

CORRESPONDENCE/MEMORANDUM

DATE: February 5, 2019

FILE REF: 3200

TO: Sean Spencer – SCR/Fitchburg

FROM: Wade Strickland – WY/3 *Wade Strickland for WSL*

SUBJECT: Water Quality-Based Effluent Limitations for the Deerfield Wastewater Treatment Facility WPDES Permit No. WI-0023744-09-0

This is in response to your request for an evaluation of the need for water quality-based effluent limitations using Chapters NR 102, 104, 105, 106, 207, 210, 212, and 217 of the Wisconsin Administrative Code (where applicable), for the discharge from the Deerfield Wastewater Treatment Facility in Dane County. This municipal wastewater treatment facility (WWTF) discharges to a tributary of Mud Creek, located in the Upper Koshkonong Creek Watershed (LR12) in the Lower Rock River Basin. This discharge is included in the Rock River TMDL as approved by EPA. 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
BOD ₅			30 mg/L	20 mg/L		1
TSS			30 mg/L	20 mg/L		1,2
pH	9.0 s.u.	6.0 s.u.				1
Dissolved Oxygen		4.0 mg/L				1
Ammonia Nitrogen						
April – May	11 mg/L		14 mg/L	7.0 mg/L		3
June – September	11 mg/L		15 mg/L	9.5 mg/L		
October – March	11 mg/L		17 mg/L	9.0 mg/L		
Chloride						
Interim			460 mg/L			1,4,5
Final WQBEL			400 mg/L 1,320 lbs/day	400 mg/L		
Copper, Total Recoverable	47 µg/L 0.15 lbs/day		33 µg/L 0.11 lbs/day	33 µg/L		4
Phosphorus						
TBL				1.0 mg/L		2,6
AM Interim Limits				1.0 mg/L	0.6 mg/L	
Final				0.225 mg/L	0.075 mg/L	
Acute WET						7

Footnotes:

1. No changes from the current permit.
2. Additional phosphorus and TSS mass limitations are required in accordance with the waste load allocations specified in the Rock River TMDL:

Month	Total Suspended Solids Effluent Limitations		Monthly Ave Total P Effluent Limit (lbs/day)
	Monthly Ave TSS Effluent Limit (lbs/day)	Weekly Ave TSS Effluent Limit (lbs/day)	
Jan	64	90	2.72
Feb	71	100	3.46
March	64	90	2.95
April	67	94	2.66
May	64	90	2.36
June	67	94	2.10
July	58	82	1.64
Aug	49	69	1.50
Sept	49	68	1.76
Oct	64	90	1.86
Nov	67	94	2.22
Dec	64	90	2.33

3. The variable daily maximum table corresponding to various effluent pH values may be included in the permit in place of the single limit.

Effluent pH s.u.	NH ₃ -N Limit mg/L	Effluent pH s.u.	NH ₃ -N Limit mg/L	Effluent pH s.u.	NH ₃ -N Limit mg/L
6.0 < pH ≤ 6.1	83	7.0 < pH ≤ 7.1	51	8.0 < pH ≤ 8.1	11
6.1 < pH ≤ 6.2	82	7.1 < pH ≤ 7.2	46	8.1 < pH ≤ 8.2	8.8
6.2 < pH ≤ 6.3	80	7.2 < pH ≤ 7.3	40	8.2 < pH ≤ 8.3	7.3
6.3 < pH ≤ 6.4	78	7.3 < pH ≤ 7.4	35	8.3 < pH ≤ 8.4	6.0
6.4 < pH ≤ 6.5	75	7.4 < pH ≤ 7.5	31	8.4 < pH ≤ 8.5	4.9
6.5 < pH ≤ 6.6	72	7.5 < pH ≤ 7.6	26	8.5 < pH ≤ 8.6	4.1
6.6 < pH ≤ 6.7	69	7.6 < pH ≤ 7.7	22	8.6 < pH ≤ 8.7	3.4
6.7 < pH ≤ 6.8	65	7.7 < pH ≤ 7.8	19	8.7 < pH ≤ 8.8	2.8
6.8 < pH ≤ 6.9	60	7.8 < pH ≤ 7.9	16	8.8 < pH ≤ 8.9	2.4
6.9 < pH ≤ 7.0	56	7.9 < pH ≤ 8.0	13	8.9 < pH ≤ 9.0	2.0

4. Additional limits to comply with the expression of limits requirements in ss. NR 106.07 and 205.065(7) are included in bold.
5. An alternative effluent limitation of 460 mg/L, equal to the current variance limit, may be included in the permit in place of the final WQBEL if the chloride variance application that was submitted is approved by EPA.
6. Under the phosphorus Adaptive Management (AM) Plan, the interim limits (and technology-based limit (TBL)) of 1.0 mg/L, monthly average and 0.6 mg/L, six-month average should be effective upon permit reissuance. The final water quality based effluent limits are 0.225 mg/L as a monthly average, 0.075 mg/L as a six-month average, and the Rock River TMDL mass limits in the above table.
7. Along with the chemical-specific recommendations mentioned above, the need for acute and chronic whole effluent toxicity (WET) monitoring and limits has also been evaluated for the discharge from Deerfield. Following the guidance provided in the Department's November 1, 2016 *Whole Effluent Toxicity Program Guidance Document - Revision #11*, two (2) 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 shall 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 Sarah Luck at (608) 275-3230 or Sarah.Luck@wisconsin.gov or Diane Figiel at (608) 264-6274 or Diane.Figiel@wisconsin.gov.

Attachments (3) – Narrative, Site Map & Temperature Limit Calculations

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**Water Quality-Based Effluent Limitations for
Deerfield Wastewater Treatment Facility**

WPDES Permit No. WI-0023744

Prepared by: Sarah Luck

PART 1 – BACKGROUND INFORMATION

Facility Description: The Village of Deerfield serves a population of approximately 2,300 people with no significant industries or anticipated growth. The Village operates a wastewater treatment facility (WWTF) consisting of activated sludge and final clarification. The WWTF treats approximately 160,000 gpd with a design of 393,000 gpd. Treatment includes raw wastewater screening, biological phosphorus removal units, two aeration basins, activated sludge treatment, final clarifiers, and effluent post-aeration.

Disinfection of the effluent is not required based on the conditions of s. NR 210.06(3). It should be noted that the recreational use standards for the state may be revised in the future based on updated EPA requirements. This potential rule change could require disinfection of the effluent at that time.

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

Existing Permit Limitations: The current permit, which expired on September 30, 2018, includes the following effluent limitations.

Parameter	Daily Maximum	Daily Minimum	Weekly Average	Monthly Average	Footnotes
BOD ₅			30 mg/L	20 mg/L	1
TSS			30 mg/L	20 mg/L	1,2
pH	9.0 s.u.	6.0 s.u.			1
Dissolved Oxygen		4.0 mg/L			1
Ammonia Nitrogen May – September October – April	34 mg/L		15 mg/L	9.5 mg/L 23 mg/L	
Chloride			460 mg/L		
Phosphorus				1.5 mg/L	2
Temperature					3

Footnotes:

1. These limitations are not being evaluated as part of this review. Because the water quality criteria, 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. Additional phosphorus and TSS mass limitations are required in accordance with the wasteload allocations specified in the Rock River TMDL. The current permit includes a compliance schedule to meet the phosphorus mass limits, along with a six-month average limit of 0.075 mg/L and a monthly average limit of 0.225 mg/L, concluding on 10/01/2022.

