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February 1, 2023

Submitted via electronic mail

Ms. Ann Bekta
Wisconsin Department of Natural Resources
2514 Morse Street
Janesville, WI 53545

Subject: **Plan of Operations Modification Request – Addendum #1**
Initial Permitting of CCR Landfill
Wisconsin Power and Light Company
Dry Ash Disposal Facility (WDNR License #3025)
Columbia Energy Center
Portage, WI

Dear Ms. Bekta,

On behalf of Wisconsin Power and Light Company (WPL), Alliant Energy is submitting this Addendum #1 to the Plan of Operations Modification intended to meet the requirements of NR 514.045 for Initial Permitting of a CCR Landfill. As described in the document and discussed with the Department staff via conference call, this Plan Modification Request for the Dry Ash Disposal Facility located at the Columbia Energy Center (#3025) will be supplemented with additional information in the coming weeks.

Thank you very much for your consideration of this initial submittal. If you have any questions or comments regarding this information, please call me at (608) 458-3853.

Regards,

Jeff Maxted
Manager – Environmental Services
Alliant Energy

CC: Tyler Sullivan – Wisconsin DNR
Eric Sandvig, Director of Operations – Columbia Energy Center
Brian Clepper, Lead GENCO Environmental Specialist – Columbia Energy Center
Phil Gearing, Eric Nelson – SCS Engineers

February 1, 2023
File No. 25222260.00

Ms. Ann Bekta
Wisconsin Department of Natural Resources
2514 Morse Street
Janesville, WI 53545

Subject: Addendum No. 1 to Plan of Operation Modification Request WDNR CCR Code Update
Dry Ash Disposal Facility, License #3025
Columbia Energy Center
Town of Pacific, Columbia County, Wisconsin

Dear Ms. Bekta:

On behalf of Wisconsin Power and Light Company (WPL), SCS Engineers (SCS) prepared this Addendum No. 1 to the Plan Modification Request/Plan of Operation Update for the Dry Ash Disposal Facility, License No. 3025, at the Columbia Energy Center. This addendum covers additional information for the Wisconsin Department of Natural Resources (WDNR) Coal Combustion Residuals (CCR) Code Update dated December 2022 to demonstrate compliance with NR 514.045. WPL and SCS plan to submit additional addendums, as discussed below.

FUTURE ADDENDUM ITEMS

As discussed during the January 23, 2023 teleconference, attended by representatives from the WDNR, Alliant Energy, WPL, and SCS, there are additional items in progress that maybe addressed through future addendums to this Plan Modification Request/Plan of Operation Update. These items include, but are not limited to:

- Groundwater monitoring network demonstration under NR 514.045(1)(h)
- Updated sampling plan under NR 514.045(1)(h)
- Leachate/Contact Water Pond abandonment strategy
- Phase 1, Modules 5 and 6 Final Cover Permanent Haul Road
- Plan for care and maintenance of the leachate collection system tanks and pumps
- Module 12 Liner Design, or proposal for the removal of the Module 11 liner runout

If you have any questions regarding this addendum, please contact Jeff Maxted with Alliant Energy at (608) 458-3853.

Sincerely,

Mark R. Huber, PE
Design Director
SCS Engineers

Phil Gearing, PE
Senior Project Manager
SCS Engineers

MRH/AJR/mjt/PEG

cc: Tyler Sullivan, WDNR
Jeff Maxted, Alliant Energy
Matt Bizjack, Alliant Energy
Brian Clepper, WPL

Encl. Addendum No. 1, Plan of Operation Modification Request WDNR CCR Code Update

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Plan of Operation Modification Request
WDNR CCR Code Update
Addendum No. 1

Columbia Dry Ash Disposal Facility
Pardeeville, Wisconsin

Prepared for:

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

SCS ENGINEERS

25222260.00 | February 1, 2023

2830 Dairy Drive
Madison, WI 53718-6751
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Table of Contents

Section Page

Tables

Figures

Appendices

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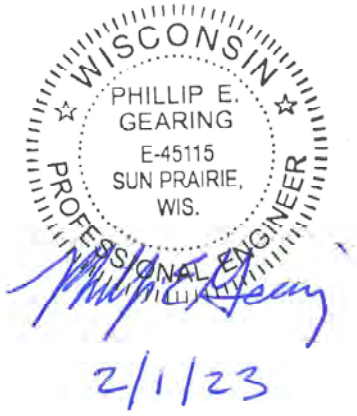
CERTIFICATIONS

"I, Phillip E. Gearing, hereby certify that I am a licensed professional engineer in the State of Wisconsin in accordance with the requirements of ch. A-E 4, Wis. Adm. Code; that this document has been prepared in accordance with the Rules of Professional Conduct in ch. A-E 8, Wis. Adm. Code; and that, to the best of my knowledge, all information contained in this document is correct and the document was prepared in compliance with all applicable requirements in chs. NR 500 to 538, Wis. Adm. Code."

_____, Senior Project Manager E-45115
Signature, title and P.E. number

February 1, 2023
Date



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1.0 INTRODUCTION

On behalf of Wisconsin Power and Light Company (WPL), SCS Engineers (SCS) prepared this Plan of Operation Modification (Plan Mod) Request – Addendum No. 1 for the Columbia Dry Ash Disposal (COL) Facility. This Addendum includes the information submitted with the original submittal and additional information developed since that submittal.

See **Figure 1** for the site location. This Plan Mod Request is submitted in accordance with the requirements of NR 514.045 and to demonstrate compliance with coal combustion residual (CCR) regulations that became effective in August 2022.

The COL facility includes an existing CCR landfill (Phase 1, Modules 1 through 3) and a new CCR landfill (Phase 1 Modules 4 through 6), all of which are contiguous and managed as a single landfill. In addition, the new CCR landfill will include Phase 2, Modules 10 and 11, which is currently under construction. The new modules will be used for disposal following approval of the liner Construction Documentation Report, which will be submitted for Wisconsin Department of Natural Resources (WDNR) review early in 2023. This Plan Mod Request addresses Phase 1, Modules 1 through 6 and Phase 2, Modules 10 and 11 (the CCR landfill). Construction of additional modules is not currently planned prior to retirement of the Columbia Energy Center, which is currently scheduled to occur no later than June 1, 2026.

2.0 PERFORMANCE AND LOCATION CRITERIA

NR514.045 (1)

> *"…The plan of operation modification shall address all phases of the CCR landfill. At a minimum, the plan of operation modification shall include all of the following:"*

2.1 PERFORMANCE CRITERIA UNDER NR 514.045 (1)(b)

NR 514.045 (b)

> *"A demonstration that all phases of the CCR landfill meet the performance criteria under s. NR 504.04 (4) (a), (b), and (c)."*

NR 504.04 (4)

> *"PERFORMANCE STANDARDS. No person may establish, construct, operate, maintain or permit the use of property for a landfill if there is a reasonable probability that the landfill will cause:"*

2.1.1 Compliance With NR 504.04 (4)(a)

NR 504.04 (4) (a)

> *"A significant adverse impact on wetlands as provided in ch. NR 103."*

Phase 1, Modules 1 through 6 are not located in wetlands. The location of Phase 1, Modules 1 through 6 is shown on **Figure 2**, and maps from a September 25, 2017 wetland delineation study conducted by Mach IV, are included in **Appendix A1**.

A wetland delineation conducted in 2017 (**Appendix A1**) identified one artificial wetland ("Wetland 1") within the Phase 2, Module 10 and 11 area (**Figure 2**). The artificial wetland was not identified as a mapped wetland in state or federal resources, and it was not located adjacent to the Waters of the State. WPL consulted with the WDNR to confirm its status as an artificial wetland and received concurrence that it is exempt from the permitting requirements of NR 103. Through the exemption process, WDNR and WPL determined that construction of Phase 2 Modules 10 and 11 would have no adverse impact on wetlands as provided in NR 103, and the artificial wetland was removed prior to construction of the Module 10 and 11 liner in 2022. No additional wetlands were delineated within the Phase 2, Module 10 and 11 area.

Run-off from the active portions of the facility is handled as contact water and is collected by a leachate collection system and internal swales, which route the contact water run-off to a lined contact water basin (shown in **Figure 2**), preventing contact water from having an adverse impact on wetlands.

The South Sedimentation Basin, shown on **Figure 2**, is designed to collect storm water diverted from covered portions of the CCR landfill. The South Sedimentation Basin discharges to a wetland area to the south of the pond. The South Sedimentation Basin is sized to handle storm water from a 25-year, 24-hour storm event without overtopping the 100-year, 24-hour emergency spillway and to allow a 15 micron particle size to settle out during a design storm event to prevent adverse impacts on downstream wetlands.

Storm water from northeast and northern parts of the CCR landfill, outside of the CCR landfill footprint, flow to swales south of Murray Road. The storm water from these swales is directed through a culvert under Murray Road, where the water infiltrates in a low spot on the north side of Murray Road. Storm water from these areas of the CCR landfill does not result in adverse impacts to downstream wetlands.

2.1.2 Compliance With NR 504.04 (4)(b)

NR 504.04 (4) (b)

"A take of an endangered or threatened species in accordance with s. 29.604, Stats."

In October 2022, an endangered resources review approved by WDNR was renewed for the construction of Modules 10 and 11. The review indicated that one federally endangered species, the slender glass lizard (*Ophisaurus attenuatus*) may be present in the surrounding area resulting in mowing and clearing requirements to ensure that the species, if present in the landfill footprint, would not be affected by construction activities or operations. The site adheres to these requirements to prevent the take of endangered or threatened species.

2.1.3 Compliance With NR 504.04 (4)(c)

NR 504.04 (4) (c)

"A detrimental effect on any surface water."

Storm water runoff calculations were performed to demonstrate that the existing storm water sedimentation basin and proposed storm water management features included in the CCR landfill can accommodate and safely convey the runoff from a 25-year, 24-hour storm event during post closure conditions. Storm water that comes into contact with waste is routed to a lined basin and

then hauled as needed to the plant for management in accordance with the facility's Wisconsin Pollutant Discharge Elimination System (WPDES) permit. Calculations were provided with the May 2022 submission of the Plan Modification Request/Plan of Operation Update.

2.2 LOCATIONAL CRITERIA UNDER NR 514.045 (1)(c)

NR 514.045 (c)

> *"A demonstration that all phases of the CCR landfill meet the locational criteria under s. NR 504.04 (3) (g), (h), and (i)…."*

NR 504.04 (3)

> *"LOCATIONAL CRITERIA. No person may establish, construct, operate, maintain or permit the use of property for a landfill where the limits of filling are or would be within the following areas:"*

2.2.1 Compliance With NR 504.04 (3)(g)

NR 504.04 (3) (g)

> *"Within 200 feet of a fault that has had displacement in Holocene time."*

Based on a review of the U.S. Geological Survey (USGS) Quaternary faults database and map as shown in Appendix A2, the CCR landfill is not located within 200 feet of the outermost damage zone of a fault that has had displacement in Holocene time. In NR 500.03 (103), Holocene is defined as the most recent epoch of the Quaternary period extending from the end of the Pleistocene Epoch to the present. The USGS map shows that no faults are located in Wisconsin.

2.2.2 Compliance With NR 504.04 (3)(h)

NR 504.04 (3) (h)

> *"Within seismic impact zones."*

The CCR landfill is not located in seismic impact zones. NR 500.03(208) defines a seismic impact zone as an area having a 10 percent or greater probability that the maximum expected horizontal acceleration in lithified earth material, 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 A3), 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.

2.2.3 Compliance With NR 504.04 (3)(i)

NR 504.04 (3) (i)

> *"Within unstable areas."*

Unstable areas are addressed in Section 2.2.4

2.2.4 Compliance With NR 514.045 (1)(c)(1)

NR 514.045 (1)(c)

> *"…The demonstration shall address all of the following factors, at a minimum, when determining whether an area is unstable:"*

NR 514.045 (1)(c)(1)

> *"On–site or local soil conditions that may result in significant differential settling.*

As discussed in **Appendices A4** and **A5**, and as shown by the geologic cross sections from the June 1980 Supplementary Feasibility Study prepared by Warzyn Engineering Inc. (see **Appendix A6**), the CCR landfill is 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.

2.2.5 Compliance With NR 514.045 (1)(c)(2)

NR 514.045 (1)(c)(2)

> *"On–site or local geologic or geomorphologic features."*

As discussed in **Appendices A4**, **A7**, and **A8**, and shown by the geologic cross sections in **Appendix A6**, the CCR landfill is 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 completed for Phase 1, Modules 1 through 4, Modules 5 and 6, and Phase 2, Modules 10 and 11 that indicate the slope stability safety factors are acceptable.

The slope stability analyses in **Appendix A7** were performed for Phase 2, Modules 10 and 11 with maximum waste slope heights of 101 feet, and slopes of 3 horizontal to 1 vertical (3H:1V) and 4H:1V. The results in **Appendix A7** confirm that the slope stability safety factors for Modules 10 and 11 are acceptable.

The waste slopes in Phase 1, Modules 1 through 6 do not exceed 101 feet, so the results of the analyses in **Appendix A7** are representative of conditions in Phase 1, Modules 1 through 6.

2.2.6 Compliance With NR 514.045 (1)(c)(3)

NR 514.045 (1)(c)(3)

> *"On–site or local human–made features or events both surface and subsurface."*

As shown by the geologic cross sections in **Appendix A6**, the CCR landfill is 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 CCR 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 CCR landfill.

As discussed in Appendix A8, 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.

2.3 LOCATIONAL CRITERIA UNDER NR 514.045 (1)(d)

2.3.1 Compliance With NR 514.045 (1)(d)

NR 514.045 (1)(d)

> *"A demonstration that the facility or practices near floodplains may not restrict the flow of the regional flood, reduce the temporary water storage capacity of the floodplain, or result in washout of solid waste so as to pose a hazard to human life, wildlife, or land or water resources."*

The CCR landfill is not located within a floodplain as shown in Appendix A9.

2.4 LOCATIONAL CRITERIA UNDER NR 514.045 (1)(e)

2.4.1 Compliance With NR 514.045 (1)(e)

NR 514.045 (1)(e)

> *"A demonstration that the facility or practices may not result in the destruction or adverse modifications of the critical habitat of endangered or threatened species as identified under s. NR 27.03 (1)."*

An Endangered Resources Review for the recent Proposed Columbia Ash Landfill Expansion was renewed on October 24, 2022. No area affected by construction of operations of the CCR landfill has been identified as critical habitat for endangered or threatened species. Information in the Wisconsin Natural Heritage Inventory are considered confidential by WDNR, so this review has been redacted from this submittal.

3.0 LANDFILL DESIGN DEMONSTRATION

3.1 LANDFILL DESIGN DEMONSTRATION UNDER NR 514.045 (1)(f)

NR 514.045 (1)(f)

> *"A demonstration that the CCR landfill design meets requirements under s. NR 504.12 or an alternate design under s. NR 504.10. The demonstration shall include a design report, engineering drawings, and calculations."*

3.1.1 Landfill Design Demonstration under NR 504.12

3.1.1.1 Compliance With NR 504.12 (2)

NR 504.12 (2)

> *"RUN–ON AND RUN–OFF CONTROLS. An existing or new CCR landfill or any lateral expansion of a CCR landfill shall be designed, constructed, operated, and maintained with a run–off and run–on control system in accordance with the requirements under s. NR 504.09 (1) (f) and (g) and all of the following:"*

NR 504.09 (1)(f)

> *"Storm water shall be diverted away from the active fill area of the landfill and any borrow areas to a sedimentation control structure."*

Storm water run-on is controlled by berms and swales around the perimeter of the landfill that divert storm water away from the landfill. Run-off from areas outside existing CCR units and areas of the existing CCR units where final or intermediate cover is in place is diverted into the perimeter drainage swales, which drain to the South Sedimentation Basin. Intermediate swales/berms and downslope channels on the final cover help minimize erosion of the final cover and divert water to the perimeter drainage system, and ultimately to the South Sedimentation Basin. Run-off from the active portions of the facility is handled as contact water and is collected by a leachate collection system and internal swales, which route the contact water run-off to the lined Leachate/Surface Water Pond.

NR 504.09 (1)(g)

> *"Containment berms placed around active fill areas shall be designed to control and collect the liquid volume resulting from the 25 year, 24–hour storm event. The design shall consider the volume of liquid generated from active fill areas which shall include areas with exposed solid waste or areas with waste covered by daily cover. Storm water in contact with active fill areas shall be handled and treated as leachate in accordance with ch. NR 506."*

The storm water features described above are designed to handle run-on and run-off from a 25-year, 24-hour storm event. Storm water run-off calculations are included in **Appendix B1**, including calculations from the 2000 Plan of Operation Update (**Appendix B1.1**), the 2021 Leachate/Surface Water Pond Capacity Evaluation calculations (**Appendix B1.2**), the 2022 Leachate/Surface Water Pond Evaluation calculations (**Appendix B1.3**), and 2022 Storm Water Management Calculations for post-closure conditions (**Appendix B1.4**). These appendices describe the storm water management design and provide calculations showing that the run-on control system will prevent flow onto the active portion of the CCR units during the peak discharge from a 25-year, 24-hour storm. The 2021 and 2022 calculations also describe the storm water management design and provide calculations showing that the run-off control system for the active portions of the CCR units will collect and control the water volume resulting from a 25-year, 24-hour storm. The South Sedimentation Basin and associated basin outlet structures are designed to safely pass run-off from a 100-year, 24-hour storm event.

NR 504.12 (2)(a)

> *"A run–on control system shall prevent flow onto the active portion of the CCR landfill during the peak discharge from a 24–hour, 25–year storm."*

The entire facility has run-on and run-off control in place, as approved by the WDNR and described further in **Appendix C2**. Run-on is controlled by berms and swales around the perimeter of the landfill that divert storm water away from the landfill.

NR 504.12 (2)(b)

> *"A run–off control system from the active portion of the CCR landfill shall collect and control, at a minimum, the water volume resulting from a 24–hour, 25–year storm."*

Run-off from the active portions of the facility is handled as leachate and is collected by a leachate collection system and internal swales, which route the contact water run-off and leachate to the lined Leachate/Surface Water Pond. Intermediate cover will be added as CCR placement progresses to reduce contact water that is directed to the pond. The contact water in the pond is used for dust control or other actions within the active landfill or, if needed, is transported with a water wagon to the generating station where it may be discharged through Outfall 003 inside the plant in accordance with a WPDES permit.

Run-off from areas outside existing CCR units and areas of the existing CCR units where final or intermediate cover is in place is diverted into the perimeter drainage swales, which drain to the South Sedimentation Basin or a low area north of the facility. Intermediate swales/berms and downslope channels on the final cover help minimize erosion of the final cover and divert water to the perimeter drainage system.

A temporary rain cover will be installed as needed over landfill liner not currently in use, to limit leachate and contact water production. Storm water collected on the rain cover will be diverted to perimeter swales, and ultimately to the sedimentation basin. The rain cover will be removed in sections to accommodate waste placement. As the rain cover is removed, new diversion berms will be constructed to form the perimeter of a storm water containment area. The berms will prevent contact water from running onto the rain cover and will anchor or ballast the rain cover at the new limits. When the rain cover has been fully removed, run-off will be controlled by the limits of the developed modules, and all water inside the lined waste limits will be managed as leachate.

3.1.1.2 Compliance With NR 504.12 (3)

NR 504.12 (3)(a)

> *"LINER DESIGN. (a) A new CCR landfill or a lateral expansion of a CCR landfill shall be designed, constructed, operated, and maintained with a composite liner that meets the requirements under s. NR 504.06 (2) and (3) and a leachate collection and removal system that meets the requirements under s. NR 504.06(5). The composite liner shall consist of 2 components; the upper component shall consist of a nominal 60–mil or thicker geomembrane liner, and the lower component shall consist of a minimum 4–foot–thick layer of compacted clay. A GCL and soil barrier may be used in place of the clay layer of a composite liner in accordance with s. NR 504.06 (7). In addition to the minimum design and construction criteria for landfill liners and leachate collection systems under s. NR 504.06, the liner and leachate collection system shall meet all of the following:"*

Construction commenced prior to October 19, 2015 for Phase 1, Modules 1 through 3. These modules do not fall under the NR 500.03 (152m) definition of "New CCR landfill" and meet the definition of "Existing CCR landfill" under NR 500.03 (76m). As existing CCR landfill modules, NR 504.12(3) is not applicable to Phase 1, Modules 1 through 3.

Phase 1, Modules 4 through 6, and Phase 2, Modules 10 and 11 were designed with a composite liner in accordance with NR 504.06 (7), shown on **Figure 3**, consisting of the following three layers from top to bottom:

- A 60-mil thick HDPE geomembrane
- A geosynthetic clay liner (GCL)
- Two feet of compacted clay soil with a hydraulic conductivity of no more than 1×10^{-7} cm/sec

A review of chemical resistance documentation for high-density polyethylene (HDPE) geomembrane provided by geomembrane manufacturers indicates that the HDPE geomembrane is chemically resistant to the CCR and CCR-generated leachate. The chemical resistance assessment is also based on a review of Columbia leachate pond analytical test results from 2011 to 2020.

The GCL specified in the design includes a polymer-enhanced bentonite clay that has appropriate chemical properties in contact with the Phase 1, Modules 4 through 6 and Phase 2, Modules 10 and 11 CCR leachate. Testing was performed to demonstrate that the GCL is compatible with the site-generated CCR leachate as shown in **Appendix B2**.

The composite liner layers have sufficient strength and thickness to prevent failure due to pressure gradients, climatic conditions, installation stresses, and daily operation stresses expected in Phase 1, Modules 4 through 6 and Phase 2, Modules 10 and 11.

GCLs used in the construction of the liner and final cover systems at the CCR Landfill meet the specifications of NR 504.07(4)(a)1 to 11. A 60-mil HDPE geomembrane is to be placed directly above the GCL. The geomembrane meets the specifications of NR 504.07(3).

The new CCR landfill has been designed with a composite liner that meets the requirements under NR 504.06 (2) and (3) and with a leachate collection and removal system that meets the requirements under NR 504.06(5).

NR 504.12 (3)(a)(1)

> *"The leachate collection and removal system shall be designed, constructed, operated, and maintained to limit the leachate head level on the liner to one foot or less."*

The Hydrologic Evaluation of Landfill Performance (HELP) Model was used to evaluate the leachate head on the Phase 1, Modules 4 through 6 and Phase 2, Modules 10 and 11 liner. Based on the model results, the head on the liner will be maintained below the maximum allowable 1-foot (30-centimeter) head. The HELP Model calculation is provided in **Appendix B3**. Based on the model, Phase 1, Modules 4 through 6 and Phase 2, Modules 10 and 11 are designed and will be operated to maintain less than a 30-centimeter depth of leachate over the liner.

NR 504.12 (3)(a)(2)

"The leachate collection and removal system shall be constructed of materials that exhibit all of the following properties:"

NR 504.12 (3)(a)(2)(a)

"Chemically resistant to the CCR and any non–CCR waste managed in the CCR landfill and the leachate expected to be generated."

The leachate collection and removal system consists of HDPE pipe, leachate drainage layer, drainage filter, coarse aggregate bedding, and geotextile as shown on **Figures 3, 4,** and **5**. The leachate drainage layer consists of imported granular soil. The drainage filter and coarse aggregate bedding are imported granular soils. The pipe, granular soils, and geotextile are chemically resistant to the CCR and CCR-generated leachate.

The pipe consists of HDPE, the same material as the HDPE geomembrane. Both the HDPE pipe and the geomembrane are resistant to the CCR and CCR-generated leachate as confirmed by the manufacturer's literature.

The geotextile may consist of polypropylene, polyester, or polyethylene. Based on testing by the manufacturers and other researchers, these materials are resistant to municipal solid waste landfill leachate that is much more aggressive than CCR leachate. Therefore, the geotextile is chemically resistant to the CCR and CCR-generated leachate.

The granular soils used in the leachate collection and removal system meet the same Wis. Adm. Code standards as the granular soils used in municipal solid waste landfills. The municipal solid waste landfill leachate is much more aggressive than CCR leachate so the granular soils are chemically resistant to the CCR and CCR-generated leachate.

NR 504.12 (3)(a)(2)(b)

"Of sufficient strength and thickness to prevent collapse under the pressures exerted by overlying waste, waste cover materials, and equipment used at the CCR landfill."

During the design of Phase 1, Modules 4 through 6 and Phase 2, Modules 10 and 11, the HDPE collection and removal pipe was evaluated for pipe strength using construction/operation loads and post-closure loads to determine the required materials of construction. Based on the pipe strength calculations in **Appendix B4**, the HDPE pipe will have sufficient strength to prevent collapse under the pressures exerted by the CCR, cover materials, and equipment used in the operation of the CCR landfill, based on the equipment currently used to operate the existing CCR units at the facility.

NR 504.12 (3)(a)(3)

"The leachate collection and removal system shall be designed and operated to minimize clogging during the active life and during the long–term care of the landfill."

The leachate collection and removal system is designed with a drainage filter as shown on **Figure 3**. The filter minimizes the movement of fine particles into the leachate collection pipes to prevent clogging**.** Filter calculations are provided in the documentation report for each module construction based on the specific gradation of material provided for coarse aggregate and drainage material. The

leachate collection and removal system is designed with cleanout riser pipes as shown on **Figures 3, 4,** and **5** to allow pipe cleaning and prevent long-term clogging. The leachate collection pipes are cleaned a minimum of once per year in accordance with Wis. Adm. Code.

NR 504.12 (3)(a)(4)

> *"The geomembrane component of the liner shall be installed in direct and uniform contact with the compacted clay soil component."*

Phase 1, Modules 4 through 6 and Phase 2, Modules 10 and 11, are designed with a composite liner, shown on **Figure 3**, consisting of the following two components from top to bottom:

- Upper Component :
  - A 60-mil thick HDPE geomembrane
  - A GCL
- Lower Component:
  - Two feet of compacted clay soil with a hydraulic conductivity of no more than 1 x 10^{-7} cm/sec

This is the same composite liner that meets the requirements of NR 504.06 (2) with the addition of the GCL layer to the upper component, in accordance with NR 504.06 (7). The GCL provides an extra layer within the composite liner to reduce the potential for liquid flow through the liner.

The presence of the GCL provides better protection against liquid flow through the Phase 1, Modules 4 through 6 and Phase 2, Modules 10 and 11 liner than a composite liner with two layers (HDPE geomembrane and 2 feet of compacted soil). The upper component (geomembrane and GCL) has direct and intimate contact with the compacted clay soil as the lower component. Laboratory test results reported by Koerner and Daniel (1993) show that the combination of a GCL in contact with a geomembrane is significantly lower in transmissivity of liquid than a compacted clay liner in contact with a geomembrane.

NR 504.12 (3)(a)(5)

> *"A liner that utilizes a GCL and soil barrier layer in accordance with s. NR 504.06 (7) shall be designed to have a liquid flow rate no greater than the liquid flow rate through 2 feet of compacted soil with a hydraulic conductivity of 1 x 10^{-7} cm/sec. The liquid flow rate comparison shall be made using the following equation, which is derived from Darcy's Law for gravity flow through porous media:*
>
> $$Q/A = q = k\,(h/t + 1)$$
>
> *Where:*
> *Q = flow rate (cubic centimeters / second).*
> *A = surface area of the liner (squared centimeters).*
> *q = flow rate per unit area (cubic centimeters / second / squared centimeter).*
> *k = hydraulic conductivity of the liner (centimeters / second).*
> *h = hydraulic head above the liner (centimeters).*
> *t = thickness of the liner (centimeters)."*

The lower component of the composite liner is the 2-foot-thick compacted clay soil layer. The addition of a GCL to the composite liner system reduces the hydraulic conductivity of the composite liner below the maximum required value of 1 x 10^{-7} cm/sec. In combination, the GCL and the compacted clay exceed the design requirements. The hydraulic conductivity of the GCL specified in the design of Phase 1, Modules 4 through 6 and Phase 3, Modules 10 and 11 is a maximum of 5 x 10^{-9} cm/sec. The hydraulic conductivity of the compacted clay specified in the design of Phase 1, Modules 4 through 6 and Phase 3, Modules 10 and 11 is a maximum of 1 x 10^{-7} cm/sec, which meets the rule requirement.

The flow rate per unit area ("q") of the GCL underlain by 2 feet of compacted clay is less than the "q" of the minimum 2-foot-thick compacted soil layer required under NR 504.06 (2) as shown by the calculations in **Appendix B5**. Therefore, the hydraulic conductivity of the GCL in combination with the 2 feet of compacted clay soil has a liquid flow rate that is no greater than the liquid flow rate through 2 feet of compacted soil with a hydraulic conductivity of 1 x 10^{-7} cm/sec. In addition, a paper by Koerner and Daniel (1993) shows that the liquid flow rate through a GCL alone is equivalent to the flow rate through 2 feet of compacted clay.

NR 504.12 (3)(b)

> *"A new CCR landfill or a lateral expansion of a CCR landfill shall be designed and constructed with a subbase grade that is located no less than 5 feet above the upper limit of the uppermost aquifer, or shall demonstrate that there will not be an intermittent recurring or sustained hydraulic connection between any portion of the base of the CCR landfill and the uppermost aquifer due to normal fluctuations in groundwater elevations, including the seasonal high water table."*
>
> *Note: A new CCR landfill or lateral expansion of a CCR landfill is also required to comply with s. NR 504.06 (2) (b) or (4) for zone–of–saturation landfills. The definition of an uppermost aquifer can be found under s. NR 500.03 (246m).*

The high water table within the uppermost aquifer below the CCR landfill is at an approximate elevation of 789 to 790 feet above mean sea level (amsl), based on a review of water table observation well water levels near the CCR landfill, for the period from October 2012 to December 2022; refer to **Appendix B6**. The highest water level elevation measured at a well in the area of the CCR landfill was 789.71 feet amsl recorded at MW-5R, which is located near the southwest corner of Phase 1, Module 1. The highest water level elevation measured in a well in the area of Phase 2, Modules 10 and 11 was 788.21 feet amsl recorded at MW-86.

Figure 6 shows the lowest subbase grades in Phase 1, Modules 4 through 6 and Phase 2, Modules 10 and 11, which represent the top of subbase soils and bottom of the clay liner. The lowest subbase elevation within Phase 1 Module 4 is approximately 801 feet amsl. The lowest subbase elevation within Phase 1, Modules 5 and 6 is approximately 802 feet amsl. Within Phase 2, Modules 10 and 11, the lowest subbase grade is approximately 794 feet amsl.

Based on this information, the CCR landfill is located at least 5 feet above the uppermost aquifer.

NR 504.12 (3)(c)

> *"A new CCR landfill or a lateral expansion of a CCR landfill may not be constructed over a closed CCR surface impoundment."*

The existing CCR landfill has not been constructed over a closed CCR surface impoundment.

3.1.1.3 Compliance With NR 504.12 (4)

NR 504.12 (4)(a)

> *"A new or existing CCR landfill or a lateral expansion of a CCR landfill shall be designed and constructed with a final cover system that meets the requirements under s. NR 504.07."*

Phase 1, Module 1 has received final cover over outer sideslope areas that will no longer receive CCR. The existing final cover in the Module 1 area will be extended to cover the remaining portion of Module 1 as shown on **Figure 8**.

The existing final cover consists of a composite cover (**Figure 7**) with the following components, from bottom to top:

- Three-inch-thick grading layer
- GCL
- Forty-mil polyethylene geomembrane
- Twelve-inch-thick drainage layer (sand)
- Twelve-inch-thick rooting zone layer
- Six-inch-thick topsoil layer

An alternative final cover system was approved by WDNR in July 2022 for future remaining areas of final cover north of Module 1. The alternative cover consists of the following components, from bottom to top:

- Three-inch-thick grading layer
- GCL
- Forty-mil polyethylene geomembrane
- Geocomposite drainage layer
- Twenty-four-inch-thick rooting zone layer
- Six-inch-thick topsoil layer

The alternative final cover design has been developed to meet the requirements of NR 504.12(4)(b) and is discussed in detail below.

Calculations for the final cover designs are included in **Appendix B7.**

NR 504.12 (4)(b)

> *"The owner or operator of a new or existing CCR landfill or a lateral expansion of a CCR landfill may propose an alternative final cover system design within a written closure plan in accordance with s. NR 504.10 and all of the following:"*

The alternative final cover system design previously approved by the Department in accordance with NR 504.10 is described further within the written closure plan provided in this Plan of Operation Update (**Appendix C3**). The final cover system design is in accordance with the federal requirements under 40 CFR Part 257, Subpart D.

NR 504.12 (4)(b)(1)

> *"The permeability of the final cover system shall be less than or equal to the permeability of any bottom liner system or natural subsoils present or shall be no greater than 1 x 10^{-5} cm/sec, whichever is less."*

The permeability of the alternative final cover system is less than or equal to the permeability of the bottom liner system and is less than 1 x 10^{-5} centimeters per second (cm/sec) required by the rule. The CCR landfill cover system contains a GCL with a permeability of 5 x 10^{-9} cm/sec. Please see the Closure Plan (**Appendix C3**) for more information. **NR 504.12 (4)(b)(2)**

> *"The design of the final cover system shall include an infiltration layer that achieves an equivalent reduction in infiltration as the layers specified under s. NR 504.07 (4)."*

The alternative final cover contains a GCL infiltration layer. Water infiltrating the final cover will be contained in the drainage layers (sand, geocomposite, and high capacity geocomposite), which will limit infiltration through the final cover system geomembrane and GCL. Further discussions with the WDNR will be needed to determine whether updates to the design are required, including potential addition of a soil barrier layer. An updated design, if required, will be provided as an Addendum to this document.

The geocomposite drainage layer will have a minimum transmissivity of 8.55 x 10^{-4} m^2/sec unless drainage outlets are constructed within the final cover. For the converging flow areas in the final cover inside corners near Phase 2, Modules 10 and 11, a high capacity geocomposite drainage layer with a minimum transmissivity of 1.0 x 10^{-3} m^2/sec will be installed. Please see the Closure Plan (**Appendix C3**) for more information.

NR 504.12 (4)(b)(3)

> *"The design of the final cover system shall include an erosion layer that provides equivalent protection from wind or water erosion as the topsoil layer specified under s. NR 504.07 (7)."*

The surface layer of 30 inches of soil supports vegetation that assists with erosion control. The surface has intermediate drainage swales to reduce the flow lengths down the final cover slope, also aiding in erosion control. Where needed, the intermediate drainage swales are connected to downslope channels to control storm water runoff and prevent erosion of the final cover.

NR 504.12 (4)(b)(4)

> *"The disruption of the integrity of the final cover system shall be minimized through a design that accommodates settling and subsidence."*

The design of the final cover system accommodates settling and subsidence of the CCR fill below the cover. The CCR at the CCR landfill is placed dry and is compacted in place. CCR continues to consolidate and gain strength as filling progresses prior to final cover placement. The final cover system is designed with a maximum slope of 25 percent (4 horizontal to 1 vertical). Because the final cover has a relatively large positive slope and the CCR has been gaining strength over time, the final cover is expected to easily accommodate the remaining relatively minor settlement potential of the CCR fill when fill placement ends and the landfill is closed.

3.1.2 Alternate Landfill Design Demonstration under NR 504.10

NR 504.10 (1)(a)

> *"An applicant may design a high volume industrial waste landfill to meet the standards contained in ss. NR 504.05 to 504.09 or may propose an alternative design in accordance with the provisions of this section."*

The CCR landfill has been designed to meet the standards contained in NR 504.05 to NR 504.09. However, an alternative final cover design that meets the requirements of NR 504.07 is being proposed, as discussed in Section 3.1.1.3. The alternative final cover design was approved by WDNR in the July 2022 plan of operation modification approval.

4.0 OPERATIONAL PLANS

4.1 LANDFILL DESIGN DEMONSTRATION UNDER NR 514.045 (1)(g)

NR 514.045 (1)(g)

> *"The plans required under s. NR 514.07 (10)."*

4.1.1 Plans Required under NR 514.07 (10)

NR 514.07 (10)

> *"ADDITIONAL REQUIREMENTS FOR CCR LANDFILLS. The owner or operator of a new or existing CCR landfill or lateral expansion of a CCR landfill shall update the plan of operation every 10 years during the landfill's active life to comply with regulations in place at the time of the update. The plan of operation update will be considered a plan of operation modification, but shall follow the completeness, review times, and pre−plan of operation submittal public meeting requirements under s. NR 514.04. The plan of operation for all CCR landfills shall include all of the following:"*

4.1.1.1 Compliance With NR 514.07 (10)(a)

NR 514.07 (10)(a)

> *"A CCR fugitive dust control plan in accordance with all of the following:*
>
> *1. The plan shall identify and describe the CCR fugitive dust control measures the owner or operator will use to minimize CCR from becoming airborne at the facility. The owner or operator shall select and include in the CCR fugitive dust control plan the CCR fugitive dust control measures that are most appropriate for site conditions, along with an explanation of how the measures selected are applicable and appropriate for site conditions. Control measures may include any of the following:*
>
> *a. Locating CCR inside an enclosure or partial enclosure.*
>
> *b. Operating a water sprayer or fogging system.*
>
> *c. Reducing fall distances at material drop points.*
>
> *d. Using wind barriers, compaction, or vegetative covers.*

e. Establishing and enforcing reduced vehicle speed limits.

f. Paving and sweeping roads.

g. Covering trucks transporting CCR.

h. Reducing or halting operations during high wind events.

i. Applying a daily or intermediate cover.

