SCS ENGINEERS

CCR Surface Impoundment Hydrologic and Hydraulic Capacity Evaluation

Indianapolis Power & Light Company

Eagle Valley Generating Station

Prepared for:

Indianapolis Power & Light Company

ipl an AES company

Eagle Valley Station
4040 Blue Bluff Road
Martinsville, Indiana 46151

Prepared by:

SCS ENGINEERS
2830 Dairy Drive
Madison, Wisconsin 53718-6751
(608) 224-2830

October 13, 2016
File No. 25216140

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1.0 INTRODUCTION

SCS Engineers (SCS) performed hydrologic and hydraulic capacity evaluations of the CCR (coal combustion residual) surface impoundments at the Indianapolis Power & Light Company (IPL) Eagle Valley Generating Station (EV) in Martinsville, Indiana. These analyses were performed in accordance with the Federal Register CFR 257.82, "Hydraulic and hydraulic capacity requirements for CCR surface impoundments". **Figure 1** shows the location of the EV. CFR 257.82 is included in **Appendix A**. The layout of the CCR surface impoundments at the EV is shown in **Figure 2**.

The EV coal powered generating station has been shut down and no CCR material is currently discharged to the CCR surface impoundments. A gas power generating station is currently under construction at the site. IP&L is currently developing plans to permanently close the CCR surface impoundments.

There are three CCR surface impoundments at EV, Ponds A, B, and C. Ponds A, B, and C are active ponds. Pond A is partially full of CCR material. Pond B and Pond C are still operating as designed. Pumps located in basement sumps within the closed generating station pump water to Pond A, when needed.

2.0 HYDROLOGIC AND HYDRAULIC ANALYSIS

A hydraulic analysis was performed in accordance with the "General Guidelines for New Dams and Improvements to Existing Dams in Indiana", published by the Indiana Department of Natural Resources, Division of Water, January 1, 2001. The hydraulic analysis was performed using HydroCAD storm water modeling software.

According to the General Guidelines, if the time of concentration (Tc) is less than 6 hours, the 6-hour probable maximum precipitation (PMP) should be used to analyze the spillway system. The ponds at the EV are contained within the containment berms, and the Tc for each pond is less than 6 hours. A Type B design storm was used in the HydroCAD model.

The hydraulic analysis evaluates the outlet of the CCR impoundments and ensures that the outlet is capable of safely passing the runoff from the design storm event without embankment overtopping and failing. The design storm event is determined by the hazardous classification of the impoundment.

Although former CCR surface impoundment Pond D is out of service, runoff from Pond D drains to Pond C. Therefore, Pond D has been included in the evaluation.

The hydraulic analysis evaluates the hydraulic capacity of the CCR impoundment outlet and ensures that the outlet is capable of safely passing the runoff from the design storm event without embankment overtopping and failing.

According to IPL personnel, Ponds A, B, and C are in the Significant Hazard classification. According to CFR 257.82(3)(ii), for a significant hazard potential CCR surface impoundment, the inflow design flood is the 1,000-year storm event.

The National Oceanic and Atmospheric Administration (NOAA) Atlas 14 Precipitation Frequency Estimate (**Appendix B**), for the Martinsville Indiana area, the 6-hour, 1,000-year storm event is 7.35 inches of precipitation.

Results

The input parameters and output of the HydroCAD model are included in **Appendix C**. The results of the hydraulic analysis are summarized below:

1,000 –year Storm Event

Pond	Berm Elevation	Maximum Water Height	Freeboard (ft)
A	629	627.96	1.0
B	619	617.19	1.8
C	619	614.65	4.4

All of the ponds can safely pass the storm event and maintain a minimum of 1.0 foot of freeboard between the water surface and the top of the berm.

3.0 QUALIFIED PROFESSIONAL ENGINEER CERTIFICATION

PROFESSIONAL ENGINEER CERTIFICATION

"I, David Hendron, hereby certify that I am a licensed professional engineer in the State of Indiana in accordance with the requirements of Indiana Administrative Code Title 864; and that, to the best of my knowledge, all information contained in this document is correct."

Signature ____________________

Title and PE Number Senior Engineer PE10000050

Date 13 October 2016

DAVID M. HENDRON
REGISTERED
NO. PE10000050
STATE OF
INDIANA
PROFESSIONAL ENGINEER

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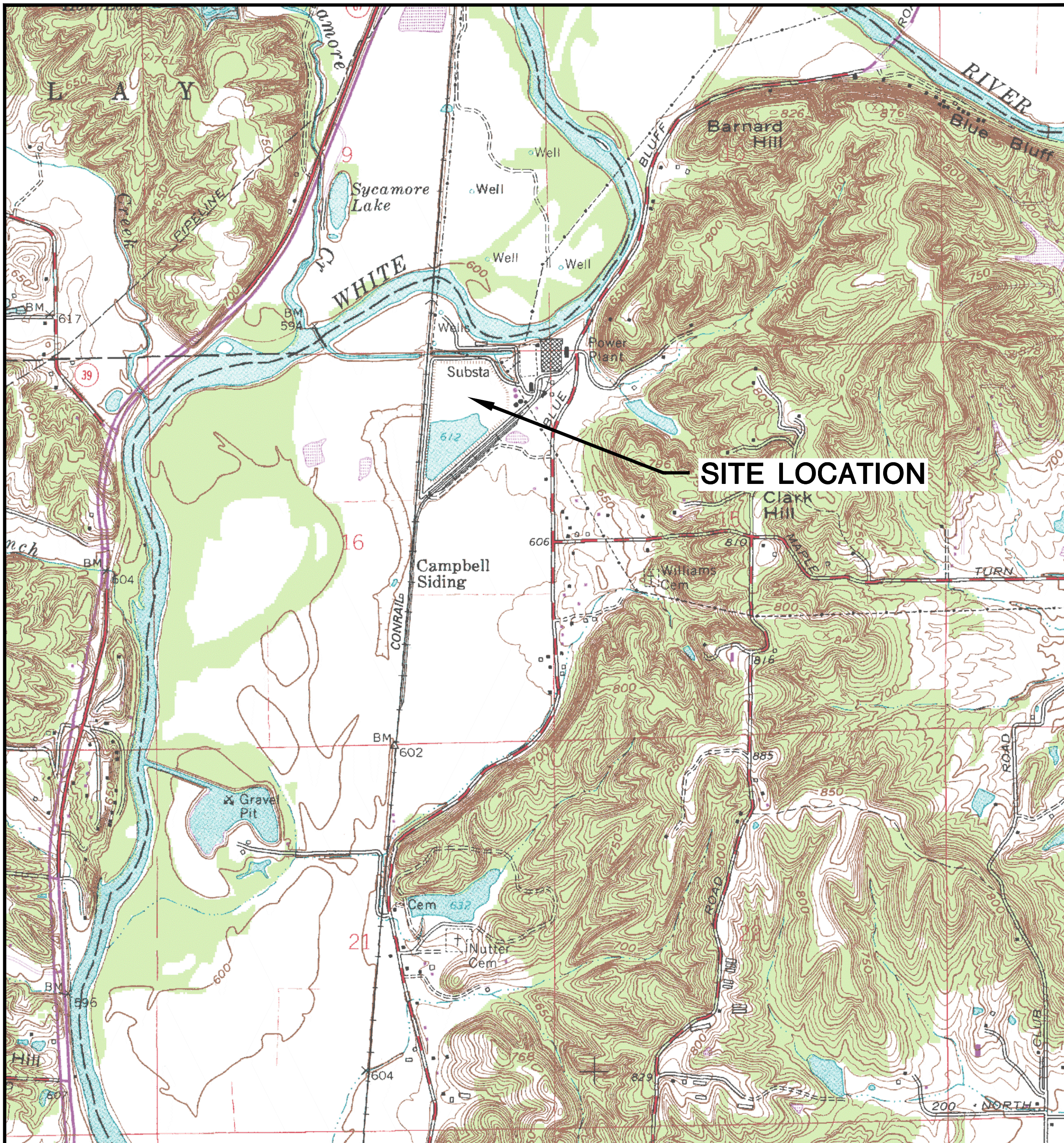
FIGURES



