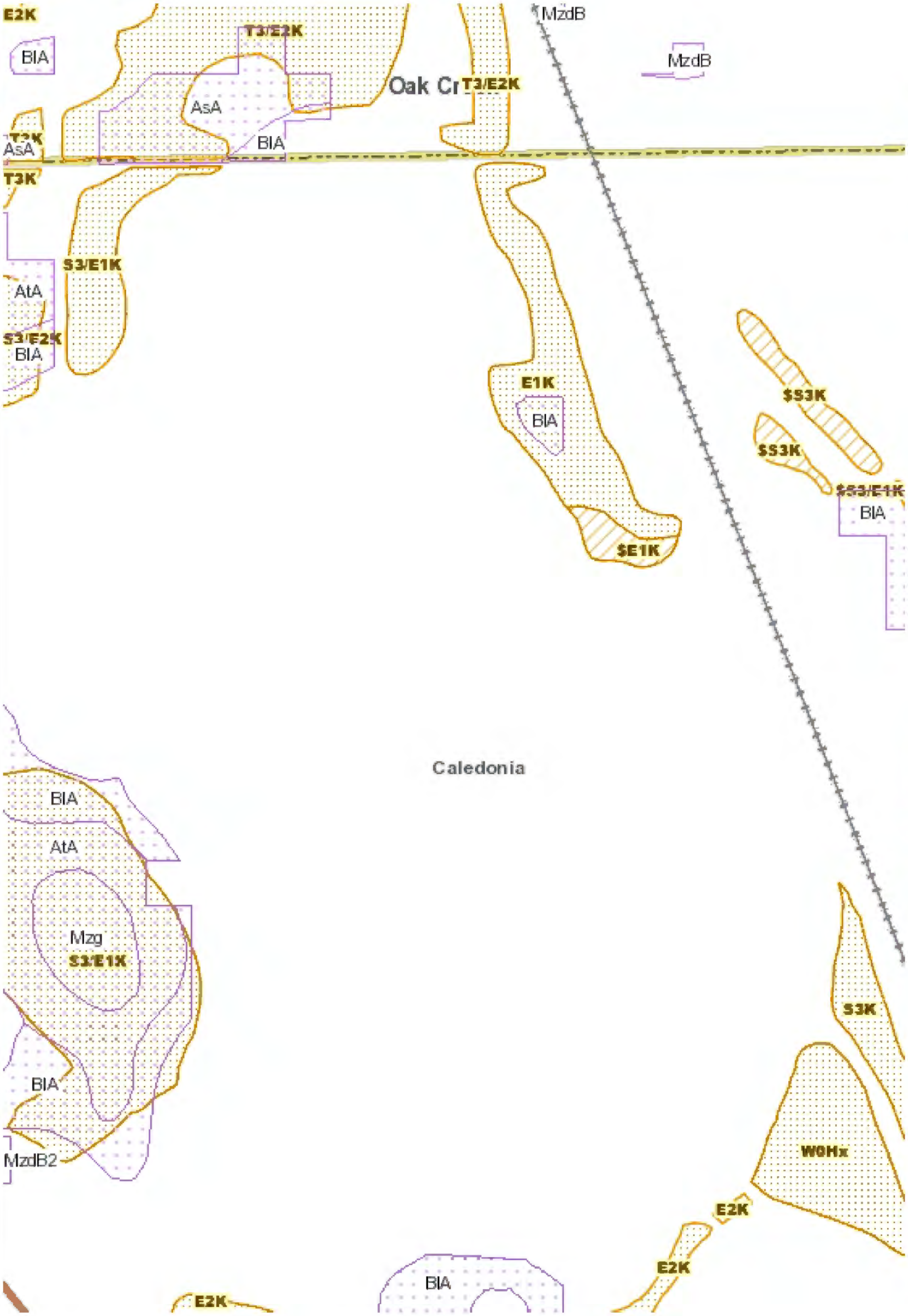
Appendix A

Wetlands Demonstration

Wisconsin Department of Natural Resources: Wetland Map



Legend

- Wetland Indicators
- Wetland Class Areas
- Wetland Class Points
  - Dammed pond
  - Excavated pond
  - Filled/drained wetland
  - Wetland too small to delineate
  - Filled excavated pond
- Filled Points
- Wetland Class Areas
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  - Filled excavated pond
- Filled Points
- Wetland Class Areas
- Filled Areas
- Wetland Identifications and Confirmations
- NRCS Wetspots
- Municipality
- State Boundaries
- County Boundaries
- Major Roads
  - Interstate Highway
  - State Highway
  - US Highway
- County and Local Roads
  - County HWY
  - Local Road
- Railroads
- Tribal Lands
- Railroads
- County Boundaries

0.1 | 0 | 0.06 | 0.1 Miles

1: 3,960

NAD_1983_HARN_Wisconsin_TM

Notes

Wisconsin Department of Natural Resources: Wetland Map

WISCONSIN DEPT. OF NATURAL RESOURCES

Legend

- Wetland Indicators
- Wetland Class Areas
- Wetland Class Points
  - Dammed pond
  - Excavated pond
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0.1 0 0.06 0.1 Miles

1: 3,960

NAD_1983_HARN_Wisconsin_TM

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Notes

U.S. Fish and Wildlife Service

National Wetlands Inventory

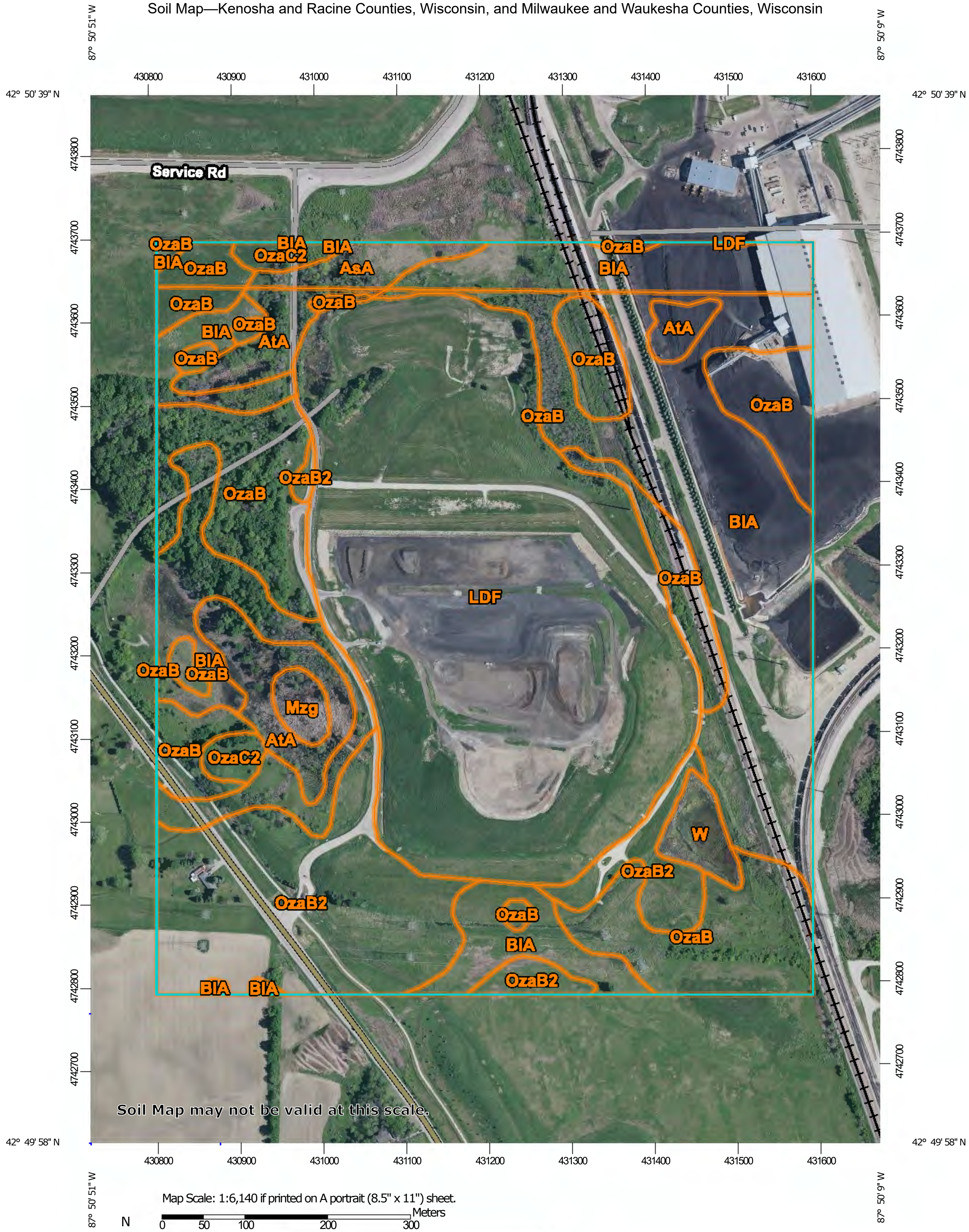
FWS NWI Map

November 16, 2022

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.



Map Scale: 1:6,140 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0, 50, 100, 200, 300

Feet: 0, 250, 500, 1000, 1500

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 16N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Unit Polygons

Soil Map Unit Lines

Soil Map Unit Points

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Kenosha and Racine Counties, Wisconsin
Survey Area Data: Version 19, Sep 6, 2022

Soil Survey Area: Milwaukee and Waukesha Counties, Wisconsin
Survey Area Data: Version 18, Sep 7, 2022

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jun 7, 2020—Aug 16, 2020

MAP LEGEND

MAP INFORMATION

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
AtA	Ashkum silty clay loam, 0 to 2 percent slopes	8.0	4.5%
BlA	Blount silt loam, 1 to 3 percent slopes	42.0	23.7%
LDF	Landfill	60.1	33.8%
Mzg	Muskego muck	1.2	0.7%
OzaB	Ozaukee silt loam, 2 to 6 percent slopes	29.4	16.6%
OzaB2	Ozaukee silt loam, 2 to 6 percent slopes, eroded	22.8	12.9%
OzaC2	Ozaukee silt loam, 6 to 12 percent slopes, eroded	0.9	0.5%
W	Water	1.9	1.1%
Subtotals for Soil Survey Area		**166.4**	**93.6%**
Totals for Area of Interest		**177.7**	**100.0%**

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
AsA	Ashkum silty clay loam, 0 to 2 percent slopes	2.2	1.3%
BlA	Blount silt loam, 1 to 3 percent slopes	6.9	3.9%
LDF	Landfill	0.0	0.0%
OzaB	Ozaukee silt loam, 2 to 6 percent slopes	1.4	0.8%
OzaC2	Ozaukee silt loam, 6 to 12 percent slopes, eroded	0.9	0.5%
Subtotals for Soil Survey Area		**11.3**	**6.4%**
Totals for Area of Interest		**177.7**	**100.0%**

Appendix B

Endangered or Threatened Species Demonstration

Endangered Resources Preliminary Assessment

Created on **10/14/2022**. This report is good for one year after the created date.

DNR staff will be reviewing the ER Preliminary Assessments to verify the results provided by the Public Portal. ER Preliminary Assessments are only valid if the project habitat and waterway-related questions are answered accurately based on current site conditions. If an assessment is deemed invalid, a full ER review may be required even if the assessment indicated otherwise.

Results

A search was conducted of the NHI Portal within a 1-mile buffer (for terrestrial and wetland species) and a 2-mile buffer (for aquatic species) of the project area. Based on these search results, below are your next steps.

An ER Review is needed to ensure compliance with Wisconsin's Endangered Species Law (s. 29.604 Wis. Stats.) and the Federal Endangered Species Act (16 USC ss 1531-43). Therefore you should request an Endangered Resources Review https://dnr.wi.gov/topic/ERReview/Review.html The ER Review will list the endangered resources that have been recorded within the vicinity of the project area and follow-up actions may be necessary.

One (or more) of the following situations apply:

- The species recorded are state or federal threatened or endangered animals.
- The species recorded are state threatened or endangered plants on public land.
- The species recorded are federal threatened or endangered plants on federal land or involve federal funds or a federal permit.
- The project site overlaps the Karner Blue Butterfly High Potential Range.
- The project overlaps the Rusty Patched Bumble Bee High Potential Zone.

A copy of this document can be kept on file and submitted with any other necessary DNR permit applications to show that the need for an ER Review has been met. This notice only addresses endangered resources issues. This notice does not constitute DNR authorization of the proposed project and does not exempt the project from securing necessary permits and approvals from the DNR and/or other permitting authorities.

Project Information

Landowner name	**We Energies**
Project address	**Oak Creek Power Plant, Caledonia Landfill**
Project description	**Plan of Operation Modification, Performance Standards Demonstrations**

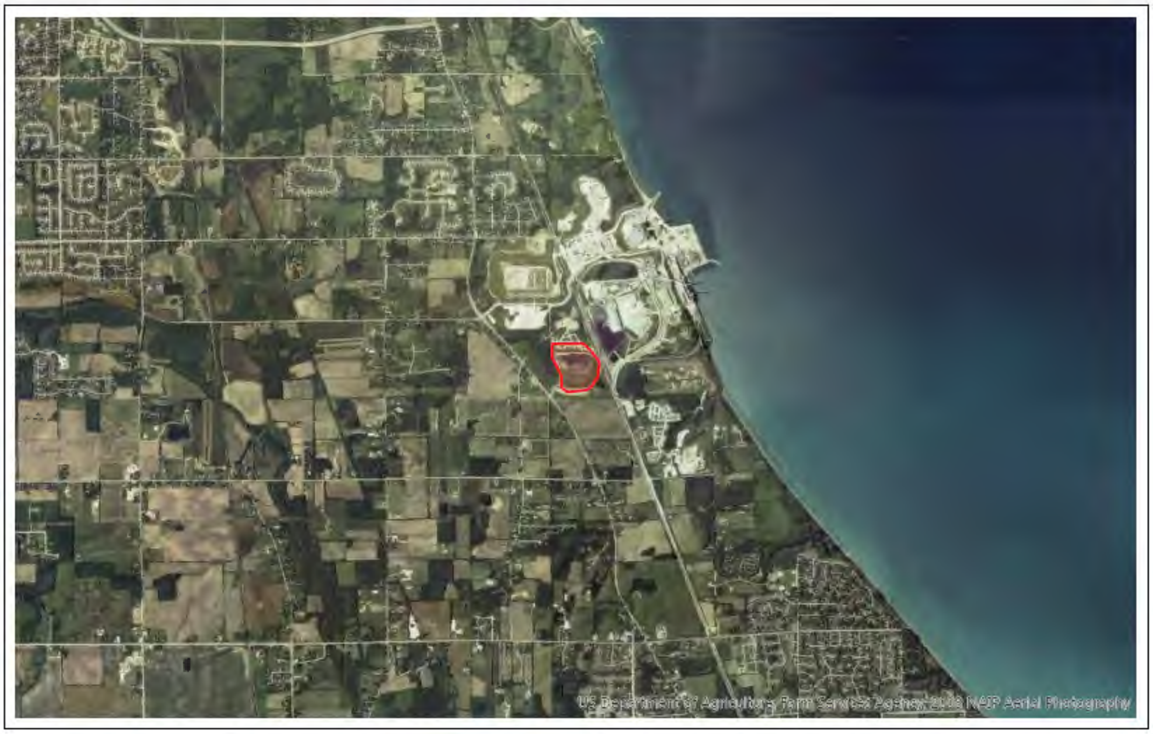
Project Questions

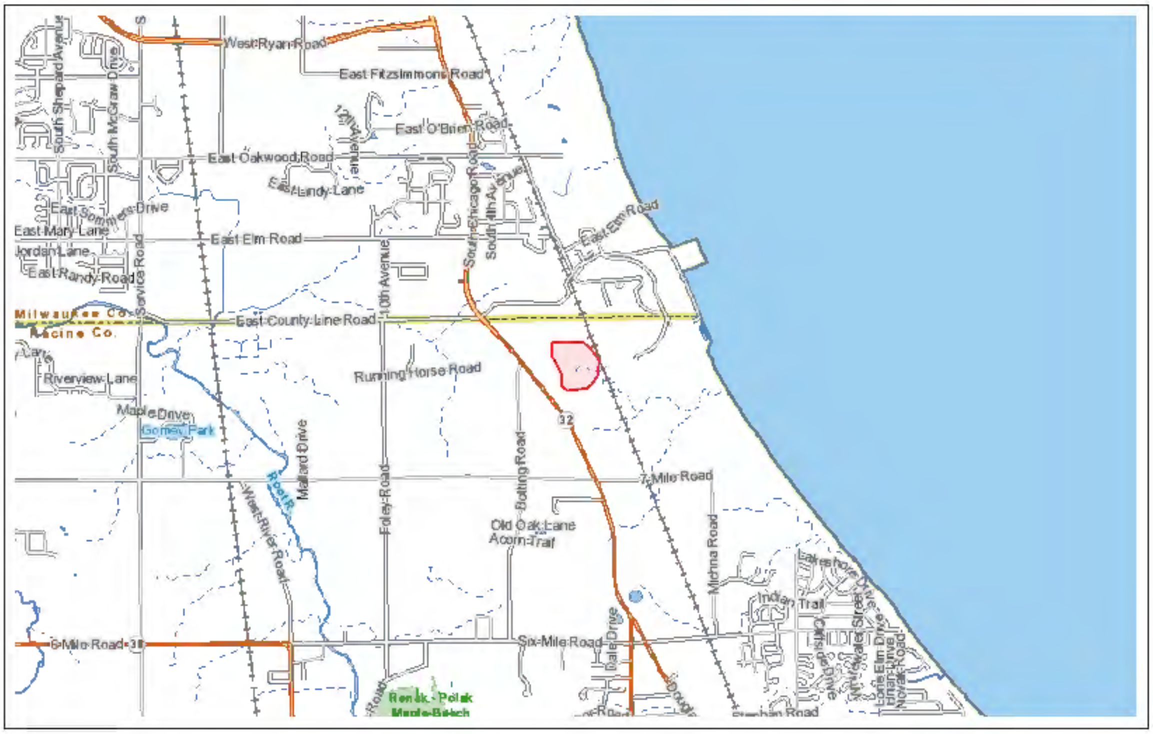
Does the project involve a public property?	**No**
Is there any federal involvement with the project?	**Yes**
Is the project a utility, agricultural, forestry or bulk sampling (associated with mining) project?	**Yes**
Is the project property in Managed Forest Law or Managed Forest Tax Law?	**No**
Project involves tree or shrub removal?	**No**
Is project near (within 300 ft) a waterbody or a shoreline?	**Yes**
Is project within a waterbody or along the shoreline?	**No**

Does the project area (including access routes, staging areas, laydown yards, select sites, source/fill sites, etc.) occur **entirely within** one or more of the following habitats?

Urban/residential	**No**
Manicured lawn	**No**
Artificial/paved surface	**No**
Agricultural land	**No**
Areas covered in crushed stone or gravel	**No**

Project Area Maps





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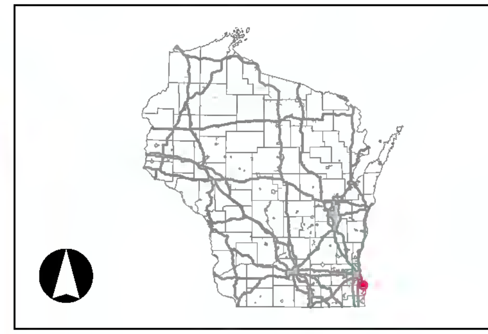
Appendix C

Surface Water Demonstration

Surface Water Data Viewer Map - Wetlands and Wetland Indicators



Legend

- 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
- Index to EN_Image_Basemap_Leaf_Off

0.3 0 0.13 0.3 Miles

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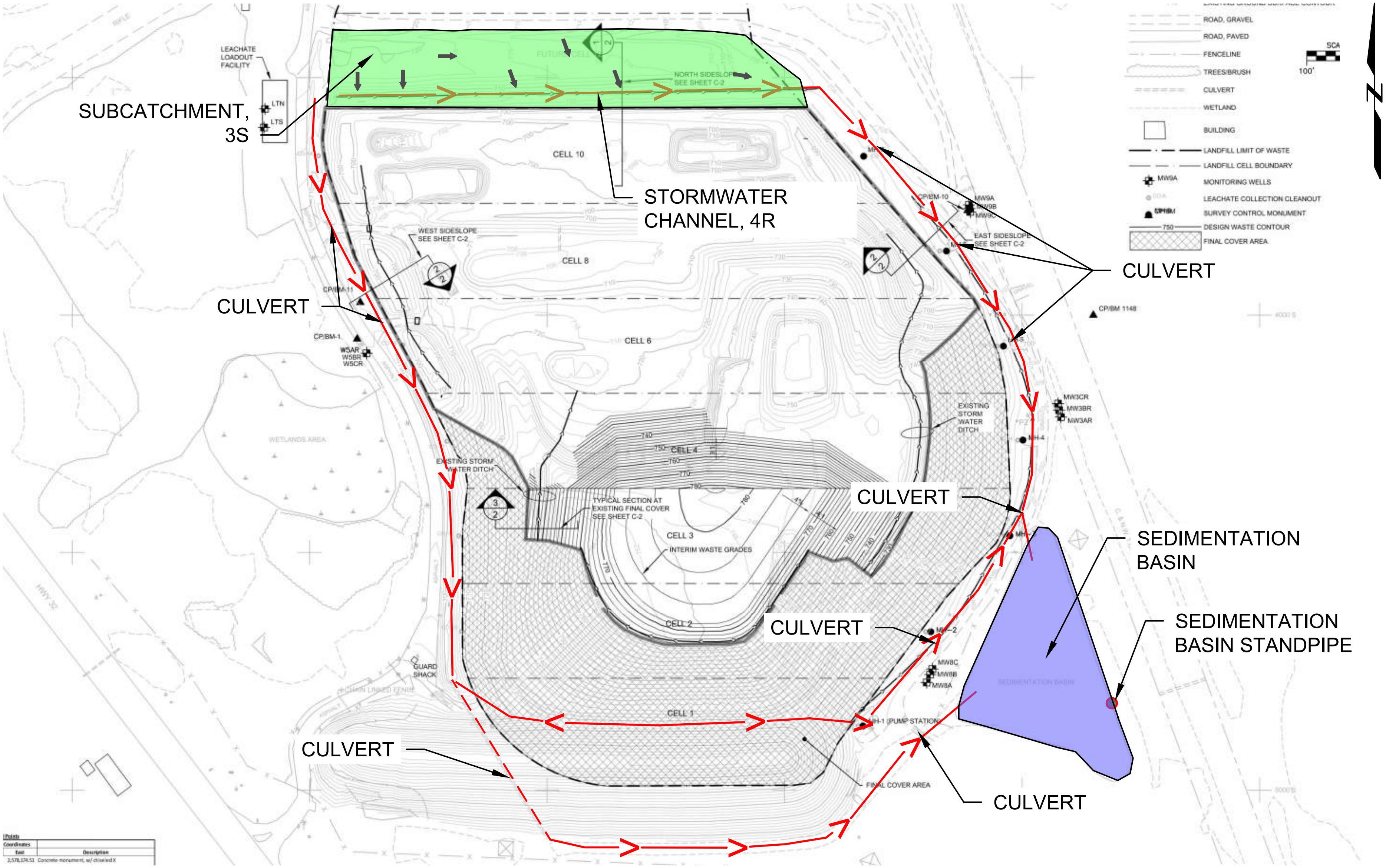
Notes

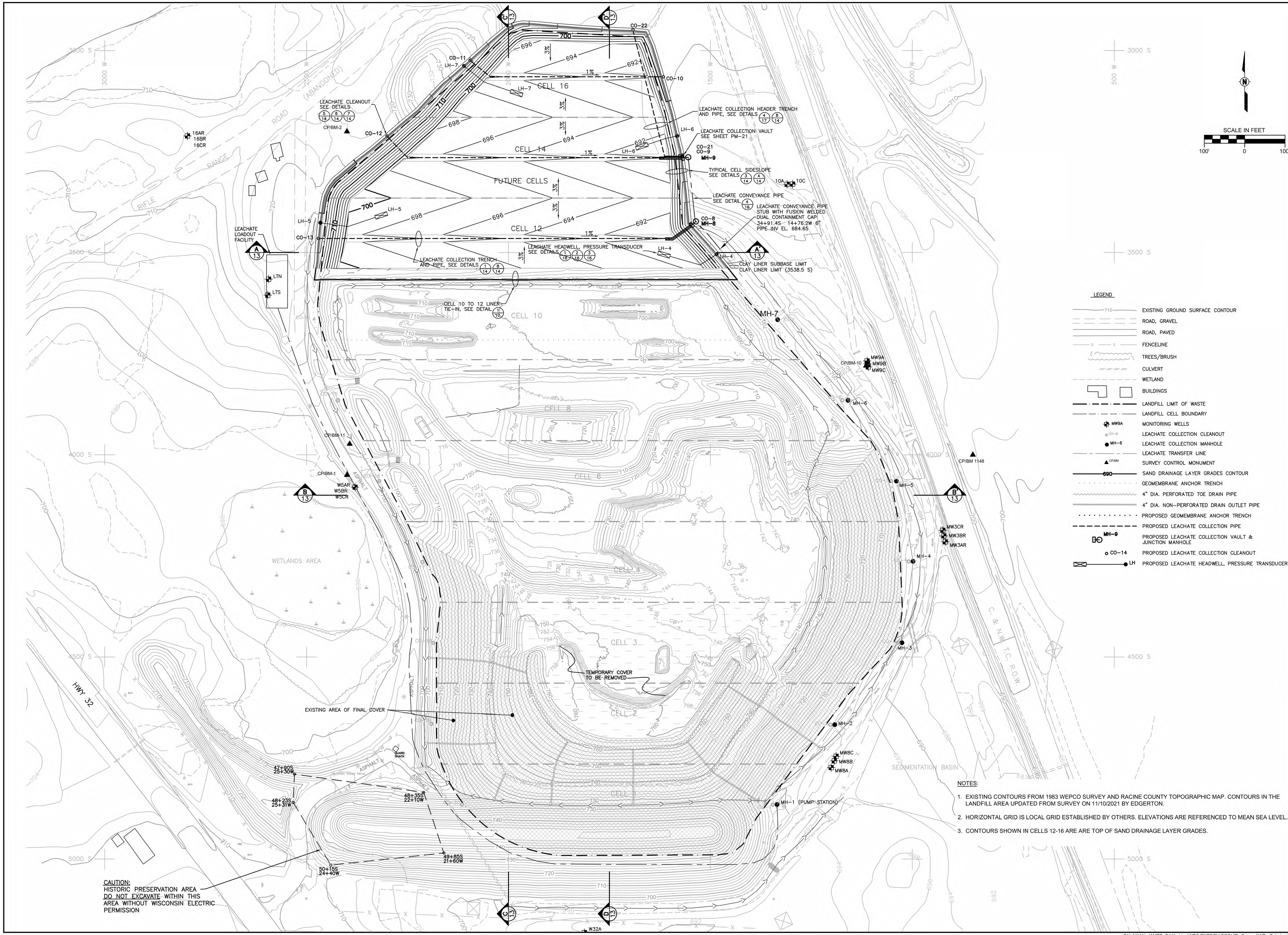


SOURCE:

1. PLAN BASED ON DWG C-1, CALEDONIA ASH LANDFILL, SUBMITTAL DATE 7/19/2021

Run-on and Run-off Control Plan Caledonia Ash Landfill Caledonia, Wisconsin	GEI Consultants	Run-On Stormwater Flow Diagram	
We Energies Milwaukee, Wisconsin	Project 1610530	August 2021	Fig. 1

\\GRB2L-WREYB C:\Landfills\WE - Caledonia\Caledonia\Dwg\1610530_run-on run-off control plan\dwg\1610530001_swc_2021.dwg - 7/23/2021



GEI Consultants
GEI CONSULTANTS, INC.
3159 VOYAGER DRIVE
GREEN BAY, WI 54311
(920)455-8200

We energies

CALEDONIA ASH LANDFILL PLAN OF OPERATION MODIFICATION

P.E. No.:	
Approved:	JXT
Checked:	JXT
Drawn:	JLC
Designed:	JLC
GEI Project:	2203724

Attention:
0 1"
If this scale bar does not measure 1" then drawing is not original scale.

NO.	DATE	ISSUE/REVISION	APP
1	9/29/2023	PLAN MOD	JXT

LEACHATE COLLECTION SYSTEM

DWG. NO.
PM-5
SHEET NO.
5 OF 21

CALAWAY, JAMES B:\Working\WEC ENERGY GROUP_General\WE - Caledonia\Caledonia\Dwg\PM22\2203724003.dwg - 9/28/2023

WISCONSIN ELECTRIC POWER COMPANY - CALENDONIA LANDFILL
LICENSE #3232; FID #252108450
STORM WATER POLLUTION PREVENTION PLAN

CALEDONIA
RACINE COUNTY
WISCONSIN

SWPPP UPDATED: August 2023

TABLE OF CONTENTS

APPENDICES

GENERAL FACILITY INFORMATION

Name of Facility:	Wisconsin Electric Power Company - Caledonia Landfill
Facility Location:	N1/2 Section 1, T4N, R22E
Facility Contact:	
Name:	Izabelle Villafuerte
Title:	Associate Environmental Consultant
Telephone:	Office: (414) 221-4434
Mailing Address:	333 W Everett St – A231
	Milwaukee, WI 53203
Owner:	Wisconsin Electric Power Company
Operator:	We Energies
Standard Industrial Classification (SIC) Code:	4953
Permit Information:	General Tier II Permit to Discharge
Facility Permit Name:	Caledonia Landfill
Permit Number:	WI-S067857-5
Initial Date of Coverage:	05/31/2021
Number of Storm Water Outfalls:	3
Receiving Waters:	An unnamed tributary of the Root River & Lake Michigan
Emergency Contact (preferably on-site):	
Name:	Izabelle Villafuerte
Telephone:	Office: (414) 221-4434

1 OVERVIEW

1.1 Introduction

This storm water pollution prevention plan (SWPPP) covers the operations at the **Caledonia Landfill**. It has been developed as required under Part III of Wisconsin's Pollutant Discharge Elimination System (WPDES) general permit for storm water discharges and in accordance with good engineering practices. This SWPPP describes this facility and its operations, identifies potential sources of storm water pollution at the facility, recommends appropriate best management practices (BMPs) or pollution control measures to reduce the discharge of pollutants in storm water runoff, and provides for periodic review of this SWPPP.

1.2 Objectives

The primary goal of the storm water permit program is to improve the quality of surface waters by reducing the amount of pollutants potentially contained in the storm water runoff. Industrial facilities subject to industrial storm water WPDES permit (i.e. Tier 1, Tier 2, scrap recycling or vehicle parts dismantling permits) must prepare and implement a SWPPP for their facility. The **Wisconsin Electric Power Company – Caledonia Landfill** is a Tier 2 facility.

This SWPPP will:

1. identify sources of storm water and non-storm water contamination to the storm water drainage system;
2. identify and prescribe appropriate "source area control" type best management practices designed to prevent storm water contamination from occurring;
3. identify and prescribe "storm water treatment" type best management practices to reduce pollutants in contaminated storm water prior to discharge;
4. prescribe actions needed either to bring non-storm water discharges under WPDES permit or to remove these discharge from the storm drainage system;
5. prescribe an implementation schedule so as to ensure that the storm water management actions prescribed in the Storm Water Pollution Prevention Plan are carried out and evaluated on a regular basis.

2 STORM WATER POLLUTION PREVENTION TEAM

The storm water pollution prevention team is responsible for developing, implementing, maintaining, and revising this SWPPP. The members of the team are familiar with the management and operations of the **Wisconsin Electric Power Company – Caledonia Landfill.**

The members of the team and their responsibilities are as follows:

Name & Title	Responsibility
Izabelle Villafuerte Storm Water Contact	Developing and Maintaining SWPPP
Eric Kovatch Landfill Manager	Implementing SWPPP Communicating updates to Storm Water Contact

	Record Keeping Conducting Annual Facility Inspections Signing Required Certifications
A.W. Oakes Site Operator	Quarterly Wet Weather Visual Inspections Semi-Annual Dry Weather Inspections Installation and maintenance of storm water and erosion control features

3 POTENTIAL SOURCES OF POLLUTANTS

3.1 Site Map

Figure 1 (attached) presents a site map of the facility showing the following features as required by the permit:

- the facility property boundaries;
- a depiction of the storm drainage collection and disposal system, including all known surface and subsurface conveyances, with the conveyances named;
- any secondary or other containment structures;
- the location of all outfalls, including outfalls recognized as permitted outfalls under another WPDES permit, numbered for reference, that discharge channelized flow to surface water, groundwater, or wetlands;
- the drainage area boundary for each storm water outfall;
- the surface area in acres draining to each outfall, including the percentage that is impervious such as paved, roofed, or highly compacted soil and the percentage that is pervious such as grassy areas and woods; existing structural storm water controls;
- the name and location of receiving waters
- and the location of activities and materials that have the potential to contaminate storm water shall also be depicted on the drainage base map.

3.2 Summary of Sampling Data

Chemical sampling is not required of a Tier 2 facility; therefore there is no chemical outfall sampling data available for the **Caledonia Landfill**.

3.3 Inventory of Potential Sources of Contamination

The following have been identified as potential sources of stormwater contamination.

- Areas of significant soil erosion
    - Due to the constant land disturbance and changing conditions at landfills, there is potential for areas with significant soil erosion to contaminate storm water with sediment.

- Immediate access roads
    - There are two main access roads used to enter and exit the **Caledonia Landfill**. The transport of the waste materials and leachate to and from the site may lead to the potential for storm water contamination.
- Material Handling
    - The **Caledonia Landfill** is permitted to receive fly ash, bottom ash, blast grit from electrostatic precipitator cleaning, FGD filter cake, waste gypsum, wastewater treatment sludge, mill rejects, sedimentation basin or ditch cleaning residues, and LCS cleaning residues. All of these products are brought into the cell by truck which introduces the possibility of spills or material loss during transport.
- Fugitive Dust
    - All of the materials that can be placed within the landfill based on the permit and license can become airborne and be deposited in areas outside of the active cell(s).
- Disposal or Application of Wastewater
    - Leachate wastewater is collected through the leachate collection system and is stored within underground tanks on site before being transported via tank truck to the Oak Creek Power Plant wastewater treatment system. There is a potential for spills of leachate through the leachate collection, storage, or transfer systems. The leachate, after coming into contact with the solid wastes in the cell, would have the potential to contain pollutants. Specifically, ash leachate could contain mercury, cadmium, arsenic, selenium, and other heavy metals.

4 OTHER PLANS INCORPORATED BY REFERENCE

The following plans are incorporated into the SWPPP by reference:

- *Plan of Operations – Caledonia Ash Landfill – License #3232*
- *Fugitive Dust Plan – Caledonia Ash Landfill*
- *Run-on and Run-off Control Plan – Caledonia Ash Landfill*

5 BEST MANAGEMENT PRACTICES

Storm water management controls, or best management practices (BMPs), will be implemented to reduce the amount of pollutants in storm water discharged from the **Wisconsin Electric Power Company – Caledonia Landfill**.

5.1 Source Area Control

To the maximum extent practicable, and to the extent it is cost effective, the use of source area control best management practices designed to prevent storm water from becoming contaminated will be used. Source area control best management practices that are either proposed or in place are indicated on the attached drainage base map described in subsection (3.1).

Erosion Control Measures
Areas prone to soil erosion shall be protected, and the soil kept out of the storm water discharge.
During periods of land disturbing activities that are common to solid waste landfills, design, installation and maintenance of BMPs will be conducted in accordance with Section 2.9, Minimum Control Requirements of the WDNR general permit WI-S067831-5 “Storm Water Associated with Land Disturbing Construction Activity”.

The vegetation around the site will be maintained to prevent soil erosion. Erosion control BMPs such as silt fence and rock check dams are located in strategic locations throughout the side for added erosion and flow control.

Good Housekeeping
Good housekeeping practices are designed to maintain a clean and orderly work environment. This will reduce the potential for significant materials to come in contact with storm water.

The following practices are included in the good housekeeping routine.

Area/Equipment	Tasks	Frequency
Access road	Wash down roadways to prevent vehicles from tracking dust or residue	As needed
Stone Checks	Inspect stone checks to ensure they are clean and adequate	Weekly
Tracking Pads	Inspect tracking pads for cleanliness and fugitive dust	Weekly
Landfill Surface	Inspect and ensure landfill surfaces are properly groomed	Weekly
Final Cell covers	Inspect any final covers and waste slopes for stability or soil erosion	Weekly
Site Vegetation	Inspect and maintain vegetation in good condition around the site – including weed control	As needed

Preventive Maintenance
Preventive Maintenance involves the regular inspection, testing, and cleaning of facility equipment and operational systems. These activities will help to uncover conditions that might lead to a release of materials allowing for maintenance to be completed as necessary to prevent such a release.

The following equipment/activities will be included in the preventive maintenance program.

Equipment	Tasks	Frequency
Leachate Collection System	Inspect leachate collection/storage system for alarms, leaks, or spills	Weekly
	Clean out leachate collection system piping	Annually
Landfill Surface Grooming	Maintain proper grooming of landfill surface to prevent fugitive dust	As needed

Quarterly Visual Comprehensive Inspections
The permit requires a quarterly inspection of the stormwater runoff. These inspections must be conducted during a runoff event. Records of the inspections must be kept on file with the SWPPP. The water must be checked for physical properties such as odor, color, suspended solids, or foam.

The water leaving the site via Outfalls 01 and 02 will be observed at the locations indicated on Figure 1. Outfall 03 will not be monitored during quarterly visual inspections due to the lack of industrial/landfill activity in that drainage area.

Spill Prevention and Response Procedures
Spills and leaks together are the largest industrial source of storm water pollution. Thus, this SWPPP specifies material handling procedures and storage requirements for significant materials. Equipment and procedures necessary for cleaning up spills and preventing the spilled materials from being discharged have also been identified. All employees have been made aware of the proper procedures.

Per the contract, A.W. Oakes employees will follow A.W. Oakes' spill plan. If there is a spill on site they will also contact Eric Kovatch and/or the Environmental Coordinator at Oak Creek Power Plant. The steps detailed in the ***Emergency Spill Response Manual – Oak Creek Generating Site Facilities*** will be followed.

Employee Training
Note: Employee training should be a major component in ensuring the success of the facilities SWPPP. The more knowledgeable all employees are about the facility's SWPPP and what is expected of them, the greater the chance that the plan will be successful.

The following is a description of the employee training programs to be implemented to inform appropriate personnel at all levels of responsibility of the components and goals of the SWPPP. (Examples: good housekeeping practices, spill prevention and response procedures, waste minimization practices, informing contractors of facility policies, etc.)

Topic	Employees Included	Frequency
Storm Water Pollution Prevention Training	A.W. Oakes site operators	Annually

Bulk Storage

Any bulk storage piles that would be at the site will be managed following best management practices.

5.2 Residual Pollutants

After the implementation of the non-structural controls, the following significant materials are expected to be present in the storm water discharge. These materials will be addressed through the use of structural controls. The potential for the following chemicals to be present must be evaluated.

Any pollutant that has an effluent limit in any discharge permit issued to this facility.

Any pollutant contained in a categorical effluent limit for this facility.

Any SARA 313 chemicals on the property to contaminate stormwater must be evaluated. The listing of SARA 313 chemicals may be found at http://www.epa.gov/ceppo/pubs/title3.pdf

Any toxic or hazardous pollutant from present or past activity at the site which could be in contact with precipitation or storm water runoff and thus be discharged to the water of the State and is not regulated by any other environmental program.

Oil and Grease, pH, total suspended solids, 5 day biological oxygen demand, and chemical oxygen demand.

After the implementation of non-structural controls the following materials may potentially still be present in the storm water being discharged from the facility.

Material	Location	SW Outfall	Planned Control Measure
Sediment (TSS)	Areas surrounding the landfill cell.	01, 02	Vegetated swales diverting water away from cell and to the sedimentation basin.
	Areas of land disturbance	01, 02	Erosion control BMP's

5.3 Stormwater Treatment Best Management Practices

Structural control measures may be necessary to control pollutants that are still present in the storm water after the non-structural controls have been implemented. These types of controls are physical features that control and prevent storm water pollution. They can range from preventive measures to collection structures to treatment systems. Structural controls will require construction of a physical feature or barrier.

Preventative Measures
Preventative measures are controls that are intended to prevent the exposure of storm water to contaminants.

The following preventive measures have been chosen for this facility.

Area	**Material**	**Control Measure**
Access Roads	Sediment or wastewater spills	Regular road washing and vehicle cleaning/maintenance. Pavement
Access Road	Sediment	Wheel washing station and cattle guards
Landfill surface	Fugitive Dust	Regular grooming and wetting of the landfill surface prevents dust from migrating.

Diversions
Diversion practices are structures (including grading and paving) that are used to divert storm water away from high risk areas and prevent contaminants from mixing with the runoff, or to channel contaminated storm water to a treatment facility or containment area.

The areas surrounding the cell are graded to divert storm water away from the cell and into vegetated swales. The water is then routed through stone checks before going to a sedimentation basin.

Containment
Containment areas are structures designed to hold pollutants or contaminated storm water to prevent it from being discharged to surface waters. These structures can range from drip pans to large containment areas.

There are currently no containment areas currently in place or proposed at the site.

Other Controls
There are other control measures that can be used that may not fit into one of the previously mentioned categories. The use of such controls is encouraged.

A sedimentation basin collects much of the storm water from the site preventing sediment and other potential contaminants from discharging directly to Lake Michigan. Due to the presence of other controls identified in this SWPPP, very little sediment is expected to reach the sedimentation basin.

5.4 Facility Monitoring

Monitoring includes regular site inspections. The purpose of monitoring is to: a) evaluate storm water outfalls for the presence of non-storm water discharges, and b) evaluate the effectiveness of the company's pollution prevention activities in controlling contamination of storm water discharges. Monitoring must include:

NON-STORM WATER DISCHARGES

All storm water outfalls shall be evaluated for non-storm water contributions to the storm drainage system for the duration of this permit. Any monitoring shall be representative of non-storm water discharges from the facility. Any unauthorized storm water discharges must be eliminated, or covered under another WPDES permit. The following is a list of non-storm water discharges or flows that are not considered illicit (unless identified as a significant source of contamination).

Water line flushing, landscape irrigation, diverted stream flows, uncontaminated groundwater infiltration, uncontaminated pumped groundwater, discharges from potable water sources, foundation drains, air conditioning condensation, irrigation water, lawn watering, individual residential car washing, flows from riparian habitats and wetlands, de-chlorinated swimming pool water, street wash water, and firefighting.

1) Evaluations shall take place during dry periods, and may include either end of pipe screening or detailed testing of the storm sewer collection system.
2) Either of the following monitoring procedures is acceptable:
   a. A detailed testing of the storm sewer collection system may be performed. Acceptable testing methods include dye testing, smoke testing, or video camera observation. A re-test shall be done every 5 years or a lesser period as deemed necessary.
   b. End of pipe screening shall consist of visual observations made at least twice per year at each outfall of the storm sewer collection system. Instances of dry weather flow, stains, sludge, color, odor, or other indications of a non-storm water discharge shall be recorded.

The semi-annual end of pipe screening logs shall be kept in Appendix B of this plan.

If outfalls cannot be evaluated for non-storm water discharges the *Landfill Manager* shall sign a statement certifying an inability to comply with this requirement, and include a copy of a statement in the SWPPP. In this case, the SWPPP shall be submitted to the department.

ANNUAL FACILITY SITE COMPLIANCE INSPECTION

The *Landfill Manager* shall make an annual inspection to evaluate the effectiveness of the SWPPP. The inspection shall be adequate to verify that the site drainage conditions and potential pollution sources identified in the SWPPP remain accurate, and that the best management practices prescribed in the SWPPP are being implemented, properly operated and adequately maintained. Information reported shall include the inspection date, inspection personnel, scope of the inspection, major observations, and revisions needed in the SWPPP.

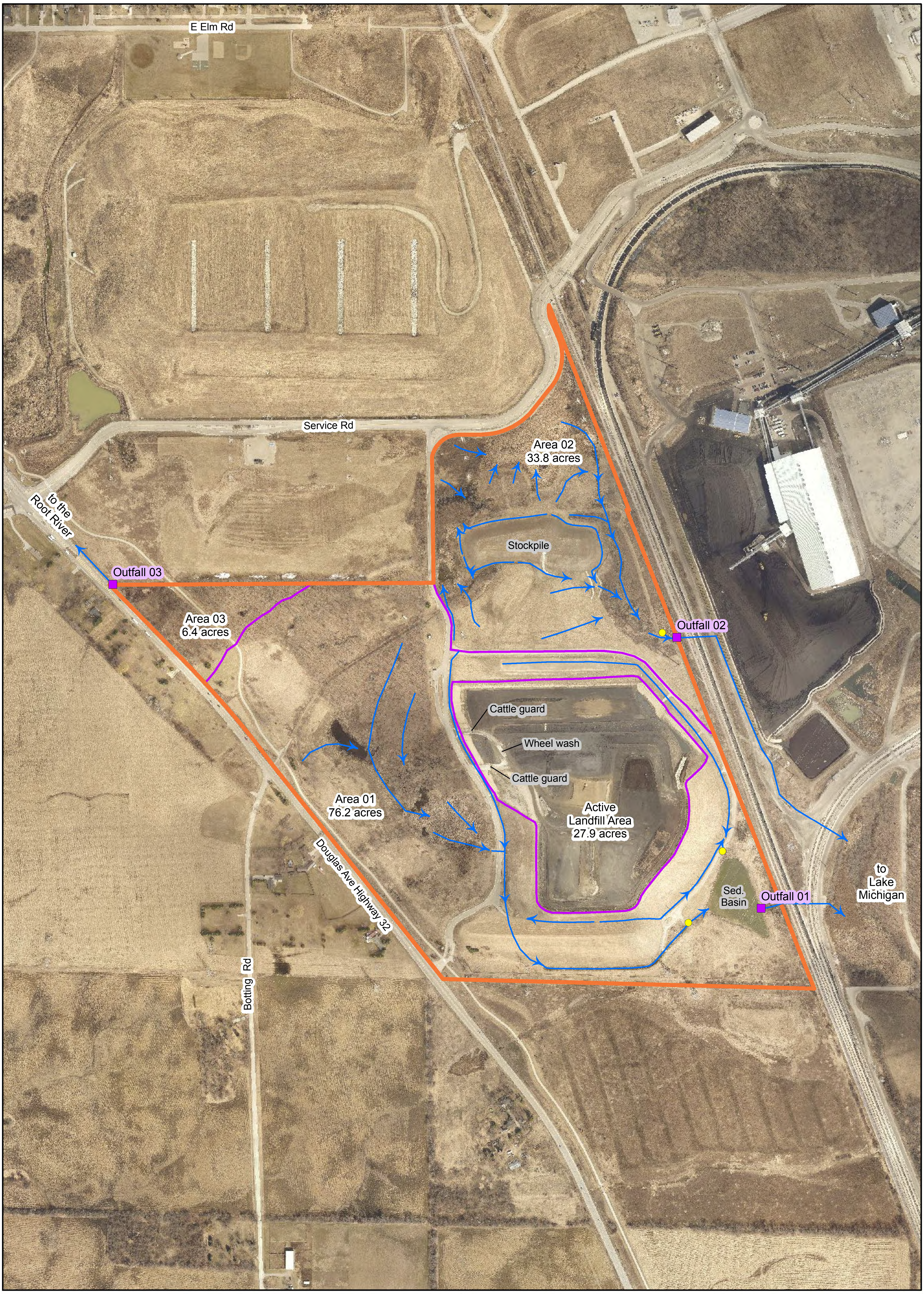
Quarterly Visual Monitoring
The *Site Operator* shall perform and document quarterly visual inspections of storm water discharge quality at each storm water discharge outfall. Inspections shall be conducted within the first 30 minutes of discharge or as soon thereafter as practical, but not exceeding 60 minutes. The inspections shall include any observations of color, odor, turbidity, floating solids, foam, oil sheen, or other obvious indicators of storm water pollution. Information reported shall include the inspection date, inspection personnel, visual quality of the storm water discharge, and probable sources of any observed storm water contamination.

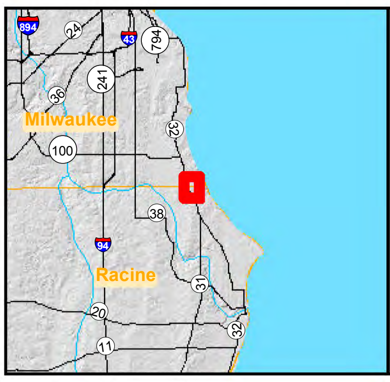
5.5 Implementation Schedule

This SWPPP becomes effective as of *01/31/2017.*

6 RECORD KEEPING AND REPORTING

Blank forms for the record keeping and reporting associated with the SWPPP are located in Appendix A. All reports and records pertaining to the permit coverage under this general permit shall be retained for the later of 5 years beyond the date of the permit cover letter, or for a minimum of three years. The forms are to be kept with the Landfill Manager and electronically. The forms shall be made available to the Department of Natural Resources upon request. In the case of facilities which discharge storm water to municipal separate storm sewer system, the records must also be made available to the operator of the municipal system.





Observation Point
Outfall
Flow Direction
Landfill Boundary
Drainage Area

N

Feet
0 500 1,000

Caledonia Landfill

Figure 1.

Source:
Milwaukee County Imagery, 2015

x42590 1/25/2017 \\Psba3naa\psbaqfoateam\DATA\FO\Env_Strategy\GIS Projects\Landfill_Properties\Maps\Caledonia_SWPPP_Fig1.mxd

APPENDIX A

Blank Quarterly and Semi-Annual Visual Inspection Forms

Quarterly Visual Inspection
Caledonia Landfill

This form is for your own use and should be kept as part of your Storm Water Pollution Prevention Plan. It **does not** have to be submitted to the Department unless requested. If false information from quarterly visual inspections is reported to the Department, you could be subject to penalties up to $10,000 pursuant to s. 283.91(4), Wis. Stats.

Quarterly Visual Inspections at each storm water discharge outfall on your site can be a valuable assessment tool and are required by the Tier 1 and Tier 2 Industrial Storm Water General Permits. This inspection should be performed when sufficient runoff occurs during daylight hours. Try to make observations within the first 30 minutes after runoff begins discharging from the outfall, or as soon as practical, but no later than 60 minutes. If you find visible pollution, note the probable source and list any possible Best Management Practices that could be used to reduce or eliminate the problem.

Make any necessary changes to your **Storm Water Pollution Prevention Plan** as needed.

Facility Name: Caledonia Ash Landfill	Location: N1/2 Section 1, T4N, R22E
Name of Person Conducting Inspection:	Employer:
Inspection Date:	Inspection Time:
Time Discharge of Water Runoff Began (Time of Rainfall Event)	

Describe your observations. An easy way to conduct this inspection is to use a glass jar to collect a sample of the storm water being discharged from the facility and visually inspect the water. Include any observations of color, odor, turbidity, floating solids, foam, oil sheen or any other visual indicators of storm water pollution and the probable sources of any observed storm water contamination.

Storm Water observation point	Observations					
Sedimentation Basin North Inlet	**Color:**	☐Clear	☐Red	☐Yellow	☐Brown	☐Other:
	Odor:	☐None	☐Musty	☐Sewage	☐Rotten Egg	☐Other:
	Clarity:	☐Clear	☐Cloudy	☐Opaque	☐Suspended Solids	☐Other:
	Floatables:	☐None	☐Foam	☐Garbage	☐Oily Film	☐Other:
	Stains/Deposits:	☐None	☐Oily	☐Sludge	☐Sediments	☐Other:
Sedimentation Basin West Inlet	**Color:**	☐Clear	☐Red	☐Yellow	☐Brown	☐Other:
	Odor:	☐None	☐Musty	☐Sewage	☐Rotten Egg	☐Other:
	Clarity:	☐Clear	☐Cloudy	☐Opaque	☐Suspended Solids	☐Other:
	Floatables:	☐None	☐Foam	☐Garbage	☐Oily Film	☐Other:
	Stains/Deposits:	☐None	☐Oily	☐Sludge	☐Sediments	☐Other:
Outfall 02 culvert inlet	**Color:**	☐Clear	☐Red	☐Yellow	☐Brown	☐Other:
	Odor:	☐None	☐Musty	☐Sewage	☐Rotten Egg	☐Other:
	Clarity:	☐Clear	☐Cloudy	☐Opaque	☐Suspended Solids	☐Other:
	Floatables:	☐None	☐Foam	☐Garbage	☐Oily Film	☐Other:
	Stains/Deposits:	☐None	☐Oily	☐Sludge	☐Sediments	☐Other:

Comments:

☐ **Outfalls could not be evaluated during this quarter due to the following reason:**

Semi-Annual Dry Weather End of Pipe Visual Screening Checklist
(Non-Storm Water Discharge Assessment)

Caledonia Landfill

Semi-annually examine the site drainage at both inlets to the sedimentation basin and at outfall 02 during periods of dry weather for any evidence of non-storm water discharges.

Observation Date:	Storm Water observation point	Observations			Potential Sources	Name of Observer
		Approximate Flow (gpm)	Illicit Discharge Indicators			
	Sedimentation Basin North Inlet		Color ☐ Odor ☐ Sheen ☐	Stains ☐ Sludge ☐ Other ☐		
	Sedimentation Basin West Inlet		Color ☐ Odor ☐ Sheen ☐	Stains ☐ Sludge ☐ Other ☐		
	Outfall 02 culvert inlet		Color ☐ Odor ☐ Sheen ☐	Stains ☐ Sludge ☐ Other ☐		

Comments:

☐This outfall could not be evaluated during this period due to the following reason:

If the outfalls are unable to be evaluated for non-storm water discharges a signed statement certifying that this requirement could not be complied with is required. Please contact the landfill manager the outfalls are unable to be observed for non-storm water discharges.

http://dnr.wi.gov/files/PDF/forms/3400/3400-176a.pdf

APPENDIX B

Completed Quarterly and Semi-Annual Inspection Forms

Quarterly Visual Inspection
Caledonia Landfill

This form is for your own use and should be kept as part of your Storm Water Pollution Prevention Plan. It **does not** have to be submitted to the Department unless requested. If false information from quarterly visual inspections is reported to the Department, you could be subject to penalties up to $10,000 pursuant to s. 283.91(4), Wis. Stats.

Quarterly Visual Inspections at each storm water discharge outfall on your site can be a valuable assessment tool and are required by the Tier 1 and Tier 2 Industrial Storm Water General Permits. This inspection should be performed when sufficient runoff occurs during daylight hours. Try to make observations within the first 30 minutes after runoff begins discharging from the outfall, or as soon as practical, but no later than 60 minutes. If you find visible pollution, note the probable source and list any possible Best Management Practices that could be used to reduce or eliminate the problem.

Make any necessary changes to your **Storm Water Pollution Prevention Plan** as needed.

Facility Name: Caledonia Ash Landfill	Location: N1/2 Section 1, T4N, R22E
Name of Person Conducting Inspection: Jason Robers	Employer: EDGERTON
Inspection Date: 3/18/22	Inspection Time: 2:30 pm.
Time Discharge of Water Runoff Began (Time of Rainfall Event)	2:00 pm

Describe your observations. An easy way to conduct this inspection is to use a glass jar to collect a sample of the storm water being discharged from the facility and visually inspect the water. Include any observations of color, odor, turbidity, floating solids, foam, oil sheen or any other visual indicators of storm water pollution and the probable sources of any observed storm water contamination.

Storm Water observation point	Observations					
Sedimentation Basin North Inlet	Color:	☒Clear	☐Red	☐Yellow	☐Brown	☐Other:
	Odor:	☒None	☐Musty	☐Sewage	☐Rotten Egg	☐Other:
	Clarity:	☒Clear	☐Cloudy	☐Opaque	☐Suspended Solids	☐Other:
	Floatables:	☒None	☐Foam	☐Garbage	☐Oily Film	☐Other:
	Stains/Deposits:	☒None	☐Oily	☐Sludge	☐Sediments	☐Other:
Sedimentation Basin West Inlet	Color:	☒Clear	☐Red	☐Yellow	☐Brown	☐Other:
	Odor:	☒None	☐Musty	☐Sewage	☐Rotten Egg	☐Other:
	Clarity:	☒Clear	☐Cloudy	☐Opaque	☐Suspended Solids	☐Other:
	Floatables:	☒None	☐Foam	☐Garbage	☐Oily Film	☐Other:
	Stains/Deposits:	☒None	☐Oily	☐Sludge	☐Sediments	☐Other:
Outfall 02 culvert inlet	Color:	☒Clear	☐Red	☐Yellow	☐Brown	☐Other:
	Odor:	☒None	☐Musty	☐Sewage	☐Rotten Egg	☐Other:
	Clarity:	☒Clear	☐Cloudy	☐Opaque	☐Suspended Solids	☐Other:
	Floatables:	☒None	☐Foam	☐Garbage	☐Oily Film	☐Other:
	Stains/Deposits:	☒None	☐Oily	☐Sludge	☐Sediments	☐Other:

Comments: ALL STORM WATER FEATURES PERFORMING WELL AT THIS TIME. NO DISCREPANCIES NOTED AT THIS TIME.

☐ **Outfalls could not be evaluated during this quarter due to the following reason:**

Quarterly Visual Inspection
Caledonia Landfill

This form is for your own use and should be kept as part of your Storm Water Pollution Prevention Plan. It **does not** have to be submitted to the Department unless requested. If false information from quarterly visual inspections is reported to the Department, you could be subject to penalties up to $10,000 pursuant to s. 283.91(4), Wis. Stats.

Quarterly Visual Inspections at each storm water discharge outfall on you site can be a valuable assessment tool and are required by the Tier 1 and Tier 2 Industrial Storm Water General Permits. This inspection should be performed when sufficient runoff occurs during daylight hours. Try to make observations within the first 30 minutes after runoff begins discharging from the outfall, or as soon as practical, but no later than 60 minutes. If you find visible pollution, note the probable source and list and possible Best Management Practices that could be used to reduce or eliminate the problem.

Make any necessary changes to your **Storm Water Pollution Prevention Plan** as needed.

Facility Name: Caledonia Landfill	Location: N1/2 Section 1, T4N, R22E
Name of Person Conducting Inspection: ZACK LAWLOR	Employer: EDGERTON CONTRACTORS
Inspection Date: 5/3/22	Inspection Time: 8:45 AM
Time Discharge of Water Runoff Began (Time of Rainfall Event): 8:00 AM	

Describe your observations. An easy way to conduct this inspection is to use a glass jar to collect a sample of the storm water being discharged from the facility and visually inspect the water. Include any observations of color, odor, turbidity, floating solids, foam, oil sheen or any other visual indicators of storm water pollution and the probable sources of any observed storm water contamination.

Storm Water observation point	Observations					
Sedimentation Basin North Inlet	Color:	☑ Clear	☐ Red	☐ Yellow	☐ Brown	☐ Other:
	Odor:	☑ None	☐ Musty	☐ Sewage	☐ Rotten Egg	☐ Other:
	Clarity:	☑ Clear	☐ Cloudy	☐ Opaque	☐ Suspended Solids	☐ Other:
	Floatables:	☑ None	☐ Foam	☐ Garbage	☐ Oily Film	☐ Other:
	Stains/Deposits:	☑ None	☐ Oily	☐ Sludge	☐ Sediments	☐ Other:
Sedimentation Basin West Inlet	Color:	☑ Clear	☐ Red	☐ Yellow	☐ Brown	☐ Other:
	Odor:	☑ None	☐ Musty	☐ Sewage	☐ Rotten Egg	☐ Other:
	Clarity:	☑ Clear	☐ Cloudy	☐ Opaque	☐ Suspended Solids	☐ Other:
	Floatables:	☑ None	☐ Foam	☐ Garbage	☐ Oily Film	☐ Other:
	Stains/Deposits:	☑ None	☐ Oily	☐ Sludge	☐ Sediments	☐ Other:
Outfall 02 culvert inlet	Color:	☑ Clear	☐ Red	☐ Yellow	☐ Brown	☐ Other:
	Odor:	☑ None	☐ Musty	☐ Sewage	☐ Rotten Egg	☐ Other:
	Clarity:	☑ Clear	☐ Cloudy	☐ Opaque	☐ Suspended Solids	☐ Other:
	Floatables:	☑ None	☐ Foam	☐ Garbage	☐ Oily Film	☐ Other:
	Stains/Deposits:	☑ None	☐ Oily	☐ Sludge	☐ Sediments	☐ Other:

Comments: Minimal flow visible. CLEAR.

☐ **Outfalls could not be evaluated during this quarter due to the following reason:**

Quarterly Visual Inspection
Caledonia Landfill

This form is for your own use and should be kept as part of your Storm Water Pollution Prevention Plan. It **does not** have to be submitted to the Department unless requested. If false information from quarterly visual inspections is reported to the Department, you could be subject to penalties up to $10,000 pursuant to s. 283.91(4), Wis. Stats.

Quarterly Visual Inspections at each storm water discharge outfall on your site can be a valuable assessment tool and are required by the Tier 1 and Tier 2 Industrial Storm Water General Permits. This inspection should be performed when sufficient runoff occurs during daylight hours. Try to make observations within the first 30 minutes after runoff begins discharging from the outfall, or as soon as practical, but no later than 60 minutes. If you find visible pollution, note the probable source and list any possible Best Management Practices that could be used to reduce or eliminate the problem.

Make any necessary changes to your **Storm Water Pollution Prevention Plan** as needed.

Facility Name: Caledonia Ash Landfill	Location: N1/2 Section 1, T4N, R22E
Name of Person Conducting Inspection: ZACK LAWLOR	Employer: EGGERTON
Inspection Date: 8/25/22	Inspection Time: 645 AM
Time Discharge of Water Runoff Began (Time of Rainfall Event) 6:00AM	

Describe your observations. An easy way to conduct this inspection is to use a glass jar to collect a sample of the storm water being discharged from the facility and visually inspect the water. Include any observations of color, odor, turbidity, floating solids, foam, oil sheen or any other visual indicators of storm water pollution and the probable sources of any observed storm water contamination.

Storm Water observation point	**Observations**					
Sedimentation Basin North Inlet	**Color:**	☑ Clear	☐ Red	☐ Yellow	☐ Brown	☐ Other:
	Odor:	☑ None	☐ Musty	☐ Sewage	☐ Rotten Egg	☐ Other:
	Clarity:	☑ Clear	☐ Cloudy	☐ Opaque	☐ Suspended Solids	☐ Other:
	Floatables:	☑ None	☐ Foam	☐ Garbage	☐ Oily Film	☐ Other:
	Stains/Deposits:	☑ None	☐ Oily	☐ Sludge	☐ Sediments	☐ Other:
Sedimentation Basin West Inlet	**Color:**	☑ Clear	☐ Red	☐ Yellow	☐ Brown	☐ Other:
	Odor:	☑ None	☐ Musty	☐ Sewage	☐ Rotten Egg	☐ Other:
	Clarity:	☑ Clear	☐ Cloudy	☐ Opaque	☐ Suspended Solids	☐ Other:
	Floatables:	☑ None	☐ Foam	☐ Garbage	☐ Oily Film	☐ Other:
	Stains/Deposits:	☑ None	☐ Oily	☐ Sludge	☐ Sediments	☐ Other:
Outfall 02 culvert inlet	**Color:**	☑ Clear	☐ Red	☐ Yellow	☐ Brown	☐ Other:
	Odor:	☑ None	☐ Musty	☐ Sewage	☐ Rotten Egg	☐ Other:
	Clarity:	☑ Clear	☐ Cloudy	☐ Opaque	☐ Suspended Solids	☐ Other:
	Floatables:	☑ None	☐ Foam	☐ Garbage	☐ Oily Film	☐ Other:
	Stains/Deposits:	☑ None	☐ Oily	☐ Sludge	☐ Sediments	☐ Other:

Comments: Clear water, slow/steady flow

No issues noted.

☐ **Outfalls could not be evaluated during this quarter due to the following reason:**

Quarterly Visual Inspection
Caledonia Landfill

This form is for your own use and should be kept as part of your Storm Water Pollution Prevention Plan. It **does not** have to be submitted to the Department unless requested. If false information from quarterly visual inspections is reported to the Department, you could be subject to penalties up to $10,000 pursuant to s. 283.91(4), Wis. Stats.

Quarterly Visual Inspections at each storm water discharge outfall on your site can be a valuable assessment tool and are required by the Tier 1 and Tier 2 Industrial Storm Water General Permits. This inspection should be performed when sufficient runoff occurs during daylight hours. Try to make observations within the first 30 minutes after runoff begins discharging from the outfall, or as soon as practical, but no later than 60 minutes. If you find visible pollution, note the probable source and list any possible Best Management Practices that could be used to reduce or eliminate the problem.

Make any necessary changes to your **Storm Water Pollution Prevention Plan** as needed.

Facility Name: Caledonia Ash Landfill	Location: N1/2 Section 1, T4N, R22E
Name of Person Conducting Inspection: Mike Newhaben	Employer: A.W. Oakes & Son
Inspection Date: 12/15/22	Inspection Time: 3:30 pm
Time Discharge of Water Runoff Began (Time of Rainfall Event) 1.5" of rain last 12 hours	

Describe your observations. An easy way to conduct this inspection is to use a glass jar to collect a sample of the storm water being discharged from the facility and visually inspect the water. Include any observations of color, odor, turbidity, floating solids, foam, oil sheen or any other visual indicators of storm water pollution and the probable sources of any observed storm water contamination.

Storm Water observation point	**Observations**					
Sedimentation Basin North Inlet	**Color:**	☒Clear	☐Red	☐Yellow	☐Brown	☐Other:
	Odor:	☒None	☐Musty	☐Sewage	☐Rotten Egg	☐Other:
	Clarity:	☒Clear	☐Cloudy	☐Opaque	☐Suspended Solids	☐Other:
	Floatables:	☒None	☐Foam	☐Garbage	☐Oily Film	☐Other:
	Stains/Deposits:	☒None	☐Oily	☐Sludge	☐Sediments	☐Other:
Sedimentation Basin West Inlet	**Color:**	☒Clear	☐Red	☐Yellow	☐Brown	☐Other:
	Odor:	☒None	☐Musty	☐Sewage	☐Rotten Egg	☐Other:
	Clarity:	☒Clear	☐Cloudy	☐Opaque	☐Suspended Solids	☐Other:
	Floatables:	☒None	☐Foam	☐Garbage	☐Oily Film	☐Other:
	Stains/Deposits:	☒None	☐Oily	☐Sludge	☐Sediments	☐Other:
Outfall 02 culvert inlet	**Color:**	☒Clear	☐Red	☐Yellow	☐Brown	☐Other:
	Odor:	☒None	☐Musty	☐Sewage	☐Rotten Egg	☐Other:
	Clarity:	☒Clear	☐Cloudy	☐Opaque	☐Suspended Solids	☐Other:
	Floatables:	☐None	☐Foam	☐Garbage	☐Oily Film	☒Other: leaves/weeds
	Stains/Deposits:	☒None	☐Oily	☐Sludge	☐Sediments	☐Other:

Comments: Minimal flow considering had decent amount of rain, and all water was clear.

☐ **Outfalls could not be evaluated during this quarter due to the following reason:**

Semi-Annual Dry Weather End of Pipe Visual Screening Checklist
(Non-Storm Water Discharge Assessment)

Caledonia Landfill

Semi-annually examine the site drainage at both inlets to the sedimentation basin and at outfall 02 during periods of dry weather for any evidence of non-storm water discharges.

Observation Date:	Storm Water observation point	Observations: Approximate Flow (gpm)	Observations: Illicit Discharge Indicators		Potential Sources	Name of Observer
5/11/22	Sedimentation Basin North Inlet	—	Color ☐	Stains ☐		ZACK LAWLOR
			Odor ☐	Sludge ☐		
			Sheen ☐	Other ☐		
	Sedimentation Basin West Inlet	—	Color ☐	Stains ☐		
			Odor ☐	Sludge ☐		
			Sheen ☐	Other ☐		
	Outfall 02 culvert inlet	—	Color ☐	Stains ☐		
			Odor ☐	Sludge ☐		
			Sheen ☐	Other ☐		

Comments: No visible flow currently. WATER IN DITCH IS CLEAR.

☐ **Outfalls could not be evaluated during this quarter due to the following reason:**

If the outfalls are unable to be evaluated for non-storm water discharges a singed statement certifying that this requirement could not be complied with is required. Please contact the landfill manager the outfalls are unable to be observed for non-storm water discharges.

Semi-Annual Dry Weather End of Pipe Visual Screening Checklist (Non-Storm Water Discharge Assessment)

Caledonia Landfill

Semi-annually examine the site drainage at both inlets to the sedimentation basin and at outfall 02 during periods of dry weather for any evidence of non-storm water discharges.

Observation Date:	Storm Water observation point	Observations			Potential Sources	Name of Observer
		Approximate Flow (gpm)	Illicit Discharge Indicators			
12/7/22	Sedimentation Basin North Inlet	0	Color ☐ Odor ☐ Sheen ☐	Stains ☐ Sludge ☐ Other ☐		Mike N
	Sedimentation Basin West Inlet	0	Color ☐ Odor ☐ Sheen ☐	Stains ☐ Sludge ☐ Other ☐		Mike N
	Outfall 02 culvert inlet	0	Color ☐ Odor ☐ Sheen ☐	Stains ☐ Sludge ☐ Other ☐	clear water standing	Mike N

Comments: Both sed basin inlets were dry.
Standing water 3/4 full in the outfall 2 culvert.

☐**This outfall could not be evaluated during this period due to the following reason:**

If the outfalls are unable to be evaluated for non-storm water discharges a signed statement certifying that this requirement could not be complied with is required. Please contact the landfill manager the outfalls are unable to be observed for non-storm water discharges.

APPENDIX C

Annual Site Facility Compliance Inspection Report

State of Wisconsin
Department of Natural Resources
PO Box 7921, Madison WI 53707-7921
dnr.wi.gov

Annual Facility Site Compliance Inspection Report (AFSCI)

For Storm Water Discharges Associated With Industrial Activity Under Wisconsin Pollutant Discharge Elimination System (WPDES) Permit

Form 3400-176 (R 01/20)

Notice: This form is authorized by s. NR 216.29(2), Wis. Adm. Code. Submittal of a completed form to the Department is mandatory for industrial facilities covered under a Tier 1 storm water general permit. Facilities covered under a Tier 1 permit are not required to submit AFSCI reports after submittal of the second AFSCI report, unless so directed by the Department. However, these inspections and quarterly visual inspections shall still be conducted and results shall be kept on site for Department inspection. Facilities covered under a Tier 2 storm water general, industry-specific general or individual permit shall keep the results of their AFSCI and quarterly visual inspections on site for Department inspection. Failure to comply with these regulations may result in fines up to $25,000 per day pursuant to s. 283.91, Wis. Stats.

Personally identifiable information on this form may be used for other water quality program purposes.

Please type or clearly print your answers to all questions.

Section I: Facility/Site Information

Facility/Site Name (As Appears on Permit Authorization)	County	
We Energies - Caledonia Landfill	Racine	
Location Address/Description (if different from mailing address below)	**State**	**ZIP Code**
Between Hwy 32 & We Energies Oak Creek Power Plant (8719 Douglas Ave)	WI	53405

○ City ○ Township ◉ Village of Caledonia

Facility Identification Number (FID) and/or FIN Number if known: FID 252108450 FIN 58153

Section II: Facility/Site Contact Person

Local Contact Person	Mailing Address (if different than site location address)	
Eric Kovatch	333 W. Everett St. - A231	
Title	**Municipality (if different than above)**	
Senior Env. Consultant	Milwaukee	
Telephone (include area code)	**State**	**ZIP Code (if different from above)**
(414) 221-2457	WI	53203
E-mail address or Website (if applicable)	**Fax (include area code)**	
eric.kovatch@wecenergygroup.com		

Section III: Certification & Signature

(Person attesting to the accuracy and completeness of Annual Facility Site Compliance Inspection Report.)

