ENVIRONMENTAL PROTECTION COMMISSION[567]

Regulatory Analysis

Notice of Intended Action to be published: Iowa Administrative Code 567—Chapter 43
"Water Supplies—Design and Operation"

Iowa Code section(s) or chapter(s) authorizing rulemaking: 455B.103(2), 455B.105(3), 455B.173(3), and 455B.173(5) through 455B.173(10)

State or federal law(s) implemented by the rulemaking: Iowa Code sections 455B.171 through 455B.188, Iowa Code sections 455B.190 through 455B.192, and the federal Safe Drinking Water Act (SDWA) as amended (42 U.S.C. §300f et seq.)

Public Hearing

A public hearing at which persons may present their views orally or in writing will be held as follows:

September 24, 2024 10 to 11 a.m.	Virtual via Zoom – see www.iowadnr.gov/environmental-Protection/Water-Quality/Water-Quality-Rulemaking for meeting information

Public Comment

Any interested person may submit written comments concerning this Regulatory Analysis. Written comments in response to this Regulatory Analysis must be received by the Department of Natural Resources (Department) no later than 4:30 p.m. on the date of the public hearing. Comments should be directed to:

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Des Moines, Iowa 50321
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Purpose and Summary

Proposed Chapter 43 implements federal health-based drinking water standards and minimum drinking water treatment requirements in Iowa. The chapter establishes the following for water supply systems: emergency procedures, engineering and construction standards and associated permitting, procedures for periodic sanitary surveys to ensure compliance with the SDWA, operation permitting program and procedures, and certain drinking water treatment requirements for compliance with the SDWA. This chapter is necessary for the State of Iowa to maintain primacy for enforcing the federal SDWA since Iowa's rules must be at least as stringent as the requirements established in the SDWA. This chapter has been reviewed and edited consistent with Executive Order 10.

Analysis of Impact

1. Persons affected by the proposed rulemaking:

- Classes of persons that will bear the costs of the proposed rulemaking:

Public water supply systems and water supply construction contractors and developers will bear the costs.

- Classes of persons that will benefit from the proposed rulemaking:

Citizens of Iowa, public water supply systems, drinking water-related businesses, and supply construction contractors and developers will benefit.

2. Impact of the proposed rulemaking, economic or otherwise, including the nature and amount of all the different kinds of costs that would be incurred:

- Quantitative description of impact:

Public water supply systems and third-party construction permit applicants such as developers are impacted by fees established in Chapter 43.

An annual operations permit fee as authorized by Iowa Code section 455B.183A is set at the greater of $25 or $0.14 multiplied by the total population served by the public water supply system. These fees are incurred only by active public water supply systems and are incurred on an annual basis. This fee is limited to $25 for noncommunity, transient public water supply systems.

Construction permit fees are incurred by those applying for a water supply construction permit (public water supply system owners and third-party developers or water supply contractors). Construction permit application fees are based on the type of system being constructed, installed, or modified as authorized by Iowa Code section 455B.183A. Generally, fees range from $100 to $5,000 for water main projects and from $100 to $16,000 for non-water-main-related construction projects. Minimum fees for time extensions or change orders are $50. The total amount of construction permit fees for a public water supply system owner during any calendar year cannot exceed $5,000 for water mains and $16,000 for non-water-main-related construction projects.

In 2023, 99.5 percent of the population in Iowa (3.05 million out of 3.07 million) served by public water supply systems regularly received water meeting all health-based drinking water standards in the SDWA. Approximately 1,800 water supply systems are active and have water supply operations permits issued by the Department, which assists in compliance with the SDWA. The water supply construction permitting program issues approximately 1,000 construction permits and approvals per year, which support water systems maintaining compliance and promote residential, business, and industrial development in the state.

- Qualitative description of impact:

Public health is protected through the enforcement of the SDWA through the public water system supervision program and its implementation of federal regulations regarding minimum water treatment requirements. A water supply operations permitting program is implemented, which supports public water system compliance with the SDWA and state rules. Department staff conducts regular sanitary survey inspections for active water supply systems. Water supply construction standards are maintained by the Department and are enforced through a water supply construction permitting program.

3. Costs to the State:

- Implementation and enforcement costs borne by the agency or any other agency:

Costs to the agency to implement Chapter 43 include staff time and salaries to administer the public water supply program (including SDWA implementation), to administer a water supply operations permitting program, to conduct sanitary surveys, to maintain and develop construction standards, and to administer a construction permitting program for water supply infrastructure. Additional costs include necessary information technology costs, such as development and maintenance of applications and programs used to administer the rules.

- Anticipated effect on state revenues:

A neutral impact on state revenues is expected because these rules were previously in effect. Costs to the agency are necessary for administration of the water supply programs and are largely offset by federal grant funding and fees collected as authorized by Iowa Code section 455B.183A.

4. Comparison of the costs and benefits of the proposed rulemaking to the costs and benefits of inaction:

Costs to the regulated public are limited to those required to comply with federal and state law and are reasonable and fair. Costs to the agency are necessary for the administration of the SDWA requirements and Iowa Code requirements for a water supply operations permitting program, a construction permitting program, and maintenance of water supply system construction standards. Costs are offset by fees collected as authorized by Iowa Code section 455B.183A and by federal grant funding.

Public health is protected by enforcement of the SDWA through the public water system supervision program and its implementation of federal regulations regarding minimum water treatment requirements. A water supply operations permitting program is implemented, which supports public water system compliance with the SDWA and state rules. Approximately 1,800 water supply systems are active and have water supply operations permits issued by the Department. Water supply construction standards are maintained by the Department and are enforced through a water supply construction permitting program. The water supply construction permitting program issues approximately 1,000 construction permits and approvals per year, which support water systems maintaining compliance and promote residential, business, and industrial development in the state.

In the absence of a State of Iowa public water system supervision program and primacy to enforce the SDWA, the Environmental Protection Agency (EPA) would administer the SDWA in the state. Local knowledge and assistance would not be available because EPA's regional office is located in Kansas.

The Department has the history, relationships, knowledge, and track record of successful implementation of the SDWA. Iowa's compliance with SDWA standards shows this; in 2023, 99.5 percent of the population in Iowa (3.05 million out of 3.07 million) served by public water supply systems regularly received water meeting all health-based drinking water standards in the SDWA.

5. Determination whether less costly methods or less intrusive methods exist for achieving the purpose of the proposed rulemaking:

There are no less costly or intrusive methods to accomplish the benefit. The regulations included in these rules implement state and federal laws.

6. Alternative methods considered by the agency:

- Description of any alternative methods that were seriously considered by the agency:

No alternative methods were considered.

- Reasons why alternative methods were rejected in favor of the proposed rulemaking:

There are no less restrictive alternatives to accomplish the benefit. A public water system supervision program that includes enforcement of the SDWA is provided for in Iowa Code chapter 455B. Chapter 43 implements provisions of the SDWA. A public water system supervision program and associated programs and requirements are necessary for Iowa to retain primacy for enforcing the SDWA in Iowa. Chapter 43 also implements programs established in the Iowa Code, including a water supply operation permitting program, a water supply construction permitting program, and establishment of water supply construction standards.

Small Business Impact

If the rulemaking will have a substantial impact on small business, include a discussion of whether it would be feasible and practicable to do any of the following to reduce the impact of the rulemaking on small business:

- Establish less stringent compliance or reporting requirements in the rulemaking for small business.
- Establish less stringent schedules or deadlines in the rulemaking for compliance or reporting requirements for small business.
- Consolidate or simplify the rulemaking's compliance or reporting requirements for small business.
- Establish performance standards to replace design or operational standards in the rulemaking for small business.
- Exempt small business from any or all requirements of the rulemaking.

If legal and feasible, how does the rulemaking use a method discussed above to reduce the substantial impact on small business?

This rulemaking will not have a substantial impact on small businesses because the current rules have been in place for a substantial period of time.

Text of Proposed Rulemaking

ITEM 1. Rescind 567—Chapter 43 and adopt the following **new** chapter in lieu thereof:

CHAPTER 43
WATER SUPPLIES—DESIGN AND OPERATION

567—43.1(455B) General information.

43.1(1) *Emergency actions regarding water supplies.* When, in the opinion of the director, an actual or imminent hazard exists, a water supplier shall comply with the directives or orders of the director necessary to eliminate or minimize that hazard.

a. Water hauling on an emergency basis. A system that is providing finished drinking water hauled from another PWS must ensure the safety of the water in an emergency situation.

(1) Hauled water must come from a PWS currently regulated by the department and in compliance with 567—Chapters 40 through 43. Written department approval is required prior to the use of water from any PWS with a chronic health-based standard violation.

(2) The receiving PWS must have written department approval prior to the use of water from any PWS located in another state. The providing PWS must be in compliance with SDWA requirements.

(3) The hauled water must be disinfected with chlorine to ensure bacterial safety in the tanker, storage vessel, and distribution system. If the PWS providing the water does not disinfect, chlorine disinfectant must be added to the hauled water before use or storage at the receiving PWS. A minimum disinfectant residual of 2.0 mg/L as total chlorine or chloramines or 0.5 mg/L as free chlorine must be maintained in the tanker, storage vessel, and distribution system. If no disinfectant is used, the transported water must be boiled before any human consumptive use, which includes drinking, bathing, handwashing, oral hygiene, food preparation, dishwashing, ice making, or food processing.

(4) The tanker or water bladder must be approved for hauling or storing food grade materials and be sanitized in accordance with AWWA C652 prior to first use.

(5) Both filling and dispensing devices must include backflow protection to protect the source water, such as an air gap, double-check-valve assembly, or reduced pressure zone device.

(6) Total coliform bacteria samples must be collected from the tanker, storage tank or bladder, and distribution system as follows:

1. Tanker: one sample after cleaning and one before first potable water use.
2. Storage tank or bladder: one sample after cleaning and one before first use.
3. Distribution system: one sample initially before first use and with each new load of water or once per month, whichever is more frequent.

(7) Records must be maintained and available for inspection for five years.

b. Water hauling on a nonemergency basis. A system that is providing finished drinking water hauled from another PWS must comply with the conditions in its operation permit.

43.1(2) *Prohibition on the use of lead.* Any pipe, pipe fitting, plumbing fitting, plumbing fixture, solder, or flux that is used in the installation or repair of any public water supply system (PWS) or any plumbing in a facility providing water for human consumption that is connected to a PWS shall be lead free as defined in 567—40.2(455B). This shall not apply to leaded joints necessary for the repair of cast iron pipe.

a. The following items are exempted from the prohibition, depending upon their use in the system: pipes, pipe fittings, plumbing fittings, or fixtures, including backflow preventers, that are used exclusively for nonpotable services such as manufacturing, industrial processing, irrigation, outdoor watering, or any other uses where the water is not anticipated to be used for human consumption.

b. Additional products that could be used exclusively for nonpotable services include:

(1) Products that are clearly labeled on the product, package, or tags with a phrase such as "not for use with water for human consumption" or another phrase that conveys the same meaning in plain language;

(2) Products that are incapable of use in potable services with other products that would be needed to convey water for potable uses; or

(3) Products that are plainly identifiable and marketed as being solely for a use other than the conveyance of water. These other uses include conveyance of air, chemicals other than water, hydraulic fluids, refrigerants, gases, or other nonwater fluids.

c. The following items are exempted from the prohibition: toilets, bidets, urinals, fill valves, flushometer valves, tub fillers, shower valves, fire hydrants, service saddles, water distribution main gate valves two inches in diameter or larger, clothes washing machines, emergency drench showers, emergency face wash equipment, eyewash devices, fire suppression sprinklers, steam capable clothes dryers, and sump pumps.

43.1(3) *Use of noncentralized treatment devices.*

a. Community PWS. CWSs shall not use bottled water, point-of-use (POU) or point-of-entry (POE) devices to achieve permanent compliance with a maximum contaminant level (MCL), treatment technique (TT), or action level (AL) requirement in 567—Chapters 41 and 43.

b. Noncommunity PWS. The department may allow NCWSs to use POU devices to achieve MCL compliance, provided the contaminant does not pose an imminent threat to health (such as bacteria) nor place a sensitive population at risk (such as infants for nitrate or nitrite).

c. Reduced monitoring requirements. Bottled water, POU, or POE devices cannot be used to avoid the monitoring requirements of 567—Chapters 41 and 43, but the department may allow reduced monitoring requirements in specific instances.

d. Bottled water requirements. The department may require a PWS exceeding an MCL, TT, or AL requirement in 567—Chapters 41 and 43 to use bottled water as a condition of an interim compliance schedule or as a temporary measure to avoid an unreasonable health risk. Any bottled water must meet the federal Food and Drug Administration (FDA) bottled water standards in 21 CFR §165.110. The system must meet the following requirements:

(1) Monitoring program. Submit a monitoring program for bottled water to the department. The monitoring program must provide reasonable assurances that the bottled water complies with all MCLs, TT, or AL requirements in 567—Chapters 41 and 43. The PWS must monitor a representative sample of bottled water for all contaminants regulated under 567—Chapters 41 and 43 the first quarter that it supplies the bottled water to the public, and annually thereafter. Monitoring program results shall be provided to the department annually. If the bottled water is from a CWS that currently meets all of the federal SDWA requirements, the monitoring requirements of this subparagraph shall be waived by the department. The specific supplier of the bottled water must be identified in order for the department to waive the monitoring requirements.

(2) Certification. The PWS must receive a certification from the bottled water company that the bottled water supplied has been taken from an approved source; the bottled water company has conducted monitoring in accordance with 43.1(3)*"b"*(1); and the bottled water meets MCL, TT, or AL requirements in 567—Chapters 41 and 43. The PWS shall provide the certification to the department the first quarter after it supplies bottled water and annually thereafter.

(3) Provision of bottled water. The PWS is fully responsible for the provision of sufficient quantities of bottled water to every person supplied by the PWS via door-to-door bottled water delivery.

43.1(4) *Cross-connection control.* To prevent backflow or backsiphonage of contaminants into a PWS, connection shall not be permitted between a PWS and any other system that does not meet the monitoring and drinking water standards of this chapter, except as provided in 43.1(4)*"a," "b,"* or *"c."*

a. Piping and plumbing systems. Piping systems or plumbing equipment carrying nonpotable water, contaminated water, stagnant water, liquids, mixtures, or waste mixtures shall not be connected

to a PWS unless properly equipped with an antisiphon device or backflow preventer acceptable to the department.

b. Water loading stations. The Ten States Standards contain construction standards regarding water loading stations.

c. Contamination as a result of cross-connection. When, in the department's opinion, evidence clearly indicates the source of contamination within a system is the result of a cross-connection, the department may require a PWS to provide public notice (PN), identify and eliminate the connection, and implement a systemwide cross-connection program.

43.1(5) *Requirement for certified operator.* The department maintains a list of certified operators in accordance with 567—Chapter 81. The list includes the operator's name, certification classification (Water Treatment, Water Distribution, or Grade A Water System), and grade (A, I, II, III, or IV), and is periodically updated during the year.

a. CWS and NTNC systems. All CWSs and NTNCs must have a certified operator in direct responsible charge (DRC) of the treatment and distribution systems, pursuant to 567—Chapters 40 through 44 and 81.

b. TNC systems.

(1) Any TNCs owned by the state or federal government or using a surface water (SW) or IGW source must have a certified operator in DRC of the treatment and distribution systems, pursuant to 567—Chapters 40 through 44 and 81.

(2) Any TNC that uses chlorine dioxide as a disinfectant or oxidant must have a certified operator in DRC of the system, pursuant to 567—Chapter 81.

(3) The department may require any TNC to have a certified operator in DRC.

43.1(6) *Return water in PWSs.* Steam condensate, cooling water from engine jackets, water used in conjunction with heat exchange devices, or treated wastewater shall not be returned to a PWS.

43.1(7) *Sanitary surveys.* Each PWS must have a periodic sanitary survey conducted by the department or its designee. Systems must provide, upon request, any information that will enable the department to conduct the sanitary survey.

a. A sanitary survey is a records review and on-site inspection that evaluates a system's ability to produce and distribute safe drinking water and identifies improvements necessary to maintain or improve drinking water quality. A survey includes review and inspection of the following areas: water source; treatment facilities; distribution systems; finished water storage; pumps, pump facilities, controls and other equipment; monitoring, reporting, and data verification, including self-monitoring; system operation and management; maintenance; operator certification; and records.

b. A sanitary survey report is issued by the department or its designee, and may include both enforceable required actions for remedying significant deficiencies and nonenforceable recommended actions.

c. Sanitary surveys shall be conducted at least once every five years for TNCs and NTNCs and once every three years for CWSs.

d. The department or its designee shall provide the PWS with a written notice describing any significant deficiencies identified during the survey no later than 30 days after identification of the deficiency. The notice may be included in the sanitary survey report and may specify corrective actions and deadlines for completion of corrective actions. Systems must respond in writing to significant deficiencies outlined in the sanitary survey report or written notice and indicate how and on what schedule the system will address the noted deficiencies, either within 30 days of receiving the survey report or notice or within the time period specified in the report or notice. All systems must take the steps necessary to address significant deficiencies identified in a sanitary survey report or written notice that are within the control of the system and its governing body.

567—43.2(455B) PWS operation permit.

43.2(1) *Fees.*

a. Annual fee. A fee for the operation of a PWS shall be paid annually. The fee will not be prorated and is nonrefundable. The fee shall be based on the population served. The fee shall be the greater of $25 per year or $0.14 multiplied by the total population served by the PWS for all CWSs and NTNCs. The fee shall be $25 per year for all TNCs. Where a system provides water to another PWS (consecutive PWS) that is required to have an operation permit, the population of the recipient system shall not be counted as a part of the PWS providing the water.

b. Fee notices. The department will send annual notices to PWSs at least 60 days prior to the operation fee due date.

c. Fee payments. The annual operation fee must be paid to the department by September 1 each year.

d. Fee adjustment. The department may adjust the per capita fee payment by up to +/– $0.02 per person served so as to achieve the targeted revenue of $350,000 during each fiscal year. The commission must approve any per capita fee rate above $0.14 per person. Any fee adjustment shall comply with Iowa Code section 455B.183A.

e. Exempted PWSs. PWSs located on Indian lands are exempt from the fee requirements.

f. Late fees. When the owner of a PWS fails to remit payment of fees by September 1, the department will notify the system by a single notice of violation and assess a late fee of $100. The department may thereafter issue an administrative order pursuant to Iowa Code section 455B.175(1) or request a referral to the attorney general under Iowa Code section 455B.175(3).

43.2(2) *Operation permit requirement.* Except as provided in 43.2(3), no person shall operate any PWS or part thereof without, or contrary to any condition of, an operation permit issued by the director.

43.2(3) *Operation permit applications.* The owner of any PWS or part thereof must submit an application for an operation permit. Upon submission of a completed application form, the time requirement for having a valid operation permit is automatically extended until the application has either been approved or disapproved by the director.

a. Application forms and timeline.

(1) Applications for operation permits shall be made on forms provided by the department.

(2) An application shall be filed at least 90 days prior to the date operation is scheduled to begin unless a shorter time is approved by the director.

(3) The director shall issue or deny operation permits within 60 days of receipt of a completed application, unless a longer period is required and the applicant is so notified.

(4) The director may require the submission of additional information deemed necessary to evaluate an application.

(5) An application that is incomplete or otherwise deficient shall not be processed until the applicant has supplied the missing information or otherwise corrected the deficiency.

b. Identity of signatories. The person who signs the application for an operation permit shall be:

(1) Corporation. In the case of a corporation, a principal executive officer of at least the level of vice president. The corporation has the option of appointing a designated signatory to satisfy this requirement.

(2) Partnership. In the case of a partnership, a general partner.

(3) Sole proprietorship. In the case of a sole proprietorship, the proprietor.

(4) Public facility. In the case of a municipal, state or other public facility, by either the principal executive officer or the ranking elected official.

c. Late applications. When the owner of a PWS fails to make timely application, the department will notify the system by a single notice of violation and may thereafter issue an administrative order pursuant to Iowa Code section 455B.175(1) or request a referral to the attorney general under Iowa Code section 455B.175(3).

43.2(4) *Operation permit conditions.*

a. Conditions. Operation permits may contain conditions deemed necessary by the director to ensure compliance with all applicable department rules, to ensure that a PWS is properly operated and

maintained, to ensure that potential hazards to the water consumer are eliminated promptly, and to ensure compliance with the SDWA.

b. Compliance schedule. Where one or more MCLs, TTs, ALs, or designated HAs cannot be met immediately, a compliance schedule for achieving compliance with standards may be included in a permit. A compliance schedule requiring alterations in accordance with the standards for construction in 43.3(1) and 43.3(2) may also be included for any supply that, in the opinion of the director, contains a potential hazard.

c. Treatment. If the department determines that a treatment method identified in 43.3(10) is technically feasible, the department may require a system to install or use that treatment method in connection with a compliance schedule, pursuant to 43.2(4)*"b."* The department's determination shall be based upon studies by the system and other relevant information.

43.2(5) *Notification of change.* The owner of a PWS shall notify the director within 30 days of any change in conditions identified in the permit application. This notice does not relieve the owner of the responsibility to obtain a construction permit as required by 567—43.3(455B).

43.2(6) *Renewal.* The department may issue operation permits for durations of up to five years. Operation permits must be renewed prior to expiration in order to remain valid. The renewal date shall be specified in the permit or in any renewal. Application for renewal must be submitted in accordance with 43.2(3).

43.2(7) *Denial, modification, or suspension.* The director may deny a new or renewal of, modify, or suspend, in whole or in part, any operation permit for good cause. Denial of a new permit, renewal of an existing permit, or modification of a permit may be appealed to the commission pursuant to 567—Chapter 7. Suspension or revocation may occur after hearing, pursuant to 567—Chapter 7. Good cause includes:

a. Violation of any term or condition of the permit.

b. Failure to pay the fee in accordance with 43.2(1).

c. Obtaining a permit by misrepresentation of fact or failure to disclose fully all material facts.

d. A change in any condition that requires either a permanent or temporary modification of a permit condition.

e. Failure to submit records and information the director may require both generally and as a condition of the operation permit in order to ensure compliance with permit conditions.

f. Violation of any requirements in, or significant noncompliance with, 567—Chapters 40 through 43, including noncompliance with applicable MCLs, TTs, or ALs.

g. Inability of a system to either achieve or maintain technical, managerial, or financial viability, as determined in 567—43.8(455B).

567—43.3(455B) PWS construction.

43.3(1) *PWS standards.*

a. Any PWS that does not meet the drinking water standards in 567—Chapters 41 and 43 shall make alterations necessary to comply with the drinking water standards in accordance with the construction standards contained in this rule unless the PWS has been granted a waiver from an MCL or TT as a provision of its operation permit pursuant to this chapter, provided that the PWS meets the schedule established pursuant to this chapter.

b. Any PWS that, in the opinion of the director, contains a potential hazard shall make alterations necessary to eliminate or minimize the hazard in accordance with the construction standards in this rule.

c. A PWS that is not operating within the construction standards may be required by the department via a compliance schedule to upgrade the deficient areas of the system before a construction permit will be issued for any work that does not address the current deficiencies.

43.3(2) *Construction standards.*

a. The construction standards for a drinking water project are the Ten States Standards, the AWWA Standards as adopted through 2023, and 43.3(7) through 43.3(9). In any conflict between the

Ten States Standards, and the AWWA Standards, and 43.3(7) through 43.3(9), the Ten States Standards, 43.3(2), and 43.3(7) to 43.3(9) shall prevail. Additional standards include the following:

(1) Polyvinyl chloride (PVC) pipe manufactured in accordance with ASTM D2241, AWWA C900, AWWA C905, ASTM F1483, or AWWA C909 may be used for water main construction. The maximum allowable pressure for PVC or polyethylene pipe shall be determined based on a safety factor of 2.0 and a surge allowance of no less than two feet per second.

(2) For CWS groundwater (GW) systems, a minimum of two wells shall be provided, unless the system demonstrates to the department's satisfaction that a single well will provide a reliable and adequate source. For NTNC and TNC GW systems, a single well is acceptable.

(3) Separation of water mains from sanitary and combined sewers.

1. Horizontal separation of water mains from gravity sanitary and combined sewers. Water mains shall be separated from gravity sanitary and combined sewer mains by a horizontal distance of at least ten feet measured edge to edge unless the bottom of the water main is at least 18 inches above the top of the sewer, and either:

- The water main is placed in a separate trench, or
- The water main is located on a bench of undisturbed earth at a minimum horizontal separation of three feet from the sewer.

If it is not possible to obtain a horizontal separation of three feet and a vertical separation of 18 inches between the bottom of the water main and the top of the sewer, a linear separation of at least three feet shall be provided, and one of the following shall be utilized:

- The water main shall be enclosed in watertight casing pipe with an evenly spaced annular gap and watertight end seals, or
- The sewer shall be constructed of water main materials.

The separation distance (SD) between the water main and the sewer shall be the maximum feasible in all cases.

2. Horizontal separation of water mains from sanitary sewer force mains. Water mains shall be separated from sanitary sewer force mains by a horizontal distance of at least ten feet measured edge to edge unless the sanitary sewer force main is constructed of water main materials and the water main is laid at least four feet horizontally from the sanitary sewer force main. The SD between the water main and the sanitary sewer force main shall be the maximum feasible in all cases.

3. Vertical separation of water mains from sanitary and combined sewer crossovers. Vertical separation of water mains crossing over any sanitary or combined sewers shall be at least 18 inches when measured from the bottom of the water main to the top of the sewer. If it is not possible to maintain the required vertical separation, one of the following shall be utilized:

- The bottom of the water main shall not be placed closer than six inches above the top of a sewer, or
- The top of the water main shall not be placed closer than 18 inches below the bottom of a sewer.

When a water main crosses below or less than 18 inches above a sanitary or combined sewer, one of the following shall be utilized within approximately ten feet measured edge to edge horizontally, centered on the crossing, with joints located as far as possible from the point of crossing:

- The water main shall be enclosed in watertight casing pipe with an evenly spaced annular gap and watertight ends, or
- Sewer pipe of water main material shall be installed.

The SD shall be the maximum feasible in all cases. Wherever a water main crosses a sanitary or combined sewer, the water main and sanitary or combined sewer pipes must be adequately supported. A low permeability soil shall be used for backfill material within ten feet of the point of crossing along the water main.

4. Horizontal separation of water mains from sanitary and combined sewer manholes. No water pipe shall pass through or come in contact with any part of a sanitary or combined sewer manhole. A minimum horizontal separation of three feet shall be maintained.

(4) Separation of water mains from storm sewers.

1. Horizontal separation of water mains from gravity storm sewers. Water mains shall be separated horizontally from gravity storm sewers by at least ten feet measured edge to edge. If it is not possible to maintain the required horizontal separation of ten feet, a minimum of three feet of separation shall be maintained and one of the following shall be utilized within ten feet measured edge to edge:

- The water main shall be constructed of ductile iron pipe with gaskets impermeable to hydrocarbons, or
- The water main shall be enclosed in watertight casing pipe with an evenly spaced annular gap and watertight end seals, or
- Storm sewer pipe of water main material shall be installed, or
- Reinforced concrete pipe storm sewers shall be constructed with gaskets manufactured in accordance with ASTM C443.

2. Vertical separation of water mains from storm sewer crossovers. Water mains shall be vertically separated from storm sewers by at least 18 inches between the outside edges of the water main and the storm sewer. The SD shall be the maximum feasible in all cases. In all cases where a water main crosses a storm sewer, the water main and storm sewer pipes must be adequately supported. A low permeability soil shall be used for backfill material within ten feet of the point of crossing along the water main. If it is not possible to obtain 18 inches of vertical separation where the water main crosses above a storm sewer, a minimum of 6 inches vertical separation shall be maintained and one of the following shall be utilized within ten feet measured edge to edge horizontally, centered on the crossing:

- The water main shall be constructed of ductile iron pipe with gaskets impermeable to hydrocarbons, or
- The water main shall be enclosed in watertight casing pipe with an evenly spaced annular gap and watertight end seals, or
- Storm sewer pipe of water main material shall be installed, or
- Reinforced concrete pipe storm sewers shall be constructed with gaskets manufactured in accordance with ASTM C443.

(5) All water mains, including those not designed to provide fire protection, shall be sized based on flow demands and pressure requirements. For regional water systems and for major distribution system upgrades, a hydraulic analysis may be required as part of the project submittal. Systems shall be designed to maintain a minimum pressure of 20 psi at ground level at all points in the distribution system under all conditions of flow. The normal working pressure in the distribution system should be approximately 60 to 80 psi and should not be less than 35 psi.

b. When engineering justification satisfactory to the director is provided substantially demonstrating that a waiver from the construction standards will result in equivalent or improved effectiveness, a waiver may be granted by the director. A waiver denial may be appealed to the commission pursuant to 567—Chapter 7. Waiver requests for projects qualifying for a waiver from the engineering requirement of 43.3(4) may be made without the retained services of a professional engineer.

43.3(3) *Construction permits.* No person shall construct, install or modify any project without first obtaining, or contrary to any condition of, a construction permit issued by the director or by a local public works department authorized to issue permits under 567—Chapter 9, except as provided in this chapter. Construction permits are not required for POU treatment devices installed by a noncommunity water system (NCWS), except for those devices required by the department to meet a drinking water standard pursuant to 567—Chapters 41 and 43. No construction permit will be issued for a new PWS without a completed, department-approved viability assessment, which demonstrates that the system is viable pursuant to 567—43.8(455B).

a. Issuance conditions. A construction permit shall be issued by the director if the director concludes that the project will comply with department rules. Project construction must begin within

one year from the permit issuance date; if it does not, the permit is no longer valid. If construction is ongoing and continuous (aside from weather delays) and the permitted project cannot be completed within one year, the permit shall remain valid until the project is completed. The department may extend a permit for a multiphase project, for a maximum two additional years.

b. Applications. A construction permit application for any project shall be submitted to the department at least 30 days prior to the proposed date for commencing construction or awarding contracts. This requirement may be waived when the department determines that an imminent health hazard exists to a PWS's consumers. Under this waiver, construction, installation, or modification may be allowed by the department prior to review and issuance of a permit if all the following conditions are met:

(1) The construction, installation, or modification will alleviate the health hazard;

(2) The construction is done in accordance with the construction standards, pursuant to 43.3(2);

(3) Plans and specifications are submitted within 30 days after construction;

(4) A professional engineer, licensed in the state of Iowa, supervises the construction; and

(5) The supplier of water receives approval of this waiver prior to any construction, installation, or modification.

c. Fees. A nonrefundable fee, as noted in this paragraph, shall be submitted with a construction permit application.

(1) Construction permit fees. The fee shall be determined based upon the total length of water main plus the non-water-main-related construction costs, calculated as follows:

1. Water mains (minimum $100; maximum $5,000):

Length of permitted water main	Rate
First 1,000 ft.	$100
Next 19,000 ft.	$0.10/ft.
Next 300,000 ft.	$0.01/ft.
Over 320,000 ft.	No additional charge

2. Non-water-main-related construction costs, including source, treatment, pumping, storage and waste handling (minimum $100; maximum $16,000):

Estimated construction cost	Rate
First $50,000	$100
Next $950,000	0.2% of estimated construction cost
Next $14,000,000	0.1% of estimated construction cost
Over $15,000,000	No additional charge

(2) "As-built" construction fees. "As-built" construction is defined as construction that occurred before a construction permit is issued. The fee shall be calculated according to 43.3(3)*"c"*(1), plus an additional fee of $200. The fee for water main projects permitted in accordance with 43.3(3)*"e"* shall be calculated in accordance with 43.3(3)*"c"*(1); however, the additional "as-built" fee of $200 shall not be assessed for these projects.

(3) Other fees. A fee for change orders, addenda, permit supplements will only be charged if the aggregate of the changes approved for the project to date causes the total project construction cost to exceed the original project construction cost by at least 5 percent. For water main extensions, the fee will be charged if the total length of water main exceeds the original approved length by 5 percent. The request for a time extension is a flat fee.

