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Stage 1 Disinfectants and Disinfection Byproducts Rule Guidance for Colorado Public Water Systems

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Colorado Department
of Public Health
and Environment

This guidance document is provided by the State of Colorado for Public Water Systems and addresses requirements for the Disinfectants and Disinfection Byproducts Rule. This document offers guidance to systems to ensure compliance with the Disinfectants and Disinfection Byproducts Rule of the Colorado Primary Drinking Water Regulations.

This document provides guidance to public water systems. The document is not, however, the actual Environmental Protection Agency or State of Colorado regulation, nor is it a regulation itself. The actual regulation can be found in 40 CFR (Code of Federal Regulations) Part 141

INTRODUCTION

PURPOSE: This guidance document provides a summary of the applicable regulatory requirements associated with the Stage 1 Disinfectants and Disinfection Byproducts Rule promulgated by the Environmental Protection Agency (EPA) on December 16, 1998 and adopted by reference by the Colorado Department of Public Health and Environment (CDPHE). This guidance provides a summary of the applicable requirements and the dates by which the requirements must be met. It is a basic “what and when” summary for all public water systems. While all systems should feel comfortable using this document as a complete and accurate summary of Stage 1 D/DBP requirements, the applicable full legal language is contained in the Code of Federal Regulation adopted by reference. The actual text of these requirements is provided, under separate cover, and is titled Stage 1 Disinfectants and Disinfection Byproducts Rule Level 2 Line of Sight Document. This document is available on the CDPHE web site at www.CDPHE.state.co.us/wq.

APPLICABILITY:

This CDPHE Guidance Applies to...	
Systems:	CWSs, NTNCWSs, TNCWSs
Source:	All sources
Persons Served:	All sizes
Treatment:	All treatments

Please note that this guidance provides a summary of “what and when” requirements. Additional references that provide guidance for plant owners and operators with respect to how to control plant operations to meet these requirements are provided throughout the document and are summarized in Appendix A.

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* This acknowledgement is not an endorsement by CDPHE of any individual or business and conveys no implication that listed individuals or businesses have or do not have specialized expertise to assist public water systems in the design, operation, management, monitoring or compliance evaluation associated with these regulations.

TABLE OF CONTENTS

ACRONYMS.....	5
PART I. REQUIREMENTS AFFECTING ALL SYSTEMS	6
1.0 Scope and Applicability.....	6
1.1 Key Compliance Dates	9
1.2 Maximum Contaminant Level Goals and Maximum Contaminant Levels for Disinfection Byproducts	11
1.3 Maximum Contaminant Level Goals and Maximum Contaminant Levels for Disinfectant Residuals	12
1.4 Water System Monitoring Plan.....	13
1.5 Analytical Methods.....	14
1.6 Best Available Technology (BAT).....	18
1.7 Record-keeping.....	18
1.8 Public Notification.....	19
1.9 USEPA Guidance Manuals.....	20
1.10 Seasonal Monitoring and Compliance Requirements.....	20
1.11 Criteria to Establish the Existence of Multiple Wells Drawing from the Same Aquifer	22
1.12 Establishing Distribution System Sampling Locations Representative of Maximum and Average Residence Time	22
1.13 Determining Compliance with TTHM/HAA5 Requirements With Multiple Plants Providing Significantly Different Proportions of the Finished Water	24
1.14 Consecutive Systems	25
1.15 Extensions To Disinfection Byproducts MCL Compliance Dates For Systems Installing GAC or Membrane Technology	25
1.16 Source Water and Treatment Definitions	26
1.17 Qualified Operating Personnel.....	26
1.18 Approval of DPD Colorimetric Tests	26
PART II. MONITORING, COMPLIANCE, AND REPORTING.....	27
2.0 General Requirements.....	27
2.1 TTHM/HAA5 Requirements for Surface Water and GWUDI Systems Serving ≥10,000 Persons.....	29
2.2 TTHM/HAA5 Requirements for Surface Water and GWUDI Systems Serving 500 to 9,999 Persons	32
2.3 TTHM/HAA5 Requirements for Surface Water and GWUDI Systems Serving <500 Persons	35
2.4 Precursor Removal for Surface Water and GWUDI Systems Using Conventional Treatment	38
2.5 Disinfection Byproduct Precursor Removal Compliance Monitoring.....	43
2.6 Disinfection Byproduct Precursor Removal Compliance Determination and Reporting – General Information.....	45
2.7 Demonstrating Compliance by Use of the Alternative Compliance Criteria	47
2.9 Ground Water Systems Serving ≥10,000 Persons	52
2.10 Ground Water Systems Serving <10,000 Persons	54
2.11 Additional Requirements for All Systems Using Chlorine and/or Chloramines	56

2.12	Additional Requirements for All Systems Using Ozone	59
2.13	Additional Requirements for All Systems Using Chlorine Dioxide.....	61
	PART III. VIOLATIONS REPORTING.....	68
3.1	Tier 2 and Tier 3 Violations Reporting.....	68
3.2	Tier 1 Violations Reporting	69

ACRONYMS

ACC	Alternative Compliance Criteria
BAT	Best Available Technology
CDPHE	Colorado Department of Public Health and Environment
CFR	Code of Federal Regulations
CWS	Community Water System
D/DBP	Disinfectants and disinfection byproducts
D/DBPR	Disinfectants and Disinfection Byproducts Rule
DBPs	Disinfection Byproducts
DBPP	Disinfection Byproducts Precursor
DOC	Dissolved Organic Carbon
EPA	United States Environmental Protection Agency
GAC10	Granular activated carbon adsorption with a 10 minute empty bed contact time
GWUDI	Ground Water Under the Direct Influence of Surface Water
HAA5	Sum of five haloacetic acids (monochloroacetic acid, dichloroacetic acid, trichloroacetic acid, monobromoacetic acid, dibromoacetic acid)
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
mg/L	Milligrams per liter
MRDL	Maximum Residual Disinfectant Level (as mg/L)
MRDLG	Maximum Residual Disinfectant Level Goal
NCWS	Non-Community Water System
NTNCWS	Non-Transient Non-Community Water System
PWS	Public Water System
SDWA	Safe Drinking Water Act
SOP	Standard Operating Procedure
SUVA	Specific Ultraviolet Absorbance
TNCWS	Transient Non-Community Water System
TOC	Total Organic Carbon
TTHMs	Total trihalomethanes (Sum of chloroform, bromoform, chlorodibromomethane, and bromodichloromethane)

PART I. REQUIREMENTS AFFECTING ALL SYSTEMS

1.0 Scope and Applicability

- 1.0.1 The purpose of the Stage 1 Disinfectants and Disinfection Byproducts Rule (D/DBPR) is to minimize consumer exposure to disinfection byproducts (DBPs) and disinfectants in drinking water. The public health benefits of common disinfection practices are significant and well recognized; however, disinfection poses risks of its own. While disinfectants are effective in controlling many harmful microorganisms, they react with organic and inorganic matter (known as disinfection byproduct precursors—DBPPs) in the water and form DBPs, some of which pose health risks at certain levels. Since the discovery of chlorination byproducts in drinking water in 1974, many toxicological studies have shown some DBPs to be carcinogenic (cancer-causing) and/or to cause reproductive or developmental effects in laboratory animals. Additionally, exposure to high levels of disinfectants over long periods of time may cause health problems, including damage to blood and kidneys. While many of these studies have been conducted at high doses, the weight-of-evidence indicates that disinfectants and DBPs present a potential public health problem that must be addressed. One of the most complex questions facing water supply professionals is how to reduce risks from disinfectants and DBPs while providing increased protection against microbial contaminants. Much of the population is exposed to these risks; therefore, a substantial concern exists.

Health risks associated with some DBPs were addressed prior to promulgation of this Rule by the regulation of total trihalomethanes (TTHM) at public water system (PWSs) serving 10,000 or more people. The Colorado Department of Public Health and Environment, however, believes that the Stage 1 D/DBPR will significantly decrease the risks posed by DBPs and disinfectants. The Stage 1 D/DBPR will broaden public health protection by: 1) reducing the TTHM allowable level, 2) regulating disinfectants and additional DBPs, 3) reducing risks from unregulated DBPs, and 4) extending coverage to all systems, including small PWSs not currently regulated for TTHM or other DBPs.

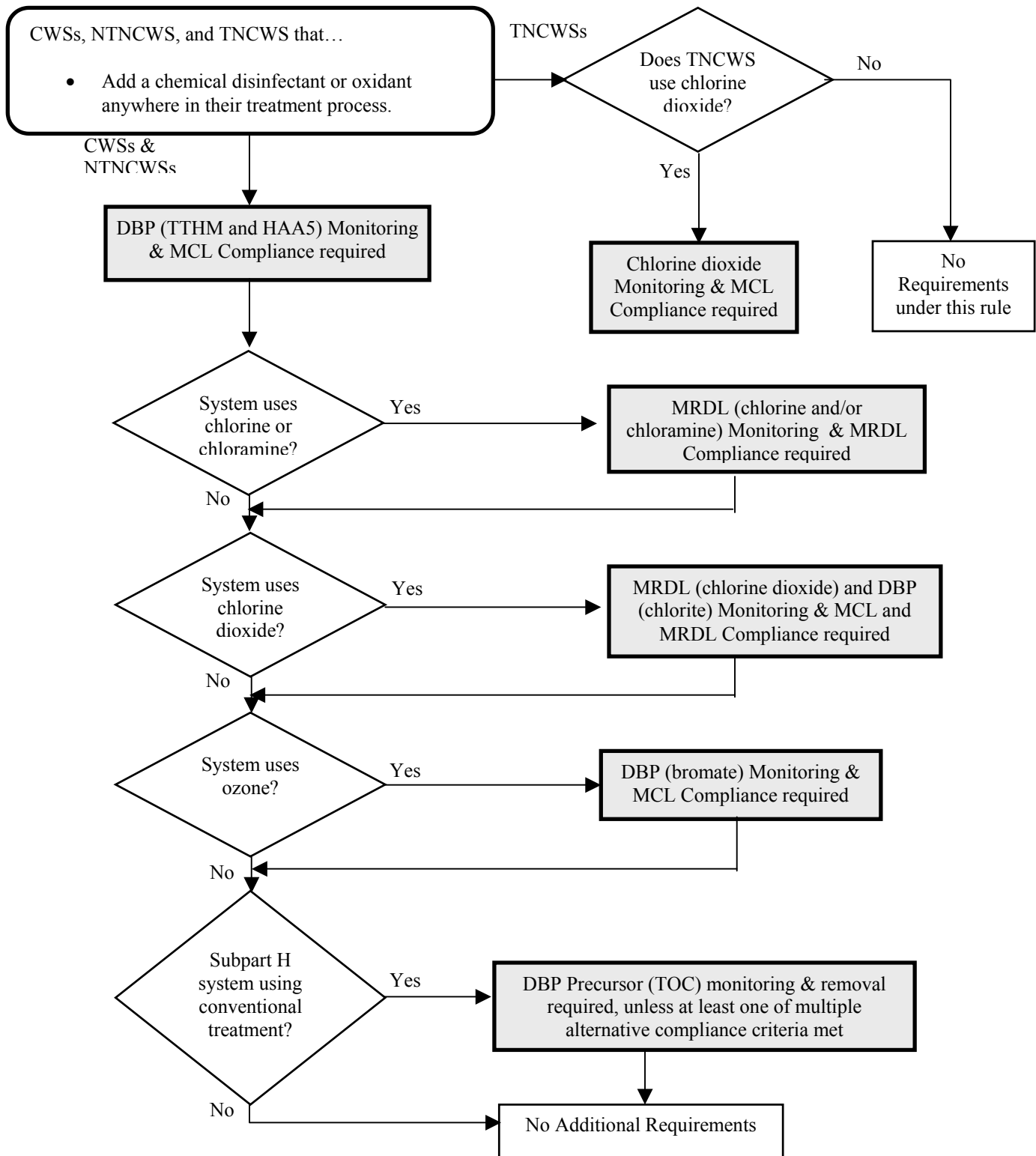
- 1.0.2 The Stage 1 D/DBPR applies to all Community Water Systems (CWSs) and Non-Transient Non-Community Water Systems (NTNCWSs) that add a chemical disinfectant to their water for either primary or residual treatment. In addition, certain requirements apply to Transient (TNCWSs) that use chlorine dioxide.
- 1.0.3 This CDPHE Guidance document explains the requirements of the Stage 1 D/DBPR that affects all or most water systems. General requirements for the rule are outlined in Figure 1-1.

- 1.0.4 With this guidance document as a guide, water systems can comply fully with the requirements of the Stage 1 D/DBPR as adopted by CDPHE, by complying with the following:

**TABLE 1-1
Compliance**

If Your System uses...	And serves...	You must comply with these Sections of this Guidance Document...
Surface water...	≥ 10,000 persons	Part 1 (All Sections) Part 2 (Sections 2.0; 2.1; 2.11)
	500 to 9,999 persons	Part 1 (All Sections) Part 2 (Sections 2.0; 2.2; 2.11)
	<500 persons	Part 1 (All Sections) Part 2 (Sections. 2.0; 2.3; 2.11)
Conventional treatment...	All system sizes; surface water and GWUDI	Part 2 (Section 2.4; 2.5; 2.6; 2.7; 2.8)
Ground water...	≥10,000 persons	Part 1 (All Sections) Part 2 (Sections. 2.0; 2.9; 2.11)
	<10,000 persons	Part 1 (All Sections) Part 2 (Sections. 2.0; 2.10; 2.11)
Ozone anywhere in the treatment process	All system sizes, surface and/or ground water	Part 2 (Section 2.12)
Chlorine dioxide anywhere in the treatment process	All system sizes, surface and/or ground water	Part 2 (Section 2.13)

**FIGURE 1-1
Stage 1 D/DBPR General Requirements**



1.1 Key Compliance Dates

- 1.1.1 Key compliance dates with provisions of the Stage 1 Disinfectants and Disinfection Byproducts Rule are summarized in Table 1-2.
- 1.1.2 Dates of compliance are determined by system type, source water, persons served, and treatment applied.
- 1.1.3 Water systems must be in compliance with the applicable requirements by their applicable compliance date(s) shown in Table 1-2.
- 1.1.4 The general requirements of the Stage 1 D/DBPR are shown in Figure 1-1. The rule elements are discussed in the following sections.

TABLE 1-2
Compliance Dates for the Stage 1 D/DBPR

System	Source Water	Persons Served	Compliance Dates
CWSs, NTNCWSs	Surface water or GWUDI	10,000 or more	By Jan. 1, 2002, comply with new MCL's (Table 1-3) and MRDL's (Table 1-4). Only systems using conventional treatment must comply with precursor removal requirements.¹ By Jan. 31, 2002, make monitoring plan available for inspection by CDPHE and public. By April 10, 2002, the Monitoring Plan must be submitted to CDPHE.
CWSs, NTNCWSs	Surface water or GWUDI	Less than 10,000	By Jan. 1, 2004, comply with new MCL's (Table 1-3) and MRDL's (Table 1-4). Only systems using conventional treatment must comply with precursor removal requirements. By Jan. 31, 2004, make monitoring plan available for inspection by CDPHE and public. By April 10, 2004, for systems 3,300 to 9,999, the Monitoring Plan must be submitted to CDPHE.
CWSs, NTNCWSs	Ground water	All Sizes	By Jan. 1, 2004, comply with new MCL's (Table 1-3) and MRDL's (Table 1-4). By Jan. 31, 2004, make monitoring plan available for inspection by CDPHE and public. April 10, 2004, begin requirement that monitoring plan must be submitted to CDPHE, if requested in writing by CDPHE.
TNCWSs	Surface water or GWUDI using chlorine dioxide	10,000 or more	By Jan. 1, 2002, comply with chlorine dioxide MRDL (see Table 1-4). By April 10, 2002, Monitoring Plan must be submitted to CDPHE.
TNCWSs	Surface water or GWUDI using chlorine dioxide	Less than 10,000	By Jan. 1, 2004, comply with chlorine dioxide MRDL (see Table 1-4). By April 10, 2004, for systems 3,300 to 9,999, the Monitoring Plan must be submitted to CDPHE.
TNCWSs	Ground water using chlorine dioxide	All sizes	By Jan. 1, 2004, comply with chlorine dioxide MRDL (see Table 1-4). By April 10, 2002, Monitoring Plan must be submitted to CDPHE, if requested in writing by CDPHE.

¹A system installing granular activated carbon (GAC) or membrane technology to comply may apply to CDPHE for an extension of up to 24 months. In no case can the compliance date be extended beyond December 31, 2003.

1.2 Maximum Contaminant Level Goals and Maximum Contaminant Levels for Disinfection Byproducts

- 1.2.1 Limits are set for the Disinfection Byproducts (DBPs) as listed in Table 1-3.
- 1.2.2 Water systems must meet the new Maximum Contaminant Levels (MCLs). Maximum Contaminant Level Goals (MCLGs) are non-enforceable health goals.
- 1.2.3 The MCL for chlorite applies only to systems using chlorine dioxide in any part of their treatment process.
- 1.2.4 The MCL for bromate applies only to systems using ozone in any part of their treatment process.

TABLE 1-3
Disinfection Byproduct MCLG's and MCL's

Disinfection Byproduct	MCLG (mg/L)	MCL (mg/L)
Total Trihalomethanes (TTHM) ¹	NA	0.080
Chloroform	Withdrawn	NA ²
Bromodichloromethane	Zero	NA ²
Bromoform	Zero	NA ²
Dibromochloromethane	0.06	NA ²
Five Haloacetic Acids (HAA5) ³	NA	0.060
Dichloroacetic Acid	Zero	NA ⁴
Trichloroacetic Acid	0.3	NA ⁴
Chlorite	0.8	1.0
Bromate	Zero	0.010

¹Total Trihalomethanes (TTHM's) = sum of chloroform, bromodichloromethane, bromoform, dibromochloromethane.

²While the concentration of any one of the constituents contributing to total trihalomethanes is not specified, the sum of all constituents must not exceed the MCL of 0.080 mg/L.

³HAA5 = sum of monochloroacetic acid, dichloroacetic acid, trichloroacetic acid, monobromoacetic acid, dibromoacetic acid.

⁴While the concentration of any one of the constituents contributing to five haloacetic acids (HAA5) is not specified, the sum of all the constituents must not exceed the MCL of 0.060 mg/L.

1.3 Maximum Contaminant Level Goals and Maximum Contaminant Levels for Disinfectant Residuals

- 1.3.1 Limits are set for disinfectant residuals listed in Table 1-4.
- 1.3.2 Water systems must meet the new Maximum Residual Disinfectant Levels (MRDLs) and must demonstrate compliance by monitoring disinfectant levels in the distribution system when total coliform samples are collected. Maximum Residual Disinfectant Level Goals (MRDLGs) are non-enforceable health goals.
- 1.3.3 Systems may increase residual disinfectant levels in the distribution system above the MRDL for chlorine or chloramines (but not chlorine dioxide) for a time necessary to protect public health, to address specific microbiological contamination problems caused by circumstances such as, but not limited to, distribution line breaks, storm run-off events, source water contamination events, or cross-connection events.
- 1.3.4 Systems using chlorine dioxide must refer to Section 2.13 of this guidance for meeting the chlorine dioxide MRDL and the chlorite MCL.

TABLE 1-4
Disinfectant Residual MRDLG's and MRDL's

Disinfectant	MRDLG (mg/L)	MRDL (mg/L)
Chlorine	4 as free Cl ₂	4.0 as free Cl ₂
Chloramines	4 as total Cl ₂	4.0 as total Cl ₂
Chlorine Dioxide	0.8 as ClO ₂	0.8 as ClO ₂

1.4 Water System Monitoring Plan

1.4.1 Basic Requirements for Systems

- (a) Each water system must develop a monitoring plan consistent with the format and content contained in the most current version of the Colorado Department of Public Health and Environment, Drinking Water Monitoring Plan Template. The most recent version is available on the CDPHE web site. Each system's monitoring plan must, in addition to providing source, treatment and distribution system information, serve as a specifically tailored roadmap as to how a system intends to comply with the Disinfectant/Disinfection Byproducts monitoring requirements. Each system required to monitor under this subpart must develop and implement a monitoring plan. The system must maintain the plan and make it available for inspection by the State and the general public no later than 30 days following the applicable compliance dates in § 141.130(b) [see Table 1-2]. All systems using surface water or ground water under the direct influence of surface water (Subpart H systems) serving more than 3,300 people must submit a copy of the monitoring plan to the State no later than the date of the first report required under § 141.134 [see Table 1-2]. Systems using ground water NOT under the direct influence of surface water serving more than 3,300 people may, at their discretion, submit a copy of the monitoring plan to the State. The State may also require the plan to be submitted by any other system. Such other systems must be notified in writing by the State of the requirement to submit a monitoring plan and the timeframe within which it must be submitted. Any plan submitted to the State is presumptively approved if after 60 days of receipt the State has not reviewed the plan or requested additional information; however, the State reserves the right to review the plans at any time and request additional information or changes to the plan. After review, the State may require changes in any plan elements. The plan must include at least the following elements:
 - (i) Specific locations and schedules for collecting samples for any parameters included in this subpart.
 - (ii) How the system will calculate compliance with MCLs, MRDLs, and treatment techniques.
 - (iii) If approved for monitoring as a consecutive system, or if providing water to a consecutive system, under the provisions of §141.29, [see Section 1.14] the sampling plan must reflect the entire distribution system.

