

# Nitrogen Management Plan Guidance

This guidance is intended to assist with the development of a nitrogen management plans (NMPs) that may be required by National Pollutant Discharge Elimination Systems/State Disposal Systems (NPDES/SDS) permits for your wastewater treatment facilities or industrial wastewater discharges. Facility specific NMP goals will depend on various factors including, but not limited to, a facility’s classification as a major municipal WWTF or high concentration municipal WWTF or industrial nitrogen discharger, downstream waterbody nitrate reduction requirements, permit requirements for new, expanding or significantly upgraded facilities and any existing or proposed NPDES/SDS permit nitrate or total nitrogen effluent limits.

Where applicable, NPDES/SDS permits will include facility specific NMP requirements. The MPCA has developed a nitrogen summary dashboard and a Microsoft Excel spreadsheet to help with the analysis of wastewater nitrogen data and development of nitrogen management plans.

The MPCA’s [Wastewater nitrogen data summary tool](#) summarizes and provides context for wastewater treatment facility flow and nitrogen data.

The [Nitrogen DMR look-up tool](#) is a Microsoft Excel file that contains Discharge Monitoring Report (DMR) data that can be used to summarize and graph facility nitrogen and flow data.

NMPs for low concentration facilities may be simple reviews of influent (where available) and effluent nitrogen data to confirm that the existing facility operations ensure optimal nitrogen management. NMPs for high concentration facilities are expected to be more complex, including analysis of source reduction facility optimization opportunities. Enhanced NMP requirements include plans to achieve effluent nitrogen reductions to levels sufficient to protect sensitive downstream waters and aquatic life.

The five sections below provide suggested NMP content.

## 1. Data review

Summarize the last 5-years of available influent and effluent flow and nitrogen series monitoring data.

### Influent

Analyte	Calendar month average <sup>2</sup>	Calendar month total	Calendar year total
Flow	mgd	Mgal	Mgal
Nitrite plus Nitrate (as N)	mg/L, kg/day	kg/month	kg/year
Nitrogen, Kjeldahl, Total	mg/L, kg/day	kg/month	kg/year
Nitrogen, Total (as N) <sup>1</sup>	mg/L, kg/day	kg/month	kg/year

<sup>1</sup>Total Nitrogen is calculated as the sum of Nitrite plus Nitrate and Total Kjeldahl Nitrogen.

<sup>2</sup>If unavailable use calendar quarter average or other available data type.

## Effluent

Analyte	Calendar month average <sup>3</sup>	Calendar month total	Calendar year total	12-month moving average	Percent removal
Flow	mgd	Mgal	Mgal		
Nitrogen, Ammonia, Total (as N)	mg/L, kg/day	kg/month	kg/year		
Nitrite plus Nitrate (as N)	mg/L, kg/day	kg/month	kg/year		
Nitrogen, Kjeldahl, Total	mg/L, kg/day	kg/month	kg/year		
Nitrogen, Total (as N) <sup>1</sup>	mg/L, kg/day	kg/month	kg/year	mg/L <sup>4</sup>	% <sup>5</sup>
Nitrogen, Organic Total <sup>2</sup>	mg/L, kg/day	kg/month	kg/year		

<sup>1</sup>Total Nitrogen is calculated as the sum of Nitrite plus Nitrate and Total Kjeldahl Nitrogen.

<sup>2</sup>Organic Nitrogen is calculated by subtracting Ammonia Nitrogen from Total Kjeldahl Nitrogen.

<sup>3</sup>If unavailable use calendar quarter average or other available data type.

<sup>4</sup>12-month moving average concentration is calculated as the average of the most recent 12 months of calendar month average values.

<sup>5</sup>Percent removal is calculated as:  $percent\ removal = \frac{influent - effluent}{influent} \times 100$ . It can be calculated either for the Total Nitrogen calendar month average concentration or the calendar month average or the calendar year total load.

### 2. Facility performance determination (benchmarking)

Your facility's influent and effluent nitrogen levels can be compared to those from other facilities using the [Wastewater nitrogen data summary tool](#)\*.

\*Note: The data are derived from reported DMR data and may contain reporting errors.

### 3. Develop a Process Control Monitoring Plan

The goal of process control monitoring for nitrogen removal is to obtain data needed to evaluate and understand the facility's nitrogen removal process. These data are necessary for making informed operational changes related to total nitrogen removal.

