DATE: May 5, 2008

TO: Office of Drinking Water Technical Staff

FROM: J. Wesley Kleene, Ph.D., P.E., Director
Office of Drinking Water

SUBJECT: SURVEILLANCE & REGULATIONS – GUDI Determinations

RELATED: WM 813 (Groundwater Source Development and Monitoring)
WM 844 (Special Notices -Boil Water, Do Not Drink, Do Not Use, Rescission Notices)
WM 898 (Compliance Sampling and Reporting)

SUMMARY STATEMENT:

This memo clarifies ODW procedures for evaluating groundwater sources for the purpose of making a Groundwater Under the Direct Influence of Surface Water (GUDI) determination. Clarification is provided to avoid potential conflicts with the recently promulgated Groundwater Rule (GWR) and current GUDI determination policy, and to reference *E. coli* analytical results in lieu of fecal coliform. Additionally this memo makes changes in the interim requirements waterworks owners must meet for sources that have been determined to be GUDI until filtration and disinfection treatment is installed and in operation to address the possible occurrence of *Cryptosporidium* in those sources.

TABLE OF CONTENTS

I. BACKGROUND……..…….. 2
II. GUDI DETERMINATION PROCEDURE……... 3
III. INTERIM ACTION REQUIREMENTS…… 6

APPENDICES

A. GUDI Determination Review Sheets …….…….8
B. GUDI Determination Flow Chart ……..……. 10
C. Model Letters ……. 11
D. Example Monitoring Plan …….. 15
E. Monitoring Plan Worksheet ……17
F. MPA Relative Risk Tables ……... 18

I. BACKGROUND

The Surface Water Treatment Rule and the *Waterworks Regulations* define GUDI sources as any water beneath the surface of the ground with significant occurrence of insects, macroorganisms, algae, or large-diameter pathogens such as *Giardia lamblia* or *Cryptosporidium*. It also means significant and relatively rapid shifts in physical water quality characteristics such as turbidity, temperature, conductivity, or pH which closely correlate to climatological events or surface water conditions. Once a source is determined to be GUDI, it is a Subpart H source, subject to requirements of the Surface Water Treatment Rule.

The *Waterworks Regulations* 12 VAC 5-590-430 (Determination of Surface Water Influence of Groundwater Sources) contains the current procedure for making a GUDI determination. The section states that all groundwater sources utilized by a waterworks, including wells, springs, and infiltration galleries shall be evaluated by the Field Office, and a determination of surface water influence shall be made. In addition, this section requires the waterworks owner to provide all information to the Field Office that may be necessary to make this determination.

12 VAC 5-590-430 3.a. and 12 VAC 5-590-840 A establish that any groundwater source with monitoring results indicating confirmed fecal coliform contamination to be GUDI. There are two problems with the use of "…confirmed fecal coliform contamination…" as the GUDI determinant: (1) there has never been a firm definition of "…confirmed fecal coliform contamination…" which has resulted in confusion, and (2) fecal coliform is no longer used as a standard analyte by DCLS or many other laboratories. Most laboratories now use *E. coli* as the standard analyte in addition to total coliform. It is not possible to simply substitute "…confirmed *E. coli* contamination…" into our current GUDI determination policy because of the Groundwater Rule.

The Groundwater Rule is based on protecting against fecal contamination, defined by the presence of viruses and bacteria. The presence of protozoa means that the source is GUDI and therefore covered by the SWTR. ODW has determined that *E. coli* will be utilized as the indicator for triggered source water monitoring, required by the Groundwater Rule (GWR). Triggered monitoring means that any routine distribution system Total Coliform Rule (TCR) sample that is total coliform positive (TC+) triggers source water monitoring for *E. coli*. If that triggered sample is *E. coli* positive, then five additional source water samples must be collected for *E. coli* analysis. If any one of the additional source water samples is found to be *E. coli* positive, then the source is declared to have "confirmed fecal contamination". A source that has confirmed fecal contamination must apply one of the GWR-prescribed treatment techniques. One of the GWR treatment techniques is treatment that reliably achieves at least a 4-log treatment (inactivation, removal or a State approved combination of inactivation and removal) of viruses for groundwater sources. As such, our GUDI determination policy must be altered to avoid making a GUDI determination based solely upon the confirmed presence of *E. coli*.