1.4.2 Monitoring Plan Revisions

- (a) Systems must revise their monitoring plans when significant new service connections are added to extend the distribution system, if the service population grows, if any major changes to the treatment processes are made or for other reasons such as a site becoming inaccessible. Sampling locations may be changed without prior notification to the CDPHE, however, all monitoring plans must document the

justification for changing sampling locations. Any revisions a system makes to their monitoring must be reflected in the monitoring plan within 30 days of the revision. In addition, systems using surface water or GWUDI serving more than 3,300 people must notify the Department in writing of any revisions made to their plan within 30 days of the revision. The revisions should be sent to the following address:

CDPHE
WQCD-CADM-B2
4300 Cherry Creek Drive South
Denver, CO 80246-1530

1.5 Analytical Methods

1.5.1 Samples for compliance with MCL's under the D/DBPR must be analyzed only by certified laboratories or Colorado Certified Operators using USEPA-approved analytical methods.

- (a) Certified Operators who are responsible for operation of Public Water Systems that conduct compliance monitoring for the D/DBPR, as a party approved by CDPHE, may delegate the above task in the same manner that they delegate other operational requirements. They remain responsible for ensuring that the parties actually conducting such tasks are properly trained and consistently follow the QA/QC procedures outlined in their system's Monitoring Plan.

1.5.2 Methods in Tables 1-5, 1-6 and 1-7 are approved for compliance monitoring.

1.5.3 Analysis by Colorado Certified Operators of residual disinfectants and other specified parameters is approved by CDPHE as shown in Tables 1-5, 1-6 and 1-7 provided they were certified after August 2002, or attended CDPHE sponsored training and quality assurance procedures specified in Section 1.5.5 are used.

1.5.4 CDPHE has approved measurement of residual disinfectant concentrations for chlorine, chloramines, and chlorine dioxide using DPD colorimetric test methods, provided quality assurance procedures specified in Section 1.5.5 are used.

1.5.5 The State of Colorado requires that the data generated to comply with this Rule is verifiable through the application of a utility-specific QA/QC Plan. Though Plans may differ widely, all should evaluate analyst performance for each method/procedure by documentation/verification of the following checks:

- (a) Calibrating instruments and ensuring that instrument measurements do not drift. Describe how this is done as a portion of each analytical SOP included in your utility's monitoring plan.
- (b) Assessing the precision of each analytical procedure by analyzing duplicate samples at a stated frequency. Describe how this is done as a portion of each analytical SOP included in your utility's monitoring plan. Justify using the frequency specified.
- (c) Determine the bias of each analytical procedure by analyzing matrix spiked samples (known/standard additions), standards from an independent source, and/or blind (performance check or unknown) samples at a stated frequency. Describe how this is

done as a portion of each analytical SOP included in your utility's monitoring plan. Justify using the frequency specified. Standards and/or performance check samples are available from, but not limited to, suppliers certified by the National Institute of Standards and Technology (NIST) National Voluntary Laboratory Accreditation Program. A list of accredited suppliers is available from the NIST website at: <http://ts.nist.gov/nvlap>

- 1.5.6 The Utility's QA/QC Plan must also state how records of performance will be kept, how to identify poor performance, and what actions will be taken to improve poor performance.

TABLE 1-5
Approved Analytical Methods for Disinfection Byproduct Precursors¹

Analyte	Technique	Approved Method	Party Approved to Conduct Analyses
TTHMs	- P&T/GC/EICD&PID - P&T/GC/MS - LLE/GC/ECD	- USEPA Method 502.2 - USEPA Method 524.2 - USEPA Method 551.1	Certified Laboratory
HAA5	- LLE/GC/ECD - SPE/GC/ECD - LLE/GC/ECD	- Standard Method 6251 B - USEPA Method 552.1 - USEPA Method 552.2	Certified Laboratory
Chlorite ²	Amperometric Titration	Standard Method 4500-ClO₂ E	- Certified Laboratory or - Certified Operator
	Ion Chromatography	EPA 300.0	Certified Laboratory
	Ion Chromatography	EPA 300.1	Certified Laboratory
Bromate	Ion Chromatography	EPA Method 300.1	Certified Laboratory

Key:

P&T	purge and trap	GC	gas chromatography
EICD	electrolytic conductivity detector	PID	photo ionization detector
MS	mass spectrometer	LLE	Liquid/liquid extraction
ECD	electron capture detector	SPE	solid phase extractor

¹ Only CDPHE-certified laboratories may analyze samples for compliance with the MCL's as indicated in Table 1-5. Methods in table 1-5 are effective for compliance monitoring on February 16, 1999.

² Amperometric titration may be used for routine daily monitoring of chlorite at the entrance to the distribution system, as prescribed in 141.132(b)(2)(i)(A). Ion chromatography must be used for routine monthly monitoring of chlorite and any additional monitoring samples of chlorite in the distribution system, as prescribed in 141.132(b)(2)(i)(B) and (b)(2)(ii). These routine monthly and additional samples must be analyzed by a certified laboratory.

TABLE 1-6
Approved Analytical Methods for Disinfectant Residuals¹

Analyte	Technique	Approved Method	Party Approved to Perform Analyses
Free Chlorine	- Amperometric Titration - Amperometric Titration - DPD Ferrous Titration - DPD Colorimetric - Syringaldazine (FACTS)	- Standard Method 4500-Cl D - ASTM Method D 1253-86 - Standard Method 4500-Cl F - Standard Method 4500-Cl G - Standard Method 4500-Cl H	- Certified Laboratory or - Certified Operator
Combined Chlorine	- Amperometric Titration - Amperometric Titration - DPD Ferrous Titrimetric - DPD Colorimetric	- Standard Method 4500-Cl D - ASTM Method D 1253-86 - Standard Method 4500-Cl F - Standard Method 4500-Cl G	- Certified Laboratory or - Certified Operator
Total Chlorine	- Amperometric Titration - Amperometric Titration - Low-Level Amperometric Titrimetric - DPD Ferrous Titration - DPD Colorimetric - Iodometric Electrode	- Standard Method 4500-Cl D - ASTM Method D 1253-86 - Standard Method 4500-Cl E - Standard Method 4500-Cl F - Standard Method 4500-Cl G - Standard Method 4500-Cl I	- Certified Laboratory or - Certified Operator
Chlorine dioxide	- DPD - Amperometric Method II	- Standard Method 4500-ClO₂ D - Standard Method 4500-ClO₂ E	- Certified Laboratory or - Certified Operator

¹ Methods in Table 1-6 are effective for compliance monitoring February 16, 1999. Systems may also measure residual disinfectant concentrations for chlorine, chloramines, and chlorine dioxide by using DPD colorimetric test kits. As Specified in Section 1.5, residual disinfectants may be analyzed by Colorado Certified Operators.

TABLE 1-7
Approved PARTIES AND Analytical Methods for Precursor Removal
Requirements

Analyte	Technique	Approved Method	Party Approved to Perform Analyses ¹
Alkalinity	• Titrimetric	• ASTM D1067-92B	• Certified Operator or Certified Laboratory
	• Titrimetric	• Standard Method 2320 B	• Certified Operator or Certified Laboratory
	• Titrimetric	• USGS I-1030-85	• Certified Operator or Certified Laboratory
TOC ²	• High-Temperature Combustion	• Standard Method 5310 B	• Certified Laboratory
	• Persulfate-UV or Heated Persulfate Oxidation	• Standard Method 5310 C	• Certified Laboratory
	• Wet-Oxidation	• Standard Method 5310 D	• Certified Laboratory
UV ₂₅₄ ³	• UV absorption method	• Standard Method 5910 B	• Certified Laboratory or • Certified Operator
pH	• Electrometric	• EPA 150.1	• Certified Laboratory or • Certified Operator
	• Electrometric	• EPA 150.2	• Certified Laboratory or • Certified Operator
	• Electrometric	• ASTM D1293-95	• Certified Laboratory or • Certified Operator
	• Electrometric	• Standard Methods 4500-H ⁺ B	• Certified Laboratory or • Certified Operator
DOC	• High-Temperature Combustion	• Standard Methods 5310 B	• Certified Laboratory
	• Persulfate-UV or Heated Persulfate Oxidation	• Standard Methods 5310C	• Certified Laboratory
	• Wet-Oxidation	• Standard Methods 5310 D	• Certified Laboratory

¹.Certified operator or certified laboratory means certified by the Colorado Water and Wastewater Facility Operators Certification Board or CDPHE respectively.

² TOC samples may not be filtered prior to analysis. TOC samples must either be analyzed or must be acidified to achieve pH less than 2.0 by minimal addition of phosphoric or sulfuric acid as soon as practical after sampling, not to exceed 24 hours. Acidified samples must be analyzed within 28 days.

³ UV absorption must be measured at 253.7 nm (may be rounded off to 254 nm). Prior to analysis, UV₂₅₄ samples must be filtered through a 0.45 um pore-diameter filter. The pH of UV₂₅₄ samples may not be adjusted. Samples must be analyzed as soon as practical after sampling, not to exceed 48 hours.

1.6 Best Available Technology (BAT)

- 1.6.1 BAT must be used if the water system intends to qualify for a variance. Otherwise, water systems are not required to install BAT and may use any technology approved by CDPHE to achieve compliance. Specified BAT is listed in Table 1-8.

TABLE 1-8
Best Available Technology (BAT)

Chemical		Best Available Technology
DBPs	TTHM and HAA5	Enhanced coagulation or granular activated carbon (GAC 10), with chlorine as the primary and residual disinfectant
	Chlorite	Control of treatment processes to reduce disinfectant demand and control of disinfection treatment processes to reduce disinfectant levels
	Bromate	Control of ozone treatment process to reduce production of bromate
Disinfectants	Chlorine, chloramine, and chlorine dioxide	Control of treatment processes to reduce disinfectant demand and control of disinfection treatment processes to reduce disinfectant levels

1.7 Record-keeping

- 1.7.1 All records pertaining to the compliance status of the water system must be retained.
- 1.7.2 In general, the following records must be available on the premises or at a convenient location nearby as specified in the system's monitoring plan:
- 1.7.3 Records of chemical analyses for not less than 10 years including:
- The date, place and time of sampling, and the name of the person who collected the sample;
 - Identification of the sample as to whether it was a routine sample, check sample, raw or process water sample or other special purpose sample;
 - Date of analysis
 - Laboratory and person responsible for performing analysis
 - Analytical technique/method used;
 - Results of the analysis

- 1.7.4 For each violation of the drinking water regulations, the records of action taken by the water system to correct the violation must be kept for not less than 3 years after the date on which the last corrective action was taken.
- 1.7.5 Records concerning a variance or exemption granted to the system must be kept for not less than 5 years following the expiration of such variance or exemption.
- 1.7.6 Records of communications regarding and follow-up actions taken by the system with respect to sanitary surveys are to be retained for not less than 10 years after the sanitary survey.
- 1.7.7 Copies of public notices and certification of public notices made to the state must be retained for 3 years following and issuance.

1.8 *Public Notification*

- 1.8.1 Public notification is required for any violation of an MCL or MRDL and failure to monitor. Refer to CDPHE Public Notification regulations and guidance for procedures and language to be used in public notices.

1.9 USEPA Guidance Manuals

- 1.9.1 USEPA developed a series of guidance manuals to help water utilities comply with the Stage 1 D/DBPR. They are listed in Table 1-9.

TABLE 1-9
USEPA Guidance Documents¹ for the Stage 1 D/DBPR

Title	Topics Covered	Reference
<i>Alternative Disinfectants and Oxidants Guidance Manual¹</i>	Explains how to select and apply alternative disinfectants and oxidants.	EPA 815-R-99-014 (April 1999)
<i>Microbial and Disinfection Byproduct Rules Simultaneous Compliance Guidance Manual¹</i>	Explains how to avoid compliance problems when attempting to comply with more than one rule.	EPA 815-R-99-015 (August 1999)
<i>Enhanced Coagulation and Enhanced Precipitative Softening Guidance Manual¹</i>	Explains how to comply with the DBP precursor removal requirements.	EPA 815-R-99-012 (May 1999)
<i>Disinfection Profiling and Benchmarking Guidance Manual¹</i>	Explains how to develop a disinfection benchmark	EPA 815-R-99-013 (August 1999)

¹ See the Office of Ground Water and Drinking Water (OGWDW) web page at <http://www.epa.gov/safewater/standards.html>. The USEPA guidance documents are located at <http://www.epa.gov/safewater/mdbp/implement.html>.

1.10 Seasonal Monitoring and Compliance Requirements

- 1.10.1 Only plants treating surface water or GWUDI, and operating in conventional mode (coagulation, flocculation, settling, & filtration), are subject to the TOC removal requirements. Plants operating in some other mode during part of the year do not have to monitor or demonstrate TOC removal levels, either through the use of enhanced coagulation or by use of the alternative compliance criteria, for that period. If a plant operates for a full month in direct filtration mode, or uses some other technology that is not conventional treatment, there is no TOC removal requirement during that time. This condition should be noted on the quarterly report. If a plant is operating in the conventional treatment mode, at any time during a month, at least one TOC sample pair must be taken for compliance purposes during that period. If a plant uses alternative

criteria to determine compliance, appropriate sampling and testing should be performed in lieu of TOC. If a conventional treatment plant changes operations, to a technology that is exempt from enhanced coagulation, there is no TOC monitoring or removal requirement for the remainder of the month. If a WTP is turned on for more than 24 hours during any given month and is subject to the TOC requirements (i.e., using conventional filtration), the system must obtain a TOC paired sample and a source water alkalinity sample for that treatment plant.

- 1.10.2 Calculations for compliance determinations should be made based only on the months that the plant was required to meet the TOC removal requirements during an annual period. Thus, if a plant operates in conventional mode for 10 months during an annual period, the running annual average will be based on the average of 10 removal ratios (see Column F, DBP Precursor Form 1). Example: consider a plant that, under normal operating conditions, determines compliance with TOC removal requirements using Table 2-9 (commonly referred to as the “3 x 3 matrix”) and DBP Precursor Form 1; however, that same plant either operates in direct filtration mode or is out of service for an entire month. This plant should NOT report a default value of 1.0 as an alternative TOC removal credit. Instead, for that month, there should be no TOC removal (or credit) recorded. A notation should be made that no TOC removal is required, and the reason (i.e. plant off, operating in direct mode).
- 1.10.3 If a plant chooses to take multiple pairs of samples during a month to track TOC removal, the monthly compliance ratio is the average of the compliance ratios calculated for each set of samples and this is the value reported on DBP Precursor Form 1.
- 1.10.4 Monitoring requirements for the disinfection byproducts TTHM and HAA5 sampling sites are based on the number of treatment plants in operation during any given quarter. Treatment plants identified as seasonal or as peaking facilities in the system’s monitoring plan would not be counted when determining the total number of samples required for the full year; however, those plants that are identified as such that are operational for at least 30 days (or 1 month) during any given quarter, would be counted when determining the number of samples to be analyzed for that quarter. For instance, let’s assume a public water system has 2 water treatment plants (WTP), but only one WTP operates year round. The other WTP is seasonal and operates throughout the months of May to October. In this example, the system must take 4 TTHM and HAA5 samples for the entire year. In addition, the system would be required to take an additional 4 samples (for a total of 8) during the second, third and fourth quarters. If, however, the second plant were only operational for half the month of October, the PWS would only be required to take 4 TTHM and HAA5 samples in the fourth quarter. In both examples, additional samples would not be required during the first quarter since the plant is not operational during that quarter. Please keep in mind that any groundwater source that is disinfected and added directly to the system would be considered one WTP unless the requirements of 1.11 can be proven.

1.11 Criteria to Establish the Existence of Multiple Wells Drawing from the Same Aquifer

Well waters to which the same disinfection treatment is applied will be considered to draw from the same aquifer by using any of the three following approaches:

- 1.11.1 Well construction and geology - Wells will be considered to draw from the same aquifer if drilling records show that wells are completed in the same geologic formation, or part of a formation, and the PWS can demonstrate that water quality is consistent, i.e., the values of the major chemical constituents and physical characteristics are within 25% of one another.

This geology and construction demonstration must consider the characteristics of the aquifer, the depth of the wells, the proximity of the wells to each other, and any potential contamination sources that may impact the wellhead or recharge area.

- 1.11.2 Water Characteristics and Chemistry - For purposes of demonstrating consistent water quality, the system may elect to conduct a water quality comparison using major physical and chemical constituents including, but not limited to, temperature, pH, conductivity, hardness, alkalinity, TOC, and total anion/cations. Other constituents known to be characteristic of the aquifer may augment the required constituents. Chemical concentrations or physical measurements within 25% of one another are indicative of waters from the same aquifer for the purposes of the D/DBPR.
- 1.11.3 Water Characteristics With Respect To Formation Of Byproducts - If byproduct formation potential for both TTHMs and HAA5 of the untreated water from each source is measured using the system's maximum distribution system residence time and maximum distribution system water temperature and if the resulting formation potential is less than 50% of the respective MCL's, the wells may be considered to be drawing from the same aquifer for the purpose of the D/DBPR. In the event a system's distribution system samples reveal a running annual average within 10% of or above the MCL, the system will be required to consult with the State and may be required to treat each well as a separate treatment plant for the purpose of the D/DBPR.

1.12 Establishing Distribution System Sampling Locations Representative of Maximum and Average Residence Time

- 1.12.1 For purposes of demonstrating average and maximum residence time sampling locations, the methods listed below provide options from which systems may choose. There is a wide variety of distribution system configurations and no one model or description fits all systems. Systems should select the simplest method appropriate for their distribution system and, if applicable, the effect and proportionate contribution of each of its multiple treatment plants. The method selected by the public water system to determine both

average and maximum residence times should be selected with the knowledge of: the zone of contribution of each treatment plant; the hydraulic complexity of the system including temporal and spatial water demands; pipe and valve configurations; storage tank locations and operating characteristics; location of pressure zones; and the distribution of the population served by the distribution system. The methods listed below generally begin with the least complex and least expensive. In its monitoring plan, each system should indicate why samples are being taken from a particular location. Sites should generally be selected using professional judgment and operational experience, backed by supporting data and a logical justification, rather than computer analyses and tracer studies. Acceptable methods include:

- (a) Distance calculation (limited applicability for looped and more extensive systems)
- (b) Simplified Residence Time Calculation [$\text{length}/(\text{flow rate}/\text{area})$]
- (c) Historical disinfectant residual concentrations
- (d) Tracer Studies
- (e) Distribution System Hydraulic Modeling
- (f) Site Specific Distribution System Evaluation

- 1.12.2 When a distance calculation is performed, a sample withdrawn at a location between 90% and 100% of the maximum distance is considered to be a sample representative of maximum residence time. Samples withdrawn at locations between 25% and 75% of the maximum distance are considered to be representative of average residence time, provided that in total, the average of the distances of the selected sampling locations approximate 50% of the maximum distance and consider population served. A distance calculation may not be appropriate if significant storage volume exists between the entry point and the farthest point depending on the location and flow-through characteristics of the storage tank. Systems should consider and account for storage system affects considering distance, time, location and flow-through characteristics.
- 1.12.3 When a simplified residence time calculation is performed, a sample withdrawn at a location between 90% and 100% of the calculated maximum is considered to be a sample representative of maximum residence time. Samples withdrawn at locations between 25% and 75% of the calculated maximum are considered to be representative of average residence time, provided that in total, the average of the residence times of the selected sampling locations approximate 50% of the maximum residence time and take into account population densities and their locations.
- 1.12.4 When historical disinfectant residual concentrations are used, calculate the historical average of disinfection residual concentrations at each sampling location. List the resultant average disinfection residual concentrations in ascending order, lowest average residual to highest. A sample location whose average disinfection residual concentration is within locations from 0 to the 10th percentile is representative of distribution system maximum residence time. Locations within the 25th to 75th percentile are representative of distribution system average residence time. Systems should be careful to not bias their selected locations toward either the 25th or the 75th percentile and should consider population density in their sample site selections.

