Permit Fact Sheet

General Information

Permit Number	WI-0030759-11-0
Permittee Name and Address	Madeline Sanitary District PO Box 267, 949 Snow Place Lane La Pointe WI 54850
Permitted Facility Name and Address	Madeline Sanitary District 949 Snow Place Lane, La Pointe, Wisconsin
Permit Term	April 01, 2025 to March 31, 2030
Discharge Location	924 Big Bay Road, S½, NW¼ of Section 21; T50N-R3W located on Madeline Island in Ashland County
Receiving Water	Lake Superior in Bayfield Peninsula Southeast of Lake Superior in Ashland County
Stream Flow ($Q_{7,10}$)	10:1 dilution ratio
Stream Classification	Cold Water (CW) community, public water supply, and outstanding resource water (ORW)
Discharge Type	Existing continuous
Annual Average Design Flow (MGD)	0.163 MGD – Changed from 0.152 MGD as identified in a 2008 design report (Summer 0.163 and Winter 0.049).
Industrial or Commercial Contributors	None
Plant Classification	A4 - Ponds, Lagoons and Natural Systems; D - Disinfection; SS - Sanitary Sewage Collection System
Approved Pretreatment Program?	N/A

Facility Description

Madeline Sanitary District owns and operates a domestic wastewater treatment system. The plant designed to treat 163,000 gallons per day currently treats an average of 58,000 gallons per day (2020-2024 data). The treatment system consists of a fine screen for solids removal from influent and hauled waste. Wastewater then flows into two covered lagoons divided into four zones using a floating curtain baffle system. Naturally occurring microorganisms present in the wastewater metabolize organic matter. A fine bubble aeration system supplies oxygen and provides mixing to provide contact between microorganisms, organic matter and submerged fixed film media curtains (BioReef) which increases the removal of BOD and nitrogen. Prior to discharging the treated wastewater (effluent) to Lake Superior a UV disinfection system is used seasonally (May through October).

Substantial Compliance Determination

There have been a few effluent violations, missed samples, and late reporting. However, Madeline Sanitary District (MSD) is working with the department to address issues, including facility planning, evaluating sludge removal, and evaluating alternatives to address RV dump station and other high strength waste. Alternative (CBOD) limits in lieu of BOD limits are being considered. No further action needed at this time.

After a desk top review of all discharge monitoring reports, phosphorous reports and CMARs, and a site visit on 9/18/2024, MSD has been found to be in substantial compliance with their current permit.

Sample Point Descriptions

Sample Point Designation		
Sample Point Number	**Discharge Flow, Units, and Averaging Period**	**Sample Point Location, Waste Type/Sample Contents and Treatment Description (as applicable)**
701	**INFLUENT** An average of 0.043 MGD (2020-2024 data)	Representative influent samples shall be collected from the pumps at the main lift station except for flow which shall be monitored prior to the screening unit.
001	**EFFLUENT** An average of 0.058 MGD (2020-2024 data)	Representative samples shall be collected from the wet well or the final lift station, except for E. coli which shall be collected immediately after the Ultraviolet disinfection system. The permittee is authorized to discharge to Lake Superior within the Lake Superior drainage basin.
002	**SLUDGE** Sludge was last removed in 2010 as part of a facility upgrade.	Representative samples shall be collected from the accumulated sludge in the ponds at various locations and depths that are composited for analysis.

Permit Requirements

1 Influent – Monitoring Requirements

1.1 Sample Point Number: 701- INFLUENT TO PLANT

Monitoring Requirements and Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Flow Rate		MGD	Daily	Total Daily	
BOD5, Total		mg/L	Weekly	Grab	
CBOD5		mg/L	Weekly	Grab	
Suspended Solids, Total		mg/L	Weekly	Grab	

1.1.1 Changes from Previous Permit:

Influent limitations and monitoring requirements were evaluated for this permit term and the following changes were made from the previous permit. See additional explanation of limits under "Explanation of Limits and Monitoring Requirements" below.

- CBOD5 monitoring has been added to the permit.

1.1.2 Explanation of Limits and Monitoring Requirements

Monitoring of influent flow, BOD5 and total suspended solids is required by s. NR 210.04(2), Wis. Adm. Code, to assess wastewater strengths and volumes and to demonstrate the percent removal requirements in s. NR 210.05, Wis. Adm. Code, and in the Standard Requirements section of the permit.

CBOD5 - The permittee applied for and has been approved for a variance as provided in NR 210.07 (4) and (5) Wis. Adm. Code to replace BOD limits with CBOD limits. Department guidance for the variance review process was utilized; and submitted data fit within the required criteria; thus, the request was granted in the December 11, 2024 "Water Quality Based Effluent Limitations for the Madeline Sanitary District" Memo (WQBEL). Influent monitoring for BOD5 and CBOD5 is required as part of the variance. Monitoring for CBOD5 satisfies the percent removal requirements of NR 210.05 Wis. Adm. Code, and monitoring for BOD5 satisfies operational requirements for the Compliance Maintenance Annual Report (CMAR).

2 Surface Water - Monitoring and Limitations

2.1 Sample Point Number: 001- EFFLUENT

Monitoring Requirements and Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Flow Rate		MGD	Daily	Total Daily	
CBOD5	Weekly Avg	40 mg/L	Weekly	Grab	
CBOD5	Monthly Avg	25 mg/L	Weekly	Grab	
Suspended Solids, Total	Weekly Avg	45 mg/L	Weekly	Grab	
Suspended Solids, Total	Monthly Avg	30 mg/L	Weekly	Grab	
Nitrogen, Ammonia (NH3-N) Total	Weekly Avg	72 mg/L	Weekly	Grab	
Nitrogen, Ammonia (NH3-N) Total	Monthly Avg	39 mg/L	Weekly	Grab	
Nitrogen, Ammonia (NH3-N) Total	Daily Max - Variable	mg/L	Weekly	Grab	Enter the daily ammonia result on the eDMR and compare to the Nitrogen, Ammonia Variable Limit column to determine compliance.
Nitrogen, Ammonia Variable Limit		mg/L	Weekly	See Table	Using the daily pH result look up the applicable ammonia limit in the "Ammonia Limitation" section and report the variable limit on the eDMR.
pH Field	Daily Min	6.0 su	Weekly	Grab	
pH Field	Daily Max	9.0 su	Weekly	Grab	

Monitoring Requirements and Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Phosphorus, Total	Monthly Avg	5.1 mg/L	Weekly	Grab	Interim limit. See the Phosphorus Limitation section for more information.
E. coli	Geometric Mean - Monthly	126 #/100 ml	Weekly	Grab	Monitoring and limit effective May through October.
E. coli	% Exceedance	10 Percent	Monthly	Calculated	Monitoring and limit effective May through October. See the E. coli Percent Limit section. Enter the result on the eDMR on the last day of the month.
PFOS		ng/L	1/ 2 Months	Grab	Monitoring only. See PFOS/PFOA Minimization Plan Determination of Need schedule.
PFOA		ng/L	1/ 2 Months	Grab	Monitoring only. See PFOS/PFOA Minimization Plan Determination of Need schedule.
Nitrogen, Total Kjeldahl		mg/L	See Listed Qtr(s)	Grab	See the Nitrogen Series Monitoring section for testing schedule.
Nitrogen, Nitrite + Nitrate Total		mg/L	See Listed Qtr(s)	Grab	See the Nitrogen Series Monitoring section for testing schedule.
Nitrogen, Total		mg/L	See Listed Qtr(s)	Calculated	Total Nitrogen = Total Nitrogen Kjeldahl (mg/L) + Nitrite + Nitrate Nitrogen (mg/L). See the Nitrogen Series Monitoring section for testing schedule.
Acute WET		TUa	See Listed Qtr(s)	Grab	Two tests are required during the permit term. See the Whole Effluent Toxicity (WET) testing section for monitoring schedule.

2.1.1 Changes from Previous Permit

Effluent limitations and monitoring requirements were evaluated for this permit term and the following changes were made from the previous permit. See additional explanation of limits under "Explanation of Limits and Monitoring Requirements" below.

- **CBOD5** monitoring and limits replace BOD5 monitoring and limits.
- Fecal coliform monitoring and limits have been replaced with **Escherichia coli (E. coli)** monitoring and limits.
- **PFOS and PFOA** monitoring, and schedule have been added to the permit.
- Annual monitoring for the **Nitrogen Series** (nitrate +nitrite, total Kjeldahl nitrogen and total nitrogen) has been added to the permit.
- Two **Acute WET** tests are required during the permit term.

2.1.3 Explanation of Limits and Monitoring Requirements

Detailed discussions of limits and monitoring requirements can be found in the attached water quality-based effluent limits (WQBEL) memo dated December 11, 2024.

CBOD5 - The permittee applied for and has been approved for a variance as provided in NR 210.07 (4) and (5) Wis. Adm. Code to replace BOD limits with CBOD limits. The facility was successful in showing that BOD5 data was flawed as the result of being inflated by at least partial nitrification that occurs in the BOD5 test. Nitrification gives erroneously high results therefore falsely indicating noncompliance.

E. coli and Fecal Coliform - Fecal coliform monitoring and limits are no longer required. Escherichia coli (E. coli) limits of 126 #/100 ml as a monthly geometric mean may never be exceeded and 410 #/100 ml as a daily maximum may not be exceeded more than 10 percent of the time in any calendar month limits apply during the disinfection season of May through October. The disinfection season extends one additional month because of a prolonged recreation season on Lake Superior.