All groundwater sources must be evaluated for possible surface water influence; as of the date of this memo, most existing sources have already undergone evaluation. <u>If a groundwater source has previously been determined to be GUDI, and filtration treatment has already been installed, ODW will not re-evaluate such sources using the revised method described in this Working Memo.</u> However, if a source was previously determined to be GUDI using the older evaluation method, and taken out of service to avoid filtration requirements, or if filtration treatment has not yet been installed, the source may be re-evaluated using the procedures outlined in this Working Memo. The decision to re-evaluate these sources will be made by the District Engineer with concurrence of the Field Director after reviewing the water quality data used to make the original GUDI determination.

GUDI determinations for all new groundwater sources, and any existing sources not previously evaluated, must be made using the method outlined in this Working Memo.

As new water quality data become available, sources previously evaluated as non-GUDI may also need to be re-evaluated. For example, WM 898 contains requirements for raw water monitoring for any disinfected groundwater source. If this raw water monitoring indicates the presence of *E. coli* in multiple samples, a GUDI re-evaluation will be necessary. Likewise, when the GWR takes effect, if the triggered source water samples show confirmed fecal contamination (as defined above), a GUDI re-evaluation of the source will be necessary. This re-evaluation is to assure that the treatment technique chosen will provide adequate treatment.

II. GUDI DETERMINATION PROCEDURE

Use the GUDI Determination Review Sheets (Appendix A) to document the evaluation of the source and all monitoring data used. The Review Sheets proceed stepwise, following the procedures outlined below. In the discussion below, the corresponding steps in the Review Sheets are shown in boxes (Step 1a., e.g.). A summary of the GUDI determination procedure is provided in flow-chart format in Appendix B. Appendix C provides model letters for transmitting results of GUDI determinations to waterworks owners.

The GUDI determination procedure begins with evaluation of the source history and location. Has the source been associated with a disease outbreak Step 1a, a chemical contamination event from the surface Step 1b, evidence of direct surface water intrusion Step 1c, or structural defect or other catastrophic event Step 1d? *Note that we deal with many wells that have been contaminated with petroleum products, mainly from leaking underground storage tanks. Many of the compounds found in petroleum products are very soluble and can travel for long distances in groundwater. Use caution when applying the "chemical contamination event from the surface" criteria in declaring a source GUDI based upon a petroleum contamination event.*

Most sources cannot be characterized on the basis of source history and location alone. Determinations will typically begin with a microbiological sampling series. The microbiological sampling series is usually a minimum of 20 samples analyzed by an approved laboratory, using an MPN test method for both total coliform and *E. coli*. At least 20 weeks of monitoring, to include multiple significant rainfall events, is normally required. The number of samples, frequency, and the duration of sampling will be determined by the District Engineer. WM 898 contains sampling guidance.

A. The 20 sample MPN series will be triggered by three different circumstances. These include:

1. New source development - A new groundwater source that is being developed will require the MPN series. For new wells drilled in non-Karst geology, the 20 samples collected during the yield test can be used to make the GUDI initial determination. For all other new wells or springs, the MPN series used for GUDI determination consists of weekly samples, as described in WM 813.

2. Groundwater Rule – When the GWR is effective, if triggered source water samples show confirmed fecal contamination (as defined on page 2), additional water quality monitoring is needed to determine if the disinfection treatment to achieve 4-log virus removal and/or inactivation alone will provide adequate treatment. A GUDI re-evaluation is required using a 20 sample MPN series.

   Note: the GWR will require that treatment be installed to achieve a 4-log removal and/or inactivation of viruses within 120 days. This requirement must be met by the waterworks owner to comply with the GWR and is considered to be separate from the additional monitoring and

GUDI re-evaluation. The purpose of the GUDI re-evaluation is to ensure that the GWR required disinfection treatment alone is sufficient.

3. Source Water Monitoring – WM 898 requires the owners of all groundwater sources with disinfection treatment to collect periodic raw water samples for Total Coliform and *E. coli* MPN analysis. *This raw water monitoring is very important in that it allows ODW staff to detect possible changes in raw water quality.* If these raw water monitoring results indicate Total Coliform in excess of 50 colonies per 100 ml in 2 or more samples or the presence of *E. coli* in 2 or more samples collected over any running 12 month period, additional water quality monitoring is needed to determine if disinfection treatment alone is sufficient. A GUDI re-evaluation is required beginning with the 20 sample MPN series. For a well located in non-Karst geology (sampling raw water once per year), or any well monitoring on a quarterly frequency, any sample indicating Total Coliform in excess of 50 colonies per 100 ml or any sample indicating the presence of *E. coli* should be followed by additional samples. The number of additional samples and collection frequency for these sources will be determined by the District Engineer. If any of the additional samples indicate Total Coliform in excess of 50 colonies per 100 ml or if any of the additional samples indicate the presence of *E. coli*, additional water quality monitoring is needed to determine if disinfection treatment alone is sufficient. A GUDI re-evaluation is required beginning with the 20 sample MPN series.

