CORRESPONDENCE/MEMORANDUM

State of Wisconsin

DATE: November 13, 2024

TO: Holly Heldstab– WCR/Eau Claire

FROM: Benjamin Hartenbower – WCR/Eau Claire

SUBJECT: Water Quality-Based Effluent Limitations for the Viola Wastewater Treatment Facility
WPDES Permit No. WI-0021148

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 Viola Wastewater Treatment Facility in Vernon County. This municipal wastewater treatment facility (WWTF) discharges to the Kickapoo River, located in the Middle Kickapoo River Watershed in the Lower Wisconsin River 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	Six-Month Average	Footnotes
Flow Rate						1,2
BOD_5			45 mg/L	30 mg/L		1
TSS				60 mg/L		1,3
pH	9.0 s.u.	6.0 s.u.				1
Ammonia Nitrogen May - October November - April	 Variable Variable		 **17 mg/L** **34 mg/L**	 **17 mg/L** **34 mg/L**		4,5
Bacteria Interim Limit Fecal Coliform				400 #/100 mL geometric mean		6
Final Limit *E. coli*				126 #/100 mL geometric mean		
Chloride						2
Phosphorus MCL WQT Computed (TP)				 1.0 mg/L 0.300 mg/L	 0.100 mg/L, 0.083 lbs/day	7
TKN, Nitrate+Nitrite, and Total Nitrogen						8
Acute WET						9

Footnotes:

1. No changes from the current permit.
2. Monitoring only.
3. The TSS limit is a variance limit according to s. NR 210.07(2), Wis. Adm. Code, where aerated lagoons and stabilization ponds are the principal treatment processes.

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4. The variable daily maximum ammonia nitrogen limit table corresponding to effluent pH values. These limits apply year-round.

Effluent pH s.u.	Limit mg/L	Effluent pH s.u.	Limit mg/L	Effluent pH s.u.	Limit mg/L
6.0 ≤ pH ≤ 6.1	72	7.0 < pH ≤ 7.1	44	8.0 < pH ≤ 8.1	9.3
6.1 < pH ≤ 6.2	71	7.1 < pH ≤ 7.2	39	8.1 < pH ≤ 8.2	7.7
6.2 < pH ≤ 6.3	69	7.2 < pH ≤ 7.3	35	8.2 < pH ≤ 8.3	6.3
6.3 < pH ≤ 6.4	67	7.3 < pH ≤ 7.4	31	8.3 < pH ≤ 8.4	5.2
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	2.9
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

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. Bacteria limits apply during the disinfection season of May through September. The fecal coliform interim limit will apply until the end of the compliance schedule when E. coli limits take effect. Additional final limit: No more than 10 percent of E. coli bacteria samples collected in any calendar month may exceed 410 count/100 mL.
7. Phosphorus WQBELS are met through WQT computed compliance limits which also require a corresponding Minimum Control Level (MCL) to be met at the discharge.
8. 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).
9. Two acute WET tests are recommended in the reissued permit. 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 Benjamin Hartenbower at (715) 225-4705 or Benjamin.Hartenbower@wisconsin.gov or Diane Figiel at Diane.Figiel@wisconsin.gov.

Attachments (2) – Narrative & Map

PREPARED BY: _____ Date: 11/13/2024

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Attachment #1

Water Quality-Based Effluent Limitations for the Viola Wastewater Treatment Facility WPDES Permit No. WI-0021148

Prepared by: Benjamin P. Hartenbower

PART 1 – BACKGROUND INFORMATION

Facility Description:
The Viola Wastewater Treatment Plant treats domestic wastewater from the Village of Viola. Primary treatment consists of a Huber fine screen and secondary treatment consists of a two-cell activated aerated lagoon system with a settling area in pond 2 and alum addition for phosphorus treatment. The annual average design flow of the facility is 0.100 million gallons per day (MGD). The discharge is to the North Bank of the Kickapoo River West of the Commercial St. (Hwy 131) bridge.

Attachment #2 is a map of the area showing the approximate location of Outfall 001.

Existing Permit Limitations
The current permit, expiring on September 30, 2024, includes the following effluent limitations and monitoring requirements.

