



Environmental
Protection Agency

Division of Drinking and Ground Waters

**Guidance for Ground Water Rule Triggered Source
Water Monitoring (TSWM) Plans and Options for
Reducing Samples**

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I. PURPOSE:

The purpose of this document is to provide guidance to public water systems applying to reduce the number of triggered source water monitoring (TSWM) samples required under the ground water rule (Ohio Administrative Code or OAC rule 3745-81-42).

II. BACKGROUND:

Pursuant to 40 CFR 141.402 and OAC rule 3745-81-42, a public water system (PWS) using a ground water source that learns of a total coliform-positive routine sample collected under the total coliform rule and does not provide at least 4-log treatment of viruses before or at the first customer must comply with the ground water rule TSWM requirement.

III. GUIDANCE:

The attached guidance document is intended to serve as an outline for options for reducing the number of TSWM samples to be collected and will be used by Ohio EPA staff to evaluate the appropriate sampling plan for the PWS.

IV. HISTORY:

The Division of Drinking and Ground Waters first issued this document on December 2, 2010.

Guidance for Ground Water Rule Triggered Source Water Monitoring (TSWM) Plans and Options for Reducing Samples

The purpose of this document is to provide guidance to public water systems applying to reduce the number of triggered source water monitoring samples required under the ground water rule. This document specifically addresses the approaches used to determine how samples will be reduced, and outlines the requirements of a TSWM plan.

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Guidance for Ground Water Rule Triggered Source Water Monitoring (TSWM) Plans and Options for Reducing Samples

Introduction

Triggered Source Water Monitoring Requirements

Any ground water system that does not provide 4-log treatment of viruses before or at the first customer must comply with the ground water rule triggered source water monitoring requirement. In addition to systems using only ground water sources, this requirement applies to systems classified as surface water that supplement their surface water sources with ground water, except when the ground water undergoes surface water treatment.

The ground water rule requires sampling each source in use at the time the routine sample was collected within 24 hours of learning that a total coliform rule (TCR) routine distribution bacteria sample is total coliform-positive (TC+). If a public water system (PWS) does not record which wells are on line during TCR sampling, a TC+ from a routine TCR sample requires that all ground water wells be sampled.

Reducing the Number of Triggered Source Water Samples

This document outlines the options available to Ohio public water systems for reducing the number of triggered source water samples that need to be collected to meet the requirements of the ground water rule. The options include collecting representative samples and mapping the distribution system. These options for reducing the number of triggered source water monitoring samples may require the development of a Triggered Source Water Monitoring (TSWM) Plan.

Assessing these options for reducing samples and determining if a TSWM plan is needed requires an evaluation of two components of the PWS facilities: 1) the flow of water to the treatment plant/raw water entry point; and 2) the total distribution system.

- **Component 1 - Entry Point Triggered Source Water Monitoring Plan:** Representative samples allow PWSs with multiple ground water sources supplying an entry point to reduce the number of source water samples required under the ground water rule by collecting raw water samples that are representative of ground water sources. Depending on the complexity and variability of the source water wells, this may require the development of an Entry Point TSWM Plan.
- **Component 2 - Distribution Triggered Source Water Monitoring Plan:** For public water systems with multiple entry points, mapping the distribution system allows TCR sample locations to be associated with specific entry points. Therefore, triggered source water monitoring samples can be collected at the source water monitoring points supplying that entry point, not source water monitoring points supplying other entry points. This option requires the development of a Distribution TSWM Plan.

This document provides the logic and justification for these approaches and outlines the requirements of a TSWM Plan. The Appendix includes instructions for submitting triggered source water monitoring plans and application templates.

Component 1 - Entry Point Options to Reduce the Number of TSWM Samples

At a raw water entry point to a treatment plant, PWSs have three options of representative samples to reduce the number of triggered source water samples required. The purpose of the triggered source water sampling is to collect samples that represent the source water quality. Definitions of these options are provided in the bullets below with additional detail provided in the option headings.

- On line well samples (Option 1); are samples collected from all the individual wells that were in operation at the time of TCR routine sample collection.
- Composite samples (Option 2); are representative samples collected from a common line before the treatment plant from multiple wells in operation at the time the TCR positive routine sample was collected. The wells should draw water from the same hydrogeologic setting and be similar in construction, so it may take more than one composite sample to fully represent the source water.
- Select sample (Option 3); is a representative sample from a single well that is considered representative of multiple wells. The wells represented should all draw water from the same hydrogeologic setting and be similar in construction.

