DISINFECTANTS AND DISINFECTION BYPRODUCTS RULES





COMMON TERMINOLOGY

- DBP(R) Disinfection Byproduct (Rule)
- TTHM Total Trihalomethanes
- HAA5 Total Haloacetic Acids
- MCL Maximum Contaminant Level
- MCLG Maximum Contaminant Level Goal
- MRT Maximum Residence Time

MRDL – Maximum Residual Disinfectant Levels

- MRDLG Maximum Residual Disinfectant Level Goal
- NOM Natural Organic Matter
- TOC Total Organic Carbon
- OEL Operational Evaluation Level

LONG TERM HEALTH EFFECTS

- Disinfectants
 - Chlorine Irritating effects to eyes and nose and stomach discomfort
 - Chloramines Irritating effects to eyes and nose, stomach discomfort, or anemia
 - Bromate Increased risk of cancer
 - Chlorine dioxide Anemia; infants and young children: nervous system effects
- Disinfection Byproducts
 - TTHMs Liver, kidney or central nervous system problems; increased risk of cancer
 - HAA5s Increased risk of cancer
 - Bromate Increased risk of cancer
 - Chlorite Anemia; infants and young children: nervous system effects

HOW DO WE GET DBPS

- Disinfectants
 - Chlorine (Cl2; gas or liquid form)
 - Chloramines (NH₂Cl;Ammonia (NH3) + Chlorine (Cl₂))
 - Chlorine dioxide (ClO₂)
 - $Ozone^*(O_3)$
- Disinfection Byproducts (DBPs)
 - Trihalomethanes (TTHM)
 - Haloacetic Acids (HAA5)
 - Chlorite (ClO_2^{-})
 - Bromate (BrO₃⁻)

*Does not provide a measurable disinfectant residual , so must be used in with another disinfectant

DBP FORMATION

DBP's are formed during water treatment, and are affected by several water quality factors:

- Natural organic matter (TOC)
- quantity of disinfectant added
- contact time
- temperature
- pH

Natural Organic Matter + $Cl_2 \rightarrow DBPs$

WHERE ARE DBPs FORMED?



TTHM concentrations are highest in water that has <u>resided in the</u> <u>distribution system the longest</u>.

More organic matter in the source water can result in a higher chlorine demand to maintain a reliable residual throughout the distribution system. The pH in a distribution system also affects disinfection byproduct (DBP) concentrations. In general,TTHM formation increases with increasing pH.

WHERE ARE DBPs FORMED?



HAA5 formation and decomposition seems to follow a pattern that is *different* than that of TTHM in the distribution system.

New research suggests that HAA5 seem to <u>form and then decompose</u> in systems with biological activity (biofilm). As a result, maximum residence times (MRTs) do not necessarily have the highest concentrations of HAA5.

NUMBER OF DBP SITES BY MONTH



WATER SYSTEMS IN NONCOMPLIANCE



D/DBP RULES: HISTORY

- The National Primary Drinking Water Regulations (1979) set standard MCL for TTHMs only.
- Stage I (1998) built upon that standard by lowering the MCL for TTHMs, introducing the MCL for HAA5s, and widening the range of affected systems to include all CWS and NTNCWSs.
- Stage II (2006) built upon Stage I by identifying more appropriate monitoring sites based on new information, and further improved protection of the public from DBP exposure by reevaluating compliance calculations.

• TTHM and HAA5 MCLs and Reporting

Disinfection Byproducts	MCL		
TTHM	0.080 mg/L (80 ppb)		
HAA5	0.060 mg/L (60 ppb)		
* MCL = the maximum allowable concentration of a contaminant			

in the water

- Total Trihalomethanes
 - Chloroform
 - Bromoform
 - Dibromochloromethane
 - Bromodichloromethane

- Haloacetic Acids
 - Monochloroacetic Acid
 - Dichloroacetic Acid
 - Trichloroacetic Acid
 - Monobromoacetic Acid
 - Dibromoacetic Acid

• Chlorite and Bromate MCLs, Monitoring and Reporting

Disinfection Byproducts	MCL
Bromate (Ozone)	0.010 mg/L (10 ppb)*
Chlorite (Chlorine Dioxide)	1.0 mg/L**
 * Based on a running annual average ** Based on monthly average of 3 DS samples 	

