Disinfectants and Disinfection Byproducts Operational Evaluation Reports

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EPA Region 8

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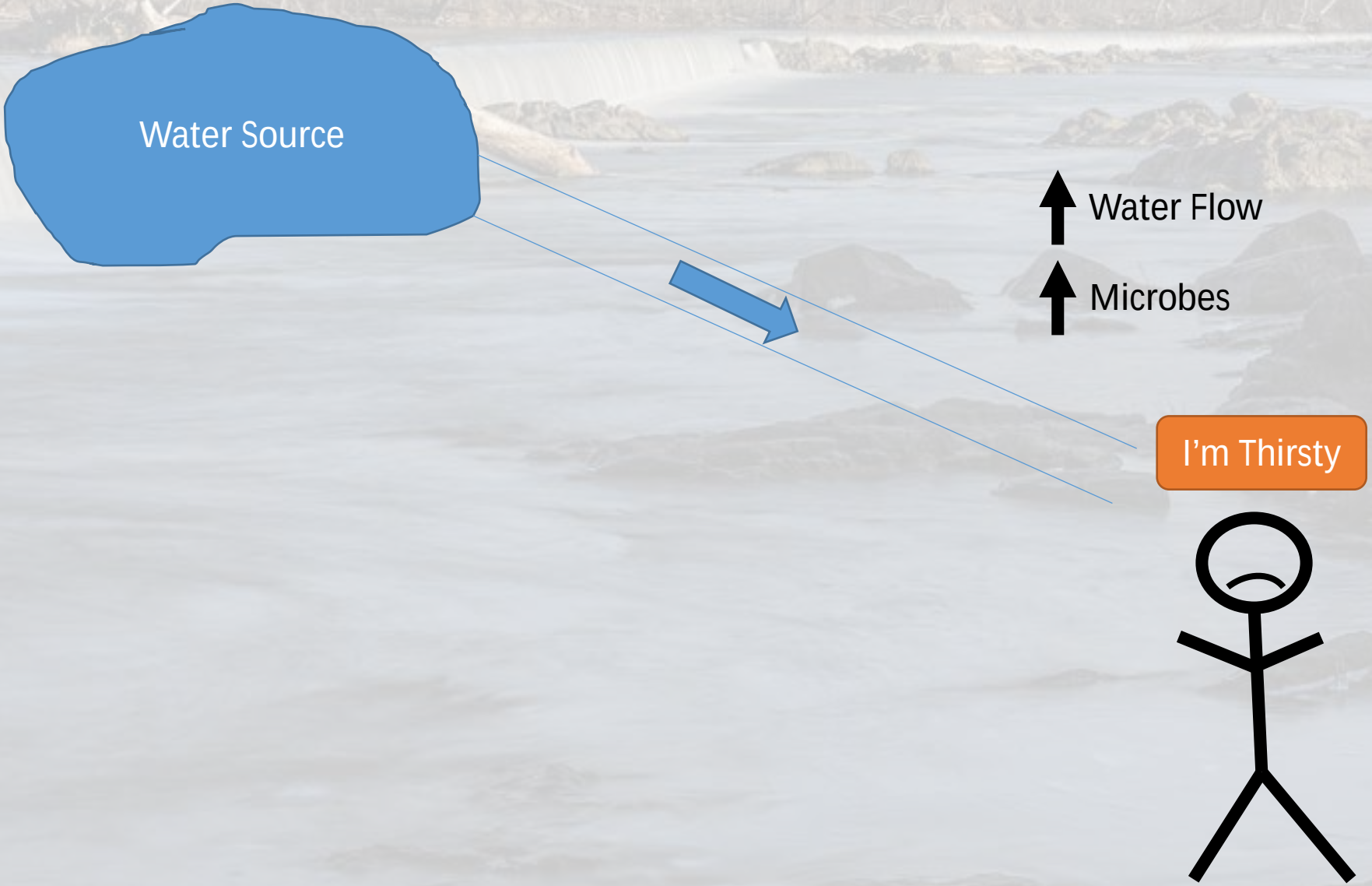
Disinfection Residuals and DBPs

Who does this apply to?

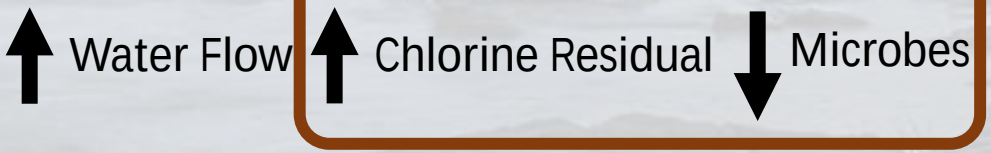
Community Water Systems and Non-Transient Non-Community Water Systems (NTNCWS)

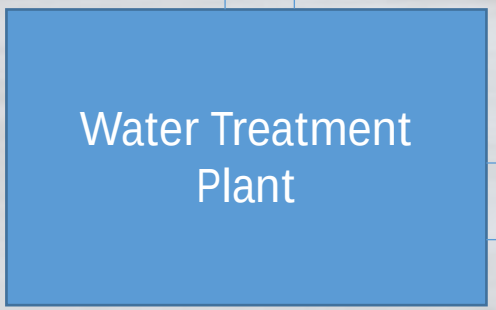
that add chlorine as a chemical disinfection.

Simultaneous Compliance

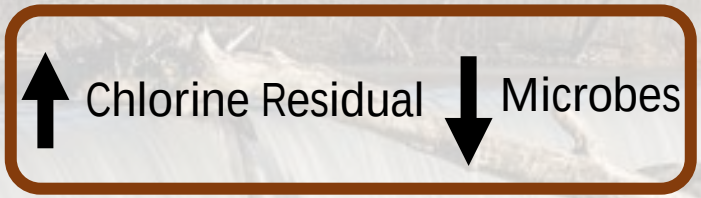


Simultaneous Compliance





Maximum Residual Disinfectant Levels (MRDLs)



Can too much of a good thing, be a bad thing?

Maximum Residual Disinfectant Levels

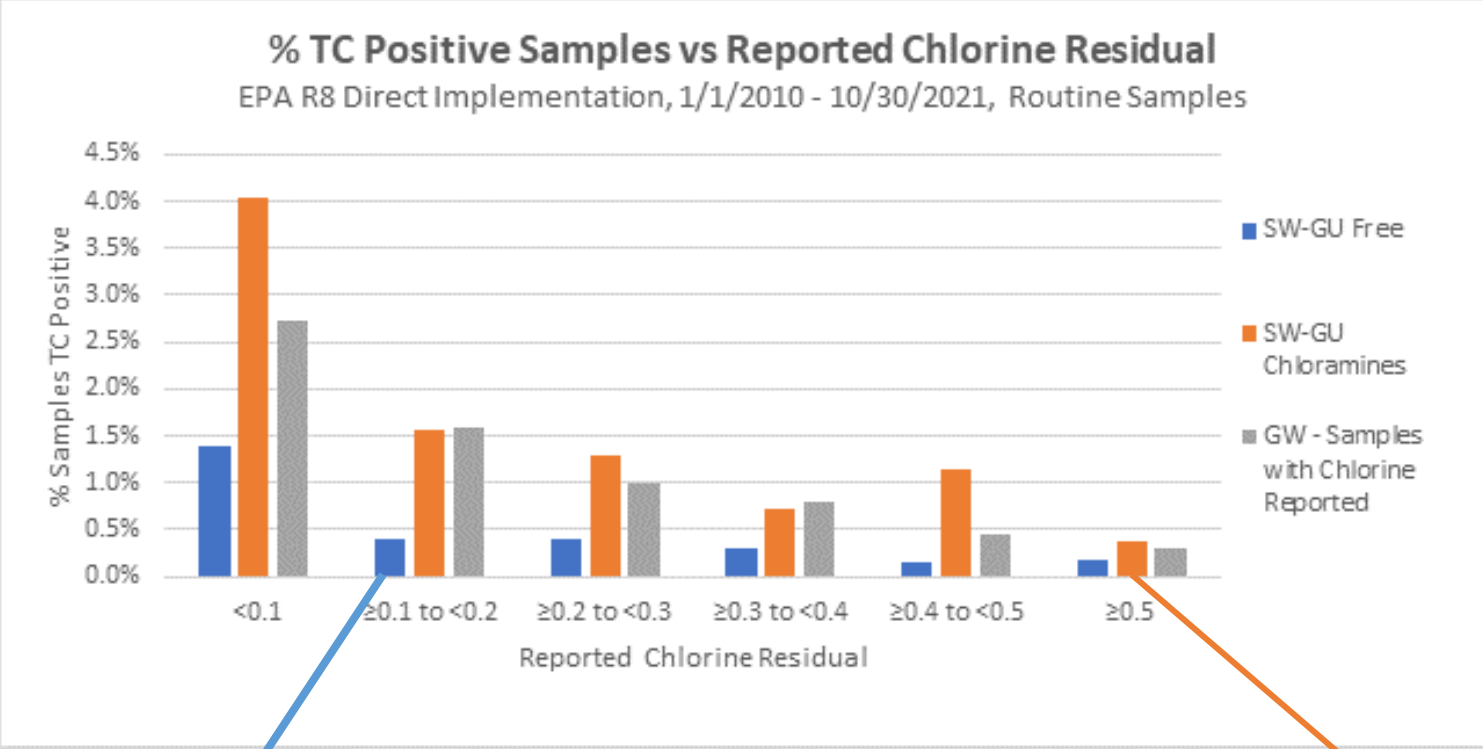
Chlorine = 4.0 mg/L

Chloramines = 4.0 mg/L

Chlorine Dioxide = 0.8 mg/L

Chlorine Residuals

If that was too much, how much is too little?