Option 1 – On Line Wells

Triggered source water samples may be reduced by recording what wells are on line. Consequently, a PWS will know what wells were contributing source water if a TCR sample detects total coliform. Triggered source water samples have to be collected at wells that were on line at the time of TCR sample collection, and not at all of the system's wells. Option 1 is the easiest way to reduce the number of required TSWM samples at an entry point.

Option 2 – Composite Samples

This option requires collecting a composite sample that is representative of the source water for the triggered source water monitoring. Figure 1, Composite Sample Flow Chart, identifies the circumstances in which a composite sample can be collected by a PWS. Systems with source water coming from a single aquifer from wells with similar construction can collect a single composite sample for each entry point as described in the Composite Sample – Simple Sources section.

If a PWS has ground water sources coming from multiple aquifers or has wells with different construction types, an Entry Point TSWM Plan is required to identify several composite samples that together are representative of the source water for triggered source water monitoring. This situation is described in the Composite Sample – Complex Sources section.

Composite Sample – Simple Sources: The Composite Sample Flow Chart (Figure 1) provides a series of questions to identify which PWSs can collect a composite sample for triggered source water monitoring. This flow chart applies to sources supplying a single entry point to the distribution system. It applies if a ground water system knows:

- their wells produce from the same aquifer;
- their wells have similar construction; and
- what wells were in operation (on line) when the TCR positive sample was collected.

If the system meets the conditions of the chart, they may collect a single composite sample. This type of sample is collected from a common line before the treatment plant with the same wells pumping as when the TCR positive routine sample was collected. A PWS that works through the Figure 1 flow chart to a composite sample box is considered accepted for collecting a composite sample and no triggered source water monitoring plan is required. Thus, in the case of a routine total coliform-positive sample, the system may take a source water sample at a common line before treatment with no further source water sampling required unless the source water sample is *E. coli* positive.

Composite Sample – Complex Sources: A PWS which fails to meet the three criteria listed above will be directed in the Figure 1 flow chart to either:

- sample all wells providing source water (on line) to the entry point at the time of the TC positive routine sample was collected; or
- provide an Entry Point TSWM Plan to Ohio EPA for acceptance to collect composite samples.

The rationale is that a PWS with more complex sources needs to evaluate the sensitivity of pathogen transport to each of the aquifers (if source water is produced from different screened intervals or multiple aquifers), and the influence of well construction on pathogen transport (if production wells have different construction; conventional or Ranney).

