DRAFT FOR PUBLIC COMMENT

Antidegradation Alternatives Analysis

Neal North Outfall 016

MidAmerican Energy Company

March 03, 2023

The Power of Commitment

Engineer Certification

I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa.

Michael Alowitz, P.E. **Date**

License Number: 18160

My license renewal date is: December 31, 2024

Pages or sheets covered by this seal: Entire Document

GHD
11228 Aurora Avenue,
Des Moines, Iowa 50322-7905, United States
T +1 515 414 3933 | **E** info-northamerica@ghd.com | **ghd.com**

Document status

Status Code	Revision	Author	Reviewer		Approved for issue		
			Name	Signature	Name	Signature	Date
S0	1	M. Alowitz	J. Simon		M. Alowitz		9/7/2022
S3	1	M. Alowitz	T. Beeching		M. Alowitz		9/8/2022
S4	1	M. Alowitz	MidAmerican	NA	M. Alowitz		10/3/2022
[Status code]							
[Status code]							

Executive summary

MidAmerican Energy Company (MidAmerican) operates the George Neal Energy Center – North (Neal North) steam electric plant in Sergeant Bluff, Iowa. An evaluation of wastewater stream containing leachate was conducted because prior operational experience determined that a zero-discharge operation is not a viable long-term practice.

The plant produces coal combustion residue (CCR) which is stored in an on-site Monofill. Precipitation that passes through the in place CCR collects as leachate. Currently leachate is pumped to a holding pond. Past attempts to enhance nature evaporation with mechanical evaporators were unsuccessful.

Five alternative approaches to manage leachate water are identified in this AAA. The Base Pollution Control Alternative (BPCA) is hauling the contents of the Leachate Pond to the Publicly Owned Treatment Works (POTW) to ensure adequate capacity remains in the Leachate Pond. Three Less-Degrading Alternatives (LDAs) were considered: piping water to the POTW, physical/chemical treatment, and discharge out existing Outfall 016. A Non-Degrading Alternative (NDA) of zero-discharge was also included, although operation experience indicates this is not practicable.

Discharge via existing Outfall 016 was identified as the best alternative. It is practical, cost-effective, compatible with the existing wastewater treatment system, and will meet the limits of the current Waste Load Allocation (WLA), most stringent Effluent Limit Guidelines (ELGs) and Water Quality Standards (WQS).

Public notifications of this AAA were completed. [Add Update After Public Comment Period Complete].

Contents

Contents (cont’d)

Table index

Appendices

1. Introduction

1.1 Existing Conditions

MidAmerican Energy Company's (MidAmerican's) George Neal Energy Center – North (Neal North) plant in Sergeant Bluff, Iowa is a steam electric power plant. The facility serves MidAmerican's customers across Iowa. The discharge of wastewater from Neal North is permitted under National Pollutant Discharge Elimination System (NPDES) Permit Number 9700102.

Outfall 016 releases water from the clay and plastic lined Process Water Pond to the Missouri River. Existing Outfall 003 discharges water from the former coal combustion residue (CCR) impoundments to the Missouri River via an unnamed stream. This Antidegradation Alternatives Analysis addresses Outfall 016 with the knowledge that Outfall 003 is closing.

1.2 Recent Activities

In 2009, MidAmerican constructed a composite-lined CCR Monofill for disposal of CCR consistent with Resource Recovery and Conservation Act (RCRA) Subtitle D standards applied to a Municipal Solid Waste (MSW) landfill. The standards exceeded the State of Iowa standards and are consistent with the current Federal standards for CCR facilities. The composite liner consisting of 2-feet of compacted clay and 60-mil high density polyethylene (HDPE) liner collects water that percolates through the CCR. This collected water, or leachate, was originally stored in frac tanks and used for dust control and conditioning of freshly placed CCR. In 2011, the NPDES Permit was renewed to include the addition of leachate via Outfall 003. The containerized system was abandoned and leachate was discharged through Outfall 003 starting in 2012.

In 2018, MidAmerican constructed a non-discharging Leachate Pond adjacent to the Process Water Pond and Outfall 016. There is no direct connection between the Leachate Pond and the Process Water Pond. The Leachate Pond was intended to be managed as a zero-discharge pond (a greater water loss on average per year than leachate pumped to the Leachate Pond, precipitation falling on or running into the pond). Reduction in Leachate Pond volume was to through 1) natural evaporation, 2) leachate used for dust control, and 3) mechanical evaporators. In 2018, leachate was redirected from Outfall 003 to the Leachate Pond.

Leachate Pond initial use coincided with a wet period of weather leading the Leachate Pond to fill faster than anticipated. Mechanical evaporators where installed and pilot tested over one and a half seasons. A letter report dated January 16, 2020 is provided as Attachment A and reports mechanical evaporator operation during 2019 pilot testing. An operational concern was drift of water droplets outside the lined area of the Leachate Pond. Adjustments were completed in 2020 in an attempt to manage drift. Ultimately it was determined drift could not be reliably managed and use of mechanical evaporators was discontinued despite the effective enhanced evaporation rates. The infrastructure for four mechanical evaporators including controls and electrical connections have remained out of use since summer of 2020. In 2021, to ensure the Leachate Pond maintained adequate freeboard and evaluate degree of sedimentation, the contents of the Leachate Pond were hauled to the local Publicly Owned Treatment Works (POTW).

Efforts to reduce leachate generation include adjusting the CCR Monofill filling plan and adding a rain cover over a large portion of the fill area. The current Monofill footprint is approximately 13.6 acres. Due to lower CCR production rates, the Monofill has not filled as swiftly as initially envisioned. Therefore, the entire open area was not needed. A rain cover consisting of a scrim reinforced plastic cover and a wind protection layer was installed over approximately 4.7 acres in 2019 to reduce leachate generation by reducing the infiltration area. The rain cover is expected to remain in place for multiple years. The fill patterns within the Monofill have been developed to help minimize pooling water and leachate generation.

In 2021, 1,634,504 gallons of leachate were generated and directed to the Leachate Pond. The amount of leachate generated year-to-year is highly variable with precipitation and CCR fill patterns (e.g., opening a new cell) and as significant factors. The volume in the Leachate Pond represents both leachate pumped (Table 1.1) to the pond and precipitation onto the pond or surrounding area that drained into the pond.

Table 1.1 Annual Leachate Generation 2019-2022.

Year	Gallons Leachate Pumped to Leachate Pond [1]
2019	4,570,313
2020	2,465,745
2021	1,634,504
2022	722, 251

[1] Values represent leachate volume pumped from Monofill to Leachate Pond. Leachate Pond volume also include run-on and precipitation.

The Leachate Pond remains in use and discharge of leachate is currently permitted through Outfall 003. Due to changes in piping configurations, changes in use of Outfall 003, and potential safety factor to address an upset condition in the Leachate Pond, it is not desirable to re-instate the leachate discharge to Outfall 003.

1.3 Proposed Changes

The potential for the Leachate Pond to overfill without a discharge option led to an evaluation of alternative management approaches. This Antidegradation Alternatives Analysis (AAA) has been prepared to address changes to Outfall 016 contemporaneous with elimination of Outfall 003. The preferred alternative to improve leachate management is to add leachate as a permitted wastewater for Outfall 016. At the same time, Outfall 003 (which currently includes leachate as a permitted wastewater source) would be removed from the permit resulting in an overall decrease in permitted discharge volume. The original permitted flow for Outfall 016 would increase by 100 gallons per minute (gpm). No changes to other permitted discharges or process wastewater sources are anticipated.

1.4 Receiving Stream

The plant wastewater addressed by this AAA discharges through Outfall 016 to Missouri River after passing through the Process Water Pond. The Missouri River is a major river designated Class A1 (primary contact recreation), Class B (WW-1) wherein the condition area is suitable to maintain water game fish populations with a resident aquatic community, and Class HH for waters used as a drinking water source and/or fish routinely harvested for consumption (IDNR, 2021a).

The stretch of Missouri River to which Outfall 016 discharges is listed as impaired in Iowa's 2020 Integrated Report (IDNR, 2021b). The stretch of Missouri River to which Outfall 016 discharges (Segment ID IA 06-WEM-1722, legacy ADB Code IA 06-WEB-0040_3) is listed as impaired for Category 5 – meaning impaired or threatened and a total maximum daily load (TMDL) value is needed. The impairment is indicator bacteria *Escherichia coli* (*E. coli*). The segment is also assessed as impaired (non-pollutant stressor) for flow alteration and habitat alternations due to past river alterations.

2. Receiving Stream Network

2.1 General

The discharge receiving stream network consists of discharge to the Missouri River. The current receiving stream network designation and impairment status are summarized below in Tables 2.1 and 2.2, respectively.

Table 2.1 Current Stream Designation for Receiving Stream Reach

Stream	Current Designation	Source
Missouri River	A1, B (WW-1), HH	IDNR, 2021a

Table 2.2 Current Impairment Status

Stream	Impairments	Notes	Source
Missouri River	Indicator bacteria Non-pollutant stressor	Multiple downstream segments impaired	IDNR, 2021b

2.2 Effluent Limits

Effluent limits for Outfall 016 are established but should be adjusted to reflect proposed changes in total flow.

