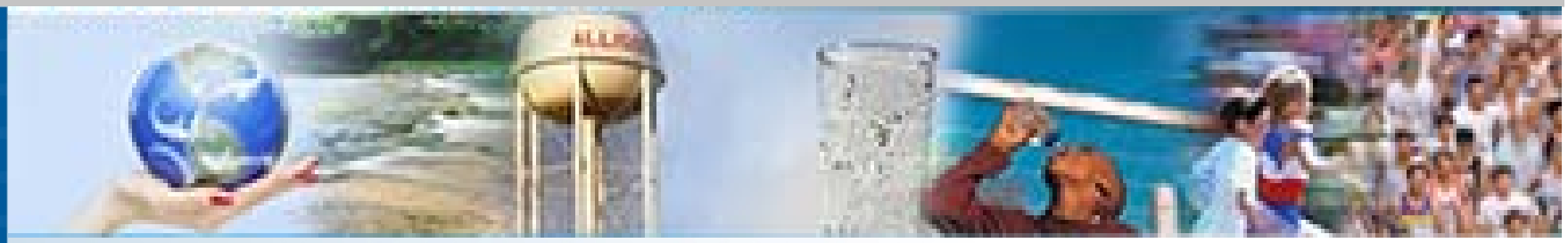
*USEPA Webinar Series*

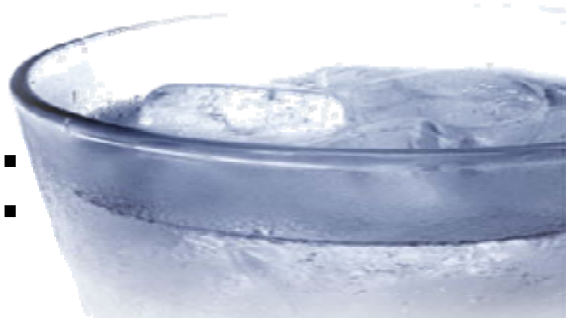
*Best Practices for Simultaneous Compliance*

*Office of Ground Water and Drinking Water*



# Simultaneous Compliance Planning Issues for Surface Water Systems

OGWDW Contract No. EP-CI-08-018
Work Assignment 1-06



# 2009 Webinar Series:

- Source/Treatment Changes
  - What Primacy Agencies Should Consider
- Simultaneous Compliance Planning Issues for Ground Water Systems
- **Simultaneous Compliance Planning Issues for Surface Water Systems**
- Water Quality Management in Distribution Systems - Simultaneous Compliance and Unintended Consequences

# Outline of Today's Discussion

1. What is Simultaneous Compliance?
2. SDWA-Driven Regulations that Frequently Impact Surface Water Systems
3. Framing Compliance Actions Common to Surface Water Systems
4. Specific Response Actions and Related Simultaneous Compliance Issues/Interactions
5. Once a Change is Under Consideration or Review..
6. Wrap-up

# Key Acronyms – SDWA Regulations

* listed chronologically

SDWA – Safe Drinking Water Act

TCR – Total Coliform Rule

SWTR – Surface Water Treatment Rule

LCR – Lead & Copper Rule

IESWTR –"Interim" Enhanced Surface Water Treatment Rule

D/DBP Rule – Disinfectant/Disinfection Byproduct Rule

FBRR – Filter Backwash (Recycle) Rule

LT1-ESWTR – Long-Term 1 Enhanced Surface Water Treatment Rule

LT2-ESWTR – Long Term 2 Enhanced Surface Water Treatment Rule

GWR – Groundwater Rule

# Key Acronyms – Water Quality

AOC - biologically-assimilatible organic carbon
CCT – corrosion control treatment under LCR
DBP – disinfection by-product
Fe/Mn – iron/manganese
IOC – inorganic chemical
NOM – naturally-occurring organic material
ORP – oxidation reduction potential (redox)
SOC – synthetic organic chemical
TOC - total organic carbon
T&O – taste & odor
VOC - volatile organic chemical

$Cl_2$ - chlorine
$NH_3$ - ammonia
$NO_3$ – nitrate
$PO_4$ – phosphate
$SO_4$ – sulfate

# Misc Acronyms

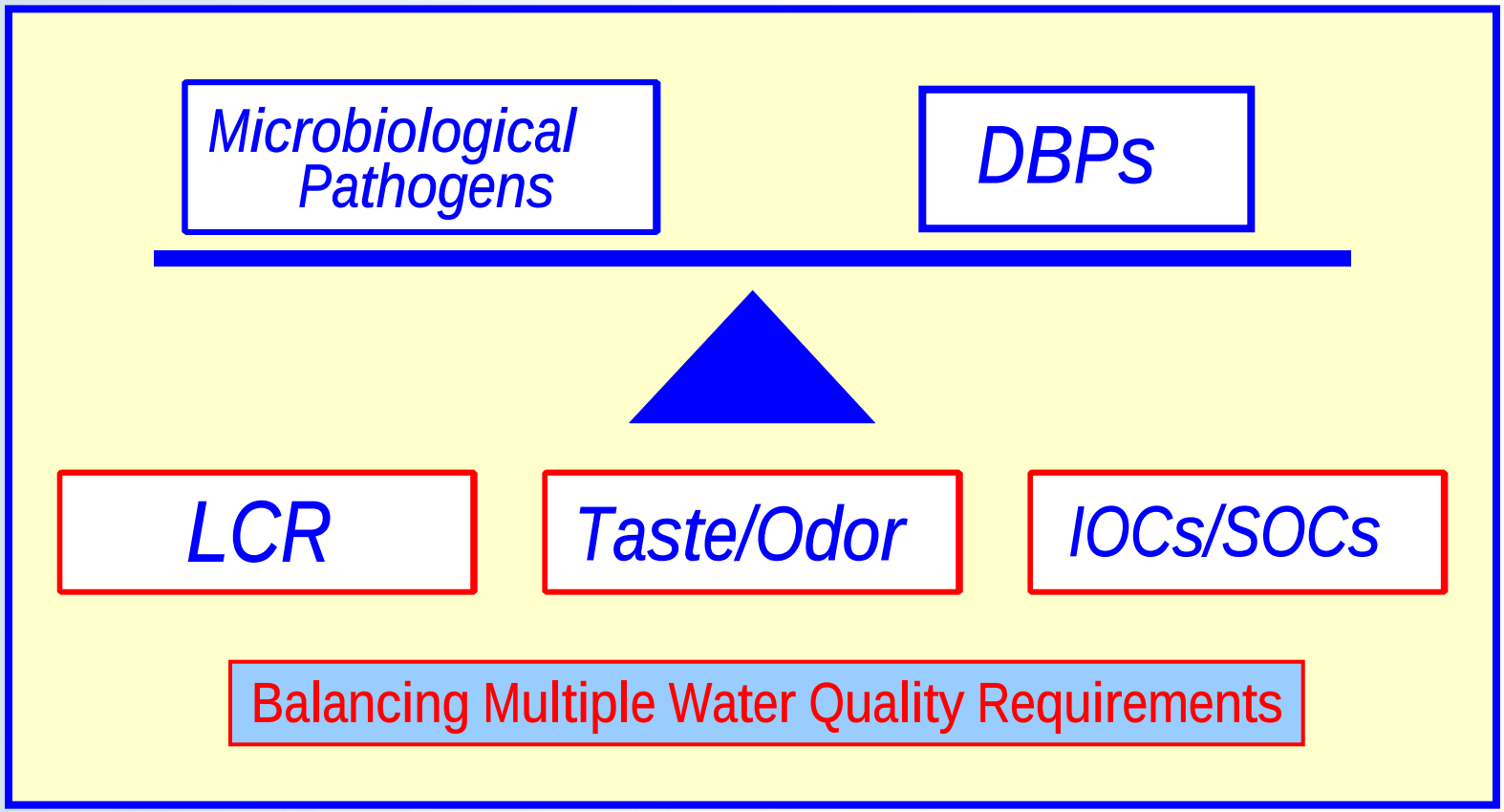
GAC – granular activated carbon
GW – groundwater
GWUDI – groundwater under direct SW influence (SWTR)
IDSE – Initial Distribution System Evaluation
IX – ion exchange
MF/UF – microfiltration/ultrafiltration
NF – nanofiltration (loose RO)
POTW – publicly-owned treatment works
PWS – public water system
RO – reverse osmosis
SW - surface water
WTP – water treatment plant
WWTP – wastewater treatment plant

