MWG

Midwest Generation, LLC

Powerton Generating Station

2024 Safety Factor Assessment for Ash Surge Basin, Bypass Basin, & Former Ash Basin

Revision 0

October 13, 2024

Issue Purpose: Use

Project No.: A12661.190

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EXECUTIVE SUMMARY

This report presents the 2024 annual safety factor assessment for the Ash Surge Basin, Bypass Basin, and Former Ash Basin at Midwest Generation, LLC's (MWG) Powerton Generating Station ("Powerton" or the "Station"). This annual assessment, prepared by Sargent & Lundy (S&L) on behalf of MWG, documents whether the critical cross section at each basin 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 basin 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 2024 safety factor assessment.

The most recent structural stability and liquefaction analyses for the Ash Surge Basin were performed in 2016 for the basin's initial federal safety factor assessment under 40 CFR 257.73(e). Since then, Powerton has taken the Ash Surge Basin out of service and has started dewatering the basin. In addition, the design seismic loading on the basin 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 Ash Surge Basin's embankments, underlying soils, adjacent topography, or groundwater levels. Moreover, the lower surface water elevation in the Ash Surge Basin and the lower design seismic loading each reduce the driving forces on the basin's critical cross section calculated for the basin's initial federal safety factor assessment. Therefore, the 2016 structural stability and liquefaction analyses for the Ash Surge Basin are conservative for the basin's current operating condition. Thus, the initial factors of safety calculated for the Ash Surge Basin in 2016 and the bases for these safety factors remain valid, albeit conservative, for this 2024 safety factor assessment.

Since last year's safety factor assessment, Powerton has retrofitted the Bypass Basin in accordance with 35 Ill. Adm. Code 845.770 by installing a new composite liner system and a new leachate collection and removal system over the basin's existing geomembrane liner, which was left in-place as a supplemental liner for the retrofitted basin. This retrofit construction was performed in accordance with the retrofit construction permit issued by the Illinois Environmental Protection Agency (EPA) on July 3, 2024, which references the retrofit construction permit application MWG submitted to Illinois EPA for the Bypass Basin on July 15, 2022. During the development of the retrofit design in 2022, S&L performed structural stability and liquefaction analyses for the retrofitted condition of the Bypass Basin. Now that the Bypass Basin has been retrofitted, S&L's 2022 evaluation supersedes the 2016 safety factor assessment performed for the basin in accordance with 40 CFR 257.73(e). This year's safety factor assessment determined that there have been no changes to the design inputs used in S&L's 2022 structural stability and liquefaction analyses of the retrofit design for the

Bypass Basin. Thus, the factors of safety calculated in that analysis remain valid for this 2024 safety factor assessment.

Finally, per last year's safety factor assessment, the initial federal safety factor assessment completed in 2018 for the Former Ash Basin concluded that an engineering analysis to calculate the safety factors for the basin could not be performed given the lack of necessary information due to the construction age of the basin. Since the minimum safety factors of the Former Ash Basin could not be demonstrated, MWG is closing the Former Ash Basin in accordance with 40 CFR 257.102. Consequently, the inputs, assumptions, and methodology utilized in the Former Ash Basin's initial safety factor assessment were not evaluated in this 2024 assessment.

Table ES-1 presents the 2024 factors of safety for the Ash Surge Basin and Bypass Basin as determined in this assessment in accordance with 35 Ill. Adm. Code 845.460(a).

Table ES-1 – 2024 Factors of Safety per 35 Ill. Adm. Code 845.460(a) for the Ash Surge Basin and Retrofitted Bypass Basin at the Powerton Generating Station

Loading Condition	Ash Surge Basin	Retrofitted Bypass Basin	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 Ash Surge and retrofitted Bypass Basins 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 Ash Surge Basin, Bypass Basin, and Former Ash Basin (the Basins) at Midwest Generation, LLC's (MWG) Powerton Generating Station ("Powerton" 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 Basins achieves the minimum safety factors specified in 35 Ill. Adm. Code 845.460(a).

This report documents the 2024 safety factor assessment conducted and completed in accordance with the Illinois CCR Rule by Sargent & Lundy (S&L) on behalf of MWG for the Ash Surge, Bypass, and Former Ash Basins at Powerton. This report:

- Lists the inputs and assumptions used in the 2024 safety factor assessment,
- Discusses the methodology used to conduct the 2024 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 assessments completed for the Basins pursuant to the aforementioned U.S. EPA regulations,
- Evaluates potential changes to the inputs used in the initial federal safety factor assessments to determine whether new or updated liquefaction and/or structural stability analyses are warranted, and
- Provides the 2024 factors of safety for the Ash Surge, Bypass, and Former Ash Basins in accordance with 35 Ill. Adm. Code 845.460(a).

1.2 SCOPE

In addition to being regulated under the Illinois CCR Rule, the Basins at Powerton 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 Ash Surge, Bypass, and Former Ash Basins 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; the Illinois EPA has yet to publish a timeline for submitting its proposed CCR permit program to the U.S. EPA for approval. However, the scope of this 2024 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 2-1 presents the safety factor acceptance criteria promulgated by both sets of regulations for existing CCR surface impoundments.

Table 2-1 – 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 Assessments

Appendix A provides the initial federal safety factor assessment conducted by Geosyntec Consultants in 2016 for the Ash Surge Basin and the Bypass Basin (Ref. 3). Meanwhile, Appendix B provides the initial federal safety factor assessment conducted by Geosyntec Consultants in 2018 for the Former Ash Basin (Ref. 4).

Site Topography & Aerial Images

Topographic data for the Ash Surge Basin, Bypass Basin, and surrounding areas was obtained from an aerial survey performed by Aero-Metric, Inc. in 2008 (Ref. 5). Historical and recent aerial images of the Basins and adjacent areas were obtained from Google Earth Pro (Ref. 6).

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 Basins in accordance with 40 CFR 257.90(e) and 35 Ill. Adm. Code 845.610(e)(1) (Refs. 15 through 21).

Basin Conditions

The operating and physical conditions for the Ash Surge and Bypass Basins were based on visual observations by S&L during site visits on August 22, 2024 (Ash Surge Basin), and September 25, 2024 (Bypass Basin), discussions with MWG personnel, and the annual inspection reports prepared for the two CCR surface impoundments in accordance with 40 CFR 257.83(b) and 35 Ill. Adm. Code 845.540(b) (Refs. 7 through 14).

Horizontal Seismic Coefficient

Pursuant to 35 Ill. Adm. Code 845.460(a)(4), the Basins 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 2-2 presents the seismic response parameters obtained from ASCE 7-22 (Ref. 22) on which the Basins' seismic loading condition was based.

Table 2-2 – Horizontal Seismic Coefficient Inputs

Parameter	Symbol	Value
Peak Ground Acceleration	PGA	0.10
Mapped Spectral Response, 1-Second Period, Adjusted for Site Effects	S_{M1}	0.20

3.0 ASSUMPTIONS

There are no assumptions in this document that require verification.

4.0 METHODOLOGY

4.1 ASH SURGE BASIN & BYPASS BASIN

As documented in last year's safety factor assessment, the 2023 factors of safety for the Ash Surge and Bypass Basins were based on the initial factors of safety calculated for the basins 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. Since then, Powerton has retrofitted the Bypass Basin in accordance with 35 Ill. Adm. Code 845.770 by installing a new composite liner system and a new leachate collection and removal system (LCRS) over the basin's existing geomembrane liner, which was left in-place as a supplemental liner for the retrofitted basin. This retrofit construction was performed in accordance with the retrofit construction permit issued by Illinois EPA on July 3, 2024, which references the retrofit construction permit application MWG submitted to Illinois EPA for the Bypass Basin on July 15, 2022. During the development of the retrofit design in 2022, S&L performed a slope stability analysis for the retrofitted condition of the Bypass Basin (Ref. 25). Now that the Bypass Basin has been retrofitted, S&L's 2022 evaluation supersedes the basin's 2016 federal safety factor assessment.

To complete this 2024 safety factor assessment, the bases for the Ash Surge Basin's 2016 safety factor assessment and for the retrofitted Bypass Basin's 2022 slope stability analysis were re-evaluated to determine if any changes have occurred since these analyses were completed. Identified changes were then evaluated to determine if updates to these 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 subject slope stability analysis, the previous evaluation of that input was considered to still be valid for this 2024 assessment.

4.2 FORMER ASH BASIN

Per last year's safety factor assessment, the initial federal safety factor assessment completed in 2018 for the Former Ash Basin (Ref. 4) concluded that an engineering analysis to calculate the safety factors for the basin could not be performed given the lack of necessary information due to the construction age of the basin. Since the minimum safety factors of the Former Ash Basin could not be demonstrated, MWG is closing the Former Ash Basin in accordance with 40 CFR 257.102. Consequently, the inputs, assumptions, and methodology utilized in the Former Ash Basin's initial safety factor assessment were not evaluated in this 2024 assessment.

5.0 ASSESSMENT

5.1 ASH SURGE BASIN

5.1.1 SUMMARY OF 2023 SAFETY FACTOR ASSESSMENT

The previous safety factor assessment for the Ash Surge Basin was completed on October 13, 2023. The 2023 factors of safety for the Ash Surge Basin 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 Ash Surge Basin concluded the basin's critical cross-section is stable and meets 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 2023 safety factor assessment concluded that the factors of safety calculated for the Ash Surge Basin 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).

5.1.2 SUMMARY OF INITIAL FEDERAL SAFETY FACTOR ASSESSMENT

The initial federal safety factor assessment for the Ash Surge Basin 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 critical cross-section for the Ash Surge Basin is stable and meets the factor of safety requirements presented in 40 CFR 257.73(e)(1)(i) through 257.73(e)(1)(iv).

5.1.3 CHANGES IN BASES FOR 2016 FEDERAL SAFETY FACTORS

The following subsections summarize the evaluation conducted to determine if (1) changes to the design inputs used in the Ash Surge Basin's 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 2024 assessment, or if further analysis is required.

Changes in Geotechnical Data

Based on reviews of the annual inspection reports (Refs. 7 through 14) and Google Earth aerial images (Ref. 6), there have been no changes to the Ash Surge Basin's embankments or underlying soils that would require updating the geotechnical parameters used in the 2016 analysis (Ref. 3).

Changes in Adjacent Topography

Based on reviews of the annual inspection reports (Refs. 7 through 14) and Google Earth aerial images (Ref. 6), there have been no significant modifications to the ground surfaces adjacent to the Ash Surge Basin (mass excavations, mass fill placement, *etc*.) since the initial federal safety factor assessment was

completed. Therefore, the topographic data collected for the site in 2008 (Ref. 5) remains valid for use in this 2024 assessment of the Ash Surge Basin.

Changes in Groundwater Level

Based on reviews of the annual groundwater monitoring and corrective action reports for the Ash Surge Basin (Refs. 15 through 21), no significant variations in seasonal groundwater elevations were noted. Because this CCR surface impoundment is lined with a geomembrane liner, its embankments are not hydraulically connected to the water levels within the basin, 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.

Changes in Embankment Geometry

Based on reviews of the annual inspection reports (Refs. 7 through 14), Google Earth aerial images (Ref. 6), and visual observations made by S&L in August 2024, there have been no significant modifications to the Ash Surge Basin's embankments since the initial federal safety factor assessment was completed. Therefore, there is no basis to re-evaluate the geometry of the basin's embankments in this 2024 assessment.

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. 23). Since the initial technical analysis was developed, an updated publication of the reference material has been produced (ASCE 7-22 (Ref. 22)), which provides updated values for the parameters used to determine the design horizontal seismic coefficient (see Table 2-2 and Table 5-1). Per Table 5-1, 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 basins' 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 federal safety factor assessment for the Ash Surge Basin.

Table 5-1 – Seismic Loading Parameters Comparison for Ash Surge Basin

Parameter	Symbol	2016 Values per ASCE 7-10	2024 Values per ASCE 7-22
Peak Ground Acceleration	PGA	0.11	0.10
Mapped Spectral Response, 1-Second Period, Adjusted for Site Effects	S_{M1}	0.20	0.20

Changes in Basin Operations

Powerton has taken the Ash Surge Basin out of service and has started dewatering the basin. MWG currently plans to retrofit the Ash Surge Basin with a new composite liner system and a new LCRS upon receipt of a retrofit construction permit from the Illinois EPA in accordance with Subpart B of the Illinois CCR Rule. MWG submitted a construction permit application for retrofitting the Ash Surge Basin to Illinois EPA on July 27, 2023.

Given the lower surface water elevation in the Ash Surge Basin compared to the operating condition evaluated in the basin's 2016 federal safety factor assessment, there is a lower driving force on the critical embankment cross section. Therefore, the 2016 analysis is conservative for the Ash Surge Basin's current operating condition. Thus, it is not necessary to re-evaluate the surface water elevations used to conduct the initial federal safety factor assessment for the Ash Surge Basin in this 2024 assessment.

5.1.4 2024 SAFETY FACTOR ASSESSMENT

Since the Ash Surge Basin's initial safety factor assessment was completed in 2016 in accordance with the Federal CCR Rule, Powerton has taken the basin out of service and has started dewatering the basin. 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 elevation in the Ash Surge Basin and the lower design seismic loading each reduce the driving forces on the basin's critical cross section calculated 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 Ash Surge Basin remains valid, albeit conservative.

Based on the preceding observations, the initial factors of safety calculated for the Ash Surge Basin in 2016 pursuant to the Federal CCR Rule and the bases for these safety factors remain valid, albeit conservative, for this 2024 assessment. As previously discussed, because the Illinois and Federal CCR Rules have the

same safety factor acceptance criteria, these factors of safety for the Ash Surge Basin 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 RETROFITTED BYPASS BASIN

5.2.1 SUMMARY OF RETROFIT CONSTRUCTION & 2022 SLOPE STABILITY ANALYSIS

The previous safety factor assessment for the Bypass Basin was completed with the last safety factor assessment for the Ash Surge Basin on October 13, 2023. Since then, Powerton has retrofitted the Bypass Basin in accordance with 35 Ill. Adm. Code 845.770 and the July 3, 2024, construction permit issued by Illinois EPA. The retrofit design features a new composite liner system and LCRS over an existing geomembrane liner, which was left in-place as a supplemental liner for the retrofitted basin. Structural fill was placed over the supplemental liner to support the new liner and to provide the slopes required for the LCRS. In addition, different layers of granular fill were placed over the new LCRS to prevent CCR and non-CCR sediments from clogging the LCRS (sand filter layer), to provide a means of deflecting the force of CCR pumped into the basin (protective warning layer), and to protect against erosion (riprap and riprap bedding layer). The total combined thickness of these layers across the basin floor and sideslopes is 1.5 feet. Finally, 1.5 feet of granular fill was placed along the top of the basin's embankments, vertically expanding the dikes to accommodate the fill layers placed along the basin floor and sideslopes and to support vehicular traffic.

Given the vertical expansion of the Bypass Basin's embankments in the retrofit design and the reduction in storage capacity from the installation of a new composite liner and LCRS, S&L completed a slope stability analysis for the retrofitted condition of the Bypass Basin in July 2022 when MWG submitted the basin's retrofit construction permit application to Illinois EPA. The inputs used to perform this analysis were S&L's retrofit design for the basin; the geotechnical data for the basin's existing dikes, site topography, and site groundwater levels used in the basin's 2016 federal safety factor assessment (Ref. 3); and the seismic loading parameters for the site calculated in accordance with ASCE 7-16 (Ref. 24).

Now that the Bypass Basin has been retrofitted, S&L's 2022 evaluation supersedes the basin's 2016 federal safety factor assessment. The results from this 2022 analysis are available in Appendix C and are summarized in Table 5-2. These results indicate that the critical cross-section for the retrofitted Bypass Basin remains stable and meets the factor of safety 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 factors of safety calculated for the retrofitted Bypass Basin are also in conformance with the safety factor criteria promulgated under 35 Ill. Adm. Code 845.460(a)(2) through 845.460(a)(5).

Table 5-2 – 2022 Factors of Safety for the Retrofitted Bypass Basin at the Powerton Generating Station (Ref. 25)

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

Notes: 1) The embankment soils for the retrofitted Bypass Basin 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.

5.2.2 CHANGES IN BASES FOR 2022 SLOPE STABILITY ANALYSIS

The following subsections summarize the evaluation conducted to determine (1) if changes to the design inputs used in the 2022 slope stability analysis for the retrofitted Bypass Basin have occurred since the evaluation was completed, and (2) whether the analysis can be accepted as-is for this 2024 assessment, or if further analysis is required.

Changes in Geotechnical Data

Because the Bypass Basin's existing geomembrane liner was left in-place as a supplemental liner in the retrofit design, the basin's original embankment fill material and foundation soils were not altered during retrofit construction. Therefore, the geotechnical parameters used in the Bypass Basin's 2016 federal safety factor assessment (Ref. 3), which were incorporated into S&L's 2022 slope stability analysis for the basin's retrofit design (Ref. 25), are still valid and do not need to be updated for this 2024 assessment.

