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Interstate Power and Light Company
Sixth Street Generation Station
CCR Surface Impoundment Safety Factor Assessment
154.018.028.007.001
Report issued: May 6, 2026

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Executive Summary

This Safety Factor Assessment (Report) for the former Sixth Street Generating Station (SSS) has been prepared in accordance with the requirements of the United States Environmental Protection Agency rules for Hazardous and Solid Waste Management System – Disposal of CCR from Electric Utilities (40 CFR Parts 257 and 261, also known as CCR Rule).

On May 8, 2024, the EPA issued the Final Legacy Coal Combustion Residual (CCR) Surface Impoundment Rule ("Legacy Surface Impoundment Rule") that established regulations for CCR surface impoundments at inactive facilities (40 C.F.R. § 257.100). The Legacy Surface Impoundment Rule requires that legacy surface impoundments that no longer receive CCR but contain both CCR and liquid on or after October 19, 2015 and that are located at an inactive electric utility, generally comply with the EPA requirements for inactive CCR surface impoundments in accordance with Title 40 of the Code of Federal Regulations, Part 257 Subpart D Hazardous and Solid Waste Management System; Disposal of CCR from Electric Utilities.

This Report serves as the initial safety factors assessment of the SSS Closed Ash Pond in Cedar Rapids, Iowa in accordance with §257.73(b) and §257.73(e) of the CCR Rule. Primarily, this Report is focused on assessing if each CCR surface impoundment achieves the minimum safety factors, which include:

- Static factor of safety under long-term, maximum storage pool loading condition,
- Static factor of safety under the maximum surcharge pool loading condition,
- Seismic factor of safety; and,
- Post-Liquefaction factor of safety for embankments constructed of soils that have susceptibility to liquefaction.

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1. INTRODUCTION

The owner or operator of the Coal Combustion Residual (CCR) unit must conduct an initial and periodic safety factor assessment to determine if each CCR surface impoundment achieves the minimum safety factors, which include:

- Static factor of safety under long-term, maximum storage pool loading condition,
- Static factor of safety under the maximum surcharge pool loading condition,
- Seismic factor of safety; and,
- Post-Liquefaction factor of safety for embankments constructed of soils that have susceptibility to liquefaction.

This Report serves as the initial analysis and has been prepared in accordance with the requirements of §257.73(b) and §257.73(e) of the CCR Rule.

1.1 CCR Rule Requirements

The CCR Rule requires a periodic safety factor assessment by a qualified professional engineer (PE) for existing and legacy CCR surface impoundments with a height of 5 feet or more and a storage volume of 20 acre-feet or more; or the existing CCR surface impoundment has a height of 20 feet or more (40 CFR §§ 257.73(b), 257.73(d) and 257.83(b)).

1.2 Safety Factor Assessment Applicability

The Interstate Power and Light Company (IPL), Sixth Street Generating Station (SSS) in Cedar Rapids, Iowa (Figure 1) has one legacy CCR surface impoundment, identified as the SSS Closed Ash Pond. The Closed Ash Pond was historically referred to as Ash Pond 1, Ash Pond 2, Ash Pond 3, and Ash Pond 4. These ash ponds were operated collectively, contiguous to one another, and were closed in place under one continuous cover system. Because of this, the ash ponds are being considered a single legacy surface impoundment. The SSS Closed Ash Pond meets the requirements of §257.73(b)(1) and/or §257.73(b)(2), and is subject to the initial and periodic safety factor assessment requirements of the CCR Rule.

2. FACILITY DESCRIPTION

SSS was located near the center of Cedar Rapids on the eastern shore of the Cedar River in Linn County at 509 6th St NE, Cedar Rapids, Iowa 52401 (Figure 1). Cedar Lake is located to the north of the facility while the commercial and industrial areas of Cedar Rapids border the east and south.

SSS originated as a town lighting plant in 1888, in a 70-foot by 70-foot building. In 1891, a 40-foot building extension was constructed with a 153-foot stack. SSS became a fossil-fueled electric generating station that initiated operations in 1921. Over the years, the facility consisted of five dual-compartment boiler steam electric generating units detailed below. SSS did not operate after June of 2008 due to a catastrophic flood, was retired at that time, and then demolished in 2015.

General Facility Information:

Date of Initial Facility Operations:	1888	
Historical NPDES Permit Number:	IA-5715109	
Latitude / Longitude:	41° 59’ 5.31” N	91° 40’ 6.70” W
Unit Nameplate Ratings:	Unit 1 & 2 (1921) 10.0 MW - Coal	
	Unit 3 & 4 (1925) 10.0 MW - Coal	
	Unit 5 & 6 (1925) 10.0 MW - Coal	
	Unit 7 & 8 (1945) 15.0 MW – Coal	
	Unit 9 & 10 (1950) 28.7 MW – Coal or Natural Gas	
Impoundment IDNR State ID	57-SDP-34-04C	

2.1 SSS Closed Ash Pond Location

The SSS Closed Ash Pond is located northeast of the former SSS facility and is situated underneath Interstate 380, which includes several highway foundations and supports throughout the closed impoundment (Figure 1). The Closed Ash Pond was historically referred to as Ash Pond 1, Ash Pond 2, Ash Pond 3, and Ash Pond 4. These ash ponds were operated collectively, contiguous to one another, and were closed in place under one continuous cover system. Because of this, the ash ponds are being considered a single legacy surface impoundment (Appendix A).

An engineered cap was constructed atop of the SSS Closed Ash Pond in 2017 and 2018. The engineered cap drainage area is approximately 10.3 acres. The embankments are approximately 12 feet high relative to the grades outside the Closed Ash Pond. The current configuration includes a stormwater retention pond on top of the cap, which handles stormwater runoff from Interstate 380. This stormwater pond largely evaporates, although in case of a significant storm event, a drainage ditch carries water to the south where an outlet structure can discharge water from a corrugated metal pipe to the south, outside the boundary of the SSS Closed Ash Pond.

The overflow outfall structure is a 12-inch diameter pipe with a concrete standpipe containing orifices and an emergency spillway at elevation 729.5. Part of the western portion of the engineered cap drains through a swale that discharges through a rock chute to the south, outside the boundary of the SSS Closed Ash Pond. The perimeter area around the Closed Ash Pond functions as a vegetated drainage ditch that drains to a 30-inch diameter culvert that discharges below the railroad tracks and into Cedar Lake.

3. SAFETY FACTOR ASSESSMENT- §257.73(e)

This Report documents whether the former SSS Closed Ash Pond achieves the minimum safety factors, which are identified on the table below.

Safety Factor Assessment	Minimum Safety Factor
Static Safety Factor Under Maximum Storage Pool Loading	1.50
Static Safety Factor Under Maximum Surcharge Pool Loading	1.40
Seismic Safety Factor	1.00
Liquefaction Safety Factor	1.20

3.1 Safety Factor Assessment Methods

The safety factor assessment was completed with the two-dimensional limit-equilibrium slope stability analyses program GeoStudio Slope/W. The program analyzes many potential failure surfaces using the toe and crest search boundaries set for each analysis. The solution occurs by balancing the resisting forces along the failure plane due to the Mohr-Columb failure strength parameters of friction angle and cohesion. The gravity driving forces are divided by the resisting forces to produce a safety factor for the slope. The minimum safety factor slip surface identified through iterations is presented as the applicable safety factor.

There are both total stress and effective stress friction angle and cohesion values for soil. In the case of cohesionless soil (gravel, sand and silt) the friction angle value is the same for total stress and effective stress analysis and there is no cohesion.

3.1.1 Soil Conditions

As identified within a 2002 Subsurface Exploration for the Pulverizer Additions,[1] surficial deposits at the site include recent alluvium associated with the nearby Cedar River. These deposits include sand and clay which were deposited by flowing water of the Cedar River. The nature of the deposit depends more on the velocity of the water flow at the time of deposition than any other single factor, with sand and gravel associated with the faster moving water, and silt and clay associated with slower moving or stagnant water.

The bedrock at SSS is derived from the Wapsipinicon Formation of the Middle Devonian Series, Devonian Period, Paleozoic Era (some 385 million years ago). The Wapsipinicon formation includes, in order of decreasing prevalence, limestone, dolomite, and shale.

From the Subsurface Exploration for the Pulverizer Additions, the fill below the SSS basement floor varied in depth from about 1.2 feet to 10.5 feet and was fractured weathered to highly weathered, very poor to fair crystalline dolomite was encountered. The dolomite bedrock was encountered to the maximum depth explored which was 22.5 feet. Rock quality was typically very poor as numerous relative fresh fractures were visible in the core samples recovered. It is possible that the near surface bedrock at SSS may have been disturbed in the initial construction, perhaps by blasting.

An Ash Pond Slope Stability and Hydraulic Analysis[2] in 2011, which was prior to the closure construction activities, included five borings and three cone penetrometer tests (CPT) atop the

[1] Subsurface Exploration, Proposed Pulverizer Additions, 6th Street Power Plant, 2002, Team Services (Soil, Environmental and Material Consultants)
[2] Ash Pond Slope Stability and Hydraulic Analysis, 6th Street Generating Station, 2011, Aether DBS

surrounding legacy CCR impoundment. The fill in all five borings was identified as ash/slag from 17 to 24 feet in depth except for three borings which contained surficial clay, which was observed from 4.5 to 7 feet thick. The locations of clay likely indicates that clay was placed on the eastern and southern embankments to construct the modern 1980s configuration of the legacy CCR impoundment. Native soil under the fill was identified as sand with a thin clay or peat layer present in some of the borings at the native soil interface. The CPT results indicated that the alluvial sands found under the fill was dense.

These soils are consistent with the results of the site borings performed in 2025 and identified additional information on the embankments of the SSS Closed Ash Pond (Appendix B). The southwest embankment consists of final cover overlying embankment stiff clay/silt overlaying loose to very loose CCR overlaying medium stiff organic clay/silt overlaying medium dense sand. The northwest embankment consists of final cover overlying upper medium dense CCR overlaying lower loose to very loose CCR overlaying medium stiff organic clay/silt overlaying medium dense sand. Limited investigation into the railroad property to the northwest has been able to be conducted but it is understood that railroad ballast fill is present near the toe of the embankment. Historic borings conducted during Iowa Department of Transportation design of the highway overpass through the impoundment area included borings in the railroad area to the north that identify weathered limestone material that would be consistent with railroad ballast fill. The findings from these borings were interpreted to apply to material along extents of the northwest embankment toe based on historic aerial imagery that shows railroad construction into the adjacent areas in approximately 1950.

The density observations from the soil borings were used to assign soil properties to the embankment and foundation soils using UFC DM 7.1 and experience. The internal friction angles selected based on the Standard Penetration Test Split Spoon (SPT) results reported on the borings used in the analysis are presented in the attached Embankment Slope Stability Analysis in Appendix D.

The very dense sand found below the loose sand was not included in the modeled soil profile, since its exact depth in the foundation of the embankments is unknown. Ignoring the very dense sand will produce a conservative slope safety factor.

3.1.2 Design water surface for maximum normal pool and maximum pool under design inflow storm

The SSS Closed Ash Pond is no longer used for process water handling and an engineered cap was constructed atop of the SSS Closed Ash Pond in 2017 and 2018. The current configuration includes a stormwater retention pond on top of the cap, which handles stormwater runoff from Interstate 380. This stormwater pond largely evaporates, although in case of a significant storm event, a drainage ditch carries water to the south where an outlet structure can discharge water from a corrugated metal pipe to the south, outside the boundary of the SSS Closed Ash Pond. The engineered cap limits infiltration into the underlying CCR material such that under normal operations, the Closed Ash Pond is dry and water levels in the soil/CCR under the embankments were assumed to be at the same elevation that was observed in nearby piezometers in August through November 2025, at approximate elevation 720 feet.

The stormwater pond and interior swale on the engineered cap of the SSS Closed Ash Pond will store 5.7 acre-feet of water during the maximum storm event analyzed in the Inflow Flood Control Plan and the maximum water elevation will reach 728 feet. The minimum crest elevation of the on the south embankment near the outlet structure is elevation 729.5 feet with a resultant freeboard of 1.5 feet at the peak of the storm flow through the engineered cap outlet structure.

3.1.3 Selection of Seismic Design Parameters and Description of Method

The design earthquake ground acceleration is selected from the United States Geologic Survey (USGS) detailed seismic design maps based on the latitude and longitude of the SSS. The peak ground acceleration value is selected for a 2% probability of exceedance in 50 years (2,500-year return period) as required by §257.53. Peak ground acceleration seismic factors were selected based on the 2014 USGS Seismic Impact Zones map of horizontal and vertical coefficient of 0.04 g for the seismic and liquefaction assessment.

3.1.4 Liquefaction Assessment Method and Parameters

Certain soils may have zero effective stress (liquefaction) during an earthquake of from static shear of a saturated embankment slope. Soils that will liquefy include loose or very loose uniform fine sand or silt, and low plasticity clay (plastic index of less than 12). The liquefaction resistance of a soil is based on its strength and effective confining stress. The strength of the saturated embankment and foundation sand is measured by the SPT results shown on the borings in Appendix B.

Liquefaction potential of the site soils was evaluated based on the simplified procedure summarized by Seed and Harder (1990) and described in RCRA Subtitle D for solid waste facilities. The procedure uses the Standard Penetration Test N values to calculate a Standardized Penetration Resistance. A Cyclic Stress Ratio is also calculated based on the maximum horizontal acceleration for the design earthquake and the effective overburden stress within the soil being evaluated for liquefaction potential.

The results for the soil profile typical of the SSS Closed Ash Pond is shown in Appendix C. The results indicate that the saturated loose CCR and medium dense sand within and below the embankment will not liquefy during the site design earthquake with an acceleration factor of 0.04 g.

3.2 SSS Closed Ash Pond

The northwest and southwest embankment tops are generally at the same elevation as the engineered cap. The southwest embankment of the SSS Closed Ash Pond consists of approximately 5H:1V at the top of the slope and 1.5H:1V at the toe of the slope on the exterior side. Exterior slopes of the northwest embankment consist of approximately 3H:1V at the top of the slope and 2H:1V at the toe of the slope. With the engineered cap construction, there are no interior embankment slopes. A section on the southwest embankment and on the northwest embankment were selected as the critical cross sections.

3.2.1 Static Safety Factor Assessment Under Maximum Storage Pool Loading - §257.73(e)(1)(i)

The critical cross-section was analyzed under normal operations where the Closed Ash Pond is dry. Water levels in the soil/CCR under the embankments were assumed to be at the same elevation of approximately 720 feet elevation based on water level measurements in nearby piezometers in August through November 2025, at approximate elevation 720 feet. Analysis for circular failure surface was conducted and shows a minimum factor of safety factor of 1.32 in the southwest embankment and 1.38 in the northwest embankment (Appendix D).

3.2.2 Static Safety Factor Assessment Under Maximum Surcharge Pool Loading - §257.73(e)(1)(ii)

The maximum surcharge pool loading condition scenario would be analyzed with a maximum surcharge pool at 728 feet elevation based on the Inflow Flood Control Plan analysis. At the analyzed embankment sections, this would result in a piezometric condition that would not have a storage pool but would fully infiltrate through the final cover system and saturate the underlying CCR. The design and construction of the final cover system would limit infiltration and therefore this scenario would not occur. Thus the surcharge pool scenario does not apply to the current Closed Ash Pond embankments and was not analyzed (Appendix D).

3.2.3 Seismic Safety Factor Assessment - §257.73(e)(1)(iii)

The SSS Closed Ash Pond was assigned a pseudo-static earthquake coefficient equal to 0.04 g for both horizontal and vertical components. Analysis for circular failure surface was conducted and shows a minimum factor of safety factor of 1.20 in the southwest embankment and 1.26 in the northwest embankment (Appendix D).

3.2.4 Liquefaction Safety Factor Assessment - §257.73(e)(1)(iv)

The embankment and foundation soils of the SSS Closed Ash Pond are not susceptible to liquefaction. See discussion in Section 3.1.4.

4. Results Summary

The results of the safety factor assessment show that the geometry and material properties of the Closed Ash Pond embankments has a calculated safety factor value that meets the minimum recommended safety factor under 40 CFR 257.73(e) for the following conditions:

- The calculated seismic factor of safety equals or exceeds 1.00.

The results show that the geometry and material properties of the SSS Closed Ash Pond embankment have a calculated FS value that does not meet the minimum recommended safety factor for the following condition:

- The calculated static factor of safety under the long-term, maximum storage pool loading condition does not equal or exceed 1.50.

The results are summarized as:

	Long-Term, Maximum Storage Pool Loading (Static)	Maximum Surcharge Pool Loading (Static)	Pseudo Static Earthquake with Normal Water Elevation	Liquefaction Potential	Post Earthquake Static Stability Normal Water Elevation
Required Safety Factor	1.5 ≥	1.4 ≥	1.0 ≥	Yes/No	1.2 ≥
SSS Closed Ash Pond – Section A-A'	1.32	Not Applicable	1.20	No	Not Applicable
SSS Closed Ash Pond – Section B-B'	1.38	Not Applicable	1.26	No	Not Applicable

5. QUALIFIED PROFESSIONAL ENGINEER CERTIFICATION

To meet the requirements of 40 CFR 257.73(e)(2), I Mark W. Loerop hereby certify that I am a licensed professional engineer in the State of Iowa; and that, to the best of my knowledge, all information contained in this document is correct and the document was prepared in compliance with all applicable requirements in 40 CFR 257.73(b) and 40 CFR 257.73(e).

By: [signature]

Name: MARK LOEROP

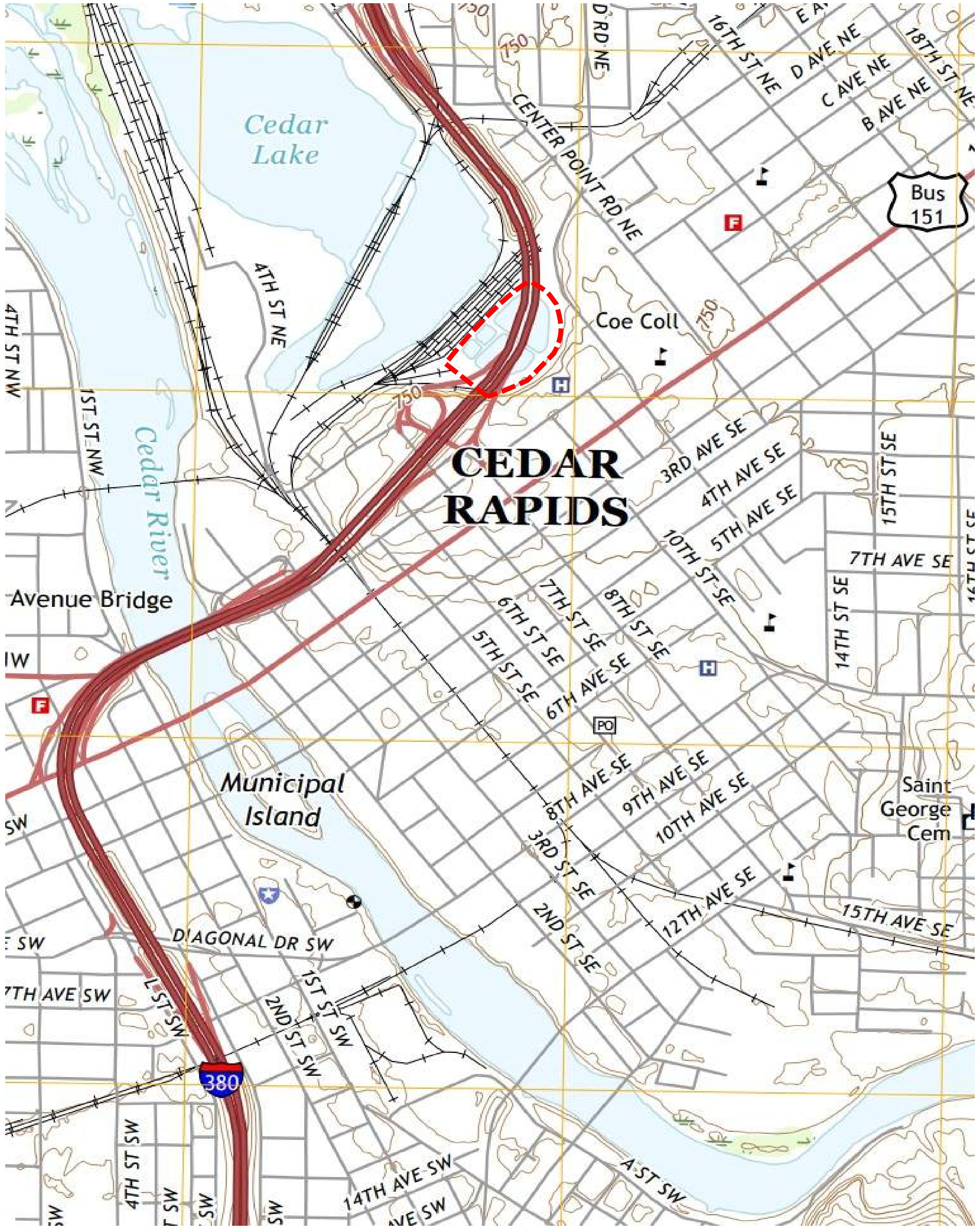
Date: MAY 6, 2026

FIGURES

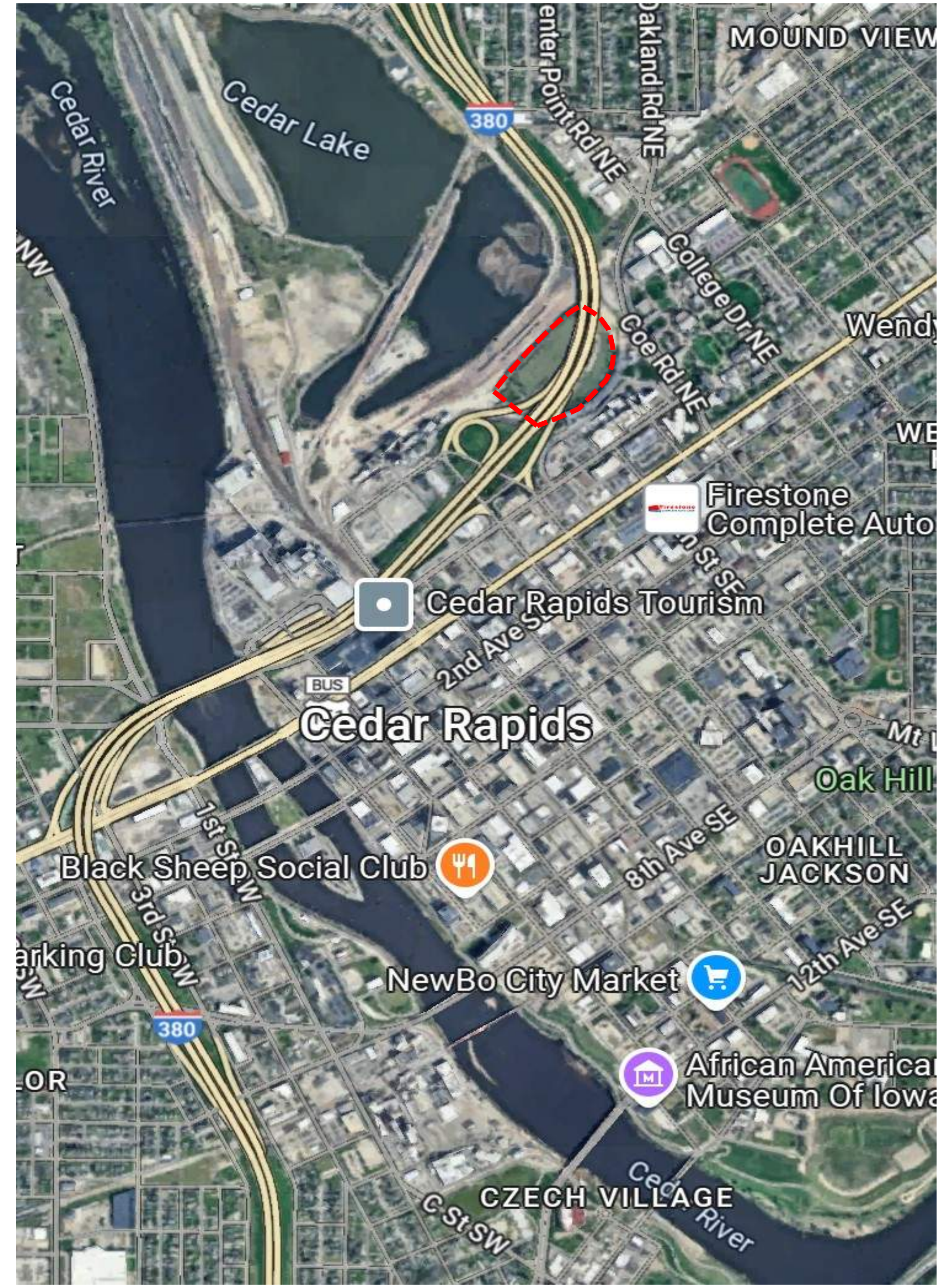
Alliant Energy
Interstate Power and Light Company
Sixth Street Generating Station
Cedar Rapids, Iowa

Safety Factor Assessment

Topography Map



Aerial Photo



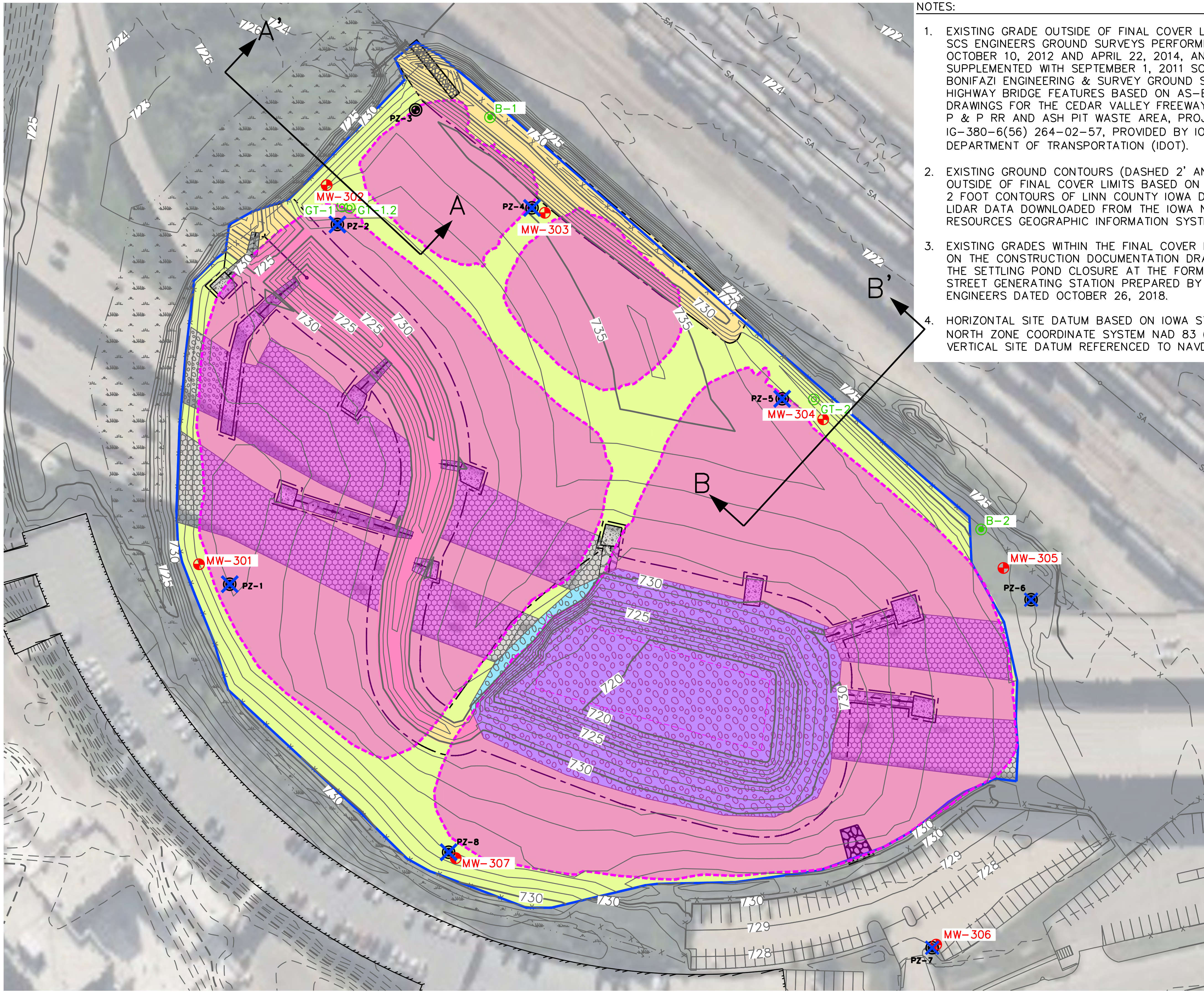
------ **Approximate Property Boundary**

hard hat SERVICES	Site Location Sixth Street Generating Station Interstate Power and Light Company	Drawing Figure 1 Date 7/8/2025

APPENDIX A – Closed Ash Pond Cross Section Location

Alliant Energy
Interstate Power and Light Company
Sixth Street Generating Station
Cedar Rapids, Iowa

Safety Factor Assessment



NOTES:

1. EXISTING GRADE OUTSIDE OF FINAL COVER LIMITS FROM SCS ENGINEERS GROUND SURVEYS PERFORMED ON OCTOBER 10, 2012 AND APRIL 22, 2014, AND SUPPLEMENTED WITH SEPTEMBER 1, 2011 SCHNOOR BONIFAZI ENGINEERING & SURVEY GROUND SURVEY. HIGHWAY BRIDGE FEATURES BASED ON AS-BUILT DRAWINGS FOR THE CEDAR VALLEY FREEWAY OVER CM ST. P & P RR AND ASH PIT WASTE AREA, PROJECT NO. IG-380-6(56) 264-02-57, PROVIDED BY IOWA DEPARTMENT OF TRANSPORTATION (IDOT).

2. EXISTING GROUND CONTOURS (DASHED 2' AND 10') OUTSIDE OF FINAL COVER LIMITS BASED ON GENERALIZED 2 FOOT CONTOURS OF LINN COUNTY IOWA DERIVED FROM LIDAR DATA DOWNLOADED FROM THE IOWA NATURAL RESOURCES GEOGRAPHIC INFORMATION SYSTEMS LIBRARY.

3. EXISTING GRADES WITHIN THE FINAL COVER LIMITS BASED ON THE CONSTRUCTION DOCUMENTATION DRAWINGS FOR THE SETTLING POND CLOSURE AT THE FORMER 6TH STREET GENERATING STATION PREPARED BY SCS ENGINEERS DATED OCTOBER 26, 2018.

4. HORIZONTAL SITE DATUM BASED ON IOWA STATE PLANE, NORTH ZONE COORDINATE SYSTEM NAD 83 (2011). VERTICAL SITE DATUM REFERENCED TO NAVD 88.

5. EXISTING WETLAND LIMITS PROVIDED BY STANTEC CONSULTING SERVICES, INC. WETLAND LIMITS ARE BASED ON STANTEC'S OCTOBER 19, 2012 ON-SITE WETLAND DETERMINATION.

6. AERIAL IMAGE FROM BING MAPS USING CIVIL 3D.

7. GEOPROBE/1"DIAMETER TEMPORARY MONITORING WELLS (PIEZOMETERS) GP-1/PZ-1 THRU GP-8/PZ-8 DRILLED/INSTALLED BY TERRACON ON AUG. 4-5, 2025.

8. PZ-1 THRU PZ-8 SURVEYED BY MOHN SURVEYING ON AUG. 27, 2025.

9. EXISTING PZ-3 TO REMAIN AS WATER LEVEL ONLY WELLS FOR INDEFINITE PERIOD OF TIME.

10. GEOTECHNICAL SOIL BORINGS AND 2" DIAMETER MONITORING WELLS MW-301 THRU MW-307 DRILLED/INSTALLED BY TERRACON ON NOVEMBER 10-13, 2025.

11. SOIL BORINGS B-1 AND B-2 WERE DRILLED ON APRIL 23-24, 2014.

LEGEND

	EXISTING GRADE (1' CONTOUR)
725	EXISTING GRADE (5' CONTOUR)
	EXISTING GRADE (2' CONTOUR)
740	EXISTING GRADE (10' CONTOUR)
	EXISTING WETLAND
x x	EXISTING CHAIN LINK FENCE
PZ-5	EXISTING GEOPROBE SOIL BORING/1" DIAMETER MONITORING WELL (PIEZOMETER) WATER LEVEL ONLY
	LIMITS OF LAMINATED GEOSYNTHETIC CLAY LINER (GCL)
	SOIL FINAL COVER AREA
	POND FINAL COVER AREA
	SWALE FINAL COVER AREA
	LIMITS OF FINAL COVER
	APPROXIMATE LIMIT OF SETTLING PONDS PRIOR TO FINAL COVER CONSTRUCTION
PZ-5	ABANDONED 1" DIAMETER MONITORING WELL (PIEZOMETER)
MW-305	EXISTING 2" DIAMETER MONITORING WELL
GT-2	GEOTECHNICAL SOIL BORING (2025)
B-2	SOIL BORING (2014)

N

100 0 100

SCALE: 1" = 100'

PROJECT NO.	25225170.01	DRAWN BY:	AR
DRAWN:	12/08/2025	CHECKED BY:	BSS
REVISED:	03/10/2026	APPROVED BY:	BSS 05/06/2026

ENGINEER: SCS ENGINEERS
2830 DAIRY DRIVE MADISON, WI 53718-6751
PHONE: (608) 224-2830

CLIENT: INTERSTATE POWER AND LIGHT CO.
200 1ST STREET S.E.
CEDAR RAPIDS, IA 52402

SITE: FORMER 6TH STREET GENERATING STATION
CEDAR RAPIDS, IOWA

CROSS SECTION LOCATION MAP

FIGURE
1

I:\25225170.01\Drawings\Slope Stability\1_Section A-A' and B-B' Location Map.dwg, 3/10/2026 4:40:35 PM

APPENDIX B – Boring Logs and Lab Data

Alliant Energy
Interstate Power and Light Company
Sixth Street Generating Station
Cedar Rapids, Iowa

Safety Factor Assessment

SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION

Revised 5/6/2026

Route To: Watershed/Wastewater ☐ Waste Management ☒
Remediation/Redevelopment ☐ Other ☐

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
IPL 6th Street Legacy CCR Site SCS#: 25225170.00	PWTS#224069-01	GT-1

Boring Drilled By: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
Scott Zeien Terracon	11/12/2025	11/12/2025	SPT auger

Unique Well No.	DNR Well ID No.	Common Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
			13.0 Feet	733.0 Feet MSL	4.3 in

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒
State Plane 3,463,429 N, 5,420,597 E S/C/(N)
SW 1/4 of NE 1/4 of Section 21, T 83 N, R 7 W
Lat 41° 59' 10.2"
Long 91° 39' 47.6"
Local Grid Location: Feet ☐ N ☐ S; Feet ☐ E ☐ W

Facility ID	County	Civil Town/City/ or Village
	Linn	Cedar Rapids, Iowa

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Pocket Penetrometer Reading (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
				TOPSOIL, very dark grayish brown (10YR 3/2), organics (root/grass), silt, sand, very brittle. (FILL)	TOPSOIL									
S1	21	22	1.5 – 3.0	LEAN CLAY (CL), dark brown, some silt, fine to coarse sand, trace fine gravel, subrounded and subangular sand, subrounded gravel, root hairs, very hard, brownish orange mottling. (FILL)	CL				4.5+	M				
S2 S3	15	23	4.5	SILT with SAND (ML), yellowish orange, very fine to fine sand, subrounded sand, light gray mottling, black mottling at base of interval. (FILL)	ML				4.5+	M				
			6.0	SILT with SAND (ML) and cement, black. (FILL)	ML									
S4	16.5	13	7.5	SILT with SAND (ML), yellowish orange, very fine to fine sand, subrounded sand, gray mottling, some clay, clay content increases with depth of silt interval. (FILL)	ML				3.0	M				
S5	15	6	9.0 – 10.5	LEAN CLAY (CL), greenish gray, some silt, very plastic, olive gray mottling, trace root hairs. (FILL)	CL				1.5	M+				
S6 S7	10	2	12.0 – 13.5	ASH, black, bottom ash and fly ash, grain sizes variable, very loose to loose. (FILL)	FILL				0.25 --	W				Started drilling with water at 13'
S8	24	1	15.0						--	W				
S9	18	5	16.5 – 18.0	pocket of poorly grained sand					--	W				
			19.5	some coal/cinders/organics from 19-20'										

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature	Firm	
[signature] Bri Salome	SCS 2830 Dairy Drive, Madison, WI 53718	Tel: Fax:

Boring Number GT-1

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Soil Properties: Pocket Penetrometer Reading (tsf)	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/ Comments
S10	13.5	50 FOR 5"		WOOD	WOOD				--	W				
S11			21.0											
			22.5	LEAN CLAY, black, very soft.	CL									
S12	16	4		SILT (ML), very dark brown, trace clay, medium stiff, brittle, root hairs, peaty.	ML				0.25	M				
S13									0.75					
			24.0	LEAN CLAY (CL), black, trace silt, medium stiff, very plastic, layer of organics overlay.	CL									
S14	19	3	25.5						0.75	W				
			27.0	POORLY GRADED SAND (SP), gray, fine to coarse sand, loose to medium dense, subrounded sand.	SP									
S15	13	14	28.5						--	W				
S16	11	15	30.0						--	W				
			31.5	some fine to coarse subrounded gravel 29-34'										
S17	10	6	33.0						--	W				
S18	12	34	34.5	POORLY GRADED SAND (SP), olive gray, fine to coarse sand, fine to coarse gravel, dense, subrounded sand, subrounded and subangular gravel, pockets of fine sand, pocket of just gravel, lots of variety in grain size, not uniform, very light brown at bottom.	SP				--	W				
			36.0	POORLY GRADED SAND (SP), light gray, very fine to medium sand, very trace fine gravel, very dense, subrounded sand and gravel.										
S19	14	50 FOR 5"	37.5		SP				--	M+				
			39.0	POORLY GRADED SAND (SP), olive gray, fine to coarse sand, fine to coarse gravel, medium to very dense, subrounded sand, subrounded and subangular gravel, pockets of fine sand, pocket of just gravel, lots of variety in grain size, not uniform, very light brown at bottom.										
S20	17	24	40.5		SP				--	W				
S21	18	57	42.0						--	W				
			43.5	POORLY GRADED SAND (SP), light brownish gray, very fine to medium sand, trace coarse sand, trace fine gravel, medium dense to dense, subrounded sand and gravel.										
S22	10	39	45.0						--	W				
S23	13	34	46.5						--	W				
			48.0		SP									
S24	13	23	49.5						--	W				
			51.0											
			52.5											

Boring Number GT-1

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Soil Properties: Pocket Penetrometer Reading (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			54.0	POORLY GRADED SAND (SP), light brownish gray, very fine to medium sand, trace coarse sand, trace fine gravel, medium dense to dense, subrounded sand and gravel. *(continued)*	SP									
S25	11	30	55.5	some fine to coarse gravel					--	W				
			57.0											
			58.5											
S26	12	25	60.0						--	W				
			61.5											
			63.0											
			64.5											
S27	11	20		color change - light orangish brown, some silt					--	W				
			66.0											
			67.5											
			69.0	color change - light gray, fine to coarse subrounded sand										
S28	19	33		pocket of subrounded gravel					--	W				
			70.5	color change - light brown, fine to medium sand, trace coarse, subrounded.										
				End of boring at 71'.										

SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION

Revised 5/6/2026

Route To: Watershed/Wastewater ☐ Waste Management ☒
Remediation/Redevelopment ☐ Other ☐

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
IPL 6th Street Legacy CCR Site SCS#: 25225170.00	PWTS#224069-01	GT-1.2

Boring Drilled By: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
Scott Zeien Terracon	11/13/2025	11/13/2025	SPT auger

Unique Well No.	DNR Well ID No.	Common Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
			13.0 Feet	733.0 Feet MSL	4.3 in

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒
State Plane 3,463,436 N, 5,420,598 E S / C / (N)
SW 1/4 of NE 1/4 of Section 21, T 83 N, R 7 W

Lat 41° 59' 10.3"
Long 91° 39' 47.6"

Local Grid Location
☐ N ☐ E
Feet ☐ S Feet ☐ W

Facility ID	County	Civil Town/City/ or Village
	Linn	Cedar Rapids, Iowa

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Soil Properties: Pocket Penetrometer Reading (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
				Blind drilled to 24'. Reference GT-1 for lithology.										
			1.5											
			3.0											
			4.5											
			6.0											
			7.5											
			9.0											
			10.5											
			12.0											
			13.5											
			15.0											
			16.5											
			18.0											
			19.5											

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature	Firm	
Bri Salome	SCS 2830 Dairy Drive, Madison, WI 53718	Tel: Fax:

Boring Number GT-1.2

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Soil Properties: Pocket Penetrometer Reading (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			21.0 22.5	Blind drilled to 24'. Reference GT-1 for lithology. *(continued)*										
	NA		24.0 25.5	SHELBY TUBE 24-26'. ORGANIC CLAY (OH), black, with sand, medium stiff.	OH				0.5		60	36	82.3	Water Content = 39.1%
				End of boring at 26'. Collected one shelby tube.										

