WISCONSIN DEPARTMENT OF NATURAL RESOURCES
NOTICE OF FINAL GUIDANCE & CERTIFICATION

Pursuant to ch. 227, Wis. Stats., the Wisconsin Department of Natural Resources has finalized and hereby certifies the following guidance document.

DOCUMENT ID

WY-19-0001-C

DOCUMENT TITLE

Guidance for Total Nitrogen Monitoring in Wastewater Permits

PROGRAM/BUREAU

Water Quality

STATUTORY AUTHORITY OR LEGAL CITATION

Wis. Stat. §§ 283.37(5) and 283.55(1)(e). Sections NR 200.065 (1) (g) and NR 200.065 (1) (h), Wis. Adm. Code.

DATE SENT TO LEGISLATIVE REFERENCE BUREAU (FOR PUBLIC COMMENTS)

09/09/2019

DATE FINALIZED

10/01/2019

DNR CERTIFICATION

I have reviewed this guidance document or proposed guidance document and I certify that it complies with sections 227.10 and 227.11 of the Wisconsin Statutes. I further certify that the guidance document or proposed guidance document contains no standard, requirement, or threshold that is not explicitly required or explicitly permitted by a statute or a rule that has been lawfully promulgated. I further certify that the guidance document or proposed guidance document contains no standard, requirement, or threshold that is more restrictive than a standard, requirement, or threshold contained in the Wisconsin Statutes.

10-1-2019

Signature Date

BUREAU OF WATER QUALITY
PROGRAM GUIDANCE

WASTEWATER POLICY AND MANAGEMENT TEAM

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Guidance for Total Nitrogen Monitoring in Wastewater Permits

October 1, 2019

EGAD# 3400-2019-01

This document is intended solely as guidance and does not contain any mandatory requirements except where requirements found in statute or administrative rule are referenced. Any regulatory decisions made by the Department of Natural Resources in any matter addressed by this guidance will be made by applying the governing statutes and administrative rules to the relevant facts.

Approved:

Adrian Stocks, Director
Bureau of Water Quality

10-1-2019
Date

Reasons for Guidance

This guidance suggests that the Department include monitoring in surface water discharge permits in order to:

- Support implementation of nutrient criteria
- Support TMDL development
- Facilitate permitting decisions
- Describe potential contributions to the Gulf Hypoxia and other observed water quality problems

The Department has already developed water quality standards for phosphorus, which is the limiting nutrient in many Wisconsin water bodies. This guidance, therefore, focuses only on nitrogen.

Wis. Stat. §§ 283.37(5) allows the department to require the applicant to submit information in addition to that supplied on the permit application. Wis. Stat. §§ 283.55(1)(e) allows the department to require the permittee to submit information necessary to identify the type and quantity of any pollutants discharged from the point source. Section NR 200.065 (1) (g), Wis. Adm. Code, states that the department may require monitoring for any pollutant in the permit application, if its presence could be reasonably expected based on wastewater sources. Section NR 200.065 (1) (h) allows for this monitoring to be collected during the permit term.

This document replaces the previous version from 2012 (EGAD# 3800-2012-02).

Background Information

The nitrogen cycle is complex. The most common sources of nitrogen in wastewater are urea contained in domestic wastewater and proteins and their break-down products in food wastes. Biological treatment is the most common method of treating wastewater for nitrogen. The biological treatment provided is dependent on the desired endpoint. If only ammonia toxicity is of concern, nitrifying bacteria established in the treatment plant are used to aerobically convert ammonia nitrogen to nitrate nitrogen. If total nitrogen (TN) removal is desired, the typical method of treatment is to denitrify the nitrate in an anoxic environment in the presence of a carbon source. Nitrogen is then released to the atmosphere as a gas. Additional basins or segments of other basins are typically provided to establish the anoxic zones necessary for the nitrate nitrogen removal.

The Department has included ammonia limits and monitoring requirements in discharge permits for over 30 years. A majority of surface water discharge permits have ammonia limits. A well designed and operated nitrifying WWTP is capable of achieving ammonia levels in the 1-2 mg/L range during warm weather. Somewhat less ammonia conversion is realized during colder conditions.

Wisconsin has regulated TN in groundwater discharges since the promulgation of Wisconsin's nitrate standard in the mid-1980s. For wastewater facilities that discharge treated effluent to groundwater, we assume that all forms of nitrogen discharged eventually convert naturally to nitrate, for which there is a health-based Enforcement Standard of 10 mg/L. DNR has, therefore, included TN limits of 10 mg/L and required data collection for facilities that discharge to groundwater for over 20 years. Information from some of these facilities was evaluated to determine discharge trends. The Preventative Action Limit (“PAL”) for nitrate is 2 mg/l.

The Department had not included TN limits and associated routine monitoring in surface water discharge permits prior to the creation of this guidance. To provide additional information on the levels of TN discharged from various types of treatment facilities, we required a single analysis of nitrate/nitrite nitrogen and total Kjeldahl with all permit applications beginning with those generated in October 2008 to the present. These data could be used with flow data to estimate nitrogen waste loads from individual facilities. This information also provides insight to characterize categories of discharge and further refine future monitoring.