PFOS and PFOA – NR 106 Subchapter VIII – Permit Requirements for PFOS and PFOA Dischargers became effective on August 1, 2022. At the first reissuance of a WPDES permit after August 1, 2022, the new rule requires WPDES permits for municipal dischargers with an average flow rate less than 1 MGD, to be evaluated on a case-by-case basis to determine if monitoring is required pursuant to s. NR 106.98(2)(c), Wis. Adm. Code. The department evaluated the need for PFOS and PFOA monitoring taking into consideration the presence of potential PFOS or PFOA industrial wastes, remediation sites and other potential sources of PFOS or PFOA. Based on information available at the time the proposed permit was drafted, it was identified that there is a PFOS fish consumption advisory in Lake Superior.

Therefore, monitoring once every two months is included. A sample frequency of once every two months means one sample is taken during any two-month period. Examples of 1/2 month sample would be every other month (Jan, March, May, etc.) or back-to-back months with a break in between (February & March, May & June, Aug & Sept, etc.). DMR Short Forms will be generated for the following time periods: January-February, March-April, May-June, July-August, September-October, and November-December. At a minimum one sample result will be present on each form.

Nitrogen Series - (nitrate +nitrite, total Kjeldahl nitrogen and total nitrogen) **–** In 2011, the Upper Mississippi River Basin Association (UMRBA) completed the report "Upper Mississippi River Nutrient Monitoring, Occurrence, and Local Impacts: A Clean Water Act Perspective". Among the many recommendations of this report was that the states should expand their NPDES discharge monitoring requirements to include both phosphorus and nitrogen as they have important impacts on the mainstem upper Mississippi River as well as in the Gulf of Mexico. Consequently, the department developed the "Guidance for Total Nitrogen Monitoring in WPDES Permits" document dated October 2019, where annual effluent monitoring for total nitrogen (total nitrogen = total Kjeldahl + (nitrite+nitrate)) is required for municipal and industrial facilities discharging to surface waters. Section 283.55(1)(e) Wis. Stats. allows the department to require the permittee to submit information necessary to identify the type and quantity of any pollutants discharged from the point source, and s. NR 200.065 (1)(h) Wis. Adm. Code allows for this monitoring to be collected during the permit term. The schedule is identified in the permit.

WET Testing - A WET Checklist was prepared to determine the number of WET tests that are needed. As toxicity potential increases, more points accumulate, and more monitoring is required to assure toxicity is not occurring over the short (acute) and long (chronic) term. Based on the total points accumulated and Chapter 1.3 of the WET Guidance Document, 2 Acute WET Tests are required this permit term as identified in the permit.

Monitoring Frequencies- The Monitoring Frequencies for Individual Wastewater Permits guidance (April 12, 2021) recommends that standard monitoring frequencies be included in individual wastewater permits based on the size and type of the facility, in order to characterize effluent quality and variability, to detect events of noncompliance, and to ensure consistency in permits issued across the state. Guidance and requirements in administrative code were considered when determining the appropriate monitoring frequencies for pollutants that have final effluent limits in effect during this permit term.

Previously permitted monitoring frequencies for pH fall below the standard monitoring frequency outlined in guidance. However, since data submitted during the previous permit term shows consistent compliance with permit limitations, and the set monitoring frequency is consistent with requirements of state code, the reduced monitoring frequency is continued in the proposed permit. If performance levels begin to vary during the permitted term, the department may re-evaluate current sampling frequencies and implement more frequent monitoring via permit modification or at permit reissuance.

3 Land Application - Monitoring and Limitations

Municipal Sludge Description						
Sample Point	**Sludge Class (A or B)**	**Sludge Type (Liquid or Cake)**	**Pathogen Reduction Method**	**Vector Attraction Method**	**Reuse Option**	**Amount Reused/Disposed (Dry Tons/Year)**
002	B	Liquid	Sludge was last removed in 2010 and removal is not anticipated this permit term. If removal is needed see the land application and schedule sections of the permit for more information.			
Does sludge management demonstrate compliance? Yes						
Is additional sludge storage required? No						
Is Radium-226 present in the water supply at a level greater than 2 pCi/liter? The community water supply is provided by private wells. Radium-226 levels are unknown since private water wells are not required to be tested for radium, but Radium-226 has not been found to be an issue in Ashland County.						
Is a priority pollutant scan required? No						

3.1 Sample Point Number: 002- Lagoon Sludge

Monitoring Requirements and Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Solids, Total		Percent	Once	Composite	
Arsenic Dry Wt	Ceiling	75 mg/kg	Once	Composite	
Arsenic Dry Wt	High Quality	41 mg/kg	Once	Composite	
Cadmium Dry Wt	Ceiling	85 mg/kg	Once	Composite	
Cadmium Dry Wt	High Quality	39 mg/kg	Once	Composite	

Monitoring Requirements and Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Copper Dry Wt	Ceiling	4,300 mg/kg	Once	Composite	
Copper Dry Wt	High Quality	1,500 mg/kg	Once	Composite	
Lead Dry Wt	Ceiling	840 mg/kg	Once	Composite	
Lead Dry Wt	High Quality	300 mg/kg	Once	Composite	
Mercury Dry Wt	Ceiling	57 mg/kg	Once	Composite	
Mercury Dry Wt	High Quality	17 mg/kg	Once	Composite	
Molybdenum Dry Wt	Ceiling	75 mg/kg	Once	Composite	
Nickel Dry Wt	Ceiling	420 mg/kg	Once	Composite	
Nickel Dry Wt	High Quality	420 mg/kg	Once	Composite	
Selenium Dry Wt	Ceiling	100 mg/kg	Once	Composite	
Selenium Dry Wt	High Quality	100 mg/kg	Once	Composite	
Zinc Dry Wt	Ceiling	7,500 mg/kg	Once	Composite	
Zinc Dry Wt	High Quality	2,800 mg/kg	Once	Composite	
Nitrogen, Total Kjeldahl		Percent	Per Application	Composite	
Nitrogen, Ammonia (NH3-N) Total		Percent	Per Application	Composite	
Phosphorus, Total		Percent	Per Application	Composite	
Phosphorus, Water Extractable		% of Tot P	Per Application	Composite	
Potassium, Total Recoverable		Percent	Per Application	Composite	
PCB Total Dry Wt	Ceiling	50 mg/kg	Once	Composite	See the Sludge Analysis for PCBs section.
PCB Total Dry Wt	High Quality	10 mg/kg	Once	Composite	See the Sludge Analysis for PCBs section.
PFOA + PFOS		ug/kg	Once	Calculated	Report the sum of PFOA and PFOS. See PFAS Permit Sections for more information.
PFAS Dry Wt			Once	Grab	Perfluoroalkyl and Polyfluoroalkyl Substances based on updated DNR PFAS List. See PFAS

Monitoring Requirements and Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
					Permit Sections for more information.

3.1.1 Changes from Previous Permit:

Sludge limitations and monitoring requirements were evaluated for this permit term and the following changes were made from the previous permit. See additional explanation of limits under "Explanation of Limits and Monitoring Requirements" below.

- **List 1 (Metals), PCB and PFAS** monitoring is required once during the permit term.
- **List 2 (Nutrients)** have been added to the table because monitored with List 1 is recommended monitoring, they have been added to the table.
- Due to changes within the land application forms, the 3400-049 ("Characteristics Report"), 3400-052 ("Other Methods of Disposal") and 3400-055 (Annual Land Application") forms will need to be submitted each year.

3.1.2 Explanation of Limits and Monitoring Requirements

Requirements for disposal, including land application of municipal sludge, are determined in accordance with ch. NR 204, Wis. Adm. Code. Ceiling and high-quality limits for metals in sludge are specified in s. NR 204.07(5). Requirements for pathogens are specified in s. NR 204.07(6) and in s. NR 204.07 (7) for vector attraction requirements. Limitations for PCBs are addressed in s. NR 204.07(3)(k).

List 2 Nutrient monitoring – Monitoring for list 2 (nutrients) is highly recommended at the same time as the monitoring of List 1 (metals) in year 2 of the permit (2026). Results will assist in the determination of the acres needed for land application of sludge should it be necessary. The number of acres needed is also required for the Sludge Management Schedule (see schedules for more information).

PFAS- The presence and fate of PFAS in municipal and industrial sludges is an emerging public health concern. EPA has developed a risk assessment regarding future land application rates and released a draft of this risk assessment in January 2025. During this time, the department is continuing to implement the "Interim Strategy for Land Application of Biosolids and Industrial Sludges Containing PFAS."

Collecting sludge data on PFAS concentrations from a wide range of wastewater treatment facilities will help protect public health from exposure to elevated levels of PFAS and determine the department's implementation of EPA's recommendations. To quantitate this risk, PFAS sampling has been included in this WPDES permit pursuant to ss. NR 214.18(5)(b) and NR 204.06(2)(b)9., Wis. Adm. Code.

Change in form submittal – In prior permit reissuances when it has been noted in the application that sludge would not be removed during the permit term, the department required sampling during the second year of the permit term and the sludge characteristic report (3400-049) would be generated only during that year. Due to moving to electronic submittal of forms via Switchboard, forms 3400-049 ("Characteristics Report"), 3400-052 ("Other Methods of Disposal") and 3400-055 ("Annual Land Application") will now be generated by the department and the permittee will be required to submit all three reports each year of the permit term. This change was adopted to provide the permittee flexibility because many lagoon desludging projects can be unexpected, are delayed or staggered over multiple years. Additionally, it is used to officially report that no land application of sludge has occurred, and annual submittal of the forms is required per the standard requirements section.

- Sludge analysis during the second year of the permit term has been included. There are check boxes available on the electronic forms to identify if desludging didn't occur.

