New England
Water Works Association
A Section of the
American Water Works Association

Pocket Sampling Guide for Operators of Small Water Systems

This Pocket Sampling Guide was revised with funding received under U.S. EPA Assistance Agreement No. X98116501-3.

New England
Water Works Association

American Water Works Association

Pocket Sampling Guide for Operators of Small Water Systems

New England Water Works Association
125 Hopping Brook Road
Holliston, MA 01746-1471
June, 2004

Acknowledgments

This pocket sampling guide was originally developed by the U.S. Environmental Protection Agency (EPA), Office of Ground Water and Drinking Water (OGWDW), Cincinnati Ohio in 1992(EPA/814-B-92-001, April 1992) and was modified in 1994 (EPA/814-B-94-001, July 1994). The Technical Support Division (TSD) of OGWDW developed the text and provided overall project management. This revised version of the sampling guide was developed under Assistance Agreement No. X98116501-3 awarded to the New England Water Works Association (NEWWA) by the U.S. Environmental Protection Agency. The Agency reviewed this document, and made comments and suggestions on the document intended to improve the scientific analysis and technical accuracy of the statements contained in the document. NEWWA accommodated EPA's comments and suggestions. However, the views expressed in this document are those of NEWWA. EPA does not endorse any products or commercial services mentioned in this publication. The contributions of Chuck Larson, Paul Riendeau, and Ted Kenney of NEWWA, Arthur Clark, Ellie Kwong, Kevin Reilly and Linda Tsang of US EPA Region I are gratefully acknowledged. In addition we appreciate the input and suggestions made by our outside reviewers, Michele Eisenstein, EDM Laboratories and Consulting Services, Morrisville, VT; Dan Laprade, Massachusetts Department of Environmental Protection, Drinking Water Program, Springfield, MA; Matt Day, Pennichuck Water Works, Nashua, NH; Anita Evenson, Charles Feldmann, R. Kent Sorrell, and Cory Wagner from the Technical Support Center, Office of Ground Water and Drinking Water, U.S. EPA, Cincinnati, OH, and drinking water staff from the states of New Hampshire and Maine. Their contribution to the Guide is also gratefully acknowledged.

IMPORTANT NOTICE

The methods and instructions in this Guide reflect the U.S. Environmental Protection Agency regulations and guidance, in addition to other reference documents. It is recognized that there can be significant differences from state to state regarding waivers, public notification, monitoring methods, laboratory sampling and handling procedures, etc. Please check with your state drinking water representative with any questions before compliance sampling is begun.

Contents

Introduction

(Please Note: All bold terms are defined in the Glossary in the Appendix.)

This guide is intended to help operators of small water systems, those community water systems serving less than 3,300 people, understand and comply with the monitoring requirements of the Amendments to the Safe Drinking Water Act (**SDWA**) passed by Congress in 1986 and in 1996.

How to Use This Guide

The main body of the Pocket Sampling Guide is divided into eight main units, which summarize the regulations and sampling procedures for each type of sample. The table below illustrates the guide's "dual tab" reference capability, which allows the user to access information by either regulation or type of sample.

Main Units/Tabs of the Pocket Sampling Guide

Regulation Tab	**Type of Sample Tab**
Total Coliform Rule (TCR)	BacT Sample[1] (Microbiological Sample)
Inorganic Chemicals (IOC)	IOC Sample[1] (Inorganic Chemical Sample)
Nitrates/Nitrites	Nitrate, Nitrite Sample[1]
Volatile Organic Compounds (VOC)	VOC Sample[2] (Volatile Organic Compound Sample)
Synthetic Organic Compounds (SOC)	SOC Sample[2] (Synthetic Organic Compound Sample)
Long Term 1 Enhanced Surface Water Treatment Rule (LT1)	Turbidity Sample[3]
Lead and Copper Rule (LCR)	LCR Sample[4] (first draw metals)
Radionuclides (RAD)	Radionuclides Sample[5] (Rad)

[1] Sample containers may have preservatives in them, but there is no concern about head space or air in the container once the sample is taken. In fact, a limited amount of headspace is desirable.

[2] Sample containers may have preservatives already added when you receive them. Consult with the laboratory for additional information and precautions. These samples should have no head space, or air, in the sample container once the sample is collected.

[3] Turbidity sample containers will have no preservative in them. Conditioning the container is recommended.

[4] Container will have no preservative. Do not condition the container because it will contain a first draw sample.

[5] Container has no preservatives, no conditioning of the container is required, and the sample tap at the entry point must be flushed.

Each unit of the Pocket Sampling Guide is structured using the following informational format.

Summary

A summary of the rule, including an introduction to the contaminant(s) of concern and a brief status and description of the regulation, is provided.

Maximum Contaminant Level (MCL)

Enforceable standard that specifies how much of a contaminant can be present in drinking water.

Monitoring Requirements

A brief description of the monitoring requirements for the rule. Information contained here may vary, but includes dates the requirements take effect, number and type of samples required, sampling location, compliance schedule, and some analytical requirements. The section also includes tables and figures to help determine specific sampling needs.

Sampling Procedures

This section contains detailed information about sampling equipment and procedures, and opens with a brief description of sample containers. The pages that follow describe step-by-step procedures for proper sampling. In some units photographs illustrate correct sampling techniques using proper equipment.

Note: The U.S. EPA Safe Drinking Water Hotline (1-800-426-4791) is available for assistance in understanding drinking water regulations and programs developed by EPA. The hotline is available M - F, 9:00 a.m. – 5:30 p.m., Eastern Time. The hotline can also be contacted through EPA's website shown below. ***As current regulations are revised, they will be posted on the U.S. EPA Website*** (http://www.epa.gov/safewater).

Important Sampling Advisory
Please Note

It is the responsibility of the operators of small water systems to understand and utilize proper sampling procedures specific to each type of sample taken. Operators uncertain of specific sampling procedures should contact a state drinking water representative or a certified drinking water laboratory for guidance and detailed information. It is important that operators taking samples obtain proper sample containers from a certified drinking water laboratory since certain samples require the use of specific containers and/or specific preservatives. **Make sure all questions are answered before conducting any sampling.**

General Sampling Considerations

Although sampling techniques and monitoring requirements vary under each of the rules in this guide, there are some general rules that are applicable to most sampling procedures.

1. Assemble Equipment

An EPA or state certified drinking water laboratory will add preservatives to sample containers before shipping them to small water systems. Coolers or insulated packing boxes for shipping may be provided by the laboratory for the operator's convenience.

2. Ensure Representative Sampling

The result of any laboratory analysis is only as good as the sample collected. The objective is to obtain a sample that "represents" the true character of the water being tested. To achieve this, a sample should be collected at a specific location using consistent methods. This sample also must receive proper handling (preservation, transport, storage, etc.) after it has been collected, so its composition will not be altered before it is analyzed.

3. Collect the Sample

Samples must be collected at the proper frequency , at the appropriate time and location, and in the proper volume in order to satisfy the requirements of specific regulations. Samples that fulfill these criteria are called **compliance monitoring samples**. Requirements are spelled out in the regulations, and are briefly summarized in this Pocket Sampling Guide.

4. Fill out Chain-of-Custody Reports

Some states require that "chain-of custody" procedures be followed for compliance monitoring samples. The typical chain-of-custody form establishes the whereabouts of, and persons responsible for, the sample at any point in time. A portion of a typical chain-of-custody form is shown in Figure 1. Use waterproof ink to fill out the form as soon as the sample is collected. Write legibly and note any special considerations that could suggest contamination.

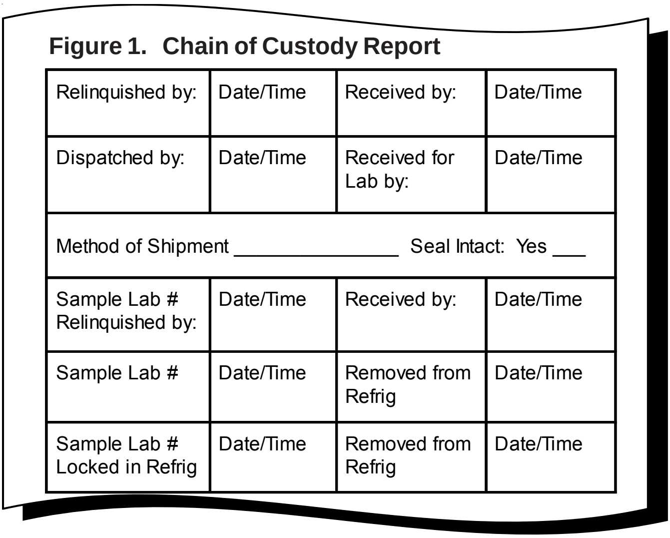


Figure 1. Chain of Custody Report

Relinquished by:	Date/Time	Received by:	Date/Time
Dispatched by:	Date/Time	Received for Lab by:	Date/Time
Method of Shipment _______________		Seal Intact: Yes ___	
Sample Lab # Relinquished by:	Date/Time	Received by:	Date/Time
Sample Lab #	Date/Time	Removed from Refrig	Date/Time
Sample Lab # Locked in Refrig	Date/Time	Removed from Refrig	Date/Time

5. Pack and Transport the Samples

During shipping, samples must be protected from breakage and must be maintained at a constant temperature that is neither too hot nor too cold. If the samples must be refrigerated, cool them with sufficient pre-frozen chemical cold packs (blue ice) to about 4C (39° F). It is also important to keep the samples from freezing. If samples requiring refrigeration are collected within driving distance of the laboratory, a picnic cooler may be used as a carrying case.

6. Holding Times

Generally, samples must be transported to the laboratory either the same day they were taken or shipped by overnight courier. Each type of sample has a different holding time. The holding time is the total elapsed time from the time at which the sample is collected until the analysis of the samples begins. Exceeding the holding time can result in rejection of the sample for analysis by the certified drinking water laboratory or the state drinking water program.

7. Be Aware of Public Notification Requirements (PNR)

(May 4, 2000; 65 FR 25981; applies to public water systems beginning May 16, 2002—see EPA website: www.epa.gov.safewater/pn.html)

If a public water system becomes aware, based on sampling results, that it has exceeded an MCL or otherwise violated requirements for compliance with a rule, it must inform the public as soon as possible. There are three types of tiered violations.

Tier 1 violations require immediate notice within 24 hours. These represent violations and situations with significant potential to have serious adverse effects on human health as a result of short-term exposure.

Tier 2 violations require notice as soon as possible, but within 30 days. These are violations and situations with potential to have serious, but not immediate, adverse effects on human health. Notice extensions of up to three months for resolved violations may be granted at the discretion of the state drinking water program.

Tier 3 requires annual notice. These are all other violations and situations not included in Tier 1 and Tier 2 and may be part of a single annual report, including in some cases the annual Consumer Confidence Report (CCR) already required by EPA.

Examples of the different notification procedures for community water systems are presented in Table 2-1. Table 2-2 presents the ten required elements of every public notice.

Table 2-1. Public Notice Delivery Requirement Examples

Tier 1	Tier 2	Tier 3
Failure to test for E. *coli* after repeat sample tests positive for TC	Bacteria MCL violation	Failure to monitor quarterly following an Atrazine MCL violation
■ Broadcast media, post, hand deliver 24 hours	■ Mail, print media, e-mail, etc. 30 days	■ Print media, Consumer Confidence Report 1 year

Table 2-2. Ten Required Elements of Every Public Notice

1.	Description.
2.	Time event occurred.
3.	Potential adverse health effects.
4.	Population at risk.
5.	Whether alternate supplies should be used.
6.	Actions consumers should take.
7.	Corrective actions.
8.	When system expects to return to compliance.
9.	Contact name, number, address.
10.	Standard regulatory language.

In addition, if a large percentage of the service population does not speak English, the notice must be written in the appropriate language(s) as well as in English. For more detailed information on public notification requirements, see *Public Notification Handbook* (EPA, 816-R-00-010, Office of Water, U.S. EPA, June 2000, or contact your state drinking water program.

TOTAL COLIFORM RULE (TCR)

Summary

The Total Coliform Rule (TCR) became effective December 31, 1990 for maximum microbiological contaminant levels. The TCR is based on the *presence* or *absence* (P/A) of coliforms rather than on the *number* of coliforms detected in the samples. The rule requires that coliform *positive* samples be further tested for **fecal coliform** (or ***E. Coli***) and that a set of repeat samples be collected for each total coliform positive sample. Furthermore, if coliforms are detected, most systems will be required to collect additional routine samples the following month. Each system must have an approved written sampling plan that lists the frequencies and locations of samples to be collected. This plan may be reviewed and revised by the regulatory agency

Status:	Final Rule-June 29, 1989 (54 **FR** 27544) Modifications - January 8, 1991 (56 FR 636); January 15, 1991 (56 FR 1556); January 15, 1992 (57 FR 1850); June 10, 1992 (57 FR 24744); December 5, 1994 (59 FR 62456); and December 1, 1999 (64 FR 67449).
MCL:	For small systems, only one (1) sample per month may be positive for total coliform. If a system exceeds this MCL (two or more positive samples), it must notify the public. (See Public Notification Requirements, pages 5-6.)

Monitoring Requirements

Check with your state drinking water program for state guidelines.

General

This rule applies to all public water systems**(PWSs)**.

Effective Date: December 31, 1990

Number of Samples

The number of samples within the distribution system that must be taken monthly is based on the population served by the water system. Table 3-1 shows *minimum* monthly monitoring requirements. Many systems routinely sample more than the minimum to keep track of the system's status.

Table 3-1. Monitoring Frequency for Routine Sampling

Population Served	Minimum Routine Samples/Month
25 - 1,000	1
1,001 - 2,500	2
2,501 - 3,300	3

States may specify a sampling frequency of less than once per month for selected systems (for example, NCWSs using ground water and serving less than 1000 persons). Contact your state drinking water program for details.

States may also require more than the minimum number of samples required by the rule based on system specific information.

For each routine sample that is total coliform positive, a system must collect a *set* of **repeat samples** and have it analyzed for total coliforms. If total coliforms are detected in any routine or repeat sample, the system must collect *five* routine samples the next month. Table 3-2 shows the required frequency for repeat sampling.

Table 3-2. Monitoring and Repeat Sampling Frequency after a Total Coliform-Positive Routine Sample

Number of Routine Samples Per Month	Number of Repeat Samples	Number of Routine Samples the Following Month
1*	4	5
2	3	5
3	3	5

*Or quarterly

Each set of repeat samples must include the following:

- One sample at the same tap as the original sample.
- One sample within 5 service connections upstream.
- One sample within 5 service connections downstream.

If an additional repeat sample is required, it should be taken within five service connections either upstream or downstream of the original sample. Figure 3-1 illustrates repeat sampling after a positive total coliform result.

All repeat samples must be collected within 24 hours of notification of the total coliform positive result, unless the state waives this requirement.

If a system has only one service connection for repeat samples, it can collect:

- One 100 mL sample on each of 4 separate days.
- Two 200 mL samples on 2 separate days.
- One 400 mL sample on 1 day.