Changes in Adjacent Topography

No significant modifications to the ground surfaces adjacent to the Bypass Basin (mass excavations, mass fill placement, *etc*.) were made during retrofit construction. Although the embankments were vertically raised by 1.5 feet, there were no lateral expansions. Therefore, the topographic data collected for the site in 2008 (Ref. 5), which was used in the 2016 initial federal safety factor assessment (Ref. 3) and subsequently

referenced in S&L's 2022 slope stability analysis (Ref. 25) for the basin's retrofit design, is still valid and does not need to be updated for this 2024 assessment.

Changes in Groundwater Level

Based on reviews of the annual groundwater monitoring and corrective action reports for the Ash Surge Basin (Refs. 15 through 21), no significant variations in seasonal groundwater elevations were noted. Because the retrofitted Bypass Basin has two liners (an upper composite liner and a lower, supplemental geomembrane liner), its embankments are not hydraulically connected to the water levels within the basin, and a typical phreatic surface normally associated with seepage through an earthen embankment is not applicable. Therefore, the static groundwater elevation using in the 2016 initial federal safety factor assessment (Ref. 3) and subsequently referenced in S&L's 2022 slope stability analysis (Ref. 25) remains valid. Moreover, there have been no significant changes in the surface water conditions near the site that would impact the site's groundwater levels.

Changes in Earthquake Design Basis

The design horizontal seismic coefficient utilized in S&L's 2022 slope stability analysis (Ref. 25) is based on published data in ASCE 7-16 (Ref. 24). Since the initial technical analysis was developed, an updated publication of the reference material has been produced (ASCE 7-22 (Ref. 22)), which provides updated values for the parameters used to determine the design horizontal seismic coefficient (see Table 2-2 and Table 5-3). Per Table 5-3, the PGA and S_{M1} have the same values under ASCE 7-22 and ASCE 7-16. Therefore, the horizontal seismic coefficient used in the 2022 analysis remains valid. Thus, it is not necessary to change the earthquake design basis used to conduct the 2022 slope stability analysis for the retrofitted Bypass Basin.

Table 5-3 – Seismic Loading Parameters Comparison for Retrofitted Bypass Basin

Parameter	Symbol	2022 Values per ASCE 7-16	2024 Values per ASCE 7-22
Peak Ground Acceleration	PGA	0.10	0.10
Mapped Spectral Response, 1-Second Period, Adjusted for Site Effects	S_{M1}	0.20	0.20

5.2.3 2024 SAFETY FACTOR ASSESSMENT

Based on the preceding observations, there have been no changes to the design inputs used in S&L's 2022 slope stability analysis of the retrofit design for the Bypass Basin. Therefore, the factors of safety calculated in that analysis remain valid for this 2024 safety factor assessment. Per Table 5-2, these factors of safety 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

6.1 ASH SURGE & BYPASS BASINS

This assessment re-evaluated the factors and design inputs used as the bases for (1) the initial federal safety factor assessment completed in 2016 in accordance with the Federal CCR Rule for Powerton's Ash Surge Basin (Ref. 3) and (2) the 2022 slope stability analysis completed by S&L for the retrofitted Bypass Basin (Ref. 25). It was determined that no significant changes have occurred since both analyses were completed that would invalidate their conclusions. Therefore, the factors of safety reported in the 2016 initial federal safety factor assessment for the Ash Surge Basin and the 2022 slope stability analysis for the retrofitted Bypass Basin remain valid for this 2024 assessment. Moreover, because the Illinois and Federal CCR Rules have the same safety factor acceptance criteria, these federal factors of safety for the Ash Surge and Bypass Basins are in conformance with the safety factor criteria promulgated under 35 Ill. Adm. Code 845.460(a)(2) through 845.460(a)(5).

Table 6-1 presents the 2024 factors of safety for the Ash Surge Basin and Bypass Basin as determined in accordance with 35 Ill. Adm. Code 845.460(a).

Table 6-1 – 2024 Illinois CCR Rule Factors of Safety for the Ash Surge Basin and Retrofitted Bypass Basin at the Powerton Generating Station

Loading Condition	Ash Surge Basin	Retrofitted Bypass Basin	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 Ash Surge and retrofitted Bypass Basins 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.

6.2 FORMER ASH BASIN

The initial federal safety factor assessment completed for the Former Ash Basin in 2018 (Ref. 4) concluded that an engineering analysis to calculate the safety factors for the basin could not be performed given the lack of necessary information due to the construction age of the Former Ash Basin. Since the minimum safety factors of the Former Ash Basin could not be demonstrated, MWG is closing the Former Ash Basin in accordance with Subpart G of the Illinois CCR Rule and 40 CFR 257.102. MWG plans to close the Former Ash Basin upon receipt of a closure construction permit from the Illinois EPA in accordance with Subpart B of the Illinois CCR Rule. A construction permit application for the closure work was submitted to the Illinois EPA on October 26, 2022.

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, 2024

Seal:

Digitally signed by Thomas Dehlin
Date: 2024.10.13 11:29:36-05'00'

8.0 REFERENCES

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APPENDIX A: 2016 FEDERAL SAFETY FACTOR ASSESSMENT FOR ASH SURGE BASIN & BYPASS BASIN

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STRUCTURAL STABILITY AND FACTOR OF SAFETY ASSESSMENT
ASH SURGE BASIN AND BYPASS BASIN
POWERTON STATION
OCTOBER 2016

This report presents documentation of the initial periodic structural stability and initial safety factor assessments for the Ash Surge Basin and Bypass Basins (the Basins) at the Powerton Station (Site) in Pekin, 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 Powerton Station is owned and operated by Midwest Generation, LLC (Midwest Generation). Based on the results provided in this report, the Ash Surge Basin and Bypass Basin 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 Ash Surge Basin and Bypass Basin 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 Ash Surge Basin is located east of the Main Wastewater Building, the cylindrical concrete clarifier and thickener structures, and the Metal Cleaning Basin, west of the inactive Limestone Basin, north of the Bypass Basin and East Roof and Yard Runoff (ERYR) Basin. The Ash Surge Basin is approximately 1,050 feet by 335 feet in plan dimensions (total plan area of approximately 8.1 acres). The surface impoundment is surrounded by a paved and a gravel perimeter access road around the western and eastern half of the impoundment, respectively.

The Bypass Basin is located east of the ERYR Basin and south of the southeast corner of the Ash Surge Basin. The Bypass Basin is approximately 160 feet by 255 feet in plan dimensions (total plan area of approximately 0.9 acres). A gravel perimeter access road is located along the northern and eastern boundaries of the Bypass Basin. A concrete-lined dewatering bin overflow

channel is located along the crest of the berm between the Bypass Basin and the ERYR Basin. A temporary construction staging area is located south of the surface impoundment.

The Ash Surge Basin and the Bypass Basin are both lined with a 60-mil high density polyethylene (HDPE) geomembrane.

Based on available documentation and discussions with site personnel, the Basins, in their current configuration, were constructed in the late 1970s and early 1980s. 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 Ash Surge Basin and the Bypass Basin consist of embankments on all sides. Because no formational materials provide lateral structural support for the embankments, the Basins do not include abutments. The remainder of this section addresses the foundation materials for the Basins.

Previous subsurface investigations performed at the Site indicate foundation materials underlying the embankments for the Ash Surge Basin and Bypass Basin generally consists of approximately 17 to 28 feet of fat and lean clay overlying approximately 35 to 40 feet of loose to very dense poorly graded sand and silty sand with some gravel associated with the Henry Formation (Geosyntec, 2016b).

Elastic settlement of the clay and sand layers underlying the embankments likely occurred very soon after construction in the late 1970s and early 1980s. Because of the age of the embankments (approximately 35 years old), the majority of consolidation and secondary compression settlement of the clay layer has likely already occurred. The initial annual inspection performed for the Basins in accordance with §257.83(b) did not identify any adverse effects on the Basins or their appurtenant structures resulting from settlement that may have occurred since construction (Geosyntec, 2016c). There are no proposed changes in operation which would increase loading conditions on the foundation materials; therefore, no significant settlement of the foundation materials underlying the embankments is anticipated to occur in the future. 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. Therefore, potential 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 Ash Surge Basin and Bypass Basin 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, 2016g). Overall, the foundation materials underlying the Ash Surge Basin and Bypass Basin have a low susceptibility to liquefaction and liquefaction-induced strength loss (Geosyntec, 2016d).

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

The Ash Surge Basin and Bypass Basin are lined with a 60-mil 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 Ash Surge Basin and Bypass Basin embankments was not available at the time of this report. Samples of embankment fill materials obtained during Geosyntec's geotechnical investigations at the Site indicate that the Ash Surge Basin embankments are compacted to relative densities on the order of 95 percent based on Standard Proctor testing (Geosyntec, 2016b). No quantitative evaluation of the degree of compaction of the embankments for the Bypass Basin was performed for the embankments in their current state. Slope stability analyses show that the embankments for the Ash Surge Basin and Bypass Basin 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)

Downstream slopes of the Ash Surge Basin and Bypass Basin have erosion protection from either vegetation or geomembrane liners located on the interior slopes of adjacent basins.

3.5 Spillway – §257.73(d)(1)(v)

The Ash Surge Basin and the Bypass Basin both contain emergency spillway structures. A description of these structures and the design storm event identified for the Basins is included in the Inflow Design Flood Control System Plan (IDFCSP) prepared for the site in accordance with §257.82(c) (Geosyntec, 2016f). The IDFCSP identifies the design event for the Site as the 1,000 year flood. Because the Ash Surge Basin and Bypass Basin do not impound water from a natural stream and do not impound stormwater flows, except for direct precipitation that falls on the embankment crest or within the Basins, the IDFCSP identifies the design event as the 24-hour, 1,000-year precipitation event. When the operating freeboard for the Basins is taken

into account, the water levels in the Basins estimated after the design precipitation event are estimated to be lower than the invert elevations of the emergency spillways and no discharge from the Basins is anticipated (Geosyntec, 2016f). Therefore, the hydraulic capacity of the spillways was not calculated.

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

Hydraulic structures passing through or beneath the embankments of the Bypass Basin and Ash Surge Basin consist of several pipes and conveyance structures associated with the inlet and outlet structures of the Basins. These structures and pipes were inspected periodically between 10 May 2016 and 24 May 2016 by a company specializing in video camera pipe inspections. The inspected structures and pipes related to the Basins included are presented on Figure 2. The video inspections did not identify significant deterioration, deformation, distortion, bedding deficiencies, sedimentation, or debris that would negatively affect operation of the pipes was observed.

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

Ponds or water bodies near downstream slopes of the Ash Surge Basin and Bypass Basin are identified on Figure 3 and include:

- The Metal Cleaning Basin located west of the Ash Surge Basin. This basin is lined with an HDPE geomembrane.
- The ERYR Basin located west of the Bypass Basin and south of the Ash Surge Basin;
- The inactive Limestone Basin located east of the Ash Surge Basin; and
- The FAB located northeast of the Ash Surge Basin.

For stability analyses performed, a "low pool" condition where the modeled groundwater depth is lowered so there is little or no stabilizing force present on the downstream slope of the Ash Surge Basin or Bypass Basin embankments was evaluated for the water bodies presented above (Geosyntec, 2016e).

Stability during rapid drawdown was also evaluated for the embankments affected by the ERYR Basin and the FAB. Rapid drawdown was not evaluated for the embankments affected by the Metal Cleaning Basin because its HDPE geomembrane minimizes potential inundation of the slopes and mitigates effects of rapid drawdown. Similarly, embankments affected by the inactive Limestone Basin were not evaluated for rapid drawdown because the volume of water in this basin is anticipated to be minimal (inflow is limited to direct precipitation) and there is no outlet structure associated with this basin that could create a rapid drawdown condition for the adjacent Ash Surge Basin embankment.

Slope stability analyses show that the embankments are designed and constructed to maintain structural stability during "low pool" and rapid drawdown conditions (Geosyntec, 2016e).

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

No structural stability deficiencies associated with the Ash Surge Basin and Bypass Basin were identified in this initial structural stability assessment and no corrective measures are required.

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 Ash Surge Basin and Bypass Basin during the 2016 calendar year. One deficiency identified in the initial annual inspection (Geosyntec, 2016c) for the Bypass Basin was 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 Ash Surge Basin and Bypass Basin 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-section for each basin, shown in Figure 3.

4.1 Slope Stability Methodology

Limit equilibrium slope stability analyses were performed to evaluate the stability of the embankments for the Ash Surge Basin and Bypass Basin. The process involved performing two-dimensional analyses on the critical cross-section 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. 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

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 Ash Surge Basin and Bypass Basin, this condition included a pool elevation at 465 feet MSL[1] for the Ash Surge Basin and 465.5 feet MSL for the Bypass Basin, and a groundwater elevation of 451.8 feet MSL (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 Ash Surge Basin and Bypass Basin 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 Ash Surge Basin and Bypass Basin 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 show 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 Ash Surge Basin and Bypass Basin embankments are summarized in Table 1 below and presented in Figures 4 through 9 (Geosyntec 2016e).

[1] Mean Sea Level based on local plant vertical datum.

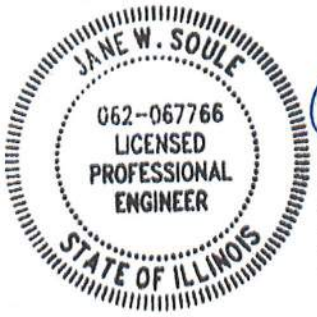
Table 1: Safety Factor Results

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).

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

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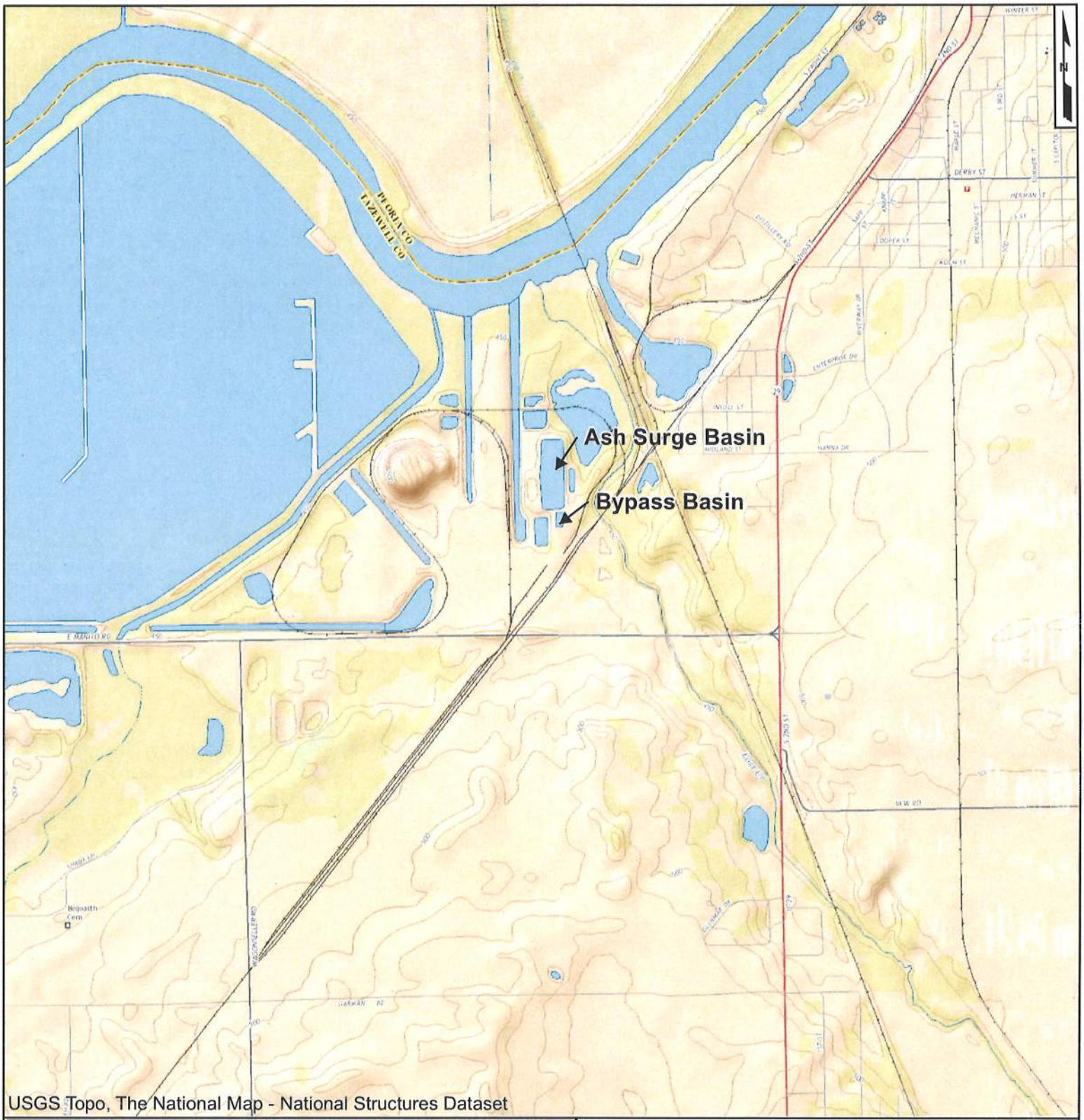
Attachments