2. *The plan shall include procedures to wet CCR with water to a moisture content that will prevent wind dispersal but will not result in free liquids. In lieu of water, wetting of CCR may be accomplished with an appropriate chemical dust suppression agent.*

3. *The plan shall include a description of the procedures the owner or operator will follow to periodically assess the effectiveness of the control plan. At a minimum, the assessment shall include a visual inspection at least every 7 days, unless the CCR landfill is inactive and all areas are covered by intermediate or final cover.*

4. *The plan shall be modified in accordance with s. NR 514.04 (6) whenever there is a change in conditions that may substantially affect the plan of operation.*

5. *The plan shall address the preparation of an annual fugitive dust control report in accordance with s. NR 506.20 (3) (a).”*

A CCR fugitive dust control plan that complies with NR 514.07 (10)(c) is in place. The amended CCR fugitive dust control plan is included in **Appendix C1**.

4.1.1.2 Compliance With NR 514.07 (10)(b)

NR 514.07 (10)(b)

“A run–on and run–off control system plan that includes all of the following:

1. *A run–on and run–off control system designed in accordance with the requirements under s. NR 504.12 (2).*

2. *Plan sheets depicting the location of run–on and run–off control features, detail drawings, and supporting engineering calculations.*

3. *Construction procedures and a schedule for construction.*

4. *Modification every 5 years from the date of the most recent plan approval or whenever there is a change in conditions that may substantially affect the written plan in effect. The modification shall be requested by the owner or operator in accordance with s. NR 514.04 (6) prior to the 5–year deadline.”*

A run-on and run-off control system plan that complies with NR 514.07 (10)(b) is in place. The amended run-on and run-off control system plan is included in **Appendix C2**.

4.1.1.3 Compliance With NR 514.07 (10)(c)

NR 514.07 (10)(c)

"A written closure plan in accordance with the requirements under s. NR 514.06 (10) and all of the following:

1. *A narrative description of how the CCR landfill will be closed, including a description of the steps necessary to close the CCR unit at any point during the active life of the CCR unit, consistent with recognized and generally accepted good engineering practices.*

2. *A description of the final cover system, designed in accordance with s. NR 504.07, and the methods and procedures to be used to install the final cover.*

3. *A demonstration, including a narrative discussion, of how final closure will meet the performance standards under s. NR 506.083 (6).*

4. *An estimate of the maximum volume in cubic yards of CCR that will be disposed on–site over the active life of the CCR landfill.*

5. *An estimate of the largest area of the CCR landfill that will require a final cover at any time during the CCR landfill's active life.*

6. *A schedule for completion of all closure activities, including ban estimate of the year in which all closure activities for the CCR landfill will be completed. The schedule shall provide sufficient information to describe the sequential steps that will be taken to close the CCR landfill, including identification of major milestones such as coordinating with other agencies and obtaining other necessary approvals or permits, installation of the final cover system, and the estimated timeframes to complete each step or phase of CCR landfill closure. If the estimated timeframes to complete closure exceed the timeframes specified under s. NR 506.083 (3) (a), the plan shall include the site–specific information, factors and considerations that support any time extension.*

7. *The plan shall be modified in accordance with s. NR 514.04 (6) whenever there is a change in conditions that may substantially affect the written closure plan or unanticipated events necessitate a revision of the written closure plan. The modification shall be submitted to the department in writing at least 60 days prior to a planned change in the operation of the CCR landfill, or no later than 60 days after an unanticipated event requires the need to revise an existing written closure plan. If a written closure plan is revised after closure activities have commenced for a CCR landfill, the owner or operator shall submit the modification request to the department no later than 30 days following the triggering event.*

8. *If closure of the CCR landfill will be accomplished through removal of CCR from the CCR landfill, the closure plan shall be modified and approved by the department prior to implementation in accordance with s. NR 514.04 (6). The closure plan shall include a description of the procedures to remove the CCR and decontaminate all areas affected by the CCR landfill in accordance with s. NR 506.08 (5).*

A written closure plan that complies with NR 514.07 (10)(c) is in place for Phase 1, Modules 1 through 6, and Phase 2, Modules 10 and 11. The amended written closure plan is included in Appendix C3.

4.1.1.4 Compliance With NR 514.07 (10)(d)

NR 514.07 (10)(d)

"A written long–term care plan that addresses all of the following:

1. *A description of the monitoring and maintenance activities and the frequency at which those activities will be performed. The activities shall include, at a minimum, all of the following:*

    a. Long–term care activities specified under s. NR 514.06 (11).

    b. Maintaining the integrity and effectiveness of the final cover system, including making repairs to the final cover as necessary to correct the effects of settlement, subsidence, erosion or other events, and preventing run–on and run–off from eroding or otherwise damaging the final cover.

    c. Maintaining the effectiveness of the leachate collection and removal system and operating the leachate collection and removal system in accordance with the requirements under s. NR 504.12 (3) (a). d. Maintaining the groundwater monitoring system and monitoring the groundwater in accordance with ch. NR 507 and the sampling plan approval.

2. *The name, address, telephone number, and email address of the person or office to contact about the facility during long– term care.*

3. *A description of the planned uses of the property during long–term care. Post–closure uses may not disturb the integrity of the final cover, liner, or any other component of the landfill, or the function of the monitoring systems unless approved in writing by the department. A written request for approval as part of the plan of operation submittal or a modification shall include a demonstration that disturbance of the final cover, liner, or other component of the containment system, including any removal of CCR, will not increase the potential threat to human health or the environment. The demonstration shall be certified by a professional engineer in accordance with s. NR 500.05 (4) (a)."*

A written long–term care plan that complies with NR 514.07 (10)(d) is in place for Phase 1, Modules 1 through 6 and Phase 2, Modules 10 and 11. The amended written long–term care plan is included in Appendix C4.

4.1.1.5 Compliance With NR 514.07 (10)(e)

NR 514.07 (10)(e)

"The long–term care plan under par. (d) may be modified in accordance with s. NR 514.04 (6). The owner or operator shall modify the long–term care plan whenever there is a change in the operation of the CCR landfill that would substantially affect the written long–term care plan in effect; or after long–term care activities have commenced, when unanticipated events necessitate a revision of the written long–term care plan. The modification shall be submitted to

the department in writing at least 60 days prior to a planned change in the operation of the CCR landfill, or no later than 60 days after an unanticipated event requires the need to revise an existing long–term care plan. If a written long–term care plan is revised after long–term care activities have commenced for a CCR landfill, the owner or operator shall submit the modification request to the department no later than 30 days following the triggering event."

Any modification of the written long–term care plan will be submitted to the department in writing in compliance with NR 514.07 (10)(e).

5.0 GROUNDWATER MONITORING NETWORK DEMONSTRATION

5.1 GROUNDWATER MONITORING NETWORK DEMONSTRATION UNDER NR 514.045 (1)(h)

NR 514.045 (1)(h)

"A demonstration that the CCR groundwater monitoring system complies with the requirements under s. NR 507.15 (3), including documentation of the design, installation, and development of any CCR wells."

To be provided in an addendum to this report, per discussions with the WDNR.

6.0 UPDATED SAMPLING PLAN

6.1 UPDATED SAMPLING PLAN UNDER NR 514.045 (1)(g)

NR 514.045 (1)(i)

"An updated sampling plan that addresses the requirements under s. NR 507.15 (3)."

To be provided in an addendum to this report, per discussions with the WDNR.

7.0 ADDENDUM DOCUMENTS

7.1 LEACHATE/SURFACE WATER POND

A pond abandonment strategy is in progress and will be submitted as an addendum to this Plan. This will include sequencing for filling the pond and adjustments to surrounding infrastructure.

7.2 PHASE 1, MODULES 5 AND 6 HAUL ROAD

Development of a permanent haul road in Modules 5 and 6 is in progress and will be submitted as an addendum to this Plan. The permanent haul road will be on the final cover system of Modules 5 and 6 and will provide future access during the post-closure period of the landfill.

7.3 CARE AND MAINTANCE OF LEACHATE COLLECTION SYSTEM TANKS AND PUMPS

Condition 6 of the July 28, 2022 conditional plan of operation approval modification for the 10-year update, states that "WPL shall submit an operation plan, which addresses the care and maintenance of the tanks and pumps, by February 1, 2023. The plan shall also address the means to monitor the tank and manholes secondary containment systems." The pumps for the leachate collection system have yet to be installed and the other infrastructure elements (tanks and manholes) are not planned to be constructed in the near future. An operational plan to address this condition may be submitted as an addendum to this Plan.

7.4 MODULE 12 LINER DESIGN

Condition 8 of the July 28, 2022 conditional plan of operation approval modification for the 10-year update, states that "WPL shall submit the design for the construction of Module 12 liner or submit a proposal for removal of the liner runout from Module 11 and timing of construction of the north berm for Module 11, by February 1, 2023." Evaluation of the need for construction of Module 12 is still in progress. The Module 12 liner design may be submitted as an addendum to this Plan once a decision is made.

7.5 GROUNDWATER MONITORING NETWORK DEMONSTRATION

The groundwater monitoring network demonstration under NR 514.045 (1)(h) will be provided as an addendum to this plan.

7.6 UPDATED SAMPLING PLAN

The updated sampling plan under NR 514.045 (1)(h) will be provided as an addendum to this plan.

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Table 1

CCR Landfill Plan of Operation Modification for Initial Permitting Checklist

Table 1.
Coal Combustion Residual (CCR) Landfill Plan of Operation Modification for Initial Permitting Checklist
Section NR 514.045, Wis. Adm. Code
Wisconsin Power and Light Company - Columbia Dry Ash and Ash Pond Disposal Facilities / SCS Engineers Project #25222260.00

REGULATORY REQUIREMENTS	COMPLETE?			LOCATION	COMMENTS
	Y	N	NA		
NR 514.045(1)(a) Does the submittal meet the requirements under s. NR 500.05, including the certifications required under s. NR 500.05(4)?					
NR 500.05 GENERAL SUBMITTAL REQUIREMENTS.					
(1) Has payment of the review fee of $30,500 been received? Note: The department sends an invoice to the facility contact upon receipt of the submittal. Payment is due within 30 days of receipt of the invoice.					
(2) Has a cover letter detailing the desired action been submitted?				Cover Letter	
(3) Have the appropriate number of written and electronic copies been submitted to the department?				N/A	
(4) Are the report and plan sheets submitted under the seals and certifications of a licensed professional engineer and professional geologist?					
(5) Technical Procedures:					
Were all test procedures specified in the report?				N/A	
Were all technical procedures used to investigate the facility current standard procedures?				N/A	
Were explanations and reasons given for deviations from any current standard method?				N/A	
(6) Do all maps, plan sheets, drawings, isometrics, cross-sections, figures, photographs and tables meet the following requirements?					
(a) No larger than 32 inches by 44 inches and no smaller than 8 ½ inches x 11 inches. Note: Section NR 514.045, Wis. Adm. Code requires engineering plans be drawn on standard 24 inch by 36-inch plan sheets.				Figures 1 - 8	
(b) Appropriate scale to show all required detail in sufficient clarity.				Figures 1 - 8	
(c) __numbered __legends for all symbols __referenced in the narrative __horizontal & vertical scales __titled __drafting and origination dates				Figures 1 - 8	
(d) Use uniform scales.				Figures 1 - 8	
(e) Contain a north arrow.				Figures 1 - 8	
(f) Use mean sea level as the basis for all elevations.				Figures 1 - 8	
(g) Contain a survey grid based on monuments established in the field and which utilize a coordinate system and datum, such as state plane coordinates, Universal Transverse Mercator (UTM), or Wisconsin Transverse Mercator.				Figures 1 - 8	
(h) Show original topography and a grid system shown on the plan sheets that show construction, operation, and closure topography.				Figures 1 - 8	
(i) Any cross-sections: __Show survey grid locations, __Reference major plan sheets, __Include a reduced diagram of plan view showing cross-section location.				N/A	
(7) A table of contents listing all sections of the submittal.				Report Table of Contents	
(8) An appendix listing the following: __names of all references __all raw data __testing and sampling procedures __calculations				Report Appendicies	
NR 514.045(1)(b) Does the submittal include a demonstration that all phases of the CCR landfill meet the performance criteria under s. NR 504.04(4)(a), (b), and (c)?					
NR 504.04(4) PERFORMANCE STANDARDS. Will the proposed landfill cause the following:					
(a) A significant adverse impact on wetlands? __yes __no Has a practicable alternatives analysis and a wetland functional values analysis been completed in accordance with ch. NR 103, if a wetland will be affected by the proposed landfill or any noncommercial soil borrow source activity? Note: See DNR wetland regulation website (https://dnr.wisconsin.gov/topic/Wetlands/permits) to help determine if a wetland permit may be needed per s. 281.36, Stats.				Report Section 2.1.1	
(b) A take of an endangered or threatened species in accordance with s. 29.604, Stats? __yes __no				Report Section 2.1.2	
(c) A detrimental effect on any surface water? __yes __no Note: Exemptions are not granted.				Report Section 2.1.3	
For new CCR landfills or a lateral expansion of a CCR landfill, if the landfill failed to make the demonstration showing compliance with the criteria above, has the landfill ceased placing CCR in the CCR landfill per NR 514.045(5)(b)?				N/A	
NR 514.045(1)(c) Does the submittal include a demonstration that all phases of the CCR landfill meet the locational criteria under s. NR 504.04(3)(g), (h), and (i)?					
NR 504.04(3) LOCATIONAL CRITERIA. Are the proposed limits of filling within:					
(g) 200 feet of a fault that has had displacement in Holocene time? __yes __no __If yes, was an exemption requested?				Report Section 2.2.1	
(h) Seismic impact zones? __yes __no __If yes, was an exemption requested?				Report Section 2.2.2	
(i) Unstable areas? __yes __no __If yes, was an exemption requested?				Report Section 2.2.3	
For new CCR landfills or a lateral expansion of a CCR landfill, if the landfill failed to make the demonstration showing compliance with the criteria above, has the landfill ceased placing CCR in the CCR landfill per NR 514.045(5)(b)?				N/A	
NR 514.045(1)(c) (continued) Does the demonstration for unstable areas address 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.				Report Section 2.2.4	
2. On-site or local geologic or geomorphologic features.				Report Section 2.2.5	
3. On-site or local human-made features or events both surface and subsurface.				Report Section 2.2.6	

Table 1.
Coal Combustion Residual (CCR) Landfill Plan of Operation Modification for Initial Permitting Checklist
Section NR 514.045, Wis. Adm. Code
Wisconsin Power and Light Company - Columbia Dry Ash and Ash Pond Disposal Facilities / SCS Engineers Project #25222260.00

REGULATORY REQUIREMENTS	COMPLETE?			LOCATION	COMMENTS
	Y	N	NA		
For existing CCR landfills that do not comply with the location criteria for unstable areas specified above, has the owner or operator, within 6 months of the determination, done the following per NR 514.045(5)(a): __ceased placing CCR and non-CCR waste streams into the CCR landfill __closed the CCR landfill in accordance with the requirements under s. NR 506.083 Note: This timeframe does not apply if the owner or operator complies with the alternative closure procedures under s. NR 506.083 (7).				N/A	
NR 514.045(1)(d) Does the submittal include a demonstration that the facility or practices near floodplains will not cause the following effects:					
__Restrict the flow of the regional flood __Reduce the temporary water storage capacity of the floodplain __Result in washout of solid waste so as to pose a hazard to human life, wildlife, or land or water resources. Note: NR 504.04(3)(c) also requires no person may establish, construct, operate, maintain, or permit the use of property for a landfill where the limits of filling are or would be within a floodplain.				Report Section 2.3.1	
For new CCR landfills or a lateral expansion of a CCR landfill, if the landfill failed to make the demonstration showing compliance with the criteria above, has the landfill ceased placing CCR in the CCR landfill per NR 514.045 (5)(b)?				N/A	
NR 514.045(1)(e) Does the submittal include a demonstration that the facility or practices will not result in the destruction or adverse modifications of the critical habitat of endangered or threatened species as identified in s. NR 27.03(1)?				Report Section 2.4.1	
For new CCR landfills or a lateral expansion of a CCR landfill, if the landfill failed to make the demonstration showing compliance with the criteria above, has the landfill ceased placing CCR in the CCR landfill per NR 514.045 (5)(b)?				N/A	
NR 514.045(1)(f) Does the submittal include a demonstration that the CCR landfill design meets requirements under s. NR 504.12 or an alternate design under s. NR 504.10? Does the demonstration include a design report, engineering drawings, and calculations? Note: Complete NR 504.12 and if applicable NR 504.10 (for an alternate design) of the NR 504 Design and Construction Criteria Completeness Checklist.				Report Section 3.0	
For new CCR landfills or a lateral expansion of a CCR landfill, if the landfill failed to make the demonstration showing compliance with NR 504.12 and NR 504.10 (for an alternate design), has the landfill ceased placing CCR in the CCR landfill per NR 514.045(5)(b)?				N/A	
NR 514.045(1)(g) Does the submittal include all of the plans required under s. NR 514.07(10)?					
NR 514.07(10) PLAN OF OPERATION. Does the submittal include all of the following:					
(a) A CCR fugitive dust control plan in accordance with all of the following:					
1. The plan shall identify and describe the CCR fugitive dust control measures the owner will use to minimize CCR from becoming airborne at the facility. The owner shall select and include in the CCR fugitive dust control plan the CCR fugitive dust control measures that are most appropriate for site conditions, along with an explanation. See s. NR 514.07 (10)(a)1. for control measure examples.				Appendix C1, Measures for Controlling Fugitive Dust	
2. The plan shall include procedures to wet CCR with water to a moisture content that will prevent wind dispersal, but will not result in free liquids. In lieu of water, wetting of CCR may be accomplished with an appropriate chemical dust suppression agent.				Appendix C1, Procedure for Conditioning CCR Prior to Placement	
3. The plan shall include a description of the procedures the owner will follow to periodically assess the effectiveness of the control plan. At a minimum, the assessment shall include a visual inspection at least every 7 days, unless the CCR landfill is inactive, and all areas are covered by intermediate or final cover.				Appendix C1, Visual Inspections	
4. The plan shall be modified in accordance with s. NR 514.04 (6) whenever there is a change in conditions that may substantially affect the plan of operation.				Appendix C1, Procedure for Periodic Review of CCR Fugitive Dust Control Plan	
5. The plan shall address the preparation of an annual fugitive dust control report in accordance with s. NR 506.20 (3)(a).				Appendix C1, Procedure for Periodic Review of CCR Fugitive Dust Control Plan	
(b) A run-on and run-off control system plan that includes all of the following:					
1. A run-on and run-off control system designed in accordance with the requirements under s. NR 504.12 (2).				Appendix C2, Section 2.0	
2. Plan sheets depicting the location of run-on and run-off control features, detail drawings, and supporting engineering calculations.				Appendix C2, Figures and Appendix A	
3. Construction procedures and a schedule for construction.				Appendix C2, Section 2.3	
4. Modification every 5 years from the date of the most recent plan approval or whenever there is a change in conditions that may substantially affect the written plan in effect. The modification shall be requested by the owner in accordance with s. NR 514.04 (6) prior to the 5-year deadline.				Appendix C2, Section 4.0	
(c) A written closure plan in accordance with all requirements under NR 514.06 (10) and all of the following:					
1. A narrative description of how the CCR landfill will be closed, including a description of the steps necessary to close the CCR unit at any point during the active life of the CCR unit, consistent with recognized and generally accepted good engineering practices.				Appendix C3, Section 2.0	
2. A description of the final cover system, designed in accordance with s. NR 504.07, and the methods and procedures to be used to install the final cover. Note: Complete NR 504.07 of the NR 504 Design and Construction Criteria Completeness Checklist.				Appendix C3, Section 3.0	
3. A demonstration, including a narrative discussion, of how final closure will meet the performance standards under s. NR 506.083 (6).				Appendix C3, Section 3.0	
4. An estimate of the maximum volume in cubic yards of CCR that will be disposed on-site over the active life of the CCR landfill.				Appendix C3, Section 4.0	
5. An estimate of the largest area of the CCR landfill that will require a final cover at any time during the CCR landfill's active life.				Appendix C3, Section 5.0	

Table 1.
Coal Combustion Residual (CCR) Landfill Plan of Operation Modification for Initial Permitting Checklist
Section NR 514.045, Wis. Adm. Code
Wisconsin Power and Light Company - Columbia Dry Ash and Ash Pond Disposal Facilities / SCS Engineers Project #25222260.00

REGULATORY REQUIREMENTS	COMPLETE?			LOCATION	COMMENTS
	Y	N	NA		
6. A schedule for completion of all closure activities, including an estimate of the year in which all closure activities for the CCR landfill will be completed.				Appendix C3, Section 6.0 and 7.0	
7. The plan shall be modified in accordance with s. NR 514.04 (6) whenever there is a change in conditions that may substantially affect the written closure plan or unanticipated events necessitate a revision of the written closure plan.				Appendix C3, Section 9.0	
8. If closure of the CCR landfill will be accomplished through removal of CCR from the CCR landfill, the closure plan shall be modified and approved by the department prior to implementation in accordance with s. NR 514.04 (6).				N/A	
(d) A written long-term care plan that addresses all of the following:					
1. A description of the monitoring and maintenance activities and the frequency at which those activities will be performed. The activities shall include, at a minimum, all of the following: ___Long-term care activities specified under s. NR 514.06 (11). ___Maintaining the integrity and effectiveness of the final cover system, including making repairs as necessary. ___Maintaining the effectiveness of the leachate collection and removal system and operating the leachate collection and removal system in accordance with the requirements under s. NR 504.12 (3) (a). ___Maintaining the groundwater monitoring system and monitoring the groundwater in accordance with ch. NR 507 and the sampling plan approval.				Appendix C4, Section 2.0	
2. The name, address, telephone number, and email address of the person or office to contact about the facility during long-term care.				Appendix C4, Section 3.0	
3. A description of the planned uses of the property during long-term care. Post- closure uses may not disturb the integrity of the final cover, liner, or other component of the landfill, or function of the monitoring systems unless approved in writing by the department. A written request for approval as part of the plan of operation submittal or a modification shall include a demonstration that disturbance of any part of the CCR landfill will not increase the potential threat to human health or the environment.				Appendix C4, Section 4.0	
NR 514.045(1) (h) Does the submittal include a demonstration that the CCR groundwater monitoring system complies with the requirements under s. NR 507.15(3), including documentation of the design, installation, and development of any CCR wells?					
NR 507.15(3) CCR LANDFILLS. In addition to the detection groundwater monitoring system required under s. NR 507.19, the CCR landfill owner shall submit a plan establishing a separate CCR groundwater monitoring system for the purpose of monitoring groundwater quality in the uppermost aquifer. The plan shall be submitted with the plan of operation modification for initial permitting in accordance with s. NR 514.045 or in the feasibility report under ch. NR 512. The plan shall include all of the following:				To be provided in an addendum	
(a) Does the monitoring system consist of a sufficient number of CCR monitoring wells, installed at appropriate locations and depths?				To be provided in an addendum	
Are the CCR wells adequate to yield groundwater samples from the uppermost aquifer that accurately represent upgradient groundwater quality that has not been affected by leakage from CCR landfill and downgradient groundwater quality passing the waste boundary of the CCR landfill?				To be provided in an addendum	
Are the downgradient monitoring wells installed to ensure detection of groundwater contamination in the uppermost aquifer, including all known or suspected contaminant pathways?				To be provided in an addendum	
(b) Has the number, spacing, and depths of monitoring wells that are part of the CCR groundwater monitoring system plan based upon site-specific technical information that includes the following? ___Aquifer thickness ___Groundwater flow rate ___Groundwater flow direction, including seasonal and temporal fluctuations in groundwater flow				To be provided in an addendum	
Does the monitoring system consider the saturated and unsaturated geologic units and fill materials overlying the uppermost aquifer, materials comprising the uppermost aquifer and materials comprising the confining unit defining the lower boundary of the uppermost aquifer, including thicknesses, stratigraphy, lithology, hydraulic conductivities, porosities, and effective porosities?				To be provided in an addendum	
(c) Does the monitoring system plan include the minimum number of monitoring wells necessary to meet performance standards specified under (a) based on the site- specific information specified under (b).?				To be provided in an addendum	
1. Does the groundwater monitoring system plan contain a minimum of one upgradient and 3 downgradient monitoring wells to be designated as CCR wells?				To be provided in an addendum	
2. Does the groundwater monitoring system contain additional monitoring wells as necessary to accurately represent the background groundwater quality in the uppermost aquifer that has not been affected by leakage from the CCR landfill and the quality of groundwater passing the waste boundary of the CCR landfill?				To be provided in an addendum	
(d) Have the monitoring wells been designed and installed in accordance with NR 507.06 and regularly inspected in accordance with NR 507.13?				To be provided in an addendum	
(e) Has the documentation of the design, installation, development, and decommissioning of all wells and measurement/sampling devices been performed in accordance with NR 507.14 and NR 141, where applicable? This includes submission of all required forms to the department in the timeframes specified.				To be provided in an addendum	
NR 514.045 (i) Does the submittal include an updated sampling plan that addresses the requirements under s. NR 507.15(3)?					
NR 507.15(3) CCR LANDFILLS. Does the sampling plan address all of the following:					
(f) A sampling plan, which includes the CCR groundwater monitoring system, in accordance with s. NR 507.16 and the requirements under s. NR 140.16. Note: Complete NR 507.16(1) below.				To be provided in an addendum	
Does the sampling plan include consistent sampling and analysis procedures designed to ensure the production of monitoring results that provide an accurate representation of groundwater results that provide an accurate representation of groundwater quality in the uppermost aquifer at the upgradient and downgradient CCR wells and that provide a characterization of leachate quality generated by the CCR landfill?				To be provided in an addendum	
(g) Does the sampling plan include sampling and analytical methods that are appropriate for groundwater sampling and that accurately measure all required monitoring parameters under ch. NR 507, Appendix I in groundwater samples?				To be provided in an addendum	
Does the sampling plan specify the CCR landfill owner or operator obtain and analyze samples in accordance with the sampling plan and the requirements under s. NR 507.17?				To be provided in an addendum	

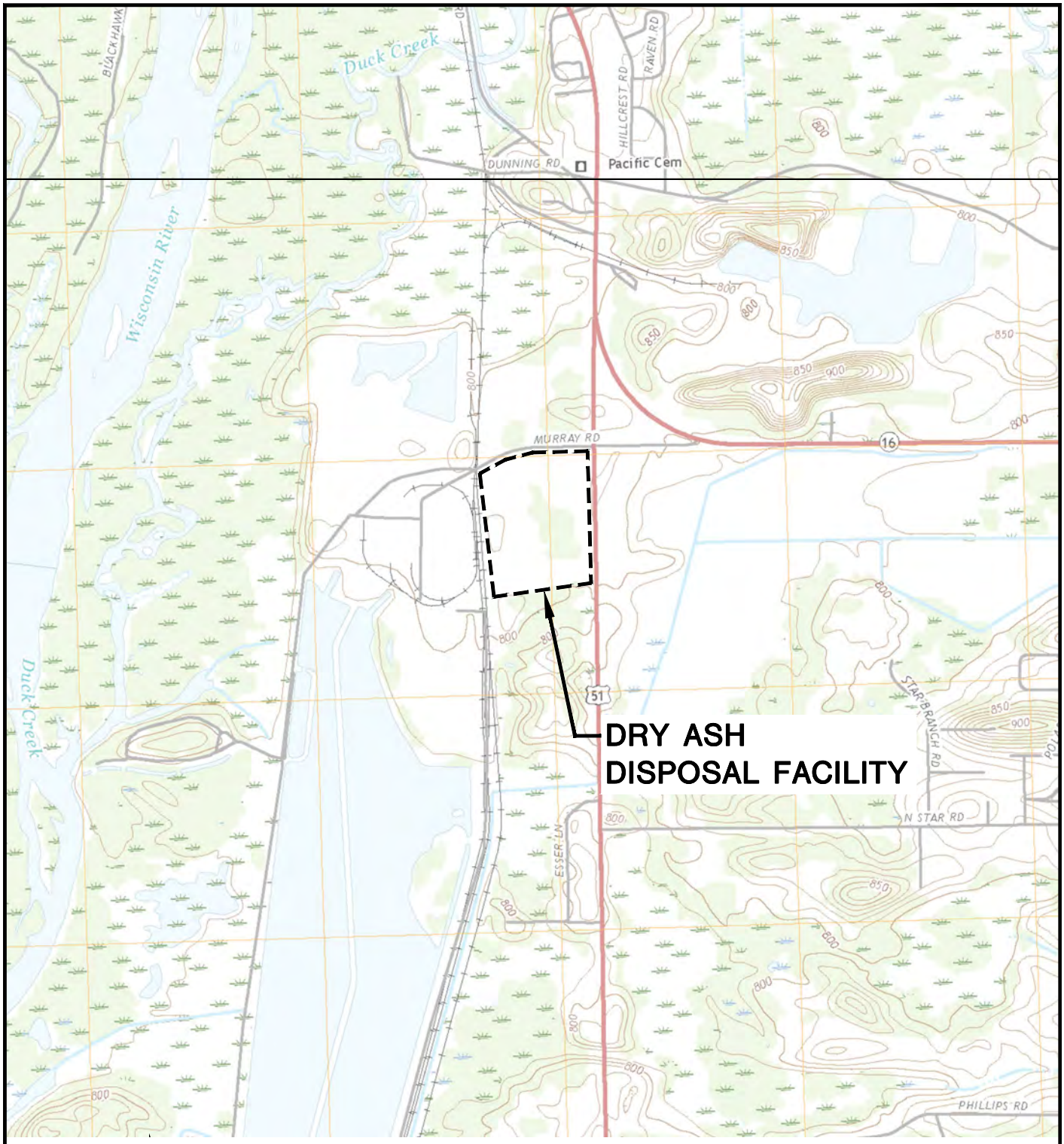
Table 1.
Coal Combustion Residual (CCR) Landfill Plan of Operation Modification for Initial Permitting Checklist
Section NR 514.045, Wis. Adm. Code
Wisconsin Power and Light Company - Columbia Dry Ash and Ash Pond Disposal Facilities / SCS Engineers Project #25222260.00

REGULATORY REQUIREMENTS	COMPLETE?			LOCATION	COMMENTS
	Y	N	NA		
(h) In addition to the field measurements required under s. NR 507.17(1), does the plan include measurement of the groundwater elevations in each CCR well immediately prior to purging, each time groundwater is sampled.				To be provided in an addendum	
Does the plan include determination of the rate and direction of groundwater flow each time groundwater is sampled and reporting the result to the department in accordance with s. NR 507.26?				To be provided in an addendum	
Does the plan include that groundwater elevations in wells that monitor the same CCR landfill be measured within a timeframe short enough to avoid temporal variations in groundwater flow that could preclude accurate determination of groundwater flow rate and direction?				To be provided in an addendum	
(i) Has the owner/operator established baseline groundwater quality levels for each CCR monitoring well in accordance with NR 507.18 for each CCR well and for each of the constituents required under ch. NR 507 Appendix I, Table 1A and the sampling plan?				To be provided in an addendum	
(j) Has the owner/operator measured the total recoverable metal concentrations when measuring groundwater quality for each CCR monitoring well?				To be provided in an addendum	
Does measurement of total recoverable metals include both the particulate fraction and dissolved fraction of metals in natural waters? To ensure this, groundwater samples from CCR wells may not be field filtered prior to analysis.				To be provided in an addendum	
(k) Does the plan specify the owner/operator notify the department in writing within 60 days of completing sampling and analysis at any CCR well when a groundwater standard at the point of standards application has been attained or exceeded in accordance with s. NR 507.30?				To be provided in an addendum	
(L) Does the plan specify the owner/operator conduct detection groundwater monitoring at all CCR monitoring wells in accordance with NR 507.19 and all of the following?				To be provided in an addendum	
Does detection groundwater monitoring include groundwater monitoring for all constituents appropriate for CCR wells as listed under ch. NR 507 Appendix I, Table 1A and additional parameters as required by the department.				To be provided in an addendum	
1. Is the minimum monitoring frequency semi-annual for detection groundwater monitoring?				To be provided in an addendum	
Has baseline groundwater quality been established at each CCR monitoring well in accordance with s. NR 507.18? This includes collection of a minimum of 8 independent groundwater quality samples for each CCR well, analyzed for constituents' approval for CCR landfills as listed under ch. NR 507 Appendix I, Tables 1A and 3 and additional parameters as required by the department.				To be provided in an addendum	
2. Does the plan specify the number and methodology of groundwater quality samples be collected and analyzed for each CCR well during subsequent sampling events consistent with the approved sampling plan?				To be provided in an addendum	
Does the plan specify the CCR landfill owner or operator inform the department in accordance with s. NR 507.26 of any CCR well that purges dry, is damaged or obstructed, or in any way is rendered such that a sample was unable to be collected from the well during a scheduled sampling event and does the plan specify the owner or operator propose remedial actions to correct the problem prior to the next sampling event?				To be provided in an addendum	
3. Does the plan specify the owner or operator of the CCR landfill notify the department and respond in accordance with s. NR 507.30 when a groundwater standard at the point of standards application has been attained or exceeded at any CCR well? This includes the establishment of an assessment monitoring program meeting the requirements under s. NR 508.06, unless the exceedance is determined by the department to be from a source other than the CCR landfill, or that the groundwater standard exceedance resulted from error in sampling, analysis, or natural variation in background groundwater quality in accordance with s. NR 508.06(2)(f)2.				To be provided in an addendum	
4. Does the plan specify the point of standards application for a groundwater quality exceedance at a CCR well, the horizontal distance for the design management zone under s. NR 140.22(3)(a) for a CCR landfill is 0 feet from the waste boundary and may not be expanded by the department under s. NR 140.22(3)(b)? The waste boundary includes the horizontal space taken up by any liner, dike or other barrier designed to contain CCR waste.				To be provided in an addendum	
(m) Does the plan specify the owner or operator of the CCR landfill prepare an annual groundwater monitoring and corrective action report for submittal to the department, placement in the written operating record and position g on the publicly accessible internet site under s. NR 506.17(2) and (3) no later than January 31 of the year following the calendar year a groundwater monitoring system has been approved by the department, and annually thereafter?				To be provided in an addendum	
Does the plan specify that the annual report document the status of the groundwater monitoring and any corrective action implemented at the CCR landfill, summarize key activities completed, describe any problems encountered, discuss actions to resolve the problems, and project key activities for the upcoming year?				To be provided in an addendum	
Does the plan specify the annual groundwater monitoring and corrective action report contain, at a minimum the information included in ss. NR 507.15(3)(m) 1. – 5.				To be provided in an addendum	
NR 507.16(1) SAMPLING PLAN. Does the sampling plan include the following information:					
(a) An 8 1/2 by 11 inch site map showing locations of all sample points and devices. An 11 by 17 inch site map may be included if clarity is compromised using the 8 1/2 by 11 inch size. Different symbols shall be used to differentiate types of monitoring devices such as groundwater monitoring wells, collection lysimeters and gas monitoring wells. Each sample point shall be labeled.				To be provided in an addendum	
(b) A sample schedule, including all of the following: __1. The months that each sample point is to be sampled. __2. The sampling period, as designated by the department. __3. The list of parameters that are to be analyzed for in the sample from each monitoring device during each month that sampling occurs.				To be provided in an addendum	
(c) Procedures for field measurements, including all of the following: __1. The order in which wells should be sampled if the groundwater has been impacted by regulated or other activities. __2. The procedures and type of equipment used to measure water level elevations. __3. The procedures and type of equipment used to measure temperature, pH, conductivity and procedures to determine turbidity, odor and color.				To be provided in an addendum	
(d) Procedures for purging wells, including all of the following: __1. Procedures to purge wells prior to collecting samples. __2. Procedures for determining the volume of water to be removed from each well. __3. The type of equipment used to purge wells. __4. The rate of flow while purging, when applicable. __5. Procedures to clean purging equipment between wells. __6. The amount of time required between purging and sampling.				To be provided in an addendum	

Table 1.
Coal Combustion Residual (CCR) Landfill Plan of Operation Modification for Initial Permitting Checklist
Section NR 514.045, Wis. Adm. Code
Wisconsin Power and Light Company - Columbia Dry Ash and Ash Pond Disposal Facilities / SCS Engineers Project #25222260.00

REGULATORY REQUIREMENTS	COMPLETE?			LOCATION	COMMENTS
	Y	N	NA		
(e) Procedures for obtaining samples from wells, including all of the following: ___1. Procedures and type of equipment used to retrieve samples. ___2. Volume of sample required for analysis. ___3. Procedures and type of equipment to filter samples, including when to filter and when not to filter samples, if applicable. ___4. The rate of flow when sampling, when applicable. ___5. Procedures and type of equipment to physically and chemically preserve samples. ___6. Procedures to clean sampling equipment following sampling of one well and prior to sampling the next well.				To be provided in an addendum	
(f) Procedures for establishing field quality assurance and quality control, including all of the following: ___1. Field blank, duplicate sample and trip blank procedures. ___2. The frequency at which the field blanks, duplicate samples and trip blanks will be collected or processed.				To be provided in an addendum	
(g) Special procedures to sample water supply wells.				To be provided in an addendum	
(h) Special procedures to sample leachate headwells and other devices.				To be provided in an addendum	
(i) Chain of custody procedures, including persons responsible for sampling and methods for transporting samples to the laboratory.				To be provided in an addendum	

Figures



N

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

CLIENT	WISCONSIN POWER AND LIGHT COMPANY COLUMBIA ENERGY CENTER W8375 MURRAY ROAD PARDEEVILLE, WI 53954	SITE	PLAN OF OPERATION MODIFICATION REQUEST COLUMBIA DRY ASH DISPOSAL FACILITY TOWN OF PACIFIC, WISCONSIN

SITE LOCATION MAP

PROJECT NO.	25222157.00	DRAWN BY:	KP
DRAWN:	08/02/2022	CHECKED BY:	PEG
REVISED:	12/12/2022	APPROVED BY:	PEG 01/31/2023

ENGINEER

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

FIGURE
1

I:\25222260.00\Drawings\Figure 1_Site Location.dwg, 1/31/2023 1:28:35 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
CONC
SOUTH SEDIMENTATION BASIN
WPDES POND
MW-83
SG-4
MW-311
MW-33B
MW-33AR
MW-34A
MW-34B
MW-88B
MW-85
MW-85B
C. M. ST. P. & P. RR.
MW-302
LS-1
MW-5R
BM202
MW-310
PHASE 1
EXISTING MODULE 1
EXISTING MODULE 2
EXISTING MODULE 3
EXISTING MODULE 4
EXISTING MODULE 5
EXISTING MODULE 6
MURRAY ROAD
MW-309
FINAL COVER AREA
INTERMEDIATE COVER AREA
MW-4
MW-92B
MW-92A
LS-3R
LH-2
LH-3
LH-5
LH-6
MW-37A
MW-91AR
MW-91B
MW-313
LAYDOWN AREA
LP-1
TOP OF POND LINER ELEVATION = 796.97'
LEACHATE/ SURFACE WATER POND
MW-89A/B
PROPOSED PHASE 2
PROPOSED MODULE 10
PROPOSED MODULE 11
MW-314
CLAY STOCKPILE
GENERAL FILL STOCKPILE
MW-301
MW-18
MW-315
LH-10A
LH-10B
LH-11A
LH-11B
BM301
BM302
MW-312
MW-93B
MW-93A
MW-86
MW-84A
MW-84B
MW-17

LEGEND

- DRY ASH DISPOSAL FACILITY LIMITS
- LIMITS OF WASTE
- LINER PHASE/MODULE LIMIT
- FINAL COVER LIMITS
- APPROXIMATE INTERMEDIATE COVER LIMITS/AREA
- LIMITS OF 2' THICK CLAY LINER
- PAVED ROAD
- UNPAVED ROAD
- RAILROAD TRACKS
- VEGETATION
- FENCE
- OVERHEAD UTILITY
- EXISTING GRADE (10' INTERVAL)
- EXISTING GRADE (2' INTERVAL)
- SWALE
- EDGE OF WATER
- WETLAND
- PAVED ROAD AND ACCESS AREA
- 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

NOTES:

1. BASE MAP CREATED FROM AERIAL SURVEY BY KBM, FLOWN DECEMBER 1, 2014, AND GROUND SURVEY BY SCS ENGINEERS IN DECEMBER 2020, AND BY DRONE SURVEY BY AMES ON JANUARY 17, 2023.
2. MONITORING WELL LOCATIONS AND ELEVATIONS SURVEYED BY WISCONSIN POWER AND LIGHT, INC. IN DECEMBER 1994, NOVEMBER 1996, APRIL 2003, AUGUST 2012, AND JANUARY 2016, AND BY SCS ENGINEERS IN MAY 2019.
3. WETLANDS OUTSIDE FACILITY LIMITS ARE FROM THE MAY 19, 2015 ASSURED WETLAND DELINEATION PERFORMED BY STANTEC. WETLANDS INSIDE FACILITY LIMITS ARE FROM THE OCTOBER 18, 2017 ASSURED WETLAND DELINEATION PERFORMED BY MACH IV.