Other Categories	Rate
Change orders, addenda, and permit supplements for water mains	$0.10/ft. of additional water main, minimum: $50

Other Categories	Rate
Change orders, addenda, and permit supplements for non-water-main-related construction costs	0.2% of additional non-water-main-related construction costs, minimum: $50
Request for time extension	$50

(4) Calendar year fee cap. The total amount of construction permit fees for a PWS owner during any calendar year shall not exceed $5,000 for water mains and $16,000 for non-water-main-related construction projects.

d. Water well construction. All water well construction must be performed by a certified well contractor in accordance with 567—Chapter 82. It is the responsibility of the PWS and certified well contractor to ensure that a public well construction permit has been issued by the department prior to initiation of well construction and to ensure that all well construction is performed in accordance with this chapter.

e. Minor water main construction permit. A PWS may obtain a minor water main construction permit from the department for construction or replacement of minor water mains that serve additional users. By obtaining this permit, the system is able to construct, extend, or replace new or existing minor water mains without obtaining an individual construction permit for each specific water main. The permit shall allow construction or replacement of minor water mains that do not exceed six inches in diameter and, in aggregation, do not increase the average daily demand (in gallons per day) of the PWS by more than 5 percent over the duration of the permit.

The additional users must have been included in the system's approved hydraulic analysis. The water demands of the additional users must be consistent with the water demands in the approved hydraulic analysis.

(1) A minor water main construction permit shall be issued subject to the following conditions:

1. The system has approved standard specifications for water main construction filed with the department;

2. The system has adequate source capacity and, where treatment is provided, adequate treatment plant capacity to meet the peak day demand of all existing users and the proposed additional users covered under the permit;

3. The system has adequate storage capacity to meet the average day demand of all existing users and the proposed additional users covered under the permit; and

4. The system submits an application for a minor water main construction permit to the department 90 days before the anticipated first use of the permit. Construction shall not commence prior to the issuance of a permit.

(2) An application for minor water main construction permit shall include:

1. An up-to-date hydraulic analysis of the system, prepared by a licensed professional engineer (unless one is already on file with the department). The hydraulic basis of flow (gallons per minute per connection) used in the analysis must be acceptable to the department. A hydraulic analysis shall include:

- All existing water mains within the system;
- All proposed water mains intended to be covered by the permit;
- A demonstration that the system has adequate hydraulic capacity to serve the existing and new users under peak flow conditions without causing the pressure to fall below 20 psi anywhere within the system;
- The location of all potential users of the system;
- The diameter of all existing and proposed pipes;
- The projected system flows; and
- The static and dynamic pressures anticipated throughout the system with the addition of the new users incorporated in the analysis.

2. A completed Schedule 1b, Form 542-3151.

(3) The PWS must submit completed Schedule 2c, Form 542-3152, prior to the construction or replacement of each minor water main covered by a permit. Each water main covered by a permit must have either been included in the previously submitted hydraulic analysis or must be included in an update to the hydraulic analysis, submitted with Schedule 2c. If an update to the hydraulic analysis is submitted, it must include all portions of the distribution system potentially affected by the new construction.

(4) By January 31 of the year following permit issuance, the PWS shall submit the following to the department:

1. A complete set of plans for all water main extensions constructed under the permit, prepared and submitted by a licensed professional engineer.
2. Completed Schedules 1a, 1c, and 2a.
3. The construction permit fee calculated in accordance with 43.3(3)*"c"*(1). The fee calculation shall be based upon the total length of water main constructed under a permit. For the purpose of calculating the total fee amount in accordance with 43.3(3)*"c"*(4), the fee shall be credited to the calendar year in which it was received by the department.

(5) A permit shall contain conditions deemed necessary by the director to ensure compliance with all applicable department rules.

(6) The director may modify a permit, in whole or in part, at any time. The director may suspend or revoke a permit, in whole or in part, at any time by providing written notice to the permit holder, and is not obligated to renew the permit. Cause for modification, suspension, or revocation of a permit includes but is not limited to:

1. Violation of any term or condition of a permit;
2. Misrepresentation of fact or failure to disclose fully all material facts in order to obtain a permit;
3. Failure to submit department-required records and information, both generally and as condition of a permit;
4. Failure to submit timely reports from previous permits;
5. Failure to construct in accordance with either approved construction standards, in accordance with 43.3(2), or with the system's approved standard specifications.

(7) A minor water main construction permit expires on December 31 of the year in which it is issued.

(8) No waiver to the construction standards is allowed under a minor water main construction permit., except for AWWA C651 Section 5.1, Sampling Frequency. If a waiver to the construction standards is needed, the system must apply for an individual construction permit following the procedures in 567—subrule 40.4(1).

43.3(4) *Waiver from engineering requirements.* The requirement for preparation of plans and specifications by a licensed professional engineer may be waived for the following types of projects, provided the proposed improvement complies with the construction standards. This waiver does not relieve the supplier of water from meeting the application and permit requirements of 43.3(3), except that the applicant need not obtain a written permit prior to installing the equipment.

a. Simple chemical feed, if all the following conditions are met:

(1) The improvement consists only of a simple chemical solution application or installation, which in no way affects the performance of a larger treatment process, or is included as part of a larger treatment project;

(2) The chemical application is by a positive displacement pump, the acceptability of said pump to be determined by the department;

(3) The supplier of water provides the department with a schematic of the installation and manufacturer's specifications sufficient to determine if the simple chemical feed installation meets the applicable construction standards, pursuant to 43.3(2);

(4) The final installation is approved based on an on-site inspection by department staff; and

(5) The installation includes only the prepackaged delivery of chemicals (from sacks, containers, or carboys) and does not include the bulk storage or transfer of chemicals (from a delivery vehicle).

b. Self-contained treatment unit, if all the following conditions are met:

(1) The equipment can be purchased "off the shelf"; is self-contained, requiring only a piping hookup for installation; and operates throughout a range of 35 to 80 psi;

(2) The plant is designed to serve no more than an average of 250 individuals per day;

(3) The supplier of water provides the department with a schematic of the installation, manufacturer's specifications, or other necessary information, sufficient to determine if the installation of the self-contained treatment unit will alleviate an MCL violation; and

(4) The final installation is approved based on an on-site inspection by department staff.

43.3(5) *Project planning and design basis.* An engineering report describing the project design basis must be submitted to the department either with the project or in advance of construction.

a. The report must contain information and data necessary to determine:

(1) Project conformance with the construction and operation standards in 43.3(2), and

(2) The adequacy of the project to supply water in sufficient quantity, at sufficient pressure, and of a quality that complies with drinking water standards in 567—Chapters 41 and 43.

b. The report must supply pertinent information as set forth in part one of the Ten States Standards.

c. The department may reject receipt or delay review of the plans and specifications until an adequate design basis is received.

43.3(6) *Standard specifications for water main construction.* Standard specifications for water main construction by an entity may be submitted to the department or an authorized local public works department for approval.

a. An approval shall apply to all future water main construction by or for that entity for which plans are submitted with a statement requiring construction in accordance with all applicable approved standard specifications unless the standards for PWSs specified in 43.3(2) are modified subsequent to an approval and the standard specifications would not be approvable under the modified standards.

b. Where approved specifications are on file, construction may commence 30 days following plan receipt by the department or an authorized local public works department, if no response has been received indicating construction shall not commence until a permit is issued.

43.3(7) *Site and monitoring requirements for new raw water source(s) and underground finished water storage facilities, and water supply separation distances (SDs).*

a. Site approval. The site for each proposed raw source or finished water below-ground level storage facility must be approved by the department prior to the submission of plans and specifications.

b. Site approval criteria. A site may be approved if the director concludes that the criteria in this paragraph are met.

(1) Groundwater (GW) source. GW wells shall be planned and constructed to adapt to the geologic and GW conditions of the proposed site to ensure production of water that is both microbially safe and free of substances that could cause harmful human health effects. GW wells must meet the following requirements:

1. Drainage must be directed away from a well in all directions for a minimum radius of 15 feet.

2. A well site must meet the minimum SDs from contamination sources specified in Table A in 43.3(7)*"d."*

3. After a well site has received preliminary department approval, the owner of the proposed well must submit, as part of the construction permit application, proof of legal control of the land for a 200-foot radius around the well, through purchase, lease, easement, ordinance, or other similar means. Legal control must be maintained by the PWS for the life of the well. The SDs specified in Table A in 43.3(7)*"d"* must be maintained for the life of the well as legal control allows. However, if the proposed well is for an existing NCWS and is replacing an existing well that either does not meet

the current standards or is in poor condition, the 200-foot legal control requirement may be waived by the department, provided that:

- The proposed well is located on the best available site;
- The existing facility does not have adequate land to provide the 200-foot control zone;
- The owner has attempted to obtain legal control without success; and
- There is no other PWS available to which the supply could connect.

4. No GW well shall be constructed within the projected plume of any known anthropogenic GW contamination without the department's written approval. The department may allow well construction within a contamination plume if an applicant can provide treatment that ensures all drinking water standards are met and ensures that the pumpage of the proposed well will not cause plume migration that impacts the water quality of other nearby wells. An applicant must demonstrate, using a hydrogeologic model acceptable to the department, that the time of transport is greater than two years for any viral, bacterial, or other microorganism contaminant and greater than ten years for all chemical contaminants. The projected plume modeling must account for the proposed well pumpage rate. The department may require additional construction standards for these situations to ensure protection of the GW from contamination.

5. The department may require that an identification tag be applied to each GW well and may supply the numbered tag. The responsibility for ensuring that the tag is properly attached to the well is with the certified water well contractor for new wells and with the department for existing wells.

(2) Surface water (SW) source.

1. An applicant must submit proof that a proposed SW source can, through readily available treatment methodology, comply with 567—Chapters 41 and 43, and that the SW source is adequately protected against potential health hazards including, but not limited to, point source discharges, hazardous chemical spills, and the potential sources of contamination listed in Table A in 43.3(7)*"d."*

2. After a SW impoundment has received preliminary department approval for use as a raw water source, the owner of the PWS shall submit proof of legal control through ownership, lease, easement, or other similar means, of contiguous land for a distance of 400 feet from the shoreline at the maximum water level. Legal control shall be for the life of the impoundment and shall control location of sources of contamination specified in Table A in 43.3(7)*"d"* within the 400-foot distance. Proof of legal control should be submitted with the construction permit application and shall be submitted prior to issuance of a construction permit.

c. New source water monitoring requirements. Water quality monitoring shall be conducted on all new water sources and results submitted to the department prior to placing the new water source into service.

(1) All sources. Water samples shall be collected from each new water source and analyzed for all appropriate contaminants, as specified in 567—Chapter 41, consistent with the particular system classification. If multiple new sources are being added, sample compositing (within a single system) shall be allowed in accordance with the composite sampling requirements in 567—Chapter 41. A single sample may be allowed to meet this requirement, if approved by the department. Subsequent water testing shall be conducted consistent with the system's operation permit monitoring schedule.

(2) GW sources. Water samples from GW sources shall be collected at the conclusion of the drawdown/yield test pumping procedure, with the exception of bacteriological monitoring. Bacteriological monitoring must be conducted after disinfection of each new well and subsequent pumping of the chlorinated water to waste. Water samples must be analyzed for ammonia and should be analyzed for alkalinity, pH, calcium, chloride, copper, hardness, iron, magnesium, manganese, potassium, silica, specific conductance, sodium, sulfate, filterable and nonfilterable solids, and zinc.

(3) SW sources. Water samples from SW sources should be collected prior to the design of the SW treatment facility and shall be collected and analyzed prior to utilization of the source. Samples shall be collected during June, July, and August. In addition, quarterly monitoring shall be conducted in March, June, September, and December at a location representative of the raw water at its point of withdrawal. Samples shall be analyzed for turbidity, alkalinity, pH, calcium, chloride, color, copper,

hardness, iron, magnesium, manganese, potassium, silica, specific conductance, sodium, sulfate, filterable and nonfilterable solids, carbonate, bicarbonate, algae (qualitative and quantitative), total organic carbon (TOC), five-day biochemical oxygen demand, dissolved oxygen, surfactants, nitrogen series (organic, ammonia, nitrite, and nitrate), and phosphate.

d. Separation distances (SDs). The minimum lateral SDs between wells and belowground finished water storage facilities and structures or sources of contamination are specified below in Table A. Additional legal and conveyance-specific SD requirements are specified for public wells in 43.3(7)*"b"* and for water mains in 43.3(2)*"a"*(3) and 43.3(2)*"a"*(4).

(1) There shall be no physical connection between a public or private potable water supply system and a sewer, or appurtenance thereto, that would permit the passage of any sewage into a potable water supply.

(2) When a proposed well is located in an existing well field and will withdraw water from the same aquifer as the existing well(s), the individual SDs listed in Table A may be waived if substantial historical data are available indicating that no contamination has resulted.

(3) Greater SDs than those listed in Table A may be required where necessary to ensure that no adverse effects to systems or the existing environment will result. Lesser SDs may be considered if detailed justification is provided by the applicant's engineer showing that no adverse effects will result from the lesser distance and the regional department field office staff recommend approval of the lesser distance. Such exceptions must be based on special construction techniques or localized geologic or hydrologic conditions.

TABLE A: PUBLIC WELL AND BELOWGROUND LEVEL FINISHED WATER STORAGE FACILITY SEPARATION DISTANCES

Structure or Source of Contamination	Required Minimum Lateral Distance, as Measured Horizontally on the Ground Surface, in feet		
	Public Wells		Belowground level finished water storage facility
	Deep Well[1]	Shallow Well[1]	
PRIVATE WELLS:			
Private wells (new or existing, deep or shallow)	200	400	50
GHEX loop boreholes[2]	200		50
WASTEWATER STRUCTURES:			
Land Disposal of Treated Wastes:			
Irrigation of wastewater	200	400	50
Land application of solid wastes[3]	200	400	50
Land application of septage[4]	500		50
Water treatment plant waste discharged to the ground surface	50		50
Other sanitary and industrial discharges to the ground surface	400		50
Wastewater Disposal Systems:			
Water treatment plant waste treatment structures[5]	50		50
PSDSs and onsite treatment systems – closed portion[6]	100	200	50
PSDSs and onsite treatment systems – open portion[6]	200	400	50
Lagoons[7]	400	1000	50
Mechanical wastewater treatment plants[8]	200	400	50
CHEMICALS:			
Transmission pipelines (including, but not limited to, fertilizer, liquid petroleum, or anhydrous ammonia)	200	400	50
Chemical applications to ground surface	100	200	50
Chemical and mineral storage, except for liquid propane gas (LPG)			
Above ground storage[9]	100	200	50
On or under ground storage	200	400	50

Structure or Source of Contamination	Required Minimum Lateral Distance, as Measured Horizontally on the Ground Surface, in feet		
	Public Wells		Belowground level finished water storage facility
	Deep Well[1]	Shallow Well[1]	
Liquid propane gas (LPG) storage tanks	15		15
ANIMALS:			
Animal pasturage	50		50
Animal enclosures (such as confinement buildings or open feedlots)	200	400	50
Earthen silage storage trenches or pits	100	200	50
Animal Wastes:			
Storage basins or lagoons or runoff control basins	400	1000	50
Solids stockpiles, solids settling facilities, or storage tanks	200	400	50
Land application of liquid, slurry, or solids	200	400	50
WATERBODIES:			
Flowing streams, ponds, lakes, reservoirs, wetlands, or drainage channels[10]	50		50
MISCELLANEOUS STRUCTURES:			
Basements, pits, or sumps[11]	10		10
Cemeteries	200		50
Cisterns	50	100	50
Railroads	100	200	50
Solid waste landfills and disposal sites[12]	1000		50
GRAVITY SANITARY SEWER MAINS AND STORM SEWERS[13] Includes sewers carrying water treatment plant wastes, building sewer service lines, and laterals[14]			
General gravity sanitary and storm sewer minimums	0-25: prohibited		0-25: prohibited
Water main materials[15]	25-75		25
Standard sanitary sewer materials[15]	75-200		50
SANITARY SEWER FORCE MAINS:[13]			
General sanitary sewer force main minimums	0-75: prohibited		0-50: prohibited
Water main materials[15]	75-400		50
Standard sanitary sewer materials[15]	400-1000		50
DRAINS:[13]			
General drains, including well house floor drains to sewers:			
General drain minimums	0-25: prohibited		0-25: prohibited
General drains - water main materials[15]	25-75		25-50
General drains - sanitary sewer materials[15]	75-200		50
Well house floor drains to surface:			
General well house floor drains to surface minimums	0-5: prohibited		0-5: prohibited
Standard sanitary sewer material[15]	5-50		5-50
MISCELLANEOUS CONVEYANCES:[13]			
Internal conveyance piping for water plant treatment process wastes treated onsite:			
Internal conveyance piping minimums	0-5: prohibited		0-5: prohibited
Standard sanitary sewer materials[15]	5-50		5-50

[1]Deep and shallow wells are defined in 567—40.2(455B).

[2]GHEX loop boreholes are defined in 567—49.2(455B).

[3]Solid wastes, for the purpose of land application, are those derived from the treatment of water or wastewater, including sewage sludge, as defined in 567—Chapter 67. Certain types of solid wastes from water treatment processes may be land-applied within the SD on an individual, case-by-case basis.

[4]Septage shall be land applied in accordance with 567—Chapter 68.

[5]The term "water treatment plant waste treatment structures" includes lagoons that are used solely to store wastes or wastewater from drinking water treatment plants, such as lime sludge storage lagoons.

[6]PSDS (private sewage disposal system) is defined in 567—subrule 69.1(2). "Onsite treatment system" includes any wastewater treatment system not included in the definition of a private sewage disposal system (i.e., provides treatment or disposal of domestic sewage from more than four dwelling units or 16 or more individuals on a continuing basis) that is utilizing onsite wastewater treatment technologies described in 567—Chapter 69 to treat domestic waste. Closed portion refers to the part of a treatment system that is fully contained and does not allow effluent or pretreated effluent to enter soil or groundwater (e.g., septic tank or impervious vault toilet). Open portion refers to the part of a treatment system that allows effluent or pretreated effluent to discharge into soil or groundwater for treatment or disposal (e.g., soil absorption system or unlined ISSF system). These SDs also apply to septic systems that are not considered privately owned.

[7]The term "lagoons" includes aerated lagoon systems, advanced aerated lagoon systems, and waste stabilization lagoons as defined in 567—subrule 81.1(1) and holding ponds, equalization basins, and sludge digestion or holding tanks as described in the IWFDS. The term does not include lagoons used to dispose of water treatment plant wastes and anaerobic lagoons used for animal wastes (as noted in footnote 6). The SD from lagoons shall be measured from the water surface.

[8]The term "mechanical treatment plants" include activated sludge systems and fixed film biological treatment systems, as defined in 567—subrule 81.1(1), and any other wastewater disposal system that is not a PSDS, an onsite treatment system, or a lagoon.

[9]The minimum SD for liquid fuel storage associated with standby power generators shall be 50 feet if secondary containment is provided. Secondary containment shall provide for a minimum of 110 percent of the liquid fuel storage capacity. Double-walled storage tanks shall not be considered as secondary containment. Electrical power transformers mounted on a single utility pole are exempt from the SD requirements.

[10]Includes drainage channels that may have a direct connection to the groundwater table or a surface water.

[11]The SDs from basements, pits, and sumps must be met in order for a well to be considered a protected source for the purposes of the coliform sampling frequency determination in 567—subparagraph 41.2(1)*"e"*(4).

[12]Solid waste, when referring to landfills and disposal sites, means garbage, refuse, rubbish, and other similar discarded solid or semisolid materials, including but not limited to such materials resulting from industrial, commercial, agricultural, and domestic activities.

[13]The SDs are dependent upon the two following factors: the type of piping that is in the existing sewer or drain, as noted in the table, and whether the piping was properly installed in accordance with the standards.

[14]The distances for building sewer service lines and laterals shall be considered the minimum distances when constructing sewer lines and shall be increased where possible to provide better protection.

[15]These are the type of materials or pipe used to construct the type of sewer, main, or drain as specified in accordance with 43.3(2) and Section 2.4 of the IWFDS.

43.3(8) *Drinking water system components.* Drinking water system components that come into contact with raw, partially treated, or finished water must be suitable for the intended use in a potable water system. Components must be certified by an American National Standards Institute (ANSI) accredited third party for conformance with ANSI/NSF Standard 61 and ANSI/NSF lead-free (through annex G of 372) specifications, if such specification exists for the particular product, unless approved components are not reasonably available for use. Component materials generally excluded from ANSI/NSF 61 requirements include concrete, stainless steel, and aluminum. If the component does not meet the ANSI/NSF Standard 61 and lead-free specifications or no specification is available, the person seeking to supply or use the component must prove to the department's satisfaction that the component is not toxic or otherwise a potential hazard in a potable PWS.

43.3(9) *Water treatment filter media material.* For single media filters, grain sizes up to 0.8 mm effective size may be approved for filters designed to remove constituents other than those contained in the primary drinking water standards. Pilot or full-scale studies demonstrating satisfactory treatment efficiency and operation with the proposed media will be required prior to issuing any construction permits that allow filter media sizes greater than 0.55 mm.

43.3(10) *Best available treatment (BAT) technology.*

a. BATs for organic compounds. The table in 40 CFR §141.61(b) identifies either granular activated carbon (GAC), packed tower aeration (PTA), or oxidation (OXID) as the BAT, TT, or other means available for achieving compliance with the MCL for organic contaminants identified in 567—paragraph 41.5(1)*"b."* When setting MCLs for synthetic organic chemicals (SOCs), any BAT must be at least as effective as GAC.

b. BATs for inorganic chemicals (IOCs) and radionuclides.

(1) IOCs. The BAT for Inorganic Compounds table in 40 CFR §141.62(c) identifies the BAT technology, TT, or other means available for achieving compliance with the MCLs for the IOC contaminants listed in 567—paragraph 41.3(1)*"b,"* except fluoride.

(2) Arsenic. The Small System Compliance Technologies for Arsenic table in 40 CFR §141.62(c) identifies the affordable technology, TT, or other means available to systems serving 10,000 or fewer persons for achieving compliance with the arsenic MCL.

(3) Radionuclides.

1. Table B in 40 CFR §141.66(g) identifies the BAT for achieving compliance with the radionuclide MCL.

2. Table D in 40 CFR §141.66(h) identifies the radionuclides BATs for systems serving 10,000 or fewer people.

c. BATs for disinfection byproducts (DBPs) and disinfectants. The BATs for achieving compliance with the MCLs for the DPBs listed in 567—paragraph 41.5(2)*"b"* and the MRDLs listed in 567—paragraph 41.5(2)"c" are identified in 40 CFR §141.64.

d. Requirement to install the BAT. The department shall require CWSs and NTNCs to install and use any treatment method identified in 43.3(10) as a condition for granting an interim contaminant level, except as provided in 43.3(10)*"e."* If, after installation of the treatment method, a system cannot meet the MCL, it shall be eligible for a compliance schedule with an interim contaminant level granted under 567—subrule 40.5(9) and 567—43.2(455B).

e. Engineering assessment option. If a system can demonstrate through comprehensive engineering assessments, which may include pilot plant studies at the department's discretion, that the treatment methods identified in 43.3(10) would only achieve a de minimis reduction in contaminants, the department may establish a compliance schedule that requires the system being granted the waiver to examine other treatment methods as a condition of obtaining the interim contaminant level.

f. Compliance schedule. If the department determines that a treatment method identified in 43.3(10)*"a,""b,"* and *"c"* is technically feasible, the department may require a system to install or use a treatment method in connection with a compliance schedule established under 567—40.5(9) and 567—43.2(455B). The determination shall be based upon studies by the system and other relevant information.

g. Avoidance of unacceptable risk to health (URTH). To avoid an URTH, the department may require a PWS to use bottled water, POU devices, POE devices, or other means as a condition of granting a waiver or an exemption from the requirements of 43.3(10) or as a condition of a compliance schedule.

567—43.4(455B) Certification of completion. Within 30 days after completion of construction, installation or modification of any project, the construction permit holder shall submit a certification by a licensed professional engineer that the project was completed in accordance with the approved plans and specifications, except if the project received a waiver pursuant to 43.3(4).

567—43.5(455B) Filtration and disinfection for surface water (SW) and influenced groundwater (IGW) PWSs.

43.5(1) *Applicability/general requirements.* These rules apply to all PWSs using SW or IGW, in whole or in part, and establish criteria under which filtration is required as a treatment technique (TT). In addition, these rules establish TT requirements in lieu of MCLs for *Giardia lamblia*, heterotrophic plate count (HPC) bacteria, *Legionella*, viruses and turbidity. Each PWS with a SW or IGW must provide source water treatment that complies with these TT requirements. Systems that serve at least 10,000 persons must also comply with 567—43.9(455B). Systems that serve fewer than 10,000 persons must also comply with 567—43.10(455B).

a. TT requirements. The TT requirements consist of installing and properly operating water treatment processes which reliably achieve:

(1) At least 99.9 percent (3-log) removal or inactivation of Giardia lamblia cysts between a point where the raw water is not subject to recontamination by SW runoff and a point downstream before or at the first customer; and

(2) At least 99.99 percent (4-log) virus removal or inactivation between a point where the raw water is not subject to recontamination by SW runoff and a point downstream before or at the first customer.

b. Criteria for identification of IGW. Direct GW influence must be determined for individual sources in accordance with department criteria. The department determination of direct influence may be based on site-specific measurements of water quality or documentation of well construction characteristics and geology with field evaluation.

c. Sources subject to this rule. Only SW and IGW that are at risk to the contamination from Giardia cysts are subject to this rule. GW sources shall not be subject to this rule.

d. Source evaluation criteria. The identification of a source as SW or IGW shall be determined for an individual source, by the department, in accordance with the criteria in this rule. These criteria shall be used to delineate between SW, IGW, and GW. The PWS shall provide to the department that information necessary to make the determination.

e. Preliminary evaluation. For all sources, the department shall conduct a preliminary evaluation of information provided by the PWS to determine if the source is an obvious SW or is an IGW. The source shall be evaluated during that period of highest susceptibility to influence from SW. A preliminary evaluation may include a review of surveys, reports, geological information of the area, physical properties of the source, and departmental and PWS records.

(1) If the source is identified as a SW, no additional evaluation is needed.

(2) If the source is GW and identified as a deep well, no additional evaluation is needed unless through direct knowledge or documentation the source does not meet the well source evaluation requirements in 43.5(1)*"f."* The deep well shall then be evaluated using a formal evaluation in accordance with 43.5(1)*"g"*(3).

(3) If the source is a shallow well, a well source evaluation shall be conducted in accordance with 43.5(1)*"f"*(2).

(4) If the source is a spring, infiltration gallery, radial collector well, or any other subsurface source, a formal evaluation shall be conducted in accordance with 43.5(1)*"g."*

f. Well source evaluation. Shallow wells greater than 50 feet in lateral distance from a SW source shall be evaluated for direct influence of SW through a review of departmental or PWS files in accordance with this paragraph. Sources that meet these criteria shall be considered to be not under the direct influence of SW, and no additional evaluation will be required. Shallow wells 50 feet or less in lateral distance from a SW shall be evaluated in accordance with 43.5(1)*"g"* and *"h."*

(1) Well construction criteria. The well shall be constructed so as to prevent SW from entering the well or traversing the casing.

(2) Water quality criteria. Water quality records shall indicate:

1. No record of total coliform or fecal coliform contamination in untreated samples collected over the past three years.

2. No history of turbidity problems associated with the well, other than turbidity as a result of inorganic chemical precipitates.

3. No history of known or suspected outbreak of Giardia or other pathogenic organisms associated with SW (e.g., *Cryptosporidium*) that has been attributed to the well.

(3) Other available data. If data on particulate matter analysis of the well are available, there shall be no evidence of particulate matter present that is associated with SW. If information on turbidity or temperature monitoring of the well and nearby SW is available, there shall be no data on the source which correlates with that of a nearby SW.

(4) Further evaluation. Wells that do not meet all the requirements of this paragraph shall require a formal evaluation in accordance with 43.5(1)*"g"* and may require a particulate analysis and physical properties evaluation in accordance with 43.5(1)*"h."*

g. Formal evaluation. A formal evaluation shall be conducted by the department or a licensed professional engineer at the direction of the PWS.

(1) A formal evaluation shall include a complete file review and may include a field survey, as noted below.

1. Complete file review. In addition to the information gathered in a preliminary evaluation in 43.5(1)*"e,"* a complete file review for a well source shall consider, but not be limited to, design and construction details; evidence of direct SW contamination; water quality analysis; indications of waterborne disease outbreaks; operational procedures; and customer complaints regarding water quality or water-related infectious illness.

2. Field survey. An evaluation of a source other than a well source shall include a complete file review and a field survey. A field survey shall substantiate findings of the complete file review and determine if the source is at risk to pathogens from direct SW influence. A survey shall examine the source for evidence that SW enters the source through defects, which may include but is not limited to a lack of a surface seal on wells, infiltration gallery laterals exposed to SW, springs open to the atmosphere, or surface runoff entering a spring or other collector. A field survey shall note the distances to obvious SW sources.

(2) A report summarizing the findings of the complete file review and the field survey, when conducted, shall be submitted to the department for final review and classification of the source. Either method or both may be used to demonstrate that the source is an SW or an IGW.

1. If the complete file review or field survey demonstrates conclusively that the source is subject to the direct SW influence, the source shall be classified as an IGW.

2. If the findings do not demonstrate conclusive evidence of direct influence of SW, the analysis and evaluation in 43.5(1)*"h"* should be conducted.

h. Particulate analysis and physical properties evaluation.

(1) SW indicators. Particulate analysis shall be conducted to identify organisms that only occur in SWs as opposed to GWs, and whose presence in GW would indicate the direct influence of SW.

1. Identification of a Giardia cyst, live diatoms, and blue-green, green, or other chloroplast containing algae in any source water shall be considered evidence of direct SW influence.

2. Rotifers and insect parts are indicators of SW. Without knowledge of which species is present, the finding of rotifers indicates that the source is either directly influenced by SW, or the water contains organic matter sufficient to support the growth of rotifers. Insects or insect parts shall be considered strong evidence of SW influence, if not direct evidence.

3. The presence of coccidia (e.g., *Cryptosporidium*) in the source water is considered a good indicator of direct influence of SW. Other macroorganisms (greater than 7 um) that are parasitic to animals and fish, such as, but not limited to, helminths (e.g., tapeworm cysts), ascaris, and Diphyllobothrium, shall be considered as indicators of direct influence of SW.

(2) Physical properties. Turbidity, temperature, pH and conductivity provide supportive, but less direct, evidence of direct influence of SW. Temperature fluctuations or turbidity fluctuations of greater than 0.5-1.0 NTU over the course of a year may indicate direct influence of SW. Changes in other chemical parameters such as pH, conductivity, or hardness may indirectly indicate influence by nearby SW.

i. Compliance. A PWS using a SW source or an IGW is considered to be in compliance with this subrule if it meets the filtration requirements in 43.5(3) and the disinfection requirements in 43.5(2).

j. Certified operator requirement. Each PWS using a SW source or an IGW must be operated by a certified operator who meets the requirements of 567—Chapter 81.

43.5(2) *Disinfection requirements.* All CWS, NTNC, and TNC using SW or IGW in whole or in part shall be required to provide disinfection in compliance with this subrule and filtration in compliance with 43.5(3). If the department has determined that filtration is required, the system must comply with any interim disinfection requirements the department deems necessary before filtration is installed. A system providing filtration on or before December 30, 1991, must comply with this subrule beginning June 29, 1993. A system providing filtration after December 30, 1991, must comply

with this subrule when filtration is installed. Failure to meet any requirement of this subrule after the applicable date is a TT violation.

a. Disinfection treatment criteria.

(1) Disinfection treatment must be sufficient to ensure that the total treatment processes of a system achieve at least 99.9 percent (3-log) inactivation or removal of *Giardia lamblia* cysts and at least 99.99 percent (4-log) virus inactivation or removal, acceptable to the department.

(2) At least 0.5 log inactivation of *Giardia lamblia* cysts must be achieved through disinfection treatment using a chemical disinfectant even if the required inactivation or removal is met or exceeded through physical treatment processes.