Attachment #1

Month	Total Suspended Solids Effluent Limitations		Monthly Ave Total P Effluent Limit (lbs/day)
	Monthly Ave TSS Effluent Limit (lbs/day)	Weekly Ave TSS Effluent Limit (lbs/day)	
Jan	64	90	2.72
Feb	71	100	3.46
March	64	90	2.95
April	67	94	2.66
May	64	90	2.36
June	67	94	2.10
July	58	82	1.64
Aug	49	69	1.50
Sept	49	68	1.76
Oct	64	90	1.86
Nov	67	94	2.22
Dec	64	90	2.33

3. Monitoring only

Receiving Water Information:

- Name: Tributary to Mud Creek
- Classification:
 - Tributary to Mud Creek: Limited Aquatic Life, non-public water supply, listed in ch. NR 104
 - Mud Creek (~1.2 mi downstream): Limited Forage Fish, from upstream of the tributary to the confluence with Koshkonong Creek, listed in NR 104
 - Koshkonong Creek (~1.5 mi downstream of the outfall): Warmwater Sport Fish
- Low Flow:
 - At outfall (Mud Creek tributary): $7-Q_{10} = 0$ cfs (cubic feet per second)

Mud Creek is listed in ch. NR 104 as Limited Forage Fish and approximately 1.2 miles downstream of the outfall. The following $7-Q_2$ value is from a U.S. Geological Survey (USGS) estimate for Mud Creek at Deerfield. The $7-Q_{10}$ flow is estimated using a $7-Q_2:7-Q_{10}$ flow ratio of 1.9, calculated using flows from stations on Koshkonong Creek.

At confluence with Tributary: $7-Q_{10} = 1.0$ cfs
 $7-Q_2 = 1.9$ cfs

Koshkonong Creek is a Warm Water Sport Fish Community by default. Koshkonong Creek is located approximately 1.5 miles downstream of the outfall. The following $7-Q_2$ value is from a U.S. Geological Survey (USGS) estimate for Koshkonong Creek at Deerfield. The $7-Q_{10}$ flow is estimated using a $7-Q_2:7-Q_{10}$ flow ratio of 1.9 referenced above.

At confluence with Mud Creek: $7-Q_{10} = 3.4$ cfs
 $7-Q_2 = 6.5$ cfs

- Hardness = 388 mg/L as $CaCO_3$. This value represents the available data from WET testing, taken in 2017.

Attachment #1

- % of low flow used to calculate limits: No flow is available at the point of discharge. 100% mixing with downstream flow is assumed in calculating limits for downstream protection.
- Source of background concentration data: Background concentrations are not included since they don't impact the calculated WQBEL when the receiving water low flows are equal to zero. Background data for downstream ammonia limits where receiving water flows are greater than zero are described later.
- Multiple dischargers: None
- Impaired water status: Mud Creek and Koshkonong Creek, both located immediately downstream of the outfall, are listed as impaired for phosphorus.

Effluent Information:

- Design Flow Rate: Annual average = 0.393 MGD (Million Gallons per Day)
For reference, the actual average flow from January 2014 through March 2018 was 0.21 MGD.
- Hardness = 325 mg/L as CaCO₃. This value represents the geometric mean of data from 2018 from the permit application.
- Acute dilution factor used: Not applicable – this facility does not have an approved Zone of Initial Dilution (ZID).
- 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, primarily metal substances plus Ammonia, Chloride, Hardness and Phosphorus.

	Chloride mg/L	Copper µg/L
1-day P ₉₉	602	217
4-day P ₉₉	472	119
30-day P ₉₉	400	66.2
Mean	363	44.2
Std	84.0	44.2
Sample size	204	17
Range	160 - 580	12.6-150

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 January 2014 – March 2018 for all parameters with limits in the current permit:

	Average Measurement	Average Mass Discharged
BOD ₅	3.93 mg/L	
TSS	4.29 mg/L	8.08 lbs/day
pH field	7.44 s.u.	
Dissolved Oxygen	6.52 mg/L	
Phosphorus	0.32 mg/L	0.61 lbs/day
Ammonia Nitrogen	0.88 mg/L	
Chloride	363 mg/L	663 lbs/day

- Water Source: Village wells
- Additives: Ferric Chloride

**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 P₉₉) 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-Q₁₀

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. Adm. 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-Q₁₀ 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.

$$\text{Limitation} = \frac{(\text{WQC})(Q_s + (1-f)Q_e) - (Q_s - fQ_e)(C_s)}{Q_e}$$

Where:

WQC = Acute toxicity criterion or secondary acute value according to ch. NR 105

Q_s = average minimum 1-day flow which occurs once in 10 years (1-day Q₁₀)

if the 1-day Q₁₀ flow data is not available = 80% of the average minimum 7-day flow which occurs once in 10 years (7-day Q₁₀).

Q_e = Effluent flow (in units of volume per unit time) as specified in s. NR 106.06(4)(d)

f = Fraction of the effluent flow that is withdrawn from the receiving water, and

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

As a rule of thumb, if the receiving water is effluent dominated under low stream flow conditions, the 1-Q₁₀ method of limit calculation probably produces the most stringent daily maximum limitations and should be used while making reasonable potential determinations.

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 = 0 cfs, (1-Q₁₀ (estimated as 80% of 7-Q₁₀)).

SUBSTANCE	REF. HARD.* mg/L	ATC	MAX. EFFL. LIMIT**	1/5 OF EFFL. LIMIT	MEAN EFFL. CONC.	1-day P ₉₉	1-day MAX. CONC.
Arsenic		340	340	68.0	<3.0		
Cadmium	325	112	112	22.3	<0.3		
Chromium	301	4450	4450	889	<5.0		
Copper	325	47.2	47.2			217	150
Lead	325	334	334	66.8	<1.4		
Nickel	268	1080	1080	216	2.1		
Zinc	325	337	337	67.5	28.1		
Chloride - mg/L		757	757			602	580

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

** Per the changes to s. NR 106.07(3), Wis. Adm. Code, effective 09/01/2016 consideration of ambient concentrations and 1-Q₁₀ flow rates yields a more restrictive limit than the 2 x ATC method of limit calculation.

Weekly Average Limits based on Chronic Toxicity Criteria (CTC)RECEIVING WATER FLOW = 0 cfs (¼ of the 7-Q₁₀)

SUBSTANCE	REF. HARD.* mg/L	CTC	MEAN BACK-GRD.	WEEKLY AVE. LIMIT	1/5 OF EFFL. LIMIT	MEAN EFFL. CONC.	4-day P ₉₉
Arsenic		152		152	30.4	<3.0	
Cadmium	175	3.82		3.82	0.764	<0.3	
Chromium	301	326		326	65.2	<5.0	
Copper	388	33.0		33.0			119
Lead	356	95.5		95.5	19.1	<1.4	
Nickel	268	169		169	33.8	2.1	
Zinc	333	345		345	68.9	28.1	
Chloride - mg/L		395		395			472

* 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 = 0 cfs (¼ of the Harmonic Mean)

SUBSTANCE	HTC	MEAN BACK- GRD.	MO'LY AVE. LIMIT	1/5 OF EFFL. LIMIT	MEAN EFFL. CONC.
Cadmium	880		880	176	<0.3
Chromium (+3)	8400000		8400000	1680000	<5.0
Lead	2240		2240	448	<1.4
Nickel	110000		110000	22000	2.1

Monthly Average Limits based on Human Cancer Criteria (HCC)

RECEIVING WATER FLOW = 0 cfs (¼ of the Harmonic Mean)

SUBSTANCE	HCC	MEAN BACK- GRD.	MO'LY AVE. LIMIT	1/5 OF EFFL. LIMIT	MEAN EFFL. CONC.
Arsenic	40		40	8.0	<3.0

Because effluent data is available for only one substance for which Human Cancer Criteria exists, and it was not detected in the effluent, 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, effluent limitations are apparently needed for Copper and Chloride.

