




Date: January 23, 2002, **Revised December 29, 2011**

To: ODW Staff

From: J. Wesley Kleene, PhD, PE, Director 
Office of Drinking Water

Subject: SURVEILLANCE AND REGULATIONS - Review of Changes to Disinfection

Project Leader: Doug Meyer  Reviewed by: Susan E. Douglas 

DELETE: Working Memo 819

Revision Highlights:

The procedure for Disinfection Profiling and benchmarking are updated, simplified and clarified to address requirements of all Enhanced Surface Water Treatment Rules. The major change is that a virus benchmark is required for all systems making significant changes to disinfection. WM 819 (developing a Disinfection Profile) is deleted and incorporated herein by reference to EPA's guidance manuals.

Summary Statement

This memo outlines the requirements for developing a Disinfection Profile, calculating the benchmark and reviewing changes to disinfection, as required by the Interim, Long Term1 and Long Term2 Enhanced Surface Water Treatment Rules.

1. PURPOSE & SCOPE

The purpose of the Disinfection Profile and benchmark requirement is to assess the impact of proposed changes to disinfection on microbial risk. A Disinfection Profile is a summary of daily microbial inactivation, through the entire water treatment plant (WTP). The methodology is described in EPA's "Disinfection Profiling and Guidance Manual" dated August 1999. If needed, the benchmark is found by reviewing the microbial inactivation results from the Disinfection Profile. When a waterworks proposes a significant change to the WTP's disinfection practice, they must evaluate the change against their benchmark to ensure they are still providing adequate disinfection.

2. BACKGROUND

The original Surface Water Treatment Rule (June 29, 1989) did not formally require a Disinfection Profile, but did require that each surface water treatment plant utilizing conventional filtration or direct filtration to be analyzed to ensure that the plant achieve 3-log removal/inactivation of *Giardia lamblia* and 4-log removal/inactivation of viruses. Properly operated facilities were credited with 2.5-logs of removal of *Giardia lamblia*, meaning that the disinfection process needed to achieve 0.5-logs of inactivation prior to the first customer. VDH staff performed the analyses, utilizing a process similar to that described below for the IESWTR and LT1ESWTR, i.e., review of plant data for a period of at least 12 months, including pumping rates, water levels in tanks and unit processes, water pH, temperature, and chlorine disinfection residuals. At that time, all SWTP in Virginia were using free chlorine for disinfection.

Following that analysis, VDH established for each surface water treatment plant a set of operating conditions that would ensure that the plant continuously met the 0.5-log inactivation requirement, based on the “CT” tables contained in EPA’s *Surface Water Treatment Rule Guidance Manual* (March 1991). NOTE: it was determined that meeting the 0.5 log inactivation requirement for *Giardia lamblia* would also result in meeting the 4-log inactivation requirement for viruses. In effect, this set of operating conditions became a 0.5-log *Giardia* benchmark.

The IESWTR and LT1ESWTR required all waterworks using conventional filtration or direct filtration to treat surface water or groundwater under the direct influence of surface water (GUDI) to complete a Disinfection Profile¹, *if* their disinfection byproducts \geq 80% MCL (TTHM \geq 0.064 mg/L or HAA5 \geq 0.048 mg/L). The LT2ESWTR requires all waterworks to develop a Disinfection Profile after completing the first round of cryptosporidium monitoring, if they are proposing a significant change to their disinfection.

The Disinfection Profile required by one of the surface water rules noted above must be compiled in spreadsheet format, and presented in graphical form. A spreadsheet calculator that can be used by the waterworks to develop a Disinfection Profile through a conventional surface water treatment plant has been developed for this purpose; a copy is available in:

[odwsrv1\odwshare:\06-Technical Resources\650-Calculators\CT-Utah\(Disinfect Profile\).xls](odwsrv1\odwshare:\06-Technical Resources\650-Calculators\CT-Utah(Disinfect Profile).xls)

Waterworks that have not yet been required to develop a Disinfection Profile and calculate a benchmark are required to submit, as part of their Monthly Operation Report, sufficient data for VDH to determine that the plant continues to meet the original SWTR-established *Giardia* / virus benchmark (i.e., demonstrate that the waterworks meets the required 0.5-log / 4.0-log inactivation requirement on each day that the plant is in operation). The minimum reporting data has been established in the ODW’s standard Monthly Operation Report templates created for surface water treatment plants.

Waterworks required to develop a Disinfection Profile must compute the disinfection achieved in each segment of the WTP daily, using parameters measured at peak hourly flow (for chemical disinfectants such as chlorine, this would be pH, temperature and disinfectant residual). A disinfection segment consists of one disinfectant addition point, contact tank or tanks, and one disinfectant residual monitoring point. The number of points to be monitored will depend on the number of disinfection segments in the treatment plant.