Refer to the complete total coliform rule sampling requirements for details and exceptions at 40 CFR 141.21(b)(3).

Variances and Exemptions

Utilities that meet a state's approved stringent criteria may receive a variance. (See Rule Modification of January 15, 1991 [56 FR 1556]). No exemptions are allowed.

Sanitary Surveys

Periodic sanitary surveys are required for all systems collecting fewer than five samples per month.

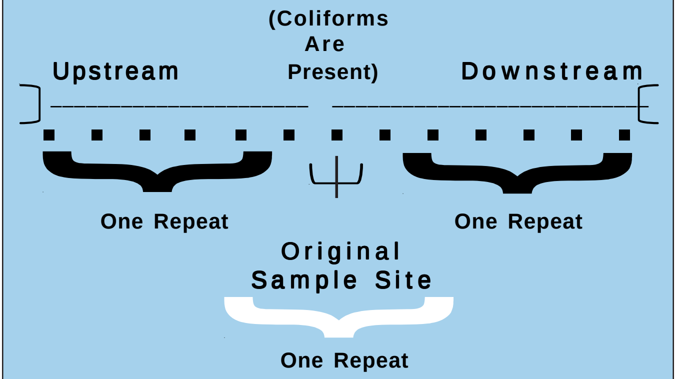
Analytical Methods

Analytical methods that may be used for total coliform analysis can be found in 40 CFR 141.21(f). Regardless of the analytical method the analysis must use a 100 mL standard sample volume.

Sampling Locations

Record the approved original and repeat sampling sites. Use some code to keep track of the sites. Figure 3-1 is only one way to conduct repeat sampling. Your state may have different requirements for identifying sampling sites.

Figure 3-1. Repeat Samples



- One must be at same site as the routine sample.
- One must be within 5 service connections upstream.
- One must be within 5 service connections downstream.
- If a fourth repeat sample is required, the system should take the sample wherever it feels it will help identify the area of contamination.

Sampling

Sample Containers

Although different sizes and types of sampling containers may be used for collecting coliform samples, most laboratories supply 125 mL sterilized, plastic bottles. Some laboratories will wrap the bottles in paper to protect them from contamination. Glass-stoppered bottles sometimes have foil covering the top for protection.A few laboratories may furnish single-service, sterilized bottles. Do not sample with any bottles that appear to have been tampered with.

Typical sampling containers and equipment used for coliform sampling

Procedure

The laboratory that supplies the sampling containers normally provides instructions with the kit for the type of monitoring being done. Refer to those instructions when provided.

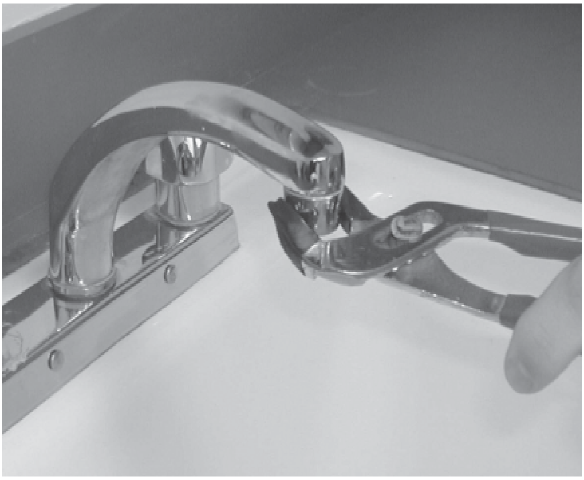
The following instructions and photos illustrate the general sampling procedures for collecting coliform and *E. coli* samples.

1. Assemble all of the sampling supplies before beginning. The proper preservatives will be added to the sampling containers by the laboratory before you receive them. A dechlorinating agent is used when sampling chlorinated waters (such as those found in the distribution system). Handle the containers

carefully as they are sterilized. Do not rinse out or dispose of any liquids, powders or tablets inside the containers. This material is the preservative.

2. Go to the sampling location(s) specified in the sampling plan. Each representative sampling location is usually located in the distribution system and is accessible during the day Examples include hospitals, city buildings, pump stations, restaurants, and dedicated sampling stations. The tap should be clean, free of attachments (hoses, etc.), and in good repair (no leaks). If possible, avoid single lever, mixing valve faucets and drinking fountains.

3. If possible, remove any aerator, strainer, or hose that is present, as any of these may harbor bacteria.

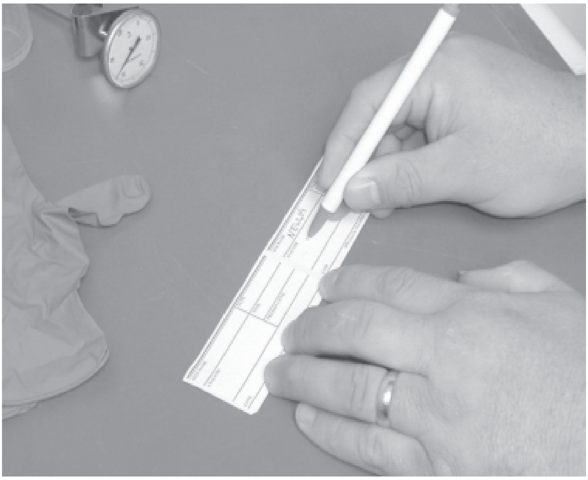


Removing aerator from faucet before starting to sample

4. Optional Step: Spray tap with chlorine solution or wipe it with alcohol. (This step is optional since many people believe this practice does not kill attached bacteria and is not necessary if the sampling tap is selected carefully.)

5. Turn on the cold water tap and run the water until the water temperature has stabilized as determined by a thermometer. This typically takes 4-5 minutes. Then reduce the flow so that the stream is no greater than ¼ inch in diameter. Check for steady flow.

While the water is running fill out the labels, tags, and laboratory forms in waterproof ink and apply the labels to the containers. Do not change the water flow once the sampling has started as that could dislodge microbial growth.



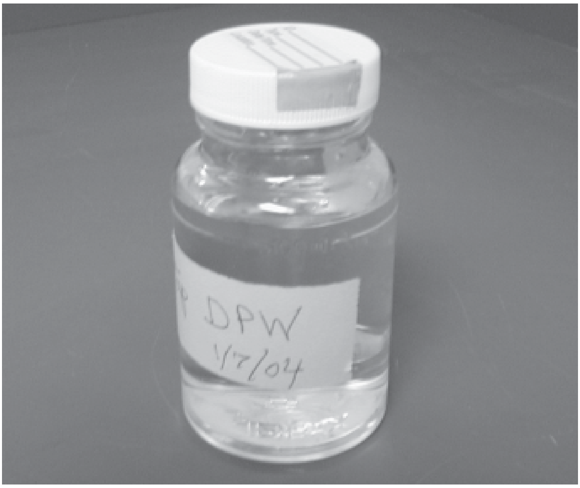
Filling out the label

Adjusting the water to about a 1/4 inch diameter flow

6. Remove the bottle cap. Be careful not to contaminate the sample by touching the inside of the cap or the inside of the sample container with your fingers. Then position the bottle under the water flow. Hold the bottle in one hand and the cap in the other. **Do not lay the cap down or put it in your pocket!**

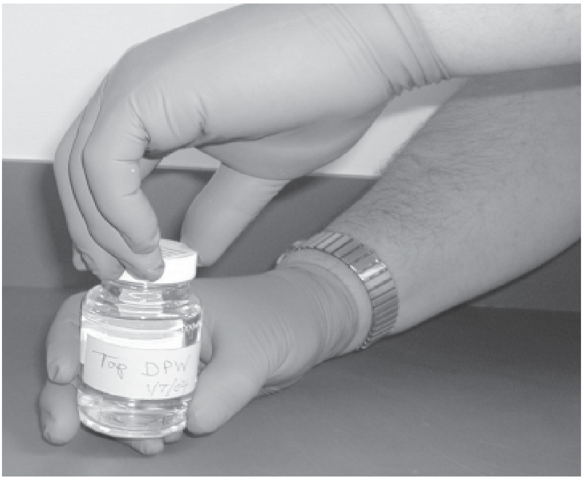
Holding the bottle under the water flow with cap in other hand

7. Fill the bottle to the shoulder or to about ¼ inch from the top. Many bottles have a 100 mL fill line.



Bottle filled to the shoulder

8. Place the cap on the bottle and close it tightly. Samples should be cooled immediately

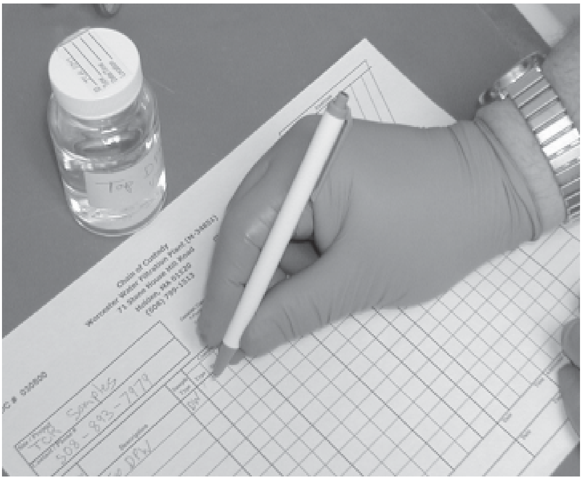


Tightening the cap on plastic bottle

9. Turn the tap off. Replace the aerator, strainer, or hose.

10. Check that the information on the label is correct (or check the laboratory form and attach it to the bottle with a rubber band).

11. Complete any additional laboratory forms that came with the sample bottle, including chain-of-custody form (if required by the state).



Filling out the chain-of-custody form

The samples must reach the laboratory and the analysis must begin within 30 hours of collection. It is recommended that all samples be refrigerated or cooled to 4 ° to 10 °C (39 ° to 50 °F). If the laboratory is nearby, refrigerate with freezer packs, and deliver the samples there directly. If not, send the samples overnight by U.S. mail or by an overnight courier.

INORGANIC CHEMICALS (IOCs)

Summary

The inorganic chemicals discussed in this section were first regulated with MCLs in the National Interim Primary Drinking Water Regulations on December 24, 1975 (40 FR 59566). Contaminated sources of these regulated metals (barium, cadmium, chromium, and mercury) and the non-metal selenium are natural mineral deposits and industrial activities such as metal finishing, textile manufacturing and painting. Cadmium, chromium, and selenium can cause damage to the kidneys, liver, and nervous and circulatory systems of humans. Mercury has been shown to damage the kidneys of laboratory animals. In addition to these chemicals antimony, beryllium, cyanide, nickel and thallium were added to the list in later legislation. These latter inorganic chemicals can come from natural sources, industrial activities such as mining operations, electroplating, or steel processing, and the manufacture of fertilizer products, glass, and alloys. These inorganic contaminants have been shown to damage the brain, lungs, kidneys, heart, and intestines of laboratory animals. Cyanide can fatally damage the spleen, brain, and liver of humans. Most of these inorganics can be removed from drinking water by various processes including activated alumina, coagulation/filtration, reverse osmosis, ion exchange, and lime softening. Other treatment processes include Granular Activated Carbon (GAC), electrodialysis, and chlorine oxidation.

Status

Promulgation Dates	***Effective Dates***
January 30, 1991 (56 FR 3526)	July 30, 1992
July 1, 1991 (56 FR 30266)	January 1, 1993
July 17, 1992 (57 FR 31838)	January 17, 1994 (MCLs)

MCLs

The MCLs for the 13 IOCs are shown in Table 4-1. If a system exceeds any of the IOC MCLs it must notify the public (See Public Notification Requirements, pages 5-6).

Table 4-1. MCLs for Inorganic Contaminants (IOCs)

MCLs	EPA Standards (mg/L)	
Contaminant	**MCL**	**Trigger Level***
Antimony	0.006	0.006
Arsenic	0.010	0.010
Asbestos	7 million fibers per liter longer than 10 mm)	
Barium	2	2
Beryllium	0.004	0.004
Cadmium	0.005	0.005
Chromium	0.1	0.1
Cyanide	0.2	0.2
Fluoride	4.0	4.0
Mercury	0.002	0.002
Nickel	0.1	0.1
Selenium	0.05	0.05
Thallium	0.002	0.002

* For the IOCs the trigger levels for increased monitoring are the same as the MCL.

Trigger Level Requirements

If detected contaminants exceed the trigger levels at any time in either initial or repeat sampling, the system must conduct quarterly sampling until the state determines that the system is reliably and consistently below the MCL. Any reduction in quarterly sampling occurs only at the discretion of the state drinking water program.

Systems Affected

CWSs and non-transient non-community water systems **(NTNCWSs)**.

Sampling Plan and Schedule

The Standardized Monitoring Framework shows the schedule of initial monitoring and repeat sampling for surface and ground water systems (Table 4-2).

Table 4-2. IOC Standardized Monitoring Framework

		Second Cycle									Third Cycle								
		1st Period			2nd Period			3rd Period			1st Period			2nd Period			3rd Period		
		2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
IOCs[1]	**Groundwater (Below MCL)**																		
	No Waiver	1			1			1			1			1			1		
	Waiver[2]	1									1								
	Surface Water (Below MCL)																		
	No Waiver	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Waiver[2]	1									1								
	Groundwater and Surface Water (Above MCL [3])																		
	> MCL or Not Reliably and Consistently ≤ MCL	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	Reliably and consistently ≤ MCL or Groundwater Systems	S 1			1			1			1			1			1		
	Reliably and Consistently ≤ MCL or Surface Water Systems	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Legend
1 = 1 sample at each entry point to distribution system (EPTDS).
4 = 4 quarterly samples, one sample per quarter, at each EPTDS within time frame designated by the state drinking water program.

[1] Until January 22, 2006 the maximum contaminant level (MCL) for arsenic is 50 ug/L; on January 23, 2006 the MCL for arsenic becomes 10 ug/L.

[2] Based on 3 rounds of monitoring at each EPTDS with all analytical results below the MCL. Waivers are not permitted under the current arsenic requirements, however systems are eligible for arsenic waivers after January 23, 2006.

[3] A system with a sampling point result above the MCL must collect quarterly samples, at that sampling point, until the system is reliably and consistently below the MCL.

Trigger Level for Increased Monitoring

MCL values for single samples are used as trigger levels.

Regular Sampling and Repeat Sampling Requirements

1. Because systems have been monitoring for IOCs since 1993, initial sampling requirements are not included here. Surface water systems must continue taking one sample every 3-year period at each sampling point. Once a system has three samples below the MCL the system may apply for a waiver for the next 9-year cycle or for the remainder of the current 9-year cycle (Figure 4-2).

2. Surface water systems must take one sample every year at each sampling point and ground water systems must take one sample every 3-year period at each sampling point, unless the system has received a waiver.

