Location Restriction Compliance Demonstrations
Phase 2, Modules 12 and 13

Columbia Dry Ash Disposal Facility

Prepared for:

Wisconsin Power and Light Company
Columbia Energy Center
W8375 Murray Road
Pardeeville, Wisconsin 53954

SCS ENGINEERS

25224034.00 | July 29, 2024

2830 Dairy Drive
Madison, WI 53718-6751
608-224-2830

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Appendices

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P.E. CERTIFICATION

I, Phillip E. Gearing, hereby certify that the location restriction demonstrations prepared for Phase 2, Modules 12 and 13 at the Columbia Energy Center dry ash disposal facility meet the requirements in 40 CFR 257.60(a), 61(a), 62(a), 63(a), and 64(a). This certification is based on my review of the 2024 Location Restriction Compliance Demonstrations for Phase 2, Modules 12 and 13 prepared by SCS Engineers. I am a duly licensed Professional Engineer under the laws of the State of Wisconsin.

(signature) 7/29/2024 (date)

Phillip Gearing
(printed or typed name)

License number E-45115-6

My license renewal date is July 31, 2026.

Pages or sheets covered by this seal:

Entire document

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1.0 INTRODUCTION AND PROJECT SUMMARY

On behalf of Wisconsin Power and Light Company (WPL), SCS Engineers (SCS) has prepared the enclosed Location Restriction Compliance Demonstrations for the Columbia (COL) Dry Ash Disposal Facility Phase 2, Modules 12 and 13 as required by 40 CFR 257.60-64.

The COL facility includes an active coal combustion residual (CCR) landfill consisting of Modules 1 through 6 and Modules 10 and 11, which are contiguous and are managed as a single landfill by the facility and by the Wisconsin Department of Natural Resources (WDNR). Under the federal CCR Rule, Modules 1 through 3 are one existing CCR landfill. Modules 4 through 6 are a new CCR landfill that initiated construction after October 19, 2015, and are therefore managed as a separate CCR unit under the CCR Rule, even though it is contiguous to Modules 1 through 3. Modules 10 and 11 were also constructed after October 19, 2015, as a lateral expansion of the CCR landfill and defined as a new landfill in 40 CFR 257.53. Modules 12 and 13 are a lateral expansion of the CCR landfill and are also defined as a new landfill per 40 CFR 257.53.

Future CCR modules (Phase 2, Modules 7 through 9), have not been currently developed. If developed, the units will be a lateral expansion of the CCR landfill, as defined in 40 CFR 257.53. This demonstration addresses Modules 12 and 13. Future Phase 2 CCR modules are not addressed by this demonstration and are not discussed further herein.

Figure 1 shows the site location. **Figure 2** shows the Modules 12 and 13 locations.

2.0 LOCATION RESTRICTIONS

§257.60. *"Placement above the uppermost aquifer."*

> *"(a) New CCR landfills, existing and new CCR surface impoundments, and all lateral expansions of CCR units must be constructed with a base that is located no less than 1.52 meters (five feet) above the upper limit of the uppermost aquifer, or must demonstrate that there will not be an intermittent, recurring, or sustained hydraulic connection between any portion of the base of the CCR unit and the uppermost aquifer due to normal fluctuations in groundwater elevations (including the seasonal high water table). The owner or operator must demonstrate by the dates specified in paragraph (c) of this section that the CCR unit meets the minimum requirements for placement above the uppermost aquifer."*

The high-water table within the uppermost aquifer below Modules 12 and 13 is at an approximate elevation of 789 feet above mean sea level (amsl), based on a review of water table observation well water levels near Modules 12 and 13, for the period from October 2012 to April 2024; refer to **Appendix A**. The highest water level elevation measured at a well in proximity to Modules 12 and 13 was 788.25 feet amsl recorded at MW-1AR. As shown on **Figure 3**, the lowest subbase grade, which represents the top of subbase soils and bottom of the clay liner, within Modules 12 and 13 to the nearest foot is 797 feet amsl. Based on this information, Modules 12 and 13 are located at least 5 feet above the uppermost aquifer.

§257.61 *"Wetlands."*

> *"(a) New CCR landfills, existing and new CCR surface impoundments, and all lateral expansions of CCR units must not be located in wetlands, as defined in §232.2 of this chapter, unless the*

owner or operator demonstrates by the dates specified in paragraph (c) of this section that the CCR unit meets the requirements of paragraphs (a)(1) through (5) of this section."

No federally or state-mapped wetlands, or mapped wetland indicator soils are present in the Module 12 and 13 area (**Appendix B**).

Since 2021, the Module 12 and 13 area has been a disturbed construction area consisting of soil stockpiles, access roads, and construction equipment laydown areas. The overall site and location of Modules 12 and 13 are shown on **Figure 2**.

§257.62 *"Fault areas."*

"(a) New CCR landfills, existing and new CCR surface impoundments, and all lateral expansions of CCR units must not be located within 60 meters (200 feet) of the outermost damage zone of a fault that has had displacement in Holocene time unless the owner or operator demonstrates by the dates specified in paragraph (c) of this section that an alternative setback distance of less than 60 meters (200 feet) will prevent damage to the structural integrity of the CCR unit."

Based on a review of the U.S. Geological Survey (USGS) Quaternary faults database and map as shown in **Appendix C**, Modules 12 and 13 are not located within 200 feet of the outermost damage zone of a fault that has had displacement in Holocene time. In 40 CFR 257.53, Holocene is defined as the most recent epoch of the Quaternary period extending from 11,700 years before present, to present. The USGS map shows that no faults are located in Wisconsin.

§257.63 *"Seismic impact zones."*

"(a) New CCR landfills, existing and new CCR surface impoundments, and all lateral expansions of CCR units must not be located in seismic impact zones unless the owner or operator demonstrates by the dates specified in paragraph (c) of this section that all structural components including liners, leachate collection and removal systems, and surface water control systems, are designed to resist the maximum horizontal acceleration in lithified earth material for the site."

Modules 12 and 13 are not located in seismic impact zones. In 40 CFR 257.53, a seismic impact zone is defined as an area having a 2 percent or greater probability that the maximum expected horizontal acceleration, expressed as a percentage of the earth's gravitational pull (g), will exceed 0.10 g in 50 years. Based on a review of the USGS 2014 Long-Term Model National Seismic Hazard Map (see **Appendix D**), the maximum expected horizontal acceleration for the majority of Wisconsin, including all of Columbia County, is less than 0.04 g, below the threshold for a seismic impact zone.

257.64 *"Unstable areas."*

"(a) An existing or new CCR landfill, existing or new CCR surface impoundment, or any lateral expansion of a CCR unit must not be located in an unstable area unless the owner or operator demonstrates by the dates specified in paragraph (d) of this section that recognized and generally accepted good engineering practices have been incorporated into the design of the CCR unit to ensure that the integrity of the structural components of the CCR unit will not be disrupted."

"(b) The owner or operator must consider all of the following factors, at a minimum, when determining whether an area is unstable:

"(1) On-site or local soil conditions that may result in significant differential settling;

As discussed in **Appendices E** and **F**, and as shown by the geologic cross sections from the June 1980 Supplementary Feasibility Study prepared by Warzyn Engineering Inc. (see **Appendix G**), Modules 12 and 13 are not located in on-site or local soil conditions that may result in significant differential settling. The site soils consist primarily of sands of alluvial and glacial origin overlaying sandstone bedrock. Based on the Standard Penetration Test (SPT) blow counts on the geologic cross sections, the soils are typically medium dense to very dense and therefore not susceptible to appreciable differential settlement under the CCR landfill loads.

(2) On-site or local geologic or geomorphologic features; and

As discussed in **Appendices E**, **H**, and **I**, and shown by the geologic cross sections in **Appendix G**, Modules 12 and 13 are not located in on-site or local geologic or geomorphologic features that are unstable. The cross sections show medium dense to very dense sands of alluvial and glacial origin overlaying sandstone bedrock. These geologic features provide a stable foundation for the CCR landfill.

This assessment is confirmed by the slope stability analyses in **Appendix H** that indicate the slope stability safety factors are acceptable. The slope stability analyses in **Appendix H** were performed for Modules 12 and 13 with maximum waste slope heights of 130 feet, and slopes of 3 horizontal to 1 vertical (3H:1V) and 4H:1V. The location of the cross-section analysis was performed in an existing area that includes scrubber byproduct and a future area that is intended to contain scrubber byproduct. The properties in the analysis are conservative for CCR that contains scrubber byproduct. The results in **Appendix H** confirm that the slope stability safety factors for Modules 12 and 13 are acceptable.

(3) On-site or local human-made features or events (both surface and subsurface)."

As shown by the geologic cross sections in **Appendix G**, Modules 12 and 13 are not located in on-site or local human-made features or events (both surface and subsurface) that are unstable. The predominant native sands are overlain by sand fill in some areas of the site. The sand fill was placed in the landfill area during excavation activities for construction of the generating station. Based on the SPT blow counts for the sand fill on the cross sections, the fill is typically medium dense to very dense and therefore provides a stable base material where present below the landfill.

As discussed in **Appendix I**, groundwater or surface water movement is unlikely to cause instability. The facility is designed with adequate run-on and run-off control systems, and is constructed above the water table.

3.0 REFERENCES

A. Heartland Ecological Group, 2022, Exemption Request for Artificial Wetlands – WPL Columbia Power Plant, Town of Pacifica, Columbia County, Wisconsin

B. Wisconsin Department of Natural Resources, March 15, 2022, Artificial Wetland Exemption Determination for an area described as Wetlands 1, 2, and active coal combustion residual surface impoundments located at T12N R9E S27 in the Town of Pacific, Columbia County.

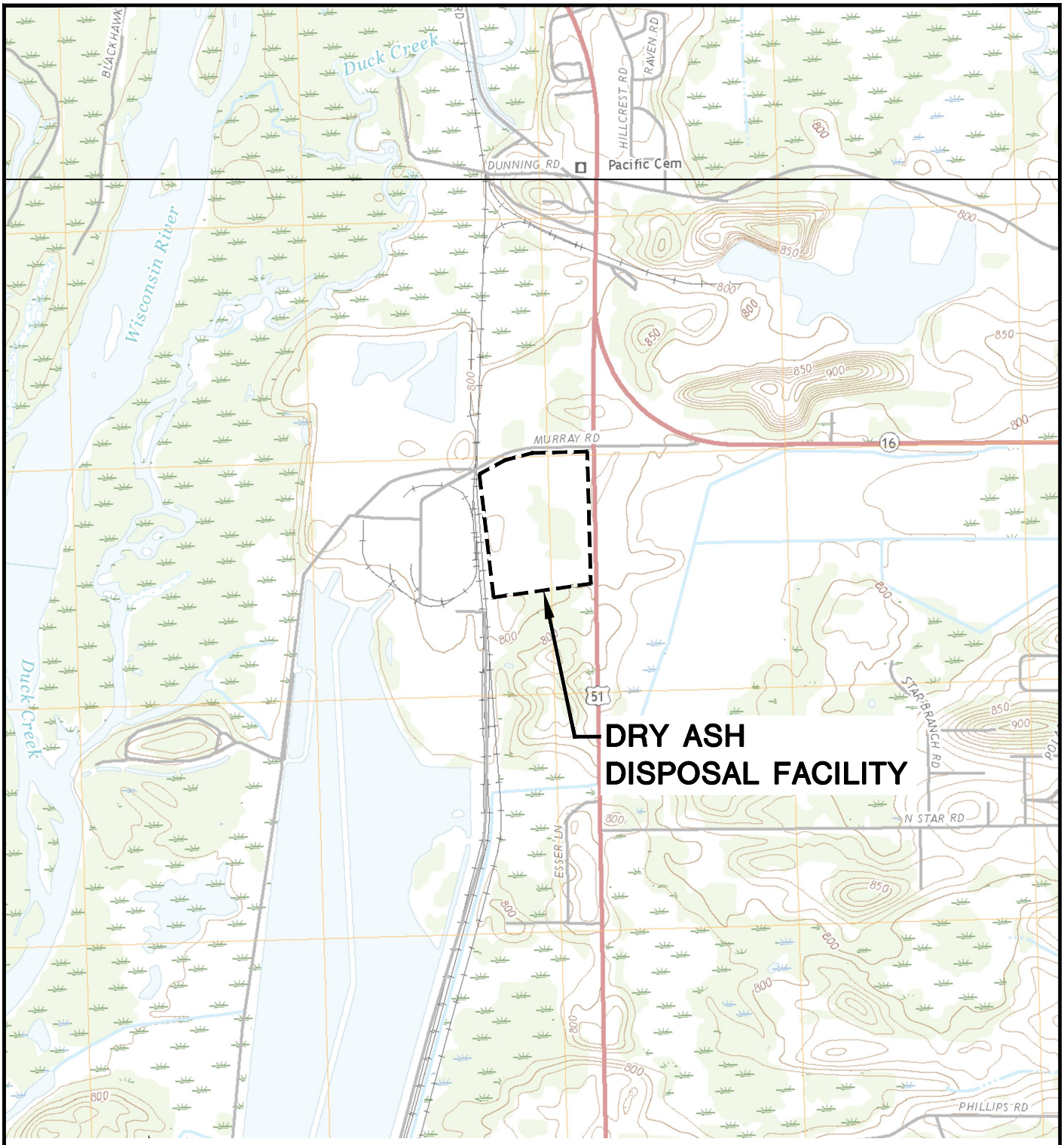
C. Mach IV, 2017, Assured Wetland Delineation Report, Alliant Columbia Energy, Town of Pacific, Columbia County, Wisconsin.

D. USGS Earthquake Hazards Program - Faults Interactive Map Website: https://www.usgs.gov/programs/earthquake-hazards/faults, Last accessed June 6, 2024.

E. USGS seismic impact zones map reference: Petersen, M.D., Moschetti, M.P., Powers, P.M., Mueller, C.S., Haller, K.M., Frankel, A.D., Zeng, Yuehua, Rezaeian, Sanaz, Harmsen, S.C., Boyd, O.S., Field, E.H., Chen, Rui, Luco, Nicolas, Wheeler, R.L., Williams, R.A., Olsen, A.H., and Rukstales, K.S., 2015, Seismic-hazard maps for the conterminous United States, 2014: U.S. Geological Survey Scientific Investigations Map 3325, 6 sheets, scale 1: 7,000,000, http://dx.doi.org/10.3133/sim3325.

F. Warzyn Engineering Inc., 1980, Supplementary Feasibility Study, Proposed Fly Ash and/or Scrubber Sludge Disposal Facility, Columbia Site – Wisconsin Power & Light Company, Town of Pacific, Columbia County, Wisconsin.

Figures



N

POYNETTE QUADRANGLE
WISCONSIN–COLUMBIA CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
2018
SCALE: 1" = 2,000'

CLIENT	WISCONSIN POWER AND LIGHT COLUMBIA ENERGY CENTER W8375 MURRAY ROAD PARDEEVILLE, WI 53954	SITE	LOCATION RESTRICTION COMPLIANCE DEMONSTRATION REPORT COLUMBIA DRY ASH DISPOSAL FACILITY TOWN OF PACIFIC, WISCONSIN

SITE LOCATION MAP

PROJECT NO.	25224034.00	DRAWN BY:	KP/SB
DRAWN:	08/02/2022	CHECKED BY:	DN
REVISED:	05/15/2024	APPROVED BY:	PEG 7/29/24

ENGINEER

SCS ENGINEERS
2830 DAIRY DRIVE MADISON, WI 53718-6751
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FIGURE
1 OF 3

C:\Projects\25224034.00\Drawings\Restrictions Compliance\1_SITE LOCATION.dwg, 5/15/2024 2:54:23 PM

540,500 N | 541,000 N | 541,500 N | 542,000 N | 542,500 N | 543,000 N | 543,500 N

2,123,500 E | 2,124,000 E | 2,124,500 E | 2,125,000 E

COAL PILE

SOUTH SEDIMENTATION BASIN

WPDES POND

ROCK CHUTE

C. M. ST. P. & P. RR.

MURRAY ROAD

PHASE 1

EXISTING MODULE 1

EXISTING MODULE 2

EXISTING MODULE 3

EXISTING MODULE 4

EXISTING MODULE 5

EXISTING MODULE 6

FINAL COVER AREA

INTERMEDIATE COVER AREA

PHASE 2

EXISTING MODULE 10

EXISTING MODULE 11

PROPOSED MODULE 12

PROPOSED MODULE 13

GENERAL FILL STOCKPILE

CLAY STOCKPILE

LEACHATE/ SURFACE WATER POND

MW-83 | SG-4 | MW-311 | MW-33AR | MW-33B | MW-34A | MW-34B | MW-88B | MW-85B | MW-302 | MW-5R | BM202 | LS-1 | MW-310 | MW-309 | MW-37A | MW-313 | MW-314 | MW-315 | MW-312 | MW-92B | MW-92A | LS-3R | MW-91AR | MW-91B | MW-16 | MW-89A/B | LP-1 | MW-301 | MW-1AR | MW-1B | MW-84A | MW-84B | MW-17 | MW-86 | MW-93B | MW-93A | BM301 | BM302 (SGH) | BM46 | LH-2 | LH-5 | LH-6 | LH-10A | LH-10B | LH-11A | LH-11B

24" CMP
N. INV. = 806.81
S. INV. = 807.54

ADF C7
30" HDPE
N. INV. = 815.26
S. INV. = 814.45

24" HDPE
E. INV. = 816.70
W. INV. = 814.55

24" HDPE
N. INV. = 805.40
S. INV. = 804.71

24" HDPE
N. INV. = 805.40
S. INV. = 804.76

TOP OF POND LINER ELEVATION = 796.97'

ADF C5-WEST
30" HDPE
N. INV. = 807.76
S. INV. = 806.89

ADF C8-WEST
30" HDPE
N. INV. = 809.14
S. INV. = 808.97

ADF C4-WEST
30" HDPE
N. INV. = 809.85
S. INV. = 809.70

ADF C3-WEST
30" HDPE
N. INV. = 811.07
S. INV. = 810.85

ADF C5-EAST
30" HDPE
N. INV. = 807.83
S. INV. = 806.78

ADF C8-EAST
30" HDPE
N. INV. = 809.25
S. INV. = 809.04

ADF C4-EAST
30" HDPE
N. INV. = 809.73
S. INV. = 809.61

ADF C3-EAST
30" HDPE
N. INV. = 810.80
S. INV. = 810.66

TRANSFORMER AND ELECTRICAL POWER TO LEACHATE VAULTS

LEACHATE PUMP CONTROL PANEL

LEGEND

- DRY ASH DISPOSAL FACILITY LIMITS
- LIMITS OF WASTE
- LINER PHASE/MODULE LIMIT
- FINAL COVER LIMITS
- APPROXIMATE EXISTING INTERMEDIATE COVER LIMITS/AREA
- APPROXIMATE EXISTING INTERMEDIATE COVER AREA WITH TOPSOIL
- LIMITS OF 2' THICK CLAY LINER
- PAVED ROAD
- UNPAVED ROAD
- RAILROAD TRACKS
- VEGETATION
- FENCE
- FM LEACHATE FORCEMAIN
- UE UNDERGROUND ELECTRIC UTILITY
- FINAL COVER INTERMEDIATE/TOE DRAIN
- 810 EXISTING GRADE (10' INTERVAL)
- EXISTING GRADE (2' INTERVAL)
- SWALE
- EDGE OF WATER
- WETLAND
- RIPRAP
- CULVERT
- TRANSMISSION TOWER
- UTILITY POLE
- MONITORING WELL
- PIEZOMETER
- WATER SUPPLY WELL
- STAFF GAUGE
- SURFACE WATER SAMPLE LOCATION
- LEACHATE HEADWELL
- LEACHATE RISER/CLEANOUT
- LYSIMETER MANHOLE
- ABANDONED MONITORING WELL
- ABANDONED PIEZOMETER
- ABANDONED TEMPORARY WATER TABLE WELL
- BENCHMARK
- MODULE 12 AND 13 LIMITS

NOTES:

1. BASE MAP CREATED FROM AERIAL SURVEY BY KBM, FLOWN DECEMBER 1, 2014, PERIODIC SURVEYS BY SCS ENGINEERS AND CEDAR CREEK SURVEYING, LLC, AND DECEMBER 2023 DRONE SURVEY BY AMES.
2. WETLANDS OUTSIDE FACILITY LIMITS ARE FROM THE MAY 19, 2015 ASSURED WETLAND DELINEATION PERFORMED BY STANTEC.
3. UTILITY LOCATIONS ARE APPROXIMATE AND NOT ALL UTILITIES ARE SHOWN.
4. LIMITS OF INTERMEDIATE FINAL COVER ARE APPROXIMATE AREA COVERED BY DECEMBER 2023.

100 0 100

SCALE: 1" = 100'

N

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PROJECT NO.	25224034.00
DRAWN:	05/15/2024
REVISED:	05/29/2024
DRAWN BY:	SB
CHECKED BY:	DN
APPROVED BY:	PEG 7/29/24

WISCONSIN POWER AND LIGHT COLUMBIA ENERGY CENTER 4917 OWEN ROAD PARDEEVILLE, WI 53954

Wisconsin Power and Light Company

CLIENT

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ENGINEER

LOCATION RESTRICTION
COMPLIANCE DEMONSTRATION REPORT
DRY ASH DISPOSAL FACILITY
TOWN OF PACIFIC, WISCONSIN

SITE

MODULE 12 AND 13 LOCATION

FIGURE

2 of 3

542,500 N | 542,500 N | 543,000 N | 543,500 N

2,124,500 E

2,125,000 E

MW-91AR
MW-91B
LP-1
MW-89A/B
MW-1AR
M-1B
MW-86
MW-93B
MW-93A
MW-313
MW-314
MW-315
MW-316
MW-317
MW-318
MW-319
MW-37A
MW-37B
LH-12A
LH-12B
LH-13A
LH-13B
BM302
SIGN

LEACHATE/ SURFACE WATER POND

EXISTING MODULE 10

EXISTING MODULE 11

PROPOSED MODULE 12

PROPOSED MODULE 13

MODULE 5 - MODULE 12 LINER TIE-IN

MODULE 6 - MODULE 13 LINER TIE-IN

MODULE 11 - MODULE 12 DELINEATION BERM TIE-IN

COMPOSITE LINER SYSTEM

LEACHATE COLLECTION PIPE (TYP.)

MODULE 12 LEACHATE COLLECTION SUMP

LEACHATE INCLINED RISER PUMP (TYP.)

INCLINED RISER PIPE AND LEACHATE VAULT (TYP.)

LEACHATE VAULT (TYP.)

LEACHATE CLEANOUT (TYP.)

MURRAY ROAD

U.S.H. 51

2.0%

0.5%

3H:1V

LEGEND

DRY ASH DISPOSAL FACILITY LIMITS	SWALE
LIMITS OF WASTE	EDGE OF WATER
LINER PHASE/MODULE LIMIT	PROPOSED GRADE (10' INTERVAL)
LIMITS OF CONSTRUCTED 2' THICK CLAY LINER	PROPOSED GRADE (2' INTERVAL)
PAVED ROAD	PROPOSED PERIMETER ROAD
UNPAVED ROAD	PROPOSED SWALE
VEGETATION	PROPOSED CULVERT
FENCE	PROPOSED SLOPE AND DIRECTION
EXISTING GRADE (10' INTERVAL)	
EXISTING GRADE (2' INTERVAL)	

	PROPOSED 6" DIAMETER PERFORATED SDR 11 HDPE LEACHATE COLLECTION LINE
	PROPOSED 6" DIAMETER SOLID SDR 11 HDPE PIPE
	PROPOSED LEACHATE COLLECTION SYSTEM CLEANOUT
	PROPOSED INCLINED RISER PIPE AND LEACHATE VAULT
MW-319	EXISTING MONITORING WELL
MW-313	ABANDONED MONITORING WELL

NOTE:

1. PROPOSED GRADES WITHIN MODULES 12 AND 13 REPRESENT BOTTOM OF 2' THICK CLAY LINER (SUBBASE GRADE).

50 0 50

SCALE: 1" = 50'

N

DRAWN BY: SB
CHECKED BY: DN
APPROVED BY: PEG 7/29/24

PROJECT NO. 25224034.00
DRAWN: 05/15/2024
REVISED: 05/29/2024

WISCONSIN POWER AND LIGHT
COLUMBIA ENERGY CENTER
2019 AGENCY ROAD
PARDEEVILLE, WI 53954

Wisconsin Power and Light Company

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ENGINEER

LOCATION RESTRICTION
COMPLIANCE DEMONSTRATION REPORT
COLUMBIA DRY ASH DISPOSAL FACILITY
TOWN OF PACIFIC, WISCONSIN

SITE

SUBBASE GRADES AND LEACHATE COLLECTION SYSTEM

FIGURE 3 of 3

Appendix A

Water Levels

Table 1. Groundwater Elevation - State Monitoring Program and CCR Well Network
Columbia Dry Ash and Ash Pond Disposal Facilities / SCS Engineers Project #25224067.00

Raw Data	MW-1AR	MW-4	MW-5R	MW-33AR	MW-33BR	MW-34A	MW-34B	MW-37A	MW-83	MW-84A	MW-84B	MW-86	MW-91AR	MW-91B	MW-92A	MW-92B	MW-93A	MW-93B	MW-312
Measurement Date																			
October 2, 2012	39.14	36.04	20.48	25.91	26.16	22.92	23.06	30.38	dry	30.44	30.32	40.98	24.94	24.55	23.98	24.35	NI	NI	NI
April 15, 2013	37.11	35.72	19.35	24.13	24.25	21.21	21.26	29.17	23.47	28.45	28.50	39.57	23.89	23.44	22.72	23.07	NI	NI	NI
October 8, 2013													23.37	23.03	22.5	22.89	NI	NI	NI
October 15, 2013	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	23.37	23.03	22.5	22.89	NI	NI	NI
April 14, 2014	37.60	35.65	19.81	24.55	24.48	21.32	21.35	29.59	24.23	28.70	28.74	39.83	23.99	23.49	22.48	22.87	NI	NI	NI
October 2-3, 2014	37.52	34.35	19.36	23.92	24.11	21.38	21.51	28.48	dry	29.04	29.08	39.60	23.56	23.17	22.72	23.08	NI	NI	NI
April 13-14, 2015	38.59	36.11	20.19	25.28	25.65	22.30	22.10	30.17	dry	29.85	29.75	40.62	24.55	24.08	23.40	23.75	NI	NI	NI
October 6-7, 2015	38.27	35.30	19.72	24.61	25.06	21.90	22.03	29.38	24.31	29.48	29.5	40.13	24.14	23.75	23.27	23.65	NI	NI	NI
April 4-6, 2016	36.73	aband	18.42	23.00	23.32	20.32	20.38	28.28	22.53	27.91	28.00	38.90	22.98	22.50	21.86	22.20	NI	NI	NI
October 11-13, 2016	35.91	aband	17.44	20.93	21.93	19.50	19.73	26.64	21.15	27.06	27.15	37.83	21.86	21.64	20.79	21.16	NI	NI	NI
April 10-13, 2017	35.59	aband	17.31	21.90	22.40	19.65	19.77	26.70	21.73	27.12	27.20	37.83	21.79	21.42	20.57	20.81	NI	NI	NI
October 3-5, 2017	37.07	aband	18.78	23.78	24.17	21.28	21.42	28.18	23.67	NM	27.77	39.21	22.95	22.62	22.00	22.39	NI	NI	NI
October 9-10, 2017	--	aband	NM	NM	NM	NM	NM	NM	NM	28.72 [6]	NM	NM	NM	NM	NM	NM	NI	NI	NI
February 21, 2018	38.58	aband	NM	NM	NM	NM	NM	NM	NM	--	NM	NM	24.35	23.99	NM	NM	NI	NI	NI
April 23-25, 2018	38.56	aband	20.08	25.20	22.03	24.18	25.26	29.76	24.64	28.40	29.35	42.25	24.32	23.92	23.24	23.60	NI	NI	NI
October 23-25, 2018	34.30	aband	15.73	19.52	20.43	18.07	18.32	25.42	19.70	25.96	26.07	36.58	20.44	20.14	19.15	19.54	NI	NI	NI
April 1-4, 2019	35.50	aband	16.80	21.66	21.85	19.13	19.13	26.57	21.18	26.93	26.92	37.63	21.58	21.27	20.43	20.78	NI	NI	NI
October 7-9, 2019	35.29	aband	16.21	20.03	20.75	18.03	18.31	26.27	19.06	26.49	26.53	37.35	21.25	20.83	19.84	20.24	NI	NI	NI
May 27-28, 2020	35.63	aband	17.10	22.28	22.64	19.97	20.06	26.82	21.93	27.26	27.27	37.85	21.77	21.40	20.61	20.94	NI	NI	NI
October 7-8, 2020	36.60	aband	17.68	22.38	22.94	20.25	20.37	27.52	22.24	28.18	28.20	38.69	22.48	22.12	21.62	22.03	NI	NI	NI
February 25, 2021	NM	aband	NM	NM	NM	21.20	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NI	NI	NI
April 14, 2021	44.43	aband	18.15	24.02	24.34	21.18	21.28	28.58	23.62	28.44	28.45	39.19	23.17	22.76	22.00	22.35	NI	NI	NI
June 11, 2021	NM	aband	NM	24.10	NM	21.29	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NI	NI	NI
October 11-12, 14, 2021	38.08	aband	18.66	24.56	24.79	21.53	21.64	29.16	24.09	29.32	29.38	40.00	23.89	23.51	22.92	23.30	NI	NI	NI
October 17, 2021	NM	aband	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NI	NI	NI
April 1, 2022	aband	aband	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
April 11-13, 2022	aband	aband	19.92	25.02	24.94	21.65	21.63	29.78	24.18	29.26	29.26	40.09	24.20	23.73	23.02	23.39	43.90	43.74	43.06
October 24-28, 2022	aband	aband	20.01	26.35	26.78	22.34	22.44	30.76	dry	29.71	29.72	40.41	24.39	23.98	23.42	23.79	44.15	44.95	43.29
February 20-23, 2023	aband	aband	NM	24.72	NM	21.47	NM	NM	NM	29.03	NM	NM	NM	NM	NM	NM	NM	NM	NM
March 27-28, 2023	aband	aband	NM	23.77	NM	20.72	NM	NM	NM	28.07	NM	NM	NM	NM	NM	NM	NM	NM	NM
April 24-27, 2023	aband	aband	17.68	22.50	23.04	19.73	19.93	28.05	21.91	27.31	27.40	38.12	22.27	21.86	20.94	21.30	42.02	41.86	41.24
May 16, 2023	aband	aband	17.65	22.65	23.14	19.89	20.00	27.65	22.19	27.40	27.47	38.05	22.08	21.70	21.00	21.36	41.66	41.50	40.82
May 30-31, 2023	aband	aband	NM	23.06	NM	20.25	NM	NM	NM	27.71	NM	NM	NM	NM	NM	NM	NM	NM	NM
October 9-11, 2023	aband	aband	20.11	25.72	26.00	22.40	22.65	30.10	dry	29.89	29.95	40.55	24.40	24.09	23.58	24.05	44.03	44.12	43.10
April 15-17, 2024	aband	aband	20.04	25.27	25.45	21.81	21.94	30.09	24.55	29.38	29.42	40.25	24.42	23.88	23.28	23.66	44.01	43.84	43.20
April 19, 2024	aband	aband	19.97	25.23	25.37	21.67	21.75	29.99	dry	29.23	29.25	40.12	24.29	23.83	22.84	23.25	43.94	43.76	43.11

Dry Ash Facility (Facility ID #03025)

Well Number	MW-1AR	MW-4	MW-5R	MW-33AR	MW-33BR	MW-34A	MW-34B	MW-37A	MW-83	MW-84A	MW-84B	MW-86	MW-91AR	MW-91B	MW-92A	MW-92B	MW-93A	MW-93B	MW-312
Top of Casing Elevation (feet amsl)	822.55	819.74	805.44	808.29	808.39	805.95	806.05	813.04	807.96	814.28	814.26	824.79	809.03	808.45	808.47	808.41	827.89	827.71	826.79
Screen Length (ft)																	10	5	10
Total Depth (ft from top of casing)	44.40	39.58	25.97	31.08	57.50	35.43	56.95	31.80	25.42	40.21	52.02	45.43	32.90	52.38	28.94	51.75	50.7	82.5	52.5
Top of Well Screen Elevation (ft)	778.15	780.16	779.47	777.21	750.89	770.52	749.10	781.24	782.54	774.07	762.24	779.36	776.13	756.07	779.53	756.66	787.19	750.21	784.29
Measurement Date																			
October 2, 2012	783.41	783.70	784.96	782.38	782.23	783.03	782.99	782.66	dry	783.84	783.94	783.81	784.09	783.90	784.49	784.06	NI	NI	NI
April 15, 2013	785.44	784.02	786.09	784.16	784.14	784.74	784.79	783.87	784.49	785.83	785.76	785.22	785.14	785.01	785.75	785.34	NI	NI	NI
October 8, 2013													785.66	785.42	785.97	785.52	NI	NI	NI
October 15, 2013	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	785.66	785.42	785.97	785.52	NI	NI	NI
April 14, 2014	784.95	784.09	785.63	783.74	783.91	784.63	784.70	783.45	783.73	785.58	785.52	784.96	785.04	784.96	785.99	785.54	NI	NI	NI
October 2-3, 2014	785.03	785.39	786.08	784.37	784.28	784.57	784.54	784.56	dry	785.24	785.18	785.19	785.47	785.28	785.75	785.33	NI	NI	NI
April 13-14, 2015	783.96	783.63	785.25	783.01	782.74	783.65	783.95	782.87	dry	784.43	784.51	784.17	784.48	784.37	785.07	784.66	NI	NI	NI
October 6-7, 2015	784.28	784.44	785.72	783.68	783.33	784.05	784.02	783.66	dry	784.80	784.76	784.66	784.89	784.70	785.20	784.76	NI	NI	NI
April 4-6, 2016	785.82	aband	787.02	785.29	785.07	785.63	785.67	784.76	785.43	786.37	786.26	785.89	786.05	785.95	786.61	786.21	NI	NI	NI
October 11-13, 2016	786.64	aband	788.00	787.36	786.46	786.45	786.32	786.40	786.81	787.22	787.11	786.96	787.17	786.81	787.68	787.25	NI	NI	NI
April 10-13, 2017	786.96	aband	788.13	786.39	785.99	786.30	786.28	786.34	786.23	787.16	787.06	786.96	787.24	787.03	787.90	787.60	NI	NI	NI
October 3-5, 2017	785.48	aband	786.66	784.51	784.22	784.67	784.63	784.86	784.29	NM	786.49	785.58	786.08	785.83	786.47	786.02	NI	NI	NI
October 9-10, 2017	NM	aband	NM	NM	NM	NM	NM	NM	NM	785.56 [6]	NM	NM	NM	NM	NM	NM	NI	NI	NI
February 21, 2018	783.97	aband	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	784.68	784.46	NM	NM	NI	NI	NI
April 23-25, 2018	783.99	aband	785.36	783.09	786.36	781.77	780.79	783.28	783.32	785.88	784.91	782.54	784.71	784.53	785.23	784.81	NI	NI	NI
October 23-25, 2018	788.25	aband	789.71	788.77	787.96	787.88	787.73	787.62	788.26	788.32	788.19	788.21	788.59	788.31	789.32	788.87	NI	NI	NI
April 1-4, 2019	787.05	aband	788.64	786.63	786.54	786.82	786.92	786.47	786.78	787.35	787.34	787.16	787.45	787.18	788.04	787.63	NI	NI	NI
October 7-9, 2019	787.26	aband	789.23	788.26	787.64	787.92	787.74	786.77	788.90	787.79	787.73	787.44	787.78	787.62	788.63	788.17	NI	NI	NI
May 27-28, 2020	786.92	aband	788.34	786.01	785.75	785.98	785.99	786.22	786.03	787.02	786.99	786.94	787.26	787.05	787.86	787.47	NI	NI	NI
October 7-8, 2020	785.95	aband	787.76	785.91	785.45	785.70	785.68	785.52	785.72	786.10	786.06	786.10	786.55	786.33	786.85	786.38	NI	NI	NI
February 25, 2021	NM	aband	NM	NM	NM	784.75	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NI	NI	NI
April 14, 2021	778.12	aband	787.29	784.27	784.05	784.77	784.77	784.46	c	785.84	785.81	785.60	785.86	785.69	786.47	786.06	NI	NI	NI
June 11, 2021	NM	aband	NM	784.19	NM	784.66	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NI	NI	NI
October 11-12, 14, 2021	784.47	aband	786.78	783.73	783.60	784.42	784.41	783.88	783.87	784.96	784.88	784.79	785.14	784.94	785.55	785.11	NI	NI	NI
October 17, 2021	NM	aband	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NI	NI	NI
April 1, 2022	aband	aband	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
April 11-13, 2022	aband	aband	785.52	783.27	783.45	784.30	784.42	783.26	783.78	785.02	785.00	784.70	784.83	784.72	785.45	785.02	783.99	783.97	783.73
October 24-28, 2022	aband	aband	785.43	781.94	781.61	783.61	783.61	782.28	dry	784.57	784.54	784.38	784.64	784.47	785.05	784.62	783.74	782.76	783.50
February 20-23, 2023	aband	aband	NM	783.57	NM	784.48	NM	NM	NM	785.25	NM	NM	NM	NM	NM	NM	NM	NM	NM
March 27-28, 2023	aband	aband	NM	784.52	NM	785.23	NM	NM	NM	786.21	NM	NM	NM	NM	NM	NM	NM	NM	NM
April 24-27, 2023	aband	aband	787.76	785.79	785.35	786.22	786.12	784.99	786.05	786.97	786.86	786.67	786.76	786.59	787.53	787.11	785.87	785.85	785.55
May 16, 2023	aband	aband	787.79	785.64	785.25	786.06	786.05	785.39	785.77	786.88	786.79	786.74	786.95	786.75	787.47	787.05	786.23	786.21	785.97
May 30-31, 2023	aband	aband	NM	785.23	NM	785.70	NM	NM	NM	786.57	NM	NM	NM	NM	NM	NM	NM	NM	NM
October 9-11, 2023	aband	aband	785.33	782.57	782.39	783.55	783.40	782.94	dry	784.39	784.31	784.24	784.63	784.36	784.89	784.36	783.86	783.59	783.69
April 15-17, 2024	aband	aband	dry	783.02	782.94	784.14	784.11	782.95	783.41	784.90	784.84	784.54	784.61	784.57	785.19	784.75	783.88	783.87	783.59
April 19, 2024	aband	aband	785.47	783.06	783.02	784.28	784.30	783.05	dry	785.05	785.01	784.67	784.74	784.62	785.63	785.16	783.95	783.95	783.68
Bottom of Well Elevation (ft)	778.15	780.16	779.47	777.21	750.89	770.52	749.10	781.24	782.54	774.07	762.24	779.36	776.13	756.07	779.53	756.66	777.19	745.21	774.29

Table 1. Groundwater Elevation - State Monitoring Program and CCR Well Network
Columbia Dry Ash and Ash Pond Disposal Facilities / SCS Engineers Project #25224067.00

