DATE: October 1, 2009, **revised April 26, 2012**

TO: Office of Drinking Water Staff

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Office of Drinking Water

SUBJECT: SURVEILLANCE & REGULATIONS – Ground Water Rule Implementation Procedures

REFERENCE: WM 823 (SDWIS), WM 851 (Sanitary Surveys) and Attachments,
WM 859 (Public Notification), WM 880 (Membrane Filters),
Compliance Sampling and Reporting Guidance Manual, SDWIS Users Manual,
EPT/002/2007: Boil Water Advisories During Hurricanes and Other Natural Disasters,
EPA's Sanitary Survey Guidance Manual for Ground Water Systems,
EPA's Triggered and Representative Source Water Monitoring Guidance Manual

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Revision Highlights:
Appendix B has been deleted and replaced with a reference to the files located on ODW Server \\Odwsrv1\odwshare\13-Public Notice & NOV Templates.
Corrective Action Plan information, Appendix A and Appendix F have been deleted and replaced with reference to WM 851 and its Attachments.
Violation codes have been deleted from Section 10 – SDWIS Data Entry, and a reference to the *SDWIS Users Manual* has been added.

SUMMARY STATEMENT

This memo summarizes the requirement of the Ground Water Rule (GWR) and ODW staff implementation procedures. The GWR establishes a risk-based approach to identify public groundwater systems susceptible to fecal contamination. Identified systems are required to take corrective action.

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1. INTRODUCTION

The Groundwater Rule (GWR) was finalized by the US Environmental Protection Agency (EPA) on November 8, 2006 to provide increased protection against microbial pathogens in waterworks that use groundwater sources. This rule is in accordance with the Safe Drinking Water Act (SDWA) as amended, which requires EPA to promulgate National Primary Drinking Water Regulations requiring disinfection as a treatment technique for all waterworks. The GWR establishes a risk-based approach to target groundwater sources that are susceptible to fecal contamination instead of requiring disinfection for all groundwater sources. In particular, the GWR focuses on reducing illness and death associated with viral infection. Corrective Action is required for waterworks with confirmed fecal contamination or a documented significant deficiency. The term 'source' in this document refers to a well or spring which produces groundwater.

2. APPLICABILITY AND COMPLIANCE DATES

The GWR is applicable to waterworks with groundwater sources, unless groundwater sources are combined with surface water or groundwater declared under the direct influence of surface water (GUDI) before filtration treatment. Wholesale waterworks that produce groundwater and consecutive waterworks which receive groundwater must comply with the requirements of the GWR. Waterworks must comply with the GWR requirements starting December 1, 2009.

3. SANITARY SURVEY REQUIREMENTS

A. Sanitary Surveys

Sanitary Surveys are required for all waterworks. Sanitary Surveys must address the following eight elements, to the extent that they apply to an individual waterworks:

1. Source(s)
2. Treatment
3. Distribution System
4. Finished Water Storage
5. Pumps, Pump Facilities and Controls
6. Monitoring, Reporting and Data Verification
7. System Management/Operation
8. Operator Compliance with VDH & DPOR requirements

Beginning December 1, 2009, the GWR requires the applicable elements to be evaluated a minimum of once every three years for community systems and once every five years for noncommunity waterworks. The evaluation of the individual elements may be conducted over multiple site visits, according to the Field Office inspection schedules, as long as all eight elements are initially evaluated by December 31, 2012 for community waterworks and December 31, 2014 for noncommunity waterworks. Completed element evaluations will be documented on written sanitary survey reports and in State Drinking Water Information

System (SDWIS) database. Further guidance on sanitary survey scheduling, tracking and documentation is provided in WM 851.

B. Significant Deficiencies

The GWR requires the waterworks owner to correct Significant Deficiencies identified by ODW staff during sanitary surveys. Further information on Significant Deficiencies is given in WM 851- Sanitary Surveys, Section 8 and Attachment F.

4. GROUNDWATER SOURCE MICROBIAL MONITORING

A. Overview

The GWR requires specific raw water testing *in addition to* the raw water monitoring outlined in the *Compliance Sampling and Reporting Guidance Manual*. A total coliform positive distribution sample 'triggers' raw water monitoring. The purpose of the 'triggered source water' sample is to assess potential fecal contamination of the source. More detailed information can be found in EPA's Triggered and Representative Source Water Monitoring Guidance Manual.

ODW has determined that *Escherichia coli* (*E. coli)* will be the source water monitoring fecal indicator utilized for GWR raw water sampling. The EPA-approved analytical methods are:

Methodology	Method Name
Colilert	9223 B
Colisure	9223 B
Membrane Filter Method with MI Agar	EPA Method 1604
m-ColiBlue24 Test	-
E*Colite Test	-
EC-MUG	9221 F
NA-MUG	9222 G

B. Triggered Source Water Monitoring

Compliance with the monitoring requirements outlined below will be completed in accordance with the deadlines in the "Compliance Determination completed by field office" task listed in the "Mandatory SDWIS Database Activities" table in WM 823.

1. Any waterworks with a groundwater source not approved for 4-log inactivation of viruses, or not verifying such treatment by conducting compliance monitoring, notified of a total coliform positive distribution system sample, must conduct triggered source water monitoring.

2. For triggered source water monitoring, at least one raw water sample must be collected from each source in use at the time the total coliform positive distribution system sample was collected.

   One triggered source water monitoring kit, for each source in service at the time of the coliform positive sample, will be included with TCR repeat sample kits, if DCLS is used.

Field Office staff will use R&R to produce lab-specific sampling documents if DCLS is used. If DCLS will perform the analysis, Field Office staff will print individual sampling input forms for each kit (triggered and repeat) as well as place the electronic ad hoc order for the following month's increased routine order. This process allows for DCLS to bill the waterworks for the correct number of kits for triggered, repeat and temporary routine monitoring. If a private lab will perform the analysis, Field Office staff will generate a sampling requirement notice (from R&R) and email, fax or mail the report to the waterworks owner. This report will include facility and sample point ID information for the waterworks owner to forward onto the private laboratory for electronically uploading results data to ODW.

