REPORT

Safety Factor Assessment
5-Year Update

San Miguel Electric Cooperative Power Plant
CCR Ponds
Atascosa County, Texas

Submitted to:

San Miguel Electric Cooperative, Inc.
6200 FM 3387
Christine, TX 78012

Submitted by:

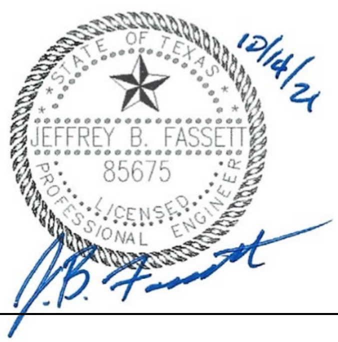
Golder Associates Inc.
Round Rock, Texas USA 78664

+1 512 671-3434

October 2021

PROFESSIONAL CERTIFICATION

This document and all attachments were prepared by Golder Associates Inc. under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I hereby certify that the Safety Factor Assessment has been prepared in accordance with the requirements of Section 257.73(e) of the CCR Rule.



Jeffrey B. Fassett, P.E.
Associate
Golder Associates Inc.
Firm Registration No. F-2578

Table of Contents

1.0 INTRODUCTION

San Miguel Electric Cooperative, Inc. (SMECI) owns and operates the San Miguel Power Plant (SMPP) located approximately 6 miles south of Christine, Texas in Atascosa County, Texas (Figure 1). The SMPP is a 440-megawatt, lignite-fired electric power plant that was placed into service in 1982. Coal Combustion Residuals (CCR) including fly ash, bottom ash and flue gas desulfurization (FGD) wastewater/solids are generated as part of SMPP operation.

From 1982 through 2020, bottom ash and FGD wastewater/solids were managed in Ash Pond A and Ash Pond B (which were collocated and referred to collectively as the Ash Ponds) and an Equalization Pond (EQ Pond). The Ash Ponds and EQ Pond are located south and southeast of the SMPP generating unit (Figure 2). In 2020, SMECI retrofitted the Ash Ponds by installing a composite liner system meeting the requirements of 40 CFR Section 257.70(b), and subdivided Ash Pond B to create a smaller Retrofitted Ash Pond B and a Retrofitted EQ Pond (See Figure 2). The previous EQ Pond (referred to herein as the Former EQ Pond) was removed from service in 2021 and is undergoing closure.

The U.S. Environmental Protection Agency promulgated 40 C.F.R. Part 257, Subpart D (the CCR Rule) to establish technical requirements for new and existing CCR landfills and surface impoundments. Retrofitted Ash Pond A, Retrofitted Ash Pond B and the Retrofitted EQ Pond have been identified as Existing CCR Surface Impoundments regulated under the CCR Rule.

Section 257.73(e) of the CCR Rule specifies that periodic safety factor assessments must be conducted for each CCR surface impoundment. In accordance with Section 257.73(g) of the CCR Rule, the initial Safety Factor Assessments for the Ash Ponds and Former EQ Pond were completed and placed in the facility operating record in October 2016 (Arias, 2016). As specified in Section 257.73(f)(3), the Safety Factor Assessment must be updated every five years from the completion date of the initial plan. Golder Associates Inc., member of WSP, was retained by SMECI to prepare this updated Safety Factor Assessment for Ash Pond A, Retrofitted Ash Pond B and the Retrofitted EQ Pond.

1.1 Description of Ash Pond A, Retrofitted Ash Pond B and Retrofitted EQ Pond

From 1982 through 2020, bottom ash transport water was managed in Ash Pond A and Ash Pond B, which were constructed as part of the original SMPP construction. The Ash Transport Water Pond Complex (Ash Pond) as originally constructed contained two pond cells, Ash Pond A on the north side and Ash Pond B immediately adjacent to the south. The system was constructed as a side-hill impoundment with the northern dike at or near natural grade and includes a central “splitter dike” that separates the pond into north and south sections with a connecting weir.

The total dike perimeter of the Ash Pond is approximately 6,000 feet, and the approximate surface area is 26 acres. The maximum dike height is approximately 20 feet with side slopes ranging from 2.5 horizontal to 1 vertical (2.5H:1V) to 3.0H:1V, with an average crest width of 20 feet. The elevation of the dike crest is 315 feet with a maximum pool water surface elevation of 313.5 feet (18 inches below crest) (AECOM, 2018).

Both ash ponds were constructed with a clay soil liner consisting of 3 feet of compacted soil with a hydraulic conductivity of no more than 1 x 10^{-7} cm/sec (ERM, 2016; Zephyr, 2017).

In 2020, SMECI retrofitted Ash Pond A and Ash Pond B as follows:

- A 60-mil HDPE geomembrane was installed in Ash Pond A over the existing clay soil liner. The HDPE geomembrane extends across the floor of the pond and up the interior faces of the perimeter dikes and is secured in anchor trenches at the top of the dikes.

- Ash Pond B was subdivided to create a smaller Retrofitted Ash Pond B and a Retrofitted EQ Pond by constructing a divider dike across the width of Ash Pond B. A 60-mil HDPE geomembrane was installed in Retrofitted Ash Pond B and the EQ Pond over the existing clay soil liner and divider dike. The HDPE geomembrane extends across the floor of the pond and up the interior faces of the perimeter dikes and is secured in anchor trenches at the top of the dikes.

The configuration of the existing perimeter dikes of the Ash Ponds was not modified as part of the Ash Pond Retrofit project.

1.2 Previous Stability Evaluations

Several stability evaluations have been performed on the Ash Ponds, specifically:

- Arias & Associates, Inc. (Arias, 2012) performed stability analyses for the CCR surface impoundments in 2012 to determine global stability safety factors at select embankment cross-sections. The calculated factors of safety met the minimum criteria presented in 40 CFR Section 257.73(e)(i) through (iv).

- Arias Geoprofessionals, Inc. (Arias, 2016) performed a second evaluation in 2016 to meet the requirements of the Initial Safety Factor Assessment. This evaluation indicated that two areas, represented by Cross Section 1B (located along the western downstream slope) and 9A (along the east downstream embankment slope), were slightly less than the minimum values in Section 257.73(e)(i) through (iv). Arias provided recommended remedial actions to increase the factors of safety.

- Following the remedial actions described in the 2016 Arias report, Wood Environment & Infrastructure Solutions, Inc. (Wood, 2018) reevaluated Sections 1B and 9A. Wood's analysis indicated that the factors of safety exceed the minimum requirements.

2.0 UPDATED SAFETY FACTOR ASSESSMENT – SECTION 257.73(e)

Section 257.73(e)(1) of the CCR Rule requires that periodic safety factor assessments be conducted by a qualified professional engineer to document that calculated factors of safety for each CCR unit achieve the following minimum values:

i. The calculated static factor of safety under the long-term, maximum storage pool loading condition must equal or exceed 1.50.

ii. The calculated static factor of safety under the maximum surcharge pool loading condition must equal or exceed 1.40.

iii. The calculated seismic factor of safety must equal or exceed 1.00.

iv. For dikes constructed of soils that have susceptibility to liquefaction, the calculated liquefaction factor of safety must equal or exceed 1.20.

The CCR Rule specifies that structural stability factors of safety be evaluated for the critical cross section of each CCR facility under static and seismic loading for “Maximum Storage Pool” (0.5 feet of freeboard for this facility) and “Maximum Surcharge Pool” (no freeboard) conditions. Liquefaction potential analysis is only necessary when soil sampling, construction documentation or anecdotal evidence from personnel with knowledge about the facility, indicates that soils of the embankment are susceptible to liquefaction.

The Updated Safety Factor Assessment performed by Golder for the CCR Ponds at the SMPPP is described in this section.

2.1 Safety Factor Assessment Methodology

Slope stability analyses were performed using a limit-equilibrium-based commercial computer program, Slide2 (Rocscience, 2021). The analyses used a searching routine to identify the potential failure surface with minimum factor of safety for a given set of geometry, ground and groundwater conditions. The Spencer (1967) method of analysis was used in the analyses to compute the factor of safety as this procedure satisfies both force and moment equilibrium, while the Morgenstern-Price method was used for verification.

The factors of safety of numerous potential failure surfaces were computed to establish minimum factors of safety. Both circular and non-circular (“cuckoo”) failure surfaces and were considered for all cases. Stability analyses were performed for “Maximum Storage Pool” (freeboard of 0.5 feet) and “Maximum Surcharge Pool” (no freeboard) conditions for the embankment slopes of the ponds.

2.2 Cross-Sections Analyzed

Based on our review of the geometry of the embankment slopes, the soil profile, and the loading conditions, Golder concluded that the sections analyzed in the previous Safety Factor Assessments represent the critical conditions.

Section 1B, located along the western embankment of Ash Pond A and Section 9A, located along the eastern embankment of Ash Pond B were analyzed. The critical cross-section locations are shown on Figure 3.

2.3 Material Properties

Golder did not perform a subsurface investigation or perform soil testing as part of this Updated Safety Factor Assessment. In 2012, Arias and Associates, Inc. (Arias, 2012) performed an investigation including seven borings along the crest and toe of the Ash Pond dikes. In addition to index testing, multistage consolidated undrained (CU) triaxial compression testing was performed on clay samples to characterize the shear strength of the foundation soils and the abutment fill. Based on the field and laboratory data, Arias divided the subsurface soils into three strata as follows.

Stratum	Soil Profile Zone	Material	Unit Weight	Strength Function
I	All Fill Soils Above Natural Grade	Fat CLAY (CH), Lean CLAY (CL)	112 pcf	**Total Stress** c_u = 216 psf ϕ = 17.2° **Effective Stress** c' = 288 psf ϕ = 20.3°
II_a	Natural Soils Above Silty Sands	Fat CLAY (CH), Lean CLAY (CL)	112 pcf	**Total Stress** c_u = 216 psf ϕ = 17.2° **Effective Stress** c' = 288 psf ϕ = 20.3°
II_b	Natural Soils Above Silty Sands	Sandy Lean CLAY (CL), Clayey SAND (SC)	120 pcf	**Total Stress** c_u = 1000 psf, ϕ = 0° **Effective Stress** c' = 200 psf, ϕ = 24°
III	Silty Sands	Silty SAND (SM), Sandy SILT (ML)	120 pcf	**Model Only With Effective Stress** c' = 0 psf, ϕ = 30°

The strength parameters for the compacted clay fill represent the average strengths from the triaxial CU compression tests. The strength parameters for the native soils were estimated based on STP N-values, pocket penetrometer results and experience with soils in the region. Based on our review of historical soil boring and geotechnical information, Golder determined that the material properties used to the perform the previous stability analyses are appropriate.

As noted above, the Ash Ponds have been retrofitted with a composite liner system comprised of a 60-mil HDPE geomembrane overlying a compacted clay liner. The presence of this liner system will limit seepage from the ponds into the adjacent embankments. For our analysis we have assume the phreatic surface within the embankment is equal to the elevation of the toe of the perimeter dikes.

2.5 Seismic Loading

2.5.1 Peak Ground Acceleration Determination

The peak ground acceleration (PGA) with a 2% probability of exceedance in 50 years was estimated for the site using U.S. Geological Survey (USGS) Unified Hazard Tool website (Unified Hazard Tool (usgs.gov)) based on the USGS 2014 conterminous hazard maps. The PGA from the 2014 USGS conterminous maps provides PGAs for a Site Class B/C boundary. Based on the STP N-values for the borings near the critical cross-sections, the site is Class D. Golder adjusted the Site Class B/C boundary to Site Class D by applying a site coefficient factor based on ASCE 7-16 (ASCE, 2017) to convert the Site Class B/C to a Site Class D. The site coefficient conversion factor used is 1.6. The PGA obtained from the USGS is 0.028 g for Site Class B/C. The adjusted PGA for Site Class D is 0.045 g (1.6 x 0.028 = 0.045 g).