Entry Point Triggered Source Water Monitoring (TSWM) Plan

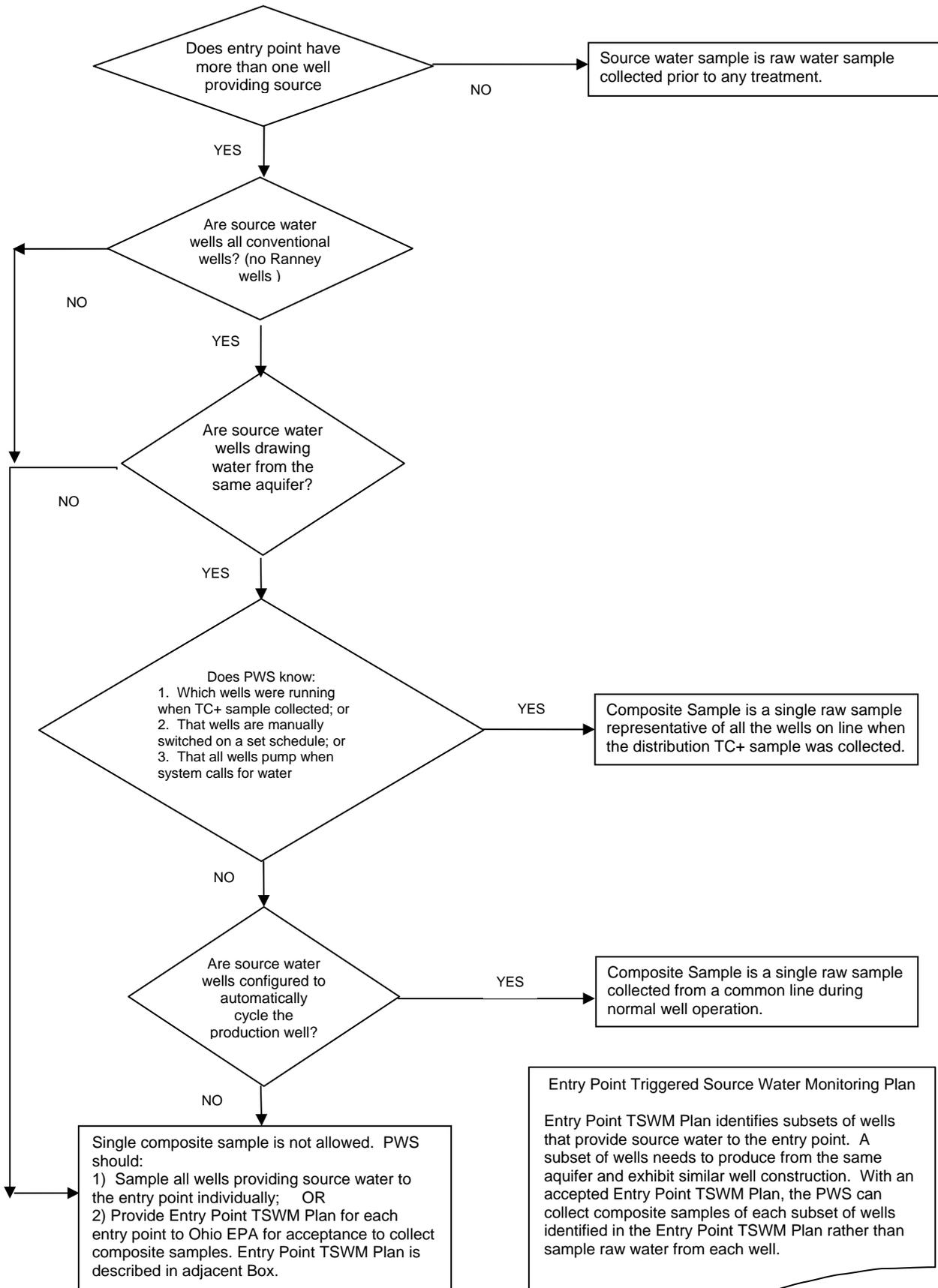
A PWS with complex sources should have their Entry Point TSWM Plan accepted by the state before the PWS implements the plan for collecting composite samples for the ground water rule.

The purpose of the Entry Point TSWM Plan is to break the PWS wells into subsets of wells producing from distinct aquifers with similar well construction to identify several composite samples that in total represent the source water. For systems with multiple sources, generally one aquifer setting or construction method will be more susceptible to pathogen contamination. The identified composite samples need to include all subsets of ground water sources and well construction types. Additionally, the plumbing geometry needs to provide common raw water lines for these subsets of wells to collect appropriate composite samples. The plan for a composite sample should include:

- a map of well locations identifying the aquifer association of each well;
- a list of well depths, casing length, screen depths and production aquifer for each well;
- the construction type and grouting method for each well;
- the group of wells that will be included in each aquifer and construction type subset; and
- the sampling point along a common line for each composite sample.

The Appendix includes a template for an Entry Point TSWM Plan for composite samples. The requirements for the composite sample are not as rigorous as those for the select sample because all ground water sources are fully represented in the group of composite samples identified for triggered source water sampling. The identified composite samples need to include all subsets of ground water sources and well construction types, and the raw water lines need to provide common lines for these subsets of wells to collect appropriate composite samples.