- Chlorite Daily (EP) and monthly (DS) monitoring
- Bromate monthly (EP) monitoring
- Report results to OPH <u>District</u> Office

Disinfectant MRDLs, Monitoring and Reporting (chlorine, chloramines, and chlorine dioxide)

Disinfectant	MRDL		
Chlorine	4.0 mg/L*		
Chloramines	4.0 mg/L*		
Chlorine Dioxide	0.8 mg/L		
*Based on a running annual average (RAA)			

- Chlorine/chloramine residuals monitor monthly at same time and location as bacteriological collection sites for RTCR; report on the lab8 form; and submit a RAA on a quarterly basis if one residual exceeds 4.0 mg/L in the DS
- Chlorine dioxide monitor daily at entry point (EP) to distribution system; 3 sample set in DS required if EP exceeds MRDL; report monthly
- Report the disinfectant results to OPH District Office

- TOC Removal, Monitoring and Reporting for surface water systems
 - Meeting one of the Alternative Compliance Criteria or use Step 1 Removals (below) or Step 2 Jar testing

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

- Monthly monitoring at source and after treatment
- Report TOC and alkalinity certified results to OPH District Office

STAGE 2 DISINFECTANTS AND DISINFECTION BYPRODUCTS RULE OVERVIEW OF MAIN REQUIREMENTS



May 2018

STAGE 2 DBP RULE

- Affects all community and non-transient noncommunity water systems that disinfect (includes consecutive systems)
- Purpose of the rule:

Reduce the peak TTHM and HAA5 levels at <u>individual sites</u> in distribution system.



STAGE 2 DBPR: CHANGES

Stage I DBPR

Running Annual Average:



compliance based on a system-wide average of all results for all sites over 4 quarters

Stage 2 DBPR

Locational Running Annual Average:

compliance based on the average of <u>each site</u> over 4 quarters

*Can NOT use results from different sites to change the average

WHAT'S NEW FOR STAGE 2 COMPLIANCE MONITORING?

The major requirements include:

- Changes in monitoring frequency and locations
- Locational Running Annual Average (LRAA) calculation to determine compliance
- Identifying when TTHM and HAA5 levels exceed the Operational Evaluation Level (OEL)

STAGE 2 MONITORING REQUIREMENTS: GROUND WATER

Source Type	Dopulation	Compliance	Monitoring
Source Type	Population	FREQ ¹	TOTAL ²
GW or GWP	<500	Peak Month	2 sites
GW or GWP	500 – 9,999	Peak Month	2 sites
GW or GWP	10K – 99,999	Every 90 Days	4 sites
GW or GWP	100K – 499,999	Every 90 Days	6 sites
GW or GWP	<u>></u> 500K	Every 90 Days	8 sites

¹All systems must monitor during month of highest DBP concentrations. ²All systems must take <u>a dual sample set</u> (TTHM and HAA5) at each site.

STAGE 2 MONITORING REQUIREMENTS: SURFACE WATER

	Population	Compliance Monitoring		
Source Type	Population	FREQ ¹	TOTAL ²	
SW or SWP	<500	Peak Month	2 sites	
SW or SWP	500 – 3,300	Every 90 Days	2 sites	
SW or SWP	3,301 – 9,999	Every 90 Days	2 sites	
SW or SWP	10K – 49,999	Every 90 Days	4 sites	
SW or SWP	50K – 249,999	Every 90 Days	8 sites	
SW or SWP	250K – 999,999	Every 90 Days	12 sites	

¹All systems must monitor during month of highest DBP concentrations. ²All systems must take <u>a dual sample set</u> (TTHM and HAA5) at each site.

STAGE 2 DPBR SAMPLE SITES

- Most systems will monitor at their Stage 1 site if its still the MRT site (oldest water) to represent the highest TTHMs
- Most systems will monitor at the distribution system midpoint where the chlorine residual is stable to represent the highest HAA5
- If the distribution system (service area) increases in size, the MRT location may change and the Stage 2 CMP will need to be updated.