N

MARTINSVILLE QUADRANLGE
INDIANA – MORGAN CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
1983
SCALE: 1" = 2,000'

QUADRANGLE LOCATION

CLIENT	INDIANAPOLIS POWER & LIGHT COMPANY	SITE	EAGLE VALLEY PLANT 4040 BLUE BLUFF ROAD MARTINSVILLE, INDIANA	SITE LOCATION MAP

PROJECT NO.	25216140	DRAWN BY:	KP	ENGINEER	SCS ENGINEERS 2830 DAIRY DRIVE MADISON, WI 53718-6751 PHONE (608) 224-2830	FIGURE
DRAWN:	02/26/08	CHECKED BY:	DH			1
REVISED:	09/29/16	APPROVED BY:				

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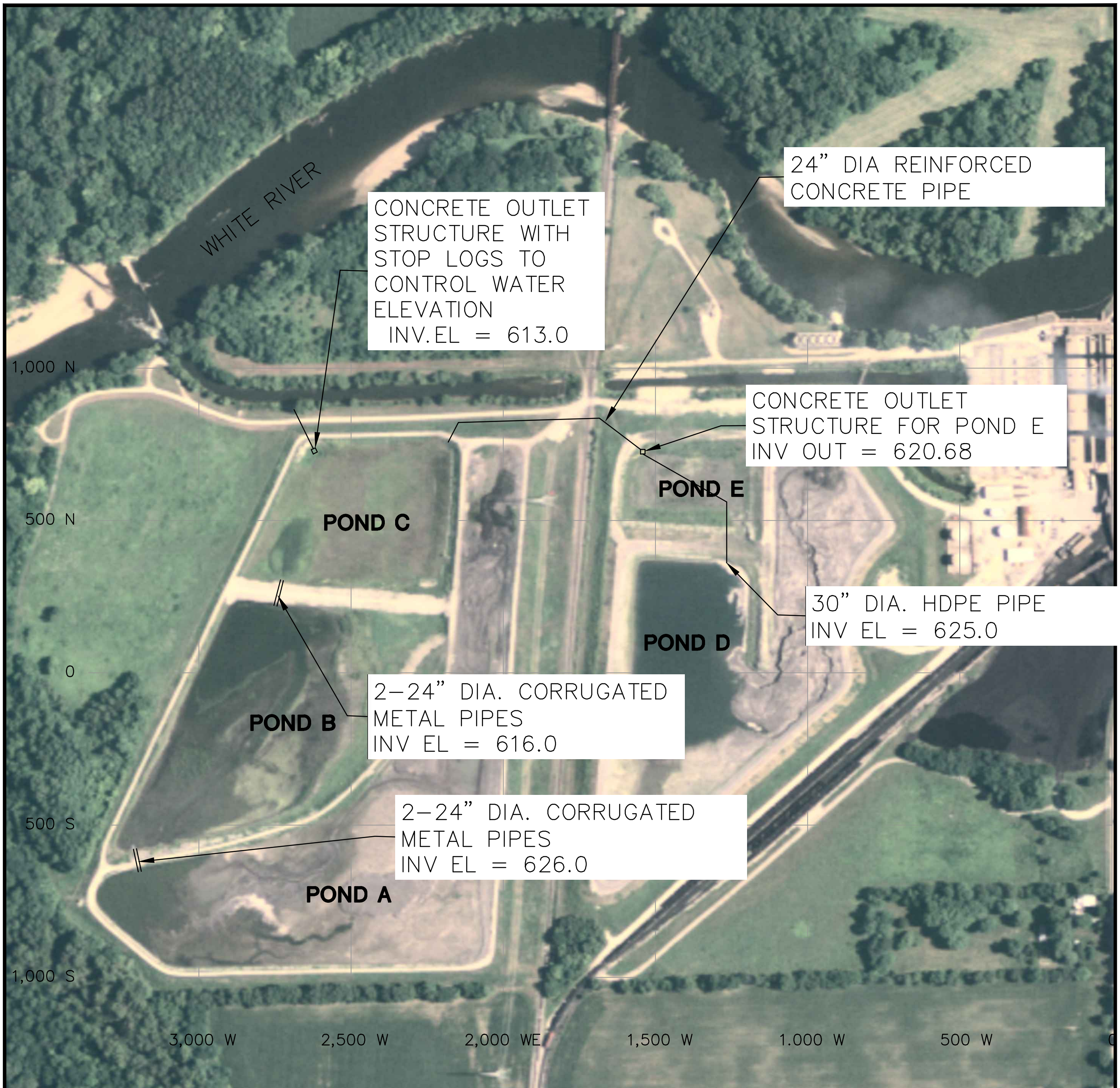

NOTES:

1. AERIAL PHOTOGRAPH FROM INDIANA SPATIAL DATA PORTAL, DATED JULY 07, 2007.
2. ON-SITE COORDINATE SYSTEM DEVELOPED FROM IPL DRAWING "EAGLE VALLEY MONITORING WELLS ASH PONDS A; B; C" DATED SEP. 13, 2011.
3. LOCATION OF OUTLET STRUCTURES IS APPROXIMATE.

500 0 500

SCALE: 1" = 500'

N

CLIENT	INDIANAPOLIS POWER & LIGHT COMPANY	SITE	EAGLE VALLEY GENERATING STATION 4040 BLUE BLUFF ROAD MARTINSVILLE, INDIANA	CCR SURFACE IMPOUNDMENT HYDRAULIC STRUCTURES LOCATION AND INFORMATION MAP

PROJECT NO.	25216140	DRAWN BY:	KG	ENGINEER: SCS ENGINEERS 2830 DAIRY DRIVE MADISON, WI 53718-6751 PHONE: (608) 224-2830	FIGURE
DRAWN:	06/07/16	CHECKED BY:			2
REVISED:	09/29/16	APPROVED BY:			

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APPENDIX A

Federal Register 40 CFR 257.82

follow to periodically assess the effectiveness of the control plan.

(5) The owner or operator of a CCR unit must prepare an initial CCR fugitive dust control plan for the facility no later than October 19, 2015, or by initial receipt of CCR in any CCR unit at the facility if the owner or operator becomes subject to this subpart after October 19, 2015. The owner or operator has completed the initial CCR fugitive dust control plan when the plan has been placed in the facility's operating record as required by § 257.105(g)(1).

(6) *Amendment of the plan.* The owner or operator of a CCR unit subject to the requirements of this section may amend the written CCR fugitive dust control plan at any time provided the revised plan is placed in the facility's operating record as required by § 257.105(g)(1). The owner or operator must amend the written plan whenever there is a change in conditions that would substantially affect the written plan in effect, such as the construction and operation of a new CCR unit.

(7) The owner or operator must obtain a certification from a qualified professional engineer that the initial CCR fugitive dust control plan, or any subsequent amendment of it, meets the requirements of this section.