Free Chlorine
EPA Recommends 0.2 mg/L

Chloramines
EPA Recommends 0.5 mg/L

Commonly Used Instruments – Free Chlorine

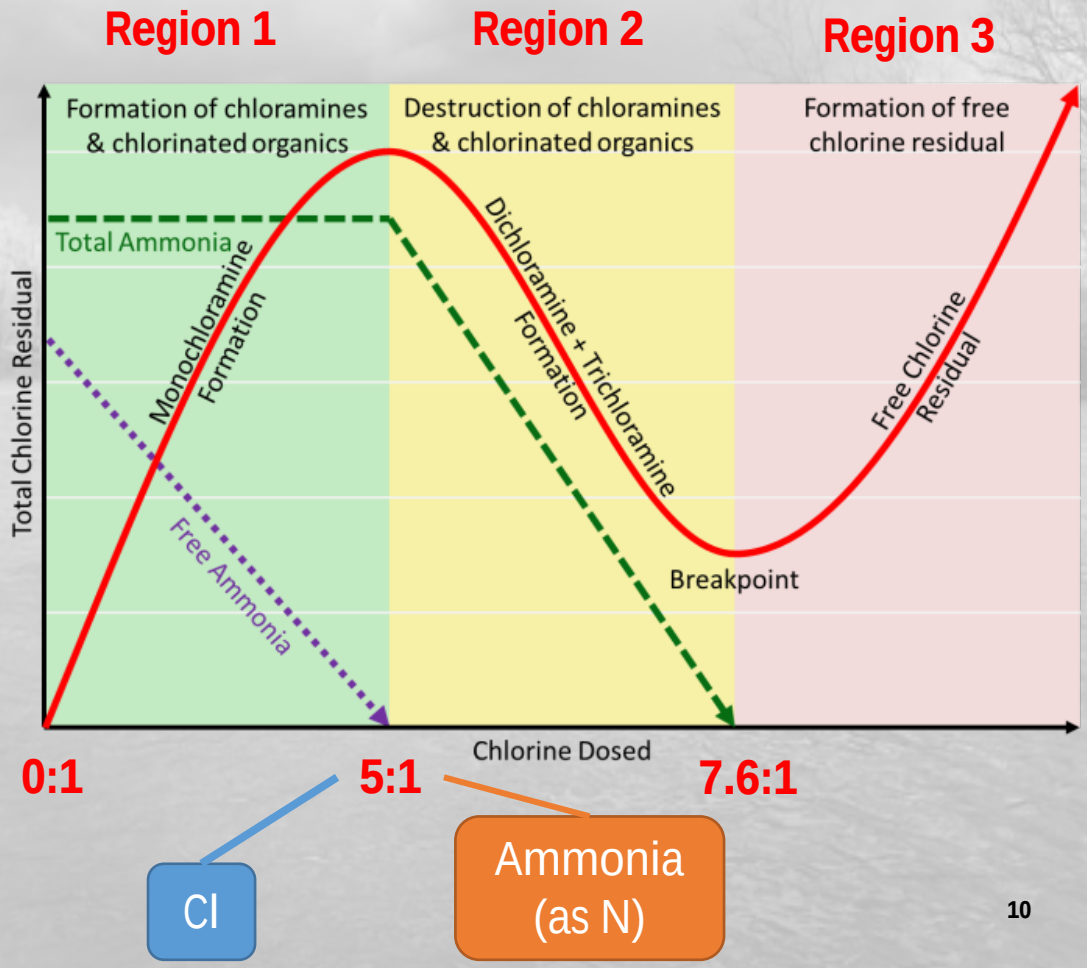
- Portable Colorimeter Pocket II / DR-300 Colorimeters
  - Relatively smaller and less expensive than other portable colorimeters
  - Measures absorbance at a fixed wavelength (i.e., single or limited parameters)
  - DR-300 replaced Pocket II model in 2019
  - Performance should be verified periodically with secondary standards

Commonly Used Instruments – Chloramines

- Portable Parallel Analyzer (PPA) SL-1000
  - Relatively more expensive than other portable colorimeters
  - Uses Chemkey reagent
  - Measures multiple parameters at different wavelengths simultaneously (4 Chemkeys and 2 probes)
  - Ideal for chloraminated water systems
  - Automated analysis minimizes potential user error and adjusts reaction time based on sample temperature
  - Saves operator time

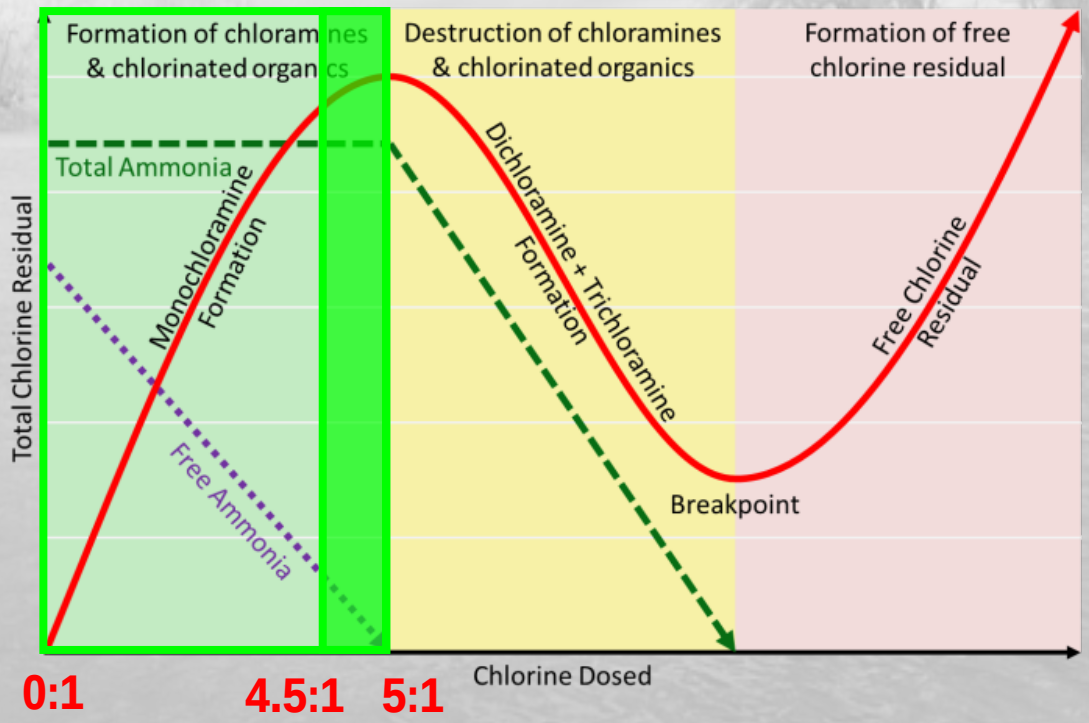
The Breakpoint Curve

- Simplified graphical representation
- Chloramine speciation influenced by:
  - Cl_2:N
  - pH
  - Alkalinity
  - Temperature
- Three distinct regions



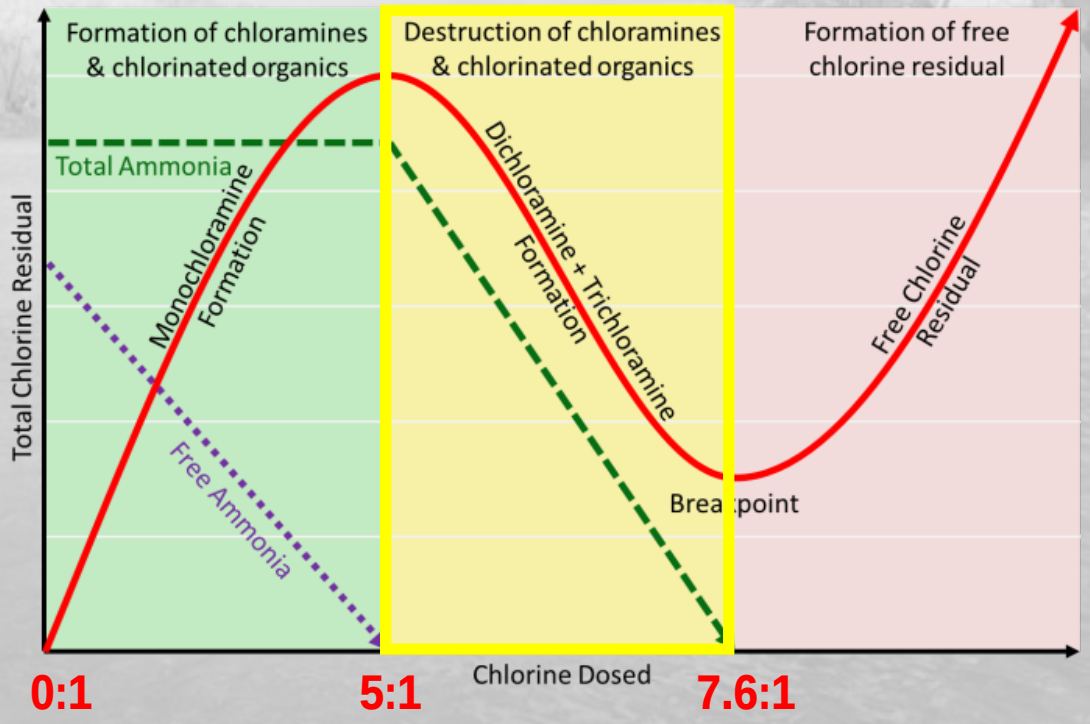
Region I: *Monochloramine Formation*

- **Desired region for chloraminated systems**
- Monochloramine is the predominant species
- As Cl_2:N ↑ from 0:1 - 5:1
  - Total Cl_2 (mostly NH_2Cl) ↑
  - Free NH_3 ↓
- Optimal Cl_2:N is 4.5:1 - 5:1 to minimize free ammonia
- Does not account for chlorine demand