	Raw Data	M-3	M-4R	MW-39A	MW-39B	MW-48A	MW-48B	MW-57	MW-59	MW-216R	MW-217	MW-220RR
	Measurement Date											
	October 2, 2012	8.10	19.34	28.13	28.16	46.83	46.91	5.71	35.60	32.30	10.60	12.35
	April 15, 2013	3.07	17.71	25.65	25.50	45.09	45.06	1.60	31.82	30.12	6.80	7.88
	October 8, 2013	7.01	19.43	NM	NM	45.17	45.26	NM	NM	30.82	9.28	10.54
	October 15, 2013	NM	NM	26.68	26.69	NM	NM	3.82	31.99	NM	NM	NM
	April 14, 2014	2.19	17.14	26.05	25.82	45.30	45.27	0.78	32.07	30.48	6.30	7.03
	October 1-3, 2014	7.07	18.55	26.20	26.18	44.81	44.90	3.97	31.93	30.42	8.92	9.87
	April 13-14, 2015	5.15	19.27	26.85	26.82	46.06	46.02	3.48	32.65	31.28	8.21	9.48
	October 6-7, 2015	7.57	19.98	26.65	26.69	45.76	45.83	4.47	32.23	31.03	9.6	10.64
	April 4-6, 2016	4.02	17.01	24.35	24.23	44.07	44.08	3.08	30.51	28.53	6.53	8.54
	October 11-13, 2016	6.35	18.22	23.87	23.98	43.13	43.23	3.17	28.97	28.05	7.80	8.81
	April 10-13, 2017	5.29	18.15	24.18	24.30	43.04	43.15	3.52	29.39	28.26	7.26	8.81
	October 3-5, 2017	7.30	19.06	26.27	26.32	44.56	44.65	3.92	31.25	30.32	9.07	10.29
	April 23-25, 2018	5.34	15.67	26.76	26.63	45.72	45.75	3.25	32.46	30.98	8.29	9.45
	October 23-25, 2018	5.28	17.63	22.50	22.62	41.74	41.85	2.81	27.75	26.72	6.65	8.38
	April 1-4, 2019	2.55	16.66	23.34	23.19	42.30	42.39	1.02	28.09	27.68	5.22	7.44
	October 7-9, 2019	2.90	15.45	22.52	22.48	42.18	42.19	1.00	28.80	27.14	5.54	7.48
	May 27-29, 2020	6.43	18.37	24.50	24.58	43.12	43.25	3.18	29.59	28.61	8.14	9.01
	October 7-8 &17, 2020	6.81	18.36	24.88	24.86	43.83	43.88	3.46	30.05	29.11	8.49	9.41
	April 12, 2021	5.93	19.76	25.96	25.85	44.73	44.76	3.50	31.40	30.24	8.40	9.41
	October 11-12, 14, 2021	7.20	19.77	26.68	26.65	45.77	45.81	4.35	32.37	31.17	9.40	10.24
	April 11-13, 2022	4.28	17.84	26.25	26.16	45.76	45.74	NM	32.49	30.81	7.62	9.07
	June 3, 2022	NM	NM	NM	NM	NM	NM	4.16	NM	NM	NM	NM
	October 25, 26, 28, 2022	7.82	22.25	28.86	28.84	49.29	49.29	7.06	36.50	35.60	11.22	11.41
	March 27-28, 2023	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
	April 24-27, 2023	3.05	23.51	24.24	24.31	44.31	44.33	NM	30.65	29.75	7.77	7.60
	May 16, 2023	5.44	24.46	24.92	24.92	44.26	44.35	3.49	30.80	30.27	9.48	8.87
	October 9-11, 2023	8.58	25.56	28.12	28.20	46.92	47.15	6.03	33.53	33.00	11.66	12.47
	April 15-17, 2024	6.50	24.72	27.04	26.99	46.44	46.49	4.47	33.25	32.04	10.08	9.50
	April 19, 2024	NM	dry	26.84	26.70	46.29	46.28	NM	33.13	31.92	9.90	9.42
	Well Number	**M-3**	**M-4R**	**MW-39A**	**MW-39B**	**MW-48A**	**MW-48B**	**MW-57**	**MW-59**	**MW-216R**	**MW-217**	**MW-220RR**
	Top of Casing Elevation (feet amsl)	788.23	806.10	809.62	809.50	828.86	828.84	786.29	815.48	814.21	791.55	792.90
	Screen Length (ft)											
Ash Pond Facility (Facility ID #02325)	**Total Depth (ft from top of casing)**	16.90	25.55	34.80	76.07	51.88	75.80	14.40	38.50	37.85	37.37	18.96
	Top of Well Screen Elevation (ft)	771.33	780.55	774.82	733.43	776.98	753.04	771.89	776.98	776.36	754.18	773.94
	Measurement Date											
	October 2, 2012	780.13	786.76	781.49	781.34	782.03	781.93	780.58	779.88	781.91	780.95	780.55
	April 15, 2013	785.16	788.39	783.97	784.00	783.77	783.78	784.69	783.66	784.09	784.75	785.02
	October 8, 2013	781.22	786.67	NM	NM	783.69	783.58	NM	NM	783.39	782.27	782.36
	October 15, 2013	NM	NM	782.94	782.81	NM	NM	782.47	783.49	NM	NM	NM
	April 14, 2014	786.04	788.96	783.57	783.68	783.56	783.57	785.51	783.41	783.73	785.25	785.87
	October 1-3, 2014	781.16	787.55	783.42	783.32	784.05	783.94	782.32	783.55	783.79	782.63	783.03
	April 13-14, 2015	783.08	786.83	782.77	782.68	782.80	782.82	782.81	782.83	782.93	783.34	783.42
	October 6-7, 2015	780.66	786.12	782.97	782.81	783.10	783.01	781.82	783.25	783.18	781.95	782.26
	April 4-6, 2016	784.21	789.09	785.27	785.27	784.79	784.76	783.21	784.97	785.68	785.02	784.36
	October 11-13, 2016	781.88	787.88	785.75	785.52	785.73	785.61	783.12	786.51	786.16	783.75	784.09
	April 10-13, 2017	782.94	787.95	785.44	785.20	785.82	785.69	782.77	786.09	785.95	784.29	784.09
	October 3-5, 2017	780.93	787.04	783.35	783.18	784.30	784.19	782.37	784.23	783.89	782.48	782.61
	April 23-25, 2018	782.89	790.43	782.86	782.87	783.14	783.09	783.04	783.02	783.23	783.26	783.45
	October 23-25, 2018	782.95	788.47	787.12	786.88	787.12	786.99	783.48	787.73	787.49	784.90	784.52
	April 1-4, 2019	785.68	789.44	786.28	786.31	786.56	786.45	785.27	787.39	786.53	786.33	785.46
	October 7-9, 2019	785.33	790.65	787.10	787.02	786.68	786.65	785.29	786.68	787.07	786.01	785.42
	May 27-29, 2020	781.80	787.73	785.12	784.92	785.74	785.59	783.11	785.89	785.60	783.41	783.89
	October 7-8 &17, 2020	781.42	787.74	784.74	784.64	785.03	784.96	782.83	785.43	785.10	783.06	783.49
	April 12, 2021	782.30	786.34	783.66	783.65	784.13	784.08	782.79	784.08	783.97	783.15	783.49
	October 11-12, 14, 2021	781.03	786.33	782.94	782.85	783.09	783.03	781.94	783.11	783.04	782.15	782.66
	April 11-13, 2022	783.95	788.26	783.37	783.34	783.10	783.10	NM	782.99	783.40	783.93	783.83
	June 3, 2022	NM	NM	NM	NM	NM	NM	782.13	NM	NM	NM	NM
	October 25, 26, 28, 2022	780.41	783.85	780.76	780.66	779.57	779.55	779.23	778.98	778.61	780.33	781.49
	March 27-28, 2023	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
	April 24-27, 2023	785.18	782.59	785.38	785.19	784.55	784.51	NM	784.83	784.46	783.78	785.30
	May 16, 2023	782.79	781.64	784.70	784.58	784.60	784.49	782.80	784.68	783.94	782.07	784.03
	October 9-11, 2023	779.65	780.54	781.50	781.30	781.94	781.69	780.26	781.95	781.21	779.89	780.43
	April 15-17, 2024	781.73	781.38	782.58	782.51	782.42	782.35	781.82	782.23	782.17	781.47	783.40
	April 19, 2024	NM	dry	782.78	782.80	782.57	782.56	NM	782.35	782.29	781.65	783.48
	Bottom of Well Elevation (ft)	771.33	780.55	774.82	733.43	776.98	753.04	771.89	776.98	776.36	754.18	773.94

Table 1. Groundwater Elevation - State Monitoring Program and CCR Well Network
Columbia Dry Ash and Ash Pond Disposal Facilities / SCS Engineers Project #25224067.00

	Raw Data	MW-301	MW-302	MW-303	MW-304	MW-304R	MW-305	M-4R	MW-33AR	MW-34A	MW-84A	MW-306	MW-307	MW-308	MW-309	MW-310	MW-311	MW-312	MW-313	MW-314	MW-315	MW-316	MW-317	MW-318	MW-319
	Measurement Date																								
CCR Rule Wells	December 21-22, 2015	21.33	28.22	27.41	19.29	NI	17.36	18.52	24.52	22.45	28.97	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
	April 4-5, 2016	20.11	27.19	26.04	17.34	NI	16.71	17.01	23.00	20.32	27.91	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
	July 7-8, 2016	20.58	26.72	26.92	18.06	NI	17.06	18.67	23.10	20.90	28.39	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
	July 28, 2016	NM	NM	27.17	NM	NI	NM	NM	NM	21.09	28.67	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
	October 11-13, 2016	19.25	25.24	25.34	17.24	NI	16.54	18.22	20.93	19.50	27.06	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
	December 29, 2016	19.52	25.95	NM	NM	NI	NM	NM	22.63	20.23	27.65	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
	January 25-26, 2017	19.62	26.11	26.24	16.08	NI	16.96	16.46	22.41	19.97	27.58	22.13	21.53	21.17	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
	April 10 & 11, 2017	19.00	25.45	25.52	17.20	NI	16.75	18.15	21.9	19.65	27.12	21.41	21.25	20.39	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
	June 6, 2017	18.64	24.63	25.03	16.84	NI	16.53	18.27	21.02	19.29	26.65	20.78	20.82	20.44	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
	August 7-9, 2017	19.55	25.45	26.10	15.90	NI	17.02	17.56	22.18	20.14	27.60	21.94	21.70	21.53	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
	October 23-24, 2017	21.00	27.06	27.60	16.45	NI	18.18	18.10	24.16	21.45	28.96	23.66	22.10	22.73	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
	February 21, 2018	NM	NM	NM	NM	NI	NM	NM	NM	NM	NM	NM	NM	NM	30.08	30.57	26.72	NI	NI	NI	NI	NI	NI	NI	NI
	March 23, 2018	NM	NM	NM	NM	NI	NM	NM	NM	NM	NM	NM	NM	NM	30.17	30.52	26.74	NI	NI	NI	NI	NI	NI	NI	NI
	April 23-25, 2018	21.60	28.63	28.25	15.73	NI	18.65	15.67	25.20	24.18	28.40	24.39	23.24	24.25	30.20	30.65	27.91	NI	NI	NI	NI	NI	NI	NI	NI
	May 24, 2018	NM	NM	NM	NM	NI	NM	NM	NM	NM	NM	21.84	21.80	NM	27.82	27.65	23.63	NI	NI	NI	NI	NI	NI	NI	NI
	June 23, 2018	NM	NM	NM	NM	NI	NM	NM	NM	NM	NM	NM	NM	NM	27.24	26.98	23.27	NI	NI	NI	NI	NI	NI	NI	NI
	July 23, 2018	NM	NM	NM	NM	NI	NM	NM	NM	NM	NM	NM	NM	NM	27.00	27.27	23.19	NI	NI	NI	NI	NI	NI	NI	NI
	August 7, 2018	19.83	NM	26.32	17.17	NI	17.76	18.47	NM	NM	27.73	NM	NM	NM	NM	NM	NM	NI	NI	NI	NI	NI	NI	NI	NI
	August 22, 2018	NM	NM	NM	NM	NI	NM	NM	NM	NM	NM	NM	NM	NM	27.73	28.22	24.28	NI	NI	NI	NI	NI	NI	NI	NI
	September 21, 2018	NM	24.63	25.02	NM	NI	NM	NM	20.39	18.94	NM	NM	NM	NM	26.19	26.38	22.08	NI	NI	NI	NI	NI	NI	NI	NI
	October 22-24, 2018	17.91	23.84	24.01	16.37	NI	16.28	17.63	19.52	18.07	25.96	19.97	20.32	19.09	25.28	25.44	21.10	NI	NI	NI	NI	NI	NI	NI	NI
	April 1-4, 2019	19.85	25.44	25.00	15.70	NI	16.25	16.66	21.66	19.13	26.93	20.91	20.18	19.37	26.97	27.24	23.36	NI	NI	NI	NI	NI	NI	NI	NI
	June 12, 2019	NM	NM	NM	NM	NI	NM	NM	NM	NM	NM	NM	NM	NM	NM	26.37	NM	NI	NI	NI	NI	NI	NI	NI	NI
	June 19, 2019	NM	NM	24.71	NM	NI	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NI	NI	NI	NI	NI	NI	NI	NI
	October 7-9, 2019	18.42	24.69	24.50	15.01	NI	15.96	15.45	NM	NM	NM	20.16	19.90	19.72	26.01	25.68	22.10	NI	NI	NI	NI	NI	NI	NI	NI
	December 13, 2019	NM	NM	NM	NM	NI	NM	NM	NM	NM	NM	20.60	21.21	20.47	NM	NM	NM	NI	NI	NI	NI	NI	NI	NI	NI
	December 23, 2019	NM	NM	NM	NM	NI	NM	NM	NM	NM	NM	NM	NM	NM	NM	38.40	NM	NI	NI	NI	NI	NI	NI	NI	NI
	January 17, 2020	NM	NM	25.94	NM	NI	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NI	NI	NI	NI	NI	NI	NI	NI
	February 3, 2020	19.65	NM	NM	NM	NI	NM	NM	NM	NM	27.78	21.86	21.32	20.42	NM	NM	NM	NI	NI	NI	NI	NI	NI	NI	NI
	May 27-29, 2020	19.12	25.71	25.96	16.12	NI	18.54	18.37	22.28	19.97	27.26	21.86	21.54	20.62	27.29	27.81	23.89	NI	NI	NI	NI	NI	NI	NI	NI
	June 30, 2020	NM	NM	NM	NM	NI	NM	NM	NM	NM	NM	NM	NM	NM	27.09	NM	NM	NI	NI	NI	NI	NI	NI	NI	NI
	August 6, 2020	NM	NM	NM	NM	NI	NM	NM	NM	NM	NM	NM	NM	NM	27.34	NM	NM	NI	NI	NI	NI	NI	NI	NI	NI
	October 7-8, 2020	20.36	26.26	26.36	16.90	NI	18.36	18.36	22.38	20.25	28.18	22.24	22.18	21.22	27.80	28.06	23.91	NI	NI	NI	NI	NI	NI	NI	NI
	December 11, 2020	NM	NM	NM	NM	NI	18.13	NM	NM	NM	NM	NM	NM	NM	28.01	28.36	NM	NI	NI	NI	NI	NI	NI	NI	NI
	February 25, 2021	NM	NM	27.25	NM	NI	17.96	NM	NM	21.20	NM	NM	NM	NM	NM	NM	NM	NI	NI	NI	NI	NI	NI	NI	NI
	April 12, 2021	20.39	27.23	27.45	17.43	NI	18.21	19.76	24.02	21.18	28.44	23.31	22.68	21.35	28.98	29.38	25.59	NI	NI	NI	NI	NI	NI	NI	NI
	June 11, 2021	NM	NM	NM	NM	NI	NM	NM	24.10	21.29	NM	NM	NM	NM	29.07	29.57	NM	NI	NI	NI	NI	NI	NI	NI	NI
	July 20, 2021	NM	NM	27.88	NM	NI	17.93	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NI	NI	NI	NI	NI	NI	NI	NI
	October 11-12, 14, 2021	21.61	27.91	28.43	17.64	NI	18.57	19.77	24.56	21.53	29.32	24.70	24.45	23.14	29.62	30.14	26.26	NI	NI	NI	NI	NI	NI	NI	NI
	December 21, 2021	NM	NM	NM	NM	NI	NM	NM	NM	NM	NM	NM	NM	NM	30.34	NM	NM	NI	NI	NI	NI	NI	NI	NI	NI
	February 24, 2022	NM	NM	29.18	NM	NI	19.83	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NI	NI	NI	NI	NI	NI	NI	NI
	April 11-13, 2022	21.45	28.58	28.12	17.22	NI	18.45	17.84	25.02	21.65	29.26	24.52	23.57	22.71	30.13	30.43	26.70	NI	NI	NI	NI	NI	NI	NI	NI
	July 27, 2022	NM	NM	28.45	NM	NI	19.29	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NI	NI	NI	NI	NI	NI	NI	NI
	October 25-27, 2022	21.98	28.38	36.78	23.63	NI	21.35	22.25	26.35	22.34	29.71	29.31	29.00	22.74	31.77	32.66	28.51	NI	NI	NI	NI	NI	NI	NI	NI
	November 30, 2022	NM	NM	NM	NM	NI	NM	NM	NM	NM	NM	NM	NM	NM	31.65	32.48	28.59	NI	NI	NI	NI	NI	NI	NI	NI
	December 2, 2022	21.77	28.52	NM	21.45	NI	NM	NM	26.38	22.24	29.52	29.11	27.35	NM	NM	NM	NM	NI	NI	NI	NI	NI	NI	NI	NI
	January 12-13, 2023	21.69	28.45	NM	NM	NI	NM	NM	25.54	21.85	29.40	NM	NM	NM	30.70	31.17	27.42	NI	NI	NI	NI	NI	NI	NI	NI
	January 20, 2023	NM	NM	NM	17.34	NI	NM	NM	NM	NM	NM	25.48	24.78	21.92	NM	NM	NM	NM	NM	NM	NM	NI	NI	NI	NI
	January 24, 2023	NM	NM	NM	NM	NI	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	43.06	36.94	37.94	36.01	NI	NI	NI	NI
	February 20-23, 2023	21.33	28.02	NM	NM	NI	NM	NM	NM	NM	NM	24.59	23.98	21.58	29.96	30.28	26.34	43.29	36.71	37.75	35.82	NI	NI	NI	NI
	March 27-28, 2023	20.06	27.13	NM	NM	NI	NM	NM	NM	NM	NM	NM	NM	NM	29.43	29.64	25.31	NM	36.18	37.16	35.21	NI	NI	NI	NI
	April 24-27, 2023	19.32	26.13	31.34	21.39	NI	NM	23.51	22.50	19.73	27.31	22.81	22.64	19.15	28.22	28.44	24.05	NM	35.09	36.14	34.19	NI	NI	NI	NI
	May 5, 2023	NM	NM	NM	NM	NI	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	41.24	NM	NM	NM	28.00	NI	NI	NI
	May 16, 2023	19.46	25.93	31.84	21.30	NI	dry	24.46	22.65	19.89	27.40	22.98	23.00	20.02	28.12	28.51	24.35	40.82	34.84	35.89	33.90	28.01	NI	NI	NI
	May 30-31, 2023	19.85	26.11	NM	NM	NI	NM	NM	NM	NM	NM	NM	NM	NM	28.37	28.93	24.77	NM	35.06	36.02	34.01	NM	NI	NI	NI
	June 29-30, 2023	20.57	26.61	NM	NM	NI	NM	NM	23.97	20.91	28.36	NM	NM	NM	29.15	29.78	25.77	NM	35.63	36.62	34.61	NM	NI	NI	NI
	July 31, 2023	NM	NM	NM	NM	NI	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	36.34	37.31	35.29	NM	NI	NI	NI
	August 31, 2023	NM	27.70	NM	NM	NI	NM	NM	NM	NM	NM	NM	NM	NM	NM	31.15	NM	NM	36.75	37.74	35.81	NM	NI	NI	NI
	October 9-11, 2023	22.22	28.35	34.51	25.33	NI	26.39	25.56	25.72	22.40	29.89	NM	NM	23.81	30.69	31.30	27.52	43.10	37.20	38.24	36.19	28.19	NI	NI	NI
	November 9, 2023	NM	NM	NM	NM	NI	NM	NM	NM	NM	NM	NM	NM	NM	30.51	NM	NM	NM	NM	NM	NM	NM	NI	NI	NI
	April 15-17, 2024	21.62	28.51	33.56	aband	22.17	25.52	24.72	25.27	21.81	29.38	25.23	24.65	22.39	30.48	30.94	27.10	43.20	37.14	38.15	36.25	26.40	35.76	37.32	43.01
	April 19, 2024	21.38	28.45	33.46	aband	22.11	dry	dry	25.23	21.67	29.23	NM	24.25	22.21	30.37	30.80	27.00	43.11	37.00	38.08	36.16	26.34	NM	NM	NM

Table 1. Groundwater Elevation - State Monitoring Program and CCR Well Network
Columbia Dry Ash and Ash Pond Disposal Facilities / SCS Engineers Project #25224067.00

	Well Number	MW-301	MW-302	MW-303	MW-304	MW-304R	MW-305	M-4R	MW-33AR	MW-34A	MW-84A	MW-306	MW-307	MW-308	MW-309	MW-310	MW-311	MW-312	MW-313	MW-314	MW-315	MW-316	MW-317	MW-318	MW-319
	Top of Casing Elevation (feet amsl)	806.89	813.00	815.72	805.42	804.34	806.32	806.10	808.29	805.95	814.28	807.63	806.89	806.9	813.27	813.62	809.74	826.786	820.3	821.57	819.78	808.49	819.36	820.94	828.77
	Screen Length (ft)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
	Total Depth (ft from top of casing)	29.40	33.6	35.80	25.7	30.73	25.6	39.58	31.08	35.43	40.21	27	26.5	28	37.67	38.41	36.19	52.5	46.2	45.0	45.6	43.7	44.3	43	47.6
	Top of Well Screen Elevation (ft)	787.49	789.40	785.72	789.72	783.61	790.72	776.52	787.21	780.52	784.07	790.63	790.39	788.90	785.60	785.21	783.55	784.29	784.1	786.6	784.2	774.79	785.1	787.9	791.2
	Measurement Date																								
	December 21-22, 2015	785.56	784.78	784.11	786.13	NI	788.96	787.58	783.77	783.50	785.31	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
	April 4-5, 2016	786.78	785.81	785.48	788.08	NI	789.61	789.09	785.29	785.63	786.37	--	--	--	--	--	--	NI	NI	NI	NI	NI	NI	NI	NI
	July 7-8, 2016	786.31	786.28	784.60	787.36	NI	789.26	787.43	785.19	785.05	785.89	--	--	--	--	--	--	NI	NI	NI	NI	NI	NI	NI	NI
	July 28, 2016	NM	NM	784.35	NM	NI	NM	NM	NM	784.86	785.61	--	--	--	--	--	--	NI	NI	NI	NI	NI	NI	NI	NI
	October 11-13, 2016	787.64	787.76	786.18	788.18	NI	789.78	787.88	787.36	786.45	787.22	--	--	--	--	--	--	NI	NI	NI	NI	NI	NI	NI	NI
	December 29, 2016	787.37	787.05	NM	NM	NI	NM	NM	785.66	785.72	786.63	--	--	--	--	--	--	NI	NI	NI	NI	NI	NI	NI	NI
	January 25-26, 2017	787.27	786.89	785.28	789.34	NI	789.36	789.64	785.88	785.98	786.70	785.50	785.36	785.73	--	--	--	NI	NI	NI	NI	NI	NI	NI	NI
	April 10 & 11, 2017	787.89	787.55	786.00	788.22	NI	789.57	787.95	786.39	786.30	787.16	786.22	785.64	786.51	--	--	--	NI	NI	NI	NI	NI	NI	NI	NI
	June 6, 2017	788.25	788.37	786.49	788.58	NI	789.79	787.83	787.27	786.66	787.63	786.85	786.07	786.46	--	--	--	NI	NI	NI	NI	NI	NI	NI	NI
	August 7-9, 2017	787.34	787.55	785.42	789.52	NI	789.30	788.54	786.11	785.81	786.68	785.69	785.19	785.37	--	--	--	NI	NI	NI	NI	NI	NI	NI	NI
	October 23-24, 2017	785.89	785.94	783.92	788.97	NI	788.14	788.00	784.13	784.50	785.32	783.97	784.79	784.17	--	--	--	NI	NI	NI	NI	NI	NI	NI	NI
	February 21, 2018	NM	NM	NM	NM	NI	NM	NM	NM	NM	NM	NM	NM	NM	783.19	783.05	783.02	NI	NI	NI	NI	NI	NI	NI	NI
	March 23, 2018	NM	NM	NM	NM	NI	NM	NM	NM	NM	NM	NM	NM	NM	783.10	783.10	783.00	NI	NI	NI	NI	NI	NI	NI	NI
	April 23-25, 2018	785.29	784.37	783.27	789.69	NI	787.67	790.43	783.09	781.77	785.88	783.24	783.65	782.65	783.07	782.97	781.83	NI	NI	NI	NI	NI	NI	NI	NI
	May 24, 2018	NM	NM	NM	NM	NI	NM	NM	NM	NM	NM	785.79	785.09	NM	785.45	785.97	786.11	NI	NI	NI	NI	NI	NI	NI	NI
	June 23, 2018	NM	NM	NM	NM	NI	NM	NM	NM	NM	NM	NM	NM	NM	786.03	786.64	786.47	NI	NI	NI	NI	NI	NI	NI	NI
	July 23, 2018	NM	NM	NM	NM	NI	NM	NM	NM	NM	NM	NM	NM	NM	786.27	786.35	786.55	NI	NI	NI	NI	NI	NI	NI	NI
	August 7, 2018	787.06	NM	785.20	788.25	NI	788.56	787.63	NM	NM	786.55	NM	NM	NM	NM	NM	NM	NI	NI	NI	NI	NI	NI	NI	NI
	August 22, 2018	NM	NM	NM	NM	NI	NM	NM	NM	NM	NM	NM	NM	NM	785.54	785.40	785.46	NI	NI	NI	NI	NI	NI	NI	NI
	September 21, 2018	NM	788.37	786.50	NM	NI	NM	NM	787.90	787.01	NM	NM	NM	NM	787.08	787.24	787.66	NI	NI	NI	NI	NI	NI	NI	NI
	October 22-24, 2018	788.98	789.16	787.51	789.05	NI	790.04	788.47	788.77	787.88	788.32	787.66	786.57	787.81	787.99	788.18	788.64	NI	NI	NI	NI	NI	NI	NI	NI
	April 1-4, 2019	787.04	787.56	786.52	789.72	NI	790.07	789.44	786.63	786.82	787.35	786.72	786.71	787.53	786.30	786.38	786.38	NI	NI	NI	NI	NI	NI	NI	NI
	June 12, 2019	NM	NM	NM	NM	NI	NM	NM	NM	NM	NM	NM	NM	NM	NM	787.25	NM	NI	NI	NI	NI	NI	NI	NI	NI
	June 19, 2019	NM	NM	786.81	NM	NI	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NI	NI	NI	NI	NI	NI	NI	NI
	October 7-9, 2019	788.47	788.31	787.02	790.41	NI	790.36	790.65	NM	NM	NM	787.47	786.99	787.18	787.26	787.94	787.64	NI	NI	NI	NI	NI	NI	NI	NI
	December 13, 2019	--	--	--	--	NI	--	--	--	--	--	787.03	785.68	786.43	--	--	--	NI	NI	NI	NI	NI	NI	NI	NI
CCR Rule Wells (cont.)	December 23, 2019	--	--	--	--	NI	--	--	--	--	--	--	--	--	--	775.22	--	NI	NI	NI	NI	NI	NI	NI	NI
	January 17, 2020	--	--	785.58	--	NI	--	--	--	--	--	--	--	--	--	--	--	NI	NI	NI	NI	NI	NI	NI	NI
	February 3, 2020	787.24	NM	NM	NM	NI	NM	NM	NM	NM	786.50	785.77	785.57	786.48	NM	NM	NM	NI	NI	NI	NI	NI	NI	NI	NI
	May 27-29, 2020	787.77	787.29	785.56	789.30	NI	787.78	787.73	786.01	785.98	787.02	785.77	785.35	786.28	785.98	785.81	785.85	NI	NI	NI	NI	NI	NI	NI	NI
	June 30, 2020	NM	NM	NM	NM	NI	NM	NM	NM	NM	NM	NM	NM	NM	786.18	NM	NM	NI	NI	NI	NI	NI	NI	NI	NI
	August 6, 2020	NM	NM	NM	NM	NI	NM	NM	NM	NM	NM	NM	NM	NM	785.93	NM	NM	NI	NI	NI	NI	NI	NI	NI	NI
	October 7-8, 2020	786.53	786.74	785.16	788.52	NI	787.96	787.74	785.91	785.70	786.10	785.39	784.71	785.68	785.47	785.56	785.83	NI	NI	NI	NI	NI	NI	NI	NI
	December 11, 2020	NM	NM	NM	NM	NI	788.19	NM	NM	NM	NM	NM	NM	NM	785.26	785.26	NM	NI	NI	NI	NI	NI	NI	NI	NI
	February 25, 2021	NM	NM	784.27	NM	NI	788.36	NM	NM	784.75	NM	NM	NM	NM	NM	NM	NM	NI	NI	NI	NI	NI	NI	NI	NI
	April 12, 2021	786.50	785.77	784.07	787.99	NI	788.11	786.34	784.27	784.77	785.84	784.32	784.21	785.55	784.29	784.24	784.15	NI	NI	NI	NI	NI	NI	NI	NI
	June 11, 2021	NM	NM	NM	NM	NI	NM	NM	784.19	784.66	NM	NM	NM	NM	784.20	784.05	NM	NI	NI	NI	NI	NI	NI	NI	NI
	July 20, 2021	NM	NM	783.64	NM	NI	788.39	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NI	NI	NI	NI	NI	NI	NI	NI
	October 11-12, 14, 2021	785.28	785.09	783.09	787.78	NI	787.75	786.33	783.73	784.42	784.96	782.93	782.44	783.76	783.65	783.48	783.48	NI	NI	NI	NI	NI	NI	NI	NI
	December 21, 2021	NM	NM	NM	NM	NI	NM	NM	NM	NM	NM	NM	NM	NM	782.93	NM	NM	NI	NI	NI	NI	NI	NI	NI	NI
	February 24, 2022	NM	NM	782.34	NM	NI	786.49	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NI	NI	NI	NI	NI	NI	NI	NI
	April 11-13, 2022	785.44	784.42	783.40	788.20	NI	787.87	788.26	783.27	784.30	785.02	783.11	783.32	784.19	783.14	783.19	783.04	NI	NI	NI	NI	NI	NI	NI	NI
	July 27, 2022	NM	NM	783.07	NM	NI	787.03	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NI	NI	NI	NI	NI	NI	NI	NI
	October 25-27, 2022	784.91	784.62	778.94	781.79	NI	784.97	783.85	781.94	783.61	784.57	778.32	777.89	784.16	781.50	780.96	781.23	NI	NI	NI	NI	NI	NI	NI	NI
	November 30, 2022	NM	NM	NM	NM	NI	NM	NM	NM	NM	NM	NM	NM	NM	781.62	781.14	781.15	NI	NI	NI	NI	NI	NI	NI	NI
	December 2, 2022	785.12	784.48	NM	783.97	NI	NM	NM	781.91	783.71	784.76	778.52	779.54	NM	NM	NM	NM	NI	NI	NI	NI	NI	NI	NI	NI
	January 12-13, 2023	785.20	784.55	NM	NM	NI	NM	NM	782.75	784.10	784.88	NM	NM	NM	782.57	782.45	782.32	NI	NI	NI	NI	NI	NI	NI	NI
	January 20, 2023	NM	NM	NM	788.08	NI	NM	NM	NM	NM	NM	782.15	782.11	784.98	NM	NM	NM	NM	NM	NM	NM	NI	NI	NI	NI
	January 24, 2023	NM	NM	NM	NM	NI	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	783.73	783.36	783.63	783.77	NI	NI	NI	NI
	February 20-23, 2023	785.56	784.98	NM	NM	NI	NM	NM	NM	NM	NM	783.04	782.91	785.32	783.31	783.34	783.40	783.50	783.59	783.82	783.96	NI	NI	NI	NI
	March 27-28, 2023	786.83	785.87	NM	NM	NI	NM	NM	NM	NM	NM	NM	NM	NM	783.84	783.98	784.43	NM	784.12	784.41	784.57	NI	NI	NI	NI
	April 24-27, 2023	787.57	786.87	784.38	784.03	NI	NM	782.59	785.79	786.22	786.97	784.82	784.25	787.75	785.05	785.18	785.69	NM	785.21	785.43	785.59	NI	NI	NI	NI
	May 5, 2023	NM	NM	NM	NM	NI	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	785.55	NM	NM	NM	780.49	NI	NI	NI
	May 16, 2023	787.43	787.07	783.88	784.12	NI	dry	781.64	785.64	786.06	786.88	784.65	783.89	786.88	785.15	785.11	785.39	785.97	785.46	785.68	785.88	780.48	NI	NI	NI
	May 30-31, 2023	787.04	786.89	NM	NM	NI	NM	NM	NM	NM	NM	NM	NM	NM	784.90	784.69	784.97	NM	785.24	785.55	785.77	NM	NI	NI	NI
	June 29-30, 2023	786.32	786.39	NM	NM	NI	NM	NM	784.32	785.04	785.92	NM	NM	NM	784.12	783.84	783.97	NM	784.67	784.95	785.17	NM	NI	NI	NI
	July 31, 2023	NM	NM	NM	NM	NI	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	783.96	784.26	784.49	NM	NI	NI	NI
	August 31, 2023	NM	785.30	NM	NM	NI	NM	NM	NM	NM	NM	NM	NM	NM	NM	782.47	NM	NM	783.55	783.83	783.97	NM	NI	NI	NI
	October 9-11, 2023	784.67	784.65	781.21	780.09	NI	779.93	780.54	782.57	783.55	784.39	NM	NM	783.09	782.58	782.32	782.22	783.69	783.10	783.33	783.59	780.30	NI	NI	NI
	November 9, 2023	NM	NM	NM	NM	NI	NM	NM	NM	NM	NM	NM	NM	NM	782.76	NM	NM	NM	NM	NM	NM	NM	NI	NI	NI
	April 15-17, 2024	785.27	784.49	782.16	aband	782.17	780.80	781.38	783.02	784.14	784.90	782.40	782.24	784.51	782.79	782.68	782.64	783.59	783.16	783.42	783.53	782.09	783.60	783.62	785.76
	April 19, 2024	785.51	784.55	782.26	aband	782.23	dry	dry	783.06	784.28	785.05	NM	782.64	784.69	782.90	782.82	782.74	783.68	783.30	783.49	783.62	782.15	NM	NM	NM
	Bottom of Well Elevation (ft)	777.49	779.40	775.72	779.72	773.61	780.72	766.52	777.21	770.52	774.07	780.63	780.39	778.90	775.60	775.21	773.55	774.29	774.10	776.61	774.18	764.79	775.06	777.94	781.17

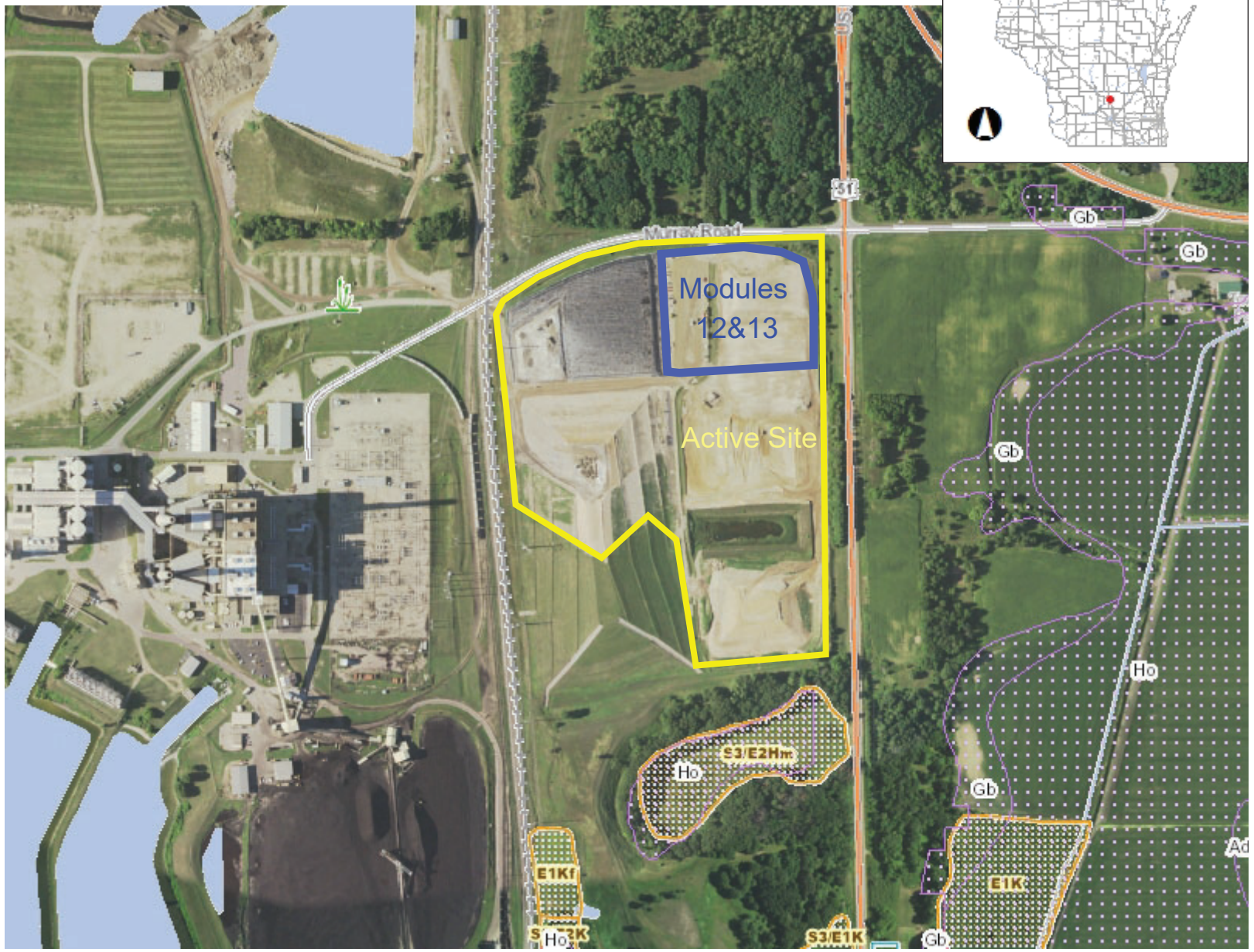
Notes:
NM = not measured
NI = not installed
aband = abandoned
(1) The depth to water at MW-84A was not measured prior to purging for sampling during the October 3-5, 2017 sampling event. The level was allowed to return to static and was measured on October 10, 2017.
(2) MW-303 was extended in 2022 due to regrading. Prior to October 2022, the TOC elevation was 811.52'. For events in October 2022 and later, the TOC elevation is 815.72'.

Created by: MDB Date: 5/6/2013
Last revision by: BLR Date: 5/17/2024
Checked by: MDB Date: 5/29/2024
Proj Mgr QA/QC: PEG Date: 6/4/2024

Appendix B

Wetland Delineation Maps

Surface Water Data Viewer Map



Legend

- Wetland Indicators
- Lake Class Areas
- Riverine/ditch Class Areas
- Wetland Class Areas
- Wetland Class Points
  - Dammed pond
  - Excavated pond
  - Filled/drained wetland
  - Wetland too small to delineate
  - Filled excavated pond
- Filled Points
- Wetland Class Areas
- Filled Areas
- Lake Class Areas
- Riverine/ditch Class Areas
- Wetland Class Areas
- Wetland Class Points
  - Dammed pond
  - Excavated pond
  - Filled/drained wetland
  - Wetland too small to delineate
  - Filled excavated pond
- Filled Points
- Wetland Class Areas
- Filled Areas
- Wetland Identifications and Confirmations
- NRCS Wetspots
- Municipality
- State Boundaries
- County Boundaries
- Major Roads
  - Interstate Highway
  - State Highway
  - US Highway

Notes

0.3 0 0.13 0.3 Miles

NAD_1983_HARN_Wisconsin_TM

1: 7,920

U.S. Fish and Wildlife Service
National Wetlands Inventory

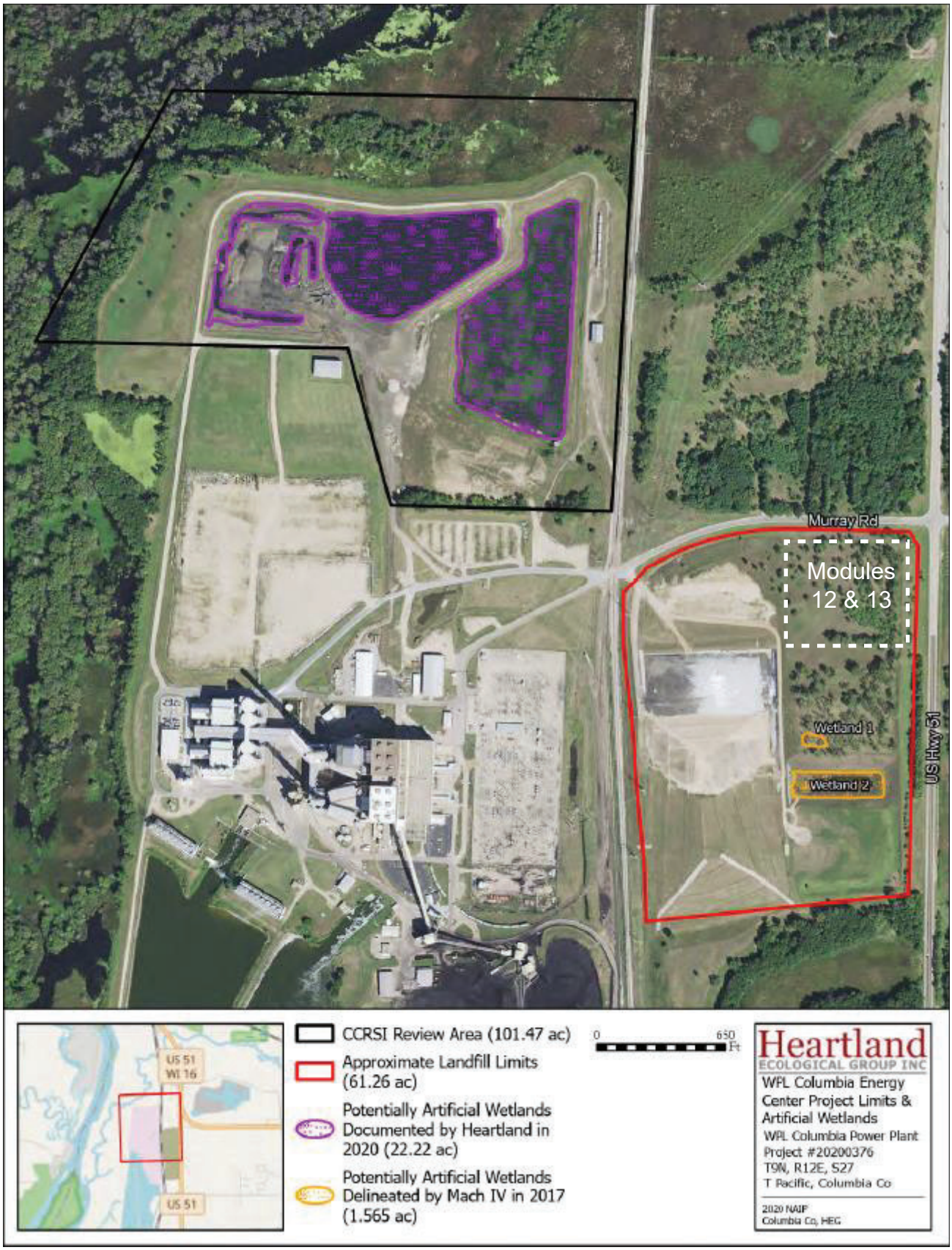
Wetlands

June 6, 2024

Wetlands

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.