This form must be signed by an official representative of the permitted facility in accordance with s. NR 216.22(7), Wis. Adm. Code. See instructions on page 4. If this form is not signed, or is found to be incomplete, it will be returned.

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Signature of Authorized Representative	Telephone Number (include area code)		
E.P. Kovatch	(414) 221-2457		
Type or Print Name	**Company Name**		
Eric P. Kovatch	WEC Energy Greoup - Business Services		
Position Title	**Mailing Address**		
Senior Env. Consultant	333 W. Everett St - A231		
Date Signed	**Municipality**	**State**	**ZIP Code**
01/11/2023	Milwaukee	WI	53203

How to Use this Form:

The first level of storm water monitoring consists of a comprehensive annual facility site compliance inspection (AFSCI) to determine if your facility is operating in compliance with your Storm Water Pollution Prevention Plan (SWPPP). You should use the results of this inspection to determine the extent to which your SWPPP needs to be updated to prevent pollution from new source areas, as well as to correct any inadequacies that the plan may have in handling existing source areas. This first level of monitoring is addressed in Section IV of this Annual Report on page 2.

The second level of storm water monitoring consists of quarterly visual observations of storm water leaving the site during runoff events caused by snow-melt or rainfall. This is a practical, low cost tool for identifying obvious contamination of storm water discharges, and can also help identify which practices are ineffective. The goal of quarterly inspections is to obtain results from a set of four inspections that are distributed as evenly as possible throughout the year and which depict runoff quality during each of the four seasons. This second level of monitoring is addressed in Section V of this Annual Report on page 3.

Section IV: Annual Facility Site Compliance Inspection

The Annual Facility Site Compliance Inspection shall be adequate to verify that: your Storm Water Pollution Prevention Plan (SWPPP) remains current; potential pollution sources at your facility are identified; the facility site map and drainage map remain accurate; and that the Best Management Practices prescribed in your SWPPP are being implemented, properly operated, and adequately maintained.

Name of Person Conducting Inspection	Inspection Date
Eric Kovatch	12/08/2022
Employer	Telephone Number
WEC Energy Group - Business Services	(414) 221-2457

Your inspection should start with a review of your written SWPPP kept at your facility. The SWPPP should be amended if, through these inspections, you find that the provisions in your SWPPP are ineffective in controlling contaminated storm water from being discharged from your facility.

		Yes	No	N/A
1.	Has your SWPPP been updated to include current Non-Storm Water Discharge Evaluation results?	○	○	◉
2.	Has your SWPPP been amended for any new construction that would affect the site map or drainage conditions at the facility?	○	○	◉
3.	Has your SWPPP been amended for any changes in facility operations that could be identified as new source areas for contamination of storm water?	○	○	◉
4.	Are there any materials at the facility that are handled, stored, or disposed in a manner to allow exposure to storm water that are not currently addressed in your SWPPP?	○	◉	○
5.	Are there any maintenance or material handling activities conducted outdoors that have not been addressed in your SWPPP?	○	◉	○
6.	Are outside areas kept in a neat and orderly condition?	◉	○	○
7.	Are regular housekeeping inspections made?	◉	○	○
8.	Do you see spots, pools, puddles, or other traces of oils, grease, or other chemicals on the ground?	○	◉	○
9.	Are particulates on the ground from industrial operations or processes being controlled?	◉	○	○
10.	Do you see leaking equipment, pipes or containers?	○	◉	○
11.	Do drips, spills, or leaks occur when materials are being transferred from one source to another?	○	◉	○
12.	Are drips or leaks from equipment or machinery being controlled?	◉	○	○
13.	Are cleanup procedures used for spilled solids?	◉	○	○
14.	Are absorbent materials (floor dry, kitty litter, etc.) regularly used in certain areas to absorb spills?	○	○	◉
15.	Can you find discoloration, residue, or corrosion on the roof or around vents or pipes that ventilate or drain work areas?	○	○	◉
16.	Are Best Management Practices implemented to reduce or eliminate contamination of storm water from source areas at the facility?	◉	○	○
17.	Are Best Management Practices adequately maintained?	◉	○	○
18.	Are there significant changes to your SWPPP needed to correct plan inadequacies to effectively control a discharge of contaminated storm water from your facility?	○	◉	○

Comments:

Section V: Quarterly Visual Inspection Reports

Quarterly Visual Inspections at each storm water discharge outfall on your site can be a valuable assessment tool and are required by the Tier 1, Tier 2, and Nonmetallic Mining Industrial Storm Water General Permits. These inspections should be performed when sufficient runoff occurs during daylight hours. Try to make observations within the first 30 minutes after runoff begins discharging from the outfall or soon thereafter as practical, but no later than 60 minutes. If you find visible pollution, note the probable source and list any possible Best Management Practices that could be used to reduce or eliminate the problem. Make any necessary changes to your Storm Water Pollution Prevention Plan as needed. If you were unable to evaluate an outfall during a specific quarter, this should be indicated along with a reason as to why this could not be done.

Outfall Number	Date of Inspection			
	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Sedimentation Basin - North Inlet	03/18/2022	05/03/2022	08/25/2022	12/15/2022
Sedimentation Basin - West Inlet	03/18/2022	05/03/2022	08/25/2022	12/15/2022
Outfall 02 Culvert Inlet	03/18/2022	05/03/2022	08/25/2022	12/15/2022

Briefly summarize what you found when conducting your Quarterly Visual Inspections. (Include any observations of color, odor, turbidity, floating solids, foam, oil sheen, or any other indications of storm water pollution and the probable sources of any observed storm water contamination.)

Instructions

Section I: Facility/Site Information

Provide the name of the facility as it appears on the permit application or permit cover letter and location address. If known, provide the Facility Identification (FID) and/or FIN Number assigned by the WDNR.

Section II: Facility/Site Contact Person

Provide the local contact person information for the facility. The mailing address should be given for the facility contact person if it is different from the facility site location address information.

Section III: Certification & Signature

State Statutes provide for severe penalties for submitting false information on this AFSCI form. State regulations require this form be signed as follows:

1. For a corporation, by a principal executive officer of at least the level of Vice President, or a duly authorized representative having overall responsibility for the operation covered by this permit.
2. For a unit of government, a principal executive officer, a ranking elected official, or other duly authorized representative.
3. For a partnership, by a general partner; for a sole proprietorship, by the proprietor.
4. For a limited liability company, by member or manager.

Section IV: Annual Facility Site Compliance Inspection

Provide the name of the person conducting the inspection, inspection date, name of employer, and telephone number. Check the appropriate box for each of the listed questions and provide explanations in the comment box as needed.

Section V: Quarterly Visual Inspection Reports

Provide the outfall number in the table and the dates of each quarterly visual inspection. Summarize the findings of your visual inspections below the table. Attach additional sheets if needed.

Mailing Address

Unless otherwise directed, mail this completed form to the Wisconsin Department of Natural Resources (WDNR) office associated with the county of the facility site location as follows:

NORTHERN REGION (NOR)

Ashland Barron Bayfield Burnett Douglas Florence	Forest Iron Langlade Lincoln Oneida Polk	Price Rusk Sawyer Taylor Vilas Washburn	WDNR Eau Claire Service Center 1300 W Clairemont Ave Eau Claire, WI 54701 715-839-1636

NORTHEAST REGION (NER)

Brown Calumet Door Fond du Lac Green Lake Kewaunee	Manitowoc Marinette Marquette Menominee Oconto Outagamie	Shawano Waupaca Waushara Winnebago	WDNR Northeast Regional Headquarters 2984 Shawano Avenue Green Bay, WI 54313-6727 (920) 662-5100

WEST CENTRAL REGION (WCR)

Adams Buffalo Chippewa Clark Crawford Dunn Eau Claire	Jackson Juneau La Crosse Marathon Monroe Pepin	Pierce Portage St. Croix Trempealeau Vernon Wood	WDNR Eau Claire Service Center 1300 W Clairemont Ave Eau Claire, WI 54701 715-839-1636

SOUTH CENTRAL REGION (SCR)

Columbia Dane Dodge Grant	Green Iowa Jefferson LaFayette	Richland Rock Sauk	WDNR South Central Regional Headquarters 3911 Fish Hatchery Road Fitchburg, WI 53711 (608) 275-3266

SOUTHEAST REGION (SER)

Kenosha Milwaukee Ozaukee	Racine Sheboygan Walworth	Washington Waukesha	WDNR SER Headquarters 2300 N Dr. Martin Luther King Jr. Dr Milwaukee, WI 53212

http://dnr.wi.gov/files/PDF/forms/3400/3400-176.pdf

APPENDIX D

Storm Water Pollution Prevention Plan Summary

All storm water drainage is directed away from the cell. A majority of the storm water around the site infiltrates, but the excess water flows through vegetated swales, over rock check dams, and/or through silt fence. Most of the remaining water ends up in the sedimentation basin on site. The overflow from the basin discharges to Lake Michigan.

Storm Water Pollution Prevention Plan Summary
Industrial Storm Water Discharges General Permit
Form 3400-167 (R 12/16)

Section VI: Storm Water Outfall Information (copy and attach additional sheets if necessary)

Outfall Number	Sources of Pollutants	BMPs Implemented	Chemical Monitoring By Outfall *	Monitoring Schedule *	Non-Storm Water Discharge: Is Discharge Present? Yes	No	Were Illicit Discharge Tests Conducted? Yes	No	Is Discharge Covered By Another WPDES Permit? Yes	No
01	Sediment	Sedimentation Basin			○	◉	○	◉	○	◉
		Wheel wash station								
	Fugitive Dust	Cell surface wetting								
02	Sediment	Vegetative cover			○	◉	○	◉	○	◉
		Rock check dams								
		Silt Fence								
03	None				○	○	○	○	○	○
					○	○	○	○	○	○
					○	○	○	○	○	○

*** Required for Tier One Facilities.**

Section VII: Facility Site Diagram (Show and label major features such as buildings, roads and driveways, drainage patterns, outdoor areas of industrial activity and storage, property boundaries, etc. Use the (+) button to add additional sheets if necessary.**)**

Attached - Figure 1 Caledonia Landfill

It is difficult to observe the overflow from the sedimentation basin in Drainage Area 01, so the quarterly wet weather inspections will evaluate the quality of the water flowing into the basin from the two designated observations points.

Drainage area 03 has no industrial activity and therefore the storm water has no exposure to any significant materials.

Section VIII: Comments (make reference to section or question number)

Section IV Question 7 - Non-storm water discharges will be completed by end of pipe visual inspections completed semi-annually. To date, no inspections have been completed but will begin as of 1/31/17. However, on a site visit on October 25, 2016 there was no evidence of non-storm water discharges at this site. The Caledonia Landfill will conduct and keep records for the quarterly wet weather visual inspections, semi-annual dry weather end of pipe visual inspections, and annual facility site compliance inspections.

Section IX: Mailing Addresses

Unless otherwise directed, mail the completed NOI form to the Wisconsin DNR (WDNR) office associated with the county of the facility site location as follows:

NORTHEAST REGION (NER)

Brown Calumet Door Fond du Lac	Green Lake Kewaunee Manitowoc Marinette	Marquette Menominee Oconto Oneida Reservation	Outagamie Shawano Waupaca Waushara Winnebago	WDNR Green Bay Service Center 2984 Shawano Avenue Green Bay, WI 54313-6727 920-662-5100

NORTHERN REGION (NOR)

Ashland Barron Bayfield Burnett	Douglas Florence Forest Iron	Langlade Lincoln Oneida Polk Price	Rusk Sawyer Taylor Vilas Washburn	WDNR Baldwin Service Center 890 Spruce Street Baldwin, WI 54002 715-684-2914 ext. 109

WEST CENTRAL REGION (WCR)

Adams Buffalo Chippewa Clark	Crawford Dunn Eau Claire Jackson Juneau	La Crosse Marathon Monroe Pepin Pierce	Portage St. Croix Trempealeau Vernon Wood	WDNR Baldwin Service Center 890 Spruce Street Baldwin, WI 54002 715-684-2914 ext. 109

SOUTH CENTRAL REGION (SCR)

Columbia Dane Dodge	Grant Green Iowa	Jefferson LaFayette Richland	Rock Sauk	WDNR South Central Regional Headquarters 3911 Fish Hatchery Road Fitchburg, WI 53711 608-275-3266

SOUTHEAST REGION (SER)

Kenosha Milwaukee	Ozaukee Racine	Sheboygan Walworth	Washington Waukesha	WDNR Waukesha Service Center 141 N.W. Barstow Street, Room 180 Waukesha, WI 53188 262-574-2100

APPENDIX E

Storm Water Pollution Prevention Plan Revision Log

Table E-1 Revision Log

Revision Log
We Energies – Caledonia Landfill

By	Date	Activity	Comments
Melissa Schultz	1/31/2017	Prepare Plan	Initial SWPP Plan
Ben Koshak	3/3/2021	Update Contacts	Updated SWPPP Contacts
Izabelle Villafuerte	8/14/2023	Update Contacts	Updated SWPPP Contacts

WPDES PERMIT

STATE OF WISCONSIN
DEPARTMENT OF NATURAL RESOURCES

PERMIT TO DISCHARGE UNDER THE WISCONSIN POLLUTANT DISCHARGE ELIMINATION SYSTEM

Wisconsin Electric Power Company

Oak Creek Power Plant & Elm Road Generating Station

is permitted, under the authority of Chapter 283, Wisconsin Statutes, to discharge from a facility located at
11060 S. Chicago Road, Oak Creek, Wisconsin
to
Lake Michigan

in accordance with the effluent limitations, monitoring requirements and other conditions set forth in this permit.

The permittee shall not discharge after the date of expiration. If the permittee wishes to continue to discharge after this expiration date an application shall be filed for reissuance of this permit, according to Chapter NR 200, Wis. Adm. Code, at least 180 days prior to the expiration date given below.

State of Wisconsin Department of Natural Resources
For the Secretary

By ______________________
Jason Knutson, P.E.
Wastewater Section Chief, Bureau of Water Quality

_____3/31/2020____________
Date Permit Signed/Issued

PERMIT TERM: EFFECTIVE DATE - October 01, 2019 **EXPIRATION DATE - September 30, 2024**
EFFECTIVE DATE OF MODIFICATION – April 01, 2020

TABLE OF CONTENTS

1 Influent Requirements - Cooling Water Intake Structure (CWIS)

1.1 Sampling Point(s)

Sampling Point Designation	
Sampling Point Number	**Sampling Point Location, WasteType/Sample Contents and Treatment Description (as applicable)**
901	Offshore wedgewire screen system.
902	Emergency Intake: Intake structure at the intake channel used when intake is inoperable or anticipated inoperable due to clogging by frazil ice or other debris or for essential maintenance.

1.2 Monitoring Requirements and BTA Determinations

The permittee shall comply with the following monitoring requirements.

1.2.1 Sampling Point 901 - Intake Structure

Monitoring Requirements and Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Flow Rate		MGD	Daily	Continuous	

1.2.1.1 CWIS - Authority to Operate

The permittee shall at all times properly operate and maintain all water intake facilities. The permittee shall give advance notice to the Department of any planned changes in the location, design, operation, or capacity of the intake structure. The permittee is authorized to use the offshore cooling water intake system.

1.2.1.2 Cooling Water Intake BTA (Best Technology Available) Determination

The Department has determined that the intake structure is BTA for the new facility (Elm Road Generating Station) and is interim BTA for the existing facility (Oak Creek Power Plant).

The offshore cooling water intake represents BTA for minimizing adverse environmental impact in accordance with the requirements in section s. 283.31 (6), Wis. Stats., and section 316(b) of the Clean Water Act, and subpart I of 40 CFR 125, for the new facility (Elm Road Generating Station).

The offshore cooling water intake represents interim BTA for minimizing adverse environmental impact in accordance with the requirements in section s. 283.31 (6), Wis. Stats., and section 316(b) of the Clean Water Act, and subpart J of 40 CFR 125, for the existing facility (Oak Creek Power Plant).

1.2.2 Sampling Point 902 - Emergency Intake

Monitoring Requirements and Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Flow Rate		MGD	Per Occurrence	Estimated	

1.2.2.1 Authority to Operate and Use Limitations

The permittee shall at all times properly operate and maintain all water intake facilities. The permittee shall give advance notice to the Department of any planned changes in the location, design, operation, or capacity of the intake structure.

The emergency onshore cooling water intake structure is authorized for use but has use restrictions as listed below. Monitoring and reporting are required.

The permittee shall only operate the emergency intake with the intake screens in the offshore intake structure are inoperable, or anticipated to be inoperable, due to clogging by frazil ice or other debris or for essential maintenance (e.g., damage repair, screen cleaning, lift pump repairs, cleaning or repairs of the on-shore forebays and pump houses). The Department shall be notified in writing within 5 days after any use of the emergency intake system. If at any time that the emergency cooling water intake structure at the intake channel is used with the gates open and the lift pumps in-service, as described in the permittee's December 1, 2006 letter, if the combined flow of the lift pumps exceed the combined OCPP circulating water (CW)pumps and results in a net discharge through the gates to the lake, such flow through the surface gates will not constitute use of the emergency intake. The permittee shall submit to the Department an Annual Certification Statement and Report (see section 1.3.4.1) which summarizes all of the following:

1) Monitoring of Flow Direction. During gates-open operation of the lift pumps, a monitoring plan will be implemented to assure that excess flow is always available to provide the necessary net flow outward to the lake as described above. This plan will consist of the following elements:

   a) A flow monitoring device will be placed at each of the five OCPP dikewall gates that will clearly display the flow direction.

   b) Regular rounds by roving operators will include the inspection of these flow devices to verify flow direction.

   c) If conditions change or are expected to change, increased monitoring of flow direction will be performed to assure that excess flow still exists. Changes in conditions include; changes to damper positions, pumps in or out of service at ERGS or OCPP, changes in lake level or forebay levels.

2) Operating Response. Loss of excess flow will be verified by observing a reversal in flow direction at the dikewall gates. Excess flow will be easier to monitor and verify with greater flow rates. If a complete loss of excess flow is discovered or anticipated, or if excess flow cannot be verified, operators have a variety of options available for recovery as listed below. The permittee shall keep records of any of the following operating responses:

   a) Start idle OCPP Lift Pump to provide increased excess flow.

   b) Shut down operating OCPP CW Pump to decrease consumption of CW flow and increase excess flow.

   c) Throttle OCPP condenser tailpipe dampers to decrease CW consumption in smaller increments.

   d) Throttle dikewall gates to decrease the area of the exiting excess flow, and increase the velocity through the gate, making monitoring and detection easier.

   e) Recirculation of OCPP CW (ice melt operations) to the west side of the dikewall to provide greater excess flow.

3) Administrative Controls. Normally, taking CW pumps in or out of service or changing damper position is done at the discretion of the Control Operator. During the gates-open operation phase, changes to plant configuration that affect CW flow will be performed only after consulting with the Shift Supervisor, and will require greater frequency of monitoring flow direction, to assure that the changes do not create a complete loss of excess flow. In addition, communications will be required from the control room operators at ERGS, so that operators at OCPP can respond to expected changes in flow rate that will affect the capacity of the OCPP Lift

Pumps. The permittee shall keep records of any of the above consults, greater frequency of monitoring, communications or other similar steps.

4) Reporting. In the event that excess flow is lost for a period of more than one hour, the permittee will provide notification to the DNR within 5 days of the incident.

1.2.2.2 BTA Determination

The emergency cooling water intake is included as a component of the water intake system technologies, and is also considered to be BTA (and interim BTA). Because of its limited use on an emergency basis, its environmental impact is minimized.

1.2.2.3 Monitoring and Reporting

The permittee shall notify the Department within 5 days after any use of the emergency cooling water intake system. The date and the duration during which the intake is open shall be monitored and reported. The permittee shall provide notification to the DNR field contact.

1.3 Cooling Water Intake Structure Standard Requirements

The following requirements and provisions apply to all water intake structures identified as sampling points in subsection 1.1.

1.3.1 Future BTA for Cooling Water Intake Structure

BTA determinations for entrainment and impingement mortality at cooling water intake structures will be made in each permit reissuance, in accordance with 40 CFR §125.80-98.

For the next permit reissuance application, the permittee shall provide all the information required in 40 CFR 122.21(r). Exemptions from some permit application requirements for existing facilities may be requested in accordance with 40 CFR §125.95(c) and §125.98(g), where information already submitted is sufficient. If an exemption is desired, a request for reduced application material requirements must be submitted at least 2 years and 6 months prior to permit expiration. Past submittals and previously conducted studies may satisfy some or all of the application material requirements.

1.3.2 Impingement Mortality Monitoring

Two years of biweekly impingement mortality monitoring is required if and only if the permittee elects to comply with the impingement mortality BTA standard using a compliance option other than those listed in 40 CFR 125.94(c)(1-4).

1.3.3 Visual or Remote Inspections

The permittee shall conduct a visual inspection or employ a remote monitoring device during periods when the cooling water intake is in operation. The inspection shall evaluate if the intakes are maintained and operated to function as designed.

The offshore intake shall be maintained as follows:

The offshore CWIS will be inspected twice a year to assess clogging. Divers will inspect the CWIS annually after the winter season in late April/early May to assess screen damage. If clogged, the divers will use high pressure water spray equipment to remove any accumulated algae, mussels, moss, or other debris. Divers will also identify any changes in the material condition of the CWIS. Any repairs will be made as soon as practicable on an as needed basis. Divers will inspect the lakebed to verify that the rip-rap remains covered with sand.

Cleaning the screens is expected to take one week and will be accomplished by divers using high pressure spray equipment. These cleanings do not require the intake structure to be removed from service and can be accomplished safely during normal operations. High pressure cleaning will be conducted as needed in early June and October.
Visual Inspections – The permittee shall conduct visual inspections of the offshore intake screens and rip-rap around the offshore intake structure and record any surface occlusion and scouring of rip-rap. These inspections shall occur by direct observation or through the use of remote-control video equipment. Visual inspections shall be performed as follows:

- once each month for the months of September through May;
- two times each month during the months of June, July and August;

For visual inspections, the date of the inspection shall be recorded, and if weather or other unsafe or hazardous conditions exist for persons conducting the inspections, the permittee shall document conditions that preclude any inspection from taking place.

The permittee shall report the number, species and size of fish observed as impinged on the screens. An estimate of total impingement may be provided based on the observation of not less than four screens.
During the months of September through May, the permittee shall, at least once per week, visually observe and record information on the relative amount and type of organisms and other material in the OCPP intake forebay and the ERGS pump house. This visual observation may be conducted coincident to the entrainment sampling required by this permit. Such visual observations shall be coordinated with and compared to the water level measurements required under the Velocity Monitoring section of this permit to determine the potential for impingement on the intake screens. If, at any time, this visual observation indicates that the intake screens may be clogged or otherwise blocked, the permittee shall schedule a visual inspection of the screens as soon as possible and report this information to the Department within 5 days of its occurrence.

Velocity and Flow Monitoring

Once per quarter the permittee shall calculate velocity based on the cooling water intake pump performance and the combined flow-through area of the wedge-wire screens. The reported cooling water intake flow will be based on pump performance. Flow will be determined by use of the pump curves for the OCPP lift station pumps and ERGS circulating water pumps. The total developed head (TDH) for the OCPP lift station pumps shall be directly measured by subtracting the suction forebay level from the discharge forebay level leading to the OCPP Units 5-8 circulating water pumps. For the ERGS units, each circulating water pump is equipped with a discharge pressure gauge. The suction forebay level will be subtracted from the pump discharge pressure after it is converted to elevation head (in feet). This equals the total developed head required (in feet) to lift the water from the suction to the pump discharge. For both the OCPP and ERGS pumps, there is a TDH vs. flow curve developed that shall be used to obtain the combined intake flow rate.

Intake Water Level Monitoring

The water levels in the OCPP intake forebay and the ERGS pump house shall be continuously monitored. Any occurrence of water levels that indicate the screens may be clogged with debris, frazil ice and or other material shall be reported to the Department within 5 days of such occurrence. The water level monitoring data shall be retained by the permittee for not less than 5 years from the date of collection and shall be available for Department inspection upon request. If, at any time, these water level measurements indicate that the intake screens may be clogged or otherwise blocked, the permittee shall schedule a visual inspection of the screens as soon as possible and report this information to the Department within 5 days of its occurrence.

1.3.4 Reporting Requirements for Cooling Water Intake

The permittee shall adhere to the reporting requirements listed below:

1.3.4.1 Annual Certification Statement and Report

Submit an Annual Certification Statement and Report signed by the authorized representative with information on the following, no later than January 31st for the previous year:

- Certification that water intake structure technologies are being maintained and operated as set forth in this permit, or a justification and request for a modification of the practices. Include a summary of the required Visual or Remote Inspections.
- If there are substantial modifications to the operation of any unit that impacts the cooling water withdrawals or operation of the water intake structure, provide a summary of those changes.
- If the information contained in the previous year's annual certification is still applicable, the certification may simply state as such.
- Compliance monitoring results for impingement mortality and entrainment characterization.
- Quarterly through-screen velocity documentation.
- A summary of the information collected about the use of the emergency onshore cooling water intake structure as required by section 1.2.2.1

1.3.5 Intake Screen Discharges and Removed Substances

Floating debris and accumulated trash collected on the cooling water intake trash rack and any other screens shall be removed and disposed of in a manner to prevent any pollutant from the material from entering the waters of the State pursuant to s. NR 205.07 (3) (a), Wis. Adm. Code, except that backwashes may contain fine materials that originated from the intake water source such as sand, silt, small vegetation or aquatic life.

1.3.6 Endangered Species Act

Nothing in this permit authorizes take for the purpose of a facility's compliance with the Endangered Species Act. Refer to 40 CFR §125.98 (b) (1) and (2).

2 In-Plant Requirements

2.1 Sampling Point(s)

Sampling Point Designation	
Sampling Point Number	**Sampling Point Location, WasteType/Sample Contents and Treatment Description (as applicable)**
105	Generator Unit 5 bottom ash and fly ash hydrovactor effluent which discharges from Outfall 003.
106	Generator Unit 6 bottom ash and fly ash hydrovactor effluent which discharges from Outfall 004.
107	Discharge from the ERGS WWTP prior to combining with any other waste stream. Flows to the WWTP include low volume waste sources, nonchemical metal cleaning wastes, coal pile runoff, FGD wastewater, and limestone & gypsum area runoff.
108	Discharge from the ERGS demineralizer regeneration waste line prior to combining with any other waste stream
109	ERGS Unit 1 boiler blowdown and/or ERGS Unit 2 boiler blowdown and/or ERGS water treatment ultrafiltration reject/backwash and RO first pass.
171	Coal pile runoff that enters the OCPP WWTP or the ERGS WWTP

2.2 Monitoring Requirements and Limitations

The permittee shall comply with the following monitoring requirements and limitations.

2.2.1 Sampling Point 105 - 003 UNIT 5 BAH and FAH

Monitoring Requirements and Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Flow Rate		MGD	2/Month	Total Daily	
Suspended Solids, Total		mg/L	2/Month	24-Hr Flow Prop Comp	
Suspended Solids (Net)	Daily Max	100 mg/L	2/Month	Calculated	
Suspended Solids (Net)	Monthly Avg	30 mg/L	2/Month	Calculated	

2.2.2 Sampling Point 106 - 004 UNIT 6 BAH and FAH

Monitoring Requirements and Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Flow Rate		MGD	2/Month	Total Daily	
Suspended Solids, Total		mg/L	2/Month	24-Hr Flow Prop Comp	
Suspended Solids (Net)	Daily Max	100 mg/L	2/Month	Calculated	

Suspended Solids (Net)	Monthly Avg	30 mg/L	2/Month	Calculated	

2.2.3 Sampling Point 107 - ERGS Treated Process WW

Monitoring Requirements and Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Flow Rate		MGD	Daily	Total Daily	
Mercury, Total Recoverable	Daily Max	0.788 μg/L	Weekly	Grab	
Mercury, Total Recoverable	Monthly Avg	0.356 μg/L	Weekly	Grab	
Suspended Solids, Total	Daily Max	100 mg/L	Weekly	24-Hr Flow Prop Comp	
Suspended Solids, Total	Monthly Avg	30 mg/L	Weekly	24-Hr Flow Prop Comp	
Suspended Solids, Total		lbs/day	Weekly	Calculated	
Oil & Grease (Hexane)	Daily Max	20 mg/L	Weekly	Grab	
Oil & Grease (Hexane)	Monthly Avg	15 mg/L	Weekly	Grab	
Oil & Grease (Hexane)		lbs/day	Weekly	Calculated	
Arsenic, Total Recoverable	Daily Max	11 μg/L	Weekly	24-Hr Flow Prop Comp	
Arsenic, Total Recoverable	Monthly Avg	8.0 μg/L	Weekly	24-Hr Flow Prop Comp	

2.2.4 Sampling Point 108 - ERGS Demin. Regen. WW

Monitoring Requirements and Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Flow Rate		MGD	Daily	Total Daily	
Mercury, Total Recoverable		ng/L	Quarterly	Grab	
Suspended Solids, Total	Daily Max	100 mg/L	Weekly	24-Hr Flow Prop Comp	
Suspended Solids, Total	Monthly Avg	30 mg/L	Weekly	24-Hr Flow Prop Comp	
Suspended Solids, Total		lbs/day	Weekly	Calculated	
Oil & Grease (Hexane)	Daily Max	20 mg/L	Weekly	Grab	

Oil & Grease (Hexane)	Monthly Avg	15 mg/L	Weekly	Grab	
Oil & Grease (Hexane)		lbs/day	Weekly	Calculated	

2.2.5 Sampling Point 109 - ERGS Blowdown, Water Treatment

Monitoring Requirements and Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Flow Rate		MGD	2/Month	Total Daily	
Suspended Solids, Total	Daily Max	100 mg/L	2/Month	Grab	
Suspended Solids, Total	Monthly Avg	30 mg/L	2/Month	Grab	
Suspended Solids, Total		lbs/day	2/Month	Calculated	
Oil & Grease (Hexane)	Daily Max	20 mg/L	Annual	Grab	
Oil & Grease (Hexane)	Monthly Avg	15 mg/L	Annual	Grab	
Oil & Grease (Hexane)		lbs/day	Annual	Calculated	

2.2.6 Sampling Point 171 - Coal Pile Runoff to Treatment

Monitoring Requirements and Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Flow Rate		MGD	Daily	Estimated	

2.2.6.1 Runoff Volume Estimate

The permittee shall report daily the coal pile runoff volume that discharges into the OCPP or ERGS wastewater treatment system. The volume shall be based on the coal pile runoff basin pump capacity multiplied by the time this pump is in operation.

3 Surface Water Requirements

3.1 Sampling Point(s)

The discharge(s) shall be limited to the waste type(s) designated for the listed sampling point(s).

Sampling Point Designation	
Sampling Point Number	**Sampling Point Location, WasteType/Sample Contents and Treatment Description (as applicable)**
001	Alternative cooling water outfall for Unit 5 (outfall 003) and to recirculate effluent from Units 5-7 (outfalls 003, 004 and 005) back into the water intake channel to prevent ice.
003	Unit 5 condenser noncontact once through cooling water, equipment heat exchangers using noncontact once through cooling water, boiler water surge tank, drip tank, fire protection system drains, bottom ash hydrovactor water discharges, fly ash hydrovactor water dischargers (back-up system), boiler blowdown (alternate route), and storm water from plant roof drains.
004	Unit 6 condenser noncontact once through cooling water, equipment heat exchangers using noncontact once through cooling water, boiler water surge tank, drip tank, fire protection system drains, bottom ash hydrovactor water discharges, fly ash hydrovactor water dischargers (back-up system), and storm water from plant roof drains.
005	Unit 7 condenser noncontact once through cooling water, plus other process flows equipment heat exchangers using noncontact once through cooling water, fire protection system drains and storm water from plant roof drains.
006	Unit 8 condenser noncontact once through cooling water, equipment heat exchangers using noncontact once through cooling water, WPDES pump station emergency overflow, fire protection system drains and storm water from plant roof drains.
007	Oak Creek wastewater treatment system effluent. Treated process wastewater includes low volume waste sources, bottom ash transport water, coal pile runoff, limestone & gypsum area runoff, nonchemical metal cleaning wastes, former north plant area drainage, equipment heat exchangers using noncontact once through cooling water, Unit 7&8 surge tank drain and overflow, storm water runoff and landfill leachate
008	Storm water runoff from: open lands (no exposure) west of ERGS; and coal pile runoff basin emergency spillway overflow.
010	Dock pump station emergency overflow.
012	Water intake traveling screen backwash.
013	ERGS Unit 1 and Unit 2 condenser noncontact once through cooling water, discharge of treated wastewater from ERGS WWTP (sample point 107), discharges from water treatment equipment and boiler blowdown (sample points 108 and 109), equipment heat exchangers using noncontact once through cooling water and fire protection system drains.
014	Storm water runoff from coal pile and materials handling area
015	Stormwater runoff from limestone and gypsum storage areas
907	Sum of mass for 107, 108, 109, and 007
606	Background monitoring for mercury and arsenic
605	Background monitoring for temperature.
604	Generator Unit 6 fly ash and bottom ash hydrovactor influent. Intake water sample used to determine the net discharge of pollutants from Outfall 004.
603	Generator Unit 5 fly ash and bottom ash hydrovactor influent. Intake water sample used to determine the net discharge of pollutants from Outfall 003

3.2 Monitoring Requirements and Effluent Limitations

The permittee shall comply with the following monitoring requirements and limitations.

3.2.1 Sampling Point (Outfall) 001 - OCPP DEICING LINE

Monitoring Requirements and Effluent Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Flow Rate		MGD	Daily	Total Daily	

3.2.2 Sampling Point (Outfall) 003 - UNIT 5 OCPP CONDENSER/OTHER

Monitoring Requirements and Effluent Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Flow Rate		MGD	Daily	Calculated	
pH Field	Daily Max	9.0 su	Weekly	Grab	
pH Field	Daily Min	6.0 su	Weekly	Grab	
Temperature Average		deg F	Daily	Continuous	
Temperature Maximum		deg F	Daily	Continuous	
Heat	Daily Avg	1,500 MBTU/hr	Daily	Calculated	
Mercury, Total Recoverable		ng/L	Quarterly	Grab	
Acute WET		TU_a	See Listed Qtr(s)	24-Hr Comp	Sample once during the permit term. See WET section 3.2.2.2.
Chronic WET		TU_c	See Listed Qtr(s)	24-Hr Comp	Sample once during the permit term. See WET section 3.2.2.2.
Phosphorus, Total	Monthly Avg	0.2 mg/L	Monthly	24-Hr Flow Prop Comp	

3.2.2.1 Mercury Monitoring

The permittee shall collect and analyze all mercury samples according to the data quality requirements of ss. NR 106.145(9) and (10), Wisconsin Administrative Code. The limit of quantitation (LOQ) used for the effluent and field blank shall be less than 1.3 ng/L, unless the samples are quantified at levels above 1.3 ng/L. The permittee shall collect at least one mercury field blank for each set of mercury samples (a set of samples may include combinations of intake, influent, effluent or other samples all collected on the same day). The permittee shall report results of samples and field blanks to the Department on Discharge Monitoring Reports.

3.2.2.2 Whole Effluent Toxicity (WET) Testing

Primary Control Water: Lab water is allowed in acute tests. Lake Michigan water shall be used for chronic tests.

Instream Waste Concentration (IWC): 9.1%

Dilution series: At least five effluent concentrations and dual controls must be included in each test.

- **Acute:** 100, 50, 25, 12.5, 6.25% and any additional selected by the permittee.
- **Chronic:** 100, 30, 10, 3, 1% and any additional selected by the permittee.

WET Testing Frequency:

Acute tests shall be conducted once per permit term quarter timed with other acute tests in order to collect seasonal information about the discharge. Tests are required during the following quarters.

- **Acute:** 3rd quarter 2020

  Acute WET testing shall continue after the permit expiration date (until the permit is reissued) in accordance with the WET requirements specified for the last full calendar year of this permit. For example, the next test would be required in 3rd quarter 2025.

Chronic tests shall be conducted on the same schedule as acute.

Testing: WET testing shall be performed during normal operating conditions. Permittees are not allowed to turn off or otherwise modify treatment systems, production processes, or change other operating or treatment conditions during WET tests.

Reporting: The permittee shall report test results on the Discharge Monitoring Report form, and also complete the "Whole Effluent Toxicity Test Report Form" (Section 6, "*State of Wisconsin Aquatic Life Toxicity Testing Methods Manual, 2nd Edition*"), for each test. The original, complete, signed version of the Whole Effluent Toxicity Test Report Form shall be sent to the Biomonitoring Coordinator, Bureau of Water Quality, 101 S. Webster St., P.O. Box 7921, Madison, WI 53707-7921, within 45 days of test completion. The Discharge Monitoring Report (DMR) form shall be submitted electronically by the required deadline.

Determination of Positive Results: An acute toxicity test shall be considered positive if the Toxic Unit - Acute (TU_a) is greater than 1.0 for either species. The TU_a shall be calculated as follows: $TU_a = 100 \div LC_{50}$. A chronic toxicity test shall be considered positive if the Toxic Unit - Chronic (TUc) is greater than 11 for either species. The TUc shall be calculated as follows: $TUc = 100 \div IC_{25}$.

Additional Testing Requirements: Within 90 days of a test which showed positive results, the permittee shall submit the results of at least 2 retests to the Biomonitoring Coordinator on "Whole Effluent Toxicity Test Report Forms". The 90-day reporting period shall begin the day after the test which showed a positive result. The retests shall be completed using the same species and test methods specified for the original test (see the Standard Requirements section herein).

3.2.3 Sampling Point (Outfall) 004 - UNIT 6 OCPP CONDENSER/OTHER

Monitoring Requirements and Effluent Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Flow Rate		MGD	Daily	Calculated	
pH Field	Daily Max	9.0 su	Weekly	Grab	
pH Field	Daily Min	6.0 su	Weekly	Grab	
Temperature Average		deg F	Daily	Continuous	
Temperature Maximum		deg F	Daily	Continuous	
Heat	Daily Avg	1,500 MBTU/hr	Daily	Calculated	

Monitoring Requirements and Effluent Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Mercury, Total Recoverable		ng/L	Quarterly	Grab	
Acute WET		TU_a	See Listed Qtr(s)	24-Hr Comp	Sample once during the permit term. See WET section 3.2.3.2.
Chronic WET		TU_c	See Listed Qtr(s)	24-Hr Comp	Sample once during the permit term. See WET section 3.2.3.2.
Phosphorus, Total	Monthly Avg	0.2 mg/L	Monthly	24-Hr Flow Prop Comp	

3.2.3.1 Mercury Monitoring

The permittee shall collect and analyze all mercury samples according to the data quality requirements of ss. NR 106.145(9) and (10), Wisconsin Administrative Code. The limit of quantitation (LOQ) used for the effluent and field blank shall be less than 1.3 ng/L, unless the samples are quantified at levels above 1.3 ng/L. The permittee shall collect at least one mercury field blank for each set of mercury samples (a set of samples may include combinations of intake, influent, effluent or other samples all collected on the same day). The permittee shall report results of samples and field blanks to the Department on Discharge Monitoring Reports.

3.2.3.2 Whole Effluent Toxicity (WET) Testing

Primary Control Water: Lab water is allowed in acute tests. Lake Michigan water shall be used for chronic tests.

Instream Waste Concentration (IWC): 9.1%

Dilution series: At least five effluent concentrations and dual controls must be included in each test.

- **Acute:** 100, 50, 25, 12.5, 6.25% and any additional selected by the permittee.
- **Chronic:** 100, 30, 10, 3, 1% and any additional selected by the permittee.

WET Testing Frequency:

Acute tests shall be conducted once per permit term quarter timed with other acute tests in order to collect seasonal information about the discharge. Tests are required during the following quarters.

- **Acute:** 4th quarter 2020

  Acute WET testing shall continue after the permit expiration date (until the permit is reissued) in accordance with the WET requirements specified for the last full calendar year of this permit. For example, the next test would be required in 4th quarter 2025.

Chronic tests shall be conducted on the same schedule as acute.

Testing: WET testing shall be performed during normal operating conditions. Permittees are not allowed to turn off or otherwise modify treatment systems, production processes, or change other operating or treatment conditions during WET tests.

Reporting: The permittee shall report test results on the Discharge Monitoring Report form, and also complete the "Whole Effluent Toxicity Test Report Form" (Section 6, "*State of Wisconsin Aquatic Life Toxicity Testing Methods Manual, 2nd Edition*"), for each test. The original, complete, signed version of the Whole Effluent

Toxicity Test Report Form shall be sent to the Biomonitoring Coordinator, Bureau of Water Quality, 101 S. Webster St., P.O. Box 7921, Madison, WI 53707-7921, within 45 days of test completion. The Discharge Monitoring Report (DMR) form shall be submitted electronically by the required deadline.

Determination of Positive Results: An acute toxicity test shall be considered positive if the Toxic Unit - Acute (TU_a) is greater than 1.0 for either species. The TU_a shall be calculated as follows: $TU_a = 100 \div LC_{50}$. A chronic toxicity test shall be considered positive if the Toxic Unit - Chronic (TUc) is greater than 11 for either species. The TUc shall be calculated as follows: $TUc = 100 \div IC_{25}$.

Additional Testing Requirements: Within 90 days of a test which showed positive results, the permittee shall submit the results of at least 2 retests to the Biomonitoring Coordinator on "Whole Effluent Toxicity Test Report Forms". The 90-day reporting period shall begin the day after the test which showed a positive result. The retests shall be completed using the same species and test methods specified for the original test (see the Standard Requirements section herein).

3.2.4 Sampling Point (Outfall) 005 - UNIT 7 OCPP CONDENSER/OTHER

Monitoring Requirements and Effluent Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Flow Rate		MGD	Daily	Calculated	
pH Field	Daily Max	9.0 su	Weekly	Grab	
pH Field	Daily Min	6.0 su	Weekly	Grab	
Temperature Average		deg F	Daily	Continuous	
Temperature Maximum		deg F	Daily	Continuous	
Heat	Daily Avg	1,700 MBTU/hr	Daily	Calculated	
Mercury, Total Recoverable		ng/L	Quarterly	Grab	
Acute WET		TU_a	See Listed Qtr(s)	24-Hr Comp	Sample once during the permit term. See WET section 3.2.4.2.
Chronic WET		TU_c	See Listed Qtr(s)	24-Hr Comp	Sample once during the permit term. See WET section 3.2.4.2.
Phosphorus, Total	Monthly Avg	0.2 mg/L	Monthly	24-Hr Flow Prop Comp	

3.2.4.1 Mercury Monitoring

The permittee shall collect and analyze all mercury samples according to the data quality requirements of ss. NR 106.145(9) and (10), Wisconsin Administrative Code. The limit of quantitation (LOQ) used for the effluent and field blank shall be less than 1.3 ng/L, unless the samples are quantified at levels above 1.3 ng/L. The permittee shall collect at least one mercury field blank for each set of mercury samples (a set of samples may include combinations of intake, influent, effluent or other samples all collected on the same day). The permittee shall report results of samples and field blanks to the Department on Discharge Monitoring Reports.

3.2.4.2 Whole Effluent Toxicity (WET) Testing

Primary Control Water: Lab water is allowed in acute tests. Lake Michigan water shall be used for chronic tests.

Instream Waste Concentration (IWC): 9.1%

Dilution series: At least five effluent concentrations and dual controls must be included in each test.

- **Acute:** 100, 50, 25, 12.5, 6.25% and any additional selected by the permittee.
- **Chronic:** 100, 30, 10, 3, 1% and any additional selected by the permittee.

WET Testing Frequency:

Acute tests shall be conducted once per permit term quarter timed with other acute tests in order to collect seasonal information about the discharge. Tests are required during the following quarters.

- **Acute:** 1st quarter 2021

  Acute WET testing shall continue after the permit expiration date (until the permit is reissued) in accordance with the WET requirements specified for the last full calendar year of this permit. For example, the next test would be required in 1st quarter 2025.

Chronic tests shall be conducted on the same schedule as acute.

Testing: WET testing shall be performed during normal operating conditions. Permittees are not allowed to turn off or otherwise modify treatment systems, production processes, or change other operating or treatment conditions during WET tests.

Reporting: The permittee shall report test results on the Discharge Monitoring Report form, and also complete the "Whole Effluent Toxicity Test Report Form" (Section 6, "*State of Wisconsin Aquatic Life Toxicity Testing Methods Manual, 2nd Edition*"), for each test. The original, complete, signed version of the Whole Effluent Toxicity Test Report Form shall be sent to the Biomonitoring Coordinator, Bureau of Water Quality, 101 S. Webster St., P.O. Box 7921, Madison, WI 53707-7921, within 45 days of test completion. The Discharge Monitoring Report (DMR) form shall be submitted electronically by the required deadline.

Determination of Positive Results: An acute toxicity test shall be considered positive if the Toxic Unit - Acute (TU_a) is greater than 1.0 for either species. The TU_a shall be calculated as follows: $TU_a = 100 \div LC_{50}$. A chronic toxicity test shall be considered positive if the Toxic Unit - Chronic (TUc) is greater than 11 for either species. The TUc shall be calculated as follows: $TUc = 100 \div IC_{25}$.

Additional Testing Requirements: Within 90 days of a test which showed positive results, the permittee shall submit the results of at least 2 retests to the Biomonitoring Coordinator on "Whole Effluent Toxicity Test Report Forms". The 90-day reporting period shall begin the day after the test which showed a positive result. The retests shall be completed using the same species and test methods specified for the original test (see the Standard Requirements section herein).

3.2.5 Sampling Point (Outfall) 006 - UNIT 8 OCPP CONDENSER/OTHER

Monitoring Requirements and Effluent Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Flow Rate		MGD	Daily	Calculated	
pH Field	Daily Max	9.0 su	Weekly	Grab	
pH Field	Daily Min	6.0 su	Weekly	Grab	
Temperature Average		deg F	Daily	Continuous	

Monitoring Requirements and Effluent Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Temperature Maximum		deg F	Daily	Continuous	
Heat	Daily Avg	1,700 MBTU/hr	Daily	Calculated	
Mercury, Total Recoverable		ng/L	Quarterly	Grab	
Acute WET		TU_a	See Listed Qtr(s)	24-Hr Comp	Sample once during the permit term. See WET section 3.2.5.2.
Chronic WET		TU_c	See Listed Qtr(s)	24-Hr Comp	Sample once during the permit term. See WET section 3.2.5.2.
Phosphorus, Total	Monthly Avg	0.2 mg/L	Monthly	24-Hr Flow Prop Comp	

3.2.5.1 Mercury Monitoring

The permittee shall collect and analyze all mercury samples according to the data quality requirements of ss. NR 106.145(9) and (10), Wisconsin Administrative Code. The limit of quantitation (LOQ) used for the effluent and field blank shall be less than 1.3 ng/L, unless the samples are quantified at levels above 1.3 ng/L. The permittee shall collect at least one mercury field blank for each set of mercury samples (a set of samples may include combinations of intake, influent, effluent or other samples all collected on the same day). The permittee shall report results of samples and field blanks to the Department on Discharge Monitoring Reports.

3.2.5.2 Whole Effluent Toxicity (WET) Testing

Primary Control Water: Lab water is allowed in acute tests. Lake Michigan water shall be used for chronic tests.

Instream Waste Concentration (IWC): 9.1%

Dilution series: At least five effluent concentrations and dual controls must be included in each test.

- **Acute:** 100, 50, 25, 12.5, 6.25% and any additional selected by the permittee.
- **Chronic:** 100, 30, 10, 3, 1% and any additional selected by the permittee.

WET Testing Frequency:

Acute tests shall be conducted once per permit term quarter timed with other acute tests in order to collect seasonal information about the discharge. Tests are required during the following quarters.

- **Acute:** 2^{nd} quarter 2022

  Acute WET testing shall continue after the permit expiration date (until the permit is reissued) in accordance with the WET requirements specified for the last full calendar year of this permit. For example, the next test would be required in 2^{nd} quarter 2025.

Chronic tests shall be conducted on the same schedule as acute.

Testing: WET testing shall be performed during normal operating conditions. Permittees are not allowed to turn off or otherwise modify treatment systems, production processes, or change other operating or treatment conditions during WET tests.

Reporting: The permittee shall report test results on the Discharge Monitoring Report form, and also complete the "Whole Effluent Toxicity Test Report Form" (Section 6, "*State of Wisconsin Aquatic Life Toxicity Testing Methods Manual, 2nd Edition*"), for each test. The original, complete, signed version of the Whole Effluent Toxicity Test Report Form shall be sent to the Biomonitoring Coordinator, Bureau of Water Quality, 101 S. Webster St., P.O. Box 7921, Madison, WI 53707-7921, within 45 days of test completion. The Discharge Monitoring Report (DMR) form shall be submitted electronically by the required deadline.

Determination of Positive Results: An acute toxicity test shall be considered positive if the Toxic Unit - Acute (TU_a) is greater than 1.0 for either species. The TU_a shall be calculated as follows: $TU_a = 100 \div LC_{50}$. A chronic toxicity test shall be considered positive if the Toxic Unit - Chronic (TUc) is greater than 11 for either species. The TUc shall be calculated as follows: $TUc = 100 \div IC_{25}$.

Additional Testing Requirements: Within 90 days of a test which showed positive results, the permittee shall submit the results of at least 2 retests to the Biomonitoring Coordinator on "Whole Effluent Toxicity Test Report Forms". The 90-day reporting period shall begin the day after the test which showed a positive result. The retests shall be completed using the same species and test methods specified for the original test (see the Standard Requirements section herein).

3.2.6 Sampling Point (Outfall) 007 - OCPP WWTP

Monitoring Requirements and Effluent Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Flow Rate		MGD	Daily	Total Daily	
Suspended Solids, Total	Daily Max	100 mg/L	Weekly	24-Hr Flow Prop Comp	
Suspended Solids, Total	Monthly Avg	30 mg/L	Weekly	24-Hr Flow Prop Comp	
Suspended Solids, Total		lbs/day	Weekly	Calculated	
Oil & Grease (Hexane)	Daily Max	20 mg/L	Weekly	Grab	
Oil & Grease (Hexane)	Monthly Avg	15 mg/L	Weekly	Grab	
Oil & Grease (Hexane)		lbs/day	Weekly	Calculated	
pH Field	Daily Max	9.0 su	Weekly	Grab	
pH Field	Daily Min	6.0 su	Weekly	Grab	
Mercury, Total Recoverable	Daily Max	3.7 ng/L	Quarterly	Grab	
Phosphorus, Total	Monthly Avg	0.4 mg/L	Monthly	24-Hr Flow Prop Comp	
Arsenic, Total Recoverable	Daily Max	1.2 µg/L	Monthly	24-Hr Flow Prop Comp	
Acute WET		TU_a	See Listed Qtr(s)	24-Hr Comp	Sample annually in rotating quarters. See WET section 3.2.6.3.
Chronic WET		TU_c	See Listed Qtr(s)	24-Hr Comp	Sample annually in rotating quarters. See WET section 3.2.6.3.

3.2.6.1 Mercury Monitoring

The permittee shall collect and analyze all mercury samples according to the data quality requirements of ss. NR 106.145(9) and (10), Wisconsin Administrative Code. The limit of quantitation (LOQ) used for the effluent and field blank shall be less than 1.3 ng/L, unless the samples are quantified at levels above 1.3 ng/L. The permittee shall collect at least one mercury field blank for each set of mercury samples (a set of samples may include combinations of intake, influent, effluent or other samples all collected on the same day). The permittee shall report results of samples and field blanks to the Department on Discharge Monitoring Reports.

3.2.6.2 Implement Pollutant Minimization Plan

For outfall 007, this permit contains a variance from a water quality-based effluent limit (WQBEL) for mercury granted in accordance with s. NR 106.145, Wis. Adm. Code. As conditions of this variance, the permittee shall (a) maintain effluent quality at or below the effluent limitation specified in the table above, (b) implement the mercury pollutant minimization measures in the Pollutant Minimization Plan as listed in the schedule.

For outfall 007, this permit contains a variance from a water quality-based effluent limit (WQBEL) for arsenic granted in accordance with s. 283.15, Wis. Stats. As conditions of this variance, the permittee shall (a) maintain effluent quality at or below the effluent limitation specified in the table above, (b) implement an investigation as defined in s. 283.15(5)(c)2., Wis. Stats., as listed in the schedule.

3.2.6.3 Whole Effluent Toxicity (WET) Testing

Primary Control Water: Lab water is allowed in acute tests. Lake Michigan water shall be used for chronic tests.

Instream Waste Concentration (IWC): 9.1%

Dilution series: At least five effluent concentrations and dual controls must be included in each test.

- **Acute:** 100, 50, 25, 12.5, 6.25% and any additional selected by the permittee.
- **Chronic:** 100, 30, 10, 3, 1% and any additional selected by the permittee.

WET Testing Frequency:

Acute tests shall be conducted annually during the following quarters.

- **Acute:** 3rd quarter 2020, 4th quarter 2021, 1st quarter 2022, 2nd quarter 2023, and 3rd quarter 2024

  Acute WET testing shall continue after the permit expiration date (until the permit is reissued) in accordance with the WET requirements specified for the last full calendar year of this permit. For example, the next test would be required in 4th quarter 2025.

Chronic test shall be conducted on the same schedule as acute.

Testing: WET testing shall be performed during normal operating conditions. Permittees are not allowed to turn off or otherwise modify treatment systems, production processes, or change other operating or treatment conditions during WET tests.

Reporting: The permittee shall report test results on the Discharge Monitoring Report form, and also complete the "Whole Effluent Toxicity Test Report Form" (Section 6, "*State of Wisconsin Aquatic Life Toxicity Testing Methods Manual, 2nd Edition*"), for each test. The original, complete, signed version of the Whole Effluent Toxicity Test Report Form shall be sent to the Biomonitoring Coordinator, Bureau of Water Quality, 101 S. Webster St., P.O. Box 7921, Madison, WI 53707-7921, within 45 days of test completion. The Discharge Monitoring Report (DMR) form shall be submitted electronically by the required deadline.

Determination of Positive Results: An acute toxicity test shall be considered positive if the Toxic Unit - Acute (TU_a) is greater than 1.0 for either species. The TU_a shall be calculated as follows: $TU_a = 100 \div LC_{50}$. A chronic toxicity test shall be considered positive if the Toxic Unit - Chronic (TUc) is greater than 11 for either species. The TUc shall be calculated as follows: $TUc = 100 \div IC_{25}$.

Additional Testing Requirements: Within 90 days of a test which showed positive results, the permittee shall submit the results of at least 2 retests to the Biomonitoring Coordinator on "Whole Effluent Toxicity Test Report Forms". The 90-day reporting period shall begin the day after the test which showed a positive result. The retests shall be completed using the same species and test methods specified for the original test (see the Standard Requirements section herein).

3.2.7 Sampling Point (Outfall) 008 - STORM WATER AND COAL PILE RUNOFF

Monitoring Requirements and Effluent Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Flow Rate		gal/month	Per Occurrence	Estimated	
Suspended Solids, Total	Daily Max	50 mg/L	Per Occurrence	Grab	See section 3.2.7.1 of permit.

3.2.7.1 ELG Applicability

Any discharge from facilities designed, constructed, and operated to treat the volume of coal pile runoff which is associated with an event that is not in excess of a 10-year, 24 hour rainfall event is subject to the limitation of 50 mg/L maximum concentration for total suspended solids.

3.2.8 Sampling Point (Outfall) 010 - OCPP EMERGENCY OVERFLOW

Monitoring Requirements and Effluent Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Flow Rate		gal/month	Per Occurrence	Estimated	

3.2.8.1 Contaminated Storm Water

There shall be no discharge of contaminated storm water runoff bypassed through this outfall except under circumstances described in standard conditions for System Operating Requirements. Stormwater can be contaminated by coal tracking, dust from stockpiles, and when rusty or other equipment is exposed to precipitation.

3.2.9 Sampling Point (Outfall) 012 - OCPP SCREEN BACKWASH

Monitoring Requirements and Effluent Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Flow Rate		MGD	Monthly	Estimated	

3.2.9.1 Macroinvertebrate Control for OCPP

The permittee may not apply chlorine at the OCPP to control macroinvertebrates unless and until the Department approves of the permittee's macroinvertebrate management plan. If the permittee receives written approval from the Department to apply chlorine at the OCCP, the permittee may apply chlorine in accordance with the approved plan and the any conditions in the approval.

3.2.10 Sampling Point (Outfall) 013 - ERGS CONDENSER/OTHER

Monitoring Requirements and Effluent Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Flow Rate		MGD	Daily	Calculated	
Mercury, Total Recoverable	Daily Max	2.3 ng/L	Weekly	Grab	
Mercury, Total Recoverable	Monthly Avg	1.3 ng/L	Weekly	Grab	
Mercury, Total Recoverable	Monthly Avg	0.012 lbs/day	Weekly	Calculated	
Temperature Average		deg F	Daily	Continuous	
Temperature Maximum		deg F	Daily	Continuous	
Heat	Daily Avg	6,200 MBTU/hr	Daily	Calculated	
Chlorine, Total Residual	Daily Max	200 µg/L	Daily	Grab	
Chlorine, Total Resdl Discharge Time	Daily Max	120 min/day	Daily	Total Daily	
pH Field	Daily Max	9.0 su	Weekly	Grab	
pH Field	Daily Min	6.0 su	Weekly	Grab	
Acute WET		TU_a	See Listed Qtr(s)	24-Hr Flow Prop Comp	Sample annually in rotating quarters. See WET section 3.2.10.4.
Chronic WET		TU_c	See Listed Qtr(s)	24-Hr Flow Prop Comp	Sample annually in rotating quarters. See WET section 3.2.10.4.
Arsenic, Total Recoverable		µg/L	Monthly	24-Hr Flow Prop Comp	See section 3.2.10.6.
Phosphorus, Total	Monthly Avg	0.2 mg/L	Monthly	24-Hr Flow Prop Comp	

3.2.10.1 Mercury Monitoring

The permittee shall collect and analyze all mercury samples according to the data quality requirements of ss. NR 106.145(9) and (10), Wisconsin Administrative Code. The limit of quantitation (LOQ) used for the effluent and field blank shall be less than 1.3 ng/L, unless the samples are quantified at levels above 1.3 ng/L. The permittee shall collect at least one mercury field blank for each set of mercury samples (a set of samples may include combinations of intake, influent, effluent or other samples all collected on the same day). The permittee shall report results of samples and field blanks to the Department on Discharge Monitoring Reports.

3.2.10.2 Total Residual Chlorine Limitations

There shall be no discharge of free available chlorine or total residual chlorine for more than 2 hours per unit per day nor shall the chlorine concentration be greater than 0.20 mg/L at any time. The time of chlorine discharge may be reported as being equivalent to the time of chlorine addition or, alternatively, as the time that detectable levels of chlorine, using the analysis methods specified in this permit's "Chlorine Compliance and Analysis Methods" Standard Condition, are present in the cooling water discharge. The time of chlorine discharge shall be monitored and summed for each day that chlorine is added to the condenser cooling water system.

3.2.10.3 Chlorine Sampling Procedure

One grab sample for total residual chlorine shall be collected during the period when the chlorine discharge of each chlorination event is the greatest. The discharge monitoring reported value shall be the maximum of the chlorination events for that day. A continuous monitor may be used to determine the greatest value and length of chlorine discharge as long as it duplicates the accuracy of a NR 219 approved method.

3.2.10.4 Whole Effluent Toxicity (WET) Testing

Primary Control Water: Lab water is allowed in acute tests. Lake Michigan water shall be used for chronic tests.

Instream Waste Concentration (IWC): 9.1%

Dilution series: At least five effluent concentrations and dual controls must be included in each test.

- **Acute:** 100, 50, 25, 12.5, 6.25% and any additional selected by the permittee.
- **Chronic:** 100, 30, 10, 3, 1% and any additional selected by the permittee.

WET Testing Frequency:

Acute tests shall be conducted annually during the following quarters.

- **Acute:** 3rd quarter 2020, 4th quarter 2021, 1st quarter 2022, 2nd quarter 2023, and 3rd quarter 2024

  Acute WET testing shall continue after the permit expiration date (until the permit is reissued) in accordance with the WET requirements specified for the last full calendar year of this permit. For example, the next test would be required in 4th quarter 2025.

Chronic test shall be conducted on the same schedule as acute.

Testing: WET testing shall be performed during normal operating conditions. Permittees are not allowed to turn off or otherwise modify treatment systems, production processes, or change other operating or treatment conditions during WET tests.

Reporting: The permittee shall report test results on the Discharge Monitoring Report form, and also complete the "Whole Effluent Toxicity Test Report Form" (Section 6, "*State of Wisconsin Aquatic Life Toxicity Testing Methods Manual, 2nd Edition*"), for each test. The original, complete, signed version of the Whole Effluent Toxicity Test Report Form shall be sent to the Biomonitoring Coordinator, Bureau of Water Quality, 101 S. Webster St., P.O. Box 7921, Madison, WI 53707-7921, within 45 days of test completion. The Discharge Monitoring Report (DMR) form shall be submitted electronically by the required deadline.

Determination of Positive Results: An acute toxicity test shall be considered positive if the Toxic Unit - Acute (TU_a) is greater than 1.0 for either species. The TU_a shall be calculated as follows: $TU_a = 100 \div LC_{50}$. A chronic toxicity test shall be considered positive if the Toxic Unit - Chronic (TUc) is greater than 11 for either species. The TUc shall be calculated as follows: $TUc = 100 \div IC_{25}$.

Additional Testing Requirements: Within 90 days of a test which showed positive results, the permittee shall submit the results of at least 2 retests to the Biomonitoring Coordinator on "Whole Effluent Toxicity Test Report Forms". The 90-day reporting period shall begin the day after the test which showed a positive result. The retests shall be completed using the same species and test methods specified for the original test (see the Standard Requirements section herein).

3.2.10.5 ERGS Macroinvertebrate Control

The permittee shall not apply chlorine to control macroinvertebrates. The permittee may employ thermal treatments to control macroinvertebrates, subject to the conditions of this section. The permittee shall indicate on the Discharge Monitoring Reports the periods in which thermal treatment is used. The permittee shall adhere to the following treatment protocol:

- Treatments may be conducted between late spring and late summer during the zebra mussel growth period.
- Treatments shall not be conducted more than three times per year.
- Each generating unit shall be thermally treated separately (i.e., simultaneous treatment of both units is prohibited).
- Treatments shall take place only when all cooling water pumps available are operating consistent with good plant operation.
- The treatment period shall not exceed a maximum of five hours.
- The discharge temperature from outfall 013 shall not exceed 85F.
- The maximum allowable temperature increase, measured at outfall 013 relative to background, shall be 25F.
- A cool-down sequence shall be employed following the thermal treatment; there shall be no sudden drops of temperature at outfall 013.

3.2.10.6 Effluent Limitations Based on Elevated Background Concentrations

The permittee shall not contribute to a statistically significant increase in arsenic intake concentration, as determined by comparing to the concentration of arsenic in the effluent (sample point 013) and intake water (sample point 606). The values of representative effluent and background concentrations for arsenic shall be statistically (P not greater than 0.01) determined using a 30-day basis (i.e. a 30-day P99) and using data for the previous five calendar years. The upper 99th percentile of 30-day average (30-day P99) discharge concentration of the substance shall be determined using the methodology specified in s. NR 106.05(5), Wis. Adm. Code. Compliance with this requirement shall be evaluated annually. The permittee shall recalculate the respective 30-day P99 values on an annual basis and submit as an annual report.

3.2.10.7 Reopener Clause

This clause authorizes modification or revocation and reissuance of the permit if new information indicates the permittee contributes to a statistically significant increase in arsenic intake substance concentration.

3.2.11 Sampling Point (Outfall) 014 - Coal Storage Runoff

Monitoring Requirements and Effluent Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Flow Rate		gpd	Daily	Estimated	
Suspended Solids, Total	Daily Max	50 mg/L	Daily	Grab	See section 3.2.11.1 of permit.

3.2.11.1 ELG Applicability

Any untreated discharge from facilities designed, constructed, and operated to treat the volume of coal pile runoff which is associated with a 10-year, 24 hour rainfall event may not be subject to the limitations of 50 mg/L maximum concentration for total suspended solids.

3.2.11.2 ERGS Emergency Overflows

There shall be no discharge from outfall 014 for rainfall events less than the 10-year, 24-hour storm. Monitoring requirements for outfall 014 are applicable only when there is runoff resulting from a storm event exceeding a 10-year, 24-hour storm. Under these circumstances, runoff may be discharged without treatment, and the discharge from these outfalls shall be considered an emergency overflow. The permittee shall report any such overflows in accordance with the procedures of standard conditions for System Operating Requirements.

3.2.12 Sampling Point (Outfall) 015 - Limestone/gypsum area runoff

Monitoring Requirements and Effluent Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Flow Rate		gpd	Daily	Estimated	
Suspended Solids, Total			Daily	Grab	

3.2.12.1 ERGS Emergency Overflows

There shall be no discharge from outfall 015 for rainfall events less than the 10-year, 24-hour storm. Monitoring requirements for outfall 015 are applicable only when there is runoff resulting from a storm event exceeding a 10-year, 24-hour storm. Under these circumstances, runoff may be discharged without treatment, and the discharge from these outfalls shall be considered an emergency overflow. The permittee shall report any such overflows in accordance with the procedures of standard conditions for System Operating Requirements.

3.2.13 Sampling Point (Outfall) 907 - SUM OF MASS ERGS, OCPP

Monitoring Requirements and Effluent Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Suspended Solids, Total	Daily Max	7,205 lbs/day	Daily	Calculated	
Suspended Solids, Total	Monthly Avg	1,351 lbs/day	Daily	Calculated	
Oil & Grease (Hexane)	Daily Max	1,441 lbs/day	Weekly	Calculated	
Oil & Grease (Hexane)	Monthly Avg	675 lbs/day	Weekly	Calculated	

3.2.13.1 Calculations

Where data is not available for a daily calculation, the permittee shall use the data from the most recent sample results.

3.2.13.2 Calculated Discharge for Outfall 907

The sum of the masses of suspended solids and oil & grease from sample points 107, 108, 109, and 007 shall be limited in accordance with the table and reported as outfall 907.

3.2.14 Sampling Point 606 - Background Mercury and Arsenic

Monitoring Requirements and Effluent Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Mercury, Total Recoverable		ng/L	Quarterly	Grab	
Arsenic, Total Recoverable		µg/L	Monthly	24-Hr Flow Prop Comp	

3.2.14.1 Mercury Monitoring

The permittee shall collect and analyze all mercury samples according to the data quality requirements of ss. NR 106.145(9) and (10), Wisconsin Administrative Code. The limit of quantitation (LOQ) used for the effluent and field blank shall be less than 1.3 ng/L, unless the samples are quantified at levels above 1.3 ng/L. The permittee shall collect at least one mercury field blank for each set of mercury samples (a set of samples may include combinations of intake, influent, effluent or other samples all collected on the same day). The permittee shall report results of samples and field blanks to the Department on Discharge Monitoring Reports.

3.2.15 Sampling Point 605 - Background for Temperature

Monitoring Requirements and Effluent Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Temperature Average		deg F	Daily	Continuous	

3.2.16 Sampling Point 604 - Unit 6 OCPP Influent FAH & BAH

Monitoring Requirements and Effluent Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Suspended Solids, Total		mg/L	2/Month	24-Hr Comp	

3.2.17 Sampling Point 603 - Unit 5 OCPP Influent FAH & BAH

Monitoring Requirements and Effluent Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Suspended Solids, Total		mg/L	2/Month	24-Hr Comp	

4 Schedules

4.1 Compliance with Federal ELG for FGD

The permittee shall comply with applicable federal ELG requirements for FGD wastewater no later than 12/31/2023 unless there is a new ELG Rulemaking that defines the final best available technology (BAT) requirements for flue gas desulfurization (FGD) wastewater (i.e., numeric limitations, BAT technology, etc.) and/or changes to the applicability dates for FGD wastewater. If there is new ELG Rulemaking that defines the final BAT requirements for flue gas desulfurization (FGD) wastewater (i.e., numeric limitations, BAT technology, etc.) and/or changes to the applicability dates for FGD wastewater rules then the permittee shall comply with the ELG by the earlier of 36 months from the effective date of a new ELG Rulemaking or the applicability dates for FGD wastewater.

4.2 Compliance with Federal ELG for Bottom Ash Transport Water

If the permittee elects to comply with applicable federal requirements for bottom ash transport water (BATW) (40 CFR 423.13 (k)) by implementing a technology other than re-use of BATW in the FGD scrubber, the permittee shall comply with such requirements by 12/31/2021. If the permittee elects to comply with applicable federal requirements for BATW water by reusing the BATW in the flue gas desulfurization scrubber, the discharge shall be diverted to the scrubber by 12/31/2021 (in order to comply with section 4.3 below), and selenium and nitrate/nitrite as N limitations will become effective on 12/31/2023 (in order to comply with 40 CFR 423.13 (g)(1)(i) or (3)(i) and section 4.1 above).

If construction authorization from the Public Service Commission is required prior to commencement of construction, the permittee must notify the department in writing and must seek this approval no later than 90 days after the effective date of this permit. If this authorization is required, the due date for this action shall be 24 months after construction authorization is granted or June 30, 2022, whichever is earlier. If construction authorization is not required, the due date for this action is December 31, 2021.

4.3 Arsenic Pollutant Minimization Program

As a condition of the variance to the water quality based effluent limitation(s) for arsenic, as defined in s. 283.15(5)(c)2., Wis. Stats, the permittee shall perform the following actions.