B. The results of the Total Coliform MPN series and the results of the *E. coli* MPN series are reviewed for a GUDI determination.

1. If the results of the Total Coliform MPN series indicate a Total Coliform geometric mean of greater than 100 colonies per 100 ml Step 2a or if more than 10% of the samples indicate Total Coliform greater than 100 colonies per 100 ml Step 2b, the source is determined to be GUDI .

2. If a source is not declared GUDI based on the Total Coliform criteria in B. 1., above, evaluate the *E. coli* MPN series according to the following criteria:

   a. If the results of the *E. coli* MPN series indicate ≥ 5 *E. coli* per 100 ml in three or more samples Step 2c, or if 5 or more of the *E. coli* MPN series shows *E. coli* to be present Step 2d, then the source must be assessed using the additional methodologies described below.

   b. Conversely, if the *E. coli* MPN series shows < 5 *E. coli* per 100 ml in no more than three samples, and if fewer than 5 of the samples in the series show *E. coli* to be present, then the source is determined to be a groundwater source (NOT GUDI). If the source is not GUDI, raw water monitoring continues per WM 898; the District Engineer may increase the frequency of this monitoring.

3. If a source is not declared GUDI based upon the Total Coliform MPN criteria in B.1., and if the results of the *E. coli* MPN series indicate the presence of *E. coli* per B.2.a., then additional water quality assessment is required, or the owner may proceed directly with filtration treatment.

   The additional water quality monitoring must include Microscopic Particulate Analysis (MPA) of the source and may also include raw water temperature, pH, turbidity, conductivity, etc. If surface water is located near the groundwater source, monitoring of the nearby surface water is recommended, using the same physical parameters and frequency as the groundwater source. In addition to the water quality parameter monitoring, records of rainfall and other climatological events at the water source should be collected. The specific parameters to be monitored, monitoring frequency, and monitoring duration will be determined by the District Engineer. The waterworks owner must submit a written source water monitoring plan for approval (see

Appendix D for examples of parameters to include). The Monitoring Plan Worksheet (Appendix E) can be used to document the required testing.

The waterworks owner must provide the District Engineer with all of the monitoring results required in the approved monitoring plan. MPA results must be provided within 10 days of receipt by the owner if the laboratory does not provide the ODW with the results directly. Other long term monitoring (physical parameters) must be provided along with applicable rainfall / climatological data to the District Engineer with a summary report. A final GUDI determination will be made based upon the results of the additional water quality monitoring. If the owner does not provide the requested data, ODW may designate the source a GUDI.

C. Physical Parameters such as water temperature, turbidity, pH, conductivity, etc. may be indicators of surface water influence. The best indicator using physical parameters is a direct correlation between groundwater monitoring results and monitoring results from a nearby surface water source, taking into account significant rainfall or other climatological events Step 3a. Another, but less reliable. indicator is water temperature fluctuations (± 15% in ^{o}F) in the groundwater following significant rainfall or other climatological event Step 3b.

D. Microscopic Particulate Analysis (MPA) is a method to identify organisms that occur only in surface waters, and whose significant occurrence in groundwater clearly indicates that at least some surface water is present. The parameters that are believed to be indicators of surface water contamination of groundwater include *Giardia lamblia* cysts, *Cryptosporidium*, *Coccidia*, diatoms, algae, insects/larvae, rotifers, and chlorophyll-containing plant debris.

1. All MPA testing and reporting of results must be in accordance with the USEPA *"Consensus Method for Determining Groundwaters Under the Direct Influence of Surface Water Using Microscopic Particulate Analysis (MPA)"* dated October 1992. This document is posted on ODWShare\03-Memos\301-Active Working Memos\301.02 Forms Letters Manuals\WMxxx.

2. To optimize the detection of direct surface water influence, MPA samples are typically collected during both wet and dry periods. The purpose of collecting both wet-period and dry-period samples is to analyze water that is most likely to contain indicator organisms typical of surface water, if any exist, at times when conditions for transport to the potential GUDI source are optimal. ODW will require a minimum of two MPA tests to be conducted, one each during a wet and a dry period. Four MPA samples (collected one per calendar quarter and at least 60 days apart) is preferred.