2.5.2 Horizontal Seismic Coefficient Determination

Pseudo-static stability analyses using the Hynes-Griffin and Franklin method (Hynes-Griffin, 1984) were performed to evaluate whether embankment deflections under seismic loading conditions will be acceptable. The Hynes-Griffin and Franklin method includes applying a horizontal pseudo-static acceleration equal to 50% of the PGA. Factors of safety greater than 1.0 indicate that embankment deflections during the design seismic event will likely be acceptable (small). Factors of safety less than or equal to 1.0 indicate that a more rigorous evaluation of seismic-induced slope deformation is warranted. A horizontal seismic load coefficient of 0.023 g (0.5 x 0.045 = 0.023 g) was used in the pseudo-static analysis.

2.5.3 Material Properties for Pseudo-Static Stability Analysis

Material shear strength parameters for all materials were lowered to 80% of the static stability analysis values to account for potential pore pressure increases during seismic loading.

2.6 Liquefaction Potential

Soil liquefaction describes a phenomenon whereby a saturated or partially saturated soil substantially loses strength and stiffness in response to an applied stress, usually earthquake shaking or other sudden change in stress condition, causing it to behave like a liquid. The phenomenon is most often observed in saturated, loose (low density or uncompacted), sandy soils. The embankment soils of the Ash Pond A and Ash Pond B are composed of clayey materials with significant fines content. The immediate foundation materials are also composed of soils containing a significant portion of fines and are also considerably dense. The subsurface investigations performed at the ponds do not indicate any soils in the embankment or its foundation that are susceptible to liquefaction. Hence, failure of the pond slopes due to liquefaction is considered unlikely for Ash Pond A and Ash Pond B surface impoundments at the SMPP.

2.7 Stability Analysis Results

Slope stability analyses were performed for long-term conditions for each of the critical cross-sections considered under static conditions. Embankment slopes were analyzed for “Maximum Storage Pool” (0.5 feet of freeboard) and “Maximum Surcharge Pool” (no freeboard) conditions. The results of the slope stability analysis cases are presented in Table 2, and the corresponding analysis outputs can be found in Appendix A.

The results indicate that the surface impoundment slopes at the SMPP comply with the minimum factors of safety specified in Section257.73(e)(1) of the CCR Rule under all considered loading scenarios.

Table 1: Slope Stability Analysis Results

Cross-Section	Pond Pool Level	Failure Surface	Figure (See Appendix A)	Required Factor of Safety	Calculated Factor of Safety (Spencer Method)
1B Static	Storage	Circular	A-1	1.5	1.58
		Non-Circular	A-2	1.4	1.56
	Surcharge	Circular	A-3	1.5	1.58
		Non-Circular	A-4	1.4	1.56
1B Pseudo-Static	Storage	Circular	A-5	1.0	1.19
		Non-Circular	A-6		1.17
	Surcharge	Circular	A-7		1.19
		Non-Circular	A-8		1.17
9A Pseudo-Static	Storage	Circular	A-9	1.5	1.50
		Non-Circular	A-10	1.4	1.48
	Surcharge	Circular	A-11	1.5	1.50
		Non-Circular	A-12	1.4	1.48
9A Seismic	Storage	Circular	A-13	1.0	1.11
		Non-Circular	A-14		1.09
	Surcharge	Circular	A-15		1.11
		Non-Circular	A-16		1.10

3.0 CONCLUSIONS

Based on our analyses, the calculated factors of safety through the critical cross sections in the Retrofitted Ash Ponds and Retrofitted EQ Pond comply with the minimum factors of safety specified in Section257.73(e)(1)(i)-(iv).

4.0 REFERENCES

AECOM, 2018. CCR Certification: Seismic Impact Zone §257.63 for the Ash Pond, Equalization Pond and Ash Pile at the San Miguel Plan, Revision 0, October 17.

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Environmental Resources Management (ERM), 2016. Existing CCR Surface Impoundment Liner Design Criteria – Ash Pond A, San Miguel Electric Cooperative, Inc., Atascosa County, Texas, October 17.

Hynes-Griffin, M.E., and A.G. Franklin, 1984. "Rationalizing the Seismic Coefficient Method", Miscellaneous Paper GL-84-13, U.S. Army Corps of Engineers, Vicksburg, Mississippi.

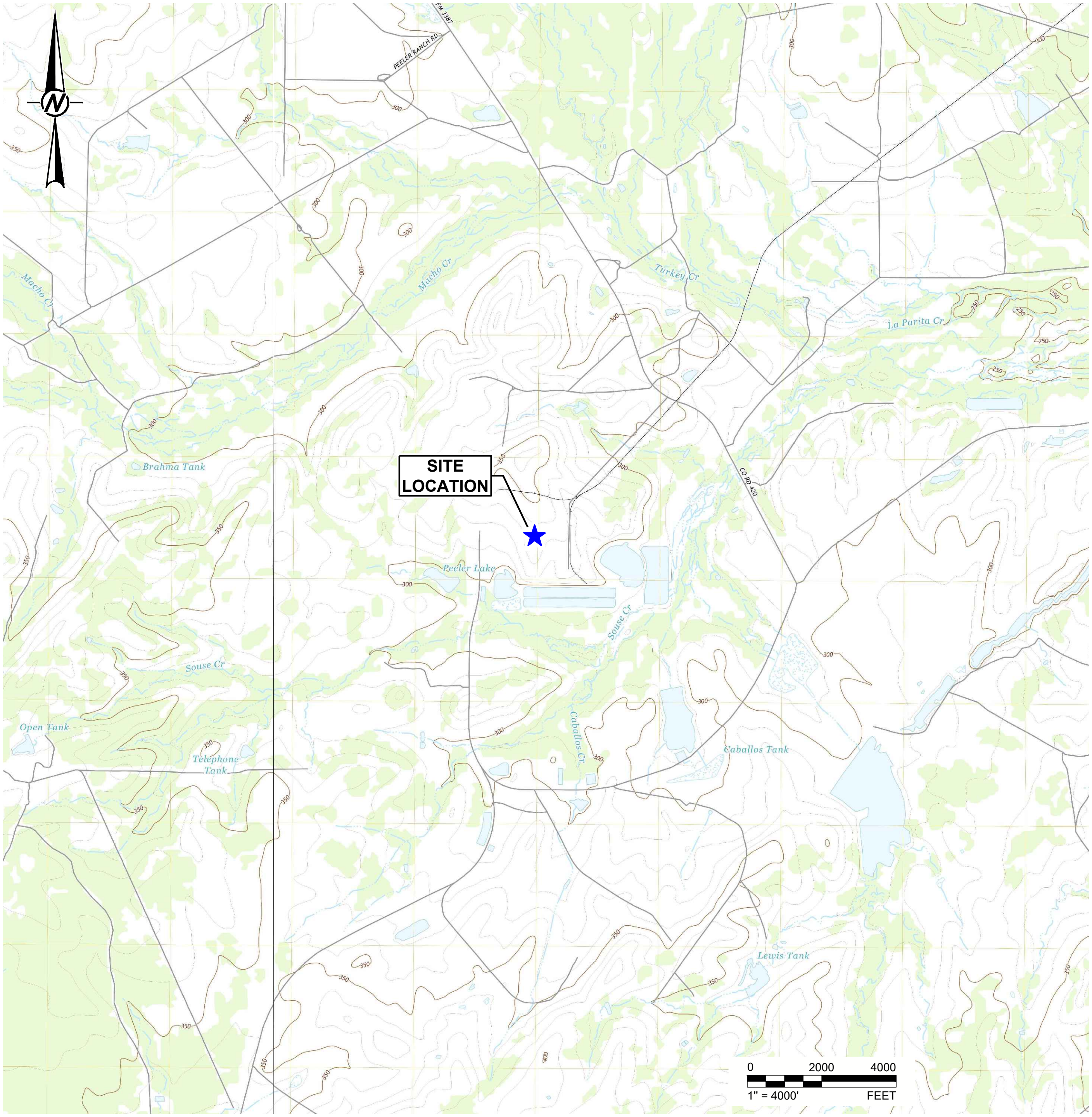
Rocscience Inc. 2021. Slide2 – Version 9.019. Toronto, Ontario, Canada.

Spencer, E. 1967. "A Method of Analysis of the Stability of Embankments Assuming Parallel Interslices Forces." Geotechnique 17(1), 11-26.

Wood Environment & Infrastructure Solutions, Inc., 2018. Safety Factor Assessment – Ash Water Transport Ponds, San Miguel Electric Cooperative Power Plant, November 14.

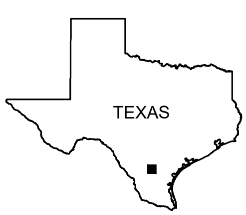
Zephyr Environmental Corporation (Zephyr), 2017. Liner System Certification Report – Ash Water Transport Pond 1-B, San Miguel Electric Cooperative, Inc., San Miguel Plant, Christine, Atascosa County, Texas, November 28.

FIGURES



REFERENCE(S)

BASE MAP TAKEN FROM USGS.GOV, CROSS NE AND CABALLOS CREEK, TX 7.5 MIN. USGS QUADRANGLE DATED 2019.



QUADRANGLE LOCATIONS

CLIENT

SAN NIGUEL ELECTRIC COOPERATIVE, INC.

PROJECT

CCR POND SAFETY FACTOR ASSESSMENT UPDATE

TITLE

SITE LOCATION MAP

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2021-09-07
DESIGNED	AJD
PREPARED	AJD
REVIEWED	PJB
APPROVED	PJB

PROJECT NO.	CONTROL	REV.	FIGURE
21455682		0	1

Last Edited By: adiamond Date: 2021-09-07 Time:3:51:50 PM | Printed By: RSalazar Date: 2021-09-24 Time:10:28:32 AM
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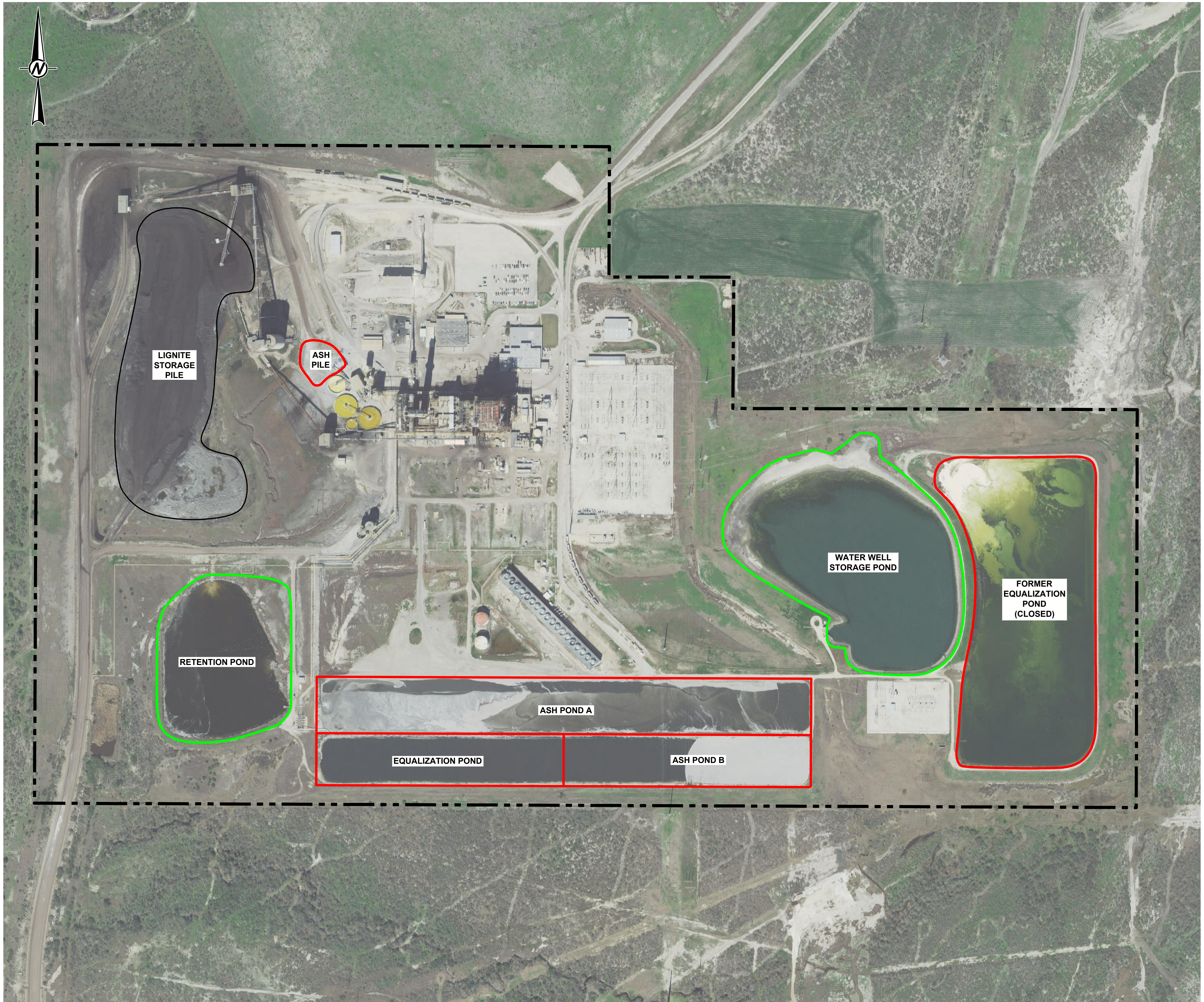
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI A

0 1 in



LEGEND

APPROX. PLANT BOUNDARY

CCR IMPOUNDMENT/UNIT

NON-CCR IMPOUNDMENT

0 250 500
1" = 500' FEET

REFERENCE(S)

BASE MAP TAKEN FROM TNRIS.ORG, ATASCOSA CO., 2015 PHOTOGRAPHY.
MONITORING WELL LOCATIONS FROM FIGURE 1 - CCR UNIT GROUNDWATER MONITORING SYSTEM, ERM, 10/16/2017.