- 1.12.5 When distribution system hydraulic modeling is performed, the system must have data to support the model's predictions are consistent with actual distribution system conditions. With this calibration, a sample withdrawn at a location between 90% and 100% of the calculated maximum is considered to be a sample representative of maximum residence time. Samples withdrawn at locations between 25% and 75% of the calculated maximum are considered to be representative of average residence time, provided that in total, the average of the residence times of the selected sampling locations approximate 50% of the maximum residence time and take into account population densities and their locations.
- 1.12.6 The Division may request that a Distribution System Evaluation (DSE) be conducted to assess compliance monitoring locations. The DSE would consist of sampling at locations throughout the distribution system for a period of time and at a number of locations established by the system in consultation with and approved by the Division. Distribution system evaluations will be used to establish sampling locations only and will not be used for determination of compliance. The Division will establish DSE sampling periods and the number and location of samples considering the Stage 2 D/DBP rule, either the agreement in principle or, when available, the promulgated rule.
- 1.12.7 In distribution systems with multiple treatment plants, multiple wells, or complex operating conditions such as sources being alternated, the Division may require a DSE to be performed in the event that historical sampling has not been distributed throughout the system in ways that consider the relative contribution of multiple treatment plants or the distribution of the population served.

1.13 Determining Compliance with TTHM/HAA5 Requirements With Multiple Plants Providing Significantly Different Proportions of the Finished Water

- 1.13.1 For systems with more than one treatment plant, It may sometimes be appropriate to calculate the quarterly average based on a weighting of the flow provided by each plant. This would be appropriate when the water quality of the individual treatment plant is significantly different from each other with respect to the formation of byproducts and the zones of contribution from each plant are discretely identifiable. In this instance, the quarterly average, representative of each treatment plant should be determined separately. The quarterly average for the entire system should then be calculated by weighing the averages for each of the treatment plants (total number of treatment plants = n) as follows:

Quarterly average for system = (Quarterly average for samples representing plant 1) X (fraction of flow¹ into system from plant 1) + (Quarterly average for samples representing

¹ For the purpose of this determination ONLY, flow is defined as the average daily flow for the subject treatment plant during the subject compliance period. This would be equal to the sum of the daily amount of water produced each day of the compliance period divided by the number of days in the compliance period. The fraction of flow for

plant 2) X (fraction of flow² into system from plant 2) + (Quarterly average for samples representing plant n) X (fraction of flow² into system from plant n). The standard reporting forms do not account for this possibility. In the event a system calculates compliance by weighting the flow from each source, they should consult with the State D/DBP Rule Manager to establish an acceptable reporting format.

1.14 Consecutive Systems

- 1.14.1 Article 1.2.2 of the Colorado Primary Drinking Water Regulations defines a Consecutive System, an Integrated System and a Supply System. As defined, a consecutive system may or may not provide disinfection beyond that provided by the supply system. Consecutive water systems receiving treated water that do not add any additional disinfectant are not currently subject to the monitoring and MCL requirements of the Disinfectants and Disinfection Byproducts regulation even if they serve more than 10,000 people. The supply system would not be required to monitor for or ensure compliance with the MCLs, MRDLs, or monitoring requirements of the D/DBP regulations for such consecutive systems. However, the CDPHE encourages all public water systems to monitor the concentrations of and to take the appropriate steps to limit the concentration of disinfection byproducts in their finished water as expeditiously as possible. Implementation of the Integrated System concept may provide consecutive systems with an effective means to provide their consumers the protections associated with the D/DBP regulations, without the need to develop their own monitoring plan or to install their own additional treatment processes.
- 1.14.2 Consecutive systems that add a disinfectant to their water are subject to the regulatory requirements of the Disinfectants/Disinfection Byproducts regulation based on their source water, system size and treatment processes used. Accordingly, consecutive systems using surface water and serving 10,000 or more people that add a disinfectant must comply with MCLs, MRDLs, and monitoring requirements starting January 1, 2002. Surface water systems serving less than 10,000 people or ground water systems of all sizes that add a disinfectant must comply with the MCLs, MRDLs, and monitoring requirements starting January 1, 2004.

1.15 Extensions To Disinfection Byproducts MCL Compliance Dates For Systems Installing GAC or Membrane Technology

Systems installing GAC or membrane technologies may apply to the state for an extension of up to 24 months (but not beyond December 31, 2003) for compliance with MCLs. This provision only applies to subpart H systems that serve 10,000 or more people.

each plant would be obtained by summing the average daily flow from each plant and dividing the result into the average daily flow total for all treatment plants.

- 1.15.1 Interim Measures – CDPHE will consider each application for an extension on an individual basis considering each system’s potential for achieving meaningful overall risk reduction through reasonable interim treatment measures. Possible treatment or operational measures that will be evaluated for efficacy include the following:
- (1) Moving the point of disinfectant application,
 - (2) Treatment changes to improve precursor removal,
 - (3) Changing primary or secondary disinfectants,
 - (4) Adjusting disinfectant dose based on temperature or pH,
 - (5) Changing pH to reduce DBP formation,
 - (6) Implementation of a main flushing or storage tank operational monitoring programs.
- 1.15.2 Extension Conditions – CDPHE will require that systems enter into compliance schedules with milestones (including construction-based milestones) with the understanding that failure to comply with the schedule or interim requirements is a violation of the primary drinking water regulations. Other extension conditions may include:
- (1) Timely progress reports,
 - (2) Notice of the extension in the annual Consumer Confidence Report,
 - (3) Reporting in the annual Consumer Confidence Report, the monitoring results of the contaminant for which the extension was granted.

1.16 Source Water and Treatment Definitions

The D/DBPR makes numerous references to “source water” and “treatment” but in the text of the regulation does not define the terms. For the purposes of the D/DBPR, “source water” means the natural water that flows to a treatment facility at a location downstream of the point where any intakes are blended and before any treatment is provided or chemical addition is made. The term “treatment” is taken to include any physical means or chemical or biological addition to water under the control of the treatment facility to change the characteristics of the water for drinking water purposes.

1.17 Qualified Operating Personnel

Each public water system subject to the D/DBPR is required to be operated by qualified personnel who meet the requirements specified by the state and are included in a State register of certified operators. For the purposes of this requirement, the CDPHE requires that operators be certified by the Colorado Water and Wastewater Facility Operators Certification Board in accordance with Regulation 100.

1.18 Approval of DPD Colorimetric Tests

Under the authority provided by the EPA (40CFR141.131(c)(2)), the Division will approve any DPD test kit, for creation of data applicable to the Stage 1 Rule, if the data

can be considered reliable. Reliable data is produced under an approved QA/QC Plan. Systems that wish the Division to approve any manufacturer's DPD test kit, must submit a SOP (as part of the system's Monitoring Plan) that includes the QA/QC elements stated in 1.5.5, above. As part of the SOP, the system must develop and describe the dilution method they will use to ensure that the actual concentration measured in mg/L is recorded when the result of any analysis exceeds the maximum readable detection limit of a colorimetric kit's color wheel. For example, if a color wheel only allows chlorine readings of up to 5 mg/L yet the results of an analysis indicate the level is equal to or greater than 5 mg/L, the system must develop a procedure that will enable the operator to accurately determine the actual residual concentration of the water being tested based on the dilution that was used to obtain a reading within the range of the color wheel. Since compliance is based on the monthly average of all analyses performed, a result recorded as '>5 mg/L' cannot be factored into the calculation and the resulting average concentration would be incorrect and reporting such a result would be considered a monitoring violation, reportable as a Tier 3 violation (see Section III).

PART II. MONITORING, COMPLIANCE, AND REPORTING

2.0 General Requirements

- 2.0.1 Part 2 of this guidance document presents the monitoring, compliance determination, and reporting requirements for the Stage 1 D/DBP rule. Requirements are presented first for TTHMs and HAA5 according to source water and system size.
- 2.0.2 It is assumed that the majority of plants will be obtaining their TTHM and HAA5 samples simultaneously; however, since this is not a regulatory requirement, plants may elect to take them at different times. In instances where plants elect to take these samples at different times, they must ensure that the samples have been obtained from the same sampling locations and must briefly explain in their monitoring plan the reasons behind this decision.
- 2.0.3 Water systems using conventional surface water treatment, chlorine and/or chloramines, ozone, or chlorine dioxide must comply with additional requirements summarized in sections 2.5, 2.6, 2.7, 2.11, 2.12 and 2.13.
- 2.0.4 All samples taken and analyzed under the provisions of the water system's monitoring plan are included in determining compliance, even if that number is greater than the minimum required unless the monitoring plan identifies sampling events that are not included for compliance determination purposes.
- 2.0.5 In general, when compliance is based on a running annual average of monthly or quarterly samples or averages and the system's failure to monitor makes it impossible to determine compliance with MRDLs or MCLs, this failure to monitor is treated as a violation for the entire period covered by the annual average.

- 2.0.6 For systems monitoring TTHM/HAA5 less frequently than quarterly, if the value or average - if more than one sample is taken - exceeds the MCL, the system must increase monitoring to once per quarter per treatment plant. If during the first year of quarterly monitoring, any individual quarter's result will cause the running annual average of that system to exceed the MCL, the system is out of compliance at the end of that quarter.
- 2.0.7 Systems that are required to sample quarterly or more frequently must report to the State **within 10 days** after the end of each quarter in which samples were collected.
- 2.0.8 If a submitted sample somehow becomes lost, broken or is ruined by the Laboratory, the system must resample during the same month and the sample must be obtained in accordance with their monitoring plan. If the original sample was taken towards the end of the month and the system is unable to resample during the same month, the system must resample as soon as possible and include any pertinent information on their monitoring forms.
- 2.0.9 If for some reason a system has not received sample results from their laboratory by the time they are required to submit their quarterly report, the system must explain the delay on the reporting form and will accrue a monitoring violation. Once a system receives those results, they must do one of two things. If the sample result(s) does not cause the system to be out of compliance with a treatment technique, MCL or MRDL, the system can report the result(s) along with the next quarterly report. If the system receives a result(s) that consequently causes a treatment technique, MCL or MRDL violation, the system must report the result(s) immediately and must also submit DDBPR Form 2 - Violation Notification to the State in the specified time frame.
- 2.0.10 Systems required to sample less frequently than quarterly must report to the State within 10 days after the end of the quarter in which samples were collected.
- 2.0.11 CDPHE may choose to perform calculations and determine whether the MCL, or MRDL was met in addition to having the system report that information.
- 2.0.12 Systems that meet applicable criteria may reduce their required monitoring or if they exceed specific criteria, have their monitoring requirements increased. Figures 2-1, 2-2 and 2-3 summarize the reduced and increased monitoring criteria for various system sizes and water sources. Systems that have analyzed appropriate samples (analyte, number, location, and method) for a full year at the full monitoring frequency prior to the effective date of the regulation using a Colorado certified laboratory may apply for reduced TTHM/HAA5 monitoring using that data.
- 2.0.13 If a system qualifies for reduced monitoring, the system must notify the Division of their intention to reduce the system's monitoring. The notification must be submitted on DDBPR Form 1 – Request for Reduced Monitoring, which must include the system's suggested monitoring frequency. In addition, the monitoring plan must be revised to address these changes and must be submitted to the state within 30 days following the change.

- 2.0.14 Once a system becomes aware of a violation, it must report the violation to the CDPHE Rule Manager for D/DBP rule on DDBPR Form 2 – Violation Notification. If the violation is a Tier 1 violation (i.e., acute violation for Chlorine Dioxide), the system must report the violation to the Department within 24 hours. In addition, the system must also notify the public within 24 hours using the appropriate public notification procedures for Tier 1 violations. If the violation is either a Tier 2 or Tier 3 violation, the system must report the violation to the Department within 48 hours and they must ensure that the public is notified in the appropriate time frame spelled out for Tier 2 and Tier 3 violations, which is no less than 30 days and 1 year respectively.
- 2.0.15 **Computer Accessibility:** As we move into the future and technologies continue to be developed and refined, the Division envisions having the capability to receive all reporting and monitoring forms electronically thus creating a more cost efficient and time effective mechanism for reporting and, at the same time, reducing the amount of paper being used. Although the Division doesn't have the ability to do so at this time, we have begun to look at ways to develop those technologies and will continue to move in that direction. We strongly suggest that all public water systems start planning for the future so that when the Division has the technology in place, all systems in Colorado will have both the hardware and software necessary to take advantage of these technologies. In addition, a computer can be a useful tool for any public water system. Beyond the simple use of reporting and monitoring, computers can ease the burden of the day-to-day plant operation. For example, they can assist in determining CT values and/or any other calculation necessary on a day-to-day basis. They can also make individual filter profiling as simple as one touch of a button. These are only a few examples and since there are numerous other applications and uses for computers, the benefits of having a computer would far outweigh the cost when everything is taken into consideration.

2.1 TTHM/HAA5 Requirements for Surface Water and GWUDI Systems Serving $\geq 10,000$ Persons

- 2.1.1 All of these systems that add a disinfectant must conduct routine compliance monitoring for TTHMs and HAA5 each year as summarized in Table 2-1. Systems must monitor for at least one year before becoming eligible for reduced monitoring. Figure 2-1 presents a monitoring flow chart for TTHMs and HAA5 for surface water and GWUDI systems serving $\geq 10,000$.
- 2.1.2 Systems may qualify for reduced monitoring, also summarized in Table 2-1; however, CDPHE may return a system to routine monitoring at the State's discretion.
- 2.1.3 Compliance determinations and reporting requirements for TTHMs and HAA5 are summarized in Table 2-2.

TABLE 2-1
TTHM/HAA5 Routine Compliance Monitoring And Reduced Monitoring
Surface Water and GWUDI Systems Serving $\geq 10,000$ Persons

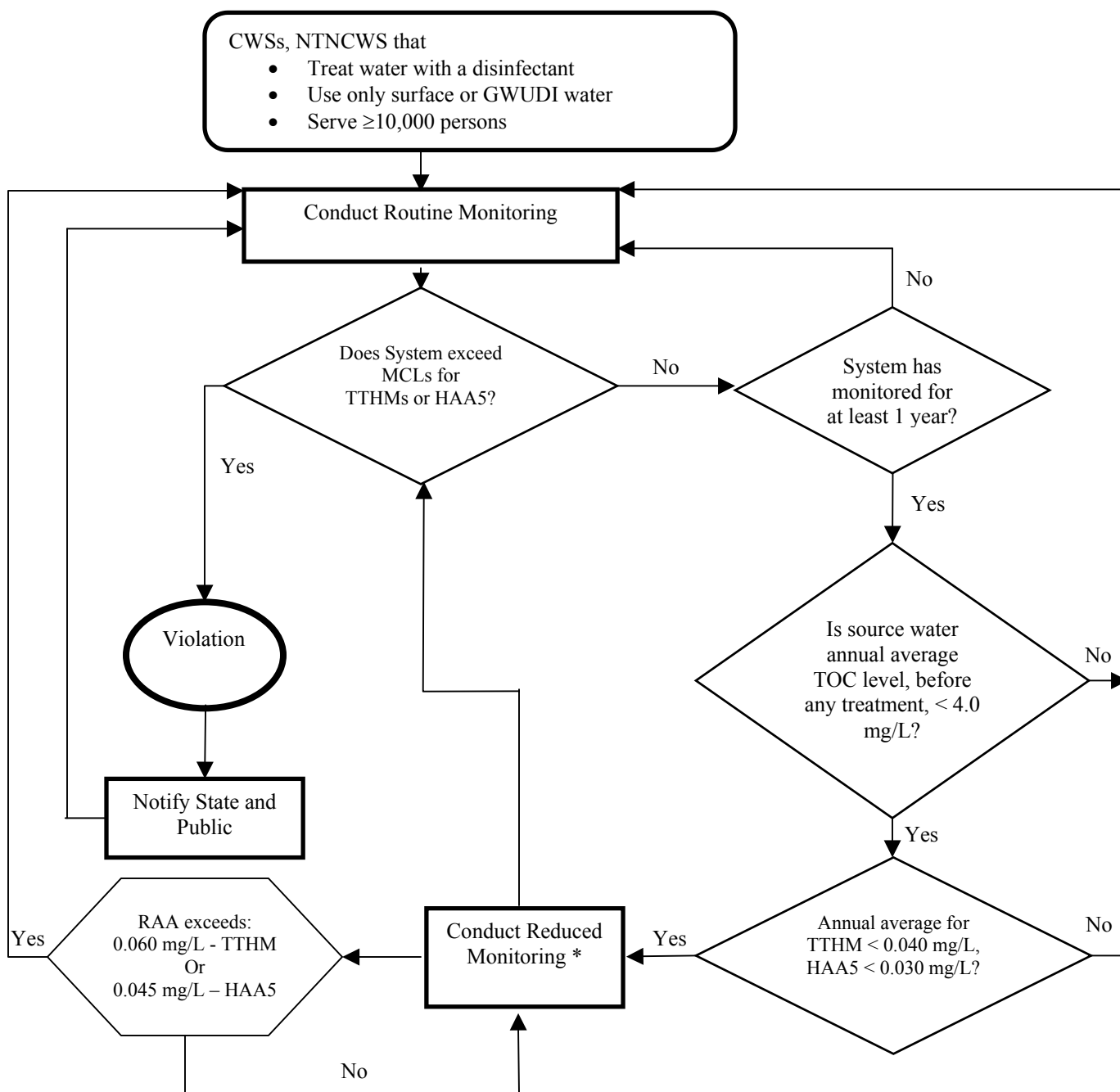
Routine Monitoring	Reduced Monitoring
<u>Frequency</u> 4 samples per plant per quarter <u>Monitoring location¹</u> - At least 25% of samples must be at locations representing maximum residence time. Remaining samples must represent average residence time and the entire distribution system (account for number of people served, different sources of water, different treatment methods).	<u>Frequency</u> 1 sample per treatment plant per quarter <u>Monitoring location</u> - Distribution system location reflecting maximum residence time. <u>Criteria to qualify for reduced monitoring for TTHMs and HAA5</u> - Source water annual average TOC ≤ 4.0 mg/L (based on monthly samples), and - Monitor for at least 1 year and the annual average TTHM ≤ 0.040 mg/L and the annual average HAA5 ≤ 0.030 mg/L

¹ If a system elects to sample more frequently than the minimum required, at least 25% of all samples collected each quarter (including those taken in excess of the required frequency) must be taken at locations that represent the maximum residence time of the water in the distribution system. The remaining samples must be taken at locations representative of at least average residence time in the distribution system.

TABLE 2-2
TTHM/HAA5 Compliance Determination and Reporting Requirements
Surface Water and GWUDI Systems Serving $\geq 10,000$ Persons

Compliance Determination	Reporting Requirements
Compliance is based on a running annual arithmetic average, computed quarterly, of quarterly arithmetic averages of all samples collected. - If annual arithmetic average of quarterly averages covering any consecutive 4-quarter period exceeds the MCL, then the system is in violation. - The system must notify the public and report to the State if in violation. - If an annual average exceeds 0.060 mg/L for TTHM or 0.045 mg/L for HAA5 and the system is on reduced monitoring, it must revert to routine monitoring immediately.	The following must be reported to CDPHE - Number of samples taken during last quarter - Location, date, result of each sample taken during last quarter - Arithmetic average of all samples taken during last quarter - Annual arithmetic average of quarterly averages for last 4 quarters - Whether MCL was violated

FIGURE 2-1
TTHM and HAA5 Routine and Reduced Monitoring Flow Chart for
Surface Water and GWUDI Systems Serving ≥10,000 Persons



* Only if the following are met: 1) monitoring data was collected under the provisions of Article 15 of the *Colorado Primary Drinking Water Regulations*; 2) the state is notified in writing of the system's intention to reduce monitoring; 3) the state approves of the reduced monitoring schedule; and 4) a copy of the revised monitoring plan is submitted for approval to the state.

2.2 TTHM/HAA5 Requirements for Surface Water and GWUDI Systems Serving 500 to 9,999 Persons

- 2.2.1 All of these systems that add a disinfectant must conduct routine compliance monitoring for TTHMs and HAA5 each year as summarized in Table 2-3. These systems must monitor for at least one year before becoming eligible for reduced monitoring. Figure 2-2 presents a monitoring flow chart for TTHMs and HAA5 for surface water and GWUDI systems serving 500 to 9,999.
- 2.2.2 Systems may qualify for reduced monitoring, also summarized in Table 2-3; however, CDPHE may return a system to routine monitoring at the State's discretion.
- 2.2.3 Compliance determinations and reporting requirements for TTHMs and HAA5 are summarized in Table 2-4.