100 0 100

SCALE: 1" = 100'

N

DRAWN BY:	KP
CHECKED BY:	PEG
APPROVED BY:	PEG 01/31/2023
PROJECT NO.	25222260.00
DRAWN:	08/02/2022
REVISED:	12/12/2022

WISCONSIN POWER AND LIGHT COMPANY
COLUMBIA ENERGY CENTER
W2644 HWY 51 SOUTH
PARDEEVILLE, WI 53954

CLIENT

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

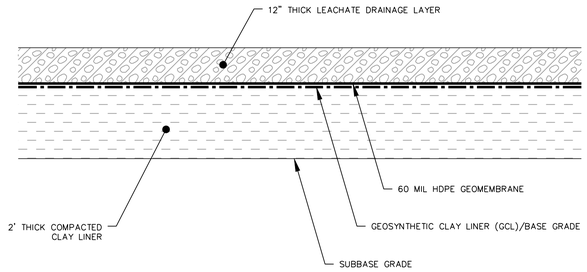
ENGINEER

PLAN OF OPERATION MODIFICATION REQUEST
COLUMBIA DRY ASH DISPOSAL FACILITY
TOWN OF PACIFIC, WISCONSIN

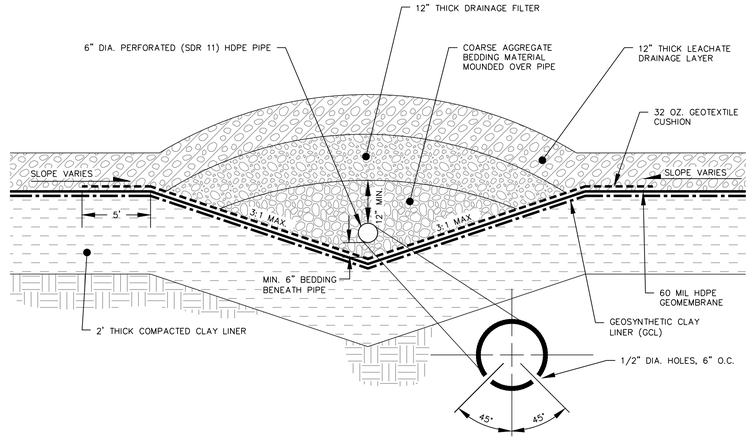
SITE

CCR LANDFILL LOCATION

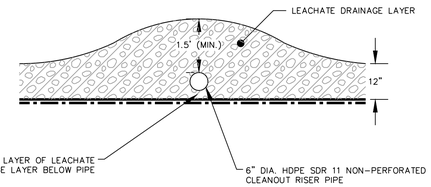
FIGURE
2

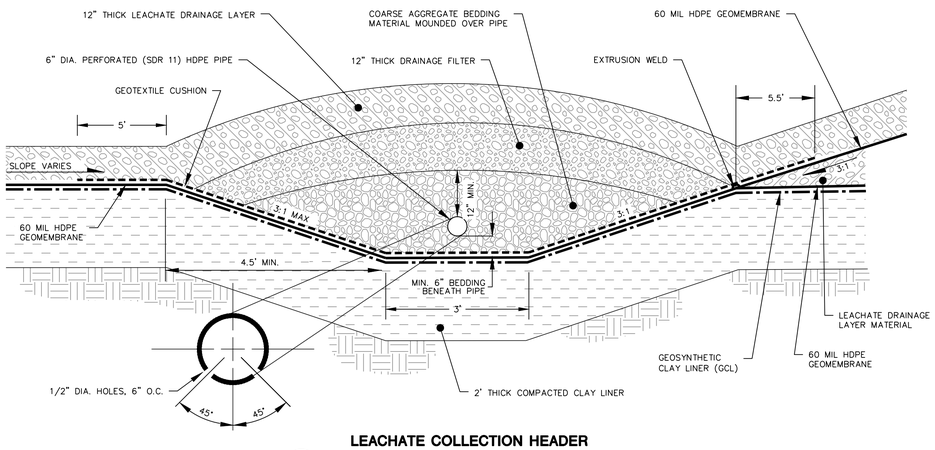


1/3 COMPOSITE LINER SYSTEM
SCALE: 1" = 2'

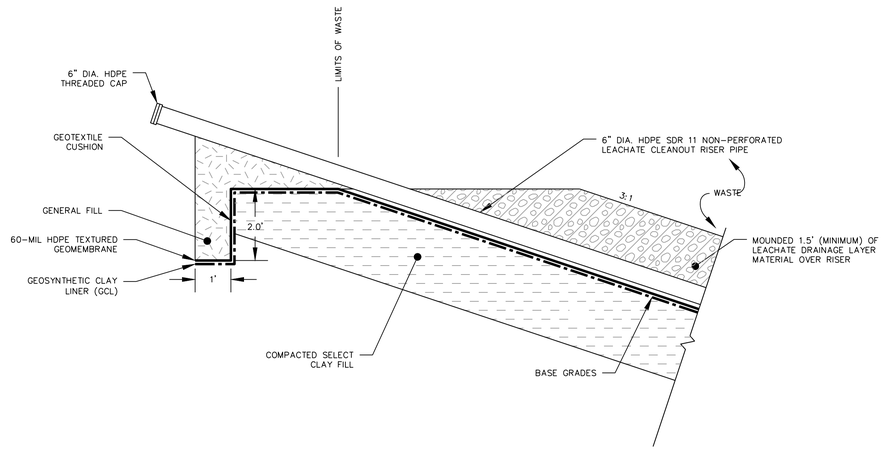


2/3 LEACHATE COLLECTION LINE (EAST-WEST)
NOT TO SCALE





3/3 LEACHATE COLLECTION HEADER (NORTH-SOUTH)
NOT TO SCALE



4/3 LEACHATE CLEANOUT
NOT TO SCALE

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

DRAWN BY: KP/MT
CHECKED BY: PEG
APPROVED BY: PEG 01/31/2023

PROJECT NO. 25222260.00
DRAWN: 01/15/2022
REVISED: 12/21/2022

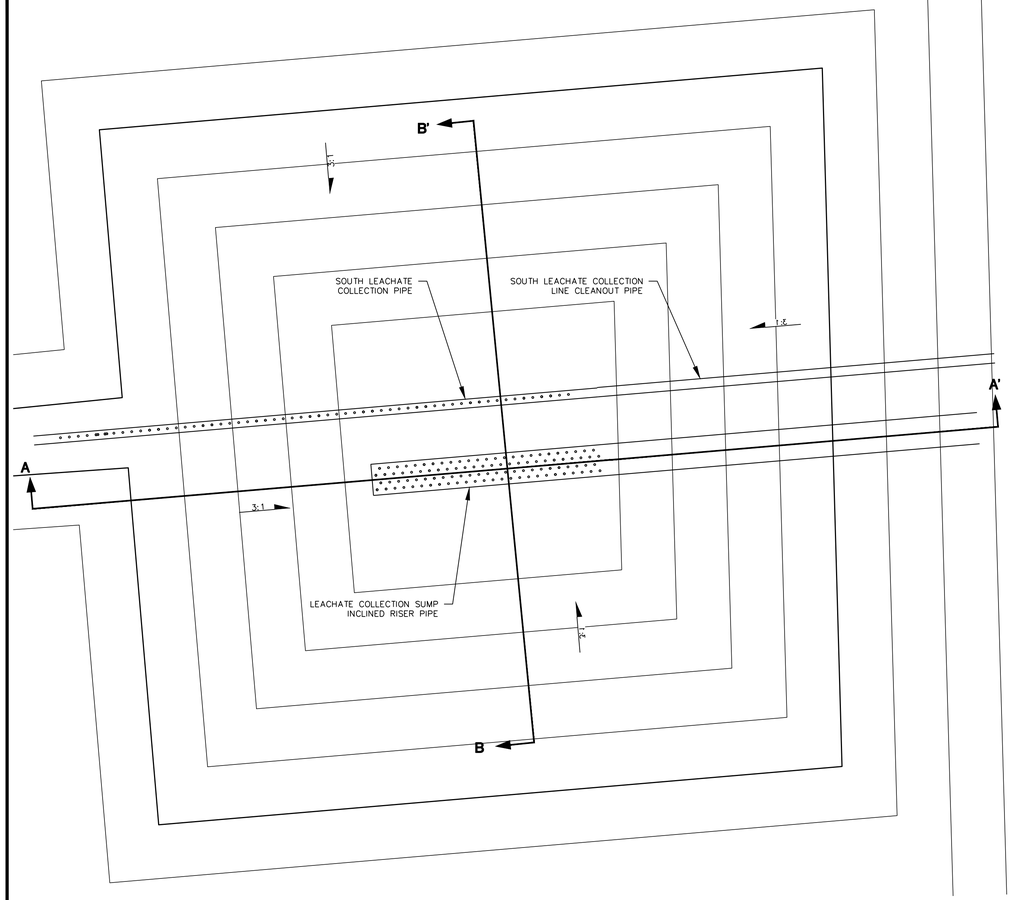
CLIENT
WISCONSIN POWER AND LIGHT COMPANY
COLUMBIA ENERGY CENTER
W8375 MURRAY ROAD
PARDEEVILLE, WI 53954

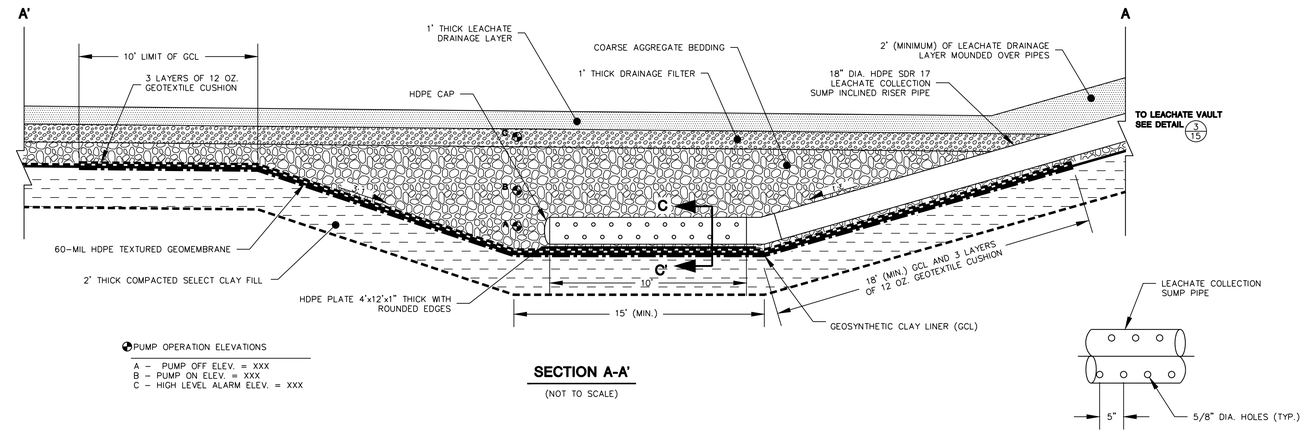
ENGINEER

SITE
PLAN OF OPERATION MODIFICATION REQUEST
COLUMBIA DRY ASH DISPOSAL FACILITY
TOWN OF PACIFIC, WISCONSIN

BASE GRADE AND LEACHATE COLLECTION SYSTEM DETAILS

FIGURE
3



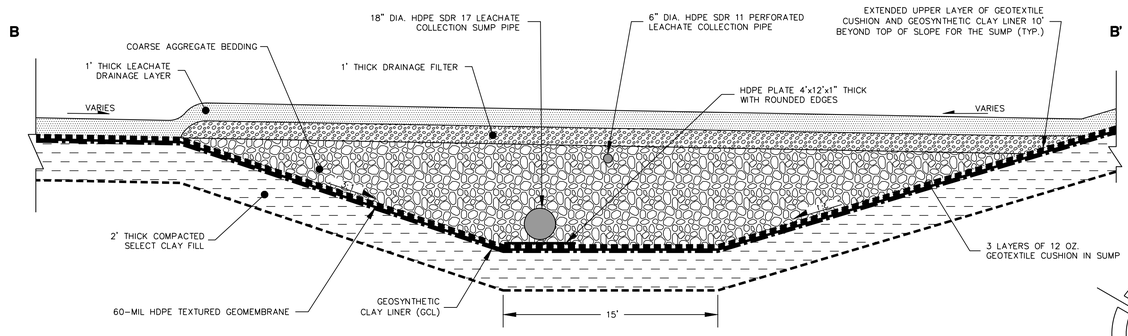


SECTION A-A'

(NOT TO SCALE)

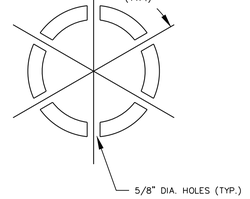
LEACHATE COLLECTION SUMP PERFORATION

(NOT TO SCALE)



SECTION B-B'

(NOT TO SCALE)



SECTION C-C'

(NOT TO SCALE)

NOTES:

1. DETAIL IS OF THE MODULE 11 SUMP, THE MODULE 10 SUMP IS SIMILAR.
2. ALL 90° ELBOWS ON LEACHATE PIPING CONSIST OF LONG SWEEP ELBOWS OR TWO 45° ELBOWS.

1/4 LEACHATE COLLECTION SUMP

SCALE: 1" = 4'

KP/MT | DRAWN BY:
PEG | CHECKED BY:
PEG 01/31/2023 | APPROVED BY:

PROJECT NO. 25222260.00
DRAWN: 01/15/2022
REVISED: 12/21/2022

WISCONSIN POWER AND LIGHT COMPANY
COLUMBIA ENERGY CENTER
W8375 MURRAY ROAD
PARDEEVILLE, WI 53954

CLIENT

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

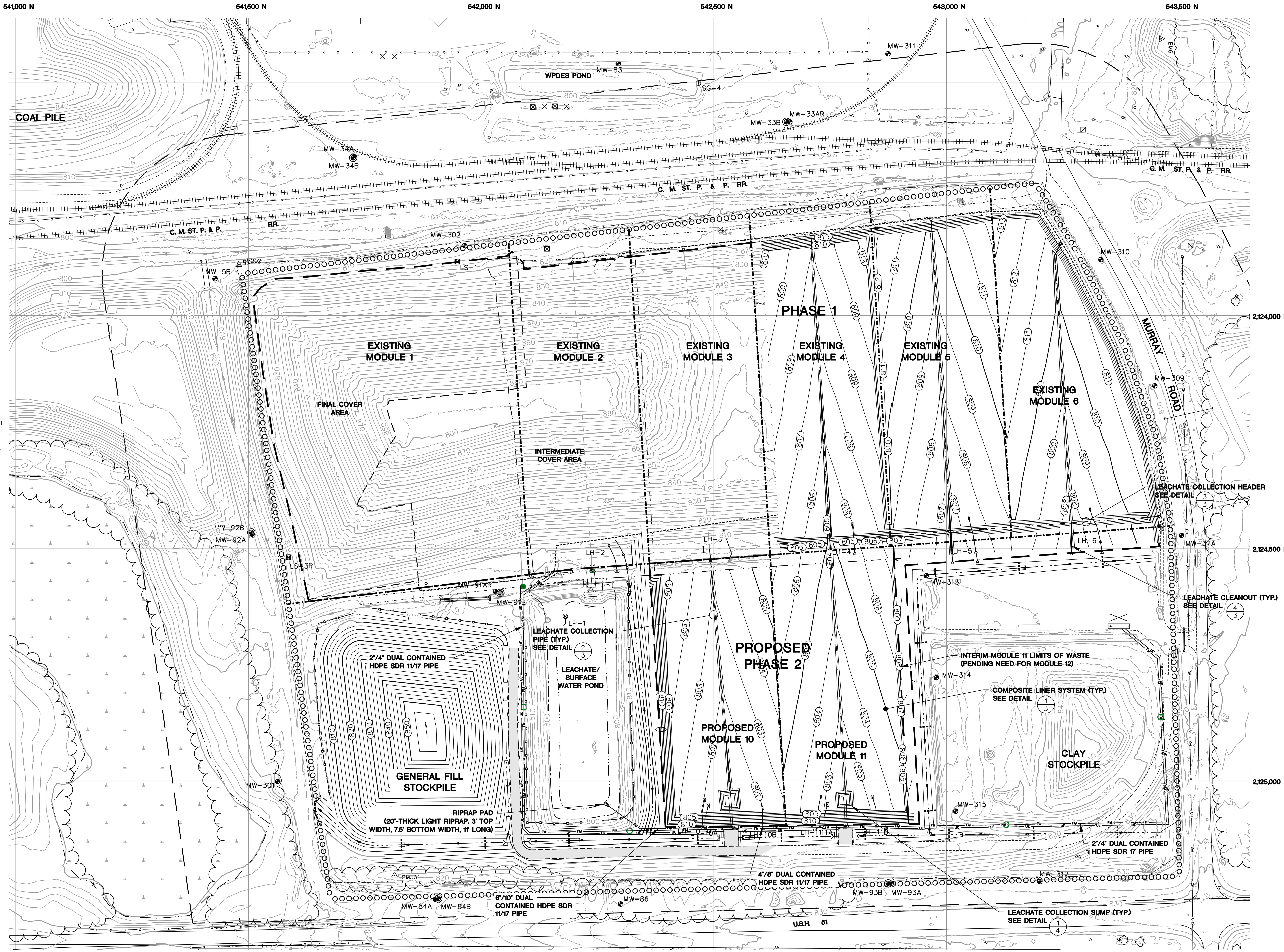
ENGINEER

PLAN OF OPERATION MODIFICATION REQUEST
COLUMBIA DRY ASH DISPOSAL FACILITY
TOWN OF PACIFIC, WISCONSIN

SITE

BASE GRADE AND LEACHATE COLLECTION SYSTEM DETAILS

FIGURE
4



LEGEND

- DRY ASH DISPOSAL FACILITY LIMITS
- LIMITS OF WASTE
- LINER PHASE/MODULE LIMIT
- FINAL COVER LIMITS
- APPROXIMATE INTERMEDIATE COVER LIMITS/AREA
- LIMITS OF CONSTRUCTED 2' THICK CLAY LINER
- PAVED ROAD
- UNPAVED ROAD
- VEGETATION
- FENCE
- 810 EXISTING GRADE (10' INTERVAL)
- EXISTING GRADE (2' INTERVAL)
- SWALE
- EDGE OF WATER
- WETLAND
- 800 PROPOSED GRADE (10' INTERVAL)
- 802 PROPOSED GRADE (2' INTERVAL)
- PROPOSED SWALE
- PROPOSED CULVERT
- 6" DIAMETER PERFORATED SDR 11 HDPE LEACHATE COLLECTION LINE
- 6" DIAMETER SOLID SDR 11 HDPE PIPE
- PROPOSED LEACHATE COLLECTION SYSTEM CLEANOUT
- PROPOSED INCLINED RISER PIPE AND LEACHATE VAULT
- PROPOSED LEACHATE MANHOLE SUMP
- PROPOSED LEACHATE FORCEMAIN CLEANOUT MANHOLE
- FM PROPOSED LEACHATE FORCEMAIN
- UE PROPOSED UNDERGROUND ELECTRIC
- PROPOSED SILT FENCE/FILTER SOCK
- PROPOSED STRAW BALE DITCH CHECK

NOTES:

1. SEE FIGURE 2 FOR BASE MAP LEGEND ITEMS AND NOTES.
2. LEACHATE COLLECTION LINE CUTTING AND CAPPING TO OCCUR AFTER WDNR APPROVAL OF MODULE 10 AND 11 LINER CONSTRUCTION.
3. MODULE 2 AND 3 LEACHATE MANHOLES TO BE INSTALLED DURING FINAL CLOSURE ACTIVITIES.

N

100 0 100

SCALE: 1" = 100'

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REVISED:	12/21/2022	APPROVED BY:	PEG 01/31/2023

WISCONSIN POWER AND LIGHT COMPANY
COLUMBIA ENERGY CENTER
W8375 MURRAY ROAD
PARDEEVILLE, WI 53954

CLIENT

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

ENGINEER

PLAN OF OPERATION MODIFICATION REQUEST
COLUMBIA DRY ASH DISPOSAL FACILITY
TOWN OF PACIFIC, WISCONSIN

SITE

BASE GRADES AND LEACHATE COLLECTION SYSTEM

FIGURE
5

LEGEND

- DRY ASH DISPOSAL FACILITY LIMITS
- LIMITS OF WASTE
- LINER PHASE/MODULE LIMIT
- FINAL COVER LIMITS
- APPROXIMATE INTERMEDIATE COVER LIMITS/AREA
- LIMITS OF CONSTRUCTED 2' THICK CLAY LINER
- PAVED ROAD
- UNPAVED ROAD
- VEGETATION
- FENCE
- 810 EXISTING GRADE (10' INTERVAL)
- EXISTING GRADE (2' INTERVAL)
- SWALE
- EDGE OF WATER
- WETLAND
- 800 PROPOSED GRADE (10' INTERVAL)
- 802 PROPOSED GRADE (2' INTERVAL)
- PROPOSED PERIMETER ROAD
- PROPOSED SWALE
- PROPOSED CULVERT
- PROPOSED SILT FENCE/FILTER SOCK
- PROPOSED STRAW BALE DITCH CHECK

NOTES:

1. SEE SHEET 2 FOR BASE MAP LEGEND ITEMS AND NOTES.

N

100 0 100

SCALE: 1" = 100'

541,000 N 541,500 N 542,000 N 542,500 N 543,000 N 543,500 N

2,124,000 E 2,124,500 E 2,125,000 E

COAL PILE
WPDES POND
MW-83
SG-4
MW-311
MW-33B
MW-33AR
MW-34A
MW-34B
C. M. ST. P. & P. RR.
MW-302
BM202
MW-5R
LS-1
MW-310
MURRAY ROAD
MW-309
MW-37A
EXISTING MODULE 1
EXISTING MODULE 2
EXISTING MODULE 3
EXISTING MODULE 4
EXISTING MODULE 5
EXISTING MODULE 6
PHASE 1
FINAL COVER AREA
INTERMEDIATE COVER AREA
MW-92B
MW-92A
LS-3R
MW-91AR
MW-91B
LP-1
LEACHATE/ SURFACE WATER POND
MW-313
INTERIM MODULE 11 LIMITS OF WASTE (PENDING NEED FOR MODULE 12)
MW-314
PROPOSED PHASE 2
PROPOSED MODULE 10
PROPOSED MODULE 11
CLAY STOCKPILE
GENERAL FILL STOCKPILE
MW-315
MW-301
BM301
BM302
MW-312
MW-93B
MW-93A
MW-86
MW-84A
MW-84B
U.S.H. 51

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APPROVED BY:	PEG 01/31/2023

CLIENT: WISCONSIN POWER AND LIGHT COMPANY
COLUMBIA ENERGY CENTER
2019 WILDWOOD ROAD
PARDEEVILLE, WI 53954

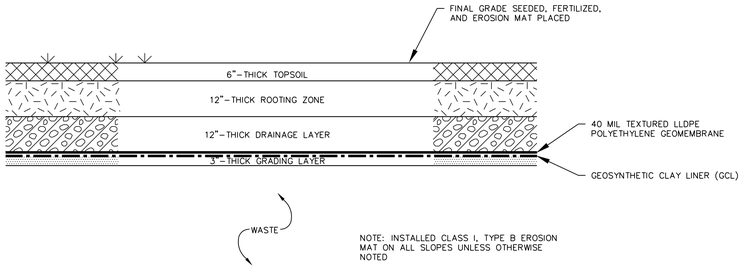
ENGINEER: SCS ENGINEERS
2830 DAIRY DRIVE MADISON, WI 53718-6751
PHONE: (608) 224-2830

SITE: PLAN OF OPERATION MODIFICATION REQUEST
COLUMBIA DRY ASH DISPOSAL FACILITY
TOWN OF PACIFIC, WISCONSIN

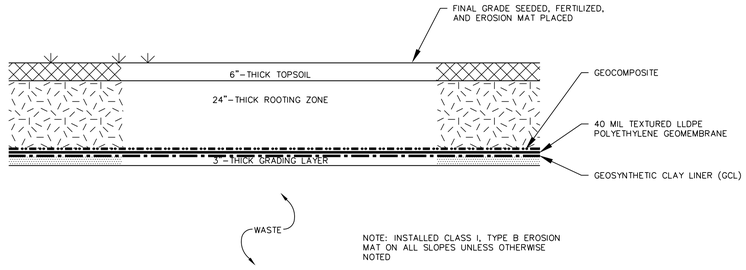
SUBBASE GRADES

FIGURE 6

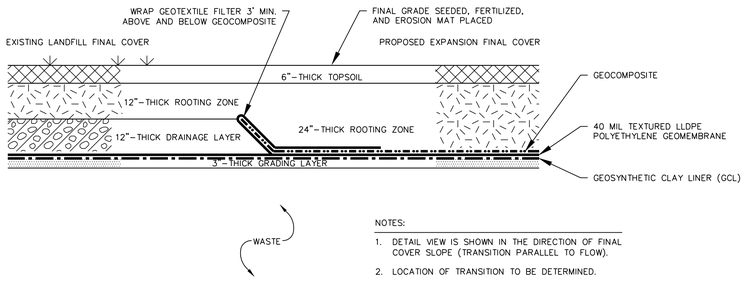
I:\25222260.00\Drawing\Figure 6_Subbase Grades.dwg, 12/21/2022 1:34:22 PM



1/7 FINAL COVER (SAND DRAINAGE LAYER)
SCALE: 1" = 2'

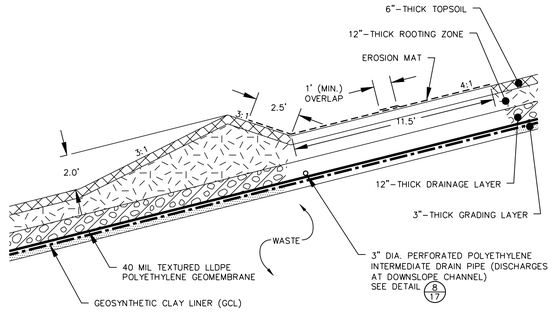


2/7 FINAL COVER (GEOCOMPOSITE DRAINAGE LAYER)
SCALE: 1" = 2'

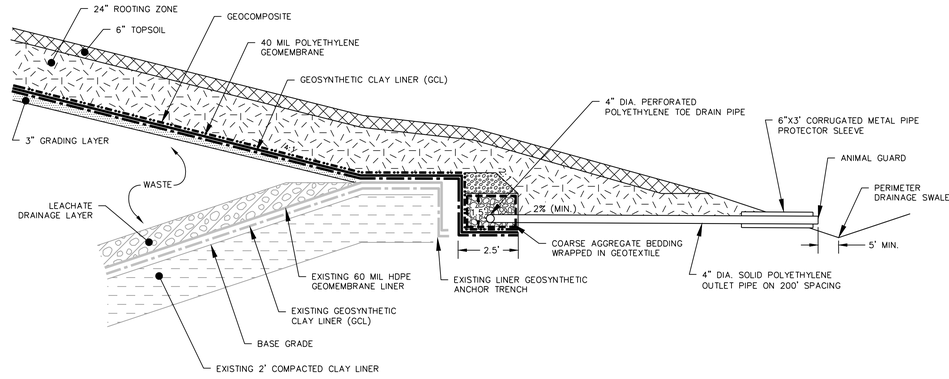


NOTES:
1. DETAIL VIEW IS SHOWN IN THE DIRECTION OF FINAL COVER SLOPE (TRANSITION PARALLEL TO FLOW).
2. LOCATION OF TRANSITION TO BE DETERMINED.

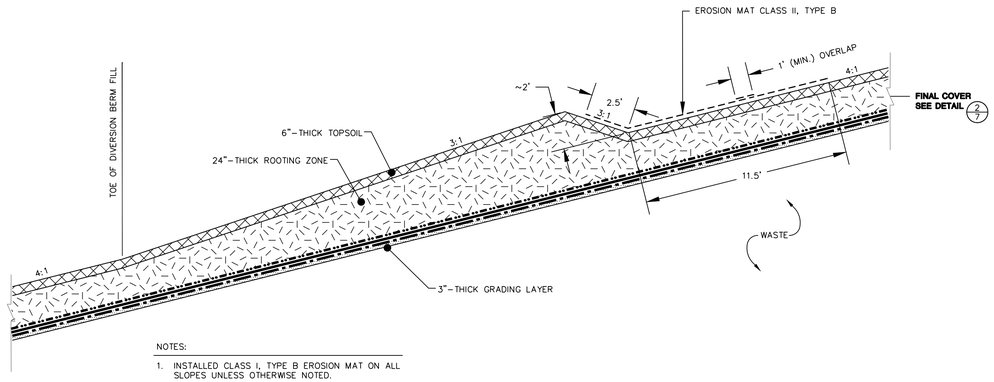
3/7 FINAL COVER TRANSITION FROM SAND TO GEOCOMPOSITE
SCALE: 1" = 2'



4/7 TYPICAL DIVERSION BERM AND INTERMEDIATE DRAIN PIPE (SAND DRAINAGE LAYER)
SCALE: 1" = 4'

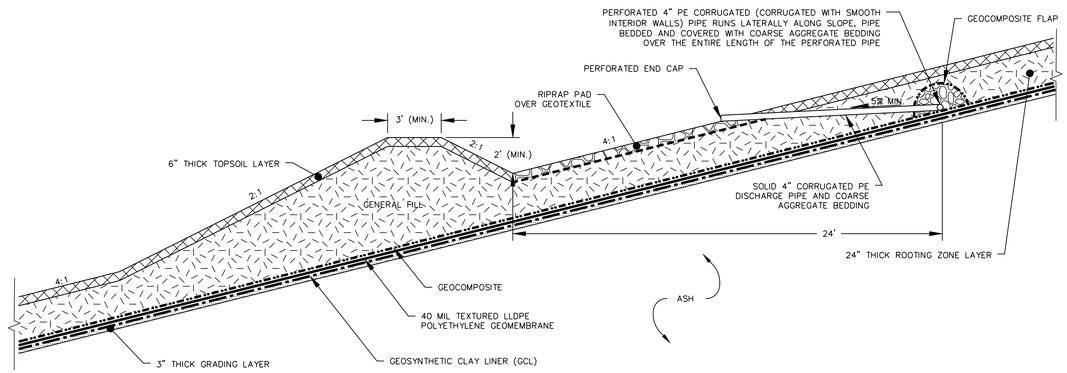


5/7 FINAL COVER TO LINER TIE-IN AND TOE DRAIN
SCALE: 1" = 3'



NOTES:
1. INSTALLED CLASS I, TYPE B EROSION MAT ON ALL SLOPES UNLESS OTHERWISE NOTED.

6/7 FINAL COVER DIVERSION BERM
SCALE: 1" = 4'



7/7 HIGH CAPACITY GEOCOMPOSITE DRAIN
SCALE: 1" = 4'

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REVISED: 12/21/2022

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PLAN OF OPERATION MODIFICATION REQUEST
COLUMBIA DRY ASH DISPOSAL FACILITY
TOWN OF PACIFIC, WISCONSIN
SITE

FINAL COVER DETAILS

FIGURE
7

LEGEND

- DRY ASH DISPOSAL FACILITY LIMITS
- LIMITS OF WASTE
- LINER PHASE/MODULE LIMIT
- FINAL COVER LIMITS
- FINAL COVER INTERMEDIATE/TOE DRAIN
- PAVED ROAD
- UNPAVED ROAD
- VEGETATION
- FENCE
- 810 EXISTING GRADE (10' INTERVAL)
- EXISTING GRADE (2' INTERVAL)
- SWALE
- EDGE OF WATER
- WETLAND
- 840 PROPOSED GRADE (10' INTERVAL)
- PROPOSED GRADE (2' INTERVAL)
- PROPOSED PERIMETER ROAD
- PROPOSED SWALE
- PROPOSED CULVERT
- PROPOSED LEACHATE COLLECTION SYSTEM CLEANOUT
- PROPOSED LEACHATE VAULT
- fw PROPOSED LEACHATE FORCEMAIN
- ue PROPOSED UNDERGROUND ELECTRIC
- PROPOSED FINAL COVER INTERMEDIATE/TOE DRAIN
- PROPOSED DIVERSION BERM
- PROPOSED DOWNSLOPE FLUME
- PROPOSED ENERGY DISSIPATOR
- PROPOSED RIPRAP
- PROPOSED SILT FENCE/FILTER SOCK
- PROPOSED STRAW BALE DITCH CHECK

NOTES:

1. SEE FIGURE 2 FOR BASE MAP LEGEND ITEMS AND NOTES.
2. INSTALL NON-CHANNEL EROSION MAT ON ALL RESTORED SLOPES GREATER OR EQUAL TO 5:1 OR AS NOTED.
3. INSTALL CHANNEL EROSION MAT IN THE PROPOSED SWALE.
4. PROTECT EXISTING MONITORING WELLS AND STRUCTURES DURING CONSTRUCTION TO BE REPLACED AT CONTRACTOR'S COST IF DAMAGED.

