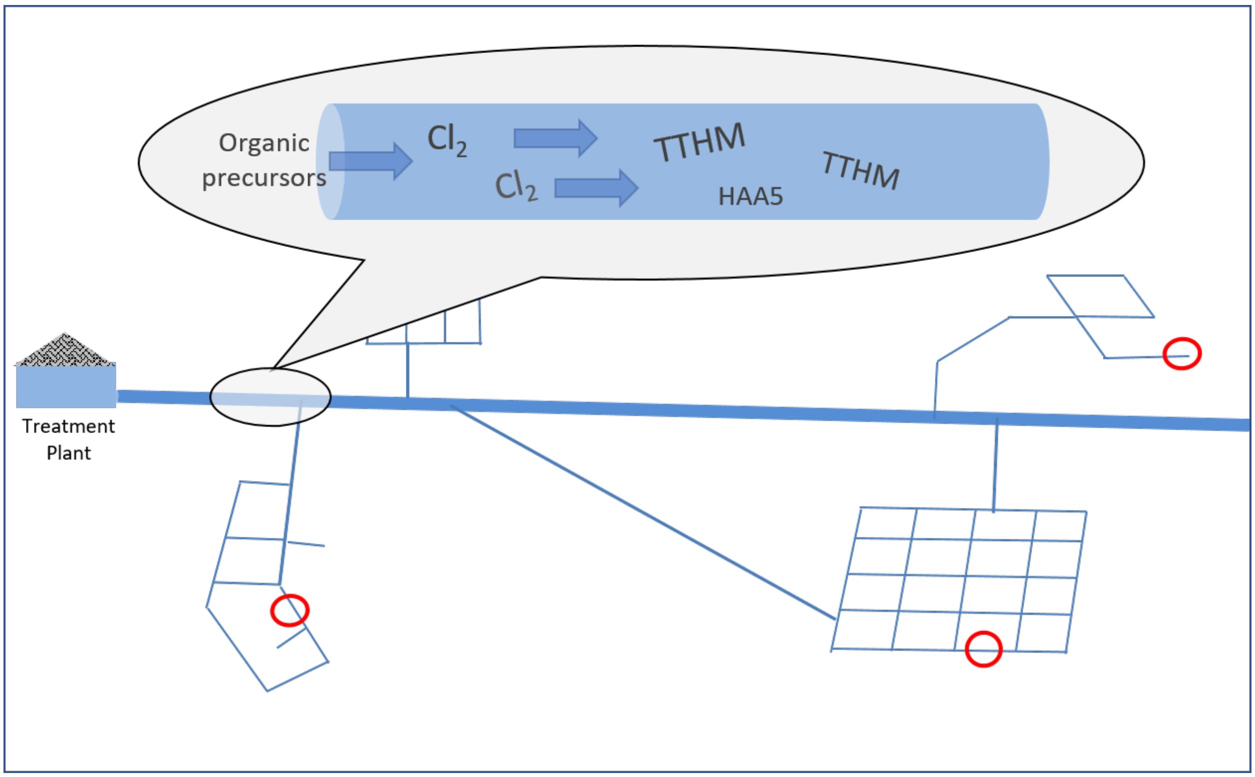
Stage 2 Disinfection Byproducts Rule Review

Operator Training



Bureau of Safe Drinking Water

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DEPARTMENT OF ENVIRONMENTAL PROTECTION

Stage 2 Disinfection Byproducts Rule (DBPR) Review

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Lesson 1
Introduction

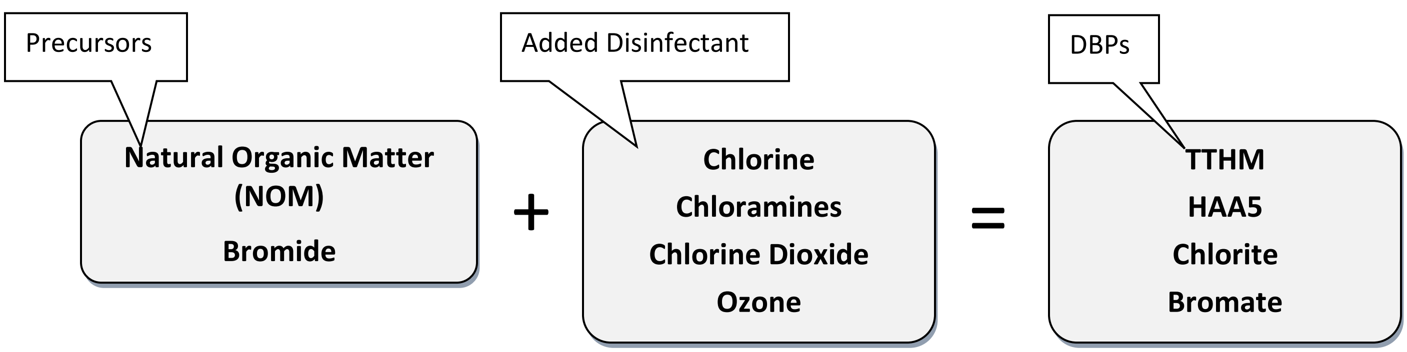
Lesson Outline

We are going to start with an introductory chapter to give you:

- An explanation how disinfection byproducts (DBPs) are formed
- Why DBPs are regulated
- The health effects of DBPs
- Who monitors for DBPs
- Intro to DBP Maximum Contaminant Levels (MCLs)

DBP Formation

Disinfectants are used to kill or inactivate harmful microorganisms in water. However, disinfectants react with natural organic matter (and bromide) in water to form Disinfection Byproducts (DBPs).



<u>Regulated DBPs</u>:

TTHM = Total trihalomethanes (4 regulated)
HAA5 = Haloacetic acids (5 regulated)

We will focus on these two DBPs for the remainder of the training

TTHMs

- Trichloromethane (chloroform) $CHCl_3$
- Dibromochloromethane $CHClBr_2$
- Bromodichloromethane $CHCl_2Br$
- Tribromomethane (bromoform) $CHBr_3$

HAA5 is the sum of 5 haloacetic acids:

- Monochloroacetic acid $ClCH_2COOH$
- Dichloracetic acid $CHCl_2COOH$
- Trichloroacetic acid $C_2HCl_3O_2$
- Monobromoacetic acid $BrCH_2COOH$
- Dibromoacetic acid $Br_2CHCOOH$

Additional Regulated DBPs:

Chlorite: forms when NOM reacts with chlorine dioxide

Bromate: forms when Bromide reacts with ozone; Bromide is a chemical compound commonly found in nature

Factors Affecting DBP Formation:

Based on the simple "equation" on the previous page, you can see the factors that affect DBP formation:

- The amount of natural organic matter (NOM) in the water
  - NOM does not refer to sticks floating in the water, rather, it refers to the byproducts of organic matter decay such as humic acid, fulvic acid, amines, and urea.
- The type and dosage of the disinfectant

Reaction time or the residence time in the distribution system is another factor affecting DBP formation. Generally speaking, the longer the contact time between disinfectant and the precursors, the greater the amount of DBP formation.

TTHM Formation:

- **Long water age:** The longer the contact time between the disinfectant and the precursors, the greater the amount of TTHM that can be formed. TTHM continues to form in drinking water as long as a disinfectant residual and precursors are present.
- **Higher water temperatures:** Higher water temperatures during summer seasons can increase DBPs as the chemical reactions happen faster at higher temperatures. Also, higher water temperatures often cause a higher chlorine demand, requiring an increased disinfectant dose and resulting in higher DBP formation potential.
- **High pH**

Sites to consider for expected highest TTHM:

- Longest water age
- Downstream of tanks or reservoirs (Storage facilities typically increase water age and possibly temperature)
- Hydraulic dead-ends
- Sparsely populated residential areas (longer water age due to less flow)
- Warmer temperature sites

Note: If your system had booster chlorination, select a site AFTER the booster is applied.

HAA5 Formation:

- **Moderate contact time but not dead ends:** Unlike TTHMs, HAA5s may not be highest in areas of longest water age. HAA5s will increase as water age increases, but only up to a point. This is because HAA5s can biodegrade in areas of very low residual and where biological activity (i.e. biofilms) is present. The main intention in selecting HAA5 sites is to avoid areas of biofilms and any other biological activity.

- **Lower pH:** Opposite of TTHMs, HAA5 formation decreases with increasing pH

Sites to consider for expected highest HAA5:

- Select sites that have less than average site residual (indicating a long residence time), but not very low or no residual.
- Avoid areas of low flow rates and dead-ends (more biological activity here)
- Select sites with warmer temperatures, since this increases HAA5 concentrations (unless biological activity is present)

Why are DBPs Regulated

Pathways of Exposure: DBPs primarily enter the body through drinking tap water. Additionally, DBPs easily evaporate and can be inhaled while showering, cooking, washing dishes and clothes; they can also be absorbed through the skin.

Health Effects: DBPs have been shown to cause chronic adverse health effects in laboratory animal studies. Chronic means that these are health effects that show up after longer periods of exposure – the type of exposure you have from drinking the same water over a period of time.

Health effects from DBPs include:

- Cancer
- Liver, Kidney and Central Nervous system problems
- Anemia
- Reproductive problems

These health effects lead EPA to create the DBP Rules (Stage 1 and Stage 2) to further protect drinking water consumers. EPA is still investigating DBPs; currently under the 4th Unregulated Contaminant Monitoring Rule, water systems are required to monitor for brominated HAAs, which may become regulated in the future.

Who Monitors for DBPs?

<u>The Stage 2 DBP Rule applies to</u>:

- All community water systems (CWS) that use a **chemical disinfectant or oxidant** (UV does not apply). This includes consecutive water systems that obtain water treated with a chemical disinfectant.
- All nontransient noncommunity water systems (NTNC) that use **a chemical disinfectant or oxidant** (UV does not apply). This includes consecutive water systems that obtain water treated with a chemical disinfectant.

- All bottled, vended, retail and bulk hauling (BVRB) water systems, that use **a chemical disinfectant or oxidant** (UV does not apply).
- TNCWSs treating with chlorine dioxide.

DBP Maximum Contaminant Levels (MCLs)

EPA has set the following MCLs for TTHMs and HAA5s. In the next lesson we will discuss how to determine compliance with these MCLs.

DBP Contaminant Group	MCL (mg/L)
TTHM	0.080
HAA5	0.060

There are additional MCLs set for chlorite (1.0 mg/L) and bromate (0.010 mg/L), but since they are fairly uncommon and most water systems don't need to monitor for them, the remainder of this training is going to focus on TTHMs and HAA5s.

Key Points

- DBPs form when natural organic matter reacts with disinfectant
- Health concerns include reproductive and developmental risks, in addition, DBPs are known carcinogens
- Monitoring is required by all CWS, NTNC and BVRB systems using a chemical disinfectant, and TNC system using chlorine dioxide
- MCLs:
    - TTHM = 0.080 mg/L
    - HAA5 = 0.060 mg/L
    - Chlorite = 1.0 mg/L
    - Bromate = 0.010 mg/L

Lesson 2: Compliance

Objectives

- Explain how compliance with the Stage 2 DBPR Maximum Contaminant Levels (MCL) is determined
- Explain how Stage 2 DBPR monitoring and reporting violations are determined
- Describe appropriate violation response and return to compliance
- Describe minimum disinfectant residual requirements of the Disinfectant Requirements Rule (DRR)
- Assess various simultaneous compliance considerations, including conflicting Disinfection Requirements Rule (DRR) requirements

MCL Compliance

TTHM and HAA5 are considered chronic contaminants, meaning that they can cause chronic health effects. Therefore, a violation of the MCL of either of these disinfection byproducts requires Tier 2 public notification (PN).

MCL compliance determinations for TTHM and HAA5 are based on **locational running annual averages (LRAAs)**.

- A running annual average (RAA) is the average of the results for the most recent 4 calendar quarters.
- A **LRAA** is a RAA that is calculated for *each* monitoring location.

MCL compliance is system level. This means that **all** DBP monitoring locations must be in compliance with the MCLs. If any one LRAA is greater than the MCL for either TTHM or HAA5, the system will incur an MCL violation.

How is the locational running annual average calculated? Each quarter, the LRAA is calculated by adding the 4 most recent quarterly results at each location and dividing by 4:

$$\text{LRAA} = \frac{Q1 + Q2 + Q3 + Q4}{4}$$

The following quarter, the RAA is:

$$\text{LRAA} = \frac{Q2 + Q3 + Q4 + Q5}{4}$$

What if a quarterly sample is missed? In that event, the LRAA will be based on 3 quarters of monitoring results. In this situation, the average is determined by dividing the 3 quarterly results by 3, since dividing by 4 would "dilute" the LRAA.

$$\text{LRAA} = \frac{Q2 + Q3 + Q4}{3}$$

What about systems on annual or triennial monitoring? If a system that is not already on quarterly monitoring has an MCL exceedance, the system must begin quarterly monitoring.

- The quarter with the exceedance becomes **Q1** in the LRAA calculation.
- Since compliance is based on the LRAA, an MCL exceedance in one quarter or an MCL exceedance in an annual or triennial sample is not automatically a violation.

Location 701	**Annual Sample 8/16/2020 (mg/L)**	**LRAA (mg/L)**	**MCL (mg/L)**
TTHM	**0.096**	0.096 ÷ 4 = **0.024**	**0.080**
HAA5	0.012	0.003	0.060

- However, *if a system on annual or triennial monitoring has any result that is more than 4 times the MCL, a violation occurs immediately.*

Location 701	**Annual Sample 8/16/2020 (mg/L)**	**LRAA (mg/L)**	**MCL (mg/L)**
TTHM	**0.34**	0.34 ÷ 4 = **0.085**	**0.080**
HAA5	0.016	0.004	0.060

IMPORTANT NOTE FOR ALL SYSTEMS:

ANY MCL exceedance requires <u>one-hour notification</u> to DEP!

Even though it may not be a violation, one-hour reporting is still required.

Extra Samples:

- MCL compliance for additional samples:
  - For systems on a quarterly frequency, a quarterly average is determined for each location with multiple results; this quarterly average is then used in the LRAA calculation.
  - For systems on an annual or triennial frequency, each individual result must meet the MCL (any exceedance causes the system to go to quarterly monitoring).

Monitoring & Reporting (M/R) Compliance

What are M/R Violations?