- Sludge characteristics report (3400-049) – at the top of the form check “yes” or “no” in the box identifying if any land application occurred that year. Complete the form if required or identify the year samples will be or have been taken in the comments section.
- 3400-052 (“Other Methods of Disposal”) and 3400-055 (“Annual Land Application”) - The reports are technically 2 separate forms that are now combined in one location but separated onto two different tabs. If you answer “No” to both listed questions the forms are complete. If you need to answer “Yes” to either question the corresponding form tabs will go from gray to blue indicting information can be entered on the report.

4 Schedules

4.1 Sludge Management Plan

A management plan is required for the land application system.

Required Action	Due Date
Sludge Management Plan Submittal: The permittee shall submit an update to the management plan for approval if removal of sludge will occur during this permit term. The plan shall demonstrate compliance with ch. NR 204 Wis. Adm. Code and at minimum address 1) How and where is sludge sampled; 2) Available sludge storage details and location(s); 3)How will the sludge be removed with details on volume, characterization and how will the treatment plant continue to function during the drawdown; 4) Describe the type of transportation and spreading vehicles and loading and unloading practices; 5) Identify approved land application sites, apply for needed sites, site limitations, total acres needed and vegetative cover management; 6) Specify record keeping procedures including site loading; 7) Address contingency plans for adverse weather and odor/nuisance abatement; and 8) Include any other pertinent information such as other disposal options that may be used or specifications of any pretreatment processes Once approved, all sludge management activities shall be conducted in accordance with the plan. Any changes to the plan must be approved by the department prior to implementing the changes. No desludging may occur unless approval from the department is obtained. Daily logs shall be kept that record where the sludge has been disposed. The plan is due at least 60 days prior to desludging.	

4.1.1 Explanation of Schedule

If the lagoons are to be de-sludged during this permit term a management plan is needed to show compliance with ch. NR 204, Wis. Adm. Code. There are outlines available to assist in plan development.

4.2 PFOS/PFOA Minimization Plan Determination of Need

Required Action	Due Date
Report on Effluent Discharge: Submit a report on effluent PFOS and PFOA concentrations and include an analysis of trends in monthly and annual average PFOS and PFOA concentrations. This analysis should also include a comparison to the applicable narrative standard in s. NR 102.04(8)(d), Wis. Adm. Code. This report shall include all additional PFOS and PFOA data that may be collected including any influent, intake, in-plant, collection system sampling, and blank sample results.	01/31/2026
Report on Effluent Discharge and Evaluation of Need: Submit a final report on effluent PFOS and	01/31/2027

PFOA concentrations and include an analysis of trends in monthly and annual average PFOS and PFOA concentrations of data collected over the last 24 months. The report shall also provide a comparison on the likelihood of the facility needing to develop a PFOS/PFOA minimization plan. This report shall include all additional PFOS and PFOA data that may be collected including any influent, intake, in-plant, collection system sampling, and blank sample results. The permittee shall also submit a request to the department to evaluate the need for a PFOS/PFOA minimization plan. If the department determines a PFOS/PFOA minimization plan is needed based on a reasonable potential evaluation, the permittee will be required to develop a minimization plan for department approval no later than 90 days after written notification was sent from the department. The department will modify or revoke and reissue the permit to include PFOS/PFOA minimization plan reporting requirements along with a schedule of compliance to meet WQBELs. Effluent monitoring of PFOS and PFOA shall continue as specified in the permit until the modified permit is issued. If, however, the department determines there is no reasonable potential for the facility to discharge PFOS or PFOA above the narrative standard in s. NR 102.04(8)(d), Wis. Adm. Code, no further action is required and effluent monitoring of PFOS and PFOA shall continue as specified in the permit.	

4.2.1 Explanation of Schedule

As stated above, ch. NR 106 Subchapter VIII – Permit Requirements for PFOS and PFOA Dischargers became effective on August 1, 2022. Section NR 106.98, Wis. Adm. Code, specifies steps to generate data in order to determine the need for reducing PFOS and PFOA in the discharge. Data generated per the effluent monitoring requirements will be used to determine the need for developing a PFOS/PFOA minimization plan. As part of the schedule, the permittee is required to submit two annual Reports on Effluent Discharge.

If the department determines that a minimization plan is needed, the permit will be modified or revoked/reissued to include additional requirements.

4.3 Phosphorus Optimization

The permittee is required to optimize performance to control phosphorus discharges per the following schedule.

Required Action	Due Date
Progress Report: Submit an update on the progress of any phosphorus optimization, including any implementation schedules identified in the previous progress reports.	04/01/2026
Progress Report: Submit an update on the progress of any phosphorus optimization, including any implementation schedules identified in the previous progress reports.	04/01/2027
Progress Report: Submit an update on the progress of any phosphorus optimization, including any implementation schedules identified in the previous progress reports.	04/01/2028
Progress Report: Submit an update on the progress of any phosphorus optimization, including any implementation schedules identified in the previous progress reports.	04/01/2029
Updated Draft Report: Submit an update on the progress of any phosphorus optimization, including any implementation schedules identified in the previous progress reports. The updated draft plan shall be used to provide an outline of all the items necessary for completion of a Final Comprehensive Facility Plan. It shall address the identified technology-based level for phosphorus removal of the existing plant and potential use of Adaptive Management Plan	03/31/2030

options/alternatives, including Water Quality Trading for achieving compliance with a final WQBEL for phosphorus. It is recognized submittal of a final comprehensive facility plan will not be required until such time the WQBEL limit for phosphorus has been determined by the department for subsequent permit re-issuance or modification.	

4.3.1 Explanation of Schedule

Once the nearshore or whole lake model is complete and limits are calculated, it is unknown if the existing treatment plant is capable of achieving the calculated water quality-based effluent limits. If the calculated loading allocations are lower than the current discharges the facility may need to consider other control methods. This compliance schedule addresses continued optimization of phosphorus discharge reduction with the existing facilities and requires an update to the comprehensive facility plan and Operational Needs Report and Optimization Plan. Upon completion of the nearshore or whole lake model, the department has the authority to modify the WPDES permit to include established WQBELs.

Attachments

Water Flow Schematic updated October 2024

Water Quality Based Effluent Limits memo dated December 11, 2024

Justification Of Any Waivers From Permit Application Requirements

A decision has been made not to require effluent monitoring for metals in the application because:

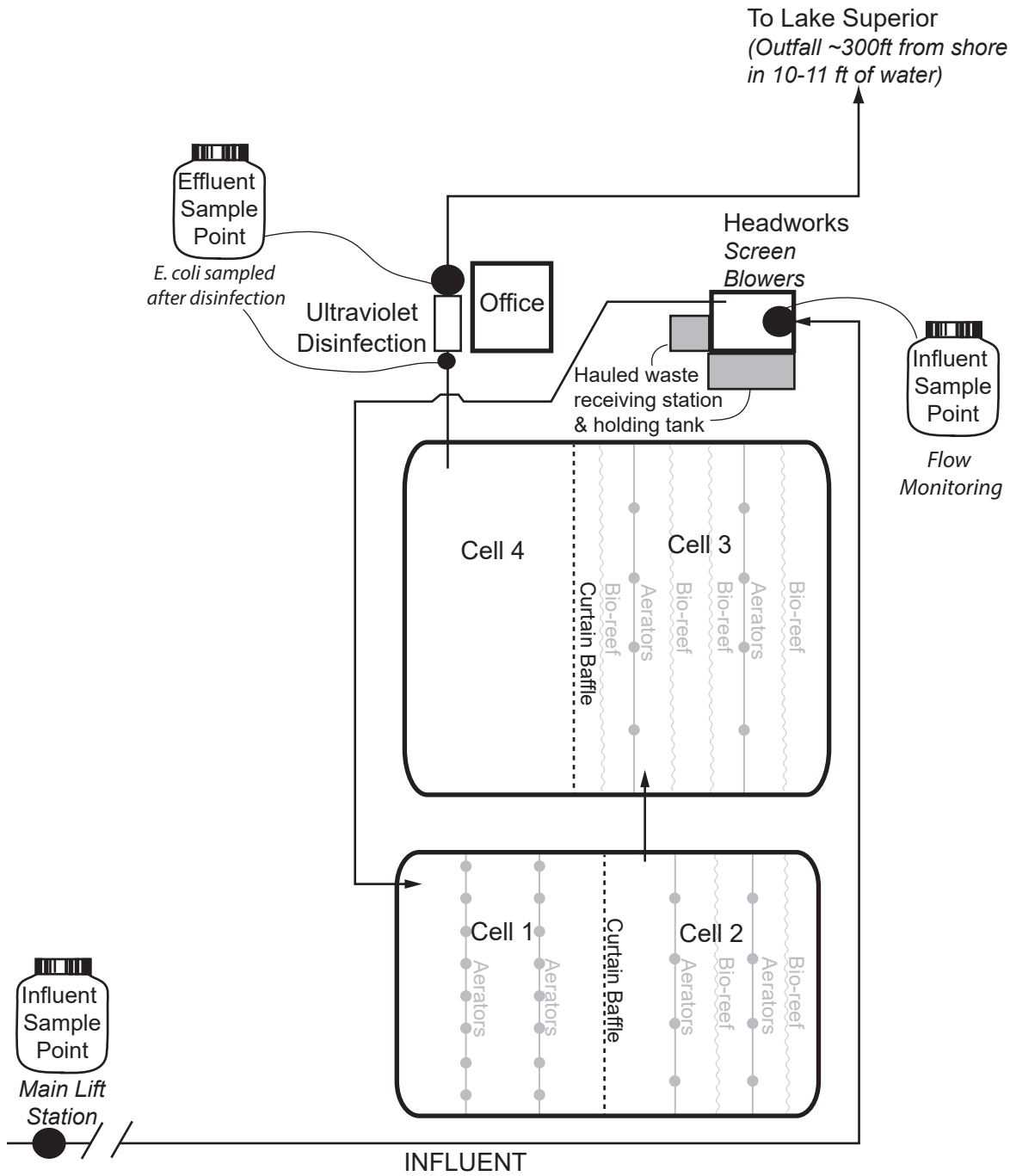
1. The low actual flows (an average of 0.058 MGD) from this facility.
2. The wastewater is all domestic with no industrial contributors to the collection system.
3. The metals in the sludge are well below high quality sludge limits which correlates to low metal concentrations in the effluent.
4. The community does not have a public water supply system and does not have any control over corrosivity in the influent wastewater.

