Permit Fact Sheet

General Information

Permit Number:	WI-0038296-09-0
Permittee Name:	UW MADISON CHARTER STREET HEATING PLANT
Address:	117 N Charter St
City/State/Zip:	MADISON WI 53715
Discharge Location:	East side of N. Charter Street, between W. Dayton and Spring Streets
Receiving Water:	Lake Monona via City of Madison storm sewers at the northwest bank of Monona Bay in Brittingham Park (Yahara River and Lake Monona Watershed, LR08 – Lower Rock River Basin) in Dane County
StreamFlow ($Q_{7,10}$):	N/A
Stream Classification:	Inland Lake

Facility Description

The UW Charter Street Heating Plant (CSHP) is located between the intersections of N Charter St, W Dayton St, N Mills St, and Spring St in Madison, Wisconsin. The plant produces electricity, chilled water for cooling, and steam used for heating for the University of Wisconsin-Madison. The original plant consisted of three coal-fired boilers constructed in the late 1950's. Between the early 1960's and the mid 1990's an additional coal-fired boiler, a natural gas boiler, and the current steam turbine generator were added to the facility. Then, between 2011 and 2013 the coal-fired boilers were replaced by gas-fired boilers. CSHP can currently produce 1,200,000 pounds of steam per hour, 26,000 tons of chilled water, 7,080 standard cubic feet of compressed air per minute, and 9.8 megawatts of electricity per hour. The plant operates 24 hours a day 7 days a week year-round.

Intake water is withdrawn from Lake Mendota for use by CSHP as well as the Walnut Street Heating Plant (WSHP) and the West Campus Cogeneration Facility (WCCF) operated by MG&E. CSHP uses intake water for boiler makeup water, cooling tower makeup make water, non-contact cooling water, and for additional cooling of the non-contact cooling water discharge in April and October. WSHP uses intake water for cooling tower makeup water and non-contact cooling water, and the WCCF uses intake water for cooling tower makeup water. The cooling water intake structure (CWIS) is located north of the Water Science and Engineering Laboratory in an area near multiple piers and a sailboat mooring field. The flow reported on the monthly eDMRs is the flow used by CSHP. The flow and % of water used for cooling used by the other two facilities is reported in the annual certification reports and on the eDMR in March annually. The permittee is also responsible for reporting the total flow and % used for cooling for the intake on the eDMR in March annually.

The CWIS consists of three upturned pipes with 31-inch diameter cylindrical screens attached to the ends. The total design intake flow (DIF) is 10.61 million gallons per day (MGD) and the actual intake flow (AIF) is 1.27 MGD. CSHP is able to use city water as a backup water source.

CSHP Outfall 001 is an optional outfall, for emergency backup use. From 2014 to 2022, Outfall 001 has not been used and no flow has been observed. Outfall 004 and Outfall 001 combine on facility property west of N Mills St, and discharge to the Monona Bay via the Municipal Separate Storm Sewer System outfall owned by the city of Madison.

Changes from previous permit have been highlighted below.

Substantial Compliance Determination

After a desk top review of all discharge monitoring reports, compliance schedule items, and a site visit on 5/18/2024, this facility has been found to be in substantial compliance with their current permit.

Compliance determination entered by Kenzie Ostien on 5/24/2024.

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	New Sample Point	Intake UW Charter Street: Water is withdrawn from Lake Mendota through the cooling water intake structure (CWIS) located approximately 592 feet offshore. The CWIS consists of three pipes with 31-inch diameter cylindrical screens, which are made of a 1-inch-wide mesh. The water than goes through a tee into a 24-inch diameter pipe made of concrete. Intake Structure Crib Location: 43°04'44.0"N, 89°24'03.0"W. Flow reported from the UW Charter Street Heating Plant flow meter only.
702	New Sample Point	Intake Walnut Street: Water is withdrawn from Lake Mendota through the cooling water intake structure (CWIS) located approximately 592 feet offshore. The CWIS consists of three pipes with 31-inch diameter cylindrical screens, which are made of a 1-inch-wide mesh. The water than goes through a tee into a 24-inch diameter pipe made of concrete. Intake Structure Crib Location: 43°04'44.0"N, 89°24'03.0"W. Sample point is for intake water used by the Walnut Street Heating Plant (WSHP).
703	New Sample Point	Intake West Campus: Water is withdrawn from Lake Mendota through the cooling water intake structure (CWIS) located approximately 592 feet offshore. The CWIS consists of three pipes with 31-inch diameter cylindrical screens, which are made of a 1-inch-wide mesh. The water than goes through a tee into a 24-inch diameter pipe made of concrete. Intake Structure Crib Location: 43°04'44.0"N, 89°24'03.0"W. Sample point is for intake water used by the West Campus Cogeneration Facility (WCCF) operated by Madison Gas & Electric.
704	New Sample Point	Intake Total: Water is withdrawn from Lake Mendota through the cooling water intake structure (CWIS) located approximately 592 feet offshore. The CWIS consists of three pipes with 31-inch diameter cylindrical screens, which are made of a 1-inch-wide mesh. The water than goes through a tee into a 24-inch diameter pipe made of concrete. Intake Structure Crib Location: 43°04'44.0"N, 89°24'03.0"W. Sample Point reporting calculated total values for the intake structure.
001	Not used regularly	Effluent: Noncontact cooling water (NCCW), without additives. Grab samples taken in chiller room. Flow meter located in the chiller room. Outfall 001 is an optional outfall, not currently in regular use. It serves as a backup for primary Outfall 004 and located just south of the Cooling Tower and Water Treatment Building. Monitoring only required if discharge occurs.

Sample Point Designation		
Sample Point Number	**Discharge Flow, Units, and Averaging Period**	**Sample Point Location, Waste Type/Sample Contents and Treatment Description (as applicable)**
004	0.39 MGD (2023)	Effluent: Noncontact cooling water (NCCW), without additives. Grab samples taken in chiller room. Flow meter located in the chiller room. Primary noncontact cooling water (NCCW) outfall. Flow meter located in chiller room.

1 Influent – Cooling Water Intake Structure - Proposed Monitoring

Sample Point Number: 701- Lake Mendota Offshore Intake – UW Charter Street

Monitoring Requirements and Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Flow Rate		MGD	Daily	Continuous	
Intake Water Used Exclusively For Cooling		% Flow	Annual	Calculated	

Changes from Previous Permit

New outfall reflective of the approved water intake.

Explanation of Limits and Monitoring Requirements

This sample point is used to report the intake water for the UW Charter Street facility and is required for all water intake facilities.

Sample Point Number: 702 – Lake Mendota Offshore Intake – Walnut Street; 703 – Lake Mendota Offshore Intake - West Campus

Monitoring Requirements and Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Flow Rate		MGD	Annual	Calculated	Report on the March eDMR annually.
Intake Water Used Exclusively For Cooling		% Flow	Annual	Calculated	Report on the March eDMR annually.

Changes from Previous Permit

New sample points reflective of the approved water intake for the Walnut Street and West Campus facilities from the UW Charter Street Cooling Water Intake Structure (CWIS). The total annual flow and % used for cooling is reported by UW Charter Street on an annual basis.

Explanation of Limits and Monitoring Requirements

These sample points are used to report the intake water and are required for all water intake facilities.

Sample Point Number: 704 – Lake Mendota Intake - Total

Monitoring Requirements and Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Flow Rate		MGD	Annual	Calculated	Report total intake water flow on the March eDMR annually.
Intake Water Used Exclusively For Cooling		% Flow	Annual	Calculated	Report on the March eDMR annually the total for all intake water.

Changes from Previous Permit

This is a new sample point for reporting of total values from all three facilities using intake water from the UW Charter Street Cooling Water Intake Structure (CWIS).

Explanation of Limits and Monitoring Requirements

The permittee shall report the calculated total values for the CWIS on the March eDMR annually. These values are required per Ch. NR 111, Wis. Adm. Code. The facility does not have a single flow meter prior to the intake water pipe to each facility. Therefore, the department has determined it is impractical to report flow daily for the facilities operated by MG&E. Instead, on an annual basis the values for those facilities will be reported to the department on the March eDMR.

Intake Structure Requirements and Explanations

Cooling Water Intake Structure (CWIS): The Influent section includes the CWIS description, authorization for use, and BTA (Best Technology Available) determination. The permittee is authorized to use the cooling water intake structure which consists of the following:

- Location: In Lake Mendota 592 feet offshore (43°04'44.0"N, 89°24'03.0"W).
- Major Components: The intake consists of three pipes with 31-inch diameter cylindrical screens, which are made of 1-inch-wide mesh and function as velocity caps.
- Maximum Design Intake Flow (DIF): The maximum design intake flow (DIF) is 10.61 MGD. This is based upon the intake's pump capacity, not counting redundant or emergency pumps.
- Percent Used for Cooling: 80-85% (for UW Charter Street facility)
- Actual Intake Flow: The actual intake flow is 1.27 MGD (11.2 cfs).
- Maximum Design Intake Velocity: The maximum design intake velocity is 5.2 fps

Intake Water Used Exclusively for Cooling: s. NR 111.22(3), Wis. Adm. Code, requires the percentage of water used for cooling to be monitored on a daily basis or on a less frequent basis if daily monitoring is infeasible or overly burdensome. The department considers daily monitoring to be overly burdensome for this facility, so annual monitoring has been included instead.