CLIENT
SAN MIGUEL ELECTRIC COOPERATIVE, INC.

PROJECT
CCR POND SAFETY FACTOR ASSESSMENT UPDATE

TITLE
SITE PLAN

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2021-09-07
DESIGNED	AJD
PREPARED	AJD
REVIEWED	PJB
APPROVED	PJB

PROJECT NO.	CONTROL	REV.	FIGURE
21455682		0	2

1 in IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

LEGEND

- APPROX. PLANT BOUNDARY
- CCR IMPOUNDMENT/UNIT
- NON-CCR IMPOUNDMENT
- SAFETY FACTOR CRITICAL CROSS-SECTION

0 150 300
1" = 300' FEET

REFERENCE(S)
BASE MAP TAKEN FROM TNRIS.ORG, ATASCOSA CO., 2015 PHOTOGRAPHY.

CLIENT
SAN MIGUEL ELECTRIC COOPERATIVE, INC.

PROJECT
CCR POND SAFETY FACTOR ASSESSMENT UPDATE

TITLE
ASH POND LAYOUT

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2021-09-23
DESIGNED	AJD
PREPARED	RS
REVIEWED	PJB
APPROVED	PJB

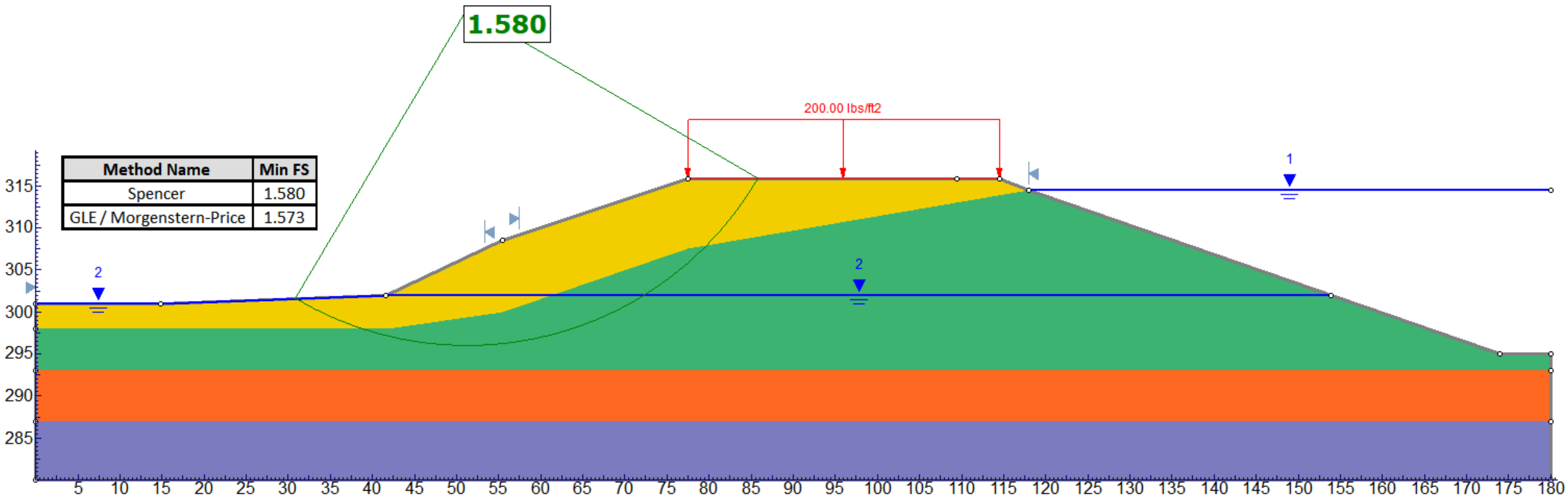
PROJECT NO.	REV.	FIGURE
21455682	0	3

APPENDIX A

Stability Analysis Output

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Fill: Fat Clay (CH), Lean Clay (CL)		112	Mohr-Coulomb	100	21
Fat Clay (CH), Lean Clay (CL) above silty sands		120	Mohr-Coulomb	150	18
Sandy Lean Clay (CL), Clayey Sand (SC) above the silty sands		120	Mohr-Coulomb	200	24
Silty Sand (SM)		120	Mohr-Coulomb	0	30

Method Name	Min FS
Spencer	1.580
GLE / Morgenstern-Price	1.573



CLIENT
SAN MIGUEL ELECTRIC COOPERATIVE, INC.

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2021-09-20
PREPARED	MB
DESIGN	-
REVIEW	JF
APPROVED	JF

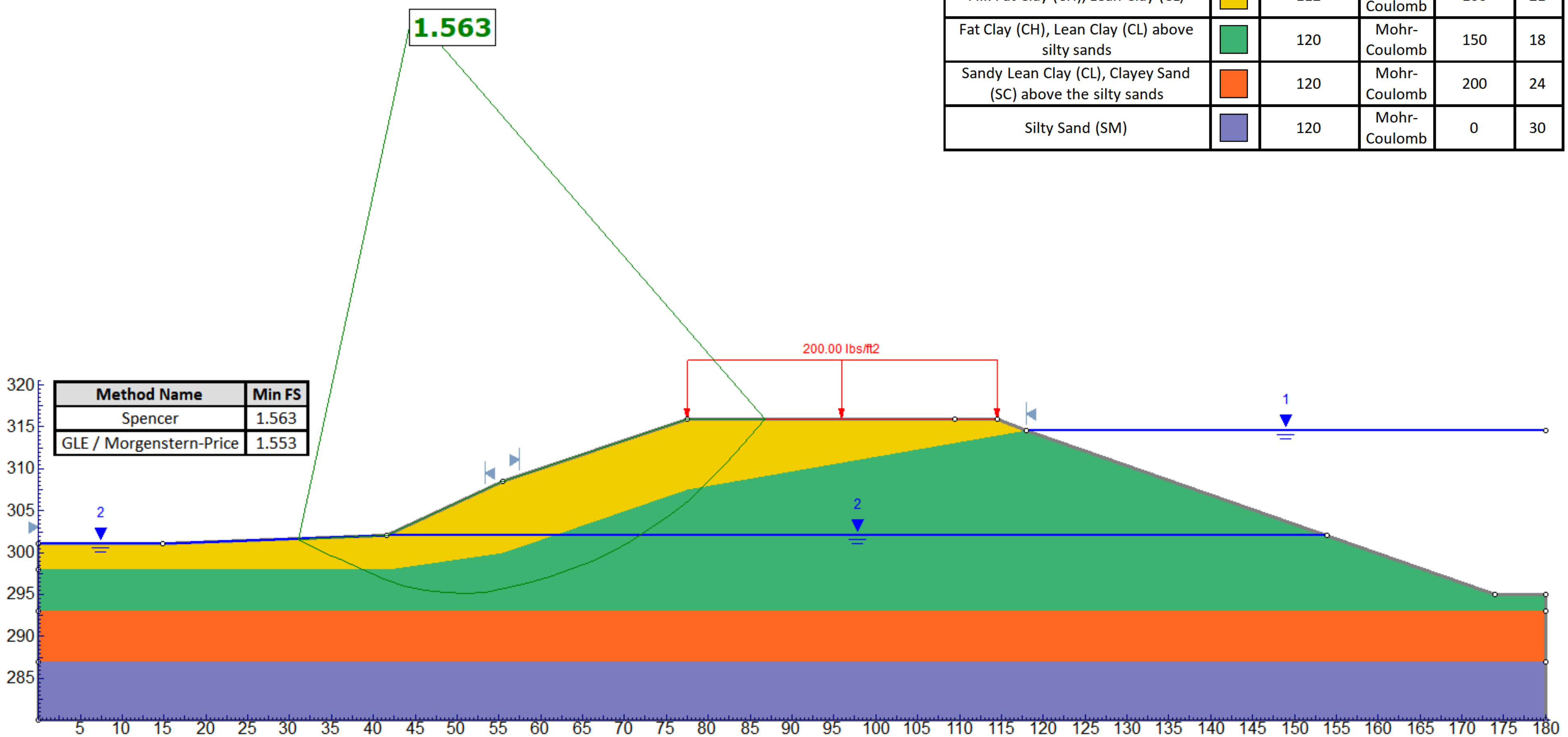
PROJECT
ASH WATER TRANSPORT PONDS
SAN MIGUEL ELECTRIC COOPERATIVE POWER PLANT
ATASCOSA COUNTY TEXAS

TITLE
SECTION 1B STATIC (CIRCULAR)
MAXIMUM STORAGE POOL

PROJECT No.	PHASE	Rev.	FIGURE
21455682	1000	01	A-1

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Fill: Fat Clay (CH), Lean Clay (CL)		112	Mohr-Coulomb	100	21
Fat Clay (CH), Lean Clay (CL) above silty sands		120	Mohr-Coulomb	150	18
Sandy Lean Clay (CL), Clayey Sand (SC) above the silty sands		120	Mohr-Coulomb	200	24
Silty Sand (SM)		120	Mohr-Coulomb	0	30

Method Name	Min FS
Spencer	1.563
GLE / Morgenstern-Price	1.553



CLIENT
SAN MIGUEL ELECTRIC COOPERATIVE, INC.