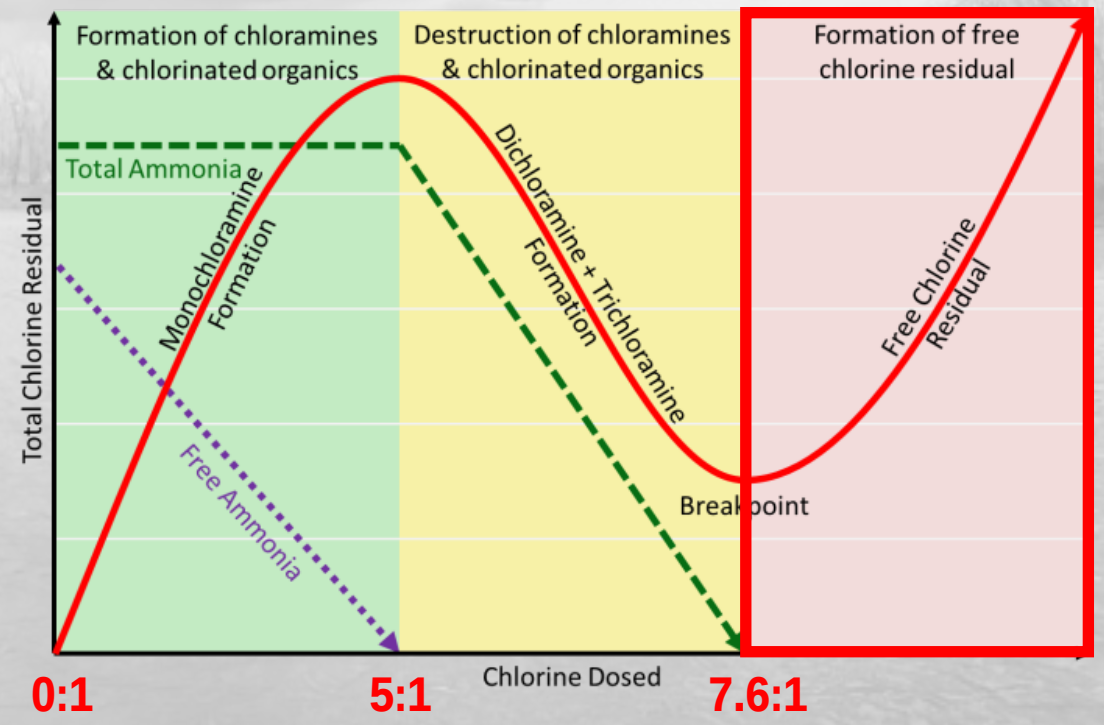
Region II: *Monochloramine Destruction*

- **Undesired region for all systems**
- Unstable mixture of mono-, di-, and trichloramine
- As Cl_2:N ↑ from 5:1 – 7.6:1
  - Total Cl_2 ↓
  - Total NH_3 ↓
- Cl_2:N to achieve breakpoint in natural water is >7.6:1, likely 9:1 to 10:1

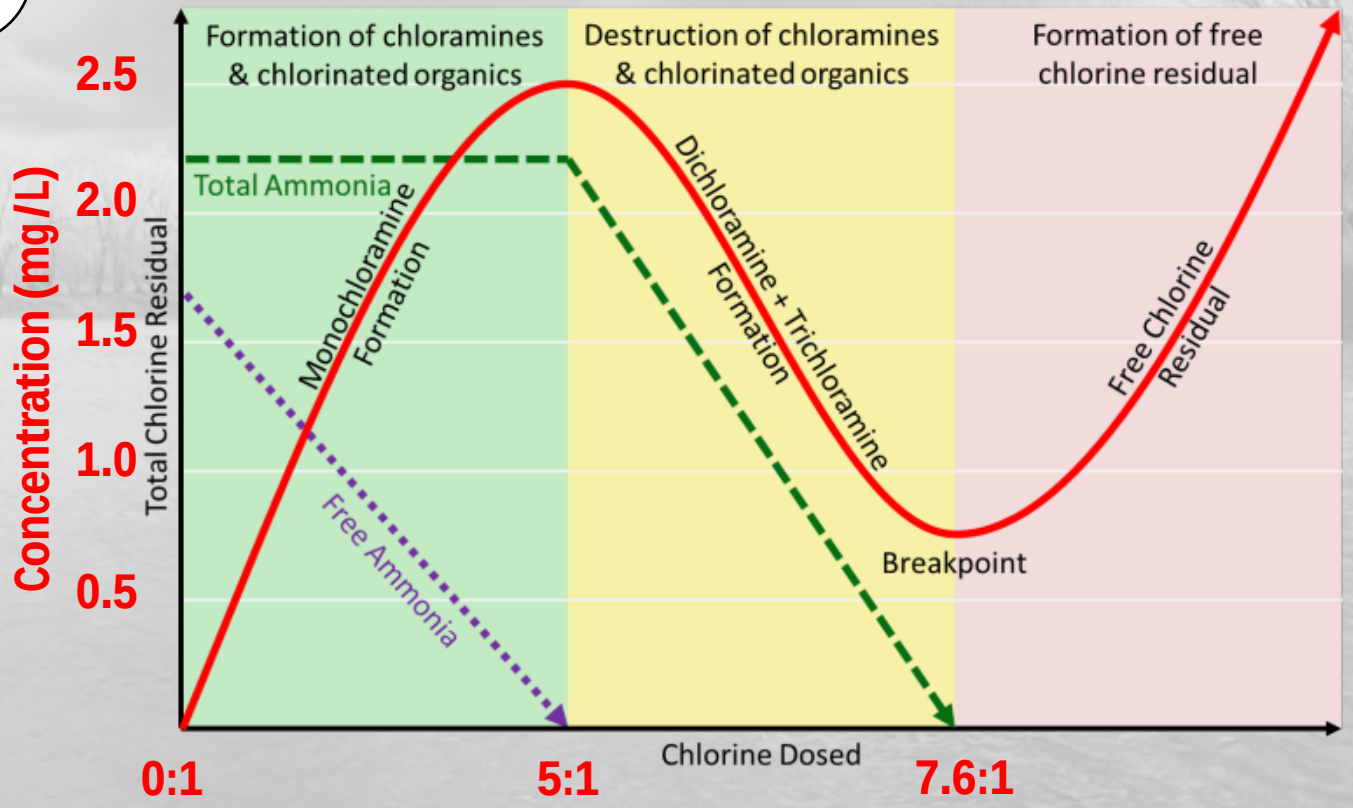


Region III: *Breakpoint*

- **Desired region for free chlorine systems**
- Predominantly free chlorine
- As Cl_2:N ↑ after breakpoint
  - Total Cl_2 ↑
  - Free Cl_2 ↑

