the landfill, it is assumed that no run-on enters PCS Bottom Ash Piles. Direct rainfall on ponds and the run-on from the PCS Bottom Ash Piles and adjoining plant areas only contribute in determination of depth in the pond for 25-year, 24-hour rainfall event.

3.3 The infiltration rate at the PCS Beneficial Use Storage area is assumed to be 1.417 in/hr. which is conservative for low permeability soil and has been used to analyze the water level at this area during peak storm.

3.4 It is assumed that the derived storage capacity of the PCS Beneficial Use Storage area is based on the average elevations of the tracks and ground surfaces as shown in Table 4.

3.5 The minimum time of concentration used for calculating the peak run off flow for the PCS Beneficial Use Storage area is 5 minutes.

3.6 Since there was no specific hydrologic soil group mentioned for the plant in the NRCS report (Attachment 8.3, Reference 7.7), hydrologic soil group B was selected based on soil materials in surrounding areas of the plant.

3.7 Based on the preliminary survey data provided by French-Reneker Associates Inc., the following parameters we derived:

3.7.1 The average existing water level in the ponds:

Table 2

Pond #	Average existing water level (ft.)
Pond 1	713.85
Pond 2	713.71
Pond 3	713.46
Pond 4	713.26

3.7.2 The minimum top of berm elevation for the ponds:

Table 3

Pond #	Minimum berm elevation (ft.)
Pond 1	716.03
Pond 2	716.43
Pond 3	714.44
Pond 4	714.46

3.7.3 The average elevations of the top of rails, PCS Beneficial Use Storage area Pile toes and top of rail toe are:

Table 4

	Top of rail track/berm elevation (ft.)	Pile Toe elevation (ft.)	Top of rail toe elevation (ft.)
North of the pile	721.26	721.53	720.83
South of the pile	721.87	721.73	721.44

4. METHODOLOGY AND ACCEPTANC CRITERIA

4.1 Methodology

For PCS Bottom Ash Piles area: The total run-off depth contributions to the ponds are evaluated for the design rainfall of 25-year, 24-hour event. The depth is calculated using the SCS CN method (Reference 7.5) wherein suitable curve numbers CN from Table 1 and Attachment 8.5 are selected for different types of land use and surfacing and a weighted CN is calculated. The weighted curve number is put into the formulas given below and depth of run-off is evaluated.

The direct rainfall depth on the ponds is as shown in Attachment 8.2.

The final water levels of the ponds after adding the depths calculated as mentioned above to the existing water level of the individual ponds are compared with the minimum berm elevations of the ponds and checked for overtopping.

The rainfall run-off depth is calculated using equations given below and also given in Reference 7.5.

$$Q = \frac{(P - Ia)^2}{(P - Ia) + S}$$

Where,

Q=run-off depth (in)
P= Rainfall (in)
S= Potential maximum retention after rainfall begins (in)

$$S = \frac{1000}{CN} - 10$$

I_a= *Initial abstraction (in) = 0.2 x S*

For PCS Beneficial Use Storage area: The total run-off volume for the design rainfall of 25-year, 24-hour event, taking into effect the infiltration, is evaluated using Pond Pack v8i (Reference7.4). The total run-off volume is then compared with the storage capacity of the low land area. If the storage capacity is greater than the required storage volume, the run-off is considered to be collected and controlled and therefore in compliance with the CCR rule.

5. CALCULATION

5.1 The peak water level at the ponds receiving discharge from PCS Bottom Ash Piles and nearby plant areas during the design rainfall event are evaluated as shown below:

5.1.1 Evaluation of run-off depth from the PCS Bottom Ash Piles and adjoining plant areas are as shown below:

Table 5

Contributing zones (col 1)	Area occupied (Sq. ft.) (Page 4 through 8 of Attachment 8.4) (col 2)	Area occupied (acres) (col 3)	CN (Table 1) (col 4)	Weighted CN (col 5)
Grasslands Plant	8120	0.19	61	71.36
Grasslands Railway	81810	1.88	61	
Roads (Overall area less the grasslands, gravel pad)	15248	0.35	98	
Gravel Pads	38175	0.88	85	
PCS Bottom Ash Piles area	6460	0.15	72	

Table 6 Area of the ponds (Page 12 to 16 of Attachment 8.4)

Pond #	Area (sq. ft.)
Pond 1	9666
Pond 2	10193
Pond 3	24537
Pond 4	55560
Total	99956

Table 7 Run-off depth calculation using SCS method (Section 4.1)

Weighted Curve Number(CN) (From Col 5 of Table 5)	71.36
S=(1000/CN)-10	4.01
I_a=0.2xS	0.80
P (rainfall for 25-year, 24-hours) in inches	5.57
Q run-off (inches) $=(P-Ia)^2/(P-Ia)+S$	2.59
Area ratio = (Sum of areas occupied by land from Table 5, Col 2)/ (Sum of area occupied by the pond from Table 6)	1.50
Water depth contribution to the pond (ft.)	0.32

5.1.2 Direct rainfall on the pond for 25-year, 24-hours rainfall event (Attachment 8.2).

Table 8

Water depth contribution from direct rainfall (25-year, 24-hours)(in.)	0.46

5.1.3 The final water level in the ponds are determined by adding the depth evaluated in Table 4 of section 5.1.1 and Table 5 of 5.1.2 to the average water levels of individual ponds as shown in Table 2. The result is shown below:

Table 9

Final Water Elevation in the Ponds (ft.)	714.63	714.49	714.24	714.04

5.2 The peak run-off volume from the PCS Beneficial Use Piles and the Storage area highlighted in Attachment 8.1 are evaluated as shown below:

5.2.1 Pond Pack v8i has been used to assess the scenario during the design storm event for both the north and south of the Beneficial Use Piles separately. Hydrologic models for the pre/post-developed conditions are created in Pond Pack from the user defined input and peak run-off rates are determined. Table 10 lists the inputs used for analysis of the low land areas. The computer software Pond Pack v8i is V&V'd S&L Program 03.7.712-8.11.01.56 by Bentley Systems. Runs were performed on computer no. ZD9467.

Table 10

Input Parameters for Pond Pack		
	North of the Pile	South of the Pile
Curve Numbers (Table 1)	61	61
Storage area (Page 9 and 16 of Attachment 8.4 for north of pile) and (Page 9 and 16 of Attachment 8.4 for south of pile)	0.3 Acres (900x 15.10=13590 sq. ft.)	0.37 Acres (900x18.77=16893 sq.ft.)
Time of concentration, Section 3.6	0.08 hrs	0.08 hrs
Infiltration Rate, Section 3.4	1.417 in/hr.	1.417 in/hr.
CN PCS Beneficial Use Storage area Piles(Table 1)	72	72
PCS Beneficial Use Storage area Piles(Half of total) (Page 1 to 3 of Attachment 8.4)	0.23 acres	0.23 acres

Pond Pack output is presented in Table 11 and software outputs are in Attachment 8.6.

Table 11

Run-off volume on north of Pile	914 ft^3
Run-off volume on south of Pile	1350 ft^3

5.3 The maximum storage capacity to store or confine run-off in between the two rail tracks north and south of the PCS Beneficial Use Storage area are evaluated as shown below:

5.3.1 The average elevations of the top of rails, PCS Beneficial Use Storage area Pile toes and top of rail toe are based on Table 4 and a rough sketch is obtained for the cross section of the storage area shown below:

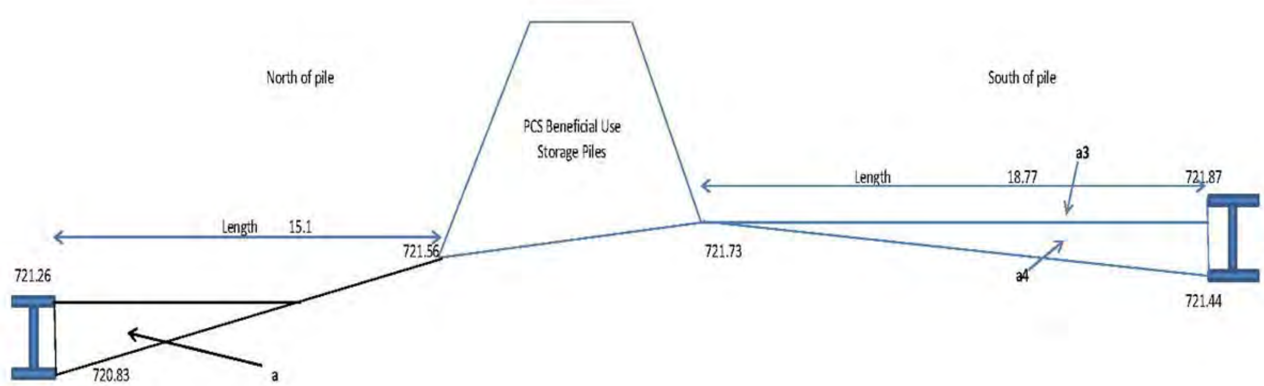


Figure 1: Cross section of the PCS Beneficial Use Storage area

5.3.2 Calculation for the cross-sectional area and determination of the maximum storage capacity is shown below:

North of Pile

Cross-sectional area,

a = 0.5 x (721.26-720.83) x [(721.26-720.83)x(15.10)/(721.56-720.83)]

= 1.91 sq. ft.