Required Action	Due Date
Annual Arsenic Progress Report: The permittee shall submit to the Department an annual progress report that shall discuss which arsenic pollutant minimization measures have been implemented during the period from the permit effective date to December 31, 2019. The report shall include an analysis of trends in monthly, quarterly, and annual total intake and effluent arsenic concentrations and mass discharge of arsenic based on sampling and flow data. The report shall provide an update on the permittee's: (1) progress in implementing pollutant minimization measures, operational improvements, and facility modifications to optimize reductions in arsenic discharges and, (2) status of evaluating the feasible alternatives for meeting arsenic WQBELs. Note that the monthly average interim limitation of 1.2 ug/L remains enforceable until new enforceable limits are established at the next permit reissuance or modification. The first annual progress report is to be submitted by the Date Due.	12/31/2019

Annual Arsenic Progress Report #2: Submit a progress report as defined above for the previous calendar year. **Repurpose:** The progress report shall also include an evaluation on whether to repurpose relatively new wastewater treatment equipment from Pleasant Prairie Power Plant after it retires in 2018 to further reduce arsenic concentrations at OCPP Outfall 007. Equipment that will be evaluated include the ultrafiltration membranes, multi-media filters, and other ancillary equipment.	12/31/2020
Annual Arsenic Progress Report #3: Submit a progress report as defined above for the previous calendar year. The permittee shall also perform the following actions and include the evaluation and/or progress of implementation the identified actions in the annual report. **1. Bottom Ash:** Continue to evaluate bottom ash handling technologies for OCPP Units 7 & 8 including but not limited to: a dry bottom ash handling system, a recirculating BATW closed loop system, or a reuse system (e.g., in the FGD system). If an EPA rulemaking identifies a different BAT technology, that technology shall also be included in the evaluation. The selected technology shall be that which results in the lowest mass loading of (i.e. highest attainable condition for) mercury and arsenic to the receiving water. If the permittee demonstrates to the department that two or more technologies will result in comparable reductions in loading of mercury and arsenic and receives written department concurrence, the permittee may implement either technology. If the technology that would result in the greatest reduction in arsenic and mercury is infeasible for technical reasons and the department concurs with this determination in writing, the permittee may implement the technology expected to achieve the next greatest reduction in mercury and arsenic loading. Begin activities to design, engineer, and conduct pilot tests (if needed) of the selected BATW technology. If the project is reviewable under ch. NR 108, Wis. Adm. Code, plans and specifications must be submitted to the department for plan review, and construction of the project may not commence until the Department has approved the project plans. Implement the selected BATW solution at Units 7 & 8 by 12/31/2021. This requirement is a separate requirement from the requirement in section 4.2, and it will not be extended or changed based on the content or date of promulgation of the federal ELG. If construction authorization from the Public Service Commission is required prior to commencement of construction, the permittee must notify the department in writing and must seek this approval no later than 90 days after the effective date of this permit. If this authorization is required, the due date for this action shall be 24 months after construction authorization is granted or June 30, 2022, whichever is earlier. If construction authorization is not required, the due date for this action is December 31, 2021. **2. FGD Implementation:** Begin activities to expeditiously plan, design, procure, and install equipment to meet the FGD limits established in EPA's forthcoming regulation on the ELG. **3. Arsenic Treatment:** Conduct an updated Evaluation of Treatment Technologies for Arsenic Removal at Outfall 007. This would be an update to the CH2M evaluation conducted in 2013 (and included in the arsenic variance application) to determine whether there are better, more cost-effective technologies available at the time of submittal. The evaluation would also address whether it is cost-effective to segregate and treat individual wastewaters. Updated cost estimates would be provided for feasible technologies.	12/31/2021
Annual Arsenic Progress Report #4: Submit a progress report as defined above for the previous calendar year. The permittee shall also evaluate and/or implement the following activities and include the evaluation and/or progress of implementation in the annual report. **1. FGD:** Review the treatment technology evaluations for FGD wastewater treatment (e.g., evaporation, zero valent iron, and biological treatment) to help decide which technology to	12/31/2022

pursue at OCER. Conduct a pilot test, as needed, using the candidate treatment technology. Evaluate the impacts to arsenic reduction. 2. **Bench Scale:** Conduct bench-scale studies to test feasible technology alternative(s) that could be employed upstream of Outfall 007.	
Annual Arsenic Progress Report #5: Submit a progress report as defined above for the previous calendar year. **Fuel Source Evaluation:** Short-term Evaluation: Conduct an analysis of arsenic content of the current coal source and other available coal sources. Include a discussion of how differences in arsenic content of coal may impact effluent concentrations at Outfall 007. Long-term Evaluation: Describe the design life/expected remaining useful life of the generating units currently in operation. Discuss any plans, considerations, or potential plans for abandonment or repurposing of the units to use alternative fuel sources that may result in lower arsenic discharges via Outfall 007. Propose actions that will be taken to consider arsenic loading as a part of future decision making on long-term planning for fuel sources.	12/31/2023
Final Arsenic Report: Submit a final report documenting the success in reducing arsenic concentrations in the effluent, as well as any anticipated future reduction in arsenic sources and arsenic effluent concentrations. The report shall summarize arsenic pollutant minimization activities that have been implemented during the current permit term and state which, if any, pollutant minimization activities were not pursued and why. The report shall also include a trend analysis on effluent data for arsenic at outfall 013. Additionally, if the permittee intends to seek to re-apply for an arsenic variance per s. 283.15, Wis. Stats for the reissued permit, a detailed pollutant minimization plan outlining the pollutant minimization activities proposed for the upcoming permit term should be submitted along with the final report.	03/31/2024
Annual Arsenic Progress Reports After Permit Expiration: In the event that this permit is not reissued on time, the permittee shall continue to submit annual arsenic progress reports each year covering pollutant minimization activities implemented and arsenic data trends. The report is due no later than January 31 for the previous year's activities.	

4.4 Pollutant Minimization Plan for Mercury

As a condition of the variance to the water quality based effluent limitation(s) for mercury granted in accordance with s. NR 106.145(6), Wis. Adm. Code, the permittee shall perform the following actions.

Required Action	Due Date
Annual Mercury Progress Report: The permittee shall submit to the Department an annual progress report that shall discuss which mercury pollutant minimization measures have been implemented during the period from the permit effective date to December 31, 2019. The report shall include an analysis of trends in monthly, quarterly, and annual total intake and effluent mercury concentrations and mass discharge of mercury based on sampling and flow data. The report shall provide an update on the permittee's: (1) progress in implementing pollutant minimization measures, operational improvements, and facility modifications to optimize reductions in mercury discharges and, (2) status of evaluating the feasible alternatives for meeting mercury WQBELs.	12/31/2019

Note that the monthly average interim limitation of 3.7 ng/L remains enforceable until new enforceable limits are established at the next permit reissuance or modification. The first annual progress report is to be submitted by the Date Due.	
Annual Mercury Progress Report #2: Submit a progress report as defined above for the previous calendar year. **1. Source Identification:** The first step will be to identify wastewaters that are potential sources of mercury influent to the Oak Creek Power Plant (OCPP) wastewater treatment facility. Following the source identification step, some of these wastewaters will be sampled and analytical work will be completed using the EPA 1631 low level mercury method. Based on the results of the sampling and analysis work, options for pollution prevention and wastewater treatment will be evaluated. Approaches to reduce mercury via source elimination or reduction will be evaluated to determine costs and cost-effectiveness. **2. Repurpose:** The progress report shall also include an evaluation on whether to repurpose relatively new wastewater treatment equipment from Pleasant Prairie Power Plant after it retires in 2018 to further reduce mercury concentrations at OCPP Outfall 007. Equipment that will be evaluated include the ultrafiltration membranes, multi-media filters, and other ancillary equipment.	12/31/2020
Annual Mercury Progress Report #3: Submit a progress report as defined above for the previous calendar year. The permittee shall also perform the following actions and include the evaluation and/or progress of implementation the identified actions in the annual report. **1. Bottom Ash:** Continue to evaluate bottom ash handling technologies for OCPP Units 7 & 8 including but not limited to: a dry bottom ash handling system, a recirculating BATW closed loop system, or a reuse system (e.g., in the FGD system). If an EPA rulemaking identifies a different BAT technology, that technology shall also be included in the evaluation. The selected technology shall be that which results in the lowest mass loading of (i.e. highest attainable condition for) mercury and arsenic to the receiving water. If the permittee demonstrates to the department that two or more technologies will result in comparable reductions in loading of mercury and arsenic and receives written department concurrence, the permittee may implement either technology. If the technology that would result in the greatest reduction in arsenic and mercury is infeasible for technical reasons and the department concurs with this determination in writing, the permittee may implement the technology expected to achieve the next greatest reduction in mercury and arsenic loading. Begin activities to design, engineer, and conduct pilot tests (if needed) of the selected BATW technology. If the project is reviewable under ch. NR 108, Wis. Adm. Code, plans and specifications must be submitted to the department for plan review, and construction of the project may not commence until the Department has approved the project plans. Implement the selected BATW solution at Units 7 & 8 by 12/31/2021. This requirement is a separate requirement from the requirement in section 4.2, and it will not be extended or changed based on the content or date of promulgation of the federal ELG. If construction authorization from the Public Service Commission is required prior to commencement of construction, the permittee must notify the department in writing and must seek this approval no later than 90 days after the effective date of this permit. If this authorization is required, the due date for this action shall be 24 months after construction authorization is granted or June 30, 2022, whichever is earlier. If construction authorization is not required, the due date for this action is December 31, 2021.	12/31/2021

2. FGD Implementation: Begin activities to expeditiously plan, design, procure, and install equipment to meet the FGD limits established in EPA's forthcoming regulation on the ELG. **3. Mercury Treatment:** Conduct an updated Evaluation of Treatment Technologies for Mercury Removal at Outfall 007. This would be an update to determine whether there are better, more cost-effective technologies available at the time of submittal. The evaluation would also address whether it is cost-effective to segregate and treat individual wastewaters. Updated cost estimates would be provided for feasible technologies.	
Annual Mercury Progress Report #4: Submit a progress report as defined above for the previous calendar year. The permittee shall also evaluate and/or implement the following activities and include the evaluation and/or progress of implementation in the annual report. **1. FGD:** Review the treatment technology evaluations for FGD wastewater treatment (e.g., evaporation, zero valent iron, and biological treatment) to help decide which technology to pursue at OCER. Conduct a pilot test, as needed, using the candidate treatment technology. Evaluate the impacts to mercury reduction. **2. Bench Scale:** Conduct bench-scale studies to test feasible technology alternative(s) that could be employed upstream of Outfall 007.	12/31/2022
Annual Mercury Progress Report #5: Submit a progress report as defined above for the previous calendar year. **Fuel Source Evaluation:** Short-term Evaluation: Conduct an analysis of mercury content of the current coal source and other available coal sources. Include a discussion of how differences in mercury content of coal may impact effluent concentrations at Outfall 007. Long-term Evaluation: Describe the design life/expected remaining useful life of the generating units currently in operation. Discuss any plans, considerations, or potential plans for abandonment of the units or repurposing of the units to use alternative fuel sources that may result in lower mercury discharges via Outfall 007. Propose actions that will be taken to consider mercury loading as a part of future decision making on long-term planning for fuel sources.	12/31/2023
Final Mercury Report: Submit a final report documenting the success in reducing mercury concentrations in the effluent, as well as any anticipated future reduction in mercury sources and mercury effluent concentrations. The report shall summarize mercury pollutant minimization activities that have been implemented during the current permit term and state which, if any, pollutant minimization activities were not pursued and why. The report shall also include a trend analysis on effluent data for mercury at outfall 013. Additionally, if the permittee intends to seek to re-apply for a mercury variance per s. 283.15, Wis. Stats for the reissued permit, a detailed pollutant minimization plan outlining the pollutant minimization activities proposed for the upcoming permit term should be submitted along with the final report.	03/31/2024
Annual Mercury Progress Reports After Permit Expiration: In the event that this permit is not reissued on time, the permittee shall continue to submit annual mercury progress reports each year covering pollutant minimization activities implemented and mercury data trends. The report is due no later than January 31 for the previous year's activities.	

5 Standard Requirements

NR 205, Wisconsin Administrative Code (Conditions for Industrial Dischargers): The conditions in ss. NR 205.07(1) and NR 205.07(3), Wis. Adm. Code, are included by reference in this permit. The permittee shall comply with all of these requirements. Some of these requirements are outlined in the Standard Requirements section of this permit. Requirements not specifically outlined in the Standard Requirement section of this permit can be found in ss. NR 205.07(1) and NR 205.07(3).

5.1 Reporting and Monitoring Requirements

5.1.1 Monitoring Results

Monitoring results obtained during the previous month shall be summarized and reported on a Department Wastewater Discharge Monitoring Report. The report may require reporting of any or all of the information specified below under 'Recording of Results'. This report is to be returned to the Department no later than the date indicated on the form. A copy of the Wastewater Discharge Monitoring Report Form or an electronic file of the report shall be retained by the permittee.

Monitoring results shall be reported on an electronic discharge monitoring report (eDMR). The eDMR shall be certified electronically by a responsible executive or officer, manager, partner or proprietor as specified in s. 283.37(3), Wis. Stats., or a duly authorized representative of the officer, manager, partner or proprietor that has been delegated signature authority pursuant to s. NR 205.07(1)(g)2, Wis. Adm. Code. The 'eReport Certify' page certifies that the electronic report form is true, accurate and complete.

If the permittee monitors any pollutant more frequently than required by this permit, the results of such monitoring shall be included on the Wastewater Discharge Monitoring Report.

The permittee shall comply with all limits for each parameter regardless of monitoring frequency. For example, monthly, weekly, and/or daily limits shall be met even with monthly monitoring. The permittee may monitor more frequently than required for any parameter.

5.1.2 Sampling and Testing Procedures

Sampling and laboratory testing procedures shall be performed in accordance with Chapters NR 218 and NR 219, Wis. Adm. Code and shall be performed by a laboratory certified or registered in accordance with the requirements of ch. NR 149, Wis. Adm. Code. Groundwater sample collection and analysis shall be performed in accordance with ch. NR 140, Wis. Adm. Code. The analytical methodologies used shall enable the laboratory to quantitate all substances for which monitoring is required at levels below the effluent limitation. If the required level cannot be met by any of the methods available in NR 219, Wis. Adm. Code, then the method with the lowest limit of detection shall be selected. Additional test procedures may be specified in this permit.

5.1.3 Recording of Results

The permittee shall maintain records which provide the following information for each effluent measurement or sample taken:

- the date, exact place, method and time of sampling or measurements;
- the individual who performed the sampling or measurements;
- the date the analysis was performed;
- the individual who performed the analysis;
- the analytical techniques or methods used; and

- the results of the analysis.

5.1.4 Reporting of Monitoring Results

The permittee shall use the following conventions when reporting effluent monitoring results:

- Pollutant concentrations less than the limit of detection shall be reported as < (less than) the value of the limit of detection. For example, if a substance is not detected at a detection limit of 0.1 mg/L, report the pollutant concentration as < 0.1 mg/L.

- Pollutant concentrations equal to or greater than the limit of detection, but less than the limit of quantitation, shall be reported and the limit of quantitation shall be specified.

- For purposes of calculating NR 101 fees, the 2 mg/l lower reporting limits for BOD_5 and Total Suspended Solids shall be considered to be limits of quantitation

- For the purposes of reporting a calculated result, average or a mass discharge value, the permittee may substitute a 0 (zero) for any pollutant concentration that is less than the limit of detection. However, if the effluent limitation is less than the limit of detection, the department may substitute a value other than zero for results less than the limit of detection, after considering the number of monitoring results that are greater than the limit of detection and if warranted when applying appropriate statistical techniques.

5.1.5 Records Retention

The permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings or electronic data records for continuous monitoring instrumentation, copies of all reports required by the permit, and records of all data used to complete the application for the permit for a period of at least 3 years from the date of the sample, measurement, report or application, except for sludge management forms and records, which shall be kept for a period of at least 5 years.

5.1.6 Other Information

Where the permittee becomes aware that it failed to submit any relevant facts in a permit application or submitted incorrect information in a permit application or in any report to the Department, it shall promptly submit such facts or correct information to the Department.

5.1.7 Reporting Requirements – Alterations or Additions

The permittee shall give notice to the Department as soon as possible of any planned physical alterations or additions to the permitted facility. Notice is only required when:

- The alteration or addition to the permitted facility may meet one of the criteria for determining whether a facility is a new source.
- The alteration or addition could significantly change the nature or increase the quantity of pollutants discharged. This notification requirement applies to pollutants which are not subject to effluent limitations in the existing permit.
- The alteration or addition results in a significant change in the permittee’s sludge use or disposal practices, and such alteration, addition, or change may justify the application of permit conditions that are different from or absent in the existing permit, including notification of additional use of disposal sites not reported during the permit application process nor reported pursuant to an approved land application plan. Additional sites may not be used for the land application of sludge until department approval is received.

5.2 System Operating Requirements

5.2.1 Noncompliance Reporting

The permittee shall report the following types of noncompliance by a telephone call to the Department's regional office within 24 hours after becoming aware of the noncompliance:

- any noncompliance which may endanger health or the environment;
- any violation of an effluent limitation resulting from a bypass;
- any violation of an effluent limitation resulting from an upset; and
- any violation of a maximum discharge limitation for any of the pollutants listed by the Department in the permit, either for effluent or sludge.

A written report describing the noncompliance shall also be submitted to the Department as directed at the end of this permit within 5 days after the permittee becomes aware of the noncompliance. On a case-by-case basis, the Department may waive the requirement for submittal of a written report within 5 days and instruct the permittee to submit the written report with the next regularly scheduled monitoring report. In either case, the written report shall contain a description of the noncompliance and its cause; the period of noncompliance, including exact dates and times; the steps taken or planned to reduce, eliminate and prevent reoccurrence of the noncompliance; and if the noncompliance has not been corrected, the length of time it is expected to continue.

A scheduled bypass approved by the Department under the ‘Scheduled Bypass’ section of this permit shall not be subject to the reporting required under this section.

NOTE: Section 292.11(2)(a), Wisconsin Statutes, requires any person who possesses or controls a hazardous substance or who causes the discharge of a hazardous substance to notify the Department of Natural Resources **immediately** of any discharge not authorized by the permit. **The discharge of a hazardous substance that is not authorized by this permit or that violates this permit may be a hazardous substance spill. To report a hazardous substance spill, call DNR's 24-hour HOTLINE at 1-800-943-0003**.

5.2.2 Bypass

Except for a controlled diversion as provided in the ‘Controlled Diversions’ section of this permit, any bypass is prohibited and the Department may take enforcement action against a permittee for such occurrences under s. 283.89, Wis. Stats. The Department may approve a bypass if the permittee demonstrates all the following conditions apply:

- The bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;
- There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities or adequate back-up equipment, retention of untreated wastes, reduction of inflow and infiltration, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate back-up equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass which occurred during normal periods of equipment downtime or preventative maintenance. When evaluating feasibility of alternatives, the department may consider factors such as technical achievability, costs and affordability of implementation and risks to public health, the environment and, where the permittee is a municipality, the welfare of the community served; and
- The bypass was reported in accordance with the ‘Noncompliance Reporting’ section of this permit.

5.2.3 Scheduled Bypass

Whenever the permittee anticipates the need to bypass for purposes of efficient operations and maintenance and the permittee may not meet the conditions for controlled diversions in the ‘Controlled Diversions’ section of this permit, the permittee shall obtain prior written approval from the Department for the scheduled bypass. A permittee’s written request for Department approval of a scheduled bypass shall demonstrate that the conditions for unscheduled bypassing are met and include the proposed date and reason for the bypass, estimated volume and duration of the bypass, alternatives to bypassing and measures to mitigate environmental harm caused by the bypass. The department may require the permittee to provide public notification for a scheduled bypass if it is determined there is significant public interest in the proposed action and may recommend mitigation measures to minimize the impact of such bypass.

5.2.4 Controlled Diversions

Controlled diversions are allowed only when necessary for essential maintenance to assure efficient operation provided the following requirements are met:

- Effluent from the wastewater treatment facility shall meet the effluent limitations established in the permit. Wastewater that is diverted around a treatment unit or treatment process during a controlled diversion shall be recombined with wastewater that is not diverted prior to the effluent sampling location and prior to effluent discharge;
- A controlled diversion may not occur during periods of excessive flow or other abnormal wastewater characteristics;
- A controlled diversion may not result in a wastewater treatment facility overflow; and
- All instances of controlled diversions shall be documented in wastewater treatment facility records and such records shall be available to the department on request.

5.2.5 Proper Operation and Maintenance

The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control which are installed or used by the permittee to achieve compliance with the conditions of this permit. Proper operation and maintenance includes effective performance, adequate funding, adequate operator staffing and training as required in ch. NR 114, Wis. Adm. Code, and adequate laboratory and process controls, including appropriate quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems only when necessary to achieve compliance with the conditions of the permit.

5.2.6 Operator Certification

The wastewater treatment facility shall be under the direct supervision of a state certified operator. In accordance with s. NR 114.53, Wis. Adm. Code, every WPDES permitted treatment plant shall have a designated operator-in-charge holding a current and valid certificate. The designated operator-in-charge shall be certified at the level and in all subclasses of the treatment plant, except laboratory. Treatment plant owners shall notify the department of any changes in the operator-in-charge within 30 days. Note that s. NR 114.52(22), Wis. Adm. Code, lists types of facilities that are excluded from operator certification requirements (i.e. private sewage systems, pretreatment facilities discharging to public sewers, industrial wastewater treatment that consists solely of land disposal, agricultural digesters and concentrated aquatic production facilities with no biological treatment).

5.2.7 Spill Reporting

The permittee shall notify the Department in accordance with ch. NR 706 (formerly NR 158), Wis. Adm. Code, in the event that a spill or accidental release of any material or substance results in the discharge of pollutants to the waters of the state at a rate or concentration greater than the effluent limitations established in this permit, or the spill or accidental release of the material is unregulated in this permit, unless the spill or release of pollutants has been reported to the Department in accordance with s. NR 205.07 (1)(s), Wis. Adm. Code.

5.2.8 Planned Changes

In accordance with ss. 283.31(4)(b) and 283.59, Stats., the permittee shall report to the Department any facility expansion, production increase or process modifications which will result in new, different or increased discharges of pollutants. The report shall either be a new permit application, or if the new discharge will not violate the effluent limitations of this permit, a written notice of the new, different or increased discharge. The notice shall contain a description of the new activities, an estimate of the new, different or increased discharge of pollutants and a description of the effect of the new or increased discharge on existing waste treatment facilities. Following receipt of this report, the Department may modify this permit to specify and limit any pollutants not previously regulated in the permit.

5.2.9 Duty to Halt or Reduce Activity

Upon failure or impairment of treatment facility operation, the permittee shall, to the extent necessary to maintain compliance with its permit, curtail production or wastewater discharges or both until the treatment facility operations are restored or an alternative method of treatment is provided.

5.3 Surface Water Requirements

5.3.1 Permittee-Determined Limit of Quantitation Incorporated into this Permit

For pollutants with water quality-based effluent limits below the Limit of Quantitation (LOQ) in this permit, the LOQ calculated by the permittee and reported on the Discharge Monitoring Reports (DMRs) is incorporated by reference into this permit. The LOQ shall be reported on the DMRs, shall be the lowest quantifiable level practicable, and shall be no greater than the minimum level (ML) specified in or approved under 40 CFR Part 136 for the pollutant at the time this permit was issued, unless this permit specifies a higher LOQ.

5.3.2 Appropriate Formulas for Effluent Calculations

The permittee shall use the following formulas for calculating effluent results to determine compliance with average concentration limits and mass limits and total load limits:

Weekly/Monthly/Six-Month/Annual Average Concentration = the sum of all daily results for that week/month/six-month/year, divided by the number of results during that time period. [Note: When a six-month average effluent limit is specified for Total Phosphorus the applicable periods are May through October and November through April.]

Weekly Average Mass Discharge (lbs/day): Daily mass = daily concentration (mg/L) x daily flow (MGD) x 8.34, then average the daily mass values for the week.

Monthly Average Mass Discharge (lbs/day): Daily mass = daily concentration (mg/L) x daily flow (MGD) x 8.34, then average the daily mass values for the month.

Six-Month Average Mass Discharge (lbs/day): Daily mass = daily concentration (mg/L) x daily flow (MGD) x 8.34, then average the daily mass values for the six-month period. [Note: When a six-month average effluent limit is specified for Total Phosphorus the applicable periods are May through October and November through April.]

Annual Average Mass Discharge (lbs/day): Daily mass = daily concentration (mg/L) x daily flow (MGD) x 8.34, then average the daily mass values for the entire year.

Total Monthly Discharge: = monthly average concentration (mg/L) x total flow for the month (MG/month) x 8.34.

Total Annual Discharge: = sum of total monthly discharges for the calendar year.

12-Month Rolling Sum of Total Monthly Discharge: = the sum of the most recent 12 consecutive months of Total Monthly Discharges.

5.3.3 Effluent Temperature Requirements

The permittee shall use the following formula for calculating the heat addition from the OCPP condenser cooling water outfalls 003, 004, 005 and 006:
The permittee is authorized to use the EtaPRO power plant performance evaluation software to determine the daily average heat addition from the condensers for OCPP Units 5-8 that discharge to the outfalls listed above. This

program is used to determine the difference in the enthalpy (a measure of heat content, "H") of the steam at the condenser inlet and outlet. The heat transferred to the cooling water discharged to each outfall is equal to the difference in enthalpy (ΔH) of the steam between the condenser inlet (Hin) and outlet (Hout) for each of the OCPP units. The daily average heat addition shall be expressed in million British thermal units per hour (MMBTU/hr). When the generating unit is on-line, the daily average flow rate for each outfall shall be calculated as follows:

Heat discharge (MMBTU/hr) = ΔH = Hin – Hout

Flow = ΔH (MMBTU/hr) / ΔT x 0.3475)

Where: Flow = average daily cooling water flow rate in million gallons per day (mgd).
ΔT is the average daily difference between background (Lake Michigan) and condenser outlet water box temperature, in degrees Fahrenheit (F) and 0.3475 is a conversion factor.

When a generating unit is offline, but the circulating water pumps are in operation, the condenser flow rate shall be estimated using the technique described in the Plans for Monitoring Heat Output from the Oak Creek Power Plant submitted by the permittee on June 29, 2005.

The permittee shall use the following formula for calculating the heat addition from the ERGS condenser water outfall 013:

Heat addition in on British thermal units per hour (MMBTU/hr) = Flow x Δ T x 0.3475

Where: Flow = average daily cooling water flow rate in million gallons per day (mgd).
ΔT is the average daily difference between background (Lake Michigan) and condenser outlet water box temperature, in degrees Fahrenheit (F) and 0.3475 is a conversion factor.

Weekly Average Temperature – The permittee shall use the following formula for calculating effluent results to determine compliance with the weekly average temperature limit (as applicable): Weekly Average Temperature = the sum of all daily maximum results for that week divided by the number of daily maximum results during that time period.

Cold Shock Standard – Water temperatures of the discharge shall be controlled in a manner as to protect fish and aquatic life uses from the deleterious effects of cold shock. 'Cold Shock' means exposure of aquatic organisms to a rapid decrease in temperature and a sustained exposure to low temperature that induces abnormal behavior or physiological performance and may lead to death.

Rate of Temperature Change Standard – Temperature of a water of the state or discharge to a water of the state may not be artificially raised or lowered at such a rate that it causes detrimental health or reproductive effects to fish or aquatic life of the water of the state.

5.3.4 Visible Foam or Floating Solids

There shall be no discharge of floating solids or visible foam in other than trace amounts.

5.3.5 Surface Water Uses and Criteria

In accordance with NR 102.04, Wis. Adm. Code, surface water uses and criteria are established to govern water management decisions. Practices attributable to municipal, industrial, commercial, domestic, agricultural, land development or other activities shall be controlled so that all surface waters including the mixing zone meet the following conditions at all times and under all flow and water level conditions:

a) Substances that will cause objectionable deposits on the shore or in the bed of a body of water, shall not be present in such amounts as to interfere with public rights in waters of the state.

b) Floating or submerged debris, oil, scum or other material shall not be present in such amounts as to interfere with public rights in waters of the state.

c) Materials producing color, odor, taste or unsightliness shall not be present in such amounts as to interfere with public rights in waters of the state.

d) Substances in concentrations or in combinations which are toxic or harmful to humans shall not be present in amounts found to be of public health significance, nor shall substances be present in amounts which are acutely harmful to animal, plant or aquatic life.

5.3.6 Total Residual Chlorine Requirements (When De-Chlorinating Effluent)

Test methods for total residual chlorine, approved in ch. NR 219 - Table B, Wis. Adm. Code, normally achieve a limit of detection of about 20 to 50 micrograms per liter and a limit of quantitation of about 100 micrograms per liter. Reporting of test results and compliance with effluent limitations for chlorine residual and total residual halogens shall be as follows:

- Sample results which show no detectable levels are in compliance with the limit. These test results shall be reported on Wastewater Discharge Monitoring Report Forms as "< 100 µg/L". (Note: 0.1 mg/L converts to 100 µg/L)

- Samples showing detectable traces of chlorine are in compliance if measured at less than 100 µg/L, unless there is a consistent pattern of detectable values in this range. These values shall also be reported on Wastewater Discharge Monitoring Report Forms as "<100 µg/L." The facility operating staff shall record actual readings on logs maintained at the plant, shall take action to determine the reliability of detected results (such as re-sampling and/or calculating dosages), and shall adjust the chemical feed system if necessary to reduce the chances of detects.

- Samples showing detectable levels greater than 100 µg/L shall be considered as exceedances, and shall be reported as measured.

- To calculate average or mass discharge values, a "0" (zero) may be substituted for any test result less than 100 µg/L. Calculated values shall then be compared directly to the average or mass limitations to determine compliance.

5.3.7 Compliance with Phosphorus Limitation

Compliance with the concentration limitation for phosphorus shall be determined as a rolling twelve-month average and shall be calculated as follows:

First, determine the pounds of phosphorus for an individual month by multiplying the average of all the concentration values for phosphorus (in mg/L) for that month by the total flow for the month in Million Gallons times the conversion factor of 8.34.

Then, the monthly pounds of phosphorus determined in this manner shall be summed for the most recent 12 months and inserted into the numerator of the following equation.

$$\text{Average concentration of P in mg/L} = \frac{\text{Total lbs of P discharged (most recent 12 months)}}{\text{Total flow in MG (most recent 12 months) X 8.34}}$$

The compliance calculation shall be performed each month with a reported discharge volume after substituting data from the most recent month(s) for the oldest month(s). A calculated value in excess of the concentration limitation will be considered equivalent to a violation of a monthly average.

5.3.8 Additives

In the event that the permittee wishes to commence use of a water treatment additive, or increase the usage of the additives greater than indicated in the permit application, the permittee must get a written approval from the Department prior to initiating such changes. This written approval shall provide authority to utilize the additives at the specific rates until the permit can be either reissued or modified in accordance with s. 283.53, Stats. Restrictions on the use of the additives may be included in the authorization letter.

5.3.9 Whole Effluent Toxicity (WET) Monitoring Requirements

In order to determine the potential impact of the discharge on aquatic organisms, static-renewal toxicity tests shall be performed on the effluent in accordance with the procedures specified in the *"State of Wisconsin Aquatic Life Toxicity Testing Methods Manual, 2nd Edition" (PUB-WT-797*, November 2004) as required by NR 219.04, Table A, Wis. Adm. Code). All of the WET tests required in this permit, including any required retests, shall be conducted on the *Ceriodaphnia dubia* and fathead minnow species. Receiving water samples shall not be collected from any point in contact with the permittee's mixing zone and every attempt shall be made to avoid contact with any other discharge's mixing zone.

5.3.10 Whole Effluent Toxicity (WET) Identification and Reduction

Within 60 days of a retest which showed positive results, the permittee shall submit a written report to the Biomonitoring Coordinator, Bureau of Water Quality, 101 S. Webster St., PO Box 7921, Madison, WI 53707-7921, which details the following:

- A description of actions the permittee has taken or will take to remove toxicity and to prevent the recurrence of toxicity;

- A description of toxicity reduction evaluation (TRE) investigations that have been or will be done to identify potential sources of toxicity, including some or all of the following actions:

  (a) Evaluate the performance of the treatment system to identify deficiencies contributing to effluent toxicity (e.g., operational problems, chemical additives, incomplete treatment)
  (b) Identify the compound(s) causing toxicity
  (c) Trace the compound(s) causing toxicity to their sources (e.g., industrial, commercial, domestic)
  (d) Evaluate, select, and implement methods or technologies to control effluent toxicity (e.g., in-plant or pretreatment controls, source reduction or removal)

- Where corrective actions including a TRE have not been completed, an expeditious schedule under which corrective actions will be implemented;

- If no actions have been taken, the reason for not taking action.

The permittee may also request approval from the Department to postpone additional retests in order to investigate the source(s) of toxicity. Postponed retests must be completed after toxicity is believed to have been removed.

5.3.11 Reopener Clause

Pursuant to s. 283.15(11), Wis. Stat. and 40 CFR 131.20, the Department may modify or revoke and reissue this permit if, through the triennial standard review process, the Department determines that the terms and conditions of this permit need to be updated to reflect the highest attainable condition of the receiving water.

6 Summary of Reports Due

FOR INFORMATIONAL PURPOSES ONLY

Description	**Date**	**Page**
Compliance with Federal ELG for FGD -Annual Arsenic Progress Report	December 31, 2019	25
Compliance with Federal ELG for FGD -Annual Arsenic Progress Report #2	December 31, 2020	26
Compliance with Federal ELG for FGD -Annual Arsenic Progress Report #3	December 31, 2021	26
Compliance with Federal ELG for FGD -Annual Arsenic Progress Report #4	December 31, 2022	26
Compliance with Federal ELG for FGD -Annual Arsenic Progress Report #5	December 31, 2023	27
Compliance with Federal ELG for FGD -Final Arsenic Report	March 31, 2024	27
Compliance with Federal ELG for FGD -Annual Arsenic Progress Reports After Permit Expiration	See Permit	27
Pollutant Minimization Plan for Mercury -Annual Mercury Progress Report	December 31, 2019	27
Pollutant Minimization Plan for Mercury -Annual Mercury Progress Report #2	December 31, 2020	28
Pollutant Minimization Plan for Mercury -Annual Mercury Progress Report #3	December 31, 2021	28
Pollutant Minimization Plan for Mercury -Annual Mercury Progress Report #4	December 31, 2022	29
Pollutant Minimization Plan for Mercury -Annual Mercury Progress Report #5	December 31, 2023	29
Pollutant Minimization Plan for Mercury -Final Mercury Report	March 31, 2024	29
Pollutant Minimization Plan for Mercury -Annual Mercury Progress Reports After Permit Expiration	See Permit	29
Wastewater Discharge Monitoring Report	no later than the date indicated on the form	29

Report forms shall be submitted electronically in accordance with the reporting requirements herein. Any facility plans or plans and specifications for municipal, industrial, industrial pretreatment and non industrial wastewater systems shall be submitted to the Bureau of Water Quality, P.O. Box 7921, Madison, WI 53707-7921. All other submittals required by this permit shall be submitted to:

Southeast Region, 2300 N Dr ML King Drive, Milwaukee, WI 53212

Appendix D

Fault Areas Demonstration

U.S. Geological Survey Quaternary Faults

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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

0 180 360 720 mi

0 285 570 1,140 km

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

USGS

Sources: Esri, USGS | Esri, USGS | Missouri DNR, Esri, HERE, Garmin, FAO, NOAA, USGS, EPA | USGS |

Appendix E

Seismic Impact Zones Demonstration

GEI Consultants	**Client**	We Energies			**Page**	1 of 1
	Project	Caledonia Plan of Operation Modification			**Rev.**	0
	By	A. Schwoerer	**Chk.**	J. Piaskowski	**App.**	J. Trast
	Date	11/16/2022	**Date**	1/6/2023	**Date**	1/6/2023
GEI Project No.	2203724	**Document No.**	N/A			
Subject	Probability of Exceedance and Return Calculations					

Purpose:

The purpose of this calculation is to demonstrate that the Caledonia Ash Landfill is not within a seismic impact zone as required by NR 504.04(3)(h) by calculating that the area has less than a two percent or greater probability that the maximum expected horizontal ground acceleration will exceed 10 percent of gravity (0.10g) in 50 years (return period of approximately 2,500 years). Using the USGS Unified Hazard Tool (2014), the annual frequency of exceedance was obtained, and the probability of exceedance and return period was calculated using equations from the USGS Earthquake Hazards 201 – Technical Q&A, August 6, 2019.

Calculations Criteria:

1. The annual frequency of exceedance with a horizontal ground acceleration of 0.10g is 7.45×10^{-5}. See Figure 1, taken from the USGS Unified Hazard Tool (2014).
2. The return period is calculated by taking the inverse of the annual frequency of exceedance:

   Return Period = 1/annual frequency of exceedance

3. The probability of exceedance in a 50-year period is calculated by:

   (50/return period) x 100 = probability of exceedance

Results:

The return period for the PPPP Ash Landfill is calculated to be:

$1/7.45 \times 10^{-5} = 13{,}423$ years

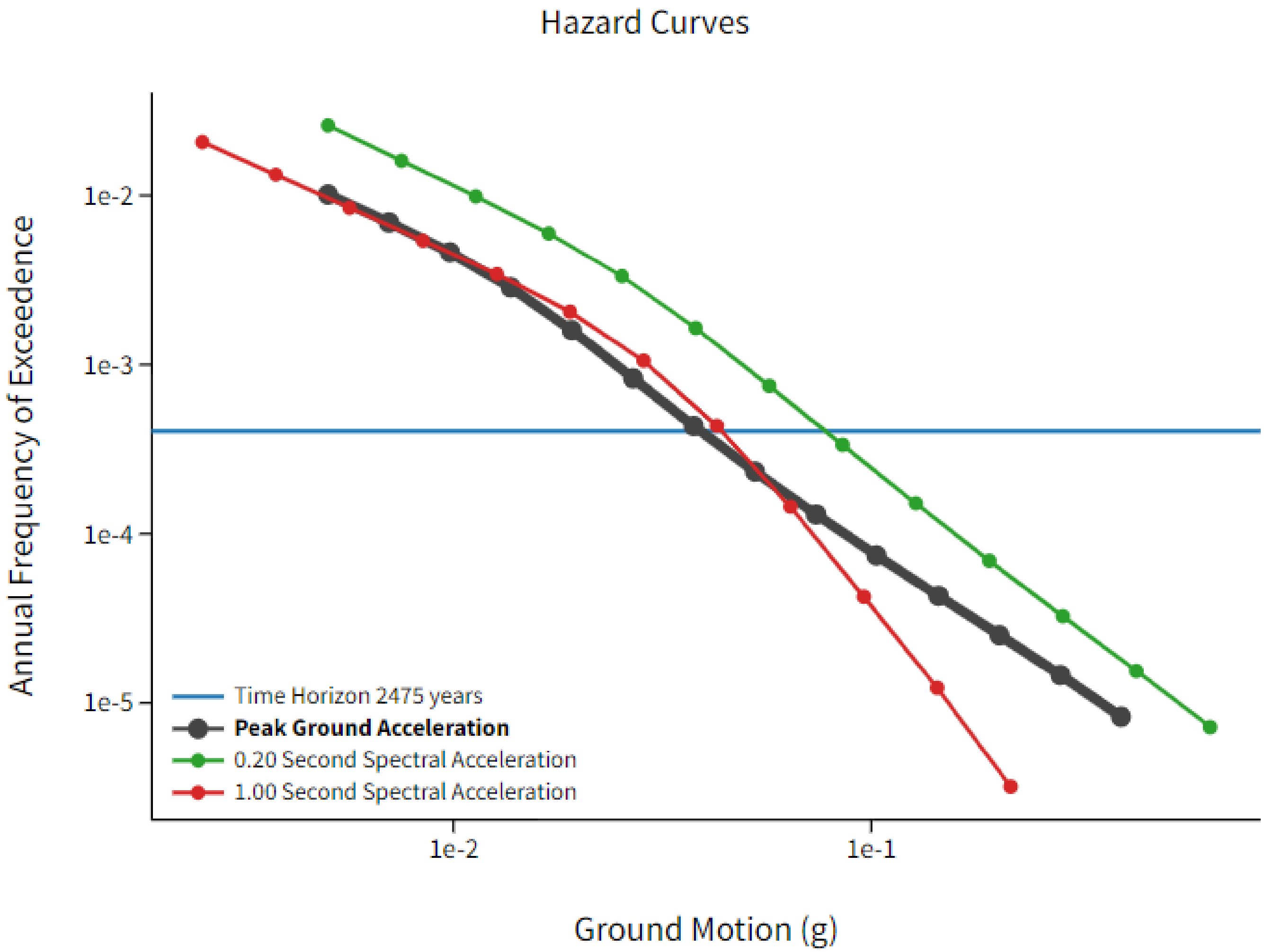
The probability of exceedance in a 50-year period at the PPPP Ash Landfill is calculated to be:

(50/13,423 years) x 100 = 0.37% probabily of exceedance in 50 years

As demonstrated, the probability of exceedance is less than two percent in 50 years for a maximum expected horizontal ground acceleration of 0.10g, the Caledonia Ash Landfill is not located in a seismic impact zone as defined in 40 CFR § 257.53 and satisfies the requirements of NR 504.04(3)(h).

Attachments:

- Figure 1 – Annual Freqency of Exceedance



Peak Ground Acceleration
Ground Motion (g): 0.10
Annual Frequency of Exceedance: 7.45E-5

Plan of Operation Modification Caledonia Ash Landfill We Energies	GEI Consultants	Annual Frequency of Exceedance
WEC Energy Group	Project 2203724	November 2022 Figure 1

Appendix F

Unstable Areas Demonstration

LOCATION RESTRICTIONS DEMONSTRATION
UNSTABLE AREAS
40 CFR PART 257.64
CALEDONIA ASH LANDFILL
WE ENERGIES

We Energies owns and operates a solid waste disposal facility on the Oak Creek Site in the NE 1/4 of Section 1, Township 4 North, Range 22 East, in the Village of Caledonia, Racine County, Wisconsin. The We Energies Caledonia Ash Landfill is regulated as an industrial waste landfill by the Wisconsin Department of Natural Resources (WDNR) under the provisions of Chapter 289 Wisconsin State Statues, and all applicable requirements of Chapters NR 500 of the Wisconsin Administrative Code. The design, construction, operation, closure, and post-closure care requirements are specified in the WDNR conditionally approved Plan of Operations, License No. 03232, FID No. 252108450. As currently constructed, the landfill has 27.2 acres open, 34.9 acres of base liner system (Cells 1, 2, 3, 4, 6, 8, and 10) is constructed, and 7.7 acres of perimeter slopes (Cells 1, 2, 3, 4, and 6) have received final cover.

In addition to the state regulations, the Caledonia Ash Landfill is also required to comply with 40 CFR Part 257 Subpart D – *Standards for Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments.* Cells 1, 2, 3, 4, 6, 8 and 10 is defined as a CCR unit and existing CCR Landfill in accordance with 40 CFR 257.53 since construction commenced prior to October 19, 2015. Future landfill cells are permitted by the WDNR in the conditionally approved Plan of Operation and defined as lateral expansions under 40 CFR 257.53 when constructed. This document fulfills the requirements for the Location Restrictions Demonstration for the Caledonia Ash Landfill as an existing CCR landfill in accordance with 40 CFR 257 Subpart D.

Location restrictions related to unstable areas are outlined in 40 CFR 257.64 – Unstable Areas:

> *§ 257.64 Unstable areas.*
>
> *(a) An existing or new CCR landfill, existing or new CCR surface impoundment, or any lateral expansion of a CCR unit must not be located in an unstable area unless the owner or operator demonstrates by the dates specified in paragraph (d) of this section that recognized and generally accepted good engineering practices have been incorporated into the design of the CCR unit to ensure that the integrity of the structural components of the CCR unit will not be disrupted. (b) The owner or operator must consider all of the following factors, at a minimum, when determining whether an area is unstable: (1) On- site or local soil conditions that may result in significant differential settling; (2) On-site or local geologic or geomorphologic features; and (3) On-site or local human-made features or events (both surface and subsurface).*

The rule defines an *"Unstable Area"* as *"a location that is susceptible to natural or human-induced events or forces capable of impairing the integrity, including structural components of some or all of the CCR unit that are responsible for preventing releases from such unit.*

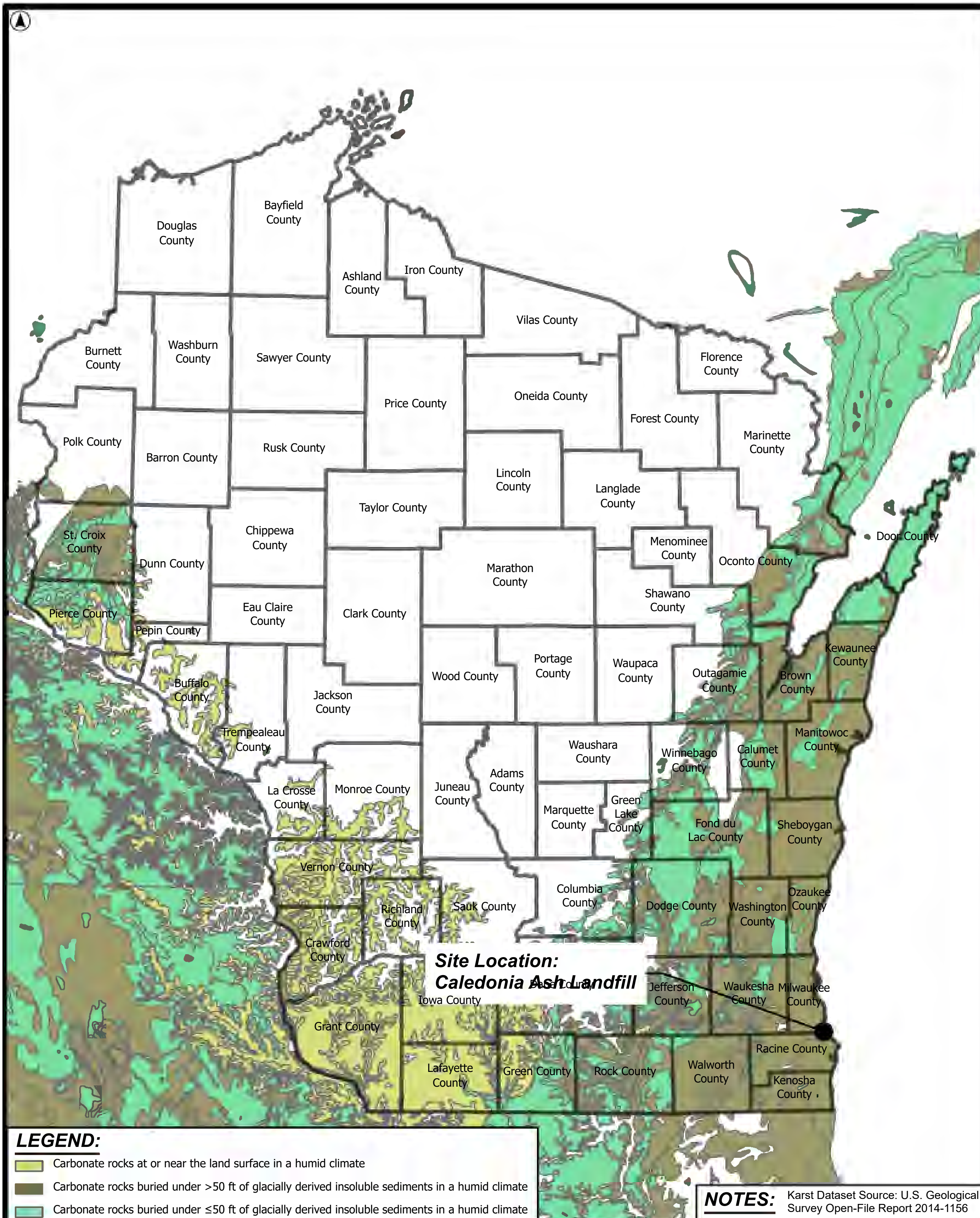
Based on review of the site's location, soil conditions, human-made features or events (both surface and subsurface), geology, and hydrogeology the existing Caledonia Ash Landfill is not located in an unstable area that could result in significant differential settlement or mass movement damaging the facility.

This report was completed under the direction of John, M. Trast, P.E. I am a licensed professional engineer in the State of Wisconsin in accordance with the requirements of ch. A-E 4, Wisconsin Administrative Code; that this document has been prepared in accordance with the Rules of Professional Conduct in ch. A-E 8, Wisconsin Administrative 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 40 CFR Part 257 Subpart D.

John Mathew Trast, P.E.
Licensed Professional Engineer No. 31792
Senior Consultant
GEI Consultants, Inc.

WISCONSIN
JOHN M.
TRAST
31792
GREEN BAY,
WISCONSIN
PROFESSIONAL ENGINEER

10/12/2018



LEGEND:

- Carbonate rocks at or near the land surface in a humid climate
- Carbonate rocks buried under >50 ft of glacially derived insoluble sediments in a humid climate
- Carbonate rocks buried under ≤50 ft of glacially derived insoluble sediments in a humid climate

NOTES: Karst Dataset Source: U.S. Geological Survey Open-File Report 2014-1156

Plan of Operation Modification
Caledonia Ash Landfill
Oak Creek, Racine County WI

WE Energies
Milwaukee, WI

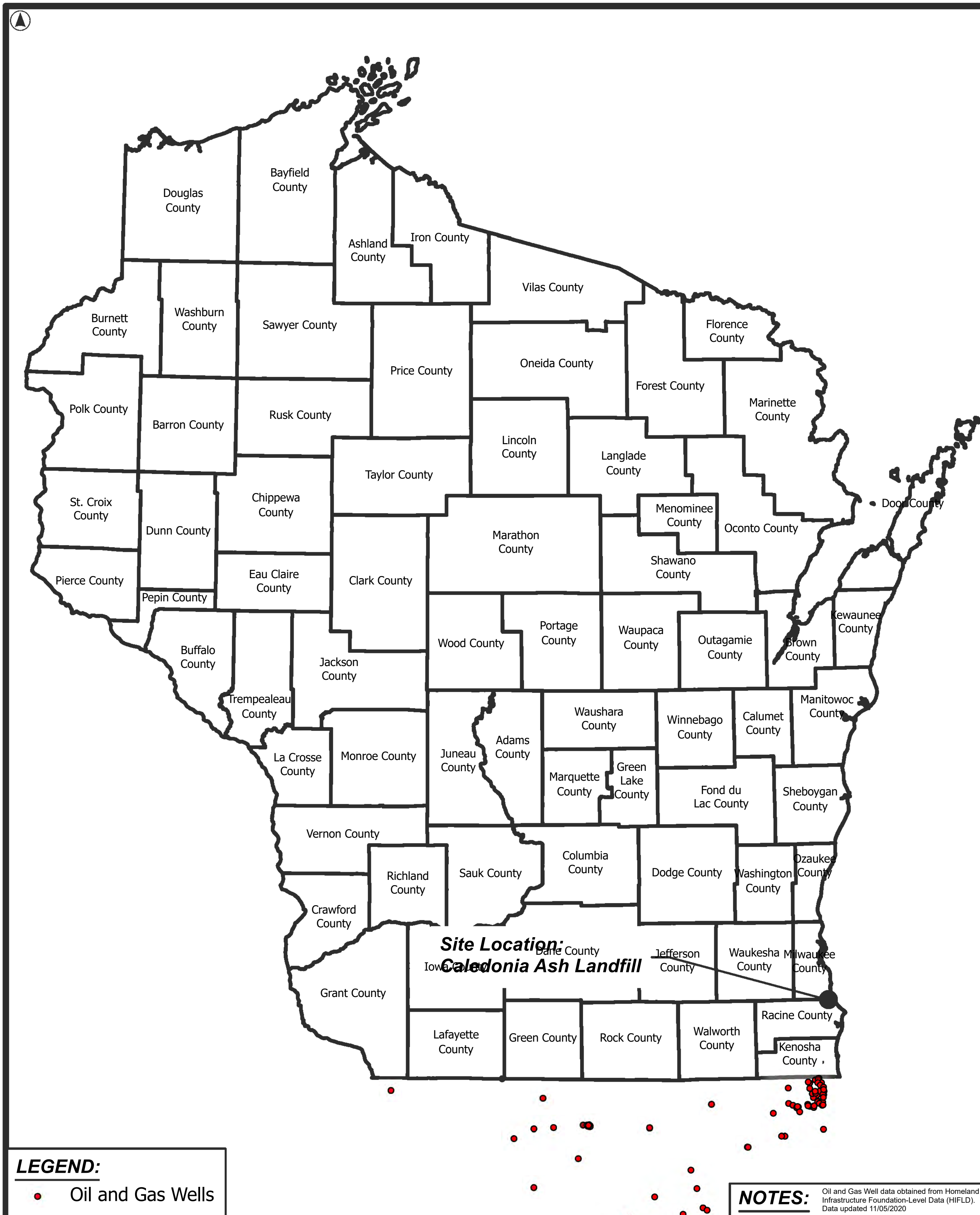
GEI Consultants

Project 2203724

USGS NATIONAL SCALE KARST PONTENTIAL

November 2022

Fig. #



Plan of Operation Modification
Caledonia Ash Landfill
Oak Creek, Racine County WI

WE Energies
Milwaukee, WI

GEI Consultants

Project 2203724

OIL AND GAS WELL MAP

November 2022

Fig. #

Path: C:\Users\jhansen\OneDrive - GEI Consultants, Inc\Documents\GIS_Work\MISCELLANEOUS\2022\2203724 - Caledonia Ash Landfill\2203724 - Caledonia Ash Landfill.aprx

Appendix G

Floodplains Demonstration

National Flood Hazard Layer FIRMette

FEMA

87°50'48"W 42°50'32"N

87°50'11"W 42°50'5"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- B 20.2 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
- 8 Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 11/16/2022 at 3:47 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

Appendix H

Liner Design Calculations

AECOM

Calculation Cover Sheet

Project	WE Energies Caledonia Ash Landfill	Division	Environment
Subject	HELP Analysis of the Proposed Liner and Cover	File No.	
Job No.	10532011	Calc. No.	
Originator	Ryan J. Baeten, E.I.T.	Date	2/03/2009
Reviewed	[signature] Date 3/5/09	No. of Sheets	49

LIST OF CALCULATIONS							
NO.	DESCRIPTION	BY	DATE	CHKD.	DATE	APPRD	DATE
1	Proposed Base Liner	RJB	3/02/09	JxT	3/5	[initials]	3/5
2	Proposed Final Cover w/ 4% Slopes (Option 1)	RJB	3/02/09	JxT			
3	Proposed Final Cover w/ 25% Slopes (Option 1)	RJB	3/02/09	JxT			
4	Proposed Final Cover w/ 4% Slopes (Option 2)	RJB	3/02/09	JxT			
5	Proposed Final Cover w/ 25% Slopes (Option 2)	RJB	3/02/09	JxT			

PRELIMINARY CALC. ☐ SUPERCEDED CALC. ☐ FINAL CALC. ☒

BRIEF SUMMARY OF CALCULATIONS INCLUDING SCOPE AND RESULTS

The Hydrologic Evaluation of Landfill Performance (HELP) Model, version 3.07, was utilized to predict the percolation rate through the proposed components of the liner and final cover systems.

The proposed base liner system consists of the following components, listed from top to bottom:

- 12 inch thick granular drainage blanket
- 60 mil HDPE geomembrane
- 36 inch thick clay layer

Likewise, the proposed final cover consists of the following components, listed from top to bottom:

- 6 inch thick topsoil
- 12 inch thick rooting zone (Option 1) or 24 inch thick rooting zone when underlain by a double-sided geocomposite (Option 2)
- 12 inch thick granular drainage layer (Option 1) or double-sided geocomposite when overlain with a 24 inch thick rooting zone (Option 2)
- 40 mil LLDPE geomembrane
- 24 inch thick fly ash barrier layer
- 6 inch thick bottom ash grading layer

According to the model predictions, the following rates of percolation can be expected within the proposed landfill system:

- Base – 3 foot thick composite liner, 0.0022 inches per year
- Cover – 2 foot thick composite cap with 1 foot thick granular drainage blanket (Option 1) on 4 percent slope, 0.3575 inches per year

Calculation Cover Sheet

- Cover – 2 foot thick composite cap with 1 foot thick granular drainage blanket (Option 1) on 25 percent slope, 0.1099 inches per year
- Cover – 2 foot thick composite cap with double-sided geocomposite (Option 2) on 4 percent slope, 0.0042 inches per year
- Cover – 2 foot thick composite cap with double-sided geocomposite (Option 2) on 25 percent slope, 0.0001 inches per year

The percolation rates for the proposed liner and cover systems are significantly less than the currently permitted systems. Specifically, the percolation rate of the proposed base liner is predicted to be 99.8 percent less than the percolation rate of the permitted base liner. Moreover, the percolation rates were highest for the proposed final cover systems with 1 foot thick granular drainage blanket (Option 1) consisting of 4 and 25 percent slopes and were estimated to be 81.2 and 94.0 percent less than respective permitted cover systems.

Combined, the proposed liner and cover system was predicted to reduce the percolation through the base liner to zero inches per year, compared to 0.0034 inches per year with the permitted landfill components.

```
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**             HELP MODEL VERSION 3.07   (1 NOVEMBER 1997)                  **
**                DEVELOPED BY ENVIRONMENTAL LABORATORY                     **
**                  USAE WATERWAYS EXPERIMENT STATION                       **
**            FOR USEPA RISK REDUCTION ENGINEERING LABORATORY               **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:     C:\HELP307\MKE_OPEN.D4
TEMPERATURE DATA FILE:       C:\HELP307\MKE_OPEN.D7
SOLAR RADIATION DATA FILE:   C:\HELP307\MKE_OPEN.D13
EVAPOTRANSPIRATION DATA:     C:\HELP307\MKE_OPEN.D11
SOIL AND DESIGN DATA FILE:   C:\HELP307\3_COMP.D10
OUTPUT DATA FILE:            C:\HELP307\3_COMP.OUT


TIME:  10:50      DATE:   3/ 2/2009


******************************************************************************

     TITLE:  CALEDONIA ASH LF - PROPOSED BASE LINER (3' COMPOSITE)

******************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                   LAYER  1
                                   --------

                         TYPE 1 - VERTICAL PERCOLATION LAYER
                             MATERIAL TEXTURE NUMBER  30
           THICKNESS                  =     240.00    INCHES
           POROSITY                   =       0.5410 VOL/VOL
           FIELD CAPACITY             =       0.1870 VOL/VOL
           WILTING POINT              =       0.0470 VOL/VOL
           INITIAL SOIL WATER CONTENT =       0.2230 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  =  0.499999987000E-04 CM/SEC
```

LAYER 2

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 1

THICKNESS	=	12.00	INCHES
POROSITY	=	0.4170	VOL/VOL
FIELD CAPACITY	=	0.0450	VOL/VOL
WILTING POINT	=	0.0180	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0464	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.999999978000E-02	CM/SEC
SLOPE	=	3.00	PERCENT
DRAINAGE LENGTH	=	100.0	FEET

LAYER 3

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.06	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12	CM/SEC
FML PINHOLE DENSITY	=	4.00	HOLES/ACRE
FML INSTALLATION DEFECTS	=	4.00	HOLES/ACRE
FML PLACEMENT QUALITY	=	3 - GOOD	

LAYER 4

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 16

THICKNESS	=	36.00	INCHES
POROSITY	=	0.4270	VOL/VOL
FIELD CAPACITY	=	0.4180	VOL/VOL
WILTING POINT	=	0.3670	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4270	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000001000E-06	CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #30 WITH BARE GROUND CONDITIONS, A SURFACE SLOPE OF 1.% AND A SLOPE LENGTH OF 100. FEET.

SCS RUNOFF CURVE NUMBER	=	96.90	
FRACTION OF AREA ALLOWING RUNOFF	=	0.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	8.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	2.823	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	4.328	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	0.376	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	69.459	INCHES
TOTAL INITIAL WATER	=	69.459	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM MILWAUKEE WISCONSIN

STATION LATITUDE	=	42.57	DEGREES
MAXIMUM LEAF AREA INDEX	=	0.00	
START OF GROWING SEASON (JULIAN DATE)	=	130	
END OF GROWING SEASON (JULIAN DATE)	=	283	
EVAPORATIVE ZONE DEPTH	=	8.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	11.60	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	72.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	70.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	74.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	75.00	%

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR MILWAUKEE WISCONSIN

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
1.64	1.33	2.58	3.37	2.66	3.59
3.54	3.09	2.88	2.25	1.98	2.03

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR MILWAUKEE WISCONSIN

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
18.70	23.00	32.10	44.60	54.80	64.90
70.50	69.30	61.90	50.90	37.30	25.10

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR MILWAUKEE WISCONSIN AND STATION LATITUDE = 42.57 DEGREES

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 40

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	1.56	1.24	2.50	3.44	2.50	3.68
	3.27	3.11	2.99	2.23	1.85	2.20
STD. DEVIATIONS	0.68	0.59	1.09	1.40	1.01	1.67
	1.78	1.36	1.31	1.04	0.89	0.97
RUNOFF						
TOTALS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATIONS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION						
TOTALS	0.551	0.483	0.637	2.214	2.443	2.894
	2.683	2.441	2.091	1.544	1.086	0.561
STD. DEVIATIONS	0.107	0.121	0.402	1.163	1.312	1.496
	1.724	1.504	1.238	0.761	0.398	0.175
LATERAL DRAINAGE COLLECTED FROM LAYER 2						
TOTALS	0.9936	0.8782	0.8952	0.6870	0.5029	0.6314
	0.9109	0.9862	0.9737	0.9538	0.9574	1.0800

STD. DEVIATIONS	0.9720	0.7742	0.6584	0.4184	0.3969	0.5752
	0.5859	0.4743	0.3902	0.4376	0.5651	0.9270

PERCOLATION/LEAKAGE THROUGH LAYER 4

TOTALS	0.0002	0.0002	0.0002	0.0001	0.0001	0.0001
	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
STD. DEVIATIONS	0.0002	0.0001	0.0001	0.0001	0.0001	0.0001
	0.0001	0.0001	0.0001	0.0001	0.0001	0.0002

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 3

AVERAGES	1.8855	1.8288	1.6995	1.3476	0.9547	1.2386
	1.7292	1.8721	1.9102	1.8107	1.8781	2.0490
STD. DEVIATIONS	1.8420	1.6089	1.2498	0.8207	0.7535	1.1283
	1.1122	0.9005	0.7654	0.8307	1.1083	1.7547

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 40

	INCHES		CU. FEET	PERCENT
PRECIPITATION	30.57	(3.981)	110972.7	100.00
RUNOFF	0.000	(0.0000)	0.00	0.000
EVAPOTRANSPIRATION	19.627	(6.4144)	71245.05	64.200
LATERAL DRAINAGE COLLECTED FROM LAYER 2	10.45037	(5.35190)	37934.859	34.18394
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.00219	(0.00102)	7.957	0.00717
AVERAGE HEAD ON TOP OF LAYER 3	1.684	(0.865)		
CHANGE IN WATER STORAGE	0.492	(8.3235)	1784.88	1.608

****

PEAK DAILY VALUES FOR YEARS 1 THROUGH 40

	(INCHES)	(CU. FT.)
PRECIPITATION	3.51	12741.300
RUNOFF	0.000	0.0000
DRAINAGE COLLECTED FROM LAYER 2	0.15410	559.38635
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.000028	0.10254
AVERAGE HEAD ON TOP OF LAYER 3	9.009	
MAXIMUM HEAD ON TOP OF LAYER 3	11.679	
LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN)	35.6 FEET	
SNOW WATER	6.60	23940.3730
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.5410	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0470	

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

FINAL WATER STORAGE AT END OF YEAR 40

LAYER	(INCHES)	(VOL/VOL)
1	71.8974	0.2996
2	1.4368	0.1197
3	0.0000	0.0000
4	15.3720	0.4270
SNOW WATER	0.421	

	Client	WEC Energy Group			Page	1 of 2
GEI Consultants	Project	Caledonia Ash Landfill Plan of Operation Modification			Pg. Rev.	0
	By	AJS	Chk.	KMK	App.	JXT
	Date	10/3/2023	Date	10/3/2023	Date	10/3/2023
Project No.	2203724	**Document No.**	N/A			
Description	Liquid Leakage Rate of Base Liner Systems					

Purpose

The purpose of this calculation is to demonstrate the liquid leakage rates of the proposed base liner system of unconstructed Cells 12, 14, and 16 at the Caledonia Ash Landfill, comprised of a GCL overlying a soil barrier layer, is not greater than the liquid leakage rate of a liner with 2 feet of compacted soil with a hydraulic conductivity of 1×10^{-7} cm/sec, as outlined in NR 504.12(3)(a)5 of the Wisconsin Administrative Code. The code sites that 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:

$q = k(h/t + 1)$

Where:

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)

Data and Assumptions

The following data and assumptions were utilized to calculate the liquid leakage rates of the two base liner systems:

- The 60-mil geomembrane layer in the two proposed base liners was ignored for this calculation.
- The hydraulic conductivities of the GCL and soil barrier layer are taken from similar landfill base liner construction projects in Wisconsin. The GCL hydraulic conductivity was assumed to be 5×10^{-9} cm/sec based on the Weston Disposal Site No. 3 Cell 1 and Cell 2 Liner Construction Documentation Report, dated March 2016, and the soil barrier layer was assumed to be an average of 9.0×10^{-8} cm/sec, which was based on undisturbed (Shelby tube) test results from the We Energies Caledonia Ash Landfill Cell 10 Liner Construction Documentation Report, dated December 28, 2010.
- Only the GCL hydraulic conductivity of 5×10^{-9} cm/sec was used in GCL and soil barrier layer base liner option in the Darcy's Law equation.
- The GCL thickness was assumed to be 0.1 feet, or 3 centimeters.
- The hydraulic head above the liner was assumed to be 1 foot, or 30 centimeters.

Results

GCL and Soil Barrier Layer

q = 5 x 10^{-9} cm/sec ((30 cm//3 cm) + 1) = 5.5 x 10^{-8} (cm^3/second)/cm^2

Compacted Soil

q = 1 x 10^{-7} cm/sec ((30 cm/60.96 cm) + 1) = 1.5 x 10^{-7} (cm^3/second)/cm^2

The liquid leakage rate of the GCL and soil barrier layer proposed base liner system at the Caledonia Ash Landill is calculated to be 5.5 x 10^{-8} (cm^3/second)/cm^2, which is not greater than the liquid leakage rate of a 2-foot compacted soil calculated to be 1.5 x 10^{-7} (cm^3/second)/cm^2. These results satisfy the demonstration required in NR 504.12(3)(a)5 of the Wisconsin Administrative Code.

Percolation Rates using HELP Model

The Hydrologic Evaluation of Landfill Performance (HELP) Model, version 4.01, was also utilized to predict the percolation rate of a GCL and soil barrier layer compared to a liner composed of 2 feet of compacted soil. The HELP model layers included a 20-foot layer of coal ash, a 1-foot vertical percolation layer of coarse drainage sand, and either a GCL and 2 feet of soil barrier layer or 2 feet of compacted soil Please note that the hydraulic conductivities of the GCL and soil barrier layer in the HELP Model are not identical to the hydraulic conductivities utilized in the Darcy's Law equations above.

A summary of the HELP Model percolation rates between the two base liner systems is provided below:

Liner Location	Description	Percolation Rate through Liner
Base	GCL and 2 feet of soil barrier layer	0.087 in/year
Base	2 feet of compacted soil with a hydraulic conductivity of 1 x 10^{-7} cm/sec	1.27 in/year

Based on the HELP Model, the percolation rate of a GCL and 2 feet of soil barrier layer is 93.1% lower than a base liner of 2 feet of compacted soil with a hydraulic conductivity of 1 x 10^{-7} cm/sec.

References

1. WDS3 Cell 1 and Cell 2 Liner Construction Documentation Report, March 2016.
2. We Energies Caledonia Ash Landfill Cell 10 Liner Construction Documentation Report, December 28, 2010.

HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 4.0 BETA (2018)
DEVELOPED BY USEPA NATIONAL RISK MANAGEMENT RESEARCH LABORATORY

Title: Base Liner (2' of compacted soil) **Simulated On:** 10/3/2023 12:48

Layer 1
Type 1 - Vertical Percolation Layer (Cover Soil)
High-Density Electric Plant Coal Fly Ash
Material Texture Number 30

Thickness	=	240	inches
Porosity	=	0.541	vol/vol
Field Capacity	=	0.187	vol/vol
Wilting Point	=	0.047	vol/vol
Initial Soil Water Content	=	0.2085	vol/vol
Effective Sat. Hyd. Conductivity	=	5.00E-05	cm/sec

Layer 2
Type 2 - Lateral Drainage Layer
CoS - Coarse Sand
Material Texture Number 1

Thickness	=	12	inches
Porosity	=	0.417	vol/vol
Field Capacity	=	0.045	vol/vol
Wilting Point	=	0.018	vol/vol
Initial Soil Water Content	=	0.045	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-02	cm/sec
Slope	=	2	%
Drainage Length	=	100	ft

Layer 3
Type 3 - Barrier Soil Liner
Liner Soil (High)
Material Texture Number 16

Thickness	=	24	inches
Porosity	=	0.427	vol/vol
Field Capacity	=	0.418	vol/vol
Wilting Point	=	0.367	vol/vol
Initial Soil Water Content	=	0.427	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-07	cm/sec

Note: Initial moisture content of the layers and snow water were computed as nearly steady-state values by HELP.

General Design and Evaporative Zone Data

SCS Runoff Curve Number	=	96.6	
Fraction of Area Allowing Runoff	=	0	%
Area projected on a horizontal plane	=	1	acres
Evaporative Zone Depth	=	8	inches
Initial Water in Evaporative Zone	=	1.46	inches
Upper Limit of Evaporative Storage	=	4.328	inches
Lower Limit of Evaporative Storage	=	0.376	inches
Initial Snow Water	=	0	inches
Initial Water in Layer Materials	=	60.831	inches
Total Initial Water	=	60.831	inches
Total Subsurface Inflow	=	0	inches/year

Note: SCS Runoff Curve Number was calculated by HELP.

Evapotranspiration and Weather Data

Station Latitude	=	42.88	Degrees
Maximum Leaf Area Index	=	0	
Start of Growing Season (Julian Date)	=	130	days
End of Growing Season (Julian Date)	=	283	days
Average Wind Speed	=	11.6	mph
Average 1st Quarter Relative Humidity	=	72	%
Average 2nd Quarter Relative Humidity	=	70	%
Average 3rd Quarter Relative Humidity	=	74	%
Average 4th Quarter Relative Humidity	=	75	%

Note: Evapotranspiration data was obtained for Oak Creek, Wisconsin

Normal Mean Monthly Precipitation (inches)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
1.074597	0.968842	1.729902	2.523413	3.751886	4.350883
3.757872	4.163231	3.634414	2.988129	2.022129	1.226606

Note: Precipitation was simulated based on HELP V4 weather simulation for: Lat/Long: 42.88/-87.9

Normal Mean Monthly Temperature (Degrees Fahrenheit)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
19.5	26.6	32.6	49.7	65.1	74.7
80.7	77.9	65.4	50.7	35.8	27.8

Note: Temperature was simulated based on HELP V4 weather simulation for:
Lat/Long: 42.88/-87.9
Solar radiation was simulated based on HELP V4 weather simulation for:
Lat/Long: 42.88/-87.9

Average Annual Totals Summary

Title: Base Liner (2' of compacted soil)
Simulated on: 10/3/2023 12:49

	Base Liner (2' of compacted soil)			
	(inches)	[std dev]	(cubic feet)	(percent)
Precipitation	32.19	[4.09]	116,856.6	100.00
Runoff	0.000	[0]	0.0000	0.00
Evapotranspiration	24.973	[3.38]	90,650.2	77.57
Subprofile1				
Lateral drainage collected from Layer 2	5.4763	[2.0044]	19,879.1	17.01
Percolation/leakage through Layer 3	1.268232	[0.196907]	4,603.7	3.94
Average Head on Top of Layer 3	1.3228	[0.4838]	---	---
Water storage				
Change in water storage	0.4748	[3.1017]	1,723.6	1.47

* Note: Average inches are converted to volume based on the user-specified area.

Peak Values Summary

Title: Base Liner (2' of compacted soil)
Simulated on: 10/3/2023 12:49

	Base Liner (2' of compacted soil)	
	(inches)	(cubic feet)
Precipitation	3.34	12,107.6
Runoff	0.000	0.0000
Subprofile1		
Drainage collected from Layer 2	0.0453	164.3
Percolation/leakage through Layer 3	0.003968	14.4
Average head on Layer 3	3.9938	---
Maximum head on Layer 3	5.5882	---
Location of maximum head in Layer 2	30.01	(feet from drain)
Other Parameters		
Snow water	2.5094	9,109.3
Maximum vegetation soil water	0.5410	(vol/vol)
Minimum vegetation soil water	0.0470	(vol/vol)

Final Water Storage in Landfill Profile at End of Simulation Period

Title: Base Liner (2' of compacted soil)
Simulated on: 10/3/2023 12:49
Simulation period: 40 years

Base Liner (2' of compacted soil)

	Final Water Storage	
Layer	(inches)	(vol/vol)
1	68.4727	0.2853
2	1.1036	0.0920
3	10.2480	0.4270
Snow water	0.0000	---

HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 4.0 BETA (2018)
DEVELOPED BY USEPA NATIONAL RISK MANAGEMENT RESEARCH LABORATORY

Title: Base Liner (2' Soil Barrier Layer and GCL) **Simulated On:** 10/3/2023 12:13

Layer 1
Type 1 - Vertical Percolation Layer (Cover Soil)
High-Density Electric Plant Coal Fly Ash
Material Texture Number 30

Thickness	=	240	inches
Porosity	=	0.541	vol/vol
Field Capacity	=	0.187	vol/vol
Wilting Point	=	0.047	vol/vol
Initial Soil Water Content	=	0.2085	vol/vol
Effective Sat. Hyd. Conductivity	=	5.00E-05	cm/sec

Layer 2
Type 2 - Lateral Drainage Layer
CoS - Coarse Sand
Material Texture Number 1

Thickness	=	12	inches
Porosity	=	0.417	vol/vol
Field Capacity	=	0.045	vol/vol
Wilting Point	=	0.018	vol/vol
Initial Soil Water Content	=	0.0462	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-02	cm/sec
Slope	=	2	%
Drainage Length	=	100	ft

Layer 3
Type 3 - Barrier Soil Liner
Bentonite (High)
Material Texture Number 17

Thickness	=	1.2	inches
Porosity	=	0.75	vol/vol
Field Capacity	=	0.747	vol/vol
Wilting Point	=	0.4	vol/vol
Initial Soil Water Content	=	0.75	vol/vol
Effective Sat. Hyd. Conductivity	=	3.00E-09	cm/sec

Layer 4

Type 1 - Vertical Percolation Layer

C (Moderate)

Material Texture Number 29

Thickness	=	24	inches
Porosity	=	0.451	vol/vol
Field Capacity	=	0.419	vol/vol
Wilting Point	=	0.332	vol/vol
Initial Soil Water Content	=	0.4189	vol/vol
Effective Sat. Hyd. Conductivity	=	6.80E-07	cm/sec

Note: Initial moisture content of the layers and snow water were computed as nearly steady-state values by HELP.