Prepared By: Sheri A. Snowbank Wastewater Specialist **Date:** January 8, 2025

WPDES # WI-0030759

Madeline Sanitary District
Wastewater Treatment Plant

The Madeline Sanitary District wastewater treatment facility consists of two covered aerated ponds. To increase treatment quality submerged curtain-type fixed film media systems (Bio-reefs) have been installed. Ultraviolet disinfection is provided from May through September, annually. Effluent is discharged to Lake Superior. The diagram below shows the treatment units and sampling locations.



● represents sample locations

NOT TO SCALE

Construction year: 2010
Seasonal Design Loadings:
Flow: 0.163 MGD (summer); 0.049 MGD (winter)
BOD: 394 lb/d (summer); 94 lb/d (winter)

CORRESPONDENCE/MEMORANDUM

State of Wisconsin

DATE: December 11, 2024

TO: Sheri Snowbank – NOR/Spooner Service Center

FROM: Michael Polkinghorn – NOR/Rhinelander Service Center

SUBJECT: Water Quality-Based Effluent Limitations for the Madeline Sanitary District
WPDES Permit No. WI-0030759-11-0

This is in response to your request for an evaluation of the need for water quality-based effluent limitations (WQBELs) using chapters NR 102, 104, 105, 106, 207, 210, 212, and 217 of the Wisconsin Administrative Code (where applicable), for the discharge from the Madeline Sanitary District in Ashland County. This municipal wastewater treatment facility (WWTF) discharges to Lake Superior, located in the Chequamegon Bay – Frontal Lake Superior Watershed in the Lake Superior Basin. The evaluation of the permit recommendations is discussed in more detail in the attached report.

Based on our review, the following recommendations are made on a chemical-specific basis at Outfall 001:

Parameter	Daily Maximum	Daily Minimum	Weekly Average	Monthly Average	Footnotes
Flow Rate					1
$CBOD_5$			40 mg/L	25 mg/L	2, 3
TSS			45 mg/L	30 mg/L	1, 3
pH	9.0 s.u.	6.0 s.u.			1, 3
E. coli May – October				126 #/100 mL geometric mean	4
Ammonia Nitrogen June – September	Variable		**72 mg/L**	**39 mg/L**	1, 5, 6
Phosphorus				5.1 mg/L	1, 7
PFOS and PFOA					8
TKN, Nitrate+Nitrite, and Total Nitrogen					9
Acute WET					10

Footnotes:

1. No changes from the current permit.
2. This facility meets the conditions as described in s. NR 210.07(4), Wis. Adm. Code. An additional requirement is the 30-day average $CBOD_5$ percent removal may not be less than 85%. Significant improvements to treatment quality at the facility will prompt a re-evaluation of this variance. Significant improvements to treatment quality at the facility will prompt a re-evaluation of this variance. Otherwise the need for $CBOD_5$ limits does not need to be demonstrated at subsequent permit reissuances if the treatment quality is expected to remain similar as compared in this evaluation.
3. These limits are based on the Cold Water (CW) community of the immediate receiving water as described in s. NR 210.05(1), Wis. Adm. Code.
4. Additional final limit: No more than 10 percent of *E. coli* bacteria samples collected in any calendar month may exceed 410 count/100 mL.
5. Additional limits to comply with the expression of limits requirements in ss. NR 106.07 and NR 205.065(7), Wis. Adm. Codes, are included in bold.

6. The variable daily maximum ammonia nitrogen limit table corresponding to various effluent pH values may be included in the permit in place of the single limit of 26 mg/L.

Daily Maximum Ammonia Nitrogen Limits

Effluent pH s.u.	Limit mg/L	Effluent pH s.u.	Limit mg/L	Effluent pH s.u.	Limit mg/L
$6.0 \leq pH \leq 6.1$	72	$7.0 < pH \leq 7.1$	44	$8.0 < pH \leq 8.1$	9.3
$6.1 < pH \leq 6.2$	71	$7.1 < pH \leq 7.2$	39	$8.1 < pH \leq 8.2$	7.6
$6.2 < pH \leq 6.3$	69	$7.2 < pH \leq 7.3$	35	$8.2 < pH \leq 8.3$	6.3
$6.3 < pH \leq 6.4$	67	$7.3 < pH \leq 7.4$	31	$8.3 < pH \leq 8.4$	5.2
$6.4 < pH \leq 6.5$	65	$7.4 < pH \leq 7.5$	27	$8.4 < pH \leq 8.5$	4.3
$6.5 < pH \leq 6.6$	63	$7.5 < pH \leq 7.6$	23	$8.5 < pH \leq 8.6$	3.5
$6.6 < pH \leq 6.7$	60	$7.6 < pH \leq 7.7$	19	$8.6 < pH \leq 8.7$	3.0
$6.7 < pH \leq 6.8$	56	$7.7 < pH \leq 7.8$	16	$8.7 < pH \leq 8.8$	2.5
$6.8 < pH \leq 6.9$	52	$7.8 < pH \leq 7.9$	14	$8.8 < pH \leq 8.9$	2.1
$6.9 < pH \leq 7.0$	48	$7.9 < pH \leq 8.0$	11	$8.9 < pH \leq 9.0$	1.8

7. Section NR 102.06(5)(a), Wis. Adm. Code, specifies a total phosphorus criterion of 5 µg/L (0.005 mg/L) for the open and nearshore waters of Lake Superior. For discharges directly to the Great Lakes, s. NR 217.13(4), Wis. Adm. Code, says that the Department shall set effluent limits consistent with nearshore or whole lake models approved by the Department. At this time, there is no model available. According to phosphorus implementation guidance, an interim limit should be set at a level that is achievable and that makes progress toward phosphorus reductions without the investment of temporary treatment or a compliance schedule to meet the interim limit.
8. Once every other month monitoring is required in accordance with s. NR 106.98(2), Wis. Adm. Code.
9. As recommended in the Department's October 1, 2019 Guidance for Total Nitrogen Monitoring in Wastewater Permits, annual total nitrogen monitoring is recommended for all minor municipal permittees. Total nitrogen is the sum of nitrate (NO_3), nitrite (NO_2), and total Kjeldahl nitrogen (TKN) (all expressed as N).
10. Two acute whole effluent toxicity (WET) tests are recommended during the reissued permit term. According to the *State of Wisconsin Aquatic Life Toxicity Testing Methods Manual* (s. NR 219.04, Table A, Wis. Adm. Code), a synthetic (standard) laboratory water may be used as the dilution water and primary control in acute WET tests. Sampling WET concurrently with any chemical-specific toxic substances is recommended. Tests should be done in rotating quarters, to collect seasonal information about this discharge and should continue after the permit expiration date (until the permit is reissued).

Please consult the attached report for details regarding the above recommendations. If there are any questions or comments, please contact Michael Polkinghorn at (715) 360-3379 or Michael.Polkinghorn@wisconsin.gov and Diane Figiel at Diane.Figiel@wisconsin.gov.

Attachments (3) – Narrative, discharge area map, & thermal table.

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Attachment #1

Water Quality-Based Effluent Limitations for
Madeline Sanitary District

WPDES Permit No. WI-0030759-11-0

Prepared by: Michael A. Polkinghorn

PART 1 – BACKGROUND INFORMATION

Facility Description

Primary treatment of influent municipal wastewater consists of a fine screen system for solids removal in addition to solid waste hauling, both taking place at the headworks building. Secondary treatment is achieved by two covered aerated lagoons, which are divided into four cells using a floating curtain baffle system. The floating covers over the first three cells retain heat and control algal growth and within the lagoons are naturally occurring metabolizing microorganisms present in the wastewater break down organic matter until effluent limits are met. A fine bubble aeration blower system supplies dissolved oxygen and mixing for improved microorganism interaction with organic matter and BioReef submerged fixed film media curtains are also present to increase BOD and nitrogen removal. Wastewater is disinfected seasonally (May – October) via ultraviolet light before discharge. Effluent is discharged on a continuous basis to Lake Superior, approx. 500 ft offshore or 3,600 ft north of the WWTF.

Attachment #2 is a discharge area map of Outfall 001.

Existing Permit Limitations

The current permit, expiring on 06/30/2024, includes the following effluent limitations and monitoring requirements.

Parameter	Daily Maximum	Daily Minimum	Weekly Average	Monthly Average	Footnotes
Flow Rate					1
BOD_5			45 mg/L	30 mg/L	2, 3
TSS			45 mg/L	30 mg/L	2, 3
pH	9.0 s.u.	6.0 s.u.			2, 3
Fecal Coliform May – October			**656#/100 mL** **geometric mean**	400#/100 mL geometric mean	4
Ammonia Nitrogen June – September	Variable		**72 mg/L**	**39 mg/L**	4, 5
Phosphorus				5.1 mg/L	6
E. coli May – October					1
Acute WET					7
Chronic WET					7

Footnotes:

1. Monitoring only.
2. These limits are based on the Cold Water (CW) community of the immediate receiving water as described in s. NR 210.05(1), Wis. Adm. Code.
3. **These limitations are not being evaluated as part of this review.** Because the water quality criteria (WQC), reference effluent flow rates, and receiving water characteristics have not changed, limitations for these water quality characteristics do not need to be re-evaluated at this time.
4. Additional limits to comply with the expression of limits requirements in ss. NR 106.07 and NR 205.065(7), Wis. Adm. Codes, are included in bold.
5. The variable daily maximum ammonia nitrogen limit table corresponding to various effluent pH values may be included in the permit in place of the single limit.