(c) *Annual CCR fugitive dust control report.* The owner or operator of a CCR unit must prepare an annual CCR fugitive dust control report that includes a description of the actions taken by the owner or operator to control CCR fugitive dust, a record of all citizen complaints, and a summary of any corrective measures taken. The initial annual report must be completed no later than 14 months after placing the initial CCR fugitive dust control plan in the facility's operating record. The deadline for completing a subsequent report is one year after the date of completing the previous report. For purposes of this paragraph (c), the owner or operator has completed the annual CCR fugitive dust control report when the plan has been placed in the facility's operating record as required by § 257.105(g)(2).

(d) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(g), the notification requirements specified in § 257.106(g), and the internet requirements specified in § 257.107(g).

§ 257.81 Run-on and run-off controls for CCR landfills.

(a) The owner or operator of an existing or new CCR landfill or any lateral expansion of a CCR landfill must design, construct, operate, and maintain:

(1) A run-on control system to prevent flow onto the active portion of the CCR unit during the peak discharge from a 24-hour, 25-year storm; and

(2) A run-off control system from the active portion of the CCR unit to collect and control at least the water volume resulting from a 24-hour, 25-year storm.

(b) Run-off from the active portion of the CCR unit must be handled in accordance with the surface water requirements under § 257.3–3.

(c) *Run-on and run-off control system plan*—(1) *Content of the plan.* The owner or operator must prepare initial and periodic run-on and run-off 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 run-on and run-off control systems have been designed and constructed to meet the applicable requirements of this section. Each plan must be supported by appropriate engineering calculations. The owner or operator has completed the initial run-on and run-off control system plan when the plan has been placed in the facility's operating record as required by § 257.105(g)(3).

(2) *Amendment of the plan.* The owner or operator may amend the written run-on and run-off control system plan at any time provided the revised plan is placed in the facility's operating record as required by § 257.105(g)(3). The owner or operator must amend the written run-on and run-off control system plan whenever there is a change in conditions that would substantially affect the written plan in effect.

(3) *Timeframes for preparing the initial plan*—(i) *Existing CCR landfills.* The owner or operator of the CCR unit must prepare the initial run-on and run-off control system plan no later than October 17, 2016.

(ii) *New CCR landfills and any lateral expansion of a CCR landfill.* The owner or operator must prepare the initial run-on and run-off control system plan no later than the date of initial receipt of CCR in the CCR unit.

(4) *Frequency for revising the plan.* The owner or operator of the CCR unit must prepare periodic run-on and run-off 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 subsequent 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 a periodic run-on and run-off control system plan when the plan has been placed in the facility's operating record as required by § 257.105(g)(3).

(5) The owner or operator must obtain a certification from a qualified professional engineer stating that the initial and periodic run-on and run-off control system plans meet the requirements of this section.

(d) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(g), the notification requirements specified in § 257.106(g), and the internet requirements specified in § 257.107(g).

§ 257.82 Hydrologic and hydraulic capacity requirements for CCR surface impoundments.

(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 (2) of this section.

(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.

(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.

(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.

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

(c) *Inflow design flood control system plan*—(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).

(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.

(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.

(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.

(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).

(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.

(d) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(g), the notification requirements specified in § 257.106(g), and the internet requirements specified in § 257.107(g).

§ 257.83 Inspection requirements for CCR surface impoundments.

(a) *Inspections by a qualified person.* (1) All CCR surface impoundments and any lateral expansion of a CCR surface impoundment must be examined by a qualified person as follows:

(i) At intervals not exceeding seven days, inspect for any appearances of actual or potential structural weakness and other conditions which are disrupting or have the potential to disrupt the operation or safety of the CCR unit;

(ii) At intervals not exceeding seven days, inspect the discharge of all outlets of hydraulic structures which pass underneath the base of the surface impoundment or through the dike of the CCR unit for abnormal discoloration, flow or discharge of debris or sediment; and

(iii) At intervals not exceeding 30 days, monitor all CCR unit instrumentation.

(iv) The results of the inspection by a qualified person must be recorded in the facility's operating record as required by § 257.105(g)(5).

(2) *Timeframes for inspections by a qualified person*—(i) *Existing CCR surface impoundments.* The owner or operator of the CCR unit must initiate the inspections required under paragraph (a) of this section no later than October 19, 2015.

(ii) *New CCR surface impoundments and any lateral expansion of a CCR surface impoundment.* The owner or operator of the CCR unit must initiate the inspections required under paragraph (a) of this section upon initial receipt of CCR by the CCR unit.

(b) Annual i*nspections by a qualified professional engineer.* (1) If the existing or new CCR surface impoundment or any lateral expansion of the CCR surface impoundment is subject to the periodic structural stability assessment requirements under § 257.73(d) or § 257.74(d), the CCR unit must additionally be inspected on a periodic basis by a qualified professional engineer to ensure that the design, construction, operation, and maintenance of the CCR unit is consistent with recognized and generally accepted good engineering standards. The inspection must, at a minimum, include:

(i) A review of available information regarding the status and condition of the CCR unit, including, but not limited to, files available in the operating record (*e.g.,* CCR unit design and construction information required by §§ 257.73(c)(1) and 257.74(c)(1), previous periodic structural stability assessments required under §§ 257.73(d) and 257.74(d), the results of inspections by a qualified person, and results of previous annual inspections);

(ii) A visual inspection of the CCR unit to identify signs of distress or malfunction of the CCR unit and appurtenant structures; and

(iii) A visual inspection of any hydraulic structures underlying the base of the CCR unit or passing through the dike of the CCR unit for structural integrity and continued safe and reliable operation.

(2) *Inspection report.* The qualified professional engineer must prepare a report following each inspection that addresses the following:

(i) Any changes in geometry of the impounding structure since the previous annual inspection;

(ii) The location and type of existing instrumentation and the maximum recorded readings of each instrument since the previous annual inspection;

(iii) The approximate minimum, maximum, and present depth and elevation of the impounded water and CCR since the previous annual inspection;

(iv) The storage capacity of the impounding structure at the time of the inspection;

(v) The approximate volume of the impounded water and CCR at the time of the inspection;

(vi) Any appearances of an actual or potential structural weakness of the CCR unit, in addition to any existing conditions that are disrupting or have the potential to disrupt the operation and safety of the CCR unit and appurtenant structures; and

(vii) Any other change(s) which may have affected the stability or operation of the impounding structure since the previous annual inspection.

(3) *Timeframes for conducting the initial inspection*—(i) *Existing CCR surface impoundments.* The owner or operator of the CCR unit must complete the initial inspection required by paragraphs (b)(1) and (2) of this section no later than January 18, 2016.