General Design and Evaporative Zone Data

SCS Runoff Curve Number	=	96.6	
Fraction of Area Allowing Runoff	=	0	%
Area projected on a horizontal plane	=	1	acres
Evaporative Zone Depth	=	8	inches
Initial Water in Evaporative Zone	=	1.46	inches
Upper Limit of Evaporative Storage	=	4.328	inches
Lower Limit of Evaporative Storage	=	0.376	inches
Initial Snow Water	=	0	inches
Initial Water in Layer Materials	=	61.552	inches
Total Initial Water	=	61.552	inches
Total Subsurface Inflow	=	0	inches/year

Note: SCS Runoff Curve Number was calculated by HELP.

Evapotranspiration and Weather Data

Station Latitude	=	42.88	Degrees
Maximum Leaf Area Index	=	0	
Start of Growing Season (Julian Date)	=	130	days
End of Growing Season (Julian Date)	=	283	days
Average Wind Speed	=	11.6	mph
Average 1st Quarter Relative Humidity	=	72	%
Average 2nd Quarter Relative Humidity	=	70	%
Average 3rd Quarter Relative Humidity	=	74	%
Average 4th Quarter Relative Humidity	=	75	%

Note: Evapotranspiration data was obtained for Oak Creek, Wisconsin

Normal Mean Monthly Precipitation (inches)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
1.074597	0.968842	1.729902	2.523413	3.751886	4.350883
3.757872	4.163231	3.634414	2.988129	2.022129	1.226606

Note: Precipitation was simulated based on HELP V4 weather simulation for:
Lat/Long: 42.88/-87.9

Normal Mean Monthly Temperature (Degrees Fahrenheit)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
19.5	26.6	32.6	49.7	65.1	74.7
80.7	77.9	65.4	50.7	35.8	27.8

Note: Temperature was simulated based on HELP V4 weather simulation for:
Lat/Long: 42.88/-87.9
Solar radiation was simulated based on HELP V4 weather simulation for:
Lat/Long: 42.88/-87.9

Average Annual Totals Summary

Title: Base Liner (2' Soil Barrier Layer and GCL)
Simulated on: 10/3/2023 12:14

	Average Annual Totals for Years 1 - 40*			
	(inches)	[std dev]	(cubic feet)	(percent)
Precipitation	32.19	[4.09]	116,856.6	100.00
Runoff	0.000	[0]	0.0000	0.00
Evapotranspiration	24.973	[3.38]	90,650.2	77.57
Subprofile1				
Lateral drainage collected from Layer 2	6.6550	[2.1379]	24,157.5	20.67
Percolation/leakage through Layer 3	0.087204	[0.016049]	316.6	0.27
Average Head on Top of Layer 3	1.6075	[0.5161]	---	---
Subprofile2				
Percolation/leakage through Layer 4	0.099485	[0.023426]	361.1	0.31
Water storage				
Change in water storage	0.4650	[3.1022]	1,687.8	1.44

* Note: Average inches are converted to volume based on the user-specified area.

Peak Values Summary

Title: Base Liner (2' Soil Barrier Layer and GCL)
Simulated on: 10/3/2023 12:14

	Peak Values for Years 1 - 40*		
	(inches)		(cubic feet)
Precipitation	3.34		12,107.6
Runoff	0.000		0.0000
Subprofile1			
Drainage collected from Layer 2	0.0487		176.9
Percolation/leakage through Layer 3	0.000468		1.6976
Average head on Layer 3	4.2995		---
Maximum head on Layer 3	5.9328		---
Location of maximum head in Layer 2	30.98	(feet from drain)	
Subprofile2			
Percolation/leakage through Layer 4	0.001017		3.6903
Other Parameters			
Snow water	2.5094		9,109.3
Maximum vegetation soil water	0.5410	(vol/vol)	
Minimum vegetation soil water	0.0470	(vol/vol)	

Final Water Storage in Landfill Profile at End of Simulation Period

Title: Base Liner (2' Soil Barrier Layer and GCL)
Simulated on: 10/3/2023 12:14
Simulation period: 40 years

	Final Water Storage	
Layer	(inches)	(vol/vol)
1	68.4727	0.2853
2	1.2145	0.1012
3	0.9000	0.7500
4	9.5630	0.3985
Snow water	0.0000	---

PIPE STRENGTH ANALYSIS

Objective

A 6-inch diameter perforated wall HDPE pipe is proposed for use as leachate collection pipe for the We Energies Caledonia Landfill. The purpose of the following calculations are to determine whether an SDR 17 pipe is able to withstand the applied pipe wall compressive stresses, pipe wall buckling, and suggested deflection limits for the anticipated overburden at final closure grades.

Design Criteria and Assumptions

1. HDPE leachate collection pipe is proposed to be a 6-inch diameter, SDR 17 HDPE pipe (refer to Attachment 1 for pipe dimensions).
2. The material over the pipe is comprised of approximately 1.5 feet of bedding stone, 2 feet of granular drainage and filter material, 83.5 feet of waste, and 3 feet of cover soil.
3. The drainage and filter material and cover soil are assumed to have a unit weight of 125 lb/ft^3, 115 lb/ft^3, respectively, and the waste is assumed to have a unit weight of 128 lb/ft^3.

Calculations

The pipe will be analyzed for compressive ring thrust (wall crushing), pipe wall buckling, and ring deflection based on the design methodology presented in the Plastic Pipe Institute (PPI) Handbook of Polyethylene Pipe.

COMPRESSIVE RING THRUST (WALL CRUSHING)

Earth pressure exerts a radially-directed force around the circumference of a pipe that results in a compressive ring thrust in the pipe wall. Wall crushing would theoretically occur when the stress in a pipe wall, due to external vertical pressure, exceeded the long-term compressive strength of the pipe material. For HDPE pipe, the recommended long-term compressive strength design value at an assumed temperature of 100°F is 780 psi.

PIPE WALL BUCKLING

Local wall buckling is a longitudinal wrinkling of the pipe wall. Buckling and collapse do not occur when the soil envelope is in full contact with the pipe and is compacted to a dense state. However, buckling can occur over a long term in non-pressurized pipe as the total external soil pressure is allowed to exceed the pipe-soil system's critical buckling pressure.

RING DEFLECTION

According to the PPI Handbook of Polyethylene Pipe, the recommended allowable ring deflection

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Client We Energies | Subject Pipe Strength Analysis, 6" Pipes | Prepared By JRP | Date 1/24/23
Project Caledonia LF | Reviewed By MJV | Date 1/25/23

Approved By | Date

for non-pressure pipe and accounting for a large safety factor is 7.5%.

Conclusions

The calculated factor of safety versus failure by the wall crushing, wall buckling, ring deflection, and flexural failure are provide in the table below. Based on the results of the calculations, an HDPE SDR 17 pipe should have sufficient strength to handle the anticipated loads for the We Energies Caledonia Landfill.

Summary of Results for 6" Diameter HDPE Pipe Calculations

Failure Mode	SDR-17 Pipe Factor of Safety	Required
Compressive Ring Thrust	1.4	1.0
Wall Buckling	2.5	1.0
Ring Deflection (%)	5.3%	< 7.5%

References

1. Evaluation of buried pipes will follow procedure outlined in the "PPI Handbook of Polyethylene Pipe", downloaded May 2006 www.plasticpipe.org/general/ppihandbook.php.

HDPE Pipe Strength Calculations - Leachate Collection System Pipes

Commonly used units for Pipe Strength Calculations:

$$pcf := \frac{lbf}{ft^3} \qquad psi := \frac{lbf}{in^2} \qquad psf := \frac{lbf}{ft^2}$$

Analysis:

We Energies Caledonia Landfill will include the use of 6-inch diameter HDPE SDR-17 pipes in the leachate collection system. The maximum depth of fill over the leachate collection pipes consists of approximately 1.5 feet of bedding stone, 2 feet of granular drainage and filter material, 83.5 feet of waste, and a 3 foot cover. The purpose of these calculations is to evaluate if the pipe will withstand applied pipe wall compressive stresses, pipe wall buckling, and suggested deflection limits.

The first step in designing buried pipe is to determine the load that will be applied. The dead load is the permanent load from the weight of soil above the pipe. The prism load is equal to the soil column projecting above the pipe. The following equation is used to determine the prism load:

$$P_e := w \cdot H$$

Where:

P_e = vertical soil pressure, lb/ft^2 (kPa)

w = unit weight of soil, lb/ft^3 (kN/m^3)
H = soil height above pipe crown, ft (m)

The maximum pressure applied to the leachate lines occurs at the peak height of the cell. A cross-section of this area consists of 1.5 feet of bedding stone, 2 feet of granular drainage and filter material, 83.5 feet of waste, and a 3 feet soil cover system overlying the pipes. The unit weight of the cover system soils was calculated as a weighted average of the various layers. The soil layers and their unit weights are defined below:

Drainage Material (Gravel):

$$w_1 := 125 \cdot pcf = 19.6 \cdot \frac{kN}{m^3}$$

$$H_1 := 1.5 \cdot ft = 0.5\,m$$

Drainage Material (Sand):

$$w_2 := 115 \cdot pcf = 18.1 \cdot \frac{kN}{m^3}$$

$$H_2 := 2 \cdot ft = 0.6 \cdot m$$

Waste: $w_3 := 128 \cdot pcf = 20.1 \cdot \frac{kN}{m^3}$

$H_3 := 83.5 \cdot ft = 25.5 \cdot m$

Cover Soil: $w_4 := 125 \cdot pcf = 19.6 \cdot \frac{kN}{m^3}$

$H_4 := 3 \cdot ft = 0.9 \cdot m$

The prism load equation was expanded to include all of the unit weights and soil layer thicknesses defined above. The total prism load applied to the pipe is:

$$P_e := w_1 \cdot H_1 + w_2 \cdot H_2 + w_3 \cdot H_3 + w_4 \cdot H_4$$

$\boxed{P_e = 549.69 \cdot kPa}$ or $\boxed{P_e = 79.73 \cdot psi}$

The calculated prism load is a conservative estimate of the total vertical force applied to the pipe. The dead load applied to a flexible plastic pipe may be considerably less than the prism load because soil shear resistance transfers part of the soil load that is directly above the pipe into trench sidewalls and embedment, referred to as arching. The maximum fill depth is assumed to represent the largest load on the pipe. Due to the depth of fill over the pipe, live loads, such as vehicular loads, are negligible and not included in this calculation.

A. Compressive Ring Thrust (Wall Crushing)

When a non-pressurized pipe that is confined in a dense embedment is subjected to a radially directed soil pressure, a circumferential, compressive thrust occurs in its wall. The compressive stress in the pipe wall is:

$$S_A := \frac{P_{RD} \cdot DR}{288}$$

Where:

S_A = pipe wall compressive stress, psi
P_{RD} = radially directed earth pressure, psf
DR = dimension ratio, D_o/t
Do = pipe outside diameter, in.
t = pipe wall thickness, in.

$P_{RD} := (VAF) \cdot w \cdot H$ or $P_{RD} := (VAF) \cdot P_e$

Where:

VAF = Vertical Arching Factor

P_{RD} = radially directed earth pressure, psf

P_e = total external pressure

$$VAF := 0.88 - \left(0.71 \cdot \frac{S_R - 1}{S_R + 2.5}\right)$$

Where:

VAF = Vertical Arching Factor

S_R = hoop thrust stiffness ratio

$$S_R := \frac{1.43 \cdot M_s \cdot r_{cent}}{E \cdot t}$$

Where:

S_R = hoop thrust stiffness ratio

M_S = one-dimensional modulus of soil, $M_s := 2400 \cdot psi$ from Table 2-14, Attachment 1, for 90% standard Proctor.

r_{cent} = radius to centroidal axis of pipe, in

E = apparent modulus of elasticity of pipe material, $E := 23000 \cdot psi$ (50-yr life, 100 degrees Fahrenheit)

t = pipe wall thickness, in.

Dimensional values for the 6-inch SDR 17 HDPE pipe were taken from Chevron Phillips Chemical Company product catalog.

$$D_o := 6.625 \cdot in = 168.3 \cdot mm$$

$$t := 0.39 \cdot in = 9.9 \cdot mm \qquad DR := \frac{D_o}{t} = 17.0$$

$$r_{cent} := \left(\frac{D_o}{2}\right) - \left(\frac{t}{2}\right) = 3.1 \cdot in$$

$$S_R := \frac{1.43 \cdot M_s \cdot r_{cent}}{E \cdot t} = 1.193$$

$$VAF := 0.88 - \left(0.71 \cdot \frac{S_R - 1}{S_R + 2.5}\right) = 0.843$$

$P_{RD} := (VAF) \cdot P_e = 9.677 \times 10^3 \cdot psf$ or $P_{RD} = 463.352 \cdot kPa$

$S_A := \frac{P_{RD} \cdot D_o}{2t} = 570.799 \cdot psi$ or $S_A = 3.936 \times 10^3 \cdot kPa$

$$\boxed{FS := \frac{780 \cdot psi}{S_A} = 1.4}$$

The recommended long-term compressive strength design value is 780 psi at 100 degrees Fahrenheit for PE 3408 pipe (see Tables 1-3 and 2-12 in Attachment 1). A factor of safety of 1.4 demonstrates that the pipe will perform without failure due to wall crushing.

B. Constrained Pipe Wall Buckling

Local wall buckling is a longitudinal wrinkling of the pipe wall. It can be forced to occur over the long-term in non-pressurized pipe if the total external pressure, P_e, is allowed to exceed the pipe-soil system's critical buckling pressure. The allowable constrained buckling pressure is defined as:

$$P_{CR} := \frac{2.4 \cdot \varphi \cdot R_H}{D_M} \cdot (E \cdot I)^{\frac{1}{3}} \cdot E_{s1}^{\frac{2}{3}}$$

Where:

P_{CR} = allowable buckling pressure, psi

φ = calibration factor, $\varphi := 0.55$ for granular soils (see page 7 of Attachment 1)

R_H = geometry factor, $R_H := 1$ for deep burial (see page 7 of Attachment 1)

D_M = mean diameter (D_o - t), in.

E = apparent modulus of elasticity of pipe material, $E := 23000\, psi$ (50-yr life, 100 degrees Fahrenheit)

I = pipe wall moment of inertia, in^4/in ($I := \frac{t^3}{12}$ if solid wall pipe)

E_{s1} = Es/(1-u)

Es = secant modulus of soil, psi

u = poisson's ratio of soil, $\mu := 0.15$ for coarse sand

The buckling pressure should be compared to the static load pressure, P_e, for the pipe.

$P_{CR} > P_e$

$$D_M := D_o - t = 6.235 \cdot in \qquad \text{or} \qquad D_M = 158.369 \cdot mm$$

$$I = 4.943 \times 10^{-3} \cdot \frac{in^4}{in} \qquad \text{or} \qquad I = 81.005 \cdot \frac{mm^4}{mm}$$

$$E_s := M_s \cdot \frac{(1+\mu)(1-2\mu)}{(1-\mu)} = 2.273 \times 10^3 \cdot psi \qquad \text{or} \qquad E_s = 1.567 \times 10^4 \cdot kPa$$

$$E_{s1} := \frac{E_s}{(1-\mu)} = 2.674 \times 10^3 \cdot psi \qquad \text{or} \qquad E_{s1} = 1.844 \times 10^4 \cdot kPa$$

$$P_{CR} := \frac{2.4 \cdot \varphi \cdot R_H}{D_M} \cdot (E \cdot I)^{\frac{1}{3}} \cdot E_{s1}^{\frac{2}{3}} = 197.59 \cdot psi \qquad \text{or} \qquad P_{CR} = 1.362 \times 10^3 \cdot kPa$$

$$FS := \frac{P_{CR}}{P_e} = 2.5$$

With a Factor of Safety, $FS = 2.5$, the critical buckling pressure, $P_{CR} = 197.589\,psi$, is sufficiently greater than the applied load pressure $P_e = 79.73\,psi$, therefore, the pipe will not buckle.

Ring Deflection

The ring deflection of the pipe can be calculated as:

$$Deflection := \frac{\Delta X}{D_M} \qquad \text{and} \qquad Deflection := D_F \cdot \varepsilon_s$$

Where:

$\Delta X/D_M$ = deflection
D_F = deformation factor
ε_s = soil strain

$$\varepsilon_s := \frac{w \cdot H}{144 \cdot E_s} \qquad \text{thus} \qquad \varepsilon_s := \frac{P_e}{144 \cdot E_s}$$

Where:

P_e = total external pressure, psf
w = weight of soil, pcf
H = depth of soil over pipe, ft
E_s = secant modulus of the soil, psi

D_F is determined from Figure 2-6 of Attachment 1 using the rigidity factor, R_F

$$R_F := \frac{12 \cdot E_s \cdot (DR - 1)^3}{E}$$

Where:

E_s = secant modulus of the soil, psi

DR = dimension ratio

E = apparent modulus of elasticity of the pipe material, psi

recall,

$$E_s := M_s \cdot \frac{(1 + \mu)(1 - 2\mu)}{(1 - \mu)} = 2.273 \times 10^3 \cdot psi$$

$$DR := \frac{D_o}{t} = 17$$

$$E = 2.3 \times 10^4 \cdot psi$$

$$R_F := \frac{12 \cdot E_s \cdot (DR - 1)^3}{E} = 4.846 \times 10^3$$

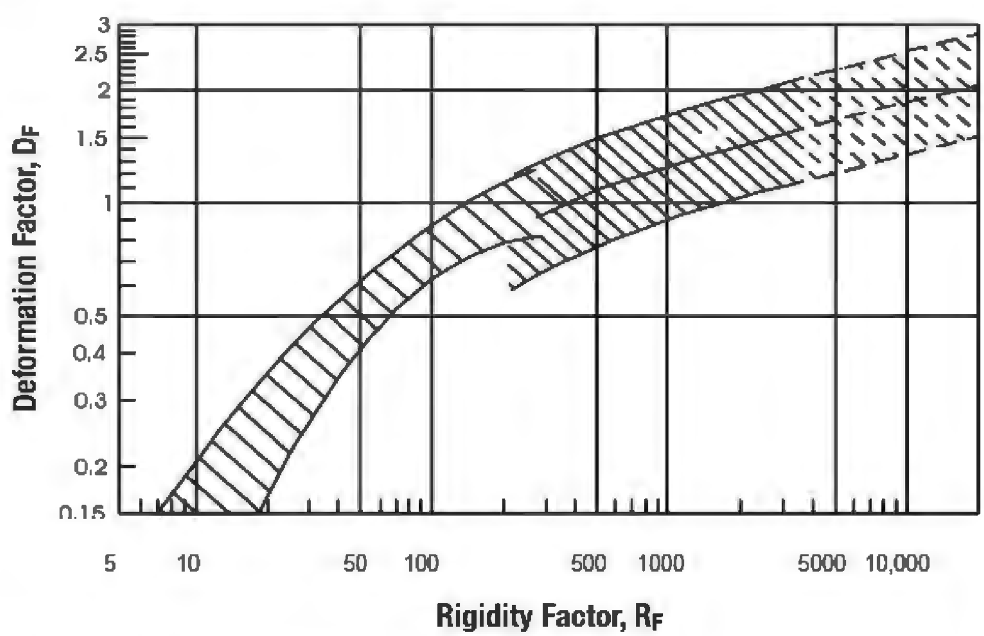

Figure 2-6 Watkins-Gaube Graph

Using Figure 2-6 and $R_F = 4.85 \times 10^3$ the Deformation Factor, $D_F := 1.5$

$$\varepsilon_s := \frac{P_e}{E_s} = 3.51 \cdot \%$$

Note: Dividing the pressure on the pipe by 144 is not required in this case since MathCAD makes the unit conversion automatically.

$$\text{Deflection} := D_F \cdot \varepsilon_s = 5.3 \cdot \%$$

The recommended allowable ring deflection for non-pressure HDPE pipe and accounting for a large safety factor is 7.5% (see page 2 in Attachment 1). Therefore, with a calculated defection of 5.3%, failure by pipe deflection is not anticipated to occur.

Conclusions

The results of the calculations above are summarized below. The proposed leachate collection pipes will perform as designed without failure due to pipe buckling, crushing, or deflection.

Results Summary	
Failure Mode	6" HDPE SDR 17 Leachate Collection Pipe
Compressive Ring Thrust (Wall Crushing)	F.S. = 1.4
Pipe Buckling	F.S. = 2.5
Ring Deflection (7.5% allowable)	5.3%

References

The Plastic Pipe Institute Handbook of Polyethylene Pipe, 2nd Edition.
http://plasticpipe.org/publications/pe_handbook.html

Harrison, S. and Watkins, R.K.": "HDPE Leachate Collection Pipe Design by Fundamentals of Mechanics", 19th International Madison Waste Conference - Municipal and Industrial Waste, 1996, pp. 217-225.

Source: "PPI Handbook of Polyethylene Pipe", downloaded May, 2006
www.plasticpipe.org/general/ppi_handbook.php

As indicated in Table 1-2, polyethylene pipe which meets the requirements of ASTM D2513 may be used for the transport of liquefied petroleum gas (LPG). NFPA 58 recommends a maximum operating pressure of 30 psig for LPG gas applications involving polyethylene pipe. This design limit is established in recognition of the higher condensation temperature for LPG as compared to that of natural gas and, thus, the maximum operating pressure is recommended to ensure that plastic pipe is not subjected to excessive exposure to LPG condensates. For further information the reader is referred to PPI's TR-22, Polyethylene Piping Distribution Systems for Components of Liquid Petroleum Gases.[14]

TABLE 1-3
Service Temperature Design Factors, F_T

Maximum Continuously Applied Service Temp., °F(°C)	Temperature Compensation Factor, FT, for PE3408
≤ 80 (26)	1.00
≤ 90 (32)	0.90
≤ 100 (38)	0.78
≤ 110 (43)	0.75
≤ 120 (49)	0.63
≤ 130 (54)	0.60
≤ 140 (60)	0.50

Fluid Flow in Polyethylene Piping

Head Loss in Pipes – Darcy-Weisbach/Fanning/Colebrook/Moody

Viscous shear stresses within the liquid and friction along the pipe walls create resistance to flow within a pipe. This resistance within a pipe results in a pressure drop, or loss of head in the piping system.

The Darcy-Weisbach or Fanning formula, Equation 1-7, and the Colebrook formula, Equation 1-10, are generally accepted methods for calculating friction losses due to liquids flowing in full pipes.[15,16] These formulas recognize dependence on pipe bore and pipe surface characteristics, liquid viscosity and flow velocity.

The Darcy-Weisbach formula is:

(1-7)

$$h_f = f \frac{L V^2}{d' 2g}$$

Bending strain occurs in the pipe wall as a result of ring deflection—outer-fiber tensile strain at the pipe springline and outer-fiber compressive strain at the crown and invert. While strain limits of 5% have been proposed, Jansen [12] reported that, on tests of PE pipe manufactured from pressure-rated resins and subjected to soil pressure only, "no upper limit from a practical design point of view seems to exist for the bending strain." In other words, as deflection increases, the pipe's performance limit will not be overstraining but reverse curvature collapse.

Thus, for non-pressure applications, a 7.5 percent deflection limit provides a large safety factor against instability and strain and is considered a safe design deflection. Some engineers will design profile wall pipe and other non-pressure pipe applications to a 5% deflection limit, but allow spot deflections up to 7.5% during field inspection.

The deflection limits for pressurized pipe are generally lower than for non-pressurized pipe. This is primarily due to strain considerations. Hoop strain from pressurization adds to the outer-fiber tensile strain. But the internal pressure acts to reround the pipe and, therefore, Eq. 2-10 overpredicts the actual long-term deflection for pressurized pipe. Safe allowable deflections for pressurized pipe are given in Table 2-11. Spangler and Handy [13] give equations for correcting deflection to account for rerounding.

TABLE 2-11
Safe Deflection Limits for Pressurized Pipe

DR or SDR	Safe Deflection as % of Diameter
32.5	7.5
26	7.5
21	7.5
17	6.0
13.5	6.0
11	5.0
9	4.0
7.3	3.0

*Based on Long-Term Design Deflection of Buried Pressurized Pipe given in ASTM F1962.

Compressive Ring Thrust

Earth pressure exerts a radial-directed force around the circumference of a pipe that results in a compressive ring thrust in the pipe wall. (This thrust is exactly opposite to the tensile hoop thrust induced when a pipe is pressurized.) See Figure 2-1b. Excessive ring compressive thrust may lead to two different performance limits:

The compressive stress in the pipe wall can be compared to the pipe material allowable compressive stress. If the calculated compressive stress exceeds the allowable stress, then a lower DR (heavier wall thickness) or heavier profile wall is required.

Allowable Compressive Stress

Table 2-12 gives allowable long-term compressive stress values for PE 3408 and PE 2406 material.

TABLE 2-12
Long-Term Compressive Stress at 73°F (23°C)

Material	Long-Term Compressive Stress, lb/in^2
PE 3408	1000
PE 2406	800

The long-term compressive stress value should be reduced for elevated temperature pipeline operation. Temperature design factors used for hydrostatic pressure may be used, i.e. 0.5 @ 140°F. Additional temperature design factors may be obtained by reference to Table 1-11 in Section 1 of this chapter.

Ring Compression Example

Find the pipe wall compressive ring stress in a DR 32.5 HDPE pipe buried under 46 ft of cover. The ground water level is at the surface, the saturated weight of the insitu silty-clay soil is 120 lbs/ft^3.

SOLUTION: Find the vertical earth pressure acting on the pipe. Use Equation 2-1.

Although the net soil pressure is equal to the buoyant weight of the soil, the water pressure is also acting on the pipe. Therefore the total pressure (water and earth load) can be found using the saturated unit weight of the soil.

Next, solve for the compressive stress.

$$P_E = (120\ pcf)(46\ ft) = 5520\ psf$$

$$S = \frac{(5520\ lb/ft^2)(32.5)}{288} = 623\ lb/inch^2$$

The compressive stress is within the 1000 lb/in^2 allowable stress for HDPE given in Table 2-12.

Attachment 1 cont.

(2-21)

$$VAF = 0.88 - 0.71\frac{S_A - 1}{S_A + 2.5}$$

WHERE

VAF = Vertical Arching Factor

S_A = Hoop Thrust Stiffness Ratio

(2-22)

$$S_A = \frac{1.43\, M_S\, r_{CENT}}{EA}$$

WHERE

r_{CENT} = radius to centroidal axis of pipe, in

M_S= one-dimensional modulus of soil, psi

E = apparent modulus of elasticity of pipe material, psi

A= profile wall average cross-sectional area, in^2/in, or wall thickness (in) for DR pipe

One-dimensional modulus values for soil can be obtained from soil testing, geotechnical texts, or Table 2-14 which gives typical values. The typical values in Table 2-14 were obtained by converting values from McGrath[20].

TABLE 2-14

Typical Values of M_S, One-Dimensional Modulus of Soil

Vertical Soil Stress[1] (psi)	Gravelly Sand/Gravels 95% Std. Proctor (psi)	Gravelly Sand/Gravels 90% Std. Proctor (psi)	Gravelly Sand/Gravels 85% Std. Proctor (psi)
10	3000	1600	550
20	3500	1800	650
40	4200	2100	800
60	5000	2500	1000
80	6000	2900	1300
100	6500	3200	1450

*Adapted and extended from values given by McGrath[20]. For depths not shown in McGrath[20], the MS values were approximated using the hyperbolic soil model with appropriate values for K and n where n=0.4 and K=200, K=100, and K=45 for 95% Proctor, 90% Proctor, and 85% Proctor, respectively.

[1] Vertical Soil Stress (psi) = [soil depth (ft) x soil density (pcf)]/144

The radial directed earth pressure can be found by multiplying the prism load (pressure) by the vertical arching factor as shown in Eq. 2-23.

(2-23)

$$P_{RD} = (VAF)wH$$

TABLE 2-15
Typical range of Poisson's Ratio for Soil (Bowles [21])

Soil Type	Poisson Ratio, μ
Saturated Clay	0.4-0.5
Unsaturated Clay	0.1-0.3
Sandy Clay	0.2-0.3
Silt	0.3-0.35
Sand (Dense)	0.2-0.4
Coarse Sand (Void Ratio 0.4-0.7)	0.15
Fine-grained Sand (Void Ratio 0.4-0.7)	0.25

Next, the designer determines the Deformation Factor, D_F, by entering the Watkins-Gaube Graph with the Rigidity Factor. See Fig. 2-6. The Deformation Factor is the proportionality constant between vertical deflection (compression) of the soil layer containing the pipe and the deflection of the pipe. Thus, pipe deflection can be obtained by multiplying the proportionality constant D_F times the soil settlement. If D_F is less than 1.0 in Fig. 2-6, use 1.0.

The soil layer surrounding the pipe bears the entire load of the overburden above it without arching. Therefore, settlement (compression) of the soil layer is proportional to the prism load and not the radial directed earth pressure. Soil strain, ε_S, may be determined from geotechnical analysis or from the following equation:

(2-27)

$$\varepsilon_S = \frac{wH}{144E_S}$$

WHERE

w = unit weight of soil, pcf

H = depth of cover (height of fill above pipe crown), ft

E_S = secant modulus of the soil, psi

The designer can find the pipe deflection as a percent of the diameter by multiplying the soil strain, in percent, by the deformation factor:

Attachment 1 cont.

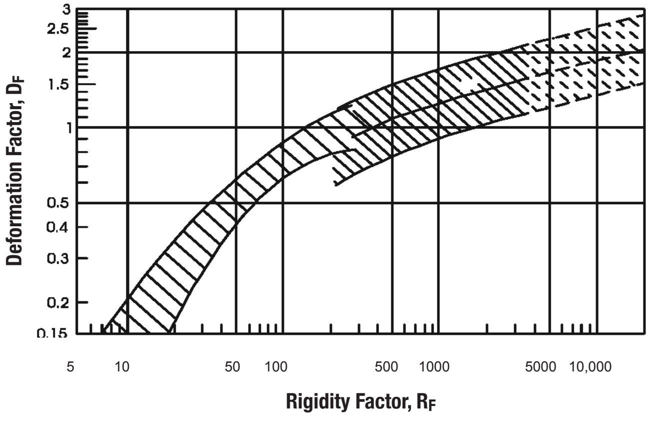

Figure 2-6 Watkins-Gaube Graph

(2-28)
$$\frac{\Delta X}{D_M}(100) = D_F \varepsilon_S$$

WHERE

$\Delta X/D_M$ multiplied by 100 gives percent deflection.

Watkins – Gaube Calculation Technique

Find the deflection of a 6″ SDR 11 pipe under 140 ft of fill with granular embedment containing 12% or less fines, compacted at 90% of standard proctor. The fill weighs 75 pcf.

SOLUTION: First, calculate the vertical soil pressure equation, Eq. 2-1.

Eq. 2-1: $P_E = wH$

$P_E = (75 lb/ft^3)(140\ ft)$

$P_E = 10{,}500\ lb/ft^2$ or 72.9 psi

The M_S is obtained by interpolation from Table 2-14 and equals 2700. The secant modulus can be found assuming a Poisson Ratio of 0.30

$$E_S = \frac{2700\ psi\,(1+0.30)(1-2(0.30))}{(1-0.30)} = 2005\ psi$$

The rigidity factor is obtained from Equation 2-24.

$$R_F = \frac{12\,(2005)\,(11-1)^3}{28250} = 852$$

Using Figure 2-6, the deformation factor is found to be 1.2. The soil strain is calculated by Equation 2-27.

$$\varepsilon_S = \frac{75pcf * 140ft}{144 * 2005\dfrac{lbs}{inch^2}} \bullet 100 = 3.6\%$$

The deflection is found by multiplying the soil strain by the deformation factor:

$$\frac{\Delta X}{D_M}(100) = 1.2 * 3.6 = 4.4\%$$

Moore-Selig Equation for Constrained Buckling in Dry Ground

As discussed previously, a compressive thrust stress exists in buried pipe. When this thrust stress approaches a critical value, the pipe can experience a local instability or large deformation and collapse. In an earlier section of this chapter, Luscher's equation was given for constrained buckling under ground water. Moore and Selig[17] have used an alternate approach called the continuum theory to develop design equations for contrained buckling due to soil pressure (buckling of embedded pipes). The particular version of their equations given below is more appropriate for dry applications than Luscher's equation. Where ground water is present, Luscher's equation should be used.

The Moore-Selig Equation for critical buckling pressure follows: (Critical buckling pressure is the pressure at which buckling will occur. A safety factor should be provided.)

(2-29)

$$P_{CR} = \frac{2.4\,\varphi\,R_H}{D_M}(EI)^{\frac{1}{3}}(E_S^*)^{\frac{2}{3}}$$

WHERE

P_{CR} = Critical constrained buckling pressure, psi

φ = Calibration Factor, 0.55 for granular soils

R_H = Geometry Factor

E = Apparent modulus of elasticity of pipe material, psi

I = Pipe wall moment of Inertia, in^4/in ($t^3/12$, if solid wall construction)

$E_S^* = ES/(1-\mu)$

E_S = Secant modulus of the soil, psi

μ_s = Poisson's Ratio of Soil

The geometry factor is dependent on the depth of burial and the relative stiffness between the embedment soil and the insitu soil. Moore has shown that for deep burials in uniform fills, R_H equals 1.0.

change cannot occur, so a longitudinal tensile stress is created along the pipe. The magnitude of this stress can be determined using Equation 3-2.

(3-2) $$\sigma = E \alpha \Delta T$$

Where terms are as defined above, and

σ = longitudinal stress in pipe, psi

E = apparent modulus elasticity of pipe material, psi

The value of the apparent modulus of elasticity of the pipe material has a large impact on the calculated stress. As with all thermoplastic materials, polyethylene's modulus, and therefore its stiffness, is dependent on temperature and the duration of the applied load. Therefore, the appropriate elastic modulus should be selected based on these two variables. When determining the appropriate time interval, it is important to consider that heat transfer occurs at relatively slow rates through the wall of polyethylene pipe; therefore temperature changes do not occur rapidly. Because the temperature change does not happen rapidly, the average temperature is often chosen for the modulus selection.

TABLE 3-1
Apparent Modulus Elasticity for HDPE Pipe Material at Various Temperatures

Load Duration	PE 3408 Apparent Elastic Modulus†, 1000 psi (MPa), at Temperature, ºF (ºC)							
	-20 (-29)	0 (-18)	40 (4)	60 (16)	73 (23)	100 (38)	120 (49)	140 (60)
Short-Term	300.0 (2069)	260.0 (1793)	170.0 (1172)	130.0 (896)	110.0 (758)	100.0 (690)	65.0 (448)	50.0 (345)
10 h	140.8 (971)	122.0 (841)	79.8 (550)	61.0 (421)	57.5 (396)	46.9 (323)	30.5 (210)	23.5 (162)
100 h	125.4 (865)	108.7 (749)	71.0 (490)	54.3 (374)	51.2 (353)	41.8 (288)	27.2 (188)	20.9 (144)
1000 h	107.0 (738)	92.8 (640)	60.7 (419)	46.4 (320)	43.7 (301)	35.7 (246)	23.2 (160)	17.8 (123)
1 y	93.0 (641)	80.6 (556)	52.7 (363)	40.3 (278)	38.0 (262)	31.0 (214)	20.2 (139)	15.5 (107)
10 y	77.4 (534)	67.1 (463)	43.9 (303)	33.5 (231)	31.6 (218)	25.8 (178)	16.8 (116)	12.9 (89)
50 y	69.1 (476)	59.9 (413)	39.1 (270)	29.9 (206)	28.2 (194)	23.0 (159)	15.0 (103)	11.5 (79)

† Typical values based on ASTM D 638 testing of molded plaque material specimens. An elastic modulus for PE 2406 may be estimated by multiplying the PE 3408 modulus value by 0.875.

Attachment 1 cont.

OD			Pipe inside diameter (d)	Minimum Wall Thickness (t)	Weight (w)
Nominal in.	Actual in.	SDR	in.	in.	lb. per foot
		7	3.88	0.795	5.172
		7.3	3.95	0.762	4.996
		9	4.25	0.618	4.182
		9.3	4.29	0.598	4.065
		11	4.49	0.506	3.505
5	5.563	11.5	4.54	0.484	3.368
		13.5	4.69	0.412	2.912
		15.5	4.80	0.359	2.564
		17	4.87	0.327	2.353
		21	5.00	0.265	1.929
		26	5.11	0.214	1.574
		32.5	5.20	0.171	1.270
		7	4.62	0.946	7.336
		7.3	4.70	0.908	7.086
		9	5.06	0.736	5.932
		9.3	5.11	0.712	5.765
		11	5.35	0.602	4.971
6	6.625	11.5	5.40	0.576	4.777
		13.5	5.58	0.491	4.130
		15.5	5.72	0.427	3.637
		17	5.80	0.390	3.338
		21	5.96	0.315	2.736
		26	6.08	0.255	2.233
		32.5	6.19	0.204	1.801
		7	6.01	1.232	12.433
		7.3	6.12	1.182	12.010
		9	6.59	0.958	10.054
		9.3	6.66	0.927	9.771
		11	6.96	0.784	8.425
8	8.625	11.5	7.04	0.750	8.096
		13.5	7.27	0.639	7.001
		15.5	7.45	0.556	6.164
		17	7.55	0.507	5.657
		21	7.75	0.411	4.637
		26	7.92	0.332	3.784

Attachment 1 cont.

OD			Pipe inside diameter (d)	Minimum Wall Thickness (t)	Weight (w)
Nominal in.	Actual in.	SDR	in.	in.	lb. per foot
		7	7.49	1.536	19.314
		7.3	7.63	1.473	18.656
		9	8.22	1.194	15.618
		9.3	8.30	1.156	15.179
		11	8.68	0.977	13.089
10	10.750	11.5	8.77	0.935	12.578
		13.5	9.06	0.796	10.875
		15.5	9.28	0.694	9.576
		17	9.41	0.632	8.788
		21	9.66	0.512	7.204
		26	9.87	0.413	5.878
		32.5	10.05	0.331	4.742
		7	8.89	1.821	27.170
		7.3	9.05	1.747	26.244
		9	9.75	1.417	21.970
		9.3	9.84	1.371	21.353
		11	10.29	1.159	18.412
12	12.750	11.5	10.40	1.109	17.693
		13.5	10.75	0.944	15.298
		15.5	11.01	0.823	13.471
		17	11.16	0.750	12.362
		21	11.46	0.607	10.134
		26	11.71	0.490	8.269
		32.5	11.92	0.392	6.671
		7	9.76	2.000	32.758
		7.3	9.93	1.918	31.642
		9	10.70	1.556	26.489
		9.3	10.81	1.505	25.745
		11	11.30	1.273	22.199
14	14.000	11.5	11.42	1.217	21.332
		13.5	11.80	1.037	18.445
		15.5	12.09	0.903	16.242
		17	12.25	0.824	14.905
		21	12.59	0.667	12.218
		26	12.86	0.538	9.970
		32.5	13.09	0.431	8.044

OD			Pipe inside diameter (d)	Minimum Wall Thickness (t)	Weight (w)
Nominal in.	Actual in.	SDR	in.	in.	lb. per foot
		7	11.15	2.286	42.786
		7.3	11.35	2.192	41.329
		9	12.23	1.778	34.598
		9.3	12.35	1.720	33.626
		11	12.92	1.455	28.994
16	16.000	11.5	13.05	1.391	27.862
		13.5	13.49	1.185	24.092
		15.5	13.81	1.032	21.214
		17	14.00	0.941	19.467
		21	14.38	0.762	15.959
		26	14.70	0.615	13.022
		7	12.55	2.571	54.151
		7.3	12.77	2.466	52.307
		9	13.76	2.000	43.788
		9.3	13.90	1.935	42.558
		11	14.53	1.636	36.696
18	18.000	11.5	14.68	1.565	35.263
		13.5	15.17	1.333	30.491
		15.5	15.54	1.161	26.849
		17	15.76	1.059	24.638
		21	16.18	0.857	20.198
		26	16.53	0.692	16.480
		32.5	16.83	0.554	13.296
		7	13.94	2.857	66.853
		7.3	14.19	2.740	64.576
		9	15.29	2.222	54.059
		9.3	15.44	2.151	52.541
		11	16.15	1.818	45.304
20	20.000	11.5	16.31	1.739	43.535
		13.5	16.86	1.481	37.643
		15.5	17.26	1.290	33.146
		17	17.51	1.176	30.418
		21	17.98	0.952	24.936
		26	18.37	0.769	20.346
		32.5	18.70	0.615	16.415

Attachment 1 cont.

OD			Pipe inside diameter (d)	Minimum Wall Thickness (t)	Weight (w)
Nominal in.	Actual in.	SDR	in.	in.	lb. per foot
		9	16.82	2.444	65.412
		9.3	16.98	2.366	63.574
		11	17.76	2.000	54.818
		11.5	17.94	1.913	52.677
22	22.000	13.5	18.55	1.630	45.548
		15.5	18.99	1.419	40.107
		17	19.26	1.294	36.805
		21	19.78	1.048	30.172
		26	20.21	0.846	24.619
		32.5	20.56	0.677	19.863
		9	18.35	2.667	77.845
		9.3	18.53	2.581	75.658
		11	19.37	2.182	65.237
		11.5	19.58	2.087	62.690
24	24.000	13.5	20.23	1.778	54.206
		15.5	20.72	1.548	47.731
		17	21.01	1.412	43.801
		21	21.58	1.143	35.907
		26	22.04	0.923	29.299
		32.5	22.43	0.738	23.638
		11	22.60	2.545	88.795
		11.5	22.84	2.435	85.329
		13.5	23.60	2.074	73.781
		15.5	24.17	1.806	64.967
28	28.000	17	24.51	1.647	59.618
		21	25.17	1.333	48.874
		26	25.72	1.077	39.879
		32.5	26.17	0.862	32.174
		11	24.22	2.727	101.934
		11.5	24.47	2.609	97.954
		13.5	25.29	2.222	84.697
		15.5	25.90	1.935	74.580
30	30.000	17	26.26	1.765	68.439
		21	26.97	1.429	56.105
		26	27.55	1.154	45.779
		32.5	28.04	0.923	36.934

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AECOM

Memorandum

Date:	April 29, 2009
To:	Mr. Tim Muehlfeld, P.E., We Energies
From:	Mr. John M. Trast, P.E., AECOM Environment
Subject:	Landfill Leachate Collection System Clogging Potential by Flue Gas Desulfurization By-Product (Gypsum)
Distribution:	Mr. Art Covi, We Energies

This memorandum summarizes the engineering evaluation and laboratory testing program performed by AECOM to evaluate clogging potential of the leachate collection system at the We Energies Caledonia Landfill with Flue Gas Desulfurization By-Product (gypsum). A sample of gypsum was obtained from We Energies to perform laboratory testing program.

The clogging potential of the landfill's leachate collection system with gypsum was evaluated by simulating the transport and migration of gypsum particles into the granular drainage layer of the leachate collection system due to storm water runoff. The depth of penetration of gypsum into the sand layer and the turbidity of the filtrate water exiting the sand layer were observed. The testing apparatus was a fixed-walled permeameter with a clear plastic cylinder so the sand-gypsum interface could be observed. The permeameter was filled approximately two-thirds full with a uniform sand to simulate the granular drainage layer. The sand was placed into the permeameter in a loose dry state with no compactive effort. The top of the permeameter was left off so the gypsum slurry could be poured directly onto the sand layer.

The gypsum slurry was prepared using the gypsum received from We Energies and deionized tap water. Approximately, 500 grams of gypsum was mixed with 1000 milliliters of water for the slurry. The slurry was agitated to keep the gypsum in suspension and quickly poured into the permeameter using a funnel to control the placement and prevent movement of the sand. Once the slurry was poured onto a sand layer, the filtrate was observed for turbidity and the sand gypsum interface was observed for particles migrating into the sand layer. The test procedure was repeated three times and the results documented.

The results of the testing showed the gypsum particles did not migrate into the sand layer. Instead, a clear delineation was observed at the top of the sand layer. The slurry water was allowed to infiltrate through the sand and collected at the bottom. The water was clear with no observed turbidity. The photographs illustrating the testing procedure and showing the results are appended.

Following the completion of the initial slurry testing, the fixed-walled permeameter was set-up and water was allowed to infiltrate through with a maximum head of 48 inches. The test was set-up and allowed to run for until approximately 20 pore volumes of water had percolated through the gypsum and sand. The filtrate water was clear with no observed turbidity and there was no observed migration of gypsum particles into the sand layer.

Based on the observed filtering by the sand drainage layer, particle size distribution curves were developed for both materials. The sand and gypsum were both tested in accordance with ASTM D 422. Filtering calculations based on the particle size distribution curves were checked, in accordance with the ratios originally defined by Bertram (1940) and subsequently modified by U.S. Army et al. (1971). The U.S. Army Corp of Engineers requires that the following conditions be satisfied to prevent the movement of soil particles into or through graded soil filters.

$$\textit{Piping Ratio} = \frac{D15\ \textit{Sand}}{D85\ \textit{Gypsum}} \leq 5 \quad \Rightarrow \quad \frac{0.460\ mm}{0.041\ mm} = 11.2 \neq 5 \qquad \text{FAILS}$$

$$\textit{Hydraulic Conductivity Ratio} = \frac{D50\ \textit{Sand}}{D50\ \textit{Gypsum}} \leq 25 \quad \Rightarrow \quad \frac{0.56\ mm}{0.030\ mm} = 18.6 \leq 25 \quad \text{OK}$$

Where: D15 = is the soil diameter at which 15% by weight is finer
D50 = is the soil diameter at which 50% by weight is finer
D85 = is the soil diameter at which 85% by weight is finer

Based on the piping ratio, the sand used in the experiment should not be performing as a filter layer, preventing the gypsum particles from migrating into the sand layer. However, Cedergren (1989) discussed observations made by Bertram in his original investigations where he observed that the grain size of uniform filter materials may be up to 10 times those of uniform soils before appreciable amounts of soil will move into or through the filter. This is clearly the same observation we made in the laboratory.

The uniformity coefficient is a ratio of the D60 to D10, where D60 is the particle diameter at which 60% of the soil by weight is finer and D10 is the corresponding value at 10% finer. A soil having a uniformity coefficient smaller than about 2 is considered uniform. The sand used in our experiment has uniformity coefficient of 1.3 and the gypsum has a uniformity coefficient of 1.44, both materials are uniform.

Materials typically used for the leachate collection system are clean sands with gradations similar to ASTM C33 Fine Aggregate. These soils are not as uniform as the sand used in the experiment with uniformity coefficients typically ranging between 2 and 5. The D15 particle size would typically range from 0.40 mm to 0.17 mm and the corresponding piping ratio would decrease from 11.2 to less than 10. Based on the gradation ranges of ASTM C 33 Fine Aggregate the piping ratio would range from 9.7 to 4.1. Assuming the gradation of the gypsum tested is representative of the gypsum that would be stockpiled or disposed of in the landfill, clogging of the leachate collection system due to particle migration should not occur.

References:

Bertram, G.E. (1940), "An Experimental Investigation of Protective Filters," Publications of the Graduate School of Engineering, Harvard University, No. 267, January 1940.

Cedergren, Harry R. (1989), "Seepage, Drainage, and Flow Nets," John Wiley & Sons, Inc. New York, New York, 3rd Edition. pp. 151-200.

Lambe, T.William, and Whitman, Robert V. (1969), "Soil Mechanics," John Wiley & Sons, Inc. New York, New York, pp. 29-39.

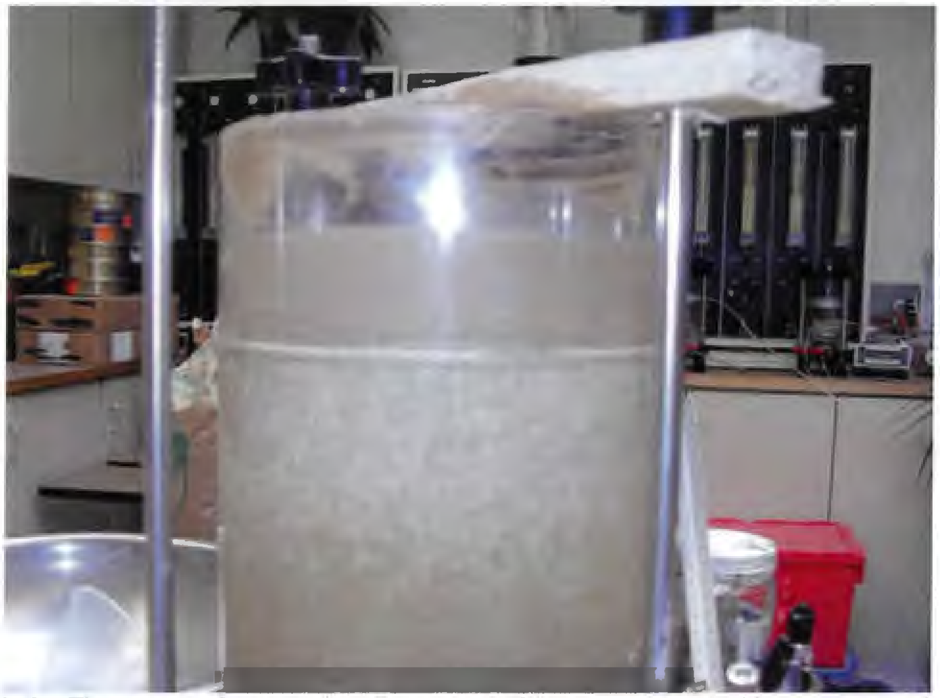
U.S. Army, U.S. Navy, and U.S. Air Force (1971), "Dewatering and Groundwater Control for Deep Excavations," TM 5-818-5, NAVFAC P-418, AFM 88-5m Chapter 6, April 1971, p. 39.

Photograph 1 – Coarse sand is placed in the clear mold and slurry of gypsum and water slurry is prepared

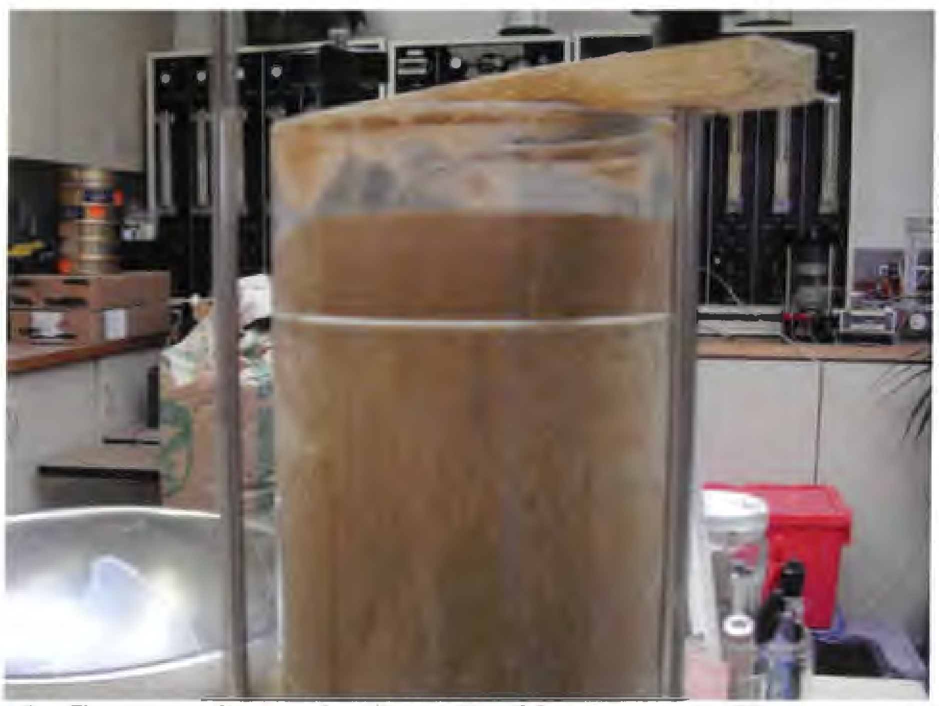
Photograph 2 – The gypsum slurry is poured into the mold on top of the coarse sand the funnel is used to prevent displacement of the sand

Photograph 3 – The slurry is allowed to drain through the sand and the filtrate water is collected

Photograph 4 – The clear filtrate water is collected from the bottom of the apparatus indicating that particulates are not being transported through the sand

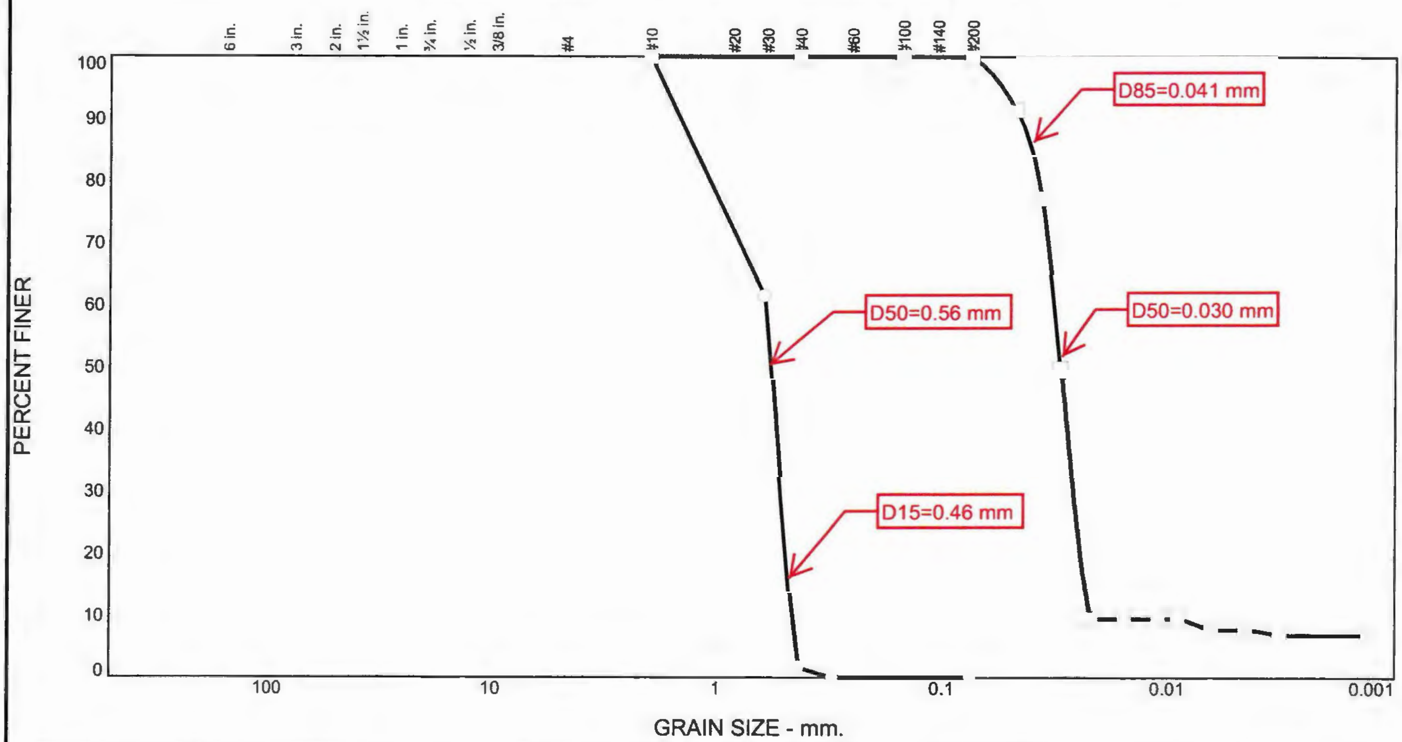


Photograph 5 – The gypsum forms a clear line on top of the coarse sand with no apparent intrusion or migration



Photograph 6 – The gypsum forms a clear line on top of the coarse sand with no apparent intrusion or migration

Particle Size Distribution Report



+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
0.0	0.0			0.0				
0.0	0.0	0.1	92.2	7.7				

SIEVE inches size	PERCENT FINER	

	GRAIN SIZE	
D_{60}	0.5965	0.0320
D_{30}	0.5107	0.0264
D_{10}	0.4549	0.0222
	COEFFICIENTS	
C_c	0.96	0.98
C_u	1.31	1.44

SIEVE number size	PERCENT FINER	
#10	100.0	100.0
#30	61.0	
#40	1.6	100.0
#50		
#100		100.0
#200		99.9

Material Description

Uniform Sand

Gypsum

REMARKS:

Source of Sample: ON-SITE Sample Number: BADGER SAND
Source of Sample: ON-SITE Sample Number: GYPSUM

STS | AECOM

Client: WE ENERGIES
Project: CALEDONIA LANDFILL PLAN OF OPERATION MODIFICATION
Project No.: 10532-011 Figure

Tested By: BOB PEETERS

	Client	WEC Energy Group			Page	1 of 3
GEI Consultants	Project	Caledonia Landfill Plan Modification			Pg. Rev.	Rev.0
	By	KMK	Chk.	AJS	App.	
	Date	08/11/2023	Date	8/11/2023	Date	
GEI Project No.	2103691	Document No.				
Subject	Cell 12-16 Sump Sizing					

Purpose

The purpose of this calculation is size the proposed leachate sumps for Caledonia Landfill Cells 12 through 16.

References

1. Filling Plan for Cell 6 and Cell 8 East Slope, dated February 25, 2022.

Assumptions

1. The Caledonia Landfill design will be modified to include leachate collection sumps in Cell 12 and Cell 14. The intent of the leachate sumps is to eliminate the base liner penetration required to gravity drain the cell directly to the leachate conveyance system. The Cell 12 sump will collect only from Cell 12, approximately 4.2 acres. The Cell 14 sump will collect from Cell 14 and Cell 16, approximately 5.7 acres.
2. The leachate sumps will pump to leachate manholes outside the limits of waste. From the leachate manholes, leachate will gravity drain in a leachate conveyance pipe. The leachate conveyance pipe is a 6-inch diameter pipe inside a 10-inch diameter carrier pipe.
3. The existing leachate conveyance pipe gravity drains to the pump station at MH-1. The proposed addition to the leachate conveyance pipe would extend the length to approximately 2,000 feet. The leachate is pumped by forcemain from MH-1 to the leachate loadout facility. The forcemain section is approximately 2,300 feet in length.
4. The proposed leachate sumps will be backfilled with open graded aggregate with an assumed porosity of 0.30.
5. The bottom of the sump will be graded flat.
6. The flow rate of the leachate pumps will range from 10 gpm to 50 gpm.
7. The assumed leachate generation rate is based on an average of 6-inches per year.

Calculation

First determine the actual infiltration rate. Assuming double the average infiltration rate (12-inches per year) and an area of 5.7 acres, that equates to 3.5 gpm. Size the sumps to handle an infiltration rate of 5 gpm.

Next, size the sump to cycle no more than 4 times per day. Assuming and infiltration rate of 5 gpm, the design sump storage volume should be on the order of 1,800 gallons, or 240 cubic feet. Assuming the sump is filled with open graded stone, porosity of 0.30, the sump volume should be at least 800 cubic feet.

	Client	WEC Energy Group			**Page**	2 of 3
	Project	Caledonia Landfill Plan Modification			**Pg. Rev.**	Rev.0
	By	KMK	**Chk.**	AJS	**App.**	
	Date	08/11/2023	**Date**	8/11/2023	**Date**	
GEI Project No.	2103691	**Document No.**				
Subject	Cell 12-16 Sump Sizing					

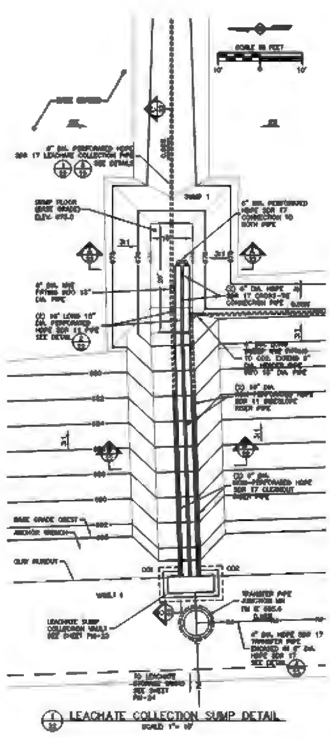
Assume the sump depth is 3.5 feet, the required sump area is approximately 230 square feet. Design the sump to be square with an average dimension of 15 wide by 15 feet long. Assuming 3H:1V slopes, the sump would measure approximately 9 feet wide by 9 feet long at the base and 21 feet wide by 21 feet long at the top.

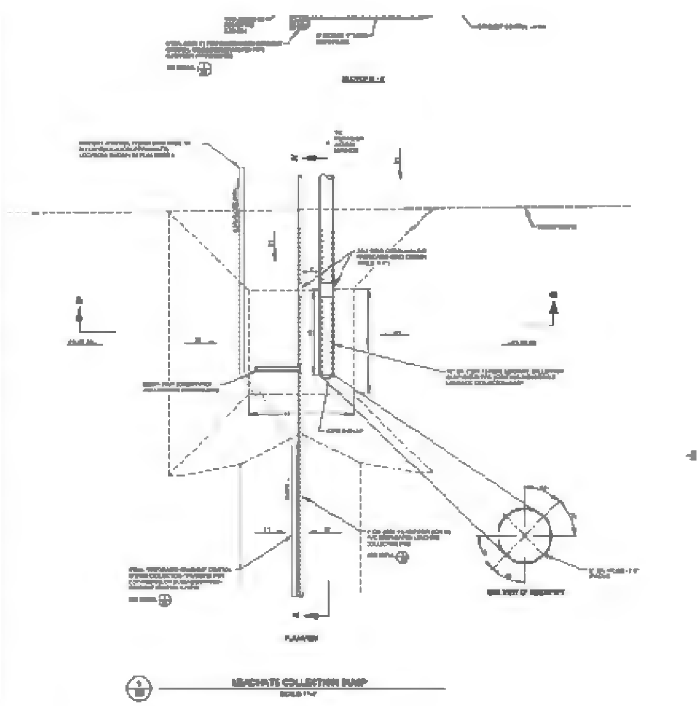
Conclusion

The proposed leachate sumps in Cells 12 and 14 should be sized to be a volume of at least 800 cubic feet to provide a leachate capacity of at least 1,800 gallons. Typical square leachate collection sumps from Weston Disposal Site No. 3, or rectangular leachate collection sumps from Pleasant Prairie Power Plant Landfill are previously approved and constructable designs that would provide the required storage volume.

Attachments

Typical leachate collection sump details from Pleasant Prairie Power Plant Landfill and Weston Disposal Site No. 3 drawings.





Appendix I

Final Cover Design Calculations

	Client	WEC Energy Group			Page	1 of 1
GEI Consultants	Project	Caledonia Ash Landfill Plan of Operation Modification			Pg. Rev.	0
	By	AJS	Chk.	KMK	App.	JXT
	Date	9/26/2023	Date	9/27/2023	Date	9/27/23
Project No.	2203724	**Document No.**	N/A			
Description	Final Cover System Drainage Layer Performance Calculations					

Brief Summary of Calculations Including Scope and Results

The Hydrologic Evaluation of Landfill Performance (HELP) Model, version 4.01, was utilized to predict the percolation rate through the proposed components of the final cover systems on both the 4% and 25% slopes. The final cover system for the Caledonia Ash Landfill will consist of the following components from top to bottom"

- 6-inch topsoil
- 30-inch rooting zone layer
- Double-sided geocomposite drainage layer
- 40-mil LLDPE geomembrane
- 24-inch compacted clay layer or a soil barrier layer with a geosynthetic clay liner (GCL)
- 6-inch ash grading layer

According to the model predictions, the following rates of percolation can be expected within the proposed landfill cover system:

- Cover (24-inch compacted clay layer) – 0.000004 inches per year on 4% slope
- Cover (24-inch compacted clay layer) – 0.000003 inches per year on 25% slope
- Cover (24-inch soil barrier layer and GCL) – 0.000003 inches per year on 4% slope
- Cover (24-inch soil barrier layer and GCL) – 0.000003 inches per year on 25% slope

The percolation rates for the proposed final cover systems are significantly less than the current permitted final cover system. Specifically, the current permitted final cover system has a percolation rate of 0.0042 inches per year on a 4% slope and 0.0001 inches per year on a 25% slope. The proposal final cover system is predicted to have a percolation rate of 99.9% percent less on the 4% slope, and a percolation rate of 97% less on the 25% slope.

HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 4.0 BETA (2018)
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Title:	Final Cover (2' Compacted Clay Liner, 4% Slope)	**Simulated On:**	9/26/2023 8:35

Layer 1
Type 1 - Vertical Percolation Layer (Cover Soil)
L - Loam
Material Texture Number 8

Thickness	=	6	inches
Porosity	=	0.463	vol/vol
Field Capacity	=	0.232	vol/vol
Wilting Point	=	0.116	vol/vol
Initial Soil Water Content	=	0.2398	vol/vol
Effective Sat. Hyd. Conductivity	=	3.70E-04	cm/sec

Layer 2
Type 1 - Vertical Percolation Layer
CL - Clay Loam
Material Texture Number 11

Thickness	=	30	inches
Porosity	=	0.464	vol/vol
Field Capacity	=	0.31	vol/vol
Wilting Point	=	0.187	vol/vol
Initial Soil Water Content	=	0.2905	vol/vol
Effective Sat. Hyd. Conductivity	=	6.40E-05	cm/sec

Layer 3
Type 2 - Lateral Drainage Layer
Drainage Net (0.5 cm)
Material Texture Number 20

Thickness	=	0.2	inches
Porosity	=	0.85	vol/vol
Field Capacity	=	0.01	vol/vol
Wilting Point	=	0.005	vol/vol
Initial Soil Water Content	=	0.01	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E+01	cm/sec
Slope	=	4	%
Drainage Length	=	350	ft

Layer 4

Type 4 - Flexible Membrane Liner

LDPE Membrane

Material Texture Number 36

Thickness	=	0.04	inches
Effective Sat. Hyd. Conductivity	=	4.00E-13	cm/sec
FML Pinhole Density	=	2	Holes/Acre
FML Installation Defects	=	0.5	Holes/Acre
FML Placement Quality	=	3	Good

Layer 5

Type 3 - Barrier Soil Liner

Liner Soil (High)

Material Texture Number 16

Thickness	=	24	inches
Porosity	=	0.427	vol/vol
Field Capacity	=	0.418	vol/vol
Wilting Point	=	0.367	vol/vol
Initial Soil Water Content	=	0.427	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-07	cm/sec

Layer 6

Type 1 - Vertical Percolation Layer (Waste)

High-Density Electric Plant Coal Bottom Ash

Material Texture Number 31

Thickness	=	6	inches
Porosity	=	0.578	vol/vol
Field Capacity	=	0.076	vol/vol
Wilting Point	=	0.025	vol/vol
Initial Soil Water Content	=	0.0751	vol/vol
Effective Sat. Hyd. Conductivity	=	4.10E-03	cm/sec

Note: Initial moisture content of the layers and snow water were computed as nearly steady-state values by HELP.

General Design and Evaporative Zone Data

SCS Runoff Curve Number	=	72.6	
Fraction of Area Allowing Runoff	=	100	%
Area projected on a horizontal plane	=	1	acres
Evaporative Zone Depth	=	18	inches
Initial Water in Evaporative Zone	=	4.575	inches
Upper Limit of Evaporative Storage	=	8.346	inches
Lower Limit of Evaporative Storage	=	2.94	inches
Initial Snow Water	=	0.169031	inches
Initial Water in Layer Materials	=	20.855	inches
Total Initial Water	=	21.024	inches
Total Subsurface Inflow	=	0	inches/year

Note: SCS Runoff Curve Number was calculated by HELP.

Evapotranspiration and Weather Data

Station Latitude	=	42.88	Degrees
Maximum Leaf Area Index	=	3.5	
Start of Growing Season (Julian Date)	=	130	days
End of Growing Season (Julian Date)	=	283	days
Average Wind Speed	=	11.6	mph
Average 1st Quarter Relative Humidity	=	72	%
Average 2nd Quarter Relative Humidity	=	70	%
Average 3rd Quarter Relative Humidity	=	74	%
Average 4th Quarter Relative Humidity	=	75	%

Note: Evapotranspiration data was obtained for Oak Creek, Wisconsin

Normal Mean Monthly Precipitation (inches)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
1.687302	1.767638	2.167392	3.358162	3.78116	3.981473
3.663696	3.908079	3.732732	2.917788	2.54738	1.83652

Note: Precipitation was simulated based on HELP V4 weather simulation for:
Lat/Long: 42.88/-87.9

Normal Mean Monthly Temperature (Degrees Fahrenheit)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
26.2	27.6	39.4	49	66.3	77.2
83.9	79.8	70.1	56.4	42.6	34.7

Note: Temperature was simulated based on HELP V4 weather simulation for:
Lat/Long: 42.88/-87.9
Solar radiation was simulated based on HELP V4 weather simulation for:
Lat/Long: 42.88/-87.9

Average Annual Totals Summary

Title: Final Cover (2' Compacted Clay Liner, 4% Slope)
Simulated on: 9/26/2023 8:36

	Average Annual Totals for Years 1 - 40*			
	(inches)	[std dev]	(cubic feet)	(percent)
Precipitation	35.35	[5.29]	128,318.0	100.00
Runoff	2.703	[1.849]	9,813.5	7.65
Evapotranspiration	27.312	[3.301]	99,143.7	77.26
Subprofile1				
Lateral drainage collected from Layer 3	5.2934	[2.7212]	19,215.0	14.97
Percolation/leakage through Layer 5	0.000004	[0.000002]	0.0158	0.00
Average Head on Top of Layer 4	0.0026	[0.0033]	---	---
Subprofile2				
Percolation/leakage through Layer 6	0.002113	[0.001155]	7.6685	0.01
Water storage				
Change in water storage	0.0381	[1.3028]	138.2	0.11

* Note: Average inches are converted to volume based on the user-specified area.