Daily Maximum Limits

Effluent pH (s.u.)	**NH_3-N Limit** (mg/L)	**Effluent pH** (s.u.)	**NH_3-N Limit** (mg/L)	**Effluent pH** (s.u.)	**NH_3-N Limit** (mg/L)
6.0 < pH ≤ 6.1	72	7.0 < pH ≤ 7.1	44	8.0 < pH ≤ 8.1	9.4
6.1 < pH ≤ 6.2	71	7.1 < pH ≤ 7.2	40	8.1 < pH ≤ 8.2	7.7
6.2 < pH ≤ 6.3	69	7.2 < pH ≤ 7.3	35	8.2 < pH ≤ 8.3	6.4
6.3 < pH ≤ 6.4	68	7.3 < pH ≤ 7.4	31	8.3 < pH ≤ 8.4	5.3
6.4 < pH ≤ 6.5	65	7.4 < pH ≤ 7.5	27	8.4 < pH ≤ 8.5	4.3
6.5 < pH ≤ 6.6	63	7.5 < pH ≤ 7.6	23	8.5 < pH ≤ 8.6	3.5
6.6 < pH ≤ 6.7	60	7.6 < pH ≤ 7.7	19	8.6 < pH ≤ 8.7	3.0
6.7 < pH ≤ 6.8	56	7.7 < pH ≤ 7.8	16	8.7 < pH ≤ 8.8	2.5
6.8 < pH ≤ 6.9	52	7.8 < pH ≤ 7.9	14	8.8 < pH ≤ 8.9	2.1
6.9 < pH ≤ 7.0	48	7.9 < pH ≤ 8.0	11	8.9 < pH ≤ 9.0	1.8

6. Section NR 102.06(5)(a), Wis. Adm. Code, specifies a total phosphorus criterion of 5 µg/L (0.005 mg/L) for the open and nearshore waters of Lake Superior. For discharges directly to the Great Lakes, s. NR 217.13(4), Wis. Adm. Code, says that the Department shall set effluent limits consistent with nearshore or whole lake models approved by the Department. At this time, there is no model available. According to phosphorus implementation guidance, an interim limit should be set at a level that is achievable and that makes progress toward phosphorus reductions without the investment of temporary treatment or a compliance schedule to meet the interim limit.
7. One acute and chronic whole effluent toxicity (WET) tests were required during the current permit term. The IWC for chronic WET was 9%.

Receiving Water Information

- Name: Lake Superior
- Waterbody Identification Code (WBIC): 2751220
- Classification used in accordance with chs. NR 102 and 104, Wis. Adm. Code: Cold Water (CW) community, public water supply, and outstanding resource water (ORW).
- Flow: A 10:1 dilution ratio will be used for calculating effluent limitations based on chronic or long-term impacts, in accordance with s. NR 106.06(4)(b)2, Wis. Adm. Code, because the receiving water does not exhibit a unidirectional flow at the point of discharge. A mixing zone is not allowed for discharges of bioaccumulating compounds of concern (BCCs) in the Great Lakes system as described in s. NR 106.06(2)(br), Wis. Adm. Code.

- Multiple dischargers: There are several other dischargers to Lake Superior; however, they are not in the immediate vicinity and the mixing zones do not overlap. Therefore, the other dischargers do not impact this evaluation.
- Impaired water status: Lake Superior is on the Clean Water Act Section 303(d) list for mercury, polychlorinated biphenols (PCBs), and perfluorinated alkylated substances (PFOS) contamination in fish tissue. These pollutants do not impact the WQBELs due to the concerned concentrations being limited to the fish tissue.

Effluent Information

- Design flow rate(s):
  Annual average = 0.163 million gallons per day (MGD)
  For reference, the actual average flow from July 2019 – September 2024 was 0.044 MGD. The previous limit evaluation (January 2019) utilized an annual average design flow of 0.152 MGD and was based on the original design flow from 1976. This flow has increased to 0.163 MGD due to a system upgrade in 2009. This does not change calculated limits because a 10:1 dilution ratio is used for a lake discharge.
- Acute dilution factor used in accordance with s. NR 106.06(3)(c), Wis. Adm. Code: Not applicable – this facility does not have an approved Zone of Initial Dilution (ZID).
- Water source: Domestic wastewater with no industrial contributors. Water supply from private wells.
- Additives: None.
- Effluent characterization: This facility is categorized as a minor municipality and received instructions in the application notification letter that exempt it from standard monitoring requirements. The permit required *e. coli* sampling during the current permit term.

The following table presents the average concentrations and loadings at Outfall 001 from July 2019 – September 2024 for all parameters with limits in the current permit to meet the requirements of s. NR 201.03(6), Wis. Adm. Code:

Parameter Averages with Limits

	Average Measurement*
BOD_5	12 mg/L
TSS	4 mg/L
pH field	7.04 s.u.
Fecal Coliform	21 #/100 mL
Ammonia Nitrogen	5.7 mg/L
Phosphorus	2.61 mg/L

*Any results below the level of detection (LOD) were included as zeroes in calculation of average.

PART 2 – WATER QUALITY-BASED EFFLUENT LIMITATIONS FOR TOXIC SUBSTANCES – EXCEPT AMMONIA NITROGEN

Permit limits for toxic substances are required whenever any of the following occur:

1. The maximum effluent concentration exceeds the calculated limit (s. NR 106.05(3), Wis. Adm. Code)
2. If 11 or more detected results are available in the effluent, the upper 99th percentile (or P_{99}) value

exceeds the comparable calculated limit (s. NR 106.05(4), Wis. Adm. Code)

3. If fewer than 11 detected results are available, the mean effluent concentration exceeds 1/5 of the calculated limit (s. NR 106.05(6), Wis. Adm. Code)

Mercury – The permit application did not require monitoring for mercury because Madeline SD is categorized as a minor facility as defined in s. NR 200.02(8), Wis. Adm. Code. In accordance with s. NR 106.145(3)(a)3., Wis. Adm. Code, a minor municipal discharger shall monitor, and report results of influent and effluent mercury monitoring once every three months if, "there are two or more exceedances in the last five years of the high-quality sludge mercury concentration of 17 mg/kg specified in s. NR 204.07(5)." Exceedances of the high-quality mercury concentrations are not expected based on similar municipal treatment plants and the lack of industries. **Therefore, mercury monitoring is not recommended during the reissued permit term.**

PFOS and PFOA – The need for PFOS and PFOA monitoring is evaluated in accordance with s. NR 106.98(2), Wis. Adm. Code. Based on the presence of a PFOS fish consumption advisory in Lake Superior; **PFOS and PFOA monitoring is recommended at a frequency of once every other month during the reissued permit term.**

PART 2 – WATER QUALITY-BASED EFFLUENT LIMITATIONS FOR BOD_5

The current permit has the BOD_5 technology-based effluent limits (TBELs) of 45 and 30 mg/L as a weekly average and monthly average respectively based on a CW classification. Upon request by the permittee, the Department may permit the use of the parameter $CBOD_5$ in place of BOD_5 if conditions are met as described in s. NR 210.07(4), Wis. Adm. Code. Madeline SD has requested the use of the $CBOD_5$ variance and has submitted the monitoring requirements to the Department. Therefore, the applicability for $CBOD_5$ limits will be evaluated at this time.

Effluent Data

The following table summarizes paired BOD_5 and $CBOD_5$ monitoring data from Outfall 001 (n = 27, June 2022 – February 2023). The facility sampled during months outside of the required months of January and July and are considered as well in this evaluation.

BOD_5 & $CBOD_5$ Paired Effluent Data

Sample Date	BOD_5 (mg/L)	$CBOD_5$ (mg/L)	Difference (mg/L)
06/29/2022	2	<3	2
07/06/2022	3	<2	3
07/13/2022	3	<2	3
07/20/2022	8	3	5
07/27/2022	13	4	9
08/03/2022	11	4	7
08/10/2022	7	3	4
08/17/2022	26	9	17
08/24/2022	53	8	45
09/07/2022	98	9	89
09/14/2022	147	11	136

Attachment #1

Sample Date	BOD_5 (mg/L)	$CBOD_5$ (mg/L)	Difference (mg/L)
09/21/2022	147	10	137
09/28/2022	74	<4	74
10/05/2022	62	5	57
10/12/2022	40	8	32
10/19/2022	54	10	44
10/26/2022	59	8	51
11/01/2022	31	4	27
11/09/2022	22	6	16
11/16/2022	18	7	11
11/21/2022	20	5	15
11/29/2022	18	5	13
01/10/2023	14	<3	14
01/17/2023	8	2	6
01/24/2023	10	<2	10
01/31/2023	9	2	7
02/07/2023	8	2	6
		Average =	31

Observation of the paired effluent data above shows 22 of 27 sets where the BOD_5 concentration is higher than the $CBOD_5$ concentration by at least 5 mg/L, with an average difference of 31 mg/L. In this case significant nitrification is shown to occur, and limits based on $CBOD_5$ are recommended during the reissued permit term. **These limits are 40 and 25 mg/L as a weekly and monthly average respectively as described in s. NR 210.05(1)(d), Wis. Adm. Code. An additional requirement is the 30-day average $CBOD_5$ percent removal may not be less than 85%.**

Significant improvements to treatment quality at the facility will prompt a re-evaluation of this variance. Otherwise the need for $CBOD_5$ limits does not need to be demonstrated at subsequent permit reissuances if the treatment quality is expected to remain similar as compared in this evaluation.