SCS ENGINEERS
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SOIL BORING LOG INFORMATION

Revised 5/6/2026

Route To: Watershed/Wastewater ☐ Waste Management ☒
Remediation/Redevelopment ☐ Other ☐

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
IPL 6th Street Legacy CCR Site SCS#: 25225170.00	PWTS#224069-01	GT-2

Boring Drilled By: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
Scott Zeien Terracon	11/12/2025	11/12/2025	SPT auger

Unique Well No.	DNR Well ID No.	Common Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
			16.0 Feet	733.0 Feet MSL	4.3 in

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒
State Plane 3,463,873 N, 5,420,778 E S / C / (N)
SW 1/4 of NE 1/4 of Section 21, T 83 N, R 7 W

Lat 41 ° 59 ' 14.5 "
Long 91 ° 39 ' 45.1 "

Local Grid Location
Feet ☐ N ☐ S Feet ☐ E ☐ W

Facility ID	County	Civil Town/City/ or Village
	Linn	Cedar Rapids, Iowa

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Soil Properties: Pocket Penetrometer Reading (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
				Blind drilled 0-24'. Reference SP-304 for lithology.										
			1.5											
			3.0											
			4.5											
			6.0											
			7.5											
			9.0											
			10.5											
			12.0											
			13.5											
			15.0											Drilling with mud started at 15'
			16.5											
			18.0											
			19.5											

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature	Firm	
Bri Salome	SCS 2830 Dairy Drive, Madison, WI 53718	Tel: Fax:

Boring Number GT-2

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Soil Properties: Pocket Penetrometer Reading (tsf)	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/ Comments
			21.0, 22.5	Blind drilled 0-24'. Reference SP-304 for lithology. *(continued)*										
	NA		24.0, 25.5	SHELBY TUBE 24-26'. SANDY ORGANIC SILT (OH), black, medium stiff.	OH				1.0		72	28	51.4	Water Content = 59.2%
S1	13	13	27.0, 28.5	POORLY GRADED SAND (SP), olive gray, fine to coarse sand, trace fine gravel, loose to medium dense, subrounded sand, subrounded and subangular gravel.	SP				--	W				
S2	12	10	30.0, 31.5						--	W				
S3	11	8	33.0						--	W				
S4	12	15	34.5, 36.0						--	W				
S5	16	25	37.5	POORLY GRADED SAND (SP), light gray, very fine to fine sand, trace medium sand, medium dense, subrounded very fine to fine, subangular medium.	SP				--	W				
S6	13	16	39.0, 40.5	trace subrounded coarse sand, some subangular medium sand					--	W				
S7	12	15	42.0, 43.5	POORLY GRADED SAND (SP), light gray, very fine to medium sand, trace coarse sand, trace fine to coarse gravel, medium dense, subrounded sand and gravel.	SP				--	W				
S8	17	4	45.0, 46.5	SILT (ML), greenish gray, very soft.	ML				--	W				
S9	10	0	48.0	POORLY GRADED SAND (SP), light gray, very fine to fine sand, trace medium sand, very loose, subrounded very fine to fine, subangular medium.	SP				--	W				
S10	11	7	49.5, 51.0, 52.5	POORLY GRADED SAND (SP), light gray, very fine to medium sand, loose to medium dense, subrounded sand.	SP				--	W				

Boring Number GT-2

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Soil Properties: Pocket Penetrometer Reading (tsf)	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/ Comments
			54.0	POORLY GRADED SAND (SP), light gray, very fine to medium sand, loose to medium dense, subrounded sand. *(continued)*	SP									
S11	13	8	55.5						--	W				
			57.0											
			58.5	color change - light olive gray										
S12	11	10	60.0						--	W				
			61.5											
			63.0											
			64.5	no recovery 64-66'										
S13	0	13	66.0						--	--				
			67.5											
			69.0	pocket of fine to coarse subrounded gravel										
S14	5	9	70.5						--	W				
				End of boring at 71'.										

SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION

Revised 5/6/2026

Route To: Watershed/Wastewater ☐ Waste Management ☒
Remediation/Redevelopment ☐ Other ☐

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
IPL 6th Street Legacy CCR Site SCS#: 25225170.00	PWTS#224069-01	SB-304/MW-304

Boring Drilled By: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
Scott Zeien Terracon	11/11/2025	11/11/2025	SPT auger

Unique Well No.	DNR Well ID No.	Common Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
		MW-304	16.0 Feet	733.1 Feet MSL	4.3 in

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒
State Plane 3,463,866 N, 5,420,774 E S / C /(N)
SW 1/4 of NE 1/4 of Section 21, T 83 N, R 7 W

Lat 41 ° 59 ' 14.5 "
Long 91 ° 39 ' 45.2 "

Local Grid Location ☐ N ☐ E Feet ☐ S Feet ☐ W

Facility ID	County	Civil Town/City/ or Village
	Linn	Cedar Rapids, Iowa

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Pocket Penetrometer Reading (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
				TOPSOIL, very dark grayish brown (10YR 3/2), silt, sand, organics (roots/grass). (FILL)	TOPSOIL									
S1	20	9	1.5	SILT with SAND (ML), light olive brown (2.5Y 5/4), very fine to fine sand, trace medium sand, subrounded very fine to fine, subangular medium. (FILL)	ML				3.5	M				
S2	21	6	3.0	Pocket of pale brown cemented material.					--	M				
				LEAN CLAY (CL), dark olive brown (2.5Y 3/3), some silt, trace fine to medium sand, trace fine to coarse gravel, subrounded sand, angular gravel, coals, cinders, black mottling. (FILL)	CL									
S3	24	41	4.5	ASH, bottom ash, multicolored (5Y 5/4, 10YR 2/2, 10YR 5/5), fine to medium grains, dense, subangular gains, coal, cinders. (FILL)	FILL				4.5	M				
S4	24	14	6.0 7.5	ASH, bottom ash mixed with fly ash, black (10YR 2/1), fine to medium grains, loose to very loose, subrounded and subangular grains, coal, cinders, cemented fly ash. (FILL) fine to medium subangular pieces of red brick at 7'					--	M				
	20	7	9.0						--	M				
S5	14	3	10.5	greenish gray mottle					--	M+				
			12.0	fine to medium subangular pieces of red brick										
	20	7	13.5	trace green gray	FILL				--	M+				
S6	21	10	15.0						--	M+				
	16	4	16.5						--	W				SATURATED AT 16'
	23	2	18.0 19.5	slight iridescent sheen - no odors or obvious contamination					--	W				

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature	Firm	
Bri Salome	SCS 2830 Dairy Drive, Madison, WI 53718	Tel: Fax:

Boring Number SB-304/MW-304

Sample Number and Type	Sample Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Pocket Penetrometer Reading (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
S7	24	2	21.0	ASH, bottom ash mixed with fly ash, black (10YR 2/1), fine to medium grains, loose to very loose, subrounded and subangular grains, coal, cinders, cemented fly ash. (FILL) *(continued)*	FILL				--	W				
S8	6	3	22.5	LEAN CLAY (CL), very dark brown (10YR 2/2), some silt, some medium sand, medium stiff, rounded sand.	CL				0.5	M+				
			24.0	End of boring at 24'. Set well MW-304 with a 10' screen at 23'.										

191 W. Edgerton Ave
Milwaukee, WI 53207
(414)933-7444

Report On: Test Report Attachment

Lab No: 25-06465
Report No: 25-06465

Project No: 25351-40 **Cust No:** 0410

Client: SCS Engineers
Debra Nelson
SCS Engineers
2830 Dairy Drive
Madison, WI 53718

Project: Former IPL 6th St. Generating Station

Report Date: 12/19/2025

Location:

Sample Date: 12/18/2025
Sampled By: Client

Remarks: See attatched for Former 6th Street Results

Orig: SCS Engineers Attn: Debra Nelson
(1-ec copy)
1-cc Laboratory

Respectfully Submitted,

Nicole Merkes,

GESTRA Engineering, Inc
191 W. Edgerton Ave
Milwaukee, WI 53207
Phone: (414) 933-7444; Fax: (414) 933-7844

Laboratory Test Results of Atterberg Limits of Soil

Project Name:	Former 6th St. Generating Station	Date:	December 17, 2025
Project Number:	25368-40	Client:	SCS
Project Location:	Cedar Rapids	SCS #:	25225170.01
ASTM Designation:	**D4318 (Method A)**		

Sample Information

Type of Sample	Shelby Tube
Boring Number	GT-1
Sample Number	--
Depth of Sample	24' -26'

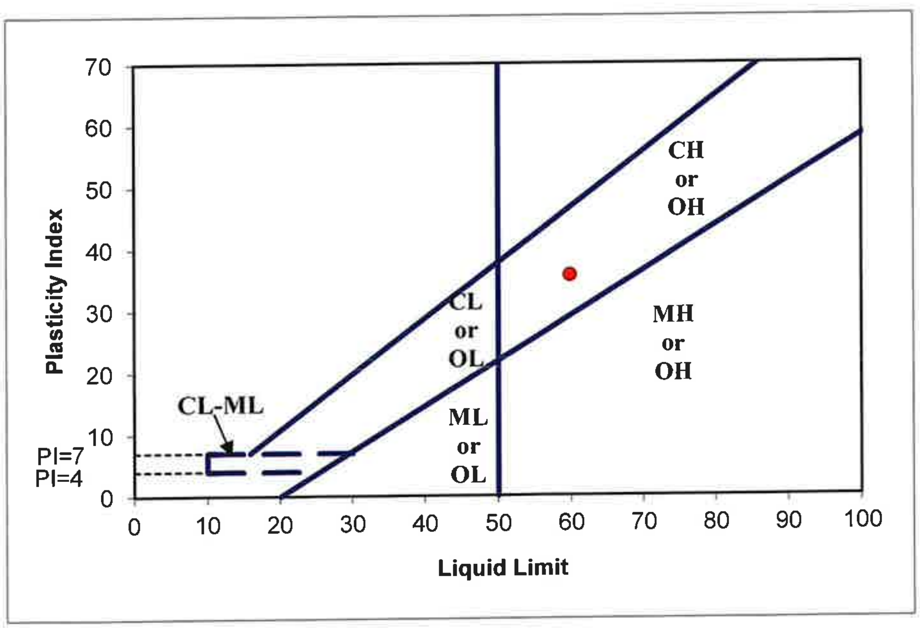
Determination of Liquid Limit

Cup Number			
Weight of Cup (g)	18.71	18.72	18.88
Weight of Wet Soil and Cup (g)	42.26	40.58	40.91
Weight of Dry Soil and Cup (g)	33.63	32.44	32.44
Moisture Content (%)	57.8	59.3	62.5
Blow Counts	31	26	17

Determination of Plastic Limit

Cup Number		
Weight of Cup (g)	6.92	7.22
Weight of Wet Soil and Cup (g)	14.17	14.33
Weight of Dry Soil and Cup (g)	12.78	12.98
Moisture Content (%)	23.7	23.4

Compilation of Test Results



Liquid Limit	60
Plastic Limit	24
Plasticity Index	36
USCS Symbol	**CH**

Performed by: M. Biddick

Reviewed By: Nicole Merkes
GESTRA Engineering, Inc.

Geotechnical-Structural-Pavement-Construction Material

GESTRA Engineering, Inc
191 W. Edgerton Ave
Milwaukee, WI 53207
Phone: (414) 933-7444; Fax: (414) 933-7844

Laboratory Test Results of
Mechanical Analysis of Soil or Aggregate

Project Name: Former 6th St. Generating Station
Project Number: 25368-40
Project Location: Cedar Rapids
ASTM Designation: **D6913** **Method B**

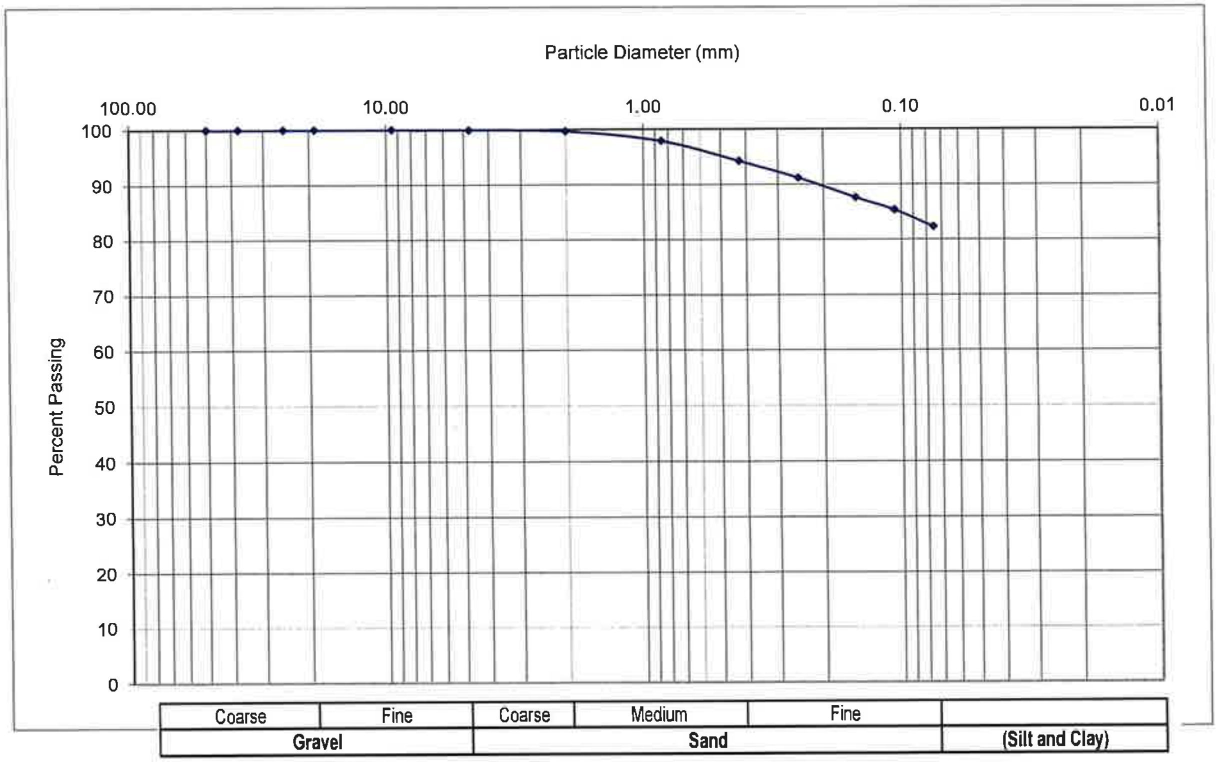
Date: December 8, 2025
Reported To: SCS
SCS #: 25225170.01

Sample Information

Type of Sample: Shelby Tube
Boring Number: GT-1
Sample Number: -
Depth of Sample: 24'-26'

Mechanical Analysis Data

Sieve	Sieve Opening (mm)	Percent Passing (%)
2	50	100.0
1 1/2	37.5	100.0
1	25.0	100.0
3/4	19.0	100.0
3/8	9.5	100.0
#4	4.75	99.9
#10	2.000	99.7
#20	0.850	97.9
#40	0.425	94.3
#60	0.250	91.2
#100	0.150	87.7
#140	0.106	85.4
#200	0.075	82.3
Pan		81.7



Moisture Content 39.1 %

Remarks: Gravel 0.1 % Sand 17.6 %
Passing #200 Sieve (Silt & Clay) 82.3 %

Performed by: C. Schneider

Reviewed by: Nicole Merkes
GESTRA Engineering, Inc.

Geotechnical-Structural-Pavement-Construction Material

GESTRA Engineering, Inc
191 W. Edgerton Ave
Milwaukee, WI 53207
Phone: (414) 933-7444; Fax: (414) 933-7844

Shelby Tube Extraction Form

Project Name:	Former 6th St. Generating Station	Date:	December 4, 2025
Project Number:	25368-40	Client:	SCS
Projection Location:	Cedar Rapids	SCS #:	25225170.01
ASTM Designation:	**D2488**		

Sample Information

Boring Number	GT-1	
Sample Number	--	qp: 0.50 - 0.75
Depth of Sample	24' - 26'	

Recovery: 18"

Soil Description: Organic fat clay, black, moist, medium stiff, with sand and trace wood fibers.
Top 4": Dark brown peat, moist.

Performed By: S. McLafferty

Reviewed By: Nicole Merkes

Geotechnical-Structural-Pavement-Construction Material

GESTRA Engineering, Inc
191 W. Edgerton Ave
Milwaukee, WI 53207
Phone: (414) 933-7444; Fax: (414) 933-7844

Laboratory Test Results of Atterberg Limits of Soil

Project Name:	Former 6th St. Generating Station	Date:	December 17, 2025
Project Number:	25368-40	Client:	SCS
Project Location:	Cedar Rapids	SCS #:	25225170.01
ASTM Designation:	**D4318 (Method A)**		

Sample Information

Type of Sample	Shelby Tube
Boring Number	GT-2
Sample Number	--
Depth of Sample	24' -26'

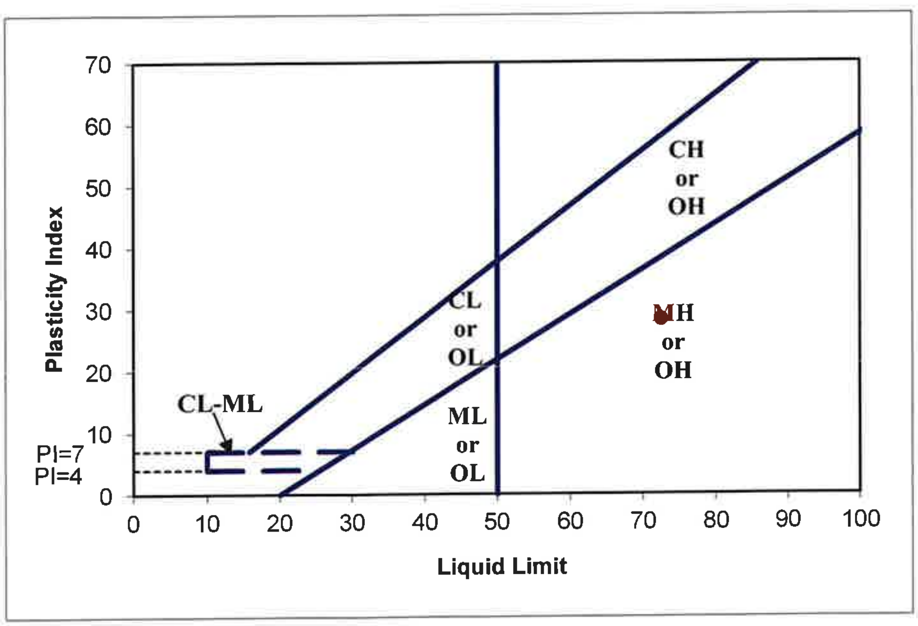
Determination of Liquid Limit

Cup Number			
Weight of Cup (g)	10.79	11.10	11.02
Weight of Wet Soil and Cup (g)	31.69	34.83	39.58
Weight of Dry Soil and Cup (g)	23.09	24.81	27.32
Moisture Content (%)	69.9	73.1	75.2
Blow Counts	33	21	18

Determination of Plastic Limit

Cup Number		
Weight of Cup (g)	7.30	7.16
Weight of Wet Soil and Cup (g)	16.76	16.35
Weight of Dry Soil and Cup (g)	13.86	13.54
Moisture Content (%)	44.2	44.0

Compilation of Test Results



Liquid Limit	72
Plastic Limit	44
Plasticity Index	28
USCS Symbol	**MH/OH**

Performed by: M. Biddick

Reviewed By: Nicole Merkes
GESTRA Engineering, Inc.

Geotechnical-Structural-Pavement-Construction Material

GESTRA Engineering, Inc
191 W. Edgerton Ave
Milwaukee, WI 53207
Phone: (414) 933-7444; Fax: (414) 933-7844

Laboratory Test Results of Mechanical Analysis of Soil or Aggregate

Project Name: Former 6th St. Generating Station
Project Number: 25368-40
Project Location: Cedar Rapids
ASTM Designation: **D6913** **Method B**

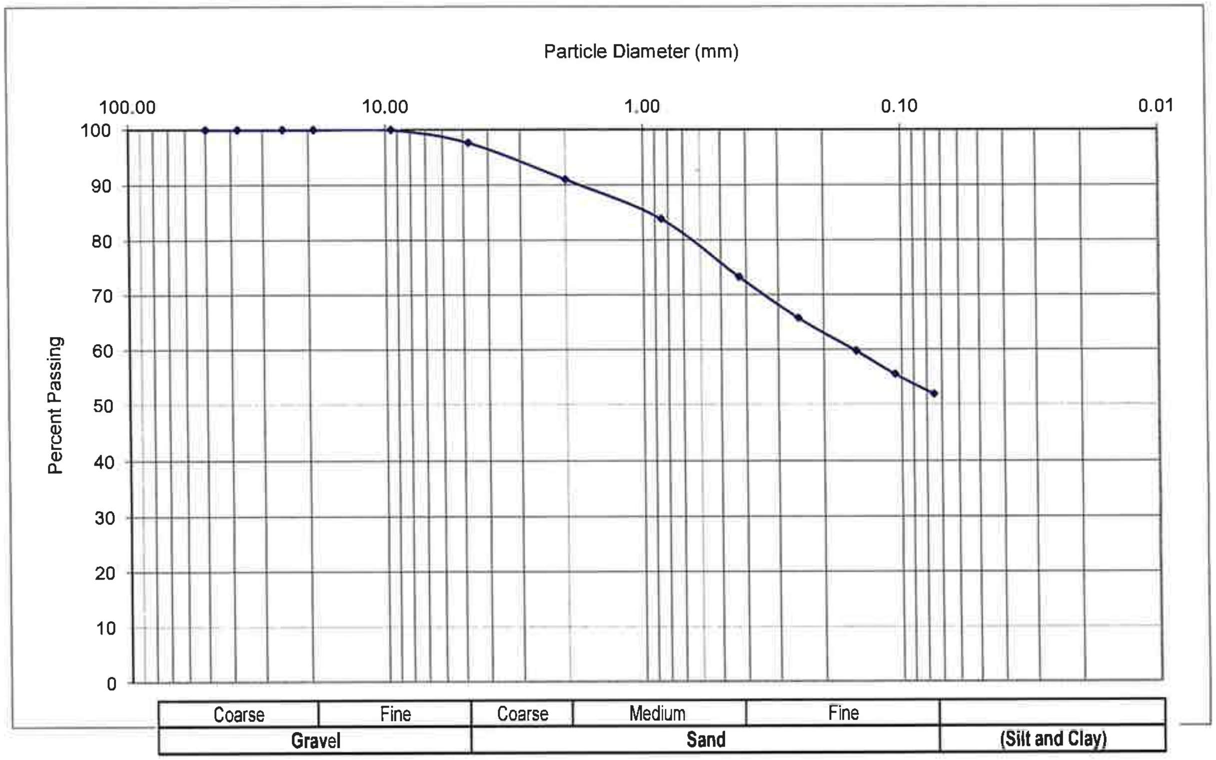
Date: December 9, 2025
Reported To: SCS
SCS #: 25225170.01

Sample Information

Type of Sample: Shelby Tube
Boring Number: GT-2
Sample Number: -
Depth of Sample: 24'-26'

Mechanical Analysis Data

Sieve	Sieve Opening (mm)	Percent Passing (%)
2	50	100.0
1 1/2	37.5	100.0
1	25.0	100.0
3/4	19.0	100.0
3/8	9.5	100.0
#4	4.75	97.7
#10	2.000	91.1
#20	0.850	83.9
#40	0.425	73.3
#60	0.250	65.8
#100	0.150	59.8
#140	0.106	55.5
#200	0.075	51.9
Pan		50.6



Moisture Content 59.2 %

Remarks: Gravel 2.3 % Sand 45.8 %
Passing #200 Sieve (Silt & Clay) 51.9 %

Performed by: C. Schneider

Reviewed by: Nicole Merkes
GESTRA Engineering, Inc.

Geotechnical-Structural-Pavement-Construction Material

GESTRA Engineering, Inc
191 W. Edgerton Ave
Milwaukee, WI 53207
Phone: (414) 933-7444; Fax: (414) 933-7844

Shelby Tube Extraction Form

Project Name:	Former 6th St. Generating Station	Date:	December 4, 2025
Project Number:	25368-40	Client:	SCS
Projection Location:	Cedar Rapids	SCS #:	25225170.01
ASTM Designation:	**D2488**		

Sample Information

Boring Number	GT-2		
Sample Number		qp:	1.00
Depth of Sample	24' - 26'		

Recovery: 19"

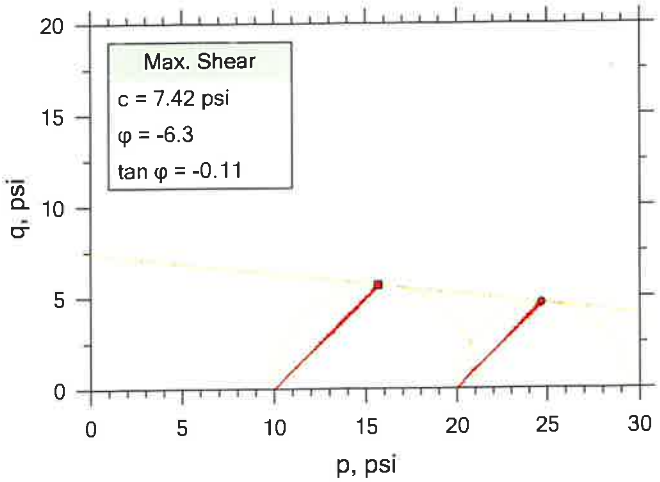
Soil Description: Sandy elastic silt, black, moist, medium stiff to stiff, plant fibers present. Bottom 8": gray sand, wet.

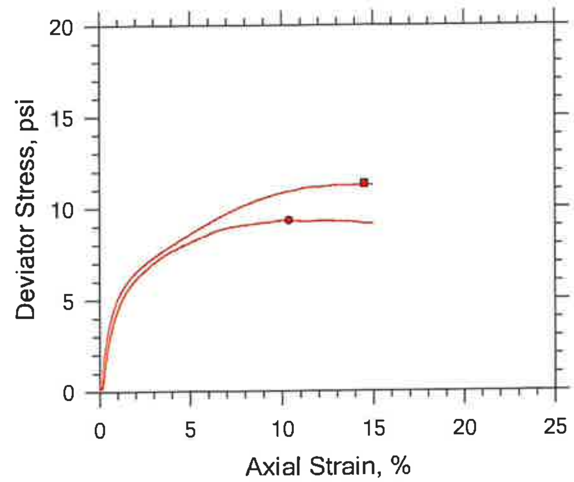
Performed By: S. McLafferty

Reviewed By: Nicole Merkes

Geotechnical-Structural-Pavement-Construction Material

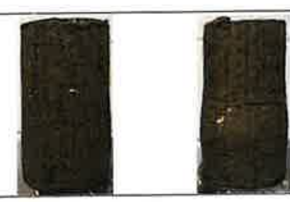
Unconsolidated Undrained by ASTM D2850





Symbol		■	●
Sample ID		N/A	N/A
Depth		24'-26'	24'-26'
Test Number		1	2
Initial	Height, in	5.700	5.695
	Diameter, in	2.691	2.685
	Moisture Content (from Cuttings), %	48.5	48.5
	Dry Density, pcf	76.2	70.9
	Saturation (Wet Method), %	108.6	95.6
	Void Ratio	1.20	1.36
Final	Moisture Content, %	44.6	50.8
	Dry Density, pcf	76.2	70.9
	Cross-Sectional Area (Method A), in²	5.685	5.661
	Saturation, %	100.0	100.0
	Void Ratio	1.19	1.36
	Back Pressure, psi	0.000	0.000
Vertical Effective Consolidation Stress, psi		9.986	19.98
Horizontal Effective Consolidation Stress, psi		9.992	19.99
Vertical Strain after Consolidation, %		0.000	0.000
Volumetric Strain after Consolidation, %		0.000	0.000
Time to 50% Consolidation, min		0.000	0.000
Shear Strength, psi		5.659	4.669
Strain at Failure, %		14.5	10.4
Strain Rate, %/min		1.000	1.000
Deviator Stress at Failure, psi		11.32	9.338
Effective Minor Principal Stress at Failure, psi		10.10	20.07
Effective Major Principal Stress at Failure, psi		21.41	29.41
B-Value		---	---

Notes:
- Before Shear Saturation set to 100% for phase calculation.
- Moisture Content determined by ASTM D2216.
- Deviator Stress includes membrane correction.
- Values for c and φ determined from best-fit straight line for the specific test conditions. Actual strength parameters may vary and should be determined by an engineer for site conditions.



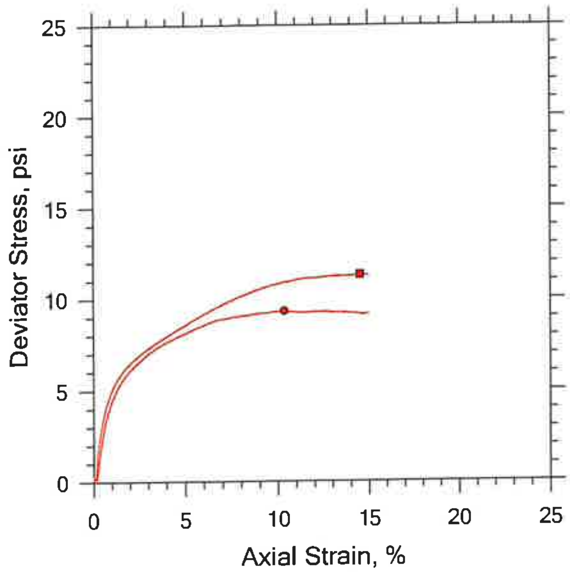
GESTRA

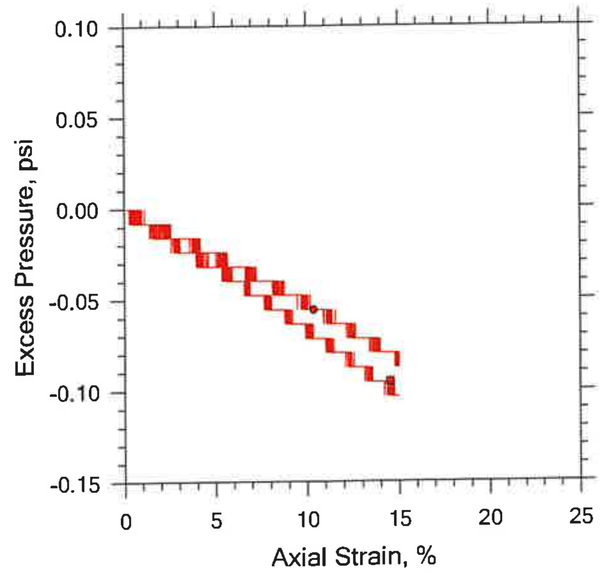
Project Name: Former 6th St. Gen. Facility	Location: Cedar Rapids	Project Number: 25368-40
Boring Number: GT-1	Tester: S. McLafferty	Checker: N. Merkes
Sample Number: N/A	Test Date: 12/08/2025	Depth: 24'-26'
Test Number: 1	Preparation: Shelby Tube	Elevation:
Client: SCS	Classification:	Group Symbol:

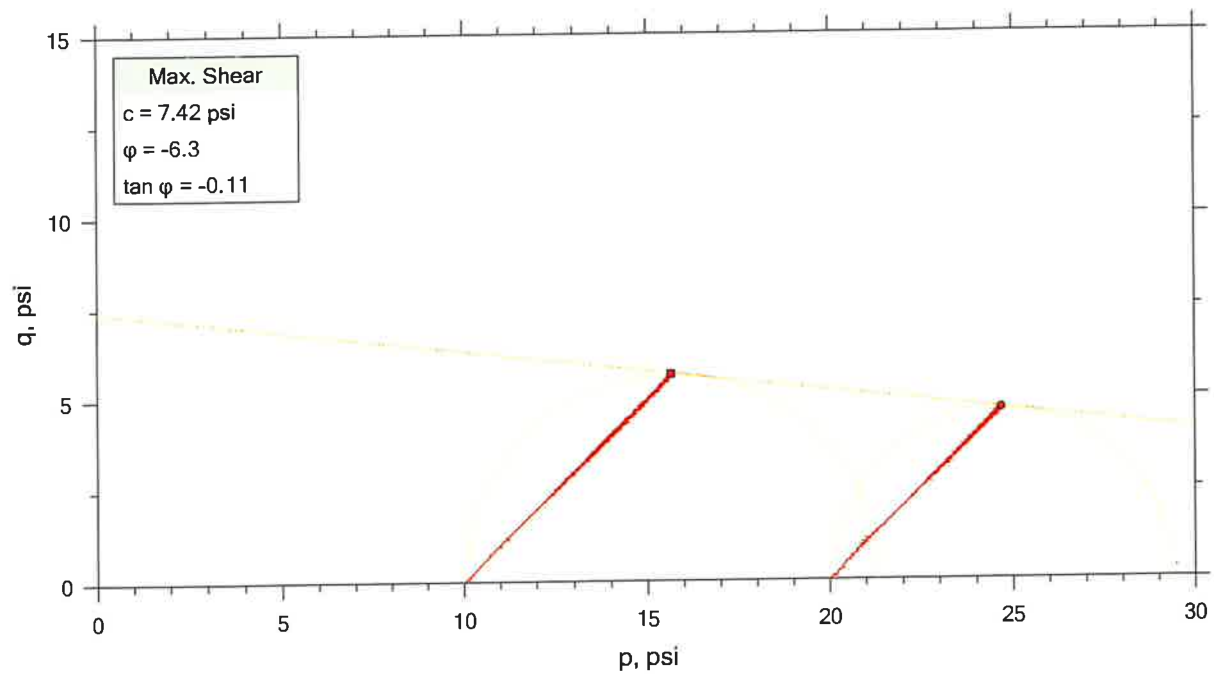
Description: Organic fat clay, black, moist, medium stiff, with sand and trace wood fibers.

Remarks:

Unconsolidated Undrained by ASTM D2850







	Sample No.	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
■	N/A	1	24'-26'	S. McLafferty	12/08/2025	N. Merkes	12/09/2025	GT-1, UU 10psi.dat
●	N/A	2	24'-26'	S. McLafferty	12-08-2025	N. Merkes	12/09/2025	GT-1, UU 20psi.dat

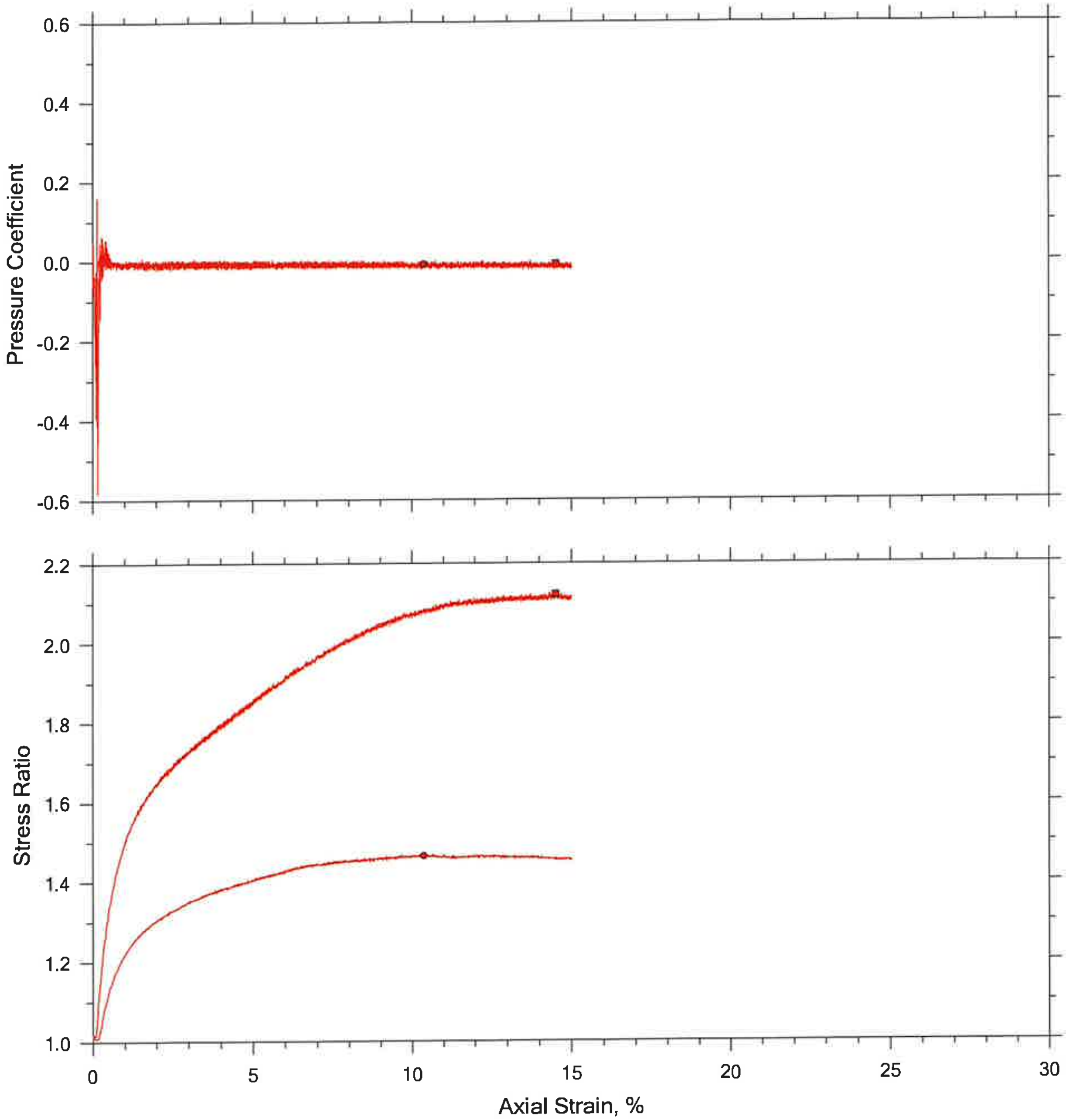
GESTRA

Project Name: Former 6th St. Gen. Facility	Location: Cedar Rapids	Project Number: 25368-40
Boring Number: GT-1	Tester: S. McLafferty	Checker: N. Merkes
Sample Number: N/A	Test Date: 12/08/2025	Depth: 24'-26'
Test Number: 1	Preparation: Shelby Tube	Elevation:
Client: SCS	Classification:	Group Symbol:

Description: Organic fat clay, black, moist, medium stiff, with sand and trace wood fibers.

Remarks:

Unconsolidated Undrained by ASTM D2850



	Sample No.	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
■	N/A	1	24'-26'	S. McLafferty	12/08/2025	N. Merkes	12/09/2025	GT-1, UU 10psi.dat
●	N/A	2	24'-26'	S. McLafferty	12-08-2025	N. Merkes	12/09/2025	GT-1, UU 20psi.dat

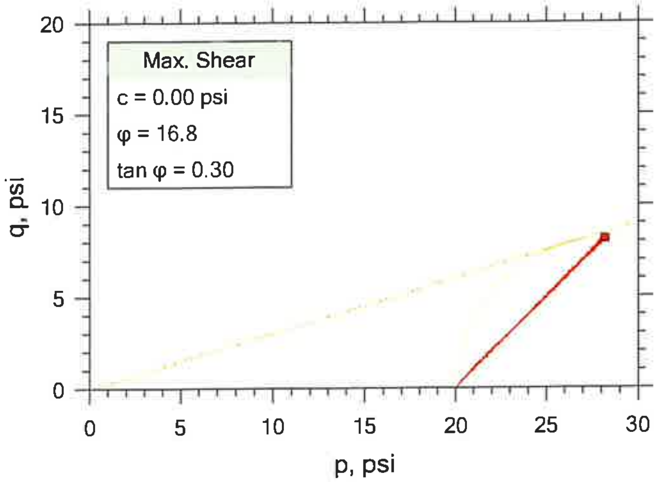
GESTRA

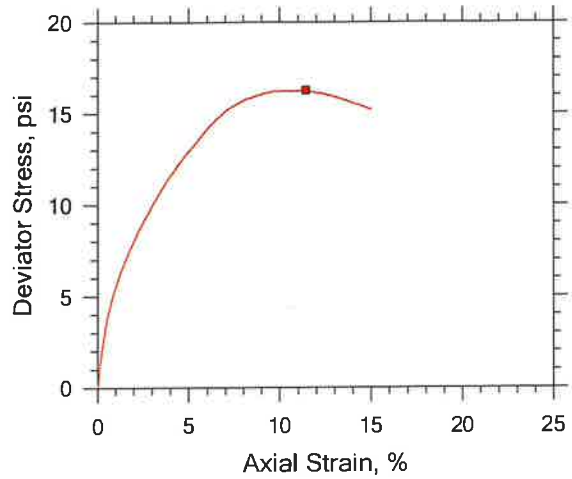
Project Name: Former 6th St. Gen. Facility	Location: Cedar Rapids	Project Number: 25368-40
Boring Number: GT-1	Tester: S. McLafferty	Checker: N. Merkes
Sample Number: N/A	Test Date: 12/08/2025	Depth: 24'-26'
Test Number: 1	Preparation: Shelby Tube	Elevation:
Client: SCS	Classification:	Group Symbol:

Description: Organic fat clay, black, moist, medium stiff, with sand and trace wood fibers.

Remarks:

Unconsolidated Undrained by ASTM D2850





Symbol		■
Sample ID		N/A
Depth		24'-26'
Test Number		1
Initial	Height, in	5.743
	Diameter, in	2.792
	Moisture Content (from Cuttings), %	86.8
	Dry Density, pcf	54.2
	Saturation (Wet Method), %	111.3
	Void Ratio	2.09
Final	Moisture Content, %	77.1
	Dry Density, pcf	54.6
	Cross-Sectional Area (Method A), in²	6.091
	Saturation, %	100.0
	Void Ratio	2.07
	Back Pressure, psi	0.000
Vertical Effective Consolidation Stress, psi		19.97
Horizontal Effective Consolidation Stress, psi		19.98
Vertical Strain after Consolidation, %		0.000
Volumetric Strain after Consolidation, %		0.000
Time to 50% Consolidation, min		0.000
Shear Strength, psi		8.139
Strain at Failure, %		11.4
Strain Rate, %/min		1.000
Deviator Stress at Failure, psi		16.28
Effective Minor Principal Stress at Failure, psi		20.63
Effective Major Principal Stress at Failure, psi		36.91
B-Value		---

Notes:
- Before Shear Saturation set to 100% for phase calculation.
- Moisture Content determined by ASTM D2216.
- Atterberg Limits determined by ASTM D4318.
- Deviator Stress includes membrane correction.
- Values for c and φ determined from best-fit straight line for the specific test conditions. Actual strength parameters may vary and should be determined by an engineer for site conditions.