Copper – Considering available effluent data from January 2018 through June 2018, the 1-day P₉₉ copper concentration is 217 µg/L, and the 4-day P₉₉ of effluent data is 119 µg/L.

Because both the 1-day P₉₉ and 4-day P₉₉ exceed the calculated daily and weekly average WQBELs, respectively, effluent limits are needed in accordance with s. NR 106.05(4)(b) Wis. Adm. Code. After rounding to two significant digits, **a daily maximum of 47 µg/L and 0.15 lbs/day and a weekly average of 33 µg/L and 0.11 lbs/day limitations are recommended.** The mass limitations are based on the concentration limit and the design flow rate of 0.393 MGD and are in accordance with s. NR 106.07(2) Wis. Adm. Code. (0.047 mg/L × 0.393 MGD × 8.34 and 0.033 mg/L × 0.393 MGD × 8.34)

Chloride – Considering available effluent data from the current permit term January 2014 through March 2018, the 1-day P₉₉ chloride concentration is 602 mg/L, and the 4-day P₉₉ of effluent data is 472 mg/L.

Because the 4-day P₉₉ exceeds the calculated weekly average WQBEL, an effluent limit is needed in accordance with s. NR 106.05(4)(b) Wis. Adm. Code.

However, Subchapter VII of ch. NR 106 provides for a variance from water quality standards for this substance, and Deerfield has requested such a variance. That variance may be granted subject to the following conditions:

- 1) The permit shall include an “Interim” limitation intended to prevent an increase in the discharge of Chloride;
- 2) The permit shall specify “Source Reduction Measures” to be implemented during the course of the permit term, with periodic progress reports; and,

- 3) The permit shall include a “Target Limit” or “Target Value” to gauge the effectiveness of the Source Reduction Measures, and progress toward the water quality-based effluent limitations.

Interim Limit for Chloride: Section NR 106.82(9) defines a “Weekly average interim limitation” as either the 4-day P₉₉ concentration or 105% of the highest weekly average concentration of the representative data. The previous permit term included an interim chloride limit of 460 mg/L which was based off the 4-day P₉₉ from 2008 through 2010.

Ideally, the effluent chloride concentration at facilities with variances will trend downward as time goes on as a result of source reduction measures, and the recalculated interim limit will decline until the plant can meet the WQBEL. Unfortunately, effluent concentrations at Deerfield are highly variable and show no significant decrease in the past few years (the 4-day P₉₉ from January 2014 through March 2018 is higher than the 2013 interim limit).

Although the 4-day P₉₉ effluent chloride concentrations at Deerfield are higher than the current interim limit of 460 mg/L, the Department does not find it appropriate to increase the interim concentration limit in the reissued permit, since it would be counterproductive to meeting the final WQBEL. **Therefore, the current weekly average interim chloride limit is recommended for permit reissuance.**

A target limit and permit language for Source Reduction Measures are not recommended as part of this evaluation. These should follow contact with Deerfield. Though if the Department and Deerfield are unable to reach agreement on all the terms of a Chloride Variance, the calculated limits described earlier should be included in the permit, in accordance with s. NR 106.83(3).

Chloride monitoring recommendations: Four samples per month (on consecutive days) are recommended. This allows for averaging of the results to compare with the interim limit, and also allows the use of the average in determining future interim limits, and degree of success with chloride reduction measures.

In the absence of a variance, Deerfield would be subject to the water quality-based effluent limit of 400 mg/L (395 rounded to two significant digits) as a weekly average; the weekly average mass limit of 1,300 lbs/day (395 mg/L x 0.393 MGD x 8.34).

Mercury – The permit application did not require monitoring for mercury because Deerfield 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., 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).” A review of the past four years of sludge characteristics data reveals that all the sample results are within expected analytical ranges and well below the 17 mg/kg level. The average concentration in the sludge from January 2014 through March 2018 was 0.18 mg/kg, with a maximum reported concentration of 0.44 mg/kg. Therefore, no Mercury monitoring is recommended at Outfall 001.

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

The State of Wisconsin promulgated revised water quality standards for Ammonia Nitrogen 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 for Outfall 001 (calculated in 2010). These limits are re-evaluated at this time due to the following changes:

- Updates to subchapter IV of ch. NR 106, Wis. Adm. Code allow limits based on available dilution instead of limits set to twice the acute criteria.
- Seasonal 20 and 40 mg/L thresholds for ammonia limits are no longer applicable under current rules.
- Updates to s. NR 106.07(3), Wis. Adm. Code require 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, 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.

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

Where:

A = 0.633 and B = 90.0 for Limited Aquatic Life,
A = 0.411 and B = 58.4 for a Limited Forage Fishery,
A = 0.411 and B = 58.4 for a Warm Water Sport fishery, and
pH (s.u.) = that characteristic of the effluent.

The effluent pH data for the past four years was examined as part of this evaluation. A total of 612 sample results were reported from January 2014 through March 2018. The maximum reported value was 8.37 s.u. (Standard pH Units), and a pH of greater than 8.0 s.u. was reported eleven times. More than 99% of the time the pH was 8.04 s.u. or less. The 1-day P₉₉, calculated in accordance with s. NR 106.05(5), is 8.17 s.u. And 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 8.14 s.u. A value of 8.1 s.u. is believed to represent the maximum reasonably expected pH, and therefore most appropriate for determining daily maximum limitations for ammonia nitrogen.

Potential changes to daily maximum Ammonia Nitrogen effluent limitations:

Updates to subchapter IV of ch. NR 106, Wis. Adm. Code (effective September 1, 2016) outline the option for the Department to implement use of the 1-Q₁₀ receiving water low flow to calculate daily maximum ammonia nitrogen limits 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. If such a determination can be made, the outcome of these changes could range from limits being reduced by 50% from the previous method of calculation (assuming maximum effluent pH has not changed) if the 1-Q₁₀ receiving water low flow is 0 cfs, to no change from the 2004 method of calculation if sufficient dilution is available - because the calculated limits using the 1-Q₁₀'s may exceed the limits calculated using the original 2× acute toxicity criterion (ATC) approach. The more restrictive of the 2×ATC approach or the 1-Q₁₀ limits should be included in the permit in accordance with s. NR 106.06(3)(b)3.

Attachment #1

The calculated daily maximum ammonia nitrogen effluent limits using the mass balance approach with the 1-Q₁₀ (estimated as 80 % of 7-Q₁₀) and the 2×ATC approach are shown below.

Summary of Calculated Daily Maximum Ammonia Nitrogen Effluent Limitations, in mg/L

	Month	April – May	June – September	October – March
LAL (tributary to Mud Creek)	2×ATC	21.42	21.42	21.42
	1-Q ₁₀	10.71	10.71	10.71
LFF (Mud Creek)	2×ATC	13.9	13.9	13.9
	1-Q ₁₀	16.0	16.0	15.9
WWSF (Koshkonong Creek)	2×ATC	13.9	13.9	13.9
	1-Q ₁₀	37.6	37.7	37.4

As shown in the table, the daily maximum ammonia nitrogen limits calculated using the 1-Q₁₀ are more restrictive than the limits calculated using the 2 × ATC approach.