(3) Each system must calculate the total inactivation ratio (CTcalculated/CTrequired) each day the treatment plant is in operation. A system's total inactivation ratio must be equal to or greater than 1.0 to ensure that the minimum inactivation and removal requirements have been achieved. If a system's total inactivation ratio for the day is below 1.0, it must notify the department within 24 hours.

b. Disinfection system. The disinfection system must include either:

(1) Redundant components, including an auxiliary power supply with automatic start-up and alarm, to ensure that disinfectant application is maintained continuously while water is being delivered to the distribution system, or

(2) Automatic shutoff of delivery of water to the distribution system when there is less than 0.3 mg/L of residual disinfectant concentration (RDC) in the water. If the department determines that automatic shutoff would cause unreasonable risk to health or interfere with fire protection, the system must comply with 43.5(2)*"b"*(1).

c. Residual disinfectant entering system. The RDC in the water entering the distribution system, measured as specified in 43.5(4)*"a"*(5) and 43.5(4)*"b"*(2)(1), cannot be less than 0.3 mg/L free residual or 1.5 mg/L total residual chlorine for more than four hours.

d. Residual disinfectant in the system. The RDC in the distribution system, measured as total chlorine, combined chlorine, or chlorine dioxide, as specified in 43.5(4)*"a"*(5) and 43.5(4)*"b"*(2)(2), cannot be undetectable in more than five percent of the samples each month for any two consecutive months that the system serves water to the public. Water within the distribution system with an HPC bacteria concentration less than or equal to 500/mL, measured as HPC as specified in 567—paragraph 41.2(3)*"e,"* is deemed to have a detectable disinfectant residual for purposes of determining compliance with this requirement. Therefore, the value "V" in the following formula cannot exceed five percent in one month for any two consecutive months.

$V = [(c + d + e) / (a + b)] \times 100$

where the letters indicate the number of instances in which:

a = RDC is measured

b = RDC is not measured but HPC bacteria is measured

c = RDC is measured but not detected and no HPC is measured

d = no RDC is detected and where the HPC is greater than 500/mL

e = RDC is not measured and HPC is greater than 500/mL

43.5(3) *Filtration requirements.* Turbidity measurements required by this subrule shall be made in accordance with 43.5(4)*"a"*(1) and 43.5(4)*"b"*(1).

a. Applicability. A PWS that uses a SW source or an IGW source must provide treatment consisting of both disinfection, as specified in 43.5(2), and filtration treatment that complies with the turbidity requirements of 43.5(3), 43.5(4), and 43.5(5). A system shall install filtration within 18 months after the department determines, in writing, that filtration is required. The department may require, and a system shall comply, with any interim turbidity requirements the department deems necessary. Failure to meet any requirements of the subrules referenced below after the dates specified is a TT violation.

(1) A system providing or required to provide filtration:

1. On or before December 30, 1991, must comply with this subrule by June 29, 1993; and

2. After December 30, 1991, must comply with this subrule when filtration is installed.

(2) Beginning:

1. January 1, 2002, systems serving at least 10,000 people must meet the turbidity requirements in 567—43.9(455B); and

2. January 1, 2005, systems serving fewer than 10,000 people must meet the turbidity requirements in 567—43.10(455B).

b. Conventional filtration treatment or direct filtration.

(1) Systems using conventional filtration serving at least 10,000 people must meet the turbidity level requirements in 43.9(3)*"a."*

(2) Systems using conventional filtration or direct filtration serving fewer than 10,000 people must meet the turbidity level requirements in 43.10(4)*"a."*

c. Slow sand filtration.

(1) For systems using slow sand filtration, the turbidity level of representative samples of a system's filtered water must be less than or equal to 0.3 NTU in at least 95 percent of the measurements taken each month.

(2) The turbidity level of representative samples of a system's filtered water must not exceed 1 NTU in two consecutive 15-minute recordings.

d. Diatomaceous earth filtration.

(1) For systems using diatomaceous earth filtration, the turbidity level of representative samples of a system's filtered water must be less than or equal to 0.3 NTU in at least 95 percent of the measurements taken each month.

(2) The turbidity level of representative samples of a system's filtered water must not exceed 1 NTU in two consecutive 15-minute recordings.

e. Other filtration technologies. A PWS may use either a filtration technology not listed in 43.5(3)*"b"* to *"d"* or a filtration technology listed in 43.5(3)*"b"* or *"c"* at a higher turbidity level if it demonstrates to the department, through a preliminary report submitted by a licensed professional engineer using pilot plant studies or other means, that the alternative filtration technology, in combination with disinfection treatment that meets the requirements of 43.5(2), consistently achieves 99.9 percent removal or inactivation of *Giardia lamblia* and 99.99 percent virus removal or inactivation. For a system that uses alternative filtration technology and makes this demonstration, the turbidity TT requirements are as follows:

(1) The turbidity level of representative samples of a system's filtered water must be less than or equal to 0.3 NTU in at least 95 percent of the measurements taken each month.

(2) The turbidity level of representative samples of a system's filtered water must not exceed 1 NTU. Beginning January 1, 2002, systems serving at least 10,000 people must meet the requirements for other filtration technologies in 43.9(3)"b." Beginning January 1, 2005, systems serving fewer than 10,000 people must meet the requirements for other filtration technologies in 567—43.10(455B).

43.5(4) *Analytical and monitoring requirements.*

a. Analytical methods. Only the analytical method(s) specified in this paragraph, or otherwise approved by the department, may be used to demonstrate compliance with 43.5(2) and 43.5(3). Measurements for pH, temperature, turbidity, and RDCs must be conducted by a Grade II, III or IV operator meeting the requirements of 567—Chapter 81, any person under the supervision of such an operator, or a laboratory certified in accordance with 567—Chapter 83. For consecutive PWSs from a SW or IGW system, the disinfectant concentration analyses must be conducted by a certified operator who meets the requirements of 567—Chapter 81. Heterotrophic plate count (HPC) bacteria measurements must be conducted by a laboratory certified by the department to do such analysis.

(1) Turbidity shall be analyzed using the methodology in the following table. Calibrate each turbidimeter at least once every 90 days with a primary standard. The calibration of each turbidimeter used for compliance must be verified at least once per week with a primary standard, secondary standard, the manufacturer's proprietary calibration confirmation device, or by a department-approved

method. If the verification is not within plus or minus 0.05 NTU for measurements of less than or equal to 0.5 NTU, or within plus or minus 10 percent of measurements greater than 0.5 NTU, the turbidimeter must be recalibrated.

Turbidity Methodology

Methodology	Analytical Method				
	EPA	SM	GLI	HACH	Other
Nephelometric[5]	180.1[1]	2130B[2]	Method 2[3]	FilterTrak 10133[4]; Hach Method 8195, Rev. 3.015	
Laser Nephelometry (online)					Mitchell M5271[6]; Mitchell M5331 Rev. 1.2[10]; Lovibond PTV 600013
LED Nephelometry (online)					Mitchell M5331[7]; Mitchell M5331 Rev. 1.2[10]; AMI Turbiwell[9]; Lovibond PTV 200012; Lovibond PTV 100014
LED Nephelometry (portable)					Orion AQ4500[8]
360-degree Nephelometry					Hach Method 10258[11]

[1]"Methods for the Determination of Inorganic Substances in Environmental Samples," EPA-600/R-93-100, August 1993. NTIS, PB94-121811.

[2]SM, 18th (1992), 19th (1995), 20th (1998), 21st (2005), 22nd (2012), and 23rd (2017) editions (any of these editions may be used).

[3]GLI Method 2, "Turbidity," November 2, 1992, Great Lakes Instruments, Inc., 8855 North 55th Street, Milwaukee, WI 53223.

[4]Hach FilterTrak Method 10133, "Determination of Turbidity by Laser Nephelometry," January 2000, Revision 2.0, www.hach.com.

[5]Styrene divinyl benzene beads (e.g., AMCO-AEPA-1 or equivalent) and stabilized formazin (e.g., Hach StablCalTM or equivalent) are acceptable substitutes for formazin.

[6]Mitchell Method M5271, Revision 1.1. "Determination of Turbidity by Laser Nephelometry," March 5, 2009. www.nemi.gov.

[7]Mitchell Method M5331, Revision 1.1. "Determination of Turbidity by LED Nephelometry," March 5, 2009. www.nemi.gov.

[8]Orion Method AQ4500, Revision 1.0. "Determination of Turbidity by LED Nephelometry," May 8, 2009. www.nemi.gov or Thermo Scientific, www.thermo.com.

[9]AMI Turbiwell, "Continuous Measurement of Turbidity Using a SWAN AMI Turbiwell Turbidimeter," August 2009. www.nemi.gov.

[10]Mitchell Method M5331, Revision 1.2. "Determination of Turbidity by LED or Laser Nephelometry," February 2016. www.nemi.gov.

[11]Hach Company. "Hach Method 10258 – Determination of Turbidity by 360-Degree Nephelometry," January 2016 and March 2018, revision 2.0, www.hach.com.

[12]Lovibond PTV 2000. "Continuous Measurement of Drinking Water Turbidity Using a Lovibond PTV 2000 660-nm LED Turbidimeter," December 2016, Revision 1.0,Tintometer, Inc., 6456 Parkland Drive, Sarasota, FL 34243.

[13]Lovibond PTV 6000. "Continuous Measurement of Drinking Water Turbidity Using a Lovibond PTV 6000 Laser Turbidimeter," December 2016, Revision 1.0, Tintometer, Inc., 6456 Parkland Drive, Sarasota, FL 34243.

[14]Lovibond PTV 1000. "Continuous Measurement of Drinking Water Turbidity Using a Lovibond PTV 1000 White Light LED Turbidimeter," December 2016, Revision 1.0, Tintometer, Inc., 6456 Parkland Drive, Sarasota, FL 34243.

[15]Hach Company. "Hach Method 8195-Determination of Turbidity by Nephelometry," March 2018, Revision 3.0, www.hach.com.

(2) The temperature and pH (hydrogen ion concentration) shall be determined in compliance with the methodology n 567—subparagraph 41.4(1)*"g"*(1).

(3) The HPC bacteria sampling and analysis shall be conducted in compliance with 567—subrule 41.2(3) and 43.5(2)*"d."* The time from sample collection to initiation of analysis shall not exceed eight hours, and the samples must be held below 10 degrees Celsius during transit.

(4) The residual disinfectant concentrations (RDCs) shall be determined using one of the analytical methods in the following table. RDCs for free chlorine and total chlorine may also be measured by using DPD colorimetric test kits. Free and total chlorine residuals may be measured continuously by adapting a specified chlorine residual method for use with a continuous monitoring instrument provided the chemistry, accuracy, and precision remain the same. Instruments used for continuous monitoring must be verified with a grab sample measurement at least every seven days. The analyzer concentration must be within plus or minus 0.1 mg/L or plus or minus 15 percent (whichever is larger) of the grab sample measurement. If the verification is not within this range, immediate actions must be taken to resolve the issue and another verification must be conducted.

Disinfectant Analytical Methodology

Residual	Methodology	SM[1,2]	SM Online[6]	Other
Free chlorine	Amperometric Titration	4500-Cl D	4500-Cl D-00	D1253-03[4], 08, 14
	DPD Ferrous Titrimetric	4500-Cl F	4500-Cl F-00	
	DPD Colorimetric	4500-Cl G	4500-Cl G-00	Hach Method 10260[10]
	Syringaldazine (FACTS)	4500-Cl H	4500-Cl H-00	
	Online Chlorine Analyzer			EPA 334.0[7]
	Amperometric Sensor			ChloroSense[8]
	Indophenol Colorimetric			Hach Method 10241[11]
Total chlorine	Amperometric Titration	4500-Cl D	4500-Cl D-00	D1253-03[4], 08, 14
	Amperometric Titration (low-level measurement)	4500-Cl E	4500-Cl E-00	
	DPD Ferrous Titrimetric	4500-Cl F	4500-Cl F-00	
	DPD Colorimetric	4500-Cl G	4500-Cl G-00	Hach Method 10260[10]
	Iodometric Electrode	4500-Cl I	4500-Cl I-00	
	Online Chlorine Analyzer			EPA 334.0[7]
	Amperometric Sensor			ChloroSense[8]
Chlorine dioxide	Amperometric Titration	4500-ClO_2 C	4500-$C10_2$ C-00	
	DPD Method	4500-ClO_2 D		
	Amperometric Titration	4500-ClO_2 E	4500-$C10_2$ E-00	
	Amperometric Sensor			ChlordioX Plus[9]
	Spectrophotometric			327.0, Revision 1.1[5]
Ozone	Indigo method	4500-O_3 B[3]	4500-O_3 B-97	

[1]SM, 18th (1992), 19th (1995), 20th (1998), 21st (2005), 22nd (2012), and 23rd (2017) editions (any of these editions may be used). Only the 18th, 19th, and 20th editions may be used for chlorine dioxide Method 4500-ClO2 D.

[2]Other analytical test procedures are contained within Technical Notes on Drinking Water Methods, EPA-600/R-94-173, October 1994, NTIS PB95-104766.

[3]SM, 18th (1992), 19th (1995), 21st (2005), and 22nd (2012) editions (any edition may be used).

[4]ASTM, Vol. 11.01, 2004; any year containing the cited version of the method may be used.

[5]EPA Method 327.0, Revision 1.1, "Determination of Chlorine Dioxide and Chlorite Ion in Drinking Water Using Lissamine Green B and Horseradish Peroxidase with Detection by Visible Spectrophotometry," May 2005, EPA 815-R-05-008, www.nemi.gov.

[6]SM Online, www.standardmethods.org. The year in which each method was approved by the Standard Methods Committee is designated by the last two digits in the method number. The methods listed are the only online versions that may be used.

[7]EPA Method 334.0, "Determination of Residual Chlorine in Drinking Water Using an On-Line Chlorine Analyzer," September 2009. EPA 815-B-09-013, www.nemi.gov.

[8]ChloroSense, "Measurement of Free and Total Chlorine in Drinking Water by Palintest ChloroSense," September 2009, www.nemi.gov or Palintest Water Analysis Technologies, www.palintest.com.

[9]ChlordioX Plus. "Chlorine Dioxide and Chlorite in Drinking Water by Amperometry Using Disposable Sensors," November 2013, Palintest Water Analysis Technologies, www.palintest.com.

[10]Hach Company. "Hach Method 10260 – Determination of Chlorinated Oxidants (Free and Total) in Water Using Disposable Planar Reagent-Filled Cuvettes and Mesofluidic Channel Colorimetry," April 2013, www.hach.com.

[11]Hach Company. "Hach Method 10241 – Spectophotometric Measurement of Free Chlorine in Finished Drinking Water," November 2015, Revision 1.2, www.hach.com.

b. Monitoring. A PWS that uses a SW or IGW source must monitor in accordance with this paragraph.

(1) Turbidity.

1. Routine monitoring. Turbidity measurements required by 43.5(3) must be performed on representative samples of the system's filtered water utilizing continuous turbidity monitoring equipment. Turbidity monitoring results must be recorded at least every 15 minutes. . Turbidity must be monitored according to a written turbidity protocol approved by the department and audited for compliance during sanitary surveys.

2. Monitoring protocol. The turbidity monitoring protocol shall include, but is not limited to: sample measurement location; calibration method, frequency, and standards; verification method frequency, and documentation; and data collection, recording frequency, and reporting.

3. Failure of continuous monitoring equipment. If there is a failure in the continuous turbidity monitoring equipment, the system must conduct grab sampling every four hours in lieu of continuous monitoring until the turbidimeter is repaired and back online. A system has a maximum of five working days after failure to repair the equipment or else the system is in violation. The system must notify the department within 24 hours of both when the turbidimeter was taken offline and when it was returned online. It is a TT violation if the turbidity exceeds 1 NTU at any time during grab sampling. The system must inform the department as soon as possible, but no later than 24 hours after the exceedance is known, in accordance with 567—subparagraph 40.5(3)*"b"*(3).

(2) Residual disinfectant.

1. Residual entering the system. The RDC of the water entering the distribution system shall be monitored continuously, and the lowest value recorded each day. If there is a failure in the continuous monitoring equipment, grab sampling every four hours may be conducted in lieu of continuous monitoring, but shall not exceed five working days following the equipment failure. If acceptable to the department, systems serving 3,300 or fewer persons may take grab samples in lieu of providing continuous monitoring on an ongoing basis at the frequencies prescribed below:

Residual Disinfectant Samples Required of SW or IGW PWS

System size (persons served)	Samples per day*
500 or fewer	1
501 to 1,000	2
1,001 to 2,500	3
2,501 to 3,300	4

*When more than one grab sample is required per day, the day's samples cannot be taken at the same time. The sampling intervals must be a minimum of four-hour intervals.

If at any time the disinfectant concentration falls below 0.3 mg/L free residual or 1.5 mg/L total residual chlorine (TRC) in a system using grab sampling in lieu of continuous monitoring, the system shall take a grab sample every four hours until the RDC is equal to or greater than 0.3 mg/L free residual or 1.5 mg/L TRC.

2. Residual in the system. The RDC must be measured at least daily in the distribution system. Residual disinfectant measurements that are required as part of the total coliform bacteria sample collection under 567—subparagraph 41.2(1)*"c"*(7) shall be used to satisfy this requirement on the day(s) when a bacteria sample(s) is collected. The department may allow a PWS that uses both a GW source and a SW source or uses an IGW to take residual disinfectant samples at points other than the total coliform sampling points, if these points are included as a part of the coliform sample site plan

meeting the requirements of 567—paragraph 41.2(1)*"c"*(1)"1" and if the department determines that such points are representative of treated (disinfected) water quality within the distribution system. HPC may be measured in lieu of RDC, using the analytical methods in 567—subparagraph 41.2(3)*"e"*(1). The time from sample collection to initiation of analysis shall not exceed eight hours. All HPC samples must be kept below 10 degrees Celsius during laboratory transit, and must be analyzed by a laboratory certified in accordance with 567—Chapter 83.

43.5(5) *Reporting.* PWSs shall report the results of routine monitoring required to demonstrate compliance with rule 567—43.5(455B) and TT violations as follows:

a. Waterborne disease outbreak. Each system, upon discovering that a waterborne disease outbreak potentially attributable to that system has occurred, must report that occurrence to the department as soon as possible, but no later than by the end of the next business day.

b. Turbidity exceeds 5 NTU. If at any time the turbidity exceeds 5 NTU, the system must inform the department as soon as possible, but no later than 24 hours after the exceedance is known, in accordance with the PN requirements in 567—subparagraph 40.5(3)*"b"*(3).

c. Residual disinfectant entering distribution system below 0.3 mg/L free residual chlorine or 1.5 mg/L total residual chlorine (TRC). If at any time the residual falls below 0.3 mg/L free residual chlorine or 1.5 mg/L TRC in the water entering the distribution system, the system must notify the department as soon as possible, but no later than by the end of the next business day. The system also must notify the department by the end of the next business day whether or not the residual was restored to at least 0.3 mg/L free residual chlorine or 1.5 mg/L TRC within four hours.

d. Routine monitoring. Routine monitoring results shall be provided as part of the MORs in accordance with rule 567—40.3(455B) and 567—subrule 40.8(3).

e. Total inactivation ratio below 1.0. If the system's total inactivation ratio for the day is below 1.0, the system must notify the department within 24 hours.

43.5(6) *Filter backwash recycle provisions.* All SW or IGW systems that employ conventional filtration or direct filtration treatment and that recycle spent filter backwash water, thickener supernatant, or liquids from dewatering processes must comply with this subrule.

a. Reporting. A system must notify the department in writing by December 8, 2003, if it recycles spent filter backwash water, thickener supernatant, or liquids from dewatering processes. This notification must include the following information.

(1) A plan schematic showing the origin of all recycled flows (including, but not limited to, spent filter backwash water, thickener supernatant, and liquids from dewatering processes), the hydraulic conveyance used to transport them, and the location where they are reintroduced back into the treatment plant.

(2) In gallons per minute (GPM), the typical recycle flow, highest observed plant flow experience in the previous year, design flow for the treatment plant, minimum plant rate during which the filter backwash will be recycled, and the department-approved operating capacity for the plant where the department has made such determinations.

b. Treatment technique (TT) requirement. Any system that recycles spent filter backwash water, thickener supernatant, or liquids from dewatering processes must return these flows through the processes of its existing conventional or direct filtration system or at an alternate location approved by the department by June 8, 2004. However, if capital improvements are necessary to modify the recycle location to meet this requirement, all capital improvements must be completed no later than June 8, 2006.

c. Recordkeeping. The system must collect and retain on file the recycle flow information specified below for department review and evaluation.

(1) A copy of the recycle notification and information submitted to the department under 43.5(6)*"a"*;

(2) A list of all recycle flows and their return frequency;

(3) The average and maximum backwash flow rate through the filters and the average and maximum duration of the filter backwash process in minutes;

(4) The typical filter run length and a written summary of how filter run length is determined;

(5) The type of treatment provided for the recycle flow; and

(6) Data on the physical dimensions of the equalization and treatment units, typical and maximum hydraulic loading rates, type of treatment chemicals used including average dose and frequency of use, and frequency of solids removal, if applicable.

567—43.6(455B) Residual disinfectant and disinfection byproduct (DBP) precursors.

43.6(1) *Residual disinfectant.*

a. Applicability.

(1) CWS and NTNC systems. This rule establishes criteria under which CWSs and NTNCs that add a chemical disinfectant to the water in any part of the drinking water treatment process or that provide water that contains a chemical disinfectant must modify their practices to meet the MCLs in 567—41.6(455B), the MRDLs in this subrule, and the TT requirements for DBP precursors in 43.6(3).

(2) TNC systems with chlorine dioxide disinfection. This rule establishes criteria under which TNCs that use chlorine dioxide as a disinfectant or oxidant must modify their practices to meet the chlorine dioxide MRDL in 43.6(1)*"b."*

(3) Compliance dates. Compliance dates for this rule are based upon the source water type and the population served. Systems must comply with this rule as follows, unless otherwise noted:

1. SW and IGW CWS and NTNC. CWSs and NTNCs using SW or IGW in whole or in part and that serve 10,000 or more persons must comply with this rule. CWS and NTNC SW or IGW systems serving fewer than 10,000 persons must comply with this rule.

2. GW CWS and NTNC. CWSs and NTNCs using only GW not under the direct influence of SW must comply with this rule.

3. TNC using chlorine dioxide. TNC systems serving over 10,000 persons and using SW or IGW and using chlorine dioxide as a disinfectant or oxidant must comply with THE chlorine dioxide requirements in this rule. TNC systems serving 10,000 persons or less, regardless of source water type, and using chlorine dioxide as a disinfectant or oxidant must comply with the chlorine dioxide requirements in this rule.

4. Extension of compliance period for GAC or membrane technology installation. A system that is installing GAC or membrane technology to comply with this rule may apply to the department for an extension of up to 24 months past the dates in 43.6(1)"a"(3). In granting the extension, the department will set a compliance schedule and may specify any interim measures the system must take. Failure to meet a compliance schedule or interim treatment requirements constitutes a violation of the public drinking water supply rules, requires PN per 567—subrule 40.5(1), and may result in an administrative order.

(4) Residual disinfectant control. Notwithstanding the MRDLs in this rule, systems may increase residual disinfectant levels of chlorine or chloramines (but not chlorine dioxide) in the distribution system to a level and for a time necessary to protect public health or to address specific microbiological contamination problems caused by circumstances including, but not limited to, distribution line breaks, storm run-off events, source water contamination events, or cross-connection events.

(5) Consecutive systems. Consecutive systems that provide water containing a disinfectant or oxidant must comply with this rule.

(6) Systems with multiple water sources. Systems with water sources that are used independently from each other, are not from the same source as determined by the department, or do not go through identical treatment processes must monitor for the applicable disinfectants or oxidants and DBPs during operation of each source. Systems must comply with this rule during the use of each water source.

b. MRDLs. The MRDLs are as follows:

Residual Disinfectant	MRDL (mg/L)
Chloramines	4.0 as Cl_2
Chlorine	4.0 as Cl_2
Chlorine dioxide	0.8 as ClO_2

c. Residual disinfectant monitoring requirements.

(1) General requirements.

1. Systems must take all samples during normal operating conditions. If a system does not use the disinfectant or oxidant on a daily basis, it must conduct the required daily monitoring each day the disinfectant or oxidant is used, and any required monthly monitoring during those months in which the disinfectant or oxidant is used during any portion of the month.

2. Failure to monitor in accordance with the monitoring plan required under 43.6(1)*"c"*(1)"5" is a monitoring violation.

3. Failure to monitor is a violation for the entire period covered by the annual average where compliance is based on an RAA of monthly or quarterly samples or averages. The system's failure to monitor makes it impossible to determine MRDL compliance.

4. Systems may use only data collected under this rule or of 567—41.6(455B) to qualify for reduced monitoring.

5. Systems required to monitor under this rule or 567—41.6(455B) must develop and implement a monitoring plan, in accordance with 567—paragraph 41.6(1)*"c"*(1)"6."

(2) Chlorine and chloramines.

1. Routine monitoring. CWSs and NTNCs using chlorine or chloramines must measure the residual disinfectant level at the same points in the distribution system and at the same time as total coliforms are sampled, as specified in 567—subrule 41.2(1). SW and IGW systems may use the results of RDC sampling conducted under 43.5(4)*"b"*(2)"2," in lieu of taking separate samples.

2. Reduced monitoring. Chlorine and chloramine monitoring may not be reduced.

(3) Chlorine dioxide.

1. Routine monitoring. Any PWSs using chlorine dioxide for disinfection or oxidation must take daily samples at the SEP.

2. Additional monitoring. On each day following a routine daily sample monitoring result that exceeds the MRDL, a system is required to take three chlorine dioxide distribution system samples at the locations required below, in addition to the routine daily sample required at the SEP.

- If chlorine dioxide or chloramines are used to maintain a residual disinfectant in the distribution system, or if chlorine is used to maintain a residual disinfectant in the distribution system and there are no disinfection addition points after the SEP (i.e., no booster chlorination), a system must take three samples as close to the first customer as possible, at intervals of at least six hours.
- If chlorine is used to maintain a residual disinfectant in the distribution system and there are one or more disinfection addition points after the SEP (i.e., booster chlorination), a system must take one sample at each of the following locations: as close to the first customer as possible, in a location representative of average residence time, and as close to the end of the distribution system as possible (reflecting maximum residence time in the distribution system).

3. Reduced monitoring. Chlorine dioxide monitoring may not be reduced.

d. Residual disinfectant analytical requirements.

(1) Analytical methods. Systems must measure RDCs for free chlorine, combined chlorine (chloramines), and chlorine dioxide by the methods listed in the following table:

Approved Methods for Residual Disinfectant Compliance Monitoring

Methodology	SM[1]	Other Method	Residual measured[2]			
			Free Chlorine	Combined Chlorine	Total Chlorine	Chlorine Dioxide
Amperometric Titration	4500-Cl D	ASTM: D 1253-86[3] (96), 03, 08, 14	X	X	X	
Low Level Amperometric Titration	4500-Cl E				X	
DPD Ferrous Titrimetric	4500-Cl F		X	X	X	
DPD Colorimetric	4500-Cl G	Hach Method 10260[6]	X	X	X	
Syringaldazine (FACTS)	4500-Cl H		X			
Amperometric Sensor		ChloroSense[5]	X		X	
Online Chlorine Analyzer		EPA 334.04	X		X	
Indophenol Colorimetric		Hach Method 10241[8]	X	X	X	
Iodometric Electrode	4500-Cl I				X	
DPD	4500-ClO_2 D					X
Amperometric Method II	4500-ClO_2 E					X
Lissamine Green Spectrophotometric		EPA: 327.0 Rev. 1.1				X
Amperometric Sensor		ChlordioX Plus[7]				X

The procedures shall be done in accordance with the documents listed below. The incorporation by reference of the following documents was approved by the Director of the Federal Register on February 16, 1999, in accordance with 5 U.S.C. 552(a) and 1 CFR Part 51. The document sources are listed below, and further document information is available from the Safe Drinking Water Hotline, 800.426.4791. Documents may be inspected at EPA's Drinking Water Docket; or at the Office of Federal Register.

The following method is available from the NTIS "Determination of Chlorine Dioxide and Chlorite Ion in Drinking Water Using Lissamine Green B and Horseradish Peroxidase with Detection by Visible Spectrophotometry, Revision 1.1," EPA, May 2005, EPA 815-R-05-008.

[1]SM, 19th (1995), 20th (1998), 21st (2005), 22nd (2012), and 23rd (2017) editions. Methods: 4500-Cl D, 4500-Cl E, 4500-Cl F, 4500-Cl G, 4500-Cl H, 4500-Cl I, 4500-ClO2 E. Only the 19th and 20th editions may be used for the chlorine dioxide Method 4500-ClO2 D.

[2]X indicates method is approved for measuring the specified residual disinfectant. Free chlorine or total chlorine may be measured for demonstrating compliance with the chlorine MRDL, and combined chlorine or total chlorine may be measured for demonstrating compliance with the chloramine MRDL.

[3]ASTM, Volume 11.01, 1996, Method D 1253-86.

[4]EPA Method 334.0, "Determination of Residual Chlorine in Drinking Water Using an On-Line Chlorine Analyzer," September 2009. EPA 815-B-09-013. www.epa/gov/safewater/methods/analyticalmethods_ogwdw.html.

[5]ChloroSense, "Measurement of Free and Total Chlorine in Drinking Water by Palintest ChloroSense," September 2009. Available at www.nemi.gov or from Palintest Water Analysis Technologies, www.palintest.com.

[6]Hach Method 10260, "Determination of Chlorinated Oxidants (Free and Total) in Water Using Disposable Planar Reagent-Filled Cuvettes and Mesofluidic Channel Colorimetry," April 2013, www.hach.com.

[7]ChlordioX Plus. "Chlorine Dioxide and Chlorite in Drinking Water by Amperometry Using Disposable Sensors," November 2013. Palintest Water Analysis Technologies, www.palintest.com.

[8]Hach Company. "Hach Method 10241 – Spectrophotometric Measurement of Free Chlorine in Finished Drinking Water," November 2015, Revision 1.2. Available at www.hach.com.

(2) Test kit use. Systems may also measure RDCs for chlorine, chloramines, and chlorine dioxide by using DPD colorimetric test kits acceptable to the department. Free and total chlorine RDCs may be measured continuously by adapting a specified chlorine residual method for use with a continuous monitoring instrument provided the chemistry, accuracy, and precision remain the same. Continuous monitoring instruments must be calibrated with a grab sample measurement at least every five days.

(3) Operator requirement. RDC measurements shall be conducted by a Grade A through IV operator meeting the requirements of 567—Chapter 81, any person under the direct supervision of such an operator, or a laboratory certified in accordance with 567—Chapter 83.

e. Residual disinfectant compliance requirements.

(1) General requirements.

1. When compliance is based on an RAA of monthly or quarterly samples or averages and the system's failure to monitor makes it impossible to determine MRDL compliance for chlorine and chloramines, this failure to monitor will be treated as a monitoring violation for the entire period covered by the annual average.

2. All samples taken and analyzed under this rule must be included in determining compliance, even if that number is greater than the minimum required.

(2) Chlorine and chloramines.

1. Compliance must be based on an RAA, computed quarterly, of monthly averages of all samples collected by the system under 43.6(1)*"c"*(2). If the average covering any consecutive four-quarter period exceeds the MRDL, the system is in violation of the MRDL and must provide PN pursuant to 567—40.5(455B) and report to the department pursuant to 567—paragraph 40.8(3)*"d."*

2. In cases where systems switch between the use of chlorine and chloramines for residual disinfection during the year, compliance must be determined by including together all monitoring results of both chlorine and chloramines. Reports submitted pursuant to 567—paragraph 40.8(3)*"d"* must clearly indicate which residual disinfectant was analyzed for each sample.

(3) Chlorine dioxide.

