Stage 2 Disinfectants and Disinfection Byproducts Rule (Stage 2 DBPR) Compliance Monitoring Plan Train-the-Trainer Webinar

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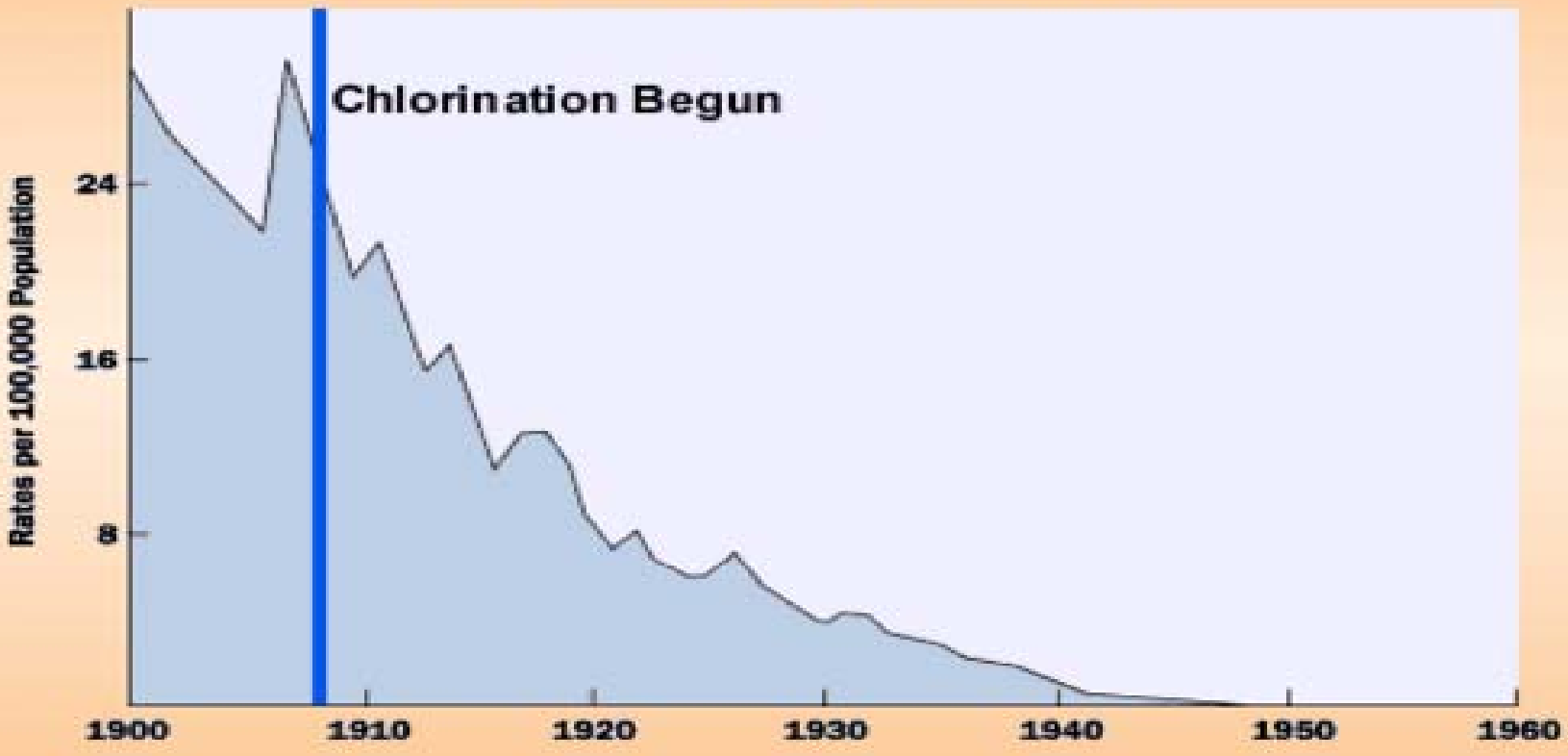
- January, 2013

Purpose of Disinfection

To Kill or to inactivate disease-causing microorganisms that cause serious illness and death (for example: typhoid, hepatitis, and cholera)