2.2.1 Wasteload Allocation

Wasteload Allocation calculations and notes dated February 23, 2023, are provided in Appendix B. This update reflects conditions after closure of Outfall 003 and with the potential addition of 100 gallons per minute of leachate entering the process water pond prior to Outfall 016 discharge.

2.2.2 Existing Limits and Applicability

Outfall 016 includes low volume wastewater such as blowdown from under-boiler submerged flight conveyor quench water, reverse osmosis reject, floor drains, low volume waste, demineralizer regeneration waste, non-chemical metal cleaning waste, auxiliary boiler blowdown in addition to stormwater. Discharges also include chemical and non-chemical metal cleaning wastewater, stormwater, and roof drains.

Low volume waste streams are subject to federal effluent guidelines (ELGs) defined in 40 Code of Federal Regulations (CFR) 423.12 (b)(3). These standards regulate the discharge of total suspended solids (TSS), and oil and grease (O&G). The monthly average limits established by 40 CF 423.12(b)(3) are 30 mg/L TSS and 15 mg/L O&G.

2.2.3 Leachate Related Limits

This AAA considers adding CCR leachate from an on-site CCR landfill to Outfall 016. In 2015, ELGs were updated for Steam Electric Power Generating industry that included leachate from CCR landfills (40 CFR, Chapter I, Part 423). Portions of these ELGs, including leachate from existing sources, were vacated by United States Court of Appeals for the Fifth Circuit in April 2019 and are no longer considered applicable. The vacated ELGs established limits for arsenic and mercury. Although vacated, these arsenic and mercury ELGs are relevant for consideration in evaluating this AAA and changes to the leachate management. These ELGs apply to leachate prior to mixing with low volume waste in the process water pond. The Best Practicable Control Technology (BPT) limits addressing TSS and O&G in leachate remain applicable and the vacated ELGs may apply as a Best Achievable Technology (BAT).

3. Design Conditions

The process water pond is designed for sedimentation of incoming process water. A consideration is to ensure additional flow to the process water pond does not impact settling time and the total suspended solids (TSS) effluent limit of 30 milligrams per liter (mg/L) is not exceeded. The overall consideration regarding the Leachate Pond is to avoid an uncontrolled release due to overtopping.

4. Alternative Development and Analysis

4.1 General

Unless specifically noted, the alternatives assume the Leachate Pond remains in place and use of water for dust control on a lined Monofill continues. The evaluated alternatives are classified as Non-Degrading Alternative (NDA), Less Degrading Alternative (LDA), or Base Pollution Control Alternative (BPCA). Cost estimates, including supporting calculations, are located in Appendix C. Alternatives, except the NDA, assume 3,000,000 gallons of water are removed from the Leachate Pond annually.

4.2 Alternative 1 –POTW Discharge of Leachate (BPCA)

This alternative represents recent operational practice. The Leachate Pond, including infrastructure to load out trucks, already exists. Costs for this alternative include transportation to City of Sioux City Publicly Owned Treatment Works (POTW), testing, and POTW fees for the discharged volume. The POTW process is geared toward treatment of biological oxygen demand (BOD) and would address suspended solids, oil and grease and pH. Metals may be affected by the treatment process but are not the target of municipal water treatment. The POTW represents a permitted, operational facility to process the water accumulated in the Leachate Pond. This alternative is flexible but relatively slow due to trucking limitation if an emergency need arose to lower the pond level. Hauling over-the-road has several disadvantages including:

- Increased chance of an accident each mile driven
- Potential for an uncontrolled release due to accident or damage
- Increased carbon emissions from diesel combustion relative to alternatives

Due to existing infrastructure, there are no capital costs associated with this alternative. For cost estimating purposes, it was assumed 3,000,000 gallons would be hauled form the Leachate Pond to POTW annually. The cost estimate for the BPCA was approximately $1,900,000 for operation and maintenance over a 20-year period. Cost estimate details are provided in Appendix C.

Under this alternative, leachate could bypass the Leachate Pond if it continues to meet anticipated internal outfall limits. Maintaining the Leachate Pond, however, provides additional protection against upset conditions and is the preferred method of operation.

4.3 Alternative 2 – Direct Discharge of Leachate to POTW

This alternative would construct a pipeline to the existing POTW forcemain located along Port Neal Road. This alternative requires a pre-treatment agreement with the POTW and significant infrastructure construction. There is limited capacity in the existing forecemain and a near-continuous low volume flow discharge could be accommodated. A pipeline would need to be constructed over more than two miles including crossing private property. Costs for this alternative are dominated by capital costs as shown in Appendix C and operating costs are based on 3,000,000 gallons per year being pumped through the force main. The total estimated cost for this alternative over 20 years is $5,000,000.

4.4 Alternative 3 – Zero-Discharge Leachate Pond (NDA)

MidAmerican pursued this alternative through a pilot study of mechanical evaporators in 2019 and 2020 immediately after the construction of the Leachate Pond. MidAmerican operated the Leachate Pond with four mechanical evaporators to enhance evaporation. Operational constraints due to wind drift of droplets made the mechanical evaporators impractical to operate. This alternative is considered non-discharging in theory; however, in practice, observed wind-carried evaporator droplets may be considered a discharge. Use of water for dust control and CCR conditioning is limited by the amount of CCR and natural evaporation from the CCR. This process is considered non-discharging because any leachate that percolates through the CCR will be collected and returned to the Leachate Pond. Although this is a means by which some Leachate Pond water may be used, it is a limited volume and evaporation (natural and mechanical) is the primary mechanism to control the volume of the Leachate Pond.

Operational experience over multiple seasons indicates it is impractical to maintain the Leachate Pond with acceptable freeboard levels long-term in a zero-discharge scenario. There are no capital costs for this alternative because it was previously implemented. For purposes of cost comparison, the use of the four previously operational mechanical evaporators (with a 25 horsepower [hp] blower and 1.5 hp pump motor each) is assumed. Operations and maintenance costs include the evaporators, leachate loadout station, and general pond inspections. Operational costs are estimated at $480,000 for 20 years (Appendix C). However, given the potential to overflow without an outlet, additional costs will likely be incurred prior to 20 years to manage the additional water volume.

4.5 Alternative 4 – Physical Chemical Treatment of Leachate (LDA)

This approach relies on treatment infrastructure including a large holding or equalization tank, clarifiers, filters, and a filter press to meet effluent criteria. This alternative would use the existing Leachate Pond as an equalization basin so a steady flow rate could be applied to the treatment system.

The treatment process will likely create a sludge or a concentrated brine solution that will need to be handled on a routine basis. The treatment system would likely be installed near the Monofill and treated water pumped to Outfall 016.

Data collected in 2021 and 2022 indicate the leachate prior to reaching the Leachate Pond already meets likely effluent criteria for Outfall 016 except for total nitrogen. As such, the treatment system would only be needed if nitrogen loading to the Process Water Pond caused an increase in total nitrogen at Outfall 016 above 10 mg/L as N. At this time, data indicate the leachate will meet the current ELGs for TSS and total oil and grease and the potential ELGs for arsenic and mercury without treatment.

This alternative was estimated to have a 20-year cost in excess of $14,000,000, assuming treatment is required, however pilot testing and design activities are required prior to implementation of this approach. Further information on the cost estimate is provided in Appendix C. Given that treatment does not appear to be required, this alternative is impractical from an engineering perspective.

4.6 Alternative 5 –Outfall 016 Discharge of Leachate (LDA)

This approach relies on sampling leachate for compliance with limits before pumping to the Process Water Pond and continuing to discharge the Process Water Pond via Outfall 016. This could be accomplished with temporary pumps or permanent pumping equipment. Conceptually, neither the Leachate Pond nor the Process Water Pond would be modified in a way that reduces capacity and free flow (non-pumped) of water between the two ponds would not occur. Leachate would be monitored at an internal outfall prior to discharge to the Process Water Pond. This is considered an LDA because it eliminate the potential for spills along the haul route in the BPCA. Water from both the POTW and under this alternative is ultimately discharged to the Missouri River.

For the cost estimate, it was assumed a permanent pump and a collection sump would be installed in the Leachate Pond for long-term reliability. Limited controls would be installed. Due to the reliability of this alternative to meet variable operational and seasonal conditions with a reduced risk of overflow, this alternative is the preferred method of operation. The estimated 20-year cost of this alternative is $510,000 as detailed in Appendix C. Most of the cost is associated with initial pump set-up.

5. Economic Evaluation

The following table summarizes the present worth cost of the alternatives from Section 4. The costs represent a 20-year O&M period. Development of these costs are shown in Appendix C.

Table 5.1 Summary of Costs

Alternative	Description	Total Present Worth
1	Leachate Haul to POTW (BPCA)	$1,900,000
2	Leachate Pipe Connection to POTW	$ 5,000,000
3	Zero-Discharge (NDA) [a]	$ 480,000
4	Physical/Chemical Treatment (LDA)	$ 14,000,000*
5	Outfall 016 Discharge (LDA)	$ 530,000

[a] See report in Appendix A. Zero-Discharge approach relies on mechanical evaporators which were deemed ineffective due to potential droplet drift.