TABLE 2-3
TTHM/HAA5 Routine Compliance Monitoring And Reduced Monitoring
Surface Water and GWUDI Systems Serving 500 to 9,999 Persons

Routine Monitoring	Reduced Monitoring
<u>Frequency</u> 1 sample per treatment plant per quarter <u>Monitoring location</u> - Location representing maximum residence time.¹	<u>Frequency</u> 1 sample per treatment plant per year during month of warmest temperature² <u>Monitoring location</u> - Distribution system location reflecting maximum residence time. <u>Criteria to qualify for reduced monitoring for TTHMs and HAA5:</u> - Source water annual average TOC ≤4.0 mg/L - Monitor for at least 1 year and the annual average TTHM ≤0.040 mg/L and the annual average HAA5 ≤0.030 mg/L

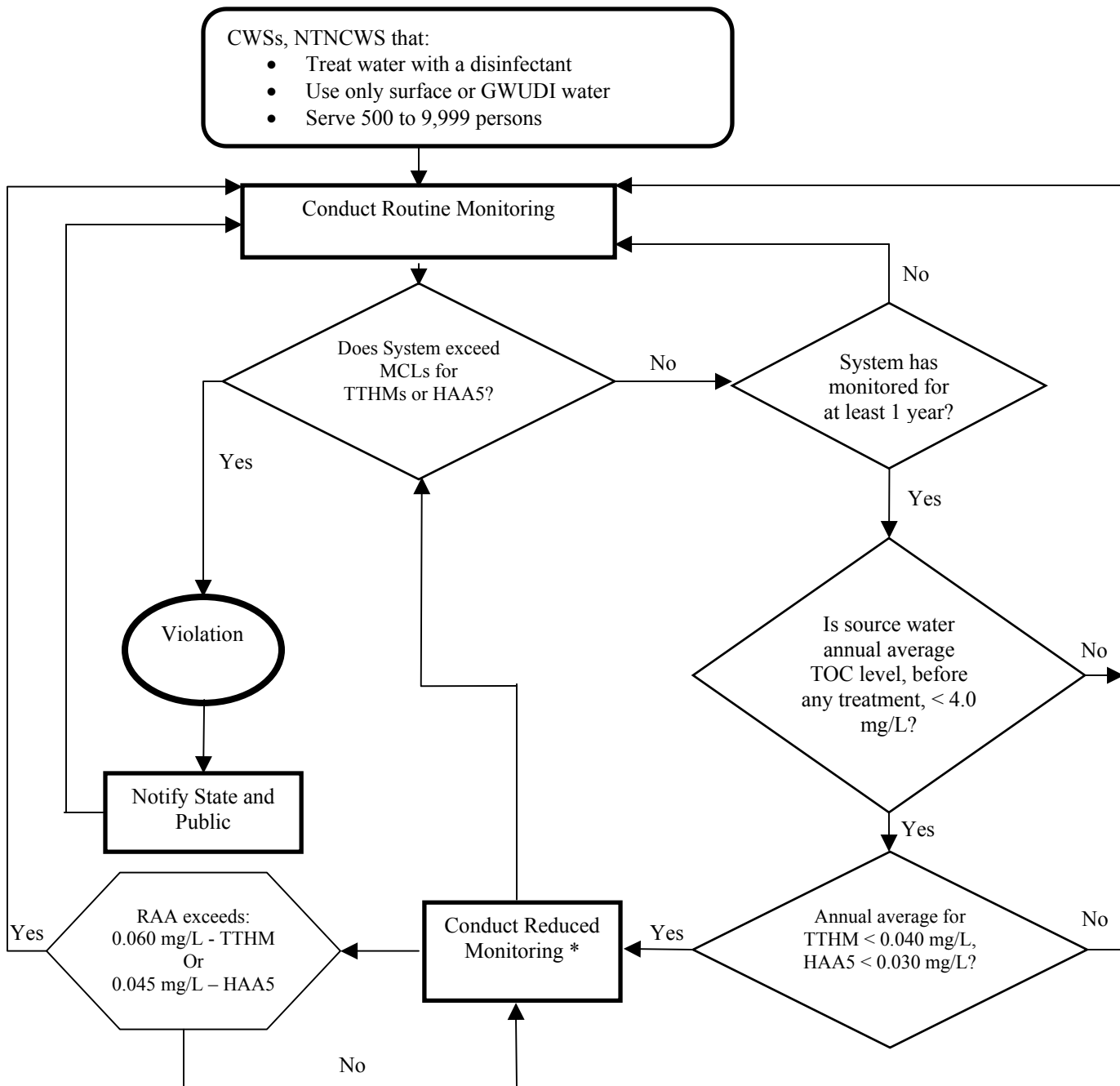
¹ If a system elects to sample more frequently than the minimum required, at least 25% of all samples collected each quarter (including those taken in excess of the required frequency) must be taken at locations that represent the maximum residence time of the water in the distribution system. The remaining samples must be taken at locations representative of at least average residence time in the distribution system.

² Systems must consider August to be the month of warmest water temperature unless they have distribution system monitoring data that substantiates a different month of warmest water temperature.

TABLE 2-4
TTHM/HAA5 Compliance Determination and Reporting Requirements
Surface Water and GWUDI Systems Serving 500 to 9,999 Persons

Compliance Determination	Reporting Requirements
<u>Compliance determination for systems monitoring quarterly</u> Running annual arithmetic average, computed quarterly, of quarterly arithmetic averages of all samples collected. • If annual arithmetic average of quarterly averages covering any consecutive 4-quarter period exceeds the MCL, then the system is in violation. • The system must notify the public and report to the State if in violation.	<u>Reporting requirements for systems monitoring quarterly</u> • Number of samples taken during last quarter (routine monitoring) • Location, date, result of each sample taken during last quarter • Arithmetic average of all samples taken over last quarter • Annual arithmetic average of quarterly averages for last 4 quarters • Whether MCL was violated
<u>Compliance determination for systems on reduced monitoring</u> • The average of samples taken that year. - o If annual arithmetic average exceeds the MCL for either TTHM or HAA5, then the system must revert to routine monitoring immediately. - o If an annual average exceeds 0.060 mg/L for TTHM or 0.045 mg/L for HAA5 and the system is on reduced monitoring, it must revert to routine monitoring immediately.	<u>Reporting requirements for systems on reduced monitoring</u> • Number of samples taken during last year • Location, date, result of each sample taken during the last monitoring period • Arithmetic average of all samples taken over last year • Whether MCL was violated

FIGURE 2-2
TTHM and HAA5 Routine and Reduced Monitoring Flow Chart
Surface Water and GWUDI Systems Serving 500 to 9,999 Persons



* Only if the following are met: 1) monitoring data was collected under the provisions of Article 15 of the *Colorado Primary Drinking Water Regulations*; 2) the state is notified in writing of the system's intention to reduce monitoring; 3) the state approves of the reduced monitoring schedule; and 4) a copy of the revised monitoring plan is submitted for approval to the state.

2.3 TTHM/HAA5 Requirements for Surface Water and GWUDI Systems Serving <500 Persons

- 2.3.1 All of these systems that add a disinfectant must conduct routine compliance monitoring for TTHMs and HAA5 each year as summarized in Table 2-5. Figure 2-3 presents a monitoring flow chart for TTHMs and HAA5 for surface water and GWUDI systems serving < 500.
- 2.3.2 Because all of these systems begin routine monitoring at a reduced level, no further reduction in frequency is allowed.
- 2.3.3 Compliance determinations and reporting requirements for TTHMs and HAA5 are summarized in Table 2-6.

TABLE 2-5
TTHM/HAA5 Routine Compliance Monitoring and Reduced Monitoring
Surface Water and GWUDI Systems Serving <500 Persons

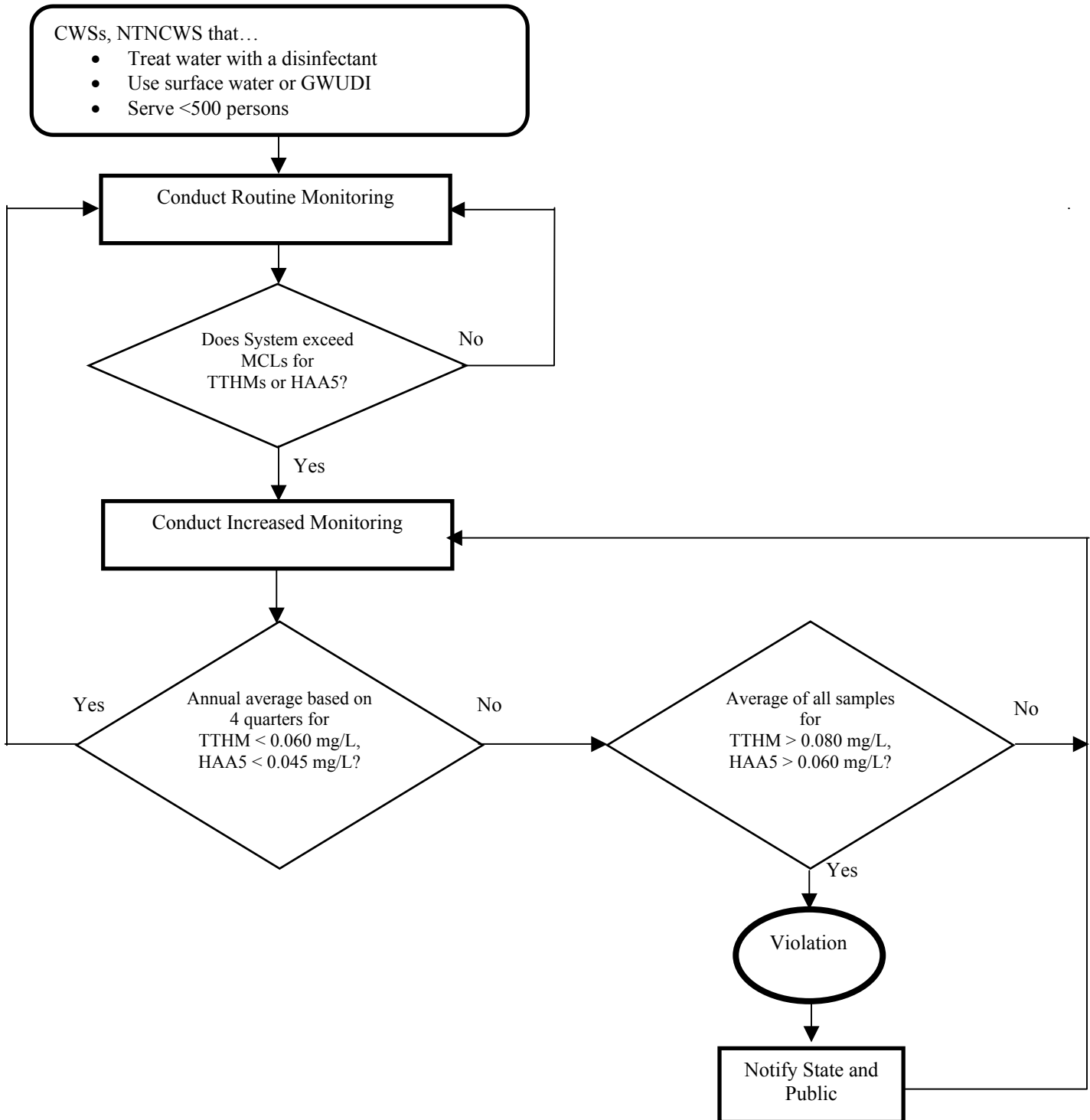
Routine Monitoring	Reduced Monitoring
<u>Frequency</u> 1 sample per treatment plant per year during month of warmest water temperature - If MCL is exceeded in yearly sample, system immediately goes to increased monitoring of 1 sample per plant per quarter - System on increased monitoring may return to annual monitoring if the annual average TTHM ≤ 0.060 mg/L and HAA5 ≤ 0.045 mg/L based on at least four quarters of monitoring <u>Monitoring location</u> - Location representing maximum residence time.¹	System begins routine monitoring at a reduced level and no further reduction in frequency is allowed.

¹ If a system elects to sample more frequently than the minimum required, at least 25% of all samples collected each quarter (including those taken in excess of the required frequency) must be taken at locations that represent the maximum residence time of the water in the distribution system. The remaining samples must be taken at locations representative of at least average residence time in the distribution system.

TABLE 2-6
TTHM/HAA5 Compliance Determination and Reporting Requirements
Surface Water and GWUDI Systems Serving <500 Persons

Compliance Determination	Reporting Requirements
Arithmetic average of all samples taken in the year. • If arithmetic average of the routine monitoring sample(s) exceeds the MCL, the system must immediately increase monitoring to once per quarter per treatment plant. Compliance will be based on 4 quarters of monitoring. • If a system on increased monitoring exceeds the MCL, it is in violation and must notify the public and report to the State.	• Number of samples taken during last year (or in last quarter if on increased monitoring) • Location, date, result of each sample taken during last year • Arithmetic average of all samples taken over last year • Whether MCL was violated

FIGURE 2-3
TTHM and HAA5 Routine and Reduced Monitoring Flow Chart
Surface Water and GWUDI Systems Serving <500 Persons



2.4 Precursor Removal for Surface Water and GWUDI Systems Using Conventional Treatment

- 2.4.1 All surface water or ground water under the direct influence of surface water systems using conventional filtration treatment must operate with and meet enhanced coagulation or enhanced softening performance requirements to remove DBP precursors according to Figure 2-4 (see Section 2.6.3 and Table 2-9), unless *one* of the following are met:
- 1) One of the alternative compliance criteria listed in Table 2-7 are met; or
 - 2) The system applies for and is approved by CDPHE for Step 2 removal in lieu of Table 2-9 requirements (see Section 2.6.4); or
 - 3) The system is approved by CDPHE in writing for a waiver of the precursor removal requirements [see Section 2.6.4(i)].
- Systems meeting one of the above elements must still comply with the TOC paired sample and source water alkalinity monitoring requirements.
- 2.4.2 The term ‘TOC paired sample’ refers to a treated water TOC sample taken at a point no later than the point of combined filter effluent turbidity while at the same time taking a source water TOC sample at a point prior to any treatment.
- 2.4.3 Softening systems that cannot achieve the TOC removals required in Table 2-9 (Step 1) may use the alternative compliance criteria in Table 2-8. Systems must still comply with the TOC paired sample and source water alkalinity monitoring requirements.
- 2.4.4 Enhanced Coagulation and Enhanced Softening Performance Requirements:
- (a) Systems using surface water or GWUDI and conventional treatment must achieve the percent reduction of TOC specified in Table 2-9 (referred to as Step 1) between the source water, prior to any treatment, and the combined filter effluent, unless CDPHE approves a system’s request for alternative minimum TOC (Step 2) requirements.
 - (b) Systems must monitor at least monthly at each treatment plant using conventional filtration for TOC no later than the point of combined filter effluent turbidity monitoring and representative of the treated water. All systems required to monitor must also monitor for TOC in the source water prior to any treatment at the same time as monitoring for TOC in the treated water. These samples (TOC source and TOC treated water) are referred to as a ‘TOC paired sample.’ At the same time as the source water sample is taken, all systems must monitor for alkalinity in the source water prior to any treatment. This monthly TOC and alkalinity sampling will account for seasonal variations in source water alkalinity and TOC. Systems may elect to monitor these parameters more frequently than monthly with the understanding that all sampling events must be used when determining compliance.
 - (c) Required Step 1 TOC reductions in Table 2-9 are determined based on each set of source water alkalinity and TOC sample analysis results. Compliance with the Step 1 TOC removal requirement is calculated by dividing the actual percentage of TOC removed – using the results of the ‘TOC paired sample’ – by the required percentage of TOC removed as determined from Table 2-9 (3x3 Table). This calculation is referred to as the TOC removal ratio. Systems that measure TOC

more frequently than monthly must use the same procedure to determine required removal for each set of samples using Table 2-9 and determine an average monthly ratio of actual TOC removed to required TOC removed. The monthly averages (if sampling more frequently than monthly) or values are then averaged to determine the running annual average for the latest 12-month period.

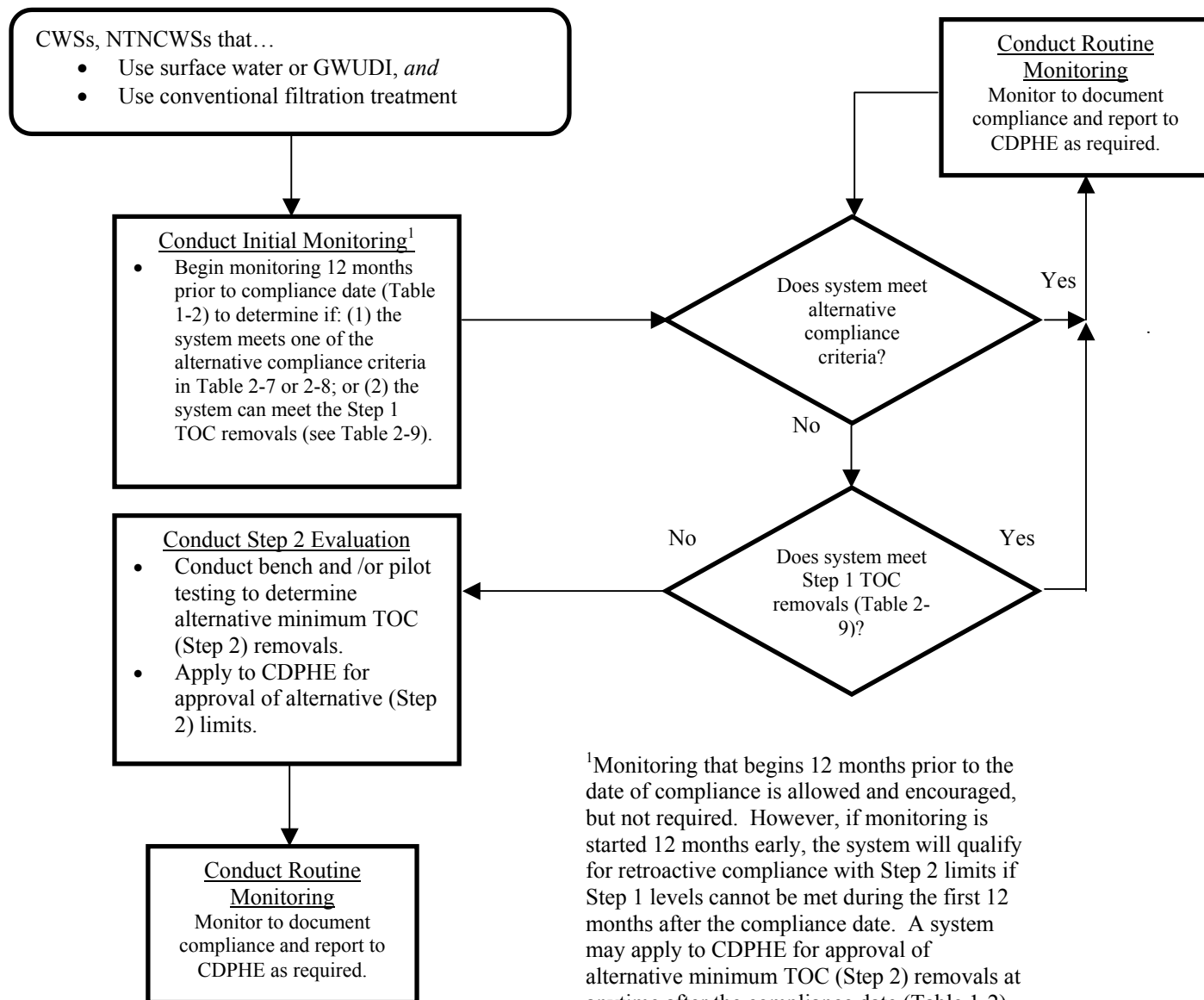
TABLE 2-7
Alternative Compliance Criteria for Enhanced Coagulation

1. Source water TOC level is <2.0 mg/L, calculated quarterly as a running annual average.
2. Treated water TOC level is <2.0 mg/L, calculated quarterly as a running annual average.
3. Source water TOC level is less than 4.0 mg/L, calculated quarterly as a running annual average; the source water alkalinity is greater than 60 mg/L (as CaCO₃), calculated quarterly as a running annual average; and either the TTHM and HAA5 running annual averages are no greater than 0.040 mg/L and 0.030 mg/L, respectively; or prior to the effective compliance date the system makes a clear and irrevocable financial commitment to use technologies that will limit the levels of TTHMs and HAA5 to no more than 0.040 mg/L and 0.030 mg/L, respectively. Systems must submit for CDPHE approval evidence of a clear and irrevocable financial commitment, in addition to a schedule containing milestones and periodic progress reports for installation and operation of appropriate technologies not later than the effective compliance date. Technologies must be installed and operating not later than June 30, 2005. Failure to install and operate these technologies by the date in the approved schedule will constitute a violation.
4. TTHM and HAA5 running annual averages are no greater than 0.040 mg/L and 0.030 mg/L, respectively, and the system uses only chlorine for primary disinfection and maintenance of a residual in the distribution system. Systems that use an oxidant such as chlorine dioxide or ozone anywhere in their treatment process, even if intended only for algae or taste and odor control may not use this alternative compliance criterion.
5. Source water SUVA, prior to any treatment and measured monthly, is ≤2.0 L/mg-m, calculated quarterly as a running annual average.
6. Finished water SUVA, measured monthly, is ≤2.0 L/mg-m, calculated quarterly as a running annual average.