N

100 0 100

SCALE: 1" = 100'

541,000 N 541,500 N 542,000 N 542,500 N 543,000 N 543,500 N

2,124,000 E 2,124,500 E 2,125,000 E

COAL PILE
WPDES POND
PHASE 1
EXISTING MODULE 1
EXISTING MODULE 2
EXISTING MODULE 3
EXISTING MODULE 4
EXISTING MODULE 5
EXISTING MODULE 6
PROPOSED MODULE 10
PROPOSED MODULE 11
LEACHATE/ SURFACE WATER POND
GENERAL FILL STOCKPILE
CLAY STOCKPILE
EXISTING FINAL COVER AREA (SAND DRAINAGE LAYER)
FINAL COVER TRANSITION FROM SAND TO GEOCOMPOSITE DRAINAGE LAYER SEE DETAIL 3/7
FINAL COVER (SAND DRAINAGE LAYER) SEE DETAIL 1/7
FINAL COVER (GEOCOMPOSITE DRAINAGE LAYER) SEE DETAIL 2/7
FINAL COVER DIVERSION BERM (TYP.) SEE DETAIL 6/7
HIGH CAPACITY GEOCOMPOSITE SEE DETAIL 7/7
FINAL COVER LINER TIE-IN AND TOE DRAIN SEE DETAIL 5/7
ROCK CHUTE (TYP.)
DOWNSLOPE FLUME INLET (TYP.)
DOWNSLOPE FLUME (TYP.)
ENERGY DISSIPATOR (TYP.)
C. M. ST. P. & P. RR.
MURRAY ROAD
MW-301 MW-302 MW-309 MW-310 MW-311 MW-312 MW-313 MW-314
MW-5R MW-17 MW-33AR MW-33B MW-34A MW-34B MW-37A MW-83
MW-84A MW-84B MW-85B MW-86 MW-88B MW-91AR MW-91B
MW-92A MW-92B MW-93A MW-93B
SG-4 LS-1 LS-3R LH-2 LP-1
BM201 BM202 BM301 BM302 BM303
TOP OF POND LINER ELEVATION = 796.97

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PARDEEVILLE, WI 53954

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PHONE: (608) 224-2830
ENGINEER

PLAN OF OPERATION MODIFICATION REQUEST
COLUMBIA DRY ASH DISPOSAL FACILITY
TOWN OF PACIFIC, WISCONSIN
SITE

FINAL GRADES

FIGURE
8

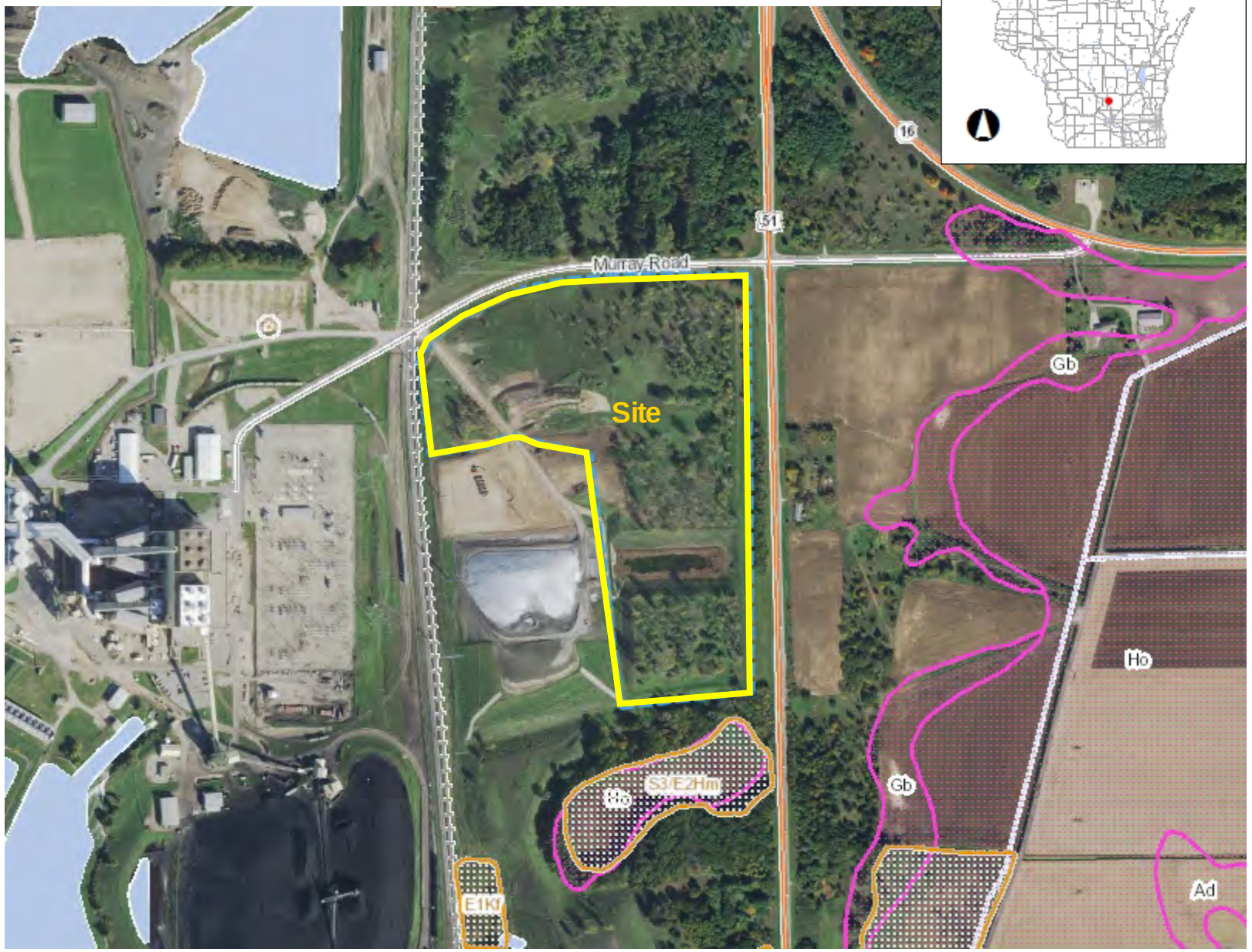
Appendix A

Performance and Location Criteria

Appendix A1

Wetland Delineation Maps

Surface Water Data Viewer Map



Legend

Wetland Class Points
- Dammed pond
- Excavated pond
- Filled excavated pond
- Filled/drained wetland
- Wetland too small to delineate

Filled Points

Wetland Class Areas
- Wetland
- Upland

Filled Areas

NRCS Wetspots

Wetland Indicators

Municipality

State Boundaries

County Boundaries

Major Roads
- Interstate Highway
- State Highway
- US Highway

County and Local Roads
- County HWY
- Local Road

Railroads

Tribal Lands

Rivers and Streams

Intermittent Streams

Lakes and Open water

Notes

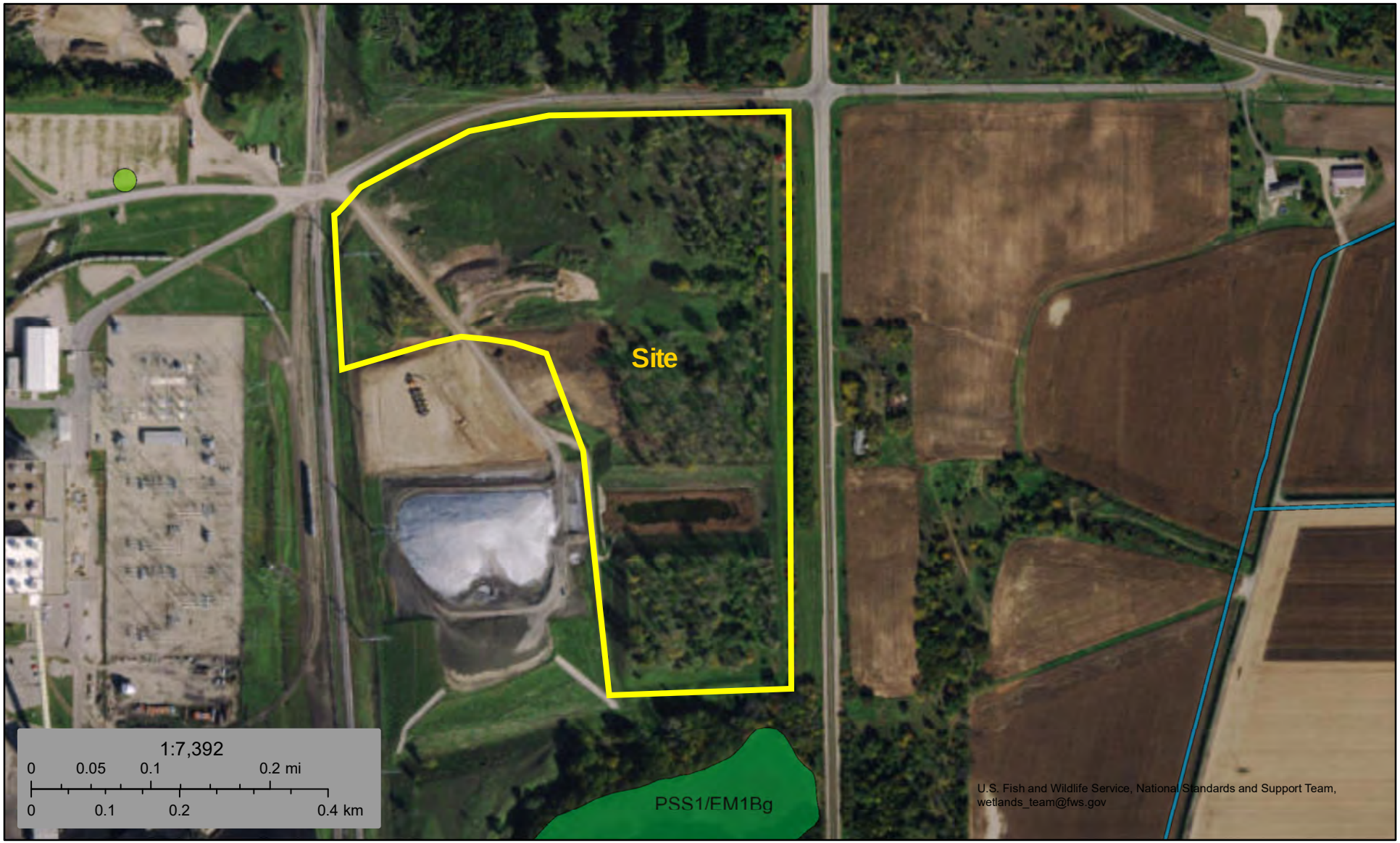
0.3 0 0.13 0.3 Miles

NAD_1983_HARN_Wisconsin_TM

1: 7,920

U.S. Fish and Wildlife Service
National Wetlands Inventory

Wetlands



September 25, 2017

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.

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.

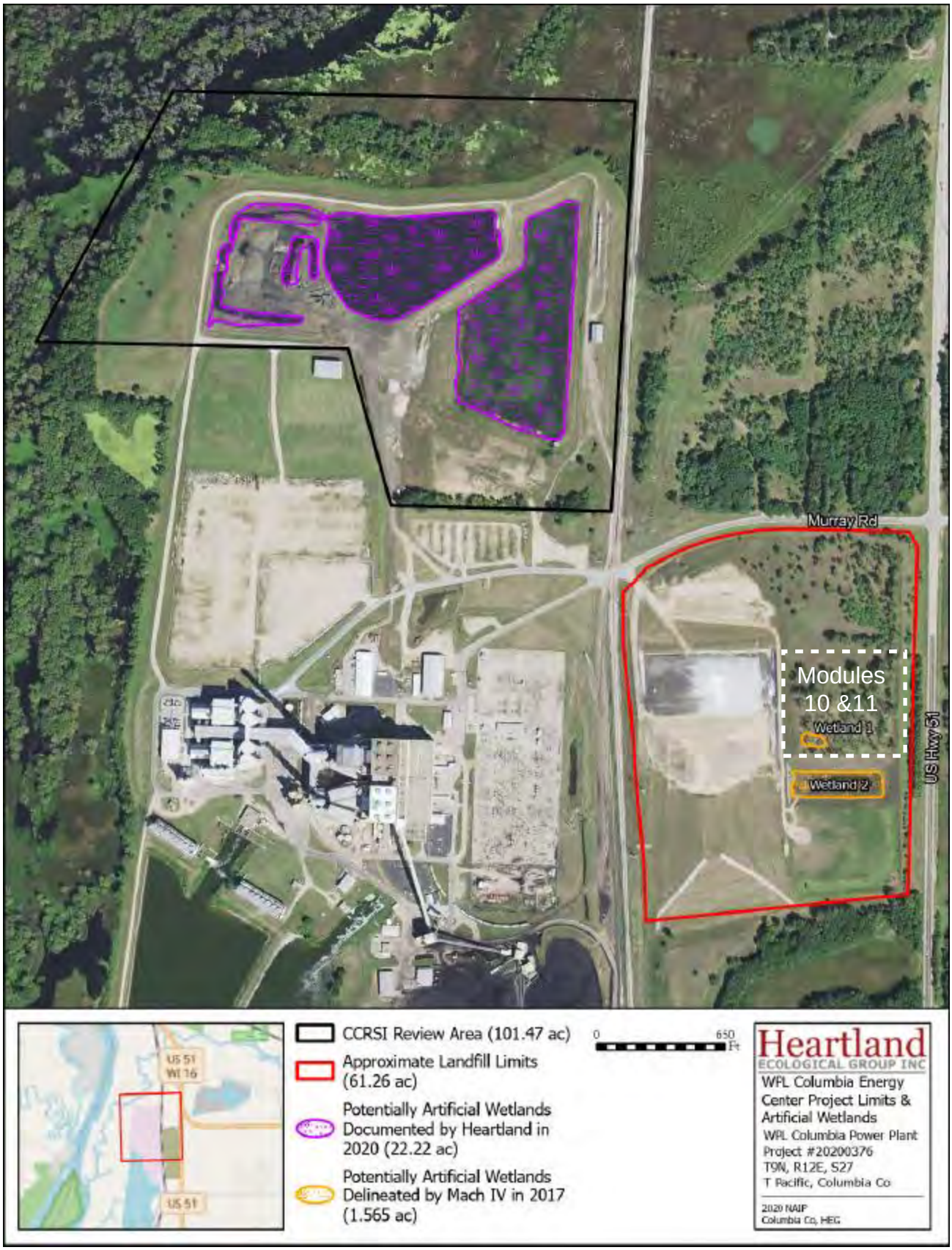
If you have any questions, please call me at (608) 228-4067 or email Allen.Ramminger@wisconsin.gov

Sincerely,

Allen Ramminger
Water Management Specialist

Copy to:

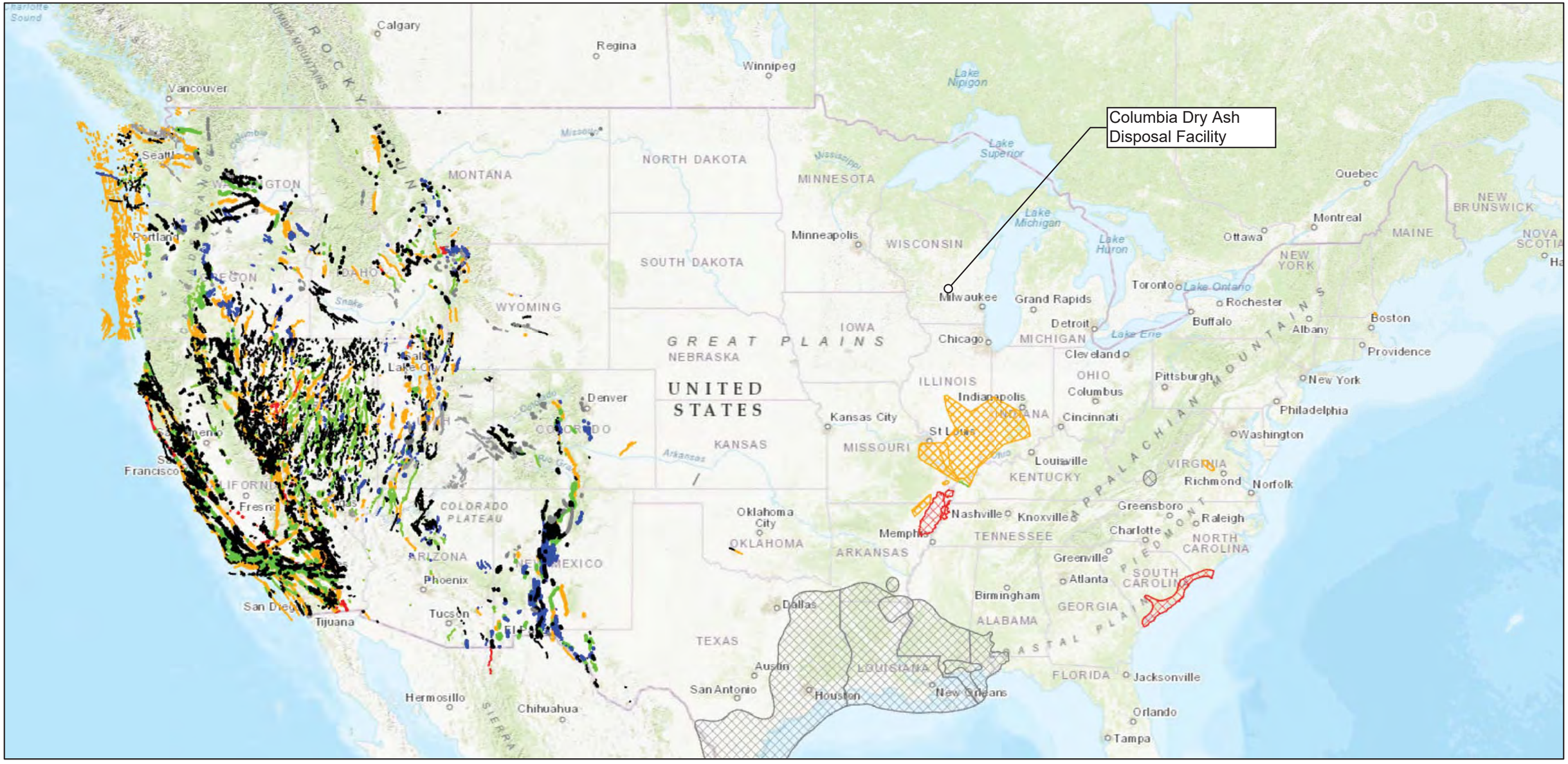
USACE Project Manager
Water Management Specialist
County Zoning Administrator
Consultant


Murray Rd
Modules
10 &11
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

Appendix A2

Fault Location Map

U.S. Geological Survey Quaternary Faults



6/4/2021, 2:28:44 PM

Fault Areas

- Class B
- historic
- late Quaternary
- latest Quaternary
- middle and late 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

1:18,489,298

0 170 340 680 mi

0 265 530 1,060 km

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

Source - https://www.usgs.gov/natural-hazards/earthquake-hazards/faults?qt-science_support_page_related_con=4#qt-science_support_page_related_con

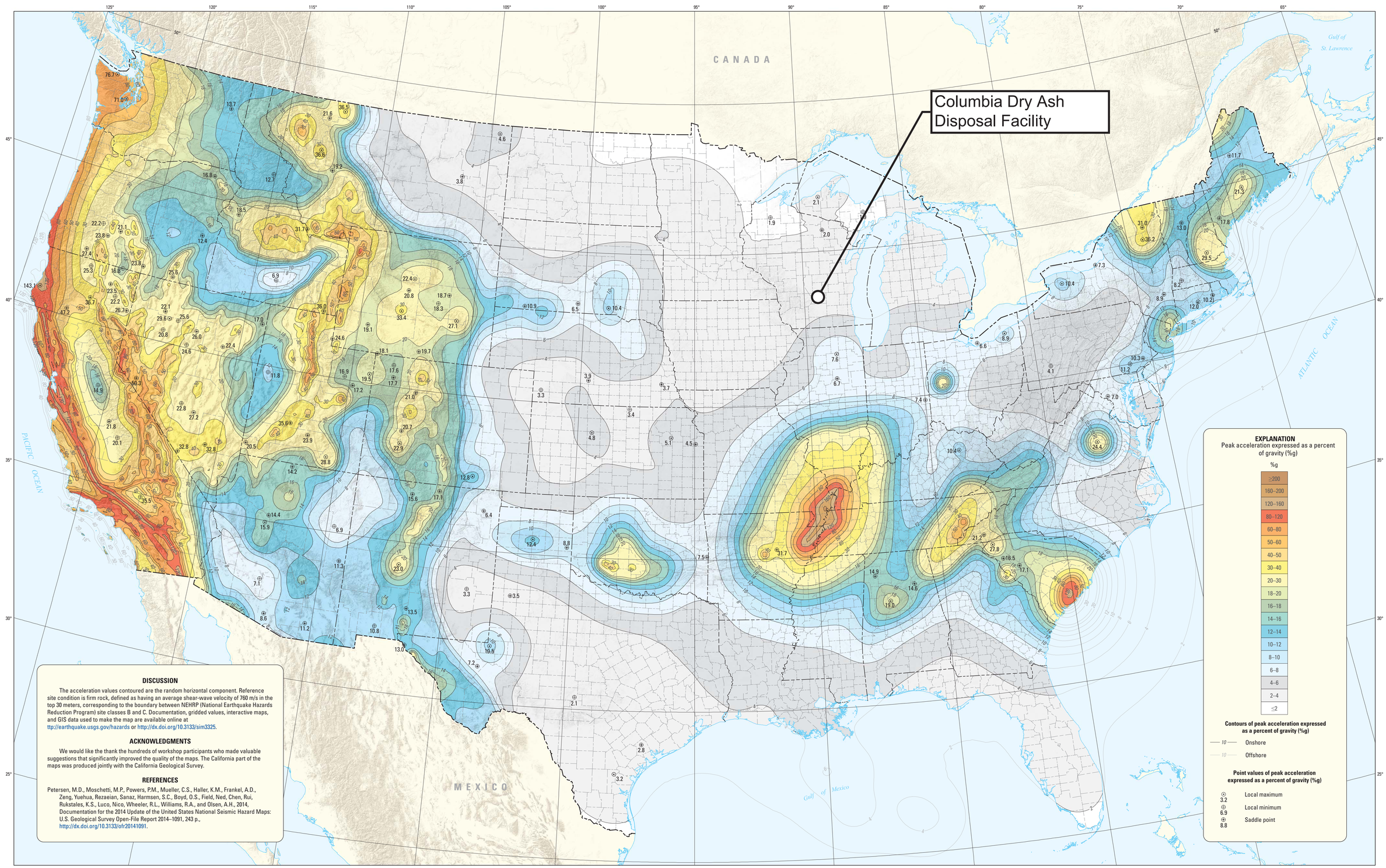
USGS

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

Appendix A3

Seismic Hazard Map

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



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.

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

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

Digital data prepared with ArcGIS 10.1 running under Windows 7

Publishing support provided by:
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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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Appendix A4

Site Description and Geologic Summary

Attachment A4.1

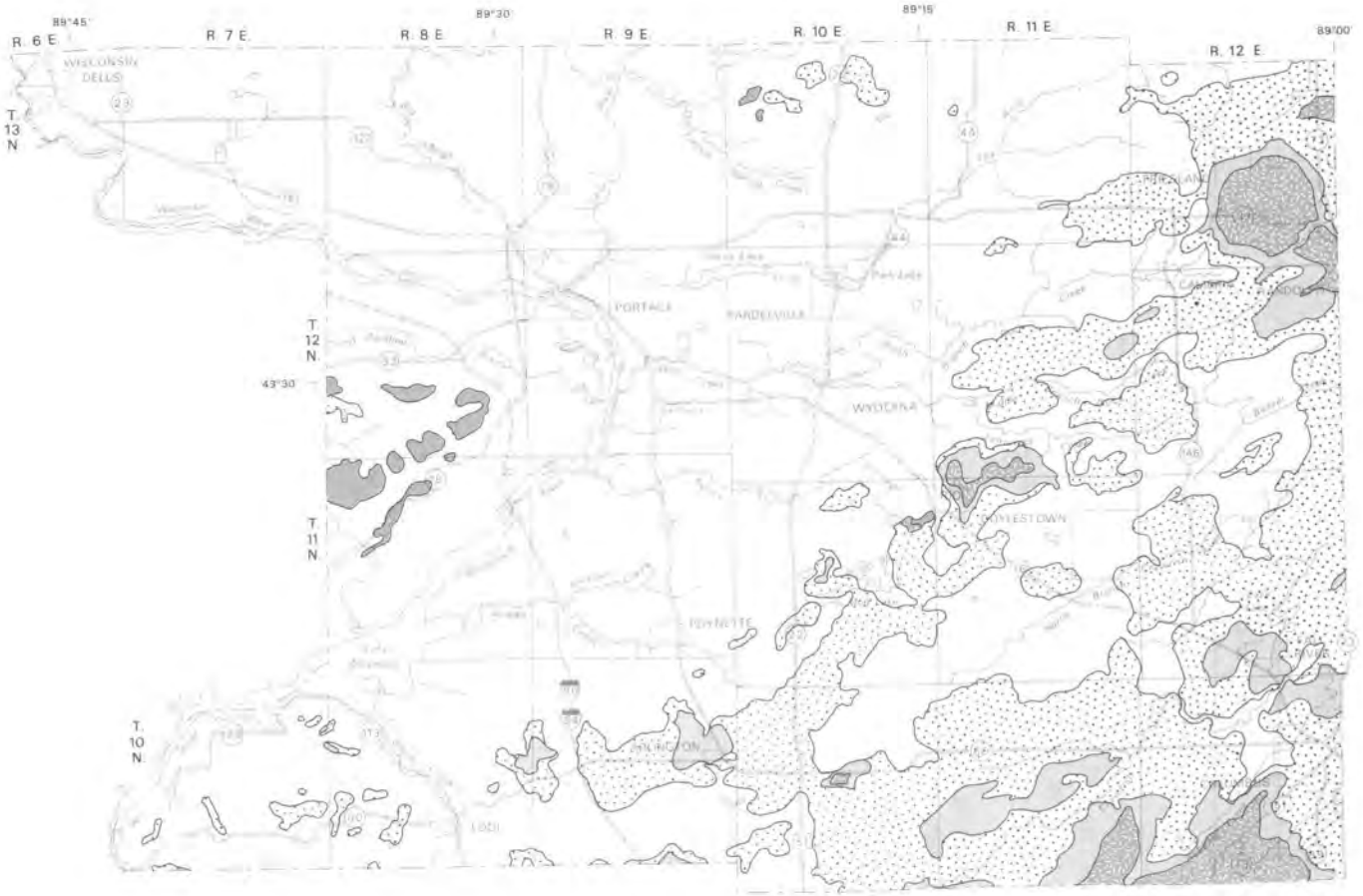


Figure 2. Bedrock geology.

Site Description and Geologic Summary

Site Information

The COL dry ash disposal facility encompasses 62.5 acres, and is located in an industrial and agricultural area with scattered private residences. The site location is Section 27, T12N, R9E, in the town of Pacific, located in Columbia County, Wisconsin. The facility is bounded by U.S. Highway 51 to the east and railroad tracks to the west. Murray Road is located to the north and wetlands are located to the south of the facility.

Regional Geology

Columbia County glacial geology consists mostly of glacial drift. Glacial sediments from the Green Bay Lobe were deposit during the Wisconsin Glaciation (Harr et. al, 1978). Underling the glacial drift is a mix of dolomite and sandstone from the Ordovician. The Ordovician units: Prairie du Chien Group (mostly dolomite), St. Peter Sandstone, as well as the Platteville and Decorah Formation, and the Galena Dolomite (Galena-Platteville unit) underlay the glacial sediments present in Columbia County (Harr et. al, 1978). In many parts of the county, the Prairie du Chien Group was eroded away and the St. Peter Sandstone overlies Cambrian Sandstone. A bedrock geology map and stratigraphic column are provided in Attachment A4.1 and A4.2.

A map of karst and shallow carbonate bedrock in Wisconsin, like the bedrock geology map from Harr et. al, (1978), shows karst structures and shallow carbonate bedrock are found within Columbia County (Bradbury, 2009); however, the karst geology identified is not located at or near the COL dry ash disposal facility (Attachment A4.3).

The COL dry ash disposal facility is located within the area of the county where Ordovician St Peter sandstone bedrock underlies the glacial drift present at the surface (Appendices A6 and A7). Karst features were not observed in boreholes at COL ADF, and the Wisconsin Geological and Natural History Survey (WGNH) did not identify the site as an area with potential karst structures.

Previous Geologic Investigations

The disposal facility area was investigated by Warzyn Engineering prior to construction by performing approximately 12 borings within and adjacent to the facility footprint. Eleven of the borings were instrumented with groundwater monitoring wells. The borings extended to depths of up to 100 feet. Split spoon samples were collected. Laboratory soil testing included grain size analysis, Atterberg limits, and organic content by loss on ignition. The boring locations and geologic cross sections are shown in Appendix A6.

Based on the results of the subsurface investigations performed prior to disposal facility construction, the soils below the liner system within the facility footprint consist primarily of medium dense to very dense sands underlain by sandstone bedrock.

References

Harr, C.A., L.C. Trotta, and R.G. Borman, 1978, "Ground-Water Resources and Geology of Columbia County, Wisconsin," University of Wisconsin-Extension Geological and Natural History Survey Information Circular Number 37, 1978.

Bradbury, K. R., "Karst and Shallow Carbonate Bedrock in Wisconsin." University of Wisconsin-Extension Geological and Natural History Survey, Factsheet 02, 2009.

Warzyn Engineering, Inc., 1978, Feasibility Study, Proposed Fly Ash and/or Scrubber Sludge Disposal Facility – Columbia Site, Wisconsin Power and Light Company, Town of Pacific, Columbia County, WI, January 1978.

Attachment A4.2

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.

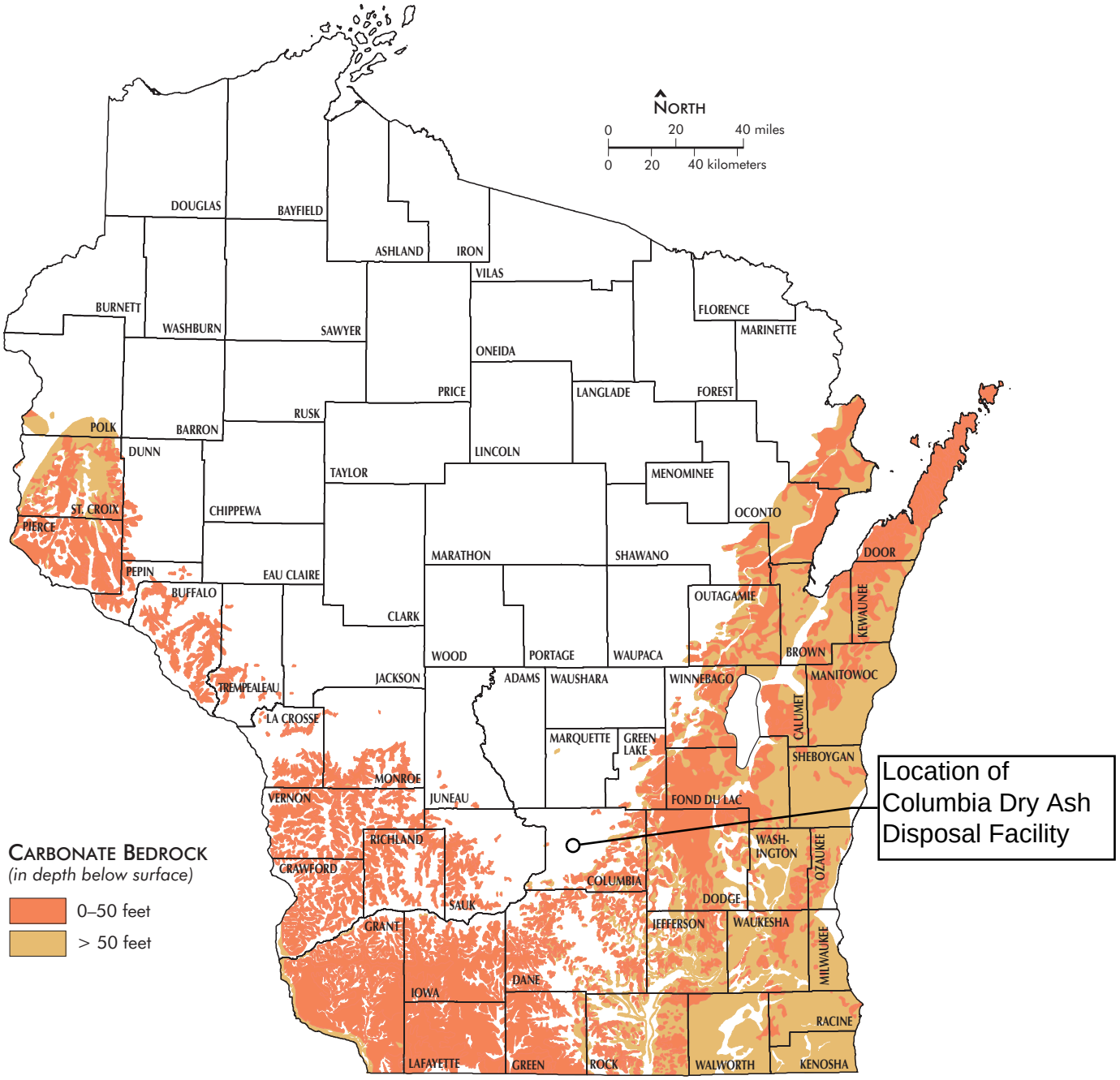
Attachment A4.3

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?

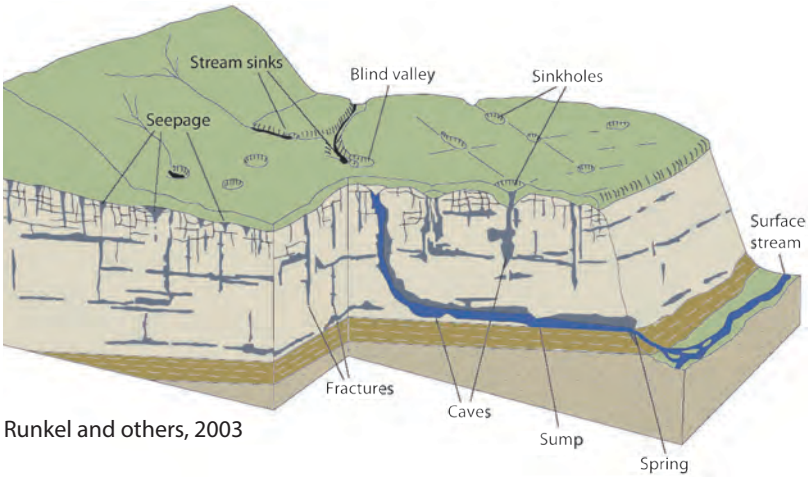
Water- and land-use management plans in areas with carbonate bedrock should always address these sorts of questions as they seek to protect groundwater quantity and quality.

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 A5

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 A3.