6. Pollutants of Concern

The pollutants of concern (POCs) include TSS, pH, and dissolved metals. Vacated ELGs for arsenic and mercury indicate these are POCs in CCR leachate. Total nitrogen is also a potential POC. Wastewater at the current Outfall 016 meets the technology bases and water quality-based effluent criteria. Data for leachate prior to reaching the Leachate Pond (4 samples in 2021 and 2022) and in the Leachate Pond (2 samples in 2021 and 2022 following clean-out of the pond) indicate the leachate, whether direct to the Process Water Pond or from the Leachate Pond, will not impact the Outfall 016 compliance conditions for metals, TSS, or pH. Sample results for leachate prior to reaching the Leachate Pond in 2016-2020 did report arsenic above the vacated ELG. These results are provided in Tables 1 and 2 and in Appendix D.

7. Alternatives Evaluation

7.1 General

The preferred alternative is Alternative 5 – Discharge via Outfall 016. This is the most cost-effective and practical alternative. Alternatives 1, 2, 4, and 5 end with water discharged to the Missouri River. Since the POTW does not target the typical chemicals of concern, Alternatives 1, 2, and 5 have an equivalent level of impact on the Missouri River. While a physical/chemical treatment process would produce a cleaner wastewater, current sampling indicates this level of treatment is not necessary to meet effluent standards. This AAA is triggered by the addition of a new waste stream and increased volume to Outfall 016.

7.2 Justification of Degradation

Management of leachate at the Neal North facility is necessary to ensure long-term safety and monitoring without an uncontrolled release. The discharge of leachate is currently permitted under Outfall 003. Leachate has not been discharged through Outfall 003 since 2018. Two long-term alternatives were considered reasonable. The selected alternative, discharge via Outfall 016, is the most cost effective and eliminates potential risk of transporting wastewater over local roadways.

Each of the previously discussed alternatives is evaluated based on whether or not it is reasonable, practicable, economically efficient, and affordable. Table 7.1 summarizes this evaluation.

Table 7.1 Alternative Classification and Evaluation

Alternative	Type	Practicable?	Economically Efficient?	Cost Relative to BPCA	Affordable?	Reasonable?
1/POTW-Haul	BPCA	Yes	Yes	1x	Yes	Yes
2/POTW-Pipeline	LDA	Yes	No	2.5x	No	No
3/Pond & Evaporators	NDA	No	Yes	0.25x	Yes	No
4/Treatment	LDA	No	No	7.8x	No	No
5/Outfall 016	LDA	Yes	Yes	0.31	Yes	Yes

8. Social/Economic Importance

8.1 General

The proposed addition of leachate to Outfall 016 will not have a significant impact on the Missouri River over existing operations or permits. The total flow volume is reduced through elimination of Outfall 003 and the water quality of the leachate meets applicable standards. The power plant is a critical component of the region's economic viability and security.

8.2 Identification of Affected Entities

The affected entity is the Neal North facility. No other entities are impacted by the proposed changes.

8.3 Identification of Relevant Factors

Process water is generated through operation of the Neal North facility and leachate from the CCR Monofill. It is imperative that the plant be able to continue to operate to support the needs of the community. Leachate management is a necessary component of operating a CCR Monofill. The addition of leachate discharge via existing Outfall 016 provides an alternative to improve long-term management of the Leachate Pond and decreases the long-term risk of an uncontrolled discharge to the ground surface from overtopping of the Leachate Pond.

8.4 Social and Economic Concerns

The Neal North facility is a primary electric generating facility in northwest Iowa along with the Neal South facility. Reliable operation of the Neal North facility is necessary for the social and economic viability of the region. The Neal North facility directly employs 125 people or contractors and serves a much larger community of residences and businesses.

8.5 Environmental Cost Benefit Analysis

The selected alternative of discharge to existing Outfall 016 is less than 40% of the cost of the BPCA and the BPCA does not represent a greater environmental benefit since the POTW is not optimized to address the chemicals of concern. The NDA alternative is the most cost-effective option but is not practical. Since the water proposed for discharge currently meets effluent standards, physical chemical treatment does not provide an environmental benefit and the cost is estimated at 8 times the BPCA. The other alternative evaluated, a pipeline to the POTW, does not provide an added environmental benefit and is estimated at 2.5 times the BPCA cost.

9. Public Review

A public notice was published in the Sioux City Journal and proof of publication is provided in Appendix E. Documentation was available at the public library and a notification provided at the post office. Notifications were also sent to the United States Environmental Protection Agency, Region VII; IDNR Field Office 3; Nebraska Department of Environmental Quality (due to shared boundary of Missouri River); Siouxland District Health Department; United States Fish and Wildlife Service; Iowa Environmental Council; and Environmental Law & Policy Center.

[Address Public Comments]

10. References

IDNR, 2021. Mississippi River IA 01-NEM-61. Accessed via https://programs.iowadnr.gov/adbnet/Segments/1722/Assessment/2020.

IDNR, 2021. 2020 Integrated Report including the 2020 Impaired Waters List. https://programs.iowadnr.gov/adbnet/Assessments/Summary/2020

Appendices

Appendix A

2020 Report on Leachate Evaporator Pilot Activities

January 16, 2020 Reference No. 11114642

Mr. Geoffrey Spain
Environmental Engineer
Land Quality Bureau
Iowa Department of Natural Resources
502 East 9th Street
Des Moines, Iowa 50319-0034

Dear Mr. Spain:

Re: Report on Leachate Evaporator Pilot Activities
Neal North Energy Center Coal Combustion Residue Monofill
Sergeant Bluff, Iowa
Permit No. 97-SDP-12-95

On behalf of MidAmerican Energy Company (MidAmerican), GHD has prepared this letter to document the use of evaporators at the Neal North Energy Center Coal Combustion Residue (CCR) Monofill (Neal North Monofill) leachate pond in 2019. The Neal North Monofill leachate management is conducted under the May 3, 2017 Revised Leachate Control Plan which was incorporated into the Operating Permit by Amendment #6 dated May 10, 2017.

1. Overview

In 2017, MidAmerican started work on a new leachate management approach for the Neal North Monofill. The work included the construction of a leachate pond which was completed in 2018. To help manage leachate volume, additional efforts have been completed, including improved grading of CCR in the Neal North Monofill, use of leachate as dust control directly on CCR in the Neal North Monofill, and testing of mechanical evaporators in 2019. The use of mechanical evaporators was approved by the Iowa Department of Natural Resources (IDNR) with issuance of Operating Permit Amendment #6, dated May 10, 2017, which also authorized construction of the new leachate pond. A modification to allow up to four mechanical evaporators to be used in 2019 was approved by the IDNR in a letter dated February 1, 2019.

2. Evaporators

The mechanical evaporators used in the Neal North Monofill leachate pond are 420F float evaporators manufactured by SMI Evaporative Solutions of Midland, Michigan. Each evaporator floats on four plastic pontoons containing closed-cell polyurethane foam. A 2 horsepower (hp) submersible pump mounted to the 420F frame pumps leachate into the fan unit where a 25 hp motor spins a blade to aerosolize the liquid. Pictures of evaporators at the Neal North Leachate Pond are provided in Attachment A. Because the evaporators are floating in the pond, large droplets are deposited inside the containment.

The evaporators are attached to a stainless steel anchor cable attached to concrete blocks on the north and south sides of the leachate pond. A maximum of two evaporators are deployed on a single cable. A winch system is used to move the evaporators across or out of the pond.

Operation is automatically controlled by a weather station based on wind direction, wind speed, air temperature, and humidity. Each evaporator is programmed independently.

3. Operation

Operation of the evaporators was initiated with two evaporators while the weather station controls could be adjusted to minimize drift. For example, the wind speed at which the evaporators shut down can be adjusted or the pump rate set to a percentage of maximum drift. Initially, the two evaporators were only operated during daylight hours for better observation of potential droplet drift and site conditions.
A timeline of evaporator milestones is listed below.

- April 2, 2019 – Evaporators 1 and 2 online, but not consistently operated
- May 15, 2019 – Evaporators 1 and 2 set to run automatically (including overnight and weekends) based on weather station conditions
- July 24, 2019 – Evaporators 3 and 4 on-line
- October 9, 2019 – All four evaporators removed for winter season

4. Observations

The evaporators appear to work well and are responsive to the weather station controls. Management of drift required adjustments to the wind direction and wind speed for which the automated system allows operation of the evaporators. Although evidence of drift was observed, it is believed to be managed by adjustments to the allowable operating conditions. It appears drift is site-specific based on localized wind patterns, position and density of evaporators in the leachate pond, and leachate pond dimensions relative to evaporator location.

No impacts to the liner system were observed from evaporator deployment or operation. No alarm conditions such as current draw or tilt alarms in the evaporators were observed. All equipment appeared to operate properly throughout the season.

5. Leachate Evaporated

To estimate evaporator effectiveness, a water balance was built around the leachate pond. The current volume in the leachate pond is estimated by monitoring equipment based on depth of water. The input of leachate added to the pond is measured by a flow meter at a lift station adjacent to the Neal North Monofill. The input of precipitation is estimated using rainfall data from the nearby Sioux Gateway Airport and the drainage area around the pond. The loss due to CCR applied for dust control is directly measured by a flow meter when leachate is pumped into haul trucks. The loss due to evaporation is estimated based on a weather station in Ames, Iowa which has similar historic evaporation results to a nearby location which no longer measures pan evaporation. Differences during the evaporator operating season are attributed to the evaporator but also capture discrepancies in the water balance, especially around precipitation and natural evaporation.