All water systems that are required to conduct TTHM/HAA5 monitoring were required to identify their monitoring locations and submit that information to DEP. Systems were required to submit this information in an IDSE Report or Compliance Monitoring Plan as part of the early implementation requirements of the Stage 2 DBP Rule.

In addition to monitoring locations, systems were required to include a sampling schedule. The sampling schedule specifies the dates on which their TTHM/HAA5 samples will be collected each quarter.

- All TTHM/HAA5 samples for that quarter (regardless of the number of samples required) must be collected in accordance with the sampling schedule.
- If samples are not collected in accordance with the sampling schedule, a monitoring and reporting violation occurs.
- Systems may collect samples on the specified date AND within 3 days before or after that date for compliance.
    - This gives the system a 1-week window in which to collect samples.
    - Samples collected outside of this window will not be counted for M/R compliance but WILL be included in MCL compliance determinations.

Example: A water system specifies in their sampling schedule that quarterly TTHM and HAA5 samples will be collected on February 12, May 12, August 12, November 12 each year. Samples collected on any days from the 9th through the 15th in each of these months will be counted for M/R compliance.

February						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28

IMPORTANT NOTE: ***The 3-day sampling window does NOT extend into the previous or subsequent quarter.***

For example, if the PWS selects September 28 as the sampling date, they will NOT be allowed to collect samples on October 1 and have them count for the third quarter monitoring period, since October 1 is the first day of the fourth calendar quarter. Conversely, if April 2 is selected as the sample date, samples collected on March 31 will not count for the second quarter monitoring period.

An additional situation that will cause an M/R violation is:

- Failure to submit an Operational Evaluation Level (OEL) Report by the due date, or the OEL report is incomplete. OELs will be discussed in detail in a later lesson.

Violation Response & Resolution

MCL Violations:

If your system incurs an MCL violation, you will receive a **Notice of Violation** from DEP.

Follow up actions after an MCL violation include:

- Issue Tier 2 Public Notification (PN), as soon as possible but within 30 days.
- Conduct routine/increased quarterly monitoring (dual sampling at all compliance locations).
- Investigate the cause of the MCL exceedance and work to correct the problem in order to avoid future MCL exceedances.

Monitoring and Reporting Violations:

If you fail to conduct required monitoring in the appropriate monitoring period or fail to properly report results to DEP, you will receive a "Compliance Notice" from DEP.

Follow up actions after a M/R violation include:

- Issue Tier 3 PN, as soon as possible but within 12 months.
- Collect the sample(s) you missed, if requested by DEP. If the next required compliance sample is due, you may not be asked to collect the sample you missed.
- If results from any additional samples indicate a problem, DEP has the option to require you to conduct additional monitoring (revert to routine/increased frequency or conduct special sampling).

Return to Compliance:

After incurring a violation, how does your system return to "in compliance" status? There are a few possibilities:

- Your water system may have entered into a Consent Order and Agreement (CO&A) with DEP. This is a legal enforcement document that establishes an agreed upon schedule for corrective actions and future compliance.
- If there is no enforcement document/schedule, then the system returns to compliance when it no longer exceeds the MCL. This can be achieved by various treatment and non-treatment methods:
  - Quarterly monitoring indicates that the MCL is being met after no action has been taken *(minimum of **2** quarters)*.

- Treatment has been installed *and* quarterly monitoring indicates that the MCL is being met *(minimum of 1 quarter)*.
- Operational changes have been made *and* quarterly monitoring indicates that the MCL is being met *(minimum of 1 quarter)*.

If non-treatment methods are used to come into compliance (i.e. sources and/or EPs are taken off-line, sources are blended), permits may need to be amended to specify blending ratios and pumping rates, to ensure that sources and/or EPs are not returned to service without first installing treatment, or to indicate that sources have been abandoned.

Compliance Exercise: Longview Water System

The Longview Water System is required to collect an annual dual sample for TTHM/HAA5 at one location, Location ID 701. Here are the results for August 12, 2019:

	Location ID 701	**MCL**
TTHM	0.095 mg/L	0.080 mg/L
HAA5	0.005 mg/L	0.060 mg/L

Based on the above results, has the system incurred an MCL violation? Why or why not?

Does the system need to report to DEP within 1 hour?

The system begins quarterly monitoring. Their results for the first 4 quarters, beginning with 3rd quarter 2019, are shown below:

	Quarter 1	**Quarter 2**	**Quarter 3**	**Quarter 4**	**LRAA**
TTHM	0.095 mg/L	0.121 mg/L	0.087 mg/L	0.089 mg/L	
HAA5	0.005 mg/L	0.004 mg/L	0.022 mg/L	0.017 mg/L	

Calculate the LRAA for both TTHM and HAA5 and enter results in the last column.

Has the system incurred an MCL violation? Why or why not?

What type of public notification is required, if any? How long does the system have to notify the public?

Simultaneous Compliance

Public water systems must deal with complex risk trade-offs between several concerns. **Simultaneous compliance** is a term used for the balancing act that goes on when trying to comply with multiple regulations and requirements at the same time. Water treatment processes often have impacts on each other. Sometimes the impact is positive, but a lot of times there is a risk of treatments interfering with one another. Simultaneous compliance requires considering *all potential impacts* of a treatment change.

Without careful planning and proper implementation, actions intended to *improve* water quality can produce serious *unintended consequences*.

Water systems must assess simultaneous compliance issues with other rules as part of the permitting process. Any *changes in source water,* or additions or *changes in treatment* **must be approved by DEP** via a permit or permit amendment ***prior to*** making the change.

- Different source waters have different chemistry and can react differently to established treatment.
- Similarly, making a treatment or chemical changes alters water chemistry.

Those changes in water chemistry that result from a change can lead to unintended consequences with regard to other drinking water regulations. Systems must simultaneously consider meeting the requirements of all of these rules:

- Surface Water Treatment Rules (SWTRs)
- Lead and Copper Rule (LCR)
- Revised Total Coliform Rule (RTCR)
- Disinfection Requirements Rule (DRR)
- Disinfectant and Disinfection Byproducts Rules (DBPRs)

Each of these rules (SWTRs, DBPRs, RTCR, LCR, DRR) has equivalent stature in law, so the goal of one rule *cannot* be undermined in favor of the goal of another.

- **Issues between DBPR and DRR**
  - Systems may consider increasing their disinfectant residual for DRR compliance, which focuses on maintaining an adequate residual for protection against recontamination in the distribution system.

  - Systems may consider decreasing their disinfectant residual for DBPR compliance. to minimize the disinfection byproduct formation potential.
- **Issues between DBPR and SWTRs**
  - The SWTRs focus on achieving adequate disinfection and pathogen removal and preventing waterborne disease outbreaks.
  - The DBPR focuses on minimizing formation of DBPs in the distribution system and reducing long-term exposure to carcinogenic compounds.
- **Issues between DBPR and LCR**
  - Systems may lower the pH for the DBP Rules for enhanced coagulation (improved precursor removal and disinfection efficiency).
  - Systems may raise the pH for the LCR for improved corrosion control.
- **Issues between DBPR and RTCR**
  - The RTCR focuses on protecting distribution systems against microbial contamination from regrowth or outside sources of contamination from a pipeline break or cross-connection.
  - Modifying treatment practices to comply with the DBPR may cause violations of the RTCR. These problems can arise from a number of changes to the chemistry and biology of the distribution system.

DRR Compliance:

The Disinfection Requirements Rule (DRR) established a minimum distribution disinfectant residual level of **0.2 mg/L** at all points in the distribution system. DRR is applicable to the following water systems:

- All community water systems;
- Any nontransient noncommunity water system using chlorine or chloramine, or purchasing water from a system using chlorine or chloramine;
- Any transient noncommunity water system that uses either a surface water or groundwater under the direct influence of surface water (GUDI) source;
- Any transient noncommunity water system that provides 4-log inactivation of viruses under the Groundwater Rule.

Many systems may have only maintained a trace disinfectant residual in distant portions of their distribution systems in the past. While striving to maintain the new minimum residual, it is critical to consider simultaneous compliance with not only the Stage 2 DBPR, but with all of the other regulations. The overall goal must be to **balance the risks associated with microbial pathogens and disinfectants /disinfection byproducts**, while at the same time **evaluating how any steps might impact treatment in place for other water quality objectives**.

It is important to note that even some *operational adjustments* have the potential to change the water chemistry enough to impact DBP formation, corrosivity, or other parameters.

Example:

A simple operational adjustment such as increasing sodium hypochlorite feed to maintain distribution chlorine residuals can have unintended consequences.

- DBPs could increase with the higher chlorine dose, causing potential MCL violations.
- pH could increase, which would impact the ability of a surface water system to maintain the required 1.0-log *Giardia* inactivation.
- Oxidation reduction potential (ORP) could increase, which could impact lead solubility and customers' exposure to lead.
- Iron and manganese precipitation could increase, resulting in dirty water complaints.

This is just one example, but it illustrates the potential consequences of making a simple treatment adjustment due to the changes in water chemistry.

What systems need to remember about simultaneous compliance issues:

There are potential treatment conflicts that may result from treatment changes to comply with the DBPR.

- There isn't one single solution that will work for all systems. Water chemistry is unique in each system and must be evaluated on a site-specific basis.
- Any change requires careful planning that includes evaluation of potential impacts *before* implementing any process changes.
- Any treatment change will likely require a permit amendment, *so the water system needs to contact their DEP Regional Office **BEFORE** any change is made*. Even if a permit amendment is not required, there is language in the federal regulations that requires State review and approval for any long-term treatment change that will affect disinfection efficacy or water corrosivity.

For assistance with considering and addressing simultaneous compliance issues, water systems can refer to EPA's Simultaneous Compliance Guidance Manual for the Long Term 2 and Stage 2 DBP Rules (document ID 815-R-07-017).

Key Points

- 1-hour reporting is required for **any** MCL exceedance, *regardless of whether the exceedance causes a violation*.
- MCL compliance is determined by calculating a Locational Running Annual Average (LRAA) for each sample location. All LRAAs must be in compliance or the system will incur an MCL violation.
- Systems have a window of one week in which to collect TTHM/HAA5 samples for M/R compliance. Samples taken outside of that window will not count for M/R compliance but will be used to determine MCL compliance.
- MCL violations require Tier 2 PN, which must be issued within 30 days. M/R violations require Tier 3 PN, which must be issued within 12 months.
- The goal of simultaneous compliance is to consider *all potential impacts* of a treatment change in order to comply with multiple regulations and requirements at the same time. That includes balancing the risks associated with microbial pathogens and disinfectants /disinfection byproducts while evaluating how these steps might impact treatment in place for other water quality objectives.

Lesson 3: Reducing DBP Formation Potential through Optimization and Best Management Practices

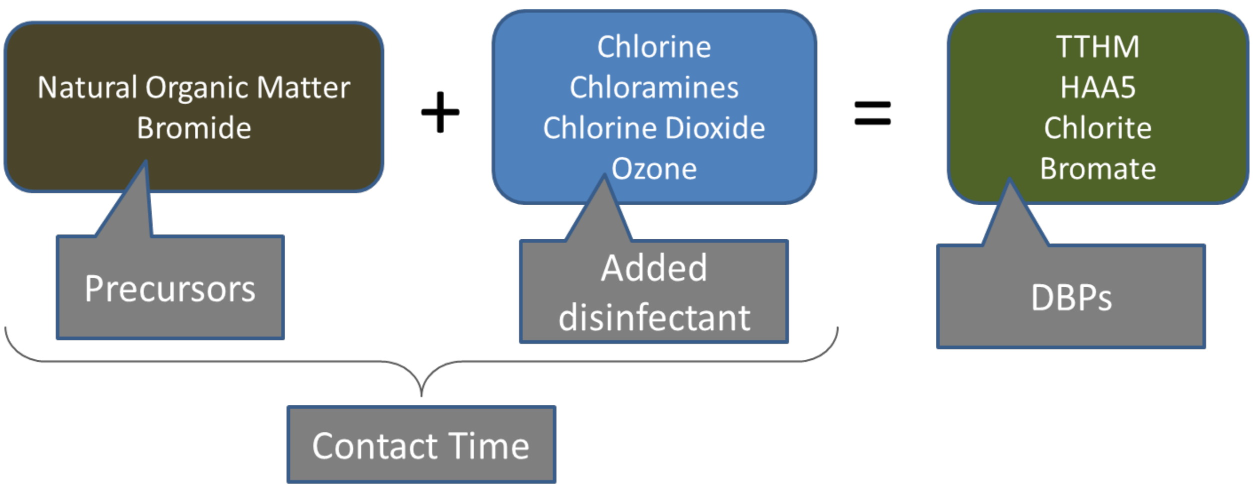
Objectives

By the end of this lesson, you will be able to:

- Describe how to reduce DBP concentration by reducing key factors in their formation
- Identify several treatment optimization options to reduce DBP formation potential
- Describe how water age and disinfectant demand affect distribution system water quality
- Identify several distribution system best management practices (BMPs) for disinfectant residual management

Reducing DBP Formation

The key factors in DBP formation are the organic precursors, the added disinfectant, and the contact time between the two.



Therefore, reducing DBP formation is dependent on reducing one of these three factors:

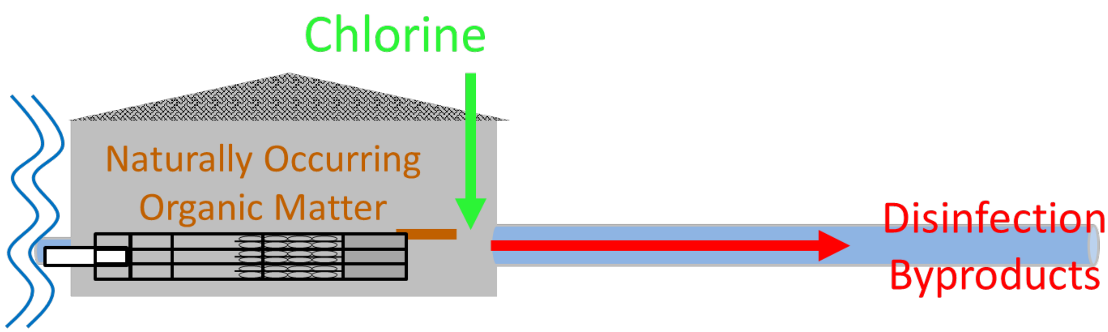
1. Precursors – this is accomplished through in-plant optimization.
2. Disinfectant – however, due to simultaneous compliance concerns with maintaining disinfection for the Disinfection Requirements Rule and for log inactivation treatment techniques, reducing the disinfectant added may not be feasible.
3. Contact time – this is accomplished through distribution system BMPs to reduce water age.