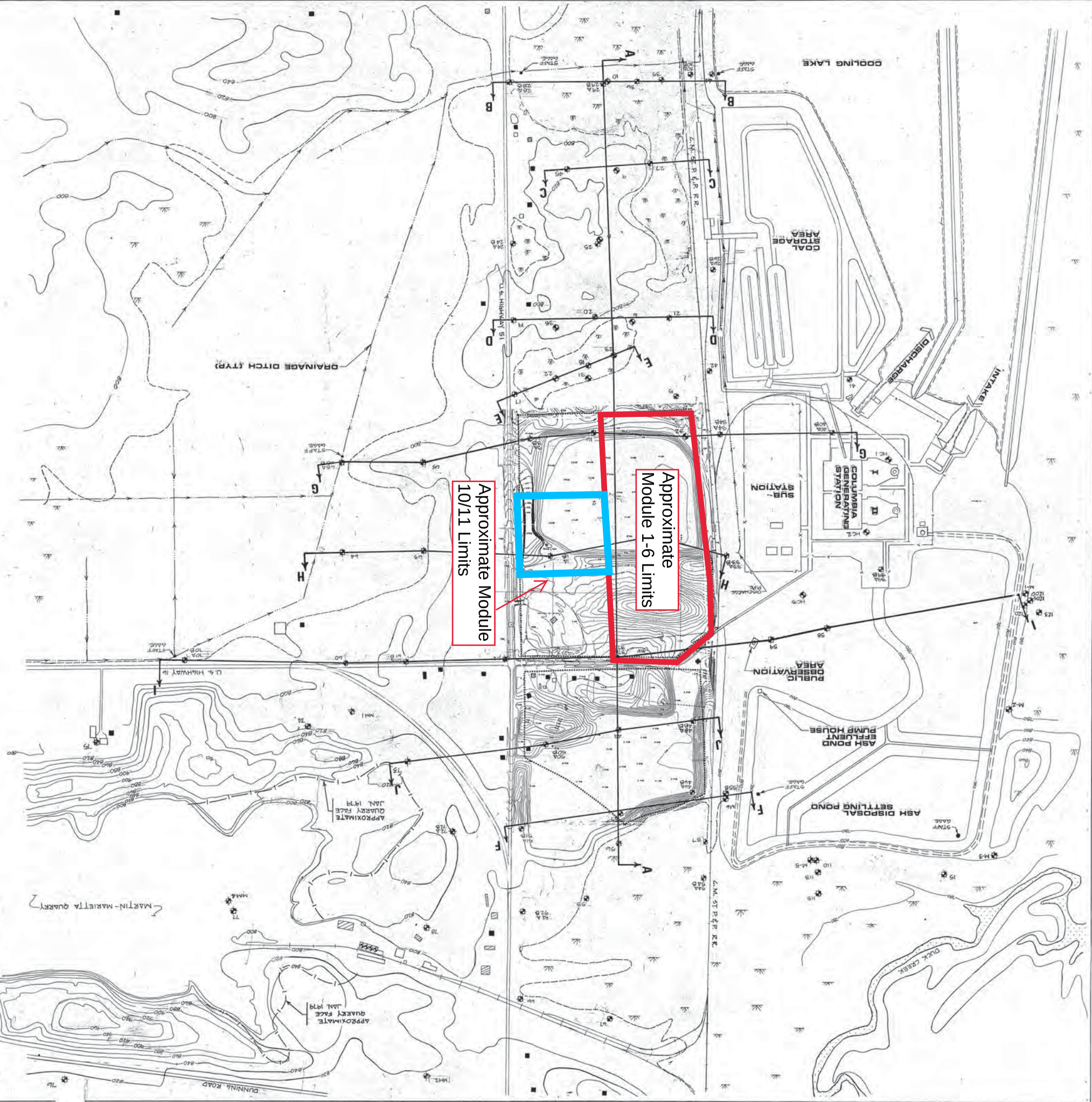
Settlement below a disposal facility can be a concern if the facility is underlain by extensive soft, fine-grained soils. Soft soils are subject to consolidation settlement depending on the load over the soft soils. The disposal facility soils consist of medium dense to very dense sands that are not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

Appendix A6

Geologic Cross Sections

Approximate Module 10/11 Limits

Approximate Module 1-6 Limits



NOTES

1) TOPOGRAPHIC INFORMATION BASED PRIMARILY ON USGS POYNETTE QUADRANGLE (CONTOUR INTERVAL: 20 FEET). TOPOGRAPHY IN THE AREA OF THE MARTIN-MARIETTA QUARRY AND THE DISPOSAL AREA HAS BEEN UPDATED, BASED ON VARIOUS MORE RECENT SURVEYS. THE COLUMBIA GENERATING STATION AND FACILITIES ARE SHOWN IN PLANIMETRIC.

2) DETAILS OF THE MARTIN-MARIETTA QUARRY ARE APPROXIMATE. REFER TO DRAWING C7134-F8 AND TEXT FOR MORE DETAILED TOPOGRAPHY AND DISCUSSION.

LEGEND

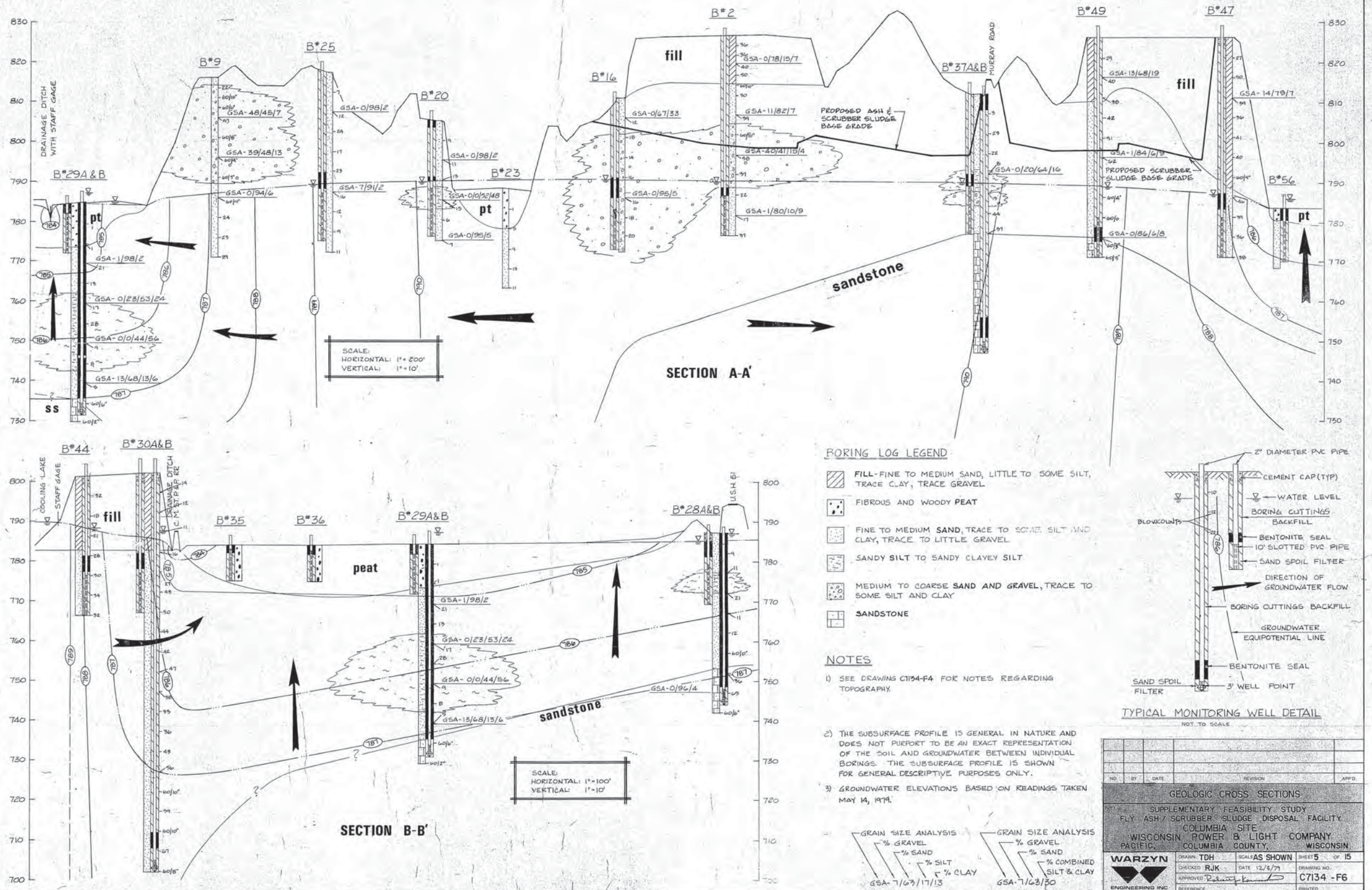
- PROPOSED PROJECT AREA
- OBSERVATION WELL LOCATION, NUMBER, AND WATER TABLE ELEVATION
- BORING LOCATION AND NUMBER
- WETLANDS
- TOPOGRAPHIC CONTOURS (CONTOUR INTERVAL: 20FT)
- PRIVATE RESIDENCES (ASSUMED LOCATIONS OF PRIVATE WATER SUPPLY WELLS)
- COMMERCIAL BUILDINGS (ASSUMED LOCATIONS OF POSSIBLE PUBLIC WATER SUPPLY WELLS)
- SURFACE WATERS (STREAMS OR DRAINAGE DITCHES; ARROWS INDICATE DIRECTION OF FLOW
- OTHER BUILDINGS (GARAGES, BARNS, ETC.)
- HIGH CAPICITY WELLS

CROSS SECTION LOCATION MAP

NO.	BY	DATE	REVISION	APP'D

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

WARZYN	DRAWN TDH	SCALE 1" = 300'
ENGINEERING INC	CHECKED RJK	DATE 12/3/79
	APPROVED	DRAWING NO. C7134-F5
	REFERENCE	SHEET 4 OF 15
		PRINTED



BORING LOG LEGEND

- **FILL** - FINE TO MEDIUM SAND, LITTLE TO SOME SILT, TRACE CLAY, TRACE GRAVEL
- FIBROUS AND WOODY **PEAT**
- FINE TO MEDIUM **SAND**, TRACE TO SOME SILT AND CLAY, TRACE TO LITTLE GRAVEL
- SANDY **SILT** TO SANDY CLAYEY **SILT**
- MEDIUM TO COARSE **SAND AND GRAVEL**, TRACE TO SOME SILT AND CLAY
- **SANDSTONE**

NOTES

1) SEE DRAWING C7134-F4 FOR NOTES REGARDING TOPOGRAPHY.

2) 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.

3) GROUNDWATER ELEVATIONS BASED ON READINGS TAKEN MAY 14, 1979.

GRAIN SIZE ANALYSIS — % GRAVEL — % SAND — % SILT — % CLAY — GSA-7/63/17/13

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

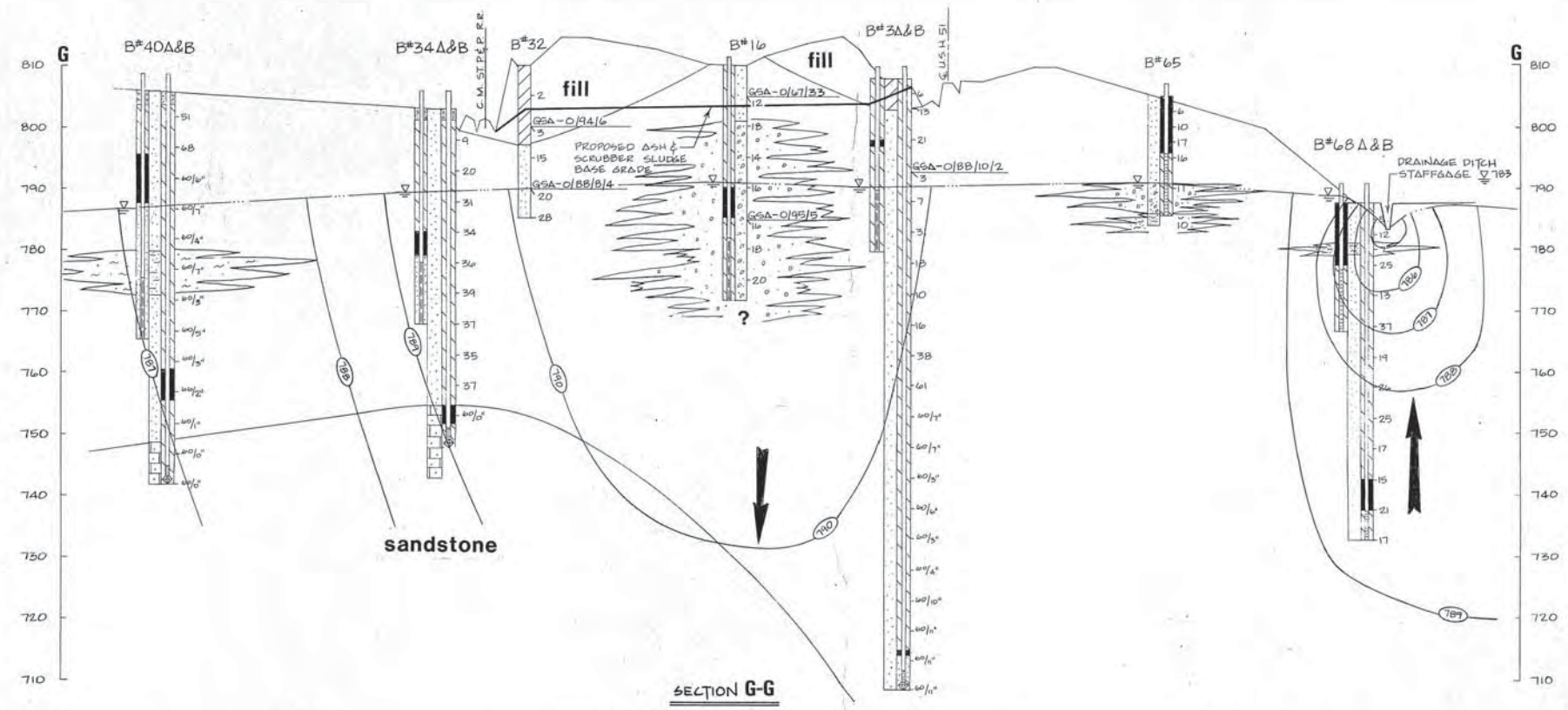
TYPICAL MONITORING WELL DETAIL
NOT TO SCALE

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 5	OF 15
CHECKED: RJK	DATE: 12/5/79	DRAWING NO.	C7134-F6
APPROVED:	REFERENCE	PRINTED	



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

NOTES

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

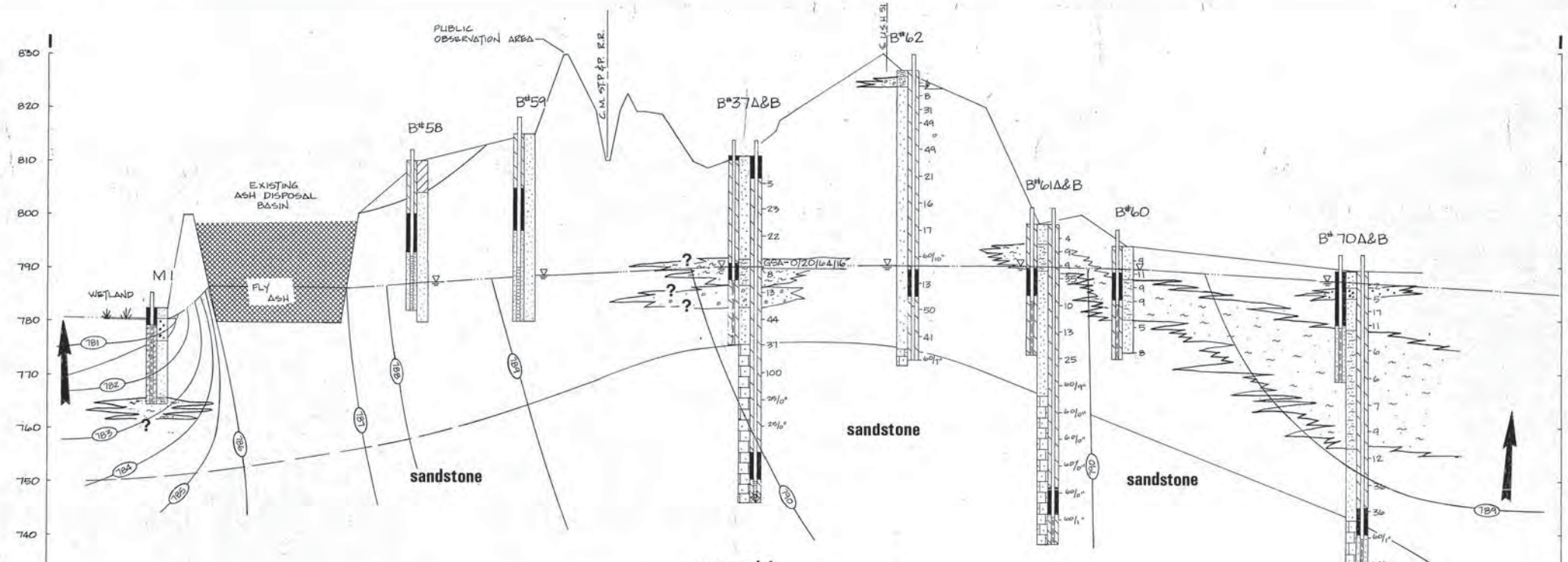
NO.	BY	DATE	REVISION	APP'D

GEOLOGIC CROSS SECTIONS

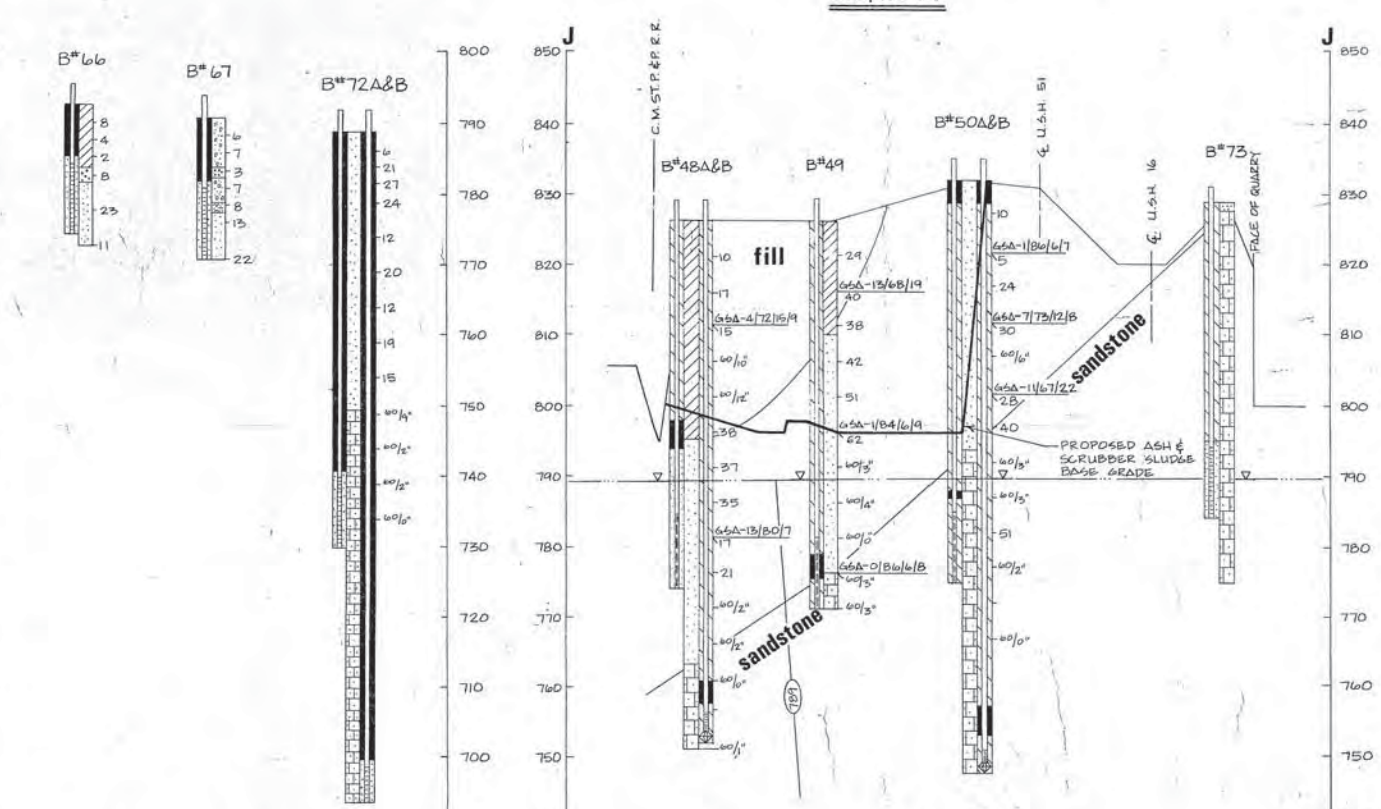
SUPPLEMENTARY FEASIBILITY STUDY
FLY ASH / SCRUBBER SLUDGE DISPOSAL FACILITY
COLUMBIA SITE
WISCONSIN POWER & LIGHT COMPANY
PACIFIC, COLUMBIA COUNTY, WISCONSIN

WARZYN ENGINEERING INC.

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



SECTION I-I



MISCELLANEOUS BORINGS

SECTION J-J

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 12/3/79	DRAWING NO.	
APPROVED Robert J. Kraus	REFERENCE	C7134-F9	
		PRINTED	

Appendix A7

Slope Stability Analysis

May 10, 2022
File No. 25220183.00

TECHNICAL MEMORANDUM

ANALYSIS BY: Brandon Suchomel

REVIEWED BY: Deb Nelson
Phil Gearing

SUBJECT: Slope Stability Analyses
Plan of Operation 2022 Update
Columbia Dry Ash Disposal Facility

PURPOSE

The purposes of the slope stability analyses were to evaluate:

- The interim 3H:1V waste slope in Module 5 at the highest waste grade (Interim Waste Filling Stage 2).
- The interim 4H:1V east waste slope in Module 4/Module 11 at the highest waste grade (Interim Waste Filling Stage 3).
- The final 4H:1V final cover slope Module 4/Module 11 at the highest final cover grade.

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 will be stable post-closure of the disposal facility.

APPROACH

SCS Engineers (SCS) evaluated the waste mass slope stability of the interim slope of Module 5 during interim waste filling stage 2 and the waste mass slope stability of the interim slope of Module 4/Module 11 during the interim waste filling stage 3 at the most critical/highest waste grade cross-sections. The Module 5 interim 3H:1V waste slope analyzed is the eastern filling face with a maximum waste fill height of approximately 63 feet above the base grade corresponding to a peak elevation of approximately 870 feet above mean sea level. The Module 4/Module 11 interim 4H:1V waste slope analyzed is at the eastern filling face with a maximum waste fill height of approximately 65 feet above the base grade corresponding to a peak elevation of approximately 870 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 22.7 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. The 4H:1V slope of analyzed is through the Module 4/Module 11 waste mass with a maximum waste fill height of approximately 101 feet above base grades corresponding to a peak elevation of approximately 908 feet above mean sea level. The final grade slope 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. 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, final grades.

5. TRI/Environmental, Interface Friction Test Results, 2016, for 2016 Module 3 Liner 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 2016, Version 8.16.2.14053, Slope/W slope stability software.

ASSUMPTIONS

- Sand drainage layer 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 or 4H: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 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 and final grade 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
Drainage Layer	115	30	0	2 and 3
CCR	86	22.7(1)	0	6, 7, 8, and Calculation
Final Cover	120	30	0	1, 2, 3, and 4

Notes: CCR friction angle iteratively calculated for minimum value for a safety factor of 1.3 for Module 5 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

BSS/DLN/REO/PEG

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Plan of Operation Update - Slope Stability Analysis
Factor of Safety Results Summary
Columbia Dry Ash Disposal Facility / SCS Project No. 25220183.00

Scenario Analyzed	Failure Type	Calculated Safety Factor	Recommended Minimum Safety Factor
Interim Waste Stage 2 (Module 5 Interim 3H:1V Waste Slope)			
2-2_Optimized Circular_Forced Full Slope_FS=1.3	Optimized Circular	1.302[(1)]	1.300
3_Block	Block	1.579	1.300
Interim Waste Stage 3 (Module 4/Module 11 Interim 4H:1V Waste Slope)			
2-1_Optimized Circular_Forced Full Slope	Optimized Circular	1.691	1.300
3_Block	Block	2.063	1.300
Final Grade (Module 4/Module 11 4H:1V Final Cover Slope)			
2_Optimized Circular	Optimized Circular	1.715	1.500
3_Block	Block	2.143	1.500

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

Updated by: BSS, 05/04/2022
Checked by: DLN, 05/05/2022

I:\25220183.00\Data and Calculations_Issued for Permitting POO Geotech Calculations\Slope Stability\Tech Memo\[A1_POO Slope Stability_FS Results Summary Table_220504.xlsx]FS Results Summary

INTERIM STAGE 2 WASTE FILLING SECTION ANALYZED

ANALYZED AS 3H:1V SLOPE

DOCUMENTED MOD 5-6 BASE GRADE

EXISTING GRADES HERE REPRESENT DOCUMENTED MOD 5-6 FROST PROTECTION

PROPOSED MOD 10-11 BASE GRADE

PROPOSED MOD 10-11 PERIMETER GRADE

N

100 0 100

SCALE: 1" = 100'

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DRAWN BY: BSS
CHECKED BY: ??
APPROVED BY:

PROJECT NO. 25220183.00
DRAWN: 04/01/2022
REVISED: 05/04/2022

WISCONSIN POWER AND LIGHT COMPANY
COLUMBIA ENERGY CENTER
W9646 AGENCY RD.
PARDEEVILLE, WI 53954

CLIENT

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

ENGINEER

COLUMBIA DRY ASH DISPOSAL FACILITY

SITE

SLOPE STABILITY CROSS SECTION LOCATIONS
INTERIM FILLING STAGE 2

FIGURE

1 or 1

DOCUMENTED MOD 4 BASE GRADE

INTERIM STAGE 3 WASTE FILLING SECTION ANALYZED

PROPOSED MOD 10-11 BASE GRADE

PROPOSED MOD 10-11 PERIMETER GRADE

N

100 0 100

SCALE: 1" = 100'

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PROJECT NO.	25220183.00
DRAWN:	04/01/2022
REVISED:	05/04/2022

CLIENT

WISCONSIN POWER AND LIGHT COMPANY
COLUMBIA ENERGY CENTER
W8375 AGRICO ROAD
PARDEEVILLE, WI 53954

ENGINEER

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

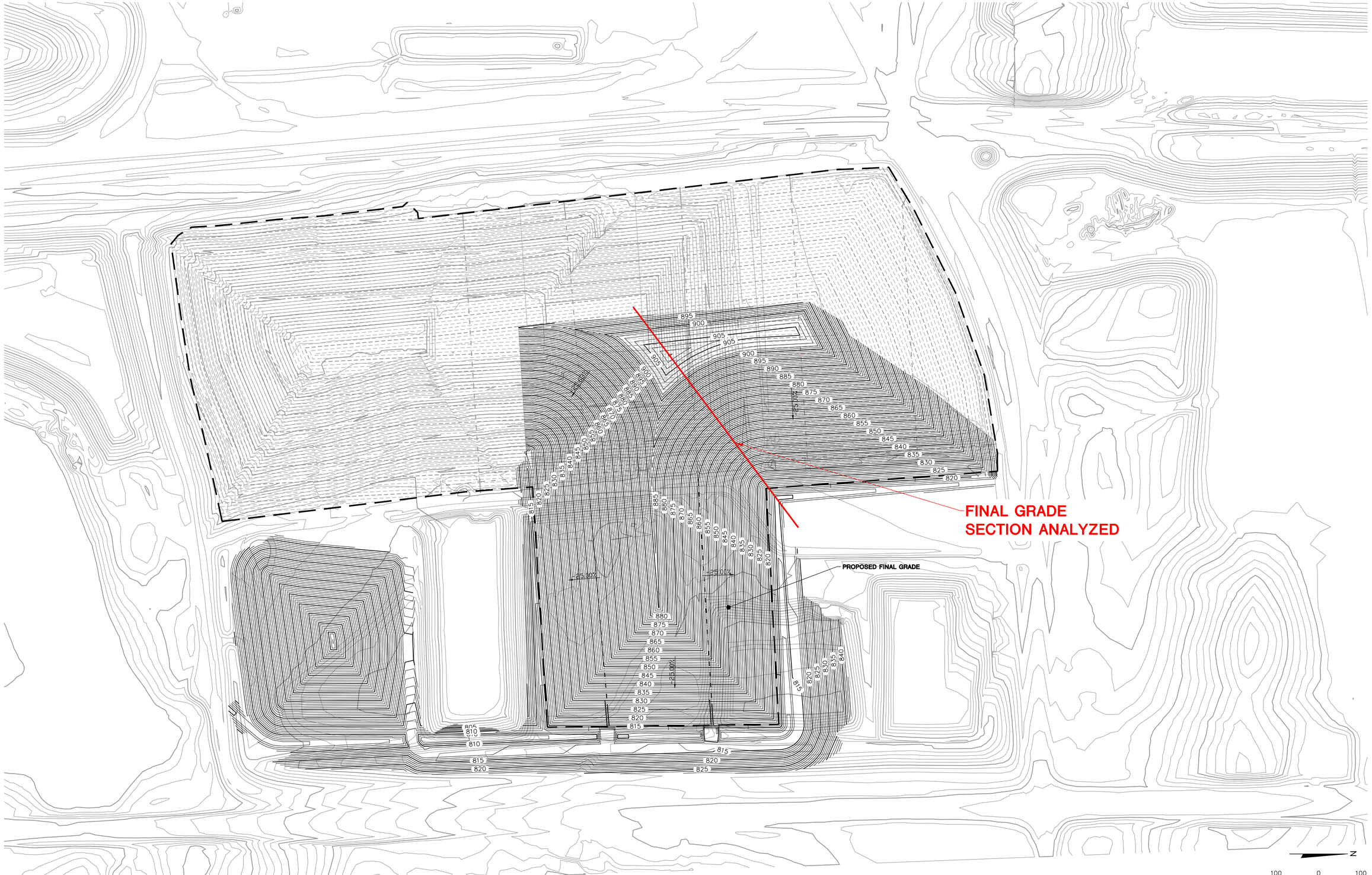
SITE

COLUMBIA DRY ASH DISPOSAL FACILITY

FIGURE

SLOPE STABILITY CROSS SECTION LOCATIONS
INTERIM FILLING STAGE 3

1 or 1



PROJECT NO.	25220183.00
DRAWN:	04/01/2022
REVISED:	05/04/2022
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CHECKED BY:	??
APPROVED BY:	

CLIENT

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

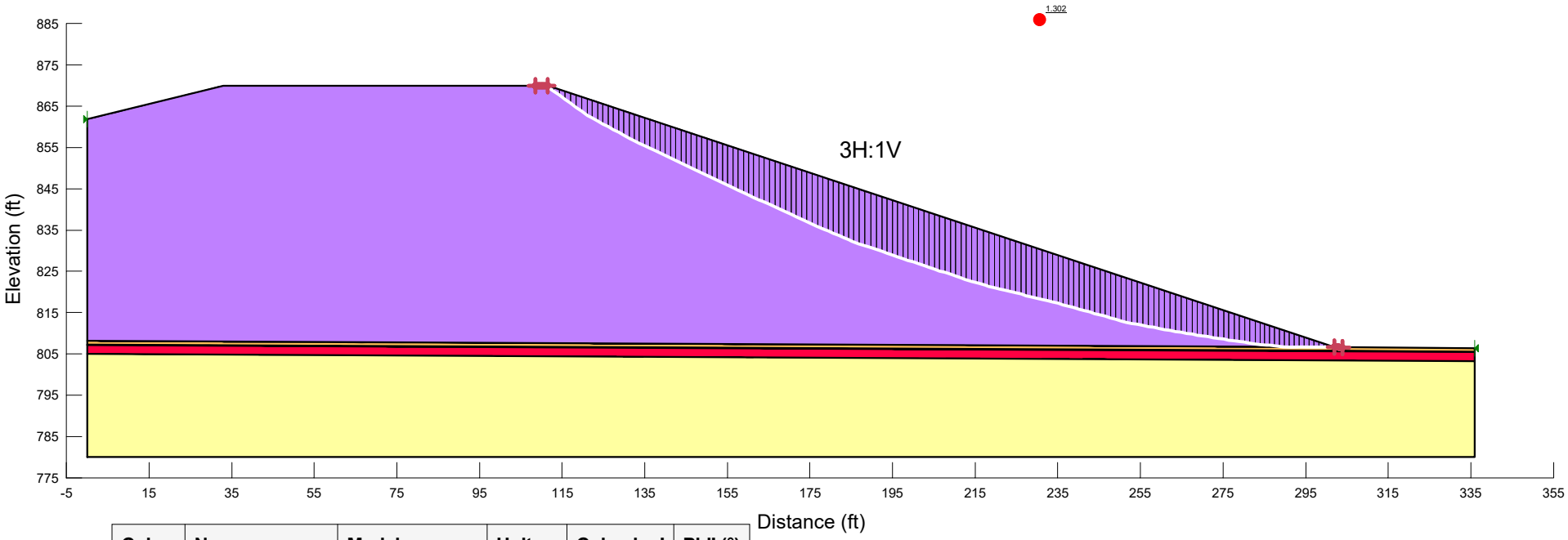
ENGINEER

COLUMBIA DRY ASH DISPOSAL FACILITY

SITE

SLOPE STABILITY CROSS SECTION LOCATIONS
FINAL GRADE

FIGURE
1 of 1



Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	CCR (Optimized Ciruclar FS=1.3)	Mohr-Coulomb	86	0	22.7
	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

Title: Columbia Mod 10-11 Interim Waste Stage 2
Name: 2-2_Optimized Circular_Forced Full Slope_FS=1.3
Method: Bishop
Last Edited By: Suchomel, Brandon

F of S: 1.302, F of S Rank (Analysis): 1 of 8,650 slip surfaces
Last Solved Date: 4/7/2022, Last Solved Time: 4:36:09 PM

2-2_Optimized Circular_Forced Full Slope_FS=1.3

File Information

File Version: 8.16
Title: Columbia Mod 10-11 Interim Waste Stage 2
Created By: Suchomel, Brandon
Last Edited By: Suchomel, Brandon
Revision Number: 54
Date: 4/7/2022
Time: 4:35:53 PM
Tool Version: 8.16.3.14580
File Name: Columbia Mod 10-11 Interim Waste Stage 2.gsz
Directory: I:\25220183.00\Data and Calculations_Issued for Permitting POO Geotech Calculations\Slope Stability\
Last Solved Date: 4/7/2022
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Project Settings

Length(L) Units: Feet
Time(t) Units: Seconds
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

2-2_Optimized Circular_Forced Full Slope_FS=1.3

Kind: SLOPE/W
Method: Bishop
Settings
    PWP Conditions Source: (none)
Slip Surface
    Direction of movement: Left to Right
    Use Passive Mode: No
    Slip Surface Option: Entry and Exit
    Critical slip surfaces saved: 10
    Resisting Side Maximum Convex Angle: 1 °
    Driving Side Maximum Convex Angle: 5 °
    Optimize Critical Slip Surface Location: Yes
    Critical Slip Surface Optimizations
        Maximum Iterations: 2,000
        Convergence Tolerance: 1e-007

Starting Points: 8
Ending Points: 16
Complete Passes per Insertion: 1
Tension Crack
Tension Crack Option: (none)
F of S Distribution
F of S Calculation Option: Constant
Advanced
Number of Slices: 150
F of S Tolerance: 0.001
Minimum Slip Surface Depth: 0.1 ft

Materials

Clay

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 0 psf
Phi': 28 °
Phi-B: 0 °

Drainage Layer

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi': 30 °
Phi-B: 0 °

Geosynthetics

Model: Mohr-Coulomb
Unit Weight: 58 pcf
Cohesion': 0 psf
Phi': 24.3 °
Phi-B: 0 °

Subbase

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 30 °
Phi-B: 0 °

CCR (Optimized Ciruclar FS=1.3)

Model: Mohr-Coulomb
Unit Weight: 86 pcf
Cohesion': 0 psf
Phi': 22.7 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range

Left-Zone Left Coordinate: (108.48, 870) ft
Left-Zone Right Coordinate: (111.54, 870) ft
Left-Zone Increment: 30
Right Projection: Range
Right-Zone Left Coordinate: (301.96, 806.59965) ft
Right-Zone Right Coordinate: (303.97, 806.58782) ft
Right-Zone Increment: 30
Radius Increments: 8

Slip Surface Limits

Left Coordinate: (0, 861.8) ft
Right Coordinate: (335.9, 806.4) ft

Points

	X (ft)	Y (ft)
Point 1	0	780
Point 2	335.9	780
Point 3	0	805
Point 4	335.9	803.3
Point 5	0	807.1
Point 6	335.9	805.4
Point 7	0	808.1
Point 8	335.9	806.4
Point 9	0	861.8
Point 10	33	870
Point 11	111.6	870
Point 12	305	805.6
Point 13	301.9	806.6
Point 14	0	807.2
Point 15	305	805.7
Point 16	335.9	805.5

Regions

	Material	Points	Area (ft^2)
Region 1	Subbase	1,2,4,3	8,112
Region 2	Clay	3,5,12,6,4	712.72
Region 3	CCR (Optimized Ciruclar FS=1.3)	7,9,10,11,13	12,746
Region 4	Geosynthetics	5,14,15,16,6,12	33.59
Region 5	Drainage Layer	14,7,13,8,16,15	299.67

Current Slip Surface

Slip Surface: 8,650
F of S: 1.302
Volume: 1,754.0514 ft^3
Weight: 150,848.42 lbs
Resisting Moment: 15,727,122 lbs-ft