Future BTA: The above determination is a final BTA determination. BTA determinations for entrainment and impingement mortality at cooling water intake structures will be made in each permit reissuance, in accordance with ch. NR 111, Wis. Adm. Code. In subsequent permit reissuance applications, the permittee shall provide all the information required in ss. NR 111.41(1) through (7) and (13), Wis. Adm. Code.

Also include an alternatives analysis report for compliance with the entrainment BTA requirements with the permit application. This alternatives analysis for entrainment BTA shall examine the options for compliance with the entrainment BTA requirement and propose a candidate entrainment BTA to the Department for consideration during its next BTA determination. The analysis must, at least narratively, address and consider the factors listed in s. NR 111.41(13)(a), Wis. Adm. Code, and may consider the factors listed in s. NR 111.41(13)(b), Wis. Adm. Code. The analysis must evaluate, at a minimum, closed-cycle recirculating systems, fine mesh screens with a mesh size of 2mm or smaller, variable speed pumps, water reuse or alternate sources of cooling water, and any additional technology identified by the department at a later date.

Visual or Remote Inspections: The permittee is required to conduct visual or remote inspections of the intake structure pursuant to s. NR 111.14(4), Wis. Adm. Code. Inspections and/or visual monitoring shall be scheduled whenever changes in intake volumes or flow rates indicate a constriction at the intake point.

Reporting Requirements: The permittee is required to submit an annual certification statement and report, pursuant to s. NR 111.15(1)(c), Wis. Adm. Code.

Intake Screen Discharges and Removed Substances: Floating debris and accumulated trash collected on the cooling water intake shall be removed and disposed of in a manner to prevent any pollutant from the material from entering the waters of the State pursuant to s. NR 205.07(3)(a), Wis. Adm. Code. Debris removed must be properly disposed of in accordance with s. NR 205.07(3)(a), Wis. Adm. Code for removed substances Solids, sludges, filter backwash or other pollutants removed from or resulting from treatment or control of wastewaters or intake waters shall be stored and disposed of in a manner to prevent any pollutant from the materials from entering the waters of the state. Additionally, land disposal or application of treatment plant solids and sludges shall be at a site or operation licensed by the department under chs. NR 500 to 538 or chs. NR 660 to 670, Wis. Adm. Code or in accordance with chs. NR 204 or 214, Wis. Adm. Code.

Endangered Species Act: This permit does not authorize take of threatened or endangered species. 40 CFR §125.98 (b)(1) requires the inclusion of this provision in all permits subject to 316(b) requirements. Contact the state Natural Heritage Inventory (NHI) staff with inquiries regarding incidental take of state-listed threatened and endangered species and the US Fish and Wildlife Service with inquiries regarding incidental take of federally-listed threatened and endangered species.

2 Surface Water - Monitoring and Limitations

Sample Point Number: 001 Optional NCCW Outfall & 004 - Primary NCCW Outfall

Monitoring Requirements and Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Flow Rate		MGD	Daily	Continuous	
Oil & Grease (Hexane)	Daily Max	10 mg/L	Monthly	Grab	
Temperature Maximum	Daily Max	103 deg F	Daily	Continuous	Limit effective August starting in 2029.
Temperature Maximum	Weekly Avg	76 deg F	Daily	Continuous	Limit effective January starting in 2029.

Monitoring Requirements and Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Temperature Maximum	Weekly Avg	71 deg F	Daily	Continuous	Limit effective February starting in 2029.
Temperature Maximum	Weekly Avg	74 deg F	Daily	Continuous	Limit effective March starting in 2029.
Temperature Maximum	Weekly Avg	75 deg F	Daily	Continuous	Limit effective April.
Temperature Maximum	Weekly Avg	85 deg F	Daily	Continuous	Limit effective May starting in 2029.
Temperature Maximum	Weekly Avg	89 deg F	Daily	Continuous	Limit effective June starting in 2029.
Temperature Maximum	Weekly Avg	92 deg F	Daily	Continuous	Limit effective July starting in 2029.
Temperature Maximum	Weekly Avg	93 deg F	Daily	Continuous	Limit effective August starting in 2029.
Temperature Maximum	Weekly Avg	86 deg F	Daily	Continuous	Limit effective September starting in 2029.
Temperature Maximum	Weekly Avg	74 deg F	Daily	Continuous	Limit effective October.
Temperature Maximum	Weekly Avg	66 deg F	Daily	Continuous	Limit effective November starting in 2029.
Temperature Maximum	Weekly Avg	73 deg F	Daily	Continuous	Limit effective December starting in 2029.

Changes from Previous Permit

Temperature limits added with a schedule for compliance. Phosphorus and TSS monitoring added.

Explanation of Limits and Monitoring Requirements

Refer to the WQBEL memo for the detailed calculations, prepared by Diane Figiel dated October 15, 2024 used for this reissuance.

Temperature - Outfall 001 is an emergency/alternative outfall used only periodically. When discharge from Outfall 001 is used temperature limits must be met in April and October. Additionally, a schedule has been added for the permittee to meet new temperature limits the other months of the year. Upon completion of the schedule the calculated temperature limits are:

Temperature Limits

	Weekly Average
January	76°F
February	71°F
March	74°F

April	75°F*
May	85°F
June	89°F
July	92°F
August	93°F
September	86°F
October	74°F*
November	66°F
December	73°F

*Limit effective and will remain in effect.

PFOS and PFOA – NR 106 Subchapter VIII – Permit Requirements for PFOS and PFOA Dischargers became effective on August 1, 2022. Pursuant to s. NR 106.98(3)(b), 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, the department has determined the permittee does not need to sample for PFOS or PFOA in the effluent as part of this permit reissuance. The department may re-evaluate the need for sampling at the next permit reissuance if new information becomes available that suggests PFOS or PFOA may be present in the discharge.

Expression of Limits- In accordance with the federal regulation 40 CFR 122.45(d) and s. NR 205.065, Wis. Adm. Code. limits in this permit are to be expressed as daily maximum and monthly average limits whenever practicable. No changes were required based on this requirement.

Monitoring Frequency Evaluation - Monitoring frequencies for parameters that have final effluent limits in effect during this permit term were evaluated, taking into consideration the size and type of the facility, and whether the monitoring occurs frequently enough to characterize effluent quality and variability, to detect events of noncompliance, and to ensure fairness and consistency in permits issued across the state. Monitoring frequency decisions are based on requirements in s. NR 205.066(1), Wis. Adm. Code, (decisions are case-by-case) and considering the factors in s. NR 210.04 (a) through (e), Wis. Adm. Code, along with recommendations provided in the *Monitoring Frequencies for Individual Wastewater Permits* guidance (April 12, 2021).

3 Schedules

3.1 Annual Certification Statements and Reports for Intake Structure

Submit an annual certification statement and report by March 31st of each year as specified by Section 1.3.3.1, Annual Certification Statement and Report, in accordance with the following schedule.

Required Action	Due Date
Submit Annual Certification Statement and Report #1: Submit an annual certification statement and report on the water intake structures. The annual certification shall include a summary of maintenance and operation of water intake structure technologies, a summary of visual or remote inspections conducted, and a summary of any substantial modifications to the operation of any units that will impact cooling water withdrawals or operation of the water intake structure. This annual certification shall also include a summary of intake water utilized at the UW Charter Street facility in April and October for additional cooling as well as total annual flow (MGD) of intake water withdrawn and percent used for cooling for UW Charter Street facility, Walnut Street Heating Plant and West Campus Cogeneration Facility.	03/31/2025
Submit Annual Certification Statement and Report #2: Submit the annual certification statement	03/31/2026

as defined above	
Submit Annual Certification Statement and Report #3: Submit the annual certification statement as defined above.	03/31/2027
Submit Annual Certification Statement and Report #4: Submit the annual certification statement as defined above.	03/31/2028
Submit Annual Certification Statement and Report #5: Submit the annual certification statement as defined above.	03/31/2029
Ongoing Annual Certification Statements and Reports: Continue to submit Annual Certification Statements and Reports until permit reissuance has been completed.	

Explanation of Schedule

This schedule requires annual reporting for compliance with 316b intake requirements. This report is due March 31 each year to allow adequate time for collection of flow data from the other facilities that use water from the intake structure.

3.2 Temperature Limits (Industrial Facilities)

This compliance schedule requires the permittee to achieve compliance by the specified date.

Required Action	Due Date
Report on Effluent Discharges: Submit a report on effluent temperature with conclusions regarding compliance. If the Department determines that because of data variability, 24 months of monitoring data is required to determine the need for temperature limits, the Department will so notify the permittee in writing and all dates in the permit schedule will be extended by 12 months. Informational Note - Refer to the Surface Water subsection regarding 'Determination of Need for Effluent Limits' for information concerning a Department determination on the need for limits and pursuing re-evaluation of limits per NR 106 Subchapters V & VI or NR 102.26, Wis. Adm. Code.	04/01/2026
Action Plan: Submit an action plan for complying with all effluent temperature limits that remain following the Department's review for necessity.	04/01/2027
Initiate Actions: Initiate actions identified in the plan.	04/01/2028
Complete Actions: Complete actions necessary to achieve compliance with effluent temperature limits.	04/01/2029

Explanation of Schedule

This compliance schedule requires the permittee to achieve compliance by the specified date. At the time of permit reissuance, the permittee was planning to complete a mixing zone study.