In this lesson, we will discuss in-plant optimization considerations to reduce organic precursors, and distribution system BMPs to reduce water age.

An important first step is to **know where DBPs are forming**. If your system has elevated DBP levels, consider some additional monitoring to determine where they are forming. Monitoring for DBPs at the entry point (EP) and at other points in the treatment process can be helpful in determining where to focus your optimization and/or BMP efforts.

Reducing DBP Precursors: In-plant Optimization

The Stage 2 DBP Rule focuses largely on distribution system issues and relies on distribution system sample results to determine compliance. However, remember that ***distribution*** system water quality starts with the ***treatment plant,*** and water quality does not improve after leaving the plant.



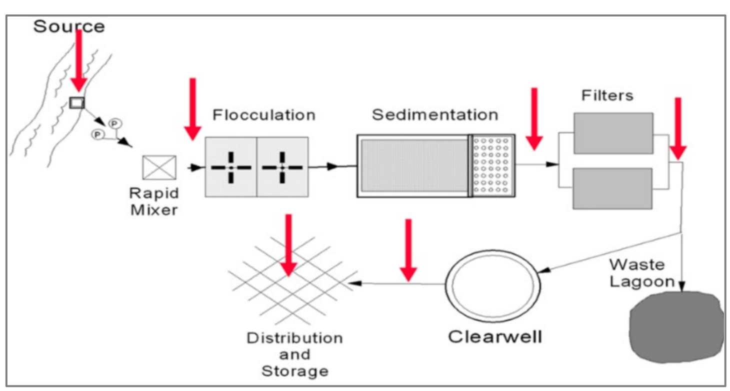
Surface water filtration plants, in particular, must consider reducing DBP formation potential at the plant. This can be accomplished by focusing on in-plant removal of TOC through optimization using the multiple barrier approach.

What is Optimization?

- Operations based changes resulting in improved water quality
- Proactively seeking out and addressing factors contributing to water quality issues
- Ensuring delivery of the highest quality of water to customers
- Promoting long-term viability through proactive measures

Instead of focusing only on the end result, operators using the ***multiple barrier approach*** focus on optimization of *each* in-plant treatment process in order to achieve the highest quality finished water possible. In the context of reducing DBPs, this refers specifically to reducing DBP formation potential by optimizing each of these treatment processes:

- Source water options
- Pre-filtration oxidation
- Flocculation
- Coagulation
- Sedimentation
- Filtration
- Disinfection



Source water options may include the following:

- Source water protection plan – watershed management efforts to limit organic matter, nutrients, and other DBP precursors and nutrients by implementation of a source water protection plan
- Alternating sources – operational flexibility to use the best possible source by blending sources together or alternating source usage based on water quality
- Multiple intake depths – pulling raw water from various levels to minimize contaminants during times of challenging water quality, such as flooding, thermal stratification, and eutrophication
- Vigilant source water monitoring – regularly monitoring source water for changing conditions that may impact DBP formation

Treatment strategies may include the following:

- Maximizing pre-oxidation with a non-chlorine oxidant – This can help by oxidizing natural organic material to reduce the DBP formation potential, as well as by precipitating inorganic compounds to reduce chlorine demand.
- Optimizing coagulation – This includes optimizing the dosage and even the type of coagulant used, as well as the optimal pH range for the coagulant. This may also include addition of a polymer to aid coagulation. Jar testing can be a useful tool for optimizing this process.
- Optimizing settling – Reducing floc carryover can significantly reduce DBP formation potential, particularly in plants that pre-chlorinate. In addition to optimizing chemical dosages, as noted above, consideration should be given to improving the sludge removal process.
- Optimizing filtration – Particle breakthrough during a filter run increases the concentration of organic precursors that come into contact with free chlorine disinfectant. Evaluating and optimizing filter run times and backwash processes can significantly reduce the DBP formation potential during disinfection.
- Evaluating disinfection practices – Maintaining adequate disinfectant dosage and contact time is critical for meeting microbial inactivation. However, by closely monitoring the disinfection process, it is possible to maintain the minimum required inactivation while at the same time minimizing any excess disinfectant concentration and/or contact time.

Special studies and increased monitoring are key to treatment plant optimization! Additional monitoring is necessary to assess the efficacy of treatment processes.

- In-plant DBP samples can be used to assess where byproducts are forming.
- Jar testing can be utilized to evaluate the impact of coagulant dosage strategies.
- UV254 and TOC monitoring can assist in evaluation of organics removal.
- Hold studies can be used to determine finished water stability and reactivity.

IMPORTANT NOTE: Don't forget simultaneous compliance!

Maintaining compliance with entry point disinfectant residuals and log inactivation requirements is critical!

Remember, water quality does not improve after leaving the treatment plant. Distribution system water quality is dependent on treatment processes. Optimizing treatment plant operations can minimize degradation of water quality and increase finished water stability.

Reducing Water Age: Distribution System BMPs

"Best management practices" (BMPs) are methods or techniques found to be the most effective and practical means to achieve an objective. In a distribution system, BMPs are operational adjustments intended to help the water system simultaneously comply with the requirements of the Stage 2 DBP Rule by minimizing byproduct formation, and the minimum disinfectant residual requirements of the Disinfectant Requirements Rule (DRR).

The implementation of BMPs in the distribution system can help water suppliers comply by:

1. Lowering chlorine demand,
2. Maintaining an adequate disinfectant residual throughout the distribution system, and
3. Reducing water age and DBP formation.

Some examples include flushing and storage tank management, which are discussed in this lesson.

Distribution System: Chlorine Demand and Disinfectant Residual

Chlorine reacts with organic matter and microbial contaminants in the distribution system. This reaction with the disinfectant leaves behind an inactive form of chlorine. The organic matter and microbial contaminants can cause excessive demand on the disinfectant. This high demand reduces the disinfectant residual available to react with additional contaminants, making it increasingly difficult to maintain adequate residuals throughout the system.

So, some BMPs are targeted towards reducing these chlorine-demanding contaminants in the distribution system. Reducing chlorine demand in turn helps systems maintain adequate disinfectant residuals, which is important for complying with the DRR.

Distribution System: Water Age

Regardless of the type of source, surface water or groundwater, water quality begins degrading immediately after leaving the treatment plant. Within the distribution system, numerous chemical, biological, and physical changes occur:

- Water reacts with pipe walls, biofilm, and sediment.

- **Disinfectant residual decreases.**
- Microbial activity increases.
- **Residual organic matter and the disinfectant continue to react and form disinfection byproducts.**

Therefore, **water age** is a major consideration for water quality and a focus of many BMPs. Minimizing water age can:

- Lower the disinfectant decay and
- Reduce disinfection byproduct formation

Water age can vary from system to system and **within** a system.

Results from Water Age Study:

System	**Water Age**
North Carolina: 300,000 customers; 1,100 miles of main (tracer study)	2 to 75 hours (3 days)
California utility	Exceeding 400 hours (16.5 days) in some areas
Canadian utility: 24,000 customers; 86 miles of main	Dead-end areas: 300 to 600 hours (12.5 to 25 days)
Examples from: EPA document "Effects of Water Age on Distribution System Water Quality" 2002	

Flushing

Flushing involves opening a distribution connection (hydrant) to the atmosphere and discharging water from the system, creating artificial demand in the system.

- Flushing removes "stale" or old water and pulls in "fresh" water with higher chlorine residual.
  - This reduces water age.
- Flushing can also create a scouring action to remove the buildup of sediment and biofilms
  - This decreases chlorine demand and organic matter available to react with chlorine to form byproducts.

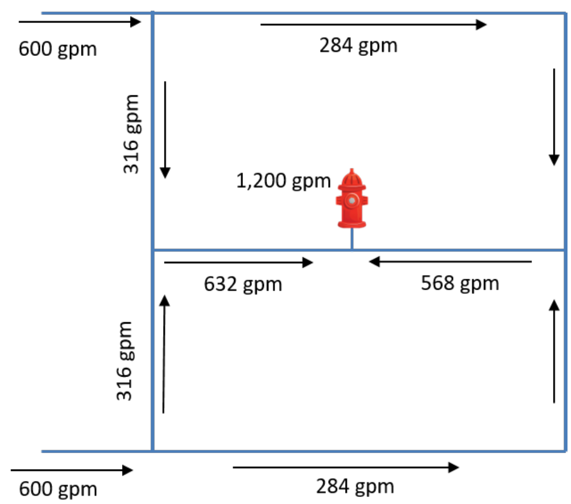
Flushing has traditionally been used for periodic removal of sediment in a "reactive mode" to water quality complaints or issues. However, flushing is now being recognized as a potential best management practice to proactively address areas of high water age and/or poor water quality.

Flushing Methods:

There are two primary methods of flushing:

1. Conventional
2. Unidirectional

Conventional Flushing Program

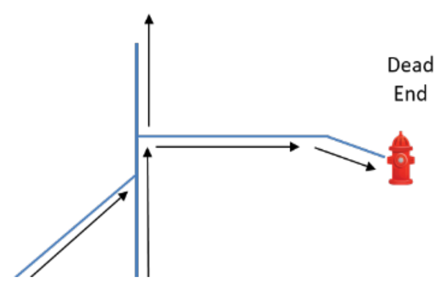


Conventional flushing may be known as **spot flushing** or stagnant area flushing.

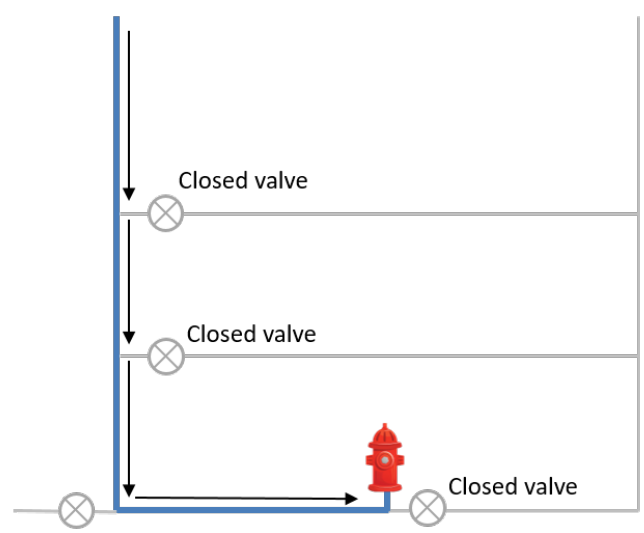
As shown in the graphic to the right, a hydrant is opened and water flows from all directions.

- This replaces stagnant water through bulk water turnover and reduces water age.
- This causes less flow in a given pipe, so velocities may be too low to clean/scour the pipes. Generally, velocities should be greater than 2.5 feet per second (fps).
- Conventional flushing requires a large quantity of water when compared to directional flushing.

Also considered conventional flushing is "**dead-end" flushing** in an area of complaints or a known stagnant area. As show in the diagram to the right, a hydrant is opened at a dead-end and this creates is a single flow path.



Unidirectional Flushing Program



In unidirectional flushing, the system isolates each pipeline to create flow in a single direction. This results in an organized sequential main flushing from a "clean" starting point.

Unidirectional flushing:

- Creates higher velocities to better clean pipe (>2.5 fps)
- Requires less water
- **Negatives:**
  - Requires extensive planning
  - Manually operated process that is labor intensive

Flushing Mechanisms:

Flushing can be either manual or automated.

- Manual – In manual flushing, operators physically open and close hydrants and/or valves. This can be labor intensive if there are multiple locations.
- Automated – In automated flusher units, there is an enclosure that contains electrically actuated valves, a controller, a battery and a means of discharging the water with backflow prevention.
    - Some units also have dechlorination measures built-in.
    - Flushers are available with timers, the ability to set flow rates, and residual sensors to trigger flushing
    - Automated units can be set to intermittent or continuous operation
    - IMPORTANT NOTE: The DEP Clean Water program requires discharge permits on automatic flushing units.

Flushing Protocol:

Water systems should evaluate or create a flushing protocol. There are several considerations.

Where:

- Will you create a full-scale system-wide flushing program?
- Or, will your program focus in portions of the system, such as:
    - Mains subject to sedimentation
    - Dead-ends
    - Areas with water quality issues

Use distribution water quality records to determine the best locations for flushing. This includes areas with lower chlorine residual measurements and/or coliform positive samples.

When:

- Determine how flushing is scheduled:
    - On a regular basis (monthly, quarterly, etc.)
        - Use water quality records to determine when to flush
    - On a seasonal basis (usually spring or fall)
    - In response to complaints or water quality issues (complaints or coliform hits or low chlorine residual).

How long:

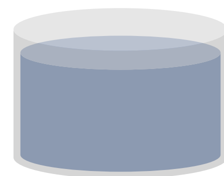
- Flushing duration – How long will flushing last? Systems can base it on:
    - Time
    - Quantity
    - Appearance (flush until clear)
    - Water quality
        - Monitor water quality during flushing (chorine residual, pH, temperature)

Dechlorination:

Dechlorination is an important consideration when flushing. You cannot discharge chlorinated water to waters of the Commonwealth, which includes storm drains.

- Dechlorination may be necessary and there are various options available.
- The DEP Clean Water program has a fact sheet called *Planned and Unplanned Discharges of Chlorinated Water to Surface Water* that is available, as well as the *Chlorinated Water Incident Report Form*.

Storage Tank Management



Storage tanks often contribute to significant water quality degradation. This is mainly due to either water age issues or stratification within the tank. Storage tank management options primarily consist of **tank turnover** and **tank mixing**.