(ii) *New CCR surface impoundments and any lateral expansion of a CCR surface impoundment.* The owner or operator of the CCR unit must complete the initial annual inspection required by paragraphs (b)(1) and (2) of this section is completed no later than 14 months

APPENDIX B

Precipitation Estimate

www.nws.noaa.gov

NOAA's National Weather Service
Hydrometeorological Design Studies Center
Precipitation Frequency Data Server (PFDS)

Home Site Map News Organization Search ◉ NWS ○ All NOAA Go

General Info
- Homepage
- Current Projects
- FAQ
- Glossary

Precipitation Frequency (PF)
- PF Data Server
  - PF in GIS Format
  - PF Maps
  - Temporal Distr.
  - Time Series Data
  - PFDS Perform.
- PF Documents

Probable Maximum Precipitation (PMP)
- PMP Documents

Miscellaneous
- Publications
- AEP Storm Analysis
- Record Precipitation

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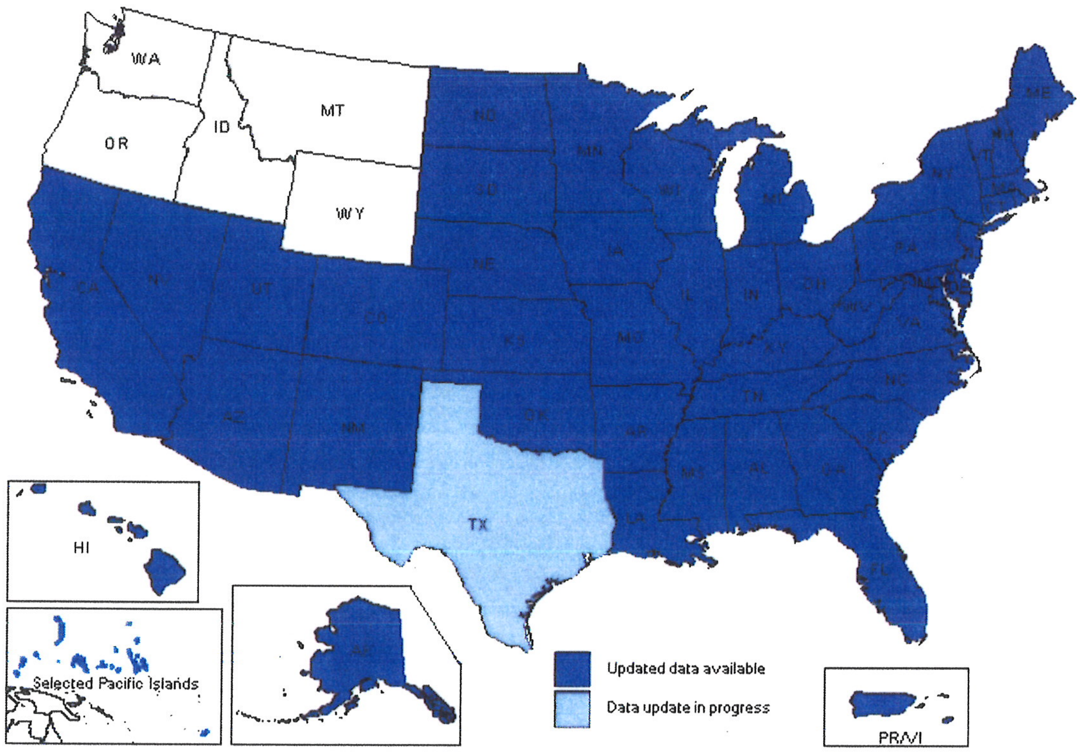
- List-server

USA.gov

State: Choose a state (or click map) Load



Precipitation Frequency Data Server (PFDS)

The Precipitation Frequency Data Server (PFDS) is a point-and-click interface developed to deliver NOAA Atlas 14 precipitation frequency estimates and associated information. Upon clicking a state on the map above or selecting a state name from the drop-down menu, an interactive map of that state will be displayed. From there, a user can identify a location for which precipitation frequency estimates are needed.

Estimates and their confidence intervals can be displayed directly as tables or graphs via separate tabs. Links to supplementary information (such as ASCII grids of estimates, associated temporal distributions of heavy rainfall, time series data at observation sites, cartographic maps, etc.) can also be found.

NOAA Atlas 14 documents provide additional information on the underlying data and functioning of the PFDS.

PFDS is compatible with all modern web browsers. However, some browsers offer a smoother experience than others. We recommend Chrome, Firefox, Internet Explorer 10+, and Safari.

Main Link Categories:
Home | OWP(OHD)

US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
Office of Water Prediction (OWP)
1325 East West Highway
Silver Spring, MD 20910
Page Author: HDSC webmaster

Disclaimer
Credits
Glossary

Privacy Policy
About Us
Career Opportunities

NOAA Atlas 14, Volume 2, Version 3
Location name: Martinsville, Indiana, USA*
Latitude: 39.4829°, Longitude: -86.4216°
Elevation: 640.5 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley

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	0.385 (0.347–0.430)	0.459 (0.413–0.511)	0.550 (0.494–0.613)	0.622 (0.556–0.693)	0.716 (0.636–0.798)	0.790 (0.696–0.882)	0.863 (0.753–0.966)	0.938 (0.810–1.06)	1.04 (0.883–1.18)	1.12 (0.935–1.28)
10-min	0.599 (0.539–0.668)	0.716 (0.645–0.798)	0.855 (0.768–0.953)	0.960 (0.859–1.07)	1.10 (0.972–1.22)	1.20 (1.06–1.34)	1.30 (1.13–1.45)	1.40 (1.21–1.58)	1.53 (1.30–1.73)	1.63 (1.36–1.86)
15-min	0.734 (0.661–0.818)	0.876 (0.789–0.976)	1.05 (0.943–1.17)	1.18 (1.06–1.32)	1.35 (1.20–1.51)	1.48 (1.31–1.66)	1.61 (1.41–1.81)	1.74 (1.50–1.96)	1.91 (1.62–2.16)	2.03 (1.70–2.32)
30-min	0.971 (0.875–1.08)	1.17 (1.06–1.31)	1.44 (1.29–1.60)	1.64 (1.47–1.83)	1.91 (1.70–2.13)	2.12 (1.87–2.37)	2.33 (2.03–2.61)	2.54 (2.19–2.86)	2.83 (2.40–3.20)	3.05 (2.55–3.48)
60-min	1.19 (1.07–1.32)	1.44 (1.30–1.60)	1.80 (1.62–2.01)	2.09 (1.87–2.33)	2.48 (2.20–2.76)	2.79 (2.46–3.12)	3.11 (2.72–3.49)	3.45 (2.98–3.88)	3.91 (3.32–4.43)	4.28 (3.58–4.89)
2-hr	1.38 (1.25–1.55)	1.68 (1.51–1.87)	2.11 (1.90–2.35)	2.45 (2.20–2.74)	2.94 (2.61–3.28)	3.35 (2.94–3.73)	3.77 (3.28–4.21)	4.22 (3.62–4.72)	4.86 (4.08–5.48)	5.38 (4.44–6.11)
3-hr	1.47 (1.33–1.65)	1.79 (1.61–2.00)	2.25 (2.02–2.52)	2.63 (2.35–2.94)	3.17 (2.80–3.54)	3.62 (3.16–4.04)	4.10 (3.54–4.58)	4.61 (3.92–5.17)	5.35 (4.44–6.05)	5.95 (4.84–6.77)
6-hr	1.76 (1.59–1.99)	2.14 (1.92–2.41)	2.70 (2.42–3.04)	3.16 (2.82–3.55)	3.83 (3.37–4.29)	4.38 (3.82–4.92)	4.98 (4.28–5.61)	5.63 (4.76–6.35)	6.57 (5.41–7.45)	7.34 (5.93–8.39)
12-hr	2.11 (1.89–2.39)	2.54 (2.29–2.88)	3.16 (2.83–3.58)	3.67 (3.27–4.14)	4.38 (3.87–4.94)	4.97 (4.35–5.60)	5.59 (4.84–6.31)	6.25 (5.32–7.08)	7.18 (6.00–8.19)	7.94 (6.51–9.10)
24-hr	2.53 (2.33–2.76)	3.03 (2.79–3.32)	3.73 (3.43–4.08)	4.28 (3.93–4.67)	5.03 (4.60–5.50)	5.64 (5.12–6.16)	6.26 (5.65–6.84)	6.90 (6.19–7.56)	7.78 (6.91–8.56)	8.48 (7.46–9.36)
2-day	2.96 (2.75–3.21)	3.55 (3.29–3.84)	4.34 (4.02–4.70)	4.96 (4.58–5.37)	5.80 (5.33–6.27)	6.47 (5.92–7.00)	7.15 (6.50–7.74)	7.84 (7.09–8.52)	8.78 (7.86–9.59)	9.52 (8.45–10.4)
3-day	3.17 (2.97–3.40)	3.80 (3.55–4.07)	4.62 (4.32–4.95)	5.26 (4.91–5.63)	6.14 (5.71–6.57)	6.84 (6.33–7.32)	7.55 (6.96–8.09)	8.27 (7.58–8.89)	9.26 (8.42–9.98)	10.0 (9.05–10.9)
4-day	3.39 (3.20–3.59)	4.04 (3.82–4.29)	4.89 (4.62–5.19)	5.56 (5.24–5.89)	6.48 (6.09–6.87)	7.21 (6.75–7.64)	7.95 (7.41–8.44)	8.71 (8.08–9.26)	9.74 (8.97–10.4)	10.5 (9.65–11.3)
7-day	3.99 (3.77–4.23)	4.74 (4.48–5.03)	5.70 (5.38–6.04)	6.47 (6.10–6.85)	7.50 (7.05–7.94)	8.32 (7.80–8.81)	9.15 (8.54–9.70)	10.0 (9.30–10.6)	11.1 (10.3–11.9)	12.0 (11.1–12.8)
10-day	4.53 (4.29–4.80)	5.38 (5.11–5.71)	6.45 (6.11–6.84)	7.30 (6.90–7.73)	8.44 (7.96–8.94)	9.33 (8.78–9.88)	10.2 (9.60–10.9)	11.2 (10.4–11.8)	12.4 (11.5–13.2)	13.3 (12.3–14.2)
20-day	6.22 (5.91–6.57)	7.36 (6.99–7.77)	8.68 (8.24–9.17)	9.71 (9.20–10.2)	11.1 (10.5–11.7)	12.1 (11.4–12.8)	13.2 (12.4–13.9)	14.2 (13.3–15.0)	15.5 (14.5–16.5)	16.5 (15.3–17.6)
30-day	7.66 (7.28–8.06)	9.02 (8.57–9.49)	10.5 (9.97–11.0)	11.7 (11.1–12.3)	13.2 (12.5–13.9)	14.3 (13.5–15.1)	15.5 (14.5–16.3)	16.6 (15.5–17.5)	18.0 (16.8–19.0)	19.1 (17.7–20.2)
45-day	9.67 (9.20–10.2)	11.4 (10.8–11.9)	13.1 (12.5–13.8)	14.4 (13.7–15.2)	16.2 (15.3–17.0)	17.4 (16.5–18.3)	18.7 (17.6–19.6)	19.9 (18.7–20.9)	21.4 (20.0–22.6)	22.5 (21.0–23.8)
60-day	11.6 (11.0–12.1)	13.5 (12.9–14.2)	15.5 (14.8–16.3)	17.0 (16.2–17.9)	19.0 (18.0–20.0)	20.4 (19.4–21.5)	21.8 (20.6–23.0)	23.2 (21.8–24.4)	24.8 (23.3–26.2)	26.0 (24.4–27.5)