Murray Rd
Modules
12 & 13
Wetland 1
Wetland 2
US Hwy 51
US 51
WI 16
US 51
CCRSI Review Area (101.47 ac)
Approximate Landfill Limits
(61.26 ac)
Potentially Artificial Wetlands
Documented by Heartland in
2020 (22.22 ac)
Potentially Artificial Wetlands
Delineated by Mach IV in 2017
(1.565 ac)
0
650
Ft
Heartland
ECOLOGICAL GROUP INC
WPL Columbia Energy
Center Project Limits &
Artificial Wetlands
WPL Columbia Power Plant
Project #20200376
T9N, R12E, S27
T Pacific, Columbia Co
2020 NAIP
Columbia Co, HEG

State of Wisconsin
DEPARTMENT OF NATURAL RESOURCES
3911 Fish Hatchery Rd.
Fitchburg, WI, 53711

Tony Evers, Governor
Preston D. Cole, Secretary
Telephone 608-266-2621
Toll Free 1-888-936-7463
TTY Access via relay - 711

03/15/2022

Jeff Maxted
4902 N Biltmore Lane
Madison, WI 53718

EXE-SC-2022-11-00802

RE: Artificial Wetland Exemption Determination for an area described as Wetlands 1, 2, and active coal combustion residual surface impoundments (purple colored on map) located at T12N R9E S27 in the Town of PACIFIC, Columbia County.

Dear Mr. Maxted:

This letter is in response to your request for an artificial wetland exemption determination for the above mentioned wetlands.

According to 281.36 (4n), State Statutes, a landscape feature where hydrophytic vegetation may be present as a result of human modification to the landscape or hydrology and for which no definitive evidence exists showing a prior wetland or stream history before August 1, 1991, may be exempt from state wetland regulations. The following types of artificial wetlands cannot be exempted from state wetland regulation: 1) a wetland that serves as a fish spawning area or that is passage to a fish spawning area and 2) a wetland created as a result of a wetland mitigation requirement. In addition, DNR must also consider whether the artificial wetland is providing significant flood protection to adjacent or downstream properties and infrastructure, and/or significant water quality functions to adjacent or downstream water bodies.

The Department reviewed the following materials to aid in our exemption determination:
The request narrative.
Historic Maps, including the Original Land Survey Plat, Bordner Survey, the USGS topographic Quad map from 1962 and 1984, and soil mapping.
Aerial photographs, including the 1937/8 era photograph, a pre-construction aerial photograph, and a post-construction photograph.
Site photographs that show different angles and views of the wetland.

Below is a summary of our findings:

Request Narrative
According to the request narrative the basis for a determination of artificial wetlands is that wetland characteristics formed within areas lacking a history of wetland land cover. This is due to the construction of CCRSIs in the CCRSI area, and the excavation/construction of a PVC-lined leachate and stormwater runoff collection basin and grading in the landfill area.

Historic Map Review
Original Land Survey Plat. The original land survey indicates inconclusive maps and notes along the WI River.
The Bordner survey indicates cropland including oak, hickory woodland.
The 1962 and 1984 USGS Quad map indicates no wetlands.
The 1913 soil survey maps indicate no wetlands.

Aerial Photograph Review
The 1937/38 aerial photograph shows farm field.
The 1972-74 aerial photographs show mass grading.

Site Photographs

The site photographs show the ponds and conveyance features.

Conclusion:
Based upon the information provided above, the wetland identified as Wetlands 1, 2 and active coal combustion residual surface impoundments (purple colored on map) lacked a wetland history prior to August 1, 1991, and fulfills all artificial wetland exemption standards. Therefore, Wetlands 1, 2, and active coal combustion residual surface impoundments (purple colored) are exempt from state wetland regulations.

This letter describes DNR's decision regarding the jurisdictional status of Wetlands 1, 2, and active coal combustion residual surface impoundments (purple colored on map) and are only valid for state jurisdictional purposes. For decisions regarding the federal jurisdictional status of Wetlands 1 and 2, you will need to contact the U.S. Army Corps of Engineers.

If you have any questions, please call me at (608) 228-4067 or email Allen.Ramminger@wisconsin.gov

Sincerely,

Allen Ramminger
Water Management Specialist

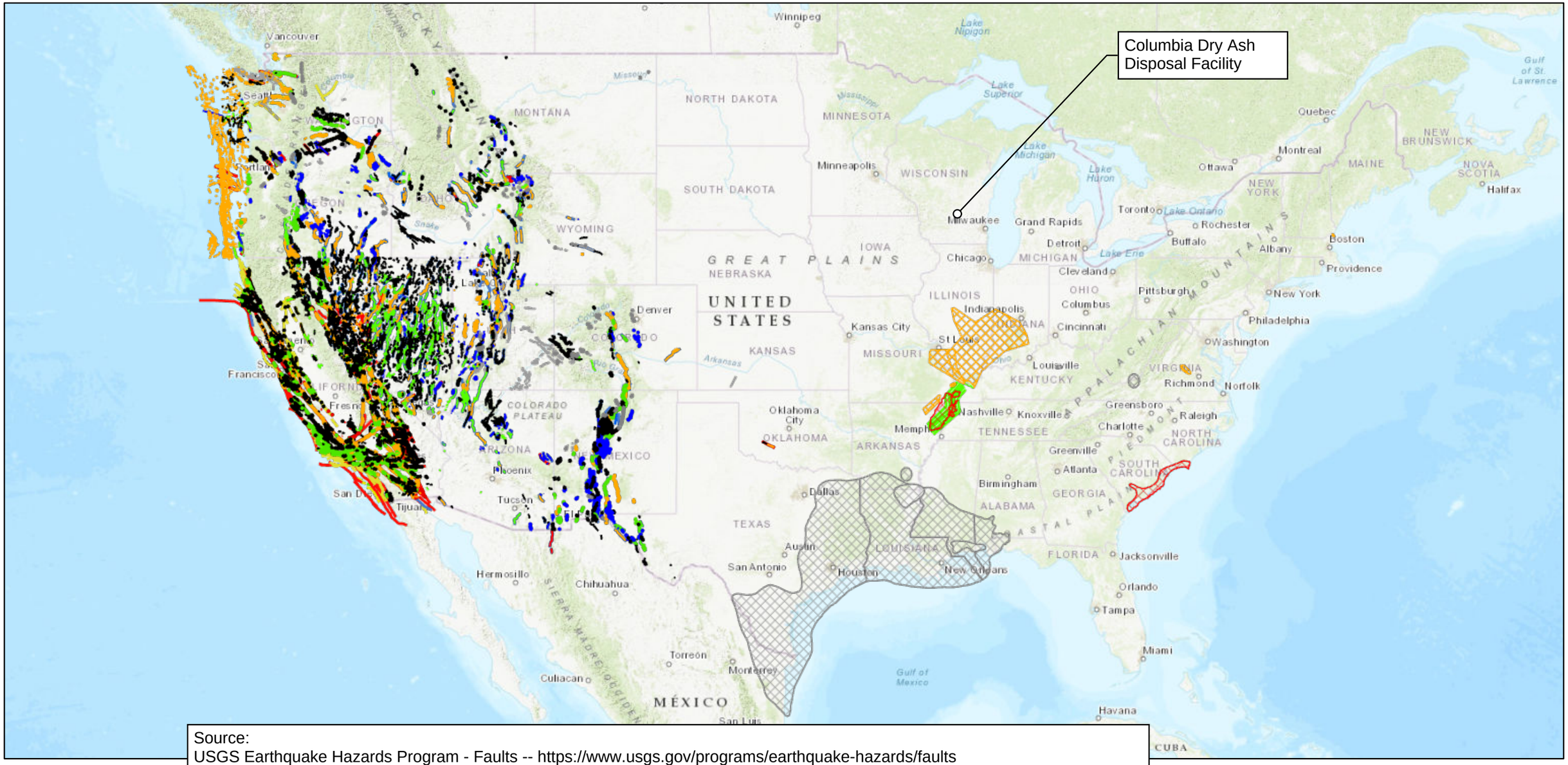
Copy to:

USACE Project Manager
Water Management Specialist
County Zoning Administrator
Consultant

Appendix C

Fault Location Map

U.S. Geological Survey Quaternary Faults



Source:
USGS Earthquake Hazards Program - Faults -- https://www.usgs.gov/programs/earthquake-hazards/faults
Interactive Fault Map -- https://usgs.maps.arcgis.com/apps/webappviewer/index.html?id=5a6038b3a1684561a9b0aadf88412fcf

6/6/2024, 2:33:54 PM

Fault Areas
- Class B
- historic
- late Quaternary
- latest Quaternary

National Database
- Historic (< 150 years), well constrained location
- Historic (< 150 years), moderately constrained location
- Historic (< 150 years), inferred location
- Latest Quaternary (<15,000 years), well constrained location
- Latest Quaternary (<15,000 years), moderately constrained location
- Latest Quaternary (<15,000 years), inferred location
- Late Quaternary (< 130,000 years), well constrained location
- Late Quaternary (< 130,000 years), moderately contrained location
- Late Quaternary (< 130,000 years), inferred location
- Middle and late Quaternary (< 750,000 years), well constrained location
- Middle and late Quaternary (< 750,000 years), moderately constrained location
- Middle and late Quaternary (< 750,000 years), inferred location
- Undifferentiated Quaternary (< 1.6 million years), well constrained location
- Undifferentiated Quaternary (< 1.6 million years), moderately constrained location
- Undifferentiated Quaternary (< 1.6 million years), inferred location
- Class B (various age), well constrained location
- Class B (various age), moderately constrained location
- Class B (various age), inferred location

NSHM 2002 Fault Sources
- Normal
- Reverse
- Strike Slip
- Thrust

NSHM 2008 Fault Sources
- Normal
- Reverse
- Strike slip
- Thrust
- Unassigned

NSHM 2014 Fault Sources
- Normal
- Strike Slip
- Thrust
- Unassigned

NSHM 2023 Fault Sources
- Strike Slip
- Thrust
- Normal
- Proxy

1:20,930,434

0 190 380 760 mi

0 300 600 1,200 km

USGS, Esri, HERE, Garmin, FAO, NOAA, USGS, EPA

USGS

USGS | Esri, HERE, Garmin, FAO, NOAA, USGS, EPA |

Appendix D

Seismic Hazard Map

U.S. Department of the Interior
U.S. Geological Survey

Scientific Investigations Map 3325
Sheet 2 of 6

Columbia Dry Ash Disposal Facility

CANADA

MEXICO

PACIFIC OCEAN

ATLANTIC OCEAN

Gulf of St. Lawrence

Gulf of Mexico

EXPLANATION
Peak acceleration expressed as a percent of gravity (%g)

%g
- ≥200
- 160–200
- 120–160
- 80–120
- 60–80
- 50–60
- 40–50
- 30–40
- 20–30
- 18–20
- 16–18
- 14–16
- 12–14
- 10–12
- 8–10
- 6–8
- 4–6
- 2–4
- ≤2

Contours of peak acceleration expressed as a percent of gravity (%g)
- 10 Onshore
- 10 Offshore

Point values of peak acceleration expressed as a percent of gravity (%g)
- 3.2 Local maximum
- 6.9 Local minimum
- 8.8 Saddle point

DISCUSSION

The acceleration values contoured are the random horizontal component. Reference site condition is firm rock, defined as having an average shear-wave velocity of 760 m/s in the top 30 meters, corresponding to the boundary between NEHRP (National Earthquake Hazards Reduction Program) site classes B and C. Documentation, gridded values, interactive maps, and GIS data used to make the map are available online at ttp://earthquake.usgs.gov/hazards or http://dx.doi.org/10.3133/sim3325.

ACKNOWLEDGMENTS

We would like the thank the hundreds of workshop participants who made valuable suggestions that significantly improved the quality of the maps. The California part of the maps was produced jointly with the California Geological Survey.

REFERENCES

Petersen, M.D., Moschetti, M.P, Powers, P.M., Mueller, C.S., Haller, K.M., Frankel, A.D., Zeng, Yuehua, Rezaeian, Sanaz, Harmsen, S.C., Boyd, O.S., Field, Ned, Chen, Rui, Rukstales, K.S., Luco, Nico, Wheeler, R.L., Williams, R.A., and Olsen, A.H., 2014, Documentation for the 2014 Update of the United States National Seismic Hazard Maps: U.S. Geological Survey Open-File Report 2014–1091, 243 p., http://dx.doi.org/10.3133/ofr20141091.

Shaded relief base from Esri Inc., 2008, Data and Maps
All other base map data from Esri Inc., 1993, Digital Chart of the World
United States County base map from the U.S. Geological Survey National Atlas, available at http://nationalatlas.gov/

Projection: Albers equal-area conic
Standard parallels 29.5°N. and 45.5°N., central meridian 95°W

SCALE 1:7 000 000

100 0 100 200 300 400 500 600 700 800 900 1000 MILES

100 0 100 200 300 400 500 600 700 800 900 1000 KILOMETERS

Digital data prepared with ArcGIS 10.1 running under Windows 7

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Center Director, USGS Geologic Hazards Science Center
Box 25046, Mail Stop 966
Denver, CO 80225
(303) 273-8579

Or visit the Geologic Hazards Science Center Web site at:
http://geohazards.cr.usgs.gov/.

Seismic-Hazard Maps for the Conterminous United States, 2014

Peak Horizontal Acceleration with 2 Percent Probability of Exceedance in 50 Years

By

Mark D. Petersen,[1] Morgan P. Moschetti,[1] Peter M. Powers,[1] Charles S. Mueller,[1] Kathleen M. Haller,[1]Arthur D. Frankel,[1] Yuehua Zeng,[1] Sanaz Rezaeian,[1] Stephen C. Harmsen,[1] Oliver S. Boyd,[1] Edward H. Field,[1] Rui Chen,[2] Nicolas Luco,[1]Russell L. Wheeler,[1] Robert A. Williams,[1] Anna H. Olsen,[1] and Kenneth S. Rukstales[1]

2015

[1]U.S. Geological Survey
[2]California Geological Survey, Sacramento, Calif.

ISSN 2329-132X (online)
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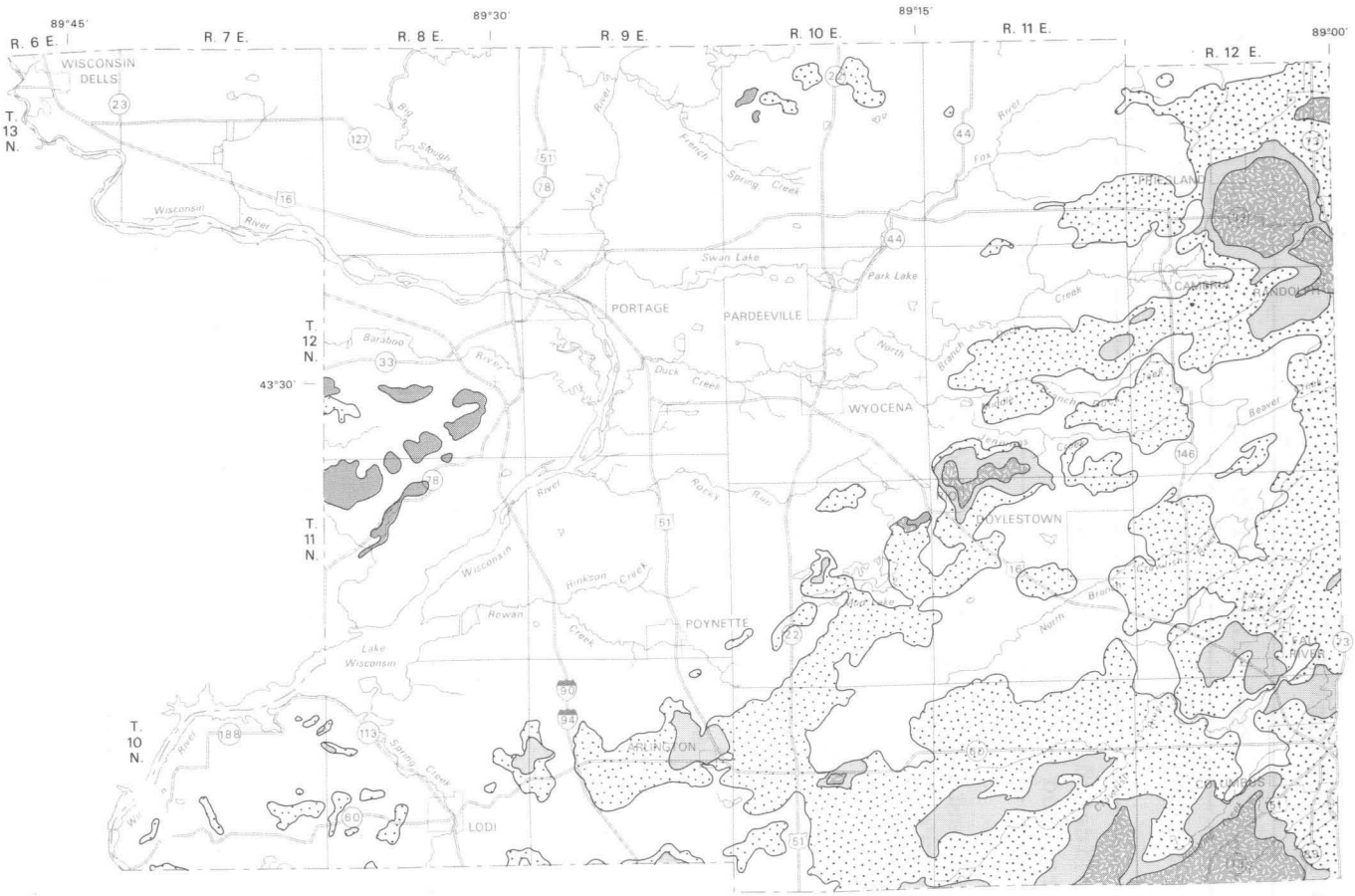
Suggested citation: Petersen, M.D., Moschetti, M.P., Powers, P.M., Mueller, C.S., Haller, K.M., Frankel, A.D., Zeng, Yuehua, Rezaeian, Sanaz, Harmsen, S.C., Boyd, O.S., Field, E.H., Chen, Rui, Luco, Nicolas, Wheeler, R.L., Williams, R.A., Olsen, A.H., and Rukstales, K.S., 2015, Seismic-hazard maps for the conterminous United States, 2014: U.S. Geological Survey Scientific Investigations Map 3325, 6 sheets, scale 1:7,000,000, http://dx.doi.org/10.3133/sim3325.

Appendix E

Site Description and Geologic Summary

Attachment E1



EXPLANATION

Galena Dolomite, Decorah, and Platteville Formations, undifferentiated
Mostly dolomite

St. Peter Sandstone
Mostly sandstone

Prairie du Chien Group
Mostly dolomite

ORDOVICIAN

Trempleau Formation and Franconia, Galesville, Eau Claire, and Mount Simon Sandstones, undifferentiated
Mostly sandstone, some shale, siltstone and dolomite

CAMBRIAN

Crystalline Rock
Mostly quartzite and rhyolite

PRECAMBRIAN

Figure 2. Bedrock geology.

Attachment E2

Table 1.--Stratigraphy of Columbia County

System	Rock unit	Predominant lithology
QUATERNARY	Holocene deposits	Unconsolidated clay, silt, sand, gravel, and organic matter.
	Pleistocene deposits	Unconsolidated clay, silt, sand, gravel, cobbles, boulders, and organic matter.
ORDOVICIAN	Galena Dolomite, Decorah Formation, and Platteville Formation, undifferentiated	Dolomite and some slightly shaly dolomite, light-gray to blue-gray.
	St. Peter Sandstone	Sandstone, dolomitic in some places, shaly at base in some places, white, light-gray, or pink, fine- to medium-grained.
	Prairie du Chien Group	Dolomite, tan, gray, or white; some sandstone and sandy dolomite.
CAMBRIAN	Trempealeau Formation	Sandstone, dolomitic, very fine- to medium-grained; dolomite interbedded with siltstone, light-gray.
	Franconia Sandstone	Sandstone, dolomitic, very fine- to medium-grained; siltstone, dolomitic.
	Galesville, Eau Claire, and Mount Simon Sandstones, undifferentiated	Sandstone, light-gray, fine- to coarse-grained, mostly medium grained.
PRECAMBRIAN	Precambrian rocks, undifferentiated	Crystalline rocks, mostly quartzite and rhyolite.

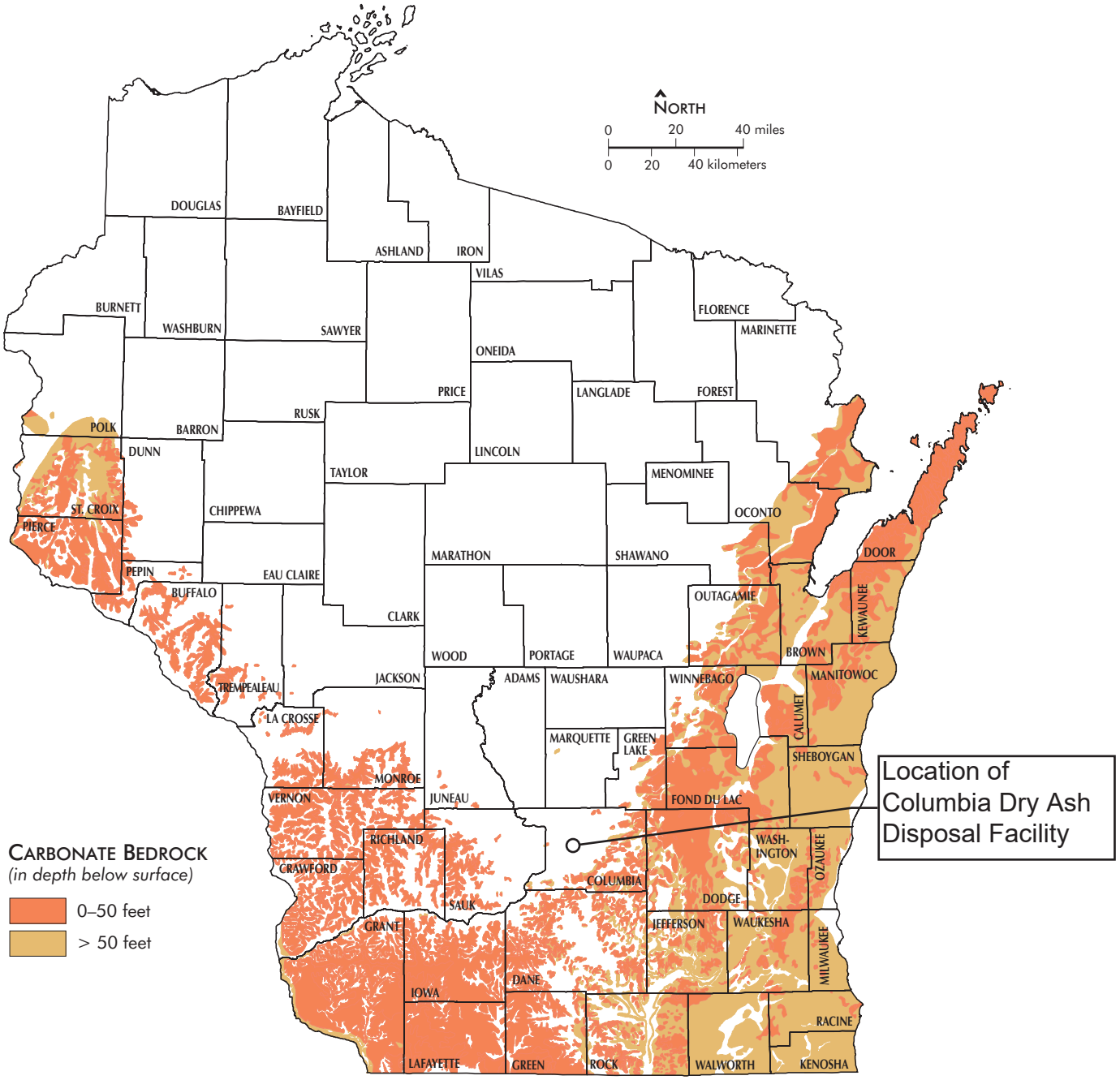
Attachment E3

Karst and shallow carbonate bedrock in Wisconsin

Wisconsin Geological and Natural History Survey

Factsheet 02 | 2009

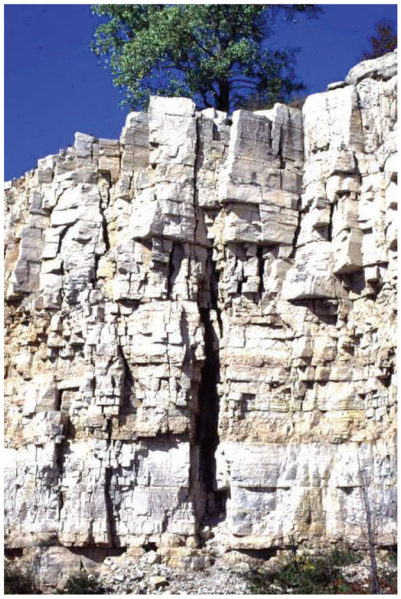
Areas with carbonate bedrock within 50 feet of the land surface are particularly vulnerable to groundwater contamination.



UW Extension
University of Wisconsin-Extension

Wisconsin Geological and Natural History Survey 3817 Mineral Point Road • Madison, Wisconsin 53705-5100
Tel 608.263.7389 • Fax 608.262.8086 • WisconsinGeologicalSurvey.org

Director and State Geologist: James M. Robertson



Fracturing and bedding in an exposure of carbonate bedrock near Sturgeon Bay in Door County.

Karst and shallow carbonate bedrock in Wisconsin

Wisconsin Geological and Natural History Survey

Factsheet 02 | 2009

Carbonate bedrock, rock formations composed primarily of limestone or dolomite, underlie the southern third of Wisconsin in a V-shaped belt (see map on other side). These rocks are commonly fractured, with the fractures providing primary pathways for groundwater movement.

Carbonate rocks are soluble, and percolating surface water can enlarge fractures to form conduits, caves, and sinkholes that are the hallmarks of a **karst** system and its related karst landscape.

In Wisconsin, karst landscapes are direct evidence of underlying shallow, fractured carbonate bedrock. But the lack of classic karst features in a landscape does not mean that shallow fractured carbonate bedrock is absent, or that the groundwater is potentially any less vulnerable to contamination.

Carbonate bedrock and groundwater contamination

Carbonate formations are important aquifers in Wisconsin. These aquifers supply water for homes, farms, cities, industries, and other human uses as well as maintaining water levels in lakes and wetlands and flows in streams and springs.

Carbonate aquifers are exceptionally vulnerable to contamination for two reasons:

- Groundwater flow in fractured rocks and karst systems can be extremely rapid—tens to hundreds of feet per day.
- Carbonate rocks are poor at filtering or otherwise removing contaminants.

Some site-specific questions to ask about carbonate aquifers

Carbonate aquifers are particularly vulnerable where overlying soils are thin or absent. There are numerous examples of groundwater contamination of carbonate aquifers in such settings in Wisconsin. Consequently, land-use activities in areas of carbonate rock must be carefully managed to avoid the release of contaminants to groundwater.

Types of questions to ask:

- Is carbonate bedrock present in the subsurface?
- How deeply is it buried? In other words, what is the thickness of the overlying material?
- What is the nature of the overlying material? For example, what is its origin, composition, grain size, etc?

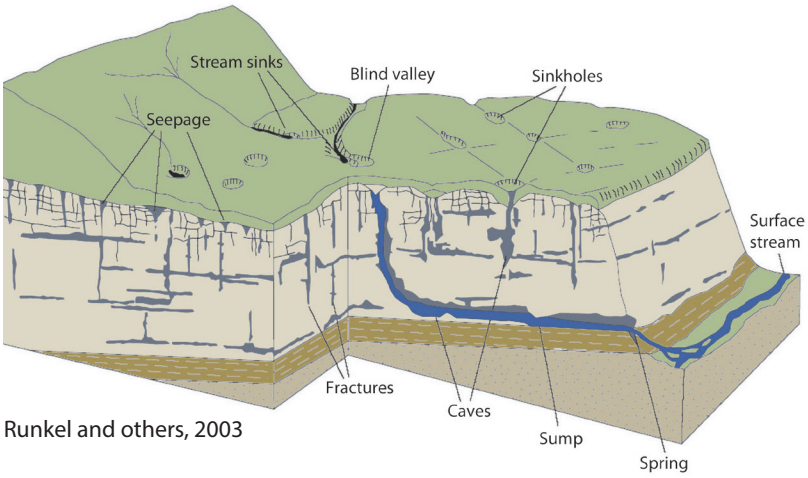
Water- and land-use management plans in areas with carbonate bedrock should always address these sorts of questions as they seek to protect groundwater quantity and quality.

For more information, contact

Kenneth R. Bradbury, Ph.D.
Wisconsin Geological and Natural History Survey
608.263.7921, krbradbu@wisc.edu

UW Extension
University of Wisconsin-Extension

Typical features of a karst sytem and landscape: Seepages, sinkholes, caves, fractures, springs, and stream sinks.



Runkel and others, 2003

Appendix F

Liquefaction and Settlement Potential Evaluation

Liquefaction and Settlement Potential Evaluation

Based on the results of the site investigation borings and laboratory soil test results, the disposal facility soils are not subject to liquefaction or settlement concerns for the performance of the disposal facility.

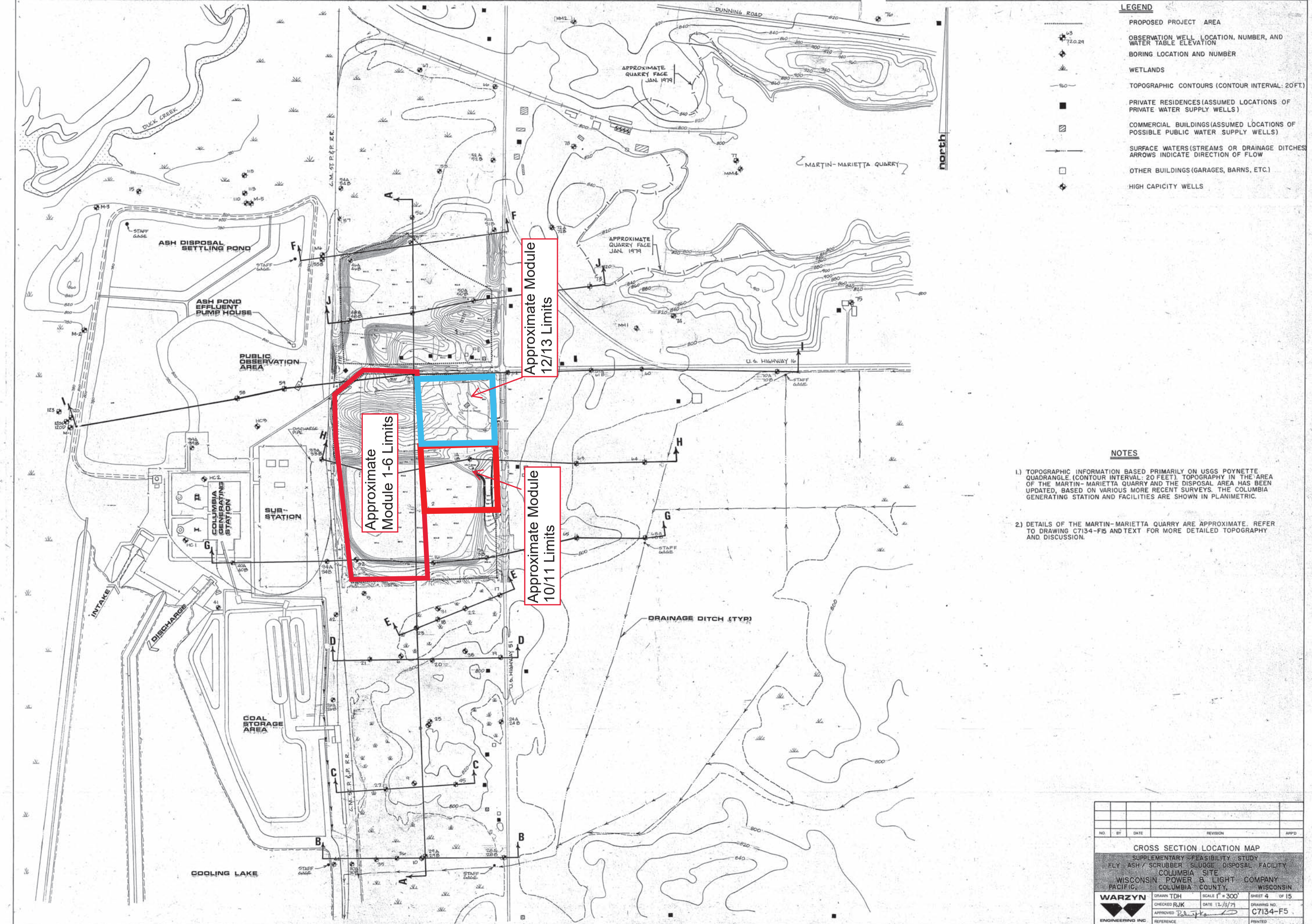
Liquefaction is the process by which a saturated, loose, cohesionless soil influenced by external forces can suddenly loses its shear strength and behave as a fluid. The external forces result from ground motion from an earthquake. The disposal facility site soils consist primarily of sand. Borings show that the sands are medium dense to very dense rather than loose so liquefaction is not a concern given the low magnitude of maximum ground accelerations expected in the area; see Appendix D.

Settlement below a disposal facility can be a concern if the facility is underlain by extensive soft, fine-grained soils. Soft soils are subject to consolidation settlement depending on the load over the soft soils. The disposal facility soils consist of medium dense to very dense sands that are not subject to consolidation settlement so settlement is not a concern at the disposal facility.

I:\25224034.00\Deliverables\Location Restrictions Compliance\Appendices\F-Liquefaction and Settlement Potential Evaluation\F1_Liquefaction and Settlement Potential Evaluation.docx

Appendix G

Geologic Cross Sections



SUPPLEMENTARY FEASIBILITY STUDY
FLY ASH / SOAPSTONE SLUDGE DISPOSAL FACILITY
COLUMBIA SITE
WISCONSIN POWER & LIGHT COMPANY
PACIFIC, COLUMBIA COUNTY, WISCONSIN

WARZYN ENGINEERING INC

DRAWN: TDH	SCALE: AS SHOWN	SHEET 5 OF 15
CHECKED: RJK	DATE: 12/6/79	DRAWING NO. C7134 -F6
APPROVED:	REFERENCE	PRINTED

NO.	BY	DATE	REVISION	APP'D

GEOLOGIC CROSS SECTIONS

GRAIN SIZE ANALYSIS
% GRAVEL
% SAND
% SILT
% CLAY
GSA-7/G9/17/13

GRAIN SIZE ANALYSIS
% GRAVEL
% SAND
% COMBINED
SILT & CLAY
GSA-7/63/30

9) GROUNDWATER ELEVATIONS BASED ON READINGS TAKEN MAY 14, 1974.

8) THE SUBSURFACE PROFILE IS GENERAL IN NATURE AND DOES NOT PURPORT TO BE AN EXACT REPRESENTATION OF THE SOIL AND GROUNDWATER BETWEEN INDIVIDUAL BORINGS. THE SUBSURFACE PROFILE IS SHOWN FOR GENERAL DESCRIPTIVE PURPOSES ONLY.

NOTES

1) SEE DRAWING C7134-F4 FOR NOTES REGARDING TOPOGRAPHY

SANDSTONE

MEDIUM TO COARSE SAND AND GRAVEL, TRACE TO SOME SILT AND CLAY

SANDY SILT TO SANDY CLAYEY SILT

FINE TO MEDIUM SAND, TRACE TO SOME SILT AND CLAY, TRACE TO LITTLE GRAVEL

FIBROUS AND WOODY PEAT

FILL - FINE TO MEDIUM SAND, LITTLE TO SOME SILT, TRACE CLAY, TRACE GRAVEL

BORING LOG LEGEND

TYPICAL MONITORING WELL DETAIL
NOT TO SCALE

2" DIAMETER PVC PIPE
CEMENT CAP(TYP)
WATER LEVEL
BORING CUTTINGS
BACKFILL
BENTONITE SEAL
10' SLOTTED PVC PIPE
SAND SPOIL FILLER
DIRECTION OF GROUNDWATER FLOW
BORING CUTTINGS BACKFILL
GROUNDWATER EQUIPOTENTIAL LINE
BENTONITE SEAL
SAND SPOIL FILLER
3" WELL POINT

SECTION B-B'

SCALE: HORIZONTAL 1"=100' VERTICAL 1"=10'

sandstone

peat

fill

pt

B"28A&B
B"29A&B
B"36
B"35
B"30A&B
B"44
DRAINAGE DITCH WITH STAFF GAGE
COOLING LAKE
GSA-13/68/13/c
GSA-0/0/44/5c
GSA-0/23/63/24
GSA-1/98/c
GSA-0/95/c
GSA-7/91/c
GSA-0/94/c
GSA-39/48/13
GSA-48/45/7

SECTION A-A'

SCALE: HORIZONTAL 1"=200' VERTICAL 1"=10'

sandstone

fill

pt

B"5A
B"47
B"49
B"37A&B
B"2
B"1A
B"23
B"20
B"25
B"9
B"29A&B
DRAINAGE DITCH WITH STAFF GAGE
GSA-14/79/7
GSA-13/68/19
GSA-0/84/6/5
GSA-0/20/44/16
PROPOSED SOFT SUBSOIL SLUDGE BASE GRADE
GSA-1/84/6/5
GSA-11/82/7
GSA-42/41/19/4
GSA-1/80/10/9
GSA-0/98/7
GSA-0/71/33
GSA-0/98/c
GSA-0/92/48
GSA-0/95/5
GSA-0/98/c
GSA-7/91/c
GSA-0/94/c
GSA-39/48/13
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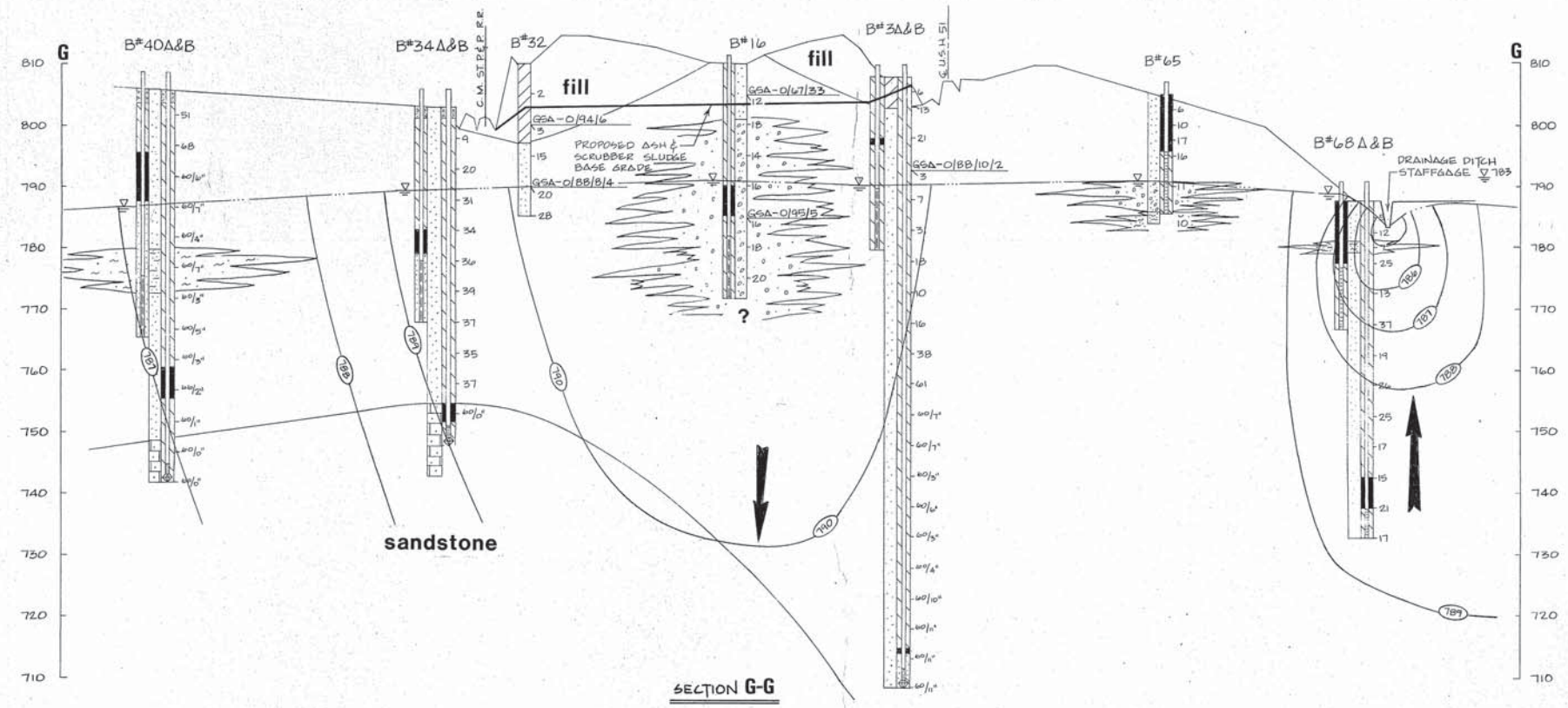
GSA-13/68/13/c
GSA-0/0/44/5c
GSA-0/23/63/24
GSA-1/98/c



SCALE:
VERTICAL: 1"=10'
HORIZONTAL: 1"=200'