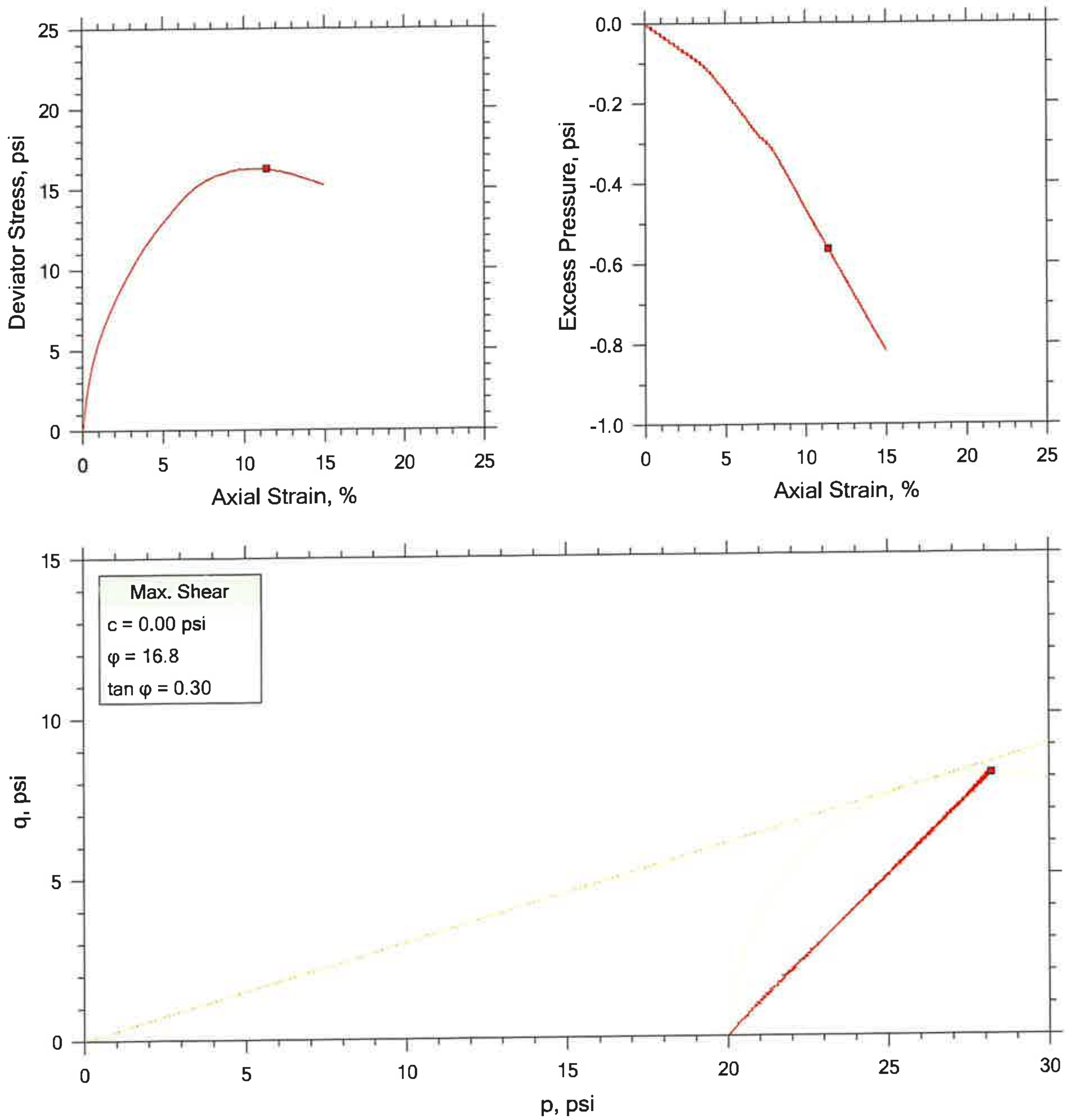
GESTRA

Project Name: Former 6th St. Gen. Station	Location: Cedar Rapids	Project Number: 25368-40
Boring Number: GT-2	Tester: N. Merkes	Checker: N. Merkes
Sample Number: N/A	Test Date: 12/09/2025	Depth: 24'-26'
Test Number: 1	Preparation: Shelby Tube	Elevation:
Client: SCS	Classification:	Group Symbol:

Description: Sandy elastic silt, black, moist, medium stiff to stiff, plant fibers present.

Remarks:

Unconsolidated Undrained by ASTM D2850



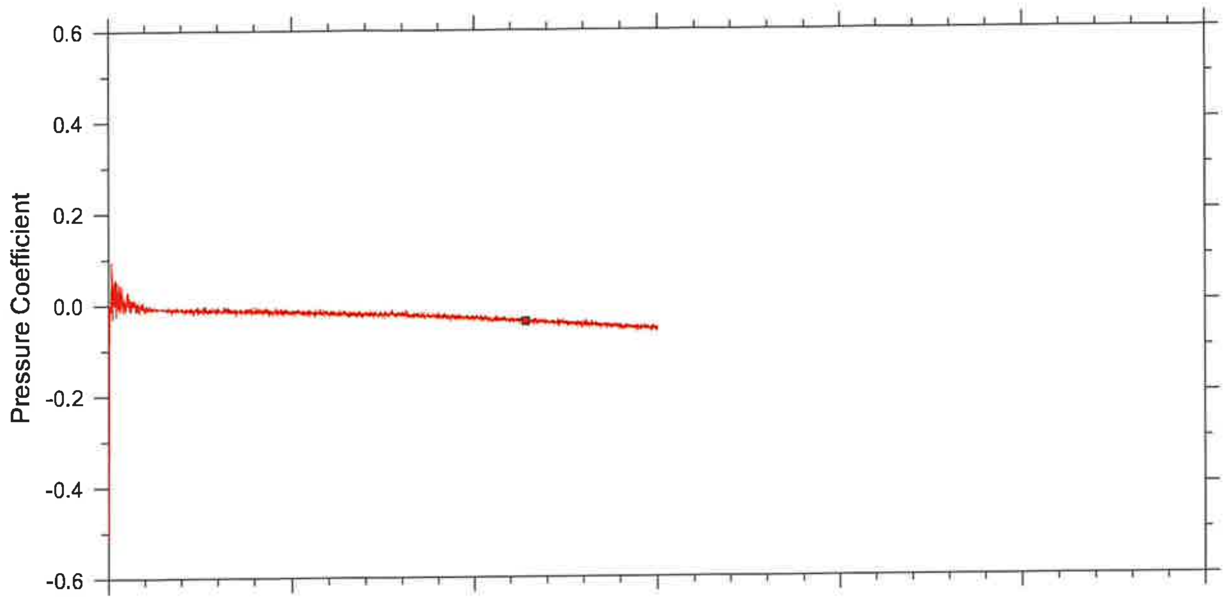
	Sample No.	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
■	N/A	1	24'-26'	N. Merkes	12/09/2025	N. Merkes	12/18/2025	GT-2, UU 20psi.dat

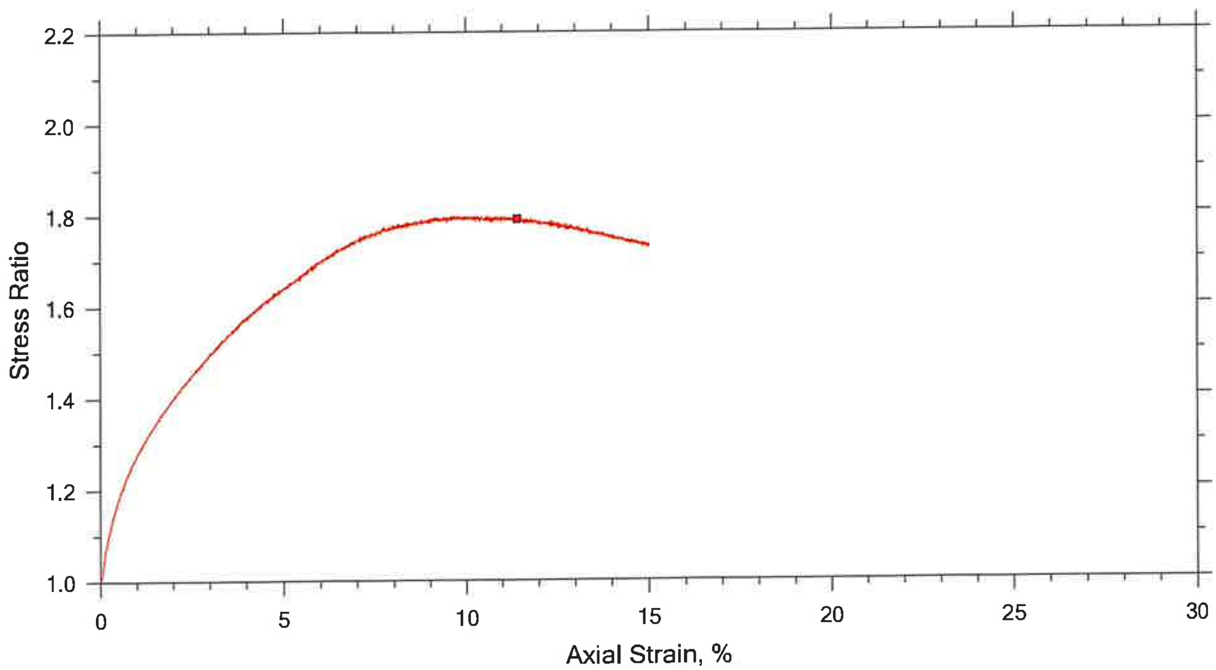
Project Name: Former 6th St. Gen. Station	Location: Cedar Rapids	Project Number: 25368-40
Boring Number: GT-2	Tester: N. Merkes	Checker: N. Merkes
Sample Number: N/A	Test Date: 12/09/2025	Depth: 24'-26'
Test Number: 1	Preparation: Shelby Tube	Elevation:
Client: SCS	Classification:	Group Symbol:

Description: Sandy elastic silt, black, moist, medium stiff to stiff, plant fibers present.

Remarks:

Unconsolidated Undrained by ASTM D2850





	Sample No.	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
■	N/A	1	24'-26'	N. Merkes	12/09/2025	N. Merkes	12/18/2025	GT-2, UU 20psi.dat

Project Name: Former 6th St. Gen. Station	Location: Cedar Rapids	Project Number: 25368-40
Boring Number: GT-2	Tester: N. Merkes	Checker: N. Merkes
Sample Number: N/A	Test Date: 12/09/2025	Depth: 24'-26'
Test Number: 1	Preparation: Shelby Tube	Elevation:
Client: SCS	Classification:	Group Symbol:

Description: Sandy elastic silt, black, moist, medium stiff to stiff, plant fibers present.

Remarks:

GESTRA

GESTRA Engineering, Inc
191 W. Edgerton Ave
Milwaukee, WI 53207
Phone (414) 933-7444, Fax (414) 933-7844

Laboratory Test Results of
Moisture Content, Organic Content, and Density of Soil

Project Name:	Former 6th St. Generating Station	Date:	December 8, 2025
Project Number:	25368-40	Report To:	SCS
Project Location:	Cedar Rapids	SCS #:	25225170.01
ASTM Designation:	**D2216, D2974 (Method A), D7263**		

Boring Number	GT-1									
Sample Number	24'-26'									
Cup Number										
Weight of Cup (g)	64.25									
Weight of Wet Soil and Cup (g)	122.61									
Weight of Dry Soil and Cup (g)	98.32									
Weight of Soil and Cup After Burn (g)	93.91									
Weight of Sample for Density (lbs)										
Diameter (in)										
Length(in)										
Moisture Content (%)	71.3									
Organic Content (%)	12.9									
Wet Density (pcf)										
Dry Density (pcf)										

Boring Number	GT-2									
Sample Number	24' - 26'									
Cup Number										
Weight of Cup (g)	63.51									
Weight of Wet Soil and Cup (g)	119.73									
Weight of Dry Soil and Cup (g)	93.61									
Weight of Soil and Cup After Burn (g)	88.16									
Weight of Sample for Density (lbs)										
Diameter (in)										
Length(in)										
Moisture Content (%)	86.8									
Organic Content (%)	18.1									
Wet Density (pcf)										
Dry Density (pcf)										

Performed by S. McLafferty/C. Schneider

Reviewed by Nicole Merkes

SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION

Route To: Watershed/Wastewater ☐ Remediation/Redevelopment ☐ Waste Management ☐ Other ☐

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
IPL-CCR Settling Ponds SCS#: 25212261.02		B-1

Boring Drilled By: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
Mike Mueller, Cascade Drilling	4/23/2014	4/23/2014	4-1/4" HSA

Unique Well No.	DNR Well ID No.	Common Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
			20.0 Feet	730.6 Feet	8.0 in

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☐
State Plane N, E S/C/N
SW 1/4 of NE 1/4 of Section 21, T 83 N, R 7 W
Lat ° ' " Long ° ' "
Local Grid Location ☐ N Feet ☐ S ☐ E Feet ☐ W

Facility ID	County	Civil Town/City/ or Village
	Linn	Cedar Rapids

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	Moisture Content (%)	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			0–1	WELL GRADED GRAVEL with SAND (fill)	FILL									
S1	12	5, 10, 12	1–3	SANDY LEAN CLAY, dark yellowish brown (10YR 4/6), mottled with very dark grayish brown (10YR 3/2), few gravel (fill)	FILL					M				140lb Hammer
S2	10	12, 9, 10	3–5	WELL GRADED SAND, dark brown (7.5YR 3/2), few brick rubble (fill)	FILL					M				
S3	1	8, 7, 8	6–8	Same as above, with trace clay 6'-7'						M				
S4	12	2, 2, 5	8–11	WELL GRADED SAND with SILT, black (10YR 2/1) (ash)	FILL			51.6		M			21.5	
S5	18	1, 1,	11–12	SILT, black (10YR 2/1) (ash), trace fine to coarse sand (ash)	FILL			124.2		W			64	

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature [signature]

Firm SCS Engineers
2830 Dairy Drive Madison, WI 53718
Tel: (608)224-2830
Fax:

Boring Number B-1

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	Moisture Content (%)	Soil Properties: Standard Penetration	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/ Comments
		1	13	SILT, black (10YR 2/1) (ash), trace fine to coarse sand (ash) *(continued)*										
S6	18	6, 5, 7	14–15	Sheen on sample 14'-15', no odor, orange brick rubble	FILL			54.3		W				
S7	2	39, 11, 7	16–17	POORLY GRADED GRAVEL, very pale brown (10YR 7/4), coarse, few wood chips, with black silt (fill)						W				
			18		FILL									
S8	8	9, 5, 6	19–20							W				
S9a	14	1, 1, 4	21	ORGANIC SILT, black (10YR 2/1), few silt (OC=13.9%)	OH			77.2	0.25	W	63	20		
S9b			22–23	PEAT, black (10YR 2/1) (OC=27.05)	PT			109.5						
S10	12	7, 7, 17	24–25	SANDY ORGANIC SILT, dark brown (7.5YR 3/2), scattered roots (OC=8.9%)	OL			51.4		W				
S11	16	9, 10, 14	26–27	ORGANIC SILT, dark brown (7.5YR 3/2), few organics (roots, etc.), with sand (OC=13.9%)				67.1	0.5	W	55	5		
			28											
S12	18	2, 5, 8	29–30		OH			73.4	1.0	W	59	8		
			31											
S13	18	1, 1,	32					55.8	0.25	W	63	3		

Boring Number B-1

Sample Number and Type	Sample Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	Moisture Content (%)	Soil Properties: Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
		6		ORGANIC SILT, dark brown (7.5YR 3/2), with sand, driller reports feeling gravel 31'-34'	OH									
			33											
S14a	10	2, 9, 26	34					56.1		W				
S14b			35	SAND, dark grayish brown (10YR 4/2), fine to coarse, with gravel	SP			11.5					4.2	
			36											
S15	16	11, 23, 19	37							W				
				Abandoned with bentonite OC=Organic Content by Loss on Ignition (%) End of boring @ 37.5										

SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☐ Other ☐

Facility/Project Name: IPL-CCR Settling Ponds SCS#: 25212261.02	License/Permit/Monitoring Number	Boring Number: B-2	
Boring Drilled By: Name of crew chief (first, last) and Firm: Mike Mueller, Cascade Drilling	Date Drilling Started: 4/24/2014	Date Drilling Completed: 4/24/2014	Drilling Method: 4-1/4" HSA
Unique Well No. / DNR Well ID No. / Common Well Name	Final Static Water Level: Feet	Surface Elevation: 728.3 Feet	Borehole Diameter: 8.0 in
Local Grid Origin ☐ (estimated: ☐) or Boring Location ☐ State Plane N, E S/C/N; SE 1/4 of NE 1/4 of Section 21, T 83 N, R 7 W	Lat ° ' " Long ° ' "	Local Grid Location: Feet ☐ N ☐ S; Feet ☐ E ☐ W	
Facility ID	County: Linn	Civil Town/City/ or Village: Cedar Rapids	

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	Moisture Content (%)	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			0–0.8	WELL GRADED GRAVEL with SAND (fill)	FILL									
S1a			1	SILT, black (10YR 2/1) (fill)	FILL									140 lb Hammer
S1b	13	2, 25, 10	2	WELL GRADED SAND, dark yellowish brown (10YR 4/3) (fill)	FILL					M				
S2	18	3, 2, 4	4	SANDY SILT, very dusky red (7.5R 2.5/3) and black (10YR 2/1), sand is fine grained, trace organics (ash)	FILL			125.4		M			54.4	
S3	18	4, 10, 25	7					63.3		M				
S4	18	6, 2, 1	9	SILT, black (10YR 2/1), trace fine sand (ash) wet @ 9.5'	FILL			142.9		W			69.4	
S5	18	1/12, 1	12					188.7		W				

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature: [signature]

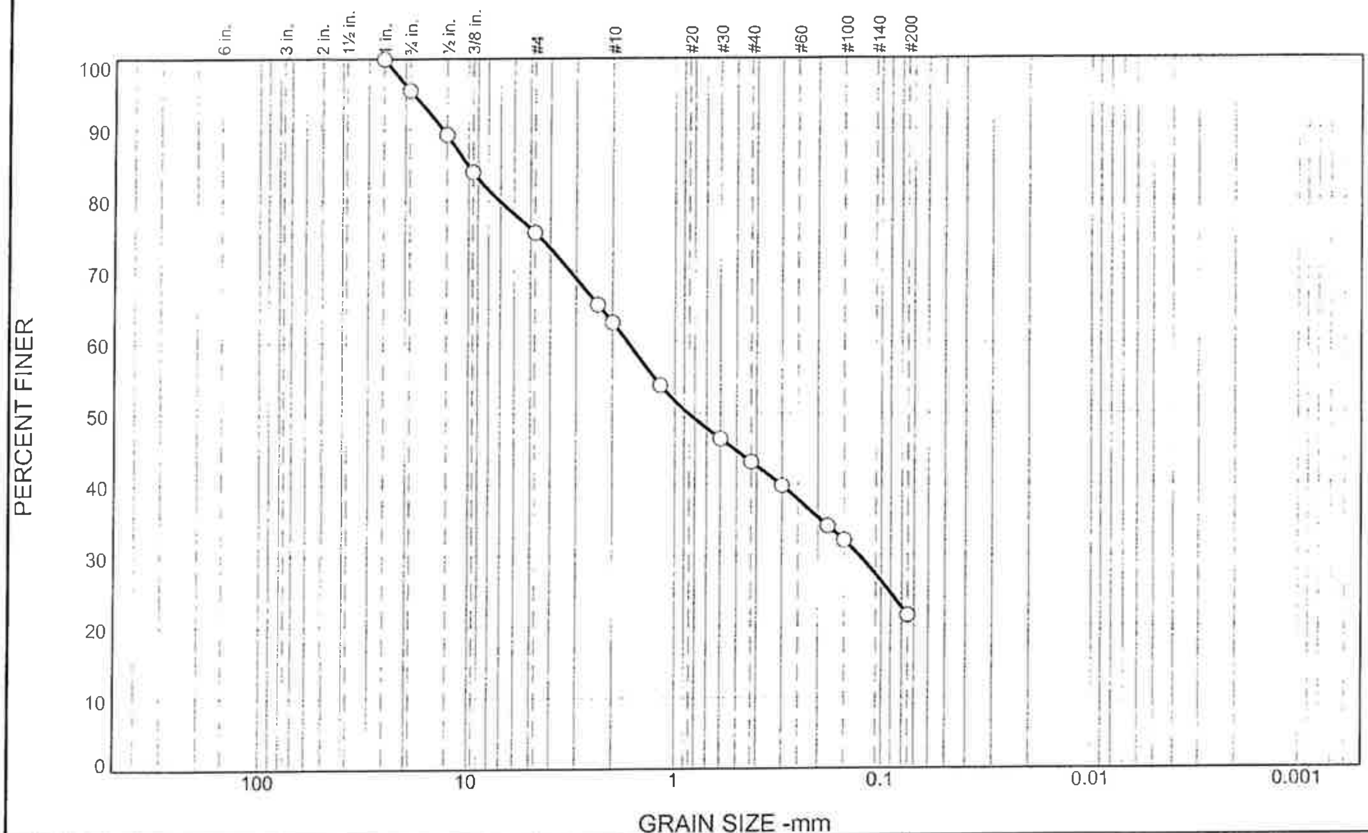
Firm: SCS Engineers
2830 Dairy Drive Madison, WI 53718
Tel: (608)224-2830
Fax:

Boring Number B-2

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	Moisture Content (%)	Soil Properties: Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
				SILT, black (10YR 2/1), trace fine sand (ash) *(continued)*										
S6	18	1, 1/12	14		FILL			208.2		W			61.5	
S7a	18	2, 5, 7	16					171.1		W				
S7b			17	SANDY ORGANIC SILT, black (10YR 2/1) and dark yellowish brown (10YR 4/6) (OC=18.2%)	OH			86.4			62	5		
			18.5	SAND, dark grayish brown (10YR 4/2), fine to medium, with gravel										
S8	8	2, 7, 17	19							W				
S9	0	1, 4, 4	21							W				
S10	12	1, 1, 4	24	with SILT (SP-SM) near 24'	SP			21.3		W			5.8	
S11	18	2, 8, 15	26							W				
S12	12	8, 27, 29	29							W				
			30	Abandoned with bentonite										

OC=Organic Content by Loss on Ignition (%)
End of boring @ 30

Particle Size Distribution Report



% +3"	% Gravel Coarse	% Gravel Fine	% Sand Coarse	% Sand Medium	% Sand Fine	% Fines Silt	% Fines Clay
0.0	4.4	20.1	12.7	19.6	21.7	21.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
3/4	95.6		
1/2	89.3		
3/8	84.0		
#4	75.5		
#8	65.3		
#10	62.8		
#16	54.0		
#30	46.5		
#40	43.2		
#50	39.8		
#80	34.1		
#100	32.1		
#200	21.5		

* (no specification provided)

Material Description

Black Fine to Coarse Sand, Some Gravel and Silt (Ash)

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 13.2318 D_{85}= 10.0709 D_{60}= 1.6919
D_{50}= 0.8595 D_{30}= 0.1278 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Natural Moisture = 51.6%
Note: Description refers to particle sizes only. No Atterberg Limits or organic content were determined.

Sample Number: B1, S4 **Depth:** 8.5-10'

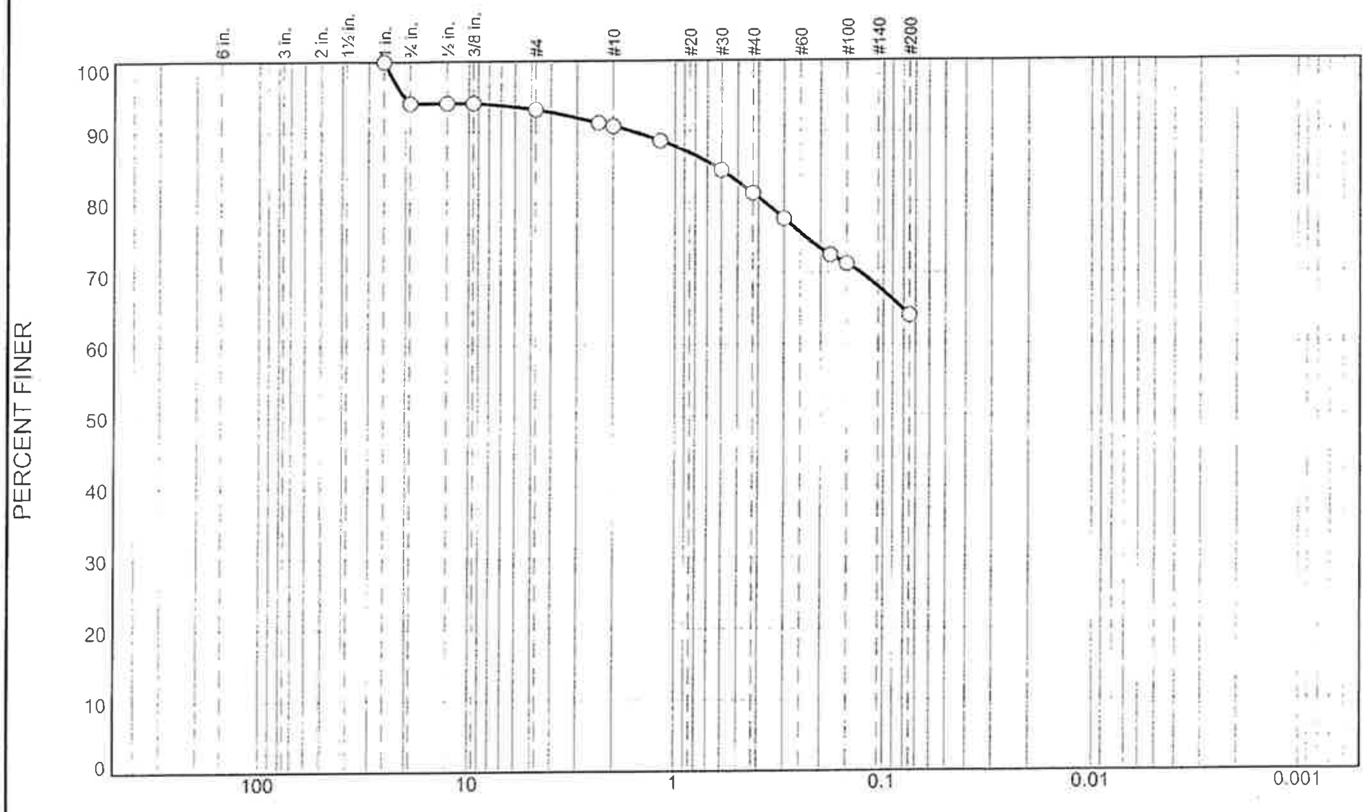
Date: 5/21/14

CGC, Inc.

Client: SCS Engineers
Project: 6th Street Generating Station (#25212261.02)
Project No: C13016-26 **Figure**

Tested By: DRW **Checked By:** DAS

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	5.9	1.0	2.3	9.6	17.2	64.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
3/4	94.1		
1/2	94.1		
3/8	94.1		
#4	93.1		
#8	91.2		
#10	90.8		
#16	88.7		
#30	84.5		
#40	81.2		
#50	77.6		
#80	72.5		
#100	71.2		
#200	64.0		

* (no specification provided)

Material Description

Black Silt, Some Sand, Little Gravel (Ash)

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 1.6064 D_{85}= 0.6402 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= ML AASHTO=

Remarks

Natural Moisture = 124.2%
Note: Description refers to particle sizes only. No Atterberg Limits or organic content were determined.

Sample Number: B1, S5 **Depth:** 11-12.5'

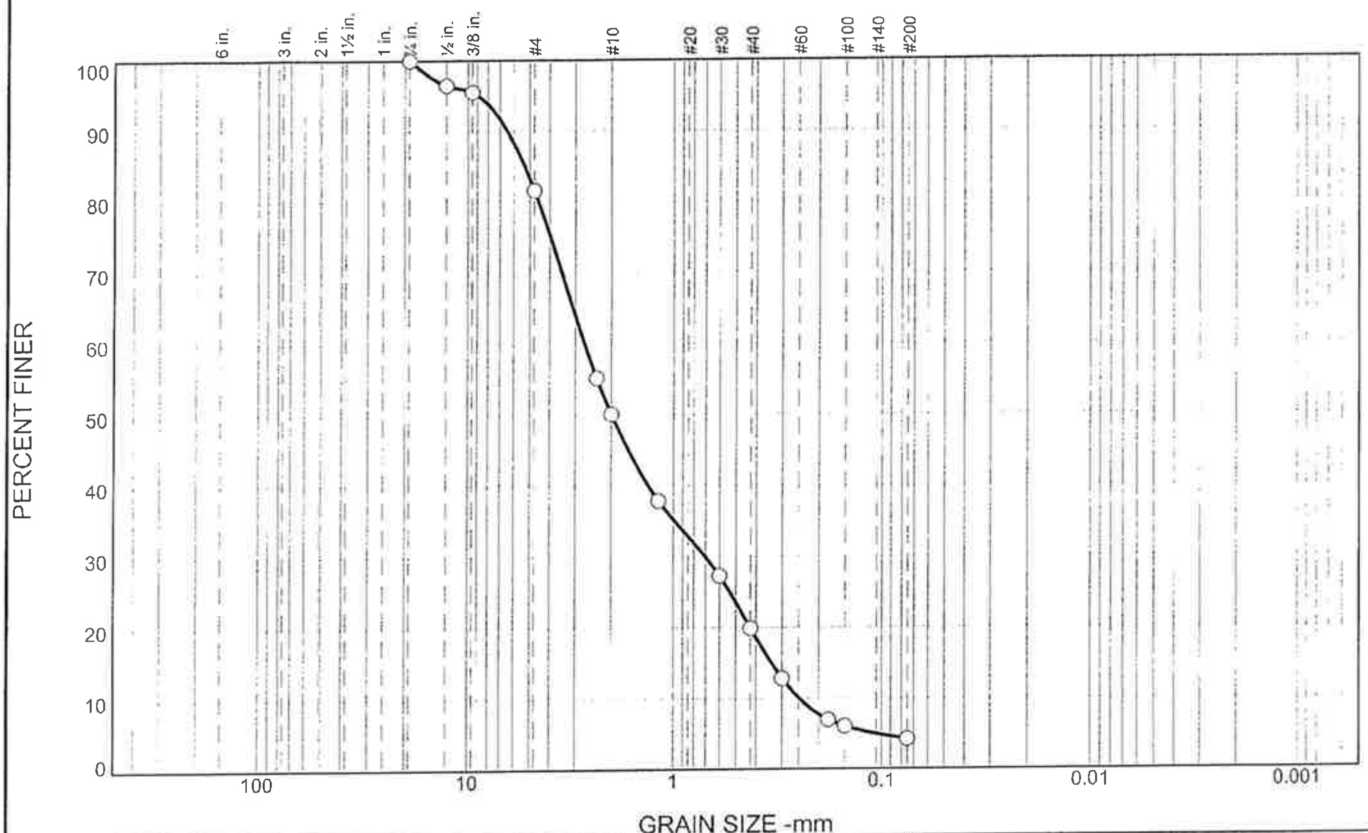
Date: 5/21/14

CGC, Inc.

Client: SCS Engineers
Project: 6th Street Generating Station (#25212261.02)
Project No: C13016-26 **Figure**

Tested By: DRW **Checked By:** DAS

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	18.4	31.5	30.2	15.7	4.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
1/2	96.5		
3/8	95.5		
#4	81.6		
#8	55.2		
#10	50.1		
#16	37.8		
#30	27.3		
#40	19.9		
#50	12.8		
#80	6.9		
#100	6.0		
#200	4.2		

* (no specification provided)

Material Description

Brown Fine to Coarse Sand, Some Gravel, Trace Silt

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 6.4387 D_{85}= 5.2987 D_{60}= 2.7031
D_{50}= 1.9941 D_{30}= 0.7042 D_{15}= 0.3375
D_{10}= 0.2489 C_u= 10.86 C_c= 0.74

Classification

USCS= SP AASHTO=

Remarks

Natural Moisture = 11.5%

Sample Number: B1, S15 **Depth:** 36-37.5'

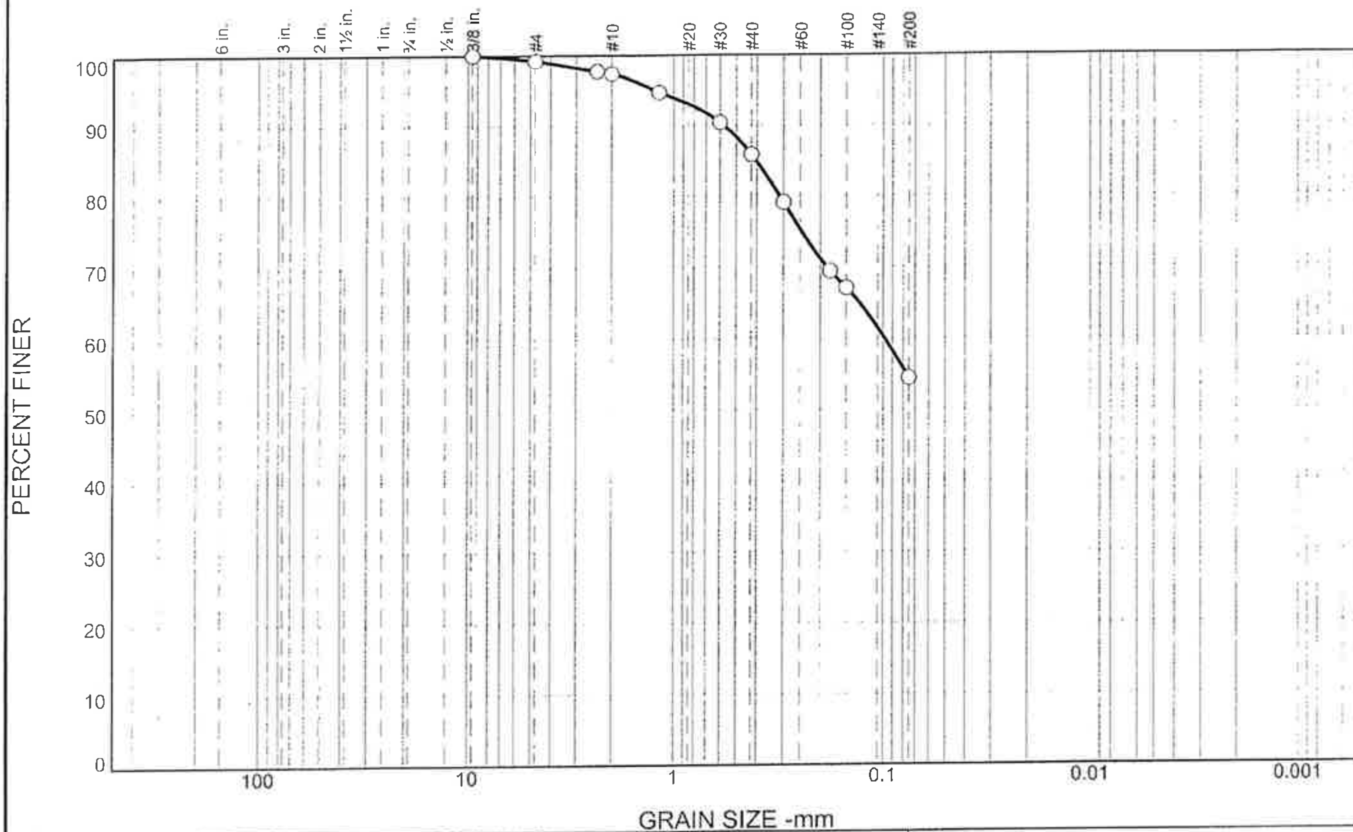
Date: 5/21/14

CGC, Inc.

Client: SCS Engineers
Project: 6th Street Generating Station (#25212261.02)
Project No: C13016-26 **Figure**

Tested By: DRW **Checked By:** DAS

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.8	1.8	11.5	31.5	54.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8	100.0		
#4	99.2		
#8	97.8		
#10	97.4		
#16	94.8		
#30	90.4		
#40	85.9		
#50	79.1		
#80	69.4		
#100	67.1		
#200	54.4		

* (no specification provided)

Material Description

Brown-Black Sandy Silt, Trace Gravel (Ash)

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.5752 D_{85}= 0.4041 D_{60}= 0.0987
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= ML AASHTO=

Remarks

Natural Moisture = 125.4%
Note: Description refers to particle sizes only. No Atterberg Limits or organic content were determined.

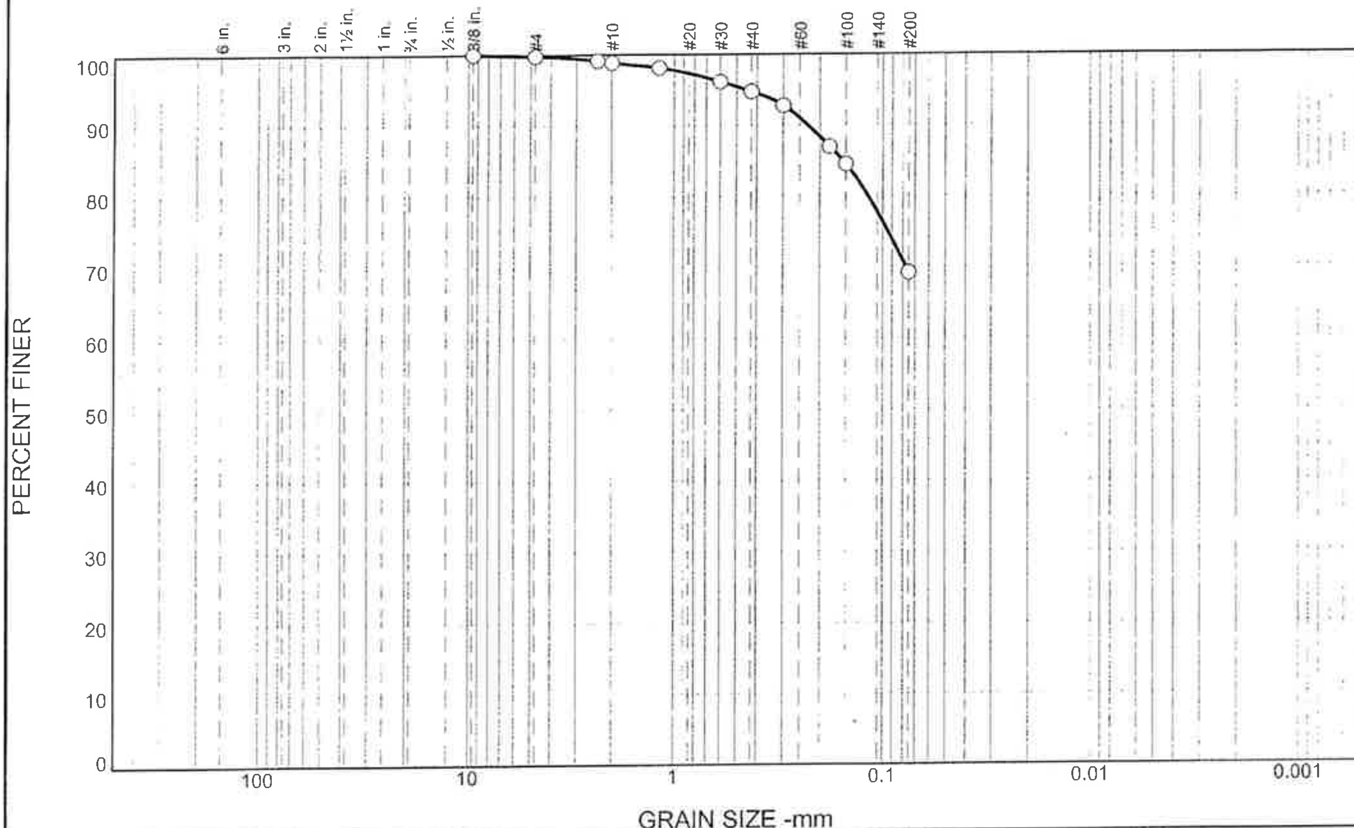
Sample Number: B2, S2 **Depth:** 3.5-5' **Date:** 5/21/14

CGC, Inc.

Client: SCS Engineers
Project: 6th Street Generating Station (#25212261.02)
Project No: C13016-26 **Figure**

Tested By: DRW **Checked By:** DAS

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.2	0.9	4.2	25.5	69.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8	100.0		
#4	99.8		
#8	99.2		
#10	98.9		
#16	98.1		
#30	96.1		
#40	94.7		
#50	92.7		
#80	86.9		
#100	84.4		
#200	69.2		

* (no specification provided)

Material Description

Black Silt, Some Sand, Trace Gravel (Ash)

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{90}= 0.2302 D_{85}= 0.1558 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= ML AASHTO= A-4(0)

Remarks

Natural Moisture = 142.9%
Note: Description refers to particle sizes only. No Atterberg Limits or organic content were determined.

Sample Number: B2, S4 **Depth:** 8.5-10'

Date: 5/21/14

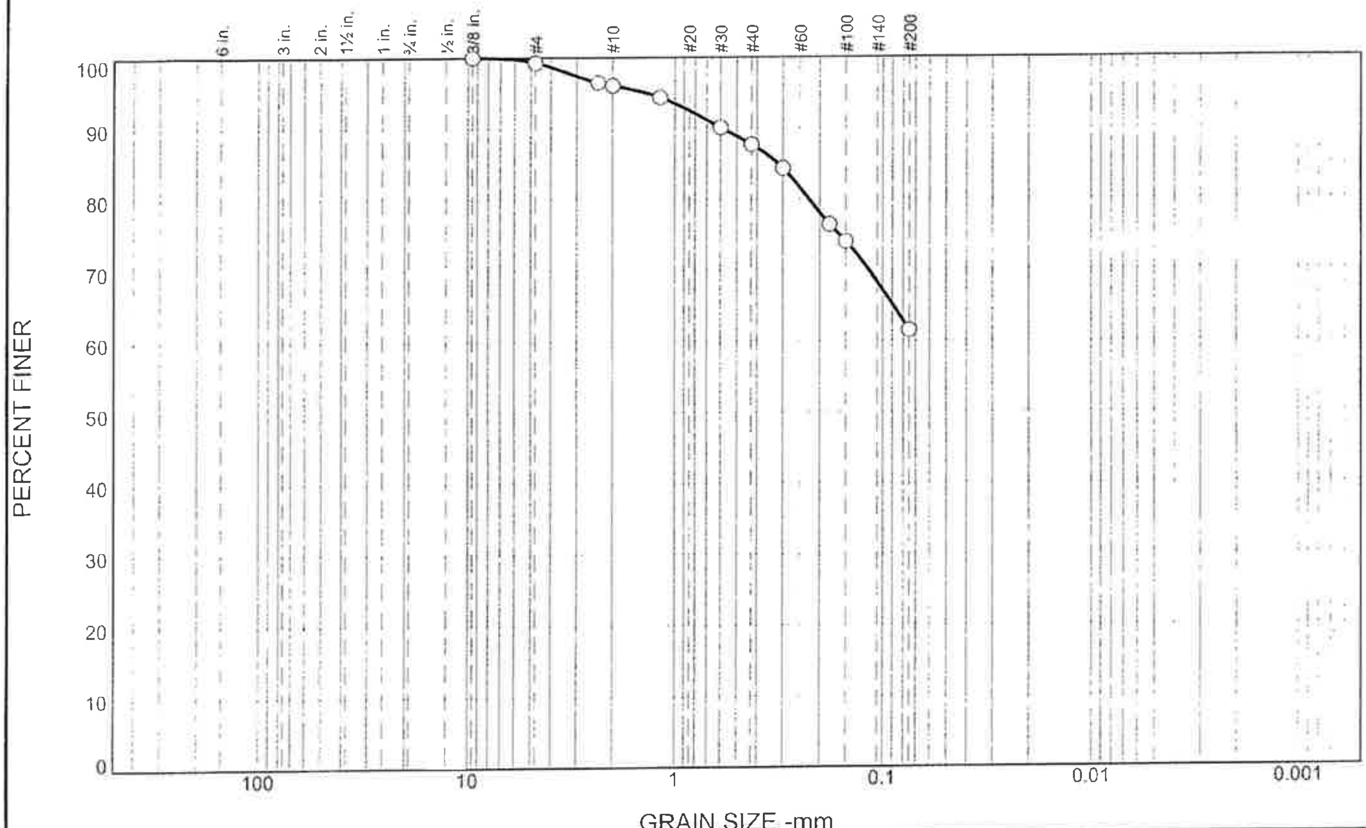
CGC, Inc.

Client: SCS Engineers
Project: 6th Street Generating Station (#25212261.02)

Project No: C13016-26 **Figure**

Tested By: DRW **Checked By:** DAS

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.7	3.3	8.3	26.2	61.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8	100.0		
#4	99.3		
#8	96.5		
#10	96.0		
#16	94.3		
#30	90.1		
#40	87.7		
#50	84.3		
#80	76.3		
#100	73.9		
#200	61.5		

* (no specification provided)

Material Description

Black Sandy Silt, Trace Gravel (Ash)

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.5926 D_{85}= 0.3181 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= ML AASHTO=

Remarks

Natural Moisture = 208.2%
Note: Description refers to particle sizes only. No Atterberg Limits or organic content were determined.