1. Acute violations. Compliance must be based on consecutive daily samples collected under 43.6(1)*"c"*(3). If any daily sample taken at the SEP exceeds the MRDL, and on the following day one or more of the three samples taken in the distribution system exceed the MRDL, the system is in violation of the MRDL and shall take immediate corrective action to lower the level of chlorine dioxide below the MRDL. Failure to take samples in the distribution system the day following an exceedance of the chlorine dioxide MRDL at the SEP is also an MRDL violation. For either violation, the system must provide notice pursuant to the Tier 1 PN requirements in 567—subrule 42.1(2), and report to the department pursuant to 567—paragraph 40.8(3)*"d."*

2. Nonacute violations. Compliance must be based on consecutive daily samples collected under 43.6(1)*"c"*(3). If any two consecutive daily samples taken at the SEP exceed the MRDL and all distribution system samples taken are below the MRDL, the system is in violation of the MRDL and must take corrective action to lower the level of chlorine dioxide below the MRDL at the point of sampling. Failure to monitor at the SEP the day following an exceedance of the chlorine dioxide MRDL at the SEP is also an MRDL violation. For either violation, the system must provide notice pursuant to the Tier 2 PN requirements in 567—subrule 40.5(3), and report to the department pursuant to 567—paragraph 40.8(3)*"d."*

f. Reporting requirements for disinfectants. Systems required to sample quarterly or more frequently must report to the department within ten days after the end of each quarter in which samples were collected, notwithstanding the PN provisions of rule 567—40.5(455B). Systems required to sample less frequently than quarterly must report to the department within ten days after the end of each monitoring period in which samples were collected. Other disinfectant reporting requirements are in 567—subparagraph 42.4(3)*"d"*(3).

43.6(2) *DBP precursors.*

a. Applicability.

(1) SW or IGW CWS and NTNC systems with conventional filtration. This rule establishes criteria under which SW or IGW CWSs and NTNCs using conventional filtration treatment that either add a chemical disinfectant to the water in any part of the drinking water treatment process, or that provide water that contains a chemical disinfectant, must modify their practices to meet the MCLs in 567—41.6(455B) and the MRDL and TT requirements for DBP precursors in this rule.

(2) CWSs and NTNCs that use ozone in their treatment process must comply with the bromide requirements of this subrule.

(3) Compliance dates for this rule are based upon the population served. CWS and NTNC systems using SW or IGW in whole or in part and that serve 10,000 or more persons must comply with this rule beginning January 1, 2002; while those systems serving fewer than 10,000 persons must comply with this rule beginning January 1, 2004.

(4) The department may require GW systems to monitor DBP precursors as a part of an operation permit.

b. DBP precursor monitoring requirements.

(1) Routine total organic carbon (TOC) monitoring.

1. SW and IGW systems using conventional filtration treatment must monitor each treatment plant for TOC no later than at the point of CFE turbidity monitoring and representative of the treated water. The systems must also monitor for TOC in the source water prior to any treatment, at the same time as monitoring for TOC in the treated water. These samples (source water and treated water) are referred to as paired samples. At the same time the source water sample is taken, all systems must monitor for alkalinity in the source water prior to any treatment. Systems must take one paired set of samples and one source water alkalinity sample per month per plant at a time representative of normal operating conditions and influent water quality.

2. SW and IGW systems that do not use conventional filtration treatment must conduct the TOC monitoring under 43.6(2)*"b"*(1)"1" in order to qualify for reduced DBP monitoring for TTHM and HAA5 under 567—paragraph 41.6(1)*"c"*(4)"2." The source water TOC RAA must be less than or equal to 4.0 mg/L based on the most recent four quarters of monitoring on a continuing basis at each treatment plant to reduce or remain on reduced TTHM and HAA5 monitoring. Once qualified for reduced TTHM and HAA5 monitoring, a system may reduce source water TOC monitoring to quarterly TOC samples taken every 90 days at a location prior to any treatment.

(2) Reduced monitoring. The department may allow SW and IGW systems with an average treated water TOC of less than 2.0 mg/L for two consecutive years, or less than 1.0 mg/L for one year, to reduce monitoring for both TOC and alkalinity to one set of paired samples and one source water alkalinity sample per plant per quarter. The system must revert to routine monitoring in the month following the quarter when the annual average treated water TOC is greater than or equal to 2.0 mg/L.

(3) Bromide. The department may allow systems required to analyze for bromate to reduce bromate monitoring from monthly to once per quarter, if a system demonstrates that the average source water bromide concentration is less than 0.05 mg/L based upon representative monthly measurements for one year. A system must continue bromide monitoring to remain on reduced bromate monitoring.

(4) The department may assign DBP precursor monitoring prior to the compliance dates in 43.6(2)*"a"*(3) as part of an operation permit.

c. DBP analytical requirements.

(1) Analytical methods. DBP precursors must be analyzed using the following methods by a laboratory certified in accordance with 567—Chapter 83, unless otherwise specified.

Approved Methods for DBP Precursor Monitoring[1]

Analyte	Methodology	EPA	SM	ASTM	Other
Alkalinity[6]	Titrimetric		2320B	D 1067-92B	
	Electrometric titration				I-1030-85
Bromide	Ion chromatography	300.0			
		300.1			
		317.0 Rev. 2.0			
		326.0			
				D 6581-00	

Analyte	Methodology	EPA	SM	ASTM	Other
Dissolved Organic Carbon[2] (DOC)	High temperature combustion	415.3 Rev. 1.2	5310B or 5310B-00		
	Persulfate-UV or heated-persulfate oxidation	415.3 Rev. 1.2	5310C or 5310C-00		
	Wet oxidation	415.3 Rev. 1.1, 415.3 Rev. 1.2	5310D or 5310D-00		
pH[3]	Electrometric	150.1, 150.2	4500-H^+-B	D 1293-84	
SUVA	Calculation using DOC and UV_{254} data	415.3 Rev. 1.2			
TOC[4]	High temperature combustion	415.3 Rev. 1.2	5310B or 5310B-00		
	Persulfate-UV or heated-persulfate oxidation	415.3 Rev. 1.2	5310C or 5310C-00		Hach Method 10267[7]
	Wet oxidation	415.3 Rev. 1.1, 415.3 Rev. 1.2	5310D or 5310D-00		
	Ozone Oxidation				Hach Method 10261[8]
UV Absorption at 254 nm[5]	Spectrophotometry	415.3 Rev. 1.1, 415.3 Rev. 1.2	5910B or 5910B-00, 11		

[1]The procedures shall be done in accordance with the documents listed below. The incorporation by reference of the following documents was approved by the Director of the Federal Register on February 16, 1999, in accordance with 5 U.S.C. 552(a) and 1 CFR Part 51. The document sources are listed below, and further document information is available from the Safe Drinking Water Hotline, 800.426.4791. Documents may be inspected at EPA's Drinking Water Docket or at the Office of Federal Register.

ASTM Methods: ASTM, Volume 11.01, 1996: Method D 1067-92B and Method D 1293-84. ASTM Volume 11.01, 2001 (or any year containing the cited version): Method D 6581-00.

The following methods are available from the NTIS:

"Determination of Inorganic Anions in Drinking Water by Ion Chromatography, Revision 1.0," EPA-600/R-98/118, 1997 (NTIS, PB98-169196): Method 300.1.

Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020, March 1983, (NTIS PB84-128677): Methods 150.1 and 150.2.

Methods for the Determination of Inorganic Substances in Environmental Samples, EPA-600/R-93/100, August 1993, (NTIS PB94-121811): Method 300.0.

"Determination of Inorganic Oxyhalide Disinfection By-Products in Drinking Water Using Ion Chromatography with the Addition of a Postcolumn Reagent for Trace Bromate Analysis, Revision 2.0," July 2001, EPA 815-B-01-001: Method 317.0.

"Determination of Inorganic Oxyhalide Disinfection By-Products in Drinking Water Using Ion Chromatography Incorporating the Addition of a Suppressor Acidified Postcolumn Reagent for Trace Bromate Analysis, Revision 1.0,", June 2002, EPA 815-R-03-007: Method 326.0.

"Determination of Total Organic Carbon and Specific UV Absorbance at 254 nm in Source Water and Drinking Water, Revision 1.1," February 2005, EPA/600/R-05/055: Method 415.3 Revision 1.1.

"Determination of Total Organic Carbon and Specific UV Absorbance at 254 nm in Source Water and Drinking Water, Revision 1.2," September 2009, EPA/600/R-09/122: Method 415.3 Revision 1.2.

SM 19th (1995), 21st (2005), 22nd (2012), and 23rd (2017) editions, Methods: 2320B (20th edition, 1998, is also accepted for this method), 4500-H+-B, and 5910B (22nd edition, 2012, is also accepted for this method). Supplement to the 19th (1996), 21st (2005), and 22nd (2012) editions, Methods: 5310B, 5310C, and 5310D. 23rd edition, Methods 5310B and 5310C.

For method numbers ending "-00", the year in which each method was approved by the Standard Methods Committee is designated by the last two digits in the method number. The methods listed are the only online versions that are IBR-approved. Method I-1030-85,Books and Open-File Reports Section, USGS, Federal Center, Box 25425, Denver, CO 80225-0425.

[2]DOC and UV254 samples used to determine a SUVA value must be taken at the same time and at the same location, prior to the addition of any disinfectant or oxidant by the system. Prior to analysis, filter DOC samples through a 0.45 µ pore-diameter filter, as soon as practical after sampling, not to exceed 48 hours. After filtration, DOC samples must be acidified to achieve pH less than or equal to 2 with minimal addition of the acid specified in the method or by the instrument manufacturer. Acidified DOC samples must be analyzed within 28 days. Remove inorganic carbon from the samples prior to analysis. Water passed through the filter prior to filtration of the sample must serve as the filtered blank. Analyze the filtered blank using procedures identical to those used for analysis of the samples and must meet a DOC concentration of <0.5 mg/L.

[3]pH must be measured by a laboratory certified in accordance with 567—Chapter 83; a Grade II, III or IV operator meeting the requirements of 567—Chapter 81; or any person under the supervision of any such operator.

[4]Remove inorganic carbon from the TOC samples prior to analysis. TOC samples may not be filtered prior to analysis. TOC samples must be acidified at the time of sample collection to achieve a pH less than or equal to 2 with minimal addition of the acid specified in the method or by the instrument manufacturer. Acidified TOC samples must be analyzed within 28 days.

[5]DOC and UV_{254} samples used to determine a SUVA value must be taken at the same time and at the same location, prior to the addition of any disinfectant or oxidant by the system. Measure UV absorption at 253.7 nm (may be rounded off to 254 nm). Prior to analysis, filter UV_{254} samples through a 0.45 μ pore-diameter filter. The pH of UV_{254} samples may not be adjusted. Samples must be analyzed as soon as practical after sampling, not to exceed 48 hours.

[6]Alkalinity must be measured by a laboratory certified in accordance with 567—Chapter 83; a Grade II, III or IV operator meeting the requirements of 567—Chapter 81; or any person under the supervision of any such operator. Only the listed titrimetric methods are acceptable.

[7]Hach Company. "Hach Method 10267 – Spectrophotometric Measurement of TOC in Finished Drinking Water," December 2015, Revision 1.2, www.hach.com.

[8]Hach Company. "Hach Method 10261 – Total Organic Carbon in Finished Drinking Water by Catalyzed Ozone Hydroxyl Radical Oxidation Infrared Analysis," December 2015, Revision 1.2, www.hach.com.

(2) SUVA. SUVA is equal to the UV absorption at 254 nm (UV_{254}) (measured in m^{-1}) divided by the DOC concentration (in mg/L). To determine SUVA, systems must separately measure UV_{254} and DOC using the methods above in 43.6(2)*"c"*(1). SUVA must be determined prior to the addition of disinfectants/oxidants. DOC and UV_{254} samples used to determine a SUVA value must be taken at the same time and at the same location.

(3) Magnesium. All methods approved for magnesium in 567—subparagraph 41.3(1)*"e"*(1) are approved for use in measuring magnesium under this rule.

d. DBP precursor compliance requirements.

(1) General requirements. All samples taken and analyzed under this rule must be included in determining compliance, even if that number is greater than the minimum required.

(2) Compliance determination. Compliance must be determined as specified in 43.6(3)*"c."* The department may assign monitoring in an operation permit, or systems may begin monitoring to determine whether Step 1 TOC removals can be met 12 months prior to the compliance date for the system. This monitoring is not required and failure to monitor during this period is not a violation. However, any system that does not monitor during this period and then determines in the first 12 months after the compliance date that it is not able to meet the Step 1 requirements in 43.6(3)*"b"*(2), and must therefore apply for alternate minimum TOC removal (Step 2) requirements, is not eligible for retroactive approval of alternate minimum TOC removal (Step 2) requirements as allowed in 43.6(3)*"b"*(3) and is in violation. Systems may apply for alternate minimum TOC removal (Step 2) requirements anytime after the compliance date. For systems required to meet Step 1 TOC removals, if the value calculated under 43.6(3)*"c"*(1)"4" is less than 1.00, the system is in violation of the TT requirements and must provide PN pursuant to 567—40.5(455B), in addition to reporting to the department pursuant to 567—paragraph 40.8(3)*"d."*

e. Reporting requirements for DBP precursors. Systems required to sample quarterly or more frequently must report to the department within ten days after the end of each quarter in which samples were collected, notwithstanding the PN provisions of 567—40.5(455B). Systems required to sample less frequently than quarterly must report to the department within ten days after the end of each monitoring period in which samples were collected. The specific reporting requirements for DBP precursors are in 567—subparagraph 40.8(3)*"d"*(4).

43.6(3) *TT for DBP precursor control.*

a. Applicability.

(1) Systems using SW or IGW and conventional filtration treatment must operate with enhanced coagulation or enhanced softening to achieve the TOC percent removal levels in 43.6(3)*"b"* unless the system meets at least one of the alternative compliance criteria in 43.6(3)*"a"*(2) or 43.6(3)*"a"*(3).

(2) Alternative compliance criteria for enhanced coagulation and enhanced softening systems. Systems using SW or IGW and conventional filtration treatment may use the alternative compliance criteria in this subparagraph to comply with this subrule in lieu of complying with 43.6(3)*"b."* Systems must still comply with monitoring requirements in 43.6(2)*"b."* TOC levels and source water alkalinity must be measured according to 43.6(2)*"c"*(1) and the SUVA must be measured monthly according to 43.6(2)*"c."*

1. The source water TOC level is less than 2.0 mg/L, calculated quarterly as a running annual average (RAA).

2. The treated water TOC level is less than 2.0 mg/L, calculated quarterly as an RAA.

3. The source water TOC level is less than 4.0 mg/L, calculated quarterly as an RAA; the source water alkalinity is greater than 60 mg/L as $_{CaCO3}$, calculated quarterly as an RAA; and either the TTHM and HAA5 RAAs are no greater than 0.040 mg/L and 0.030 mg/L, respectively; or prior to the effective date for compliance in 567—subparagraphs 41.6(1)*"a"*(3) and 43.6(2)*"a"*(3), the system has made a clear and irrevocable financial commitment to use of technologies that will limit the levels of TTHMs and HAA5 to no more than 0.040 mg/L and 0.030 mg/L, respectively. Systems must submit evidence of a clear and irrevocable financial commitment, in addition to a schedule containing milestones and periodic progress reports for installation and operation of appropriate technologies, to the department for approval not later than the effective date for compliance in 567—subparagraphs 41.6(1)*"a"*(3) and 43.6(2)*"a"*(3). These technologies must be installed and operating not later than June 30, 2005. Failure to install and operate these technologies by the date in the approved schedule will constitute a TT violation.

4. The TTHM and HAA5 RAAs are less than or equal to 0.040 mg/L and 0.030 mg/L, respectively, and the system uses only chlorine for primary disinfection and maintenance of a residual in the distribution system.

5. The source water SUVA, prior to any treatment, is less than or equal to 2.0 L/mg-m, calculated quarterly as an RAA.

6. The finished water SUVA is less than or equal to 2.0 L/mg-m, calculated quarterly as an RAA.

(3) Additional alternative compliance criteria for softening systems. Systems practicing enhanced softening that cannot achieve the TOC removals required by 43.6(3)*"b"*(2) may use the alternative compliance criteria in this subparagraph in lieu of complying with 43.6(3)*"b."* Systems must still comply with monitoring requirements in 43.6(2)*"b."*

1. Softening that lowers the treated water alkalinity to less than 60 mg/L as $CaCO_3$, measured monthly according to 43.6(2)*"c"* and calculated quarterly as an RAA.

2. Softening that removes at least 10 mg/L of magnesium hardness as $CaCO_3$, measured monthly and calculated quarterly as an RAA.

b. Enhanced coagulation and enhanced softening performance requirements.

(1) Systems must achieve the TOC percent reduction in 43.6(3)*"b"*(2) between the source water and the CFE, unless the department approves a system's request for alternate minimum TOC removal (Step 2 requirements under 43.6(3)*"b"*(3)).

(2) Required Step 1 TOC reductions, indicated in the following table, are based upon specified source water parameters measured in accordance with 43.6(2)*"c."* Systems using softening must meet the Step 1 TOC reductions in the right-hand column (> 120 mg/L) for the specified source water TOC:

Step 1 Required TOC Removal by Enhanced Coagulation and Enhanced Softening for SW or IGW Systems Using Conventional Treatment[1,2]

	Source water Alkalinity, mg/L as $CaCO_3$		
Source water TOC, mg/L	0-60	>60-120	>120[3]
>2.0 - 4.0	35.0%	25.0%	15.0%
>4.0 - 8.0	45.0%	35.0%	25.0%
>8.0	50.0%	40.0%	30.0%

[1]Systems meeting at least one of the conditions in 43.6(3)*"a"*(2)"1" through "6" are not required to operate with enhanced coagulation.

[2]Softening systems meeting one of the alternative compliance criteria in 43.6(3)*"a"*(3) are not required to operate with enhanced softening.

[3]Systems practicing softening must meet the TOC removal requirements in this column.

(3) SW and IGW systems using conventional treatment that cannot achieve the Step 1 TOC removals required by 43.6(3)*"b"*(2) due to water quality parameters (WQPs) or operational constraints must apply to the department for approval of alternative minimum Step 2 TOC removal requirements submitted by the system within three months of failure to achieve the TOC removals. If the department approves the alternative minimum Step 2 TOC removal requirements, it may make those requirements retroactive for the purposes of determining compliance. The system must meet the Step 1 TOC removals in 43.6(3)*"b"*(2) until the department approves the alternate minimum Step 2 TOC removal requirements.

(4) Alternate minimum Step 2 TOC removal requirements. Applications made to the department by enhanced coagulation systems for approval of alternate minimum Step 2 TOC removal requirements under 43.6(3)*"b"*(3) must include, as a minimum, results of bench-scale or pilot-scale testing conducted under 43.6(3)*"b"*(4)"1" below and used to determine the alternate enhanced coagulation level.

1. Alternate enhanced coagulation level is defined as coagulation at a coagulant dose and pH as determined by the method described in this subparagraph such that an incremental addition of 10 mg/L of alum (or equivalent amount of ferric salt) results in a TOC removal of less than or equal to 0.3 mg/L. The TOC percent removal at this point on the "TOC removal versus coagulant dose" curve is then defined as the minimum TOC removal required for the system. Once approved by the department, this minimum requirement supersedes the minimum TOC removal required by the table in 43.6(3)*"b"*(2). This requirement will be effective until such time as the department approves a new value based on the results of a new bench-scale or pilot-scale test. Failure to achieve department-set alternative minimum TOC removal levels is a TT violation.

2. Conduct bench-scale or pilot-scale testing of enhanced coagulation using representative water samples and adding 10 mg/L increments of alum (or equivalent amounts of ferric salt) until the pH is reduced to a level less than or equal to the enhanced coagulation Step 2 target pH shown in the following table:

Enhanced Coagulation Step 2 Target pH

Alkalinity (mg/L as $CaCO_3$)	Target pH
0 - 60	5.5
>60 - 120	6.3
>120 - 240	7.0
>240	7.5

3. For waters with alkalinities of less than 60 mg/L for which addition of small amounts of alum or equivalent addition of iron coagulant drives the pH below 5.5 before significant TOC removal occurs, a system must add necessary chemicals to maintain the pH between 5.3 and 5.7 in samples until the TOC removal of 0.3 mg/L per 10 mg/L alum added (or equivalent addition of iron coagulant) is reached.

4. A system may operate at any coagulant dose or pH necessary (consistent with department rules) to achieve the minimum TOC percent removal approved under 43.6(3)*"b"*(3).

5. If the TOC removal is consistently less than 0.3 mg/L of TOC per 10 mg/L of incremental alum dose at all dosages of alum (or equivalent addition of iron coagulant), the water is deemed to contain TOC not amenable to enhanced coagulation. The system may then apply to the department for a waiver of enhanced coagulation requirements.

c. Compliance calculations.

(1) SW or IGW systems other than those identified in 43.6(3)*"a"*(2) or 43.6(3)*"a"*(3) must comply with requirements in 43.6(3)*"b"*(2) or 43.6(3)*"b"*(3). Systems must calculate compliance quarterly, beginning after the collection of 12 months of data, by determining an annual average using the following method:

1. Step 1: Determine actual monthly TOC percent removal using the following equation, to two decimal places:

$$\text{Actual monthly TOC percent removal} = 1 - \left(\frac{\text{treated water TOC}}{\text{source water TOC}} \right) \times 100$$

2. Step 2: Determine the required monthly TOC percent removal from either 43.6(3)*"b"*(2) or 43.6(3)*"b"*(3).

3. Step 3: Divide the "actual monthly TOC percent removal" value (from Step 1) by the "required monthly TOC percent removal" value (from Step 2). Determine this value for each of the last 12 months.

$$\text{Monthly percent removal ratio} = \frac{\text{actual monthly TOC percent removal}}{\text{required monthly TOC percent removal}}$$

4. Step 4: Add together the "monthly percent removal ratio" values from Step 3 for each of the last 12 months and divide by 12 to determine the annual average value.

$$\text{Annual average} = \frac{\Sigma \text{ monthly percent removal ratio}}{12}$$

5. Step 5: If the "annual average" value calculated in Step 4 is less than 1.00, the system is not in compliance with the TOC percent removal requirements.

(2) Systems may use the provisions in this subparagraph in lieu of the calculations in the previous subparagraph (43.6(3)*"c"*(1))to determine compliance with TOC percent removal requirements. Systems may assign a monthly value of 1.0 (in lieu of the value calculated in 43.6(3)*"c"*(1)"3") when calculating compliance under 43.6(3)*"c"*(1), in any month that:

1. The system's treated or source water TOC level, measured according to 43.6(2)"c"(1), is less than 2.0 mg/L;

2. A system practicing softening removes at least 10 mg/L of magnesium hardness as $CaCO_3$;

3. The system's source water SUVA, prior to any treatment and measured according to 43.6(2)*"c"*(2), is less than or equal to 2.0 L/mg-m;

4. The system's finished water SUVA, measured according to 43.6(2)*"c"*(2), is less than or equal to 2.0 L/mg-m; or

5. A system using enhanced softening lowers alkalinity below 60 mg/L as $CaCO_3$.

(3) SW or IGW systems using conventional treatment may also comply with this subrule by meeting the criteria in 43.6(3)*"a"*(2) or 43.6(3)*"a"*(3).

d. TT requirements for DBP precursors. The TTs to control the level of DBP precursors in drinking water treatment and distribution systems for SW or IGW systems using conventional filtration treatment are enhanced coagulation or enhanced softening.

567—43.7(455B) Lead and copper treatment techniques (TTs).

43.7(1) *Corrosion control treatment (CCT) for lead and copper control.*

a. Applicability. Systems shall complete the applicable CCT requirements by the deadlines specified in the following rules:

(1) Large systems serving more than 50,000 persons. A large system (serving greater than 50,000 persons) shall complete the CCT steps in 43.7(1)*"d,"* unless the system is deemed to have OCC under 43.7(1)*"b"*(2) or 43.7(1)*"b"*(3).

(2) Small and medium-size systems serving 50,000 or fewer persons. A small system (serving less than or equal to 3,300 persons) or a medium-size system (serving greater than 3,300 and less than or equal to 50,000 persons) shall complete the CCT steps in 43.7(1)*"e,"* unless the system has OCC under 43.7(1)*"b"*(1), 43.7(1)*"b"*(2), or 43.7(1)*"b"*(3).

b. Determination that a system has optimized corrosion control (OCC). A PWS has OCC and is not required to complete the applicable CCT steps in this subrule if the system satisfies one of the criteria in 43.7(1)*"b"*(1) through 43.7(1)*"b"*(3). Any system deemed to have OCC under this paragraph and that has treatment in place shall continue to operate and maintain optimal corrosion control treatment (OCCT) and meet any requirements that the department determines appropriate to ensure OCCT is maintained.

(1) A small or medium-size PWS has optimized CCT if the system meets the lead and copper ALs during each of two consecutive six-month monitoring periods, conducted in accordance with 567—paragraph 41.4(1)*"c."*

(2) Any PWS may be deemed to have optimized CCT if it demonstrates to the department's satisfaction that it has conducted activities equivalent to the corrosion control steps applicable to such system under this subrule. If the department makes this determination, it shall provide the PWS with written notice explaining the basis for its decision and shall specify the WQPs representing OCC in accordance with 43.7(2)*"f."* Systems deemed to have OCCT under this paragraph shall operate in compliance with the department-designated OWQPs in accordance with 43.7(1)*"g"* and continue to conduct lead and copper tap and WQP sampling in accordance with 567—paragraph 41.4(1)*"c"*(4)"3" and (4), respectively. A system shall provide the department with the following information to support a determination under this paragraph:

1. The results of all samples collected for each of the WQPs in 43.7(2)*"c"*(3);
2. A report explaining the test methods used by the system to evaluate the CCTs in 43.7(2)*"c"*(1), the results of all testing, and the basis for the system's selection of OCCT;
3. A report explaining how CCT was installed and how it is being maintained to ensure minimal lead and copper concentrations at consumers' taps; and
4. The results of tap water samples collected in accordance with 567—paragraph 41.4(1)*"c"* at least once every six months for one year after CCT has been installed.

(3) Any system has OCCT if it submits results of tap water monitoring conducted in accordance with 567—paragraph 41.4(1)*"c"* and source water monitoring conducted in accordance with 567—paragraph 41.4(1)*"e"* that demonstrate, for two consecutive six-month monitoring periods, that the difference between the 90th percentile tap water lead level computed under 567—subparagraph 41.4(1)*"b"*(3) and the highest source water lead concentration is less than the practical quantitation level for lead in 567—paragraph 41.4(1)*"g."* Pursuant to this paragraph:

1. Those systems whose highest source water lead level is below the method detection limit may also be deemed to have OCCT if the 90th percentile tap water lead level is less than or equal to the lead PQL for two consecutive six-month monitoring periods.
2. Any system deemed to have OCC shall continue lead and copper monitoring at the tap no less frequently than once every three calendar years using the reduced number of sites specified in 567—subparagraph 41.4(1)*"c"*(3) and collecting the samples at times and locations specified in 567—paragraph 41.4(1)*"c"*(4)"4," fourth bulleted paragraph.
3. Any system deemed to have OCC shall notify the department in writing of any upcoming long-term change in treatment or the addition of a new source, pursuant to 567—subparagraph 40.8(2)*"a"*(3). The department must review and approve the addition of a new source or long-term change in water treatment before it is implemented by the water system.
4. Unless a system meets the copper AL, it is not deemed to have OCCT and shall implement CCT pursuant to 43.7(1)*"b"*(3)"5."
5. Any system triggered into corrosion control because it is no longer deemed to have OCCT shall implement CCT in accordance with 43.7(1)*"e."* Any such large system shall adhere to the schedule specified in that paragraph for medium-size systems, with the time periods for completing each step being triggered by the date the system is no longer deemed to have OCC.

c. Requirements to recommence corrosion control steps. Any small or medium-size system required to complete the corrosion control steps due to its exceedance of the lead or copper AL may cease completing the treatment steps when it meets both ALs during each of two consecutive

monitoring periods conducted pursuant to 567—paragraph 41.4(1)*"c"* and submits the results to the department. If any such system thereafter exceeds the lead or copper AL during any monitoring period, it shall recommence completion of the applicable treatment steps, beginning with the first treatment step that was not previously completed in its entirety. The department may require a system to repeat previously completed steps when it determines the steps are necessary to properly implement the treatment requirements of this rule. The department will notify the system of such a determination in writing and explain the basis for its decision. The requirement for any small or medium-size system to implement CCT steps in accordance with 43.7(1)*"e"* (including systems deemed to have OCC under 43.7(1)*"b"*(1)) is triggered when any such system exceeds the lead or copper AL.

d. Treatment steps and deadlines for large systems. Except as provided in 43.7(1)*"b"*(2) or 43.7(1)*"b"*(3), large systems shall complete the following CCT steps (described in the rules referenced below) by the indicated dates:

(1) Step 1. The system shall conduct initial monitoring pursuant to 567—paragraph 41.4(1)*"c"*(4)"1" and 567—subparagraph 41.4(1)*"d"*(2) during two consecutive six-month monitoring periods by January 1, 1993.

(2) Step 2. The system shall complete corrosion control studies pursuant to 43.7(2)*"c"* by July 1, 1994.

(3) Step 3. The department will designate OCCT within six months of receiving the corrosion control study results.

(4) Step 4. The system shall install OCCT by January 1, 1997.

(5) Step 5. The system shall complete follow-up sampling pursuant to 567—paragraph 41.4(1)*"c"*(4)"2" and 567—subparagraph 41.4(1)*"d"*(3) by January 1, 1998.

(6) Step 6. The department will review installation of treatment and designate OWQPs pursuant to 43.7(2)*"f"* by July 1, 1998.

(7) Step 7. The system shall operate in compliance with OWQPs delineated by the department and continue to conduct tap sampling.

e. Treatment steps and deadlines for small and medium-size systems. Except as provided in 43.7(2), small and medium-size systems shall complete the following CCT steps (described in the rules referenced below) by the indicated time periods:

(1) Step 1. A system shall conduct initial tap sampling pursuant to 567—paragraph 41.4(1)*"c"*(4)"1" and 567—subparagraph 41.4(1)*"d"*(2) until it either exceeds the lead or copper AL or becomes eligible for reduced monitoring under 567—paragraph 41.4(1)*"c"*(4)"4." A system exceeding the lead or copper AL shall recommend OCCT under 43.7(2)*"a"* within six months after the end of the monitoring period during which it exceeds one of the ALs.

(2) Step 2. Within 12 months after the end of the monitoring period during which a system exceeds the lead or copper AL, the department may require the system to perform corrosion control studies under 43.7(2)"b." If the system is not required to perform such studies, the department will specify OCCT under 43.7(2)*"d"* as follows: for medium-size systems, within 18 months after the end of the monitoring period during which such system exceeds the lead or copper AL, and, for small systems, within 24 months after the end of the monitoring period during which such system exceeds the lead or copper AL.

(3) Step 3. If a system is required to perform corrosion control studies under Step 2, it shall complete the studies (under 43.7(2)*"c"*) within 18 months after such studies are required to commence.

(4) Step 4. If the system has performed corrosion control studies under Step 2, the department will designate OCCT under 43.7(2)*"d"* within six months after completion of Step 3.

(5) Step 5. Systems shall install OCCT under 43.7(2)*"e"* within 24 months after such treatment is designated.

(6) Step 6. Systems shall complete follow-up sampling pursuant to 567—paragraph 41.4(1)*"c"*(4)"2" and 567—subparagraph 41.4(1)*"d"*(3) within 36 months after OCCT is designated.

(7) Step 7. The department will review a system's installation of treatment and designate OWQPs pursuant to 43.7(2)*"f"* within six months after completion of Step 6.

(8) Step 8. Systems shall operate in compliance with the department-designated OWQPs under 43.7(2)*"f"* (and continue to conduct tap sampling as per 567—paragraphs 41.4(1)*"c"*(4)"3" and 41.4(1)*"d"*(4)).

43.7(2) *CCT requirements.* Each PWS shall complete the CCT requirements described below that are applicable to such systems under 43.7(1).

a. PWS recommendation. Based on the results of lead and copper tap monitoring and WQP monitoring, small and medium-size systems exceeding the lead or copper AL shall recommend installation of one or more of the CCTs in 43.7(2)*"c"* that the system believes constitute OCC. The department may require a system to conduct additional WQP monitoring in accordance with 567—subparagraph 41.4(1)*"d"*(2) to assist in reviewing the system's recommendation.

b. Department decision to require CCT studies (small and medium-size systems). The department may require any small or medium-size system that exceeds the lead or copper AL to perform corrosion control studies under 43.7(2)*"c"* to identify OCCT.

c. Performance of corrosion control studies.