Activating Moment: 12,083,493 lbs-ft
F of S Rank (Analysis): 1 of 8,650 slip surfaces
F of S Rank (Query): 1 of 8,650 slip surfaces
Exit: (301.8996, 806.60013) ft
Entry: (111.00732, 870) ft
Radius: 95.822462 ft
Center: (282.35976, 1,073.0057) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	111.30366	869.78663	0	14.901895	6.2335978	0
Slice 2	112.27238	869.08913	0	47.970541	20.066512	0
Slice 3	113.61713	868.12087	0	84.304041	35.265144	0
Slice 4	114.96189	867.15261	0	120.63754	50.463777	0
Slice 5	116.30665	866.18435	0	156.97104	65.662409	0
Slice 6	117.6514	865.21609	0	193.30454	80.861041	0
Slice 7	118.99616	864.24784	0	229.63804	96.059674	0
Slice 8	120.34091	863.27958	0	265.97154	111.25831	0
Slice 9	121.64885	862.45093	0	307.70165	128.71439	0
Slice 10	122.91997	861.76189	0	327.15121	136.85031	0
Slice 11	124.1911	861.07285	0	346.60077	144.98624	0
Slice 12	125.46222	860.38381	0	366.05033	153.12217	0
Slice 13	126.73334	859.69477	0	385.4999	161.2581	0
Slice 14	128.00446	859.00573	0	404.94946	169.39403	0
Slice 15	129.27559	858.31669	0	424.39902	177.52996	0
Slice 16	130.54671	857.62765	0	443.84858	185.66588	0
Slice 17	131.81132	856.98435	0	468.71531	196.06786	0
Slice 18	133.06943	856.38679	0	482.02669	201.63613	0
Slice 19	134.32754	855.78924	0	495.33807	207.2044	0
Slice 20	135.58564	855.19168	0	508.64945	212.77267	0
Slice 21	136.84375	854.59412	0	521.96083	218.34094	0
Slice 22	138.10185	853.99656	0	535.27221	223.90922	0
Slice 23	139.35996	853.39901	0	548.58359	229.47749	0
Slice 24	140.61807	852.80145	0	561.89497	235.04576	0
Slice 25	141.87617	852.20389	0	575.20635	240.61403	0

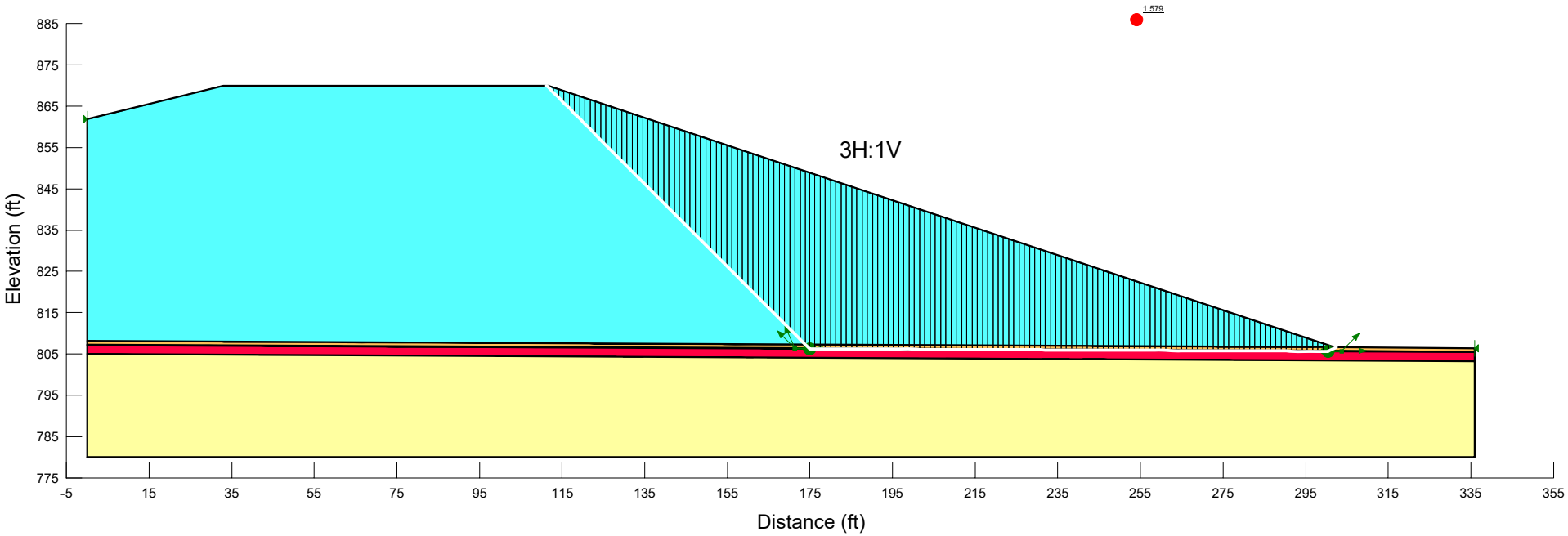
Slice 26	143.13428	851.60633	0	588.51773	246.1823	0
Slice 27	144.39238	851.00878	0	601.82911	251.75057	0
Slice 28	145.65049	850.41122	0	615.14049	257.31884	0
Slice 29	146.90859	849.81366	0	628.45187	262.88711	0
Slice 30	148.1667	849.2161	0	641.76325	268.45538	0
Slice 31	149.42481	848.61854	0	655.07463	274.02365	0
Slice 32	150.68291	848.02099	0	668.38601	279.59192	0
Slice 33	151.94102	847.42343	0	681.69739	285.1602	0
Slice 34	153.19913	846.82587	0	695.00877	290.72847	0
Slice 35	154.45723	846.22831	0	708.32015	296.29674	0
Slice 36	155.71534	845.63076	0	721.63153	301.86501	0
Slice 37	156.97344	845.0332	0	734.94291	307.43328	0
Slice 38	158.23155	844.43564	0	748.25429	313.00155	0
Slice 39	159.48966	843.83808	0	761.56567	318.56982	0
Slice 40	160.74776	843.24053	0	774.87705	324.13809	0
Slice 41	162.00587	842.64297	0	788.18843	329.70636	0
Slice 42	163.28072	842.05115	0	805.41636	336.91296	0
Slice 43	164.57233	841.46506	0	817.1082	341.80376	0
Slice 44	165.86394	840.87897	0	828.80004	346.69457	0
Slice 45	167.15555	840.29289	0	840.49189	351.58537	0
Slice 46	168.44716	839.7068	0	852.18373	356.47618	0
Slice 47	169.73877	839.12071	0	863.87557	361.36698	0
Slice 48	171.03038	838.53463	0	875.56742	366.25778	0
Slice 49	172.32199	837.94854	0	887.25926	371.14859	0
Slice 50	173.6136	837.36245	0	898.9511	376.03939	0
Slice 51	174.90521	836.77636	0	910.64295	380.9302	0
Slice	176.19682	836.19028	0	922.33479	385.821	0

52						
Slice 53	177.48843	835.60419	0	934.02663	390.7118	0
Slice 54	178.78004	835.0181	0	945.71848	395.60261	0
Slice 55	180.04425	834.46978	0	966.36152	404.23778	0
Slice 56	181.28106	833.95921	0	973.84146	407.36671	0
Slice 57	182.51788	833.44863	0	981.32141	410.49564	0
Slice 58	183.7547	832.93807	0	988.80136	413.62457	0
Slice 59	184.99151	832.4275	0	996.2813	416.7535	0
Slice 60	186.28858	831.93574	0	1,019.4282	426.43606	0
Slice 61	187.64588	831.46281	0	1,021.0319	427.10689	0
Slice 62	189.0032	830.98987	0	1,022.6355	427.77771	0
Slice 63	190.3605	830.51694	0	1,024.2392	428.44853	0
Slice 64	191.71782	830.04401	0	1,025.8428	429.11935	0
Slice 65	193.03417	829.5952	0	1,031.2415	431.37765	0
Slice 66	194.30958	829.17051	0	1,031.224	431.37034	0
Slice 67	195.58499	828.74582	0	1,031.2065	431.36302	0
Slice 68	196.8604	828.32113	0	1,031.189	431.35571	0
Slice 69	198.13581	827.89645	0	1,031.1715	431.3484	0
Slice 70	199.41122	827.47176	0	1,031.1541	431.34109	0
Slice 71	200.68662	827.04707	0	1,031.1366	431.33377	0
Slice 72	201.96203	826.62238	0	1,031.1191	431.32646	0
Slice 73	203.23744	826.19769	0	1,031.1016	431.31915	0
Slice 74	204.51285	825.77301	0	1,031.0841	431.31183	0
Slice 75	205.78826	825.34832	0	1,031.0666	431.30452	0
Slice 76	207.06366	824.92363	0	1,031.0492	431.29721	0
Slice 77	208.33907	824.49894	0	1,031.0317	431.2899	0
Slice 78	209.61448	824.07426	0	1,031.0142	431.28258	0

Slice 79	210.88989	823.64957	0	1,030.9967	431.27527	0
Slice 80	212.1653	823.22488	0	1,030.9792	431.26796	0
Slice 81	213.44071	822.80019	0	1,030.9618	431.26065	0
Slice 82	214.78558	822.3828	0	1,041.5881	435.70573	0
Slice 83	216.19992	821.9727	0	1,036.7818	433.69523	0
Slice 84	217.61425	821.56259	0	1,031.9755	431.68472	0
Slice 85	218.96492	821.1995	0	1,038.6881	434.49264	0
Slice 86	220.25192	820.88343	0	1,029.7049	430.73488	0
Slice 87	221.53892	820.56736	0	1,020.7216	426.97711	0
Slice 88	222.82591	820.25128	0	1,011.7384	423.21935	0
Slice 89	224.11291	819.93521	0	1,002.7552	419.46159	0
Slice 90	225.39991	819.61913	0	993.77197	415.70382	0
Slice 91	226.68691	819.30306	0	984.78875	411.94606	0
Slice 92	227.97391	818.98699	0	975.80553	408.18829	0
Slice 93	229.26091	818.67091	0	966.8223	404.43053	0
Slice 94	230.54791	818.35484	0	957.83908	400.67277	0
Slice 95	231.8349	818.03876	0	948.85585	396.915	0
Slice 96	233.1219	817.72269	0	939.87263	393.15724	0
Slice 97	234.4089	817.40662	0	930.88941	389.39947	0
Slice 98	235.68854	817.07255	0	915.05172	382.77443	0
Slice 99	236.96081	816.72049	0	909.38064	380.40216	0
Slice 100	238.23309	816.36842	0	903.70957	378.0299	0
Slice 101	239.50537	816.01636	0	898.03849	375.65764	0
Slice 102	240.77764	815.6643	0	892.36742	373.28538	0
Slice 103	242.04992	815.31224	0	886.69634	370.91311	0
Slice 104	243.32219	814.96018	0	881.02526	368.54085	0

Slice 105	244.59447	814.60811	0	875.35419	366.16859	0
Slice 106	245.86675	814.25605	0	869.68311	363.79633	0
Slice 107	247.13902	813.90399	0	864.01204	361.42406	0
Slice 108	248.4113	813.55193	0	858.34096	359.0518	0
Slice 109	249.68358	813.19986	0	852.66988	356.67954	0
Slice 110	250.95585	812.8478	0	846.99881	354.30728	0
Slice 111	252.25214	812.53777	0	856.00314	358.07387	0
Slice 112	253.57244	812.26977	0	842.12775	352.26967	0
Slice 113	254.89275	812.00176	0	828.25236	346.46547	0
Slice 114	256.2161	811.74951	0	819.12328	342.64669	0
Slice 115	257.54249	811.51301	0	802.41621	335.65797	0
Slice 116	258.86888	811.27652	0	785.70914	328.66925	0
Slice 117	260.19527	811.04002	0	769.00206	321.68053	0
Slice 118	261.52166	810.80352	0	752.29499	314.69181	0
Slice 119	262.84805	810.56702	0	735.58792	307.70309	0
Slice 120	264.17444	810.33052	0	718.88084	300.71437	0
Slice 121	265.50083	810.09403	0	702.17377	293.72565	0
Slice 122	266.82722	809.85753	0	685.4667	286.73693	0
Slice 123	268.1267	809.64225	0	673.0427	281.53986	0
Slice 124	269.39927	809.44819	0	654.19403	273.65529	0
Slice 125	270.67185	809.25414	0	635.34535	265.77072	0
Slice 126	271.94442	809.06008	0	616.49668	257.88615	0
Slice 127	273.217	808.86602	0	597.648	250.00157	0
Slice 128	274.48957	808.67196	0	578.79932	242.117	0
Slice 129	275.76215	808.47791	0	559.95065	234.23243	0
Slice 130	277.03472	808.28385	0	541.10197	226.34786	0
Slice	278.3073	808.08979	0	522.2533	218.46329	0

131						
Slice 132	279.57987	807.89573	0	503.40462	210.57871	0
Slice 133	280.85245	807.70168	0	484.55595	202.69414	0
Slice 134	282.12502	807.50762	0	465.70727	194.80957	0
Slice 135	283.34622	807.34941	0	451.95442	189.05663	0
Slice 136	284.51604	807.22705	0	429.7078	179.75067	0
Slice 137	285.68586	807.10469	0	407.46119	170.44471	0
Slice 138	286.85568	806.98234	0	385.21458	161.13875	0
Slice 139	288.0255	806.85998	0	362.96796	151.83279	0
Slice 140	289.19532	806.73762	0	340.72135	142.52683	0
Slice 141	290.3862	806.67262	0	322.98961	135.10948	0
Slice 142	291.59814	806.66499	0	288.9907	120.88743	0
Slice 143	292.81007	806.65736	0	254.9918	106.66538	0
Slice 144	294.02201	806.64973	0	220.99289	92.443328	0
Slice 145	295.23395	806.6421	0	186.99398	78.221278	0
Slice 146	296.44588	806.63447	0	152.99508	63.999227	0
Slice 147	297.65782	806.62684	0	118.99617	49.777177	0
Slice 148	298.86976	806.61921	0	84.997265	35.555126	0
Slice 149	300.08169	806.61158	0	50.998359	21.333076	0
Slice 150	301.29363	806.60395	0	16.999453	7.1110253	0



Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	CCR	Mohr-Coulomb	86	0	22.7
	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

Title: Columbia Mod 10-11 Interim Waste Stage 2
Name: 3_Block
Method: Janbu
Last Edited By: Suchomel, Brandon

F of S: 1.579, F of S Rank (Analysis): 1 of 553,536 slip surfaces
Last Solved Date: 5/4/2022, Last Solved Time: 5:54:25 PM

3_Block

File Information

File Version: 8.16
Title: Columbia Mod 10-11 Interim Waste Stage 2
Created By: Suchomel, Brandon
Last Edited By: Suchomel, Brandon
Revision Number: 59
Date: 5/4/2022
Time: 5:51:08 PM
Tool Version: 8.16.3.14580
File Name: Columbia Mod 10-11 Interim Waste Stage 2.gsz
Directory: I:\25220183.00\Data and Calculations_Issued for Permitting POO Geotech Calculations\Slope Stability\
Last Solved Date: 5/4/2022
Last Solved Time: 5:54:25 PM

Project Settings

Length(L) Units: Feet
Time(t) Units: Seconds
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

3_Block

Kind: SLOPE/W
Method: Janbu
Settings
    PWP Conditions Source: (none)
Slip Surface
    Direction of movement: Left to Right
    Use Passive Mode: No
    Slip Surface Option: Block
    Critical slip surfaces saved: 10
    Resisting Side Maximum Convex Angle: 1 °
    Driving Side Maximum Convex Angle: 5 °
    Restrict Block Crossing: No
    Optimize Critical Slip Surface Location: No
    Tension Crack
        Tension Crack Option: (none)
F of S Distribution
    F of S Calculation Option: Constant
Advanced

Number of Slices: 150
F of S Tolerance: 0.001
Minimum Slip Surface Depth: 0.1 ft

Materials

CCR

Model: Mohr-Coulomb
Unit Weight: 86 pcf
Cohesion': 0 psf
Phi': 22.7 °
Phi-B: 0 °

Clay

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 0 psf
Phi': 28 °
Phi-B: 0 °

Drainage Layer

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi': 30 °
Phi-B: 0 °

Geosynthetics

Model: Mohr-Coulomb
Unit Weight: 58 pcf
Cohesion': 0 psf
Phi': 24.3 °
Phi-B: 0 °

Subbase

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 30 °
Phi-B: 0 °

Slip Surface Limits

Left Coordinate: (0, 861.8) ft
Right Coordinate: (335.9, 806.4) ft

Slip Surface Block

Left Grid
Upper Left: (171.41, 806.37) ft
Lower Left: (171.41, 806.24) ft
Lower Right: (177.59, 806.22) ft

X Increments: 30
Y Increments: 3
Starting Angle: 115 °
Ending Angle: 135 °
Angle Increments: 5

Right Grid
Upper Left: (299.3, 805.73) ft
Lower Left: (299.3, 805.62) ft
Lower Right: (303.71, 805.6) ft
X Increments: 30
Y Increments: 3
Starting Angle: 0 °
Ending Angle: 45 °
Angle Increments: 5

Points

	X (ft)	Y (ft)
Point 1	0	780
Point 2	335.9	780
Point 3	0	805
Point 4	335.9	803.3
Point 5	0	807.1
Point 6	335.9	805.4
Point 7	0	808.1
Point 8	335.9	806.4
Point 9	0	861.8
Point 10	33	870
Point 11	111.6	870
Point 12	305	805.6
Point 13	301.9	806.6
Point 14	0	807.2
Point 15	305	805.7
Point 16	335.9	805.5

Regions

	Material	Points	Area (ft²)
Region 1	Subbase	1,2,4,3	8,112
Region 2	Clay	3,5,12,6,4	712.72
Region 3	CCR	7,9,10,11,13	12,746
Region 4	Geosynthetics	5,14,15,16,6,12	33.59
Region 5	Drainage Layer	14,7,13,8,16,15	299.67

Current Slip Surface

Slip Surface: 218,230
F of S: 1.579
Volume: 4,130.1925 ft³
Weight: 358,224.99 lbs

Resisting Force: 147,760.65 lbs
Activating Force: 93,577.095 lbs
F of S Rank (Analysis): 1 of 553,536 slip surfaces
F of S Rank (Query): 1 of 553,536 slip surfaces
Exit: (302.33287, 806.59745) ft
Entry: (111.184, 870) ft
Radius: 102.0734 ft
Center: (222.53102, 885.85064) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	111.392	869.792	0	14.140131	5.9149449	0
Slice 2	112.23621	868.94779	0	57.121324	23.894367	0
Slice 3	113.50862	867.67538	0	114.80345	48.023322	0
Slice 4	114.78103	866.40297	0	172.48557	72.152277	0
Slice 5	116.05345	865.13055	0	230.16769	96.281232	0
Slice 6	117.32586	863.85814	0	287.84982	120.41019	0
Slice 7	118.59827	862.58573	0	345.53194	144.53914	0
Slice 8	119.87069	861.31331	0	403.21406	168.6681	0
Slice 9	121.1431	860.0409	0	460.89619	192.79705	0
Slice 10	122.41552	858.76848	0	518.57831	216.92601	0
Slice 11	123.68793	857.49607	0	576.26043	241.05496	0
Slice 12	124.96034	856.22366	0	633.94256	265.18392	0
Slice 13	126.23276	854.95124	0	691.62468	289.31287	0
Slice 14	127.50517	853.67883	0	749.30681	313.44183	0
Slice 15	128.77758	852.40642	0	806.98893	337.57078	0
Slice 16	130.05	851.134	0	864.67105	361.69974	0
Slice 17	131.32241	849.86159	0	922.35318	385.82869	0
Slice 18	132.59482	848.58918	0	980.0353	409.95765	0
Slice 19	133.86724	847.31676	0	1,037.7174	434.0866	0
Slice 20	135.13965	846.04435	0	1,095.3995	458.21556	0
Slice 21	136.41207	844.77193	0	1,153.0817	482.34451	0
Slice 22	137.68448	843.49952	0	1,210.7638	506.47347	0
Slice 23	138.95689	842.22711	0	1,268.4459	530.60242	0
Slice 24	140.22931	840.95469	0	1,326.128	554.73138	0
Slice	141.50172	839.68228	0	1,383.8102	578.86033	0

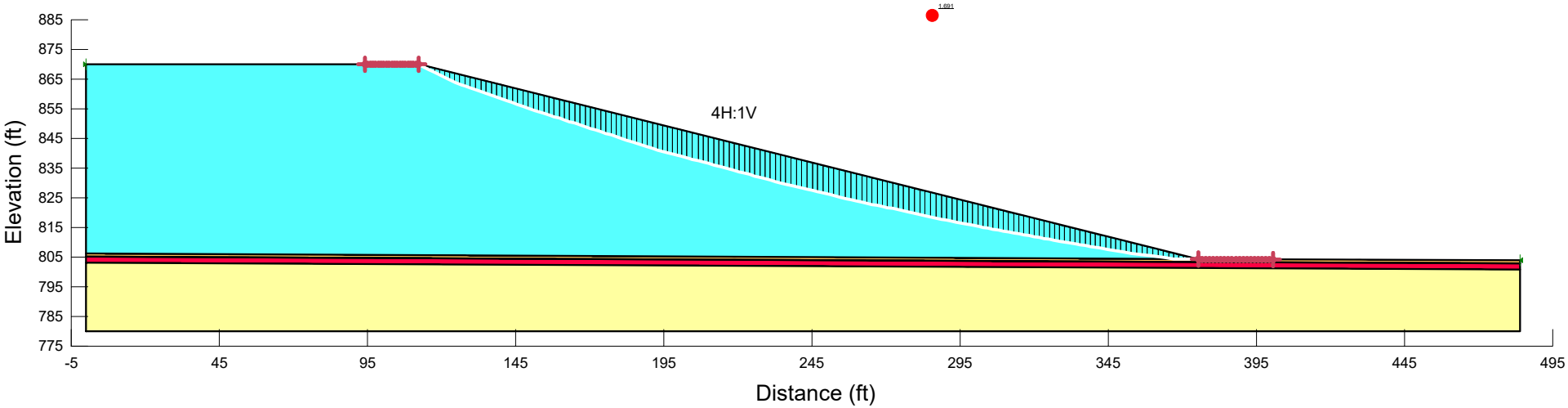
25						
Slice 26	142.77413	838.40987	0	1,441.4923	602.98929	0
Slice 27	144.04655	837.13745	0	1,499.1744	627.11824	0
Slice 28	145.31896	835.86504	0	1,556.8565	651.2472	0
Slice 29	146.59137	834.59263	0	1,614.5387	675.37615	0
Slice 30	147.86379	833.32021	0	1,672.2208	699.50511	0
Slice 31	149.1362	832.0478	0	1,729.9029	723.63406	0
Slice 32	150.40862	830.77538	0	1,787.585	747.76302	0
Slice 33	151.68103	829.50297	0	1,845.2672	771.89197	0
Slice 34	152.95344	828.23056	0	1,902.9493	796.02093	0
Slice 35	154.22586	826.95814	0	1,960.6314	820.14988	0
Slice 36	155.49827	825.68573	0	2,018.3135	844.27884	0
Slice 37	156.77068	824.41332	0	2,075.9956	868.40779	0
Slice 38	158.0431	823.1409	0	2,133.6778	892.53674	0
Slice 39	159.31551	821.86849	0	2,191.3599	916.6657	0
Slice 40	160.58792	820.59608	0	2,249.042	940.79465	0
Slice 41	161.86034	819.32366	0	2,306.7241	964.92361	0
Slice 42	163.13275	818.05125	0	2,364.4063	989.05256	0
Slice 43	164.40517	816.77883	0	2,422.0884	1,013.1815	0
Slice 44	165.67758	815.50642	0	2,479.7705	1,037.3105	0
Slice 45	166.94999	814.23401	0	2,537.4526	1,061.4394	0
Slice 46	168.22241	812.96159	0	2,595.1348	1,085.5684	0
Slice 47	169.49482	811.68918	0	2,652.8169	1,109.6973	0
Slice 48	170.76723	810.41677	0	2,710.499	1,133.8263	0
Slice 49	172.03965	809.14435	0	2,768.1811	1,157.9552	0
Slice 50	173.31206	807.87194	0	2,825.8633	1,182.0842	0
Slice 51	174.39608	806.78792	0	2,672.3431	1,542.878	0

Slice 52	174.87794	806.30606	0	2,868.8112	1,295.3179	0
Slice 53	175.54616	806.26887	0	3,667.4758	1,655.9288	0
Slice 54	176.81448	806.2626	0	3,631.7233	1,639.786	0
Slice 55	178.08281	806.25633	0	3,595.9708	1,623.6431	0
Slice 56	179.35113	806.25006	0	3,560.2183	1,607.5002	0
Slice 57	180.61945	806.24379	0	3,524.4658	1,591.3573	0
Slice 58	181.88778	806.23752	0	3,488.7133	1,575.2144	0
Slice 59	183.1561	806.23125	0	3,452.9608	1,559.0716	0
Slice 60	184.42442	806.22498	0	3,417.2082	1,542.9287	0
Slice 61	185.69275	806.21871	0	3,381.4557	1,526.7858	0
Slice 62	186.96107	806.21244	0	3,345.7032	1,510.6429	0
Slice 63	188.22939	806.20617	0	3,309.9507	1,494.5001	0
Slice 64	189.49772	806.1999	0	3,274.1982	1,478.3572	0
Slice 65	190.76604	806.19363	0	3,238.4457	1,462.2143	0
Slice 66	192.03436	806.18736	0	3,202.6932	1,446.0714	0
Slice 67	193.30269	806.18109	0	3,166.9407	1,429.9285	0
Slice 68	194.57101	806.17482	0	3,131.1881	1,413.7857	0
Slice 69	195.83933	806.16856	0	3,095.4356	1,397.6428	0
Slice 70	197.10766	806.16229	0	3,059.6831	1,381.4999	0
Slice 71	198.37598	806.15602	0	3,023.9306	1,365.357	0
Slice 72	199.6443	806.14975	0	2,988.1781	1,349.2141	0
Slice 73	200.91263	806.14348	0	2,952.4256	1,333.0713	0
Slice 74	202.18095	806.13721	0	2,916.6731	1,316.9284	0
Slice 75	203.44927	806.13094	0	2,880.9205	1,300.7855	0
Slice 76	204.7176	806.12467	0	2,845.168	1,284.6426	0
Slice 77	205.98592	806.1184	0	2,809.4155	1,268.4997	0

Slice 78	207.25424	806.11213	0	2,773.663	1,252.3569	0
Slice 79	208.52257	806.10586	0	2,737.9105	1,236.214	0
Slice 80	209.79089	806.09959	0	2,702.158	1,220.0711	0
Slice 81	211.05921	806.09332	0	2,666.4055	1,203.9282	0
Slice 82	212.32754	806.08705	0	2,630.653	1,187.7854	0
Slice 83	213.59586	806.08078	0	2,594.9004	1,171.6425	0
Slice 84	214.86418	806.07452	0	2,559.1479	1,155.4996	0
Slice 85	216.13251	806.06825	0	2,523.3954	1,139.3567	0
Slice 86	217.40083	806.06198	0	2,487.6429	1,123.2138	0
Slice 87	218.66915	806.05571	0	2,451.8904	1,107.071	0
Slice 88	219.93747	806.04944	0	2,416.1379	1,090.9281	0
Slice 89	221.2058	806.04317	0	2,380.3854	1,074.7852	0
Slice 90	222.47412	806.0369	0	2,344.6328	1,058.6423	0
Slice 91	223.74244	806.03063	0	2,308.8803	1,042.4994	0
Slice 92	225.01077	806.02436	0	2,273.1278	1,026.3566	0
Slice 93	226.27909	806.01809	0	2,237.3753	1,010.2137	0
Slice 94	227.54741	806.01182	0	2,201.6228	994.07081	0
Slice 95	228.81574	806.00555	0	2,165.8703	977.92793	0
Slice 96	230.08406	805.99928	0	2,130.1178	961.78505	0
Slice 97	231.35238	805.99301	0	2,094.3653	945.64217	0
Slice 98	232.62071	805.98674	0	2,058.6127	929.49929	0
Slice 99	233.88903	805.98047	0	2,022.8602	913.35641	0
Slice 100	235.15735	805.97421	0	1,987.1077	897.21353	0
Slice 101	236.42568	805.96794	0	1,951.3552	881.07066	0
Slice 102	237.694	805.96167	0	1,915.6027	864.92778	0
Slice 103	238.96232	805.9554	0	1,879.8502	848.7849	0
Slice	240.23065	805.94913	0	1,844.0977	832.64202	0

104						
Slice 105	241.49897	805.94286	0	1,808.3451	816.49914	0
Slice 106	242.76729	805.93659	0	1,772.5926	800.35626	0
Slice 107	244.03562	805.93032	0	1,736.8401	784.21338	0
Slice 108	245.30394	805.92405	0	1,701.0876	768.0705	0
Slice 109	246.57226	805.91778	0	1,665.3351	751.92762	0
Slice 110	247.84059	805.91151	0	1,629.5826	735.78475	0
Slice 111	249.10891	805.90524	0	1,593.8301	719.64187	0
Slice 112	250.37723	805.89897	0	1,558.0775	703.49899	0
Slice 113	251.64556	805.8927	0	1,522.325	687.35611	0
Slice 114	252.91388	805.88643	0	1,486.5725	671.21323	0
Slice 115	254.1822	805.88017	0	1,450.82	655.07035	0
Slice 116	255.45053	805.8739	0	1,415.0675	638.92747	0
Slice 117	256.71885	805.86763	0	1,379.315	622.78459	0
Slice 118	257.98717	805.86136	0	1,343.5625	606.64172	0
Slice 119	259.25549	805.85509	0	1,307.81	590.49884	0
Slice 120	260.52382	805.84882	0	1,272.0574	574.35596	0
Slice 121	261.79214	805.84255	0	1,236.3049	558.21308	0
Slice 122	263.06046	805.83628	0	1,200.5524	542.0702	0
Slice 123	264.32879	805.83001	0	1,164.7999	525.92732	0
Slice 124	265.59711	805.82374	0	1,129.0474	509.78444	0
Slice 125	266.86543	805.81747	0	1,093.2949	493.64156	0
Slice 126	268.13376	805.8112	0	1,057.5424	477.49868	0
Slice 127	269.40208	805.80493	0	1,021.7898	461.35581	0
Slice 128	270.6704	805.79866	0	986.03733	445.21293	0
Slice 129	271.93873	805.79239	0	950.28482	429.07005	0
Slice 130	273.20705	805.78612	0	914.53231	412.92717	0

Slice 131	274.47537	805.77986	0	878.77979	396.78429	0
Slice 132	275.7437	805.77359	0	843.02728	380.64141	0
Slice 133	277.01202	805.76732	0	807.27476	364.49853	0
Slice 134	278.28034	805.76105	0	771.52225	348.35565	0
Slice 135	279.54867	805.75478	0	735.76974	332.21277	0
Slice 136	280.81699	805.74851	0	700.01722	316.0699	0
Slice 137	282.08531	805.74224	0	664.26471	299.92702	0
Slice 138	283.35364	805.73597	0	628.5122	283.78414	0
Slice 139	284.62196	805.7297	0	592.75968	267.64126	0
Slice 140	285.89028	805.72343	0	557.00717	251.49838	0
Slice 141	287.15861	805.71716	0	521.25466	235.3555	0
Slice 142	288.42693	805.71089	0	485.50214	219.21262	0
Slice 143	289.69525	805.70462	0	449.74963	203.06974	0
Slice 144	290.96358	805.69835	0	413.99712	186.92687	0
Slice 145	292.2319	805.69208	0	378.2446	170.78399	0
Slice 146	293.50022	805.68581	0	342.49209	154.64111	0
Slice 147	294.76855	805.67955	0	306.73958	138.49823	0
Slice 148	296.03687	805.67328	0	270.98706	122.35535	0
Slice 149	297.30519	805.66701	0	235.23455	106.21247	0
Slice 150	298.57352	805.66074	0	199.48204	90.069593	0
Slice 151	299.84184	805.65447	0	163.72952	73.926714	0
Slice 152	300.54492	805.68645	0	166.29893	75.086847	0
Slice 153	301.25692	806.04923	0	100.60907	58.086672	0
Slice 154	302.11643	806.48718	0	15.767383	9.1033026	0



Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	CCR	Mohr-Coulomb	86	0	22.7
	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

Title: Columbia Mod 10-11 Interim Waste Stage 3
Name: 2-1_Optimized Circular_Forced Full Slope
Method: Bishop
Last Edited By: Suchomel, Brandon

F of S: 1.691, F of S Rank (Analysis): 1 of 3,970 slip surfaces
Last Solved Date: 5/4/2022, Last Solved Time: 5:59:59 PM

2-1_Optimized Circular_Forced Full Slope

File Information

File Version: 8.16
Title: Columbia Mod 10-11 Interim Waste Stage 3
Created By: Suchomel, Brandon
Last Edited By: Suchomel, Brandon
Revision Number: 50
Date: 5/4/2022
Time: 5:59:45 PM
Tool Version: 8.16.3.14580
File Name: Columbia Mod 10-11 Interim Waste Stage 3.gsz
Directory: I:\25220183.00\Data and Calculations_Issued for Permitting POO Geotech Calculations\Slope Stability\
Last Solved Date: 5/4/2022
Last Solved Time: 5:59:59 PM

Project Settings

Length(L) Units: Feet
Time(t) Units: Seconds
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

2-1_Optimized Circular_Forced Full Slope

Kind: SLOPE/W
Method: Bishop
Settings
    PWP Conditions Source: (none)
Slip Surface
    Direction of movement: Left to Right
    Use Passive Mode: No
    Slip Surface Option: Entry and Exit
    Critical slip surfaces saved: 10
    Resisting Side Maximum Convex Angle: 1 °
    Driving Side Maximum Convex Angle: 5 °
    Optimize Critical Slip Surface Location: Yes
    Critical Slip Surface Optimizations
        Maximum Iterations: 2,000
        Convergence Tolerance: 1e-007
        Starting Points: 8
        Ending Points: 16
        Complete Passes per Insertion: 1

Tension Crack
Tension Crack Option: (none)
F of S Distribution
F of S Calculation Option: Constant
Advanced
Number of Slices: 150
F of S Tolerance: 0.001
Minimum Slip Surface Depth: 0.1 ft

Materials

CCR

Model: Mohr-Coulomb
Unit Weight: 86 pcf
Cohesion': 0 psf
Phi': 22.7 °
Phi-B: 0 °

Clay

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 0 psf
Phi': 28 °
Phi-B: 0 °

Drainage Layer

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi': 30 °
Phi-B: 0 °

Geosynthetics

Model: Mohr-Coulomb
Unit Weight: 58 pcf
Cohesion': 0 psf
Phi': 24.3 °
Phi-B: 0 °

Subbase

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 30 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (94.1, 870) ft
Left-Zone Right Coordinate: (112.23, 870) ft
Left-Zone Increment: 20

Right Projection: Range
Right-Zone Left Coordinate: (375.32, 804.29919) ft
Right-Zone Right Coordinate: (400.59, 804.20629) ft
Right-Zone Increment: 20
Radius Increments: 8

Slip Surface Limits

Left Coordinate: (0, 870) ft
Right Coordinate: (483.9, 803.9) ft

Points

	X (ft)	Y (ft)
Point 1	0	780
Point 2	483.9	780
Point 3	0	805.2
Point 4	483.9	802.9
Point 5	483.9	800.9
Point 6	0	803.2
Point 7	0	870
Point 8	112.5	870
Point 9	379.2	803.3
Point 10	0	806.2
Point 11	375.1	804.3
Point 12	483.9	803.9
Point 13	0	805.3
Point 14	483.9	803
Point 15	379.2	803.4

Regions

	Material	Points	Area (ft²)
Region 1	Subbase	1,6,5,2	10,670
Region 2	Clay	6,3,9,4,5	944.17
Region 3	Geosynthetics	3,13,15,14,4,9	48.39
Region 4	Drainage Layer	13,10,11,12,14,15	430.8
Region 5	CCR	10,7,8,11	15,661

Current Slip Surface

Slip Surface: 3,970
F of S: 1.691
Volume: 1,735.9578 ft³
Weight: 149,292.37 lbs
Resisting Moment: 32,761,608 lbs-ft
Activating Moment: 19,375,797 lbs-ft
F of S Rank (Analysis): 1 of 3,970 slip surfaces
F of S Rank (Query): 1 of 3,970 slip surfaces
Exit: (375.08152, 804.30462) ft

Entry: (112.07755, 870) ft
Radius: 116.45652 ft
Center: (372.09783, 1,350.7512) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	112.28878	869.89648	0	7.9403998	3.3215412	0
Slice 2	113.34107	869.38075	0	31.358062	13.117361	0
Slice 3	115.0232	868.55634	0	62.312587	26.06592	0
Slice 4	116.70533	867.73193	0	93.267112	39.014478	0
Slice 5	118.38746	866.90752	0	124.22164	51.963036	0
Slice 6	120.06959	866.08311	0	155.17616	64.911595	0
Slice 7	121.75172	865.2587	0	186.13069	77.860153	0
Slice 8	123.43385	864.43429	0	217.08521	90.808711	0
Slice 9	125.16346	863.70958	0	247.02114	103.33118	0
Slice 10	126.94057	863.08457	0	261.29339	109.30139	0
Slice 11	128.71767	862.45957	0	275.56565	115.27161	0
Slice 12	130.49477	861.83457	0	289.8379	121.24182	0
Slice 13	132.27188	861.20956	0	304.11016	127.21203	0
Slice 14	134.04898	860.58456	0	318.38241	133.18225	0
Slice 15	135.82609	859.95955	0	332.65466	139.15246	0
Slice 16	137.60319	859.33455	0	346.92692	145.12267	0
Slice 17	139.38029	858.70955	0	361.19917	151.09289	0
Slice 18	141.1574	858.08454	0	375.47143	157.0631	0
Slice 19	142.9345	857.45954	0	389.74368	163.03331	0
Slice 20	144.71161	856.83453	0	404.01594	169.00353	0
Slice 21	146.48871	856.20953	0	418.28819	174.97374	0
Slice 22	148.26581	855.58453	0	432.56045	180.94395	0
Slice 23	150.04292	854.95952	0	446.8327	186.91417	0
Slice 24	151.80489	854.36508	0	462.02398	193.26882	0
Slice 25	153.55174	853.8012	0	472.12555	197.49439	0
Slice 26	155.29858	853.23732	0	482.22711	201.71997	0
Slice 27	157.04543	852.67344	0	492.32868	205.94555	0