Public Health & Disinfection

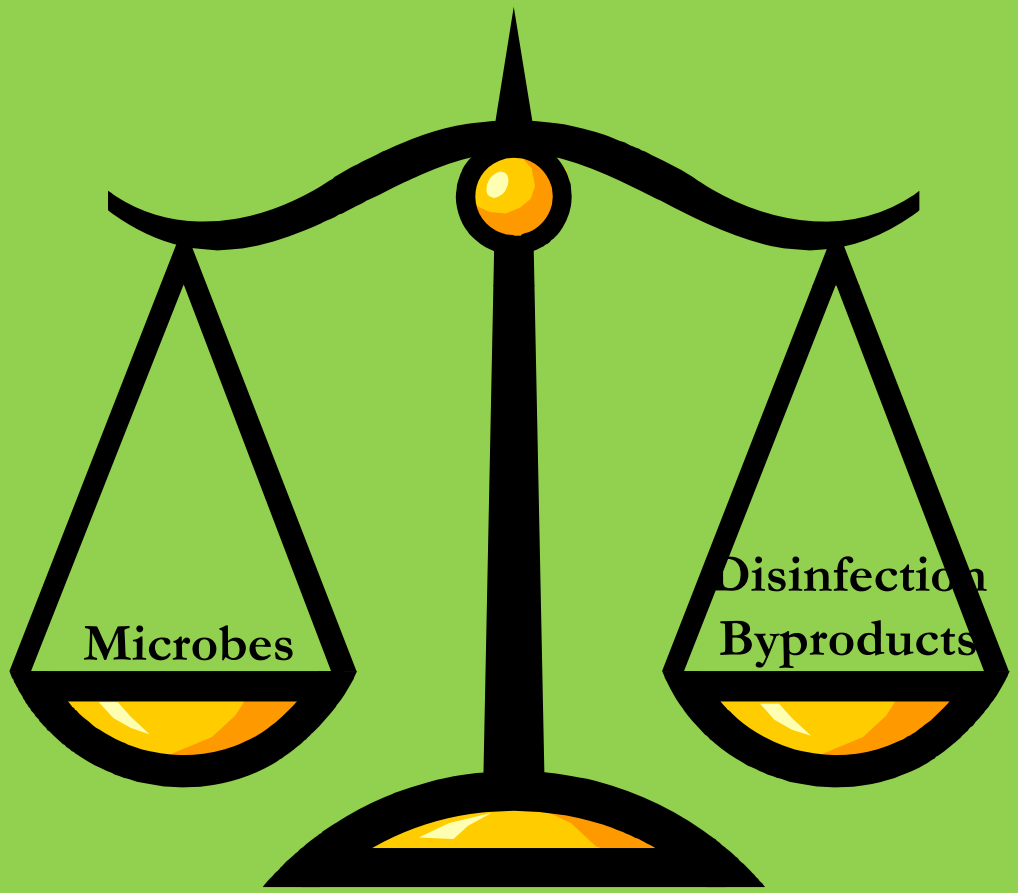


Source: U.S. Centers for Disease Control and Prevention, Summary of Notifiable Diseases, 1997.

Disinfection Byproducts

Disinfectants react with naturally occurring materials in the water (e.g., natural organic matter, bromide, or DBP precursors) to form unintended disinfection by-products (DBPs); DBPs cause problems with liver, kidney, reproductive systems & cancer

Risk-Risk Trade off
A Delicate Balance



How Are DBPs Formed?

DBP Precursor in Water

Natural Organic Matter (NOM-TOC)

Bromide

+

Added Disinfectant

Chlorine

Chloramines

Chlorine Dioxide

Ozone

=

Disinfection Byproducts (DBP)

TTHM

HAA5

Chlorite

Bromate

- Stage 1 DBPR – promulgated on December/16/1998 (applies to C & NTNC systems that disinfect)
- Stage 2 DBPR – promulgated on January/04/2006 (applies to C & NTNC systems that deliver disinfected water – purchasers included)