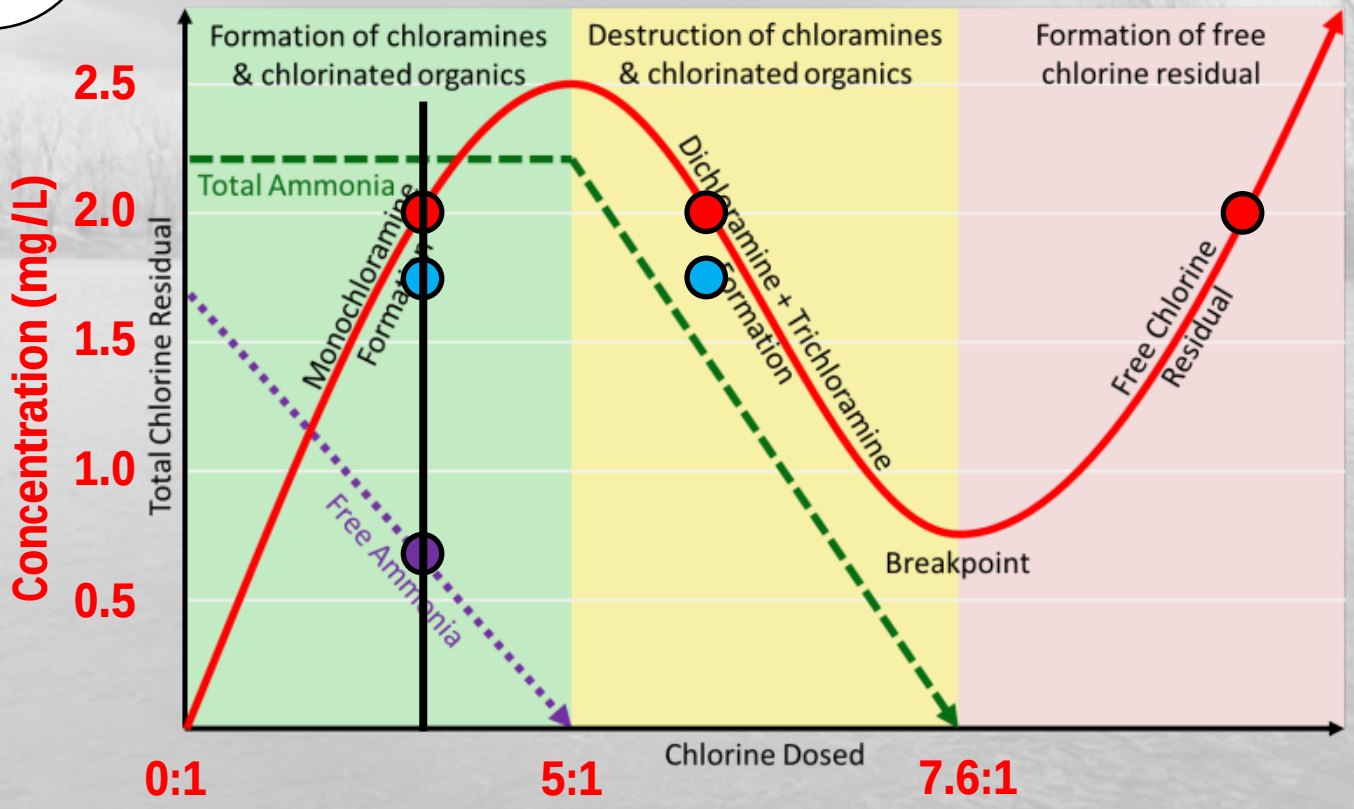


Breakpoint Curve Example



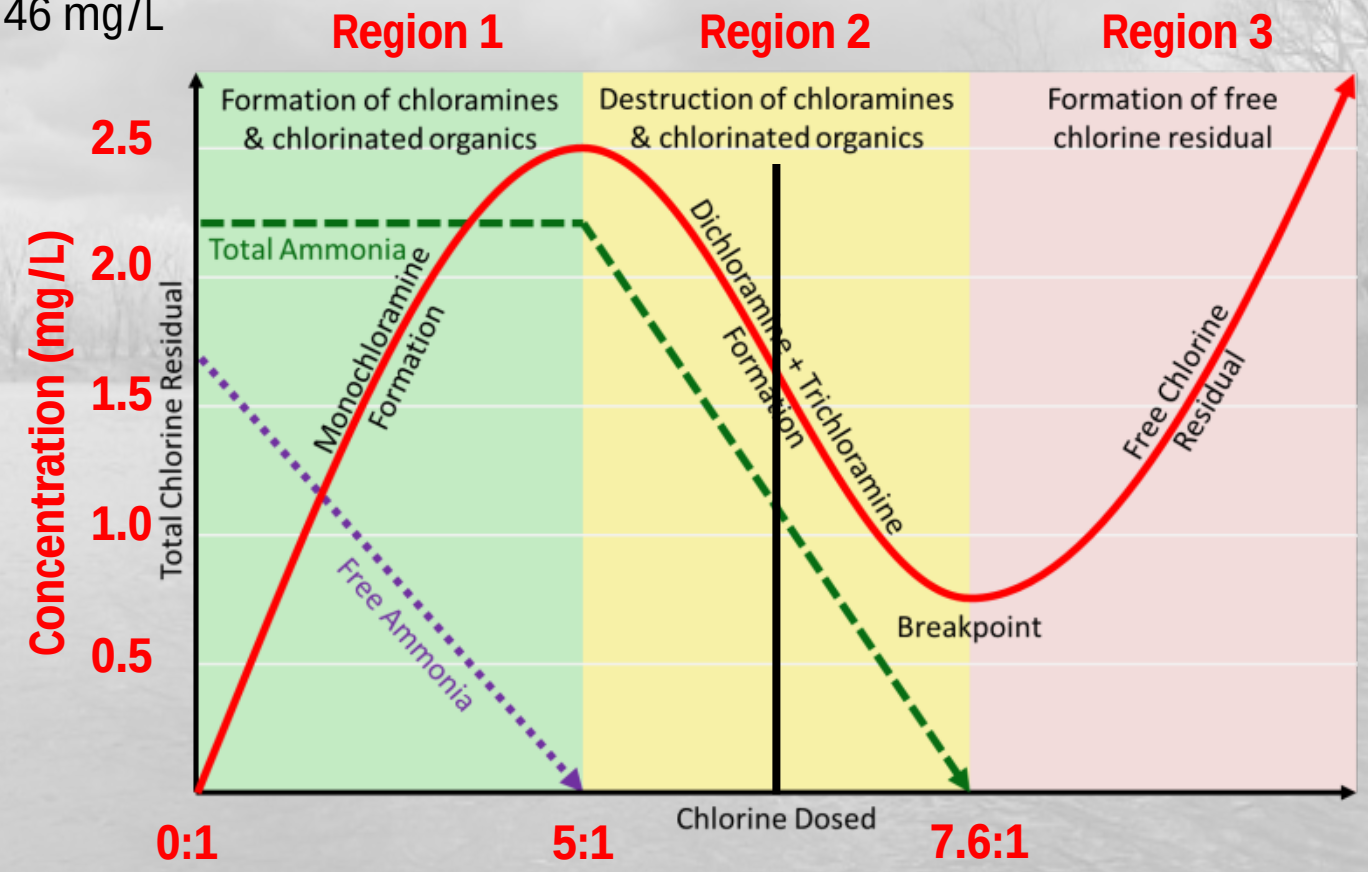
Breakpoint Curve Example

I got...
2.0 mg/L Total Cl_2
1.7 mg/L Mono
0.6 mg/L Free NH_3



Breakpoint Curve: Quiz Question #1

- Where on the curve is this sample?
  - Total Cl_2: 1.78 mg/L
  - Mono: 1.23 mg/L
  - Free NH_3: 0.01 mg/L
  - Free Cl_2: 0.46 mg/L

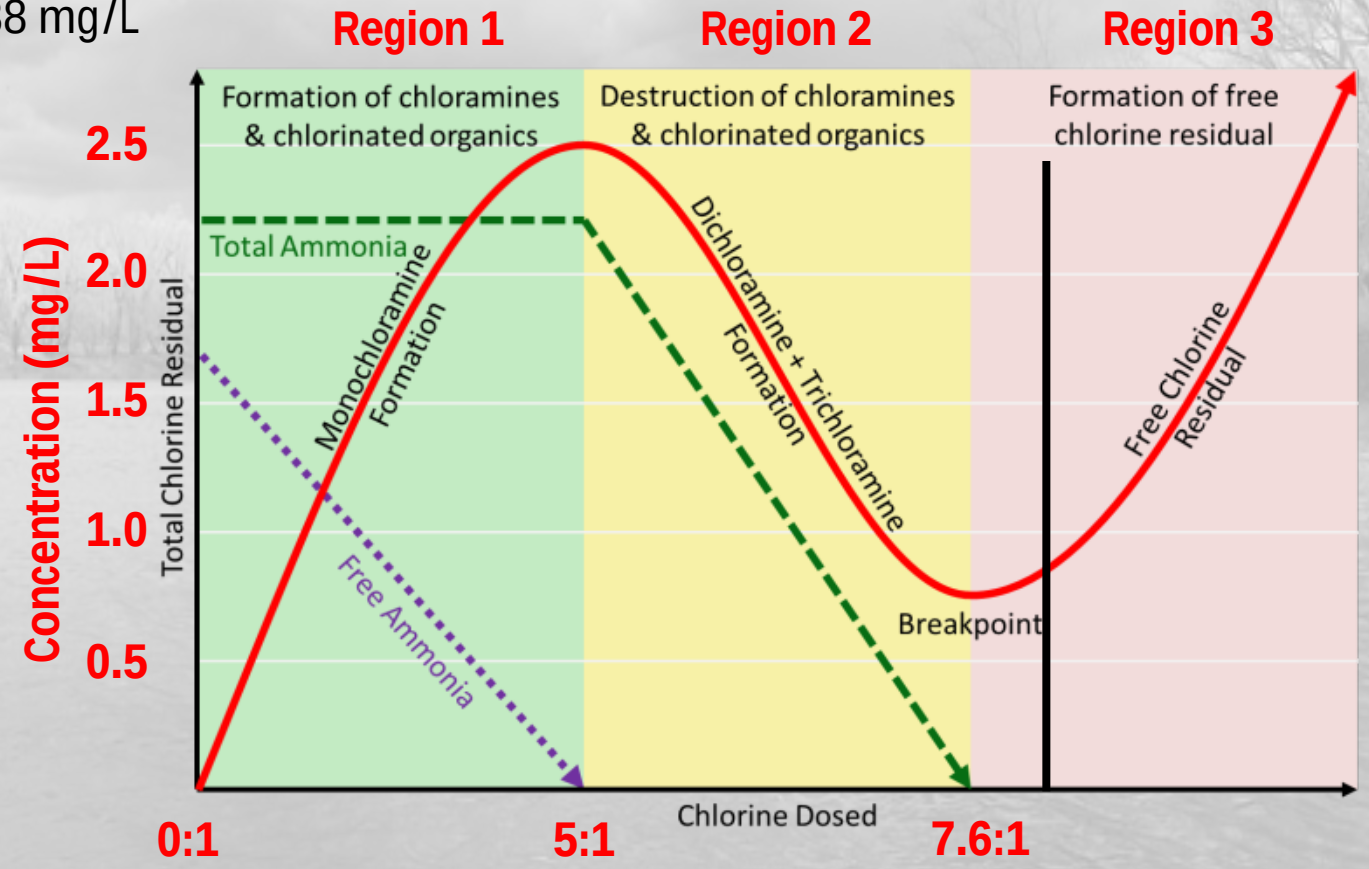


Actual water quality data collected from the Kickapoo WTP finished water tap on May 20, 2021.