[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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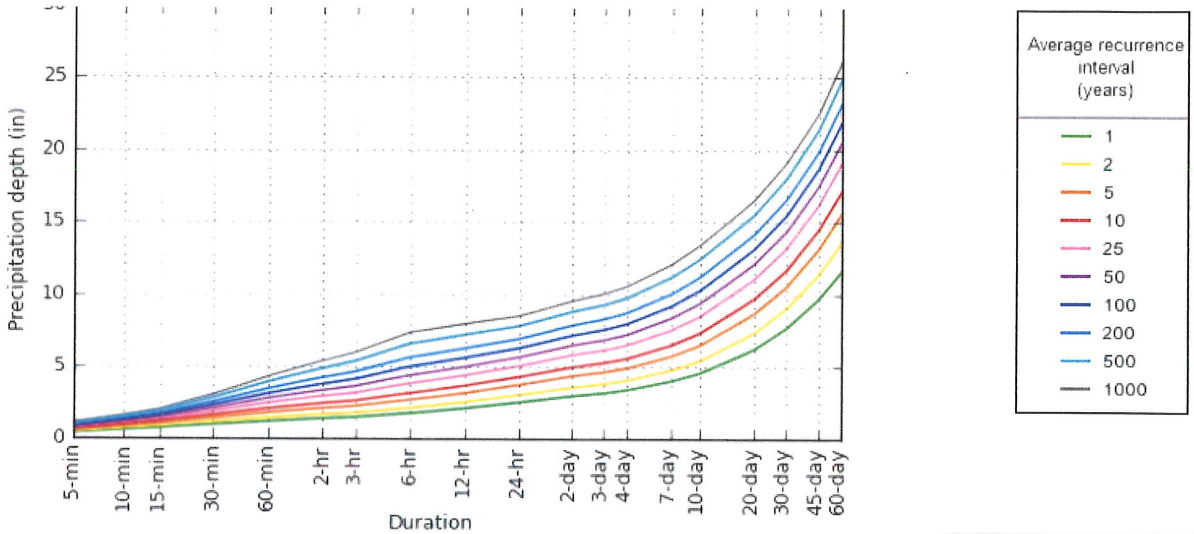
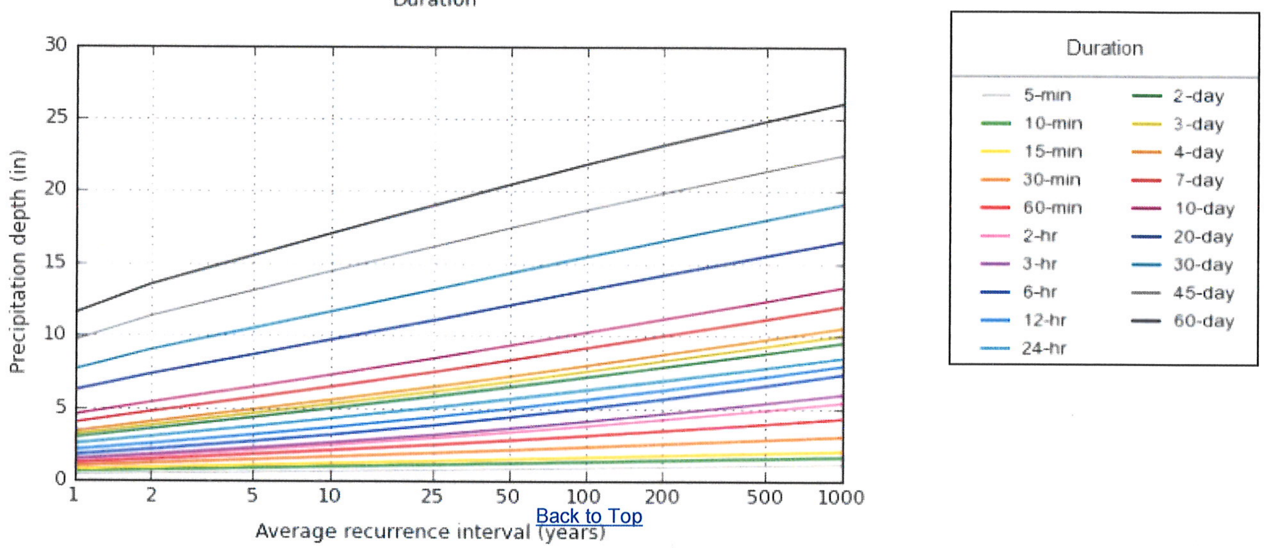
PF graphical