Parameter	Daily Maximum	Daily Minimum	Weekly Average	Monthly Average	Six-Month Average	Footnotes
Flow Rate						1,2
BOD_5			45 mg/L	30 mg/L		1
TSS				60 mg/L		1,3
pH	9.0 s.u.	6.0 s.u.				1
Ammonia Nitrogen May - October November - April	 Variable Variable		 **17 mg/L** **34 mg/L**	 **17 mg/L** **34 mg/L**		4,5
Fecal Coliform May - September			**656 #/100 mL geometric mean**	400 #/100 mL geometric mean		5
Phosphorus Interim MDV Interim Final WQBEL				 4.30 mg/L 1.00 mg/L 0.300 mg/L	 0.100 mg/L	6

Footnotes:

1. 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.
2. Monitoring only.
3. The TSS limit is a variance limit according to s. NR 210.07(2), Wis. Adm. Code, where aerated lagoons and stabilization ponds are the principal treatment processes.

4. The variable daily maximum ammonia nitrogen limit tables corresponding to effluent pH values.

November to April Ammonia Limits			
Effluent pH (s.u.)	NH_3-N Limit (mg/L)	Effluent pH (s.u.)	NH_3-N Limit (mg/L)
7. < pH ≤ 7.5	>34	8.2 < pH ≤ 8.3	9.4
7.5 < pH ≤ 7.6	34	8.3 < pH ≤ 8.4	7.8
7.6 < pH ≤ 7.7	29	8.4 < pH ≤ 8.5	6.4
7.7 < pH ≤ 7.8	24	8.5 < pH ≤ 8.6	5.3
7.8 < pH ≤ 7.9	20	8.6 < pH ≤ 8.7	4.4
7.9 < pH ≤ 8.0	17	8.7 < pH ≤ 8.8	3.7
8.0 < pH ≤ 8.1	14	8.8 < pH ≤ 8.9	3.1
8.1 < pH ≤ 8.2	11	8.9 < pH ≤ 9.0	2.6

May to October Limits			
Effluent pH (s.u.)	NH_3-N Limit (mg/L)	Effluent pH (s.u.)	NH_3-N Limit (mg/L)
pH ≤ 7.9	>17	8.4 < pH ≤ 8.5	6.4
7.9 < pH ≤ 8.0	17	8.5 < pH ≤ 8.6	5.3
8.0 < pH ≤ 8.1	14	8.6 < pH ≤ 8.7	4.4
8.1 < pH ≤ 8.2	11	8.7 < pH ≤ 8.8	3.7
8.2 < pH ≤ 8.3	9.4	8.8 < pH ≤ 8.9	3.1
8.3 < pH ≤ 8.4	7.8	8.9 < pH ≤ 9.0	2.6

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.
4. Under the phosphorus MDV, a highest attainable condition (HAC) limit of 1.0 mg/L was effective October 1, 2022.

Receiving Water Information

- Name: Kickapoo River
- Waterbody Identification Code (WBIC): 1182400
- Classification used in accordance with chs. NR 102 and 104, Wis. Adm. Code: Cold Water (Category 4), Class II trout stream, non-public water supply.
- Low flows used in accordance with chs. NR 106 and 217, Wis. Adm. Code: The following 7-Q_{10} and 7-Q_2 values are from USGS for Station 05408000 in the Kickapoo River, where Outfall 001 is located.

  7-Q_{10} = 63.0 cubic ft per second (cfs)
  7-Q_2 = 77.0 cfs

  Harmonic Mean Flow = 130 cfs using a drainage area of 266.0 mi^2.
  The Harmonic Mean has been estimated based on average flow and the 7-Q_{10} using an equation from U.S. EPA's *Technical Support Document for Water Quality-Based Toxics Control* (March 1991, EPA/505/2-90-001, pgs. 88-89).
- Hardness = 263 mg/L as $CaCO_3$. This value represents the geometric mean of 10 samples collected in the Kickapoo River from 08/07/1991 to 07/07/1992.
- % of low flow used to calculate limits in accordance with s. NR 106.06(4)(c)5., Wis. Adm. Code: 25%

- Source of background concentration data: Chloride and metals data are from the Kickapoo River. The numerical values are shown in the tables below. If no data is available, the background concentration is assumed to be negligible and a value of zero is used in the computations. Background data for calculating effluent limitations for ammonia nitrogen are described later.
- Multiple dischargers: There are several other dischargers to the Kickapoo River 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: The Kickapoo River is listed as impaired for Total Phosphorus.