*Sample site changes must be approved prior to monitoring

INCREASED MONITORING

For Water Systems on Reduced or Routine Monitoring;

Increase sampling frequency to **every 90 days** and to **dual sampling** at all sites when ANY of the following happens:

- Any TTHM sample > 0.080 mg/L or HAA5 sample > 0.060 mg/L at any location.
- Any source water annual average TOC level, before any treatment,
 >4.0 mg/L at any treatment plant.

In order for a water system to return to Routine Monitoring:

For <u>four consecutive quarters</u> the LRAA for every monitoring location is ≤0.060 mg/L for TTHM and ≤0.045 mg/L for HAA5 (3/4 the MCL)

REDUCED MONITORING QUALIFICATIONS

After the first year of Stage 2 compliance monitoring;

• Systems qualify if LRAAs at <u>all</u> monitoring locations are:

\leq 0.040 mg/L for TTHM, and \leq 0.030 mg/L for HAA5

- Surface water or GUDI systems must also have TOC levels < 4.0 mg/L in source water at each treatment plant
 - Systems must sample for TOC every 30 days to qualify for reduced monitoring

REMAINING ON STAGE 2 DBPR REDUCED MONITORING

- Systems on quarterly reduced monitoring
 - All sites LRAAs for TTHMs and HAA5 must be < 0.040 mg/L and 0.030 mg/L, respectively (half MCL)
- Systems on annual or less frequent monitoring
 - All samples for TTHMs and HAA5 must be \leq 0.060 mg/L and 0.045 mg/L, respectively (3/4 MCL)

 Surface water or GUDI systems must monitor TOC levels every 90 days and maintain annual average levels of <a> 4.0 mg/L in source water at each treatment plant

APPLICATION FOR REDUCED MONITORING

- The system must submit a <u>written request</u> to go to reduced monitoring along with a table showing the last four quarters of results and the calculated LRAA for each site.
- The system's request should include the suggested sites and monitoring period. LDH will review the request and either edit the request, approve, or deny.
- The State may return the system to routine monitoring at the State's discretion.

STAGE 2 REDUCED MONITORING REQUIREMENTS: GROUND WATER

Population Size Category	Monitoring Frequency	Monitoring Locations	
< 500	Every 3 rd year	2 sites ¹ - take individual TTHM and HAA5 samples	
500 – 9,999	Once per year during	<u>or</u> I site – take dual sampl set	
10,000 – 99,999	concentration	2 sites – take dual sample sets	
100,000 – 499,999	Every 90 days	2 sites – take dual sample sets	

¹ System is required to take individual TTHM and HAA5 samples (instead of a dual sample set) at the locations with the highest TTHM and HAA5 concentration, respectively.

STAGE 2 REDUCED MONITORING REQUIREMENTS: SURFACE WATER

Population Size Category	Monitoring Frequency	Monitoring Locations
< 500		2 sites ¹ - take individual TTHM and HAA5 samples
500 – 3,300	Once per year during month of highest DBP concentration	<u>or</u> I site – take dual sample set
3,301 – 9,999		2 sites – take dual sample sets

¹ System is required to take individual TTHM and HAA5 samples (instead of a dual sample set) at the locations with the highest TTHM and HAA5 concentration, respectively.

STAGE 2 REDUCED MONITORING REQUIREMENTS: SURFACE WATER

Population Size Category	Monitoring Frequency	Monitoring Locations
10,000 – 49,999		2 – take dual sample sets
50,000 – 249,999	Every 90 days	4 – take dual sample sets
250,000 – 999,999		6 – take dual sample sets

EXAMPLE: CALCULATE LRAA

Sample Site	Jul 3Q17	Oct 4Q17	Jan 1Q18	Apr 2Q18	TTHM LRAA	Violation (Yes/No)
Site A			50		50	YES
Site B	20	31	60	45	39	*Any site
Site C	120	105	95	65	96 *	based on
Site D	50		95	100	82 *	LRAA means violation