Sample Number: B2, S6 **Depth:** 13.5-15'

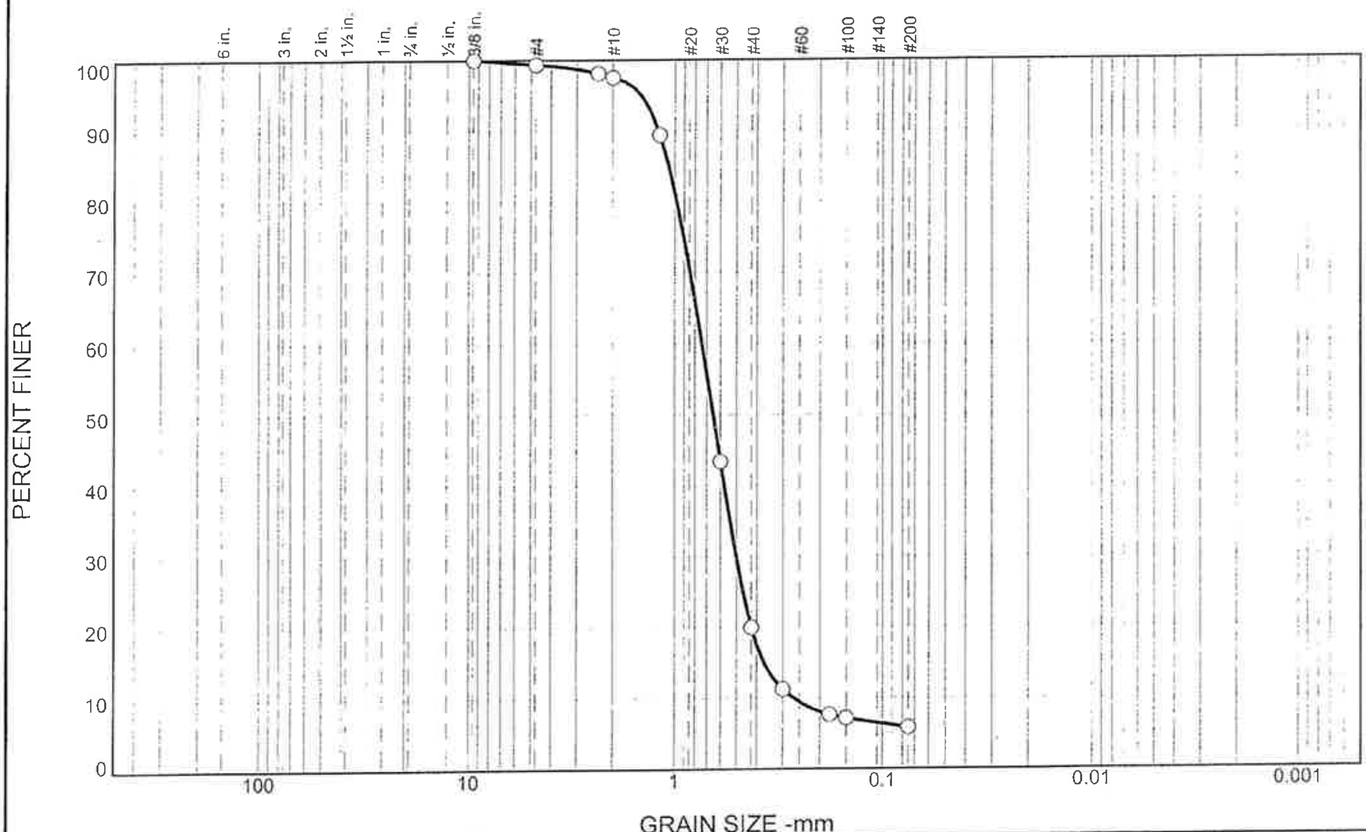
Date: 5/21/14

CGC,Inc.

Client: SCS Engineers
Project: 6th Street Generating Station (#25212261.02)
Project No: C13016-26 **Figure**

Tested By: DRW **Checked By:** DAS

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.7	1.8	77.6	14.1	5.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8	100.0		
#4	99.3		
#8	98.1		
#10	97.5		
#16	89.4		
#30	43.4		
#40	19.9		
#50	11.3		
#80	7.6		
#100	7.2		
#200	5.8		

* (no specification provided)

Material Description

Brown Fine to Medium Sand, Little Silt, Trace Gravel

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 1.1995 D_{85}= 1.0713 D_{60}= 0.7387
D_{50}= 0.6515 D_{30}= 0.5032 D_{15}= 0.3705
D_{10}= 0.2662 C_u= 2.77 C_c= 1.29

Classification

USCS= SP-SM AASHTO=

Remarks

Natural Moisture = 21.3%

Sample Number: B2, S10 **Depth:** 23.5-25' **Date:** 5/21/14

CGC,Inc.

Client: SCS Engineers
Project: 6th Street Generating Station (#25212261.02)
Project No: C13016-26 **Figure**

Tested By: DRW **Checked By:** DAS

solutions and action

APPENDIX C – Liquefaction Analysis

Alliant Energy
Interstate Power and Light Company
Sixth Street Generating Station
Cedar Rapids, Iowa

Safety Factor Assessment

Problem Statement:

Evaluate the liquefaction potential of the Coal Combustion Residuals (CCR) layers and sand layers within and below the impoundment perimeter berm induced by an earthquake in accordance with 40 CFR Section 257.73. Liquefaction is most likely to occur in saturated loose CCR layers and loose sand layers. Because the saturated soils below the CCR and above the sand layers are primarily clay, the clay layers are not prone to liquefaction and are not included in the liquefaction evaluation.

Given:

- Boring log GT1.
- Laboratory soil test results for boring GT1.
- RCRA Subtitle D (258) Seismic Design Guidance for Municipal Solid Waste Landfill Facilities. (refer to attached pages).
- Seed and Harder, *Cyclic Pore Pressure* (refer to attached pages).
- Liao and Whitman, Overburden Correction Factors for SPT in Sand (refer to attached pages).

Assumptions:

- Boring GT1 is located on the berm of the CCR surface impoundment and was advanced to 71 ft below ground surface (bgs). The CCR extends from a depth of approximately 12.5 bgs to 22 bgs. The sand deposits extend from a depth of approximately 26 feet bgs to the end of boring. Groundwater was near 14 ft bgs based on recent readings in a nearby piezometer. Based on the recorded blow counts in this boring, the calculated average blow count for the saturated CCR is 3 and sand deposit is 29.
- The effective (F'_F) and total (F_F) overburden stresses were calculated below the top surface of the perimeter berm. To be conservative, these stresses were calculated by assuming the saturated loose CCR and medium dense sands are 1 foot thick. The effective (F'_F) and total (F_F) overburden stresses for CCR, are 1648.8 psf and 1680.0 psf (see attached table). The effective (F'_F) and total (F_F) overburden stresses for medium dense sands, are 2075.0 psf and 2855.0 psf (see attached table).
- From the 2014 USGS seismic hazard map, the maximum horizontal acceleration is approximately 0.0400 g.
- From Seed and Harder, the Standardized Penetration Resistance $(N_1)_{60}$ is calculated by the following equation (for stress in tsf):

$$(N_1)_{60} = N \times C_N$$

$$C_N = \sqrt{\frac{1}{\sigma'_F}}$$

- From RCRA, the Cyclic Stress Ratio (CSR), is calculated by the following equation:

$$CSR = \frac{(\tau_H)_{ave}}{\sigma'_F} = (0.65)\frac{(a_{max})(\sigma_F)}{(g)(\sigma'_F)}(r_d)$$

$$r_d = 1 - 0.015D$$

Where,

CSR	= Cyclic Stress Ratio
a_{max}	= Horizontal acceleration, 0.0400 g
$(\tau_H)_{ave}$	= Static driving shear stress (psf)
g	= Acceleration due to gravity, 32.2 ft/sec^2
σ_F	= Final total overburden stress (psf)
σ'_F	= Final effective overburden stress (psf)
r_d	= Stress reduction factor at depth (m)

- The depth (D) is the depth in meters measured from the surface of the saturated loose CRR layers and medium dense sand layer. To be conservative, we are assuming the saturated medium dense sands are 1 foot thick at this location (when they are estimated to be approximately 30 to 60 feet thick).

Calculations:

See attached tables for calculations.

The calculated CCR CSR of 0.00082 and the average $(N_1)_{60}$ of 2.94, and the medium dense sand CSR of 0.0011 and the average $(N_1)_{60}$ of 28.3 are plotted on Figure 5.5 from Seed and Harder. The points are well below the line of liquefaction potential.

Results:

Results of the liquefaction evaluation indicate that the saturated loose CCR and medium dense sands within and below the impoundment perimeter berm will not liquefy during an earthquake with a horizontal acceleration of 0.0400g.

SSS CCR Surface Impoundment A-A' Stresses by Geologic Layer (Loose to Very Loose CCR)								
Location / Point	Layer Description	Unit Thickness (ft)	Unit Weights (pcf)		Bottom-Layer Stresses (psf)		Mid-Layer Stresses (psf)	
			λ_{sat} soil	$\lambda_{bouyant}$ soil	σ' (effective)	σ (total)	σ' (effective)	σ (total)
GT1	Final Cover	4.0	120	120.00	480.00	480.00	240.00	240.00
	Embankment Stiff Clay/Silt	8.5	120	120.00	1,500.00	1,500.00	990.00	990.00
	Loose to Very Loose CCR Above Groundwater	1.5	90	90.00	1,635.00	1,635.00	1,567.50	1,567.50
	Loose to Very Loose CCR Below Groundwater	1.0	90	27.60			1,648.80	1,680.00

Calculations (Loose to Very Loose CCR)				
N	C_N (tsf)	$(N_1)_{60}$	r_d (meters)	CSR
3	1.101	2.94	0.995	0.00082

SSS CCR Surface Impoundment A-A' Stresses by Geologic Layer (Medium Dense Sand)								
Location / Point	Layer Description	Unit Thickness (ft)	Unit Weights (pcf)		Bottom-Layer Stresses (psf)		Mid-Layer Stresses (psf)	
			λ_{sat} soil	$\lambda_{bouyant}$ soil	σ' (effective)	σ (total)	σ' (effective)	σ (total)
GT1	Final Cover	4.0	120	120.00	480.00	480.00	240.00	240.00
	Embankment Stiff Clay/Silt	8.5	120	120.00	1,500.00	1,500.00	990.00	990.00
	Loose to Very Loose CCR Above Groundwater	1.5	90	90.00	1,635.00	1,635.00	1,567.50	1,567.50
	Loose to Very Loose CCR Below Groundwater	8.0	90	27.60	1,855.80	2,355.00	1,745.40	1,995.00
	Medium Stiff Organic Clay/Silt	4.0	110	47.60	2,046.20	2,795.00	1,951.00	2,575.00
	Medium Dense Sand	1.0	120	57.60			2,075.00	2,855.00

Calculations (Medium Dense Sand)				
N	C_N (tsf)	$(N_1)_{60}$	r_d (meters)	CSR
29	0.9818	28.3	0.995	0.0011

Prepared by: LAC, 01/20/2026
Reviewed by: DLN, 01/20/2026

I:\25225170.01\Data and Calculations\Geotechnical\Liquefaction\[SSS Liquefaction Calculations.xlsx]SSS-A

RCRA SUBTITLE D (258)
SEISMIC DESIGN GUIDANCE
FOR
MUNICIPAL SOLID WASTE LANDFILL FACILITIES

Prepared By:

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PROJECT MANAGER

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Risk Reduction Engineering Laboratory
Office of Research and Development
U.S. Environmental Protection Agency
Cincinnati, Ohio 45268

Procedure for evaluating liquefaction potential at the site of a MSWLF can be carried out using the following steps:

Step 1: From in-situ testing and laboratory index tests, develop a detailed understanding of site conditions: stratigraphy, layer geometry, material properties and their variability, and the areal extent of potential problem zones. Establish the most critical zones to be analyzed and develop simplified sections amenable to analysis. The data should include location of the water table, either SPT blowcount, N, or tip resistance of a standard CPT cone, q_c, and mean grain size, D_{50}, the unit weight of the soil, and the percentage of fines (percent by weight passing the No. 200 sieve) for the materials involved in the liquefaction potential assessment.

Step 2: Evaluate the total vertical stress, σ_o, and vertical effective stress, σ_o', in the deposit at the time of exploration and for design. Design values should include the overburden stress due to the landfill. Outside of the waste footprint, the exploration and design values may be the same if the design ground water level is at the same elevation as the ground water was during sampling, or they may be different due to temporal fluctuations in the water table.

Step 3: Evaluate the stress reduction factor, r_d. The stress reduction factor is a soil flexibility factor defined as the ratio of the peak shear stress for the soil column, $(\tau_{max})_d$, to that of a rigid body, $(\tau_{max})_r$. There are several ways to determine r_d. For depths less than 40 ft (12 m), the average value from Figure 5.3 (Seed and Idriss, 1982) can be used. Alternatively, the following equation proposed by Iwasaki et al. (1978) can be used:

$$\boxed{r_d = 1 - 0.015\,D} \qquad (5.1)$$

where D is depth in meters.

If results of a site response analyses (e.g., a SHAKE analysis) are available, r_d can be determined directly from results of such analysis, as:

$$r_d = \frac{(\tau_{max})_{@depth=D}}{(\sigma_o)_{@depth=D} \cdot (a_{max}/g)_{@surface}} \qquad (5.2)$$

where a_{max} is the peak ground surface acceleration and g is the acceleration of gravity.

Use of the results of a site response analysis to evaluate r_d is considered to be generally more reliable than either of the two simplified approaches and is strongly recommended for sites that are marginal with respect to liquefaction potential (sites where the factor of safety for liquefaction is close to 1.0).

Step 4: Calculate the critical stress ratio induced by the design earthquake, CSR_{EQ}, as:

$$CSR_{EQ} = 0.65\ (a_{max}/g)\ r_d\ (\sigma_o/\sigma_o') \quad (5.3)$$

Step 5: Evaluate the *standardized* SPT blowcount, N_{60}. N_{60} is the standard penetration test blowcount for a hammer with an efficiency of 60 percent (60 percent of the nominal SPT energy is delivered to the rods). The "standardized" equipment corresponding to an efficiency of 60 percent is specified in Table 5.4. If nonstandard equipment is used, N_{60} is determined as:

$$N_{60} = N \cdot C_{60} \quad (5.4)$$

where C_{60} is the product of various correction factors. Correction factors recommended by various investigators for some common non-standard SPT configurations are provided in Table 5.3. Alternatively, if CPT data are used, N_{60} can be obtained from the chart relating N_{60} to q_c and D_{50} shown in Figure 5.2 (Seed and De Alba, 1986).

Step 6: Calculate the normalized standardized SPT blowcount, $(N_1)_{60}$. $(N_1)_{60}$ is the standardized blow count normalized to an effective overburden pressure of 1 tsf (2000 psf or 950 kPa) in order to eliminate the influence of confining pressure. The most commonly used way to normalize blowcount is via the correction factor, C_N, shown in Figure 5.4 (Seed et al., 1983). However, the closed-form expression proposed by Liao and Whitman (1986) may also be used:

$$C_N = (1/\sigma_o')^{1/2} \quad (5.5)$$

where σ_o' equals the vertical effective stress at the sampling point in tons/ft^2.

As illustrated in Figure 5.4, Equation 5.5, and the correction factor curves are valid only for depths greater than 3 m (10 ft). For depths of less than 3 m (10 ft),

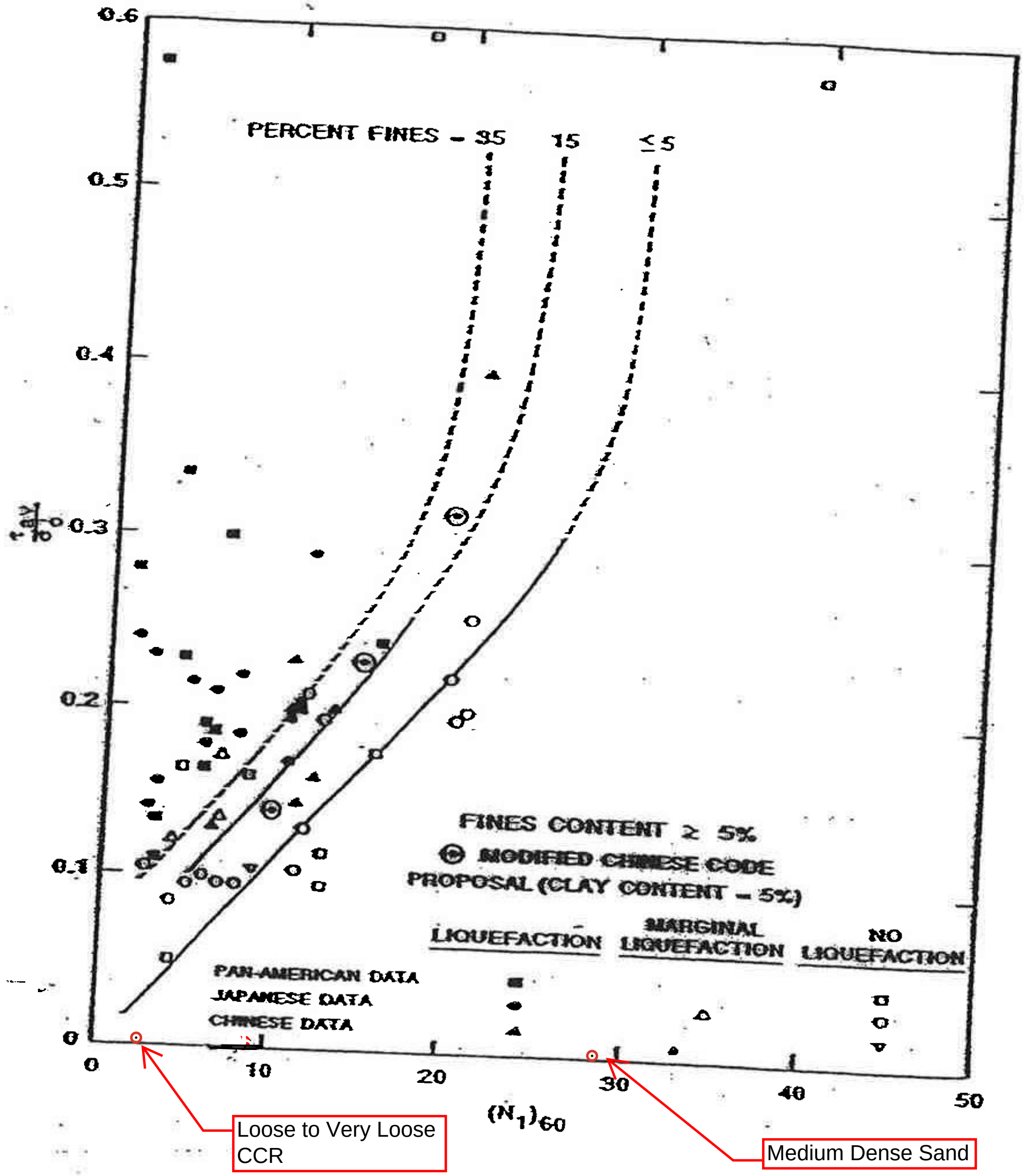

Figure 5.5 Relationships Between Stress Ratio Causing Liquefaction and $(N_1)_{60}$ Values for Sands for M 7.5 Earthquakes (Seed et al., 1985).

Soils below the water table were modelled using effective or "bouyant" unit weights to account for bouyancy in evaluating effective stresses. The effects of seepage forces were evaluated based on an initial flownet analysis from which seepage forces were derived; these were then applied as equivalent nodal forces. The final calculated effective stresses within each element provided the key static stresses (σ'_o and τ_{hv}) necessary for subsequent stages of the overall analytical process.

Seed et al. [1, 4] presented dynamic response analyses of the Lower San Fernando Dam performed in 1972 using the program QUAD4 [14]. Similar analyses were performed more recently using the code FLUSH [15], and the mesh illustrated in Figure 2. Both analyses used static stresses, calculated as described above, as a basis for modelling dynamic shear moduli of cohesionless zones, though slightly different relationships were used to model the nonlinear relationships between shear strain and dynamic shear modulus and damping: [16] for the earlier analyses, and [17] for the more recent analyses. Similarly, the relationships proposed in [16] were used to model strain-dependent moduli and damping in the cohesive zones in the earlier analyses, and [18] in the more recent analyses.

The earlier analyses used the input motions described by Seed et al. [1, 4]: (a) an interpretation of the abutment record by Scott [19], and (b) a modified version of the time history recorded at the Pacoima station during the 1971 San Fernando earthquake. The modifications consisted of trimming of acceleration pulses of greater than 0.9 g, then scaling the record to a maximum horizontal acceleration of 0.6 g, providing a motion in good agreement with Scott's [20] interpretation of the 1971 seismoscope record from the abutment of the Lower San Fernando Dam, but without the unusual low frequency components of the interpreted abutment record. The more recent analyses employed the modified Pacoima input motion scaled to 0.55 g.

The results of the 1973 and 1987 analyses were in close agreement: both produced maximum horizontal crest accelerations on the order of 0.5 to 0.55 g, in good agreement with the actual recorded peak crest accelerations. Both analyses also calculated similar peak cyclic horizontal shear stresses ($\tau_{hv,cyclic}$) within the hydraulic fill zones of the embankment.

It is interesting to note that Jong [20] performed one-dimensional, columnar analyses of individual vertical soil columns through the embankment using the program SHAKE [21]. These analyses, modelling vertical propagation of shear waves and using the same nonlinear soil models and soil parameters as the 2-D FLUSH analyses, significantly underestimated both accelerations and cyclic shear stresses near the crest and upper faces of the embankment. These analyses also, however, provided relatively good agreement with the 2-D dynamic response analyses with regard to cyclic shear stresses ($\tau_{hv,cyclic}$) within the hydraulic fill zones near the base of the embankment, typically calculating peak cyclic shear stresses only 5% to 15% lower than those calculated by the 2-D analyses in these zones.

EVALUATION OF LIQUEFACTION RESISTANCE

Having calculated the cyclic shear stresses resulting from the earthquake loading at each point within the hydraulic fill, the next step is to evaluate the resistance of this material to cyclic pore pressure generation or accumulation of cyclic shear strain. This constitutes evaluation of the resistance to "triggering" or initiation of potential liquefaction failure, defined as sufficient pore pressure or strain accumulation to bring the material to a condition at which undrained residual (or "steady state") strength will control further behavior.

Figure 3 shows a recommended relationship between "corrected" SPT penetration resistance and the equivalent uniform cyclic stress ratio required to "trigger" liquefaction during an earthquake with a duration (or number of loading cycles) representative of a typical earthquake with a magnitude of $M \approx 7\frac{1}{2}$, as suggested by Seed et al. [22, 23]. In this relationship, cyclic stress ratio (CSR) is defined as the ratio of the cyclic shear stress acting on a horizontal plane ($\tau_{hv,c}$) to the initial (pre-earthquake) effective vertical or overburden stress (σ'_o), as $CSR = (\tau_{hv,c})/\sigma'_o$. The relationships presented in Figure 3 represent a significant improvement over earlier, similar relationships developed by Dr. Seed and his colleagues, as (a) they directly account for the influence of fines content on the relationship between penetration resistance and liquefaction resistance, and (b) they are based on a "corrected" or "standardized" SPT penetration resistance.

The standardized penetration resistance $(N_1)_{60}$ is a new "standard" SPT blowcount, based on standardized equipment and procedures as presented (in part) in Table 1 [22, 23]. The use of other types of hammer (e.g. donut hammers), or other types of mechanisms to raise and drop the hammer (e.g. automatic mechanical "trip" hammers, "free fall" hammers, rope and cathead with three turns of the rope about the cathead, etc.), can impart different levels of energy to the top of the drill stem. These non-standard procedures and equipment require correction of the blowcounts in order to develop the standardized blowcount. The $(N_1)_{60}$ "standardized" system and procedures, combined with a "typical" rope and cathead system (with two turns of the rope about the cathead) typically deliver approximately 60% of the theoretical "free fall" hammer energy to the drill stem. For other systems, the measured penetration resistances (N, blows/ft) should be corrected as

$$N_{60} = N \times \frac{ER}{60\%}$$

where ER or energy ratio is the "efficiency" or percent of theoretical free fall energy delivered by the hammer system actually used to the top of the drill stem. This can be measured directly, using a pile analyzer, or can be estimated (for the most common alternate systems in widespread use) based on correlations and data summarized by Seed et al. [22, 23].

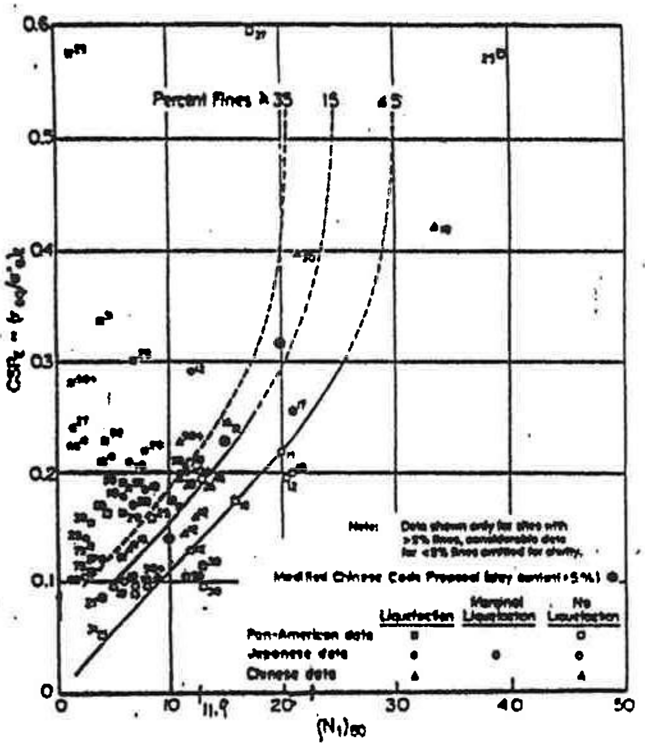

Fig. 3: Relationship Between Cyclic Stress Ratio Causing Liquefaction and N_1-Values for M = 7½ Earthquakes (After Seed, et al., 1984)

Table 1: Recommended "Standardized" SPT Equipment and Procedures (After Seed, et al., 1984)

Sampler:	Std. Sampler with: (a) O.D. = 2.00 inches, and (b) I.D. = 1.375 inches (constant - i.e. no room for liners in the barrel.)
Drill Rods:	A or AW for depths less than 50 feet N or NW for greater depths
Energy Delivered to Sampler:	2520 in.-lbs. (60% of theoretical free fall maximum.)
Blowcount Rate:	30 to 40 blows per minute
Penetration Resistance Count:	Measured over range of 6 to 18 inches of penetration into the ground

An additional correction, increasing the measured N-value by between 10% to 30%, can be necessitated by the use of an ASTM standard sampler configured to accommodate an internal sample liner (tube), but with the liner ommitted. This is fairly common practice in the U.S., and causes a reduction in frictional drag inside the sampler, lowering the blowcounts by about 10% to 30% (increasing percent change with increased blowcount), as summarized by Seed et al. [22, 23] relative to the blowcounts obtained using a standard sampler with a constant inside diameter of 1.375 inches.

Having made any appropriate corrections necessary to develop the standardized blowcount $(N)_{60}$, this penetration resistance must be further corrected to account for effective overburden stress to develop the final, standardized and corrected penetration resistance $(N_1)_{60}$ representative of the "equivalent" penetration resistance at a hypothetical overburden stress of σ'_o = 1 ton/ft² (1 kg/cm²) as:

$$(N_1)_{60} = N_{60} \times c_N$$

Dr. Seed and his colleagues have long recommended a pair of relationships between σ'_o and c_N; one for sandy soils at $D_R \approx$ 40 to 60% and one for $D_R \approx$ 60 to 80%, as shown in Figure 4. An alternate relationship, proposed by Liao and Whitman [24] is $c_N = 1/\sqrt{\sigma'_o}$ where σ'_o is expressed in units of [tons/ft²]. This provides a relationship intermediate between the two suggested relationships shown in Figure 4, and so eliminates the need to estimate D_R. If D_R must be estimated, for in situ, clean sandy soils not placed recently, the approximate relationship presented in Figure 5 can be used as a guide [25]. This relationship should not be used for freshly-placed soils, or for coarser materials than fine to medium sands.

The relationships between $(N_1)_{60}$ and the equivalent uniform cyclic stress ratio necessary to cause liquefaction (CSR_ℓ) in Figure 3 can be extended to earthquakes of magnitude other than M ≈ 7½ by noting that earthquakes of larger magnitude tend to produce a longer duration of shaking and thus more cycles of loading. Seed et al. [26, 27] present procedures for converting a typical, irregular earthquake-induced cyclic load history to an "equivalent" number of uniform loading cycles with an amplitude equal to 65% of the peak or maximum amplitude of the irregular load history. Processing a large number of recorded earthquake time histories using these techniques, Seed et al. [26, 27] developed the "typical" or average numbers of equivalent uniform loading cycles for different magnitude events shown in Table 2.

For earthquakes of magnitude not equal to 7½, the value of CSR_ℓ determined from Figure 3 can be corrected to develop an estimate of the CSR necessary to cause liquefaction as

$$CSR_{\ell(M=M)} = CSR_{\ell(M=7\frac{1}{2})} \cdot C_M$$

where C_M values are a function of magnitude, as suggested by the first and third columns of Table 2. These values are based on review of a considerable body of laboratory test data [26]. An alternate procedure would be to develop an estimate of the number of equivalent, uniform

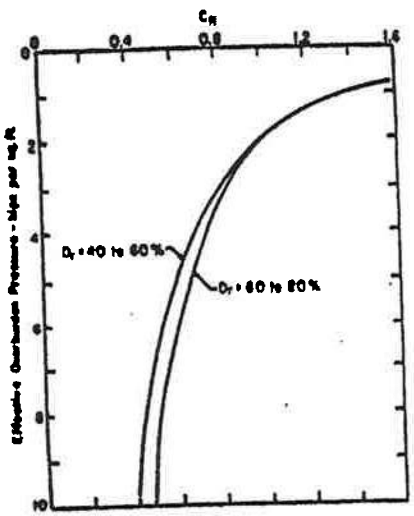

Fig. 4: Chart for Values of C_N

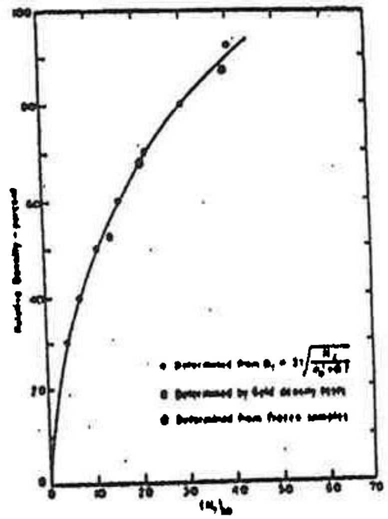

Fig. 5: Approximate Relationship Between D_R and $(N_1)_{60}$. [25]

Table 2: Relationship Between Magnitude, Number of Equivalent Uniform Load Cycles, and Liquefaction Resistance Factor C_M

Earthquake Magnitude, M	No. of representative cycles at 0.65 $\tau_{cyclic, max}$	Magnitude or Duration Correction Factor: C_M
8 1/2	26	0.89
7 1/2	15	1.0
6 3/4	10	1.13
6	5-6	1.32
5 1/4	2-3	1.5

loading cycles representing the earthquake in question (after Seed et al., [27]), and then use the second and third columns of Table 2 to select an appropriate value of C_M. Either of these procedures result in relationships between $(N_1)_{60}$ and CSR_ℓ for earthquakes of other magnitudes than M ≈ 7½ that are in good agreement with available field data [22, 23], though the field (case history) data base is less extensive for events of other ranges of magnitude.

Virtually all of the field (case history) data reflected in Figure 3 (and in similar collections of data for other magnitude ranges) are for level ground conditions and relatively shallow soils with relatively small initial effective

overburden stresses. At higher effective overburden stresses, a [illegible] CSR and number of loading cycles will be more damaging. This is because while soils generally develop higher cyclic load resistance with increasing confinement, the normalized resistance as expressed in terms of cyclic stress ratio usually decreases with increasing confinement. Accordingly, values of CSR_ℓ from Figure 3 can be used for in situ conditions where $\sigma'_o \leq$ 1 ton/ft^2 (1 kg/cm^2), but must be corrected for conditions with initial effective overburden stresses greater than 1 ton/ft^2 as

$$CSR_{\ell(\sigma'_o=\sigma'_o)} = CSR_{\ell(\sigma'_o = 1\,tsf)} \cdot K_\sigma$$

A recommended relationship between K_σ and σ'_o is presented in Figure 6, based on data summarized by Harder [28].

Finally, all of the above has been based on "level ground conditions", or conditions in which there is no static "driving" shear stress acting on a horizontal plane in the soil. Generation of pore pressures and accumulation of shear strains under cyclic loading can be significantly affected by the presence of a static (non-cyclic) driving shear stress, and this too must be accounted for in analysis of liquefaction resistance within dams and embankments.

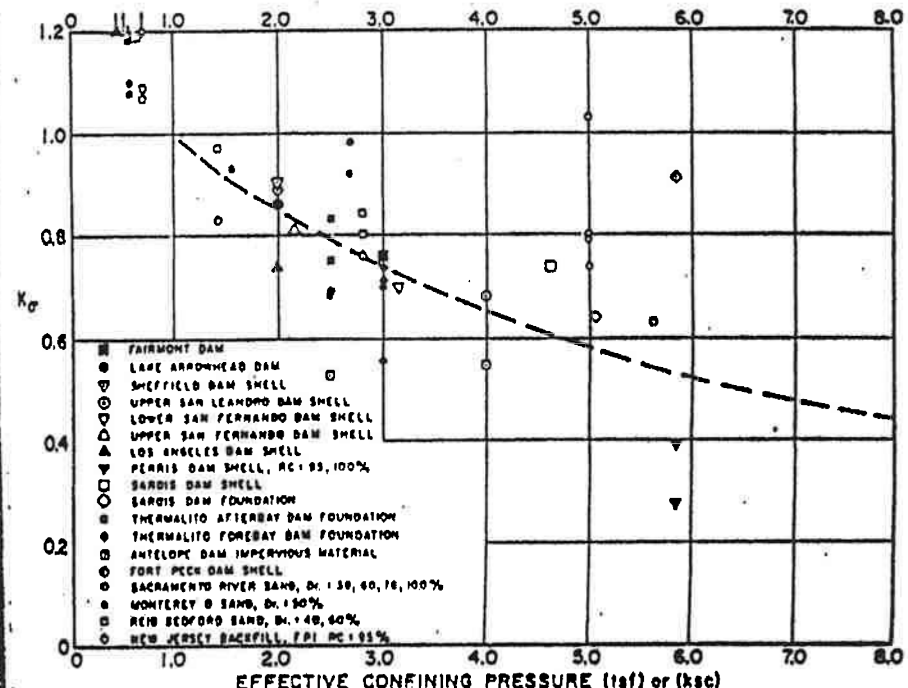

Fig. 6: Relationship Between Effective Vertical Stress (σ'_o) and K_σ

portion of the test data for which grain size characteristics were determined. It is noted that although the fines content varied considerably for the two sands, the mean grain diameter was nearly always about 0.2 mm, with a standard deviation of only 0.04 mm.

The generated plot indicates that if the presence of fines were to increase from 6% to 30%, by dry weight and for the same mean grain diameter, the ratio q_c/N could drop by half. Finally, if the entire data bank were to be examined, realizing that the natural sand has, typically, about double the amount of fines as the fill sand, a similar conclusion can be drawn regarding the significant effect of the fines content on the q_c/N ratio.

Conclusions

The relationship between q_c/N and the mean soil grain diameter presented by Robertson and Campanella (3) represents a good average for sands with low fines content (less than 10%). Such correlations should take into account conditions that would cause variability in either the cone, the SPT results, or both.

Data from a site in Alameda, CA indicates that the ratio q_c/N is significantly less for sands with higher fine contents than for mostly clean sands. It appears that this difference is primarily related to the dominant effects of the fines fraction of the permeability and, hence, pore pressure distribution and the modification of the compressibility and ductility characteristics of these sands.

The data do not indicate that the q_c/N ratio is a function of the numerical value of the cone tip resistance.

It is suggested that variations in the q_c/N ratio from established generalized correlations of this type be considered when conducting analyses that are correlation based, such as the proposed empirical procedure by Robertson and Campanella (3) for liquefaction analyses, and also for those cases where conversion of cone penetration test data to standard penetration test blow count is being made for studies of settlement, seismically induced pore pressures, and others, where the current field experience is heavily weighted in favor of the standard penetration test.

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Acknowledgment

The cooperation of Harbor Bay Isle Associates and Doric Development, Inc. is greatly appreciated.

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Overburden Correction Factors for SPT in Sand

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Introduction

The need for normalizing or correcting the results of the standard penetration test in sands to account for overburden was first clearly demonstrated by the data published by Gibbs and Holtz (1957). Since then, the correction for overburden has become a standard aspect of calculations of settlements on sand and liquefaction potential. Several formulae and charts for making the correction have been published. However, depending on *which* published correction factor is used, very different interpretations may result. The purpose of this technical note is to try to clarify and resolve some of these differences, and to propose a simple formula for the correction factor.

The experimental basis for the correction factors rests for the most part on data for normally consolidated, uncemented, unaged, primarily quartz, clean sands. Further research is required for the range of soils in general.

Published Correction Factors

The SPT correction factor C_N is defined as the ratio of the SPT resistance measured at a given effective vertical stress level σ_v to the resistance measured at a standard stress level $(\bar{\sigma}_v)_{ref}$, usually 1 ton/sq ft or equivalently 1 kg/cm². In practice, the SPT resistance N is measured and then normalized or corrected to N_1 using the equation

$$N_1 = C_N N \quad (1)$$

The commonly used overburden correction factors that have been published in the literature are summarized in Table 1 and plotted in Fig. 1.

Inconsistent Correction Factors.—Fig. 1(*a*) shows the wide range of correction factors that are available in the literature. The Teng (1962) equation plots to the right of all the other correction factors simply because its reference stress level $(\sigma_v)_{ref}$ is at approximately 2.9 tsf (40 psi), whereas the other curves are standardized at 1.0 tsf. The use of different stress levels for standardization of the SPT N-value does not present a conflict, as long as empirical correlations associated with each are consistently applied. For example, if liquefaction criteria are established from data using a correction based on a certain $(\bar{\sigma}_v)_{ref}$, then future evaluations

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TABLE 1.—Summary of Published Correction Factors

Reference (1)	Correction factor C_N (2)	Units of $\bar{\sigma}_v$ (3)
Teng (1962)	$C_N = \dfrac{50}{10 + \bar{\sigma}_v}$	psi
Bazaraa (1967)	$C_N = \begin{cases} \dfrac{4}{1 + 2\bar{\sigma}_v} & \sigma_v \le 1.5 \\ \dfrac{4}{3.25 + 0.5\bar{\sigma}_v} & \bar{\sigma}_v > 1.5 \end{cases}$	ksf
Peck, Hansen, and Thornburn (1974)	$C_N = 0.77 \log_{10} \dfrac{20}{\bar{\sigma}_v}$	tsf
Seed (1976)	$C_N = 1 - 1.25 \log_{10} \bar{\sigma}_v$	tsf
Seed (1979)	See Fig. 1(*b*)	tsf
Tokimatsu and Yoshimi (1983)	$C_N = \dfrac{1.7}{0.7 + \bar{\sigma}_v}$	kg/cm²

should use the same correction factor.

The Teng (1962) correction is also frequently referred to as the Gibbs and Holtz correction factor. Although the interpretation of Terzaghi and Peck's (1948) classifications of SPT resistance as a function of relative density, which led to this particular correction, originated with Gibbs and Holtz (1957), the actual equation for the correction factor can be attributed to Teng (1962).

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The leftmost curve in Fig. 1(*a*) is that presented by Seed (1976). This correction factor is very conservative especially at high overburden pressures, and in fact, becomes negative for $\bar{\sigma}_v > 6.3$ tsf. Seed (1979) has since revised his recommendations for C_N, based particularly on the data from Marcuson and Bieganousky (1977a, 1977b). Even so, the earlier Seed

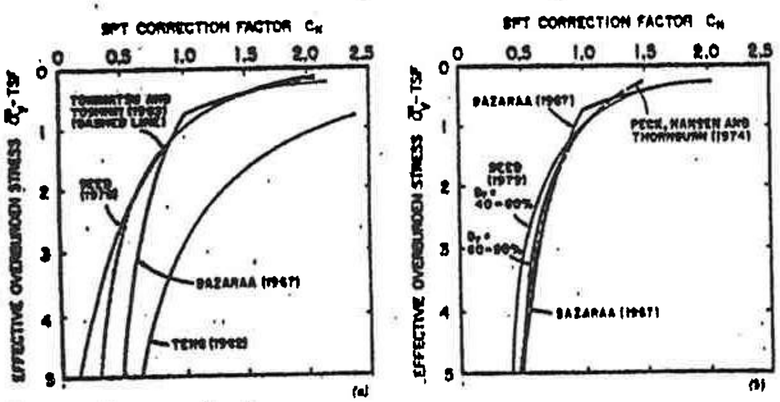

FIG. 1.—Comparison of Published Corrections Factors: (*a*) Inconsistent Correction Factors; (*b*) Consistent Correction Factors

(1976) correction factor may still be in use, though this practice [should] be discouraged.

The correction factor presented by Tokimatsu and Yoshimi (1983) is based on Meyerhoff (1957) and is also somewhat conservative for $\bar{\sigma}_v >$ 1.5 tsf. Tokimatsu and Yoshimi propose that this is justified because of a reduction in the energy reaching the SPT sampler for the longer rod lengths and depths corresponding to higher values of $\bar{\sigma}_v$. However, this constitutes a mixing of the different effects of overburden and energy transmission, which would be better taken care of, in the writers' opinion, by accounting *separately* for these effects using a formulation similar to that proposed by Kovacs, et al. (1984), or Seed, et al. (1985). Based on the available data, it appears that the correction factor C_N is independent of hammer energy, even though relative density correlations may be affected.

Consistent Correction Factors.—Fig. 1(*b*) shows the Bazaraa (1967), Peck, Hansen, and Thornburn (1973) and the Seed (1979) correction factors. The Bazaraa (1967) correction factor has a slope discontinuity and does not equal 1 at $\bar{\sigma}_v$ = 1 tsf. It is shown in both Figs. 1(*a*–*b*) as a reference for comparison. The Seed (1979) correction curves are based on the data presented by Marcuson and Bieganousky (1977b), which show a dependence not only on $\bar{\sigma}_v$, but also on the relative density D_r. The curves in Fig. 1(*b*) all fall within a fairly narrow band of values. Thus for engineering applications, and considering the statistical errors associated with the SPT, these correction factors may be considered to be practically equivalent.

