OCTOBER 2016

CLECO POWER LLC
DOLET HILLS POWER STATION

SAFETY FACTOR ASSESSMENT:

ASH BASIN No. 1

Prepared By:

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Project Number 002-185

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1.0 INTRODUCTION

Providence was contracted by Cleco Power LLC (Cleco) to conduct safety factor assessments of Ash Basin No. 1 at Cleco's Dolet Hills Power Station. Recent Coal Combustion Residual (CCR) regulations at 40 CFR 257.73(e)(1) established requirements for owners and operators to conduct safety factor assessments to document whether the calculated factors of safety for the Ash Basin No. 1 achieve the minimum safety factors specified below:

- The calculated static factor of safety under the long-term, maximum storage pool loading condition must equal or exceed 1.50.
- The calculated static factor of safety under the maximum surcharge pool loading condition must equal or exceed 1.40.
- The calculated seismic factor of safety must equal or exceed 1.00.
- For dikes constructed of soils that have susceptibility to liquefaction, the calculated liquefaction factor of safety must equal or exceed 1.20.

The Cleco Dolet Hills Power Station is located approximately 8 miles southeast of Mansfield, DeSoto Parish, LA. A site location map showing the Dolet Hills Power Station is included as **Figure 1**. This safety factor assessment pertains to Ash Basin No. 1 utilized for the Unit 1 coal-fired generation unit. A site map for Ash Basin No. 1 is included as **Figure 2**.

2.0 FACTORS OF SAFETY

Providence performed a structural stability analysis (slope stability analysis) for the western levee for Ash Basin No. 1. The location of Ash Basin No. 1 is shown in **Figure 2**. This analysis required a review of the original permit and construction drawings for Ash Basin No. 1, a detailed topographic survey of the perimeter levees of Ash Basin No. 1, and installation of borings in the perimeter levees to determine the structural properties of these levees.

Providence mobilized to the Dolet Hills Power Station in March of 2016 to install a geotechnical boring in the perimeter levee of Ash Basin No .1. Geotechnical testing Laboratory, Inc. installed 1 boring in 2016 for Ash Basin No. 1. A soil profile was generated for the section along the Ash Basin that shows the results of the geotechnical boring and the laboratory analysis. Based on the geotechnical results, **Table 1** shows the soil profile for this section and the characteristics used for the slope stability modeling.

Table 1 Subsurface Soil Classification and Parameters

	Soil	Depth (ft)	Unit Wt. (lb/ft^3)	Cohesion (lb/ft^2)	Friction Angle(Φ)
Ash Basin No. 1 Section 1 B-1	**CL-CH**	22.0	109	1,000	-
	CH	11.0	109	730	-
	CH	5.0	111	1,000	-
	CL-CH	22.0	115	1,200	-

The slope stability analysis uses the strength of the soil material of which the levee is made of and subgrade to assess levee stability in accordance to the existing conditions. The Spencer Method for slope stability was used since it is the most conservative approach. The Spencer Method is a general method of slices developed on the basis of limit equilibrium. It requires satisfying equilibrium of forces and moments acting on individual blocks. The blocks are created by dividing the soil above the slip surface by dividing planes. Deep failure analysis evaluates the potential of the levees to fail through the bottom of the levees into the existing native soils. The analysis was based upon the following assumptions and input parameters.

- The subgrade stratigraphy was modeled using soil profile from the completed soil boring at the site with the soil profile condition at this section for this pond through the levee system. (**Table 1**).
- The height and exterior slope of the levee was determined based on actual field surveys and previously permitted design data and the bottom elevation and the interior slope of the levee below the water line was determined based on the previously permitted design provided by Cleco.
- The input parameters used in our analyses were based upon results from geotechnical investigations conducted for this slope stability analysis. **Appendix A** includes a copy of the geotechnical results as provided by the geotechnical contractor.
- The fill material in the pond was assumed to be water for Ash Basin No. 1. Maximum water elevation in Ash Basin No. 1 is 251.5 feet NAVD 88.

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

Providence modeled Ash Basin No. 1 under the long-term, maximum storage to the freeboard level for the surface impoundment. Based on the results of the slope stability analysis, the following minimum factor of safety was obtained:

Table 2 Long-Term Factor of Safety

Surface Impoundment	Section Number	Soil Boring No.	Maximum Water Elevation (feet NAVD 88)	Analysis	Factor of Safety
Ash Basin No. 1	Section 2	B-5 and B-6	242.5	Spencer Method Circular Failure	1.59

The calculated long-term static factor of safety under maximum storage pool loading conditions is greater than 1.50, therefore this safety factor is adequate.