3. MPA laboratory results must be reported in accordance with the above mentioned EPA consensus method. Application of this method results in relative risk factors (scores) that will be used to determine the degree of risk associated with influence by surface water. The following relative risk factors will be used to make the GUDI determination:

   • High risk – A lab-provided MPA risk calculation equal to or greater than 20
   • Moderate risk - A MPA risk calculation equal to or greater than 10 and equal to or less than 19
   • Low risk – A MPA risk calculation equal to or less than 9

   EPA Relative Risk Tables are shown in Appendix F.

4. If any single MPA sample result indicates a score greater than or equal to 20, the source is determined to be GUDI Step 3c.

5. If any two MPA sample results indicate scores equal to or greater than 15, the source is determined to be GUDI Step 3d.

6. If all MPA sample results indicate scores of equal to or less than 9, the source is determined to be a groundwater source (NOT GUDI) Step 3e. Note that raw water monitoring continues per WM 898. The District Engineer may increase the frequency of this monitoring or require additional monitoring parameters.

7. If the conditions stated in items 4, 5, and 6 do not apply, a decision on future action will have to be made. All of the available water quality data, geology, well construction, and any other relevant factors are to be reviewed and evaluated by the District Engineer. Proceed to one of the following actions with concurrence of the Field Director:

    - Consider the source to be "at risk" and continue to monitor. The District Engineer will establish the monitoring parameters and monitoring frequency.
    - Declare the source to be a groundwater source (NOT GUDI). Note that even with this action raw water monitoring continues per WM 898.

Use the GUDI Determination Review Sheets (Appendix E) to document the evaluation of the source and all monitoring data used. The Review Sheets proceed stepwise, following the procedure outlined above. Appendix F provides model letters for transmitting results of GUDI determinations to waterworks owners.

III. INTERIM ACTION REQUIREMENTS

Any waterworks with a source that has been determined to be GUDI must comply with the requirements of the Surface Water Treatment Rule and the *Waterworks Regulations* 12 VAC 5-590-420 B.2.f. by installing acceptable filtration and disinfection treatment within 18 months of the determination.

These requirements were developed and adopted prior to the LT2 Rule and do not take into account the possible occurrence of *Cryptosporidium* in GUDI sources. To address the public health concerns of *Cryptosporidium* in GUDI sources, a continuous boil water notice will be required for all waterworks using a GUDI source until filtration and disinfection treatment is installed and in operation.

During the interim period, until filtration and disinfection is installed and in operation, the waterworks owner shall:

A. Discontinue use of the GUDI source

B If the GUDI source must remain in service because discontinuing use of the source is not a viable option, the waterworks owner shall provide chlorine disinfection during the interim period before filtration is installed as follows:

    1. The total chlorine residual disinfectant concentration at the entry point to the distribution system shall not be less than 2.0 mg/L for more than four hours. Monitoring equipment must be installed that will ensure compliance with this requirement.

    2. The waterworks owner shall issue a boil water notice through the public notification procedure in 12 VAC 5-590-540 until such time as the required filtration and disinfection treatment is installed.

For waterworks that collect routine distribution system bacteriological samples at a monthly frequency, the waterworks shall collect twice the number of samples required for that population each month. For waterworks that collect routine bacteriological samples at a quarterly frequency, the waterworks shall increase the sampling frequency to monthly.

APPENDIX A - GUDI Review Sheets

GUDI Determination Review Sheet

Date: _____

Waterworks Name: _____

PWSID: _____

City / County: _____ Determined By: _____

Source Name: _____ Reviewed By: _____

STEP 1 of the evaluation procedure consists of reviewing the source history and location.

Step 1: Source History		**Yes / No**
a.	Has this source been directly associated with a biological waterborne disease outbreak?	
b.	Has this source been directly impacted by a chemical contamination incident from the surface?	
c.	Are there any demonstrated or known direct connections between this source to surface water via surface water bodies, sinkholes, troughs, drainage ways, or other geologic features?	
d.	Has a sanitary survey revealed or is there other evidence to indicate that surface water is directly entering this source?	

Step 1 Summary:

- If the answer to 1a, 1b, 1c, or 1d is **YES** – **STOP** – the source is GUDI.
- If the answers to 1a, 1b, 1c, or 1d are all **NO** proceed to Step 2

STEP 2 consists of evaluating the results of a minimum 20 sample series of raw water microbiological samples. Results must include both Total Coliform MPN's and *E. coli* MPN's.