Section NR 106.33(2) was also updated effective September 1, 2016. As a result, seasonal 20 and 40 mg/L thresholds for including ammonia limits in municipal discharge permits are no longer applicable under current rules. As such, s. NR 106.33(1) enables the Department to determine the need to include ammonia limits in municipal discharge permits based on the statistical comparisons in s. NR 106.05.

Presented below is a table of daily maximum limitations corresponding to various effluent pH values. Use of this table is not necessarily recommended in the permit, but it is presented herein for informational purposes.

Daily Maximum Limits – Limited Aquatic Life

Effluent pH s.u.	NH ₃ -N Limit mg/L	Effluent pH s.u.	NH ₃ -N Limit mg/L	Effluent pH s.u.	NH ₃ -N Limit mg/L
6.0 < pH ≤ 6.1	83	7.0 < pH ≤ 7.1	51	8.0 < pH ≤ 8.1	11
6.1 < pH ≤ 6.2	82	7.1 < pH ≤ 7.2	46	8.1 < pH ≤ 8.2	8.8
6.2 < pH ≤ 6.3	80	7.2 < pH ≤ 7.3	40	8.2 < pH ≤ 8.3	7.3
6.3 < pH ≤ 6.4	78	7.3 < pH ≤ 7.4	35	8.3 < pH ≤ 8.4	6.0
6.4 < pH ≤ 6.5	75	7.4 < pH ≤ 7.5	31	8.4 < pH ≤ 8.5	4.9
6.5 < pH ≤ 6.6	72	7.5 < pH ≤ 7.6	26	8.5 < pH ≤ 8.6	4.1
6.6 < pH ≤ 6.7	69	7.6 < pH ≤ 7.7	22	8.6 < pH ≤ 8.7	3.4
6.7 < pH ≤ 6.8	65	7.7 < pH ≤ 7.8	19	8.7 < pH ≤ 8.8	2.8
6.8 < pH ≤ 6.9	60	7.8 < pH ≤ 7.9	16	8.8 < pH ≤ 8.9	2.4
6.9 < pH ≤ 7.0	56	7.9 < pH ≤ 8.0	13	8.9 < pH ≤ 9.0	2.0

Weekly Average & 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. The 30-day chronic toxicity criterion (CTC) for ammonia in waters classified for Limited Aquatic Life (LAL) is calculated by the following equation.

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

Where:

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

E = 1.0,

C = $8.09 \times 10^{(0.028 \times (25 - T))}$

T = the temperature of the receiving (°C)

The 30-day chronic toxicity criterion (CTC) for ammonia in waters classified as a Limited Forage Fish Community is calculated by the following equation.

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

Where:

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

E = 1.0,

C = the minimum of 3.09 or $3.73 \times 10^{(0.028 \times (25 - T))}$ – (Early Life Stages Present), or

C = $3.73 \times 10^{(0.028 \times (25 - T))}$ – (Early Life Stages Absent), and

T = the temperature (°C) of the receiving water – (Early Life Stages Present), or

T = the maximum of the actual temperature (°C) and 7 - (Early Life Stages Absent)

The 30-day chronic toxicity criterion (CTC) for ammonia in waters classified as a Warm Water Sport Fish Community is calculated by the following equation.

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

Where:

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

E = 0.854,

C = the minimum of 2.85 or $1.45 \times 10^{(0.028 \times (25 - T))}$ – (Early Life Stages Present), or

C = $1.45 \times 10^{(0.028 \times (25 - T))}$ – (Early Life Stages Absent), and

T = the temperature (°C) of the receiving water – (Early Life Stages Present), or

T = the maximum of the actual temperature (°C) and 7 - (Early Life Stages Absent)

The 4-day criterion is simply equal to the 30-day criterion multiplied by 2.5. The 4-day criteria are used in a mass-balance equation with the 7-Q₁₀ (4-Q₃, if available) to derive weekly average limitations. And the 30-day criteria are used with the 30-Q₅ (estimated as 85% of the 7-Q₂ if the 30-Q₅ 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 °C, 25% of the flow is used if the Temperature < 11 °C, and 50% of the flow is used if the Temperature ≥ 11 °C but < 16 °C.

The rules provide a mechanism for less stringent weekly average and monthly average effluent limitations

Attachment #1

when early life stages of critical organisms are absent from the receiving water. This applies only when the water temperature is less than 14.5°C, during the winter and spring months. Burbot, an early spawning species, are not believed to be present in the Tributary to Mud Creek, Mud Creek, or in Koshkonong Creek. So “Early Life Stages Absent” criteria apply from October through March, and “Early Life Stages Present” criteria will apply from April through September for a limited forage fish waterbody.

Since minimal ambient data is available, the “default” basin assumed values are used for Temperature, pH and background ammonia concentrations, shown in the table below, with the resulting criteria and effluent limitations.

Limited Aquatic Life (LAL)

		Spring	Summer	Winter
		April & May	June – Sept.	Oct. - March
Effluent Flow	Qe (MGD)	0.393	0.393	0.393
Background Information	7-Q ₁₀ (cfs)	0	0	0
	7-Q ₂ (cfs)	0	0	0
	Ammonia (mg/L)	0.09	0.07	0.135
	Temperature (°C)	15	19	7
	pH (s.u.)	8.04	8.08	7.99
	% of Flow used	50	100	25
	Reference Weekly Flow (cfs)	0	0	0
	Reference Monthly Flow (cfs)	0	0	0
Criteria mg/L	4-day Chronic	36.3	26.6	65.5
	30-day Chronic	14.5	10.6	26.2
Effluent Limits mg/L	Weekly Average	36.3	26.6	65.5
	Monthly Average	14.5	10.7	26.2

Limited Forage Fish (LFF)

		Spring	Summer	Winter
		April & May	June – Sept.	Oct. - March
Effluent Flow	Qe (MGD)	0.393	0.393	0.393
Background Information	7-Q ₁₀ (cfs)	1.0	1.0	1.0
	7-Q ₂ (cfs)	1.9	1.9	1.9
	Ammonia (mg/L)	0.09	0.07	0.135
	Temperature (°C)	15	19	7
	pH (s.u.)	8.04	8.08	7.99
	% of Flow used	50	100	25
	Reference Weekly Flow (cfs)	0.5	1	0.25
	Reference Monthly Flow (cfs)	0.8075	1.615	0.40375
Criteria mg/L	4-day Chronic			
	Early Life Stages Present	7.3	6.9	7.8
	Early Life Stages Absent	16.8	11.0	20.8
	30-day Chronic			
	Early Life Stages Present	2.9	2.7	3.1
Early Life Stages Absent	6.7	4.4	8.3	
Effluent Limitations	Weekly Average			
	Early Life Stages Present	13.2	18.0	
	Early Life Stages Absent			29.3

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mg/L	Monthly Average			
	Early Life Stages Present	6.7	9.9	
	Early Life Stages Absent			13.8
Effluent Limitations mg/L (adjusted for decay)	Weekly Average			
	Early Life Stages Present	13.8	19.1	
	Early Life Stages Absent			30.0
	Monthly Average			
	Early Life Stages Present	7.0	10.4	
	Early Life Stages Absent			14.1

Warm Water Sport Fish (WWSF)