Results of the long-term slope stability analysis and model input parameters can be found in **Appendix A**.

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

Providence modeled the ponds using a short-term scenario where the facility allows the pond to fill to the freeboard level for Ash Basin No. 1 surface impoundment. This scenario represents the flood/heavy rainfall conditions. The new elevation was determined using 2.5 feet of freeboard from the lowest levee crown elevation for each pond.

Based on the results of the short-term slope stability analysis, the following minimum factor of safety was obtained:

Table 3 Short-Term Factor of Safety

Surface Impoundment	Section Number	Soil Boring No.	Maximum Water Elevation (feet NAVD 88)	Analysis	Factor of Safety
Ash Basin No. 1	Section 1	B-1	251.5	Spencer Method Circular Failure	2.78

The calculated short-term static factor of safety under maximum surcharge pool loading conditions is greater than 1.40, therefore this safety factor is adequate.

Results of the short-term slope stability analysis and model input parameters can be found in **Appendix A**.

The calculated seismic factor of safety must equal or exceed 1.00

The Dolet Hills Power Station is not located in a seismic area. The Louisiana Geological Survey and the United States Geological Survey classifies the entire state of Louisiana as a low seismic risk area. This low seismic risk classification

denotes that the levels of horizontal shaking that have a 2 in 100 chance of being exceed in in a 50-year period range from 0-8% g where g is the acceleration of a falling object due to gravity. The nearest published fault system to the Dolet Hills Power Station is approximately 26 miles away. Therefore, the calculated seismic factor of safety is not applicable to Ash Basin No. 1.

For dikes constructed of soils that have susceptibility to liquefaction, the calculated liquefaction factor of safety must equal or exceed 1.2

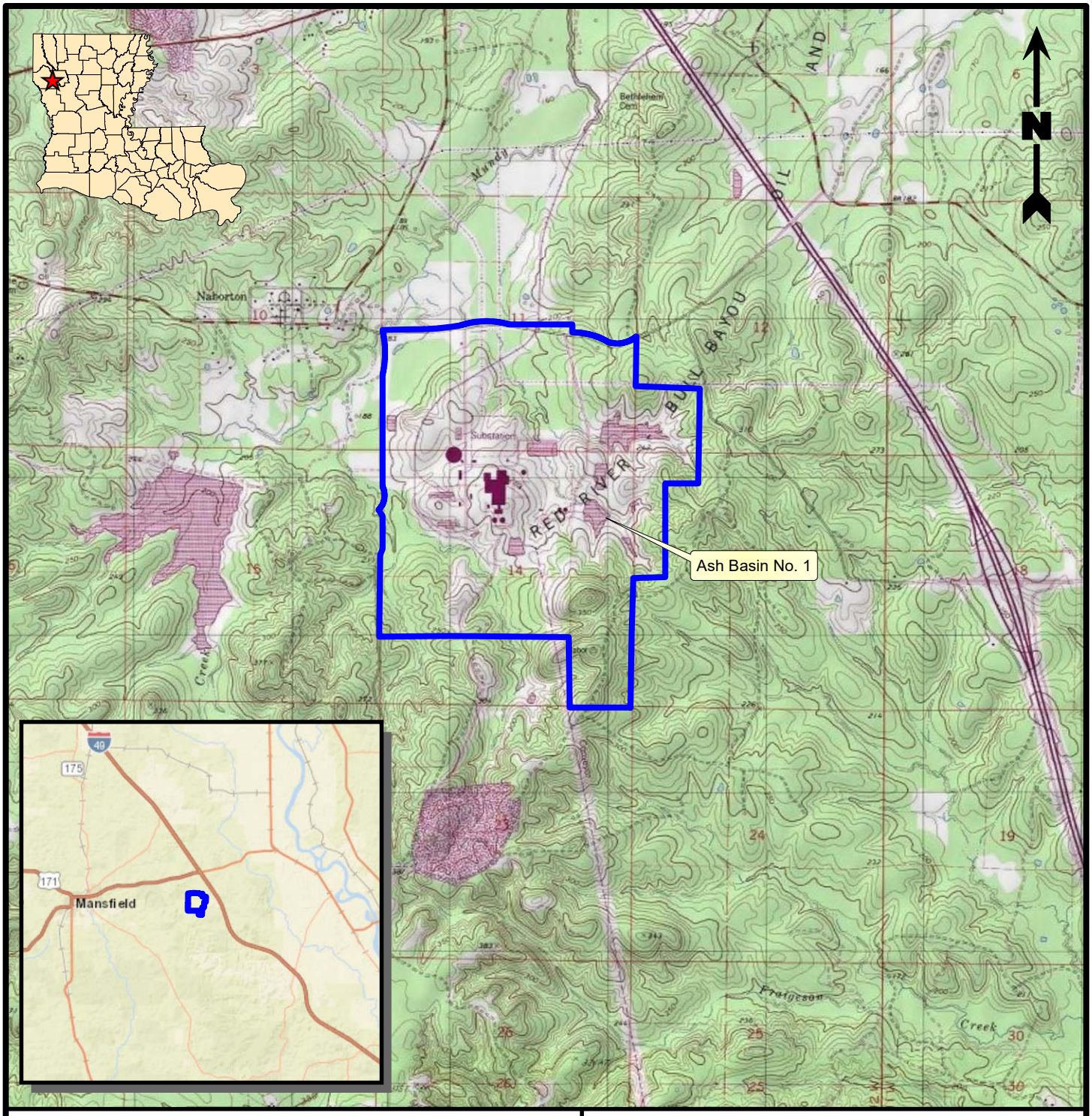
The clay soils found in the Ash Basin No. 1 levees are not subject to liquefaction.