Raw domestic wastewater typically contains 40-70 mg/L of total nitrogen that enters the wastewater treatment facility in the form of Total Kjeldahl Nitrogen (TKN). Nitrification is an aerobic treatment that converts ammonia to nitrate and is the first step in the removal of total nitrogen. Nitrification is often the most difficult step in removing total nitrogen. Denitrification is the final step to remove total nitrogen and is the reduction of nitrate into nitrogen gas.

The following parameters should be monitored to assist in process control.

- Temperature
- pH/Alkalinity
- Dissolved Oxygen
- Ammonia
- Nitrate

For additional detail see the MPCA's:

- [Process Control Monitoring for Nitrogen Removal Fact Sheet](#); and
- [Biological Nutrient Removal Manual](#)

Process control monitoring will need to be established at frequencies that are sufficient to inform facility operations for optimal nutrient removal. The use of automated continuous monitoring equipment should be evaluated, particularly for facilities with NO<sub>3</sub>-N or TN effluent limits.

#### 4. Develop Nitrogen Management Plan goals

Your Nitrogen NMPs goals may be based on facility priorities, permit requirements or on other objectives such as [Minnesota's Nutrient Reduction Strategy](#) reduction goals. The following NMP goal alternatives are provided as examples. Your NMP goals may include any combination of these or other goals of your choosing.

- Determine the facility's influent and effluent nitrogen characteristics and compare the facility's performance to other similar communities or facilities in Minnesota.
- Determine whether the facility is receiving unusually high influent nitrogen concentrations or loads, and whether source reduction alternatives are achievable.
- Optimize the existing facility's nitrogen removal capabilities to the extent possible.
- Develop an enhanced NMP to meet effluent TN concentrations necessary to protect sensitive downstream water resources and prevent aquatic life impacts.
- Optimize the existing facility's nitrogen removal capabilities to meet a 10 mg/L or lower effluent TN concentration, potentially in conjunction with water quality trading projects<sup>1</sup>.
- Optimize the existing facility's nitrogen removal capabilities to attain or maintain compliance with current or future permit limits.
- Optimize the nitrogen removal capabilities of a new, expanded or upgraded facility.
- Evaluate and optimize operations to maximize the facility's effluent nitrogen and phosphorus removal capabilities.

#### 5. Develop the facility's Nitrogen Management Implementation Plan

Provide a detailed sequence of implementation steps designed to achieve your NMP's chosen goals. The following implementation plan steps are provided as examples. Your NMP implementation plan may include any combination of these or other goals of your choosing.

- Develop and implement monitoring plans intended to achieve your NMP's goals:
  - Collection system monitoring if needed to track unknown sources of excess nitrogen to the facility.
  - Facility process control monitoring needed to understand and optimize the facility's nitrogen removal capabilities.
  - Evaluate the need for any changes to the current influent and/or effluent monitoring schedule for better characterization of the facility's nitrogen and/or phosphorus removal capabilities.
  - Best Management Practice (BMP) monitoring plan if applicable for structural water quality trading projects (constructed or reestablished wetlands, controlled drainage, bioreactors, etc.).

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<sup>1</sup>In order to participate as a buyer or seller of water quality trading credits, facilities are required to meet a Minimum Control Level (MCL). The MCL defines the facility's minimum baseline level of performance required to participate in water quality trading. See Section 4.2 of the MPCA's [Water Quality Trading Guidance](#) for details.

- b. Develop and implement plans to work with businesses, industries or institutions on plans to reduce excess sources of nitrogen (if any) to the facility.
  - Evaluate the need for development of, or updates to existing, significant industrial user (SIU) agreements for control of influent nitrogen concentrations and/or loads. Implement where appropriate.
  - Evaluate the need for development of, or revisions to, local limits for nitrogen concentrations and/or loads for existing SIU agreements. Implement where appropriate.
  - Work with other businesses, industries or institutions to reduce excess sources of nitrogen to the facility.
- c. Develop and implement facility optimization plans:
  - Changes or modifications to equipment or use of facilities (aerators, pumps, brushes, probes, recirculation rates, etc.).
  - Establishment of anoxic and anaerobic zones.
  - Changes or modification in sludge wasting procedures and biosolids management.
  - Changes or modifications to piping or facility flow configuration.
- d. Develop and implement plans to evaluate the success of your NMP and adjust your goals and/or implementation plans as needed. The MPCA recommends that nitrogen management activities, influent and effluent nitrogen data and NMP goals be reviewed on an annual basis.