Breakpoint Curve: Quiz Question #2

- Where on the curve is this sample?
  - Total Cl_2: 1.48 mg/L
  - Mono: 0.03 mg/L
  - Free NH_3: 0.01 mg/L
  - Free Cl_2: 0.38 mg/L

For free chlorine systems, Recommend Free chlorine > 85% of Total

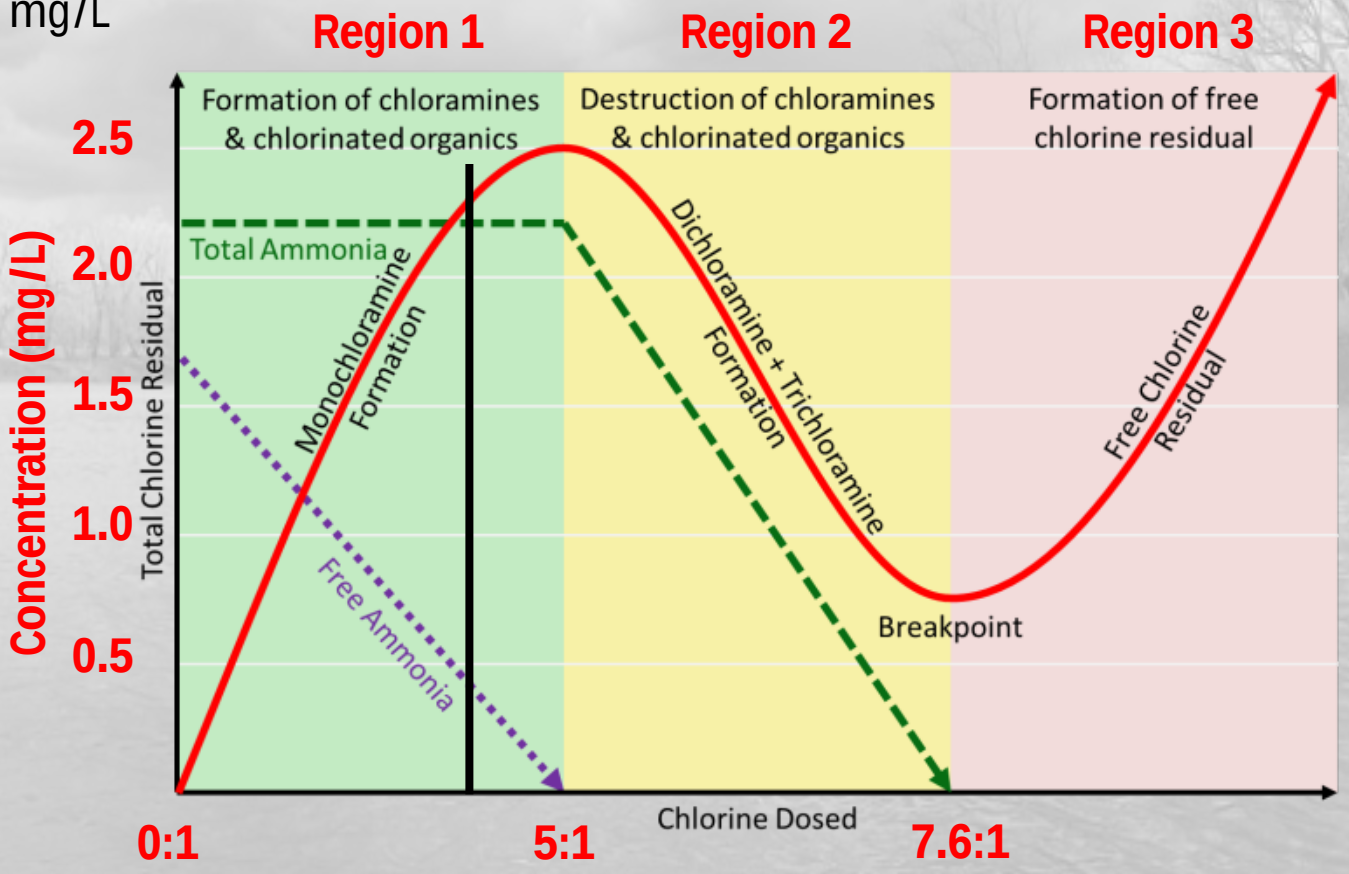


Actual water quality data collected from the Kickapoo WTP finished water tap on May 20, 2021.

Breakpoint Curve: Quiz Question #3

- Where on the curve is this sample?
  - Total Cl_2: 2.86 mg/L
  - Mono: 2.59 mg/L
  - Free NH_3: >0.60 mg/L
  - Free Cl_2: 0.12 mg/L

Actual water quality data collected from the Kickapoo WTP finished water tap on May 20, 2021.



Disinfection Byproducts (DBPs)

DBP Precursor in Water

- Natural Organic Matter (NOM-TOC)
- Bromide

↑ Precursors ↑ Chlorine Dosage ↑ Water Age = ↑ DBPs

Added Disinfectant

- Chlorine
- Chloramines
- Chlorine Dioxide
- Ozone

→

Disinfection Byproducts (DBP)

- TTHM = 0.080 mg/L
- HAA5 = 0.060 mg/L
- Chlorite = 1.0 mg/L
- Bromate = 0.010 mg/L

DBP Monitoring Plan

DBPs – LRAA Reporting Form

Only for Systems on Quarterly Monitoring

US Environmental Protection Agen
Drinking Water Section
1595 Wynkoop Street
Denver, CO 80202-1129
https://www.epa.gov/region8

Quarterly Stage 2 Disinfection Byproducts Rule (DBPR) Reporting Form for
Total Trihalomethanes (TTHMs) and Haloacetic Acids (HAA5s) - *Automated Calculations*

PWSID No:	WY5605000			SYSTEM NAME:	Nice Place		
DATE:	August 26, 2020			PREPARED BY:	Seth Tourney		
	POPULATION SERVED:	495		TITLE:	DBP Rule Manager		
	WATER SOURCE TYPE:		Groundwater	X	Surface Water		Both
Sample Point:	S2-SHOPHOUSE			**Note: One form per sample location.			
Sample Point Description:	Town Shop				Peak Month	8	
Samples Required to be collected:	X	TTHMs	X	HAA5s	Units of Measurement	mg/L	
Current Year:	2020						
Check One (Use X):		1st Quarter		2nd Quarter	X	3rd Quarter		4th Quarter
Report Due:	September 10, 2020						

Locational Running Annual Average (LRAA)

$$\frac{\text{QTR 1} + \text{QTR 2} + \text{QTR 3} + \text{QTR 4}}{4} = \text{LRAA}$$

Column E Data Results	
TTHMs mg/L	HAA5s mg/L
0.065	0.033
0.078	0.04
0.095	0.045
0.055	0.03
0.073	0.037

Operational Evaluation Level (OEL)

Current Quarter	OEL Calculation TTHMs mg/L	OEL Calculation HAA5s mg/L	OEL Exceedance? TTHMs	OEL Exceedance? HAA5s	You must fillout an OPERATIONAL EVALUATION REPORT
3rd Quarter	0.083	0.041	Yes	No	Report is Due on 11/30/2020

For the Operational Evaluation Report (OER) form, go to www.epa.gov/region8-waterops. Then go to reporting forms.
QUESTIONS? Contact DBP RULE MANAGER: Seth Tourney - tourney.seth@epa.gov - (303) 312-6579

DBPs – LRAA Reporting Form

Only for Systems on Quarterly Monitoring

US Environmental Protection Agen
Drinking Water Section
1595 Wynkoop Street
Denver, CO 80202-1129
https://www.epa.gov/region8

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Current Year:	2020						
Check One (Use X):		1st Quarter		2nd Quarter	X	3rd Quarter		4th Quarter
Report Due:	September 10, 2020						

Locational Running Annual Average (LRAA)

$$\frac{0.065 + 0.078 + 0.095 + 0.055}{4} = 0.073 \text{ mg/L}$$

	Column E Data Results	
	TTHMs mg/L	HAA5s mg/L
	0.065	0.033
	0.078	0.04
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DBPs – LRAA Reporting Form

Operational Evaluation Level

$$\frac{2 * \text{Current Quarter} + \text{Previous Quarter} + \text{2nd Previous Quarter}}{4} = \text{OEL}$$

Operational Evaluation Level (OEL)					
	OEL Calculation		OEL Exceedance?		You must fillout an OPERATIONAL EVALUATION REPORT
Current Quarter	TTHMs mg/L	HAA5s mg/L	TTHMs	HAA5s	
3rd Quarter	0.083	0.041	Yes	No	Report is Due on 11/30/2020

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DBPs – LRAA Reporting Form

Operational Evaluation Level (OEL)					
	OEL Calculation		OEL Exceedance?		You must fillout an OPERATIONAL EVALUATION REPORT
Current Quarter	TTHMs mg/L	HAA5s mg/L	TTHMs	HAA5s	
3rd Quarter	0.083	0.041	Yes	No	Report is Due on 11/30/2020

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QUESTIONS? Contact DBP RULE MANAGER: Seth Tourney - tourney.seth@epa.gov - (303) 312-6579

Operational Evaluation Level

$$\frac{2 * 0.095 + 0.078 + 0.065}{4} = 0.083 \text{ mg/L}$$

If OEL is greater than the MCL, Operational Evaluation Report Required

Operational Evaluation Report

What is an operational evaluation report?