		Spring	Summer	Winter
		April & May	June – Sept.	Oct. - March
Effluent Flow	Qe (MGD)	0.393	0.393	0.393
Background Information	7-Q ₁₀ (cfs)	3.4	3.4	3.4
	7-Q ₂ (cfs)	6.5	6.5	6.5
	Ammonia (mg/L)	0.09	0.07	0.17
	Temperature (°C)	9	23	3
	pH (s.u.)	7.97	8.21	7.97
	% of Flow used	50	100	25
	Reference Weekly Flow (cfs)	1.7	3.4	0.85
	Reference Monthly Flow (cfs)	2.7625	5.525	1.38125
Criteria mg/L	4-day Chronic			
	Early Life Stages Present	5.6	4.1	6.2
	Early Life Stages Absent	5.6	3.7	6.9
	30-day Chronic			
	Early Life Stages Present	2.2	1.6	2.5
	Early Life Stages Absent	2.2	1.5	2.8
Effluent Limitations mg/L	Weekly Average			
	Early Life Stages Present	20.9	26.4	
	Early Life Stages Absent			16.3
	Monthly Average			
	Early Life Stages Present	11.9	15.8	
	Early Life Stages Absent			8.7
Effluent Limitations mg/L (adjusted for decay)	Weekly Average			
	Early Life Stages Present	22.0	28.4	
	Early Life Stages Absent			16.8
	Monthly Average			
	Early Life Stages Present	12.6	16.9	
	Early Life Stages Absent			8.9

Ammonia Decay: Because the calculated limits are more restrictive than the current limits, ammonia decay is considered to determine limits at the outfall to protect the downstream classification. The more restrictive calculated limits should be used to protect at the point of discharge and downstream uses. Where the calculated limits are more restrictive based on downstream uses, ammonia decay can be considered to determine if these more restrictive limits are needed or if the ammonia will decay before it reaches the point of the classification change.

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Ammonia decay rates are dependent on temperature with in-stream nitrification essentially non-existent in the winter. In-stream decay is expected so a first order decay model will be used. Based on the available literature, a decay rate of 0.25 day⁻¹ at 20°C has been suggested as a default rate. A temperature correction factor of $\theta = 1.08$ is ($k_t = k_{20} \theta^{(T-20)}$).

$$N_{Limit} = \left(\frac{N_{down}}{\text{EXP}(-k_t T)} \right)$$

- Where: N_{Limit} = Ammonia limit needed to protect downstream use (mg/L)
 N_{down} = Ammonia limit calculated based on downstream classification and flow (mg/L)
 $-k_t$ = Ammonia decay rate at background stream temperature (day⁻¹)
 T = Travel time from outfall to downstream use (day)

The velocity of the receiving water is assumed to be 5 miles per day and the distance from the point of discharge to the classification change is approximately 2.5 miles for a travel time of 0.6 days. This equation shows that at the location where the classification change, 87% – 95% of the ammonia is remaining throughout the year. After decay, the limits are increased as shown in the following table.

Ammonia Limits mg/L	At Outfall (no decay required) LAL	At Mud Creek (at LFF)	LFF (adjusted for decay – 1.2 miles downstream)	At Koshkonong Creek (at WWSF)	WWSF (adjusted for decay – 1.5 miles downstream)	Current Permit Limits
April - May						
Daily max.	11	14	15	14	15	34 April None May
Weekly average	36	13	14	21	22	None April 15 May
Monthly average	15	6.7	7.0	12	13	23 April 9.5 May
June – Sept.						
Daily max.	11	14	15	14	15	none
Weekly average	27	18	19	26	28	15
Monthly average	11	9.9	10	16	17	9.5
Oct - March						
Daily max.	11	14	14	14	14	34
Weekly average	66	29	30	16	17	none
Monthly average	26	14	14	8.7	9.0	23

Bold values indicate the most restrictive value.

Effluent Data

The following table evaluates the statistics based on ammonia data reported from January 2014 through March 2018.

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	Ammonia mg/L April - May	Ammonia mg/L June - September	Ammonia mg/L October - March
1-day P ₉₉	5.7	2.1	14
4-day P ₉₉	3.3	1.3	8.9
30-day P ₉₉	1.4	0.55	3.7
Mean*	0.68	0.21	1.3
Std	1.3	0.55	3.8
Sample size	64	126	213
Range	<0.09 – 6.9	<0.04 – 4.6	<0.06 - 32

Where there are existing ammonia nitrogen limits in the permit, the limits are recommended to be retained regardless of reasonable potential, consistent with s. NR 106.33(1), 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.

Antidegradation:

The calculated weekly average limit of 17 mg/L for April-May and the weekly and monthly average limits of 26 mg/L and 11 mg/L for June-September are less restrictive than the limits of 15 mg/L and 9.5 mg/L in the current permit. Without a demonstration of need for a higher limit in accordance with s. NR 207.04 Wis. Adm. Code, the current limits of 15 mg/L and 9.5 mg/L should be continued in the reissued permit.

Conclusions and Recommendations:

In summary, after rounding to two significant figures, the following effluent limitations for Ammonia Nitrogen are recommended for Deerfield. No mass limitations are recommended in accordance with s. NR 106.32(5).

Months Applicable	Daily Maximum mg/L	Weekly Average mg/L	Monthly Average mg/L
April & May	11	14	7.0
June – September	11	15	9.5
October – March	11	17	9.0

PART 4 –PHOSPHORUS

Technology Based Effluent Limit (TBL)

Wisconsin Administrative Code, ch. NR 217, 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 (ACL). Deerfield exceeded the 150 lbs. per month threshold and has an alternative concentration limit of 1.4 mg/L in the current permit based on biological phosphorus removal in s. NR 217.04(2)(a)2, Wis. Adm. Code. However, an ACL was not

requested again, and the average phosphorus concentration from January 2014 – March 2018 is 0.32 mg/L and the 30-day P₉₉ is 0.48 mg/L. **Therefore, the TBL of 1.0 mg/L is effective upon reissuance.**

Water Quality-Based Effluent Limits (WQBEL)

Revisions to the administrative rules for phosphorus discharges took effect on December 1, 2010. These rule revisions include additions to ch. NR 102 (s. NR 102.05), which establish phosphorus standards for surface waters. Revisions to ch. NR 217 (s. NR 217, Subchapter III) establish procedures for determining water quality based effluent limits for phosphorus, based on the applicable standards in ch. NR 102.

The Department has developed a TMDL for the Upper and Lower Rock River Basins. The US EPA approved the Rock River TMDL on September 28, 2011. The document, along with the referenced appendices can be found at:

http://dnr.wi.gov/topic/TMDLs/RockRiver/Final_Rock_River_TMDL_Report_with_Tables.pdf

Section NR 217.16, Wis. Adm. Code, states that the Department may include a TMDL-derived water quality based effluent limit (WQBEL) for phosphorus in addition to, or in lieu of, a s. NR 217.13 WQBEL in a WPDES permit. The monthly WLAs of phosphorus for the Village of Deerfield are intended to represent a portion of the needed reductions to Lake Koshkonong and do not address protection for the tributary of Mud Creek or other waterways downstream of the discharge. To protect the immediate receiving water, an evaluation of phosphorus limits at the point of discharge is necessary along with the TMDL evaluation.

TMDL Phosphorus Limits

For the Rock River Basin TMDL, the monthly average total phosphorus (Total P) effluent limits in lbs/day are calculated based on the monthly phosphorus wasteload allocation (WLA) given in pounds per month as suggested in the Guidance for Implementing TMDLs in Wisconsin dated September 13, 2012. These limits are equivalent to concentrations ranging from 0.46 to 1.06 mg/L at the facility design flow of 0.393 MGD.

