MWG

Midwest Generation, LLC

Waukegan Generating Station

2025 Safety Factor Assessment for East Ash Pond & West Ash Pond

Revision 0

October 13, 2025

Issue Purpose: Use

Project No.: A12661.198

55 East Monroe Street
Chicago, IL 60603-5780 USA
312-269-2000
www.sargentlundy.com

Sargent & Lundy

TABLE OF CONTENTS

EXECUTIVE SUMMARY

This report presents the 2025 annual safety factor assessment for the East Ash Pond and West Ash Pond at Midwest Generation, LLC's (MWG) Waukegan Generating Station ("Waukegan" or the "Station"). This annual assessment, prepared by Sargent & Lundy (S&L) on behalf of MWG, documents whether the critical cross section at each pond achieves the minimum safety factors specified in 35 Ill. Adm. Code 845.460(a). To complete this assessment, S&L re-evaluated the bases for the most recent structural stability and liquefaction analyses performed for each pond to determine (1) if any changes have occurred and (2) whether identified changes warrant updating the subject structural stability or liquefaction analysis. Where no changes were noted for a given input, or where identified changes were determined to have no impact to the results and conclusions of the subject structural stability or liquefaction analysis, the previous evaluation of that input was considered to still be valid for this 2025 safety factor assessment.

The most recent structural stability and liquefaction analyses for the East Ash Pond and West Ash Pond were performed in 2016 for the ponds' initial federal safety factor assessment under 40 CFR 257.73(e). Since then, Waukegan has taken the East Ash Pond and West Ash Pond out of service and has opened the Recycle Water Sump drain gates to lower and control the water levels in the ponds. As a result, the operating water level in each pond is limited to approximately one foot. In addition, the design seismic loading on the ponds has been reduced due to updates made to the reference design standard (ASCE 7) used to calculate the seismic design parameters for the site. However, there have been no significant modifications to the ponds' embankments, underlying soils, adjacent topography, or groundwater levels. Moreover, the lower surface water elevation in the ponds and the lower design seismic loading each reduce the driving forces on each pond's critical cross section calculated for the ponds' initial federal safety factor assessment. Therefore, the 2016 structural stability and liquefaction analyses for the East Ash Pond and West Ash Pond are conservative for the ponds' current operating conditions. Thus, the initial factors of safety calculated for the East Ash Pond and West Ash Pond in 2016 and the bases for these safety factors remain valid, albeit conservative, for this 2025 safety factor assessment.

Table ES-1 on the following page presents the 2025 factors of safety for the East Ash Pond and West Ash Pond as determined in this assessment in accordance with 35 Ill. Adm. Code 845.460(a).

Table ES-1 – 2025 Factors of Safety per 35 Ill. Adm. Code 845.460(a) for the East Ash Pond and West Ash Pond at the Waukegan Generating Station

Loading Condition	East Ash Pond	West Ash Pond	Min. Allowable Factor of Safety
Long-Term, Maximum Storage Pool	≥ 1.50	≥ 1.50	**1.50**
Maximum Surcharge Pool	≥ 1.40	≥ 1.40	**1.40**
Seismic	≥ 1.00	≥ 1.00	**1.00**
Liquefaction	Note 1	Note 1	**1.20**

Notes: 1) The embankment soils for the Ponds are not considered susceptible to liquefaction because saturation of the embankment soils is unlikely based on the installed geomembrane liner system. A limited portion of the bottom of the embankments may become saturated with groundwater based on the design phreatic surface. Liquefaction triggering analyses of these saturated soils show that liquefaction and associated post-liquefaction shear strength loss is unlikely for the design seismic event (Ref. 3). Thus, liquefaction safety factors are not reported.

1.0 PURPOSE & SCOPE

1.1 PURPOSE

The East and West Ash Ponds (the Ponds) at Midwest Generation, LLC's (MWG) Waukegan Generating Station ("Waukegan" or the "Station") are existing coal combustion residual (CCR) surface impoundments that are regulated by the Illinois Pollution Control Board's "Standards for the Disposal of Coal Combustion Residuals in CCR Surface Impoundments." These regulations are codified in Part 845 to Title 35 of the Illinois Administrative Code (35 Ill. Adm. Code 845, Ref. 1) and are also referred to herein as the "Illinois CCR Rule." Pursuant to 35 Ill. Adm. Code 845.460(a), MWG must conduct and complete an annual safety factor assessment that documents whether the critical cross section at each of the Ponds achieves the minimum safety factors specified in 35 Ill. Adm. Code 845.460(a).

This report documents the 2025 safety factor assessment conducted and completed in accordance with the Illinois CCR Rule by Sargent & Lundy (S&L) on behalf of MWG for the East and West Ash Ponds at Waukegan. This report:

- Lists the inputs and assumptions used in the 2025 safety factor assessment,
- Discusses the methodology used to conduct the 2025 safety factor assessment,
- Lists and compares the safety factor acceptance criteria for CCR surface impoundments promulgated by the Illinois CCR Rule and by the U.S. Environmental Protection Agency's (EPA) regulations for CCR surface impoundments,
- Summarizes the results from the initial federal safety factor assessment completed for the Ponds pursuant to the aforementioned U.S. EPA regulations,
- Evaluates potential changes to the inputs used in the initial federal safety factor assessment to determine whether new or updated liquefaction and/or structural stability analyses are warranted, and
- Provides the 2025 factors of safety for the East and West Ash Ponds in accordance with 35 Ill. Adm. Code 845.460(a).

1.2 SCOPE

In addition to being regulated under the Illinois CCR Rule, the Ponds at Waukegan are also regulated by the U.S. EPA's "Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments," 40 CFR Part 257 Subpart D (Ref. 2), also referred to herein as the "Federal CCR Rule." Per the 2016 Water Infrastructure Improvements for the Nation (WIIN) Act, the East and West Ash Ponds will continue to be subject to both the Illinois and Federal CCR Rules until the U.S. EPA approves the Illinois EPA's CCR permit program. However, the scope of this 2025 safety factor assessment is strictly limited to demonstrating compliance with the Illinois CCR Rule. Pursuant to 40 CFR 257.73(f)(3), the next safety factor

assessment for demonstrating compliance with the Federal CCR Rule is not required until 2026, five years after the last federal assessment was completed (2021).

2.0 INPUTS

Safety Factor Acceptance Criteria for CCR Surface Impoundments

The Illinois CCR Rule (Ref. 1, § 845.460) requires each existing CCR surface impoundment to achieve four minimum safety factors at the impoundment's critical cross section, which is defined by the Illinois CCR Rule as "the cross section anticipated to be the most susceptible of all cross-sections to structural failure based on appropriate engineering considerations, including loading conditions." The Federal CCR Rule (Ref. 2, § 257.73(e)) has the same safety factor acceptance criteria as the Illinois CCR Rule. Table 1 presents the safety factor acceptance criteria promulgated by both sets of regulations for existing CCR surface impoundments.

Table 1 – Safety Factor Acceptance Criteria for Existing CCR Surface Impoundments

Loading Condition	Minimum Allowable Factor of Safety	Illinois CCR Rule Reference	Federal CCR Rule Reference
Long-Term, Maximum Storage Pool	1.50	§ 845.460(a)(2)	§ 257.73(e)(1)(i)
Maximum Surcharge Pool	1.40	§ 845.460(a)(3)	§ 257.73(e)(1)(ii)
Seismic	1.00	§ 845.460(a)(4)	§ 257.73(e)(1)(iii)
Liquefaction	1.20	§ 845.460(a)(5)	§ 257.73(e)(1)(iv)

Initial Federal Safety Factor Assessment

Appendix A provides the initial federal safety factor assessment conducted by Geosyntec Consultants in 2016 for the Ponds (Ref. 3).

Site Topography & Aerial Images

Topographic data for the Ponds and the adjacent areas was obtained from an aerial survey flown at the site in December 2015 (Ref. 4). Historical and recent aerial images of the Ponds and adjacent areas were obtained from Google Earth Pro (Ref. 5).

Groundwater

Static water elevation data for groundwater at the site was obtained from annual groundwater monitoring reports prepared by KPRG and Associates, Inc. for the Ponds in accordance with 40 CFR 257.90(e) and 35 Ill. Adm. Code 845.610(e)(1) (Refs. 15 through 23).

Ash Pond Conditions

The operating and physical conditions for the East and West Ash Ponds are based on the following inputs:

- Observations made during a site visit by S&L on August 28, 2025.
- Discussions with MWG personnel.
- The annual inspection reports prepared for the CCR surface impoundments in accordance with 40 CFR 257.83(b) and 35 Ill. Adm. Code 845.540(b) (Refs. 6 through 14).
- The weekly inspection reports prepared in accordance with 35 Ill. Adm. Code 845.540(a) since the 2024 safety factor assessment was issued (Ref. 26).

Horizontal Seismic Coefficient

Pursuant to 35 Ill. Adm. Code 845.460(a)(4), the Ponds must have a minimum factor of safety of 1.00 when analyzed under a seismic loading condition. This loading condition is represented by a horizontal seismic coefficient that is based on a peak ground acceleration (PGA) with a 2 percent probability of exceedance in 50 years in accordance with the definition of "[m]aximum horizontal acceleration in lithified earth material" promulgated by 35 Ill. Adm. Code 845.120. The design horizontal seismic coefficient is also based on the mapped spectral response acceleration at a period of 1 second adjusted for site-specific soil conditions (S_{M1}). Table 2 presents the seismic response parameters obtained from ASCE 7-22 (Ref. 24) on which the Ponds' seismic loading condition was based.

Table 2 – Horizontal Seismic Coefficient Inputs

Parameter	Symbol	Value
Peak Ground Acceleration	PGA	0.066
Mapped Spectral Response, 1-Second Period, Adjusted for Site Effects	S_{M1}	0.13

3.0 ASSUMPTIONS

There are no assumptions in this document that require verification.

