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October 11, 2021

Electric Energy, Inc.
2100 Portland Road
Joppa, Illinois 62953

Subject: **USEPA CCR Rule and IEPA Part 845 Rule Applicability Cross-Reference**
2021 USEPA CCR Rule Periodic Certification Report
East Ash Pond, Joppa Power Plant, Joppa, Illinois

At the request of Electric Energy Incorporated (EEI), Geosyntec Consultants (Geosyntec) has prepared this letter to document how the attached 2021 United States Environmental Protection Agency (USEPA) CCR Rule Periodic Certification Report (Report) was prepared in accordance with both the Federal USEPA CCR Rule[1] and the state-specific Illinois Environmental Protection Agency (IEPA) Part 845 Rule[2]. Specific sections of the report and the applicable sections of the USEPA CCR Rule and Illinois Part 845 Rule are cross-referenced in **Table 1**. A certification from a Qualified Professional Engineer for each of the CCR Rule sections listed in **Table 1** is provided in Section 9 of the attached Report. This certification statement is also applicable to each section of the Part 845 Rule listed in **Table 1.**

Table 1 – USEPA CCR Rule and Illinois Part 845 Rule Cross-Reference

Report Section	USEPA CCR Rule		Illinois Part 845 Rule	
3	§257.73 (a)(2)	Hazard Potential Classification	845.440	Hazard Potential Classification Assessment[3]
4	§257.73 (c)(1)	History of Construction	845.220(a)	Design and Construction Plans (Construction History)
5	§257.73 (d)(1)	Structural Stability Assessment	845.450 (a) and (c)	Structural Stability Assessment
6	§257.73 (e)(1)	Safety Factor Assessment	845.460 (a-b)	Safety Factor Assessment
7	§257.82 (a)(1-3)	Adequacy of Inflow Design Control System Plan	845.510(a), (c)(1), (c)(3)	Hydrologic and Hydraulic Capacity Requirements / Inflow Design Flood Control System Plan
	§257.82 (b)	Discharge from CCR Unit	845.510(b)	Discharge from CCR Surface Impoundment

[1] United Stated Environmental Protection Agency, 2015. *40 CFR Parts 257 and 261, Hazardous and Solid Waste Management System, Disposal of Coal Combustion Residuals from Electric Utilities, Final Rule.*
[2] State of Illinois, Joint Committee on Administrative Rule, Administrative Code (2021). *Title 35: Environmental Protection, Subtitle G: Waste Disposal, Chapter I: Pollution Control Board, Subchapter j: Coal Combustion Waste Surface Impoundment, Part 845 Standards for the Disposal of Coal Combustion Residuals in Surface Impoundments.*
[3] "Significant" and "High" hazard, per the CCR Rule[1], are equivalent to Class II and Class I hazard potential, respectively, per Part 845[2].

CLOSING

This letter has been prepared to demonstrate that the content and Qualified Professional Engineer Certification of the 2021 Periodic USEPA CCR Rule Certification Report fulfills the corresponding requirements of Part 845 of Illinois Administrative Code listed in **Table 1**.

Sincerely,

Lucas P. Carr, P.E.
Senior Engineer

John Seymour, P.E.
Senior Principal

2021 USEPA CCR RULE PERIODIC CERTIFICATION REPORT §257.73(a)(2), (c), (d[1]), (e) and §257.82 EAST ASH POND Joppa Power Plant Joppa, Illinois

Submitted to

Electric Energy, Inc.

2100 Portland Road
Joppa, Illinois 62953

Submitted by

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October 11, 2021

[1] Except for §257.73(d)(1)(vi).

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EXECUTIVE SUMMARY

This Periodic United States Environmental Protection Agency (USEPA) Coal Combustion Residuals (CCR) Rule [1] certification report (Periodic Certification Report) for the East Ash Pond (EAP)[2] at the Joppa Power Plant (JPP), also referred to as Joppa Power Station, has been prepared in accordance with Rule 40, Code of Federal Regulations (CFR) §257. herein referred to as the "CCR Rule" [1]. The CCR Rule requires that initial certifications for existing CCR surface impoundment, completed in 2016 and subsequently posted on the Electric Energy, Incorporated (EEI) CCR Website ([2], [3], [4], [5], [6]) be updated on a five-year basis.

The initial certification reports developed in 2016 were independently reviewed by Geosyntec ([2], [3], [4], [5], [6], [7], [8]). Additionally, field observations, interviews with plant staff, and evaluations were performed to compare conditions in 2021 at the EAP relative to the 2016 initial certifications. These tasks determined that updates are not required for the Initial Hazard Potential Classification. However, due to changes at the site and technical review comments, updates were required and were performed for the:

- History of Construction Report,
- Initial Structural Stability Assessment,
- Initial Safety Factor Assessment, and
- Initial Inflow Design Flood Control System Plan.

Geosyntec's evaluations of the initial certification reports and updated analyses identified that the EAP meets all requirements for hazard potential classification, history of construction reporting, structural stability, safety factor assessment, and hydrologic and hydraulic control, with the exception of the structural integrity of hydraulic structures (§257.73(d)(1)(vi)), which was certified by others. **Table 1** provides a summary of the initial 2016 certifications and the 2021 periodic certifications.

[2] The EAP is also referred to as ID Number W1270100004-02, East Ash Pond 2 by the Illinois Environmental Protection Agency (IEPA); CCR unit ID 401 by EEI; and IL50714 within the National Inventory of Dams (NID) maintained by the Illinois Department of Natural Resources (IDNR). Within this document it is referred to as the EAP.

Table 1 – Periodic Certification Summary

Section	CCR Rule Reference	Requirement Summary	2016 Initial Certification		2021 Periodic Certification	
			Requirement Met?	**Comments**	**Requirement Met?**	**Comments**
Hazard Potential Classification						
3	§257.73(a)(2)	Document hazard potential classification	Yes	The East Ash Pond was determined to have a High hazard potential classification [2].	Yes	Updates were not determined to be necessary. Geosyntec recommends retaining the High hazard potential classification.
History of Construction						
4	§257.73(c)(1)	Compile a history of construction	Yes	A history of Construction report was prepared for the EAP [3].	Yes	A letter listing updates to the History of Construction report is provided in **Attachment C**.
Structural Stability Assessment						
5	§257.73(d)(1)(i)	Stable foundations and abutments	Yes	Foundations and abutments were found to be stable [8].	Yes	Foundations and abutments were found to be stable after performing updated slope stability analyses.
	§257.73(d)(1)(ii)	Adequate slope protection	Yes	Slope protection was adequate [8].	Yes	No changes were identified that may affect this requirement.
	§257.73(d)(1)(iii)	Sufficiency of dike compaction	Yes	Dike compaction was sufficient for expected ranges in loading conditions [8].	Yes	Dike compaction was found to be sufficient after performing updated slope stability analyses.
	§257.73(d)(1)(iv)	Presence and condition of slope vegetation	Yes	Vegetation was present on exterior slopes and is maintained. Interior slopes had alternate protection (geomembrane liner) [8].	Yes	No changes were identified that may affect this requirement.
	§257.73(d)(1)(v)(A) and (B)	Adequacy of spillway design and management	Yes	Spillways were adequately designed and constructed and were expected to adequately manage flow during probable maximum flood (PMF) [8].	Yes	Spillways were found to be adequately designed and constructed and are expected to adequately manager flow during the PMF, after performing updated hydrologic and hydraulic analyses.
	§257.73(d)(1)(vi)	Structural integrity of hydraulic structures	No	Requirement could not be certified in 2016 due to inability to complete a CCTV inspection of the 26-inch diameter south outlet pipe due to water-filled pipe portions. AECOM recommended inspecting this pipe as soon as feasible to address the issue [8].	Periodic certification of §257.73(d)(1)(vi) was performed independently Luminant in 2020 [9].	
	§257.73(d)(1)(vii)	Stability of downstream slopes inundated by water body.	Not Applicable	Inundation of exterior slopes was not expected; this requirement was not applicable [8].	Yes	No changes were identified that may affect this requirement.
Safety Factor Assessment						
6	§257.73(e)(1)(i)	Maximum storage pool safety factor must be at least 1.50	Yes	Safety factors were calculated to be 1.59 and higher [8].	Yes	Safety factors from updated slope stability analyses were calculated to be 1.53 and higher.
	§257.73(e)(1)(ii)	Maximum surcharge pool safety factor must be at least 1.40	Yes	Safety factors were calculated to be 1.57 and higher [8].	Yes	No changes were identified that may affect this requirement.
	§257.73(e)(1)(iii)	Seismic safety factor must be at least 1.00	Yes	Safety factors were calculated to be 1.01 and higher [8].	Yes	Safety factors from updated slope stability analyses were calculated to be 1.00 and higher.
	§257.73(e)(1)(iv)	For dike construction of soils that have susceptible to liquefaction, safety factor must be at least 1.20	Not Applicable	Dike soils were not susceptible to liquefaction. This requirement was not applicable [8].	Not Applicable	No changes were identified that may affect this requirement.
Inflow Design Flood Control System Plan						
7	§257.82(a)(1), (2), (3)	Adequacy of inflow design control system plan.	Yes	Flood control system adequately managed inflow and peak discharge during the PMP, 24-hour, Inflow Design Flood [8].	Yes	The flood control system was found to adequately manage inflow and peak discharge during the PMP, 24-hour, Inflow Design Flood, after performing updated hydrologic and hydraulic analyses.
	§257.82(b)	Discharge from CCR Unit	Yes	Discharge from the CCR Unit is routed through a NPDES-permitted outfall during both normal and PMP, 24-hour Inflow Design Flood conditions [8].	Yes	Discharge from the CCR Unit is routed through a NPDES-permitted outfall during both normal and PMP, 24-hour Inflow Design Flood conditions, after performing updated hydrologic and hydraulic analyses.

SECTION 1

INTRODUCTION AND BACKGROUND

This Periodic United States Environmental Protection Agency (USPA) Coal Combustion Residual (CCR) Rule [1] Certification Report was prepared by Geosyntec Consultants (Geosyntec) for Electric Energy Incorporated (EEI) to document the periodic certification of the East Ash Pond (EAP) at the Joppa Power Plant, also known as the Joppa Power Station, (JOP), located at 2100 Portland Road in Joppa, Illinois, 62953. The location of JPP is provided in **Figure 1**, and a site plan showing the location of the EAP is provided in **Figure 2**.

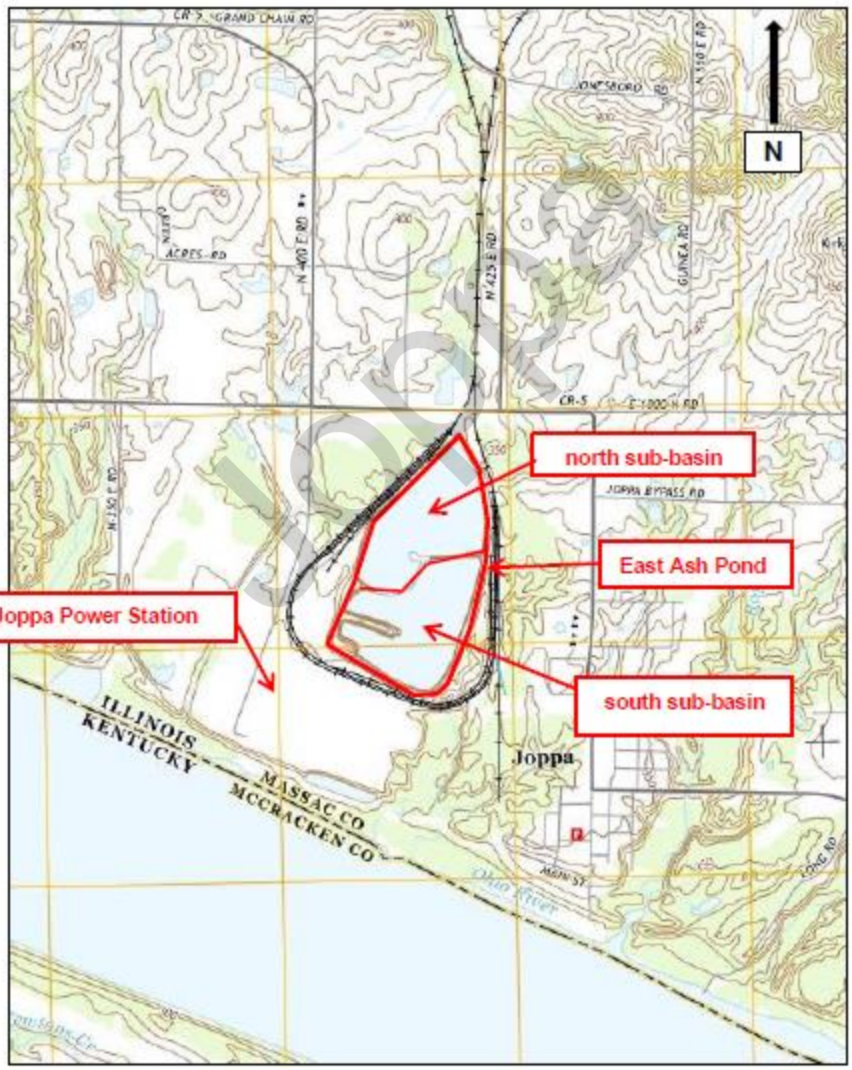

Figure 1 – Joppa Power Plant Location Map (from AECOM, 2016)

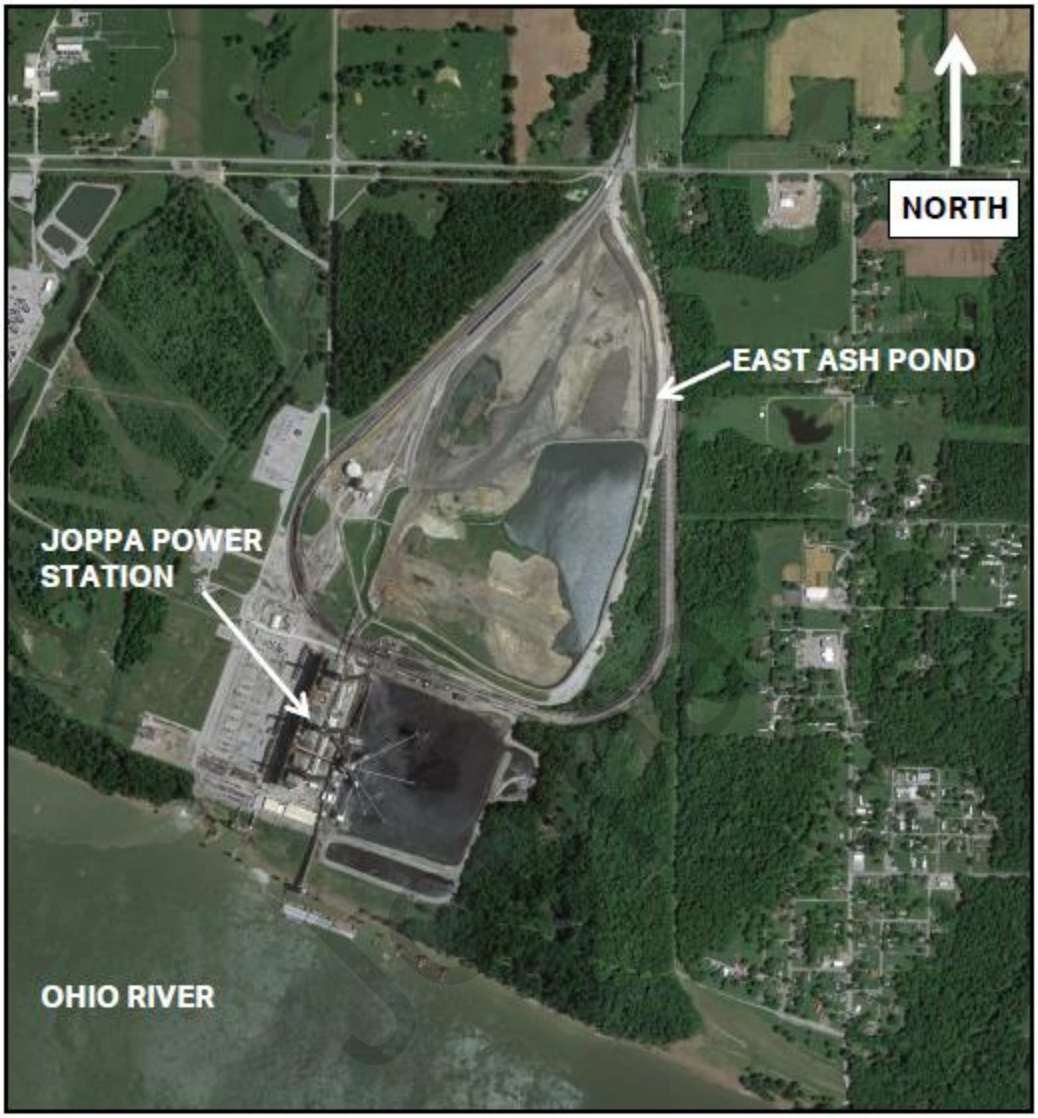

Figure 2 – Joppa Power Plant Site Plan (from AECOM, 2016)

1.1 EAP Description

The East Ash Pond serves as the sole wet ash impoundment basin for the Joppa Power Plant and contains materials such as bottom ash, fly ash and other non-CCR waste streams from the Joppa Power Plant. The East Ash Pond receives sluiced CCRs from the power plant which discharges into the southwest corner of the south sub-basin. A third-party recycling company recovers acceptable fly ash and bottom ash for beneficial reuse, and unacceptable materials are left in the East Ash Pond [8].

Only the south sub-basin includes a free-water pool under normal operating conditions. The north sub-basin is mostly filled with CCR materials and free water is limited to the interior drainage channel that occasionally flows from the south sub-basin through an overflow pipe. Outflow from the north sub-basin of the East Ash Pond is discharged to the effluent control tank, which is a concrete basin used for water quality mixing purposes located at the northern toe of the East Ash Pond dike. Water discharged from the effluent control tank is via a concrete weir is conveyed approximately 650 feet southward to the Ohio River at the site's NPDES-permitted outfall [8].

Outflow from the south sub-basin of the East Ash Pond is discharged directly to the mixing tank through a 24-inch vertical ductile iron tee (invert elevation 372.7 feet[3]) located on the east side of the impoundment. Flow enters the tee from the bottom of the structure, although the tee is also open on the top and includes a corrugated metal skimmer that allows for additional flow to enter the tee during high water conditions. The 24-inch diameter tee is connected to the end of a horizontal 26-inch high-density polyethylene (HDPE) pipe that penetrates the East Ash Pond embankment before dropping in elevation and transporting discharge water approximately 900 feet northward into the 48-inch RCP spillway pipe for the north sub-basin. The south and north sub-basins are connected with a 36-inch corrugated HDPE pipe (invert elevation 373.2 feet) that allows for flow between the two basins during stormwater conditions when the pool level in the south sub-basin exceeds the El. 373.2 ft normal level [8].

In 2016, an approximately 800-foot-long zone of foundation of the East Ash Pond was improved using deep-mixing method (DMM) ground improvement technology and buttressing. This zone, located at the southeast corner of the East Ash Pond dike, was installed to improve the seismic factor of safety within a zone of liquefaction-susceptible sluiced fly ash over which the East Ash Pond dike was originally constructed. The zone was installed at and partially underneath the downstream toe of the East Ash Pond embankment, and consisted of the placement of columns, arranged into transverse shear walls, consisting of native embankment and foundation soil and CCRs mechanically mixed with Portland cement to improve the shear strength within the foundation soils at the East Ash Pond. The zone was designed and constructed to improve seismic and post-earthquake (i.e., "liquefaction" or "post-liquefaction") slope stability to meet the criteria listed in §257.73(e) of the CCR Rule [1]. Sluiced fly ash was not identified within the foundation of the East Ash Pond in any other areas than where the DMM was installed [8].

An engineered liner system is not present beneath the East Ash Pond. The surface area of the impoundment is approximately 111 acres, and the embankment portion of the East Ash Pond has a total length of approximately 8,950 feet and a maximum height above the exterior grade of 43 feet. The embankment was constructed as a homogenous earthen structure with well-compacted clayey fill. The exterior slopes are graded at a slope of approximately 1.5H:1V and predominately covered in crushed stone or vegetation. The interior slopes are graded at a s approximately 1.5H:1V and are covered with either vegetation or mechanically stacked CCRs. Embankment crest width ranges from approximately 15 to 35 feet, and the crest is covered with a gravel access road. As currently operated, the normal pool of the East Ash Pond was El. 373.5 feet in the south sub-basin, as controlled by the 36-inch diameter HDPE pipe connecting the north and south sub-basins, the

[3] All elevations in this report are in the North American Vertical Datum of 1988 (NAVD88), unless otherwise noted.

invert of the 24-inch ductile iron pipe tee spillway structure is El. 372.7, and process flow volumes [10]. The north sub-basin does not have a free water pool during normal conditions and only includes the 36-inch overflow structure and open stormwater collection channel.

Initial certifications for the EAP for Hazard Potential Classification (§257.73(a)(2)), History of Construction (§257.73(c)), Structural Stability Assessment (§257.73(d)), Safety Factor Assessment (§257.73(e)(1)), and Inflow Design Flood Control System Plan (§257.82) were completed by Stantec and AECOM in 2016 and 2017 and subsequently posted to EEI's CCR Website ([2], [3], [4], [5], [6]). Additional documentation for the initial certifications included a detailed operating record reports containing calculations and other information prepared for the hazard potential classification by Stantec [7] and for the structural stability assessment, safety factor assessment, and inflow design flood control system plan by AECOM [8]. These operating record reports were not posted to EEI's CCR Website.

1.2 Report Objectives

These following objectives are associated with this report:

- Compare site conditions from 2015/2016, when the initial certifications were developed, to site conditions in 2020/2021, when data for the periodic certification was obtained, and evaluate if updates are required to the:
  - §257.73(a)(2) Hazard Potential Classification [2];
  - §257.73(c) History of Construction [3];
  - §257.73(d) Structural Stability Assessment [4];
  - §257.73(e) Safety Factor Assessment [5], and/or
  - §257.82 Inflow Design Flood Control System Plan [6].
- Independently review the Hazard Potential Classification ([2], [7]), Structural Stability Assessment ([4], [8]), Safety Factor Assessment ([5], [8]), and Inflow Design Flood Control System Plan ([6], [8]) reports to determine if updates may be required based on technical considerations.
  - The History of Construction report [3] was not independently reviewed for technical considerations, as this report contained historical information primarily developed prior to promulgation of the CCR Rule [1] for the CCR units at JOP, and did not include calculations or other information used to certify performance and/or integrity of the impoundments under §257.73(a)(2), §257.73(c)-(e), or §257.82.

- Confirm that the EAP meets all of the requirements associated with §257.73(a)(2), (c), (d), (e), and §257.82, or, if the EAP does not meet all requirements, provide recommendations for compliance with these sections of the CCR Rule [1].

SECTION 2

COMPARISION OF INITIAL AND PEROIDIC SITE CONDITIONS

2.1 Overview

This section describes the comparison of conditions at the EAP between the start of the initial CCR certification program in 2015 and 2016 (initial conditions) and subsequent collection of periodic certification site data in 2020 and 2021 (periodic conditions).