NOTES

1) REFER TO DRAWING C7134-F5 FOR NOTES AND LEGEND

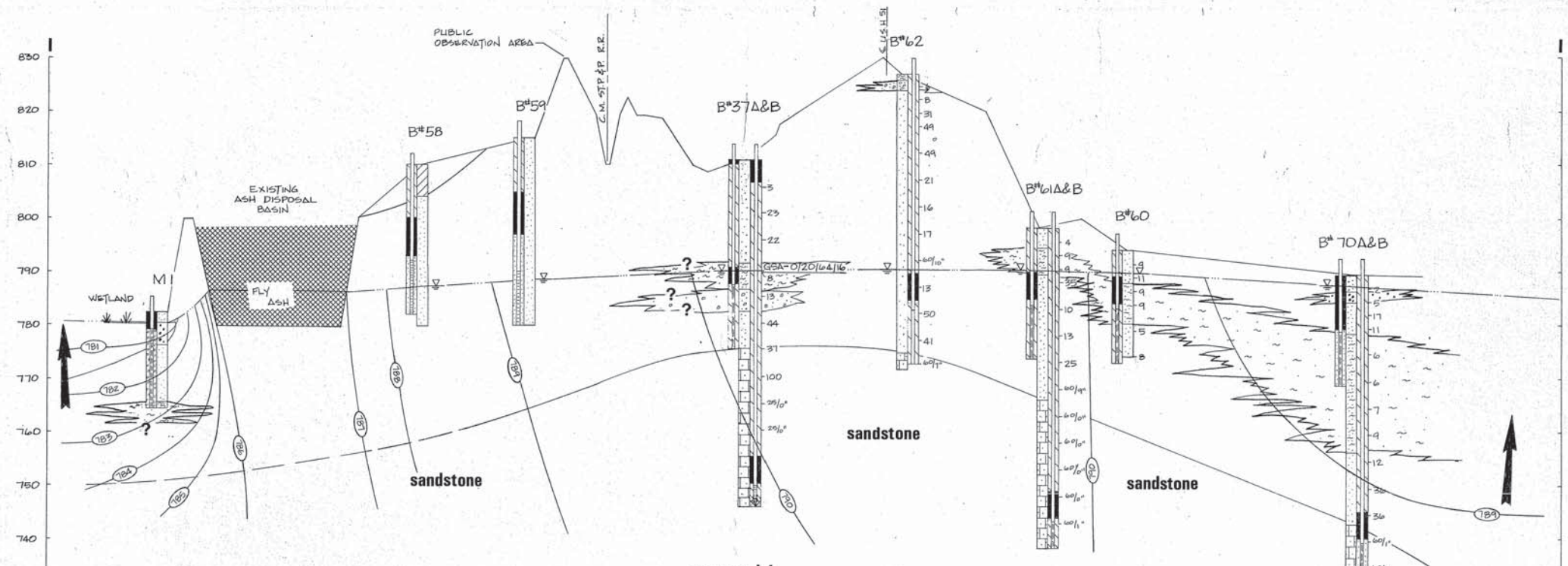
NO.	BY	DATE	REVISION	APP'D

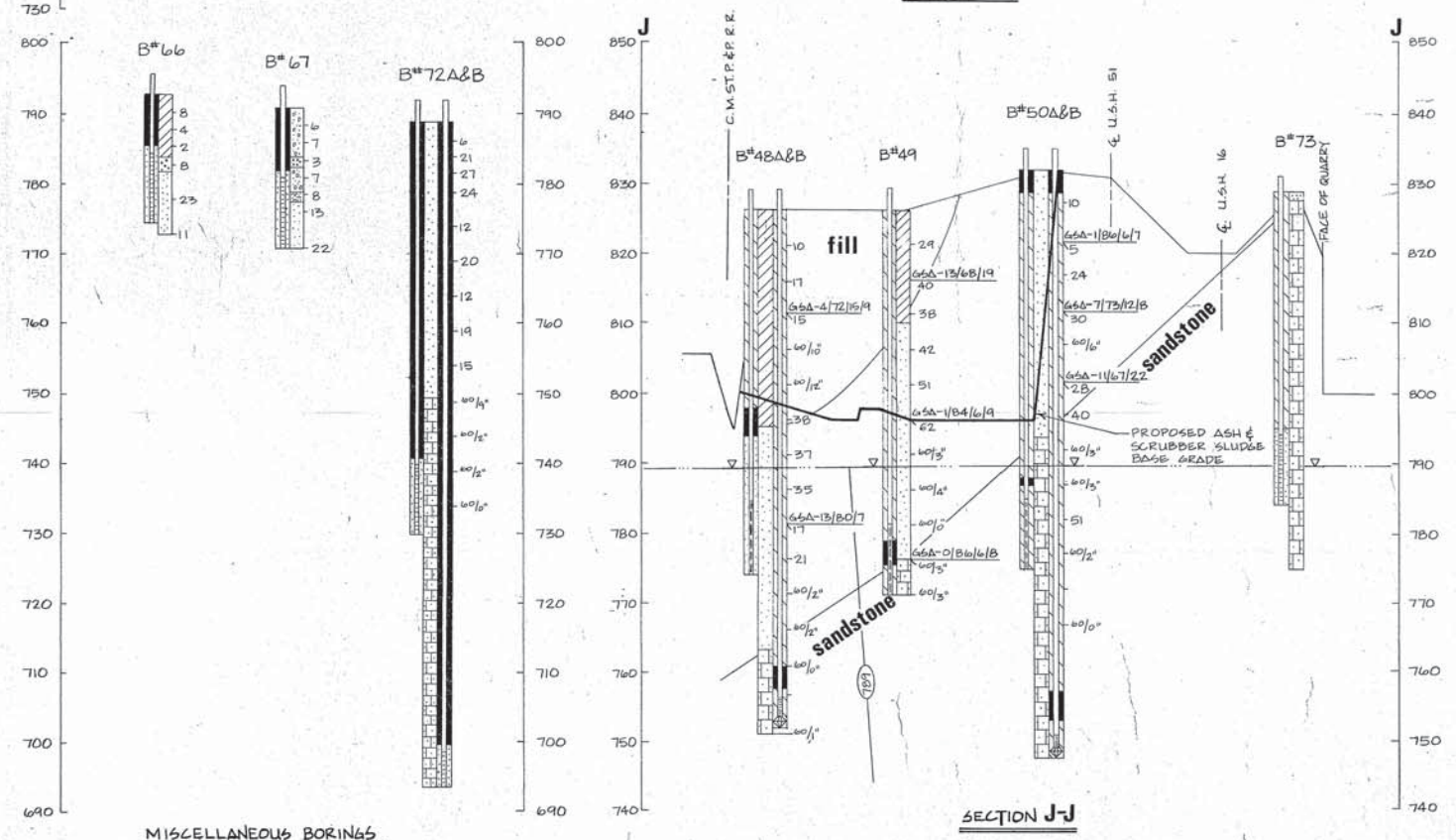
GEOLOGIC CROSS SECTIONS

SUPPLEMENTARY FEASIBILITY STUDY
FLY ASH / SCRUBBER SLUDGE DISPOSAL FACILITY
COLUMBIA SITE
WISCONSIN POWER & LIGHT COMPANY
PACIFIC, COLUMBIA COUNTY, WISCONSIN

WARZYN ENGINEERING INC.

DRAWN TDH	SCALE AS SHOWN	SHEET 7	OF 15
CHECKED RJK	DATE 12/3/79	DRAWING NO.	C7134 -F8
APPROVED			
REFERENCE		PRINTED	





SCALE:
VERTICAL: 1"=10'
HORIZONTAL: 1"=300'

NOTES

1) REFER TO DRAWING C7134-F5 FOR NOTES AND LEGEND.

NO.	BY	DATE	REVISION	APP'D

GEOLOGIC CROSS SECTIONS

SUPPLEMENTARY FEASIBILITY STUDY
FLY ASH / SCRUBBER SLUDGE DISPOSAL FACILITY
COLUMBIA SITE
WISCONSIN POWER & LIGHT COMPANY
PACIFIC, COLUMBIA COUNTY, WISCONSIN

WARZYN ENGINEERING INC

DRAWN TDH	SCALE AS SHOWN	SHEET 8 OF 15	
CHECKED RJK	DATE 12/3/74	DRAWING NO.	
APPROVED Robert J. Kuss		C7134-F9	
REFERENCE		PRINTED	

Appendix H

Slope Stability Analysis

August 31, 2023
File No. 25222260.00

TECHNICAL MEMORANDUM

ANALYSIS BY: Niko Villanueva

REVIEWED BY: Deb Nelson
Keith Gilkey
Phil Gearing

SUBJECT: Slope Stability Analyses
Plan of Operation 2023 Update
Columbia Dry Ash Disposal Facility

PURPOSE

The purposes of the slope stability analyses were to evaluate:

- The final 4H:1V final cover slope in Module 12/Module 13 at the highest final cover grade.
- The interim 3H:1V waste slope in Modules 12/13 at the highest waste grade.
- The access road over 4H:1V final cover slope through Module 6.

CONCLUSION

The attached results confirm that the interim waste slopes will be stable during the construction and operation of the disposal facility modules and that the final grade slope, as well as the overlying access road, will be stable post-closure of the disposal facility.

APPROACH

SCS Engineers (SCS) evaluated the waste mass slope stability of Modules 12/13 during interim waste filling conditions at the most critical/highest waste grades. The Modules 12/13 interim 3H:1V waste slope analyzed is the northern filling face with a maximum waste fill height of approximately 122 feet above the base grade corresponding to a peak elevation of approximately 912 feet above mean sea level. The interim waste slopes were evaluated for block failure and optimized circular failure.

SCS completed analysis for this waste slope by iteratively modifying the coal combustion residual (CCR) friction angle to determine the minimum friction angle required for a safety factor of 1.3. This calculated CCR friction angle was used in the other analyzed sections. The calculated CCR friction

angle of 23.5 degrees is still conservative based on assumed published values of stabilized CCR in the range of 35 to 45 degrees (see Reference 7).

SCS evaluated the final grade slope stability of longest final cover slope at the most critical/highest final grade cross-section within the Modules 12/13 footprint. The critical cross-section analyzed is through the Modules 12/ 13 waste mass with slope of 4H:1V, a maximum waste fill height of approximately 130 feet above base grades, and a peak elevation of approximately 938 feet above mean sea level. The final grade slope was evaluated for block failure and optimized circular failure.

SCS evaluated the final grade slope stability of the final grade access road. The critical cross section analyzed is through Module 6 final cover with slope of 4H:1V, and 1% slope under the access road. The shoulder of the access road has a 3H:1V slope. The access road was evaluated for block failure and optimized circular failure.

RESULTS

The calculated safety factors for each slope section and failure type are shown in the attached summary table.

SCS recommends a minimum safety factor of 1.3 for the interim waste slopes and 1.5 for the final grade slopes and the access road. The results indicate that the interim waste slopes and final grade slopes have acceptable minimum safety factors.

REFERENCES

1. SCS Engineers, Columbia Dry Ash Disposal Facility, Module 3 Liner Construction, 2016, existing composite liner grades and material properties for geosynthetics.

2. SCS Engineers, Columbia Dry Ash Disposal Facility, 2018 Module 4 Liner Construction, 2018, existing composite liner grades and material properties for subbase, clay, and drainage layer.

3. SCS Engineers, Columbia Dry Ash Disposal Facility, Module 5-6 Liner Construction, 2021, existing composite liner grades and material properties for subbase, clay, and drainage layer.

4. SCS Engineers, Columbia Dry Ash Disposal Facility, Plan of Operation 2022 Update, 2022, Module 10-11 composite liner grades, interim waste filling stages, and final grades.

5. TRI/Environmental, Interface Friction Test Results, 2016, for 2016 Module 3 Liner Construction, and Modules 1 and 2 Cover Construction.

6. TRI/Environmental, Consolidated-Undrained Triaxial Compression Test Results for FGD Material, 2015, material properties for CCR (SCS Project No. 25214049.00).

7. U.S. Department of Transportation, Federal Highway Administration, Recycled Materials, User Guidelines for Waste and Byproduct Materials in Pavement Construction.

8. Stabilization of FGD By-Products by Using Fly Ash, Cement, and Sialite, 2009 WOCA Conference.

9. Geo-Slope International, Ltd., GeoStudio 2023.1.2, Version 23.1.2.11, Slope/W slope stability software.

10. SCS Engineers, Plan Modification Request/Plan of Operation Update, Dry Ash Disposal Facility, Columbia Energy Center, Base Grade and Final Grade Plan Sheets, August 2023.

ASSUMPTIONS

- Sand drainage layers in each of the existing and future modules have the same properties.
- Geosynthetics installed for each of the module composite liners have the same properties.
- Clay material for each of the module composite liners have the same properties.
- CCR waste material will be the same in each of the existing and future modules.
- A waste fill slope of 3H:1V is representative of the design interim waste slopes.
- The groundwater elevation will remain below the elevation at the base of the landfill liner system.
- The access road vehicle is a John Deere 410 off-road haul truck with a fully loaded weight capacity of approximately 152,000 pounds. The surcharge load on the road will be 630 pcf over the truck width.
- The disposal facility will be operated to prevent development of liquid pressures, or seepage forces, within the waste, and there will be no buildup of leachate above the top of the drainage layer.
- The disposal facility will be operated to prevent placement of weak layers of waste within the overall waste mass.
- Optimized circular and sliding block failure stability analyses are appropriate to evaluate the waste interim grade, final grade, and access road slope stability.
- Material properties are as shown in the table below, based on the indicated references and assumed values based on experience. Friction angles for soils are conservative assumed values based on soil type, published typical values, and SCS experience. The CCR friction angle is a calculated conservative value that is in line with assumed published values, and the CCR unit weight is based on 2015 triaxial compression test results by TRI/Environmental for CCR.

Table 1. Material Properties Summary Table

Material	Unit Weight (pcf)	Friction Angle (degrees)	Cohesion (psf)	Reference
Subbase	120	30	0	1, 2, and 3
Clay	125	28	0	1, 2, and 3
Geosynthetics	58	24.3	0	5, 10
Drainage Layer	115	30	0	2 and 3
CCR	86	23.5(1)	0	6, 7, 8, and Calculation
Soil Barrier Layer	125	28	0	10
Geotextile	58	30	0	5, 10
Rooting Zone/Sand	120	30	0	10
Road Aggregate	135	35	0	10

Notes:
(1) CCR friction angle iteratively calculated for minimum value for a safety factor of 1.3 for Module 12/13 interim 3H:1V analysis. Calculated CCR friction angle was used in the other analyzed sections.

Attachments: Calculations organized as follows:

- Factor of Safety Summary Table
- Cross Section Locations
- Slope/W Outputs

NV/jsn/DLN/KRG/PEG

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Slope Stability Analysis
Factor of Safety Results Summary
Columbia Dry Ash Disposal Facility / SCS Project No. 25222260.00

Scenario Analyzed	Calculated Safety Factor	Recommended Minimum Safety Factor
Interim Waste Conditions (Module 12-13 Interim 3H:1V Waste Slope)		
Optimized Circular (Rotational Failure)	1.306[(1)]	1.300
Block (Translational Failure)	1.61	1.300
Final Grade (Module 12-13 Final Cover 4H:1V Slope)		
Optimized Circular (Rotational Failure)	1.745	1.500
Block (Translational Failure)	2.073	1.500
Access Road (Overlying 4H:1V Final Cover Slope)		
Optimized Circular (Rotational Failure)	1.709	1.500
Block (Translational Failure)	1.724	1.500

Notes:
1. Coal combustion residual (CCR) friction angle iteratively calculated for minimum value for a safety factor of 1.3.

Updated by: NV, 08/02/2023
Checked by: DLN, 08/30/2023

I:\25222260.00\Data and Calculations\Geotech Calculations\Slope Stability\2023 Tech Memo and Attachments\[A1_Slope Stability_FS Results Summary Table_230802.xlsx]FS Results Summary

540,500 N | 541,000 N | 541,500 N | 542,000 N | 542,500 N | 543,000 N | 543,500 N

2,123,500 | 2,124,000 | 2,124,500 | 2,125,000 E

COAL PILE

SOUTH SEDIMENTATION BASIN

CULVERT C7

C. M. ST. P. & P. RR.

MURRAY ROAD

PHASE 1

PHASE 2

LOCATION OF CROSS SECTION FOR ACCESS ROAD STABILITY ANALYSIS

LOCATION OF CROSS SECTION FOR FINAL COVER STABILITY ANALYSIS

4H:1V | 10H:1V | 3.0%

LEGEND

- DRY ASH DISPOSAL FACILITY LIMITS
- LIMITS OF WASTE
- FINAL COVER LIMITS
- APPROXIMATE EXISTING INTERMEDIATE COVER LIMITS/AREA
- PAVED ROAD
- UNPAVED ROAD
- VEGETATION
- FENCE
- EXISTING GRADE (10' INTERVAL)
- EXISTING GRADE (2' INTERVAL)
- SWALE
- EDGE OF WATER
- WETLAND
- PROPOSED GRADE (10' INTERVAL)
- PROPOSED GRADE (2' INTERVAL)
- PROPOSED PERIMETER ROAD
- PROPOSED SWALE
- PROPOSED CULVERT
- PROPOSED SLOPE AND DIRECTION
- PROPOSED LEACHATE MANHOLE SUMP
- PROPOSED LEACHATE FORCEMAIN CLEANOUT MANHOLE
- PROPOSED LEACHATE FORCEMAIN
- PROPOSED UNDERGROUND ELECTRIC
- PROPOSED FINAL COVER TOE DRAIN
- PROPOSED FINAL COVER TOE DRAIN OUTLET PIPE
- PROPOSED DIVERSION BERM
- PROPOSED DOWNSLOPE FLUME
- PROPOSED ENERGY DISSIPATOR
- PROPOSED CATCH BASIN
- PROPOSED RIPRAP
- PROPOSED SILT FENCE/FILTER SOCK
- PROPOSED STRAW BALE DITCH CHECK
- PROPOSED MODULE 13 MONITORING WELL
- PROPOSED INTERMEDIATE DRAIN COLLECTION PIPE
- PROPOSED INTERMEDIATE DRAIN OUTLET PIPE
- PROPOSED 2024 FINAL COVER CONSTRUCTION

NOTES:

1. SEE SHEET 2 FOR BASE MAP LEGEND ITEMS AND NOTES.
2. PROPOSED GRADES WITHIN LIMITS OF WASTE REPRESENT TOP OF FINAL COVER (FINAL GRADE).

100 0 100

SCALE: 1" = 100'

N

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PROJECT NO.	25222\00.00
DRAWN:	05/17/18
REVISED:	08/28/23
DRAWN BY:	KRG
CHECKED BY:	DLN
APPROVED BY:	PEG

WISCONSIN POWER AND LIGHT
COLUMBIA ENERGY CENTER
LANDFILL #2 EXPANSION
PARDEEVILLE, WISCONSIN 53954

CLIENT: Wisconsin Power and Light Company

SCS ENGINEERS
2830 DAIRYDRIVE MADISON, WI 53718-6751
PHONE: (608) 224-2830

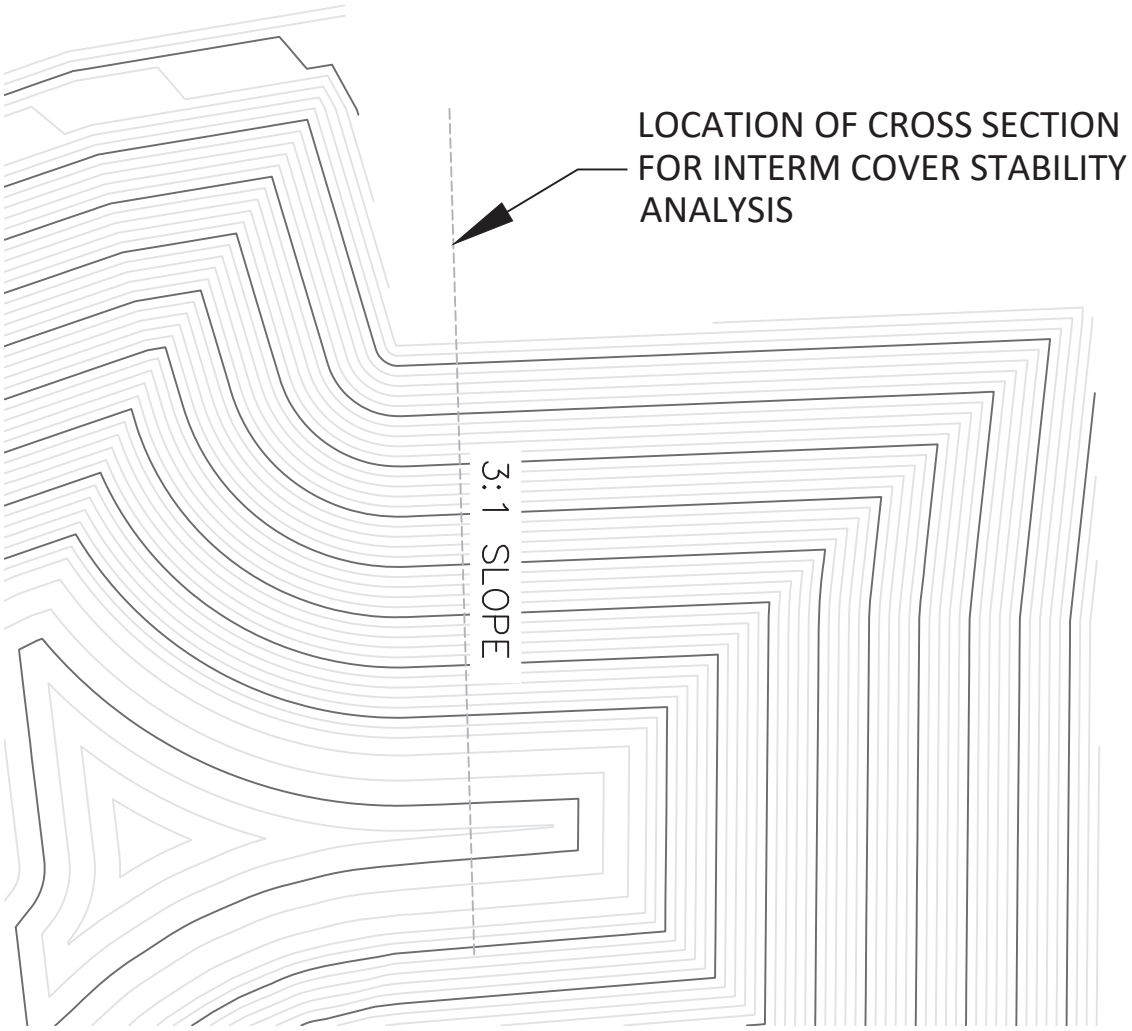
ENGINEER

PLAN OF OPERATION UPDATE
COLUMBIA ENERGY CENTER
COLUMBIA COUNTY LANDFILL FACILITY
TOWN OF PACIFIC, WISCONSIN

SITE

STABILITY ANALYSIS CROSS SECTION LOCATIONS

FIGURE
E1

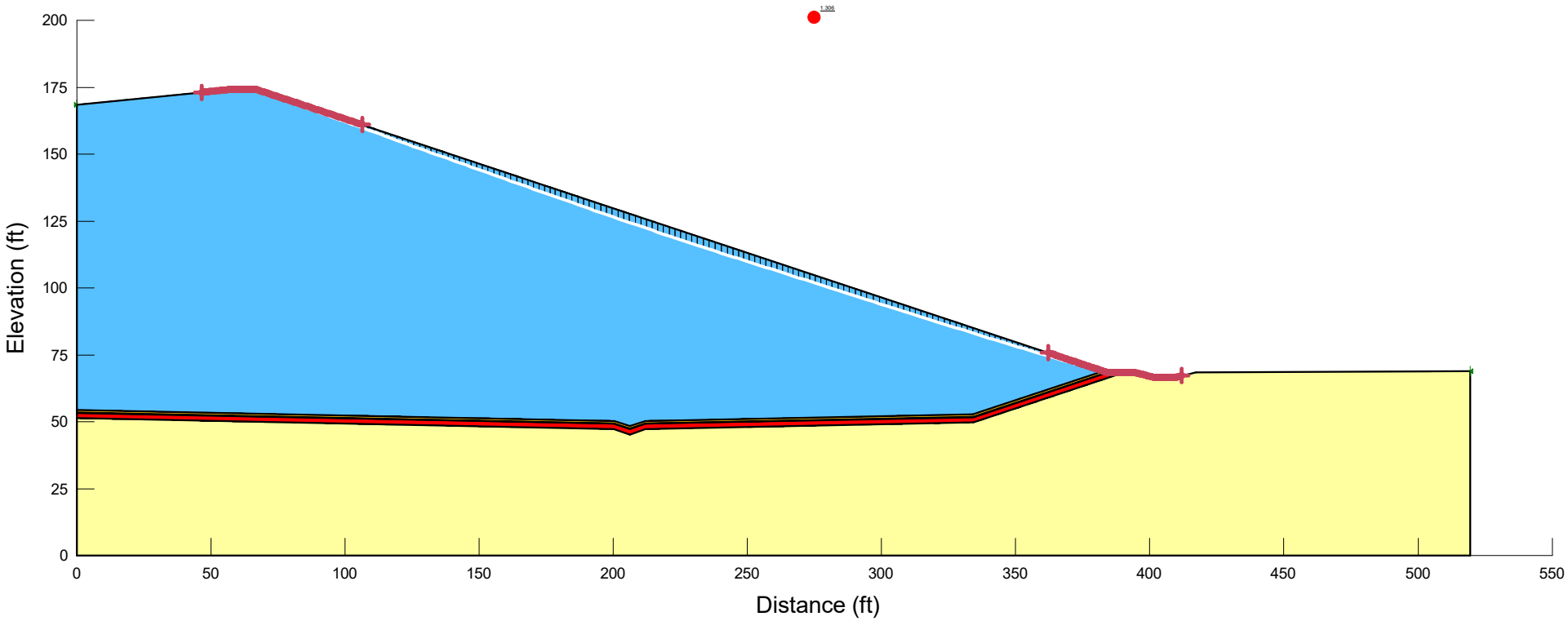


CLIENT	WISCONSIN POWER AND LIGHT COMPANY COLUMBIA ENERGY CENTER W8375 MURRAY ROAD PARDEEVILLE, WI 53954	SITE	PLAN OF OPERATION UPDATE COLUMBIA DRY ASH DISPOSAL FACILITY TOWN OF PACIFIC, WISCONSIN	LOCATION OF INTERM GRADES STABILITY ANALYSIS CROSS SECTION	
PROJECT NO.	25222260.00	DRAWN BY:	KRG	ENGINEER	FIGURE
DRAWN:	08/02/2022	CHECKED BY:	DLN	SCS ENGINEERS 2830 DAIRY DRIVE MADISON, WI 53718-6751 PHONE: (608) 224-2830	E2
REVISED:	08/28/2023	APPROVED BY:	PEG		

Title: Columbia Mod 12-13 Interim Conditions
Name: Optimized Circular_FS=1.3
Method: Bishop
Last Edited By: Villanueva, Niko

F of S: 1.306
F of S Rank (Analysis): 1 of 51,006 slip surfaces
Last Solved Date: 8/2/2023, Last Solved Time: 3:30:24 PM

Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	CCR	Mohr-Coulomb	86	0	23.5
	Clay	Mohr-Coulomb	125	0	28
	Drainage Layer	Mohr-Coulomb	115	0	30
	Geosynthetics	Mohr-Coulomb	58	0	24.3
	Subbase	Mohr-Coulomb	120	0	30



Optimized Circular_FS=1.3

File Information

File Version: 11.05
Title: Columbia Mod 12-13 Interim Conditions 3:1 Slope
Created By: Villanueva, Niko
Last Edited By: Gilkey, Keith
Revision Number: 27
Date: 08/07/2023
Time: 09:58:32 AM
Tool Version: 23.1.1.829
File Name: COL_Mod12-13_Interim Conditions.gsz
Directory: I:\25222260.00\Data and Calculations\Geotech Calculations\Slope Stability\SlopeW\
Last Solved Date: 08/28/2023
Last Solved Time: 01:19:10 PM

Project Settings

Unit System: U.S. Customary Units

Analysis Settings

Optimized Circular_FS=1.3

Kind: SLOPE/W
Analysis Type: Bishop
Settings
- PWP Conditions from: (none)
- Unit Weight of Water: 62.4 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: Yes
- Optimizations Settings
  - Maximum Iterations: 2,000
  - Starting Points: 8
  - Ending Points: 16
  - Driving Side Maximum Convex Angle: 5 °
  - Resisting Side Maximum Convex Angle: 1 °
- Tension Crack Option: (none)

Distribution
- F of S Calculation Option: Constant

Convergence
- Geometry Settings
  - Minimum Slip Surface Depth: 0.1 ft
  - Number of Columns: 150
- Factor of Safety Convergence Settings

Maximum Number of Iterations: 20,000
Tolerable difference in F of S: 0.001

Materials

CCR

Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 86 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 23.5 °
Phi-B: 0 °

Clay

Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 125 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 28 °
Phi-B: 0 °

Drainage Layer

Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 115 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 30 °
Phi-B: 0 °

Geosynthetics

Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 58 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 24.3 °
Phi-B: 0 °

Subbase

Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 120 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 30 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Type: Range
Left-Zone Left Coordinate: (46.59062, 173.12871) ft
Left-Zone Right Coordinate: (106.54318, 161) ft
Left-Zone Increment: 100
Right Type: Range
Right-Zone Left Coordinate: (362.19284, 75.78345) ft
Right-Zone Right Coordinate: (412, 67.22491) ft
Right-Zone Increment: 100
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 168.49196) ft
Right Coordinate: (519.45834, 68.88205) ft

Geometry

Name: Default Geometry

Settings

View: 2D
Element Thickness: 1 ft

Points

	X	Y
Point 1	0 ft	51.34809 ft
Point 2	200.19951 ft	47.31405 ft
Point 3	206.14741 ft	45.33145 ft
Point 4	212.095 ft	47.31198 ft
Point 5	334.29245 ft	49.73507 ft
Point 6	390.42013 ft	68.42378 ft
Point 7	390.59413 ft	68.42454 ft
Point 8	394.34772 ft	68.44017 ft
Point 9	401.75147 ft	66.62062 ft
Point 10	409.75552 ft	66.6544 ft
Point 11	417.15984 ft	68.53647 ft
Point 12	519.45834 ft	68.88205 ft
Point 13	519.45834 ft	0 ft
Point 14	0 ft	0 ft
Point 15	0 ft	54.44831 ft
Point 16	0 ft	53.44811 ft
Point 17	200.21671 ft	49.41372 ft
Point 18	206.14743 ft	47.43686 ft
Point 19	212.07782 ft	49.41166 ft
Point 20	334.27528 ft	51.83475 ft
Point 21	384.18447 ft	68.4529 ft
Point 22	382.60264 ft	68.98018 ft
Point 23	334.10353 ft	52.83154 ft
Point 24	211.90606 ft	50.40845 ft
Point 25	206.14759 ft	48.49089 ft
Point 26	200.38878 ft	50.41046 ft
Point 27	0 ft	53.34809 ft
Point 28	200.19951 ft	49.31405 ft
Point 29	206.14741 ft	47.33145 ft
Point 30	212.095 ft	49.31198 ft
Point 31	334.29245 ft	51.73507 ft
Point 32	384.34265 ft	68.40018 ft
Point 33	386.24265 ft	68.40557 ft
Point 34	386.24265 ft	67.50557 ft
Point 35	386.34265 ft	67.50557 ft

Point 36	386.34265 ft	68.40601 ft
Point 37	386.34265 ft	68.50557 ft
Point 38	384.34265 ft	68.50557 ft
Point 39	0 ft	168.49196 ft
Point 40	66.5815 ft	174.32056 ft
Point 41	58.24521 ft	174.28859 ft

Regions

	Material	Points	Area
Region 1	Subbase	1,2,3,4,5,6,7,8,9,10,11,12,13,14	28,504 ft²
Region 2	Drainage Layer	15,16,17,18,19,20,21,22,23,24,25,26	386.75 ft²
Region 3	Geosynthetics	16,27,28,29,30,31,32,33,34,35,36,37,38,21,20,19,18,17	39.07 ft²
Region 4	Clay	27,1,2,3,4,5,6,36,35,34,33,32,31,30,29,28	774.67 ft²
Region 5	CCR	39,15,26,25,24,23,22,40,41	29,542 ft²

Slip Results

Slip Surfaces Analysed: 46903 of 51006 converged

Current Slip Surface

Slip Surface: 51,006
Factor of Safety: 1.306
Volume: 695.49644 ft³
Weight: 59,812.727 lbf
Resisting Moment: 50,841,807 lbf·ft
Activating Moment: 38,936,047 lbf·ft
Resisting Force: 23,408.102 lbf
Activating Force: 17,938.848 lbf
Slip Rank: 1 of 51,006 slip surfaces
Exit: (382.78319, 68.919998) ft
Entry: (66.579471, 174.32055) ft
Radius: 153.07166 ft
Center: (885.3998, 2,069.3162) ft

Slip Columns

	X	Y	PWP	Base Normal Stress	Frictional Strength	Cohesive Strength	Suction Strength	Base Material
Column 1	66.58049 ft	174.32017 ft	0 psf	0.029738458 psf	0.01293065 psf	0 psf	0 psf	CCR
Column 2	67.73459 ft	173.88130 ft	0 psf	4.1901142 psf	1.8219135 psf	0 psf	0 psf	CCR
Column 3	70.04078 ft	173.00435 ft	0 psf	12.451389 psf	5.4140179 psf	0 psf	0 psf	CCR
Column 4	72.34697 ft	172.12740 ft	0 psf	20.712663 psf	9.0061223 psf	0 psf	0 psf	CCR
Column 5	74.65315 ft	171.25045 ft	0 psf	28.973938 psf	12.598227 psf	0 psf	0 psf	CCR
Column 6	76.95934 ft	170.37350 ft	0 psf	37.235212 psf	16.190331 psf	0 psf	0 psf	CCR
Column	79.20885	169.54584	0	43.500805	18.914688	0 psf	0 psf	CCR

7	ft	ft	psf	psf	psf			
Column 8	81.40169 ft	168.76748 ft	0 psf	47.147318 psf	20.500237 psf	0 psf	0 psf	CCR
Column 9	83.59454 ft	167.98912 ft	0 psf	50.793832 psf	22.085787 psf	0 psf	0 psf	CCR
Column 10	85.78738 ft	167.21076 ft	0 psf	54.440346 psf	23.671336 psf	0 psf	0 psf	CCR
Column 11	87.98022 ft	166.43240 ft	0 psf	58.086859 psf	25.256885 psf	0 psf	0 psf	CCR
Column 12	90.17307 ft	165.65404 ft	0 psf	61.733373 psf	26.842434 psf	0 psf	0 psf	CCR
Column 13	92.36591 ft	164.87568 ft	0 psf	65.379887 psf	28.427984 psf	0 psf	0 psf	CCR
Column 14	94.55875 ft	164.09732 ft	0 psf	69.0264 psf	30.013533 psf	0 psf	0 psf	CCR
Column 15	96.75159 ft	163.31896 ft	0 psf	72.672914 psf	31.599082 psf	0 psf	0 psf	CCR
Column 16	98.94444 ft	162.54060 ft	0 psf	76.319427 psf	33.184631 psf	0 psf	0 psf	CCR
Column 17	101.13728 ft	161.76224 ft	0 psf	79.965941 psf	34.770181 psf	0 psf	0 psf	CCR
Column 18	103.30055 ft	160.98728 ft	0 psf	83.94283 psf	36.499381 psf	0 psf	0 psf	CCR
Column 19	105.43426 ft	160.21572 ft	0 psf	88.573452 psf	38.512833 psf	0 psf	0 psf	CCR
Column 20	107.56797 ft	159.44415 ft	0 psf	93.204074 psf	40.526285 psf	0 psf	0 psf	CCR
Column 21	109.70168 ft	158.67259 ft	0 psf	97.834696 psf	42.539737 psf	0 psf	0 psf	CCR
Column 22	111.83538 ft	157.90103 ft	0 psf	102.46532 psf	44.553188 psf	0 psf	0 psf	CCR
Column 23	113.96909 ft	157.12946 ft	0 psf	107.09594 psf	46.56664 psf	0 psf	0 psf	CCR
Column 24	116.10280 ft	156.35790 ft	0 psf	111.72656 psf	48.580092 psf	0 psf	0 psf	CCR
Column 25	118.23651 ft	155.58634 ft	0 psf	116.35718 psf	50.593544 psf	0 psf	0 psf	CCR
Column 26	120.37022 ft	154.81477 ft	0 psf	120.98781 psf	52.606996 psf	0 psf	0 psf	CCR
Column 27	122.50392 ft	154.04321 ft	0 psf	125.61843 psf	54.620448 psf	0 psf	0 psf	CCR
Column 28	124.63763 ft	153.27165 ft	0 psf	130.24905 psf	56.633899 psf	0 psf	0 psf	CCR
Column 29	126.77134 ft	152.50008 ft	0 psf	134.87967 psf	58.647351 psf	0 psf	0 psf	CCR
Column 30	128.90505 ft	151.72852 ft	0 psf	139.5103 psf	60.660803 psf	0 psf	0 psf	CCR
Column 31	131.03527 ft	150.96444 ft	0 psf	143.90592 psf	62.572076 psf	0 psf	0 psf	CCR
Column 32	133.16201 ft	150.20785 ft	0 psf	147.57233 psf	64.166276 psf	0 psf	0 psf	CCR
Column 33	135.28874 ft	149.45125 ft	0 psf	151.23874 psf	65.760477 psf	0 psf	0 psf	CCR

Column 34	137.41548 ft	148.69466 ft	0 psf	154.90515 psf	67.354677 psf	0 psf	0 psf	CCR
Column 35	139.54222 ft	147.93806 ft	0 psf	158.57156 psf	68.948877 psf	0 psf	0 psf	CCR
Column 36	141.66895 ft	147.18147 ft	0 psf	162.23797 psf	70.543077 psf	0 psf	0 psf	CCR
Column 37	143.79569 ft	146.42487 ft	0 psf	165.90438 psf	72.137278 psf	0 psf	0 psf	CCR
Column 38	145.92243 ft	145.66828 ft	0 psf	169.57079 psf	73.731478 psf	0 psf	0 psf	CCR
Column 39	148.04916 ft	144.91168 ft	0 psf	173.2372 psf	75.325678 psf	0 psf	0 psf	CCR
Column 40	150.17590 ft	144.15509 ft	0 psf	176.90361 psf	76.919878 psf	0 psf	0 psf	CCR
Column 41	152.30264 ft	143.39850 ft	0 psf	180.57002 psf	78.514079 psf	0 psf	0 psf	CCR
Column 42	154.42937 ft	142.64190 ft	0 psf	184.23643 psf	80.108279 psf	0 psf	0 psf	CCR
Column 43	156.55611 ft	141.88531 ft	0 psf	187.90284 psf	81.702479 psf	0 psf	0 psf	CCR
Column 44	158.68285 ft	141.12871 ft	0 psf	191.56925 psf	83.29668 psf	0 psf	0 psf	CCR
Column 45	160.80958 ft	140.37212 ft	0 psf	195.23566 psf	84.89088 psf	0 psf	0 psf	CCR
Column 46	162.93632 ft	139.61552 ft	0 psf	198.90207 psf	86.48508 psf	0 psf	0 psf	CCR
Column 47	165.06306 ft	138.85893 ft	0 psf	202.56848 psf	88.07928 psf	0 psf	0 psf	CCR
Column 48	167.18979 ft	138.10233 ft	0 psf	206.23489 psf	89.673481 psf	0 psf	0 psf	CCR
Column 49	169.31653 ft	137.34574 ft	0 psf	209.9013 psf	91.267681 psf	0 psf	0 psf	CCR
Column 50	171.38820 ft	136.61143 ft	0 psf	213.43539 psf	92.804351 psf	0 psf	0 psf	CCR
Column 51	173.40481 ft	135.89940 ft	0 psf	216.50015 psf	94.136944 psf	0 psf	0 psf	CCR
Column 52	175.42142 ft	135.18737 ft	0 psf	219.5649 psf	95.469538 psf	0 psf	0 psf	CCR
Column 53	177.43802 ft	134.47534 ft	0 psf	222.62966 psf	96.802131 psf	0 psf	0 psf	CCR
Column 54	179.45463 ft	133.76331 ft	0 psf	225.69441 psf	98.134724 psf	0 psf	0 psf	CCR
Column 55	181.47124 ft	133.05128 ft	0 psf	228.75917 psf	99.467318 psf	0 psf	0 psf	CCR
Column 56	183.55171 ft	132.32028 ft	0 psf	231.87626 psf	100.82267 psf	0 psf	0 psf	CCR
Column 57	185.69605 ft	131.57029 ft	0 psf	234.58812 psf	102.00182 psf	0 psf	0 psf	CCR
Column 58	187.84039 ft	130.82031 ft	0 psf	237.29998 psf	103.18097 psf	0 psf	0 psf	CCR
Column 59	189.98473 ft	130.07032 ft	0 psf	240.01184 psf	104.36012 psf	0 psf	0 psf	CCR