4.0 METHODOLOGY

As documented in last year's safety factor assessment, the 2024 factors of safety for the East and West Ash Ponds were based on the initial factors of safety calculated for the Ponds in 2016 pursuant to the Federal CCR Rule after it was determined that the bases for the initial federal safety factor assessment were still valid. Accordingly, the bases for the East and West Ash Ponds' initial factors of safety as documented within the Ponds' initial federal safety factor assessment were re-evaluated to determine if any changes have occurred since the initial federal assessment was completed. Identified changes were then evaluated to determine if updates to the Ponds' previous structural stability and/or liquefaction analyses were warranted.

Where no changes were noted for a given input, or where identified changes were determined to have no impact to the results and conclusions of the initial federal safety factor assessment, the previous evaluation of that input was considered to still be valid for this 2025 assessment.

5.0 ASSESSMENT

5.1 SUMMARY OF 2024 SAFETY FACTOR ASSESSMENT

The previous safety factor assessment for the East and West Ash Ponds was completed on October 13, 2024. The 2024 factors of safety for the East and West Ash Ponds were based on the factors of safety calculated in the initial federal safety factor assessment after it was determined that the bases for the initial federal safety factor assessment were still valid. The initial federal safety factor assessment for the East and West Ash Ponds concluded the Ponds' critical cross-sections are stable and meet the safety factor requirements presented in 40 CFR 257.73(e)(1)(i) through 257.73(e)(1)(iv). Because the Illinois and Federal CCR Rules have the same safety factor acceptance criteria, the 2024 safety factor assessment concluded that the factors of safety calculated for the Ponds in the initial federal safety factor assessment are in conformance with the safety factor criteria promulgated under 35 Ill. Adm. Code 845.460(a)(2) through 845.460(a)(5).

5.2 SUMMARY OF INITIAL FEDERAL SAFETY FACTOR ASSESSMENT

The initial federal safety factor assessment for the East and West Ash Ponds was completed in October 2016 and is included in its entirety in Appendix A. As previously stated, the results of this assessment indicated that the Ponds' critical cross-sections are stable and meet the factor of safety requirements presented in 40 CFR 257.73(e)(1)(i) through 257.73(e)(1)(iv). In addition to evaluating the pond's earthen dikes, the initial federal safety factor assessment also evaluated a metal bin retaining wall located along a portion of the East and West Ash Ponds' northern dikes. This wall section was analyzed to confirm it meets or exceeds the minimum factors of safety for bearing capacity, overturning, and sliding that are generally accepted industry standards.

5.3 CHANGES IN BASES FOR INITIAL FEDERAL SAFETY FACTORS

The following subsections summarize the evaluation conducted to determine if (1) changes to the design inputs used in East and West Ash Ponds' initial federal safety factor assessment have occurred since the assessment was completed in 2016, and (2) whether the 2016 structural stability and liquefaction analyses can be accepted as-is for this 2025 assessment or if further analysis is required.

5.3.1 CHANGES IN GEOTECHNICAL DATA

Based on reviews of the annual inspection reports (Refs. 6 through 14) and Google Earth aerial images (Ref. 5), there have been no significant changes to the embankments or underlying soils that would require updating the geotechnical parameters used in the 2016 analysis (Ref. 3).

5.3.2 CHANGES IN TOPOGRAPHY ADJACENT TO ASH PONDS

Based on reviews of the annual inspection reports (Refs. 6 through 14) and Google Earth aerial images (Ref. 5), there have been no significant modifications to the ground surfaces adjacent to the Ponds (mass excavations, mass fill placement, *etc*.) since the initial federal safety factor assessment was completed. Therefore, the topographic data collected for the site in 2015 (Ref. 4) remains valid for use in this 2025 assessment.

5.3.3 CHANGES IN GROUNDWATER LEVEL

Based on reviews of the annual groundwater monitoring and corrective action reports for the Ponds (Refs. 15 through 23), no significant variations in seasonal groundwater elevations were noted. Because the East and West Ash Ponds are lined with a geomembrane liner, the embankments are not hydraulically connected to the water levels within the Ponds, and a typical phreatic surface normally associated with seepage through an earthen embankment is not applicable. The reported static groundwater elevation is valid for this analysis and there have been no significant changes in the surface water conditions near the site that would impact the site's groundwater levels.

5.3.4 CHANGES IN EMBANKMENT GEOMETRY

Based on reviews of the annual inspection reports (Refs. 6 through 14), Google Earth aerial images (Ref. 5), and visual observations made by S&L in August 2025, there have been no significant modifications to the embankments for the Ponds since the initial federal safety factor assessment was completed. Therefore, there is no basis to re-evaluate the embankment geometry of the Ponds for this 2025 assessment.

5.3.5 CHANGES IN EARTHQUAKE DESIGN BASIS

The design horizontal seismic coefficient utilized in the initial technical analysis (Ref. 3) is based on published data in ASCE 7-10 (Ref. 25). Since the initial analysis was developed, an updated publication of the reference material has been produced (ASCE 7-22 (Ref. 24)), which provides updated values for the parameters used to determine the design horizontal seismic coefficient (see Table 2 and Table 3). Per Table 3, S_{M1} has the same value under ASCE 7-22 and ASCE 7-10, but PGA has a lower value. Based on the reduction in PGA from ASCE 7-10 to ASCE 7-22, the horizontal seismic coefficient for the Ponds' seismic loading condition will be less than the value used in the initial federal safety factor assessment. Therefore,

the horizontal seismic coefficient used for the 2016 analysis is conservative. Thus, it is not necessary to change the earthquake design basis used to conduct the initial safety factor assessment for the Ponds.

Table 3 – Seismic Loading Parameters Comparison

Parameter	Symbol	2016 Values per ASCE 7-10	2025 Values per ASCE 7-22
Peak Ground Acceleration	PGA	0.086	0.066
Mapped Spectral Response, 1-Second Period, Adjusted for Site Class Effects	S_{M1}	0.13	0.13

5.3.6 CHANGES IN ASH POND OPERATIONS

In June 2020, Waukegan took the West Ash Pond out of service for routine cleaning. In April 2021, MWG filed a notice of intent to close the West Ash Pond in accordance with the Federal CCR Rule's closure criteria (Ref. § 257.102). Following the retirements of Units 7 and 8 in June 2022, Waukegan ceased placing CCR wastestreams into the East Ash Pond but continued to use the pond to manage stormwater run-off from the Station property. After implementing modifications to its stormwater management system in May 2024, the Station ceased placing stormwater run-off into the East Ash Pond, and MWG filed a notice of intent to close the East Ash Pond in June 2024. Closure construction activities will commence at both ponds upon receipt of closure construction permits from the Illinois EPA in accordance with Subpart B of the Illinois CCR Rule.

As a part of the modifications made in 2024 to the Station's stormwater management system, the Station opened the Recycle Water Sump drain gates to lower the water level in the East Ash Pond, and the Station continues to keep these gates open to limit water accumulation in the East and West Ash Ponds, essentially leaving the ponds in a constant dewatering state. Because these drain gates are situated one foot above the bottom of each pond, the normal water level in each pond will be limited to approximately one foot (Ref. 26). S&L observed no appreciable surface water in the East Ash Pond and approximately one foot of water in the West Ash Pond during our site visit on August 28, 2025.

The decreases in surface water elevations in the East and West Ash Ponds decrease the driving forces on the embankments; therefore, the surface water elevations used for the 2016 analysis are conservative for the ponds' current operation condition. Therefore, it is not necessary to re-evaluate the surface water elevations used to conduct the initial federal safety factor assessment for the Ponds in this 2025 assessment.

5.4 2025 SAFETY FACTOR ASSESSMENT

Since the Ponds' initial safety factor assessment was completed in 2016 in accordance with the Federal CCR Rule, Waukegan has implemented operational changes that reduce the Ponds' operating water levels

to approximately one foot. In addition, the horizontal seismic coefficient calculated using the updated seismic design parameters in ASCE 7 will be less than the value used in the initial federal safety factor assessment. However, there have been no significant changes to the embankments, underlying soils, adjacent topography, or groundwater levels. Moreover, the lower surface water elevations in the Ponds and the lower design seismic loading each reduce the driving forces on each pond's critical cross section calculated in in the initial federal safety factor assessment, thereby making the 2016 analysis conservative under present design criteria. Therefore, the initial federal safety factor assessment completed in 2016 for the East and West Ash Ponds remains valid, albeit conservative.

Based on the preceding observations, the initial factors of safety calculated for the East and West Ponds in 2016 pursuant to the Federal CCR Rule and the bases for these safety factors remain valid, albeit conservative, for this 2025 assessment. As previously discussed, because the Illinois and Federal CCR Rules have the same safety factor acceptance criteria, these factors of safety for the East and West Ash Ponds are in conformance with the safety factor criteria promulgated under 35 Ill. Adm. Code 845.460(a)(2) through 845.460(a)(5).

6.0 CONCLUSIONS

This assessment re-evaluated the factors and design inputs used as the bases for the initial federal safety factor assessment completed in 2016 in accordance with the Federal CCR Rule for Waukegan's East and West Ash Ponds (Ref. 3). Since 2016, the Station has lowered the operating water levels in both ponds, and the design seismic loading has been reduced due to updates made to the reference design standard (ASCE 7) used to calculate the seismic design parameters for the site; both of these updates reduce the driving forces on each pond's critical cross section. Otherwise, it was determined that no other significant changes have occurred within the last nine years that would invalidate the conclusions of the initial federal safety factor assessment. Therefore, the factors of safety reported in the initial federal safety factor assessment for the East and West Ash Ponds' earthen dikes and retaining wall remain valid, albeit conservative, for this 2025 assessment. Moreover, because the Illinois and Federal CCR Rules have the same safety factor acceptance criteria, these federal factors of safety for the East and West Ash Ponds are in conformance with the safety factor criteria promulgated under 35 Ill. Adm. Code 845.460(a)(2) through 845.460(a)(5).

Table 4 on the following page presents the 2025 factors of safety for the East and West Ash Ponds' earthen dikes at Waukegan in accordance with 35 Ill. Adm. Code 845.460(a).