Peak Values Summary

Title: Final Cover (2' Compacted Clay Liner, 4% Slope)
Simulated on: 9/26/2023 8:36

	Peak Values for Years 1 - 40*	
	(inches)	(cubic feet)
Precipitation	2.85	10,327.6
Runoff	2.690	9,765.1
Subprofile1		
Drainage collected from Layer 3	0.6141	2,229.1
Percolation/leakage through Layer 5	0.000006	0.0233
Average head on Layer 4	5.6730	---
Maximum head on Layer 4	4.9407	---
Location of maximum head in Layer 3	28.33 (feet from drain)	
Subprofile2		
Percolation/leakage through Layer 6	0.000027	0.0998
Other Parameters		
Snow water	2.3006	8,351.2
Maximum vegetation soil water	0.4523 (vol/vol)	
Minimum vegetation soil water	0.1633 (vol/vol)	

Final Water Storage in Landfill Profile at End of Simulation Period

Title: Final Cover (2' Compacted Clay Liner, 4% Slope)
Simulated on: 9/26/2023 8:36
Simulation period: 40 years

	Final Water Storage	
Layer	(inches)	(vol/vol)
1	1.4804	0.2467
2	10.4260	0.3475
3	0.0053	0.0267
4	0.0000	0.0000
5	10.2480	0.4270
6	0.3662	0.0610
Snow water	0.0212	---

HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
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Title:	Final Cover (2' Compacted Clay Liner, 25% Slope)	**Simulated On:**	9/26/2023 8:28

Layer 1
Type 1 - Vertical Percolation Layer (Cover Soil)
L - Loam
Material Texture Number 8

Thickness	=	6	inches
Porosity	=	0.463	vol/vol
Field Capacity	=	0.232	vol/vol
Wilting Point	=	0.116	vol/vol
Initial Soil Water Content	=	0.2408	vol/vol
Effective Sat. Hyd. Conductivity	=	3.70E-04	cm/sec

Layer 2
Type 1 - Vertical Percolation Layer
CL - Clay Loam
Material Texture Number 11

Thickness	=	30	inches
Porosity	=	0.464	vol/vol
Field Capacity	=	0.31	vol/vol
Wilting Point	=	0.187	vol/vol
Initial Soil Water Content	=	0.2905	vol/vol
Effective Sat. Hyd. Conductivity	=	6.40E-05	cm/sec

Layer 3
Type 2 - Lateral Drainage Layer
Drainage Net (0.5 cm)
Material Texture Number 20

Thickness	=	0.2	inches
Porosity	=	0.85	vol/vol
Field Capacity	=	0.01	vol/vol
Wilting Point	=	0.005	vol/vol
Initial Soil Water Content	=	0.01	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E+01	cm/sec
Slope	=	25	%
Drainage Length	=	400	ft

Layer 4

Type 4 - Flexible Membrane Liner

LDPE Membrane

Material Texture Number 36

Thickness	=	0.04	inches
Effective Sat. Hyd. Conductivity	=	4.00E-13	cm/sec
FML Pinhole Density	=	2	Holes/Acre
FML Installation Defects	=	0.5	Holes/Acre
FML Placement Quality	=	3	Good

Layer 5

Type 3 - Barrier Soil Liner

Liner Soil (High)

Material Texture Number 16

Thickness	=	24	inches
Porosity	=	0.427	vol/vol
Field Capacity	=	0.418	vol/vol
Wilting Point	=	0.367	vol/vol
Initial Soil Water Content	=	0.427	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-07	cm/sec

Layer 6

Type 1 - Vertical Percolation Layer (Waste)

High-Density Electric Plant Coal Bottom Ash

Material Texture Number 31

Thickness	=	6	inches
Porosity	=	0.578	vol/vol
Field Capacity	=	0.076	vol/vol
Wilting Point	=	0.025	vol/vol
Initial Soil Water Content	=	0.0751	vol/vol
Effective Sat. Hyd. Conductivity	=	4.10E-03	cm/sec

Note: Initial moisture content of the layers and snow water were computed as nearly steady-state values by HELP.

General Design and Evaporative Zone Data

SCS Runoff Curve Number	=	73.8	
Fraction of Area Allowing Runoff	=	100	%
Area projected on a horizontal plane	=	1	acres
Evaporative Zone Depth	=	18	inches
Initial Water in Evaporative Zone	=	4.581	inches
Upper Limit of Evaporative Storage	=	8.346	inches
Lower Limit of Evaporative Storage	=	2.94	inches
Initial Snow Water	=	0.169031	inches
Initial Water in Layer Materials	=	20.862	inches
Total Initial Water	=	21.031	inches
Total Subsurface Inflow	=	0	inches/year

Note: SCS Runoff Curve Number was calculated by HELP.

Evapotranspiration and Weather Data

Station Latitude	=	42.88	Degrees
Maximum Leaf Area Index	=	3.5	
Start of Growing Season (Julian Date)	=	130	days
End of Growing Season (Julian Date)	=	283	days
Average Wind Speed	=	11.6	mph
Average 1st Quarter Relative Humidity	=	72	%
Average 2nd Quarter Relative Humidity	=	70	%
Average 3rd Quarter Relative Humidity	=	74	%
Average 4th Quarter Relative Humidity	=	75	%

Note: Evapotranspiration data was obtained for Oak Creek, Wisconsin

Normal Mean Monthly Precipitation (inches)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
1.687302	1.767638	2.167392	3.358162	3.78116	3.981473
3.663696	3.908079	3.732732	2.917788	2.54738	1.83652

Note: Precipitation was simulated based on HELP V4 weather simulation for:
Lat/Long: 42.88/-87.9

Normal Mean Monthly Temperature (Degrees Fahrenheit)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
26.2	27.6	39.4	49	66.3	77.2
83.9	79.8	70.1	56.4	42.6	34.7

Note: Temperature was simulated based on HELP V4 weather simulation for:
Lat/Long: 42.88/-87.9
Solar radiation was simulated based on HELP V4 weather simulation for:
Lat/Long: 42.88/-87.9

Average Annual Totals Summary

Title: Final Cover (2' Compacted Clay Liner, 25% Slope)
Simulated on: 9/26/2023 8:30

	Average Annual Totals for Years 1 - 40*			
	(inches)	[std dev]	(cubic feet)	(percent)
Precipitation	35.35	[5.29]	128,318.0	100.00
Runoff	2.733	[1.852]	9,921.3	7.73
Evapotranspiration	27.329	[3.308]	99,204.3	77.31
Subprofile1				
Lateral drainage collected from Layer 3	5.2469	[2.7129]	19,046.4	14.84
Percolation/leakage through Layer 5	0.000003	[0.000001]	0.0112	0.00
Average Head on Top of Layer 4	0.0004	[0.0002]	---	---
Subprofile2				
Percolation/leakage through Layer 6	0.002103	[0.001153]	7.6331	0.01
Water storage				
Change in water storage	0.0381	[1.309]	138.4	0.11

* Note: Average inches are converted to volume based on the user-specified area.

Peak Values Summary

Title: Final Cover (2' Compacted Clay Liner, 25% Slope)
Simulated on: 9/26/2023 8:30

	Peak Values for Years 1 - 40*	
	(inches)	(cubic feet)
Precipitation	2.85	10,327.6
Runoff	2.691	9,768.9
Subprofile1		
Drainage collected from Layer 3	0.5895	2,139.9
Percolation/leakage through Layer 5	0.000000	0.0001
Average head on Layer 4	0.0177	---
Maximum head on Layer 4	0.0353	---
Location of maximum head in Layer 3	0.00 (feet from drain)	
Subprofile2		
Percolation/leakage through Layer 6	0.000028	0.1001
Other Parameters		
Snow water	2.3006	8,351.2
Maximum vegetation soil water	0.4528 (vol/vol)	
Minimum vegetation soil water	0.1633 (vol/vol)	

Final Water Storage in Landfill Profile at End of Simulation Period

Title: Final Cover (2' Compacted Clay Liner, 25% Slope)
Simulated on: 9/26/2023 8:30
Simulation period: 40 years

	Final Water Storage	
Layer	(inches)	(vol/vol)
1	1.4873	0.2479
2	10.4296	0.3477
3	0.0025	0.0126
4	0.0000	0.0000
5	10.2480	0.4270
6	0.3667	0.0611
Snow water	0.0212	---

HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 4.0 BETA (2018)
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Title: Final Cover (2' SBL and GCL, 4% Slope) **Simulated On:** 9/26/2023 8:01

Layer 1
Type 1 - Vertical Percolation Layer (Cover Soil)
L - Loam
Material Texture Number 8

Thickness	=	6	inches
Porosity	=	0.463	vol/vol
Field Capacity	=	0.232	vol/vol
Wilting Point	=	0.116	vol/vol
Initial Soil Water Content	=	0.2398	vol/vol
Effective Sat. Hyd. Conductivity	=	3.70E-04	cm/sec

Layer 2
Type 1 - Vertical Percolation Layer
CL - Clay Loam
Material Texture Number 11

Thickness	=	30	inches
Porosity	=	0.464	vol/vol
Field Capacity	=	0.31	vol/vol
Wilting Point	=	0.187	vol/vol
Initial Soil Water Content	=	0.2905	vol/vol
Effective Sat. Hyd. Conductivity	=	6.40E-05	cm/sec

Layer 3
Type 2 - Lateral Drainage Layer
Drainage Net (0.5 cm)
Material Texture Number 20

Thickness	=	0.2	inches
Porosity	=	0.85	vol/vol
Field Capacity	=	0.01	vol/vol
Wilting Point	=	0.005	vol/vol
Initial Soil Water Content	=	0.01	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E+01	cm/sec
Slope	=	4	%
Drainage Length	=	350	ft

Layer 4

Type 4 - Flexible Membrane Liner

LDPE Membrane

Material Texture Number 36

Thickness	=	0.04	inches
Effective Sat. Hyd. Conductivity	=	4.00E-13	cm/sec
FML Pinhole Density	=	2	Holes/Acre
FML Installation Defects	=	0.5	Holes/Acre
FML Placement Quality	=	3	Good

Layer 5

Type 3 - Barrier Soil Liner

Bentonite (High)

Material Texture Number 17

Thickness	=	0.24	inches
Porosity	=	0.75	vol/vol
Field Capacity	=	0.747	vol/vol
Wilting Point	=	0.4	vol/vol
Initial Soil Water Content	=	0.75	vol/vol
Effective Sat. Hyd. Conductivity	=	3.00E-09	cm/sec

Layer 6

Type 1 - Vertical Percolation Layer

SiL - Silty Loam(Moderate)

Material Texture Number 23

Thickness	=	24	inches
Porosity	=	0.461	vol/vol
Field Capacity	=	0.36	vol/vol
Wilting Point	=	0.203	vol/vol
Initial Soil Water Content	=	0.36	vol/vol
Effective Sat. Hyd. Conductivity	=	9.00E-06	cm/sec

Layer 7

Type 1 - Vertical Percolation Layer (Waste)

High-Density Electric Plant Coal Bottom Ash

Material Texture Number 31

Thickness	=	6	inches
Porosity	=	0.578	vol/vol
Field Capacity	=	0.076	vol/vol
Wilting Point	=	0.025	vol/vol
Initial Soil Water Content	=	0.076	vol/vol
Effective Sat. Hyd. Conductivity	=	4.10E-03	cm/sec

Note: Initial moisture content of the layers and snow water were computed as nearly steady-state values by HELP.

General Design and Evaporative Zone Data

SCS Runoff Curve Number	=	72.6	
Fraction of Area Allowing Runoff	=	100	%
Area projected on a horizontal plane	=	1	acres
Evaporative Zone Depth	=	18	inches
Initial Water in Evaporative Zone	=	4.575	inches
Upper Limit of Evaporative Storage	=	8.346	inches
Lower Limit of Evaporative Storage	=	2.94	inches
Initial Snow Water	=	0.169031	inches
Initial Water in Layer Materials	=	19.433	inches
Total Initial Water	=	19.602	inches
Total Subsurface Inflow	=	0	inches/year

Note: SCS Runoff Curve Number was calculated by HELP.

Evapotranspiration and Weather Data

Station Latitude	=	42.88	Degrees
Maximum Leaf Area Index	=	3.5	
Start of Growing Season (Julian Date)	=	130	days
End of Growing Season (Julian Date)	=	283	days
Average Wind Speed	=	11.6	mph
Average 1st Quarter Relative Humidity	=	72	%
Average 2nd Quarter Relative Humidity	=	70	%
Average 3rd Quarter Relative Humidity	=	74	%
Average 4th Quarter Relative Humidity	=	75	%

Note: Evapotranspiration data was obtained for Oak Creek, Wisconsin

Normal Mean Monthly Precipitation (inches)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
1.687302	1.767638	2.167392	3.358162	3.78116	3.981473
3.663696	3.908079	3.732732	2.917788	2.54738	1.83652

Note: Precipitation was simulated based on HELP V4 weather simulation for:
Lat/Long: 42.88/-87.9

Normal Mean Monthly Temperature (Degrees Fahrenheit)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
26.2	27.6	39.4	49	66.3	77.2
83.9	79.8	70.1	56.4	42.6	34.7

Note: Temperature was simulated based on HELP V4 weather simulation for:
Lat/Long: 42.88/-87.9
Solar radiation was simulated based on HELP V4 weather simulation for:
Lat/Long: 42.88/-87.9

Average Annual Totals Summary

Title: Final Cover (2' SBL and GCL, 4% Slope)
Simulated on: 9/26/2023 8:02

	Average Annual Totals for Years 1 - 40*			
	(inches)	[std dev]	(cubic feet)	(percent)
Precipitation	35.35	[5.29]	128,318.0	100.00
Runoff	2.703	[1.849]	9,813.5	7.65
Evapotranspiration	27.312	[3.301]	99,143.7	77.26
Subprofile1				
Lateral drainage collected from Layer 3	5.2934	[2.7212]	19,215.0	14.97
Percolation/leakage through Layer 5	0.000003	[0.000001]	0.0111	0.00
Average Head on Top of Layer 4	0.0026	[0.0033]	---	---
Subprofile2				
Percolation/leakage through Layer 7	0.000002	[0.000007]	0.0057	0.00
Water storage				
Change in water storage	0.0402	[1.303]	145.9	0.11

* Note: Average inches are converted to volume based on the user-specified area.

Peak Values Summary

Title: Final Cover (2' SBL and GCL, 4% Slope)
Simulated on: 9/26/2023 8:03

	Peak Values for Years 1 - 40*	
	(inches)	(cubic feet)
Precipitation	2.85	10,327.6
Runoff	2.690	9,765.1
Subprofile1		
Drainage collected from Layer 3	0.6141	2,229.1
Percolation/leakage through Layer 5	0.000004	0.0130
Average head on Layer 4	5.6730	---
Maximum head on Layer 4	4.9407	---
Location of maximum head in Layer 3	28.33 (feet from drain)	
Subprofile2		
Percolation/leakage through Layer 7	0.000023	0.0834
Other Parameters		
Snow water	2.3006	8,351.2
Maximum vegetation soil water	0.4523 (vol/vol)	
Minimum vegetation soil water	0.1633 (vol/vol)	

Final Water Storage in Landfill Profile at End of Simulation Period

Title: Final Cover (2' SBL and GCL, 4% Slope)
Simulated on: 9/26/2023 8:03
Simulation period: 40 years

	Final Water Storage	
Layer	(inches)	(vol/vol)
1	1.4804	0.2467
2	10.4260	0.3475
3	0.0053	0.0267
4	0.0000	0.0000
5	0.1800	0.7500
6	8.6400	0.3600
7	0.4560	0.0760
Snow water	0.0212	---

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Title:	Final Cover (2' SBL and GCL, 25% Slope)	**Simulated On:**	9/26/2023 8:05

Layer 1
Type 1 - Vertical Percolation Layer (Cover Soil)
L - Loam
Material Texture Number 8

Thickness	=	6	inches
Porosity	=	0.463	vol/vol
Field Capacity	=	0.232	vol/vol
Wilting Point	=	0.116	vol/vol
Initial Soil Water Content	=	0.2408	vol/vol
Effective Sat. Hyd. Conductivity	=	3.70E-04	cm/sec

Layer 2
Type 1 - Vertical Percolation Layer
CL - Clay Loam
Material Texture Number 11

Thickness	=	30	inches
Porosity	=	0.464	vol/vol
Field Capacity	=	0.31	vol/vol
Wilting Point	=	0.187	vol/vol
Initial Soil Water Content	=	0.2905	vol/vol
Effective Sat. Hyd. Conductivity	=	6.40E-05	cm/sec

Layer 3
Type 2 - Lateral Drainage Layer
Drainage Net (0.5 cm)
Material Texture Number 20

Thickness	=	0.2	inches
Porosity	=	0.85	vol/vol
Field Capacity	=	0.01	vol/vol
Wilting Point	=	0.005	vol/vol
Initial Soil Water Content	=	0.01	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E+01	cm/sec
Slope	=	25	%
Drainage Length	=	400	ft

Layer 4

Type 4 - Flexible Membrane Liner

LDPE Membrane

Material Texture Number 36

Thickness	=	0.04	inches
Effective Sat. Hyd. Conductivity	=	4.00E-13	cm/sec
FML Pinhole Density	=	2	Holes/Acre
FML Installation Defects	=	0.5	Holes/Acre
FML Placement Quality	=	3	Good

Layer 5

Type 3 - Barrier Soil Liner

Bentonite (High)

Material Texture Number 17

Thickness	=	0.24	inches
Porosity	=	0.75	vol/vol
Field Capacity	=	0.747	vol/vol
Wilting Point	=	0.4	vol/vol
Initial Soil Water Content	=	0.75	vol/vol
Effective Sat. Hyd. Conductivity	=	3.00E-09	cm/sec

Layer 6

Type 1 - Vertical Percolation Layer

SiL - Silty Loam(Moderate)

Material Texture Number 23

Thickness	=	24	inches
Porosity	=	0.461	vol/vol
Field Capacity	=	0.36	vol/vol
Wilting Point	=	0.203	vol/vol
Initial Soil Water Content	=	0.36	vol/vol
Effective Sat. Hyd. Conductivity	=	9.00E-06	cm/sec

Layer 7

Type 1 - Vertical Percolation Layer (Waste)

High-Density Electric Plant Coal Bottom Ash

Material Texture Number 31

Thickness	=	6	inches
Porosity	=	0.578	vol/vol
Field Capacity	=	0.076	vol/vol
Wilting Point	=	0.025	vol/vol
Initial Soil Water Content	=	0.076	vol/vol
Effective Sat. Hyd. Conductivity	=	4.10E-03	cm/sec

Note: Initial moisture content of the layers and snow water were computed as nearly steady-state values by HELP.

General Design and Evaporative Zone Data

SCS Runoff Curve Number	=	73.8	
Fraction of Area Allowing Runoff	=	100	%
Area projected on a horizontal plane	=	1	acres
Evaporative Zone Depth	=	18	inches
Initial Water in Evaporative Zone	=	4.581	inches
Upper Limit of Evaporative Storage	=	8.346	inches
Lower Limit of Evaporative Storage	=	2.94	inches
Initial Snow Water	=	0.169031	inches
Initial Water in Layer Materials	=	19.439	inches
Total Initial Water	=	19.608	inches
Total Subsurface Inflow	=	0	inches/year

Note: SCS Runoff Curve Number was calculated by HELP.

Evapotranspiration and Weather Data

Station Latitude	=	42.88	Degrees
Maximum Leaf Area Index	=	3.5	
Start of Growing Season (Julian Date)	=	130	days
End of Growing Season (Julian Date)	=	283	days
Average Wind Speed	=	11.6	mph
Average 1st Quarter Relative Humidity	=	72	%
Average 2nd Quarter Relative Humidity	=	70	%
Average 3rd Quarter Relative Humidity	=	74	%
Average 4th Quarter Relative Humidity	=	75	%

Note: Evapotranspiration data was obtained for Oak Creek, Wisconsin

Normal Mean Monthly Precipitation (inches)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
1.687302	1.767638	2.167392	3.358162	3.78116	3.981473
3.663696	3.908079	3.732732	2.917788	2.54738	1.83652

Note: Precipitation was simulated based on HELP V4 weather simulation for:
Lat/Long: 42.88/-87.9

Normal Mean Monthly Temperature (Degrees Fahrenheit)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
26.2	27.6	39.4	49	66.3	77.2
83.9	79.8	70.1	56.4	42.6	34.7

Note: Temperature was simulated based on HELP V4 weather simulation for:
Lat/Long: 42.88/-87.9
Solar radiation was simulated based on HELP V4 weather simulation for:
Lat/Long: 42.88/-87.9

Average Annual Totals Summary

Title: Final Cover (2' SBL and GCL, 25% Slope)
Simulated on: 9/26/2023 8:07

	Average Annual Totals for Years 1 - 40*			
	(inches)	[std dev]	(cubic feet)	(percent)
Precipitation	35.35	[5.29]	128,318.0	100.00
Runoff	2.733	[1.852]	9,921.3	7.73
Evapotranspiration	27.329	[3.308]	99,204.3	77.31
Subprofile1				
Lateral drainage collected from Layer 3	5.2469	[2.7129]	19,046.4	14.84
Percolation/leakage through Layer 5	0.000003	[0.000001]	0.0101	0.00
Average Head on Top of Layer 4	0.0004	[0.0002]	---	---
Subprofile2				
Percolation/leakage through Layer 7	0.000002	[0.00001]	0.0057	0.00
Water storage				
Change in water storage	0.0402	[1.3092]	146.0	0.11

* Note: Average inches are converted to volume based on the user-specified area.

Peak Values Summary

Title: Final Cover (2' SBL and GCL, 25% Slope)
Simulated on: 9/26/2023 8:07

	Peak Values for Years 1 - 40*	
	(inches)	(cubic feet)
Precipitation	2.85	10,327.6
Runoff	2.691	9,768.9
Subprofile1		
Drainage collected from Layer 3	0.5895	2,139.9
Percolation/leakage through Layer 5	0.000000	0.0001
Average head on Layer 4	0.0177	---
Maximum head on Layer 4	0.0353	---
Location of maximum head in Layer 3	0.00 (feet from drain)	
Subprofile2		
Percolation/leakage through Layer 7	0.000023	0.0852
Other Parameters		
Snow water	2.3006	8,351.2
Maximum vegetation soil water	0.4528 (vol/vol)	
Minimum vegetation soil water	0.1633 (vol/vol)	

Final Water Storage in Landfill Profile at End of Simulation Period

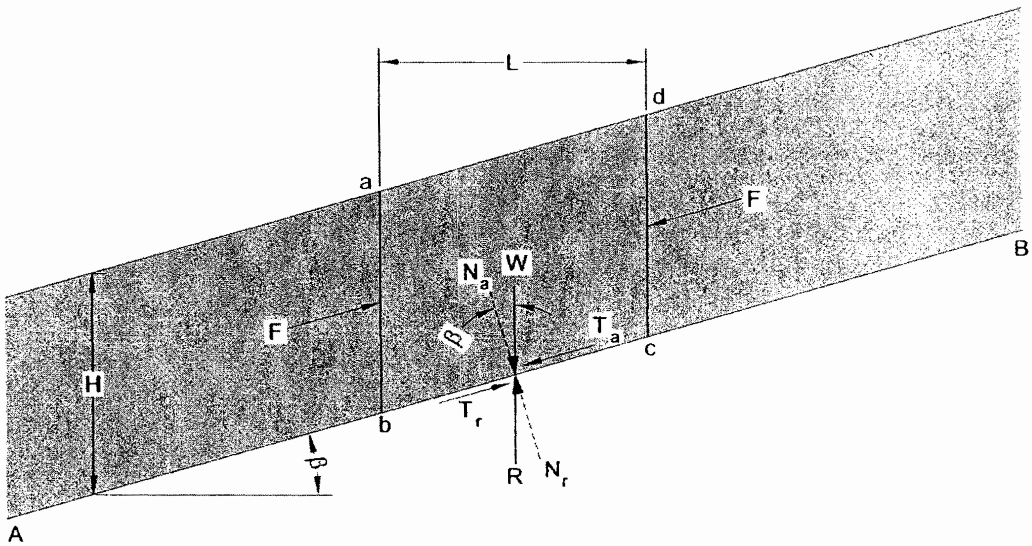
Title: Final Cover (2' SBL and GCL, 25% Slope)
Simulated on: 9/26/2023 8:08
Simulation period: 40 years

	Final Water Storage	
Layer	(inches)	(vol/vol)
1	1.4873	0.2479
2	10.4296	0.3477
3	0.0025	0.0126
4	0.0000	0.0000
5	0.1800	0.7500
6	8.6400	0.3600
7	0.4560	0.0760
Snow water	0.0212	---

Residual Final Cover Interface Friction Angle

Determine the final cover interface friction angle on the 4:1 final cover system consisting of the following physical properties:

- Cover slope 4H:1V, $\beta := \text{atan}\left(\frac{1}{4}\right) = \beta = 14.04 \cdot \text{deg}$
- Final cover components - listed from bottom to top - comprise of: compacted clay layer, 40-mil textured LLDPE geomembrane, $h_1 := 30\text{in}$ drainage/rooting layer, and $h_2 := 12\text{in}$ thick topsoil.
- Assumed cover soil moist unit weights of $\gamma_1 := 110.0\text{pcf}$ and $\gamma_2 := 100\text{pcf}$ and no cohesion ($c' := 0\text{psf}$) due to the sandy consistency of the soil.



The factor of safety with respect to strength can be determined by: $FS = \dfrac{c'}{\gamma \cdot H \cdot \cos(\beta)^2 \cdot \tan(\beta)^2} + \dfrac{\tan(\phi')}{\tan(\beta)}$

The minimum required interface friction angle can be determined by rearranging the equation and substituting in $c' = 0 \cdot \text{psf}$ to obtain $\phi'(FS) := \text{atan}(FS \cdot \tan(\beta))$

The interface friction angles for factors of safety of 1.0, 1.5, and 2.0 are $\phi'(1.0) = 14.0 \cdot \text{deg}$, $\phi'(1.5) = 20.6 \cdot \text{deg}$, and $\phi'(2.0) = 26.6 \cdot \text{deg}$ respectively.

When $c' = 0$ the factor of safety against slope failure is represented by $FS(\phi') := \dfrac{\tan(\phi')}{\tan(\beta)}$. The expected friction angle is between $\phi' := 25\text{deg}, 30\text{deg}$ The resulting factor of safety would be between $FS(\phi') = \begin{pmatrix} 1.87 \\ 2.31 \end{pmatrix}$.

Reference:

Das, B.M., 2002. Principles of Geotechnical Engineering - 5th ed. Wadsworth Group. Brooks/Cole, Pacific Grove, CA.

Appendix J

Fugitive Dust Control Plan

GEI Consultants

Consulting
Engineers and
Scientists

Regulation Compliance Report

Fugitive Dust Control Plan

Caledonia Ash Landfill
Caledonia, Wisconsin

Submitted to:

WEC Energy Group
333 West Everett Street, A231
Milwaukee, Wisconsin 53203

Submitted by:

GEI Consultants, Inc.
3159 Voyager Drive
Green Bay, Wisconsin 54313
920-455-8200

September 2023, Rev 1

John M. Trast, P.E., D.GE
Vice President/Waste Management Leader

Andrew J. Schwoerer, P.G.
Project Professional

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Revision History

Revision 0 – Original fugitive dust control plan dated October 19, 2015.

Revision 1 – Update of the original fugitive dust control plan for the Plan of Operation Modification submittal to comply with the updated NR 500 of the Wisconsin Administrative Code.

1. Introduction

This fugitive dust control plan has been prepared to meet the requirements of 40 CFR 257.80(b) Subpart D – *Standards for Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments* and NR 514.07(10)(a) of the Wisconsin Administrative Code. Revision 0 of the fugitive dust control plan was issued on October 19, 2015, for the active Caledonia Ash Landfill. Revision 1 updates the fugitive dust control plan to comply with all requirements of NR 514.07(10)(a) for the active Caledonia Ash Landfill.

The active area of the Caledonia Ash Landfill is divided into a disposal area and various segregated coal combustion residuals (CCR) stockpiles, which are staged for eventual beneficial utilization. The Caledonia Ash Landfill also includes areas that have been filled and have a final cover in place.

2. Fugitive Dust Control Measures

2.1 Conditioning and Delivery of CCR

All CCR delivered to the Caledonia Ash Landfill are conditioned with water at the source prior to transporting the materials to the landfill. Water is added to the CCR at the source in sufficient quantities such that the CCR is not dusty during transport or delivery. CCR will also be conditioned at the source as necessary to the extent that the delivered CCR does not contain free water.

All CCR, except flue gas desulfurization (FGD) filter cake from Elm Road Generating Station (ERGS), is delivered to the Caledonia Ash Landfill in dump trucks equipped with deployed tarpaulins to minimize generation of dust during transport. FGD filter cake from ERGS is dropped into special luggers in the wastewater treatment plant. These luggers are not equipped with covers. The FGD filter cake is thoroughly and evenly conditioned during the filter press process and there is no likelihood of this material becoming airborne during the short drive (less than 1-1/2 miles) to the Caledonia Ash Landfill over private roads.

2.2 Access Road

The Caledonia Ash Landfill access road is paved to minimize the generation of dust due to truck traffic. The paved surface also facilitates sweeping and watering as described below. The access road is swept and watered regularly to minimize the accumulation of dust and dirt on the road surface that might become airborne due to truck traffic. The access road has a posted speed limit of 25 MPH to help minimize the generation of airborne dust due to traffic.

2.3 Compaction and Grooming

CCR is unloaded from transport vehicles at the designated stockpile or disposal area in the active landfill area as appropriate. Although CCR are conditioned for transport, they may not be delivered at a moisture level necessary to achieve adequate compaction. If materials are delivered dry of the optimum compaction range, water is applied to the material by a water truck. If materials are delivered wet of the optimum compaction range, they are allowed to dry. CCR delivered to the Caledonia Ash Landfill are graded and compacted into the designated stockpile or disposal area as soon as the materials are within the optimum compaction moisture range.

The entire surface of the active landfill, including stockpiles, is kept groomed to minimize the amount of loose material that could become airborne under windy conditions. The landfill is groomed under moist conditions to facilitate compaction of the surface and to minimize dust generation during the grooming process. Backdragging the surface with a bulldozer or front end loader is the normal effective method of grooming the landfill surface.

2.4 Active Area Traffic Control

Networks of roads within the active area of the landfill provide access to the disposal area and to the segregated stockpiles. These roads are constructed of bottom ash and minimize the need to have traffic routed over areas with fine grained surfaces, such as fly ash. Bottom ash provides structurally sound all-season roads, containing low fines content. These bottom ash roads are watered regularly to minimize dust generation due to wind or traffic.

2.5 Active Area Exit

To minimize track-out onto the access road, all trucks and equipment are routed over a stone tracking pad, through a wheel wash station and over a cattle guard prior to leaving the active landfill area. The wheel wash station is a shallow concrete basin filled with water. The bottom of the wheel wash basin is ridged concrete that vibrates the tires while driving through the station to loosen and remove material stuck to tire treads. The wheel wash station is operated outside of freezing conditions. The wheel wash station is maintained regularly by removing solids and by changing the water in the basin. A stone tracking pad provides the approach to the wheel wash station. The wheel wash exit is also a stone tracking pad that extends to the cattle guard. The cattle guard also vibrates the tires to help remove material that may still be adhering to the treads and also provides a hydraulic break between the active landfill and the access road beyond the waste limit. Stone tracking pads are groomed as they become clogged with fines and are replaced as necessary.

2.6 Control of Wind Generated Dust in Active Area

In addition to traffic control and surface compaction and grooming efforts discussed above, the generation of windborne fugitive dust is effectively minimized by regularly wetting exposed CCR surfaces with a water truck equipped with spray bars and water jets. Leachate generated at the landfill is used and is supplemented as necessary with clean water. Only clean water is applied to the access road. In the winter, snow fencing is erected along long slopes and slope breaks as necessary to help minimize the generation of windborne dust due to wind scouring.

2.7 Final Cover

Due to the success of our beneficial use program, CCR disposal activities at the Caledonia Ash Landfill are fairly minimal and the majority of the active area of the landfill is devoted to beneficial reuse stockpile management. CCR that is delivered to the landfill for disposal are placed in the designated disposal area and sections of final cover are installed as soon as final waste grades are achieved over a sufficient area to support a practical final cover installation work scope.

3. Citizen Complaints

Citizen complaints will be routed to the Facility Manager for the Caledonia Ash Landfill. Citizen complaints are generally received by the We Energies Call Center at (800) 242-9137, but may also be received by the Control Room, Media Relations, etc. The Facility Manager will prepare a complaint summary including information provided by the citizen (such as name, date, time, and nature of complaint), a summary of conversations with the citizen, and a summary of any actions taken to address the citizen complaint. Complaint summaries will be included in the annual fugitive dust control report as required by 40 CFR 257.80(c) and NR 506.20(3)(a).

4. Assessment and Amendments of the Fugitive Dust Control Plan

The fugitive dust control measures outlined in this plan were developed as part of the Plan of Operation Modification for the Caledonia Ash Landfill in accordance with NR 514.07(10)(a) of the Wisconsin Administrative Code. These fugitive dust control measures have been in effect for years have been effective in minimizing the generation of airborne dust at the facility. The continuing effectiveness of this fugitive dust control plan will be evaluated with a visual inspection at least every 7 days in accordance with NR 514.07(10)(a)3, and during the annual inspections required by 40 CFR 257.84 and NR 514.07(10)(a)5. An annual fugitive dust control report will be submitted by a licensed Professional Engineer by January 31 of each year in accordance with NR 506.20(3)(a). In accordance with NR 514.07(10)(a)(4), the fugitive dust control plan will be modified following NR 514.04(6) whenever there is a change in conditions that may substantially affect the Plan of Operation Modification.

5. Certification

The fugitive dust control plan was completed under the direction of John M. Trast, P.E. I am a licensed professional engineer in the State of Wisconsin in accordance with the requirements of ch. A-E 3, Wisconsin Administrative Code; that this document has been prepared in accordance with the Rules of Professional Conduct in ch. A-E 8, Wisconsin Administrative 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 40 CFR Part 257 Subpart D and NR 500 of the Wisconsin Administrative Code.

John M. Trast, P.E., D.GE
Professional Engineer License No. 31792

WISCONSIN
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PROFESSIONAL ENGINEER
09/29/2023

Appendix K

Run-on and Run-off Control Plan

GEI Consultants

Consulting p
Engineers and
Scientists

Regulation Compliance Report

Run-on and Run-off Control Plan

Caledonia Ash Landfill
Caledonia, Wisconsin

Submitted to:
WEC Energy Group – Business Services
333 W. Everett Street, A231
Milwaukee, Wisconsin 53203

Submitted by:
GEI Consultants, Inc.
3159 Voyager Drive
Green Bay, Wisconsin 54313
920.455.8200

October 2021, Revision 1

Project 1610530

John M. Trast, P.E., D.GE.
Vice President

William S. Reybrock, P.E.
Project Professional

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Tables

Appendices

Revision Schedule

Revision 0 October 2016
Revision 1 October 2021: This plan was updated in accordance with § 257.81(c)(4) which required the owner or operator of the CCR unit to prepare periodic run-on and run-off control system plans every five years. Updated the existing site conditions and engineering calculations.

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1. Introduction

WEC Energy Group (WEC) owns and operates a solid waste disposal facility on the Oak Creek Site in the NE 1/4 of Section 1, Township 4 North, Range 22 East, in the Village of Caledonia, Racine County, Wisconsin. The WEC Caledonia Ash Landfill is regulated as an industrial waste landfill by the Wisconsin Department of Natural Resources (WDNR) under the provisions of Chapter 289 Wisconsin State Statues, and all applicable requirements of Chapters NR 500 of the Wisconsin Administrative Code. The design, construction, operation, closure, and post-closure care requirements are specified in the WDNR conditionally approved Plan of Operations, License No. 03232, FID No. 252108450. As currently constructed, the landfill has 24.2 acres open, 34.9 acres of base liner system (Cells 1, 2, 3, 4, 6, 8, and 10) is constructed, and 10.7 acres of perimeter slopes (Cells 1, 2, 3, 4, and 6) have received final cover.

In addition to the state regulations, the landfill is also required to comply with 40 CFR Part 257 Subpart D – *Standards for Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments*. Cells 1, 2, 3, 4, 6, 8, and 10 were constructed prior to October 14, 2015, and are defined as an existing CCR landfill in accordance with § 257.53. Future landfill cells are permitted by the WDNR in the conditionally approved Plan of Operation and defined as lateral expansions under § 257.53 when developed.

This report fulfills the requirements of § 257.81 - *Run-on and run-off controls for CCR landfills* for the Caledonia Ash Landfill, which specifies that the owner or operator must complete the assessments required by this section every five years. In accordance with 257.81(c)(1) this report describes how the run-on and run-off control systems have been designed and constructed to meet the applicable requirements and supported by appropriate engineering calculations.

This run-off and run-on system control plan includes the following sections:

Section 1 – Introduction

Section 2 – Storm and Stormwater Volume Determination

Section 3 – Run-on Control System

Section 4 – Run-off Control System

Section 5 – Conclusion and Certification

Section 6 – References

2. Storm and Stormwater Volume Determination

§ 257.81 *Run-on and run-off controls for CCR landfills* requires that the owner or operator of an existing or new CCR landfill or any lateral expansion of a CCR landfill must design, construct, operate, and maintain a run-on control system to prevent flow onto the active portion of the CCR unit during the peak discharge from a 24-hour, 25-year storm; and a run-off control system from the active portion of the CCR unit to collect and control at least the water volume resulting from a 24-hour, 25-year storm.

The active filling area of the landfill is approximately 24.2 acres and approximately 10.7 acres of the landfill has final cover. All precipitation that falls into the active filling area of the permitted limits of waste is contained within the landfill and handled as leachate. Any precipitation that falls outside the limits of waste is directed away from the active landfill. Any precipitation that falls on the portion with final cover is directed off the landfill as noncontact water. Drawing C-1 – Caledonia Ash Landfill shows existing landfill grades as of December 29, 2017, and shows intermediate filling plan elevations for the Caledonia Ash Landfill. The drawing is located in Appendix A – Drawings.

The rainfall depth estimate for a 24-hour, 25-year storm for the Caledonia Ash Landfill was determined following the procedures outlined in Precipitation-Frequency Atlas of the United States, Atlas 14, Volume 8, Version 2: Wisconsin. For the Caledonia Ash Landfill a 24-hour, 25-year storm will result in 4.48 inches of rainfall. Calculations for determining the 24-hour, 25-year storm event are included in Appendix B: NOAA 14, Vol. 8 Rainfall Analysis and Run-off Volume.

Table 2-1 summarizes the storm recurrence interval, rainfall depth, lined area of the CCR landfill, and minimum stormwater volume required to be managed within Landfill.

Table 2-1 Summary of Rainfall Precipitation and Run-off Volume Data

Storm Recurrence Interval	Rainfall Depth (inches)	Active Landfill Lined Area (acres)	Run-off Volume (acre-ft)
24-hour, 25-year	4.48	24.24	9.05

3. Run-on Control System

§ 257.81 (a)(1) requires a run-on control system to prevent flow onto the active portions of the CCR unit during the peak discharge from a 24-hour, 25-year storm. The federal rule defines "Run-on" as "*any rainwater, leachate, or other liquid that drains over land onto any part of a CCR landfill*."

In order to control stormwater and prevent run-on to the landfill, perimeter berms have been established around the landfill facility. These perimeter berms contain all run-off within the landfill. On the east and west sides of the landfill, stormwater ditches between the access road and the landfill perimeter berm conveys stormwater southward. On the east side of the landfill the stormwater is routed to the stormwater detention basin immediately southeast of the landfill. On the west side of the landfill the stormwater is routed south, through a culvert running under the site screening berm, and then east to the stormwater detention basin immediately southeast of the landfill. In general, all stormwater drainage at the site is directed away from the active landfill and to the stormwater detention basin.

Along the north side of the landfill, an intercell berm was constructed to prevent run-on from entering the landfill and to prevent run-off from leaving the landfill. A perimeter ditch along the north edge of the intercell berm intercepts and directs stormwater run-on to the east away from the active area and connects to the east stormwater ditch described above. Run-on controls are shown on Drawing C-1 in Appendix A.

Stormwater modeling was completed to confirm that the current run-on control system on the north side of the landfill is sufficiently sized to manage a 24-hour, 25-year precipitation event. HydroCAD 10.0 was used to model the potential for stormwater run-on into the landfill from the north. The stormwater run-on calculations are included in Appendix C – Stormwater Run-on Calculations. Based on the stormwater model, the current run-on control system on the north side of the Caledonia landfill will be able to handle the 24-hour, 25-year precipitation event without allowing any non-contact water to enter the limits of waste. The estimated peak water level in the channel is 1.2 feet. The conveyance channel north of the intercell berm is adequately sized to prevent run-on to Cell 1 associated with the 24-hour, 25-year precipitation event.

Based on a review of current topography and stormwater calculations, the Caledonia Ash Landfill has an acceptable run-on control system that follows current engineering standards and is in compliance with § 257.81(a)(1).

4. Run-off Control System

§ 257.81 (a)(2) requires a run-off control system from the active portion of the CCR unit to collect and control at least the water volume resulting from a 24-hour, 25-year storm. The federal rule defines "Run-off" as "*any rainwater, leachate, or other liquid that drains overland from any part of a CCR landfill*."

During the operation and filling of the Caledonia Ash Landfill precipitation within the active landfill is handled as contact stormwater and treated as leachate in accordance with § 257.3-3. The contact stormwater is directed to the temporary stormwater ditches on the inside of the landfill and routed to temporary infiltrations area in Cells 8 and 10, where it is allowed to infiltrate into the leachate collection system. The water is managed as leachate in accordance with the landfill Plan of Operations.

A stormwater run-off model was completed to confirm that the current run-off control system for the operation of the Caledonia Ash Landfill can adequately manage a 24-hour, 25-year precipitation event. Stormwater flow was modeled using HydroCAD 10.0 to model the operational filling condition as shown on Drawing C-1. Based on the landfill development plan the condition that will have the steepest and longest slopes directing stormwater to the temporary containment ditches will occur prior to the installation of the final cover over Cells 2 and 3. This plan will require updating after final cover is installed over Cells 2 and 3. The stormwater run-off calculations for the proposed filling condition are included in Appendix C: Stormwater Run-off Calculations.

For modeling purposes contact stormwater on the proposed intermediate filling condition are divided into five (5) sub-catchments: southwest side, north slope, southeast side, west side slope, and stormwater surge area. Stormwater for the sub-catchments is routed as sheet flow and shallow concentrated flow either directly into an intercell stormwater surge area on the perimeter of Cells 8 and 10 of the landfill, or as sheet flow until the water is intercepted by a temporary stormwater channel.

In general, the intermediate cover perimeter channels are a minimum of 3 feet deep and have a 2H:1V interior and 2H:1V or 3H:1V exterior slopes depending on the location within the landfill. In Cells 8 and 10, the exterior slope is 3H:1V and is the top of the granular drainage layer of the leachate collection system. At other locations where the ditch is simply constructed in the CCR the slope is 2H:1V. Contact stormwater from the perimeter channels is conveyed to the intercell stormwater surge area. From the intercell stormwater surge area the water infiltrates through the granular drainage layer into the leachate collection system and is treated as leachate. Although contact stormwater can and will infiltrate once it reaches the perimeter ditch, for the stormwater modeling and sizing purposes, we have conservatively assumed a 2H:1V ditch that does not allow infiltration. During installation of the final cover, the temporary stormwater containment ditches will be filled with soil or CCR prior to placement of the final cover system. Along the access road a cattle bridge or cattle guard is installed to function at cell entrance points as a hydraulic break and prevent stormwater from running down the road and escaping the site. The cattle bridge also allows for the continuation of the perimeter ditch.

Based on the analysis, the run-off control system for the Caledonia Ash Landfill is able to contain, manage, and control the run-off from a 24-hour, 25-year precipitation event without allowing any contact water to escape the permitted limits of waste. The intercell stormwater surge area has a minimum crest elevation of approximately El. 700.0 feet, and the estimated water level associated with the 24-hour, 25-year storm is El. 695.6 feet. Both the temporary stormwater containment ditches and the stormwater surge area are designed to contain, manage, and control the run-off from the landfill associated with the 24-hour, 25-year storm event.

5. Conclusion and Certification

The Caledonia Ash Landfill is regulated under 40 CFR Part 257 Subpart D as an existing CCR landfill. The rule specifies that existing CCR landfills must develop plans to meet certain meet operating criteria designated by October 17, 2016, and that the owner or operator must also conduct and complete the assessments required by this section every five (5) years maximum based on the completion date of this plan. This report is the 5-year update to the original plan. The revised plan must be placed in the facility's operating record as required by §257.105(g). The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(g), the notification requirements specified in § 257.106(g), and the internet requirements specified in § 257.107(g).

This report documents that the Caledonia Ash Landfill has an established run-on and run-off control system design capable of controlling the peak discharge from a 24-hour, 25-year storm event and complies with § 257.81 *Run-on and run-off controls for CCR landfills*. All leachate that is collected at the Caledonia Ash Landfill is either recycled for use as a dust control agent in the active landfill or hauled to the wastewater treatment facility in accordance with the Plan of Operations; thus, it complies with § 257.3-3.

The plan was completed under the direction of John M. Trast, P.E., D.GE. I am a licensed professional engineer in the State of Wisconsin in accordance with the requirements of ch. A-E 4, Wisconsin Administrative Code; that this document has been prepared in accordance with the Rules of Professional Conduct in ch. A-E 8, Wisconsin Administrative 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 40 CFR Part 257 Subpart D.

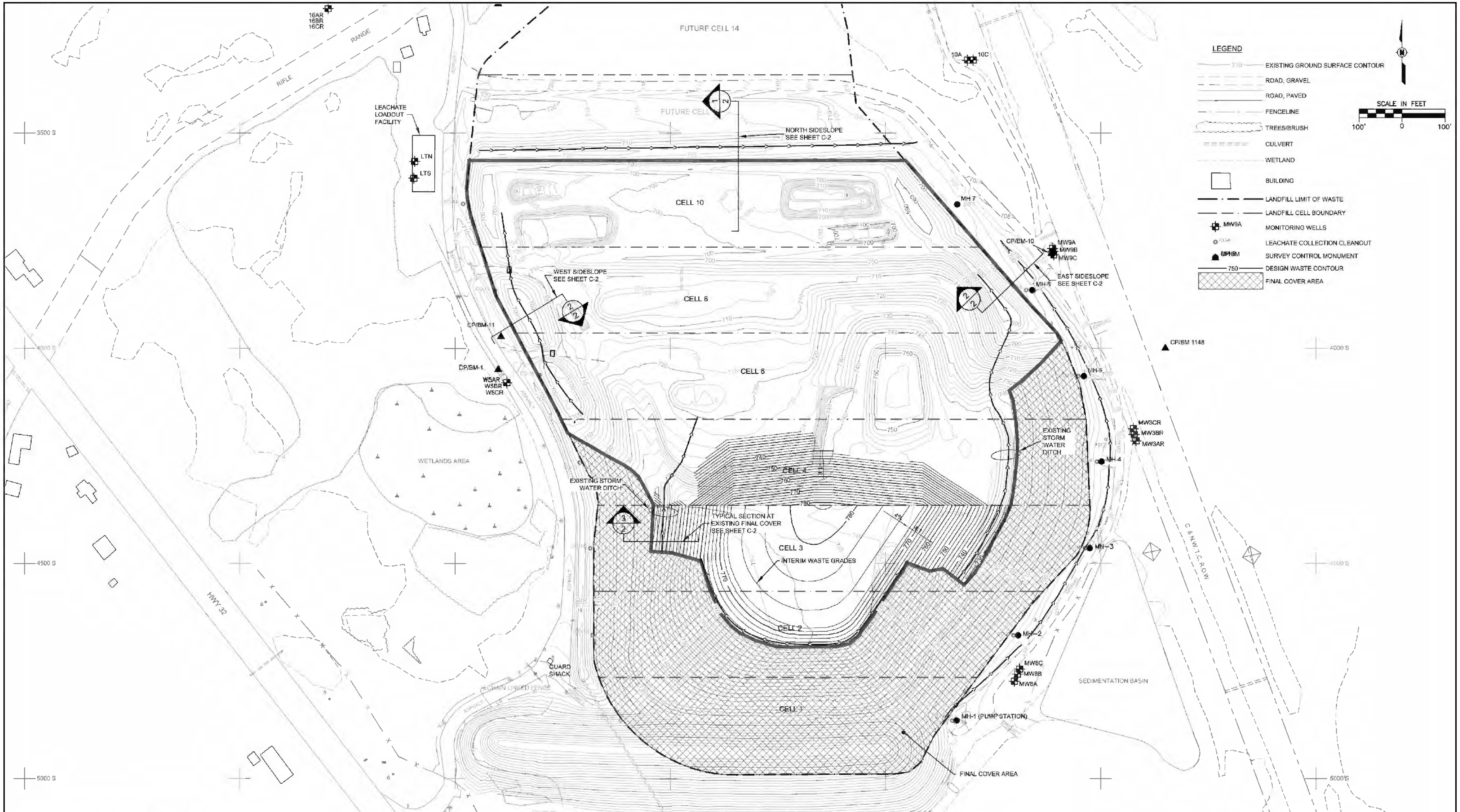
6. References

Perica, S., D. Martin, S. Pavlovic, I. Roy, M. St. Laurent, C. Trypaluk, D. Unruh, M. Yekta, G. Bonnin (2013). NOAA Atlas 14 Volume 8 Version 2.0, *Precipitation-Frequency Atlas of the United States, Midwestern States*. National Oceanic and Atmospheric Administration, National Weather Service, Silver Spring, Maryland.

US Department of Commerce. National Oceanic and Atmospheric Administration, National Weather Service. (2016). Precipitation Frequency Data Server (PFDS). http://hdsc.nws.noaa.gov/hdsc/pdfs/.

Appendix A

Drawings



Survey Control Points

	Site Grid Coordinates			State Plane Coordinates		
Point	South	West	Elevation	North	East	Description
CP/ BM-1	4,050.00	2,400.00	700.75	313,022.18	2,578,174.51	Concrete monument, w/ chiseled X
CP/ BM 1148	4,000.00	850.00	702.66	313,072.18	2,579,724.51	Concrete monument, w/ chiseled X
CP/ BM-2	3,200.00	2,400.00	717.99	313,872.18	2,578,174.51	Concrete monument, w/ Aluminum cap
CP/ BM-10	3,779.93	1,114.60	704.12	313,292.25	2,579,459.91	7/8" x18" rebar w/Alum. Cap inside 2' IDX24' IP
CP/ BM-11	3,973.04	2,393.41	702.09	313,099.14	2,578,181.10	7/8" x18" rebar w/Alum. Cap inside 2' IDX24' IP

Grid Conversion
Site Grid 0 N/S = 317,072.18 N/S State Plane Coordinates
Site Grid 0 E/W = 2,580,574.51 E/W State Plane Coordinates

NOTES:

1. EXISTING CONTOURS FROM 1983 WEPCO SURVEY AND RACINE COUNTY TOPOGRAPHIC MAP. CONTOURS WITHIN THE CELL 2 PARTIAL CLOSURE CONSTRUCTION AREA ARE TOP OF FINAL COVER GRADES AND WERE SURVEYED 12/29/2017 BY EDGERTON.

2. HORIZONTAL GRID IS LOCAL GRID ESTABLISHED BY OTHERS. ELEVATIONS ARE REFERENCED TO MEAN SEA LEVEL.

Attention: If this scale bar does not measure 1" then drawing is not original scale.

NO.	DATE	ISSUE/REVISION	APP
0	X	X	X

Designed: JXT
Checked: JXT
Drawn: JLC
Submittal Date: 7/19/2021

GEI Consultants
3159 Voyager Drive
Green Bay, Wisconsin 54311
920-455-8200

WE ENERGIES
333 WEST EVERETT STREET, A231
MILWAUKEE, WISCONSIN 53203

GEI Project 1610530

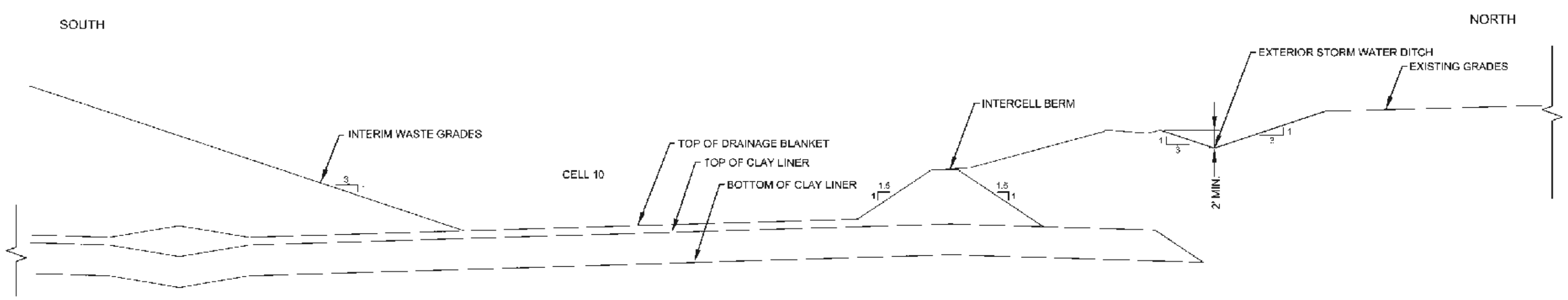
REGULATION COMPLIANCE REPORT
RUN-ON AND RUN-OFF CONTROL PLAN

CALEDONIA ASH LANDFILL

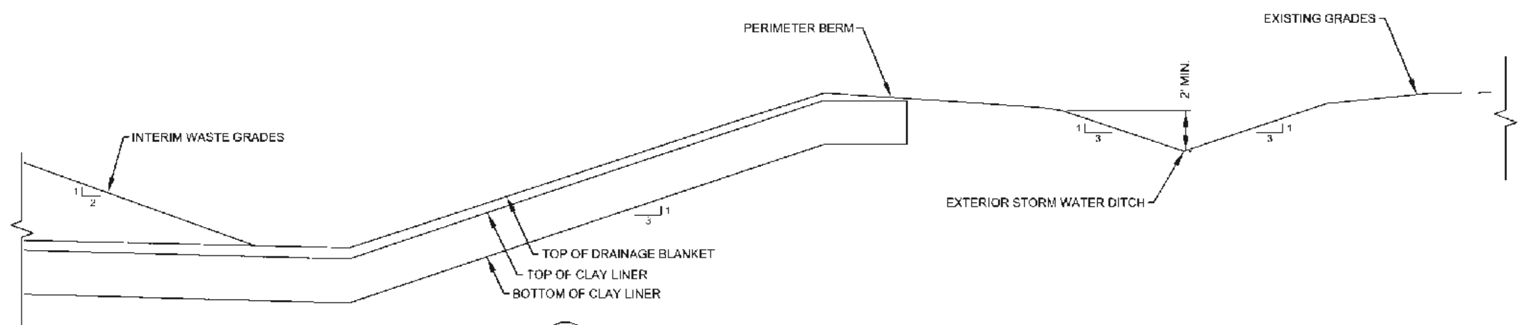
DWG. NO. C-1

SHEET NO. 1

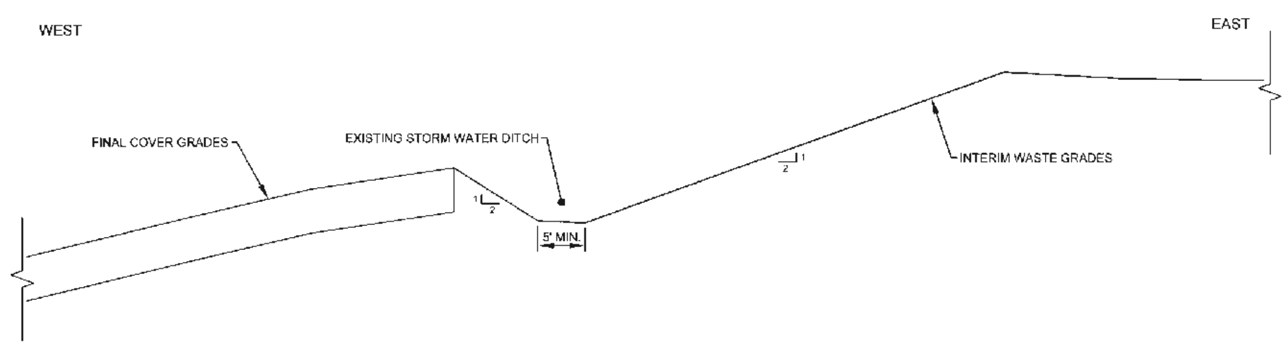
Filename: J:\LANDFILL\SWE - CALEDONIA\CALEDONIA\DWG\1610530_RUN-ON RUN-OFF CONTROL PLAN\DWG\1610530001 2021.DWG Last saved by: JCALAWAY Last Plotted: 2021-07-19



1/2 NORTH SIDESLOPE DETAIL
SCALE: 1"=10'



2/2 EAST & WEST SIDESLOPE DETAIL
SCALE: 1"=10'



3/2 TYPICAL SECTION AT EXISTING FINAL COVER DETAIL
SCALE: 1"=10'

Attention: 0 1" If this scale bar does not measure 1" then drawing is not original scale.	0	X	X	X	
	NO.	DATE	ISSUE/REVISION	APP	

Designed:	JXT
Checked:	JXT
Drawn:	JLC
Submittal Date:	7/19/2021

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GEI Project 1610530

REGULATION COMPLIANCE REPORT
RUN-ON AND RUN-OFF CONTROL PLAN

DWG. NO. C-2

CALEDONIA ASH LANDFILL
DETAILS

SHEET NO. 2

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Appendix B

NOAA 14, Vol. 8 Rainfall Analysis and Run-off Volume

GEI Consultants	Client	WEC Energy Group			Page	1 of 4
	Project	Caledonia LF Run-on and Run-off Control Plan			Rev.	0
	By	W. Reybrock	Chk.	A. Schwoerer	App.	A. Schwoerer
	Date	10/03/2016	Date	8/30/21	Date	8/30/21
GEI Project No.	1610530	Document No.	N/A			
Subject	NOAA 14, Vol. 8 Rainfall Analysis and Run-off Volume					

Purpose:

The purpose of this calculation is to estimate the 24-hour, 25-year precipitation event at Caledonia landfill. The 24-hour, 25-year precipitation event is required for the run-on and run-off control system plan for the landfill.

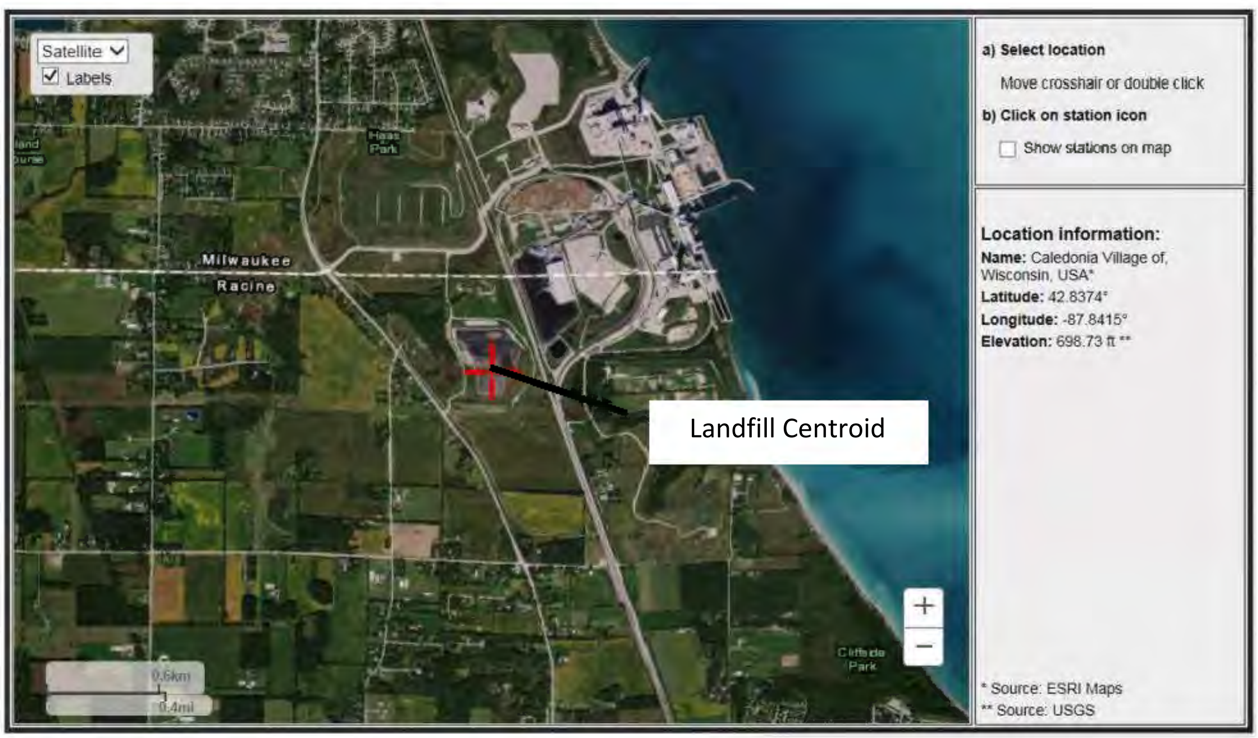
Procedure:

The rainfall depth estimation follows the procedures outlined in Precipitation-Frequency (PF) Atlas of the United States (Atlas 14, Volume 8, Version 2: Wisconsin).

As instructed in Atlas 14, the user is referred to the NOAA Precipitation Frequency Data Server (PFDS) http://hdsc.nws.noaa.gov/hdsc/pfds/index.html. The approximate center of the landfill was input into the PFDS and the PF estimates were returned.

Landfill Centroid Coordinates

42°50'14.64"N	42.8374°
87°50'29.40"W	-87.8415°



Tabular Output from the PFDS:

PDS-based precipitation frequency estimates with 90% confidence intervals (in inches)[1]

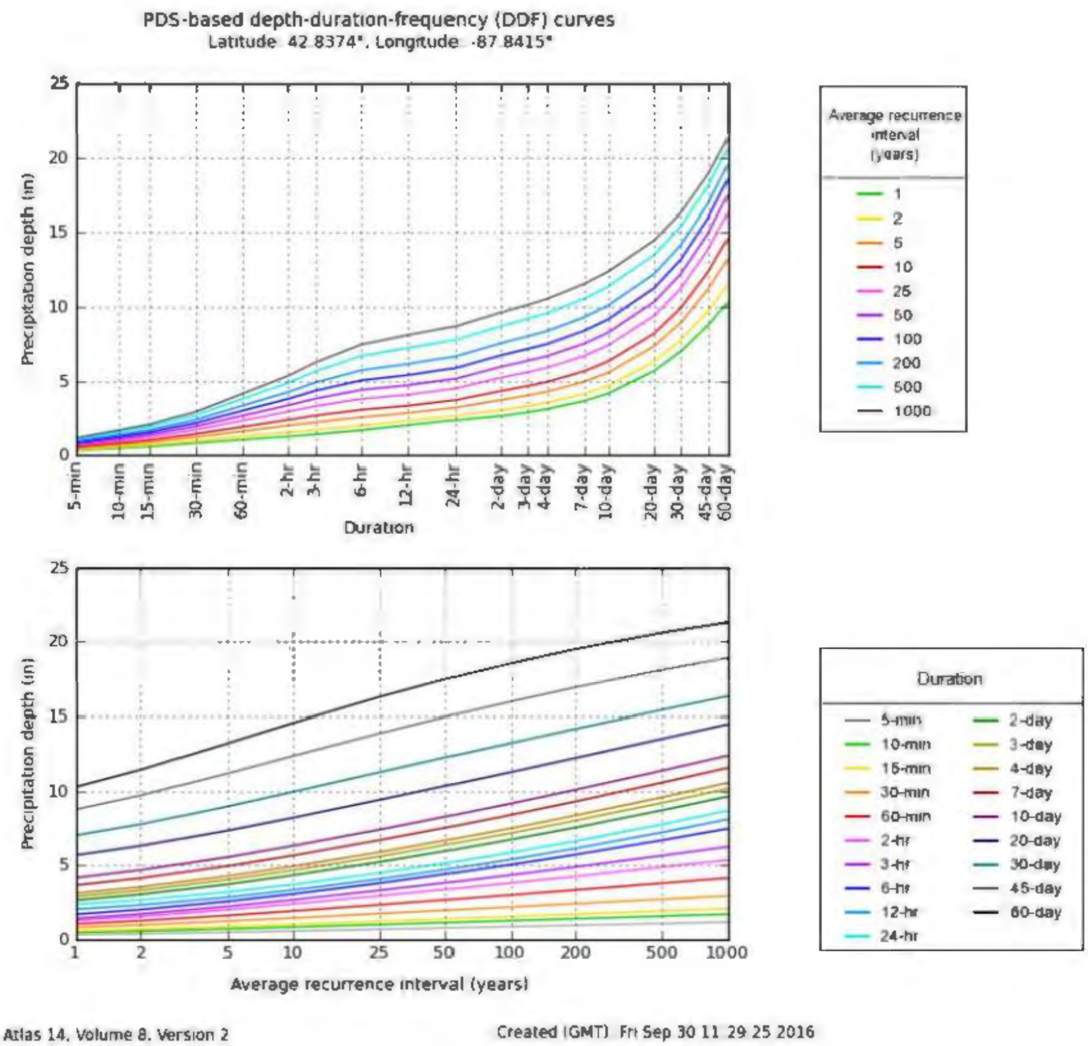
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.326** (0.278–0.393)	**0.387** (0.330–0.467)	**0.488** (0.414–0.588)	**0.571** (0.482–0.691)	**0.685** (0.560–0.847)	**0.774** (0.619–0.965)	**0.863** (0.668–1.09)	**0.953** (0.709–1.23)	**1.07** (0.770–1.41)	**1.16** (0.815–1.55)
10-min	**0.478** (0.407–0.575)	**0.567** (0.483–0.683)	**0.714** (0.606–0.861)	**0.836** (0.706–1.01)	**1.00** (0.820–1.24)	**1.13** (0.906–1.41)	**1.26** (0.978–1.60)	**1.40** (1.04–1.80)	**1.57** (1.13–2.07)	**1.70** (1.19–2.27)
15-min	**0.583** (0.497–0.701)	**0.692** (0.589–0.833)	**0.871** (0.739–1.05)	**1.02** (0.860–1.23)	**1.22** (1.00–1.51)	**1.38** (1.11–1.72)	**1.54** (1.19–1.95)	**1.70** (1.27–2.20)	**1.91** (1.37–2.52)	**2.08** (1.46–2.76)
30-min	**0.819** (0.698–0.985)	**0.976** (0.831–1.18)	**1.23** (1.05–1.49)	**1.45** (1.22–1.75)	**1.74** (1.42–2.15)	**1.96** (1.57–2.45)	**2.19** (1.69–2.77)	**2.41** (1.80–3.11)	**2.71** (1.95–3.56)	**2.94** (2.06–3.91)
60-min	**1.05** (0.890–1.26)	**1.26** (1.07–1.52)	**1.62** (1.37–1.95)	**1.92** (1.62–2.32)	**2.34** (1.91–2.90)	**2.67** (2.13–3.33)	**3.00** (2.32–3.81)	**3.34** (2.49–4.32)	**3.80** (2.73–5.00)	**4.15** (2.91–5.52)
2-hr	**1.27** (1.09–1.51)	**1.55** (1.33–1.84)	**2.00** (1.71–2.39)	**2.39** (2.04–2.86)	**2.94** (2.43–3.60)	**3.37** (2.72–4.17)	**3.81** (2.98–4.79)	**4.26** (3.21–5.46)	**4.88** (3.55–6.37)	**5.36** (3.80–7.06)
3-hr	**1.41** (1.22–1.67)	**1.71** (1.48–2.03)	**2.23** (1.92–2.64)	**2.67** (2.29–3.18)	**3.31** (2.76–4.05)	**3.82** (3.11–4.71)	**4.35** (3.43–5.45)	**4.90** (3.72–6.25)	**5.66** (4.14–7.36)	**6.25** (4.46–8.19)
6-hr	**1.69** (1.48–1.98)	**2.01** (1.75–2.35)	**2.57** (2.23–3.01)	**3.06** (2.65–3.60)	**3.80** (3.21–4.62)	**4.40** (3.63–5.39)	**5.05** (4.03–6.28)	**5.73** (4.41–7.26)	**6.69** (4.97–8.64)	**7.46** (5.39–9.69)
12-hr	**2.04** (1.79–2.35)	**2.32** (2.04–2.69)	**2.85** (2.50–3.30)	**3.33** (2.91–3.87)	**4.08** (3.49–4.93)	**4.71** (3.94–5.72)	**5.40** (4.37–6.67)	**6.15** (4.79–7.73)	**7.22** (5.43–9.25)	**8.10** (5.91–10.4)
24-hr	**2.36** (2.10–2.70)	**2.66** (2.36–3.04)	**3.20** (2.84–3.67)	**3.71** (3.27–4.26)	**4.48** (3.88–5.35)	**5.14** (4.34–6.18)	**5.86** (4.79–7.16)	**6.64** (5.23–8.26)	**7.76** (5.90–9.84)	**8.67** (6.40–11.0)
2-day	**2.64** (2.37–2.98)	**3.04** (2.72–3.43)	**3.73** (3.33–4.21)	**4.33** (3.85–4.92)	**5.23** (4.54–6.13)	**5.96** (5.06–7.04)	**6.73** (5.55–8.10)	**7.56** (6.00–9.26)	**8.71** (6.68–10.9)	**9.63** (7.19–12.1)
3-day	**2.89** (2.61–3.24)	**3.31** (2.98–3.71)	**4.04** (3.63–4.53)	**4.67** (4.18–5.27)	**5.61** (4.90–6.52)	**6.37** (5.44–7.47)	**7.17** (5.94–8.56)	**8.02** (6.41–9.77)	**9.21** (7.11–11.4)	**10.2** (7.64–12.7)
4-day	**3.11** (2.82–3.47)	**3.54** (3.21–3.95)	**4.29** (3.87–4.79)	**4.94** (4.43–5.54)	**5.89** (5.17–6.82)	**6.68** (5.73–7.79)	**7.50** (6.24–8.90)	**8.37** (6.72–10.1)	**9.58** (7.43–11.8)	**10.5** (7.98–13.1)
7-day	**3.66** (3.34–4.04)	**4.14** (3.78–4.57)	**4.96** (4.51–5.49)	**5.67** (5.13–6.29)	**6.70** (5.92–7.66)	**7.53** (6.51–8.69)	**8.39** (7.05–9.87)	**9.31** (7.54–11.2)	**10.6** (8.27–12.9)	**11.6** (8.83–14.3)
10-day	**4.16** (3.82–4.57)	**4.68** (4.29–5.14)	**5.56** (5.09–6.12)	**6.32** (5.75–6.98)	**7.40** (6.57–8.39)	**8.27** (7.18–9.47)	**9.16** (7.73–10.7)	**10.1** (8.22–12.0)	**11.4** (8.95–13.8)	**12.4** (9.51–15.2)
20-day	**5.69** (5.27–6.16)	**6.32** (5.85–6.85)	**7.35** (6.78–7.98)	**8.21** (7.54–8.95)	**9.41** (8.41–10.5)	**10.3** (9.06–11.7)	**11.3** (9.60–13.0)	**12.2** (10.1–14.4)	**13.5** (10.7–16.2)	**14.5** (11.3–17.6)
30-day	**7.02** (6.55–7.55)	**7.77** (7.24–8.37)	**8.98** (8.33–9.68)	**9.95** (9.20–10.8)	**11.3** (10.1–12.4)	**12.3** (10.8–13.7)	**13.2** (11.3–15.0)	**14.2** (11.7–16.5)	**15.4** (12.3–18.3)	**16.3** (12.8–19.7)
45-day	**8.76** (8.22–9.36)	**9.72** (9.10–10.4)	**11.2** (10.5–12.0)	**12.4** (11.5–13.3)	**13.9** (12.5–15.1)	**15.0** (13.2–16.5)	**16.0** (13.7–18.0)	**16.9** (14.1–19.5)	**18.1** (14.6–21.3)	**18.9** (14.9–22.7)
60-day	**10.3** (9.68–10.9)	**11.4** (10.8–12.2)	**13.2** (12.4–14.1)	**14.6** (13.6–15.6)	**16.3** (14.7–17.6)	**17.5** (15.5–19.2)	**18.5** (16.0–20.7)	**19.5** (16.3–22.3)	**20.6** (16.6–24.1)	**21.3** (16.9–25.5)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

GEI Consultants	**Client**	WEC Energy Group			**Page**	3 of 4
	Project	Caledonia LF Run-on and Run-off Control Plan			**Rev.**	0
	By	W. Reybrock	**Chk.**	A. Schwoerer	**App.**	A. Schwoerer
	Date	10/03/2016	**Date**	8/30/21	**Date**	8/30/21
GEI Project No.	1610530	**Document No.**	N/A			
Subject	NOAA 14, Vol. 8 Rainfall Analysis and Run-off Volume					

Graphical Output from the PFDS:



	Client	WEC Energy Group			Page	4 of 4
GEI Consultants	Project	Caledonia LF Run-on and Run-off Control Plan			Rev.	0
	By	W. Reybrock	Chk.	A. Schwoerer	App.	A. Schwoerer
	Date	10/03/2016	Date	8/30/21	Date	8/30/21

GEI Project No.	1610530	**Document No.**	N/A
Subject	NOAA 14, Vol. 8 Rainfall Analysis and Run-off Volume		

Regulations:

The Caledonia Landfill is regulated under 40 CFR Part 257 Subpart D – Standards for Disposal of Coal Combustion Residuals (CCR) in Landfills and Surface Impoundments as an existing landfill. The regulations specify that landfill must have the following plans in place:

- A run-on control system to prevent flow onto the active portion of the CCR unit during the peak discharge from a 24-hour, 25-year storm.
- A run-off control system from the active portion of the CCR unit to collect and control at least the water volume resulting from a 24-hour, 25-year storm.