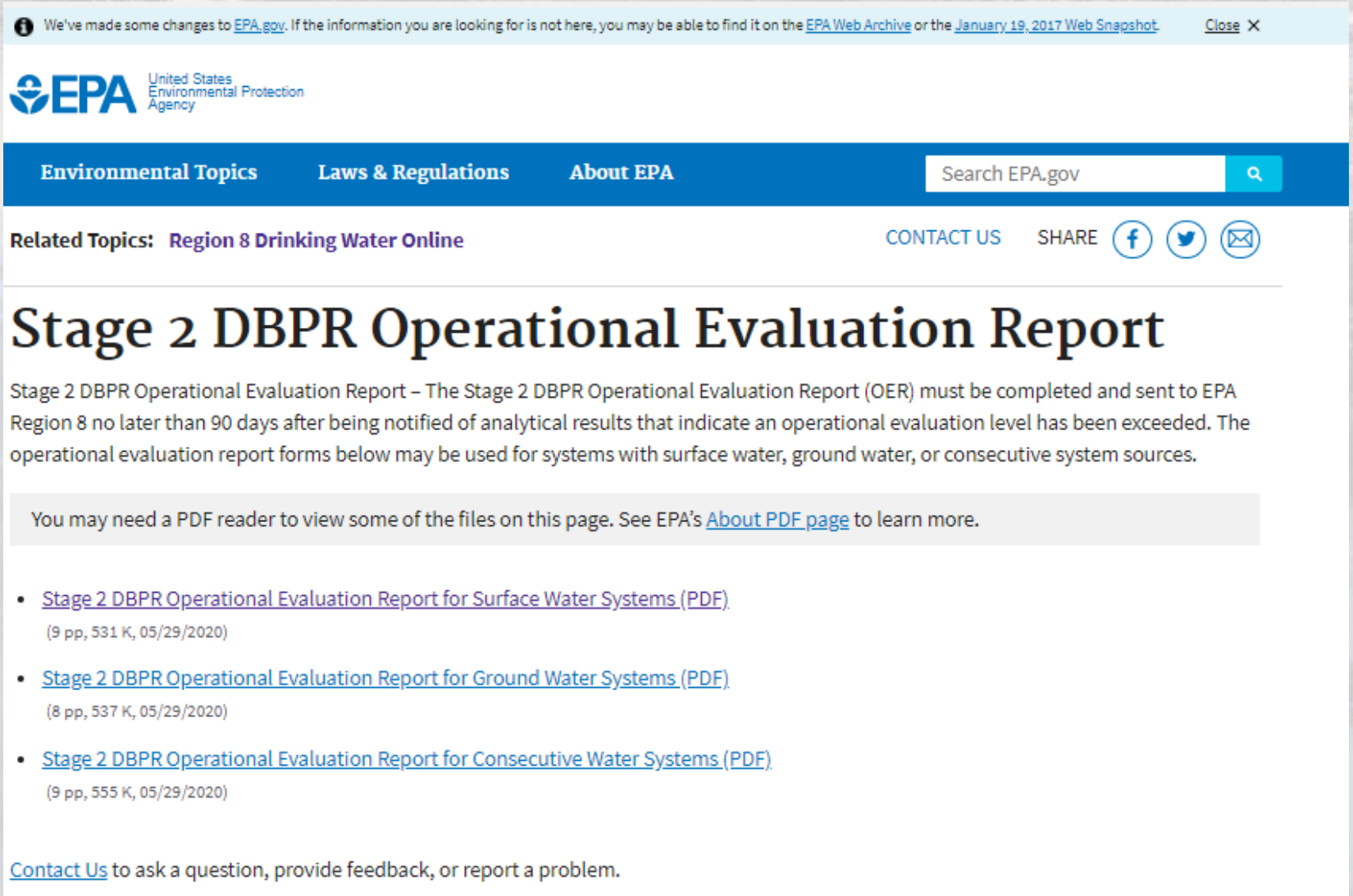
An operational evaluation examines system treatment and operational practices that may contribute to TTHM and HAA5 formation

AND

What steps could be considered to minimize future exceedances

Operational Evaluation Report

https://www.epa.gov/region8-waterops/stage-2-dbpr-operational-evaluation-report



We've made some changes to EPA.gov. If the information you are looking for is not here, you may be able to find it on the EPA Web Archive or the January 19, 2017 Web Snapshot. Close ×

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Stage 2 DBPR Operational Evaluation Report

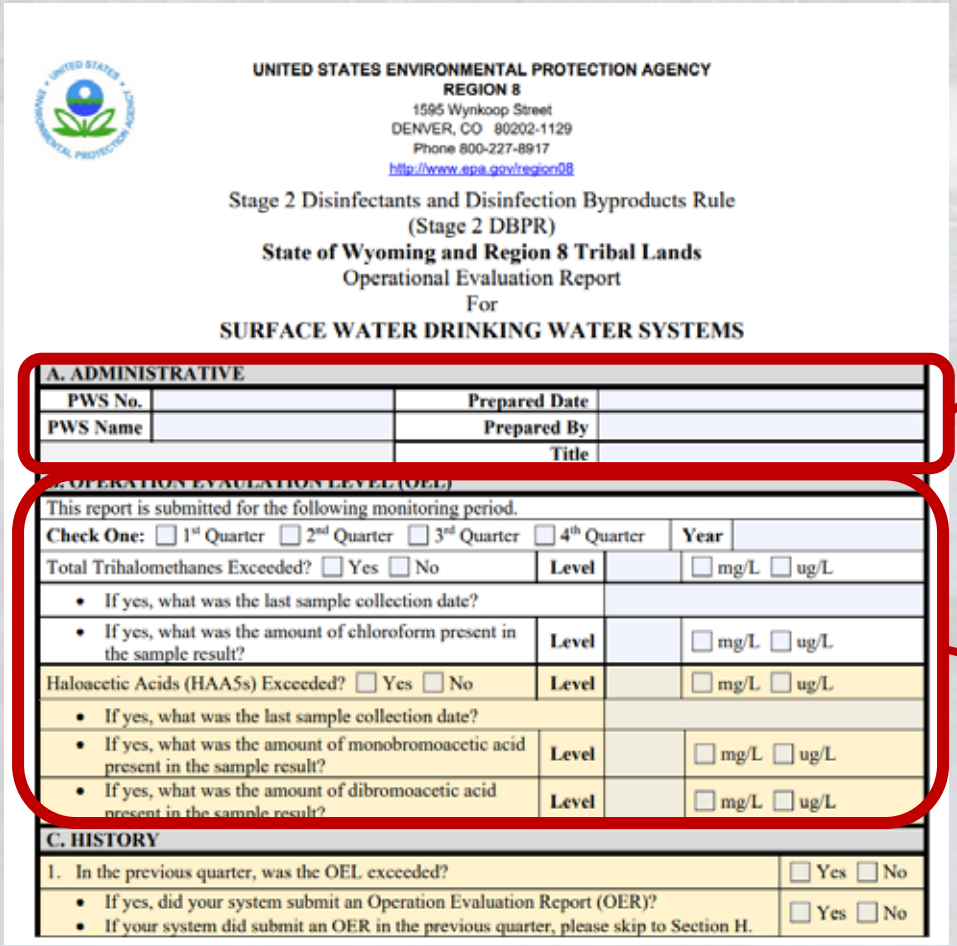
Stage 2 DBPR Operational Evaluation Report – The Stage 2 DBPR Operational Evaluation Report (OER) must be completed and sent to EPA Region 8 no later than 90 days after being notified of analytical results that indicate an operational evaluation level has been exceeded. The operational evaluation report forms below may be used for systems with surface water, ground water, or consecutive system sources.

You may need a PDF reader to view some of the files on this page. See EPA's About PDF page to learn more.

- Stage 2 DBPR Operational Evaluation Report for Surface Water Systems (PDF)
  (9 pp, 531 K, 05/29/2020)
- Stage 2 DBPR Operational Evaluation Report for Ground Water Systems (PDF)
  (8 pp, 537 K, 05/29/2020)
- Stage 2 DBPR Operational Evaluation Report for Consecutive Water Systems (PDF)
  (9 pp, 555 K, 05/29/2020)

Contact Us to ask a question, provide feedback, or report a problem.