# Defining Simultaneous Compliance

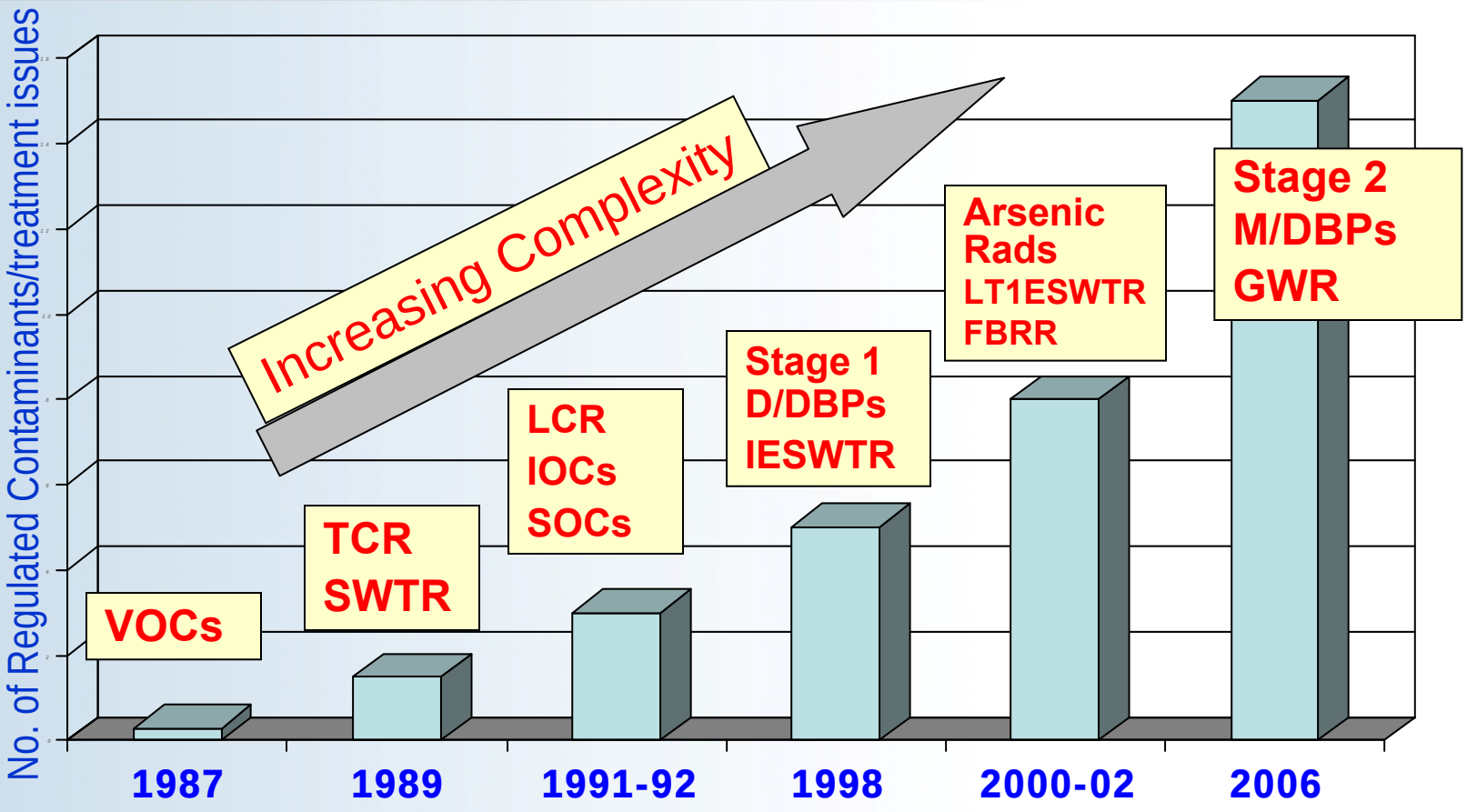
# Defining Simultaneous Compliance

- Without careful planning and proper implementation, actions intended to improve one aspect of regulatory compliance can produce conflicts (or at least pose challenges) in other areas of water quality performance.
- Simultaneous Compliance is the comprehensive assessment and implementation of processes and practices which promote compliance with all SDWA regulations.