Stage 1 DBPR Components

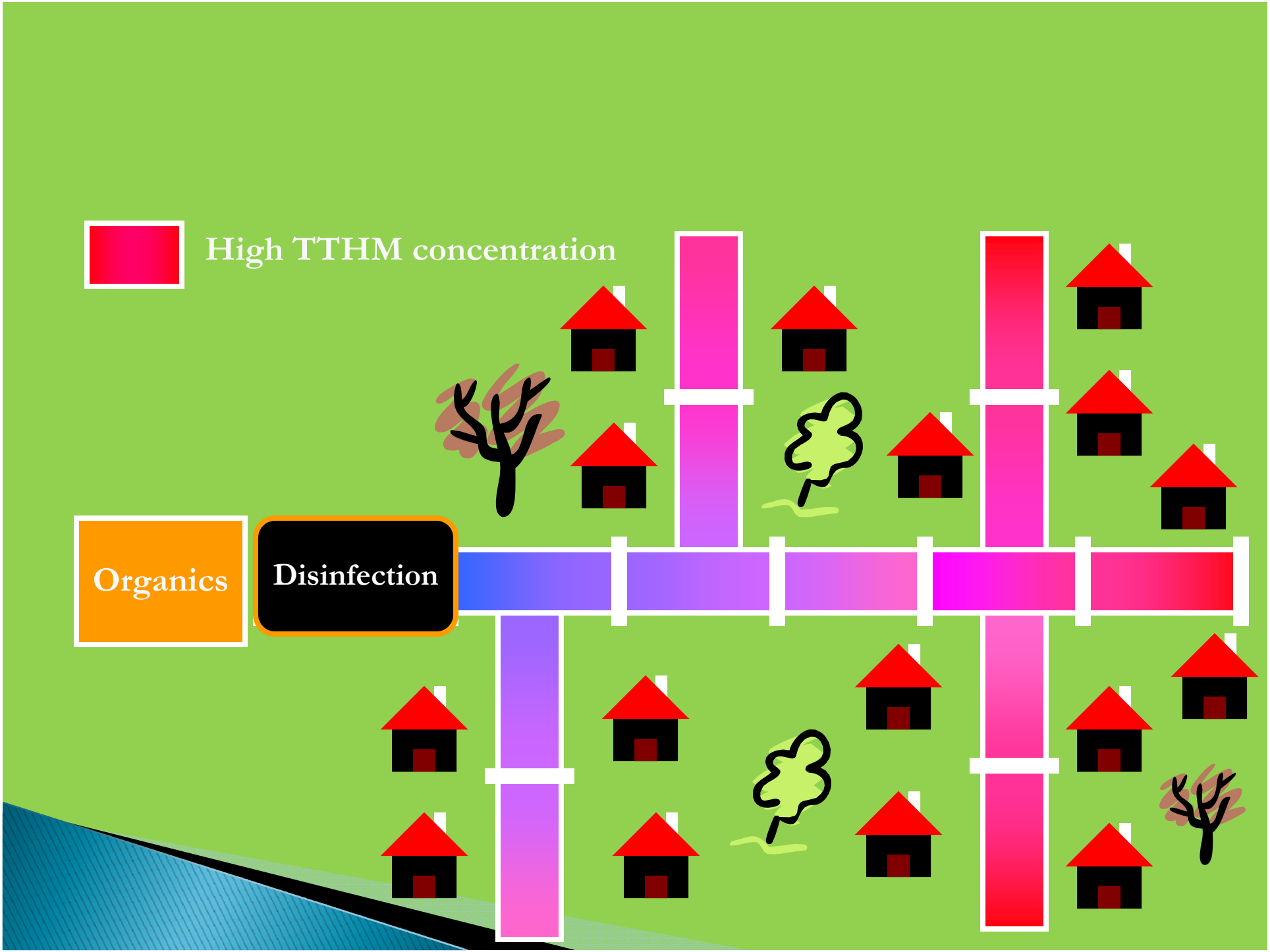
- Maximum Residual Disinfectant Levels (MRDLs) for chlorine, chloramines & chlorine dioxide
- MCLs for TTHM, HAA5, bromate & chlorite
- Enhanced coagulation for conventional filtration to remove specific percentage of DBP precursors between raw and finished water
- Stage 1 Monitoring Plan