Note: Systems that have more than one source are required to collect a sample from each source in service unless they have an approved triggered source water monitoring plan that allows representative monitoring (see Section 4.G.2. of this memo).

3. Raw water samples must be collected within 24 hours of notification of the total coliform positive sample result.

4. Each raw water sample must be analyzed for the presence of *E. coli*. If the raw water sample tests *E. coli* - positive then the waterworks must provide public notification as described in Section 7.A. of this memo, and conduct additional raw water monitoring as described in Section 4.C.

5. Waterworks serving a population of 1,000 or fewer persons may use a groundwater raw sample to satisfy the requirements of both the triggered source monitoring requirement of the GWR and repeat sampling requirement of the Total Coliform Rule (TCR).

   Note: Only sources <u>without treatment</u> will be allowed to use a triggered source sample as a TCR repeat sample. If the raw water sample is coliform-positive and E. coli - negative, the GWR does not require further action but the waterworks is in violation of the TCR MCL.

C. Additional Source Water Monitoring.

1. If a triggered raw water sample result is *E. coli*-positive, then the waterworks must collect five (5) additional raw water samples from the *E. coli*-positive source(s) within 24-hours of notification. Public notification as described in Section 7.A. is required.

   Field Office staff will use R&R to produce lab specific sampling documents. If DCLS will perform the analysis, Field Office staff will print individual sampling input forms for each selected source. If a private lab will perform the analysis, Field Office staff will generate a sampling requirement notice from R&R and email, fax or mail the report to the waterworks owner. This report will include facility and sample point ID information for the waterworks owner to forward onto the private laboratory for electronically uploading results data to ODW.

2. All five (5) of the additional raw water samples must be analyzed for the presence of

E. coli. If any of the five samples is *E. coli*-positive, then the waterworks are required to take the following actions:

- Corrective Action(s) as defined in Section 5.B of this memo.
- Public notification as described in Section 7.A.
- A GUDI re-evaluation of the source(s) as described in Section 7 of the *Compliance Sampling and Reporting Guidance Manual*. The purpose of the GUDI re-evaluation is to ensure that 4-log inactivation alone is sufficient treatment.

D. TCR-Positive Results & Repeat Sampling for Consecutive and Wholesale Waterworks

1. Consecutive waterworks that have a total coliform positive distribution system water sample must notify the wholesale waterworks, within 24 hours of notification, of the total coliform positive sample.

2. Wholesale waterworks must, upon receipt of notification of a total coliform positive distribution system sample from a consecutive waterworks, collect a raw water sample from each of its water sources that provide water to the consecutive waterworks and have it analyzed for presence of *E. coli* within 24-hours of notification.

3. Wholesale waterworks must notify all consecutive waterworks served of any raw water *E. coli* - positive results.

E. General Sampling Requirements

1. All waterworks required to monitor raw water must use a lab certified by DCLS for the analysis of *E. coli*. The approved list of test methods is given in Section 4.A.

2. Raw water sample taps must be provided for all sources. Taps must be located prior to any treatment or storage. Sample collectors at waterworks with treatment facilities should be advised to collect the raw water sample when the well pump is pumping.

3. Representative sampling may be approved on a case-by-case basis should the piping configuration not allow sampling of the well itself.

4. A Total Coliform-negative raw water sample result equates to *E. coli* - negative.

5. If a groundwater source sample is invalidated per Section 4. F, the waterworks must collect another raw water sample within 24-hours of being notified of the invalidation decision and have it analyzed for the presence of *E. coli*.

F. Sample Invalidation

Positive sample invalidation should be a rare occurrence. However, a waterworks may request invalidation of an *E. coli* - positive groundwater raw water sample if the following conditions exist:

1. The waterworks provides ODW with written notice from the laboratory that an improper sample analysis occurred, or

2. The waterworks provides sufficient evidence and ODW determines, and documents in writing, that an *E. coli* - positive raw water sample is not related to source water quality.

G. Triggered Source Water Monitoring Plans (TSWMP)

1. A triggered source water monitoring plan is required for all waterworks with groundwater sources not approved for 4-log inactivation of viruses. The plan must include the applicable monitoring requirements of the GWR. Waterworks must submit triggered source water monitoring plans to ODW for approval. This will be incorporated into the Bacteriological Sample Site Report (BSSR) and include the following items:

   a. Map of waterworks with sources and/or entry points and TCR BSSR monitoring locations indicated;

   b. For wholesale waterworks, identification of consecutive waterworks served and sources providing water to the consecutive waterworks;

   c. For consecutive waterworks, identification of wholesale waterworks along with notification requirements;

   d. For waterworks rotating sources in and out of service based on seasonal operating practices, listing of typical begin and end dates of service. Waterworks with multiple sources that are not operated simultaneously for consecutive weeks or months shall provide clear statements that raw water samples are to be collected from the source(s) in service at the time the total coliform positive distribution system sample was collected;

   e. Public notification requirements in the event of an *E. coli* - positive source water sample

   f. Number of raw water samples to be collected from sources in the event of a total coliform positive distribution system sample and *E. coli* - positive raw water sample.

2. Waterworks with multiple sources may conduct *representative* raw water sampling in order to reduce the burden of triggered raw water monitoring. One of the following specific conditions must be met and listed in the approved triggered raw water monitoring plan:

   a. Hydraulic conditions dictate that a source provides water to an isolated area of the distribution system. Consequently, only source(s) identified as providing water to specific TCR monitoring locations must collect the triggered raw water samples based on sample results from the specified TCR sample point. The plan must clearly identify groundwater sources linked to each TCR monitoring site in the waterworks' BSSR.

   b. Documentation accepted by ODW exists that clearly demonstrates that the sources are hydraulically connected, and have similar chemical and physical properties.