# PWS Increasingly are Required to Balance Competing Regulatory Water Quality Requirements

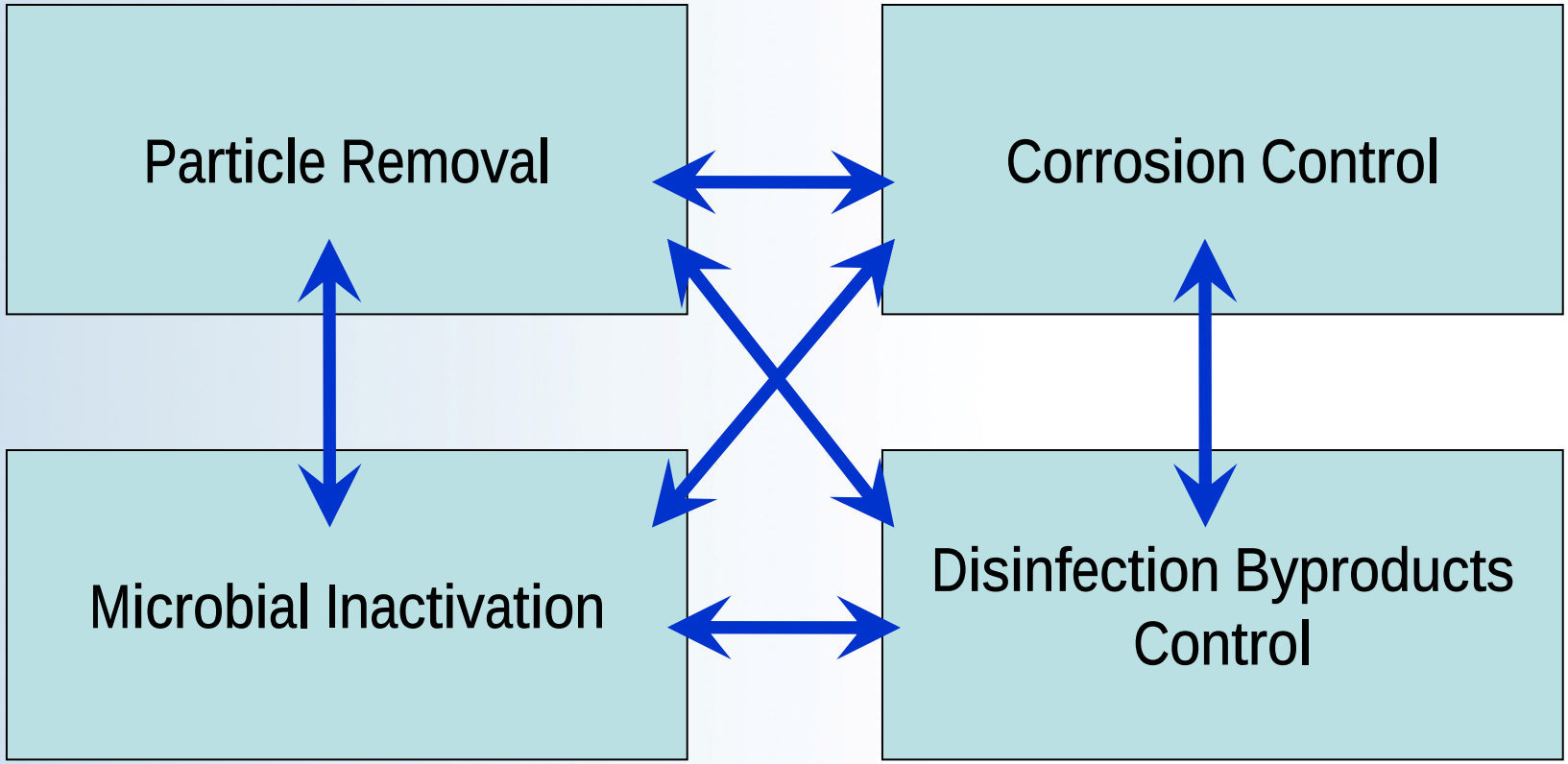


# Simultaneous Compliance Complexity has Increased Significantly in 20 Years

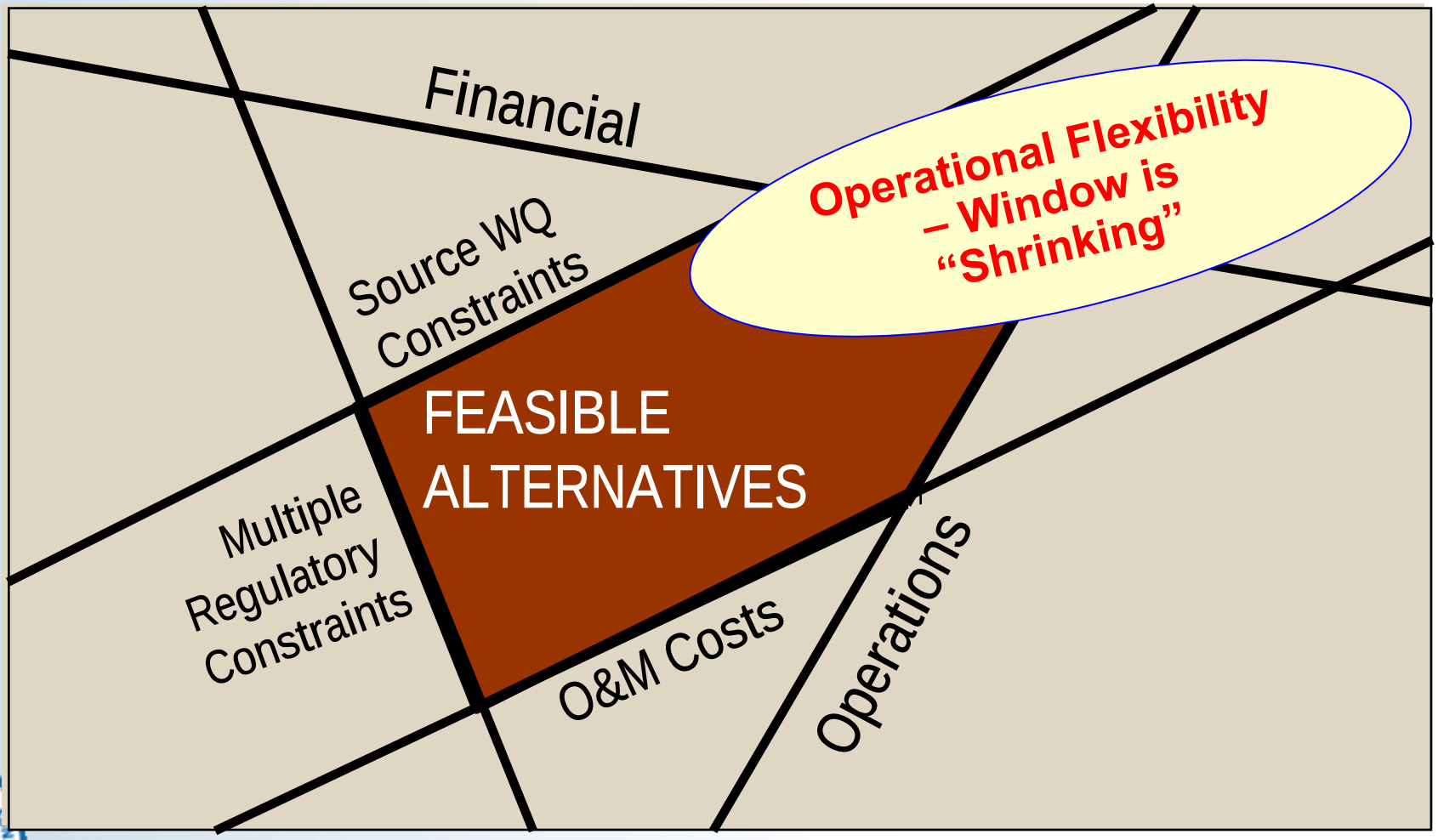



**Many "secondary water quality impacts" are also related to SDWA regulatory compliance**

# Simultaneous Compliance Interactions Challenges and Conflicts



# PWS Operations are Increasingly Complex and Flexibility is Shrinking




Source: Balancing Multiple Water Quality Objectives, AWWARF, 1998

# SDWA-driven Regulations that Most Frequently Impact SW Systems

# SDWA-Driven Regulations Impacting Surface Water Systems

**Frequently Impact SW Systems**

Surface Water Treatment Rule (SWTR)
Total Coliform Rule (TCR)
Lead and Copper Rule (LCR)
Stage 1 and 2 D/DBP Rules
IESWTR, LT1, LT2ESWTR
Filter Backwash Rule
Synthetic Organic Chemicals (SOCs)

**Rules Drive Compliance Actions**

**Compliance Actions Create Conflicts & Challenges**

***Somewhat* Less Frequent SW Impact:**

Inorganic Chemicals (except Fe/Mn)
Ground Water Rule (GWR)
Arsenic Rule • Radionuclides Rule
Wellhead/Well Field Protection
Volatile Organics (VOCs)

# Changes and Utility Actions Driven by Regulatory Requirements

- Modify source utilization to mitigate raw water contaminants
- Provide new treatment to remove contaminants:
  - Particulates, turbidity
  - Bacteria, viruses, protozoans
  - NOM/DBP precursors
  - SOCs
  - Hardness/T&O/Fe/Mn

# Wide Array of Utility Responses (cont.)

- Assess existing WQ performance
  - LT1ESWTR Disinfection profiling/benchmarking
  - LCR tap water monitoring
  - LT2 source water monitoring
  - Stage 2 D/DBP IDSE
- Modify/optimize existing treatment
  - Coagulation/sedimentation
  - Disinfection practices
  - Softening
  - CCT Practices

## How Rules May Impact SW Systems

# Surface Water Treatment Rule

- Source of Supply Changes
  - To decrease turbidity/organics
  - Shift/shutdown well production (GWUDI)
- Particulate Removal Processes
  - Better Coagulation/flocculation/sedimentation
  - Granular media filtration performance
  - Membrane filtration (MF/UF)
  - Enhanced precipitative softening
- Disinfection Practices
  - Primary disinfection (*Giardia*/virus CT performance)
  - Secondary Disinfection (residual chlorine/monochloramine)
  - Pre-oxidation/disinfection alternatives
- Impact of above on CCT Practices

## How Rules May Impact SW Systems

# Total Coliform Rule (TCR)

- Source of Supply Changes
  - Decrease microbial contaminants/risk
  - Source blending changes (coliform/turbidity/organics)
- Disinfection Practices
  - Particulate Removal (granular media, MF/UF)
  - Primary disinfection (*Giardia*/virus CT performance)
  - Secondary Disinfection (residual chlorine/monochloramine)
  - Pre-oxidation/alternative disinfectants
  - Distribution System O&M Practices
- Impact of above on CCT Practices

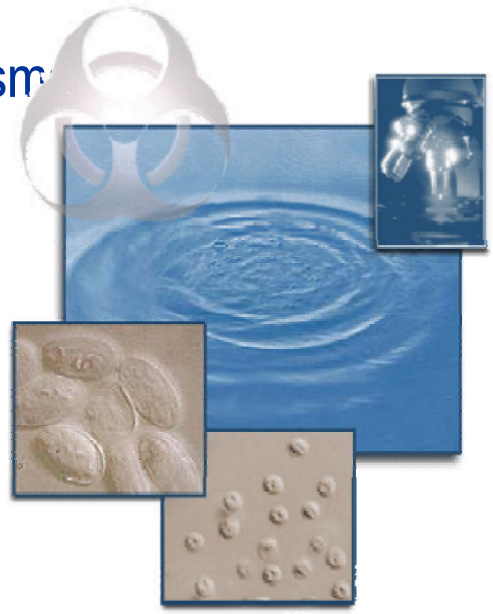
## How Rules May Impact GW Systems

# Lead & Copper Rule (LCR)

- New or modified treatment process impacts CCT chemistry (pH, alkalinity, ORP, $SO_4$, $PO_4$)
  - Oxidation/disinfection
  - Coagulation/softening
  - Ion exchange/NF/RO
- Action level exceedance for Pb or Cu leads to more monitoring & re-optimization of CCT
- Desktop, bench or pilot-scale CCT studies may be necessary (these take time!)

# How Rules May Impact SW Systems
# IESWTR/ LT1ESWTR/ LT2ESWTR

- Crypto Source Water Monitoring
- Source of Supply Changes
  - Watershed management/control program
  - Decrease cryptosporidium/pathogenic organisms
- Disinfection Profiling & Benchmarking
- Microbial Toolbox Treatment
  - Coagulation/filtration performance
  - Additional Crypto inactivation (ClO2, O3, UV)
  - Two-stage lime softening
  - Bank filtration
  - Membrane filtration/cartridge filtration
  - Multiple filters in series
  - Slow sand filtration
- Changes that impact CCT chemistry



## How Rules May Impact SW Systems

# Stage 1 / Stage 2 DBP Rules

- IDSE Monitoring Requirements
- Source of Supply Changes
  - Decrease NOM/DBP precursors
  - Decrease oxidant demand
- Existing/New Treatment Processes
  - Modified pre-oxidation practices
  - Enhanced coagulation/softening
  - Modified disinfection practices
  - Alternate disinfectants >> shift in DBPs
- New or modified treatment process impacts CCT chemistry (pH, alkalinity, ORP, $SO_4$, $PO_4$)

