Disinfectants and Disinfection Byproducts Rule (Stage 1&2 DBPRs)

Wyoming Potable Water Age, Lagoon Aeration and Utility Line Replacement Seminar
Hosted by
Water Quality Division, Wyoming DEQ

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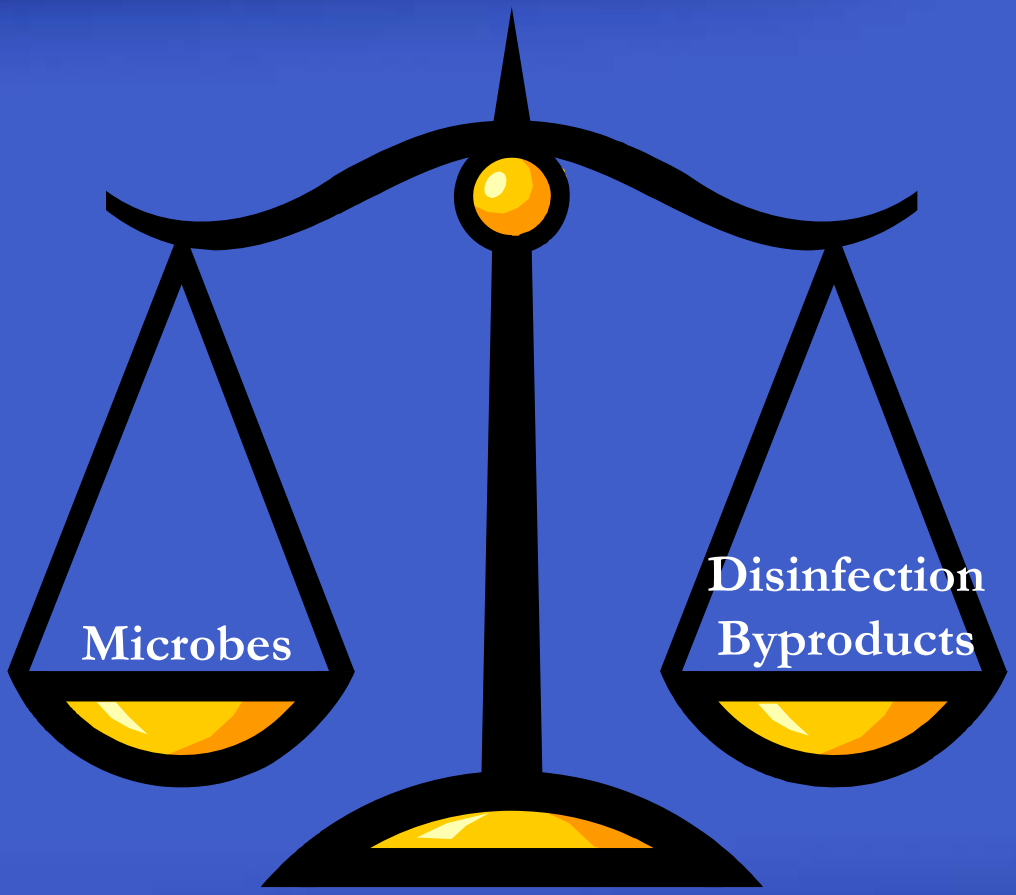
WHY DBPR?

- **Purpose of Disinfection** - To Kill or to inactivate disease-causing microorganisms that cause serious illness and death (for example: typhoid, hepatitis, and cholera)
- **Disinfection Byproducts** - Disinfectants react with naturally occurring materials in the water (e.g., natural organic matter, bromide, or DBP precursors) to form unintended disinfection by-products (DBPs)