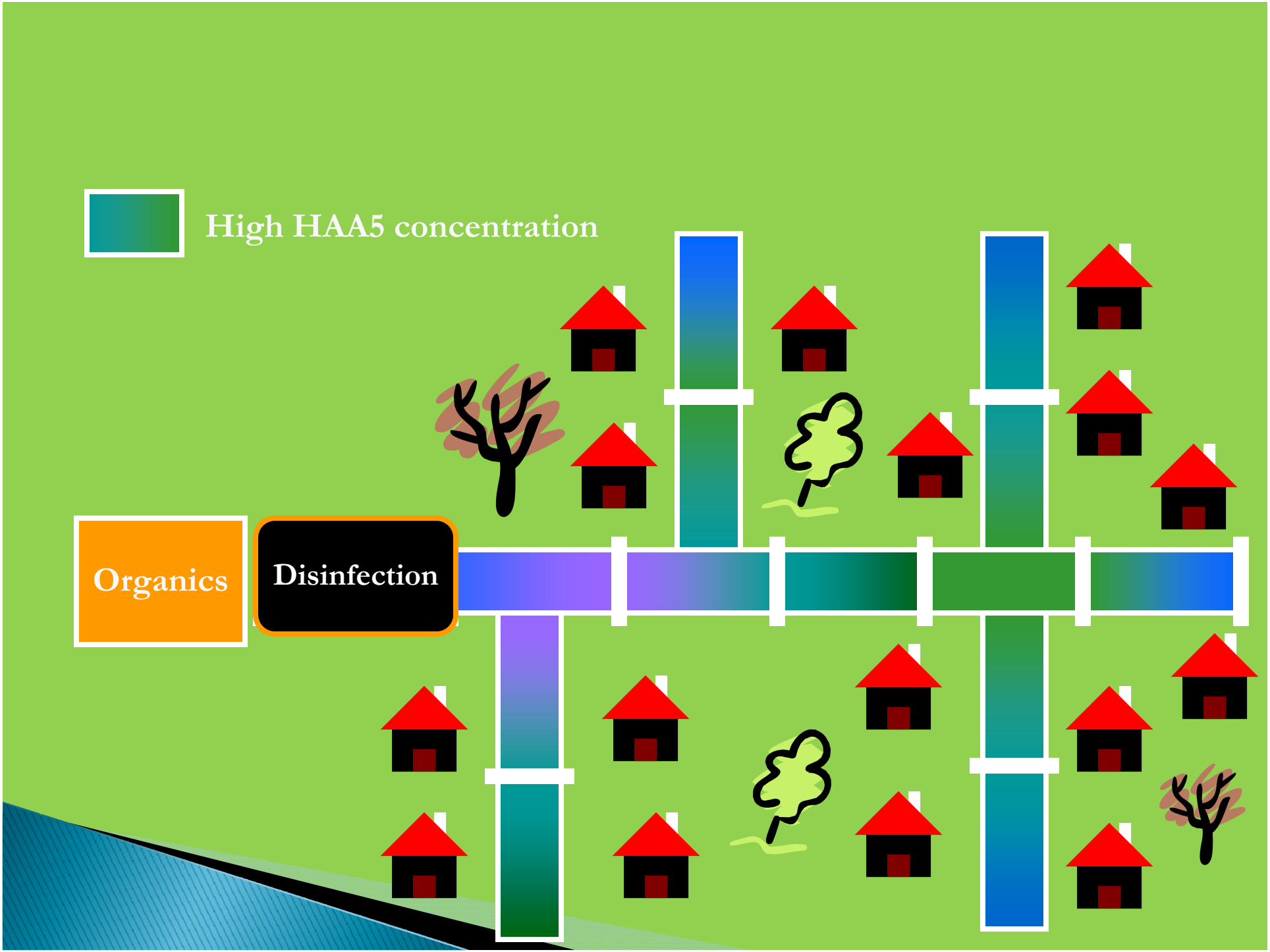
MRDL Compliance

- Chlorine residual (CR) must be measured at the same time/location when taking TCR samples
- Write the CR on the lab slip & ask your lab to forward CR with the TCR sampling result to EPA
- Highest level is 4.0 mg/L (as Cl_2) based on the running annual average (RAA) calculation of 12-month data
  - * As free, total or combined chlorines
- Short-term exceedance of MRDL (4.0 mg/L) is allowed to control microbiological contamination problems (e.g. during emergency situation or shock chlorination after unsafe TCR results)

DBP (TTHM/HAA5) Compliance

- Monitor at the maximum residence time (MRT) in the distribution system
- Monitor in the month with the warmest water temperature (when on the annual schedule)
- MCL: TTHM = 0.080 mg/L
  HAA5 = 0.060 mg/L
- Compliance is based on RAA of 4 consecutive quarters.
- A one time monitoring result exceeding MCL is NOT an MCL violation; instead must increase to quarterly monitoring (when on the annual schedule)
- Analyzed by certified laboratories


High TTHM concentration
Organics
Disinfection


High HAA5 concentration
Organics
Disinfection

Stage 2 DBPR Components

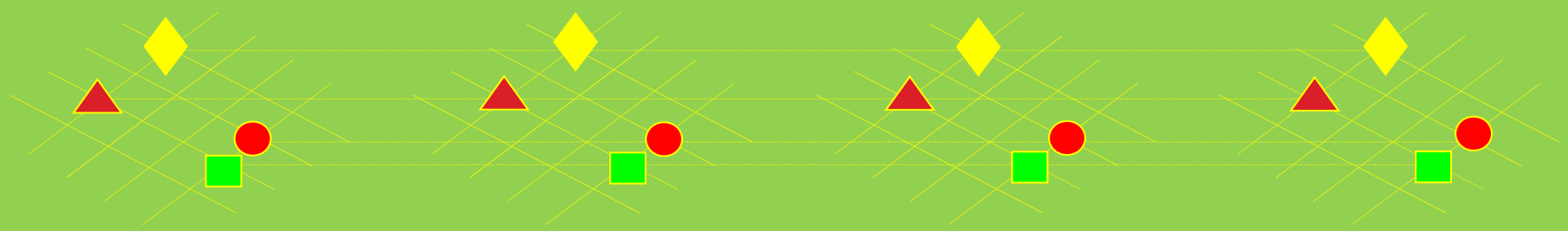
- Consecutive systems included
- Compliance calculation – locational RAA (LRAA)
- DBP monitoring – at the highest DBP locations
- Sampling frequency – population based
- Precision of certified Lab (MDLs and acceptance limits)