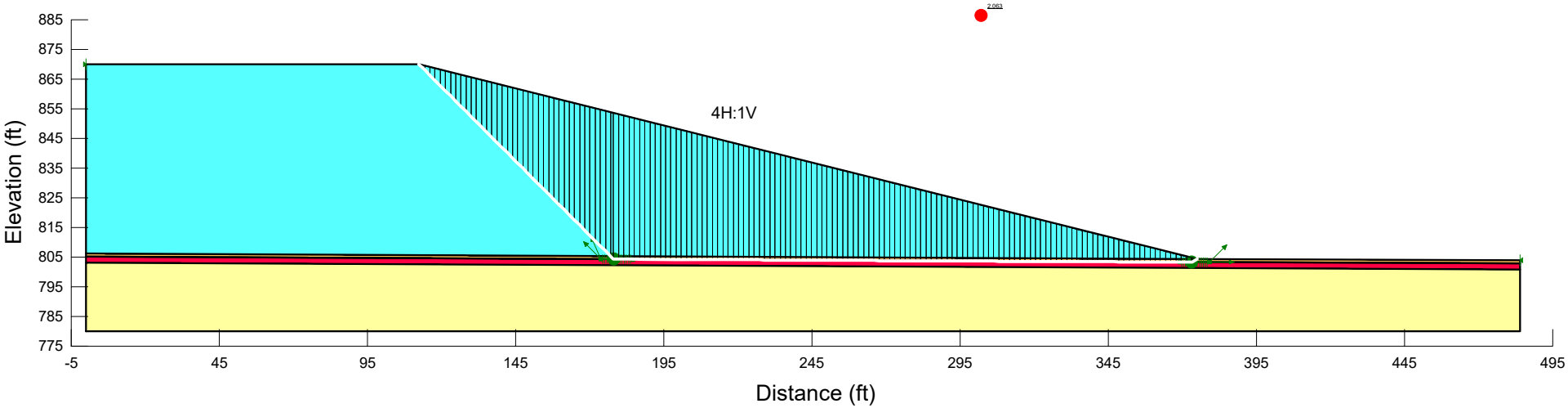
Slice 28	158.79227	852.10956	0	502.43025	210.17112	0
Slice 29	160.53912	851.54568	0	512.53181	214.3967	0
Slice 30	162.28596	850.9818	0	522.63338	218.62228	0
Slice 31	164.03281	850.41792	0	532.73495	222.84786	0
Slice 32	165.77965	849.85404	0	542.83651	227.07343	0
Slice 33	167.5265	849.29016	0	552.93808	231.29901	0
Slice 34	169.27334	848.72628	0	563.03965	235.52459	0
Slice 35	171.02019	848.1624	0	573.14121	239.75016	0
Slice 36	172.76703	847.59852	0	583.24278	243.97574	0
Slice 37	174.51388	847.03464	0	593.34435	248.20132	0
Slice 38	176.26072	846.47076	0	603.44591	252.42689	0
Slice 39	178.00757	845.90688	0	613.54748	256.65247	0
Slice 40	179.75441	845.343	0	623.64905	260.87805	0
Slice 41	181.50126	844.77912	0	633.75061	265.10362	0
Slice 42	183.2481	844.21524	0	643.85218	269.3292	0
Slice 43	184.99495	843.65136	0	653.95374	273.55478	0
Slice 44	186.74179	843.08748	0	664.05531	277.78035	0
Slice 45	188.48864	842.5236	0	674.15688	282.00593	0
Slice 46	190.23548	841.95972	0	684.25844	286.23151	0
Slice 47	191.98233	841.39584	0	694.36001	290.45708	0
Slice 48	193.67524	840.89879	0	710.01929	297.0075	0
Slice 49	195.31421	840.46857	0	711.64781	297.68873	0
Slice 50	196.95319	840.03835	0	713.27633	298.36995	0
Slice 51	198.59217	839.60812	0	714.90485	299.05118	0
Slice 52	200.23115	839.1779	0	716.53337	299.7324	0
Slice 53	201.87012	838.74768	0	718.16189	300.41362	0
Slice	203.64843	838.28605	0	720.41291	301.35525	0

54						
Slice 55	205.56608	837.79301	0	721.48539	301.80388	0
Slice 56	207.39225	837.31305	0	721.33214	301.73977	0
Slice 57	209.12696	836.84616	0	723.98333	302.84879	0
Slice 58	210.86167	836.37927	0	726.63452	303.95781	0
Slice 59	212.59638	835.91239	0	729.28571	305.06682	0
Slice 60	214.33109	835.4455	0	731.9369	306.17584	0
Slice 61	216.0658	834.97861	0	734.5881	307.28486	0
Slice 62	217.80051	834.51172	0	737.23929	308.39387	0
Slice 63	219.53522	834.04484	0	739.89048	309.50289	0
Slice 64	221.26993	833.57795	0	742.54167	310.61191	0
Slice 65	223.00463	833.11106	0	745.19286	311.72093	0
Slice 66	224.73934	832.64418	0	747.84405	312.82994	0
Slice 67	226.47405	832.17729	0	750.49524	313.93896	0
Slice 68	228.20876	831.7104	0	753.14643	315.04798	0
Slice 69	229.94347	831.24351	0	755.79762	316.15699	0
Slice 70	231.67818	830.77663	0	758.44881	317.26601	0
Slice 71	233.41289	830.30974	0	761.1	318.37503	0
Slice 72	235.1476	829.84285	0	763.7512	319.48405	0
Slice 73	236.91982	829.39551	0	769.91705	322.06328	0
Slice 74	238.72955	828.96771	0	767.88747	321.21429	0
Slice 75	240.53929	828.53991	0	765.85789	320.36529	0
Slice 76	242.34902	828.11211	0	763.82831	319.5163	0
Slice 77	244.15876	827.68431	0	761.79873	318.66731	0
Slice 78	245.96849	827.25652	0	759.76915	317.81832	0
Slice 79	247.77822	826.82872	0	757.73957	316.96933	0
Slice 80	249.58796	826.40092	0	755.70999	316.12033	0

Slice 81	251.39769	825.97312	0	753.68041	315.27134	0
Slice 82	253.24754	825.53553	0	751.57388	314.39017	0
Slice 83	255.1375	825.08816	0	749.50415	313.52438	0
Slice 84	257.02745	824.64079	0	747.43443	312.65859	0
Slice 85	258.91741	824.19341	0	745.3647	311.79281	0
Slice 86	260.80737	823.74604	0	743.29497	310.92702	0
Slice 87	262.61573	823.34871	0	745.01303	311.6457	0
Slice 88	264.34249	823.00144	0	738.07047	308.74157	0
Slice 89	266.06925	822.65416	0	731.12791	305.83743	0
Slice 90	267.796	822.30688	0	724.18534	302.93329	0
Slice 91	269.52276	821.95961	0	717.24278	300.02915	0
Slice 92	271.29595	821.58763	0	708.55328	296.39426	0
Slice 93	273.11557	821.19094	0	703.77422	294.39513	0
Slice 94	274.9352	820.79426	0	698.99516	292.39601	0
Slice 95	276.75482	820.39757	0	694.2161	290.39688	0
Slice 96	278.57444	820.00088	0	689.43703	288.39776	0
Slice 97	280.39406	819.6042	0	684.65797	286.39863	0
Slice 98	282.21369	819.20751	0	679.87891	284.39951	0
Slice 99	284.03331	818.81083	0	675.09985	282.40038	0
Slice 100	285.85293	818.41414	0	670.32079	280.40126	0
Slice 101	287.67255	818.01745	0	665.54172	278.40213	0
Slice 102	289.49218	817.62077	0	660.76266	276.40301	0
Slice 103	291.3118	817.22408	0	655.9836	274.40388	0
Slice 104	293.09319	816.86859	0	654.41264	273.74674	0
Slice 105	294.83634	816.5543	0	644.38282	269.55117	0
Slice 106	296.57151	816.23752	0	634.04049	265.22488	0

Slice 107	298.2987	815.91827	0	624.75774	261.34183	0
Slice 108	300.02589	815.59902	0	615.475	257.45877	0
Slice 109	301.75308	815.27976	0	606.19225	253.57571	0
Slice 110	303.48026	814.96051	0	596.9095	249.69265	0
Slice 111	305.20745	814.64126	0	587.62675	245.8096	0
Slice 112	306.93464	814.322	0	578.34401	241.92654	0
Slice 113	308.66183	814.00275	0	569.06126	238.04348	0
Slice 114	310.38901	813.6835	0	559.77851	234.16042	0
Slice 115	312.1162	813.36425	0	550.49577	230.27737	0
Slice 116	313.84339	813.04499	0	541.21302	226.39431	0
Slice 117	315.57058	812.72574	0	531.93027	222.51125	0
Slice 118	317.29776	812.40649	0	522.64752	218.62819	0
Slice 119	319.02495	812.08723	0	513.36478	214.74514	0
Slice 120	320.75214	811.76798	0	504.08203	210.86208	0
Slice 121	322.47933	811.44873	0	494.79928	206.97902	0
Slice 122	324.20393	811.14243	0	486.17056	203.36955	0
Slice 123	325.92595	810.8491	0	474.82366	198.62304	0
Slice 124	327.64797	810.55576	0	463.47676	193.87653	0
Slice 125	329.36999	810.26243	0	452.12985	189.13001	0
Slice 126	331.09201	809.9691	0	440.78295	184.3835	0
Slice 127	332.81403	809.67576	0	429.43605	179.63699	0
Slice 128	334.53605	809.38243	0	418.08915	174.89048	0
Slice 129	336.25807	809.08909	0	406.74225	170.14397	0
Slice 130	337.98009	808.79576	0	395.39534	165.39746	0
Slice 131	339.70211	808.50242	0	384.04844	160.65094	0
Slice 132	341.42413	808.20909	0	372.70154	155.90443	0
Slice	343.14615	807.91575	0	361.35464	151.15792	0

133						
Slice 134	344.86817	807.62242	0	350.00774	146.41141	0
Slice 135	346.59019	807.32909	0	338.66084	141.6649	0
Slice 136	348.31221	807.03575	0	327.31393	136.91838	0
Slice 137	350.03423	806.74242	0	315.96703	132.17187	0
Slice 138	351.79639	806.47788	0	304.26993	127.27887	0
Slice 139	353.5987	806.24214	0	286.34431	119.78042	0
Slice 140	355.40101	806.0064	0	268.4187	112.28197	0
Slice 141	357.20332	805.77066	0	250.49308	104.78352	0
Slice 142	359.00563	805.53491	0	232.56746	97.285077	0
Slice 143	360.80794	805.29917	0	214.64184	89.786628	0
Slice 144	362.61025	805.06343	0	196.71623	82.28818	0
Slice 145	364.41256	804.82769	0	178.79061	74.789732	0
Slice 146	366.21487	804.59195	0	160.86499	67.291283	0
Slice 147	367.91257	804.45713	0	140.3953	58.728628	0
Slice 148	369.50567	804.42324	0	109.19635	45.677822	0
Slice 149	371.09877	804.38935	0	77.997391	32.627016	0
Slice 150	372.69187	804.35546	0	46.798435	19.576209	0
Slice 151	374.28497	804.32157	0	15.599478	6.5254031	0



Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	CCR	Mohr-Coulomb	86	0	22.7
	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

Title: Columbia Mod 10-11 Interim Waste Stage 3
Name: 3_Block
Method: Janbu
Last Edited By: Suchomel, Brandon

F of S: 2.063, F of S Rank (Analysis): 1 of 147,456 slip surfaces
Last Solved Date: 5/4/2022, Last Solved Time: 6:00:41 PM

3_Block

File Information

File Version: 8.16
Title: Columbia Mod 10-11 Interim Waste Stage 3
Created By: Suchomel, Brandon
Last Edited By: Suchomel, Brandon
Revision Number: 50
Date: 5/4/2022
Time: 5:59:45 PM
Tool Version: 8.16.3.14580
File Name: Columbia Mod 10-11 Interim Waste Stage 3.gsz
Directory: I:\25220183.00\Data and Calculations_Issued for Permitting POO Geotech Calculations\Slope Stability\
Last Solved Date: 5/4/2022
Last Solved Time: 6:00:41 PM

Project Settings

Length(L) Units: Feet
Time(t) Units: Seconds
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

3_Block

Kind: SLOPE/W
Method: Janbu
Settings
    PWP Conditions Source: (none)
Slip Surface
    Direction of movement: Left to Right
    Use Passive Mode: No
    Slip Surface Option: Block
    Critical slip surfaces saved: 10
    Resisting Side Maximum Convex Angle: 1 °
    Driving Side Maximum Convex Angle: 5 °
    Restrict Block Crossing: No
    Optimize Critical Slip Surface Location: No
    Tension Crack
        Tension Crack Option: (none)
F of S Distribution
    F of S Calculation Option: Constant
Advanced

Number of Slices: 150
F of S Tolerance: 0.001
Minimum Slip Surface Depth: 0.1 ft

Materials

CCR

Model: Mohr-Coulomb
Unit Weight: 86 pcf
Cohesion': 0 psf
Phi': 22.7 °
Phi-B: 0 °

Clay

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 0 psf
Phi': 28 °
Phi-B: 0 °

Drainage Layer

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi': 30 °
Phi-B: 0 °

Geosynthetics

Model: Mohr-Coulomb
Unit Weight: 58 pcf
Cohesion': 0 psf
Phi': 24.3 °
Phi-B: 0 °

Subbase

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 30 °
Phi-B: 0 °

Slip Surface Limits

Left Coordinate: (0, 870) ft
Right Coordinate: (483.9, 803.9) ft

Slip Surface Block

Left Grid
Upper Left: (173.66, 804.44) ft
Lower Left: (173.65, 804.32) ft
Lower Right: (184.43, 804.28) ft

X Increments: 15
Y Increments: 3
Starting Angle: 115 °
Ending Angle: 135 °
Angle Increments: 5

Right Grid
Upper Left: (369.03, 803.46) ft
Lower Left: (369.04, 803.34) ft
Lower Right: (379.14, 803.32) ft
X Increments: 15
Y Increments: 3
Starting Angle: 0 °
Ending Angle: 45 °
Angle Increments: 5

Points

	X (ft)	Y (ft)
Point 1	0	780
Point 2	483.9	780
Point 3	0	805.2
Point 4	483.9	802.9
Point 5	483.9	800.9
Point 6	0	803.2
Point 7	0	870
Point 8	112.5	870
Point 9	379.2	803.3
Point 10	0	806.2
Point 11	375.1	804.3
Point 12	483.9	803.9
Point 13	0	805.3
Point 14	483.9	803
Point 15	379.2	803.4

Regions

	Material	Points	Area (ft²)
Region 1	Subbase	1,6,5,2	10,670
Region 2	Clay	6,3,9,4,5	944.17
Region 3	Geosynthetics	3,13,15,14,4,9	48.39
Region 4	Drainage Layer	13,10,11,12,14,15	430.8
Region 5	CCR	10,7,8,11	15,661

Current Slip Surface

Slip Surface: 52,648
F of S: 2.063
Volume: 6,571.6975 ft³
Weight: 569,769.11 lbs
Resisting Force: 243,018.44 lbs

Activating Force: 117,793.02 lbs
F of S Rank (Analysis): 1 of 147,456 slip surfaces
F of S Rank (Query): 1 of 147,456 slip surfaces
Exit: (375.01939, 804.32017) ft
Entry: (112.30933, 870) ft
Radius: 124.18106 ft
Center: (255.97976, 886.41996) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	112.40467	869.90467	0	6.8170337	2.8516269	0
Slice 2	113.3717	868.93763	0	60.372004	25.254156	0
Slice 3	115.11511	867.19423	0	153.84788	64.355961	0
Slice 4	116.85851	865.45082	0	247.32375	103.45777	0
Slice 5	118.60191	863.70742	0	340.79962	142.55957	0
Slice 6	120.34532	861.96402	0	434.2755	181.66138	0
Slice 7	122.08872	860.22061	0	527.75137	220.76318	0
Slice 8	123.83212	858.47721	0	621.22724	259.86499	0
Slice 9	125.57553	856.73381	0	714.70312	298.96679	0
Slice 10	127.31893	854.9904	0	808.17899	338.0686	0
Slice 11	129.06233	853.247	0	901.65487	377.1704	0
Slice 12	130.80574	851.5036	0	995.13074	416.27221	0
Slice 13	132.54914	849.76019	0	1,088.6066	455.37401	0
Slice 14	134.29254	848.01679	0	1,182.0825	494.47582	0
Slice 15	136.03595	846.27339	0	1,275.5584	533.57762	0
Slice 16	137.77935	844.52998	0	1,369.0342	572.67942	0
Slice 17	139.52275	842.78658	0	1,462.5101	611.78123	0
Slice 18	141.26616	841.04318	0	1,555.986	650.88303	0
Slice 19	143.00956	839.29977	0	1,649.4619	689.98484	0
Slice 20	144.75296	837.55637	0	1,742.9377	729.08664	0
Slice 21	146.49637	835.81297	0	1,836.4136	768.18845	0
Slice 22	148.23977	834.06956	0	1,929.8895	807.29025	0
Slice 23	149.98317	832.32616	0	2,023.3653	846.39206	0
Slice 24	151.72658	830.58276	0	2,116.8412	885.49386	0
Slice 25	153.46998	828.83935	0	2,210.3171	924.59567	0

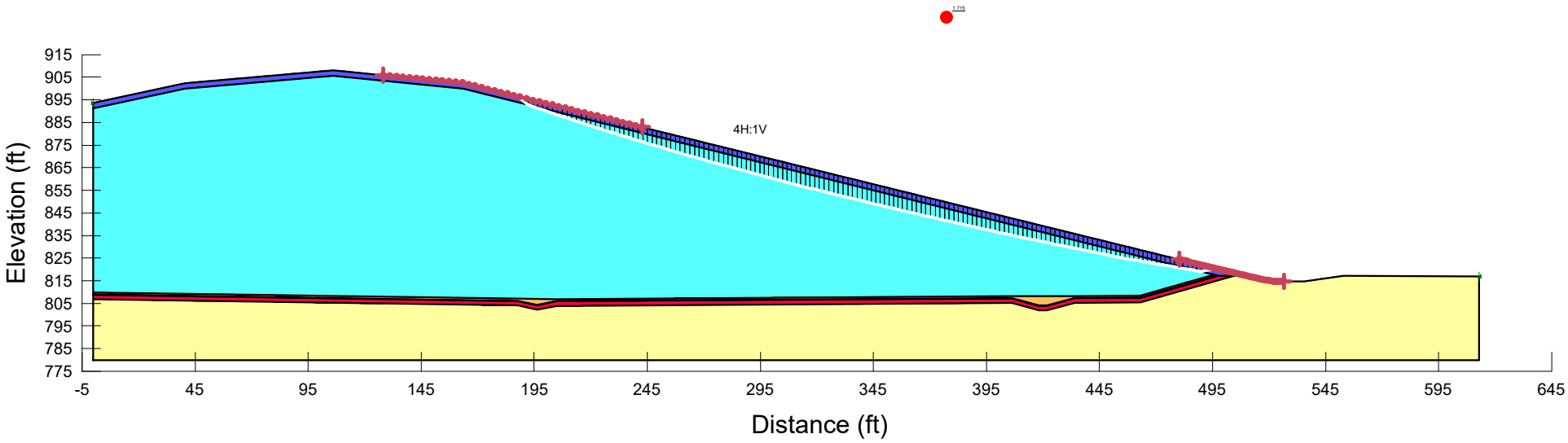
Slice 26	155.21338	827.09595	0	2,303.793	963.69747	0
Slice 27	156.95679	825.35255	0	2,397.2688	1,002.7993	0
Slice 28	158.70019	823.60914	0	2,490.7447	1,041.9011	0
Slice 29	160.44359	821.86574	0	2,584.2206	1,081.0029	0
Slice 30	162.187	820.12234	0	2,677.6965	1,120.1047	0
Slice 31	163.9304	818.37893	0	2,771.1723	1,159.2065	0
Slice 32	165.6738	816.63553	0	2,864.6482	1,198.3083	0
Slice 33	167.41721	814.89213	0	2,958.1241	1,237.4101	0
Slice 34	169.16061	813.14872	0	3,051.6	1,276.5119	0
Slice 35	170.90401	811.40532	0	3,145.0758	1,315.6137	0
Slice 36	172.64742	809.66192	0	3,238.5517	1,354.7155	0
Slice 37	174.39082	807.91851	0	3,332.0276	1,393.8173	0
Slice 38	176.13422	806.17511	0	3,425.5034	1,432.9191	0
Slice 39	177.45332	804.85601	0	3,295.7974	1,902.8295	0
Slice 40	178.81192	804.37175	0	4,204.9245	1,898.5962	0
Slice 41	180.60202	804.33032	0	4,201.5161	1,897.0573	0
Slice 42	182.35981	804.32121	0	4,164.5095	1,880.3481	0
Slice 43	184.1176	804.31209	0	4,127.5028	1,863.639	0
Slice 44	185.87539	804.30297	0	4,090.4962	1,846.9298	0
Slice 45	187.63318	804.29386	0	4,053.4895	1,830.2207	0
Slice 46	189.39097	804.28474	0	4,016.4828	1,813.5115	0
Slice 47	191.14876	804.27562	0	3,979.4762	1,796.8024	0
Slice 48	192.90655	804.2665	0	3,942.4695	1,780.0932	0
Slice 49	194.66434	804.25739	0	3,905.4628	1,763.3841	0
Slice 50	196.42213	804.24827	0	3,868.4562	1,746.6749	0
Slice 51	198.17992	804.23915	0	3,831.4495	1,729.9658	0
Slice	199.93771	804.23004	0	3,794.4429	1,713.2566	0

52						
Slice 53	201.6955	804.22092	0	3,757.4362	1,696.5475	0
Slice 54	203.45329	804.2118	0	3,720.4295	1,679.8383	0
Slice 55	205.21108	804.20268	0	3,683.4229	1,663.1292	0
Slice 56	206.96886	804.19357	0	3,646.4162	1,646.42	0
Slice 57	208.72665	804.18445	0	3,609.4095	1,629.7109	0
Slice 58	210.48444	804.17533	0	3,572.4029	1,613.0017	0
Slice 59	212.24223	804.16622	0	3,535.3962	1,596.2926	0
Slice 60	214.00002	804.1571	0	3,498.3895	1,579.5834	0
Slice 61	215.75781	804.14798	0	3,461.3829	1,562.8743	0
Slice 62	217.5156	804.13886	0	3,424.3762	1,546.1652	0
Slice 63	219.27339	804.12975	0	3,387.3696	1,529.456	0
Slice 64	221.03118	804.12063	0	3,350.3629	1,512.7469	0
Slice 65	222.78897	804.11151	0	3,313.3562	1,496.0377	0
Slice 66	224.54676	804.1024	0	3,276.3496	1,479.3286	0
Slice 67	226.30455	804.09328	0	3,239.3429	1,462.6194	0
Slice 68	228.06234	804.08416	0	3,202.3362	1,445.9103	0
Slice 69	229.82013	804.07505	0	3,165.3296	1,429.2011	0
Slice 70	231.57792	804.06593	0	3,128.3229	1,412.492	0
Slice 71	233.33571	804.05681	0	3,091.3163	1,395.7828	0
Slice 72	235.0935	804.04769	0	3,054.3096	1,379.0737	0
Slice 73	236.85129	804.03858	0	3,017.3029	1,362.3645	0
Slice 74	238.60908	804.02946	0	2,980.2963	1,345.6554	0
Slice 75	240.36687	804.02034	0	2,943.2896	1,328.9462	0
Slice 76	242.12466	804.01123	0	2,906.2829	1,312.2371	0
Slice 77	243.88245	804.00211	0	2,869.2763	1,295.5279	0
Slice 78	245.64024	803.99299	0	2,832.2696	1,278.8188	0

Slice 79	247.39803	803.98387	0	2,795.2629	1,262.1096	0
Slice 80	249.15582	803.97476	0	2,758.2563	1,245.4005	0
Slice 81	250.91361	803.96564	0	2,721.2496	1,228.6913	0
Slice 82	252.6714	803.95652	0	2,684.243	1,211.9822	0
Slice 83	254.42919	803.94741	0	2,647.2363	1,195.273	0
Slice 84	256.18698	803.93829	0	2,610.2296	1,178.5639	0
Slice 85	257.94477	803.92917	0	2,573.223	1,161.8547	0
Slice 86	259.70256	803.92005	0	2,536.2163	1,145.1456	0
Slice 87	261.46035	803.91094	0	2,499.2096	1,128.4364	0
Slice 88	263.21814	803.90182	0	2,462.203	1,111.7273	0
Slice 89	264.97593	803.8927	0	2,425.1963	1,095.0181	0
Slice 90	266.73372	803.88359	0	2,388.1897	1,078.309	0
Slice 91	268.49151	803.87447	0	2,351.183	1,061.5998	0
Slice 92	270.2493	803.86535	0	2,314.1763	1,044.8907	0
Slice 93	272.00709	803.85623	0	2,277.1697	1,028.1815	0
Slice 94	273.76488	803.84712	0	2,240.163	1,011.4724	0
Slice 95	275.52267	803.838	0	2,203.1563	994.76323	0
Slice 96	277.28046	803.82888	0	2,166.1497	978.05408	0
Slice 97	279.03825	803.81977	0	2,129.143	961.34493	0
Slice 98	280.79604	803.81065	0	2,092.1363	944.63578	0
Slice 99	282.55383	803.80153	0	2,055.1297	927.92663	0
Slice 100	284.31162	803.79241	0	2,018.123	911.21749	0
Slice 101	286.06941	803.7833	0	1,981.1164	894.50834	0
Slice 102	287.8272	803.77418	0	1,944.1097	877.79919	0
Slice 103	289.58499	803.76506	0	1,907.103	861.09004	0
Slice 104	291.34277	803.75595	0	1,870.0964	844.38089	0

Slice 105	293.10056	803.74683	0	1,833.0897	827.67174	0
Slice 106	294.85835	803.73771	0	1,796.083	810.96259	0
Slice 107	296.61614	803.72859	0	1,759.0764	794.25344	0
Slice 108	298.37393	803.71948	0	1,722.0697	777.54429	0
Slice 109	300.13172	803.71036	0	1,685.0631	760.83514	0
Slice 110	301.88951	803.70124	0	1,648.0564	744.12599	0
Slice 111	303.6473	803.69213	0	1,611.0497	727.41684	0
Slice 112	305.40509	803.68301	0	1,574.0431	710.7077	0
Slice 113	307.16288	803.67389	0	1,537.0364	693.99855	0
Slice 114	308.92067	803.66477	0	1,500.0297	677.2894	0
Slice 115	310.67846	803.65566	0	1,463.0231	660.58025	0
Slice 116	312.43625	803.64654	0	1,426.0164	643.8711	0
Slice 117	314.19404	803.63742	0	1,389.0097	627.16195	0
Slice 118	315.95183	803.62831	0	1,352.0031	610.4528	0
Slice 119	317.70962	803.61919	0	1,314.9964	593.74365	0
Slice 120	319.46741	803.61007	0	1,277.9898	577.0345	0
Slice 121	321.2252	803.60096	0	1,240.9831	560.32535	0
Slice 122	322.98299	803.59184	0	1,203.9764	543.6162	0
Slice 123	324.74078	803.58272	0	1,166.9698	526.90706	0
Slice 124	326.49857	803.5736	0	1,129.9631	510.19791	0
Slice 125	328.25636	803.56449	0	1,092.9564	493.48876	0
Slice 126	330.01415	803.55537	0	1,055.9498	476.77961	0
Slice 127	331.77194	803.54625	0	1,018.9431	460.07046	0
Slice 128	333.52973	803.53714	0	981.93646	443.36131	0
Slice 129	335.28752	803.52802	0	944.92979	426.65216	0
Slice 130	337.04531	803.5189	0	907.92313	409.94301	0
Slice	338.8031	803.50978	0	870.91647	393.23386	0

131						
Slice 132	340.56089	803.50067	0	833.9098	376.52471	0
Slice 133	342.31868	803.49155	0	796.90314	359.81556	0
Slice 134	344.07647	803.48243	0	759.89648	343.10642	0
Slice 135	345.83426	803.47332	0	722.88981	326.39727	0
Slice 136	347.59205	803.4642	0	685.88315	309.68812	0
Slice 137	349.34984	803.45508	0	648.87649	292.97897	0
Slice 138	351.10763	803.44596	0	611.86982	276.26982	0
Slice 139	352.86542	803.43685	0	574.86316	259.56067	0
Slice 140	354.62321	803.42773	0	537.8565	242.85152	0
Slice 141	356.381	803.41861	0	500.84983	226.14237	0
Slice 142	358.13879	803.4095	0	463.84317	209.43322	0
Slice 143	359.89658	803.40038	0	426.83651	192.72407	0
Slice 144	361.65437	803.39126	0	389.82984	176.01492	0
Slice 145	363.41216	803.38214	0	352.82318	159.30577	0
Slice 146	365.16995	803.37303	0	315.81652	142.59663	0
Slice 147	366.92774	803.36391	0	278.80986	125.88748	0
Slice 148	368.68553	803.35479	0	241.80319	109.17833	0
Slice 149	370.44332	803.34568	0	204.79653	92.469178	0
Slice 150	372.20111	803.33656	0	167.78987	75.760029	0
Slice 151	373.17588	803.38085	0	162.70935	73.466091	0
Slice 152	374.12637	803.86515	0	82.91754	47.872464	0
Slice 153	375.00019	804.31039	0	1.398867	0.58515874	0



Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	CCR	Mohr-Coulomb	86	0	22.7
	Clay	Mohr-Coulomb	125	0	28
	Drainage Layer	Mohr-Coulomb	115	0	30
	Final Cover	Mohr-Coulomb	120	0	30
	Geosynthetics	Mohr-Coulomb	58	0	24.3
	Subbase	Mohr-Coulomb	120	0	30

Title: Columbia Mod 10-11 Final Grade
Name: 2_Optimized Circular
Method: Bishop
Last Edited By: Suchomel, Brandon

F of S: 1.715, F of S Rank (Analysis): 1 of 15,130 slip surfaces
Last Solved Date: 5/4/2022, Last Solved Time: 6:09:49 PM

2_Optimized Circular

File Information

File Version: 8.16
Title: Columbia Mod 10-11 Final Grade
Created By: Suchomel, Brandon
Last Edited By: Suchomel, Brandon
Revision Number: 76
Date: 5/4/2022
Time: 6:09:17 PM
Tool Version: 8.16.3.14580
File Name: Columbia Mod 10-11 Final Grade.gsz
Directory: I:\25220183.00\Data and Calculations_Issued for Permitting POO Geotech Calculations\Slope Stability\
Last Solved Date: 5/4/2022
Last Solved Time: 6:09:49 PM

Project Settings

Length(L) Units: Feet
Time(t) Units: Seconds
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

2_Optimized Circular

Kind: SLOPE/W
Method: Bishop
Settings
    PWP Conditions Source: (none)
Slip Surface
    Direction of movement: Left to Right
    Use Passive Mode: No
    Slip Surface Option: Entry and Exit
    Critical slip surfaces saved: 10
    Resisting Side Maximum Convex Angle: 1 °
    Driving Side Maximum Convex Angle: 5 °
    Optimize Critical Slip Surface Location: Yes
    Critical Slip Surface Optimizations
        Maximum Iterations: 2,000
        Convergence Tolerance: 1e-007
        Starting Points: 8
        Ending Points: 16
        Complete Passes per Insertion: 1

Tension Crack
Tension Crack Option: (none)
F of S Distribution
F of S Calculation Option: Constant
Advanced
Number of Slices: 150
F of S Tolerance: 0.001
Minimum Slip Surface Depth: 0.1 ft

Materials

CCR

Model: Mohr-Coulomb
Unit Weight: 86 pcf
Cohesion': 0 psf
Phi': 22.7 °
Phi-B: 0 °

Clay

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 0 psf
Phi': 28 °
Phi-B: 0 °

Drainage Layer

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi': 30 °
Phi-B: 0 °

Geosynthetics

Model: Mohr-Coulomb
Unit Weight: 58 pcf
Cohesion': 0 psf
Phi': 24.3 °
Phi-B: 0 °

Subbase

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 30 °
Phi-B: 0 °

Final Cover

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 30 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (128.23053, 906.01) ft
Left-Zone Right Coordinate: (242.77011, 883.007) ft
Left-Zone Increment: 40
Right Projection: Range
Right-Zone Left Coordinate: (480.36, 824.4345) ft
Right-Zone Right Coordinate: (526.61, 814.8) ft
Right-Zone Increment: 40
Radius Increments: 8

Slip Surface Limits

Left Coordinate: (0, 893.8) ft
Right Coordinate: (613, 816.8) ft

Points

	X (ft)	Y (ft)
Point 1	0	808.8
Point 2	187.7	806
Point 3	196.4	804.2
Point 4	205.1	805.9
Point 5	406.3	807.2
Point 6	418.1	803.9
Point 7	421.7	803.9
Point 8	433.9	807.3
Point 9	463	807.5
Point 10	497.4	817.3
Point 11	0	806.8
Point 12	187.7	804
Point 13	196.4	802.2
Point 14	205.1	803.9
Point 15	406.3	805.2
Point 16	418.1	801.9
Point 17	421.7	801.9
Point 18	433.9	805.3
Point 19	463	805.5
Point 20	504.6	817.3
Point 21	0	809.8
Point 22	187.7	807
Point 23	205.1	806.9
Point 24	406.3	808.2
Point 25	433.9	808.3
Point 26	463	808.5
Point 27	494	817.3
Point 28	0	891.3
Point 29	40.4	900
Point 30	106.1	905.7

Point 31	163.7	900
Point 32	0	893.8
Point 33	40.4	902.5
Point 34	106.1	908.2
Point 35	163.7	902.5
Point 36	509.3	817.3
Point 37	521.2	814.8
Point 38	535.6	814.8
Point 39	553.1	817.2
Point 40	613	816.8
Point 41	0	780
Point 42	613	780
Point 43	497	817.3
Point 44	0	808.9
Point 45	187.7	806.1
Point 46	196.4	804.3
Point 47	205.1	806
Point 48	406.3	807.3
Point 49	418.1	804
Point 50	421.7	804
Point 51	433.9	807.4
Point 52	463	807.6

Regions

	Material	Points	Area (ft²)
Region 1	Subbase	41,11,12,13,14,15,16,17,18,19,20,36,37,38,39,40,42	16,750
Region 2	Clay	11,1,2,3,4,5,6,7,8,9,10,20,19,18,17,16,15,14,13,12	1,002.9
Region 3	Geosynthetics	1,44,45,46,47,48,49,50,51,52,43,10,9,8,7,6,5,4,3,2	49.96
Region 4	Drainage Layer	44,21,22,23,24,25,26,27,43,52,51,50,49,48,47,46,45	512.68
Region 5	CCR	21,28,29,30,31,10,43,27,26,25,24,23,22	31,970
Region 6	Final Cover	28,32,33,34,35,36,20,10,31,30,29	1,333.3

Current Slip Surface

Slip Surface: 15,130
F of S: 1.715
Volume: 2,057.5599 ft³
Weight: 205,107.91 lbs
Resisting Moment: 1.9773823e+008 lbs-ft
Activating Moment: 1.1529957e+008 lbs-ft
F of S Rank (Analysis): 1 of 15,130 slip surfaces
F of S Rank (Query): 1 of 15,130 slip surfaces
Exit: (496.40689, 820.47851) ft
Entry: (187.91178, 896.53112) ft
Radius: 135.32146 ft
Center: (884.20908, 3,149.1166) ft