In 2019, based on available data, it is estimated 1.2 million gallons were evaporated from the Neal North leachate pond through the mechanical evaporators. Longer-term operation and data collection will improve confidence in future projections. Variability in monthly precipitation and evaporation can significantly affect this estimate.

6. Recommendations

It is recommended the mechanical evaporators be incorporated into the long-term leachate management approach for the Neal North Monofill. Use of the evaporators helps minimize the potential for large-scale treatment and/or discharge of treated leachate.

In 2020, MidAmerican will consider further changes to allow greater operational up-time for the evaporators while continuing to manage drift. Drift is a site-specific condition and to increase the area over which droplets may deposit, MidAmerican is considering positioning the evaporators further apart and putting stricter weather operational conditions in place. For example, evaporators moved further to the south in the leachate pond may only be allowed to operate when there is a south wind and thus the northern portion of the leachate pond would be available to capture drift rather than centrally locating the evaporators and attempting to allow operation when the wind is blowing in any direction.

7. Closing

If you have any questions, please contact Jenny Coughlin of MidAmerican at 515-281-2344 or Michael Alowitz at 515-414-3934.

Sincerely,

GHD

Michael Alowitz   Margaret Zuckweiler

Michael Alowitz, P.E.   Margaret Zuckweiler

KA/hs/7

Encl.
Attachment A - Photographic Log

cc: Jenny Coughlin, MidAmerican
Josh Love, MidAmerican
Justin Terrell, MidAmerican
Elisa Zappacosta, MidAmerican

Attachment A

Photographic Log

Photo 1 - 6/6/2018 – Evaporator at proveout testing with clean water. Two evaporators were deployed in April 2019. (Two additional evaporators were added July 24, 2019).

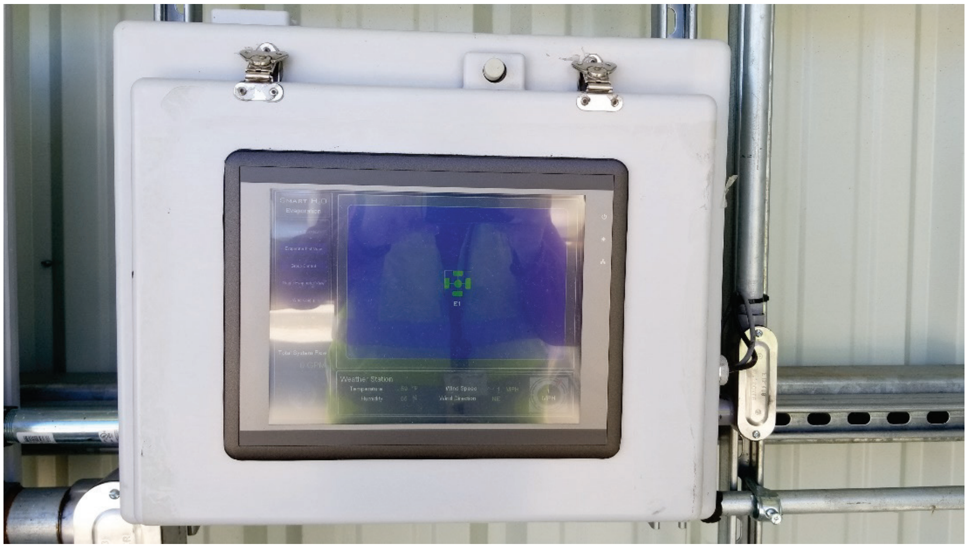

Photo 2 - 9/25/2018 – Evaporator status screen example. Weather related information is displayed at the bottom of the screen..

Site Photographs

Photo 3 - 6/7/2019 – Two evaporators in operation on the Neal North Monofill leachate pond.

Photo 4 - 7/31/19 – Leachate pond with four evaporators deployed. Evaporators are not operating in the photograph, likely due to wind conditions.

www.ghd.com

Appendix B

Wasteload Allocation dated Feb 23, 2023

2/23/2023 *NPDES # 6-97-00-1-02*

MidAmerican Energy - Neal North Energy Center

This Package Contains

WASTELOAD ALLOCATION CALCULATIONS & NOTES

ENVIRONMENTAL SERVICES DIVISION
WATER QUALITY-BASED PERMIT LIMITS

SECTION VI: WATER QUALITY-BASED PERMIT LIMITS

Facility Name: MidAmerican Energy - Neal North Energy Center Sewage File Number: 6-97-00-1-02

Parameters	Ave. Conc. (mg/l)	Max. Conc. (mg/l)	Ave. Mass (lbs/d)	Max. Mass (lbs/d)

Outfall No. 009	**ADW = 417.6 MGD & AWW = 417.6 MGD**			
Temperature	Monthly Average		Daily Maximum	
Month	T (C)	T (F)	T (C)	T (F)
January	20.7	69.3	100.0	212.0
February	20.5	68.9	100.0	212.0
March	29.1	84.4	100.0	212.0
April	41.8	107.2	100.0	212.0
May	46.6	115.9	100.0	212.0
June	49.7	121.5	72.3	162.1
July	51.7	125.1	52.5	126.4
August	50.7	123.3	64.4	147.9
September	48.2	118.8	88.8	191.8
October	38.1	100.6	87.6	189.8
November	30.1	86.2	100.0	212.0
December	20.3	68.5	100.0	212.0

Stream Network/Classification of Receiving Stream: Missouri River (A1, B(WW-1), HH)

Annual critical low flows in the Missouri River at the outfall:
1Q10 flow 6,409 cfs, 7Q10 flow 8,645 cfs, 30Q10 flow 9,748 cfs, 30Q5 flow 11,834 cfs, harmonic mean flow 25,073 cfs

Performed by: Alex Martin

ENVIRONMENTAL SERVICES DIVISION
WATER QUALITY-BASED PERMIT LIMITS

SECTION VI: WATER QUALITY-BASED PERMIT LIMITS

Facility Name: MidAmerican Energy - Neal North Energy Center Sewage File Number: 6-97-00-1-02

Parameters	Ave. Conc. (mg/l)	Max. Conc. (mg/l)	Ave. Mass (lbs/d)	Max. Mass (lbs/d)
Outfall No. 016	**ADW = 0.965 MGD & AWW = 0.989 MGD**			
Ammonia - Nitrogen				
January	750.7	750.7	6043.9	6043.9
February	904.0	904.0	7276.8	7276.8
March	742.4	742.4	5976.5	5976.5
April	508.6	508.6	4094.1	4094.1
May	617.3	617.3	4968.7	4968.7
June	619.3	619.3	4985.5	4985.5
July	619.3	619.3	4985.5	4985.5
August	619.3	619.3	4985.5	4985.5
September	509.7	509.7	4102.8	4102.8
October	510.7	510.7	4111.4	4111.4
November	509.6	509.6	4102.7	4102.7
December	508.8	508.8	4096.1	4096.1
Chloride	6.447E+04	6.447E+04	5.190E+05	5.190E+05
Sulfate	1.572E+05	1.572E+05	1.266E+06	1.266E+06
TRC	2.058E+00	2.058E+00	1.657E+01	1.657E+01
Boron	3.63E+02	3.63E+02	2.92E+03	2.92E+03
Magnesium	1.12E+06	1.12E+06	9.04E+06	9.04E+06
Manganese	3.67E+02	3.67E+02	2.95E+03	2.95E+03
Molybdenum	1.37E+04	1.37E+04	1.11E+05	1.11E+05
pH	3.8-14.0 Standard Units			
Major Facility Acute WET Testing Ratio: Use 0.9% of effluent and 99.1% of dilution water for the testing				

Stream Network/Classification of Receiving Stream: Missouri River (A1, B(WW-1), HH)

Annual critical low flows in the Missouri River at the outfall:
1Q10 flow <u>6,409</u> cfs, 7Q10 flow <u>8,645</u> cfs, 30Q10 flow <u>9,748</u> cfs, 30Q5 flow <u>11,834</u> cfs, harmonic mean flow <u>25,073</u> cfs

Performed by: Alex Martin

ENVIRONMENTAL SERVICES DIVISION
WATER QUALITY-BASED PERMIT LIMITS

SECTION VI: WATER QUALITY-BASED PERMIT LIMITS

Facility Name: MidAmerican Energy - Neal North Energy Center Sewage File Number: 6-97-00-1-02