Tank turnover time:

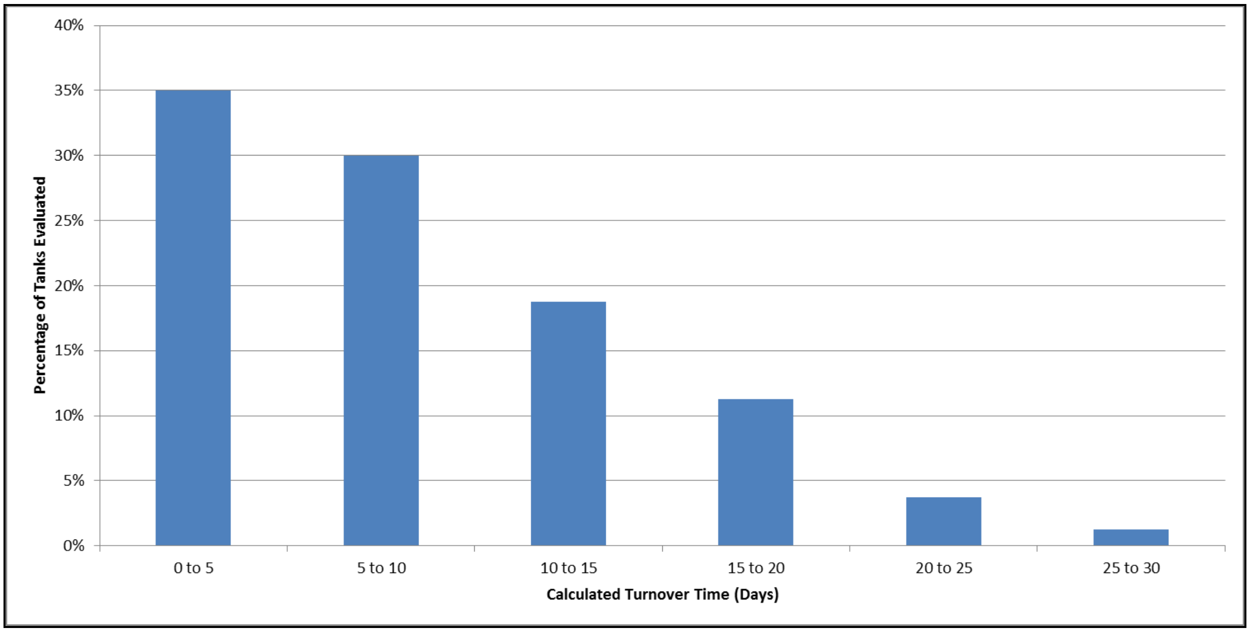
Tank turnover time refers to the amount of time that it takes for the volume of the water in a tank to be completely replaced.

- Both the EPA and the DEP Distribution Optimization Programs have a guideline of a *maximum* of 5 days turnover time.
- For example:
  - A 1 million-gallon tank draws 20% of its water volume per day and is refilled with fresh water.
  - The total volume of the tank (1 MG) would be replaced in 5 days.
- In tanks, longer turnover times lead to excessive water age. This leads to:
  - Disinfectant residual decay and
  - An increase in DBP formation.

Many systems are aware that storage tanks may be an issue, but tank turnover and water age have not been assessed. Below and on the following page are the results of 80 tank assessments at 21 water systems in Pennsylvania. This study was done by the DEP Distribution Optimization program.

This study shows that:

- 35% of tanks assessed met the operational guideline of 5 days.
- 65% did not, suggesting water age may be an issue for these tanks.
- The average turnover time for the tanks in the study was 8.8 days.

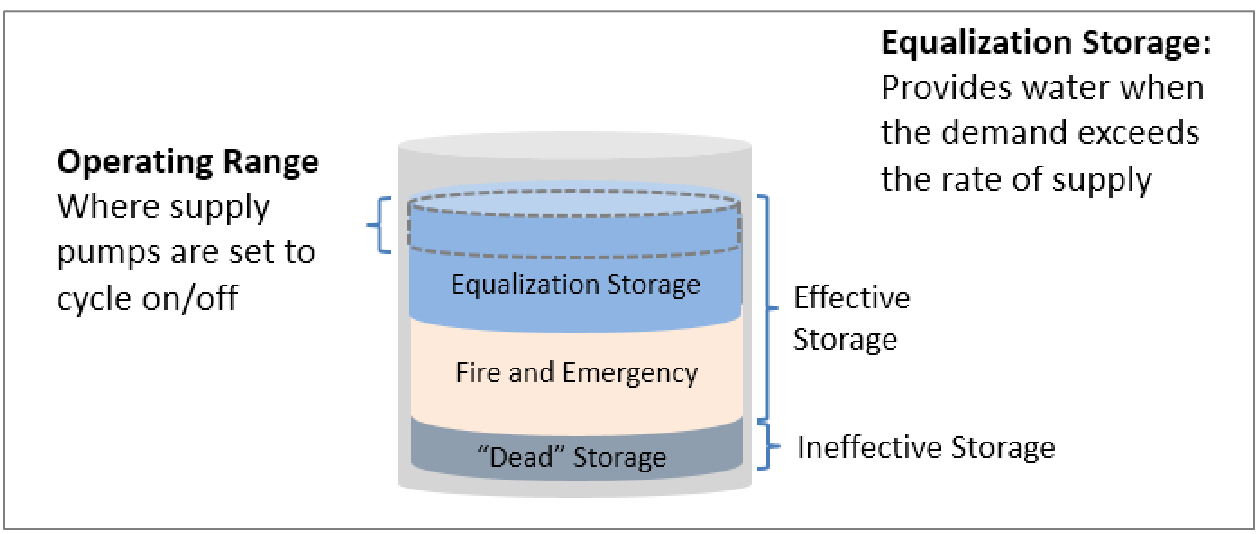


Managing Tanks: Adjusting Operating Ranges

The "equalization" and the fire and "emergency storage" are what is considered the **"effective storage"**.

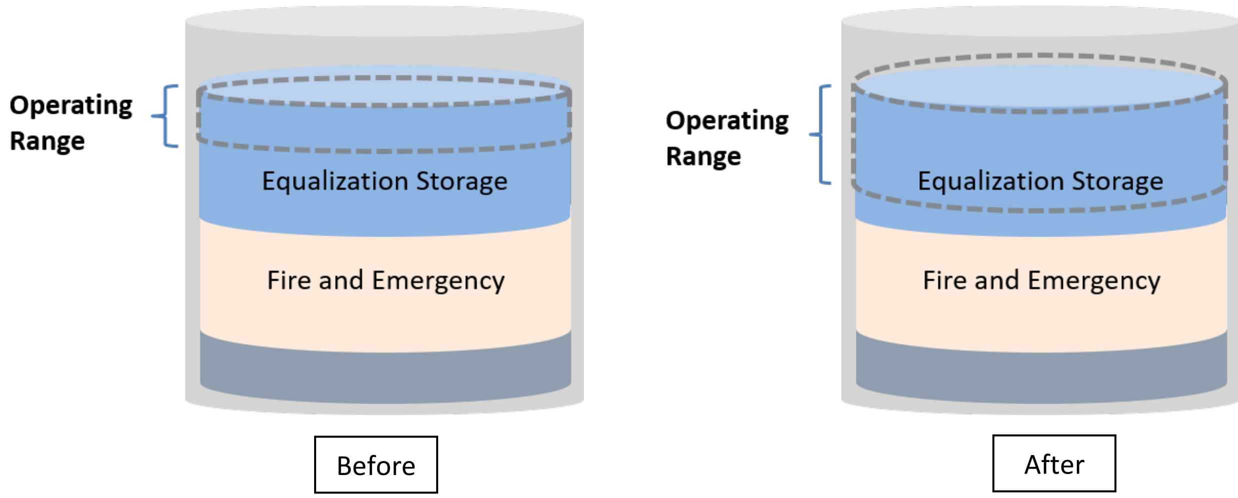
For tanks that "float" on the system, meaning that they provide pressure for the system, there is always "dead" or ineffective storage that is used to maintain the system pressure.

Within the equalization storage is the actual **operating range** where systems set their pumps to cycle on/off. Normally, it is set to use only a portion of the effective storage before the tank is refilled.

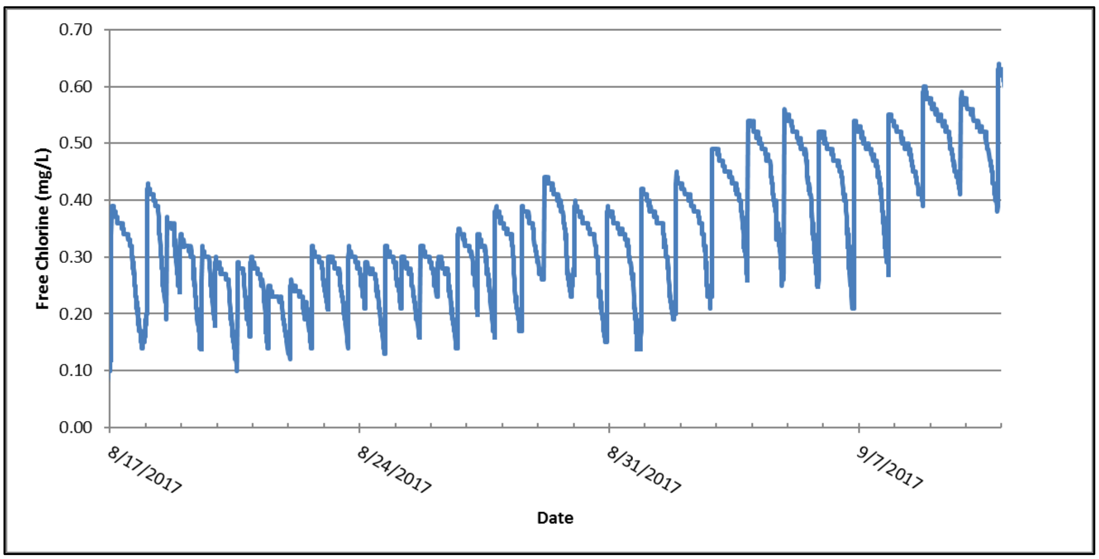


Adjust Operating Ranges: Deep Cycle

To deep cycle a tank, a water system decreases the lower operating level. In other words, the tank is drawn down further before refilling. This exchanges a greater volume during each cycle, allowing "older" water to exit the tank and bringing fresh water in.



Deep Cycling Example Data:



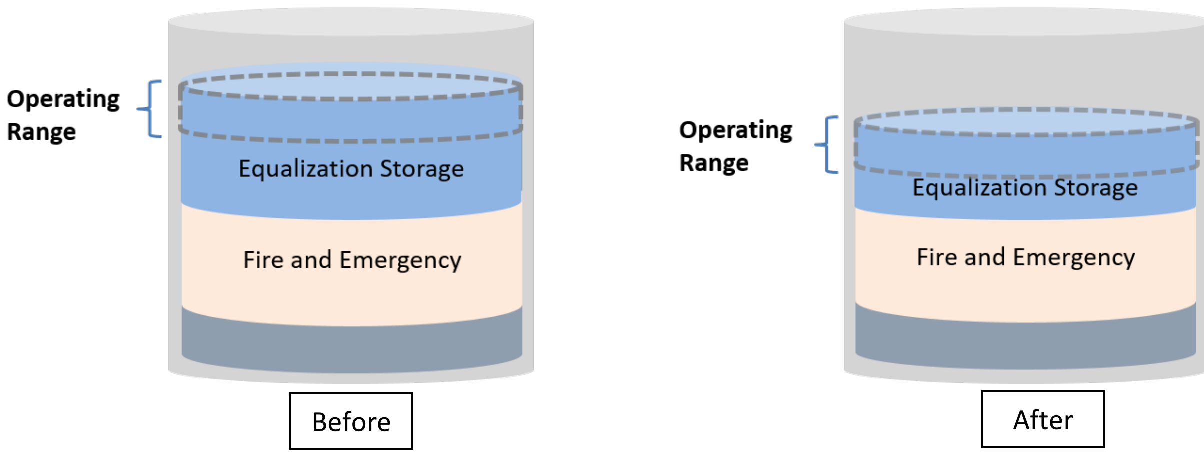
This graph that shows the impact of changing the operating levels of the tank.

- On 8/29, the system began deep cycling the tank and consequently the fill/draw cycle changed from 2 per day to 1 per day. This is revealed by the widening sawtooth pattern. This sawtooth pattern is the free chlorine residual increasing and decreasing in the tank during fill and draw cycles. The higher residual occurs during the fill cycle, when the tank is filled with fresher water; the chlorine level falls as higher-aged water is drawn from the tank.

- With the increased volume of water exchanged, the overall residual levels in the tank began increasing as more "fresh" water was used to refill the tank. This allowed the system to increase the residual in the tank.

<u>Adjust Operating Ranges: Increase % of Total Volume Exchanged</u>

Another tactic is to increase the *percent* of total volume exchanged. To increase the percentage of volume exchanged, systems lower both the upper and lower operating levels in the tank. Essentially, you are maintaining less storage volume, which causes a greater percentage of the tank to be exchanged. In turn, you are reducing the water age in the tank by bringing in a higher percentage of "fresh" water.



A system would first need to determine if, and how much, the overall storage volume can be decreased. Water system engineers can determine the required equalization volume for a system by reviewing demand patterns based on flow and storage tank volume changes, historical production, pumping, and tank level records.

Remember: It is critical to maintain adequate distribution system pressure and storage volume for emergency situations

Assessing Tank Turnover:

Tank turnover is a calculated value.

- EPA developed a spreadsheet with a turnover calculator for tanks and it can be found on the DEP Distribution Optimization website.
  - To download the spreadsheet:
    - Search for: "PA DEP distribution optimization"
    - Open the DEP Optimization website and click the link on the right side for "Distribution System Optimization Goals"
    - Under the heading "Tank Operations", scroll until you see the link for "Drinking Water Storage Tank Assessment Software"

- The spreadsheet **inputs** include tank diameter, sidewall length, and maximum operating water depth.

I. Tank Characteristics (See Glossary worksheet for illustrations of Tank Characte

**Data must be entered into this section for the spreadsheet to fu

**Do not enter tank dimensions if the tank is NOT cylindrical, rectar

**Hydropillar tanks can be approximated as cylindrical tanks depen

A.	Name of Tank	Example
B.	Volume (MG)	0.5

If the SCADA/ telemetery reports tank level in feet answer question C, then answer questions E, F, and G. If the SCADA/ telemetry does not report the tank level in feet, answer "n" in question C and then answer questions D1, D2, E3, F, and G.