Approximate longitudinal length of the cross-section=900 ft.

(Page 9 of Attachment 8.4)

Storage capacity towards north of Pile = 1.91 x 900 ft^3

= 1719 ft^3

South of the Pile

Rectangular area, a3 = (721.87-721.73)*18.77 = 2.62 sq. ft.

Triangular area, a4 = 0.5x18.77x (721.73-721.44) =2.72 sq. ft.

Total area, a3 + a4 = 2.62 + 2.72 = 5.34 sq. ft.

Approximate longitudinal length of the cross-section=900 ft.
(Page 10 of Attachment 8.4)

Storage capacity towards north of Pile = 5.34 x 900 ft^3

= 4806 ft^3

6. RESULTS & CONCLUSIONS

6.1 It is observed that the water elevations in the receiving ponds resulting from a design storm event using the procedure described in 5.1 for the PCS Bottom Ash Piles are below the minimum berm elevation for the ponds as shown in Table 12. Hence, the run-off from the 25-year, 24-hour storm event is collected and controlled.

Table 12

Description	Pond 1	Pond 2	Pond 3	Pond 4
Final water elevation in the pond after contribution for 25-year, 24-hour rainfall event (ft.)	714.64	714.50	714.25	714.05
Minimum berm elevation of the pond (ft.)	716.03	716.43	714.44	714.46
Free Board (ft.)	1.39	1.93	0.19	0.41

6.2 It is observed that the storage area receiving the run-off from the PCS Beneficial Use Storage area Piles will not overtop on the northern or the southern side of the piles for the design rainfall as evaluated and described in section 5.2 and shown in Table 13.

Thus, per §257.81, controlled run-on and run-off of the low land for the design rainfall is met.

Table 13

Description	North of the pile	South of the pile
Total Run off volume (ft3)	914	1350
Total Storage volume of low land (ft3)	1719	4806
Remarks	Overtopping will not occur	Overtopping will not occur

7. REFERENCES

7.1 Google Earth Pro version 6.2.2.6613

7.2 40 CFR 257; Environmental Protection Agency Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities; Final Rule. Federal Register. Vol. 80. No. 74. 17 April 2015. Amended 2 July 2015.

7.3 Department of Commerce, USA, "NOAA Atlas 14, Volume 8, version 2, Location name: Cedar Rapids, Iowa,US, Lat: 41.94, Long:-91.64, Elevation 741 ft.

7.4 PondPack v8.i, Haestad Methods, Inc. 2002. S&L Software No. 03.7.712-8.11.01.56.

7.5 US Department of Agriculture, "Urban Hydrology for Small Watersheds, TR-55", June 1986.

7.6 Michael R. Lindeburg, "Engineer-In-Trainee Reference Manual 8th Edition."

7.7 US Department of Agriculture, National Resource Conservation Service, "Custom Soil Report for Soil County, IOWA", Dated August 18, 2016.

8. ATTACHMENTS

8.1 Google Earth Pro," Aerial View of Generating Station and Ancillary Areas".

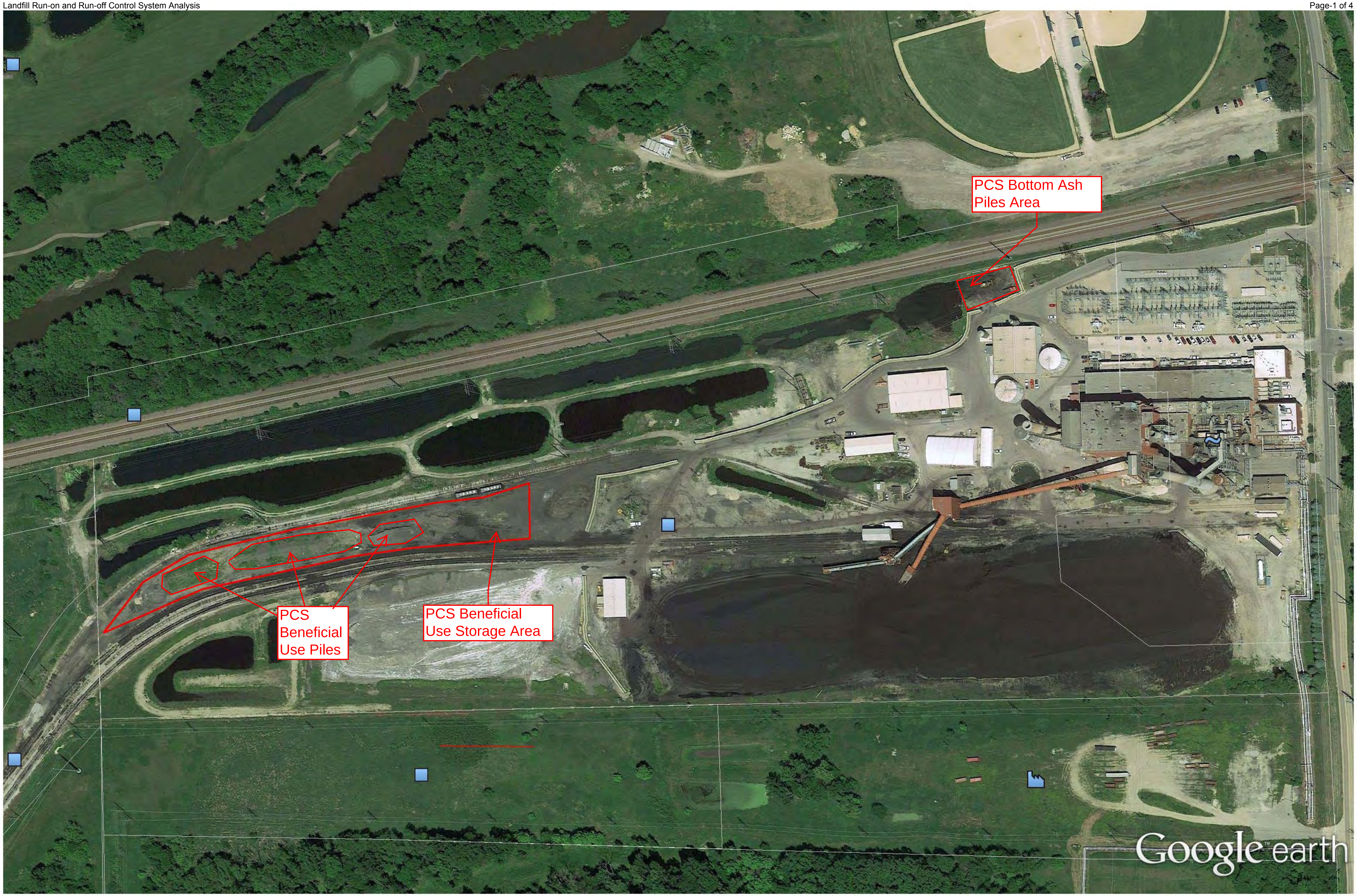
8.2 Rainfall Data for the site from NOAA Atlas 14 for Linn County, Iowa, US.