Slip Slices

	X (ft)	Y (ft)	PWP	Base Normal Stress	Frictional Strength	Cohesive Strength

			(psf)	(psf)	(psf)	(psf)
Slice 1	188.94788	895.64148	0	59.043882	34.089001	0
Slice 2	191.02008	893.8622	0	177.13165	102.267	0
Slice 3	192.136	892.90403	0	255.19769	106.75151	0
Slice 4	193.30095	892.46224	0	297.05904	124.26249	0
Slice 5	195.47124	891.71573	0	313.92727	131.31862	0
Slice 6	197.64153	890.96921	0	330.79551	138.37476	0
Slice 7	199.81182	890.2227	0	347.66374	145.43089	0
Slice 8	201.98211	889.47619	0	364.53198	152.48703	0
Slice 9	204.1524	888.72967	0	381.40021	159.54317	0
Slice 10	206.32269	887.98316	0	398.26845	166.5993	0
Slice 11	208.45878	887.27447	0	415.11896	173.64802	0
Slice 12	210.56069	886.60361	0	427.38749	178.78006	0
Slice 13	212.6626	885.93275	0	439.65601	183.91209	0
Slice 14	214.76451	885.2619	0	451.92453	189.04413	0
Slice 15	216.86642	884.59104	0	464.19306	194.17616	0
Slice 16	218.96833	883.92018	0	476.46158	199.3082	0
Slice 17	221.07024	883.24932	0	488.7301	204.44023	0
Slice 18	223.17215	882.57846	0	500.99863	209.57227	0
Slice 19	225.27406	881.9076	0	513.26715	214.7043	0
Slice 20	227.37597	881.23675	0	525.53567	219.83633	0
Slice 21	229.47788	880.56589	0	537.8042	224.96837	0
Slice 22	231.57979	879.89503	0	550.07272	230.1004	0
Slice 23	233.66565	879.251	0	563.18804	235.58666	0
Slice 24	235.73548	878.6338	0	571.84604	239.20838	0
Slice 25	237.8053	878.0166	0	580.50403	242.83009	0
Slice 26	239.87513	877.3994	0	589.16202	246.45181	0
Slice 27	241.94495	876.7822	0	597.82001	250.07353	0
Slice 28	244.01478	876.165	0	606.478	253.69524	0
Slice 29	246.0846	875.5478	0	615.136	257.31696	0
Slice 30	248.15443	874.9306	0	623.79399	260.93868	0

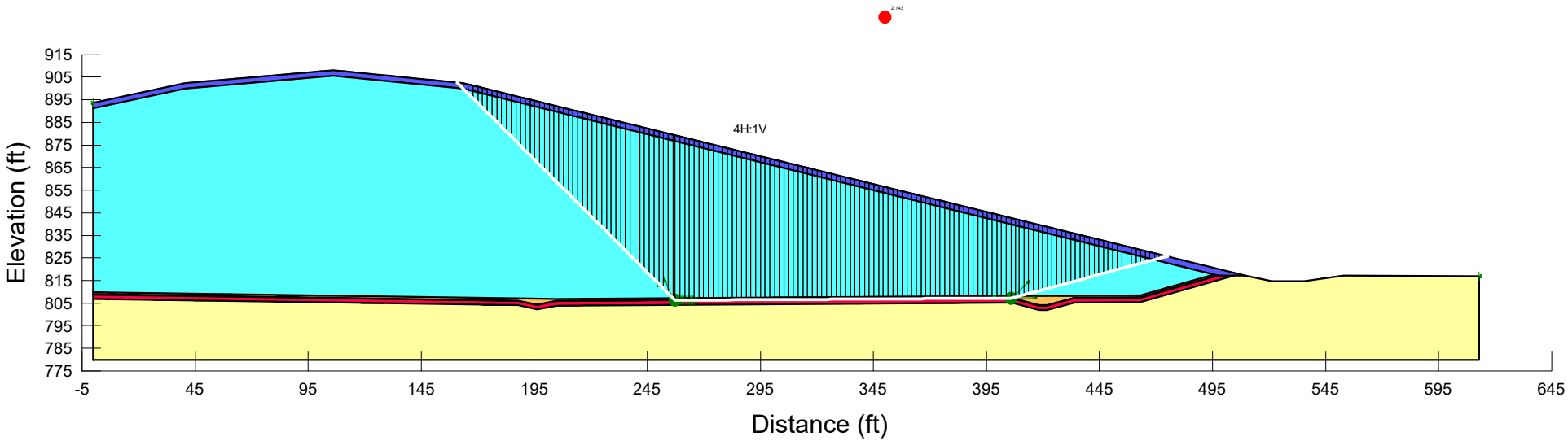
Slice 31	250.22425	874.3134	0	632.45198	264.56039	0
Slice 32	252.29407	873.6962	0	641.10997	268.18211	0
Slice 33	254.3639	873.079	0	649.76797	271.80383	0
Slice 34	256.43372	872.4618	0	658.42596	275.42554	0
Slice 35	258.50355	871.8446	0	667.08395	279.04726	0
Slice 36	260.57337	871.2274	0	675.74194	282.66898	0
Slice 37	262.6432	870.6102	0	684.39994	286.29069	0
Slice 38	264.76104	870.0051	0	694.99471	290.72258	0
Slice 39	266.9269	869.4121	0	699.84528	292.75162	0
Slice 40	269.09277	868.8191	0	704.69585	294.78066	0
Slice 41	271.25863	868.2261	0	709.54641	296.80969	0
Slice 42	273.42449	867.6331	0	714.39698	298.83873	0
Slice 43	275.59036	867.0401	0	719.24755	300.86777	0
Slice 44	277.67848	866.47383	0	724.38225	303.01566	0
Slice 45	279.68887	865.9343	0	728.01062	304.53344	0
Slice 46	281.69926	865.39476	0	731.63899	306.05122	0
Slice 47	283.70965	864.85523	0	735.26736	307.569	0
Slice 48	285.72004	864.31569	0	738.89573	309.08678	0
Slice 49	287.73043	863.77616	0	742.5241	310.60456	0
Slice 50	289.74082	863.23662	0	746.15247	312.12234	0
Slice 51	291.75121	862.69709	0	749.78083	313.64012	0
Slice 52	293.7616	862.15755	0	753.4092	315.1579	0
Slice 53	295.77199	861.61802	0	757.03757	316.67568	0
Slice 54	297.78237	861.07848	0	760.66594	318.19346	0
Slice 55	299.79276	860.53895	0	764.29431	319.71124	0
Slice 56	301.80315	859.99941	0	767.92268	321.22902	0
Slice	303.81354	859.45988	0	771.55105	322.7468	0

57						
Slice 58	305.82393	858.92034	0	775.17942	324.26458	0
Slice 59	307.83432	858.38081	0	778.80779	325.78236	0
Slice 60	309.84471	857.84127	0	782.43616	327.30014	0
Slice 61	311.8551	857.30174	0	786.06453	328.81792	0
Slice 62	313.86549	856.7622	0	789.6929	330.3357	0
Slice 63	315.87588	856.22267	0	793.32127	331.85347	0
Slice 64	317.93207	855.6982	0	799.58807	334.47494	0
Slice 65	320.03408	855.18881	0	798.96026	334.21232	0
Slice 66	322.13609	854.67942	0	798.33244	333.94969	0
Slice 67	324.2381	854.17003	0	797.70462	333.68707	0
Slice 68	326.3401	853.66064	0	797.07681	333.42445	0
Slice 69	328.44211	853.15125	0	796.44899	333.16183	0
Slice 70	330.54412	852.64185	0	795.82117	332.89921	0
Slice 71	332.64613	852.13246	0	795.19336	332.63659	0
Slice 72	334.74813	851.62307	0	794.56554	332.37397	0
Slice 73	336.85014	851.11368	0	793.93772	332.11134	0
Slice 74	338.95215	850.60429	0	793.30991	331.84872	0
Slice 75	341.05416	850.0949	0	792.68209	331.5861	0
Slice 76	343.08943	849.60487	0	792.40744	331.47121	0
Slice 77	345.05798	849.13423	0	791.29902	331.00755	0
Slice 78	347.02653	848.66358	0	790.19061	330.54389	0
Slice 79	348.99507	848.19292	0	789.0822	330.08023	0
Slice 80	350.96362	847.72227	0	787.97378	329.61657	0
Slice 81	352.93216	847.25162	0	786.86537	329.15291	0
Slice 82	354.90071	846.78098	0	785.75696	328.68925	0
Slice 83	356.86926	846.31033	0	784.64854	328.22559	0

Slice 84	358.89006	845.83546	0	784.28138	328.07201	0
Slice 85	360.96313	845.35638	0	781.76363	327.01881	0
Slice 86	363.0362	844.87731	0	779.24588	325.96561	0
Slice 87	365.10927	844.39823	0	776.72813	324.91241	0
Slice 88	367.18234	843.91915	0	774.21037	323.85921	0
Slice 89	369.2554	843.44007	0	771.69262	322.80602	0
Slice 90	371.32847	842.96099	0	769.17487	321.75282	0
Slice 91	373.40154	842.48192	0	766.65712	320.69962	0
Slice 92	375.47461	842.00284	0	764.13936	319.64642	0
Slice 93	377.52585	841.53663	0	762.36799	318.90544	0
Slice 94	379.55527	841.08329	0	758.62269	317.33874	0
Slice 95	381.58468	840.62994	0	754.87739	315.77205	0
Slice 96	383.6141	840.1766	0	751.13208	314.20536	0
Slice 97	385.64352	839.72326	0	747.38678	312.63866	0
Slice 98	387.67293	839.26991	0	743.64148	311.07197	0
Slice 99	389.70235	838.81657	0	739.89618	309.50528	0
Slice 100	391.73177	838.36323	0	736.15088	307.93858	0
Slice 101	393.76119	837.90989	0	732.40558	306.37189	0
Slice 102	395.7906	837.45654	0	728.66028	304.8052	0
Slice 103	397.82002	837.0032	0	724.91498	303.2385	0
Slice 104	399.84944	836.54986	0	721.16968	301.67181	0
Slice 105	401.87885	836.09651	0	717.42438	300.10512	0
Slice 106	403.90827	835.64317	0	713.67908	298.53842	0
Slice 107	405.93372	835.20322	0	710.95565	297.39919	0
Slice 108	407.95521	834.77667	0	705.16772	294.97805	0
Slice 109	409.9767	834.35013	0	699.37979	292.5569	0

Slice 110	411.99819	833.92358	0	693.59187	290.13576	0
Slice 111	414.04037	833.4998	0	688.2659	287.90786	0
Slice 112	416.10325	833.07881	0	681.17935	284.94349	0
Slice 113	418.16613	832.65781	0	674.0928	281.97913	0
Slice 114	420.22901	832.23682	0	667.00625	279.01476	0
Slice 115	422.29189	831.81582	0	659.9197	276.05039	0
Slice 116	424.35477	831.39483	0	652.83315	273.08602	0
Slice 117	426.41765	830.97383	0	645.7466	270.12165	0
Slice 118	428.48053	830.55284	0	638.66005	267.15729	0
Slice 119	430.54341	830.13184	0	631.5735	264.19292	0
Slice 120	432.60629	829.71085	0	624.48695	261.22855	0
Slice 121	434.66916	829.28985	0	617.4004	258.26418	0
Slice 122	436.73204	828.86886	0	610.31385	255.29981	0
Slice 123	438.79492	828.44786	0	603.2273	252.33545	0
Slice 124	440.8578	828.02687	0	596.14075	249.37108	0
Slice 125	442.92068	827.60587	0	589.0542	246.40671	0
Slice 126	444.98356	827.18488	0	581.96765	243.44234	0
Slice 127	447.04644	826.76388	0	574.8811	240.47798	0
Slice 128	449.10932	826.34289	0	567.79455	237.51361	0
Slice 129	451.1722	825.92189	0	560.708	234.54924	0
Slice 130	453.23508	825.5009	0	553.62146	231.58487	0
Slice 131	455.25753	825.11339	0	547.84698	229.16936	0
Slice 132	457.23956	824.75938	0	536.83751	224.56399	0
Slice 133	459.22159	824.40536	0	525.82804	219.95863	0
Slice 134	461.20362	824.05135	0	514.81857	215.35327	0
Slice 135	463.18565	823.69734	0	503.8091	210.74791	0
Slice	465.16768	823.34332	0	492.79962	206.14255	0

136						
Slice 137	467.14971	822.98931	0	481.79015	201.53719	0
Slice 138	469.13453	822.64483	0	471.04949	197.04427	0
Slice 139	471.12216	822.30988	0	458.32507	191.72153	0
Slice 140	473.10978	821.97494	0	445.60064	186.39879	0
Slice 141	475.09741	821.63999	0	432.87622	181.07605	0
Slice 142	477.08503	821.30505	0	420.1518	175.7533	0
Slice 143	479.07266	820.9701	0	407.42737	170.43056	0
Slice 144	481.06028	820.63515	0	394.70295	165.10782	0
Slice 145	483.0479	820.30021	0	381.97853	159.78508	0
Slice 146	485.03553	819.96526	0	369.2541	154.46234	0
Slice 147	487.02315	819.63032	0	356.52968	149.1396	0
Slice 148	489.01078	819.29537	0	343.80526	143.81685	0
Slice 149	491.07519	819.35375	0	315.06893	181.90513	0
Slice 150	493.21107	819.80433	0	188.85259	109.03409	0
Slice 151	495.34162	820.25378	0	62.950863	36.344698	0



Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	CCR	Mohr-Coulomb	86	0	22.7
	Clay	Mohr-Coulomb	125	0	28
	Drainage Layer	Mohr-Coulomb	115	0	30
	Final Cover	Mohr-Coulomb	120	0	30
	Geosynthetics	Mohr-Coulomb	58	0	24.3
	Subbase	Mohr-Coulomb	120	0	30

Title: Columbia Mod 10-11 Final Grade
Name: 3_Block
Method: Janbu
Last Edited By: Suchomel, Brandon

F of S: 2.143, F of S Rank (Analysis): 1 of 65,536 slip surfaces
Last Solved Date: 5/4/2022, Last Solved Time: 6:10:13 PM

3_Block

File Information

File Version: 8.16
Title: Columbia Mod 10-11 Final Grade
Created By: Suchomel, Brandon
Last Edited By: Suchomel, Brandon
Revision Number: 76
Date: 5/4/2022
Time: 6:09:17 PM
Tool Version: 8.16.3.14580
File Name: Columbia Mod 10-11 Final Grade.gsz
Directory: I:\25220183.00\Data and Calculations_Issued for Permitting POO Geotech Calculations\Slope Stability\
Last Solved Date: 5/4/2022
Last Solved Time: 6:10:13 PM

Project Settings

Length(L) Units: Feet
Time(t) Units: Seconds
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

3_Block

Kind: SLOPE/W
Method: Janbu
Settings
    PWP Conditions Source: (none)
Slip Surface
    Direction of movement: Left to Right
    Use Passive Mode: No
    Slip Surface Option: Block
    Critical slip surfaces saved: 10
    Resisting Side Maximum Convex Angle: 1 °
    Driving Side Maximum Convex Angle: 5 °
    Restrict Block Crossing: No
    Optimize Critical Slip Surface Location: No
    Tension Crack
        Tension Crack Option: (none)
F of S Distribution
    F of S Calculation Option: Constant
Advanced

Number of Slices: 150
F of S Tolerance: 0.001
Minimum Slip Surface Depth: 0.1 ft

Materials

CCR

Model: Mohr-Coulomb
Unit Weight: 86 pcf
Cohesion': 0 psf
Phi': 22.7 °
Phi-B: 0 °

Clay

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 0 psf
Phi': 28 °
Phi-B: 0 °

Drainage Layer

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi': 30 °
Phi-B: 0 °

Geosynthetics

Model: Mohr-Coulomb
Unit Weight: 58 pcf
Cohesion': 0 psf
Phi': 24.3 °
Phi-B: 0 °

Subbase

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 30 °
Phi-B: 0 °

Final Cover

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 30 °
Phi-B: 0 °

Slip Surface Limits

Left Coordinate: (0, 893.8) ft
Right Coordinate: (613, 816.8) ft

Slip Surface Block

Left Grid
- Upper Left: (256.72, 806.35) ft
- Lower Left: (256.72, 806.22) ft
- Lower Right: (266.56, 806.28) ft
- X Increments: 15
- Y Increments: 3
- Starting Angle: 115 °
- Ending Angle: 135 °
- Angle Increments: 3

Right Grid
- Upper Left: (398.42, 807.26) ft
- Lower Left: (398.42, 807.12) ft
- Lower Right: (406.38, 807.17) ft
- X Increments: 15
- Y Increments: 3
- Starting Angle: 0 °
- Ending Angle: 45 °
- Angle Increments: 3

Points

	X (ft)	Y (ft)
Point 1	0	808.8
Point 2	187.7	806
Point 3	196.4	804.2
Point 4	205.1	805.9
Point 5	406.3	807.2
Point 6	418.1	803.9
Point 7	421.7	803.9
Point 8	433.9	807.3
Point 9	463	807.5
Point 10	497.4	817.3
Point 11	0	806.8
Point 12	187.7	804
Point 13	196.4	802.2
Point 14	205.1	803.9
Point 15	406.3	805.2
Point 16	418.1	801.9
Point 17	421.7	801.9
Point 18	433.9	805.3
Point 19	463	805.5
Point 20	504.6	817.3
Point 21	0	809.8
Point 22	187.7	807
Point 23	205.1	806.9
Point 24	406.3	808.2
Point 25	433.9	808.3
Point 26	463	808.5
Point 27	494	817.3

Point 28	0	891.3
Point 29	40.4	900
Point 30	106.1	905.7
Point 31	163.7	900
Point 32	0	893.8
Point 33	40.4	902.5
Point 34	106.1	908.2
Point 35	163.7	902.5
Point 36	509.3	817.3
Point 37	521.2	814.8
Point 38	535.6	814.8
Point 39	553.1	817.2
Point 40	613	816.8
Point 41	0	780
Point 42	613	780
Point 43	497	817.3
Point 44	0	808.9
Point 45	187.7	806.1
Point 46	196.4	804.3
Point 47	205.1	806
Point 48	406.3	807.3
Point 49	418.1	804
Point 50	421.7	804
Point 51	433.9	807.4
Point 52	463	807.6

Regions

	Material	Points	Area (ft²)
Region 1	Subbase	41,11,12,13,14,15,16,17,18,19,20,36,37,38,39,40,42	16,750
Region 2	Clay	11,1,2,3,4,5,6,7,8,9,10,20,19,18,17,16,15,14,13,12	1,002.9
Region 3	Geosynthetics	1,44,45,46,47,48,49,50,51,52,43,10,9,8,7,6,5,4,3,2	49.96
Region 4	Drainage Layer	44,21,22,23,24,25,26,27,43,52,51,50,49,48,47,46,45	512.68
Region 5	CCR	21,28,29,30,31,10,43,27,26,25,24,23,22	31,970
Region 6	Final Cover	28,32,33,34,35,36,20,10,31,30,29	1,333.3

Current Slip Surface

Slip Surface: 18,298
F of S: 2.143
Volume: 12,851.682 ft³
Weight: 1,137,317.2 lbs
Resisting Force: 483,744.11 lbs
Activating Force: 225,710.24 lbs
F of S Rank (Analysis): 1 of 65,536 slip surfaces
F of S Rank (Query): 1 of 65,536 slip surfaces
Exit: (475.02664, 825.74934) ft
Entry: (160.86254, 902.78079) ft
Radius: 153.63542 ft
Center: (332.11038, 922.03865) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	162.28127	901.36206	0	120.84936	69.772411	0
Slice 2	164.75354	898.88979	0	312.2515	130.61763	0
Slice 3	166.86063	896.7827	0	426.57116	178.43858	0
Slice 4	168.96772	894.67562	0	540.89082	226.25953	0
Slice 5	171.0748	892.56853	0	655.21047	274.08048	0
Slice 6	173.18189	890.46145	0	769.53013	321.90143	0
Slice 7	175.28897	888.35436	0	883.84978	369.72237	0
Slice 8	177.39606	886.24727	0	998.16944	417.54332	0
Slice 9	179.50315	884.14019	0	1,112.4891	465.36427	0
Slice 10	181.61023	882.0331	0	1,226.8088	513.18522	0
Slice 11	183.71732	879.92601	0	1,341.1284	561.00617	0
Slice 12	185.82441	877.81893	0	1,455.4481	608.82711	0
Slice 13	187.93149	875.71184	0	1,569.7677	656.64806	0
Slice 14	190.03858	873.60475	0	1,684.0874	704.46901	0
Slice 15	192.14566	871.49767	0	1,798.407	752.28996	0
Slice 16	194.25275	869.39058	0	1,912.7267	800.11091	0
Slice 17	196.35984	867.2835	0	2,027.0463	847.93185	0
Slice 18	198.46692	865.17641	0	2,141.366	895.7528	0
Slice 19	200.57401	863.06932	0	2,255.6857	943.57375	0
Slice 20	202.6811	860.96224	0	2,370.0053	991.3947	0
Slice 21	204.78818	858.85515	0	2,484.325	1,039.2156	0
Slice 22	206.89527	856.74806	0	2,598.6446	1,087.0366	0
Slice 23	209.00235	854.64098	0	2,712.9643	1,134.8575	0
Slice 24	211.10944	852.53389	0	2,827.2839	1,182.6785	0
Slice 25	213.21653	850.42681	0	2,941.6036	1,230.4994	0
Slice 26	215.32361	848.31972	0	3,055.9232	1,278.3204	0
Slice 27	217.4307	846.21263	0	3,170.2429	1,326.1413	0
Slice 28	219.53779	844.10555	0	3,284.5626	1,373.9623	0
Slice 29	221.64487	841.99846	0	3,398.8822	1,421.7832	0

Slice 30	223.75196	839.89137	0	3,513.2019	1,469.6042	0
Slice 31	225.85905	837.78429	0	3,627.5215	1,517.4251	0
Slice 32	227.96613	835.6772	0	3,741.8412	1,565.2461	0
Slice 33	230.07322	833.57012	0	3,856.1608	1,613.067	0
Slice 34	232.1803	831.46303	0	3,970.4805	1,660.888	0
Slice 35	234.28739	829.35594	0	4,084.8002	1,708.7089	0
Slice 36	236.39448	827.24886	0	4,199.1198	1,756.5299	0
Slice 37	238.50156	825.14177	0	4,313.4395	1,804.3508	0
Slice 38	240.60865	823.03468	0	4,427.7591	1,852.1718	0
Slice 39	242.71574	820.9276	0	4,542.0788	1,899.9927	0
Slice 40	244.82282	818.82051	0	4,656.3984	1,947.8137	0
Slice 41	246.92991	816.71343	0	4,770.7181	1,995.6346	0
Slice 42	249.03699	814.60634	0	4,885.0377	2,043.4556	0
Slice 43	251.14408	812.49925	0	4,999.3574	2,091.2765	0
Slice 44	253.25117	810.39217	0	5,113.6771	2,139.0975	0
Slice 45	255.35825	808.28508	0	5,227.9967	2,186.9184	0
Slice 46	256.85891	806.78443	0	5,009.3458	2,892.1472	0
Slice 47	258.3866	806.30899	0	6,344.487	2,864.6457	0
Slice 48	260.51276	806.28732	0	6,343.6373	2,864.2621	0
Slice 49	262.60393	806.30064	0	6,298.1818	2,843.7381	0
Slice 50	264.69511	806.31397	0	6,252.7263	2,823.2142	0
Slice 51	266.78628	806.32729	0	6,207.2708	2,802.6902	0
Slice 52	268.87746	806.34061	0	6,161.8153	2,782.1663	0
Slice 53	270.96863	806.35394	0	6,116.3598	2,761.6423	0
Slice 54	273.0598	806.36726	0	6,070.9043	2,741.1184	0
Slice 55	275.15098	806.38059	0	6,025.4488	2,720.5945	0

Slice 56	277.24215	806.39391	0	5,979.9933	2,700.0705	0
Slice 57	279.33332	806.40723	0	5,934.5378	2,679.5466	0
Slice 58	281.4245	806.42056	0	5,889.0823	2,659.0226	0
Slice 59	283.51567	806.43388	0	5,843.6268	2,638.4987	0
Slice 60	285.60685	806.44721	0	5,798.1713	2,617.9747	0
Slice 61	287.69802	806.46053	0	5,752.7158	2,597.4508	0
Slice 62	289.78919	806.47385	0	5,707.2603	2,576.9268	0
Slice 63	291.88037	806.48718	0	5,661.8048	2,556.4029	0
Slice 64	293.97154	806.5005	0	5,616.3493	2,535.8789	0
Slice 65	296.06271	806.51383	0	5,570.8938	2,515.355	0
Slice 66	298.15389	806.52715	0	5,525.4383	2,494.831	0
Slice 67	300.24506	806.54047	0	5,479.9827	2,474.3071	0
Slice 68	302.33623	806.5538	0	5,434.5272	2,453.7831	0
Slice 69	304.42741	806.56712	0	5,389.0717	2,433.2592	0
Slice 70	306.51858	806.58045	0	5,343.6162	2,412.7352	0
Slice 71	308.60976	806.59377	0	5,298.1607	2,392.2113	0
Slice 72	310.70093	806.60709	0	5,252.7052	2,371.6874	0
Slice 73	312.7921	806.62042	0	5,207.2497	2,351.1634	0
Slice 74	314.88328	806.63374	0	5,161.7942	2,330.6395	0
Slice 75	316.97445	806.64707	0	5,116.3387	2,310.1155	0
Slice 76	319.06562	806.66039	0	5,070.8832	2,289.5916	0
Slice 77	321.1568	806.67371	0	5,025.4277	2,269.0676	0
Slice 78	323.24797	806.68704	0	4,979.9722	2,248.5437	0
Slice 79	325.33915	806.70036	0	4,934.5167	2,228.0197	0
Slice 80	327.43032	806.71369	0	4,889.0612	2,207.4958	0
Slice 81	329.52149	806.72701	0	4,843.6057	2,186.9718	0
Slice	331.61267	806.74033	0	4,798.1502	2,166.4479	0

82						
Slice 83	333.70384	806.75366	0	4,752.6947	2,145.9239	0
Slice 84	335.79501	806.76698	0	4,707.2392	2,125.4	0
Slice 85	337.88619	806.78031	0	4,661.7837	2,104.876	0
Slice 86	339.97736	806.79363	0	4,616.3282	2,084.3521	0
Slice 87	342.06854	806.80695	0	4,570.8727	2,063.8281	0
Slice 88	344.15971	806.82028	0	4,525.4172	2,043.3042	0
Slice 89	346.25088	806.8336	0	4,479.9617	2,022.7802	0
Slice 90	348.34206	806.84692	0	4,434.5062	2,002.2563	0
Slice 91	350.43323	806.86025	0	4,389.0506	1,981.7324	0
Slice 92	352.5244	806.87357	0	4,343.5951	1,961.2084	0
Slice 93	354.61558	806.8869	0	4,298.1396	1,940.6845	0
Slice 94	356.70675	806.90022	0	4,252.6841	1,920.1605	0
Slice 95	358.79792	806.91354	0	4,207.2286	1,899.6366	0
Slice 96	360.8891	806.92687	0	4,161.7731	1,879.1126	0
Slice 97	362.98027	806.94019	0	4,116.3176	1,858.5887	0
Slice 98	365.07145	806.95352	0	4,070.8621	1,838.0647	0
Slice 99	367.16262	806.96684	0	4,025.4066	1,817.5408	0
Slice 100	369.25379	806.98016	0	3,979.9511	1,797.0168	0
Slice 101	371.34497	806.99349	0	3,934.4956	1,776.4929	0
Slice 102	373.43614	807.00681	0	3,889.0401	1,755.9689	0
Slice 103	375.52731	807.02014	0	3,843.5846	1,735.445	0
Slice 104	377.61849	807.03346	0	3,798.1291	1,714.921	0
Slice 105	379.70966	807.04678	0	3,752.6736	1,694.3971	0
Slice 106	381.80084	807.06011	0	3,707.2181	1,673.8731	0
Slice 107	383.89201	807.07343	0	3,661.7626	1,653.3492	0
Slice 108	385.98318	807.08676	0	3,616.3071	1,632.8253	0

Slice 109	388.07436	807.10008	0	3,570.8516	1,612.3013	0
Slice 110	390.16553	807.1134	0	3,525.3961	1,591.7774	0
Slice 111	392.2567	807.12673	0	3,479.9406	1,571.2534	0
Slice 112	394.34788	807.14005	0	3,434.4851	1,550.7295	0
Slice 113	396.43905	807.15338	0	3,389.0296	1,530.2055	0
Slice 114	398.53023	807.1667	0	3,343.5741	1,509.6816	0
Slice 115	400.6214	807.18002	0	3,298.1185	1,489.1576	0
Slice 116	402.71257	807.19335	0	3,252.663	1,468.6337	0
Slice 117	404.80375	807.20667	0	3,207.2075	1,448.1097	0
Slice 118	406.00948	807.25625	0	3,364.1808	1,518.9859	0
Slice 119	406.23482	807.31662	0	3,411.2113	1,969.4637	0
Slice 120	407.11898	807.55353	0	3,361.7917	1,940.9313	0
Slice 121	408.75694	807.99242	0	3,270.2285	1,888.0673	0
Slice 122	410.60729	808.48822	0	3,108.7021	1,300.3983	0
Slice 123	412.67002	809.04093	0	3,012.497	1,260.1548	0
Slice 124	414.73275	809.59364	0	2,916.292	1,219.9114	0
Slice 125	416.79548	810.14634	0	2,820.0869	1,179.6679	0
Slice 126	418.85821	810.69905	0	2,723.8818	1,139.4244	0
Slice 127	420.92094	811.25176	0	2,627.6767	1,099.181	0
Slice 128	422.98367	811.80447	0	2,531.4717	1,058.9375	0
Slice 129	425.0464	812.35717	0	2,435.2666	1,018.6941	0
Slice 130	427.10913	812.90988	0	2,339.0615	978.45063	0
Slice 131	429.17187	813.46259	0	2,242.8564	938.20717	0
Slice 132	431.2346	814.01529	0	2,146.6514	897.96372	0
Slice 133	433.29733	814.568	0	2,050.4463	857.72026	0
Slice 134	435.36006	815.12071	0	1,954.2412	817.47681	0

Slice 135	437.42279	815.67342	0	1,858.0361	777.23335	0
Slice 136	439.48552	816.22612	0	1,761.8311	736.9899	0
Slice 137	441.54825	816.77883	0	1,665.626	696.74645	0
Slice 138	443.61098	817.33154	0	1,569.4209	656.50299	0
Slice 139	445.67371	817.88424	0	1,473.2158	616.25954	0
Slice 140	447.73645	818.43695	0	1,377.0108	576.01608	0
Slice 141	449.79918	818.98966	0	1,280.8057	535.77263	0
Slice 142	451.86191	819.54237	0	1,184.6006	495.52917	0
Slice 143	453.92464	820.09507	0	1,088.3955	455.28572	0
Slice 144	455.98737	820.64778	0	992.19047	415.04227	0
Slice 145	458.0501	821.20049	0	895.9854	374.79881	0
Slice 146	460.11283	821.75319	0	799.78033	334.55536	0
Slice 147	462.17556	822.3059	0	703.57525	294.3119	0
Slice 148	464.23829	822.85861	0	607.37018	254.06845	0
Slice 149	466.30102	823.41132	0	511.1651	213.82499	0
Slice 150	468.36376	823.96402	0	414.96003	173.58154	0
Slice 151	470.33371	824.49187	0	312.26526	180.28643	0
Slice 152	472.21088	824.99486	0	187.35915	108.17186	0
Slice 153	474.08805	825.49784	0	62.453052	36.057286	0

Appendix A8

Seepage Potential and Karst Condition Assessment

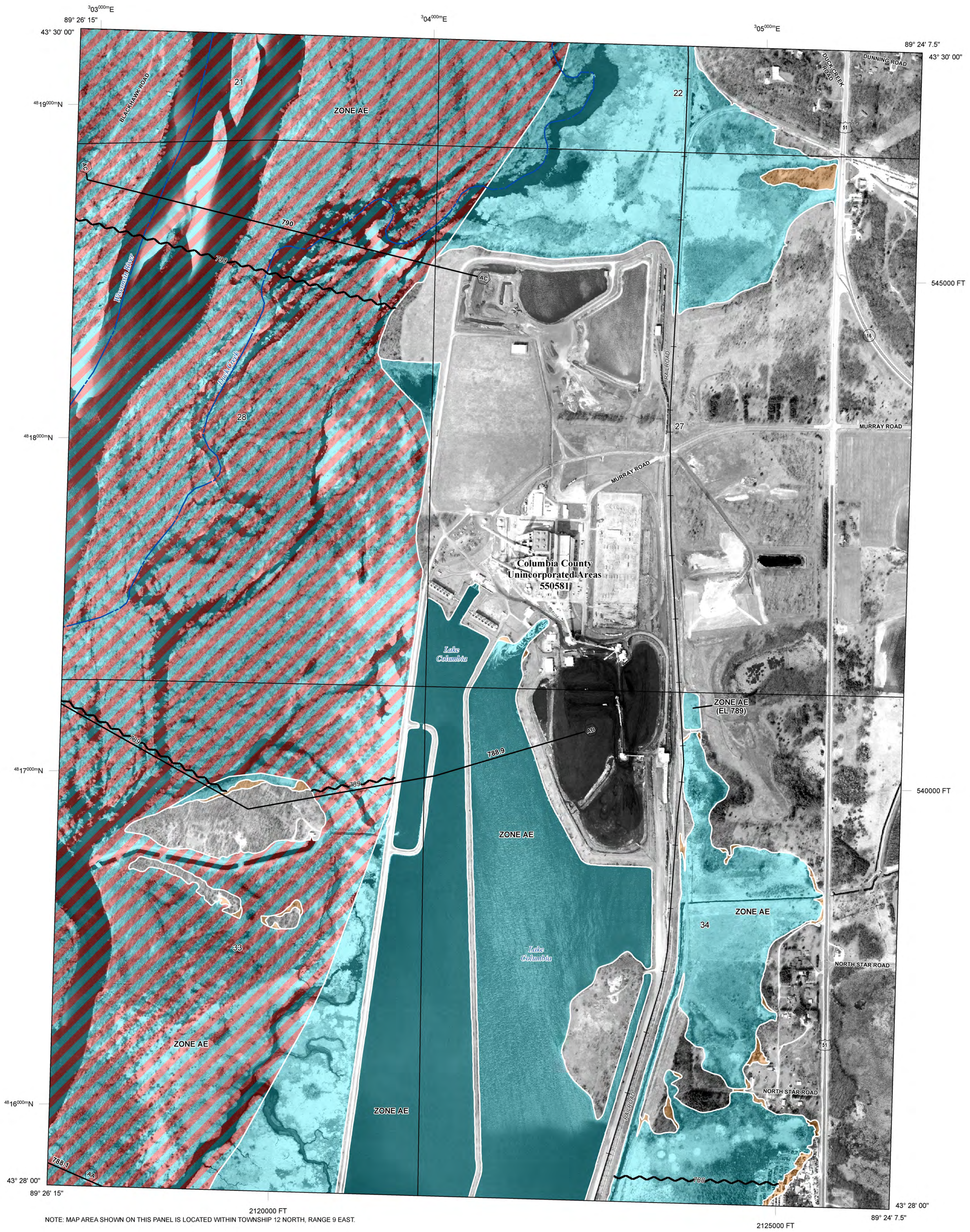
Seepage Potential and Karst Condition Assessment

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 A4, 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 A4 indicates that karst structures are not located in or near the disposal facility.

Appendix A9

FEMA Flood Insurance Rate Map



NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 12 NORTH, RANGE 9 EAST.

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR ZONE DESCRIPTIONS AND INDEX MAP

THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT

HTTP://MSC.FEMA.GOV

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A,V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee See Notes. *Zone X*

OTHER AREAS
- NO SCREEN — Areas Determined to be Outside the 0.2% Annual Chance Floodplain *Zone X*
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Accredited or Provisionally Accredited Levee, Dike, or Floodwall
- Non-accredited Levee, Dike, or Floodwall

OTHER FEATURES
- E 18.2 / 17.5 — Cross Sections with 1% Annual Chance Water Surface Elevation (BFE)
- 8 — Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 — Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

NOTES TO USERS

For information and questions about this map, available products associated with this FIRM including historic versions of this FIRM, how to order products or the National Flood Insurance Program in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Map Service Center website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the website. Users may determine the current map date for each FIRM panel by visiting the FEMA Map Service Center website or by calling the FEMA Map Information eXchange.

Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Map Service Center at the number listed above.

For community and countywide map dates refer to the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in the community, contact your Insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

Base map information shown on this FIRM was provided by the Wisconsin Regional Orthophotography Consortium (WROC). The aerial photography was acquired in the spring of 2010 to create 1":1000' scale digital orthophotos with 18-inch resolution.

SCALE

N

Map Projection:
NAD 1983 HARN UTM Zone 16N;
Western Hemisphere; Vertical Datum: NAVD 88

1 inch = 500 feet 1:6,000

0 500 1,000 2,000 Feet

0 125 250 500 Meters

PANEL LOCATOR

* PANEL NOT PRINTED

NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP

COLUMBIA COUNTY, WISCONSIN
AND INCORPORATED AREAS

PANEL 381 OF 620

FEMA

Panel Contains:

COMMUNITY	NUMBER	PANEL	SUFFIX
COLUMBIA COUNTY	550581	0381	F

VERSION NUMBER
2.2.2.1

MAP NUMBER
55021C0381F

MAP REVISED
May 16, 2016

Appendix B

Landfill Design Demonstration