2.2 Review of Annual Inspection Reports

Annual onsite inspections for the EAP were performed between 2016 and 2020 ([11], [12], [13], [14], [15]) and were certified by a licensed professional engineer in accordance with §257.83(b). Each inspection report stated the following information, relative to the previous inspection:

- A statement that no changes in geometry of the impounding structure were observed since the previous inspection;
- Information on maximum recorded instrumentation readings and water levels;
- Approximate volumes of impounded water and CCR at the time of inspection;
- A statement that no appearances of actual or potential structural weakness or other disruptive conditions were observed; and
- A statement that no other changes which may have affected the stability or operation of the impounding structure were observed.

In summary, the reports did not indicate any significant changes to the EAP between 2015 and 2020. No signs of instability, structural weakness, or changes which may have affected the operation or stability of the EAP were noted in the inspection reports.

2.3 Review of Instrumentation Data

Twenty-three piezometers, JOP-P001 through JOP-P023, are present at the EAP and are monitored monthly by EEI. Data collected between August 6, 2015 and May 6, 2021 were provided to Geosyntec. Geosyntec reviewed the piezometer data to evaluate if significant fluctuations, partially increases in phreatic levels, may have occurred between development of the initial structural stability and factor of safety certifications ([8], [4], [5]) and May 6, 2021. Available piezometer readings are plotted in **Attachment A**.

In summary, only minor changes in phreatic conditions were observed in the available piezometric data. Phreatic levels typically varied by 2 to 5 ft, although levels for JOP-P007, JOP-P014, and

JOP-P020 exhibited consistent seasonal variations of approximately 10 to 20 ft. These changes do not indicate significantly different phreatic levels than those utilized for the initial structural stability and factor of safety certifications ([8], [4], [5]).

2.4 Comparison of Initial to Periodic Surveys

The initial survey of the EAP, conducted by Weaver Consultants (Weaver) in 2015 [16], was compared to the periodic survey of the EAP, conducted by IngenAE, LLC (IngenAE) in 2020 [10], using AutoCAD Civil3D 2021 software. This comparison quantified changes in the volume of CCR placed within the EAP and considered volumetric changes above and below the starting water surface elevation (SWSE) used for the 2016 §257.82 inflow design flood control plan hydraulic analysis ([6], [8]). Potential changes to embankment geometry were also evaluated. This comparison is presented in a plan view in **Drawing 1** and in an isopach map denoting changes in ground surface elevation in **Drawing 2**. A summary of the water elevations and changes in CCR volumes is provided in **Table 2**.

Table 2 – Initial to Periodic Survey Comparison

Initial Surveyed Pool Elevation (ft)	372.7
Periodic Surveyed Pool Elevation (ft)	373.5
Initial §257.82 Starting Water Surface Elevation (SWSE) (ft)	373.2
Total Change in CCR Volume, North and South Sub-Basins (CY)	+38,674 (fill)
Change in CCR Volume Above SWSE, North Sub-Basin (CY)	+77,554 (fill)
Change in CCR Volume Above SWSE, South Sub-Basin (CY)	+18,182 (fill)
Change in Volume Below SWSE, North Sub-Basin (CY)	+1,661 (fill)
Change in Volume Below SWSE, South Sub-Basin (CY)	-58,677 (cut)

The comparison indicated that approximately 39,000 CY (net cut and fill) of CCR was placed in the EAP between the initial and periodic surveys. However, this comparison also indicated approximately 59,000 CY of cut below the SWSE in the south sub-basin. As CCR was unlikely to have been removed below the SWSE, this apparent cut may be due to differences in bathymetric survey equipment and/or survey data processing between bathymetry measured by the initial and periodic surveys, rather than an actual change in volume.

The comparison also indicated a total placement of CCR above the SWSE of approximately 78,000 CY in the north sub-basin and 18,000 CY in the south sub-basin. thereby leading to a potential for the peak water surface elevation (PWSE) to increase during the inflow design PMP flood event. Furthermore, the comparison indicated that the water surface elevation (WSE) in the south-sub basin was approximately 0.3 ft higher than the SWSE from the 2016 IDF ([6], [8]), thereby also leading to a potential for the PWSE to increase during the inflow design PMP flood event.

No significant changes to embankment geometry appeared to have occurred between the initial and periodic surveys, outside of embankment buttressing and armoring associated with construction of the DMM zone in 2016 [8].

2.5 Comparison of Initial to Periodic Aerial Photography

Initial aerial photographs of the EAP collected by Weaver in 2015 [16] were compared to periodic aerial photographs collected by IngenAE in 2020 [10] to visually evaluate if potential site changes (i.e., changes to the embankment, outlet structures, limits of CCR, other appurtenances) may have occurred. A comparison of these aerial photographs is provided in **Drawing 3**. The following changes were noted in the comparison:

- Standing water was no longer present in the north sub-basin, and
- Embankment buttressing and armoring associated with the construction of the DMM zone in 2016 [8] were also apparent.

2.6 Comparison of Initial to Periodic Site Visits

An initial site visit to the EAP was conducted by AECOM in 2015 and documented with a Site Visit Summary and corresponding photographs [17]. A periodic site visit was conducted by Geosyntec on May 26, 2021, with Mr. Lucas P. Carr, P.E. and Mr. Pourya Kargar conducting the site visit. The site visit was intended to evaluate potential changes at the site since the initial certifications were prepared (i.e., modification to the embankment, outlet structures or other appurtenances, limits of CCR, maintenance programs, repairs), in addition to performing visual observations of the EAP to evaluate if the structural stability requirements (§257.73(d)) were still met. The stie visit included walking the perimeter of the EAP, visually observing conditions, recording filed notes, and collecting photographs. The site visit is documented in a photographic log provided in **Attachment B**. A summary of significant findings from the periodic site visit is provided below:

- No new development was observed in the vicinity of the EAP, although the observation was limited to the portions of the vicinity visible on foot from the crest of the EAP dikes.
- No signs of structural instability or erosion were observed during the site visit.
- Embankment buttressing and armoring associated with the construction of the DMM zone in 2016 [8] were observed.

2.7 Interview with Power Plant Staff

An interview with Mr. Bruce Parker and Mr. Roger Faughn of JPP was conducted by Mr. Lucas P. Carr of Geosyntec on May 26, 2021. Mr. Parker had been employed at JPP for 32 years as the manager of environmental and chemistry, with the responsibility of managing the EAP from an environmental standpoint. Mr. Faughn had been employed by JPP for one year and is part of the JPP environmental group, with the responsibility of supporting EAP environmental compliance. The interview included a discussion of potential changes that may have occurred at the EAP since development of the initial certifications ([2], [3], [4], [5], [6]). A summary of the interview is provided below.

- Were any construction projects completed for the EAP since 2015, and, if so, can you please describe the work, reason for the work, and provide any design drawings and/or details available?
    - The DMM zone was installed in 2016.
    - Wet spots were noted on the road at the east side of the embankment in 2020 and were evaluated by both EEI and Hanson Professional Services (Hanson). The wetness was addressed by over-excavating an approximately 100-ft long area, putting down (from bottom to top) filter fabric, sand, filter fabric, and then gravel, based on a repair plan developed by Hanson ([18], [19]). The area has since been dry.
- Were there any changes to the purpose or operation of the EAP since 2015?
    - No changes have occurred.
- Were there any changes to the to the instrumentation program and/or physical instruments for the EAP between 2015 and 2021, and, if so, are records available?
    - Several piezometers have been abandoned since 2015 due to access difficulties or problems with the instrument no longer functioning. These piezometers are marked as abandoned in the monthly piezometer reading spreadsheet maintained by EEI.
- Have area-capacity curves for the EAP been prepared since 2015?
    - No known curves have been prepared.
- Were there any changes to spillways and/or diversion features for the EAP completed since 2015, and, if so, are records available?
    - No known changes have occurred.
- Were there any changes to construction specifications, surveillance, maintenance, and repair procedures for the EAP since 2015, and, if so, are records available?
    - No changes have occurred.
- Were there any instances of dike and/or structural instability for the EAP since 2015, and, if so, are records available?

- No known instances of dike and/or structural instability have occurred.

SECTION 3

HAZARD POTENTIAL CLASSIFICATION - §257.73(a)(2)

3.1 Overview of Initial HPC

The Initial Hazard Potential Classification (Initial HPC) was prepared by Stantec Consulting Services, Inc. (Stantec) in 2016 ([2], [7]), following the requirements of §257.73(a)(2). The Initial HPC included the following information:

- Performing six breach analyses using HEC-RAS Version 5.0.1 software [20], using pool levels estimated within the EAP during the probable Maximum Precipitation (PMP) rainfall event, for multiple locations around the east, south, and west embankments of the EAP.

- Evaluating potential effects of flooding in multiple areas, including breach flood wave velocities and/or flood depths, for areas north, east, west, and south of the EAP.

- While a breach map is not included in the Initial HPC, it is included within the §257.73(a)(3) Initial Emergency Action Plan prepared by Stantec [21].

The breach analysis concluded that a breach of the EAP could impact multiple occupied structures on the north, east, west, and south of the EAP, with maximum flood depths of greater than 2 ft and velocities of greater than 5 ft/sec. Based on the finding of impacts to occupied structures, a breach of the EAP represented a probable threat to human life. The Initial HPC therefore recommended a "High" hazard potential classification for the EAP [2].

3.2 Review of Initial HPC

Geosyntec performed a review of the Initial HPC ([2], [7]), in terms of technical approach, input parameters, and assessment of the results. The review included the following tasks:

- Reviewing the rainfall depths utilized in the breach analysis for appropriateness,

- Reviewing breach assessment inputs for appropriateness,

- Reviewing the selected HPC for appropriateness based on the results of the breach analysis, including flow velocities and depths, and

- Reviewing the HPC vs. applicable requirements of the CCR Rule.

No significant technical issues were noted within the technical review, although a detailed review (e.g., check) of the calculations was not performed.

3.3 Summary of Site Changes Affecting the Initial HPC

Geosyntec did not identify any changes at the site that may affect the HPC. No new structures, infrastructure, frequently occupied facilities/areas, or waterways were present in the probable breach area indicated in the Initial EmAP [21], although Geosyntec's evaluation of new structures was limited to visual observations completed from the dike crest during the site visit and a review of available aerial imagery provided by EEI ([16], [10]). Additionally, no significant changes to the topography within the EAP nor in the probable breach area were identified.

3.4 Periodic HPC

Geosyntec recommends retaining the "High" hazard potential classification for the EAP, per §257.73(a)(2), based on a the lack of site changes potentially affecting the Initial HPC occurring since the Initial HPC was developed, as described in **Section 3.3**, and the lack of significant review comments, as described in **Section 3.2**. Updates to the Initial HPC reports ([2], [7]) are not recommended at this time.

SECTION 4

HISTORY OF CONSTRUCTION REPORT - §257.73(c)

4.1 Overview of Initial HoC

The Initial History of Construction report (Initial HoC) was prepared by AECOM in 2016 [3], following the requirements of §257.73(c), and included information on the EAP at JOP. The Initial HoC included the following information for the CCR surface impoundment:

- The name and address of the owner/operator,
- Location maps,
- A statement of purpose,
- The names and size of the surrounding watershed,
- A description of the foundation and abutment materials,
- Available design and engineering drawings,
- A summary of instrumentation,
- Area capacity curves for the north and south sub-basins,
- Information on spillway structures,
- A statement that construction specifications are not reasonably and readily available,
- A statement that an operations and maintenance plan is currently being prepared; and
- A summary of eight separate surficial movements that occurred along the downstream slope of the perimeter embankment, followed by a statement that other historical structural instability had not occurred at the CCR surface impoundment.

4.2 Summary of Site Changes Affecting the Initial HoC

Several significant changes were identified at the site that occurred after development of the initial HoC report [4] and are described below:

- A state identification number (ID) of W1270100004-02 was assigned to the EAP by the Illinois Environmental Protection Agency (IEPA).

- A wet area was observed at the eastern toe of the perimeter dike and was repaired by excavating the area and backfill it with geotextile, sand, and crushed stone in 2020, in accordance with a memo and design prepared by Hanson ([18], [19]).

- Several piezometers were abandoned or have become inaccessible between 2015 and 2020. These piezometers are no longer being monitored.

- Revised area-capacity curves and spillway design calculations for the EAP were prepared as part of the periodic Inflow Design Flood Control System Plan, as described in **Section 6.3**.

A letter documenting changes to the HoC report is provided in **Attachment C**.

SECTION 5

STRUCTURAL STABILITY ASSESSMENT - §257.73(d)

5.1 Overview of Initial SSA

The Initial Structural Stability Assessment (Initial SSA) was prepared by AECOM in 2016 ([4], [8]), following the requirements of §257.73(d)(1), and included the following evaluations:

- Stability of dike foundations, dike abutments, slope protection, dike compaction, and slope vegetation,
- Spillway stability including capacity, structural stability and integrity; and
- Downstream slope stability under sudden drawdown conditions for an adjacent, downstream water body.

The Initial SSA concluded that all EAP met all structural stability requirements for §257.73(d)(1)(i)-(v) and (vii), but recommended inspection of the 26-inch diameter HDPE spillway pipe to verify that the EAP meets the structural stability and structural integrity criteria for hydraulic outfall structures, per §257.73(d)(1)(vi). A complete inspection of the pipe was not performed in 2015 or 2016 due to the pipe being full of water as necessary for plant operations.

The Initial SSA referenced the results of the Initial Structural Factor Assessment (Initial SFA), to demonstrate stability of the stability of foundations and abutments (§257.73(d)(1)(i)) sufficiency of dike compaction (§257.73(d)(1)(iii)) portions of the SSA criteria. This included stating that slope stability analyses for slip surfaces passing through the foundation met or exceeded the criteria listed in §257.73(e)(1), for the stability of foundations and abutments. For the sufficiency of dike compaction, this included stating that slope stability analyses for slip surfaces passing through the dike also met or exceeded the §257.73(e)(1) criteria.

A periodic certification of the structural stability and structural integrity for hydraulic outfall structures (§257.73(d)(1)(vi)) was performed by Luminant in 2020 [9]. This certification independently determined that the criteria was met due to the condition of the spillway pipes and the soil types within the embankment. Therefore, the review and certification of §257.73(d)(1)(vi) is not included within the scope of this report.

5.2 Review of Initial SSA

Geosyntec performed a review of the Initial SSA ([4], [8]) in terms of technical approach, calculation input parameters and methodology, recommendations, and completeness. The review included the following tasks:

- Reviewing photographs collected in 2015 and used to demonstrate compliance with §257.73(d)(1)(i)-(vii).

- Reviewing geotechnical calculations used to demonstrate the stability of foundations, per §257.73(d)(1)(i) and sufficiency of dike compaction, per §257.73(d)(1)(iii), in terms of supporting geotechnical investigation and testing data, input parameters, analysis methodology, selection of critical cross-sections, and loading conditions.

- Review of the methodology used to demonstrate that a downstream water body that could induce a sudden drawdown condition, per §257.73(d)(1)(vii), is not present.

- Reviewing the contents vs. the applicable CCR Rule requirements [1].

No significant technical issues were noted within the technical review of the Initial SSA. A detailed review (e.g., check) of the calculations was not performed.

5.3 Summary of Site Changes Affecting Initial SSA

Several changes at the site that occurred after development of the Initial SSA were identified. These changes required updates to the Initial SSA and are described below:

- The Initial SSA utilized the results of the Initial Inflow Design Flood Control System Plan (IDF) to demonstrate compliance with the adequacy of spillway design and management (§257.73(d)(1)(v)(A)-(B)). The Initial IDF was subsequently updated to develop a Periodic IDF, based on site changes, as discussed in **Section 7**.

- The Initial SFA utilized the results of the Initial Safety Factor Assessment (SFA), in addition to separate slope stability analyses to evaluate the effects of foundation liquefaction and cyclic softening, to demonstrate compliance with the stability of foundations and abutments (§257.73(d)(1)(i)) and sufficiency of dike compaction (§257.73(d)(1)(iii)). The Initial SFA was subsequently updated to develop a Periodic SFA, based on site changes, as discussed in **Section 6**.

5.4 Periodic SSA

The Periodic SFA (**Section 6**) indicates that foundations and abutments are stable and dike compaction is sufficient for expected ranges in loading conditions, as slope stability factors of safety were found to meet or exceed the requirements of §257.73(e)(1), including for static maximums storage pool conditions and post-earthquake loading conditions assessing the consequences of liquefaction and cyclic softening in the foundation soils. Therefore, the requirements of §257.73(d)(1)(i) and §257.73(d)(1)(iii) are met for the Periodic SSA.

The Periodic IDF (**Section 7**) indicates that spillways are adequately designed and constructed to adequately manage flow during the PMF flood, as the spillways can adequately manage flow during peak discharge from the PMP storm event without overtopping of the embankments. Therefore, the requirements of §257.73(d)(1)(v)(A)-(B) are met for the Periodic SSA.

Certification of §257.73(d)(1)(vi) was performed independently by Luminant [9].

SECTION 6

SAFETY FACTOR ASSESSMENT - §257.73(e)(1)

6.1 Overview of Initial SFA

The Initial Safety Factor Assessment (Initial SFA) was prepared by AECOM in 2016 ([5], [8]), following the requirements of §257.73(e)(1). The Initial SFA included the following information:

- A geotechnical investigation program with in-situ and laboratory testing;
- An assessment of the potential for liquefaction in the dike and foundations soils;
- The development of six slope stability cross-sections for limit equilibrium stability analysis using GeoStudio SLOPE/W software;
- The analysis of each cross-section for maximums storage pool, maximum surcharge pool, seismic, and post-earthquake (i.e., liquefaction) location conditions;
- Calculations used to design the DMM zone installed in 2016; and
- Simplified seismic deformation analyses to estimate seismically-induced deformations occurring after an earthquake event.

The Initial SFA concluded that the EAP met all safety factor requirements, per §257.73(e), as all calculated safety factors were equal to or higher than the minimum required values.

6.2 Review of Initial SFA

Geosyntec performed a review of the Initial SFA ([5], [8]) in terms of technical approach, calculation input parameters and methodology, recommendations, and completeness. The review included the following tasks:

- Reviewing geotechnical calculations used to demonstrate the acceptable safety factors, per §257.73(e)(1), in terms of:
    - Completeness and adequacy of supporting geotechnical investigation and testing data;
    - Completeness and approach of liquefaction triggering assessments; and
    - Input parameters, analysis methodology, selection of critical cross-sections, and loading conditions utilized for slope stability analyses.

- Phreatic conditions based on piezometric data collected between August 6, 2015 and May 6, 2021, as discussed in **Section 2.3**.

No significant technical issues were noted within the technical review. A detailed review (e.g., check) of the calculations was not performed.

6.3 Summary of Site Changes Affecting the Initial SFA

Several changes at the site that occurred after the development of the Initial SFA ([5], [8]) were identified. These changes required updates to the Initial SFA and are described below:

- The normal pool elevation within the south sub-basin of the EAP increased from 373.2 ft to 373.5 ft, resulting in a 0.3 ft of additional water loading on the embankment dikes for the maximum storage pool and seismic loading conditions (§257.73(e)(1)(i) and (iii), relative the Initial SFA.

6.4 Periodic SFA

Geosyntec revised existing slope stability analyses associated with the Initial SFA ([5], [8]) for cross-sections adjacent to the south sub-basin of the EAP to account for the increase in normal pool loading, as described in **Section 6.3**. The following approach and input data were used to revise the analyses:

- Analyses were updated for cross-sections B-B and K-K, as they are directly adjacent to the south sub-basin and subjected to increased pool loading.
  - Water levels in the EAP for the maximum storage pool, seismic, and liquefaction slope stability analysis loading conditions were increased to El. 373.5 ft.
  - Section H-H is also near the south sub-basin, but not adjacent to the free water pool, as CCR is located directly behind the dike. The phreatic water level assumed in the slope stability analyses for the initial SFA was above El. 373.5 ft. Therefore, slope stability analyses for Section H-H were not updated.
  - The seismic deformation analysis performed in the Initial SFA for Section K-K utilized the Bray and Travasarou (2007) methodology [22], including a spreadsheet that was, at the time of the Initial SFA, posted on a website hosted by Prof. Bray [23]. This spreadsheet has since been updated following Bray and Macedo (2019) methodology [24], and the spreadsheet utilized for the initial IDF is no longer available on Prof. Bray's website. Therefore, the seismic deformation analyses were updated to use the currently available Bray and Macedo (2019) method and spreadsheet.

- All other analysis input data and settings form the Initial SFA ([5], [8]) were utilized, including, but not limited to, subsurface stratigraphy and soil strengths, phreatic conditions, ground surface geometry, software package and version, slip surface search routines and methods, and input data for the seismic analyses (i.e., acceleration, magnitudes, probability of exceedances, maximum tolerable deformation).

Factors of safety from the Periodic SFA (cross-sections B-B and K-K) and the Initial SFA (A-A, C-C, G-G, and H-H) are summarized in **Table 3** and confirm that the EAP meets the requirements of §257.73(e)(1). Slope stability analysis output associated with the Initial SFA is provided in **Attachment D**.

Table 3 – Factors of Safety from Periodic SFA

	Structural Stability Assessment (§257.73(d)) and Safety Factor Assessment (§257.73(e))				**Structural Stability Assessment (§257.73(d))**
Cross-Section	**Maximum Storage Pool §257.73(e)(1)(i) Minimum Required = 1.50**	**Maximum Surcharge Pool[1] §257.73(e)(1)(ii) Minimum Required = 1.40**	**Seismic §257.73(e)(1)(iii) Minimum Required = 1.00**	**Dike Liquefaction §257.73(e)(1)(iv) Minimum Required = 1.20**	**Foundation Liquefaction §257.73(d)(1)(i) Minimum Required = 1.20**
A-A[2]	1.83	1.83	1.05	N/A	1.63
B-B[3]	1.77	1.78	1.13	N/A	2.12
C-C[2]	1.77	1.71	1.26	N/A	N/A
G-G[2]	1.68	1.68	1.16	N/A	N/A
H-H[2]	1.72	1.70	1.04	N/A	1.39
K-K[3]	1.53*	1.57*	1.00*	N/A	1.22*

Notes:
[1]Maximum surcharge pool analyses were not updated as the Periodic IDF water levels did not increase above the Initial IDF water levels and water levels used within the Initial SFA analyses.
[2]Denotes cross-section where results from the Initial SFA are presented due to no observed changes relative to the Initial IDF.
[3]Denotes cross-section where changes are occurred, and results are presented from the Periodic SFA.
*Indicates critical cross-section (i.e., lowest calculated factor of safety out of the two cross-sections analyzed)
N/A – Loading condition is not applicable.

SECTION 7

INFLOW DESIGN FLOOD CONTROL SYSTEM PLAN - §257.82

7.1 Overview of Initial IDF

The Initial Inflow Design Flood Control System Plan (Initial IDF) was prepared by AECOM in 2016 ([6], [8]), following the requirements of §257.82. The Initial IDF included the following information:

- A hydraulic and hydrologic analysis, performed for the probable maximum flood event because of the hazard potential classification of “high”, which corresponded to 36 inches of rainfall over a 24-hour period.
- The Initial IDF utilized a HydroCAD Version 10.0 model to evaluate spillway flows and pool level increases during the design flood, with a SWSE of 370 ft in the North Sub-Basin and 373.2 ft in the South Sub-Basin of the EAP.