Column 60	192.12907 ft	129.32034 ft	0 psf	242.72369 psf	105.53927 psf	0 psf	0 psf	CCR
Column 61	194.27341 ft	128.57035 ft	0 psf	245.43555 psf	106.71842 psf	0 psf	0 psf	CCR
Column 62	196.41774 ft	127.82037 ft	0 psf	248.14741 psf	107.89756 psf	0 psf	0 psf	CCR
Column 63	198.56208 ft	127.07038 ft	0 psf	250.85927 psf	109.07671 psf	0 psf	0 psf	CCR
Column 64	200.70642 ft	126.32040 ft	0 psf	253.57113 psf	110.25586 psf	0 psf	0 psf	CCR
Column 65	202.85076 ft	125.57041 ft	0 psf	256.28298 psf	111.43501 psf	0 psf	0 psf	CCR
Column 66	204.99510 ft	124.82043 ft	0 psf	258.99484 psf	112.61416 psf	0 psf	0 psf	CCR
Column 67	207.13944 ft	124.07044 ft	0 psf	261.7067 psf	113.79331 psf	0 psf	0 psf	CCR
Column 68	209.26771 ft	123.34386 ft	0 psf	264.3559 psf	114.94522 psf	0 psf	0 psf	CCR
Column 69	211.37990 ft	122.64068 ft	0 psf	264.28736 psf	114.91541 psf	0 psf	0 psf	CCR
Column 70	213.49209 ft	121.93750 ft	0 psf	264.21881 psf	114.88561 psf	0 psf	0 psf	CCR
Column 71	215.60428 ft	121.23433 ft	0 psf	264.15027 psf	114.85581 psf	0 psf	0 psf	CCR
Column 72	217.71647 ft	120.53115 ft	0 psf	264.08172 psf	114.826 psf	0 psf	0 psf	CCR
Column 73	219.82866 ft	119.82797 ft	0 psf	264.01318 psf	114.7962 psf	0 psf	0 psf	CCR
Column 74	221.94085 ft	119.12479 ft	0 psf	263.94463 psf	114.76639 psf	0 psf	0 psf	CCR
Column 75	224.05305 ft	118.42161 ft	0 psf	263.87609 psf	114.73659 psf	0 psf	0 psf	CCR
Column 76	226.16524 ft	117.71843 ft	0 psf	263.80754 psf	114.70678 psf	0 psf	0 psf	CCR
Column 77	228.27743 ft	117.01525 ft	0 psf	263.739 psf	114.67698 psf	0 psf	0 psf	CCR
Column 78	230.38962 ft	116.31208 ft	0 psf	263.67045 psf	114.64717 psf	0 psf	0 psf	CCR
Column 79	232.50181 ft	115.60890 ft	0 psf	263.60191 psf	114.61737 psf	0 psf	0 psf	CCR
Column 80	234.61400 ft	114.90572 ft	0 psf	263.53336 psf	114.58757 psf	0 psf	0 psf	CCR
Column 81	236.81778 ft	114.17639 ft	0 psf	263.42442 psf	114.5402 psf	0 psf	0 psf	CCR
Column 82	239.11312 ft	113.42092 ft	0 psf	262.677 psf	114.21521 psf	0 psf	0 psf	CCR
Column 83	241.40848 ft	112.66545 ft	0 psf	261.92958 psf	113.89022 psf	0 psf	0 psf	CCR
Column 84	243.57960 ft	111.96250 ft	0 psf	261.21188 psf	113.57816 psf	0 psf	0 psf	CCR
Column 85	245.62650 ft	111.31209 ft	0 psf	258.7319 psf	112.49983 psf	0 psf	0 psf	CCR

Column 86	247.67341 ft	110.66168 ft	0 psf	256.25192 psf	111.42151 psf	0 psf	0 psf	CCR
Column 87	249.72031 ft	110.01126 ft	0 psf	253.77194 psf	110.34318 psf	0 psf	0 psf	CCR
Column 88	251.76721 ft	109.36085 ft	0 psf	251.29196 psf	109.26485 psf	0 psf	0 psf	CCR
Column 89	253.81411 ft	108.71044 ft	0 psf	248.81198 psf	108.18653 psf	0 psf	0 psf	CCR
Column 90	255.86102 ft	108.06003 ft	0 psf	246.332 psf	107.1082 psf	0 psf	0 psf	CCR
Column 91	257.90792 ft	107.40961 ft	0 psf	243.85202 psf	106.02988 psf	0 psf	0 psf	CCR
Column 92	259.95482 ft	106.75920 ft	0 psf	241.37204 psf	104.95155 psf	0 psf	0 psf	CCR
Column 93	262.00172 ft	106.10879 ft	0 psf	238.89206 psf	103.87322 psf	0 psf	0 psf	CCR
Column 94	264.04862 ft	105.45837 ft	0 psf	236.41208 psf	102.7949 psf	0 psf	0 psf	CCR
Column 95	266.09553 ft	104.80796 ft	0 psf	233.9321 psf	101.71657 psf	0 psf	0 psf	CCR
Column 96	268.14243 ft	104.15755 ft	0 psf	231.45212 psf	100.63825 psf	0 psf	0 psf	CCR
Column 97	270.18933 ft	103.50714 ft	0 psf	228.97214 psf	99.559919 psf	0 psf	0 psf	CCR
Column 98	272.23623 ft	102.85672 ft	0 psf	226.49216 psf	98.481593 psf	0 psf	0 psf	CCR
Column 99	274.28314 ft	102.20631 ft	0 psf	224.01218 psf	97.403267 psf	0 psf	0 psf	CCR
Column 100	276.33004 ft	101.55590 ft	0 psf	221.5322 psf	96.324941 psf	0 psf	0 psf	CCR
Column 101	278.42490 ft	100.88613 ft	0 psf	219.06082 psf	95.250357 psf	0 psf	0 psf	CCR
Column 102	280.56772 ft	100.19701 ft	0 psf	217.10705 psf	94.400834 psf	0 psf	0 psf	CCR
Column 103	282.71054 ft	99.50788 ft	0 psf	215.15328 psf	93.55131 psf	0 psf	0 psf	CCR
Column 104	284.85336 ft	98.81876 ft	0 psf	213.19951 psf	92.701787 psf	0 psf	0 psf	CCR
Column 105	286.99618 ft	98.12964 ft	0 psf	211.24574 psf	91.852264 psf	0 psf	0 psf	CCR
Column 106	289.13900 ft	97.44052 ft	0 psf	209.29197 psf	91.00274 psf	0 psf	0 psf	CCR
Column 107	291.28182 ft	96.75139 ft	0 psf	207.3382 psf	90.153217 psf	0 psf	0 psf	CCR
Column 108	293.42464 ft	96.06227 ft	0 psf	205.38443 psf	89.303693 psf	0 psf	0 psf	CCR
Column 109	295.71917 ft	95.32194 ft	0 psf	203.35924 psf	88.423116 psf	0 psf	0 psf	CCR
Column 110	298.16540 ft	94.53041 ft	0 psf	201.50547 psf	87.617072 psf	0 psf	0 psf	CCR
Column 111	300.61163 ft	93.73888 ft	0 psf	199.6517 psf	86.811028 psf	0 psf	0 psf	CCR

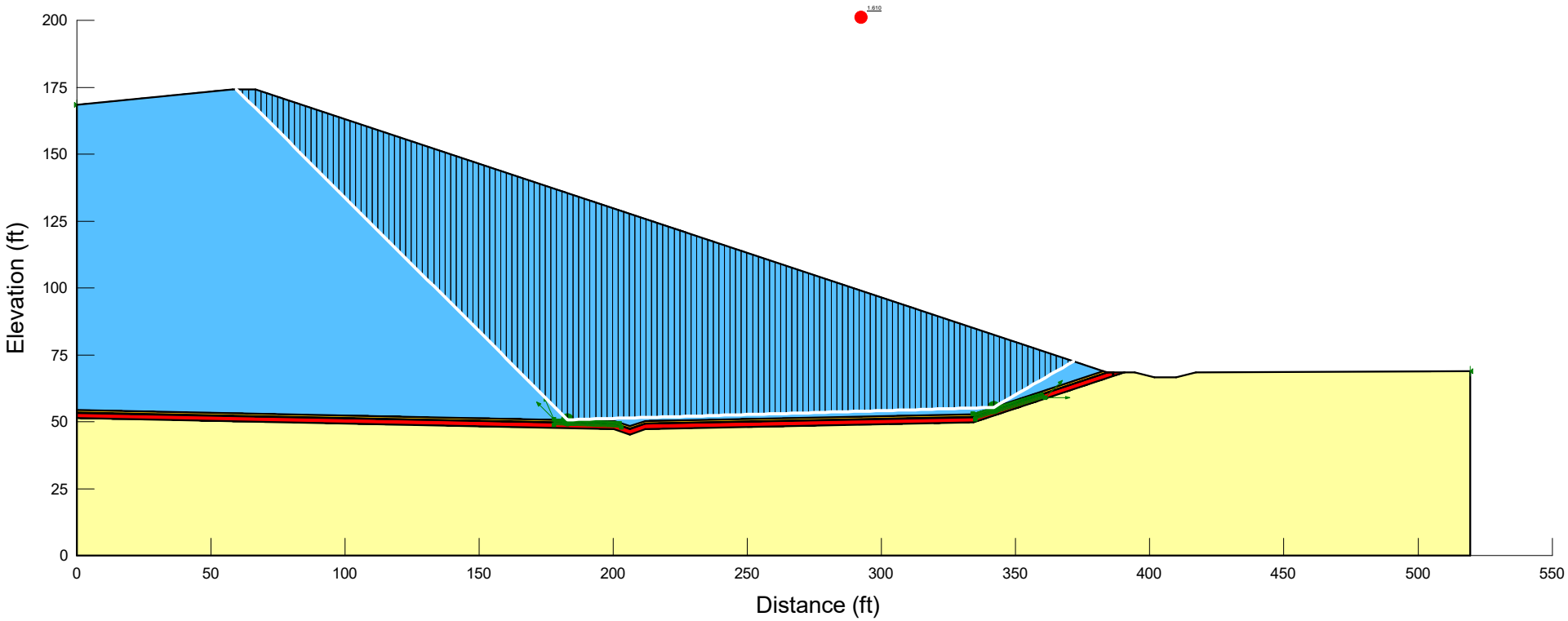
Column 112	302.91346 ft	93.00204 ft	0 psf	197.7276 psf	85.974406 psf	0 psf	0 psf	CCR
Column 113	305.07088 ft	92.31991 ft	0 psf	194.84809 psf	84.722359 psf	0 psf	0 psf	CCR
Column 114	307.22831 ft	91.63778 ft	0 psf	191.96857 psf	83.470312 psf	0 psf	0 psf	CCR
Column 115	309.38573 ft	90.95564 ft	0 psf	189.08906 psf	82.218264 psf	0 psf	0 psf	CCR
Column 116	311.54315 ft	90.27351 ft	0 psf	186.20955 psf	80.966217 psf	0 psf	0 psf	CCR
Column 117	313.70057 ft	89.59138 ft	0 psf	183.33004 psf	79.71417 psf	0 psf	0 psf	CCR
Column 118	315.85800 ft	88.90924 ft	0 psf	180.45053 psf	78.462122 psf	0 psf	0 psf	CCR
Column 119	318.01542 ft	88.22711 ft	0 psf	177.57102 psf	77.210075 psf	0 psf	0 psf	CCR
Column 120	320.17284 ft	87.54498 ft	0 psf	174.6915 psf	75.958028 psf	0 psf	0 psf	CCR
Column 121	322.33026 ft	86.86284 ft	0 psf	171.81199 psf	74.705981 psf	0 psf	0 psf	CCR
Column 122	324.48769 ft	86.18071 ft	0 psf	168.93248 psf	73.453933 psf	0 psf	0 psf	CCR
Column 123	326.64511 ft	85.49858 ft	0 psf	166.05297 psf	72.201886 psf	0 psf	0 psf	CCR
Column 124	328.77373 ft	84.83343 ft	0 psf	162.96735 psf	70.860218 psf	0 psf	0 psf	CCR
Column 125	330.87355 ft	84.18526 ft	0 psf	158.92995 psf	69.104708 psf	0 psf	0 psf	CCR
Column 126	332.97337 ft	83.53709 ft	0 psf	154.89255 psf	67.349198 psf	0 psf	0 psf	CCR
Column 127	335.07320 ft	82.88892 ft	0 psf	150.85516 psf	65.593688 psf	0 psf	0 psf	CCR
Column 128	337.17302 ft	82.24075 ft	0 psf	146.81776 psf	63.838178 psf	0 psf	0 psf	CCR
Column 129	339.27284 ft	81.59258 ft	0 psf	142.78036 psf	62.082668 psf	0 psf	0 psf	CCR
Column 130	341.37266 ft	80.94441 ft	0 psf	138.74297 psf	60.327158 psf	0 psf	0 psf	CCR
Column 131	343.47248 ft	80.29624 ft	0 psf	134.70557 psf	58.571648 psf	0 psf	0 psf	CCR
Column 132	345.57230 ft	79.64807 ft	0 psf	130.66817 psf	56.816138 psf	0 psf	0 psf	CCR
Column 133	347.67213 ft	78.99990 ft	0 psf	126.63078 psf	55.060628 psf	0 psf	0 psf	CCR
Column 134	349.77195 ft	78.35173 ft	0 psf	122.59338 psf	53.305118 psf	0 psf	0 psf	CCR
Column 135	351.87177 ft	77.70356 ft	0 psf	118.55598 psf	51.549608 psf	0 psf	0 psf	CCR
Column 136	353.98692 ft	77.06536 ft	0 psf	113.81717 psf	49.489113 psf	0 psf	0 psf	CCR
Column 137	356.11740 ft	76.43712 ft	0 psf	107.40211 psf	46.699767 psf	0 psf	0 psf	CCR

Column 138	358.24789 ft	75.80887 ft	0 psf	100.98706 psf	43.910421 psf	0 psf	0 psf	CCR
Column 139	360.37837 ft	75.18063 ft	0 psf	94.572 psf	41.121076 psf	0 psf	0 psf	CCR
Column 140	362.50885 ft	74.55239 ft	0 psf	88.156945 psf	38.33173 psf	0 psf	0 psf	CCR
Column 141	364.63933 ft	73.92414 ft	0 psf	81.741889 psf	35.542385 psf	0 psf	0 psf	CCR
Column 142	366.76981 ft	73.29590 ft	0 psf	75.326834 psf	32.753039 psf	0 psf	0 psf	CCR
Column 143	368.90030 ft	72.66765 ft	0 psf	68.911778 psf	29.963694 psf	0 psf	0 psf	CCR
Column 144	371.03078 ft	72.03941 ft	0 psf	62.496723 psf	27.174348 psf	0 psf	0 psf	CCR
Column 145	373.14453 ft	71.45006 ft	0 psf	54.002694 psf	23.48104 psf	0 psf	0 psf	CCR
Column 146	375.24156 ft	70.89961 ft	0 psf	42.253635 psf	18.372403 psf	0 psf	0 psf	CCR
Column 147	377.33859 ft	70.34916 ft	0 psf	30.504575 psf	13.263767 psf	0 psf	0 psf	CCR
Column 148	379.43562 ft	69.79871 ft	0 psf	18.755516 psf	8.1551303 psf	0 psf	0 psf	CCR
Column 149	381.54339 ft	69.24543 ft	0 psf	6.9462823 psf	3.0203295 psf	0 psf	0 psf	CCR
Column 150	382.69291 ft	68.94369 ft	0 psf	0.6589839 psf	0.38046453 psf	0 psf	0 psf	Drainage Layer

Title: Columbia Mod 12-13 Interim Conditions
Name: Block_FS=1.3
Method: Janbu
Last Edited By: Villanueva, Niko

F of S: 1.610
F of S Rank (Analysis): 1 of 234,256 slip surfaces
Last Solved Date: 8/2/2023, Last Solved Time: 3:33:10 PM

Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	CCR	Mohr-Coulomb	86	0	23.5
	Clay	Mohr-Coulomb	125	0	28
	Drainage Layer	Mohr-Coulomb	115	0	30
	Geosynthetics	Mohr-Coulomb	58	0	24.3
	Subbase	Mohr-Coulomb	120	0	30



Block_FS=1.3

File Information

File Version: 11.05
Title: Columbia Mod 12-13 Interim Conditions 3:1 Slope
Created By: Villanueva, Niko
Last Edited By: Gilkey, Keith
Revision Number: 27
Date: 08/07/2023
Time: 09:58:32 AM
Tool Version: 23.1.1.829
File Name: COL_Mod12-13_Interim Conditions.gsz
Directory: I:\25222260.00\Data and Calculations\Geotech Calculations\Slope Stability\SlopeW\
Last Solved Date: 08/28/2023
Last Solved Time: 01:23:04 PM

Project Settings

Unit System: U.S. Customary Units

Analysis Settings

Block_FS=1.3

Kind: SLOPE/W
Analysis Type: Janbu
Settings
- PWP Conditions from: (none)
- Unit Weight of Water: 62.4 pcf

Slip Surface
- Direction of movement: Left to Right
- Use Passive Mode: No
- Slip Surface Option: Block
- Critical slip surfaces saved: 10
- Restrict Block Crossing: No
- 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
  - Number of Columns: 150
- Factor of Safety Convergence Settings
  - Maximum Number of Iterations: 100
  - Tolerable difference in F of S: 0.001

Materials

CCR

Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 86 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 23.5 °
Phi-B: 0 °

Clay

Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 125 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 28 °
Phi-B: 0 °

Drainage Layer

Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 115 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 30 °
Phi-B: 0 °

Geosynthetics

Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 58 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 24.3 °
Phi-B: 0 °

Subbase

Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 120 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 30 °
Phi-B: 0 °

Slip Surface Limits

Left Coordinate: (0, 168.49196) ft
Right Coordinate: (519.45834, 68.88205) ft

Slip Surface Block

Left Grid
- Upper Left: (178, 51) ft
- Lower Left: (178, 49) ft
- Lower Right: (203, 48) ft
- X Increments: 10
- Y Increments: 10
- Starting Angle: 115 °
- Ending Angle: 135 °

Angle Increments: 3

Right Grid

Starting Angle: 0 °

Ending Angle: 45 °

Upper Left: (334, 53) ft

Lower Left: (335, 51) ft

Lower Right: (361, 59) ft

X Increments: 10

Y Increments: 10

Angle Increments: 3

Geometry

Name: Default Geometry

Settings

View: 2D

Element Thickness: 1 ft

Points

	X	Y
Point 1	0 ft	51.34809 ft
Point 2	200.19951 ft	47.31405 ft
Point 3	206.14741 ft	45.33145 ft
Point 4	212.095 ft	47.31198 ft
Point 5	334.29245 ft	49.73507 ft
Point 6	390.42013 ft	68.42378 ft
Point 7	390.59413 ft	68.42454 ft
Point 8	394.34772 ft	68.44017 ft
Point 9	401.75147 ft	66.62062 ft
Point 10	409.75552 ft	66.6544 ft
Point 11	417.15984 ft	68.53647 ft
Point 12	519.45834 ft	68.88205 ft
Point 13	519.45834 ft	0 ft
Point 14	0 ft	0 ft
Point 15	0 ft	54.44831 ft
Point 16	0 ft	53.44811 ft
Point 17	200.21671 ft	49.41372 ft
Point 18	206.14743 ft	47.43686 ft
Point 19	212.07782 ft	49.41166 ft
Point 20	334.27528 ft	51.83475 ft
Point 21	384.18447 ft	68.4529 ft
Point 22	382.60264 ft	68.98018 ft
Point 23	334.10353 ft	52.83154 ft
Point 24	211.90606 ft	50.40845 ft
Point 25	206.14759 ft	48.49089 ft
Point 26	200.38878 ft	50.41046 ft
Point 27	0 ft	53.34809 ft
Point 28	200.19951 ft	49.31405 ft
Point 29	206.14741 ft	47.33145 ft

Point 30	212.095 ft	49.31198 ft
Point 31	334.29245 ft	51.73507 ft
Point 32	384.34265 ft	68.40018 ft
Point 33	386.24265 ft	68.40557 ft
Point 34	386.24265 ft	67.50557 ft
Point 35	386.34265 ft	67.50557 ft
Point 36	386.34265 ft	68.40601 ft
Point 37	386.34265 ft	68.50557 ft
Point 38	384.34265 ft	68.50557 ft
Point 39	0 ft	168.49196 ft
Point 40	66.5815 ft	174.32056 ft
Point 41	58.24521 ft	174.28859 ft

Regions

	Material	Points	Area
Region 1	Subbase	1,2,3,4,5,6,7,8,9,10,11,12,13,14	28,504 ft²
Region 2	Drainage Layer	15,16,17,18,19,20,21,22,23,24,25,26	386.75 ft²
Region 3	Geosynthetics	16,27,28,29,30,31,32,33,34,35,36,37,38,21,20,19,18,17	39.07 ft²
Region 4	Clay	27,1,2,3,4,5,6,36,35,34,33,32,31,30,29,28	774.67 ft²
Region 5	CCR	39,15,26,25,24,23,22,40,41	29,542 ft²

Slip Results

Slip Surfaces Analysed: 175692 of 234256 converged

Current Slip Surface

Slip Surface: 218,739
Factor of Safety: 1.610
Volume: 14,659.824 ft³
Weight: 1,260,744.9 lbf
Resisting Moment: 71,899,110 lbf·ft
Activating Moment: 41,317,828 lbf·ft
Resisting Force: 510,914.88 lbf
Activating Force: 317,436.82 lbf
Slip Rank: 1 of 234,256 slip surfaces
Exit: (371.64688, 72.632102) ft
Entry: (59.506573, 174.29343) ft
Radius: 171.79774 ft
Center: (240.40937, 199.70876) ft

Slip Columns

	X	Y	PWP	Base Normal Stress	Frictional Strength	Cohesive Strength	Suction Strength	Base Material
Column 1	60.68573 ft	173.11427 ft	0 psf	80.15187 psf	34.851025 psf	0 psf	0 psf	CCR
Column 2	63.04404 ft	170.75596 ft	0 psf	240.45561 psf	104.55307 psf	0 psf	0 psf	CCR
Column 3	65.40235 ft	168.39765 ft	0 psf	400.75935 psf	174.25512 psf	0 psf	0 psf	CCR

Column 4	67.62095 ft	166.17905 ft	0 psf	527.83503 psf	229.5092 psf	0 psf	0 psf	CCR
Column 5	69.69985 ft	164.10015 ft	0 psf	621.68266 psf	270.31531 psf	0 psf	0 psf	CCR
Column 6	71.77875 ft	162.02125 ft	0 psf	715.53028 psf	311.12142 psf	0 psf	0 psf	CCR
Column 7	73.85766 ft	159.94234 ft	0 psf	809.37791 psf	351.92753 psf	0 psf	0 psf	CCR
Column 8	75.93656 ft	157.86344 ft	0 psf	903.22553 psf	392.73364 psf	0 psf	0 psf	CCR
Column 9	78.01546 ft	155.78454 ft	0 psf	997.07316 psf	433.53975 psf	0 psf	0 psf	CCR
Column 10	80.09436 ft	153.70564 ft	0 psf	1,090.9208 psf	474.34586 psf	0 psf	0 psf	CCR
Column 11	82.17326 ft	151.62674 ft	0 psf	1,184.7684 psf	515.15196 psf	0 psf	0 psf	CCR
Column 12	84.25217 ft	149.54783 ft	0 psf	1,278.616 psf	555.95807 psf	0 psf	0 psf	CCR
Column 13	86.33107 ft	147.46893 ft	0 psf	1,372.4637 psf	596.76418 psf	0 psf	0 psf	CCR
Column 14	88.40997 ft	145.39003 ft	0 psf	1,466.3113 psf	637.57029 psf	0 psf	0 psf	CCR
Column 15	90.48887 ft	143.31113 ft	0 psf	1,560.1589 psf	678.3764 psf	0 psf	0 psf	CCR
Column 16	92.56777 ft	141.23223 ft	0 psf	1,654.0065 psf	719.18251 psf	0 psf	0 psf	CCR
Column 17	94.64667 ft	139.15333 ft	0 psf	1,747.8542 psf	759.98862 psf	0 psf	0 psf	CCR
Column 18	96.72558 ft	137.07442 ft	0 psf	1,841.7018 psf	800.79472 psf	0 psf	0 psf	CCR
Column 19	98.80448 ft	134.99552 ft	0 psf	1,935.5494 psf	841.60083 psf	0 psf	0 psf	CCR
Column 20	100.88338 ft	132.91662 ft	0 psf	2,029.397 psf	882.40694 psf	0 psf	0 psf	CCR
Column 21	102.96228 ft	130.83772 ft	0 psf	2,123.2447 psf	923.21305 psf	0 psf	0 psf	CCR
Column 22	105.04118 ft	128.75882 ft	0 psf	2,217.0923 psf	964.01916 psf	0 psf	0 psf	CCR
Column 23	107.12008 ft	126.67992 ft	0 psf	2,310.9399 psf	1,004.8253 psf	0 psf	0 psf	CCR
Column 24	109.19899 ft	124.60101 ft	0 psf	2,404.7875 psf	1,045.6314 psf	0 psf	0 psf	CCR
Column 25	111.27789 ft	122.52211 ft	0 psf	2,498.6352 psf	1,086.4375 psf	0 psf	0 psf	CCR
Column 26	113.35679 ft	120.44321 ft	0 psf	2,592.4828 psf	1,127.2436 psf	0 psf	0 psf	CCR
Column 27	115.43569 ft	118.36431 ft	0 psf	2,686.3304 psf	1,168.0497 psf	0 psf	0 psf	CCR
Column 28	117.51459 ft	116.28541 ft	0 psf	2,780.178 psf	1,208.8558 psf	0 psf	0 psf	CCR
Column 29	119.59350 ft	114.20650 ft	0 psf	2,874.0257 psf	1,249.6619 psf	0 psf	0 psf	CCR

Column 30	121.67240 ft	112.12760 ft	0 psf	2,967.8733 psf	1,290.468 psf	0 psf	0 psf	CCR
Column 31	123.75130 ft	110.04870 ft	0 psf	3,061.7209 psf	1,331.2741 psf	0 psf	0 psf	CCR
Column 32	125.83020 ft	107.96980 ft	0 psf	3,155.5685 psf	1,372.0802 psf	0 psf	0 psf	CCR
Column 33	127.90910 ft	105.89090 ft	0 psf	3,249.4162 psf	1,412.8864 psf	0 psf	0 psf	CCR
Column 34	129.98800 ft	103.81200 ft	0 psf	3,343.2638 psf	1,453.6925 psf	0 psf	0 psf	CCR
Column 35	132.06691 ft	101.73309 ft	0 psf	3,437.1114 psf	1,494.4986 psf	0 psf	0 psf	CCR
Column 36	134.14581 ft	99.65419 ft	0 psf	3,530.959 psf	1,535.3047 psf	0 psf	0 psf	CCR
Column 37	136.22471 ft	97.57529 ft	0 psf	3,624.8067 psf	1,576.1108 psf	0 psf	0 psf	CCR
Column 38	138.30361 ft	95.49639 ft	0 psf	3,718.6543 psf	1,616.9169 psf	0 psf	0 psf	CCR
Column 39	140.38251 ft	93.41749 ft	0 psf	3,812.5019 psf	1,657.723 psf	0 psf	0 psf	CCR
Column 40	142.46142 ft	91.33858 ft	0 psf	3,906.3495 psf	1,698.5291 psf	0 psf	0 psf	CCR
Column 41	144.54032 ft	89.25968 ft	0 psf	4,000.1972 psf	1,739.3352 psf	0 psf	0 psf	CCR
Column 42	146.61922 ft	87.18078 ft	0 psf	4,094.0448 psf	1,780.1413 psf	0 psf	0 psf	CCR
Column 43	148.69812 ft	85.10188 ft	0 psf	4,187.8924 psf	1,820.9474 psf	0 psf	0 psf	CCR
Column 44	150.77702 ft	83.02298 ft	0 psf	4,281.74 psf	1,861.7535 psf	0 psf	0 psf	CCR
Column 45	152.85592 ft	80.94408 ft	0 psf	4,375.5876 psf	1,902.5597 psf	0 psf	0 psf	CCR
Column 46	154.93483 ft	78.86517 ft	0 psf	4,469.4353 psf	1,943.3658 psf	0 psf	0 psf	CCR
Column 47	157.01373 ft	76.78627 ft	0 psf	4,563.2829 psf	1,984.1719 psf	0 psf	0 psf	CCR
Column 48	159.09263 ft	74.70737 ft	0 psf	4,657.1305 psf	2,024.978 psf	0 psf	0 psf	CCR
Column 49	161.17153 ft	72.62847 ft	0 psf	4,750.9781 psf	2,065.7841 psf	0 psf	0 psf	CCR
Column 50	163.25043 ft	70.54957 ft	0 psf	4,844.8258 psf	2,106.5902 psf	0 psf	0 psf	CCR
Column 51	165.32933 ft	68.47067 ft	0 psf	4,938.6734 psf	2,147.3963 psf	0 psf	0 psf	CCR
Column 52	167.40824 ft	66.39176 ft	0 psf	5,032.521 psf	2,188.2024 psf	0 psf	0 psf	CCR
Column 53	169.48714 ft	64.31286 ft	0 psf	5,126.3686 psf	2,229.0085 psf	0 psf	0 psf	CCR
Column 54	171.56604 ft	62.23396 ft	0 psf	5,220.2163 psf	2,269.8146 psf	0 psf	0 psf	CCR
Column 55	173.64494 ft	60.15506 ft	0 psf	5,314.0639 psf	2,310.6207 psf	0 psf	0 psf	CCR

Column 56	175.72384 ft	58.07616 ft	0 psf	5,407.9115 psf	2,351.4269 psf	0 psf	0 psf	CCR
Column 57	177.80275 ft	55.99725 ft	0 psf	5,501.7591 psf	2,392.233 psf	0 psf	0 psf	CCR
Column 58	179.88165 ft	53.91835 ft	0 psf	5,595.6068 psf	2,433.0391 psf	0 psf	0 psf	CCR
Column 59	181.96055 ft	51.83945 ft	0 psf	5,689.4544 psf	2,473.8452 psf	0 psf	0 psf	CCR
Column 60	184.04474 ft	50.83026 ft	0 psf	7,310.068 psf	3,178.508 psf	0 psf	0 psf	CCR
Column 61	186.13421 ft	50.89079 ft	0 psf	7,244.4513 psf	3,149.9771 psf	0 psf	0 psf	CCR
Column 62	188.22368 ft	50.95132 ft	0 psf	7,178.8345 psf	3,121.4461 psf	0 psf	0 psf	CCR
Column 63	190.31316 ft	51.01184 ft	0 psf	7,113.2177 psf	3,092.9151 psf	0 psf	0 psf	CCR
Column 64	192.40263 ft	51.07237 ft	0 psf	7,047.6009 psf	3,064.3841 psf	0 psf	0 psf	CCR
Column 65	194.49211 ft	51.13289 ft	0 psf	6,981.9841 psf	3,035.8531 psf	0 psf	0 psf	CCR
Column 66	196.58158 ft	51.19342 ft	0 psf	6,916.3673 psf	3,007.3221 psf	0 psf	0 psf	CCR
Column 67	198.67105 ft	51.25395 ft	0 psf	6,850.7505 psf	2,978.7911 psf	0 psf	0 psf	CCR
Column 68	200.76053 ft	51.31447 ft	0 psf	6,785.1337 psf	2,950.2601 psf	0 psf	0 psf	CCR
Column 69	202.85000 ft	51.37500 ft	0 psf	6,719.517 psf	2,921.7291 psf	0 psf	0 psf	CCR
Column 70	204.93947 ft	51.43553 ft	0 psf	6,653.9002 psf	2,893.1981 psf	0 psf	0 psf	CCR
Column 71	207.02895 ft	51.49605 ft	0 psf	6,588.2834 psf	2,864.6671 psf	0 psf	0 psf	CCR
Column 72	209.11842 ft	51.55658 ft	0 psf	6,522.6666 psf	2,836.1362 psf	0 psf	0 psf	CCR
Column 73	211.20789 ft	51.61711 ft	0 psf	6,457.0498 psf	2,807.6052 psf	0 psf	0 psf	CCR
Column 74	213.29737 ft	51.67763 ft	0 psf	6,391.433 psf	2,779.0742 psf	0 psf	0 psf	CCR
Column 75	215.38684 ft	51.73816 ft	0 psf	6,325.8162 psf	2,750.5432 psf	0 psf	0 psf	CCR
Column 76	217.47632 ft	51.79868 ft	0 psf	6,260.1995 psf	2,722.0122 psf	0 psf	0 psf	CCR
Column 77	219.56579 ft	51.85921 ft	0 psf	6,194.5827 psf	2,693.4812 psf	0 psf	0 psf	CCR
Column 78	221.65526 ft	51.91974 ft	0 psf	6,128.9659 psf	2,664.9502 psf	0 psf	0 psf	CCR
Column 79	223.74474 ft	51.98026 ft	0 psf	6,063.3491 psf	2,636.4192 psf	0 psf	0 psf	CCR
Column 80	225.83421 ft	52.04079 ft	0 psf	5,997.7323 psf	2,607.8882 psf	0 psf	0 psf	CCR
Column 81	227.92368 ft	52.10132 ft	0 psf	5,932.1155 psf	2,579.3572 psf	0 psf	0 psf	CCR

Column 82	230.01316 ft	52.16184 ft	0 psf	5,866.4987 psf	2,550.8262 psf	0 psf	0 psf	CCR
Column 83	232.10263 ft	52.22237 ft	0 psf	5,800.8819 psf	2,522.2953 psf	0 psf	0 psf	CCR
Column 84	234.19211 ft	52.28289 ft	0 psf	5,735.2652 psf	2,493.7643 psf	0 psf	0 psf	CCR
Column 85	236.28158 ft	52.34342 ft	0 psf	5,669.6484 psf	2,465.2333 psf	0 psf	0 psf	CCR
Column 86	238.37105 ft	52.40395 ft	0 psf	5,604.0316 psf	2,436.7023 psf	0 psf	0 psf	CCR
Column 87	240.46053 ft	52.46447 ft	0 psf	5,538.4148 psf	2,408.1713 psf	0 psf	0 psf	CCR
Column 88	242.55000 ft	52.52500 ft	0 psf	5,472.798 psf	2,379.6403 psf	0 psf	0 psf	CCR
Column 89	244.63947 ft	52.58553 ft	0 psf	5,407.1812 psf	2,351.1093 psf	0 psf	0 psf	CCR
Column 90	246.72895 ft	52.64605 ft	0 psf	5,341.5644 psf	2,322.5783 psf	0 psf	0 psf	CCR
Column 91	248.81842 ft	52.70658 ft	0 psf	5,275.9477 psf	2,294.0473 psf	0 psf	0 psf	CCR
Column 92	250.90789 ft	52.76711 ft	0 psf	5,210.3309 psf	2,265.5163 psf	0 psf	0 psf	CCR
Column 93	252.99737 ft	52.82763 ft	0 psf	5,144.7141 psf	2,236.9853 psf	0 psf	0 psf	CCR
Column 94	255.08684 ft	52.88816 ft	0 psf	5,079.0973 psf	2,208.4544 psf	0 psf	0 psf	CCR
Column 95	257.17632 ft	52.94868 ft	0 psf	5,013.4805 psf	2,179.9234 psf	0 psf	0 psf	CCR
Column 96	259.26579 ft	53.00921 ft	0 psf	4,947.8637 psf	2,151.3924 psf	0 psf	0 psf	CCR
Column 97	261.35526 ft	53.06974 ft	0 psf	4,882.2469 psf	2,122.8614 psf	0 psf	0 psf	CCR
Column 98	263.44474 ft	53.13026 ft	0 psf	4,816.6301 psf	2,094.3304 psf	0 psf	0 psf	CCR
Column 99	265.53421 ft	53.19079 ft	0 psf	4,751.0134 psf	2,065.7994 psf	0 psf	0 psf	CCR
Column 100	267.62368 ft	53.25132 ft	0 psf	4,685.3966 psf	2,037.2684 psf	0 psf	0 psf	CCR
Column 101	269.71316 ft	53.31184 ft	0 psf	4,619.7798 psf	2,008.7374 psf	0 psf	0 psf	CCR
Column 102	271.80263 ft	53.37237 ft	0 psf	4,554.163 psf	1,980.2064 psf	0 psf	0 psf	CCR
Column 103	273.89211 ft	53.43289 ft	0 psf	4,488.5462 psf	1,951.6754 psf	0 psf	0 psf	CCR
Column 104	275.98158 ft	53.49342 ft	0 psf	4,422.9294 psf	1,923.1444 psf	0 psf	0 psf	CCR
Column 105	278.07105 ft	53.55395 ft	0 psf	4,357.3126 psf	1,894.6135 psf	0 psf	0 psf	CCR
Column 106	280.16053 ft	53.61447 ft	0 psf	4,291.6959 psf	1,866.0825 psf	0 psf	0 psf	CCR
Column 107	282.25000 ft	53.67500 ft	0 psf	4,226.0791 psf	1,837.5515 psf	0 psf	0 psf	CCR

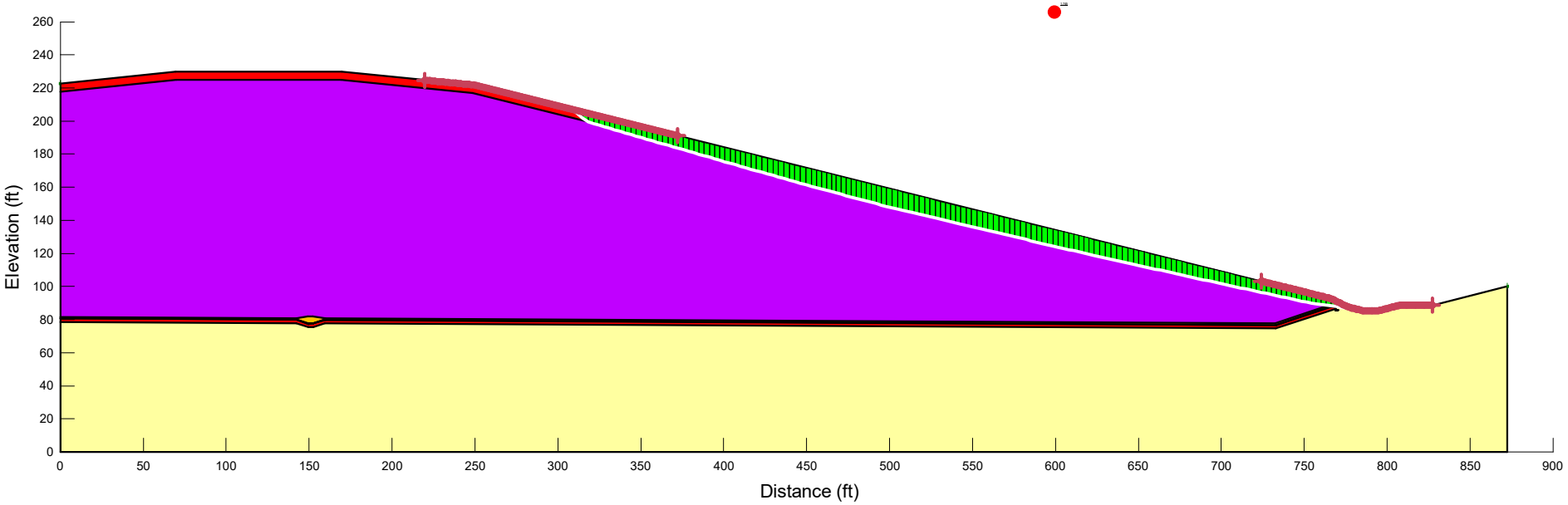
Column 108	284.33947 ft	53.73553 ft	0 psf	4,160.4623 psf	1,809.0205 psf	0 psf	0 psf	CCR
Column 109	286.42895 ft	53.79605 ft	0 psf	4,094.8455 psf	1,780.4895 psf	0 psf	0 psf	CCR
Column 110	288.51842 ft	53.85658 ft	0 psf	4,029.2287 psf	1,751.9585 psf	0 psf	0 psf	CCR
Column 111	290.60789 ft	53.91711 ft	0 psf	3,963.6119 psf	1,723.4275 psf	0 psf	0 psf	CCR
Column 112	292.69737 ft	53.97763 ft	0 psf	3,897.9951 psf	1,694.8965 psf	0 psf	0 psf	CCR
Column 113	294.78684 ft	54.03816 ft	0 psf	3,832.3783 psf	1,666.3655 psf	0 psf	0 psf	CCR
Column 114	296.87632 ft	54.09868 ft	0 psf	3,766.7616 psf	1,637.8345 psf	0 psf	0 psf	CCR
Column 115	298.96579 ft	54.15921 ft	0 psf	3,701.1448 psf	1,609.3035 psf	0 psf	0 psf	CCR
Column 116	301.05526 ft	54.21974 ft	0 psf	3,635.528 psf	1,580.7726 psf	0 psf	0 psf	CCR
Column 117	303.14474 ft	54.28026 ft	0 psf	3,569.9112 psf	1,552.2416 psf	0 psf	0 psf	CCR
Column 118	305.23421 ft	54.34079 ft	0 psf	3,504.2944 psf	1,523.7106 psf	0 psf	0 psf	CCR
Column 119	307.32368 ft	54.40132 ft	0 psf	3,438.6776 psf	1,495.1796 psf	0 psf	0 psf	CCR
Column 120	309.41316 ft	54.46184 ft	0 psf	3,373.0608 psf	1,466.6486 psf	0 psf	0 psf	CCR
Column 121	311.50263 ft	54.52237 ft	0 psf	3,307.444 psf	1,438.1176 psf	0 psf	0 psf	CCR
Column 122	313.59211 ft	54.58289 ft	0 psf	3,241.8273 psf	1,409.5866 psf	0 psf	0 psf	CCR
Column 123	315.68158 ft	54.64342 ft	0 psf	3,176.2105 psf	1,381.0556 psf	0 psf	0 psf	CCR
Column 124	317.77105 ft	54.70395 ft	0 psf	3,110.5937 psf	1,352.5246 psf	0 psf	0 psf	CCR
Column 125	319.86053 ft	54.76447 ft	0 psf	3,044.9769 psf	1,323.9936 psf	0 psf	0 psf	CCR
Column 126	321.95000 ft	54.82500 ft	0 psf	2,979.3601 psf	1,295.4626 psf	0 psf	0 psf	CCR
Column 127	324.03947 ft	54.88553 ft	0 psf	2,913.7433 psf	1,266.9317 psf	0 psf	0 psf	CCR
Column 128	326.12895 ft	54.94605 ft	0 psf	2,848.1265 psf	1,238.4007 psf	0 psf	0 psf	CCR
Column 129	328.21842 ft	55.00658 ft	0 psf	2,782.5098 psf	1,209.8697 psf	0 psf	0 psf	CCR
Column 130	330.30789 ft	55.06711 ft	0 psf	2,716.893 psf	1,181.3387 psf	0 psf	0 psf	CCR
Column 131	332.39737 ft	55.12763 ft	0 psf	2,651.2762 psf	1,152.8077 psf	0 psf	0 psf	CCR
Column 132	334.48684 ft	55.18816 ft	0 psf	2,585.6594 psf	1,124.2767 psf	0 psf	0 psf	CCR
Column 133	336.57632 ft	55.24868 ft	0 psf	2,520.0426 psf	1,095.7457 psf	0 psf	0 psf	CCR