Conclusion:

The 24-hour, 25-year storm for the Caledonia Landfill is 4.48 inches. This value will be utilized in the stormwater run-off model (under a separate calculation package).

Appendix C

Stormwater Run-on Calculations

	Client	We Energies			Page	1 of 2
GEI Consultants	Project	Caledonia Ash Landfill Run-on and Run-off Control Plan			Rev.	0
	By	W. Reybrock	Chk.	A. Schwoerer	App.	A. Schwoerer
	Date	07/26/2021	Date	8/30/21	Date	8/30/21
GEI Project No.	1610530	Document No.	N/A			
Subject	Stormwater Run-on Calculations					

Purpose:

The purpose of this calculation is to model and confirm the current run-on control system for the Caledonia Ash Landfill can adequately manage a 24-hour, 25-year precipitation event.

Design Criteria and Assumptions:

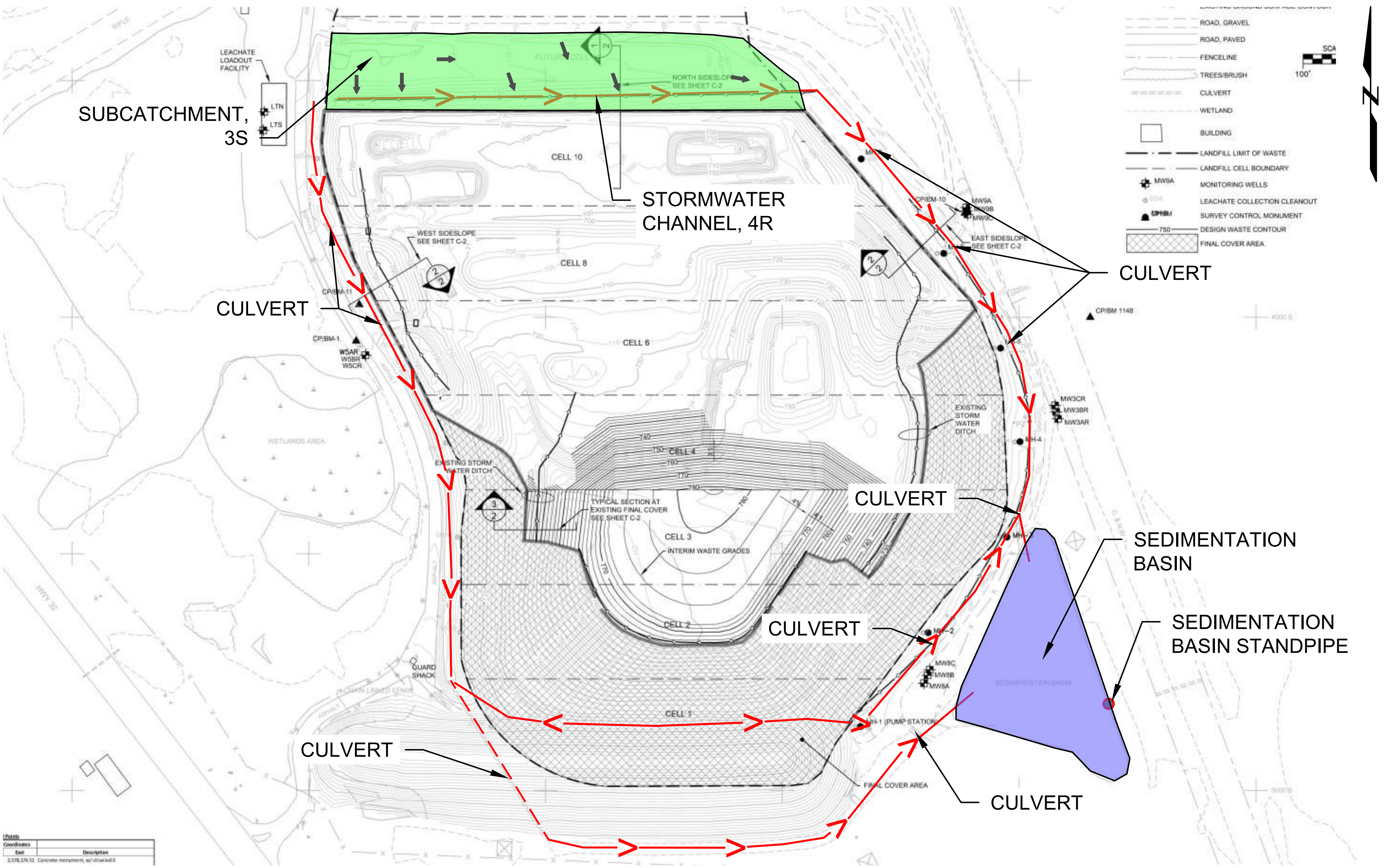
1. The rainfall depth estimation for the 24-hr, 25-yr event is 4.48 inches. The rainfall depth was determined by following procedures outlined in Precipitation-Frequency (PF) Atlas of the United States (Atlas 14, Volume 8, Version 2: Wisconsin). (See Appendix B)
2. On the east and west sides of the landfill, stormwater ditches between the access road and the landfill perimeter berm conveys stormwater to the detention basin southeast of the landfill. On the east the ditch is routed directly to the detention basin. On the west the stormwater is routed south, through a culvert running under the site screening berm, and then east to the detention basin.
3. Along the north side of the landfill, a stormwater run-on control ditch runs west to east along the entire length of Cell 10. The ditch intercepts and prevents stormwater run-on from entering Cell 10. The ditch redirect the run-on to the east perimeter ditch and eventually the stormwater detention basin.
4. Stormwater modeling was completed to confirm that the current run-on control system on the north side of the landfill is sufficiently sized to manage a 24-hr, 25-yr precipitation event.
5. HydroCAD 10.0 was used to model the stormwater run-on.
6. The stormwater run-on control ditch is 2-feet-deep with 3H:1V side slopes.
7. Subcatchment and reach parameters are included in the attached HydroCAD Report.

Results:

Based on stormwater model, the current run-on control system on the north side of the Caledonia Ash Landfill is able to handle the 24-hr, 25-yr precipitation event without allowing run-on stormwater to enter the landfill. The estimated peak water level in the channel is 1.2 feet; which is less than the 2-feet-deep channel. The conveyance channel north of the intercell berm is adequately sized to prevent run-on to Cell 10 associated with the 24-hour, 25-year precipitation event.

Attachments:

- Figure 1 – Stormwater Flow Diagram
- HydroCAD Summary Report

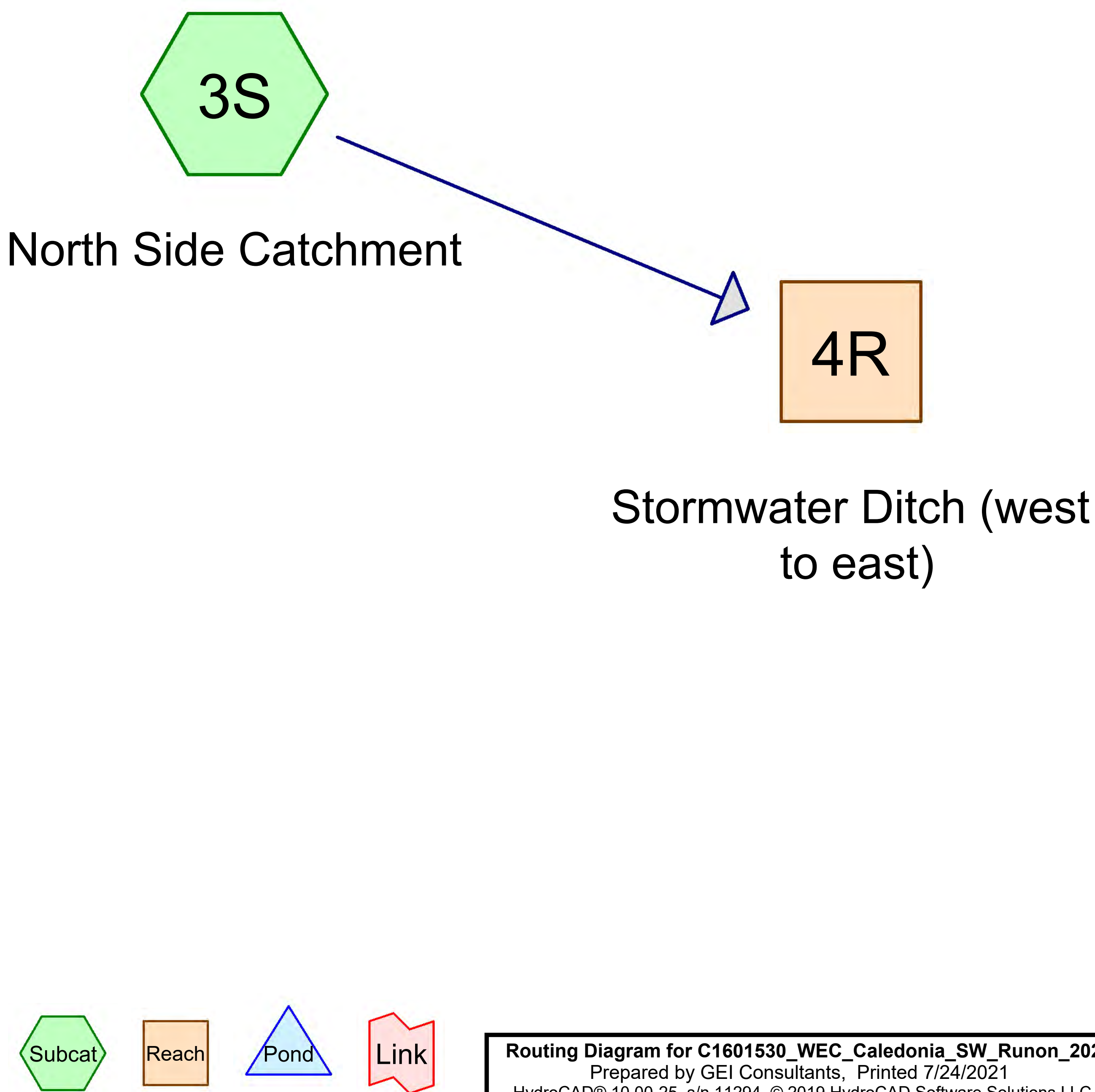


SOURCE:

1. PLAN BASED ON DWG C-1, CALEDONIA ASH LANDFILL, SUBMITTAL DATE 7/19/2021

Run-on and Run-off Control Plan Caledonia Ash Landfill Caledonia, Wisconsin	GEI Consultants	Run-On Stormwater Flow Diagram	
We Energies Milwaukee, Wisconsin	Project 1610530	August 2021	Fig. 1

\\GRB2L-WREYB C:\Landfills\WE - Caledonia\Caledonia\Dwg\1610530_run-on run-off control plan\dwg\1610530001_swc_2021.dwg - 7/23/2021



Routing Diagram for C1601530_WEC_Caledonia_SW_Runon_2021
Prepared by GEI Consultants, Printed 7/24/2021

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
3.547	86	<50% Grass cover, Poor, HSG C (3S)
3.547	**86**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
3.547	HSG C	3S
0.000	HSG D	
0.000	Other	
3.547		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	3.547	0.000	0.000	3.547	<50% Grass cover, Poor	3S
0.000	**0.000**	**3.547**	**0.000**	**0.000**	**3.547**	**TOTAL AREA**	

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment3S: North Side Catchment Runoff Area=154,524 sf 0.00% Impervious Runoff Depth=2.98"
Flow Length=122' Slope=0.0492 '/' Tc=1.1 min CN=86 Runoff=20.28 cfs 0.882 af

Reach 4R: Stormwater Ditch (west to Avg. Flow Depth=1.24' Max Vel=3.69 fps Inflow=20.28 cfs 0.882 af
n=0.022 L=1,000.0' S=0.0061 '/' Capacity=61.12 cfs Outflow=16.08 cfs 0.882 af

Total Runoff Area = 3.547 ac Runoff Volume = 0.882 af Average Runoff Depth = 2.98"
100.00% Pervious = 3.547 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 3S: North Side Catchment

[49] Hint: Tc<2dt may require smaller dt

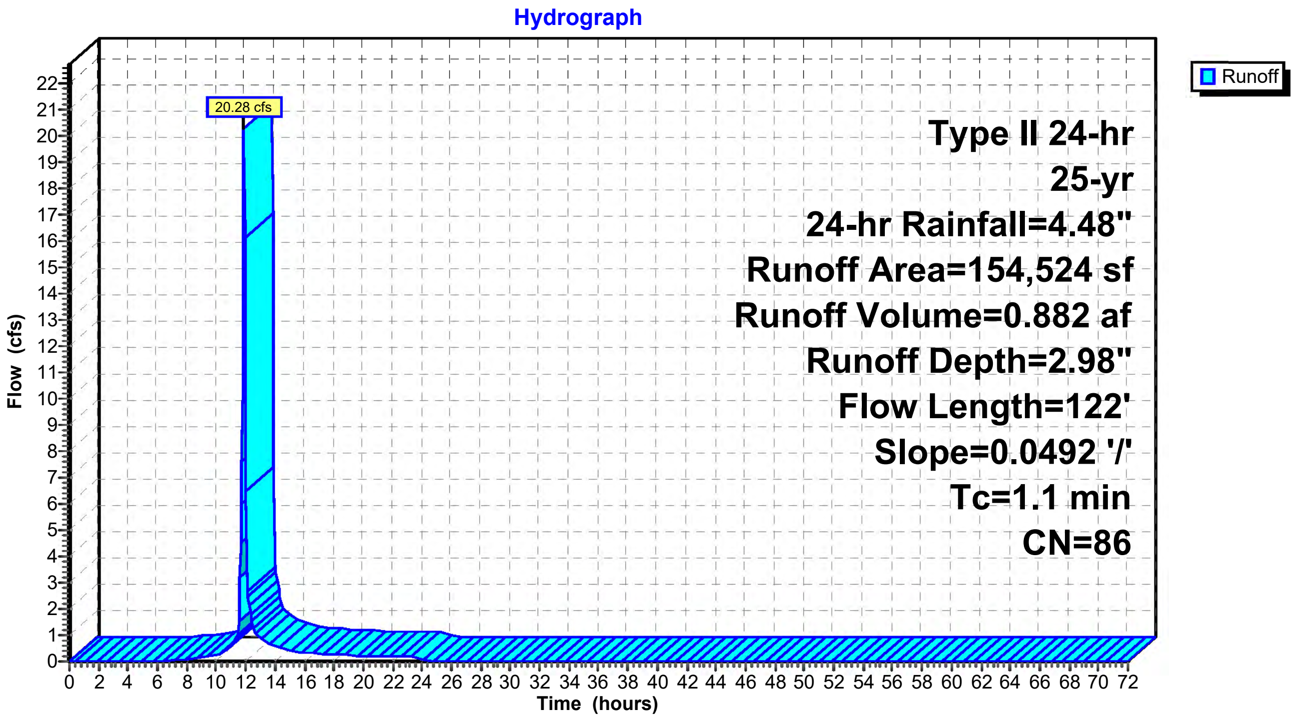
Runoff = 20.28 cfs @ 11.90 hrs, Volume= 0.882 af, Depth= 2.98"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr, 24-hr Rainfall=4.48"

Area (sf)	CN	Description
154,524	86	<50% Grass cover, Poor, HSG C
154,524		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	122	0.0492	1.87		**Sheet Flow, Side slope** Smooth surfaces n= 0.011 P2= 2.66"

Subcatchment 3S: North Side Catchment



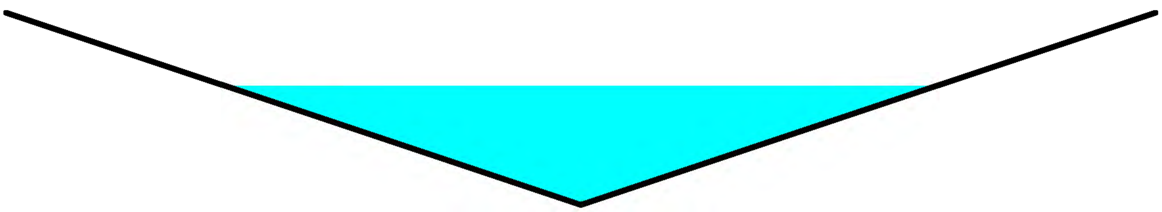
Summary for Reach 4R: Stormwater Ditch (west to east)

Inflow Area = 3.547 ac, 0.00% Impervious, Inflow Depth = 2.98" for 25-yr, 24-hr event
Inflow = 20.28 cfs @ 11.90 hrs, Volume= 0.882 af
Outflow = 16.08 cfs @ 12.02 hrs, Volume= 0.882 af, Atten= 21%, Lag= 6.9 min

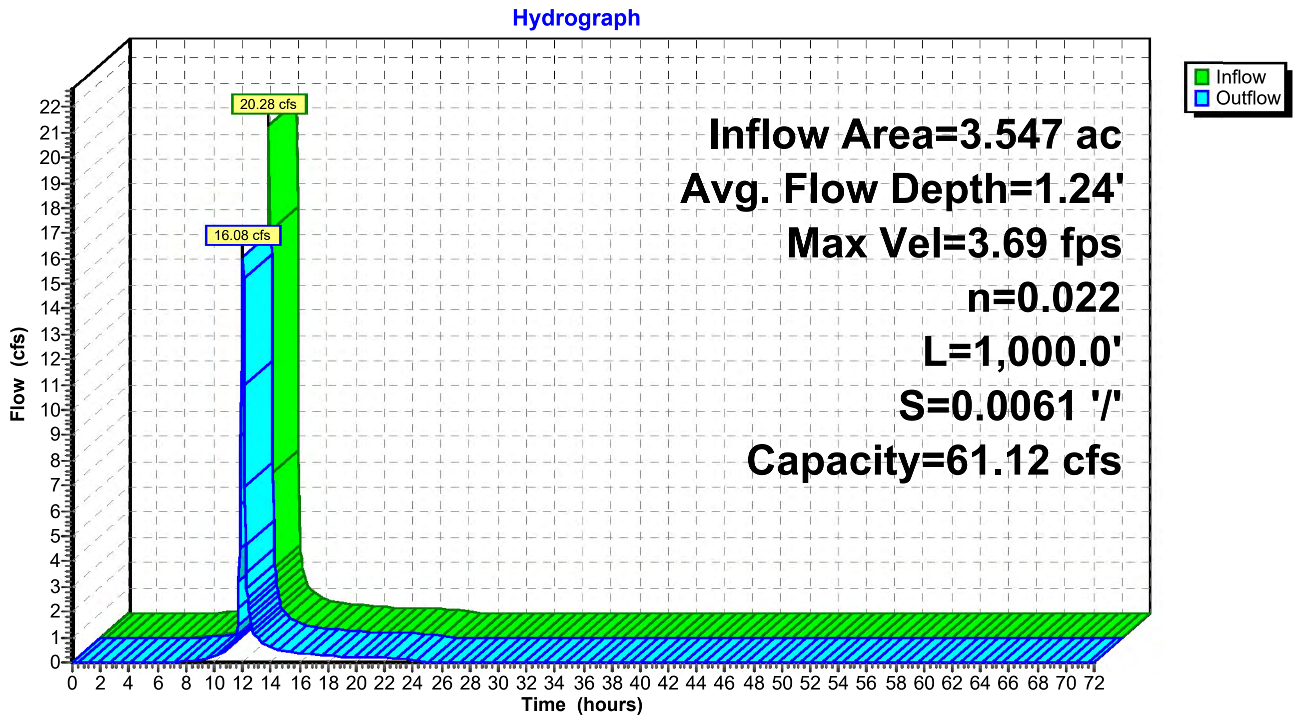
Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.69 fps, Min. Travel Time= 4.5 min
Avg. Velocity = 1.10 fps, Avg. Travel Time= 15.2 min

Peak Storage= 4,584 cf @ 11.94 hrs
Average Depth at Peak Storage= 1.24'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 61.12 cfs

0.00' x 2.00' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 3.0 '/' Top Width= 12.00'
Length= 1,000.0' Slope= 0.0061 '/'
Inlet Invert= 710.00', Outlet Invert= 703.90'



Reach 4R: Stormwater Ditch (west to east)



Appendix D

Stormwater Run-off Calculations

	Client	We Energies			Page	1 of 2
GEI Consultants	Project	Caledonia Ash Landfill Run-on and Run-off Control Plan			Rev.	0
	By	W. Reybrock	Chk.	A. Schwoerer	App.	A. Schwoerer
	Date	7/27/2021	Date	8/30/21	Date	8/30/21
GEI Project No.	1610530	Document No.	N/A			
Subject	Stormwater Run-off Calculations					

Purpose:

The purpose of this calculation is to model and confirm the current run-off control system for the construction of landfill can adequately manage the stormwater run-off associated with 24-hour, 25-year precipitation event at Caledonia Ash Landfill.

Design Criteria and Assumptions:

1. The rainfall depth estimation for the 24-hour, 25-year event is 4.48 inches. The rainfall depth was determined by following procedures outlined in Precipitation-Frequency (PF) Atlas of the United States (Atlas 14, Volume 8, Version 2: Wisconsin). (See Appendix B)
2. Stormwater on the Cell was divided into five subcatchments: west side slope, southwest side slope, north slope, southeast side slope, and the stormwater surge area, as shown on Figure 1.
3. HydroCAD 10.0 was used to model the stormwater associated with the Caledonia Ash Landfill.
4. The attached HydroCAD Report details the Subcatchment, reach, and pond parameters of the model.
5. In general, contact stormwater sheet flows to temporary stormwater ditches on the inside of the landfill, which are routed to a temporary stormwater surge area on the east side of Cell 8 and Cell 10, where the stormwater is allowed to infiltrate into the leachate collection system.
6. The model evaluated is the intermediate filling condition where Cells 2 and 3 have reached final waste grades as shown on Drawing C-1.
7. Stormwater on the intermediate filling condition is divided into five (5) subcatchments: west side slope, southwest side slope, north slope, southeast side slope, and the stormwater surge area, as shown on Figure 1. Stormwater for the subcatchments is routed as sheet flow and shallow concentrated flow either directly into an intercell stormwater surge area or as sheet flow until the water is intercepted by temporary stormwater channels. In general, the intermediate filling condition perimeter channels are a minimum of 3 feet deep and have a 2H:1V interior and 2H:1V (within ash) or 3H:1V (granular drainage layer) exterior slopes depending on the location within the landfill.
8. Contact stormwater from perimeter channels is conveyed to the stormwater surge area. Stormwater in the surge area is allowed infiltrate through the granular drainage layer into the leachate collection system and is treated as leachate.

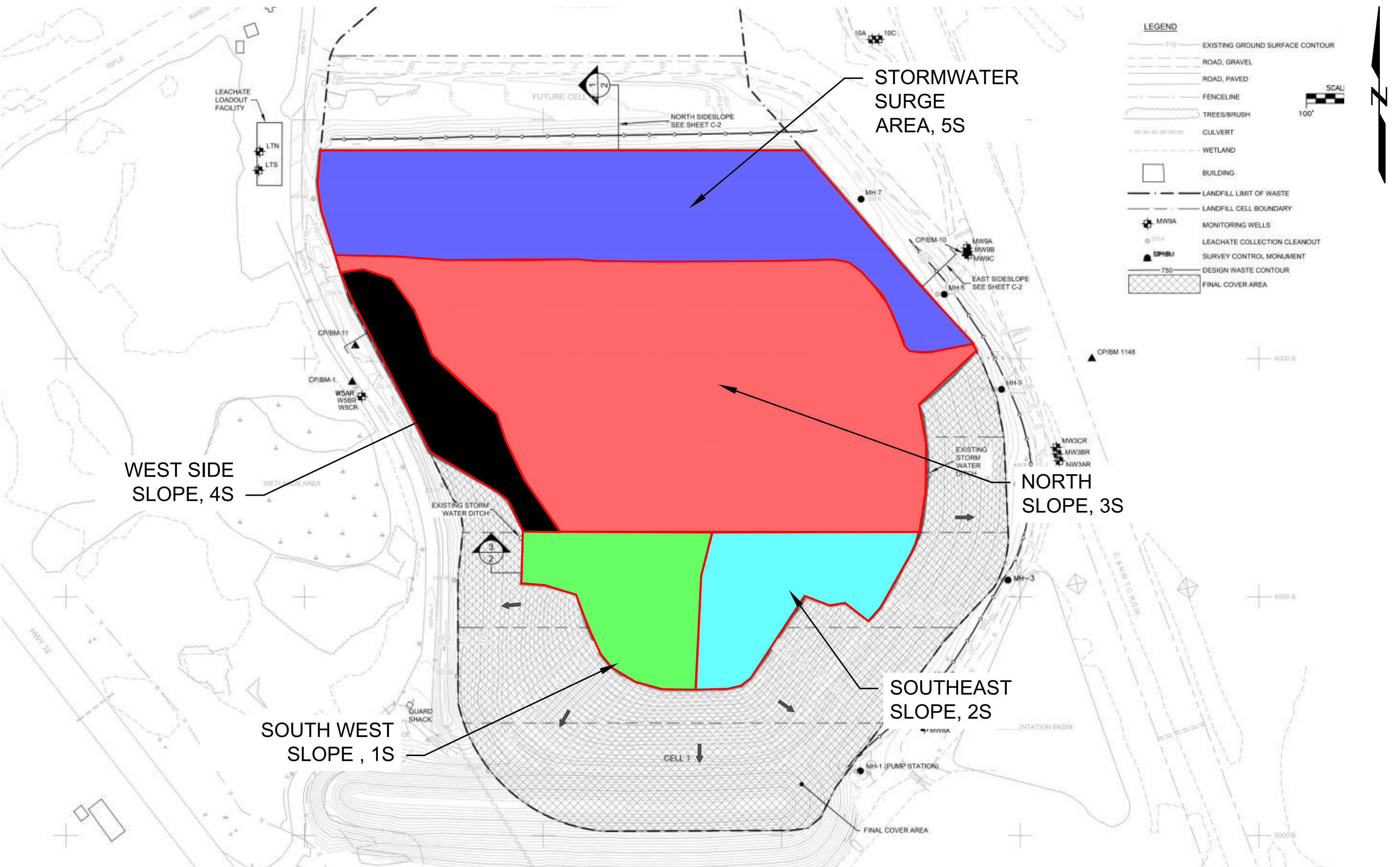
GEI Consultants	**Client**	We Energies			**Page**	2 of 2
	Project	Caledonia Ash Landfill Run-on and Run-off Control Plan			**Rev.**	0
	By	W. Reybrock	**Chk.**	A. Schwoerer	**App.**	A. Schwoerer
	Date	7/27/2021	**Date**	8/30/21	**Date**	8/30/21
GEI Project No.	1610530	**Document No.**	N/A			
Subject	Stormwater Run-off Calculations					

Results:

Based on the analysis, the run-off control system for the Caledonia Ash Landfill is able to contain, manage, and control the run-off from a 24-hour, 25-year precipitation event without allowing any contact water to escape the constructed limits of the landfill. The intercell stormwater surge area has a minimum crest elevation of El. 700.0 feet, and the estimated water level associated with the 24-hour, 25-year storm event s El. 695.64 feet. Both the temporary stormwater containment ditches and the stormwater surge area are designed to contain, manage, and control the run-off from the landfill associated with the 24-hour, 25-year storm event.

Attachments:

- Figure 1 – Stormwater
- HydroCAD Summary Report

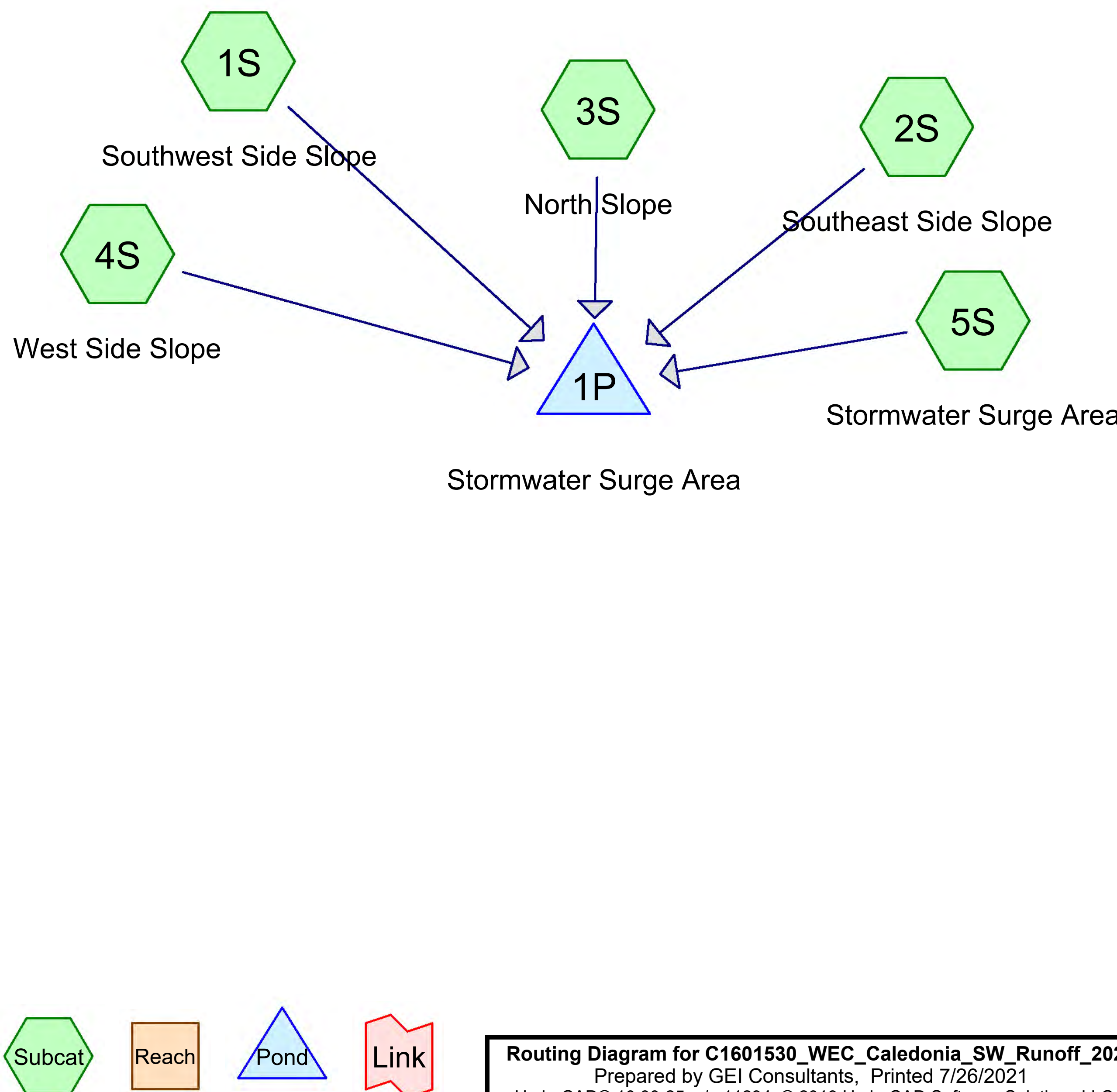


SOURCE:

1. PLAN BASED ON DWG C-1, CALEDONIA ASH LANDFILL, SUBMITTAL DATE 7/19/2021

Run-on and Run-off Control Plan Caledonia Ash Landfill Caledonia, Wisconsin	GEI Consultants	Run-Off Stormwater Flow Diagram
We Energies Milwaukee, Wisconsin	Project 1610530	September 2021 Fig. 1

\\GRB2L-WREYB C:\Landfills\WE - Caledonia\Caledonia\Dwg\1610530_run-on run-off control plan\dwg\1610530001_swc_2021.dwg - 7/23/2021



Routing Diagram for C1601530_WEC_Caledonia_SW_Runoff_2021
Prepared by GEI Consultants, Printed 7/26/2021
HydroCAD® 10.00-25 s/n 11294 © 2019 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
17.941	91	Newly graded area, HSG C (1S, 2S, 3S, 4S)
6.302	98	Water Surface, HSG C (5S)
24.244	**93**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
24.244	HSG C	1S, 2S, 3S, 4S, 5S
0.000	HSG D	
0.000	Other	
24.244		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	17.941	0.000	0.000	17.941	Newly graded area	1S, 2S, 3S, 4S
0.000	0.000	6.302	0.000	0.000	6.302	Water Surface	5S
0.000	**0.000**	**24.244**	**0.000**	**0.000**	**24.244**	**TOTAL AREA**	

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Southwest Side Slope Runoff Area=89,106 sf 0.00% Impervious Runoff Depth=3.48"
Flow Length=860' Tc=4.1 min CN=91 Runoff=12.36 cfs 0.593 af

Subcatchment 2S: Southeast Side Slope Runoff Area=90,715 sf 0.00% Impervious Runoff Depth=3.48"
Flow Length=920' Tc=3.7 min CN=91 Runoff=12.72 cfs 0.604 af

Subcatchment 3S: North Slope Runoff Area=534,656 sf 0.00% Impervious Runoff Depth=3.48"
Flow Length=600' Tc=2.7 min CN=91 Runoff=76.04 cfs 3.558 af

Subcatchment 4S: West Side Slope Runoff Area=67,044 sf 0.00% Impervious Runoff Depth=3.48"
Flow Length=600' Tc=37.7 min CN=91 Runoff=3.91 cfs 0.446 af

Subcatchment 5S: Stormwater Surge Runoff Area=274,530 sf 100.00% Impervious Runoff Depth=4.24"
Tc=0.0 min CN=98 Runoff=45.11 cfs 2.229 af

Pond 1P: Stormwater Surge Area Peak Elev=695.64' Storage=323,624 cf Inflow=138.46 cfs 7.430 af
Outflow=0.00 cfs 0.000 af

Total Runoff Area = 24.244 ac Runoff Volume = 7.430 af Average Runoff Depth = 3.68"
74.00% Pervious = 17.941 ac 26.00% Impervious = 6.302 ac

Summary for Subcatchment 1S: Southwest Side Slope

[49] Hint: Tc<2dt may require smaller dt

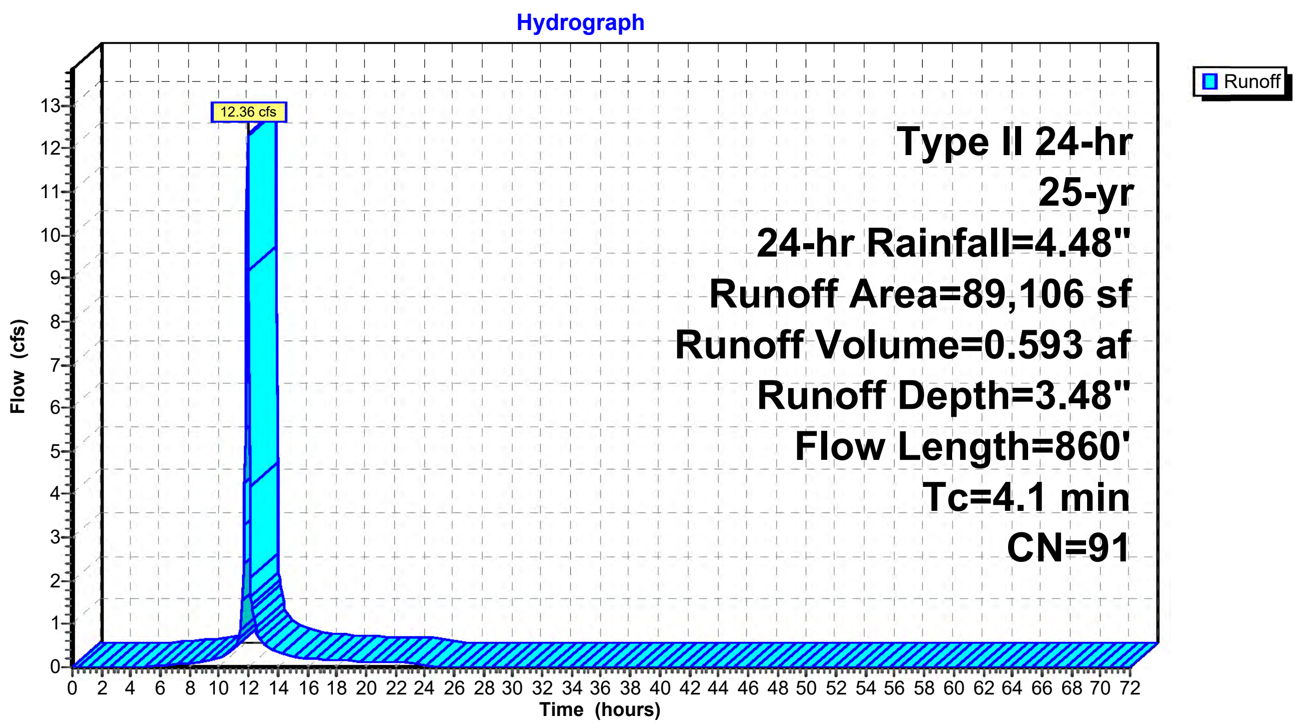
Runoff = 12.36 cfs @ 11.94 hrs, Volume= 0.593 af, Depth= 3.48"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr, 24-hr Rainfall=4.48"

	Area (sf)	CN	Description
*	89,106	91	Newly graded area, HSG C
	89,106		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.1	250	0.0400	1.99		**Sheet Flow, Top of slope** Smooth surfaces n= 0.011 P2= 2.66"
0.3	60	0.2500	3.11		**Sheet Flow, Side Slope** Smooth surfaces n= 0.011 P2= 2.66"
1.7	550	0.0200	5.55	18.22	**Trap/Vee/Rect Channel Flow, stormwater ditch perimeter** Bot.W=5.00' D=0.54' Z= 2.0 '/' Top.W=7.16' n= 0.022 Earth, clean & straight
4.1	860	Total			

Subcatchment 1S: Southwest Side Slope



Summary for Subcatchment 2S: Southeast Side Slope

[49] Hint: Tc<2dt may require smaller dt

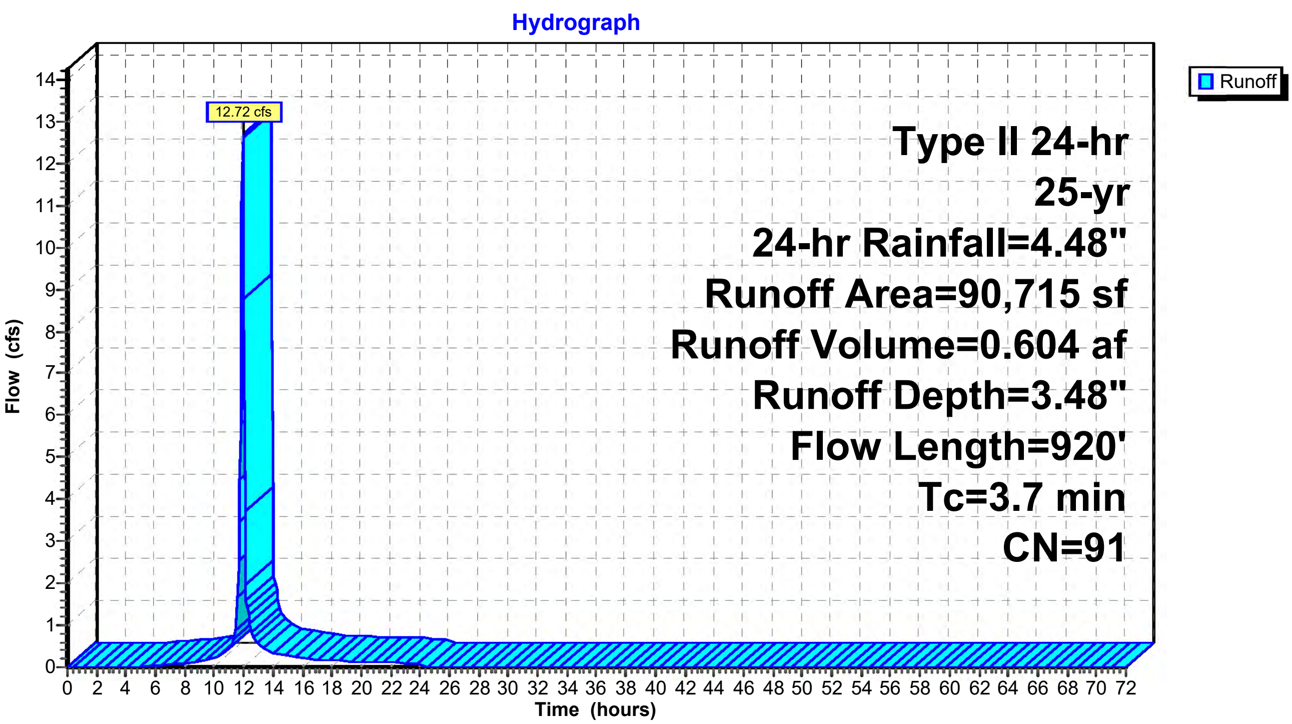
Runoff = 12.72 cfs @ 11.94 hrs, Volume= 0.604 af, Depth= 3.48"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr, 24-hr Rainfall=4.48"

	Area (sf)	CN	Description
*	90,715	91	Newly graded area, HSG C
	90,715		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.8	200	0.0400	1.90		**Sheet Flow, Top of slope** Smooth surfaces n= 0.011 P2= 2.66"
0.2	40	0.2500	2.87		**Sheet Flow, Side Slope** Smooth surfaces n= 0.011 P2= 2.66"
1.7	680	0.0300	6.80	22.31	**Trap/Vee/Rect Channel Flow, stormwater ditch perimeter** Bot.W=5.00' D=0.54' Z= 2.0 '/' Top.W=7.16' n= 0.022 Earth, clean & straight
3.7	920	Total			

Subcatchment 2S: Southeast Side Slope



Summary for Subcatchment 3S: North Slope

[49] Hint: Tc<2dt may require smaller dt

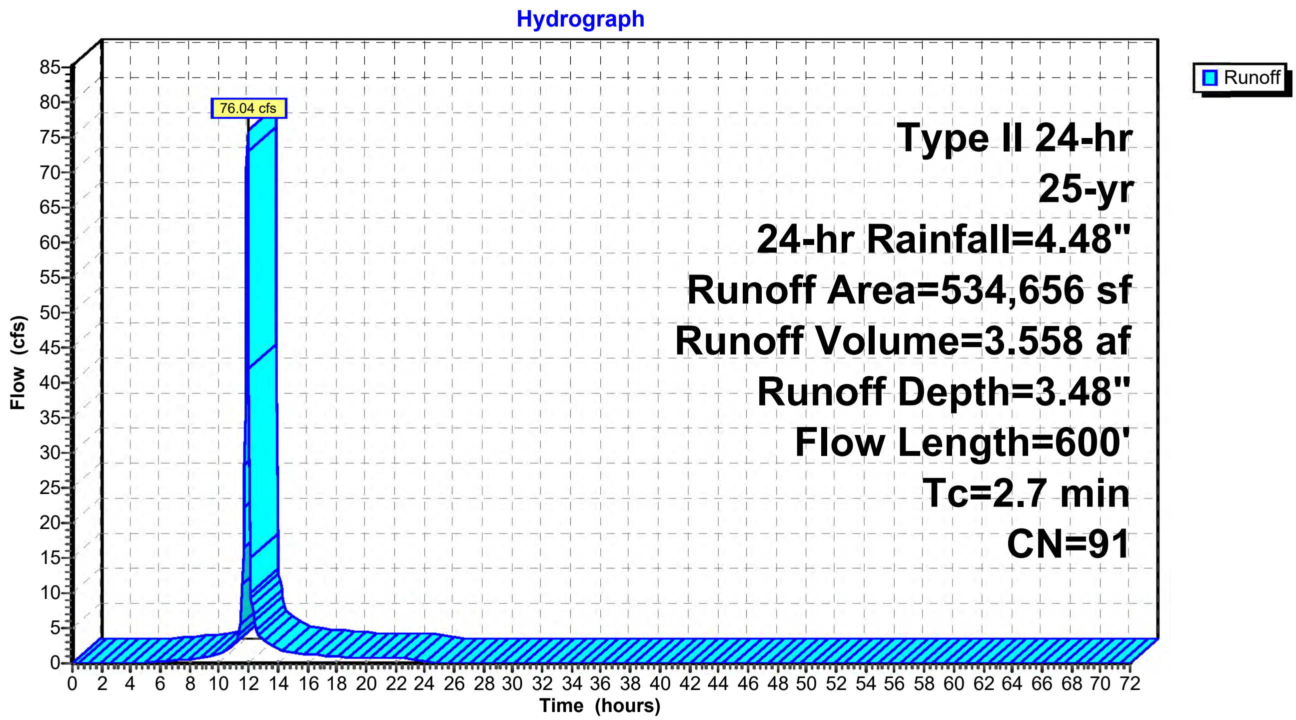
Runoff = 76.04 cfs @ 11.93 hrs, Volume= 3.558 af, Depth= 3.48"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr, 24-hr Rainfall=4.48"

	Area (sf)	CN	Description
*	534,656	91	Newly graded area, HSG C
	534,656		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0	300	0.3333	4.81		**Sheet Flow, Side Slope** Smooth surfaces n= 0.011 P2= 2.66"
1.7	300	0.0900	3.00		**Shallow Concentrated Flow, north slope shallow** Nearly Bare & Untilled Kv= 10.0 fps
2.7	600	Total			

Subcatchment 3S: North Slope



Summary for Subcatchment 4S: West Side Slope

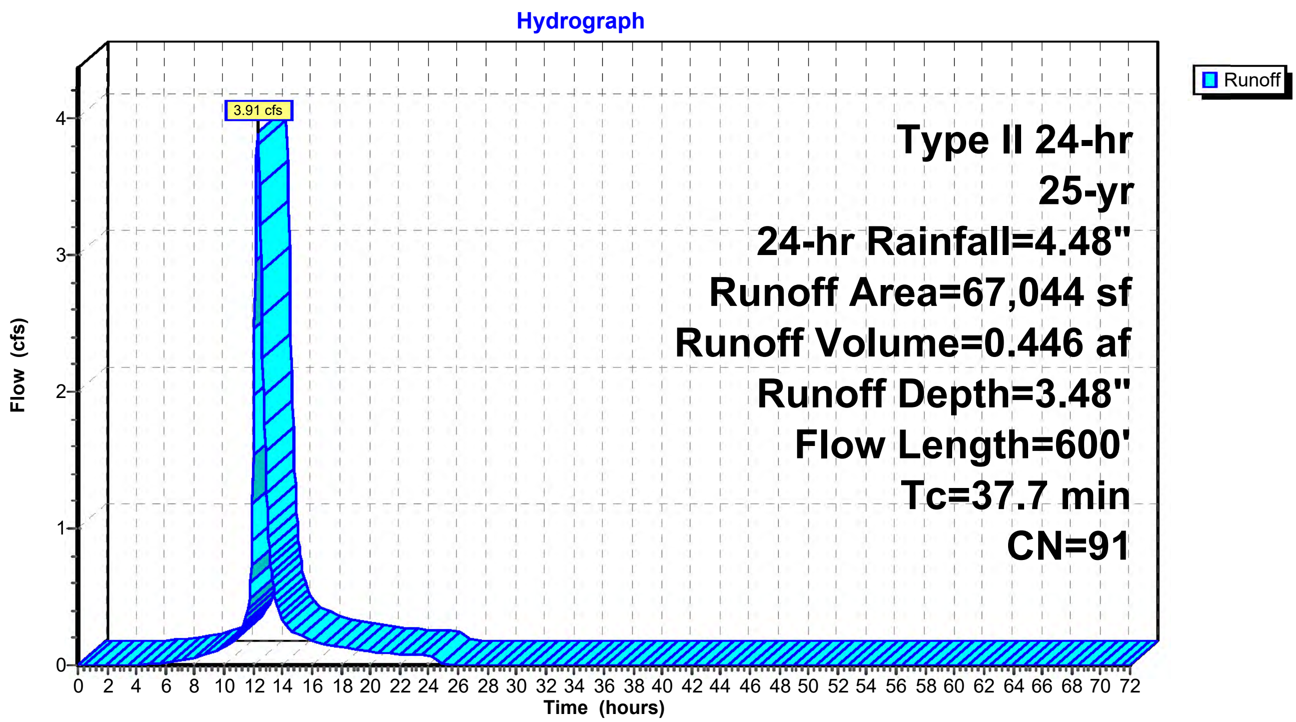
Runoff = 3.91 cfs @ 12.32 hrs, Volume= 0.446 af, Depth= 3.48"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr, 24-hr Rainfall=4.48"

	Area (sf)	CN	Description
*	67,044	91	Newly graded area, HSG C
	67,044		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	100	0.3330	3.86		**Sheet Flow, Top of slope** Smooth surfaces n= 0.011 P2= 2.66"
37.3	500	0.0005	0.22		**Shallow Concentrated Flow, flow to the north cell 10** Nearly Bare & Untilled Kv= 10.0 fps
37.7	600	Total			

Subcatchment 4S: West Side Slope



Summary for Subcatchment 5S: Stormwater Surge Area

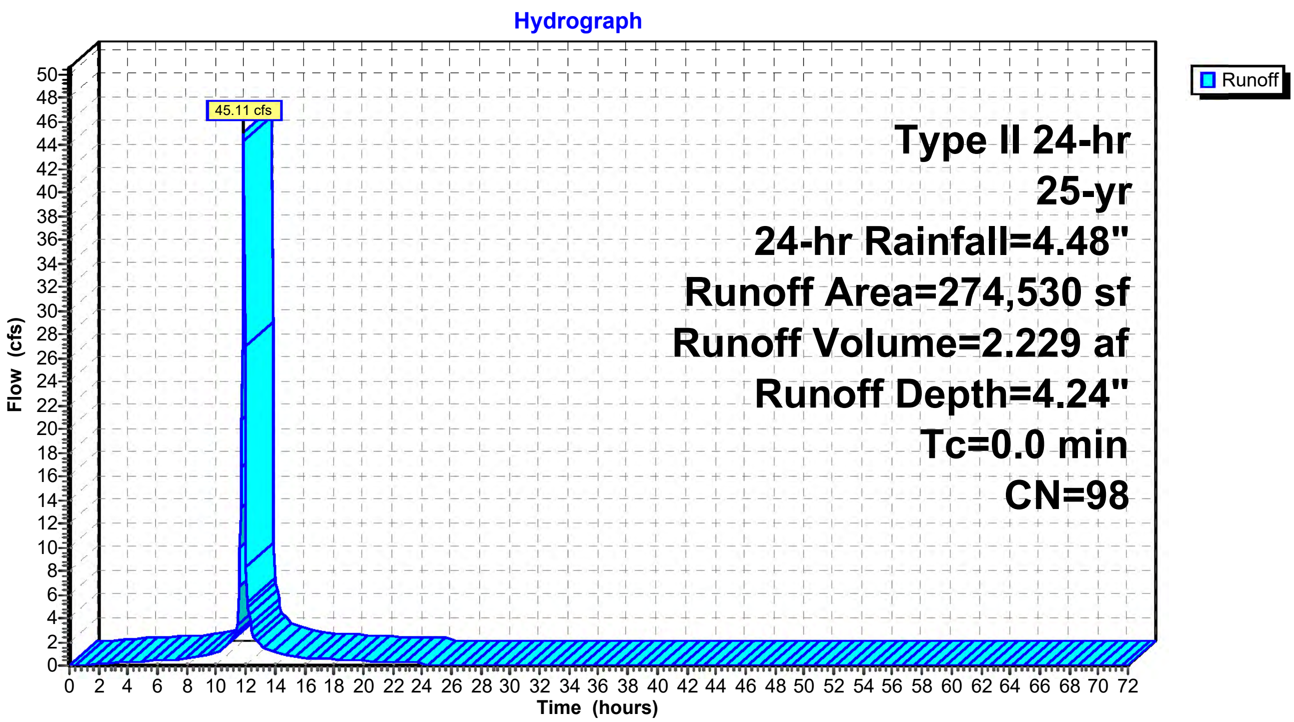
[46] Hint: Tc=0 (Instant runoff peak depends on dt)

Runoff = 45.11 cfs @ 11.89 hrs, Volume= 2.229 af, Depth= 4.24"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr, 24-hr Rainfall=4.48"

Area (sf)	CN	Description
274,530	98	Water Surface, HSG C
274,530		100.00% Impervious Area

Subcatchment 5S: Stormwater Surge Area



Summary for Pond 1P: Stormwater Surge Area

Inflow Area = 24.244 ac, 26.00% Impervious, Inflow Depth = 3.68" for 25-yr, 24-hr event
Inflow = 138.46 cfs @ 11.91 hrs, Volume= 7.430 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

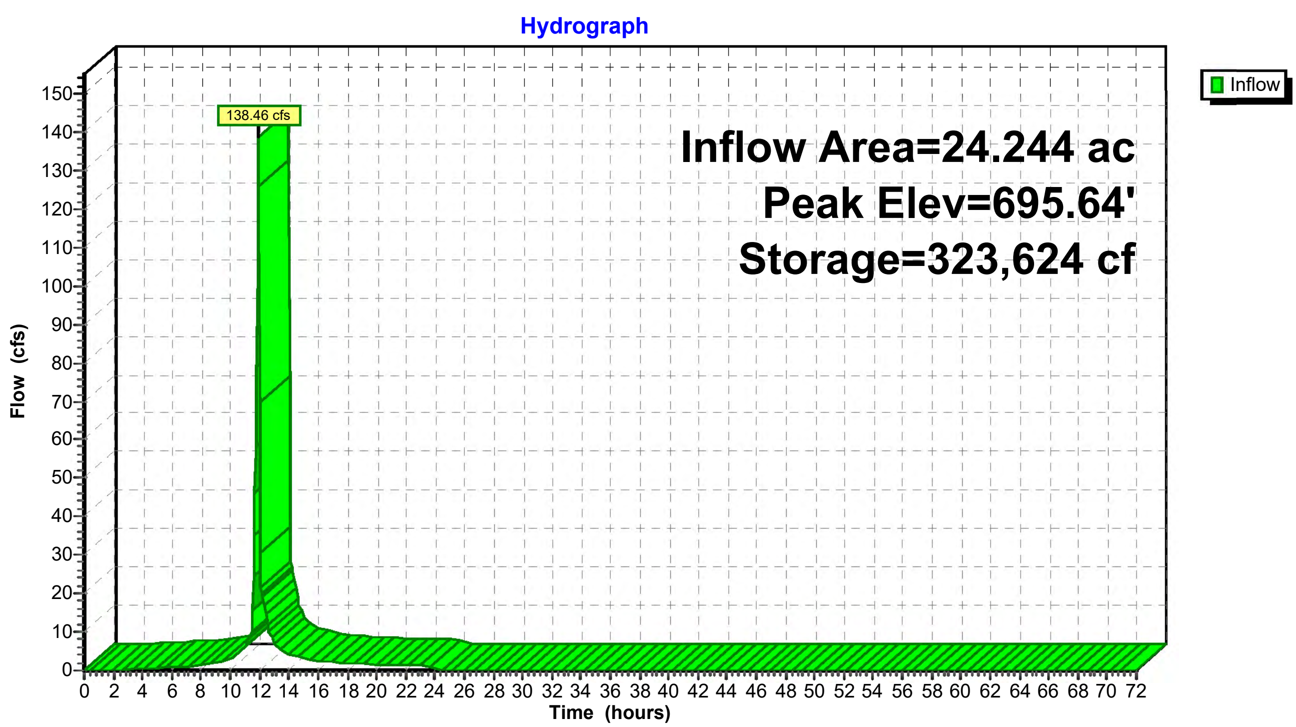
Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 695.64' @ 26.20 hrs Surf.Area= 119,103 sf Storage= 323,624 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	690.00'	1,091,327 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
690.00	2,259	0	0
692.00	38,418	40,677	40,677
694.00	80,466	118,884	159,561
696.00	127,464	207,930	367,491
698.00	180,961	308,425	675,916
700.00	234,450	415,411	1,091,327

Pond 1P: Stormwater Surge Area



Appendix L

Closure Plan

GEI Consultants

Consulting
Engineers and
Scientists

Regulation Compliance Report

Closure Plan

Caledonia Ash Landfill
Caledonia, Wisconsin

Submitted to:
WEC Energy Group
333 West Everett Street, A231
Milwaukee, Wisconsin 53203

Submitted by:
GEI Consultants, Inc.
3159 Voyager Drive
Green Bay, Wisconsin 54313
920-455-8200

September 2023, Revision 1

Project 2203724

John M. Trast, P.E., D.GE
Vice President

Andrew J. Schwoerer, P.G.
Project Professional

Table of Contents

Revision History

Revision 0 – Original Closure Plan dated October 2016.
Revision 1 – Update of the original Closure Plan for the Plan of Operation Modification submittal to comply with the updated NR 500 of the Wisconsin Administrative Code.

AJS:amp
K:\WEC Energy Group\1610530_We Energies Caledonia LF Engineering Assistance\In_Progress\CCR Closure\R1610530 Caledonia CCR

1. Introduction

We Energies owns and operates a solid waste disposal facility on the Oak Creek Site in the NE 1/4 of Section 1, Township 4 North, Range 22 East, in the Village of Caledonia, Racine County, Wisconsin. The We Energies Caledonia Ash Landfill is regulated as an industrial waste landfill by the Wisconsin Department of Natural Resources (WDNR) under the provisions of Chapter 289 Wisconsin State Statues, and all applicable requirements of Chapters NR 500 of the Wisconsin Administrative Code. The design, construction, operation, closure, and post-closure care requirements are specified in the WDNR conditionally approved Plan of Operations, License No. 03232, FID No. 252108450. As currently constructed, the landfill has 22.7 acres open, 34.9 acres of base liner system (Cells 1, 2, 3, 4, 6, 8, and 10) is constructed, and 12.2 acres of perimeter slopes (Cells 1, 2, 3, 4, 6, and 8) have received partial final cover.

On August 1, 2022, the WDNR updated NR 500 of the Wisconsin Administrative Code (Wis. Adm. Code) to include changes to new and existing Coal Combustion Residual (CCR) Landfills in the State of Wisconsin. As required in the new NR 514.045, an updated Plan of Operation Modification was prepared for the Caledonia Ash Landfill, including all future phases, and submitted for initial permitting by February 1, 2023.

In addition to the state regulations, the Caledonia Ash Landfill is also required to comply with 40 CFR Part 257 Subpart D – *Standards for Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments* and is defined as a CCR unit. Cells 1, 2, 3, 4, 6, 8 and 10 were constructed prior to February 1, 2023, and are defined as an existing CCR landfill in accordance with § 257.53. Future landfill cells are permitted by the WDNR in the conditionally approved Plan of Operation Modification and defined as lateral expansions under § 257.53 when constructed.

This report fulfills the requirements for a written Closure Plan of the Caledonia Ash Landfill in accordance with § 257.102 - *Criteria for Conducting the Closure or Retrofit of CCR Units* and NR 514.07(10(c) of the Wisconsin Administrative Code. In accordance with § 257.102(b)(1) and NR 514.07(10)(c)1, this report describes the engineering design of the landfill, phased development, a description of the final cover system and how the final cover will be constructed, and how the final cover system will meet the applicable performance standards contained in § 257.102(d) and NR 506.083(6). In addition, it also includes an estimate of the maximum inventory of CCR, an estimate of the maximum open area that would require closure at one time, and a generalized schedule based on the anticipated landfill filling rates and disposal volumes.

This closure plan includes the following sections:

Section 1 Introduction

Section 2 Closure Narrative

Section 3 Final Cover System

Section 4 Schedule for Closure

Section 5 Conclusion and Certification

2. Closure Narrative

This section provides the closure narrative as required by § 257.102(b)(i) and NR 514.07(10)(c)1. Closure of the Caledonia Ash Landfill will be accomplished by leaving the CCR in place and installing a final cover meeting the requirements of § 257.102(d)(3) and NR 504.07 over the CCR. The final cover system is described in Section 3. The areal limits of Caledonia Ash Landfill are shown on drawing C-1 in Appendix A. Closure activities for the landfill will commence when CCR disposed in the cell reach final waste grades shown on drawing PM-11 in Appendix A. It may be necessary to laterally expand the landfill with the construction of Cell 12 before final waste grades are completed in Cells 8 and 10. At that time this closure plan will be updated to comply with the federal rules.

§ 257.102(b)(1)(iv)/NR 514.07(10)(c)4 requires an estimate of the maximum inventory of CCR ever on the site over the active life of the CCR unit. The design capacity of the Caledonia Ash Landfill as currently constructed (Cells 1, 2, 3, 4, 6, 8, and 10) is 3,021,000 cubic yards.

§ 257.102(b)(1)(v)/NR 514.07(10)(c)5 requires an estimate of the largest area of the CCR unit ever requiring final cover, at any time during the active life of the CCR unit. The area of the landfill that has been constructed (Cells 1, 2, 3, 4, 6, 8, and 10) is approximately 34.9 acres and the area of the landfill that has received final cover prior to February 1, 2023, are 12.2 acres. So, the largest area of Caledonia Ash Landfill requiring final cover is approximately 22.7 acres.

§ 257.102(d)(1)(i)/NR 514.07(10)(c)2. The final cover system described in Section 3 is a composite final cover system which will envelop the CCR, minimizing post-closure infiltration and the potential release of CCR, leachate, or contaminated run-off from the closed unit. Fugitive dust from exposed CCR before and during final cover construction will be managed in accordance with the Fugitive Dust Control Plan. Surface water that has come into contact with CCR before and during final cover construction will be managed as leachate in accordance with the Run-on and Run-off Control Plan.

§ 257.102(d)(1)(iii)/NR 514.07(10)(c)3. Slope stability of the CCR and final cover is enhanced in the manner in which the CCR is conditioned, placed, and compacted; how the facility is operated to promote storm and contact water management; and how the leachate collection system is designed and monitored to ensure leachate is being removed from the waste and not allowed to build-up within the landfill. The permitted final cover slopes will be at a 4% minimum slope at the top of the landfill to promote surface water drainage and prevent ponding due to the settlement of the final cover system. The perimeter side slopes of the landfill will be at a maximum slope of 25% to provide long-term stable slopes that promote stormwater drainage, can be protected from excessive erosion, and safely maintained.

§ 257.102(d)(1)(iv)/NR 514.07(10)(c)3. The final cover system described in Section 3 will minimize infiltration, which in turn minimizes the demand on the leachate collection system. The final cover will be vegetated with grass to promote evapotranspiration and prevent erosion. The final cover system vegetation will be maintained by fertilizing as necessary to develop a well-established vegetative cover and periodic mowing to stimulate root growth and prevent the establishment of woody vegetation. Final slopes will be between 4% and 25% to facilitate mowing. Slopes greater than 10% will be covered with erosion matting after seeding to minimize erosion during the establishment of vegetative cover.

§ 257.102(d)(1)(v)/NR 514.07(10)(c)3. The final cover system described in Section 3 uses readily available equipment and materials and can easily be completed in a single construction season.

NR 514.07(10)(c)7. This 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.

3. Final Cover System

This section is included to fulfill the requirements of § 257.102(b)(1)(iii) and NR 514.07(10)(c)2.

Filling to final contours will result in a final slope no greater than 25% sloping downward from the center of the fill area to the perimeter of the site. The top portion of the landfill will be graded to no less than 4% sloping downward from the center to ensure positive drainage to the perimeter of the site. Drainage features, such as the perimeter ditches, terraces, and runoff channels will be constructed, as necessary, to accommodate surface runoff from phased closure.

The final cover system has been designed to minimize leachate generation by limiting percolation through the final cover barrier layer, promoting subsurface drainage to limit head on the barrier layer, and establishing vigorous plant growth to maximize evapotranspiration. The final cover system has also been designed for stability and to reduce maintenance.

The 7.7 acres of the final cover shown in Appendix A, PM-2 was installed over portions of Cells 1, 2, 3, 4 and 6 and was installed prior to the Plan of Operations Modification issued by WDNR on May 19, 2010. This 7.7 acres of final cover consists of top to bottom a 6-inch-thick topsoil layer, 24-inch-thick rooting zone layer, 24-inches of compacted clay with a hydraulic conductivity no greater than 1.0×10^{-7} cm/s, and a 6-inch- thick grading layer of bottom ash or clay.

The final cover system permitted by the WDNR on May 19, 2010, consists from top to bottom a 6-inch-thick topsoil layer, 24- inch-thick rooting zone layer, geocomposite drainage layer, 40-mil textured liner low-density polyethylene (LLDPE) geomembrane liner, 24-inch-thick compacted FGD filter cake/fly ash barrier layer with a hydraulic conductivity no greater than 5×10^{-5} cm/s, and 6-inch-thick ash grading layer. The geocomposite drainage layer is incorporated into the final cover system cross-section to promote subsurface drainage and prevent the build-up of head pressure on the barrier layer and pore pressures in the final cover system soils. The remaining 4.1 acres of the final cover shown in Appendix A, PM-2 was installed over portions of Cells 2, 6, and 8 incorporates this final cover.

The Plan of Operation Modification submitted to the WDNR dated September 29, 2023, incorporates an increase to the thickness of the rooting zone layer from 24-inches to 30-inches in accordance with NR 504.07(6) and changes the barrier layer design to be constructed out of clay or soil with a GCL in accordance with NR 504.07(4) All final cover construction subsequent to September 29, 2023 will incorporate these design changes into final cover construction. Drawing PM-15 in Appendix A shows details of this updated final cover.

The hydraulic conductivity of the final cover system is required by § 257.102(d)(3)(i)(A) and NR 504.12(4)(b)1 to be less than or equal to the hydraulic conductivity of the bottom liner system or natural subsoils present or a hydraulic conductivity no greater than 1.0 x 10^{-5} cm/s, whichever is less. The Caledonia Ash Landfill is divided into two phases. Phase I (Cells 1, 2, 3, 4, 6, and 8) was constructed with a 5-foot thick compacted clay liner with a maximum hydraulic conductivity of 1.0 x 10^{-7} cm/s. Phase II (Cell 10) was constructed with a composite base liner system consisting of 4-foot-thick compacted clay layer and polyethylene geomembrane liner. The approved final cover system to be installed after the approval of the May 19, 2010, Plan of Operation Modification is a composite final cover consisting of a 2-foot compacted barrier layer, polyethylene geomembrane, drainage layer, and vegetated soil layers. The 7.7 acres of final cover installed prior to May 19, 2010, matches the hydraulic conductivity of the base liner for Cells 1, 2, 3, 4 and 6 complying with the requirements of § 257.102(d)(3)(i)(A) and NR 504.12(4)(b)1.

Construction equipment and methods normally used in developing landfills and performing earth-moving projects will be used. The following sub-sections discuss the construction of the individual components of the final cover system. Layout and details of the final cover system to be installed after February 1, 2023, are shown on the drawings included in Appendix A.

3.1 Compacted Barrier Layer

A minimum 2-foot-thick layer of compacted barrier layer constructed of clay or soil will be constructed above a 6-inch grading layer as the soil component of the composite barrier layer in accordance with NR 504.06(2)(a) and (f) for the clay barrier layer and NR 504.07(4)(a)(12) through (14) for the soil barrier layer option. The materials will be placed and compacted with a large vibratory smooth-drum roller, with a minimum operating weight of 15,000 pounds, and while in vibratory mode, can provide 30,000 pounds of compactive energy. The barrier layer will be placed and compacted in lifts not exceeding 6 inches. The prepared barrier layer shall provide a firm, smooth surface for deployment of the geomembrane. The barrier layer should be free of any angular particles protruding from the surface greater than 0.5 inches, sharp breaks in grade or excessive rutting greater than 0.2 feet.

The select clay barrier layer material will be placed and compacted to a minimum density of 90 percent of the modified Proctor or 95 percent of the standard Proctor density at moisture content at least 2 percent wet of optimum if using the modified Proctor method and wet of optimum if using the standard Proctor method. For the fine-grained soil barrier layer meeting the classification specified in NR 504.07(4)(a)(12), the soil layer will be compacted to the 90 percent modified or 95 percent standard Proctor density or greater at a moisture content at or wet of optimum.

3.2 Geosynthetic Clay Liner (GCL)

If soil barrier layer is utilized, GCL will be installed above the barrier layer in accordance with NR 504.07(4)(a). Specifications for the materials, installation, and documentation of the CLare included in the CQA Plan in Appendix N.

Before the GCL is placed, the compacted soil barrier layer surface will be examined for protruding rocks, foreign objects, holes left from rock or stake removal, loose material,

desiccation, and overall smoothness of the surface. Coarse gravel or cobbles larger than 2-inches in diameter will be removed from the surface by hand. Other courses of remedy that may be practiced include smooth drum-rolling the surface, filling in ruts or holes with fill, a sand/bentonite mixture, or bentonite, and watering the surface.

The GCL panels will be placed in an orientation that runs directly down the sideslopes. The GCL panels will be placed with a minimum 6-inch longitudinal overlap and a minimum of 20 inches of overlap at the panel end seams. A seal of loose bentonite will be placed in the seam overlaps at a minimum of one quarter pound per linear foot of seam unless additional overlap has been approved as an alternative by the WDNR. The GCL will be installed dry and covered the same day.

3.3 Geomembrane

The geomembrane component of the final cover system will be a 40-mil textured linear low-density polyethylene (LLDPE) geomembrane. The LLDPE geomembrane has been selected in order to provide flexibility of the final cover system to accommodate expected settling and subsidence in accordance with § 257.102(d)(3)(i)(D)/NR 504.07(5). Geomembrane panels will be positioned by suspending rolls of material with a front-end loader and unrolling the suspended material by hand or with the aid of an ATV, as the loader remains stationary. The geomembrane will be installed in a loose and relaxed condition. Panels will be overlapped approximately 4 inches and fusion-welded together. At seam intersections and other repair locations, a geomembrane patch extending a minimum of 12 inches beyond the intersection or repair will be extrusion-welded into place. All seams will be non-destructively tested by air or vacuum testing. The integrity of fusion welds will be air tested, and extrusion welds will be vacuum tested.

3.4 Drainage/Rooting Layer and Topsoil

A geocomposite drainage layer and a 30-inch-thick rooting zone layer meeting the requirements of § 257.102(d)(3)(i)(B) and NR 504.07(6) will be installed above the geomembrane final cover. The drainage layer will be installed to aid in the removal of subsurface storm water drainage; the rooting zone layer will be installed to support vegetative growth and both layers will provide protection of the geomembrane and compacted barrier layer. The geocomposite will be deployed such that the seams run perpendicular to the contour lines of the slope to the extent possible. The geonet will be cable-tied every 3 feet along the edge of the panels and every 12 feet for end seams.

The top geotextile will be sewn. The rooting layer will be placed over the geocomposite in a single lift using low ground pressure dozers. The material will be classified as SW, SP, SM, SC, ML, or CL and have a maximum particle size of 3 inches. The rooting layer will consist of on-site or off-site soils.