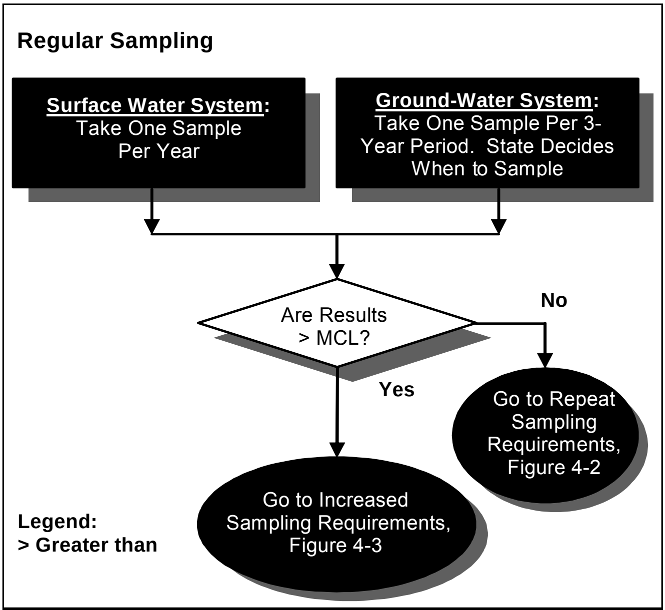
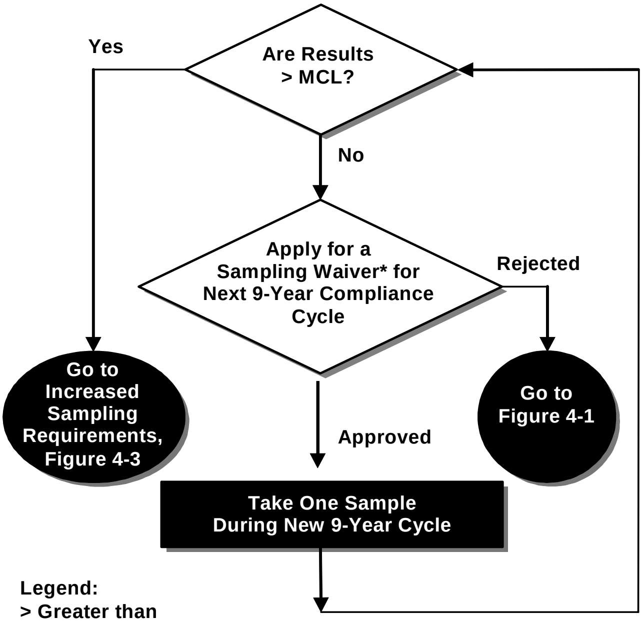


Figure 4-1. **Inorganics Initial Sampling Requirements**



Legend:
> Greater than

*System must have a minimum of 3 rounds of sampling data before applying for a waiver.

Figure 4-2. Inorganics Repeat Sampling Requirements

Increased Sampling

A system must begin quarterly monitoring immediately if at any time the contaminant concentrations exceed the MCLs (Figure 4-3). Systems must take a minimum of two samples for a ground water source, and a minimum of four samples for a surface water source to establish a baseline, before the state may reduce the monitoring frequency

Reduction in monitoring frequency from quarterly sampling can only occur at the discretion of the state drinking water program.

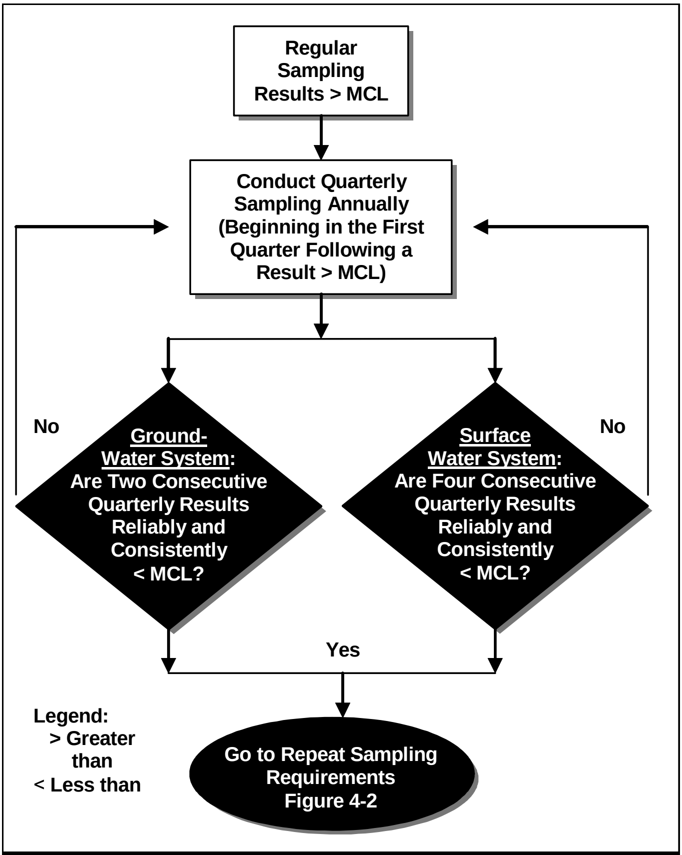


Figure 4-3. Inorganics Increased Sampling Requirements

Confirmation Sample

If the state requires a confirmation sample, the system must take one at the original sampling point within 2 weeks of taking the initial sample. States have the right to request a confirmation sample for any positive or negative result.

Compositing

Compositing of up to five samples is allowed at state discretion. Contact your state drinking water program to determine if this is allowed.

Waivers

Systems may qualify for a waiver for one or more inorganics. In order to qualify for a waiver , a system must have a minimum of three previous samples from a source with all analytical results below the MCL.

Sampling

Sampling Containers

Pre-cleaned glass or plastic bottles are used. The size of the container may vary. Follow the laboratory's instructions.

Procedures

The general procedure for sampling regulated IOCs is below:

1. Take one sample at each **entry point** to the distribution system (EPTDS) as approved by the state.
2. Remove any attachment from the tap.
3. Turn on the cold water tap and run the water until the temperature has stabilized as determined by a thermometer. This typically takes 4-5 minutes. Then reduce the flow so that the stream is no greater than ¼ inch in diameter.
4. While the water is running, fill out the label with the required information and apply to sample container while it is still dry.

If the laboratory has any additional recommendations or requirements, they should be followed.

There are three different IOC groups that need to be considered while sampling.

The **<u>first group is comprised of inorganic non-metals.</u>** This group includes alkalinity, bromate, chloride, color, conductivity, fluoride, odor, orthophosphate, silica, total dissolved solids, and sulfate. Follow the laboratory's instructions regarding the volume of sample to collect. One container may provide water for the analysis of several parameters. Fill the container to its shoulder, leaving room for shaking.

The **second group is inorganic metals**. The containers used may have an acid added as a preservative.

Caution-Hazard: Containers may contain liquid acid which is toxic and may cause burns. If any preservative contacts the skin or eyes, flush with liberal amounts of water until the EMTs arrive.

Important safety precautions. Safety glasses must be worn. Wash hands before and after sampling. The use of clean nitrile gloves is strongly recommended.

Containers up to one liter may be used. Usually, a separate container is provided for mercury The laboratory may add nitric acid to the empty containers before providing them.

Hold bottle at an angle pointing away from your face and carefully fill it to its shoulder. If acid has been added to the bottle, it will mix rapidly with the water and may spatter a bit. Leave room in the container for gentle shaking to mix.

The **third "group" is cyanide**. For cyanide one liter brown glass or plastic containers are used. The laboratory should NOT add a preservative to them.

Note: If the laboratory has not provided ascorbic acid (a powder) and a separate bottle containing sodium hydroxide preservative, do **NOT** collect the cyanide samples and contact the laboratory for further instructions. Cyanide samples must be dechlorinated and preserved with sodium hydroxide at the time of collection as discussed below

1. Fill the bottle to its shoulder leaving room for adding preservatives and for shaking.

2. Add 0.1 gram of powered ascorbic acid. Cap the bottle and shake to dissolve the ascorbic acid. Check a small portion of the sample with a chlorine field test kit to determine if any chlorine is present. If chlorine is still present, repeat this step.

3. Open the sample container and add 10 drops of sodium hydroxide to the sample. Cap the bottle and shake briefly to disperse the sodium hydroxide. Open the bottle, pour a few drops of the sample into the bottle cap and check the pH with pH paper. If the pH is not 12 or greater, repeat this step.

All of the three groups should complete the following steps.

1. Screw the cap on the container.

2. Complete the forms supplied by the testing laboratory with the requested information.

3. Pack the samples in a cooler with freezer packs.

4. Deliver the samples to the laboratory or ship the samples by an overnight courier

NITRATE (NO_3-) AND NITRITE (NO_2-)

Summary

On January 30, 1991, MCLs for nitrate and nitrite were promulgated by EPA. The existence of these chemicals in drinking water is generally due to natural deposits, agricultural activity, and sewage. Nitrate can cause methemoglobinemia, known as “blue baby syndrome.” The **best available technologies** (**BATs**) to remove these contaminants are ion exchange and reverse osmosis.

Status

Promulgation Date	***Effective Date***
January 30, 1991 (56 FR 3526)	July 30, 1992

MCLs

MCLs for nitrate, nitrite, and total nitrate/nitrite are shown in Table 5-1. If a system exceeds either of these MCLs it must notify the public (see Public Notification Requirements on pages 5-6).

Some states may have more stringent monitoring requirements than others. Check with your state drinking water representative for exact requirements.

Table 5-1. Regulations for Nitrate and Nitrite

Contaminants	EPA standard (mg/L)*	
	MCL	Trigger Level
Nitrate (NO_3-)	10	5**
Nitrite (NO_2-)	1	0.5
Total Nitrate/Nitrite	10	5

* As Nitrogen. ** Not applicable to TNCWSs.

Monitoring Requirements

All public water systems **(PWSs)** must take samples for nitrate and nitrite.

Sampling Plan and Schedule

Nitrate and Nitrite have different sampling requirements. Table 5-2 illustrates the Standardized Monitoring Framework for nitrate and nitrite. Community water systems, NTNCWs, and TNCWSs follow a similar schedule for nitrite sampling. Community water systems, NTNCWSs, and TNCWSs follow different sampling schedules (as shown in Table 5-2) for nitrate sampling.

Table 5-2. Nitrate/Nitrite Standardized Monitoring Framework

		Second Cycle									Third Cycle								
		1st Period			2nd Period			3rd Period			1st Period			2nd Period			3rd Period		
		2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Nitrate	**CWSs & NTNCWSs**																		
	≥ 1/2 MCL	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	Groundwater Reliably and Consistently < MCL*	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Surface Water with 4 Quarters of Results < 1/2 MCL*	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	TNCWSs																		
	Standard Monitoring	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Nitrite	**CWSs, NTNCWSs and TNCWSs**	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
	< 1/2 MCL	Systems must monitor at a frequency specified by the State.																	
	≥ 1/2 MCL or not Reliably and Consistently < MCL	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	Reliably and Consistently < MCL*	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

* Samples must be taken during the quarter which previously resulted in the highest analytical result.

Legend
1 = 1 sample at each entry point to distribution system (EPTDS).
4 = 4 quarterly samples, one sample per quarter, at each EPTDS within time frame designated by the state drinking water program.

Sample Location

At the entry point to the distribution system after any treatment.

Trigger Level for Increased Monitoring

The trigger level for increased monitoring is fifty percent of the MCL as shown in Table 5-1 (not applicable to TNCWSs for nitrate monitoring).

Since nitrate and nitrite have different sampling schedules and requirements, the requirements for each chemical will be covered separately.

Nitrite

Sampling Requirements

When the nitrite result is less than one half the MCL (trigger level) then the system is required to take at least one sample at each sampling point during the 9-year compliance cycle. The state decides in which year the system takes the sample during the 9-year cycle.

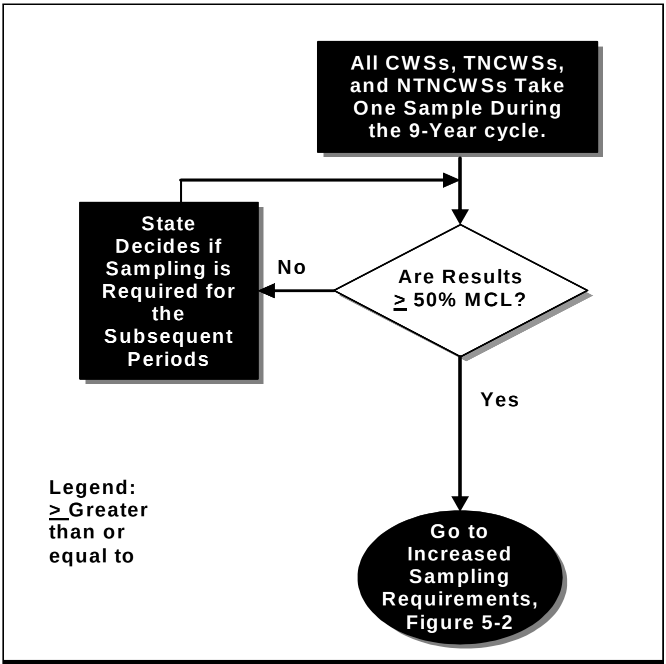


Figure 5-1. Nitrite Sampling Requirements

Increased Sampling Requirements

If any system equals or exceeds the trigger level (greater than or equal to one half the MCL) for nitrite at any time, the system must conduct quarterly sampling beginning in the next quarter. The state may allow a system to reduce the quarterly sampling to annual sampling provided four quarterly results are **reliably and consistently** below the MCL (Figure 5-2).

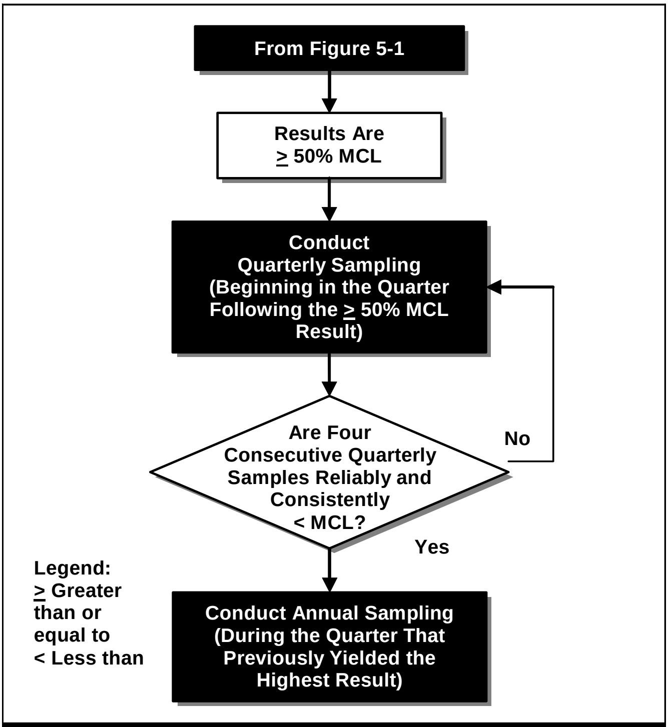


Figure 5-2. **Nitrite Increased Sampling Requirements**

Nitrate

Sampling Requirements

Community water systems, NTNCWSs, and TNCWSs have different sampling requirements.