# How Rules May Impact SW Systems
# IOCs/SOCs

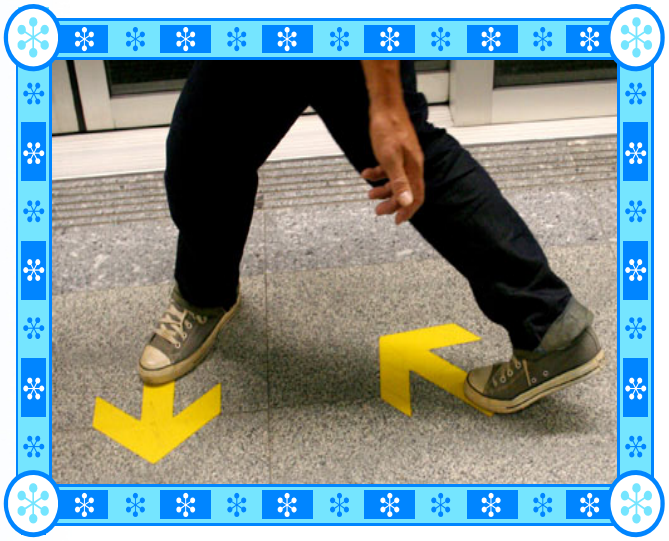
- Source of Supply Changes
  - Shift sources (shutdown)
  - New blending scenarios
- Treatment Processes - IOCs
  - Ion exchange, NF/RO
- Treatment Processes – SOCs/NOM
  - GAC adsorption, ion exchange, NF/RO
- Modify Existing Processes
  - Coagulation, softening, oxidation, disinfection

# SW Systems also Under Pressure to Meet Secondary Water Quality Goals

- Hardness
- Dirty water
- Taste & odor
- Scale stability
- Fe/Mn
- Other Secondary MCLs

# Framing Compliance Actions Common to Surface Water Systems

# "Making New Moves"
## Responses Common to SW Systems

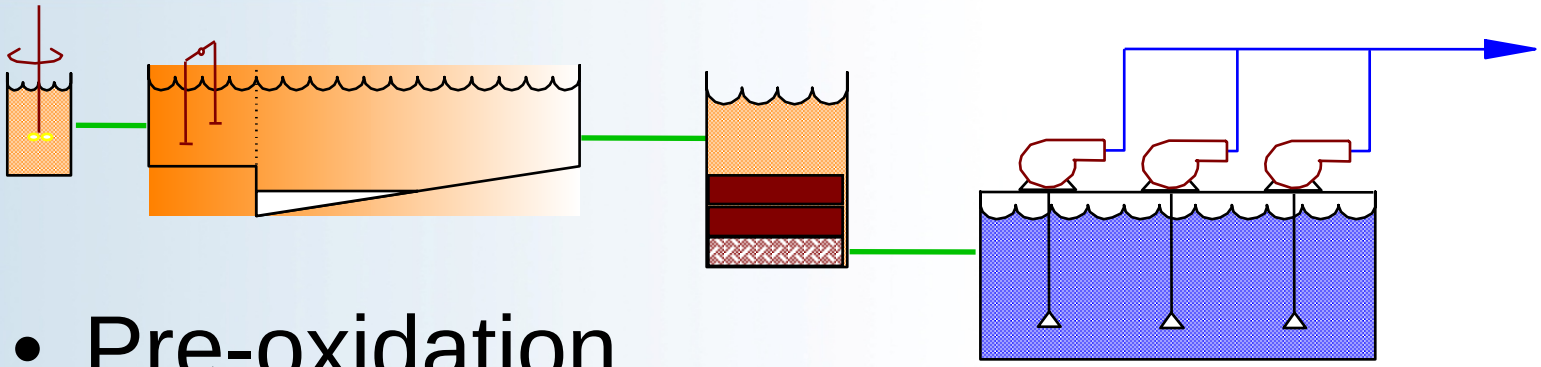


- Source Changes
- Increased Production
- Changes to Existing Unit Processes/Treatment
- Implementing New Unit Process(es)
- Discontinue Existing Treatment Process

# Source/Capacity Changes

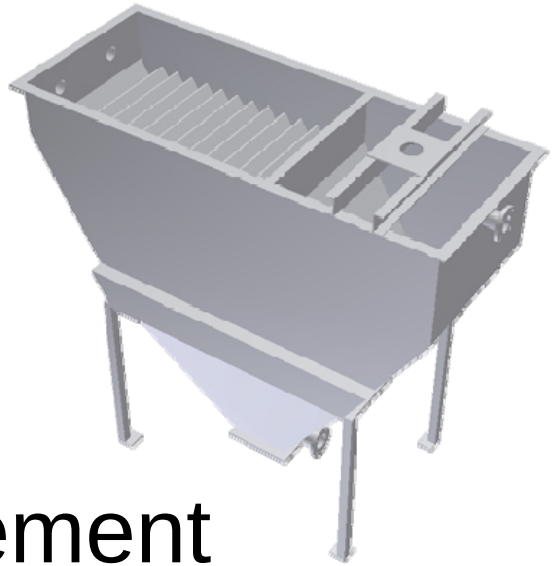
- New Source of Supply
- New Blending Scenarios for Existing Sources
- New or Multiple System “Entry Points”
- Intake Relocation or ”depth” management
- Increasing/Decreasing Pumping Capacity

# Modify/Optimize Existing Unit Processes/Treatment



- Pre-oxidation
- Adsorptive media
- Modified Coagulation
- Moving Point of Disinfection
- Change of Treatment Chemicals

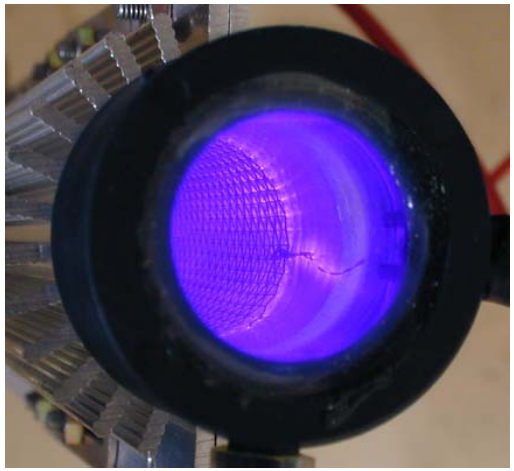
# Modify/Optimize Existing Unit Processes/Treatment (cont.)



- Mixing Improvements
- High-Rate Clarification
- Filtration Rate Increase
- Filtration Media Replacement
- Increase/Decrease Finished Water Storage Volume

# Implementing New Processes

- New Oxidants
- GAC Adsorption
- Membrane Filtration Technologies (MF/UF)
- Open Finished Water Reservoir Disinfection
- Additional Chemical Feed Systems (NH3, PAC, polymer, etc.)



# Stopping an Existing Process or Practice May Create Compliance Problems

- Seasonal Variation in Source Water Quality/Blending
- Discontinue Softening
- Filter Backwash Recycle
- Primary Disinfection CT upstream of Filtration
- Taste & Odor Control

# Specific Response Actions and Related Simultaneous Compliance Issues/Interactions

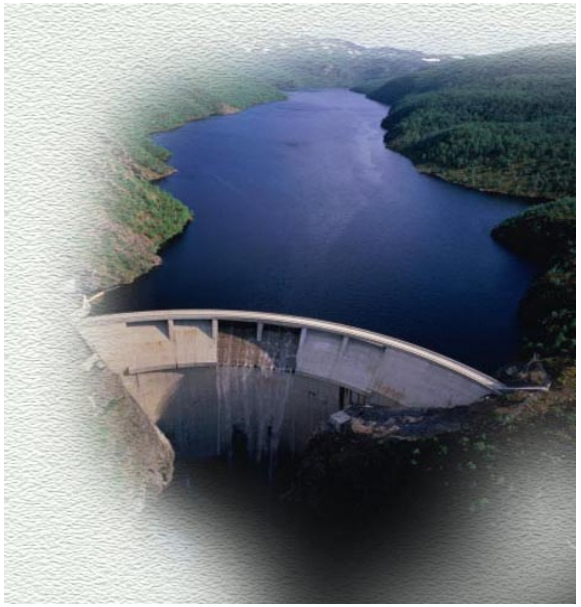
- √ *What to watch for..*
- √ *How to overcome challenges*

# Specific Utility Response Actions Covered in Detail Today:

- Source of Supply Changes
- Disinfection Practice Changes
- Enhanced Coagulation/Filtration
- Softening Practices
- Membrane Filtration (MF/UF)
- Granular Activated Carbon (GAC)
- Nanofiltration/RO

*Specific Change:*

# Source of Supply Changes



- Adding new source(s)
- Blending multiple sources
- Modifications to existing sources of supply to reduce O&M costs

**Most source changes will impact treatment requirements and/or distribution system chemistry.**

Source of Supply Changes

# Why Change Source Water?

***To Increase Capacity!!***

***To Improve Quality/Consistency:***

- Turbidity/pathogen levels
- Microbial quality (LT2)
- Decrease NOM/DBP precursors
- Lower disinfectant demand
- Residuals production
- IOCs/SOCs
- Residuals production

