BUREAU OF WATER QUALITY
PROGRAM GUIDANCE

WASTEWATER POLICY MANAGEMENT TEAM

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Implementation of Bacteria Water Quality Standards in Wastewater Permits

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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:

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Regulations

Federal Law:

- Clean Water Act section 303(i)(1)(B), requires states to adopt water quality criteria for pathogens and pathogen indicators for coastal recreation waters (e.g., the Great Lakes) based on federal criteria published by EPA.
- Sections 40 CFR 131.10 and 11, require states to develop water quality criteria to protect designated uses and require that criteria be based on federal guidance, federal guidance modified to reflect site-specific criteria, or other scientifically-defensible methods.
- Sections 40 CFR 131.4 and 131.11, allow states to adopt their own water quality criteria so long as these criteria are protective of human health, enhance the quality of the water, and serve the purposes of the Clean Water Act.
- Section 40 CFR 122.44(d), provides that water quality based effluent limits (WQBELs) must be derived from and comply with water quality standards and designated uses.

State Statute:

- Section 281.15, Wis. Stats., mandates that the department promulgate water quality standards, including water quality criteria and designated uses. It recognizes that different use categories and criteria are appropriate for different types of waterbodies, and that the department shall establish criteria which are not more stringent than reasonably necessary to ensure attainment of the designated use for the waterbodies in question.
- Sections 283.31(3) and (4), Wis. Stats., state that the department may issue a permit upon the condition that the permit contains limitations necessary to comply with any applicable federal law or regulation, state water quality standards, and total maximum daily loads.
- Section 283.55, Wis. Stats., grants the department authority to impose monitoring and reporting requirements.

State Administrative Code:

- Chapter NR 102, Wis. Adm. Code, contains the state's surface water quality criteria, including bacteria criteria.
- Section NR 210.06(2)(a)1., Wis. Adm. Code, includes the following limits for publicly and privately owned sewage treatment works that must be included in permits when those facilities are required to disinfect for protection of recreational use.
    - The geometric mean of *E. coli* bacteria in effluent samples collected in any calendar month may not exceed 126 counts/100 mL.
    - No more than 10% of *E. coli* bacteria samples collected in any calendar month may exceed 410 counts/100 mL.
- Section NR 210.06(2)(a)2., Wis. Adm. Code, includes limits for publicly and privately-owned sewage treatment works that must be included in permits when those facilities are required to disinfect for protection of a public drinking water supply.
    - The geometric mean of fecal coliform bacteria in effluent samples collected in any 30 consecutive days may not exceed 400 counts/100 mL OR

- The *E. coli* bacteria limits for recreational use apply when disinfection is required for public drinking water supply.

- Chapter NR 219, Wis. Adm. Code, includes tables of approved methods for analyzing bacteria-related parameters. Tables A, EM, and H, or portions thereof related to bacteria, incorporate EPA's most recent approved methods.

Background

The Clean Water Act (CWA) requires states to adopt water quality standards to protect recreation in and on the water. Water quality standards (WQS) include a recreation designated use and water quality criteria that protect this use. In addition to the CWA requirements, the Beaches Environmental Assessment and Coastal Health (BEACH) Act requires states with coastal waters (e.g., the Great Lakes) to adopt new or revised criteria for pathogens (including bacteria) to protect recreation anytime that the United States Environmental Protection Agency (EPA) publishes revised criteria, to maintain eligibility for grant funding for communities. The EPA last published recommended recreation water quality criteria for bacteria in 2012.