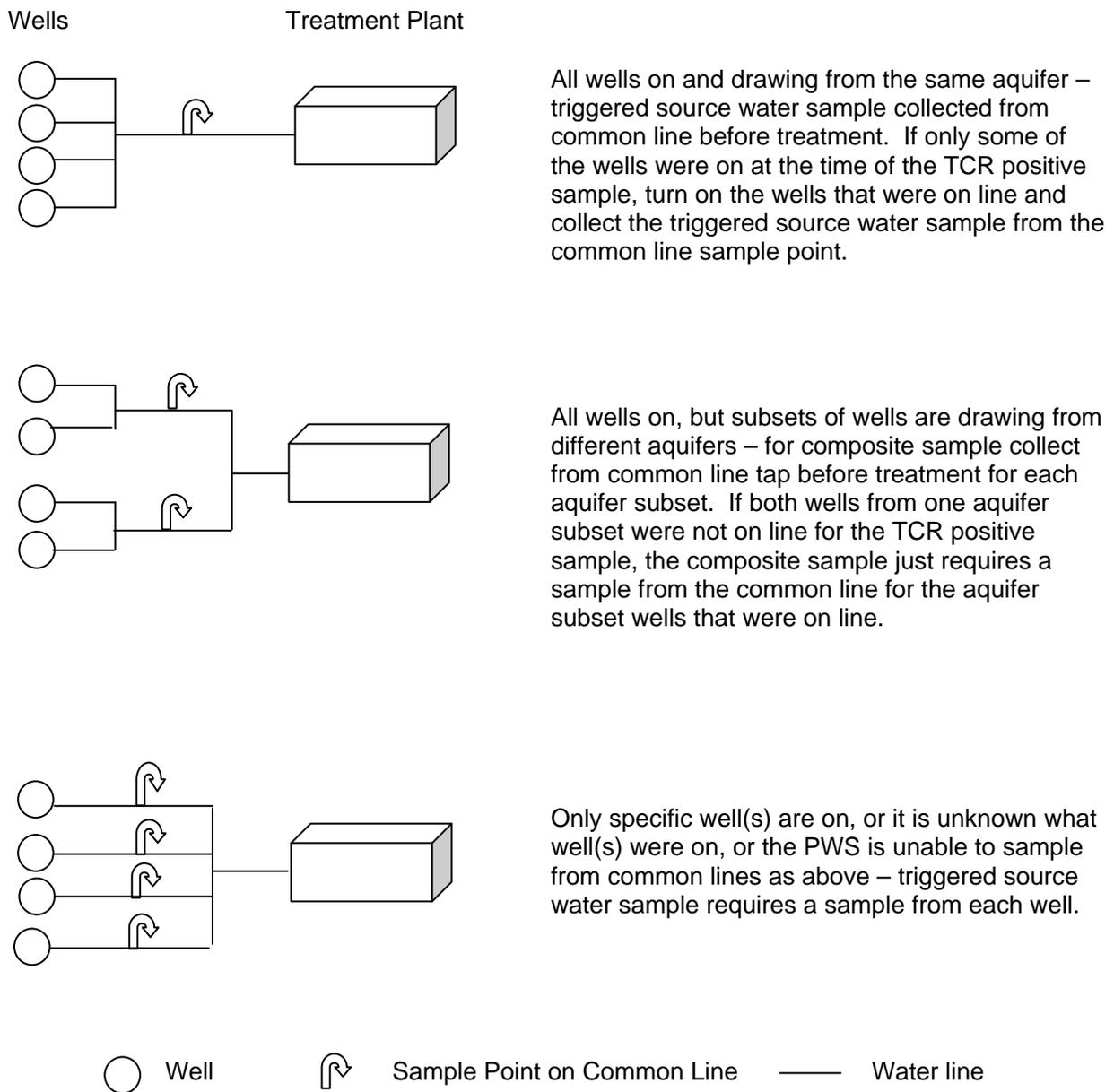
Figure 1. Composite Sample Flow Chart for Entry Point



Additional Considerations for Taking Composite Samples

The collection of composite samples requires that there are common raw water lines with sample taps where samples can be collected. The piping at every PWS is different so the local operator needs to determine if common line sampling taps are available for composite samples. To illustrate the issue, Figure 2 provides schematic diagrams of examples of pipe and sample point geometries that allow composite samples to be collected. The figure also shows one example that excludes collecting composite samples. Contact your local district inspector if you have questions about appropriate sample tap locations for composite samples.

Figure 2. Examples of common line sample tap locations for composite samples.



Option 3 – Select Samples

A select well sample representative of multiple wells may be considered where composite samples are not a viable option. The ground water rule allows a system to identify one or more ground water sources that are representative of each monitoring site in a system's sample siting plan. A single well can be sampled and considered representative of multiple wells that are located in similar hydrogeologic settings, have similar well construction characteristics, and are in good sanitary condition. With Ohio EPA acceptance, the PWS can use one or more wells out of this group as select sources for triggered source monitoring. The system should keep in mind that the proposed select sampling should be as protective of public health as sampling every source.