PROPOSED CORRECTION FACTOR

Standardization.—In view of the recent efforts at promoting stricter standardization of the SPT (e.g., Kovacs and Salamone 1982; Kovacs, et al. 1984; and Seed et al. 1984), it is proposed that standards of common interpretation of overburden correction factors should also be desirable. Thus it is recommended that the Teng (1962) correction factor should be phased out of usage, because its standard stress level is set too high at $(\bar{\sigma}_v)_{ref}$ = 2.9 tsf. It is also recommended that the Seed (1976) and Tokimatsu and Yoshimi (1983) correction factors should not be used, or at least be restricted for use to $\sigma_v \le 1.5$ tsf, because of their conservative values for $\sigma_v > 1.5$ tsf. *Use of any of the correction factors shown in Fig. 1(b) is acceptable and would lead to at least a temporary standard of interpretation and fairly consistent results.* However, a simple correction factor, which is comparable to any of those in Fig. 1(*b*) is proposed as:

$$C_N = \sqrt{\frac{1}{\bar{\sigma}_v}} \quad (\bar{\sigma}_v \text{ in tsf or kg/cm}^2) \qquad (2)$$

Comparison of this correction factor with the Bazaraa (1967) and the Seed (1979) correction factors is shown in Fig. 2.

Other Rationale.—The mathematical form of the proposed correction factor is not new. More generally, the form can be written as

$$C_N = \left[\frac{(\bar{\sigma}_v)_{ref}}{\bar{\sigma}_v}\right]^k \qquad (3)$$

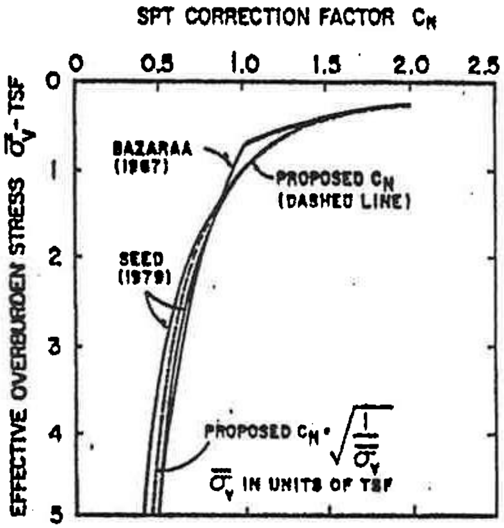

FIG. 2.—Comparison of Proposed C_N with Bazaraa (1967) and Seed (1969) Correction Factors

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where k is a parameter to be obtained by fitting to test data. Al-Akwati (1975), Fardis and Veneziano (1981), and Baldi, et al. (1985) have fitted data from static and dynamic penetration tests to Eq. 3 or to a similar form. Their results indicate k to vary between 0.4 to 0.6 depending on the data used and the method of regression. Baldi, et al. (1985) indicate slightly higher values of k for cone penetration data with a mean k = 0.72.

It is probable that the coefficient k is a function of relative density, as suggested by Marcuson and Bieganousky (1977b) and Seed (1979), and possibly other factors as well. However, as a practical matter, considering the relative crudeness and the accuracy (or lack thereof) with which the penetration resistance can be measured, k = 0.5 or Eq. 2 is considered to be appropriate as a tentative recommendation.

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Problem Statement:

Evaluate the liquefaction potential of the Coal Combustion Residuals (CCR) layers and sand layers within and below the impoundment perimeter berm induced by an earthquake in accordance with 40 CFR Section 257.73. Liquefaction is most likely to occur in saturated loose CCR layers and loose sand layers. Because the saturated soils below the CCR and above the sand layers are primarily clay, the clay layers are not prone to liquefaction and are not included in the liquefaction evaluation.

Given:

- Boring log GT2/SP304.
- Laboratory soil test results for boring GT2/SP304.
- RCRA Subtitle D (258) Seismic Design Guidance for Municipal Solid Waste Landfill Facilities. (refer to attached pages).
- Seed and Harder, *Cyclic Pore Pressure* (refer to attached pages).
- Liao and Whitman, Overburden Correction Factors for SPT in Sand (refer to attached pages).

Assumptions:

- Boring GT2/SP304 is located on the berm of the CCR surface impoundment and was advanced to 71 ft below ground surface (bgs). The loose CCR extends from a depth of approximately 8 bgs to 23 bgs. The sand deposits extend from a depth of approximately 26 feet bgs to the end of boring. Groundwater was near 12 ft bgs based on recent readings in a nearby piezometer. Based on the recorded blow counts in this boring, the calculated average blow count for the saturated loose CCR is 6 and sand deposit is 11.
- The effective (F'_F) and total (F_F) overburden stresses were calculated below the top surface of the perimeter berm. To be conservative, these stresses were calculated by assuming the saturated loose CCR and medium dense sands are 1 foot thick. The effective (F'_F) and total (F_F) overburden stresses for CCR, are 1273.8 psf and 1305.0 psf (see attached table). The effective (F'_F) and total (F_F) overburden stresses for medium dense sands, are 1735.2 psf and 2640.0 psf (see attached table).
- From the 2014 USGS seismic hazard map, the maximum horizontal acceleration is approximately 0.0400 g.
- From Seed and Harder, the Standardized Penetration Resistance $(N_1)_{60}$ is calculated by the following equation (for stress in tsf):

$$(N_1)_{60} = N \times C_N$$

$$C_N = \sqrt{\frac{1}{\sigma'_F}}$$

- From RCRA, the Cyclic Stress Ratio (CSR), is calculated by the following equation:

$$CSR = \frac{(\tau_H)_{ave}}{\sigma'_F} = (0.65)\frac{(a_{max})(\sigma_F)}{(g)(\sigma'_F)}(r_d)$$

$$r_d = 1 - 0.015D$$

Where,

CSR	= Cyclic Stress Ratio
a_{max}	= Horizontal acceleration, 0.0400 g
$(\tau_H)_{ave}$	= Static driving shear stress (psf)
g	= Acceleration due to gravity, 32.2 ft/sec^2
σ_F	= Final total overburden stress (psf)
σ'_F	= Final effective overburden stress (psf)
r_d	= Stress reduction factor at depth (m)

- The depth (D) is the depth in meters measured from the surface of the saturated loose CRR layers and medium dense sand layer. To be conservative, we are assuming the saturated medium dense sands are 1 foot thick at this location (when they are estimated to be approximately 30 to 60 feet thick).

Calculations:

See attached tables for calculations.

The calculated CCR CSR of 0.00082 and the average $(N_1)_{60}$ of 7.67, and the medium dense sand CSR of 0.0012 and the average $(N_1)_{60}$ of 11.7 are plotted on Figure 5.5 from Seed and Harder. The points are well below the line of liquefaction potential.

Results:

Results of the liquefaction evaluation indicate that the saturated loose CCR and medium dense sands within and below the impoundment perimeter berm will not liquefy during an earthquake with a horizontal acceleration of 0.0400g.

SSS CCR Surface Impoundment B-B' Stresses by Geologic Layer (Loose to Very Loose CCR)								
Location / Point	Layer Description	Unit Thickness (ft)	Unit Weights (pcf)		Bottom-Layer Stresses (psf)		Mid-Layer Stresses (psf)	
			λ_{sat} soil	$\lambda_{bouyant}$ soil	σ' (effective)	σ (total)	σ' (effective)	σ (total)
GT2/SP304	Final Cover	4.0	120	120.00	480.00	480.00	240.00	240.00
	Embankment Stiff Clay/Silt	2.0	120	120.00	720.00	720.00	600.00	600.00
	Upper Medium Dense CCR	2.0	90	90.00	900.00	900.00	810.00	810.00
	Loose to Very Loose CCR Above Groundwater	4.0	90	90.00	1,260.00	1,260.00	1,080.00	1,080.00
	Loose to Very Loose CCR Below Groundwater	1.0	90	27.60			1,273.80	1,305.00

Calculations (Loose to Very Loose CCR)				
N	C_N (tsf)	$(N_1)_{60}$	r_d (meters)	CSR
6	1.253	7.67	0.995	0.00082

SSS CCR Surface Impoundment B-B' Stresses by Geologic Layer (Medium Dense Sand)								
Location / Point	Layer Description	Unit Thickness (ft)	Unit Weights (pcf)		Bottom-Layer Stresses (psf)		Mid-Layer Stresses (psf)	
			λ_{sat} soil	$\lambda_{bouyant}$ soil	σ' (effective)	σ (total)	σ' (effective)	σ (total)
GT2/SP304	Final Cover	4.0	120	120.00	480.00	480.00	240.00	240.00
	Embankment Stiff Clay/Silt	2.0	120	120.00	720.00	720.00	600.00	600.00
	Upper Medium Dense CCR	2.0	90	90.00	900.00	900.00	810.00	810.00
	Loose to Very Loose CCR Above Groundwater	4.0	90	90.00	1,260.00	1,260.00	1,080.00	1,080.00
	Loose to Very Loose CCR Below Groundwater	11.0	90	27.60	1,563.60	2,250.00	1,411.80	1,755.00
	Medium Stiff Organic Clay/Silt	3.0	110	47.60	1,706.40	2,580.00	1,635.00	2,415.00
	Medium Dense Sand	1.0	120	57.60			1,735.20	2,640.00

Calculations (Medium Dense Sand)				
N	C_N (tsf)	$(N_1)_{60}$	r_d (meters)	CSR
11	1.074	11.7	0.995	0.0012

Prepared by: LAC, 01/20/2026
Reviewed by: DLN, 01/20/2026

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RCRA SUBTITLE D (258)
SEISMIC DESIGN GUIDANCE
FOR
MUNICIPAL SOLID WASTE LANDFILL FACILITIES

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Procedure for evaluating liquefaction potential at the site of a MSWLF can be carried out using the following steps:

Step 1: From in-situ testing and laboratory index tests, develop a detailed understanding of site conditions: stratigraphy, layer geometry, material properties and their variability, and the areal extent of potential problem zones. Establish the most critical zones to be analyzed and develop simplified sections amenable to analysis. The data should include location of the water table, either SPT blowcount, N, or tip resistance of a standard CPT cone, q_c, and mean grain size, D_{50}, the unit weight of the soil, and the percentage of fines (percent by weight passing the No. 200 sieve) for the materials involved in the liquefaction potential assessment.

Step 2: Evaluate the total vertical stress, σ_o, and vertical effective stress, σ_o', in the deposit at the time of exploration and for design. Design values should include the overburden stress due to the landfill. Outside of the waste footprint, the exploration and design values may be the same if the design ground water level is at the same elevation as the ground water was during sampling, or they may be different due to temporal fluctuations in the water table.

Step 3: Evaluate the stress reduction factor, r_d. The stress reduction factor is a soil flexibility factor defined as the ratio of the peak shear stress for the soil column, $(\tau_{max})_d$, to that of a rigid body, $(\tau_{max})_r$. There are several ways to determine r_d. For depths less than 40 ft (12 m), the average value from Figure 5.3 (Seed and Idriss, 1982) can be used. Alternatively, the following equation proposed by Iwasaki et al. (1978) can be used:

$$\boxed{r_d = 1 - 0.015\ D} \qquad (5.1)$$

where D is depth in meters.

If results of a site response analyses (e.g., a SHAKE analysis) are available, r_d can be determined directly from results of such analysis, as:

$$r_d = \frac{(\tau_{max})_{@depth=D}}{(\sigma_o)_{@depth=D} \cdot (a_{max}/g)_{@surface}} \qquad (5.2)$$

where a_{max} is the peak ground surface acceleration and g is the acceleration of gravity.

Use of the results of a site response analysis to evaluate r_d is considered to be generally more reliable than either of the two simplified approaches and is strongly recommended for sites that are marginal with respect to liquefaction potential (sites where the factor of safety for liquefaction is close to 1.0).

Step 4: Calculate the critical stress ratio induced by the design earthquake, CSR_{EQ}, as:

$$CSR_{EQ} = 0.65\ (a_{max}/g)\ r_d\ (\sigma_o/\sigma_o') \qquad (5.3)$$

Step 5: Evaluate the *standardized* SPT blowcount, N_{60}. N_{60} is the standard penetration test blowcount for a hammer with an efficiency of 60 percent (60 percent of the nominal SPT energy is delivered to the rods). The "standardized" equipment corresponding to an efficiency of 60 percent is specified in Table 5.4. If nonstandard equipment is used, N_{60} is determined as:

$$N_{60} = N \cdot C_{60} \qquad (5.4)$$

where C_{60} is the product of various correction factors. Correction factors recommended by various investigators for some common non-standard SPT configurations are provided in Table 5.3. Alternatively, if CPT data are used, N_{60} can be obtained from the chart relating N_{60} to q_c and D_{50} shown in Figure 5.2 (Seed and De Alba, 1986).

Step 6: Calculate the normalized standardized SPT blowcount, $(N_1)_{60}$. $(N_1)_{60}$ is the standardized blow count normalized to an effective overburden pressure of 1 tsf (2000 psf or 950 kPa) in order to eliminate the influence of confining pressure. The most commonly used way to normalize blowcount is via the correction factor, C_N, shown in Figure 5.4 (Seed et al., 1983). However, the closed-form expression proposed by Liao and Whitman (1986) may also be used:

$$C_N = (1/\sigma_o')^{1/2} \qquad (5.5)$$

where σ_o' equals the vertical effective stress at the sampling point in tons/ft^2.

As illustrated in Figure 5.4, Equation 5.5, and the correction factor curves are valid only for depths greater than 3 m (10 ft). For depths of less than 3 m (10 ft),

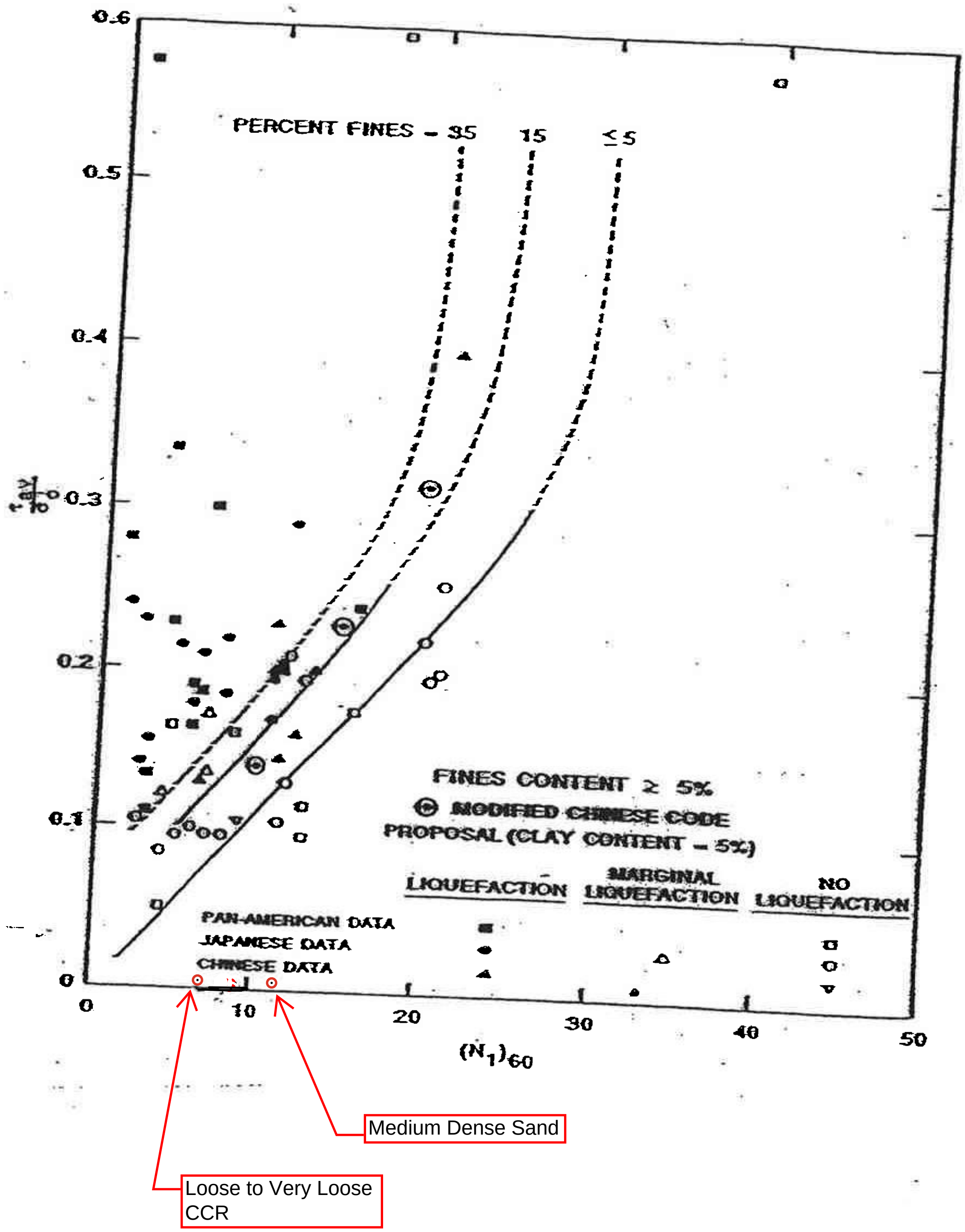

Figure 5.5 Relationships Between Stress Ratio Causing Liquefaction and $(N_1)_{60}$ Values for Sands for M 7.5 Earthquakes (Seed et al., 1985).

Soils below the water table were modelled using effective or "bouyant" unit weights to account for bouyancy in evaluating effective stresses. The effects of seepage forces were evaluated based on an initial flownet analysis from which seepage forces were derived; these were then applied as equivalent nodal forces. The final calculated effective stresses within each element provided the key static stresses (σ'_o and τ_{hv}) necessary for subsequent stages of the overall analytical process.

Seed et al. [1, 4] presented dynamic response analyses of the Lower San Fernando Dam performed in 1972 using the program QUAD4 [14]. Similar analyses were performed more recently using the code FLUSH [15], and the mesh illustrated in Figure 2. Both analyses used static stresses, calculated as described above, as a basis for modelling dynamic shear moduli of cohesionless zones, though slightly different relationships were used to model the nonlinear relationships between shear strain and dynamic shear modulus and damping: [16] for the earlier analyses, and [17] for the more recent analyses. Similarly, the relationships proposed in [16] were used to model strain-dependent moduli and damping in the cohesive zones in the earlier analyses, and [18] in the more recent analyses.

The earlier analyses used the input motions described by Seed et al. [1, 4]: (a) an interpretation of the abutment record by Scott [19], and (b) a modified version of the time history recorded at the Pacoima station during the 1971 San Fernando earthquake. The modifications consisted of trimming of acceleration pulses of greater than 0.9 g, then scaling the record to a maximum horizontal acceleration of 0.6 g, providing a motion in good agreement with Scott's [20] interpretation of the 1971 seismoscope record from the abutment of the Lower San Fernando Dam, but without the unusual low frequency components of the interpreted abutment record. The more recent analyses employed the modified Pacoima input motion scaled to 0.55 g.

The results of the 1973 and 1987 analyses were in close agreement: both produced maximum horizontal crest accelerations on the order of 0.5 to 0.55 g, in good agreement with the actual recorded peak crest accelerations. Both analyses also calculated similar peak cyclic horizontal shear stresses ($\tau_{hv,cyclic}$) within the hydraulic fill zones of the embankment.

It is interesting to note that Jong [20] performed one-dimensional, columnar analyses of individual vertical soil columns through the embankment using the program SHAKE [21]. These analyses, modelling vertical propagation of shear waves and using the same nonlinear soil models and soil parameters as the 2-D FLUSH analyses, significantly underestimated both accelerations and cyclic shear stresses near the crest and upper faces of the embankment. These analyses also, however, provided relatively good agreement with the 2-D dynamic response analyses with regard to cyclic shear stresses ($\tau_{hv,cyclic}$) within the hydraulic fill zones near the base of the embankment, typically calculating peak cyclic shear stresses only 5% to 15% lower than those calculated by the 2-D analyses in these zones.

EVALUATION OF LIQUEFACTION RESISTANCE

Having calculated the cyclic shear stresses resulting from the earthquake loading at each point within the hydraulic fill, the next step is to evaluate the resistance of this material to cyclic pore pressure generation or accumulation of cyclic shear strain. This constitutes evaluation of the resistance to "triggering" or initiation of potential liquefaction failure, defined as sufficient pore pressure or strain accumulation to bring the material to a condition at which undrained residual (or "steady state") strength will control further behavior.

Figure 3 shows a recommended relationship between "corrected" SPT penetration resistance and the equivalent uniform cyclic stress ratio required to "trigger" liquefaction during an earthquake with a duration (or number of loading cycles) representative of a typical earthquake with a magnitude of M ≈ 7½, as suggested by Seed et al. [22, 23]. In this relationship, cyclic stress ratio (CSR) is defined as the ratio of the cyclic shear stress acting on a horizontal plane ($\tau_{hv,c}$) to the initial (pre-earthquake) effective vertical or overburden stress (σ'_o), as $CSR = (\tau_{hv,c})/\sigma'_o$. The relationships presented in Figure 3 represent a significant improvement over earlier, similar relationships developed by Dr. Seed and his colleagues, as (a) they directly account for the influence of fines content on the relationship between penetration resistance and liquefaction resistance, and (b) they are based on a "corrected" or "standardized" SPT penetration resistance.

The standardized penetration resistance $(N_1)_{60}$ is a new "standard" SPT blowcount, based on standardized equipment and procedures as presented (in part) in Table 1 [22, 23]. The use of other types of hammer (e.g. donut hammers), or other types of mechanisms to raise and drop the hammer (e.g. automatic mechanical "trip" hammers, "free fall" hammers, rope and cathead with three turns of the rope about the cathead, etc.), can impart different levels of energy to the top of the drill stem. These non-standard procedures and equipment require correction of the blowcounts in order to develop the standardized blowcount. The $(N_1)_{60}$ "standardized" system and procedures, combined with a "typical" rope and cathead system (with two turns of the rope about the cathead) typically deliver approximately 60% of the theoretical "free fall" hammer energy to the drill stem. For other systems, the measured penetration resistances (N, blows/ft) should be corrected as

$$N_{60} = N \times \frac{ER}{60\%}$$

where ER or energy ratio is the "efficiency" or percent of theoretical free fall energy delivered by the hammer system actually used to the top of the drill stem. This can be measured directly, using a pile analyzer, or can be estimated (for the most common alternate systems in widespread use) based on correlations and data summarized by Seed et al. [22, 23].

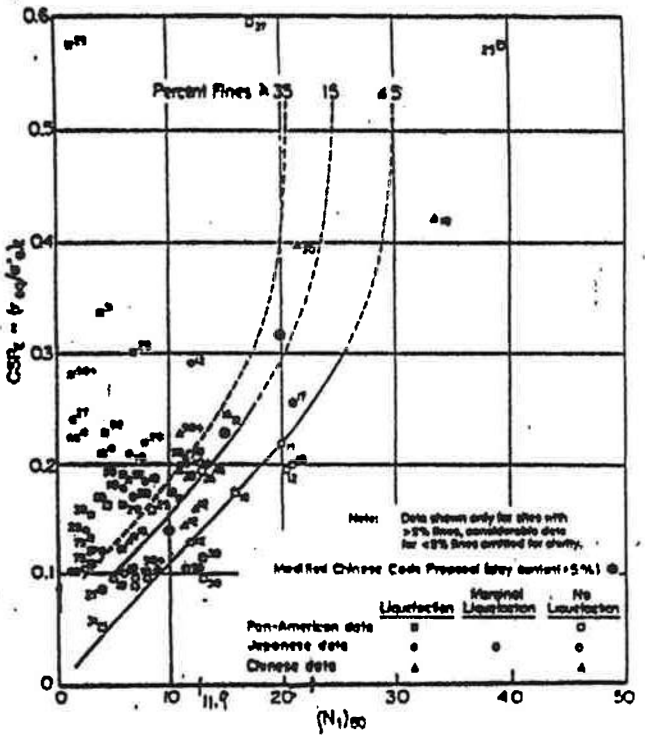

Fig. 3: Relationship Between Cyclic Stress Ratio Causing Liquefaction and N_1-Values for M = 7½ Earthquakes (After Seed, et al., 1984)

Table 1: Recommended "Standardized" SPT Equipment and Procedures (After Seed, et al., 1984)

Sampler:	Std. Sampler with: (a) O.D. = 2.00 inches, and (b) I.D. = 1.375 inches (constant - i.e. no room for liners in the barrel.)
Drill Rods:	A or AW for depths less than 50 feet N or NW for greater depths
Energy Delivered to Sampler:	2520 in.-lbs. (60% of theoretical free fall maximum.)
Blowcount Rate:	30 to 40 blows per minute
Penetration Resistance Count:	Measured over range of 6 to 18 inches of penetration into the ground

An additional correction, increasing the measured N-value by between 10% to 30%, can be necessitated by the use of an ASTM standard sampler configured to accommodate an internal sample liner (tube), but with the liner ommitted. This is fairly common practice in the U.S., and causes a reduction in frictional drag inside the sampler, lowering the blowcounts by about 10% to 30% (increasing percent change with increased blowcount), as summarized by Seed et al. [22, 23] relative to the blowcounts obtained using a standard sampler with a constant inside diameter of 1.375 inches.

Having made any appropriate corrections necessary to develop the standardized blowcount $(N)_{60}$, this penetration resistance must be further corrected to account for effective overburden stress to develop the final, standardized and corrected penetration resistance $(N_1)_{60}$ representative of the "equivalent" penetration resistance at a hypothetical overburden stress of σ'_o = 1 ton/ft^2 (1 kg/cm^2)as:

$$(N_1)_{60} = N_{60} \times c_N$$

Dr. Seed and his colleagues have long recommended a pair of relationships between σ'_o and c_N; one for sandy soils at $D_R \approx$ 40 to 60% and one for $D_R \approx$ 60 to 80%, as shown in Figure 4. An alternate relationship, proposed by Liao and Whitman [24] is $c_N = 1/\sqrt{\sigma'_o}$ where σ'_o is expressed in units of [tons/ft^2]. This provides a relationship intermediate between the two suggested relationships shown in Figure 4, and so eliminates the need to estimate D_R. If D_R must be estimated, for in situ, clean sandy soils not placed recently, the approximate relationship presented in Figure 5 can be used as a guide [25]. This relationship should not be used for freshly-placed soils, or for coarser materials than fine to medium sands.

The relationships between $(N_1)_{60}$ and the equivalent uniform cyclic stress ratio necessary to cause liquefaction (CSR_ℓ) in Figure 3 can be extended to earthquakes of magnitude other than M ≈ 7½ by noting that earthquakes of larger magnitude tend to produce a longer duration of shaking and thus more cycles of loading. Seed et al. [26, 27] present procedures for converting a typical, irregular earthquake-induced cyclic load history to an "equivalent" number of uniform loading cycles with an amplitude equal to 65% of the peak or maximum amplitude of the irregular load history. Processing a large number of recorded earthquake time histories using these techniques, Seed et al. [26, 27] developed the "typical" or average numbers of equivalent uniform loading cycles for different magnitude events shown in Table 2.

For earthquakes of magnitude not equal to 7½, the value of CSR_ℓ determined from Figure 3 can be corrected to develop an estimate of the CSR necessary to cause liquefaction as

$$CSR_{\ell(M=M)} = CSR_{\ell(M=7\frac{1}{2})} \cdot C_M$$

where C_M values are a function of magnitude, as suggested by the first and third columns of Table 2. These values are based on review of a considerable body of laboratory test data [26]. An alternate procedure would be to develop an estimate of the number of equivalent, uniform

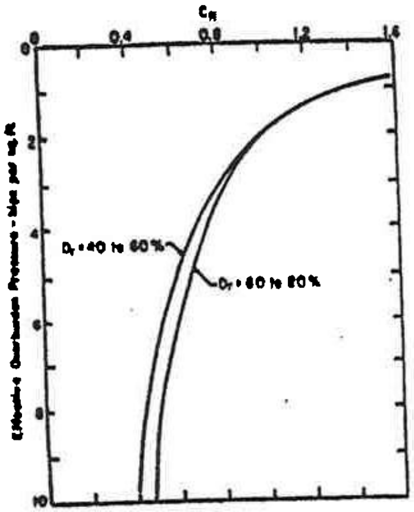

Fig. 4: Chart for Values of C_N

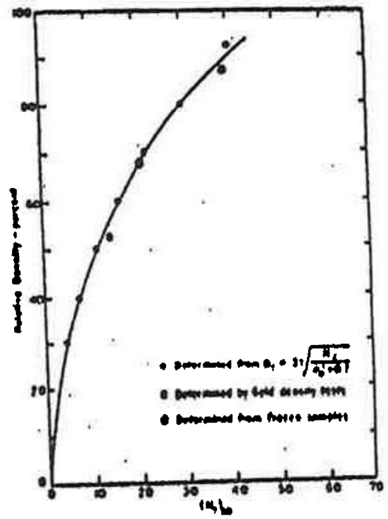

Fig. 5: Approximate Relationship Between D_R and $(N_1)_{60}$. [25]

Table 2: Relationship Between Magnitude, Number of Equivalent Uniform Load Cycles, and Liquefaction Resistance Factor C_M

Earthquake Magnitude, M	No. of representative cycles at 0.65 $\tau_{cyclic, max}$	Magnitude or Duration Correction Factor: C_M
8 1/2	26	0.89
7 1/2	15	1.0
6 3/4	10	1.13
6	5-6	1.32
5 1/4	2-3	1.5

loading cycles representing the earthquake in question (after Seed et al., [27]), and then use the second and third columns of Table 2 to select an appropriate value of C_M. Either of these procedures result in relationships between $(N_1)_{60}$ and CSR_ℓ for earthquakes of other magnitudes than M ≈ 7½ that are in good agreement with available field data [22, 23], though the field (case history) data base is less extensive for events of other ranges of magnitude.

Virtually all of the field (case history) data reflected in Figure 3 (and in similar collections of data for other magnitude ranges) are for level ground conditions and relatively shallow soils with relatively small initial effective

overburden stresses. At higher effective overburden stresses, a [illegible] CSR and number of loading cycles will be more damaging. This is because while soils generally develop higher cyclic load resistance with increasing confinement, the normalized resistance as expressed in terms of cyclic stress ratio usually decreases with increasing confinement. Accordingly, values of CSR_ℓ from Figure 3 can be used for in situ conditions where $\sigma'_o \leq$ 1 ton/ft^2 (1 kg/cm^2), but must be corrected for conditions with initial effective overburden stresses greater than 1 ton/ft^2 as

$$CSR_{\ell(\sigma'_o = \sigma'_o)} = CSR_{\ell(\sigma'_o = 1\,tsf)} \cdot K_\sigma$$

A recommended relationship between K_σ and σ'_o is presented in Figure 6, based on data summarized by Harder [28].

Finally, all of the above has been based on "level ground conditions", or conditions in which there is no static "driving" shear stress acting on a horizontal plane in the soil. Generation of pore pressures and accumulation of shear strains under cyclic loading can be significantly affected by the presence of a static (non-cyclic) driving shear stress, and this too must be accounted for in analysis of liquefaction resistance within dams and embankments.

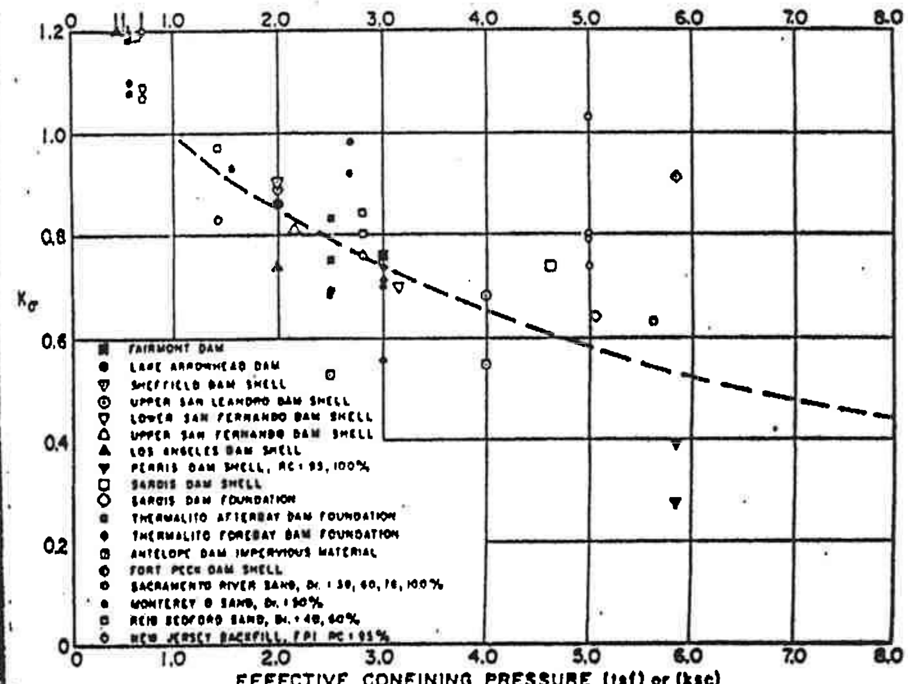

Fig. 6: Relationship Between Effective Vertical Stress (σ'_o) and K_σ

portion of the test data for which grain size characteristics were determined. It is noted that although the fines content varied considerably for the two sands, the mean grain diameter was nearly always about 0.2 mm, with a standard deviation of only 0.04 mm.

The generated plot indicates that if the presence of fines were to increase from 6% to 30%, by dry weight and for the same mean grain diameter, the ratio q_c/N could drop by half. Finally, if the entire data bank were to be examined, realizing that the natural sand has, typically, about double the amount of fines as the fill sand, a similar conclusion can be drawn regarding the significant effect of the fines content on the q_c/N ratio.

Conclusions

The relationship between q_c/N and the mean soil grain diameter presented by Robertson and Campanella (3) represents a good average for sands with low fines content (less than 10%). Such correlations should take into account conditions that would cause variability in either the cone, the SPT results, or both.

Data from a site in Alameda, CA indicates that the ratio q_c/N is significantly less for sands with higher fine contents than for mostly clean sands. It appears that this difference is primarily related to the dominant effects of the fines fraction of the permeability and, hence, pore pressure distribution and the modification of the compressibility and ductility characteristics of these sands.

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The data do not indicate that the q_c/N ratio is a function of the numerical value of the cone tip resistance.

It is suggested that variations in the q_c/N ratio from established generalized correlations of this type be considered when conducting analyses that are correlation based, such as the proposed empirical procedure by Robertson and Campanella (3) for liquefaction analyses, and also for those cases where conversion of cone penetration test data to standard penetration test blow count is being made for studies of settlement, seismically induced pore pressures, and others, where the current field experience is heavily weighted in favor of the standard penetration test.

Acknowledgment

The cooperation of Harbor Bay Isle Associates and Doric Development, Inc. is greatly appreciated.

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Overburden Correction Factors for SPT in Sand

By Samson S. C. Liao,[1] A. M. ASCE and Robert V. Whitman,[2] F. ASCE

Introduction

The need for normalizing or correcting the results of the standard penetration test in sands to account for overburden was first clearly demonstrated by the data published by Gibbs and Holtz (1957). Since then, the correction for overburden has become a standard aspect of calculations of settlements on sand and liquefaction potential. Several formulae and charts for making the correction have been published. However, depending on *which* published correction factor is used, very different interpretations may result. The purpose of this technical note is to try to clarify and resolve some of these differences, and to propose a simple formula for the correction factor.

The experimental basis for the correction factors rests for the most part on data for normally consolidated, uncemented, unaged, primarily quartz, clean sands. Further research is required for the range of soils in general.

Published Correction Factors

The SPT correction factor C_N is defined as the ratio of the SPT resistance measured at a given effective vertical stress level $\bar{\sigma}_v$ to the resistance measured at a standard stress level $(\bar{\sigma}_v)_{ref}$, usually 1 ton/sq ft or equivalently 1 kg/cm^2. In practice, the SPT resistance N is measured and then normalized or corrected to N_1 using the equation

$$N_1 = C_N N \qquad (1)$$

The commonly used overburden correction factors that have been published in the literature are summarized in Table 1 and plotted in Fig. 1.

Inconsistent Correction Factors.—Fig. 1(*a*) shows the wide range of correction factors that are available in the literature. The Teng (1962) equation plots to the right of all the other correction factors simply because its reference stress level $(\bar{\sigma}_v)_{ref}$ is at approximately 2.9 tsf (40 psi), whereas the other curves are standardized at 1.0 tsf. The use of different stress levels for standardization of the SPT N-value does not present a conflict, as long as empirical correlations associated with each are consistently applied. For example, if liquefaction criteria are established from data using a correction based on a certain $(\bar{\sigma}_v)_{ref}$, then future evaluations

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Note.—Discussion open until August 1, 1986. To extend the closing date one month, a written request must be filed with the ASCE Manager of Journals. The manuscript for this paper was submitted for review and possible publication on September 5, 1985. This paper is part of the *Journal of Geotechnical Engineering*, Vol. 112, No. 3, March, 1986. ©ASCE, ISSN 0733-9410/86/0003-0373/$01.00. Paper No. 20479.

TABLE 1.—Summary of Published Correction Factors

Reference (1)	Correction factor C_N (2)	Units of $\bar{\sigma}_v$ (3)
Teng (1962)	$C_N = \dfrac{50}{10 + \bar{\sigma}_v}$	psi
Bazaraa (1967)	$C_N = \begin{cases} \dfrac{4}{1 + 2\bar{\sigma}_v} & \sigma_v \le 1.5 \\ \dfrac{4}{3.25 + 0.5\bar{\sigma}_v} & \bar{\sigma}_v > 1.5 \end{cases}$	ksf
Peck, Hansen, and Thornburn (1974)	$C_N = 0.77 \log_{10} \dfrac{20}{\bar{\sigma}_v}$	tsf
Seed (1976)	$C_N = 1 - 1.25 \log_{10} \bar{\sigma}_v$	tsf
Seed (1979)	See Fig. 1(*b*)	tsf
Tokimatsu and Yoshimi (1983)	$C_N = \dfrac{1.7}{0.7 + \bar{\sigma}_v}$	kg/cm²

should use the same correction factor.

The Teng (1962) correction is also frequently referred to as the Gibbs and Holtz correction factor. Although the interpretation of Terzaghi and Peck's (1948) classifications of SPT resistance as a function of relative density, which led to this particular correction, originated with Gibbs and Holtz (1957), the actual equation for the correction factor can be attributed to Teng (1962).

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The leftmost curve in Fig. 1(*a*) is that presented by Seed (1976). This correction factor is very conservative especially at high overburden pressures, and in fact, becomes negative for $\bar{\sigma}_v$ > 6.3 tsf. Seed (1979) has since revised his recommendations for C_N, based particularly on the data from Marcuson and Bieganousky (1977a, 1977b). Even so, the earlier Seed

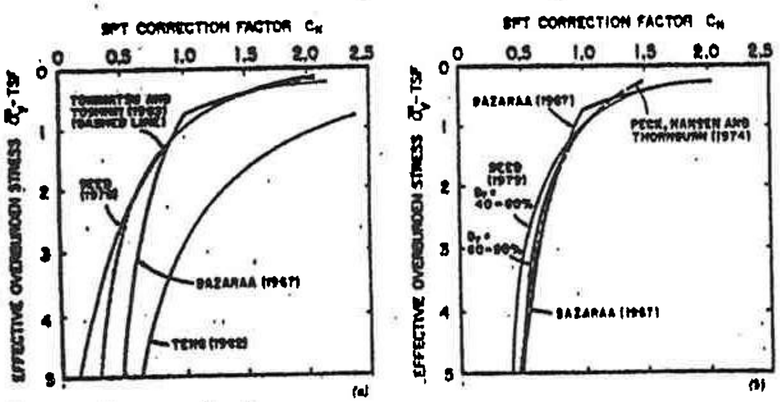

FIG. 1.—Comparison of Published Corrections Factors: (*a*) Inconsistent Correction Factors; (*b*) Consistent Correction Factors

(1976) correction factor may still be in use, though this practice ...ld be discouraged.

The correction factor presented by Tokimatsu and Yoshimi (1983) is based on Meyerhoff (1957) and is also somewhat conservative for $\bar{\sigma}_v$ > 1.5 tsf. Tokimatsu and Yoshimi propose that this is justified because of a reduction in the energy reaching the SPT sampler for the longer rod lengths and depths corresponding to higher values of $\bar{\sigma}_v$. However, this constitutes a mixing of the different effects of overburden and energy transmission, which would be better taken care of, in the writers' opinion, by accounting *separately* for these effects using a formulation similar to that proposed by Kovacs, et al. (1984), or Seed, et al. (1985). Based on the available data, it appears that the correction factor C_N is independent of hammer energy, even though relative density correlations may be affected.

Consistent Correction Factors.—Fig. 1(*b*) shows the Bazaraa (1967), Peck, Hansen, and Thornburn (1973) and the Seed (1979) correction factors. The Bazaraa (1967) correction factor has a slope discontinuity and does not equal 1 at $\bar{\sigma}_v$ = 1 tsf. It is shown in both Figs. 1(*a*–*b*) as a reference for comparison. The Seed (1979) correction curves are based on the data presented by Marcuson and Bieganousky (1977b), which show a dependence not only on $\bar{\sigma}_v$, but also on the relative density D_r. The curves in Fig. 1(*b*) all fall within a fairly narrow band of values. Thus for engineering applications, and considering the statistical errors associated with the SPT, these correction factors may be considered to be practically equivalent.

Proposed Correction Factor

Standardization.—In view of the recent efforts at promoting stricter standardization of the SPT (e.g., Kovacs and Salamone 1982; Kovacs, et al. 1984; and Seed et al. 1984), it is proposed that standards of common interpretation of overburden correction factors should also be desirable. Thus it is recommended that the Teng (1962) correction factor should be phased out of usage, because its standard stress level is set too high at $(\bar{\sigma}_v)_{ref}$ = 2.9 tsf. It is also recommended that the Seed (1976) and Tokimatsu and Yoshimi (1983) correction factors should not be used, or at least be restricted for use to $\sigma_v \le$ 1.5 tsf, because of their conservative values for σ_v > 1.5 tsf. *Use of any of the correction factors shown in Fig. 1(b) is acceptable and would lead to at least a temporary standard of interpretation and fairly consistent results.* However, a simple correction factor, which is comparable to any of those in Fig. 1(*b*) is proposed as:

$$C_N = \sqrt{\frac{1}{\bar{\sigma}_v}} \quad (\bar{\sigma}_v \text{ in tsf or kg/cm}^2) \qquad (2)$$

Comparison of this correction factor with the Bazaraa (1967) and the Seed (1979) correction factors is shown in Fig. 2.