8.3 Custom Soil Resource Report by NRCS for Linn County, Iowa.

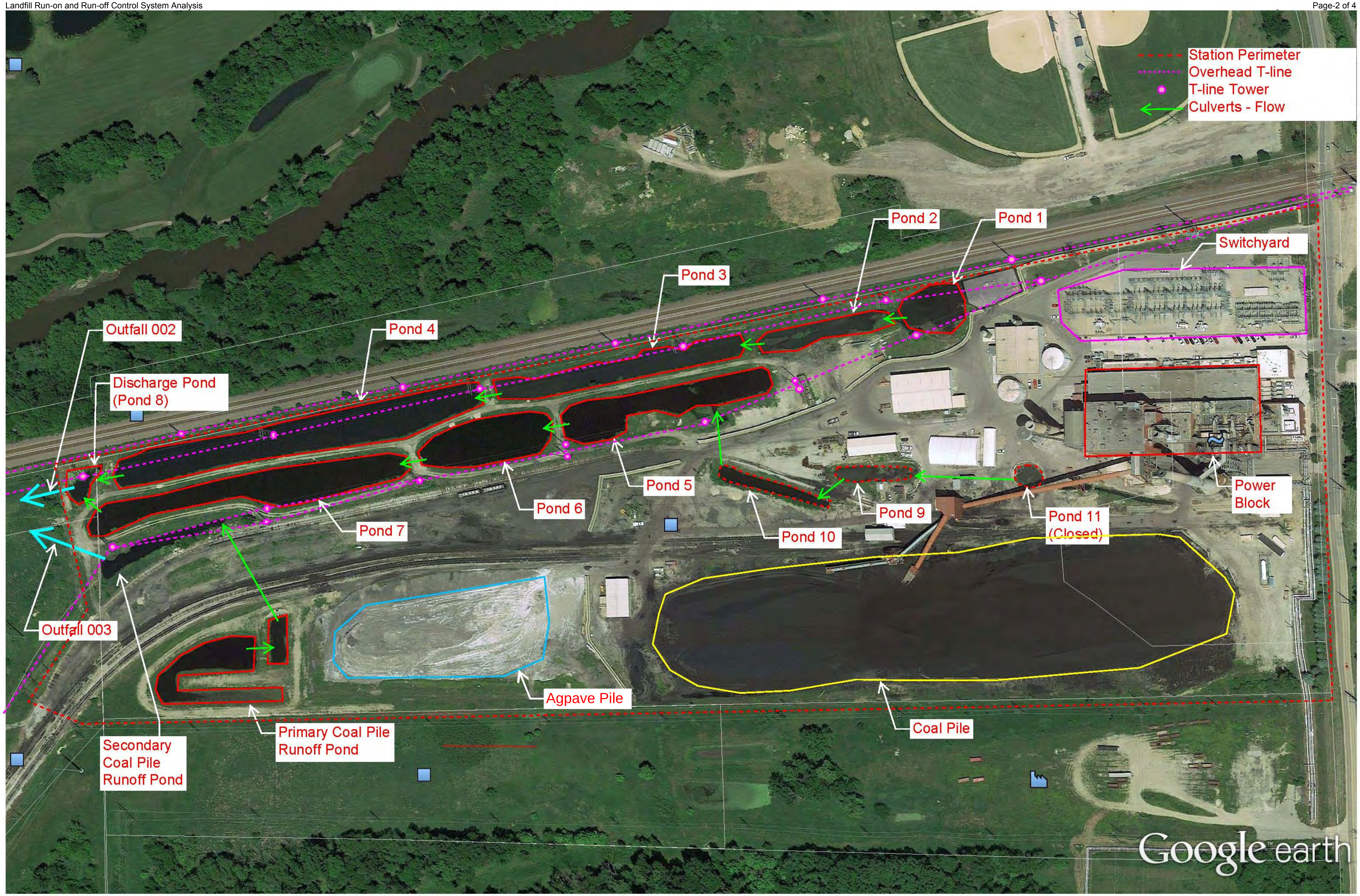
8.4 Drainage and delineated sketches.

8.5 Curve Numbers CN Table from TR-55.

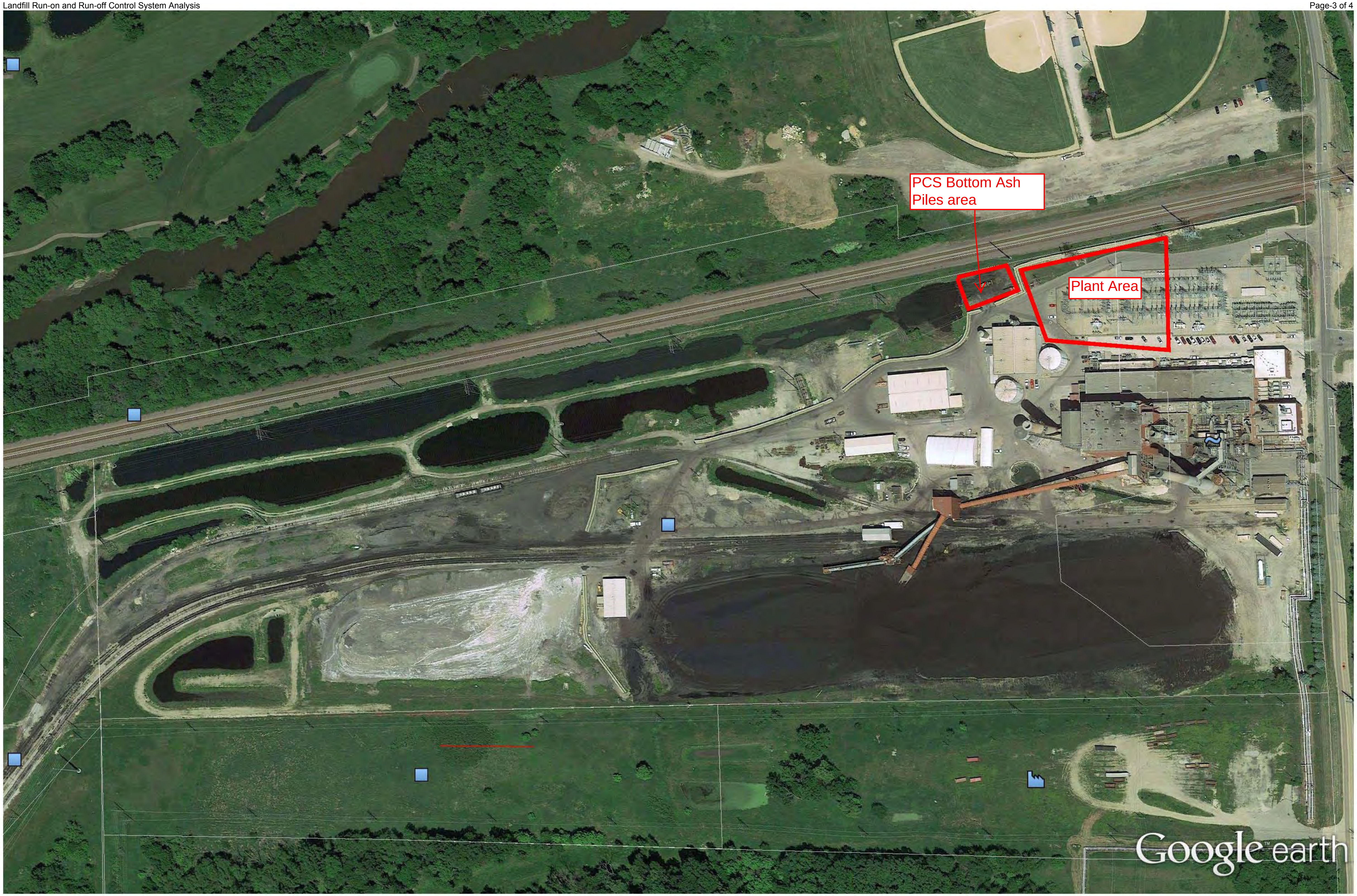
8.6 Pond Pack output results for the low land areas surrounding PCS Beneficial Use Storage area.