Effluent Information:

- Design Flow Rates(s):
  Annual Average = 0.100 MGD (Million Gallons per Day)
  Peak daily = 1.14 MGD (estimated)
  For reference, the actual average flow from September 2018 to August 2024 was 0.069 MGD.
- Hardness = 238 mg/L as $CaCO_3$. This value represents the geometric mean of 4 effluent samples collected from 01/10/2023 to 01/31/2023.
- 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 water supply from wells.
- Additives: Aluminum Sulfate
- Effluent characterization: This facility is categorized as a minor municipality, so the permit application required effluent sample analyses for a limited number of common pollutants, as specified in s. NR 200.065, Table 1, Wis. Adm. Code, primarily metal substances plus Chloride and Hardness. The permit-required monitoring for Ammonia Nitrogen and Phosphorus from September 2018 to August 2024 is used in this evaluation.

Chemical Specific Effluent Data at Outfall 001

Sample Date	Copper µg/L	Sample Date	Chloride mg/L
01/10/2023	6.26	01/10/2023	342
01/13/2023	4.16	01/17/2023	334
01/17/2023	3.95	01/24/2023	304
01/20/2023	4.01	01/31/2023	304
01/24/2023	4.1	10/07/2024	278
01/27/2023	5.84	10/10/2024	288
01/31/2023	7.18	10/13/2024	281
02/03/2023	4.15	10/16/2024	292
02/07/2023	4.92	10/19/2024	298
02/14/2023	5.04		
02/17/2023	5.04		
1-day P_{99}	7.96	mean	302
4-day P_{99}	6.34		

"<" means that the pollutant was not detected at the indicated level of detection. The mean concentration was calculated using zero in place of the non-detected results.

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 001 from September 2018 to August 2024 for all parameters with limits in the current permit to meet the requirements of s. NR 201.03(6):

Parameter Averages with Limits

	Average Measurement
BOD_5	21.3 mg/L
TSS	26.3 mg/L
pH	7.33 s.u.
Ammonia Nitrogen	8.80 mg/L
Fecal Coliform	359#/100 mL
Phosphorus	0.95 mg/L

*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)

Acute Limits based on 1-Q_{10}

Daily maximum effluent limitations for toxic substances are based on the acute toxicity criteria (ATC), listed in ch. NR 105, Wis. Adm. Code. Previously daily maximum limits for toxic substances were calculated as two times the ATC. However, changes to ch. NR 106, Wis. Code, (September 1, 2016) require the Department to calculate acute limitations using the same mass balance equation as used for other limits along with the 1-Q_{10} receiving water low flow to determine if more restrictive effluent limitations are needed to protect the receiving stream from discharges which may cause or contribute to an exceedance of the acute water quality standards. The mass balance equation is provided below.

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

Where:

WQC =Acute toxicity criterion 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.

If the receiving water is effluent dominated under low stream flow conditions, the 1-Q_{10} method of limit calculation produces the most stringent daily maximum limitations and should be used while making reasonable potential determinations. This is not the case for the Viola Wastewater Treatment Facility and the limits are set based on two times the acute toxicity criteria.

The following tables list the calculated WQBELs for this discharge along with the results of effluent sampling. 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 = 50 cfs, (1-Q_{10} (estimated as 80% of 7-Q_{10})), as specified in s. NR 106.06(3)(bm), Wis. Adm. Code.