In September 2011, the Upper Mississippi River Basin Association (UMRBA) Water Quality Task Force (WQTF) completed the report *Upper Mississippi River Nutrient Monitoring, Occurrence, and Local impacts: A Clean Water Act Perspective* (UMRBA 2011). Among the many recommendations of this report was the following:

> *"Pursue consistent NPDES discharge monitoring requirements for both nitrogen and phosphorus among states. As discussed throughout this report, both phosphorus and nitrogen have important impacts on the mainstem UMR as well as in the Gulf of Mexico. Therefore, the states should expand their NPDES discharge monitoring requirements to include both phosphorus and nitrogen and seek to make these requirements more consistent among states."*

The WQTF and the UMRBA Water Quality Executive Committee (WQEC) subsequently identified this recommendation as a priority for implementation. The compilation of UMR states' nitrogen and phosphorus NPDES monitoring recommendations found in this document is the WQTF's first step in implementing this recommendation. During a July 31, 2012 WQTF meeting, the consensus of the task force members was that states not embark on extensive monitoring efforts until a comprehensive plan and defined approach, including non-point source evaluations, is developed. The following recommendations are designed to provide useful discharge characterizations without expending major resources. Subsequently, the 2012 version of this guidance recommended that the Department begin to collect quarterly effluent TN monitoring only from major municipal dischargers and larger cheese plants in the Mississippi River Basin. This latest version of the guidance recommends implementing this monitoring strategy on a statewide basis.

Cost of TN Analysis

The TN concentration is determined by summing the results of testing for total Kjeldahl nitrogen and nitrate/nitrite nitrogen. The test for total Kjeldahl nitrogen (TKN) detects both the organic nitrogen and ammonia nitrogen components. The procedure for TKN is to: 1) analyze for ammonia; 2) chemically convert the organic nitrogen component to ammonia; and 3) reanalyze for ammonia to determine the total of the organic and ammonia components. The cost for the State Lab of Hygiene to run nitrogen tests (2019 dollars) is: ammonia \$30; TKN \$39; and nitrate/nitrite \$30 – for a total of \$99 per sample for TN.

Observations Based on Existing Data

In 2009, staff evaluated existing data to draw the following preliminary conclusions used to develop recommendations for future monitoring. Many of these conclusions were based on limited data. The data provided with the permit applications was not sorted by the time of year during which the sampling took place. The first and second conclusions below are based on slightly less than 200 data points for municipalities. The conclusions regarding removal from various treatment types are based on subsets of data that contain significantly less data points.

- The median and average discharge levels reported on the applications of municipal facilities is 16 mg/L and 18 mg/L, respectively, of TN.
- There does not appear to be a correlation between size of municipal facility and level of TN discharged.
- Consistent with literature, influent levels of TKN for municipal plants appears to be around 40 mg/L. Influent TKN levels can affect the discharge of TN.
- Based on 3 years of monitoring data of 2 municipal discharges to groundwater (Lake Geneva 2.5 MOD Oxidation Ditch; and Alma Center – SBR Activated Sludge) it appears that denitrification plants are capable of achieving 5 mg/L TN. There appear to be slightly higher discharge levels in the winter months. Crandon (Conventional Activated Sludge) also achieved levels of 5 mg/L; but the discharge was highly variable and winter time discharges were in the 20-30 mg/L range.
- Sequencing Batch Reactor activated sludge plants appear capable of removing TN. (Data points for 3 municipal plants were 2.6, 5.1, and 8.5 mg/L.) Anoxic conditions are likely forming during the non-aeration cycles.
- Oxidation Ditch activated sludge plants tended to remove more TN than conventional activated sludge. This is likely due to anoxic zones in the ditch.
- The TN removal from Extended Aeration activated sludge plants appears comparable to that of conventional activated sludge plants.
- The TN discharge levels from activated sludge plants that have biological phosphorus removal appear to be slightly less than those without Bio-P. This is not conclusive, but is likely due to the fact that the anoxic zones used at most Bio-P plants will enhance the TN removal.
- Rotating Biological Contactors (RBC) plants appear to remove less TN than activated sludge plants.
- Fill and Draw Stabilization Ponds appeared to have low levels of TN discharged. Since these ponds discharge only in the spring and fall, the data is only for those seasons. Based on a cursory review of the data, the fall discharge levels seem to be lower than the spring.
- Municipal Aerated Lagoons appear to be able to remove TN to the 5-10 mg/L range for periods in the summer.
- The TN discharge levels from paper mills and Wisconsin's only oil refinery are in the 3-5 mg/L range. These facilities have nutrient deficient wastewater and must add nitrogen to maintain proper biological activity in the WWTP.
- Categorical Standards require TN limits and monitoring for Meat Processors (40 CFR Part 432). Four years of data from a sausage manufacturing plant shows TN levels which average approximately 5 mg/L. A poultry slaughtering plant has an average effluent of approximately 45 mg/L TN and an influent of approximately 150 mg/L TKN.
- Cheese processing plants generally have deficient nitrogen for proper operation of their WWTPs. Many facilities add nitrogen. Data from 6 plants ranged from 1.3-11.8 mg/L, with a median of approximately 2.0 mg/L.

Suggested Future Permitting Decisions

The above discussed data provided good insight into the discharge levels of many categories of facilities. Based on the preliminary conclusion drawn from that data and in order to further gather information where data is limited, the following actions are recommended:

1. Include quarterly TN (ammonia nitrogen, organic nitrogen, and nitrate/nitrite) monitoring for the term of the permit at reissuance for all permittees that fall into the following categories:
    a. Major municipalities.
    b. All facilities whose permit application shows unusually high levels of TN (> 40 mg/L).
    c. Larger cheese plants (those issued in central office).
2. Include annual TN monitoring for all other municipal facilities. Data should be collected seasonally (e.g., in rotating quarters).
3. Include TN monitoring in permits for meat processors where required by categorical standards in 40 CFR Part 432.
4. Continue to require a single analysis of TN for all facilities with the permit application.
5. Evaluate future data to determine whether seasonal variability exists.