PROJECT
ASH WATER TRANSPORT PONDS
SAN MIGUEL ELECTRIC COOPERATIVE POWER PLANT
ATASCOSA COUNTY TEXAS

CONSULTANT
GOLDER
MEMBER OF WSP

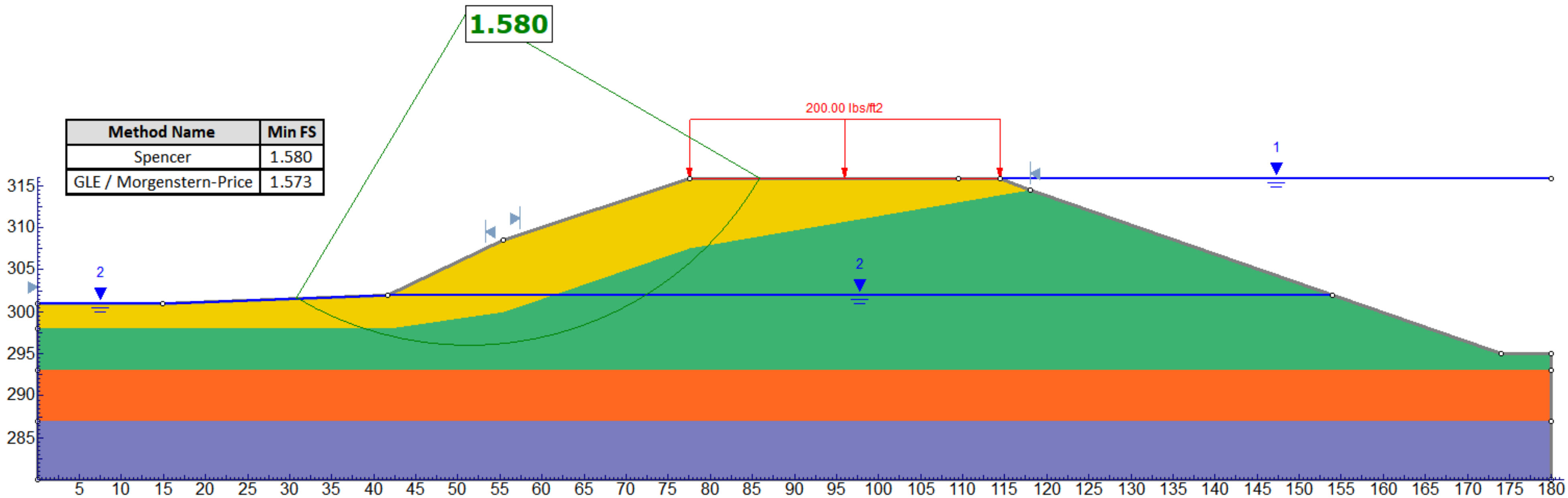
YYYY-MM-DD	2021-09-20
PREPARED	MB
DESIGN	-
REVIEW	JF
APPROVED	JF

TITLE
SECTION 1B STATIC (NON-CIRCULAR)
MAXIMUM STORAGE POOL

PROJECT No.	PHASE	Rev.	FIGURE
21455682	1000	01	A-2

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Fill: Fat Clay (CH), Lean Clay (CL)		112	Mohr-Coulomb	100	21
Fat Clay (CH), Lean Clay (CL) above silty sands		120	Mohr-Coulomb	150	18
Sandy Lean Clay (CL), Clayey Sand (SC) above the silty sands		120	Mohr-Coulomb	200	24
Silty Sand (SM)		120	Mohr-Coulomb	0	30

Method Name	Min FS
Spencer	1.580
GLE / Morgenstern-Price	1.573



CLIENT
SAN MIGUEL ELECTRIC COOPERATIVE, INC.

PROJECT
ASH WATER TRANSPORT PONDS
SAN MIGUEL ELECTRIC COOPERATIVE POWER PLANT
ATASCOSA COUNTY TEXAS

CONSULTANT

GOLDER
MEMBER OF WSP

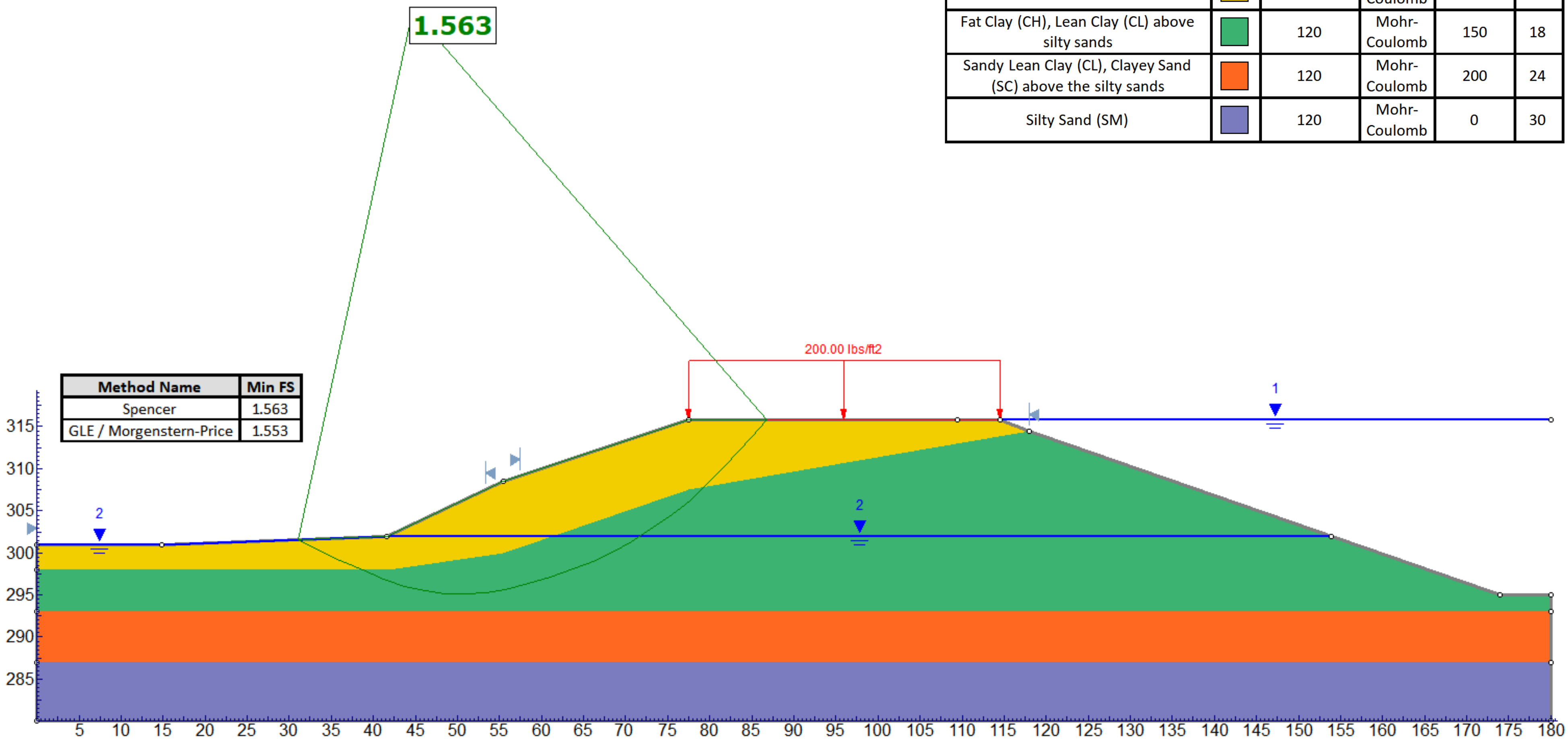
YYYY-MM-DD	2021-09-20
PREPARED	MB
DESIGN	-
REVIEW	JF
APPROVED	JF

TITLE
SECTION 1B STATIC (CIRCULAR)
MAXIMUM SURCHARGE POOL

PROJECT No.	PHASE	Rev.	FIGURE
21455682	1000	01	A-3

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Fill: Fat Clay (CH), Lean Clay (CL)		112	Mohr-Coulomb	100	21
Fat Clay (CH), Lean Clay (CL) above silty sands		120	Mohr-Coulomb	150	18
Sandy Lean Clay (CL), Clayey Sand (SC) above the silty sands		120	Mohr-Coulomb	200	24
Silty Sand (SM)		120	Mohr-Coulomb	0	30

Method Name	Min FS
Spencer	1.563
GLE / Morgenstern-Price	1.553



CLIENT
SAN MIGUEL ELECTRIC COOPERATIVE, INC.

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2021-09-20
PREPARED	MB
DESIGN	-
REVIEW	JF
APPROVED	JF

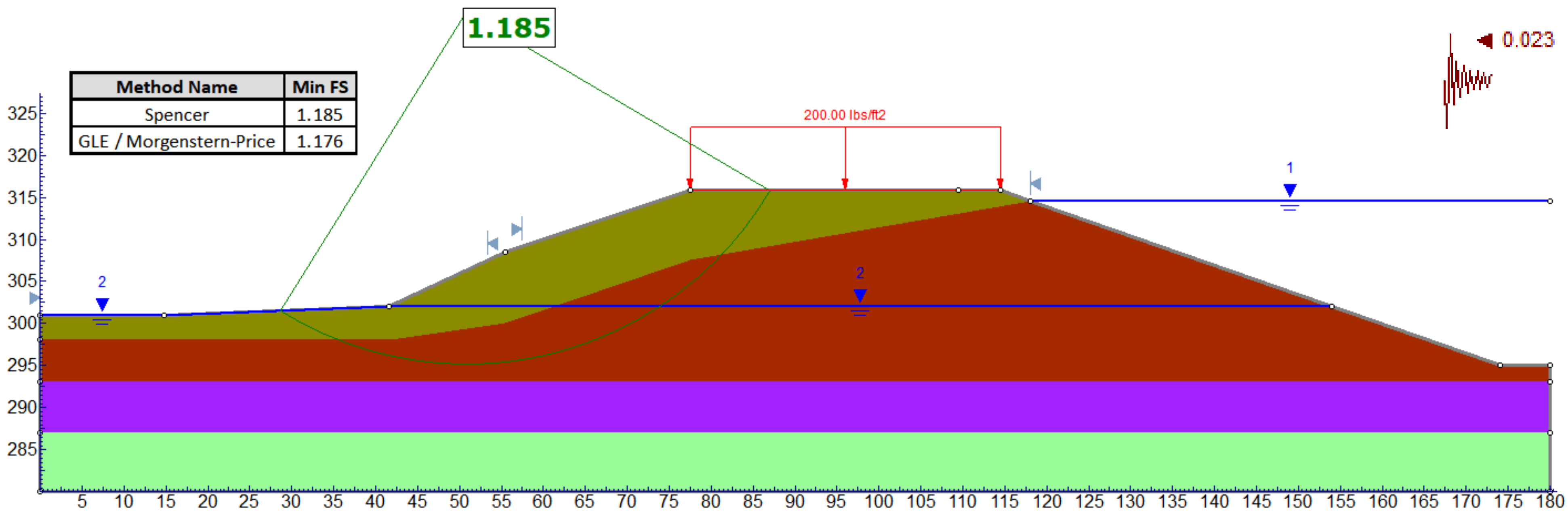
PROJECT
ASH WATER TRANSPORT PONDS
SAN MIGUEL ELECTRIC COOPERATIVE POWER PLANT
ATASCOSA COUNTY TEXAS

TITLE
SECTION 1B STATIC (NON-CIRCULAR)
MAXIMUM SURCHARGE POOL

PROJECT No.	PHASE	Rev.	FIGURE
21455682	1000	01	A-4

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Fill: Fat Clay (CH), Lean Clay (CL)_Reduced 20%		112	Mohr-Coulomb	80	17.1
Fat Clay (CH), Lean Clay (CL) above silty sands_Reduced 20%		120	Mohr-Coulomb	120	14.6
Sandy Lean Clay (CL), Clayey Sand (SC) above the silty sands_Reduced 20%		120	Mohr-Coulomb	160	19.6
Silty Sand (SM)_Reduced 20%		120	Mohr-Coulomb	0	24.8

Method Name	Min FS
Spencer	1.185
GLE / Morgenstern-Price	1.176



CLIENT
SAN MIGUEL ELECTRIC COOPERATIVE, INC.