Operational Evaluation Report



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 8
1595 Wynkoop Street
DENVER, CO 80202-1129
Phone 800-227-8917
http://www.epa.gov/region08

Stage 2 Disinfectants and Disinfection Byproducts Rule
(Stage 2 DBPR)
State of Wyoming and Region 8 Tribal Lands
Operational Evaluation Report
For
SURFACE WATER DRINKING WATER SYSTEMS

A. ADMINISTRATIVE			
PWS No.		Prepared Date	
PWS Name		Prepared By	
		Title	

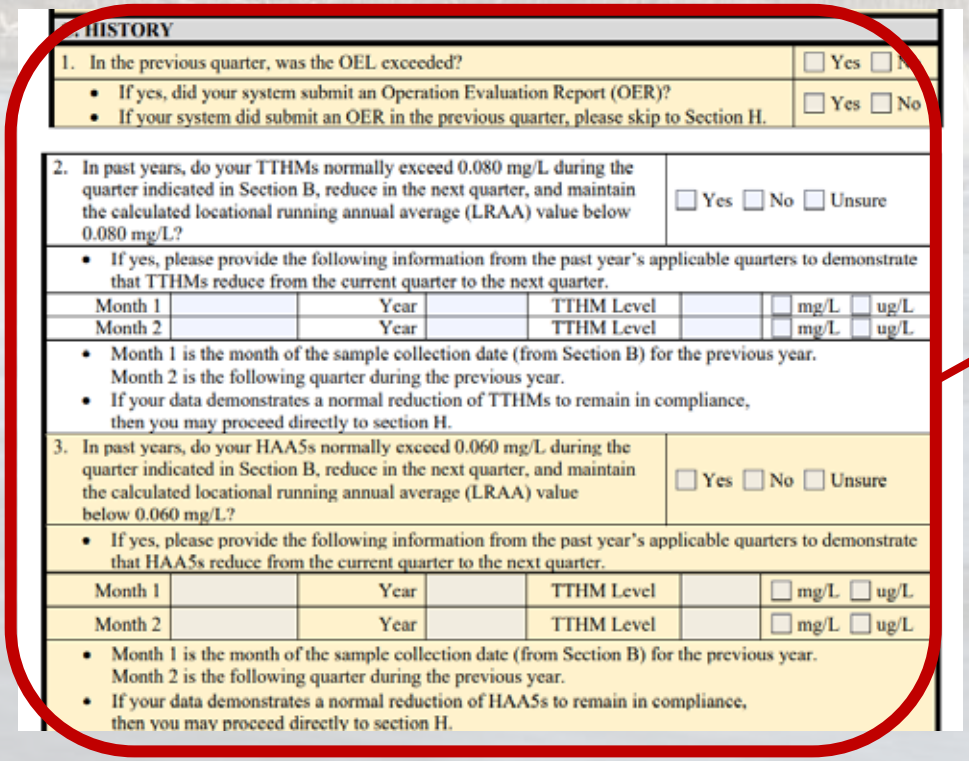
B. OPERATION EVALUATION LEVEL (OEL)			
This report is submitted for the following monitoring period.			
Check One: ☐ 1st Quarter ☐ 2nd Quarter ☐ 3rd Quarter ☐ 4th Quarter		**Year**	
Total Trihalomethanes Exceeded? ☐ Yes ☐ No	**Level**		☐ mg/L ☐ ug/L
• If yes, what was the last sample collection date?			
• If yes, what was the amount of chloroform present in the sample result?	**Level**		☐ mg/L ☐ ug/L
Haloacetic Acids (HAA5s) Exceeded? ☐ Yes ☐ No	**Level**		☐ mg/L ☐ ug/L
• If yes, what was the last sample collection date?			
• If yes, what was the amount of monobromoacetic acid present in the sample result?	**Level**		☐ mg/L ☐ ug/L
• If yes, what was the amount of dibromoacetic acid present in the sample result?	**Level**		☐ mg/L ☐ ug/L

C. HISTORY	
1. In the previous quarter, was the OEL exceeded?	☐ Yes ☐ No
• If yes, did your system submit an Operation Evaluation Report (OER)? • If your system did submit an OER in the previous quarter, please skip to Section H.	☐ Yes ☐ No

Administrative
Contact Information

What was your OEL
And Sample Result?

Operational Evaluation Report



HISTORY

1. In the previous quarter, was the OEL exceeded? ☐ Yes ☐ No
   - If yes, did your system submit an Operation Evaluation Report (OER)? ☐ Yes ☐ No
   - If your system did submit an OER in the previous quarter, please skip to Section H.

2. In past years, do your TTHMs normally exceed 0.080 mg/L during the quarter indicated in Section B, reduce in the next quarter, and maintain the calculated locational running annual average (LRAA) value below 0.080 mg/L? ☐ Yes ☐ No ☐ Unsure
   - If yes, please provide the following information from the past year's applicable quarters to demonstrate that TTHMs reduce from the current quarter to the next quarter.

Month 1		Year		TTHM Level		☐ mg/L	☐ ug/L
Month 2		Year		TTHM Level		☐ mg/L	☐ ug/L

   - Month 1 is the month of the sample collection date (from Section B) for the previous year. Month 2 is the following quarter during the previous year.
   - If your data demonstrates a normal reduction of TTHMs to remain in compliance, then you may proceed directly to section H.

3. In past years, do your HAA5s normally exceed 0.060 mg/L during the quarter indicated in Section B, reduce in the next quarter, and maintain the calculated locational running annual average (LRAA) value below 0.060 mg/L? ☐ Yes ☐ No ☐ Unsure
   - If yes, please provide the following information from the past year's applicable quarters to demonstrate that HAA5s reduce from the current quarter to the next quarter.

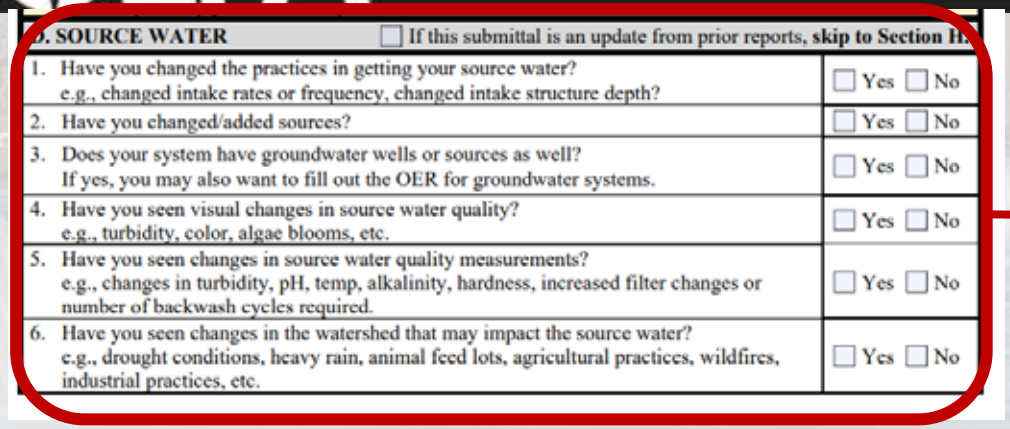
Month 1		Year		TTHM Level		☐ mg/L	☐ ug/L
Month 2		Year		TTHM Level		☐ mg/L	☐ ug/L

   - Month 1 is the month of the sample collection date (from Section B) for the previous year. Month 2 is the following quarter during the previous year.
   - If your data demonstrates a normal reduction of HAA5s to remain in compliance, then you may proceed directly to section H.

History

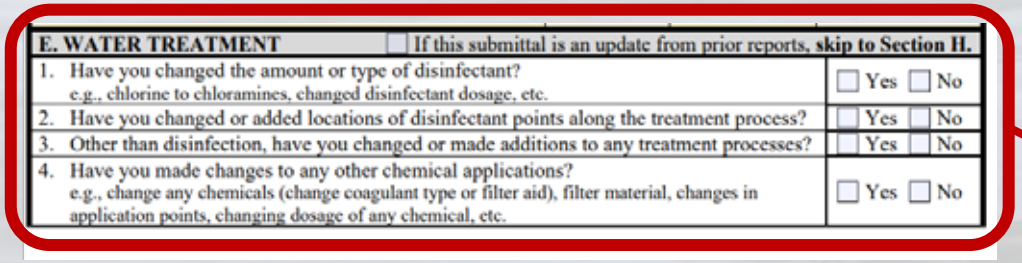
Does this OEL exceedance occur every year during the peak month?