In general - to improve raw water treatability for turbidity, microbials and/or DBP precursors

## Source of Supply Changes
# Possible Conflicts/Challenges

- Stage 2 DBPR issues with shift in TOC, NOM, chlorine demand, temperature
- Source quality/monitoring impacts LT2ESWTR “bin” placement for crypto treatment requirements
- Temperature shifts from SW/GW blending may help/hurt treatment
- Alkalinity/hardness shifts require adjustment of coagulation/softening

## Source of Supply Changes

# Other Possible Conflicts/Challenges

- Source changes can affect aesthetics; regrowth potential, scale stability, nitrates, Fe/Mn/Sulfides
- LCR CCT impacted by shift in pH, ORP, alkalinity and/or NOM
- Alternating between sources requires careful control of CCT chemistry

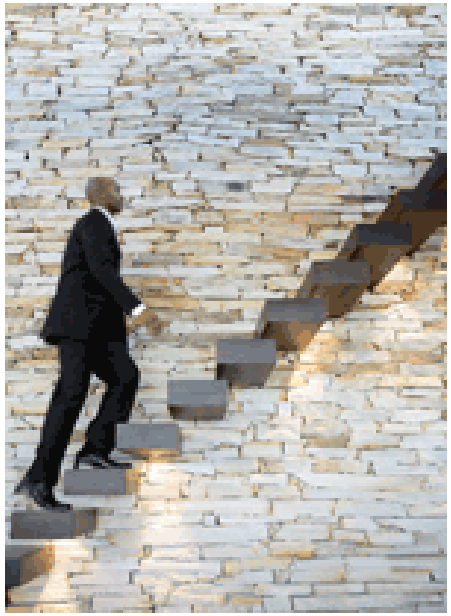
## Source of Supply Changes

# Mitigating Potential Conflicts/Challenges

- Identify/evaluate potential conflicts/interactions
- Recognize potential for source changes to impact existing treatment/distribution system chemistry
  - Exercise positive control over coagulation and softening chemical treatment/dosages
  - Maintain pH and alkalinity targets in both plant and distribution system
  - Monitor TOC and shifts in disinfectant demand

## Source of Supply Changes
# Overcoming Conflicts/Challenges

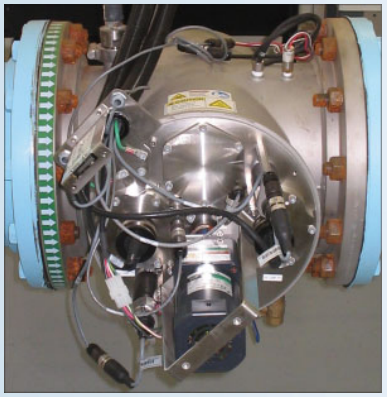
- **Collect data! Evaluate!**
- Re-optimize CCT as needed, and ensure CCT is effective over the full range of raw water quality conditions
- Keep distribution system chemistry as consistent as possible to promote scale stability and mitigate dirty water episodes



*Specific Change:*

# Disinfection Practices

- Dosage changes
- Relocating disinfectant application point
- Switching to a new disinfectant
- Applying multiple disinfectants



Disinfection Changes

# Why Change Disinfection Practices?

- Meet CT criteria under changing source water conditions
- Control/reduce DBP formation
- Improve “secondary” disinfectant residual in distribution system
- Optimize disinfectant consumption
- Control microbial regrowth
- Oxidation of iron and manganese
- Protection from Asiatic clams, zebra mussels and algal growth
- Aesthetics (taste & odor)

Disinfection Changes

# New Disinfectant Combinations Often Pose Unique Challenges

| Existing Disinfection Scheme | New Disinfectant Combination |
| --- | --- |
| Chlorine/Chlorine | Chlorine Dioxide/Chlorine<br>Chlorine/Chloramine<br>Chloramine/Chloramine<br>Chlorine Dioxide/Chloramine<br>Ozone/Chlorine<br>Ozone/Chloramine |
| Chlorine/Chloramine | Chlorine Dioxide/Chloramine<br>Ozone/Chloramine |
| Chloramine/Chloramine<br>Ozone/Chlorine | Ozone/Chloramine |

*Note: Disinfection scenario listed as "primary/secondary" disinfectant chemicals.*

## Disinfection Changes
# Possible Conflicts/Challenges

- Oxidation of TOC, NOM may cause shifts in DBP formation/speciation
- Oxidation-related coagulation and filtration performance
- Interactions with adsorptive processes (e.g. GAC, IX)
- Conversion to chloramines may cause seasonal nitrification in distribution system
- Chlorine dioxide may form chlorides/chlorates under specific conditions

Disinfection Changes

# Possible Conflicts/Challenges

- Softening chemistry may limit disinfection alternatives upstream of granular media filtration
- Ozone impacts on downstream treatment processes (e.g., bio-regrowth; fouling of membranes)
- Shifts in pH, alkalinity, ORP and NOM may require re-optimization of CCT
- Changes in residuals production and characteristics

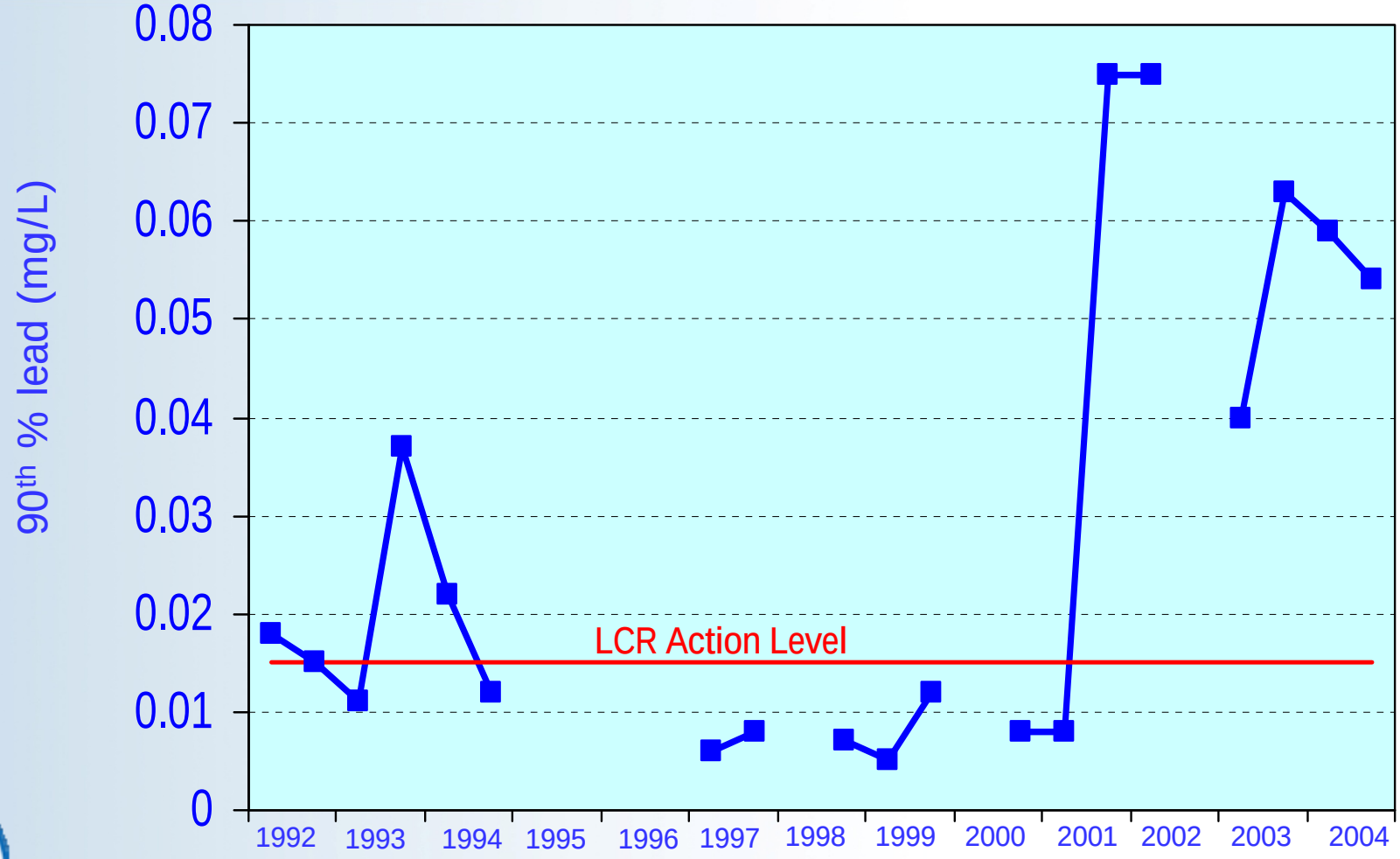
## Chloramine Conversion Example

# Washington DC

- Conventionally-treated surface water supplied to DC-WASA by Washington Aqueduct (WAD)
  - Free chlorine – secondary disinfection
  - Carbonate Passivation CCT
- November 2000 – WAD switched from free chlorine to monochloramines; and from dry alum to liquid alum
- Dramatic increase in tap water lead levels
  - July 2001 - June 2002: 90th percentile Pb = 75 ppb
  - Jan 2003 - June 2003: 90th percentile Pb = 40 ppb