PROJECT
ASH WATER TRANSPORT PONDS
SAN MIGUEL ELECTRIC COOPERATIVE POWER PLANT
ATASCOSA COUNTY TEXAS

CONSULTANT

GOLDER
MEMBER OF WSP

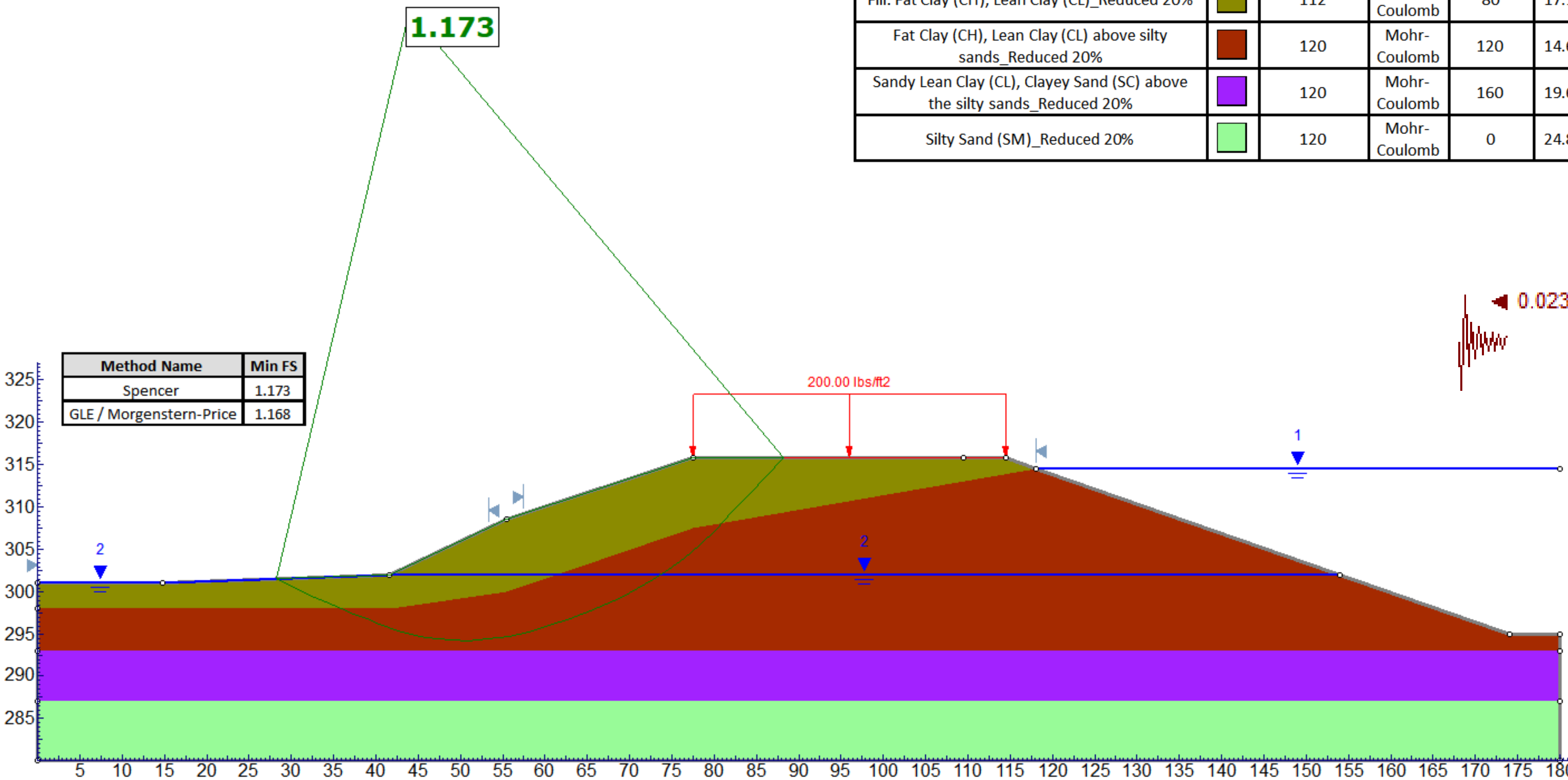
YYYY-MM-DD	2021-09-20
PREPARED	MB
DESIGN	-
REVIEW	JF
APPROVED	JF

TITLE
SECTION 1B PSEUDO-STATIC (CIRCULAR)
MAXIMUM STORAGE POOL

PROJECT No.	PHASE	Rev.	FIGURE
21455682	1000	01	A-5

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Fill: Fat Clay (CH), Lean Clay (CL)_Reduced 20%		112	Mohr-Coulomb	80	17.1
Fat Clay (CH), Lean Clay (CL) above silty sands_Reduced 20%		120	Mohr-Coulomb	120	14.6
Sandy Lean Clay (CL), Clayey Sand (SC) above the silty sands_Reduced 20%		120	Mohr-Coulomb	160	19.6
Silty Sand (SM)_Reduced 20%		120	Mohr-Coulomb	0	24.8

Method Name	Min FS
Spencer	1.173
GLE / Morgenstern-Price	1.168



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CONSULTANT

GOLDER
MEMBER OF WSP

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REVIEW	JF
APPROVED	JF

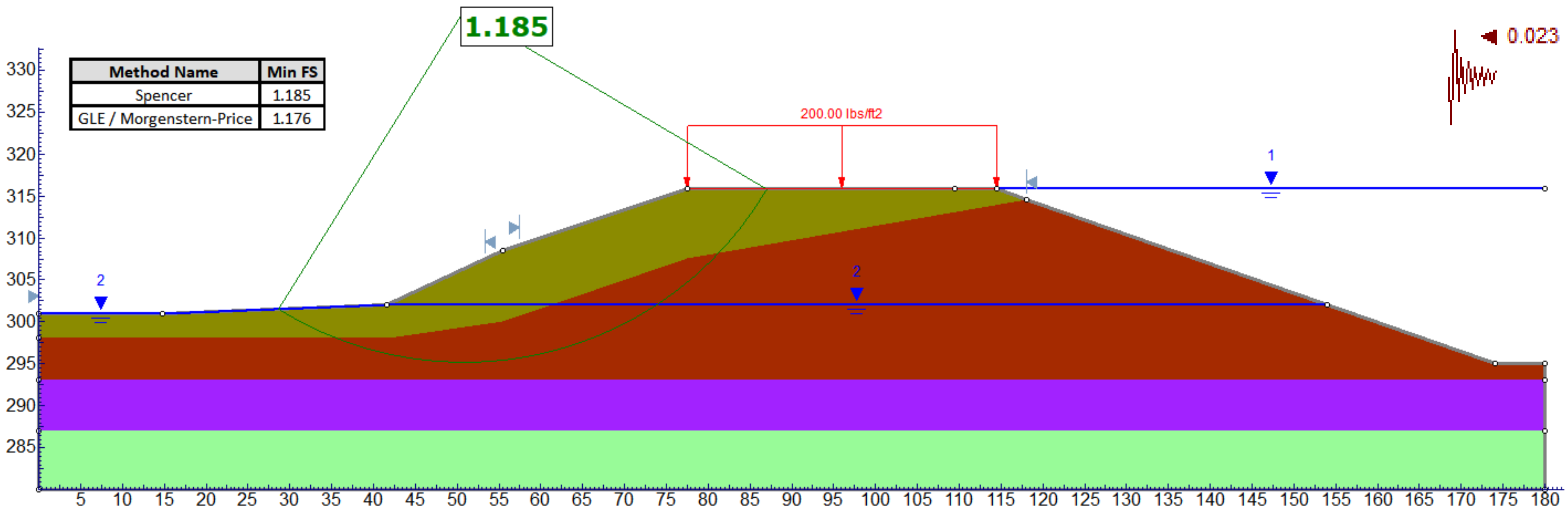
PROJECT
ASH WATER TRANSPORT PONDS
SAN MIGUEL ELECTRIC COOPERATIVE POWER PLANT
ATASCOSA COUNTY TEXAS

TITLE
SECTION 1B PSEUDO-STATIC (NON-CIRCULAR)
MAXIMUM STORAGE POOL

PROJECT No.	PHASE	Rev.	FIGURE
21455682	1000	01	A-6

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Fill: Fat Clay (CH), Lean Clay (CL)_Reduced 20%		112	Mohr-Coulomb	80	17.1
Fat Clay (CH), Lean Clay (CL) above silty sands_Reduced 20%		120	Mohr-Coulomb	120	14.6
Sandy Lean Clay (CL), Clayey Sand (SC) above the silty sands_Reduced 20%		120	Mohr-Coulomb	160	19.6
Silty Sand (SM)_Reduced 20%		120	Mohr-Coulomb	0	24.8

Method Name	Min FS
Spencer	1.185
GLE / Morgenstern-Price	1.176



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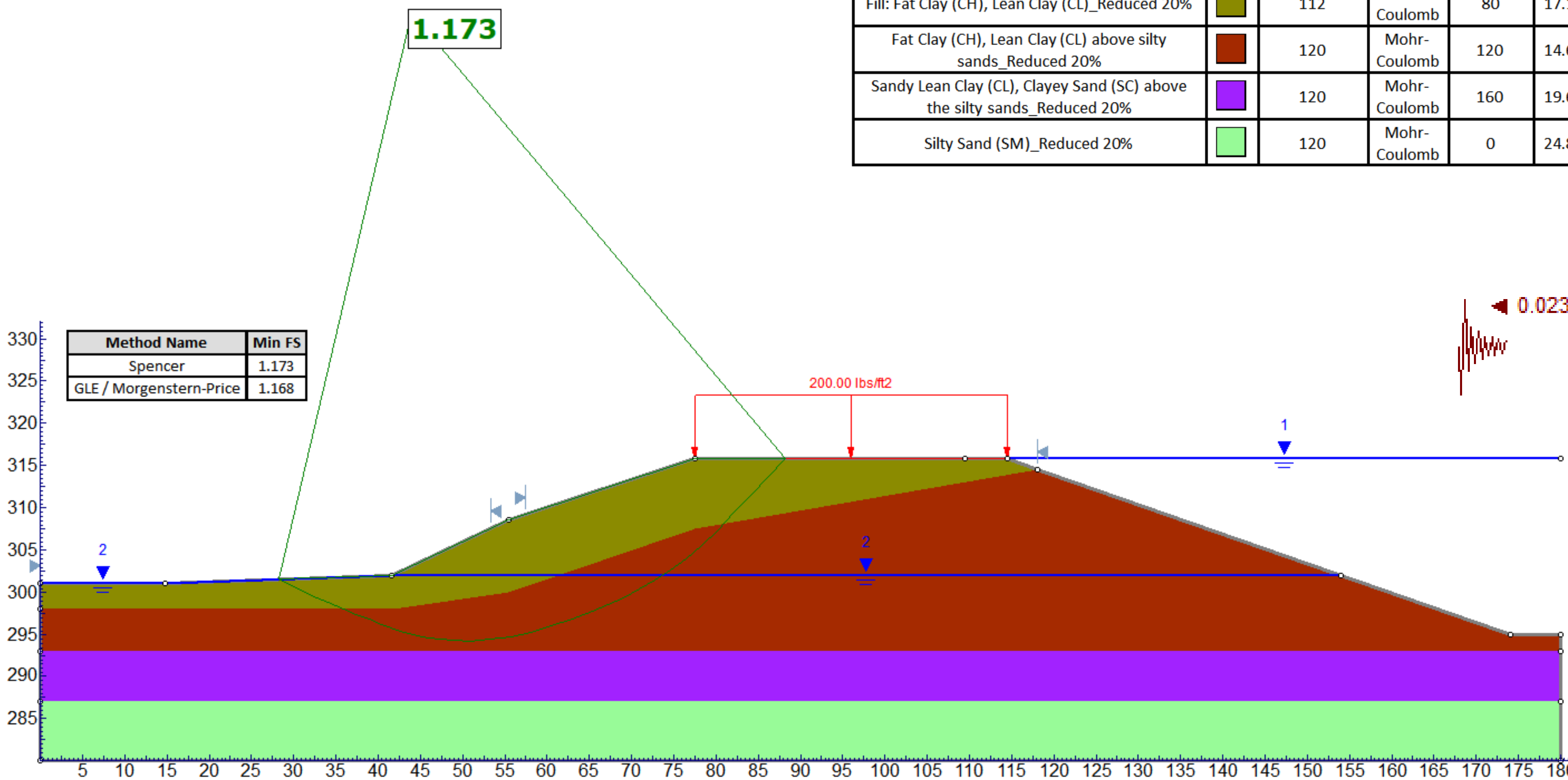
ASH WATER TRANSPORT PONDS
SAN MIGUEL ELECTRIC COOPERATIVE POWER PLANT
ATASCOSA COUNTY TEXAS

TITLE
SECTION 1B PSEUDO-STATIC (CIRCULAR)
MAXIMUM SURCHARGE POOL

PROJECT No.	PHASE	Rev.	FIGURE
21455682	1000	01	A-7

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Fill: Fat Clay (CH), Lean Clay (CL)_Reduced 20%		112	Mohr-Coulomb	80	17.1
Fat Clay (CH), Lean Clay (CL) above silty sands_Reduced 20%		120	Mohr-Coulomb	120	14.6
Sandy Lean Clay (CL), Clayey Sand (SC) above the silty sands_Reduced 20%		120	Mohr-Coulomb	160	19.6
Silty Sand (SM)_Reduced 20%		120	Mohr-Coulomb	0	24.8