Special Reporting Requirements

None

Other Comments:

None

Attachments:

Water Quality Based Effluent Limits dated 10/15/2024, amended 11/1/2024
Cooling Water Intake Structure Best Technology Available Determination dated 1/12/2023, amended11/4/2024

Expiration Date:

March 31, 2030

Justification Of Any Waivers From Permit Application Requirements

None

Prepared By:
Jennifer Jerich, Wastewater Specialist

Date: 10/10/2024
Date amended post Fact Check: 12/12/2024
Date amended post Public Notice:

Wisconsin Department of Natural Resources

Cooling Water Intake Structure Best Technology Available Determination

University of Wisconsin-Madison Charter Street Heating Plant

S. Hanson – Wastewater Engineer
November 4, 2024

Executive Summary

In conformity with Section 316(b) of the Clean Water Act, the location, design, construction, and capacity of cooling water intake structures should reflect the best technology available (BTA) for minimizing adverse environmental impacts. The department has made a Best Technology Available (BTA) determination for one cooling water intake structure (CWIS) utilized by University of Wisconsin-Madison's Charter Street Heating Plant (CSHP) in accordance with ch. NR 111, Wis. Adm. Code. The BTA for the CWIS is based on the required information submitted for a facility that withdraws greater than 2 MGD Design Intake Flow (DIF) and uses at least 25% of the total water withdrawn for cooling purposes. CSHP is considered an existing facility for purposes of the rule because construction of the facility commenced prior to January 17, 2002 (s. NR 111.02(3)(a), Wis. Adm. Code). The department has concluded that existing impingement mortality and entrainment reduction measures at CSHP including a closed-cycle recirculating system (CCRS), three variable speed pumps (VSPs), and an actual through screen velocity less than 0.5 fps are the best technologies available for minimizing adverse environmental impact.

The CCRS meets the impingement mortality standards of s. NR 111.12(1)(a)1., Wis. Adm. Code. The department has determined that no additional requirements of s. NR 111.12 are necessary.

The department must establish BTA standards for entrainment reduction for the intake on a site-specific basis (s. NR 111.13, Wis. Adm. Code). "These standards shall reflect the department's determination of the maximum reduction in entrainment warranted after consideration of the relevant factors as specified in subs. (2) and (3)." (s. NR 111.13, Wis. Adm. Code). After consideration of the factors specified in s. NR 111.13(2) and (3), Wis. Adm. Code, the department has concluded that the current technologies employed at CSHP are considered the best technology available to achieve the maximum reduction in entrainment.

The BTA determination will be reviewed at the next permit reissuance and at subsequent reissuances in accordance with ch. NR 111, Wis. Adm. Code, as applicable. In subsequent permit reissuance applications, the permittee shall provide all the information required in s. NR 111.40(2)(b), Wis. Adm. Code, unless a request to reduce the information required has been submitted by the permittee and accepted by the department, as allowed by s. NR 111.42(1)(a), Wis. Adm. Code.

Background Information

The Charter Street Heating Plant is located between the intersections of N Charter St, W Dayton St, N Mills St, and Spring St in Madison, Wisconsin. The plant produces electricity, chilled water for cooling, and steam used for heating for the University of Wisconsin-Madison. The original plant consisted of three coal-fired boilers constructed in the late 1950's. Between the early 1960's and the mid 1990's an additional coal-fired boiler, a natural gas boiler, and the current steam turbine generator were added to the facility. Then, between 2011 and 2013 the coal-fired boilers were replaced by gas-fired boilers. CSHP can currently produce 1,200,000 pounds of steam per hour, 26,000 tons of chilled water, 7,080 standard cubic feet of compressed air per minute, and 9.8 megawatts of electricity per hour.

Makeup water for the CCRS is withdrawn from Lake Mendota. The cooling water intake structure (CWIS) is located north of the Water Science and Engineering Laboratory in an area near multiple piers and a sailboat mooring field. The CWIS consists of three upturned 36-inch diameter pipes with cylindrical screens attached to the ends. This CWIS also provides non-contact cooling water and cooling tower makeup water to the Walnut Street Heating Plant (WSHP) and cooling tower makeup water to the West Campus Cogeneration Facility (WCCF).

The total design intake flow (DIF) is 10.61 million gallons per day (MGD) and the actual intake flow (AIF) is 1.27 MGD.

Intake Velocity Calculation

For the design and configuration of the CWIS and three pump operation (10.61 MGD DIF), the calculated maximum design through-screen velocity (v) is:

$$v = (total\ pump\ rate\ MGD) \times (1{,}000{,}000) \times \left(\frac{1\ day}{24\ hours}\right) \times \left(\frac{1\ hour}{60\ min}\right) \times \left(\frac{1\ min}{60\ sec}\right) \times \left(\frac{0.1337\ ft^3}{gal}\right) \times \left(\frac{1}{total\ open\ area\ of\ intake}\right)$$

$$v = (10.61) \times (1{,}000{,}000) \times \left(\frac{1}{24}\right) \times \left(\frac{1}{60}\right) \times \left(\frac{1}{60}\right) \times (0.1337) \times \left(\frac{1}{3.14}\right)$$

$$v = 5.2\ ^{ft}/_{sec}$$

Where:

$total\ open\ area\ of\ intake$ = $overall\ area \times open\ area\ percentage/100$

$total\ open\ area\ of\ intake$ = $\pi \times (1\text{ft})^2 \times 1$

$total\ open\ area\ of\ intake$ = $3.14 ft^2$

open area based on a pipe with a diameter of 24 in

For the design and configuration of the CWIS and three pump operation (1.27 MGD AIF), the calculated actual through-screen velocity (v) is:

$$v = (total\ pump\ rate\ MGD) \times (1{,}000{,}000) \times \left(\frac{1\ day}{24\ hours}\right) \times \left(\frac{1\ hour}{60\ min}\right) \times \left(\frac{1\ min}{60\ sec}\right) \times \left(\frac{0.1337\ ft^3}{gal}\right) \times \left(\frac{1}{total\ open\ area\ of\ intake}\right)$$

$$v = (1.27) \times (1{,}000{,}000) \times \left(\frac{1}{24}\right) \times \left(\frac{1}{60}\right) \times \left(\frac{1}{60}\right) \times (0.1337) \times \left(\frac{1}{3.14}\right)$$

$v = 0.63\,^{ft}/_{sec}$

Where:

$total\ open\ area\ of\ intake = overall\ area \times open\ area\ percentage/100$

$total\ open\ area\ of\ intake = \pi \times (1ft)^2 \times 1$

$total\ open\ area\ of\ intake = 3.14 ft^2$

open area based on a pipe with a diameter of 24 in

Intake Structure Description

Makeup water for the CCRS is withdrawn from Lake Mendota through the cooling water intake structure (CWIS) located approximately 592 feet offshore. The CWIS consists of three 36-inch diameter pipes with cylindrical screens, which are made of a 1-inch-wide mesh and function as velocity caps. The water than goes through a tee into a 24-inch diameter pipe made of concrete that connects to an underground structure. The water then passes through another 24-inch pipe that runs southeast to the pumphouse located on the north side of the Helen C. White Library.

The AIF is 1.27 MGD and it has a total DIF of 10.61 MGD. Using the AIF, an actual intake velocity of 0.63 feet per second (fps) was calculated above. According to the results from a model shown in the application material the maximum through screen velocity would be 0.38 fps, however as calculated above the maximum design intake velocity would be 5.2 fps.

Intake Structure Crib Location: 43°04'44.0"N, 89°24'03.0"W

Pumphouse Location: 43°04'37.3"N, 89°24'04.4"W

S. NR111.41, Wis. Adm. Code Application Materials Submitted

As part of the WPDES Permit Application, CSHP was required to submit information required under s. NR 111.41(1) through (7). CSHP provided the information required under s. NR 111.41(1) through (7) and (13). Most of the relevant application materials were included in a report titled "Section 316(b) 40 CFR 122.21(r) Information for the Charter Street Heating Plant", dated March 2022 and produced by Burns & McDonnell. The remaining information was provided in a report titled "Alternatives Analysis for Candidate Entrainment Best Technology Available at the Charter Street Heating Plant", dated March 2, 2022 and produced by Burns & McDonnell.

In accordance with s. NR 111.11(1)(a), CSHP is subject to the best technology available (BTA) standards for impingement mortality reduction under s. NR 111.12 and entrainment mortality reduction under s. NR 111.13, including any measures to protect federally-listed threatened and endangered species and

designated critical habitat established under s. NR 111.14(7). A discussion on the BTA standards for impingement mortality is provided first followed by entrainment.

BTA Standards for Impingement Mortality

In accordance with s. NR 111.12(1)(a), CSHP must comply with one of the alternatives in sub.1. through 7. except as provided in sub. (b)1. or 2., when approved by the department. In addition, a facility may also be subject to the requirements of s. NR 111.12(2), Wis. Adm. Code if the department requires such additional measures.