TABLE 2-8
Alternative Compliance Criteria for Softening Systems

1. Softening that results in lowering the treated water alkalinity to less than 60 mg/L (as CaCO₃), measured monthly and calculated quarterly as a running annual average.
2. Softening that results in removing at least 10 mg/L of magnesium hardness (as CaCO₃), measured monthly and calculated quarterly as a running annual average.

FIGURE 2-4
Suggested Compliance Strategy for DBP Precursor Removal Requirements



¹Monitoring that begins 12 months prior to the date of compliance is allowed and encouraged, but not required. However, if monitoring is started 12 months early, the system will qualify for retroactive compliance with Step 2 limits if Step 1 levels cannot be met during the first 12 months after the compliance date. A system may apply to CDPHE for approval of alternative minimum TOC (Step 2) removals at anytime after the compliance date (Table 1-2).

TABLE 2-9
TOC Removal (Step 1) Required by Enhanced Coagulation and Enhanced Softening^{1,2}
(3 x 3 Table)

Source Water TOC, mg/L	Source Water Alkalinity, mg/L as CaCO ₃		
	0 to 60	>60 to 120	>120 ³
>2.0 to 4.0 ⁴	35.0%	25.0%	15.0%
>4.0 to 8.0	45.0%	35.0%	25.0%
>8.0	50.0%	40.0%	30.0%

¹ Systems meeting at least one of the conditions in Table 2-7 are not required to operate with enhanced coagulation.

² Softening systems meeting one of the alternative compliance criteria in Table 2-8 are not required to operate with enhanced softening.

³ Systems practicing softening must meet the TOC removal requirements in this column for the specified source water TOC.

⁴ Systems with source water TOC ≤2.0 mg/L may not interpolate to a lower required TOC value, but may use the specified removal values identified in this row to calculate actual removal ratios for determining compliance.

2.4.5 TOC Step 2 Removal Determinations

- (a) Systems which cannot achieve the Step 1 minimum TOC removal requirements, as presented in Table 2-9, or the alternative compliance criteria due to water quality parameters or operational constraints must apply to CDPHE for approval of alternative minimum TOC removal (Step 2) requirements. These alternative minimum removal levels are determined by conducting jar or bench scale testing. Systems must follow the guidance contained in Sections 3.2.2.2 – 3.2.3 of EPA Publication 815-R-99-012, May 1999, (Enhanced Coagulation and Enhanced Precipitative Softening Guidance Manual) for conducting this testing and CDPHE will use this guidance for determining how and under what conditions to approve Step 2 TOC removal requirements.
- (b) The purpose of the jar tests is to establish an alternative TOC removal requirement, not to determine full-scale operating conditions. Once an alternative removal requirement is defined by bench-scale or pilot-scale testing and approved by CDPHE, the utility is free to achieve that removal in the full-scale plant with any combination of coagulant, coagulant aid, filter aid and acid addition. Plants may wish to perform further jar and pilot testing before implementing full-scale changes. NSF International has established maximum limits for the addition of some treatment chemicals; these limits are summarized in Table 2-10. Utilities required to implement the Step 2 requirements should consult with the CDPHE Rule Manager for the D/DBP rule.

TABLE 2-10
NSF International Product Limits on Chemical Additives

Chemical Additive	Maximum Use²
Alum	150 mg/L
Ferric sulfate	200-600 mg/L
Ferric Chloride	141-250 mg/L
Sulfuric Acid	50 mg/L
Polyaluminum Chloride (PACl)	100-454 mg/L

2.4.6 Alternative Minimum TOC Removal (Step 2) Requirements:

- (a) Systems that cannot meet the Step 1 removal requirements of Table 2-9 because of water quality conditions or operational constraints must apply to CDPHE, within 3 months of failure to achieve the TOC removals of Table 2-9, for approval of an alternative minimum TOC removal requirement (Step 2).
- (b) If CDPHE approves the alternative minimum TOC removal (Step 2) requirement, CDPHE may make that requirement retroactive for the purpose of determining compliance, but not for the one year compliance period starting January 1, 2002 for systems serving 10,000 or more people or January 1, 2004 for systems serving less than 10,000, unless a system conducted monitoring in accordance with the precursor removal provisions in the year prior to their respective compliance date.
- (c) Until CDPHE approves the alternative minimum TOC removal (Step 2) requirement, the system must meet the Step 1 requirement in Table 2-9.
- (d) Applications to CDPHE for approval of alternate minimum TOC (Step 2) requirements must include, at a minimum, results of bench-scale or pilot-scale testing. CDPHE will use these tests to determine the alternate enhanced coagulation level.
- (e) The ‘alternative enhanced coagulation level’ is defined as...
 - (1) Coagulation at a coagulant dose and pH such that an incremental addition of 10 mg/L of alum (or equivalent amount of ferric salt) results in a TOC removal of ≤ 0.3 mg/L.
 - (2) The percent removal of TOC at this point on the ‘TOC removal versus coagulant dose’ curve is defined as the minimum TOC removal required for the system.
 - (a) Once approved by CDPHE, this minimum requirement supersedes the minimum TOC removal required by Table 2-9.
 - (b) This CDPHE-approved TOC removal requirement is effective until such time as CDPHE approves a new value based on the results of a new bench-scale and pilot-scale test.
 - (c) Failure to achieve CDPHE-approved alternative minimum TOC removals is a violation.
- (f) Bench-scale or pilot-scale testing of enhanced coagulation must be conducted by using representative water samples and adding 10 mg/L increments of alum (or

² The limits shown here are for general guidance only. Each product (i.e., brand or trademark) has limits specific to that product, depending on the chemical nature of the additive and impurities present. The numbers in this column represent a range of the limits recommended for several brands of additives.

equivalent amounts of ferric salt) until the pH is reduced to a level less than or equal to the target pH listed in Table 2-11.

TABLE 2-11
Enhanced Coagulation Step 2 Target pH

Alkalinity (mg/L as CaCO₃)	Target pH
0 to 60	5.5
>60 to 120	6.3
>120 to 240	7.0
>240	7.5

- (g) For waters with alkalinities of less than 60 mg/L for which addition of small amounts of alum or equivalent addition of iron coagulant drives the pH below 5.5 before significant TOC removal occurs, the system must add necessary chemicals to maintain the pH between 5.3 and 5.7 in samples until the TOC removal of 0.3 mg/L per 10 mg/L of alum added (or equivalent addition of iron coagulant) is reached.
- (h) The system may operate at any coagulant dose or pH necessary to achieve the minimum TOC percent removal approved by CDPHE.
- (i) If the TOC removal is consistently less than 0.3 mg/L of TOC per 10 mg/L of incremental alum dose at all dosages of alum (or equivalent addition of iron coagulant), the water is deemed to contain TOC not amenable to enhanced coagulation. The system may then apply to CDPHE for a waiver of enhanced coagulation requirements.
- (j) Refer to EPA's *Enhanced Coagulation and Enhanced Precipitative Softening Guidance Manual*, EPA 815-R-99-012 (May 1999) for detailed procedures to comply with precursor removal requirements.

2.5 Disinfection Byproduct Precursor Removal Compliance Monitoring

- 2.5.1 Basic compliance monitoring requirements for precursor removal are summarized in Table 2-12. Systems may need to conduct additional monitoring for UV, DOC, or magnesium hardness if they desire to meet the alternative compliance criteria of Table 2-7 or 2-8.
- 2.5.2 Systems may begin to monitor to determine whether Step 1 TOC removals can be met 12 months prior to the compliance date for the system. This monitoring is not required and failure to monitor during this period is not a monitoring violation. However, any system that does not perform this advanced monitoring, will not be eligible for retroactive

approval of Step 2 alternative compliance levels, if in fact they determine that Step 1 TOC removals cannot be met.

- 2.5.3 Systems can apply to CDPHE for Step 2 alternative minimum TOC removal limits any time after their respective compliance date.
- 2.5.4 Meeting a finished water specific ultraviolet absorption (SUVA) criterion may allow some systems to determine compliance with the TOC precursor treatment technique if the SUVA value is less than 2.0 L/mg-m. The determination of SUVA should be made on finished water that has not been exposed to any oxidant during treatment. If there is no oxidant (such as chlorine) added prior to the finished water DOC and UV-254 monitoring, full-scale samples may be used to calculate SUVA to allow comparison with this criterion. However, if oxidants are added prior to the finished water DOC and UV-254 sampling, the system is required to establish treated water SUVA by conducting a jar test in which no disinfectants or oxidants are added. The jar test is to be performed by adding an equivalent amount of coagulant (metal coagulant plus any polymer at concentrations used full-scale) in a jar test apparatus and performing bench-scale coagulation tests. After completion of the jar test, the settled water should be characterized for its DOC and UV-254 values to calculate SUVA. Filtration with a pre-washed 0.45 um membrane is required for DOC and UV-254 determination. Due to interference from iron in the UV-254 measurement, systems using ferric salts for coagulation are required to conduct the jar test described above using equivalent amounts of alum. For systems that do not add an oxidant or disinfectant until after their water has been coagulated, flocculated, and settled, a sample of the treatment plant settled water may be used to determine DOC and UV-254 and ultimately SUVA for determining compliance with the finished water SUVA criterion. This sample would also require filtration with a pre-washed 0.45 um membrane prior to analysis.

TABLE 2-12
Summary of Routine and Reduced Compliance Monitoring for Precursor Removal

Routine Monitoring	Reduced Monitoring
- Take one 'paired sample' for TOC and one source water alkalinity sample per month per plant at a time representative of normal operating conditions and influent water quality. - A 'paired sample' for TOC is defined as taking, at the same time, one sample no later than the point of combined filter effluent turbidity monitoring (representative of the treated water) and a sample of source water prior to any treatment.	- If the average treated water TOC is <2.0 mg/L for two consecutive years, or <1.0 mg/L for one year, the system with written CDPHE approval may reduce monitoring for both TOC and alkalinity to one 'paired sample' and one source water alkalinity sample per plant per quarter. - The system must revert to routine monitoring in the month following the quarter when the annual average treated water TOC ≥ 2.0 mg/L.

2.6 Disinfection Byproduct Precursor Removal Compliance Determination and Reporting – General Information

It is essential that systems understand both their options for demonstrating compliance with the precursor removal requirements, and how to use the CDPHE reporting forms that are available to facilitate this demonstration. Basically, systems treating surface water or GWUDISW using conventional treatment, must meet the precursor (as measured by TOC) levels specified in Table 2-9 unless they can demonstrate that they meet one of the Alternative Compliance Criteria (ACC) listed in Table 2-7.

Systems will generally choose in advance the method (removal or ACC) they will use to determine compliance. However, they may also choose to make their determination at the end of each monitoring quarter provided:

- 1.) Their monitoring plan articulates that this is the strategy they will pursue;
- 2.) They monitor all of the appropriate parameters (Table 2-13) associated with determining compliance by use of one, some, or all of the ACC, and;
- 3.) They monitor all of the appropriate parameters, (Table 2-14) associated with determining compliance by actual precursor removal.

Compliance with either method (removal or ACC) is always based on meeting the respective criteria and is determined based on a running annual average of the monitoring results from the four most recent consecutive quarters for systems using the ACC or the 12 most recent consecutive months for systems measuring actual removal.

- 2.6.1 Systems that have more than one treatment plant that use conventional treatment for surface water or GWUDISW must, to achieve compliance, meet the precursor removal requirements at each treatment plant.
- 2.6.2 All systems treating surface water or GWUDISW using conventional treatment regardless of which method they use to demonstrate compliance, must monitor their source water for TOC and alkalinity, and their treated water for TOC for each treatment plant.

Systems that desire to demonstrate compliance by using only the ACC (as opposed to demonstrating actual TOC removal) must monitor the appropriate parameters associated with the alternative compliance criteria they intend to use, as detailed in Table 2-13 and calculate compliance based on a running annual average determined quarterly.

Generally, systems will select in advance which of the available alternative criteria they will use to demonstrate compliance and will monitor just the associated parameters. Systems may, however, choose at the end of each quarter which one of the available ACC they will use to demonstrate compliance. To make use of this flexibility, a system must use data from the four most recent consecutive quarters to determine compliance. Consequently, if a system chooses to appropriately monitor all of the parameters associated with all of the alternative compliance criteria, it may at the end of each reporting quarter, determine compliance by using which ever of the available criteria it

meets. The selected criteria may change from quarter to quarter as long as data from the four most recent consecutive quarters are used to calculate the RAA to determine compliance. Systems with treatment plants subject to the enhanced coagulation requirements and using any of the available ACC, report compliance using DBP Precursor Form 2. Systems with treatment plants subject to the enhanced softening requirements and using any of the available ACC report compliance using DBP Precursor Form 3.

TABLE 2-13
Alternative Compliance Criteria and Associated Parameters to Monitor Systems Using Enhanced Coagulation

<i>Systems Using Enhanced Coagulation</i>	
ACC	Parameter to be Monitored
(i)	Source Water TOC
(ii)	Treated Water TOC
(iii)	Source Water TOC, Alkalinity, Distribution System, TTHM/HAA5
(iv)	Distribution System TTHM/HAA5
(v)	Source Water SUVA
(vi)	Finished Water SUVA
<i>Systems Using Enhanced Softening</i>	
ACC	Parameter to be Monitored
(i)	Source & Treated Water Alkalinity
(ii)	Source & Treated Water Magnesium Hardness

- 2.6.3 Systems that choose to demonstrate compliance with the TOC removal requirement (as opposed to using the ACC) by measuring the actual removal performance of their treatment plants, are afforded the opportunity, on a sampling event basis, to use an assigned removal ratio of 1.0 as specified in 40 CFR 141.135 (c)(2) in lieu of the actual removal ratio calculated in accordance with §141.135 (c)(1). Systems may make use of this option if they monitor the appropriate parameters and meet the associated criteria. Again, while systems will generally choose in advance which of the available parameters they will monitor to enable them to take advantage of the option to assign a removal ratio, they may monitor all of the parameters and decide on a sampling event basis whether they desire to use any one of the criteria they meet that will allow them to assign the value of “1.0” as a removal ratio. Systems planning to make use of these provisions must, monitor as appropriate the parameters detailed in Table 2-14.
- 2.6.4 The directions both for reporting monitoring information and for determining compliance provided in the paragraphs to follow are specific to each compliance method (ACC or removal) and referenced form. Systems are advised to follow the directions carefully to avoid mistakes that may affect their compliance status.

TABLE 2-14
Parameters to Monitor for Assigning Removal Ratios

<i>Systems Using Enhanced Coagulation</i>	
Criterion	Parameter to Monitor
(i)	Treated or Source TOC
(iii)	Source Water SUVA
(iv)	Finished Water SUVA
<i>Systems Using Enhanced Softening</i>	
Criterion	Parameter to Monitor
(ii)	Source and Treated Magnesium Hardness
(v)	Finished Water Alkalinity

2.7 Demonstrating Compliance by Use of the Alternative Compliance Criteria

2.7.1 Systems Using Enhanced Coagulation and the ACC. Use DDBP Precursor Form 2 to report monitoring results for each treatment plant subject to the enhanced coagulation requirements for both the most recent quarter and the three consecutive quarters preceding the most recent quarter. Submit copies of the appropriate laboratory report forms (DBP Precursor Form 1) only for the most recent quarter's monitoring results. In the event the system monitors more frequently than once per month, (consistent with their written monitoring plan) the value to be entered in each of Columns A-G of DBP Precursor Form 2 is the average of all samples taken that month. Note: this is not the procedure to be followed when the system demonstrates compliance using actual treatment plant precursor removal ratios (Section 2.8).

2.7.1.1 Regardless of which ACC a system chooses to demonstrate compliance, it must always report source water TOC and alkalinity and finished water TOC.

2.7.1.2 The information on DBP Precursor Form 2 is used to calculate compliance based on a running annual average of the four most recent consecutive quarters. Compliance can not be determined until one year (four quarters) after the date the precursor removal requirement of the rule are applicable to the system. Subsequent to the first year, compliance with the running annual average requirements of the ACC is determined each quarter using the monitoring results from the most recent four consecutive quarters.

2.7.2 Systems Using Enhanced Softening and the ACC. Use DBP Precursor Removal Form 3 to report monitoring results for each treatment plant subject to the enhanced softening requirements. Submit copies of the appropriate laboratory report forms (DBP Precursor Form 1) only for the most recent quarter's monitoring results. In the event the system monitors more frequently than once each month (consistent with their written monitoring

plan) the value to be entered in each of Columns A-E of DBP Precursor Form 3 is the average of all samples of the respective parameters taken that month. Note: this is not the procedure to be followed when the system demonstrates compliance using actual treatment plant precursor removal ratios (Section 2.8).

2.7.2.1 Generally, systems will choose in advance which one of the ACC they will use to determine compliance and will monitor only the associated parameter. Systems may however, choose quarterly, which one of the available ACC they will use to demonstrate compliance provided they have collected sufficient data to demonstrate they have met the selected criteria for the previous four consecutive quarters. Regardless of which criteria a system chooses to demonstrate compliance, systems must always report source water TOC and alkalinity and finished water TOC.

2.8 Demonstrating Compliance by Actual Precursor Removal Ratio

- 2.8.1 Use DDBP Precursor Form 4 for each treatment plant that is subject to the enhanced coagulation requirements and is using the actual TOC removal ratio method to determine compliance. Report monitoring results on DDBP Precursor Form 4 for the 3 months of the most recent quarter and the nine consecutive months preceding the most recent quarter. Note that compliance with the annual precursor removal requirement is calculated using the twelve most recent month's data and not the 4 most recent quarters of data. This distinction is significant for those systems that have conventional treatment facilities that are not in operation during any one or more months during the year. All systems will determine their running annual average by looking back twelve months and calculating an average based on the compliance ratios achieved for the number of months that their plant was in operation. Note also that the monthly compliance ratio that is entered into Column M of DBP Precursor Form 4 is the average of the actual removal ratios of each paired sampling event that occurred during the month. DBP Precursor Form 4 provides room for reporting up to five paired sampling events each month for systems that desire to monitor their plant's removal performance more often than the monthly minimum specified in the regulations. Systems that expect to monitor more than five times each month should contact the CDPHE DBP rule manager for reporting forms to accommodate their more frequent sampling protocol.
- 2.8.2 Systems demonstrating compliance by actual removal ratio may for each paired sampling event where the actual removal ratio (as determined by the procedure in steps 1-5 of Table 2-15) is less than 1.00, assign a value of 1.0 if they monitor appropriately and meet the criteria listed in items (7) – (12) of Table 2-15.
- 2.8.3 Compliance determinations for precursor removal are summarized in Table 2-15 for systems required to meet Step 1 TOC removals. If the value calculated is less than 1.00, the system is in violation and must notify the public and CDPHE.
- 2.8.4 Refer to EPA's *Enhanced Coagulation and Enhanced Precipitative Softening Guidance Manual*, EPA 815-R-99-012 (May 1999) for detailed procedures, including example worksheets, to determine compliance with precursor removal requirements.

- 2.8.5 CDPHE may choose to perform calculations and determine whether precursor removal requirements were met in place of having the system report that information.