Human waste contains a number of pathogens that can be spread through water and cause a wide range of diseases. The EPA employs the pathogen indicator concept for these criteria in which the indicator itself does not cause disease, but instead signals the potential for illness caused by human fecal contamination. Pathogen indicators, such as certain bacteria, are used because they tend to be more numerous than pathogens in human fecal matter and are cheaper, safer, and easier to measure. Wisconsin had used fecal coliform as its indicator since 1986. However, in their 2012 recommended criteria, EPA provided a choice for states to use either *E. coli* or enterococci as their pathogen indicator. Since the adoption of the BEACH Act in 2004, permittees in Wisconsin and the other Great Lake States have monitored for *E. coli* in the Great Lakes basin. As such, there is a large amount of data on *E. coli* levels in the Great Lakes. Additionally, the department has been assessing inland and Great Lakes beaches against EPA's 1986 *E. coli* criteria. For these reasons, the department chose to use *E. coli* as the pathogen indicator for the revised recreation criteria.

Revisions to Wisconsin's bacteria surface WQS to protect recreational uses and related implementation procedures were published in the administrative register on April 27, 2020 and took effect May 1, 2020. These rule revisions changed the bacteria WQS from fecal coliform to *Escherichia coli* (*E. coli*) in ch. NR 102, Wis. Adm. Code, as necessary to further protect recreational uses. The rule revisions also changed permit requirements for publicly and privately owned sewage treatment works in ch. NR 210, Wis. Adm. Code, and updated analytical methods for bacteria in ch. NR 219, Wis. Adm. Code. Starting on May 1, 2020, the fecal coliform WQS are no longer applicable during the recreation season and are replaced with *E. coli* WQS consistent with state law.

Permits for publicly and privately owned sewage treatment works that are required to disinfect that are reissued after May 1, 2020, must include monitoring and limits for *E. coli* during the recreation season (s. NR 210.06(2)(a)1., Wis. Adm. Code). The department does not plan to modify current permits to include *E. coli* requirements; new *E. coli* requirements will be included at the time of permit reissuance. All current permits will continue to have fecal limitations apply until the next permit reissuance. However, if a permittee would like *E. coli* requirements included in their permit prior to the next reissuance, they may make a formal request to the department to modify the current permit.

This document provides guidance related to implementation of bacteria WQS in wastewater permits. Guidance intended to assist staff that are determining whether disinfection should be required or whether a recreation season should be extended for a particular discharge is provided in another document titled "*Disinfection Requirements for Discharges to Streams Designated for Recreational Use*".

E. Coli Effluent Limits

Permits for publicly and privately owned sewage treatment works that are required to disinfect must include monitoring and limits for *E. coli* during the disinfection period (s. NR 210.06(2)(a)1., Wis. Adm. Code). Fecal coliform limits and monitoring are no longer required for recreational protection. Section NR 210.06(2)(a)1., Wis. Adm. Code, includes two limits which must be included in permits for facilities which are required to disinfect in order to protect recreation:

1. The geometric mean of *E. coli* bacteria in effluent samples collected in any calendar month cannot exceed 126 counts/100 mL.
2. No more than 10% of *E. coli* bacteria samples collected in any calendar month can exceed 410 counts/100 mL.

Compliance Schedules

Permittees that need time to comply with new *E. coli* limitations may be given a compliance schedule that allows time for the permittee to investigate options for meeting their limits while coming into compliance with the limits as soon as possible (NR 106.117(3), Wis. Adm. Code). Since *E. coli* is a new WQS that has not previously been required in WPDES permits, most permittees will need time to monitor their effluent for *E. coli* in order to determine whether they can meet their new limits. Permittees that already have representative data when the permit is being reissued may only be granted a compliance schedule if the data show that the new limits are not readily attainable by the discharger. A minimum of weekly monitoring for *E. coli* for 5 months during the recreation season (May - September if seasonal; any 5 consecutive months if year round) is typically needed to determine if a facility's wastewater discharge is in compliance with *E. coli* limits. If *E. coli* data show that the discharger is able to meet the new limits, no schedule can be given and limits will be effective immediately upon reissuance. (Note: a full recreation season of data is necessary to evaluate the potential for variability throughout the season; data may be collected during the same recreation season or in separate seasons.)