Consequently, one source may serve as the triggered raw water sample location representing two or more sources. The plan must clearly list representative triggered raw water monitoring procedures, based on the documentation. References to the documentation must be included in the plan.

Note: Field Office staff must ensure that all waterworks have an approved combined BSSR / TSWMP before December 1, 2009. Use the revised model BSSR/TSWMP in the Compliance Sampling and Reporting Guidance Manual.

5. TREATMENT TECHNIQUE REQUIREMENTS

A. General

A waterworks is subject to the Treatment Technique requirements of this section if it meets either one of the following criteria:

1. The waterworks has an *E. coli* - positive sample result in any one of the five additional triggered raw water samples. A confirmed *E. coli* contamination is defined as E. coli - positive results in the triggered and any one of the additional source water samples.

2. A significant deficiency has been identified as outlined in WM 851 (Section 8 and Attachment F).

Field Office staff shall place a high priority on initiating action to resolve a Treatment Technique requirement. Technical assistance should be provided by the Field Office staff by contacting the wholesalers of groundwater whenever staff becomes aware of a coliform-positive TCR sample collected from a consecutive waterworks.

B. Corrective Actions

The GWR requires that waterworks notified of meeting either one of the above criteria implement Corrective Action. An ODW-approved Corrective Action Plan is required as outlined in Section 5.D. Corrective Action(s) must include at least one of the following activities:

1. Correct all significant deficiencies.

2. Provide an alternate source(s) of water. (example: new well or connection to another waterworks)

3. Eliminate the source of contamination. (example: cross connection has been identified)

4. Provide treatment that reliably achieves at least 4-log (99.99%) inactivation of viruses before or at the first customer. This Corrective Action requires ODW review and approval prior to implementation. See next section for additional information.

Note: Temporary disinfection of groundwater sources by applying shock chlorination may be considered if there is reason to suspect that recent groundwater source maintenance activity or flooding has contributed to the distribution system coliform-positive result. Well disinfection

procedures for groundwater systems shall be consistent with Appendix 4 of Boil Water Advisories During Hurricanes and Other Natural Disasters (EPT/002/2007). Specific recommendations are as follows:

- *The disinfection should take place before the triggered sample is collected. Refer to the advisory for proper time to take the sample. Documentation must be made to the file indicating why the sample collection was delayed.*
- *If a coliform-positive distribution sample is collected in the monitoring period following the original coliform-positive result and the well was disinfected previously, then no well disinfection should be allowed before collecting the triggered water sample.*

Shock chlorination of the groundwater source may be considered in the appropriate situations to prevent a waterworks from being unnecessarily subject to the Treatment Technique requirements and Corrective Action requirements of the GWR. However, the potential exists for the abuse of this policy by waterworks. Shock chlorination is not an appropriate solution to a chronic bacteriological problem.

C. Field Office Staff Actions.

Field Office staff will act on confirmed *E. coli* contamination and Significant Deficiencies as follows:

1. For confirmed *E. coli* contamination the Field Office staff will:

   a. Upon becoming aware of the sample result, immediately contact the waterworks to issue a Boil Water Advisory as part of a Tier 1 public notice. Phone or in-person contact will be the minimum acceptable contact type to satisfy this requirement. E-mail is not acceptable primary contact method, but can used for supplemental communication;

   b. Within 5 business days mail written follow-up notification to the waterworks. Use the Treatment Technique Notification letter with Corrective Action Plan template in Appendix A. The default corrective action is requiring 4-log virus inactivation treatment of the source.

   c. Initiate steps for a GUDI evaluation of the source as described in Section 7 of the *Compliance Sampling and Reporting Guidance Manual*.

2. Significant Deficiency has been identified: follow the Significant Deficiency issuance procedure as outlined in Section 8 of WM 851.

D. Corrective Action Plans

Draft Corrective Action Plans (CAP) will usually be generated by ODW staff and included with the formal notification of a significant deficiency or confirmed *E. coli* contamination. Refer to WM 851, Section 9 for further guidance.

E. Corrective Action Plan Follow-Up

The waterworks shall notify ODW of corrective action implementation, and the Field Office shall conduct follow-up site visits. Staff shall document visits, record all action items and their status in SDWIS. Refer to WM 851, Section 10 and the *SDWIS Users Manual* for further information.

F. 4-log Inactivation of Viruses

Treatment for the 4-log inactivation of viruses may be chosen by the waterworks owner as an alternative to triggered source water monitoring or it may be a prescribed Corrective Action by ODW. For waterworks that do not currently chlorinate, Lead & Copper sampling must return to initial monitoring schedules as described in Section 6 of the *Compliance Sampling and Reporting Guidance Manual.*
If 4-log inactivation is required as a Corrective Action, then completion of a GUDI re-evaluation of the source as described in as described in Section 7 of the *Compliance Sampling and Reporting Guidance Manual* is required to determine if 4-log inactivation alone is sufficient treatment.

1. Application of chemical disinfectants

   Disinfection shall be accomplished by the application of chlorine. The specific chlorine compound shall be selected based on the site-specific requirements. Design, operation and maintenance shall be in accordance with the *Waterworks Regulations*.

   "CT" is to be evaluated in accordance with the *Waterworks Regulations.* The District Engineer is responsible for reviewing the waterworks proposed treatment for compliance with the 4-log inactivation of viruses. Use the review form given in Appendix B. The virus inactivation tables show that waters with a pH between 6 and 9 provide the same inactivation capability. Groundwater sources with a history of pH greater than 9 (pH < 6 assumes a greater inactivation rate) will have to be evaluated on a case-by-case basis. ODW has assumed that the minimum groundwater temperature in all geographic regions of the Commonwealth is no colder than 50 degrees F.