Case 1. Transient Non-Community Water Systems (TNCWS) Standard Monitoring

Transient non-community water systems (NCWSs) must conduct annual sampling each year of the 9-year cycle, without exception at each entry point to the distribution system.

Case 2. Community Water Systems and Non-Transient Non-Community Water Systems (CWS and NTNCWS)

- Annual sampling is required for ground water CWSs and NTNCWSs.
- Quarterly sampling is required for surface water CWSs and NTNCWSs.

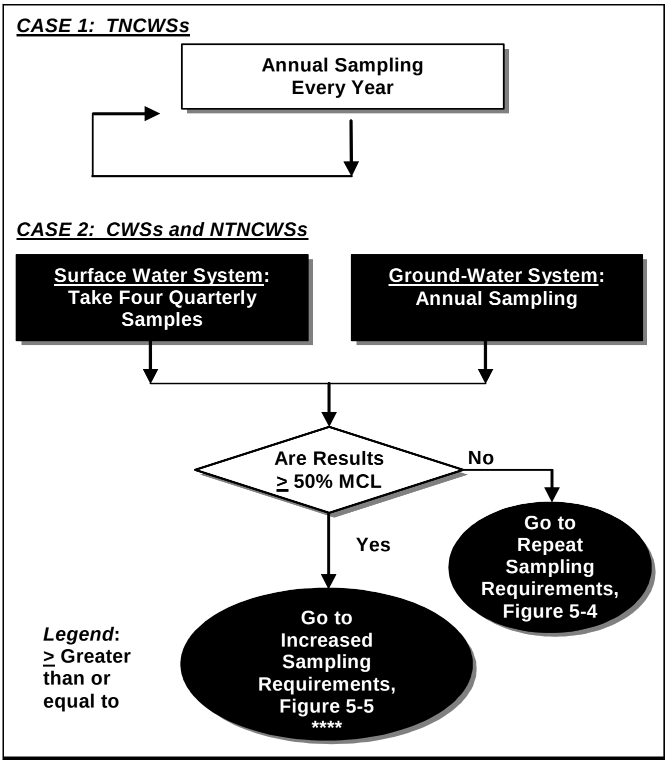


Figure 5-3. Nitrate Reduced Sampling Requirements

Reduced Sampling Requirements for CWSs and NTNCWSs (Figure 5-3; Case 2)

If the average of the quarterly sampling is less than 50% of the MCL, the sampling requirement can be reduced to annually at the discretion of the state.

Repeat Sampling Requirements for CWSs and NTNCWSs (Figure 5-4)

Community water systems and NTNCWSs must conduct annual sampling during the quarter that previously yielded the highest results.

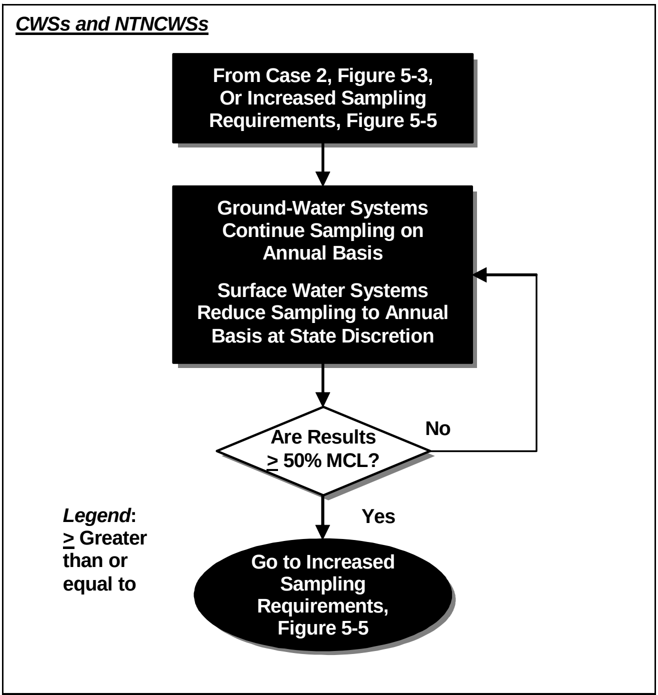


Figure 5-4. **Nitrate Repeat Sampling Requirements**

Increased Sampling Requirements for CWSs and NTNCWSs (Figure 5-5)

If any result from sampling for a CWS or a NTNCWS is greater or equal to 50% of the MCL, the system must meet increased sampling requirements. The state may allow a system to reduce the quarterly sampling to annual sampling provided four quarterly results are reliably and consistently below the MCL.

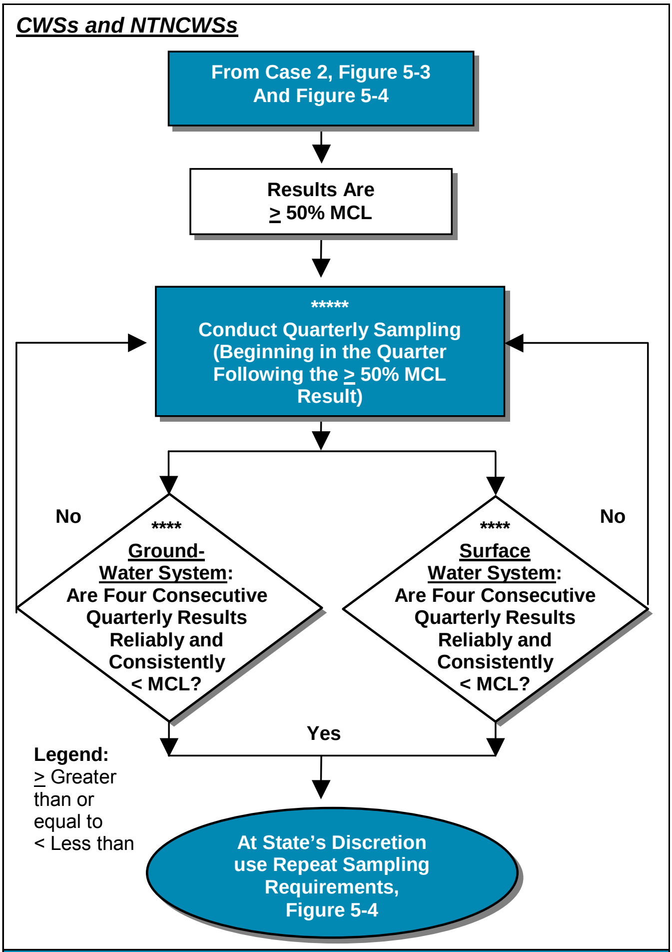
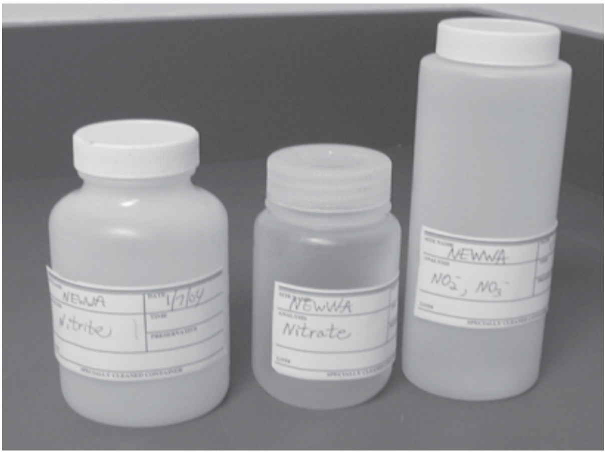


Figure 5-5. Nitrate Increased Sampling Requirements

Sampling

Sampling Containers

Samples may be collected for nitrate, nitrite and/or nitrate-plus-nitrite. The laboratory generally will supply containers for sampling. Check with the laboratory to see if any preservatives need to be added. The required volume is 500 mL or less as determined by the laboratory, and the laboratory may require only one container for both parameters. The container may be made of glass or plastic.



Typical nitrite and nitrate sampling containers

Procedures

The general sampling procedures for nitrate and nitrite monitoring are below.

Important safety precautions. Safety glasses <u>must</u> be worn. Wash hands before and after sampling. The use of <u>clean</u> nitrile gloves is recommended.

1. One sample at each entry point to the distribution system as approved by the state.

2. Remove any attachment(s) from the tap.

3. Turn on the cold water tap and run the water until the temperature has stabilized as determined by a thermometer. This typically takes 4-5 minutes. Then reduce the flow so that the stream is no greater than ¼ inch in diameter.

4. While the water is flushing, fill out the label with the required information. If the water is known to be chlorinated, add this information to the label.

5. Hold container at an angle <u>pointing away from your face</u> and carefully fill it to its shoulder. If acid is in the container, it will mix rapidly with the water and may splatter a bit. Leave enough room in the bottle so that the sample can be shaken to mix.

Caution - Hazard: Containers may contain liquid acid which is toxic and will cause burns. If any preservative contacts skin or eyes, flush with liberal amounts of water until EMTs arrive.

Collecting the sample

6. For samples to be analyzed for nitrite and /or nitrate separately, do not add acid (and do not use a container which may already contain acid).

7. **For nitrate-plus-nitrite samples only;** if acid has not been added to the sample bottle and the laboratory has instructed you to preserve the sample, add sulfuric acid one drop at a time to the sample to adjust the pH to 2, following the laboratory's instructions. Swirl the sample gently after each addition of acid. Measure the pH with a pH meter or pH paper.

8. Complete the forms supplied by the testing laboratory with the requested information.

9. Pack the samples in a cooler with freezer packs.

10. Deliver to the laboratory the same day or ship by courier or overnight delivery service.

VOLATILE ORGANIC COMPOUNDS (VOCs)

Summary

The U.S. EPA has established MCLs for 21 **VOCs**. Volatile organic compounds can occur in both untreated and treated drinking water. They are generally found at higher concentrations in ground water than in surface water. This is because evaporation is restricted in ground water. Because these organic chemicals are volatile, they require special sampling procedures.

Status

Promulgation Date	***Effective Date***
July 1, 1991 (56 FR30266)	January 1, 1993
July 17, 1992 (57FR31838)	August 17, 1992 (monitoring)
	January 17, 1996 (MCLs)

MCLs

MCLs for the 21 VOCs are shown in Table 6-1. If a system violates any of the MCLs, it must notify the public (see Public Notification Requirements, pages 5-6).

Trigger Level Requirements

If VOC contaminants exceed the trigger levels at any time in either initial or repeat sampling, the system must conduct quarterly sampling until the state determines that the system is reliably and consistently below the MCL. Any reduction in quarterly sampling occurs only at the discretion of the state.

Table 6-1. Volatile Organic Chemicals (VOCs)

Contaminant	MCL mg/L	Trigger Level mg/L
Vinyl Chloride	0.002	0.0005
Benzene	0.005	0.0005
Carbon Tetrachloride	0.005	0.0005
1,2-Dichloroethane	0.005	0.0005
Trichloroethylene	0.005	0.0005
para-Dichlorobenzene	0.075	0.0005
1,1-Dichloroethylene	0.007	0.0005
1,1,1-Trichloroethane	0.2	0.0005
cis-1,2-Dichloroethylene	0.07	0.0005
1,2-Dichloropropane	0.005	0.0005
Ethylbenzene	0.7	0.0005
Monochlorobenzene	0.1	0.0005
o-Dichlorobenzene	0.6	0.0005
Styrene	0.1	0.0005
Tetrachloroethylene	0.005	0.0005
Toluene	1	0.0005
trans-1, 2-Dichlorethylene	0.1	0.0005
Xylenes (total)	10	0.0005
Dichloromethane	0.005	0.0005
1,2,4-Trichlorobenzene	0.07	0.0005
1,1, 2-Trichlorothane	0.005	0.0005

Monitoring Requirements

Some states may have more stringent monitoring requirements than others; check with your state drinking water representative for exact requirements.

General

This rule applies to all community and non-transient, non-community water systems (CWS and NTNCWS).

Number of Samples

A minimum of one sample must be taken per source. For monitoring frequencies please see Table 6-2.

Confirmation Sample

If the state requires a confirmation sample, the system must take one at the original sampling point (within two weeks of the initial sample).

Repeat Monitoring

For each sample that exceeds the MCL, or is not reliably and consistently less than the MCL, the system must take repeat samples either quarterly or at the discretion of the state. The frequency of repeat sampling is based on detection, vulnerability, source, and system size. See Table 6-2 for further guidance.

Location

Ground water systems shall take minimum of one sample at every entry point to the distribution system (EPTDS) that is representative of each well after treatment.

Surface water systems (or combined surface and ground water systems) shall take a minimum of one sample at points in the distribution system that are representative of each source or at each EPTDS after treatment.

Schedule

The U.S. EPA has established a Standardized Monitoring Framework (see Table 6-2) to help coordinate and synchronize monitoring schedules. Within this framework, the state has the flexibility to determine when each system should sample. See Figure 6-1 for examples of how to determine numbers of samples and locations for sampling.

Table 6-2. VOC Standardized Monitoring Framework

		Second Cycle									Third Cycle								
		1st Period			2nd Period			3rd Period			1st Period			2nd Period			3rd Period		
		2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Volatile Organic Contaminants (VOCs)	**Groundwater (Below Detection Limit)**																		
	No Waiver[1]	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	< Detect, Vulnerability Assessment, and Waiver [2]	1						1						1					
	Surface Water (Below Detection Limit)																		
	No aiveW	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	< Detect, Vulnerability Assessment, and Waiver [3]	No sampling required unless required by the State.																	
	Above Detection Limit																		
	≥ Detect or Not Reliably and Consistently ≤ CL M	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	Reliably and Consistently < MCL [4]		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Legend

1 = 1 sample at each entry point to distribution system (EPTDS).

4 = 4 quarterly samples, one sample per quarter, at each EPTDS within time frame designated by the state drinking water program.

[1] If all the monitoring results during initial quarterly monitoring are less than the detection limit, the system can take annual samples. If after a minimum of 3 years of annual sampling with all the analytical results less than the detection limit, the state drinking water program can allow the system to take 1 sample during the compliance period. Systems are also eligible for a waiver.

[2] Groundwater systems must update their vulnerability assessments during the time the waiver is effective. The state drinking water program.must re-confirm that the system is non-vulnerable within 3 years of the initial determination or the system must return to annual sampling.

[3] The state drinking water program must determine that a surface water system is non-vulnerable based on a vulnerability assessment during each compliance periodor the system must return to annual sampling.

[4] Samples must be taken during the quarter which previously resulted in the highest analytical result. Systems can apply for a waiver after three consecutive annual sampling results are below the detection limit.