The Initial IDF concluded that the EAP met the requirements of §257.82, as the peak water surface estimated by the HydroCAD model was El. 376.2 ft in the North Sub-Basin and El. 377.6 ft in the South Sub-Basin, relative to a minimum EAP dike crest elevation of 378.0 ft in both subbasins. Therefore, overtopping was not expected. The Initial IDF also evaluated the potential for discharge from the CCR unit and determined that discharge in violation of the existing NDPES for the EAP was not expected, as all discharge from the EAP during both normal and inflow design flood conditions was expected to be routed through the existing spillway and NDPES-permitted outfall.

7.2 Review of Initial IDF

Geosyntec performed a review of the Initial IDF ([6], [8]) in terms of technical approach, calculation input parameters and methodology, recommendations, and completeness. The review included the following tasks:

- Reviewing the return interval used vs. the hazard potential classification.
- Reviewing the rainfall depth and distribution for appropriateness.
- Performing a high-level review of the inputs to the hydrological modeling.
- Reviewing the hydrologic model parameters for spillway parameters, starting pool elevation, and storage vs. the reference data.
- Reviewing the overall Initial IDF vs. the applicable requirements of the CCR Rule [1].

Several review comments were identified during review of the Initial IDF. The comments are described below:

- The Initial IDF utilized the National Resource Conservation Service (NRCS) Type II rainfall distribution type [25]. Geosyntec recommend utilizing the NRCS 24-hour Emergency Spillway and Freeboard (ESFB) distribution [26] which is a distribution that NRCS utilizes in making determination and analysis of auxiliary spillway flow depth and duration, for the reasons listed below.
    - The ESFB rainfall distribution was determined by NRCS to be a more accurate representation of a 24-hour Probable Maximum Precipitation (PMP) event per a study applying different rainfall distributions to 24-hour PMP storm events for purposes of evaluating existing high-hazard dams east of the 105th meridian [26]:
        - *For the area east of the 105th meridian, the Type II and Type III patterns used with 24-hour PMP values consistently produces one-hour and two-hour intensities that far exceeded any known or documented rates…Because the Type II and Type III distributions over-predicted the maximum one-hour intensity for PMP events, they were excluded from further study.*
        - *The dimensionless conversion of the ESFB distribution from a 6-hour to a 24-hour pattern has been used with PMP events in a number of states where 24-hour storms are required as a part of the State's dam safety criteria and approval process……Although the ESFB Distribution and the World Curve distribution were developed from entirely independent data sources, the distributions are similar when compared on a volume-duration basis. The world curve supports the ESFB.*
        - *The World Curve Distribution is a valid basis for design of high hazard structures…It would seem logical to use the World Curve distribution for PMP size event.*
    - The NRCS study [26] determined that the NRCS ESFB is comparable to the World Curve. The World Curve is developed from worldwide maximum rainfall records and deemed by NRCS to be logical to use for a PMP size event and valid for design of high hazard structures.
    - The NRCS study [26] deemed the NRCS Type II (and III) distributions to overpredict PMP maximum 1-hr intensities, which typically control dam capacity design, and therefore were not considered further as a basis for rainfall distributions of PMP size events.

7.3 Summary of Site Changes Affecting the Initial IDF

Two changes at the site that occurred after development of the Initial IDF were identified. These changes required updates to the Initial IDF and are described below:

- Approximately 18,000 CY and 78,000 CY of CCR were placed above the SWSE utilized for the Initial IDF certification in the south and north sub-basins of the EAP, respectively, thereby altering the stage-storage curve for both sub-basins, relative to the Initial IDF.

- The surveyed water surface elevation (WSE) within the south sub-basin of the EAP was 373.5 ft in 2020 [10]; this is 0.3 ft higher than the SWSE used in the Initial IDF and 0.5 ft above the WSE surveyed in 2016 [16], thereby the SWSE utilized in the Initial IDF was no longer consistent with conditions observed in 2020.

7.4 Periodic IDF

Geosyntec revised the HydroCAD model associated with the Initial IDF to account for the revised rainfall distribution type, increase in SWSE, and additional CCR placement, as described in **Sections 7.2** and **7.3**. The following approach and input data were used for the revised analyses:

- Stage-storage (i.e., area-capacity) curves for both the north and south sub-basins of the EAP were updated based on the 2020 site survey [10].
    - A revised stage-volume curve for the EAP was prepared based on measuring the area of both north and south subbasins within the EAP at every one-foot increment of depth from an elevation just beneath the normal pool elevation (369.0 ft) to the perimeter dike embankment crest elevation (378.0 ft). This elevation-surface area curve was input to HydroCAD, which computed a stage-volume curve for the subbasins using the conic volume method. The survey showed a total overall loss of 78 ac-ft of storage volume from the EAP from 2016 to 2020.

- The SWSE within the south sub-basin of the EAP was updated from 373.2 ft to 373.5 ft to reflect the 2020 site survey [10].

- The rainfall distribution type was updated to the "Spillway Emergency" storm type provided by HydroCAD [23], which replicates the NRCS 24-hour ESFB distribution.

- All other input data and settings from the Initial IDF HydroCAD model were utilized, including, but not limited to software package and version, runoff method, analysis time span and analysis time step.

The results of the Updated IDF are summarized in **Table 4** and confirm that the EAP sill meets the requirements of §257.82(a)-(b), as the peak water surface elevation does not exceed the minimum perimeter dike crest elevations. Additionally, all discharge from the EAP is routed through the existing spillway system to the NPDES-permitted outfall, during both normal and IDF conditions. Updated area-capacity curves and HydroCAD model output is provided in **Attachment E**.

Table 4 – Water Levels from Periodic IDF

	North Sub-Basin		South Sub-Basin		
Analysis	**Starting Water Surface Elevation (ft)**	**Peak Water Surface Elevation (ft)**	**Starting Water Surface Elevation (ft)**	**Peak Water Surface Elevation (ft)**	**Minimum Dike Crest Elevation (ft)**
Initial IDF	370.0	376.2	373.2	377.6	378.0
Periodic IDF	370.0	376.0	373.5	377.3	378.0
Initial to Periodic Change[1]	0.0	-0.2	+0.3	-0.3	

Notes:
[1]Postive change indicates increase in the WSE relative to the Initial IDF, negative change indicates decrease in the WSE, relative to the Initial IDF.

SECTION 8

CONCLUSIONS

The EAP at JPP was evaluated relative to the USEPA CCR Rule periodic assessment requirements for:

- Hazard potential classification (§257.73(a)(2)),
- History of Construction reporting (§257.73(d)),
- Structural stability assessment (§257.73(d)), with the exception of §257.73(d)(1)(vi) that was independently certified by Luminant [9],
- Safety factor assessment (§257.73(e)), and
- Inflow design flood control system planning (§257.82).

Based on the evaluations presented herein, the referenced requirements are satisfied.

SECTION 9

CERTIFICATION STATEMENT

CCR Unit: Electric Energy Incorporated, Joppa Power Plant, East Ash Pond

I, Lucas P. Carr, being a Registered Professional Engineer in good standing in the State of Illinois, do hereby certify, to the best of my knowledge, information, and belief that the information contained in this 2021 USEPA CCR Rule Periodic Certification Report, has been prepared in accordance with the accepted practice of engineering. I certify, for the above-referenced CCR Unit, that the periodic assessment of the hazard potential classification, history of construction report, structural stability, safety factors, and inflow design flood control system planning, dated October 2021, were conducted in accordance with the requirements of 40 CFR §257.73(a)(2), (c), (d), (e), and §257.82, with the exception of §257.73(d)(1)(vi)) that was independently certified by others.

Lucas P. Carr

10/11/2021

Date

LICENSED PROFESSIONAL ENGINEER
LUCAS PHILIP
CARR
062066694
STATE OF ILLINOIS
Exp. 11/30/2021

SECTION 10

REFERENCES

[1] United States Environmental Protection Agency, 40 CFR Parts 257 and 261; Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities; Final Rule, 2015.

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[4] AECOM, "CCR Rule Report: Initial Structural Stability Assessment For East Ash Pond At Joppa Power Station," St. Louis, MO, October 2016.

[5] AECOM, "CCR Rule Report: Initial Safety Factor Assessment For East Ash Pond At Joppa Power Station," St. Louis, MO, October 2016.

[6] AECOM, "CCR Rule Report: Initial Inflow Design Flood Control System Plan For East Ash Pond At Joppa Power Station," St. Louis, MO, October 2016.

[7] Stantec Consulting Services, Inc., "Documentation of Initial Hazard Potential Classification Assessment, East Ash Pond, Joppa Power Station, Massac County, Illinois," October 12, 2016.

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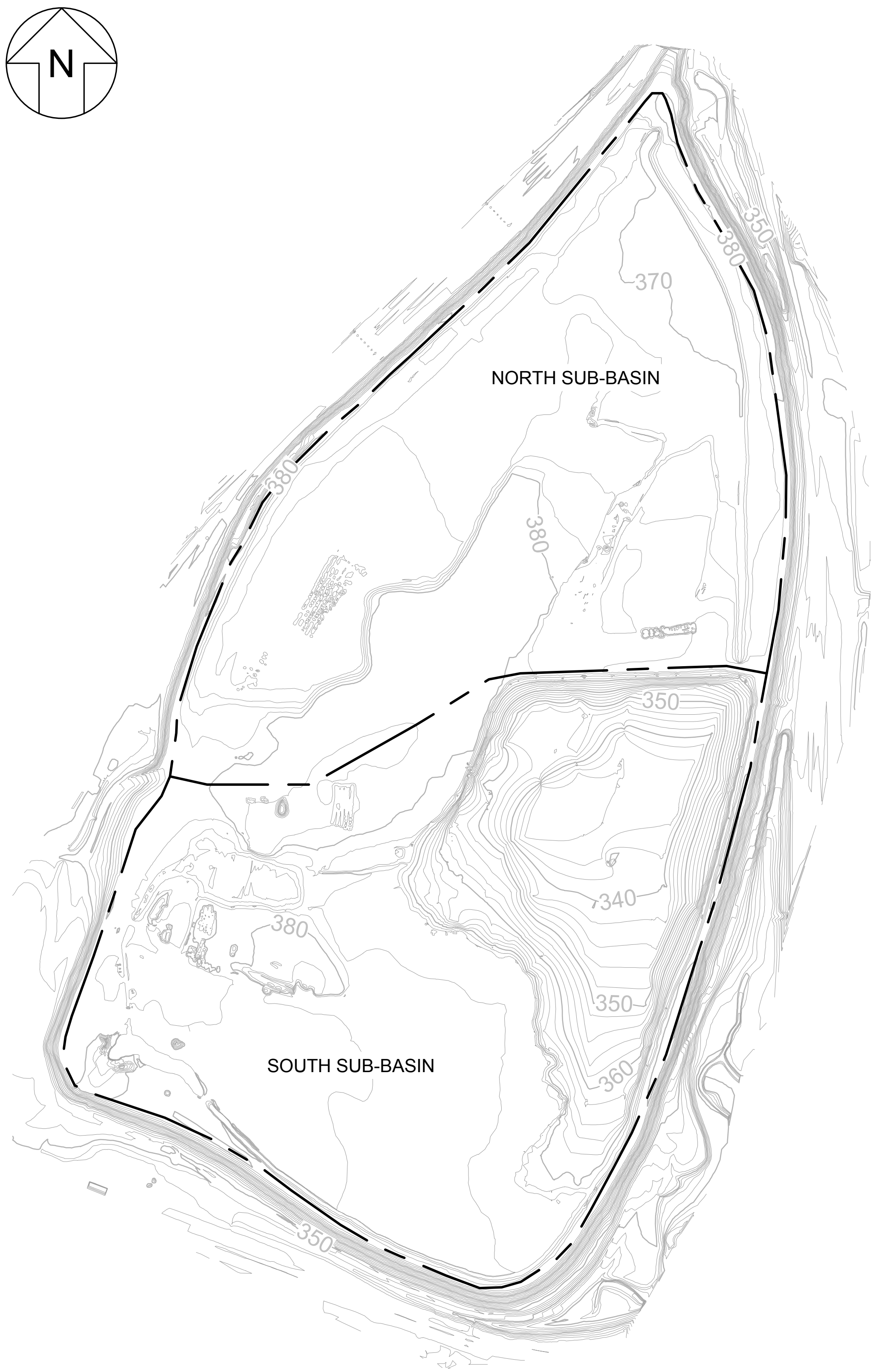
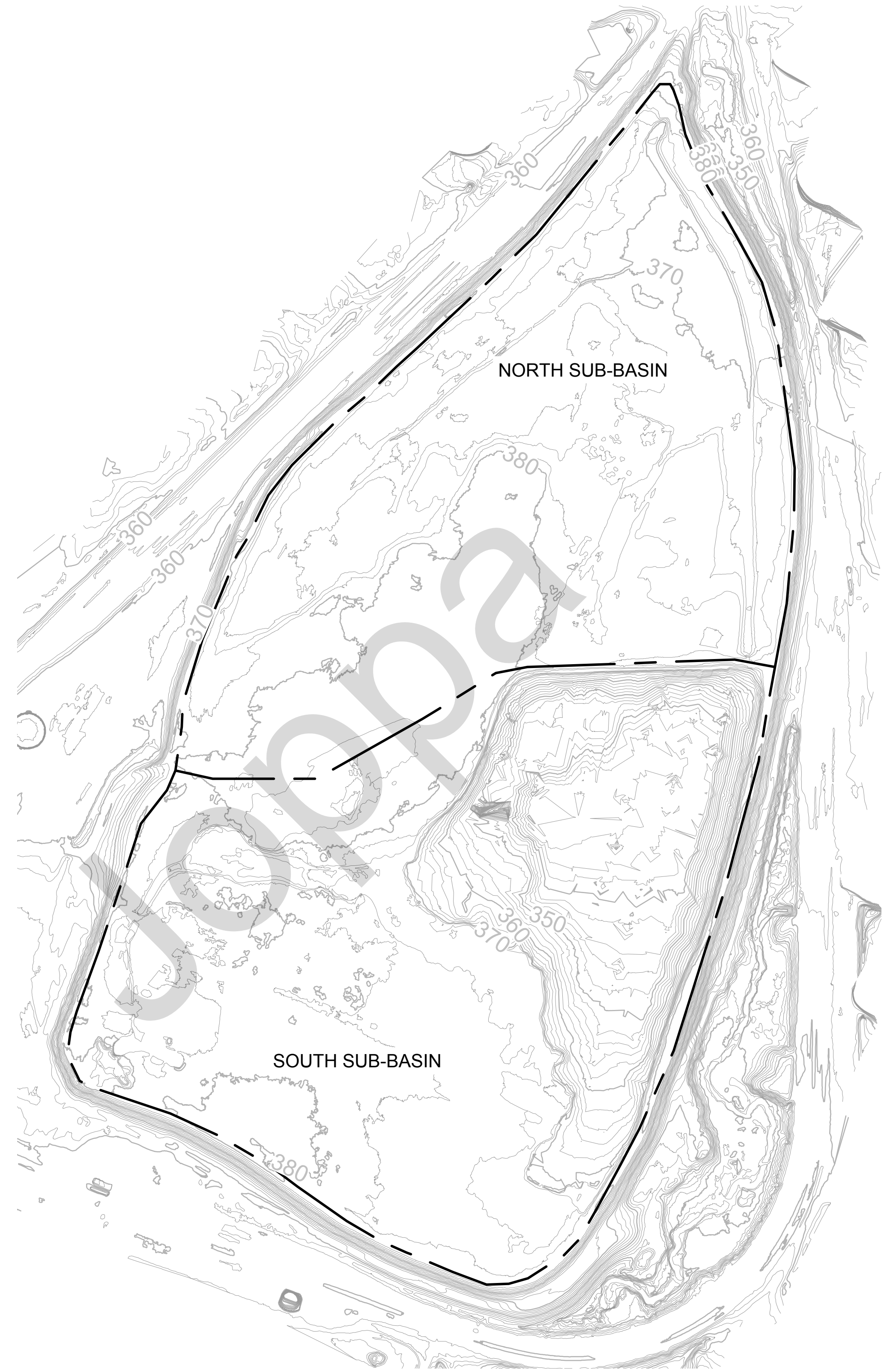
DRAWINGS



INITIAL SURVEY
12-01-2015 TOPOGRAPHY



PERIODIC SURVEY
03-09-2021 TOPOGRAPHY

NOTES:

1. THE INITIAL SURVEY WAS TAKEN FROM THE DRAWING PACKAGE TITLED “DYNEGY, COLLINSVILLE, ILLINOIS, 2015 - JOPPA EXISTING TOPOGRAPHY”, PREPARED BY WEAVER CONSULTANTS GROUP, DATED DECEMBER 1, 2015.
2. THE PERIODIC SURVEY WAS TAKEN FROM THE DRAWING PACKAGE TITLED “LUMINANT, ELECTRIC ENERGY, INC., JOPPA POWER STATION, DECEMBER 2020 TOPOGRAPHY”, PREPARED BY INGENAE, DATED MARCH 9, 2021.
3. ALL SURVEY DATA WAS COLLECTED IN THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88) AND NORTH AMERICAN DATUM OF 1983 (NAD83) FOR VERTICAL AND HORIZONTAL COORDINATES, RESPECTIVELY.

0 500
SCALE IN FEET

INITIAL TO PERIODIC SURVEY COMPARISON EAST ASH POND JOPPA POWER PLANT JOPPA, ILLINOIS		
Geosyntec consultants		FIGURE 1
GLP8027.06	MAY 2021	

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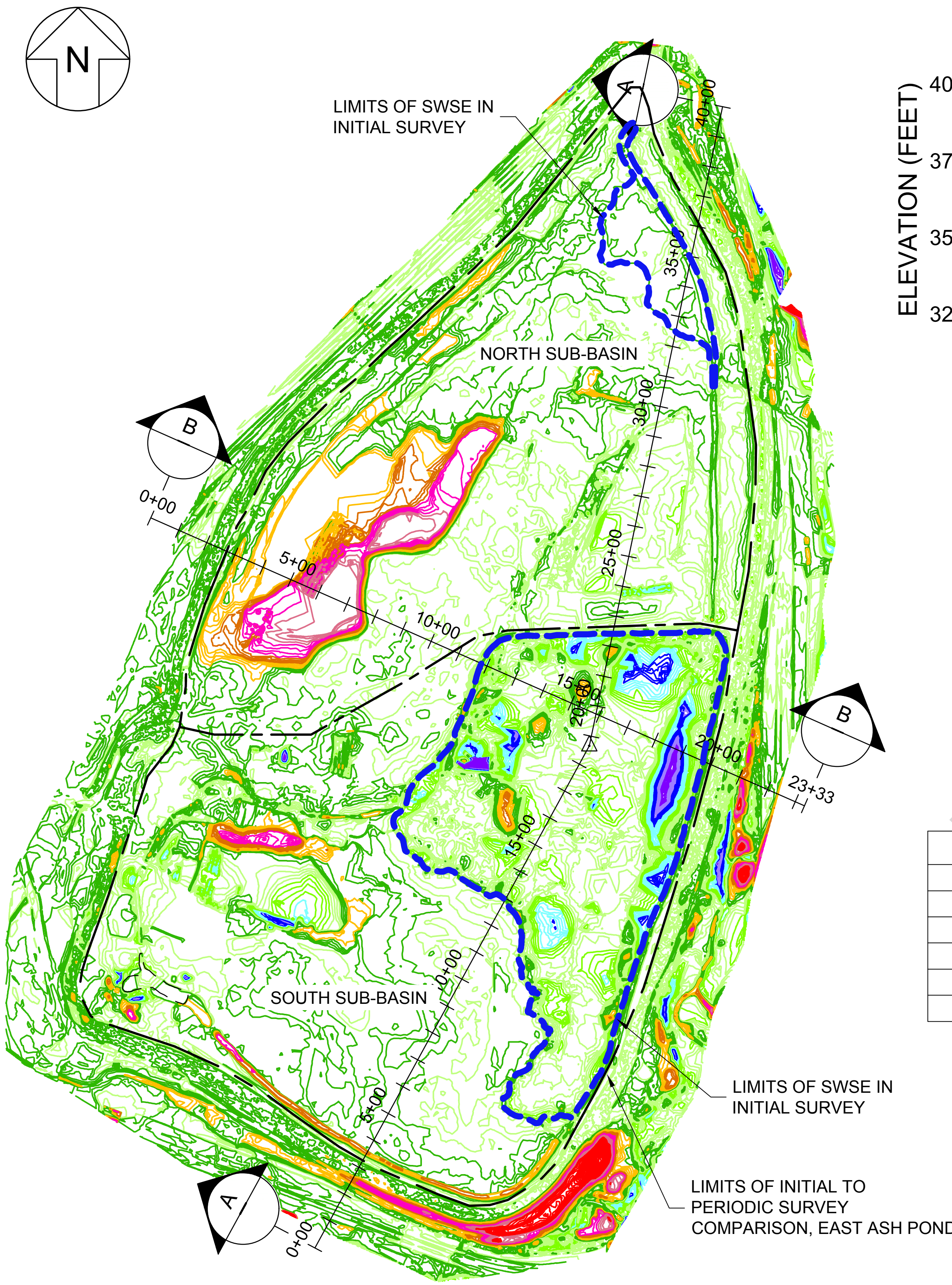

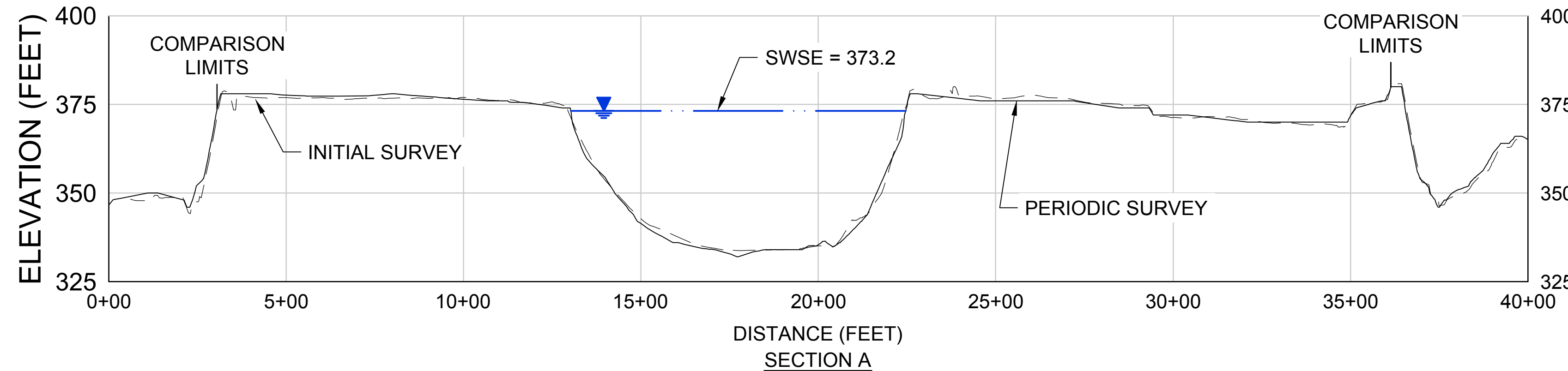

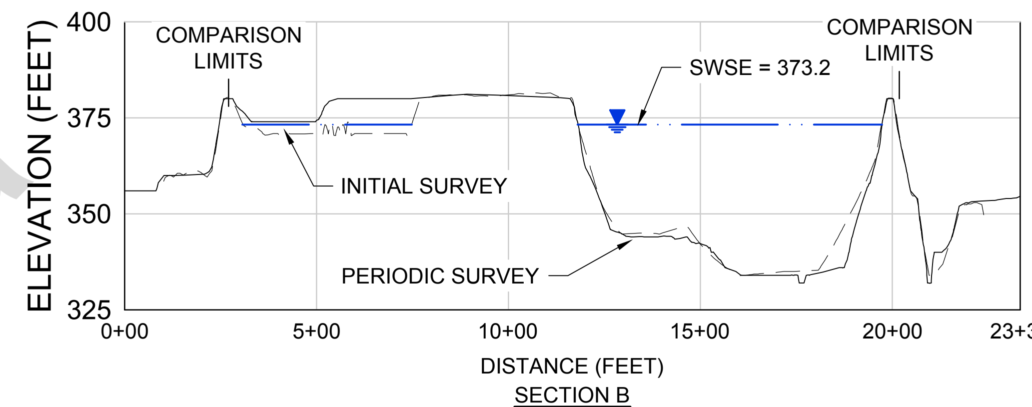

ISOPACH CONTOUR KEY		
COLOR	MIN ELEV	MAX ELEV
	-28	-10
	-10	-8
	-8	-6
	-6	-4
	-4	-2
	-2	0
	0	2
	2	4
	4	6
	6	8
	8	10
	10	34

0 50
VERT: SCALE IN FEET

0 500
HORZ: SCALE IN FEET

INITIAL TO PERIODIC SURVEY COMPARISON SUMMARY			
	CUT	FILL	NET (CU. YD.)
EAST ASH POND	102,389	141,063	38,674 (FILL)
ABOVE SWSE - NORTH SUB-BASIN	21,085	98,639	77,554 (FILL)
ABOVE SWSE - SOUTH SUB-BASIN	17,252	35,435	18,182 (FILL)
BELOW SWSE - NORTH SUB-BASIN	192	1,853	1,661 (FILL)
BELOW SWSE - SOUTH SUB-BASIN	63,829	5,151	58,677 (CUT)

NOTES:

1. THE INITIAL SURVEY WAS TAKEN FROM THE DRAWING PACKAGE TITLED “DYNEGY, COLLINSVILLE, ILLINOIS, 2015 - JOPPA EXISTING TOPOGRAPHY”, PREPARED BY WEAVER CONSULTANTS GROUP, DATED DECEMBER 1, 2015.
2. THE PERIODIC SURVEY WAS TAKEN FROM THE DRAWING PACKAGE TITLED “LUMINANT, ELECTRIC ENERGY, INC., JOPPA POWER STATION, DECEMBER 2020 TOPOGRAPHY”, PREPARED BY INGENAE, DATED MARCH 9, 2021.
3. ALL SURVEY DATA WAS COLLECTED IN THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88) AND NORTH AMERICAN DATUM OF 1983 (NAD83) FOR VERTICAL AND HORIZONTAL COORDINATES, RESPECTIVELY.
4. THE STARTING WATER SURFACE ELEVATION (SWSE) OF THE EAST ASH POND IS EL. 373.2 FT IN THE SOUTH SUB-BASIN AND 370.0 FT IN THE NORTH SUB-BASIN, AS NOTED IN THE REPORT TITLED “CCR CERTIFICATION REPORT: INITIAL STRUCTURAL STABILITY ASSESSMENT, INITIAL SAFETY FACTOR ASSESSMENT, AND INITIAL INFLOW DESIGN FLOOD CONTROL SYSTEM PLAN FOR EAST ASH POND AT JOPPA POWER STATION”, PREPARED BY AECOM, DATED OCTOBER, 2016.