Table 4 – 2025 Illinois CCR Rule Factors of Safety for the East and West Ash Ponds at the Waukegan Generating Station

Loading Condition	East Ash Pond	West Ash Pond	Min. Allowable Factor of Safety
Long-Term, Maximum Storage Pool	≥ 1.50	≥ 1.50	**1.50**
Maximum Surcharge Pool	≥ 1.40	≥ 1.40	**1.40**
Seismic	≥ 1.00	≥ 1.00	**1.00**
Liquefaction	Note 1	Note 1	**1.20**

Notes: 1) The embankment soils for the Ponds are not considered susceptible to liquefaction because saturation of the embankment soils is unlikely based on the installed geomembrane liner system. A limited portion of the bottom of the embankments may become saturated with groundwater based on the design phreatic surface. Liquefaction triggering analyses of these saturated soils show that liquefaction and associated post-liquefaction shear strength loss is unlikely for the design seismic event (Ref. 3). Thus, liquefaction safety factors are not reported.

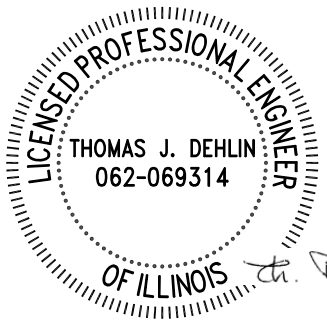
7.0 CERTIFICATION

I certify that:

- This safety factor assessment was prepared by me or under my direct supervision.
- The work was conducted in accordance with the requirements of 35 Ill. Adm. Code 845.460.
- I am a registered professional engineer under the laws of the State of Illinois.

Certified By: Thomas J. Dehlin Date: October 13, 2025

Seal:



Digitally signed by Thomas Dehlin
Date: 2025.10.13 22:12:54-05'00'

8.0 REFERENCES

1. Illinois Pollution Control Board. “Standards for Disposal of Coal Combustion Residuals in CCR Surface Impoundments.” 35 Ill. Adm. Code 845. Accessed September 27, 2024.
2. U.S. Environmental Protection Agency. “Standards for Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments.” 40 CFR Part 257 Subpart D. https://www.ecfr.gov/current/title-40/chapter-I/subchapter-I/part-257/subpart-D. Accessed September 27, 2024.
3. Geosyntec Consultants. “Structural Stability and Factor of Safety Assessment, East and West Ash Basins, Waukegan Station.” October 2016.
4. GeoTerra. Photogrammetric Survey, Waukegan Generating Station. Flight Date: December 4, 2015.
5. Google Earth Pro v7.3.0.3832. Accessed September 15, 2025.
6. Geosyntec Consultants. “Annual Inspection Report, West and East Ash Basins, Waukegan Station.” January 2016.
7. Geosyntec Consultants. “Annual Inspection Report, West and East Ash Basins, Waukegan Station.” October 2017.
8. Civil & Environmental Consultants, Inc. “Annual Inspection Report, East Ash Pond and West Ash Pond, Waukegan Station.” October 2018.
9. Civil & Environmental Consultants, Inc. “Annual Inspection Report, East Ash Pond and West Ash Pond, Waukegan Station.” October 2019.
10. Civil & Environmental Consultants, Inc. “Annual Inspection Report, East Ash Pond and West Ash Pond, Waukegan Station.” October 2020.
11. Civil & Environmental Consultants, Inc. “Annual Inspection Report – East Ash Pond and West Ash Pond, Waukegan Station.” October 2021.
12. Civil & Environmental Consultants, Inc. “Annual Inspection Report – East Ash Pond and West Ash Pond, Waukegan Station.” October 2022.
13. Civil & Environmental Consultants, Inc. “Annual Inspection Report – East Ash Pond and West Ash Pond, Waukegan Station.” October 2023.
14. Civil & Environmental Consultants, Inc. “Annual Inspection Report – East Ash Pond and West Ash Pond, Waukegan Station.” October 2024.
15. KPRG and Associates, Inc. “CCR Compliance, Annual Groundwater Monitoring and Corrective Action Report – 2017: Midwest Generation, LLC, Waukegan Station, 401 E. Greenwood Avenue, Waukegan, Illinois.” Dated January 24, 2018.

16. KPRG and Associates, Inc. “CCR Compliance, Annual Groundwater Monitoring and Corrective Action Report – 2018: Midwest Generation, LLC, Waukegan Station, 401 E. Greenwood Avenue, Waukegan, Illinois.” Dated January 31, 2019.
17. KPRG and Associates, Inc. “CCR Compliance, Annual Groundwater Monitoring and Corrective Action Report – 2019: Midwest Generation, LLC, Waukegan Station, 401 E. Greenwood Avenue, Waukegan, Illinois.” Dated January 31, 2020.
18. KPRG and Associates, Inc. “CCR Compliance, Annual Groundwater Monitoring and Corrective Action Report – 2020: Midwest Generation, LLC, Waukegan Station, 401 E. Greenwood Avenue, Waukegan, Illinois.” Dated January 31, 2021.
19. KPRG and Associates, Inc. “CCR Compliance, Annual Groundwater Monitoring and Corrective Action Report – 2021: Midwest Generation, LLC, Waukegan Station, 401 E. Greenwood Avenue, Waukegan, Illinois.” January 2022.
20. KPRG and Associates, Inc. “Illinois CCR Compliance, Annual Groundwater Monitoring and Corrective Action Report - 2021: Midwest Generation, LLC, Waukegan Station, 401 E. Greenwood Avenue, Waukegan Illinois.” January 2022.
21. KPRG and Associates, Inc. “Illinois CCR Compliance, Annual Groundwater Monitoring and Corrective Action Report - 2022: Midwest Generation, LLC, Waukegan Station, 401 E. Greenwood Avenue, Waukegan Illinois.” January 2023.
22. KPRG and Associates, Inc. “Illinois CCR Compliance, Annual Groundwater Monitoring and Corrective Action Report - 2023: Midwest Generation, LLC, Waukegan Station, 401 E. Greenwood Avenue, Waukegan Illinois.” January 2024.
23. KPRG and Associates, Inc. “Illinois CCR Compliance, Annual Groundwater Monitoring and Corrective Action Report - 2024: Midwest Generation, LLC, Waukegan Station, 401 E. Greenwood Avenue, Waukegan Illinois.” January 2025.
24. American Society of Civil Engineers. *Minimum Design Loads and Associated Criteria for Buildings and Other Structures*. ASCE/SEI 7-22. 2022.
25. American Society of Civil Engineers. *Minimum Design Loads and Associated Criteria for Buildings and Other Structures*. ASCE/SEI 7-10. 2010.
26. Midwest Generation, LLC. “IL Weekly and Monthly Inspection.” 2024 Week 41 through 2025 Week 36. Accessed via https://midwestgenerationllc.com/illinois-ccr-rule-compliance-data-and-information/.

APPENDIX A: 2016 FEDERAL SAFETY FACTOR ASSESSMENT FOR EAST & WEST ASH PONDS

Geosyntec consultants

16644 West Bernardo Drive, Suite 301
San Diego, CA 92127
Phone: 858.674.6559
Fax: 858.674.6586
www.geosyntec.com

STRUCTURAL STABILITY AND FACTOR OF SAFETY ASSESSMENT
EAST AND WEST ASH BASINS
WAUKEGAN STATION
OCTOBER 2016

This report presents the initial periodic structural stability and initial safety factor assessment of the East and West Ash Basins (the Basins) at the Waukegan Station (Site) in Waukegan, Illinois (Figure 1). This report addresses the initial structural stability and safety factor assessment requirements of the Coal Combustion Residuals (CCR) regulations, Code of Federal Regulations Title 40, Part 257, Subpart D (referred to as the CCR Rule). These regulations were published in the Federal Register on 17 April 2015 and became effective on 19 October 2015. The Waukegan Station is owned and operated by Midwest Generation, LLC (Midwest Generation). Based on the results provided in this report, the East and West Ash Ponds meet the requirements of §257.73(d) and §257.73(e) of the CCR Rule.

The work presented in this report was performed under the direction of Ms. Jane Soule, P.E., of Geosyntec Consultants Inc. (Geosyntec) in accordance with §257.73(d) and §257.73(e). Mr. Robert White reviewed this report in accordance with Geosyntec's senior review policy.

1. Regulation Requirements - §257.73

Structural integrity criteria for existing CCR impoundments is described in §257.73 and includes structural stability and factor of safety assessments. The East and West Ash Basins meet the minimum size and capacity criteria under §257.73(b) and are subject to the structural stability and safety factor assessments required.

2. Site Conditions

The Basins are co-located in the southeastern portion of the Waukegan Station. A divider berm extends north-south between the Basins. The Basins are irregular in shape, and each includes a finger berm extending from the northern boundary southward approximately 715 feet. The West Ash Basin is approximately 470 feet by 975 feet in plan dimensions with a total plan area of approximately 11.0 acres (including the finger berm and embankment crests). The East Ash Basin is approximately 470 feet by 1,030 feet in plan dimensions with a total plan area of approximately 11.8 acres (including the finger berm and embankment crests).

A retaining wall is located on the downstream side of the north embankment, north of the outlet structures for the Basins.

Based on available documentation and discussions with site personnel, the Basins, in their current configuration, were constructed in the late 1970s. A history of construction for the Basins

was prepared in accordance with §257.73(c) and describes the design of the Basins and their construction (Geosyntec, 2016a).

3. Structural Stability Assessment

The following subsections address the components of §257.73(d)(1).

3.1 Foundations and Abutments – §257.73(d)(1)(i)

The East and West Ash Basins consist of fill embankments on all sides. The area west of the West Ash Basin includes fill graded to approximately the same elevation as the west embankment crest. Because no formational material provides lateral structural support for the embankments, there are no abutments associated with the Basins. The remainder of this section addresses the foundation materials for the East and West Ash Basins.

Previous subsurface investigations performed at the Site indicate the foundation materials underlying the embankments for the East and West Ash Basins generally consist of approximately 30 feet of dense, poorly graded sand with some gravel, and silt and silty sand associated with the Henry Formation (Geosyntec, 2016b). Due to the granular nature of the foundation soils (mostly sand and gravel), settlement associated with the construction and operation of the Basins is anticipated to be predominately elastic settlement, which would likely have occurred soon after construction in the late 1970s. Because of the age of the embankments (over 35 years old), the majority of potential consolidation and secondary compression settlement has likely already occurred. Further, the embankments of the Basins were not constructed with abutments or separate engineered zones that would be most susceptible to the adverse effects of differential settlement.