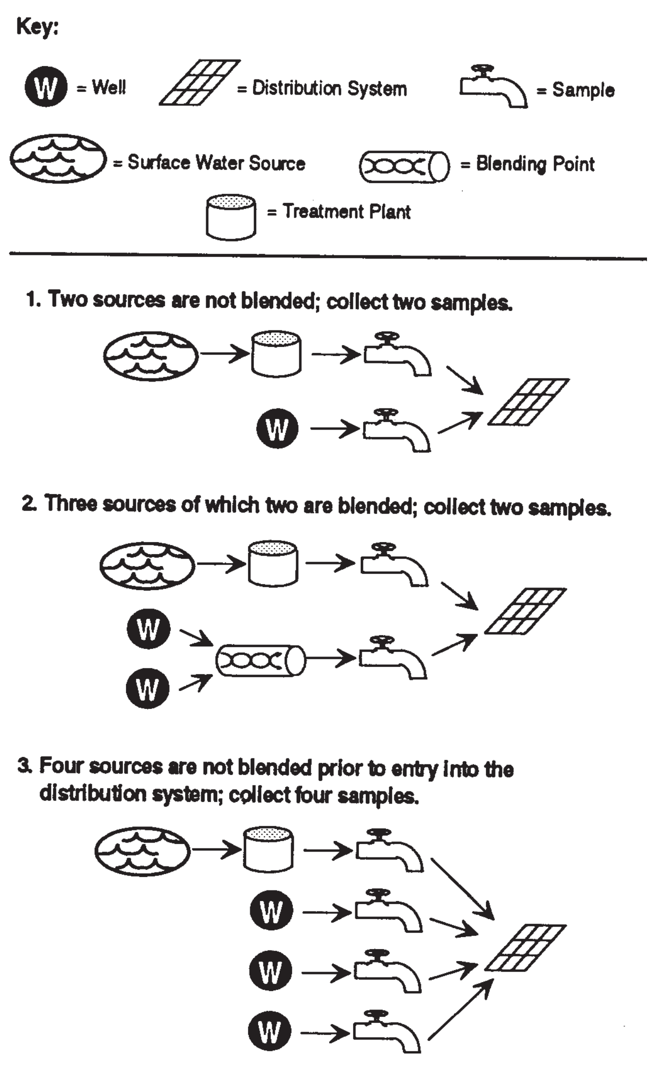


Figure 6-1. Examples for Determining Sampling Locations and Numbers of Required Samples

Compositing

Compositing of up to five samples is allowed at state discretion.

Sampling

Sampling Containers

The laboratory normally supplies pre-cleaned containers for sampling. The required containers are 40 mL to 120 mL glass vials. The laboratory will normally add the proper preservative in advance. For chlorinated waters, a powdered dechlorinating agent (ascorbic acid) will be added, and the sampler must subsequently add hydrochloric acid to the filled vials. For unchlorinated waters, the laboratory will add the acid to the empty vials. Samplers should obtain specific instructions from the laboratory at the time the empty vials are received.

Important. If the laboratory supplying the sample containers is not at the same immediate location as the water utility, it will send **field reagent blanks**, also known as **trip blanks**, along with the sample vials. A trip blank consists of two vials filled with water at the laboratory. They will be in the shipping container sent by the laboratory. Do not open these blanks. Leave them in the shipping container and return them to the laboratory with the samples. If the laboratory has not included trip blanks, contact the laboratory before taking any samples.

Typical VOC sampling containers and equipment

Procedure

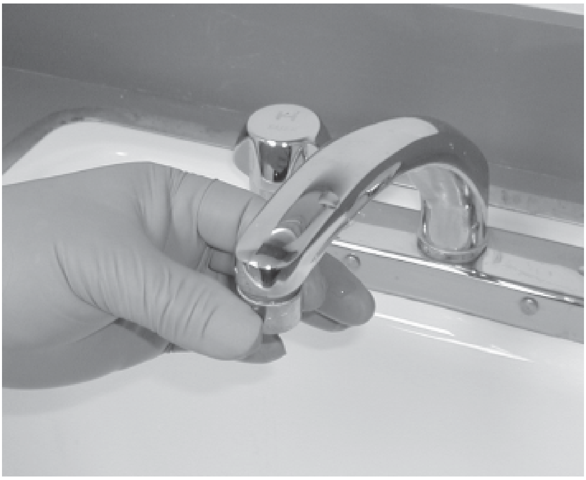
The laboratory that supplies the containers will normally provide sampling instructions with the sampling kit for the type of monitoring being done. Refer to these instructions. If the sampling kit does not include them, contact the laboratory for specific instructions before taking samples. **The following instructions and photos illustrate the general sampling procedures to be followed for collecting VOC monitoring samples.**

Important safety precautions. Safety glasses must be worn. Wash hands before and after sampling. The use of clean nitrile gloves is strongly recommended.

1. Select a state approved sampling location if any have been designated. If not, select a representative sampling location. For a surface water system, the plant effluent tap might be an appropriate sampling location. For a well discharging directly into a distribution system, a tap on the well's discharge piping *after* any treatment would be appropriate.

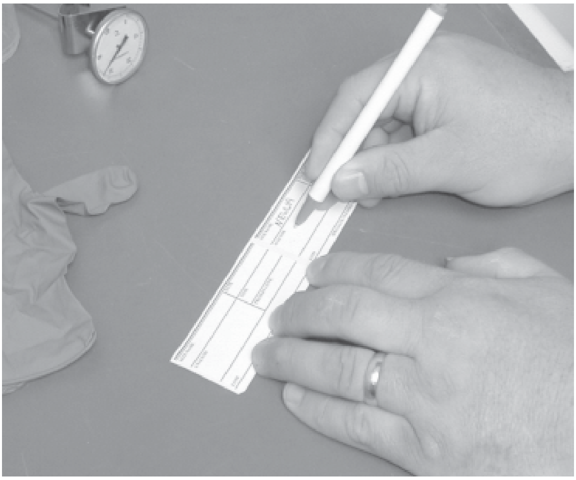
2. If possible, use a non-mixing valve faucet and remove all attachments, including any aerators, strainers and hoses. Do not take a sample if all attachments cannot be removed because they will alter the concentrations of any VOCs present.

3. Turn on the cold water tap and run the water until the temperature has stabilized as determined by a thermometer. This typically takes 4-5 minutes. Then reduce the flow so that the stream is no greater than ¼ inch in diameter



Removing aerator from faucet before starting to sample

4. While the water is running fill out the label in waterproof ink. Be sure to clearly identify the exact sample location, the date and time of collection, and the sampler's name. If the sample collection point has a specific coded identification, include it on the label and sample submission form.



Filling out the label

Caution-Hazard. Vials may contain liquid or powdered preservative. Liquid preservative will cause burns. If it contacts skin or eyes, flush with liberal amounts of water until EMTs arrive.

5. If the water has been chlorinated, select vials to which powdered ascorbic acid has been added. If the water has not been chlorinated, select vials to which liquid hydrochloric acid has been added. Fill at least two vials for each sample that is taken.

   Remove the cap from the vial, keeping the vial upright to prevent spilling any preservatives. Do not put the cap face down or put it in your pocket. Do not allow the inside of the cap, the inside of the vial, or the bottle threads to be touched by any object.

Tilting the vial to prevent formation of air bubbles

6. Hold the vial at an angle pointing away from your face and carefully fill it until it is nearly full. Be careful not to rinse out the preservative. If acid has been added to the vial by the laboratory, it will mix rapidly with the water and may spatter a bit. If ascorbic acid powder (dechlorinating agent) has been added to the vial by the laboratory, it will rapidly dissolve. Carefully complete filling the vial by putting water inside the cap and transferring it one drop at a time to the vial to form a meniscus.

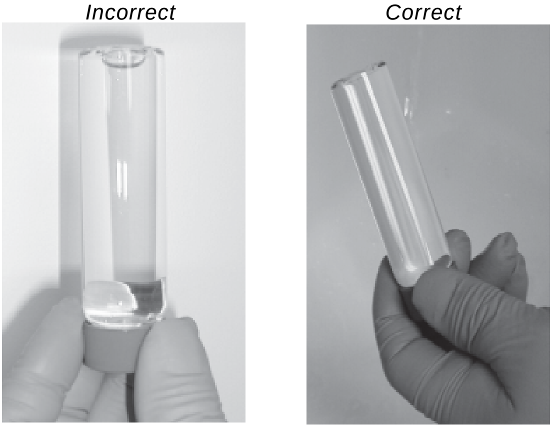
Topping off the vial with the bottle cap to form a meniscus

7. If the water has been chlorinated, add one drop of 1:1 (one part acid to one part water) hydrochloric acid (HCl) for each 20 mL of sample volume. For example, for a 40 mL vial, add two drops with a pipette to the top of the meniscus.

8. Screw the cap on the bottle so that the shiny white (Teflonâ) side of the septum is in contact with the water. *Do not touch the septum and do not overtighten the cap!*

Screwing on the cap

9. Invert the bottle, tap against your other hand, and check for air bubbles. If any are present, add additional water to reform the meniscus, seal and check again.



Inverting the vial to determine if there are air bubbles (left) or no air bubbles (right)

10. Shake the bottle vigorously for 1 minute.

11. Remember that each “sample” consists of 2 to 3 filled vials. Repeat steps 6-10 above to fill additional vials for each sample.

12. Complete the forms supplied by the laboratory with the appropriate information such as public water system **(PWS)** identification number, exact sample collection location, date and time, type of sample collection (raw, plant tap, entry point, or distribution), and type of analysis to be run. In many states, the same form that is filled out here will be used to report the analytical results. Also, complete a chain of custody form if required.

13. Place the samples in a cooler . The trip blanks should still be in the cooler. Keep the samples at 2° to 6° C (36° to 43° F) and keep them away from direct light or gasoline and solvent vapors. Deliver them to the laboratory or ship them by courier or overnight express to the laboratory. Enough ice or freezer packs must be included to keep the samples at 2° to 6° C (36° to 43° F), but they must be kept from freezing.

SYNTHETIC ORGANIC CHEMICALS (SOCs)

Summary

The U.S. EPA has promulgated regulations for polychlorinated biphenyls (**PCBs**), 23 pesticides, and six other synthetic organic chemicals (**SOCs**). Residues of these chemical contaminants are carried to surface and ground water systems through farmland runoff, stormwater discharge, and even direct discharge due to aerial spraying. These chemicals have been shown to cause cancer in laboratory animals. Many of these contaminants can be removed by granular activated carbon (GAC), and, in some cases, by packed tower aeration. The best treatment for glyphosate is using chlorine or ozone oxidation .

Status

Promulgation Dates	***Effective Dates***
January 30, 1991	July 30, 1992 (56 FR 3526)
July 1, 1991	January 1, 1993 (56 FR 30266)
July 17, 1992	January 17, 1994 (57 FR 31838)

MCLs

MCLs for the 33 SOC contaminants and their trigger levels are listed in Table 7-1. If a system violates (exceeds) any of the MCLs it must notify the public (see Public Notification Requirements, pages 5-6).

Table 7-1. Regulated Synthetic Organic Chemicals (SOCs) EPA Standard, (mg/L)

Contaminant	MCL	Trigger Level
Alachlor (Lasso)	0.002	0.0002
Aldicarb*	0.003	0.0005
Aldicarb Sulfoxide*	0.004	0.0005
Aldicarb Sulfone*	0.002	0.0008
Atrazine	0.003	0.0001
Benzo(a)pyrene	0.0002	0.00002
Carbofuran	0.04	0.0009
Chlordane	0.002	0.0002
Dalapon	0.2	0.001
Dibromochloropropane (DBCP)	0.0002	0.00002
Di(2-ethylhexyl)adipate	0.4	0.0006
Di(2-ethylhexyl)phthalate	0.006	0.0006
Dinoseb	0.007	0.0002
Diquat	0.02	0.0004
2,4-D	0.07	0.0001
Endothall	0.1	0.009
Endrin	0.002	0.00001
Ethlyene Dibromide (EDB)	0.00005	0.00001
Glyphosate	0.7	0.006
Heptachlor	0.0004	0.00004
Heptachlor Epoxide	0.0002	0.00002
Hexachlorobenzene	0.001	0.0001
Hexachlorocyclopentadiene	0.05	0.0001
Lindane	0.0002	0.00002
Methoxychlor	0.04	0.0001
Oxamyl (Vydate)	0.2	0.002
Pentachlorophenol	0.001	0.00004
Picloram	0.5	0.0001
Polychlorinated Biphenyls (PCBs)	0.0005	0.0001
Simazine	0.004	0.00007
Toxaphene	0.003	0.001
2,3,7,8-TCDD (Dioxin)	3 x 10-8	5 x 10-9
2,4,5-TP (Silvex)	0.05	0.0002

*Aldicarb, aldicarb sulfoxide, and aldicarb sulfone are considered regulated contaminants although their MCLs have been temporarily set aside.

Compositing

Compositing of up to five samples is allowed at state discretion.

Monitoring Requirements

Some states may have more stringent monitoring requirements than others; check with your state drinking water representative for exact requirements.

General

This rule applies to all community and non-transient non-community water systems (CWS and NTNCWS).

Trigger Level for Increased Monitoring

Table 7-1 lists the trigger levels for increased monitoring for the regulated SOCs, including the pesticides.

Monitoring

See Table 7-2 for monitoring requirements.

Waiver. The system may apply to the state for a sampling waiver for the next 3-year period. If the waiver is approved, sampling will be at state discretion for the next three years. A system is eligible for both "use" and "susceptibility" waivers provided the system has conducted a vulnerability assessment. A system receiving a waiver will sample at the states discretion. Waivers are effective for one compliance period (3 years) and must be renewed in subsequent compliance periods. (See "Waiver" in Table 7-2).

Repeat Sampling Requirements

After sampling, a system may have to conduct repeat sampling. There are three cases of applicable repeat sampling requirements.

Case 1. If a sample is less than the detection limit (trigger level) and does not have a waiver, then the state may allow the system to repeat the sample once during the 3-year compliance period.(Table 7-2)

Table 7-2. SOC Standardized Monitoring Framework

	Population less than or equal to 3,300 only.	Second Cycle									Third Cycle								
		1st Period			2nd Period			3rd Period			1st Period			2nd Period			3rd Period		
		2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
SOCs	**Below Trigger Level**																		
	< Detect and No Waiver (Case 1)	1			1			1			1			1			1		
	Waiver	No sampling required unless required by the state.																	
	Above Trigger Level																		
	> Detect or Not Reliably and Consistently < MCL (Case)	24	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	Reliably and Consistently < MCL* (Case) 3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

* Samples must be taken during the quarter which previously resulted in the highest analytical result.
Systems can apply for a waiver after three consecutive annual sampling results are below the detection limit.

Legend
1 = 1 sample at each entry point to distribution system (EPTDS).
4 = 4 quarterly samples, one sample per quarter, at each EPTDS within time frame designated by the state drinking water program.