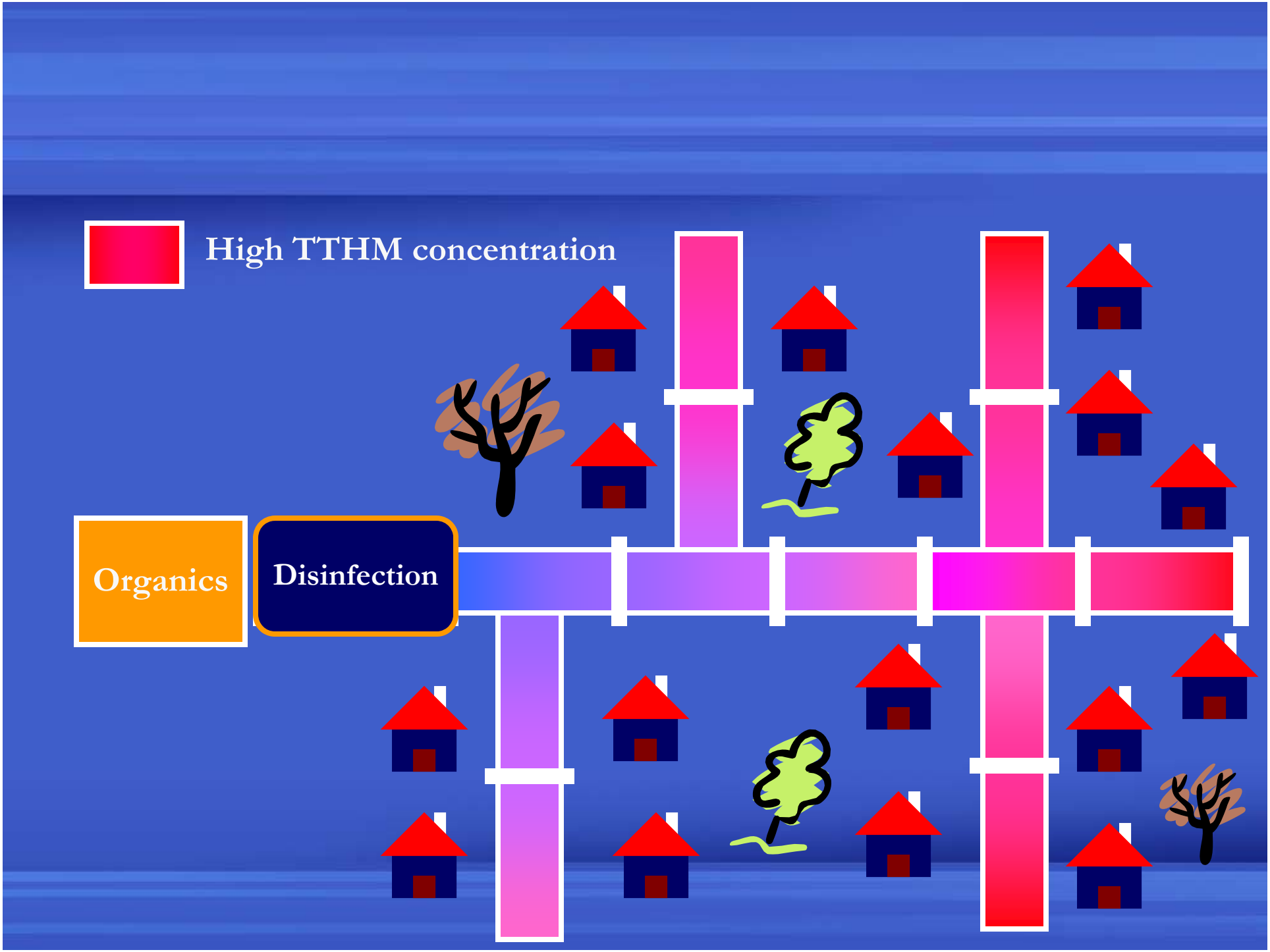
Risk-Risk Trade off
A Delicate Balance

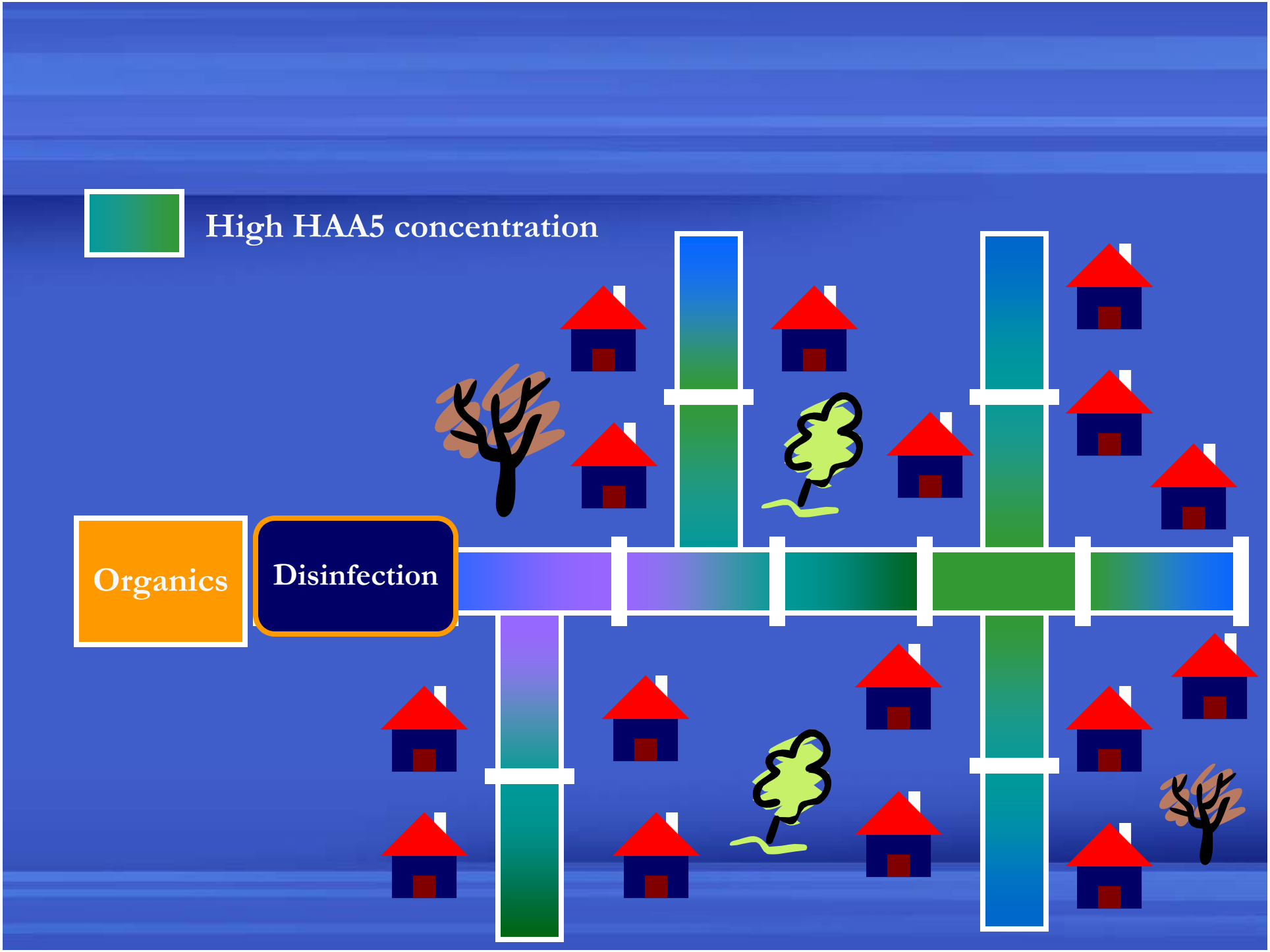


- Stage 1 DBPR - promulgated on December/16/1998
- Stage 2 DBPR - promulgated on January/04/2006

Stage 1 DBPR Components

- Set Maximum Residual Disinfectant Levels (MRDLs) for chlorine, chloramines & chlorine dioxide
- Set MCLs for TTHM, HAA5, bromate & chlorite
- Enhanced coagulation requirement for conventional filtration to remove DBP precursors
- Stage 1 Monitoring Plan