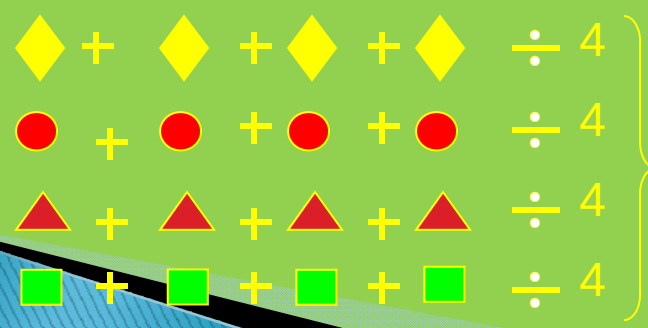
RAA vs. LRAA

1st Quarter | 2nd Quarter | 3rd Quarter | 4th Quarter

Average All Samples | Average All Samples | Average All Samples | Average All Samples

RAA of Quarterly Averages Must be Below MCL





EACH LRAA MUST BE BELOW MCL

Stage 2 DBPR
Early Implementation – IDSE

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

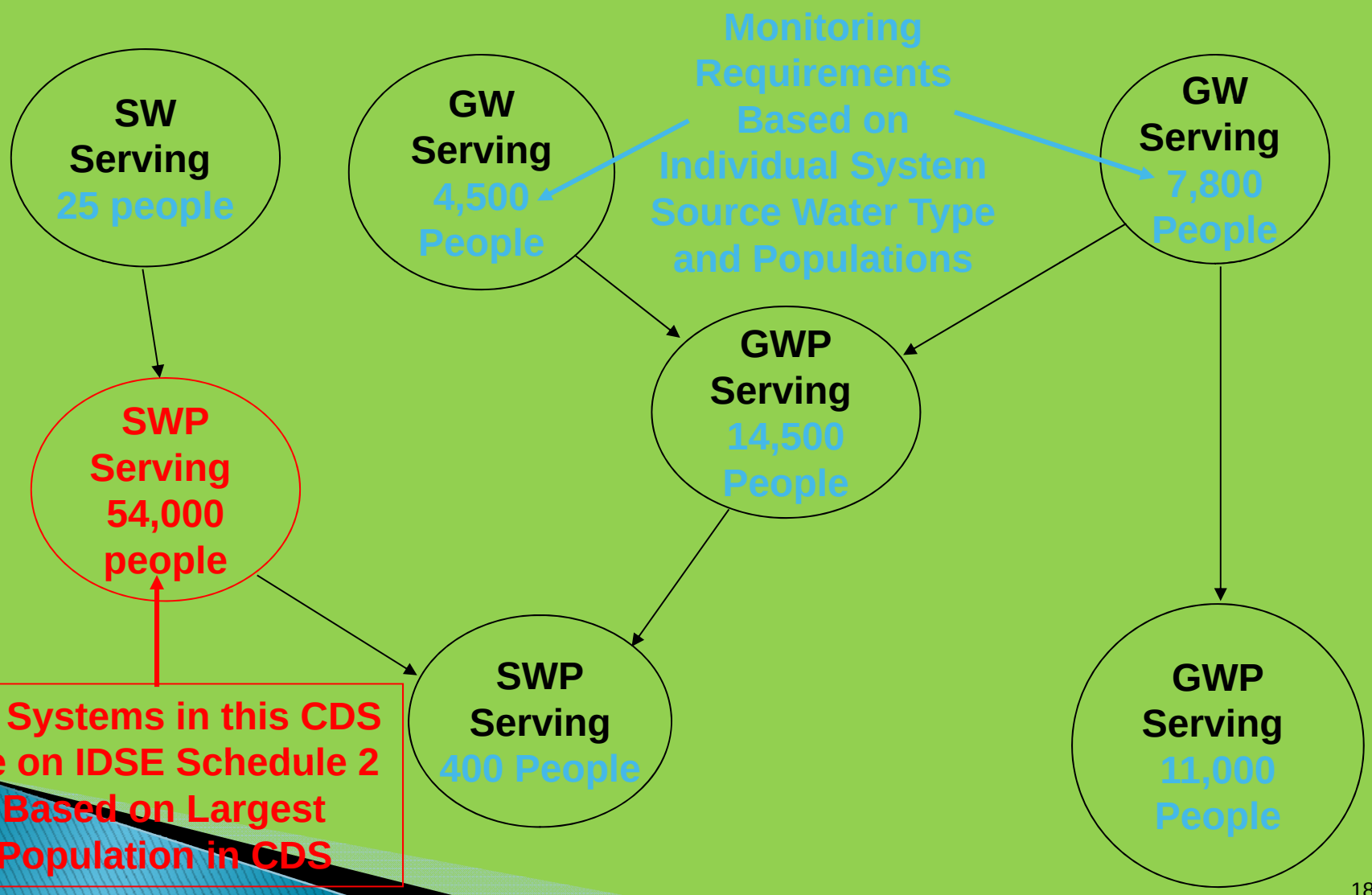
IDSE Options

- Very Small System Waiver (VSS) – no IDSE so need to prepare a Stage 2 Compliance Monitoring Plan
- 40/30 Certification Waiver – no IDSE so need to prepare a Stage 2 Compliance Monitoring Plan
- Standard Monitoring – Conduct IDSE
- System Specific Study – Conduct IDSE

Combined Distribution System (CDS)

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

Combined Distribution System (CDS)



All Systems in this CDS are on IDSE Schedule 2 Based on Largest Population in CDS

Stage 2 DBPR Schedules

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

Stage 2 Monitoring Plan

Must be developed <u>before</u> taking any Stage 2 samples and must include the following

- Monitoring locations
- Monitoring dates
- Compliance calculation procedures
- Peak historical month
- Monitoring Plan for any other systems in a CDS if approved by EPA for reduced monitoring requirements

Important Notes

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

Operational Evaluation Level (OEL)

- Applies to Stage 2 DBPR systems which monitor quarterly
- Peaks in TTHM/HAA5 will sometimes occur, even when systems are in full compliance with the Stage 2 DBPR
- Determined at any monitoring location

Formulation to determine OEL exceedance

$$(A + B + (2 * C)) / 4 = D$$

A = TTHM/HAA5 results for two quarters prior to current quarter

B = TTHM/HAA5 results for one quarter prior to current quarter

C = TTHM/HAA5 results for the current quarter

D = Operational Evaluation Value

If D for TTHM/HAA5 is > 0.080/0.060 mg/L, it is an OEL exceedance

Corrective Actions after OEL Exceedance

OEL exceedance is not a violation, but failure to take the following action is a Tier 3 violation:

- Conduct an operational evaluation to determine the cause of exceedance
- Submit a written evaluation report to EPA within 90 days after being notified of the analytical results
- Keep a copy of the operational evaluation report for public review upon request

Factors Affecting DBP Formation

- Disinfectant applied
- Disinfectant dosage and contact time
- Type and level of DBP precursors
- Disinfection point
- pH and water temperature
- Residence time in the distribution system

For more Information

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

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

  –Drinking Water Watch (DWW) password secured website at:

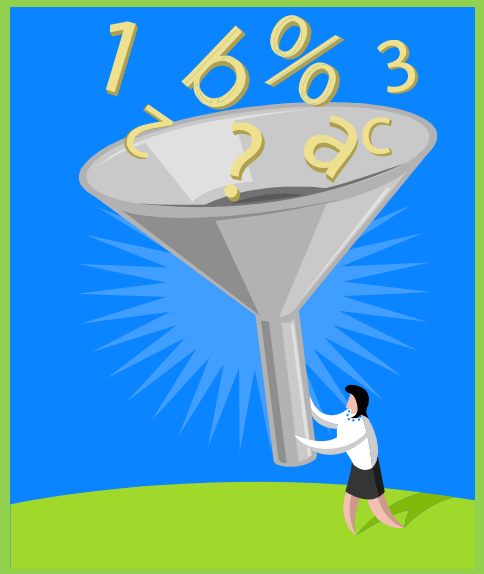
https://sdwisr8.epa.gov/Region8DWW/JSP/loginForm.jsp

Stage 2 Compliance Monitoring Plan
Determining Your Peak Historical Month

- If you have more than 1 source:
  - Identify the source associated with the highest TTHM and HAA5 levels, based on your Stage 1 monitoring data
- Look at your TTHM and HAA5 data for the past few years, and pick the month with the highest TTHM and HAA5 levels
  - If the highest TTHM and/or HAA5 results occur at different times in different years, choose the year which is most representative of typical system operation and weather conditions.
  - If the highest TTHM and HAA5 results occur in different months, look at the overall trend (based on historical data), and pick the one that is most consistently closer to the MCL.
- If you have no TTHM/HAA5 data
  - Pick the month of warmest water temperature

Factors Affecting DBP Formation (Consider For Site Selection)

- Precursor concentration
  - NOM, Bromide
- Disinfectant – type and dose
  - Chlorine, Chloramines
- Water chemistry
  - pH, alkalinity
- Temperature
- Residence Time
- Biodegradation of HAAs



Selecting High TTHM Sites

- TTHM formation
  - **Advanced residence time** is primary factor
- Avoid
  - Dead ends with no users
  - Sites upstream of booster chlorination
  - Sites after the last hydrant or blowoff