SUBSTANCE	REF. HARD. mg/L	ATC	MEAN BACK-GRD.	MAX. EFFL. LIMIT**	1/5 OF EFFL. LIMIT	MEAN EFFL. CONC.	1-day P_{99}	1-day MAX. CONC.
Arsenic		340		680	136	1		
Cadmium	238	11.8	0.015	23.5	4.7	<0.084		
Chromium (+3)	238	3665	0.836	7329	1466	<0.7		
Copper	238	35.1	0.632	70.3			8.0	7.2
Lead	238	247	0.950	494	99	<1.08		
Nickel	238	976		1952	390	1.5		
Zinc	238	257	2.935	513	103	<26		
Chloride		757	9.1	1514	303	302		342

* * The 2 × ATC method of limit calculation yields a more restrictive limit than consideration of ambient concentrations and 1-Q_{10} flow rates per the changes to s. NR 106.07(3), Wis. Adm. Code, effective 09/01/2016.

Weekly Average Limits based on Chronic Toxicity Criteria (CTC)
RECEIVING WATER FLOW = 16 cfs (¼ of the 7-Q_{10}), as specified in s. NR 106.06(4)(c), Wis. Adm. Code.

SUBSTANCE	REF. HARD.* mg/L	CTC	MEAN BACK-GRD.	MAX. EFFL. LIMIT	1/5 OF EFFL. LIMIT	MEAN EFFL. CONC.	4-day P_{99}
Arsenic		148		15214	3043	1	
Cadmium	175	3.8	0.015	391.2	78.2	<0.084	
Chromium (+3)	263	3980	0.836	409003	81801	<0.7	
Copper	263	23.7	0.632	2368.8			6.3
Lead	263	71	0.950	7229	1446	<1.08	
Nickel	263	118		12155	2431	1.5	
Zinc	263	280	2.935	28518	5704	<26	
Chloride		395	9.1	39680	7936	302	

* The indicated hardness may differ from the receiving water hardness because the receiving water hardness exceeded the maximum range in ch. NR 105, Wis. Adm. Code, over which the chronic criteria are applicable. In that case, the maximum of the range is used to calculate the criterion.

Monthly Average Limits based on Wildlife Criteria (WC)
The effluent characterization did not include any effluent sampling results for substances for which Wildlife Criteria exist.

Monthly Average Limits based on Human Threshold Criteria (HTC)
RECEIVING WATER FLOW = 33 cfs (¼ of the Harmonic Mean), as specified in s. NR 106.06(4), Wis. Adm. Code.

SUBSTANCE	HTC	MEAN BACK-GRD.	MAX. EFFL. LIMIT	1/5 OF EFFL. LIMIT	MEAN EFFL. CONC.	30-day P_{99}
Cadmium	370.0	0.015	78086.3	15617.3	<0.084	
Chromium (+3)	3818000	0.836	805799430	161159886	<0.7	
Lead	140	0.950	29348	5870	<1.08	
Nickel	43000		9075271	1815054	1.5	

Monthly Average Limits based on Human Cancer Criteria (HCC)
RECEIVING WATER FLOW = 33 cfs (¼ of the Harmonic Mean), as specified in s. NR 106.06(4), Wis. Adm. Code.

SUBSTANCE	HCC	MEAN BACK-GRD.	MAX. EFFL. LIMIT**	1/5 OF EFFL. LIMIT	MEAN EFFL. CONC.	30-day P_{99}
Arsenic	13.3		2807.0	561.4	1	

In addition to evaluating the need for limits for each individual substance for which HCC exist, s. NR 106.06(8), Wis. Adm. Code, requires the evaluation of the cumulative cancer risk. Because no effluent limits are needed based on HCC, determination of the cumulative cancer risk is not needed per s. NR 106.06(8), Wis. Adm. Code.

Conclusions and Recommendations: Based on a comparison of the effluent data and calculated effluent limitations, limits are not required for toxic substances.

Chloride – Considering available effluent data from January 2023 to October 2024, the mean effluent concentration is 302 mg/L. This value is below 1/5 of the calculated WQBELs for chloride, therefore no effluent limits are needed. To ensure that representative sample results are available at the next permit issuance, **monthly chloride monitoring is recommended.**

PFOS and PFOA
The need for PFOS and PFOA monitoring is evaluated in accordance with s. NR 106.98, Wis. Adm. Code. PFOS and PFOA were not detected in the water supply. Based on the annual design flow and lack of nondomestic contributions, it is unlikely that the effluent will contain PFOS or PFOA. **Therefore, monitoring is not recommended.** If information becomes available that indicates PFOS or PFOA may be present in the effluent, the monitoring requirements may change.