Total Phosphorus Effluent Limitations

Month	Monthly Total P WLA¹ (lbs/month)	Days Per Month	Monthly Ave Total P Effluent Limit² (lbs/day)
Jan	84.29	31	2.72
Feb	96.98	28	3.46
March	91.47	31	2.95
April	79.84	30	2.66
May	73.21	31	2.36
June	63.08	30	2.10
July	50.78	31	1.64
Aug	46.58	31	1.50
Sept	52.7	30	1.76
Oct	57.6	31	1.86
Nov	66.61	30	2.22
Dec	72.17	31	2.33

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Footnotes:

- 1- Appendix P. Monthly Total Phosphorus Allocations by Wastewater Treatment Facility (p. 147)
- 2- monthly average Total P effluent limit (lbs/day) = monthly Total P WLA (lbs/month) ÷ days per month

Point of Discharge Phosphorus Limits

Phosphorus criteria in s. NR 102.06 do not apply to limited aquatic life waters [s. NR 102.06 (6) (d)]. These waters were not included in the USGS/WDNR stream and river studies and, therefore, the Department lacked the technical basis to determine and propose applicable criteria. At some time in the future, the Department may adopt phosphorus criteria based on new studies focusing on limited aquatic life waters. The guidance suggests that during the interim, water quality based effluent limitations should be based on the criteria and flow conditions for the next stream segment downstream (or downstream lake or reservoir, if appropriate). The discharge location of the wastewater from Deerfield is classified as limited aquatic life downstream from the point of discharge downstream to the confluence with Mud Creek. Mud Creek is classified as a limited forage fishery.

Section NR 102.06(3)(a) specifically names reaches of rivers for which a phosphorus criterion of 0.1 mg/l applies. For other stream segments that are not specified in s. NR 102.06(3)(a), s. NR 102.06(3)(b), Wis. Adm. Code, specifies a phosphorus criterion of 0.075 mg/L. The phosphorus criterion of 0.075 mg/L applies for Mud Creek.

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):

$$\text{Limitation} = [(WQC)(Q_s + (1-f) Q_e) - (Q_s - f Q_e) (C_s)] / Q_e$$

Where: WQC = 0.075 mg/L for Mud Creek.

Qs = 100% of the 7-Q₂ of 2.4 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 = 0.393 MGD = 0.608 cfs

f = the fraction of effluent withdrawn from the receiving water (f = 0)

Although no phosphorus data exists for Mud Creek, the Upper Koshkonong Creek Watershed generally has streams which are above criteria (such as Koshkonong Creek and Inlet of Lake Ripley). Furthermore, downstream waters (Koshkonong Creek and Lake Koshkonong) are phosphorus impaired. Therefore, an effluent phosphorus limit is set at the criteria. A limit of **0.075 mg/L as a six-month average** is recommended along with a **monthly average limit of 0.225 mg/L**, based on s. NR 217.14(2). A six-month average limit should be averaged during the months of May – October and November – April.

The facility may opt to sample Mud Creek upstream of the confluence with the discharge's tributary for total phosphorus. The water quality-based limit may be amended if background phosphorus stream data, collected during the period of May – October and with regards to other stipulations laid out in s. NR 217.13(2)(d), is submitted to the Department. For informational purposes only, the following table shows a range of limits based on various possible background concentrations using the equation above, data for Mud Creek (WQC=0.075 mg/L and Qs=2.4 cfs), and the effluent flow rate from Deerfield (Qe=0.393 MGD = 0.608 cfs).

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River Background Total Phosphorus (mg/L)	Corresponding Six Month Average Limit (mg/L)
0.04	0.213
0.05	0.174
0.06	0.134
0.07	0.095
≥ 0.075	0.075

Effluent Data

The following table summarizes effluent total phosphorus monitoring data from January 2014 through March 2018. The data suggest that a compliance schedule will be necessary in order for the facility to meet the given phosphorus limits.

	Phosphorus mg/L
1-day P ₉₉	1.6
4-day P ₉₉	0.85
30-day P ₉₉	0.48
Mean	0.32
Std	0.32
Sample size	612
Range	0.02-2.3

Adaptive Management Interim Limit

Deerfield intends to pursue adaptive management (AM) to comply with the phosphorus water quality based effluent limits. Since this is the first permit term which AM is being pursued, the interim limit is 0.6 mg/L, expressed as a 6-month average per s. NR 217. 18(3)(e)1, Wis. Adm. Code. The permittee may be allowed up to five years to meet this interim limit.

Deerfield has shown the ability to meet the required interim limit, starting in May 2016. However, since there is less than one year of data demonstrating compliance with this limit, a short term compliance schedule is recommended to allow for optimization over the course of one full year. Until the 0.6 mg/L limit becomes effective, a 1.0 mg/L interim limit, expressed as a monthly average shall be included in the permit.

PART 5 –THERMAL

New surface water quality standards for temperature took effect on October 1, 2010. These new regulations are detailed in Chapters NR 102 (Subchapter II – Water Quality Standards for Temperature) and NR 106 (Subchapter V – Effluent Limitations for Temperature) of the Wisconsin Administrative Code. The daily maximum effluent temperature limitation shall be 86 °F for discharges to surface waters classified as Limited Aquatic Life (LAL) according to s. NR 104.02(3)(b)1, except for those classified as wastewater effluent channels and wetlands regulated under ch. NR 103 [s. NR 106.55(2), Wis. Adm. Code] which have a daily maximum effluent temperature limitation of 120°F.

Downstream Impacts

Daily maximum and weekly average temperature criteria are available for the 12 different months of the year depending on the receiving water classification.

In accordance with s. NR 106.53(2)(b), the highest daily maximum flow rate for a calendar month is used to determine the acute (daily maximum) effluent limitation. In accordance with s. NR 106.53(2)(c), the highest 7-day rolling average flow rate for a calendar month is used to determine the sub-lethal (weekly average) effluent limitation. These values were based off actual flow reported from January 1, 2014 – March 31, 2018.

To consider downstream impacts, a heat loss equation is used to adjust the calculated limit based upon the length of the LAL segment. The discharge from Outfall 001 travels 1.2 miles (6336 feet) before reaching the Limited Forage Fish (LFF) segment. Under s. NR 106.55(5), Wis. Adm. Code, the default cooling rate is estimated as 1° F for every 400 feet of storm sewer/storm water conveyance channel. This is used as an estimate of heat loss in the LAL segment. The adjusted limits are shown in the table below and in the attachment.

Reasonable Potential

Based on the available discharge temperature data from April 4, 2017 to December 29, 2017, summarized in the table below, the maximum daily effluent temperature reported was 73°F; therefore, no reasonable potential for exceeding the daily maximum limit exists, and **no limits or monitoring are recommended**. Although effluent data is not available from January through March, based on data from the other months there is no reasonable potential for these months. Downstream impacts were considered, but the calculated limits are less restrictive.

Month	Representative Highest Monthly Effluent Temperature		Calculated Effluent Limit LAL	Calculated Effluent Limit LFF	
	Weekly Maximum	Daily Maximum	Daily Maximum Effluent Limitation	Weekly Average Effluent Limitation	Daily Maximum Effluent Limitation
	(°F)	(°F)	(°F)	(°F)	(°F)
JAN			86	112	120
FEB			86	105	120
MAR			86	111	120
APR	56	56	86	113	120
MAY	57	57	86	106	120
JUN	68	68	86	115	120
JUL	71	72	86	118	120
AUG	72	72	86	116	120
SEP	72	73	86	113	120
OCT	72	72	86	100	120
NOV	50	50	86	90	120
DEC	56	57	86	106	120

PART 6 – 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. The following evaluation is based on procedures in the Department's WET Program Guidance Document (revision #11, dated November 1, 2016).