Case 2. If a sample is greater than the detection limit (trigger level) or not reliably and consistently less the than the MCL, then four quarterly repeat samples must be taken within the time frame designated by the state. (Table 7-2)

Case 3. If a sample is reliably and consistently less than the MCL then yearly samples must be taken during the quarter that had the highest result. Any reduction in sampling occurs only at the discretion of the state. (Table 7-2)

Confirmation Sample

If the state requires a confirmation sample, the system must take one at the original sampling point within two weeks of the initial sample for each positive result. States have the right to request a confirmation sample for any positive or negative results.

Sampling

Sampling Containers

The testing laboratory generally will supply pre-cleaned containers for sampling. Several containers are required because the laboratory uses several different methods to analyze for all the contaminants. The volume of the sampling containers may be 40 mL, 60 mL, or 1 liter, depending on the analytical method used. The containers must be made of glass, except for the container for diquat, which must be made of high density amber polyvinyl chloride (PVC) or silanized amber glass. It is essential that the laboratory be informed whether the water is chlorinated or unchlorinated at the time sampling containers (vials or bottles) are ordered.

The laboratory will normally add the proper preservative in advance. For chlorinated waters, a powdered dechlorinating agent will be added, and you may be required to add an acid (usually hydrochloric acid) to the filled containers. For unchlorinated waters, the laboratory will add the acid to the empty containers, if necessary, instead of a dechlorinating agent. Obtain specific instructions from the laboratory at the time empty containers are received. The instructions provided by the laboratory will indicate when field reagent blanks have been included. If the sampling kit does not include them, contact the laboratory for specific instructions before taking samples. If you are sampling for carbamates, obtain specific instructions from the laboratory.

Procedures

Follow the procedures recommended by the laboratory (if any) for sampling and addition of preservatives. **The following instructions and photos illustrate the general sampling procedures to be followed for collecting SOC monitoring samples.**

Important safety precautions: Safety glasses must be worn. Wash hands before and after sampling. The use of clean nitrile gloves is recommended.

1. Select a state approved sampling location if any have been designated. If not, select a representative sampling location. For a surface water system, the plant effluent tap might be an appropriate sampling location. For a well discharging directly into a distribution system (entry point to the distribution system or EPTDS), a tap on the well's discharge piping after any treatment would be appropriate.

2. If possible, use a non-swivel faucet and remove all attachments, including any aerators, strainers and hoses. Do not take a sample if all attachments cannot be removed because they will alter the concentrations of any SOCs present.

3. Turn on the cold water tap and run the water until the temperature has stabilized as determined by a thermometer. This typically takes 4-5 minutes. Then reduce the flow so that the stream is no greater than ¼ inch in diameter.

Flushing the tap until the water temperature stabilizes

4. While the water is running fill out the label in waterproof ink. Be sure to clearly identify the exact sample location, the date and time of collection, and the sampler's name. If the sample collection point has a specific coded identification, include it on the label and sample submission form.

Caution - Hazard. Containers may contain liquid acid which is toxic and will cause burns. If any preservative contacts skin or eyes, flush with liberal amounts of water until the EMTs arrive.

5. Remove the cap from the container, keeping the container upright to prevent spilling any preservatives. Do not put the cap face down or put it in your pocket. Do not allow the inside of the cap, the inside of the container, or the container threads to be touched by any object.

6. There are two different SOC groups that need to be considered while sampling.

   6A. SOCs collected in bottles. Hold container at an angle pointing away from your face and carefully fill it to its shoulder. If acid is in the container, it will mix rapidly with the water and may splatter a bit. Leave enough room in the bottle so that the sample can be shaken to mix the preservative.

Put the cap on the container, tighten it, and shake the bottle vigorously for one minute. Proceed to step 7.

6B. SOCs collected in vials. Hold the vial at an angle pointing away from your face and carefully fill it until it is nearly full. Be careful not to rinse out any preservative. If a dechlorinating agent has been added to the vial by the laboratory, it will rapidly dissolve. Carefully complete filling the vial by putting water inside the cap and transferring it one drop at a time to the vial to form a meniscus. (The meniscus is the curved upper surface of a liquid formed by surface tension.) Screw the cap on the bottle so that the shiny white (Teflonâ) side of the septum is in contact with the water. **Do not touch the septum and do not overtighten the cap!** Proceed to step 7.

7. Remember that each “sample” consists of 2 to 3 filled containers. Repeat steps 5-6 above and 8-9 below to fill additional containers for each sample.

8. Complete the forms supplied by the laboratory with the appropriate information such as PWS identification number, exact sample collection location, date and time, type of sample collection (raw, plant tap, entry point, or distribution), and type of analyses to be run. In many states, the same form that is filled out here will be used to report the analytical results. Also, complete a chain of custody form if required.

9. Place the samples in a closed cooler. The **trip blanks** should still be inside the cooler. Keep the samples at 2° to 6° C (36° to 43° F) and keep them away from direct light and gasoline or solvent vapors. Deliver them directly or ship them by courier or overnight express to the laboratory

LONG TERM 1 ENHANCED SURFACE WATER TREATMENT RULE (LT1)

Summary

The Long Term 1 **(LT1)** is a refinement of the Surface Water Treatment Rule **(SWTR)**. The SWTR was established because all surface waters and ground waters under the direct influence (GWUDI) of surface water are at risk from contamination by various microorganisms. To protect the public from waterborne diseases, all public water systems using surface water sources or GWUDI are required to disinfect and may be required by the state to install filtration to remove or **inactivate** disease causing microrganisms.

The Interim Enhanced Surface Water Treatment Rule **(IESWTR)** and the LT1 both require the 2-log (99%) removal of *Cryptosporidium* for those systems that do not have a waiver from filtration. The IESWTR applies to those surface water systems serving equal to or greater than 10,000 people.

The LT1 applies to those surface water systems serving less than 10,000 people. This section of the guide will exclusively address those system requirements for LT1 systems.

Unfiltered waivered systems need to contact their state regulatory agency for the specific requirements of their system.

Status: Final Rule Dates

LT1	January 14, 2002 (67 FR 1812)
IESWTR	Revisions January 16, 2001 (66 FR 3770)
IESWTR	December 16, 1998 (63 FR 69478)
SWTR	June 29, 1989 (54 FR 27488)

MCL	None. The regulation establishes specific <u>treatment techniques</u> requiring disinfection of all and filtration of most surface and GWUDI systems in place of MCLs.

Treatment Techniques

Treatment techniques requirements are established in place of the MCLs for:

- *Cryptosporidium*
- *Giardia lamblia*
- Viruses
- HPC Bacteria
- *Legionella*
- Turbidity

Monitoring Requirements

Check with your state drinking water representative to determine if more stringent state regulations apply than the minimum federal regulations shown in this section.

General

This LT1 rule applies to all public water systems serving less than 10,000 people using surface water or GWUDI.

The LT1 classifies these surface water systems into three categories for the purpose of establishing treatment techniques and monitoring requirements.

1. **<u>GWUDI.</u>** This is a classification of ground water sources that might include shallow wells, springs and infiltration galleries. States review systems to determine which are at risk and must, therefore, comply with the requirements of the LT1.

2. Unfiltered surface water systems that can avoid filtration are referred to as waivered systems. Consult the state for the specific regulatory requirements for your system.

3. Surface water systems that filter must physically remove a minimum 99% (2-log) of *Cryptosporidium*.

Disinfection Profiling and Benchmark Requirements

These requirements stem from complying with the Stage 1 Disinfectants and Disinfection By-Products Rule (Stage 1 DBPR). Systems have to consider how to maintain protection from microorganisms while controlling the levels of disinfection by-products produced. Developing a disinfection profile is done to understand how to balance these risks.

Trigger Levels and Effective Dates

Disinfection Profiling may be avoided if the Total Trihalomethanes **(TTHM)** are equal to or less than 0.064 mg/L and the five haloacetic acids **(HAA5)** are equal to or less than 0.048 mg/L.

Consult the state drinking water program for the specific requirements of your system.

July 1, 2003 - 500 to 9,999 population served.
Systems must have started profiling unless the state determines it is unnecessary.

January 1, 2004 - 25 to 499 population served.
Systems must have started profiling unless the state determines it is unnecessary.

June 30, 2004 - 500 to 9,999 population served.
Systems must have completed their profiling, and they must maintain on file for sanitary survey review by the State.

December 31, 2004 - 25 to 499 population served.
Systems must have completed their profiling, and they must maintain on file for sanitary survey review by the State.

Prior to making a significant change to disinfection practices, systems are required to consult with the state drinking water program.

Note: Refer to VOC and SOC sections for information on sampling requirements for **TTHM** and haloacetic acids **(HAA5s)**.

January 14, 2005 - 25 to 9,999 population served. Systems must comply with applicable LT1 provisions below.

- Turbidity Standards
- Combined Filter Effluent
- Individual Filter Effluent

When filtered systems meet the turbidity requirements listed below, it is presumed they are meeting the 2-log (99%) minimum removal of *Cryptosporidium* requirement. (Note: In the proposed Long Term 2 Enhanced Surface Water Treatment Rule (LT2) it is demonstrated through various studies that a minimum 3-log (99.9%) removal actually occurs and this credit for 3-log removal of the cryptosporidium is proposed to be given that level of compliance.)

Turbidity Monitoring

Combined Filter Effluent (CFE) Turbidity

Turbidity is measured at least every 4 hours. This may be reduced by the state to once a day for systems using slow sand/alternative filtration or for systems serving fewer than 500 people regardless of the type of filtration used.

- Conventional and Direct Filtration. Equal to or less than 0.3 **NTU** in at least 95% of measurements taken each month. One NTU is the maximum level allowed.

- Slow Sand and Diatomaceous Earth (DE) filtration: 1 NTU in at least 95% of measurements taken each month. Five NTU is the maximum level.

- Alternative technologies other than conventional, direct, slow sand, or DE filters. Turbidity levels are set by the state based on filter demonstration data submitted by the system. State limits must not exceed 1 NTU (95% of measurements) or 5 NTU (maximum).

Individual Filter Effluent (IFE) Turbidity (Table 8-1)

This applies only to Conventional and Direct Filtration.

Take continuous turbidity readings for each filter, recorded at least every 15 minutes.

Table 8-1. Monitoring Frequencies for Systems with Filtration

System Size	Filtered Water Turbidity Samples		Disinfectant Residual Concentration	
	CFE	IFE	Entering Distribution System	Within Distribution System
<500	Every 4 hours (State may reduce to 1/day*)	Performed continuously, recorded every 15 minutes for all size systems. (Systems with 2 or fewer filters may substitute continuous CFE turbidity monitoring every 15 minutes instead of IFE)	1/day	Same frequency as Total Coliform Rule Sampling (see page 11)
500-1,000	Every 4 hours		2/day	
1,001-2,500	Every 4 hours		3/day	
2,501-3,300	Every 4 hours		4/day	
>3,300	Every 4 hours		Continuous Monitoring	

*Applies to slow sand or alternative filtration systems

Follow-Up Action Triggers

If the IFE turbidity levels indicate that the same filter exceeds 1.0 NTU in 2 consecutive (or more) readings (15 minutes apart) in one month, then follow-up actions are required. Contact the state the next business day for more information on the next required steps.

If the IFE turbidity levels indicate the same filter exceeds 1.0 NTU in 2 consecutive (or more) readings (15 minutes apart) for three months in a row, then follow-up actions are required. Contact the state the next business day for more information on the next required steps.

If the IFE turbidity levels indicate the same filter exceeds 2.0 NTU in 2 consecutive (or more) readings (15 minutes apart) for two months in a row, then follow-up actions are required. Contact the state the next business day for more information on the next required steps.

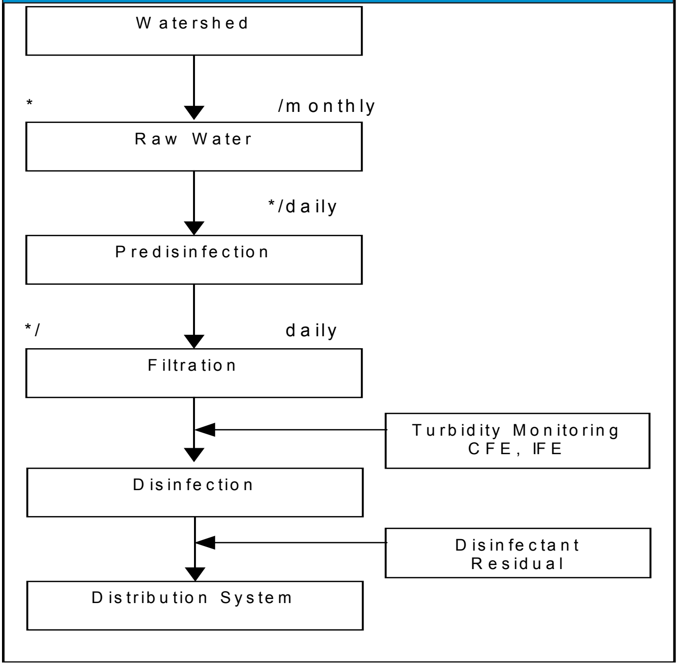
Systems with two or fewer filters may conduct continuous monitoring every 15 minutes of CFE turbidity in place of IFE turbidity monitoring.

Sampling - Systems with Filtration

Turbidity Monitoring

The turbidity sample should be representative of the system's filtered water. This sample could be taken from combined filter effluent, clearwell effluent, or plant effluent, or be the average of each filter's effluent. States will specify where the turbidity samples must be collected for compliance. (See Figure 8-1).

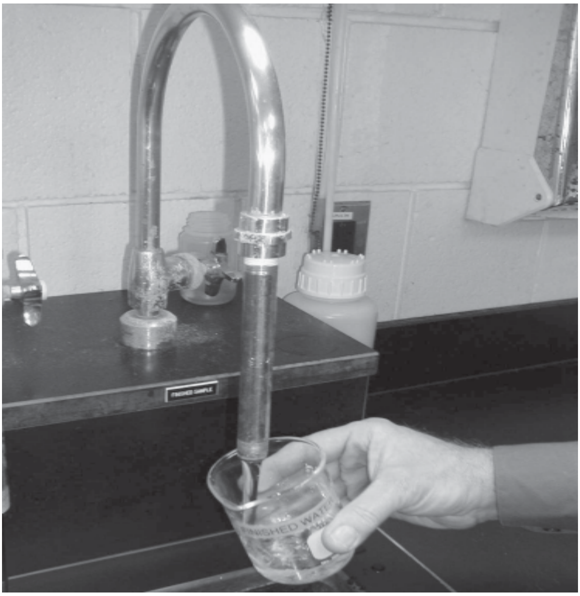
Figure 8-1. Monitoring Locations for Systems with Filtration



*Turbidity should be measured at these points too, but it is not a regulatory requirement.

Procedure

1. Collect the sample in a clean glass or plastic bottle from the designated sample collection point.



Collecting the sample from finished plant effluent

2. Calibrate the turbidimeter , following the manufacturer's operating instructions.

Calibrating the turbidimeter according to manufacturer's instructions

3. Transfer the sample to a clear glass sample tube after first gently shaking the sample and allowing any bubbles to escape. *Do not handle the tube where the light will strike it.* If bubbles form on the inside of the tube, tap the tube gently with your finger to dislodge the bubbles.