During the initial annual inspection performed for the Basins in accordance with §257.83(b), no visual evidence of adverse effects resulting from settlement was observed (Geosyntec, 2016c). There are no proposed changes in operation which would increase loading conditions on the foundation; therefore, no significant settlement of the foundation materials underlying the embankments is anticipated to occur in the future and the settlement of the foundation is not anticipated to impact the integrity of the impoundment embankments.

A factor of safety against the triggering of liquefaction was calculated for saturated foundation materials underlying the Basins' embankments. The factor of safety was calculated based methods outlined in Idriss and Boulanger (2008) using information obtained from field explorations, including borings, Cone Penetration Test (CPT) soundings, laboratory data (Geosyntec, 2016b), and seismic data (Geosyntec, 2016d). The liquefaction triggering analyses shows a very low likelihood of liquefaction occurring in the foundation materials underlying the embankments (Geosyntec, 2016d).

3.2 Upstream Slope Protection – §257.73(d)(1)(ii)

The West and East Basins are lined with a 60-mil high density polyethylene (HDPE) geomembrane that protects the interior basin slopes from erosion, the effects of wave action, and mitigates potential effects of rapid drawdown.

3.3 Dike Compaction – §257.73(d)(1)(iii)

Documentation of as-built construction conditions for the East and West Ash Basin embankments was not available at the time of this report. However, available construction drawings from 1977 indicated that embankment fill was to be compacted to a minimum of 95 percent relative compaction as determined by Modified Proctor testing. No recent quantitative evaluation of the degree of compaction of the embankments was performed on the embankments in their current state; however, slope stability analyses shows the embankments for the East and West Ash Basins are sufficient to withstand the range of loading conditions in the CCR units (Geosyntec, 2016e).

3.4 Downstream Slope Vegetation – §257.73(d)(1)(iv)

The northern and southern downstream slopes of the West and East Ash Basins are covered with established vegetation. The eastern downstream slope of the East Ash Basin has been recently covered in erosion control matting and seeded. Based on site observations, the existing surface conditions of the slopes provide adequate slope protection.

3.5 Spillway – §257.73(d)(1)(v)

The West and East Basins were designed and constructed, and are operated and maintained, without spillways. Inflows for the Basins consist solely of regulated flows from plant operations and precipitation that falls within the surface area of the Basins and embankment crests. There is no significant run-on to the Basins. Subsequently, surface water levels are maintained by regulating inflow from plant operations, regulating outflow quantities, and monitoring and maintaining freeboard to accommodate precipitation from the design storm event. An inflow design flood control system plan has been prepared to document that the Basins adequately manage flow from the design event (Geosyntec, 2016f).

3.6 Structural Integrity of Hydraulic Structures – §257.73(d)(1)(vi)

Hydraulic structures passing through or beneath the embankments of the East and West Ash Basins consist of six pipes and conveyance structures associated with the inlet and outlet structures of the Basins. These structures and pipes were inspected between 1 June 2016 and 7 June 2016 by a company specializing in video camera pipe inspections. Inspections consisted

only of the length of the pipe or structure that passes through or beneath the Basins' embankments. The inspected structures and pipes related to the East and West Ash Basins are presented on Figure 2.

The video inspections showed no significant deterioration, deformation, distortion, bedding deficiencies, sedimentation, or debris that would negatively affect the operation of Pipes 1, 2, 3, and 5. The video inspections identified isolated areas of deformation and deterioration of Pipes 4E and 4W, which are 24-inch diameter concrete pipes with invert locations at the bottom of the outlet structures for the East and West Ash Basins, respectively. These pipes are located under the north embankment and are utilized for dewatering the outlet structure. Repairs were made to Pipe 4E to mitigate the isolated areas of deformation and deterioration identified during the inspection. The valve for controlling flow into Pipe 4W has been closed by Site personnel, and Pipe 4W will not be used until a repair is completed. Pipe 4W is not required for normal operation of the West Ash Basin.

3.7 Downstream Slopes Adjacent to Water Bodies – §257.73(d)(1)(vii)

Water bodies near the East and West Ash Basins include a drainage channel located south of the Basins and marsh area east of the Basins. Stability analyses presented in Section 3 demonstrate structural stability with the water body at a "low pool" condition where there is little or no stabilizing force present on the downstream slope of the embankments.

Significant inundation of the downstream slopes of the East and West Ash Basins from the water body is unlikely, and the generally coarse-grained embankment fill materials that are relatively free-draining make a rapid drawdown analysis not applicable. Therefore, a rapid drawdown condition is not anticipated to impact structural stability of the impoundment embankments.

3.8 Structural Stability Assessment Deficiencies - §257.73(d)(2)

A structural stability deficiency associated Pipe 4W was identified in this initial structural stability assessment. Geosyntec suggests relining the interior of the deficient portions of the pipe as a corrective action. The pipe will remain out of service until the repair is complete. Documentation detailing the corrective measures taken to repair the pipe will be prepared after the repair is complete.

3.9 Annual Inspection Requirement - §257.83(b)(4)(ii)

In accordance with §257.83(b)(4)(ii), submittal of this structural stability assessment precludes the requirement of an annual inspection under §257.83(b) for the East and West Ash Basins during the 2016 calendar year. Deficiencies identified in the initial annual inspection for the East

and West Ash Basins were corrected as documented in the Notice of Remedy prepared in response to the initial annual inspection.

4. Safety Factor Assessment

This section describes the initial safety factor assessment for the East and West Ash Basins and the methodology used to perform the assessment in accordance with §257.73(e)(1). This assessment includes slope stability analyses of the critical embankment cross-sections for each basin, shown in Figure 3, and evaluation of stability of the retaining wall north of the Basins.

4.1 Slope Stability Methodology

Limit equilibrium slope stability analyses were performed to evaluate the stability of the embankments for the East and West Ash Basins. The process involved performing two-dimensional analyses on the critical cross-sections for each basin using Spencer's Method as coded in the computer program SLOPE/W (Version 8.15.4.11512, www.geoslope.com) which satisfies vertical and horizontal force equilibrium and moment equilibrium (Geosyntec, 2016e). For each cross section analyzed, the program searches for the sliding surface that produces the lowest factor of safety (FS). Factor of safety is defined as the ratio of the shear forces/moments resisting movement along a sliding surface to the forces/moments driving the instability.

Subsurface stratigraphy, groundwater conditions, and engineering parameters for the embankment and foundation materials were developed based on previous subsurface investigations performed at the Site (Geosyntec, 2016b and Geosyntec, 2016e).

4.2 Slope Stability Analyses

As presented in Table 1, four cases were analyzed to satisfy the safety factor assessment requirements in §257.73(e) (Geosyntec, 2016e).

4.2.1 Static, Long-Term Maximum Storage Pool Loading – §257.73(e)(1)(i)

Pursuant to §257.73(e)(1)(i) a static, long-term condition with the maximum operating pool loading on the embankments was evaluated. For the East and West Ash Basins, this condition included a pool elevation 2 feet below the lowest point of the embankment crest (Geosyntec, 2016e).

4.2.2 Static, Maximum Storage Pool Loading – §257.73(e)(1)(ii)

The conditions for §257.73(e)(1)(ii) are identical to §257.73(e)(1)(i) with the exception of the pool elevation, which is set at the lowest points of the embankment crest (Geosyntec, 2016e).

4.2.3 Seismic – §257.73(e)(1)(iii)

Pursuant to §257.73(e)(1)(iii), a seismic condition for East and West Ash Basins was also analyzed. Seismic stability was evaluated with a pseudostatic analysis that uses constant horizontal accelerations to represent the effects of earthquake shaking. The horizontal accelerations are represented in SLOPE/W by a horizontal seismic coefficient. The horizontal seismic coefficient used for analysis was based on a peak ground acceleration with a 2 percent probability of exceedance in 50 years (Geosyntec, 2016g).

4.2.4 Liquefaction – §257.73(e)(1)(iv)

The majority of the embankment soils for the East and West Ash Basins are not considered susceptible to liquefaction because saturation of the embankment soils is unlikely based on the presence of a geomembrane liner system. Based on the design phreatic surface discussed in Geosyntec (2016b), a limited portion of the bottom of the embankments may become saturated from groundwater. Liquefaction triggering analyses of these saturated embankment soils indicate that liquefaction and associated post-liquefaction shear strength loss is unlikely for the seismic design event (Geosyntec, 2016d). Because the likelihood of liquefaction and associated shear strength loss of the embankment soils is very low, post-liquefaction conditions are represented by the static factor of safety analyses.

4.3 Results

The results of the slope stability analysis for the critical cross sections of the East and West Ash Basin embankments are summarized in Table 1 below and presented in Figures 4 through 9 (Geosyntec 2016e).

Section	Safety Factor			
	257.73(e)(1)(i)	257.73(e)(1)(ii)	257.73(e)(1)(iii)	257.73(e)(1)(iv)
1	≥1.50	≥1.40	≥1.00	≥1.20
2	≥1.50	≥1.40	≥1.00	≥1.20

These results meet the factor of safety requirements presented in §257.73(e)(1)(i) through §257.73(e)(1)(iv).

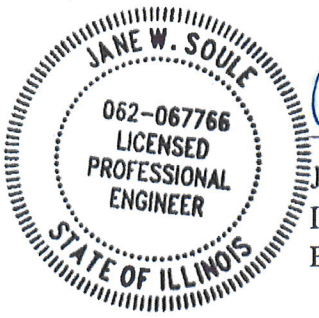
4.4 Retaining Wall Analyses

Stability of the retaining wall located north of the East and West Ash Basins was also evaluated (Geosyntec, 2016h). Construction drawings for the wall were not available, but Geosyntec personnel observed that the wall is a metal bin wall, a form of gravity retaining structure similar to a crib wall, built by combining "bins", or cells filled with soil. Inputs for the analyses were based on field observations and measurements of the wall the subsurface investigations at the

Site (Geosyntec, 2016h and Geosyntec, 2016b). Factors of safety for bearing capacity, overturning, and sliding were calculated for the wall based on methods for evaluating a cantilever retaining wall in Das (2007). Results show that the factors of safety for the wall exceed minimum industry standard values (Geosyntec, 2016h).