PART 3 – WATER QUALITY-BASED EFFLUENT LIMITATIONS FOR AMMONIA NITROGEN

The State of Wisconsin promulgated revised water quality standards for ammonia nitrogen in ch. NR 105, Wis. Adm. Code, effective March 1, 2004 which includes criteria based on both acute and chronic toxicity to aquatic life. The current permit has daily maximum, weekly average and monthly average limits during June – September. These limits are re-evaluated at this time due to the following changes:

- Section NR 106.07(3), Wis. Adm. Code requires weekly and monthly average limits for municipal treatment plants.
- The maximum expected effluent pH has changed

Daily Maximum Limits based on Acute Toxicity Criteria (ATC)
Daily maximum limitations are based on acute toxicity criteria in ch. NR 105, Wis. Adm. Code, which are a function of the effluent pH and the receiving water classification. The acute toxicity criterion (ATC) for ammonia is calculated using the following equation:

$$ATC \text{ in mg/L} = [A \div (1 + 10^{(7.204 - pH)})] + [B \div (1 + 10^{(pH - 7.204)})]$$

Where:

A = 0.275 and B = 39.0 for a CW Community (Category 1), and
pH (s.u.) = that characteristic of the effluent.

The effluent pH data was examined as part of this evaluation. A total of 261 sample results were reported from July 2019 – September 2024. The maximum reported value was 7.45 s.u. (Standard pH Units). The effluent pH was 7.43 s.u. or less 99% of the time. The 1-day P_{99}, calculated in accordance with s. NR 106.05(5), Wis. Adm. Code, is 7.51 s.u. The mean plus the standard deviation multiplied by a factor of 2.33, an estimate of the upper ninety ninth percentile for a normally distributed dataset, is 7.50 s.u. Therefore, a value of 7.51 s.u. is believed to represent the maximum reasonably expected pH, and therefore most appropriate for determining daily maximum limitations for ammonia nitrogen. Substituting a value of 7.51 s.u. into the equation above yields an ATC = 12.99 mg/L.

Daily Maximum Ammonia Nitrogen Effluent Limitations Calculation Method

Daily maximum effluent limitations for toxic substances are based on the acute toxicity criteria (ATC), listed in ch. NR 105, Wis. Adm. Code. In accordance with s. NR 106.06(3)(b), limitations based on acute toxicity are either set equal to two times the ATC (the final acute value) or calculated using the mass balance equation below, whichever is more restrictive.

$$\text{Limitation} = \frac{(WQC)\,(Qs + (1-f)\,Qe) - (Qs - f\,Qe)\,(Cs)}{Qe}$$

Where:

WQC =ATC or secondary acute value according to ch. NR 105, Wis. Adm. Code.
Qs = average minimum 1-day flow which occurs once in 10 years (1-day Q_{10}) if the 1-day Q_{10} flow data is not available = 80% of the average minimum 7-day flow which occurs once in 10 years (7-day Q_{10}).
Qe = Effluent flow (in units of volume per unit time) as specified in s. NR 106.06(4)(d), Wis. Adm. Code.
f = Fraction of the effluent flow that is withdrawn from the receiving water, and
Cs = Background concentration of the substance (in units of mass per unit volume) as specified in s. NR 106.06(4)(e), Wis. Adm. Code.

The calculated daily maximum ammonia nitrogen effluent limits using the mass balance approach with the 1-Q_{10} (estimated as 80 % of 7-Q_{10}) and the 2×ATC approach are shown below.

Daily Maximum Ammonia Nitrogen Determination

Method	Ammonia Nitrogen Limit (mg/L)
2×ATC	26
1-Q_{10}	143

The 2×ATC method yields the most stringent limits for Madeline SD.

The current permit has variable daily maximum effluent limits based on effluent pH. Presented below is a table of daily maximum limitations corresponding to various effluent pH values.

Attachment #1

Daily Maximum Ammonia Nitrogen Limits – CW Community (Category 1)

Effluent pH s.u.	Limit mg/L	Effluent pH s.u.	Limit mg/L	Effluent pH s.u.	Limit mg/L
$6.0 \leq pH \leq 6.1$	72	$7.0 < pH \leq 7.1$	44	$8.0 < pH \leq 8.1$	9.3
$6.1 < pH \leq 6.2$	71	$7.1 < pH \leq 7.2$	39	$8.1 < pH \leq 8.2$	7.6
$6.2 < pH \leq 6.3$	69	$7.2 < pH \leq 7.3$	35	$8.2 < pH \leq 8.3$	6.3
$6.3 < pH \leq 6.4$	67	$7.3 < pH \leq 7.4$	31	$8.3 < pH \leq 8.4$	5.2
$6.4 < pH \leq 6.5$	65	$7.4 < pH \leq 7.5$	27	$8.4 < pH \leq 8.5$	4.3
$6.5 < pH \leq 6.6$	63	$7.5 < pH \leq 7.6$	23	$8.5 < pH \leq 8.6$	3.5
$6.6 < pH \leq 6.7$	60	$7.6 < pH \leq 7.7$	19	$8.6 < pH \leq 8.7$	3.0
$6.7 < pH \leq 6.8$	56	$7.7 < pH \leq 7.8$	16	$8.7 < pH \leq 8.8$	2.5
$6.8 < pH \leq 6.9$	52	$7.8 < pH \leq 7.9$	14	$8.8 < pH \leq 8.9$	2.1
$6.9 < pH \leq 7.0$	48	$7.9 < pH \leq 8.0$	11	$8.9 < pH \leq 9.0$	1.8

Weekly and Monthly Average Limits based on Chronic Toxicity Criteria (CTC)

The weekly and monthly average ammonia nitrogen limits calculation from the previous limit evaluation (January 2019) do not change because there have been no changes in the effluent and receiving water flow rates. These limits and calculations are provided in the table below:

Weekly & Monthly Average Ammonia Nitrogen Limits – Limit Evaluation (January 2019)

		Spring	Summer	Winter
		April & May	June – Sept.	Oct. - March
Effluent Flow	Qe (MGD)	0.152		
Background Information	Ammonia (mg/L)	0.03	0.03	0.025
	Temperature (°C)	10.8	16.4	4.17
	pH (s.u.)	7.46	7.50	7.50
Criteria mg/L	4-day Chronic	11.3	8.84	10.9
	30-day Chronic	4.51	3.54	4.36
Effluent Limits mg/L	Weekly Average	124	97.0	120
	Monthly Average	49.4	38.6	47.8

Effluent Data

The following table evaluates the statistics based upon ammonia data reported from July 2019 – September 2024, with those results being compared to the calculated limits to determine the need to include ammonia limits in the Madeline SD permit for the respective month ranges. That need is determined by calculating 99th upper percentile (or P_{99}) values for ammonia during each of the month ranges and comparing the daily maximum values to the daily maximum limit.

Ammonia Nitrogen Effluent Data

Statistics (mg/L)	April - May	June - September	October - March
1-day P_{99}	2.8	53.3	12.0
4-day P_{99}	1.5	30.7	6.8
30-day P_{99}	0.9	18.7	2.9
Mean*	0.6	13.5	1.4
Std	0.6	10.7	3.0
Sample size	42	96	122

Range	0.1 - 2.8	<0.1 - 39.8	<0.1 - 14.8

*Values lower than the level of detection were substituted with a zero

Based on this comparison, daily maximum limits are required in June – September. The current permit has daily maximum, weekly average and monthly average limits during June – September. **Where there are existing ammonia nitrogen limits in the permit, the limits must be retained regardless of reasonable potential, consistent with s. NR 106.33(1)(b), Wis. Adm. Code:**

> (b) If a permittee is subject to an ammonia limitation in an existing permit, the limitation shall be included in any reissued permit. Ammonia limitations shall be included in the permit if the permitted facility will be providing treatment for ammonia discharges.

PART 4 – WATER QUALITY-BASED EFFLUENT LIMITATIONS FOR BACTERIA

On May 1, 2020, revisions to chs. NR 102 and NR 210, Wis. Adm. Codes, became effective which replace fecal coliform limits with new *Escherichia coli* (*E. coli*) limits for protection of recreational uses. Section NR 210.06(2)(a)1, Wis. Adm. Code, includes two limits which must be included in permits for facilities which are required to disinfect:

1. The geometric mean of *E. coli* bacteria in effluent samples collected in any calendar month may not exceed 126 counts/100 mL.
2. No more than 10 percent of *E. coli* bacteria samples collected in any calendar month may exceed 410 counts/100 mL.

E. coli monitoring is recommended at the same frequency that fecal coliform monitoring is required in the current permit. Because Madeline SD's permit requires weekly monitoring, the 410 counts/100 mL limit will effectively function as a daily maximum limit unless the facility performs additional monitoring. Any additional monitoring beyond what is required by the permit must also be reported on the DMR as required in the standard requirements section of the permit.

These limits are required during May – October. This disinfection season was extended beyond the minimum range of May – September due to the expected amount of recreation on this section of Lake Superior. Because of a lack of information indicating this use has changed, no changes are recommended to the current recreational period and the required disinfection season.