C.	Is the tank Cylindrical (C), Rectangular (R), Hydropillar[1] (H), or None of these (n)?	c
D1.	Does the SCADA/ telemetry report tank level in volume (y/n)?	n
D2.	If SCADA/ telemetry is reported in volume, are the tank mixing equations applicable - see note 4 (y/n)?	
E1.	(if cylindrical/hydropillar/) Tank diameter or (if rectangular) Longest Sidewall length, D (ft)	50
E2.	(If rectangular) Shortest Sidewall length, L (ft)	
E3.	(all tanks) Inlet Diameter, d (ft)	1.00
F.	(all tanks) Maximum Operating Water Depth, H (ft)	24
G.	(all tanks) Is the tank operated fill-draw (fd) or flow-through[2] (ft)?	fd
	H/D ratio	0.48

- There are several outputs from the spreadsheet, but for course we are most interested in turnover time. Example:

Avg Duration (Fill + Draw Time)	0.5	days
Avg Flow Rate into tank	0.06	MGD
Avg Tank Vol	0.26	MG
Turnover Time	**4.6**	**days**

You can also use the spreadsheet to estimate the effect of changing the operating levels of the tank. You can input a different maximum tank level or minimum level and see how the calculated turnover changes.

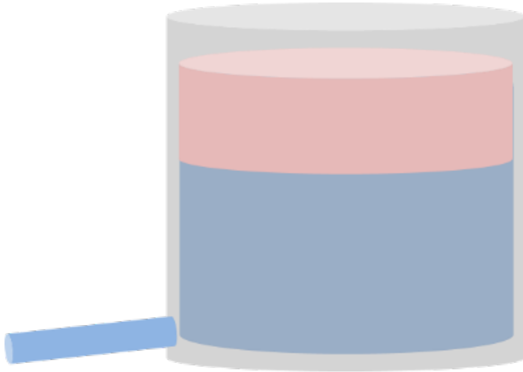
- Here is an example excerpt from the spreadsheet with changes to the max and min operating level. The turnover time was reduced from 4.6 to 4.2 days.

	No Changes	Scenario A
High/Max Level	18.71	17.00
Low/Min Level	16.79	15.00
Turnover Time	4.6	4.2

Managing Tanks: Mixing

Poor mixing in tanks leads to **stratification.** Here is how stratification occurs:

- Heat from sun warms water in the tank
- Less dense warm water floats to top
- When the tank drains, warmer water stays on top
- Fresh water that fills the tank from the bottom is colder
- This creates a *thermocline* that traps the "older," warmer water at the top
- This older water may eventually be drawn into the system during heavy use



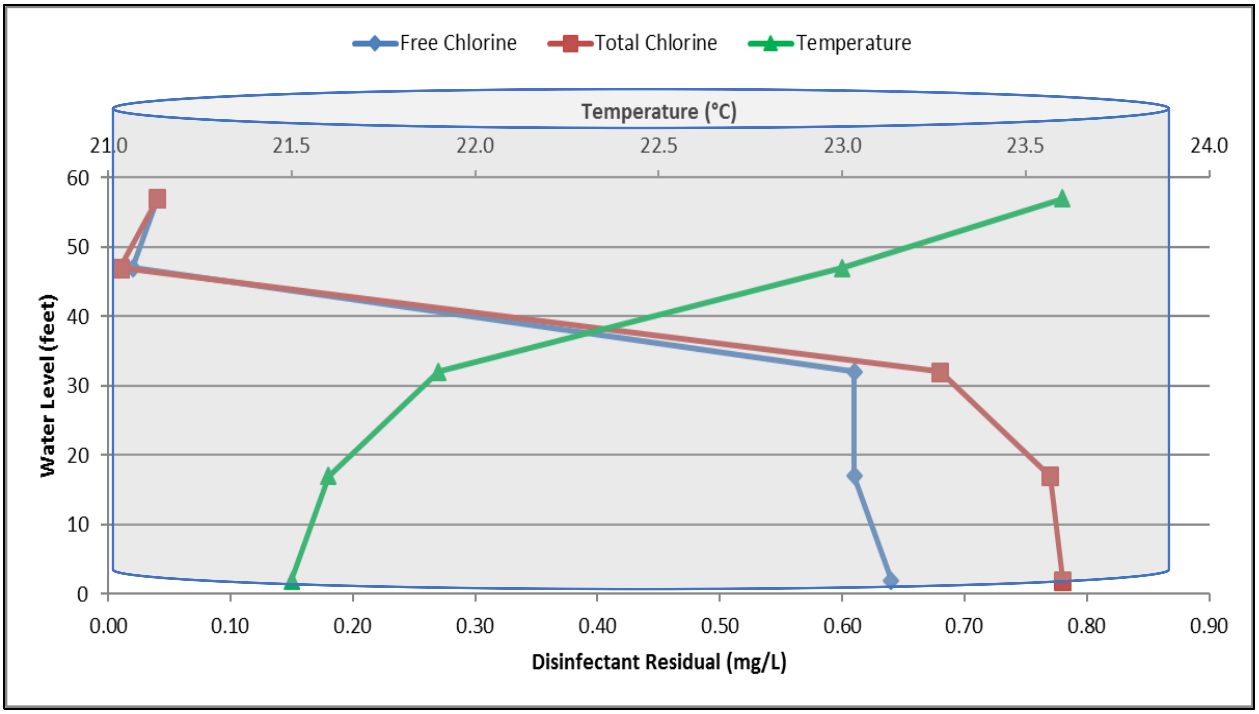
Stratification leads to inconsistent water quality. Disinfectant residual, pH, and temperature vary across the depth of the tank.

IMPORTANT NOTE: **Mixing does NOT decrease water age or improve <u>the quality of the water entering the tank</u>**. In other words, low chlorine residuals coming into the tank will *not* increase in the tank with mixing.

Mixing DOES homogenize water quality by preventing stratification. This promotes consistent disinfectant residual and decreases chlorine demand.

<u>Thermal Stratification: Unmixed Standpipe</u>

The graph on the following page demonstrates actual data from a DEP study of an unmixed storage tank. There is an overlay graphic of a tank to help you visualize the data within the tank setting.

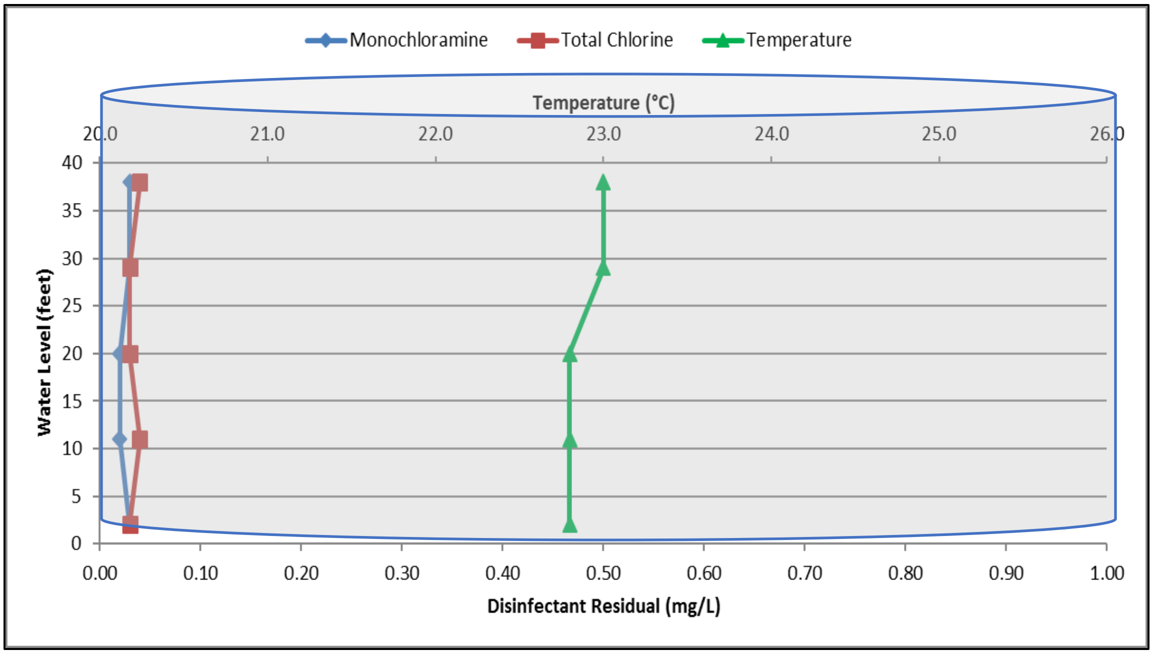


- The water level in feet is shown on the left, with 0 feet being the bottom of the tank.
- The temperature scale is shown across the top.
- The disinfectant residual scale is shown across the bottom.
- The temperature data, which is shown with triangular data points, reveals thermal stratification.
    - Near the bottom of the tank the temperature is 21.5 degrees C.
    - At about 32 feet there is a sharp increase in temperature.
    - Please note that the thermal stratification takes place with about 2 degrees C. It does not take much of a temperature change to be stratified.
- You can also see that the free chlorine residual (shown in diamond data points) drops sharply at 32 feet and up.

Because of the thermal stratification, the warm, less dense water stays at the top of the tank and doesn't get removed during draw cycles. The water age continues to increase at the top of the tank.

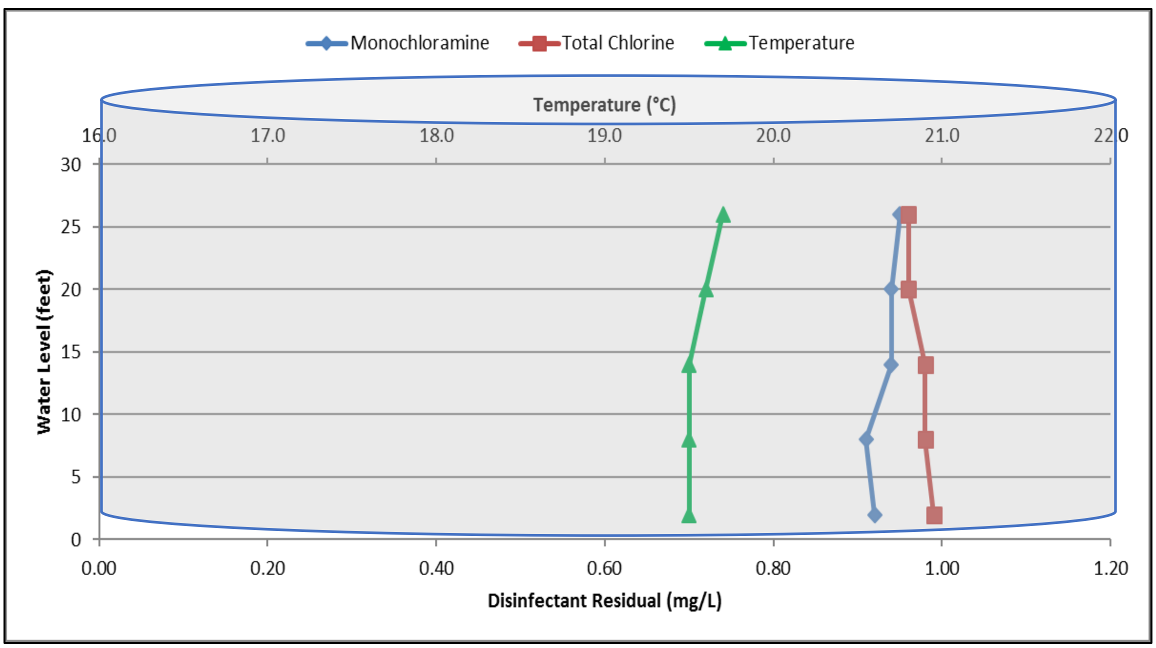
<u>Standpipe with Mixing System:</u>

On the following page is data from a storage tank with a mixing system from another DEP study. You can see that the temperature and disinfectant residual stay consistent throughout the tank.



Note also, that the chlorine residual in this tank was not very good, even if it was consistent.

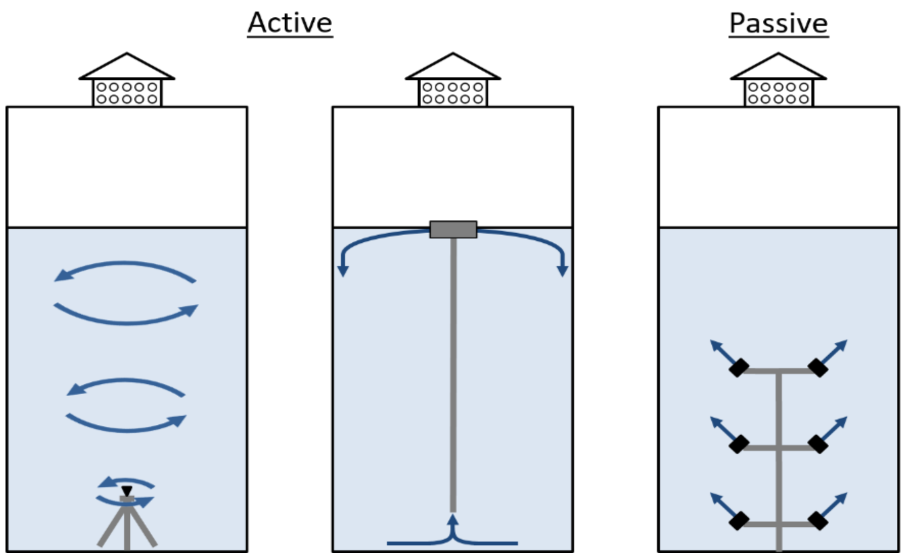
It should be note however that **systems should NOT assume a tank needs a mixing system**. The graph below shows a tank WITHOUT a mixing system that was not stratified.



The tank has a turnover time of around 4 days. Based on the design of the tank and the operational strategy, there is likely no need for a mixing system.

Systems should evaluate their tanks to determine if a mixing system is necessary prior to spending tens of thousands of dollars in capital improvements that may not be necessary or help improve water quality.

Mixing systems in storage tanks are classified as active or passive. The active systems are on all the time no matter what the level of tank. The passive system, shown on the right side only has an effect during filling of the tank.