5. Limitations and Certification

This initial periodic structural stability and safety factor assessment meets the requirements of §257.73(d) and §257.73(e) of the Code of Federal Regulations Title 40, Part 257, Subpart D, and was prepared in accordance with current practices and the standard of care exercised by scientists and engineers performing similar tasks in the field of civil engineering. The contents of this report are based solely on the observations of the conditions observed by Geosyntec personnel and information provided to Geosyntec by Midwest Generation. Consistent with applicable professional standards of care, our opinions and recommendations were based in part on data furnished by others, which was consistent with other information that we developed in the course of our performance of the scope of services. The information contained in this report is intended for use solely by Midwest Generation and their subconsultants.



Jane W. Soule, P.E.
Illinois Professional Engineer No. 062-067766
Expiration Date: 11/30/2017

6. References

Das, 2007. "Principles of Foundation Engineering," Sixth edition. Thomson Canada Limited.

Geosyntec, 2016a. History of Construction Report, East and West Ash Basins, Waukegan Station, October.

Geosyntec, 2016b. East and West Ash Basin – Soil Properties Calculation, Waukegan Station, October.

Geosyntec, 2016c. Annual Inspection Report, East and West Ash Basin, Waukegan Station, 18 January 2016.

Geosyntec, 2016d. East and West Ash Basin – Liquefaction Calculations, Waukegan Station, October.

Geosyntec, 2016e. East and West Ash Basin – Slope Stability Calculations, Waukegan Station, October.

Geosyntec, 2016f. Inflow Design Flood Control System Plan, West and East Ash Basins, Waukegan Generating Station, October.

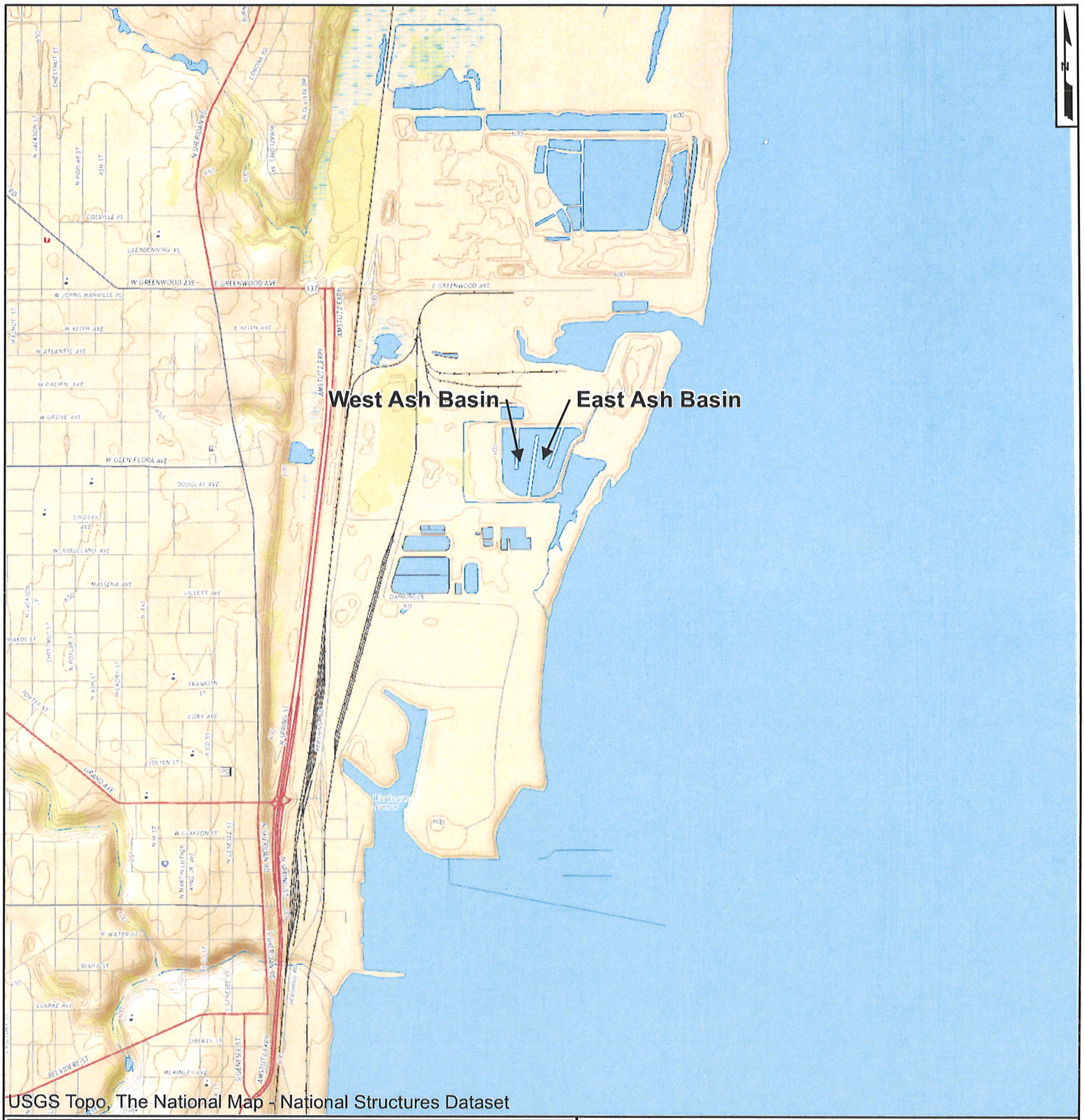
Geosyntec, 2016g. East and West Ash Basin – Seismic Coefficient Calculations, Waukegan Station, October.

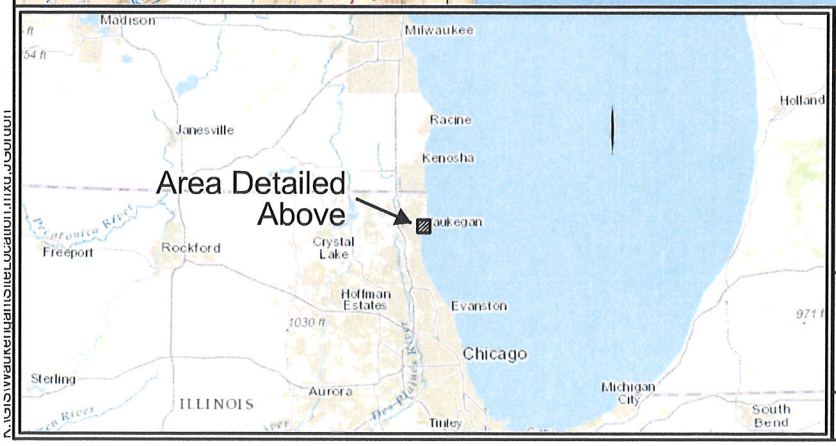
Geosyntec, 2016h. East and West Ash Basin – Retaining Wall Calculations, Waukegan, October.

Idriss and Boulanger, 2008. "Soil Liquefaction During Earthquakes". Earthquake Engineering Research Institute, MNO-12.

Attachments

Figure 1 – Site Location
Figure 2 – Pipe Locations
Figure 3 – Slope Stability Cross Sections
Figure 4 – Slope Stability Output, Section 1 - 257.73(e)(1)(i)
Figure 5 – Slope Stability Output, Section 1 - 257.73(e)(1)(ii)
Figure 6 – Slope Stability Output, Section 1 - 257.73(e)(1)(iii)
Figure 7 – Slope Stability Output, Section 2 - 257.73(e)(1)(i)
Figure 8 – Slope Stability Output, Section 2 - 257.73(e)(1)(ii)
Figure 9 – Slope Stability Output, Section 2 - 257.73(e)(1)(iii)





2,000 1,000 0 2,000 Feet

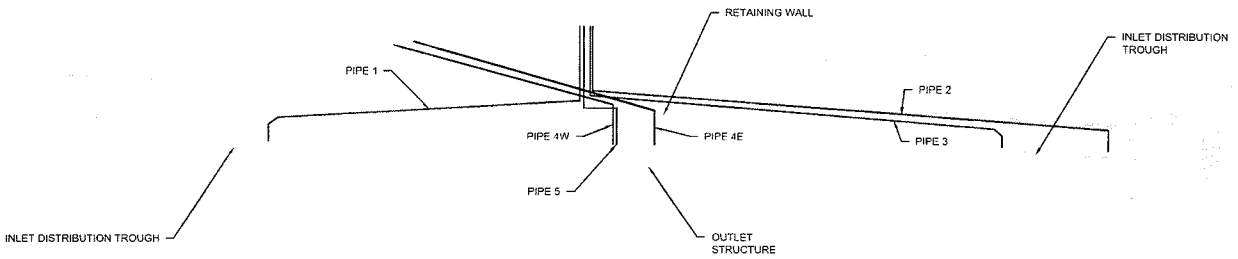
Site Location

East and West Ash Basins
Waukegan Station
Waukegan, Illinois

Geosyntec consultants

San Diego | October 2016

Figure 1



WEST BASIN EAST BASIN

ACCESS RAMP

ACCESS RAMP

LEGEND

EXISTING GROUND MAJOR CONTOUR (5')

EXISTING GROUND MINOR CONTOUR (1')

EXISTING FENCE

EXISTING PIPE

NOTES

1. EXISTING PHOTOGRAMMETRIC SURVEY DATA PROVIDED BY GEO TERRA. FLIGHT DATE: 4 DECEMBER 2015. EAST EMBANKMENT GRADING BASED ON EAST ASH BASIN MODIFICATION CONSTRUCTION DRAWINGS BY GEOSYNTEC (2016).
2. ALL PIPE LOCATIONS ARE APPROXIMATE.
3. PIPES 4E AND 4W DISCHARGE TO THE COAL PILE RUNOFF BASIN. LOCATIONS OF THESE UNDERGROUND PIPES ARE ESTIMATED.