Figure 1 – Site Location
Figure 2 – Hydraulic Structure Locations
Figure 3 – Stability 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)



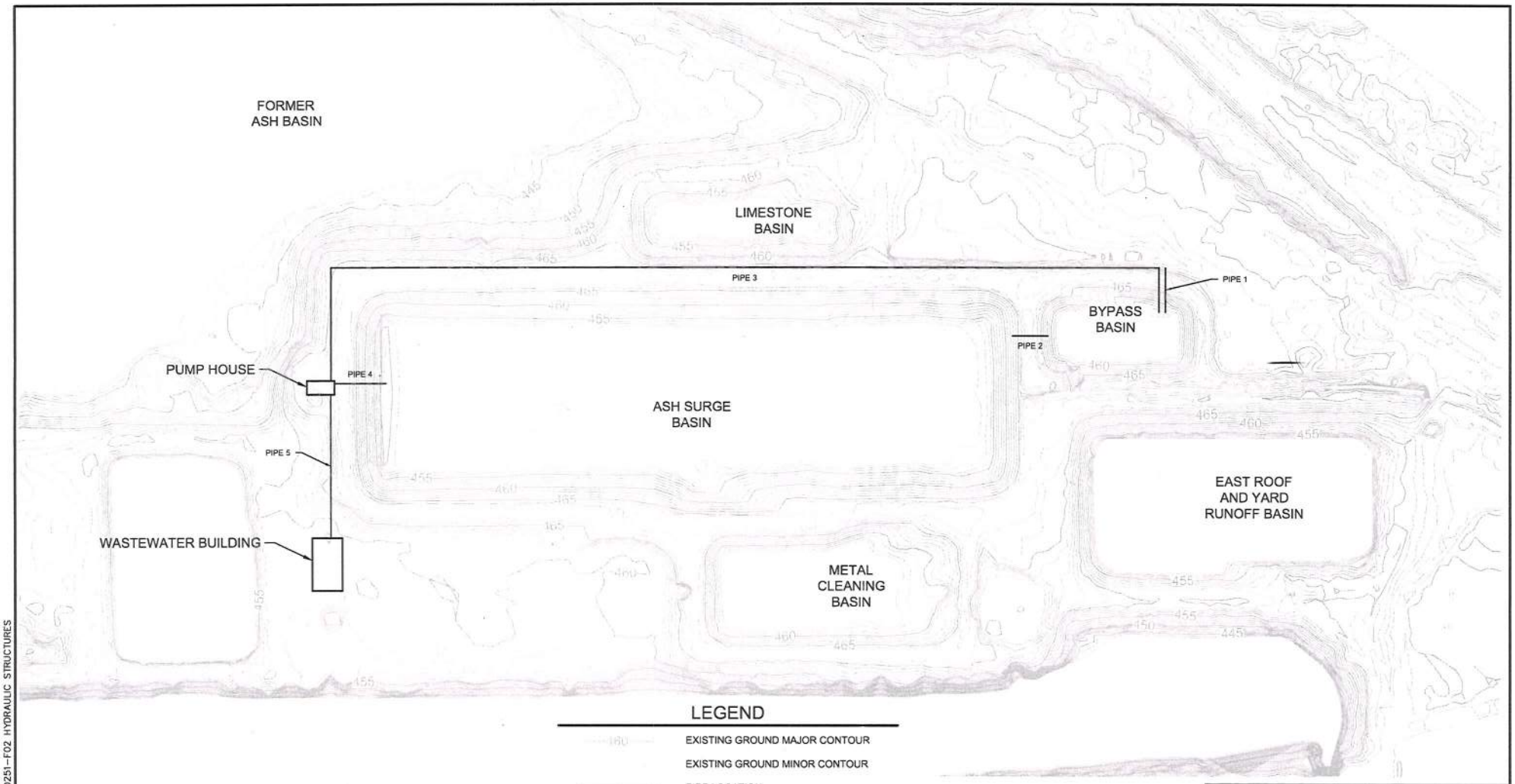
2,000 1,000 0 2,000 Feet

Site Location

Ash Surge and Bypass Basins
Powerton Station
Pekin, Illinois

Geosyntec consultants

San Diego	October 2016	Figure 1



LEGEND

- EXISTING GROUND MAJOR CONTOUR
- EXISTING GROUND MINOR CONTOUR
- PIPE LOCATION

SOURCE OF SURVEY:
TOPOGRAPHY WITHIN THE ASH SURGE AND BYPASS BASINS IS BASED ON TOP OF LINER TOPOGRAPHY FOR LINER REPLACEMENT PROJECTS (NRT, 2011 AND 2013). TOPOGRAPHY OUTSIDE THE LINER LIMIT OF THE BASINS IS AEROMETRIC, INC. PROJECT NUMBER 1080611, DATED 6-19-2008.

HORIZONTAL DATUM: NAD83 IL SPC WEST

VERTICAL DATUM: LOCAL PLANT DATUM

NOTES:
1. ALL PIPE LOCATIONS ARE APPROXIMATE.

N

0 150' 300'

SCALE IN FEET

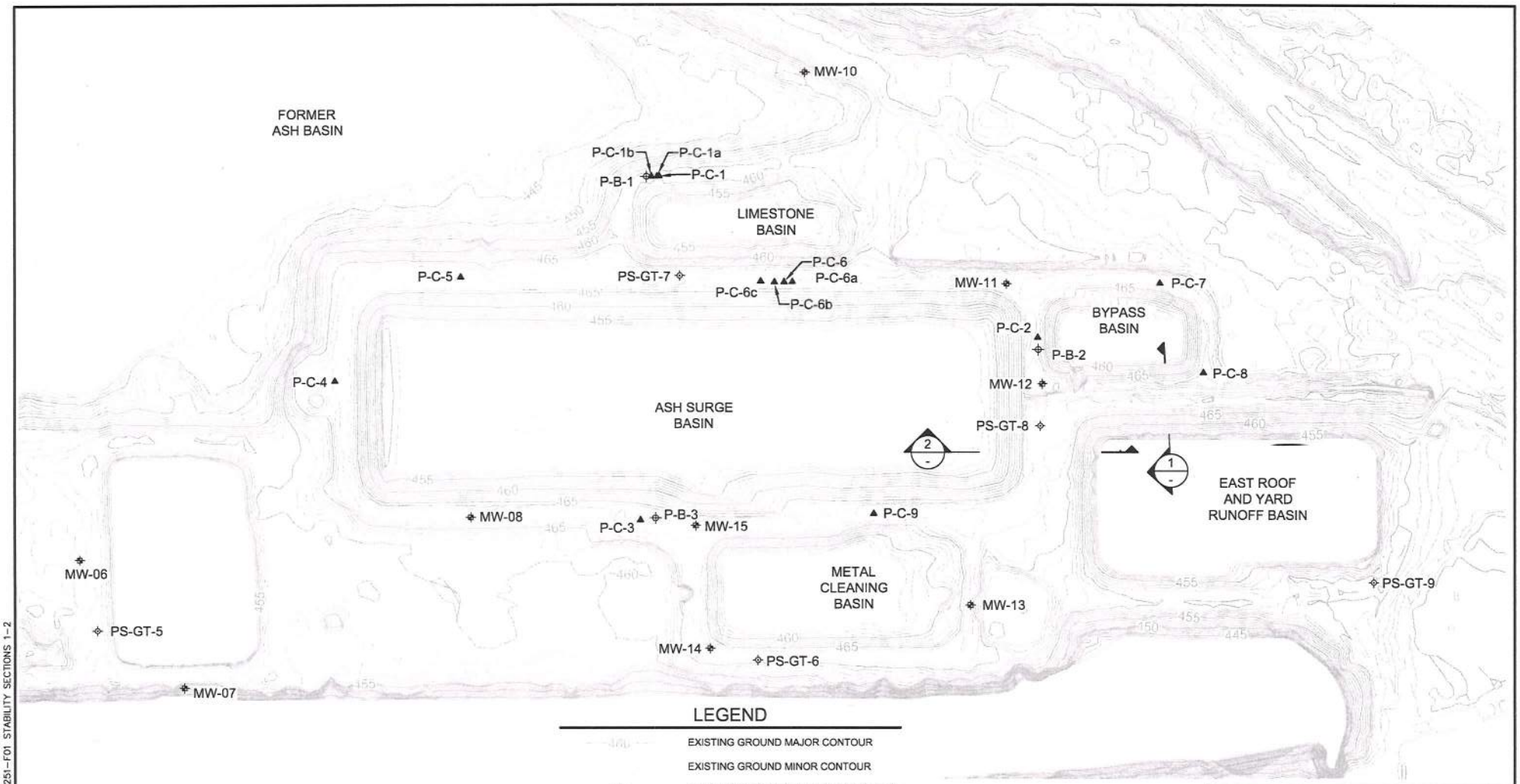
HYDRAULIC STRUCTURE LOCATIONS
ASH SURGE AND BYPASS BASINS
POWERTON STATION
PEKIN, ILLINOIS

Geosyntec consultants

FIGURE 2

PROJECT NO: SW0251-07 | OCTOBER 2016

Z:\CADD\FIGURES\POWERTON\SW0251-F02 HYDRAULIC STRUCTURES



LEGEND

- EXISTING GROUND MAJOR CONTOUR
- EXISTING GROUND MINOR CONTOUR
- MW-03 MONITORING WELL (PATRICK, 2011)
- P-B-1 BORING (GEOSYNTEC, 2016)
- P-C-1 CPT SOUNDING (GEOSYNTEC, 2016)
- PS-GT-5 BORING (KPRG, 2005)
- 1 / - CROSS SECTION LOCATION

NOTES:
1. ALL EXPLORATION LOCATIONS ARE APPROXIMATE.

SOURCE OF SURVEY:
TOPOGRAPHY WITHIN THE ASH SURGE AND BYPASS BASINS IS BASED ON TOP OF LINER TOPOGRAPHY FOR LINER REPLACEMENT PROJECTS (NRT, 2011 AND 2013). TOPOGRAPHY OUTSIDE THE LINER LIMIT OF THE BASINS IS AEROMETRIC, INC. PROJECT NUMBER 1080611, DATED 6-19-2008.
HORIZONTAL DATUM: NAD83 IL SPC WEST
VERTICAL DATUM: LOCAL PLANT DATUM

N

0 150' 300'
SCALE IN FEET

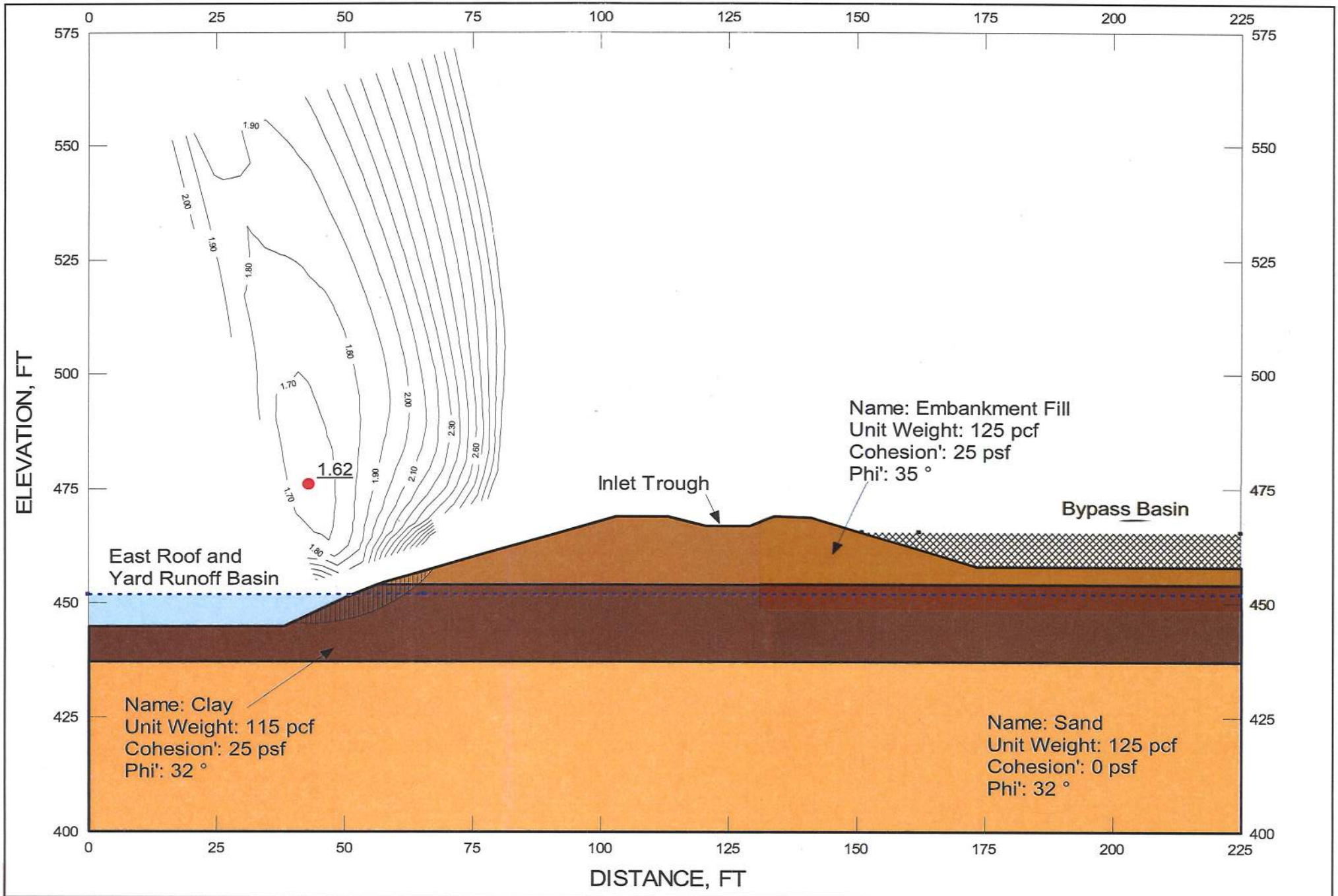
STABILITY SECTIONS
ASH SURGE AND BYPASS BASINS
POWERTON STATION
PEKIN, ILLINOIS

Geosyntec consultants

FIGURE 3

PROJECT NO: SW0251-07 | OCTOBER 2016

Z:\CADD\FIGURES\POWERTON\SW0251-F01 STABILITY SECTIONS 1-2



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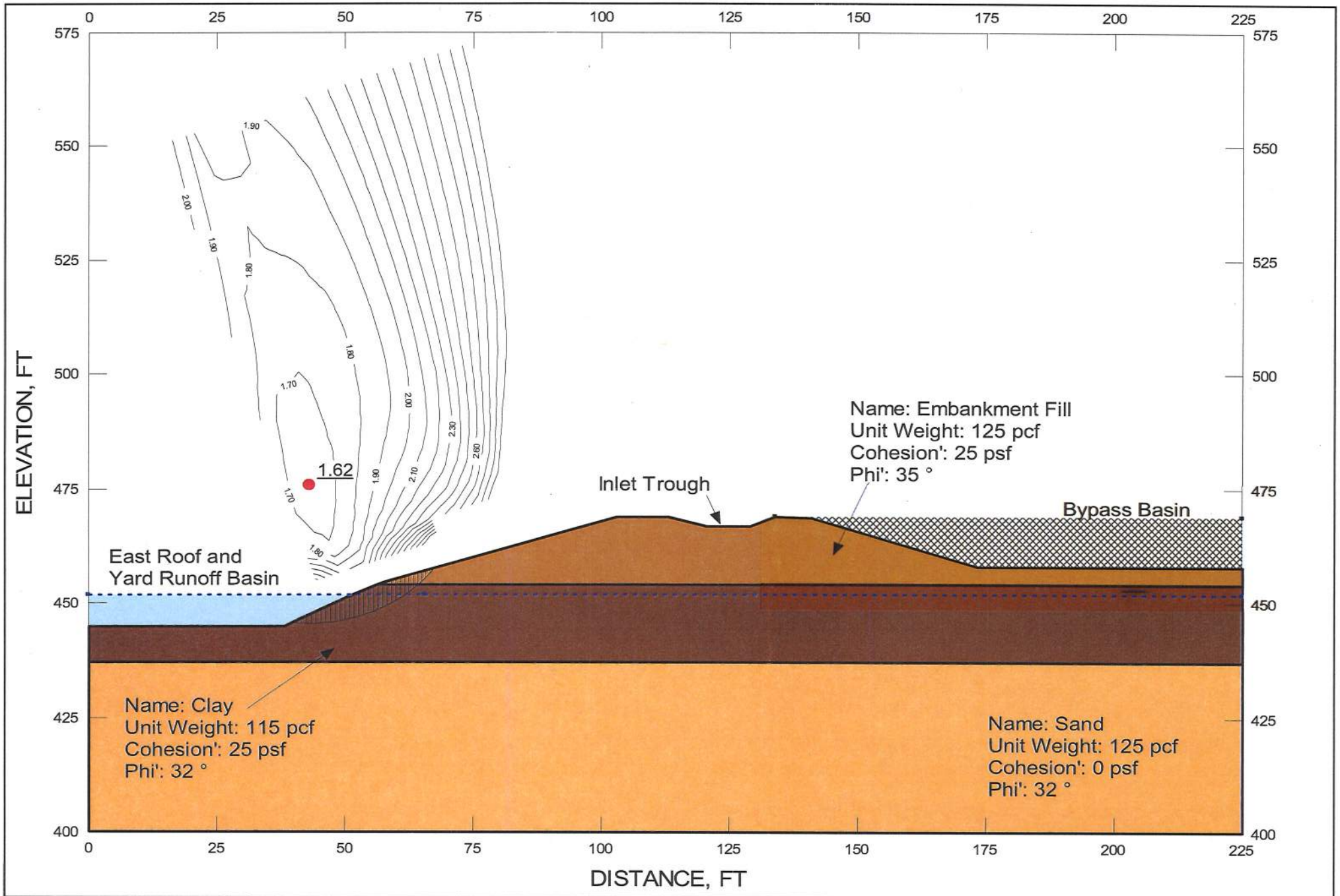
Analysis	Section 1 - §257.73(e)(1)(i): Long Term, Maximum Storage Pool Loading		
Project	Powerton Ash Surge and Bypass Basins	Analysis By	Cory Russell
File Name	Powerton Section 1.gsz	Date	October 2016