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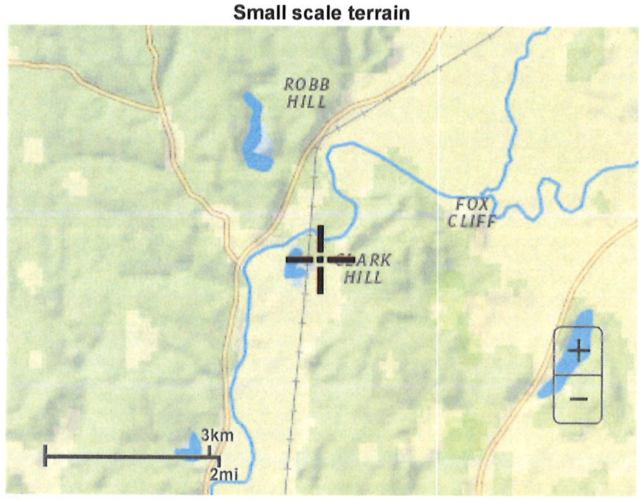
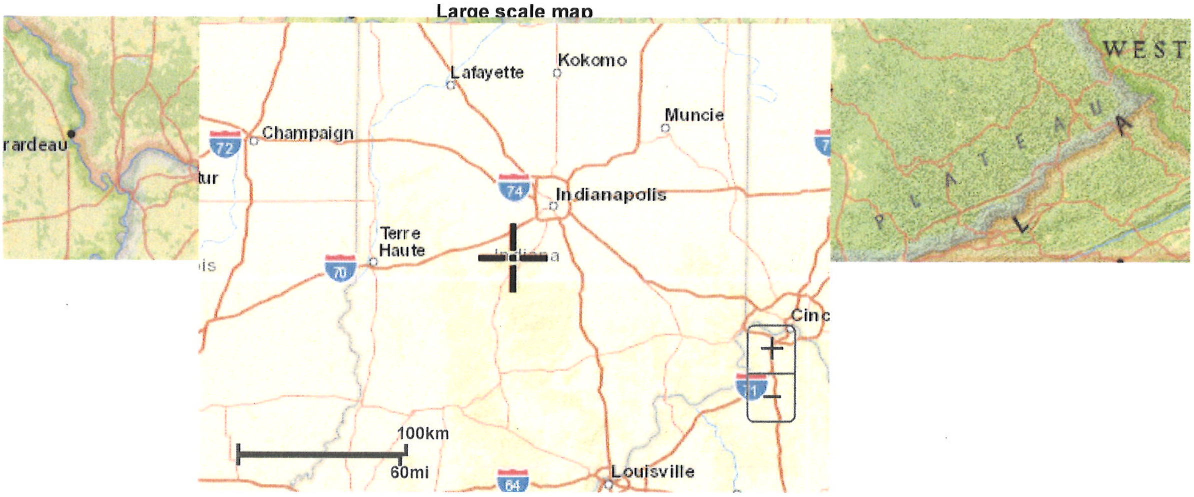
NOAA Atlas 14, Volume 2, Version 3 Created (GMT): Wed Sep 28 16:01:16 2016

Maps & aerials

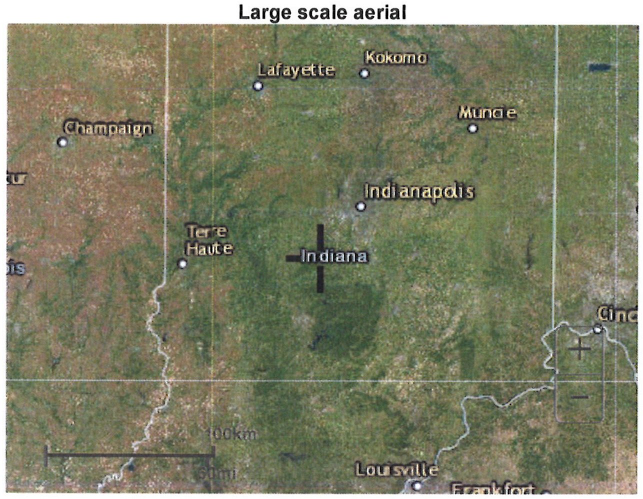
Small scale terrain



Large scale map



Large scale aerial



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Disclaimer

APPENDIX C

HydroCAD Model Analysis

SCS ENGINEERS

				Sheet No.	1
				Calc. No.	
				Rev. No.	
Job No.	25216140.00	Job	IP&L - Eagle Valley Station	By KRG	Date 9/26/16
Client	IP&L	Subject	CCR Impoundment Hydraulic Evaluation	Chk'd BP	Date 10/12/16

Purpose

Determine if the CCR ponds at IP&L Eagle Valley Generating Station can adequately manage flow into and out of the ponds during the design storm event, specified by 40 CFR 257.82.

Approach

Determine the storage capacity of each basin. Use HydroCAD to generate the runoff hydrograph, route the hydrograph through the ponds and outlet structures and determine the maximum water elevation and outflow from each pond. HydroCAD uses the TR-20 methodologies to generate the hydrograph. The ponds are shown on Figure 2.

Assumptions

* The Eagle Valley Generating Station has been closed down and is no longer in service. No CCR is sent to the ponds. There is a small amount of rain water that is pumped to Pond A from sumps within the station.

* The berms around the CCR ponds are all above the surrounding topography and there is no run-on into the CCR ponds.

* Pond D is out of service. Runoff from Pond D drains to Pond C, therefore Pond D is included in the hydraulic analysis.

* The elevation of the crest of the berm around each pond is below. The crest elevation is from survey information provided by IP&L.

Pond	Crest Elevation
A	629
B	619
C	619
D	642

* According to IP&L personnel, Ponds A, B, and C are classified as significant hazards. Structures classified as high hazard are required to contain the probable maximum flood (PMP), without overtopping.

* According to NOAA Atlas 14, the 1,000 year storm event for Martinsville, Indiana = 7.35 inches of precipitation for the 6-hr storm.

* According to the General Guidelines for New Dams and Improvements to Existing Dams in Indiana 2001, for a Tc less than 6 hours, a 6-hour storm event is used. All of the CCR ponds have a Tc less than 6 hours.

* Based on information provided by IP&L, storm water runoff from approximately 3-4 acres around the Generating Station is collected and pumped to the CCR ponds. Two pumps, each capable of 500 gpm pump the collected water to Pond A. To model the worst-case condition, this is modeled as a constant inflow of 1,000 gpm (2.2 cfs).

* Pond E is filled with CCR, a soil cover and turf; and is closed.

* Pond D is partially filled with CCR to the elevation of the outlet and drains to the outlet at an approximate 0.5% slope.

* Pond A is partially filled with CCR and drains to the outlet at an approximate 0.5% slope.

SCS ENGINEERS

		Sheet No.	2
		Calc. No.	
		Rev. No.	
Job No. 25216140.00	Job IP&L - Eagle Valley Station	By KRG	Date 9/26/16
Client IP&L	Subject CCR Impoundment Hydraulic Evaluation	Chk'd BP	Date 10/11/16

* **Outlets**

Pond A	2 - 24" CMP at EL = 626.0
Pond B	2 - 24" CMP at EL = 616.0
Pond C	concrete structure with 33" wide opening and stop logs at EL 613.0
Pond D	1 - 30" HDPE pipe at EL 625.0 to the former outlet structure of pond E, then a 24" dia. RCP to Pond C.