Method Name	Min FS
Spencer	1.173
GLE / Morgenstern-Price	1.168



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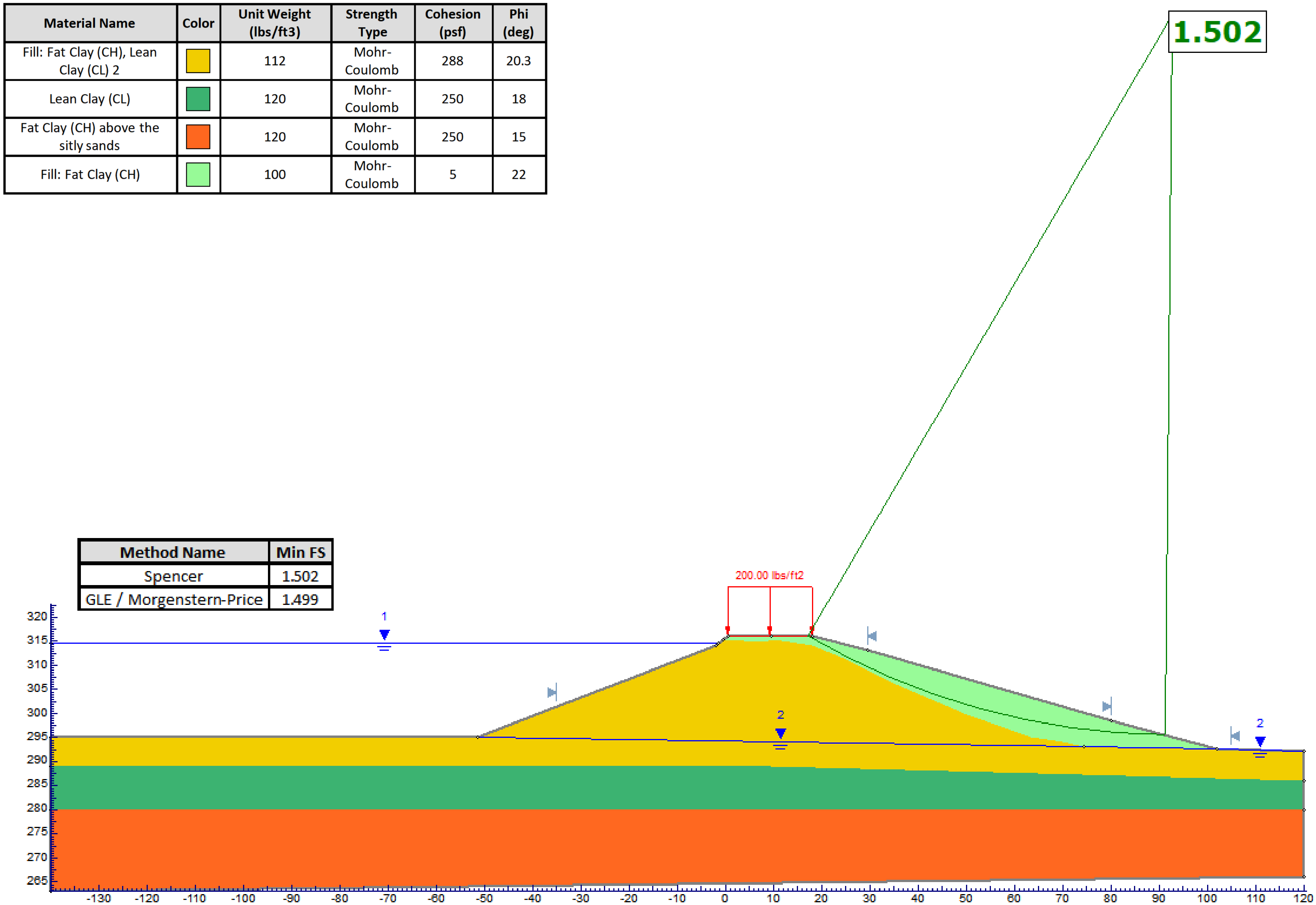
ASH WATER TRANSPORT PONDS
SAN MIGUEL ELECTRIC COOPERATIVE POWER PLANT
ATASCOSA COUNTY TEXAS

TITLE
SECTION 1B PSEUDO-STATIC (NON-CIRCULAR)
MAXIMUM SURCHARGE POOL

PROJECT No.	PHASE	Rev.	FIGURE
21455682	1000	01	A-8

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Fill: Fat Clay (CH), Lean Clay (CL) 2		112	Mohr-Coulomb	288	20.3
Lean Clay (CL)		120	Mohr-Coulomb	250	18
Fat Clay (CH) above the sitly sands		120	Mohr-Coulomb	250	15
Fill: Fat Clay (CH)		100	Mohr-Coulomb	5	22

Method Name	Min FS
Spencer	1.502
GLE / Morgenstern-Price	1.499



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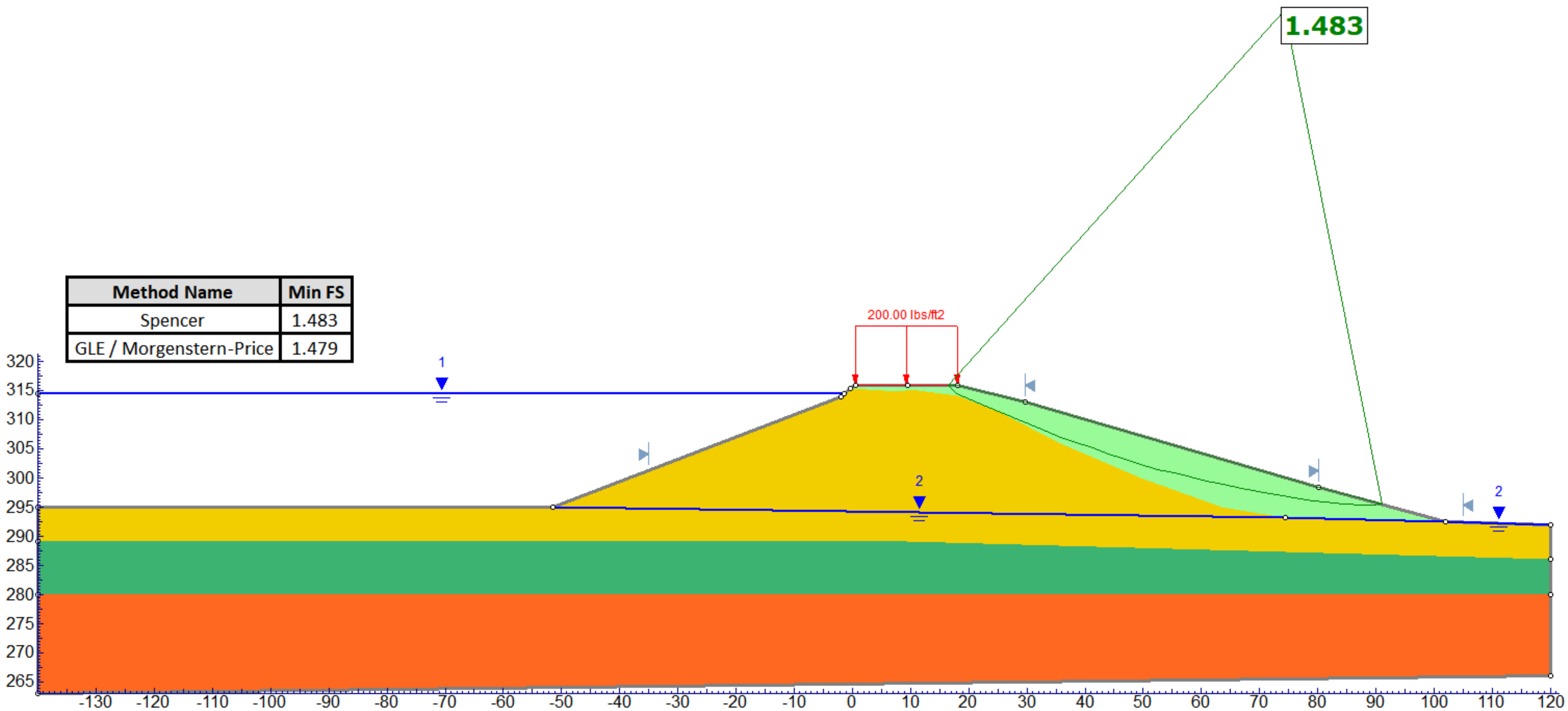
TITLE
SECTION 9A (CIRCULAR)
MAXIMUM STORAGE POOL

PROJECT No.	PHASE	Rev.	FIGURE
21455682	1000	01	A-9

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Fill: Fat Clay (CH), Lean Clay (CL) 2		112	Mohr-Coulomb	288	20.3
Lean Clay (CL)		120	Mohr-Coulomb	250	18
Fat Clay (CH) above the sitly sands		120	Mohr-Coulomb	250	15
Fill: Fat Clay (CH)		100	Mohr-Coulomb	5	22

Method Name	Min FS
Spencer	1.483
GLE / Morgenstern-Price	1.479



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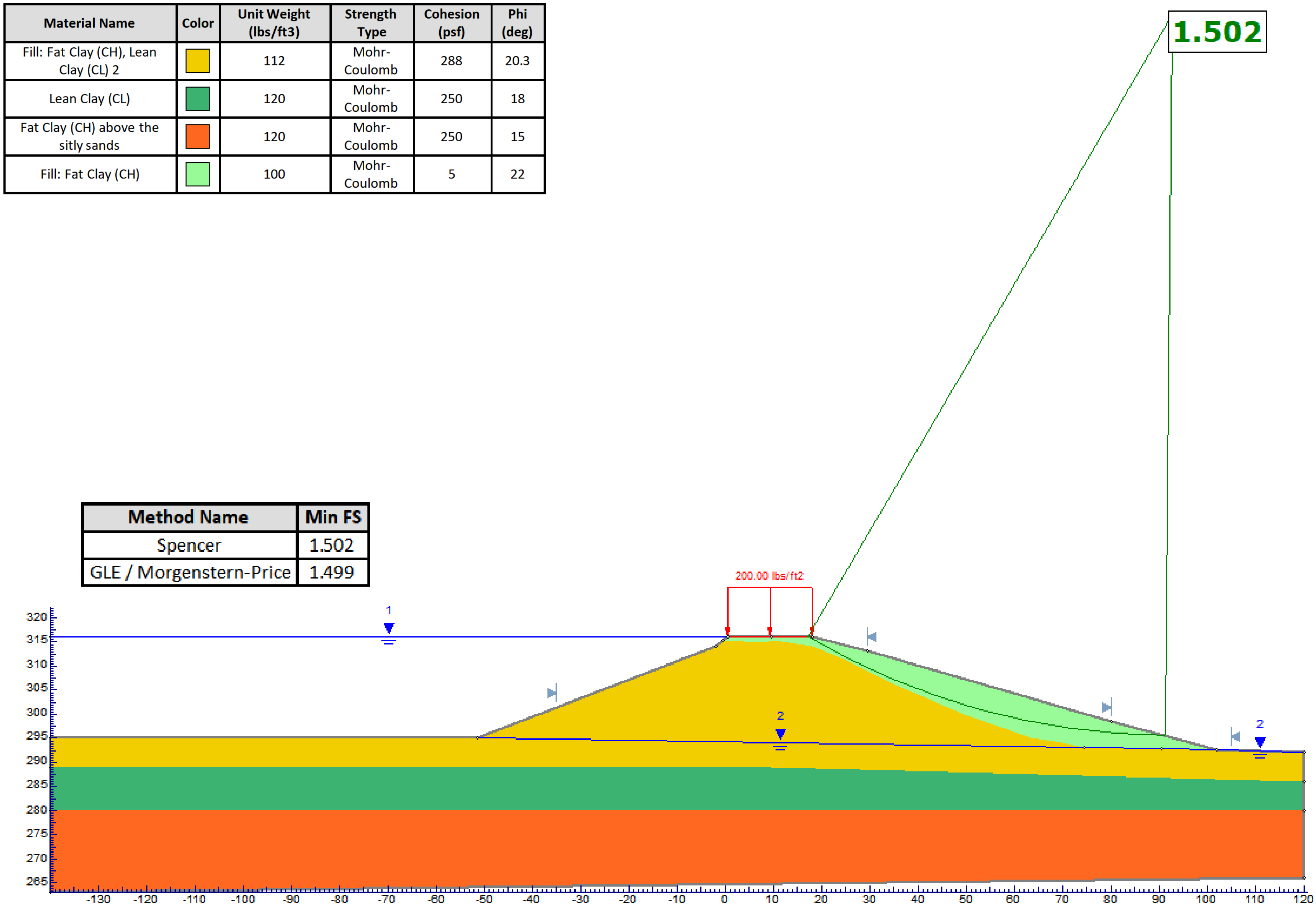
TITLE
SECTION 9A (NON-CIRCULAR)
MAXIMUM STORAGE POOL