# Chloramine Conversion Example

# Washington DC



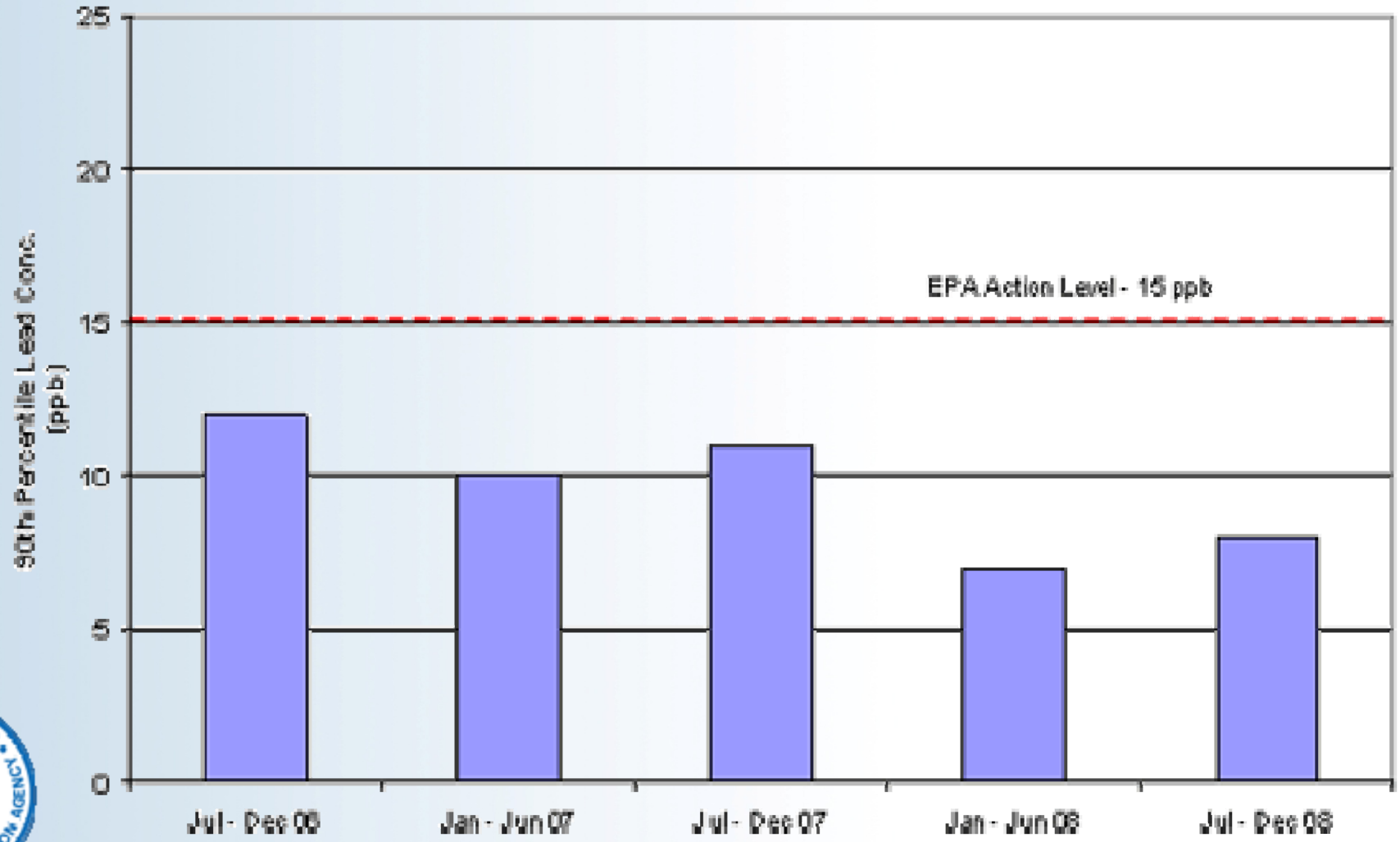
## Chloramine Conversion Example

# Washington DC

- Water quality implications of chloramine conversion not proactively managed
  - Alkalinity shifts
  - ORP shifts
  - nitrification
- Supplemental baseline monitoring suggested ORP shifts and localized nitrification increased lead solubility and release from existing scales
- August 2004 – orthophosphate addition

# Chloramine Conversion Example

# Washington DC



# Disinfection Changes
# Recognize Potential Conflicts/Challenges

- Identify/evaluate potential conflicts/interactions
- Control chlorine/ammonia ratio, water age and other factors to avoid nitrification
- Evaluate ozone impacts on downstream treatment processes
  - AOC & bio-regrowth potential
  - Biological filtration may be needed
  - Membrane fouling potential

# Disinfection Changes
# Mitigating Potential Conflicts/Challenges

- Conduct site-specific treatability testing to establish how new oxidation conditions impact:
  - DBP speciation, bromate, chlorides/chlorates, etc.
  - Primary Disinfection/CT
  - Coagulation/softening/Corrosion
- Re-optimize CCT (if needed)
- Keep distribution system chemistry as consistent as possible to promote scale stability - and avoid AL exceedences or aesthetics problems

# Disinfection Changes
# Ozone / Ozone-related AOPs

## Ozone / Ozone-related AOPs

- Good broad-spectrum oxidant for Fe/Mn, T&O, natural organics.
- Potential Coagulation/filtration benefits
- O3 + bromide = Bromates
- AOC biologically assimilatible organic carbon (food for bugs in distribution system)
- Can form unregulated DBPs (aldehydes, ketones, bromimated organics)

## Ozone for Primary Disinfection & Taste & Odor Control

# Ann Arbor, MI

- 50 MGD two-stage softening plant
- Blended SW/GW (subject to SWTR)
- Switched from pre-chlorination and pre-chloramination to Pre-ozonation followed by biological filtration
- Ozone added following recarbonation
- NaOH and phosphate inhibitor for CCT
- Enhanced filtered water chloramination to protect against biosolids shedding
- Post-chloramination

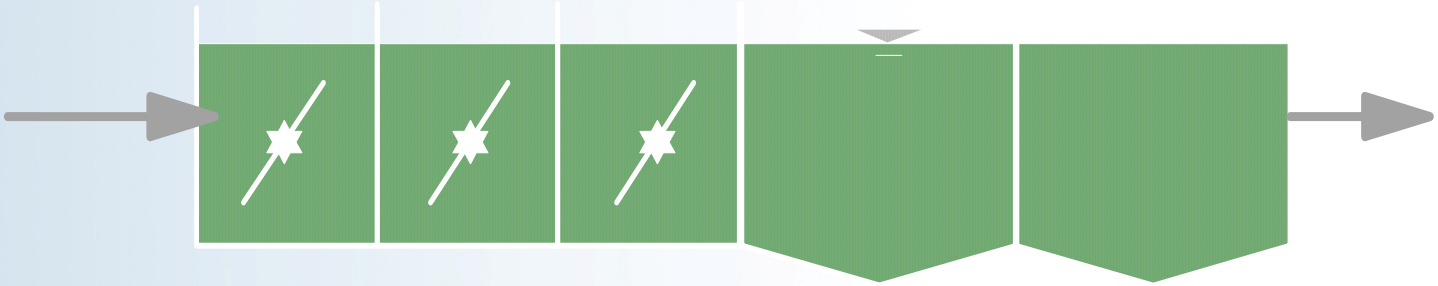
# Ozone for Primary Disinfection & Taste & Odor Control
# Ann Arbor, MI (cont.)