One option for compliance with the impingement mortality BTA standard is the use of a CCRS (s. NR 111.12(1)(a)1., Wis. Adm. Code). The USEPA estimates that freshwater cooling towers, compared to once-through cooling systems, reduce impingement mortality and entrainment by 97.5 percent.[1]

In order for the cooling towers to confirm with the impingement mortality BTA standard they must be operated at a minimum of 3.0 cycles of concentration or they must reduce the intake flow by 97.5% or more when compared to a once through system.

BTA Standards for Entrainment

The permittee proposes that the design and operation of the intake meets the BTA standards for entrainment mortality reduction. The department has evaluated this proposal under s. NR 111.13 and recommends the approval of this proposal. Below is a written explanation of the proposed entrainment determination as required by s. NR 111.13(1).

For entrainment control, the regulations expressly call for the permitting agency to make a site-specific determination of which technologies and/or practices satisfy the BTA standard for each individual facility (s. NR 111.13, Wis. Adm. Code). The BTA "shall reflect the department's determination of the maximum reduction in entrainment warranted after consideration of the relevant factors as specified in subs. (2) and (3)." The regulations also give the department the discretion to reject an otherwise available technology as the BTA for entrainment if the social costs are not justified by the social benefits or if there are other unacceptable adverse factors that cannot be mitigated (s. NR 111.13(4)).

The proposed determination must be based on consideration of any additional information required by the department and the factors listed in s. NR 111.13(2)(a). The weight given to each factor is within the department's discretion based upon the circumstances of each facility.

In accordance with s. NR 111.13(2), the following factors must be considered:

[1] USEPA. Technical Development Document for the Final Section 316(b) Existing Facilities Rule. EPA-821-R-14-002. May 2014.

1. Numbers and types of organisms entrained, including, specifically, the numbers and species (or lowest taxonomic classification possible) of Federally-listed, threatened and endangered species, and designated critical habitat (e.g., prey base);
2. Impact of changes in particulate emissions or other pollutants associated with entrainment technologies;
3. Land availability inasmuch as it relates to the feasibility of entrainment technology;
4. Remaining useful plant life; and
5. Quantified and qualitative social benefits and costs of available entrainment technologies when such information on both benefits and costs is of sufficient rigor to make a decision.

In addition, the proposed determination may be based on consideration of the following factors listed in s. NR 111.13(3):

1. Entrainment impacts on the waterbody;
2. Thermal discharge impacts;
3. Credit for reductions in flow associated with the retirement of units occurring within the ten years preceding October 14, 2014;
4. Impacts on the reliability of energy delivery within the immediate area;
5. Impacts on water consumption; and
6. Availability of process water, gray water, wastewater, reclaimed water, or other waters of appropriate quantity and quality for reuse as cooling water.

In the preamble to the 316(b) Rule (79 Fed. Reg. 48300 at 48303), USEPA indicated the following:

> *The entrainment provision reflects EPA's assessment that there is no single technology basis that is BTA for entrainment at existing facilities, but instead a number of factors that are best accounted for on a site-specific basis. Site-specific decision making may lead to a determination by the NPDES permitting authority that entrainment requirements should be based on variable speed pumps, water reuse, fine mesh screens, a closed-cycle recirculating system, or some combination of technologies that constitutes BTA for the individual site. The site-specific decision-making may also lead to no additional technologies being required.*

Entrainment reduction technologies and strategies provided in s. NR 111.41(13) include CCRS, fine mesh screens with a mesh size of 2 millimeters or smaller, variable speed pumps, and water reuse or alternate sources of cooling water.

Evaluation of Other Candidate Entrainment Control Technologies

CCRS and variable speed pumps are already in use at CSHP. In order to make the BTA determination the department evaluated the candidate entrainment control technologies that are not currently in place. Below is an evaluation of the candidate technologies:

TECHNOLOGY: Fine Mesh Cylindrical Wedge Wire Screens

1.1. FACTOR s. NR 111.13(2)(a)1., Wis. Adm. Code: Numbers and types of organisms entrained, including, specifically, the numbers and species (or lowest taxonomic classification possible) of Federally-listed, threatened and endangered species and designated critical habitat (e.g., prey base).

Fine mesh cylindrical wedge wire screens would potentially reduce entrainment. This is because fine mesh screens can physically block organisms from entering the intake. No studies on the current entrainment for the CWIS at CSHP exist and thus in the application material studies from Blount Station, which withdraws water from Lake Monona, and studies on the fish and mussel populations in Lake Mendota were used to determine what fish species are the most likely to be entrained. These species were then analyzed for how susceptible they are to being entrained. From this it was determined that Black bullhead, Black crappie, Bluegill, Brook Silverside, Walleye, White bass, Yellow bass, and Yellow perch are the most abundant and most frequently impinged and would thus be the most likely to be entrained.

From the determination of which species are most likely to be entrained at CSHP an analysis of their susceptibility to entrainment was performed. All eight species were deemed to have a low susceptibility to being entrained based on where spawning occurs, where eggs are deposited, the amount of parental care, and the behavior of the larvae. With a fine mesh screen it is likely that the eggs and larvae that no longer become entrained will become impinged and likely die on the screens without a mechanism for safe removal in place.

1.2. FACTOR s. NR 111.13(2)(a)2., Wis. Adm. Code: Impact of changes in particulate emissions or other pollutants associated with entrainment technologies.

No change in particulate emissions is likely to occur due to the installation of cylindrical wedge wire screens. There is a chance that dredging may be required for the installation of these screens and if that is the case there could be resuspension of sediment that may be contaminated.

1.3. FACTOR s. NR 111.13(2)(a)3., Wis. Adm. Code: Land availability inasmuch as it relates to the feasibility of entrainment technology.

The fine mesh cylindrical wedge wire screens would be installed in place of the current cylindrical mesh screens. The CWIS is near a sailboat mooring field and is in an area with a high amount of recreational boating. The cylindrical wedge wire screens would be larger than the current screens, which with the location of the CWIS would lead to an increase the chance of anchor entanglement and screen damage.

1.4. FACTOR s. NR 111.13(2)(a)4., Wis. Adm. Code: Remaining useful plant life.

There are no plans to retire CSHP, WSHP, or WCCF, so the remaining useful plant life was not considered in making this determination.

1.5. FACTOR s. NR 111.13(2)(a)5., Wis. Adm. Code: Quantified and qualitative social benefits and costs of available entrainment technologies when such information on both benefits and costs is of sufficient rigor to make a decision.

A social cost and benefit study was not done because CSHP withdraws less than 125 MGD, but the permittee asserts in the application materials that were submitted that there would likely be little social benefit from saving the fish, eggs, and larvae that are entrained since the facility already reduces entrainment by such a large amount by using a CCRS and VSPs.

1.6. Summary/Conclusion.

Fine mesh cylindrical wedge wire screens would possibly reduce entrainment due to physical exclusion. However, due to the high amount of recreational boating in the area around the CWIS this technology is deemed infeasible at CSHP.

TECHNOLOGY: Fine Mesh Traveling Screens

2.1. Summary/Conclusion.

The department did not do a full evaluation of fine mesh traveling screens due to the fact that there is not enough available land to implement this technology. Due to the lack of land the department has concluded that fine mesh traveling screens are infeasible at CSHP.

TECHNOLOGY: Water Reuse or Alternative Sources of Cooling Water

3.1. FACTOR s. NR 111.13(2)(a)1., Wis. Adm. Code: Numbers and types of organisms entrained, including, specifically, the numbers and species (or lowest taxonomic classification possible) of Federally-listed, threatened and endangered species and designated critical habitat (e.g., prey base).

Water reuse and alternative sources of cooling water would potentially reduce entrainment by reducing the flow needed be withdrawn from Lake Mendota. The entrainment reduction that may occur from the use of water reuse or an alternative source of cooling water is likely to be minimal due to CCRS and VSPs already being in place and used and thus already greatly reducing flow.

Discussion on the types and number of organisms entrained can be found in the previous technology evaluation above.

3.2. FACTOR s. NR 111.13(2)(a)2., Wis. Adm. Code: Impact of changes in particulate emissions or other pollutants associated with entrainment technologies.

One option for an alternative source of cooling water is to use groundwater. The groundwater may however contain naturally occurring metals that may not be present at all or in as high of concentrations as the water that is being withdrawn from Lake Mendota currently.

3.3. FACTOR s. NR 111.13(2)(a)3., Wis. Adm. Code: Land availability inasmuch as it relates to the feasibility of entrainment technology.

In order to provide the design intake flow of 10.61 MGD by using groundwater four to six vertical wells drawing 1,500 gpm to 2,500 gpm each would be needed. The wells would need to be spaced approximately 2,640 feet apart from each other. The new wells would also need to be spaced at an appropriate distance from the many existing wells located nearby in order to avoid negatively impacting the amount of water provided by the existing wells. An estimated 11.4 to 12.8 acres would be required in total in order to provide the necessary amount of cooling water from groundwater. With CSHP's location this amount of land is not available nearby.