0 150' 300'

SCALE IN FEET

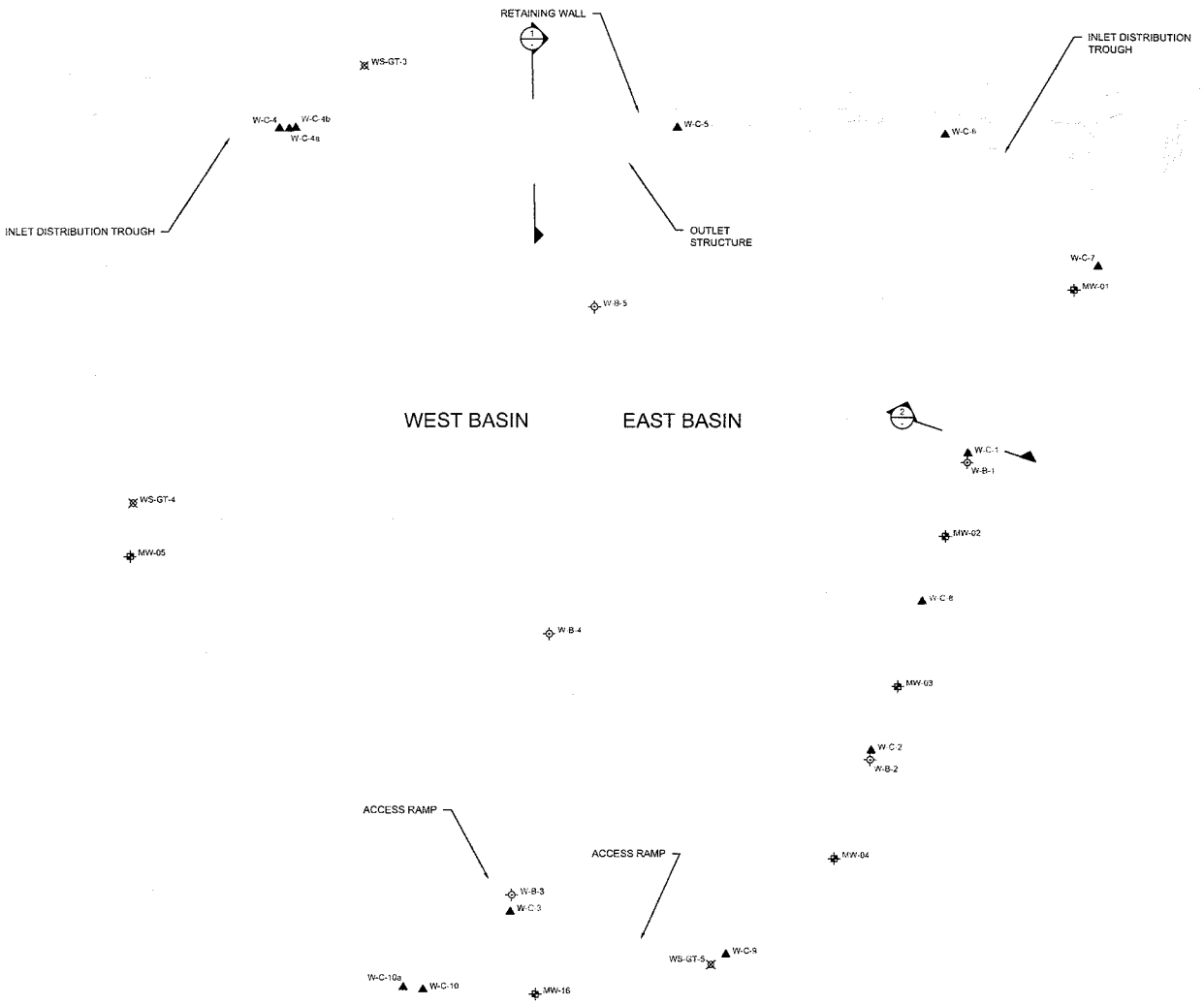
PIPE LOCATIONS
WEST AND EAST ASH BASINS
WAUKEGAN STATION
WAUKEGAN, ILLINOIS

Geosyntec consultants

FIGURE 2

PROJECT NO: SW0251-08 | OCTOBER 2016

Z:\CADD\FIGURES\WAUKEGAN\SW0251-F02--PIPE LOCATIONS



LEGEND

- EXISTING GROUND MAJOR CONTOUR (5')
- EXISTING GROUND MINOR CONTOUR (1')
- EXISTING FENCE
- MONITORING WELL (PATRICK, 2011)
- BORINGS (KPRG, 2005, 2015)
- CPT SOUNDING (GEOSYNTEC, 2016)
- BORING (GEOSYNTEC, 2016)
- CROSS SECTION LOCATION

NOTES

1. EXISTING PHOTOGRAMMETRIC SURVEY DATA PROVIDED BY GEO TERRA. FLIGHT DATE: 4 DECEMBER 2015. PROPOSED GRADING CONTOURS REFER TO DESIGN GRADES CONTAINED IN EAST ASH BASIN SLOPE MODIFICATION CONSTRUCTION DRAWINGS.
2. ALL EXPLORATION LOCATIONS ARE APPROXIMATE.

0 150' 300'

SCALE IN FEET

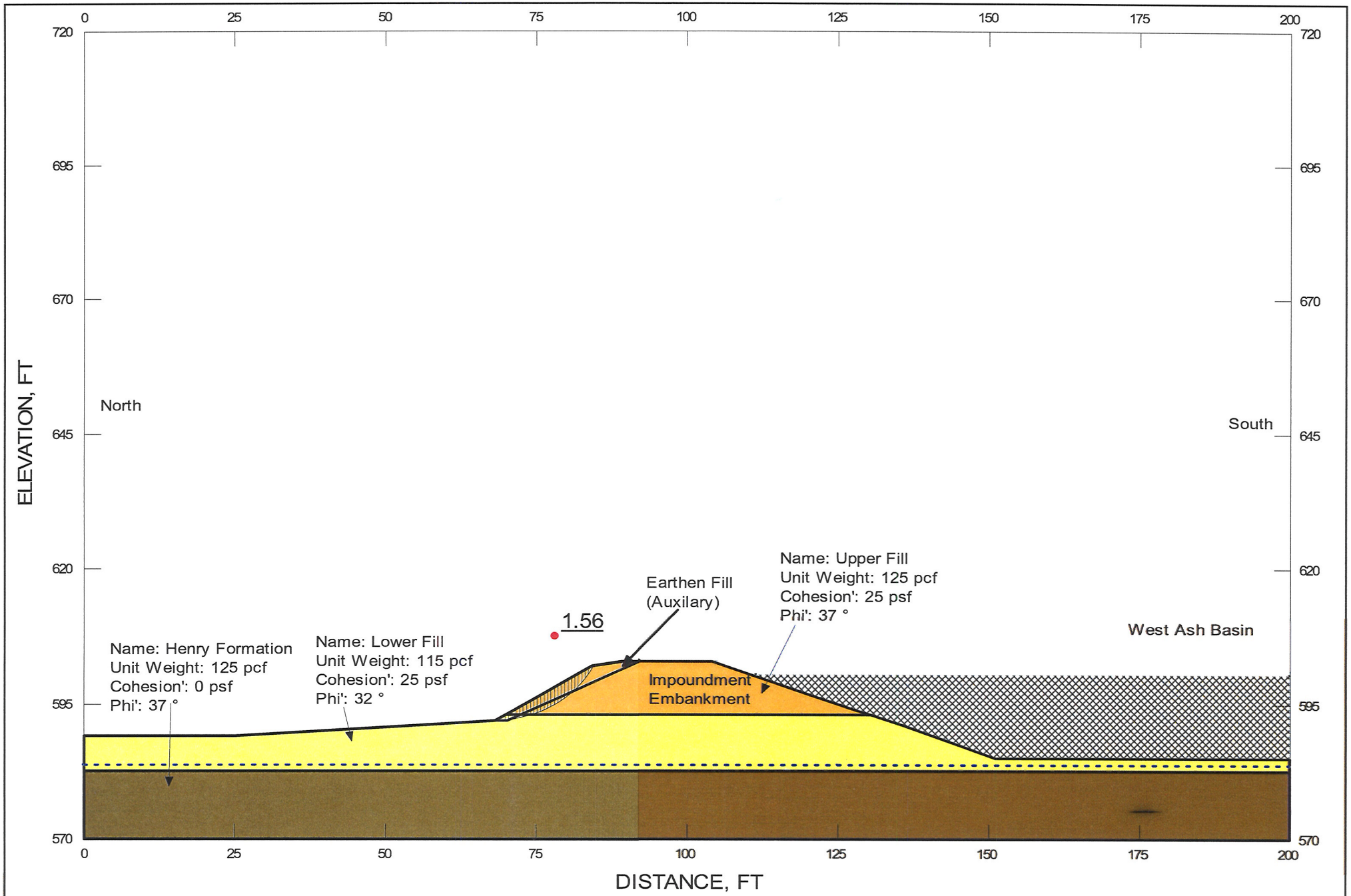
SLOPE STABILITY CROSS SECTIONS
WEST AND EAST ASH BASINS
WAUKEGAN STATION
WAUKEGAN, ILLINOIS