Transferring the sample to a glass sample tube

4. Carefully wipe the outside of the sample tube with a lint free laboratory tissue to remove water droplets, condensation, and fingerprints.

Wiping the outside of the tube

5. Place the tube into the instrument and read turbidity on the proper scale setting.

Placing the tube into the instrument

6. Record the result.

Disinfection Monitoring

Entering the distribution system. The residual disinfectant concentration in the water entering the distribution system cannot be less than 0.2 mg/L for more than 4 hours. Refer to Table 8-1 for sampling frequency. The system must tell the state if the residual remained below 0.2 mg/L for more than 4 hours.

Procedure

If using a continuous monitor, record the lowest disinfection residual each day.

OR

If collecting grab samples, follow the steps below.

1. Collect the samples at different times during the day at intervals prescribed by the state. See Table 8-1 for frequency.

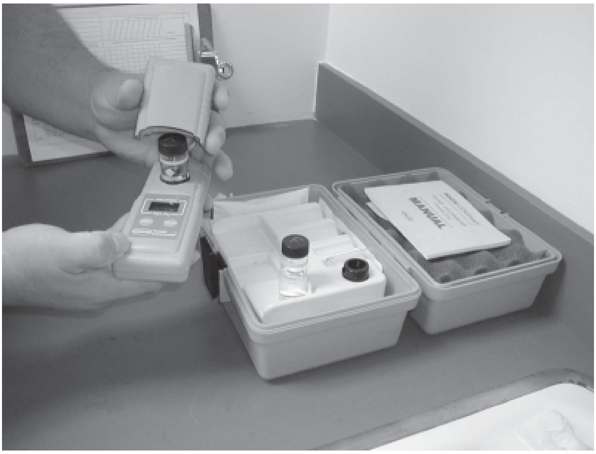
2. Analyze the sample as soon as possible but always within 15 minutes. Analyze in accordance with any method listed in 40 CFR (41.74(a)(1).

3. Record the result.

Recording the result of analysis

Within the Distribution System

The disinfectant residual sample must be collected at the same frequency and location as samples for total coliforms (see the Total Coliform Rule, p. 10). Disinfectant residuals in the distribution system must also be detectable in 95% of the samples.



Measuring chlorine residual in the distribution system

Procedure

1. Collect a minimum of 100 mL of sample.

2. Analyze the sample as soon as possible but always within 15 minutes. Analyze in accordance with *Standard Methods for the Examination of Water and Wastewater* (1998, 20th Edition, American Public Health Association et al.) or use methods approved by the state.

3. Record the result.

If no residual is detected, the system has the option to measure for heterotrophic plate count (HPC) bacteria. If HPC is less than 500 CFU/mL, the site is considered to have a detectable residual.

Analytical Methods

Sampling and analysis must be in accordance with one of the U.S. EPA approved methods listed below . (See bibliography for references).

Chlorine

Method 4500-Cl	D.	Amperometric Titration
Method 4500-Cl	E.	Low Level Amperometric Titration
Method 4500-Cl	F.	**DPD** Ferrous Titrimetric
Method 4500-Cl	G.	**DPD** Colorimetric*
Method 4500-Cl	H.	Syringaldazine (FACTS)

***Note: In some states the chlorine “color wheel” is no longer an acceptable method for determining free chlorine or combined chlorine in drinking water. Check with your state drinking water program.**

Chloramine (Total Chlorine)

Use the same methods as with chlorine above, except Method 4500-Cl H may not be used for chloramines, and Method 4500-Cl I (Iodometric Electrode Technique) may be used to determine the amount of chloramines in water.

Chlorine Dioxide

Method 4500-Cl D. Amperometric Titration

Method 4500-Cl E. Low Level Amperometric Titration

Ozone

Use only methods approved by USEPA.

Figure 8-1 and Table 8-1 summarize the sampling locations and frequencies for monitoring the performance of public water systems that provide filtration.

Variances and Exemptions

Variances from the disinfection requirements are not allowed under the SWTR, the IESWTR and the LT1. Exemptions are not allowed for disinfection requirements at the point of entry to the distribution system. They may, however, be granted for other requirements. Check with your state drinking water representative for details.

LEAD AND COPPER RULE (LCR)

Summary

The U. S. EPA has determined that lead and copper are a health concern at certain levels of exposure, and therefore the Lead and Copper Rule (LCR) was promulgated. Young children and pregnant women are especially at risk from high levels of lead in the blood. Some of the most pronounced effects in children are interference with growth, deficits in IQ, and altered physical and mental development. The U.S. EPA has estimated that 600,000 children will have their blood lead level reduced as a result of this rule. Copper health effects include stomach and intestinal distress, liver and kidney damage and some rare cases of **Wilson's Disease**.

The rule establishes a treatment technique requirement for lead and copper that includes monitoring, optimum **corrosion** control treatment, source water treatment, public education, and **lead service line** replacement.

Monitoring for lead and copper began on July 1, 1993, for systems that serve less than 3,300 people. One-liter samples need to be collected from household taps from as many as 20 locations (depending on the population served by the water system). In addition, monitoring for other water quality parameters such as pH, alkalinity and calcium are required if an action level **(AL)** is exceeded.

Status:	Final Rule - June 7, 1991 (56 FR 26460) LCR Rule revisions - January 12, 2000 (65 FR 1950) Effective Date

MCL

There is no MCL for lead. The rule establishes a treatment technique requirement that is triggered by exceeding the action level. Table 9-1 shows the action levels for lead and copper

If a system violates the lead and/or copper rule, then it must notify the public (see Public Notification Requirements, pages 5-6).

Table 9-1. **Action Levels for Lead and Copper**

	Action Level* (mg/L)
Lead (Pb)	0.015
Copper (Cu)	1.3

*Measured in 90th percentile at consumers' taps.

Treatment Techniques

The treatment technique requirements for small systems are triggered by exceeding the applicable action level, measured at the 90th percentile at the consumers' taps. The **90th percentile lead level** means 90 percent of the samples collected must be equal to or lower than the action level for lead and copper Treatment technique requirements for lead include:

- Optimal corrosion control treatment
- Source water treatment
- Public education
- Lead service line (LSL) replacement

Treatment technique requirements for copper include:

- Optimal corrosion control treatment
- Source water treatment

For details concerning the material presented in this section call the SDWA Hotline at 1-800-426-4791. They will provide helpful information to PWSs, including situations where action levels are exceeded and PWSs will need to implement corrosion control, source water monitoring, public education, and /or lead service line replacement.

Monitoring Requirements

Check with your state drinking water representative for more stringent state guidelines or regulations.

General

This rule applies to all community (CWS) and nontransient, noncommunity water systems (NTNCWS).

Tap Water Sampling

Initial monitoring

All tap water samples are first-draw samples collected from the cold water tap of a kitchen or bathroom sink.

All small systems (those serving fewer than 3,300 persons) shall monitor during each 6-month monitoring period until:

1. the system exceeds the lead or copper action level, in which case, corrosion control treatment must be implemented and monitoring continued; or

2. the system meets the lead and copper action levels for two consecutive 6-month monitoring periods, in which case, the system can reduce the number of tap water sampling sites (see Table 9-2) and collection frequency to once per year. If the system has a 90th percentile for lead of less than 0.005 mg/L and less than 0.65 mg/L for copper, the system can go directly to monitoring once every 3 years without state approval. The state must approve the reduction in the number of samples taken.

Follow-up Monitoring

Follow-up monitoring will not be required until after installation of optimal corrosion control or source water treatment.

Sampling Location

For sampling in community water systems (CWSs), use **high-risk**, single family structures that:

1. contain copper pipes with lead solder installed between 1982 and 1986;
2. contain **lead pipes**; and/or
3. are served by a lead service line.

If the system has lead service lines (LSLs), then at least 50 percent of the monitoring sites must have LSLs.

For NTNCWS, select structures that meet the criteria above, if possible.

Number of Samples

Table 9-2 shows the minimum number of monitoring sites required by the Rule. Collect one sample for lead and copper from each site.

Table 9-2. Number of Monitoring Sites*

Population Served	Standard Monitoring	Reduced Monitoring
501 to 3,300	20	10
101 to 500	10	5
<100	5	5

*Per 6-month monitoring period, or reduced monitoring period (annual or once every 3 years).

Monitoring for Water Quality Parameters

If the system exceeds the lead or copper action, the following water quality parameters also will need to be monitored (see Table 9-3).

Table 9-3. Monitoring for Water Quality Parameters		
Parameter	**Minimum Sample Volume, mL**	**Maximum Holding Time**
pH*	25	Test immediately (in the field)
Alkalinity	100	14 days
Calcium	100	6 months
Conductivity	50	28 days
Water Temperature*	1,000	Test immediately (in the field)
Silica**	50	28 days
Orthophosphate**	50	48 hours

*Measurement of pH and temperature must be done in the field at the time the samples are collected.

**Orthophosphate and silica must be monitored only when orthoinhibitors containing phosphate or silica compounds are used. Do not use glass containers when sampling for silica (since silica is a component of glass).

The minimum number of sites required for additional tap water quality monitoring is shown inTable 9-4 below.

Table 9-4. Number of Sampling Sites for Tap Water Quality Parameters*		
Population Served	**Standard Monitoring**	**Reduced Monitoring**
501 to 3,300	2	1
<500	1	1

*Per 6-month monitoring period.

Initial Monitoring for Water Quality Parameters

- Tap samples—Two samples per 6-month monitoring period are required.
- Entry points—Two samples per 6-month monitoring period are required.

Follow-up Monitoring

Follow-up monitoring is not done until after installation of optimal corrosion control equipment or source water treatment.

- Tap water samples — Collect two samples per 6-month monitoring period for every parameter except temperature and conductivity. (No orthophosphate or silica samples are required if these chemicals are not used.)
- Entry points — Collect one sample every 2 weeks for pH, alkalinity, and corrosion inhibitor.

Source Water Sampling

Source water sampling is required for systems that fail to meet the lead or copper action level in tap samples.

- Initial monitoring—Collect one source water sample from each entry point to the distribution system within 6-months after the action level exceedance.
- Follow-up monitoring—Collect an additional source water sample from each entry point during two consecutive 6-month monitoring periods.

Sampling

Sample Containers

Sampling containers for lead and copper may be plastic or glass and should be at least 1 liter in volume. A 1-liter plastic bottle is most commonly used and can be marked with a fill line for precise measurements. Only sample containers which have been pre-cleaned for lead and copper sampling can be used.

Procedure

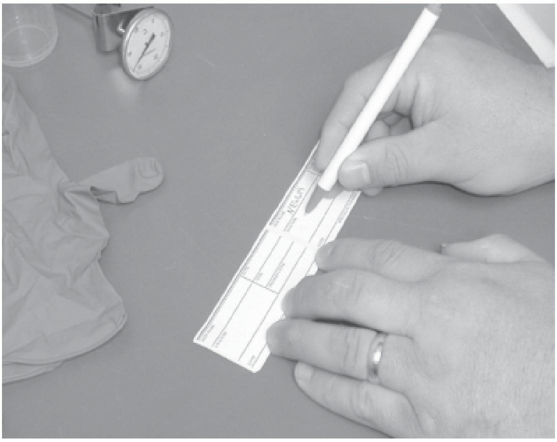
The laboratory that supplies the sampling containers will normally provide instructions with the kit for the type of monitoring being done. Refer to these instructions when they are provided. Samples will either be collected by system personnel or by the homeowner. If the homeowner is collecting the samples, be sure to review the procedure with him or her when the kit is dropped off.

The following instructions and photos illustrate the general sampling procedures for collecting lead and copper first-draw samples. A short video entitled "Sampling Our Drinking Water for Lead and Copper Content" is also available from the New England Water Works Association or the American Water Works Association.

First-Draw Sampling

1. All tap samples should be first-draw samples, taken from a kitchen or bathroom sink cold water tap. This means that the water in the plumbing system should have stood motionless in the pipes for at least six hours. If the homeowner will be collecting the samples, instruct him or her not to use any water (including flushing the toilets) for at least 6 hours prior to collecting the first-draw sample. This sample could be collected either first thing in the morning or after returning from work, if no water has been used during that period.

2. Fill out the sample label(s), indicating the date and time of sample collection, location, type of sample (first draw, service line, etc.), and the sampler's name.



Filling out the sample label <u>before</u> affixing it to the container

3. Before turning on the water to draw the sample, remove the cap from the container and position it under the faucet. Turn on the cold water tap and begin filling the container.

Holding bottle under the tap (left) before turning on the water (right)

4. Fill to the 1-liter mark on the bottle. Turn off the water.

5. The sample container should be tightly capped and placed in a closed chest or sealable plastic bag. Refrigeration is not necessary. Samples must be delivered to the analytical laboratory within 14 days.

Service Line Sampling

Service line sampling may be required if, after installing corrosion control or source water treatment, a system still exceeds the lead action level in tap samples. Systems required to conduct lead service line replacement programs also may be required to sample lead service lines. Contact the state for further guidance.

RADIONUCLIDES RULE (Rad)

Summary

The new Radionuclides Rule was published in the Federal Register on December 7, 2002. This Rule replaces the original Rule that was promulgated in 1976. The rule establishes a new MCL for uranium, which was not previously regulated, and keeps the MCLs, but revises the monitoring requirements, for combined radium 226/228, gross alpha particle radioactivity, and beta particle and photon radioactivity.

Status

Promulgation Date	***Effective Date***
December 7, 2002 (65 FR 76708)	December 8, 2003

Date initial monitoring must be completed by: December 31, 2007.

MCLs

The MCLs for radionuclides are found in Table 10-1. If a system exceeds the MCLs, it must notify the public (see Public Notification Requirements, pages 5-6).

Table 10-1. Radiological MCLs

Regulated Radionuclide	**MCL**
Beta/photon emitters	4 mrem/year
Gross alpha particle	15 pCi/L
Combined radium 226/228	5 pCi/L
Uranium	30 pCi/L

Monitoring Requirements

General

This rule applies to all community water supplies (CWS). For this guide only gross alpha, combined radium 226/228 and uranium are covered, since most community water supplies will not be required to sample for beta particle and photon radioactivity. Please contact your state drinking water program if you have any questions about your requirements (see Table 10-2 for the Standardized Monitoring Framework for radionuclides).

Initial Monitoring

Collect samples at each entry point to the distribution system (EPTDS) after any treatment for four consecutive quarters for gross alpha and radium 226/228 (see Table 10-2). If the gross alpha is equal to or less than 15 pCi/L, no samples are required for uranium. If the gross alpha is equal to or less than 5 pCi/L, then radium 226 is not required, but is recommended.

Reduced Monitoring (See Table 10-2)

If the average of the initial monitoring results for each contaminant is below the detection limit, then one sample at each EPTDS every nine (9) years is required.