Step 2: Total Coliform and *E coli* Sampling		**Yes / No**
a.	Is the geometric mean of the Total Coliform MPN series greater than 100 colonies per 100 ml ?	
b.	Do more than 10% of the samples indicate a Total Coliform density of greater than 100 colonies per 100 ml ?	
c.	Does the *E. coli* MPN series indicate an *E. coli* density of greater than 5 per 100 ml in more than 3 samples?	
d.	Does the *E. coli* MPN series show *E. coli* to be present in 5 or more samples?	

Step Two Summary:

- If the answer to Step 2a is **YES** – **STOP** – the source is GUDI
- If the answer to Step 2b is **YES** – **STOP** – the source is GUDI
- If the answer to Step 2a, 2b, 2c, and 2d is **NO - STOP** – the source is a groundwater source and is not GUDI.
- If the answer to Step 2c or 2d is **YES** proceed to Step 3e.

STEP 3 consists of evaluating the results of additional water quality monitoring conducted in accordance with an approved monitoring plan. The monitoring results must include Microscopic Particulate Analysis (MPA) results and may include physical parameters such as turbidity, water temperature, pH, conductivity, etc. A minimum of two MPA tests must be collected – one each during wet and dry conditions.

Step 3: Additional Water Quality Monitoring		**Yes / No**
a.	Do the physical parameter monitoring results indicate a direct correlation between groundwater source monitoring and a nearby surface water source monitoring in relation to rainfall or other climatological event?	
b.	Does the water temperature monitoring results of the groundwater source fluctuate by ± 15% in direct response to a rainfall or other climatological event?	
c.	Does any single sample MPA result indicate a score of equal to or greater than 20?	
d.	Do any two MPA sample results indicate a score of equal to or greater than 15?	
e.	Do all MPA sample results indicate a score of equal to or less than 9?	

Step 3 Summary:

- If the answer to Step 3a is **YES** - **STOP** – the source is GUDI
- If the answer to Step 3b is **YES** - **STOP** – the source is GUDI
- If the answer to Step 3c is **YES** - **STOP** – the source is GUDI
- If the answer to Step 3d is **YES** - **STOP** – the source is GUDI
- If the answer to Step 3e is **YES** – **STOP** - the source is a groundwater source and is not GUDI.
- If the answer to Step 3e is **NO,** the District Engineer must evaluate all of the water quality monitoring data, well construction, geology, and any other relevant factors. Proceed to one of the following actions with concurrence of the Field Director:

    1) Consider the source to be "at risk" and continue to monitor. The District Engineer will establish the monitoring parameters and monitoring frequency.
    2) Declare the source to be a groundwater source (NOT GUDI). Note that even with this action raw water monitoring continues.

CONCLUSION:

☐ Based upon the criteria established in STEP _____, question _____ this source is determined to be GUDI. Filtration and disinfection treatment must be installed within 18 months and the waterworks owner must initiate the interim requirements.

☐ Based upon the criteria established in STEP _____, question _____ this source is determined to be a groundwater source and is NOT GUDI.

- ☐ Disinfection treatment alone is sufficient. Raw water monitoring must continue.
- ☐ Disinfection treatment is not required.

☐ This source is determined to be "at risk" for surface water influence. Raw water monitoring must continue as directed by the District Engineer.

_____
District Engineer

_____
Field Director

Attach all relevant water quality results

Appendix B
GUDI Determination Flow Chart

Step 1

Is the source associated with a waterborne disease outbreak, catastrophic event, or surface water intrusion?

Y → GUDI

N ↓

Step 2

The following circumstances require raw water microbial monitoring, comprised of series of 20 Total coliform MPNs and 20 *E. coli* MPNs. Except for initial raw water sampling for well development, series usually consist of samples collected weekly, for at least 20 weeks.

- Well development sampling
- Sampling triggered by Ground Water Rule, when GWR sampling indicates confirmed *E. coli* in source water
- Routine source water monitoring, with results showing the presence of *E. coli* in more than one sample in six months.

Using results from the Total Coliform MPN series…
Is the Total Coliform geometric mean > 100 colonies per 100 ml? OR
Do more than 10% of samples Total Coliform samples show > 100 colonies per 100 ml?

Y → GUDI

N ↓

Using results from the *E. coli* MPN series…
Do 3 or more samples show an *E. coli* density > 5 *E. coli* per 100 ml? OR
Do 5 or more samples show *E. coli* to be present?

N → NOT GUDI

Source is Groundwater. DE may adjust frequency and timing of ongoing raw water monitoring.