Geosyntec consultants

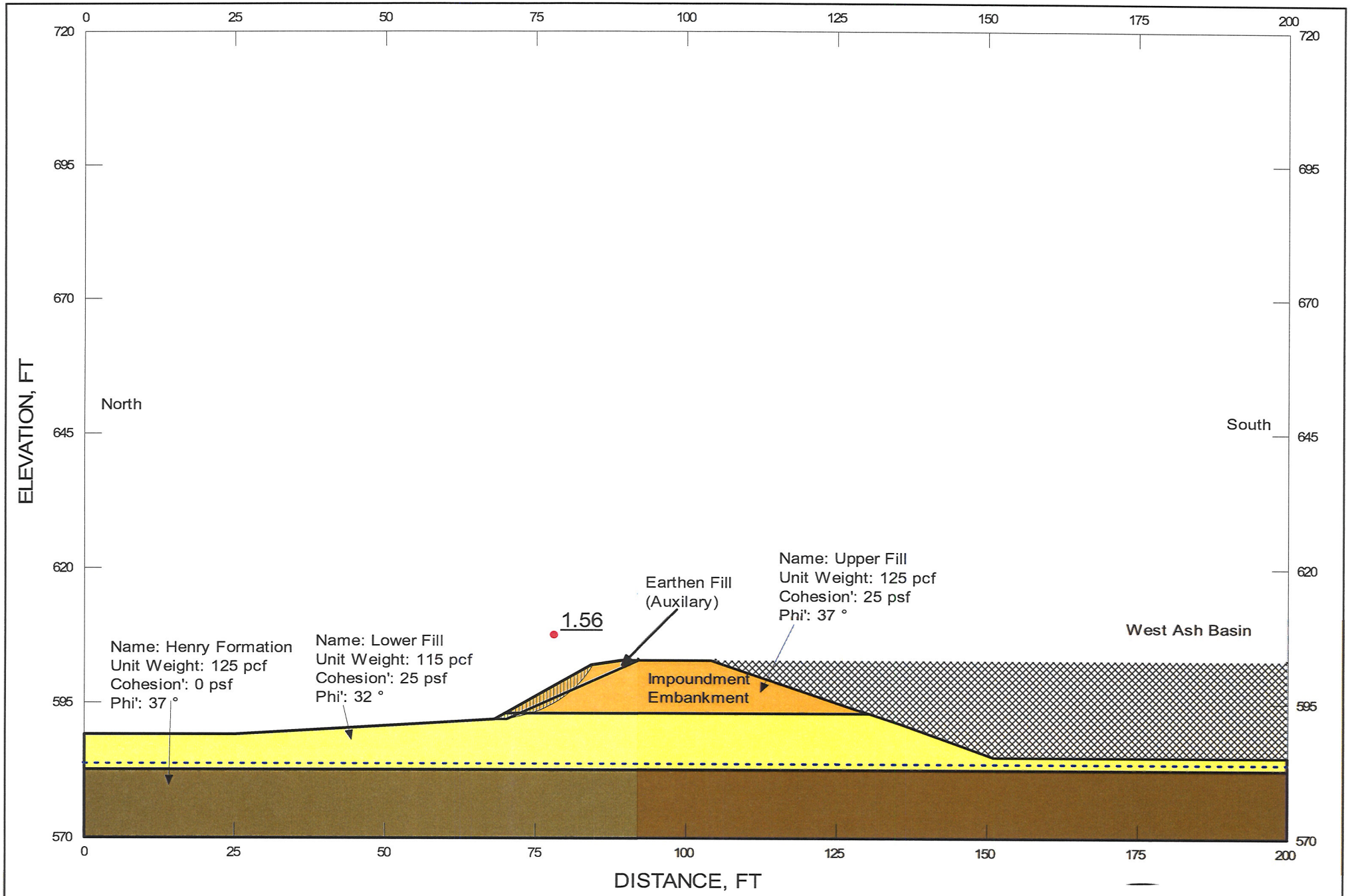
PROJECT NO: SW0251-08 | OCTOBER 2016

FIGURE 3

Z:\CADD\FIGURES\WAUKEGAN\SW0251-F03-STABILITY SECTIONS 1-2

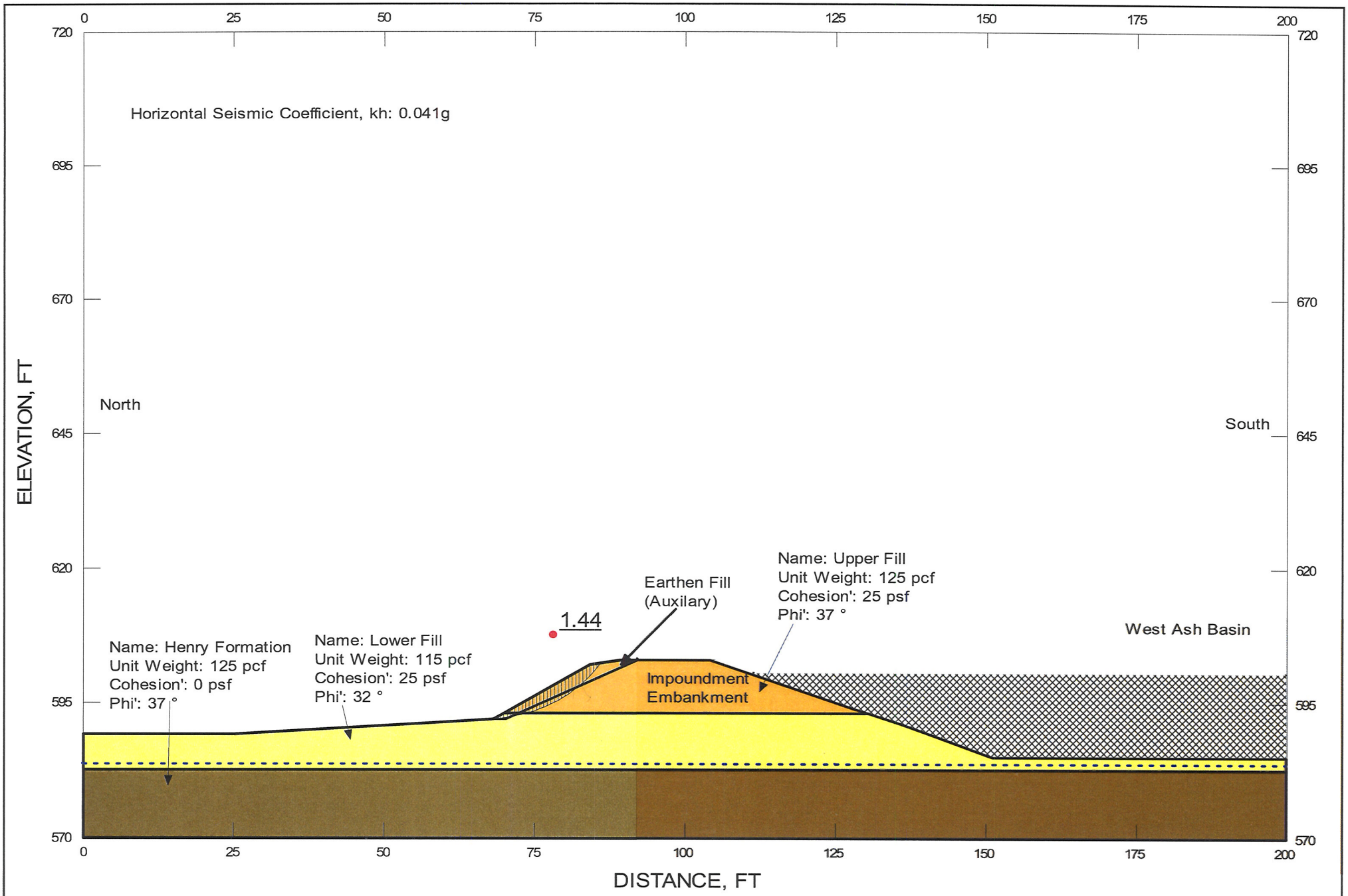


Geosyntec consultants	Analysis: Section 1 - §257.73(e)(1)(i): Long Term, Maximum Storage Pool Loading		FIGURE 4
	Project: Waukegan East and West Ash Basins	Analysis By: Jay Griffin	
	File Name: Waukegan Section 1.gsz	Date: October 2016	

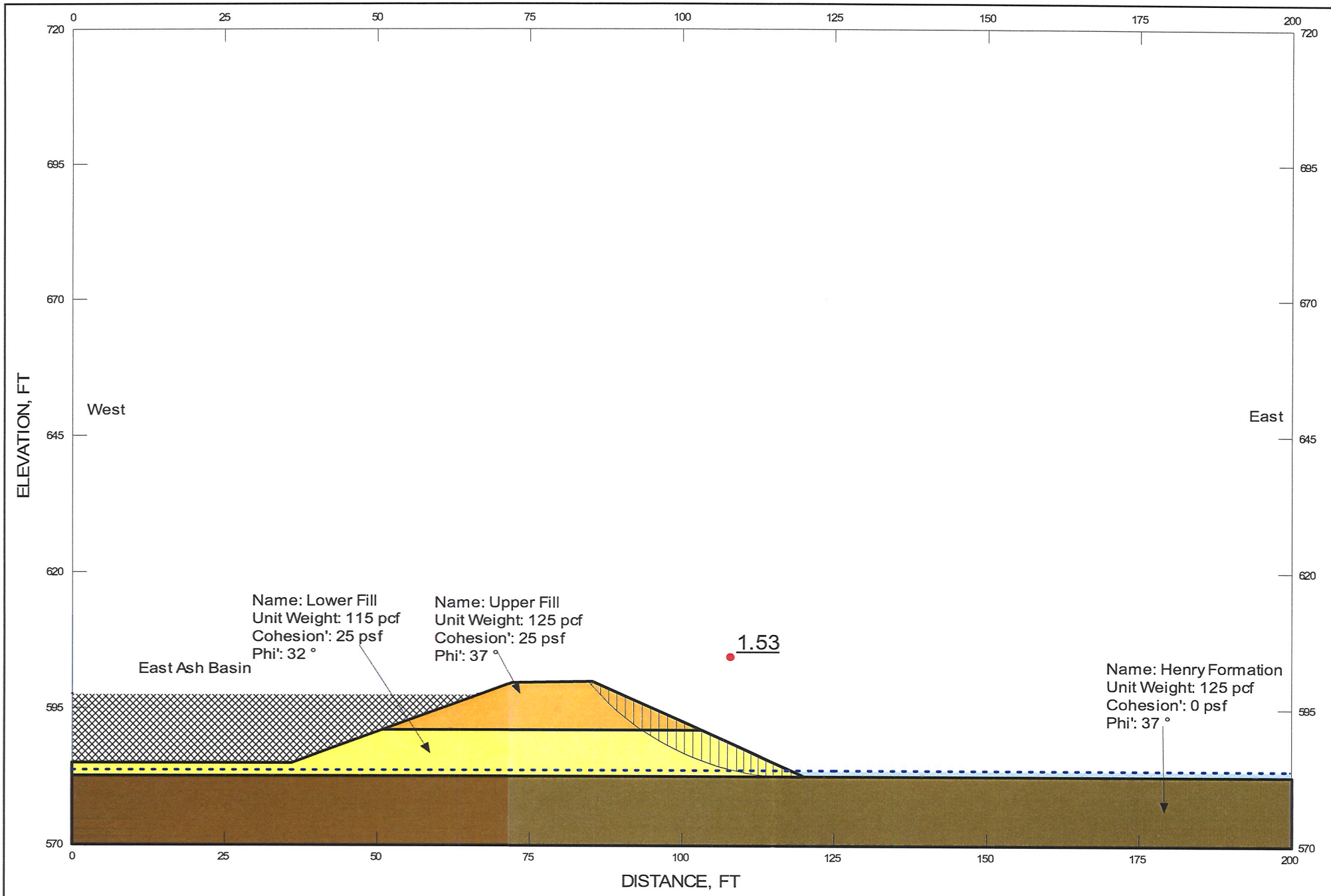


Geosyntec consultants

Analysis	Section 1 - §257.73(e)(1)(ii): Maximum Surcharge Pool Loading		FIGURE 5
Project	Waukegan East and West Ash Basins	Analysis By	Jay Griffin
File Name	Waukegan Section 1.gsz	Date	October 2016