Column 134	338.66579 ft	55.30921 ft	0 psf	2,454.4258 psf	1,067.2147 psf	0 psf	0 psf	CCR
Column 135	340.75526 ft	55.36974 ft	0 psf	2,388.809 psf	1,038.6837 psf	0 psf	0 psf	CCR
Column 136	342.86596 ft	56.01543 ft	0 psf	2,670.429 psf	1,161.1356 psf	0 psf	0 psf	CCR
Column 137	344.99788 ft	57.24630 ft	0 psf	2,472.6194 psf	1,075.1255 psf	0 psf	0 psf	CCR
Column 138	347.12980 ft	58.47716 ft	0 psf	2,274.8099 psf	989.11549 psf	0 psf	0 psf	CCR
Column 139	349.26172 ft	59.70803 ft	0 psf	2,077.0003 psf	903.10544 psf	0 psf	0 psf	CCR
Column 140	351.39364 ft	60.93889 ft	0 psf	1,879.1908 psf	817.0954 psf	0 psf	0 psf	CCR
Column 141	353.52556 ft	62.16975 ft	0 psf	1,681.3812 psf	731.08536 psf	0 psf	0 psf	CCR
Column 142	355.65748 ft	63.40062 ft	0 psf	1,483.5717 psf	645.07532 psf	0 psf	0 psf	CCR
Column 143	357.78940 ft	64.63148 ft	0 psf	1,285.7621 psf	559.06528 psf	0 psf	0 psf	CCR
Column 144	359.92132 ft	65.86235 ft	0 psf	1,087.9526 psf	473.05523 psf	0 psf	0 psf	CCR
Column 145	362.05324 ft	67.09321 ft	0 psf	890.143 psf	387.04519 psf	0 psf	0 psf	CCR
Column 146	364.18516 ft	68.32408 ft	0 psf	692.33344 psf	301.03515 psf	0 psf	0 psf	CCR
Column 147	366.31708 ft	69.55494 ft	0 psf	494.52389 psf	215.02511 psf	0 psf	0 psf	CCR
Column 148	368.44900 ft	70.78580 ft	0 psf	296.71433 psf	129.01506 psf	0 psf	0 psf	CCR
Column 149	370.58092 ft	72.01667 ft	0 psf	98.904777 psf	43.005021 psf	0 psf	0 psf	CCR

Title: Columbia Mod 12-13 Full Buildout
Name: Optimized Circular_FS=1.5
Method: Bishop
Last Edited By: Villanueva, Niko

F of S: 1.745
F of S Rank (Analysis): 1 of 51,006 slip surfaces
Last Solved Date: 08/30/2023, Last Solved Time: 07:35:34 AM

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	CCR	Mohr-Coulomb	86	0	23.5
	Clay	Mohr-Coulomb	125	0	28
	Drainage Layer	Mohr-Coulomb	115	0	30
	Geosynthetics	Mohr-Coulomb	58	0	24.3
	Subbase	Mohr-Coulomb	120	0	30



Optimized Circular_FS=1.5

File Information

File Version: 11.05
Title: Columbia Mod 12-13 Full Buildout
Created By: Villanueva, Niko
Last Edited By: Villanueva, Niko
Revision Number: 56
Date: 08/30/2023
Time: 07:34:03 AM
Tool Version: 23.1.1.829
File Name: COL_Mod12-13_Full Buildout.gsz
Directory: I:\25222260.00\Data and Calculations\Geotech Calculations\Slope Stability\SlopeW\
Last Solved Date: 08/30/2023
Last Solved Time: 07:35:34 AM

Project Settings

Unit System: U.S. Customary Units

Analysis Settings

Optimized Circular_FS=1.5

Kind: SLOPE/W
Analysis Type: Bishop
Settings
- PWP Conditions from: (none)
- Unit Weight of Water: 62.4 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: Yes
- Optimizations Settings
  - Maximum Iterations: 2,000
  - Starting Points: 8
  - Ending Points: 16
  - Driving Side Maximum Convex Angle: 5 °
  - Resisting Side Maximum Convex Angle: 1 °
- Tension Crack Option: (none)

Distribution
- F of S Calculation Option: Constant

Convergence
- Geometry Settings
  - Minimum Slip Surface Depth: 0.1 ft
  - Number of Columns: 150
- Factor of Safety Convergence Settings
  - Maximum Number of Iterations: 30,000
  - Tolerable difference in F of S: 0.001

Materials

CCR

Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 86 pcf
Effective Cohesion: 0 psf

Effective Friction Angle: 23.5 °
Phi-B: 0 °

Clay
Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 125 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 28 °
Phi-B: 0 °

Drainage Layer
Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 115 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 30 °
Phi-B: 0 °

Geosynthetics
Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 58 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 24.3 °
Phi-B: 0 °

Subbase
Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 120 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 30 °
Phi-B: 0 °

Slip Surface Entry and Exit
Left Type: Range
Left-Zone Left Coordinate: (219.68881, 224.73412) ft
Left-Zone Right Coordinate: (372.17498, 191.11662) ft
Left-Zone Increment: 100
Right Type: Range
Right-Zone Left Coordinate: (723.92456, 103.25913) ft
Right-Zone Right Coordinate: (827.14488, 88.78332) ft
Right-Zone Increment: 100
Radius Increments: 4

Slip Surface Limits
Left Coordinate: (0, 222.8) ft
Right Coordinate: (872.23081, 100) ft

Geometry
Name: Default Geometry

Settings
View: 2D
Element Thickness: 1 ft

Points

	X	Y
Point 1	768.91041 ft	87.74349 ft
Point 2	766.02664 ft	87.74317 ft
Point 3	732.66754 ft	76.62354 ft
Point 4	159.35647 ft	79.79909 ft

Point 5	152.46501 ft	77.58553 ft
Point 6	149.45787 ft	77.54639 ft
Point 7	142.29499 ft	79.95559 ft
Point 8	0 ft	80.72488 ft
Point 9	0 ft	78.63599 ft
Point 10	142.29493 ft	77.86789 ft
Point 11	149.45787 ft	75.41847 ft
Point 12	152.46501 ft	75.45626 ft
Point 13	159.35619 ft	77.75007 ft
Point 14	732.66724 ft	74.58984 ft
Point 15	768.91041 ft	86.64701 ft
Point 16	872.23081 ft	100 ft
Point 17	828.17946 ft	88.78332 ft
Point 18	808.17769 ft	88.78332 ft
Point 19	794.02935 ft	85.24543 ft
Point 20	786.03116 ft	85.24543 ft
Point 21	776.0289 ft	87.7443 ft
Point 22	769.01095 ft	87.8435 ft
Point 23	769.01041 ft	85.84317 ft
Point 24	770.01041 ft	85.84317 ft
Point 25	770.01041 ft	85.74351 ft
Point 26	768.91041 ft	85.74351 ft
Point 27	0 ft	0 ft
Point 28	872.23081 ft	0 ft
Point 29	764.03814 ft	88.23984 ft
Point 30	732.49201 ft	77.72453 ft
Point 31	159.6047 ft	80.8285 ft
Point 32	152.35619 ft	82.00202 ft
Point 33	148.97182 ft	82.00419 ft
Point 34	142.29493 ft	80.97938 ft
Point 35	0 ft	81.74787 ft
Point 36	0 ft	80.82487 ft
Point 37	142.31162 ft	80.0555 ft
Point 38	149.47361 ft	77.64661 ft
Point 39	152.44871 ft	77.68532 ft
Point 40	159.34108 ft	79.89918 ft
Point 41	732.65158 ft	76.72363 ft
Point 42	766.01041 ft	87.84317 ft
Point 43	249.53 ft	221.75 ft
Point 44	169.53 ft	229.75 ft
Point 45	69.53 ft	229.75 ft
Point 46	0 ft	222.8 ft
Point 47	0 ft	217.82 ft
Point 48	69.78 ft	224.75 ft
Point 49	169.28 ft	224.75 ft
Point 50	248.67 ft	216.81 ft
Point 51	769.01041 ft	87.84351 ft
Point 52	766.02664 ft	92.74317 ft
Point 53	766.02718 ft	87.74317 ft
Point 54	768.91095 ft	87.74349 ft
Point 55	768.91095 ft	85.7435 ft
Point 56	770.01095 ft	85.7435 ft
Point 57	770.01095 ft	85.84316 ft
Point 58	769.01095 ft	85.84316 ft
Point 59	766.01095 ft	87.84316 ft
Point 60	732.65213 ft	76.72363 ft
Point 61	159.34162 ft	79.89918 ft
Point 62	152.44925 ft	77.68532 ft

Point 63	149.47415 ft	77.6466 ft
Point 64	142.31216 ft	80.0555 ft
Point 65	142.29553 ft	79.95558 ft
Point 66	149.45841 ft	77.54639 ft
Point 67	152.46555 ft	77.58552 ft
Point 68	159.35701 ft	79.79909 ft
Point 69	732.66808 ft	76.62354 ft
Point 70	768.91095 ft	85.74351 ft
Point 71	770.01041 ft	85.84316 ft
Point 72	769.01095 ft	85.84317 ft
Point 73	732.65159 ft	76.72363 ft
Point 74	159.34161 ft	79.89918 ft
Point 75	149.4741 ft	77.64662 ft
Point 76	142.29501 ft	79.95558 ft
Point 77	149.45839 ft	77.5464 ft
Point 78	159.357 ft	79.79909 ft
Point 79	732.66755 ft	76.62354 ft

Regions

	Material	Points	Area
Region 1	Clay	1,53,69,79,3,68,78,67,66,77,6,76,8,9,10,11,12,13,14,15	1,576.1 ft²
Region 2	Subbase	16,17,18,19,20,21,22,72,24,71,57,56,55,70,26,15,14,13,12,11,10,9,27,28	68,366 ft²
Region 3	Drainage Layer	29,30,31,32,33,34,35,36,37,64,75,39,40,74,61,41,73,42	769.27 ft²
Region 4	Clay	43,44,45,46,47,48,49,50,29,42,51,22,21,52	3,896.4 ft²
Region 5	CCR	50,49,48,47,35,34,33,32,31,30,29	72,914 ft²
Region 6	Geosynthetics	53,1,54,70,55,56,57,71,58,72,22,59,60,73,41,61,74,62,63,75,64,37,36,8,76,65,77,66,67,78,68,3,79,69	77.457 ft²

Slip Results

Slip Surfaces Analysed: 39342 of 51006 converged

Current Slip Surface

Slip Surface: 51,006
Factor of Safety: 1.745
Volume: 4,009.1179 ft³
Weight: 435,365.84 lbf
Resisting Moment: 6.698018e+08 lbf·ft
Activating Moment: 3.8392957e+08 lbf·ft
Resisting Force: 179,103.91 lbf
Activating Force: 102,795.44 lbf
Slip Rank: 1 of 51,006 slip surfaces
Exit: (785.97288, 85.259989) ft
Entry: (308.50283, 207.02019) ft
Radius: 210.34059 ft
Center: (1,393.2702, 3,660.481) ft

Slip Columns

	X	Y	PWP	Base Normal Stress	Frictional Strength	Cohesive Strength	Suction Strength	Base Material
Column 1	310.14171 ft	205.75520 ft	0 psf	86.593136 psf	46.042387 psf	0 psf	0 psf	Clay
Column 2	313.41948 ft	203.22520 ft	0 psf	259.77941 psf	138.12716 psf	0 psf	0 psf	Clay

Column 3	316.70451 ft	200.68961 ft	0 psf	433.34934 psf	230.41593 psf	0 psf	0 psf	Clay
Column 4	319.95630 ft	198.94705 ft	0 psf	604.21909 psf	262.72194 psf	0 psf	0 psf	CCR
Column 5	323.16761 ft	198.00312 ft	0 psf	615.54908 psf	267.64836 psf	0 psf	0 psf	CCR
Column 6	326.37891 ft	197.05920 ft	0 psf	626.87907 psf	272.57478 psf	0 psf	0 psf	CCR
Column 7	329.59021 ft	196.11527 ft	0 psf	638.20907 psf	277.5012 psf	0 psf	0 psf	CCR
Column 8	332.80152 ft	195.17134 ft	0 psf	649.53906 psf	282.42762 psf	0 psf	0 psf	CCR
Column 9	336.01282 ft	194.22742 ft	0 psf	660.86906 psf	287.35404 psf	0 psf	0 psf	CCR
Column 10	339.22413 ft	193.28349 ft	0 psf	672.19905 psf	292.28046 psf	0 psf	0 psf	CCR
Column 11	342.43543 ft	192.33957 ft	0 psf	683.52904 psf	297.20689 psf	0 psf	0 psf	CCR
Column 12	345.64674 ft	191.39564 ft	0 psf	694.85904 psf	302.13331 psf	0 psf	0 psf	CCR
Column 13	348.85804 ft	190.45171 ft	0 psf	706.18903 psf	307.05973 psf	0 psf	0 psf	CCR
Column 14	352.06934 ft	189.50779 ft	0 psf	717.51902 psf	311.98615 psf	0 psf	0 psf	CCR
Column 15	355.28065 ft	188.56386 ft	0 psf	728.84902 psf	316.91257 psf	0 psf	0 psf	CCR
Column 16	358.45208 ft	187.63799 ft	0 psf	740.22605 psf	321.85945 psf	0 psf	0 psf	CCR
Column 17	361.58365 ft	186.73018 ft	0 psf	750.2683 psf	326.22594 psf	0 psf	0 psf	CCR
Column 18	364.71522 ft	185.82237 ft	0 psf	760.31055 psf	330.59243 psf	0 psf	0 psf	CCR
Column 19	367.84679 ft	184.91456 ft	0 psf	770.3528 psf	334.95893 psf	0 psf	0 psf	CCR
Column 20	370.97836 ft	184.00675 ft	0 psf	780.39504 psf	339.32542 psf	0 psf	0 psf	CCR
Column 21	374.10993 ft	183.09894 ft	0 psf	790.43729 psf	343.69192 psf	0 psf	0 psf	CCR
Column 22	377.24149 ft	182.19113 ft	0 psf	800.47954 psf	348.05841 psf	0 psf	0 psf	CCR
Column 23	380.37306 ft	181.28332 ft	0 psf	810.52179 psf	352.4249 psf	0 psf	0 psf	CCR
Column 24	383.50463 ft	180.37551 ft	0 psf	820.56404 psf	356.7914 psf	0 psf	0 psf	CCR
Column 25	386.63620 ft	179.46769 ft	0 psf	830.60629 psf	361.15789 psf	0 psf	0 psf	CCR
Column 26	389.76777 ft	178.55988 ft	0 psf	840.64854 psf	365.52439 psf	0 psf	0 psf	CCR
Column 27	392.89934 ft	177.65207 ft	0 psf	850.69079 psf	369.89088 psf	0 psf	0 psf	CCR
Column 28	396.03091 ft	176.74426 ft	0 psf	860.73303 psf	374.25737 psf	0 psf	0 psf	CCR
Column 29	399.16247 ft	175.83645 ft	0 psf	870.77528 psf	378.62387 psf	0 psf	0 psf	CCR
Column 30	402.29404 ft	174.92864 ft	0 psf	880.81753 psf	382.99036 psf	0 psf	0 psf	CCR
Column 31	405.42561 ft	174.02083 ft	0 psf	890.85978 psf	387.35686 psf	0 psf	0 psf	CCR
Column 32	408.55718 ft	173.11302 ft	0 psf	900.90203 psf	391.72335 psf	0 psf	0 psf	CCR
Column 33	411.68875 ft	172.20521 ft	0 psf	910.94428 psf	396.08985 psf	0 psf	0 psf	CCR

Column 34	414.82032 ft	171.29740 ft	0 psf	920.98653 psf	400.45634 psf	0 psf	0 psf	CCR
Column 35	418.04195 ft	170.37935 ft	0 psf	932.12055 psf	405.29755 psf	0 psf	0 psf	CCR
Column 36	421.35365 ft	169.45106 ft	0 psf	940.21248 psf	408.81602 psf	0 psf	0 psf	CCR
Column 37	424.66535 ft	168.52277 ft	0 psf	948.30441 psf	412.33449 psf	0 psf	0 psf	CCR
Column 38	427.97705 ft	167.59449 ft	0 psf	956.39634 psf	415.85296 psf	0 psf	0 psf	CCR
Column 39	431.28875 ft	166.66620 ft	0 psf	964.48827 psf	419.37143 psf	0 psf	0 psf	CCR
Column 40	434.60045 ft	165.73791 ft	0 psf	972.5802 psf	422.88991 psf	0 psf	0 psf	CCR
Column 41	437.91214 ft	164.80963 ft	0 psf	980.67213 psf	426.40838 psf	0 psf	0 psf	CCR
Column 42	441.22384 ft	163.88134 ft	0 psf	988.76406 psf	429.92685 psf	0 psf	0 psf	CCR
Column 43	444.53554 ft	162.95305 ft	0 psf	996.85599 psf	433.44532 psf	0 psf	0 psf	CCR
Column 44	447.84724 ft	162.02477 ft	0 psf	1,004.9479 psf	436.96379 psf	0 psf	0 psf	CCR
Column 45	451.15894 ft	161.09648 ft	0 psf	1,013.0398 psf	440.48226 psf	0 psf	0 psf	CCR
Column 46	454.47064 ft	160.16819 ft	0 psf	1,021.1318 psf	444.00073 psf	0 psf	0 psf	CCR
Column 47	457.59438 ft	159.30603 ft	0 psf	1,029.8793 psf	447.80426 psf	0 psf	0 psf	CCR
Column 48	460.53016 ft	158.50997 ft	0 psf	1,034.9039 psf	449.98902 psf	0 psf	0 psf	CCR
Column 49	463.46594 ft	157.71392 ft	0 psf	1,039.9285 psf	452.17378 psf	0 psf	0 psf	CCR
Column 50	466.40171 ft	156.91788 ft	0 psf	1,044.9531 psf	454.35853 psf	0 psf	0 psf	CCR
Column 51	469.33749 ft	156.12183 ft	0 psf	1,049.9777 psf	456.54329 psf	0 psf	0 psf	CCR
Column 52	472.31393 ft	155.31721 ft	0 psf	1,055.2757 psf	458.84693 psf	0 psf	0 psf	CCR
Column 53	475.33104 ft	154.50404 ft	0 psf	1,060.0442 psf	460.92034 psf	0 psf	0 psf	CCR
Column 54	478.34815 ft	153.69087 ft	0 psf	1,064.8127 psf	462.99375 psf	0 psf	0 psf	CCR
Column 55	481.36526 ft	152.87769 ft	0 psf	1,069.5812 psf	465.06716 psf	0 psf	0 psf	CCR
Column 56	484.38237 ft	152.06452 ft	0 psf	1,074.3497 psf	467.14056 psf	0 psf	0 psf	CCR
Column 57	487.39948 ft	151.25134 ft	0 psf	1,079.1182 psf	469.21397 psf	0 psf	0 psf	CCR
Column 58	490.41659 ft	150.43817 ft	0 psf	1,083.8868 psf	471.28738 psf	0 psf	0 psf	CCR
Column 59	493.43370 ft	149.62500 ft	0 psf	1,088.6553 psf	473.36078 psf	0 psf	0 psf	CCR
Column 60	496.57821 ft	148.82414 ft	0 psf	1,097.1704 psf	477.06329 psf	0 psf	0 psf	CCR
Column 61	499.85012 ft	148.03561 ft	0 psf	1,094.8056 psf	476.03503 psf	0 psf	0 psf	CCR
Column 62	503.12204 ft	147.24708 ft	0 psf	1,092.4408 psf	475.00677 psf	0 psf	0 psf	CCR
Column 63	506.39395 ft	146.45855 ft	0 psf	1,090.0759 psf	473.9785 psf	0 psf	0 psf	CCR
Column 64	509.66587 ft	145.67002 ft	0 psf	1,087.7111 psf	472.95024 psf	0 psf	0 psf	CCR

Column 65	512.93778 ft	144.88148 ft	0 psf	1,085.3463 psf	471.92198 psf	0 psf	0 psf	CCR
Column 66	516.20970 ft	144.09295 ft	0 psf	1,082.9814 psf	470.89372 psf	0 psf	0 psf	CCR
Column 67	519.48161 ft	143.30442 ft	0 psf	1,080.6166 psf	469.86546 psf	0 psf	0 psf	CCR
Column 68	522.75353 ft	142.51589 ft	0 psf	1,078.2517 psf	468.8372 psf	0 psf	0 psf	CCR
Column 69	526.02544 ft	141.72736 ft	0 psf	1,075.8869 psf	467.80894 psf	0 psf	0 psf	CCR
Column 70	529.18802 ft	140.96820 ft	0 psf	1,073.8558 psf	466.9258 psf	0 psf	0 psf	CCR
Column 71	532.24125 ft	140.23842 ft	0 psf	1,071.1569 psf	465.75226 psf	0 psf	0 psf	CCR
Column 72	535.29448 ft	139.50865 ft	0 psf	1,068.4579 psf	464.57871 psf	0 psf	0 psf	CCR
Column 73	538.34771 ft	138.77887 ft	0 psf	1,065.7589 psf	463.40516 psf	0 psf	0 psf	CCR
Column 74	541.40094 ft	138.04909 ft	0 psf	1,063.0599 psf	462.23161 psf	0 psf	0 psf	CCR
Column 75	544.55978 ft	137.29768 ft	0 psf	1,060.5259 psf	461.1298 psf	0 psf	0 psf	CCR
Column 76	547.82423 ft	136.52463 ft	0 psf	1,057.0528 psf	459.61963 psf	0 psf	0 psf	CCR
Column 77	551.08868 ft	135.75158 ft	0 psf	1,053.5796 psf	458.10945 psf	0 psf	0 psf	CCR
Column 78	554.35313 ft	134.97854 ft	0 psf	1,050.1064 psf	456.59927 psf	0 psf	0 psf	CCR
Column 79	557.61758 ft	134.20549 ft	0 psf	1,046.6333 psf	455.08909 psf	0 psf	0 psf	CCR
Column 80	560.88203 ft	133.43244 ft	0 psf	1,043.1601 psf	453.57892 psf	0 psf	0 psf	CCR
Column 81	564.14647 ft	132.65940 ft	0 psf	1,039.6869 psf	452.06874 psf	0 psf	0 psf	CCR
Column 82	567.41092 ft	131.88635 ft	0 psf	1,036.2138 psf	450.55856 psf	0 psf	0 psf	CCR
Column 83	570.67537 ft	131.11330 ft	0 psf	1,032.7406 psf	449.04839 psf	0 psf	0 psf	CCR
Column 84	573.93982 ft	130.34026 ft	0 psf	1,029.2674 psf	447.53821 psf	0 psf	0 psf	CCR
Column 85	577.20427 ft	129.56721 ft	0 psf	1,025.7942 psf	446.02803 psf	0 psf	0 psf	CCR
Column 86	580.46872 ft	128.79416 ft	0 psf	1,022.3211 psf	444.51785 psf	0 psf	0 psf	CCR
Column 87	583.73317 ft	128.02111 ft	0 psf	1,018.8479 psf	443.00768 psf	0 psf	0 psf	CCR
Column 88	586.99761 ft	127.24807 ft	0 psf	1,015.3747 psf	441.4975 psf	0 psf	0 psf	CCR
Column 89	590.26206 ft	126.47502 ft	0 psf	1,011.9016 psf	439.98732 psf	0 psf	0 psf	CCR
Column 90	593.52651 ft	125.70197 ft	0 psf	1,008.4284 psf	438.47714 psf	0 psf	0 psf	CCR
Column 91	596.79096 ft	124.92893 ft	0 psf	1,004.9552 psf	436.96697 psf	0 psf	0 psf	CCR
Column 92	600.05541 ft	124.15588 ft	0 psf	1,001.482 psf	435.45679 psf	0 psf	0 psf	CCR
Column 93	603.31986 ft	123.38283 ft	0 psf	998.00888 psf	433.94661 psf	0 psf	0 psf	CCR
Column 94	606.47852 ft	122.65026 ft	0 psf	995.76287 psf	432.97002 psf	0 psf	0 psf	CCR
Column 95	609.53141 ft	121.95816 ft	0 psf	989.99576 psf	430.46241 psf	0 psf	0 psf	CCR

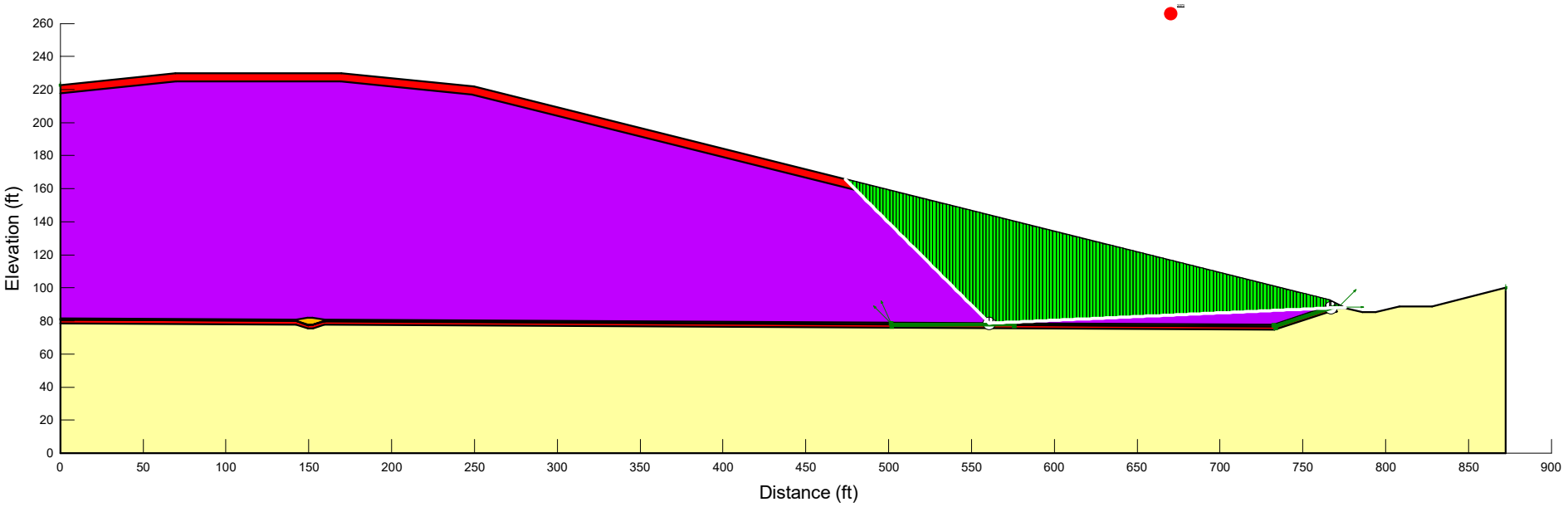
Column 96	612.58429 ft	121.26607 ft	0 psf	984.22865 psf	427.9548 psf	0 psf	0 psf	CCR
Column 97	615.63718 ft	120.57397 ft	0 psf	978.46154 psf	425.44719 psf	0 psf	0 psf	CCR
Column 98	618.69006 ft	119.88187 ft	0 psf	972.69443 psf	422.93958 psf	0 psf	0 psf	CCR
Column 99	621.74295 ft	119.18978 ft	0 psf	966.92732 psf	420.43197 psf	0 psf	0 psf	CCR
Column 100	624.98277 ft	118.45139 ft	0 psf	960.6082 psf	417.68433 psf	0 psf	0 psf	CCR
Column 101	628.40952 ft	117.66671 ft	0 psf	954.77523 psf	415.14809 psf	0 psf	0 psf	CCR
Column 102	631.83627 ft	116.88203 ft	0 psf	948.94226 psf	412.61184 psf	0 psf	0 psf	CCR
Column 103	635.26302 ft	116.09734 ft	0 psf	943.1093 psf	410.07559 psf	0 psf	0 psf	CCR
Column 104	638.68977 ft	115.31266 ft	0 psf	937.27633 psf	407.53935 psf	0 psf	0 psf	CCR
Column 105	642.11652 ft	114.52798 ft	0 psf	931.44336 psf	405.0031 psf	0 psf	0 psf	CCR
Column 106	645.45015 ft	113.77637 ft	0 psf	926.39638 psf	402.80861 psf	0 psf	0 psf	CCR
Column 107	648.69066 ft	113.05784 ft	0 psf	918.95572 psf	399.57332 psf	0 psf	0 psf	CCR
Column 108	651.93117 ft	112.33931 ft	0 psf	911.51506 psf	396.33803 psf	0 psf	0 psf	CCR
Column 109	655.17168 ft	111.62077 ft	0 psf	904.0744 psf	393.10274 psf	0 psf	0 psf	CCR
Column 110	658.41218 ft	110.90224 ft	0 psf	896.63374 psf	389.86745 psf	0 psf	0 psf	CCR
Column 111	661.65269 ft	110.18371 ft	0 psf	889.19308 psf	386.63216 psf	0 psf	0 psf	CCR
Column 112	664.89320 ft	109.46517 ft	0 psf	881.75242 psf	383.39687 psf	0 psf	0 psf	CCR
Column 113	668.13371 ft	108.74664 ft	0 psf	874.31176 psf	380.16157 psf	0 psf	0 psf	CCR
Column 114	671.37421 ft	108.02811 ft	0 psf	866.87111 psf	376.92628 psf	0 psf	0 psf	CCR
Column 115	674.61472 ft	107.30957 ft	0 psf	859.43045 psf	373.69099 psf	0 psf	0 psf	CCR
Column 116	677.85523 ft	106.59104 ft	0 psf	851.98979 psf	370.4557 psf	0 psf	0 psf	CCR
Column 117	681.09574 ft	105.87251 ft	0 psf	844.54913 psf	367.22041 psf	0 psf	0 psf	CCR
Column 118	684.32338 ft	105.16099 ft	0 psf	837.31073 psf	364.07307 psf	0 psf	0 psf	CCR
Column 119	687.53817 ft	104.45649 ft	0 psf	829.24559 psf	360.56625 psf	0 psf	0 psf	CCR
Column 120	690.75295 ft	103.75198 ft	0 psf	821.18046 psf	357.05942 psf	0 psf	0 psf	CCR
Column 121	693.96773 ft	103.04748 ft	0 psf	813.11532 psf	353.5526 psf	0 psf	0 psf	CCR
Column 122	697.18252 ft	102.34298 ft	0 psf	805.05019 psf	350.04578 psf	0 psf	0 psf	CCR
Column 123	700.39730 ft	101.63847 ft	0 psf	796.98505 psf	346.53896 psf	0 psf	0 psf	CCR
Column 124	703.61208 ft	100.93397 ft	0 psf	788.91991 psf	343.03214 psf	0 psf	0 psf	CCR
Column 125	706.82687 ft	100.22947 ft	0 psf	780.85478 psf	339.52532 psf	0 psf	0 psf	CCR
Column 126	710.04165 ft	99.52497 ft	0 psf	772.78964 psf	336.0185 psf	0 psf	0 psf	CCR

Column 127	713.25643 ft	98.82046 ft	0 psf	764.72451 psf	332.51168 psf	0 psf	0 psf	CCR
Column 128	716.47122 ft	98.11596 ft	0 psf	756.65937 psf	329.00486 psf	0 psf	0 psf	CCR
Column 129	719.59880 ft	97.43481 ft	0 psf	748.96071 psf	325.65738 psf	0 psf	0 psf	CCR
Column 130	722.63918 ft	96.77700 ft	0 psf	740.6362 psf	322.03779 psf	0 psf	0 psf	CCR
Column 131	725.67956 ft	96.11920 ft	0 psf	732.31169 psf	318.41819 psf	0 psf	0 psf	CCR
Column 132	728.71994 ft	95.46139 ft	0 psf	723.98719 psf	314.79859 psf	0 psf	0 psf	CCR
Column 133	731.76032 ft	94.80359 ft	0 psf	715.66268 psf	311.17899 psf	0 psf	0 psf	CCR
Column 134	734.80070 ft	94.14579 ft	0 psf	707.33817 psf	307.55939 psf	0 psf	0 psf	CCR
Column 135	737.84109 ft	93.48798 ft	0 psf	699.01366 psf	303.93979 psf	0 psf	0 psf	CCR
Column 136	740.88147 ft	92.83018 ft	0 psf	690.68915 psf	300.32019 psf	0 psf	0 psf	CCR
Column 137	743.92185 ft	92.17237 ft	0 psf	682.36465 psf	296.70059 psf	0 psf	0 psf	CCR
Column 138	746.96223 ft	91.51457 ft	0 psf	674.04014 psf	293.08099 psf	0 psf	0 psf	CCR
Column 139	750.00261 ft	90.85676 ft	0 psf	665.71563 psf	289.46139 psf	0 psf	0 psf	CCR
Column 140	752.96270 ft	90.30768 ft	0 psf	660.0558 psf	287.00043 psf	0 psf	0 psf	CCR
Column 141	755.84249 ft	89.86732 ft	0 psf	636.91515 psf	276.93859 psf	0 psf	0 psf	CCR
Column 142	758.72228 ft	89.42696 ft	0 psf	613.7745 psf	266.87675 psf	0 psf	0 psf	CCR
Column 143	761.62830 ft	88.98260 ft	0 psf	580.35843 psf	308.58205 psf	0 psf	0 psf	Clay
Column 144	764.56053 ft	88.53422 ft	0 psf	546.43685 psf	290.54563 psf	0 psf	0 psf	Clay
Column 145	767.55552 ft	88.07625 ft	0 psf	466.13834 psf	247.85015 psf	0 psf	0 psf	Clay
Column 146	770.82052 ft	87.57699 ft	0 psf	328.47082 psf	189.64272 psf	0 psf	0 psf	Subbase
Column 147	774.29277 ft	87.04603 ft	0 psf	182.87759 psf	105.58442 psf	0 psf	0 psf	Subbase
Column 148	777.68623 ft	86.52713 ft	0 psf	91.734141 psf	52.962731 psf	0 psf	0 psf	Subbase
Column 149	781.00089 ft	86.02027 ft	0 psf	55.040484 psf	31.777639 psf	0 psf	0 psf	Subbase
Column 150	784.31555 ft	85.51342 ft	0 psf	18.346828 psf	10.592546 psf	0 psf	0 psf	Subbase

Title: Columbia Mod 12-13 Full Buildout
Name: Block_FS=1.5
Method: Janbu
Last Edited By: Villanueva, Niko

F of S: 2.073
F of S Rank (Analysis): 1 of 234,256 slip surfaces
Last Solved Date: 08/30/2023, Last Solved Time: 07:51:00 AM

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	CCR	Mohr-Coulomb	86	0	23.5
	Clay	Mohr-Coulomb	125	0	28
	Drainage Layer	Mohr-Coulomb	115	0	30
	Geosynthetics	Mohr-Coulomb	58	0	24.3
	Subbase	Mohr-Coulomb	120	0	30



Block_FS=1.5

File Information

File Version: 11.05
Title: Columbia Mod 12-13 Full Buildout
Created By: Villanueva, Niko
Last Edited By: Villanueva, Niko
Revision Number: 59
Date: 08/30/2023
Time: 07:48:22 AM
Tool Version: 23.1.1.829
File Name: COL_Mod12-13_Full Buildout.gsz
Directory: I:\25222260.00\Data and Calculations\Geotech Calculations\Slope Stability\SlopeW\
Last Solved Date: 08/30/2023
Last Solved Time: 07:51:00 AM

Project Settings

Unit System: U.S. Customary Units

Analysis Settings

Block_FS=1.5

Kind: SLOPE/W
Analysis Type: Janbu
Settings
- PWP Conditions from: (none)
- Unit Weight of Water: 62.4 pcf

Slip Surface
- Direction of movement: Left to Right
- Use Passive Mode: No
- Slip Surface Option: Block
- Critical slip surfaces saved: 10
- Restrict Block Crossing: No
- 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
  - Number of Columns: 150
- Factor of Safety Convergence Settings
  - Maximum Number of Iterations: 30,000
  - Tolerable difference in F of S: 0.001

Materials

CCR

Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 86 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 23.5 °
Phi-B: 0 °

Clay

Slope Stability Material Model: Mohr-Coulomb

Unit Weight: 125 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 28 °
Phi-B: 0 °

Drainage Layer

Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 115 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 30 °
Phi-B: 0 °

Geosynthetics

Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 58 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 24.3 °
Phi-B: 0 °

Subbase

Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 120 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 30 °
Phi-B: 0 °

Slip Surface Limits

Left Coordinate: (0, 222.8) ft
Right Coordinate: (872.23081, 100) ft

Slip Surface Block

Left Grid
- Upper Left: (501.66323, 78.59637) ft
- Lower Left: (501.71597, 76.77685) ft
- Lower Right: (575.63085, 76.85596) ft
- X Increments: 10
- Y Increments: 10
- Starting Angle: 115 °
- Ending Angle: 135 °
- Angle Increments: 3

Right Grid
- Upper Left: (732.31286, 77.23832) ft
- Lower Left: (733.52148, 75.77333) ft
- Lower Right: (771.48024, 88.43235) ft
- X Increments: 10
- Y Increments: 10
- Angle Increments: 3

Geometry

Name: Default Geometry

Settings

View: 2D
Element Thickness: 1 ft

Points

	X	Y
Point 1	768.91041 ft	87.74349 ft
Point 2	766.02664 ft	87.74317 ft
Point 3	732.66754 ft	76.62354 ft

Point 4	159.35647 ft	79.79909 ft
Point 5	152.46501 ft	77.58553 ft
Point 6	149.45787 ft	77.54639 ft
Point 7	142.29499 ft	79.95559 ft
Point 8	0 ft	80.72488 ft
Point 9	0 ft	78.63599 ft
Point 10	142.29493 ft	77.86789 ft
Point 11	149.45787 ft	75.41847 ft
Point 12	152.46501 ft	75.45626 ft
Point 13	159.35619 ft	77.75007 ft
Point 14	732.66724 ft	74.58984 ft
Point 15	768.91041 ft	86.64701 ft
Point 16	872.23081 ft	100 ft
Point 17	828.17946 ft	88.78332 ft
Point 18	808.17769 ft	88.78332 ft
Point 19	794.02935 ft	85.24543 ft
Point 20	786.03116 ft	85.24543 ft
Point 21	776.0289 ft	87.7443 ft
Point 22	769.01095 ft	87.8435 ft
Point 23	769.01041 ft	85.84317 ft
Point 24	770.01041 ft	85.84317 ft
Point 25	770.01041 ft	85.74351 ft
Point 26	768.91041 ft	85.74351 ft
Point 27	0 ft	0 ft
Point 28	872.23081 ft	0 ft
Point 29	764.03814 ft	88.23984 ft
Point 30	732.49201 ft	77.72453 ft
Point 31	159.6047 ft	80.8285 ft
Point 32	152.35619 ft	82.00202 ft
Point 33	148.97182 ft	82.00419 ft
Point 34	142.29493 ft	80.97938 ft
Point 35	0 ft	81.74787 ft
Point 36	0 ft	80.82487 ft
Point 37	142.31162 ft	80.0555 ft
Point 38	149.47361 ft	77.64661 ft
Point 39	152.44871 ft	77.68532 ft
Point 40	159.34108 ft	79.89918 ft
Point 41	732.65158 ft	76.72363 ft
Point 42	766.01041 ft	87.84317 ft
Point 43	249.53 ft	221.75 ft
Point 44	169.53 ft	229.75 ft
Point 45	69.53 ft	229.75 ft
Point 46	0 ft	222.8 ft
Point 47	0 ft	217.82 ft
Point 48	69.78 ft	224.75 ft
Point 49	169.28 ft	224.75 ft
Point 50	248.67 ft	216.81 ft
Point 51	769.01041 ft	87.84351 ft
Point 52	766.02664 ft	92.74317 ft
Point 53	766.02718 ft	87.74317 ft
Point 54	768.91095 ft	87.74349 ft
Point 55	768.91095 ft	85.7435 ft
Point 56	770.01095 ft	85.7435 ft
Point 57	770.01095 ft	85.84316 ft
Point 58	769.01095 ft	85.84316 ft
Point 59	766.01095 ft	87.84316 ft
Point 60	732.65213 ft	76.72363 ft
Point 61	159.34162 ft	79.89918 ft

Point 62	152.44925 ft	77.68532 ft
Point 63	149.47415 ft	77.6466 ft
Point 64	142.31216 ft	80.0555 ft
Point 65	142.29553 ft	79.95558 ft
Point 66	149.45841 ft	77.54639 ft
Point 67	152.46555 ft	77.58552 ft
Point 68	159.35701 ft	79.79909 ft
Point 69	732.66808 ft	76.62354 ft
Point 70	768.91095 ft	85.74351 ft
Point 71	770.01041 ft	85.84316 ft
Point 72	769.01095 ft	85.84317 ft
Point 73	732.65159 ft	76.72363 ft
Point 74	159.34161 ft	79.89918 ft
Point 75	149.4741 ft	77.64662 ft
Point 76	142.29501 ft	79.95558 ft
Point 77	149.45839 ft	77.5464 ft
Point 78	159.357 ft	79.79909 ft
Point 79	732.66755 ft	76.62354 ft

Regions

	Material	Points	Area
Region 1	Clay	1,53,69,79,3,68,78,67,66,77,6,76,8,9,10,11,12,13,14,15	1,576.1 ft²
Region 2	Subbase	16,17,18,19,20,21,22,72,24,71,57,56,55,70,26,15,14,13,12,11,10,9,27,28	68,366 ft²
Region 3	Drainage Layer	29,30,31,32,33,34,35,36,37,64,75,39,40,74,61,41,73,42	769.27 ft²
Region 4	Clay	43,44,45,46,47,48,49,50,29,42,51,22,21,52	3,896.4 ft²
Region 5	CCR	50,49,48,47,35,34,33,32,31,30,29	72,914 ft²
Region 6	Geosynthetics	53,1,54,70,55,56,57,71,58,72,22,59,60,73,41,61,74,62,63,75,64,37,36,8,76,65,77,66,67,78,68,3,79,69	77.457 ft²