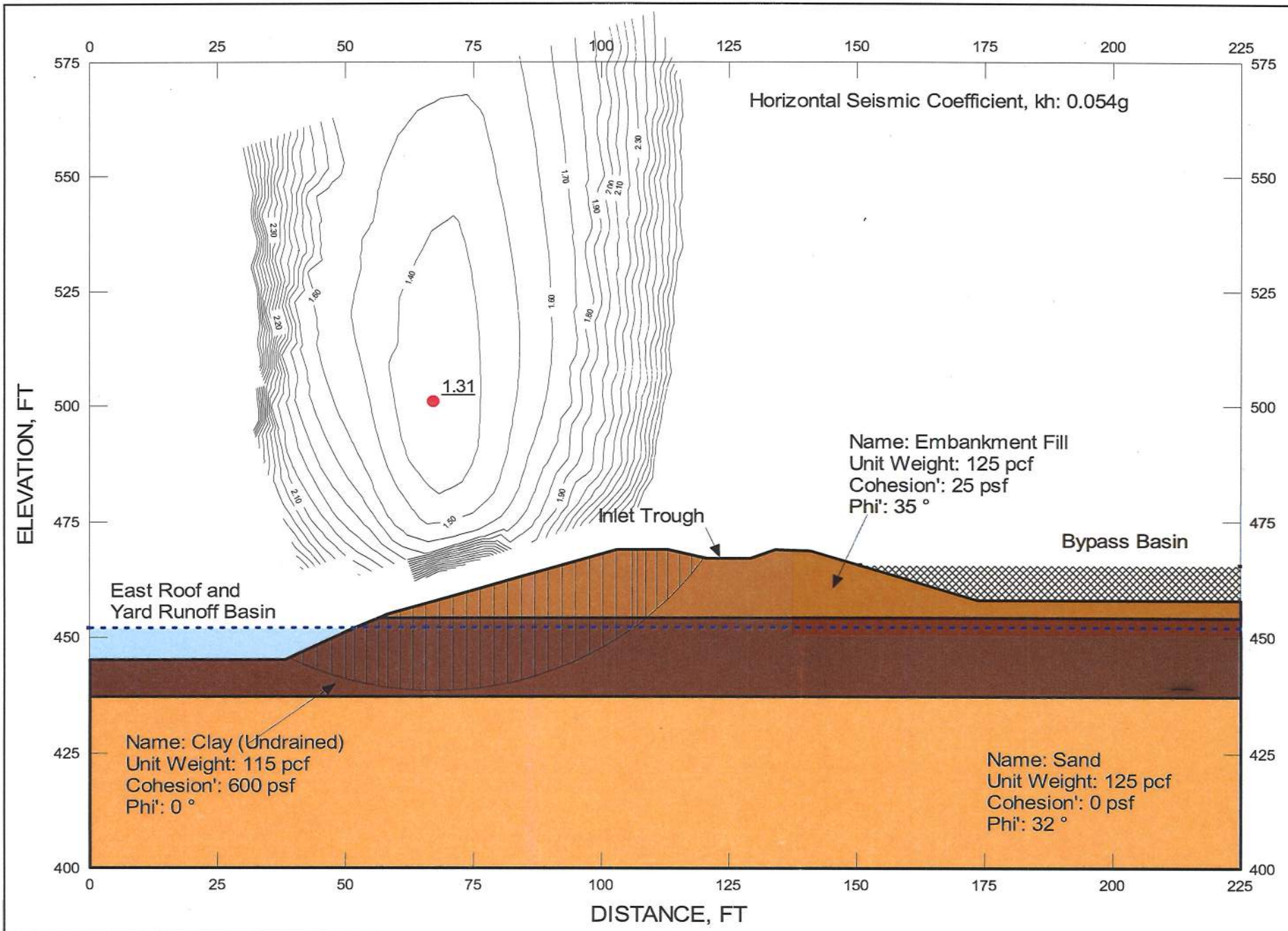
FIGURE 4



Geosyntec consultants

Analysis	Section 1 - §257.73(e)(1)(ii): Maximum Surcharge Pool Loading		
Project	Powerton Ash Surge and Bypass Basins	Analysis By	Cory Russell
File Name	Powerton Section 1.gsz	Date	October 2016

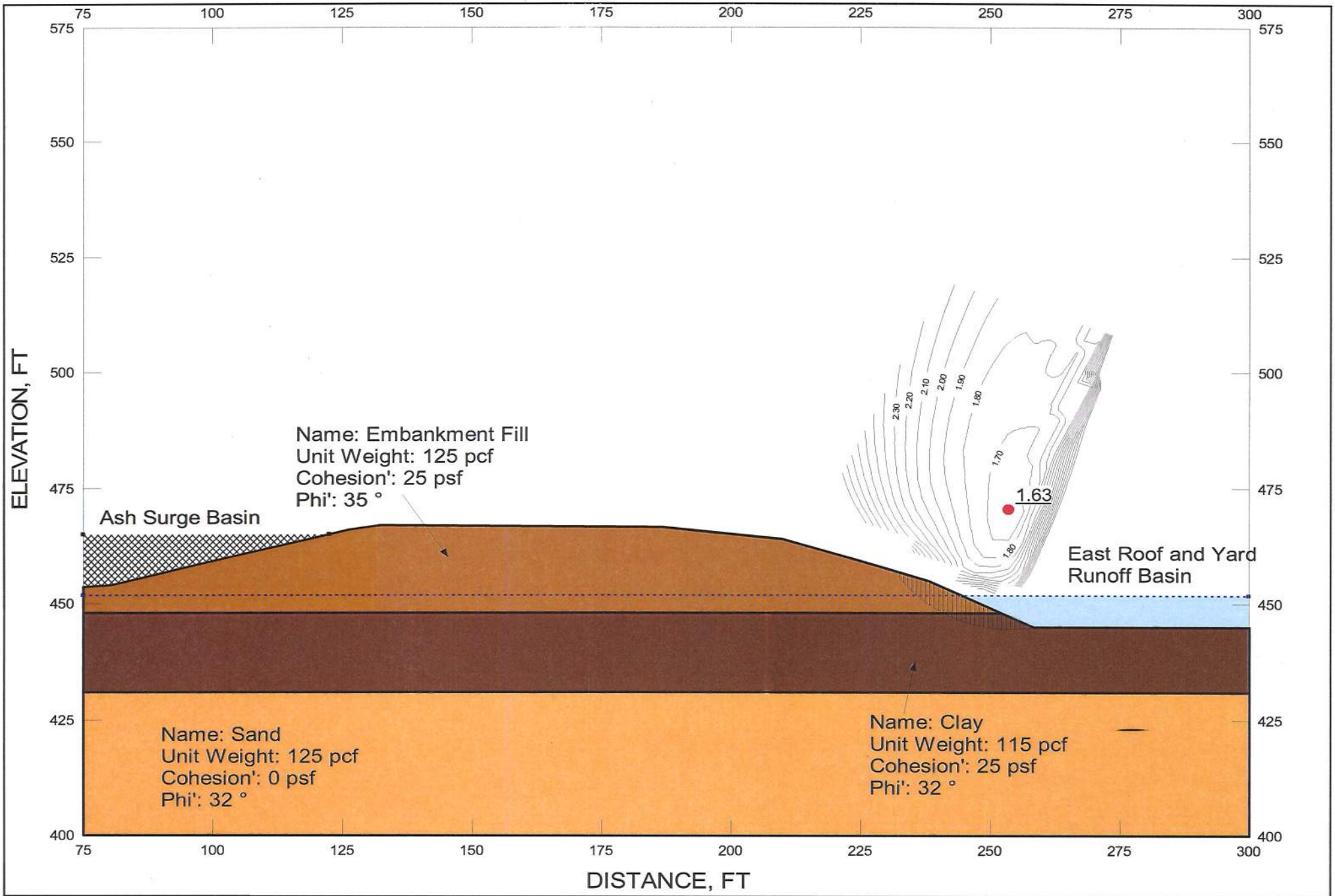
FIGURE 5



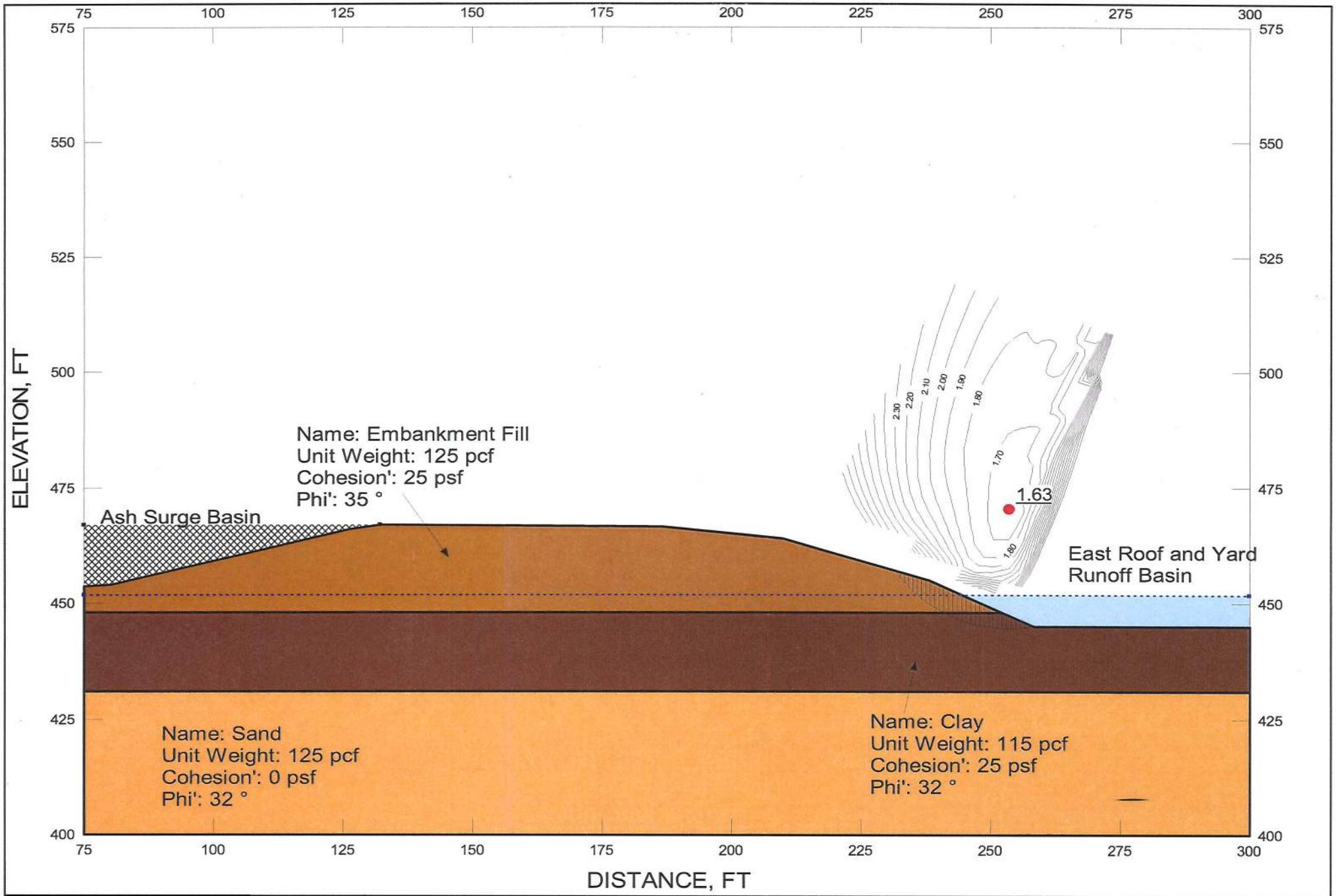
Geosyntec consultants

Analysis	Section 1 - §257.73(e)(1)(iii): Long Term, Maximum Storage Pool Loading with Seismic (Undrained Conditions)		
Project	Powerton Ash Surge and Bypass Basins	Analysis By	Cory Russell
File Name	Powerton Section 7.gsz	Date	October 2016

FIGURE 6



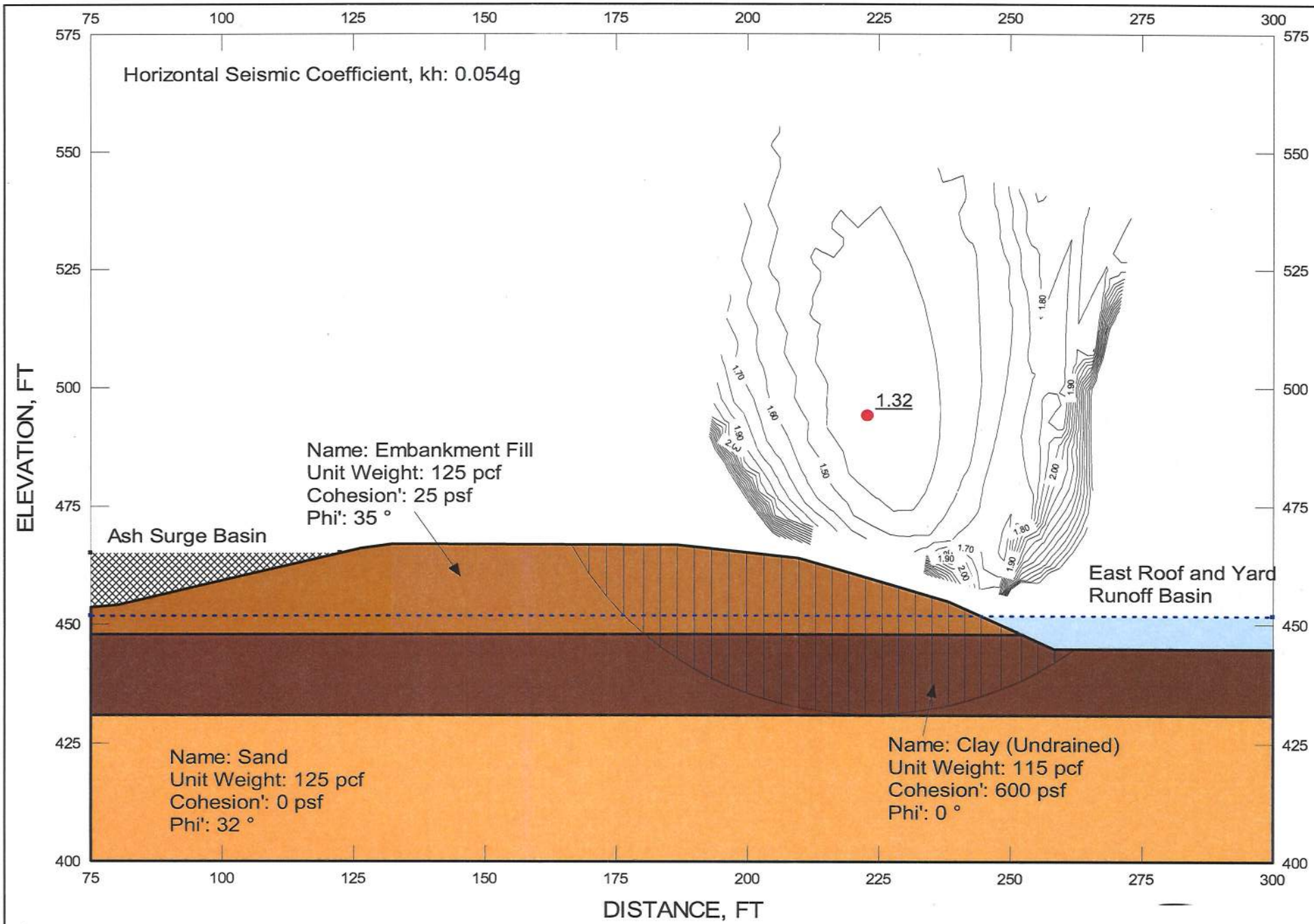
Geosyntec consultants	Analysis: Section 2 - §257.73(e)(1)(i): Long Term, Maximum Storage Pool Loading		FIGURE 7
	Project: Powerton Ash Surge and Bypass Basins	Analysis By: Cory Russell	
	File Name: Powerton Section 2.gsz	Date: October 2016	



Geosyntec consultants

Analysis	Section 2 - §257.73(e)(1)(ii): Maximum Surcharge Pool Loading		
Project	Powerton Ash Surge and Bypass Basins	Analysis By	Cory Russell
File Name	Powerton 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 (Undrained Conditions)		FIGURE 9
	Project: Powerton Ash Surge and Bypass Basins	Analysis By: Cory Russell	
	File Name: Powerton Section 2.gsz	Date: October 2016	

APPENDIX B: 2018 FEDERAL SAFETY FACTOR ASSESSMENT FOR FORMER ASH BASIN

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SAFETY FACTOR ASSESSMENT
FORMER ASH BASIN
POWERTON STATION
APRIL 2018

This report presents documentation of the initial periodic safety factor assessment for the Former Ash Basin (FAB) at the Powerton Station (Site) in Pekin, Illinois (Figure 1). This report addresses the initial safety factor assessment requirement for 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, became effective on 19 October 2015, and were amended on 05 August 2016. The Powerton Station is owned and operated by Midwest Generation, LLC (Midwest Generation). Based on the results detailed in this report, it cannot be documented that the FAB achieves the minimum safety factors requirements of §257.73(e)(1)(i) through (iv) of the CCR Rule.