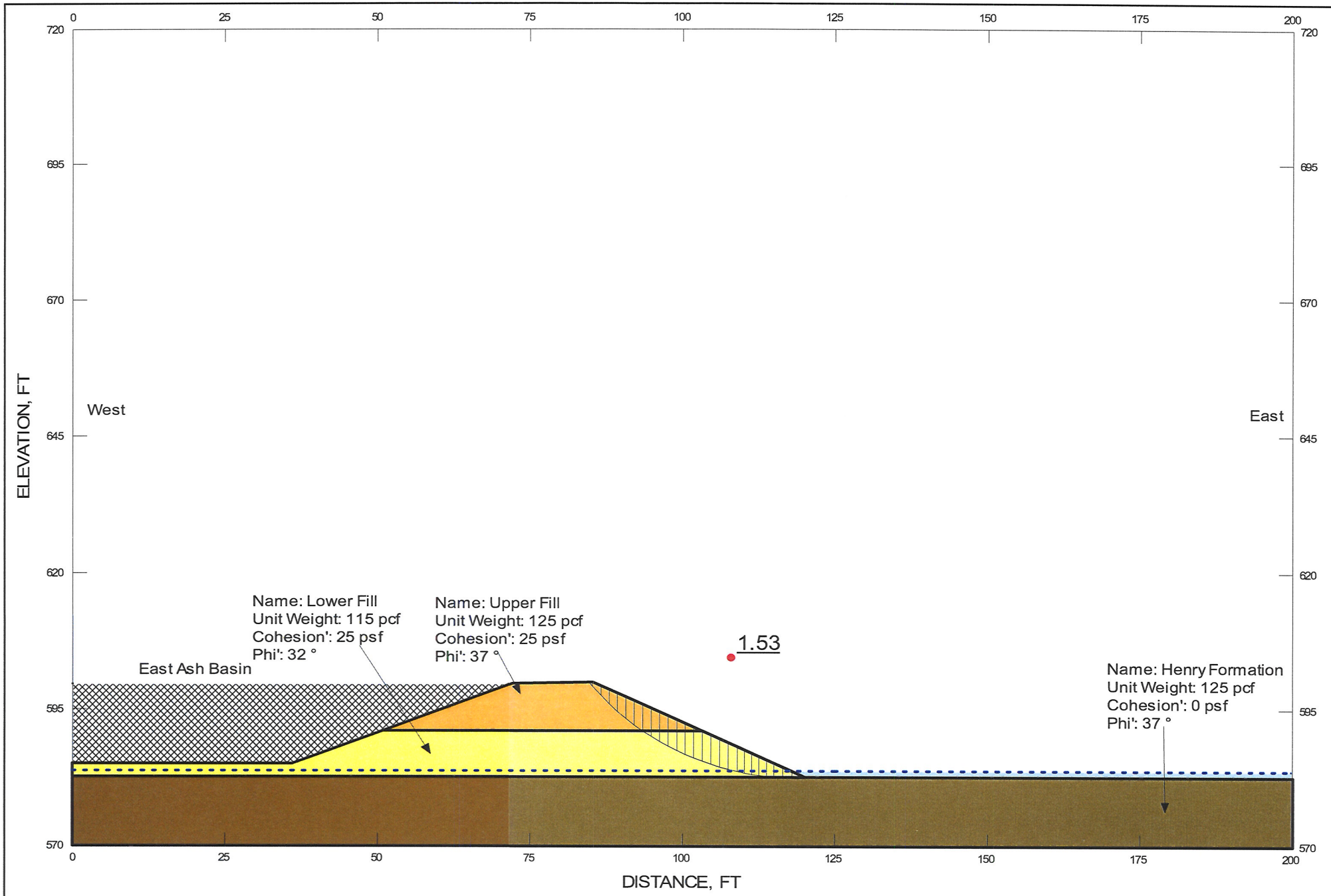
Geosyntec consultants	Analysis: Section 1 - §257.73(e)(1)(iii): Long Term, Maximum Storage Pool Loading with Seismic		FIGURE 6
	Project: Waukegan East and West Ash Basins	Analysis By: Jay Griffin	
	File Name: Waukegan Section 1.gsz	Date: October 2016	



Geosyntec consultants

Analysis	Section 2 - §257.73(e)(1)(i): Long Term, Maximum Storage Pool Loading		
Project	Waukegan East and West Ash Basins	Analysis By	Jay Griffin
File Name	Waukegan Section 2.gsz	Date	October 2016

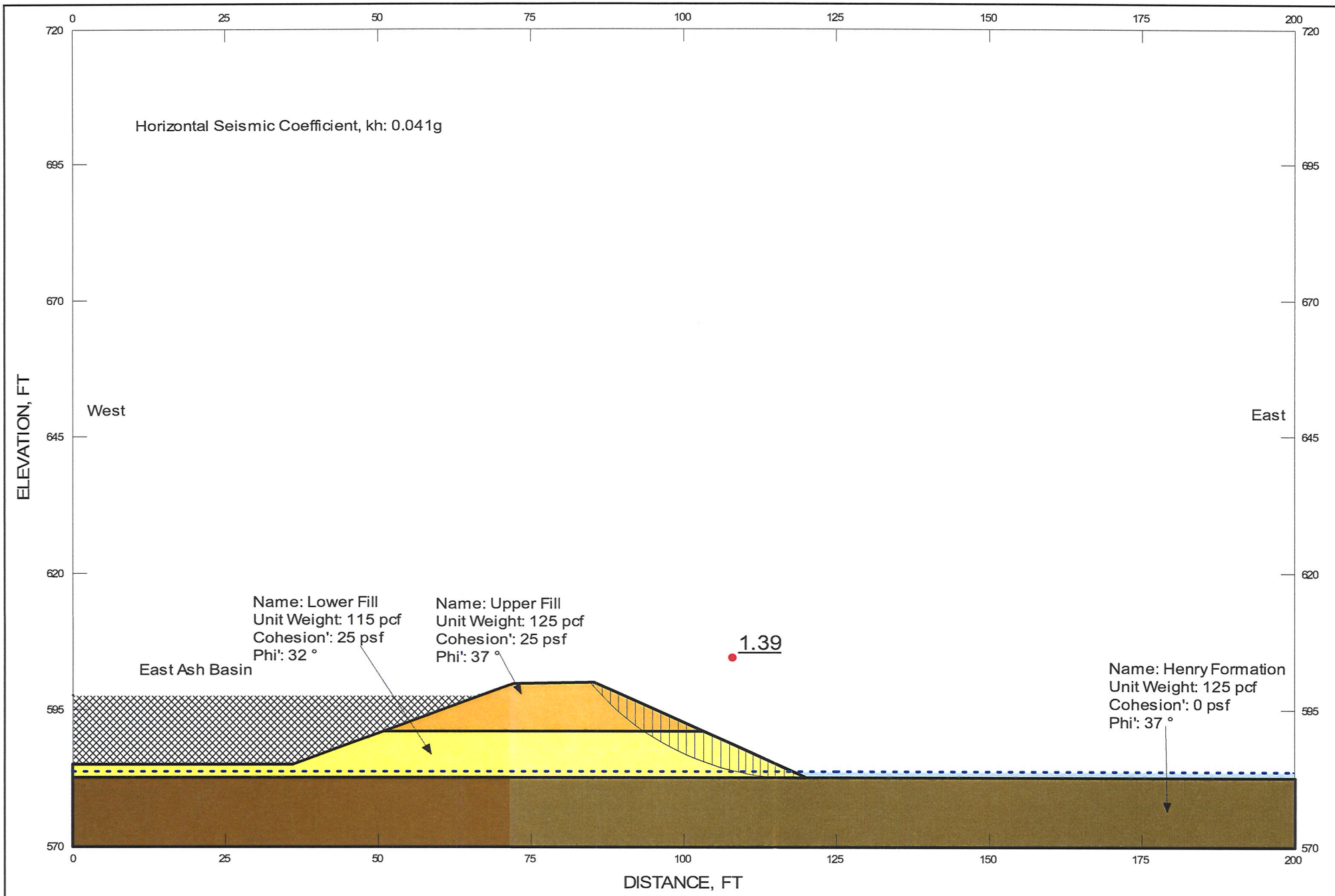
FIGURE 7



Geosyntec consultants

Analysis	Section 2 - §257.73(e)(1)(ii): Maximum Surcharge Pool Loading		
Project	Waukegan East and West Ash Basins	Analysis By	Jay Griffin
File Name	Waukegan Section 2.gsz	Date	October 2016

FIGURE 8



Geosyntec consultants	Analysis: Section 2 - §257.73(e)(1)(iii): Long Term, Maximum Storage Pool Loading with Seismic		FIGURE 9
	Project: Waukegan East and West Ash Basins	Analysis By: Jay Griffin	
	File Name: Waukegan Section 2.gsz	Date: October 2016	