(1) Any PWS performing corrosion control studies shall evaluate the effectiveness of each of the following treatments and, if appropriate, combinations of the following treatments to identify the OCCT: alkalinity and pH adjustment; calcium hardness adjustment; and phosphate or silicate-based corrosion inhibitor addition at a concentration sufficient to maintain an effective residual concentration in all test tap samples.

(2) PWSs shall evaluate each of the CCTs using either pipe rig/loop tests, metal coupon tests, partial-system tests, or analyses based on documented analogous treatments with other systems of similar size, water chemistry, and distribution system configuration.

(3) PWSs shall measure the following WQPs in any tests conducted under this paragraph before and after evaluating the CCTs listed above:

1. Lead;
2. Copper;
3. pH;
4. Alkalinity;
5. Calcium;
6. Conductivity;
7. Orthophosphate (when an inhibitor containing a phosphate compound is used);
8. Silicate (when an inhibitor containing a silicate compound is used); and
9. Water temperature.

(4) PWSs shall identify all chemical or physical constraints that limit or prohibit the use of a particular CCT and outline such constraints with data and documentation either showing that a particular CCT has adversely affected other water treatment processes when used by another system with comparable water quality characteristics; or demonstrating that the system has previously attempted to evaluate a particular CCT and has found that the treatment is ineffective or adversely affects other water quality treatment processes.

(5) Systems shall evaluate the effect of the chemicals used for CCT on other water quality treatment processes.

(6) Based on analysis of the data generated during each evaluation, a system shall recommend in writing to the department the treatment option that the corrosion control studies indicate constitutes OCCT for that system. The system shall provide a rationale for its recommendation along with all supporting documentation required by this paragraph.

d. Department designation of OCCT.

(1) Based on consideration of available information including, where applicable, studies performed under 43.7(2)*"c"* and a system's recommended treatment alternative, the department will either approve the CCT option recommended by the PWS, or designate alternative treatment(s) from

among those listed in 43.7(2)*"c."* The department will consider the effects that additional treatment will have on WQPs and on other water treatment processes.

(2) The department will notify a PWS of its decision on OCCT in writing and explain the basis for this determination. If the department requests additional information to aid its review, a PWS shall provide the information.

e. Installation of OCC. Each PWS shall properly install and operate throughout its distribution system the OCCT designated under 43.7(2)*"d."*

f. Department review of treatment and specification of optimal water quality control parameters (OWQPs).

(1) The department will evaluate the results of all lead and copper tap samples and WQP samples submitted by a PWS and determine whether the system has properly installed and operated the OCCT designated in 43.7(2)*"d."* After reviewing the sampling results , both before and after a system installs optimal treatment, the department will designate the following:

1. A minimum value or a range of values for pH measured at each SEP;

2. A minimum pH value, measured in all tap samples. Such value shall be equal to or greater than 7.0 unless meeting a pH level of 7.0 is not technologically feasible or is not necessary for the PWS to optimize corrosion control;

3. If a corrosion inhibitor is used, a minimum concentration or a range of concentrations for the inhibitor, measured at each SEP and in all tap samples, necessary to form a passivating film on the interior walls of the pipes of the distribution system;

4. If alkalinity is adjusted as part of OCCT, a minimum concentration or a range of concentrations for alkalinity, measured at each SEP and in all tap samples; or

5. If calcium carbonate stabilization is used as part of corrosion control, a minimum concentration or a range of concentrations for calcium, measured in all tap samples.

(2) The values for the applicable WQPs listed above shall be those reflecting OCCT for a PWS. The department may designate values for additional WQPs determined to reflect OCC for the system. The department will notify the system in writing of these determinations and explain the basis for its decisions.

g. Continued operation with OCC and WQP monitoring compliance determination. In accordance with this paragraph, all systems optimizing corrosion control shall continue to operate and maintain OCCT, including maintaining WQPs at or above minimum values or within ranges designated by the department under 43.7(2)*"f,"* for all samples collected under 567—subparagraphs 41.4(1)*"d"*(4) through 41.4(1)*"d"*(6). Compliance with this paragraph shall be determined every six months, as specified in 567—subparagraph 41.4(1)*"d"*(4). A system is out of compliance with this paragraph for a six-month period if it has excursions for any department-specified parameter on more than nine days during the period. An excursion occurs when the daily value for one or more of the WQPs measured at a sampling location is below the minimum value or outside the department-designated range. The department has the discretion to invalidate results of obvious sampling errors from this calculation. Daily values for WQP collected at a single sampling location are calculated as follows.

(1) On days when more than one measurement for the WQP is collected, the daily value shall be the average of all results collected during the day regardless of whether they are collected through continuous monitoring, grab sampling, or a combination of both.

(2) On days when only one measurement for the WQP is collected, the daily value shall be the result of that measurement.

(3) On days when no measurement is collected for the WQP, the daily value shall be the daily value calculated on the most recent day that the WQP was measured at the sample site.

h. Modification of department treatment decisions. A determination of the OCCT under 43.7(2) *"d"* or OWQPs under 43.7(2)*"f"* may be modified. A modification request from a PWS or other interested party shall be in writing, explain why the modification is appropriate, and provide supporting documentation. The department may modify its determination when it concludes that such

change is necessary to ensure that a PWS continues to optimize CCT. A revised determination will be made in writing, set forth the new treatment requirements, explain the basis for the decision, and provide an implementation schedule for completing treatment modifications.

43.7(3) *Source water treatment requirements.* PWSs shall complete the applicable source water monitoring and treatment requirements, as described in the referenced portions of 43.7(3)*"b,"* and in 567—paragraphs 41.4(1)*"c"* and *"e,"* by the following deadlines.

a. Deadlines for completing source water treatment steps.

(1) Step 1. A PWS exceeding the lead or copper AL shall complete lead and copper source water monitoring under 567—subparagraph 41.4(1)*"e"*(2) and make a written treatment recommendation to the department no later than 180 days after the end of the monitoring period during which the lead or copper AL was exceeded.

(2) Step 2. The department will make a determination regarding source water treatment pursuant to 43.7(3)*"b"*(2) within six months after submission of monitoring results under Step 1.

(3) Step 3. If installation of source water treatment is required, the system shall install treatment pursuant to 43.7(3)*"b"*(3) within 24 months after completion of Step 2.

(4) Step 4. A PWS shall complete follow-up tap water monitoring under 567—paragraph 41.4(1)*"c"*(4)"2" and source water monitoring under 567—subparagraph 41.4(1)*"e"*(3) within 36 months after completion of Step 2.

(5) Step 5. The department will review the system's installation and operation of source water treatment and specify maximum permissible source water levels under 43.7(3)*"b"*(4) within six months after completion of Step 4.

(6) Step 6. A PWS shall operate in compliance with the maximum permissible lead and copper source water levels in 43.7(3)*"b"*(4) and continue source water monitoring pursuant to 567—subparagraph 41.4(1)*"e"*(4).

b. Description of treatment requirements.

(1) System treatment recommendation. Any system that exceeds the lead or copper AL shall recommend in writing to the department the installation and operation of one of the source water treatments in 43.7(3)*"b"*(2). A system may recommend that no treatment be installed based upon a demonstration that source water treatment is not necessary to minimize lead and copper levels at users' taps.

(2) Source water treatment determinations. The department will evaluate the results of all source water samples submitted by a PWS to determine whether source water treatment is necessary to minimize lead or copper levels in water delivered to users' taps. If the department determines that treatment is needed, it will require installation and operation of the source water treatment recommended by the PWS or require the installation and operation of another source water treatment from among the following: ion exchange, reverse osmosis, lime softening, or coagulation/filtration. If the department requests additional information to aid in its review, the PWS shall provide the information by the specified date. The department will notify the system in writing of its determination and set forth the basis for its decision.

(3) Source water treatment installation. PWSs shall properly install and operate the source water treatment designated by the department under 43.7(3)*"b"*(2).

(4) Department review and specification. The department will review a system's source water samples both before and after the installation of source water treatment and determine whether the system has properly installed and operated the designated treatment. After the review, the department will designate maximum permissible lead and copper concentrations for finished water entering the distribution system. Such levels shall reflect the contaminant removal capability of the treatment (properly operated and maintained). The department will notify the PWS in writing and explain the basis for its decision.

(5) Continued operation and maintenance. Each PWS shall maintain lead and copper levels below the maximum permissible concentrations designated by the department at each sampling point monitored in accordance with 567—paragraph 41.4(1)*"e."* A system is out of compliance with this

paragraph if the lead or copper level at any sampling point is greater than the maximum permissible designated concentration.

(6) Modification of decisions. The department may modify its determinations of the source water treatment or maximum permissible lead and copper concentrations made under subparagraphs (2) and (4) of this paragraph. A modification request from a PWS or other interested party shall be in writing, explain why the modification is appropriate, and provide supporting documentation. The department may modify its determination where it concludes that such change is necessary to ensure that a system continues to minimize lead and copper concentrations in source water. A revised determination will be made in writing, set forth the new treatment requirements, explain the basis for the decision, and provide an implementation schedule for completing treatment modifications.

43.7(4) *Lead service line replacement (LSLR) requirements.*

a. Applicability. PWSs that fail to meet the lead AL in tap samples taken pursuant to 567—paragraph 41.4(1)*"c"*(4)"2" after installing corrosion control or source water treatment (whichever sampling occurs later), shall replace lead service lines (LSLs) in accordance with this subrule. If a system is in violation of 43.7(1) and 43.7(3) for failure to install source water or CCT, the department may require the system to commence LSLR under this subrule after the date by which the system was required to conduct monitoring under 567—paragraph 41.4(1)*"c"*(4)"2" has passed.

b. LSLR schedule. A PWS shall replace annually at least seven percent of the initial number of LSLs in its distribution system. The initial number of LSLs is the number of lead lines in place at the time the replacement program begins. A system shall identify the initial number of LSLs in its distribution system, including an identification of the portion(s) owned by the system, based upon a materials evaluation, including the evaluation required under 567—subparagraph 41.4(1)*"c"*(1), and relevant legal authorities regarding the portion owned by the system.

(1) The first year of LSLR shall begin on the first day following the end of the monitoring period in which the AL was exceeded in tap sampling referenced in 43.7(4)*"a."* If monitoring is required annually or less frequently, the end of the monitoring period is September 30 of the calendar year in which the sampling occurs. If the department has established an alternate monitoring period, then the end of the monitoring period will be the last day of that period.

(2) Any system resuming an LSLR program after the cessation of its program as allowed by 43.7(4)*"g"* shall update its inventory of LSLs to include those sites that were previously determined not to require replacement through the sampling provision of 43.7(4)*"c."* The system will then divide the updated number of remaining LSLs by the number of remaining years in the program to determine the number of lines that must be replaced per year. Seven percent LSLR is based on a 15-year replacement program. For example, systems resuming LSLR after previously conducting two years of replacement would divide the updated inventory by 13.

(3) For those systems that have completed a 15-year LSLR program, the department will determine a schedule for replacing or retesting lines that were previously exempted through testing under 43.7(4)*"c"* from the replacement program when the system re-exceeds the AL.

c. Exemption to LSLR requirement. A PWS is not required to replace an individual LSL if the lead concentration in all service line samples from that line, taken pursuant to 567—paragraph 41.4(1)*"c"*(2)"3," is less than or equal to 0.015 mg/L.

d. LSLR requirements. A PWS shall replace that portion of the LSL that it owns. In cases where a system does not own the entire LSL, it shall notify the owner of the line, or the owner's authorized agent, that it will replace the portion of the service line that it owns and shall offer to replace the owner's portion of the line. A system is not required to bear the cost of replacing the privately owned portion of the line, nor is it required to replace the privately owned portion of the line where the line owner chooses not to pay the cost of replacement, or where replacing the privately owned portion would be precluded by state, local, or common law. A system that does not replace the entire length of the service line shall complete the following tasks.

(1) Resident notification. At least 45 days prior to commencing with the partial replacement of a LSL, a PWS shall provide to the resident(s) of all buildings served by the line notice explaining that

the resident(s) may experience a temporary increase of lead levels in their drinking water, along with guidance on measures consumers may take to minimize their lead exposure. The department may allow a system to provide this notice less than 45 days prior to commencing partial LSLR where such replacement is in conjunction with emergency repairs. In addition, a system shall inform the resident(s) served by the line that the system will, at its expense, collect a lead sample from each service line that is representative of the water in the line, as prescribed by 567—paragraph 41.4(1)*"c"*(2)"3," within 72 hours after the completion of the partial service line replacement. The system shall collect the sample and report the analysis results to the owner and the resident(s) served by the line within three business days of receiving the results. Mailed notices postmarked within three business days of receiving the results shall be considered "on time."

(2) Notification methods. The PWS shall provide the information required by 43.7(4)*"d"*(1) to the residents of individual dwellings by mail or by other department-approved methods. In instances where multifamily dwellings are served by the line, a system shall have the option to post the information at a conspicuous location.

e. LSLR schedule. The department may require a PWS to replace LSLs on a shorter schedule than that required by this subrule, taking into account the number of LSLs in the system, where such a shorter replacement schedule is feasible. The department will make this determination in writing and notify the system of its finding within six months after the system is triggered into LSLR based on monitoring referenced in 43.7(4)*"a."*

f. Cessation of LSLR. Any PWS may cease replacing LSLs when first draw samples collected pursuant to 567—paragraph 41.4(1)*"c"*(2)"2" meet the lead AL during each of two consecutive monitoring periods and the system submits the results. If the first draw tap samples collected in any such system thereafter exceed the lead AL, the system shall recommence replacing LSLs, as detailed in 43.7(4)*"b."*

g. LSLR reporting requirements. To demonstrate compliance with 43.7(4)*"a"* through *"d,"* a system shall report the information in 567—paragraph 42.4(2)*"e."*

567—43.8(455B) Viability assessment.

43.8(1) *Definitions specific to viability assessment.*

a. For viability assessment purposes:

"New system" includes newly constructed PWSs and systems that do not meet the definition of a PWS, but which expand their infrastructure and thereby grow to become a PWS. Systems not currently meeting the definition of a PWS and that add additional users and thereby become a PWS without constructing any additional infrastructure are not "new systems" for the purposes of this subrule.

"Nonviable system" means a system lacking the technical, financial, and managerial ability to comply with 567—Chapters 40 through 43 and 81.

"Viable system" means a system with the technical, financial, and managerial ability to comply with applicable drinking water standards adopted by the state of Iowa.

b. "Significant noncompliance" or "SNC" and "viability" are defined in 567—Chapter 40.

43.8(2) *Applicability and purpose.* These rules apply to all new and existing PWS, including the following: new systems; systems deemed to be in SNC with the primary drinking water standards; DWSRF applicants; and existing systems. The purpose of the viability assessment program is to ensure the safety of the PWS and ensure the viability of new PWS upon commencement of operation. The department may require PN and assess administrative penalties to any PWS that fails to fulfill the requirements of this rule.

43.8(3) *Contents of a viability assessment.* A viability assessment must address the areas of technical, financial, and managerial viability for a PWS. An assessment must include evaluation of the following areas, and the PWS may be required to include additional information as directed by the department.

a. Technical viability. Supply sources and facilities, treatment, and infrastructure.

b. Managerial viability. Operation, maintenance, management, and administration.

c. Financial viability. Capital and operating costs, revenue sources, and contingency plans.

43.8(4) *New systems.*

a. Viability assessment submission.

(1) New PWSs (including CWSs, NTNCs and TNCs) must submit a completed system viability assessment for department review prior to obtaining a construction permit. A viability assessment may be submitted with a construction permit application.

(2) Viability assessment worksheets are available on the department's website at www.iowadnr.gov.

(3) The department may reject receipt or delay review of the construction plans and specifications until an adequate viability assessment is provided.

(4) If the department finds, upon review and approval of the viability assessment, that the PWS will be viable, a construction permit will be issued in accordance with 567—Chapters 40 and 43. Prior to beginning operation, a PWS operation permit must be obtained in accordance with rule 567—43.2(455B) and rule 567—40.5(455B).

b. Viability assessment review. If the department declines to approve a viability assessment, or if the department finds that a PWS is nonviable, the construction and operation permit applications will be denied. If the viability assessment is conditionally approved, construction and operation permits will be issued, with conditions and a compliance schedule specified in the operation permit.

43.8(5) *Existing systems.*

a. Definition of existing system. Any CWS, NTNC, or TNC in operation prior to October 1, 1999 that was regulated as a PWS by the department shall be considered an existing system. Any system that does not currently meet the definition of a PWS, but which expands their infrastructure and thereby grows to become a PWS, is considered a new system. Systems not currently meeting the definition of a PWS and that add additional users and thereby become a PWS without constructing any additional infrastructure are considered existing systems for the purposes of this subrule.

b. Viability assessment submission. All PWSs should complete a viability assessment. However, only existing PWSs meeting one or more of the following criteria are required to complete a viability assessment.

(1) Systems applying for DWSRF loan funds.

(2) Systems categorized as being in SNC by the department, due to their history of failure to comply with drinking water standards.

(3) Systems identified by the department via a sanitary survey as having technical, managerial, or financial problems as evidenced by such conditions as poor operational control, a poor state of repair or maintenance, vulnerability to contamination, or inability to maintain adequate distribution system operating pressures.

(4) Systems that have been unable to retain a certified operator in accordance with 567—Chapter 81.

c. Forms. Viability assessment worksheets are available on the department's website at www.iowadnr.gov.

d. Review of required viability assessments.

(1) If the assessment is incomplete and does not include all of the required elements, the system will be notified in writing by the department and will be given an opportunity to modify and resubmit the assessment within the specified time period. If the system fails to resubmit a completed viability assessment as specified, the department may find that the system is nonviable.

(2) If the assessment is complete, the department will either indicate that the system is viable or nonviable after the assessment review process. The system will be notified of the results of the department's evaluation.

e. Review of voluntarily submitted viability assessments. All existing systems should complete a viability assessment and submit it to the department. Voluntarily submitted assessments may be reviewed upon request and will be exempt from any requirements to modify the assessment if it is not

approved, or from a determination that the system is not viable, providing the system does not meet any of the criteria for mandatory completion of a viability assessment set forth in 43.8(4)*"b"* above.

43.8(6) *Nonviable systems.* The following applies to CWSs, NTNC, and TNCs:

a. Systems applying for DWSRF loan funds must be viable, or the loan funds must be used to assist the system in attaining viable status. If a system applying for a loan is found to be nonviable, and loan funds will not be sufficient or available to ensure viability, then the situation must be corrected to the department's satisfaction prior to qualification to apply for loan funds.

b. Systems that meet the department's SNC criteria are considered nonviable. The system's viability assessment and the most recent sanitary survey results will be evaluated by the department to assist the system in returning to and remaining in compliance, which would achieve viability. Required corrective actions will be specified in the system's operation permit and will include a compliance schedule. Inspections will be conducted on an as-needed basis to assist the system in implementing the required improvements.

c. Systems experiencing technical, managerial, or financial problems as noted by the department in the sanitary survey will be considered nonviable. The system's viability assessment will be evaluated by the department to assist the system in attaining viability, and any required corrective actions will be specified in the system's operation permit.

d. Systems unable to retain a certified operator will be considered nonviable. All CWSs and NTNCs, and TNCs denoted by the department, must have a certified operator who meets the requirements of 567—Chapter 81. The system's viability assessment will be used to determine the source of the problem, and required corrective actions will be specified in the system's operation permit.

43.8(7) *Revocation or denial of operation or construction permit.*

a. Operation permit revocation or denial. Failure to correct the deficiencies regarding viability, as identified in a compliance schedule set by the department, may result in revocation or denial of a system's operation permit. If the department revokes or denies the operation permit, the system's owner must negotiate an alternative arrangement with the department for providing treatment or water supply services within 30 days of receipt of the notification unless the system's owner appeals the decision. The PWS is required to provide water that continually meets all health-based standards during the appeal process.

b. Denial of new construction permits for an existing system. In addition to the criteria provided in 567—Chapters 40 through 44, new construction permits for system improvements may be denied until a system makes the required corrections and attains viable status, unless the proposed project is necessary to attain viability.

c. Failure to conform or comply. Failure of a project to conform to approved construction plans and specifications, or failure to comply with 567—Chapters 40 to 44, constitutes grounds for the director to withhold the applicable construction and operation permits. The system is then responsible for ensuring that the identified problem with the project is rectified so that permits may be issued. Once an agreement for correcting the problem is reached between the department and the system, the department will issue the appropriate permits according to the provisions of the agreement. If an agreement cannot be reached within a reasonable time period, the permits shall be denied.

d. Contents of denial notification. The notification of denial or withholding approval of the operation or construction permit will state the department's reasons for withholding or denying permit approval.

43.8(8) *Appeals.*

a. Request for formal review of viability determination. A person or entity who disagrees with the decision regarding the viability of a PWS may request a formal review of the action. A request for review must be submitted in writing to the director by the owner or their designee within 30 days of the viability decision.

b. Appeal of denial of operation or construction permit. A decision to deny an operation or construction permit may be appealed by the applicant to the commission pursuant to 567—Chapter 7.

The appeal must be made in writing to the director within 30 days of receiving the notice of denial by the owner of the PWS.

567—43.9(455B) Enhanced filtration and disinfection requirements for SW and IGW systems serving at least 10,000 people.

43.9(1) *General requirements.*

a. Applicability. The requirements of this rule constitute national primary drinking water regulations. This rule establishes the filtration and disinfection requirements in addition to the filtration and disinfection requirements in 567—43.5(455B). This rule is applicable to all PWSs using SW or IGW, in whole or in part, and that serve at least 10,000 people. This rule establishes or extends TT requirements in lieu of MCLs for the following contaminants: *Giardia lamblia*, viruses, HPC bacteria, *Legionella*, *Cryptosporidium*, and turbidity. Each SW or IGW system serving at least 10,000 people must provide treatment of its source water that complies with these TT requirements. The TT requirements consist of installing and properly operating water treatment processes that reliably achieve:

(1) At least 99 percent (2-log) removal of *Cryptosporidium* between a point where the raw water is not subject to recontamination by SW runoff and a point downstream before or at the first customer for filtered systems.

(2) Compliance with the profiling and benchmark requirements under 43.9(2).

(3) The department may require other SW or IGW systems to comply with this rule, through an operation permit.

b. Compliance determination. A PWS subject to this rule is considered in compliance with 43.9(1)*"a"* if it meets the applicable filtration requirements in either 43.5(3) or 43.9(3) and the disinfection requirements in 43.5(2) and 43.6(2).

c. Prohibition of new construction of uncovered intermediate or finished water storage facilities. Systems required to comply with this rule may construct only covered intermediate or finished water storage facilities. For the purposes of this rule, an intermediate storage facility is defined as a storage facility or reservoir after the clarification treatment process.

d. Systems with populations that increased after January 1, 2002, to more than 10,000 people served. Systems using SW or IGW sources that did not conduct optional monitoring under 43.9(2) because they served fewer than 10,000 persons when such monitoring was required, but serve more than 10,000 persons prior to January 1, 2005, must comply with 43.9(1), 43.9(3), 43.9(4), and 43.9(5). These systems must also consult with the department to establish a disinfection benchmark. A system that decides to make a significant change to its disinfection practice as described in 43.9(2)*"c"*(1)"1" through "4" must consult with the department prior to making such a change.

43.9(2) *Disinfection profiling and benchmarking.*

a. Determination of systems required to profile. A PWS subject to this rule must determine its total trihalomethane (TTHM) and haloacetic acid (HAA5) annual averages using the procedures listed below. The annual average is the arithmetic average of the quarterly averages of four consecutive quarters of monitoring. Both TTHM and HAA5 samples must be collected as paired samples during the same time period in order for each parameter to have the same annual average period for result comparison. A paired sample is one that is collected at the same location and time and is analyzed for both TTHM and HAA5 parameters.

(1) Allowance of information collection rule data. Those systems that collected data under the federal Information Collection Rule in 40 CFR Part 141, Subpart M, must use the results of the TTHM and HAA5 samples collected during the last four quarters of monitoring required under 40 CFR §141.142. The system must have submitted the results of the samples collected during the last 12 months of required monitoring.

(2) Systems that have not collected TTHM and HAA5 data. Those systems that have not collected four consecutive quarters of paired TTHM and HAA5 samples as described above in 43.9(2)*"a"*(1) must comply with all other provisions of this subrule as if the HAA5 monitoring had been

conducted and the results of that monitoring required compliance with 43.9(2)*"b."* The system that elects this option must notify the department in writing of its decision.

(3) The department may require that a system use a more representative annual data set than the data set determined under 43.9(2)*"a"*(1) to determine the applicability of this subrule.

(4) Profiling determination criteria. Any system having either a TTHM annual average greater than 0.064 mg/L or an HAA5 annual average greater than 0.048 mg/L during the period identified in 43.9(2)*"a"*(1) through 43.9(2)*"a"*(3) must comply with 43.9(2)*"b."*

b. Disinfection profiling.

(1) Applicability. Any system that meet the criteria in 43.9(2)*"a"*(4) must develop a disinfection profile of its disinfection practice for a period of up to three years.

(2) Monitoring requirements. A system must monitor daily for a period of 12 consecutive calendar months to determine the total log inactivation for each day of operation, based on the CT99.9 values in Tables 1 through 8 in Appendix A, as appropriate, through the entire treatment plant. A system must begin this monitoring as directed by the department. As a minimum, a system with a single point of disinfectant application prior to entrance to the distribution system must conduct the monitoring in "1" through "4" below. A system with more than one point of disinfectant application must conduct the monitoring in "1" through "4" below for each disinfection segment. A system must monitor the parameters necessary to determine the total inactivation ratio, using analytical methods in 43.5(4)*"a,"* as follows:

1. The temperature of the disinfected water must be measured once per day at each RDC sampling point during peak hourly flow.

2. If the system uses chlorine, the pH of the disinfected water must be measured once per day at each chlorine RDC sampling point during peak hourly flow.

3. The disinfectant contact time(s) ("T") must be determined for each day during peak hourly flow.

4. The RDC(s) ("C") of the water before or at the first customer and prior to each additional point of disinfection must be measured each day during peak hourly flow.

(3) Use of existing data. A system that has existing operational data may use that data to develop a disinfection profile for additional years, in addition to the disinfection profile generated under 43.9(2)*"b"*(2). Such systems may use these additional yearly disinfection profiles to develop a benchmark under 43.9(2)*"c."* The department must determine whether these operational data are substantially equivalent to data collected under 43.9(2)*"b"*(2). These data must be representative of inactivation through the entire treatment plant and not just of certain treatment segments.

(4) Calculation of the total inactivation ratio. The system must calculate the total inactivation ratio as follows, using the CT99.9 values from Tables 1 through 8 listed in Appendix A:

1. If the system uses only one point of disinfectant application, it may determine the total inactivation ratio for the disinfection segment using either of the following methods:

- Determine one inactivation ratio (CTcalc/CT99.9) before or at the first customer during peak hourly flow; or
- Determine successive CTcalc/CT99.9 values, representing sequential inactivation ratios, between the point of disinfectant application and a point before or at the first customer during peak hourly flow. Under this alternative, the system must calculate the total inactivation ratio by determining (CTcalc/CT99.9) for each sequence and then adding the (CTcalc/CT99.9) values together to determine Σ(CTcalc/CT99.9).

2. If the system uses more than one point of disinfectant application before the first customer, the system must determine the CT value of each disinfection segment immediately prior to the next point of disinfectant application, or for the final segment, before or at the first customer, during peak hourly flow. The CTcalc/CT99.9 value of each segment and Σ(CTcalc/CT99.9) must be calculated using a method above in 43.9(2)*"b"*(4)"1."

3. The system must determine the total log inactivation by multiplying the value calculated above in 43.9(2)*"b"*(4)"1" or "2" by 3.0.

(5) Systems using chloramines or ozone. A system that uses either chloramines or ozone for primary disinfection must also calculate the log inactivation for viruses using a department-approved method.

(6) Profile retention. The system must retain disinfection profile data in graphic form, as a spreadsheet, or in some other format acceptable to the department for review as part of sanitary surveys conducted by the department. The department may require the system to submit the data directly or as part of a MOR.

c. Disinfection benchmarking.

(1) Significant change to disinfection practice. Any system required to develop a disinfection profile under 43.9(2)*"a"* or *"b"* that decides to make a significant change to its disinfection practice must obtain department approval prior to making such change. Significant changes to disinfection practice are:

1. Changes to the point of disinfection;
2. Changes to the disinfectant(s) used in the treatment plant;
3. Changes to the disinfection process; and
4. Any other modification identified by the department.

(2) Calculation of the disinfection benchmark. Any system that is modifying its disinfection practice must calculate its disinfection benchmark using the procedure specified below:

1. For each year of profiling data collected and calculated under 43.9(2)*"b,"* the system must determine the lowest average monthly *Giardia lamblia* inactivation in each year of profiling data. The system must determine the average *Giardia lamblia* inactivation for each calendar month for each year of profiling data by dividing the sum of daily *Giardia lamblia* inactivation by the number of values calculated for that month.
2. The disinfection benchmark is the lowest monthly average value (for systems with one year of profiling data) or average of lowest monthly average values (for systems with more than one year of profiling data) of the monthly log inactivation of *Giardia lamblia* in each year of profiling data.

(3) A system that uses either chloramines or ozone for primary disinfection must also calculate the disinfection benchmark for viruses using a department-approved method.

(4) The system must submit the following information to the department as part of its consultation process:

1. A description of the proposed change;
2. The disinfection profile for *Giardia lamblia* (and, if necessary, viruses) under 43.9(2)*"b"* and the disinfection benchmark as required by 43.9(2)*"c"*(2); and
3. An analysis of how the proposed change will affect the current levels of disinfection.

43.9(3) *Filtration.*

a. Conventional filtration treatment or direct filtration. Turbidity measurements required by this paragraph shall be made in accordance with 43.5(4)*"a"*(1) and 43.5(4)*"b"*(1).

(1) Turbidity requirement in 95 percent of samples. For systems using conventional filtration or direct filtration, the turbidity level of representative samples of a system's filtered water (CFE) must be less than or equal to 0.3 NTU in at least 95 percent of the measurements taken each month.

(2) Maximum turbidity level. The turbidity level of representative samples of a system's filtered water (CFE) must at no time exceed 1 NTU in two consecutive 15 minute recordings. If at any time the CFE turbidity exceeds 1 NTU in two consecutive 15 minute recordings, the system must inform the department as soon as possible, but no later than 24 hours after the exceedance is known, in accordance with the PN requirements in 567—subparagraph 42.1(3)*"b"*(3).

b. Filtration technologies other than conventional, direct, slow sand, or diatomaceous earth. The department may allow a PWS to use a filtration technology not listed in 43.9(3)*"a"* or 43.5(3)*"c"* or *"d"* if it demonstrates to the department, using pilot plant studies or other means, that the alternative filtration technology, in combination with disinfection treatment that meets the requirements of 43.5(2), consistently achieves 99.9 percent removal or inactivation of *Giardia lamblia* cysts, 99.99 percent removal or inactivation of viruses, and 99 percent removal of *Cryptosporidium*

oocysts, and the department approves the use of the filtration technology. For each approval, the department will set turbidity performance requirements that the system must meet at least 95 percent of the time and will require that the system not exceed at any time a level that consistently achieves 99.9 percent removal or inactivation of *Giardia lamblia* cysts, 99.99 percent removal or inactivation of viruses, and 99 percent removal of *Cryptosporidium* oocysts.

43.9(4) *Filtration sampling.*

a. Monitoring requirements for systems using filtration treatment. In addition to monitoring required by 43.5(4), a PWS subject to this rule that provides conventional filtration treatment or direct filtration must conduct continuous turbidity monitoring for each individual filter using an approved method in 43.5(4)*"a"*(1). Turbidity must be monitored according to a written turbidity protocol approved by the department and audited for compliance during sanitary surveys. Major elements of the protocol shall include, but are not limited to: sample measurement location; calibration method, frequency, standards, method of verification, and verification frequency; and data collection, recording frequency, and reporting. PWSs must calibrate turbidimeters at least every 90 days with a primary standard. The calibration of each turbidimeter used for compliance must be verified at least once per week with a primary standard, secondary standard, the manufacturer's proprietary calibration confirmation device, or by a department-approved method. If the verification is not within plus or minus 0.05 NTU for measurements of less than or equal to 0.5 NTU, or within plus or minus 10 percent of measurements greater than 0.5 NTU, then the turbidimeter must be recalibrated. Systems must record the results of individual filter monitoring every 15 minutes.

b. Failure of the continuous turbidity monitoring equipment. If there is a failure in the continuous turbidity monitoring equipment, a system must conduct grab sampling every four hours in lieu of continuous monitoring until the turbidimeter is repaired and back online. A system has a maximum of five working days after failure to repair the equipment, or else it is in violation.