   The minimum free chlorine residual must be determined for the waterworks as outlined in the Evaluation Form in Appendix B. This information, along with the compliance monitoring requirements, will be transmitted to the waterworks. Use notification letter in Appendix C. The waterworks must be aware that physical changes to the waterworks prior to the entry point may alter the criteria used to determine 4-log inactivation of viruses.

   For any existing or new treatment facilities, engineering description sheets and waterworks operations permits will be amended to indicate the Special Permit Requirements for 4-log inactivation of viruses (use template provided in Appendix D). This requirement will enable staff to easily differentiate between waterworks that provide 4-log inactivation of viruses and waterworks which are applying chlorine for other reasons.

The amended Operation Permit will be submitted to the Central Office for processing within 45 days of a determination that the existing treatment facilities are capable of 4-log virus inactivation.

Other chemical disinfectants may be considered on a case-by-case basis. Confer with the ODW Technical Services Division to determine requirements.

The waterworks must begin compliance monitoring within 30 days of the 4-log inactivation notification.

2. Virus removal via membranes

   In accordance with WM 880, no credit for virus reduction using membranes will be given.

Note: When reviewing plans for modification to the waterworks, the impact of the modification on the 4-log inactivation treatment facilities must be evaluated. If the proposed modification will result in an inability of the waterworks to meet 4-log inactivation, they must redesign their proposed modifications to ensure that 4-log inactivation is continued.

G. Compliance Monitoring

Waterworks providing 4-log inactivation of viruses using chlorine as required by ODW, or as an option to avoid triggered source water monitoring, must monitor for and ensure the ODW determined minimum free chlorine residual concentration is continuously maintained. No routine monitoring of temperature or pH is necessary unless alternate criteria were used in the 4-log inactivation evaluation.

1. Waterworks serving populations ≤ 3,300 must determine free chlorine residual once a day at an approved location (i.e. location stated in the ODW document informing the waterworks of monthly reporting requirements or in the waterworks chlorine residual monitoring plan).

   If the chlorinator feeds into a line with relatively constant flow (e.g. well pump discharge) then monitoring anytime when the pump is running is adequate. In the event that the chlorination is paced to widely variable flow (e.g. pressure tank or booster pump discharge), the timing of the sample collection should coincide with the peak demand.

   Note: The ≤ 3,300 population waterworks may elect to provide continuous monitoring as outlined below to satisfy this requirement; however, daily attendance or remote monitoring (described below) is still required.

2. Waterworks serving populations > 3,300 persons must monitor and record free chlorine residual continuously at the approved location (i.e. location stated in the ODW document informing the waterworks of monthly reporting requirements or in the waterworks chlorine residual monitoring plan).

Continuous online analyzers are those that analyze on a frequency of less than 15 minutes. The waterworks must report the lowest residual detected on each day. Instruments used for continuous monitoring must be calibrated with a grab sample measurement at least every five days. The calibration samples shall be maintained in a separate log for review during routine sanitary surveys.

Note: Waterworks that provide a continuous online analyzer and provide a means of remote monitoring 24 hours per day / 7 days per week may visit the site three times per week instead of daily attendance.

3. In the event that a waterworks either does not maintain the ODW-specified minimum free chlorine residual, or has inoperable continuous monitoring equipment, then waterworks must collect free chlorine residual samples every 4 hours until sufficient free chlorine residual is verified or continuous monitoring equipment is returned to service. In the event of insufficient free chlorine residual for more than 4 hours, the waterworks will be cited for a treatment technique violation.

4. Malfunctioning continuous monitoring or recording equipment must be returned to service within 14 days. Exceeding the 14 day limit is a treatment technique violation.

H. Discontinuing Treatment and/or Compliance Monitoring

A waterworks that has chosen to provide 4-log inactivation of viruses to avoid triggered source water monitoring may request to cease providing this treatment. The waterworks may cease 4-log inactivation treatment and/or compliance monitoring upon written approval by the Field Director.

1. A request to cease 4-log inactivation treatment may be granted if the source has been evaluated in accordance with Section 7 of the *Compliance Sampling and Reporting Guidance Manual* and does not require a disinfectant.

2. A request to cease compliance monitoring may be granted as long as the waterworks agrees to conduct triggered source water monitoring in accordance with Section 4.

Sources that have been required to install 4-log inactivation treatment may not discontinue treatment or compliance monitoring.

6. WATERWORKS REPORTING REQUIREMENTS AND COMPLIANCE DETERMINATIONS

Field office staff must provide monthly oversight in five areas, as listed below:

A. Monthly Operations Reports (MORs)

Waterworks providing 4-log inactivation of virus treatment must document daily virus inactivation in monthly operations reports. Documentation of compliance monitoring must include, at a minimum, the daily lowest free chlorine residual concentration. ODW considers groundwater pH and temperature to be seasonally consistent and the same each day within

the following parameters: pH – 6 to 9; temperature ≥50 Degrees F. Therefore, monthly reporting of pH and temperature will not be required, unless alternate criteria were specified in ODW's 4-log inactivation approval letter.

B. Triggered Source Water Monitoring

Results from triggered and additional raw water samples must be reported to ODW by the 10th of the subsequent month of the monitoring period within which the samples were collected. Field Office staff will evaluate compliance status of triggered source water monitoring events simultaneously with monthly TCR compliance determinations. SDWIS TCR compliance determination tools will be used.

Waterworks owners must report to ODW as soon as practical, but no later than 24 hours, after learning of an *E. coli* positive source water sample.

C. Corrective Actions

Waterworks must report, within 30 days from the date of completion, the individual corrective actions completed. By the first of every month Field Office staff will update the status of individual Corrective Actions per the approved Corrective Action Plan and update status in SDWIS.