High TTHM concentration
Organics
Disinfection


High HAA5 concentration
Organics
Disinfection

Stage 2 DBPR Components

- Consecutive systems - regulated
- Compliance calculation - locational RAA (LRAA)
- DBP monitoring - at the highest DBP locations
- Sampling frequency - population based
- Precision of certified Lab (MDLs and acceptance limits)

Combined Distribution System (CDS)

- Interconnected distribution system consisting of the distribution systems of wholesale systems and of the consecutive systems that receive finished water

IDSE - Stage 2 DBPR Early Implementation

Community* PWSs must conduct an Initial Distribution System Evaluation (IDSE) and use its results in conjunction with the Stage 1 monitoring results to find the highest DBP locations for the stage 2 compliance sampling sites

IDSE Options

- Very Small System Waiver (VSS) – no IDSE plan required
- 40/30 Certification – no IDSE plan required
- Standard Monitoring
- System Specific Study

Stage 2 DBPR Schedules

Schedule	Largest Service Population within a CDS	IDSE Report Due by	Stage 2 Compliance Monitoring Starts on
#1	≥ 100,000	1/01/2009	4/01/2012
#2	50,000 - 99,999	7/01/2009	10/01/2012
#3	10,000 - 49,999	1/01/2010	10/01/2013
#4	< 10,000	7/01/2010	10/01/2013*

Stage 2 DBPR TTHM/HAA5 Routine Monitoring Table

Source Water Type	Population size	Monitoring frequency[1]	Distribution system monitoring location			
			Total per monitoring period[2]	Highest TTHM locations	Highest HAA5 locations	Existing Stage 1 compliance location
Subpart H	<500	per year	2	1	1	-
	500-3,300	per quarter	2	1	1	-
	3,301-9,999	per quarter	2	1	1	-
	10,000-49,999	per quarter	4	2	1	1
	50,000-249,999	per quarter	8	3	3	2
Ground Water	<500	per year	2	1	1	-
	500-9,999	per year	2	1	1	-
	10,000-99,999	per quarter	2	2	1	1
	100,000-499,999	per quarter	4	3	2	1

1. All systems must monitor during month of highest DBP concentrations.
2. Systems on quarterly monitoring must take dual sample sets every 90 days at each monitoring location, except for subpart H systems serving 500-3,300. Systems on annual monitoring and subpart H systems serving 500-3,300 are required to take individual TTHM and HAA5 samples (instead of a dual sample set) at the locations with the highest TTHM and HAA5 concentrations respectively. Only one location with a dual sample set per monitoring period is needed if highest TTHM and HAA5 concentrations occur at the same location, (and month, if monitored annually).

Important Notes

- Stage 2 only replaces TTHM/HAA5 part of the Stage 1
- PWSs must continue to monitor TTHM/HAA5 under the Stage 1 until Stage 2 compliance date starts
- PWSs must develop a Stage 2 Monitoring Plan at least 6 months before staring Stage 2 monitoring and submit it to EPA for approval
- IDSE Report can be used as a substitute for Stage 2 Monitoring Plan

Enhanced Coagulation

The addition of sufficient coagulant to improve removal of disinfection byproduct precursors (TOC) by conventional filtration treatment

Required TOC removal % is based on source water TOC and alkalinity (3x3 matrix for TOC removal – Step 1)

BAT for TTHM/HAA5

- GAC 10 – Granular activated carbon filter beds with an empty-bed contact time of 10 minutes based on average daily flow and a carbon reactivation frequency of every 120 days
- GAC20
- Nanofiltration (NF) – Membrane molecular weight cutoff of 1000 Daltons or less
- Chloramination – for consecutive systems

Strategies to Reduce TTHM/HAA5

- Improve precursor (TOC) removal – EC/ES, oxidant addition
- Adjust finished water pH
- Reduce water age in the distribution system
- Move chlorination point to later in the treatment process
- Change disinfectant – O_3, ClO_2, Cl_2, UV, or Chloramines