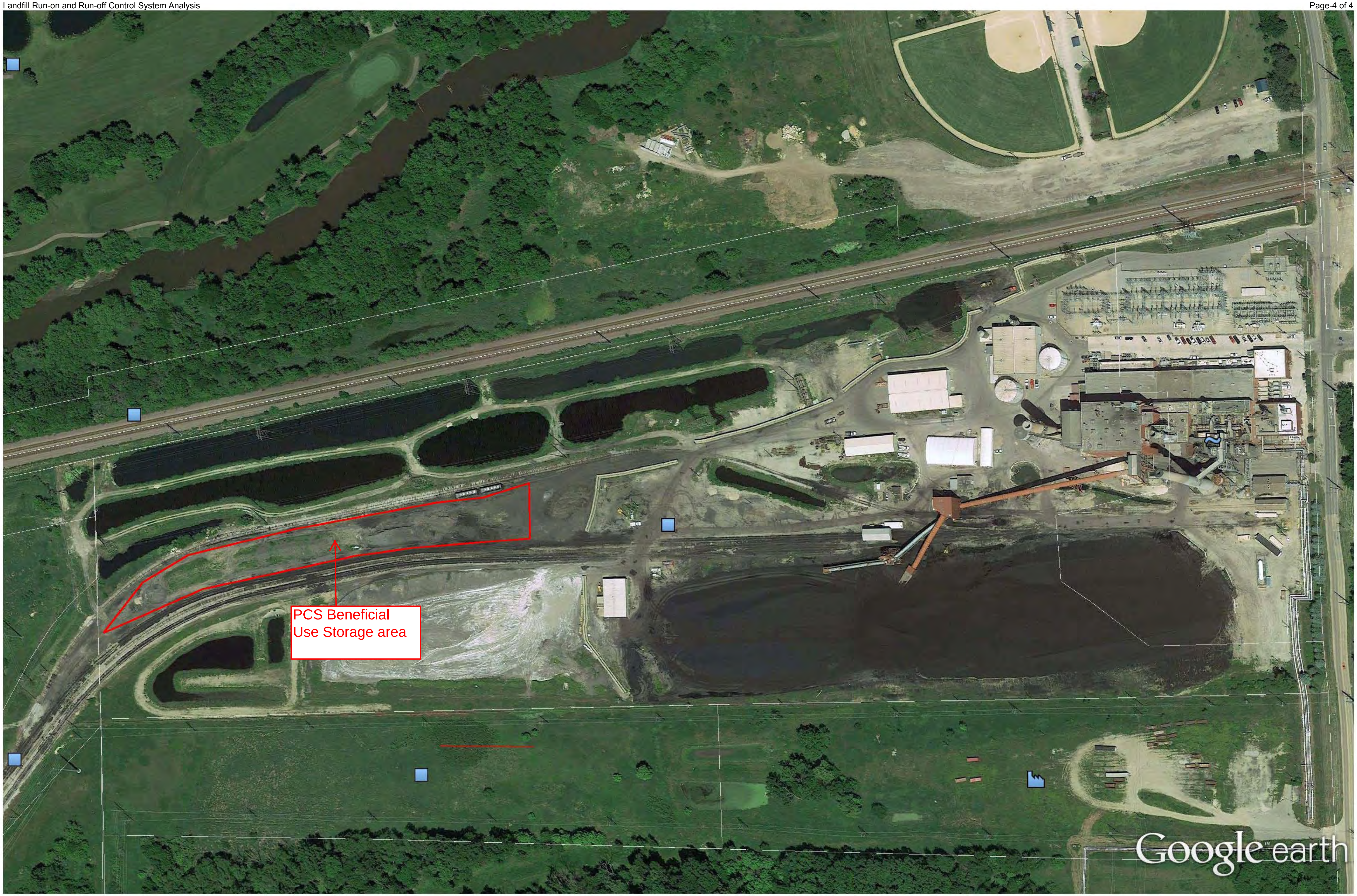
PCS Bottom Ash Piles Area and PCS Beneficial Use Storage Area Highlighted



Plant Layout with Storm Water Ponds and Conveyance System Highlighted



Rainfall Limits for PCS Bottom Ash Piles and adjacent areas



Rainfall Limits for Beneficial Use Storage area

Precipitation Frequency Data Server

NOAA Atlas 14, Volume 8, Version 2
Location name: Cedar Rapids, Iowa, US*
Latitude: 41.9400°, Longitude: -91.6400°
Elevation: 780 ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

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

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.378 (0.293-0.486)	0.440 (0.341-0.565)	0.543 (0.419-0.699)	0.632 (0.485-0.816)	0.759 (0.565-1.01)	0.860 (0.626-1.15)	0.964 (0.678-1.31)	1.07 (0.725-1.49)	1.22 (0.795-1.72)	1.34 (0.847-1.90)
10-min	0.554 (0.429-0.711)	0.644 (0.499-0.827)	0.796 (0.614-1.02)	0.926 (0.711-1.20)	1.11 (0.828-1.47)	1.26 (0.916-1.68)	1.41 (0.993-1.92)	1.57 (1.06-2.18)	1.79 (1.16-2.52)	1.96 (1.24-2.79)
15-min	0.676 (0.524-0.867)	0.785 (0.608-1.01)	0.970 (0.749-1.25)	1.13 (0.867-1.46)	1.35 (1.01-1.80)	1.54 (1.12-2.05)	1.72 (1.21-2.34)	1.92 (1.29-2.65)	2.18 (1.42-3.08)	2.39 (1.51-3.40)
30-min	0.954 (0.740-1.23)	1.11 (0.861-1.43)	1.38 (1.06-1.77)	1.61 (1.23-2.08)	1.93 (1.44-2.56)	2.19 (1.59-2.93)	2.46 (1.73-3.34)	2.74 (1.85-3.79)	3.12 (2.03-4.40)	3.41 (2.17-4.87)
60-min	1.24 (0.961-1.59)	1.45 (1.12-1.86)	1.80 (1.39-2.32)	2.11 (1.62-2.72)	2.56 (1.91-3.40)	2.92 (2.13-3.92)	3.31 (2.33-4.50)	3.71 (2.51-5.15)	4.27 (2.78-6.04)	4.71 (2.98-6.71)
2-hr	1.53 (1.20-1.94)	1.78 (1.39-2.26)	2.22 (1.73-2.83)	2.61 (2.03-3.34)	3.19 (2.41-4.21)	3.66 (2.69-4.86)	4.15 (2.96-5.62)	4.68 (3.20-6.45)	5.41 (3.57-7.62)	6.00 (3.84-8.50)
3-hr	1.70 (1.34-2.14)	1.98 (1.56-2.50)	2.48 (1.95-3.14)	2.93 (2.29-3.72)	3.59 (2.74-4.73)	4.15 (3.08-5.49)	4.73 (3.40-6.38)	5.36 (3.70-7.38)	6.25 (4.15-8.77)	6.96 (4.49-9.82)
6-hr	1.99 (1.59-2.49)	2.33 (1.85-2.91)	2.92 (2.32-3.66)	3.47 (2.74-4.36)	4.29 (3.31-5.60)	4.98 (3.74-6.55)	5.71 (4.15-7.66)	6.51 (4.54-8.90)	7.64 (5.13-10.7)	8.56 (5.57-12.0)
12-hr	2.29 (1.85-2.83)	2.68 (2.16-3.31)	3.37 (2.71-4.17)	4.00 (3.19-4.97)	4.96 (3.87-6.41)	5.76 (4.38-7.50)	6.62 (4.86-8.79)	7.55 (5.32-10.2)	8.87 (6.01-12.3)	9.95 (6.54-13.8)
24-hr	2.61 (2.13-3.19)	3.04 (2.48-3.72)	3.81 (3.10-4.67)	4.51 (3.64-5.54)	5.57 (4.39-7.13)	6.45 (4.96-8.32)	7.40 (5.49-9.74)	8.42 (6.00-11.3)	9.87 (6.76-13.6)	11.0 (7.34-15.3)
2-day	3.02 (2.49-3.64)	3.47 (2.86-4.19)	4.27 (3.51-5.17)	5.00 (4.08-6.08)	6.10 (4.87-7.73)	7.03 (5.46-8.98)	8.02 (6.02-10.5)	9.09 (6.54-12.1)	10.6 (7.34-14.5)	11.8 (7.95-16.3)
3-day	3.33 (2.77-4.00)	3.78 (3.13-4.53)	4.57 (3.78-5.50)	5.30 (4.36-6.39)	6.40 (5.14-8.05)	7.33 (5.73-9.31)	8.32 (6.29-10.8)	9.41 (6.82-12.5)	10.9 (7.63-14.9)	12.2 (8.24-16.7)
4-day	3.60 (3.00-4.29)	4.04 (3.37-4.83)	4.84 (4.02-5.79)	5.57 (4.60-6.69)	6.67 (5.38-8.34)	7.59 (5.96-9.59)	8.58 (6.51-11.1)	9.65 (7.03-12.8)	11.2 (7.82-15.1)	12.4 (8.42-16.9)
7-day	4.23 (3.56-5.00)	4.74 (3.99-5.61)	5.61 (4.71-6.66)	6.38 (5.32-7.60)	7.50 (6.08-9.24)	8.40 (6.65-10.5)	9.35 (7.15-11.9)	10.4 (7.59-13.6)	11.8 (8.28-15.8)	12.9 (8.80-17.4)
10-day	4.79 (4.06-5.63)	5.37 (4.54-6.31)	6.33 (5.34-7.46)	7.14 (6.00-8.46)	8.31 (6.76-10.1)	9.23 (7.33-11.4)	10.2 (7.81-12.9)	11.2 (8.22-14.5)	12.5 (8.85-16.7)	13.5 (9.33-18.3)
20-day	6.50 (5.58-7.55)	7.23 (6.20-8.40)	8.43 (7.20-9.82)	9.44 (8.01-11.0)	10.8 (8.89-13.0)	11.9 (9.55-14.5)	13.0 (10.1-16.2)	14.1 (10.5-18.1)	15.6 (11.1-20.6)	16.7 (11.6-22.4)
30-day	8.01 (6.92-9.23)	8.91 (7.69-10.3)	10.4 (8.92-12.0)	11.6 (9.89-13.4)	13.2 (10.9-15.8)	14.4 (11.7-17.5)	15.7 (12.2-19.5)	16.9 (12.6-21.6)	18.5 (13.3-24.3)	19.7 (13.8-26.4)
45-day	10.0 (8.71-11.5)	11.2 (9.71-12.8)	13.0 (11.3-15.0)	14.5 (12.5-16.8)	16.5 (13.7-19.5)	17.9 (14.6-21.6)	19.4 (15.2-23.8)	20.7 (15.6-26.3)	22.5 (16.2-29.3)	23.7 (16.7-31.6)
60-day	11.8 (10.3-13.4)	13.2 (11.5-15.1)	15.5 (13.5-17.7)	17.2 (14.9-19.8)	19.5 (16.2-22.9)	21.1 (17.2-25.2)	22.7 (17.8-27.8)	24.1 (18.2-30.4)	25.9 (18.8-33.6)	27.1 (19.2-36.0)