Note: When considering developing a select sampling option for an Entry Point TSWM Plan, the PWS should consult with Ohio EPA to discuss if select sample monitoring is applicable in principle for their situation, and if the level of effort to collect and document the required information will be worth the resources the system will save by reducing the number of required triggered source samples.

If a PWS intends to identify select sample sites, the PWS should characterize the geological and physical conditions of the wells in the representative group based on well locations, well construction, water chemistry, aquifer type, well field hydrogeology, and distribution of local pathogen sources. The PWS needs to provide significant documentation that the sampled well is representative and demonstrates similar vulnerability to pathogens as the unsampled sources in order to justify that sampling at a selected source is as protective as sampling every source, or as a composite sample of all sources. This documentation should include:

- contour map of well locations to denote proximity to other wells and local pathogen sources;
- well construction details for each well, including depth, casing length, grouting, sanitary seal, and screened interval;
- water chemistry results, such as total dissolved solids and nitrates, to demonstrate the chemical similarity of the ground water source; and
- aquifer information and other hydrogeologic studies that document the equivalent geologic setting and pathogen vulnerability of the represented group of wells. For example, this information may include wellhead protection or source water assessment studies; state, USGS, and other hydrogeologic investigations; hydrogeologic and geologic maps; capture zone models.

This documentation will be included as part of an Entry Point TSWM Plan. Analysis from a professional geologist or professional engineer may be submitted for review and is strongly recommended for complex geological settings and for water systems with complex raw water distribution lines or operation. It is expected that similar documentation as listed above will be included in the consultant report. The analysis should include a description of each source, summary of data evaluated, and a detailed discussion of the analytical tools and methods used to support the proposed candidates for select monitoring. PWSs with ground water sources in multiple aquifers and/or a variety of well construction types should have a representative sample for each aquifer and well construction type supplying the PWS, or design an Entry Point TSWM Plan that combines select and composite samples.

The system should also demonstrate that all of the wells under consideration are in good sanitary condition. Wells should be structurally sound and similar in design to one another to be included in a group that qualifies for a select sample. A well in poor sanitary condition cannot

be excluded from triggered source monitoring because it could be a source of fecal contamination. For that reason, in addition to the justification based on hydrogeologic evidence, an Entry Point TSWM Plan for select sample monitoring should include documentation that all sources included in a subset of wells represented by a select sample meet the well standards specified under Ohio Administrative Code rule 3745-9-08.

No template is provided for the select sample option due to the complex nature of the documentation required for identifying select sample locations and the fact that composite samples are considered the safer option for reducing the number of triggered source water samples. Contact your district representative to discuss the required documentation to be submitted in an Entry Point TSWM Plan for the select sample option. State acceptance should be granted before a PWS can begin select sample monitoring under the ground water rule.

Component 2 - Distribution Options to Reduce the Number of Triggered Source Water Samples

For PWSs with multiple entry points, associating areas of the distribution system to each entry point supplying the source water allows a reduction in the number of ground water rule triggered source water samples required. This mapping allows the location of a TCR positive sample to be associated with a single entry point so the triggered source water monitoring samples can be collected for the entry point providing the source water instead of for all the entry points. This guidance describes approaches to help map the distribution system, outlines the requirements for a Distribution Triggered Source Water Monitoring (TSWM) Plan, and provides a template for this plan in the Appendix to this document. The mapping may identify mixed zones between areas of the distribution system supplied by multiple entry points. A total coliform-positive routine sample collected in one of these mixed source areas will require triggered source water samples be collected for all entry points contributing source water to the mixed zone.