A standard compliance schedule has been created that should apply in most situations where one is needed. This schedule allows flexibility for the facility and the permit reissuance process. In cases where a facility does not have *E. coli* data, it will likely be unclear if the facility will be able to meet the new limits, need only minor operational improvements, or require construction upgrades. Therefore, the standard schedule was written to allow for three main phases:

1. Data Collection and Operational Evaluation
2. Initiation of Operational Improvements
3. Construction Upgrades (if needed)

Facilities should be able to either meet their final effluent limits or determine that construction upgrades will be necessary after one full disinfection season of data collection and minor operational

changes (at most 24 months after reissuance). If construction is necessary, the standard compliance schedule described below allows for final effluent limits to go into effect during the last year of the permit term. Note that the schedule below is a paraphrased version of the full schedule that would be included in a WPDES permit.

In this standard compliance schedule, there is an "off-ramp" when it has been determined that construction upgrades are not necessary to meet the new limits. If it is determined (within phase 1) that only operational changes are needed to attain compliance, action items #3 through #7 shown below will not be necessary and limits will become effective sooner. This so-called "off-ramp" allows this to occur without permit modification and with minimal report submittals from the permittee. Department staff will need to make SWAMP coding changes to make the appropriate updates to Discharge Monitoring Report (DMR) forms when this "off-ramp" is utilized.

	Schedule Action Item	**Explanation**
#1	**Status Update**	In preparation for *E. coli* monitoring, the facility shall submit information within the DMR comment section documenting the steps taken in preparation for properly monitoring and testing for *E. coli.*
#2	**Operational Evaluation Report**	The report shall include: 1. An evaluation of collected effluent data 2. Proposed operational improvements 3. Implementation timeline If the Operational Evaluation Report concludes that the operational improvements **are expected** to result in compliance with the final *E. coli* limitations, the permittee shall comply with the final *E. coli* limitations. If the Operational Evaluation Report concludes that operational improvements alone **are not expected** to result in compliance with the final *E. coli* limitations, the permittee shall initiate development of a facility plan for meeting final *E. coli* limitations

As previously stated, the remainder of the compliance schedule will only apply to those facilities that have determined construction upgrades are necessary. Otherwise, the limit will become effective and the rest of the action items will no longer be required.

	Schedule Action Item	**Explanation**
#3	**Submit Facility Plan**	A facility shall submit either a full Facility Plan or an abbreviated facility plan depending on the complexity of the upgrades proposed.
#4	**Final Plans and Specifications**	Submittal of final construction plans to the Department for approval.

#5	**Treatment Plant Upgrade to Meet Limitations**	Initiation of bidding, procurement, and/or construction of the project
#6	**Construction Upgrade Progress Report**	A simple progress report on construction upgrades
#7	**Complete Construction**	Construction should be completed
#8	**Achieve Compliance**	Compliance with final *E. coli* limitations

Operational Improvement and Upgrade Options

Each facility and discharge situation is unique, so the chosen compliance alternative will have to be determined on a case-by-case basis. A list of possible improvements/upgrades that a facility may need to comply with their new *E. coli* limits is shown below. This list is not meant to be all encompassing. Each permittee will need to evaluate their own effluent data and disinfection treatment process to determine what will work best for them.

Operational Improvements:

- Increase chlorine chemical addition
- Improve nitrification stability (chlorination facilities)
- Clean UV lamps & bulbs more often
- Increase UV intensity
- Optimize ferric dose to reduce UV bulb/sleeve fouling

Improvements Requiring Plans & Specs:

- Additional tankage for either increased chlorine contact time or additional UV equipment
- Additional/upgraded UV equipment
- Switch from chlorine disinfection to UV disinfection
- Additional pumps for chemical addition

The complexity and cost of a specific project along with available relevant planning efforts (phosphorus compliance alternatives plan or comprehensive facility planning, for example) will dictate the scope of a facility plan and final design documents. If a facility will require construction to meet *E. coli* limitations, the community or their consultant is encouraged to contact municipal plan review staff (https://dnr.wi.gov/topic/wastewater/permitsstaff.html) to determine an appropriate scope for the plan submittals.

