UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

WSG 71

Date Signed: February 1, 1994

MEMORANDUM

SUBJECT: Clarification of Turbidity Requirements for Filtered Systems under the Surface Water Treatment Rule (SWTR)

FROM: James R. Elder, Director
Office of Ground Water and Drinking Water

TO: Water Management Division Directors, Regions I-X
Environmental Services Division Directors, Regions I-X

This water supply guidance clarifies three issues related to turbidity requirements for filtered water systems under the SWTR[1]. Specifically, these are (1) where turbidity samples are to be collected for filtered water systems, (2) when a system is to notify the State and the public of high turbidity levels and anticipated turbidity violations, and (3) backwashing practices.

1. Turbidity sampling location for filtered water systems

As specified above, the SWTR requires systems that filter to measure the turbidity level in representative samples of a system's filtered water. The rule did not specify a more precise sample location in order to allow for differences in configuration among Public Water Systems (PWS) . Therefore, the rule clearly places the burden on the PWS to determine where to take

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[1]The SWTR established treatment technique requirements for Giardia lamblia, viruses, heterotrophic plate count bacteria, Legionella, and turbidity. These requirements consist of installing and properly operating water treatment processes that reliably achieve at least 99.9% (3-log) removal and/or inactivation of Giardia Lamblia cysts and at least 99.99% (4 -log) removal and/or inactivation of viruses (40 CFR 141.70). Further the SWTR established disinfection requirements in §141.72 and filtration requirements in §141.73. Failure to meet any of the requirements in §141.70, §141.72, or §141.73 is a treatment technique violation.

The turbidity requirements with which filtered systems must comply are contained in §141.73:

– For all systems, the turbidity level of representative samples of filtered water must at no time exceed 5 NTU.

– For systems using conventional or direct filtration, the turbidity level of representative samples of a system's filtered water must be less than or equal to 0.5 NTU in at least 95% of the measurements taken each month, measured as specified in §141.74 (a) (4) and (c) (1) . The State may substitute a higher level if the State determines that the system is capable of achieving at least 99.9% removal/inactivation of Giardia lamblia cysts at some higher level. The State may not approve a turbidity limit that allows more than 1 NTU in more than 5% of the samples taken each month.

– For systems using slow sand or diatomaceous earth filtration, the turbidity level of representative samples of a system's filtered water must be less than or equal to 1 NTU in at least 95% of the measurements taken each month, measured as specified in §141.74(a)(4) and (c)(1).

samples and to ensure that these samples are representative of the quality of the filtered water. Moreover, any information which the PWS has on turbidity in filtered water must be evaluated by the PWS to determine if that is representative. If so, then these measurements should be reported to the State.

Turbidity is an indicator of (1) filtration efficiency for removal of pathogens and other particles, and (2) the treatability of the water by disinfection. A high turbidity level indicates the potential for pathogen breakthrough and interference with disinfection efficiency. Unless other circumstances in the PWS make another locations more representative, turbidity samples for filtered water systems should be collected immediately after t the confluence of flow from all the filters, and if possible, before the clearwell. In addition, EPA guidance (SWTR Guidance Manual, October 1990, Section 4.3.2) recommends that systems regularly monitor the turbidity level in the water exiting from each filter to isolate problems with individual filter performance.

Failure by a PWS to Perform this monitoring obligation properly (e.g., choosing sites-that are not representative of filtered water quality, deliberately reporting data only from those sampling sites that are known to be under the limits specified in the SWTR) is a violation of requirements in the SWTR. Moreover, it-could subject the owner/operator of the PWS to criminal action under Title 18 of the U.S. Code, that is, deliberately making false statements to the Federal Government or State primacy agent is a federal criminal offense.

2. Notification by the PWS of high turbidity levels

The SWTR requires filtered systems to report a number of items to the State on a monthly basis. These include turbidity measurements, as required by §141.74(c)(1) and disinfection information specified in §141.74(c)(2) and §141.74(c)(3). The specific items that must be reported are contained in §141.75(b). These items must be reported within ten days after the end of each month.

The SWTR also requires filtered systems to report three specific items to the State as soon as possible, but no later than the end of the next business day (§141.75(b)(3)). These are: a waterborne disease outbreak potentially attributable to the water system, any time the turbidity exceeds 5 Nephelometric Turbidity Units (NTU), and any time the disinfectant residual falls below 0.2 mg/l in the water entering the distribution system. (In this third case, the system must also notify the State by the end of the next business day whether or not the residual was restored to at least 0.2 mg/l within 4 hours.)

In addition, anytime a system fails to meet any of the requirements of the SWTR, it incurs a treatment technique violation. This requires notification to the State in accord with §141.31 and notification to the public in accord with §141.32. Treatment technique violations are considered non-acute violations and therefore, public notification must be completed as soon as possible, but in no case later than 14 days after the violation.