- Good TTHM sites
  - Downstream of tanks
  - Dead ends, but prior to last customer and prior to last hydrant or blowoff
  - Hydraulic dead ends and mixing zones
  - Downstream of booster chlorination
  - Sites with difficulty maintaining residual
  - Areas with low water use
  - Areas of high historic levels

Selecting High TTHM Sites

- In general, pick low residual areas, relative to average residual value locations
  - If your system has booster stations, sample downstream of booster stations
- Sparsely populated residential areas typically have older water
- Sampling sites should be representative of water received by customers
- Prioritize sites based on most criteria met (e.g., a site that has a low residual, is downstream of a tank, near the end of the distribution system, in a sparsely populated area)

Selecting High HAA5 Sites

- HAA5 formation
  - Residence time, but also consider biodegradation
- Avoid
  - Areas with known biofilm growth
  - Areas with difficulty maintaining a residual
- Good HAA5 sites
  - Downstream of booster chlorination
  - Sites with low but detectable residual
  - Areas of high historic levels
  - Downstream of Tanks
  - Dead ends – low flows
  - Hydraulic dead ends and hydraulic mixing zones
  - Low water use

Selecting High HAA5 Sites

- Checking for Biodegradation
  - Are the highest HAA5 values typically in the summer months?
  - Are the highest HAA5 values at maximum residence time locations?
  - Do the highest HAA5 values generally occur at the same time of the year, and locations as high TTHM values?
- If you answer 'no' to any of these, HAA5 may be degrading in your system – select sites with lower water age
- Look at residual and microbial data together

Selecting High HAA5 Sites

- Using Residual Data
  - In general, use sites with low disinfectant residuals, relative to the system average
  - Use residual data from months of warmest water temperature
  - Avoid very low or no residual sites – Do not select sites that regularly, or in the summer months, have free chlorine residuals less than 0.2 mg/L, or with chloramines residuals below 0.5mg/L.
- Prioritize sites based on most criteria met (e.g., a site that has a low residual, is downstream of a tank, near the end of the distribution system, in a sparsely populated area)

Stage 2 Sampling Site Selection – Justification

- Plan must include a justification for the selection of each site to be sampled during Standard Monitoring

Site	Example Justifications High HAA5 Sites
High HAA5	This area has high HAA5 levels based on Stage 1 HAA5 data
High HAA5	This site is downstream of booster Cl2, near the end of the distribution system, and it has long residence time. Chlorine levels are low in the summer, but above 0.2 mg/L, and HPC levels are historically low here (less than 500)
High HAA5	This site is located on an 8 inch pipe in a commercial area. It is in an area of high water age that has a history of high chlorine residual concentrations (2 to 2.2 mg/L in summer). HPC levels historically are below 500
High HAA5	This site is downstream of booster chlorination, in an area with low water usage, and fairly high chlorine levels (1.8 mg/L) compared to the ends of the distribution system, where we have trouble maintaining a residual
High HAA5	This area is a hydraulic dead-end, flow of water is low or stagnant, and it has a low population density, but chloramines residuals are above 1.5mg/L

Site	Example Justifications High TTHM Sites
High TTHM	This area has high TTHM levels based on Stage 1 TTHM data
High TTHM	Near the end of the distribution system, before the last group of customers, in an area with low water usage, hydraulically downstream of storage facilities and booster disinfection
High TTHM	This site is near the end of the distribution system, right before the last group of customers, in an area where we have trouble maintaining the residual in the summer months

Stage 2 Monitoring Dates
(Example – Sampling Every 90 Days)

- Stage 2 DBPR: Every 90 days

July						
S	M	T	W	Th	F	Sa
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
29	30	31				

October						
S	M	T	W	Th	F	Sa
	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	29	30	31			

- **NOT: Every quarter**

July						
S	M	T	W	Th	F	Sa
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
29	30	31				

Over 5 Months Apart

December						
S	M	T	W	Th	F	Sa
				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	29	30	

Stage 2 Monitoring Dates Example

- Start with your Peak Historical Month
  - For this example, we will assume the system is on Schedule 4, the Peak Historical Month is August, and that the system has to collect TTHM & HAA5 samples every quarter (90 days)
- You MUST monitor during the Peak Historical Month (in this example, August)
- Assume that the system picks the first week of the month to monitor (i.e., 1st week, August)
- Go backward and forward in 90 day intervals from the 1st week in August to pick the remaining 3 monitoring dates (see next slide)

Stage 2 Monitoring Sample Dates (Example)

- This system is on Schedule 4, so the Stage 2 Monitoring Plan must be in place by October 1, 2013. The first monitoring period is from October 1, 2013 through December 31, 2013. The first August during this monitoring period is August 2014.