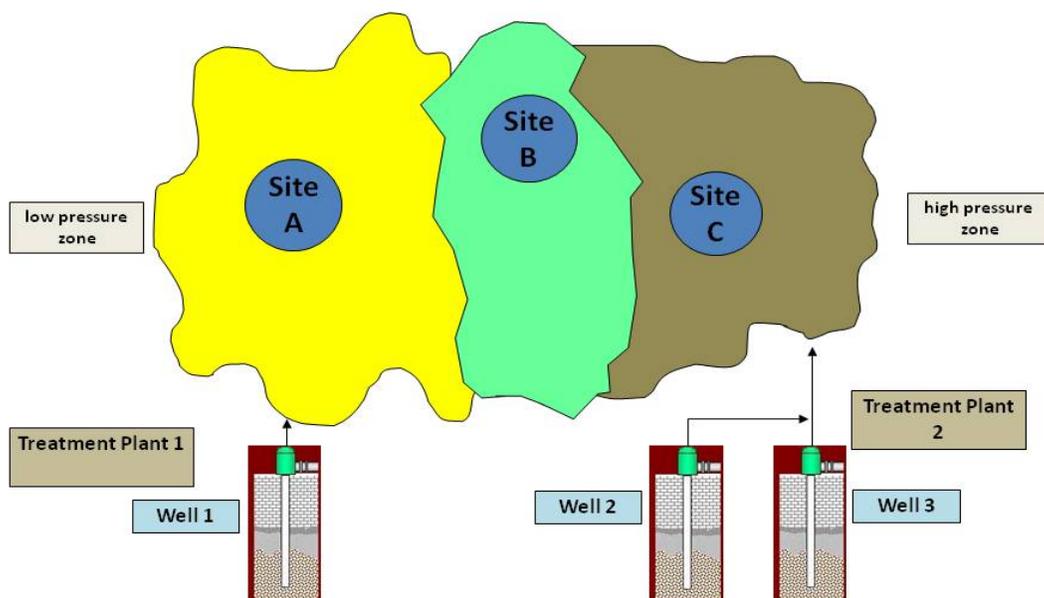
It is possible that varying flow from different entry points makes mapping the distribution of source water in the distribution system difficult and unreliable. Under these circumstances a PWS could decide not to map the distribution system, however, the system can still consider evaluating the options for reducing the number of triggered source water samples collected for each entry point. In this case, with no distribution TSWM Plan, any TCR positive routine sample would require triggered source water samples be collected for all entry points, but the number of these samples for each entry point may be reduced by collecting composite samples. If the ground water sources for an entry point are simple sources, composite samples may be collected without an Entry Point TSWM Plan based on the Composite Sample Flow Chart for Entry Point (Figure 1).

Distribution Triggered Source Water Monitoring Plans

Distribution TSWM Plans are only required for PWS with multiple entry points to the distribution system and if the PWS wants to avoid collecting triggered source water monitoring samples for all entry points in response to a routine total coliform-positive sample result. For PWSs with multiple entry points, areas of the distribution system need to be identified with the entry point that is supplying the source water. Identification is necessary so the distribution TCR samples with total coliform can be associated with the appropriate source water for triggered source water sampling. For example, in Figure 3, Site A's source is from Treatment Plant 1, and Site C's source comes from Treatment Plant 2. Site B's source water it is difficult to determine. *Without a Distribution TSWM Plan*, a total coliform-positive in a routine distribution sample at Site A will result in the collection of triggered source water monitoring samples at all three wells.

However, with an accepted distribution TSWM plan, a total coliform-positive at Site A only requires a triggered source water monitoring sample from Well 1. A routine total coliform-positive sample result collected at Site B (a mixed zone) will require triggered source water monitoring samples be collected from both well fields. Mapping the distribution system is also complicated by surface water and/or purchased water sources. If a PWS has only one entry point, the TSWM Plan does not need to address the association of the entry point and distribution since the entire distribution systems is served by source water from one entry point.

Figure 3. Areas of the distribution system with treatment plants and source water.



If a PWS can identify sources that do not contribute to a TCR sampling site, those sources may be excluded from ground water source locations for triggered source water monitoring. A system wanting to demonstrate to Ohio EPA that certain sources are hydraulically isolated from parts of the distribution system can use the following information:

- Operation records: Historical operations records such as tank levels versus pumping data and interviews with system operators to provide insight to delineation patterns in the distribution system.
- Hydraulic models: Some utilities have hydraulic models to identify flow paths in their distribution systems or to meet requirements of the Stage 2 Disinfectants and Disinfection Byproducts (D/DBP) Rule. These models may be utilized to confirm which entry point sources contribute to a routine total coliform sampling site.
- Tracer studies: A tracer study may aid in better understanding the paths, destinations, and water age in the distribution system. It is possible to investigate each source individually by adding a tracer at the wellhead and measuring how it diminishes in the distribution system.