Important Note: A permit is required for the addition of tank mixers. Contact your local DEP office.

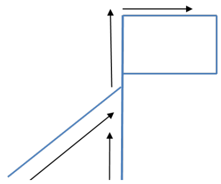
Managing Tanks: Remove Unnecessary Tanks from Service

Some systems can consider removing storage tanks, if possible. This may be the case in an area in which an industrial facility (large user) has left or closed.

Other Possible BMPs

Looping Dead-ends:

In some systems with physical dead-ends, the system may be able to loop these dead-ends. This is done by connecting a dead-end main to another water main. This eliminates the physical dead-end, which can help to reduce water age.



Disinfectant Residual Boosting:

Disinfectant residual boosting in the distribution system is another possibility for systems with water age issues. This involves the addition of a second dose of chlorine at strategic locations in the distribution system.

- Boosting can be used to increase the chlorine residual in distant areas of distribution
- Boosting is a good alternative to increasing in-plant chlorine doses which may allow for lower in-plant chlorine doses. This can help delay the formation of DBPs. However, systems still must maintain compliance with treatment plant and entry point disinfection requirements.

There are several considerations when boosting residual chlorine in the distribution:

- Residual should be monitored *before* and *after* chlorine addition to optimize the treatment and monitor performance.
- Alarms and site visits are critical for remote locations.
- Boosting chloraminated residuals is very complex (discuss with engineer).
- IMPORTANT: A permit is required for the addition of chlorine boosting in the distribution. Talk to your local DEP office.

Distribution System Component Maintenance:

Distribution system components are potential sources of organic matter and microbial contamination.

- Example sources of contamination in the distribution include: Aging pipes, improperly installed valves, cross connections

Contamination is then a source of chlorine demand, which "uses up" the disinfectant residual in the distribution and can provide organic matter for byproduct formation.

Asset Management Plan

Because of the potential sources of contamination in the distribution, a best management practice is to create an asset management plan that addresses the planned replacement of distribution system components. Water systems use the plan to make sure that planned maintenance can be conducted and capital assets (pumps, motors, pipes, etc.) can be repaired, replaced, or upgraded on time and that there is enough money to pay for it.

For more information on Asset Management, speak with your local DEP office and ask about the Capability Enhancement program, or visit the website at this link: https://www.dep.pa.gov/Business/Water/BureauSafeDrinkingWater/CapabilityEnhancement/Pages/AssetManagement.aspx

Leak Detection

As a practice, systems should have a leak detection program to reduce "non-revenue" or "unaccounted for" water. Systems should consider system-wide surveys on a regular basis followed by any necessary repairs. Leaks are not simply a loss of revenue for a water utility, but the leak is a potential pathway for contamination.

There are various methods for detecting water distribution system leaks. These methods usually involve using sonic leak-detection equipment, which identifies the sound of water escaping a pipe.

Proper Pipe Replacement and Repair

Closely tied to leak detection and asset management is the topic of proper pipe replacement and repair. There are many considerations for repair and replacement of pipes to prevent contamination and subsequent chlorine demand.

- Trained crew, proper technique, appropriate materials, adequate tools
- Follow AWWA Standard C651

<u>Cross-Connection Control and Backflow Prevention Program</u>

Finally, systems should implement a Cross-Connection and Backflow Prevention program. If a system already has a program, it should be reviewed and potentially upgraded. Implementing or upgrading a Cross-Connection and Backflow Prevention Program can prevent the flow of contaminants into a system.

- In PA, it is the responsibility of the customer to eliminate cross-connections and provide backflow devices to prevent contamination of the distribution system from their building/facility. For example, a commercial building with a sprinkler system is required to install and test backflow prevention devices.
- Through local ordinances the water supplier's jurisdiction and enforcement can be established. The water system's program can set customer requirements for cross-connection and backflow prevention at the customer.
- The water system's program should then monitor customer compliance and backflow prevention testing.

Resources and Reference Material for Distribution BMPs:

PA DEP Technical Assistance:

DEP has assistance programs in both distribution system optimization and capability enhancement, as well as the Filter Plant Performance Evaluation (FPPE) program for filter plant optimization. The distribution program can assist systems with distribution analysis, such as tank storage studies. The Capability Enhancement program provides asset management planning assistance and includes an operator outreach program for technical assistance.

More information on these programs can be found at the below link, then click on the appropriate button:

https://www.dep.pa.gov/Business/Water/BureauSafeDrinkingWater/

- DEP Distribution Optimization Program
- DEP Capability Enhancement Program
- Filter Plant Performance Optimization (FPPE) Program

AWWA Manuals and Standards:

The following are available through the AWWA bookstore:
https://www.awwa.org/Publications

- AWWA Manuals of Practice:
  - AWWA M28: Rehabilitation of Water Mains, Third Edition
  - AWWA M68: Water Quality in Distribution Systems
- AWWA Standards:
  - AWWA C651: Disinfecting Water Mains

Key Points

- Reducing DBP formation is dependent on reducing organic precursors through in-plant treatment optimization or reducing contact time between organic material and disinfectant in the distribution system by reducing water age.
- In plant optimization using the multiple barrier approach can be used to focus efforts on each step in the treatment process, including source, oxidation, flocculation, coagulation, sedimentation, filtration, and disinfection.
- The primary goals of distribution system best management practices for disinfectant residuals are to:
    - Reduce chlorine demand
    - Maintain adequate disinfection residual
    - Reduce water age and DBP formation
- Flushing and storage tank management are two potential distribution system BMPs systems can use.
- Other possible BMPs include looping dead ends, disinfectant residual boosting, leak detection, proper pipe repair and replacement, and cross connection controls.

Lesson 5
Operational Evaluation Levels

Lesson Outline

- Define OEL
- Who must calculate OEL (which systems)
- How and when should it be calculated
- How to report an OEL exceedance
- Conducting an Operational Evaluation (OE)

What is the OE?

OE = Operational Evaluation

An OE is initiated by a rising trend of DBP levels found during compliance monitoring.

The purpose of the evaluation is to determine the cause of higher DBPs and reverse the trend, hopefully prior to a violation. The OE examines all parts of the water system to determine what the cause of the elevated DBPs might be. It looks at the source, treatment, storage, and distribution system, then has the water system identify corrective actions.

What is the OEL?

OEL = Operational Evaluation Level.

Exceedance of the OEL is what triggers a water system to have to conduct an OE.

Correcting a DBP problem can take weeks or months, therefore the evaluation must begin before an MCL violation occurs. This is a very important component of the regulation to avoid violations and health issues.

Who has to calculate the OEL?

Any system collecting compliance samples under Stage 2 on a QUARTERLY schedule. This includes:

- Any system on increased monitoring
- Most surface water/GUDI systems on a routine monitoring schedule
- Groundwater systems 10,000 or greater on a routine monitoring schedule
- Surface water/GUDI systems 10,000 or greater on a reduced monitoring schedule
- Groundwater systems 100,000 or greater on a reduced monitoring schedule

Do not rely on DEP to calculate the OEL for you, OEL calculations must be done by the water system for each monitoring location.

How and when to calculate the OEL:

- Once on a quarterly frequency, OEL must be calculated at the end of the 3rd quarter and every quarter thereafter while the water system is on quarterly monitoring.

- The OEL must be calculated for both TTHMs and HAA5s at *each* location by the system **once the sample result is received from the lab**.
- An OEL exceedance occurs if any OEL value is above the MCL value.
- Again, do not wait to do the calculation! If there is an OEL exceedance, there are some deadlines that we'll discuss later in this lesson.

Here is the OEL calculation that is completed at each location:

$$\frac{\text{(Result from the Quarter before the previous quarter + Result from the previous quarter + Current quarter result + Current quarter result)}}{4} = \textbf{OEL}$$

You can see that the equation uses the current quarter of data twice. This is essentially "predicting" that the next quarter will be the same as the current quarter result. This is simply a way to analyze four quarters of data when you only have three quarters of data.

Example: **Site 701**

TTHM				
Location	**2nd Q 2019 (mg/L)**	**3rd Q 2019 (mg/L)**	**4th Q 2019 (mg/L)**	**OEL (mg/L)**
701	0.075	0.078	0.096	0.086

Calculation for Location 701:

(0.075 + 0.078 + 0.096 + 0.096) ÷ 4 = 0.086 mg/L

The OEL result is then compared to the TTHM MCL (0.080 mg/L). You can see that Site 701 exceeds the MCL.

This calculation must be done for HAA5 as well. The OELs are then compared to the HAA5 MCL of 0.060 mg/L.

Remember that compliance is based on the Locational Running Annual Average. Let's assume that for our first example, quarter 1 at location 701 was 0.065 mg/L (TTHM). As you can see, the LRAA calculates to 0.079, which is less than the MCL:

TTHM					
Location	**1st Q 2019 (mg/L)**	**2nd Q 2019 (mg/L)**	**3rd Q 2019 (mg/L)**	**4th Q 2019 (mg/L)**	**LRAA (mg/L)**
701	0.065	0.075	0.078	0.096	0.079

However, the most recent OEL, which looks at quarters 2, 3, and 4 (twice), exceeds the MCL. Now we know the system has a DBP issue and an OE is required.

Rounding Note: Just like in the compliance calculations, the OEL is rounded to the same decimal place as the MCL. Therefore, in the equation above, 0.08175 rounds to 0.082.

Exercise: Here is the data for HAA5 at the same system. Calculate the OEL for sites 701 through 704.

HAA5				
Location	**2nd Q 2019 (mg/L)**	**3rd Q 2019 (mg/L)**	**4th Q 2019 (mg/L)**	**OEL (mg/L)**
701	0.033	0.041	0.050	
702	0.042	0.048	0.055	
703	0.037	0.043	0.046	
704	0.043	0.045	0.052	

HAA5 MCL = 0.060 mg/L

Do any of the locations have an OEL exceedance for HAA5?

What if a location exceeds the OEL?

10 Days

If a location's OEL value exceeds the MCL for either TTHM or HAA5, notify DEP **within 10 days of the end of quarter** in which the OEL was exceeded.

Give DEP the following information:

- Monitoring location
- Date notified of sample result causing exceedance
- Calculated OELs

DEP has a form available for reporting the OEL exceedance to DEP. You may obtain the form electronically from from the eLibrary

- Go to eLibrary: http://www.depgreenport.state.pa.us/elibrary/
- Click "Search" on the top left corner of the screen
- In the box under "Document Number" type: 3930-FM-BSDW0521
- Hit search

90 Days

Conduct an operational evaluation to identify the cause of the exceedance. Submit a report to the DEP (Regional/District Office) **within 90 days *after being notified of the sample* result** that caused the exceedance (not the end of the quarter).

Violation Note: Failure to submit the OE report within 90 days is a violation that requires Tier 3 Public Notice.

OE and Report:

There is a provision for a limited scope evaluation that we will discuss later. First, let's review the full evaluation and report.

Operational Evaluation (OE):

The evaluation must include an examination of the **raw water source, system treatment and distribution practices** that may contribute to TTHM and HAA5 formation.

The OE must also include what steps could be considered to "correct" the issue and minimize future exceedances.

EPA OEL Guidance and Checklists:

Checklists: There are checklists available to help conduct the investigation and find the cause of the elevated DBPs. These are not just paperwork – they are a helpful troubleshooting guide.

- Source Water Evaluation Checklist
- Distribution System Evaluation Checklist
- Treatment Process Evaluation Checklist

The **guidance manual** has more information for each checklist item and can help with follow-up/BMPs.

The checklists and the OEL Guidance Manual are available on DEP's DBP website:

- Conduct a web search for "PA DEP Stage 2"

  Or

- Go to: https://www.dep.pa.gov/Business/Water/BureauSafeDrinkingWater/DrinkingWaterMgmt/Regulations/Pages/Stage-2-DDBP.aspx

Recommended Approach for Conducting an OE:

The OEL guidance document outlines a recommended approach for conducting operational evaluations in a six step process:

Step 1: Confirm Proper Data Collection & Analysis Protocols
Step 2: Review DBP Data at Other Sites
Step 3: Request Limited Scope (if applicable)
Step 4: Conduct OE
Step 5: Identify Steps to Minimize Future OEL Exceedances
Step 6: Prepare and Submit Report

Step 1: Confirm Proper Data Collection & Analysis Protocols

This step is located in section 2.1 in the guidance, EPA recommends confirming that the appropriate methods, sample containers, preservatives, and dechlorinating agents were used and that correct storage guidelines and sample collection guidelines were followed when collecting the samples.

There is a checklist at the end of the section that can be used to ensure that all of the guidelines were met.

You may have to call your lab to confirm that the proper analytical methods were used, or it may be indicated on the sample result report.

Step 2: Review DBP Data at Other Sites

Section 2.2 of the guidance document suggests that water systems review TTHM and HAA5 data at other sites within the distribution system to assess whether the OEL exceedance is a system-wide or localize problem.

If the data review demonstrates that TTHM and HAA5 results are increasing proportionally throughout the distribution system, it probably indicates a source and/or treatment issue and should be considered a system-wide issue. However, if the only elevated levels are at the site which had the OEL exceedance than it is most likely a localized problem.

For more complex systems with multiple water treatment plants, pressure zones, and finished water storage facilities, a hydraulic or water quality model may be needed to determine if the OEL exceedance is a system-wide or localized problem.

Step 3: Request Limited Scope Evaluation – covered under section 2.3

The limited scope evaluation is a less comprehensive evaluation for when a water system can immediately identify the cause of the OEL exceedance

To be eligible for a limited scope evaluation, the water system must be able to determine the cause of the OEL exceedance to DEP's satisfaction.

DEP must approve the limited scope evaluation in writing. The PWS must keep the approval with the completed report.

The request to limit the scope of the evaluation does not extend the due date for submitting the report to DEP so if the limited scope is denied, the PWS must still complete the full operational evaluation and submit the report on time or they will end up with a violation.

This option is not going to be applicable in many cases, so **when should the limited scope option be used?**

Not recommended if this is the first time that the system has completed an operational evaluation because the problem isn't always where or what the PWS expects it to be so it is more beneficial to conduct a full operational evaluation of the system.

A limited scope evaluation may be used if:

- Subsequent OEL exceedance for the system, i.e. it is not the first exceedance or operational evaluation that they have conducted.
- An issue has been identified but corrective actions have not yet taken place.