PROJECT No.	PHASE	Rev.	FIGURE
21455682	1000	01	A-10

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Fill: Fat Clay (CH), Lean Clay (CL) 2		112	Mohr-Coulomb	288	20.3
Lean Clay (CL)		120	Mohr-Coulomb	250	18
Fat Clay (CH) above the sitly sands		120	Mohr-Coulomb	250	15
Fill: Fat Clay (CH)		100	Mohr-Coulomb	5	22

Method Name	Min FS
Spencer	1.502
GLE / Morgenstern-Price	1.499



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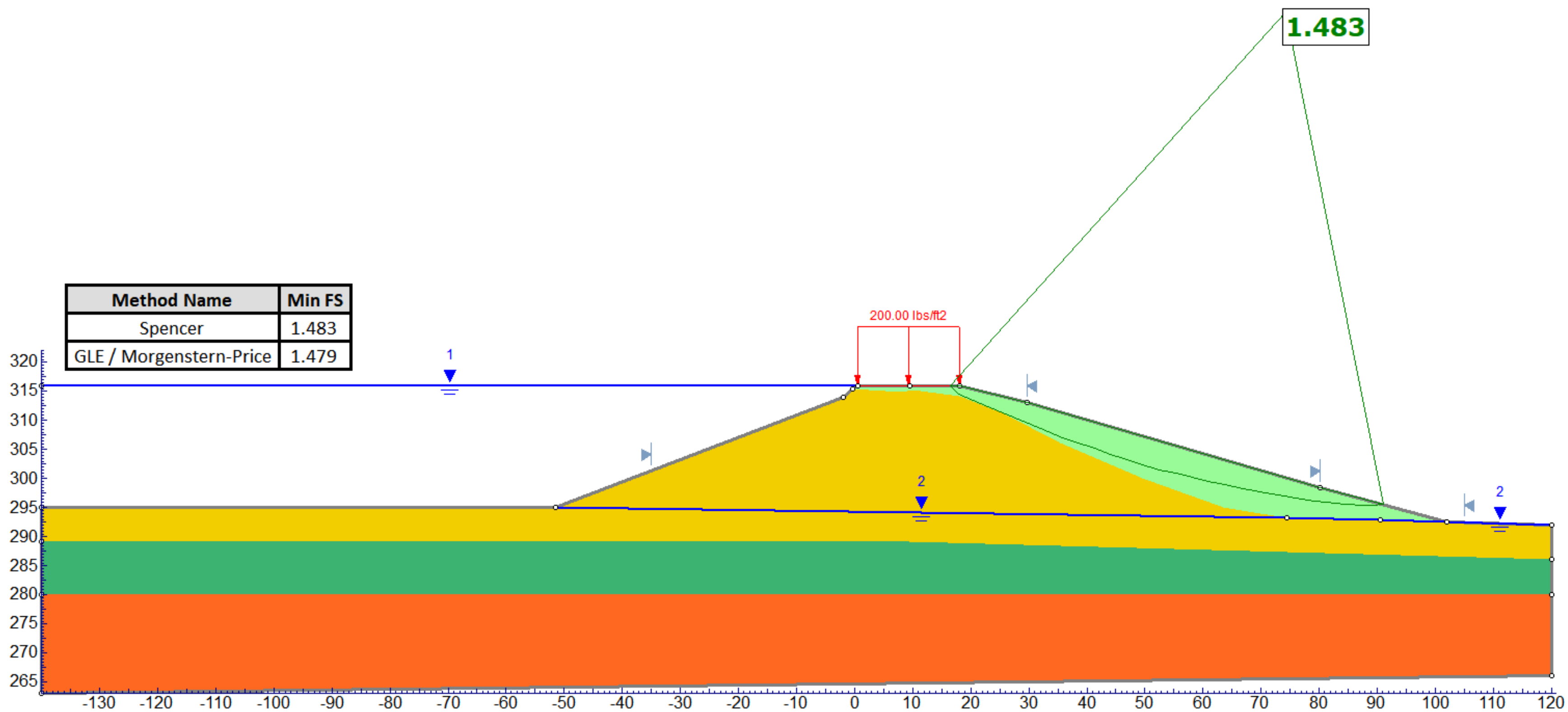
TITLE
SECTION 9A (CIRCULAR)
MAXIMUM SURCHARGE POOL

PROJECT No.	PHASE	Rev.	FIGURE
21455682	1000	01	A-11

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Fill: Fat Clay (CH), Lean Clay (CL) 2		112	Mohr-Coulomb	288	20.3
Lean Clay (CL)		120	Mohr-Coulomb	250	18
Fat Clay (CH) above the sitly sands		120	Mohr-Coulomb	250	15
Fill: Fat Clay (CH)		100	Mohr-Coulomb	5	22

Method Name	Min FS
Spencer	1.483
GLE / Morgenstern-Price	1.479



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ASH WATER TRANSPORT PONDS
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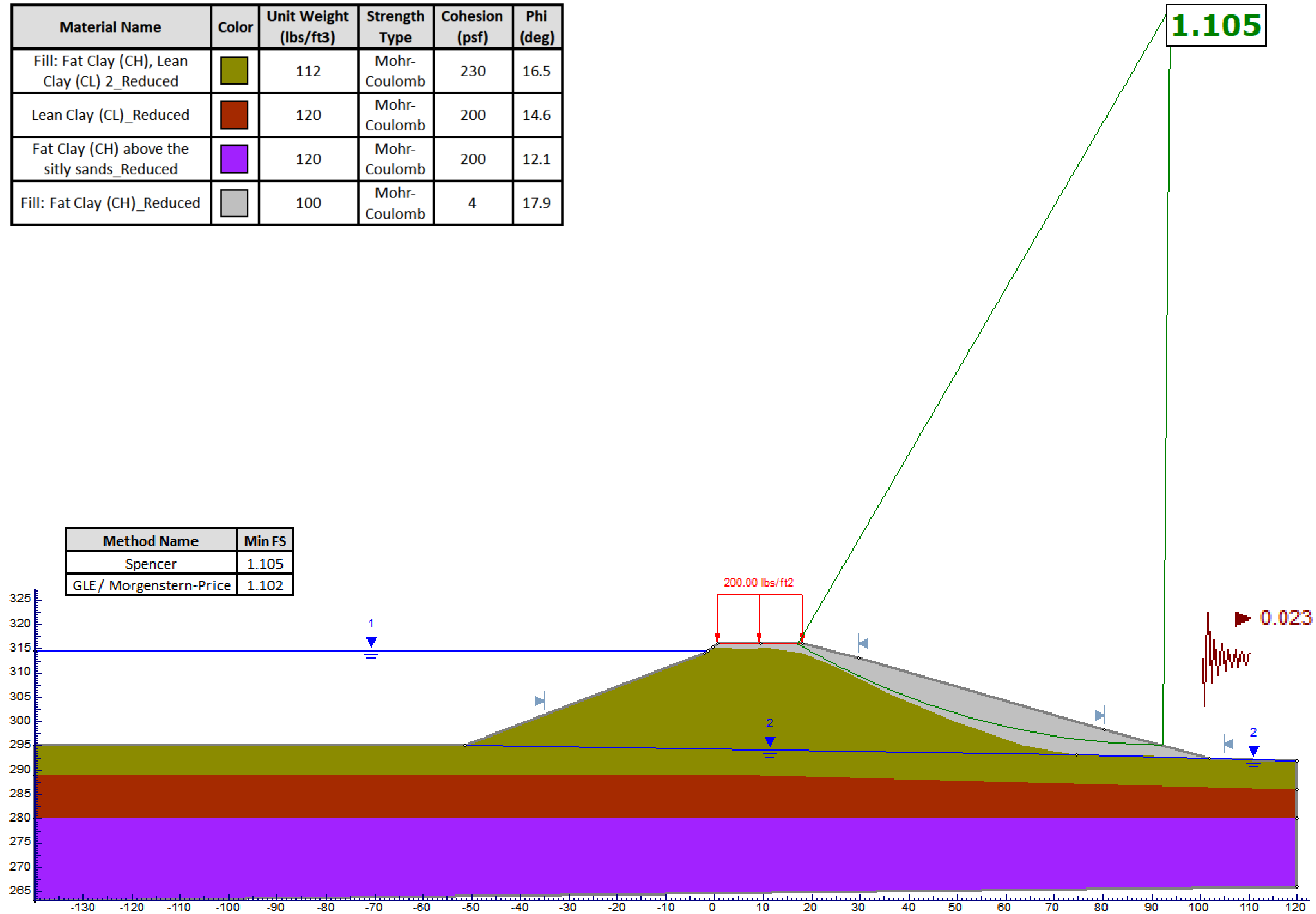
ATASCOSA COUNTY TEXAS

TITLE
SECTION 9A (NON-CIRCULAR)
MAXIMUM SURCHARGE POOL

PROJECT No.	PHASE	Rev.	FIGURE
21455682	1000	01	A-12

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Fill: Fat Clay (CH), Lean Clay (CL) 2_Reduced		112	Mohr-Coulomb	230	16.5
Lean Clay (CL)_Reduced		120	Mohr-Coulomb	200	14.6
Fat Clay (CH) above the sitly sands_Reduced		120	Mohr-Coulomb	200	12.1
Fill: Fat Clay (CH)_Reduced		100	Mohr-Coulomb	4	17.9