[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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Farmland classification: Not prime farmland

Map Unit Composition

Spillville, frequently flooded, and similar soils: 50 percent
Sigglekov, frequently flooded, and similar soils: 35 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Spillville, Frequently Flooded

Setting

Landform: Flood plains
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy alluvium

Typical profile

A - 0 to 54 inches: loam
C - 54 to 60 inches: loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.14 to 1.42 in/hr)
Depth to water table: About 12 to 42 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Available water storage in profile: High (about 11.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8w
Hydrologic Soil Group: B/D
Hydric soil rating: Yes

Description of Sigglekov, Frequently Flooded

Setting

Landform: Flood plains
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy alluvium

Typical profile

A - 0 to 9 inches: loam
C1 - 9 to 15 inches: sandy loam
C2 - 15 to 35 inches: sand
C3 - 35 to 80 inches: coarse sand

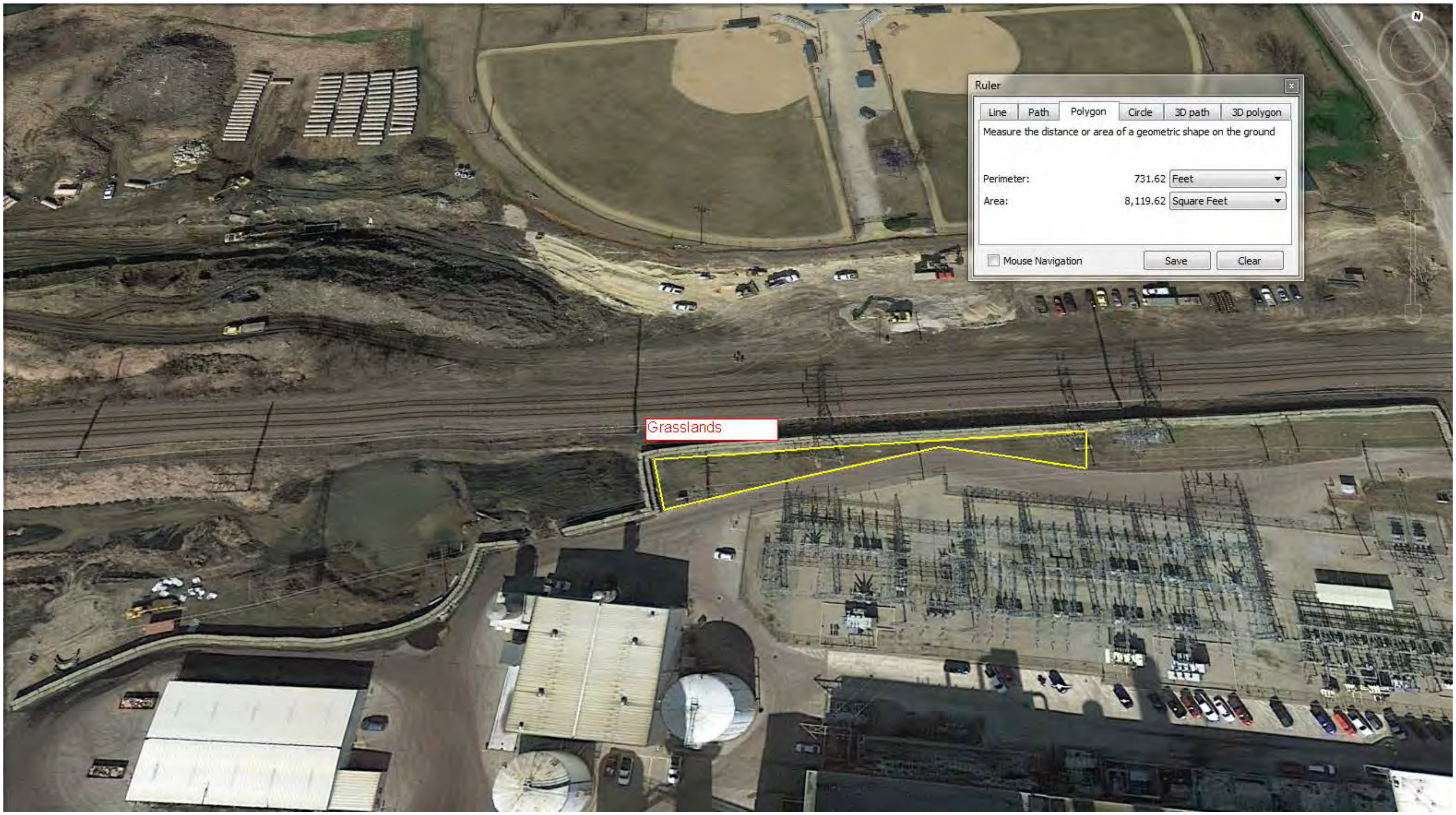
Properties and qualities

Slope: 0 to 2 percent

Drainage & Delineation Sketch-PCS Beneficial Use Storage area- Area 10,414 sq.ft.

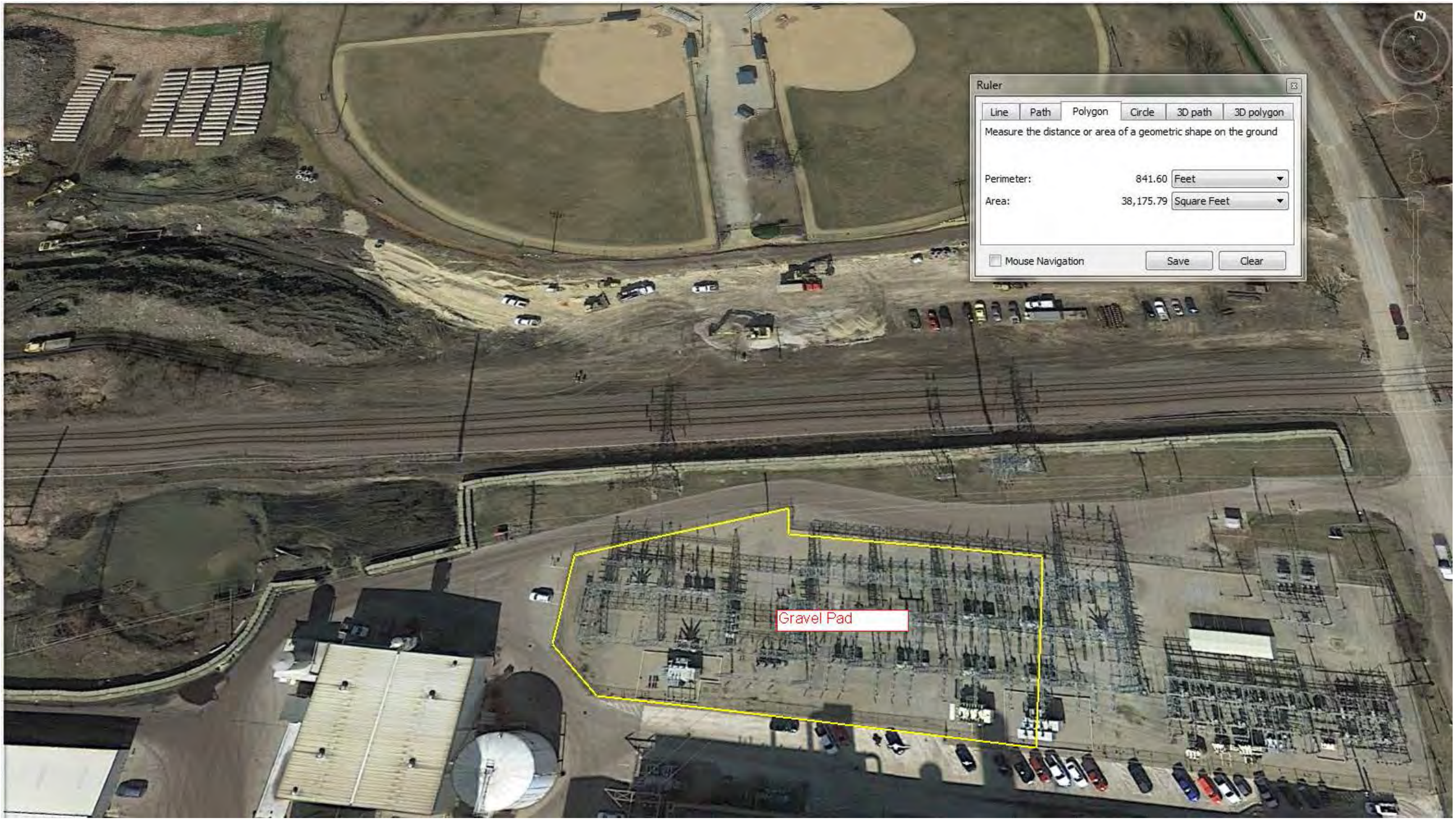
Drainage & Delineation Sketch-PCS Beneficial Use Storage area- Area 6375 sq.ft.