Slip Results

Slip Surfaces Analysed: 70472 of 234256 converged

Current Slip Surface

Slip Surface: 230,157
Factor of Safety: 2.073
Volume: 10,076.604 ft³
Weight: 924,351.53 lbf
Resisting Moment: 40,261,081 lbf·ft
Activating Moment: 21,196,838 lbf·ft
Resisting Force: 385,720.03 lbf
Activating Force: 186,047.9 lbf
Slip Rank: 1 of 234,256 slip surfaces
Exit: (775.71947, 87.898943) ft
Entry: (473.69516, 165.75963) ft
Radius: 146.39865 ft
Center: (639.76145, 185.22481) ft

Slip Columns

	X	Y	PWP	Base Normal Stress	Frictional Strength	Cohesive Strength	Suction Strength	Base Material
Column 1	474.82486 ft	164.62994 ft	0 psf	84.31206 psf	44.829518 psf	0 psf	0 psf	Clay
Column 2	477.08425 ft	162.37054 ft	0 psf	252.93618 psf	134.48855 psf	0 psf	0 psf	Clay

Column 3	479.34365 ft	160.11115 ft	0 psf	421.5603 psf	224.14759 psf	0 psf	0 psf	Clay
Column 4	481.47737 ft	157.97743 ft	0 psf	578.95722 psf	251.73776 psf	0 psf	0 psf	CCR
Column 5	483.48541 ft	155.96938 ft	0 psf	686.02951 psf	298.29412 psf	0 psf	0 psf	CCR
Column 6	485.49346 ft	153.96134 ft	0 psf	793.1018 psf	344.85048 psf	0 psf	0 psf	CCR
Column 7	487.50150 ft	151.95329 ft	0 psf	900.1741 psf	391.40684 psf	0 psf	0 psf	CCR
Column 8	489.50954 ft	149.94525 ft	0 psf	1,007.2464 psf	437.96319 psf	0 psf	0 psf	CCR
Column 9	491.51759 ft	147.93720 ft	0 psf	1,114.3187 psf	484.51955 psf	0 psf	0 psf	CCR
Column 10	493.52563 ft	145.92916 ft	0 psf	1,221.391 psf	531.07591 psf	0 psf	0 psf	CCR
Column 11	495.53368 ft	143.92111 ft	0 psf	1,328.4633 psf	577.63227 psf	0 psf	0 psf	CCR
Column 12	497.54172 ft	141.91307 ft	0 psf	1,435.5356 psf	624.18863 psf	0 psf	0 psf	CCR
Column 13	499.54977 ft	139.90502 ft	0 psf	1,542.6079 psf	670.74498 psf	0 psf	0 psf	CCR
Column 14	501.55781 ft	137.89698 ft	0 psf	1,649.6801 psf	717.30134 psf	0 psf	0 psf	CCR
Column 15	503.56586 ft	135.88893 ft	0 psf	1,756.7524 psf	763.8577 psf	0 psf	0 psf	CCR
Column 16	505.57390 ft	133.88089 ft	0 psf	1,863.8247 psf	810.41406 psf	0 psf	0 psf	CCR
Column 17	507.58195 ft	131.87284 ft	0 psf	1,970.897 psf	856.97041 psf	0 psf	0 psf	CCR
Column 18	509.58999 ft	129.86480 ft	0 psf	2,077.9693 psf	903.52677 psf	0 psf	0 psf	CCR
Column 19	511.59804 ft	127.85675 ft	0 psf	2,185.0416 psf	950.08313 psf	0 psf	0 psf	CCR
Column 20	513.60608 ft	125.84871 ft	0 psf	2,292.1139 psf	996.63949 psf	0 psf	0 psf	CCR
Column 21	515.61413 ft	123.84067 ft	0 psf	2,399.1862 psf	1,043.1958 psf	0 psf	0 psf	CCR
Column 22	517.62217 ft	121.83262 ft	0 psf	2,506.2585 psf	1,089.7522 psf	0 psf	0 psf	CCR
Column 23	519.63022 ft	119.82458 ft	0 psf	2,613.3308 psf	1,136.3086 psf	0 psf	0 psf	CCR
Column 24	521.63826 ft	117.81653 ft	0 psf	2,720.4031 psf	1,182.8649 psf	0 psf	0 psf	CCR
Column 25	523.64631 ft	115.80849 ft	0 psf	2,827.4754 psf	1,229.4213 psf	0 psf	0 psf	CCR
Column 26	525.65435 ft	113.80044 ft	0 psf	2,934.5477 psf	1,275.9776 psf	0 psf	0 psf	CCR
Column 27	527.66240 ft	111.79240 ft	0 psf	3,041.6199 psf	1,322.534 psf	0 psf	0 psf	CCR
Column 28	529.67044 ft	109.78435 ft	0 psf	3,148.6922 psf	1,369.0904 psf	0 psf	0 psf	CCR
Column 29	531.67848 ft	107.77631 ft	0 psf	3,255.7645 psf	1,415.6467 psf	0 psf	0 psf	CCR
Column 30	533.68653 ft	105.76826 ft	0 psf	3,362.8368 psf	1,462.2031 psf	0 psf	0 psf	CCR
Column 31	535.69457 ft	103.76022 ft	0 psf	3,469.9091 psf	1,508.7594 psf	0 psf	0 psf	CCR
Column 32	537.70262 ft	101.75217 ft	0 psf	3,576.9814 psf	1,555.3158 psf	0 psf	0 psf	CCR
Column 33	539.71066 ft	99.74413 ft	0 psf	3,684.0537 psf	1,601.8721 psf	0 psf	0 psf	CCR

Column 34	541.71871 ft	97.73608 ft	0 psf	3,791.126 psf	1,648.4285 psf	0 psf	0 psf	CCR
Column 35	543.72675 ft	95.72804 ft	0 psf	3,898.1983 psf	1,694.9849 psf	0 psf	0 psf	CCR
Column 36	545.73480 ft	93.71999 ft	0 psf	4,005.2706 psf	1,741.5412 psf	0 psf	0 psf	CCR
Column 37	547.74284 ft	91.71195 ft	0 psf	4,112.3429 psf	1,788.0976 psf	0 psf	0 psf	CCR
Column 38	549.75089 ft	89.70390 ft	0 psf	4,219.4152 psf	1,834.6539 psf	0 psf	0 psf	CCR
Column 39	551.75893 ft	87.69586 ft	0 psf	4,326.4875 psf	1,881.2103 psf	0 psf	0 psf	CCR
Column 40	553.76698 ft	85.68781 ft	0 psf	4,433.5597 psf	1,927.7666 psf	0 psf	0 psf	CCR
Column 41	555.77502 ft	83.67977 ft	0 psf	4,540.632 psf	1,974.323 psf	0 psf	0 psf	CCR
Column 42	557.78307 ft	81.67173 ft	0 psf	4,647.7043 psf	2,020.8794 psf	0 psf	0 psf	CCR
Column 43	559.79111 ft	79.66368 ft	0 psf	4,754.7766 psf	2,067.4357 psf	0 psf	0 psf	CCR
Column 44	561.80308 ft	78.70480 ft	0 psf	5,846.4191 psf	2,542.0954 psf	0 psf	0 psf	CCR
Column 45	563.81897 ft	78.79509 ft	0 psf	5,794.8437 psf	2,519.6697 psf	0 psf	0 psf	CCR
Column 46	565.83487 ft	78.88538 ft	0 psf	5,743.2682 psf	2,497.2441 psf	0 psf	0 psf	CCR
Column 47	567.85076 ft	78.97567 ft	0 psf	5,691.6927 psf	2,474.8184 psf	0 psf	0 psf	CCR
Column 48	569.86666 ft	79.06596 ft	0 psf	5,640.1172 psf	2,452.3928 psf	0 psf	0 psf	CCR
Column 49	571.88255 ft	79.15625 ft	0 psf	5,588.5417 psf	2,429.9671 psf	0 psf	0 psf	CCR
Column 50	573.89844 ft	79.24654 ft	0 psf	5,536.9663 psf	2,407.5415 psf	0 psf	0 psf	CCR
Column 51	575.91434 ft	79.33683 ft	0 psf	5,485.3908 psf	2,385.1158 psf	0 psf	0 psf	CCR
Column 52	577.93023 ft	79.42712 ft	0 psf	5,433.8153 psf	2,362.6901 psf	0 psf	0 psf	CCR
Column 53	579.94613 ft	79.51741 ft	0 psf	5,382.2398 psf	2,340.2645 psf	0 psf	0 psf	CCR
Column 54	581.96202 ft	79.60770 ft	0 psf	5,330.6644 psf	2,317.8388 psf	0 psf	0 psf	CCR
Column 55	583.97791 ft	79.69799 ft	0 psf	5,279.0889 psf	2,295.4132 psf	0 psf	0 psf	CCR
Column 56	585.99381 ft	79.78828 ft	0 psf	5,227.5134 psf	2,272.9875 psf	0 psf	0 psf	CCR
Column 57	588.00970 ft	79.87857 ft	0 psf	5,175.9379 psf	2,250.5619 psf	0 psf	0 psf	CCR
Column 58	590.02559 ft	79.96886 ft	0 psf	5,124.3624 psf	2,228.1362 psf	0 psf	0 psf	CCR
Column 59	592.04149 ft	80.05915 ft	0 psf	5,072.787 psf	2,205.7105 psf	0 psf	0 psf	CCR
Column 60	594.05738 ft	80.14944 ft	0 psf	5,021.2115 psf	2,183.2849 psf	0 psf	0 psf	CCR
Column 61	596.07328 ft	80.23973 ft	0 psf	4,969.636 psf	2,160.8592 psf	0 psf	0 psf	CCR
Column 62	598.08917 ft	80.33002 ft	0 psf	4,918.0605 psf	2,138.4336 psf	0 psf	0 psf	CCR
Column 63	600.10506 ft	80.42031 ft	0 psf	4,866.4851 psf	2,116.0079 psf	0 psf	0 psf	CCR
Column 64	602.12096 ft	80.51060 ft	0 psf	4,814.9096 psf	2,093.5823 psf	0 psf	0 psf	CCR

Column 65	604.13685 ft	80.60089 ft	0 psf	4,763.3341 psf	2,071.1566 psf	0 psf	0 psf	CCR
Column 66	606.15274 ft	80.69118 ft	0 psf	4,711.7586 psf	2,048.731 psf	0 psf	0 psf	CCR
Column 67	608.16864 ft	80.78147 ft	0 psf	4,660.1831 psf	2,026.3053 psf	0 psf	0 psf	CCR
Column 68	610.18453 ft	80.87176 ft	0 psf	4,608.6077 psf	2,003.8796 psf	0 psf	0 psf	CCR
Column 69	612.20043 ft	80.96205 ft	0 psf	4,557.0322 psf	1,981.454 psf	0 psf	0 psf	CCR
Column 70	614.21632 ft	81.05234 ft	0 psf	4,505.4567 psf	1,959.0283 psf	0 psf	0 psf	CCR
Column 71	616.23221 ft	81.14263 ft	0 psf	4,453.8812 psf	1,936.6027 psf	0 psf	0 psf	CCR
Column 72	618.24811 ft	81.23292 ft	0 psf	4,402.3058 psf	1,914.177 psf	0 psf	0 psf	CCR
Column 73	620.26400 ft	81.32321 ft	0 psf	4,350.7303 psf	1,891.7514 psf	0 psf	0 psf	CCR
Column 74	622.27989 ft	81.41350 ft	0 psf	4,299.1548 psf	1,869.3257 psf	0 psf	0 psf	CCR
Column 75	624.29579 ft	81.50379 ft	0 psf	4,247.5793 psf	1,846.9001 psf	0 psf	0 psf	CCR
Column 76	626.31168 ft	81.59408 ft	0 psf	4,196.0039 psf	1,824.4744 psf	0 psf	0 psf	CCR
Column 77	628.32758 ft	81.68437 ft	0 psf	4,144.4284 psf	1,802.0487 psf	0 psf	0 psf	CCR
Column 78	630.34347 ft	81.77465 ft	0 psf	4,092.8529 psf	1,779.6231 psf	0 psf	0 psf	CCR
Column 79	632.35936 ft	81.86494 ft	0 psf	4,041.2774 psf	1,757.1974 psf	0 psf	0 psf	CCR
Column 80	634.37526 ft	81.95523 ft	0 psf	3,989.7019 psf	1,734.7718 psf	0 psf	0 psf	CCR
Column 81	636.39115 ft	82.04552 ft	0 psf	3,938.1265 psf	1,712.3461 psf	0 psf	0 psf	CCR
Column 82	638.40705 ft	82.13581 ft	0 psf	3,886.551 psf	1,689.9205 psf	0 psf	0 psf	CCR
Column 83	640.42294 ft	82.22610 ft	0 psf	3,834.9755 psf	1,667.4948 psf	0 psf	0 psf	CCR
Column 84	642.43883 ft	82.31639 ft	0 psf	3,783.4 psf	1,645.0692 psf	0 psf	0 psf	CCR
Column 85	644.45473 ft	82.40668 ft	0 psf	3,731.8246 psf	1,622.6435 psf	0 psf	0 psf	CCR
Column 86	646.47062 ft	82.49697 ft	0 psf	3,680.2491 psf	1,600.2178 psf	0 psf	0 psf	CCR
Column 87	648.48651 ft	82.58726 ft	0 psf	3,628.6736 psf	1,577.7922 psf	0 psf	0 psf	CCR
Column 88	650.50241 ft	82.67755 ft	0 psf	3,577.0981 psf	1,555.3665 psf	0 psf	0 psf	CCR
Column 89	652.51830 ft	82.76784 ft	0 psf	3,525.5226 psf	1,532.9409 psf	0 psf	0 psf	CCR
Column 90	654.53420 ft	82.85813 ft	0 psf	3,473.9472 psf	1,510.5152 psf	0 psf	0 psf	CCR
Column 91	656.55009 ft	82.94842 ft	0 psf	3,422.3717 psf	1,488.0896 psf	0 psf	0 psf	CCR
Column 92	658.56598 ft	83.03871 ft	0 psf	3,370.7962 psf	1,465.6639 psf	0 psf	0 psf	CCR
Column 93	660.58188 ft	83.12900 ft	0 psf	3,319.2207 psf	1,443.2382 psf	0 psf	0 psf	CCR
Column 94	662.59777 ft	83.21929 ft	0 psf	3,267.6453 psf	1,420.8126 psf	0 psf	0 psf	CCR
Column 95	664.61366 ft	83.30958 ft	0 psf	3,216.0698 psf	1,398.3869 psf	0 psf	0 psf	CCR

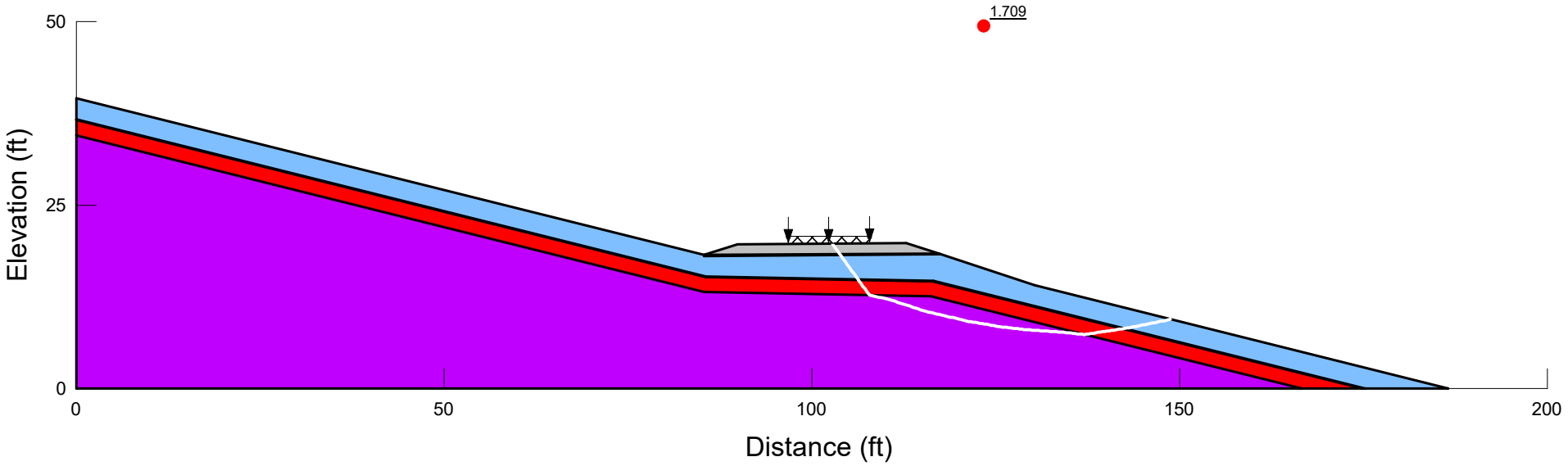
Column 96	666.62956 ft	83.39987 ft	0 psf	3,164.4943 psf	1,375.9613 psf	0 psf	0 psf	CCR
Column 97	668.64545 ft	83.49016 ft	0 psf	3,112.9188 psf	1,353.5356 psf	0 psf	0 psf	CCR
Column 98	670.66135 ft	83.58045 ft	0 psf	3,061.3433 psf	1,331.11 psf	0 psf	0 psf	CCR
Column 99	672.67724 ft	83.67074 ft	0 psf	3,009.7679 psf	1,308.6843 psf	0 psf	0 psf	CCR
Column 100	674.69313 ft	83.76103 ft	0 psf	2,958.1924 psf	1,286.2587 psf	0 psf	0 psf	CCR
Column 101	676.70903 ft	83.85132 ft	0 psf	2,906.6169 psf	1,263.833 psf	0 psf	0 psf	CCR
Column 102	678.72492 ft	83.94161 ft	0 psf	2,855.0414 psf	1,241.4073 psf	0 psf	0 psf	CCR
Column 103	680.74081 ft	84.03190 ft	0 psf	2,803.466 psf	1,218.9817 psf	0 psf	0 psf	CCR
Column 104	682.75671 ft	84.12219 ft	0 psf	2,751.8905 psf	1,196.556 psf	0 psf	0 psf	CCR
Column 105	684.77260 ft	84.21248 ft	0 psf	2,700.315 psf	1,174.1304 psf	0 psf	0 psf	CCR
Column 106	686.78850 ft	84.30277 ft	0 psf	2,648.7395 psf	1,151.7047 psf	0 psf	0 psf	CCR
Column 107	688.80439 ft	84.39306 ft	0 psf	2,597.164 psf	1,129.2791 psf	0 psf	0 psf	CCR
Column 108	690.82028 ft	84.48335 ft	0 psf	2,545.5886 psf	1,106.8534 psf	0 psf	0 psf	CCR
Column 109	692.83618 ft	84.57364 ft	0 psf	2,494.0131 psf	1,084.4278 psf	0 psf	0 psf	CCR
Column 110	694.85207 ft	84.66393 ft	0 psf	2,442.4376 psf	1,062.0021 psf	0 psf	0 psf	CCR
Column 111	696.86797 ft	84.75422 ft	0 psf	2,390.8621 psf	1,039.5764 psf	0 psf	0 psf	CCR
Column 112	698.88386 ft	84.84451 ft	0 psf	2,339.2867 psf	1,017.1508 psf	0 psf	0 psf	CCR
Column 113	700.89975 ft	84.93480 ft	0 psf	2,287.7112 psf	994.72513 psf	0 psf	0 psf	CCR
Column 114	702.91565 ft	85.02509 ft	0 psf	2,236.1357 psf	972.29948 psf	0 psf	0 psf	CCR
Column 115	704.93154 ft	85.11538 ft	0 psf	2,184.5602 psf	949.87382 psf	0 psf	0 psf	CCR
Column 116	706.94743 ft	85.20567 ft	0 psf	2,132.9847 psf	927.44816 psf	0 psf	0 psf	CCR
Column 117	708.96333 ft	85.29596 ft	0 psf	2,081.4093 psf	905.02251 psf	0 psf	0 psf	CCR
Column 118	710.97922 ft	85.38625 ft	0 psf	2,029.8338 psf	882.59685 psf	0 psf	0 psf	CCR
Column 119	712.99512 ft	85.47654 ft	0 psf	1,978.2583 psf	860.1712 psf	0 psf	0 psf	CCR
Column 120	715.01101 ft	85.56683 ft	0 psf	1,926.6828 psf	837.74554 psf	0 psf	0 psf	CCR
Column 121	717.02690 ft	85.65711 ft	0 psf	1,875.1074 psf	815.31989 psf	0 psf	0 psf	CCR
Column 122	719.04280 ft	85.74740 ft	0 psf	1,823.5319 psf	792.89423 psf	0 psf	0 psf	CCR
Column 123	721.05869 ft	85.83769 ft	0 psf	1,771.9564 psf	770.46857 psf	0 psf	0 psf	CCR
Column 124	723.07458 ft	85.92798 ft	0 psf	1,720.3809 psf	748.04292 psf	0 psf	0 psf	CCR
Column 125	725.09048 ft	86.01827 ft	0 psf	1,668.8055 psf	725.61726 psf	0 psf	0 psf	CCR
Column 126	727.10637 ft	86.10856 ft	0 psf	1,617.23 psf	703.19161 psf	0 psf	0 psf	CCR

Column 127	729.12227 ft	86.19885 ft	0 psf	1,565.6545 psf	680.76595 psf	0 psf	0 psf	CCR
Column 128	731.13816 ft	86.28914 ft	0 psf	1,514.079 psf	658.34029 psf	0 psf	0 psf	CCR
Column 129	733.15405 ft	86.37943 ft	0 psf	1,462.5035 psf	635.91464 psf	0 psf	0 psf	CCR
Column 130	735.16995 ft	86.46972 ft	0 psf	1,410.9281 psf	613.48898 psf	0 psf	0 psf	CCR
Column 131	737.18584 ft	86.56001 ft	0 psf	1,359.3526 psf	591.06333 psf	0 psf	0 psf	CCR
Column 132	739.20173 ft	86.65030 ft	0 psf	1,307.7771 psf	568.63767 psf	0 psf	0 psf	CCR
Column 133	741.21763 ft	86.74059 ft	0 psf	1,256.2016 psf	546.21201 psf	0 psf	0 psf	CCR
Column 134	743.23352 ft	86.83088 ft	0 psf	1,204.6262 psf	523.78636 psf	0 psf	0 psf	CCR
Column 135	745.24942 ft	86.92117 ft	0 psf	1,153.0507 psf	501.3607 psf	0 psf	0 psf	CCR
Column 136	747.26531 ft	87.01146 ft	0 psf	1,101.4752 psf	478.93505 psf	0 psf	0 psf	CCR
Column 137	749.28120 ft	87.10175 ft	0 psf	1,049.8997 psf	456.50939 psf	0 psf	0 psf	CCR
Column 138	751.29710 ft	87.19204 ft	0 psf	998.32424 psf	434.08374 psf	0 psf	0 psf	CCR
Column 139	753.31299 ft	87.28233 ft	0 psf	946.74877 psf	411.65808 psf	0 psf	0 psf	CCR
Column 140	755.32889 ft	87.37262 ft	0 psf	895.17329 psf	389.23242 psf	0 psf	0 psf	CCR
Column 141	757.34478 ft	87.46291 ft	0 psf	843.59781 psf	366.80677 psf	0 psf	0 psf	CCR
Column 142	759.36067 ft	87.55320 ft	0 psf	792.02233 psf	344.38111 psf	0 psf	0 psf	CCR
Column 143	761.37657 ft	87.64349 ft	0 psf	740.44686 psf	321.95546 psf	0 psf	0 psf	CCR
Column 144	763.21133 ft	87.72567 ft	0 psf	702.67465 psf	405.6894 psf	0 psf	0 psf	Drainage Layer
Column 145	765.03239 ft	87.80723 ft	0 psf	653.80591 psf	377.47502 psf	0 psf	0 psf	Drainage Layer
Column 146	766.55335 ft	87.87535 ft	0 psf	582.26311 psf	309.59478 psf	0 psf	0 psf	Clay
Column 147	768.15998 ft	87.89894 ft	0 psf	472.25478 psf	251.10232 psf	0 psf	0 psf	Clay
Column 148	770.31984 ft	87.89894 ft	0 psf	337.32485 psf	179.3588 psf	0 psf	0 psf	Clay
Column 149	772.47969 ft	87.89894 ft	0 psf	202.39491 psf	107.61528 psf	0 psf	0 psf	Clay
Column 150	774.63955 ft	87.89894 ft	0 psf	67.464969 psf	35.87176 psf	0 psf	0 psf	Clay

Title: Columbia Mod 12-13 Access Road
Name: Optimized Circular_FS=1.5
Method: Bishop
Last Edited By: Villanueva, Niko

F of S: 1.709
F of S Rank (Analysis): 1 of 10,572 slip surfaces
Surcharge (Unit Weight): 630 pcf
Last Solved Date: 08/23/2023, Last Solved Time: 09:55:54 AM

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	CCR	Mohr-Coulomb	86	0	23.5
	Clay	Mohr-Coulomb	125	0	28
	Geosynthetics	Mohr-Coulomb	58	0	24.3
	Geotextile	Mohr-Coulomb	58	0	30
	Road Aggregate	Mohr-Coulomb	135	0	35
	Rooting Zone/Sand	Mohr-Coulomb	120	0	30



Optimized Circular_FS=1.5

File Information

File Version: 11.05
Title: Columbia Mod 12-13 Access Road
Created By: Villanueva, Niko
Last Edited By: Villanueva, Niko
Revision Number: 122
Date: 08/23/2023
Time: 09:51:08 AM
Tool Version: 23.1.1.829
File Name: COL_Mod12-13_Access Road_3H1V.gsz
Directory: I:\25222260.00\Data and Calculations\Geotech Calculations\Slope Stability\SlopeW\
Last Solved Date: 08/23/2023
Last Solved Time: 09:55:54 AM

Project Settings

Unit System: U.S. Customary Units

Analysis Settings

Optimized Circular_FS=1.5

Kind: SLOPE/W
Analysis Type: Bishop
Settings
- PWP Conditions from: (none)
- Unit Weight of Water: 62.4 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: Yes
- Optimizations Settings
  - Maximum Iterations: 2,000
  - Starting Points: 8
  - Ending Points: 16
  - Driving Side Maximum Convex Angle: 5 °
  - Resisting Side Maximum Convex Angle: 1 °
- Tension Crack Option: (none)

Distribution
- F of S Calculation Option: Constant

Convergence
- Geometry Settings
  - Minimum Slip Surface Depth: 0.1 ft
  - Number of Columns: 150
- Factor of Safety Convergence Settings

Maximum Number of Iterations: 30,000
Tolerable difference in F of S: 0.001

Materials

CCR

Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 86 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 23.5 °
Phi-B: 0 °

Clay

Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 125 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 28 °
Phi-B: 0 °

Geosynthetics

Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 58 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 24.3 °
Phi-B: 0 °

Rooting Zone/Sand

Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 120 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 30 °
Phi-B: 0 °

Road Aggregate

Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 135 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 35 °
Phi-B: 0 °

Geotextile

Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 58 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 30 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Type: Range
Left-Zone Left Coordinate: (78.91665, 19.808399) ft
Left-Zone Right Coordinate: (108.8813, 19.83983) ft

Left-Zone Increment: 30
Right Type: Range
Right-Zone Left Coordinate: (109.43572, 19.845042) ft
Right-Zone Right Coordinate: (150.00821, 9.142644) ft
Right-Zone Increment: 30
Radius Increments: 10

Slip Surface Limits

Left Coordinate: (0, 39.537491) ft
Right Coordinate: (186.5395, 0) ft

Surcharge Loads

Surcharge Load 1

Surcharge (Unit Weight): 630 pcf
Direction: Vertical

Coordinates

	X	Y
	96.84206 ft	20.783361 ft
	107.8622 ft	20.783361 ft

Geometry

Name: Default Geometry

Settings

View: 2D
Element Thickness: 1 ft

Points

	X	Y
Point 1	112.87744 ft	19.877396 ft
Point 2	89.91043 ft	19.661493 ft
Point 3	85.31702 ft	18.208312 ft
Point 4	117.29 ft	18.41 ft
Point 5	85.31765 ft	18.108314 ft
Point 6	117.58 ft	18.31 ft
Point 7	130.28 ft	14.08 ft
Point 8	0 ft	39.537491 ft
Point 9	0 ft	36.702121 ft
Point 10	85.59619 ft	15.303152 ft
Point 11	116.51412 ft	14.68512 ft
Point 12	175.28247 ft	0 ft
Point 13	186.5395 ft	0 ft
Point 14	0 ft	36.599043 ft
Point 15	85.58289 ft	15.203397 ft
Point 16	116.50083 ft	14.585366 ft

Point 17	174.86997 ft	0 ft
Point 18	0 ft	34.537491 ft
Point 19	85.31702 ft	13.208312 ft
Point 20	116.23507 ft	12.590279 ft
Point 21	166.62008 ft	0 ft
Point 22	0 ft	0 ft

Regions

	Material	Points	Area
Region 1	Road Aggregate	1,2,3,4	40.095 ft²
Region 2	Geotextile	4,3,5,6	3.241 ft²
Region 3	Rooting Zone/Sand	7,6,5,3,8,9,10,11,12,13	531.75 ft²
Region 4	Geosynthetics	10,9,14,15,16,17,12,11	17.952 ft²
Region 5	Clay	16,15,14,18,19,20,21,17	350.11 ft²
Region 6	CCR	20,19,18,22,21	2,752.8 ft²

Slip Results

Slip Surfaces Analysed: 8730 of 10572 converged

Current Slip Surface

Slip Surface: 10,572
Factor of Safety: 1.709
Volume: 257.46814 ft³
Weight: 29,861.711 lbf
Resisting Moment: 798,807.09 lbf·ft
Activating Moment: 467,413.8 lbf·ft
Resisting Force: 14,053.471 lbf
Activating Force: 8,738.6005 lbf
Slip Rank: 1 of 10,572 slip surfaces
Exit: (148.7607, 9.4548574) ft
Entry: (102.81763, 19.782828) ft
Radius: 21.246033 ft
Center: (135.55203, 58.237563) ft

Slip Columns

	X	Y	PWP	Base Normal Stress	Frictional Strength	Cohesive Strength	Suction Strength	Base Material
Column 1	102.98675 ft	19.539875 ft	0 psf	416.97639 psf	291.97001 psf	0 psf	0 psf	Road Aggregate
Column 2	103.32498 ft	19.053968 ft	0 psf	457.28021 psf	320.19105 psf	0 psf	0 psf	Road Aggregate
Column 3	103.66321 ft	18.568061 ft	0 psf	497.58404 psf	348.41209 psf	0 psf	0 psf	Road Aggregate
Column 4	103.86734 ft	18.274802 ft	0 psf	555.5742 psf	320.76091 psf	0 psf	0 psf	Geotextile
Column 5	104.06699 ft	17.987985 ft	0 psf	575.9994 psf	332.55341 psf	0 psf	0 psf	Rooting Zone/Sand
Column	104.39625	17.514966	0	613.16315	354.00991	0 psf	0 psf	Rooting

6	ft	ft	psf	psf	psf			Zone/Sand
Column 7	104.70699 ft	17.079336 ft	0 psf	658.41853 psf	380.13812 psf	0 psf	0 psf	Rooting Zone/Sand
Column 8	104.99922 ft	16.681095 ft	0 psf	690.19252 psf	398.48284 psf	0 psf	0 psf	Rooting Zone/Sand
Column 9	105.29144 ft	16.282854 ft	0 psf	721.96651 psf	416.82756 psf	0 psf	0 psf	Rooting Zone/Sand
Column 10	105.58366 ft	15.884613 ft	0 psf	753.7405 psf	435.17228 psf	0 psf	0 psf	Rooting Zone/Sand
Column 11	105.87589 ft	15.486372 ft	0 psf	785.51449 psf	453.517 psf	0 psf	0 psf	Rooting Zone/Sand
Column 12	106.16811 ft	15.088131 ft	0 psf	817.28848 psf	471.86172 psf	0 psf	0 psf	Rooting Zone/Sand
Column 13	106.35146 ft	14.838256 ft	0 psf	896.70745 psf	404.87894 psf	0 psf	0 psf	Geosynthetics
Column 14	106.53606 ft	14.586694 ft	0 psf	875.54461 psf	465.53533 psf	0 psf	0 psf	Clay
Column 15	106.83076 ft	14.185081 ft	0 psf	909.79611 psf	483.74717 psf	0 psf	0 psf	Clay
Column 16	107.12545 ft	13.783467 ft	0 psf	944.04761 psf	501.95902 psf	0 psf	0 psf	Clay
Column 17	107.42015 ft	13.381854 ft	0 psf	978.29912 psf	520.17087 psf	0 psf	0 psf	Clay
Column 18	107.71485 ft	12.980240 ft	0 psf	1,012.5506 psf	538.38271 psf	0 psf	0 psf	Clay
Column 19	107.86881 ft	12.770425 ft	0 psf	608.76308 psf	323.68507 psf	0 psf	0 psf	Clay
Column 20	107.88514 ft	12.759206 ft	0 psf	810.88297 psf	431.15412 psf	0 psf	0 psf	Clay
Column 21	108.05570 ft	12.720411 ft	0 psf	824.2937 psf	358.4131 psf	0 psf	0 psf	CCR
Column 22	108.37737 ft	12.647244 ft	0 psf	830.80461 psf	361.24412 psf	0 psf	0 psf	CCR
Column 23	108.69904 ft	12.574077 ft	0 psf	837.31551 psf	364.07515 psf	0 psf	0 psf	CCR
Column 24	109.02071 ft	12.500910 ft	0 psf	843.82642 psf	366.90617 psf	0 psf	0 psf	CCR
Column 25	109.34238 ft	12.427743 ft	0 psf	850.33732 psf	369.73719 psf	0 psf	0 psf	CCR
Column 26	109.66405 ft	12.354576 ft	0 psf	856.84823 psf	372.56821 psf	0 psf	0 psf	CCR
Column 27	109.98572 ft	12.281409 ft	0 psf	863.35913 psf	375.39923 psf	0 psf	0 psf	CCR
Column 28	110.30739 ft	12.208242 ft	0 psf	869.87004 psf	378.23026 psf	0 psf	0 psf	CCR
Column 29	110.61880 ft	12.123666 ft	0 psf	858.45061 psf	373.26495 psf	0 psf	0 psf	CCR
Column 30	110.91995 ft	12.027681 ft	0 psf	866.60168 psf	376.80914 psf	0 psf	0 psf	CCR
Column 31	111.22110 ft	11.931697 ft	0 psf	874.75276 psf	380.35332 psf	0 psf	0 psf	CCR
Column 32	111.52225 ft	11.835713 ft	0 psf	882.90384 psf	383.89751 psf	0 psf	0 psf	CCR

Column 33	111.82341 ft	11.739728 ft	0 psf	891.05491 psf	387.4417 psf	0 psf	0 psf	CCR
Column 34	112.12456 ft	11.643744 ft	0 psf	899.20599 psf	390.98589 psf	0 psf	0 psf	CCR
Column 35	112.42571 ft	11.547760 ft	0 psf	907.35706 psf	394.53008 psf	0 psf	0 psf	CCR
Column 36	112.72686 ft	11.451775 ft	0 psf	915.50814 psf	398.07427 psf	0 psf	0 psf	CCR
Column 37	113.02683 ft	11.356169 ft	0 psf	917.24799 psf	398.83078 psf	0 psf	0 psf	CCR
Column 38	113.32561 ft	11.260941 ft	0 psf	912.57661 psf	396.7996 psf	0 psf	0 psf	CCR
Column 39	113.63904 ft	11.158843 ft	0 psf	904.99296 psf	393.50214 psf	0 psf	0 psf	CCR
Column 40	113.96711 ft	11.049874 ft	0 psf	900.22892 psf	391.43067 psf	0 psf	0 psf	CCR
Column 41	114.29519 ft	10.940905 ft	0 psf	895.46487 psf	389.35921 psf	0 psf	0 psf	CCR
Column 42	114.62326 ft	10.831936 ft	0 psf	890.70083 psf	387.28774 psf	0 psf	0 psf	CCR
Column 43	114.95134 ft	10.722967 ft	0 psf	885.93679 psf	385.21628 psf	0 psf	0 psf	CCR
Column 44	115.27941 ft	10.613998 ft	0 psf	881.17275 psf	383.14482 psf	0 psf	0 psf	CCR
Column 45	115.57539 ft	10.528768 ft	0 psf	896.68343 psf	389.88905 psf	0 psf	0 psf	CCR
Column 46	115.83926 ft	10.467275 ft	0 psf	890.6373 psf	387.26012 psf	0 psf	0 psf	CCR
Column 47	116.10313 ft	10.405782 ft	0 psf	884.59117 psf	384.63119 psf	0 psf	0 psf	CCR
Column 48	116.36795 ft	10.344069 ft	0 psf	879.64813 psf	382.48189 psf	0 psf	0 psf	CCR
Column 49	116.50747 ft	10.311554 ft	0 psf	877.53551 psf	381.5633 psf	0 psf	0 psf	CCR
Column 50	116.64343 ft	10.279871 ft	0 psf	875.33411 psf	380.6061 psf	0 psf	0 psf	CCR
Column 51	116.90206 ft	10.219600 ft	0 psf	871.31658 psf	378.85923 psf	0 psf	0 psf	CCR
Column 52	117.16069 ft	10.159330 ft	0 psf	867.29905 psf	377.11236 psf	0 psf	0 psf	CCR
Column 53	117.43500 ft	10.095404 ft	0 psf	866.51197 psf	376.77013 psf	0 psf	0 psf	CCR
Column 54	117.73805 ft	10.024782 ft	0 psf	866.02807 psf	376.55972 psf	0 psf	0 psf	CCR
Column 55	118.05415 ft	9.951117 ft	0 psf	862.61689 psf	375.0765 psf	0 psf	0 psf	CCR
Column 56	118.37025 ft	9.877453 ft	0 psf	859.20571 psf	373.59327 psf	0 psf	0 psf	CCR
Column 57	118.68636 ft	9.803789 ft	0 psf	855.79453 psf	372.11005 psf	0 psf	0 psf	CCR
Column 58	119.00246 ft	9.730125 ft	0 psf	852.38334 psf	370.62683 psf	0 psf	0 psf	CCR

Column 59	119.31856 ft	9.656461 ft	0 psf	848.97216 psf	369.1436 psf	0 psf	0 psf	CCR
Column 60	119.63466 ft	9.582797 ft	0 psf	845.56098 psf	367.66038 psf	0 psf	0 psf	CCR
Column 61	119.95076 ft	9.509133 ft	0 psf	842.1498 psf	366.17715 psf	0 psf	0 psf	CCR
Column 62	120.26686 ft	9.435468 ft	0 psf	838.73862 psf	364.69393 psf	0 psf	0 psf	CCR
Column 63	120.58297 ft	9.361804 ft	0 psf	835.32744 psf	363.21071 psf	0 psf	0 psf	CCR
Column 64	120.89907 ft	9.288140 ft	0 psf	831.91625 psf	361.72748 psf	0 psf	0 psf	CCR
Column 65	121.21517 ft	9.214476 ft	0 psf	828.50507 psf	360.24426 psf	0 psf	0 psf	CCR
Column 66	121.52489 ft	9.151643 ft	0 psf	836.78531 psf	363.84461 psf	0 psf	0 psf	CCR
Column 67	121.82824 ft	9.099642 ft	0 psf	831.92249 psf	361.73019 psf	0 psf	0 psf	CCR
Column 68	122.13158 ft	9.047640 ft	0 psf	827.05966 psf	359.61578 psf	0 psf	0 psf	CCR
Column 69	122.43493 ft	8.995639 ft	0 psf	822.19684 psf	357.50136 psf	0 psf	0 psf	CCR
Column 70	122.73827 ft	8.943637 ft	0 psf	817.33402 psf	355.38695 psf	0 psf	0 psf	CCR
Column 71	123.04161 ft	8.891636 ft	0 psf	812.4712 psf	353.27253 psf	0 psf	0 psf	CCR
Column 72	123.34496 ft	8.839634 ft	0 psf	807.60838 psf	351.15812 psf	0 psf	0 psf	CCR
Column 73	123.64830 ft	8.787633 ft	0 psf	802.74556 psf	349.0437 psf	0 psf	0 psf	CCR
Column 74	123.95165 ft	8.735631 ft	0 psf	797.88273 psf	346.92929 psf	0 psf	0 psf	CCR
Column 75	124.25499 ft	8.683630 ft	0 psf	793.01991 psf	344.81487 psf	0 psf	0 psf	CCR
Column 76	124.55833 ft	8.631628 ft	0 psf	788.15709 psf	342.70046 psf	0 psf	0 psf	CCR
Column 77	124.86168 ft	8.579627 ft	0 psf	783.29427 psf	340.58604 psf	0 psf	0 psf	CCR
Column 78	125.16502 ft	8.527625 ft	0 psf	778.43145 psf	338.47163 psf	0 psf	0 psf	CCR
Column 79	125.46837 ft	8.475624 ft	0 psf	773.56862 psf	336.35721 psf	0 psf	0 psf	CCR
Column 80	125.76779 ft	8.432283 ft	0 psf	778.36888 psf	338.44442 psf	0 psf	0 psf	CCR
Column 81	126.06330 ft	8.397603 ft	0 psf	772.23426 psf	335.77701 psf	0 psf	0 psf	CCR
Column 82	126.35880 ft	8.362923 ft	0 psf	766.09963 psf	333.1096 psf	0 psf	0 psf	CCR
Column 83	126.65430 ft	8.328243 ft	0 psf	759.96501 psf	330.44219 psf	0 psf	0 psf	CCR
Column 84	126.94981 ft	8.293563 ft	0 psf	753.83039 psf	327.77478 psf	0 psf	0 psf	CCR