3.0 CONCLUSIONS

Based on the results from the safety factor analysis, the existing levee design for Ash Basin No. 1 achieves the minimum safety factor requirements of the 40 CFR 257.73(e)(1) CCR regulations. Results of the safety factor analysis and model input parameters can be found in **Appendix A**. **Appendix B** contains a P.E. Certification that attests to the safety factor assessment.

FIGURE 1

SITE LOCATION MAP



3,000 1,500 0 3,000 Feet

Legend

Facility Boundary

Reference

Base map comprised of U.S.G.S. 7.5 minute topographic maps, "Lena, LA", "Boyce, LA", "Jericho, LA", and "Gardner, LA".

Site Location Map

Safety Factor Assessment - Ash Basin No. 1
Mansfield, DeSoto Parish, Louisiana

Cleco Power LLC
Dolet Hills Power Station

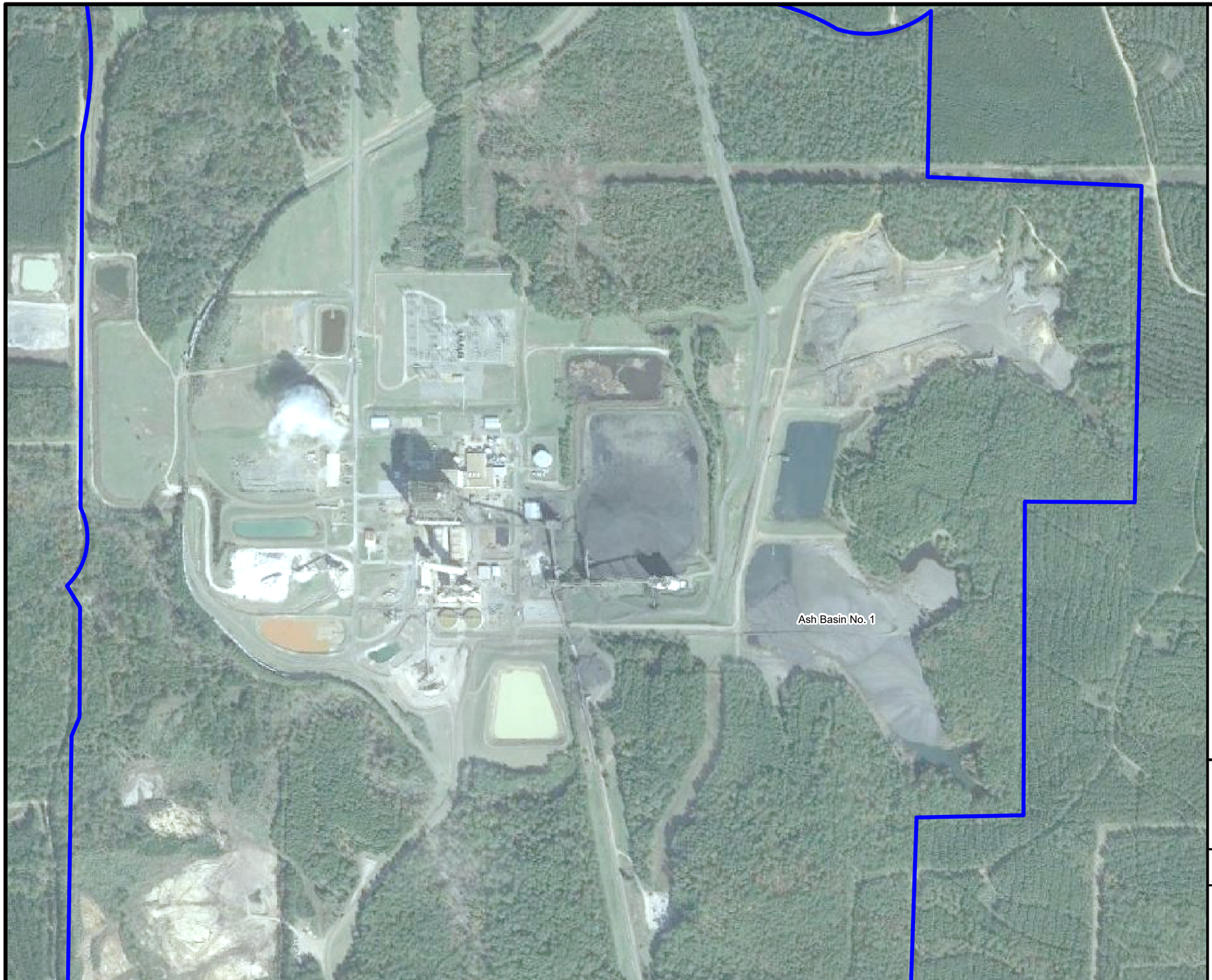
Drawn By	LMM	10/04/16
Checked By	LMH	10/04/16
Approved By	CVH	10/04/16

PROVIDENCE

Project Number	002-185
Drawing Number	002-185-A018
1	Figure

FIGURE 2

SITE MAP



N

Legend

Facility Boundary

Reference

Base map comprised of Google Earth aerial imagery from 11/06/12.

600 300 0 600
Feet

Site Map

Safety Factor Assessment - Ash Basin No. 1
Mansfield, DeSoto Parish, Louisiana

Cleco Power LLC
Dolet Hills Power Station

PROVIDENCE

Drawn By	LMM	10/04/16
Checked By	LMH	10/04/16
Approved By	CVH	10/04/16

Project Number 002-185

Drawing Number 002-185-B019

2
Figure

APPENDIX A

SLOPE STABILITY ANALYSIS

APS Engineering and Testing

October 16, 2016

PROVIDENCE
1201 Main Street
Baton Rouge, LA 70802

Attn: Mr. Gary Leonards, P.E.

Re: Slope Stability Analysis of Ash Basin 1
Cleco Dolet Hills Power Station
Mansfield, Louisiana

Dear Mr. Leonards:

APS Engineering and Testing, LLC has completed slope stability analysis of Ash Basin 1 located at Cleco Dolet Hills Power Station in Mansfield, Louisiana. Authorization to proceed with this work was received from **Mr. Gary Leonards** via email on July 18, 2016. Our analysis was performed based on the soil boring log data provided by the client. Our scope of services included performing landside stability of the existing levee with maximum ash slurry elevation, as requested by the client. This report provides the stability analysis results of Ash Basin 1.

Background

Ash Basin 1 at the Dolet Hills Power Station was constructed in 1984. The facility went into operation in 1985 when the coal fired boiler system (Unit #1) came on line. The bottom ash is sluiced to Ash Basin 1. The Ash Basin 1 is an existing unit that is essential component for the management of solid residuals generated at the Dolet Hills Power Station.