Drainage & Delineation Sketch-PCS Beneficial Use Storage area- Area 3633 sq.ft.

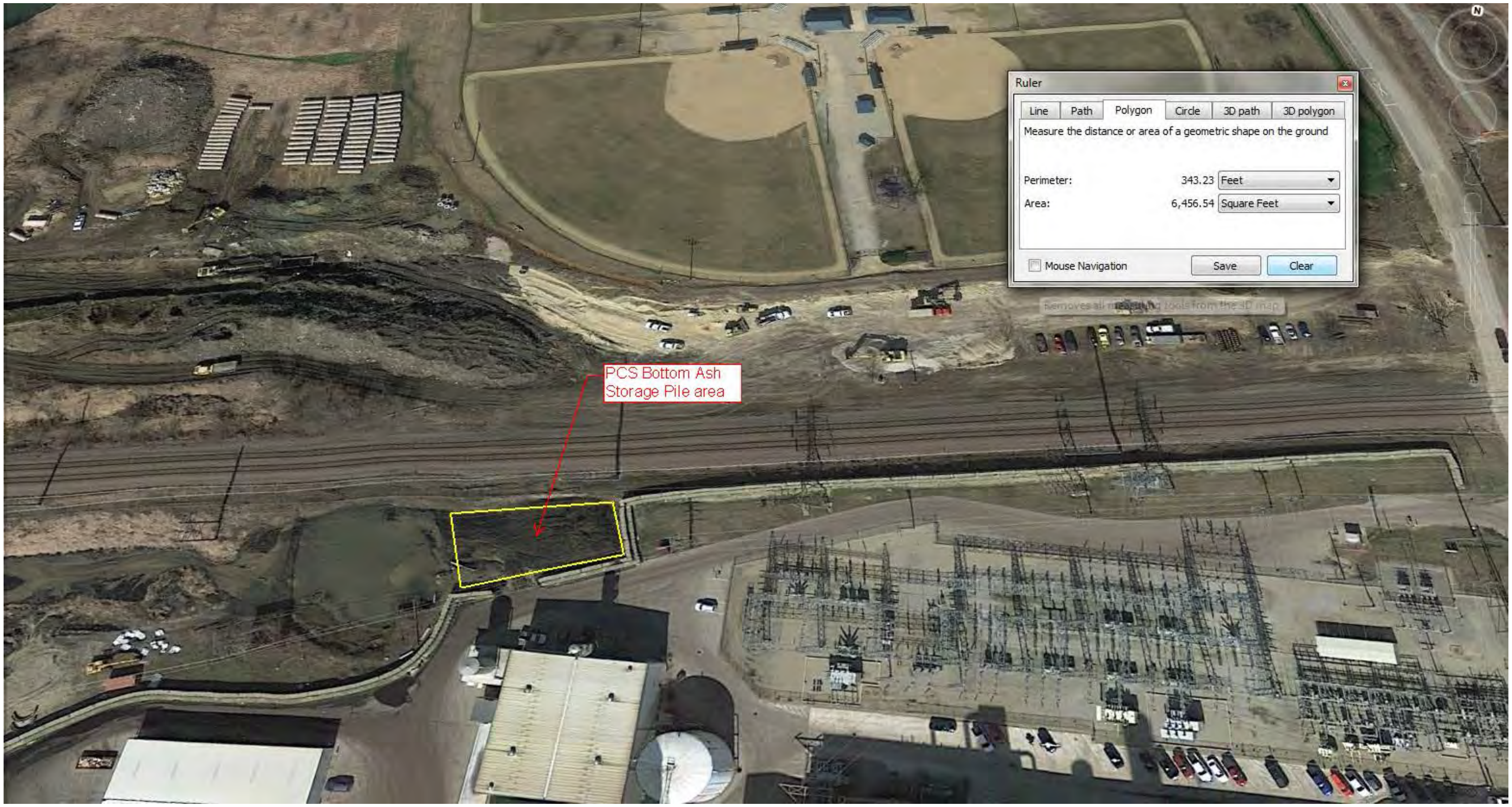


Drainage & Delineation Sketch-Grasslands Plant- Area 3633 sq.ft.

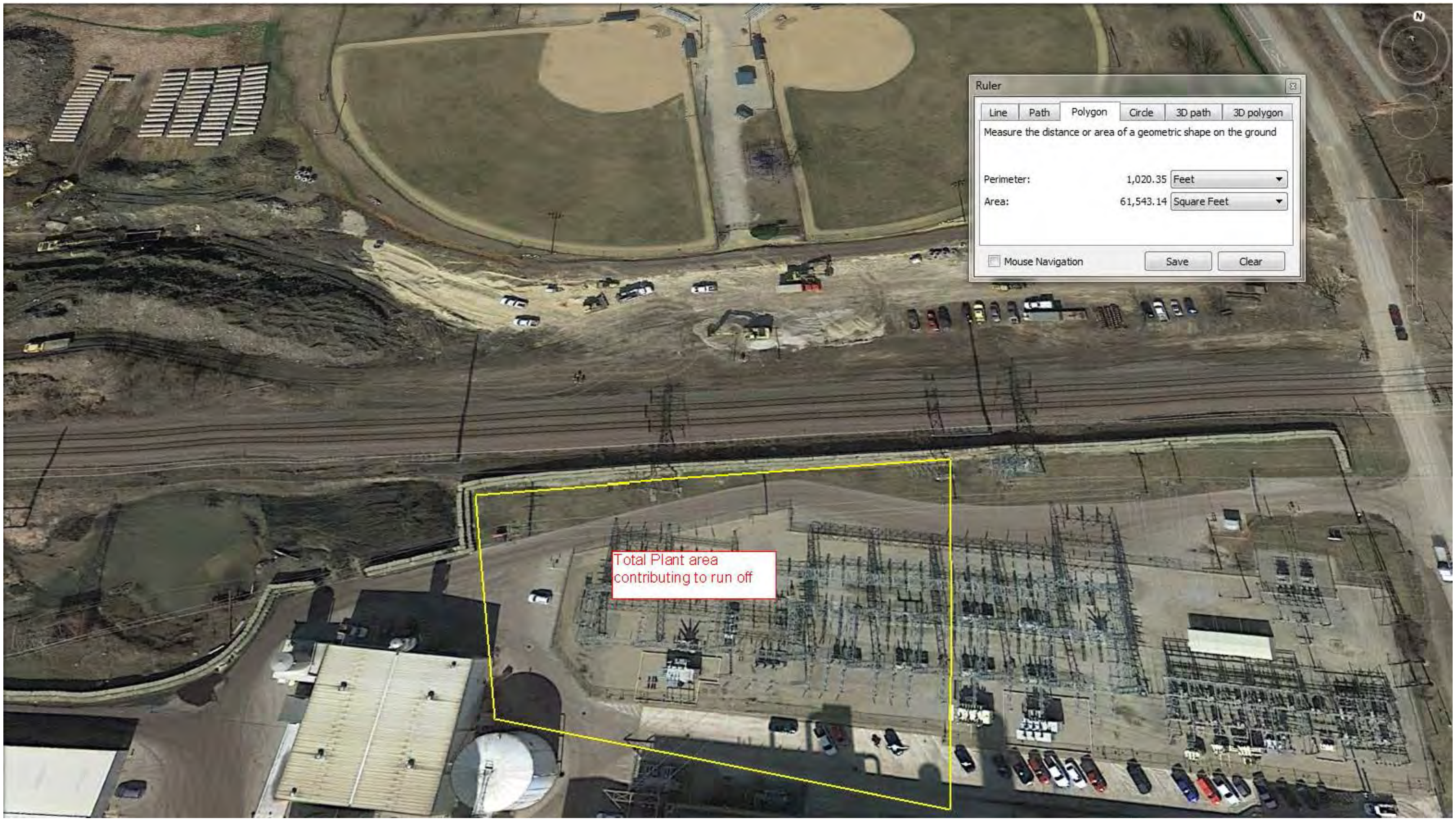
Drainage & Delineation Sketch-Grasslands (Railway)- Area 81,810 sq.ft.