D. Equipment Malfunctions

1. Chlorination equipment - The waterworks must notify ODW as soon as possible but no later than the end of the next business day of any failure to provide continuous chlorination.

2. Continuous chlorine residual analyzers and recording equipment - The waterworks must notify ODW as soon as possible but no later than the end of the next business day of a failure of the analyzer or the recording equipment. In the event of a recording equipment failure the waterworks will record chlorine residual as specified in Section 5.G.3 of this memo.

E. Records Retention

Verification that waterworks are maintaining adequate documentation and records will be made during routine inspections. Copies of records must be retained as follows:

- Notices to the public: 3 years.
- Corrective Actions: 10 years.
- Consecutive waterworks - notification to the wholesale waterworks of total coliform positive sample(s): 5 years.

7. PUBLIC NOTIFICATION

Field Office staff must inform waterworks to perform timely Public Notification (PN) when there is a failure to comply with requirements of the GWR. A list of violations and the required method of notification (PN, CCR or Special Notice) is presented below. Examples are provided on the ODW server \\Odwsrv1\odwshare\13-Public Notice & NOV Templates.

Issue	Notification Required
Uncorrected significant deficiency – Community[1]	Special Notice in CCR
Uncorrected significant deficiency – NonCommunity[2]	Special Notice
E. coli - positive source sample – Community[2]	Tier 1 public notice, Special notice in CCR
E. coli - positive source sample –NonCommunity	Tier 1 public notice
Unaddressed *E. coli.* Positive source water sample – Community	Special notice in CCR
Failure to take corrective action - Community	Tier 2 public notice, CCR
Failure to take corrective action - NonCommunity	Tier 2 public notice
Failure to maintain 4-log treatment of viruses – Community	Tier 2 public notice, CCR
Failure to maintain 4-log treatment of viruses – NonCommunity	Tier 2 public notice
Failure to meet monitoring requirements - Community	Tier 3 public notice, CCR
Failure to meet monitoring requirements – NonCommunity	Tier 3 public notice

The GWR explicitly allows ODW to add other violations and/or situations to the Tier 1 list that have significant potential to have serious adverse health effects. Specific requirements are outlined as follows:

A. GWR Events Requiring Tier 1 Notice

Tier 1 notification is required when:

1. A raw water sample collected under triggered monitoring is *E. coli* positive (Section 4.B of this memo) or

2. A raw water sample collected under additional source water monitoring is *E. coli* positive (Section 4.C of this memo).

Note: Item 1 does not require a Boil Water Advisory be issued with the notice. Item 2 does require a Boil Water Advisory be issued.

[1] Waterworks must continue to notify the public annually until the significant deficiency has been corrected.
[2] Consecutive waterworks served by the groundwater source must also notify the public.

B. GWR Events Requiring Tier 2 Notice

Tier 2 notification is required when:

1. Waterworks fails to meet a schedule deadline for Corrective Action with any one of the following:
   a. Waterworks has been notified by ODW of a Significant Deficiency.
      Example: Deadline passes for a corrective action listed in a Corrective Action Plan
   b. ODW required Corrective Action due to confirmed fecal contamination in raw water sample(s). Example: Waterworks failed to install 4-log inactivation treatment within the required schedule.

2. Failure to maintain continuous 4-log inactivation of viruses for a period greater than four hours.

3. Failure to comply with ODW- required interim measures related to correcting a Significant Deficiency and/or eliminating fecal contamination in a groundwater source. Example: Waterworks fails, as required by ODW, to issue a boil water notice during a corrective action activity time period.

4. Malfunctioned continuous chlorine residual monitoring or recording equipment used to confirm 4-log virus inactivation is not returned to service within 14 days.

C. GWR Events Requiring Tier 3 Notice

Tier 3 notification is required when:

1. Failure to conduct any triggered or additional source water monitoring.

2. Failure to conduct compliance monitoring
   Example A: ≤ 3,300 population waterworks fails to determine one or more daily free chlorine residuals at the approved location to verify 4-log virus inactivation.

   Example B: > 3,300 population waterworks fails to determine one or more 'every 4 hour' free chlorine residuals when continuous chlorine residual monitoring or recording equipment malfunctions.

8. CONSUMER CONFIDENCE REPORTS

Consumer Confidence Reports (CCR) will be verified to have content pertinent to the requirements of the GWR. Specifically, where applicable, the following information:

- Uncorrected Significant Deficiencies and/or *E. Coli* - positive source water sample for the appropriate year. Uncorrected is not failure to correct; it is stating the waterworks is in the process of correcting the Significant Deficiency.

- Treatment technique violations. Specifically, list failure(s) to take corrective action and failure to maintain continuous 4-log inactivation of viruses.

- Corrected Significant Deficiencies.

- Failures to conduct triggered water, additional source water or compliance monitoring.

9. SPECIAL NOTICE REQUIREMENTS

Special notice requirements are applicable to community and noncommunity waterworks. This notice is to inform the public of any uncorrected Significant Deficiencies or notification of an *E. coli* positive source water sample. Uncorrected is not the same as failure to correct; it is stating the waterworks is in the process of correcting the Significant Deficiency in accordance with the approved Corrective Action Plan.

Field Office staff will provide the noncommunity waterworks draft special notices approximately 30 days prior to the Significant Deficiency issuance 12 month anniversary date. The letter transmitting the draft special notice will advise the noncommunity waterworks of the requirement to issue the notice as well as the method to notify the public. Methods allowed will be the same as Tier 2 TCR MCL violations for noncommunity waterworks. The notice must include the date and nature of the Significant Deficiency, the complete ODW approved plan and schedule and completion status of each item. The waterworks will be advised that the notice may be modified and that ODW concurrence to changes must be requested prior to issuance.

The special notice must be re-issued every 12 months thereafter until the Significant Deficiency is resolved.