TABLE 2-15
Compliance Determination for
Enhanced Coagulation and Enhanced Softening

Using CDPHE DBP Precursor Form 4 Systems calculate compliance at each treatment plant quarterly, beginning after 12 months of data has been collected, by determining an annual average of monthly removal ratios (actual or assigned) for each treatment plant using the following method:

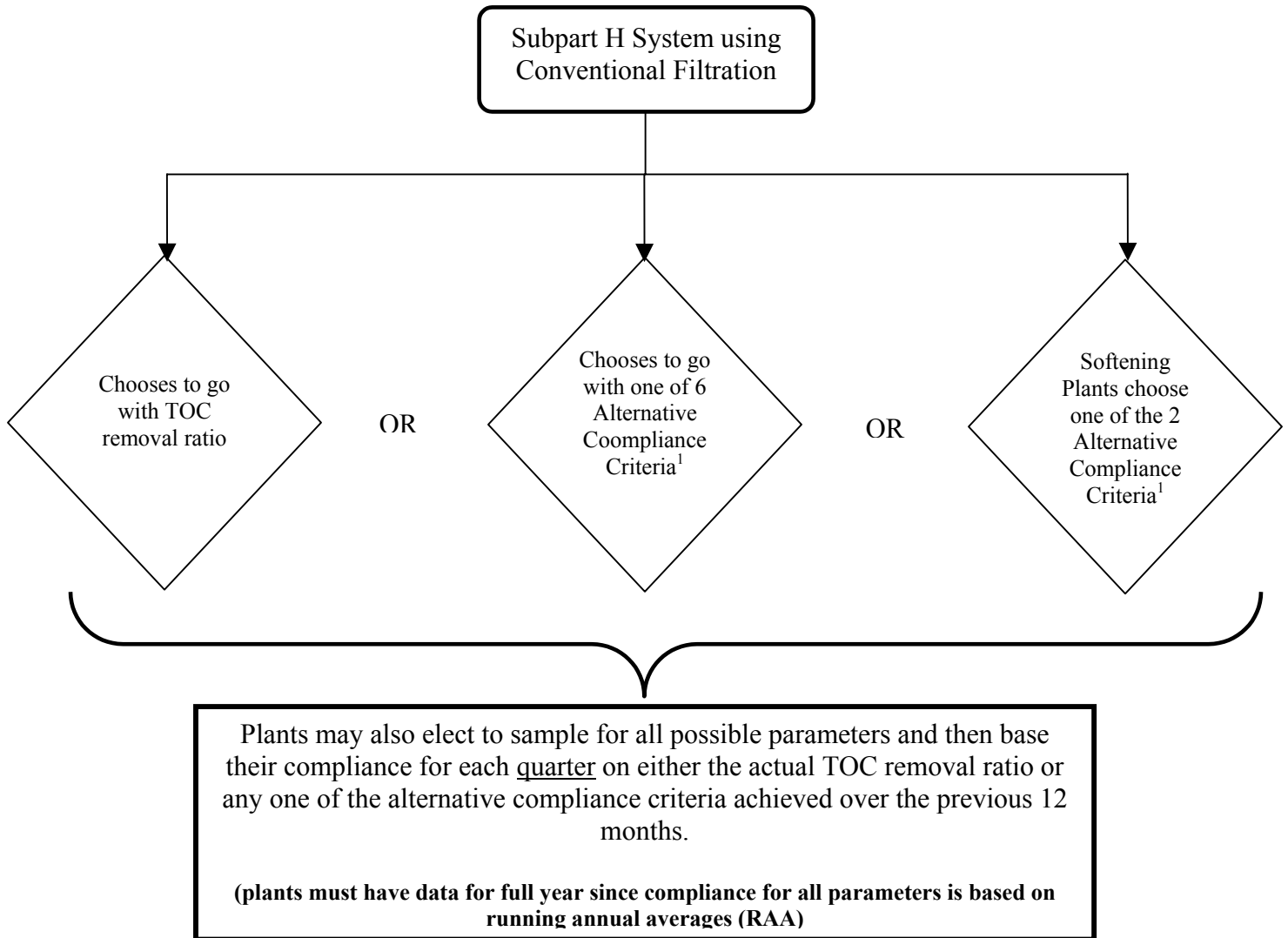
- (1) For each paired sampling event determine the actual TOC percent removal, equal to: $(1 - (\text{treated water TOC} / \text{source water TOC})) \times 100$
- (2) Determine the required TOC percent removal for each paired sampling event¹ (either from Table 2-9 or use the alternative minimum TOC (Step 2) removal approved by CDPHE).
- (3) Divide the actual TOC removal from (1) above by the required TOC removal from (2) above. If the calculated value is less than 1.0, refer to the note below.
- (4) Add together the results of (3) above for all samples collected during a month. During any month a plant was not operating do not report a value.
- (5) Add the results from (4) above and divide by the number of months during the 12 most recent consecutive months that a removal ratio was calculated.
- (6) If the value indicated in (4) above is <1.00 , the system is not in compliance with the TOC percent removal requirements.

Note: For each treatment plant the system may assign a monthly removal ratio of 1.0 when calculating compliance for any of the following conditions:

- (7) In any paired sample where the plant's treated or source water TOC level <2.0 mg/L.
- (8) In any paired sample that a plant practicing softening removes at least 10 mg/L of magnesium hardness (as CaCO_3).
- (9) In any paired sample that the plant's source water SUVA, prior to any treatment, is ≤ 2.0 L/mg-m.
- (10) In any paired sample that the plant's finished water SUVA is ≤ 2.0 L/mg-m.
- (11) In any paired sample that a plant practicing enhanced softening lowers the alkalinity below 60 mg/L (as CaCO_3).
- (12) Systems may also comply by meeting the alternative compliance criteria in Table 2-7 or 2-8. However, systems must identify in their monitoring plan the method they will use to determine compliance with the precursor removal requirements.

¹ Systems are required to sample at least once each month. However, systems may (and are encouraged to) take more than one set of source alkalinity and paired TOC samples each month. In this event the additional sampling must be reflected in the system's written monitoring plan and the value to be reported for that month on DBP Precursor Form 4 is the average of all of the actual or assigned removal ratios determined each month.

**FIGURE 2-5
Precursor Removal Compliance Determination**



¹ If a system - whether they are practicing enhanced coagulation or enhanced softening - chooses to use one of the alternative compliance criteria for compliance determination, they must continue to sample for source water TOC, source water alkalinity and finished water TOC.

TABLE 2-16
Reporting Requirements for Precursor Removal

If you are a system that...	You must report...
Monitors monthly or quarterly for TOC and is required to meet TOC removals in Table 2-9 or alternative minimum TOC (Step 2) removals as approved by CDPHE.	1 The number of paired (source water and treated water) samples taken during the last quarter. 2 The location, date, and results of each paired sample and associated source water alkalinity taken during the last quarter. 3 For each month in the reporting period that paired samples were taken, the arithmetic average of the compliance ratio of TOC for each paired sample and the required TOC percent removal. 4 Calculations for determining compliance with the TOC percent removal requirements (as shown in Table 2-9). 5 Whether the system is in compliance with the enhanced coagulation or enhanced softening removal requirements for the last four consecutive quarters.
Monitors monthly or quarterly for TOC and meets one or more of the alternative compliance criteria (Table 2-7 or 2-8).	1 The alternative compliance criteria that the system is using. 2 The number of paired samples taken during the last quarter. 3 The location, date, and result of each paired sample and associated alkalinity taken during the last quarter. 4 The running annual arithmetic average based on quarterly averages of monthly samples (or quarterly samples) of source water TOC for systems meeting criterion 1 or 3 of Table 2-7, or of treated water TOC for systems meeting criterion 2 of Table 2-7. 5 The running annual arithmetic average based on quarterly averages of monthly samples (or quarterly samples) of source water SUVA for systems meeting criterion 5 of Table 2-7, or of treated water SUVA for systems meeting criterion 6 of Table 2-7. 6 The running annual average of source water alkalinity for systems meeting criterion 3 of Table 2-7, and of treated water alkalinity for systems meeting criterion 1 of Table 2-8. 7 The running annual average for both TTHM and HAA5 for systems meeting criterion 3 or 4 of Table 2-7. 8 The running annual average of the amount of magnesium hardness removal (as CaCO₃ in mg/L) for systems meeting criterion 2 of Table 2-8. 9 Whether the system is in compliance with the particular alternative compliance criterion in Table 2-7 or 2-8.

2.9 Ground Water Systems Serving $\geq 10,000$ Persons

- 2.9.1 All of these systems that add a disinfectant must conduct routine compliance monitoring for TTHMs and HAA5 each year as summarized in Table 2-17. Monitoring is summarized in Figure 2-6.
- 2.9.2 Systems may qualify for reduced monitoring, also summarized in Table 2-17; however, CDPHE may return a system to routine monitoring at the State's discretion.
- 2.9.3 Compliance determinations and reporting requirements for TTHMs and HAA5 is summarized in Table 2-18.

FIGURE 2-6
TTHM and HAA5 Monitoring Flow Chart for
Ground Water Systems Serving $\geq 10,000$ Persons

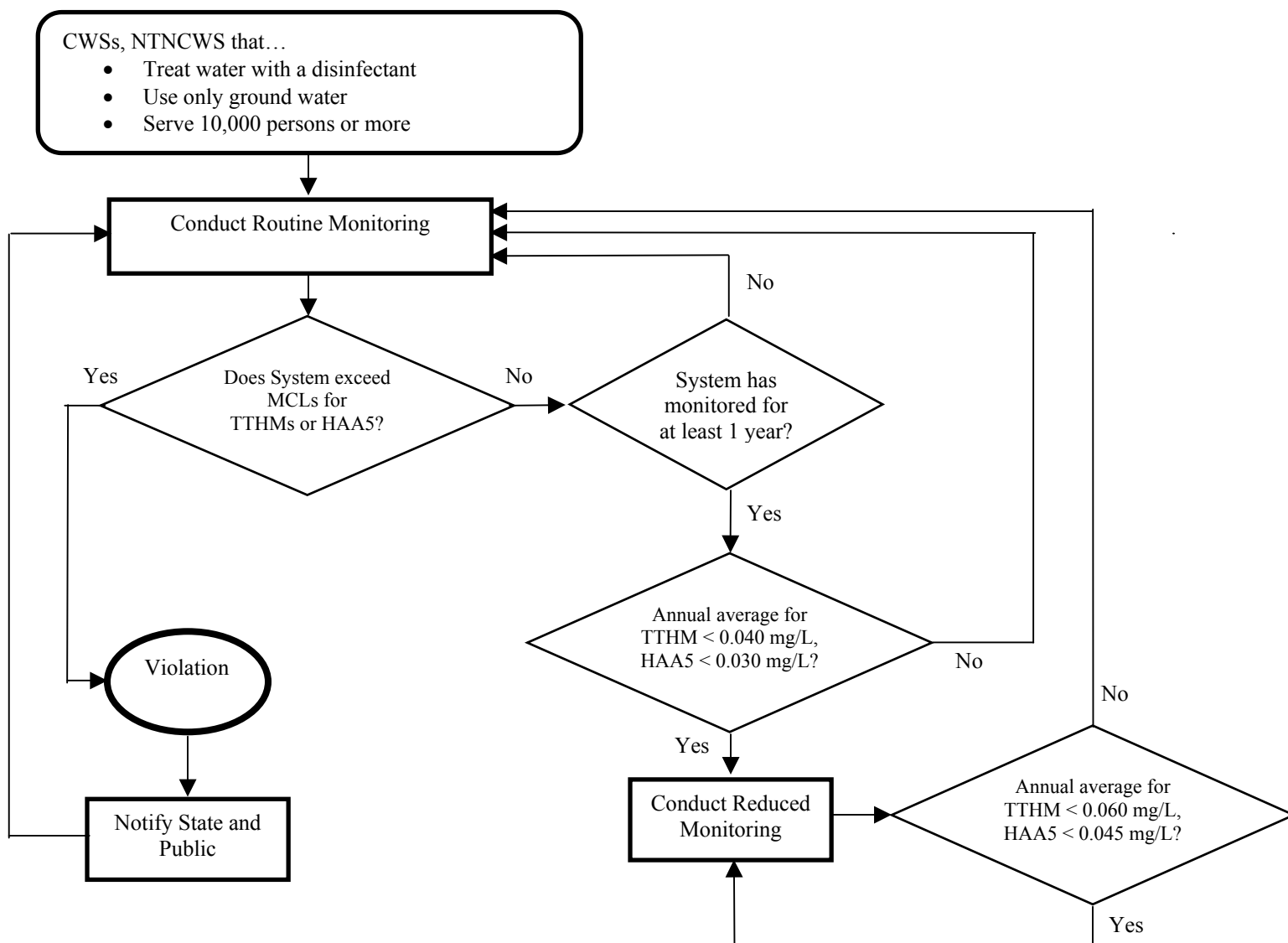


TABLE 2-17
Routine Compliance Monitoring and Reduced Monitoring for TTHMs and HAA5
Ground Water Systems Serving ≥10,000 Persons

Routine Monitoring	Reduced Monitoring
<u>Frequency</u> 1 sample per plant per quarter¹ <u>Monitoring location</u> - Location representing maximum residence time².	<u>Frequency</u> 1 sample per treatment plant per year. <u>Monitoring location</u> - Distribution system location reflecting maximum residence time during month of warmest temperature. <u>Conditions for reduced monitoring</u> - Monitored for at least 1 year and annual average TTHM ≤0.040 mg/L & annual average HAA5 ≤0.030 mg/L

¹ With CDPHE approval, multiple wells drawing water from a single aquifer may be considered one treatment plant for determining the minimum number of samples required. (See Section 1.11)

² If a system elects to sample more frequently than the minimum required, at least 25% of all samples collected each quarter (including those taken in excess of the required frequency) must be taken at locations that represent the maximum residence time of the water in the distribution system. The remaining samples must be taken at locations representative of at least average residence time in the distribution system.

TABLE 2-18
Compliance Determination and Reporting Requirements for TTHMs and HAA5
Ground Water Systems Serving ≥10,000 Persons

Compliance Determination	Reporting Requirements
Arithmetic average of all samples taken in the year. - If arithmetic average of these samples exceeds the MCL, the system is in violation. - If the system is on reduced monitoring and the systems running annual average for TTHM > 0.060 mg/L or for HAA5 > 0.045 mg/L, the system must immediately return to routine monitoring. Systems required to return to routine monitoring of once per quarter must calculate compliance by including the sample that triggered the increased monitoring plus the following three quarters of monitoring. Compliance will then be based on 4 quarters of monitoring. - The system must notify the public and report to the State if in violation.	- Number of samples taken during last year - Location, date, result of each sample taken during last year - Arithmetic average of all samples taken over last year - Whether MCL was violated <i>If conducting reduced monitoring:</i> - Location, date, result of last sample taken - Whether MCL was violated or if system exceeds 0.060mg/L for TTHM or 0.045 mg/L for HAA5

2.10 Ground Water Systems Serving <10,000 Persons

- 2.10.1 All of these systems that add a disinfectant must conduct routine compliance monitoring for TTHMs and HAA5 for each year as summarized in Table 2-19. Requirements are summarized in Figure 2-7.
- 2.10.2 Systems may qualify for reduced monitoring, also summarized in Table 2-19; however, CDPHE may return a system to routine monitoring at the State's discretion.
- 2.10.3 Compliance determinations and reporting requirements for TTHMs and HAA5 are summarized in Table 2-20.

TABLE 2-19
Routine Compliance Monitoring And Reduced Monitoring for TTHMs and HAA5
Ground Water Systems Serving <10,000 Persons

Routine Monitoring	Reduced Monitoring
<u>Frequency</u> 1 sample per plant per year during month of warmest water temperature¹ <u>Monitoring location</u> - Location representing maximum residence time².	<u>Frequency</u> 1 sample per plant per 3-year cycle during month of warmest water temperature. - The three year cycle begins on Jan. 1 following the quarter in which the system qualifies for reduced monitoring. <u>Monitoring location</u> - Location representative of maximum residence time. <u>Conditions for reduced monitoring</u> System meets either of the following: - Annual average TTHM ≤ 0.040 mg/L & annual average HAA5 ≤ 0.030 mg/L for 2 consecutive years; OR - Annual average TTHM ≤ 0.020 mg/L & annual average HAA5 ≤ 0.015 mg/L for 1 year

¹ With CDPHE approval, multiple wells drawing water from a single aquifer may be considered one treatment plant for determining the minimum number of samples required. (See Section 1.11)

² If a system elects to sample more frequently than the minimum required, at least 25% of all samples collected each quarter (including those taken in excess of the required frequency) must be taken at locations that represent the maximum residence time of the water in the distribution system. The remaining samples must be taken at locations representative of at least average residence time in the distribution system.

FIGURE 2-7
TTHM and HAA5 Routine and Reduced Monitoring Flow Chart for
Ground Water Systems Serving <10,000 Persons

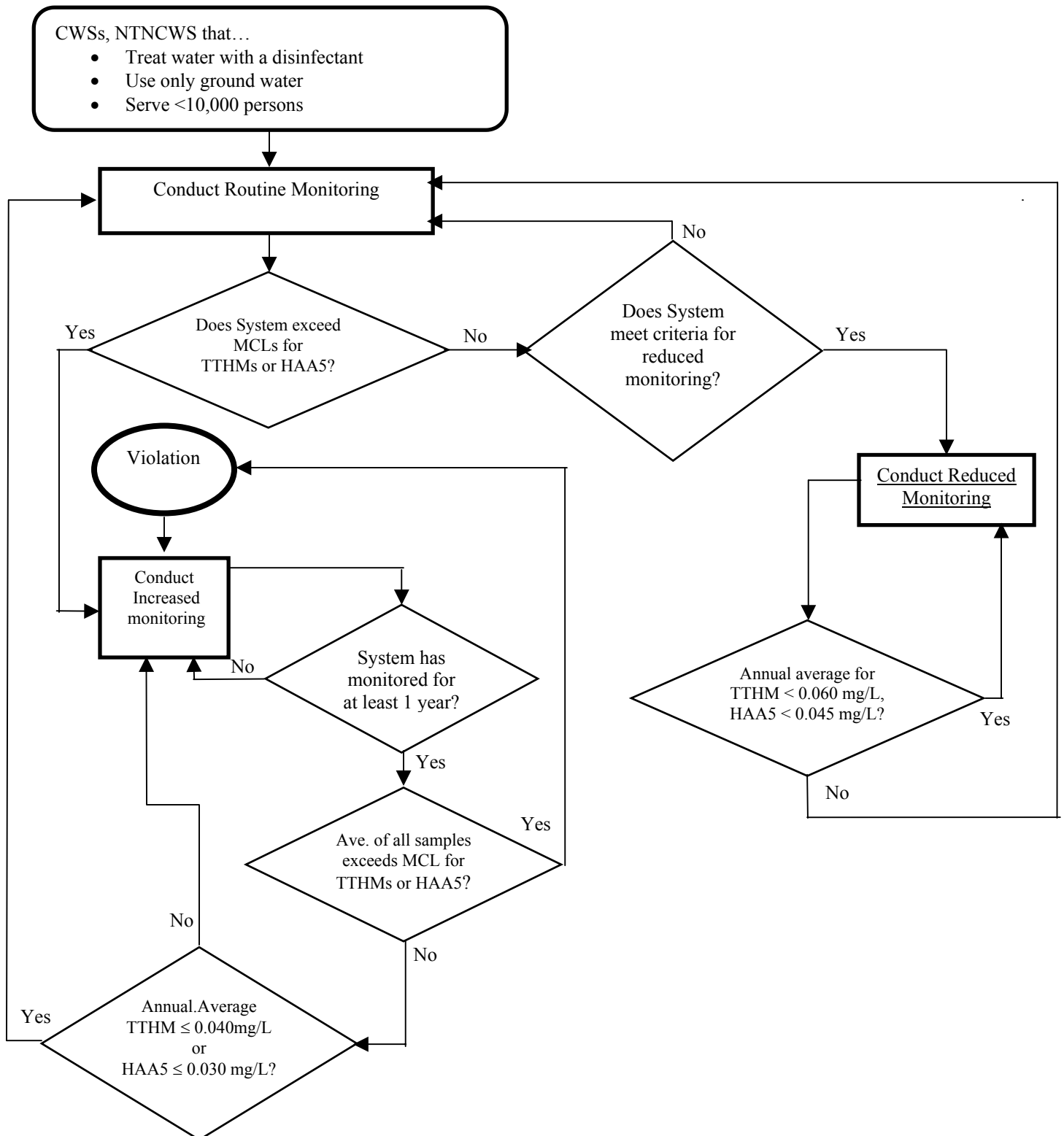


TABLE 2-20
Compliance Determination and Reporting Requirements for TTHMs and HAA5
Ground Water Systems Serving <10,000 Persons

Compliance Determination	Reporting Requirements
Arithmetic average of all samples taken in the year. - If arithmetic average of the sample(s) exceeds the MCL, the system must increase monitoring to once per quarter per treatment plant. The system is not in violation of the MCL until it has completed one year of quarterly monitoring, unless the result of fewer than four quarters of monitoring will cause the running annual average to exceed the MCL, in which case the system is in violation at the end of that quarter. Systems required to increase monitoring frequency to quarterly monitoring must calculate compliance by including the sample that triggered the increased monitoring plus the following three quarters of monitoring. Compliance will then be based on 4 quarters of monitoring. - The system must notify the public and report to the State if in violation.	- Number of samples taken during last year - Location, date, result of each sample taken during last year - Arithmetic average of all samples taken over last year - Whether MCL was violated <i>If conducting reduced monitoring:</i> - Location, date, result of last sample taken - Whether MCL was violated