It is important that the standard for reporting to the State and the public be clearly understood. In both instances, the requirement is to report **as soon as possible.** This means that

the reporting must be accomplished not within the maximum timeframe allowed by the regulations but as soon as the system is physically able to do so.

For example, if a large city exceeds 5 NTU on Tuesday at 7:00 a.m., the city should report that to the State as soon as the State offices open. The notice to the public should be in that evening's newspaper or, if there is no evening paper, then in the next day's paper. Note that the city does not have until the end of the next business day to report to the State nor do they have 14 days to issue the public notice because it is possible to accomplish both of these items in less than the maximum time allowed by the regulations. For purposes of reporting to the State, there are very few instances where that cannot be done almost immediately after the violation occurs. For purposes of reporting to the public there are very few situations where this cannot occur within 1-2 days of a violation; an obvious example would be a rural community that is served only by a weekly newspaper.

Failure by a system to report as soon as possible, even if it is accomplished within the time allowed by the regulations, is a violation and could subject the system to an enforcement action.

There are sound public health reasons for requiring notification as soon as possible. Pathogens are likely to accompany the turbidity particles that exit the filters, especially with poor quality source waters. High turbidity levels in the filtered water, even for a limited time, may represent a significant risk to the public. Increasing the disinfection residual in such cases is essential, but some pathogens (e.g., Giardia and Cryptosporidium) are relatively resistant to disinfection. States then should require the system to issue an immediate public notice of the turbidity violation if the violation is considered to be an immediate health concern.

Moreover, if at any point during the month it becomes apparent that a system will exceed the monthly turbidity performance standards, as specified earlier in this memorandum, or if a system exceeds the monthly turbidity performance standards in §141.73 for an extended period of time (e.g., more than 12 hours), the system should advise the State as soon as possible for reasons of public health.

3. Backwashing Practices

Systems often recycle backwash water. Unless precautions are taken, this water may contain high pathogen densities that challenge the filter and result in a breakthrough. Several recent waterborne disease outbreaks have been associated with questionable backwash procedures.

In the interest of public health, systems should either run backwash waters to waste or treat these waters before reuse. Treatment may consist of coagulation and settling, and/or disinfection. As an additional measure, a system may also wish to monitor the source water for Cryptosporidium and avoid recycling the backwash water when the Cryptosporidium density in the source water exceeds a particular value (the Severn-Trent Water Authority in England uses a

value of five oocysts/liter). For determining the Cryptosporidium density, we recommend that systems use the analytical method specified in the upcoming monitoring and reporting regulation, the "Information Collection Requirements", which would be used to gain additional information for the Disinfection Byproducts Rule and the Enhanced Surface Water Treatment Rule.

Section 4.3.2 of the SWTR Guidance Manual recommends procedures for preventing spikes in the turbidity level in the filter effluent when the filter is placed back on line after backwash. The section also includes filter-to-waste operating guidelines critical to the implementation of these procedures is the continuous routine turbidity monitoring of each filter effluent. I am attaching a copy of Section 4.3.2 of the SWTR Guidance Manual for your information.

Should you have any questions, please contact Brian Maas at (202) 260-5530.

Attachment

cc:

Drinking Water Branch Chiefs, Regions I-X
Drinking Water Section Chiefs, Regions I-X
Enforcement Coordinators, Regions I-X
PWSS Regional Counsel Contacts, Regions I-X
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ATTACHMENT

GUIDANCE MANUAL FOR COMPLIANCE WITH THE FILTRATION AND DISINFECTION REQUIREMENTS FOR PUBLIC WATER SYSTEMS USING SURFACE WATER SOURCES

for

Science and Technology Branch
Criteria and Standards Division
Office of Drinking Water
U.S. Environmental Protection Agency
Washington, D.C.

Contract No. 68-01-6989

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4.3.2 General

The following recommendations apply to all filtration plants:

a. All filtration plants should provide continuous turbidity monitoring of the effluent turbidity from each individual filter.[3],[4] If continuous monitoring is impractical, routine monitoring of individual filters is recommended as a minimum.

b. All filtration systems should be concerned with the peak turbidity levels in the filtered water after backwashing and make every attempt to operate the filters to minimize the magnitude and duration of these turbidity spikes.[5]

Individual filters should be monitored as discussed in Section 4.3.2.a and when excessive turbidity spikes are found, corrective actions taken. During these turbidity peaks, Giardia cysts and other pathogens may be passed into the finished water. There is evidence that a 0.2 to 0.3 NTU increase in the turbidity during the first period of the filter run can be associated with rises in Giardia cyst concentrations by factors of twenty to forty (Logsdon, 1985). Special studies should be conducted to determine the extent of the turbidity spike problems.