Note: Special notice information for community waterworks is included in the annual CCR.

10. SDWIS DATA ENTRY

The GWR requires tracking and logging of various data elements in SDWIS to provide state records and optimize efficiency of ODW tasks. See the *SDWIS Users Manual* for detailed data entry instructions. A summary of items for data entry follows:

- The SDWIS "Site Visit" module must be updated to indicate which of the 8 essential sanitary survey elements were evaluated during a site visit.

- Significant Deficiencies 'found' during an inspection must be entered as part of a 'site visit' created for an inspection. Among the data elements to enter for a Significant Deficiency are the deadlines for individual scheduled activities to complete the required corrective action and the creation of a "deficiency" compliance schedule.

- A Corrective Action Plan will be entered into SDWIS as a compliance schedule subsequent to a *E. coli* positive "additional monitoring" raw water sample analysis result. The compliance schedule data entry will include delineated deadlines to resolve the problem.

- The GWR Data Bridge will be used to create individual source triggered monitoring schedule(s) subsequent to validation of TCR TC positive samples. Additional raw water source monitoring schedules will be manually entered into SDWIS following an *E. coli* positive trigger sample analysis result.

- Public notification required as described in Section 9 of this memo must be entered into the SDWIS "Enforcement" module with 30 days of advising the waterworks of the notification requirement. The SIE, SIF and SFH type enforcement actions required to document public notification due to E. coli positive 'trigger' or 'additional' samples will not be 'associated' to a violation while enforcement actions due to the other violation events listed in Section 9 will have the enforcement actions 'associated' to the pertinent violation.

- The GWR resulted in the addition of numerous violation codes to the "Monitoring" module. Refer to the *SDWIS Users Manual* for a list of new violation codes.

- A new treatment objective signifying that a treatment plant facility provides 4-log virus inactivation treatment must be added to treatment plants practicing 4-log virus inactivation.

- Three indicators are available that must be used to document the status of a waterworks or appropriate facility as follows:
    - A waterworks level indicator for groundwater waterworks $\leq$ 1,000 population and not adding chlorine to the water that signifies the waterworks may substitute a trigger sample to count as one the four repeat samples required subsequent to a TCR TC positive sample. Refer to the *SDWIS Users Manual* for additional data entry instructions.
    - A well facility level indicator that indicates a specific well of a multi well waterworks, where the wells are in the same aquifer, will be used to provide a singe representative trigger sample in the event a waterworks TCR sample is TC positive.
    - A treatment plant facility level indicator used to document that a treatment plant is capable of providing 4-log virus inactivation but is not required to verify achievement of 4-log virus inactivation

APPENDIX A
LETTER FOR CONFIRMED *E. COLI* & CORRECTIVE ACTION PLAN

<<date>>

NOTIFICATION OF TREATMENT TECHNIQUE REQUIREMENT

Subject: <<County>>
Water- <<Waterworks Name>>
PWSID No.

«Owner Name»
«Address»
«Address»

Dear «Owner Name»:

According to Virginia Department of Health records your well *(spring)* water tested positive for *E. coli* bacteria in (two- *state total number)* raw water samples collected on *{dates}*. Because your well (spring) has confirmed *E. coli* contamination, federal law requires you to complete the following actions:

Treatment Technique Requirements / Corrective Action Plan**:**

Section 141.403(a)(4) of the federal *Groundwater Rule* requires you to consult with this Office to develop a Corrective Action Plan (CAP) that will resolve the confirmed *E. coli* contamination. Enclosed is a proposed CAP for you to review, sign, and return if acceptable no later than <insert date of letter plus 30 days>. If you wish to revise the CAP please contact this Office immediately.

Upon completion of each action item, you must report the status to this Office within 30 days after the completion date. Once the CAP has been fully implemented, contact this Office to schedule an inspection.

Failure to respond by the above deadlines may constitute non-compliance with the federal *Groundwater Rule* that was established to protect public health, and formal enforcement action may be initiated to compel compliance.

Public Notification:

On *{insert date}*, I (or *other individual's name* of this office) talked with you by telephone about the public notification requirements. You were advised to notify your customers of the confirmed *E. coli* contamination in your well *(spring)* within 24 hours. We provided a sample written notice for you to distribute to your customers. A copy of the draft public notice is enclosed. The federal *Groundwater Rule* characterizes this as a Tier 1 situation.

APPENDIX A (cont.)
LETTER FOR CONFIRMED *E. COLI* & CORRECTIVE ACTION PLAN

Public Notice Confirmation**:**

Within ten (10) days of distribution of the public notice to your customers, you must provide this Office with a copy of the notice you distributed and a signed certification of the distribution completion date and methods used. A sample certification form is enclosed for your use. Failure to distribute the public notice and report to the Virginia Department of Health may be a violation of the *Waterworks Regulations*.

Sincerely,

District Engineer

Enclosure(s): 1. Corrective Action Plan
2. Public Notice
3. Public Notice Certification form

cc: <<County>> County Health Department, Attention, Name of Health Director, Director
<<County>> County Administrator

APPENDIX A (cont.)
LETTER FOR CONFIRMED *E. COLI* & CORRECTIVE ACTION PLAN

CORRECTIVE ACTION PLAN

Implement the following interim and corrective actions to address the confirmed *E. coli* contamination of your groundwater source.

A. INTERIM ACTION REQUIREMENTS

1. Discontinue use of the groundwater source until such time as the Corrective Action Plan has been fully implemented, or

2. If the well must remain in service because discontinuing use of the source is not a viable option:

   a. The waterworks owner shall issue a Boil Water Advisory through the public notification procedure in 12 VAC 5-590-540 of the *Waterworks Regulations* until such time as the Virginia Department of Health approved 4-log virus treatment facilities have been installed and are operational.

   b. Provide emergency chlorine disinfection during the interim period as follows: the free chlorine residual disinfectant concentration at the entry point to the distribution system shall not be less than 2.0 mg/L.

   c. Chlorine residual in the distribution system shall not be less than 0.2 mg/L.