If the average of the initial monitoring results for each contaminant is greater than or equal to the detection limit, but less than or equal to one half the MCL, then one sample at each EPTDS every six (6) years.

If the average of the initial monitoring results for each contaminant is greater than one half the MCL, but less than or equal to the MCL, then one sample at each EPTDS is required every three (3) years.

Increased Monitoring

A system with an entry point result above the MCL must return to quarterly monitoring until 4 consecutive quarterly samples are below the MCL.

Table 10-2. Radionuclide Standardized Monitoring Framework

		Second Cycle									Third Cycle								
		1st Period			2nd Period			3rd Period			1st Period			2nd Period			3rd Period		
		2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Radionuclides	< Detection Level			4				1									1		
	≥ Detection Level but ≤ 1/2 MCL			4				1						1					
	> 1/2 MCL but ≤ CL M			4				1			1			1			1		
	> CLM			4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4

Legend
1 = 1 sample at each entry point to distribution system (EPTDS).
4 = 4 quarterly samples, one sample per quarter, at each EPTDS within time frame designated by the state drinking water program.

Sampling

Sample Containers

Containers used for radionuclide sampling are either a pre-cleaned 1-gallon plastic bottle or two pre-cleaned 2-liter plastic bottles per sample. No preservative is added.

Sample Location

All samples for radionuclides will be taken at each entry point to the distribution system (EPTDS) after any treatment.

Procedure

1. Remove any aerator or screen from the sample tap.

2. Turn on the cold-water tap and run the water until the water temperature has stabilized as determined by a thermometer. This typically takes 4-5 minutes. Then reduce the flow so that the stream is no greater than 1/4 inch in diameter . Fill out the labels in waterproof ink while the water is running.

3. Remove the container cap. Do not put cap face down or in your pocket. Do not allow the inside of the cap, the inside of the bottle, or the bottle threads to be touched by any object.

4. Fill the bottle to the shoulder and screw on the cap securely.

5. Complete the chain of custody form if provided and any associated paperwork that the laboratory supplied.

6. Place the samples in a cooler supplied by the laboratory.

7. Deliver them to the laboratory immediately or ship them by courier or overnight express to the laboratory.

Radon Sampling Protocol

Sampling Containers

The laboratory normally supplies pre-cleaned containers for sampling. The required containers are glass 40 mL screw cap vials with a **PFTE**-faced (Teflonò) silicone septum.

Procedure

The laboratory that supplies the containers will normally provide sampling instructions with the sampling kit. Refer to these instructions. If the sampling kit does not include them, contact the laboratory for specific instructions before taking samples.

1. Select a state approved sampling location if any have been designated. If not, select a representative sampling location. For a surface water system, the plant effluent tap might be an appropriate sampling location. For a well discharging directly into a distribution system, a tap on the well's discharge piping *after* any treatment would be appropriate.

2. If possible, use a non-swivel faucet and remove all attachments, including any aerators, strainers and hoses. Do not take a sample if all attachments cannot be removed because they will alter the concentration of any radon present.

3. Turn on the cold water tap and run the water until the temperature has stabilized as determined by a thermometer. This typically takes 4 to 5 minutes. Then reduce the flow so that the stream is no greater than ¼ inch in diameter

4. While the water is running, fill out the labels with the required information and apply to sample containers while they are still dry Be sure to clearly identify the exact sample location, the date and time of collection, and the sampler's name. If the sample collection point has a specific coded identification, include it on the labels and sample submission form.

5. Remember that each sample consists of 2 to 3 filled vials. Repeat steps (6 - 9) to fill the additional vials for each sample.

6. Remove the cap from the vial. Do not put the cap face down or put it in your pocket. Do not allow the inside of the cap, the inside of the vial, or the bottle threads to be touched by any object.

7. Hold the vial at an angle <u>pointing away from your face</u> and carefully fill it until it is nearly full (see picture on page 43). Carefully complete filling the vial by putting water inside the cap and transferring it dropwise to the vial to form a meniscus. (The meniscus is the curved upper surface of a liquid formed by surface tension.)

8. Screw the Teflon cap on the bottle so that the shiny white (Teflon®) side of the septum is in contact with the water. *Do not touch the septum and do not overtighten!*

9. Invert the bottle, tap it against your other hand, and check for air bubbles. If any are present, add additional water to reform the meniscus, seal and check again.

10. Repeat steps 6 through 9 above to fill the additional vials for <u>each</u> sample. If duplicate samples are required, <u>fill at least four vials (two for each sample</u>).

11. Place the samples in a closed cooler. Refrigeration is not necessary. However, avoid large temperature changes. Deliver them to the laboratory the same day, or ship them to the laboratory by courier or overnight express.

Appendix A

Glossary

90th Percentile Lead Level	Ninety percent of the samples collected must be equal to or lower than the action level of 0.015 mg/L for lead, and 1.3 mg/L for copper. If more than 10 % of the samples collected are greater than the action levels, the treatment technique requirements are triggered. The rule contains procedures for calculating this value.
Action Level (AL)	Concentration that determines the treatment requirements in the lead and copper rule.
BATs	Best available technologies
Biocide	A preservative (usually acid) added to the sample to prevent microbial degradation by lowering the pH.
Compliance Cycle	The 9-year calendar cycle during which public water systems must monitor.
Compliance Monitoring	Monitoring *required* by a rule.
Compliance Period	A 3-year calendar period within a compliance cycle.
Compositing	Combining more than one sample for analysis.
Corrosion	Process of wearing away or dissolving of plumbing material.
CWS	Community Water System –A PWS that serves at least 15 service connections or 25 year-round residents.

Detection Limit	Concentration at which the presence of a contaminant can be detected, but not reliably quantified.
DPD	The reagent used in a colorimetric test to determine residual disinfectant concentrations.
E. coli	(*Escherichia coli*) *E. coli* is a type of fecal coliform bacteria commonly found in the intestines of animals and humans. The presence of *E. coli* in water is a strong indication of recent sewage of animal waste contamination.
Entry Point	A place where water enters the distribution system, and is the sampling point for certain water tests.
Fecal Coliforms	A group of related bacteria, associated with fecal matter of warm-blooded animals, whose presence in drinking water indicates the possible presence of disease-causing micro-organisms and indicates that the water is not safe for human consumption. Their confirmed presence is considered an acute violation of the TCR.
Field Duplicates	Multiple field samples collected at the same time and place under identical circumstances. They are placed in separate sample containers and treated identically throughout field and laboratory procedures. Analysis of field duplicates provides a measure of the precision associated with sample collection, preservation, storage, and laboratory procedures.

Field Reagent Blank	Reagent water placed in a sample container in the laboratory and sent to the field collection area in the shipping container. It allows the laboratory to determine if interferences were introduced during handling in the field and during shipping. Field reagent blanks should not be opened in the field.
First-Draw Tap Sample	One liter sample of tap water that has been standing in pipes for at least 6 hours and is collected without flushing the tap. (LCR)
Follow-up Monitoring	Monitoring required after a PWS installs treatment.
FR	Federal Register.
GWUDI	Under Direct Influence – This term is used when referring to ground water under the direct influence of surface water.
HAA5s	Haloacetic acids - chemicals formed when chlorine reacts with organic materials and chemical contaminants in drinking water. HAA's consist mostly of monochloroacetic acid, dichloroacetic acid, trichloroacetic acid, bromoacetic acid, and dibromoacetic acid.
High-Risk Homes	Homes with lead solder installed prior to 1987, lead pipes, and/or lead service lines.
HPC	Heterotrophic plate count bacteria. Their presence in high numbers may indicate deficiencies in water treatment or insufficient distribution system residual disinfectant.

Inactivation	Prevents a microorganism from reproducing. It is not destroyed.
IESWTR	Interim Enhanced Surface Water Treatment Rule
IOC	Inorganic chemical or compound.
Lead Pipe	Any pipe containing 8% or more lead.
Lead Service Line (LSL)	A water service line made of lead which connects the water main to the building inlet.
Lead Solder	A solder containing 0.2% or more lead.
LT1	Long Term 1 Enhanced Surface Water Treatment Rule
MCL	Maximum Contaminant Level – *Enforceable* standard that specifies how much of a contaminant can be present in drinking water.
MCLG	Maximum Contaminant Level Goal – *Nonenforceable* goal that specifies the level of contaminant at which there is no health concern.
NCWS	Non-community water system.
NTNCWS	Non-transient, non-community water system. A public water supply that regularly serves at least 25 of the same persons for over 6 months each year but is not a community water system. Examples include schools, hospitals, and factories with their own source of water.

NTU	Nephelometric Turbidity Unit – A measure of turbidity or cloudiness of water.
PCBs	Polychlorinated biphenyls – Organic chemicals once widely used in electrical transformers and other industrial equipment.
Promulgated	Put a regulation into effect by formal public announcement.
PTFE	Tetrafluoroethylene polymer, commonly known as TeflonÒ.
PVC	Polyvinyl chloride.
PWS	Public Water Supply. A system that regularly supplies at least 15 service connections or at least 25 people for at least 60 or more days per year
Reduced Monitoring	A schedule that allows a system to monitor with less frequency if the system meets the requirement for a certain number of years.
Reliably and Consistently	**“Reliably and Consistently”** below the MCL means that, although a system detects contaminants in its water supply, the state has sufficient knowledge of the source or extent of the contamination to predict that the MCL would not be exceeded in the future.
Repeat Sampling	Subsequent rounds of sampling following the initial sampling. Generally, repeat sampling requirements can be reduced if initial sampling results in no detection of a contaminant.

SDWA	Safe Drinking Water Act – Act passed in 1974 expanding the scope of federal responsibility for the safety of drinking water Amended in 1986 and 1996.
SOC	Synthetic organic compound (or chemical).
SWTR	Surface Water Treatment Rule.
TCR	Total Coliform Rule.
TTHMs	Total Trihalomethanes – Chemicals formed when chlorine reacts with organic materials and chemical contaminants in drinking water. Total THMs consist of chloroform, bromodichloromethane, bromoform, and dibromochloromethane.
TNCWS	Transient non-community water systems. A public water system that has at least 15 service connections or serves water to 25 different persons at least 60 days of the year. Examples are restaurants, motels, campgrounds, and ski areas.
Trigger Level	A specified concentration of a contaminant above which a system must increase monitoring.
Trip Blank	See field reagent blank definition.
Virus	An infectious agent smaller than bacteria.

VOC	Volatile organic chemical (or compound).
Vulnerability	A system is considered vulnerable if the analysis of several factors shows susceptibility to contamination.
Waiver	Document that permits system to substantially reduce its monitoring requirements.
Wilson’s Disease	Excessive copper retention and toxic accumulation in the liver and brain.

Appendix B

Bibliography

EPA Fact Sheets

Stage 1 Disinfectants and Disinfection Byproducts Rule:
A Quick Reference Guide. May 2001.
EPA 816-F-01-010. U.S. EPA Office of Water.

Stage 1 Disinfectants and Disinfection Byproducts Rule:
Laboratory Quick Reference Guide.
December 2002. EPA 816-F-02-021.
U.S. EPA Office of Water.

Long Term 1 Enhanced Surface Water Treatment Rule:
A Quick Reference Guide. January 2002.
EPA 816-F-02-001. U.S. EPA Office of Water.

Interim Enhanced Surface Water Treatment Rule:
A Quick Reference Guide. May 2001.
EPA 816-F-01-011. U.S. EPA Office of Water.

Filter Backwash Recycling Rule:
A Quick Reference Guide. June 2001.
EPA 816-F-01-019. U.S. EPA Office of Water.

Total Coliform Rule:
A Quick Reference Guide. November 2001.
EPA 816-F-01-035. U.S. EPA Office of Water.

Arsenic and Clarifications to Compliance and New Source Monitoring Rule:
A Quick Reference Guide. January 2001.
EPA 816-F-01-004. U.S. EPA Office of Water

Radionuclides Rule:
A Quick Reference Guide. June 2001.
EPA 816-F-01-0003 U.S. EPA Office of Water.

National Primary Drinking Water Standards.
March 2001. EPA 816-F-01-007.
U.S. EPA Office of Water

The Public Notification Rule:
A Quick Reference Guide. May 2000. EPA 816-F-00-023. U.S. EPA Office of Water.

Lead and Copper Rule Minor Revisions:

Fact Sheet of Public Water Systems That Serve 3,300 or Fewer Persons. March 2000. EPA 816-F-00-007. U.S. EPA Office of Water.

Pocket Sampling Guide for Operators of Small Water Systems:
1992. EPA 814-B-92-001. U.S. EPA, Office of Ground Water and Drinking Water.

Pocket Sampling Guide for Operators of Small Water Systems: Phase II and V:
1994, EPA-814-B-94-001. U.S. EPA, Office of Ground Water and Drinking Water.

Standard Methods for the Examination of Water and Wastewater, 18th (1992), 19th (1995), and 20th ed.
1998. American Public Health Association, et al.

Public Notification Handbook:
2000. EPA-816-R-00-010. U.S. EPA Office of Water.

A Small Systems Guide to the Total Coliform Rule:
2001. EPA 816-R-01-017A. U.S. EPA, Office of Water.

Small Systems Guide to Safe Drinking Water Act Regulations - The First STEP to Providing Safe and Reliable Drinking Water: 2003. EPA 816-R-03-017. U.S. EPA, Office of Ground Water and Drinking Water.

Appendix C

National Primary Drinking Water Regulations

40 Code of Federal Regulations

Part 141.21	Coliform Sampling
Part 141.23	Inorganic Chemical Sampling and Analytical Requirements.
Part 141.24	Organic Chemicals, Sampling and Analytical Requirements
Part 141.25	Analytical Methods for Radioactivity
Part 141.61	Maximum Contaminant Levels (MCL) for Organic Contaminants
Part 141.62	MCL for Inorganic Contaminants
Part 141.63	MCL for Microbiological Contaminants
Part 141.64	MCL for Disinfection Byproducts
Part 141.65	Maximum Residual Disinfection Levels
Part 141.66	MCL for Radionuclides
Part 141.74	Analytical and Monitoring Requirements (Filtration and Disinfection)
Part 141.86	Monitoring Requirements for Lead and Copper in Tap Water
Part 141.87	Monitoring Requirements for Water Quality Parameters (Lead and Copper)
Part 141.131	Analytical Requirements (Disinfectant Residuals, Disinfection Byproducts and Disinfection Byproduct Precursors, DBP)

Part 141.132	Monitoring Requirements (DBP)
Part 141.172	Disinfection Profiling and Benchmarking (Enhanced Filtration and Disinfection)
Part 141.174	Filtration Sampling Requirements
Part 141.201	General Public Notification Requirements

The U.S. EPA Safe Drinking Water Hotline (1-800-426-4791) is available for assistance in understanding drinking water regulations and programs developed by EPA. The hotline is available M - F, 9:00 a.m. – 5:30 p.m., Eastern Time. The hotline can also be contacted through EPA's Website shown above. ***As current regulations are revised, they will be posted on the USEPA Website*** (http://www.epa.gov/safewater).