Method Name	Min FS
Spencer	1.105
GLE/ Morgenstern-Price	1.102



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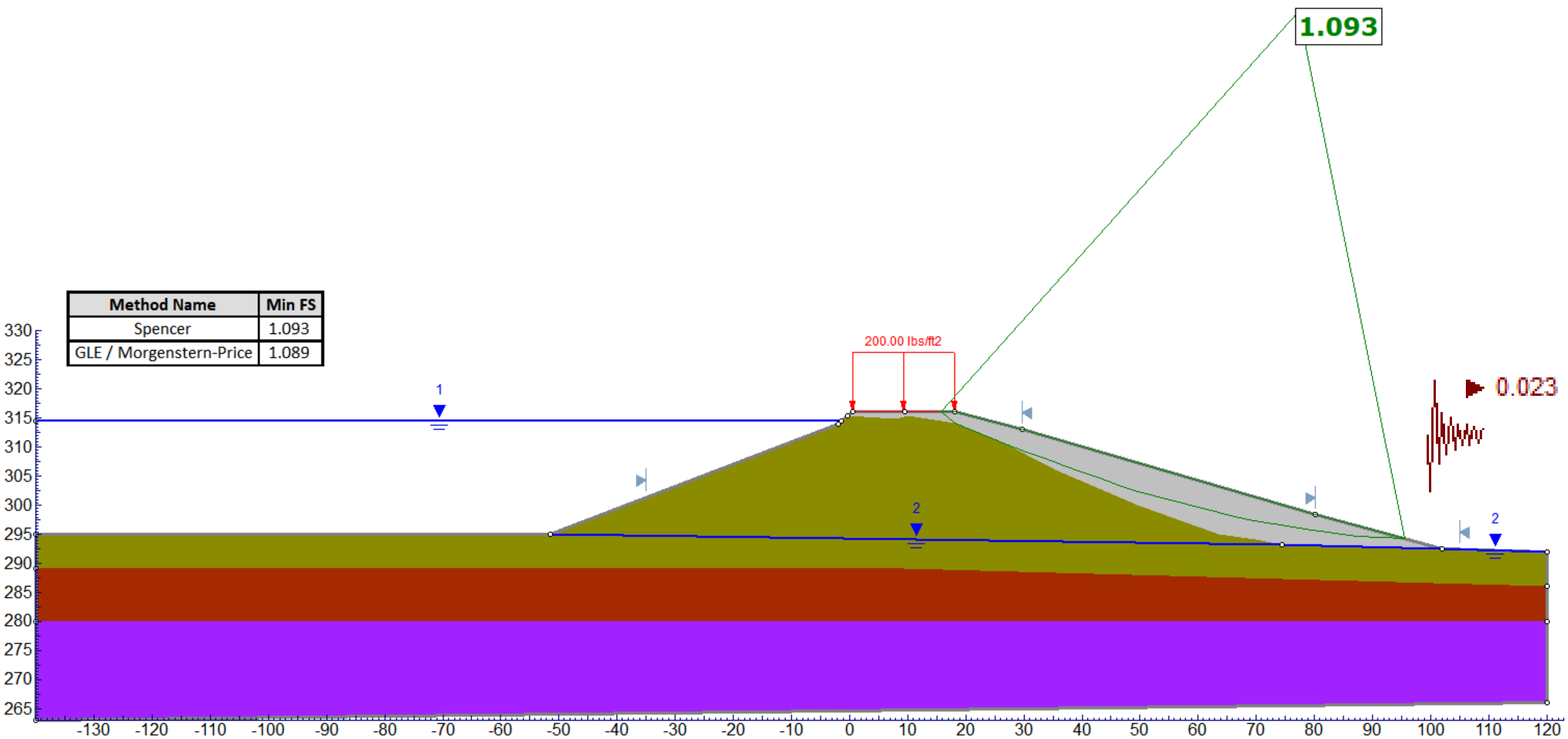
ATASCOSA COUNTY TEXAS

TITLE
SECTION 9A PSEUDO-STATIC (CIRCULAR)
MAXIMUM STORAGE POOL

PROJECT No.	PHASE	Rev.	FIGURE
21455682	1000	01	A-13

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Fill: Fat Clay (CH), Lean Clay (CL) 2_Reduced		112	Mohr-Coulomb	230	16.5
Lean Clay (CL)_Reduced		120	Mohr-Coulomb	200	14.6
Fat Clay (CH) above the sitly sands_Reduced		120	Mohr-Coulomb	200	12.1
Fill: Fat Clay (CH)_Reduced		100	Mohr-Coulomb	4	17.9

Method Name	Min FS
Spencer	1.093
GLE / Morgenstern-Price	1.089



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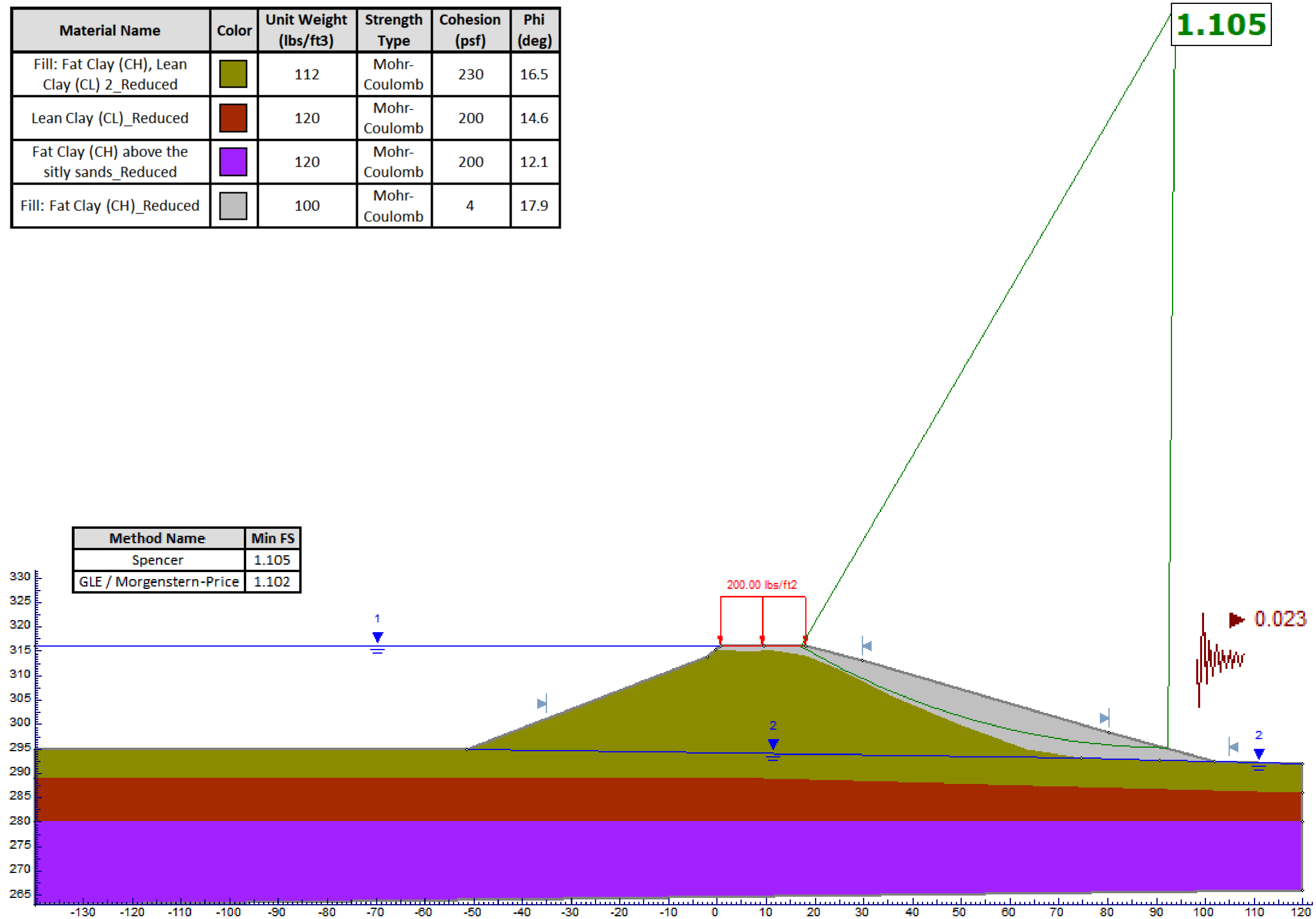
ATASCOSA COUNTY TEXAS

TITLE
SECTION 9A PSEUDO-STATIC (NON-CIRCULAR) MAXIMUM STORAGE POOL

PROJECT No.	PHASE	Rev.	FIGURE
21455682	1000	01	A-14

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Fill: Fat Clay (CH), Lean Clay (CL) 2_Reduced		112	Mohr-Coulomb	230	16.5
Lean Clay (CL)_Reduced		120	Mohr-Coulomb	200	14.6
Fat Clay (CH) above the sitly sands_Reduced		120	Mohr-Coulomb	200	12.1
Fill: Fat Clay (CH)_Reduced		100	Mohr-Coulomb	4	17.9

Method Name	Min FS
Spencer	1.105
GLE / Morgenstern-Price	1.102



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ASH WATER TRANSPORT PONDS
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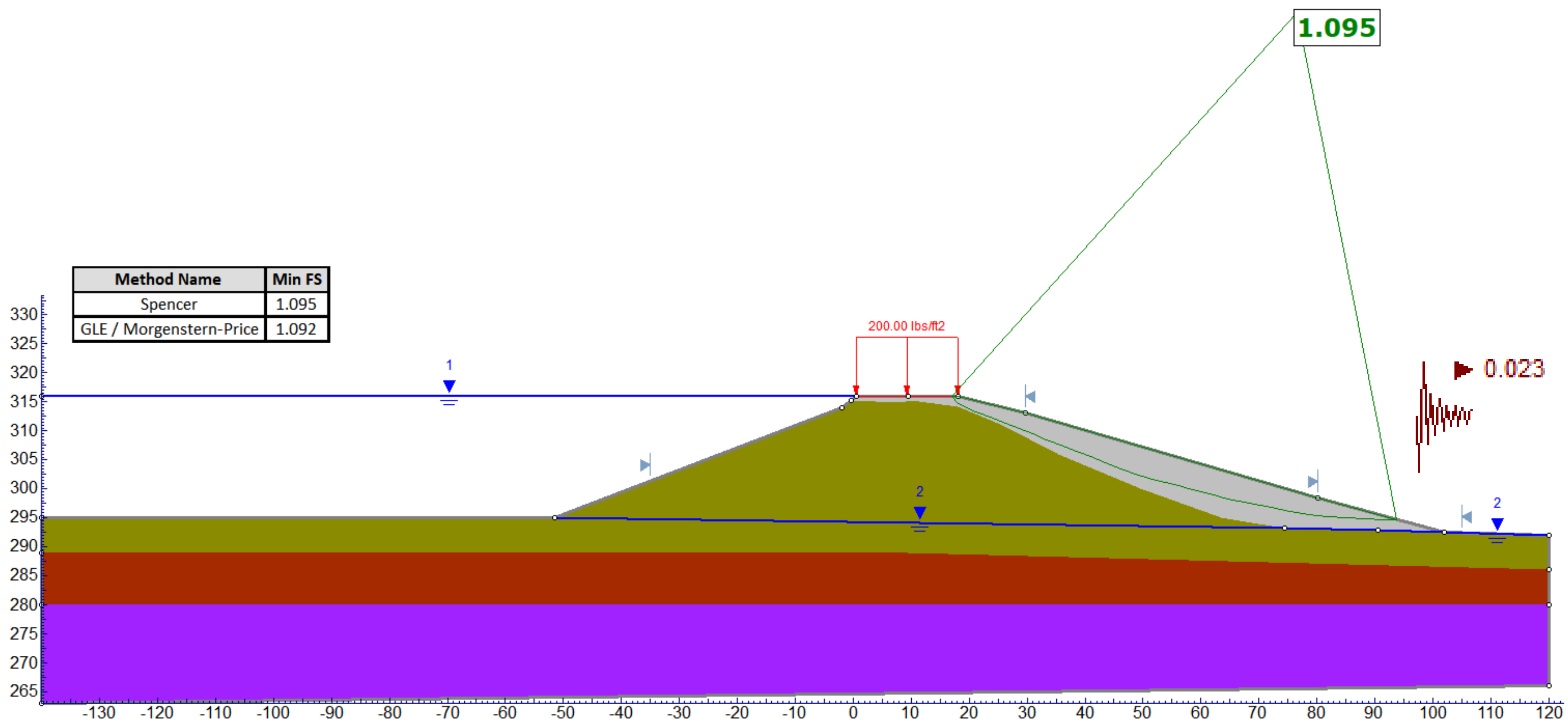
ATASCOSA COUNTY TEXAS

TITLE
SECTION 9A PSEUDO-STATIC (CIRCULAR)
MAXIMUM SURCHARGE POOL

PROJECT No.	PHASE	Rev.	FIGURE
21455682	1000	01	A-15

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Fill: Fat Clay (CH), Lean Clay (CL) 2_Reduced		112	Mohr-Coulomb	230	16.5
Lean Clay (CL)_Reduced		120	Mohr-Coulomb	200	14.6
Fat Clay (CH) above the sitly sands_Reduced		120	Mohr-Coulomb	200	12.1
Fill: Fat Clay (CH)_Reduced		100	Mohr-Coulomb	4	17.9

Method Name	Min FS
Spencer	1.095
GLE / Morgenstern-Price	1.092



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PROJECT
ASH WATER TRANSPORT PONDS
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ATASCOSA COUNTY TEXAS

TITLE
SECTION 9A PSEUDO-STATIC (NON-CIRCULAR)
MAXIMUM SURCHARGE POOL

PROJECT No.	PHASE	Rev.	FIGURE
21455682	1000	01	A-16

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