- 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.
- Chronic tests predict the concentration that interferes with the growth or reproduction of test organisms during a seven-day exposure. In order to assure that a discharge is not chronically toxic to organisms in the receiving water, WET tests must produce a statistically valid IC₂₅ (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 15% shown in the WET Checklist summary below was calculated according to the following equation, as specified in s. NR 106.03(6):

$$\text{IWC (as \%)} = Q_e \div \{(1 - f) Q_e + Q_s\} \times 100$$

Where:

Q_e = annual average design flow = 0.393 MGD = 0.608 cfs

f = fraction of the Q_e withdrawn from the receiving water = 0

Q_s = 100% of the 7-Q₁₀ = 3.4 cfs in Koshkonong Creek

The IWC is calculated for protection of the first downstream full fish and aquatic life water, using 100% mixing because this point is 1.5 mi downstream from the outfall.

- According to the *State of Wisconsin Aquatic Life Toxicity Testing Methods Manual* (s. NR 219.04, Table A, Wis. Adm. Code), a synthetic (standard) laboratory water may be used as the dilution water and primary control in acute WET tests, unless the use of different dilution water is approved by the Department prior to use. The primary control water must be specified in the WPDES permit.
- According to the *State of Wisconsin Aquatic Life Toxicity Testing Methods Manual* (s. NR 219.04, Table A, Wis. Adm. Code), receiving water must be used as the dilution water and primary control in chronic WET tests, unless the use of different dilution water is approved by the Department prior to use. The dilution water used in WET tests conducted on Outfall 001 shall be a grab sample collected from Koshkonong Creek, upstream and out of the influence of the discharge. The specific receiving water location must be specified in the WPDES permit.
- Shown below is a tabulation of all available WET data for Outfall 001. Efforts are made to ensure that decisions about WET monitoring and limits are made based on representative data. Data which is not believed to be representative of the discharge is not included in reasonable potential calculations. The table below differentiates between tests used and not used when making WET determinations.

WET Data History

Date Test Initiated	Acute Results LC ₅₀ % (% survival in 100% effluent)				Chronic Results IC ₂₅ %				Footnotes or Comments
	<i>C. dubia</i>	Fathead minnow	Pass or Fail?	Used in RP?	<i>C. dubia</i>	Fathead Minnow	Pass or Fail?	Use in RP?	
11/10/2005	>100	>100	Pass	Yes	>100	83.53	Pass	No	1
05/11/2006	>100	>100	Pass	Yes	>100	>100	Pass	Yes	
08/09/2007					>100	>100	Pass	Yes	
06/23/2015					>100	>100	Pass	Yes	
09/19/2017					>100	>100	Pass	Yes	

I. Data Not Representative. WWTP, industrial processes or contributions, or other significant changes have occurred which renders data unrepresentative. Significant changes were made to WET test methods in 2004 and these changes were assumed to be fully implemented by certified labs by no later than June 2005. It may be appropriate to exclude data collected before July 1, 2005, unless 1) it shows repeated toxicity that was never resolved or 2) older data is all that is available, and no significant changes have occurred which obviously make it unrepresentative. Ammonia limits were added to the permit in 2005 based on updated water quality criteria.

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

According to s. NR 106.08(6)(d), TUa effluent values are equal to zero whenever toxicity is not detected (i.e. when the LC50, IC25 or IC 50 \geq 100%).

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

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

The WET Checklist was developed to help DNR staff make recommendations regarding WET limits, monitoring, and other permit conditions. The Checklist steps the user through a series of questions that evaluate the potential for effluent toxicity. The Checklist indicates whether acute and chronic WET limits are needed, based on requirements specified in s. NR 106.08, Wis. Adm. Code, and recommends 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. The completed WET Checklist recommendations for this permittee are summarized in the table below. Staff recommendations, based on the WET Checklist and best professional judgment, are provided below the summary table. For guidance related to RP and the WET Checklist, see Chapter 1.3 of the WET Guidance Document: <http://dnr.wi.gov/topic/wastewater/WETguidance.html>.

WET Checklist Summary

	Acute	Chronic
AMZ/IWC	Not Applicable. 0 Points	IWC = 15% 0 Points
Historical Data	1 test used to calculate RP = 0. 0 tests failed No data within last 5 years. 5 Points	4 tests used to calculate RP = 0 0 tests failed 0 Points
Effluent Variability	Little variability, no violations or upsets, consistent WWTF operations. 0 Points	Same as Acute. 0 Points
Receiving Water Classification	< 4 mi to non-variance water 5 Points	Same as Acute. 5 Points
Chemical-Specific Data	Limits for chloride and copper based on ATC; ammonia, nickel, and zinc detected. 9 Points	Limits for chloride and copper based on CTC; ammonia, nickel, and zinc detected. 9 Points
Additives	0 Biocides and 1 Water Quality Conditioners (ferric chloride) added. SorbX-100 Used: No 1 Point	All additives used more than once per 4 days. 1 Point
Discharge Category	0 Industrial Contributors. 0 Points	Same as Acute. 0 Points
Wastewater Treatment	Secondary or Better Treatment 0 Points	Same as Acute. 0 Points
Downstream Impacts	No impacts known 0 Points	Same as Acute. 0 Points
Total Checklist Points:	20 Points	15 Points
Recommended Monitoring Frequency (from Checklist):	2 tests during permit term (year 2, 4, 6, etc.)	No testing
Limit Required?	No	No
TRE Recommended? (from Checklist)	No	No

- Following the guidance provided in the Department's WET Program Guidance Document (revision #11, dated November 1, 2016), based upon the point totals generated by the WET Checklist, other information given above, and Chapter 1.3 of the WET Guidance Document, **two (2) acute WET tests** are recommended in the reissued permit. Tests should be done in rotating quarters, to collect seasonal information about this discharge. WET testing shall continue after the permit expiration date (until the permit is reissued).

PART 7 – EXPRESSION OF LIMITS

Revisions to chs. NR 106 and 205, Wis. Adm. Code align Wisconsin’s water quality-based effluent limits with 40 CFR 122.45(d), which requires WPDES permits contain the following concentration limits, whenever practicable and necessary to protect water quality:

- Weekly average and monthly average limitations for continuous discharges subject to ch. NR 210.
- Daily maximum and monthly average limitations for all other discharges.

Deerfield is a municipal treatment facility and is therefore subject to weekly average and monthly average limitations whenever limitations are determined to be necessary.

This evaluation provides additional limitations necessary to comply with the expression of limits in ss. NR 106.07 and NR 205.065(7), Wis. Adm. Code. Pollutants already compliant with these rules or that have an approved impracticability demonstration, are excluded from this evaluation including water-quality based effluent limitations for phosphorus, temperature, and pH, among other parameters. Mass limitations are not subject to the limit expression requirements if concentrations limits are given.

Method for calculation:

The methods for calculating limitations for continuous discharges subject to ch. NR 210 to conform to 40 CFR 122.45(d) are specified in s. NR 106.07(3), and are as follows:

1. Whenever a daily maximum limitation is determined necessary to protect water quality, a weekly and monthly average limitation shall also be included in the permit and set equal to the daily maximum limit unless a more restrictive limit is already determined necessary to protect water quality.
2. Whenever a weekly average limitation is determined necessary to protect water quality, a monthly average limitation shall also be included in the permit and set equal to the weekly average limit unless a more restrictive limit is already determined necessary to protect water quality.
3. Whenever a monthly average limitation is determined necessary to protect water quality, a weekly average limit shall be calculated using the following procedure and included in the permit unless a more restrictive limit is already determined necessary to protect water quality:

$$\text{Weekly Average Limitation} = (\text{Monthly Average Limitation} \times \text{MF})$$

Where:

MF= Multiplication factor as defined in Table 1

CV= coefficient of variation (CV) as calculated in s. NR 106.07(5m)

[CV = Standard deviation/arithmetic mean,
= 0.6 for < 10 data points and for fecal coliform]

n= the number of samples per month required in the permit

s. NR 106.07 (3) (e) 4. Table 1 — Multiplication Factor (for CV = 0.6)

CV	n=1	n=2	n=3	n=4	n=8	n=12	n=16	n=20	n=24	n=30
0.6	1.00	1.31	1.51	1.64	1.95	2.12	2.23	2.30	2.36	2.43

Note: This methodology is based on the *Technical Support Document for Water Quality-based Toxics Control* (March 1991). PB91-127415.