SURVEY COMPARISION ISOPACH
EAST ASH POND
JOPPA POWER PLANT
JOPPA, ILLINOIS

Geosyntec consultants

FIGURE 2

GLP8027.06 | MAY 2021

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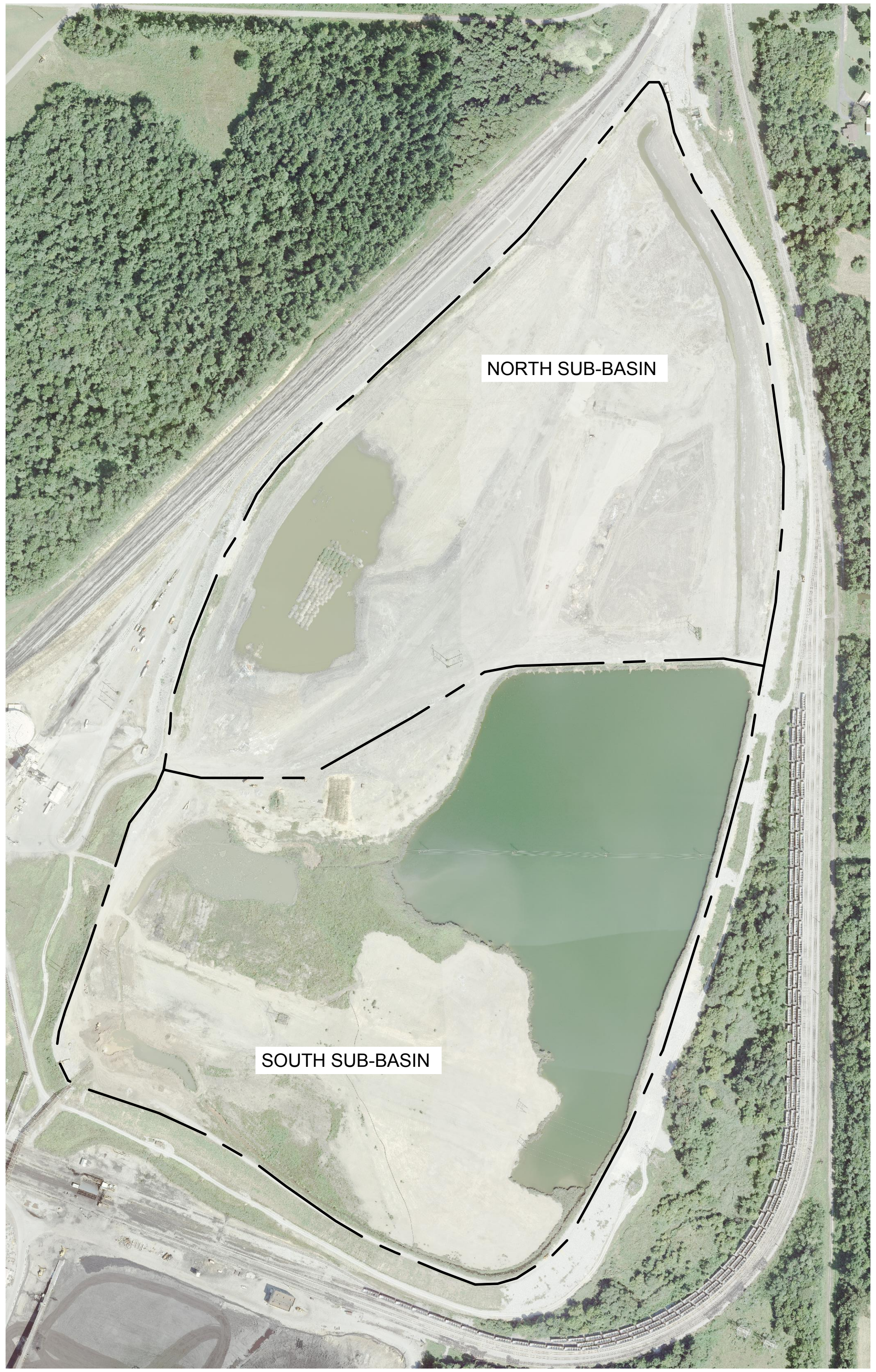
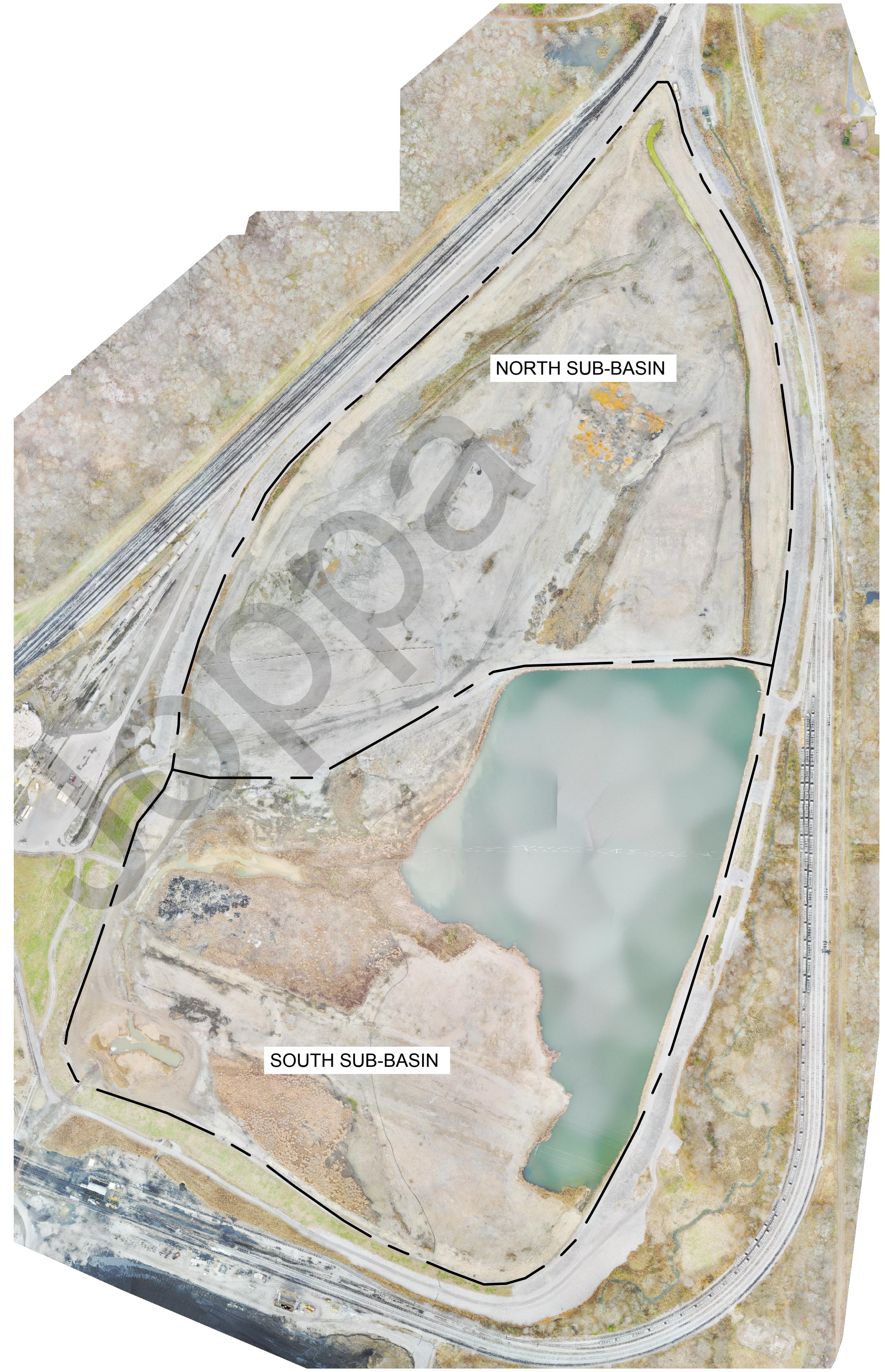


INITIAL AERIAL
12-01-2015 IMAGERY



PERIODIC AERIAL
03-09-2021 IMAGERY

NOTES:

1. THE INITIAL IMAGERY WAS TAKEN FROM THE DRAWING PACKAGE TITLED "DYNEGY, COLLINSVILLE, ILLINOIS, 2015 - JOPPA EXISTING TOPOGRAPHY", PREPARED BY WEAVER CONSULTANTS GROUP, DATED DECEMBER 1, 2015.
2. THE PERIODIC IMAGERY WAS TAKEN FROM THE DRAWING PACKAGE TITLED "LUMINANT, ELECTRIC ENERGY, INC., JOPPA POWER STATION, DECEMBER 2020 TOPOGRAPHY", PREPARED BY INGENAE, DATED MARCH 9, 2021.

0 500
SCALE IN FEET

INITIAL TO PERIODIC AERIAL IMAGERY COMPARISON
EAST ASH POND
JOPPA POWER PLANT
JOPPA, ILLINOIS

Geosyntec consultants

DRAWING 3

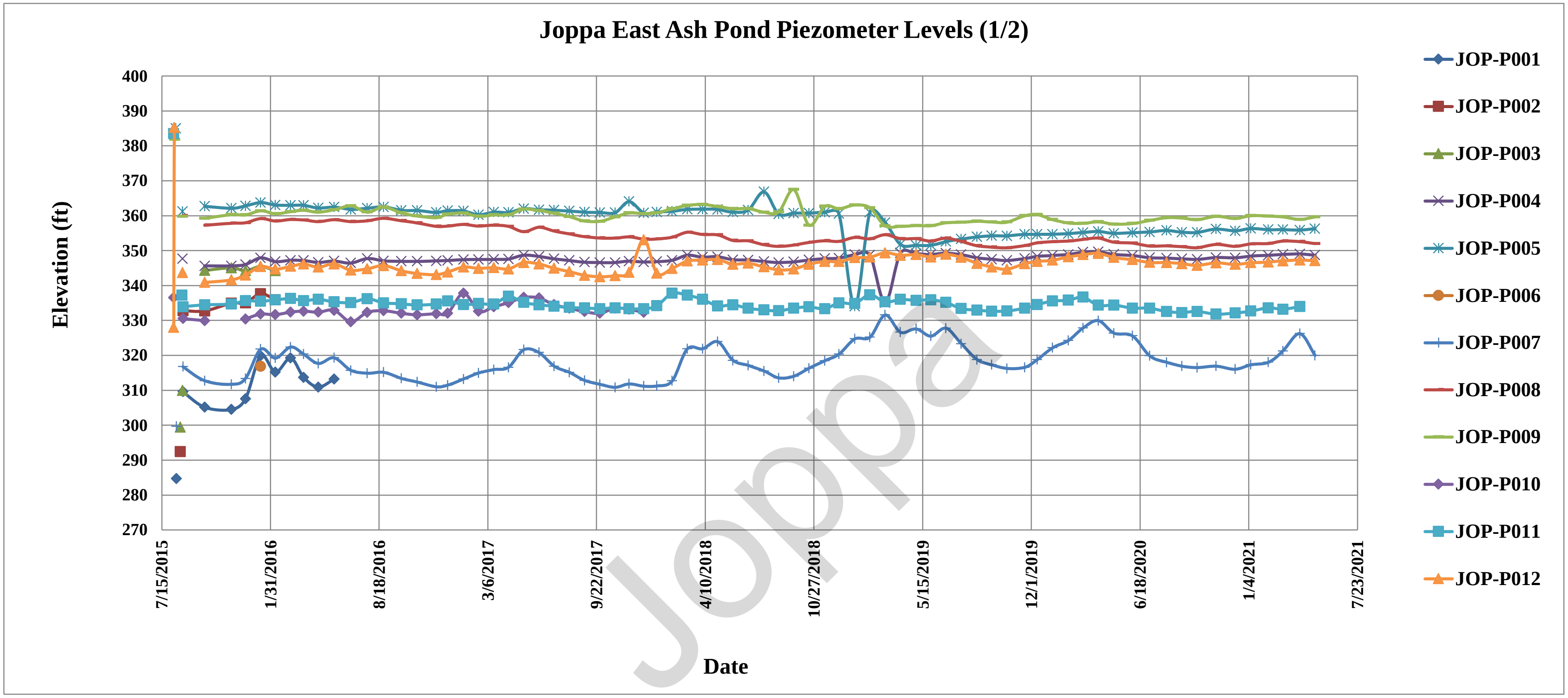
GLP8027.06 | MAY 2021

P:\CADD\PROJECTS\VISTRA PONDS\JOPPA\FIGURES\GLP802706F02 - Last Saved by: KHanavec on 5/24/21

ATTACHMENTS

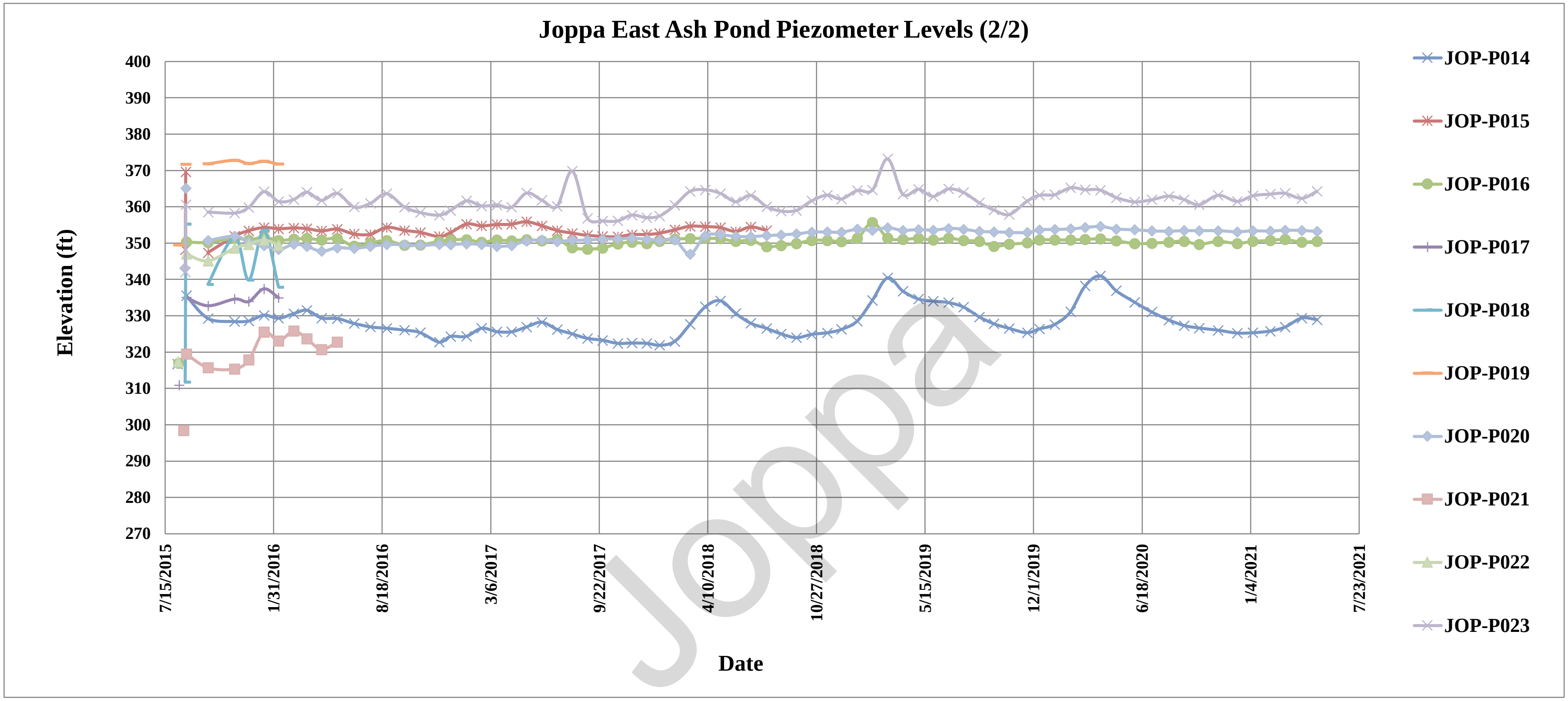
Attachment A

EAP Piezometer Data Plots



NOTES:
1. Piezometer data was taken from the spreadsheet titled "Joppa Piezo Measurements_20160109", provided by the Joppa Power Plant.

PIEZOMETER DATA PERIODIC CERTIFICATION JOPPA POWER PLANT JOPPA, ILLINOIS		
Geosyntec consultants		Figure A-1
GLP8027	5/20/2021	



NOTES:
1. Piezometer data was taken from the spreadsheet titled "Joppa Piezo Measurements_20160109", provided by the Joppa Power Plant.

PIEZOMETER DATA PERIODIC CERTIFICATION JOPPA POWER PLANT JOPPA, ILLINOIS		
Geosyntec consultants		Figure A-2
GLP8027	5/20/2021	

Attachment B

EAP Site Visit Photolog

GEOSYNTEC CONSULTANTS
Photographic Record

Site Owner: Electric Energy Inc. | **Project Number:** GLP8027

CCR Unit: East Ash Pond (EAP) | **Site:** Joppa Power Plant

Photo: 01

Date: 05/26/2021

Direction Facing: N

Comments: Overview of EAP perimeter dike.

Photo: 02

Date: 05/26/2021

Direction Facing: NE

Comments: Overview of perimeter slope protection

GEOSYNTEC CONSULTANTS
Photographic Record

Site Owner: Electric Energy Inc.	**Project Number:** GLP8027
CCR Unit: East Ash Pond (EAP)	**Site:** Joppa Power Plant

Photo: 03 **Date:** 05/26/2021 **Direction Facing:** NE **Comments:** Overview of perimeter slope protection	
Photo: 04 **Date:** 05/26/2021 **Direction Facing:** N **Comments:** Overview of slope protection near 72" CMP inlet	

Site Owner: Electric Energy Inc.	**Project Number:** GLP8027
CCR Unit: East Ash Pond (EAP)	**Site:** Joppa Power Plant

Photo: 05

Date: 05/26/2021

Direction Facing: N

Comments: Overview of perimeter slope protection. Material was dumped crushed stone and fines.

Photo: 06

Date: 05/26/2021

Direction Facing: N

Comments: Outfall structure mixing tank overview.

GEOSYNTEC CONSULTANTS
Photographic Record

Site Owner: Electric Energy Inc. **Project Number:** GLP8027

CCR Unit: East Ash Pond (EAP) **Site:** Joppa Power Plant

Photo: 07

Date: 05/26/2021

Direction Facing: E

Comments: Outfall structure mixing tank and weir overview.

Photo: 08

Date: 05/26/2021

Direction Facing: E

Comments: Inlet for culvert leading to outfall structure. Note plugging with algae and debris. Geosyntec recommended cleaning of inlet as part of routine site maintenance.

GEOSYNTEC CONSULTANTS
Photographic Record

Geosyntec consultants

Site Owner: Electric Energy Inc.	**Project Number:** GLP8027
CCR Unit: East Ash Pond (EAP)	**Site:** Joppa Power Plant

Photo: 09

Date: 05/26/2021

Direction Facing: SW

Comments: Outfall discharge into the mixing basin.

Photo: 10

Date: 05/26/2021

Direction Facing: S

Comments: Overview of northeast embankment exterior and slope protection.

Geosyntec Consultants

Site Owner: Electric Energy Inc.	**Project Number:** GLP8027
CCR Unit: East Ash Pond (EAP)	**Site:** Joppa Power Plant

Photo: 11

Date: 05/26/2021

Direction Facing: SW

Comments: Exterior embankment slope protection.

Photo: 12

Date: 05/26/2021

Direction Facing: SE

Comments: North EAP interior slope protection (vegetation and crushed stone).

Site Owner: Electric Energy Inc.	**Project Number:** GLP8027
CCR Unit: East Ash Pond (EAP)	**Site:** Joppa Power Plant

Photo: 13

Date: 05/26/2021

Direction Facing: SE

Comments: North EAP exterior slope protection.