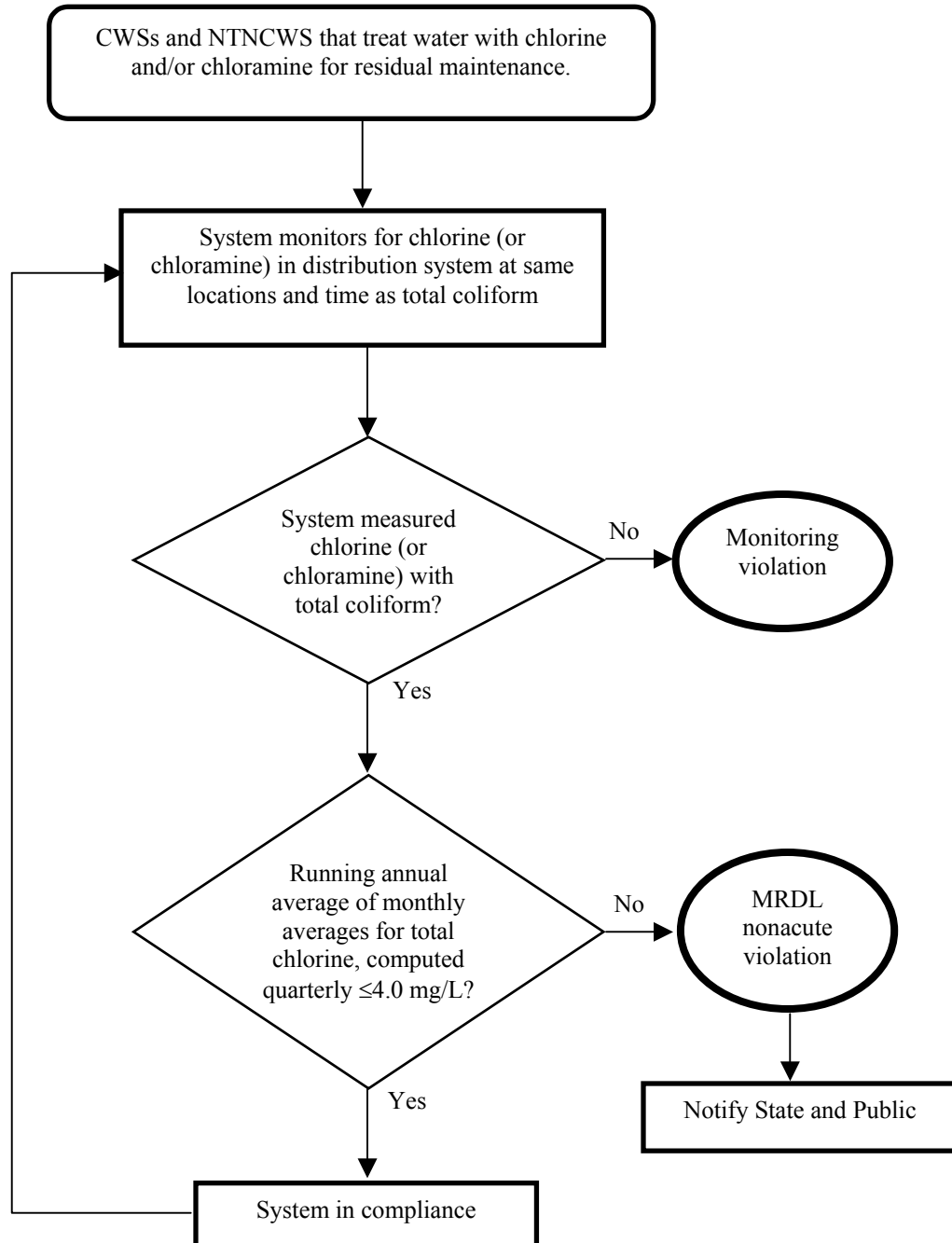
2.11 Additional Requirements for All Systems Using Chlorine and/or Chloramines

2.11.1 All systems that add a disinfectant must conduct routine compliance monitoring for chlorine and/or chloramine residual (Table 2-21). Requirements are summarized in Figure 2-8.

2.11.2 Reduced monitoring is not allowed for chlorine or chloramine.

2.11.3 Compliance determinations and reporting requirements for chlorine and chloramines are summarized in Table 2-22.

FIGURE 2-8
Summary Flow Chart of Chlorine and Chloramine Monitoring and Compliance Determinations



Notes:

1. Systems may increase residuals to a level above the MRDL for short periods of time to protect public health and to address specific microbiological problems.
2. If the system switches between chlorine and chloramines, compliance is determined by including all monitoring results of both chlorine and chloramines in calculation compliance.
3. Running annual average is first calculated after the first 12 months of monitoring.
4. Systems that use only chlorine are not required to monitor for chloramines and vice versa.

TABLE 2-21
Routine Compliance Monitoring and Reduced Monitoring for Chlorine and Chloramines

Routine Monitoring ¹	Reduced Monitoring
<u>Frequency</u> - Same time as total coliform samples are taken, including routine, repeat or any additional samples taken in excess of minimum. <u>Monitoring location</u> - Same locations as total coliform samples are taken. - Additional samples in excess of those required by the coliform monitoring may be used provided they are reflected in the written monitoring plan and representative of conditions in the distribution system.	No reduced monitoring allowed.

¹ The State may allow a public water system that uses both a surface water source or GWUDI and a ground water source to take disinfectant residual samples at points other than the total coliform sampling points if the State determines that such points are more representative of treated (disinfected) water quality in the distribution system.

TABLE 2-22
Chlorine and Chloramines Compliance Determination and Reporting Requirements

Compliance Determination	Reporting Requirements
- Running annual arithmetic average of monthly averages, computed quarterly, of all samples collected. - If annual arithmetic average of monthly averages, computed quarterly, covering any consecutive 4-quarter period exceeds the MRDL, then the system is in violation. - The system must notify the public and report to the State if in violation. - If system switches between chlorine and chloramines for residual disinfection during the year, compliance must be determined by including together all monitoring results of both chlorine and chloramines.	- Number of samples taken during each month of last quarter - Monthly arithmetic average of all samples taken in each month - Arithmetic average of all monthly averages for last 12 months - Whether MRDL was violated

2.12 Additional Requirements for All Systems Using Ozone

- 2.12.1 All CWS and NTNCWS using ozone must conduct routine compliance monitoring for bromate as summarized in Table 2-23. A flow chart for bromate monitoring is provided in Figure 2-9.
- 2.12.2 Systems may qualify for reduced bromate monitoring based on their running annual average bromide concentration. Reduced monitoring is also summarized in Table 2-23.
- 2.12.3 CDPHE may at its discretion return a system to routine bromate monitoring.
- 2.12.4 Compliance for bromate is based on a running annual arithmetic average, computed quarterly, on monthly samples (or, for months in which the system takes more than one sample, the average of all samples taken during the month) collected by the system.
- 2.12.5 If the average of samples covering any consecutive four-quarter period exceeds the MCL, the system is in violation of the MCL and must notify the public and CDPHE.
- 2.12.6 If the system fails to complete 12 consecutive months' monitoring, compliance with the MCL for the last four-quarter compliance period must be based on the average of the available data.
- 2.12.7 Using DBP Form 6 a system monitoring for bromate must report the following information:
- The number of samples taken during the last quarter.
 - The location, date and result of each sample taken during the last quarter.
 - The arithmetic average of the monthly arithmetic averages of all samples taken in the last year.
 - Whether the MCL was exceeded (as described above).

FIGURE 2-9
Bromate Monitoring Flow Chart

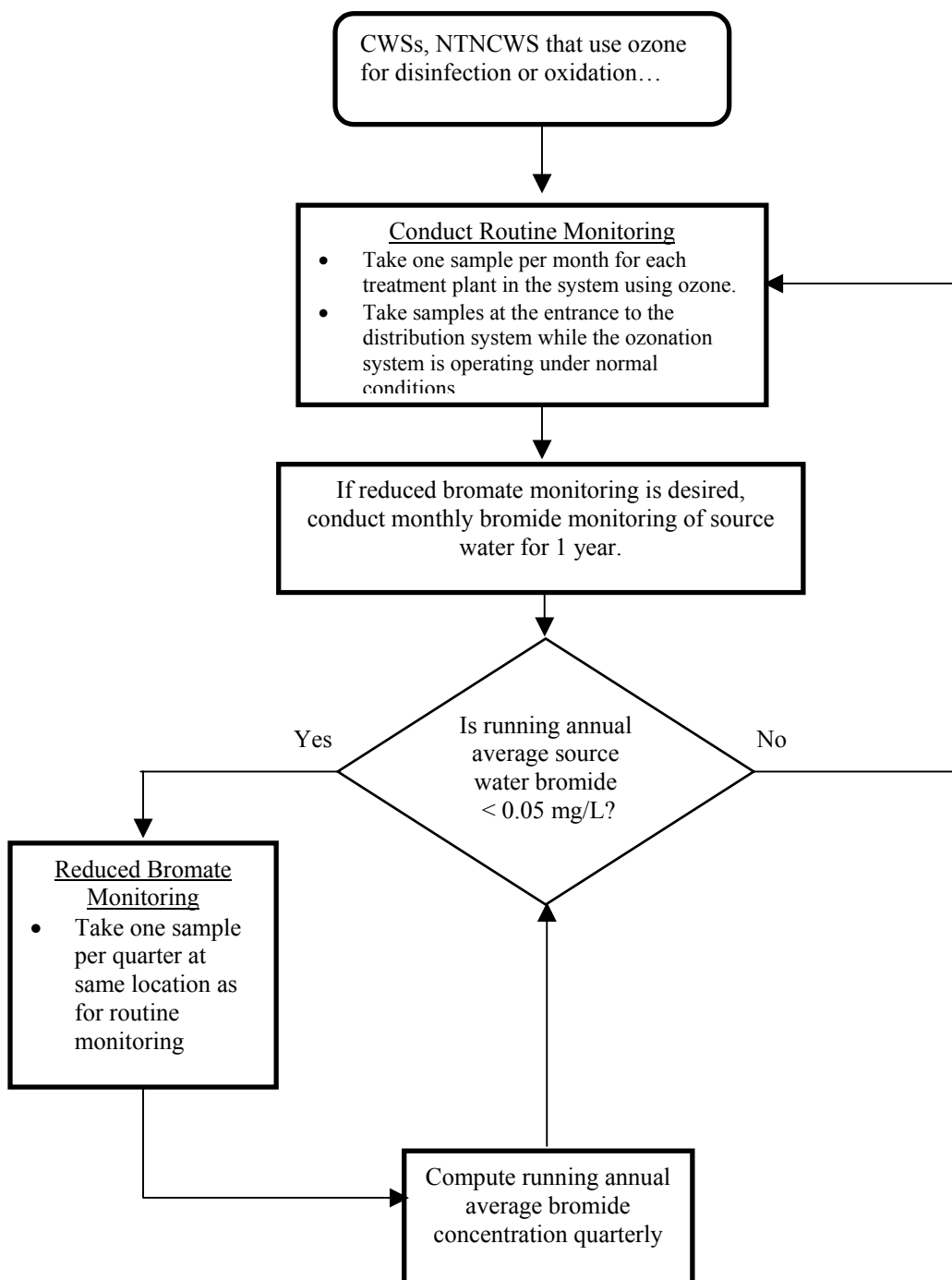


TABLE 2-23
Compliance Monitoring for Bromate

Routine Monitoring	Reduced Monitoring
CWSs and NTNCWSs using ozone... - Take one sample per month for each treatment plant in the system using ozone. - Systems must take samples monthly at the entrance to the distribution system while the ozone system is operating under normal conditions. - Systems on reduced bromate monitoring must continue to monitor monthly for source water bromide to remain on reduced monitoring.	Reduced monitoring from monthly to quarterly is allowed. - If the system demonstrates that the average source water bromide concentration is <0.05 mg/L based on representative monthly bromide measurements for one year. - If the running annual average source water bromide concentration is ≥0.05 mg/L, the system must return to routine monitoring.

2.13 Additional Requirements for All Systems Using Chlorine Dioxide

2.13.1 Chlorine Dioxide Monitoring Requirements

2.13.1.1 All CWS and NTNCWS using chlorine dioxide must conduct routine compliance monitoring and comply with MRDL and MCL for chlorine dioxide and chlorite. TNCWS must conduct routine compliance monitoring and comply with the MRDL for chlorine dioxide

2.13.1.2 Routine monitoring requirements for chlorine dioxide are summarized in Table 2-24 and Figure 2-10. **Chlorine dioxide monitoring may not be reduced.**

2.13.1.3 Additional requirements for chlorine dioxide if the daily sample taken at the entrance to the distribution system exceeds 0.8 mg/L include the following:

A single sample result at the entrance to the distribution system that exceeds 0.8 mg/L is not of itself a violation. It does, however, trigger the requirement to take additional samples in the distribution system the following day in addition to the daily sample always required at the entrance to the distribution system. In the event any of the distribution system sample results exceed 0.8 mg/L or if the system fails to monitor for additional samples in the distribution system the day following a daily entry point exceedance, it is an acute violation (tier one) violation with associated public notice

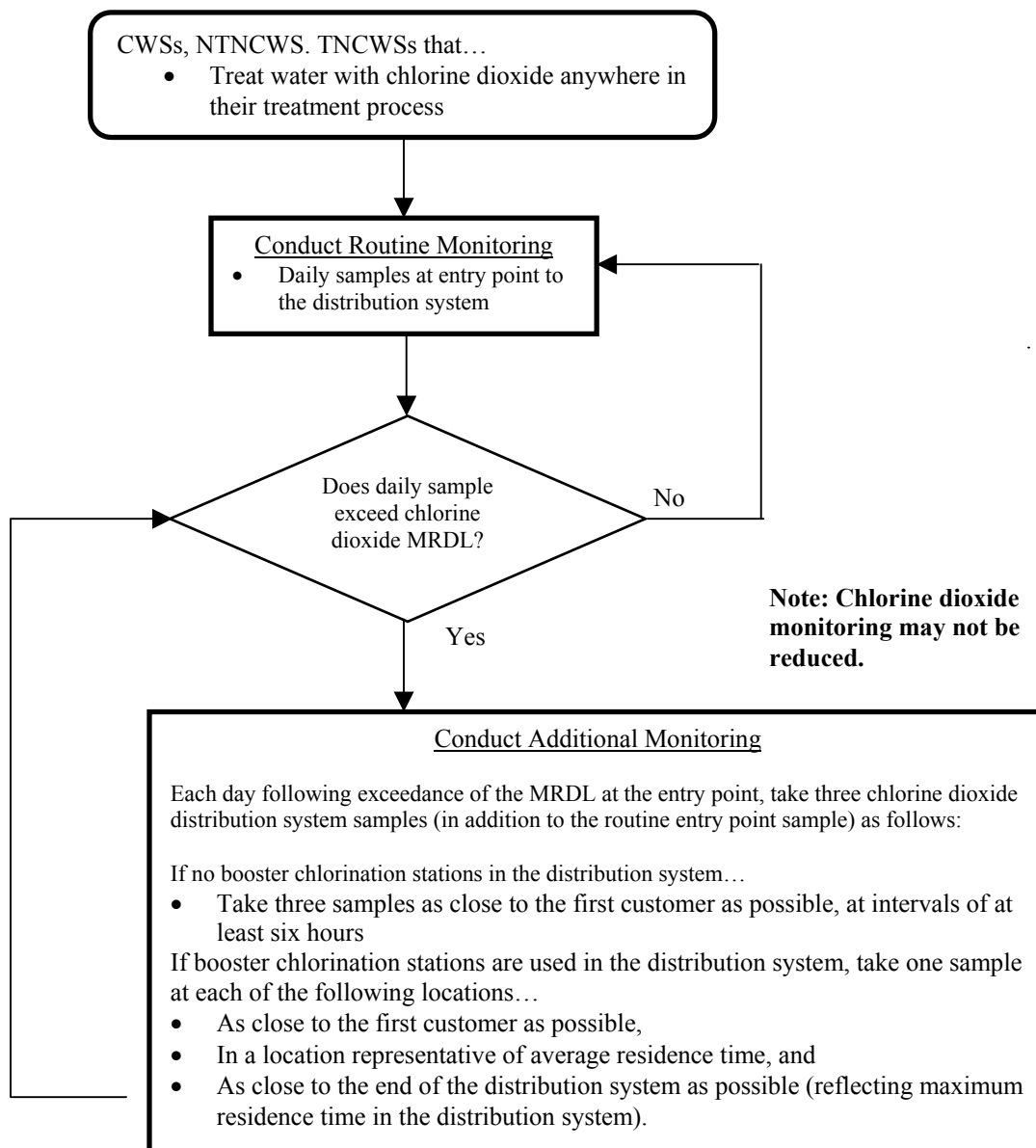
and State reporting requirements. In the event that the distribution system sample results do not exceed 0.8 mg/L, but the second consecutive daily sample at the entrance to the distribution system exceeds 0.8 mg/L, it is a tier two violation with associated public notice and State reporting requirements. In the event that none of the additional distribution system samples, nor the next day's sample at the entrance to the distribution system exceed 0.8 mg/L, there is no violation and no special reporting requirements. However, all monitoring results are required to be included with the routine monitoring report. Should a situation that triggers additional monitoring occur on the last day of the reporting period not result in a violation, report the additional monitoring results to CDPHE along with the next quarterly report (see Section 2.0.9).

- 2.13.1.4 Distribution system samples may be analyzed by a certified operator to determine chlorine dioxide concentration. Such sample analyses are to be conducted immediately upon collection.
- 2.13.1.5 Distribution system samples analyzed by a certified laboratory are to be conducted within the time requirements specified in the approved method.

TABLE 2-24
Chlorine Dioxide Compliance Monitoring

Chemical	Frequency	Where monitoring must be conducted
Chlorine dioxide	Daily	Sample taken at the entrance to the distribution system. For any daily sample that exceeds the MRDL, the system must take three samples in the distribution system the following day as follows: • If no booster chlorination in the distribution systems, take three samples as close to the first customer as possible, at intervals of at least six hours. • If there is one or more chlorine booster station in the distribution system, take one sample at each of the following locations: as close to the first customer as possible, in a location representative of average residence time, and as close to the end of the distribution system as possible (reflecting maximum residence time in the distribution system).

FIGURE 2-10
Chlorine Dioxide Monitoring Flow Chart



2.13.2 Chlorite Monitoring Requirements

2.13.2.1 Routine and reduced monitoring requirements for chlorite are summarized in Table 2-25 and Figure 2-11. Reduced monitoring for chlorite is allowed only as described in Table 2-25.

2.13.2.2 The samples taken daily at the entrance to the distribution systems may be analyzed by a Colorado certified operator. All monthly and additional samples taken in the distribution system for the purposes of determining compliance must be analyzed by a certified laboratory.

2.13.2.3 Additional requirements for chlorite if the daily sample taken at the entrance to the distribution system exceeds the MCL include the following:

A single sample result at the entrance to the distribution system that exceeds 1.0 mg/L is not of itself a violation. It does however trigger the requirement to take additional samples in the distribution system the following day in addition to the daily sample always required at the entrance to the distribution system and to include these results in the routine monitoring report. In the event the average of results of any three-sample set taken in the distribution system exceeds the MCL, it is a tier two violation with associated public notice requirements (see Article 10 of Colorado Primary Drinking Water Regulations). In addition, this violation must be reported to CDPHE within 48 hours.

2.13.2.4 Additional distribution system samples are to be analyzed by a certified laboratory within 28 days of collection. Analytical results of additional samples collected within the distribution system as a result of a daily sample exceeding 1.0 mg/L must be reported to CDPHE within 30 days of their collection if there is no MCL violation, and within 48 hour of becoming aware of a MCL violation.

2.13.2.5 CDPHE may at its discretion return a system to routine monitoring.

2.13.2.6 Compliance determinations for chlorine dioxide and chlorite are summarized in Table 2-26. Reporting requirements for chlorine dioxide and chlorite are summarized in Table 2-27.