Mercury – The permit application did not require monitoring for mercury because the Viola Wastewater Treatment Facility 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). However, since the Viola Wastewater Treatment Facility is a lagoon system that has not had sludge removed and sampling is not available. It is not expected that there are exceedances of the high-quality mercury concentration based on similar municipal treatment plants and the lack of industries. **No monitoring is recommended.**

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. These limits are re-evaluated at this time due to the following changes:

- Subchapter IV of ch. NR 106, Wis. Adm. Code allows limits based on available dilution instead of limits set to twice the acute criteria.
- 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.

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

Where:

A = 0.275 and B = 39 for a Cold-Water Category 4 fishery, and
pH (s.u.) = that characteristic of the effluent.

The effluent pH data was examined as part of this evaluation. A total of 2075 sample results were reported from September 2018 to August 2024. The maximum reported value was 9.50 s.u. (Standard pH Units). The effluent pH was 8.10 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 7.96 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 7.94 s.u. Therefore, a value of 8.10 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 8.1 s.u. into the equation above yields an ATC = 4.64 mg/L.

Daily Maximum Ammonia Nitrogen Effluent Limitations Calculation Method
In accordance with s. NR 106.32(2), Wis. Adm. Code daily maximum ammonia limitations are calculated using the 1-Q_{10} receiving water low flow if it is determined that the previous method of acute ammonia limit calculation (2×ATC) is not sufficiently protective of the fish and aquatic life. The more restrictive calculated limits shall apply.

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

	Ammonia Nitrogen Limit mg/L
2×ATC	9.28
1-Q_{10}	1494

The 2×ATC method yields the most stringent limits for the Viola Wastewater Treatment Facility.

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. This table has been updated to reflect Coldwater, Category 4 criteria.

Daily Maximum Ammonia Nitrogen Limits – Coldwater (Category 4)

Effluent pH s.u.	Limit mg/L	Effluent pH s.u.	Limit mg/L	Effluent pH s.u.	Limit mg/L
6.0 ≤ pH ≤ 6.1	72	7.0 < pH ≤ 7.1	44	8.0 < pH ≤ 8.1	9.3
6.1 < pH ≤ 6.2	71	7.1 < pH ≤ 7.2	39	8.1 < pH ≤ 8.2	7.7
6.2 < pH ≤ 6.3	69	7.2 < pH ≤ 7.3	35	8.2 < pH ≤ 8.3	6.3
6.3 < pH ≤ 6.4	67	7.3 < pH ≤ 7.4	31	8.3 < pH ≤ 8.4	5.2
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	2.9
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

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

The ammonia limit calculation also warrants evaluation of weekly and monthly average limits based on chronic toxicity criteria for ammonia, since those limits relate to the assimilative capacity of the receiving water.

Weekly average and monthly average limits for ammonia nitrogen are based on chronic toxicity criteria in ch. NR 105, Wis. Adm. Code.

The 30-day chronic toxicity criterion (CTC) for ammonia in waters classified as Cold-water Community is calculated by the following equation, according to subchapter IV of NR 106, Wis. Adm. Code.

$$CTC = E \times \{[0.0676 \div (1 + 10^{(7.688 - pH)})] + [2.912 \div (1 + 10^{(pH - 7.688)})]\} \times C$$

Where:

pH = the pH (s.u.) of the <u>receiving water</u>,

E = 0.854,

C = the minimum of 2.85 or $1.45 \times 10^{(0.028 \times (25 - T))}$

T= the temperature (ºC) of the receiving water$\times 10^{(0.028 \times (25 - T))}$

The 4-day criterion is equal to the 30-day criterion multiplied by 2.5. The 4-day criteria are used in a mass-balance equation with the 7-Q_{10} (4-Q3, if available) to derive weekly average limitations. And the 30-day criteria are used with the 30-Q_5 (estimated as 85% of the 7-Q_2 if the 30-Q_5 is not available) to derive monthly average limitations. The stream flow value is further adjusted to temperature; 100% of the flow is used if the Temperature ≥ 16 ºC, 25% of the flow is used if the Temperature < 11 ºC, and 50% of the flow is used if the Temperature ≥ 11 ºC but < 16 ºC.