Photo: 14

Date: 05/26/2021

Direction Facing: SE

Comments: North EAP interior slope protection (crushed stone and vegetation).

Site Owner: Electric Energy Inc.	**Project Number:** GLP8027
CCR Unit: East Ash Pond (EAP)	**Site:** Joppa Power Plant

Photo: 15

Date: 05/26/2021

Direction Facing: SW

Comments: North EAP exterior slope.

Photo: 16

Date: 05/26/2021

Direction Facing: S

Comments: North EAP exterior slope.

Site Owner: Electric Energy Inc. | **Project Number:** GLP8027

CCR Unit: East Ash Pond (EAP) | **Site:** Joppa Power Plant

Photo: 17

Date: 05/26/2021

Direction Facing: S

Comments: Perimeter slope protection overview

Photo: 18

Date: 05/26/2021

Direction Facing: S

Comments: Perimeter slope protection overview

GEOSYNTEC CONSULTANTS

Site Owner: Electric Energy Inc.	**Project Number:** GLP8027
CCR Unit: East Ash Pond (EAP)	**Site:** Joppa Power Plant

Photo: 19

Date: 05/26/2021

Direction Facing: SW

Comments: Perimeter slope vegetation.

Photo: 20

Date: 05/26/2021

Direction Facing: SW

Comments: Perimeter slope vegetation

GEOSYNTEC CONSULTANTS **Photographic Record**	
Site Owner: Electric Energy Inc.	**Project Number:** GLP8027
CCR Unit: East Ash Pond (EAP)	**Site:** Joppa Power Plant

Photo: 21 **Date:** 05/26/2021 **Direction Facing:** SE **Comments:** Sluice pipe discharge area.	
Photo: 22 **Date:** 05/26/2021 **Direction Facing:** E **Comments:** South perimeter dike overview.	

GEOSYNTEC CONSULTANTS	
Site Owner: Electric Energy Inc.	**Project Number:** GLP8027
CCR Unit: East Ash Pond (EAP)	**Site:** Joppa Power Plant

Photo: 23 **Date:** 05/26/2021 **Direction Facing:** E **Comments:** South perimeter dike crest and exterior slope overview.	
Photo: 24 **Date:** 05/26/2021 **Direction Facing:** E **Comments:** Overview of DMM area and slope protection.	

GEOSYNTEC CONSULTANTS Photographic Record	
Site Owner: Electric Energy Inc.	**Project Number:** GLP8027
CCR Unit: East Ash Pond (EAP)	**Site:** Joppa Power Plant

Photo: 25	
Date: 05/26/2021	
Direction Facing: NE	
Comments: Overview of DMM area and slope protection.	

Photo: 26	
Date: 05/26/2021	
Direction Facing: N	
Comments: Overview of perimeter slope protection	

Site Owner: Electric Energy Inc. **Project Number:** GLP8027

CCR Unit: East Ash Pond (EAP) **Site:** Joppa Power Plant

Photo: 27

Date: 05/26/2021

Direction Facing: N

Comments: Interior slope vegetation overview

Photo: 28

Date: 05/26/2021

Direction Facing: N

Comments: Perimeter slope protection and vegetation

Geosyntec Consultants
Photographic Record

Geosyntec consultants

Site Owner: Electric Energy Inc.	**Project Number:** GLP8027
CCR Unit: East Ash Pond (EAP)	**Site:** Joppa Power Plant

Photo: 29

Date: 05/26/2021

Direction Facing: N

Comments: Culvert between north and south basins of EAP.

Photo: 30

Date: 05/26/2021

Direction Facing: W

Comments: Staff gauge installed within the EAP, on the handrails.

Site Owner: Electric Energy Inc.	**Project Number:** GLP8027
CCR Unit: East Ash Pond (EAP)	**Site:** Joppa Power Plant

Photo: 31

Date: 05/26/2021

Direction Facing: SE

Comments: Overview of DSM toe in area of reinforced soil slope (RSS).

Photo: 32

Date: 05/26/2021

Direction Facing: N

Comments: Inlet to 72" CMP at east dike toe.

Site Owner: Electric Energy Inc.	**Project Number:** GLP8027
CCR Unit: East Ash Pond (EAP)	**Site:** Joppa Power Plant

Photo: 33

Date: 05/26/2021

Direction Facing: N

Comments: Another view of the inlet to the 72" CMP

Photo: 34

Date: 05/26/2021

Direction Facing: E

Comments: Outlet to 72" CMP. Some section loss observed at outlet. However, this pipe does not penetrate the dike of the EAP and is located downstream of the discharge of the EAP.

Attachment C

Periodic History of Construction Report Update Letter

1 McBride and Son Center Drive, Suite 202
Chesterfield, MO 63005
PH 636-812-0800
www.geosyntec.com

October 11, 2021

Electric Energy, Inc.
2100 Portland Road
Joppa, Illinois 62953

Subject: Periodic History of Construction Report Update Letter
USEPA Final CCR Rule, 40 CFR §257.73(c)
Joppa Power Plant
Joppa, Illinois

At the request of Electric Energy, Inc. (EEI), Geosyntec Consultants (Geosyntec) has prepared this Letter to documents updates to the Initial History of Construction (HoC) report for the Joppa Power Plant (JPP), also known as the Joppa Power Station (JOP). The Initial HoC report was prepared by AECOM in October of 2016 [1] in accordance with 40 Code of Federal Regulations (CFR) §257.73(c) of the United States Environmental Protection Agency (USEPA) Coal Combustion Residuals Rule, known as the CCR Rule [2]. This letter also includes information required by Section 845.220(a)(1)(B) (Design and Construction Plans) of the state-specific Illinois Environmental Protection Agency (IEPA) Part 845 CCR Rule [3] that is not expressly required by §257.73(c).

BACKGROUND

The CCR Rule required that, by October 17, 2016, Initial HoC reports to be compiled for existing CCR surface impoundments with: (1) a height of five feet or more and a storage volume of 20 acre-feet or more, or (2) a height of 20 feet or more. The Initial HoC report was required to contain, to the extent feasible, the information specified in 40 CFR §257.73(c)(1)(i)-(xii). The Initial HoC report for JPP, which included the existing CCR surface impoundment, the East Ash Pond (EAP), was prepared and subsequently posted to EEI's CCR Website prior to October 17, 2016.

The CCR Rule requires that Initial HoC to be updated if there is a significant change to any information complied in the Initial HoC report, as listed below:

§ 257.73(c)(2): If there is a significant change to any information complied under paragraph (c)(1) of this section, the owner or operator of the CCR unit must update the relevant information and place it in the facility's operating record as required by § 257.105(f)(9).

EEI retained Geosyntec to review the Initial HoC report, review reasonably and readily available information for the EAP generated since the Initial HoC report was prepared, and perform a site visit to JPP to evaluate if significant changes may have occurred since the Initial HoC report was prepared. This Letter contains the results of Geosyntec's evaluation and documents significant changes that have occurred at the EAP and JPP, as they pertain the requirements of §257.73(c)(1)(i)-(xii)

UPDATES TO HISTORY OF CONSTRUCTION REPORT

Geosyntec's evaluation for the JPP EAP determined that no known significant changes requiring updates to the information in the Initial HoC report pertaining to §257.73(c)(1)(ii)-(vi) and (xi)-(xii) of the CCR Rule had occurred since the Initial HoC report was developed.

However, Geosyntec's evaluation determined that significant changes at the JPP EAP pertaining to §257.73(c)(1)(i) and (vii)-(x) of the CCR Rule had occurred since the Initial HoC report had been developed. Additionally, information how long the CCR surface impoundments have been operating and the types of CCR in the surface impoundments, as required by Section 845.220(a)(1)(B) of the Part 845 Rule were not included in the Initial HoC report, as this information is not required by the CCR Rule. Each change and the subsequent updates to the Initial HoC report is described within this section.

Section 845.220(a)(1)(B): A statement of … how long the CCR surface impoundment has been in operation, and the types of CCR that have been placed in the surface impoundment.

<u>*East Ash Pond*</u>
The EAP is in operation since 1973 for a total of approximately 48 years [4].

CCR placed in the EAP is being used to store and dispose of sluiced bottom ash, fly ash, and dredged material from the coal pile runoff pond [4].

§ 257.73(c)(1)(i): The name and address of the person(s) owning or operating the CCR unit; the name associated with the CCR unit; and the identification number of the CCR unit if one has been assigned by the state.

A state identification numbers (IDs) for the EAP was assigned by the Illinois Environmental Protection Agency (IEPA). The ID is listed in **Table 1**.

Table 1 – IEPA ID Numbers

CCR Surface Impoundment	State ID
East Ash Pond (EAP)	W1270100004-02

§ 257.73(c)(1)(vii): At a scale that details engineering structures and appurtenances relevant to the design, construction, operation, and maintenance of the CCR unit, detailed dimensional drawings of the CCR unit, including a plan view and cross sections of the length and width of the CCR unit, showing all zones, foundation improvements, drainage provisions, spillways diversion ditches, outlets, instrument locations, and slope protection, in addition to the normal operating pool surface elevation and the maximum pool surface elevation following peak discharge from the inflow design flood, the expected maximum depth of CCR within the CCR surface impoundment, and any identifiable natural or manmade features that could adversely affect operation of the CCR unit due to malfunction or mis-operation.

A wet area was observed at the toe of the eastern perimeter dike of the EAP in 2020. The wet area was repaired with geotextile, sand, and crushed stone in 2020, based on engineering drawings. Drawings for this repair are provided in **Attachment A**.

§ 257.73(c)(1)(viii): A description of the type, purpose, and location of existing instrumentation.

Several piezometers were abandoned, have stopped working, or are no longer being read due health and safety concerns related with poor accessibility that have developed since 2016. These piezometers include:

- JOP-P001, JOP-P002, JOP-P003, JOP-P010, JOP-P015, JOP-P017, JOP-P018, JOP-P019, JOP-P021, JOP-P022, B1, and B2.

§ 257.73(c)(1)(ix): Area-capacity curves for the CCR unit.

Updated area-capacity curves were prepared for the north and south sub-basins of the EAP in 2021. These curves are provided in **Figures 1** and **2**.

Figure 1 – Area-Capacity Curve for East Ash Pond – North Sub-Basin

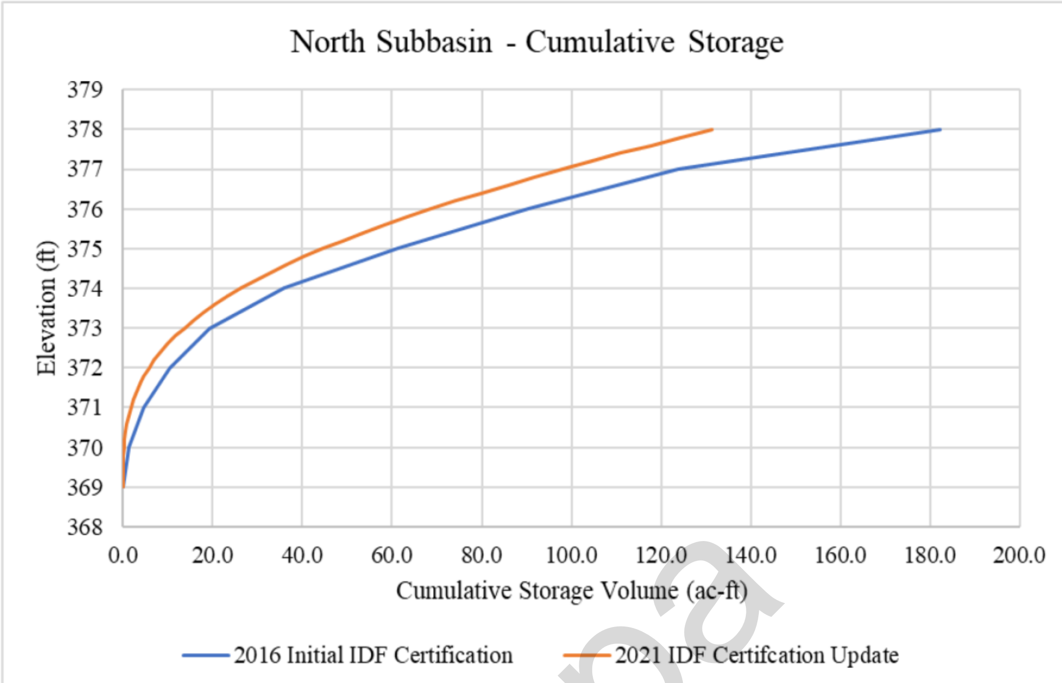
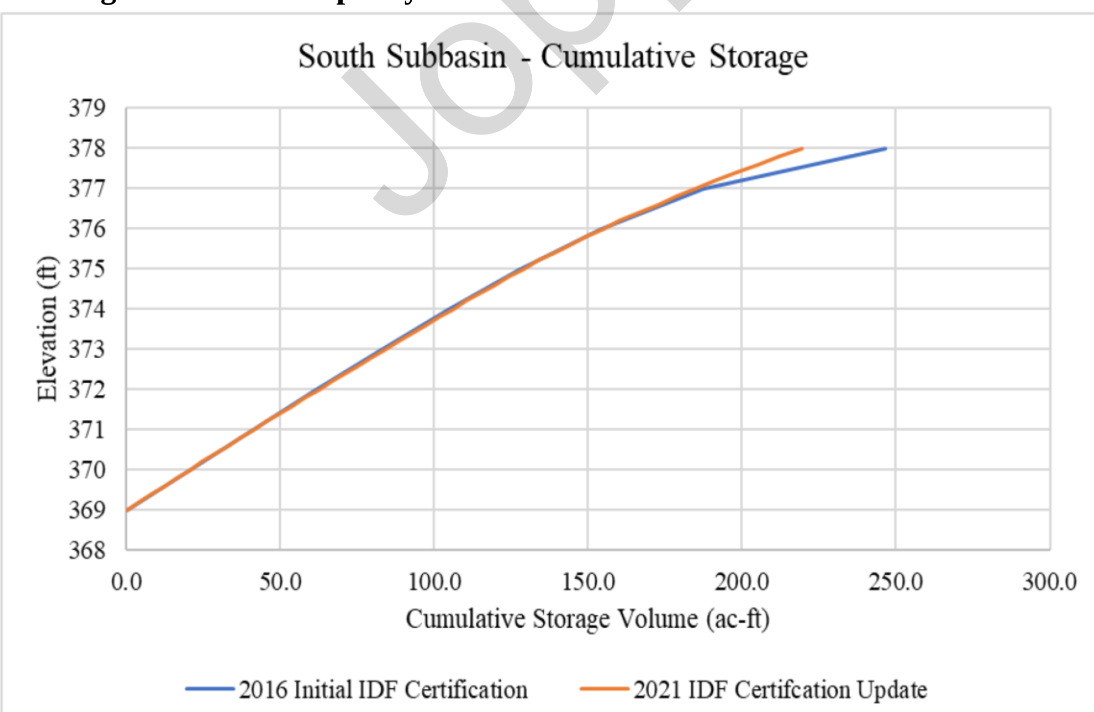


Figure 2 – Area-Capacity Curve for East Ash Pond – South Sub-Basin



§ 257.73(c)(1)(x): A description of each spillway and diversion design features and capacities and calculations used in their determination.

Updated discharge capacity calculations for the existing spillways were prepared in 2021 using HydroCAD 10 modeling software. The calculations indicate that the EAP has sufficient storage capacity and will not overtop the embankments during the Probable Maximum Precipitation (PMP), 24-hour, storm event. The results of the calculations are provided in **Table 2**.

Table 2 – Results of Updated Discharge Capacity Calculations

	North Sub-Basin	South Sub-Basin
Approximate Berm Minimum Elevation[1], ft	378.0	378.0
Approximate Emergency Spillway Elevation[1], ft	Not Applicable	Not Applicable
Starting Water Surface Elevation[1] (SWSE), ft	370.0	373.5
Peak Water Surface Elevation[1] (PWSE), ft	375.95	377.29
Time to Peak, hr	12.6	15.5
Surface Area[2], ac	26.8	33.6
Storage[3], ac-ft	67.3	99.4

Notes:
[1]Elevations are based on the NAVD88 datum
[2] Surface Area is defined as the water surface area at the PWSE
[3]Storage is defined as the volume between the SWSE and PWSE

CLOSING

This letter has been prepared to document Geosyntec's evaluation of changes that have occurred at the EAP at the JPP since the Initial HoC was developed, based on reasonably and readily available information provided by EEI, observed by Geosyntec during the site visit, or generated by Geosyntec as part of subsequent calculations.

Sincerely,

Lucas P. Carr, P.E.
Senior Engineer

John Seymour, P.E.
Senior Principal

REFERENCES

[1] AECOM, "History of Construction, USEPA 40 CFR § 257.73(c), Joppa Power Station, Joppa, Illinois," October 2016.

[2] United Stated Environmental Protection Agency, "40 CFR Parts 257 and 261, Hazardous and Solid Waste Management System, Disposal of Coal Combustion Residuals from Electric Utilities, Final Rule, 2015," 2015.

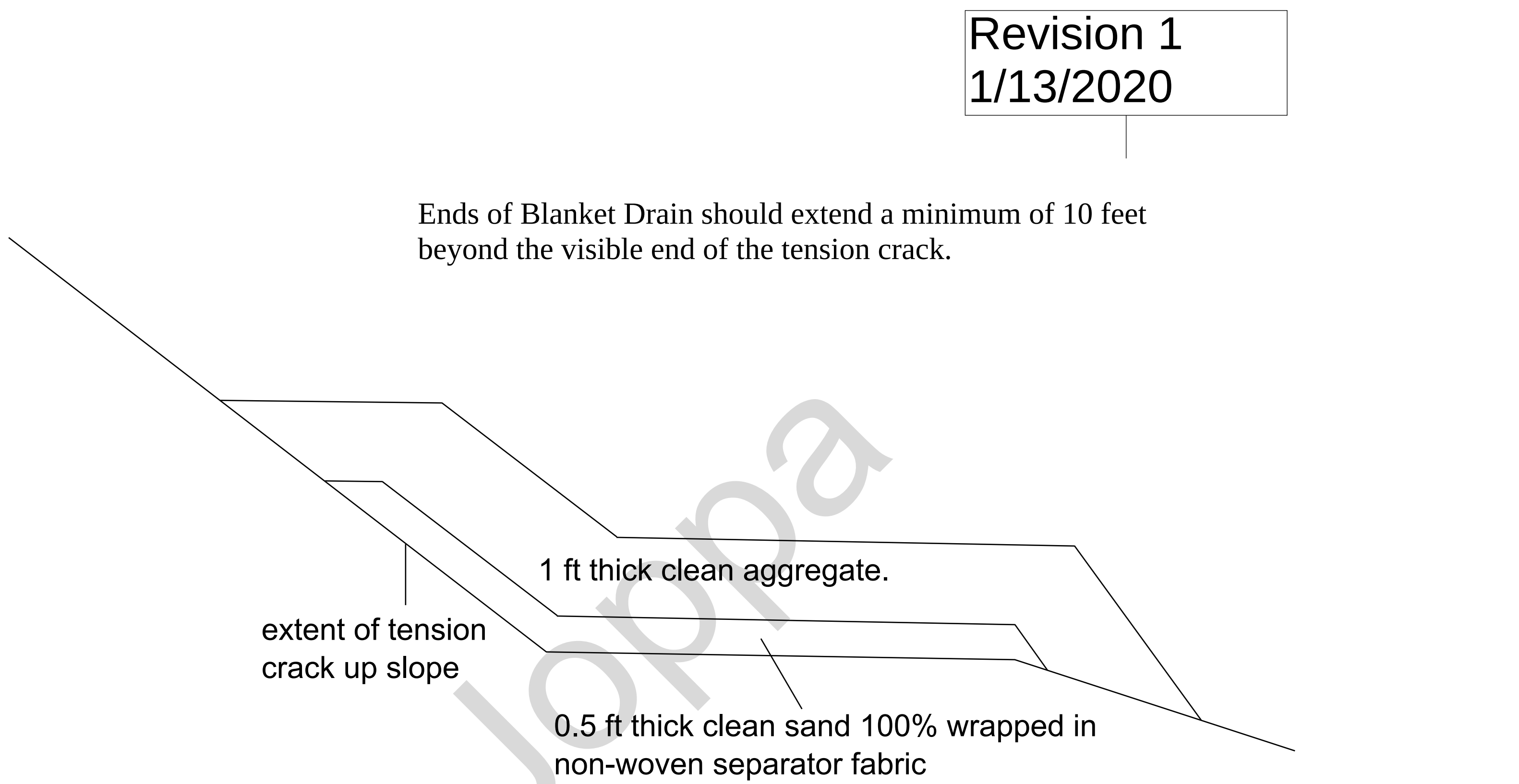
[3] Illinois Environmental Protection Agency, "35 Ill. Adm. Code Part 845, Standards for the Disposal of Coal Combustion Residuals in Surface Impoundments," Springfield, IL, 2021.

[4] AECOM, "History of Construction, USEPA Final CCR Rule, 40 CFR § 257.73(c), Hennepin Power Station, Hennepin, Illinois," October 2016.