Interim Limits

An interim limit will be necessary when a compliance schedule is given to provide time for the permittee to comply with new *E. coli* limits in order to prevent backsliding. Since the purpose of the interim limit is to prevent backsliding, the interim limit should be the same fecal coliform limit that appeared in the previous permit, usually 400 cfu/mL as a monthly geomean (Note: a weekly fecal coliform limit is no longer necessary). The interim limit should apply until compliance schedule steps are completed and the new *E. coli* limit has taken effect, at which time the fecal coliform limit will no longer apply during the recreation season.

Year-round Disinfection

Rule revisions completed in 2020 updated the recreational WQS and require *E. coli WQBELs* during the disinfection season to protect the waterbody's recreational use. Since year-round disinfection for protection of a public drinking water supply intake is not protection of a recreational use, the new *E. coli* WQBELs do not need to apply to these discharges outside of the recreation season. However, the recreational use *E. coli* WQBELs would also be protective of the drinking water supply intake, and some of these facilities may prefer to discontinue fecal coliform monitoring and limits for monitoring and reporting simplicity. For facilities that must disinfect year-round in order to protect a public drinking water supply intake, the permittee can choose to either continue to meet the same *E. coli* limits year−round or they can choose to meet *E. coli* limits during the recreation season and a fecal coliform limit (monthly geometric mean of 400 counts/100 mL) during the rest of the year (s. NR 210.06 (2)(a)2., Wis. Adm. Code).

Effluent Monitoring to Establish Need for a Compliance Schedule

As noted above, most permittees will need time to monitor their effluent for *E. coli* in order to determine whether they can meet their new limits, since *E. coli* is a new parameter that has not previously been required in most WPDES permits. It is recommended that permittees begin choosing test methods and sampling their effluent for *E. coli* as soon as possible now that the new standard has been promulgated. Effluent monitoring should take place during the permittee's required disinfection season (i.e., the months that they are required to disinfect in their current permit).

For the first few years after the effective date of this new rule, DNR staff will send a letter with the permit application that requires 5 months' worth (usually May-Sept) of effluent monitoring for *E. coli*. This data will be used during the permit reissuance process to determine whether the permittee can immediately comply with the new effluent limits or if a compliance schedule is needed to allow time for the permittee to come into compliance.

Minimum Monitoring Frequencies for Bacteria

The minimum recommended monitoring frequency for *E. coli* and fecal coliform is twice weekly for major municipal dischargers ($\geq$ 1.0 MGD) and once weekly for all other publicly and privately owned sewage treatment works. Major dischargers may be considered for once weekly monitoring on a case-by-case basis, if they maintain excellent historical performance. See *Monitoring Frequencies for Individual Wastewater Permits* for guidance related to what constitutes excellent historical performance. Reductions in monitoring are not recommended if year round disinfection is required because the discharge is in close proximity to a public water supply intake. Since the monitoring frequency is already at once per week for minor municipals, no reduction in monitoring is suggested.

If a permittee collects less than 10 sample results per month, the 410 counts/100 mL percent exceedance limit will effectively function as a daily maximum limit. 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.

Bacteria Testing Methods

Approved analytical methods for bacteria in ch. NR 219 Table A, Wis. Adm. Code, include membrane filtration, multiple well methods such as Colilert, or multiple tube fermentation. EPA developed the *E. coli* criteria using membrane filtration methods. Therefore, counts generated using membrane filtration are the most directly comparable to the criteria. However, the other listed analytical techniques are also approved by EPA for this purpose. Quantitative polymerase chain reaction (qPCR) may be used on a site-specific basis only if approved by EPA as an "alternative method" for the site.

It may prove beneficial to try multiple methods during data collection to find the method that is most consistent. More information about test methods is provided in the fact sheet *Test Methods for Measuring E. coli in Wastewater* (2020) (available online at: https://dnr.wi.gov/water/wsSWIMSDocument.ashx?documentSeqNo=132254684).