Effluent Data

Madeline SD has monitored effluent *E. coli* from July 2019 – September 2024 and a total of 137 results are available. A geometric mean of 126 counts/100 mL was exceeded once out of the last 29 months, with a maximum monthly geometric mean of 143 counts/100 mL. Effluent data has exceeded 410 counts/100 mL 4 times (which is 3% of the total sample results). The maximum reported value was 890 counts/100 mL. **Based on this effluent data it appears that the facility can meet new *E. coli* limits and a compliance schedule is not needed in the reissued permit.**

PART 5 – PHOSPHORUS

Technology-Based Effluent Limit

Subchapter II of Chapter NR 217, Wis. Adm. Code, requires municipal wastewater treatment facilities

that discharge greater than 150 pounds of total phosphorus per month to comply with a monthly average limit of 1.0 mg/L, or an approved alternative concentration limit.

Because Madeline SD does not currently have an existing technology-based limit, the need for this limit in the reissued permit is evaluated. The data demonstrates that the annual monthly average phosphorus loading is less than 150 lbs/month, which is the threshold for municipalities in accordance with s. NR 217.04(1)(a)1, Wis. Adm. Code. **Therefore, a technology-based limit is not recommended during the reissued permit term.** In addition, the need for a WQBEL for phosphorus must be considered.

Annual Average Mass Total Phosphorus Loading

Month	Average Phosphorus Concentration (mg/L)	Total Effluent Flow (Million Gallons)	Calculated Mass (lbs/month)
Oct. 2023	6.12	0.925	47
Nov. 2023	4.55	1.191	45
Dec. 2023	3.66	0.489	15
Jan. 2024	2.38	0.722	14
Feb. 2024	1.82	0.557	8.5
March 2024	1.59	0.457	6.0
April 2024	1.47	1.135	14
May 2024	1.53	1.042	13
June 2024	2.07	1.217	21
July 2024	3.87	0.996	32
Aug. 2024	5.76	0.845	41
Sept. 2024	6.44	0.929	50
		Average =	**26**

Total P (lbs/month) = Monthly average (mg/L) × total flow (MG/month) × 8.34 (lbs/gallon)
Where total flow is the sum of the actual flow (MGD) for that month

Water Quality-Based Effluent Limits (WQBEL)
Revisions to administrative rules regulating phosphorus took effect on December 1, 2010. These rule revisions include additions to s. NR 102.06, Wis. Adm. Code, which establish phosphorus standards for surface waters. Subchapter III of NR 217, Wis. Adm. Code, establishes procedures for determining WQBELs for phosphorus, based on the applicable standards in ch. NR 102, Wis. Adm. Code.

Section NR 102.06(5)(a), Wis. Adm. Code, specifies a total phosphorus criterion of 5 µg/L (0.005 mg/L) for the open and nearshore waters of Lake Superior. For discharges directly to the Great Lakes, s. NR 217.13(4), Wis. Adm. Code, says that the Department shall set effluent limits consistent with nearshore or whole lake models approved by the Department. At this time, there is no model available. According to phosphorus implementation guidance, an interim limit should be set at a level that is achievable and that makes progress toward phosphorus reductions without the investment of temporary treatment or a compliance schedule to meet the interim limit. In the absence of an approved model, a WQBEL of 0.6 mg/L as a 6-month average would be recommended. This limit is indicative of the best readily available phosphorus removal technology at the time this rule was promulgated in 12/01/2010.

Effluent Data
The following table summarizes effluent total phosphorus monitoring data from July 2019 – September 2024.

Attachment #1

Total Phosphorus Effluent Data

Statistics	Conc. (mg/L)
1-day P_{99}	8.15
4-day P_{99}	4.96
30-day P_{99}	3.35
Mean	2.61
Std	1.57
Sample size	257
Range	0.084 - 6.61

Interim Limit

An interim limit is required per s. NR 217.17 when a compliance schedule is needed in the permit to meet the WQBEL. The interim limit should reflect a concentration that the facility is able to meet without investing in additional "temporary" treatment, but also should prevent backsliding from current conditions. **Therefore, it is recommended the current monthly average limit of 5.1 mg/L continue as the interim limit, along with requirements for optimization of phosphorus removal.** A review month average effluent phosphorus data (July 2019 – September 2024) show the facility has exceeded their current limit 4 times during the current permit term, with monthly averages ranging 5.8 – 6.4 mg/L.

The *Guidance for Implementation of Wisconsin's Phosphorus Water Quality Standards* states that facilities discharging to the Great Lakes will be required to optimize facility operations upon permit reissuance. During the permit term, the facility has carried out optimization efforts as part of the phosphorus compliance schedule. The facility should continue the measures in their optimization plan until a near-shore or whole lake model allows for the calculation of a WQBEL.

PART 6 – WATER QUALITY-BASED EFFLUENT LIMITATIONS FOR THERMAL

Surface water quality standards for temperature took effect on October 1, 2010. These regulations are detailed in chs. NR 102 (Subchapter II – Water Quality Standards for Temperature) and NR 106 (Subchapter V – Effluent Limitations for Temperature) of the Wisconsin Administrative Code. Daily maximum and weekly average temperature criteria are available for the 12 different months of the year depending on the receiving water classification.

In accordance with s. NR 106.53(2)(b), Wis. Adm. Code, the highest daily maximum flow rate for a calendar month is used to determine the acute (daily maximum) effluent limitation. In accordance with s. NR 106.53(2)(c), Wis. Adm. Code, the highest 7-day rolling average flow rate for a calendar month is used to determine the sub-lethal (weekly average) effluent limitation. These values were based off actual flow reported from July 2019 – September 2024.

The lowest calculated limit is 120 ºF as a daily maximum. The complete thermal calculations are included as attachment #3. At temperatures above approximately 103° F, conventional biological treatment systems do not function properly and experience upsets. There is no indication that this has ever occurred in this treatment system, so there is no reasonable potential for the discharge to exceed this limit. **Therefore, temperature limits or monitoring are not recommended during the reissued permit term.**

PART 7 – WHOLE EFFLUENT TOXICITY (WET)

WET testing is used to measure, predict, and control the discharge of toxic materials that may be harmful to aquatic life. In WET tests, organisms are exposed to a series of effluent concentrations for a given time and effects are recorded. Decisions below related to the selection of representative data and the need for WET limits were made according to ss. NR 106.08 and 106.09, Wis. Adm. Code. WET monitoring frequency and toxicity reduction evaluation (TRE) recommendations were made using the best professional judgment of staff familiar with the discharge after consideration of the guidance in the *Whole Effluent Toxicity (WET) Program Guidance Document (2022).*

- Acute tests predict the concentration that causes lethality of aquatic organisms during a 48 to 96-hour exposure. To assure that a discharge is not acutely toxic to organisms in the receiving water, WET tests must produce a statistically valid LC_{50} (Lethal Concentration to 50% of the test organisms) greater than 100% effluent, according to s. NR 106.09(2)(b), Wis. Adm Code.

- Chronic tests predict the concentration that interferes with the growth or reproduction of test organisms during a seven-day exposure. To assure that a discharge is not chronically toxic to organisms in the receiving water, WET tests must produce a statistically valid IC_{25} (Inhibition Concentration) greater than the instream waste concentration (IWC), according to s. NR 106.09(3)(b), Wis. Adm Code. The IWC is an estimate of the proportion of effluent to total volume of water (receiving water + effluent). The IWC is 9% based on dilution of 10 parts lake water to 1-part effluent, as specified in s. NR 106.06(4)(b)2, Wis. Adm. Code, or a factor of 1 in 11 to calculate the IWC.

- According to the *State of Wisconsin Aquatic Life Toxicity Testing Methods Manual* (s. NR 219.04, Table A, Wis. Adm. Code), a synthetic (standard) laboratory water may be used as the dilution water and primary control in acute WET tests, unless the use of different dilution water is approved by the Department prior to use. The primary control water must be specified in the WPDES permit.

- According to the *State of Wisconsin Aquatic Life Toxicity Testing Methods Manual* (s. NR 219.04, Table A, Wis. Adm. Code), receiving water must be used as the dilution water and primary control in chronic WET tests, unless the use of different dilution water is approved by the Department prior to use. The dilution water used in WET tests conducted on Outfall 001 shall be a grab sample collected from the receiving water location, upstream and out of the influence of the mixing zone and any other known discharge. The specific receiving water location must be specified in the WPDES permit.

- Shown below is a tabulation of all available WET data for Outfall 001. Efforts are made to ensure that decisions about WET monitoring and limits are made based on representative data, as specified in s. NR 106.08(3), Wis. Adm Code. Data which is not believed to be representative of the discharge was not included in reasonable potential calculations. The table below differentiates between tests used and not used when making WET determinations.

Attachment #1

WET Data History

Date Test Initiated	Acute Results LC_{50} %				Chronic Results IC_{25} %				Footnotes or Comments
	C. dubia	Fathead minnow	Pass or Fail?	Used in RP?	*C. dubia*	Fathead Minnow	Pass or Fail?	Use in RP?	
05/16/2011	>100	>100	Pass	Yes	>100	>100	Pass	Yes	
08/20/2019	>100	77.2	Fail	No	>100	>100	Pass	No	1
07/11/2022	>100	>100	Pass	Yes	>100	>100	Pass	Yes	

Footnotes:

1. *Qualified or Inconclusive Data.* Data quality concerns were noted during testing which calls into question the reliability of the test results.

- According to s. NR 106.08, Wis. Adm. Code, WET reasonable potential is determined by multiplying the highest toxicity value that has been measured in the effluent by a safety factor, to predict the likelihood (95% probability) of toxicity occurring in the effluent above the applicable WET limit. The safety factor used in the equation changes based on the number of toxicity detects in the dataset. The fewer detects present, the higher the safety factor, because there is more uncertainty surrounding the predicted value. WET limits must be given, according to s. NR 106.08(6), Wis. Adm. Code, whenever the applicable Reasonable Potential equation results in a value greater than 1.0.