TABLE 2-25
Chlorite Compliance Monitoring

Chemical	Frequency	Where monitoring must be conducted
Chlorite	Daily and Monthly	<u>Daily Monitoring</u> - Take daily samples at the entrance to the distribution system. For any daily sample that exceeds the chlorite MCL, the system must take three additional samples in the distribution system the following day (in addition to the entry point sample); one sample as close to the first customer as possible, one sample in a location representing average residence time, and the third sample as close to the end of the distribution system as possible (reflecting the maximum residence time in the distribution system). <u>Reduced Monitoring.</u> Daily chlorite monitoring at the entrance to the distribution system may not be reduced. <u>Monthly Monitoring</u> - Take a three-sample set each month in the distribution system. The system must take one sample at each of the following locations: near the first customer, at a location representative of average residence time, and at a location reflecting maximum residence time in the distribution system. - Any additional routine sampling must be conducted in the same manner (as three-sample sets, at the specified locations). - The system may use results of additional monitoring described above to meet the monthly sampling requirement. <u>Reduced Monitoring.</u> Monthly monitoring in the distribution system may be reduced to one three-sample set per quarter after one year of monitoring where no individual chlorite sample taken in the distribution system has exceeded the MCL and the system has not been required to conduct additional distribution system monitoring as a result of an entry point exceedance. - The system may remain on the reduced monitoring schedule until either any of the three individual chlorite samples taken in the distribution system exceeds the MCL, or the system is required to conduct additional distribution system monitoring as a result of an entry point exceedance.

FIGURE 2-11
Summary Flow Chart of Chlorite Monitoring Requirements

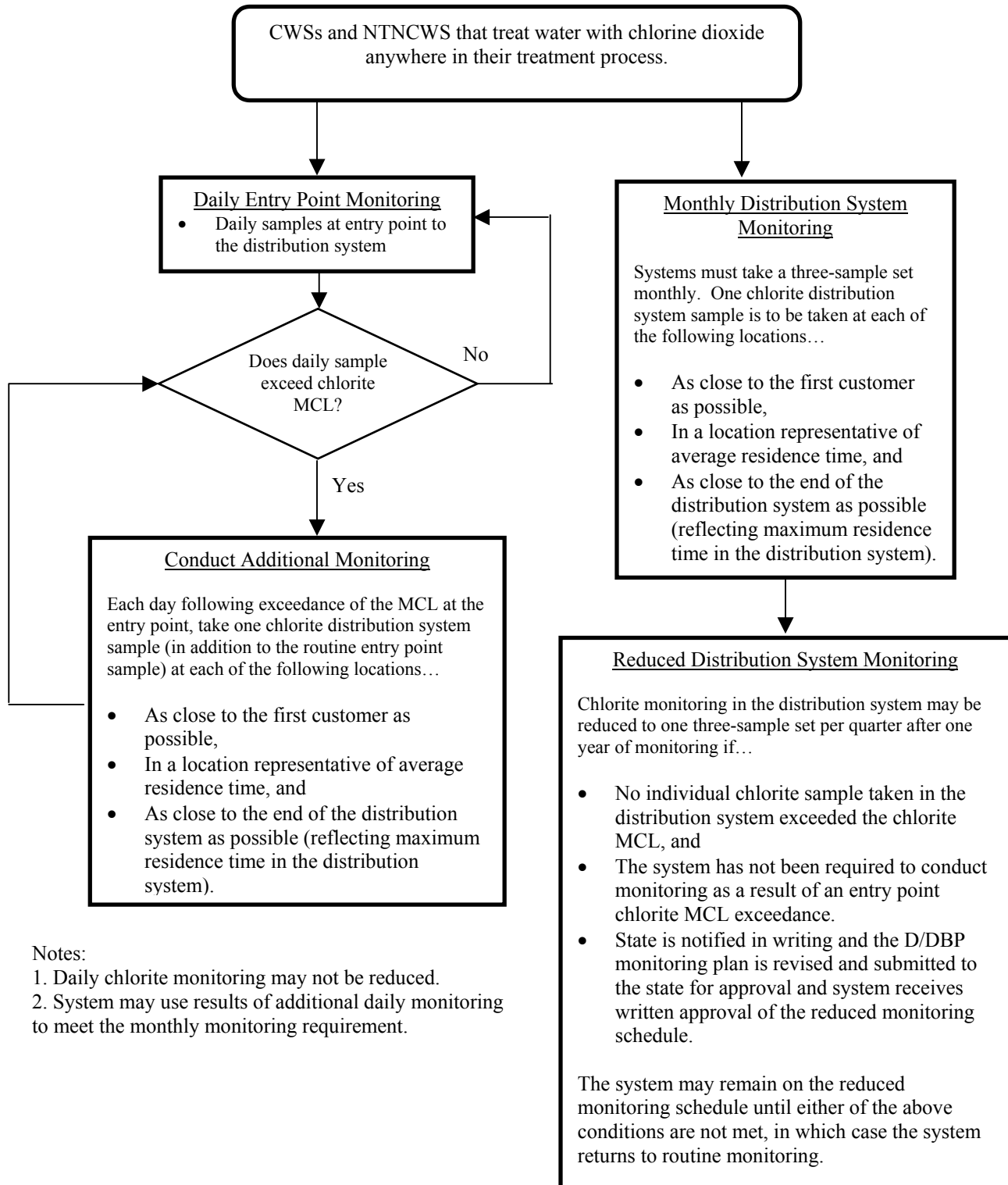


TABLE 2-26
Chlorine Dioxide and Chlorite Compliance Determination

Chemical	Compliance is based on...
Chlorine dioxide	Compliance is based on consecutive daily samples collected by the system [141.132(c)(2)]. <u>Acute Violation</u> (NOTE: Notify CDPHE in writing within 24 hours) • If any daily sample taken at the entrance to the distribution system exceeds the MRDL, and on the following day one (or more) of the three samples taken in the distribution system exceed the MRDL, the system is in violation of the MRDL and must take immediate corrective action to lower the level of chlorine dioxide below the MRDL and must notify the public following the procedures for acute health risks [141.32.(a)(1)(iii)(E)], in addition to reporting to the CDPHE. • A certified laboratory must analyze samples that have been taken in the distribution system as a result of a daily sample exceeding the MRDL. However, if the system's party-approved-by-the-state takes a measurement and it exceeds the MRDL, the system may use these results as a basis for Public Notification pending results of analysis by a certified laboratory. • Failure to take samples in the distribution system the day following an exceedance of the chlorine dioxide MRDL at the entrance to the distribution system will also be considered an MRDL violation and the system must notify the public following the procedures for acute health risks [141.32(a)(1)(iii)(E)], in addition to reporting to the CDPHE within 24 hours. <u>Non-Acute Violation</u> • If any two consecutive daily samples taken at the entrance to the distribution system exceed the MRDL and all distribution system samples taken as a result of those exceedances are below the MRDL, the system is in violation of the MRDL and must take corrective action to lower the level of chlorine dioxide below the MRDL at the point of sampling and is required to notify the public following the procedures for non-acute health risks [141.32(e)(78)] in addition to reporting to CDPHE within 48 hours. • Failure to monitor at the entrance to the distribution system the day following an exceedance of the chlorine dioxide MRDL at the entrance to the distribution system is also an MRDL violation and the system must notify the public of the violation in accordance with the provisions for nonacute violations [141.32(e)(78)] in addition to reporting to CDPHE within 48 hours.
Chlorite	Compliance is based on an arithmetic average of each three-sample set taken in the distribution system. • If the arithmetic average of any three-sample set taken in any month exceeds the MCL, the system is in violation of the MCL and must notify the public and report to CDPHE within 48 hours.

TABLE 2-27
Reporting Requirements for Chlorine Dioxide and Chlorite

Chemical	What must be reported
Chlorine dioxide	• The dates, results, and locations of samples taken during the last quarter. • Whether, based on 141.133(c)(2), the MRDL was violated. • Whether the MRDL was exceeded in any two consecutive daily samples and whether the resulting violation was acute or nonacute.
Chlorite	• The number of entry point samples taken each month for the last 3 months. • The location, date, and result of each sample (both entry point and distribution system) taken during the last quarter. • For each month in the reporting period, the arithmetic average of all samples taken in each three sample set taken in the distribution system. • Whether, based on 141.133(b)(3), the MCL was violated, in which month, and how many times it was violated each month.

PART III. VIOLATIONS REPORTING

Routine monitoring reports are to be submitted within 10 days after the end of each quarter in which samples were collected. Systems required to sample less frequently than quarterly must report to CDPHE within 10 days after the end of each monitoring period in which samples were collected. Table 4-1 summarizes all D/DBP rule violations

3.1 Tier 2 and Tier 3 Violations Reporting

3.1.1 For each monitoring period that a system has a Tier 2 or a Tier 3 violation of any provision of the D/DBP rule, it must use DDBPR Form 2 - Violation Notification to report the violation to the CDPHE rule manager for the D/DBP rule within 48 hours of becoming aware of the violation and report to the public in accordance with Article 10 or the *Colorado Primary Drinking Water Regulations*. In addition, the system must identify the violation in their routine monitoring report.

Tier 2 Violations include the following:

- All violations of the MCL, MRDL, and treatment technique requirements of the regulations, except where a Tier 1 notice is required or where the Water Quality Control Division determines that a Tier 1 notice is required. Examples include, but are not limited to, the following:
 - **Chlorine Dioxide Non-Acute violation**
 - **TTHM or HAA5 MCL violation**
 - **Treatment Technique (TT) violation related to TOC removal**
 - **Chlorine MRDL violation.**
- Violations of the monitoring and testing procedure requirements, where the Water Quality Control Division determines that a Tier 2 rather than a Tier 3 public notice is required, taking into account potential health impacts and persistence of the violation.

- Failure to comply with the terms and conditions of any variance or exemption.

Tier 3 Violations include the following:

- All monitoring violations, except where a Tier 1 notice is required or where the Water Quality Control Division determines that a Tier 2 notice is required.
Examples include:
 - **Failure to monitor for ‘TOC paired sample’**
 - **Failure to monitor for TTHM or HAA5**
 - **Failure to monitor in accordance with Monitoring Plan**
 - **Failure to submit reports by the proper date**
- Failure to comply with a testing procedure, except where a Tier 1 notice is required or where the Water Quality Control Division determines that a Tier 2 notice is required.
- Operation under a variance or exemption granted in accordance with the Safe Drinking Water Act.
- Availability of unregulated contaminant monitoring results.
- Exceedance of the fluoride secondary maximum contaminant level (SMCL).

3.2 Tier 1 Violations Reporting

- 3.2.1 For each Tier 1 violation of the D/DBP rule, the system must complete DDBPR Form 2 - Violation Notification and send it via fax to the CDPHE rule manager for the D/DBP rule. Such fax is to be received by CDPHE within 24 hours of the system becoming aware of the violation. In the event that the violation becomes known on a holiday, Saturday or Sunday, the system must in addition call the CDPHE Emergency Management Unit (1-877-518-5608) to report the auto violation. In addition, the system must notify the public within 24 hours in accordance with Article 10 of the *Colorado Primary Drinking Water Regulations*.

Tier 1 Violations include the following:

- Violation of the MCL for total coliforms when fecal coliform or E. coli are present in the water distribution system, or when the water system fails to test for fecal coliforms or E. coli when any repeat sample tests positive for coliform.
- Violation of the MCL for nitrate, nitrite, or total nitrate and nitrite or when the water system fails to take a confirmation sample within 24 hours of the system's receipt of the first sample showing an exceedance of the nitrate or nitrite MCL.
- Exceedance of the nitrate MCL by non-community water systems, where permitted to exceed the MCL by the Water Quality Control Division.
- **Violation of the MRDL for chlorine dioxide when one or more samples taken in the distribution system the day following an exceedance of the MRDL at the entrance of the distribution system exceed the MRDL, or when the water system does not take the required samples in the distribution system. For example:**
 - **Acute Chlorine Dioxide violation**
- Violation of the turbidity MCL where the Water Quality Control Division determines, after consultation, that a Tier 1 notice is required or where

consultation does not take place within 24 hours after the system learns of the violation.

- Violation of the Surface Water Treatment Rule (SWTR) or Interim Enhanced Surface Water Treatment rule (IESWTR) treatment technique requirement resulting from a single exceedance of the maximum allowable turbidity limit, where the Water Quality Control Division determines, after consultation, that a Tier 1 notice is required or where consultation does not take place within 24 hours after the system learns of the violation.
- Occurrence of a waterborne disease outbreak or other waterborne emergency (such as a failure or significant interruption in key water treatment processes, a natural disaster that disrupts the water supply or distribution system, or a chemical spill or unexpected loading of possible pathogens into the source water that significantly increases the potential for drinking water contamination);
- Other violations or situations with significant potential to have serious adverse effects on human health as a result of short-term exposure, as determined by the Water Quality Control Division either in regulation or on a case-by-case basis.

TABLE 3-1
Stage 1 Disinfectants/Disinfection Byproducts Violation Reporting List

SDWIS Violation/ Contaminant Code	Regulated Contaminant/ Requirement	Citation	Violation Type	System Size and Type Affected	Violation	Initial Compliance Date
MAXIMUM CONTAMINANT LEVEL (MCL) VIOLATIONS						
02/011	Bromate	§141.64(a)	MCL	All systems using ozone for disinfection or oxidation	If the running annual average computed quarterly of monthly samples exceeds the MCL 0.010 mg/L.	January 1, 2002 January 1, 2004
02/1009	Chlorite	§141.64(a)	MCL	All systems using chlorine dioxide for disinfection or oxidation	If the average of any three sample set, exceeds the MCL of 1.0 mg/L.	January 1, 2002 January 1, 2004
02/2456	HAA5	§141.64(a)	MCL	All systems	If the running annual average computed quarterly of quarterly averages of available samples exceed 0.060 mg/L for HAA5.	January 1, 2002 January 1, 2004
02/2950	TTHM	§141.64(a)	MCL	All systems	If the running annual average computed quarterly of quarterly averages of available samples exceed 0.080 mg/L for TTHM.	January 1, 2002 January 1, 2004
MAXIMUM RESIDUAL DISINFECTANT LEVEL (MRDL) VIOLATIONS						
11/1006	Chloramines	§141.65(a)	MRDL	All systems using chloramines If systems use both chloramines and chlorine, systems must average all results for compliance	If the annual average, computed quarterly, of monthly averages exceeds 4.0 mg/L (unless increased residual levels in the distribution system address specific microbial contamination problems)	January 1, 2002 January 1, 2004
11/0999	Chlorine	§141.65(a)	MRDL	All systems using chlorine If systems use both chloramines and chlorine, systems must average all results for compliance	Exceedance of the MRDL for Chlorine: 4.0 mg/L (unless increased residual levels in the distribution system address specific microbial contamination problems)	January 1, 2002 January 1, 2004
11/1008 Acute/ Non Acute	Chlorine Dioxide	§141.65(a)	MRDL	All systems using chlorine dioxide for disinfection or oxidation	ACUTE: If any of the three required distribution samples taken on the day following a daily entry point sample	January 1, 2002 January 1, 2004

SDWIS Violation/ Contaminant Code	Regulated Contaminant/ Requirement	Citation	Violation Type	System Size and Type Affected	Violation	Initial Compliance Date
					MRDL exceedance 0.8 mg/L NON-ACUTE: If any two consecutive daily samples exceed 0.8 mg/L and all distribution samples are less than 0.8 mg/L	
11/1008 Acute/ Non Acute	Chlorine Dioxide	§141.132(a)	MRDL	All systems using chlorine dioxide for disinfection or oxidation	Failure to collect and report additional samples the day following an MRDL exceedance.	January 1, 2002 January 1, 2004
TREATMENT TECHNIQUE (TT) VIOLATIONS						
37/0400	TTHM	§141.30(f)	TT	All subpart H systems that add disinfectant	Failure to submit and obtain state approval of a plan detailing significant treatment process modifications prior to making such modifications	February 1999
12/0400	Treatment Plant Operators	§141.130(c)	TT	All CWS's and NTNCWS's that add a chemical disinfectant	Failure to have a state-approved and listed qualified operator running the plant.	January 1, 2002 January 1, 2004
46/2920	DBP Precursors (TOC)	§141.135	TT	All subpart H systems that use conventional filtration	Failure to meet the Treatment Technique requirements for DBP precursor removal	January 1, 2002 January 1, 2004
MONITORING AND REPORTING (M/R) VIOLATIONS						
27/0400	Monitoring Plan	§141.132(a)(3)	M/R Major	All CWS's and NTNCWS's which add a chemical disinfectant	Failure to develop, within thirty days of the initial compliance dates, implement and monitor in accordance with the monitoring plan	January 1, 2002 January 1, 2004
27/0400	Monitoring Plan	§141.132(f) §141.134(a)	M/R Major	Subpart H systems serving over 3,300 people	Failure to submit a copy of the monitoring plan to the state no later than the date of the first report required under §141.134	January 1, 2002 January 1, 2004

SDWIS Violation/ Contaminant Code	Regulated Contaminant/ Requirement	Citation	Violation Type	System Size and Type Affected	Violation	Initial Compliance Date
27/1006	Chloramines	§141.132 (c)	M/R Major	All systems using chloramines	Failure to collect and report <i>at least</i> 90 percent of samples (taken at same time and location as total coliform samples), failure to monitor using the EPA-approved monitoring & analytical methods and certified labs, and/or failure to report within 10 days after the end of the applicable reporting period.	January 1, 2002 January 1, 2004
			M/R Minor		Collecting and reporting between 90 – 99 percent, or Failure to monitor using the EPA-approved monitoring & analytical methods and certified labs, and report <u>between 90% and 99% of all required results and information</u> within 10 days after the end of the applicable reporting period, for the applicable contaminant.	
27/1011	Bromate	§141.132 (b)(3)	M/R Major	All systems using ozone for disinfection or oxidation	Failure to collect and report 100% of required samples: 1/plant/month for routine monitoring and 1 plant/quarter for reduced monitoring (system must revert to routine if running annual average source water bromide 0.05 mg/L	January 1, 2002 January 1, 2004
27/0999	Chlorine	§141.132 (c) (1)	M/R Major	All systems using chlorine	Failure to collect and report <i>at least</i> 90% of Chlorine samples (taken at the same time and location as total coliform samples)	January 1, 2002 January 1, 2004
			M/R Minor		Collecting and reporting 90-99% of required samples	
27/1008	Chlorine Dioxide	§141.132 (c)(2)	M/R Major	All systems using chlorine dioxide for disinfection or oxidation- systems may not reduce chlorine dioxide monitoring	Failure to collect and report <i>at least</i> 90% of required samples	January 1, 2002 January 1, 2004
			M/R Minor		Collecting and reporting 90-99% of required samples	

SDWIS Violation/ Contaminant Code	Regulated Contaminant/ Requirement	Citation	Violation Type	System Size and Type Affected	Violation	Initial Compliance Date
27/1099	Chlorite	§141.132 (b)(2)	M/R Major	All CWS and NTNCWS using chlorine dioxide for disinfection or oxidation systems may not reduce daily Chlorite, but can reduce monthly three sample set in distribution system to quarterly. Systems must revert to routine if any distribution sample exceeds MCL of 1.0 mg/L	Failure to collect and report at least 90 percent of daily samples at the entrance to the distribution system and monthly three set samples in distribution system.	January 1, 2002 January 1, 2004
			M/R Minor		Collecting and reporting between 90-99 percent of daily samples	
27/2920	DBP Precursors	§141.132 (d)(1)	M/R Major	All Subpart H systems that use conventional filtration - Systems can remain on reduced monitoring as long as annual average treated TOC does not exceed 2.0 mg/L	Failure to collect source and finished water TOC samples and alkalinity sample (at the same time as source water TOC sample) – 1/plant/month on routine monitoring or 1/plant/quarter on reduced monitoring	January 1, 2002 January 1, 2004
Subpart H serving at least 10,000 people						
27/2456 27/2950	HAA5 TTHM	§141.132	M/R Major	Subpart H serving at least 10,000 people -Systems on reduced must revert to routine if annual average exceeds 0.060 mg/L for TTHM or 0.045 mg/L HAA5	Failure to collect and report <i>at least</i> 90 percent of required samples: Routine = 4/plant/quarter Reduced = 1/plant/quarter	January 1, 2002
			M/R Minor		Collecting and reporting between 90-99 percent of required samples	
Subpart H serving 500 to 9,999 people						
27/2456 27/2950	HAA5 TTHM	§141.132	M/R Major	Subpart H serving 500 to 9,999 people - Systems on reduced must revert to routine if annual average exceeds 0.060 mg/L for	Failure to collect and report <i>at least</i> 90 percent of required samples: Routine = 1/plant/quarter Reduced = 1/plant/year during month of warmest water temperature	January 1, 2004

SDWIS Violation/ Contaminant Code	Regulated Contaminant/ Requirement	Citation	Violation Type	System Size and Type Affected	Violation	Initial Compliance Date
			M/R Minor	TTHM or 0.045 mg/L for HAA5	Collecting and reporting between 90-99 percent of required samples	
Subpart H serving fewer than 500 people						
27/2456 27/2950	HAA5 TTHM	§141.132	M/R Major	Subpart H serving fewer than 500 people – There is no reduced monitoring	Failure to collect and report <i>at least</i> 1 sample per plant per year during the month of warmest water temperatures	January 1, 2004