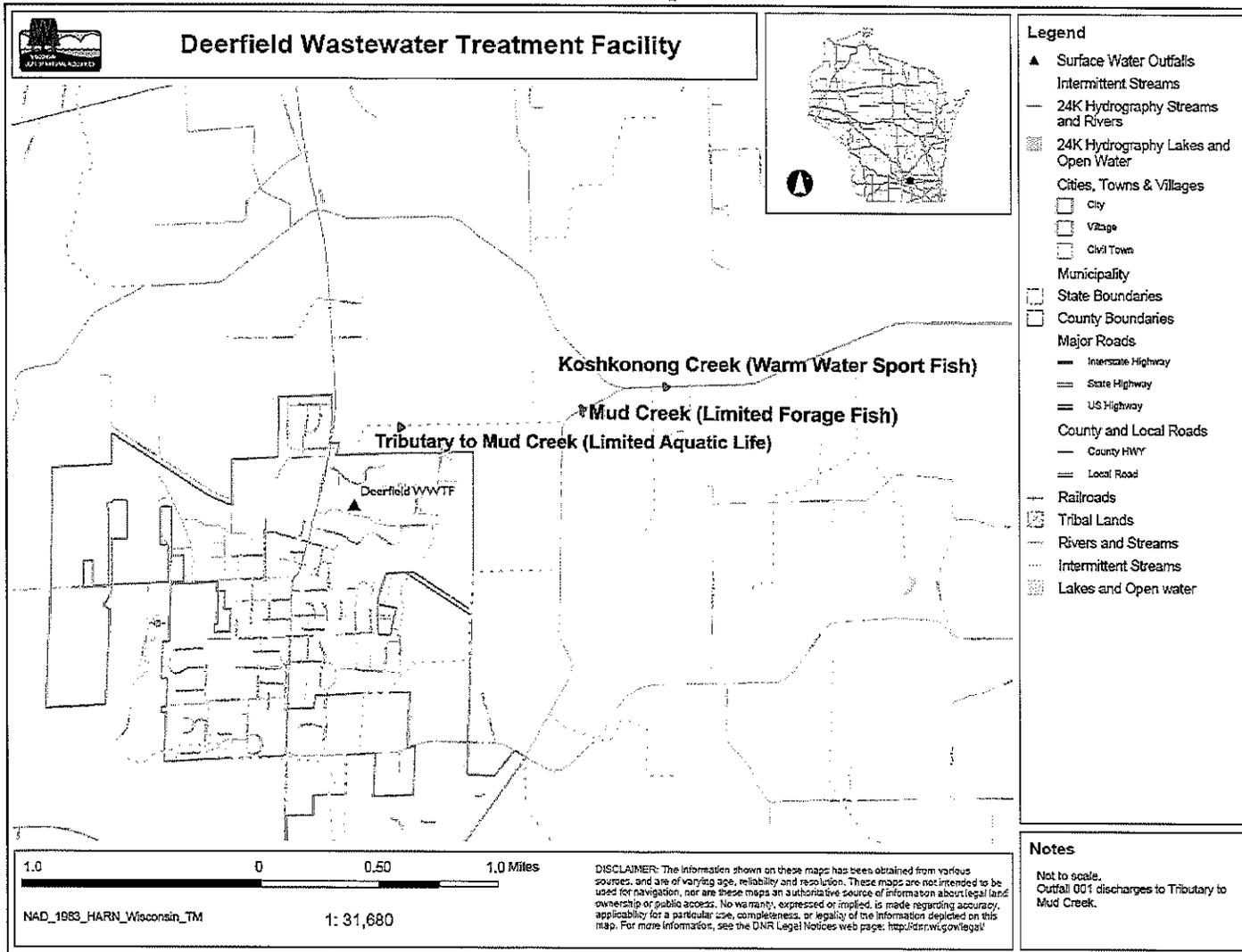
Attachment #1

Summary of Additional Limitations:

In conclusion, the following additional limitations are required to comply with ss. NR 106.07 and NR 205.065(7) Expression of Limits. This requirement for chloride only applies if the variance is not approved.

Parameter	Daily Maximum	Weekly Average	Monthly Average	Multiplication Factor (CV)	Assumed Monitoring Frequency (n)
Chloride		400 mg/L	400 mg/L		
Copper	47 mg/L	33 mg/L	33 mg/L		

Attachment #2
Site Map



Attachment #3

Temperature limits for receiving waters with unidirectional flow

(calculation using default ambient temperature data)

Facility:	Deerfield Wastewater Treatment Facility	Flow Dates:	7-Q ₁₀ :	1.00	cfs	Temp Dates:	
Outfall(s):	001	Start:	01/01/14	Dilution:	100%	Start:	04/04/17
Date Prepared:	1/27/2019	End:	03/31/18	f:	0	End:	12/29/17
Design Flow (Q_e):	0.39 MGD	Stream type:	Limited forage fish community				
Distance to Surface Water:	6336 feet	Q_s:Q_e ratio:	1.6 :1				
Calculation Needed? YES							

Month	Water Quality Criteria			Receiving Water Flow Rate (Q _s) (cfs)	Representative Highest Effluent Flow Rate (Q _e)		f	Representative Highest Monthly Effluent Temperature		Calculated Effluent Limit		Adjusted Thermal Limits	
	T _a (default)	Sub-Lethal WQC	Acute WQC		7-day Rolling Average (Q _{es}) (MGD)	Daily Maximum Flow Rate (Q _{ea}) (MGD)		Weekly Average	Daily Maximum	Weekly Average Effluent Limitation	Daily Maximum Effluent Limitation	Weekly Average	Daily Maximum
	(°F)	(°F)	(°F)		(MGD)	(MGD)		(°F)	(°F)	(°F)	(°F)	(°F)	(°F)
JAN	37	54	78	1.00	0.263	0.307	0			96	120	112	120
FEB	39	54	79	1.00	0.272	0.384	0			90	120	105	120
MAR	43	57	80	1.00	0.235	0.345	0			95	120	111	120
APR	50	63	81	1.00	0.246	0.541	0	56	56	97	118	113	120
MAY	59	70	84	1.00	0.348	0.711	0	57	57	90	107	106	120
JUN	64	77	85	1.00	0.386	0.609	0	68	68	99	107	115	120
JUL	69	81	86	1.00	0.367	0.510	0	71	72	102	108	118	120
AUG	68	79	86	1.00	0.338	0.448	0	72	72	100	112	116	120
SEP	63	73	85	1.00	0.263	0.338	0	72	73	98	120	115	120
OCT	55	63	83	1.00	0.246	0.483	0	72	72	84	120	100	120
NOV	46	54	80	1.00	0.257	0.344	0	50	50	74	120	90	120
DEC	40	54	79	1.00	0.251	0.533	0	56	57	90	120	106	120