This Report was prepared by Ms. Beth Pittaway and reviewed in accordance with Geosyntec's internal review policy by Mr. Michael Houlihan and Mr. Jesse Varsho, P.E., P.G. Mr. Varsho is a licensed Professional Engineer in the State of Illinois.

1. Regulation Requirements - §257.73

Structural integrity criteria for inactive CCR surface impoundments is described in §257.73. The FAB meets the minimum size and capacity criteria under §257.73(b) and is therefore subject to the safety factor assessment requirements of §257.73(e).

2. Site Conditions

Located to the east of the existing Ash Surge Basin, the FAB is an inactive CCR surface impoundment which was historically used for bottom ash disposal. It is estimated that the FAB stopped receiving CCRs by the 1970s. Originally a single pond, in 2010 the FAB was bisected into two areas by construction of a railroad embankment. The two bisected ponds are now designated as the North Pond and South Pond (Figure 2). Due to the duration of inactive use, both areas contain heavy vegetation. Based on acreage and several soil borings performed in 2016, the volume of CCR in the North Pond and South Pond are estimated to be less than 300,000 and 200,000 cubic yards, respectively.

The FAB is irregularly shaped with maximum dimensions of approximately 1,250 feet by 2,150 feet with a total area of approximately 25 acres. The surface impoundment is surrounded by a gravel and soil perimeter road which allows access to groundwater monitoring wells. The berm height varies in height up to approximately 4 feet around the basin perimeter.

3. Safety Factor Assessment

The initial and periodic safety factory assessment required by §257.73(e)(1) of the CCR Rule is dependent on analyses performed on the critical cross section of the embankment. The critical cross section is defined as the cross section anticipated to be the most susceptible to structural failure based on appropriate engineering considerations, including loading conditions. The minimum safety factors of 1.5 (long-term, maximum storage pool loading conditions), 1.4 (maximum surcharge pool loading conditions) and 1.0 (seismic conditions) to be achieved are detailed in §257.73(e)(1)(i) through (iv).

At the time of this report, information was not available on the construction materials, strength of the berm, or cross-section details necessary to perform the required engineering evaluation. The required calculations for §257.73(e)(1)(i) through (iv) were not performed and it is anticipated that the results, if available, would not meet the minimum safety factor requirements.

An engineering analysis to calculate the safety factors could not be performed due to a lack of necessary information due to the construction age of the FAB. Since the minimum safety factors as required by §257.73(e) cannot be demonstrated, the FAB will be closed in accordance with §257.102 as referenced by §257.73(f)(4).

4. Limitations and Certification

This initial periodic safety factor assessment meets the requirements of §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.

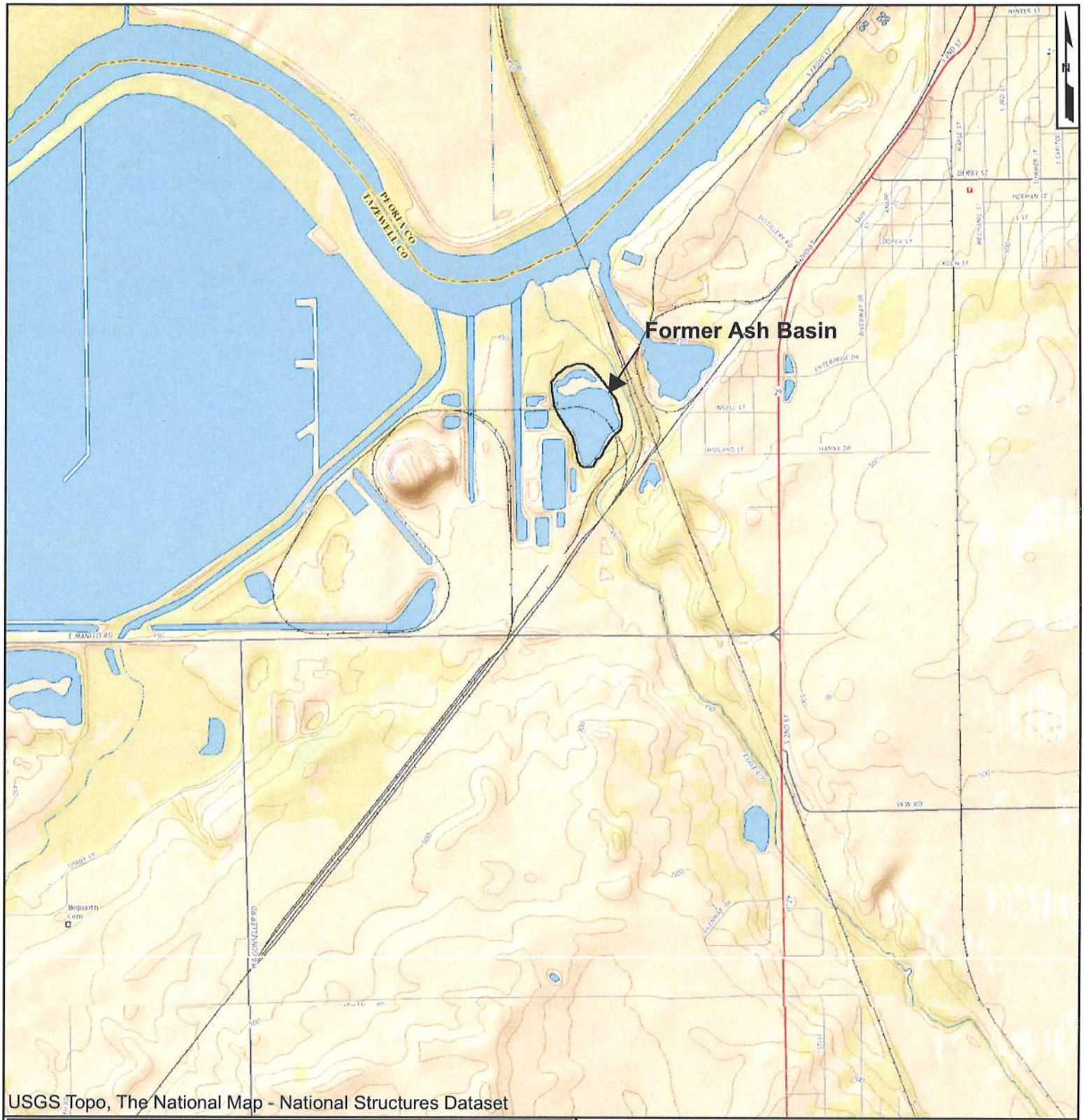
Jesse Varsho April 13, 2018

Jesse Varsho, P.E., P.G.
Illinois Professional Engineer No. 062.059069
Expiration Date: 11/30/2019

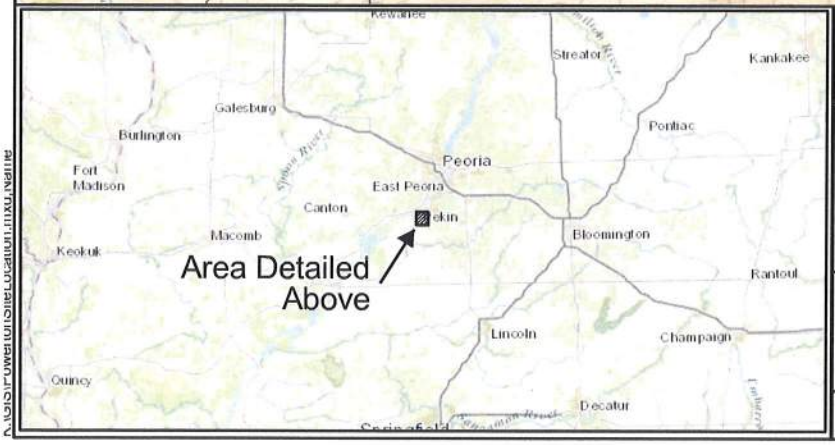
Attachments

Figure 1 – Site Location
Figure 2 – North and South Pond Detail

FIGURES



USGS Topo, The National Map - National Structures Dataset



2,000 1,000 0 2,000 Feet

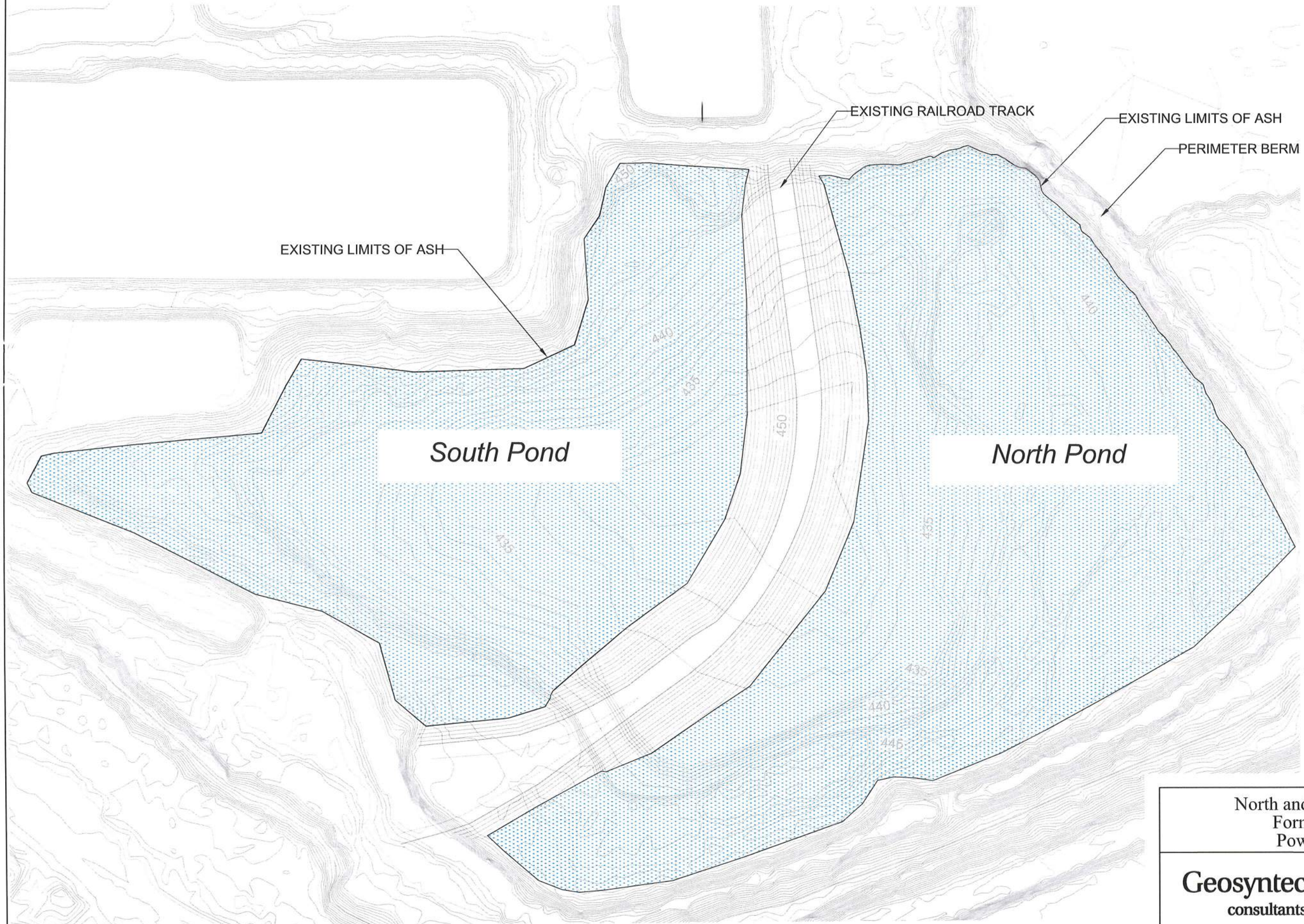
Site Location

Former Ash Basin
Powerton Station
Pekin, IL

Geosyntec consultants

Columbia, MD | April 2018

Figure 1



N

LEGEND

440 EXISTING CONTOUR

NOTES:

1. ELEVATIONS ARE IN FEET ABOVE MEAN SEA LEVEL.
2. CONTOURS BELOW ELEVATION 440 FT-MSL WERE OBTAINED FROM A DRAWING ENTITLED, "BORING LOCATIONS PLAN", BY PATRICK ENGINEERING INC., LISLE, ILLINOIS DATED 6 OCTOBER 2008. REMAINING SURVEY INFORMATION WAS OBTAINED FROM ELECTRONIC FILE OF AERIAL SURVEY BY AER-METRIC, INC. OF SHEBOYGAN, WISCONSIN; FLYOVER DATE 19 JUNE 2006.
3. RAILROAD EMBANKMENT WAS LOCATED USING SATELLITE INFORMATION OBTAINED FROM GOOGLE EARTH. TOP OF THE EMBANKMENT WAS ASSUMED TO BE ELEVATION 458 FT-MSL.
4. EXTENT OF ASH IS CONSIDERED TO BE AT THE TOE OF THE PERIMETER BERM.