  Acute Reasonable Potential = [(TUa effluent) (B)(AMZ)]
  Chronic Reasonable Potential = [(TUc effluent) (B)(IWC)]

  According to s. NR 106.08(6)(d), Wis. Adm. Code, TUa and TUc effluent values are equal to zero whenever toxicity is not detected (i.e. when the LC_{50}, IC_{25} or $IC_{50} \geq 100\%$).

  Acute Reasonable Potential = $0 < 1.0$, **reasonable potential is not shown, and a limit is not required.**

  Chronic Reasonable Potential = $0 < 1.0$, **reasonable potential is not shown, and a limit is not required.**

The WET checklist was developed to help DNR staff make recommendations regarding WET limits, monitoring, and other related permit conditions. The checklist indicates whether acute and chronic WET limits are needed, based on requirements specified in s. NR 106.08, Wis. Adm. Code. The checklist steps the user through a series of questions, assesses points based on the potential for effluent toxicity, and suggests monitoring frequencies based on points accumulated during the checklist analysis. As toxicity potential increases, more points accumulate, and more monitoring is recommended to ensure that toxicity is not occurring. A summary of the WET checklist analysis completed for this permittee is shown in the table below. Staff recommendations based on best professional judgment are provided below the summary table. For guidance related to reasonable potential and the WET checklist, see Chapter 1.3 of the WET Guidance Document: https://dnr.wisconsin.gov/topic/Wastewater/WET.html.

WET Checklist Summary

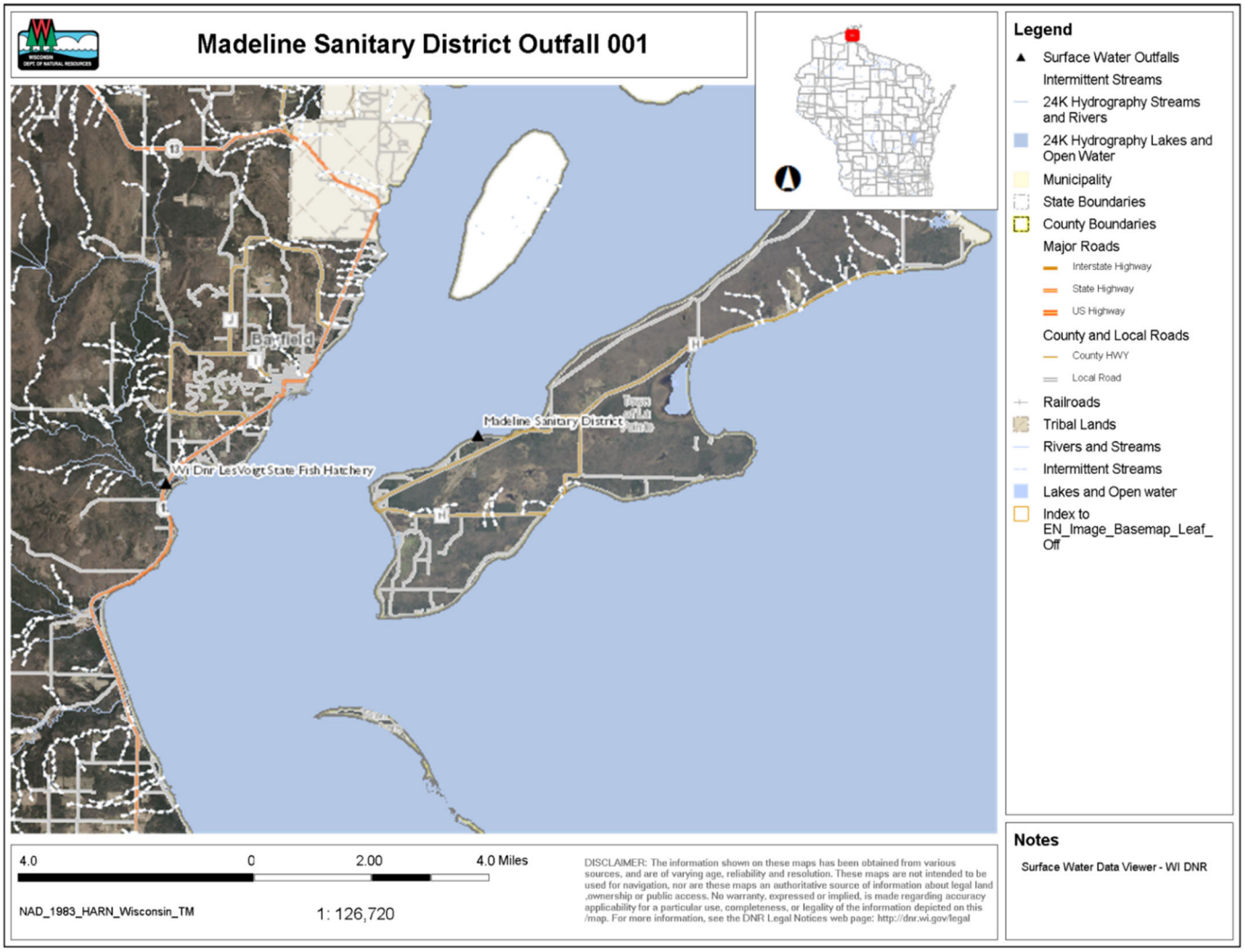
	Acute	Chronic
AMZ/IWC	Not applicable. **0 Points**	IWC = 9%. **0 Points**

Attachment #1

	Acute	Chronic
Historical Data	Two tests used to calculate RP. No tests failed. **0 Points**	Two tests used to calculate RP. No tests failed. **0 Points**
Effluent Variability	Multiple BOD_5 limit exceedances. Likely due to nitrifiers in BOD_5 tests. Two ammonia nitrogen limit exceedances due to peak tourism loading (Town of LaPointe, State campground) and sludge accumulation in lagoons. Facility currently working with consultant and sources to evaluate facility planning and sludge removal efforts. **0 Points**	Same as acute. **0 Points**
Receiving Water Classification	Lake Superior. **15 Points**	Same as acute. **15 Points**
Chemical-Specific Data	Reasonable potential for limits for ammonia nitrogen based on ATC; no other toxic substances sampled. **5 Points**	No reasonable potential for limits based on CTC; Ammonia nitrogen limit carried over from the current permit. No other toxic substances sampled. **1 Point**
Additives	No additives. **0 Points**	No additives. **0 Points**
Discharge Category	No industrial contributors. **0 Points**	Same as acute. **0 Points**
Wastewater Treatment	Secondary or better. **0 Points**	Same as acute. **0 Points**
Downstream Impacts	No impacts known. **0 Points**	Same as acute. **0 Points**
Total Checklist Points:	**20 Points**	**16 Points**
Recommended Monitoring Frequency (from Checklist):	Two acute tests recommended.	No chronic tests recommended.
Limit Required?	No.	No.
TRE Recommended? (from Checklist)	No.	No.

- After consideration of the guidance provided in the Department's WET Program Guidance Document (2022) and other information described above, **2x acute WET tests are recommended in the reissued permit term.** Tests should be done in rotating quarters to collect seasonal information about this discharge. WET testing should continue after the permit expiration date (until the permit is reissued).

Attachment #2



Attachment #3

Temperature Limits for Receiving Waters without Unidirectional Flow

(calculation using default ambient temperature data)

Facility: Madeline SD

Outfall(s): 001

Date Prepared: 11/13/2024

Design Flow (Qe): 0.152 MGD

Lake Type: Lake Superior

Discharge Type: Great Lakes shore discharge

Maximum area of mixing zone allowed (coefficient "A"): 3,125,000 ft^2

	Temp Dates	Flow Dates
Start:	NA	07/01/19
End:	NA	09/30/24

Month	Water Quality Criteria			Representative Highest Effluent Flow Rate (Qe)		B	e^{-a} (for SL-WQBEL)	e^{-a} (for A-WQBEL)	Representative Highest Monthly Effluent Temperature		Calculated Effluent Limit	
	Ta (default)	Sub-Lethal WQC	Acute WQC	7-day Rolling Average (Qesl)	Daily Maximum Flow Rate (Qea)				Weekly Average	Daily Maximum	**Weekly Average Effluent Limitation**	**Daily Maximum Effluent Limitation**
	(°F)	(°F)	(°F)	(MGD)	(MGD)				(°F)	(°F)	(°F)	(°F)
JAN	35	41	69	0.06	0.08	0.405	7.3E-291	2.1E-238			NA	120
FEB	34	46	69	0.05	0.06	0.405	0.0E+00	0.0E+00			NA	120
MAR	34	51	69	0.08	0.11	0.405	1.4E-234	6.9E-167			NA	120
APR	35	57	69	0.25	0.41	0.405	9.0E-75	4.4E-46			NA	120
MAY	41	63	70	0.07	0.07	0.405	3.3E-285	3.5E-265			NA	120
JUN	49	69	72	0.07	0.09	0.405	1.7E-261	4.7E-219			NA	120
JUL	55	72	73	0.09	0.13	0.405	9.6E-214	6.2E-151			NA	120
AUG	57	71	73	0.07	0.08	0.405	5.0E-252	6.1E-227			NA	120
SEP	57	64	73	0.06	0.07	0.405	9.6E-297	3.5E-265			NA	120
OCT	50	55	72	0.08	0.09	0.405	9.2E-234	8.2E-205			NA	120
NOV	43	45	70	0.10	0.13	0.405	5.0E-189	1.4E-148			NA	120
DEC	38	42	69	0.08	0.19	0.405	2.1E-225	4.5E-100			NA	120