The other potential option for an alternative source of cooling water is to use another permittee's effluent. The nearest source of another permittee's effluent would be from Madison Gas and Electric Blount Station, however as this effluent would be heated and thus not feasible to be used for cooling water. Other potential nearby options for sources of permittee's effluent include the Madison Metropolitan Sewer District Wastewater Treatment Facility, WI DNR Nevin Fish Hatchery, the Dane County Regional Airport, and Wagner Dairy Farm. The Madison Metropolitan Sewer District Wastewater Treatment Facility is the most likely option to be used as it is located only 3.5 miles away from CSHP and would likely be able to supply the necessary amount and quality of wastewater needed by CSHP. The pipeline between CSHP and the Madison Metropolitan Sewer District Wastewater Treatment Facility would need to over 3.5 miles long and would run through developed areas of various densities.

3.4. FACTOR s. NR 111.13(2)(a)4., Wis. Adm. Code: Remaining useful plant life.

See the previous technology evaluation above for information on remaining useful plant life.

3.5. FACTOR s. NR 111.13(2)(a)5., Wis. Adm. Code: Quantified and qualitative social benefits and costs of available entrainment technologies when such information on both benefits and costs is of sufficient rigor to make a decision.

As with the previously discussed technology an evaluation of social costs and benefits was not completed. It can however be concluded that the social costs of using an alternative source of cooling water would significantly outweigh the social benefits due to the cost of building the necessary pipeline as well as the minimal reduction in entrainment that is expected.

3.6. Summary/Conclusion.

The department has rejected water reuse and alternative sources of cooling water due to minimal reduction in entrainment and thus the minimal social benefits that are expected as well as the significant costs associated with building the necessary pipeline in order to use another permittee's effluent and the lack of available land for groundwater wells.

Entrainment BTA Decision

Currently CSHP uses a CCRS consisting of two cooling towers as well as three VSPs. Both technologies are listed as candidates for entrainment reduction technologies under s. NR 111.41(13). Cooling towers are also used by the other two facilities (WSHP and WCCF) that make use of this CWIS.

Fine mesh traveling screens, fine mesh cylindrical wedge wire screens, and using different sources for cooling water were all considered as part of this evaluation. The key issues with each technology that lead to them being consider infeasible are listed in the following paragraph.

The use of a fine mesh traveling screen would require an onshore CWIS for which land near the pump station is not available and were thus deemed infeasible. Alternative sources of cooling water were deemed infeasible due to a couple of reasons. The first reason being that CSHP does not have enough land available to be able to draw the necessary water from groundwater, which they estimated would require a total of 11.4 to 12.8 acres with 4 to 6 vertical wells each drawing 1,500 to 2,500 gpm. The use of groundwater is made further complicated due to the fact that several wells that are used by the City of Madison are nearby. In analyzing the use of alternative sources of cooling water the use of wastewater was looked at. However, the closest source of non-heated effluent that could provide the maximum design flow of 10.61 MGD is the Madison Metropolitan Sewer District Wastewater Treatment Facility, which would require more than 3.5 miles of piping that would need to run through developed areas of varying use. Fine mesh cylindrical wedge wire screens were deemed infeasible due to the land availability limitations that come from the CWIS being located near a sailboat mooring field and in an area that has a high amount of recreational boating.

After considering the factors specified in s. NR 111.13, the department has concluded that CSHP's CCRS and VSPs are considered the best technology available to achieve the maximum reduction in entrainment at CSHP.

Summary

1. The department has made a Best Technology Available (BTA) determination for one cooling water intake structure (CWIS) located at the Charter Street Heating Plant (CSHP) in accordance with ch. NR 111, Wis. Adm. Code. The department has concluded that the existing CWIS is the best technology available for minimizing adverse environmental impact.
2. The permittee proposes to comply with the BTA impingement standard in s. NR 111.12(1)(a)1., Wis. Adm. Code, through the use of a CCRS.
3. After consideration of the factors listed in s. NR 111.13, Wis. Adm. Code, the department has concluded that existing CCRS and VSPs are considered the best technologies available to achieve the maximum reduction in entrainment.
4. In order for the CCRS to comply with BTA standards for impingement mortality and entrainment the cooling towers must be operated at a minimum of 3.0 cycles of concentration or reduce flow by a minimum of 97.5% when compared to a once through system.

5. BTA determinations will be reviewed at the next reissuance and at subsequent reissuances in accordance with ch. NR 111, Wis. Adm. Code. In subsequent permit reissuance applications, the permittee shall provide all the information required in s. NR 111.4(2)(b), Wis. Adm. Code unless a request to reduce the information required has been submitted by the permittee and accepted by the department, as allowed by s. NR 111.42(1)(a).
6. The BTA includes requirements for monitoring and inspection of the CWIS and other requirements and terms; please see the permit for those requirements.

CORRESPONDENCE/MEMORANDUM

State of Wisconsin

DATE: October 15, 2024; Amended November 1, 2024

TO: Jennifer Jerich – SCR

FROM: Diane Figiel – WY/3

SUBJECT: Water Quality-Based Effluent Limitations for the UW Madison Charter Street Heating Plant WPDES Permit No. WI-0038296-09

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 UW Madison Charter Street Heating Plant in Dane County. This industrial facility discharges to the Lake Monona, located in the Yahara River and Lake Monona Watershed in the Lower Rock River Basin. This discharge is not included in the Rock River TMDL as approved by EPA but is within the TMDL area due to the lack of net phosphorus and TSS discharge. 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 004 (Primary noncontact cooling water (NCCW) and Outfall 001 (Optional NCCW outfall):

Parameter	Daily Maximum	Daily Minimum	Weekly Average	Monthly Average	Footnotes
Flow Rate					1
Oil & Grease (Hexane)	10 mg/L				
Temperature					2,3
January			76°F		
February			71°F		
March			74°F		
April			75°F		
May			85°F		
June			89°F		
July			92°F		
August	103°F		93°F		
September			86°F		
October			74°F		
November			66°F		
December			73°F		

Footnotes:

1. Monitoring only
2. The calculated temperature limits based on flow rates for the current permit term was 77 degrees F in April. The current permit limit of 75 degrees F should be retained in the permit unless the facility meets the antidegradation and antibacksliding requirements in ch. NR 207 to get the higher limit.
3. The limits in the table above account for heat loss in the storm sewer and are intended to be temperature measurements taken at the facility. If temperature measurements are taken at the end of the storm sewer, the calculated limits in the table below (without heat loss considered) should be included in the permit.

Month	Calculated Effluent Limit	
	Weekly Average Effluent Limitation (°F)	Daily Maximum Effluent Limitation (°F)
JAN	65	
FEB	60	
MAR	64	
APR	67	
MAY	74	
JUN	78	
JUL	81	91
AUG	82	92
SEP	76	93
OCT	64	
NOV	55	
DEC	62	

This discharge is exempt from complying with a Rock River TMDL allocation due to sources of TSS and phosphorus in the discharge originating from Lake Mendota which is directly connected to the receiving water (Lake Monona). If other sources of phosphorus and TSS are added to the discharge, the need for limits will be re-evaluated.

Limits and monitoring at in-plant sampling points are not addressed in this memo.

Please consult the attached report for details regarding the above recommendations. If there are any questions or comments, please contact Diane Figiel at Diane.Figiel@wisconsin.gov.

Attachments (3) – Narrative, Thermal Tables & Map

E-cc: Kenzie Ostien, Wastewater Engineer – SCR
Adebowale Adesanwo, Acting Regional Wastewater Supervisor – SCR

Attachment #1

Water Quality-Based Effluent Limitations for
UW Madison Charter Street Heating Plant

WPDES Permit No. WI-0038296-09

Prepared by: Diane Figiel

PART 1 – BACKGROUND INFORMATION

Facility Description:
The Charter Street Heating Plant (CSHP) serves the University of Wisconsin-Madison campus in producing electricity, steam for heating, and chilled water for cooling purposes. The primary fuels for the CSHP are natural gas and fuel oil, with the fuel oil used as a back-up fuel source. The CSHP can produce steam at 1,200,000 lbs/hour, 26,000 tons of chilled water, 9.8 megawatts of electricity and 7080 scfm of compressed air.

In August 2013, CSHP completed a project to rebuild and expand the plant to utilize natural gas and backup fuel oil instead of coal.

Outfall 001 is an optional outfall, for emergency backup use. From 2014 to 2022, Outfall 001 has not been used and no flow has been observed. Outfall 004 and Outfall 001 combine on facility property west of N Mills St, and discharge to the Monona Bay via the Municipal Separate Storm Sewer System outfall owned by the city of Madison. Additional intake water from Lake Mendota is added to the effluent in April and October to meet existing temperature limits.

Attachment #3 is a map of the area showing the approximate location of Outfall 004.

Existing Permit Limitations: The current permit, which expired on 06/30/2019, includes the following effluent limitations.

Outfall 004: Primary NCCW outfall at 2MH013

Parameter	Daily Maximum	Daily Minimum	Weekly Average	Monthly Average	Footnotes
Flow Rate					1
Oil & Grease (Hexane)	10 mg/L				2
Temperature Maximum April October			 75°F 74°F		3

Footnotes:
1. Monitoring only
2. Monthly grab sampling.
3. Limits effective 10/01/2018.