The "default" basin assumed values are used for temperature and background ammonia concentrations, because minimum ambient data is available. The values for pH are based on data collected from the Kickapoo River. These values are shown in the table below, with the resulting criteria and effluent limitations.

Weekly and Monthly Ammonia Nitrogen Limits – Coldwater (Category 4)

		May-October	November-April
Effluent Flow	Qe (MGD)	0.100	0.100
Background Information	$7\text{-}Q_{10}$ (cfs)	63	63
	$7\text{-}Q_2$ (cfs)	77	77
	Ammonia (mg/L)	0.07	0.14
	Temperature (°C)	17.8	8.3
	pH (s.u.)	8.21	8.00
	% of Flow used	50	25
	Reference Weekly Flow (cfs)	32	16
	Reference Monthly Flow (cfs)	33	16
Criteria mg/L	4-day Chronic	3.58	6.11
	30-day Chronic	1.43	2.44
Effluent Limitations mg/L	Weekly Average	718	614
	Monthly Average	290	247

Effluent Data

The following table evaluates the statistics based upon ammonia data reported from September 2018 to August 2024, with those results being compared to the calculated limits to determine the need to include ammonia limits in the Viola Wastewater Treatment Facility permit for the respective month ranges.

Ammonia Nitrogen Effluent Data

Ammonia Nitrogen mg/L	May-October	November-April
1-day P_{99}	22.247	43.8
4-day P_{99}	12.231	26.95
30-day P_{99}	5.701	18.46
Mean	3.057	14.54
Std	4.877	8.38
Sample size	152	152
Range	0.034 - 24.5	0.15 - 28.8

Based on this comparison, daily limits are required year-round.

The permit currently has daily maximum, weekly average, and monthly average limits. 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.

Conclusions and Recommendations

In summary, after rounding to two significant figures, the following ammonia nitrogen limitations are recommended. No mass limitations are recommended in accordance with s. NR 106.32(5), Wis. Adm Code.

Final Ammonia Nitrogen Limits

	Daily Maximum mg/L	Weekly Average mg/L	Monthly Average mg/L
May-October	Variable	17	17
November-April	Variable	34	34

PART 4 – WATER QUALITY-BASED EFFLUENT LIMITATIONS FOR BACTERIA

Section NR 102.04(5), Wis. Adm. Code, states that all surface waters shall be suitable for supporting recreational use and shall meet *E. coli* criteria during the recreation season. Section NR 102.04(5)(b), Wis. Adm. Code, allows the Department to make exceptions when it determines, in accordance with s. NR 210.06(3), Wis. Adm. Code, that wastewater disinfection is not required to meet *E. coli* limits and protect the recreational use. Section NR 210.06(3), Wis. Adm. Code, tasks the Department with determining the need for disinfection using a site-specific analysis based on potential risk to human or animal health. It sets out the factors that must be considered in determining the necessity to disinfect municipal wastewater or to change the length of the disinfection season.

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. The Viola Wastewater Treatment Facility permit requires weekly 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 through September. No changes are recommended to the required disinfection season.

Effluent Data
The Viola Wastewater Treatment Facility has monitored effluent *E. coli* from May 2022 to September 2022 and a total of 21 results are available. A geometric mean of 126 counts/100 mL was exceeded in 3 out of 5 months, with a maximum monthly geometric mean of 276 counts/100 mL. Effluent data exceeded 410 counts/100 mL 4 times (which is 19% of the total sample results). The maximum reported value was 2098 counts/100 mL. Based on this effluent data it appears that the facility cannot meet new *E. coli* limits and a compliance schedule is needed in the reissued permit.