Y ↓

Step 3

Waterworks must develop and submit a monitoring plan for ODW Approval. Plan must include MPA and other tests.

Does physical parameter monitoring show a direct correlation with nearby surface water in relation to rainfall or other climatological events OR
Does water temperature fluctuate by ± 15% following rainfall events? OR
Does a single MPA result show a relative risk factor ≥ 20? OR
Do two or more MPA results show a relative risk factor ≥ 15?

Y → GUDI

N ↓

Do all MPA results show a relative risk factor ≤ 9? AND
Does physical parameter monitoring show little or no correlation with nearby surface water in relation to rainfall or other climatological events?

Y → NOT GUDI

Source is Groundwater. Raw water MPN analysis continues. DE may adjust frequency and timing of ongoing raw water monitoring, or require additional parameters

N ↓

With Field Director concurrence, the source may be deemed to be **At Risk** of surface water influence or **NOT GUDI**.

For **At Risk** sources the District Engineer will establish parameters and frequency for continued monitoring (e.g., ongoing MPA and physical parameter monitoring).

For sources determined at this step to be **NOT GUDI**, periodic raw water MPN analysis continues. The DE may adjust the frequency and timing of ongoing raw water monitoring, or require additional parameters.

APPENDIX C – Model Letters

DATE

NOTICE OF VIOLATION

SUBJECT: *County / City*
Water – *Waterworks Name*
PWSID *Waterworks PWSID*

Waterworks Owner name
Address 1
Address 2
City, State, Zip

Dear *Administrative Contact*:

This notice is to inform you that our records and laboratory testing results indicate that *GUDI source name* is under the direct influence of surface water and, therefore, you may be in violation of the *U.S. EPA Surface Water Treatment Rule* and *§ 12 VAC 5-590-430 of the Virginia Waterworks Regulations*. Attached is a summary of the raw water sample results for *GUDI source name*. A water source is determined to be under the influence of surface water if *insert GUDI determination criteria*. Since *initial monitoring date*, there have been *Insert applicable monitoring results* sample results.

Accordingly, we request that you install filtration and disinfection treatment techniques within 18 months of this notice or by *letter date plus 18 months*, in accordance with *§ 12 VAC 5-590-420 of the Waterworks Regulations*. Additional options that you might wish to pursue are: permanent disconnection of the surface influenced source, development of new sources, or the connection to a regional waterworks.

During the interim period (effective upon receipt of this notice) but before resolution of this problem, we request that you initiate the attached interim requirements.

Please notify this office by *letter date plus 10 days* of your intentions with regard to discontinuing use of this GUDI source, or the installation of acceptable filtration and disinfection treatment. If you must continue use of this GUDI source we will coordinate the requirements and issuance of a Boil Water Notice with you. **If you dispute the Office's determination that your groundwater source is under the direct influence of surface water, you have the right to an informal fact finding proceeding (IFFP), pursuant to *VA Code § 2.2-4019*, to present evidence and argument to refute this conclusion. Please contact this Office within 30 days of the date of this letter if you wish us to schedule an IFFP.**

If you have any questions, please contact me at *phone number of Field Director* or *name of District Engineer* at *phone number of District Engineer.*

Sincerely,

Directors Name, P.E., Engineering Field Director
Field Office Name Field Office

cc *Local Health Department, ATTN – District Medical Director*
VDH - Richmond Central

INTERIM ACTION REQUIREMENTS

Under the Commonwealth of Virginia *Waterworks Regulations* 12 VAC 5-590-420 the following interim requirements must be followed by a waterworks owner utilizing unfiltered surface water sources or groundwater sources that have been determined to be under the direct influence of surface water (GUDI) during the period before filtration is installed:

The owner must discontinue use of the GUDI source name until such time as acceptable filtration and disinfection treatment is installed and is in operation, or

1. If the GUDI source must remain in service because discontinuing use of the source is not a viable option, the waterworks owner shall provide chlorine disinfection during the interim period before filtration is installed as follows:
    a. The total chlorine residual disinfectant concentration at the entry point to the distribution system shall not be less than 2.0 mg/L for more than four hours. Monitoring equipment must be installed that will ensure compliance with this requirement.
    b. The waterworks owner shall issue a boil water notice through the public notification procedure in 12 VAC 5-590-540 until such time as the required filtration and disinfection treatment is installed.
    c. For waterworks that collect routine distribution system bacteriological samples at a monthly frequency, the waterworks shall collect twice the number of samples required for that population each month. For waterworks that collect routine bacteriological samples at a quarterly frequency, the waterworks shall increase the sampling frequency to monthly.