Outfall 001: Optional NCCW outfall 2MH011

Attachment #1

Parameter	Daily Maximum	Daily Minimum	Weekly Average	Monthly Average	Footnotes
Flow Rate					1
Oil & Grease (Hexane)	10 mg/L				1
Temperature Maximum					1

Footnotes:

1. Monitoring when discharge present.

Receiving Water Information:

- Name: Lake Monona
- Classification: Inland Lake. This lake is a two-story inland lake for consideration of temperature and phosphorus criteria. Warm water sport fish community, non-public water supply will apply to this discharge for all remaining substances.
- Flow: A ten-to-one dilution ratio will be used for calculating effluent limitation based on chronic or long-term impacts, in accordance with s. NR 106.06(4)(b)2, because the receiving water does not exhibit a unidirectional flow at the point of discharge.
- Hardness = 220 mg/L as $CaCO_3$. This value is the geometric mean of data from WET testing conducted by Madison Gas and Electric (Permit WI-0001961) which discharges to Lake Monona collected from 08/15/2006 to 08/11/2015 (n=5)
- Source of background concentration data: Chloride data from Lake Monona is available, however monitoring data is over 30 years old which is unlikely to be representative of current conditions, therefore it is assumed that effluent chloride is approximately equal to chloride concentrations in Lake Mendota from 2022 monitoring (SWIMS Station ID 133318).
- Multiple dischargers: There are several other dischargers to Lake Monona 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 Monona is impaired due to Mercury, PFOS (contaminated fish tissue), PCBs (contaminated fish tissue and sediments) and Total Phosphorus.

Effluent Information Outfall 004:

- Flow Rate(s):
  Annual average = 0.507 MGD (Million Gallons per Day)
  Peak daily = 0.85 MGD
  For reference, the actual average flow from June 2018 to May 2023 was 0.61 MGD.

No effluent was discharged through Outfall 001 between 07/01/2014 to 05/31/2023.

- Hardness = 220 mg/L as $CaCO_3$. This value is the geometric mean of data from WET testing conducted by Madison Gas and Electric on Lake Monona. Since Lake Monona and Lake Mendota are connected, it is assumed that their hardness value's will be similar. Since the permittee discharges water sourced from Lake Mendota, this estimated hardness for Lake Mendota is used to estimate effluent hardness. Effluent hardness data will be available at next permit issuance from permit application data and WET testing.
- Acute dilution factor used: Not applicable – this facility does not have an approved Zone of Initial

Dilution (ZID).

- Water Source: Most of the discharge (~99%) is originally sourced from an intake structure on Lake Mendota and infiltrated groundwater makes up the remaining 1% of the discharge.
- Additives: None used
- Effluent characterization: This facility is categorized as a secondary industry, so the permit application required effluent sample analyses for a limited number of common pollutants, primarily Ammonia, Chloride and Phosphorus. Instructions were provided to the facility in an email from Nathan Wells that with the exception of a single copper sample, metals sampling was not required.

Temp08192024	Phosphorus mg/L	Ammonia mg/L
09/20/2018	0.0276	
09/26/2018	0.0288	0.0212
10/04/2018	0.049	
10/10/2018	0.0391	
10/18/2018	0.0682	0.0654
10/24/2018	0.0865	
11/01/2018	0.0999	
11/07/2018	0.113	0.0379
11/15/2018	0.117	
11/21/2018	0.109	
11/29/2018	0.11	0.0618
12/05/2018	0.112	
1-day P_{99}	0.196	
4-day P_{99}	0.130	
30-day P_{99}	0.0962	
Mean	0.0800	0.0466
Std	0.0354	0.0208
Sample size	12	4

Effluent data for substances for which a single sample was analyzed is shown in the tables in Part 2 below, in the column titled “MEAN EFFL. CONC.”.

The following table presents the average concentrations and loadings at Outfall 004 from June 2018 to May 2023 for all parameters with limits in the current permit to meet the requirements of s. NR 201.03(6), Wis. Adm. Code:

	Average
Oil & Grease	1.15 mg/L
Temperature	82°F

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

In general, permit limits for toxic substances are recommended 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)

Acute Limits based on 2 × ATC

Daily maximum effluent limitations for toxic substances are based on the acute toxicity criteria (ATC), listed in ch. NR 105, Wis. Adm. Code. For discharges to lakes, daily or acute limits are calculated as equal to 2 × ATC.

Chronic Limits

Chronic limits for lake discharges are based on an estimated 10:1 lake: effluent mixing zone unless a previous mixing zone study has established a more appropriate mixing zone. Chronic limits based on CTC, WC, HTC, or HCC are derived as follows:

Limitation = 11(WQC) - 10 (Cs)

Where:

WQC =Water quality criterion or secondary acute value according to ch. NR 105

Cs = Background concentration of the substance (in units of mass per unit volume) as specified in s. NR 106.06(4)(e).

The following tables list the water quality-based effluent limitations for this discharge along with the results of effluent sampling for all the detected substances. All concentrations are expressed in terms of micrograms per Liter (µg/L), except for hardness and chloride (mg/L).

Daily Maximum Limits based on Acute Toxicity Criteria (ATC)

RECEIVING WATER FLOW = 10:1 Mixing Zone, 2xATC

SUBSTANCE	REF. HARD. mg/L	ATC	MEAN BACK-GRD.	MAX. EFFL. LIMIT	1/5 OF EFFL. LIMIT	MEAN EFFL. CONC.
Chlorine		19.0		38.1	7.61	<0.02
Copper	219	32.5		65.0	13.0	<5.0
Chloride (mg/L)		757	87.5	1514	303	87.5

Weekly Average Limits based on Chronic Toxicity Criteria (CTC)
RECEIVING WATER FLOW = 10:1 Mixing Zone

SUBSTANCE	REF. HARD.* mg/L	CTC	MEAN BACK-GRD.	WEEKLY AVE. LIMIT	1/5 OF EFFL. LIMIT	MEAN EFFL. CONC.
Chlorine		7.28		80.1	16.0	<0.02
Copper	219	20.2		224	44.7	<5.0
Chloride (mg/L)		395	87.5	3782	756	87.5

Monthly Average Limits based on Wildlife Criteria (WC), Human Threshold Criteria (HTC), and Human Cancer Criteria (HCC)
The effluent characterization did not include any effluent sampling results for substances for which WC, HTC, or HCC exist.

Conclusions and Recommendations: Based on a comparison of the effluent data and calculated effluent limitations, no limits for toxic substances are needed.

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 type of discharge, the effluent flow rate, the available PFOS/PFOA monitoring data, and known levels of PFOS/PFOA in the source water PFOS and PFOA monitoring is not recommended. PFOS and PFOA monitoring may be required in the future if information becomes available that indicates PFOS or PFOA may be present in the discharge.

PART 3 – WATER QUALITY-BASED EFFLUENT LIMITATIONS FOR BOD_5 AND AMMONIA NITROGEN

This discharge consists entirely of NCCW, which is not typically a significant source of BOD_5 or Ammonia Nitrogen. Effluent sampling for BOD_5 conducted with the permit application indicated concentrations below the limit of detection. Effluent sampling for ammonia (n=4) indicated effluent concentrations of 0.0466 mg/L. This concentration of ammonia is below any calculated ammonia limit and similar to ambient ammonia concentrations found in surface waters. **Therefore, no BOD_5 or ammonia nitrogen limits are recommended.**

PART 4 –PHOSPHORUS

UW Madison Charter Street Heating Plant currently withdraws from Lake Mendota and discharges water to Lake Monona without adding process waters or phosphorus containing additives. Both receiving waters are hydraulically connected through the Yahara River

The following table summarizes effluent total phosphorus monitoring data from 09/20/2018 – 12/05/2018 and available source water monitoring data from around the same time period.

Attachment #1

	Phosphorus mg/L	
Sample Date	Effluent Concentration	Lake Mendota Concentration*
09/19/2018		0.0291
09/20/2018	0.0276	
09/26/2018	0.0288	
10/02/2018		0.173
10/04/2018	0.049	
10/10/2018	0.0391	
10/18/2018	0.0682	0.082
10/24/2018	0.0865	
10/29/2018		0.123
11/01/2018	0.0999	
11/07/2018	0.113	
11/14/2018		0.128
11/15/2018	0.117	
11/21/2018	0.109	
11/29/2018	0.11	
11/30/2018		0.131
12/05/2018	0.112	
1-day P_{99}	0.196	
4-day P_{99}	0.130	
30-day P_{99}	0.0962	
Mean	0.0800	0.111
Sample size	12	6

*Data comes from the SWIMS database. Multiple sample results were collected at the same monitoring station on each day. The displayed value is the average of the monitoring results from that day.

Effluent data indicates average phosphorus concentrations within the range observed through in-lake monitoring. Monitoring data from September 2014 to August 2022 collected through in-lake monitoring indicate the average in-lake phosphorus concentration is 0.138 mg/L. As such, effluent data supports that this discharge is not a net source of phosphorus and does not fall under the applicability of ch. NR 217, Wis. Adm. Code which states that it applies to "Noncontact cooling water discharges which contain phosphorus unless 100 percent of the phosphorus in the discharge originates from the receiving water as intake water. Therefore, **no WQBEL, TMDL, or technology-based limit (TBL) phosphorus limit or monitoring is recommended at this time.**

If the discharge is modified in the future to contain additional inputs, intake and effluent phosphorus monitoring would be recommended to ensure that the discharge does not contribute a net phosphorus load for future permit reissuances. This monitoring would check that any additives, municipal water, or groundwater that might be present in the discharge do not contribute phosphorus to the receiving water.