43.9(5) *Reporting and recordkeeping.*

a. Additional requirements. In addition to the reporting and recordkeeping requirements in 567—paragraph 40.8(3)*"c"*:

(1) A system subject to this rule that provides conventional filtration treatment or direct filtration must report monthly to the department the information in 43.9(5)*"b"* and *"c"*; and

(2) A system subject to this rule that provides filtration approved under 43.9(3)*"b"* must report monthly to the department the information in 43.9(5)*"b."*

b. Turbidity. Turbidity measurements required by 43.9(3) must be reported in a format acceptable to the department and within ten days after the end of each month that the system serves water to the public. This reporting is in lieu of the reporting specified in 567—subparagraph 40.8(3)*"c"*(1). Information that must be reported includes:

(1) The total number of filtered water (CFE) turbidity measurements taken during the month;

(2) The number and percentage of filtered water (CFE) turbidity measurements taken during the month that are less than or equal to the turbidity limits in 43.9(3)*"a"* or *"b"*; and

(3) The date and value of any CFE turbidity measurements taken during the month that exceed 1 NTU in two consecutive recordings taken 15 minutes apart for systems using conventional filtration treatment or direct filtration or that exceed the maximum level set in 43.9(3)*"b."*

(4) The dates and summary of calibration and verification of all compliance turbidimeters.

c. Individual filter turbidity monitoring.

(1) Systems must maintain the results of individual filter turbidity per monitoring taken under 43.9(4) for at least three years.

(2) Systems must report to the department that they have conducted individual filter turbidity monitoring under 43.9(4) within ten days after the end of each month that the system serves water to the public.

(3) Systems must report to the department individual filter turbidity measurement results taken under 43.9(4) within ten days after the end of each month that the system serves water to the public only if measurements demonstrate one or more of the conditions in 43.9(5)*"c"*(5).

(4) Systems that use lime softening may apply to the department for alternative exceedance levels for the levels specified in 43.9(5)*"c"*(5) if they can demonstrate that higher turbidity levels in individual filters are due to lime carryover only and not due to degraded filter performance.

(5) In all of the following instances, the system must report the filter number, the turbidity measurement, and the date(s) when the exceedance occurred:

1. For any individual filter that has a measured turbidity level of greater than 1.0 NTU in two consecutive measurements taken 15 minutes apart. In addition, the system must either produce a filter profile for the filter within seven days of the exceedance (if the system is not able to identify an obvious reason for the abnormal filter performance) and report that the profile has been produced, or report the obvious reason for the exceedance.

2. For any individual filter that has a measured turbidity level of greater than 0.5 NTU in two consecutive measurements taken 15 minutes apart anytime following the first four hours of continuous filter operation, after the filter has been backwashed or otherwise taken offline. In addition, the system must either produce a filter profile for the filter within seven days of the exceedance (if the system is not able to identify an obvious reason for the abnormal filter performance) and report that the profile has been produced, or report the obvious reason for the exceedance.

3. For any individual filter that has a measured turbidity level of greater than 1.0 NTU in two consecutive measurements taken 15 minutes apart at any time in each month of three consecutive months. In addition, the system must conduct a self-assessment of the filter within 14 days of the exceedance and report that the self-assessment was conducted. The self-assessment must consist of an assessment of filter performance; development of a filter profile; identification and prioritization of factors limiting filter performance; assessment of the applicability of corrections; and preparation of a filter self-assessment report.

4. For any individual filter that has a measured turbidity level of greater than 2.0 NTU in two consecutive measurements taken 15 minutes apart at any time in each month of two consecutive months. In addition, the system must arrange for a comprehensive performance evaluation to be conducted by the department or a department-approved third party no later than 30 days following the exceedance and have the evaluation completed and submitted to the department no later than 90 days following the exceedance.

d. Additional reporting requirement for turbidity combined filter effluent (CFE). In the following situations, the system must consult with the department as soon as practical, but no later than 24 hours after the exceedance is known, in accordance with the PN requirements under 567—subparagraph 42.1(3)*"b"*(3).

(1) In a system using conventional filtration treatment or direct filtration, if the turbidity exceeds 1 NTU in the CFE in two consecutive recordings taken 15 minutes apart.

(2) If at any time the turbidity in representative samples of filtered water (CFE) exceeds the maximum level in 43.9(3)*"b"* for filtration technologies other than conventional filtration treatment, direct filtration, slow sand filtration, or diatomaceous earth filtration.

567—43.10(455B) Enhanced filtration and disinfection requirements for SW and IGW systems serving fewer than 10,000 people.

43.10(1) *General requirements.*

a. Applicability. This rule constitutes national primary drinking water regulations, and it establishes requirements for filtration and disinfection in addition to the filtration and disinfection requirements in 567—43.5(455B). This rule is applicable beginning January 1, 2005, unless otherwise noted, to all PWSs using SW or IGW, in whole or in part, and that serve less than 10,000 people. This rule establishes or extends TT requirements in lieu of MCLs for the following contaminants: *Giardia lamblia*, viruses, HPC bacteria, *Legionella*, *Cryptosporidium*, and turbidity. The TT requirements consist of installing and properly operating water treatment processes that reliably achieve:

(1) At least 99 percent (2 log) removal of *Cryptosporidium* between a point where the raw water is not subject to recontamination by SW runoff and a point downstream before or at the first customer for filtered systems; and

(2) Compliance with the profiling and benchmark requirements in 43.10(2) and 43.10(3).

b. Prohibition of new construction of uncovered intermediate or finished water storage facilities. Systems required to comply with this rule may construct only covered intermediate or finished water storage facilities. For the purposes of this rule, an intermediate storage facility is defined as a storage facility or reservoir after the clarification treatment process.

43.10(2) *Disinfection profile.*

a. Applicability. A disinfection profile is a graphical representation of a system's level of *Giardia lamblia* or virus inactivation measured during the course of a year. All systems required to comply with this rule must develop a disinfection profile unless the department determines that such a profile is unnecessary. Records must be maintained according to 43.10(7).

(1) The department may approve the use of a more representative data set for disinfection profiling than the data set required in 43.10(2)*"b."*

(2) The department may determine that a disinfection profile is unnecessary only if a system's TTHM and HAA5 levels are below 0.064 mg/L and 0.048 mg/L, respectively. To determine these levels, TTHM and HAA5 samples must be collected during the month with the warmest water temperature and at the point of maximum residence time in the distribution system. The department may approve the use of a more representative annual data set to determine the applicability of this subrule. The annual data set must be calculated on an annual average using the arithmetic average of the quarterly averages of four consecutive quarters of monitoring. At least 25 percent of the samples collected in each quarter must be collected at the maximum residence time location in the distribution system.

(3) If a producing system that provides water to other PWSs meets the byproduct level requirements of less than 0.064 mg/L for TTHM and less than 0.048 mg/L for HAA5, it will not be required to develop a disinfection profile and benchmark unless:

1. The consecutive system cannot meet the byproduct level requirements of less than 0.064 mg/L for TTHM and less than 0.048 mg/L for HAA5 in its distribution system, and

2. The producing system wants to make a significant change to its disinfection practices.

b. Required elements of a disinfection profile.

(1) A system must monitor the following parameters to determine the total log inactivation using the analytical methods in 43.5(4)*"a,"* once per week on the same calendar day, over 12 consecutive months.

1. Temperature of the disinfected water at each RDC sampling point during peak hourly flow, measured in degrees Celsius;

2. For systems using chlorine, the pH of the disinfected water at each RDC sampling point during peak hourly flow, measured in standard pH units;

3. The disinfectant contact time ("T") during peak hourly flow, measured in minutes; and

4. The RDC(s) ("C") of the water following each point of disinfection at a point(s) prior to each subsequent point of disinfection and at the entry point to the distribution system or at a location just prior to the first customer during peak hourly flows, measured in mg/L.

(2) The data collected in 43.10(2)*"b"*(1) must be used to calculate the weekly log inactivation, along with the CT99.9 tables in Appendix A. The system must calculate the total inactivation ratio as follows and multiply the value by 3.0 to determine log inactivation of *Giardia lamblia*.

1. If a system uses more than one point of disinfectant application before the first customer, the system must determine the (CT calc/CT99.9) value of each disinfection segment immediately prior to the next point of disinfectant application, or for the final segment, before or at the first customer, during peak hourly flow. The system must calculate the total inactivation ratio by determining (CT calc/CT99.9) for each sequence and then adding the (CT calc/CT99.9) values together to determine (ΣCT calc/CT99.9).

2. If the system uses only one point of disinfectant application, it must determine:

- One inactivation ratio (CT calc/CT99.9) before or at the first customer during peak hourly flow, or
- Successive (CT calc/CT99.9) values, representing sequential inactivation ratios, between the point of disinfection application and a point before or at the first customer during peak hourly flow. The total inactivation ratio must be calculated from the successive values by determining (CT calc/CT99.9) for each sequence and then adding the (CT calc/CT99.9) values together to determine (ΣCT calc/CT99.9).

3. If a system uses chloramines, ozone, or chlorine dioxide for primary disinfection, the system must also calculate the inactivation logs for viruses and develop an additional disinfection profile for viruses using department-approved methods.

(3) The weekly log inactivations are used to develop a disinfection profile by graphing each log inactivation data point versus time. Each log inactivation serves as a data point in the disinfection profile. The system will have obtained 52 measurements at a minimum, one for each week of the year.

(4) A disinfection profile depicts the variation of microbial inactivation over the course of the year. The system must retain the disinfection profile data both in a graphic form and in a spreadsheet, which must be available for review by the department. This profile is used to calculate a disinfection benchmark if the system is considering changes to its disinfection practices.

43.10(3) *Disinfection benchmark.*

a. Applicability. Any system required to develop a disinfection profile under 43.10(2) must develop a disinfection benchmark prior to making any significant change in disinfection practice. The system must receive department approval before any significant change in disinfection practice is implemented. Records must be maintained according to 43.10(7).

b. Significant changes. Significant changes to disinfection practice include:

(1) Changes to the point of disinfection;

(2) Changes to the disinfectant(s) used in the treatment plant;

(3) Changes to the disinfection process; or

(4) Any other modification identified by the department.

c. Disinfection benchmark calculation. Systems must calculate the disinfection benchmark in the following manner:

(1) Step 1. Using the data collected to develop the disinfection profile, determine the average *Giardia lamblia* inactivation for each calendar month by dividing the sum of all *Giardia lamblia* inactivations for that month by the number of values calculated for that month.

(2) Step 2. Determine the lowest monthly average value out of the 12 values. This value becomes the disinfection benchmark.

d. Information required for department approval of a change in disinfection practice. Systems must submit the following information to the department as part of the consultation and approval process.

(1) A description of the proposed change;

(2) The disinfection profile for *Giardia lamblia* and, if necessary, viruses;

(3) The disinfection benchmark;

(4) An analysis of how the proposed change will affect the current levels of disinfection; and

(5) Any additional information requested by the department.

e. Additional benchmarks if chloramines, ozone, or chlorine dioxide is used for primary disinfection. If a system uses chloramines, ozone, or chlorine dioxide for primary disinfection, the system must calculate the disinfection benchmark from the data collected for viruses to develop a disinfection profile. This viral benchmark must be calculated in addition to, and in the same manner as, the Giardia lamblia disinfection benchmark in 43.10(3)*"c."*

43.10(4) *Combined filter effluent (CFE) turbidity requirements.* All systems using SW or IGW that serve less than 10,000 people must use filtration, and the turbidity limits that must be met depend upon the type of filtration used.

a. Turbidity measurements. Turbidity must be measured in the CFE as described in 43.5(4)*"a"* and *"b."*

b. Turbidity monthly reporting. The monthly reporting requirements are in 43.10(6).

c. Conventional filtration treatment or direct filtration.

(1) The turbidity in the CFE must be less than or equal to 0.3 NTU in 95 percent of the turbidity measurements taken each month.

(2) The turbidity in the CFE must never exceed 1 NTU in two consecutive recordings taken 15 minutes apart during the month. If the CFE turbidity exceeds 1 NTU in two consecutive 15 minute recordings, the system must inform the department as soon as possible, but no later than 24 hours after the exceedance is known, in accordance with the PN requirements under 567—subparagraphs 40.5(3)*"b"*(3) and 40.5(2)*"a"*(8).

d. Slow sand filtration or diatomaceous earth filtration. The CFE turbidity limits of 43.5(3) must be met.

e. Other alternative filtration technologies. By using pilot studies or other means, a system using alternative filtration must demonstrate to the department's satisfaction that the system's filtration, in combination with disinfection treatment, consistently achieves 99 percent removal of *Cryptosporidium* oocysts; 99.9 percent removal, inactivation, or a combination of both, of *Giardia lamblia* cysts; and 99.99 percent removal, inactivation, or a combination of both, of viruses. The department will then use the pilot study data to determine system-specific turbidity limits.

(1) The turbidity must be less than or equal to a value set by the department in 95 percent of the CFE turbidity measurements taken each month, based on the pilot study.

(2) The CFE turbidity must never exceed a value set by the department, based on the pilot study. The value may not exceed 1 NTU in two consecutive recordings taken 15 minutes apart.

43.10(5) *Individual filter turbidity requirements.* All systems utilizing conventional filtration or direct filtration must conduct continuous turbidity monitoring for each individual filter. Turbidity must be monitored according to a written turbidity protocol approved by the department and audited for compliance during sanitary surveys. Major elements of the protocol shall include, but are not limited to: sample measurement location; calibration method, frequency, standards, method of verification, and verification frequency; and data collection, recording frequency, and reporting. Records must be maintained according to 43.10(7).

a. Continuous turbidity monitoring requirements.

(1) Conduct monitoring using an approved method listed in 43.5(4)*"a"*;

(2) Calibrate turbidimeters at least every 90 days with a primary standard. The calibration of each turbidimeter used for compliance must be verified at least once per week with a primary standard, secondary standard, the manufacturer's proprietary calibration confirmation device, or by a department-approved method. If the verification is not within plus or minus 0.05 NTU for measurements of less than or equal to 0.5 NTU, or within plus or minus 10 percent of measurements greater than 0.5 NTU, the turbidimeter must be recalibrated;

(3) Record turbidity monitoring results at least every 15 minutes; and

(4) Complete monthly reporting in accordance with 43.10(6).

b. Equipment failure. If there is a failure in the continuous turbidity monitoring equipment, a system must conduct grab sampling every four hours in lieu of continuous monitoring until the turbidimeter is back on-line. A system has a maximum of 14 days after failure to repair the equipment, or else the system is in violation. The system must notify the department within 24 hours, both when a turbidimeter is taken off-line and when it is returned on-line.

c. Special provision for one-filter or two-filter systems. If a system has only one or two filters, it may conduct continuous monitoring of the CFE turbidity instead of individual effluent turbidity monitoring. The continuous monitoring must meet the requirements in 43.10(5)*"a"* and *"b."*

d. Alternative turbidity levels for systems using lime softening. Systems using lime softening may apply to the department for alternative turbidity exceedance levels for the levels specified in

43.10(5)*"e."* The system must be able to demonstrate to the department's satisfaction that higher turbidity levels are due to lime carryover only, and not due to degraded filter performance.

e. Requirements triggered by individual filter turbidity monitoring data. Systems must conduct additional activities based upon their individual filter turbidity monitoring data, as listed in this paragraph.

(1) If the turbidity of an individual filter (or the CFE turbidity for a system with one or two filters, pursuant to 43.10(5)*"c"*) exceeds 1.0 NTU in two consecutive recordings taken 15 minutes apart, a system must report the following information in the MOR to the department by the tenth day of the following month:

1. The filter number(s);
2. Corresponding date(s);
3. Turbidity value(s) which exceeded 1.0 NTU; and
4. The cause of the exceedance(s), if known.

(2) If the turbidity of an individual filter (or the CFE turbidity for a system with one or two filters, pursuant to 43.10(5)*"c"*) exceeds 1.0 NTU in two consecutive recordings 15 minutes apart in three consecutive months, a system must conduct a self-assessment of the filter(s) within 14 days of the day the filter exceeded 1.0 NTU in two consecutive measurements for the third straight month, unless a comprehensive performance evaluation (CPE) as specified in the following subparagraph is required. Two-filter systems that monitor the CFE turbidity instead of the individual filters must conduct a self-assessment of both filters. The self-assessment must consist of the following:

1. Assessment of filter performance;
2. Development of a filter profile;
3. Identification and prioritization of factors limiting filter performance;
4. Assessment of the applicability of corrections;
5. Preparation of a filter self-assessment report;
6. Date the self-assessment requirement was triggered; and
7. Date the self-assessment was completed.

(3) If the turbidity of an individual filter (or the CFE turbidity for a system with one or two filters, pursuant to 43.10(5)*"c"*) exceeds 2.0 NTU in two consecutive recordings 15 minutes apart in two consecutive months, a system must arrange to have a CPE conducted by the department or a department-approved third party no later than 60 days following the day the filter exceeded 2.0 NTU in two consecutive measurements for the second straight month.

1. The CPE report must be completed and submitted to the department within 120 days following the day the filter exceeded 2.0 NTU in two consecutive measurements for the second straight month.

2. A new CPE is not required if a CPE has been completed by the department or a department-approved third party within the prior 12 months, or if the system and department are jointly participating in an ongoing comprehensive technical assistance project at the system.

(4) The department may conduct a CPE at a system regardless of individual filter turbidity levels.

43.10(6) *Reporting requirements.* Systems must report as follows:

a. CFE turbidity monitoring.

(1) The following information must be reported in the MOR to the department by the tenth day of the following month:

1. Total number of filtered water turbidity measurements taken during the month;

2. The number and percentage of filtered water turbidity measurements taken during the month that are less than or equal to the system's required 95th percentile limit;

3. The date and analytical result of any turbidity measurements taken during the month that exceeded the maximum turbidity limit for the system, in addition to the requirements of 43.10(6)*"a"*(2); and

4. The dates and summary of calibration and verification of all compliance turbidimeters.

(2) For an exceedance of the CFE maximum turbidity limit, as described below, the system must consult with the department as soon as practical, but no later than 24 hours after the exceedance is known, in accordance with the PN requirements under 567—subparagraph 40.5(3)*"b"*(3). Consultation is required if at any time the turbidity in representative samples of filtered water exceeds:

1. 1 NTU in the CFE in two consecutive recordings taken 15 minutes apart for systems using conventional filtration treatment or direct filtration;
2. The maximum level under 43.5(3) for slow sand filtration or diatomaceous earth filtration; or
3. The maximum level in 43.10(4)*"c"* for filtration technologies other than conventional filtration treatment, direct filtration, slow sand filtration, or diatomaceous earth filtration.

b. Individual filter effluent (IFE) turbidity monitoring. The following information must be reported in the MOR to the department by the tenth day of the following month, unless otherwise noted.

(1) That the system conducted individual filter turbidity monitoring during the month.

(2) For any filter that had two consecutive measurements taken 15 minutes apart that exceeded 1.0 NTU:

1. The filter number(s);
2. The corresponding dates;
3. The turbidity values that exceeded 1.0 NTU; and
4. The cause, if known, of the exceedance.

(3) If a self-assessment was required, the date it was triggered, and the date the assessment was completed. If the self-assessment requirement was triggered in the last four days of the month, the information must be reported to the department by the 14th day of the following month.

(4) If a CPE was required, the date it was triggered. A copy of the CPE report must be submitted to the department within 120 days of when the CPE requirement was triggered.

(5) The dates and summary of calibration and verification of all compliance turbidimeters.

c. Disinfection profiling. The following information must be reported to the department by January 1, 2004, for systems serving fewer than 500 people.

(1) Results of DBP monitoring that indicate TTHM levels less than 0.064 mg/L and HAA5 levels less than 0.048 mg/L; or

(2) That the system has begun to collect the profiling data.

d. Disinfection benchmarking. Before a system that was required to develop a disinfection profile makes a significant change to its disinfection practice, it must report the following information to the department, and the system must receive department approval before any significant change in disinfection practice is implemented.

(1) Description of the proposed change in disinfection practice;

(2) The disinfection profile for *Giardia lamblia* and, if applicable, for viruses;

(3) The disinfection benchmark; and

(4) An analysis of how the proposed change will affect the current disinfection levels.

43.10(7) *Recordkeeping requirements.* Systems must meet the following recordkeeping requirements, in addition to the recordkeeping requirements in 567—paragraph 40.8(3)*"c"* and rule 567—40.9(455B).

a. IFE turbidity. The results of the IFE turbidity monitoring must be kept for at least three years.

b. Disinfection profiling and benchmarking. The results of the disinfection profile and disinfection benchmark, including raw data and analysis, must be kept indefinitely.

567—43.11(455B) Enhanced treatment for *Cryptosporidium*.

43.11(1) *Applicability.* The requirements of this rule are national primary drinking water regulations and establish or extend TT requirements in lieu of MCLs for *Cryptosporidium*. These requirements are in addition to the filtration and disinfection requirements of rules 567—43.5(455B), 567—43.9(455B) and 567—43.10(455B) and apply to all Iowa PWSs supplied by SW or IGW sources.

a. Wholesale systems. Wholesale systems must comply with these requirements based on the population of the largest system in the combined distribution system.

b. Filtered systems. This rule applies to those filtered systems that must provide filtration treatment pursuant to rule 567—43.5(455B), whether or not the system is currently operating a filtration system.

43.11(2) *General.* Systems subject to this rule must comply with the following:

a. Source water monitoring. Systems must conduct two rounds of source water monitoring for each plant that treats a SW or IGW source. This monitoring may include sampling for *Cryptosporidium*, *E. coli*, and turbidity, as described in 43.11(3), to determine what level, if any, of additional *Cryptosporidium* treatment the systems must provide.

b. Disinfection profiles and benchmarks. Systems planning to make a significant change to their disinfection practice must develop disinfection profiles and calculate disinfection benchmarks, as described in 43.11(4).

c. Treatment bin determination. Systems must determine their *Cryptosporidium* treatment bin classification and provide additional *Cryptosporidium* treatment, if required, according to the prescribed schedule.

d. Additional treatment. Systems required to provide additional *Cryptosporidium* treatment must implement microbial toolbox options as described in 43.11(8) through 43.11(13).

e. Recordkeeping and reporting. Systems must comply with the applicable recordkeeping and reporting requirements in 43.11(14) and 43.11(15).

f. Significant deficiencies. Systems must address significant deficiencies identified during sanitary surveys as described in 43.1(7).

43.11(3) *Source water monitoring.*

a. Schedule. Systems must conduct the source water monitoring no later than the month and year listed in Table 1. A system may avoid the source water monitoring if it provides a total of at least 5.5-log treatment for *Cryptosporidium*, equivalent to meeting the treatment requirements of Bin 4 in 43.11(6). The system must install and operate technologies to provide this level of treatment by the applicable treatment compliance date specified in 43.11(7).

Table 1: Source Water Monitoring Schedule

System	First round of monitoring	Second round of monitoring
Serves at least 100,000 people	October 2006	April 2015
Serves 50,000-99,999 people	April 2007	October 2015
Serves 10,000-49,999 people	April 2008	October 2016
Serves fewer than 10,000 people and only monitors *E. coli*	October 2008	October 2017
Serves fewer than 10,000 people and monitors *Cryptosporidium*	April 2010	April 2019

b. Monitoring requirements. The minimum monitoring requirements are listed below. Systems may sample more frequently, provided the sampling frequency is evenly spaced throughout the monitoring period.

(1) Serving at least 10,000 people. Systems serving at least 10,000 people must sample their source water for *Cryptosporidium*, *E. coli*, and turbidity at least monthly for 24 months.

(2) Serving fewer than 10,000 people. Systems serving fewer than 10,000 people are allowed to first conduct *E. coli* monitoring to determine if further *Cryptosporidium* monitoring is required.

1. Systems must sample their source water for *E. coli* at least once every two weeks for 12 months. If the annual mean *E. coli* concentration is at or below 100 *E. coli* per 100 mL, the system can avoid further *Cryptosporidium* monitoring in that sampling round.

2. A system may avoid *E. coli* monitoring if it notifies the department no later than three months prior to the *E. coli* monitoring start date that the system will conduct *Cryptosporidium* monitoring.

3. Systems that fail to conduct the required *E. coli* monitoring or that cannot meet the *E. coli* annual mean limit must conduct *Cryptosporidium* monitoring. The system must sample its source water for *Cryptosporidium* either at least twice per month for 12 months or at least monthly for 24 months.

4. A system that begins monitoring for *E. coli* and determines during the sampling period that the system mathematically cannot meet the applicable *E. coli* annual mean limit may discontinue the *E. coli* monitoring. The system is then required to start *Cryptosporidium* monitoring according to the schedule in Table 1.

(3) Plants operating only part of the year. Systems with SW or IGW treatment plants that operate for only part of the year must conduct source water monitoring in accordance with this rule, but with the following modifications.

1. Systems must sample their source water only during the months that the plant operates unless the department specifies another monitoring period based on plant operating practices.

2. Systems with plants that operate less than six months per year must collect at least six samples per year for two years. The samples must be evenly spaced throughout the period the plant operates.

(4) New sources. A system that begins using a new SW or IGW source after the dates in Table 1 must monitor according to a department-approved schedule and comply with this subrule. The system must also meet the requirements of the bin classification and *Cryptosporidium* treatment for the new source on a department-approved schedule. The system must conduct the second round of source water monitoring no later than six years following the initial bin classification or determination of the mean *Cryptosporidium* level, as applicable.

(5) Monitoring violation determination. Failure to collect any source water sample required under this subrule in accordance with the sampling plan, location, analytical method, approved laboratory, or reporting requirements of 43.11(3)*"c"* through *"e"* is a monitoring violation.

c. Sampling plan. Systems must submit a sampling plan that specifies the sampling locations in relation to the sources and treatment processes and the calendar dates of sample collection. The specific treatment process locations that must be included in the plan are pretreatment, points of chemical treatment, and filter backwash recycle.

(1) The sampling plan must be submitted in a form acceptable to the department no later than three months prior to the applicable monitoring date in Table 1. If the department does not respond to a system regarding the submitted sampling plan prior to the start of the monitoring period, the system must sample according to the submitted plan.

(2) The system must monitor within two days of the date specified in the plan, unless one of the following conditions occurs.

1. If an extreme condition or situation exists that may pose danger to the sample collector, or that cannot be avoided, and causes the system to be unable to sample in the scheduled five-day period, the system must sample as close to the scheduled date as is feasible unless the department approves an alternative sampling date. The system must submit an explanation for the delayed sampling date to the department within one week of the missed sampling period. A replacement sample must be collected.

2. If a system is unable to report a valid analytical result for a scheduled sampling date due to equipment failure, loss of or damage to the sample, failure to comply with the analytical method or quality control requirements, or failure of the laboratory to analyze the sample, the system must notify the department of the cause of the delay and collect a replacement sample.

3. A replacement sample must be collected within 21 days of the scheduled sampling period or on the department-approved resampling date.

(3) Missed sampling dates. Systems that fail to collect source water samples on the dates specified in their sampling plan must revise their sampling plan to add collection dates all missed

samples. The revised plan must be submitted to the department for approval prior to the collection of the missed samples.

d. Sampling locations. Systems must collect samples for each treatment plant that treats a SW or IGW source. If multiple plants draw water from the same influent (same pipe or intake), the department may approve one set of monitoring results to be used to satisfy the requirements for those plants.

(1) Chemical treatment location. Systems must collect source water samples prior to chemical treatment. If the system cannot feasibly collect a sample prior to chemical treatment, the department may grant approval in writing for sample collection after chemical treatment. This approval would only be granted if the department determines that sample collection prior to chemical treatment is not feasible for the system and that the chemical treatment is unlikely to have a significant adverse effect on the sample analysis.

(2) Filter backwash recycle return location. Systems that recycle filter backwash water must collect source water samples prior to the point of filter backwash water addition.

(3) Bank filtration credit sampling location.

1. Systems that receive *Cryptosporidium* treatment credit for bank filtration under 43.9(3)*"b"* or 43.10(4)*"c"* must collect source water samples in the SW source prior to bank filtration.

2. Systems that use bank filtration as pretreatment to a filtration plant must collect source water samples from the well, which is after bank filtration has occurred. Use of bank filtration during monitoring must be consistent with routine operational practice. Systems collecting samples after a bank filtration process may not receive treatment credit for the bank filtration under 43.11(10)*"c."*

(4) Multiple sources. Systems with plants that use multiple water sources, including multiple SW sources and blended SW and GW sources, must collect samples as follows:

1. The use of multiple sources during monitoring must be consistent with routine operational practice.

2. If a sampling tap is available where the sources are combined prior to treatment, the system must collect samples from that tap.

3. If a sampling tap where the sources are combined prior to treatment is not available, the system must collect samples at each source near the intake on the same day and must use either of the following options for sample analysis.

- Physically composite the source samples into a single sample for analysis. Systems may composite the sample from each source into one sample prior to analysis. The volume of the sample from each source must be weighted according to the proportion of the source in the total plant flow at the time of sample collection, or
- Analyze the samples from each source separately and mathematically composite the results by calculating a weighted average of the analytical results for each sampling date. Calculate the weighted average by multiplying the analytical result for each source by the fraction that source contributed to the total plant flow at the time of sample collection and summing the weighted analytical results.

e. Analytical methodology, laboratory certification, and data reporting requirements. Systems must have samples analyzed pursuant to this paragraph. The system must report, in a format acceptable to the department, the analytical results from the source water monitoring no later than ten days after the end of the first month following the month when the sample is collected.

(1) *Cryptosporidium* samples must be analyzed by a laboratory that is approved under EPA's Laboratory Quality Assurance Evaluation Program for Analysis of *Cryptosporidium* in Water.

1. Approved analytical methods for *Cryptosporidium*:

- "Method 1623: *Cryptosporidium* and *Giardia* in Water by Filtration/IMS/FA," 2005, EPA-815-R-05-002, www.nemi.gov;
- "Method 1622: *Cryptosporidium* in Water by Filtration/IMS/FA," 2005, EPA-815-R-05-001, www.nemi.gov; and
- "Method 1623.1: *Cryptosporidium* and *Giardia* in Water by Filtration/Immunomagnetic Separation/Immunofluorescence Assay Microscopy," 2012, EPA-816-R-12-001, www.nepis.epa.gov.

2. Using one of the approved methods, the laboratory must analyze at least a 10 L sample or a packed pellet volume of at least 2 mL. Systems unable to process a 10 L sample must analyze as much sample volume as can be filtered by two filters specified in the method, up to a packed pellet volume of at least 2 mL.

3. A matrix spike (MS) sample must be spiked and filtered by the laboratory according to the approved method. If the volume of the MS sample is greater than 10 L, the system may filter all but 10 L of the MS sample in the field and ship the filtered sample and the remaining 10 L of source water to the laboratory. In this case, the laboratory must spike the remaining 10 L of water and filter it through the filter used to collect the balance of the sample in the field.

4. Flow cytometer-counted spiking suspensions must be used for the MS samples and the ongoing precision and recovery samples.

5. The following data must be reported for each *Cryptosporidium* analysis:

- PWS ID.
- Facility ID.
- Sample collection date.
- Sample type (i.e., field or MS).
- Sample volume filtered (L), to the nearest 0.25 L.
- Whether 100 percent of the filtered volume was examined by the laboratory.
- Number of oocysts counted.
- For MS samples: sample volume spiked and estimated number of oocysts spiked.
- For samples in which less than 10 L is filtered or less than 100 percent of the sample volume is examined: the number of filters used and the packed pellet volume.
- For samples in which less than 100 percent of sample volume is examined: the volume of resuspended concentrate and the volume of this resuspension processed through immunomagnetic separation.

(2) *E. coli* samples must be analyzed by a laboratory certified by EPA, the National Environmental Laboratory Accreditation Conference, or the department for total coliform or fecal coliform analysis in drinking water samples using the same approved *E. coli* method for the source water analysis.