Parameters	Ave. Conc. (mg/l)	Max. Conc. (mg/l)	Ave. Mass (lbs/d)	Max. Mass (lbs/d)
Outfall No. 016	**ADW = 0.965 MGD & AWW = 0.989 MGD**			
Toxics				
1,1,1-Trichloroethane	2.860E+03	2.860E+03	2.302E+04	2.302E+04
1,1-Dichloroethylene	5.850E+03	5.850E+03	4.709E+04	4.709E+04
1,2-Dichloroethane	1.554E+03	6.391E+03	1.251E+04	5.145E+04
1,2-Dichloropropane	6.300E+02	6.300E+02	5.070E+03	5.070E+03
2,3,7,8-TCDD (Dioxin)	2.142E-07	2.142E-07	1.724E-06	1.724E-06
3,3-Dichlorobenzidine	1.176E+00	1.176E+00	9.464E+00	9.464E+00
4,4' DDT	1.449E-03	1.192E-01	1.166E-02	9.592E-01
Aldrin	2.100E-03	3.250E-01	1.690E-02	2.616E+00
Aluminum	2.708E+02	2.708E+02	2.180E+03	2.180E+03
Antimony	1.192E+03	1.192E+03	9.592E+03	9.592E+03
Arsenic (III)	3.683E+01	3.683E+01	2.965E+02	2.965E+02
Barium	2.220E+04	2.220E+04	1.787E+05	1.787E+05
Benzene	1.787E+03	1.787E+03	1.439E+04	1.439E+04
Benzo(a)Pyrene	7.560E-01	7.560E-01	6.084E+00	6.084E+00
Beryllium	5.416E+01	5.416E+01	4.360E+02	4.360E+02
Bis(2-ethylhexyl)phthalate	9.240E+01	9.240E+01	7.436E+02	7.436E+02
Bromoform	5.880E+03	5.880E+03	4.732E+04	4.732E+04
Cadmium	6.331E-01	6.331E-01	5.097E+00	5.097E+00
Carbon Tetrachloride	6.720E+01	2.334E+03	5.408E+02	1.879E+04
Chlordane	6.230E-03	2.600E-01	5.014E-02	2.093E+00
Chlorobenzene	1.744E+03	1.744E+03	1.404E+04	1.404E+04
Chlorodibromomethane	5.460E+02	5.460E+02	4.394E+03	4.394E+03
Chloroform	1.974E+04	1.974E+04	1.589E+05	1.589E+05
Chloropyrifos	8.991E-03	8.991E-03	7.238E-02	7.238E-02
Chromium (VI)	1.765E+00	1.765E+00	1.421E+01	1.421E+01
Copper	2.914E+00	2.914E+00	2.346E+01	2.346E+01
Cyanide	2.383E+00	2.383E+00	1.918E+01	1.918E+01
Dichlorobromomethane	7.140E+02	7.140E+02	5.746E+03	5.746E+03
Dieldrin	2.268E-03	2.600E-02	1.825E-02	2.093E-01
Endosulfan	2.383E-02	2.383E-02	1.918E-01	1.918E-01
Endrin	9.316E-03	9.316E-03	7.499E-02	7.499E-02
Ethylbenzene	2.454E+03	2.454E+03	1.975E+04	1.975E+04
Fluoride	8.481E+02	8.481E+02	6.827E+03	6.827E+03
gamma-Hexachlorocyclohexane (Lindane)	1.029E-01	1.029E-01	8.284E-01	8.284E-01
Heptachlor	3.318E-03	5.633E-02	2.670E-02	4.535E-01

SECTION VI: WATER QUALITY-BASED PERMIT LIMITS

Facility Name: MidAmerican Energy - Neal North Energy Center Sewage File Number: 6-97-00-1-02

Parameters	Ave. Conc. (mg/l)	Max. Conc. (mg/l)	Ave. Mass (lbs/d)	Max. Mass (lbs/d)
Outfall No. 016	**ADW = 0.965 MGD & AWW = 0.989 MGD**			
Toxics				
Heptachlor epoxide	1.638E-03	5.633E-02	1.318E-02	4.535E-01
Hexachlorobenzene	1.218E-02	1.218E-02	9.802E-02	9.802E-02
Hexachlorocyclopentadiene	2.181E+03	2.181E+03	1.755E+04	1.755E+04
Iron	1.083E+02	1.083E+02	8.720E+02	8.720E+02
Lead	1.114E+01	2.139E+01	8.970E+01	1.721E+02
Mercury (II)	1.784E-01	1.784E-01	1.436E+00	1.436E+00
Nickel	9.136E+01	9.136E+01	7.354E+02	7.354E+02
Nitrate as N	3.466E+04	3.466E+04	2.791E+05	2.791E+05
Nitrate+Nitrite as N	3.466E+04	3.466E+04	2.791E+05	2.791E+05
para-Dichlorobenzene	2.167E+02	2.167E+02	1.744E+03	1.744E+03
Parathion	7.041E-03	7.041E-03	5.668E-02	5.668E-02
Pentachlorophenol (PCP)	3.156E+00	3.156E+00	2.541E+01	2.541E+01
Phenols	7.244E+01	2.708E+02	5.830E+02	2.180E+03
Polychlorinated Biphenyls (PCBs)	2.688E-03	2.167E-01	2.163E-02	1.744E+00
Polynuclear Aromatic Hydrocarbons (PAHs)	4.346E-02	3.250E+00	3.498E-01	2.616E+01
Selenium	2.091E+00	2.091E+00	1.683E+01	1.683E+01
Silver	1.351E+00	1.351E+00	1.087E+01	1.087E+01
Tetrachloroethlyene	1.386E+02	1.386E+02	1.115E+03	1.115E+03
Thallium	9.319E-01	6.478E+01	7.500E+00	5.215E+02
Toluene	7.244E+01	2.708E+02	5.830E+02	2.180E+03
Toxaphene	2.897E-03	7.908E-02	2.332E-02	6.366E-01
trans-1,2-Dichloroethylene	2.776E+02	2.776E+02	2.234E+03	2.234E+03
Trichloroethylene (TCE)	1.159E+02	4.333E+02	9.328E+02	3.488E+03
Vinyl Chloride	1.008E+02	1.008E+02	8.112E+02	8.112E+02
Zinc	2.335E+01	2.335E+01	1.880E+02	1.880E+02

WLAs/Permit Limits for MidAmerican Energy - Neal North Energy Center's Wastewater Discharge

These wasteload allocations and water quality-based permit limitations are for MidAmerican Energy - Neal North Energy Center's wastewater discharge. The wasteload allocations/permit limits are based on the Water Quality Standards (IAC 567.61) and the "Iowa Wasteload Allocation (WLA) Procedure," effective November 11, 2020. The chloride allocation/permit limits are based on the criteria that became effective on November 11, 2009.

The water quality-based limits in this WLA are calculated to meet the surface water quality criteria to protect downstream uses. There could be technology-based limits applicable to this facility that are more stringent than the water quality-based limits shown in this WLA. The technology-based limits could be derived from either federal guidelines based on different industrial categories or permit writer's judgment.

1. BACKGROUND:

MidAmerican Energy - Neal North Energy Center discharges a stream of wastewater from two outfalls, described below. The flows and pollutants for each discharge are shown in Table 1.

Outfall 009 – Consists of once-through non-contact cooling water from unit 3, non-contact cooling water used in various desanders and strainers, unit 3 boiler blowdown and intake screen wash water to the Missouri River (at 42° 19' 24.6" N, 96° 22' 46.5" W).

Outfall 016 – Consists of blowdown from under-boiler submerged flight conveyor quench water, reverse osmosis reject, floor drains, low volume waste, demineralizer regeneration waste, non-chemical metal cleaning waste, auxiliary boiler blowdown, combustion residual leachate, and stormwater to the Missouri River (at 42° 19' 10.7" N, 96° 22' 31.0" W).

Table 1: Outfall flows and pollutants

Outfall	ADW (MGD)	AWW (MGD)	Pollutants
009	417.6	417.6	Temperature
016	0.965	0.989	Sulfate, Iron, WET Testing, All Chapter 61 Table 1, pH, Ammonia, Boron, Magnesium, Manganese, Molybdenum

Route of flow and use designations:

The Missouri River is an A1, B(WW-1), HH designated use waterbody. The designations have been adopted in Iowa's state rule described in the rule-referenced document of "Surface Water Classification," effective July 24, 2019. Based on the pollutants of concern, the use designations of waterbodies further downstream will not impact the resulting limits for this facility.

Critical low flow determination:

The critical low flows were estimated based on the drainage area ratio method and flow statistics obtained at USGS gage 06486000 at Sioux City, Iowa.

This facility utilizes a large volume of surface water that is drawn from the Missouri River upstream from Outfall 009. However, the limits for Outfall 009 are based on a thermal study, and Outfall 016 is downstream from Outfall 009; thus, the total river flows (intake flow not subtracted) are used for WLA calculations for the protection of the Missouri River.

Table 2: Annual critical low flows

Location	D.A. (mi^2)	1Q10 (cfs)	7Q10 (cfs)	30Q10 (cfs)	30Q5 (cfs)	Harmonic mean (cfs)
Missouri River at the outfall	315,518	6,409	8,645	9,748	11,834	25,073
Missouri River at the USGS gage 06486000	314,600	6,390	8,620	9,720	11,800	25,000

CORMIX temperature study:
This facility conducted a thermal study in January 2011. That study specified temperature limits as discussed in Section 3. Although the results of the old CORMIX study can be used in this WLA, future NPDES permits for this facility will not be able to consider the old study in their calculations. If desired, a new study can be completed and considered in the calculation of the limits for this facility's following NPDES permit.

2. TOTAL MAXIMUM DAILY LOAD (TMDL) LIMITATIONS:

The following waterbodies in the discharge route are on the 2022 impaired waters list:

- Missouri River for flow alteration, habitat alteration, and bacteria (indicator bacteria – *E. coli*)
- Upper Blencoe Bend for flow alteration

There are currently no approved TMDLs in the discharge route.

The results presented in this report are wasteload allocations based on meeting the State's current water quality standards in the receiving waterbody. Additional and/or more stringent effluent limits may be applicable to this discharge based on approved TMDLs for impaired waterbodies, which may provide watershed based wasteload allocations. Information on impaired streams in Iowa and approved TMDLs can be found at the following website: http://www.iowadnr.gov/Environmental-Protection/Water-Quality/Watershed-Improvement/Impaired-Waters.