Other Rationale.—The mathematical form of the proposed correction factor is not new. More generally, the form can be written as

$$C_N = \left[\frac{(\bar{\sigma}_v)_{ref}}{\bar{\sigma}_v}\right]^k \qquad (3)$$

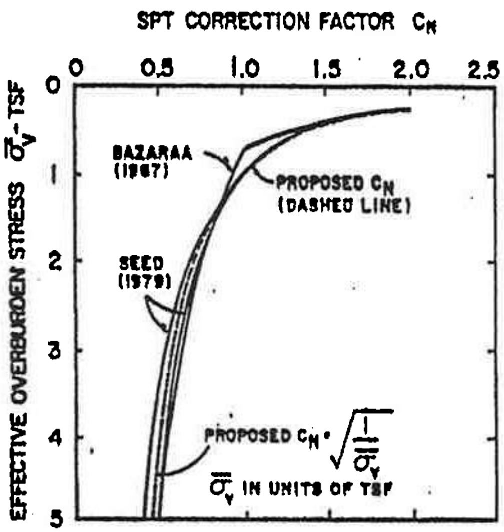

FIG. 2.—Comparison of Proposed C_N with Bazaraa (1967) and Seed (1969) Correction Factors

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where k is a parameter to be obtained by fitting to test data. Al-Akwati (1975), Fardis and Veneziano (1981), and Baldi, et al. (1985) have fitted data from static and dynamic penetration tests to Eq. 3 or to a similar form. Their results indicate k to vary between 0.4 to 0.6 depending on the data used and the method of regression. Baldi, et al. (1985) indicate slightly higher values of k for cone penetration data with a mean k = 0.72.

It is probable that the coefficient k is a function of relative density, as suggested by Marcuson and Bieganousky (1977b) and Seed (1979), and possibly other factors as well. However, as a practical matter, considering the relative crudeness and the accuracy (or lack thereof) with which the penetration resistance can be measured, k = 0.5 or Eq. 2 is considered to be appropriate as a tentative recommendation.

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APPENDIX D – Slope Stability Analysis

Alliant Energy
Interstate Power and Light Company
Sixth Street Generating Station
Cedar Rapids, Iowa

Safety Factor Assessment

March 10, 2026
File No. 25225170.01

TECHNICAL MEMORANDUM

ANALYSIS PREPARED BY:	Lukas Charmelo Brandon Suchomel
ANALYSIS REVIEWED BY:	Deb Nelson
SUBJECT:	Embankment Slope Stability Analysis SSS Closed Ash Pond Sixth Street Generation Station, Cedar Rapids, Iowa

PURPOSE

The purpose of this memorandum is to summarize the analyses performed for the safety factor assessment of the existing embankments of the Closed Ash Pond at the Sixth Street Generating Station. The Closed Ash Pond is a legacy Coal Combustion Residual (CCR) surface impoundment and is subject to the requirements under 40 CFR 257.73(e) which requires evaluation of the following:

- (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.

CONCLUSION

The attached results confirm that geometry and material properties of the Closed Ash Pond embankment has a calculated Factors of Safety (FS) that meet the minimum recommended FS under 40 CFR 257.73(e) for the following condition:

- The calculated seismic factor of safety equals or exceeds 1.00.

The attached results show that the geometry and material properties of the Closed Ash Pond embankment have calculated FS values that do not meet the minimum recommended FS for the following condition:

- The calculated static factor of safety under the long-term, maximum storage pool loading condition does not equal or exceed 1.50.

A separate analysis shows that the embankment and foundation soils are not susceptible to liquefaction.

The maximum surcharge pool loading condition scenario would be analyzed with a maximum surcharge pool at 728 feet elevation (see Reference 11). At the analyzed embankment sections, this would result in a piezometric condition that would not have a storage pool but would fully infiltrate through the final cover system and saturate the underlying CCR. The design and construction of the final cover system would limit infiltration and therefore this scenario would not occur. Therefore, the surcharge pool scenario does not apply to the current Closed Ash Pond embankments and was not analyzed.

APPROACH

The Closed Ash Pond embankment was evaluated at the post-closure conditions. Initial closure of the former CCR surface impoundment was substantially completed in October 2018.. Analysis was performed at the most critical/highest embankment height location through the southwest and northwest embankment.

- (i) The calculated static factor of safety under the long-term, maximum storage pool loading condition must equal or exceed 1.50.
  - Under normal operations the Closed Ash Pond is dry. Water levels in the soil under the embankment were assumed to be at the same elevation that was observed in nearby piezometers in August through November 2025 (elevation 720 ft).
- (ii) The calculated static factor of safety under the maximum surcharge pool loading condition must equal or exceed 1.40.
  - The surcharge pool scenario does not apply to the current Closed Ash Pond embankments and was not analyzed.
- (iii) The calculated seismic factor of safety must equal or exceed 1.00.
  - Evaluated psuedostatic analysis utilizing earthquake horizontal coefficient of 0.04 g and vertical coefficient of 0.04 g (see Reference 10). Water level in the soil under the embankment were assumed to be at the same elevation that was observed in nearby piezometers in August through November 2025 (elevation 720 ft).
- (iv) For dikes constructed of soils that have susceptibility to liquefaction, the calculated liquefaction factor of safety must equal or exceed 1.20.
  - The embankment and foundation soils are not susceptible to liquefaction (see Reference 12).

Section Setup

The southwest embankment consists of final cover overlying embankment stiff clay/silt overlaying loose to very loose CCR overlaying medium stiff organic clay/silt overlaying medium dense sand (see Reference 4).

The geometry of the analyzed section was generalized based on 2014 and 2018 survey data of the site (see Reference 2). Embankment slopes are approximately 5H:1V at the top of the slope and 1.5H:1V at the toe of the slope.

Water levels observed in nearby piezometers in August through November 2025 were used to represent the piezometric conditions in the soils underlying the embankment under normal conditions and long-term condition. The water level in the exterior Closed Ash Pond was assumed to be equal to the groundwater elevation beneath the embankment.

The northwest embankment consists of final cover overlying upper medium dense CCR overlaying lower loose to very loose CCR overlaying medium stiff organic clay/silt overlaying medium dense sand (see Reference 4). Limited investigation into the railroad property to the northwest has been able to be conducted but it is understood that railroad ballast fill is present near the toe of the embankment. Historic borings conducted during Iowa Department of Transportation design of the highway overpass through the impoundment area included borings in the railroad area to the north (see Reference 5) that identify weathered limestone material that would be consistent with railroad ballast fill. The findings from these borings were interpreted to apply to material along extents of the northwest embankment toe based on historic aerial imagery that shows railroad construction into the adjacent areas in approximately 1950 (see Reference 13). The slope of the installed railroad ballast material was assumed to be placed at an approximate 1H:1V slope.

The geometry of the analyzed section was generalized based on 2014 and 2018 survey data of the site (see Reference 2). Embankment slopes are approximately 3H:1V at the top of the slope and 2H:1V at the toe of the slope.

Water levels observed in nearby piezometers in August through November 2025 were used to represent the piezometric conditions in the soils underlying the embankment under normal conditions and long-term condition. The water level in the exterior Closed Ash Pond was assumed to be equal to the groundwater elevation beneath the embankment.

ASSUMPTIONS

The analyses were performed with the following assumptions:

- Water level and piezometric conditions are appropriate for the current site condition understanding.
- Circular slip surface failure stability analyses are appropriate to evaluate the slope stability.
- Material properties shown in the attached *Material Properties and Factor of Safety Results Summary* tables are based on the indicated references, laboratory test results, and assumed values based on experience.. Friction angles for soils are conservative assumed values based on soil type, published typical values (UFC DM 7.1), and SCS experience.

RESULTS

The calculated safety factors for each slope section and failure type are shown in the attached *Material Properties and Factor of Safety Results Summary* table.

REFERENCES

1. Geo-Slope International, Ltd., GeoStudio 2024.2.1, Slope/W slope stability software.

2. SCS Engineers, Former 6th Street Generating Station Settling Pond Closure Construction Documentation Drawings, October 2018.

3. SCS Engineers, 6th Street Generating Station Coal Combustion Residue (CCR) Settling Ponds Closure Plan Drawings, December 2014, Amended January 2016.

4. SCS Engineers, GT1 and GT2 Geotechnical Borings, drilled November 2025, and Borings B1 and B2 drilled in 2014.

5. Iowa Department of Transportation Soil Borings, installed between May 1963 and March 1971.

6. GESTRA Engineering, Inc., Laboratory Test Report for Borings GT1 and GT2, December 19, 2025.

7. CGC, Inc., Laboratory Test Report for Borings B1 and B2, May 2014.

8. Unified Facilities Criteria, Soil Mechanics (DM 7.1) UFC 3-220-10, 1 February 2022, US Department of Defense, Chapter 8 Correlations for Soil and Rock (Correlations with Standard Penetration Test).

9. SCS Engineers, Sixth Street Generation Station Liquefaction Analysis, December 2025.

10. USGS Seismic Impact Zones Map, Two-Percent probability of exceedance in 50 years, 2014.

11. Hard Hat Services, CCR Surface Impoundment, Inflow Design Flood Control Plan.

12. Hard Hat Services, CCR Surface Impoundment, Safety Factor and Structural Stability Assessment.

13. Hard Hat Services, CCR Surface Impoundment, History of Construction Report.

Attachments: Calculations organized as follows:

- Analysis Section Location Figure
- Material Properties and Factor of Safety Summary Results Table
- Slope/W Outputs

BSS/LAC/ACR/DLN/EJN

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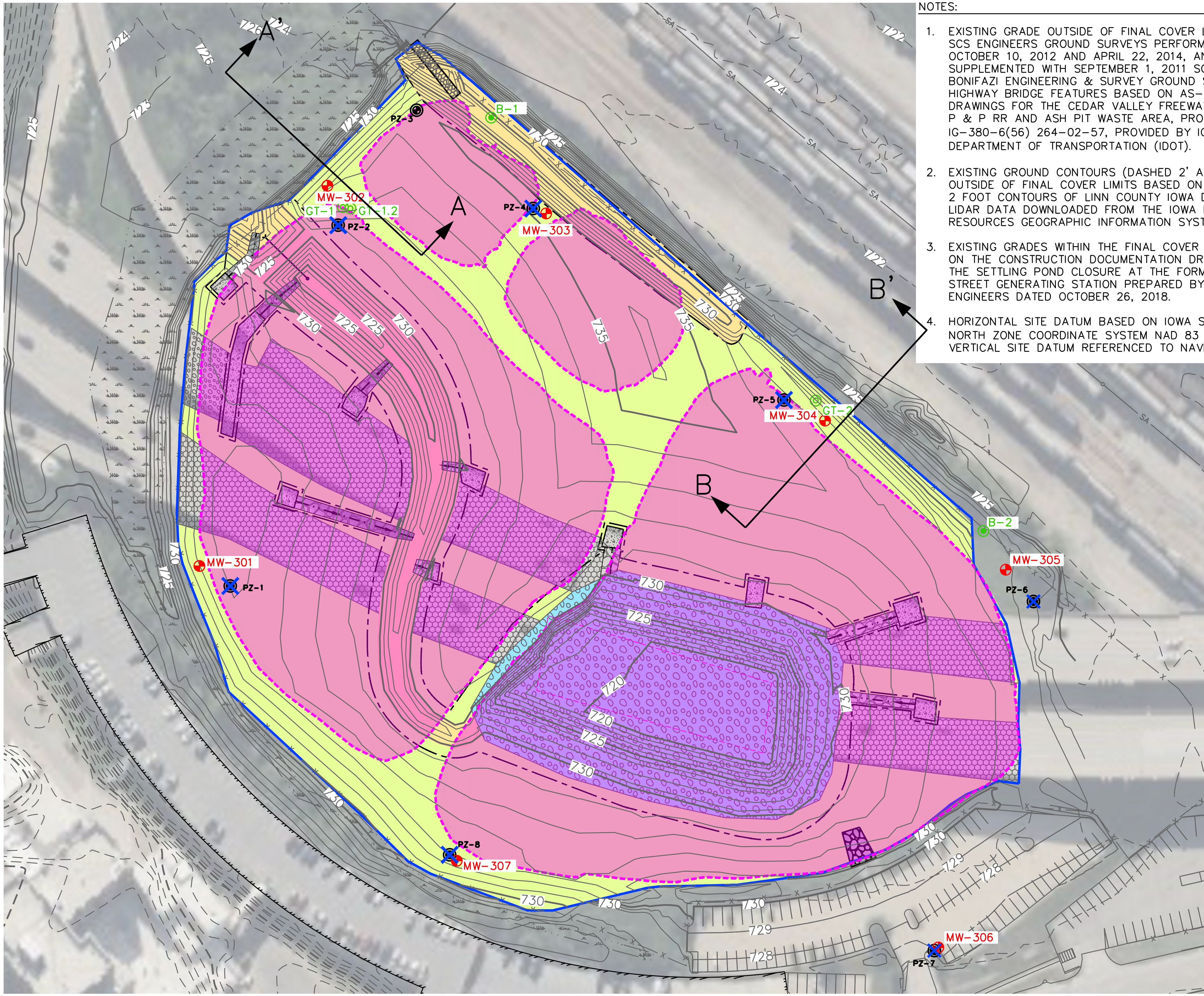

NOTES:

1. EXISTING GRADE OUTSIDE OF FINAL COVER LIMITS FROM SCS ENGINEERS GROUND SURVEYS PERFORMED ON OCTOBER 10, 2012 AND APRIL 22, 2014, AND SUPPLEMENTED WITH SEPTEMBER 1, 2011 SCHNOOR BONIFAZI ENGINEERING & SURVEY GROUND SURVEY. HIGHWAY BRIDGE FEATURES BASED ON AS-BUILT DRAWINGS FOR THE CEDAR VALLEY FREEWAY OVER CM ST. P & P RR AND ASH PIT WASTE AREA, PROJECT NO. IG-380-6(56) 264-02-57, PROVIDED BY IOWA DEPARTMENT OF TRANSPORTATION (IDOT).
2. EXISTING GROUND CONTOURS (DASHED 2' AND 10') OUTSIDE OF FINAL COVER LIMITS BASED ON GENERALIZED 2 FOOT CONTOURS OF LINN COUNTY IOWA DERIVED FROM LIDAR DATA DOWNLOADED FROM THE IOWA NATURAL RESOURCES GEOGRAPHIC INFORMATION SYSTEMS LIBRARY.
3. EXISTING GRADES WITHIN THE FINAL COVER LIMITS BASED ON THE CONSTRUCTION DOCUMENTATION DRAWINGS FOR THE SETTLING POND CLOSURE AT THE FORMER 6TH STREET GENERATING STATION PREPARED BY SCS ENGINEERS DATED OCTOBER 26, 2018.
4. HORIZONTAL SITE DATUM BASED ON IOWA STATE PLANE, NORTH ZONE COORDINATE SYSTEM NAD 83 (2011). VERTICAL SITE DATUM REFERENCED TO NAVD 88.
5. EXISTING WETLAND LIMITS PROVIDED BY STANTEC CONSULTING SERVICES, INC. WETLAND LIMITS ARE BASED ON STANTEC'S OCTOBER 19, 2012 ON-SITE WETLAND DETERMINATION.
6. AERIAL IMAGE FROM BING MAPS USING CIVIL 3D.
7. GEOPROBE/1" DIAMETER TEMPORARY MONITORING WELLS (PIEZOMETERS) GP-1/PZ-1 THRU GP-8/PZ-8 DRILLED/INSTALLED BY TERRACON ON AUG. 4-5, 2025.
8. PZ-1 THRU PZ-8 SURVEYED BY MOHN SURVEYING ON AUG. 27, 2025.
9. EXISTING PZ-3 TO REMAIN AS WATER LEVEL ONLY WELLS FOR INDEFINITE PERIOD OF TIME.
10. GEOTECHNICAL SOIL BORINGS AND 2" DIAMETER MONITORING WELLS MW-301 THRU MW-307 DRILLED/INSTALLED BY TERRACON ON NOVEMBER 10-13, 2025.
11. SOIL BORINGS B-1 AND B-2 WERE DRILLED ON APRIL 23-24, 2014.

LEGEND

- EXISTING GRADE (1' CONTOUR)
- 725 — EXISTING GRADE (5' CONTOUR)
- EXISTING GRADE (2' CONTOUR)
- 740 — EXISTING GRADE (10' CONTOUR)
- EXISTING WETLAND
- x — x EXISTING CHAIN LINK FENCE
- PZ-5 EXISTING GEOPROBE SOIL BORING/1" DIAMETER MONITORING WELL (PIEZOMETER) WATER LEVEL ONLY
- LIMITS OF LAMINATED GEOSYNTHETIC CLAY LINER (GCL)
- SOIL FINAL COVER AREA
- POND FINAL COVER AREA
- SWALE FINAL COVER AREA
- LIMITS OF FINAL COVER
- APPROXIMATE LIMIT OF SETTLING PONDS PRIOR TO FINAL COVER CONSTRUCTION
- PZ-5 ABANDONED 1" DIAMETER MONITORING WELL (PIEZOMETER)
- MW-305 EXISTING 2" DIAMETER MONITORING WELL
- GT-2 GEOTECHNICAL SOIL BORING (2025)
- B-2 SOIL BORING (2014)

N

100 0 100

SCALE: 1" = 100'

PROJECT NO.	25225170.01	DRAWN BY:	AR
DRAWN:	12/08/2025	CHECKED BY:	BSS
REVISED:	03/10/2026	APPROVED BY:	BSS 05/06/2026

ENGINEER: SCS ENGINEERS
2830 DAIRY DRIVE MADISON, WI 53718-6751
PHONE: (608) 224-2830

CLIENT: INTERSTATE POWER AND LIGHT CO.
200 1ST STREET S.E.
CEDAR RAPIDS, IA 52402

SITE: FORMER 6TH STREET GENERATING STATION
CEDAR RAPIDS, IOWA

CROSS SECTION LOCATION MAP

FIGURE
1

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Slope Stability - CCR Surface Impoundment - Section A-A' & B-B'
Material Properties and Factors of Safety Results Summary
6th Street Generating Station

Material	Unit Weight (pcf)	Friction Angle (degrees)	Cohesion (psf)
Final Cover	120	28	0
Embankment Stiff Clay/Silt	120	28	0
Railroad Ballast	135	32	0
Medium Dense CCR	90	25	0
Loose to Very Loose CCR	90	22	0
Medium Stiff Organic Clay/Silt	110	0	750
Medium Dense Sand	120	30	0

Required Minimum Safety Factor (CFR 257.73(e))

FS = 1.5 for normal operation condition

FS = 1.4 for maximum surcharge pool loading condition

FS = 1.0 for seismic factor of safety

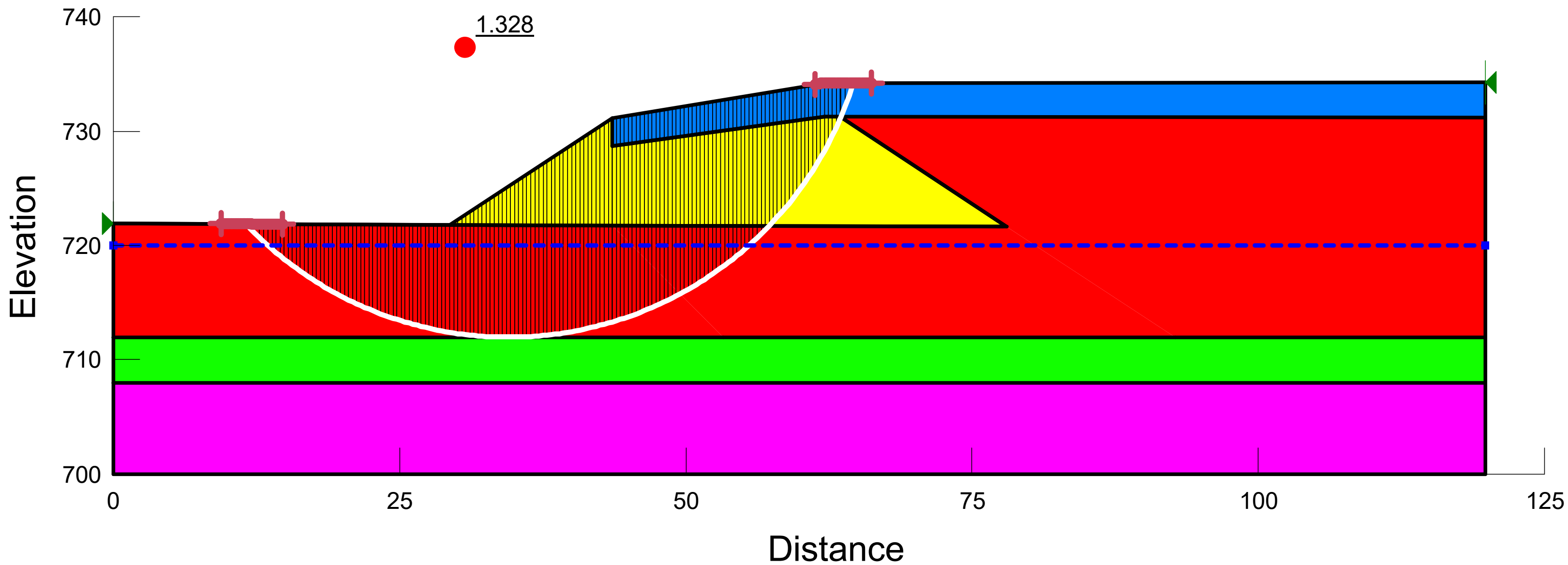
FS = 1.2 for normal operating condition for dikes constructed of soils susceptible to liquefaction

Scenario Analyzed	Failure Type	Calculated Safety Factor	Required Safety Factor	Comments
Section A				
01_SSS A-A' Base Condition	Circular	1.328	1.5	Evaluating Section A-A'. Piezo WL set at normal pond water elevation of 720 ft.
02_SSS A-A' Base Condition_Seismic	Circular	1.203	1.0	Evaluating Section A-A'. Piezo WL set at normal pond water elevation of 720 ft. Seismic horizontal and vertical coefficients: 0.04g
Section B				
01_SSS B-B' Base Condition	Circular	1.381	1.5	Evaluating Section B-B'. Piezo WL set at normal pond water elevation of 720 ft. Section slip surface want to be shallow veneer on outer slope. Forced minimum slip surface dept to 10 ft to evaluate deep seated failure.
02_SSS B-B' Base Condition_Seismic	Circular	1.263	1.0	Evaluating Section B-B'. Piezo WL set at normal pond water elevation of 720 ft. Seismic horizontal and vertical coefficients: 0.04g Section slip surface want to be shallow veneer on outer slope. Forced minimum slip surface dept to 10 ft to evaluate deep seated failure.

Notes:
1. Seismic coefficient based on USGS 2014 Seismic Hazard Maps which show the site mapped in the zone of 0.02g-0.04g zone for peak acceleration.
2. Under normal operations the Closed Ash Pond does not have pooled water at the embankment section locations. Water level in the soil under the embankment were assumed to be at elevation 720 ft based on August-September 2025 temporary piezometer measurements.
3. Maximum surcharge storage pool condition does not apply to the Closed Ash Pond sections and was not analyzed.
4. Liquefaction analysis scenario not conducted as Closed Ash Pond embankments and underlying materials/soils are not susceptible to liquefaction.

Updated by: LAC 03/02/2026
Checked by: BSS 03/10/2026

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Phi-B (°)	Piezometric Surface
Yellow	Embankment Stiff Clay/Silt	Mohr-Coulomb	120	0	28	0	1
Blue	Final Cover	Mohr-Coulomb	120	0	28	0	
Red	Loose to Very Loose CCR	Mohr-Coulomb	90	0	22	0	1
Magenta	Medium Dense Sand	Mohr-Coulomb	120	0	30	0	1
Green	Medium Stiff Organic Clay/Silt	Mohr-Coulomb	110	750	0	0	1



Title: SSS Closed Ash Pond Embankment Analysis
Name: 01_SSS A-A' Base Condition
Directory: I:\25225170.01\Data and Calculations\Geotechnical\Slope Stability\SlopeW\6th Street A.gsz

SCS ENGINEERS

01_SSS A-A' Base Condition

File Information

File Version: 11.07
Product Version: 24.2.1.28
Title: SSS Closed Ash Pond Embankment Analysis
Comments: Slope stability for 6th Street.
Created By: Charmelo, Lukas
Last Edited By: Suchomel, Brandon
Revision Number: 101
Date: 01/21/2026
Time: 08:22:25 AM
File Name: 6th Street A.gsz
Directory: I:\25225170.01\Data and Calculations\Geotechnical\Slope Stability\SlopeW\
Last Solved Date: 01/21/2026
Last Solved Time: 08:22:34 AM

Project Settings

Unit System: U.S. Customary Units

Analysis Settings

01_SSS A-A' Base Condition

- Kind: SLOPE/W
- Analysis Type: Bishop
- Settings
  - PWP Conditions from: Piezometric Surfaces
  - Apply Phreatic Correction: No
  - Use Staged Rapid Drawdown: No
  - Unit Weight of Water: 62.430189 pcf
- Slip Surface
  - Direction of movement: Right to Left
  - Use Passive Mode: No
  - Slip Surface Option: Entry and Exit
  - Critical slip surfaces saved: 10
  - Optimize Critical Slip Surface Location: No
  - Tension Crack Option: (none)
- Distribution
  - F of S Calculation Option: Constant
- Convergence
  - Geometry Settings
    - Minimum Slip Surface Depth: 0.1 ft
    - Minimum Slip Surface Volume: 35.314667 ft³
    - Number of Columns: 150
  - Factor of Safety Convergence Settings
    - Maximum Number of Iterations: 100
    - Tolerable difference in F of S: 0.001

Under-Relaxation Criteria
Initial Rate: 1
Minimum Rate: 0.1
Rate Reduction Factor: 0.65
Reduction Frequency (iterations): 50

Materials

Final Cover

Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 120 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 28 °
Phi-B: 0 °

Loose to Very Loose CCR

Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 90 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 22 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Surface: 1

Embankment Stiff Clay/Silt

Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 120 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 28 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Surface: 1

Medium Stiff Organic Clay/Silt

Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 110 pcf
Effective Cohesion: 750 psf
Effective Friction Angle: 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Surface: 1

Medium Dense Sand

Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 120 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 30 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Surface: 1

Slip Surface Entry and Exit

Left Type: Range
Left-Zone Left Coordinate: (9.42044, 721.90649) ft
Left-Zone Right Coordinate: (14.79345, 721.88225) ft
Left-Zone Increment: 50
Right Type: Range
Right-Zone Left Coordinate: (61.2656, 734.10116) ft
Right-Zone Right Coordinate: (66.20398, 734.241) ft
Right-Zone Increment: 50
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 721.94898) ft
Right Coordinate: (119.80222, 734.2613) ft

Piezometric Surfaces

Piezometric Surface 1

Coordinates

	X	Y
Coordinate 1	0 ft	720 ft
Coordinate 2	119.80222 ft	720 ft

Geometry

Name: 2D Geometry

Settings

View: 2D
Element Thickness: 1 ft

Points

	X	Y
Point 1	0 ft	700 ft
Point 2	119.80222 ft	700 ft
Point 3	0 ft	707.98508 ft
Point 4	119.80222 ft	711.95031 ft
Point 5	119.80222 ft	731.19405 ft
Point 6	63.45831 ft	731.23838 ft
Point 7	92.77349 ft	711.95031 ft
Point 8	43.56608 ft	731.16743 ft
Point 9	29.28922 ft	721.77392 ft
Point 10	77.95491 ft	721.70025 ft
Point 11	62.09989 ft	731.23838 ft
Point 12	43.56608 ft	728.72413 ft
Point 13	119.80222 ft	734.2613 ft
Point 14	62.09989 ft	734.23945 ft

Point 15	62.09989 ft	731.23945 ft
Point 16	53.25898 ft	711.95031 ft
Point 17	77.95494 ft	721.70025 ft
Point 18	43.56625 ft	721.7523 ft
Point 19	0 ft	707.96495 ft
Point 20	0 ft	721.94898 ft
Point 21	119.80222 ft	707.96941 ft
Point 22	77.74707 ft	721.70056 ft
Point 23	43.56422 ft	721.75231 ft
Point 24	29.35406 ft	721.81658 ft
Point 25	0.00012 ft	707.98508 ft
Point 26	0 ft	711.95031 ft
Point 27	9e-05 ft	711.95031 ft

Regions

	Material	Points	Area
Region 1	Loose to Very Loose CCR	4,5,6,17,7	802.8 ft²
Region 2	Embankment Stiff Clay/Silt	8,24,23,22,10,6,11,12	301.58 ft²
Region 3	Final Cover	13,14,8,12,15,6,5	225.49 ft²
Region 4	Loose to Very Loose CCR	16,7,17,10,22,18	360.92 ft²
Region 5	Medium Dense Sand	1,2,21,19	954.49 ft²
Region 6		3,19,25	1.2078e-06 ft²
Region 7	Loose to Very Loose CCR	20,26,27,16,18,23	478.82 ft²
Region 8	Medium Stiff Organic Clay/Silt	19,21,4,7,16,27,25	477.19 ft²
Region 9	Medium Stiff Organic Clay/Silt	24,20,23	0.0025801 ft²

Slip Results

Slip Surfaces Analysed: 2163 of 13005 converged

Current Slip Surface

Slip Surface: 5,274
Factor of Safety: 1.328
Volume: 573.93348 ft³
Weight: 59,572.556 lbf
Resisting Moment: 627,292.76 lbf·ft
Activating Moment: 472,527.02 lbf·ft
Resisting Force: 16,486.829 lbf
Activating Force: 14,216.093 lbf
Slip Rank: 1 of 13,005 slip surfaces
Exit: (64.620056, 734.2404) ft
Entry: (11.569644, 721.8968) ft
Radius: 31.49264 ft
Center: (34.510842, 743.47196) ft

Slip Columns

	X	Y	PWP	Base Normal Stress	Frictional Strength	Cohesive Strength	Suction Strength	Column Base Material

Column 1	64.43842 ft	733.68497 ft	0 psf	29.953582 psf	15.926602 psf	0 psf	0 psf	Final Cover
Column 2	64.07514 ft	732.63406 ft	0 psf	92.099987 psf	48.970432 psf	0 psf	0 psf	Final Cover
Column 3	63.70405 ft	731.66996 ft	0 psf	154.91582 psf	82.370201 psf	0 psf	0 psf	Final Cover
Column 4	63.48646 ft	731.13523 ft	-695.17451 psf	191.67849 psf	101.91726 psf	0 psf	0 psf	Embankment Stiff Clay/Silt
Column 5	63.28851 ft	730.68691 ft	-667.18604 psf	224.19803 psf	119.20821 psf	0 psf	0 psf	Embankment Stiff Clay/Silt
Column 6	62.94890 ft	729.94766 ft	-621.03415 psf	279.54641 psf	148.63746 psf	0 psf	0 psf	Embankment Stiff Clay/Silt
Column 7	62.60930 ft	729.25501 ft	-577.79197 psf	333.80633 psf	177.48797 psf	0 psf	0 psf	Embankment Stiff Clay/Silt
Column 8	62.26969 ft	728.60242 ft	-537.05064 psf	386.9679 psf	205.75448 psf	0 psf	0 psf	Embankment Stiff Clay/Silt
Column 9	61.92830 ft	727.98172 ft	-498.30045 psf	437.32452 psf	232.52957 psf	0 psf	0 psf	Embankment Stiff Clay/Silt
Column 10	61.58513 ft	727.38916 ft	-461.30694 psf	484.77367 psf	257.75873 psf	0 psf	0 psf	Embankment Stiff Clay/Silt
Column 11	61.24196 ft	726.82479 ft	-426.07278 psf	531.01693 psf	282.34671 psf	0 psf	0 psf	Embankment Stiff Clay/Silt
Column 12	60.89879 ft	726.28581 ft	-392.42415 psf	576.10137 psf	306.31853 psf	0 psf	0 psf	Embankment Stiff Clay/Silt
Column 13	60.55562 ft	725.76990 ft	-360.21588 psf	620.07265 psf	329.69847 psf	0 psf	0 psf	Embankment Stiff Clay/Silt
Column 14	60.21244 ft	725.27510 ft	-329.32521 psf	662.9743 psf	352.50969 psf	0 psf	0 psf	Embankment Stiff Clay/Silt
Column 15	59.86927 ft	724.79972 ft	-299.64718 psf	704.84749 psf	374.77406 psf	0 psf	0 psf	Embankment Stiff Clay/Silt
Column 16	59.52610 ft	724.34231 ft	-271.09125 psf	745.73093 psf	396.51217 psf	0 psf	0 psf	Embankment Stiff Clay/Silt
Column 17	59.18293 ft	723.90162 ft	-243.57863 psf	785.66086 psf	417.74329 psf	0 psf	0 psf	Embankment Stiff Clay/Silt
Column 18	58.83975 ft	723.47653 ft	-217.04023 psf	824.67118 psf	438.48545 psf	0 psf	0 psf	Embankment Stiff Clay/Silt
Column 19	58.49658 ft	723.06607 ft	-191.41509 psf	862.79357 psf	458.75548 psf	0 psf	0 psf	Embankment Stiff Clay/Silt
Column 20	58.15341 ft	722.66937 ft	-166.64911 psf	900.05762 psf	478.56912 psf	0 psf	0 psf	Embankment Stiff Clay/Silt
Column 21	57.81024 ft	722.28566 ft	-142.69396 psf	936.49095 psf	497.94107 psf	0 psf	0 psf	Embankment Stiff Clay/Silt
Column 22	57.46707 ft	721.91424 ft	-119.50632 psf	972.11941 psf	516.88506 psf	0 psf	0 psf	Embankment Stiff Clay/Silt
Column 23	57.11667 ft	721.54716 ft	-96.589183 psf	1,079.5332 psf	436.15974 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 24	56.75904 ft	721.18429 ft	-73.935577 psf	1,107.3885 psf	447.41398 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 25	56.40142 ft	720.83290 ft	-51.997803 psf	1,134.4652 psf	458.35368 psf	0 psf	0 psf	Loose to Very Loose CCR

Column 26	56.04379 ft	720.49244 ft	-30.742996 psf	1,160.7913 psf	468.99014 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 27	55.68616 ft	720.16244 ft	-10.14121 psf	1,186.3929 psf	479.33384 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 28	55.33022 ft	719.84392 ft	9.7439039 psf	1,213.2409 psf	486.24434 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 29	54.97595 ft	719.53640 ft	28.942848 psf	1,241.1581 psf	489.76675 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 30	54.62169 ft	719.23795 ft	47.57483 psf	1,268.1303 psf	493.13643 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 31	54.26742 ft	718.94826 ft	65.660561 psf	1,294.195 psf	496.36012 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 32	53.91316 ft	718.66700 ft	83.219189 psf	1,319.3866 psf	499.44406 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 33	53.55889 ft	718.39391 ft	100.26846 psf	1,343.7372 psf	502.39397 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 34	53.20463 ft	718.12871 ft	116.82484 psf	1,367.2762 psf	505.21513 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 35	52.85036 ft	717.87116 ft	132.90365 psf	1,390.031 psf	507.91244 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 36	52.49610 ft	717.62104 ft	148.51919 psf	1,412.0273 psf	510.49041 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 37	52.14183 ft	717.37812 ft	163.68476 psf	1,433.2886 psf	512.95326 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 38	51.78757 ft	717.14220 ft	178.41284 psf	1,453.8372 psf	515.3049 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 39	51.43330 ft	716.91311 ft	192.71509 psf	1,473.6938 psf	517.54898 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 40	51.07904 ft	716.69066 ft	206.60243 psf	1,492.8776 psf	519.6889 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 41	50.72477 ft	716.47470 ft	220.08513 psf	1,511.4069 psf	521.72785 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 42	50.37051 ft	716.26506 ft	233.17282 psf	1,529.2986 psf	523.66881 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 43	50.01624 ft	716.06161 ft	245.87457 psf	1,546.5688 psf	525.51456 psf	0 psf	0 psf	Loose to Very Loose CCR

Column 44	49.66198 ft	715.86420 ft	258.19891 psf	1,563.2324 psf	527.26774 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 45	49.31044 ft	715.67413 ft	270.06478 psf	1,579.1843 psf	528.91862 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 46	48.96162 ft	715.49120 ft	281.48515 psf	1,594.4469 psf	530.47097 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 47	48.61280 ft	715.31378 ft	292.56157 psf	1,609.1599 psf	531.94027 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 48	48.26398 ft	715.14177 ft	303.3005 psf	1,623.3348 psf	533.32849 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 49	47.91516 ft	714.97506 ft	313.70805 psf	1,636.9822 psf	534.63748 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 50	47.56634 ft	714.81357 ft	323.79 psf	1,650.1123 psf	535.869 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 51	47.21752 ft	714.65720 ft	333.55184 psf	1,662.7346 psf	537.0247 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 52	46.86870 ft	714.50588 ft	342.99875 psf	1,674.8583 psf	538.10617 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 53	46.51988 ft	714.35953 ft	352.13563 psf	1,686.4918 psf	539.11488 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 54	46.17107 ft	714.21807 ft	360.96715 psf	1,697.6434 psf	540.05226 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 55	45.82225 ft	714.08143 ft	369.49771 psf	1,708.3208 psf	540.91962 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 56	45.47343 ft	713.94954 ft	377.73149 psf	1,718.5312 psf	541.71825 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 57	45.12574 ft	713.82274 ft	385.6476 psf	1,728.2514 psf	542.44716 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 58	44.77919 ft	713.70094 ft	393.25165 psf	1,737.491 psf	543.10797 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 59	44.43263 ft	713.58365 ft	400.57386 psf	1,746.2892 psf	543.70429 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 60	44.08608 ft	713.47083 ft	407.61754 psf	1,754.6518 psf	544.23716 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 61	43.73944 ft	713.36239 ft	414.3874 psf	1,762.5861 psf	544.70762 psf	0 psf	0 psf	Loose to Very Loose CCR

Column 62	43.56515 ft	713.30897 ft	417.72208 psf	1,766.4142 psf	544.90699 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 63	43.38659 ft	713.25652 ft	420.99698 psf	1,760.4771 psf	541.1851 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 64	43.03134 ft	713.15442 ft	427.371 psf	1,748.3337 psf	533.70358 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 65	42.67609 ft	713.05681 ft	433.46458 psf	1,735.6172 psf	526.10379 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 66	42.32083 ft	712.96365 ft	439.28041 psf	1,722.3327 psf	518.38678 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 67	41.96558 ft	712.87490 ft	444.82104 psf	1,708.4853 psf	510.55349 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 68	41.61032 ft	712.79053 ft	450.08884 psf	1,694.0793 psf	502.60476 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 69	41.25507 ft	712.71048 ft	455.08607 psf	1,679.1189 psf	494.54138 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 70	40.89981 ft	712.63474 ft	459.81484 psf	1,663.608 psf	486.36402 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 71	40.54456 ft	712.56326 ft	464.27711 psf	1,647.55 psf	478.07329 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 72	40.18931 ft	712.49602 ft	468.47473 psf	1,630.9481 psf	469.66973 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 73	39.83405 ft	712.43300 ft	472.40943 psf	1,613.8051 psf	461.15378 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 74	39.47880 ft	712.37416 ft	476.08279 psf	1,596.1235 psf	452.52583 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 75	39.12355 ft	712.31948 ft	479.49631 psf	1,577.9056 psf	443.78618 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 76	38.76829 ft	712.26894 ft	482.65134 psf	1,559.1534 psf	434.93506 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 77	38.41304 ft	712.22253 ft	485.54915 psf	1,539.8684 psf	425.97262 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 78	38.05778 ft	712.18021 ft	488.19088 psf	1,520.052 psf	416.89896 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 79	37.70253 ft	712.14198 ft	490.57756 psf	1,499.7053 psf	407.71408 psf	0 psf	0 psf	Loose to Very Loose CCR

Column 80	37.34728 ft	712.10782 ft	492.71012 psf	1,478.8291 psf	398.41794 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 81	36.99202 ft	712.07772 ft	494.58941 psf	1,457.424 psf	389.01041 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 82	36.63677 ft	712.05166 ft	496.21614 psf	1,435.49 psf	379.49128 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 83	36.28151 ft	712.02964 ft	497.59094 psf	1,413.0273 psf	369.86028 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 84	35.92626 ft	712.01165 ft	498.71434 psf	1,390.0354 psf	360.11707 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 85	35.57100 ft	711.99767 ft	499.58678 psf	1,366.5137 psf	350.26123 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 86	35.21575 ft	711.98771 ft	500.20859 psf	1,342.4615 psf	340.29227 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 87	34.86050 ft	711.98176 ft	500.58 psf	1,317.8775 psf	330.20961 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 88	34.50524 ft	711.97982 ft	500.70116 psf	1,292.7602 psf	320.01262 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 89	34.14999 ft	711.98189 ft	500.57211 psf	1,267.1079 psf	309.70056 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 90	33.79474 ft	711.98797 ft	500.19281 psf	1,240.9185 psf	299.27262 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 91	33.43948 ft	711.99805 ft	499.56311 psf	1,214.1898 psf	288.72792 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 92	33.08423 ft	712.01215 ft	498.68276 psf	1,186.919 psf	278.06548 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 93	32.72897 ft	712.03027 ft	497.55144 psf	1,159.1031 psf	267.28422 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 94	32.37372 ft	712.05242 ft	496.16871 psf	1,130.7389 psf	256.383 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 95	32.01846 ft	712.07861 ft	494.53402 psf	1,101.8227 psf	245.36056 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 96	31.66321 ft	712.10884 ft	492.64677 psf	1,072.3506 psf	234.21554 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 97	31.30796 ft	712.14312 ft	490.5062 psf	1,042.3181 psf	222.94649 psf	0 psf	0 psf	Loose to Very Loose CCR