- Lessons Learned
  - THM/HAA formation reduced (as expected)
  - 45-55% TOC removal
  - Enhanced *Giardia* and virus inactivation
  - Ozone-induced AOC stabilized by biological filtration
  - Bromate from bromides present in source
  - Nitrification control required
  - Higher degree of operator attention required intensive training

Specific Change:

# Coagulation/Softening Changes

- Enhanced Coagulation
  - Consumes alkalinity
  - Lower coagulation pH
  - Increasing coagulant dose
  - Switch coagulant
  - Adding a coagulant aid polymer
- Enhanced Softening



## Coagulation/Softening Changes

# Why Enhanced Coagulation or Softening?

- Reduce DBP formation
- Improve disinfection effectiveness by:
  - Reducing NOM
  - Allow increased disinfectant dosages for pathogen inactivation
- Reduce bromate formation
- Improve arsenic and rad removal
- Improve GAC adsorption performance

## Coagulation/Softening Changes

# Recognize Potential Conflicts/Challenges

- Flocculation/Sedimentation performance
- Filter performance - shift in particle size distribution and character
- Increase in soluble aluminum may create post-precipitation problems
- Shifts in pH, $Cl^-/SO^{-2}$ ratio, TOC, and alkalinity may impact LCR-CCT
- Changes in residuals quantity or characteristics

*Specific Change:*

# Softening Practices

## Softening Alternatives

- Precipitative Softening
  - Straight Lime
  - Lime-soda Softening
  - Excess Lime Softening
- Membrane Softening (nanofiltration)
  - Removes all particulates
  - Inorganic and larger dissolved organic compounds
- Ion Exchange
  - Exchanges Ca & Mg for Na
  - Effective for As, $NO_3$, Uranium

*Specific Change:*

# Softening Practices

## All softened waters not equal!

- Lime or Membrane Softening
  - Removes/lowers alkalinity
  - Removes/lowers dissolved solids
- Ion Exchange Softening
  - Exchanges $Na^{+}$ for $Ca^{++}$ and $Mg^{++}$
  - Does not remove/lower alkalinity
    - High alkalinity may promote Cu problem
  - Does not remove/lower dissolved solids

Simultaneous Compliance Challenges and Treatment Process Interactions are Likewise Unequal

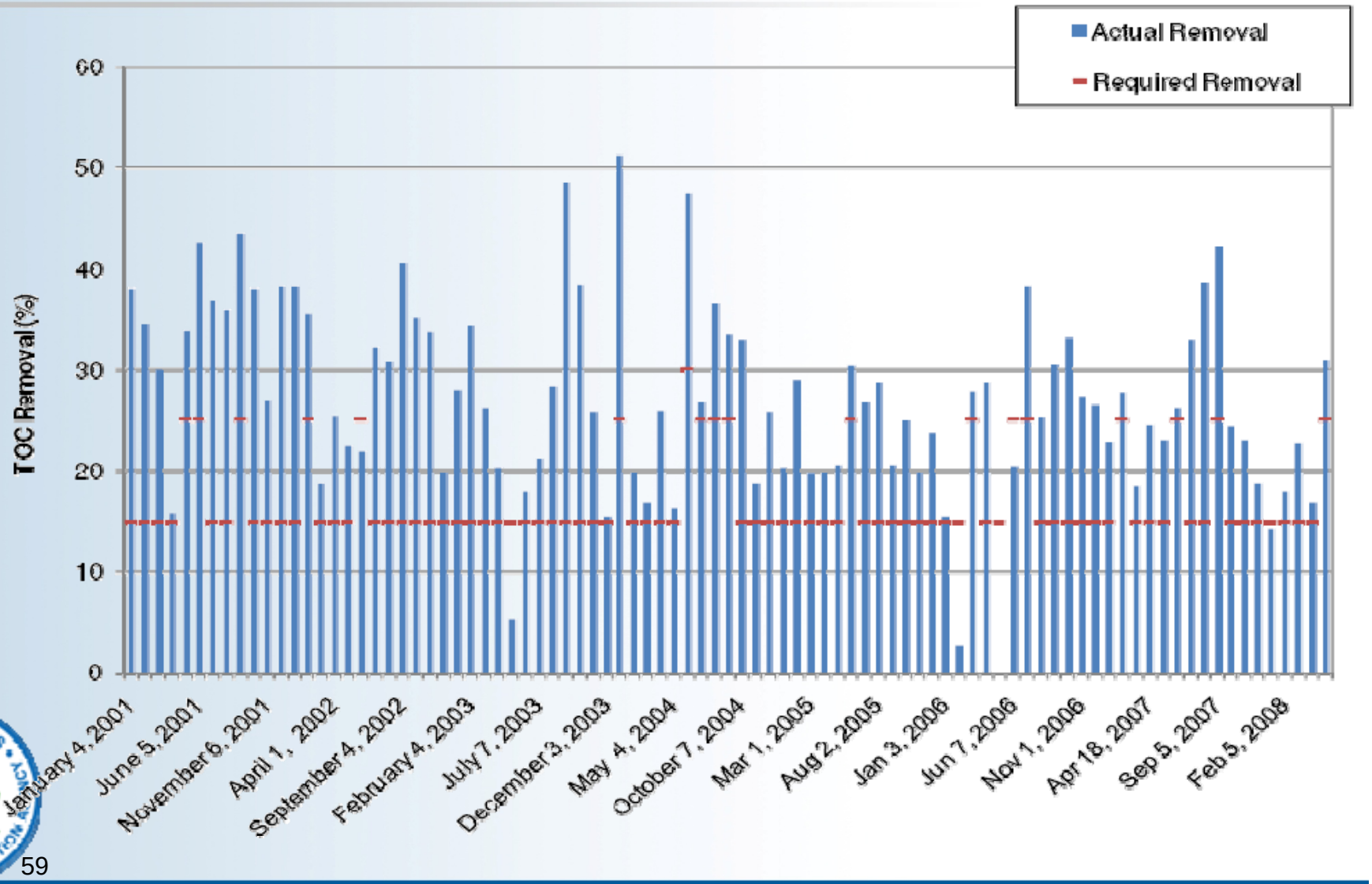
# Softening
# Simultaneous Compliance Challenges

Precipitative Softening

- Removes TOC/DBP precursors (with coagulant)
- Stabile WQ if enough alkalinity
- Required stabilization
  - bypass/blending
  - recarbonation
  - sequestering agent
- May limit disinfection alternatives
- Increases scaling potential
- High residuals production

# TOC Removal by Straight Lime Softening

## Bay City, Michigan



# Softening
# Simultaneous Compliance Issues

Nanofiltration/Reverse Osmosis

- Rejects bacteria, viruses, protozoa
- Removes DBP precursors, As, $NO_3$
- Removes hardness
- Removes SOCs/VOCs
- Increases corrosivity
- 20-30% loss to reject
- Pre-treatment
- Post-treatment

# NF Membrane Softening for TOC Removal
# West Palm Beach, FL

- 13.5 MGD lime softening plant converted to membrane softening
  - High DBPs / High TOC GW
  - Achieved softening, 90% TOC removal, other organics
- Significant pre-treatment and post treatment
  - Degasification air stripping
  - Raw water blending for carbonate stability and CCT
  - Chloramination

# Softening
# Simultaneous Compliance Issues

Softening practices have significant simultaneous compliance interactions!!

- May constrain primary disinfection options
  - Chlorine less effective at higher pH
  - Giardia CT not defined above pH 9
  - ClO2 plus recarbonation >> Chlorates
  - High pH with ozone may form more bromate
- CCT Impacts
  - pH/Alkalinity/DIC shifts
  - Buffering capacity
  - Carbonate stability
  - Cl/SO4 ratio shifts

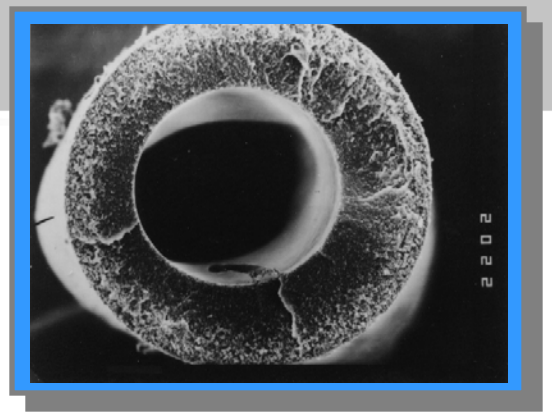
# Softening
# Simultaneous Compliance Issues

Softening practices have significant simultaneous compliance interactions

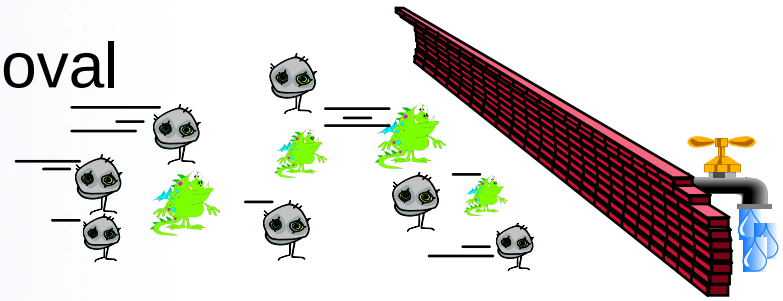
- Recarbonation or sequestering agent for stabilization
  - Stabile water if pH/alkalinity right
  - If not, may increase scaling potential
  - Excessive use of sequestering agents may destabilize scale in distribution system
- NF/RO membranes easily fouled by organics/minerals
- NF/RO will increases corrosivity
- High residuals production
- High TDS residuals stream