TTHM MCL = 80 ppb

 $mg/L = ppm \quad \mu g/L = ppb$

MCL AND OEL VALUES

- MCL Compliance is determined on the LRAA of each site (Minimum 4 quarters) – Notice of Violation will be sent to the water system with public notification requirements
- OEL Compliance determines the requirement on completing and submitting an OEL report to the State
- Submit OELs to the State if exceeded: PO Box 4489, Baton Rouge, LA 70821

OEL CALCULATION

The OEL exceeds the MCL limit:

$$OEL = Q_{1} + Q_{2} + 2Q_{3}$$
4

MCL for **TTHM** 80 µg/L

MCL for **HAA5** 60 μg/L

Where

- Q_3 = current quarter result multiplied by 2
- \circ Q₂ = previous quarter result
- $Q_1 =$ quarter before previous quarter result
- For example: If you sample quarterly in May 2017. May 2017 = Q_3 , February 2017 = Q_2 , and November 2016 = Q_1

OPERATIONAL EVALUATION LEVEL

What is it?

- Requires water systems to determine if the DBPs operating level is above the MCL
- Early warning for systems with possible MCL violations which allows systems to act to prevent violations
- Systems with an OEL triggered must create an OEL Report within <u>30 days</u> and submit to LDH within <u>90 days</u> of the notification of exceedance

OEL REPORT: WHAT TO WRITE?

- The OEL Report must describe how to minimize high DBP levels and how <u>each</u> of the following may have affected DBP levels:
 - Storage tank operations
 - Excess storage capacity
 - Distribution system flushing
 - Treatment changes
 - Changes in sources or source water quality
 - Any problems that may contribute to TTHM
 - and HAA5 formation
- Report form is on the SDWP homepage under the DBPR section

RESULTS LETTER



This letter is to acknowledge that the Louisiana Office of Public Health (OPH) - Engineering Services has received and reviewed the attached drinking water monitoring results. Per the Disinfection By-Products Rule (DBPR), water samples were collected from the above water system by Regional OPH staff and were submitted to Pace Analytical Services, Inc. for analysis.

Please review and retain the enclosed results for your water system. Results that were less than the Laboratory's Minimum Detection Limit (MDL) are indicated by a less than sign (<). Per 40 CFR §141.33, records of chemical analyses must be retained for a minimum of 10 years.

Report Summary:					
Sample ID	Sample Date	Point of Collection			
35349685001	11/20/2017	121 Math : (DBP01)			
35349685002	11/20/2017	242 Horseshoe	DBP02)		
Flagged Sample(s):					
Sample ID	Flagged Analyte	Flagged Reason		Follow Up Action (if necessary)	
35349685001	Tthm	$\geq 80 \text{ ug/L}$		Evaluate LRAA and OEL	
35349685002	Tthm	$\geq 80 \text{ ug/L}$		Evaluate LRAA and OEL	

Compliance with the DBPR is based on a locational running annual average (LRAA). Individual samples that exceed the Maximum Contaminant Level (MCL) for Total Trihalomethanes (TTHMs) or Haloacetic Acids (HAA5) may not result in a violation of the DBPR, but does require quarterly monitoring. A system is out of compliance when any LRAA exceeds an MCL for TTHMs and HAA5. Compliance values listed in Drinking Water Watch (DWW) for TTHMs and HAA5 are calculated from individual analytes and may differ slightly from totals reported in the enclosed results.

If your system is required to submit Operational Evaluation Level (OEL) report(s), see SDWP Website: www.ldh.la.gov/SafeDrinkingWater

Sincerely Vadea alla

Parker Allen Safe Drinking Water Program

> LDH - OPH • ENGINEERING SERVICES P.O. BOX 4489 · BATON ROUGE, LOUISIANA 70821-4489 PHONE: 225-342-7499 • FAX: 225-342-7303 • www.ldh.la.gov "AN EQUAL OPPORTUNITY EMPLOYER"

Report Summary:

Sample ID Sample Date 35349685001 11/20/2017 35349685002 11/20/2017

Point of Collection 121 Math : (DBP01) 242 Horseshoe DBP02)

Flagged Sample(s):