PART 5 –TOTAL SUSPENDED SOLIDS

The Rock River TMDL also has wasteload allocations (WLA) for total suspended solids (TSS). For an industrial discharge, the limits for TSS must be expressed as daily maximums and monthly averages.

Similar to phosphorus, the CSHP is not believed to be a significant source of TSS to Lake Monona. Only effluent TSS data is available for CSHP, so it cannot be confirmed that 100% of the TSS is coming from the Lake, or that CSHP is reducing TSS concentrations through their treatment system. Given the current information available, however, **TMDL-derived TSS limits are also not recommended at this time**. For reference, the CSHP is located on Reach 64 of the Rock River from Nine Springs Creek to Spring (Dorn) Creek, Pheasant Branch Creek, which has a TSS load reduction target of 42% for treatment facilities.

PART 6 –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.

Because the discharge is to a storm sewer, a heat loss equation is used to adjust the calculated limit based upon the length of the storm sewer before discharge to waters of the state. The discharge from permit Outfall 004 travels through at least 4300 feet of storm sewer/storm water conveyance channel before reaching Lake Monona. Under s. NR 106.55(5), Wis. Adm. Code, the default cooling rate is estimated as 1º F for every 400 feet of storm sewer/storm water conveyance channel which results in an estimated 10.8°F of heat loss. The adjusted limits are shown in the table below. UW Madison Charter Street Heating Plant may opt to conduct a study to determine an alternative heat loss value. Such a study would generally involve collecting site specific information and data used to calculate an alternative heat loss value and resulting temperature limits.

The table below summarizes the maximum temperatures reported during monitoring from January 2019 to May 2023. The maximum daily temperature data reported from 7/1/2014 to 12/31/2018 was recorded once per day around midnight and is not considered to be representative of the discharge due to improper sampling and reporting procedures.

Attachment #1

Month	Representative Highest Monthly Effluent Temperature		Calculated Effluent Limit		Calculated Effluent Limit Adjusted for 4300 ft Storm Sewer	
	Weekly Maximum (°F)	Daily Maximum (°F)	Weekly Average Effluent Limitation (°F)	Daily Maximum Effluent Limitation (°F)	Weekly Average Effluent Limitation (°F)	Daily Maximum Effluent Limitation (°F)
JAN	91	92	**65**	120	**76**	120
FEB	93	94	**60**	102	**71**	112
MAR	93	100	**64**	101	**74**	112
APR	74	82	**67**	99	77	110
MAY	88	96	**74**	97	**85**	108
JUN	91	93	**78**	95	**89**	106
JUL	93	99	**81**	**91**	**92**	102
AUG	94	104	**82**	**92**	**93**	**103**
SEP	89	94	**76**	**93**	**86**	104
OCT	74	85	**64**	91	74	102
NOV	95	98	**55**	100	**66**	111
DEC	92	95	**62**	116	**73**	120

Reasonable Potential

Permit limits for temperature are recommended based on the procedures in s. NR 106.56.

- An acute limit for temperature is recommended for each month in which the representative daily maximum effluent temperature for that month exceeds the acute WQBEL. The representative daily maximum effluent temperature is the greater of the following:
  (a) The highest recorded representative daily maximum effluent temperature
  (b) The projected 99th percentile of all representative daily maximum effluent temperatures
- A sub−lethal limitation for temperature is recommended for each month in which the representative weekly average effluent temperature for that month exceeds the weekly average WQBEL. The representative weekly average effluent temperature is the greater of the following:
  (a) The highest weekly average effluent temperature for the month.
  (b) The projected 99th percentile of all representative weekly average effluent temperatures for the month

Comparing the representative highest effluent temperature to the calculated effluent limits determines the reasonable potential of exceeding the effluent limits. Based on this analysis, weekly average temperature maximum limits are necessary in all months except April and October, and a daily maximum limit is needed in August.

Current Permit Limits

The facility has been utilizing additional intake water to comply with thermal limits for April and October. CSHP sets temperature set point for April and October for the control loop to maintain the

temperature below the limit by controlling intake lake water. In addition, there are alarms for temperature excursions with operator responses as a back up to the automated control loop. When there is not a limit for the month, an alarm is not set, and the effluent is discharged no matter the temperature. Therefore, the limits of 75 degrees F in April and 74 degrees F are recommended to be continued in the reissued permit as well.

Antidegradation/Antibacksliding
Although the calculated temperature limit for April of 77 degrees F is less restrictive than the current permit limit of 75 degrees F, the current permit limit should be retained in the permit unless the facility meets the antidegradation and antibacksliding requirements in ch. NR 207 to get the higher limit.

The following general options are available for a facility to explore potential relief from the temperature limits:

- Effluent monitoring data: Verification or additional effluent monitoring (flow and/or temperature) may be appropriate if there were questions on the representativeness of the current effluent data.
- Mixing zone studies: A demonstration of an alternative effluent mixing zone may indicate a mixing zone greater than the default lake mixing zone is allowable.
- Collection of site-specific ambient temperature: default background temperatures for lakes in Wisconsin, so actual data from the direct receiving water may provide for relaxed thermal limits but only if the site-specific temperatures are lower than the small stream defaults used in the above tables.
- A variance to the water quality standard: This is typically considered to be the least preferable and most complex option as it requires the evaluation of the other alternatives.

These options are explained in additional detail in the August 15, 2013 Department *Guidance for Implementation of Wisconsin's Thermal Water Quality Standards*
http://dnr.wi.gov/topic/surfacewater/documents/ThermalGuidance2edition8152013.pdf

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 WET Program Guidance Document (October 29, 2019).

- 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.

- 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). The IWC is an estimate of the proportion of effluent to total volume of water (receiving water + effluent). The IWC of 9.1% shown in the calculation below, as specified in s. NR 106.03(6):

> The IWC is 9.1% based on dilution of 10 parts lake water to 1-part effluent, 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 004 shall be a grab sample collected from the Lake Monona, outside of the mixing zone of the discharge. The specific receiving water location must be specified in the WPDES permit.

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 = 9.1%. **0 Points**
Historical Data	No data available **5 Points**	No data available **5 Points**
Effluent Variability	Little variability, no violations or upsets, consistent operations **0 Points**	Same as Acute. **0 Points**
Receiving Water Classification	WWSF **5 Points**	Same as Acute. **5 Points**
Chemical-Specific Data	Chloride detected. Additional Compounds of Concern: none **1 Points**	Reasonable potential limits for zero substances based on CTC; chloride detected. Additional Compounds of Concern: none **1 Point**

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	Acute	Chronic
Additives	All additives are added to the cooling towers and the cooling tower blowdown is currently going to the sanitary sewer. No P treatment chemicals in use **0 Points**	Additives used more than once per 4 days. **0 Points**
Discharge Category	No process wastewater **0 Points**	Same as Acute. **0 Points**
Wastewater Treatment	NCCW, Boiler or Cooling Tower Blowdown **0 Points**	Same as Acute. **0 Points**
Downstream Impacts	No impacts known. **0 Points**	Same as Acute. **0 Points**
Total Checklist Points:	**11 Points**	**11 Points**
Recommended Monitoring Frequency (from Checklist):	None	None
Limit Required?	No	No
TRE Recommended? (from Checklist)	No	No

After consideration of the guidance provided in the Department's WET Program Guidance Document (2019) and other information described above **no acute and no chronic WET tests are recommended in the reissued permit**. 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

Complete Thermal Table

Temperature limits for receiving waters without unidirectional flow

(calculation using default ambient temperature data)