When completing a limited scope evaluation:

- Use the same OE reporting form that is used when completing a full OE
- Include supporting documentation for a limited scope evaluation
  - Example: If only looking at the distribution system, include distribution checklist and supporting maps, data, etc.

Step 4: Conduct the Operational Evaluation – Covered under section 2.4

As mentioned previously, there are checklists available to help guide water systems through conducting a thorough evaluation in each portion of the water system. These checklists should be used when conducting the evaluation.

Review data representing all three monitoring periods used to calculate the OEL. It cannot be assumed that the monitoring period with the highest TTHM or HAA5 level "caused" the exceedance. It is possible that a previous quarter was higher indicating an issue that has been ongoing for more than just one quarter.

If multiple sources and/or treatment facilities provide finished water to the distribution system, you may focus on the source(s) and treatment facility that provides water to the area of the distribution system with the elevated levels of DBPs.

Detailed guidance on how to conduct evaluations in each portion of the water system are provided in the guidance document under the following chapters:

- Chapter 3: Distribution System Evaluation
- Chapter 4: Treatment Process Evaluation
- Chapter 5: Source Water Evaluation

Each evaluation requires use of available water quality and operational data

- Examples: Temperature, pH, disinfectant residual, TOC, turbidity, alkalinity, customer complaints

Step 5: Identify Steps to Minimize Future OEL Exceedances – covered under section 2.5

As part of the operational evaluation, the water system is required to identify steps to minimize future exceedances

Steps may include changes to all or just one portion of the water system depending the issues that were discovered, for example, there may be changes needed to both treatment and the distribution system.

Chapter 6 of the guidance document provides guidance to water systems in determining best management practices and other operational changes that will minimize future OEL exceedances. Many of which we discussed in lesson 3 of this training.

Step 6: Prepare and Submit Report – covered under section 2.6

As we discussed earlier, the water supplier must submit the written report to DEP within 90 days after being notified of the result that caused the OEL exceedance.

Water systems can use the Operational Evaluation Reporting Form that is found on the DEP Stage 2 Website.

In addition, the report must:

- Be made available to the public upon request
- Include results of examining the distribution, treatment and source water operational practices
- Include steps that could be considered to minimize future OEL exceedances

Example Case:

- Elm City Water Department: Pineville Neighborhood Exceedance
- Large surface water system that is required to collect 8 DBPs samples per quarter
- Exceeded TTHM OEL at location #2 (702) in the Pineville neighborhood. The calculation was done after the 6/03/19 sample result was obtained.
- An OEL exceedance has not occurred at this location in the past. No other sampling locations exceeded the OEL based on the June results.
- They cannot immediately determine the cause of the exceedance, so the system must conduct a full evaluation.

The next several pages contain a full evaluation report for the Elm City system exceedance in the Pineville neighborhood. The report includes:

- Operational Evaluation Reporting Form
  - Complete using information gathered from checklists
- Detailed description of suspected issue(s)
- Proposed corrective action(s) to minimize future exceedances
- Completed checklists (source, treatment and distribution)

This represents a complete OE submission expected by DEP

Questions to consider while we are reviewing the report:

In what portion of the water system did Elm City determine the problem was?

Source Water?

Treatment?

Distribution?

Did they determine the cause of the OEL exceedance?

What was the cause of the OEL exceedance?

How do they plan to minimize future exceedances?

Operational Evaluation Reporting Form

I. GENERAL INFORMATION

A. Facility Information

Facility Name: **Elm City Water Department** PWSID: **0123456**

Facility Address: **34561 East St.**

City: **Elm City** State: **PA** Zip: **12345**

B. Report Prepared by:

(Print): **Flo Pace** Date prepared: **June 22, 2019**

(Signature): *Flo Pace*

Contact Telephone Number: **111-222-3344**

II. MONITORING RESULTS

A. Provide the Compliance Monitoring Site(s) where the OEL was Exceeded.

Stage 2 Monitoring Location 702: Pineville Neighborhood

Note: The site name or number should correspond to a site in your Stage 2 DBPR compliance monitoring plan.

B. Monitoring Results for the Site(s) Identified in II.A (include duplicate pages if there was more than one exceedance)

1. Check TTHM or HAA5 to indicate which result caused the OEL exceedance. ☑ TTHM ☐ HAA5
2. Enter your results for TTHM or HAA5 (whichever you checked above).

	Quarter			Operational Evaluation Value
	Results from Two Quarters Ago	Prior Quarter's Results	Current Quarter	
	A	B	C	D = (A+B+(2*C))/4
Date sample was collected	**12/3/2018**	**03/03/2019**	**06/03/2019**	
TTHM (mg/L)	**0.065**	**0.072**	**0.098**	**0.083**
HAA5 (mg/L)				

Note: *The operational evaluation value is calculated by summing the two previous quarters of TTHM or HAA5 values plus twice the current quarter value, divided by four. If the value exceeds 0.080 mg/L for TTHM or 0.060 mg/L for HAA5, an OEL exceedance has occurred.*

C. Has an OEL exceedance occurred at this location in the past?	☐ Yes	☑ No
If NO, proceed to section III. If YES, when did exceedance occur?		
Was the cause determined for the previous exceedance(s)?	☐ Yes	☐ No
Are the previous evaluations/determinations applicable to the current OEL exceedance?	☐ Yes	☐ No

Operational Evaluation Reporting Form

III. OPERATIONAL EVALUATION FINDINGS

A. Did the State allow you to limit the scope of the operational evaluation? ☐ Yes ☑ No

If NO, proceed to item B. If YES, attach written correspondence from the State.

B. Did **the distribution system** cause or contribute to your OEL exceedance(s)? ☑ Yes ☐ No ☐ Possibly

If NO, proceed to item C. If YES or POSSIBLY, explain (attach additional pages if necessary):

See attachment III.B.

C. Did the **treatment** system cause or contribute to your OEL exceedance(s)? ☐ Yes ☑ No ☐ Possibly

If NO, proceed to item D. If YES or POSSIBLY, explain (attach additional pages if necessary):

D. Did **source water quality** cause or contribute to your OEL exceedance(s)? ☐ Yes ☑ No ☐ Possibly

If NO, proceed to item E. If YES or POSSIBLY, explain (attach additional pages if necessary):

E. Attach all supporting operational or other data that support the determination of the cause(s) of your OEL exceedance(s).

F. If you are unable to determine the cause(s) of the OEL exceedance(s), list the steps that you can use to better identify the cause(s) in the future (attach additional pages if necessary):

G. List steps that could be considered to minimize future OEL exceedances (attach additional pages if necessary)

See attachment III.G.

H. Total **Number of Pages** Submitted, Including Attachments and Checklists: **12**

Attachments

III.B. Changes in the Distribution System

A main break in the Pineville neighborhood occurred on June 2, 2019, early in the morning. The system pressure in the vicinity of the main break dropped to 30 psi, which is significantly below the normal pressure range for that area (50-60 psi). SCADA data indicated that rapid drawdown from the Pineville tank began on June 3, 2019, at 5 am. The water level in the tank dropped to a hydraulic grade of 80 feet at 7 am. The normal minimum hydraulic grade for the tank is 115 feet as determined from historic SCADA data for the tank. It is anticipated that the rapid and excessive drawdown was due to the main break and subsequent pressure drop in the region. The tank did not refill prior to the morning peak demand period (7 am to 9 am), and the water level dropped to 70 feet during this period, as evident from the SCADA data.

The DBP sampling at monitoring site # 702 was conducted on June 3 at 10 am. The city's hydraulic model was used to predict whether a significant portion of the water at that site originated from the Pineville tank. A main break was simulated and the pressures in the surrounding areas were within 5 psi of what was observed on June 3, 2019, in the early morning. The results from the model indicated that a significant portion of the water at monitoring site # 702 originated from the Pineville tank during the morning hours of June 3.

The Pineville elevated tank has a large diameter inlet (36-inch) at the base of the tank. When the tank supplies water during normal conditions, water comes from the bottom portion of the tank where the turnover is expected to be good and water age is expected to be relatively low. However, during the main break that resulted in pressure loss in the vicinity of monitoring site # 702, water was introduced into the area from the top portion of that tank. It is anticipated that the top portion of the tank remains relatively unmixed and therefore has high water age and DBP levels.

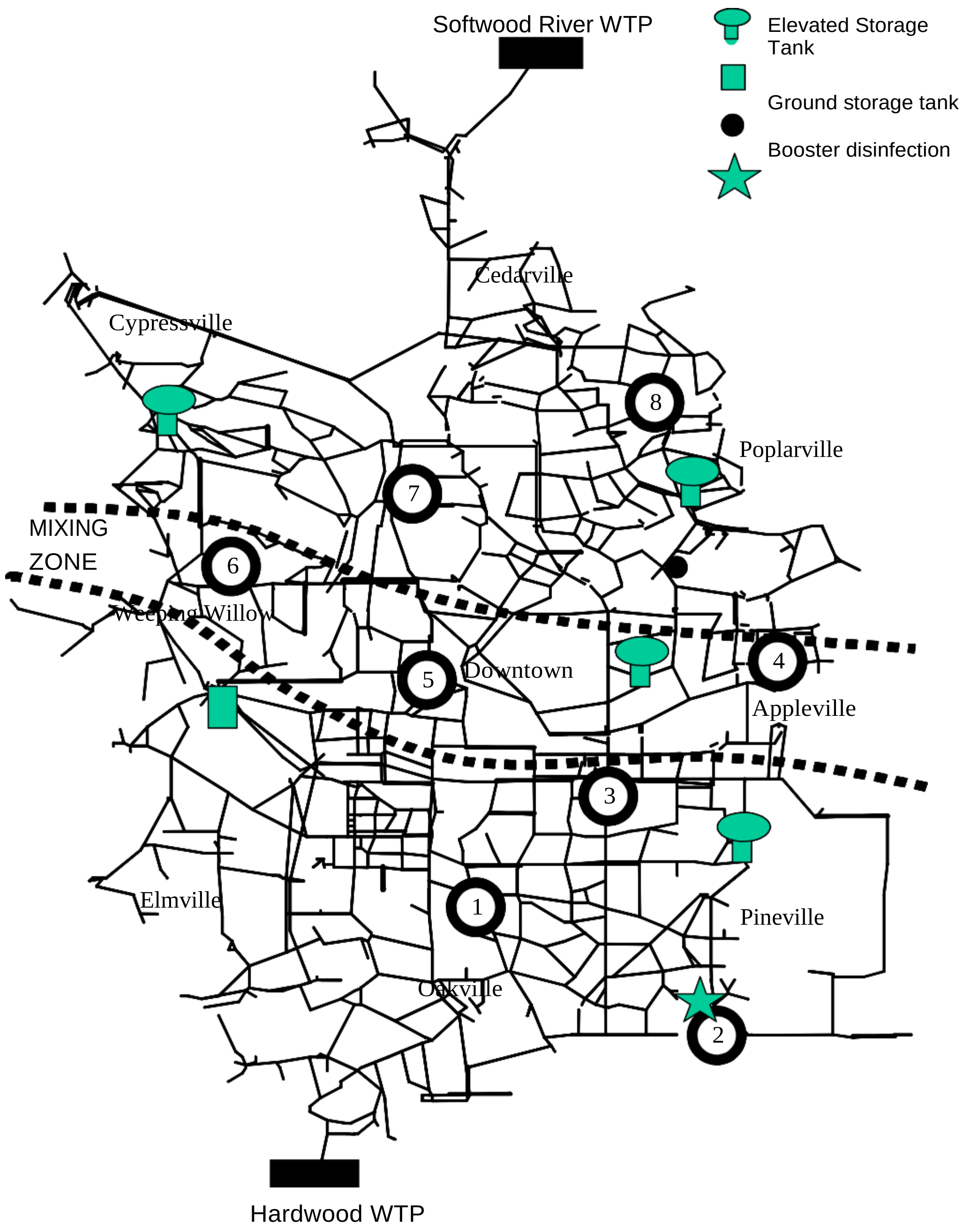
The following data are attached to support the conclusion stated above:

1. Schematic of distribution system map
2. SCADA data for Pineville tank level from May 3, 2019, to June 4, 2019 *(not included as part of this example)*
3. Results from hydraulic model indicating contribution of Pineville tank water to monitoring site # 2 *(not included as part of this example)*

III.G. Minimizing Future Exceedances

The water turnover in the top portion of Pineville tank needs to be improved to minimize water age and DBP formation in that part of the tank so that high DBP levels are not introduced into the distribution system. We plan to reduce the inlet diameter to increase the inlet velocity. The water jet will then reach the top portion of the tank and mix the stored water in that portion of the tank. Computational fluid dynamic modeling for the tank indicated that under current inflow rate conditions, the inlet pipe diameter needs to be 12-inches to produce a water jet sufficient enough to reach the top portion of the tank.

System Schematic



Distribution System Evaluation Checklist

System Name: Elm City Water Dept.

Checklist Completed by: Flo Pace   Date: June 22, 2019

A. Do you have disinfectant residual or temperature data for the monitoring location where you experienced the OEL exceedance? ☑ Yes ☐ No

If NO, proceed to item B. If YES, answer the following questions for the period in which an OEL exceedance occurred:

Yes	No	
☐	☑	Was the water temperature higher than normal for that time of the year at that location?
☐	☑	Was the disinfectant residual lower than normal for that time of the year at that location?
☐	☑	Was the disinfectant residual higher than normal for that time of the year at that location?

B. Do you have maintenance records available for the time period just prior to the OEL exceedance? ☑ Yes ☐ No

If NO, proceed to item C. If YES, answer the following questions:

Yes	No	
☑	☐	Did any line breaks or replacements occur in the vicinity of the exceedance?
☐	☑	Were any storage tanks or reservoirs taken off-line and cleaned?
☐	☑	Did flushing or other hydraulic disturbances (e.g., fires) occur in the vicinity of the exceedance?
☐	☑	Were any valves operated in the vicinity of the OEL exceedances?