The invert of the outlet of Ponds A, B, and C is from a survey performed by IP&L. The invert of Pond D is from the Pond D/E Berm Reconstruction design drawings by BT Squared dated 9/24/09.

* Assume the water level at the start of the storm event is level with the outlet of the pond.

* Storage within each pond was calculated by using AutoCAD to determine the surface area of the top elevation of each pond and interpolating the remaining contour surface area by assuming a 3H:1V interior side slope to the elevation of the outlet structure.

Pond A

Elevation	Area (ac)
629	19.3
628	5.9
627	3.8
626	0.7

Pond B

Elevation	Area (ac)
619	12.5
618	12.3
617	12.0
616	11.8

Pond C

Elevation	Area (ac)
619	6.6
617	6.3
615	6.0
613	5.8

Pond D

Elevation	Area (ac)
642	15.9
640	15.2
635	13.6
630	12.0
625	0.0

To model precipitation falling directly in the ponds, a Tc of 0 was used.

* The General Guidelines call for a Type B storm event.

SCS ENGINEERS

Job No. 25216140.00	Job IP&L - Eagle Valley Station	By KRG	Date 9/26/16
Client IP&L	Subject CCR Impoundment Hydraulic Evaluation	Chk'd BP	Date 10/11/16

Sheet No. 3
Calc. No.
Rev. No.

Results:

For Significant Hazard Ponds (1,000-year Storm)

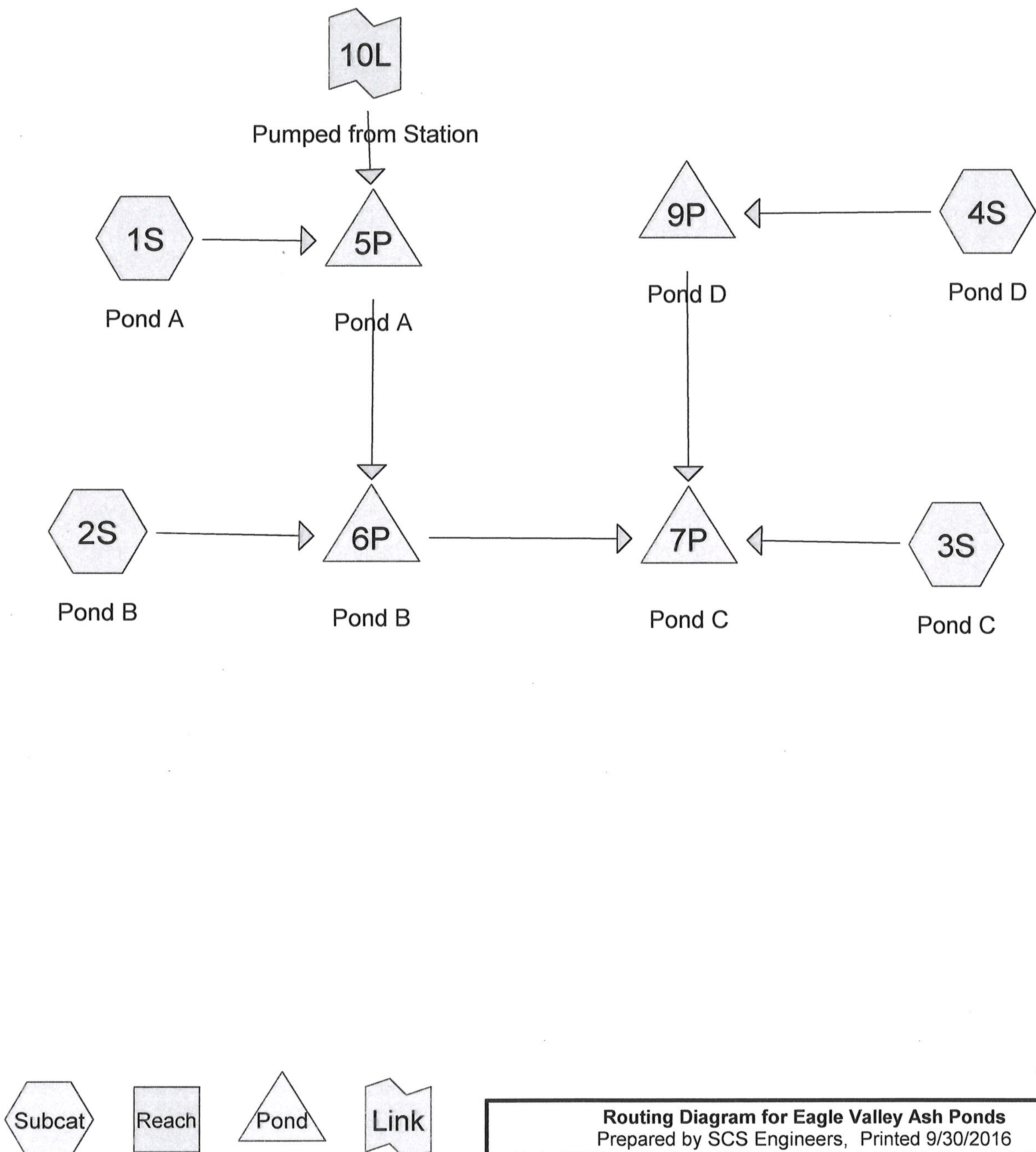
Pond	Water Elevation in Pond	Pond Freeboard (ft)	Pond Discharge Rate (cfs)
A	627.96	1.0	22.6
B	617.19	1.8	10.4
C	614.65	4.4	16.5

A freeboard amount of 1.0 foot or greater is considered adequate to prevent overtopping of the pond.
From Part 650 Engineering Field Handbook by USDA Natural Resources Conservation Service (NRCS),
Chapter 11 - Ponds and Reservoirs.

Therefore, all of the ponds at Eagle Valley Station have adequate freeboard for the design storm event.

Pond A, Pond B, and Pond C Modeling

1,000-year Storm Event for Significant Hazard Rated Structures



Routing Diagram for Eagle Valley Ash Ponds
Prepared by SCS Engineers, Printed 9/30/2016
HydroCAD® 10.00-15 s/n 05804 © 2015 HydroCAD Software Solutions LLC

Summary for Subcatchment 1S: Pond A

[46] Hint: Tc=0 (Instant runoff peak depends on dt)

Runoff = 111.22 cfs @ 2.39 hrs, Volume= 11.821 af, Depth= 7.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-20.00 hrs, dt= 0.01 hrs
Type B 6-hr 1,000-yr Rainfall=7.35"

	Area (ac)	CN	Description
*	19.300	100	Ash
	19.300		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.0					**Direct Entry, Pond A**

Summary for Subcatchment 2S: Pond B

[46] Hint: Tc=0 (Instant runoff peak depends on dt)

Runoff = 72.04 cfs @ 2.39 hrs, Volume= 7.656 af, Depth= 7.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-20.00 hrs, dt= 0.01 hrs
Type B 6-hr 1,000-yr Rainfall=7.35"

	Area (ac)	CN	Description
*	12.500	100	
	12.500		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.0					**Direct Entry, Pond B**

Summary for Subcatchment 3S: Pond C

[46] Hint: Tc=0 (Instant runoff peak depends on dt)