Drainage & Delineation Sketch-Gravel Pad- Area 38,175 sq.ft.



Drainage & Delineation Sketch-PCS Beneficial Use Storage Area- Area 6456 sq.ft.



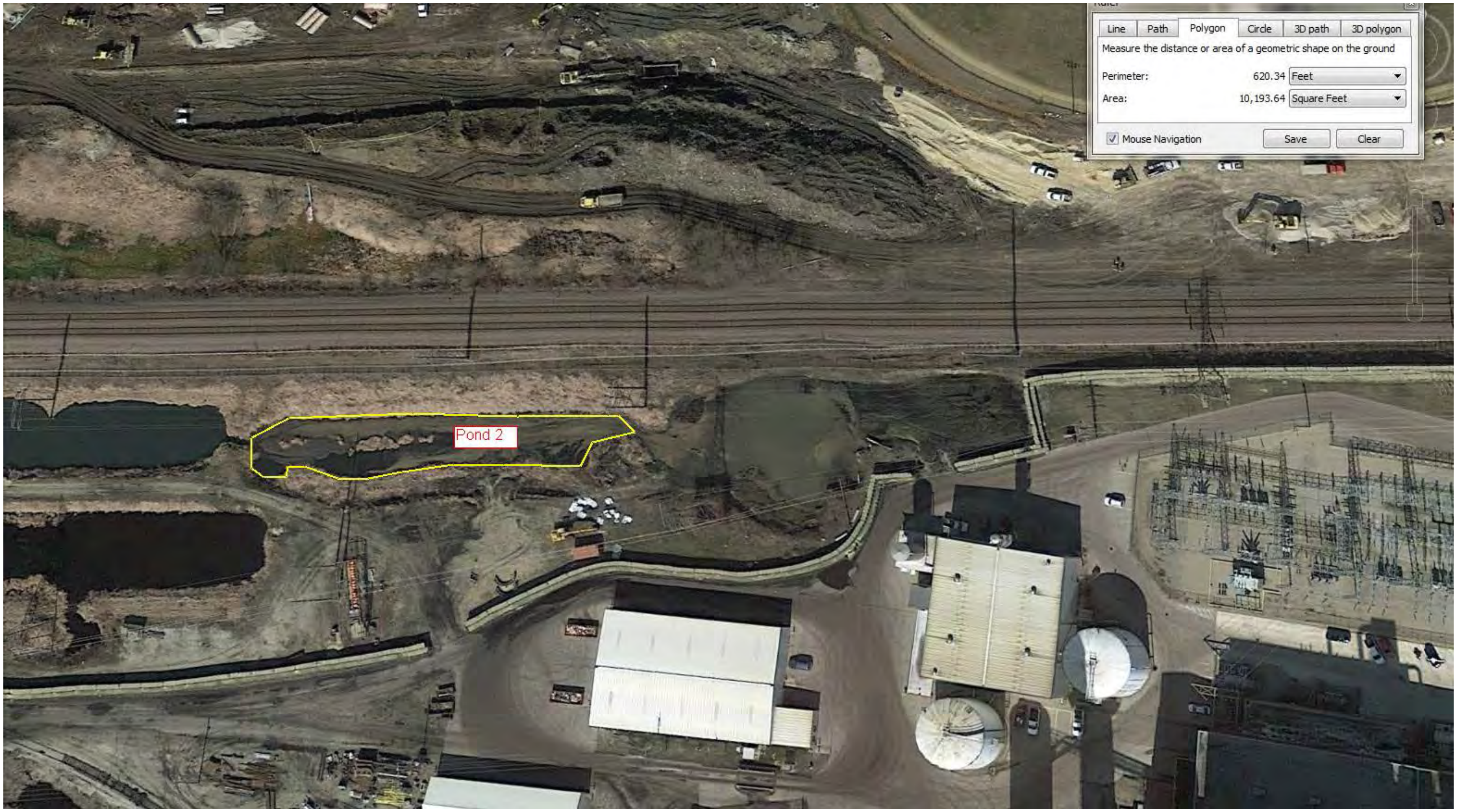
Drainage & Delineation Sketch-Total Run-off Area from Plant- Area 61,543 sq.ft.

Drainage & Delineation Sketch-Longitudinal limit of low land, north of PCS Bottom Ash Piles - Length 900ft.

Drainage & Delineation Sketch-Longitudinal limit of low land, south of PCS Bottom Ash Piles - Length 900ft.

Drainage & Delineation Sketch-Overall low land- Area 75,646 sq.ft.

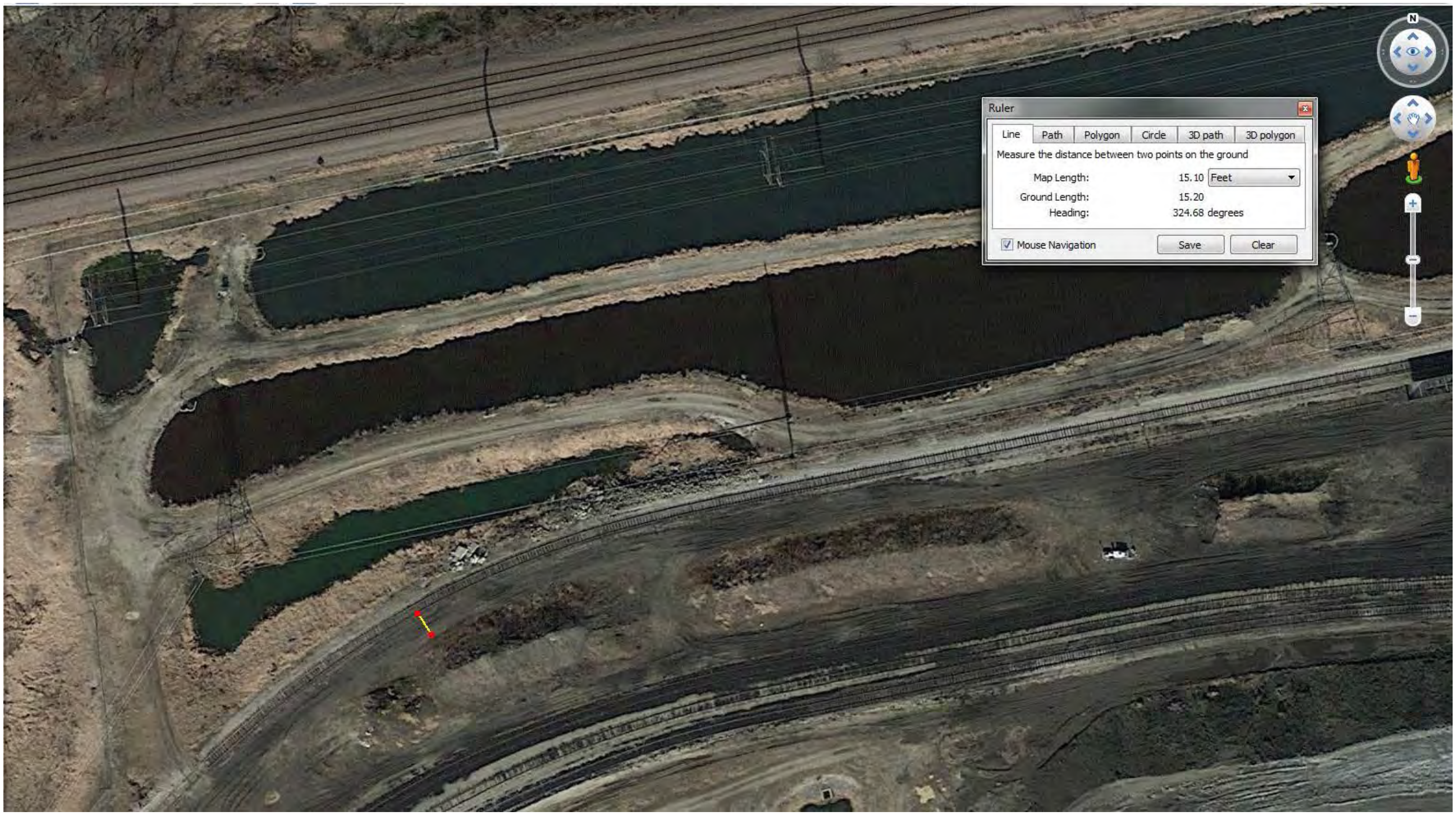
Drainage & Delineation Sketch-Pond 1- Area 9666 sq.ft.