3. CALCULATIONS:

The WLAs/permit limits for this outfall are calculated based on the facility's Average Dry Weather (ADW) flows and its Average Wet Weather (AWW) flows, as shown in Table 1.

Only wasteload allocations/permit limits (water quality-based effluent limits) calculated using DNR approved design flows can be applied in NPDES permits. Water quality-based effluent limits calculated using proposed flows that have not been approved by the DNR for permitting and compliance may be used for informational purposes only.

The water quality-based permit concentration limits are derived using the allowed stream flow and the ADW flow, while the loading limits are derived using the allowed stream flow and the AWW flow.

Toxics and TRC (Outfall 016):

The toxics wasteload allocations will consider the procedures included in the 2000 revised WQS and the 2007 chemical criteria.

To protect the aquatic life use:
Important to toxics is the use of the 1Q10 stream flow in association with the acute wasteload allocation calculation. The chronic WLA will continue to use the 7Q10 stream flow in its calculations. In this case,

10% of the 7Q10 flow and 1.0% of the 1Q10 flow in the Missouri River at the outfall are used as the Mixing Zone (MZ) and the Zone of Initial Dilution (ZID), respectively.

Effective November 11, 2020, water quality criteria for metals (excluding aluminum) are expressed as dissolved in IAC 567.61. Using EPA dissolved metal translators, water quality-based effluent limits in this WLA are expressed as total recoverable.

Effective November 11, 2020, water quality criteria for aluminum are expressed as bioavailable in IAC 567.61. Water quality-based effluent limits for aluminum in this WLA are expressed as total recoverable.

To protect the human health (HH) use:
For pollutants that are non-carcinogenic and have criteria for HH protection, the criteria apply at the end of the MZ, which in this case is 10% of the 30Q5 flow in the Missouri River at the outfall.

For pollutants that are carcinogenic and have criteria for HH protection, the criteria apply at the end of the MZ, which in this case is 10% of the harmonic mean flow in the Missouri River at the outfall.

Final limits:
The maximum limits are those calculated for the protection of the aquatic life use and the average limits are the more stringent between those for the protection of the aquatic life use and those for the protection of the HH use.

The TRC limits are based on a sampling frequency of 1/week; the limits for other toxics are based on a sampling frequency of 1/week.

Magnesium (Outfall 016):
Currently there is no numeric water quality criteria for magnesium. The guideline values for magnesium for livestock watering is 800 mg/l. It must be met at the boundary of the MZ, which in this case is 10% of the 7Q10 flow in the Missouri River at the outfall of this facility.

Ammonia Nitrogen (Outfall 016):
Standard stream background pH, temperatures, and concentrations of NH3-N are mixed with the discharge from the facility's effluent pH and temperature values to calculate the applicable instream criteria for the protection of the Missouri River.

Based on the ratio of the stream flow to the discharge flow, 2.5% of the 1Q10 flow and 25% of the 30Q10 flow in the Missouri River at the outfall are used as the ZID and the MZ, respectively. The Missouri River is a B(WW-1) stream; therefore, early life protection will begin in February and run through September.

The monthly background pH, temperatures, and NH3-N concentrations shown in Table 3 are used for the wasteload allocation/permit limits calculations based on the Year 2000 ammonia nitrogen criteria. Table 4 shows the statewide monthly effluent pH and temperature values for industrial facilities. Table 5 shows the calculated ammonia nitrogen wasteload allocations for this facility.

Table 3: Background pH, temperatures, and NH3-N concentrations for use with Year 2000 ammonia nitrogen criteria

Months	pH	Temperature (°C)	NH_3-N (mg/l)
January	8.1	0.5	0.05
February	8.0	0.5	0.05
March	8.1	4.5	0.11
April	8.3	11.2	0.03
May	8.2	17.1	0.02
June	8.2	23.0	0.01
July	8.2	26.0	0.01
August	8.2	25.8	0.01
September	8.3	21.0	0.01
October	8.3	14.0	0.01
November	8.3	7.0	0.02
December	8.3	1.0	0.04

Table 4: Standard effluent pH and temperature values for industrial facilities

Months	pH	Temperature (°C)
January	7.9	17.83
February	8.1	17.83
March	8.0	27.67
April	8.2	33.89
May	8.3	35.89
June	8.2	38.67
July	8.2	40.61
August	8.2	39.61
September	8.3	34.50
October	8.2	31.89
November	8.2	29.39
December	8.1	24.67

Table 5: Wasteload allocations for ammonia nitrogen for the protection of aquatic life

Months	ADW-based*		AWW-based**	
	Acute (mg/l)	Chronic (mg/l)	Acute (mg/l)	Chronic (mg/l)
January	750.7	5480.7	732.8	5347.8
February	904.0	3893.5	882.2	3799.1
March	742.4	3246.0	724.6	3167.3
April	508.6	2440.3	496.4	2381.2
May	617.3	2447.3	602.4	2388.0
June	619.3	1679.0	604.4	1638.3
July	619.3	1380.8	604.4	1347.4
August	619.3	1399.0	604.4	1365.0
September	509.7	1622.8	497.4	1583.4
October	510.7	2557.6	498.5	2495.6
November	509.6	4009.4	497.4	3912.2
December	508.8	3976.8	496.6	3880.3

*: bases for concentration limits; **: bases for mass loading limits

Chloride and Sulfate (Outfall 016):
The chloride and sulfate criteria became effective on November 11, 2009 and apply to all Class B waters. The default hardness for background and effluent is 200 mg/l.

Chloride criteria are functions of hardness and sulfate concentration, shown as follows:

$$\text{Acute criteria} = 287.8*(\text{Hardness})^{0.205797} *(\text{Sulfate})^{-0.07452}$$
$$\text{Chronic criteria} = 177.87*(\text{Hardness})^{0.205797} *(\text{Sulfate})^{-0.07452}$$

Sulfate criteria, shown in Table 6, are functions of hardness and chloride concentration and serve as both the acute and chronic criteria.

Table 6: Sulfate criteria

Hardness (mg/l as CaCO3)	Sulfate criteria (mg/l)		
	Chloride < 5 mg/l	5 mg/l <= Chloride < 25 mg/l	25 mg/l <= Chloride < 500 mg/l
< 100	500	500	500
100<=H<=500	500	(-57.478+5.79*H+54.163*Cl)*0.65	(1276.7+5.508*H-1.457*Cl)*0.65
H> 500	500	2,000	2,000

The acute criteria apply at the end of the ZID, and the chronic criteria apply at the end of the MZ. In this case, 10% of the 7Q10 flow and 1.0% of the 1Q10 flow in the Missouri River at the outfall are used as the MZ and the ZID, respectively.

The default chloride concentration for both background water and effluent is 34 mg/l, while the default sulfate concentration for both background water and effluent is 63 mg/l. The limits are calculated based on an assumed sampling frequency of 1/week.

Iron (Outfall 016):
Iron criteria are defined in the issue paper “Iron Criteria and Implementation for Iowa’s Surface Waters” (November 11, 2020). A dissolved iron criterion of 1 mg/L applies at the end of the ZID for both general

use and designated use streams. In this case, the ZID is 1.0% of the 1Q10 flow in the Missouri River at the outfall. Water quality-based effluent limits for iron in this WLA are expressed as total recoverable.

Boron, Manganese, and Molybdenum (Outfall 016):
There are no numerical criteria for boron, manganese, or molybdenum in Iowa's water quality standards. However, the water quality standards specify, in the form of narrative criteria, that all surface waters shall be free from materials attributable to wastewater discharges or agricultural practices in concentrations or combinations which are acutely toxic to human, animal, or plant life (567 IAC 61.3(2)d).

This narrative criterion is implemented through the concept of establishing a no effect level or LC_0 as described in the 'Iowa Wasteload Allocation Procedure'. The LC_0 or the estimate of the concentration that will not be acutely toxic is determined by calculating the value of ½ the 48 or 96-hour LC_{50} for the most sensitive resident species. In cases with multiple applicable 48 or 96-hour LC_{50} values, the Species Mean Acute Value (SMAV) was used.

There is limited toxicity data available for the toxics. The criteria are shown in Table 7. These apply at the end of the ZID. In this case, 1.0% of the 1Q10 flow in the Missouri River at the outfall are used as the ZID.

Table 7: Narrative Criteria for Select Toxics

Toxic	Criterion (mg/l)	Toxicity End Point	Toxicity Testing Organism
Boron	3.35	1/2 48hrLC_{50}	Water Flea
Manganese	3.386	1/2 SMAV	Midge
Molybdenum	126.9	1/2 SMAV	Fathead Minnow

pH (Outfall 016):
Iowa Water Quality Standards (IAC 567.61.3.(3).a.(2) and IAC 567.61.3.(3).b.(2)) require that pH in Class A or Class B waters "shall not be less than 6.5 nor greater than 9.0." The criteria apply at the end of the MZ, which is 10% of the 7Q10 flow in the Missouri River at the outfall.

TDS:
Effective November 11, 2009, the site-specific TDS approach is no longer applicable; instead, the new chloride and sulfate criteria became applicable. However, the TDS level should be controlled to a level such that the narrative criteria stated in IAC 567.61.3 are fulfilled.