APPENDICES

Appendix A Drawings for 2020 EAP Wet Area Repair

Appendix A
Drawings for 2020 EAP Wet Area Repair



Revision 1
1/13/2020

Notes:

1) fill and roll the slope to repair rutting/erosion features
2) extend sand blanket 1 ft upslope from tension crack
3) separator fabric strength dependent on expected roadway traffic (recommend US Fabrics 160NW or equivalent)
4) clean sand = IDOT FA-1 or similar
5) clean aggregate = IDOT CA-1, CA-7 or similar

HANSON Hanson Professional Service inc.	BLANKET DRAIN JOPPA ACTIVE SOUTH ASH POND JOPPA, ILLINOIS JOB NO. 19E0122 FIGURE 1

Attachment D

Periodic Structural Stability and Safety Factor Assessment Analyses

Computed By: VMCh Date: 8/25/2016
Checked By: ZJF Date: 8/25/2016
Modified By: PK Date: 8/25/2021
Checked By: PB Date: 8/25/2021

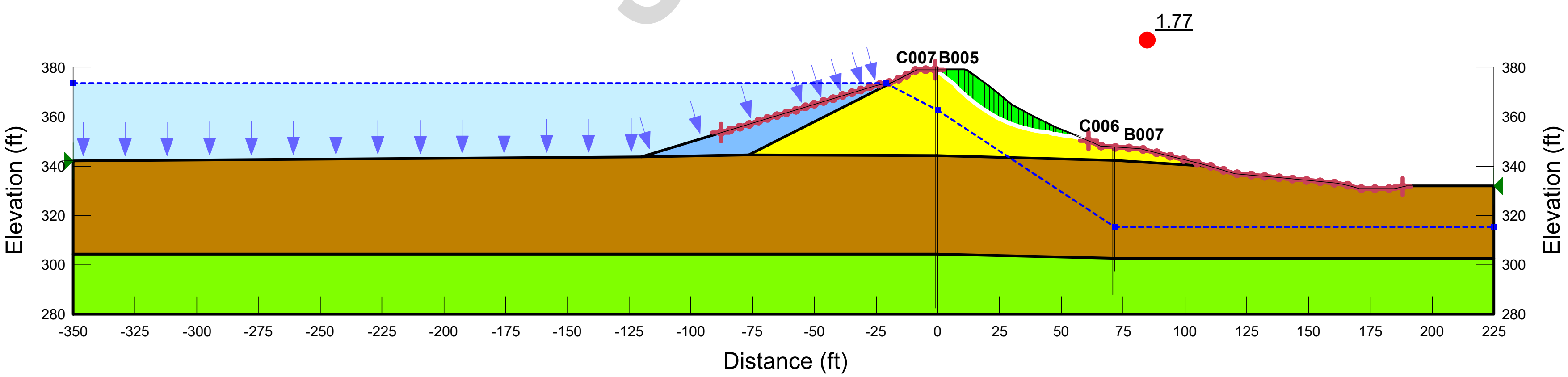
Joppa Section B
Long-Termed Drained Stability

Kind: SLOPE/W
Method: Spencer
F of S: 1.77

Section B Normal Pool

Name: Embankment Fill (Peak Drained) Unit Weight: 131 pcf Strength Function: Embankment Fill Peak Drained Piezometric Line: 1
Name: Foundation Clay (Peak Drained) Unit Weight: 128 pcf C-Horizontal: 0 psf C-Vertical: 0 psf Phi-Horizontal: 29 ° Phi-Vertical: 33 ° Piezometric Line: 1
Name: Foundation Sand (Peak Drained) Unit Weight: 128 pcf Cohesion': 0 psf Phi': 35 ° Piezometric Line: 1
Name: Fly Ash (Peak Drained) Unit Weight: 106 pcf C-Horizontal: 0 psf C-Vertical: 0 psf Phi-Horizontal: 29 ° Phi-Vertical: 33 ° Piezometric Line: 1

Materials
- Embankment Fill (Peak Drained)
- Foundation Clay (Peak Drained)
- Foundation Sand (Peak Drained)
- Fly Ash (Peak Drained)



\\STLOUISMO-01\Data\Company\Projects_post_2014\GLP8027_CCR_ReCert\500_Technical\506_JOP\506d_Periodic_Report\EAP\Revised SFA\2016_AECOM_Files\JOP_Section_B_Drained_PK_08252021.gsz

Computed By: VMCh / AJW	Date: 10/02/16
Checked By: ZJF / VMCh	Date: 10/03/16
Modified By: PK	Date: 08/25/21
Checked By: PB	Date: 08/25/21

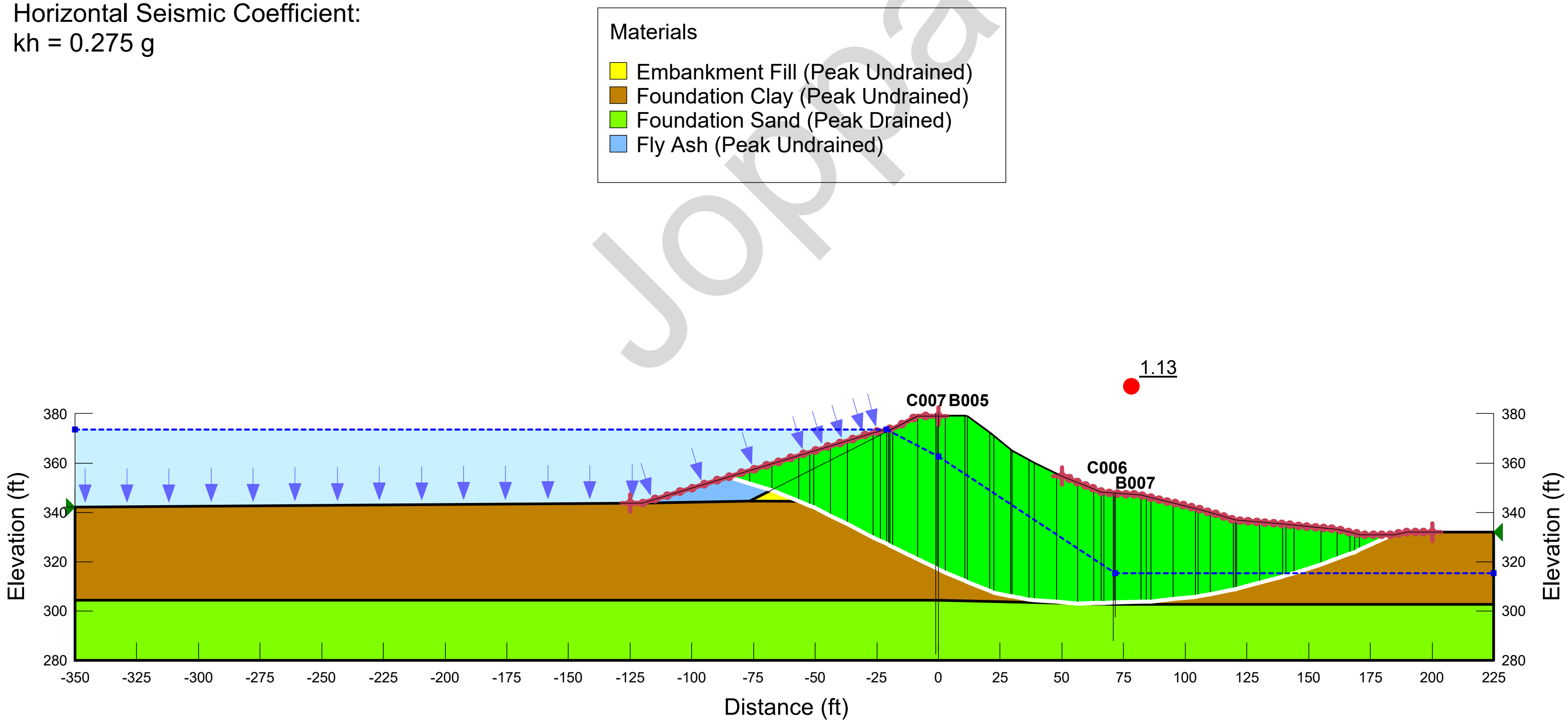
Joppa Section B
Seismic Slope Stability

Kind: SLOPE/W
Method: Spencer
F of S: 1.13

Section B Pseudostatic (kh)

Name: Embankment Fill (Peak Undrained) Unit Weight: 131 pcf Strength Function: Embankment Fill Peak Undrained Piezometric Line: 1
Name: Foundation Clay (Peak Undrained) Unit Weight: 128 pcf Strength Function: Foundation Clay Peak Undrained Piezometric Line: 1
Name: Foundation Sand (Peak Drained) Unit Weight: 128 pcf Cohesion': 0 psf Phi': 35 ° Piezometric Line: 1
Name: Fly Ash (Peak Undrained) Unit Weight: 106 pcf Tau/Sigma Ratio: 0.44 Minimum Strength: 0 psf Piezometric Line: 1

Horizontal Seismic Coefficient:
kh = 0.275 g



\\STLOUISMO-01\Data\Company\Projects_post_2014\GLP8027_CCR_ReCert\500_Technical\506_JOP\506d_Periodic_Report\EAP\Revised SFA\2016_AECOM_Files\JOP_Section_B_Undrained_PK_08252021.gsz

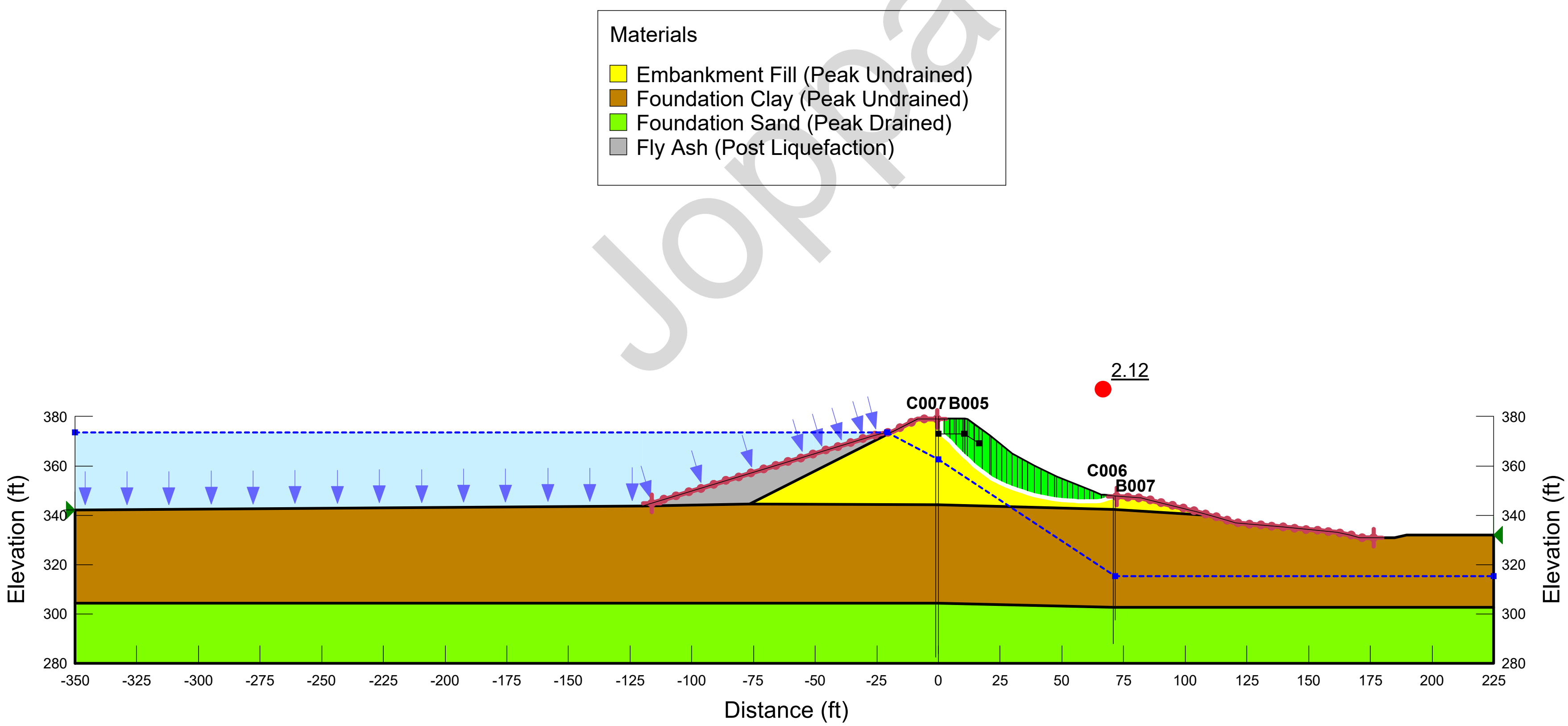
Computed By: VMCh / AJW   Date: 10/02/16
Checked By: ZJF / VMCh   Date: 10/03/16
Modified By: PK   Date: 08/25/21
Checked By: PB   Date: 08/25/21

Joppa Section B
Seismic Slope Stability

Kind: SLOPE/W
Method: Spencer
F of S: 2.12

Section B Post Earthquake

Name: Embankment Fill (Peak Undrained)   Unit Weight: 131 pcf   Strength Function: Embankment Fill Peak Undrained   Piezometric Line: 1
Name: Foundation Clay (Peak Undrained)   Unit Weight: 128 pcf   Strength Function: Foundation Clay Peak Undrained   Piezometric Line: 1
Name: Foundation Sand (Peak Drained)   Unit Weight: 128 pcf   Cohesion': 0 psf   Phi': 35 °   Piezometric Line: 1
Name: Fly Ash (Post Liquefaction)   Unit Weight: 106 pcf   Tau/Sigma Ratio: 0.07   Minimum Strength: 0 psf   Piezometric Line: 1



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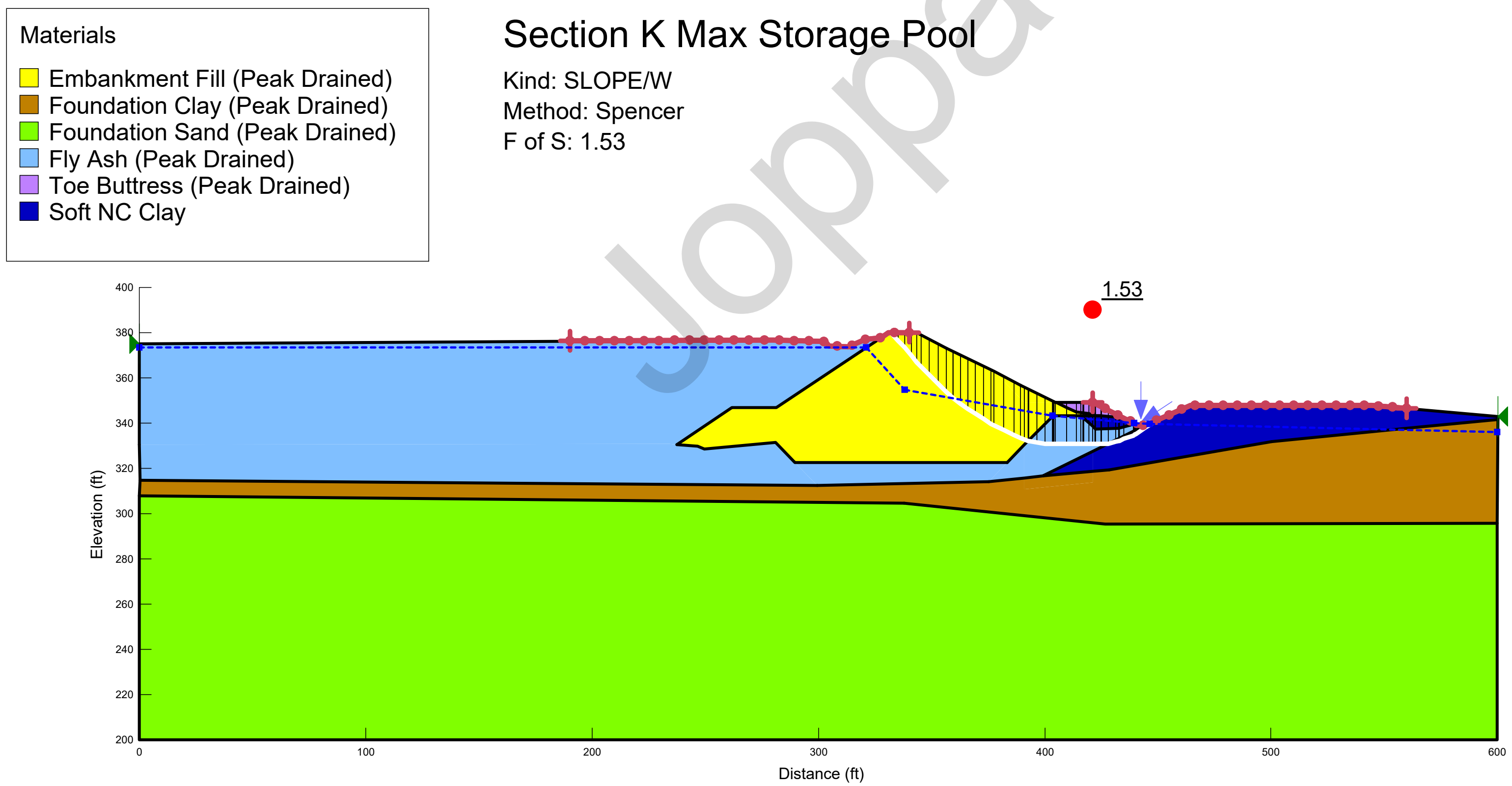
Computed By: LPC
Modified By: PK
Checked By: PB
Date: 8/25/2021

Joppa Section K DMM Design
Long-Termed Drained Stability

Name: Embankment Fill (Peak Drained) Unit Weight: 131 pcf Cohesion': 0 psf Phi': 35 ° Piezometric Line: 1
Name: Foundation Clay (Peak Drained) Unit Weight: 128 pcf C-Horizontal: 0 psf C-Vertical: 0 psf Phi-Horizontal: 29 ° Phi-Vertical: 33 ° Piezometric Line: 1
Name: Foundation Sand (Peak Drained) Unit Weight: 128 pcf Cohesion': 0 psf Phi': 35 ° Piezometric Line: 1
Name: Fly Ash (Peak Drained) Unit Weight: 106 pcf C-Horizontal: 0 psf C-Vertical: 0 psf Phi-Horizontal: 29 ° Phi-Vertical: 33 ° Piezometric Line: 1
Name: Toe Buttress (Peak Drained) Unit Weight: 125 pcf Cohesion': 0 psf Phi': 30 ° Piezometric Line: 1
Name: Soft NC Clay Unit Weight: 125 pcf Cohesion': 0 psf Phi': 25 ° Piezometric Line: 1

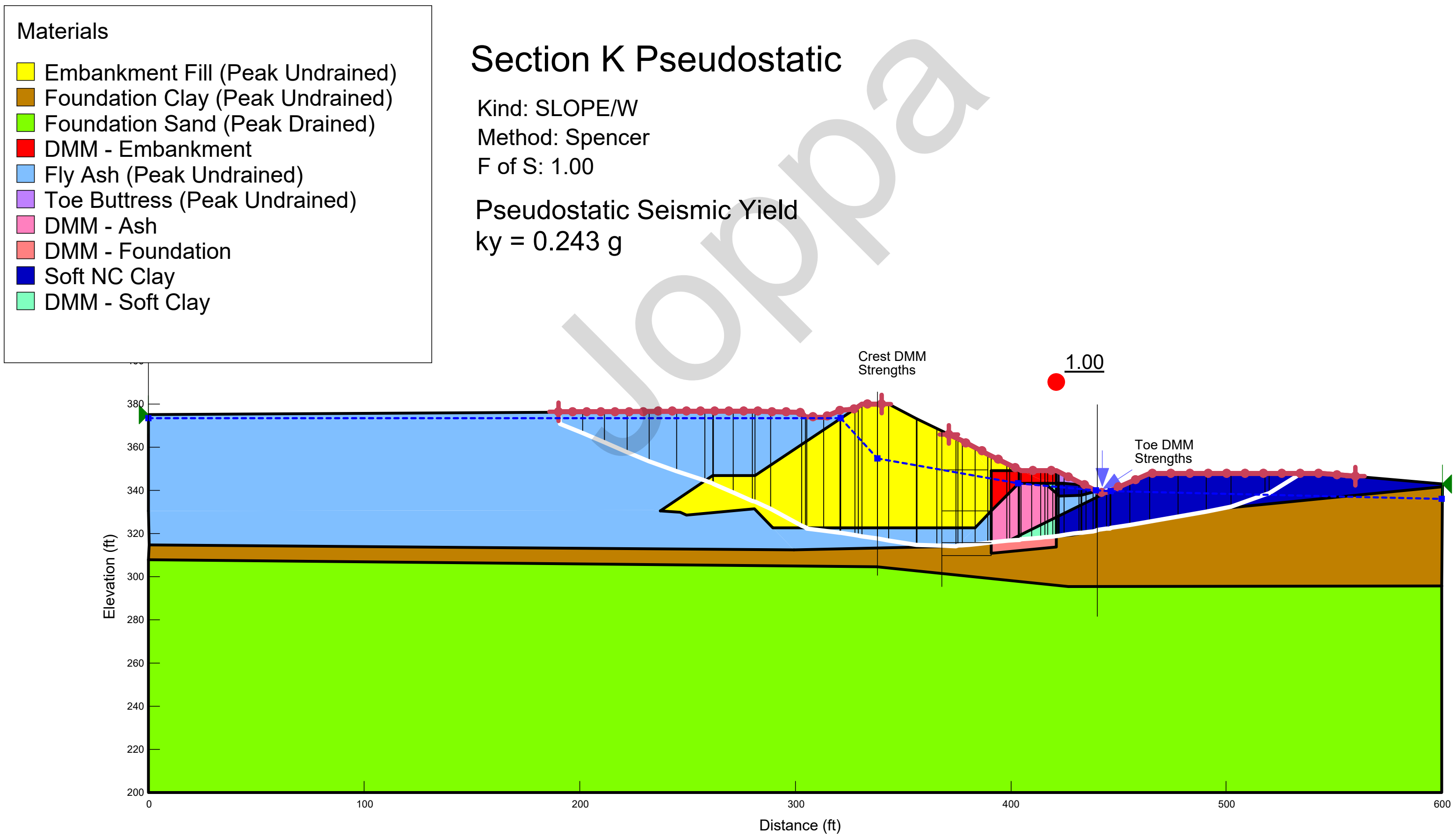


\\STLOUISMO-01\Data\Company\Projects_post_2014\GLP8027_CCR_ReCert\500_Technical\506_JOP\506d_Periodic_Report\EAP\Revised SFA\2016_AECOM_Files\JOP_Section_K_Ash_DMM_Remediation_Drained_PK_08252021.gsz

Joppa Section K DMM Design

Computed By: LPC
Modified By: PK
Checked By: PB
Date: 8/25/2021

Name: Embankment Fill (Peak Undrained) Unit Weight: 131 pcf Strength Function: Embankment Fill Peak Undrained Piezometric Line: 1
Name: Foundation Clay (Peak Undrained) Unit Weight: 128 pcf Strength Function: Foundation Clay Peak Undrained Piezometric Line: 1
Name: Foundation Sand (Peak Drained) Unit Weight: 128 pcf Cohesion': 0 psf Phi': 35 ° Piezometric Line: 1
Name: DMM - Embankment Unit Weight: 131 pcf Cohesion Spatial Fn: Embankment Fill DMM Phi': 0 ° Piezometric Line: 1
Name: Fly Ash (Peak Undrained) Unit Weight: 106 pcf Tau/Sigma Ratio: 0.44 Minimum Strength: 0 psf Piezometric Line: 1
Name: Toe Buttress (Peak Undrained) Unit Weight: 125 pcf Cohesion': 1,500 psf Phi': 0 ° Piezometric Line: 1
Name: DMM - Ash Unit Weight: 106 pcf Cohesion Spatial Fn: Ash DMM Phi': 0 ° Piezometric Line: 1
Name: DMM - Foundation Unit Weight: 128 pcf Cohesion Spatial Fn: Foundation DMM Phi': 0 ° Piezometric Line: 1
Name: Soft NC Clay Unit Weight: 125 pcf Tau/Sigma Ratio: 0.23 Minimum Strength: 500 psf Piezometric Line: 1
Name: DMM - Soft Clay Unit Weight: 125 pcf Cohesion': 3,448 psf Phi': 0 ° Piezometric Line: 1



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Procedure for Estimating Shear-Induced Seismic Slope Displacement for Shallow Crustal Earthquakes

by Jonathan D. Bray and Jorge Macedo, UC Berkeley and Georgia Tech

Procedure for Estimating Shear-Induced Seismic Slope Displacement for Shallow Crustal Earthquakes, ASCE JGGE, 2019, 145(12), doi: 10.1061/(ASCE)GT.1943-5

SEE NOTES BELOW FOR GUIDANCE IN THE USE OF SPREADSHEET

Input Parameters		
Case	Deterministic-Pseudoprobabilistic (EQ8&9)	*** Select Ordinary or Pulse or Combined Equations**
Yield Coefficient (k_y) [(a)]	0.24	
Initial Fundamental Period (T_s) [(b)]	0.15	seconds
Degraded Period ($1.3T_s$)	0.20	seconds
Moment Magnitude (M_w)	7.6	
Spectral Acceleration ($S_a(1.3T_s)$) [(c)]	1.23	g
PGV Information	Both Ordinary & Pulse Motions	
Peak Ground Velocity (PGV) [(d)]	1.0	cm/s
Percentile (if Pulse ground Motion) [(e)]	Both Ordinary & Pulse Motions	
Additional Input Parameters		
Probability of Exceedance #1 (P1)	84	%
Probability of Exceedance #2 (P2)	50	%
Probability of Exceedance #3 (P3)	16	%
Displacement Threshold (d_threshold)	91.44	cm