There are basically four approaches available for correcting problems with turbidity spikes after backwashing. These are as follows (Bucklin, et a] 1988):

– Proper chemical conditioning of the influent water to the filter can minimize the magnitude and duration of these turbidity spikes. This could include proper control of the primary coagulant chemicals such as alum or iron compounds. In some cases filter aids using polymers may be needed to control the turbidity spikes

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[3]Although this is not a requirement of the SWTR, it is recommended because of the possibility that not all filters in a treatment plant will produce the same effluent turbidity. This may be due to a variety of conditions that include bed upsets, failure of media support or underdrain systems, etc. Although the combined effluent from all the filters may meet the turbidity requirements of the SWTR, the turbidity level from an individual filter may substantially exceed the limits. This may result in the passage of Giardia cysts or other pathogens.

[4]Validation should be performed at least twice a week based on the procedure outlined in Part 214A in the 16th Edition of Standard Methods. It should be noted that improper installation of continuous monitors may allow for air bubbles to enter the monitor resulting in false turbidity spikes. To avoid air bubbles reaching the turbidimeter the sample tap should be installed below the center line of the pipe and an air release valve may be included on the sample line.

[5]For most high rate granular bed filters, there is a period of conditioning, or break-in immediately following backwashing, during which turbidity and particle removal is at a minimum, referred to as the break-in period. The turbidity peaks are thought to be caused by remnants of backwash water within the pores of and above the media passing through the filter, and/or floc breakup during the filter ripening period before it can adequately remove influent turbidity.

- Gradually increasing the filtration rate in increments when placing the filter in operation. Starting the filter at a low flow rate and then increasing the flow in small increments over 10 to 15 minutes has been shown to reduce the turbidity spikes in some cases (Logsdon, 1987).

- Addition of coagulants to the backwash water has also been shown to reduce the extent of turbidity spikes after backwash. Typically the same primary coagulant used in the plant is added to the back-wash water. Polymers alone or in combination with the primary coagulant may also be used.

- Filter-to-waste may be practiced where a portion of the filtered water immediately after starting the filter is wasted. This is only possible where the filter system has provided the necessary valves and piping to allow this procedure. There is some concern whether or not this practice is beneficial. The extra valve operations needed for filter-to-waste can disrupt the filter flow rate to the extent that they create their own turbidity spikes. Some knowledge of the time actually needed for filter-to-waste is also needed before it can be determined that this is an effective procedure for controlling turbidity spikes. If the length of time the filter-to-waste is practiced is less than that before the turbidity spike passes, the disruption caused by the valve operation may actually increase the turbidity spike.

Different plants and the individual filters within the plant may have different turbidity spike characteristics. The four approaches presented above, therefore, must be evaluated on a case-by-case basis. Special studies will be required to identify those filters with the turbidity spike problems and assist in selecting which of the four approaches is best for correcting the problem. It has been generally found that turbidity spikes can be minimized through one or a combination of the first three approaches.

In order to establish filter-to-waste operating guidelines, the following procedure is suggested:

- Review the effluent turbidity data for each filter and determine which filter historically has the highest effluent turbidity.

- Following backwashing of the filter with the poorest performance, place that filter into service and collect grab samples every 5 to 10 minutes for a period of at least 60 minutes.[6]

- Analyze the grab samples for turbidity and determine how long the filter must be in operation before the effluent turbidity drops

[6]Continuous turbidity monitoring can be used in place of grab sampling.

- to less than or equal to 0.5 NTU

- or 1 NTU in cases where a filtered water turbidity of less than or equal to 1 NTU is allowed.

Limited information exists on the typical magnitude and duration of peak turbidity levels after backwashing and what levels are considered acceptable to assure that these turbidity spikes are not associated with passage of Giardia cysts. Information from plant scale tests, showing the typical magnitude and duration of these turbidity spikes is available from two plants (Bucklin et al., 1988). Studies conducted at these plants over a year showed that these peaks occurred within the first few minutes after the filter was placed back in operation, their effects lasted for several hours, and varied in magnitude from 0.08 to 0.35 NTU on average.

For existing plants without provisions for filter-to-waste, the decision to add the necessary piping to provide this capability should be made only after carefully evaluating the other three approaches. If the results of special studies show that the other three options are not effective in minimizing the turbidity spikes then the expense of adding the filter-to-waste capabilities may be justified.

For new plants the capability of filter-to-waste may be required by the Primacy Agency or should be considered. By having this capability, additional flexibility will be available for turbidity spike control. This flexibility may also be useful for other filter maintenance functions such as after media replacement or when heavy chlorination of the filter is needed after maintenance.