Recommendations

- Conduct a pilot study on site during high risk period to evaluate TOC removal capability of the proposed treatment improvement
- Perform finished water DBP formation potential to evaluate proposed treatment performance in meeting the DBP requirement

Options to Reduce DBPs

- Operational changes (less costly)
- Equipment changes (capital improvements)

Operational Changes

- Chemical Dosage Optimization - Enhanced Coagulation (EC)
- Distribution System Flushing Program
- Water Age Reduction

Chemical Optimization

Optimize chemical dosage to remove DBP precursors (total organics) – Enhanced Coagulation

- Required for systems using conventional filtration as the final filtration barrier
- Recommended for the rest of subpart H water systems

Distribution System Cleaning and Flushing Program

Regular cleaning and flushing program in the distribution system to remove accumulated sediments and stagnant organic material/biofilm that is reacting with the disinfectant to form DBPs.

Water Age Reduction

- Stagnant water or long detention time promotes loss of chlorine residual, and higher DBP formation
- Recommendations:
  - **Clean tanks at least once/5 years**
  - **Turn over 30 to 50% of tank storage daily**
  - **Keep less than 5 to 7 days of hydraulic retention time …decrease storage while meeting fire protection requirements**

Significant Disinfectant Changes

- You must consult with EPA before making a significant change to your disinfection practices.
- Consultation must include:
  - a copy of your 1-year disinfection profile/benchmark,
  - a description of the proposed change,
  - an analysis of how the proposed change will affect current levels of disinfection.

Types of Significant Disinfection Changes For Reducing DBPs

- Changing type of disinfectant (e.g. switch from chlorine to chloramines or install UV in front of chlorination)
- Significantly decreasing the dosage of current disinfectant.
- Changing the point(s) of disinfectant application

Examples of Things to Consider in Making a Significant Change to Disinfection Practices

- To prechlorinate (before filters) to control biological growth in wet wells, or in filters….or
- To oxidize/precipitate out metals - would added oxidants address these problems but create DBPs compliance problem?

Examples of Things to Consider in Making a Significant Change to Disinfection Practices

- To switch disinfectants from chlorine to chloramines –adding ammonia, will increase nutrients for nitrifying bacteria in distribution system. Also, changes to chloramines will change water quality which may increase leaching of lead or copper from pipes, pinhole leaks in brass, accelerate deterioration of rubber materials, etc. You need to evaluate the chemistry of these disinfectants before deciding to make the switch

Examples of Things to Consider in Making a Significant Change to Disinfection Practices

- If you change your type of filter aid/chemical pretreatment, or change the order in which the chemicals are added to improve TOC removal, this can affect other processes
- For example, adding lime for alkalinity/pH adjustment at the same location as your iron or aluminum based coagulants can hurt turbidity removal since the coagulant reacts with the lime.

Examples of Things to Consider in Making a Significant Change to Disinfection Practices

- Evaluate how treatment changes can affect:

-- Turbidity of finished water

-- Lead and Copper in pipes

-- Total Coliform Compliance

-- CT Inactivation rates (from pH changes, etc.)

Examples of Things to Consider in Making a Significant Change to Disinfection Practices

- Are you greatly overdosing your chlorine – look at disinfection profile for logs of inactivation. Rerun the profile with the lower dosage of chlorine you are proposing, and check if you still meet SWTR inactivation requirements (compare to benchmark).
- Is your chlorine dose erratic? Large surges in chlorine may increase DBP formation.
- REMEMBER – consult with EPA before making these significant changes.

For more Information

- Safe Drinking Water Hotline
  1-800-426-4791
- EPA R8 Drinking Water Websites –

  - Drinking Water Online website at
  www.epa.gov/region8/waterops

  -Drinking Water Watch (DWW) password secured website at:
  iaspub.epa.gov/Region8DWW/JSP/loginForm.jsp