Interim Limit
The permit will include a compliance schedule to meet these limits. During the compliance schedule, an interim limit applies to prevent back-sliding from the current level of disinfection during the compliance schedule period. Therefore, the current **fecal coliform limit shall be included in the reissued permit as an interim limit of 400 counts/100 mL as a monthly geometric mean**. Any weekly geometric mean limit which was included in the current permit for expression of limits purposes does not need to be included in the permit as an interim limit.

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 the Viola Wastewater Treatment Facility currently has a limit of 1.0 mg/L, this limit should be included in the reissued permit. This limit remains applicable unless a more stringent WQBEL is given.

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(3)(a), Wis. Adm. Code, specifically names river segments for which a phosphorus criterion of 0.100 mg/L applies. For other stream segments that are not specified in s. NR 102.06(3)(a), Wis. Adm. Code, s. NR 102.06(3)(b), Wis. Adm. Code, specifies a phosphorus criterion of 0.075 mg/L. The phosphorus criterion of 0.100 mg/L applies for the Kickapoo River.

The conservation of mass equation is described in s. NR 217.13(2)(a), Wis. Adm. Code, for phosphorus WQBELs and includes variables of water quality criterion (WQC), receiving water flow rate (Qs), effluent flow rate (Qe), and upstream phosphorus concentrations (Cs) provided below.

$$\text{Limitation} = [(WQC)(Qs+(1-f)\ Qe) - (Qs-f\ Qe)\ (Cs)]/Qe$$

Where:

WQC = 0.100 mg/L for the Kickapoo River.
Qs = 100% of the 7-Q_2 of 77 cfs
Cs = background concentration of phosphorus in the receiving water pursuant to s. NR 217.13(2)(d), Wis. Adm. Code
Qe = effluent flow rate = 0.100 MGD = 0.155 cfs
f = the fraction of effluent withdrawn from the receiving water = 0

Section NR 217.13(2)(d), Wis. Adm. Code, specifies that the background phosphorus concentration used in the limit calculation formula shall be calculated using the procedures specified in s. NR 102.07(1)(b) to (c), Wis. Adm. Code. The median shall be calculated with at least one year of data using samples collected once per month during the period of May through October. All representative data from the most recent 5 years shall be used, but data from the most recent 10 years may be used if representative of current conditions.

The following data were considered in estimating the background phosphorus concentration:

SWIMS ID	533027
Station Name	Monitoring station at Kickapoo River - Banker Park In Viola
Waterbody	Kickapoo River
Sample Count	6
First Sample	10/29/2009
Last Sample	09/07/2010
Mean	0.215 mg/L
Median	0.186 mg/L

Substituting a background concentration above criteria into the limit calculation equation above would result in a calculated limit that is less than the applicable criterion of 0.100 mg/L. However, s. NR 217.13(7), Wis. Adm. Code, specifies that "if the water quality-based effluent limitation calculated pursuant to the procedures in this section is less than the phosphorus criterion specified in s. NR 102.06, Wis. Adm. Code, for the water body, the effluent limit shall be set equal to the criterion."

The impaired water listing of the Kickapoo River also points towards the notion that effluent phosphorus limits equal to the water quality criterion are needed to prevent the discharge from contributing to further impairment of the receiving water. The Guidance for Implementing Wisconsin's Phosphorus Water Quality Standards for Point Source Discharges (2020) suggests setting effluent limits equal to the criterion in the absence of an EPA approved total maximum daily load for discharges of phosphorus to phosphorus impaired waters.

Effluent Data

The following table summarizes effluent total phosphorus monitoring data from September 2018 to August 2024.

Phosphorus Effluent Data

	Phosphorus mg/L
1-day P_{99}	2.94
4-day P_{99}	1.79
30-day P_{99}	1.22
Mean	0.95
Std	0.56
Sample size	305
Range	0.049 - 5.35

Reasonable Potential Determination
Since the 30-day P_{99} of reported effluent total phosphorus data is greater than the calculated WQBEL, the discharge has reasonable potential to cause or contribute to an exceedance of the water quality criterion. Therefore, a WQBEL is required.