Major Facility Acute WET Testing Ratio (Outfall 016):
The acute whole effluent toxicity (WET) testing ratio is calculated using the ADW design flow and 1.0% of the 1Q10 flow in the Missouri River at the outfall as the ZID.

Temperature (Outfall 009):
This facility conducted a thermal study in January 2011. The study calculated 30-day average limits based on the 3°C rise criterion, daily maximum limits based on the 32°C max criterion, and rate of change limits based on the 1°C per hour rate of change criterion. The thermal study was based on navigation season (April – September) and non-navigation season (October – March) 7Q10 flows of 21,284 and 10,090 cfs, respectively. The thermal study was based on a discharge flow of 495,000 gpm (712.8 MGD) which is much higher than the current discharge flows (ADW = 417.6 MGD, AWW = 417.6 MGD). This is because generating unit 1 and unit 2 were retired in April 2016. However, at the lower discharge flow rate the limits in the study are considered to still be applicable and protective. The 30-

day average and daily maximum temperature limits from the 2011 thermal study are shown on Page 1 of this report.

Allowed Maximum Effluent Temperature Change:
Cessation of thermal inputs to the receiving water by a thermal discharge shall occur gradually so as to avoid fish mortality due to cold shock during the winter months (November through March). The basis for this requirement is to allow fish associated with the discharge-heated mixing zone to acclimate to the decreasing temperature. Likewise, when the discharge resumes the temperature would need to be increased gradually to avoid negative impacts to aquatic life in the receiving stream.

4. PERMIT LIMITATIONS:

- *Based on the Year 2006 Water Quality Standards and 2002 Permit Derivation Procedure.*

The acute and chronic WLAs are used as the values for input into the current permit derivation procedure. Under the 2002 permit derivation procedure, only for toxic parameters is the monitoring frequency considered in the calculation of final limits. The water quality-based limits are shown on Pages 1 – 4 of this report.

Appendix C

Cost Estimates

Table C1

ALTERNATIVE 1 - Leachate Haul to POTW

Line Item	Quantities	Unit	Unit Price	Extended Price	Notes
No capital costs					
Operations and Maintenance					
Hauling Contractor	3,000,000	gallons	$0.0516	$154,800	2021 Pricing, inflation factor of 20%
Operations and Maintenance	1	Annual	$15,000	$15,000	Electrical, coordination, inspections
POTW Fees	3000	1000 gal	$2.011	$6,033	
Rate of Return	7%	Annual	-	-	For Present Value Calculations
20-Year O&M Subtotal	20	Years		**$1,862,777**	Operations and Maintenance cost for 20 years
20-Year Total Estimated Cost				**$1,862,777**	

Notes:
gal - gallons
O&M - Operation and Maintenance
POTW - Publically Owned Treatment Works

Table C2

ALTERNATIVE 2 - Leachate Pipe Connection to POTW

Line Item	**Quantities**	**Unit**	**Unit Price**	**Extended Price**	**Notes**
Mobilization	1	LS	$150,000	$150,000	
Site Preparation/Restoration (tree removal)	1	LS	$125,000	$125,000	
Right-of-Way/Easements	1	LS	$175,000	$175,000	
Survey	11,500	FT	$6.25	$71,875	Pipeline areas/record
Wet Well/Lift Station	1	LS	$300,000	$300,000	Prepackaged System
8" SDR 17 HDPE Pipe	11,500	FT	$93.00	$1,069,500	
Manholes/Fittings - General Allowance	11,500	FT	$35.00	$402,500	Valves, access points
Tie-In Connection	1	LS	$150,000	$150,000	To existing force main
Horizontal Bores	250	FT	$1,200	$300,000	Estimate 2 bores
Design	420	Hours	$150.00	$63,000	
Controls/Telemetry Upgrades/Install	1	LS	$275,000	$275,000	Adapted from WSEC costs
Restoration Allowance	1	LS	$100,000	$100,000	Seed, matting
Subtotal				**$3,181,875**	
Contractor G & A	15%			$477,281	
Construction Oversight and Documentation	12%			$381,825	
Contingency 15%	15%			$477,281	
Capital Total				**$4,518,263**	
Operations and Maintenance					
Monthly Connection Fee	12	Month	$469.67	$5,636	
Sampling Allowance	12	Month	$500.00	$6,000	
Disposal Fee	3,000	1,000 gal	$2.40	$7,200	Cost/1,000 gallons
Maintenance	1	Year	$15,000	$15,000	
Electrical	1	Year	$10,000	$10,000	
Subtotal Annual O&M Cost				$43,836	
Rate of Return	7%	Annual	-	-	For Present Value Calculations
20-Year O&M Subtotal	20	Years		**$464,400**	Operations and Maintenance cost for 20 years
20-Year Total Estimated Cost				**$4,982,662**	

Notes:
FT - foot
G & A - General and Administrative
gal - gallons
HDPE - high-density polyethylene pipe
LS - lump sump
O&M - Operation and Maintenance
POTW - Publically Owned Treatment Works
SDR - standard dimension ratio
WSEC - Walter Scott Energy Center

Table C3

ALTERNATIVE 3 - Zero-Dicharge (Existing Leachate Pond)

Line Item	Quantities	Unit	Unit Price	Extended Price	Notes
No capital costs					
Operations and Maintenance					
Operations and Maintenance	1	Annual	$5,000	$5,000	Loadout, coordination, inspections
Evaporator Operation and Maintenance	4	Ea/year	$10,000	$40,000	Evaporator electrical, maint. Part replacement.
Rate of Return	7%	Annual	-	-	For Present Value Calculations
20-Year O&M Subtotal	20	Years		**$476,731**	Operations and Maintenance cost for 20 years
20-Year Total Estimated Cost				**$476,731**	

Note: Prepared assuming operation of 4 evaporators was to continue. Due to concerns of droplet drift, the use of evaporators has been discontinued.
Ea - each
O&M - Operation and Maintenance

Table C4

ALTERNATIVE 4 - Physical/Chemical Treatment

Line Item	Quantities	Unit	Unit Price	Extended Price	Notes
Engineered Equipment	1	LS	$2,000,000	$2,000,000	
Piping	1	LS	$1,500,000	$1,500,000	
Civil, Piling, Concrete, Structural, Architectural	1	LS	$1,000,000	$1,000,000	
Electrical and Controls	1	LS	$400,000	$400,000	Pipeline areas/record
Engineering/Pilot Testing	1	LS	$500,000	$500,000	
Subtotal				**$5,400,000**	
Contractor G & A	15%			$810,000	
Construction Oversight and Documentation	12%			$648,000	
Taxes, Bond, Warranty	10%			$540,000	
Construction Management	10%			$540,000	
Contingency 15%	15%			$810,000	
Capital Total				**$8,748,000**	
Operations and Maintenance					
Operations and Maintenance	1	Annual	$500,000	$500,000	Assumed.
Rate of Return	7%	Annual	-	-	For Present Value Calculations
20-Year O&M Subtotal	20	Years		**$5,297,007**	Operations and Maintenance cost for 20 years
20-Year Total Estimated Cost				**$14,045,007**	

Notes:
G & A - General and Administrative
O&M - Operation and Maintenance
LS - lump sum

Table C5

ALTERNATIVE 5 - Outfall 016 Discharge

Line Item	Quantities	Unit	Unit Price	CCL Cost Option Extended Price	Notes
Mobilization	1	LS	$25,000	$25,000	
Sump Construction in Leachate Pond	1	LS	$200,000	$200,000	Prepare sideslopes/floor
Pump and Controls, Installed	1	LS	$70,000	$70,000	
Engineering/Permitting	1	LS	$30,000	$30,000	
Subtotal				**$325,000**	
Contractor G & A	15%			$48,750	
Construction Oversight and Documentation	5%			$16,250	
Contingency 101%	10%			$32,500	
Capital Total				**$422,500**	
Operations and Maintenance					
Operations and Maintenance	1	Annual	$5,000	$5,000	Loadout, coordination, inspections
Pump Operations and Maintenance	1	Year	$5,000	$5,000	Annual cost, pull pump for winter, electrical
Rate of Return	7%	Annual	-	-	For Present Value Calculations
20-Year O&M Subtotal	20	Years		**$105,940**	
20-Year Total Estimated Cost				**$528,440**	Operations and Maintenance cost for 20 years

Notes:
G & A - General and Administrative
O&M - Operation and Maintenance
LS - lump sum

WLA says 570 gpm - includes 100 gpm allowance for intermittent flows
That is based on high water useage summer high
For estimated total annual flow, use: 470 gpm, 365 days/year