Meeting the requirements of § 257.102(d)(3)(i)(C) and NR 504.07(7), topsoil capable of sustaining vegetative growth will be placed and spread into a uniform loose lift thickness of 6 inches. Once placed, the topsoil will be fertilized, seeded, and mulched. The seed mix used on the final cover will be selected per Section 630 of the Wisconsin Department of Transportation (WDOT) specifications. Furthermore, certain seed species will also be selected and incorporated into the final cover seed mix that will create a new habitat for endangered species Karner Blue Butterflies and Rusty Patched Bumble Bees, as discussed in Section 3.2 of the Plan of Operation Modification. On all slopes greater than 10%, a temporary straw mulch blanket will be used to limit erosion and protect the seed prior to the establishment of vegetation.

4. Schedule for Closure

This section is included to fulfill § 257.102(b)(1)(v) and NR 514.07(10)(c)(6). The Cells 1, 2, 3, 4, 6, 8, and 10 have been constructed. Portions of the perimeter slopes of Cells 1, 2, 3, 4, 6, and 8 have received final cover prior to February 1, 2023, as shown in Appendix A, Drawing PM-2. In accordance with the WDNR approved Plan of Operation, the landfill has a phased development plan, describing the construction, operation, and closure of each phase of the landfill. In general, the development plan requires active landfill cells which have reached final waste grades be closed as soon as practical to limit the maximum open area, leachate generation, and the potential operational problems.

In accordance with 40 CFR 257.102(b)(1)(vi) and NR 514.07(10)(c)(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, is provided in the table below at the current CCR disposal rate of approximately 10,000 cubic yards per year:

Unit	Estimated Closure Date
Cell 2	Fall 2035
Cell 3	Fall 2047
Cell 4	Fall 2059
Cell 6	Fall 2090
Cell 8	Fall 2107
Cell 10	Fall 2157
Cell 12	Fall 2203
Cells 14/16	Fall 2265

The estimated year in which all closure activities will be completed for each cell as necessary to satisfy the closure criteria is dependent on CCR generation rates, beneficial reuse programs, and disposal rate volumes. However, final closure of the landfill will begin no later than 30 days following the final waste receipt for the CCR unit in accordance with §257.102(e)(1). A preliminary closure schedule, including the sequential steps and major milestones for closing Cell 2 of the Caledonia Ash Landfill, is provided in Appendix B.

Final cover construction at the Caledonia Ash Landfill will be completed in accordance with the WDNR approved Plan of Operation under License No. 03232. No additional state or local approvals are required for We Energies to begin construction of the next phase of the landfill or closure of an existing phase. The final cover system described in Section 3 uses standard and readily available equipment and materials and can easily be completed in a single construction season.

5. Conclusion and Certification

We Energies owns and operates a solid waste disposal facility on the Oak Creek Site in the NE 1/4 of Section 1, Township 4 North, Range 22 East, in the Village of Caledonia, Racine County, Wisconsin. Caledonia Ash Landfill is required to comply with 40 CFR Part 257 Subpart D — *Standards for Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments* and NR 500 of the Wisconsin Administrative Code. This plan fulfills the requirements for a written Closure Plan of the Caledonia Ash Landfill, in accordance with § 257.102 - *Criteria for Conducting the Closure or Retrofit of CCR Units* and NR 514.07(10)(c), describing the engineering design and construction of the final cover system, how the final cover system will meet the applicable performance standards contained in § 257.102(d) and NR 514.07(10)(c)3, an estimate of the maximum inventory of CCR, an estimate of the maximum open area that would require closure at one time, and a generalized schedule based on the anticipated landfill filling rates and disposal volumes.

The Closure Plan was completed under the direction of John M. Trast, P.E. I am 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 40 CFR Part 257 Subpart D and NR 500 of the Wisconsin Administrative Code.

John M. Trast, P.E., D.GE
Professional Engineer License No. 31792

WISCONSIN
JOHN
MATHEW
TRAST
37192-6
GREEN BAY
WISCONSIN
PROFESSIONAL ENGINEER
09/29/2023

Table 1 - Closure Cost Estimate
We Energies
Caledonia Ash Landfill
GEI Consultants, Inc.
September 29, 2023

Item[1]	*Quantity*	*Unit*[3][4]	*Unit Cost*	*Total*
Engineering Plans and Specifications				
Engineering Plans and Specifications	1	LS	$30,000.00	$30,000
Final Cover Construction				
Mobilization	1	LS	$10,000.00	$10,000
Survey and Construction Staking	1	LS	$20,000.00	$20,000
24-inch Barrier Layer (Clay or Soil) - Haul, Place, and Compact	73,245	cy	$12.00	$878,940
Geosynthetic Clay Liner (GCL) (if soil barrier layer is utilized)	988,812	sf	$0.70	$692,168
40-mil LLDPE Geomembrane Textured	988,812	sf	$0.69	$682,280
Geocomposite Drainage Layer	988,812	sf	$0.75	$741,609
Rooting Zone Soil (30-inches)	91,556	cy	$15.30	$1,400,807
Topsoil (6-inches)	18,311	cy	$25.00	$457,775
Seed, Mulch, Fertilizer, Lime	22.7	acre	$5,000.00	$113,500
Construction QA & Documentation				
Construction QA & Documentation	22.7	acre	$25,000.00	$567,500

Subtotal Closure Cost	$5,594,579
Contingency (10%)	$559,458
Total Closure Cost	$6,154,037

Notes

[1]This closure cost estimate is based on the largest open area of the staged construction plan of 22.7 acres.
[2]The final cover cross-section is based on the Plan of Operation Modfiction dated September 2023.
[3]Unit prices are based on previous liner/final cover construction projects and vendor cost estimates.
[4]Costs are in 2023 dollars.

Appendix A

Drawings

Drawing PM-2: Existing Site Conditions, Caledonia Ash Landfill, Plan of Operation Modification, dated 9/29/2023

Drawing PM-11: Final Waste Grades, Caledonia Ash Landfill, Plan of Operation Modification, dated 9/29/2023

Drawing PM-12: Final Cover Grades, Caledonia Ash Landfill, Plan of Operation Modification, dated 9/29/2023

Drawing PM-15: Construction Details, Caledonia Ash Landfill, Plan of Operation Modification, dated 9/29/2023

LEGEND

- EXISTING GROUND SURFACE CONTOUR
- ROAD, GRAVEL
- ROAD, PAVED
- FENCELINE
- TREES/BRUSH
- CULVERT
- WETLAND
- BUILDINGS
- LANDFILL LIMIT OF WASTE
- LANDFILL CELL BOUNDARY
- MONITORING WELLS
- LEACHATE COLLECTION CLEANOUT
- LEACHATE COLLECTION MANHOLE
- LEACHATE TRANSFER LINE
- SURVEY CONTROL MONUMENT
- GEOMEMBRANE ANCHOR TRENCH
- 4" DIA. PERFORATED TOE DRAIN PIPE
- 4" DIA. NON-PERFORATED DRAIN OUTLET PIPE

NOTES:

1. EXISTING CONTOURS FROM 1983 WEPCO SURVEY AND RACINE COUNTY TOPOGRAPHIC MAP. CONTOURS IN THE LANDFILL AREA UPDATED FROM SURVEY ON 11/10/2021 BY EDGERTON.
2. HORIZONTAL GRID IS LOCAL GRID ESTABLISHED BY OTHERS. ELEVATIONS ARE REFERENCED TO MEAN SEA LEVEL.

Survey Control Points

	Site Grid Coordinates			State Plane Coordinates		
Point	South	West	Elevation	North	East	Description
CP/ BM-1	4,050.00	2,400.00	700.75	313,022.18	2,578,174.51	Concrete monument, w/ chiseled X
CP/ BM 1148	4,000.00	850.00	702.66	313,072.18	2,579,724.51	Concrete monument, w/ chiseled X
CP/ BM-2	3,200.00	2,400.00	717.99	313,872.18	2,578,174.51	Concrete monument, w/ Aluminum cap
CP/ BM-10	3,779.93	1,114.60	704.12	313,292.25	2,579,459.91	7/8"x18" rebar w/Alum. Cap inside 2"IDX24"IP
CP/ BM-11	3,973.04	2,393.41	702.09	313,099.14	2,578,181.10	7/8"x18" rebar w/Alum. Cap inside 2"IDX24"IP

Grid Conversion
Site Grid 0 N/S = 317,072.18 N/S State Plane Coordinates
Site Grid 0 E/W = 2,580,574.51 E/W State Plane Coordinates

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3159 VOYAGER DRIVE
GREEN BAY, WI 54311
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we energies

CALEDONIA ASH LANDFILL PLAN OF OPERATION MODIFICATION

P.E. No.:	
Approved:	JXT
Checked:	JXT
Drawn:	JLC
Designed:	JLC
GEI Project:	2203724

Attention:
0 1"
If this scale bar does not measure 1" then drawing is not original scale.

NO.	DATE	ISSUE/REVISION	APP
1	9/29/2023	PLAN MOD	JXT

EXISTING SITE CONDITIONS

DWG. NO.
PM-2
SHEET NO.
2 OF 21

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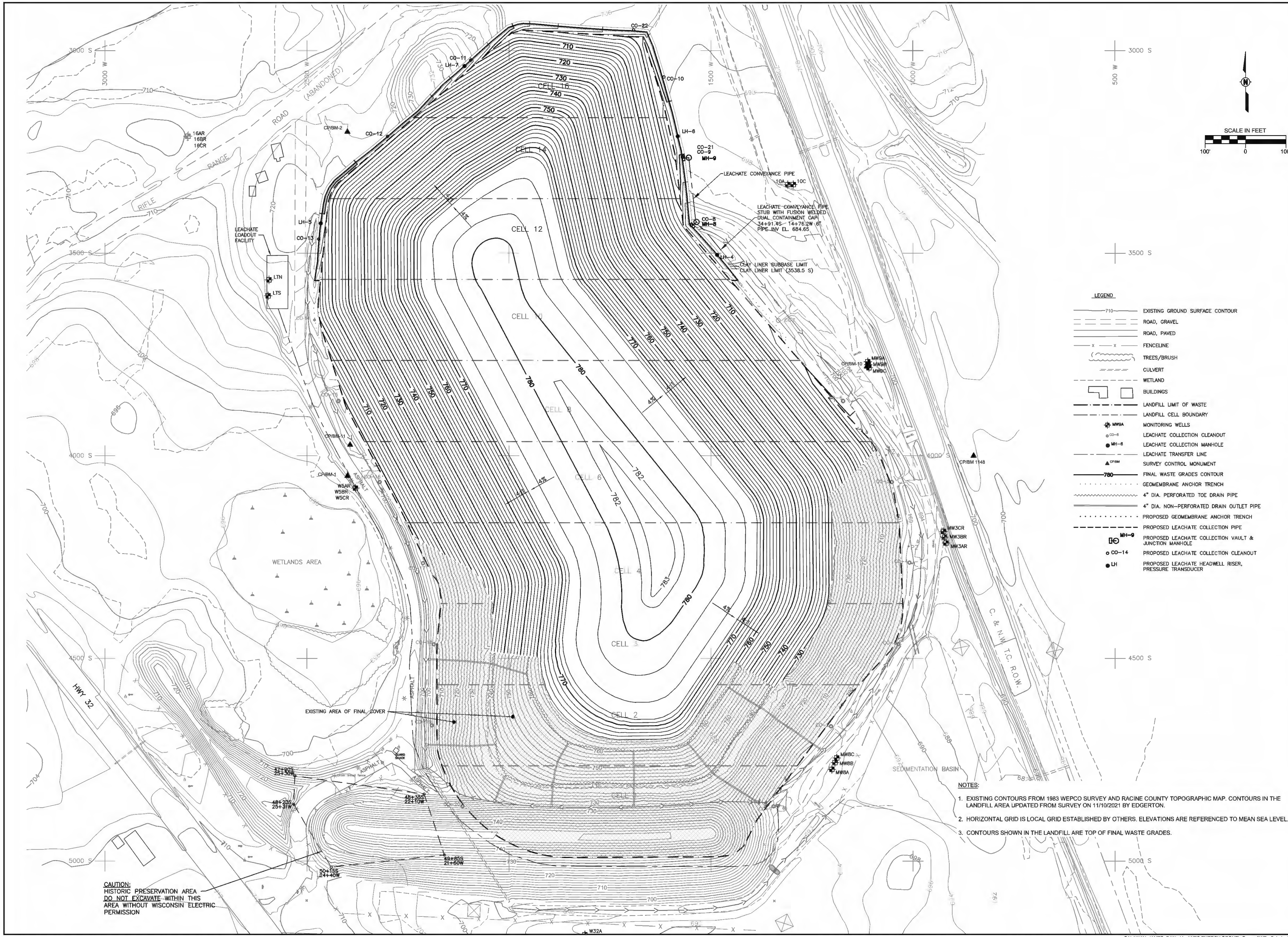

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2. HORIZONTAL GRID IS LOCAL GRID ESTABLISHED BY OTHERS. ELEVATIONS ARE REFERENCED TO MEAN SEA LEVEL.
3. CONTOURS SHOWN IN THE LANDFILL ARE TOP OF FINAL WASTE GRADES.

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CALEDONIA ASH LANDFILL PLAN OF OPERATION MODIFICATION

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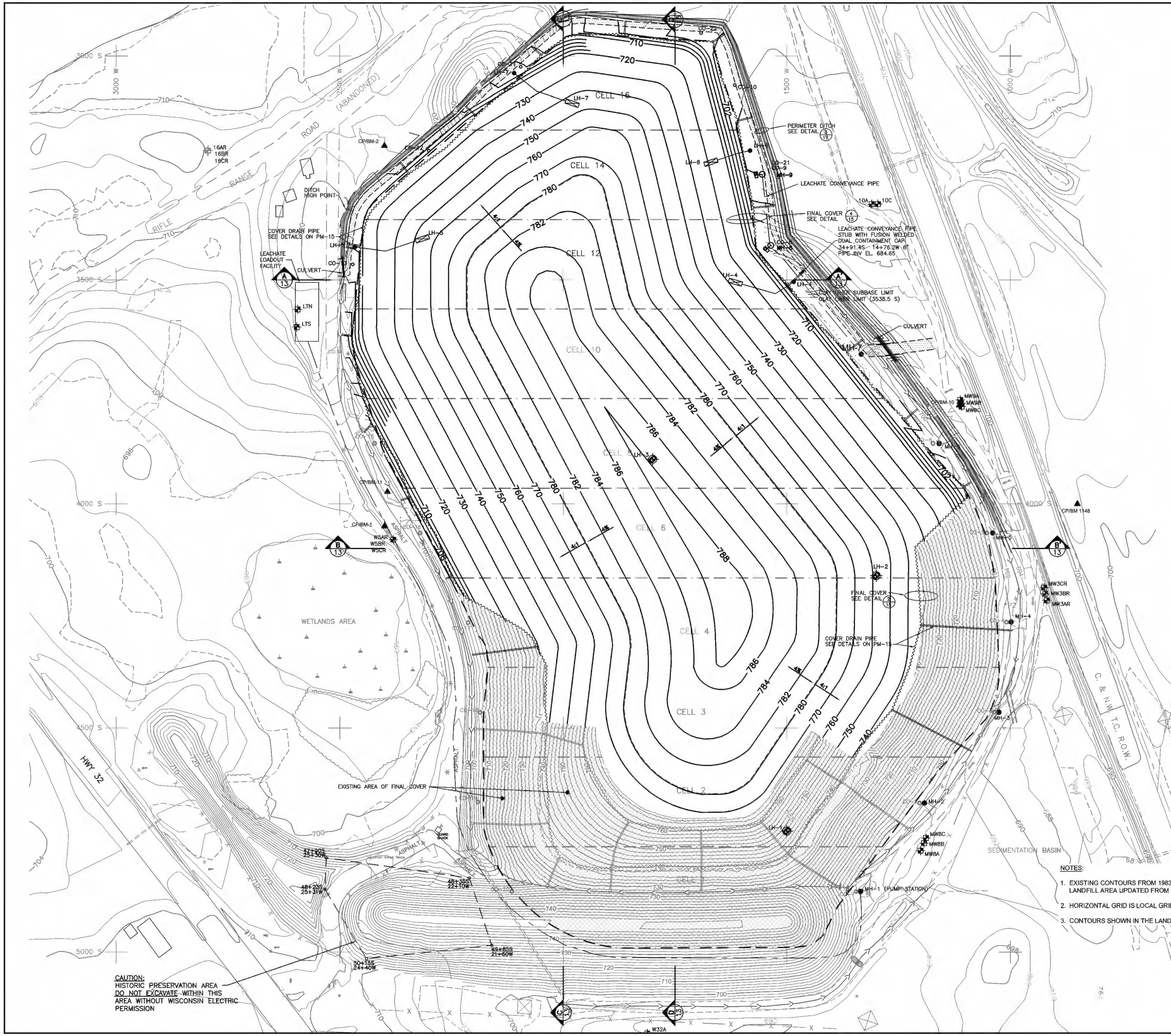
1	9/29/2023	PLAN MOD	JXT

FINAL WASTE GRADES

DWG. NO.
PM-11
SHEET NO.
11 OF 21



LEGEND

- EXISTING GROUND SURFACE CONTOUR
- ROAD, GRAVEL
- ROAD, PAVED
- FENCELINE
- TREES/BRUSH
- CULVERT
- WETLAND
- BUILDINGS
- LANDFILL LIMIT OF WASTE
- LANDFILL CELL BOUNDARY
- MONITORING WELLS
- LEACHATE COLLECTION CLEANOUT
- LEACHATE COLLECTION MANHOLE
- LEACHATE TRANSFER LINE
- SURVEY CONTROL MONUMENT
- FINAL COVER GRADES CONTOUR
- GEOMEMBRANE ANCHOR TRENCH
- 4" DIA. PERFORATED TOE DRAIN PIPE
- 4" DIA. NON-PERFORATED DRAIN OUTLET PIPE
- PROPOSED 4" DIA. PERFORATED TOE DRAIN PIPE
- PROPOSED 4" DIA. NON-PERFORATED DRAIN OUTLET PIPE
- PROPOSED HAUL ROAD
- PROPOSED LEACHATE HEADWELL DRILLED WELL
- PROPOSED LEACHATE HEADWELL, PRESSURE TRANSDUCER
- PROPOSED HEADWELL RISER, PRESSURE TRANSDUCER

CELLS 14/16 FINAL COVER CONSTRUCTION QUANTITIES

Final Grading	10	AC
Leachate Head Monitoring Well	-	EA
Grading Layer	8,150	CY
Select Clay or Soil Barrier Layer	32,600	CY
GCL (if soil barrier layer is utilized)	440,000	SF
40-mil Geomembrane	440,000	SF
Geocomposite Drainage Layer	440,000	SF
Anchor Trench	1,600	LF
Rooting Zone Soil	40,750	CY
Slope and Toe Drain Pipe and Outlets	400	LF
Topsoil	8,150	CY
Seed, Mulch, Fertilizer, and Lime	10	AC

Note:
Volumes are in-place volumes. Quantities are subject to change based on in-field conditions at the time of construction.

NOTES:

1. EXISTING CONTOURS FROM 1983 WEPCO SURVEY AND RACINE COUNTY TOPOGRAPHIC MAP. CONTOURS IN THE LANDFILL AREA UPDATED FROM SURVEY ON 11/10/2021 BY EDGERTON.
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CALEDONIA ASH LANDFILL PLAN OF OPERATION MODIFICATION

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Designed:	JLC
GEI Project:	2203724

Attention: 0 1"
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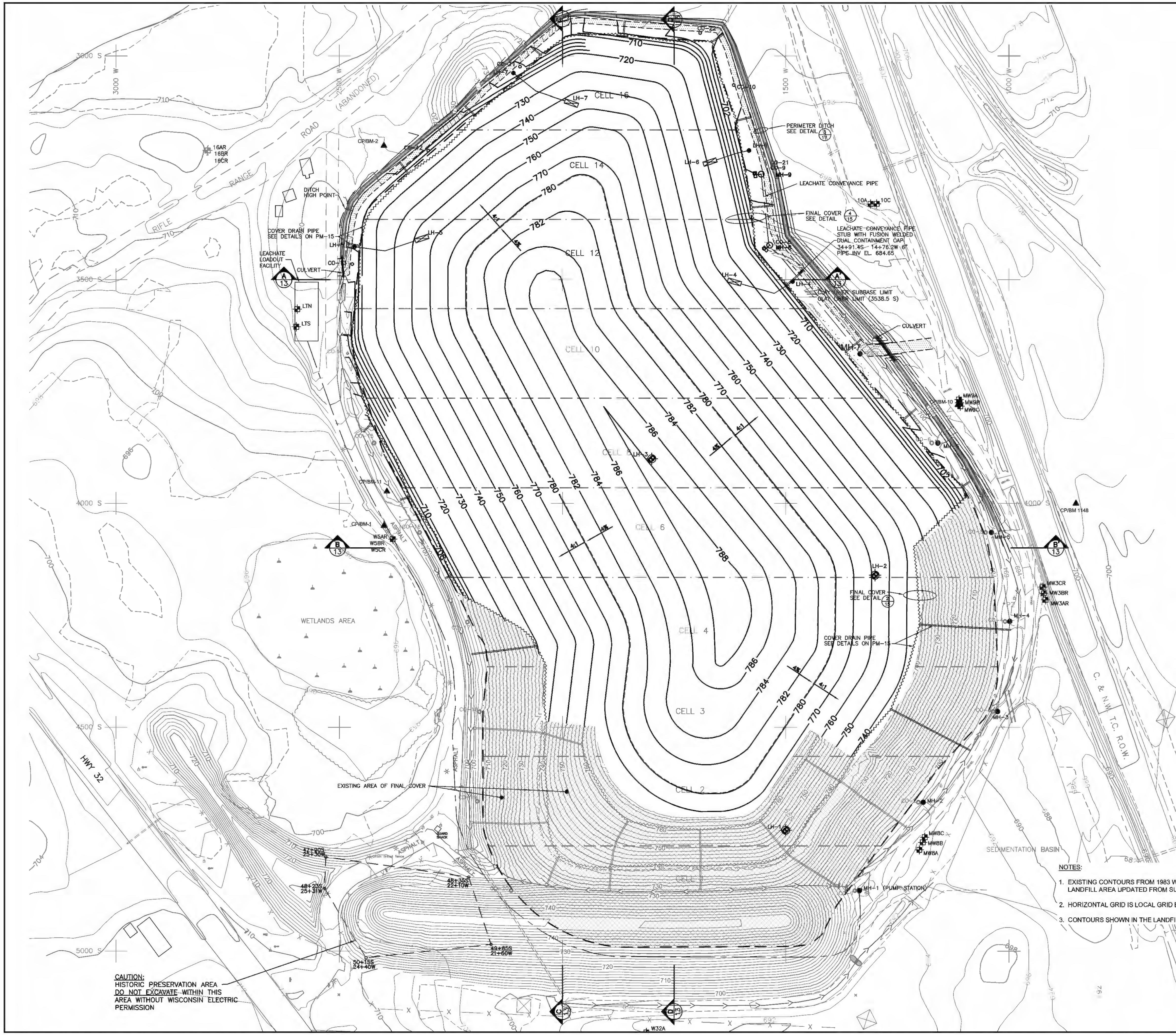
NO.	DATE	ISSUE/REVISION	APP
1	9/29/2023	PLAN MOD	JXT

FINAL COVER GRADES

DWG. NO.
PM-12



LEGEND

710	EXISTING GROUND SURFACE CONTOUR
	ROAD, GRAVEL
	ROAD, PAVED
x x	FENCELINE
	TREES/BRUSH
	CULVERT
	WETLAND
	BUILDINGS
	LANDFILL LIMIT OF WASTE
	LANDFILL CELL BOUNDARY
MW9A	MONITORING WELLS
CO-6	LEACHATE COLLECTION CLEANOUT
MH-6	LEACHATE COLLECTION MANHOLE
	LEACHATE TRANSFER LINE
CP/BM	SURVEY CONTROL MONUMENT
780	FINAL COVER GRADES CONTOUR
	GEOMEMBRANE ANCHOR TRENCH
	4" DIA. PERFORATED TOE DRAIN PIPE
	4" DIA. NON-PERFORATED DRAIN OUTLET PIPE
	PROPOSED 4" DIA. PERFORATED TOE DRAIN PIPE
	PROPOSED 4" DIA. NON-PERFORATED DRAIN OUTLET PIPE
	PROPOSED HAUL ROAD
LH-1	PROPOSED LEACHATE HEADWELL DRILLED WELL
LH	PROPOSED LEACHATE HEADWELL, PRESSURE TRANSDUCER
LH	PROPOSED HEADWELL RISER, PRESSURE TRANSDUCER

CELLS 14/16 FINAL COVER CONSTRUCTION QUANTITIES

Final Grading	10	AC
Leachate Head Monitoring Well	-	EA
Grading Layer	8,150	CY
Select Clay or Soil Barrier Layer	32,600	CY
GCL (if soil barrier layer is utilized)	440,000	SF
40-mil Geomembrane	440,000	SF
Geocomposite Drainage Layer	440,000	SF
Anchor Trench	1,600	LF
Rooting Zone Soil	40,750	CY
Slope and Toe Drain Pipe and Outlets	400	LF
Topsoil	8,150	CY
Seed, Mulch, Fertilizer, and Lime	10	AC

Note:
Volumes are in-place volumes. Quantities are subject to change based on in-field conditions at the time of construction.

NOTES:

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3. CONTOURS SHOWN IN THE LANDFILL ARE TOP OF FINAL COVER GRADES.

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we energies

CALEDONIA ASH LANDFILL PLAN OF OPERATION MODIFICATION

P.E. No.:	
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Drawn:	JLC
Designed:	JLC
GEI Project:	2203724

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NO.	DATE	ISSUE/REVISION	APP
1	9/29/2023	PLAN MOD	JXT

FINAL COVER GRADES

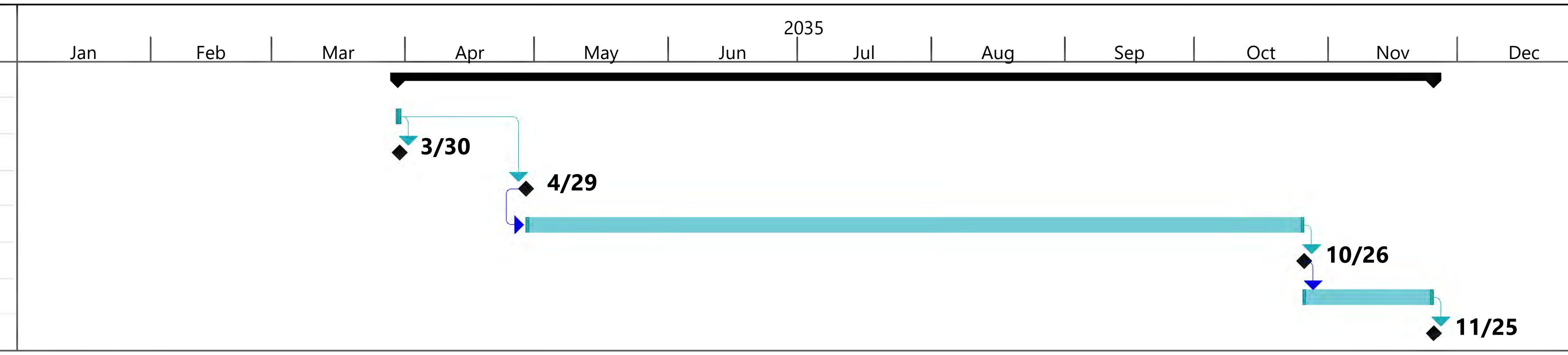
DWG. NO.
PM-12
SHEET NO.
12 OF 21

Appendix B

Cell 2 Preliminary Closure Schedule

Initial Closure Plan Schedule - Cell 2

ID	Task Name	Duration	Start	Finish
1	**Closure of Cell 2**	**241 days**	**Fri 3/30/35**	**Sun 11/25/35**
2	Ash Filling Ceases	1 day	Fri 3/30/35	Fri 3/30/35
3	Other Regulatory Permits - None	0 days	Fri 3/30/35	Fri 3/30/35
4	Notification of Intent to Close	0 days	Sun 4/29/35	Sun 4/29/35
5	Construction Activities	180 days	Sun 4/29/35	Thu 10/25/35
6	Notification of Closure Completion	0 days	Fri 10/26/35	Fri 10/26/35
7	Documentation	30 days	Fri 10/26/35	Sat 11/24/35
8	State Submittal - Documentation Report	0 days	Sun 11/25/35	Sun 11/25/35



Project: Closure Plan
Date: Wed 7/5/23

Task	Inactive Milestone	Manual Summary Rollup	External Milestone
Split	Inactive Summary	Start-only	Deadline
Milestone	Manual Task	Finish-only	Progress
Inactive Task	Duration-only	External Tasks	Manual Progress

Appendix M

Post Closure Care Plan

GEI Consultants

Consulting
Engineers and
Scientists

Regulation Compliance Report

Post-Closure Plan

Caledonia Ash Landfill,
Caledonia, Wisconsin

Submitted to:
WEC Energy Group
333 West Everett Street, A231
Milwaukee, Wisconsin 53203

Submitted by:
GEI Consultants, Inc.
3159 Voyager Drive
Green Bay, Wisconsin 54313
920-455-8200

September 2023, Revision 1

Project 2203724

John M. Trast, P.E., D.GE
Vice President/Senior Waste
Management Leader

Andrew J. Schwoerer, P.G.
Project Professional

Table of Contents

Tables

Revision History

Revision 0 – Original post-closure plan dated October 2016.

Revision 1 – Updated post-closure plan to comply with the updated NR 500 of the Wisconsin Administrative Code.

AJS:amp
K:\WEC Energy Group\1610530_We Energies Caledonia LF Engineering Assistance\In_Progress\CCR Post Closure\1610530 Caledonia LF CCR Post Closure Plan_October 2016.docx

1. Introduction

We Energies owns and operates a solid waste disposal facility on the Oak Creek Site in the NE 1/4 of Section 1, Township 4 North, Range 22 East, in the Village of Caledonia, Racine County, Wisconsin. The We Energies Caledonia Ash Landfill is regulated as an industrial waste landfill by the Wisconsin Department of Natural Resources (WDNR) under the provisions of Chapter 289 Wisconsin State Statues, and all applicable requirements of Chapters NR 500 of the Wisconsin Administrative Code. The design, construction, operation, closure, and post-closure care requirements are specified in the WDNR conditionally approved Plan of Operations, License No. 03232, FID No. 252108450.

In addition to the state regulations, the landfill is also required to comply with 40 CFR Part 257 Subpart D – *Standards for Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments* and is defined as a CCR unit and existing CCR landfill in accordance with §257.53. Future landfill cells are permitted by the WDNR in the conditionally approved Plan of Operation and defined as lateral expansions under § 257.53 when constructed.

This report fulfills the requirements for a written Post-Closure Plan for the Caledonia Ash Landfill in accordance with § 257.104 – *Post Closure Care Requirements* and NR 514.07 of the Wisconsin Administrative Code. In accordance with § 257.104(d)(1) and NR 514.07(10)(d), this report describes the monitoring and maintenance activities for the CCR unit, and the frequency at which these activities will be performed; provides the name, address, telephone number, and email address of the person or office to contact about the facility during the post-closure care period; and provides a description of the planned uses of the property during the post-closure period.

This post-closure plan includes the following sections:

Section 1 Introduction

Section 2 Post-Closure Narrative

Section 3 Conclusion and Certification

2. Post-Closure Narrative

This plan fulfills the requirements for a written Post-Closure Plan for the Caledonia Ash Landfill in accordance with § 257.104 – *Post Closure Care Requirements* and NR 514.07(10)(d).

Following the final closure of Caledonia Ash Landfill, We Energies will be responsible for the post-closure care of the facility. In accordance with NR 506.084(2)(a), the long-term care period for a CCR landfill is 40 years for purposes of record keeping and proof of owner financial responsibility and that monitoring, and maintenance of the landfill is required in perpetuity, unless an approval is granted by the department to discontinue monitoring after the 40-year long-term care period is completed. The post-closure care period is for a minimum of 40 years if the owner or operator is under detection monitoring. If the facility is in assessment monitoring, the post-closure care period is extended until the facility returns to detection monitoring.

In accordance with § 257.104(b) and NR 514(10)(d), We Energies is responsible for providing post-closure care and maintenance including: maintaining the integrity and effectiveness of the final cover system; making repairs to the final cover as necessary to correct the effects of settlement, subsidence, erosion, or other events; maintaining the leachate collection and removal system in accordance with NR 514.07(10)(d)1.c.; maintaining the groundwater monitoring system and monitoring the groundwater in accordance with the requirements of §§ 257.90 through 257.98 and NR 514.07(10)(d)1.d.; and complying with the recordkeeping requirements specified in § 257.105(i), the notification requirements specified in § 257.106(i), and the Internet requirements specified in § 257.107(i) during the post-closure period.

§ 257.104(d)(1)(i)/NR 514.07(10)(d)1.a. A long-term care schedule that includes activities specified in NR 514.06(11) is provided in the table below:

Monitoring and Maintenance	Frequency
Final Cover Vegetation Maintenance	Annually for first five years, every five years thereafter
Inspection of Stormwater Control Structures and Final Cover System	Annually
Final Cover Maintenance and Repairs	As needed, determined by annual inspection
Leachate Collection System Cleaning	Annually
Environmental Monitoring - Groundwater and Leachate	Semi-Annually

§ 257.104(d)(ii)/NR 514.07(10)(d)2. Post-closure period facility contact:

Mr. Eric P. Kovatch, P.G
WEC Energy Group
333 West Everett Street
Milwaukee, WI 53203
(414) 221-2457
eric.kovatch@wecenergygroup.com

§ 257.104(d)(iii)/NR 514.07(10)(d)3. During the post-closure care period, use of the landfill final cover area will be limited to green space or other activities that do not disturb the integrity of the final cover, base liner, or any other component of the containment, leachate collection, or groundwater monitoring systems.

2.1 Final Cover System Maintenance

Inspection of the final cover system is included in the annual inspection required under § 257.84(b). The annual inspection will note any final cover defects requiring repair.

Maintenance of the final cover will include repairs due to settlement, subsidence, erosion, or other events and regular mowing of the cover vegetation. Final cover system repairs necessitated due to settlement, subsidence, erosion, or other events will be completed as soon as practical. Actions should be taken as soon as practical to restore and protect areas that require maintenance and reestablish vegetation for erosion protection. Final cover repair and maintenance activities will be noted in the annual inspection report required under §257.84(b)(2) and NR 514.07(10)(d)1.b.

The final cover will be mowed at a minimum on an annual basis for the first five years to help establish a well-vegetated final cover and at a minimum once every five years thereafter, to inhibit the growth and presence of woody vegetation. Mowing on a more frequent basis may be required to accommodate more vigorous growth rate or to prevent the establishment of woody vegetation. Other techniques may also be employed to aid in the establishment of the desired vegetation and control of invasive grasses and woody vegetation, including selective herbicide applications and prescribed burning as a native prairie restoration practice.

2.2 Leachate Collection System

We Energies will be responsible for maintaining the effectiveness of the leachate collection and removal system and operating the leachate collection and removal system in accordance with the requirements of NR 504.12(3)(a). The leachate collection system will be annually jetted with a water jet cleanout device with a maximum pressure of 10,000 pounds per square inch from each access point to the toe of the opposite slope. A video camera inspection shall be conducted on all leachate collection pipes at 5 year intervals and shall extend a minimum of 300 feet onto the base grades of each leachate collection line. All blockages of the leachate collection pipe, pipe breaks, or any impedances shall be investigated. A summary report shall be submitted for each pipe cleaning and each video camera inspection event in accordance with NR 506.07(5)(g).

2.3 Ground Water Monitoring Network

We Energies will be responsible for maintaining the groundwater monitoring system and monitoring the groundwater in accordance with the requirements of §§ 257.90 through 257.98 and NR 514.07(10)(d)1.d. The groundwater monitoring network will be inspected on a semi-annual basis, in conjunction with the groundwater sampling. Any noted deficiencies, damage or required repairs will be completed as soon as practical but prior to the next sampling event. All groundwater monitoring will be completed in accordance with the facility's Groundwater Monitoring Plan for a minimum of 40-years post-closure care period. Provided the site is at detection monitoring at the conclusion of the 40-year post-closure care period, monitoring will cease. However, if groundwater monitoring is at assessment monitoring, groundwater monitoring will continue until monitoring returns to detection monitoring. All sampling and analysis will be completed in accordance with the facility's sampling and analysis plan.

3. Conclusion and Certification

We Energies owns and operates a solid waste disposal facility on the Oak Creek Site in the NE 1/4 of Section 1, Township 4 North, Range 22 East, in the Village of Caledonia, Racine County, Wisconsin. Caledonia Ash Landfill is required to comply with 40 CFR Part 257 Subpart D — *Standards for Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments* and NR 500 of the Wisconsin Administrative Code. This plan fulfills the requirements for a written Post-Closure Plan for the Caledonia Ash Landfill in accordance with § 257.104 - *Criteria for Conducting the Closure or Retrofit of CCR Units* and NR 514.07(10)(d), describing the monitoring and maintenance activities for the CCR unit, and the frequency at which these activities will be performed; provides the name, address, telephone number, and email address of the person or office to contact about the facility during the post-closure care period; and provides a description of the planned uses of the property during the post-closure period.

The Post-Closure Plan was completed under the direction of John M. Trast, P.E. I am a licensed professional engineer in the State of Wisconsin in accordance with the requirements of ch. A-E 4, Wisconsin Administrative Code; that this document has been prepared in accordance with the Rules of Professional Conduct in ch. A-E 8, Wisconsin Administrative 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 40 CFR Part 257 Subpart D and NR 500 of the Wisconsin Administrative Code.

John M. Trast, P.E., D.GE
Professional Engineer License No. 31792

WISCONSIN
JOHN
MATHEW
TRAST
37192-6
GREEN BAY
WISCONSIN
PROFESSIONAL ENGINEER
09/29/2023

Table 1 - Long-Term Care Cost Estimate
We Energies
Caledonia Ash Landfill
GEI Consultants, Inc.
September 29, 2023

Item	*Quantity*	*Unit*	*Unit Cost*[1]	*Total*
Cover Maintenance				
Erosion Repair, Fertilizer, Seed/Mulch	1.80	ac	6,000.00	$ 10,800.00
Mowing	9.00	ac	140.00	$ 1,260.00
Road/Site Access Maintenance	1.00	LS	2,000.00	$ 2,000.00
Monitoring System Maintenance				
Groundwater Montiroing Wells	0.68	ea	2,500.00	$ 1,700.00
Leachate Management System Maintenance				
Leachate Line Cleaning	6,500	lf	0.72	$ 4,680.00
Lift Pump Inspection	24	hr	140.00	$ 3,360.00
Leachate Pumping Electricity Costs	1	LS	1,325.00	$ 1,325.00
Pump Replacement[2]	0.10	ea	11,000.00	$ 1,100.00
Leachate/Condensate Hauling[3]	1,221.9	1000 gal	60.00	$ 73,314.00
Leachate/Condensate Treatment & Disposal[3]	1,221.9	1000 gal	30.00	$ 36,657.00
Site Inspections				
Inspection of Final Cover System - Semi-Annual	2	LS	3,000.00	$ 6,000.00
Groundwater and Groundwater Head Monitoring (Semi-Annual)				
Semi-annual Landfill Well Monitoring (22 wells - field parameters & analytical)	44	ea	231.79	$ 10,198.76
Piezometer Monitoring (Elevation)	4	ea	193.13	$ 772.52
Leachate Monitoring				
Leacahte Head Well Eelvation (Quarterly)	20	ea	13.02	$ 260.40
Leachate Sample Analysis (Semi-Annual)	2	ea	489.52	$ 979.04
Leachate Analysis for SVOCs (annual)	1	ea	281.40	$ 281.40
Sedimentation Basin Monitoring (Semi-Annual)				
Sedimentation Basin Analysis	2	ea	170.52	$ 341.04
Lab Report Generation / Mobilization				
EDD/Reporting	2	ea	60.00	$ 120.00
Mobilizations, travel, miles. S&H support, & misc exspenses	1	ea	4,000.00	$ 4,000.00

Summary	Number of Years	Annual Cost	Total Cost	
Land Surface Care	40	14,060.00	562,400.00	
Site Inspection Years	40	6,000.00	240,000.00	
Groundwater Monitoring	40	15,211.28	608,451.20	
Leachate Monitoring	40	1,260.44	50,417.60	
Leachate Hauling	40	73,314.00	2,932,560.00	
Leachate Treatment	40	36,657.00	1,466,280.00	
Leachate System Maintenance	40	10,465.00	418,600.00	
Leachate Head Monitoring	40	260.40	10,416.00	
Sedimentation Basin Monitoring	40	341.04	13,641.60	
Subtotal Long-Term Care Cost:		157,569.16	$ 6,302,766.40	**$ 6,303,000**
Contingency (10%)		15,756.92	630,276.64	
Total Annual Long-Term Care Cost:		173,326.08	6,933,043.04	**$ 6,933,000**

Notes

[1]Annual costs are in 2023 dollars.

[2]Assumes the leachate pumps will be replaced once throughout the duration of LTC.

[3]Leachate treatment volume is based on an estimated rate of one inch per year per acre.

Appendix N

Construction Quality Assurance Plan

GEI Consultants

Consulting
Engineers and
Scientists

Construction Quality Assurance Plan Update for the Caledonia Landfill

Caledonia, Wisconsin

Submitted to:
WEC Energy Group
333 West Everett Street
Milwaukee, Wisconsin 53203

Submitted by:
GEI Consultants, Inc.
3159 Voyager Drive
Green Bay, Wisconsin 54311
920.455.8200

September 29, 2023
Project 2203724

Andrew J. Schwoerer, P.G.
Project Professional

John M. Trast, P.E., D.GE
Vice President/Solid Waste Leader

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K:\WEC Energy Group\2203724_WEC CCR Landfill Permitting\05_In_Progress\Caledonia Plan of Operation\Appendix N - CQA Plan_GEI Format.docx

1. Introduction

1.1 Summary

This Construction Quality Assurance (CQA) Plan has been prepared for, and is included in, the Plan of Operation Modification submittal for Caledonia Ash Landfill. This CQA Plan is intended to be a "working" document, in other words, one that is updated to reflect changes in specific materials, installation practices, industry standards, or tests and testing methods as the site develops. This plan is to be followed during construction to monitor and confirm that the base liner and final cover systems are installed accordance with the Manufactures recommendations, Engineers design, the Plan of Operation Modification Approval, and Chapters NR 500 of the Wisconsin Administrative Code.

1.2 Purpose and Scope

The purpose of the CQA program is to provide minimum requirements for construction observation, testing, and documentation activities for the base liner and final cover systems to be performed and to verify that the constructed facility meets or exceeds design requirements, specifications, and regulatory and local approvals. The plan outlines sampling and testing programs to be carried out during construction. Testing and acceptance criteria are based on Chapter NR 500, Wisconsin Administrative Code, requirements where applicable. Geosynthetics testing and acceptance criteria are based on the Geosynthetic Research Institute (GRI) Standards, American Society for Testing and Materials (ASTM) and on current acceptable industry standards and practice. The primary goal of the CQA plan is to provide a means of evaluating the quality of the constructed facility, so that the intent of the design is met.

The CQA Plan addresses the construction of the following systems within the landfill facility:

- Composite liner
- Leachate collection system (LCS)
- Leachate transfer system (from landfill collection manholes to leachate collection tank)
- Composite final cover
- Storm water management system
- Access and maintenance roads

The following sources were used in the development of this Plan:

- EPA Technical Guidance Document, EPA/530-SW-86-031, titled "Construction Quality Assurance for Hazardous Waste Land Disposal Facilities"
- EPA Technical Guidance Document, EPA/530-SW-86-007, titled "Design, Construction, and Evaluation of Clay Liners for Hazardous Waste Facilities"
- Geosynthetic Research Institute, "GRI Test Method GN 4," revision 4 – 7/9/2020
- Geosynthetic Research Institute, "GRI Test Method GM 12a," revision 2 – 3/3/16
- Geosynthetic Research Institute, "GRI Test Method GM 13," revision 16 –3/17/2021
- Geosynthetic Research Institute, "GRI Test Method GM 17," revision 14– 3/17/2021
- Geosynthetic Research Institute, "GRI Test Method GM 19a," revision 10 – 3/18/2021
- American Society of Testing and Materials, *Annual Book of ASTM Standards*.
- Chapter NR 500, Wisconsin Administrative Code.

1.3 Design Summary

In general, the design of Landfill consists of a perimeter containment dikes, a composite liner system, leachate collection and transfer system, and a geosynthetic final cover system.

The base grades of the landfill consist of 3H:1V perimeter sideslopes; the floor slopes toward the leachate collection pipes at a 3 percent grade, and at a 1 percent grade to the east. Leachate collection trenches are spaced 200 feet apart. The slope of the base and the leachate collection pipe spacing results in a flow distance of approximately 100 feet.

The base liner system will be a composite liner system consisting of a 3-foot compacted clay layer, plus an additional 1-foot of compacted clay if a subbase investigation and material replacement is not performed, and a 60-mil textured high-density polyethylene (HDPE) geomembrane. A 12 ounce per square yard non-woven geotextile cushion layer will be installed over the floor. A double-sided geocomposite drainage layer will be installed in the leachate collection trenches. The leachate collection system will consist of a network of perforated HDPE pipe installed in trenches spaced 200 feet apart along the floor of the cell. The pipe trenches will be backfilled with gravel and covered with a coarse sand filter layer. A 1-foot-thick granular drainage layer will be placed over the entire landfill base and perimeter side slopes.

The final waste grades of the landfill are 4H:1V perimeter sideslopes and a 4 percent slope on the landfill top. The final cover system will consist of a 6-inch grading layer, 2-foot compacted barrier layer, a geosynthetic clay liner (if soil is used in the barrier layer), textured 40-mil linear low density polyethylene (LLDPE) geomembrane, a geocomposite drainage layer, a 2.5-foot of rooting zone layer and 6 inches of topsoil.

2. Responsibility and Authority

2.1 Permitting Agencies

The Wisconsin Department of Natural Resource (WDNR) has the regulatory authority for approval or denial of the development and operational permits required for the landfill facility. Other agencies could be involved with construction and will be identified on a project-specific basis at the preconstruction meeting.

2.2 Facility Owner/Operator

We Energies is responsible for the design, construction, and operation of the facility in compliance with the regulatory requirements.

2.3 Design Engineer

The Design Engineer (Engineer) has the responsibility of designing the landfill to meet the permitted design and operational requirements of the WDNR and We Energies.

2.4 Construction Contractor

The Contractor is responsible for construction of the landfill as indicated on the construction drawings and technical specifications. The Contractor may implement their own construction quality control (CQC) program for purposes of monitoring their construction. The CQA program presented in this document provides the minimum standards for the acceptance of the work.

2.5 Construction Quality Assurance Officer

The CQA Officer is a designated representative of We Energies. The CQA Officer will be a professional engineer registered in the state of Wisconsin with experience associated with landfill construction and the geosynthetic components of the landfill liner and final cover systems. The CQA Officer is responsible for supervising all quality assurance (QA) requirements of this section. The CQA Officer is also responsible for the preparation of the construction documentation reports following each phase of construction.

The responsibilities for administering the QA program are the responsibility of the CQA Officer and include the following:

- Reviewing plans and specifications for clarity and completeness.

- Educating and training QA personnel on requirements and procedures outlined in the program.
- Scheduling and coordinating QA activities.
- Supervising field personnel.
- Confirming that QA data are accurately recorded and maintained.
- Verifying that raw QA data are properly recorded, reduced, summarized, and interpreted.
- Providing associated organizations with reports on CQA activities and results.
- Identifying non-conforming construction and verifying corrective measures are implemented.

2.6 Construction Quality Assurance Technician(s) (CQAT)

The CQAT(s), under the direct supervision of the CQA Officer, shall be present to perform observations and testing during the following construction activities:

Base Liner Construction

- Confirmation of the top 5-feet of subgrade for fine grained soils.
- Subgrade preparation and structural fill placement.
- Installation of the compacted clay layer.
- Installation of the textured 60-mil polyethylene geomembrane.
- Installation of 12 oz/sy geotextile cushion layer
- Installation of the geocomposite drainage layer
- Installation of the leachate collection pipes, pipe bedding gravel, and filter sand.
- Placement of 1-foot-thick granular drainage layer.
- Installation of the leachate collection and transfer manhole.
- Installation of the double encased leachate transfer line.
- Site restoration.

Final Cover Construction

- Final waste grading.
- Installation of the 6-inch grading layer.
- Installation of the compacted clay or soil barrier layer.

- Installation of a geosynthetic clay liner (GCL) if soil is used in the barrier layer
- Installation of the textured 40-mil polyethylene geomembrane.
- Installation of the geocomposite drainage layer or granular drainage material.
- Installation of the drainage piping and outlets.
- Installation of the rooting layer.
- Installation of topsoil layer.
- Site restoration.

2.7 Geosynthetics Installer

The Geosynthetics Installer is the company hired by the Construction Contractor or Owner to install the geosynthetic components referenced in this manual and to perform the nondestructive seam testing of the geomembranes as required by this Plan. The term ″Installer″ is used throughout this Plan when reference is made to the tasks and responsibilities of a Geosynthetics Installer.

The Installer will be trained and qualified to install the various geosynthetic components covered by this Plan. The Installer of the geomembranes will be approved and/or licensed by the Manufacturer.

Prior to confirmation of any contractual agreements, the Installer of the geosynthetics will provide the CQA Officer and/or Owner with the following written information, which must be approved by the CQA Officer and/or the Owner:

- Corporate background and information.
- Installation capabilities, including the following:
  - Information on equipment and personnel
  - Resumes of personnel
  - Daily anticipated production
  - Quality control manual for installation
- A list of at least 10 completed facilities, totaling a minimum of 2,000,000 square feet for which the Installer has completed the installation of polyethylene geomembrane. For each installation, the following information will be provided:
  - Name and purpose of facility, its location, and date of installation
  - Name of owner, project manager, designer, manufacturer, and fabricator (if any)

- Thickness and type of polyethylene geomembrane and the surface area of the installed geomembrane

The Installer will provide a copy of the field tensiometer certification, indicating the date in which the tensiometer was calibrated prior to the start of any seaming operations. The Installer is responsible for delays caused to the project until tensiometer certification is delivered to the CQAT.

Tensiometers used in the state of Wisconsin are required to be calibrated within 3 months prior to the start of geomembrane installation. The Installer is responsible for meeting this requirement, and must supply a copy of the certification at the time of mobilization to the job site.

All personnel performing geomembrane seaming operations will be qualified by experience or by successfully passing seaming tests for the seaming methods to be used. At least one seamer will have experience in seaming a minimum of 2,000,000 square feet of polyethylene geomembrane using the same type of seaming apparatus in use at the site. The most experienced seamer, the ″master seamer,″ will provide direct supervision, as required, over less experienced seamers. No field seaming will take place without an experienced seamer (meeting the seaming criteria stated above) being present.

The Installer will provide the CQA Officer with a list of proposed seaming and testing personnel, and their professional records, prior to installation of the geosynthetics. This document will be reviewed by the CQA Officer. Any proposed seaming personnel deemed insufficiently experienced will not be accepted by the CQA Officer and/or the Owner.

The Installer will designate one representative as the Superintendent, who will represent the Installer at all site meetings and who will be responsible for acting as the Installer's spokesperson on-site. This Superintendent will be prequalified for this role on the basis of experience, management ability, and authority.

3. Meetings

The meeting requirements for the CQA program include a preconstruction meeting, construction progress meetings, and special meetings. The meetings are to be documented by a designated secretary, and minutes will be transmitted to all parties.

3.1 Preconstruction Meeting

A preconstruction meeting will be held prior to the start of construction and shall be attended by all principle parties (We Energies, Contractor, CQA officer) involved in the project. The WDNR will be notified as soon as possible in advance of the preconstruction meeting, in the event a representative wishes to attend. The purpose of the meeting is to:

Exchange the following information: business addresses, phone numbers, fax numbers, e-mail addresses, and pager numbers of the Owner, Engineer, CQA Officer, and pertinent personnel for the construction contractor.

- Resolve any uncertainties following the award of the construction contract.
- Review work scope.
- Conduct a site walkover and inspection.
- Discuss the construction contractor’s overall construction schedule and anticipated work hours.
- Discuss project administration.
- Review status of submittals required to be transmitted.
- Discuss any appropriate design modifications or clarifications.
- Discuss the construction contractor’s surface water and dust management plan.
- Discuss the schedule and procedures of the geomembrane installation.
- Discuss owner’s emergency notification and operating practices for emergency situations.
- Review project methods, site security, and safety.

3.2 Progress Meetings

A progress meeting shall be held prior to the beginning of each major phase or on an “as needed” basis. The day of week and time of day will be determined and agreed upon by all parties prior to the meeting. The meeting will be conducted by the engineer. The purpose of the meetings will be to:

- Review coordination of work.
- Review schedule to expedite the work.
- Review the previous work activities and accomplishments.
- Review the status of the construction contractor's submittals.
- Review the construction contractor's progress report.
- Identify the construction contractor's personnel and equipment assignments for the up-coming work.
- Discuss any existing or potential construction problems and their respective corrective actions.

3.3 Preinstallation Submittal

A preinstallation report will be prepared for each phase of construction of the composite liner and each phase of the composite final cover. The preinstallation report will be submitted to the WDNR no later than 15 days prior to the preinstallation meeting (refer to Subsection 3.4). The preinstallation report will include the information required under s. NR 516.04(5), including the following items:

- Any revisions and detail diagrams incorporating all changes between the owner, installer, and the quality assurance contractor.
- Identification of the manufacturer of the geosynthetics used in construction, manufacturer qualifications, technical specifications for each item, and results of the manufacturer's quality control tests for products supplied to the project.
- Results of a shear test conducted, in accordance with ASTM D5321 on the soils and geosynthetic materials selected for use in construction of the liner and the final cover.
- A Quality Control Plan which provides all information specified in s. NR 514.07(1)(i), as well as the identification of the installation contractor, contractor qualifications, and on-site supervisory staff.
- A Quality Assurance Plan which provides all information specified in s. NR 514.07(1)(j), as well as identification of the professional engineer and qualified technician who will be providing quality assurance and a summary of their qualifications and related work experience.

3.4 Preinstallation Meeting

Prior to commencement of the installation of the geomembrane component for each phase of construction of the composite liner and final cover, a preinstallation meeting will be held in accordance with s. NR 516.04(4). This meeting will include the parties involved in the construction, including the appropriate WDNR district and central staff, the CQA Officer or designated representative, the CQAT, the Construction Contractor, the Geosynthetic Installer, and the Owner.

The purpose of this meeting is to begin the planning and coordination of geosynthetic installation tasks, identify potential problems that might cause difficulties and delays in construction, to properly interpret the design intent, and to present the CQA Plan to all of the parties involved. It is important that the requirements regarding testing, seaming, repairs, etc., be known and accepted by each party to this Plan.

Specific topics considered for this meeting include the following:

- Review the proposed panel layouts and critical design details involving geosynthetic installation.
- Review measures for storm water controls and pumping requirements.
- Clarify or confirm design changes.
- Confirm acceptability of selected geosynthetic materials.
- Clarify construction concepts or practices required by the approved plans and preinstallation submittal.
- Review the responsibilities of each party.
- Review lines of authority and communication.
- Review methods for documenting and reporting, and for distributing documents and reports.
- Review requirements of geosynthetics testing laboratory regarding sample size, method of collection, and shipment. Also review turn times for sample data and their implications on the construction schedule, pending receipt of acceptance data.
- Review the number and locations of the tests required for geosynthetic components.
- Review methods of clay layer surface preparation and approval prior to geosynthetics placement.
- Establish rules for writing on the geosynthetic (i.e., who is authorized to write, what can be written, and in which color), and outline procedures for packaging and storing archive samples.

- Review geosynthetics panel and seam layout diagrams and numbering systems.
- Establish procedures for use of the geomembrane welding apparatus, if applicable.
- Finalize field cutout sample sizes.
- Review geosynthetic repair procedures.
- Establish procedures for the deployment of materials over prepared sub-grade and installed geosynthetics emphasizing protection of the geosynthetics. Specific discussion will address deployment of select granular or aggregate fill drainage materials on the sidewalls.
- Review the construction schedule.
- Review survey requirements.

The CQA Officer and/or the Owner will document this meeting, and minutes may be distributed to parties involved in the construction project.

3.5 Special Meetings

Special meetings will be called at the discretion of the owner, engineer, or contractor to resolve problems or other work-related issues.

4. Construction Observations

4.1 Daily Reports

The CQAT(s) collects all of the samples and performs the majority of the QA testing required by the CQA Plan. A daily inspection report is prepared by each CQAT for each day of activity and kept in a record book, which is to be made available to the owner on a daily basis. The report will contain (at a minimum) the following information:

- Date.
- Type of observations.
- Summary of weather conditions.
- Summary of any meetings held and attendees.
- Equipment and personnel on the project.
- Summary of construction activities and locations.
- Description of off-site materials received.
- Calibration and recalibration of test equipment.
- Description of procedures used.
- Test locations, procedures, results, and test data sheets.
- Summary of samples collected.
- Personnel involved in daily observations and sampling activities.
- Signature of the technician.
- Description of delays in construction activities.
- Detailed description of any problems or non-conforming construction and resolution/alternatives for each situation.
- Approximate quantities completed each day (approximate volume of fill placed, area of subgrade prepared, square footage of geosynthetics placed, etc.).
- Site Visitors, names, times, and reason.

4.2 Photographs

Dated photographs will be taken for all items of construction. A sufficient number of photographs will be taken to document the construction of each construction item. Each photograph will be recorded in a Photo Log showing roll number, photo number, date taken, and description.

Construction problems and non-conforming work will be documented with photographs taken before and after the problem or non-conforming work is corrected. At the end of the project, one set of photos will be given to the owner.

4.3 Test Data Sheets

The CQAT will record all field test data results on the test data sheets provided in Appendices A through K. Independent consultants or laboratories engaged by the CQA Officer shall submit their test results on forms acceptable to and approved by the CQA Officer.

4.4 Documentation and Record Storage

The daily records maintained during construction activities include, but are not limited to the following:

- Daily observation reports.
- Test data sheets.
- Test data from independent consultants or laboratories (if any).
- Field book maintained by each CQAT.
- Daily records shall be copied and forwarded to the CQA Officer on a daily basis.

4.5 Surveying

Documentation surveying requirements for each composite liner or cover component are described in their respective report sections. Required surveying will be performed by personnel experienced in construction surveying. Surveys will be based on survey control points previously established at the site. Elevations will be based on mean sea level (M.S.L.) datum, and coordinates will be based on the site-specific horizontal control. The location of field tests and samples will be recorded. Generally, these locations can be determined by reference to nearby construction stakes or markings. However, if such convenient reference is not readily available, the CQA Officer or the designated CQAT will be responsible for providing or requesting survey control.

5. Earthwork Observations and Testing

The following section summarizes the quality assurance plan proposed for testing and monitoring of the soil components of the landfill cell construction.

5.1 Compacted Select Clay Fill

This section includes the quality assurance requirements for placement, backfilling, and compaction of select clay fill. Compacted select clay fill will be used in the following manner:

- Constructing the landfill liner
- Constructing the final cover unless the select clay fill is replaced by a GCL overlying a minimum 2-feet-thick soil barrier layer.

Field tests and soil sample types will be recorded in the daily construction reports (refer to Subsection 4.2) including locations (by coordinates or survey point reference number) and elevation or lift number of field tests and laboratory sample points.

5.1.1 Procedures and Observation

The CQAT will observe compacted select clay fill construction activities and will document relevant observations to support certification of the following requirements:

- The CQAT will confirm the subbase is acceptable and ready for select clay fill placement prior to placement of select clay fill over the subbase. Procedures for determining subbase acceptance are discussed in Subsection 5.2.
- The CQAT will confirm the uniformity of the excavated soil to be used as select clay fill. Soil placement will be monitored for segregation and removal of unsuitable material and for changes in soil type, color, texture, and moisture content.
- The Construction Contractor will segregate and/or remove unsuitable materials such as granular soil, silty or sandy clay not meeting acceptance criteria, boulders, cobbles, organic material, and other deleterious material.
- The CQAT will observe clay placement and will measure field densities and moisture contents, using methods described in Subsection 5.1.2 (Sampling Requirements and Acceptance Criteria), to document that the compacted clay liner and cover are in substantial conformance with the placement specifications and that soil placement has been conducted in a manner to achieve a uniform, homogeneous clay mass.
- Voids created by nuclear density gauge (NDG) probes or as the result of Shelby tube samples will be backfilled with granular bentonite.

- Areas of unacceptable permeability, density, or moisture content, as defined by Subsection 5.1.2 (Sampling Requirements and Acceptance Criteria), will be documented by the CQAT. Corrective action will consist of moisture-conditioning of the soil and/or additional compactive effort as necessary. Methods for moisture-conditioning soil are described below. Following corrective actions, such areas will be retested.
- If necessary, surfaces of liner or cover to receive successive lifts of clay will be moisture-conditioned either by scarification and addition of water where desiccated, or by discing and air drying where saturated to promote effective bonding of lifts. Following scarification, water will be applied with a spray bar applicator or equivalent method to achieve uniform distribution.
- The Contractor will place barrier layer material in maximum 6-inch compacted lifts.
- The CQAT will verify that compaction equipment has a minimum static weight of 30,000 pounds or has a minimum static weight 15,000 pounds that is capable of vibrating to produce a minimum dynamic compaction force of 30,000 pounds.
- The CQAT will verify that compaction equipment used to compact the clay layer has compaction feet a minimum of 6 inches long and that a sufficient number of equipment passes have been conducted to ensure complete remolding of the clay.
- Clay placement will be performed in a manner to achieve continuous and complete keying together of clay liner and cover construction areas. Stepped joints will be utilized to connect lateral segments of clay liner construction, as shown on the construction plan details.
- No frozen soil will be used for select clay fill liner or cover construction. Frozen soil in the compaction work area will be removed or allowed to melt prior to compaction.
- Stones and other penetrating objects 2 inches or larger and stones with sharp edges or points protruding from the surface of the final lift of compacted select clay fill will be removed to avoid puncturing the geomembrane. The CQAT will observe the liner or cover during this process and will document the removal of stones and other objects by the Contractor. Voids made by the removal of stones will be filled with clay soil or bentonite, and the entire liner surface will be rolled with a smooth-drum compactor.
- Preconstruction planning will be undertaken to sequence construction activities to minimize the length of time any completed clay surface will be exposed prior to receiving protective cover. Protective cover will be provided by the installation of the geomembrane.

5.1.2 Sampling Requirements and Acceptance Criteria

Field and laboratory sampling frequencies are based on the area or volume of material placed, as specified in s. NR 516.07. This section describes the required analyses, methods, sample frequencies, and acceptance limits. The CQAT will perform field tests and will collect soil samples for laboratory analysis.

5.1.2.1 Field Testing

The following field testing methods will be used by the CQAT during construction:

PARAMETER	METHOD
Soil density/Moisture content	ASTM D6938

Field density and moisture content tests will be performed on a 100-foot grid pattern for each 1-foot thickness of compacted select clay fill placed. The testing pattern will be offset on alternate lifts. In confined areas where compaction equipment is hindered or hand compaction is necessary, a minimum of two field density and moisture content tests will be performed for each 1-foot thickness of clay placed.

5.1.2.2 Field Testing Acceptance Criteria

Acceptance criteria for field density will require soil compaction to a minimum of 90 percent of the Modified Proctor (ASTM D1557) maximum dry density, or a minimum of 95 percent of the Standard Proctor (ASTM D698) maximum dry density. Moisture content requirements will be at least 2 percent wet of optimum if using the Modified Proctor, and at least wet of optimum if using the Standard Proctor, in accordance with s. NR 504.06(2)(f)(3). The acceptable range will be based on Proctor moisture-density relationships and compaction versus permeability relationships.

5.1.3 Laboratory Testing

Routine laboratory testing of the clay liner soil will be performed on samples from the clay borrow area and on the in-place clay soil samples collected by the CQAT. Samples for determining in-place properties will be collected by pushing Shelby tubes. Soil characteristics will be determined from representative samples and from Shelby tube samples.

5.1.3.1 Undisturbed Sample Analysis

One undisturbed sample will be taken for each acre or less for every 1-foot thickness of clay placed and will be submitted to the Soil Testing Laboratory.

The following analyses will be performed on all undisturbed samples obtained:

PARAMETER	TEST METHOD
Moisture content and dry density	ASTM D2216
Atterberg limits	ASTM D4318

Grain-size analysis	ASTM D6913

One of every three undisturbed samples will also be analyzed for hydraulic conductivity as follows:

PARAMETER	TEST METHOD
Hydraulic conductivity	ASTM D5084 or SW 846 EPA Method 9100

5.1.3.2 Representative Sample Analysis

Representative (grab) samples will be obtained on the basis of three criteria. First, an initial sample will be obtained from the clay borrow source (if not used in construction of a prior phase) and analyzed prior to construction. This will confirm soil characteristics and provide an initial maximum dry density and optimum moisture content for field moisture/density testing. Second, routine samples will be obtained for every 5,000 cubic yards placed. Third, in the event that changes in physical appearance or soil characteristics are observed, a sample will be obtained and analyzed. The maximum dry density and optimum moisture content values used for compaction testing may be adjusted during the course of liner and cover construction based on the results of the above sampling.

The following laboratory analyses will be performed on all representative samples obtained:

PARAMETER	TEST METHOD
Moisture-density relationship using Modified/Standard Proctor compaction	ASTM D1557 [a, b]/ ASTM D698 [a, b]
Atterberg limits	ASTM D4318
Grain-size analysis	ASTM D6913[c]

Notes:
[a]Five-point Proctor analysis required for first and second sampling criteria.
[b]A one-point Proctor analysis may be utilized for representative samples collected for the third sampling criterion (apparent changes in soil quality) to verify applicability of previously analyzed moisture-density relationships. If the result does not verify applicability, then a five-point analysis will be performed in accordance with the first sampling criterion.
[c]Distribution is to be reported through the 0.002-mm particle size.

5.1.3.3 Laboratory Testing Acceptance Criteria

The following acceptance criteria will apply to the compacted select clay fill.

- A minimum 50 percent by weight that passes the #200 sieve
- A saturated hydraulic conductivity of 1×10^{-7} cm/s or less, when compacted to required moisture contents and densities based on the modified Proctor method, standard Proctor method, or a line of optimums method approved by the WDNR.

- No clods greater than 4 inches.
- An average liquid limit of 25 or greater, with no values less than 20
- An average plasticity index of 12 or greater, with no values less than 10

5.1.4 Thickness Documentation

The bottom and top of the clay liner portion of the composite liner will be surveyed on a 50-foot grid pattern (same location for the top and bottom of the clay liner) and at other key location (breaks in slope, toe of slopes, top of slopes, limit of liner construction, etc.) to determine that minimum as-constructed clay liner thicknesses were achieved.

The bottom of the final cover select clay fill layer will be surveyed on a maximum 100-foot grid pattern (maximum 50-foot grid pattern if the final cover construction is less than 4 acres) and at key locations for final cover.

In the alignment for leachate collection lines, bottom and top of the clay liner elevation of the trench will be surveyed at maximum 25-foot intervals (maximum 50-foot intervals if a total station, laser equipment, or survey quality global positioning system equipment is used). The clay liner and cover thicknesses will be determined at surveyed locations or cover auger locations and reported in a tabular fashion. The minimum acceptable liner/cover thickness will be as indicated on the Plan of Operations drawings and details.

5.2 General Fill

This section includes the quality assurance requirements for placement, compaction, and grading of general soil (i.e., general fill). General soil may be any inorganic soil. General soil will be used in the construction of the following landfill components:

- Subbase preparation
- Final cover
- Access roads
- Landfill perimeter berms

All field tests, soil sample types, and survey measurements will be recorded as record construction data, including locations (by coordinates) and elevations or lifts of field tests and laboratory sample points.

5.2.1 Procedures and Observation

The CQAT will observe general soil placement activities and will document relevant observations to support certification of the following requirements:

- The CQAT will periodically observe loads of general fill for general conformance to material specifications and may randomly sample loads. The CQAT will perform routine conformance sampling as defined in Subsection 5.2.2.
- No frozen soil will be used for backfilling. Any frozen soil in the compaction work area will be removed.
- Loose lift thickness for general soil compaction will not exceed 18 inches.
- General soil used as structural fill (i.e., subbase preparation, perimeter landfill berms and roads) will be compacted to a minimum of 90 percent or 95 percent of the maximum dry density as determined by the Modified or Standard Proctor test, respectively.
- Unacceptable compaction density, as defined above, will be reported to the CQA Officer by the CQAT. Corrective action will consist of moisture-conditioning of the soil and/or additional compactive effort, as necessary.
- The CQAT will confirm the subbase is acceptable and ready for select clay fill placement prior to placement of select clay fill over the subbase. The CQAT will notify the Engineer of any soft appearing areas of the subbase during subbase development and prior to select clay fill placement.

Field densities using methods described in Subsection 5.2.2 will be measured to document that the in-place soil is in substantial conformance with the required density.

5.2.2 Sampling Requirements and Acceptance Criteria

Testing is required for general soil used as structural fill (recompacted soil used in subgrade and berm construction). No field or laboratory testing of general soil will be required for placement in the final cover. Sampling and testing of structural fill will be conducted in accordance with NR 516.07(1m)

5.2.2.1 Field Testing

The following field testing method will be used by the CQAT during construction:

PARAMETER	TEST METHOD
Soil density/Moisture content	ASTM D6938

Field density and moisture content tests will be performed on a 100-foot grid pattern as much as reasonably possible for each 1-foot thickness of compacted structural fill placed or at a minimum frequency of one test per 370 cubic yards of structural fill placed. The testing pattern will be offset on alternate lifts as much as reasonably possible. In confined areas where compaction equipment is hindered or hand compaction is necessary, a minimum of two field density and moisture content tests will be performed for each 1-foot thickness of structural fill placed.

5.2.2.2 Field Testing Acceptance Criteria

Acceptance criteria for field density will require soil compaction to a minimum of 90 percent of the Modified Proctor (ASTM D1557) maximum dry density, or a minimum of 95 percent of the Standard Proctor (ASTM D698) maximum dry density.

5.2.3 Laboratory Testing

Routine laboratory testing of the structural fill will be performed on representative samples collected from the general fill borrow area and/or general fill stockpiles. Soil characteristics will be determined from representative samples.

5.2.3.1 Representative Sample Analysis

Representative (grab) samples of the structural fill will be obtained at a minimum frequency of one sample for every 5,000 cubic yards placed and a sample will be collected in the event that changes in physical appearance or soil characteristics are observed. The maximum dry density values used for compaction testing may be adjusted during the course construction based on the results of the above sampling.

The following laboratory analyses will be performed on all representative samples obtained:

PARAMETER	TEST METHOD
Moisture-density relationship using Modified or Standard Proctor compaction	ASTM D1557 [(a)]/ ASTM D698 [(a)]
Atterberg limits[(b)]	ASTM D4318
Grain-size analysis[(c)]	ASTM D6913

Notes:
[(a)]A one-point Proctor analysis may be utilized for representative samples collected for the third sampling criterion (apparent changes in soil quality) to verify applicability of previously analyzed moisture-density relationships. If the result does not verify applicability, then a five-point analysis will be performed in accordance with the first sampling criterion.
[(b)] Atterberg limits are only applicable when the sample is fine grain soil.
[(c)]Distribution is to be reported through the 0.002-mm particle size.

5.2.3.2 Laboratory Testing Acceptance Criteria

There are no laboratory acceptance criteria for general fill.