SUBJECT: *County / City*
Water – *Waterworks Name*
PWSID *Waterworks PWSID*

Waterworks Owner name
Address 1
Address 2
City, State, Zip

Dear *Administrative Contact*:

This notice is to inform you that in accordance with the Commonwealth of Virginia *Waterworks Regulations* 12 VAC 5-590-430 the following determinations have been made with respect to the direct influence of surface water of the groundwater sources serving the *Waterworks Name* waterworks.

> ***Source name*** **has been determined to be a groundwater source and is NOT under the direct influence of surface water**.

Since the above referenced source has been determined to be a groundwater source, no further action on your part is required with respect to the filtration requirements of the USEPA Surface Water Treatment Rule or the *Waterworks Regulations*.

You must continue to conduct periodic raw water (prior to any treatment) monitoring of the *source name*. One sample is to be collected each *raw water monitoring frequency (year, quarter, month, week per WM 898)*.[1] All samples must be analyzed for Total Coliform and *E. coli* by an approved laboratory and by a test method that yields a most probable number (MPN) result. Depending upon the results of this raw water monitoring, a groundwater under the direct influence re-evaluation may be deemed necessary at some future date.

Please feel free to call me at *phone number of District Engineer* should you have any concerns or additional questions.

Sincerely,

District Engineer
Field Office Name Field Office

[1] Note that the District Engineer may establish different raw water monitoring parameters and monitoring frequencies.

SUBJECT: *County / City*
Water – *Waterworks Name*
PWSID *Waterworks PWSID*

Waterworks Owner name
Address 1
Address 2
City, State, Zip

Dear *Administrative Contact*:

The results of routine raw water bacteriological monitoring from the *source name* over the past *monitoring time frame* have indicated the presence of Total Coliform and / or *E. coli*. A summary of these monitoring results are attached. In accordance the *Waterworks Regulations* 12 VAC 5-590-360 we request that *waterworks name* begin a more aggressive raw water monitoring program to better assess the potential of surface water influence of your groundwater source*(s).*

The raw water monitoring program must include one sample per week (collected prior to any treatment) from the *source name*. All samples must be analyzed for Total Coliform and *E. coli* by an approved laboratory and by a test method that yields a most probable number (MPN) result. A minimum of 20 samples are required, however additional samples may be necessary. Please notify the *Field Office Name* Field Office if you wish to use the state laboratory (DCLS) for this monitoring so that sample container distribution and scheduling can be coordinated.

You are encouraged to take samples within 72 hours of a rainfall event.

Please feel free to call me at *phone number of District Engineer* should you have any concerns or additional questions.

Sincerely,

District Engineer
Field Office Name Field Office

APPENDIX D – Example Monitoring Plan

Water Quality Monitoring Plan for GUDI Determination

It is important to develop an appropriate, site-specific Water Quality Monitoring Plan. This plan, at a minimum, must include Microscopic Particulate Analysis (MPA) and may include additional parameters including turbidity, pH, temperature, and rainfall. Other parameters that may be considered for monitoring include dissolved oxygen, color, and conductivity. If the water source in question is located near a surface water source, the nearby surface water should be monitored for the same physical parameters as the groundwater source. Correlation data between the suspected GUDI source and the nearby surface water can be utilized to determine hydraulic connectivity.

Example Water Quality Parameter Monitoring: The following list includes parameters that may be included in the monitoring plan. Ideally, monitoring will last for one year to establish seasonal variations, but shorter periods may be allowed. Obviously, the monitoring period must include significant rainfall events.

Total Coliform and *E. coli*:
- Collect samples once per week.
- Collect samples from the raw water prior to any treatment.
- Use only laboratories State-certified to perform TC[1] and *E. coli* enumeration analysis[1].
- Report results as densities (MPN) rather than present or absent.

Temperature:
- Take measurements daily; minimum of 4 days per week.
- Monitor at the source being evaluated and the nearest surface water source (no more than 1,000 feet distant)
- An alcohol-filled thermometer or electric probe may be used.
- Use an instrument capable of reading ± 0.5° F increments.
- Use the same instrument for all readings.

Conductivity:
- Take measurements once per week minimum.
- Monitor the source being evaluated and the nearest surface water source (no more than 1,000 feet distant)
- Calibrate the instrument per manufacturer's recommendations, or submit to a State-certified laboratory.