B. CORRECTIVE ACTION REQUIREMENTS

The following corrective actions and schedules must be followed. As you complete each action item you are required to report in writing the status to the VDH.

ACTION ITEM	START DATE	COMPLETION DATE
Submit plans and specifications prepared by a Virginia licensed Professional Engineer for a continuous chlorination system capable of meeting the 4-log virus inactivation requirements.	Immediately	Target 45 days
Complete construction and have in operation the approved treatment facilities.	Upon issuance of construction permit	Target 120 days from construction permit issuance

I agree to fully implement the above interim and corrective actions to bring my waterworks into compliance with the Treatment Technique requirement of the federal *Groundwater Rule.*

Waterworks Owner (Signature) Date

APPENDIX B
4-LOG VIRUS TREATMENT EVALUATION FORM

INSTRUCTIONS

This form is to be used in evaluating a waterworks for compliance with 4-log treatment for virus removal.

1. Determine what facilities the waterworks has that may be used in calculating CT. Recommended procedure is to evaluate atmospheric storage first, pressure storage second and pipeline last. For pressure tanks that float on the system with a combined inlet/outlet no effective T is available.

2. Determine the peak hourly flow rate for each component to be evaluated. For example, the peak flow for an atmospheric tank would be the greater of the booster pump(s) or well pump(s) capacity. The peak flow for a pressure tank would be the greater of booster pump(s) capacity or the formula $Q_{pk} = 11.4 * (N^{0.544})$.

3. Select a lowest free chlorine residual (C) value between 0.5 and 1.5 mg/L, with calculations starting on the lower end and following an iterative process until CT requirements are met.

4. Evaluate CT credit from atmospheric storage. The minimum operating volume should be based on the lowest expected water level (actual pump "on" and "off" levels should be used to compute effective storage volume). The appropriate baffling factor should be applied to the effective volume. Use guidance in attached worksheet, for assigning a baffling factor (adopted from Table L-8 of the *Waterworks Regulations)*. If CT requirements are met go to step 7, otherwise proceed to the next step.

5. Evaluate CT credit from pressure storage. Typically only 1/3 of pressure storage is available Typical baffling factor would be 0.1 for inlet/outlet on the same end ("unbaffled") , or 0.3 for separate inlet/outlet on opposite ends of the tank ("poorly baffled"). If CT requirements are met go to step 7, otherwise proceed to the next step.

6. Evaluate CT credit from pipelines. Any CT credit shall be prior to the entry point sample tap, to avoid collecting a sample out in the distribution system.

7. Compare CT_{credit} to $CT_{required}$. If current facilities do not provide for the required CT, then waterworks may follow established procedures to obtain a construction permit for modifications.

8. Complete the Disinfectant Residual Achievable worksheet. The chlorine feed rate required, Q_{pump}, must be less than 80% of the capacity of the existing pump.

APPENDIX B (cont.)
4-LOG VIRUS TREATMENT EVALUATION FORM

INSTRUCTIONS (CONT.)

Baffling Factor, per *Waterworks Regulations*

Baffling Condition	Baffling Factor = T_{10}/T	Baffling Description
Unbaffled (mixed flow)	0.1	None, agitated basin, very low length to width ratio, high inlet and outlet flow velocities
Poor	0.3	Single or multiple unbaffled inlets and outlets, no intrabasin baffles
Average	0.5	Baffled inlet or outlet with some intra-basin baffles
Superior	0.7	Perforated inlet baffle, serpentine or perforated intra-basin baffles, outlet weir or perforated launders
Excellent	0.9	Serpentine baffling throughout basin, very high length to width ratio
Perfect	1.0	Very high length to width ratio (pipeline flow), perforated inlet, outlet and intra-basin baffles

4-LOG VIRUS TREATMENT EVALUATION FORM

Evaluator:		PWSID No.:	
Date:		Waterworks Name:	

GROUNDWATER SYSTEMS : 4-LOG VIRUS TREATMENT EVALUATION For waterworks that disinfect with gaseous chlorine or sodium hypochlorite			
Step 1. Determine CT Credit			
Lowest free chlorine residual, C			mg/L
CT from Atmospheric Storage			
1	Minimum Operating Volume, V		gal
2	Peak hourly flow, Q_{pk}		gpm
3	Theoretical Contact Time, $T=V/Q_{pk}$		minutes
4	Baffling Factor, BF		
5	Effective Contact Time, $T_{10} = T * BF$		minutes
6	$CT_{atm\text{-}storage} = C * T_{10}$		min-mg/L
CT from Pressure Storage			
1	Minimum Operating Volume, V		gal
2	Peak hourly flow, Q_{pk}		gpm
3	Theoretical Contact Time, $T=V/Q_{pk}$		minutes
4	Baffling Factor, BF		
5	Effective Contact Time, $T_{10} = T * BF$		minutes
6	$CT_{press\text{-}storage} = C * T_{10}$		min-mg/L
CT from Pipelines			
1	Pipe length, L		feet
2	Pipe Diameter, D		inch
3	Pipe Volume, V = L * 3.14 * (D/24)^2 * 7.48		gal
4	Minimum pipe detention time, $T_{pipe} = V / Q_{pk}$		minutes
5	$CT_{pipe} = C * T_{pipe}$		min-mg/L
Total $CT_{credit} = CT_{pipe} + CT_{atm\text{-}storage} + CT_{press\text{-}storage}$			min-mg/L
Step 2. Determine $CT_{required}$			
10	Coldest water temperature, t = **(if unknown, use default value = 10 ^{o}C)**		^{o}C
On Table below Line A – circle value of coldest water temperature. Line B – circle corresponding = $CT_{required}$			
Step 3. Compare Total CT credit : $CT_{required}$			
Total $CT_{credit} \geq CT_{required}$? (circle answer)		YES	NO