Facility: UW Madison CSHP

Outfall(s): 004

Date Prepared: 06/24/2023

Design Flow (Qe): 0.5 MGD

Flow Data: June 2018 to May 2023

Lake Type: Southern Inland Lakes

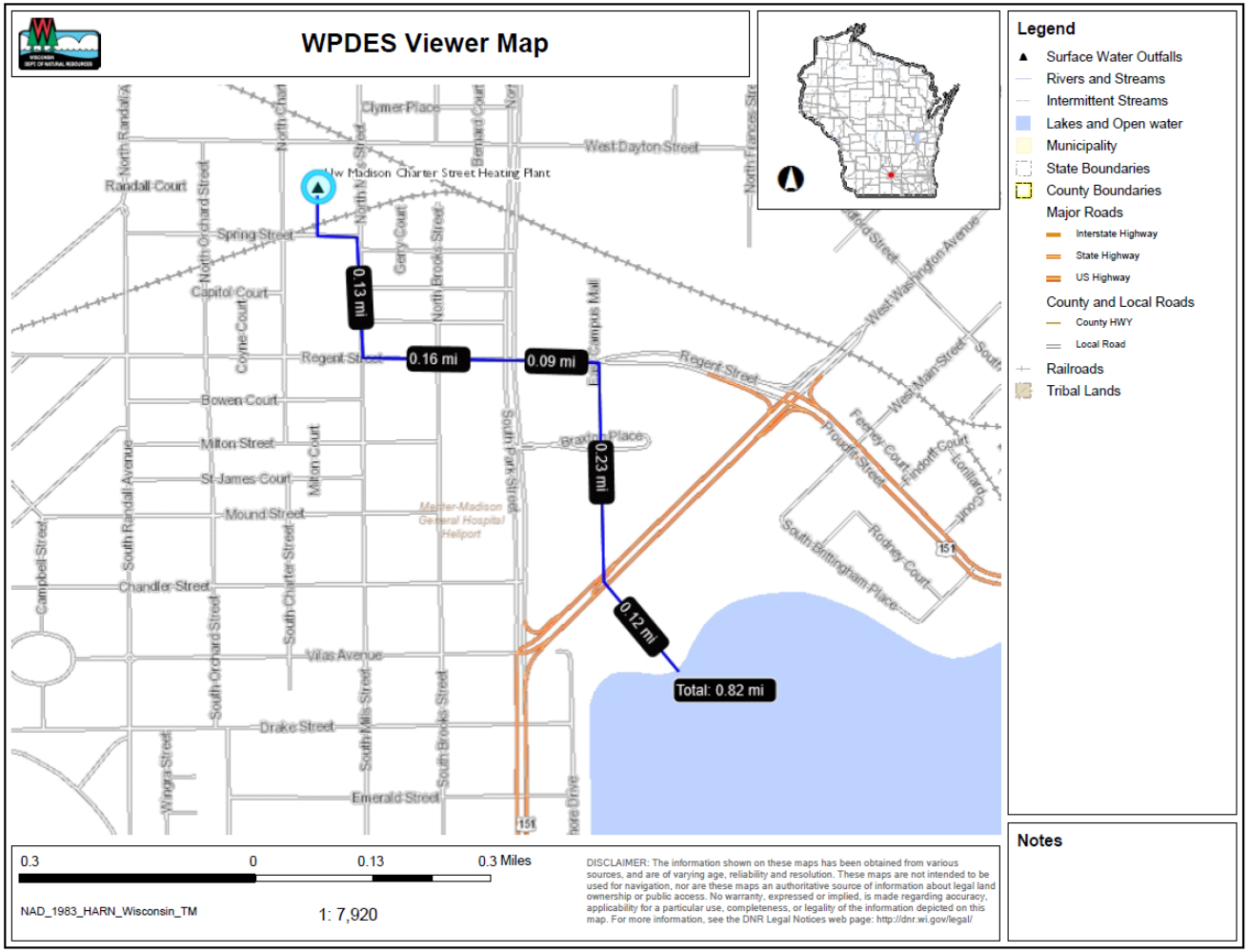
Discharge Type: Inland lake or impoundment shore discharge

Maximum area of mixing zone allowed (coefficient "A"): 15,708 ft^2

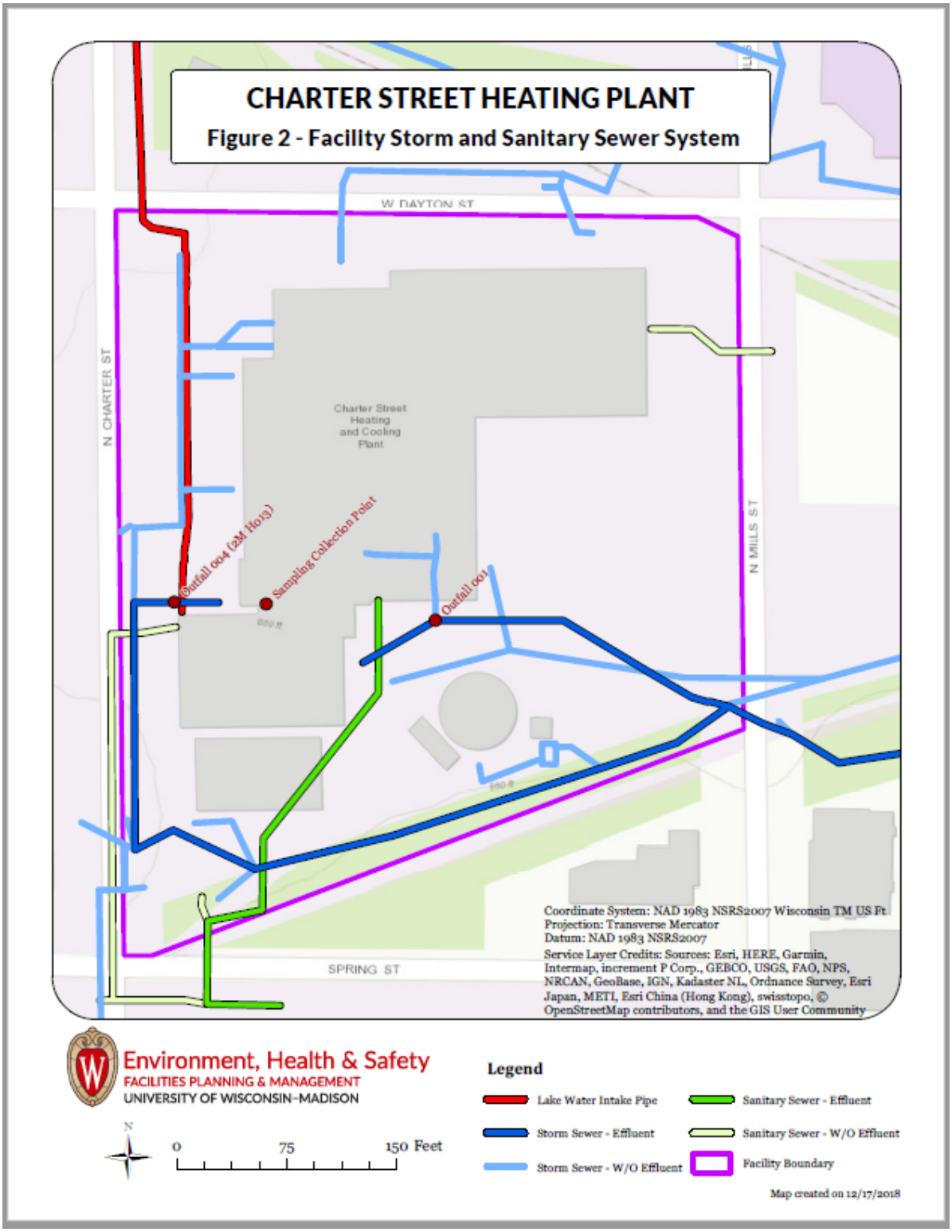
Month	Water Quality Criteria			Representative Highest Effluent Flow Rate (Qe)		B	e^{-a} (for SL-WQBEL)	e^{-a} (for A-WQBEL)	Representative Highest Monthly Effluent Temperature Data Jan 2019 to May 2023		**Calculated Effluent Limit Adjusted for 4300 ft Storm Sewer**	
	Ta (default)	Sub-Lethal WQC	Acute 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	49	77	0.28	0.28	0.405	0.460	0.460	91	92	**76**	120
FEB	39	52	78	0.46	0.46	0.405	0.623	0.623	93	94	**71**	112
MAR	41	55	78	0.45	0.45	0.405	0.617	0.617	93	100	**74**	112
APR	49	60	80	0.46	0.46	0.405	0.623	0.623	74	82	77	110
MAY	58	68	82	0.44	0.44	0.405	0.610	0.610	88	96	**85**	108
JUN	70	75	86	0.63	0.63	0.667	0.630	0.630	91	93	**89**	106
JUL	77	80	87	0.85	0.85	0.667	0.710	0.710	93	99	**92**	102
AUG	76	80	87	0.80	0.80	0.667	0.695	0.695	94	104	**93**	**103**
SEP	67	73	85	0.70	0.70	0.555	0.690	0.690	89	94	**86**	104
OCT	54	61	81	0.70	0.70	0.405	0.733	0.733	74	85	74	102
NOV	42	50	78	0.45	0.45	0.405	0.617	0.617	95	98	**66**	111
DEC	35	49	77	0.33	0.33	0.405	0.518	0.518	92	95	**73**	120

Attachment #3

Map of Outfall and Estimated Storm Sewer Path



Estimated storm sewer path and length denoted on map.


CHARTER STREET HEATING PLANT
Figure 2 - Facility Storm and Sanitary Sewer System
W DAYTON ST
N CHARTER ST
N MILLS ST
SPRING ST
Charter Street Heating and Cooling Plant
Outfall 004 (2M H013)
Sampling Collection Point
Outfall 003
Coordinate System: NAD 1983 NSRS2007 Wisconsin TM US Ft
Projection: Transverse Mercator
Datum: NAD 1983 NSRS2007
Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, © OpenStreetMap contributors, and the GIS User Community
Environment, Health & Safety
FACILITIES PLANNING & MANAGEMENT
UNIVERSITY OF WISCONSIN-MADISON
N
0
75
150 Feet
Legend
Lake Water Intake Pipe
Storm Sewer - Effluent
Storm Sewer - W/O Effluent
Sanitary Sewer - Effluent
Sanitary Sewer - W/O Effluent
Facility Boundary
Map created on 12/17/2018