Appendix

Submitting a Triggered Source Water Monitoring Plan

For PWSs with complex ground water sources providing source water to an entry point or for PWSs with multiple entry points, the development and acceptance of a Triggered Source Water Monitoring (TSWM) Plan is required to reduce the number of triggered source water samples required after a routine total coliform-positive sample is reported. Plans should be submitted to the Ohio EPA, DDAGW district inspector for review. Plans will be reviewed within 90 days and the PWS will be notified of the results.

A complete TSWM Plan identifies which ground sources should be sampled in response to a total coliform-positive sample at any given TCR site. **A TSWM Plan must be accepted by Ohio EPA prior to the PWS implementing the plan to reduce the number of triggered source water samples collected in response to a routine total coliform-positive sample in the distribution system.**

All TSWM Plan includes an information section (Section A – General Information) that identifies basic characteristics of the PWS and which components of the plan are included in it.

Depending on the system's sources and distribution system geometry, the plan may include Entry Point TSWM Plans (Appendix - Component 1) and Distribution TSWM Plans (Appendix - Component 2). If a PWS has only one entry point then the plan does not need to include a Distribution TSWM Plan (Component 2). If all of the PWS sources for an entry point are simple sources as described in the guidance (Component 1, Option 2 – Composite Sample – Simple Sources) then an Entry Point TSWM Plan is not required. **A TSWM Plan may include the following elements:**

- **Section A** - General Information and outline of TSWM Plan (included in all TSWMP)
- **Component 1** – Entry Point TSWM Plan
This section identifies the triggered source water sample locations for composite samples. The TSWM Plan will have an Entry Point TSWM Plan for each entry point with complex sources. If a PWS has only one entry point, then the plan will include Section A and Component 1 only. The TSWM Plan for composite samples needs to include the documentation and justification listed in the earlier sections of this guidance, including:
 1. A map of the wells and sample locations for composite samples;
 2. A schematic diagram of the common lines to illustrate that the composite samples have common lines for the identified subsets of wells for aquifers and construction types; and sample taps are present at identified composite sample points.
- **Component 2** – Distribution TSWM Plan
This section maps or associates areas of the distribution system and TCR sample locations to specific entry points which provide the source water and is only included if the PWS has more than one entry point to the distribution system. Component 2 – Distribution TSWM Plan includes:
 1. A map or schematic of the system with entry points, sources, and TCR sampling locations identified.
 2. The source type and level of treatment provided for each source/entry point and whether it is seasonal, emergency, ground water, surface water, a wholesale supply, etc.
 3. The sources/entry point serving each total coliform routine monitoring location and the basis for the determination (e.g., system hydraulics, operation, water

quality data, etc.) or a distribution map identifying the areas of the distribution system each ground water source supplies.

4. For wholesale systems, the consecutive systems served, and if applicable, the sources serving each consecutive system.
5. Documentation of changes in pumping that will influence the relative input to entry points which may influence the Distribution TSWM plan, such as the use of seasonal sources, rotating sources, etc.

The templates in this Appendix (Section A – General Information, Component 1 –Entry Point TSWM Plan, and Component 2 – Distribution TSWM Plan) are provided to facilitate the completion of TSWM Plans. The completed plan, including map attachments should be sent to the appropriate Ohio EPA, DDAGW district inspector and it will be reviewed within 90 days of receipt. The PWS will be notified of the results of the review. **Triggered source water sampling based on a submitted TSWM Plan is not allowed until after this plan has been accepted by Ohio EPA.**

**Appendix - Section A
TSWM Plan Application General Information Section**

Section A – General Information - This section is required for all Triggered Source Water Monitoring Plans submitted to Ohio EPA for review.

PWS Name _____

PWS ID _____ PWS Type (circle) COM NTNC TNC

PWS Address _____

Contact _____

Contact phone number _____ E-mail _____

Ohio EPA Inspector _____

A1. Number of active wells serving your PWS _____

A2. Number of treatment plants/entry points to the distribution system _____

Are you submitting a Distribution TSWM Plan for review (Section C)?
(circle) YES NO

Fill out the Entry Point Table – one row for each entry point (add rows if necessary).