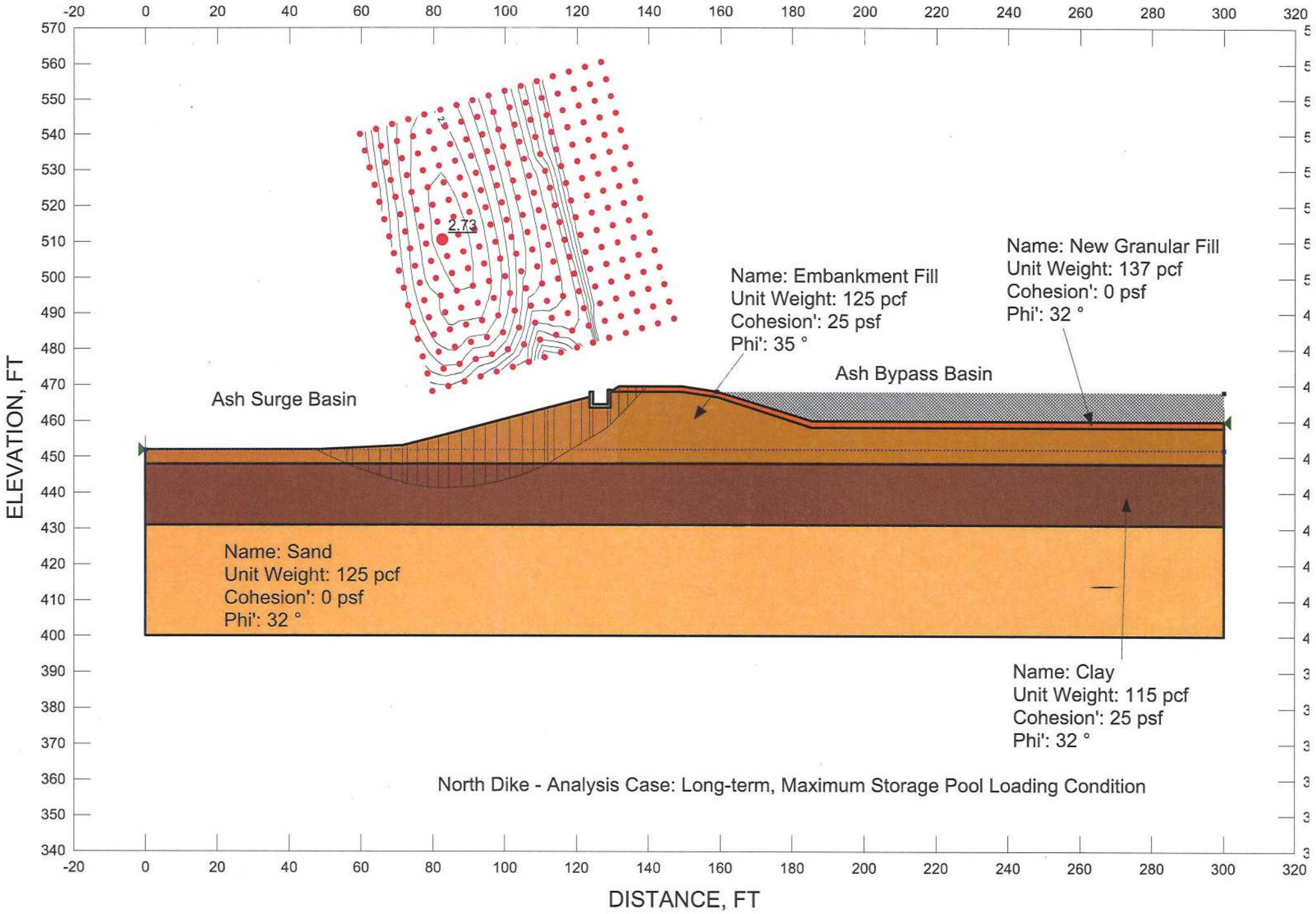
0 150'
SCALE IN FEET

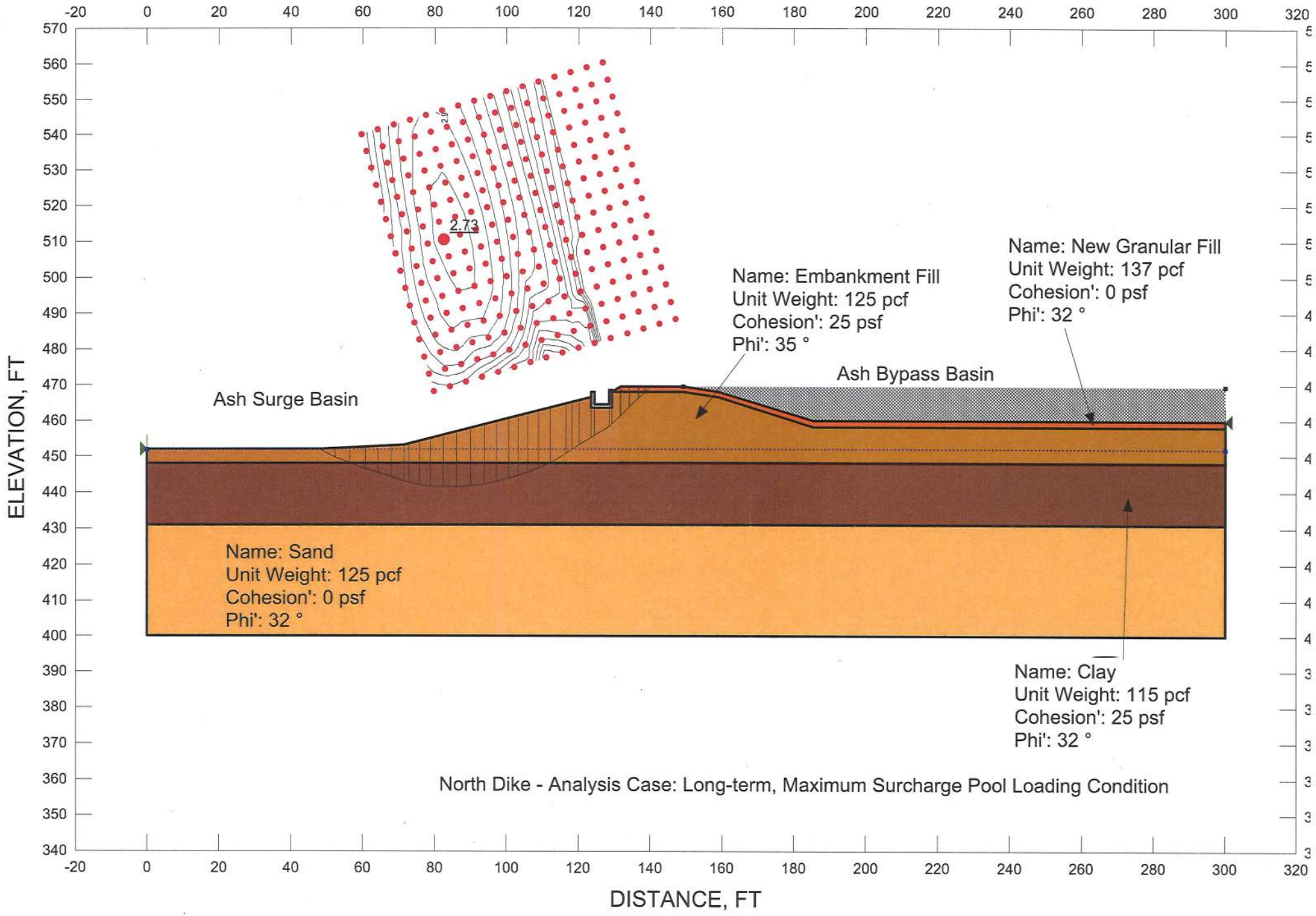
North and South Pond Detail
Former Ash Basin
Powerton Station

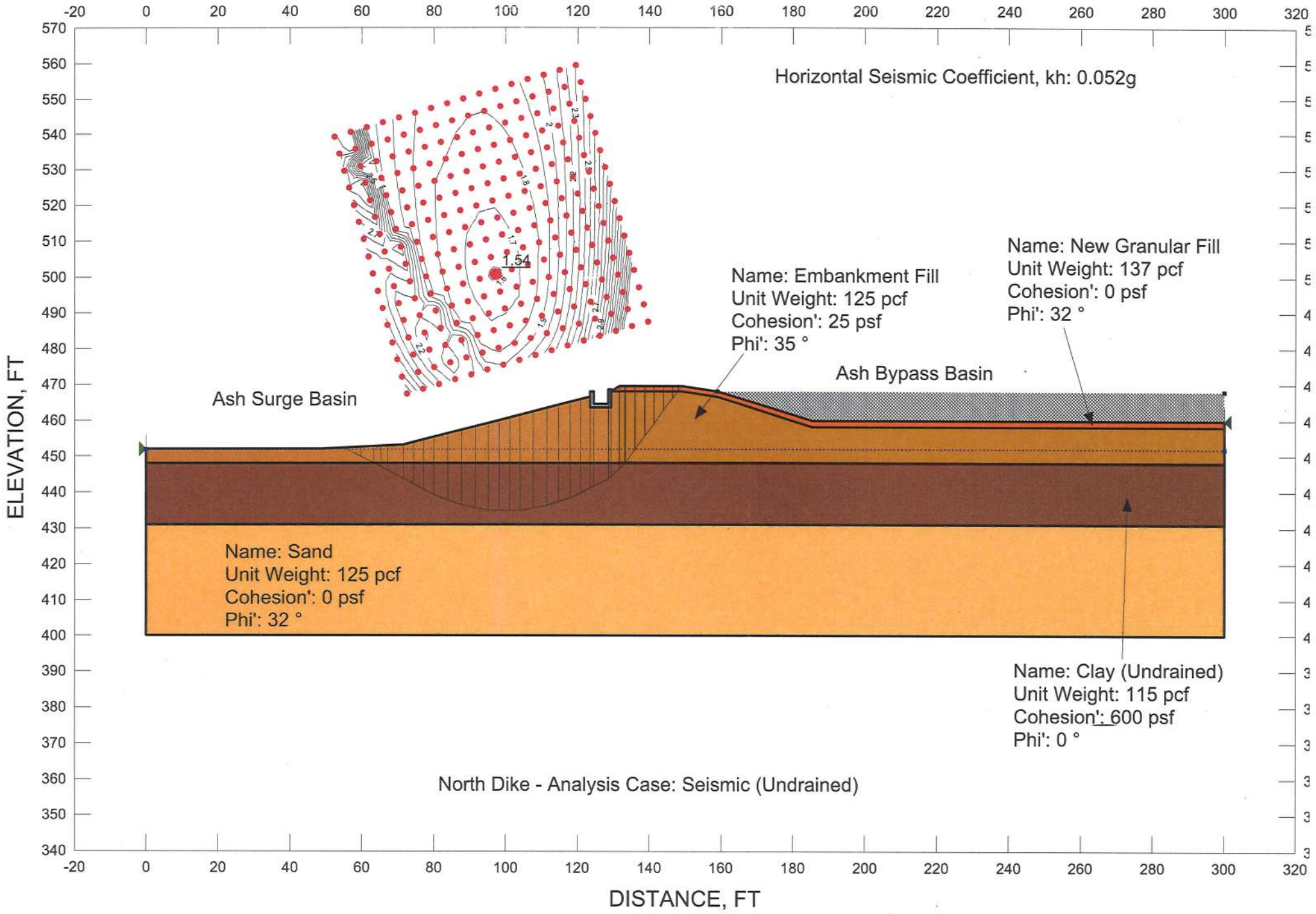
Geosyntec consultants
COLUMBIA, MARYLAND

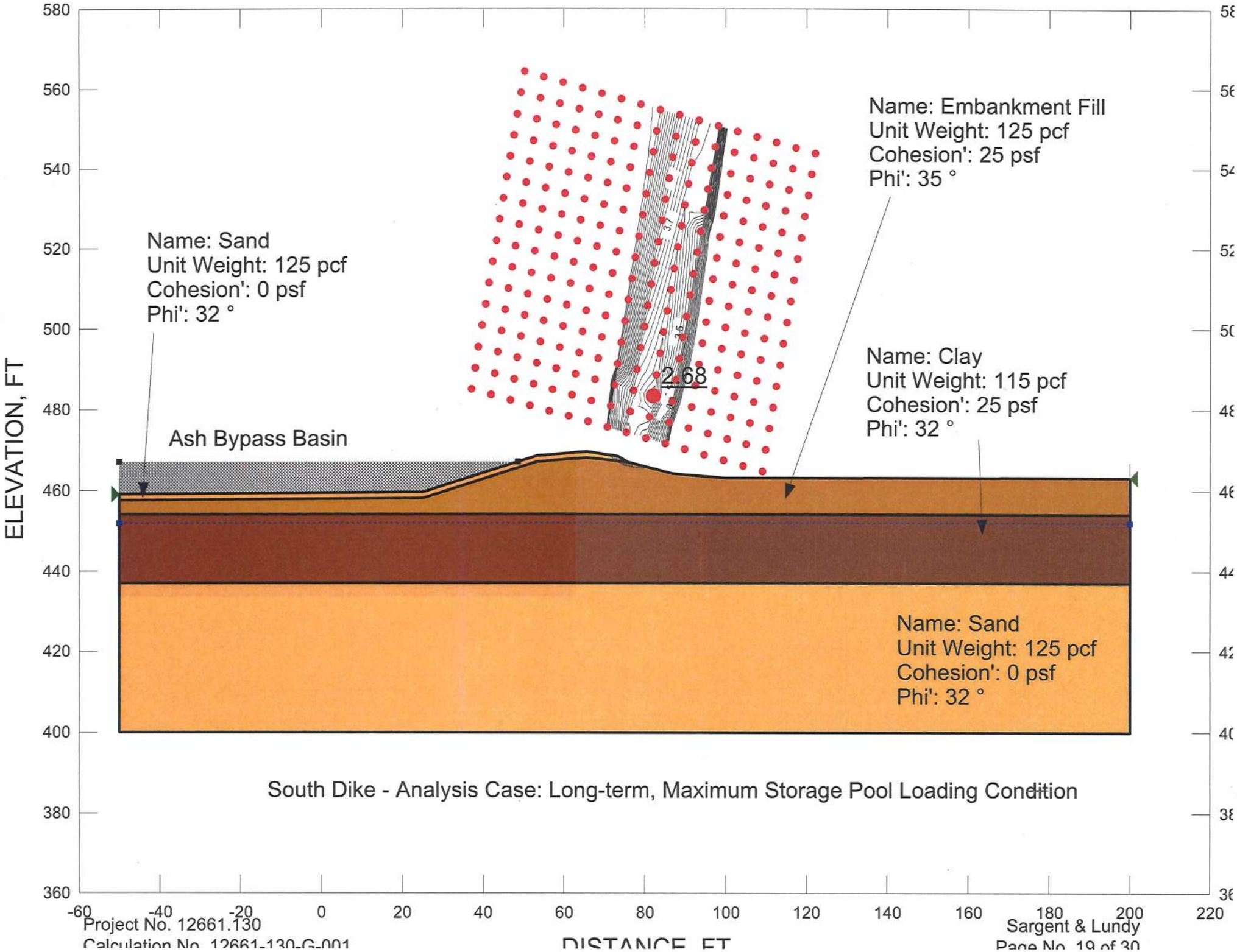
DATE:	April 2018
PROJECT NO.	ME1615
DOCUMENT NO.	
FILE NO.	f005
FIGURE NO.	2

APPENDIX C: 2022 SLOPE STABILITY ANALYSIS RESULTS FOR RETROFITTED BYPASS BASIN

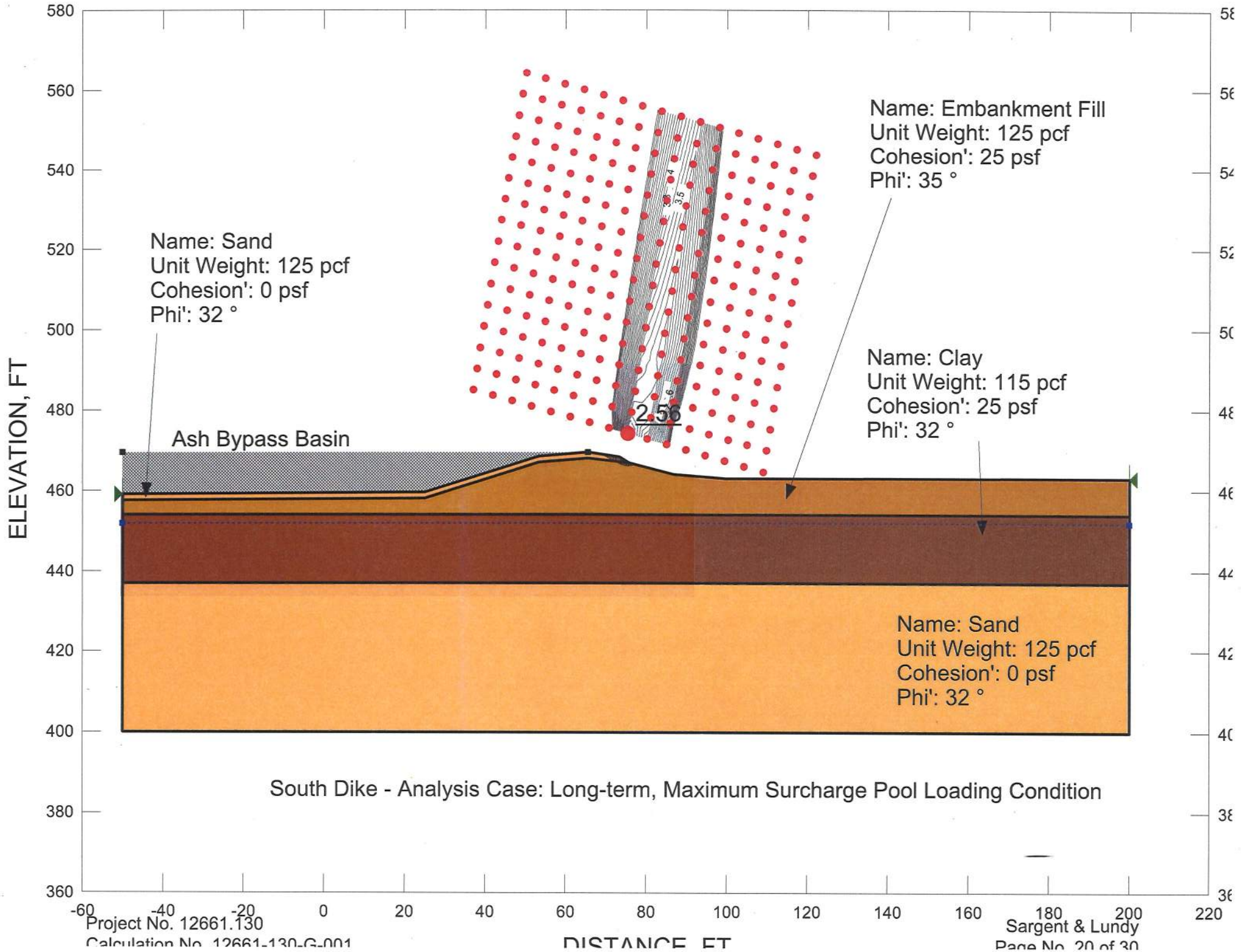

2.73
Name: Embankment Fill
Unit Weight: 125 pcf
Cohesion': 25 psf
Phi': 35 °
Name: New Granular Fill
Unit Weight: 137 pcf
Cohesion': 0 psf
Phi': 32 °
Ash Surge Basin
Ash Bypass Basin
Name: Sand
Unit Weight: 125 pcf
Cohesion': 0 psf
Phi': 32 °
Name: Clay
Unit Weight: 115 pcf
Cohesion': 25 psf
Phi': 32 °
North Dike - Analysis Case: Long-term, Maximum Storage Pool Loading Condition
ELEVATION, FT
DISTANCE, FT