The standard hold time for bacteria testing (fecal coliform & *E. coli*) is 8 hours as listed in s. NR 219.04(2) Table F, Wis. Adm. Code. This may make it impossible for a facility to send their sample out for testing at a commercial lab and therefore testing may need to be performed in house. Laboratories performing bacteria testing of wastewater effluent are exempt from the certification and registration requirements in ch. NR 149, Wis. Adm. Code (s. NR 219.037, Wis. Adm. Code). During routine compliance inspections, DNR staff will be evaluating sampling, holding, and testing protocols to ensure compliance, whether or not the tests are performed on-site or at a contract laboratory.

Appendix A - Reporting Data Too Numerous to Count

There may be times when bacteria counts may be Too Numerous to Count (TNTC). When reporting such results on the Discharge Monitoring Report (DMR) form, an asterisk, which in the DNR's SWAMP database signifies TNTC, should be reported on the DMR for that particular sample event. One TNTC for a month would result in a geometric mean of TNTC and in most cases a permit violation. The real issue, however, is what a facility does next and how the Department considers such a violation.

If a TNTC occurs, then the day a TNTC is determined, an asterisk should be recorded for that day on the DMR and a new sample obtained immediately. (The reason for recording an asterisk is that SWAMP is not programmed to calculate geometric means using the greater than (>) sign; consequently, the geometric mean for a given month in SWAMP will show an asterisk signifying at least one > fecal or *E. coli* count.) If the membrane filtration method is being used, to reduce interference from overcrowding, the dilution series should be changed or a smaller portion of the sample should be filtered such that a countable number is obtained. If the multiple tube/multiple well method is being used, the dilution series should be changed, or a different count tray should be utilized which has a higher range. As stated previously, an asterisk signifying TNTC must be reported on the DMR for the appropriate sample day.

The QC exceedance box should be checked on the DMR and the appropriate comments added in the Laboratory Quality Control Comments section for that date. State the specific date of the questionable TNTC data in the comments section. Also included within the comments section, should be the number of colonies that the TNTC is greater than. For example, if a facility were using a membrane filter with an ideal counting range of 20-60 colonies, the smallest sample volume filtered was 0.1 ml, and a TNTC occurred, the result should be calculated using 60 colonies and the result greater than value written in the comments section. In this case a facility would write the date, > 6000 counts per 100 ml, missed the dilution. Including the TNTC to calculate the geometric mean results in a TNTC geometric mean. In no case should > values be used in reporting DMR daily data. It is acceptable, however, to show a > value in the comments section.

When assessing the violation, the Department will take into account the frequency of TNTCs as well as the facility's response to them, i.e. assuming the facility takes an immediate follow-up sample and that sample result, not including the TNTC, provides for an acceptable geometric mean.

Appendix B - Reporting Less Than Detected Values

All < daily values should be reported on the DMR as less than whatever the dilution series would indicate. For example, if counts from all filters in a dilution series are zero, report the count for the fecal coliform as a less than value. Calculate the number of colonies per 100 ml that would have been reported if there had been one colony on the filter representing the largest filtration volume. For example, sample volumes of 25, 10 and 2 ml produced colonies of 0, 0, and 0 respectively. The count would be reported as < than 4 colonies per 100 ml.

$$\frac{< 1 \text{ counts} \times 100}{25 \text{ ml}} = < 4 \text{ colonies per } 100\text{ml}$$

Whenever a facility has 0 counts in all sample volumes, < 1 should be substituted in the formula rather than zero for the largest sample volume filtered. This is shown in the above calculation to arrive at a less than value (i.e. < 4).

Consistent with how other < values are used in SWAMP, any < value for purposes of determining the monthly geometric mean is treated as 1 fecal count/100 ml. This is because the log of 1 is 0. Zero is thus included in averaging the logs similar to other parameters (other than fecal coliform and *E. coli*), where < values for calculating an arithmetic average are treated as 0.