Operational Evaluation Report



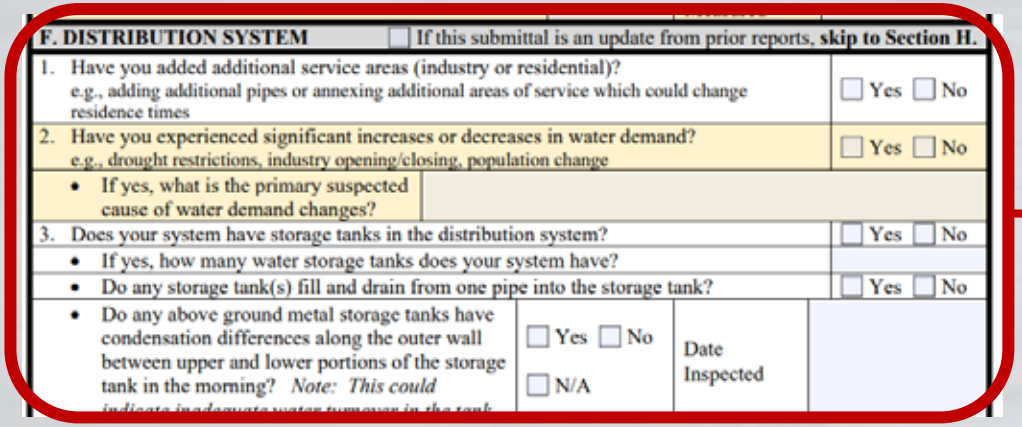
D. SOURCE WATER	☐ If this submittal is an update from prior reports, skip to Section H.
1. Have you changed the practices in getting your source water? e.g., changed intake rates or frequency, changed intake structure depth?	☐ Yes ☐ No
2. Have you changed/added sources?	☐ Yes ☐ No
3. Does your system have groundwater wells or sources as well? If yes, you may also want to fill out the OER for groundwater systems.	☐ Yes ☐ No
4. Have you seen visual changes in source water quality? e.g., turbidity, color, algae blooms, etc.	☐ Yes ☐ No
5. Have you seen changes in source water quality measurements? e.g., changes in turbidity, pH, temp, alkalinity, hardness, increased filter changes or number of backwash cycles required.	☐ Yes ☐ No
6. Have you seen changes in the watershed that may impact the source water? e.g., drought conditions, heavy rain, animal feed lots, agricultural practices, wildfires, industrial practices, etc.	☐ Yes ☐ No

Source Water



E. WATER TREATMENT	☐ If this submittal is an update from prior reports, skip to Section H.
1. Have you changed the amount or type of disinfectant? e.g., chlorine to chloramines, changed disinfectant dosage, etc.	☐ Yes ☐ No
2. Have you changed or added locations of disinfectant points along the treatment process?	☐ Yes ☐ No
3. Other than disinfection, have you changed or made additions to any treatment processes?	☐ Yes ☐ No
4. Have you made changes to any other chemical applications? e.g., change any chemicals (change coagulant type or filter aid), filter material, changes in application points, changing dosage of any chemical, etc.	☐ Yes ☐ No

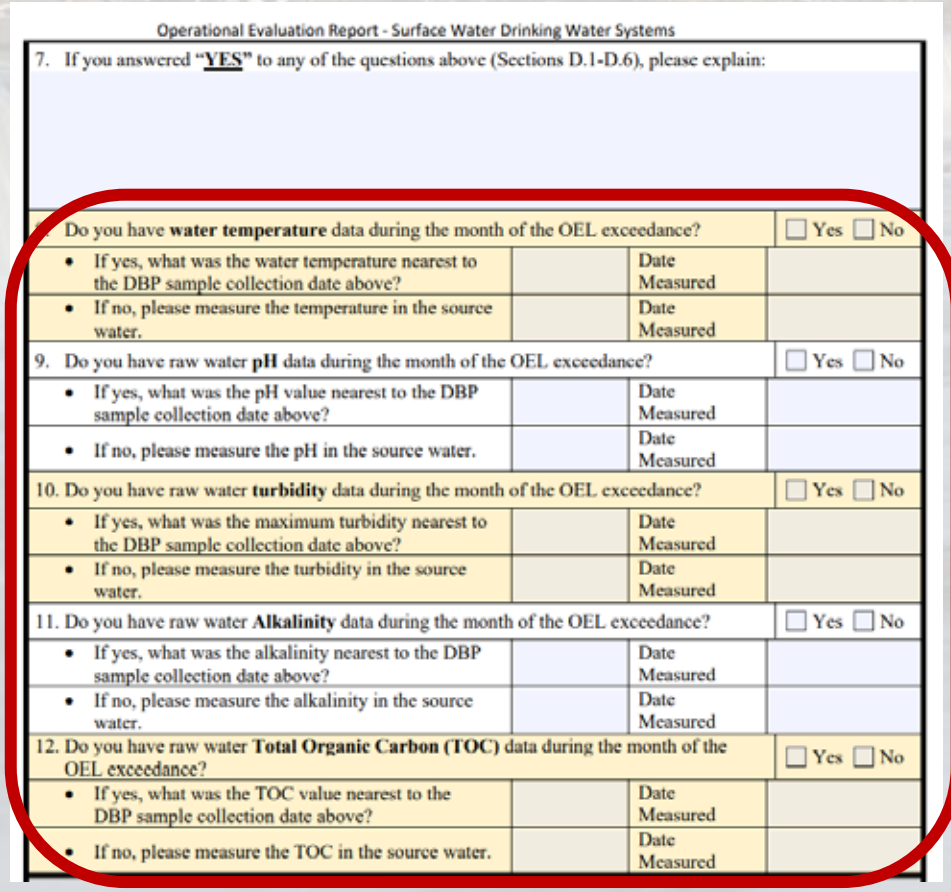
Water Treatment



F. DISTRIBUTION SYSTEM	☐ If this submittal is an update from prior reports, skip to Section H.		
1. Have you added additional service areas (industry or residential)? e.g., adding additional pipes or annexing additional areas of service which could change residence times	☐ Yes ☐ No		
2. Have you experienced significant increases or decreases in water demand? e.g., drought restrictions, industry opening/closing, population change	☐ Yes ☐ No		
• If yes, what is the primary suspected cause of water demand changes?			
3. Does your system have storage tanks in the distribution system?	☐ Yes ☐ No		
• If yes, how many water storage tanks does your system have?			
• Do any storage tank(s) fill and drain from one pipe into the storage tank?	☐ Yes ☐ No		
• Do any above ground metal storage tanks have condensation differences along the outer wall between upper and lower portions of the storage tank in the morning? *Note: This could indicate inadequate water turnover in the tank*	☐ Yes ☐ No ☐ N/A	Date Inspected	

Distribution System

Operational Evaluation Report



Operational Evaluation Report - Surface Water Drinking Water Systems

7. If you answered "**YES**" to any of the questions above (Sections D.1-D.6), please explain:			
Do you have **water temperature** data during the month of the OEL exceedance?			☐ Yes ☐ No
• If yes, what was the water temperature nearest to the DBP sample collection date above?		Date Measured	
• If no, please measure the temperature in the source water.		Date Measured	
9. Do you have raw water **pH** data during the month of the OEL exceedance?			☐ Yes ☐ No
• If yes, what was the pH value nearest to the DBP sample collection date above?		Date Measured	
• If no, please measure the pH in the source water.		Date Measured	
10. Do you have raw water **turbidity** data during the month of the OEL exceedance?			☐ Yes ☐ No
• If yes, what was the maximum turbidity nearest to the DBP sample collection date above?		Date Measured	
• If no, please measure the turbidity in the source water.		Date Measured	
11. Do you have raw water **Alkalinity** data during the month of the OEL exceedance?			☐ Yes ☐ No
• If yes, what was the alkalinity nearest to the DBP sample collection date above?		Date Measured	
• If no, please measure the alkalinity in the source water.		Date Measured	
12. Do you have raw water **Total Organic Carbon (TOC)** data during the month of the OEL exceedance?			☐ Yes ☐ No
• If yes, what was the TOC value nearest to the DBP sample collection date above?		Date Measured	
• If no, please measure the TOC in the source water.		Date Measured	

Example of water quality parameters

Operational Evaluation Report

G. CONTROL PLAN	☐ If this submittal is an update from prior reports, **skip to Section H.**
1. In terms of your source water management, do you plan to monitor or implement best management practices in your source water?	☐ Yes ☐ No
• Does your system have a source water management plan?	☐ Yes ☐ No
• Does your system implement any best management practices (BMPs) in your watershed?	☐ Yes ☐ No
• Does your system monitor for any water quality parameters in the source water?	☐ Yes ☐ No
2. In regarding your existing equipment and infrastructure, do you plan to make **operational adjustments** to improve the quality of your drinking water for DBP control?	☐ Yes ☐ No
• If yes, are you planning to adjust your chemical feeds?	☐ Yes ☐ No
• If yes, are you planning to change any chemical products?	☐ Yes ☐ No
• If yes, are you planning to start up any existing process equipment not used during the sampling period indicated in Section A?	☐ Yes ☐ No
• If yes, are you planning to adjust any existing powdered activated carbon (PAC) feed rates?	☐ Yes ☐ No
• If yes, are you planning to adjust your chlorine dosage?	☐ Yes ☐ No
• If yes, are you planning to adjust any existing aeration processes in your drinking water treatment plant?	☐ Yes ☐ No

What's the plan?

H. CONTROL PLAN UPDATES	
Only fill out this section, if you filled out an operational evaluation report (OER) in the previous quarter, or the data provided from Sections C.2 and C.3 instructed you to complete this section.	
1. Does your plan only rely on natural decreasing water temperatures to bring your locational running annual average (LRAA) calculated value within compliance?	☐ Yes ☐ No
2. Are you continuing with the exact same control plan in your previous report?	☐ Yes ☐ No
• If yes, please provide an update on the status of accomplishing the items identified in the previous control plan:	
3. Are you planning to use other methods not identified in your previous report to lower your disinfection byproducts (DBPs) ?	☐ Yes ☐ No
• If yes, are these new methods going to be implemented in the source watershed? *(If yes, go back to Section D Source Water above)*	☐ Yes ☐ No
• If yes, are these new methods going to be implemented in the water treatment process? *(If yes, go back to fill out Section E Water Treatment above)*	☐ Yes ☐ No
• If yes, are these new methods going to be implemented in the distribution system or the water storage tanks? *(If yes, go back to fill out Section F Distribution System above)*	☐ Yes ☐ No
4. Please provide a short-written statement about the control plan updates and status that your system is planning or implementing to reduce disinfection byproducts (DBPs):	

If this is a continuation, what is the update and status?

Questions?

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