Runoff = 38.03 cfs @ 2.39 hrs, Volume= 4.043 af, Depth= 7.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-20.00 hrs, dt= 0.01 hrs
Type B 6-hr 1,000-yr Rainfall=7.35"

	Area (ac)	CN	Description
*	6.600	100	
	6.600		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.0					**Direct Entry, Pond C**

Summary for Subcatchment 4S: Pond D

[46] Hint: Tc=0 (Instant runoff peak depends on dt)

Runoff = 91.63 cfs @ 2.39 hrs, Volume= 9.739 af, Depth= 7.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-20.00 hrs, dt= 0.01 hrs
Type B 6-hr 1,000-yr Rainfall=7.35"

	Area (ac)	CN	Description
*	15.900	100	
	15.900		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.0					**Direct Entry, Pond D**

Summary for Pond 5P: Pond A

Inflow Area = 19.300 ac,100.00% Impervious, Inflow Depth > 9.61" for 1,000-yr event
Inflow = 113.42 cfs @ 2.39 hrs, Volume= 15.459 af
Outflow = 22.58 cfs @ 3.36 hrs, Volume= 14.603 af, Atten= 80%, Lag= 58.1 min
Primary = 22.58 cfs @ 3.36 hrs, Volume= 14.603 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-20.00 hrs, dt= 0.01 hrs
Peak Elev= 627.96' @ 3.36 hrs Surf.Area= 5.815 ac Storage= 6.862 af

Plug-Flow detention time= 211.4 min calculated for 14.603 af (94% of inflow)
Center-of-Mass det. time= 164.8 min (430.5 - 265.7)

Volume	Invert	Avail.Storage	Storage Description
#1	626.00'	19.700 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
626.00	0.700	0.000	0.000
627.00	3.800	2.250	2.250
628.00	5.900	4.850	7.100
629.00	19.300	12.600	19.700

Device	Routing	Invert	Outlet Devices
#1	Primary	626.00'	**24.0" Round Culvert X 2.00** L= 75.0' Ke= 0.900 Inlet / Outlet Invert= 626.00' / 625.00' S= 0.0133 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 3.14 sf

Primary OutFlow Max=22.58 cfs @ 3.36 hrs HW=627.96' TW=616.69' (Dynamic Tailwater)
└─**1=Culvert** (Barrel Controls 22.58 cfs @ 4.56 fps)

Summary for Pond 6P: Pond B

Inflow Area = 31.800 ac,100.00% Impervious, Inflow Depth > 8.40" for 1,000-yr event
Inflow = 89.94 cfs @ 2.40 hrs, Volume= 22.260 af
Outflow = 10.36 cfs @ 8.61 hrs, Volume= 11.728 af, Atten= 88%, Lag= 373.0 min
Primary = 10.36 cfs @ 8.61 hrs, Volume= 11.728 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-20.00 hrs, dt= 0.01 hrs
Peak Elev= 617.19' @ 8.61 hrs Surf.Area= 12.057 ac Storage= 14.183 af

Plug-Flow detention time= 512.0 min calculated for 11.722 af (53% of inflow)
Center-of-Mass det. time= 337.3 min (675.6 - 338.4)

Volume	Invert	Avail.Storage	Storage Description
#1	616.00'	36.450 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
616.00	11.800	0.000	0.000
617.00	12.000	11.900	11.900
618.00	12.300	12.150	24.050
619.00	12.500	12.400	36.450

Device	Routing	Invert	Outlet Devices
#1	Primary	616.00'	**24.0" Round Culvert X 2.00** L= 75.0' Ke= 0.900 Inlet / Outlet Invert= 616.00' / 615.00' S= 0.0133 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 3.14 sf

Primary OutFlow Max=10.36 cfs @ 8.61 hrs HW=617.19' TW=614.65' (Dynamic Tailwater)
└─**1=Culvert** (Barrel Controls 10.36 cfs @ 3.82 fps)

Summary for Pond 7P: Pond C

Inflow Area = 54.300 ac,100.00% Impervious, Inflow Depth > 5.63" for 1,000-yr event
Inflow = 53.02 cfs @ 2.40 hrs, Volume= 25.479 af
Outflow = 16.47 cfs @ 9.21 hrs, Volume= 18.858 af, Atten= 69%, Lag= 408.9 min
Primary = 16.47 cfs @ 9.21 hrs, Volume= 18.858 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-20.00 hrs, dt= 0.01 hrs
Peak Elev= 614.65' @ 9.21 hrs Surf.Area= 5.965 ac Storage= 9.727 af

Plug-Flow detention time= 351.4 min calculated for 18.848 af (74% of inflow)
Center-of-Mass det. time= 203.0 min (677.6 - 474.6)

Volume	Invert	Avail.Storage	Storage Description
#1	613.00'	37.000 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
613.00	5.800	0.000	0.000
615.00	6.000	11.800	11.800
617.00	6.300	12.300	24.100
619.00	6.600	12.900	37.000

Device	Routing	Invert	Outlet Devices
#1	Device 2	613.00'	**2.7' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#2	Primary	612.00'	**30.0" Round Culvert** L= 100.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 612.00' / 608.00' S= 0.0400 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 4.91 sf

Primary OutFlow Max=16.47 cfs @ 9.21 hrs HW=614.65' (Free Discharge)
↑—**2=Culvert** (Passes 16.47 cfs of 28.00 cfs potential flow)
  ↑—**1=Sharp-Crested Rectangular Weir** (Weir Controls 16.47 cfs @ 4.20 fps)

Summary for Pond 9P: Pond D

Inflow Area = 15.900 ac,100.00% Impervious, Inflow Depth = 7.35" for 1,000-yr event
Inflow = 91.63 cfs @ 2.39 hrs, Volume= 9.739 af
Outflow = 17.05 cfs @ 3.33 hrs, Volume= 9.709 af, Atten= 81%, Lag= 56.2 min
Primary = 17.05 cfs @ 3.33 hrs, Volume= 9.709 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-20.00 hrs, dt= 0.01 hrs
Peak Elev= 627.09' @ 3.33 hrs Surf.Area= 5.019 ac Storage= 5.247 af

Plug-Flow detention time= 199.5 min calculated for 9.709 af (100% of inflow)
Center-of-Mass det. time= 198.9 min (361.6 - 162.8)

Volume	Invert	Avail.Storage	Storage Description
#1	625.00'	197.100 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
625.00	0.000	0.000	0.000
630.00	12.000	30.000	30.000
635.00	13.600	64.000	94.000
640.00	15.200	72.000	166.000
642.00	15.900	31.100	197.100

Device	Routing	Invert	Outlet Devices
#1	Primary	620.00'	**24.0" Round Culvert** L= 700.0' Ke= 0.900 Inlet / Outlet Invert= 620.00' / 617.00' S= 0.0043 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 3.14 sf
#2	Device 1	625.00'	**30.0" Round Culvert** L= 450.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 625.00' / 620.00' S= 0.0111 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 4.91 sf

Primary OutFlow Max=17.05 cfs @ 3.33 hrs HW=627.09' TW=613.83' (Dynamic Tailwater)
↑**1=Culvert** (Passes 17.05 cfs of 22.00 cfs potential flow)
↑**2=Culvert** (Inlet Controls 17.05 cfs @ 3.89 fps)

Summary for Link 10L: Pumped from Station

Inflow	=	2.20 cfs @	0.00 hrs, Volume=	3.638 af
Primary	=	2.20 cfs @	0.00 hrs, Volume=	3.638 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-20.00 hrs, dt= 0.01 hrs

Constant Inflow= 2.20 cfs