Projected Sampling Dates					
Sampling Period 1	Sampling Period 2	Sampling Period 3	Sampling Period 4	Sampling Period 5 (continues)	Sampling Period 6 (cont.)
11-13 First Wk	02-14 First Wk	05-14 First Wk	08-14 First Wk	11-14 First Wk	02-15 First Wk

PEAK HISTORICAL MONTH

Distribution System Schematic

- Distribution system schematics must include:
  - Entry points
  - Sources
  - Treatment Plants
  - Storage facilities
  - Booster pump stations
  - Locations of all proposed Stage 2 monitoring sites
- Important note: These schematics should not contain information that poses a security risk to your system

Distribution System Schematic (Label Your Stage 2 monitoring sites)

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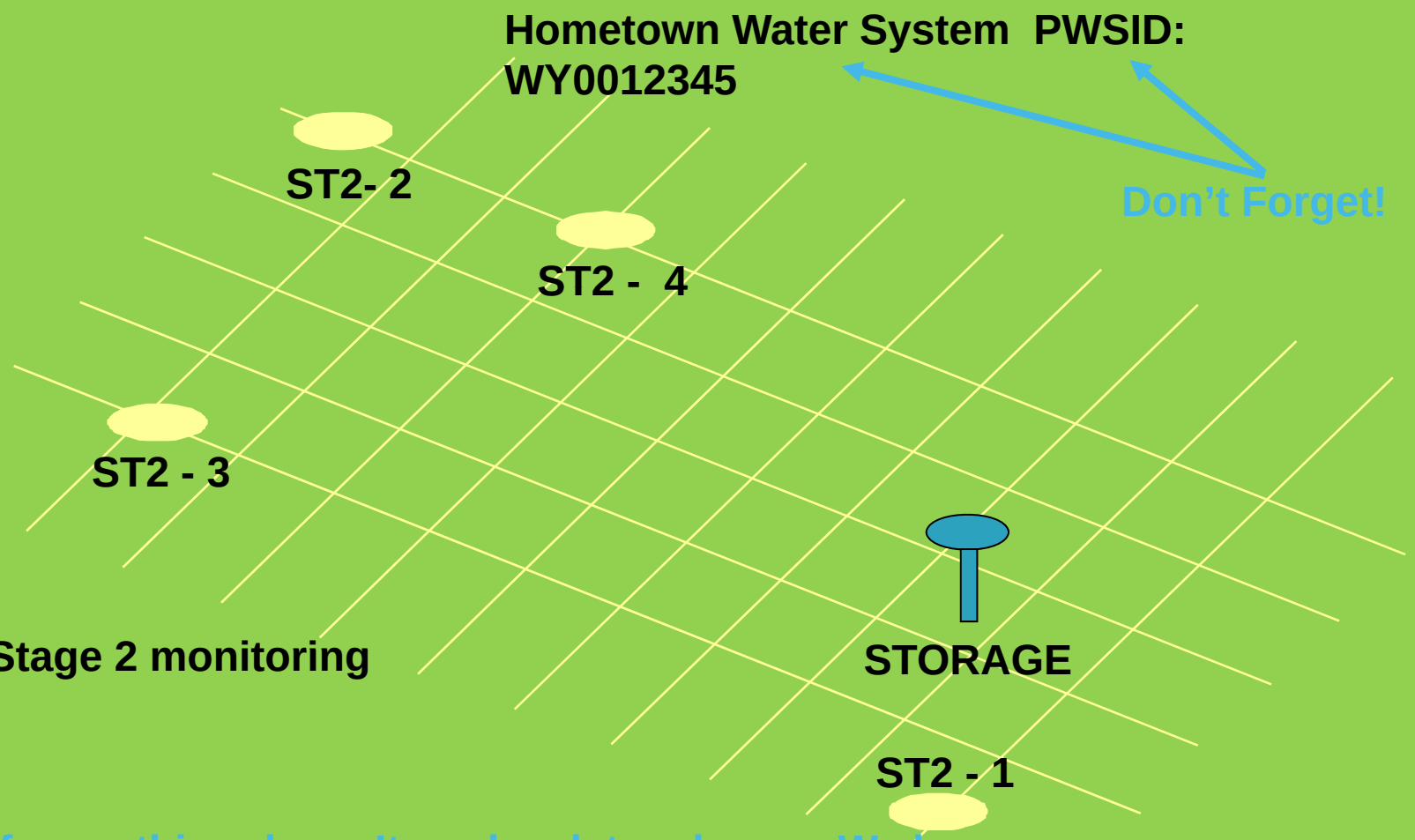

ST2-X: Stage 2 monitoring sites

If something doesn't apply – let us know: We have no pressure zones, treatment plants, or booster chlorination stations