1. Approved analytical methods for the enumeration of *E. coli* in source water are shown in Table 2.

Table 2: *E. coli* Analytical Methods

Method	EPA	SM	Other
Most probable number (MPN) with multiple tube or multiple well[1, 2]		9223 B[11]	991.15[4], Colilert[3, 5] Colilert-18[3, 5, 6]
Membrane filtration, single step[1, 7, 8]	1603[9]		m-ColiBlue24[10]
Membrane filtration, two step		9222D/9222G[12]	

[1]Tests must be conducted to provide organism enumeration (i.e., density). Select the appropriate configuration of tubes/filtrations and dilutions/volumes to account for the quality, consistency, and anticipated organism density in the water sample.

[2]Enumerate samples using the multiple-tube or multiple-well procedure. Using multiple-tube procedures, employ an appropriate tube and dilution configuration of the sample as needed and report the MPN. Samples tested with Colilert® may be enumerated with the multiple-well procedures, Quanti-Tray®, Quanti-Tray® 2000, and the MPN calculated from the table provided by the manufacturer.

[3]These tests are collectively known as defined enzyme substrate tests, where, for example, a substrate is used to detect the enzyme beta-glucouronidase produced by *E. coli*.

[4]Association of Official Analytical Chemists, International. "Official Methods of Analysis of AOAC International, 16th Ed., Volume 1, Chapter 17, 1995. AOAC, 481 N. Frederick Ave., Suite 500, Gaithersburg, MD 20877-2417.

[5]Descriptions of the Colilert®, Colilert-18®, Quanti-Tray®, and Quanti-Tray® 2000 may be obtained from IDEXX Laboratories, Inc., 1 IDEXX Drive, Westbrook, ME 04092.

[6]Colilert-18® is an optimized formulation of the Colilert® for the determination of total coliforms and E. coli that provides results within 18 hours of incubation at 35 degrees Celsius rather than the 24 hours required for the Colilert® test.

[7]The filter must be a 0.45 micron membrane filter or a membrane filter with another pore size certified by the manufacturer to fully retain cultivated organisms and to be free of extractables that could interfere with organism growth.

[8]When the membrane filter method has been used previously to test waters with high turbidity or large numbers of noncoliform bacteria, a parallel test should be conducted with a multiple-tube technique to demonstrate applicability and comparability of results.

[9]Method 1603: *Escherichia coli* (*E. coli*) in Water by Membrane Filtration Using Modified Membrane-Thermotolerant *Escherichia coli* Agar (modified mTEC), July 2006, EPA 821-R-06-011, www.nepis.epa.gov.

[10]A description of the m-ColiBlue24® test, Total Coliforms and E. coli, Hach Company, 100 Dayton Ave., Ames, IA 50010.

[11]SM 18th (1992), 19th (1995), and 20th (1998) editions.

[12]SM, 20th edition (1998).

2. The holding time (the time period from sample collection to initiation of analysis) shall not exceed 30 hours. The department may approve a 48-hour holding time on a case-by-case basis, if the 30-hour holding time is not feasible. If an extension is allowed, the laboratory must use the Colilert® reagent version of the SM 9223B to conduct the analysis.

3. The samples must be maintained between 0 and 10 degrees Celsius during storage and transit to the laboratory.

4. The following data must be reported for each *E. coli* analysis:

- PWS ID.
- Facility ID.
- Sample collection date.
- Analytical method number.
- Method type.
- Source type (flowing stream or river; lake or reservoir; or IGW).
- Number of *E. coli* per 100 mL.
- Turbidity in NTU.

(3) Turbidity. The approved analytical methods for turbidity are in 43.5(4)*"a"*(1). Turbidity measurements must be made by a party approved by the department, and reported on the laboratory data sheet with the corresponding *E. coli* sample.

43.11(4) *Disinfection profiling and benchmarking.*

a. General requirements. Following completion of the first round of source water monitoring, a system that plans to make a significant change to its disinfection practice must develop disinfection profiles and calculate disinfection benchmarks for *Giardia lamblia* and viruses.

(1) A system must notify the department prior to changing its disinfection practice and must include in the notice the completed disinfection profile and disinfection benchmark for *Giardia lamblia* and viruses, a description of the proposed change in disinfection practice, and an analysis of how the proposed change will affect the current level of disinfection.

(2) A significant change to the disinfection practice is defined as:

1. Any change to the point of disinfection;
2. Any change to the disinfectant(s) used in the treatment plant;
3. Any change to the disinfection process; or
4. Any other modification identified by the department as a significant change to disinfection practice.

b. Developing a disinfection profile. To develop a disinfection profile, a system must monitor at least weekly for a period of 12 consecutive months to determine the total log inactivation for *Giardia lamblia* and viruses. If a system monitors more frequently, the frequency must be evenly spaced. A system that operates for fewer than 12 months per year must monitor weekly during the operation period. Systems must determine log inactivation for *Giardia lamblia* through the entire plant, based on CT99.9 values in Appendix A, Tables 1 through 6, as applicable. Systems must determine log inactivation for viruses through the entire treatment plant based on a department-approved protocol.

(1) Monitoring requirements. Systems with a single point of disinfectant application prior to the entrance to the distribution system must conduct the monitoring in this subparagraph. Systems with multiple points of disinfectant application must conduct the same monitoring for each disinfection

segment. Systems must monitor the parameters necessary to determine the total inactivation ratio. The analytical methods for the parameters are n 43.5(4)*"a."* All measurements must be taken during peak hourly flow.

1. For systems using a disinfectant other than UV, the temperature of the disinfected water must be measured in degrees Celsius at each RDC sampling point or at an alternative department-approved location.

2. For systems using chlorine, the pH of the disinfected water must be measured at each chlorine RDC sampling point or at an alternative department-approved location.

3. The disinfectant contact time must be determined in minutes.

4. The RDCs of the water must be determined in mg/L before or at the first customer and prior to each additional point of disinfectant application.

5. A system may use existing data to meet the monitoring requirements if: the data are substantially equivalent to the required data, it has not made any significant change to its treatment practice, and it has the same source water as it had when the data were collected. Systems may develop disinfection profiles using up to three years of existing data.

6. A system may use disinfection profiles developed under 43.9(2) or 43.10(2) if it has not made a significant change to its treatment practice and has the same source water as it had when the profile was developed. The virus profile must be developed using the same data on which the *Giardia lamblia* profile is based.

(2) Total inactivation ratio calculation for *Giardia lamblia*.

1. Systems using only one point of disinfectant application may determine the total inactivation ratio (CTcalc/CT99.9) for the disinfection segment using either of the following methods.

- Determine one inactivation ratio before or at the first customer during peak hourly flow; or
- Determine successive sequential inactivation ratios between the point of disinfectant application and a point before or at the first customer during peak hourly flow. Calculate the total inactivation ratio by determining the inactivation ratio for each sequence (CTcalc/CT99.9) and adding the values together.

2. Systems using more than one point of disinfectant application before the first customer must determine the CT value of each disinfection segment immediately prior to the next point of disinfectant application, or for the final segment, before or at the first customer, during peak hourly flow. Calculate the (CTcalc/CT99.9) value of each segment and add the values together to determine the total inactivation ratio.

3. Systems must then determine the total logs of inactivation by multiplying the total inactivation ratio by 3.0.

(3) Total inactivation ratio calculation for viruses. The system must calculate the log of inactivation for viruses using a department-approved protocol.

c. Disinfection benchmark calculation.

(1) For each year of profiling data collected and calculated under this subrule, systems must determine the lowest mean monthly level of both *Giardia lamblia* and virus inactivation. Systems must determine the mean *Giardia lamblia* and virus inactivation for each calendar month for each year of profiling data by dividing the sum of daily or weekly *Giardia lamblia* and virus log inactivation by the number of values calculated for that month.

(2) For a system with one year of profiling data, the disinfection benchmark is the lowest monthly mean value. For a system with more than one year of profiling data, the disinfection benchmark is the mean of the lowest monthly mean values of *Giardia lamblia* and virus log inactivation in each year of profiling data.

43.11(5) *Bin classification.* Upon completion of the first round of source water monitoring, systems must calculate an initial *Cryptosporidium* bin concentration for each plant for which monitoring was required. Calculation of the bin concentration must use the *Cryptosporidium* results reported under 43.11(3)*"a."*

a. Calculation of mean Cryptosporidium or bin concentration value.

(1) For systems that collect a total of at least 48 samples, the bin concentration is equal to the arithmetic mean of all sample concentrations.

(2) For systems that collect at least 24 samples but not more than 47 samples, the bin concentration is equal to the highest arithmetic mean of all sample concentrations in any 12 consecutive months during which *Cryptosporidium* samples were collected.

(3) For systems that serve fewer than 10,000 people and monitor *Cryptosporidium* for only one year (i.e., 24 samples in 12 months), the bin concentration is equal to the arithmetic mean of all sample concentrations.

(4) For systems with plants operating only part of the year that monitor fewer than 12 months per year, the bin concentration is equal to the highest arithmetic mean of all sample concentrations during any year of *Cryptosporidium* monitoring.

(5) If the monthly *Cryptosporidium* sampling frequency varies, systems must first calculate a monthly average for each month of monitoring. Systems must then use these monthly average concentrations, rather than individual sample concentrations, in the applicable calculation for bin classification.

b. Determination of bin classification.

(1) First monitoring round. A system must determine the bin classification from Table 3, using its calculated bin concentration from 43.11(5)*"a."*

Table 3: Bin Classification Table

System Type	*Cryptosporidium* Concentration, in oocysts/L	Bin Classification
Systems required to monitor for *Cryptosporidium* under 43.11(3)*"b"*(1) or 43.11(3)*"b"*(2)"3"	Fewer than 0.075 oocysts/L	Bin 1
	Between 0.075 and fewer than 1.0 oocysts/L	Bin 2
	Between 1.0 and fewer than 3.0 oocysts/L	Bin 3
	3.0 oocysts/L or greater	Bin 4
Systems serving fewer than 10,000 and not required to monitor for *Cryptosporidium*, pursuant to 43.11(3)*"b"*(2)"1"	Not applicable	Bin 1

(2) Second monitoring round. Following completion of the second round of source water monitoring, a system must recalculate its bin concentration and determine its new bin classification, using the protocols in 43.11(5)*"a"* and *"b."*

c. Reporting bin classification to the department. Within six months of the end of the sampling period, the system must report its bin classification to the department for approval. The report must include a summary of the source water monitoring data and the calculation procedure used to determine the bin classification.

d. TT violation. Failure to comply with 43.11(5)*"b"* and *"c"* is a violation of the TT requirement.

43.11(6) *Additional Cryptosporidium treatment requirements.* A system must provide the level of additional *Cryptosporidium* treatment specified in Table 4 based on its bin classification determined in 43.11(5) and according to the schedule in 43.11(7).

a. Determination of additional requirements. Using Table 4, a system must determine any additional *Cryptosporidium* treatment requirements based upon its bin classification. The Bin 1 classification does not require any additional treatment. Bins 2 through 4 require additional treatment.

Table 4: Additional *Cryptosporidium* Treatment Requirements

Bin Classification	Treatment Used by the System for Compliance with 43.5, 43.9, and 43.10			
	Conventional filtration (including softening)	Direct filtration	Slow sand or diatomaceous earth filtration	Alternative filtration technologies
Bin 1	No additional treatment	No additional treatment	No additional treatment	No additional treatment
Bin 2	1-log treatment	1.5-log treatment	1-log treatment	At least 4.0-log[1]
Bin 3	2-log treatment	2.5-log treatment	2-log treatment	At least 5.0-log[1]
Bin 4	2.5-log treatment	3-log treatment	2.5-log treatment	At least 5.5-log[1]

[1]The total *Cryptosporidium* removal and inactivation must be at least this value, as determined by the department.

b. Treatment requirements for Bins 2 through 4. A system that is classified as Bin 2, 3, or 4 must use one or more of the treatment and management options in 43.11(8) to comply with the additional *Cryptosporidium* treatment requirements. Systems classified as Bins 3 and 4 must achieve at least 1-log of additional *Cryptosporidium* treatment by using either one or a combination of the following: bag filters, bank filtration, cartridge filters, chlorine dioxide, membranes, ozone, or UV, as listed in 43.11(9) through 43.11(13).

c. TT violation. Failure by a system in any month to achieve treatment credit by meeting criteria in 43.11(9) through 43.11(13) that is at least equal to the level of treatment required in 43.11(6)*"a"* is a violation of the TT requirement.

d. Significant changes to the watershed. If, after the system's completion of source water monitoring (either round), the department determines during a sanitary survey or an equivalent source water assessment that significant changes occurred in the system's watershed that could lead to increased contamination of the source water by *Cryptosporidium*, the system must take department-specified actions to address the contamination. These actions may include additional source water monitoring or implementation of the microbial toolbox options in 43.11(8).

43.11(7) *Schedule for compliance with Cryptosporidium treatment.* Following the initial bin classification under 43.11(5), systems must provide the level of *Cryptosporidium* treatment required in 43.11(6), according to the schedule in Table 5. If a system's bin classification changes following the second round of source water monitoring, the system must provide the level of *Cryptosporidium* treatment required in 43.11(6), on a department-approved schedule.

Table 5: *Cryptosporidium* Treatment Compliance Dates

Schedule	Population Served by System	Compliance Date for *Cryptosporidium* treatment requirements[1]
1	At least 100,000 people	April 1, 2012
2	From 50,000 to 99,999 people	October 1, 2012
3	From 10,000 to 49,999 people	October 1, 2013
4	Fewer than 10,000 people	October 1, 2014

[1]The department may allow up to an additional two years for compliance with the treatment requirement if the system must make capital improvements.

43.11(8) *Microbial toolbox options for meeting Cryptosporidium treatment requirements.* Systems receive the treatment credits listed in Table 6 by meeting the conditions for microbial toolbox options described in 43.11(9) through 43.11(13). Systems apply these treatment credits to meet the treatment requirements in 43.11(6). Table 6 summarizes options in the microbial toolbox.

Table 6: Microbial Toolbox Summary Table: Options, Treatment Credits, and Criteria

Toolbox Option	Specific Criteria Rule	*Cryptosporidium* treatment credit with design and implementation criteria
Source Protection and Management Toolbox Options		

Toolbox Option	Specific Criteria Rule	*Cryptosporidium* treatment credit with design and implementation criteria
Watershed control program (WCP)	43.11(9)	0.5-log credit for department-approved program comprising required elements, annual program status report to department, and regular watershed survey.
Alternative source/intake management	43.11(9)*"b"*	No prescribed credit. Systems may conduct simultaneous monitoring for treatment bin classification at alternative intake locations or under alternative intake management strategies.
Prefiltration Toolbox Options		
Presedimentation basin with coagulation	43.11(10)*"a"*	0.5-log credit during any month that presedimentation basins achieve a monthly mean reduction of 0.5-log or greater in turbidity or alternative department-approved performance criteria. To be eligible, basins must be operated continuously with coagulant addition and all plant flow must pass through the basins.
Two-stage lime softening	43.11(10)*"b"*	0.5-log credit for two-stage softening where chemical addition and hardness precipitation occur in both stages. All plant flow must pass through both stages. Single-stage softening is credited as equivalent to conventional treatment.
Bank filtration	43.11(10)*"c"*	0.5-log credit for 25-foot setback; 1.0-log credit for 50-foot setback; aquifer must be unconsolidated sand containing at least 10 percent fines; average turbidity in wells must be less than 1 NTU. A system using a well followed by filtration when conducting source water monitoring must sample the well to determine bin classification and is not eligible for additional credit.
Treatment Performance Toolbox Options		
Combined filter performance	43.11(11)*"a"*	0.5-log credit for CFE turbidity less than or equal to 0.15 NTU in at least 95 percent of measurements each month.
Individual filter performance	43.11(11)*"b"*	0.5-log credit (in addition to the 0.5-log combined filter performance credit) if IFE turbidity is less than or equal to 0.15 NTU in at least 95 percent of samples each month in each filter and is never greater than 0.3 NTU in two consecutive measurements in any filter.

Toolbox Option	Specific Criteria Rule	*Cryptosporidium* treatment credit with design and implementation criteria
Demonstration of performance	43.11(11)*"c"*	Credit awarded to unit process or treatment train based on a demonstration to the department with a department-approved protocol.
Additional Filtration Toolbox Options		
Bag or cartridge filters (individual filters)	43.11(12)*"a"*	Up to 2-log credit based on the removal efficiency demonstrated during challenge testing with a 1.0-log factor of safety.
Bag or cartridge filters (in series)	43.11(12)*"a"*	Up to 2.5-log credit based on the removal efficiency demonstrated during challenge testing with a 0.5-log factor of safety.
Membrane filtration	43.11(12)*"b"*	Log credit equivalent to removal efficiency demonstrated in challenge test for device if supported by direct integrity testing.
Second-stage filtration	43.11(12)*"c"*	0.5-log credit for second separate granular media filtration stage if treatment train includes coagulation prior to first filter.
Slow sand filtration	43.11(12)*"d"*	2.5-log credit as a secondary filtration step; 3.0-log credit as a primary filtration process. No prior chlorination for either option.
Inactivation Toolbox Options		
Chlorine dioxide	43.11(13)	Log credit based on measured CT in relation to CT table.
Ozone	43.11(13)	Log credit based on measured CT in relation to CT table.
UV	43.11(13)	Log credit based on validated UV dose in relation to UV dose table; reactor validation testing required to establish UV dose and associated operating conditions.

43.11(9) *Source toolbox components.*

a. Watershed control program (WCP). Systems receive 0.5-log *Cryptosporidium* treatment credit for implementing a WCP that meets the requirements of this paragraph.

(1) Notification. Systems that intend to apply for the WCP credit must notify the department of this intent no later than two years prior to the applicable treatment compliance date in 43.11(7).

(2) Proposed watershed control plan. Systems must submit a proposed watershed control plan to the department no later than one year before the applicable treatment compliance date in 43.11(7). The department must approve the plan for the system to receive WCP treatment credit. The plan must include the following:

1. Identification of an "area of influence" outside of which the likelihood of *Cryptosporidium* or fecal contamination affecting the treatment plant intake is not significant. This is the area to be evaluated in future watershed surveys under 43.11(9)*"a"*(5)"2."

2. Identification of both potential and actual sources of *Cryptosporidium* contamination and an assessment of the relative impact of these sources on the system's source water quality.

3. An analysis of the effectiveness and feasibility of control measures that could reduce *Cryptosporidium* loading from sources of contamination to the system's source water.

4. A statement of goals and specific actions the system will undertake to reduce source water *Cryptosporidium* levels. The plan must explain how the actions are expected to contribute to specific goals, identify watershed partners and their roles, identify resource requirements and commitments, and include a schedule for plan implementation with deadlines for completing specific actions.

(3) Existing WCPs. Systems with WCPs that were in place on January 5, 2006, are eligible to seek this credit. The systems' watershed control plans must meet the criteria in 43.11(9)*"a"*(2) and must specify ongoing and future actions that will reduce source water *Cryptosporidium* levels.

(4) Department response to plan. If the department does not respond to a system regarding approval of a watershed control plan submitted under this subrule and the system meets the other requirements of this subrule, the WCP will be considered approved and 0.5-log *Cryptosporidium* treatment credit will be awarded unless and until the department subsequently withdraws such approval.

(5) System requirements to maintain 0.5-log credit. Systems must complete the following actions to maintain the 0.5-log credit.

1. Submit an annual WCP status report to the department. The WPC status report must describe the system's implementation of the approved plan and assess the adequacy of the plan to meet its goals. The report must explain how the system is addressing any shortcomings in plan implementation, including those previously identified by the department or as a result of the watershed survey conducted under 43.11(9)*"a"*(5)"2." It must also describe any significant watershed changes that have occurred since the last watershed sanitary survey. If a system determines during implementation that significant changes to its approved WCP are necessary, it must notify the department prior to making the changes. If a program change is likely to reduce the level of source water protection, the system must list in its notification the actions the system will take to mitigate this effect.

2. Undergo a watershed sanitary survey every three years for CWSs and every five years for NTNCs or TNCs and submit the survey report to the department. Surveys must be conducted according to department guidelines and by persons acceptable to the department.

- A watershed sanitary survey must encompass the region identified in the department-approved watershed control plan as the area of influence; assess the implementation of actions to reduce source water *Cryptosporidium* levels; and identify any significant new sources of *Cryptosporidium*.
- If the department determines that significant changes may have occurred in the watershed since the previous watershed sanitary survey, systems must undergo another watershed sanitary survey by the department-specified date, which may be earlier than the regular three- or five-year frequency.

3. Systems must make the watershed control plan, annual status reports, and watershed sanitary survey reports available to the public upon request. These documents must be in plain language and include criteria to evaluate the success of the WCP in achieving plan goals. The department may approve systems to withhold portions of the plan or the reports from the public, based on security considerations.

(6) Withdrawal of WCP treatment credit. If the department determines that a system is not carrying out the approved watershed control plan, it may withdraw the WCP treatment credit.

b. Alternative source. Systems may conduct source water monitoring that reflects a different intake location (either in the same source or for an alternate source) or a different procedure for the timing or level of withdrawal from the source (alternative source monitoring). If the department approves, a system may determine its bin classification under 43.11(5) based on alternative source monitoring results.

(1) Systems conducting alternative source monitoring must also monitor their current plan intake concurrently, as described in 43.11(3).

(2) Alternative source monitoring must meet the requirements for source monitoring to determine bin classification, as described in 43.11(3). Systems must report the alternative source monitoring results to the department and provide supporting information documenting the operating conditions during sample collection.

(3) If a system determines its bin classification under 43.11(5) using alternative source monitoring results that reflect a different intake location or a different procedure for managing the timing or level of withdrawal from the source, it must relocate the intake or permanently adopt the withdrawal procedure, as applicable, no later than the applicable treatment compliance date in 43.11(7).

43.11(10) *Prefiltration treatment toolbox components.*

a. Presedimentation. Systems receive 0.5-log *Cryptosporidium* treatment credit for a presedimentation basin during any month the process meets the criteria in this paragraph.

(1) The presedimentation basin must be in continuous operation and must treat the entire plant flow taken from a SW or IGW source.

(2) The system must continuously add a coagulant to the presedimentation basin.

(3) The presedimentation basin must achieve either of the following performance criteria:

1. Demonstrates at least 0.5-log mean reduction of influent turbidity, determined by using daily turbidity measurements in the presedimentation process influent and effluent, and calculated as follows: LOG10(monthly mean of daily influent turbidity) – LOG10(monthly mean of daily effluent turbidity); or

2. Complies with department-approved performance criteria that demonstrate at least 0.5-log mean removal of micron-sized particulate material through the presedimentation process.

b. Two-stage lime softening. Systems receive an additional 0.5-log *Cryptosporidium* treatment credit for a two-stage lime softening plant if chemical addition and hardness precipitation occur in two separate and sequential softening stages prior to filtration. Both softening stages must treat the entire plant flow taken from a SW or IGW source.

c. Bank filtration. Systems receive *Cryptosporidium* treatment credit for bank filtration that serves as pretreatment to a filtration plant by meeting the criteria in this paragraph. Systems using bank filtration when beginning source water monitoring under 43.11(3)*"a"* must collect samples as described in 43.11(3)*"d"*(3) and are not eligible for this credit.

(1) Treatment credit. Wells with a GW flow path of at least 25 feet receive 0.5-log treatment credit; wells with a GW flow path of at least 50 feet receive 1.0-log treatment credit. The GW flow path must be determined as specified in 43.11(10)*"c"*(4).

(2) Credit eligibility. Only horizontal and vertical wells in granular aquifers are eligible for treatment credit. Granular aquifers are those comprised of sand, clay, silt, rock fragments, pebbles or larger particles, and minor cement. A system must characterize the aquifer at the well site to determine aquifer properties. Systems must extract a core from the aquifer and demonstrate that in at least 90 percent of the core length, grains less than 1.0 mm in diameter constitute at least 10 percent of the core material.

(3) GW flow path measurement. For vertical wells, the GW flow path is the measured distance from the edge of the surface water body under high flow conditions (determined by the 100-year floodplain elevation boundary or by the floodway, as defined in Federal Emergency Management Agency flood hazard maps) to the well screen. For horizontal wells, the GW flow path is the measured distance from the bed of the river under normal flow conditions to the closest horizontal well lateral screen.

(4) Turbidity monitoring at the wellhead. Systems must monitor each wellhead for turbidity at least once every four hours while the bank filtration process is in operation. If monthly average turbidity levels, based on daily maximum values in the well, exceed 1 NTU, the system must report this result to the department and conduct an assessment within 30 days to determine the cause of the high turbidity levels in the well. If the department determines that microbial removal has been

compromised, it may revoke treatment credit until the system implements department-approved corrective actions to remediate the problem.

(5) Springs and infiltration galleries. This treatment credit is not eligible for springs and infiltration galleries. Springs and infiltration galleries are eligible for credit through demonstration of performance study under 43.11(11)*"c."*

(6) Bank filtration demonstration of performance. The department may approve *Cryptosporidium* treatment credit for bank filtration based on a demonstration of performance study that meets the criteria in this subparagraph. This treatment credit may be greater than 1.0-log and may be awarded to bank filtration that does not meet the criteria in 43.11(10)*"c"*(1) to (5). The study must:

1. Follow a department-approved protocol;

2. Involve the collection of data on the removal of *Cryptosporidium* or a surrogate for *Cryptosporidium* and related hydrogeologic and WQPs during the full range of operating conditions; and

3. Include sampling both from the production well(s) and from monitoring wells that are screened and located along the shortest flow path between the SW source and the production well(s).

43.11(11) *Treatment performance toolbox components.* This option pertains to physical treatment processes.

a. Combined filter performance. Systems using conventional filtration treatment or direct filtration treatment receive an additional 0.5-log *Cryptosporidium* treatment credit during any month the system meets the criteria in this paragraph. CFE turbidity must be less than or equal to 0.15 NTU in at least 95 percent of the measurements. Turbidity must be measured as described in 43.5(4) and, if applicable, 43.10(4).

b. Individual filter performance. Systems using conventional filtration treatment or direct filtration treatment receive 0.5-log *Cryptosporidium* treatment credit during any month the system meets the criteria in this paragraph, which can be in addition to the CFE 0.5-log credit from 43.11(11) *"a."* Compliance with these criteria must be based on individual filter turbidity monitoring as described in 43.9(4) or 43.10(5), as appropriate.

(1) The filtered water turbidity for each individual filter must be less than or equal to 0.15 NTU in at least 95 percent of the measurements recorded each month.

(2) No individual filter may have a measured turbidity greater than 0.3 NTU in two consecutive measurements taken 15 minutes apart.

(3) Any system that has received treatment credit for individual filter performance and fails to meet the requirements of 43.11(11)*"b"*(2) and 43.11(11)*"b"*(3) during any month shall not receive a TT violation under 43.11(6) if the department determines the following:

1. The failure was due to unusual and short-term circumstances that could not reasonably be prevented through optimizing the treatment plant design, operation, and maintenance.

2. The system has experienced no more than two such failures in any calendar year.

c. Demonstration of performance. The department may approve *Cryptosporidium* treatment credit for drinking water treatment processes based on a demonstration of performance study meeting the criteria in this paragraph. This treatment credit may be greater than or less than the prescribed treatment credits in 43.11(6) or 43.11(10) through 43.11(13) and may be awarded to treatment processes that do not meet the criteria for the prescribed credits.

(1) Systems cannot receive the prescribed treatment credit for any toolbox option in 43.11(10) through 43.11(13) if that toolbox option is included in a demonstration of performance study for which treatment credit is awarded under this paragraph.

(2) The demonstration of performance study must follow a department-approved protocol and must demonstrate the level of *Cryptosporidium* reduction the treatment process will achieve under the full range of expected operating conditions for the system.

(3) Department approval must be in writing and may include monitoring and treatment performance criteria that the system must demonstrate and report on an ongoing basis to remain eligible for the treatment credit. The department may designate such criteria where necessary to verify

that the conditions under which the demonstration of performance credit was approved are maintained during routine operation.

43.11(12) *Additional filtration toolbox components.*

a. Bag and cartridge filters. By meeting the criteria in this paragraph, systems receive *Cryptosporidium* treatment credit of up to 2.0-log for the use of individual bag or cartridge filters and up to 2.5-log for the use of bag or cartridge filters operated in series. To be eligible for this credit, systems must report the results of challenge testing that meets the requirements of 43.11(12)*"a"*(2) through 43.11(12)*"a"*(9) to the department. The filters must treat the entire plant flow taken from a SW or IGW source.

(1) The *Cryptosporidium* treatment credit awarded for use of bag or cartridge filters must be based on the removal efficiency demonstrated during challenge testing conducted in accordance with the criteria in 43.11(12)*"a"*(2) through 43.11(12)*"a"*(9). A safety factor equal to 1-log for individual bag or cartridge filters and 0.5-log for bag or cartridge filters in series must be applied to challenge testing results to determine removal credit.

(2) Perform challenge testing on full-scale bag or cartridge filters and associated filter housing or pressure vessels that are identical in material and construction to the filters and housings the system will use for removal of *Cryptosporidium*. Bag or cartridge filters must be challenge tested in the same configuration that the system will use, either as individual filters or as a series configuration of filters.

(3) Conduct challenge testing using *Cryptosporidium* or a surrogate that is removed no more efficiently than *Cryptosporidium*. The microorganism or surrogate used during challenge testing is referred to as the challenge particulate. The challenge particulate concentration must be determined using a method capable of discretely quantifying the specific microorganisms or surrogate used in the test; gross measurements such as turbidity shall not be used.

(4) The maximum feed water concentration that can be used during a challenge test must be based on the detection limit of the challenge particulate in the filtrate (i.e., filtrate detection limit) and must be calculated using this equation:

Maximum Feed Water Concentration = 10,000 × Filtrate Detection Limit

(5) Conduct challenge testing at the maximum design flow rate for the filter specified by the manufacturer.

(6) Each filter evaluated must be tested for a duration sufficient to reach 100 percent of the terminal pressure drop, which thereby establishes the maximum pressure drop under which the filter may be used to comply with this paragraph.

(7) Removal efficiency of a filter must be determined from the results of the challenge test and expressed in terms of log removal values (LRV) using the following equation:

$LRV = LOG_{10}(C_f) - LOG_{10}(C_p)$

Where:

LRV = log removal value demonstrated during challenge test;

C_f = feed concentration measured during challenge test; and

C_p = filtrate concentration measured during challenge test.

Equivalent units must be used for the feed and filtrate concentrations. If the challenge particulate is not detected in the filtrate, the term C_p must be set equal to the detection limit.

(8) Each filter tested must be challenged with the challenge particulate during three periods over the filtration cycle: within two hours of start-up of a new filter; when the pressure drop is between 45 and 55 percent of the terminal pressure drop; and at the end of the cycle after the pressure drop has reached 100 percent of the terminal pressure drop. An LRV must be calculated for each of these challenge periods for each filter tested. The LRV for the filter (LRV_{filter}) must be assigned the value of the minimum LRV observed during the three challenge periods for that filter.

(9) If fewer than 20 filters are tested, the overall removal efficiency for the filter product line must be set equal to the lowest LRV_{filter} among the filters tested. If 20 or more filters are tested, the overall removal efficiency for the filter product line must be set equal to the tenth percentile of the set

of LRV_{filter} values for the various filters tested. The percentile is defined by [i/(n+1)] where "i" is the rank of "n" individual data points ordered lowest to highest. If necessary, the tenth percentile may be calculated using linear interpolation.

(10) If a previously tested filter is modified in a manner that could change the removal efficiency of the filter product line, conduct challenge testing to demonstrate the removal efficiency of the modified filter and submit the results to the department.

b. Membrane filtration.

(1) Systems receive *Cryptosporidium* treatment credit for using membrane filtration that meets the criteria of this paragraph. Systems using membrane cartridge filters that meet the definition of membrane filtration in 567—40.2(455B) are eligible for this credit. The level of treatment credit a system receives is equal to the lower of the values determined under the following two paragraphs:

1. The removal efficiency demonstrated during challenge testing conducted under the criteria in 43.11(12)*"b"*(2).

2. The maximum removal efficiency that can be verified through DIT used with the membrane filtration process under the conditions in 43.11(12)*"b"*(3).