TABLE 1.0

Levee at	Soil boring data used*	Boring Depth (Feet)	Average Top of Levee Elevation (feet, NAVD88)	Max Ash Slurry Elevation (feet, NAVD88)
Ash Basin -1	B-1	60	254.0	251.5

*This data was obtained from Report No.: 03-16-039 prepared by Geotechnical Testing Laboratory (GTL), Inc.,

Ash Slurry Properties

Cohesion (psf)	20 (assumed)
Unit Weight (pcf)	75.0 (provided by client)

Assumptions and Observations:

- Soil layers are horizontal with uniform thickness.
- Soil layers encountered in Levee Centerline boring were used for the analysis.
- Cross section profiles were extended horizontally on the land side, whenever the failure plane passes the limits.

Slope Stability Analysis Results

Slope stability analysis was performed using Spencer method for both short term and long term conditions as requested by the client. Changes in slopes, structural loadings, and other conditions may affect the results of slope stability analysis. Factors of safety (FoS) obtained from slope stability analysis results do meet 1.50 according to HSDRRS guidelines for steady water level conditions.

TABLE 2.0

Soil Type	Phi	Cohesion (psf)
Silt (ML)	28°	0
Clay (CL/CH)	28°	0
Sand (SP / SM)	37°	0

TABLE 3.0

Stability Check	Flood Side Slurry Elevation	Condition	Factor of Safety	Recommended FoS
Ash Basin-1	251.5	Short Term	2.68	1.50
Ash Basin-1	251.5	Long Term	1.59	1.50

Based on the results presented in the above table, Ash Basin 1 meets minimum required factor of safety for both short term and long term conditions with the projected maximum Ash Slurry Elevations. This is based on the soil boring data provided by the client.

Liquefaction

The clay soils present at the project site are not susceptible to liquefaction.

If you have any questions pertaining to this report, or if we may be of further service, please contact our office.