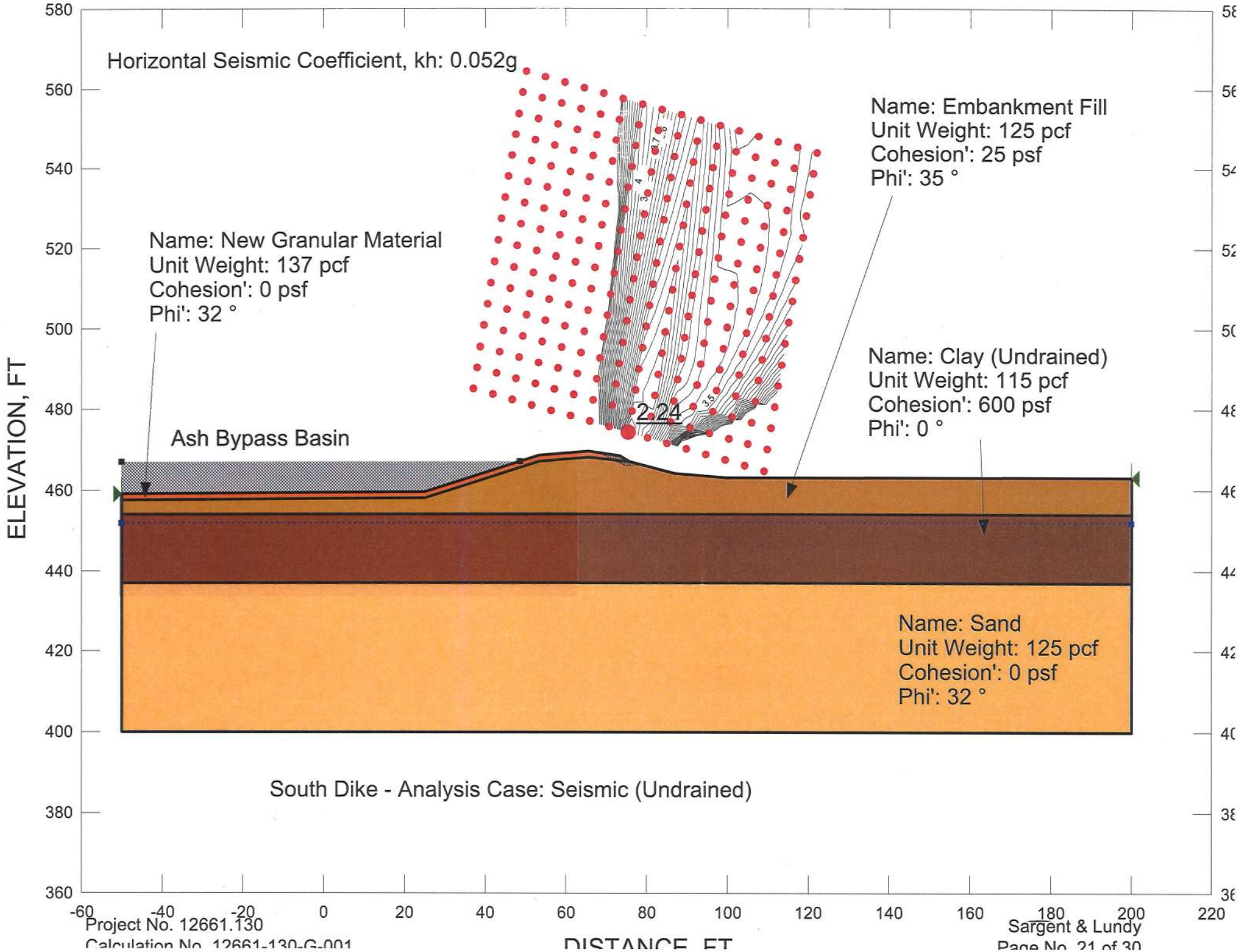

-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320
570 560 550 540 530 520 510 500 490 480 470 460 450 440 430 420 410 400 390 380 370 360 350 340
ELEVATION, FT
DISTANCE, FT
2.73
Name: Embankment Fill
Unit Weight: 125 pcf
Cohesion': 25 psf
Phi': 35 °
Name: New Granular Fill
Unit Weight: 137 pcf
Cohesion': 0 psf
Phi': 32 °
Ash Surge Basin
Ash Bypass Basin
Name: Sand
Unit Weight: 125 pcf
Cohesion': 0 psf
Phi': 32 °
Name: Clay
Unit Weight: 115 pcf
Cohesion': 25 psf
Phi': 32 °
North Dike - Analysis Case: Long-term, Maximum Surcharge Pool Loading Condition

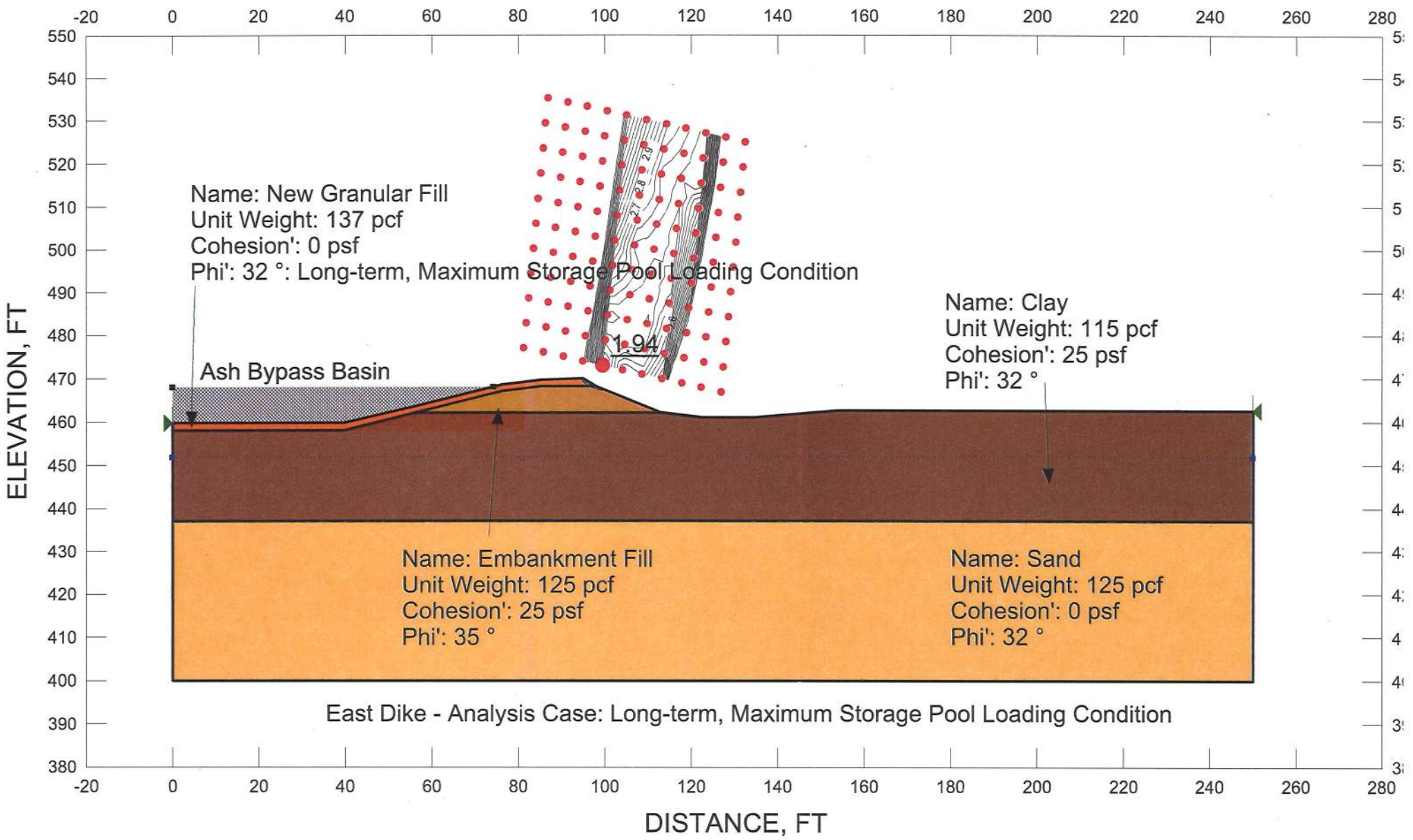

Horizontal Seismic Coefficient, kh: 0.052g
1.54
Name: Embankment Fill
Unit Weight: 125 pcf
Cohesion': 25 psf
Phi': 35 °
Name: New Granular Fill
Unit Weight: 137 pcf
Cohesion': 0 psf
Phi': 32 °
Ash Surge Basin
Ash Bypass Basin
Name: Sand
Unit Weight: 125 pcf
Cohesion': 0 psf
Phi': 32 °
Name: Clay (Undrained)
Unit Weight: 115 pcf
Cohesion': 600 psf
Phi': 0 °
North Dike - Analysis Case: Seismic (Undrained)
ELEVATION, FT
DISTANCE, FT



South Dike - Analysis Case: Long-term, Maximum Storage Pool Loading Condition


Name: Embankment Fill
Unit Weight: 125 pcf
Cohesion': 25 psf
Phi': 35 °
Name: Sand
Unit Weight: 125 pcf
Cohesion': 0 psf
Phi': 32 °
Name: Clay
Unit Weight: 115 pcf
Cohesion': 25 psf
Phi': 32 °
Ash Bypass Basin
2.56
Name: Sand
Unit Weight: 125 pcf
Cohesion': 0 psf
Phi': 32 °
South Dike - Analysis Case: Long-term, Maximum Surcharge Pool Loading Condition
ELEVATION, FT
DISTANCE, FT
580
560
540
520
500
480
460
440
420
400
380
360
-60
-40
-20
0
20
40
60
80
100
120
140
160
180
200
220


Horizontal Seismic Coefficient, kh: 0.052g
Name: Embankment Fill
Unit Weight: 125 pcf
Cohesion': 25 psf
Phi': 35 °
Name: New Granular Material
Unit Weight: 137 pcf
Cohesion': 0 psf
Phi': 32 °
Name: Clay (Undrained)
Unit Weight: 115 pcf
Cohesion': 600 psf
Phi': 0 °
Ash Bypass Basin
2.24
Name: Sand
Unit Weight: 125 pcf
Cohesion': 0 psf
Phi': 32 °
South Dike - Analysis Case: Seismic (Undrained)
ELEVATION, FT
DISTANCE, FT
580
560
540
520
500
480
460
440
420
400
380
360
-60
-40
-20
0
20
40
60
80
100
120
140
160
180
200
220