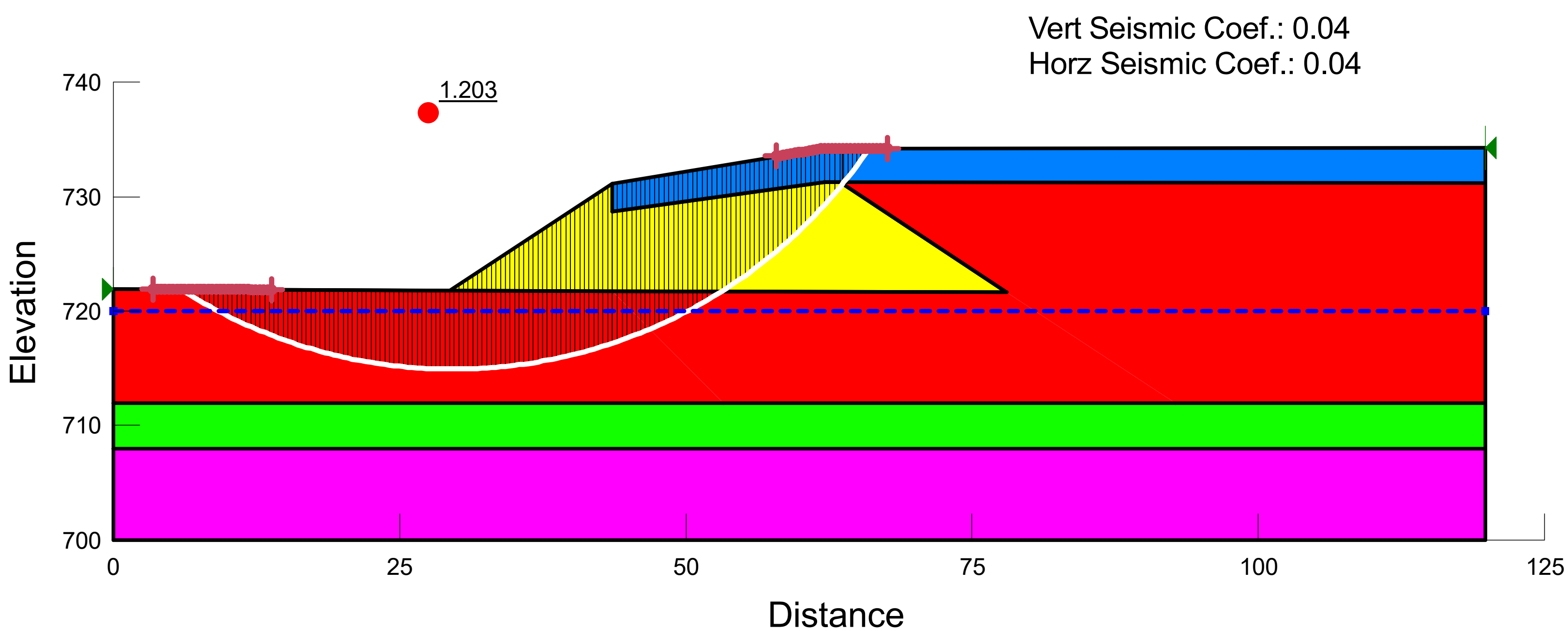
Column 98	30.95270 ft	712.18148 ft	488.1115 psf	1,011.7207 psf	211.55185 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 99	30.59745 ft	712.22393 ft	485.46172 psf	980.55317 psf	200.02993 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 100	30.24219 ft	712.27047 ft	482.55582 psf	948.81008 psf	188.37895 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 101	29.88694 ft	712.32114 ft	479.39265 psf	916.48553 psf	176.59698 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 102	29.53169 ft	712.37595 ft	475.97097 psf	883.57319 psf	164.68199 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 103	29.17806 ft	712.43463 ft	472.30747 psf	864.98536 psf	158.65217 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 104	28.82607 ft	712.49717 ft	468.40308 psf	860.88857 psf	158.57443 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 105	28.47408 ft	712.56385 ft	464.24055 psf	856.42029 psf	158.4509 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 106	28.12208 ft	712.63468 ft	459.81818 psf	851.57742 psf	158.28101 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 107	27.77009 ft	712.70971 ft	455.13419 psf	846.35667 psf	158.06414 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 108	27.41809 ft	712.78896 ft	450.18666 psf	840.75452 psf	157.79966 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 109	27.06610 ft	712.87246 ft	444.97353 psf	834.76726 psf	157.48689 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 110	26.71411 ft	712.96025 ft	439.49264 psf	828.39094 psf	157.12511 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 111	26.36211 ft	713.05237 ft	433.74165 psf	821.62138 psf	156.71358 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 112	26.01012 ft	713.14886 ft	427.71812 psf	814.45416 psf	156.2515 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 113	25.65812 ft	713.24975 ft	421.41942 psf	806.8846 psf	155.73804 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 114	25.30613 ft	713.35509 ft	414.84279 psf	798.90775 psf	155.17232 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 115	24.95414 ft	713.46494 ft	407.98531 psf	790.51837 psf	154.55339 psf	0 psf	0 psf	Loose to Very Loose CCR

Column 116	24.60214 ft	713.57933 ft	400.84388 psf	781.71092 psf	153.88027 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 117	24.25015 ft	713.69832 ft	393.41521 psf	772.47955 psf	153.15193 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 118	23.89815 ft	713.82197 ft	385.69587 psf	762.81809 psf	152.36727 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 119	23.54616 ft	713.95033 ft	377.68218 psf	752.71998 psf	151.5251 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 120	23.19417 ft	714.08347 ft	369.3703 psf	742.17832 psf	150.62421 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 121	22.84217 ft	714.22145 ft	360.75616 psf	731.18579 psf	149.66329 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 122	22.49018 ft	714.36434 ft	351.83544 psf	719.73465 psf	148.64093 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 123	22.13818 ft	714.51221 ft	342.60362 psf	707.81673 psf	147.55567 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 124	21.78619 ft	714.66515 ft	333.0559 psf	695.42334 psf	146.40595 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 125	21.43420 ft	714.82322 ft	323.18723 psf	682.54531 psf	145.19009 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 126	21.08220 ft	714.98652 ft	312.99225 psf	669.17288 psf	143.90632 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 127	20.73021 ft	715.15514 ft	302.46532 psf	655.29572 psf	142.55274 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 128	20.37821 ft	715.32918 ft	291.60047 psf	640.90286 psf	141.12732 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 129	20.02622 ft	715.50872 ft	280.3914 psf	625.98262 psf	139.62792 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 130	19.67423 ft	715.69389 ft	268.83142 psf	610.5226 psf	138.0522 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 131	19.32223 ft	715.88479 ft	256.91347 psf	594.50957 psf	136.39768 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 132	18.97024 ft	716.08154 ft	244.63006 psf	577.92943 psf	134.66169 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 133	18.61825 ft	716.28428 ft	231.97326 psf	560.76713 psf	132.84135 psf	0 psf	0 psf	Loose to Very Loose CCR

Column 134	18.26625 ft	716.49313 ft	218.93464 psf	543.00656 psf	130.93355 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 135	17.91426 ft	716.70824 ft	205.50527 psf	524.63048 psf	128.93496 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 136	17.56226 ft	716.92976 ft	191.67563 psf	505.62041 psf	126.84192 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 137	17.21027 ft	717.15786 ft	177.43563 psf	485.95647 psf	124.65051 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 138	16.85828 ft	717.39270 ft	162.77448 psf	465.61726 psf	122.35643 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 139	16.50628 ft	717.63447 ft	147.6807 psf	444.57971 psf	119.95499 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 140	16.15429 ft	717.88336 ft	132.14203 psf	422.81888 psf	117.44107 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 141	15.80229 ft	718.13960 ft	116.14533 psf	400.30771 psf	114.80905 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 142	15.45030 ft	718.40339 ft	99.676577 psf	377.01684 psf	112.05274 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 143	15.09831 ft	718.67499 ft	82.720681 psf	352.91426 psf	109.16529 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 144	14.74631 ft	718.95465 ft	65.261451 psf	327.96498 psf	106.13912 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 145	14.39432 ft	719.24265 ft	47.28145 psf	302.13066 psf	102.96577 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 146	14.04232 ft	719.53930 ft	28.761868 psf	275.36911 psf	99.635792 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 147	13.69033 ft	719.84491 ft	9.68237 psf	247.63371 psf	96.138581 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 148	13.31987 ft	720.17690 ft	-11.043891 psf	213.07969 psf	86.089783 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 149	12.93094 ft	720.53677 ft	-33.510836 psf	170.75237 psf	68.988436 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 150	12.54201 ft	720.90909 ft	-56.754712 psf	125.77473 psf	50.81629 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 151	12.15308 ft	721.29448 ft	-80.814681 psf	77.865645 psf	31.459763 psf	0 psf	0 psf	Loose to Very Loose CCR

Column 152	11.76413 ft	721.69366 ft	-105.73557 psf	26.688127 psf	10.782703 psf	0 psf	0 psf	Loose to Very Loose CCR

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Phi-B (°)	Piezometric Surface
(yellow)	Embankment Stiff Clay/Silt	Mohr-Coulomb	120	0	28	0	1
(blue)	Final Cover	Mohr-Coulomb	120	0	28	0	
(red)	Loose to Very Loose CCR	Mohr-Coulomb	90	0	22	0	1
(magenta)	Medium Dense Sand	Mohr-Coulomb	120	0	30	0	1
(green)	Medium Stiff Organic Clay/Silt	Mohr-Coulomb	110	750	0	0	1



Title: SSS Closed Ash Pond Embankment Analysis
Name: 02_SSS A-A' Base Conditions_Seismic
Directory: I:\25225170.01\Data and Calculations\Geotechnical\Slope Stability\SlopeW\6th Street A.gsz

SCS ENGINEERS

02_SSS A-A' Base Conditions_Seismic

File Information

- File Version: 11.07
- Product Version: 24.2.1.28
- Title: SSS Closed Ash Pond Embankment Analysis
- Comments: Slope stability for 6th Street.
- Created By: Charmelo, Lukas
- Last Edited By: Suchomel, Brandon
- Revision Number: 98
- Date: 01/21/2026
- Time: 08:19:57 AM
- File Name: 6th Street A.gsz
- Directory: I:\25225170.01\Data and Calculations\Geotechnical\Slope Stability\SlopeW\
- Last Solved Date: 01/21/2026
- Last Solved Time: 08:20:10 AM

Project Settings

- Unit System: U.S. Customary Units

Analysis Settings

02_SSS A-A' Base Conditions_Seismic

- Kind: SLOPE/W
- Analysis Type: Bishop
- Settings
  - PWP Conditions from: Piezometric Surfaces
  - Apply Phreatic Correction: No
  - Use Staged Rapid Drawdown: No
  - Unit Weight of Water: 62.430189 pcf
- Slip Surface
  - Direction of movement: Right to Left
  - Use Passive Mode: No
  - Slip Surface Option: Entry and Exit
  - Critical slip surfaces saved: 10
  - Optimize Critical Slip Surface Location: No
  - Tension Crack Option: (none)
- Distribution
  - F of S Calculation Option: Constant
- Convergence
  - Geometry Settings
    - Minimum Slip Surface Depth: 0.1 ft
    - Minimum Slip Surface Volume: 35.314667 ft³
    - Number of Columns: 150
  - Factor of Safety Convergence Settings
    - Maximum Number of Iterations: 100
    - Tolerable difference in F of S: 0.001

Under-Relaxation Criteria
Initial Rate: 1
Minimum Rate: 0.1
Rate Reduction Factor: 0.65
Reduction Frequency (iterations): 50

Materials

Final Cover
Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 120 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 28 °
Phi-B: 0 °

Loose to Very Loose CCR
Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 90 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 22 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Surface: 1

Embankment Stiff Clay/Silt
Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 120 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 28 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Surface: 1

Medium Stiff Organic Clay/Silt
Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 110 pcf
Effective Cohesion: 750 psf
Effective Friction Angle: 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Surface: 1

Medium Dense Sand
Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 120 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 30 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Surface: 1

Slip Surface Entry and Exit

Left Type: Range
Left-Zone Left Coordinate: (3.4626, 721.93336) ft
Left-Zone Right Coordinate: (13.81498, 721.88667) ft
Left-Zone Increment: 30
Right Type: Range
Right-Zone Left Coordinate: (57.91415, 733.54565) ft
Right-Zone Right Coordinate: (67.64137, 734.24155) ft
Right-Zone Increment: 30
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 721.94898) ft
Right Coordinate: (119.80222, 734.2613) ft

Piezometric Surfaces

Piezometric Surface 1

Coordinates

	X	Y
Coordinate 1	0 ft	720 ft
Coordinate 2	119.80222 ft	720 ft

Seismic Coefficients

Horz Seismic Coef.: 0.04
Vert Seismic Coef.: 0.04

Geometry

Name: 2D Geometry

Settings

View: 2D
Element Thickness: 1 ft

Points

	X	Y
Point 1	0 ft	700 ft
Point 2	119.80222 ft	700 ft
Point 3	0 ft	707.98508 ft
Point 4	119.80222 ft	711.95031 ft
Point 5	119.80222 ft	731.19405 ft
Point 6	63.45831 ft	731.23838 ft
Point 7	92.77349 ft	711.95031 ft
Point 8	43.56608 ft	731.16743 ft
Point 9	29.28922 ft	721.77392 ft

Point 10	77.95491 ft	721.70025 ft
Point 11	62.09989 ft	731.23838 ft
Point 12	43.56608 ft	728.72413 ft
Point 13	119.80222 ft	734.2613 ft
Point 14	62.09989 ft	734.23945 ft
Point 15	62.09989 ft	731.23945 ft
Point 16	53.25898 ft	711.95031 ft
Point 17	77.95494 ft	721.70025 ft
Point 18	43.56625 ft	721.7523 ft
Point 19	0 ft	707.96495 ft
Point 20	0 ft	721.94898 ft
Point 21	119.80222 ft	707.96941 ft
Point 22	77.74707 ft	721.70056 ft
Point 23	43.56422 ft	721.75231 ft
Point 24	29.35406 ft	721.81658 ft
Point 25	0.00012 ft	707.98508 ft
Point 26	0 ft	711.95031 ft
Point 27	9e-05 ft	711.95031 ft

Regions

	Material	Points	Area
Region 1	Loose to Very Loose CCR	4,5,6,17,7	802.8 ft^2
Region 2	Embankment Stiff Clay/Silt	8,24,23,22,10,6,11,12	301.58 ft^2
Region 3	Final Cover	13,14,8,12,15,6,5	225.49 ft^2
Region 4	Loose to Very Loose CCR	16,7,17,10,22,18	360.92 ft^2
Region 5	Medium Dense Sand	1,2,21,19	954.49 ft^2
Region 6		3,19,25	1.2078e-06 ft^2
Region 7	Loose to Very Loose CCR	20,26,27,16,18,23	478.82 ft^2
Region 8	Medium Stiff Organic Clay/Silt	19,21,4,7,16,27,25	477.19 ft^2
Region 9	Medium Stiff Organic Clay/Silt	24,20,23	0.0025801 ft^2

Slip Results

Slip Surfaces Analysed: 862 of 4805 converged

Current Slip Surface

Slip Surface: 1,213
Factor of Safety: 1.203
Volume: 470.30055 ft^3
Weight: 49,812.758 lbf
Resisting Moment: 807,451.42 lbf·ft
Activating Moment: 671,354.59 lbf·ft
Resisting Force: 16,209.895 lbf
Activating Force: 14,564.146 lbf
Slip Rank: 1 of 4,805 slip surfaces
Exit: (66.010648, 734.24093) ft
Entry: (5.8781553, 721.92247) ft
Radius: 43.875354 ft
Center: (29.651856, 758.79872) ft

Slip Columns

	X	Y	PWP	Base Normal Stress	Frictional Strength	Cohesive Strength	Suction Strength	Column Base Material
Column 1	65.82565 ft	733.97139 ft	0 psf	20.457163 psf	10.877267 psf	0 psf	0 psf	Final Cover
Column 2	65.45566 ft	733.44064 ft	0 psf	61.483531 psf	32.691373 psf	0 psf	0 psf	Final Cover
Column 3	65.08567 ft	732.92608 ft	0 psf	102.19408 psf	54.337559 psf	0 psf	0 psf	Final Cover
Column 4	64.71567 ft	732.42675 ft	0 psf	142.5715 psf	75.806613 psf	0 psf	0 psf	Final Cover
Column 5	64.34568 ft	731.94180 ft	0 psf	182.60216 psf	97.09129 psf	0 psf	0 psf	Final Cover
Column 6	63.97569 ft	731.47047 ft	0 psf	222.27541 psf	118.18593 psf	0 psf	0 psf	Final Cover
Column 7	63.73295 ft	731.16690 ft	-697.15146 psf	269.62739 psf	108.93654 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 8	63.56676 ft	730.96354 ft	-684.45599 psf	264.33766 psf	140.55083 psf	0 psf	0 psf	Embankment Stiff Clay/Silt
Column 9	63.23191 ft	730.56216 ft	-659.39772 psf	300.83935 psf	159.95912 psf	0 psf	0 psf	Embankment Stiff Clay/Silt
Column 10	62.77910 ft	730.03219 ft	-626.31148 psf	347.9453 psf	185.0058 psf	0 psf	0 psf	Embankment Stiff Clay/Silt
Column 11	62.32629 ft	729.51881 ft	-594.26139 psf	394.48077 psf	209.74914 psf	0 psf	0 psf	Embankment Stiff Clay/Silt
Column 12	61.89618 ft	729.04540 ft	-564.70596 psf	435.35613 psf	231.48296 psf	0 psf	0 psf	Embankment Stiff Clay/Silt
Column 13	61.48876 ft	728.60980 ft	-537.51171 psf	470.51293 psf	250.17616 psf	0 psf	0 psf	Embankment Stiff Clay/Silt
Column 14	61.08134 ft	728.18583 ft	-511.04296 psf	505.10754 psf	268.57044 psf	0 psf	0 psf	Embankment Stiff Clay/Silt
Column 15	60.67392 ft	727.77300 ft	-485.26996 psf	539.14401 psf	286.66795 psf	0 psf	0 psf	Embankment Stiff Clay/Silt
Column 16	60.26650 ft	727.37088 ft	-460.16527 psf	572.6267 psf	304.47102 psf	0 psf	0 psf	Embankment Stiff Clay/Silt
Column 17	59.85908 ft	726.97905 ft	-435.70353 psf	605.5602 psf	321.98207 psf	0 psf	0 psf	Embankment Stiff Clay/Silt
Column 18	59.45167 ft	726.59715 ft	-411.86128 psf	637.94924 psf	339.20363 psf	0 psf	0 psf	Embankment Stiff Clay/Silt
Column 19	59.04425 ft	726.22482 ft	-388.61671 psf	669.79864 psf	356.13825 psf	0 psf	0 psf	Embankment Stiff Clay/Silt
Column 20	58.63683 ft	725.86174 ft	-365.94954 psf	701.11327 psf	372.78854 psf	0 psf	0 psf	Embankment Stiff Clay/Silt
Column 21	58.22941 ft	725.50761 ft	-343.84087 psf	731.89799 psf	389.15706 psf	0 psf	0 psf	Embankment Stiff Clay/Silt
Column 22	57.82199 ft	725.16213 ft	-322.27306 psf	762.15764 psf	405.24641 psf	0 psf	0 psf	Embankment Stiff Clay/Silt
Column 23	57.41457 ft	724.82506 ft	-301.2296 psf	791.89702 psf	421.05911 psf	0 psf	0 psf	Embankment Stiff Clay/Silt
Column 24	57.00715 ft	724.49614 ft	-280.69503 psf	821.12083 psf	436.59769 psf	0 psf	0 psf	Embankment Stiff Clay/Silt

Column 25	56.59973 ft	724.17514 ft	-260.65484 psf	849.83372 psf	451.8646 psf	0 psf	0 psf	Embankment Stiff Clay/Silt
Column 26	56.19231 ft	723.86184 ft	-241.09539 psf	878.04019 psf	466.86225 psf	0 psf	0 psf	Embankment Stiff Clay/Silt
Column 27	55.78489 ft	723.55603 ft	-222.00388 psf	905.74467 psf	481.59299 psf	0 psf	0 psf	Embankment Stiff Clay/Silt
Column 28	55.37747 ft	723.25753 ft	-203.3682 psf	932.95147 psf	496.05909 psf	0 psf	0 psf	Embankment Stiff Clay/Silt
Column 29	54.97005 ft	722.96614 ft	-185.17697 psf	959.66474 psf	510.26279 psf	0 psf	0 psf	Embankment Stiff Clay/Silt
Column 30	54.56264 ft	722.68171 ft	-167.41943 psf	985.88853 psf	524.20623 psf	0 psf	0 psf	Embankment Stiff Clay/Silt
Column 31	54.15522 ft	722.40405 ft	-150.0854 psf	1,011.6268 psf	537.89149 psf	0 psf	0 psf	Embankment Stiff Clay/Silt
Column 32	53.74780 ft	722.13303 ft	-133.16526 psf	1,036.8832 psf	551.32059 psf	0 psf	0 psf	Embankment Stiff Clay/Silt
Column 33	53.34037 ft	721.86848 ft	-116.64975 psf	1,061.6618 psf	564.49557 psf	0 psf	0 psf	Embankment Stiff Clay/Silt
Column 34	52.92251 ft	721.60383 ft	-100.12761 psf	1,142.7313 psf	461.69342 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 35	52.49422 ft	721.33927 ft	-83.610774 psf	1,160.9666 psf	469.06096 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 36	52.06592 ft	721.08142 ft	-67.513414 psf	1,178.7314 psf	476.2384 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 37	51.63762 ft	720.83016 ft	-51.826987 psf	1,196.0308 psf	483.2278 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 38	51.20933 ft	720.58535 ft	-36.543385 psf	1,212.8699 psf	490.03123 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 39	50.78103 ft	720.34687 ft	-21.654913 psf	1,229.2535 psf	496.65066 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 40	50.35274 ft	720.11460 ft	-7.1542612 psf	1,245.1864 psf	503.08796 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 41	49.93292 ft	719.89279 ft	6.693157 psf	1,261.3725 psf	506.92337 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 42	49.52159 ft	719.68111 ft	19.908239 psf	1,277.7415 psf	508.19763 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 43	49.11026 ft	719.47488 ft	32.783581 psf	1,293.5725 psf	509.39181 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 44	48.69893 ft	719.27400 ft	45.3245 psf	1,308.874 psf	510.50713 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 45	48.28760 ft	719.07839 ft	57.536073 psf	1,323.6538 psf	511.54478 psf	0 psf	0 psf	Loose to Very Loose CCR

Column 46	47.87627 ft	718.88799 ft	69.423141 psf	1,337.9197 psf	512.50587 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 47	47.46494 ft	718.70271 ft	80.990329 psf	1,351.6788 psf	513.39147 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 48	47.05361 ft	718.52248 ft	92.242052 psf	1,364.9381 psf	514.20258 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 49	46.65433 ft	718.35223 ft	102.87078 psf	1,377.3437 psf	514.92049 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 50	46.26709 ft	718.19162 ft	112.8978 psf	1,388.93 psf	515.55048 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 51	45.87986 ft	718.03531 ft	122.65567 psf	1,400.0896 psf	516.11683 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 52	45.49263 ft	717.88328 ft	132.14747 psf	1,410.8274 psf	516.62024 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 53	45.08242 ft	717.72694 ft	141.90746 psf	1,421.7351 psf	517.08395 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 54	44.64923 ft	717.56678 ft	151.90612 psf	1,432.7644 psf	517.50035 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 55	44.21604 ft	717.41178 ft	161.58303 psf	1,443.2832 psf	517.84048 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 56	43.78276 ft	717.26184 ft	170.94355 psf	1,453.2989 psf	518.10517 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 57	43.56515 ft	717.18782 ft	175.56502 psf	1,458.1479 psf	518.19713 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 58	43.36122 ft	717.12073 ft	179.75319 psf	1,451.2206 psf	513.70618 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 59	42.95521 ft	716.98936 ft	187.95452 psf	1,437.0948 psf	504.68545 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 60	42.54921 ft	716.86234 ft	195.88478 psf	1,422.3923 psf	495.5412 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 61	42.14320 ft	716.73962 ft	203.54641 psf	1,407.1172 psf	486.27416 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 62	41.73720 ft	716.62116 ft	210.94176 psf	1,391.2736 psf	476.88501 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 63	41.33119 ft	716.50693 ft	218.07307 psf	1,374.8652 psf	467.37437 psf	0 psf	0 psf	Loose to Very Loose CCR

Column 64	40.92519 ft	716.39690 ft	224.94247 psf	1,357.8956 psf	457.7428 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 65	40.51919 ft	716.29103 ft	231.552 psf	1,340.3681 psf	447.99077 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 66	40.11318 ft	716.18929 ft	237.90359 psf	1,322.2855 psf	438.11875 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 67	39.70718 ft	716.09165 ft	243.99909 psf	1,303.6508 psf	428.12709 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 68	39.30117 ft	715.99809 ft	249.84025 psf	1,284.4665 psf	418.01614 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 69	38.89517 ft	715.90857 ft	255.42874 psf	1,264.7349 psf	407.78615 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 70	38.48916 ft	715.82308 ft	260.76612 psf	1,244.4581 psf	397.43735 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 71	38.08316 ft	715.74158 ft	265.85391 psf	1,223.638 psf	386.9699 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 72	37.67715 ft	715.66406 ft	270.69352 psf	1,202.2764 psf	376.3839 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 73	37.27115 ft	715.59049 ft	275.28627 psf	1,180.3746 psf	365.67941 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 74	36.86514 ft	715.52086 ft	279.63343 psf	1,157.9339 psf	354.85644 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 75	36.45914 ft	715.45514 ft	283.73619 psf	1,134.9555 psf	343.91493 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 76	36.05314 ft	715.39332 ft	287.59565 psf	1,111.4402 psf	332.85479 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 77	35.64713 ft	715.33538 ft	291.21285 psf	1,087.3885 psf	321.67586 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 78	35.24113 ft	715.28131 ft	294.58877 psf	1,062.8011 psf	310.37794 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 79	34.83512 ft	715.23108 ft	297.72429 psf	1,037.6782 psf	298.96077 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 80	34.42912 ft	715.18470 ft	300.62024 psf	1,012.0197 psf	287.42405 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 81	34.02311 ft	715.14214 ft	303.27741 psf	985.82567 psf	275.7674 psf	0 psf	0 psf	Loose to Very Loose CCR

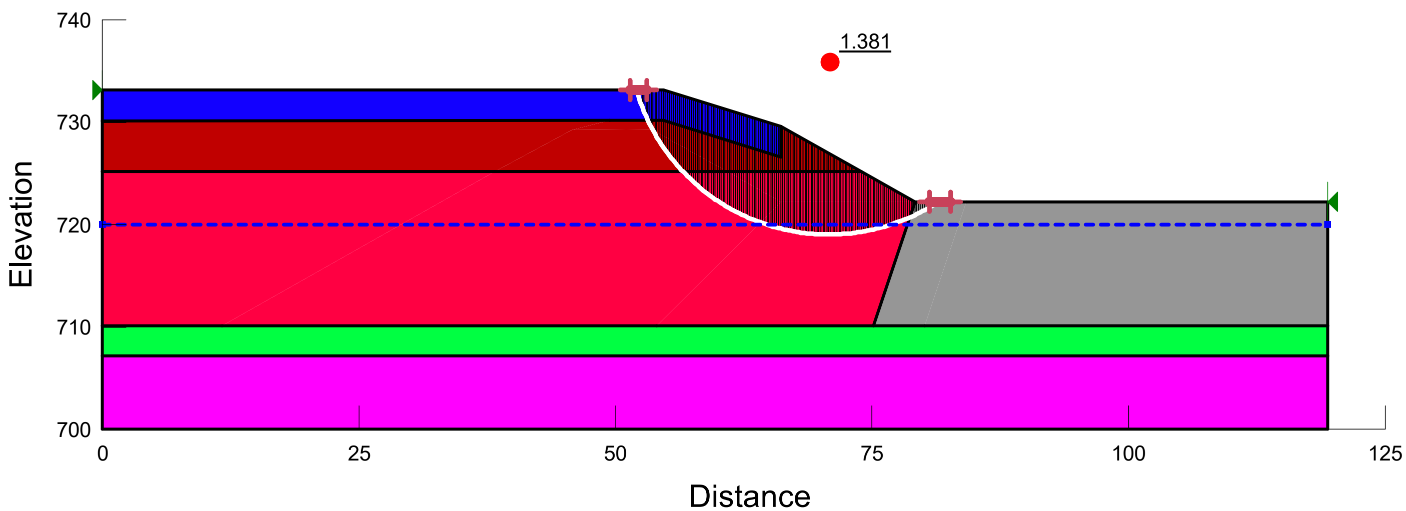
Column 82	33.61711 ft	715.10339 ft	305.69647 psf	959.09567 psf	263.99041 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 83	33.21110 ft	715.06844 ft	307.87806 psf	931.8292 psf	252.09262 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 84	32.80510 ft	715.03729 ft	309.82276 psf	904.02553 psf	240.0735 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 85	32.39909 ft	715.00993 ft	311.53106 psf	875.68372 psf	227.93247 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 86	31.99309 ft	714.98635 ft	313.00342 psf	846.80264 psf	215.66888 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 87	31.58709 ft	714.96653 ft	314.2402 psf	817.38096 psf	203.28206 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 88	31.18108 ft	714.95049 ft	315.24174 psf	787.41713 psf	190.77124 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 89	30.77508 ft	714.93821 ft	316.00829 psf	756.9094 psf	178.13561 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 90	30.36907 ft	714.92970 ft	316.54004 psf	725.85581 psf	165.3743 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 91	29.96307 ft	714.92494 ft	316.83714 psf	694.25417 psf	152.48638 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 92	29.55706 ft	714.92394 ft	316.89965 psf	662.10209 psf	139.47084 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 93	29.15217 ft	714.92667 ft	316.72872 psf	646.24327 psf	133.13252 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 94	28.74839 ft	714.93313 ft	316.32557 psf	646.83494 psf	133.53445 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 95	28.34461 ft	714.94331 ft	315.69027 psf	647.08419 psf	133.89183 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 96	27.94083 ft	714.95720 ft	314.82267 psf	646.99001 psf	134.20432 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 97	27.53706 ft	714.97483 ft	313.72254 psf	646.5513 psf	134.47155 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 98	27.13328 ft	714.99618 ft	312.3896 psf	645.76684 psf	134.69315 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 99	26.72950 ft	715.02126 ft	310.82352 psf	644.63533 psf	134.86873 psf	0 psf	0 psf	Loose to Very Loose CCR

Column 100	26.32572 ft	715.05009 ft	309.02388 psf	643.15535 psf	134.99788 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 101	25.92194 ft	715.08266 ft	306.99023 psf	641.32538 psf	135.08017 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 102	25.51816 ft	715.11900 ft	304.72204 psf	639.1438 psf	135.11516 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 103	25.11438 ft	715.15909 ft	302.21873 psf	636.60887 psf	135.10239 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 104	24.71060 ft	715.20297 ft	299.47965 psf	633.71874 psf	135.04136 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 105	24.30683 ft	715.25063 ft	296.50409 psf	630.47146 psf	134.93157 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 106	23.90305 ft	715.30209 ft	293.29126 psf	626.86492 psf	134.7725 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 107	23.49927 ft	715.35737 ft	289.84034 psf	622.89693 psf	134.5636 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 108	23.09549 ft	715.41647 ft	286.15039 psf	618.56515 psf	134.30428 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 109	22.69171 ft	715.47942 ft	282.22046 psf	613.86713 psf	133.99395 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 110	22.28793 ft	715.54623 ft	278.04948 psf	608.80027 psf	133.63199 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 111	21.88415 ft	715.61692 ft	273.63634 psf	603.36183 psf	133.21774 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 112	21.48037 ft	715.69151 ft	268.97985 psf	597.54894 psf	132.75053 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 113	21.07660 ft	715.77002 ft	264.07875 psf	591.35858 psf	132.22964 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 114	20.67282 ft	715.85246 ft	258.93168 psf	584.78758 psf	131.65433 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 115	20.26904 ft	715.93887 ft	253.53724 psf	577.83259 psf	131.02382 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 116	19.86526 ft	716.02926 ft	247.89392 psf	570.49012 psf	130.33732 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 117	19.46148 ft	716.12367 ft	242.00014 psf	562.75649 psf	129.59398 psf	0 psf	0 psf	Loose to Very Loose CCR

Column 118	19.05770 ft	716.22211 ft	235.85424 psf	554.62787 psf	128.79291 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 119	18.65392 ft	716.32462 ft	229.45446 psf	546.10021 psf	127.93319 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 120	18.25014 ft	716.43123 ft	222.79895 psf	537.16929 psf	127.01386 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 121	17.84637 ft	716.54196 ft	215.88579 psf	527.83068 psf	126.03392 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 122	17.44259 ft	716.65686 ft	208.71294 psf	518.07973 psf	124.9923 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 123	17.03881 ft	716.77595 ft	201.27827 psf	507.91159 psf	123.8879 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 124	16.63503 ft	716.89926 ft	193.57955 psf	497.32115 psf	122.71957 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 125	16.23125 ft	717.02685 ft	185.61444 psf	486.30308 psf	121.48609 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 126	15.82747 ft	717.15874 ft	177.38049 psf	474.85179 psf	120.1862 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 127	15.42369 ft	717.29498 ft	168.87514 psf	462.9614 psf	118.81856 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 128	15.01991 ft	717.43560 ft	160.0957 psf	450.62578 psf	117.38177 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 129	14.61614 ft	717.58067 ft	151.03938 psf	437.83849 psf	115.87436 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 130	14.21236 ft	717.73021 ft	141.70323 psf	424.59275 psf	114.29479 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 131	13.80858 ft	717.88429 ft	132.08418 psf	410.88148 psf	112.64142 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 132	13.40480 ft	718.04295 ft	122.17903 psf	396.69724 psf	110.91256 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 133	13.00102 ft	718.20625 ft	111.98443 psf	382.03221 psf	109.10639 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 134	12.59724 ft	718.37423 ft	101.49686 psf	366.87818 psf	107.22101 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 135	12.19346 ft	718.54697 ft	90.71265 psf	351.22651 psf	105.25443 psf	0 psf	0 psf	Loose to Very Loose CCR

Column 136	11.78969 ft	718.72453 ft	79.627974 psf	335.06812 psf	103.20452 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 137	11.38591 ft	718.90696 ft	68.238815 psf	318.39347 psf	101.06904 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 138	10.98213 ft	719.09433 ft	56.540974 psf	301.19248 psf	98.845624 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 139	10.57835 ft	719.28672 ft	44.53006 psf	283.45455 psf	96.531761 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 140	10.17457 ft	719.48420 ft	32.201476 psf	265.1685 psf	94.124788 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 141	9.77079 ft	719.68684 ft	19.550409 psf	246.32252 psf	91.621879 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 142	9.36701 ft	719.89473 ft	6.57182 psf	226.90413 psf	89.02003 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 143	8.95969 ft	720.10987 ft	-6.8593887 psf	205.21781 psf	82.913377 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 144	8.54882 ft	720.33245 ft	-20.754845 psf	181.05604 psf	73.151389 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 145	8.13796 ft	720.56074 ft	-35.006794 psf	155.97552 psf	63.018199 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 146	7.72709 ft	720.79483 ft	-49.621661 psf	129.9412 psf	52.499651 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 147	7.31622 ft	721.03486 ft	-64.606196 psf	102.9155 psf	41.580559 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 148	6.90536 ft	721.28091 ft	-79.967496 psf	74.858031 psf	30.244608 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 149	6.49449 ft	721.53312 ft	-95.713025 psf	45.725335 psf	18.474235 psf	0 psf	0 psf	Loose to Very Loose CCR
Column 150	6.08361 ft	721.79162 ft	-111.85139 psf	15.468818 psf	6.2498081 psf	0 psf	0 psf	Loose to Very Loose CCR

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Piezometric Surface
	Final Cover	Mohr-Coulomb	120	0	28	
	Lower Loose to Very Loose CCR	Mohr-Coulomb	90	0	22	1
	Medium Dense Sand	Mohr-Coulomb	120	0	30	1
	Medium Stiff Organic Clay/Silt	Mohr-Coulomb	110	750	0	1
	Railroad Ballast	Mohr-Coulomb	135	0	32	1
	Upper Medium Dense CCR	Mohr-Coulomb	90	0	25	



Title: SSS Closed Ash Pond Embankment Analysis
Name: 01_SSS B-B' Base Condition
Directory: I:\25225170.01\Data and Calculations\Geotechnical\Slope Stability\SlopeW\6th Street B Updated.gsz

SCS ENGINEERS

01_SSS B-B' Base Condition

File Information

- File Version: 11.07
- Product Version: 24.2.1.28
- Title: SSS Closed Ash Pond Embankment Analysis
- Comments: Slope stability for 6th Street.
- Created By: Charmelo, Lukas
- Last Edited By: Suchomel, Brandon
- Revision Number: 115
- Date: 03/09/2026
- Time: 03:48:00 PM
- File Name: 6th Street B Updated.gsz
- Directory: I:\25225170.01\Data and Calculations\Geotechnical\Slope Stability\SlopeW\
- Last Solved Date: 03/09/2026
- Last Solved Time: 03:48:08 PM

Project Settings

- Unit System: U.S. Customary Units

Analysis Settings

01_SSS B-B' Base Condition

- Kind: SLOPE/W
- Analysis Type: Bishop
- Settings
  - PWP Conditions from: Piezometric Surfaces
  - Apply Phreatic Correction: No
  - Use Staged Rapid Drawdown: No
  - Unit Weight of Water: 62.430189 pcf
- Slip Surface
  - Direction of movement: Left to Right
  - Use Passive Mode: No
  - Slip Surface Option: Entry and Exit
  - Critical slip surfaces saved: 10
  - Optimize Critical Slip Surface Location: No
  - Tension Crack Option: (none)
- Distribution
  - F of S Calculation Option: Constant
- Convergence
  - Geometry Settings
    - Minimum Slip Surface Depth: 10 ft
    - Minimum Slip Surface Volume: 35.314667 ft³
    - Number of Columns: 150
  - Factor of Safety Convergence Settings
    - Maximum Number of Iterations: 100
    - Tolerable difference in F of S: 0.001

Under-Relaxation Criteria
Initial Rate: 1
Minimum Rate: 0.1
Rate Reduction Factor: 0.65
Reduction Frequency (iterations): 50

Materials

Upper Medium Dense CCR

Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 90 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 25 °
Phi-B: 0 °

Lower Loose to Very Loose CCR

Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 90 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 22 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Surface: 1

Final Cover

Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 120 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 28 °
Phi-B: 0 °

Medium Stiff Organic Clay/Silt

Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 110 pcf
Effective Cohesion: 750 psf
Effective Friction Angle: 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Surface: 1

Medium Dense Sand

Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 120 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 30 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Surface: 1

Railroad Ballast

Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 135 pcf
Effective Cohesion: 0 psf

Effective Friction Angle: 32 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Surface: 1

Slip Surface Entry and Exit

Left Type: Range
Left-Zone Left Coordinate: (51.40306, 733.1498) ft
Left-Zone Right Coordinate: (53.07696, 733.1498) ft
Left-Zone Increment: 50
Right Type: Range
Right-Zone Left Coordinate: (80.58912, 722.21018) ft
Right-Zone Right Coordinate: (82.64774, 722.21018) ft
Right-Zone Increment: 50
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 733.1498) ft
Right Coordinate: (119.41702, 722.21018) ft

Piezometric Surfaces

Piezometric Surface 1

Coordinates

	X	Y
Coordinate 1	0 ft	720 ft
Coordinate 2	119.41702 ft	720 ft

Geometry

Name: 2D Geometry

Settings

View: 2D
Element Thickness: 1 ft

Points

	X	Y
Point 1	73.95787 ft	725.1498 ft
Point 2	60.88996 ft	725.1498 ft
Point 3	53.53923 ft	729.29685 ft
Point 4	45.74408 ft	729.28022 ft
Point 5	49.43444 ft	730.2176 ft
Point 6	54.66288 ft	730.22161 ft
Point 7	66.10049 ft	726.58269 ft
Point 8	66.10049 ft	729.58269 ft

Point 9	0 ft	707.1498 ft
Point 10	0 ft	700 ft
Point 11	119.41702 ft	700 ft
Point 12	119.41702 ft	707.1498 ft
Point 13	0 ft	710.1498 ft
Point 14	54.04012 ft	710.1498 ft
Point 15	119.41702 ft	710.1498 ft
Point 16	11.65535 ft	710.1498 ft
Point 17	66.10049 ft	722.21018 ft
Point 18	38.24312 ft	725.1498 ft
Point 19	0 ft	725.1498 ft
Point 20	0 ft	730.1498 ft
Point 21	0 ft	733.1498 ft
Point 22	54.66288 ft	733.1498 ft
Point 23	79.1684 ft	722.21018 ft
Point 24	119.41702 ft	722.21018 ft
Point 25	75.14602 ft	710.1498 ft
Point 26	84.18975 ft	722.21018 ft
Point 27	80.13282 ft	710.1498 ft

Regions

	Material	Points	Area
Region 1	Upper Medium Dense CCR	1,8,7,6,5,4,3,2	50.59 ft^2
Region 2	Medium Dense Sand	9,10,11,12	853.81 ft^2
Region 3	Medium Stiff Organic Clay/Silt	9,12,15,27,25,14,16,13	358.25 ft^2
Region 4	Lower Loose to Very Loose CCR	16,14,17,2,18	536.88 ft^2
Region 5	Lower Loose to Very Loose CCR	13,19,18,16	374.24 ft^2
Region 6	Upper Medium Dense CCR	5,4,18,19,20	216.38 ft^2
Region 7	Final Cover	8,7,6,5,20,21,22	195.85 ft^2
Region 8	Upper Medium Dense CCR	4,18,2,3	62.995 ft^2
Region 9	Lower Loose to Very Loose CCR	2,1,23,17	38.415 ft^2
Region 10	Railroad Ballast	15,24,26,27	449.32 ft^2
Region 11	Lower Loose to Very Loose CCR	17,14,25,23	206.07 ft^2
Region 12	Railroad Ballast	23,25,27,26	60.351 ft^2

Slip Results

Slip Surfaces Analysed: 3691 of 13005 converged

Current Slip Surface

Slip Surface: 4,954
Factor of Safety: 1.381
Volume: 194.23483 ft^3
Weight: 18,767.632 lbf
Resisting Moment: 155,221.21 lbf·ft
Activating Moment: 112,373.15 lbf·ft
Resisting Force: 6,738.2673 lbf
Activating Force: 5,743.0419 lbf
Slip Rank: 1 of 13,005 slip surfaces

Exit: (81.45374, 722.21018) ft
Entry: (52.039142, 733.1498) ft
Radius: 19.523971 ft
Center: (70.796052, 738.56864) ft

Slip Columns

	X	Y	PWP	Base Normal Stress	Frictional Strength	Cohesive Strength	Suction Strength	Column Base Material
Column 1	52.13145 ft	732.84859 ft	0 psf	16.017813 psf	8.5168225 psf	0 psf	0 psf	Final Cover
Column 2	52.31608 ft	732.27626 ft	0 psf	49.190234 psf	26.154912 psf	0 psf	0 psf	Final Cover
Column 3	52.50070 ft	731.75721 ft	0 psf	82.143668 psf	43.676563 psf	0 psf	0 psf	Final Cover
Column 4	52.68532 ft	731.27989 ft	0 psf	114.6667 psf	60.969368 psf	0 psf	0 psf	Final Cover
Column 5	52.86995 ft	730.83650 ft	0 psf	146.65741 psf	77.97913 psf	0 psf	0 psf	Final Cover
Column 6	53.05457 ft	730.42147 ft	0 psf	178.06938 psf	94.681167 psf	0 psf	0 psf	Final Cover
Column 7	53.23025 ft	730.04857 ft	0 psf	216.3461 psf	100.88384 psf	0 psf	0 psf	Upper Medium Dense CCR
Column 8	53.39698 ft	729.71291 ft	0 psf	238.76278 psf	111.33691 psf	0 psf	0 psf	Upper Medium Dense CCR
Column 9	53.56371 ft	729.39257 ft	0 psf	260.6832 psf	121.55857 psf	0 psf	0 psf	Upper Medium Dense CCR
Column 10	53.74865 ft	729.05401 ft	0 psf	284.39527 psf	132.61569 psf	0 psf	0 psf	Upper Medium Dense CCR
Column 11	53.95181 ft	728.69864 ft	0 psf	309.86566 psf	144.49273 psf	0 psf	0 psf	Upper Medium Dense CCR
Column 12	54.15498 ft	728.35970 ft	0 psf	334.70387 psf	156.07498 psf	0 psf	0 psf	Upper Medium Dense CCR
Column 13	54.35814 ft	728.03559 ft	0 psf	358.94336 psf	167.37804 psf	0 psf	0 psf	Upper Medium Dense CCR
Column 14	54.56130 ft	727.72498 ft	0 psf	382.6148 psf	178.41621 psf	0 psf	0 psf	Upper Medium Dense CCR