Respectfully submitted,
APS ENGINERING AND TESTING, LLC

Sairam Eddanapudi, P.E.
Project Manager

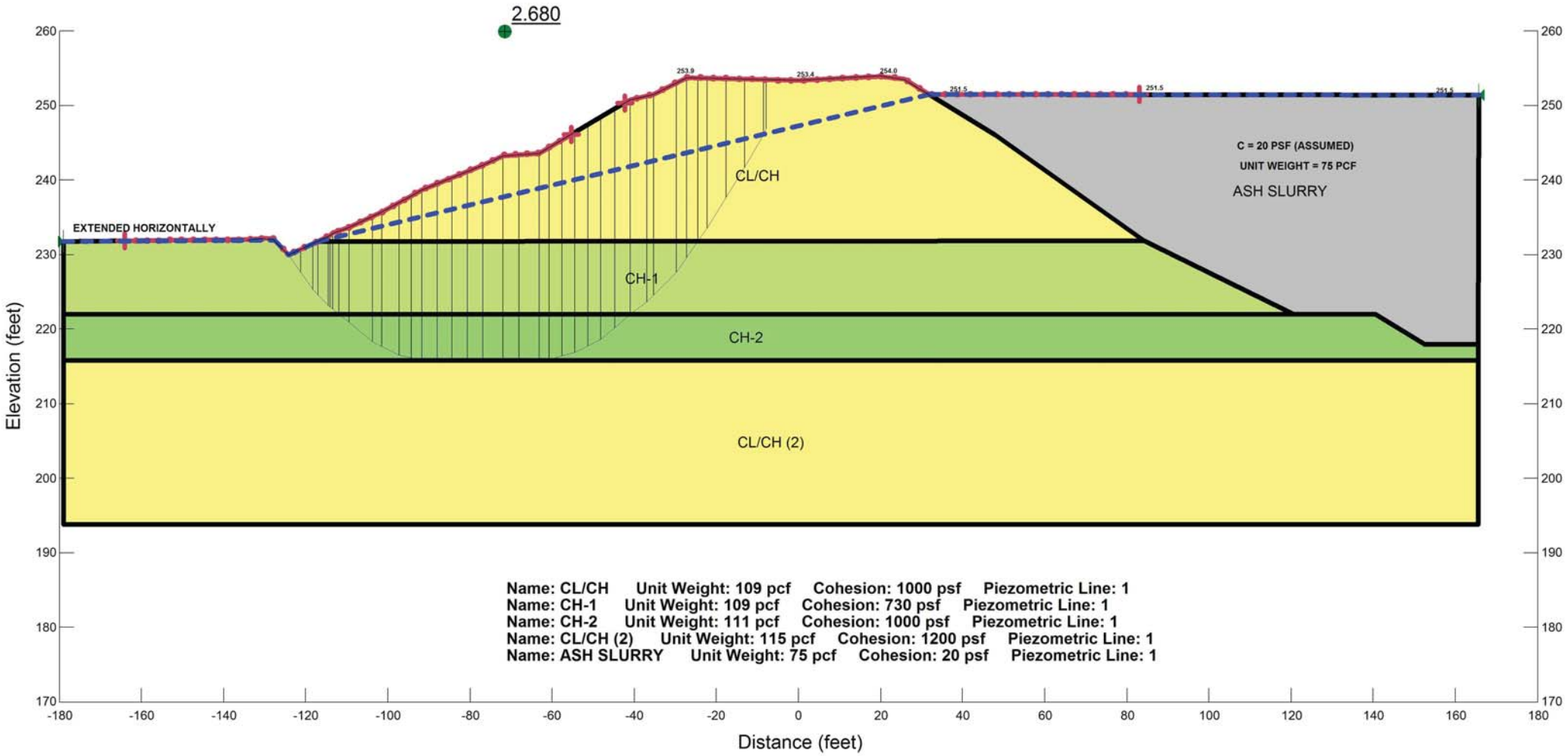
Sergio Aviles, P.E.
President

Attachments

Boring Location Plan
Slope Stability Analysis Results

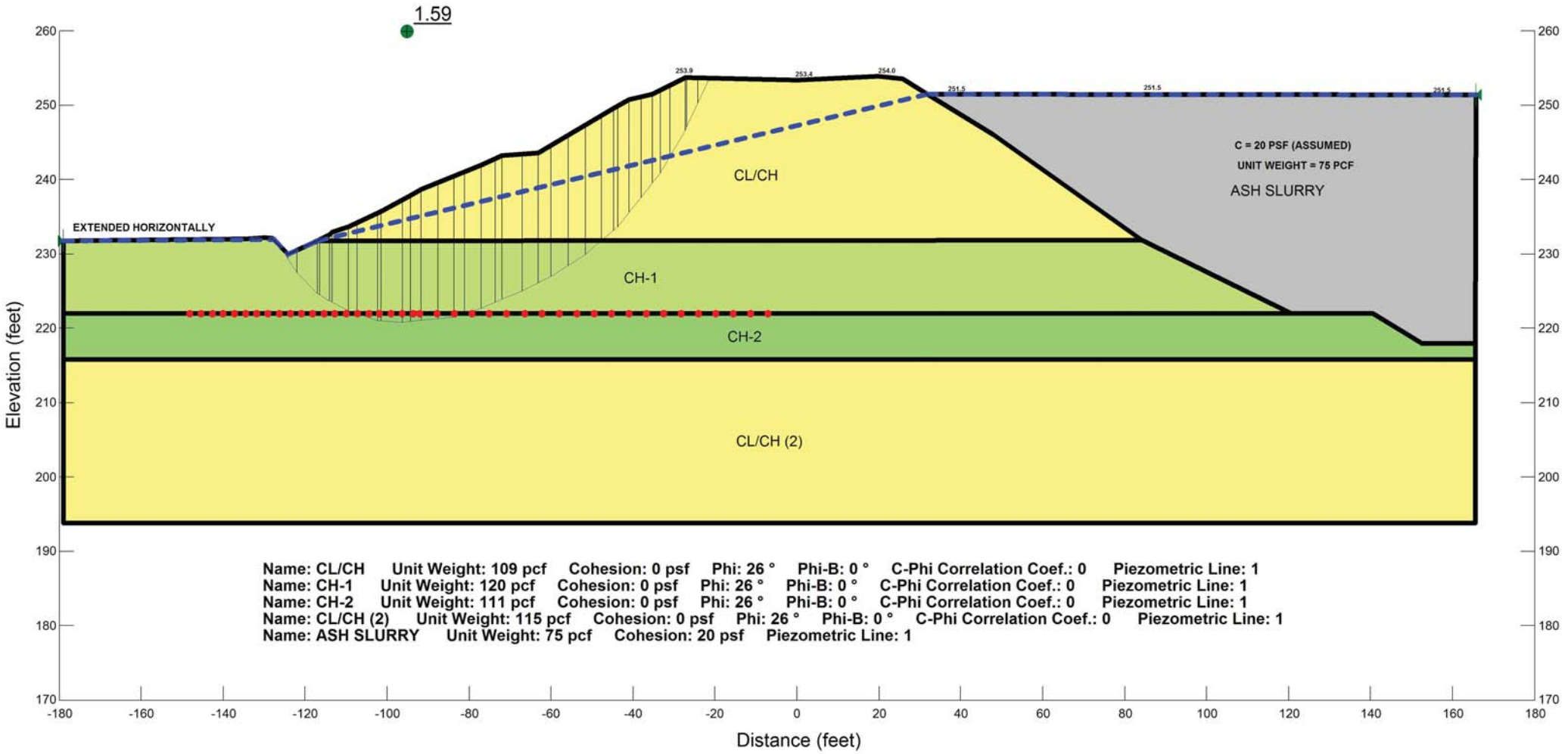
ASH BASIN 1

CLECO DOLET HILLS POWER STATION
ASH BASIN 1
SHORT TERM SLOPE STABILITY ANALYSIS
SOIL BORING B-1 DATA (FROM GTL REPORT NO.: 03-16-039)



Name: CL/CH Unit Weight: 109 pcf Cohesion: 1000 psf Piezometric Line: 1
Name: CH-1 Unit Weight: 109 pcf Cohesion: 730 psf Piezometric Line: 1
Name: CH-2 Unit Weight: 111 pcf Cohesion: 1000 psf Piezometric Line: 1
Name: CL/CH (2) Unit Weight: 115 pcf Cohesion: 1200 psf Piezometric Line: 1
Name: ASH SLURRY Unit Weight: 75 pcf Cohesion: 20 psf Piezometric Line: 1

CLECO DOLET HILLS POWER STATION
ASH BASIN 1
LONG TERM SLOPE STABILITY ANALYSIS (S-CASE)