Turbidity:
- Take measurements daily; minimum of 4 days per week.
- Monitor the source being evaluated and the nearest surface water source (no more than 1,000 feet distant)
- Use an instrument capable of reading 0.1 NTU increments.
- Standardize and calibrate instrument per manufacturer's recommendations.

[1] There is no explicit laboratory certification for MPNs. However, the statistical analyses used to calculate MPNs rely on Presence/Absence (PA) testing of the water, whether using Multiple Tube techniques on a series of dilutions, or ONPG-MUG techniques on a Quantitray array. In this sense, the lab reporting MPNs should be certified for the underlying PA methods used.

Specific Ions:
Any specific ions known to differ in concentration between the surface water and ground water. ODW will determine applicability of these analyses. Establish frequency, accuracy and calibration requirements on a case by case basis.

Rainfall:
- Identify source of rainfall gauging.
- May need to use more than one rainfall location if utilizing existing gauges not in close proximity to the groundwater source (i.e. compare rainfall data from two wastewater treatment plants, each located greater than 10 miles from the source)

Microscopic Particulate Analysis *(note that MPA testing is required):*
- A minimum of two MPA samples is required. Four samples collected one per quarter (and at least 60 days apart, is preferred.
- Collect samples during both dry periods and wet periods.
- Wet period sample shall be taken between 12-48 hours following a significant rainfall event.
- Collect samples from the source prior to any treatment.
- Sample shall be analyzed by an EPA certified lab per USEPA "Consensus Method for Determining Groundwater Under the Direct Influence of Surface Water Using Microscopic Particulate Analysis (MPA)"
- Lab shall submit results per the Consensus Method's risk rating protocol

APPENDIX E –GUDI Monitoring Plan Worksheet

Facsimile Only. Three-page worksheet available at
ODWShare\03-Memos\301-Active Working Memos\301.02 Forms Letters Manuals\WMxxx.

Water Quality Monitoring Plan Worksheet for GUDI Determination

Waterworks Name:	
PWSID:	
Sources being evaluated, and distance to nearest surface water source	
Date prepared:	
Prepared by:	

☐ Raw water MPN for Total Coliform and *E. coli*	
Frequency:	
Duration:	
Locations:	
Laboratory:	
Special instructions:	• Use only laboratories state-certified to perform Total Coliform and *E. coli* analysis • Report results as densities (Most Probable Number) rather than present /absent

☐ Temperature	
Frequency:	
Duration:	
Locations:	
Special instructions:	• An alcohol-filled thermometer or electric probe may be used. • Use an instrument capable of reading ± 0.5°F incre ments. • Use the same instrument for all readings.

☐ Conductivity	
Frequency:	
Duration:	
Locations:	
Special instructions:	• Calibrate the instrument per manufacturer's recommendations, or submit to a State-certified laboratory.

APPENDIX F – MPA Relative Risk Tables

EPA RELATIVE RISK TABLES

Table A. Numerical range of each bio-indicator based on numbers counted per 100 gallons filtered water*

Indicators of Surface Water*	Extremely Heavy	Heavy	Moderate	Rare	None Found
Giardia**	>30	16-30	6-15	1-5	0
Coccidia**	>30	16-30	6-15	1-5	0
Diatoms	>150	41-149	11-40	1-10	0
Other Algae	>300	96-299	21-95	1-20	0
Insects/Larvae	>100	31-99	16-30	1-15	0
Rotifers	>150	61-149	21-60	1-20	0
Plant Debris	>200	71-200	26-70	1-25	0

Table B. Relative surface water risk factors associated with scoring of bio-indicators present during MPA of subsurface water sources.

Particulates Indicative of Surface Water*	Extremely Heavy***	Heavy	Moderate	Rare	None Found
Giardia	40	30	25	20	0
Coccidia	35	30	25	20	0
Diatoms	16	13	11	6	0
Other Algae	14	12	9	4	0
Insects/Larvae	9	7	5	3	0
Rotifers	4	3	2	1	0
Plant Debris	3	2	1	0	0

Table C. Risk of Groundwater Contamination by Surface Water Influence

RISK OF GROUNDWATER CONTAMINATION

≥20****	High Risk
10-19	Moderate Risk
≤ 9	Low Risk

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* According to EPA "Guidance Manual for Compliance with the Filtration and Disinfection Requirements for Public Water Systems Using Surface Water Sources," March, 1991 ed.

** If *Giardia* cysts, *Cryptosporidium*, or other coccidia are found in any sample, irrespective of volume, score as above.

*** Refer to Table A for range of indicators counted per 100 gallons under 100X.

**** Refer to Table B for numerical relative risk factor.