Drainage & Delineation Sketch-Pond 2- Area 10,193 sq.ft.

Drainage & Delineation Sketch-Pond 3- Area 24,537 sq.ft.

Drainage & Delineation Sketch-Pond 4- Area 55,560 sq.ft.



Drainage & Delineation Sketch-Lateral limit of low land, north of PCS Bottom Ash Piles - Length 15.10ft.

Drainage & Delineation Sketch-Lateral limit of low land, south of PCS Bottom Ash Piles - Length 18.77ft.

Table 2-2c Runoff curve numbers for other agricultural lands [1]

Cover description		Curve numbers for hydrologic soil group			
Cover type	Hydrologic condition	A	B	C	D
Pasture, grassland, or range—continuous forage for grazing. [2]	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	61	74	80
Meadow—continuous grass, protected from grazing and generally mowed for hay.	—	30	58	71	78
Brush—brush-weed-grass mixture with brush the major element. [3]	Poor	48	67	77	83
	Fair	35	56	70	77
	Good	30 [4]	48	65	73
Woods—grass combination (orchard or tree farm). [5]	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79
Woods. [6]	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	30 [4]	55	70	77
Farmsteads—buildings, lanes, driveways, and surrounding lots.	—	59	74	82	86

1 Average runoff condition, and $I_a = 0.2S$.
2 *Poor:* <50%) ground cover or heavily grazed with no mulch.
Fair: 50 to 75% ground cover and not heavily grazed.
Good: > 75% ground cover and lightly or only occasionally grazed.
3 *Poor:* <50% ground cover.
Fair: 50 to 75% ground cover.
Good: >75% ground cover.
4 Actual curve number is less than 30; use CN = 30 for runoff computations.
5 CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.
6 *Poor:* Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.
Fair: Woods are grazed but not burned, and some forest litter covers the soil.
Good: Woods are protected from grazing, and litter and brush adequately cover the soil.

Table 2-2a Runoff curve numbers for urban areas [1/]

Cover description: Cover type and hydrologic condition	Average percent impervious area [2/]	Curve numbers for hydrologic soil group: A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.) [3/]:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) [4/]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)				96	96
Urban districts:					
Commercial and business				94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation) [5/]		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in table 2-2c).					

For PCS Beneficial Use Storage Area/ PCS Bottom Ash Piles

1 Average runoff condition, and $I_a = 0.2S$.
2 The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.
3 CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.
4 Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.
5 Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

Scenario Calculation Summary-**PCS Bottom Ash PIles Landfill (North)**

Scenario Summary

ID	1
Label	Pre-Development 25 year return
Notes	
Active Topology	Pre-Development Active Topology
Hydrology	Pre-Development Hydrology
Rainfall Runoff	25 year return
Physical	Pre-Development Physical
Initial Condition	Pre-Development Initial Condition
Boundary Condition	Pre-Development Boundary Condition
Infiltration and Inflow	Pre-Development Infiltration and Inflow
Output	Pre-Development Output
User Data Extensions	Pre-Development User Data Extensions
PondPack Engine Calculation Options	Base Calculation Options

Output Summary

Output Increment	0.050 hours	Duration	24.000 hours

Rainfall Summary

Return Event Tag	25	Rainfall Type	Time-Depth Curve
Total Depth	5.6 in	Storm Event	25-YR

Executive Summary (Nodes)

Label	Scenario	Return Event (years)	Truncation	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
Low Land-North of pile	Pre-Development 25 year return	25	None	0.045	11.950	0.79	(N/A)	(N/A)
PCS Bottom Ash Pile	Pre-Development 25 year return	25	None	0.051	11.950	0.92	(N/A)	(N/A)
PCS Bottom Ash Piles low land (IN)	Pre-Development 25 year return	25	None	0.095	11.950	1.71	(N/A)	(N/A)
PCS Bottom Ash Piles low land (OUT)	Pre-Development 25 year return	25	None	0.000	0.000	0.00	721.16	0.021

Executive Summary (Links)

Label	Type	Location	Hydrograph Volume (ac-ft)	Peak Time (hours)	Peak Flow (ft³/s)	End Point	Node Flow Direction

Scenario Calculation Summary-**PCS Bottom Ash PIles Landfill (North)**

Message Id	7
Scenario	Pre-Development 25 year return
Element Type	Catchment
Element Id	29
Label	Low Land-North of pile
Time	(N/A)
Message	The difference between calculated peak flow and interpolated peak flow 2.2 % is greater than 1.5 %. Computed peak flow= 0.81 ft³/s Interp. peak flow= 0.79 ft³/s. Output increment for this catchment may be too large.
Source	Warning
Message Id	7
Scenario	Pre-Development 25 year return
Element Type	Catchment
Element Id	45
Label	PCS Bottom Ash Pile
Time	(N/A)
Message	The difference between calculated peak flow and interpolated peak flow 4.4 % is greater than 1.5 %. Computed peak flow= 0.96 ft³/s Interp. peak flow= 0.92 ft³/s. Output increment for this catchment may be too large.
Source	Warning
Message Id	40
Scenario	Pre-Development 25 year return
Element Type	Pond
Element Id	28
Label	PCS Bottom Ash Piles low land
Time	(N/A)
Message	Mass balance for routing volumes vary by more than 0.5 %. (2.5 % of Inflow Volume))
Source	Warning

Scenario Calculation Summary-**PCS Bottom Ash PIles Landfill (South)**

Scenario Summary

ID	1
Label	Pre-Development 25 year return
Notes	
Active Topology	Pre-Development Active Topology
Hydrology	Pre-Development Hydrology
Rainfall Runoff	25 year return
Physical	Pre-Development Physical
Initial Condition	Pre-Development Initial Condition
Boundary Condition	Pre-Development Boundary Condition
Infiltration and Inflow	Pre-Development Infiltration and Inflow
Output	Pre-Development Output
User Data Extensions	Pre-Development User Data Extensions
PondPack Engine Calculation Options	Base Calculation Options

Output Summary

Output Increment	0.050 hours	Duration	24.000 hours

Rainfall Summary

Return Event Tag	25	Rainfall Type	Time-Depth Curve
Total Depth	5.6 in	Storm Event	25-YR

Executive Summary (Nodes)

Label	Scenario	Return Event (years)	Truncation	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
Low Land-south of pile	Pre-Development 25 year return	25	None	0.055	11.950	0.98	(N/A)	(N/A)
PCS Bottom Ash Piles	Pre-Development 25 year return	25	None	0.051	11.950	0.92	(N/A)	(N/A)
PCS Bottom Ash Piles low land (IN)	Pre-Development 25 year return	25	None	0.106	11.950	1.90	(N/A)	(N/A)
PCS Bottom Ash Piles low land (OUT)	Pre-Development 25 year return	25	None	0.000	0.000	0.00	721.71	0.031

Executive Summary (Links)

Label	Type	Location	Hydrograph Volume (ac-ft)	Peak Time (hours)	Peak Flow (ft³/s)	End Point	Node Flow Direction

Scenario Calculation Summary-**PCS Bottom Ash PIles Landfill (South)**

Message Id	7
Scenario	Pre-Development 25 year return
Element Type	Catchment
Element Id	29
Label	Low Land-south of pile
Time	(N/A)
Message	The difference between calculated peak flow and interpolated peak flow 2.2 % is greater than 1.5 %. Computed peak flow= 1.01 ft^3/s Interp. peak flow= 0.98 ft^3/s. Output increment for this catchment may be too large.
Source	Warning

Message Id	7
Scenario	Pre-Development 25 year return
Element Type	Catchment
Element Id	45
Label	PCS Bottom Ash Piles
Time	(N/A)
Message	The difference between calculated peak flow and interpolated peak flow 4.4 % is greater than 1.5 %. Computed peak flow= 0.96 ft^3/s Interp. peak flow= 0.92 ft^3/s. Output increment for this catchment may be too large.
Source	Warning

Message Id	40
Scenario	Pre-Development 25 year return
Element Type	Pond
Element Id	28
Label	PCS Bottom Ash Piles low land
Time	(N/A)
Message	Mass balance for routing volumes vary by more than 0.5 %. (1.7 % of Inflow Volume))
Source	Warning