(a) **Based on pseudostatic analysis**

(b) **1D: T_s=4H/V_s 2D: T_s=2.6H/V_s**

(c) **Input the Spectral Acceleration (g) at the base of the sliding mass assuming there is no material above it.**

(d) **PGV (cm/s) is required for near-fault pulse motions & for EQ9 when PGV > 115 cm/s; it is estimated at the base of sliding mass assuming no material above it.**

(e) **If Pulse motion the percentile is given as either D100 or D50. D100 should be used for fault-normal direction**

Intermediate Calculated Parameters			
Non-Zero Seismic Displacement Est (D)	14.2	cm	eq. (3) or (5) or (7) or (9)
Standard Deviation of Non-Zero Seismic D	0.736		

Results			
Probability of Negligible Displ. (P(D=0))	**0.01**		eq. (2) or (4) or (6) or (8)
D1	**6.7**	**cm**	calc. using eq. (11)
D2	**14.2**	**cm**	calc. using eq. (11)
D3	**29.5**	**cm**	calc. using eq. (11)
P(D>d_threshold)	**0.01**		eq. (11)

Notes

1. Values highlighted in blue are input parameters, and results are presented in the table with the yellow heading.
2. Probability of Exceedance is the desired probability of exceeding a particular displacement value.
3. Displacements D1, D2, and D3 correspond to P1, P2, and P3, respectively.
   (e.g., the probability of exceeding displacement D1 is P1 and it is referred to as the (100% - P1) percentile value.
4. The 16%, 50%, and 84% percentile displacement values at selected k_y values are shown to the right.
5. Calculated seismic displacements are due to deviatoric deformation only (add in volumetrically induced movement).
6. k_y may range between 0.01 and 0.8, T_s between 0 and 2 s, S_a between 0.002 and 4.5 g, M_w between 5.5 and 8.2
7. Rigid slope is assumed for T_s < 0.05 s, i.e. T_s = 0.0. If Ts is just less than 0.05 s, set T_s = 0.050 s
8. When a value for D is not calculated, D is < 0.5 cm
9. k_y should be estimated with a slope stability program; the simplified equations shown below provide approximate values.
10. Examples of how T_s is estimated are shown below.
11. V_s = weighted avg. shear wave velocity for the sliding mass, e.g., for 2 layers, V_s = [(h1)(V_s1) + (h2)(V_s2)]/(h1 + h2)

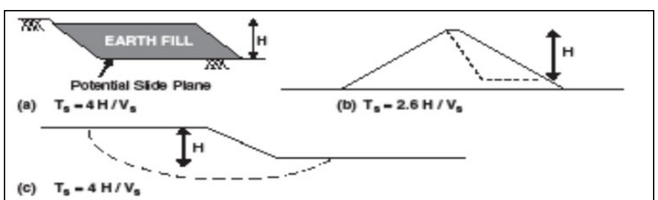


Fig. 14.4. Estimating the initial fundamental period of potential sliding blocks

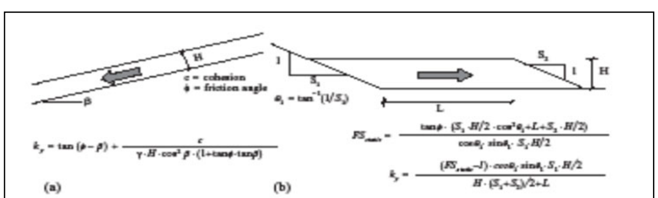


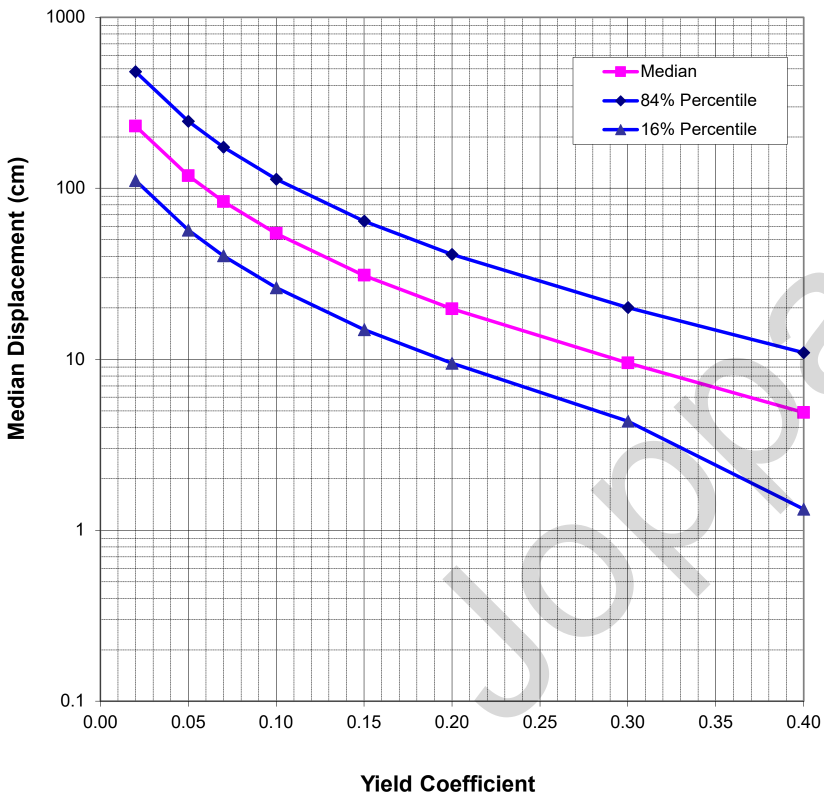
Fig. 14.1. Simplified estimates of the yield coefficient: (a) shallow sliding and (b) deep sliding

Figures from Bray, J.D. (2007) “Chapter 14: Simplified Seismic Slope Displacement Procedures,” Earthquake Geotechnical Engineering, 4th Inter. Conf. on Earthquake Geotechnical Engineering - Invited Lectures, in Geotechnical, Geological, and Earthquake Engineering Series, Vol. 6, Pitilakis, Kyriazis D., Ed., Springer, Vol. 6, pp. 327-353.

5606.0002143

Dependence on k_y

k_y	P(D="0")	D (cm)	Dmedian (cm)	D-84% (cm)	D-16% (cm)
0.020	0.000	231.2	231.2	480.8	111.2
0.05	0.000	118.6	118.6	246.6	57.0
0.07	0.000	83.7	83.7	174.0	40.3
0.1	0.000	54.4	54.4	113.2	26.2
0.15	0.000	31.0	31.0	64.4	14.9
0.2	0.001	19.8	19.7	41.0	9.5
0.3	0.029	9.8	9.5	20.1	4.3
0.4	0.139	5.7	4.87	10.93	1.33



Joppa Section K DMM Design

Computed By: LPC
Modified By: PK
Checked By: PB
Date: 8/25/2021

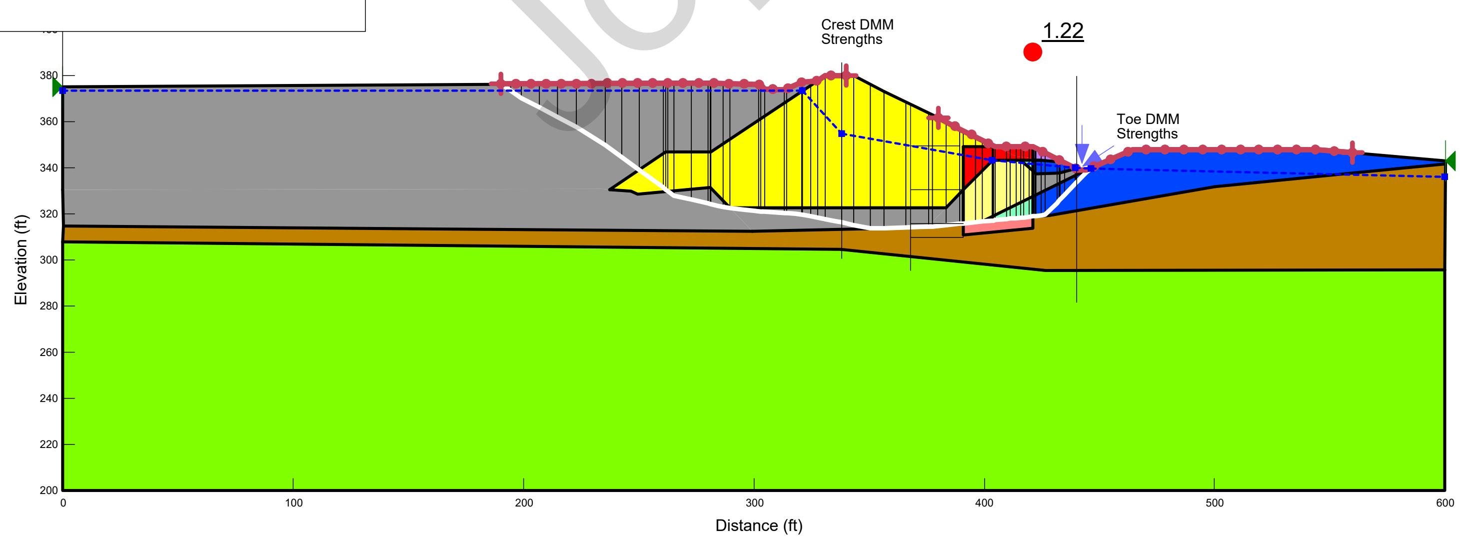
Name: Embankment Fill (Peak Undrained) Unit Weight: 131 pcf Strength Function: Embankment Fill Peak Undrained Piezometric Line: 1
Name: Foundation Clay (Peak Undrained) Unit Weight: 128 pcf Strength Function: Foundation Clay Peak Undrained Piezometric Line: 1
Name: Fly Ash (Post-Liquefaction) Unit Weight: 106 pcf Tau/Sigma Ratio: 0.07 Minimum Strength: 0 psf Piezometric Line: 1
Name: Foundation Sand (Peak Drained) Unit Weight: 128 pcf Cohesion': 0 psf Phi': 35 ° Piezometric Line: 1
Name: DMM - Embankment Unit Weight: 131 pcf Cohesion Spatial Fn: Embankment Fill DMM Phi': 0 ° Piezometric Line: 1
Name: Toe Buttress (Peak Undrained) Unit Weight: 125 pcf Cohesion': 1,500 psf Phi': 0 ° Piezometric Line: 1
Name: DMM - Foundation Unit Weight: 128 pcf Cohesion Spatial Fn: Foundation DMM Phi': 0 ° Piezometric Line: 1
Name: DMM - Ash (Post-EQ) Unit Weight: 106 pcf Cohesion Spatial Fn: Ash DMM - Post-EQ Phi': 0 ° Piezometric Line: 1
Name: Soft NC Clay - Softened Unit Weight: 125 pcf Tau/Sigma Ratio: 0.184 Minimum Strength: 400 psf Piezometric Line: 1
Name: DMM - Soft Clay Unit Weight: 125 pcf Cohesion': 3,448 psf Phi': 0 ° Piezometric Line: 1

Materials

- Embankment Fill (Peak Undrained)
- Foundation Clay (Peak Undrained)
- Fly Ash (Post-Liquefaction)
- Foundation Sand (Peak Drained)
- DMM - Embankment
- Toe Buttress (Peak Undrained)
- DMM - Foundation
- DMM - Ash (Post-EQ)
- Soft NC Clay - Softened
- DMM - Soft Clay

Section K Post-EQ

Kind: SLOPE/W
Method: Spencer
F of S: 1.22



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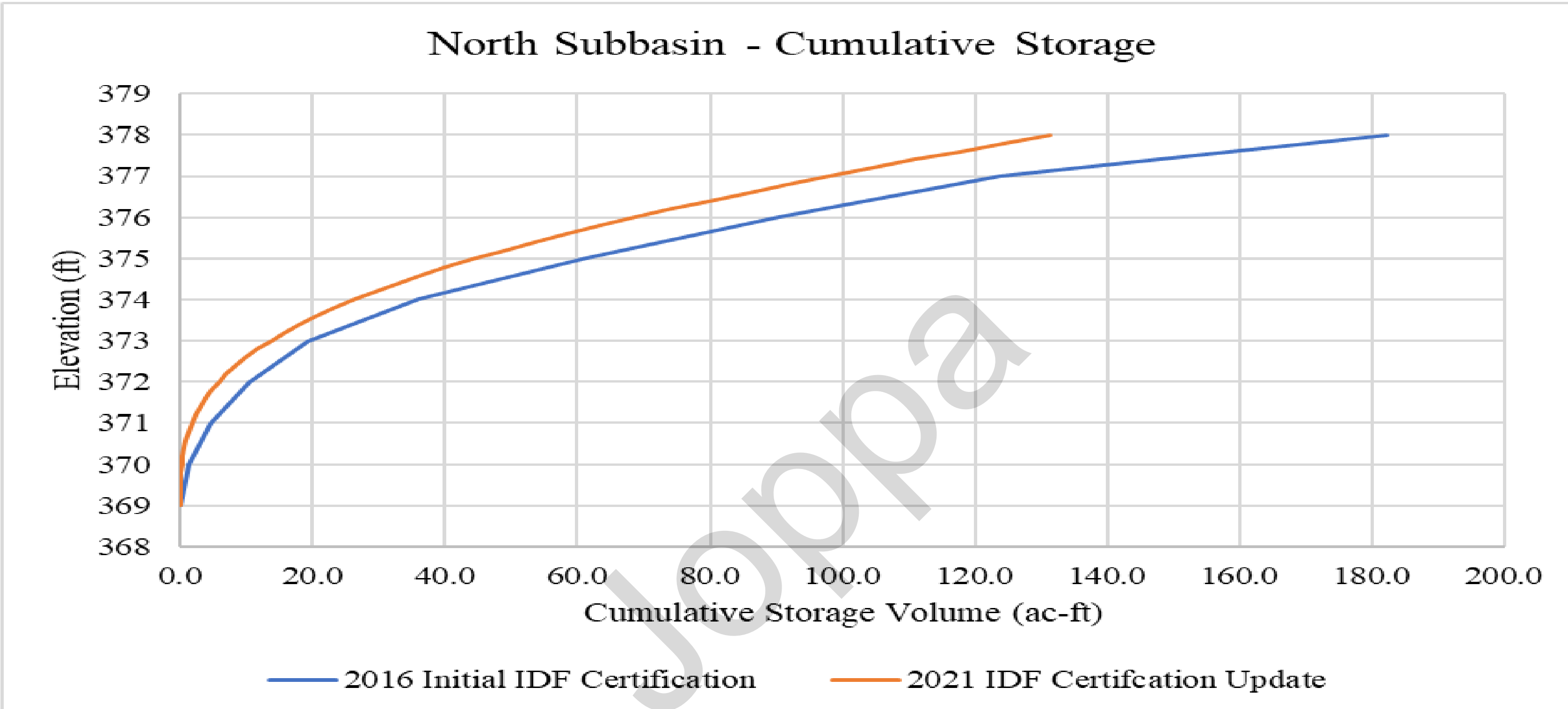
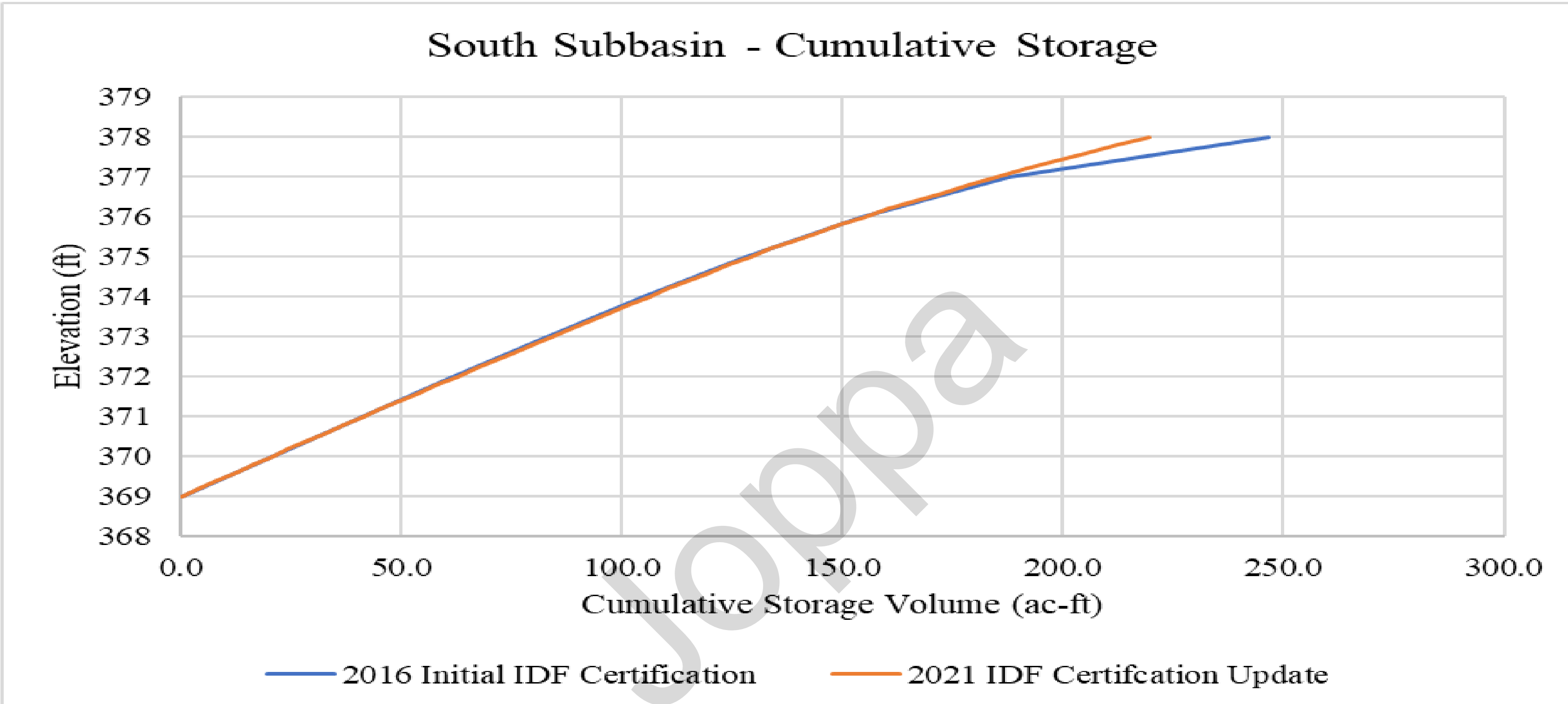
Attachment E

Periodic Inflow Design Flood Control System Plan Analyses



NORTH SUBBASIN - CUMULATIVE STORAGE PERIODIC CERTIFICATION JOPPA POWER PLANT JOPPA, ILLINOIS		
Geosyntec consultants		Figure E-1
GLP8027	8/24/2021	