Sample ID **Flagged Analyte** 35349685001 Tthm 35349685002 Tthm

Flagged Reason $\geq 80 \text{ ug/L}$ $\geq 80 \text{ ug/L}$

Follow Up Action (if necessary) Evaluate LRAA and OEL Evaluate LRAA and OEL

These are Individual Results LRAAs and OELs can be calculated by the water system

Water system is responsible for submitting OEL reports to the State

DBPR COMPLIANCE OPTIONS

BAT - Improve Distribution System & Storage Tank Management:

- Reduce Residence Times in Dead Ends by implementing a Flushing Program
- Reduce Residence Times and Dead Zones (mixing) in Storage Facilities

Alternative Disinfectants (Use in combination with Chlorine)

- Chloramines (maybe harder to meet CT requirements)
- Chlorine Dioxide
- Ozone (high cost)
- UV

TOC Reduction:

- Flocculation & Filtration
- Granular or Powdered Activated Carbon (GAC/PAC)
- Membranes (NF, RO) pilot study and LDH approval is required
- Oxidants (*i.e.*, Potassium permanganate (KMnO₄))

REDUCING DBP PRODUCTION

Minimizing Residence Time

- Increase fill time
- Increase inlet momentum
- Optimize inlet location and orientation
- Avoid Baffles
- Looping of Dead Ends
- Using Blow-offs
- Replace Oversized Pipes

REDUCING DBP PRODUCTION

Minimize Amount of Disinfection Required

- Clean/repair/line casts iron pipes
- Flushing
- Booster Disinfection
- Combination of disinfection strategies

REDUCING DBP PRODUCTION

Alternative Disinfection Methods

- Chlorine Dioxide
- Chloramines
- Ozone
- UV
- Potassium Permanganate
- GAC

Comparison of the Production of <u>THM's</u> and HAA5's For Free Chlorine and Chloramine for a Typical Water System



VIOLATIONS AND PUBLIC NOTIFICATION

- Public Notification (PN) required for:
 - <u>Tier 2 PN for MCL violations</u> (e.g., TTHM LRAA > 0.080 mg/L or HAA5 LRAA > 0.060 mg/L)
 - ✓ I4 days for newspaper <u>AND</u>
 - \checkmark 30 days for mail/hand delivery notice to customers
 - <u>Tier 3 PN for Monitoring violations</u> (e.g., failed to monitor/report TTHM-HAA5,TOC, Bromate, chlorine, etc. results)
 - ✓45 days for newspaper <u>AND</u>
 - \checkmark 90 days for mail/hand delivery notice to customers

PUBLIC NOTICES

- <u>All</u> of the *italicized* language between the two horizontal lines on the bottom of the first page and top of the second page <u>must</u> be in the public notice.
- Include the telephone number of the owner, operator, or designee of the public water system as a source of additional information concerning the notice.
- Steps being taken to comply should also be included.
- You may add language to the notice as long as it is factual.

WHERE TO SUBMIT STAGE 2 DBPR INFO?

- Send the following to LDH-Central Office (address below):
 - Public Notices related to DBP (TTHM/HAA5);
 - Operational Evaluation Level Reports; and
 - Monitoring Plan changes.

LDH-OPH, Engineering Services P.O. BOX 4489 Baton Rouge, LA 70821

STAGE 2 DBPR - RECORDS

- Maintain the following for:
 - Initial Distribution System Evaluation (IDSE) Reports 10 years
 - Monitoring Plans as long as it applicable
 - Chemical (*i.e.*, TTHM-HAA5) data 10 years
 - LDH correspondence (*i.e.*, violation/monitoring letters, etc.) 3 years
 - Operational Evaluation Level (OEL) Reports 10 years
 - Public Notices 3 years
 - Consumer Confidence Reports 3 years

QUESTIONS?

Parker Allen DBP Compliance Manager 225-342-6163 Parker.Allen@la.gov

Sean Nolan Compliance Manager 225-342-7495 <u>Sean.Nolan@la.gov</u>

Caryn Benjamin Deputy Chief Engineer 225-342-6157 Caryn.benjamin@la.gov Websites:

Safe Drinking Water Program

www.ldh.la.gov/SafeDrinkingWater

Certified Labs

Drinking Water Watch

http://www.ldh.la.gov/index.cfm/page/1290