In accordance with s. NR 217.15(2), Wis. Adm. Code, there is reasonable potential for the discharge to cause or contribute to an exceedance of the water quality criteria. The data suggest that a compliance schedule will be necessary for the facility to meet the given phosphorus limits.

Limit Expression
According to s. NR 217.14 (2), Wis. Adm. Code, because the calculated WQBEL is less than or equal to 0.3 mg/L, the effluent limit of 0.100 mg/L may be expressed as a six-month average. If a concentration limitation expressed as a six-month average is included in the permit, a monthly average concentration limitation of 0.300 mg/L, equal to three times the WQBEL calculated under s. NR 217.13, Wis. Adm. Code shall also be included in the permit. The six-month average should be averaged during the months of May – October and November – April.

Mass Limits
Because the discharge is to a surface water that is to or upstream of a phosphorus impaired water, a mass limit is also required, pursuant to s. NR 217.14(1)(a), Wis. Adm. Code. **This final mass limit shall be 0.100 mg/L × 8.34 × 0.100 MGD = 0.083 lbs/day expressed as a six-month average.**

WQT Minimum Control Level (MCL)
A water quality trading plan has been submitted as an alternative compliance option to offset any Total Phosphorus discharged from Outfall 001 that exceeds the WQBELs. The phosphorus WQBELs may be expressed as computed compliance limits, but a Minimum Control Level (MCL) must be set as a limit not to be exceeded at the outfall location. **The current limit of 1.0 mg/L is recommended as the MCL.**

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.

Due to the amount of upstream flow available for dilution in the limit calculation (Qs:Qe >30:1), the lowest calculated limitation is 120° F (s. NR 106.55(6)(a), Wis. Adm. Code). For lagoon treatment systems of domestic waste, there is no reasonable potential for the discharge to exceed this limit. **Therefore, no temperature limits or monitoring are recommended.**

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 LC50 (Lethal Concentration to 50% of the test organisms) greater than 100% effluent, according to s. NR 106.09(2)(b), Wis. Adm Code.

- Chronic testing is usually not recommended where the ratio of the 7-Q_{10} to the effluent flow exceeds 100:1. For Viola, that ratio is approximately 407:1. With this amount of dilution, there is believed to be little potential for chronic toxicity effects in the Kickapoo River associated with the discharge from the Viola WWTF, so the need for chronic WET testing will not be considered further.

- According to the *State of Wisconsin Aquatic Life Toxicity Testing Methods Manual*, 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.

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**	Chronic WET not evaluated.
Historical Data	Data not available in past 5 years. **5 Points**	
Effluent Variability	BOD_5, Fecal Coliform, Ammonia Nitrogen, pH, Phosphorus, and TSS exceedances. NON sent in 2021. **5 Points**	
Receiving Water Classification	Cold Water (5 pts) **5 Points**	
Chemical-Specific Data	Reasonable potential for Ammonia and Chloride limits based on ATC; (6 pts) Arsenic, Copper, and Nickel detected. (3 pts) Additional Compounds of Concern: none **9 Points**	
Additives	No biocides and one water quality conditioner (1 pt) added. Permittee has proper P chemical SOPs in place. **1 Point**	
Discharge Category	No Industrial Contributors **0 Points**	
Wastewater Treatment	Secondary or Better **0 Points**	
Downstream Impacts	No impacts known. **0 Points**	
Total Checklist Points:	**20 Points**	
Recommended Monitoring Frequency (from Checklist):	2 tests during permit term	
Limit Required?	No	
TRE Recommended? (from Checklist)	No	

- After consideration of the guidance provided in the Department's WET Program Guidance Document (2022) and other information described above, **two acute WET tests are recommended in the reissued permit.** 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).

WISCONSIN DEPARTMENT OF NATURAL RESOURCES

Viola WWTF

Legend

Permits

Surface Water Outfalls

Basemaps

Hydro

24K Hydro (Cached) Inland

Water Resources

Rivers and Streams

Intermittent Streams

Open Water

Great Lakes

water

Imagery

Latest Leaf Off Imagery

Red: Band_1

Notes

1:4,886

0 400 800 ft

Service layer credits:
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