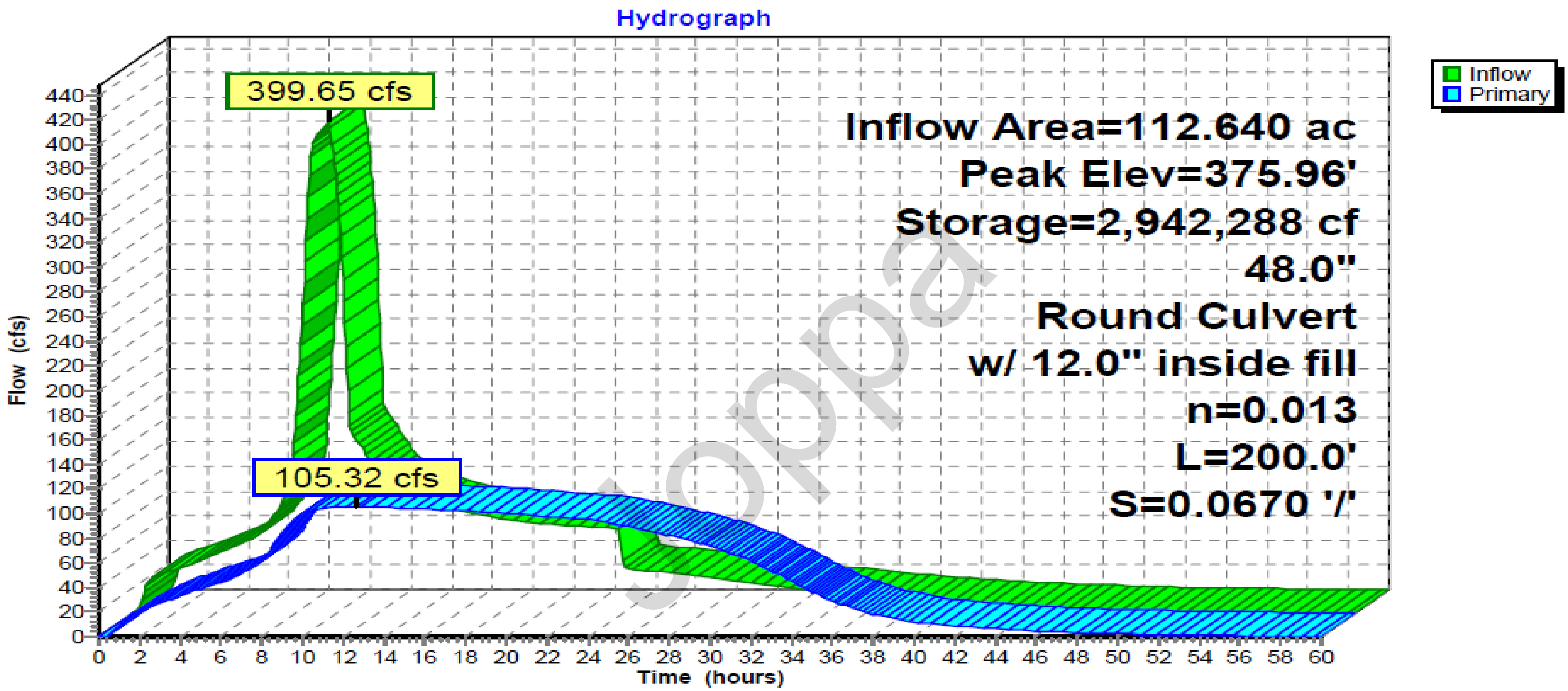


SOUTH SUBBASIN - CUMULATIVE STORAGE
PERIODIC CERTIFICATION
JOPPA POWER PLANT
JOPPA, ILLINOIS

Geosyntec consultants

Figure E-2

GLP8027 | 8/24/2021

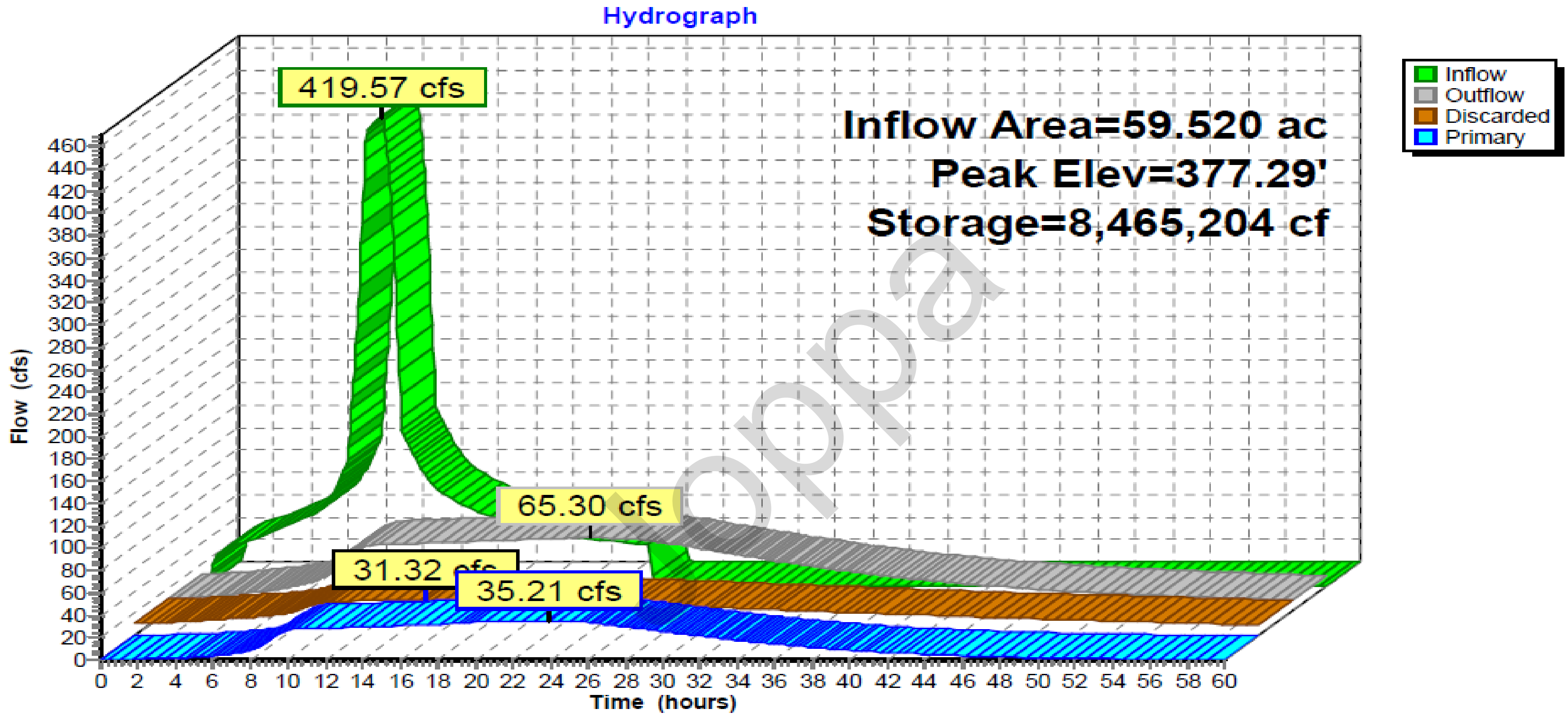


HYDROGRAPH
PERIODIC CERTIFICATION
JOPPA POWER PLANT
JOPPA, ILLINOIS

Geosyntec consultants

Figure E-3

GLP8027 | 8/24/2021

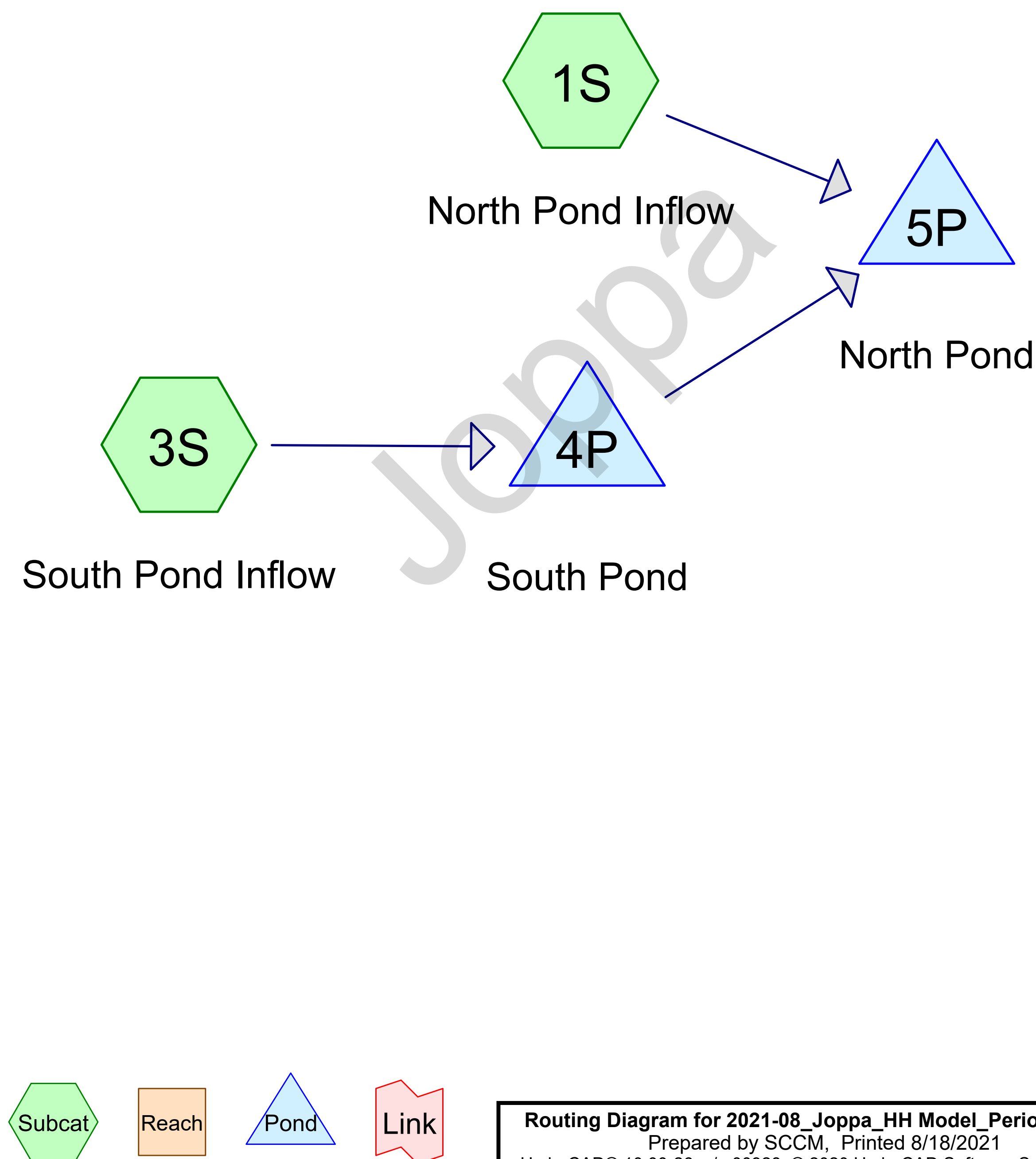


HYDROGRAPH
PERIODIC CERTIFICATION
JOPPA POWER PLANT
JOPPA, ILLINOIS

Geosyntec consultants

Figure E-4

GLP8027 | 8/24/2021



Routing Diagram for 2021-08_Joppa_HH Model_Periodic Review
Prepared by SCCM, Printed 8/18/2021

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
112.640	98	Unconnected pavement, HSG B (1S, 3S)
112.640	**98**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
112.640	HSG B	1S, 3S
0.000	HSG C	
0.000	HSG D	
0.000	Other	
112.640		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	112.640	0.000	0.000	0.000	112.640	Unconnected pavement	1S, 3S
0.000	**112.640**	**0.000**	**0.000**	**0.000**	**112.640**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	4P	373.20	372.20	175.0	0.0057	0.020	36.0	0.0	0.0
2	4P	372.00	350.00	900.0	0.0244	0.013	24.0	0.0	0.0
3	5P	368.90	355.50	200.0	0.0670	0.013	48.0	0.0	12.0

Time span=0.00-60.00 hrs, dt=0.05 hrs, 1201 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 1S: North Pond Inflow Runoff Area=53.120 ac 100.00% Impervious Runoff Depth=35.76"
Tc=5.0 min CN=98 Runoff=374.46 cfs 158.281 af

Subcatchment 3S: South Pond Inflow Runoff Area=59.520 ac 100.00% Impervious Runoff Depth=35.76"
Tc=5.0 min CN=98 Runoff=419.57 cfs 177.351 af

Pond 4P: South Pond Peak Elev=377.29' Storage=8,465,204 cf Inflow=419.57 cfs 177.351 af
Discarded=31.32 cfs 104.811 af Primary=35.21 cfs 74.924 af Outflow=65.30 cfs 179.735 af

Pond 5P: North Pond Peak Elev=375.96' Storage=2,942,288 cf Inflow=399.65 cfs 233.205 af
48.0" Round Culvert w/ 12.0" inside fill n=0.013 L=200.0' S=0.0670 '/' Outflow=105.32 cfs 233.218 af

Total Runoff Area = 112.640 ac Runoff Volume = 335.632 af Average Runoff Depth = 35.76"
0.00% Pervious = 0.000 ac 100.00% Impervious = 112.640 ac

Summary for Subcatchment 1S: North Pond Inflow

[49] Hint: Tc<2dt may require smaller dt

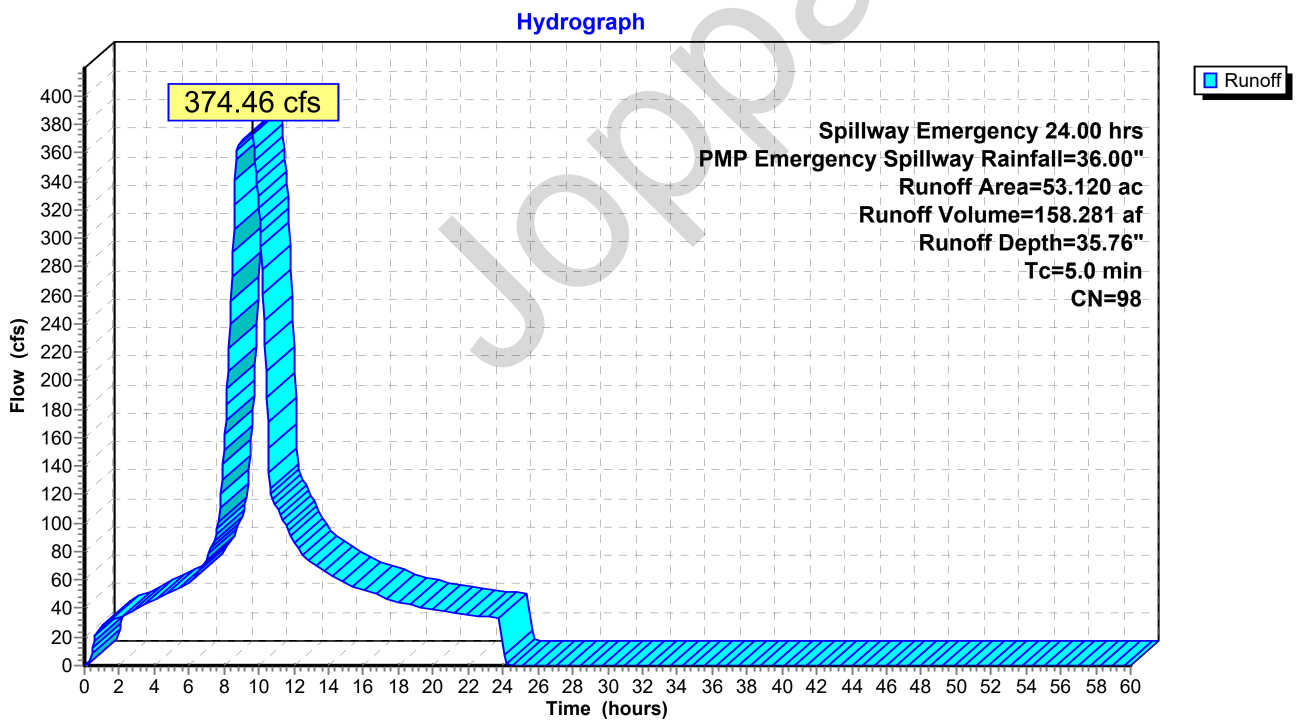
Runoff = 374.46 cfs @ 9.60 hrs, Volume= 158.281 af, Depth=35.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Spillway Emergency 24.00 hrs PMP Emergency Spillway Rainfall=36.00"

Area (ac)	CN	Description
53.120	98	Unconnected pavement, HSG B
53.120		100.00% Impervious Area
53.120		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Direct Inflow**

Subcatchment 1S: North Pond Inflow



Summary for Subcatchment 3S: South Pond Inflow

[49] Hint: Tc<2dt may require smaller dt

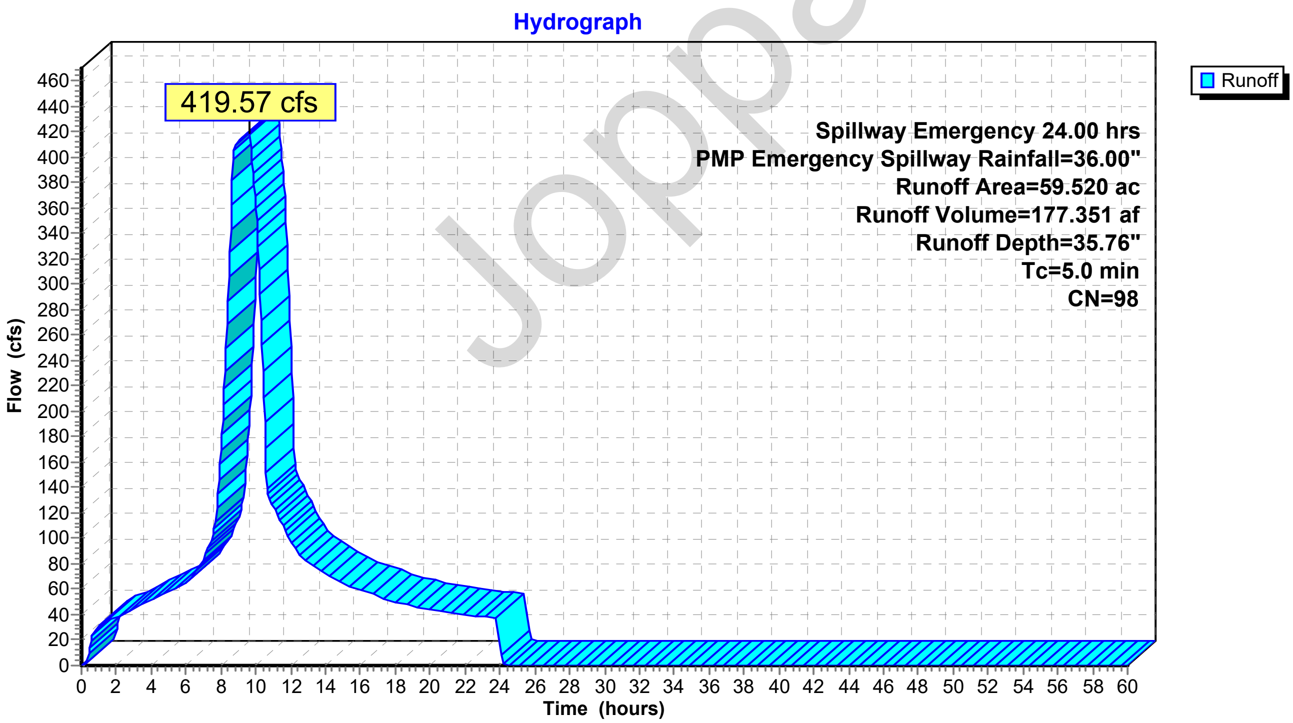
Runoff = 419.57 cfs @ 9.60 hrs, Volume= 177.351 af, Depth=35.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Spillway Emergency 24.00 hrs PMP Emergency Spillway Rainfall=36.00"

Area (ac)	CN	Description
59.520	98	Unconnected pavement, HSG B
59.520		100.00% Impervious Area
59.520		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Direct Inflow**

Subcatchment 3S: South Pond Inflow



Summary for Pond 4P: South Pond

Inflow Area = 59.520 ac,100.00% Impervious, Inflow Depth = 35.76" for PMP Emergency Spillway event
Inflow = 419.57 cfs @ 9.60 hrs, Volume= 177.351 af
Outflow = 65.30 cfs @ 22.53 hrs, Volume= 179.735 af, Atten= 84%, Lag= 775.6 min
Discarded = 31.32 cfs @ 15.46 hrs, Volume= 104.811 af
Primary = 35.21 cfs @ 23.99 hrs, Volume= 74.924 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Starting Elev= 373.50' Surf.Area= 954,920 sf Storage= 4,136,553 cf
Peak Elev= 377.29' @ 15.46 hrs Surf.Area= 1,464,313 sf Storage= 8,465,204 cf (4,328,651 cf above start)

Plug-Flow detention time= 1,778.7 min calculated for 84.703 af (48% of inflow)
Center-of-Mass det. time= 876.5 min (1,536.1 - 659.7)

Volume	Invert	Avail.Storage	Storage Description
#1	369.00'	9,563,776 cf	**Custom Stage Data (Conic)**Listed below (Recalc)

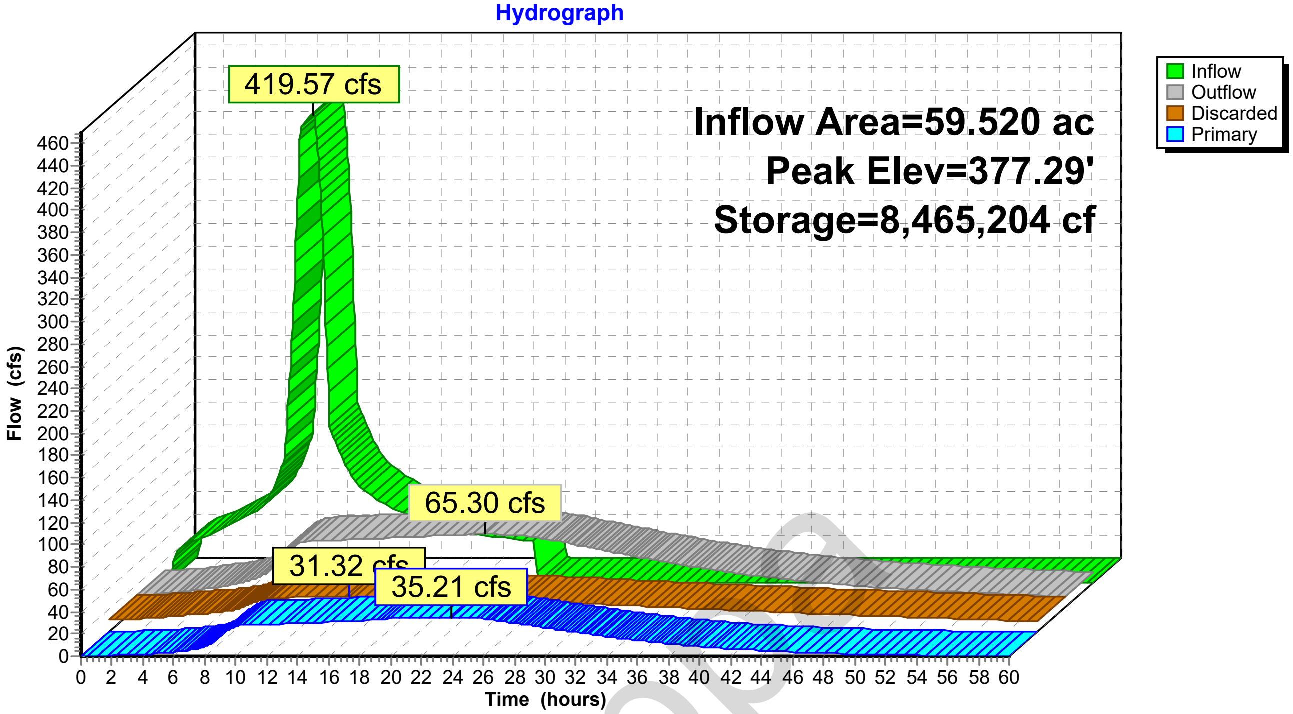
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
369.00	883,378	0	0	883,378
373.00	947,474	3,660,956	3,660,956	948,894
374.00	962,395	954,925	4,615,881	964,211
375.00	1,039,863	1,000,879	5,616,760	1,041,761
376.00	1,216,987	1,127,265	6,744,024	1,218,925
377.00	1,404,766	1,309,754	8,053,779	1,406,747
378.00	1,617,733	1,509,997	9,563,776	1,619,759

Device	Routing	Invert	Outlet Devices
#1	Primary	373.20'	**36.0" Round Culvert** L= 175.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 373.20' / 372.20' S= 0.0057 '/' Cc= 0.900 n= 0.020 Corrugated PE, corrugated interior, Flow Area= 7.07 sf
#2	Discarded	372.00'	**24.0" Round Culvert** L= 900.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 372.00' / 350.00' S= 0.0244 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#3	Device 2	372.70'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=31.32 cfs @ 15.46 hrs HW=377.29' (Free Discharge)
└─**2=Culvert** (Inlet Controls 31.32 cfs @ 9.97 fps)
  └─**3=Orifice/Grate** (Passes 31.32 cfs of 32.40 cfs potential flow)

Primary OutFlow Max=35.26 cfs @ 23.99 hrs HW=376.91' TW=375.12' (Dynamic Tailwater)
└─**1=Culvert** (Outlet Controls 35.26 cfs @ 5.16 fps)

Pond 4P: South Pond



Summary for Pond 5P: North Pond

Inflow Area = 112.640 ac,100.00% Impervious, Inflow Depth > 24.84" for PMP Emergency Spillway event
Inflow = 399.65 cfs @ 9.63 hrs, Volume= 233.205 af
Outflow = 105.32 cfs @ 12.56 hrs, Volume= 233.218 af, Atten= 74%, Lag= 176.2 min
Primary = 105.32 cfs @ 12.56 hrs, Volume= 233.218 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-60.00 hrs, dt= 0.05 hrs
Starting Elev= 370.00' Surf.Area= 27,734 sf Storage= 9,245 cf
Peak Elev= 375.96' @ 12.56 hrs Surf.Area= 1,165,823 sf Storage= 2,942,288 cf (2,933,043 cf above start)

Plug-Flow detention time= 317.4 min calculated for 233.005 af (100% of inflow)
Center-of-Mass det. time= 314.1 min (1,213.6 - 899.4)

Volume	Invert	Avail.Storage	Storage Description
#1	369.00'	5,719,616 cf	**Custom Stage Data (Conic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
369.00	0	0	0	0
373.00	443,746	591,661	591,661	443,771
374.00	667,599	551,876	1,143,537	667,640
375.00	931,347	795,823	1,939,360	931,406
376.00	1,176,580	1,051,578	2,990,938	1,176,666
377.00	1,383,194	1,278,495	4,269,433	1,383,319
378.00	1,518,220	1,450,183	5,719,616	1,518,413

Device	Routing	Invert	Outlet Devices
#1	Primary	369.90'	**48.0" Round Culvert w/ 12.0" inside fill** L= 200.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 368.90' / 355.50' S= 0.0670 '/' Cc= 0.900 n= 0.013, Flow Area= 10.11 sf

Primary OutFlow Max=105.32 cfs @ 12.56 hrs HW=375.96' (Free Discharge)
└─**1=Culvert** (Inlet Controls 105.32 cfs @ 10.42 fps)

Pond 5P: North Pond