5.2.4 Thickness Documentation

Top of subbase grades will be documented on an approximate 50-foot grid, and at other key locations, such as breaks in grade, toes of slope, mid-points, and tops of slopes. In the alignment for leachate collection undercuts, the bottom of trench undercut elevations will be surveyed at maximum 25-foot intervals (maximum 50-foot intervals if total station, laser equipment, or survey grade global positioning system equipment is used). The allowable tolerance in subbase elevation will be -0.1 foot or as allowed by the CQA Officer.

The top of the grading layer elevations in the final cover will be surveyed on an approximate 100-foot grid pattern (50-foot grid pattern on final cover areas less than 4 acres), and at other key locations, such as breaks in grade and toe of slopes. The top of grading layer elevations will be at or below the approved design grades prior to final cover construction.

The rooting zone thickness of the final cover will be measured on an approximate 100-foot grid (50-foot on final cover areas less than 4 acres), and at other key locations, such as breaks in grade and toes of slopes.

In addition to survey measurements for elevation, measurements for horizontal location will also be performed using previously established horizontal control to document the boundaries and alignment of the general soil placement.

5.3 Compacted Barrier Layer

This section includes the quality assurance requirements for placing, backfilling, and compacting the barrier layer soil in the final cover system if the barrier layer option for the final cover is used. The 24-inch–thick soil barrier layer will consist of fine-grained soil or well graded sand with fines.

5.3.1 Subgrade Preparation

The Contractor will be responsible for the preparation of the subgrade of the barrier layer. Subgrade preparation will include grading the top-of-waste.

The CQA Officer or CQAT will inspect the subgrade, upon completion of the grading work and will verify, at a minimum, the following:

- A qualified surveyor has verified lines and grades as described in Subsection 5.4.
- The grading layer meets the criteria in the project specifications.

The CQAT will indicate to the Contractor any observed locations that are not adequate for the placement of the barrier layer during final cover construction. The Contractor will repair defects in the subgrade soil such that the properties of the repaired areas meet the minimum subgrade requirements.

5.3.2 Procedures and Observations

The CQAT will observe and document barrier layer construction activities to support certification of the following requirements:

- The CQAT will confirm the uniformity of the barrier layer soil and will monitor for segregation and removal of unsuitable material and for changes in soil type, color, texture, and moisture content. The Contractor will segregate and/or remove unsuitable materials, such as soil not meeting acceptance criteria, boulders, cobbles, and organic material.
- The CQAT will observe the barrier layer placement and will measure field densities and moisture contents (refer to Subsection 5.3.3.), to document that the barrier layer is in substantial conformance with the specifications and that soil placement has been conducted in a manner to achieve a uniform, homogeneous mass.
- The CQAT will backfill with granular bentonite, or a bentonite-soil mixture, voids created by nuclear density gauge probes.
- The CQAT will document areas of unacceptable density or moisture content, as defined by Subsection 5.3.3. The Contractor will perform corrective action that will consist of the moisture-conditioning of the soil and/or additional compactive effort, as necessary. The CQAT will retest the area, following corrective actions.
- The Contractor will place soil barrier layer material in maximum 1-foot lifts.
- The CQAT will verify that compaction equipment has a minimum static weight of 30,000 pounds or has a minimum static weight 15,000 pounds that is capable of vibrating to produce a minimum dynamic compaction force of 30,000 pounds.
- The CQAT will verify that compaction equipment used to compact the barrier layer has compaction feet a minimum of 6 inches long.
- The Contractor will not use frozen soil in the barrier layer and will remove frozen soil from the compaction work area.
- The barrier layer should be free of any angular particles protruding from the surface greater than 0.5 inches, sharp breaks in grade or excessive rutting greater than 0.2 feet. The CQAT will document the removal of the stones and other objects. The Contractor will fill with barrier layer soil or bentonite any voids made by the removal of stones, and the entire cover surface will be rolled with a smooth-drum compactor.

5.3.3 Sampling Requirements and Acceptance Criteria

5.3.3.1 Field Testing

The CQAT will use the following field-testing methods during construction of the barrier layer:

PARAMETER	TEST METHOD
Soil density/Moisture content	ASTM D6938

Moisture content and field density tests will be performed in accordance with NR 516.07(2m)(b)(1) using a nuclear density gauge on a 100-foot grid pattern for each 1-foot thickness of barrier layer soil placed. The testing grid pattern will be offset on each subsequent layer of tests. In confined areas where compaction equipment is hindered or hand compaction is necessary, a minimum of two field density and moisture content tests will be performed for each 1-foot thickness of barrier layer soil placed.

5.3.3.2 Field Testing Acceptance Criteria

Acceptance criteria for field density will require soil compaction to a minimum of 90 percent of the Modified Proctor (ASTM D1557) maximum dry density or to a minimum of 95 percent of the Standard Proctor (ASTM D698) maximum dry density and at a moisture content wet of optimum moisture content.

5.3.3.3 Laboratory Testing

Routine laboratory testing of the barrier layer soil will be performed on samples from the borrow area or on-site stockpile (representative). Soil characteristics will be determined from the representative samples.

5.3.3.4 Representative Sample Analysis

Representative (grab) samples will be obtained on the basis of three criteria. First, an initial sample will be obtained from the borrow source (if not used in construction of a prior phase) and analyzed prior to construction. This will confirm soil characteristics and provide an initial maximum dry density and optimum moisture content for field moisture/density testing. Second, routine samples will be obtained for every 5,000 cubic yards placed. Third, in the event that changes in physical appearance or soil characteristics are observed, a sample will be obtained and analyzed. The maximum dry density and optimum moisture content values used for compaction testing may be adjusted during the course of cover construction based on the results of the above sampling.

The following laboratory analyses will be performed on the representative samples obtained:

PARAMETER	TEST METHOD
Moisture-density relationship using Modified or Standard Proctor compaction	ASTM D1557 (1, 2)/ ASTM D698 (1, 2)
Atterberg limits	ASTM D4318
Grain-size analysis	ASTM D6913(3)

Notes:
(1)Five-point Proctor analysis required, except as described in Note 2, below.
(2)One-point Proctor analysis may be utilized for representative samples collected for apparent changes in soil quality to verify applicability of previously analyzed moisture-density relationships. If the result does not verify applicability, then a five-point analysis will be performed in accordance with the first sampling criteria.

(3)Distribution is to be reported through the 0.002-mm particle size.

5.3.3.5 Laboratory Testing Acceptance Criteria

The following acceptance criteria will apply to the barrier layer.

- The upper 1 foot of the barrier layer will have a maximum particle diameter of 2-inches and the lower 1 foot of the barrier layer will have a maximum particle diameter of 4 inches.
- Fine grained-soil or well graded sandy soil with fines meeting the USCS soil types ML, CL, CH, SM, or SC, or dual-symbol classifications composed of those soil types, with at least 25 percent by weight passing the #200 sieve.

5.4 Thickness Documentation

The bottom of the final cover barrier layer (top of grading layer) will be surveyed on a maximum 100-foot grid pattern (maximum 50-foot grid pattern if the final cover construction is less than 4 acres) and at key locations on the final cover. Key locations include breaks in grade, top of slopes, and limits of final cover construction. The barrier layer thickness will be determined at top of grading layer surveyed locations and reported in a tabular fashion in the Construction Documentation Report.

The top of barrier layer will be documented by survey and compared to the design elevations. The maximum allowable difference from documented grades to design grades is +/- 0.20 foot. If the documented top of subgrade differs from the design grades by more than +/- 0.20 foot, the subgrade will be regraded and redocumented. The minimum acceptable barrier layer thickness will be 2 feet.

5.5 Granular Drainage Material

Field sampling and laboratory testing frequencies are based on proportionate sampling of construction areas or volumes of material placed as specified by s. NR 516.07. This section describes the required analyses, methods, sampling frequencies, and acceptance limits. The CQAT will collect soil samples for laboratory analysis.

The CQAT will observe granular soil placement activities and will document relevant observations to support certification of the following requirements:

- No trucks or heavy equipment will travel directly on the liner or final cover geomembrane. Only low-ground pressure tracked equipment (< 5 psi) may operate above the geomembrane when there is a minimum 12-inch–thick layer of select granular fill or soil is in-place between the tracks of the equipment and the geomembrane. A minimum of 2 feet of material will be required to be placed over the geomembrane prior to operating other tracked and flotation tire–equipped vehicles. Rubber-tired equipment may not travel above the geomembrane unless a minimum of 3 feet of material is in-place over the geomembrane. Procedures for deployment of pipe, select aggregate fill, geocomposite drainage layers and geotextiles overlying geomembranes will be planned at the preconstruction meeting or at progress meetings. Special requirements for geomembrane protection and equipment necessary to deploy materials must be approved by the CQA Officer. Guidance will be provided to machine operators placing soil on geomembrane by the use of an observer with an unobstructed view of the advancing lift of soil.

- Care will be exercised during placement of granular soil to prevent undue damage to pipes, geomembrane, geocomposites, and geotextiles. Stone will not be dropped from a height greater than 3 feet above the pipe trench or sump.
- Select granular fill or soil placed above the geomembrane shall be placed during cooler temperatures, to the extent possible, to minimize the movement and folding of wrinkles in the geomembrane.
- Granular drainage layer will be placed above on the landfill base and the lower 10 feet of the sideslopes less than 30 days after completion of the geosynthetics to lessen desiccation effects.

5.5.1 Field Testing

No field testing will be required for select granular fill, select aggregate fill, or pipe bedding material soil. The CQAT will perform a visual inspection of this soil for conformance to material specifications and may randomly sample deliveries.

5.5.2 Laboratory Testing

Material testing of the granular drainage material will be performed in accordance with ASTM D 6913 as a rate of one sample per 1,000 cyd of in-place material and ASTM D 2434 Permeability of Granular Soils at a rate of one sample per 2,500 cyd of in-place material. The granular drainage material shall be a clean granular soil classified as a SW or SP, meeting the following specification requirements:

Sieve Size	% Passing by Weight
1 inch	100
No. 4	90 to 100
No. 200	0 to 5

The hydraulic conductivity shall be 1.0×10^{-2} centimeters per second or greater.

If tests indicate the sand drainage material does not meet the specified requirements, the material shall be removed, replaced, and retested.

5.5.3 Thickness Documentation

The finished elevation of the select granular drainage layer portion of the leachate and gradient control systems will be surveyed on a 50-foot grid, which coincides with the grid used for the clay liner and final cover barrier layer, respectively, to verify its layer thicknesses. The minimum acceptable drainage layer thickness will be 12 inches or as shown on the Plan of Operations drawings.

5.6 Filter Sand

The CQAT will collect samples of the filter sand for laboratory testing in accordance with the following specifications.

Grain size distribution testing of filter sand will be performed in accordance with ASTM D 6913 at a rate of one sample per 1,000 linear feet of pipe or a minimum of three samples, whichever is greater. The filter sand shall meet the gradation requirements of ASTM C 33 Fine Aggregate or meet the filtering criteria:

Sieve Size	% Passing by Weight
1 inch	100
No. 4	90 to 100
No. 8	80 to 100
No. 16	50 to 85
No. 30	25 to 60
No. 50	5 to 30
No. 100	0 to 10
No. 200	0 to 3

Filtering Criteria:

$$\frac{D_{15}\text{ (bedding stone)}}{D_{85}\text{ (filter sand)}} \leq 5$$

$$\frac{D_{50}\text{ (bedding stone)}}{D_{50}\text{ (filter sand)}} \leq 25$$

If tests indicate the sand drainage material does not meet the specified requirements, the material shall be removed, replaced, and retested.

5.7 Pipe Bedding Stone

The CQAT will collect samples of the pipe bedding stone for laboratory testing in accordance with the following specifications.

Grain size distribution testing of pipe bedding stone will be performed in accordance with ASTM D 6913 at a rate of one sample per 1,000 linear feet of pipe or a minimum of three samples, whichever is greater. The pipe bedding stone shall meet the gradation requirements of the table below (similar to ASTM C33 No. 67 Stone) or meet the filtering criteria:

Sieve Size	% Passing by Weight
1 inch	100
3/4 inch	90 to 100
3/8 inch	20 to 55
No. 4	0 to 5
No. 8	0 to 5

Filtering Criteria:

$$\frac{D_{15}\text{ (bedding stone)}}{D_{85}\text{ (filter sand)}} \leq 5$$

$$\frac{D_{50}\text{ (bedding stone)}}{D_{50}\text{ (filter sand)}} \leq 25$$

The stone shall be non-calcareous, defined as less than 15% loss on reaction to hydrochloric acid (ASTM D 3042). Select aggregate fill utilized in the leachate collection system (leachate collection pipe bedding and leachate sump backfill material) will have a uniformity coefficient of less than 4, will contain no more than 5 percent by weight passing the #4 sieve, will have a maximum particle diameter of 1 ½ inches, and have a minimum hydraulic conductivity of 1 cm/s at the anticipated field density. Limestone and dolomite stone will not be used in the leachate collection system unless no other suitable material is reasonably available. Select aggregate fill used in the leachate collection system above geomembrane should be rounded to subangular.

The pipe bedding material for the leachate transfer line may meet the gradation requirements of the granular drainage material, provided the material is placed and compacted to a minimum of 90% of the modified Proctor maximum dry density. Field compaction testing shall be completed at a rate of one test per 100 linear feet of pipe.

If tests indicate the pipe bedding stone does not meet the specified requirements, the material shall be removed, replaced, and retested.

5.7.1 Thickness Documentation

Pipe bedding placed along collection pipe alignments will be surveyed for elevation prior to pipe placement and following pipe backfilling at 25-foot intervals to document the thickness of gravel placed below pipe inverts and above the top of pipe. The minimum acceptable stone thickness will be 4 inches below and 24 inches above the leachate collection piping.

5.8 Topsoil

This section includes the quality assurance requirements for the excavation and placement of the topsoil and for the fertilization, seeding, mulching, and watering of the topsoil layer for vegetation. Topsoil is the final layer of soil material installed on the final cover, along the outside slopes of the perimeter berms, along the ditches, and on other perimeter areas. Topsoil will be obtained from existing on-site stockpiles, from soil excavated by the clearing of the landfill footprint and associated disturbed perimeter areas, or from an off-site borrow source.

5.8.1 Procedures and Observation

Work covered by this section will be performed in accordance with the construction plans and specifications. The CQAT will observe topsoil placement activities and will document relevant observations to support certification of the following requirements:

- The CQAT will confirm the source and uniformity of topsoil used. Soil excavation and placement will be monitored for minimization of inorganic soil not compatible for establishment of vegetation.
- Prior to seeding, the topsoil will be worked to prepare a suitable seedbed.
- Fertilizing, seeding, and mulching will be performed in a timely manner and will be applied with rates approved by the CQA Officer.

5.8.2 Sampling Requirements and Acceptance Criteria

The topsoil will be suitable for the establishment and long-term maintenance of the selected vegetation seed mix with appropriate fertilization. At the CQA Officer's discretion, samples may be collected for laboratory testing.

5.8.3 Thickness Documentation

The thickness of topsoil placement on the final cover will be documented on a 100-foot grid by surveying or by hand shoveling or auguring and measuring the observed thickness of topsoil.

5.9 Anchor Trenches

Quality assurance associated with monitoring and testing of anchor trenches shall include the following:

- Anchor trench excavation shall be monitored for proper depth and location.
- Geosynthetic panels extending into the anchor trench shall be monitored for complete seaming within the anchor trench.
- Anchor trench backfill operations will be observed and documented.
- The depth of a typical anchor trench shall be documented to conform to approved project drawings.
- Backfill shall be placed in thin lifts not to exceed 1 foot in loose thickness.
- Density tests will be performed at a minimum interval of one per 500 linear feet of anchor trench to observe a minimum of 85% of the maximum dry density has been obtained, as determined by ASTM D698 or D1557.
- The geosynthetic panel runout in the anchor trench shall be within 0.3 feet as shown on the drawings.

6. Geomembrane Liner Observations and Testing

The following section summarizes the QA plan proposed for testing and monitoring of the geomembrane installation for the landfill construction.

6.1 Geomembrane Rolls and Panels

Construction QA monitoring for the rolls and panels include:

- Monitoring and documenting the unloading of trucks delivering geomembrane rolls to the site.
- Monitoring the handling and on-site storage of geomembrane rolls.
- Recording the manufacturing roll and batch number of geomembrane rolls delivered to the site.
- Reviewing the manufacturer's quality control testing for conformance with the specifications as outlined in Table 6.1 and Table 6.2. Specifications for the 40-mil and 60-mil geomembrane will follow the most recent version of GRI GM-17 and GRI GM-13, respectively, in the event that the specifications outlined in Table 6.1 and Table 6.2 are updated.
- Fixing a code number to samples and recording the manufacturing numbers of the rolls from which samples are taken.
- Labeling, packaging, and shipping samples to an off-site laboratory for conformance testing (if required).
- Interpreting laboratory test results in accordance with the specifications and accepting or rejecting delivered rolls based on results of off-site testing.
- Observing and marking geomembrane as it is unrolled and deployed at the job site for uniformity, damage, and imperfections, including holes, cracks, thin spots, tears, punctures, blisters, and foreign matter.

Table 6.1 40-mil Textured Polyethylene Geomembrane Properties

Properties	Test Method	Test Value 40 Mil Textured	Testing Frequency (minimum)
Thickness mils (min. avg.)	D5994	Nom. (-5%)	Per roll
♦ Lowest individual for 8 out of 10 values		-10%	
♦ Lowest individual for any of the 10 values		-15%	
Asperity Height mils (min. avg.)[1]	D 7466	16	Every 2nd Roll[2]
Density g/ml (max)	D1505/ D792	0.939	200,000 lb
Tensile Properties [3] (min. avg.) ♦ Break strength ♦ Break elongation	D6693 Type IV	 60 lb/in 250%	20,000 lb
2% Modules (max)	D5323	2400 lb/in	per formulation
Tear Resistance (min. avg.)	D1004	22 lb	45,000 lb
Puncture Resistance (min. avg.)	D4833	44 lb	45,000 lb
Axi-Symmetric Break Resistance Strain(min.)	D5617	30%	Per formulation
Carbon Black Content (range)	D1603 [4]	2.0-3.0	45,000 lb
Carbon Black Dispersion	D5596	Note [5]	45,000 lb
Oxidative Induction Time (OIT) (min. avg.) [6] (a) Standard OIT ---or--- (b) High Pressure OIT	 D3895 D5885	 100 min 400 min	200,000lb
Oven Aging at 85°C [7] (a) Standard OIT (min. avg.) - % retained after 90 days ---or-- (b) High Pressure OIT (min. avg.) - % retained after 90 days	D5721 D3895 D5885	 35% 60%	Per each formula
UV Resistance [8] (a) Standard OIT (min. avg.) ---or--- (b) High Pressure OIT (min. avg.) - % retained after 1,600 hrs. [10]	 D3895 D5885	 N.R. [9] 35%	Per each formula

Notes:

1. Of 10 readings; 8 out of 10 must be ≥ 7 mils, and lowest individual reading must be ≥ 5 mils; also see Note 5.
2. Alternate the measurement side for double sided textured sheet.
3. Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction.
   - Break elongation is calculated using a gauge length of 2.0 inches at 2.0 in/min.
4. Other methods such as D 4218 (muffle furnace) or microwave methods are acceptable if an appropriate correlation to D 1603 (tube furnace) can be established.
5. Carbon black dispersion (only near spherical agglomerates) for 10 different views: 9 in Categories 1 or 2 and 1 in Category 3.
6. The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.
7. It is also recommended to evaluate samples at 30 and 60 days to compare with the 90 day response
8. The condition of the test should be 20 hr. UV cycle at 75°C followed by 4 hr. condensation at 60°C.
9. Not recommended since the high temperature of the std-OIT test produces an unrealistic result for some of the antioxidants in the UV exposed samples.
10. UV resistance is based on percent retained regardless of the original HP-OIT value.

Table 6.2 60-mil Textured Polyethylene Geomembrane Properties

Properties	Test Method	60-Mil Test Values Textured	Testing Frequency (minimum)
Thickness (min. ave.) ♦ Lowest individual for 8 out of 10 values ♦ Lowest individual for any of the 10 values	D5199 or D5994	Nom. (-5%) -10% -15%	Per roll
Asperity Height (min. ave.) (1)	D7466	16 mil	Every 2nd Roll(2)
Density (min. ave)	D1505/ D792	0.940 g/cc	200,000 lb
Tensile Properties (min. ave.) (2) ♦ Yield strength ♦ Break strength ♦ Yield elongation ♦ Break elongation	D6693 Type IV	126 lb/in. 90 lb/in. 12% 100%	20,000 lb
Tear Resistance (min. ave)	D1004	42 lb	per formulation
Puncture Resistance (min. ave.)	D4833	90 lb	45,000 lb
Stress Crack Resistance (3)	D5397 (App.)	500 hr.	45,000 lb
Carbon Black Content (range)	D4218 (4)	2.0-3.0%	45,000 lb
Carbon Black Dispersion	D5596	Note (5)	45,000 lb
Oxidative Induction Time (OIT) (min. ave.) (6) (a) Standard OIT ---or--- (b) High Pressure OIT	D3895 D5885	100 min. 400 min	200,000 lb
Oven Aging at 85°C (6), (7) (a) Standard OIT (min. ave.) retained after 90 day ---or-- (b) High Pressure OIT (min. ave.) retained after 90 days	D5721 D3895 D5885	55% 80%	Per each formula
UV Resistance (8) (a) Standard OIT (min. ave.) ---or--- (b) High Pressure OIT (min. ave) retained after 1,600 hrs (10)	D7238 D3895 D5885	N.R. (9) 50%	Per each formula

Notes:

1. Alternate the measurement side for double sided textured sheet.
2. Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction.
   Yield elongation is calculated using a gage length of 1.3 inches
   Break elongation is calculated using a gage length of 2.0 inches
3. P-NCTL test is not appropriate for testing geomembranes with textured or irregular rough surfaces. Test should be conducted on smooth edges of textured rolls or on smooth sheets made from the same formulation as being used for the textured sheet materials. The yield stress used to calculate the applied load for the SP-NCTL test should be the manufacturer's mean value via MQC testing.
4. Other methods such as D 1603 (tube furnace) or D 6370 (TGA) are acceptable if an appropriate correlation to D 4218 (muffle furnace) can be established.
5. Carbon black dispersion (only near spherical agglomerates) for 10 different views: 9 in Categories 1 or 2 and 1 in Category 3.
6. The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.

7. It is also recommended to evaluate samples at 30 and 60 days to compare with the 90 day response
8. The condition of the test should be 20 hr. UV cycle at 75°C followed by 4 hr. condensation at 60°C.
9. Not recommended since the high temperature of the std-OIT test produces an unrealistic result for some of the antioxidants in the UV exposed samples.
10. UV resistance is based on percent retained regardless of the original HP-OIT value.

6.2 Earthwork

The Contractor will be responsible for preparing the supporting soil according to the plans and specifications. For each day of installation of the geomembrane, the Installer, the Contractor, and the CQAT will observe the surface and certify that the surface is acceptable for installations. The installer with prepare and sign a subgrade acceptance form for each day of geomembrane deployment.

Prior to deploying geomembrane, the geomembrane subgrade (clay liner or soil barrier layer) will be smooth drum rolled to remove irregularities, protrusions, loose, and abrupt changes in grade. The Contractor will observe the surface to certify that the subgrade is free of stone, grading stakes, construction debris, and contain no areas softened by high water content. The soil surface shall be sufficiently dry and dense such that construction equipment during panel placement will not create ruts in the subgrade surface. The soil surface will also be evaluated during geomembrane installation for any areas softened by precipitation or cracked due to desiccation. The Construction Contractor will rework areas determined to be unacceptable until acceptable.

6.3 Panel Placement

Quality assurance monitoring for panel placement includes:

- Obtaining a written acceptance of the subgrade by the geomembrane installer.
- Evaluating and documenting weather conditions (e.g., temperature, wind) for geomembrane placement and informing the CQA Officer if requirements for weather conditions are not met, so the CQA Officer can decide whether or not to stop geomembrane placement.
- Monitoring and documenting geomembrane placement as well as conditions of panels as placed.
    - Noting panel defects, tears, or other deformities.
    - Observing panel placement for proper overlap.
    - Measuring panel thickness at a minimum rate of five areas measured per panel.
    - Measuring as delivered panel lengths.

- Recording the locations of installed panels and checking that the panels have been installed in accordance with the design plan.
- Assigning each panel a unique panel number and identifying that panel with the manufacturer's roll number.
- Recording panel numbers and locations on a panel layout diagram.

6.4 Geomembrane Field Seam Construction

Quality assurance monitoring and testing to be conducted for seam construction includes:

- Monitoring Trial Test Seams:

  Test seams shall be made each day prior to commencing field seaming. These seams shall be made on fragment pieces of geomembrane liner to observe that seaming conditions are adequate. Such test seams shall be made at the beginning of each seaming period; at changes of equipment, equipment settings, weather, power supply interruption, or sheet temperature; at the CQA Officer's discretion; and at least once every five hours during continuous operation of each welding machine. Also, each seamer shall make at least one test seam each day. Requirements for test seams are as follows:

  - The test seam sample shall be at least 5 feet (0.9 m) long by 1-foot (0.3 m) wide with the seam centered lengthwise. Ten adjoining specimens, 1 inch (25 mm) wide each, shall be die cut from the test seam sample. These specimens shall be tested in the field with a tensiometer for both shear (5 specimens) and peel (5 specimens) for single-track fusion welds or extrusion welds. For dual-track fusion welds, the contractor shall test each track as if it was a single-track weld. Test seams shall be tested by the contractor under observation of the construction inspector, or designated representative of the owner. The specimens should not fail in the weld. No strain measurements need to be obtained in the field. A passing fusion or extrusion welded test seam shall be achieved when the criteria described in Table 7.4 are satisfied. If a test seam fails, the entire operation shall be repeated. If the additional test seam fails, the seaming apparatus or seamer shall not be accepted and shall not be used for seaming until the deficiencies are corrected and two consecutive successful full test seams are achieved. Test seam failure is defined as failure of any one of the specimens tested in shear or peel. For double-weld seams, both weld tracks shall meet the test seam criteria.
  - The CQAT shall log the date, hour, ambient temperature, number of seaming unit, name of seamer, and pass or fail description.

- Non-Destructive Testing:

  Production seams shall be tested by the contractor continuously using non-destructive techniques. The contractor shall perform all pressure and vacuum testing under the observation of the CQAT(s) or CQA Officer. Requirements for non-destructive testing are as follows:

- Single Weld Seams
  1. The Contractor shall maintain and use equipment and personnel at the site to perform continuous vacuum box testing on all single weld production seams. The system shall be capable of applying a vacuum of at least 5 psi (35 kPa). The vacuum shall be held for a minimum of 10 seconds for each section of seam.
  2. If bubbles are present, the area shall be marked clearly for repair.
  3. If the vacuum test indicates leakage, the area shall be patched; or the entire seam shall be capped.
- Double Weld Seams (split wedge)
  1. The Contractor shall maintain and use equipment and personnel to perform air pressure testing of all double weld seams. The system shall be capable of applying a pressure of at least 30 psi (207 kPa) for not less than 5 minutes.
  2. Pressure loss tests shall be conducted in accordance with the procedures outlined in "Pressurized Air Channel Test for Dual Seamed Geomembranes," Geosynthetic Research Institute Test Method GM-6. As outlined by the test method, the seam or portion thereof being tested shall be pressurized to 30 psi and, following a 2-minute pressurized stabilization period, pressure losses over a measurement period of 5 minutes shall not exceed 4 psi for a 40-mil sheet and 3 psi for 60 mil.
  3. The Contractor shall demonstrate the required pressure over the entire length of the seam.
  4. If pressure drops below the allowance, the test shall be considered a failure and the following procedures shall be implemented:
     a. Check to determine if there is excessive seepage around the inflation needle.
     b. Check both ends of the seam to ensure the flow channel is completely sealed off.
     c. Walk the length of the seam; look and listen for air leaks.
     d. If either of these procedures fails to identify the leak, trim the seam overlap, and vacuum test the seam to locate the leak.
     e. Once the leak is identified, make the necessary repairs, and retest the seam.

- Destructive Testing:

  Destructive testing shall be performed on at least one field-seamed sample per day per seaming crew or machine. The sampling frequency shall be at least one sample every 500 linear feet (150 m) of production seam. If the weather conditions are such that the ambient air temperature is less than 41°F, then the minimum frequency may be increased by the owner, CQAT, or CQA officer. The locations shall be selected by the CQAT or CQA Officer. Sufficient samples shall be obtained by the contractor to provide one sample to the archive, one sample to the CQAT or CQA Officer for laboratory testing (if required), and one sample to be retained by the Contractor for field testing. The contractor shall mark each sample with the name of the person welding, date, time, ambient air temperature, temperature of heating element, speed of seaming, and identification number of seaming unit. The test seam sample shall be a minimum of 3 feet (0.9 m) long by 1-foot (0.3 m) wide with the seam centered lengthwise. Testing requirements are as indicated in Table 6.3 and are taken from GRI GM-19a. The CQAT or CQA Officer will refer to the most recent version of GRI-GM19a when testing seam samples.

- The contractor shall test samples in the field under the observation of the CQAT or CQA Officer. All tests shall be performed using a calibrated, motor-driven, strain controlled tensiometer approved by the CQA Officer.
  1. Peel shall be measured for one sample (that is, five specimens). Peel tests shall be evaluated for the criteria described in Table 6.3. For double track welders, peel tests (5 specimens) shall be evaluated for each track.
  2. Shear shall be measured for one sample (that is, five specimens). Tests shall be evaluated for the criteria described in Table 6.3.
- In addition to the 42-inch sample cut for laboratory testing, an additional sample will be cut from at least one end of each fusion seam weld greater than 100 feet in length for field-testing as described below. The end-of seam sample, or "end bones", will consist of a minimum of two 1 inch wide samples, often referred to as bones, can be cut from the portion of the seam that extends into/passed the anchor trench so as not to require an additional repair. A minimum of one bone will be field tested in shear mode and a minimum of one bone will be field tested in peel mode (inner and outer seam).

- The CQAT(s) or CQA Officer shall observe all production seam field test procedures and may perform laboratory testing for both peel and shear and evaluate test results in accordance with Table 6.3.
- The CQAT or CQA Officer shall be responsible for the archive specimen and shall assign a number to the archive sample and mark the sample with the number and shall also log the date, seam number, approximate location in the seam, and field test pass or fail description, if applicable.

Table 6.3 Textured Polyethylene Geomembrane Properties

Property	Method	Specified Value	
		60-mil	40-mil
Bonded Seam Strength	ASTM D6392	120 ppi minimum	60 ppi minimum
Peel Adhesion: Fusion Extrusion	 ASTM D6392 ASTM D6392	 91 ppi minimum 78 ppi minimum	 44 ppi minimum 50 ppi minimum
Modifications to ASTM D4437: For shear tests, sheet shall yield before failure of seam. For peel adhesion, seam separation shall not extend more than 50% of seam width into seam. For either test, testing shall be discontinued when sample has visually yielded. For bonded seam strength tests five of five samples shall pass and for peel adhesion four of five samples shall pass for seam to qualify and all shall have a strength value.			

- When seaming of the geomembrane is completed, the CQAT will examine the geomembrane for wrinkles and determine which wrinkles (i.e., taller than wide) should be cut out and reseamed by the Installer. The wrinkle repair will be done in accordance with the Section 6.4 and non-destructively testing in accordance with Section 6.3.

6.5 Seam Repair

Damaged and sample coupon areas of geomembrane shall be repaired by the contractor by construction of a cap strip. No repairs shall be made to seams by application of an extrusion bead to a seam edge previously welded by fusion or extrusion methods. Repaired areas shall be tested for seam integrity. Damaged materials are the property of the contractor and shall be removed from the site. The following quality assurance monitoring and testing will be implemented to monitor defect repairs:

- Destructive Test Failure Procedures:

  When sample fails destructive testing, contractor has the following options:

  - Repair seam between any two passing destructive test locations.
  - Trace welding path to intermediate point (10 feet minimum from point of failed test in each direction) and take small sample with 1-inch-wide die for an additional field test at each location. If these additional samples pass test, then take full size destructive sample for peel and shear testing in accordance with this section. If these samples pass tests, repair seam between these locations. If either sample fails, repeat process to establish zone in which seam should be repaired.
  - Acceptable repaired seams shall be bound by locations from which samples passing destructive tests have been taken. In cases exceeding 150 feet of repaired seam, the CQA Officer may have contractor destructive test repair seam.
  - When sample fails, CQA Officer or CQAT may require additional testing of seams that were welded by same welder and/or welding apparatus during same time shift.

- Repair Verification:
  - The Construction Inspector or CQAT shall observe, number, and log each repair.
  - The Construction Inspector or CQAT shall observe non-destructive testing of each repair.
  - The Construction Inspector or CQAT shall document passing non-destructive test results as adequate repairs.
  - Repairs more than 150 feet long, may require destructive test sampling.
  - Failed destructive or non-destructive tests indicate that repair shall be redone and retested until passing test results.

6.6 Documentation and Reporting

Documentation and reporting methods will be implemented to systematically record results of on-site monitoring and testing. Reporting forms will be used for roll and panel placement, trial weld construction, panel seaming, non-destructive seam testing, and destructive seam testing. Unique identifying numbers will be assigned to each panel and seam and used to reference the panel and seam location and test results.

Copies of QA forms are included in Appendices D through K.

Panel location and seam location diagrams will be kept showing the location of all panel and seams, repairs, and destructive sample test locations. These location diagrams will be updated on a daily basis and will be available for review.

A photo log will be created containing photos of all phases of the geomembrane liner installation, including deployment, seaming, testing, and anchor trench construction.

Copies of test results for any off site laboratory testing shall be forwarded to the CQA Officer and CQAT. The laboratory test result documents will be maintained in a job file and submitted with the final certification report.

6.7 Leak Location Testing

Leak location testing (electrical resistivity testing or other approved method) of the installed geomembrane in the liner system will be completed by or observed by the CQA Officer, CQAT, or a qualified technician. Leak location testing will be conducted after the leachate collection layer has been placed on the base grades and lower half of the sideslopes, at a minimum. Documentation of the testing method, including a description of the procedures and photographic documentation will be included in the construction documentation report. The documentation report will also include documentation of all defects and repairs including testing data for geomembrane sheet and welding and photographic documentation of the defects prior to and after repairs.

7. Geocomposite Drainage Layer Observations and Testing

The following section defines the CQA program for installation of the geocomposite drainage layer in the leachate collection trenches and in the final cover system.

7.1 Geocomposite Drainage Layer Rolls and Panels

CQA monitoring for geocomposite drainage layer rolls and panels includes the following:

- Monitoring and documenting the unloading of geocomposite and geonet rolls delivered to the site.
- Monitoring the handling and on-site storage of geocomposite and geonet rolls.
- Recording the roll number of geocomposite and geonet rolls delivered to the site.
- Reviewing manufacturer's quality control testing for conformance with the project specifications, as shown in Table 7.1. Specifications for the geocomposite will follow the most recent version of GRI GN-4, in the event that the specifications outlined in Table 7.1 are updated.
- Obtaining samples and recording the manufacturer roll numbers from which samples are taken.
- Labeling, packaging, and shipping samples to an off-site laboratory for conformance testing (if required).
- Observing geocomposite and geonet as it is installed for uniformity, damage, and imperfections, including holes, tears, thin spots, punctures, and foreign matter.

Table 7.1 Geocomposite Properties

Property	Test Method	Frequency	Minimum Average Roll Values
PE Resin			
Polymer Density, g/cm^3	ASTM D 1505	Once Per Lot	0.95
Geonet Tests			
Carbon Black, %	ASTM D 1603/4218	1/50,000ft^2	1.5 to 3.0
Tensile Strength, MD, lbs/ft	ASTM D 5035	1/50,000 ft^2	45
Density, g/cm^3	ASTM D 1505	1/50,000 ft^2	0.95
Geotextile Tests			
Mass per Unit Area, oz/yd^2	ASTM D 5261	1/90,000 ft^2	8
Grab Strength, lbs	ASTM D 4632	1/90,000 ft^2	200

Puncture, lbs	ASTM D 6241	1/90,000 ft^2	430
AOS, mm	ASTM D 4751	1/540,000 ft^2	0.25
Flow Rate, sec^{-1}	ASTM D 4491	1/540,000 ft^2	0.2
UV Resistance, % Retained	ASTM D 4355 (after 500 hours)	Once per resin formulation	50
Geocomposite Tests			
Ply Adhesion, lbs/in.	ASTM D 7005	1/50,000 ft^2	1.0
Transmissivity, gpm/ft	ASTM D 4716	1/540,000 ft^2	2.0

7.2 Geocomposite and Geonet Seams and Overlaps

The following requirements will be used with regard to the overlapping and joining of geocomposite rolls:

- The geotextile portion of the geocomposite will be overlapped 4 to 6 inches, and the upper geotextile will be sewn or fusion welded. The geonet portion will be overlapped a minimum of 2 inches, and will be secured with plastic ties.
- Tying will be performed with pull ties. Ties will be white or brightly colored plastic for easy identification. Ties will be placed 3 feet to 5 feet on center along the edges, and 6 inches on center on the ends of the rolls and in the anchor trenches. Metallic devices will not be used under any circumstances.
- No horizontal joints or overlaps will be allowed on slopes greater than 3 horizontal to 1 vertical, except as part of a patch.
- The Installer will pay particular attention to the overlapped areas to ensure that no earthen or foreign materials could be inadvertently trapped beneath the geocomposite.

The CQAT will observe and document that the Installer performs each of the above steps. Any noncompliance with the above requirements will be reported by the CQAT to the CQA Officer and the Owner.

7.3 Geocomposite and Geonet Repairs

Any tears or other defects in the geocomposite will be repaired by placing a patch with minimum overlaps described in Subsection 7.2. The patch will be secured to the original geocomposite by tying every 6 inches. If the tear or other defect width is more than 50 percent of the roll width, the damaged area will be cut out and replaced with new geocomposite. Tying will be as indicated in Subsection 7.2.

The CQAT will examine and document that the repair of any geocomposite is performed according to the above procedure.

7.4 Geocomposite and Geonet Sampling

CQA monitoring will include sampling of the geocomposite and geonet materials if required. Samples may be forwarded to a laboratory for testing at the CQA Officer's discretion.

7.5 Documentation and Reporting

Daily estimates of the amount of geocomposite and geonet placed and seamed will be kept. This information will be included in the CQA Technician's field book and on the daily reports. A record of geocomposite and geonet roll numbers delivered to the project site will be kept with a copy of the required manufacturer certifications as indicated in the Project Specifications.

A photo log will be created containing photos of all phases of the geocomposite and geonet installation, including deployment and seaming.

8. Non-woven Geotextile Cushion Layer Observations and Testing

The following section defines the CQA program for installation of the non-woven geotextile cushion layer over the 60-mil HDPE base liner.

8.1 Non-woven Geotextile Rolls and Panels

CQA monitoring for geotextile rolls and panels includes the following:

- Monitoring and documenting the unloading of geotextile rolls delivered to the site.
- Monitoring the handling and on-site storage of geotextile rolls.
- Recording the roll number of geotextile rolls delivered to the site.
- Reviewing manufacturer's quality control testing for conformance with the project specifications as shown on Table 8.1. Specifications for the geotextile will follow the most recent version of GRI GT-12(a), in the event that the specifications outlined in Table 8.1 are updated.
- Obtaining samples and recording the manufacturer roll numbers from which samples are taken.
- Labeling, packaging, and shipping samples to an off¬ site laboratory for conformance testing (if required).
- Observing geotextile as it is installed for uniformity of proper overlap, seams are completely sewn or thermally bonded, damage, and imperfections, including holes, tears, thin spots, punctures, and foreign matter.

Table 8.1 Non-Woven Geotextile Properties

Property	Method	Value	Frequency
Mass per Unit Area	ASTM D 5261	12 ounces/square yard nominal	1 per 100,000 sq ft
Puncture Resistance	ASTM D 4833	800-lb minimum	1 per 100,000 sq ft
Grab Tensile	ASTM D 4632	300-lb minimum	1 per 100,000 sq ft
UV Resistance	ASTM D 4355*	70% minimum	1 per 100,000 sq ft
*Modification: Utilize ASTM D 4632 to evaluate effect of exposure on geotextile.			

Note: Alternative test methods must be approved by Engineer.

8.2 Placement

The Installer will install all geotextile in such a manner so as to ensure that it is not damaged and that it complies with the following requirements:

- On sideslopes, the geotextile will be securely anchored and then rolled down the slope in such a manner so as to continually keep the geotextile in tension.
- In the presence of wind, all geotextile will be secured by suitable methods. The temporary securing material will be left in place until replaced with cover material, if applicable.
- In-place geotextile will be cut with special care to protect other materials from damage that could be caused by the cutting of the geotextile.
- The Installer will take the necessary precautions to prevent damage to any underlying layers during placement of the geotextile.
- During placement of the geotextile, care will be taken not to entrap in the geotextile any stones, excessive dust, or moisture that could damage the geotextile or the underlying geosynthetics, or that could clog drains or filters.
- A visual examination of the geotextile will be carried out over the entire surface after the installation by the Installer to ensure that no potentially harmful objects, such as needles, are present.
- The edges of the geomembrane between phases will be protected with a geotextile wrap and/or an overlying protective material until the edges are spliced together with the liner system of the adjacent phase.

8.3 Geotextile Seams and Overlaps

- Geotextile placed as geotextile cushion (to protect the geomembrane liner from the drainage layer material and drainage layer material placement) will be continuously sewn, heat-bonded or seamed using another method approved by the CQA Officer. Geotextile will be overlapped 6 inches prior to seaming. The sewing method and stitch type will be per the Manufacturer's recommendation, but must be approved by the CQA Officer and the Owner. Overlapping of geotextile without sewing may be acceptable for certain applications (i.e., seams under riprap, access roads) with approval from the CQA Officer.
- No horizontal seams will be allowed on slopes steeper than 5 horizontal to 1 vertical (i.e., seams will be along, not across, the slopes), except as part of a geotextile repair.
- Sewing will be performed with thread made from the same base material as the geotextile, or suitable equivalent.

- The Installer will pay particular attention to seams to ensure that materials are not inadvertently trapped beneath the geotextile.

The CQAT will be responsible for observing and documenting that the above provisions are performed by the Installer in an acceptable manner.

8.4 Geotextile Repairs

Observe that repairs to the geotextile conform to the technical specification.

8.5 Geotextile Sampling

CQA monitoring will include sampling of the geotextile if required. Samples may be forwarded to a laboratory for testing at the CQA Officer's discretion.

8.6 Documentation and Reporting

Daily estimates of the amount of geotextile and seamed will be kept. This information will be included in the CQA Technician's field book and on the daily reports. A record of geotextile roll numbers delivered to the project site will be kept with a copy of the required manufacturer certifications as indicated in the Project Specifications. A photo log will be created containing photos of all phases of the geotextile installation, including deployment and seaming.

9. Geosynthetic Clay Liner

9.1 Introduction

This section is divided into three major subheadings, which cover the quality assurance requirements for preinstallation (includes the geosynthetic clay liner [GCL] manufacturer), installation, and post-installation (includes the final examination of GCL prior to the placement of the geomembrane). The terms preinstallation, installation, and post-installation are applicable only to the GCL installation and do not apply to the overall construction.

9.2 Preinstallation

Preinstallation activities are designed to help ensure that a high-quality product is being manufactured and that it is properly delivered, handled, and stored to maintain its quality.

9.2.1 Manufacturer's Quality Control Plan (MQCP)

The manufacturer of each component of the GCL and the GCL itself will have a Manufacturer's Quality Control Plan (MQCP) to ensure that their product meets all of the stated minimum properties. These manufacturers include the Bentonite Supplier, the Geotextile Manufacturer, and the GCL Manufacturer.

9.2.1.1 Bentonite Supplier

The Bentonite Supplier will have a MQCP that will be adhered to in the manufacturing process. This plan will include the following information:

- Documentation that the bentonite is sodium bentonite
- Testing that demonstrates that the bentonite meets specified gradation requirements
- Testing that demonstrates that the bentonite meets specified index test requirements
- Testing that demonstrates that the bentonite has not been treated with synthetic chemicals or polymers

9.2.1.2 Geotextile Manufacturer

The Geotextile Manufacturer will have a MQCP that will be adhered to in their manufacturing process. This plan will include the following provisions:

- Testing that demonstrates that the product is made of specified polymers

- Testing that demonstrates that the product meets certain minimum average roll values (for geotextiles)

9.2.1.3 GCL Manufacturer

The GCL manufacturer will have a MQCP that describes the procedures for accomplishing quality in the final product. At a minimum, the tests shown in Table 9-1 shall be performed by the Manufacturer.

This MQCP will also dictate the following requirements:

- Overlap alignment lines are to be marked on the edges.
- Completed rolls are to be securely wrapped in plastic.
- Completed rolls are to be stored indoors, and provisions are to be in place to prevent rolls from being stacked too high, to ensure that they are kept dry, and to prevent damage during handling.
- Quality control certificates are to be provided.

9.2.2 Materials

The GCL will be needle-punched reinforced composite GCL consisting of a layer of pure sodium bentonite clay encapsulated between two geotextiles, and will comply with all of the manufacturing processes and physical/chemical criteria listed in this Section.

The bentonite clay utilized in the manufacture of the GCL, as well as any accessory bentonite clay (i.e., Volclay® granular sodium bentonite or approved equivalent) provided for seaming and detail work, will meet the manufacturer’s minimum requirements, as specified in the MQCP.

The geotextile components of the GCL, and the geosynthetic clay liner itself, will meet the minimum requirements of the respective MQCPs.

9.2.3 GCL Delivery, Handling, and Storage

The GCL panels will be supplied to the site in factory-produced rolls, which are of standard factory roll dimensions.

Table 9-1 GCL Material Tests, Test Methods, and Acceptance Criteria

	PROPERTY	TEST METHOD(1)	UNITS	VALUE
Bentonite properties	Swell Index Moisture Content Fluid loss	ASTM D5890 ASTM D4643 ASTM D5891	ml/2g % ml	24 (min) 12 (max) 18(max)(3)
Geotextile (as received)	Non-woven (mass per unit area) Woven (mass per unit area)	ASTM D5261 ASTM D5261	oz/yd^2 oz/yd^2	5.9 (MARV) 3.0 (MARV)
Physical GCL properties	Bentonite mass per unit area(1) @ 0% moisture Tensile Strength(2) Peel Strength Hydraulic Conductivity(3) Index Flux(4) Internal Shear Strength(4)	ASTM D5993 ASTM D6768 ASTM D6496 ASTM D5887 ASTM D5887 ASTM D6243	lb/ft^2 lb/in lb/in cm/sec $m^3/m^2/sec$ psf	0.75 (MARV) 23 (MARV) 2.1 (MARV) 5×10^{-9} (max) 1×10^{-8} (max) 500 (typical)

Notes:
(1)At 0% moisture content
(2)Tested in machine and cross direction
(3)Deaired, deionized water @ 5 psi maximum effective confining stress and 2 psi head pressure
(4)Typical peak value for specimen hydrated for 24 hours and sheared under a 200 psf normal stress

Each roll of GCL supplied to the site will be labeled with the following information:

- Name and date of manufacturer
- Product type and identification number (if any)
- Roll number
- Lot (batch) number

The GCL Manufacturer will ensure that the crushing strength of all GCL roll cores will be sufficient to avoid collapse or other damage while in use.

The rolls of GCL will be carefully unloaded by the Contractor upon arrival at the site. At a minimum, the following practices will be followed in receiving and storing GCL rolls in the covered storage area at the job site:

- While unloading or transferring the GCL rolls from one location to another, prevent damage to the GCL.
- For standard rolls, a steel support pipe will be inserted through the cardboard roll core. The slings or lifting chains will be attached at one end to the support pipe and at the other end to the bucket of a front-end loader or lifting device. A spreader bar will be used to support and spread the slings. The bar and support pipe must be long enough to prevent damage to the edges of the GCL during hoisting.

- Alternatively, forklift trucks can be modified to lift the rolls with a steel bar, securely attached to the fork lift and inserted into the roll core. At no time will the rolls be lifted by sliding the forks under the roll.
- The rolls of GCL will be stored in their original, unopened, wrapped cover in a clean, dry area. The material will be stored off the ground on pallets or by other suitable techniques that provide continuous support over the entire length of the roll. It will be covered with a heavy, protective tarpaulin or stored beneath a roof. Care will be used to protect the GCL from the following:
  - Precipitation
  - Ultraviolet radiation, including sunlight
  - Strong oxidizing chemicals, acids or bases
  - Flames, including welding sparks
  - Temperatures in excess of 160°F

The CQAT will be responsible throughout the preinstallation, installation, and post- installation periods, for observing and documenting that the Installer provides adequate handling equipment used for moving GCL rolls and that the equipment and handling methods used do not pose any risk of damage.

The CQAT will be responsible for making certain that the name of the manufacturer, the type, and the thickness of each roll (as noted on the roll marking label described above) are correct. The CQAT will also maintain a log of GCL roll deliveries. The following information, at a minimum, will be recorded on the log for each shipment received at the job site:

- Date of receipt of delivery at job site
- For each GCL roll, the following information will be noted:
  - Roll number
  - Batch (lot) number

9.2.4 Submittals

Submittals will be made prior to installation of the GCL concerning the GCL manufacturer/production information and the GCL installer information.

The GCL Manufacturer/Production Information will include the following:

- Corporate background and information.

- Manufacturer's Quality Control Plan (MQCP) for bentonite, geotextile, and GCL manufacturers.
- Project reference list consisting of the principal details of at least 10 projects totaling at least 8 million square feet of GCL installation, if required by the CQAT or CQA Officer.
- Results of tests conducted by the Bentonite Supplier and Geotextile Supplier to document the quality of the materials used to manufacture the GCL rolls assigned to the project.
- Copy of quality control certificates, signed by a responsible entity of the Manufacturer. Each quality control certificate will include roll identification numbers, and the results of quality control tests (refer to Subsection 9.2.1 above for minimum testing requirements).
- Manufacturer's written certification that the GCL meets the project specifications, that the GCL has been continuously inspected and found to be needle-free, that the bentonite will not shift during transportation or installation, and that the bentonite and geotextile materials meet the Manufacturer's specifications.

GCL Installer information will include the following:

- Corporate background information.
- Project reference list consisting of the principal details of at least five projects totaling at least 1 million square feet, if required by the CQAT or CQA Officer.
- List of personnel performing field operations, along with pertinent experience information, if required by the CQAT or CQA Officer.

The proposed panel layout diagram identifying placement of the GCL panels and seams, as well as any variances or additional details that deviate from the engineering drawings will also be submitted prior to installation. The layout will be drawn to scale, will include information such as dimensions and details, and will be adequate for use as a construction plan.

9.3 Installation

The following installation procedures are designed to ensure the effectiveness of the GCL in meeting its design requirements and to simplify the deployment procedures. These procedures are to be followed by the Installer, unless the Installer proposes alternative procedures in writing and the CQA Officer approves them in writing prior to installation.

9.3.1 Testing Requirements

This subsection describes the test methods, including sampling procedures and frequencies, and the role of the Geosynthetic Testing Laboratory in testing the GCL roll samples. Unless specified otherwise, all sampling procedures will be performed in accordance with the referenced test method defined in this section.

GCL roll samples will be collected by the Contractor at the discretion of, and under the direction of, the CQAT, at a rate specified by the CQAT.

Samples will be 3 feet long by the full width of the roll and will not include the first 3 feet of any roll.

Table 12-1 lists the tests and the test methods that may be performed on GCL roll samples. The specifications and methods used in evaluating the results are discussed later in this subsection. At a minimum, the testing required by NR516.07(2m)(a) will be conducted on the GCL.

9.3.1.1 Role of Testing Laboratory

The Geosynthetic Testing Laboratory will be responsible for performing the tests on samples submitted to them. The results of tests performed will be reported to the CQAT and CQA Officer.

Retesting of GCL rolls for quality assurance purposes, because of failure to meet any or all of the acceptance specifications in this section, can only be authorized by the CQA Officer.

The GCL Manufacturer and/or Installer may perform their own tests according to the methods and procedures defined in Table 9-1; however, the results will only be applicable to their own quality control needs. These results will not be substituted for the quality assurance testing described herein.

9.3.1.2 Procedure For Determining GCL Roll Test Failures

Table 9-1 lists the specifications that are applicable to the GCL. For any referenced test method that requires the testing of multiple specimens, the criteria in Table 9-1 will be met based on the average results of the multiple specimen tests.

The following procedure will be used for interpreting the results relative to acceptance or rejection of rolls, lots, and shipments of GCL to the site:

1. If the test values meet the stated specifications, then the roll and batch will be accepted for use at the job site. If the sample represents all rolls from an entire shipment, then the entire shipment will also be considered accepted.
2. If the results do not meet the specification, then the roll and the batch will be retested at the Contractor's expense using specimens either from the original roll sample or from another sample collected by the CQAT. For retesting, two additional tests will be performed for the failed test procedure. (Each additional test will consist of multiple specimen tests if multiple specimens are called for in the failed test procedure.) If both of the retests are acceptable, then the roll and batch will be considered as having passed this particular acceptance test; if either of the two additional tests fail, then the roll and batch

will be considered as being unsuitable without further recourse. The CQAT may obtain samples from other rolls in the batch. On the basis of testing these samples, the CQA Officer may choose to accept a portion of the batch while rejecting the remainder.

3. If retesting does not result in passing test results as defined in the preceding paragraph, or if there is any other nonconformity with the material specifications, then the Contractor will withdraw the rolls from use in the project at Contractor's sole risk, cost, and expense. Once withdrawn, the same rolls will not be resubmitted for use. Expenses for removing this GCL from the site and replacing it with acceptable GCL will be the sole risk and responsibility of Contractor.

9.3.2 Required Equipment

The following installation equipment is required on-site:

- Front end loader, crane, or other similar equipment. The selected piece of equipment will not cause damage to the subgrade, such as rutting. The Installer will verify in the presence of the CQAT that the selected piece of equipment does not damage the subgrade.
- A spreader bar to prevent slings from damaging the ends of the rolls.
- Several steel pipes to be inserted into the roll's core for lifting.
- Wooden pallets for aboveground storage of the GCL rolls.
- Heavy waterproof tarps for protecting all GCL rolls.
- Sandbags for securing the GCL during installation and for securing the tarps.
- Adhesive or tape for securing patches.
- Granular bentonite for seams and patches, and for securing around penetrations and structures as shown on the drawings.

9.3.3 Surface/Subgrade Preparation

GCL liner installation will not begin until a proper subbase has been prepared to accept the bentonite liner. Base material will be fine-grained soil free from angular rocks, roots, grass, and vegetation. Foreign materials and protrusions will be removed, and all cracks and voids will be filled; the surface will be made smooth and uniformly sloping. Unless otherwise required by the contract specifications and drawings, the prepared surface will be free from excessive moisture, loose earth, rocks or clay clods larger than 2 inches in diameter, rubble, and other foreign matter. The subgrade will be uniformly compacted to a minimum of 90 percent Modified Proctor density (ASTM D1557) or 95 percent Standard Proctor density (ASTM D698), to ensure against localized settlement and rutting under wheel loads and will be smoothed with a smooth drum or vibratory roller.

The surface on which the liner is to be placed will be maintained in a firm, clean, and smooth condition, free of standing water, during liner installation.

9.3.4 Deployment

As each roll is moved from the storage area, the labels will be removed by the Installer or CQAT for storage in the project file.

The rolls of GCL will be brought to the area to be lined with a front-end loader, and support pipe will be set up such that the roll of liner is fully supported across its length. A spreader bar or similar device will be used to prevent the lifting chains or slings from damaging the edges. Dragging of the GCL liner will be minimized.

The Contractor will ensure, and the CQAT will verify, that the following criteria are being met:

- The equipment used does not damage the GCL by handling, excessive heat, leakage of hydrocarbons, or by other means.
- The prepared surface underlying the GCL has not deteriorated since previous acceptance, and it is still acceptable at the time of GCL placement.
- Personnel working on the GCL do not smoke, wear damaging clothing, or engage in other activities that could damage the GCL.
- The method used to unroll the GCL does not cause damage to the GCL, and/or the subgrade.
- The method used to place the rolls minimizes wrinkles (especially wrinkles between adjacent panels).

GCL must not be placed during precipitation events, in the presence of excessive moisture, in any area of ponded water, or during excessive winds. The GCL must be dry when installed and must be dry when covered.

The proper side of the GCL, as per the manufacturer’s recommendation, will face upward (unless otherwise dictated by project requirements). The liner will be placed over the prepared surface such that material handling will be minimized.

The GCL panels will be placed in a manner that ensures sufficient overlap as described in Subsection 12.3.5. Horizontal seams will not occur on slopes steeper than 7H:1V.

The cover material (i.e., geomembrane) will be placed over the bentonite liner during the same day as the placement of the GCL. Only those GCL rolls that can be covered that same day will be unpacked and placed in position.

When wind conditions could affect installation, the GCL liner installation will be started at the upwind side of the project and will proceed downwind. The leading edge of the liner will be secured at all times with sandbags or other means sufficient to hold it down during high winds.

The GCL will be installed in a relaxed condition and will be free of tension or stress upon completion of the installation. Stretching of the liner to fit will not be allowed. Deployed rolls (panels) will be straightened by the installation personnel to smooth out creases or irregularities.

The CQAT will visually inspect the geotextile's quality, the bentonite uniformity, and the degree of hydration, if any, of the GCL. Any areas in need of repair will be marked.

9.3.5 Seaming

Once the first panel has been deployed, adjoining panels will be laid with a 6-inch minimum overlap on longitudinal seams, and 20 inches on the panel end seams, depending on project specifications. Six-inch overlap lines will be marked on the liner to assist in obtaining the proper overlap. All dirt, gravel, or other debris will be removed from the overlap area of the GCL.

Seam overlaps, whenever possible, will be placed such that the direction of flow is from the top panel to the underlying panel to form a shingle effect.

If the GCL requires a granular bentonite seam, then the overlapping panel edge will be pulled back and granular Volclay® (or approved equivalent) sodium bentonite will be poured continuously along all seams and lap areas from the panel edge to the 6-inch lapline, at a minimum application rate of ¼ pound per linear foot or as recommended by the manufacturer.

9.3.6 Patches/Repairs

Irregular shapes, cuts, or tears in the installed GCL will be covered with sufficient liner to provide a 12-inch overlap in all directions beyond the damaged area. A layer of granular bentonite will be placed in the overlap zone in accordance with the Manufacturer's recommendations. An epoxy-based adhesive, or other approved method, will be used to secure the patch during backfill operations. Alternatively, the patch can be placed underneath the defective liner.

9.3.7 Penetration Seals

The GCL will be sealed around penetrations, pipes, and structures in accordance with the recommendations of the GCL Manufacturer.

Pipe penetrations will incorporate a collar of GCL wrapped around the pipe and securely fastened. A bentonite or mastic grout will be placed around the corners for additional protection. An additional GCL skirt placed over the bentonite grout is also recommended to provide a third level of protection and to prevent the bentonite grout from being displaced. If the seal requires granular bentonite, then a 1- to 2-inch cut will be excavated around the circumference of the pipe, into the subgrade at least 12 inches out from the pipe. Volclay® sodium bentonite (or approved equivalent) will then be packed around the pipe in the subgrade excavation and on adjacent areas so that the pipe is surrounded with granular bentonite. The GCL panel will then be placed over the pipe by penetrating the GCL with slits in a ″pie″ configuration where the pipe is to protrude in a manner that will create a snug fit between the GCL and the pipe. More sodium bentonite will then be spread around the cut edges of the GCL against the pipe and over adjacent areas. To complete the pipe penetration seal, a collar of GCL will be cut in a manner similar to that made on the main panel and will be fit around the pipe, with additional Volclay® sodium bentonite (or approved equivalent) being applied into any gaps that may remain.

9.3.8 Covering GCL

Only the amount of GCL that can be inspected, repaired, and covered with geomembrane in the same day will be installed. The GCL must be covered with geomembrane or alternative temporary cover the same day on which it is installed.

9.3.8.1 Geosynthetics

When covering the GCL, precautions will be taken to prevent damage to the GCL by restricting heavy equipment traffic. If a textured geomembrane is to be placed over the GCL, the CQAT may require a slip sheet (such as 20-mil smooth HDPE) will be placed over the GCL to allow the textured geomembrane to slide into its proper position. The slip sheet will be removed after the geomembrane is in place.

The following requirements apply to soil placement over the GCLs:

- Equipment used for placing the soil must not be driven directly on the GCL.
- A minimum thickness of 1 foot of soil is specified between a light dozer (i.e., maximum contact pressure of 5 lb/sq. inch) and the GCL.
- A minimum thickness of 3 feet of soil is specified between rubber-tired vehicles and the GCL.

Any leading edge or panels of GCL left unprotected must be covered with a heavy, waterproofing tarp that is secured and protected with sandbags or other ballast.

9.3.9 Submittals

The following will be submitted during installation:

- Daily records/logs prepared by the Installer documenting work performed, personnel involved, general working conditions, and any problems encountered or expected on the project. These records will be submitted on a weekly basis.
- Copy of daily subgrade acceptance forms by the Installer.
- Quality control documentation.

9.4 Post-Installation

9.4.1 Final Examination

The CQAT will perform a final GCL examination after portions of installation have been completed. The CQAT will examine the GCL for the following:

- Tears or defects
- Proper overlaps

If any portion of the GCL requires repairs based on the above examination, it will be repaired in accordance with the procedures in Subsection 9.3.6.

9.4.2 Submittals

The following will be submitted after installation is complete:

- Installation certification prepared by the Installer certifying that the GCL was installed in substantial accordance with the specifications and the CQA Plan.
- An as-build panel layout diagram prepared by the Installer identifying the placement of panels and seams. The numbering sequence will be as agreed upon between the CQAT and the Installer prior to commencing installation.
- A copy of the Warranty obtained from the Manufacturer/Installer.

10. High Density Polyethylene Pipe Observations and Testing

The following section defines the CQA program for installation of the high-density polyethylene pipe used for leachate collection, leachate transfer, and cover piping.

10.1 Material Specifications

The HDPE piping used must be made of from extra high molecular weight (EHMW) polyethylene (PE) resin, and manufactured piping must be classified as Type III, Class C, Category 5, Grade PE 34 material according to ASTM D 1248 and must also have a cell classification of 345434C as defined by ASTM D 3350. Pipe will be free of paint or surface treatments.

10.2 Delivery, Storage, and Handling

Each bundle of pipe will be marked with the following information:

- Name of Manufacturer
- Product type and identification number
- Batch (or lot) number
- Date of manufacture
- Pipe diameter (ID)
- Pipe Standard Dimension Ratio (SDR)

Pipe will be protected from puncture or other damage and from deleterious conditions. Contractor will provide adequate equipment for moving and handling the pipe. Contractor is responsible for the means and methods to implement the work.

10.3 Pipe Seams

Unless otherwise approved by CQA Officer, HDPE pipe seams will be made by butt fusion procedure in accordance with the manufacture's specifications. The CQAT will observe and document welding is performed as per manufactures specifications.

10.4 Pipe Placement

Pipe placement will be in accordance with the following requirements:

- Pipe placement will not be performed in presence of excessive moisture. This will be documented by the CQAT.
- That the method used to place the pipe has not caused damage to underlying materials or the pipe. This will be documented by the CQAT.
- That all piping has been placed to the lines and grades as indicated on the drawings. Contractor is responsible for the correct lines and grades of the pipe placement. Pipe inverts (or top of pipe) will be surveyed at a minimum of 25-foot intervals and at all tee and elbow connections. The CQAT will document the lines and grades.

10.5 Post-Construction

Leachate collection pipes will be cleaned with a water jet cleanout device with a maximum pressure of 10,000 pounds per square inch after collection pipe and leachate drainage layer installation is complete. The pipes will be cleaned by jetting from each cleanout access point to the toe of the opposite sideslope. Any pipes that do not appear to be free flowing will be immediately reported to the CQA Officer, and corrective action will be taken.

A video camera inspection will be conducted on all leachate collection pipes after initial pipe cleaning activities described above. The video camera inspection will extend a minimum of 300 feet onto the base grades of each leachate collection pipe.

A summary report will be submitted after the pipe cleaning and video camera inspection. The report will summarize any specialty equipment used in collection pipe cleaning, blockages or difficulties in cleaning pipes, and how blockages were removed, or pipe damage repaired. Recording tape or disk of the video camera inspection will be included with the summary report.

Solid-wall pipe (single- and double-walled) outside the limits of waste will be air pressure–tested to document that the piping system is airtight. The line will be air-pressurized to 5.0 pounds/square inch (gauge pressure). The valve on the pressurizing unit will be closed, and the system will be pressure monitored. A system pressure of 4.8 psi or greater maintained for 30 minutes after the valve closing will be considered as acceptable. The CQAT will observe and document that this operation is carried out and that the pipes are airtight.

Pipe invert elevations will be documented every 25 linear feet by survey or every 50 feet if a total station, GPS, or laser equipment is used, as well as at key points, including changes in grade, intersections, and end points.

11. Construction Certification Report

11.1 Summary

A Construction Certification Report shall be prepared under the direction of the CQA Officer in accordance with NR 516 of the Wisconsin Administrative Code. The report will contain, at a minimum, the following information:

Based on the review of the data and the CQA Officer's personal observations during construction, the CQA Officer shall certify that the construction has been prepared and constructed in conformance with the engineering plans and specifications.

- Daily Field Reports.
- Detailed narrative describing the construction activities in chronological order.
- Analysis and discussion of all quality assurance testing performed with summaries of all test results.
- All raw data and test reports performed during construction.
- Detailed description and documentation of all material and equipment types and specifications.
- Discussion of any construction material or equipment which deviated from the engineering plan and reasons for deviation.
- Photographs documenting all aspects of construction.
- Record drawings containing:
  - Existing site grades prior to construction.
  - Liner system subgrade grades.
  - Granular drainage layer thickness measurement locations.
  - Pipe invert grades.
  - Geomembrane panel layout diagram, including seam locations and types, repair locations, destructive sample locations, and anchor trench location.
  - Location of all field tests.
  - Final site grades.
- Correspondence and documentation with WDNR concerning rule exceptions or CQA changes.

Appendix A

Field Report

FIELD OBSERVATION REPORT

Project:		**Date:**	
Client:	.	**Weather:**	
Contractor:		**Report No:**	
Location:		Page:	
Arrival Time:		GEI Project No:	
Departure Time:		**Prep and Report Time:**	
Travel Time:		**Mileage:**	
Total Hours:			
Purpose of Site Visit:			
Observations:			
Technician:		Date:	
Reviewed by:		Date	
Final Review by:		Date:	

Photo 1:

Photo 2:

Photo 3:

Photo 4:

Appendix B

Certificate of Acceptance of Prepared Subgrade

Certificate of Acceptance
Of Prepared Subgrade

GEI

GEOSYNTHETICS CONTRACTOR

NAME: ______________________________

ADDRESS: ______________________________

____

PROJECT

LOCATION: ______________________________

PROJECT: ______________________________

____

I, _________________________, a duly authorized representative of _________________________, have visually inspected the subgrade surface described above and found the surface to be acceptable for installation of the GCL. I do hereby accept the soil subgrade area as described below and shall be responsible for its integrity for suitability, installation, and future containment performance in accordance with these specifications from this date to completion and acceptance of the installation. This certification is based on observations of the surface of the subgrade only.

Area Accepted: ____

____

____

SUBGRADE RELEASED BY:

GENERAL CONTRACTOR

DATE: ______________________________

AUTHORIZED REPRESENTATIVE:

SIGNATURE: ____________________________

NAME: ____________________________

TITLE: ____________________________

SUBGRADE ACCEPTED BY:

GEOSYNTHETICS CONTRACTOR

DATE: ______________________________

AUTHORIZED REPRESENTATIVE:

SIGNATURE: ____________________________

NAME: ____________________________

TITLE: ____________________________

SUBGRADE OBSERVED BY:

CQA CONSULTANT

DATE: ______________________________

AUTHORIZED REPRESENTATIVE:

SIGNATURE: ____________________________

NAME: ____________________________

TITLE: ____________________________

Appendix C

Initial Roll Inventory

Initial Roll Inventory

GEI Consultants

Project Name: ____________________ QA/QC Monitor: ____________________

Project Number: ____________________ Material Type: ____________________

Roll Number	Lot Number	Width/Length	Conf. Sample (Yes/No)	Certificate Sheet (Yes/No)	Date Shipped to Lab	Lab Pass/ Fail	Visual Inspection/Remarks

Appendix D

Panel Placement Summary

Panel Placement Summary

Project Name: ______________________ QA/QC Monitor: ______________________

Project Number: ______________________ Material Type: ______________________

Panel Number	Date	Time	Roll Number	Material Type	Thickness (mils)					Final Length (Feet)	Final Width (Feet)	Final Area (Sq. Ft.)	Comments

Appendix E

Trial Weld Summary

GEI Consultants

Trial Weld Summary

Project Name: ______________________

Project Number: ______________________

QA/QC Monitor: ______________________

Requirements: Peel 50(F) 44(E) Shear: 60

Test No.	Date	Time	Weather (Cloudy/ Sunny)	Amb. Temp. (°F)	Welder I.D.	Machine Number	Temp. Setting/ Speed	Weld Type	(5) PEEL (ppi)										(5) SHEAR (ppi)					Test Result (P/F)	Comments
									(5) Outside Weld					(5) Inside Weld											
									1	2	3	4	5	1	2	3	4	5	1	2	3	4	5		
1																									
2																									
3																									
4																									
5																									
6																									
7																									
8																									
9																									
10																									
11																									
12																									
13																									
14																									
15																									
16																									
17																									

Appendix F

Panel Seaming Summary

Panel Seaming Summary

Project Name: ____________________ QA/QC Monitor: ____________________

Project Number: ____________________

Seam Number	Date Seamed	Final Seam Length (Feet)	Welder Id.	Weld Type	Machine Number	Machine Temp/ Speed/ Preheat	Time		Ambient Temp. (°F)	End of Seam Destructive Test (P/F)	Comments
							Start	Stop			

Appendix G

Non-Destructive Test Summary

Non-Destructive Test Summary

Project Name: ______________________________ QA/QC Monitor: ____________________

Project Number: ______________________________ Requirements: Mil=min psi - max psi drop

Seam Number	Date Tested	Location	Air					Vacuum	Comments
			Air Pressure				Air Test Results (P/F)	Vac. Test Results (P/F)	
			Start		End				
			PSI	Time	PSI	Time			

Appendix H

Repair Summary

Repair Summary

Project Name: ______________________ QA/QC Monitor: ______________________

Project Number: ______________________

Repair Number	Date	Time	Oper./Mach.	Repair Location	Description	Size of Repair	Date Vacuum Tested	Test Results (P/F)

Appendix I

Destructive Test Summary - Field

Destructive Test Summary - Field

Project Name: ____________________ QA/QC Monitor: ____________________

Project Number: ____________________ Requirements: Peel - / Shear

Sample Number	Seam Number	Date Sampled	Date Shipped	Description of Sample Location	Peel (ppi)		Shear (ppi)	Laboratory Results (P/F)	Comments
					Inside	Outside			

Appendix J

Destructive Test Summary - Laboratory

Destructive Test Summary - Laboratory

Project Name: ______________________ QA/QC Monitor: ______________________

Project Number: ______________________ Requirements: Peel - / Shear

Sample Number	Seam Number	Date Sampled	Date Shipped	Description of Sample Location	Peel (ppi)		Shear (ppi)	Laboratory Results (P/F)	Comments
					Inside	Outside			

Appendix K

Field Compaction Summary

Field Compaction Summary

Project Name: ______________________ Compaction Equipment: ______________________

Project Number: ______________________ Density Equipment: ______________________

Test No.	Date	North	East	Lift	Material Number	Lab. Max Dry Density	In-Place Wet Density	Moisture Content	In-Place Dry Density	Percent Compaction	Comments
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											
13											
14											
15											
16											
17											
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32											
33											
34											
35											
36											