Column 85	127.24531 ft	8.258882 ft	0 psf	747.69576 psf	325.10737 psf	0 psf	0 psf	CCR
Column 86	127.54082 ft	8.224202 ft	0 psf	741.56114 psf	322.43996 psf	0 psf	0 psf	CCR
Column 87	127.83632 ft	8.189522 ft	0 psf	735.42652 psf	319.77255 psf	0 psf	0 psf	CCR
Column 88	128.13182 ft	8.154842 ft	0 psf	729.29189 psf	317.10514 psf	0 psf	0 psf	CCR
Column 89	128.42733 ft	8.120162 ft	0 psf	723.15727 psf	314.43773 psf	0 psf	0 psf	CCR
Column 90	128.71716 ft	8.092523 ft	0 psf	724.6398 psf	315.08235 psf	0 psf	0 psf	CCR
Column 91	129.00131 ft	8.071925 ft	0 psf	717.59804 psf	312.02051 psf	0 psf	0 psf	CCR
Column 92	129.28546 ft	8.051328 ft	0 psf	710.55627 psf	308.95866 psf	0 psf	0 psf	CCR
Column 93	129.56962 ft	8.030730 ft	0 psf	703.51451 psf	305.89681 psf	0 psf	0 psf	CCR
Column 94	129.85377 ft	8.010132 ft	0 psf	696.47274 psf	302.83497 psf	0 psf	0 psf	CCR
Column 95	130.13792 ft	7.989534 ft	0 psf	689.43098 psf	299.77312 psf	0 psf	0 psf	CCR
Column 96	130.43024 ft	7.968345 ft	0 psf	683.65272 psf	297.26066 psf	0 psf	0 psf	CCR
Column 97	130.73072 ft	7.946564 ft	0 psf	679.13796 psf	295.29759 psf	0 psf	0 psf	CCR
Column 98	131.03119 ft	7.924782 ft	0 psf	674.62321 psf	293.33452 psf	0 psf	0 psf	CCR
Column 99	131.33167 ft	7.903001 ft	0 psf	670.10846 psf	291.37145 psf	0 psf	0 psf	CCR
Column 100	131.63215 ft	7.881220 ft	0 psf	665.59371 psf	289.40838 psf	0 psf	0 psf	CCR
Column 101	131.93263 ft	7.859439 ft	0 psf	661.07895 psf	287.44531 psf	0 psf	0 psf	CCR
Column 102	132.23311 ft	7.837658 ft	0 psf	656.5642 psf	285.48224 psf	0 psf	0 psf	CCR
Column 103	132.53358 ft	7.815877 ft	0 psf	652.04945 psf	283.51917 psf	0 psf	0 psf	CCR
Column 104	132.83406 ft	7.794096 ft	0 psf	647.5347 psf	281.5561 psf	0 psf	0 psf	CCR
Column 105	133.13454 ft	7.772315 ft	0 psf	643.01994 psf	279.59303 psf	0 psf	0 psf	CCR
Column 106	133.44519 ft	7.746577 ft	0 psf	635.43867 psf	276.2966 psf	0 psf	0 psf	CCR
Column 107	133.76601 ft	7.716882 ft	0 psf	631.18338 psf	274.44634 psf	0 psf	0 psf	CCR
Column 108	134.08682 ft	7.687188 ft	0 psf	626.92808 psf	272.59609 psf	0 psf	0 psf	CCR
Column 109	134.40764 ft	7.657494 ft	0 psf	622.67279 psf	270.74583 psf	0 psf	0 psf	CCR
Column 110	134.72845 ft	7.627800 ft	0 psf	618.41749 psf	268.89558 psf	0 psf	0 psf	CCR

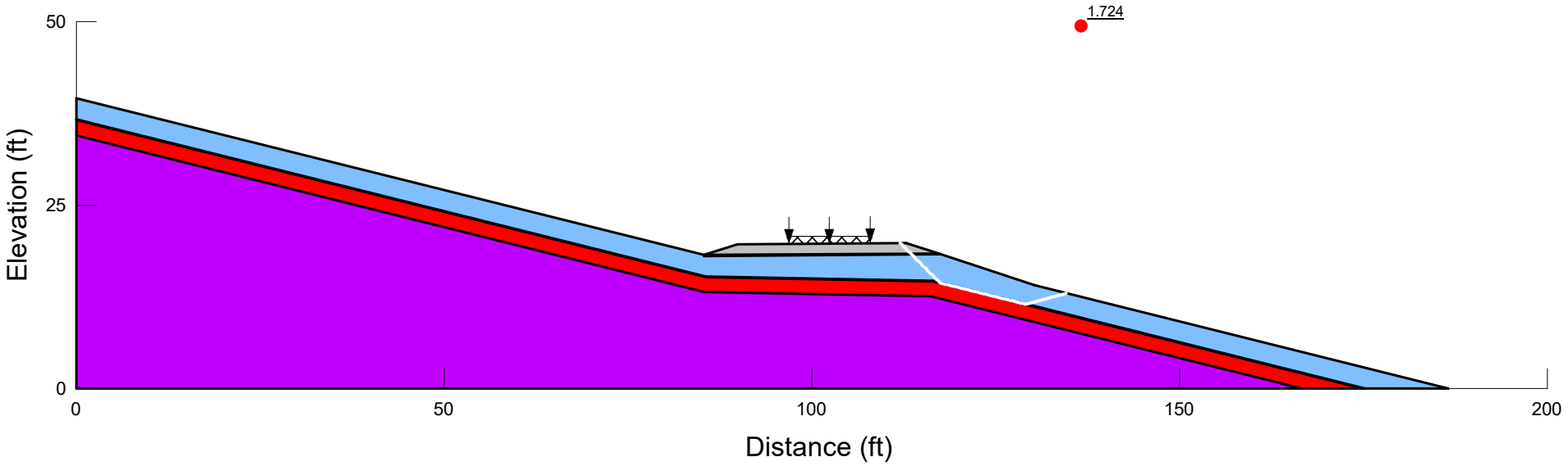
Column 111	135.04927 ft	7.598105 ft	0 psf	614.1622 psf	267.04532 psf	0 psf	0 psf	CCR
Column 112	135.36119 ft	7.566917 ft	0 psf	607.90836 psf	264.32608 psf	0 psf	0 psf	CCR
Column 113	135.66421 ft	7.534234 ft	0 psf	604.29235 psf	262.75379 psf	0 psf	0 psf	CCR
Column 114	135.96723 ft	7.501551 ft	0 psf	600.67635 psf	261.18151 psf	0 psf	0 psf	CCR
Column 115	136.27025 ft	7.468869 ft	0 psf	597.06034 psf	259.60923 psf	0 psf	0 psf	CCR
Column 116	136.57327 ft	7.436186 ft	0 psf	593.44434 psf	258.03694 psf	0 psf	0 psf	CCR
Column 117	136.87629 ft	7.403503 ft	0 psf	589.82833 psf	256.46466 psf	0 psf	0 psf	CCR
Column 118	137.03706 ft	7.388548 ft	0 psf	627.74274 psf	272.95031 psf	0 psf	0 psf	CCR
Column 119	137.20234 ft	7.413293 ft	0 psf	624.81493 psf	332.21999 psf	0 psf	0 psf	Clay
Column 120	137.51439 ft	7.460010 ft	0 psf	608.45182 psf	323.51957 psf	0 psf	0 psf	Clay
Column 121	137.82644 ft	7.506727 ft	0 psf	592.08872 psf	314.81916 psf	0 psf	0 psf	Clay
Column 122	138.13849 ft	7.553444 ft	0 psf	575.72561 psf	306.11874 psf	0 psf	0 psf	Clay
Column 123	138.45054 ft	7.600161 ft	0 psf	559.36251 psf	297.41832 psf	0 psf	0 psf	Clay
Column 124	138.76259 ft	7.646878 ft	0 psf	542.9994 psf	288.7179 psf	0 psf	0 psf	Clay
Column 125	139.07464 ft	7.693595 ft	0 psf	526.63629 psf	280.01748 psf	0 psf	0 psf	Clay
Column 126	139.38669 ft	7.740312 ft	0 psf	510.27319 psf	271.31707 psf	0 psf	0 psf	Clay
Column 127	139.69874 ft	7.787029 ft	0 psf	493.91008 psf	262.61665 psf	0 psf	0 psf	Clay
Column 128	140.01079 ft	7.833746 ft	0 psf	477.54698 psf	253.91623 psf	0 psf	0 psf	Clay
Column 129	140.32284 ft	7.880463 ft	0 psf	461.18387 psf	245.21581 psf	0 psf	0 psf	Clay
Column 130	140.63489 ft	7.927180 ft	0 psf	444.82076 psf	236.5154 psf	0 psf	0 psf	Clay
Column 131	140.94694 ft	7.973897 ft	0 psf	428.45766 psf	227.81498 psf	0 psf	0 psf	Clay
Column 132	141.25899 ft	8.020614 ft	0 psf	412.09455 psf	219.11456 psf	0 psf	0 psf	Clay
Column 133	141.57104 ft	8.067331 ft	0 psf	395.73145 psf	210.41414 psf	0 psf	0 psf	Clay
Column 134	141.84910 ft	8.107971 ft	0 psf	380.27546 psf	202.19605 psf	0 psf	0 psf	Clay
Column 135	142.09318 ft	8.142536 ft	0 psf	367.7688 psf	195.54614 psf	0 psf	0 psf	Clay
Column 136	142.34686 ft	8.178461 ft	0 psf	355.90849 psf	160.69885 psf	0 psf	0 psf	Geosynthetics

Column 137	142.69826 ft	8.228224 ft	0 psf	345.80605 psf	199.65121 psf	0 psf	0 psf	Rooting Zone/Sand
Column 138	143.05551 ft	8.285168 ft	0 psf	332.81623 psf	192.15154 psf	0 psf	0 psf	Rooting Zone/Sand
Column 139	143.33049 ft	8.336813 ft	0 psf	317.38137 psf	183.24022 psf	0 psf	0 psf	Rooting Zone/Sand
Column 140	143.62365 ft	8.394759 ft	0 psf	302.58048 psf	174.69492 psf	0 psf	0 psf	Rooting Zone/Sand
Column 141	143.93498 ft	8.459008 ft	0 psf	284.24227 psf	164.10735 psf	0 psf	0 psf	Rooting Zone/Sand
Column 142	144.24632 ft	8.523256 ft	0 psf	265.90406 psf	153.51978 psf	0 psf	0 psf	Rooting Zone/Sand
Column 143	144.55766 ft	8.587504 ft	0 psf	247.56585 psf	142.93221 psf	0 psf	0 psf	Rooting Zone/Sand
Column 144	144.86899 ft	8.651753 ft	0 psf	229.22764 psf	132.34464 psf	0 psf	0 psf	Rooting Zone/Sand
Column 145	145.18033 ft	8.716001 ft	0 psf	210.88943 psf	121.75707 psf	0 psf	0 psf	Rooting Zone/Sand
Column 146	145.49167 ft	8.780249 ft	0 psf	192.55122 psf	111.1695 psf	0 psf	0 psf	Rooting Zone/Sand
Column 147	145.80300 ft	8.844498 ft	0 psf	174.213 psf	100.58192 psf	0 psf	0 psf	Rooting Zone/Sand
Column 148	146.11434 ft	8.908746 ft	0 psf	155.87479 psf	89.994354 psf	0 psf	0 psf	Rooting Zone/Sand
Column 149	146.42567 ft	8.972995 ft	0 psf	137.53658 psf	79.406783 psf	0 psf	0 psf	Rooting Zone/Sand
Column 150	146.73701 ft	9.037243 ft	0 psf	119.19837 psf	68.819212 psf	0 psf	0 psf	Rooting Zone/Sand
Column 151	147.04835 ft	9.101491 ft	0 psf	100.86016 psf	58.231641 psf	0 psf	0 psf	Rooting Zone/Sand
Column 152	147.35968 ft	9.165740 ft	0 psf	82.521949 psf	47.64407 psf	0 psf	0 psf	Rooting Zone/Sand
Column 153	147.67102 ft	9.229988 ft	0 psf	64.183738 psf	37.056499 psf	0 psf	0 psf	Rooting Zone/Sand
Column 154	147.98236 ft	9.294236 ft	0 psf	45.845527 psf	26.468928 psf	0 psf	0 psf	Rooting Zone/Sand
Column 155	148.29369 ft	9.358485 ft	0 psf	27.507316 psf	15.881357 psf	0 psf	0 psf	Rooting Zone/Sand
Column 156	148.60503 ft	9.422733 ft	0 psf	9.1691055 psf	5.2937855 psf	0 psf	0 psf	Rooting Zone/Sand

Title: Columbia Mod 12-13 Access Road
Name: Block_FS=1.5
Method: Janbu
Last Edited By: Villanueva, Niko

F of S: 1.724
F of S Rank (Analysis): 1 of 234,256 slip surfaces
Surcharge (Unit Weight): 630 pcf
Last Solved Date: 08/23/2023, Last Solved Time: 10:14:59 AM

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	CCR	Mohr-Coulomb	86	0	23.5
	Clay	Mohr-Coulomb	125	0	28
	Geosynthetics	Mohr-Coulomb	58	0	24.3
	Geotextile	Mohr-Coulomb	58	0	30
	Road Aggregate	Mohr-Coulomb	135	0	35
	Rooting Zone/Sand	Mohr-Coulomb	120	0	30



Block_FS=1.5

File Information

File Version: 11.05
Title: Columbia Mod 12-13 Access Road
Created By: Villanueva, Niko
Last Edited By: Villanueva, Niko
Revision Number: 124
Date: 08/23/2023
Time: 10:14:01 AM
Tool Version: 23.1.1.829
File Name: COL_Mod12-13_Access Road_3H1V.gsz
Directory: I:\25222260.00\Data and Calculations\Geotech Calculations\Slope Stability\SlopeW\
Last Solved Date: 08/23/2023
Last Solved Time: 10:14:58 AM

Project Settings

Unit System: U.S. Customary Units

Analysis Settings

Block_FS=1.5

Kind: SLOPE/W
Analysis Type: Janbu
Settings
- PWP Conditions from: (none)
- Unit Weight of Water: 62.4 pcf

Slip Surface
- Direction of movement: Left to Right
- Use Passive Mode: No
- Slip Surface Option: Block
- Critical slip surfaces saved: 10
- Restrict Block Crossing: No
- 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
  - Number of Columns: 150
- Factor of Safety Convergence Settings
  - Maximum Number of Iterations: 100
  - Tolerable difference in F of S: 0.001

Materials

CCR

Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 86 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 23.5 °
Phi-B: 0 °

Clay

Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 125 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 28 °
Phi-B: 0 °

Geosynthetics

Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 58 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 24.3 °
Phi-B: 0 °

Rooting Zone/Sand

Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 120 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 30 °
Phi-B: 0 °

Road Aggregate

Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 135 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 35 °
Phi-B: 0 °

Geotextile

Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 58 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 30 °
Phi-B: 0 °

Slip Surface Limits

Left Coordinate: (0, 39.537491) ft
Right Coordinate: (186.5395, 0) ft

Slip Surface Block

Left Grid

Upper Left: (105.31355, 15.853234) ft
Lower Left: (105.22097, 14.202143) ft
Lower Right: (120.46655, 13.230005) ft
X Increments: 10
Y Increments: 10
Starting Angle: 115 °
Ending Angle: 135 °
Angle Increments: 3

Right Grid
Upper Left: (122.69352, 13.67688) ft
Lower Left: (122.4491, 12.521425) ft
Lower Right: (155.15737, 4.611001) ft
X Increments: 10
Y Increments: 10
Angle Increments: 3

Surcharge Loads

Surcharge Load 1

Surcharge (Unit Weight): 630 pcf
Direction: Vertical

Coordinates

	X	Y
	96.9402 ft	20.742933 ft
	107.91703 ft	20.742933 ft

Geometry

Name: Default Geometry

Settings

View: 2D
Element Thickness: 1 ft

Points

	X	Y
Point 1	112.87744 ft	19.877396 ft
Point 2	89.91043 ft	19.661493 ft
Point 3	85.31702 ft	18.208312 ft
Point 4	117.29 ft	18.41 ft
Point 5	85.31765 ft	18.108314 ft
Point 6	117.58 ft	18.31 ft
Point 7	130.28 ft	14.08 ft
Point 8	0 ft	39.537491 ft
Point 9	0 ft	36.702121 ft
Point 10	85.59619 ft	15.303152 ft
Point 11	116.51412 ft	14.68512 ft
Point 12	175.28247 ft	0 ft
Point 13	186.5395 ft	0 ft

Point 14	0 ft	36.599043 ft
Point 15	85.58289 ft	15.203397 ft
Point 16	116.50083 ft	14.585366 ft
Point 17	174.86997 ft	0 ft
Point 18	0 ft	34.537491 ft
Point 19	85.31702 ft	13.208312 ft
Point 20	116.23507 ft	12.590279 ft
Point 21	166.62008 ft	0 ft
Point 22	0 ft	0 ft

Regions

	Material	Points	Area
Region 1	Road Aggregate	1,2,3,4	40.095 ft²
Region 2	Geotextile	4,3,5,6	3.241 ft²
Region 3	Rooting Zone/Sand	7,6,5,3,8,9,10,11,12,13	531.75 ft²
Region 4	Geosynthetics	10,9,14,15,16,17,12,11	17.952 ft²
Region 5	Clay	16,15,14,18,19,20,21,17	350.11 ft²
Region 6	CCR	20,19,18,22,21	2,752.8 ft²

Slip Results

Slip Surfaces Analysed: 233976 of 234256 converged

Current Slip Surface

Slip Surface: 144,946
Factor of Safety: 1.724
Volume: 59.378416 ft³
Weight: 7,134.8484 lbf
Resisting Moment: 30,069.202 lbf·ft
Activating Moment: 17,647.289 lbf·ft
Resisting Force: 3,242.053 lbf
Activating Force: 1,880.6689 lbf
Slip Rank: 1 of 234,256 slip surfaces
Exit: (134.62224, 12.993273) ft
Entry: (112.01875, 19.869324) ft
Radius: 11.580067 ft
Center: (124.88928, 21.588336) ft

Slip Columns

	X	Y	PWP	Base Normal Stress	Frictional Strength	Cohesive Strength	Suction Strength	Base Material
Column 1	112.09030 ft	19.797766 ft	0 psf	6.9339626 psf	4.8552129 psf	0 psf	0 psf	Road Aggregate
Column 2	112.23342 ft	19.654650 ft	0 psf	20.801888 psf	14.565639 psf	0 psf	0 psf	Road Aggregate
Column 3	112.37653 ft	19.511534 ft	0 psf	34.669813 psf	24.276064 psf	0 psf	0 psf	Road Aggregate
Column 4	112.51965 ft	19.368419 ft	0 psf	48.537738 psf	33.98649 psf	0 psf	0 psf	Road Aggregate

Column 5	112.66277 ft	19.225303 ft	0 psf	62.405663 psf	43.696916 psf	0 psf	0 psf	Road Aggregate
Column 6	112.80588 ft	19.082187 ft	0 psf	76.273589 psf	53.407342 psf	0 psf	0 psf	Road Aggregate
Column 7	112.95551 ft	18.932564 ft	0 psf	88.209495 psf	61.764953 psf	0 psf	0 psf	Road Aggregate
Column 8	113.11164 ft	18.776433 ft	0 psf	98.213381 psf	68.76975 psf	0 psf	0 psf	Road Aggregate
Column 9	113.26777 ft	18.620301 ft	0 psf	108.21727 psf	75.774547 psf	0 psf	0 psf	Road Aggregate
Column 10	113.42390 ft	18.464170 ft	0 psf	118.22115 psf	82.779344 psf	0 psf	0 psf	Road Aggregate
Column 11	113.55245 ft	18.335621 ft	0 psf	130.28018 psf	75.217297 psf	0 psf	0 psf	Geotextile
Column 12	113.67975 ft	18.208324 ft	0 psf	135.07325 psf	77.984575 psf	0 psf	0 psf	Rooting Zone/Sand
Column 13	113.83337 ft	18.054696 ft	0 psf	143.70491 psf	82.96807 psf	0 psf	0 psf	Rooting Zone/Sand
Column 14	113.98700 ft	17.901068 ft	0 psf	152.33658 psf	87.951564 psf	0 psf	0 psf	Rooting Zone/Sand
Column 15	114.14063 ft	17.747440 ft	0 psf	160.96824 psf	92.935058 psf	0 psf	0 psf	Rooting Zone/Sand
Column 16	114.29426 ft	17.593812 ft	0 psf	169.59991 psf	97.918553 psf	0 psf	0 psf	Rooting Zone/Sand
Column 17	114.44788 ft	17.440184 ft	0 psf	178.23157 psf	102.90205 psf	0 psf	0 psf	Rooting Zone/Sand
Column 18	114.60151 ft	17.286557 ft	0 psf	186.86324 psf	107.88554 psf	0 psf	0 psf	Rooting Zone/Sand
Column 19	114.75514 ft	17.132929 ft	0 psf	195.49491 psf	112.86904 psf	0 psf	0 psf	Rooting Zone/Sand
Column 20	114.90877 ft	16.979301 ft	0 psf	204.12657 psf	117.85253 psf	0 psf	0 psf	Rooting Zone/Sand
Column 21	115.06240 ft	16.825673 ft	0 psf	212.75824 psf	122.83603 psf	0 psf	0 psf	Rooting Zone/Sand
Column 22	115.21602 ft	16.672045 ft	0 psf	221.3899 psf	127.81952 psf	0 psf	0 psf	Rooting Zone/Sand
Column 23	115.36965 ft	16.518417 ft	0 psf	230.02157 psf	132.80301 psf	0 psf	0 psf	Rooting Zone/Sand
Column 24	115.52328 ft	16.364789 ft	0 psf	238.65323 psf	137.78651 psf	0 psf	0 psf	Rooting Zone/Sand
Column 25	115.67691 ft	16.211162 ft	0 psf	247.2849 psf	142.77 psf	0 psf	0 psf	Rooting Zone/Sand
Column 26	115.83054 ft	16.057534 ft	0 psf	255.91656 psf	147.7535 psf	0 psf	0 psf	Rooting Zone/Sand
Column 27	115.98416 ft	15.903906 ft	0 psf	264.54823 psf	152.73699 psf	0 psf	0 psf	Rooting Zone/Sand
Column 28	116.13779 ft	15.750278 ft	0 psf	273.1799 psf	157.72049 psf	0 psf	0 psf	Rooting Zone/Sand
Column 29	116.29142 ft	15.596650 ft	0 psf	281.81156 psf	162.70398 psf	0 psf	0 psf	Rooting Zone/Sand
Column 30	116.44505 ft	15.443022 ft	0 psf	290.44323 psf	167.68748 psf	0 psf	0 psf	Rooting Zone/Sand

Column 31	116.59867 ft	15.289395 ft	0 psf	299.07489 psf	172.67097 psf	0 psf	0 psf	Rooting Zone/Sand
Column 32	116.75230 ft	15.135767 ft	0 psf	307.70656 psf	177.65446 psf	0 psf	0 psf	Rooting Zone/Sand
Column 33	116.90593 ft	14.982139 ft	0 psf	316.33822 psf	182.63796 psf	0 psf	0 psf	Rooting Zone/Sand
Column 34	117.05956 ft	14.828511 ft	0 psf	324.96989 psf	187.62145 psf	0 psf	0 psf	Rooting Zone/Sand
Column 35	117.21319 ft	14.674883 ft	0 psf	333.60155 psf	192.60495 psf	0 psf	0 psf	Rooting Zone/Sand
Column 36	117.36121 ft	14.526862 ft	0 psf	343.27191 psf	198.18813 psf	0 psf	0 psf	Rooting Zone/Sand
Column 37	117.45270 ft	14.435371 ft	0 psf	369.66238 psf	166.90896 psf	0 psf	0 psf	Geosynthetics
Column 38	117.52649 ft	14.401765 ft	0 psf	439.4875 psf	198.43621 psf	0 psf	0 psf	Geosynthetics
Column 39	117.65489 ft	14.369798 ft	0 psf	439.30039 psf	198.35173 psf	0 psf	0 psf	Geosynthetics
Column 40	117.80467 ft	14.332507 ft	0 psf	437.88932 psf	197.71461 psf	0 psf	0 psf	Geosynthetics
Column 41	117.95445 ft	14.295216 ft	0 psf	436.47825 psf	197.07749 psf	0 psf	0 psf	Geosynthetics
Column 42	118.10423 ft	14.257926 ft	0 psf	435.06718 psf	196.44037 psf	0 psf	0 psf	Geosynthetics
Column 43	118.25400 ft	14.220635 ft	0 psf	433.65612 psf	195.80324 psf	0 psf	0 psf	Geosynthetics
Column 44	118.40378 ft	14.183345 ft	0 psf	432.24505 psf	195.16612 psf	0 psf	0 psf	Geosynthetics
Column 45	118.55356 ft	14.146054 ft	0 psf	430.83398 psf	194.529 psf	0 psf	0 psf	Geosynthetics
Column 46	118.70334 ft	14.108763 ft	0 psf	429.42291 psf	193.89188 psf	0 psf	0 psf	Geosynthetics
Column 47	118.85312 ft	14.071473 ft	0 psf	428.01184 psf	193.25476 psf	0 psf	0 psf	Geosynthetics
Column 48	119.00290 ft	14.034182 ft	0 psf	426.60077 psf	192.61763 psf	0 psf	0 psf	Geosynthetics
Column 49	119.15268 ft	13.996892 ft	0 psf	425.1897 psf	191.98051 psf	0 psf	0 psf	Geosynthetics
Column 50	119.30246 ft	13.959601 ft	0 psf	423.77863 psf	191.34339 psf	0 psf	0 psf	Geosynthetics
Column 51	119.45223 ft	13.922310 ft	0 psf	422.36756 psf	190.70627 psf	0 psf	0 psf	Geosynthetics
Column 52	119.60201 ft	13.885020 ft	0 psf	420.95649 psf	190.06914 psf	0 psf	0 psf	Geosynthetics
Column 53	119.75179 ft	13.847729 ft	0 psf	419.54542 psf	189.43202 psf	0 psf	0 psf	Geosynthetics
Column 54	119.90157 ft	13.810439 ft	0 psf	418.13435 psf	188.7949 psf	0 psf	0 psf	Geosynthetics
Column 55	120.05135 ft	13.773148 ft	0 psf	416.72328 psf	188.15778 psf	0 psf	0 psf	Geosynthetics
Column 56	120.20113 ft	13.735858 ft	0 psf	415.31222 psf	187.52066 psf	0 psf	0 psf	Geosynthetics

Column 57	120.35091 ft	13.698567 ft	0 psf	413.90115 psf	186.88353 psf	0 psf	0 psf	Geosynthetics
Column 58	120.50069 ft	13.661276 ft	0 psf	412.49008 psf	186.24641 psf	0 psf	0 psf	Geosynthetics
Column 59	120.65046 ft	13.623986 ft	0 psf	411.07901 psf	185.60929 psf	0 psf	0 psf	Geosynthetics
Column 60	120.80024 ft	13.586695 ft	0 psf	409.66794 psf	184.97217 psf	0 psf	0 psf	Geosynthetics
Column 61	120.95002 ft	13.549405 ft	0 psf	408.25687 psf	184.33504 psf	0 psf	0 psf	Geosynthetics
Column 62	121.09980 ft	13.512114 ft	0 psf	406.8458 psf	183.69792 psf	0 psf	0 psf	Geosynthetics
Column 63	121.24958 ft	13.474823 ft	0 psf	405.43473 psf	183.0608 psf	0 psf	0 psf	Geosynthetics
Column 64	121.39936 ft	13.437533 ft	0 psf	404.02366 psf	182.42368 psf	0 psf	0 psf	Geosynthetics
Column 65	121.54914 ft	13.400242 ft	0 psf	402.61259 psf	181.78656 psf	0 psf	0 psf	Geosynthetics
Column 66	121.69892 ft	13.362952 ft	0 psf	401.20152 psf	181.14943 psf	0 psf	0 psf	Geosynthetics
Column 67	121.84869 ft	13.325661 ft	0 psf	399.79045 psf	180.51231 psf	0 psf	0 psf	Geosynthetics
Column 68	121.99847 ft	13.288371 ft	0 psf	398.37938 psf	179.87519 psf	0 psf	0 psf	Geosynthetics
Column 69	122.14825 ft	13.251080 ft	0 psf	396.96832 psf	179.23807 psf	0 psf	0 psf	Geosynthetics
Column 70	122.29803 ft	13.213789 ft	0 psf	395.55725 psf	178.60094 psf	0 psf	0 psf	Geosynthetics
Column 71	122.44781 ft	13.176499 ft	0 psf	394.14618 psf	177.96382 psf	0 psf	0 psf	Geosynthetics
Column 72	122.59759 ft	13.139208 ft	0 psf	392.73511 psf	177.3267 psf	0 psf	0 psf	Geosynthetics
Column 73	122.74737 ft	13.101918 ft	0 psf	391.32404 psf	176.68958 psf	0 psf	0 psf	Geosynthetics
Column 74	122.89715 ft	13.064627 ft	0 psf	389.91297 psf	176.05246 psf	0 psf	0 psf	Geosynthetics
Column 75	123.04692 ft	13.027336 ft	0 psf	388.5019 psf	175.41533 psf	0 psf	0 psf	Geosynthetics
Column 76	123.19670 ft	12.990046 ft	0 psf	387.09083 psf	174.77821 psf	0 psf	0 psf	Geosynthetics
Column 77	123.34648 ft	12.952755 ft	0 psf	385.67976 psf	174.14109 psf	0 psf	0 psf	Geosynthetics
Column 78	123.49626 ft	12.915465 ft	0 psf	384.26869 psf	173.50397 psf	0 psf	0 psf	Geosynthetics
Column 79	123.64604 ft	12.878174 ft	0 psf	382.85762 psf	172.86685 psf	0 psf	0 psf	Geosynthetics
Column 80	123.79582 ft	12.840883 ft	0 psf	381.44655 psf	172.22972 psf	0 psf	0 psf	Geosynthetics
Column 81	123.94560 ft	12.803593 ft	0 psf	380.03548 psf	171.5926 psf	0 psf	0 psf	Geosynthetics
Column 82	124.09538 ft	12.766302 ft	0 psf	378.62442 psf	170.95548 psf	0 psf	0 psf	Geosynthetics

Column 83	124.24515 ft	12.729012 ft	0 psf	377.21335 psf	170.31836 psf	0 psf	0 psf	Geosynthetics
Column 84	124.39493 ft	12.691721 ft	0 psf	375.80228 psf	169.68123 psf	0 psf	0 psf	Geosynthetics
Column 85	124.54471 ft	12.654431 ft	0 psf	374.39121 psf	169.04411 psf	0 psf	0 psf	Geosynthetics
Column 86	124.69449 ft	12.617140 ft	0 psf	372.98014 psf	168.40699 psf	0 psf	0 psf	Geosynthetics
Column 87	124.84427 ft	12.579849 ft	0 psf	371.56907 psf	167.76987 psf	0 psf	0 psf	Geosynthetics
Column 88	124.99405 ft	12.542559 ft	0 psf	370.158 psf	167.13275 psf	0 psf	0 psf	Geosynthetics
Column 89	125.14383 ft	12.505268 ft	0 psf	368.74693 psf	166.49562 psf	0 psf	0 psf	Geosynthetics
Column 90	125.29361 ft	12.467978 ft	0 psf	367.33586 psf	165.8585 psf	0 psf	0 psf	Geosynthetics
Column 91	125.44338 ft	12.430687 ft	0 psf	365.92479 psf	165.22138 psf	0 psf	0 psf	Geosynthetics
Column 92	125.59316 ft	12.393396 ft	0 psf	364.51372 psf	164.58426 psf	0 psf	0 psf	Geosynthetics
Column 93	125.74294 ft	12.356106 ft	0 psf	363.10265 psf	163.94713 psf	0 psf	0 psf	Geosynthetics
Column 94	125.89272 ft	12.318815 ft	0 psf	361.69158 psf	163.31001 psf	0 psf	0 psf	Geosynthetics
Column 95	126.04250 ft	12.281525 ft	0 psf	360.28052 psf	162.67289 psf	0 psf	0 psf	Geosynthetics
Column 96	126.19228 ft	12.244234 ft	0 psf	358.86945 psf	162.03577 psf	0 psf	0 psf	Geosynthetics
Column 97	126.34206 ft	12.206944 ft	0 psf	357.45838 psf	161.39865 psf	0 psf	0 psf	Geosynthetics
Column 98	126.49184 ft	12.169653 ft	0 psf	356.04731 psf	160.76152 psf	0 psf	0 psf	Geosynthetics
Column 99	126.64161 ft	12.132362 ft	0 psf	354.63624 psf	160.1244 psf	0 psf	0 psf	Geosynthetics
Column 100	126.79139 ft	12.095072 ft	0 psf	353.22517 psf	159.48728 psf	0 psf	0 psf	Geosynthetics
Column 101	126.94117 ft	12.057781 ft	0 psf	351.8141 psf	158.85016 psf	0 psf	0 psf	Geosynthetics
Column 102	127.09095 ft	12.020491 ft	0 psf	350.40303 psf	158.21303 psf	0 psf	0 psf	Geosynthetics
Column 103	127.24073 ft	11.983200 ft	0 psf	348.99196 psf	157.57591 psf	0 psf	0 psf	Geosynthetics
Column 104	127.39051 ft	11.945909 ft	0 psf	347.58089 psf	156.93879 psf	0 psf	0 psf	Geosynthetics
Column 105	127.54029 ft	11.908619 ft	0 psf	346.16982 psf	156.30167 psf	0 psf	0 psf	Geosynthetics
Column 106	127.69007 ft	11.871328 ft	0 psf	344.75875 psf	155.66455 psf	0 psf	0 psf	Geosynthetics
Column 107	127.83984 ft	11.834038 ft	0 psf	343.34768 psf	155.02742 psf	0 psf	0 psf	Geosynthetics
Column 108	127.98962 ft	11.796747 ft	0 psf	341.93662 psf	154.3903 psf	0 psf	0 psf	Geosynthetics

Column 109	128.13940 ft	11.759457 ft	0 psf	340.52555 psf	153.75318 psf	0 psf	0 psf	Geosynthetics
Column 110	128.28918 ft	11.722166 ft	0 psf	339.11448 psf	153.11606 psf	0 psf	0 psf	Geosynthetics
Column 111	128.43896 ft	11.684875 ft	0 psf	337.70341 psf	152.47894 psf	0 psf	0 psf	Geosynthetics
Column 112	128.58874 ft	11.647585 ft	0 psf	336.29234 psf	151.84181 psf	0 psf	0 psf	Geosynthetics
Column 113	128.73852 ft	11.610294 ft	0 psf	334.88127 psf	151.20469 psf	0 psf	0 psf	Geosynthetics
Column 114	128.88830 ft	11.573004 ft	0 psf	333.4702 psf	150.56757 psf	0 psf	0 psf	Geosynthetics
Column 115	129.03807 ft	11.535713 ft	0 psf	332.05913 psf	149.93045 psf	0 psf	0 psf	Geosynthetics
Column 116	129.13212 ft	11.522199 ft	0 psf	378.79113 psf	171.03075 psf	0 psf	0 psf	Geosynthetics
Column 117	129.23189 ft	11.548934 ft	0 psf	379.70229 psf	219.22122 psf	0 psf	0 psf	Rooting Zone/Sand
Column 118	129.39314 ft	11.592140 ft	0 psf	366.92589 psf	211.84476 psf	0 psf	0 psf	Rooting Zone/Sand
Column 119	129.55439 ft	11.635347 ft	0 psf	354.1495 psf	204.46831 psf	0 psf	0 psf	Rooting Zone/Sand
Column 120	129.71563 ft	11.678553 ft	0 psf	341.3731 psf	197.09185 psf	0 psf	0 psf	Rooting Zone/Sand
Column 121	129.87688 ft	11.721759 ft	0 psf	328.59671 psf	189.7154 psf	0 psf	0 psf	Rooting Zone/Sand
Column 122	130.03813 ft	11.764965 ft	0 psf	315.82031 psf	182.33894 psf	0 psf	0 psf	Rooting Zone/Sand
Column 123	130.19938 ft	11.808171 ft	0 psf	303.04391 psf	174.96249 psf	0 psf	0 psf	Rooting Zone/Sand
Column 124	130.35487 ft	11.849834 ft	0 psf	291.54096 psf	168.32125 psf	0 psf	0 psf	Rooting Zone/Sand
Column 125	130.50460 ft	11.889955 ft	0 psf	281.31146 psf	162.41524 psf	0 psf	0 psf	Rooting Zone/Sand
Column 126	130.65433 ft	11.930076 ft	0 psf	271.08195 psf	156.50924 psf	0 psf	0 psf	Rooting Zone/Sand
Column 127	130.80406 ft	11.970196 ft	0 psf	260.85244 psf	150.60323 psf	0 psf	0 psf	Rooting Zone/Sand
Column 128	130.95380 ft	12.010317 ft	0 psf	250.62293 psf	144.69722 psf	0 psf	0 psf	Rooting Zone/Sand
Column 129	131.10353 ft	12.050438 ft	0 psf	240.39343 psf	138.79121 psf	0 psf	0 psf	Rooting Zone/Sand
Column 130	131.25326 ft	12.090558 ft	0 psf	230.16392 psf	132.8852 psf	0 psf	0 psf	Rooting Zone/Sand
Column 131	131.40299 ft	12.130679 ft	0 psf	219.93441 psf	126.97919 psf	0 psf	0 psf	Rooting Zone/Sand
Column 132	131.55272 ft	12.170800 ft	0 psf	209.7049 psf	121.07318 psf	0 psf	0 psf	Rooting Zone/Sand
Column 133	131.70246 ft	12.210920 ft	0 psf	199.4754 psf	115.16717 psf	0 psf	0 psf	Rooting Zone/Sand
Column 134	131.85219 ft	12.251041 ft	0 psf	189.24589 psf	109.26116 psf	0 psf	0 psf	Rooting Zone/Sand

Column 135	132.00192 ft	12.291162 ft	0 psf	179.01638 psf	103.35516 psf	0 psf	0 psf	Rooting Zone/Sand
Column 136	132.15165 ft	12.331282 ft	0 psf	168.78687 psf	97.449147 psf	0 psf	0 psf	Rooting Zone/Sand
Column 137	132.30139 ft	12.371403 ft	0 psf	158.55737 psf	91.543138 psf	0 psf	0 psf	Rooting Zone/Sand
Column 138	132.45112 ft	12.411524 ft	0 psf	148.32786 psf	85.637129 psf	0 psf	0 psf	Rooting Zone/Sand
Column 139	132.60085 ft	12.451644 ft	0 psf	138.09835 psf	79.73112 psf	0 psf	0 psf	Rooting Zone/Sand
Column 140	132.75058 ft	12.491765 ft	0 psf	127.86884 psf	73.825111 psf	0 psf	0 psf	Rooting Zone/Sand
Column 141	132.90032 ft	12.531886 ft	0 psf	117.63934 psf	67.919102 psf	0 psf	0 psf	Rooting Zone/Sand
Column 142	133.05005 ft	12.572006 ft	0 psf	107.40983 psf	62.013093 psf	0 psf	0 psf	Rooting Zone/Sand
Column 143	133.19978 ft	12.612127 ft	0 psf	97.180321 psf	56.107084 psf	0 psf	0 psf	Rooting Zone/Sand
Column 144	133.34951 ft	12.652248 ft	0 psf	86.950813 psf	50.201076 psf	0 psf	0 psf	Rooting Zone/Sand
Column 145	133.49925 ft	12.692368 ft	0 psf	76.721306 psf	44.295067 psf	0 psf	0 psf	Rooting Zone/Sand
Column 146	133.64898 ft	12.732489 ft	0 psf	66.491799 psf	38.389058 psf	0 psf	0 psf	Rooting Zone/Sand
Column 147	133.79871 ft	12.772610 ft	0 psf	56.262291 psf	32.483049 psf	0 psf	0 psf	Rooting Zone/Sand
Column 148	133.94844 ft	12.812730 ft	0 psf	46.032784 psf	26.57704 psf	0 psf	0 psf	Rooting Zone/Sand
Column 149	134.09817 ft	12.852851 ft	0 psf	35.803276 psf	20.671031 psf	0 psf	0 psf	Rooting Zone/Sand
Column 150	134.24791 ft	12.892972 ft	0 psf	25.573769 psf	14.765022 psf	0 psf	0 psf	Rooting Zone/Sand
Column 151	134.39764 ft	12.933092 ft	0 psf	15.344261 psf	8.8590133 psf	0 psf	0 psf	Rooting Zone/Sand
Column 152	134.54737 ft	12.973213 ft	0 psf	5.1147537 psf	2.9530044 psf	0 psf	0 psf	Rooting Zone/Sand

Appendix I

Seepage Potential and Karst Condition Assessment

Seepage Potential and Karst Condition Assessment

The disposal facility is designed and constructed to include storm water run-on and run-off management and leachate collection systems. The liner system is designed and constructed to be above the high groundwater level. There are currently no concerns that storm water, leachate, or groundwater movement will impact the stability of the landfill.

As noted in **Appendix E**, karst features were not observed in the borings within and adjacent to the disposal facility. The borings encountered sandstone bedrock that is not subject to karst conditions. The Wisconsin map of karst and shallow carbonate bedrock in **Appendix E** indicates that karst structures are not located in or near the disposal facility.

I:\25224034.00\Deliverables\Location Restrictions Compliance\Appendices\I-Seepage Potential and Karst Condition Assessment\I1_Seepage Potential and Karst Condition Assessment.docx