Entry Point Table

Entry Point Name	STU ID	Source Water (GW, SW, PGW, PSW)*	Simple or Complex Sources**	Number of Wells	Entry Point TSWM Plan included for review? (YES or NO)

* GW = Ground Water; SW = Surface Water; P = Purchased, record all that apply.** Simple or complex sources as described in the composite samples section (Component 1, Option 2) of guidance.

I certify under penalty of law that I have personally completed the information required in this form and the data used is true, accurate and complete; and I am aware that falsification thereof could result in the imposition of fines and penalties.

Signature of Responsible Person

Date

Printed Name and Title of Responsible Person

Phone Number

(Subset 2) _____
Name _____

Wells included: _____

_____ Name _____

Wells included: _____

B5. Are sample taps available on common lines so that a composite sample of each of the identified subsets of wells can be collected? (circle) YES NO

If no, how are you planning to collect a composite sample for the subset of wells? _____

B6. Are sample taps installed on each of the wells?

If no, when are you planning to install samples taps on these wells? _____

B7. Complete the **Wells Table**. In the Wells Table, group the wells in the subsets described above and provide all the requested information. Enlarge the table as needed. Include copies of the ODNR Well Logs listed in the Wells Table or other well logs produced by the driller.

B8. Are you confident that collecting a composite sample for each of the subset of wells identified in this entry point TSWM plan provides a representative sample of the pathogens in the source water supplied to treatment plant/entry point? ** (circle) YES NO

Print Name: _____ Title: _____

Signature: _____ Date: _____

** In the event of collecting a composite triggered source water monitoring sample for this entry point, only the wells that were on line when the positive TCR sample was collected would be on line for collecting the composite sample.

Well Information Table – List wells in each subset and provide information

Well Number	Date Drilled	* Well Type	Drilling Method	Grouting Method	Pump Rate	Well Depth	Casing Length	Screen Length	Screen Depth Range	Static Water Depth	ODNR Well Log #	Aquifer Type	Bedrock Depth
Subset 1													
Subset 2													

* Indicate if well is conventional construction (C) or Ranney Well construction (R).

**Appendix – Component 2
Distribution TSWM Plan Application**

Section C - Distribution Triggered Source Water Monitoring Plan Application

This Distribution TSWM Plan should be completed by every PWS that has multiple entry points and wants to reduce the number of required ground water rule triggered source water monitoring samples by mapping the distribution system and associating TCR sample locations with specific entry points. If a PWS distribution has only one entry point, a Distribution TSWM Plan is not needed.

Name of PWS _____ PWS ID _____

C1. How many entry points supply water to your distribution system? _____

C2. How many of the entry points are supplied by ground water sources? _____

Distribution System Table

Entry Point Name	STU ID	Source Water (GW, SW, PGW, PSW)*	Flow into System (GPD or MGPD)**	Range of Flow into System **	Number of TCR Samples Associated with Entry Point (per month)

* GW = Ground Water; SW = Surface Water; P = Purchased; record all that apply.

** Gallons Per Day, Million Gallons Per Day or define other units

C3. Provide a **Distribution System Map** which includes entry point locations and TCR sample locations. This map needs to identify and provide locations of all:

- Entry points and source water type;
- Valves and piping;
- TCR sample locations;
- Areas of contribution for each entry point;
- Mixed zones in the distribution system (contribution from multiple entry points); and
- Physical barriers to mixing water from multiple Entry Points.

All items on the distribution system map should be clearly labeled and consistent with the Distribution System Table.

C4. What tools have been used to map the distribution of source water in the distribution system and how were they utilized?

C5. Are there any valves or other physical boundaries that prevent mixing of water from different entry points? (circle) YES NO

C5a. Describe the boundaries below and identify the location of these features on the Distribution System Map.

C6. Are there any seasonal sources that are used as source water? If so describe.

C7. The Distribution System Table lists the flow and range of flow into the distribution system for each entry point. Does the relative flow from one entry point change significantly compared to the other entry points through the year, which could influence the entry point distribution boundaries drawn on the Distribution System Map? (circle) YES NO

C7a. If yes, what adjustments have you made to the areas of contribution for each entry point on the Distribution System Map to accommodate the changes in entry point flow?

C8. Are you confident that the Distribution System Map provided with this Distribution TSWM Plan application represents an accurate delineation of the areas of entry point contributions to the distribution system? (circle) YES NO

Print Name: _____ Title: _____

Signature: _____ Date: _____