247032000 Gallons/year

Appendix D

Sample Data

Table 1

Leachate Sample Results (Prior to Leachate Pond)
Neal North

Analyte	Units	Vacated ELG / Other	Outfall 016 WLA*	11/8/2016	9/12/2017	8/28/2018	9/19/2019	9/23/2020
Aluminum	mg/L		270.8					
Antimony	mg/L		1192	0.00152	<0.00100	<0.00300	<0.00100	<0.00100
Arsenic	mg/L	0.008	36.83	0.0151	0.0193	0.0178	0.0124	0.0140
Barium	mg/L		22,200	0.0775	0.157	0.111	0.0901	0.0914
Beryllium	mg/L		54.16	<0.00100	<0.00100	<0.00300	<0.00100	<0.00100
Boron	mg/L		363	5.35	3.49	6.60	5.85	4.69
Cadmium	mg/L		0.6331	<0.000500	<0.000500	<0.00150	0.000469	0.00548
Calcium	mg/L			113	191	254	95.9	164
Chromium	mg/L		1.765	0.131	0.485	0.792	0.456	0.373
Cobalt	mg/L			0.00266	0.0033	0.00213	0.00481	0.00528
Copper	mg/L		2.914					
Iron	mg/L		108.3					
Lead	mg/L		11.14	<0.000500	0.0029	<0.00150	<0.000500	<0.000500
Lithium	mg/L			<0.100	0.012	<0.0300	<0.0100	0.0111
Magnesium	mg/L		1,120,000					
Manganese	mg/L		367					
Molybdenum	mg/L		13,700	0.682	0.626	1.53	1.03	1.52
Nickel	mg/L		91.36					
Potassium	mg/L							
Selenium	mg/L		2.091	0.172	0.208	0.435	0.299	0.425
Silver	mg/L		1.351					
Sodium	mg/L							
Strontium	mg/L							
Thallium	mg/L		0.9319	<0.00100	<0.00100	<0.00300	<0.00100	<0.00100
Tin	mg/L							
Titanium	mg/L							
Uranium	mg/L							
Vanadium	mg/L							
Zinc	mg/L		23.35	NS	NS	NS	NS	
Mercury	mg/L	0.000356	0.1784	<0.0002000	<0.0002000	<0.0002000	<0.0002000	<0.0002000
pH	Standard	6-9	3.8-14.0	Not Recorded	8.93	10.6	11.07	8.8
Nitrite as N	mg/L							
Nitrate as N	mg/L		34,660					
NO3+NO2 as N	mg/L		34,660					
Chloride	mg/l		64,470					
Sulfate	mg/L		157,200					
Fluoride	mg/L		848.1					
Total N	mg/L	10						
HEM - Oil and Grease	mg/L							
Cyanide	mg/L		2.383					
Ammonia as N	mg/L		Varies					
TKN	mg/L							
Total Phosphorus as P	mg/L							
Phenols	mg/L		72.44					
TOC	mg/L							
TSS	mg/L	30						
BOD	mg/L							
COD	mg/L							
TDS	mg/L							3570
Radium226+228	pCi/L							0.974

* Dated February 23, 2023

Table 1

Leachate Sample Results (Prior to Leachate Pond)
Neal North

Analyte	Units	7/13/2021	7/15/2021	8/5/2021	10/25/2021	4/13/2022	9/15/2022
Aluminum	mg/L	0.243		0.372	0.0451 J	0.261	
Antimony	mg/L	<0.00110	<0.00200	<0.00110	<0.00110	0.00114 J	<0.00200
Arsenic	mg/L	0.00463	0.00448	0.00562	0.00525	0.00619	0.00517
Barium	mg/L	0.0938	0.0715	0.130	0.0446	0.0985	0.0506
Beryllium	mg/L	<0.000270	<0.00100	<0.000270	<0.000270	<0.000270	<0.00100
Boron	mg/L	2.40		2.76	2.05	2.66	2.09
Cadmium	mg/L	0.0000610 J		0.000166	0.0000590 J	0.000142	<0.000100
Calcium	mg/L	348	321	427	200	423	295
Chromium	mg/L	0.0644	0.0515	0.118	0.0381	0.0711	0.0611
Cobalt	mg/L	0.00181	0.00116	0.00278	0.000974	0.00223	0.00116
Copper	mg/L	0.00411 J		0.00687	0.00444 J	0.0061	
Iron	mg/L	0.17		0.222	<0.0360	0.167	
Lead	mg/L	0.000472 J	<0.000500	0.000674	<0.000210	0.000333 J	<0.000500
Lithium	mg/L	0.0108	<0.0100	0.0134	0.00884 J	0.0133	<0.0100
Magnesium	mg/L	19.4		26.1	13.4	22.7	
Manganese	mg/L	0.00607 J		0.00849	<0.00440	0.00637 J	
Molybdenum	mg/L	0.17	0.127	0.403	0.108	0.352	0.149
Nickel	mg/L	0.0215		0.0551	0.00958	0.0567	
Potassium	mg/L	26.2		46.9	18	44.2	
Selenium	mg/L	0.0313	0.0249	0.0696	0.024	0.0763	0.0455
Silver	mg/L	<0.000420		<0.000420	<0.000420	0.000501 J	
Sodium	mg/L	439		917	218	764	
Strontium	mg/L	4.17		5.9	2.37	5.89	
Thallium	mg/L	<0.000260		<0.00104	<0.000260	<0.000260	<0.00100
Tin	mg/L	<0.00300		<0.00300	<0.00300	<0.00300	
Titanium	mg/L	0.0134		0.0258	<0.00170	0.0162	
Uranium	mg/L	0.00722		0.00655	0.0048	0.00635	
Vanadium	mg/L				0.0538	0.04	
Zinc	mg/L	0.0262		0.013	<0.0100	0.0122 J	
Mercury	mg/L	0.00000577	<0.000200	0.000025	0.00000373	0.00000717	<0.000200
pH	Standard	8.3	8.3	7.3	8.4	8	8.3
Nitrite as N	mg/L	<0.0340		0.0344	<0.0340	<0.680	
Nitrate as N	mg/L	14.1		33	6.28	16.9	
NO3+NO2 as N	mg/L	14.1		33.0	6.3	16.9	
Chloride	mg/l		283			735	407
Sulfate	mg/L	914	774	1370	626	1970	856
Fluoride	mg/L	0.212	<0.500	0.678	5.91	14.6	<0.500
Total N	mg/L	21.4		49.4	9.2	24.4	
HEM - Oil and Grease	mg/L	<4.6		<4.2	<4.4	<4.4	
Cyanide	mg/L	<0.00530		<0.00530	<0.00530	0.0145	
Ammonia as N	mg/L	<0.220		<0.220	<0.220	<0.220	
TKN	mg/L	7.3		16.4	2.93	7.54	
Total Phosphorus as P	mg/L	0.0585 J		0.0841 J	<0.0390	0.0422 J	
Phenols	mg/L	<0.0130		<0.0122	<0.0117	<0.0132	
TOC	mg/L	3.85		5.68	3.89	7.97	
TSS	mg/L	13.3		13.7	<1.70	37	
BOD	mg/L	<12.0		8.33	<3.00	6.71	
COD	mg/L	56.3		152	68.5	82.2	
TDS	mg/L		1940				2420
Radium226+228	pCi/L		0.793				

* Dated February 23, 2023

Table 2

Leachate Pond Sample Results(Leachate Pond after it was cleaned out)
Neal North

Analyte	Units	Vacated ELG / Other	Outfall 016 WLA *	11/1/2021	4/13/2022
Aluminum	mg/L		270.8		0.509
Antimony	mg/L		1192	<0.00200	<0.00276
Arsenic	mg/L	0.008	36.83	<0.00200	0.00513 J
Barium	mg/L		22,200	0.0498	0.181
Beryllium	mg/L		54.16	<0.00100	<0.00108
Boron	mg/L		363	1.17	5.37
Cadmium	mg/L		0.6331	0.000284	0.000956
Calcium	mg/L			104	397
Chromium	mg/L		1.765	0.0252	0.0601
Cobalt	mg/L			0.00155	0.00572
Copper	mg/L		2.914	<0.0100	0.423
Iron	mg/L		108.3		0.725
Lead	mg/L		11.14	0.000654	<0.000960
Lithium	mg/L				0.0169 J
Magnesium	mg/L		1,120,000		19.1
Manganese	mg/L		367		0.0492
Molybdenum	mg/L		13,700	0.185	1.22
Nickel	mg/L		91.36		0.318
Potassium	mg/L				56.2
Selenium	mg/L		2.091	0.0502	0.353
Silver	mg/L		1.351		<0.00196
Sodium	mg/L				1290
Strontium	mg/L				6.03
Thallium	mg/L		0.9319	<0.00100	<0.00104
Tin	mg/L				<0.0120
Titanium	mg/L				0.0169 J
Uranium	mg/L				0.00442
Vanadium	mg/L				0.0129 J
Zinc	mg/L		23.35		0.369
Mercury	mg/L	0.000356	0.1784	<0.00200	0.0000126
pH	pH units	6-9	3.8-14.0	8.1	7.9
Nitrite as N	mg/L				
Nitrate as N	mg/L		34,660		
NO3+NO2 as N	mg/L		34,660		
Chloride	mg/l		64,470	102	907
Sulfate	mg/L		157,200	429	1220
Fluoride	mg/L		848.1	1.9	22.6
Total N	mg/L	10			
HEM - Oil and Grease	mg/L				<4.3
Cyanide	mg/L		2.383		<0.00430
Ammonia as N	mg/L		Varies		3.18
TKN	mg/L				14.4
Total Phosphorus as P	mg/L				0.0580 J
Phenols	mg/L		72.44		<0.0132
TOC	mg/L				26.1
TSS	mg/L				10.3
BOD	mg/L				<3.00
COD	mg/L				166
TDS	mg/L			570	
Radium226+228	pCi/L				

* February 23, 2023

Appendix E

Proof of Publication (to be completed)

ghd.com → The Power of Commitment