Name: New Granular Fill
Unit Weight: 137 pcf
Cohesion': 0 psf
Phi': 32 °: Long-term, Maximum Storage Pool Loading Condition
Ash Bypass Basin
1.94
Name: Clay
Unit Weight: 115 pcf
Cohesion': 25 psf
Phi': 32 °
Name: Embankment Fill
Unit Weight: 125 pcf
Cohesion': 25 psf
Phi': 35 °
Name: Sand
Unit Weight: 125 pcf
Cohesion': 0 psf
Phi': 32 °
East Dike - Analysis Case: Long-term, Maximum Storage Pool Loading Condition
ELEVATION, FT
DISTANCE, FT
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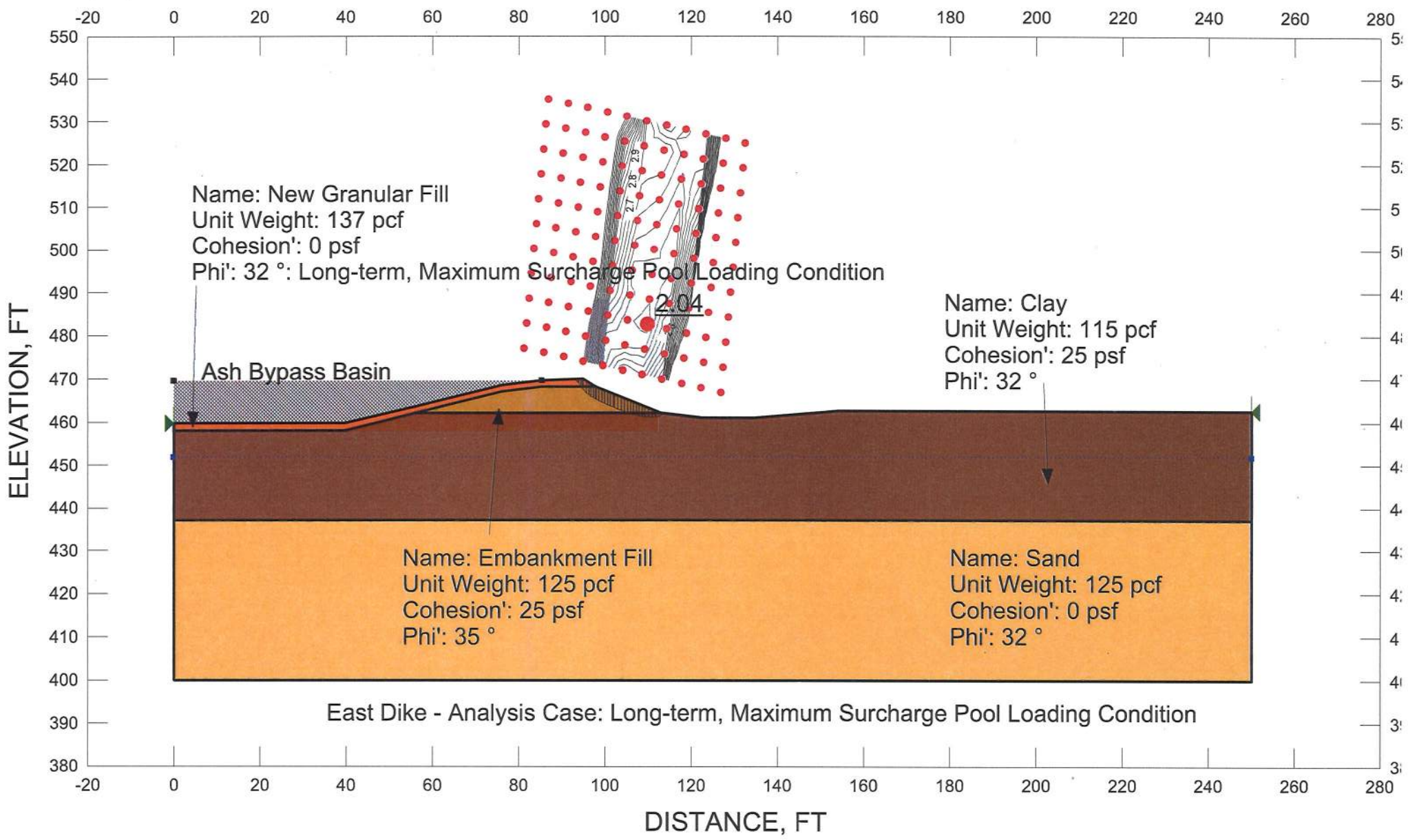
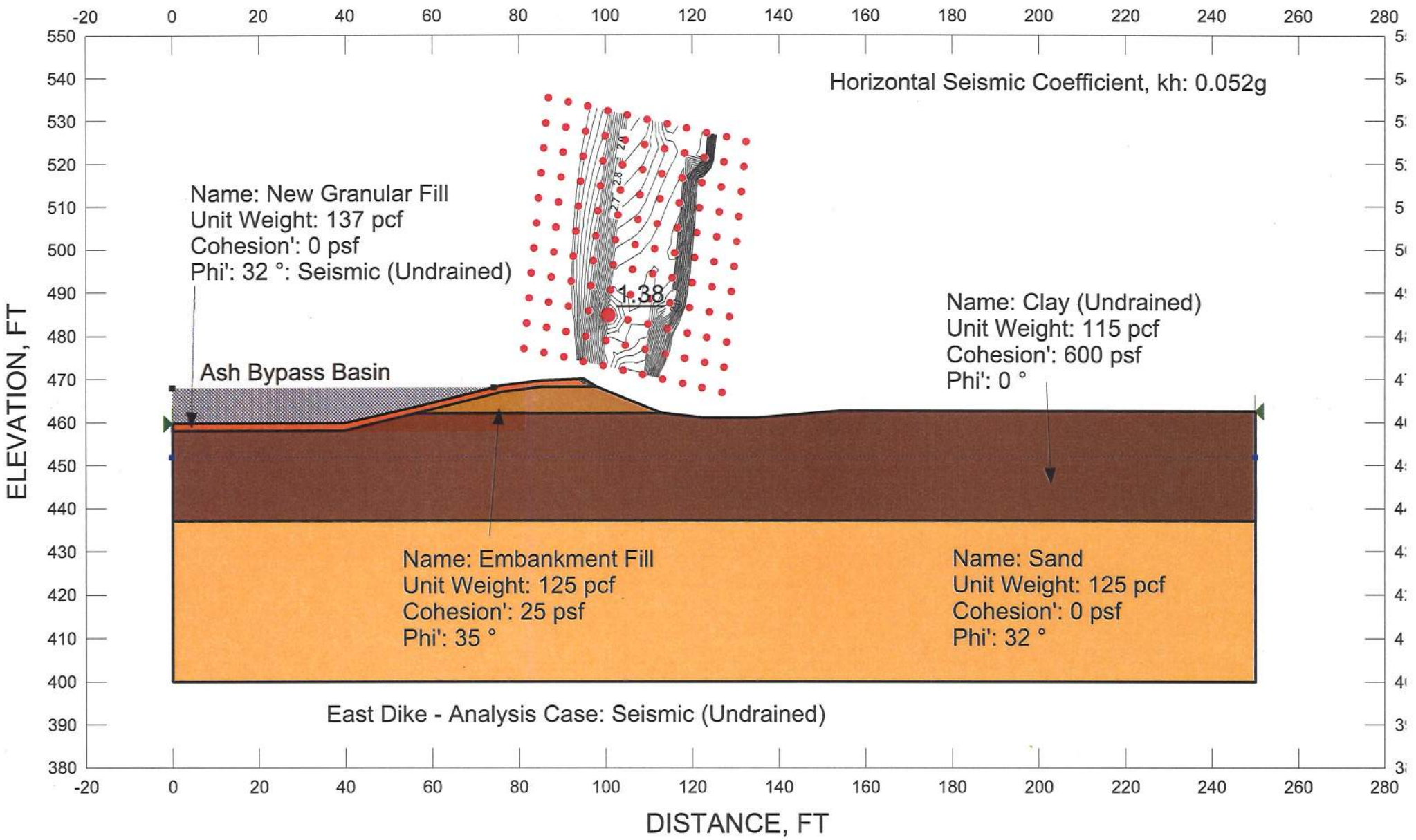
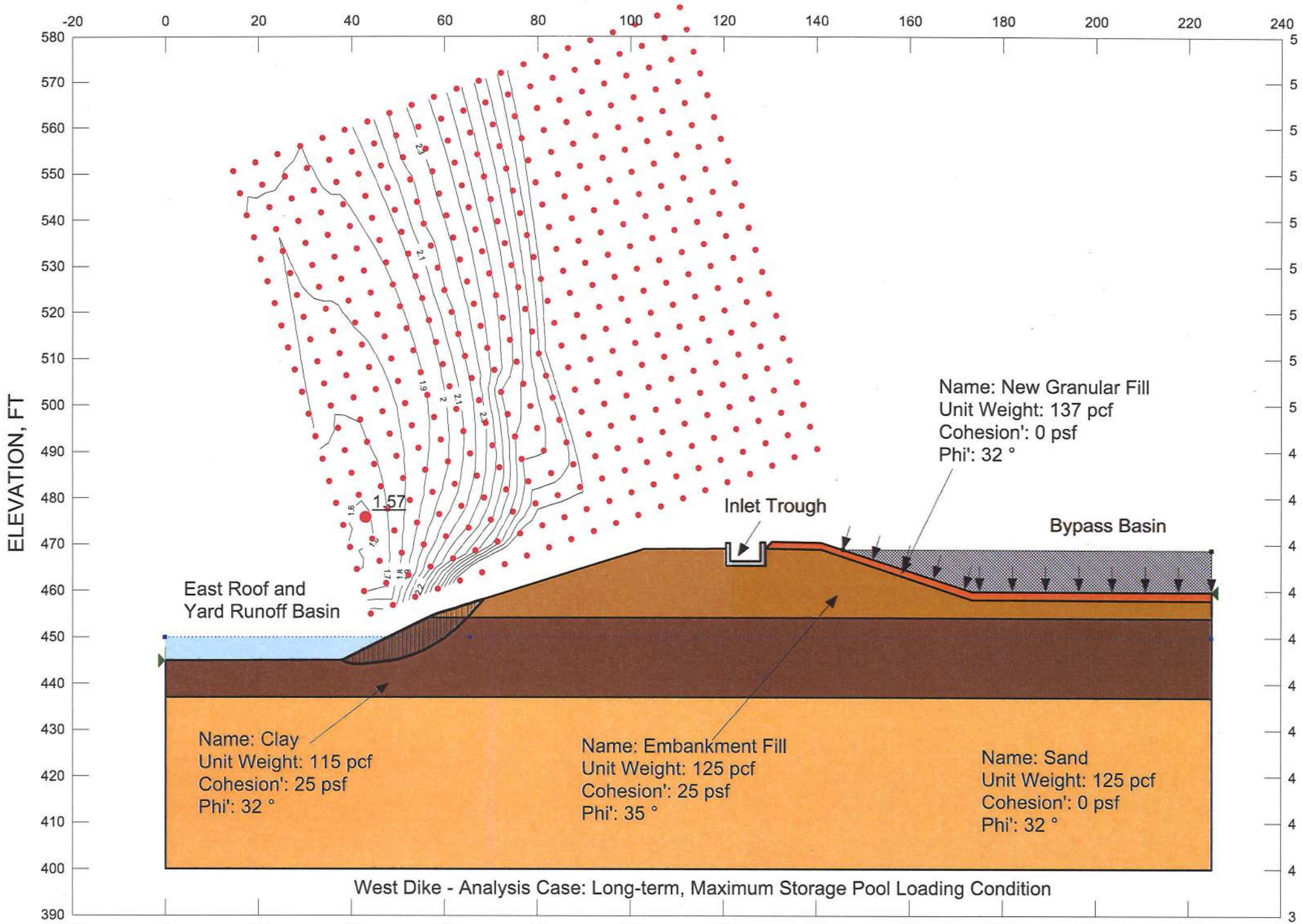
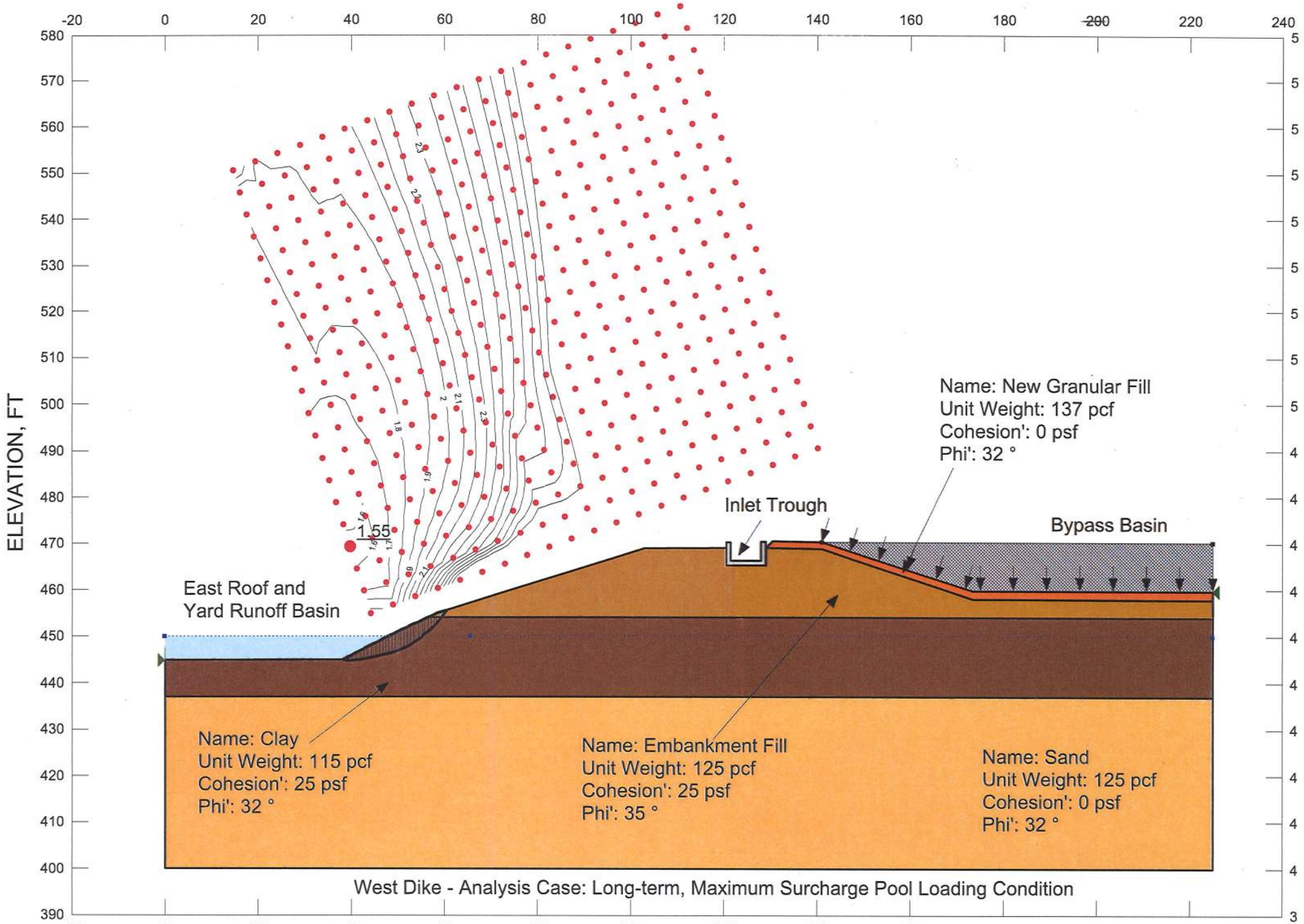
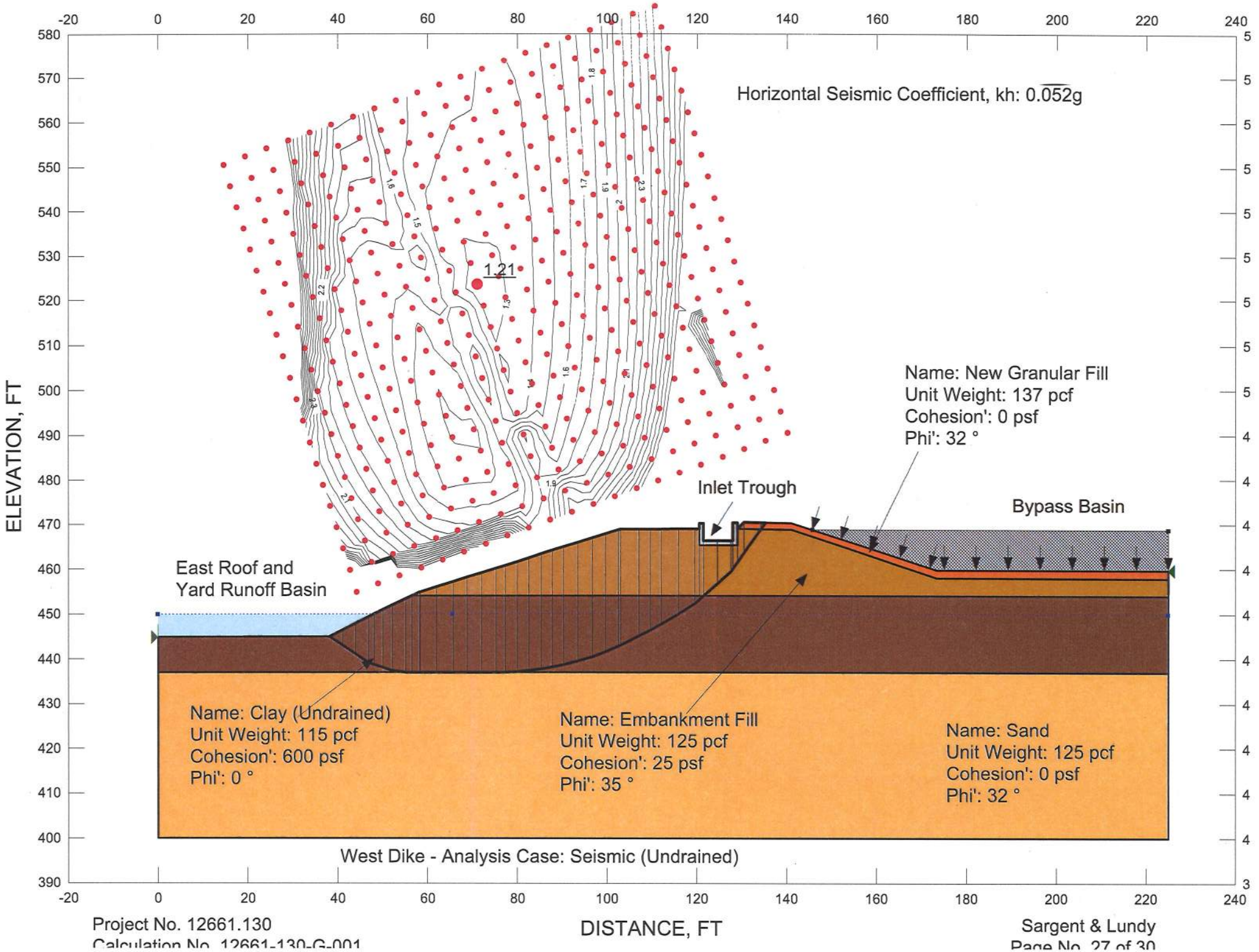
550 540 530 520 510 500 490 480 470 460 450 440 430 420 410 400 390 380


Name: New Granular Fill
Unit Weight: 137 pcf
Cohesion': 0 psf
Phi': 32 °: Long-term, Maximum Surcharge Pool Loading Condition
2.04
Ash Bypass Basin
Name: Clay
Unit Weight: 115 pcf
Cohesion': 25 psf
Phi': 32 °
Name: Embankment Fill
Unit Weight: 125 pcf
Cohesion': 25 psf
Phi': 35 °
Name: Sand
Unit Weight: 125 pcf
Cohesion': 0 psf
Phi': 32 °
East Dike - Analysis Case: Long-term, Maximum Surcharge Pool Loading Condition
ELEVATION, FT
DISTANCE, FT
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280
550 540 530 520 510 500 490 480 470 460 450 440 430 420 410 400 390 380


Horizontal Seismic Coefficient, kh: 0.052g
Name: New Granular Fill
Unit Weight: 137 pcf
Cohesion': 0 psf
Phi': 32 °: Seismic (Undrained)
1.38
Ash Bypass Basin
Name: Clay (Undrained)
Unit Weight: 115 pcf
Cohesion': 600 psf
Phi': 0 °
Name: Embankment Fill
Unit Weight: 125 pcf
Cohesion': 25 psf
Phi': 35 °
Name: Sand
Unit Weight: 125 pcf
Cohesion': 0 psf
Phi': 32 °
East Dike - Analysis Case: Seismic (Undrained)
ELEVATION, FT
DISTANCE, FT
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280
550 540 530 520 510 500 490 480 470 460 450 440 430 420 410 400 390 380


ELEVATION, FT
DISTANCE, FT
1.57
Inlet Trough
Bypass Basin
East Roof and
Yard Runoff Basin
Name: New Granular Fill
Unit Weight: 137 pcf
Cohesion': 0 psf
Phi': 32 °
Name: Clay
Unit Weight: 115 pcf
Cohesion': 25 psf
Phi': 32 °
Name: Embankment Fill
Unit Weight: 125 pcf
Cohesion': 25 psf
Phi': 35 °
Name: Sand
Unit Weight: 125 pcf
Cohesion': 0 psf
Phi': 32 °
West Dike - Analysis Case: Long-term, Maximum Storage Pool Loading Condition


ELEVATION, FT
DISTANCE, FT
Name: New Granular Fill
Unit Weight: 137 pcf
Cohesion': 0 psf
Phi': 32 °
Inlet Trough
Bypass Basin
East Roof and
Yard Runoff Basin
1.55
Name: Clay
Unit Weight: 115 pcf
Cohesion': 25 psf
Phi': 32 °
Name: Embankment Fill
Unit Weight: 125 pcf
Cohesion': 25 psf
Phi': 35 °
Name: Sand
Unit Weight: 125 pcf
Cohesion': 0 psf
Phi': 32 °
West Dike - Analysis Case: Long-term, Maximum Surcharge Pool Loading Condition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1.21
Name: New Granular Fill
Unit Weight: 137 pcf
Cohesion': 0 psf
Phi': 32 °
Inlet Trough
Bypass Basin
East Roof and
Yard Runoff Basin
Name: Clay (Undrained)
Unit Weight: 115 pcf
Cohesion': 600 psf
Phi': 0 °
Name: Embankment Fill
Unit Weight: 125 pcf
Cohesion': 25 psf
Phi': 35 °
Name: Sand
Unit Weight: 125 pcf
Cohesion': 0 psf
Phi': 32 °
West Dike - Analysis Case: Seismic (Undrained)
ELEVATION, FT
DISTANCE, FT
-20 0 20 40 60 80 100 120 140 160 180 200 220 240
580 570 560 550 540 530 520 510 500 490 480 470 460 450 440 430 420 410 400 390