C. If your system is metered, do you have access to historical records showing water use at individual service connections? ☑ Yes ☐ No

If NO, proceed to item D. If YES, was overall water use in your system unusually low, indicating higher than normal water age? ☐ Yes ☑ No

D. Do you have high-volume customers in your system (e.g., an industrial processing plant)? ☑ Yes ☐ No

If NO, proceed to item E. If YES, was there a change in water use by a high-volume customer? ☐ Yes ☑ No

E. Is there a finished water storage facility hydraulically upstream from the monitoring location where you experienced the OEL exceedance? ☑ Yes ☐ No

If NO, proceed to item F. If YES, review storage facility operations and water quality data to answer the following questions for the period in which the OEL exceedance occurred:

Yes	No	
☐	☑	Was a disinfectant residual detected in the stored water or at the tank outlet?
☑	☐	Do you know of any mixing problems with the tank or reservoir?
☑	☐	Does the facility operate in “last in-first out” mode?
☑	☐	Was the tank or reservoir drawn down more than usual prior to OEL exceedance, indicating a possible discharge of stagnant water?
☐	☑	Was there a change in water level fluctuations that would have resulted in increased water age within the tank or reservoir?

F. Does your system practice booster chlorination? ☐ Yes ☑ No

If NO, proceed to item G. If YES, was there an increase in booster chlorination feed rates? ☐ Yes ☐ No

G. Did you have customer complaints in the vicinity of the OEL exceedance? ☑ Yes ☐ No

If NO, proceed to item H. If YES, explain.

There were complaints of low water pressure in the vicinity.

H. Did concern about complying with a rule other than Stage 2 DBPR, such as the Lead and Copper rule, the TCR, or any other rule constrain your options to reduce the DBP levels at this site? For example, are you limited by the need to maintain a detectable disinfectant residual in your ability to control DBP levels in the distribution system? ☐ Yes ☑ No

If NO, proceed to item I. If YES, explain below and consult EPA's *Simultaneous Compliance Guidance Manual* for alternative compliance approaches.

I. Conclusion

Did the distribution system cause or contribute to the OEL exceedance(s)? ☑ Yes ☐ No ☐ Possibly

If NO, proceed to evaluations of treatment systems and source water. If YES or POSSIBLY, explain below.

A main break caused a sudden decrease in Pineville tank water levels. Model results indicate the main break and associates pressure loss caused high age water from the tank to flow into the distribution system.

Treatment Process Evaluation Checklist

☐ **NO DATA AVAILABLE**

Facility Name: **Elm City Water Treatment Plant**

Checklist Completed by: **Flo Pace** Date: **June 22, 2019**

A. Review finished water data for the time period prior to the OEL exceedance(s) and compare to historical finished water data using the following questions:

	Yes	No
Were DBP precursors (TOC, DOC, SUVA, bromide, etc.) higher than normal?	☐	☑
Was finished water pH higher or lower than normal?	☐	☑
Was the finished water temperature higher than normal?	☐	☑
Was finished water turbidity higher than normal?	☐	☑
Was the disinfectant concentration leaving the plant(s) higher than normal?	☐	☑
Were finished water TTHM/HAA5 levels higher than normal?	☐	☑
Were operational and water quality data available to the system operator for effective decision making?	☑	☐

B. Does the treatment process include predisinfection? ☐ Yes ☑ No

If NO, proceed to item C. If YES, answer the following questions for the period in which an OEL exceedance occurred:

Yes	No	
☐	☐	Was disinfected raw water stored for an unusually long time?
☐	☐	Were treatment plant flows lower than normal?
☐	☐	Were treatment plant flows equally distributed among different trains?
☐	☐	Were water temperatures high or warmer than usual?
☐	☐	Were chlorine feed rates outside the normal range?
☐	☐	Was a disinfectant residual present in the treatment train following predisinfection?
☐	☐	Were online instruments utilized for process control?
☐	☐	Did you switch to free chlorine as the oxidant?
☐	☐	Was there a recent change (or addition) of pre-oxidant?
☐	☐	Did you change the location of the predisinfection application?

C. Does your treatment process include presedimentation? ☐ Yes ☑ No

If NO, proceed to item D. If YES, answer the following questions for the period in which an OEL exceedance occurred:

Yes	No	
☐	☐	Were flows low?
☐	☐	Were flows high?
☐	☐	Were online instruments utilized for process control?
☐	☐	Was sludge removed from the presedimentation basin?
☐	☐	Was sludge allowed to accumulate for an excessively long time?
☐	☐	Do you add a coagulant to your presedimentation basin?
☐	☐	Was there a problem with the coagulant feed?

Treatment Process Evaluation Checklist

D. Does your treatment process include coagulation and/or flocculation? ☑ Yes ☐ No

If NO, proceed to item E. If YES, answer the following questions for the period in which an OEL exceedance occurred:

Yes	No	
☐	☑	Were there any feed pump failures or were feed pumps operating at improper feed rates?
☑	☐	Were chemical feed systems controlled by flow pacing?
☐	☑	Were there changes in coagulation practices or the feed point?
☐	☑	Did you change the type or manufacturer of the coagulant?
☐	☑	Do you suspect that the coagulant in use at the time of the OEL exceedance did not meet industry standards?
☐	☑	Did the pH or alkalinity change at the point of coagulant addition?
☐	☑	Were there broken or plugged mixers?
☐	☑	Were flow rates above the design rate or was there short-circuiting?

E. Does your treatment process include sedimentation or clarification? ☑ Yes ☐ No

If NO, proceed to item F. If YES, answer the following questions for the period in which an OEL exceedance occurred:

Yes	No	
☐	☑	Were there changes in plant flow rate that may have resulted in a decrease in settling time or carry-over of process solids?
☐	☑	Were settled water turbidities higher than normal?
☐	☑	Was there any disruption in the sludge blanket that may have resulted in carryover to the point of disinfection?
☐	☑	Was there any maintenance in the basin that may have stirred sludge from the bottom of the basin and caused it to carry over to the point of disinfectant addition?
☐	☑	Was sludge allowed to accumulate for an excessively long time or was there a malfunction in the sludge removal equipment?

Treatment Process Evaluation Checklist

F. Does your treatment process include filtration? ☑ Yes ☐ No

If NO, proceed to item G. If YES, answer the following questions for the period in which an OEL exceedance occurred:

Yes	No	
☐	☑	Was there an increase in individual or combined filter effluent turbidity or particle counts?
☐	☑	Was there an increase in turbidity or particle loading onto the filters?
☐	☑	Was there an increase in flow onto the filters or malfunction of the rate of flow controllers?
☐	☑	Were any filters taken off-line for an extended period of time that caused the other filters to operate near maximum design capacity and creating the conditions for possible breakthrough?
☐	☑	Were any filters operated beyond their normal filter run time?
☐	☑	Were there any unusual spikes in individual filter effluent turbidity (which may indicate particulate or colloidal TOC breakthrough) in the days leading to the excursion?
☑	☐	Were all filters run in a filter-to-waste mode during initial filter ripening?
☐	☐	If GAC filters are used, is it possible the adsorptive capacity of the GAC bed was reached before reactivation occurred (leave blank if not applicable)?
☐	☐	If biological filtration is used, were there any process upsets that may have resulted in the breakthrough of TOC (leave blank if not applicable)?

G. Does your treatment process include primary disinfection by injecting chlorine prior to a clearwell? ☑ Yes ☐ No

If NO, proceed to item H. If YES, answer the following questions for the period in which an OEL exceedance occurred:

Yes	No	
☐	☑	Was there a sudden increase in the amount of chlorine fed or an increase in the chlorine residual?
☐	☑	Was there an increase in clearwell holding time?
☐	☑	Was the plant shut down or were plant flows low?
☐	☑	Was there an increase in clearwell water temperature?
☐	☑	Did you switch to free chlorine recently as the primary disinfectant?
☐	☑	Was the inactivation of *Giardia* and/or viruses exceptionally high?
☐	☑	Was there a change in the mixing strategy (i.e. mixers not used, adjustment of tank level)?

H. Does your plant recycle spent filter backwash or other streams? ☐ Yes ☑ No

If NO, proceed to item I. If YES, answer the following questions for the period in which an OEL exceedance occurred:

Yes	No	
☐	☐	Did a change in the recycle stream quality contribute to increased DBP precursor loading that was not addressed by treatment plant processes?
☐	☐	Did a recycle event result in flows in excess of typical or design flows?

I. Do you inject a disinfectant after your clearwell to maintain a distribution system residual? ☑ Yes ☐ No

If NO, proceed to item J. If YES, answer the following questions for the period in which an OEL exceedance occurred:

Yes	No	
☐	☑	Was there a sudden increase in the amount of chlorine fed?
☐	☑	Was there a switch from chloramines to free chlorine for a burnout period?
☐	☐	If using chloramines, was the chlorine to ammonia ratio in the proper range?
☐	☑	Was there a problem with either chlorine or ammonia mixing?

J. Did concern about complying with a rule other than Stage 2 DBPR, such as the Lead and Copper rule, the LT2ESWTR, or any other rule constrain your options to reduce the DBP levels at this site? For example, are you limited by other treatment targets/requirements in your ability to control precursors in coagulation/flocculation? ☐ Yes ☑ No

If NO, proceed to item K. If YES, explain below and consult EPA's *Simultaneous Compliance Guidance Manual* for alternative compliance approaches.

K. Conclusion

Did treatment factors and/or variations in the plant performance contribute to the OEL exceedance(s)? ☐ Yes ☑ No ☐ Possibly

If YES or POSSIBLY, explain below.

Source Water Evaluation Checklist

☐ **NO DATA AVAILABLE**

System Name: **Elm City Water Dept.**

Checklist Completed by: **Flo Pace** Date: **June 22, 2019**

A. Do you have source water temperature data? ☑ Yes ☐ No

If NO, proceed to item B. If YES, was the source water temperature high? ☐ Yes ☑ No

If NO, proceed to item B. If YES, answer the following questions for the time period prior to the OEL exceedance.

Yes	No	
☐	☐	Was the raw water storage time longer than usual?
☐	☐	Did you place another water source on-line?
☐	☐	Were river/reservoir flow rates lower than usual? If yes, indicate the location of lower flow rates and the anticipated impact on the OEL exceedance.
☐	☐	Did point or non-point sources in the watershed contribute to the OEL exceedance?

B. Do you have data that characterizes organic matter in your source water (e.g., TOC, DOC, SUVA, color, THM formation potential)? ☑ Yes ☐ No

If NO, proceed to item C. If YES, were these values higher than normal? ☐ Yes ☑ No

If NO, proceed to item C. If YES, answer the following questions for the time period prior to the OEL exceedance.

Yes	No	
☐	☐	Did heavy rainfall or snowmelt occur in the watershed?
☐	☐	Did you place another water source on-line?
☐	☐	Did lake or reservoir turnover occur?
☐	☐	Did point or non-point sources in the watershed contribute to the OEL exceedance?
☐	☐	Did an algal bloom occur in the source water?
☐	☐	If algal blooms were present, were appropriate algae control measures employed (e.g., addition of copper sulfate)?
☐	☐	Did a taste and odor incident occur?

C. Do you have source water bromide data? ☐ Yes ☑ No

If NO, proceed to item D. If YES, were the bromide levels higher or lower than normal? ☐ Yes ☐ No

If NO, proceed to item D. If YES, answer the following questions for the time period prior to the OEL exceedance.

Yes	No	
☐	☐	Has saltwater intrusion occurred?
☐	☐	Are you experiencing a long-term drought?
☐	☐	Did heavy rainfall or snowmelt occur in the watershed?
☐	☐	Did you place another water source on-line?
☐	☐	Are you aware of any industrial spills in the watershed?

Source Water Evaluation Checklist

D. Do you have source water turbidity or particle count data? ☑ Yes ☐ No

If NO, proceed to item E. If YES, were the turbidity values or particle counts higher than normal? ☐ Yes ☑ No

If NO, proceed to item E. If YES, answer the following questions for the time period prior to the OEL exceedance.

Yes	No	
☐	☐	Did lake or reservoir turnover occur?
☐	☐	Did heavy rainfall or snowmelt occur in the watershed?
☐	☐	Did logging, fires, or landslides occur in the watershed?
☐	☐	Were river/reservoir flow rates higher than normal?

E. Do you have source water pH or alkalinity data? ☑ Yes ☐ No

If NO, proceed to item F. If YES, was the pH or alkalinity different from normal values? ☐ Yes ☑ No

If NO, proceed to item F. If YES, answer the following questions for the time period prior to the OEL exceedance.

Yes	No	
☐	☐	Was there an algal bloom in the source water?
☐	☐	If algal blooms were present, were algae control measures employed?
☐	☐	Did heavy rainfall or snowmelt occur in the watershed?
☐	☐	Has the PWS experienced diurnal pH changes in source water?

F. Conclusion

Did source water quality factors contribute to your OEL exceedance? ☐ Yes ☑ No ☐ Possibly

If YES or POSSIBLY, explain below.

____

____

____

____

____

Consecutive Systems:

If you are a consecutive system and purchase all of your water, the operational evaluation should focus on the distribution system.

- Consecutive systems should consider collecting TTHM and HAA5 data at the wholesale connection point (e.g., master meter, intertie, turnout, etc.). Knowledge of the concentration of these DBPs at the entry point to the system will help assess how they change (i.e., increase or decrease) within the system.

Compliance

An OEL exceedance ***is not*** a violation of the Stage 2 DBP Rule. However, failure to submit an OE report to the State within 90 days is a violation and require Tier 3 public notice (as required by the Public Notification Rule).

Additional Tools:

Water Quality Assessment Software:

Located on DEP's Stage 2 website, this is a spread sheet that can help the water supplier to track and trend DBP data, it also includes a calculation for the OEL.

CT and Chlorine Demand Spreadsheet:

This spreadsheet can help water systems determine what residual they need to maintain CTs, it is very possible that at some water systems who are having DBP issues they are overfeeding chlorine. This is available on DEP's disinfectant residual rule (DRR) website.

Key Points

- OEL must be calculated by any water system on quarterly monitoring under Stage 2
- OEL must be calculated by water system for TTHM & HAA5 at each monitoring location
- If OEL exceeds MCL:
  - Notify DEP within 10 days from end of quarter in which exceedance occurred.
  - Conduct an operational evaluation and submit report to DEP within 90 days of being notified of result causing OEL exceedance.
- Use EPA checklists and guidance manual to help evaluate why the exceedance occurred. The checklists and associated attachments may serve as the report.