APPENDIX B (cont.)
4-LOG VIRUS TREATMENT EVALUATION FORM

CT Values for 4-Log Virus Inactivation by Free Chlorine, pH = 6.0 – 9.0										
A	Temp ^{o}C	1	2	3	4	5	6	7	8	9
B	4-Log Inactivation	11.6	10.7	9.8	8.9	8.0	7.6	7.2	6.8	6.4

CT Values for 4-Log Virus Inactivation by Free Chlorine, pH = 6.0 – 9.0										
A	Temp ^{o}C	10	11	12	13	14	15	16	17	18
B	4-Log Inactivation	6.0	5.6	5.2	4.8	4.4	4.0	3.8	3.6	3.4

DISINFECTANT RESIDUAL ACHIEVABLE

The following worksheet determines if the required free chlorine concentration can be achieved with the existing facilities to obtain 4-Log Virus treatment.

Free Chlorine Residual required, $C_{residual}$ Measurement location: (Typically at the Entry Point sample tap)		mg/L
Chlorine demand, C_{demand} (assume 0.2 mg/L unless actual data is provided)		mg/L
Peak hourly flow, Q_{pk}		gpm
Chlorine feed capacity evaluation: Chlorine solution concentration, C_{soln} Chlorine feed required based on minimum CL residual, Q_{pump} $Q_{pump} = ((Q_{pk} * 1440) * (C_{residual} + C_{demand})) / C_{soln}$		 mg/L gpd
Can the waterworks provide the required minimum chlorine dosage? (Q_{pump} must be less than 80% of existing pump capacity)	YES	NO
Is the minimum chlorine residual concentration acceptable to customers?	YES	NO

APPENDIX C
4-LOG NOTIFICATION LETTER

<<date>>

Subject: <<County>>
Water- <<Waterworks Name>>
PWSID No.

«Owner Name»
«Address»
«Address»

Dear «Owner Name»:

We have evaluated the performance of the chlorine disinfection facilities of your waterworks relative to meeting 4-Log virus inactivation described in the Groundwater Rule (GWR). The waterworks appears to provide the required 4-Log virus inactivation, as it is currently configured and operated. A copy of our completed waterworks performance evaluation form is attached for your information. The evaluation was based on the peak flow through the disinfection process, and an assumed minimum water temperature value of 10°C (76°F).

In order to consistently achieve 4-log inactivation of virus your waterworks will need to be operated and monitored to assure that the following finished water quality is produced:

- Minimum Free Residual Chlorine Concentration, measured at the entry point sample tap – *{insert here}*mg/L
- Minimum/Maximum pH Range: 6.0 – 9.0

Please note that the minimum chlorine residual specified above is for meeting the 4-Log inactivation requirements for viruses. A greater chlorine dosage may be necessary to maintain acceptable chlorine residuals and bacteriological quality in the distribution system than is required to provide 4-Log virus inactivation.

Waterworks population > 3,300 or population <=3,300 who choose this option:
You must continuously monitor and record the residual disinfectant concentration at the approved location each day that you serve water from the well(s) to the public. The daily lowest residual disinfectant concentration must be reported on the monthly operations report submitted to this office.

APPENDIX C (cont.)
4-LOG NOTIFICATION LETTER

Waterworks population <=3,300:
You must collect at least one grab sample from the entry point sample tap, during the hour of peak flow, each day that you serve water from the well(s) to the public. The daily grab sample result must be reported on the monthly operations report submitted to this office.

The operators of your waterworks will need to closely monitor the entry point free chlorine residual. Failure to maintain adequate chlorine residual may result in a Treatment Technique violation of the *Waterworks Regulations*. Enclosed is a revised monthly operation report (MOR), which will be reviewed by this Office to evaluate compliance with the virus inactivation Treatment Technique. Use of the enclosed MOR must begin on (*month, year)*, but you may start to use it immediately.

Your cooperation during our evaluation is appreciated. Should you have any questions, please feel free to contact _____, District Engineer, or me.

Sincerely,

Engineering Field Director

<<engr initials:typist>>
cc: <<county>> County Health Department, Attn: <<Director>>

APPENDIX D
SPECIAL PERMIT REQUIREMENTS FOR 4-LOG INACTIVIATION

SPECIAL PERMIT REQUIREMENTS
PWSID No. *{permit number}*

These permit requirements are issued by the State Board of Health of the Commonwealth of Virginia, under authority granted in the *Code of Virginia* Title 32.1. Failure to comply with these requirements shall constitute a violation of this Permit.

The following operational control conditions and reporting requirements for the disinfection unit process are imposed:

1. In order to consistently achieve 4-Log inactivation of virus, the minimum free residual chlorine concentration, measured at the entry point sample tap for *{name of source}* must be maintained at *{insert}* mg/L.

2. *Waterworks population > 3,300 or populations <= 3,300 choosing this option:*

   The free chlorine residual concentration must be continuously monitored and recorded at the approved entry point location to the distribution system each day that you serve water from *{name of source}* to the public. The daily lowest free chlorine residual concentration must be reported on the monthly operations report submitted to the *{name}* Field Office.

3. *Waterworks population <= 3,300*

   The free chlorine residual concentration must be measured and recorded on a grab sample collected at the approved entry point location to the distribution system during the hour of maximum peak flow each day that you serve water from *{name of source}* to the public. The daily grab sample chlorine residual concentration must be reported on the monthly operations report submitted to the *{name}* Field Office.

4. The monthly operations report must be submitted to the *{name}* Field Office no later than the 10th day of the month following the month in which data is reported.

Approved: _____P.E.
Director, Office of Drinking Water
For the State Health Commissioner pursuant to VA Code § 2.2-604

Date: _____