The Disinfection Profile must be developed over a period of at least 12 months. This data is used to calculate the required microbial inactivation benchmark for the WTP. Under the IESWTR and LT1ESWTR, WTPs using free chlorine as a primary disinfectant established a benchmark only for *Giardia lamblia*. WTPs using either chloramines or ozone as the primary disinfectant were required to establish benchmarks for both *Giardia lamblia* and viruses. EPA recommended that WTPs using chlorine dioxide as the primary disinfectant establish benchmarks for both *Giardia lamblia* and viruses.

¹ Refer to *Waterworks Regulations* for additional requirements on developing Disinfection Profiles.

IF the waterworks has *NOT* made a significant change to its treatment process *AND has not* changed sources since a Disinfection Profile was developed under IESTWR or LT1ESTWR, then waterworks may use existing Disinfection Profiles in lieu of developing a new profile. If the existing profile is being used, there are two options for providing the required benchmark for virus:

- a. If the original profile provided a benchmark for virus, it is used.
- b. If the original profile did not, the original data is used to calculate a benchmark.

Waterworks may use existing data to develop Disinfection Profiles *if* they have at least one year of data that is substantially equivalent to that required for developing a Disinfection Profile, and during the data period there have been no significant treatment changes nor changes to raw water sources.

3. INITIAL DISINFECTION BENCHMARK

If a WTP is proposing a change to their disinfection practice, it must calculate its benchmark for *Giardia lamblia* and virus inactivation under LT2ESTWR. The benchmark is the lowest monthly average value (for waterworks with one year of profiling data) or average of lowest monthly average values (for waterworks with more than one year of profiling data) of the monthly logs of inactivation in each year of profiling data.

4. SIGNIFICANT CHANGES TO DISINFECTION

Any waterworks using conventional filtration or direct filtration to treat surface water or GUDI, that proposes significant changes to their disinfection practices after completion of initial source water monitoring (required by the LT2ESWTR), must develop Disinfection Profiles and calculate disinfection benchmarks for *Giardia lamblia* and virus.

Significant changes to disinfection practice are:

- a. Changes to the point of disinfection;
- b. Changes to the disinfectant(s) used in the treatment plant;
- c. Changes to the disinfection process; or
- d. Any other modification identified by the State as a significant change to disinfection practice.

The waterworks must submit the following information to the VDH prior to making any disinfection change, as part of its consultation process:

- a. A description of the proposed change;
- b. The Disinfection Profile for *Giardia lamblia* and viruses, and benchmark; and
- c. An analysis of how the proposed change will affect the current levels of disinfection.

5. CHANGES TO DISINFECTION BENCHMARK

According to the EPA Disinfection Profiling and Benchmarking Guidance Manual, waterworks “..should calculate “modification benchmarks,” based on the current operating conditions before the process change is made. These modification benchmarks should be compared to the original benchmark to evaluate the expected inactivation level of the modified disinfection practice.

The steps to calculate these modification benchmarks, described in the EPA Disinfection Profiling and Benchmarking Guidance Manual, are as follows:

- a. Identify the lowest average months from the original profile (i.e., the one to three months that were averaged to calculate the original benchmark).
- b. Using the temperature, pH, and contact times (unless the modification significantly changes these values) from the original profile calculations, systems calculate the daily log inactivation for *Giardia* (and/or viruses) for each day of the month under the proposed modification (i.e., for conditions after the modification is complete). The water system will need to assume reasonable values for the disinfectant residuals. It may also need to calculate or estimate contact times, or identify new points of disinfectant residual sampling to reflect the modification.
- c. Calculate the average log *Giardia* and/or virus inactivation for the months identified in paragraph “a” above.
- d. Calculate the average of the monthly values. This value is the modification benchmark.
- e. Compare the original benchmarks to the modification benchmarks.
 - If the modification benchmarks are greater than the original benchmarks, the modification will likely be acceptable to VDH.
 - If the modification benchmarks are lower than the original benchmarks but meet regulatory requirements, VDH should carefully review whether the resulting increase in microbial risk is justified by other factors including source water quality and watershed conditions (discussed further in Chapter 6 of the EPA Guidance Manual).
 - If the modification benchmarks do not meet regulatory requirements, the modifications will likely NOT be acceptable to VDH.

The waterworks should discuss the reasons for any modification and whether better options exist, and assess the modification’s impact on log inactivation. The VDH and the waterworks should jointly assess the impact that the proposed modification will have on log inactivation levels of *Giardia* and/or viruses.

A formal approval shall be provided in a manner consistent with current policies and procedures.

Those waterworks required to complete the Disinfection Profile and establish a benchmark, are to keep this data on file until it is needed to consult with the VDH about a change in disinfection practice.

END OF MEMO