(2) Challenge testing. The membrane used by the system must undergo challenge testing to evaluate removal efficiency, and the system must report the challenge testing results to the department. Conduct challenge testing according to the criteria in this subparagraph.

1. Conduct challenge testing on either a full-scale membrane module, identical in material and construction to the membrane modules used in the system's treatment facility, or a smaller-scale membrane module, identical in material and similar in construction to the full-scale module. A module is defined as the smallest component of a membrane unit in which a specific membrane surface area is housed in a device with a filtrate outlet structure.

2. Conduct challenge testing using *Cryptosporidium* oocysts or a surrogate that is removed no more efficiently than *Cryptosporidium* oocysts. The organisms or surrogate used during challenge testing is referred to as the challenge particulate. The concentration of the challenge particulate, in both the feed and filtrate water, must be determined using a method capable of discretely quantifying the specific challenge particulate used in the test; gross measurements such as turbidity shall not be used.

3. The maximum feed water concentration that can be used during a challenge test is based on the detection limit of the challenge particulate in the filtrate and must be determined according to the following equation:

Maximum Feed Water Concentration = 3,160,000 × Filtrate Detection Limit

4. Conduct challenge testing under representative hydraulic conditions at the maximum design flux and maximum design process recovery specified by the manufacturer for the membrane module. Flux is defined as the throughput of a pressure-driven membrane process expressed as flow per unit of membrane area. Recovery is defined as the volumetric percent of feed water that is converted to filtrate over the course of an operating cycle uninterrupted by events such as chemical cleaning or a solids removal process (i.e., backwashing).

5. Calculate removal efficiency of a membrane module using the challenge test results expressed as a log removal value (LRV), according to the following equation:

$LRV = LOG_{10}(C_f) - LOG_{10}(C_p)$

Where:

LRV = log removal value demonstrated during challenge test;

C_f = feed concentration measured during challenge test; and

C_p = filtrate concentration measured during challenge test.

Use equivalent units for the feed and filtrate concentrations. If the challenge particulate is not detected in the filtrate, the term C_p must be set equal to the detection limit for the purpose of calculating the LRV. An LRV must be calculated for each membrane module evaluated during the challenge test.

6. The removal efficiency of a membrane filtration process demonstrated during challenge testing must be expressed as a log removal value ($LRV_{C\text{-}Test}$). If fewer than 20 modules are tested, then $LRV_{C\text{-}Test}$ is equal to the lowest of the representative LRVs among the modules tested. If 20 or more modules are tested, then $LRV_{C\text{-}Test}$ is equal to the tenth percentile of the representative LRVs among the modules tested. The percentile is defined by [i/(n+1)] where "i" is the rank of "n" individual data points ordered lowest to highest. If necessary, the tenth percentile may be calculated using linear interpolation.

7. The challenge test must establish a quality control release value (QCRV) for a nondestructive performance test that demonstrates the *Cryptosporidium* removal capability of the membrane filtration module. In order to verify *Cryptosporidium* removal capability, this performance test must be applied to each production membrane module that was not directly challenge tested but was used by the system. Production modules that do not meet the established QCRV are not eligible for the treatment credit demonstrated during the challenge test.

8. If a previously tested membrane is modified in a manner that could change the removal efficiency of the membrane or the applicability of the nondestructive performance test and associated QCRV, conduct additional challenge testing to demonstrate the removal efficiency of the modified membrane and submit the results to the department, along with determination of a new QCRV.

(3) Direct integrity testing (DIT). Systems must conduct DITs in a manner that demonstrates a removal efficiency equal to or greater than the removal credit awarded for the membrane filtration process and meets the requirements of this subparagraph. A DIT is defined as a physical test applied to a membrane unit in order to identify and isolate integrity breaches (i.e., one or more leaks that could result in contamination of the filtrate).

1. A DIT must be independently applied to each membrane unit in service. A membrane unit is defined as a group of membrane modules that share common valving that allows the unit to be isolated from the rest of the system for the purpose of integrity testing or other maintenance.

2. The DIT method must have a resolution of 3 micrometers or less, where resolution is defined as the size of the smallest integrity breach that contributes to a response from the DIT.

3. The DIT must have a sensitivity sufficient to verify the log treatment credit awarded by the department for the membrane filtration process, where sensitivity is defined as the maximum LRV that can be reliably verified by a DIT. Sensitivity must be determined using the approach applicable to the type of DIT the system uses, as follows:

- For DITs using applied pressure or vacuum, calculate test sensitivity using the following equation:

$LRV_{DIT} = LOG_{10} [Q_p/(VCF \times Q_{breach})]$

Where:

LRV_{DIT} = the sensitivity of the DIT;

Q_p = total design filtrate flow from the membrane unit;

Q_{breach} = flow of water from an integrity breach associated with the smallest integrity test response that can be reliably measured; and

VCF = volumetric concentration factor, which is the ratio of the suspended solids concentration on the high-pressure side of the membrane relative to that in the feed water.

- For DITs using a particulate or molecular marker, calculate test sensitivity using the following equation:

$LRV_{DIT} = LOG_{10} (C_f) – LOG_{10} (C_p)$

Where:

LRV_{DIT} = the sensitivity of the DIT;

C_f = typical feed concentration of the marker used in the test; and

C_p = filtrate concentration of the marker from an integral membrane unit.

4. Establish a control limit within the sensitivity limits of the DIT that is indicative of an integral membrane unit capable of meeting the removal credit awarded by the department.

5. If the result of a DIT exceeds the control limit established under 43.11(12)*"b"*(3)"4," the system must remove the membrane unit from service. Systems must conduct a DIT to verify any repairs and may return the membrane unit to service only if the DIT is within the established control limit.

6. Conduct a DIT on each membrane unit at a frequency of not less than once each day that the membrane unit is in operation. The department may approve less frequent testing, based on demonstrated process reliability, the use of multiple barriers effective for *Cryptosporidium*, or reliable process safeguards.

(4) Indirect integrity monitoring. Systems must conduct continuous indirect integrity monitoring on each membrane unit according to the following criteria. Indirect integrity monitoring is defined as monitoring some aspect of filtrate water quality that is indicative of the removal of particulate matter. A system that implements continuous DITs of membrane units in accordance with 43.11(12)*"b"*(3) is not subject to the continuous indirect integrity monitoring requirements. Systems must submit a monthly report to the department summarizing all continuous indirect integrity monitoring results triggering direct integrity testing and the corrective action that was taken in each case.

1. Continuous indirect integrity monitoring must:

- Include continuous filtrate turbidity monitoring, unless the department approves an alternative parameter;
- Be conducted at a frequency of no less than once every 15 minutes; and
- Be separately conducted on each membrane unit.

2. If indirect integrity monitoring includes turbidity and if the filtrate turbidity readings are above 0.15 NTU for a period greater than 15 minutes (i.e., two consecutive 15-minute readings above 0.15 NTU), DIT must immediately be performed on the associated membrane unit as specified in 43.11(12)*"b"*(3)"1" through "5."

3. If indirect integrity monitoring includes a department-approved alternative parameter and if the alternative parameter exceeds a department-approved control limit for a period greater than 15 minutes, DIT must immediately be performed on the associated membrane units as specified in 43.11(12)*"b"*(3)"1" through"5."

c. Second-stage filtration. Systems receive 0.5-log *Cryptosporidium* treatment credit for using a separate second stage of filtration that consists of sand, dual media, GAC, or other fine-grain media following granular media filtration, if the department approves. To be eligible for this credit, the first stage of filtration must be preceded by a coagulation step and both filtration stages must treat the entire plant flow taken from a SW or IGW source. A cap, such as GAC, on a single stage of filtration is not eligible for this credit. The department must approve the treatment credit based on an assessment of the design characteristics of the filtration process.

d. Slow sand filtration (as secondary filter). Systems are eligible to receive 2.5-log *Cryptosporidium* treatment credit for using a slow sand filtration process that follows a separate stage of filtration if both filtration stages treat the entire plant flow taken from a SW or IGW source and no disinfectant residual is present in the influent water to the slow sand filtration process. The department must approve the treatment credit based on an assessment of the design characteristics of the filtration process. This does not apply to treatment credit awarded for slow sand filtration used as a primary filtration process.

43.11(13) *Inactivation toolbox components.*

a. Calculation of CT values.

(1) CT is the product of the disinfectant contact time (T, in minutes) and disinfectant concentration (C, in milligrams per liter). Systems with treatment credit for chlorine dioxide or ozone under 43.11(13)*"b"* or *"c"* must calculate CT at least once each day, with both C and T measured during peak hourly flow as specified in 43.5(4).

(2) Systems with several disinfection segments in sequence may calculate CT for each segment, where a disinfection segment is defined as a treatment unit process with a measurable disinfectant

residual level and a liquid volume. Under this approach, systems must add the *Cryptosporidium* CT values in each segment to determine the total CT for the treatment plant.

b. CT values for chlorine dioxide and ozone. As described in 43.11(13)*"a"*:

(1) Systems receive the *Cryptosporidium* treatment credit in Table 1 of Appendix B by meeting the corresponding chlorine dioxide CT value for the applicable water temperature.

(2) Systems receive the *Cryptosporidium* treatment credit in Table 2 of Appendix B by meeting the corresponding ozone CT value for the applicable water temperature.

c. Site-specific study. The department may approve alternative chlorine dioxide or ozone CT values to those in 43.11(13)*"b"* on a site-specific basis. The department must base its approval on a site-specific study conducted by the system. The study must follow a department-approved protocol.

d. Ultraviolet light (UV). Systems receive *Cryptosporidium*, *Giardia lamblia*, and virus treatment credits for UV light reactors by achieving the corresponding UV dose values in Table 3 of Appendix B. Systems must use the following procedures to validate and monitor UV reactors in order to demonstrate that the reactors are achieving a particular UV dose value for treatment credit.

(1) Reactor validation testing. Systems must use UV reactors that have undergone validation testing to determine the operating conditions under which the reactor delivers the required UV dose (i.e., validated operating conditions). These operating conditions must include flow rate, UV intensity as measured by a UV sensor, and UV lamp status.

1. When determining validated operating conditions, systems must account for the following factors: UV absorbance of the water; lamp fouling and aging; measurement uncertainty of on-line sensors; UV dose distributions arising from the velocity profiles through the reactor; failure of UV lamps or other critical system components; and UV reactor inlet and outlet piping or channel configurations.

2. Validation testing must include full-scale testing of a reactor that conforms uniformly to the UV reactors used by the system and inactivation of a test microorganism whose dose response characteristics have been quantified with a low-pressure mercury vapor lamp.

3. The department may approve an alternative approach to validation testing.

(2) Reactor monitoring.

1. Systems must monitor their UV reactors to determine if the reactors are operating within validated conditions, as determined under 43.11(13)*"d"*(1). This monitoring must include UV sensor, flow rate, lamp status, and other parameters the department designates based on UV reactor operation. Systems must verify the calibration of UV sensors and recalibrate sensors in accordance with a department-approved protocol.

2. To receive UV light treatment credit, systems must treat at least 95 percent of the water delivered to the public during each month by UV reactors operating within validated conditions for the required UV dose. Systems must demonstrate compliance with this condition by completing the monitoring required in this subparagraph.

43.11(14) *Reporting requirements.* Systems must report the following to the department:

a. Source water sampling schedules and monitoring results under 43.11(3)*"c"* and *"e,"* unless the systems notify the department that they will not conduct source water monitoring due to meeting the criteria of 5.5-log treatment for *Cryptosporidium* under 43.11(3)*"a."*

b. Cryptosporidium bin classification determined under 43.11(5).

c. Disinfection profiles and benchmarks as described in 43.11(4)*"a"* and *"b"* prior to making a significant change in disinfection practice.

d. In accordance with Table 7 for any microbial toolbox options used to comply with treatment requirements under 43.11(6).

Table 7: Microbial Toolbox Reporting Requirements

Toolbox Option	Systems must submit this information	Submit information in accordance with the applicable treatment compliance dates in subrule 43.11(7), as noted
1. Watershed control program (WCP)	Notice of intention to develop a new or continue an existing WCP	No later than two years before applicable date
	Watershed control plan	No later than one year before applicable date
	Annual WCP status report	Every 12 months, beginning one year after applicable date
	Watershed sanitary survey report	- For CWS, every 3 years, beginning 3 years after applicable date - For NTNC or TNC, every 5 years, beginning 5 years after applicable date
2. Alternative source/intake management	Verification that system has relocated the intake or adopted the intake withdrawal procedure reflected in monitoring results	No later than the applicable date
3. Presedimentation	Monthly verification: - Continuous basin operation; - Treatment of 100 percent of the flow; - Continuous coagulant addition; and - At least 0.5-log mean reduction of influent turbidity or compliance with alternative department-approved performance criteria	Monthly reporting within 10 days following the month monitoring was conducted, beginning on applicable date
4. Two-stage lime softening	Monthly verification: - Chemical addition and hardness precipitation occurred in two separate and sequential softening stages prior to filtration; and - Both stages treated 100 percent of plant flow	Monthly reporting within 10 days following the month monitoring was conducted, beginning on applicable date
5. Bank filtration	Initial demonstration of: - Unconsolidated, predominantly sandy aquifer; and - Setback distance of at least 25 feet for 0.5-log credit or 50 feet for 1.0-log credit	No later than applicable date
	If monthly average of daily maximum turbidity is greater than 1 NTU, report result and	Report within 30 days following the month monitoring was conducted, beginning on applicable date

Toolbox Option	Systems must submit this information	Submit information in accordance with the applicable treatment compliance dates in subrule 43.11(7), as noted
	submit an assessment of the cause.	
6. Combined filter performance	Monthly verification of CFE turbidity levels less than or equal to 0.15 NTU in at least 95 percent of the 4-hour CFE measurements taken each month	Monthly reporting within 10 days following the month monitoring was conducted, beginning on applicable date
7. Individual filter performance	Monthly verification of: - IFE turbidity levels less than or equal to 0.15 NTU in at least 95 percent of samples each month in each filter; and - No IFE turbidity levels greater than 0.3 NTU in two consecutive readings 15 minutes apart	Monthly reporting within 10 days following the month monitoring was conducted, beginning on applicable date
8. Demonstration of performance	Results from testing following a department-approved protocol	No later than applicable date
	As required by the department, monthly verification of operation within conditions of department approval for demonstration of performance credit	Within 10 days following the month monitoring was conducted, beginning on applicable date
9. Bag filters and cartridge filters	Demonstration that the: - Process meets the definition of bag or cartridge filtration, and - Removal efficiency established through challenge testing is meeting criteria	No later than applicable date
	Monthly verification that 100 percent of plant flow was filtered	Within 10 days following the month monitoring was conducted, beginning on applicable date
10. Membrane filtration	Results of verification testing demonstrating: - Removal efficiency established through challenge testing meets criteria; and - Integrity test method and parameters, including resolution, sensitivity, test frequency, control limits, and associated baseline	No later than applicable date
	Monthly report summarizing: - All DITs above the control limit, and	Within 10 days following the month monitoring was

Toolbox Option	Systems must submit this information	Submit information in accordance with the applicable treatment compliance dates in subrule 43.11(7), as noted
	- If applicable, any turbidity or alternative department-approved indirect integrity monitoring results triggering DITs and corrective action that was taken	conducted, beginning on applicable date
11. Second-stage filtration	Monthly verification that 100 percent of flow was filtered through both stages and that first stage was preceded by coagulation step	Within 10 days following the month monitoring was conducted, beginning on applicable date
12. Slow sand filtration as a secondary filter	Monthly verification that both a slow sand filter and a preceding separate stage of filtration treated 100 percent of the flow from surface or IGW sources	Within 10 days following the month monitoring was conducted, beginning on applicable date
13. Chlorine dioxide	Summary of CT values for each day as described in 43.11(13)	Within 10 days following the month monitoring was conducted, beginning on applicable date
14. Ozone	Summary of CT values for each day as described in 43.11(13)	Within 10 days following the month monitoring was conducted, beginning on applicable date
15. UV	Validation test results demonstrating operating conditions that achieve required UV dose	No later than the applicable date
	Monthly report summarizing the percentage of water entering the distribution system that was not treated by UV reactors operating within validated conditions for the required dose as specified in 43.11(13)*"d"*	Within 10 days following the month monitoring was conducted, beginning on applicable date

43.11(15) *Recordkeeping requirements.*

a. Source water monitoring. Systems must keep results from the initial round of source water monitoring under 43.11(3)*"a"* and the second round of source water monitoring under 43.11(3)*"b"* until three years after bin classification under 43.11(5) for the particular round of monitoring.

b. Systems meeting 5.5-log Cryptosporidium treatment. Systems must keep, for three years, records of any notification to the department that they will meet the 5.5-log Cryptosporidium treatment requirements and avoid source water monitoring.

c. Microbial toolbox treatment monitoring. Systems must keep the results of treatment monitoring associated with microbial toolbox options under 43.11(8) through 43.11(13) for three years.

567—43.12(455B) Turbidity optimization goals. SW and IGW systems must meet the requirements in this chapter. To encourage operational optimization, the department has adopted the following goals

for systems using SW or IGW that wish to pursue the optimization of their existing treatment processes. These goals are voluntary. Data collected for optimization purposes will not be used to determine compliance with this chapter unless the optimization data are identical to the compliance data.

43.12(1) *Sedimentation performance goals.* The sedimentation performance goals are based upon the average annual raw water turbidity levels. When the annual average raw water turbidity is:

a. Less than or equal to 10 NTU over the course of the calendar year, the turbidity should be less than or equal to 1 NTU in at least 95 percent of measurements based on the maximum daily value of readings taken at least once every four hours from each sedimentation basin while the plant is operating.

b. More than 10 NTU over the course of the calendar year, the turbidity should be less than or equal to 2 NTU in at least 95 percent of measurements based on the maximum daily value of readings taken at least once every four hours from each sedimentation basin while the plant is operating.

43.12(2) *Individual filter performance goals.* Individual filter performance goals depend upon a system's capability of filtering to waste.

a. For systems that have the capability of filtering to waste, the individual filter turbidity should be less than or equal to 0.10 NTU in at least 95 percent of measurements over the course of the calendar year, based on the daily maximum value of readings recorded at least once per minute while the plant is in operation. The maximum individual filter turbidity must not exceed 0.30 NTU at any time. The filter must return to service with a turbidity of 0.10 NTU or less.

b. For systems that do not have the capability of filtering to waste, the individual filter turbidity should be less than or equal to 0.10 NTU in at least 95 percent of measurements over the course of the calendar year, excepting the 15 minutes following the completion of the backwash process, based on the daily maximum value of readings recorded at least once per minute while the plant is in operation. The maximum individual filter turbidity must not exceed 0.30 NTU following backwash and must return to a level at or below 0.10 NTU within 15 minutes of returning the filter to service.

43.12(3) *Combined filter performance goal.* The combined filter performance goal has two components:

a. CFE turbidity should be less than or equal to 0.10 NTU in at least 95 percent of measurements over the course of the calendar year, based on daily maximum value of readings recorded at least once per minute while the plant is operating.

b. The maximum individual filter turbidity must not exceed 0.30 NTU at any time.

These rules are intended to implement Iowa Code sections 455B.171 through 455B.188 and 455B.190 through 455B.192.

APPENDIX A: Disinfection Profiling - CT Values (CT99.9) for 99.9 Percent Inactivation of *Giardia lamblia* Cysts

These tables provide the CT99.9 values for 99.9 percent inactivation of *Giardia lamblia* cysts using the indicated disinfectant at the indicated temperature in degrees Celsius (C). The CT values in the tables achieve greater than a 99.99 percent inactivation of viruses. Any CT values between the indicated pH values in each table, and any CT values between the indicated temperatures of different tables, may be determined by linear interpolation. If no interpolation is used, use the CT99.9 value at the lower temperature and at the higher pH.

TABLE 1: Inactivation by Free Chlorine at 0.5°C or Lower

Free Residual Chlorine, mg/L	pH						
	>6.0	6.5	7.0	7.5	8.0	8.5	>9.0
>0.4	137	163	195	237	277	329	390
0.6	141	168	200	239	286	342	407
0.8	145	172	205	246	295	354	422
1.0	148	176	210	253	304	365	437
1.2	152	180	215	259	313	376	451
1.4	155	184	221	266	321	387	464
1.6	157	189	226	273	329	397	477
1.8	162	193	231	279	338	407	489
2.0	165	197	236	286	346	417	500
2.2	169	201	242	297	353	426	511
2.4	172	205	247	298	361	435	522
2.6	175	209	252	304	368	444	533
2.8	178	213	257	310	375	452	543
3.0	181	217	261	316	382	460	552

TABLE 2: Inactivation by Free Chlorine at 5.0°C

Free Residual Chlorine, mg/L	pH						
	>6.0	6.5	7.0	7.5	8.0	8.5	>9.0
>0.4	97	117	139	166	198	236	279
0.6	100	120	143	171	204	244	291
0.8	103	122	146	175	210	252	301
1.0	105	125	149	179	216	260	312
1.2	107	127	152	183	221	267	320
1.4	109	130	155	187	227	274	329
1.6	111	132	158	192	232	281	337
1.8	114	135	162	196	238	287	345
2.0	116	138	165	200	243	294	353
2.2	118	140	169	204	248	300	361
2.4	120	143	172	209	253	306	368
2.6	122	146	175	213	258	312	375
2.8	124	148	178	217	263	318	382
3.0	126	151	182	221	268	324	389

TABLE 3: Inactivation by Free Chlorine at 10.0°C

Free Residual Chlorine, mg/L	pH						
	>6.0	6.5	7.0	7.5	8.0	8.5	>9.0
>0.4	73	88	104	125	149	177	209
0.6	75	90	107	128	153	183	218
0.8	78	92	110	131	158	189	226
1.0	79	94	112	134	162	195	234
1.2	80	95	114	137	166	200	240
1.4	82	98	116	140	170	206	247
1.6	83	99	119	144	174	211	253
1.8	86	101	122	147	179	215	259
2.0	87	104	124	150	182	221	265
2.2	89	105	127	153	186	225	271
2.4	90	107	129	157	190	230	276
2.6	92	110	131	160	194	234	281
2.8	93	111	134	163	197	239	287
3.0	95	113	137	166	201	243	292

TABLE 4: Inactivation by Free Chlorine at 15.0°C

Free Residual Chlorine, mg/L	pH						
	>6.0	6.5	7.0	7.5	8.0	8.5	>9.0
>0.4	49	59	70	83	99	118	140
0.6	50	60	72	86	102	122	146
0.8	52	61	73	88	105	126	151
1.0	53	63	75	90	108	130	156
1.2	54	64	76	92	111	134	160
1.4	55	65	78	94	114	137	165
1.6	56	66	79	96	116	141	169
1.8	57	68	81	98	119	144	173
2.0	58	69	83	100	122	147	177
2.2	59	70	85	102	124	150	181
2.4	60	72	86	105	127	153	184
2.6	61	73	88	107	129	156	188
2.8	62	74	89	109	132	159	191
3.0	63	76	91	111	134	162	195

TABLE 5: Inactivation by Free Chlorine at 20.0°C

Free Residual Chlorine, mg/L	pH						
	>6.0	6.5	7.0	7.5	8.0	8.5	>9.0
>0.4	36	44	52	62	74	89	105
0.6	38	45	54	64	77	92	109
0.8	39	46	55	66	79	95	113
1.0	39	47	56	67	81	98	117
1.2	40	48	57	69	83	100	120
1.4	41	49	58	70	85	103	123
1.6	42	50	59	72	87	105	126
1.8	43	51	61	74	89	108	129
2.0	44	52	62	75	91	110	132
2.2	44	53	63	77	93	113	135
2.4	45	54	65	78	95	115	138
2.6	46	55	66	80	97	117	141
2.8	47	56	67	81	99	119	143
3.0	47	57	68	83	101	122	146

TABLE 6: Inactivation by Free Chlorine at 25.0°C and Higher

Free Residual Chlorine, mg/L	pH						
	>6.0	6.5	7.0	7.5	8.0	8.5	>9.0
0.4	24	29	35	42	50	59	70
0.6	25	30	36	43	51	61	73
0.8	26	31	37	44	53	63	75
1.0	26	31	37	45	54	65	78
1.2	27	32	38	46	55	67	80
1.4	27	33	39	47	57	69	82
1.6	28	33	40	48	58	70	84
1.8	29	34	41	49	60	72	86
2.0	29	35	41	50	61	74	88
2.2	30	35	42	51	62	75	90
2.4	30	36	43	52	63	77	92
2.6	31	37	44	53	65	78	94
2.8	31	37	45	54	66	80	96
3.0	32	38	46	55	67	81	97

TABLE 7: Inactivation by Chlorine Dioxide and Ozone

Disinfectant	Temperature, °C					
	<1	5	10	15	20	>25
Chlorine Dioxide	63	26	23	19	15	11
Ozone	2.9	1.9	1.4	0.95	0.72	0.48

TABLE 8: Inactivation by Chloramines[1]

Disinfectant	Temperature, °C					
	<1	5	10	15	20	25
Chloramines	3800	2200	1850	1500	1100	750

[1]These values are for pH values of 6 to 9. These CT values may be assumed to achieve greater than 99.99 percent inactivation of viruses only if chlorine is added and mixed in the water prior to the addition of ammonia. If this condition is not met, the system must demonstrate, based on on-site studies or other department-approved information, that the system is achieving at least 99.99 percent inactivation of viruses.

APPENDIX B: CT TABLES FOR *CRYPTOSPORIDIUM* INACTIVATION

TABLE 1: CT Values (mg-min/L) for *Cryptosporidium* Inactivation by Chlorine Dioxide[1]

Log Credit	Water Temperature, °C										
	>0.5	1	2	3	5	7	10	15	20	25	30
0.25	159	153	140	128	107	90	69	45	29	19	12
0.5	319	305	279	256	214	180	138	89	58	38	24
1.0	637	610	558	511	429	360	277	179	116	75	49
1.5	956	915	838	767	643	539	415	268	174	113	73
2.0	1275	1220	1117	1023	858	719	553	357	232	150	98
2.5	1594	1525	1396	1278	1072	899	691	447	289	188	122
3.0	1912	1830	1675	1534	1286	1079	830	536	347	226	147

[1]Systems may use this equation to determine log credit between the indicated values:

Log credit = $[0.001506 \times (1.09116)^{Temp}] \times CT$

TABLE 2: CT Values (mg-min/L) for *Cryptosporidium* Inactivation by Ozone[1]

Log Credit	Water Temperature, °C										
	>0.5	1	2	3	5	7	10	15	20	25	30
0.25	6.0	5.8	5.2	4.8	4.0	3.3	2.5	1.6	1.0	0.6	0.39
0.5	12	12	10	9.5	7.9	6.5	4.9	3.1	2.0	1.2	0.78
1.0	24	23	21	19	16	13	9.9	6.2	3.9	2.5	1.6
1.5	36	35	31	29	24	20	15	9.3	5.9	3.7	2.4
2.0	48	46	42	38	32	26	20	12	7.8	4.9	3.1
2.5	60	58	52	48	40	33	25	16	9.8	6.2	3.9
3.0	72	69	63	57	47	39	30	19	12	7.4	4.7

[1]Systems may use this equation to determine log credit between the indicated values:

Log credit = $[0.0397 \times (1.09757)^{Temp}] \times CT$

TABLE 3: UV Dose for *Cryptosporidium*, *Giardia lamblia*, and Virus Inactivation Credit[1]

Log Credit	*Cryptosporidium* UV dose (mJ/cm^2)	*Giardia lamblia* UV dose (mJ/cm^2)	Virus UV dose (mJ/cm^2)
0.5	1.6	1.5	39
1.0	2.5	2.1	58
1.5	3.9	3.0	79
2.0	5.8	5.2	100
2.5	8.5	7.7	121
3.0	12	11	143
3.5	15	15	163
4.0	22	22	186

[1]The treatment credits listed in Table 3 are for UV light at a wavelength of 254 nm as produced by a low-pressure mercury vapor lamp. To receive treatment credit for other lamp types, systems must demonstrate an equivalent germicidal dose through reactor validation testing. The UV dose values in this table are applicable only to post-filter applications of UV in filtered systems.

APPENDIX C: CT TABLES FOR VIRUS INACTIVATION UNDER THE GROUNDWATER RULE, 567—41.7(455B)

TABLE 1: CT Values (mg-min/L) for Inactivation of Viruses by Free Chlorine, pH 6.0-9.0

(CT values provided are modified by linear interpolation between 0.5° Celsius (C) increments)

Inactivation Log Credit	Water Temperature, °C												
	1	2	3	4	5	6	7	8	9	10	11	12	13
2	5.8	5.3	4.9	4.4	4.0	3.8	3.6	3.4	3.2	3.0	2.8	2.6	2.4
3	8.7	8.0	7.3	6.7	6.0	5.6	5.2	4.8	4.4	4.0	3.8	3.6	3.4
4	11.6	10.7	9.8	8.9	8.0	7.6	7.2	6.8	6.4	6.0	5.6	5.2	4.8

Inactivation Log Credit	Water Temperature, °C										
	15	16	17	18	19	20	21	22	23	24	25
2	2.0	1.8	1.6	1.4	1.2	1.0	1.0	1.0	1.0	1.0	1.0
3	3.0	2.8	2.6	2.4	2.2	2.0	1.8	1.6	1.4	1.2	1.0
4	4.0	3.8	3.6	3.4	3.2	3.0	2.8	2.6	2.4	2.2	2.0

TABLE 2: CT Values (mg-min/L) for Inactivation of Viruses by Free Chlorine, pH 9.1-10.0

Inactivation Log Credit	Water Temperature, °C					
	0.5	5	10	15	20	25
2	45	30	22	15	11	7
3	66	44	33	22	16	11
4	90	60	45	30	22	15

TABLE 3: CT Values (mg-min/L) for Inactivation of Viruses by Chlorine Dioxide, pH 6.0-9.0

(CT values provided are modified by linear interpolation between 0.5°C increments)

Inactivation Log Credit	Water Temperature, °C												
	1	2	3	4	5	6	7	8	9	10	11	12	13
2	8.4	7.7	7.0	6.3	5.6	5.3	5.0	4.8	4.5	4.2	3.9	3.6	3.4
3	25.6	23.5	21.4	19.2	17.1	16.2	15.4	14.5	13.7	12.8	12.0	11.1	10.3
4	50.1	45.9	41.8	37.6	33.4	31.7	30.1	28.4	26.8	25.1	23.4	21.7	20.1

Inactivation Log Credit	Water Temperature, °C											
	14	15	16	17	18	19	20	21	22	23	24	25
2	3.1	2.8	2.7	2.5	2.4	2.2	2.1	2.0	1.8	1.7	1.5	1.4
3	9.4	8.6	8.2	7.7	7.3	6.8	6.4	6.0	5.6	5.1	4.7	4.3
4	18.4	16.7	15.9	15.0	14.2	13.3	12.5	11.7	10.9	10.0	9.2	8.4

TABLE 4: CT Values (mg-min/L) for Inactivation of Viruses by Ozone

(CT values provided are modified by linear interpolation between 0.5°C increments)

Inactivation Log Credit	Water Temperature, °C												
	1	2	3	4	5	6	7	8	9	10	11	12	13
2	0.90	0.83	0.75	0.68	0.60	0.58	0.56	0.54	0.52	0.50	0.46	0.42	0.38
3	1.40	1.28	1.15	1.03	0.90	0.88	0.86	0.84	0.82	0.80	0.74	0.68	0.62
4	1.80	1.65	1.50	1.35	1.20	1.16	1.12	1.08	1.04	1.00	0.92	0.84	0.76

Inactivation Log Credit	Water Temperature, °C											
	14	15	16	17	18	19	20	21	22	23	24	25
2	0.34	0.30	0.29	0.28	0.27	0.26	0.25	0.23	0.21	0.19	0.17	0.15
3	0.56	0.50	0.48	0.46	0.44	0.42	0.40	0.37	0.34	0.31	0.28	0.25
4	0.68	0.60	0.58	0.56	0.54	0.52	0.50	0.46	0.42	0.38	0.34	0.30

No CT table is provided for chloramines or total chlorine because the CT values would be prohibitively high for GW systems. Tables are from the EPA Groundwater Rule Implementation Guidance, EPA 816-R-09-004, January 2009, pages 97-98.