Column 15	54.76045 ft	727.43240 ft	0 psf	403.47428 psf	188.14315 psf	0 psf	0 psf	Upper Medium Dense CCR
Column 16	54.95560 ft	727.15646 ft	0 psf	421.4947 psf	196.54621 psf	0 psf	0 psf	Upper Medium Dense CCR
Column 17	55.15075 ft	726.89031 ft	0 psf	438.9789 psf	204.69922 psf	0 psf	0 psf	Upper Medium Dense CCR
Column 18	55.34590 ft	726.63328 ft	0 psf	455.95156 psf	212.6137 psf	0 psf	0 psf	Upper Medium Dense CCR
Column 19	55.54105 ft	726.38480 ft	0 psf	472.43518 psf	220.30014 psf	0 psf	0 psf	Upper Medium Dense CCR
Column 20	55.73620 ft	726.14436 ft	0 psf	488.45031 psf	227.76812 psf	0 psf	0 psf	Upper Medium Dense CCR
Column 21	55.93134 ft	725.91149 ft	0 psf	504.01578 psf	235.02642 psf	0 psf	0 psf	Upper Medium Dense CCR
Column 22	56.12649 ft	725.68579 ft	0 psf	519.14893 psf	242.08312 psf	0 psf	0 psf	Upper Medium Dense CCR
Column 23	56.32164 ft	725.46689 ft	0 psf	533.86569 psf	248.94566 psf	0 psf	0 psf	Upper Medium Dense CCR
Column 24	56.51679 ft	725.25445 ft	0 psf	548.18082 psf	255.62091 psf	0 psf	0 psf	Upper Medium Dense CCR
Column 25	56.71154 ft	725.04857 ft	-315.18321 psf	582.32263 psf	235.27362 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 26	56.90588 ft	724.84896 ft	-302.72154 psf	595.85615 psf	240.74151 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 27	57.10023 ft	724.65493 ft	-290.60814 psf	609.00913 psf	246.05566 psf	0 psf	0 psf	Lower Loose to Very Loose CCR

Column 28	57.29457 ft	724.46625 ft	-278.82862 psf	621.79352 psf	251.22089 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 29	57.48892 ft	724.28270 ft	-267.36976 psf	634.22043 psf	256.24169 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 30	57.68326 ft	724.10409 ft	-256.21933 psf	646.30024 psf	261.12225 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 31	57.87761 ft	723.93025 ft	-245.36604 psf	658.04266 psf	265.86649 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 32	58.07195 ft	723.76099 ft	-234.79942 psf	669.45677 psf	270.47809 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 33	58.26630 ft	723.59617 ft	-224.50974 psf	680.55109 psf	274.96049 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 34	58.46064 ft	723.43564 ft	-214.48796 psf	691.33362 psf	279.31691 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 35	58.65499 ft	723.27927 ft	-204.72562 psf	701.81187 psf	283.5504 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 36	58.84933 ft	723.12693 ft	-195.21485 psf	711.99293 psf	287.66382 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 37	59.04368 ft	722.97850 ft	-185.94827 psf	721.88345 psf	291.65984 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 38	59.23803 ft	722.83387 ft	-176.91896 psf	731.48972 psf	295.54103 psf	0 psf	0 psf	Lower Loose to Very Loose CCR

Column 39	59.43237 ft	722.69293 ft	-168.12044 psf	740.81767 psf	299.30977 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 40	59.62672 ft	722.55560 ft	-159.54661 psf	749.87291 psf	302.96832 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 41	59.82106 ft	722.42177 ft	-151.19174 psf	758.66073 psf	306.51883 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 42	60.01541 ft	722.29137 ft	-143.05042 psf	767.18615 psf	309.96333 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 43	60.20975 ft	722.16430 ft	-135.11756 psf	775.45391 psf	313.30372 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 44	60.40410 ft	722.04049 ft	-127.38836 psf	783.46851 psf	316.54182 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 45	60.59844 ft	721.91988 ft	-119.85826 psf	791.23419 psf	319.67937 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 46	60.79279 ft	721.80238 ft	-112.52298 psf	798.75501 psf	322.71797 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 47	60.99071 ft	721.68589 ft	-105.25035 psf	806.16427 psf	325.71151 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 48	61.19222 ft	721.57045 ft	-98.043409 psf	813.45711 psf	328.65801 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 49	61.39372 ft	721.45816 ft	-91.033234 psf	820.49863 psf	331.50297 psf	0 psf	0 psf	Lower Loose to Very Loose CCR

Column 50	61.59523 ft	721.34896 ft	-84.215981 psf	827.29247 psf	334.24785 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 51	61.79673 ft	721.24280 ft	-77.588 psf	833.84205 psf	336.89406 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 52	61.99823 ft	721.13961 ft	-71.145831 psf	840.15066 psf	339.4429 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 53	62.19974 ft	721.03934 ft	-64.886193 psf	846.22137 psf	341.89563 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 54	62.40124 ft	720.94195 ft	-58.80597 psf	852.05712 psf	344.25342 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 55	62.60275 ft	720.84738 ft	-52.902203 psf	857.66067 psf	346.5174 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 56	62.80425 ft	720.75560 ft	-47.172082 psf	863.03466 psf	348.68864 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 57	63.00576 ft	720.66655 ft	-41.612935 psf	868.18156 psf	350.76812 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 58	63.20726 ft	720.58020 ft	-36.222223 psf	873.10373 psf	352.75681 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 59	63.40876 ft	720.49652 ft	-30.997531 psf	877.80339 psf	354.65559 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 60	63.61027 ft	720.41545 ft	-25.936562 psf	882.28263 psf	356.46532 psf	0 psf	0 psf	Lower Loose to Very Loose CCR

Column 61	63.81177 ft	720.33697 ft	-21.037132 psf	886.54344 psf	358.1868 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 62	64.01328 ft	720.26105 ft	-16.297163 psf	890.58767 psf	359.82078 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 63	64.22228 ft	720.18501 ft	-11.550139 psf	894.55137 psf	361.42221 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 64	64.43879 ft	720.10902 ft	-6.8060461 psf	898.4199 psf	362.9852 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 65	64.65529 ft	720.03587 ft	-2.2393029 psf	902.04433 psf	364.44957 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 66	64.85904 ft	719.96952 ft	1.9030774 psf	905.4031 psf	365.0377 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 67	65.05003 ft	719.90963 ft	5.6420985 psf	908.50308 psf	364.77951 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 68	65.24102 ft	719.85187 ft	9.2474845 psf	911.3855 psf	364.48742 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 69	65.43202 ft	719.79624 ft	12.720469 psf	914.05264 psf	364.16184 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 70	65.62301 ft	719.74272 ft	16.062225 psf	916.50668 psf	363.80317 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 71	65.81400 ft	719.69127 ft	19.273871 psf	918.74968 psf	363.41182 psf	0 psf	0 psf	Lower Loose to Very Loose CCR

Column 72	66.00499 ft	719.64190 ft	22.356465 psf	920.78361 psf	362.98813 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 73	66.19871 ft	719.59393 ft	25.351272 psf	836.49225 psf	327.72223 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 74	66.39514 ft	719.54740 ft	28.2556 psf	833.68383 psf	325.41413 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 75	66.59158 ft	719.50302 ft	31.026494 psf	830.63518 psf	323.06288 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 76	66.78801 ft	719.46076 ft	33.664882 psf	827.34799 psf	320.66879 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 77	66.98445 ft	719.42061 ft	36.171644 psf	823.82382 psf	318.23214 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 78	67.18088 ft	719.38255 ft	38.547604 psf	820.06416 psf	315.75318 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 79	67.37731 ft	719.34657 ft	40.793541 psf	816.07036 psf	313.23217 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 80	67.57375 ft	719.31267 ft	42.910182 psf	811.8437 psf	310.66931 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 81	67.77018 ft	719.28083 ft	44.898211 psf	807.38534 psf	308.0648 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 82	67.96662 ft	719.25103 ft	46.758262 psf	802.69635 psf	305.41881 psf	0 psf	0 psf	Lower Loose to Very Loose CCR

Column 83	68.16305 ft	719.22328 ft	48.490928 psf	797.77771 psf	302.73151 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 84	68.35949 ft	719.19756 ft	50.096756 psf	792.63031 psf	300.00303 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 85	68.55592 ft	719.17386 ft	51.57625 psf	787.25494 psf	297.23349 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 86	68.75236 ft	719.15218 ft	52.929874 psf	781.65231 psf	294.42298 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 87	68.94879 ft	719.13250 ft	54.158049 psf	775.82302 psf	291.57158 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 88	69.14522 ft	719.11483 ft	55.261154 psf	769.76762 psf	288.67935 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 89	69.34166 ft	719.09916 ft	56.239532 psf	763.48653 psf	285.74634 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 90	69.53809 ft	719.08548 ft	57.093482 psf	756.98012 psf	282.77256 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 91	69.73453 ft	719.07379 ft	57.823266 psf	750.24865 psf	279.75802 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 92	69.93096 ft	719.06409 ft	58.429109 psf	743.29232 psf	276.7027 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 93	70.12740 ft	719.05637 ft	58.911195 psf	736.11121 psf	273.60657 psf	0 psf	0 psf	Lower Loose to Very Loose CCR

Column 94	70.32383 ft	719.05062 ft	59.26967 psf	728.70535 psf	270.46957 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 95	70.52027 ft	719.04686 ft	59.504645 psf	721.07466 psf	267.29164 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 96	70.71670 ft	719.04507 ft	59.61619 psf	713.219 psf	264.07268 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 97	70.91314 ft	719.04526 ft	59.604339 psf	705.13811 psf	260.81257 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 98	71.10957 ft	719.04743 ft	59.469088 psf	696.83168 psf	257.5112 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 99	71.30600 ft	719.05157 ft	59.210398 psf	688.29928 psf	254.16841 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 100	71.50244 ft	719.05770 ft	58.828188 psf	679.54042 psf	250.78402 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 101	71.69887 ft	719.06580 ft	58.322342 psf	670.5545 psf	247.35785 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 102	71.89531 ft	719.07588 ft	57.692707 psf	661.34084 psf	243.88968 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 103	72.09174 ft	719.08796 ft	56.93909 psf	651.89867 psf	240.37927 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 104	72.28818 ft	719.10202 ft	56.061261 psf	642.22711 psf	236.82638 psf	0 psf	0 psf	Lower Loose to Very Loose CCR

Column 105	72.48461 ft	719.11807 ft	55.058949 psf	632.32522 psf	233.23071 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 106	72.68105 ft	719.13613 ft	53.931847 psf	622.19192 psf	229.59197 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 107	72.87748 ft	719.15618 ft	52.679606 psf	611.82605 psf	225.90983 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 108	73.07391 ft	719.17825 ft	51.301838 psf	601.22635 psf	222.18393 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 109	73.27035 ft	719.20234 ft	49.798113 psf	590.39146 psf	218.41389 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 110	73.46678 ft	719.22845 ft	48.167962 psf	579.3199 psf	214.59931 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 111	73.66322 ft	719.25660 ft	46.410871 psf	568.01008 psf	210.73976 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 112	73.85965 ft	719.28678 ft	44.526284 psf	556.4603 psf	206.83477 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 113	74.05356 ft	719.31858 ft	42.541132 psf	544.82317 psf	202.93512 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 114	74.24494 ft	719.35195 ft	40.458059 psf	533.10374 psf	199.04178 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 115	74.43632 ft	719.38728 ft	38.252157 psf	521.15108 psf	195.10383 psf	0 psf	0 psf	Lower Loose to Very Loose CCR

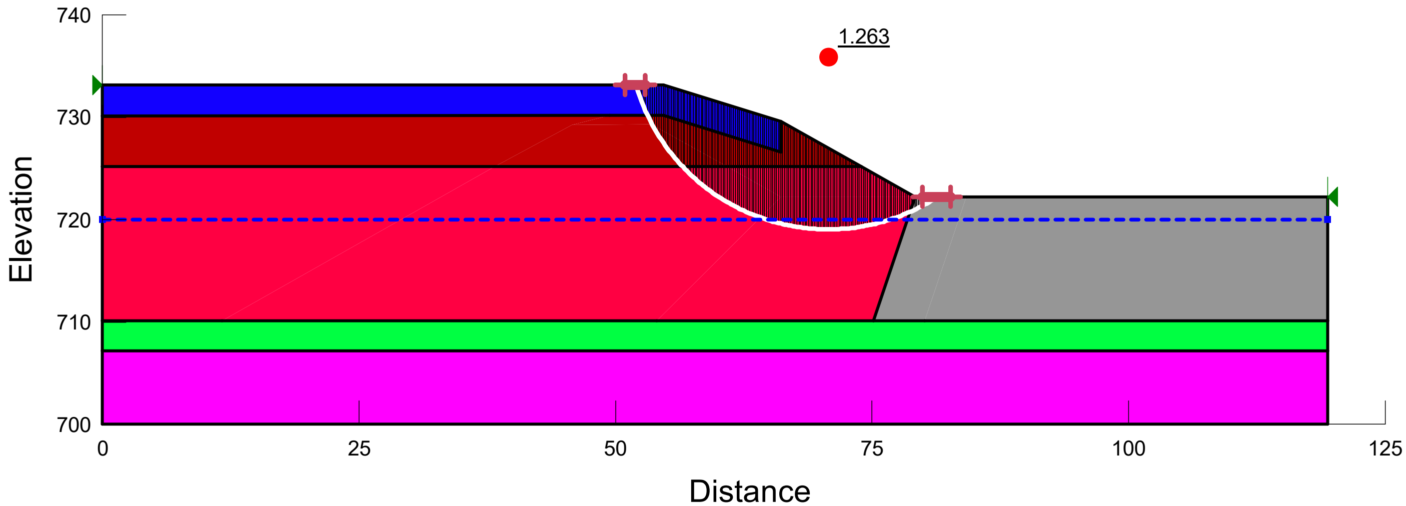
Column 116	74.62770 ft	719.42459 ft	35.922746 psf	508.96315 psf	191.12073 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 117	74.81908 ft	719.46390 ft	33.469102 psf	496.5378 psf	187.0919 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 118	75.01046 ft	719.50520 ft	30.890458 psf	483.87274 psf	183.01672 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 119	75.20184 ft	719.54852 ft	28.185997 psf	470.96556 psf	178.89455 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 120	75.39322 ft	719.59387 ft	25.35486 psf	457.81368 psf	174.72471 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 121	75.58459 ft	719.64126 ft	22.396134 psf	444.41441 psf	170.50645 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 122	75.77597 ft	719.69071 ft	19.308859 psf	430.76488 psf	166.23902 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 123	75.96735 ft	719.74224 ft	16.092023 psf	416.86207 psf	161.92161 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 124	76.15873 ft	719.79586 ft	12.744556 psf	402.7028 psf	157.55336 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 125	76.35011 ft	719.85159 ft	9.2653386 psf	388.28368 psf	153.13335 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 126	76.54149 ft	719.90945 ft	5.653188 psf	373.60117 psf	148.66063 psf	0 psf	0 psf	Lower Loose to Very Loose CCR

Column 127	76.73287 ft	719.96946 ft	1.9068642 psf	358.65151 psf	144.13419 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 128	76.93058 ft	720.03377 ft	-2.1080156 psf	342.6931 psf	138.457 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 129	77.13462 ft	720.10255 ft	-6.4022749 psf	325.66336 psf	131.57654 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 130	77.33866 ft	720.17386 ft	-10.853886 psf	308.25796 psf	124.5443 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 131	77.54270 ft	720.24771 ft	-15.464687 psf	290.46763 psf	117.35654 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 132	77.74675 ft	720.32415 ft	-20.23661 psf	272.28255 psf	110.00929 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 133	77.95079 ft	720.40320 ft	-25.171691 psf	253.6923 psf	102.49834 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 134	78.15483 ft	720.48489 ft	-30.272068 psf	234.68579 psf	94.819214 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 135	78.35887 ft	720.56928 ft	-35.539994 psf	215.25125 psf	86.967149 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 136	78.56291 ft	720.65638 ft	-40.977837 psf	195.37614 psf	78.937084 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 137	78.74884 ft	720.73804 ft	-46.076068 psf	204.76693 psf	127.95258 psf	0 psf	0 psf	Railroad Ballast
Column 138	78.91666 ft	720.81385 ft	-50.808616 psf	210.99756 psf	131.84591 psf	0 psf	0 psf	Railroad Ballast

Column 139	79.08449 ft	720.89157 ft	-55.660927 psf	216.99926 psf	135.59619 psf	0 psf	0 psf	Railroad Ballast
Column 140	79.26362 ft	720.97675 ft	-60.978631 psf	212.88887 psf	133.02773 psf	0 psf	0 psf	Railroad Ballast
Column 141	79.45407 ft	721.06970 ft	-66.781356 psf	198.38904 psf	123.96723 psf	0 psf	0 psf	Railroad Ballast
Column 142	79.64451 ft	721.16522 ft	-72.745176 psf	183.23129 psf	114.49562 psf	0 psf	0 psf	Railroad Ballast
Column 143	79.83496 ft	721.26338 ft	-78.872759 psf	167.38728 psf	104.59518 psf	0 psf	0 psf	Railroad Ballast
Column 144	80.02540 ft	721.36419 ft	-85.166909 psf	150.82645 psf	94.246825 psf	0 psf	0 psf	Railroad Ballast
Column 145	80.21585 ft	721.46773 ft	-91.630573 psf	133.51573 psf	83.42989 psf	0 psf	0 psf	Railroad Ballast
Column 146	80.40629 ft	721.57403 ft	-98.266848 psf	115.41936 psf	72.122018 psf	0 psf	0 psf	Railroad Ballast
Column 147	80.59674 ft	721.68314 ft	-105.079 psf	96.498482 psf	60.298944 psf	0 psf	0 psf	Railroad Ballast
Column 148	80.78718 ft	721.79513 ft	-112.07045 psf	76.710882 psf	47.934279 psf	0 psf	0 psf	Railroad Ballast
Column 149	80.97763 ft	721.91005 ft	-119.24483 psf	56.010529 psf	34.999263 psf	0 psf	0 psf	Railroad Ballast
Column 150	81.16807 ft	722.02796 ft	-126.60594 psf	34.347137 psf	21.462473 psf	0 psf	0 psf	Railroad Ballast
Column 151	81.35852 ft	722.14893 ft	-134.15781 psf	11.665631 psf	7.2894954 psf	0 psf	0 psf	Railroad Ballast

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Piezometric Surface
	Final Cover	Mohr-Coulomb	120	0	28	
	Lower Loose to Very Loose CCR	Mohr-Coulomb	90	0	22	1
	Medium Dense Sand	Mohr-Coulomb	120	0	30	1
	Medium Stiff Organic Clay/Silt	Mohr-Coulomb	110	750	0	1
	Railroad Ballast	Mohr-Coulomb	135	0	32	1
	Upper Medium Dense CCR	Mohr-Coulomb	90	0	25	

Vert Seismic Coef.: 0.04
Horz Seismic Coef.: 0.04



Title: SSS Closed Ash Pond Embankment Analysis
Name: 02_SSS B-B' Base Condition_Seismic
Directory: I:\25225170.01\Data and Calculations\Geotechnical\Slope Stability\SlopeW\6th Street B Updated.gsz

SCS ENGINEERS

02_SSS B-B' Base Condition_Seismic

File Information

- File Version: 11.07
- Product Version: 24.2.1.28
- Title: SSS Closed Ash Pond Embankment Analysis
- Comments: Slope stability for 6th Street.
- Created By: Charmelo, Lukas
- Last Edited By: Suchomel, Brandon
- Revision Number: 117
- Date: 03/09/2026
- Time: 04:51:01 PM
- File Name: 6th Street B Updated.gsz
- Directory: I:\25225170.01\Data and Calculations\Geotechnical\Slope Stability\SlopeW\
- Last Solved Date: 03/09/2026
- Last Solved Time: 04:51:09 PM

Project Settings

- Unit System: U.S. Customary Units

Analysis Settings

02_SSS B-B' Base Condition_Seismic

- Kind: SLOPE/W
- Analysis Type: Bishop
- Settings
  - PWP Conditions from: Piezometric Surfaces
  - Apply Phreatic Correction: No
  - Use Staged Rapid Drawdown: No
  - Unit Weight of Water: 62.430189 pcf
- Slip Surface
  - Direction of movement: Left to Right
  - Use Passive Mode: No
  - Slip Surface Option: Entry and Exit
  - Critical slip surfaces saved: 10
  - Optimize Critical Slip Surface Location: No
  - Tension Crack Option: (none)
- Distribution
  - F of S Calculation Option: Constant
- Convergence
  - Geometry Settings
    - Minimum Slip Surface Depth: 10 ft
    - Minimum Slip Surface Volume: 35.314667 ft³
    - Number of Columns: 150
  - Factor of Safety Convergence Settings
    - Maximum Number of Iterations: 100
    - Tolerable difference in F of S: 0.001

Under-Relaxation Criteria
Initial Rate: 1
Minimum Rate: 0.1
Rate Reduction Factor: 0.65
Reduction Frequency (iterations): 50

Materials

Upper Medium Dense CCR

Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 90 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 25 °
Phi-B: 0 °

Lower Loose to Very Loose CCR

Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 90 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 22 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Surface: 1

Final Cover

Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 120 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 28 °
Phi-B: 0 °

Medium Stiff Organic Clay/Silt

Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 110 pcf
Effective Cohesion: 750 psf
Effective Friction Angle: 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Surface: 1

Medium Dense Sand

Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 120 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 30 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Surface: 1

Railroad Ballast

Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 135 pcf
Effective Cohesion: 0 psf

Effective Friction Angle: 32 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Surface: 1

Slip Surface Entry and Exit

Left Type: Range
Left-Zone Left Coordinate: (50.90808, 733.1498) ft
Left-Zone Right Coordinate: (52.93113, 733.1498) ft
Left-Zone Increment: 50
Right Type: Range
Right-Zone Left Coordinate: (79.96446, 722.21018) ft
Right-Zone Right Coordinate: (82.6629, 722.21018) ft
Right-Zone Increment: 50
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 733.1498) ft
Right Coordinate: (119.41702, 722.21018) ft

Piezometric Surfaces

Piezometric Surface 1

Coordinates

	X	Y
Coordinate 1	0 ft	720 ft
Coordinate 2	119.41702 ft	720 ft

Seismic Coefficients

Horz Seismic Coef.: 0.04
Vert Seismic Coef.: 0.04

Geometry

Name: 2D Geometry

Settings

View: 2D
Element Thickness: 1 ft

Points

	X	Y
Point 1	73.95787 ft	725.1498 ft
Point 2	60.88996 ft	725.1498 ft
Point 3	53.53923 ft	729.29685 ft
Point 4	45.74408 ft	729.28022 ft

Point 5	49.43444 ft	730.2176 ft
Point 6	54.66288 ft	730.22161 ft
Point 7	66.10049 ft	726.58269 ft
Point 8	66.10049 ft	729.58269 ft
Point 9	0 ft	707.1498 ft
Point 10	0 ft	700 ft
Point 11	119.41702 ft	700 ft
Point 12	119.41702 ft	707.1498 ft
Point 13	0 ft	710.1498 ft
Point 14	54.04012 ft	710.1498 ft
Point 15	119.41702 ft	710.1498 ft
Point 16	11.65535 ft	710.1498 ft
Point 17	66.10049 ft	722.21018 ft
Point 18	38.24312 ft	725.1498 ft
Point 19	0 ft	725.1498 ft
Point 20	0 ft	730.1498 ft
Point 21	0 ft	733.1498 ft
Point 22	54.66288 ft	733.1498 ft
Point 23	79.1684 ft	722.21018 ft
Point 24	119.41702 ft	722.21018 ft
Point 25	75.14602 ft	710.1498 ft
Point 26	84.18975 ft	722.21018 ft
Point 27	80.13282 ft	710.1498 ft

Regions

	Material	Points	Area
Region 1	Upper Medium Dense CCR	1,8,7,6,5,4,3,2	50.59 ft^2
Region 2	Medium Dense Sand	9,10,11,12	853.81 ft^2
Region 3	Medium Stiff Organic Clay/Silt	9,12,15,27,25,14,16,13	358.25 ft^2
Region 4	Lower Loose to Very Loose CCR	16,14,17,2,18	536.88 ft^2
Region 5	Lower Loose to Very Loose CCR	13,19,18,16	374.24 ft^2
Region 6	Upper Medium Dense CCR	5,4,18,19,20	216.38 ft^2
Region 7	Final Cover	8,7,6,5,20,21,22	195.85 ft^2
Region 8	Upper Medium Dense CCR	4,18,2,3	62.995 ft^2
Region 9	Lower Loose to Very Loose CCR	2,1,23,17	38.415 ft^2
Region 10	Railroad Ballast	15,24,26,27	449.32 ft^2
Region 11	Lower Loose to Very Loose CCR	17,14,25,23	206.07 ft^2
Region 12	Railroad Ballast	23,25,27,26	60.351 ft^2

Slip Results

Slip Surfaces Analysed: 3991 of 13005 converged

Current Slip Surface

Slip Surface: 7,019

Factor of Safety: 1.263

Volume: 194.31795 ft^3

Weight: 18,772.523 lbf

Resisting Moment: 159,860.3 lbf·ft
Activating Moment: 126,549.94 lbf·ft
Resisting Force: 6,954.2424 lbf
Activating Force: 6,545.9864 lbf
Slip Rank: 1 of 13,005 slip surfaces
Exit: (81.367649, 722.21018) ft
Entry: (52.000527, 733.1498) ft
Radius: 19.502831 ft
Center: (70.737534, 738.56136) ft

Slip Columns

	X	Y	PWP	Base Normal Stress	Frictional Strength	Cohesive Strength	Suction Strength	Column Base Material
Column 1	52.09284 ft	732.84851 ft	0 psf	15.835673 psf	8.4199768 psf	0 psf	0 psf	Final Cover
Column 2	52.27748 ft	732.27609 ft	0 psf	48.74602 psf	25.918719 psf	0 psf	0 psf	Final Cover
Column 3	52.46211 ft	731.75701 ft	0 psf	81.563945 psf	43.368319 psf	0 psf	0 psf	Final Cover
Column 4	52.64674 ft	731.27970 ft	0 psf	114.05484 psf	60.644032 psf	0 psf	0 psf	Final Cover
Column 5	52.83137 ft	730.83637 ft	0 psf	146.0993 psf	77.682376 psf	0 psf	0 psf	Final Cover
Column 6	53.01601 ft	730.42140 ft	0 psf	177.63745 psf	94.451508 psf	0 psf	0 psf	Final Cover
Column 7	53.22916 ft	729.97404 ft	0 psf	221.70053 psf	103.38065 psf	0 psf	0 psf	Upper Medium Dense CCR
Column 8	53.47085 ft	729.49746 ft	0 psf	254.31633 psf	118.58965 psf	0 psf	0 psf	Upper Medium Dense CCR
Column 9	53.69881 ft	729.07486 ft	0 psf	284.24243 psf	132.54442 psf	0 psf	0 psf	Upper Medium Dense CCR
Column 10	53.91305 ft	728.69971 ft	0 psf	311.5795 psf	145.2919 psf	0 psf	0 psf	Upper Medium Dense CCR
Column 11	54.12728 ft	728.34284 ft	0 psf	338.24078 psf	157.72427 psf	0 psf	0 psf	Upper Medium Dense CCR
Column 12	54.34152 ft	728.00238 ft	0 psf	364.26163 psf	169.85799 psf	0 psf	0 psf	Upper Medium Dense CCR
Column 13	54.55576 ft	727.67679 ft	0 psf	389.67457 psf	181.70824 psf	0 psf	0 psf	Upper Medium Dense CCR

Column 14	54.75864 ft	727.38069 ft	0 psf	411.41407 psf	191.84553 psf	0 psf	0 psf	Upper Medium Dense CCR
Column 15	54.95016 ft	727.11179 ft	0 psf	429.47385 psf	200.26695 psf	0 psf	0 psf	Upper Medium Dense CCR
Column 16	55.14168 ft	726.85221 ft	0 psf	447.02635 psf	208.45181 psf	0 psf	0 psf	Upper Medium Dense CCR
Column 17	55.33320 ft	726.60133 ft	0 psf	464.09359 psf	216.4104 psf	0 psf	0 psf	Upper Medium Dense CCR
Column 18	55.52471 ft	726.35861 ft	0 psf	480.69575 psf	224.15211 psf	0 psf	0 psf	Upper Medium Dense CCR
Column 19	55.71623 ft	726.12358 ft	0 psf	496.85132 psf	231.68558 psf	0 psf	0 psf	Upper Medium Dense CCR
Column 20	55.90775 ft	725.89581 ft	0 psf	512.57733 psf	239.01874 psf	0 psf	0 psf	Upper Medium Dense CCR
Column 21	56.09927 ft	725.67491 ft	0 psf	527.88949 psf	246.15891 psf	0 psf	0 psf	Upper Medium Dense CCR
Column 22	56.29079 ft	725.46053 ft	0 psf	542.80229 psf	253.11287 psf	0 psf	0 psf	Upper Medium Dense CCR
Column 23	56.48231 ft	725.25237 ft	0 psf	557.32921 psf	259.88688 psf	0 psf	0 psf	Upper Medium Dense CCR
Column 24	56.67607 ft	725.04783 ft	-315.13691 psf	593.6557 psf	239.85247 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 25	56.87206 ft	724.84678 ft	-302.58552 psf	607.82065 psf	245.57548 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 26	57.06806 ft	724.65140 ft	-290.38796 psf	621.5959 psf	251.14105 psf	0 psf	0 psf	Lower Loose to Very Loose CCR

Column 27	57.26405 ft	724.46146 ft	-278.52952 psf	634.99346 psf	256.55401 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 28	57.46005 ft	724.27672 ft	-266.99667 psf	648.02452 psf	261.8189 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 29	57.65604 ft	724.09701 ft	-255.77692 psf	660.69951 psf	266.93993 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 30	57.85204 ft	723.92212 ft	-244.85874 psf	673.02821 psf	271.92105 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 31	58.04803 ft	723.75189 ft	-234.23144 psf	685.01976 psf	276.76595 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 32	58.24403 ft	723.58617 ft	-223.88509 psf	696.68273 psf	281.4781 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 33	58.44002 ft	723.42479 ft	-213.81046 psf	708.02519 psf	286.06075 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 34	58.63602 ft	723.26763 ft	-203.99895 psf	719.05471 psf	290.51696 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 35	58.83201 ft	723.11456 ft	-194.44252 psf	729.7784 psf	294.84961 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 36	59.02801 ft	722.96545 ft	-185.13366 psf	740.20298 psf	299.06142 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 37	59.22400 ft	722.82020 ft	-176.06533 psf	750.33479 psf	303.15493 psf	0 psf	0 psf	Lower Loose to Very Loose CCR

Column 38	59.42000 ft	722.67869 ft	-167.23094 psf	760.17979 psf	307.13257 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 39	59.61599 ft	722.54083 ft	-158.62427 psf	769.74363 psf	310.99662 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 40	59.81199 ft	722.40652 ft	-150.2395 psf	779.03165 psf	314.74922 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 41	60.00798 ft	722.27568 ft	-142.07113 psf	788.04888 psf	318.39242 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 42	60.20398 ft	722.14822 ft	-134.11399 psf	796.80011 psf	321.92814 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 43	60.39997 ft	722.02407 ft	-126.3632 psf	805.28985 psf	325.35822 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 44	60.59597 ft	721.90315 ft	-118.81414 psf	813.52238 psf	328.68438 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 45	60.79196 ft	721.78539 ft	-111.46244 psf	821.50177 psf	331.90826 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 46	60.99057 ft	721.66924 ft	-104.21098 psf	829.33161 psf	335.07172 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 47	61.19180 ft	721.55471 ft	-97.060865 psf	837.00925 psf	338.17369 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 48	61.39303 ft	721.44331 ft	-90.106266 psf	844.43173 psf	341.17257 psf	0 psf	0 psf	Lower Loose to Very Loose CCR

Column 49	61.59426 ft	721.33499 ft	-83.343388 psf	851.6026 psf	344.06979 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 50	61.79549 ft	721.22967 ft	-76.768636 psf	858.52521 psf	346.8667 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 51	61.99672 ft	721.12732 ft	-70.378599 psf	865.20275 psf	349.5646 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 52	62.19794 ft	721.02787 ft	-64.170042 psf	871.63821 psf	352.16469 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 53	62.39917 ft	720.93128 ft	-58.139893 psf	877.83445 psf	354.66814 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 54	62.60040 ft	720.83750 ft	-52.285235 psf	883.79416 psf	357.07602 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 55	62.80163 ft	720.74649 ft	-46.603296 psf	889.51991 psf	359.38937 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 56	63.00286 ft	720.65820 ft	-41.091441 psf	895.01409 psf	361.60916 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 57	63.20409 ft	720.57259 ft	-35.747165 psf	900.27899 psf	363.73632 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 58	63.40531 ft	720.48964 ft	-30.568088 psf	905.31677 psf	365.77172 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 59	63.60654 ft	720.40929 ft	-25.551942 psf	910.12945 psf	367.71616 psf	0 psf	0 psf	Lower Loose to Very Loose CCR

Column 60	63.80777 ft	720.33152 ft	-20.696575 psf	914.71894 psf	369.57044 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 61	64.00900 ft	720.25629 ft	-15.999935 psf	919.08704 psf	371.33527 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 62	64.21654 ft	720.18136 ft	-11.32263 psf	923.35852 psf	373.06106 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 63	64.43040 ft	720.10688 ft	-6.6727137 psf	927.52104 psf	374.74283 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 64	64.64426 ft	720.03517 ft	-2.1956074 psf	931.43904 psf	376.3258 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 65	64.84757 ft	719.96947 ft	1.9061866 psf	935.11968 psf	377.04273 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 66	65.04032 ft	719.90949 ft	5.6502488 psf	938.56366 psf	376.92148 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 67	65.23308 ft	719.85170 ft	9.2583327 psf	941.77842 psf	376.76257 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 68	65.42584 ft	719.79607 ft	12.731695 psf	944.76635 psf	376.56644 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 69	65.61860 ft	719.74257 ft	16.07153 psf	947.52969 psf	376.33352 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 70	65.81135 ft	719.69119 ft	19.278975 psf	950.07059 psf	376.06422 psf	0 psf	0 psf	Lower Loose to Very Loose CCR

Column 71	66.00411 ft	719.64192 ft	22.355107 psf	952.39109 psf	375.75893 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 72	66.19871 ft	719.59430 ft	25.3278 psf	865.3967 psf	339.40987 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 73	66.39514 ft	719.54837 ft	28.195553 psf	862.66531 psf	337.14767 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 74	66.59158 ft	719.50457 ft	30.929987 psf	859.68274 psf	334.83785 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 75	66.78801 ft	719.46289 ft	33.532019 psf	856.45064 psf	332.48071 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 76	66.98445 ft	719.42332 ft	36.002514 psf	852.97057 psf	330.07652 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 77	67.18088 ft	719.38584 ft	38.342287 psf	849.24396 psf	327.62554 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 78	67.37731 ft	719.35044 ft	40.552104 psf	845.27214 psf	325.128 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 79	67.57375 ft	719.31711 ft	42.63268 psf	841.05633 psf	322.58409 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 80	67.77018 ft	719.28585 ft	44.584687 psf	836.59766 psf	319.99401 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 81	67.96662 ft	719.25663 ft	46.40875 psf	831.89714 psf	317.35791 psf	0 psf	0 psf	Lower Loose to Very Loose CCR

Column 82	68.16305 ft	719.22945 ft	48.105448 psf	826.9557 psf	314.67593 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 83	68.35949 ft	719.20431 ft	49.675318 psf	821.77417 psf	311.94818 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 84	68.55592 ft	719.18118 ft	51.118854 psf	816.35326 psf	309.17477 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 85	68.75236 ft	719.16008 ft	52.436508 psf	810.69361 psf	306.35575 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 86	68.94879 ft	719.14098 ft	53.62869 psf	804.79576 psf	303.4912 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 87	69.14522 ft	719.12389 ft	54.695769 psf	798.66016 psf	300.58113 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 88	69.34166 ft	719.10880 ft	55.638077 psf	792.28716 psf	297.62555 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 89	69.53809 ft	719.09570 ft	56.455902 psf	785.67702 psf	294.62446 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 90	69.73453 ft	719.08459 ft	57.149496 psf	778.82992 psf	291.57782 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 91	69.93096 ft	719.07546 ft	57.719072 psf	771.74593 psf	288.48558 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 92	70.12740 ft	719.06832 ft	58.164804 psf	764.42504 psf	285.34766 psf	0 psf	0 psf	Lower Loose to Very Loose CCR

Column 93	70.32383 ft	719.06316 ft	58.486828 psf	756.86714 psf	282.16396 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 94	70.52027 ft	719.05999 ft	58.685242 psf	749.07205 psf	278.93438 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 95	70.71670 ft	719.05879 ft	58.760107 psf	741.03947 psf	275.65876 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 96	70.91314 ft	719.05957 ft	58.711445 psf	732.76903 psf	272.33694 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 97	71.10957 ft	719.06232 ft	58.539241 psf	724.26024 psf	268.96874 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 98	71.30600 ft	719.06706 ft	58.243443 psf	715.51255 psf	265.55396 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 99	71.50244 ft	719.07378 ft	57.823961 psf	706.52527 psf	262.09234 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 100	71.69887 ft	719.08248 ft	57.280667 psf	697.29766 psf	258.58365 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 101	71.89531 ft	719.09317 ft	56.613395 psf	687.82883 psf	255.02759 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 102	72.09174 ft	719.10585 ft	55.821941 psf	678.11784 psf	251.42386 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 103	72.28818 ft	719.12052 ft	54.906061 psf	668.16361 psf	247.77213 psf	0 psf	0 psf	Lower Loose to Very Loose CCR

Column 104	72.48461 ft	719.13719 ft	53.865473 psf	657.96496 psf	244.07204 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 105	72.68105 ft	719.15586 ft	52.699857 psf	647.52061 psf	240.32319 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 106	72.87748 ft	719.17654 ft	51.40885 psf	636.82918 psf	236.52517 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 107	73.07391 ft	719.19923 ft	49.992052 psf	625.88914 psf	232.67753 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 108	73.27035 ft	719.22395 ft	48.449019 psf	614.69887 psf	228.77979 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 109	73.46678 ft	719.25069 ft	46.779266 psf	603.25662 psf	224.83145 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 110	73.66322 ft	719.27948 ft	44.982266 psf	591.56052 psf	220.83195 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 111	73.85965 ft	719.31031 ft	43.057448 psf	579.60857 psf	216.78072 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 112	74.05666 ft	719.34330 ft	40.997877 psf	567.3626 psf	212.66515 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 113	74.25423 ft	719.37847 ft	38.802137 psf	554.81862 psf	208.48419 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 114	74.45180 ft	719.41575 ft	36.475083 psf	542.00886 psf	204.2489 psf	0 psf	0 psf	Lower Loose to Very Loose CCR

Column 115	74.64937 ft	719.45514 ft	34.015944 psf	528.9307 psf	199.95854 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 116	74.84694 ft	719.49666 ft	31.423902 psf	515.58136 psf	195.61231 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 117	75.04452 ft	719.54032 ft	28.698088 psf	501.95788 psf	191.20937 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 118	75.24209 ft	719.58614 ft	25.837576 psf	488.05713 psf	186.74882 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 119	75.43966 ft	719.63413 ft	22.84139 psf	473.87578 psf	182.22972 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 120	75.63723 ft	719.68431 ft	19.708493 psf	459.41033 psf	177.65108 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 121	75.83481 ft	719.73670 ft	16.437793 psf	444.65706 psf	173.01182 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 122	76.03238 ft	719.79132 ft	13.028136 psf	429.61204 psf	168.31082 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 123	76.22995 ft	719.84818 ft	9.4783038 psf	414.27109 psf	163.5469 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 124	76.42752 ft	719.90730 ft	5.7870157 psf	398.62982 psf	158.7188 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 125	76.62509 ft	719.96872 ft	1.9529216 psf	382.68357 psf	153.82517 psf	0 psf	0 psf	Lower Loose to Very Loose CCR

Column 126	76.82175 ft	720.03214 ft	-2.006281 psf	366.26847 psf	147.98207 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 127	77.01749 ft	720.09756 ft	-6.0907263 psf	349.34548 psf	141.14474 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 128	77.21323 ft	720.16530 ft	-10.31972 psf	332.05001 psf	134.15691 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 129	77.40897 ft	720.23538 ft	-14.694866 psf	314.37285 psf	127.01487 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 130	77.60471 ft	720.30783 ft	-19.217847 psf	296.30424 psf	119.71469 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 131	77.80045 ft	720.38267 ft	-23.890431 psf	277.83387 psf	112.25217 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 132	77.99619 ft	720.45995 ft	-28.714474 psf	258.95078 psf	104.6229 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 133	78.19193 ft	720.53967 ft	-33.691924 psf	239.64333 psf	96.82219 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 134	78.38767 ft	720.62189 ft	-38.824828 psf	219.89918 psf	88.845035 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 135	78.58341 ft	720.70663 ft	-44.115333 psf	199.70518 psf	80.686132 psf	0 psf	0 psf	Lower Loose to Very Loose CCR
Column 136	78.80306 ft	720.80496 ft	-50.253666 psf	213.26396 psf	133.26211 psf	0 psf	0 psf	Railroad Ballast
Column 137	79.04662 ft	720.91762 ft	-57.28748 psf	222.7302 psf	139.17727 psf	0 psf	0 psf	Railroad Ballast

Column 138	79.26837 ft	721.02360 ft	-63.903621 psf	219.41898 psf	137.10819 psf	0 psf	0 psf	Railroad Ballast
Column 139	79.46830 ft	721.12227 ft	-70.063814 psf	203.05432 psf	126.88242 psf	0 psf	0 psf	Railroad Ballast
Column 140	79.66823 ft	721.22381 ft	-76.403 psf	185.87092 psf	116.14504 psf	0 psf	0 psf	Railroad Ballast
Column 141	79.86816 ft	721.32827 ft	-82.924343 psf	167.82825 psf	104.87073 psf	0 psf	0 psf	Railroad Ballast
Column 142	80.06809 ft	721.43570 ft	-89.631178 psf	148.88219 psf	93.031917 psf	0 psf	0 psf	Railroad Ballast
Column 143	80.26802 ft	721.54616 ft	-96.527019 psf	128.98462 psf	80.598536 psf	0 psf	0 psf	Railroad Ballast
Column 144	80.46796 ft	721.65970 ft	-103.61557 psf	108.08293 psf	67.537713 psf	0 psf	0 psf	Railroad Ballast
Column 145	80.66789 ft	721.77640 ft	-110.90075 psf	86.119466 psf	53.813415 psf	0 psf	0 psf	Railroad Ballast
Column 146	80.86782 ft	721.89631 ft	-118.38668 psf	63.030843 psf	39.386042 psf	0 psf	0 psf	Railroad Ballast
Column 147	81.06775 ft	722.01950 ft	-126.07773 psf	38.747219 psf	24.21195 psf	0 psf	0 psf	Railroad Ballast
Column 148	81.26768 ft	722.14605 ft	-133.97853 psf	13.191389 psf	8.242895 psf	0 psf	0 psf	Railroad Ballast