SOIL BORING B-1 DATA (FROM GTL REPORT NO.: 03-16-039)



Name: CL/CH Unit Weight: 109 pcf Cohesion: 0 psf Phi: 26 ° Phi-B: 0 ° C-Phi Correlation Coef.: 0 Piezometric Line: 1
Name: CH-1 Unit Weight: 120 pcf Cohesion: 0 psf Phi: 26 ° Phi-B: 0 ° C-Phi Correlation Coef.: 0 Piezometric Line: 1
Name: CH-2 Unit Weight: 111 pcf Cohesion: 0 psf Phi: 26 ° Phi-B: 0 ° C-Phi Correlation Coef.: 0 Piezometric Line: 1
Name: CL/CH (2) Unit Weight: 115 pcf Cohesion: 0 psf Phi: 26 ° Phi-B: 0 ° C-Phi Correlation Coef.: 0 Piezometric Line: 1
Name: ASH SLURRY Unit Weight: 75 pcf Cohesion: 20 psf Piezometric Line: 1

APPENDIX B

P.E. CERTIFICATION

CLECO BRAME ENERGY CENTER
ASH BASIN NO. 1
CCR SAFETY FACTOR ASSESSMENT

PROFESSIONAL ENGINEER CERTIFICATION

I hereby certify that I have performed a safety factor assessment for Cleco's Dolet Hills Power Station Ash Basin No. 1 in accordance with the 40 CFR 257.73(e)(1) CCR requirements. This safety factor assessment has determined that Ash Basin No. 1 has met the following requirements:

- The calculated static factor of safety under the long-term, maximum storage pool loading condition must equal or exceed 1.50.
- The calculated static factor of safety under the maximum surcharge pool loading condition must equal or exceed 1.40.

And that these requirements were not applicable based on the findings:

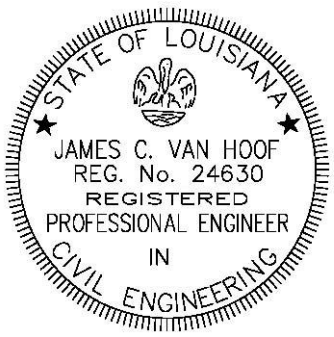
- The calculated seismic factor of safety must equal or exceed 1.00.
- For dikes constructed of soils that have susceptibility to liquefaction, the calculated liquefaction factor of safety must equal or exceed 1.20.

James C. Van Hoof
Name

24630 **LA**
Registration No. State

James C. Van Hoof, P.E.
Signature

10/17/2016
Date



(Seal)