## Specific Change:

# Membrane Filtration

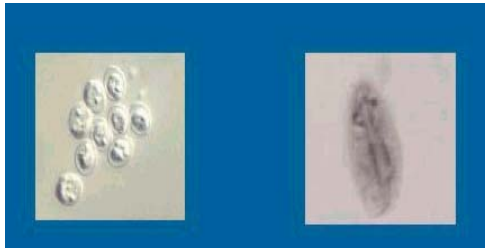


- Low pressure membranes
  - Microfiltration (0.1-0.4 um)
  - Ultrafiltration (0.01-0.05 um)
- Excellent removal of bacteria, Giardia, Cryptosporidium
- Virus removal a fundamental difference between MF and UF:
  - MF 0.5 - 2.0 log virus removal
  - UF 3.0 - 4.0 log virus removal



# Membrane Filtration:
# Why Practice Membrane Filtration?

- **Surface Water Treatment Rule (SWTR)**
  - 3-log removal/inactivation of *Giardia*
  - 4-log removal/inactivation of viruses
  - Combined filter effluent turbidity 0.5 NTU



- **Interim Enhanced and LT1 Enhanced SWTR**
  - 2-log *Cryptosporidium* removal/inactivation
  - CFE 0.3 NTU and individual filter monitoring requirements

- **Long Term 2 Enhanced SWTR**
  - Up to 2.5-log *Cryptosporidium* removal/inactivation beyond conventional treatment based on source concentration

# Membrane Filtration:
# Recognize Potential Conflicts/Challenges

- Fouling Potential
  - NOM
  - Fe, Mn, carbonate solids, others
- Pretreatment requirements
  - NOM/TOC/DBP precursors
  - Coagulation-sedimentation
- Oxidant compatibility (polypropylene)
- Membrane integrity
- Demonstration requirements
- Operator training/skill set

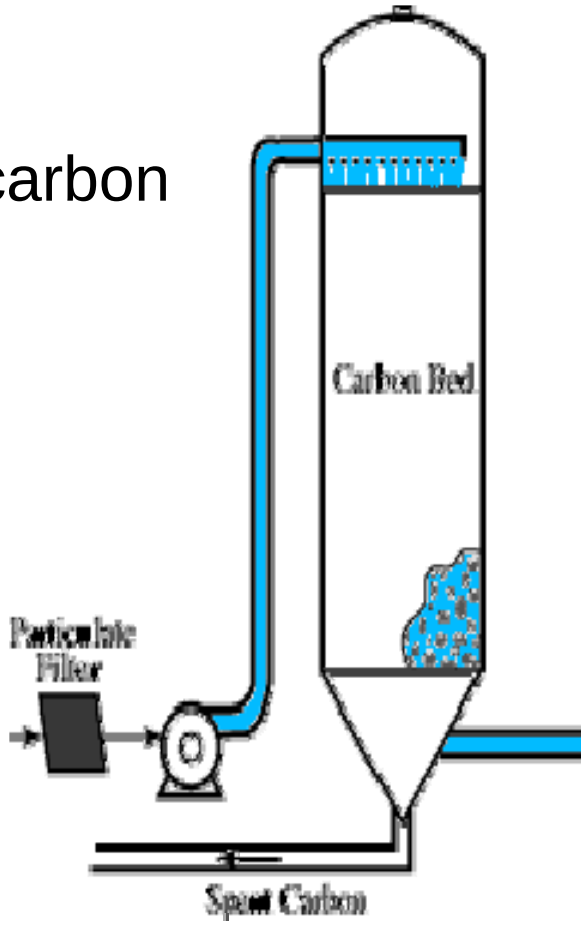
# Membrane Filtration:
# Mitigating Potential Conflicts/Challenges

- Pretreatment for removal of NOM, DBP precursors, other foulants
  - Coagulation
  - Sedimentation
  - Pre-oxidation/pre-filtration
- Demonstrate log removal credit for pathogens (especially viruses)
- Review/understand:
  - State demonstration requirements
  - Operator training/certification

## SOC/NOM Removal Processes

# Granular Activated Carbon Adsorption

- Good DBP precursor removal
- Significant T&O Removal
- Removes assimilatible organic carbon (AOC) after ozone
- Limits ability to pre-chlorinate
- Unintended reduction in disinfectant residual
- Bacteria release from biologically-active GAC
- New residuals - spent GAC disposal



## Atrazine & TOC Removal using GAC Filter-Adsorbers
# Higginsville, Missouri

- 2 MGD facility / 12-hr/day operation
- Converted dual-media filters to GAC filter-adsorbers (7.5 min EBCT)
- Good particulate removal
- Trade-off between removal of Atrazine and DBP precursors (pH effects)
  - 50% Atrazine removal
  - 25% TOC removal
- Bench-scale testing – needed before implementation

*GAC in Existing Filters*

## SOC/NOM/IOC Removal:
# Nanofiltration/Reverse Osmosis

- Rejects bacteria, viruses, protozoa
- High DBP precursor removal
- Removes $As^{+3}$ and $As^{+5}$
- NF/RO membranes easily fouled by organics/precipitated minerals
- Demineralization increases corrosivity
- Residuals – disposal of high TDS reject stream

GAC/NF/RO Processes

# Overcoming Compliance Challenges

- Recognize potential for GAC and NF/RO to impact existing treatment and distribution system chemistry
  - Anti-scaling chemicals for NF/RO
  - GAC impacts on disinfectant residual
  - Control any release of bio-mass from GAC
  - NF/RO membrane fouling potential
- Collect data! Evaluate!

GAC/NF/RO Processes

# Overcoming Compliance Challenges

- Re-optimize CCT as needed, and ensure CCT is effective over the full range of WQ conditions
- Keep distribution system chemistry as consistent as possible
- Evaluate impact of GAC and membrane processes on residuals quantity, character and disposal options

# Once a change is under consideration or review…

# Required Advanced Notification

## 40 CFR 141.90 (a) (3)

*"… as early as possible prior to the **addition of a new source or any long-term change** in water treatment, a water system deemed to have optimized corrosion control… shall **submit written documentation** to the State describing the change or addition.*

*The State must **review and approve** the addition of a new source or long-term change in treatment **before it is implemented**…*

*Examples of long-term treatment changes include the addition of a new treatment process or modification of an existing treatment process. ."*

# Required Advanced Notification Long-Term v. Short-Term Changes

**Long-Term Changes**

- New treatment process
- Modification of existing treatment process
- Switching secondary disinfectants
- Switching coagulants
- Switching corrosion inhibitors

**Short-Term Changes (notification not required)**

- Adjusting chemical feed rates to match variations in source water quality or temperature
- "Tweaking" existing operational practices
- Distribution system BMPs (nitrification control, flushing, etc.)
- General "optimization" efforts

# Utilities/Regulators Need to Anticipate Interactions/Conflicts/Challenges

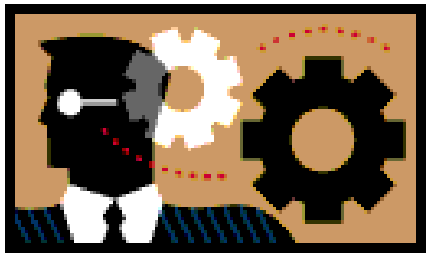
- Direct SDWA-driven Rule conflicts
- Treatment process interactions/impacts
  - Disinfection
  - Oxidation/aeration
  - Softening
  - GAC Adsorption
  - Residuals production
- Distribution system impacts
  - Microbial/regrowth
  - Chemistry/Corrosion/Pipe-scale
  - Secondary/Aesthetics/O&M practices

ID possible solutions

Recognize Potential Issues

Screen Alternatives

Collect Site-specific Data



# Once a Change is Under Consideration/Review...

- Characterize response "why, what, how?"
- Why was this response selected over another?
- Were alternatives compared? What?
- Is this compatible with existing treatment? Are we sure?
- How might this alter dist. system WQ?

# Once a Change is Under Consideration/Review… cont.

Identify possible system conflicts/challenges

- Weigh impacts on existing treatment:  Data?
- Will it fit? Footprint? Hydraulic grade line?
- Residuals production/disposal
- Need to re-optimize CCT?
- WWTP Impacts (P, Zn)
- Wholesale/consecutive system issues
- Sufficient operator training/skill set in place?

# How Was Proposed Response or Recommended Change Developed?

Evaluation/demonstration completed?

- Water quality monitoring
- Disinfection Profiling/Benchmarking
- Hydraulic modeling
- Desktop evaluations
- Analogous System Study
- Bench-scale testing
- Pilot Plant testing
- Engineering report

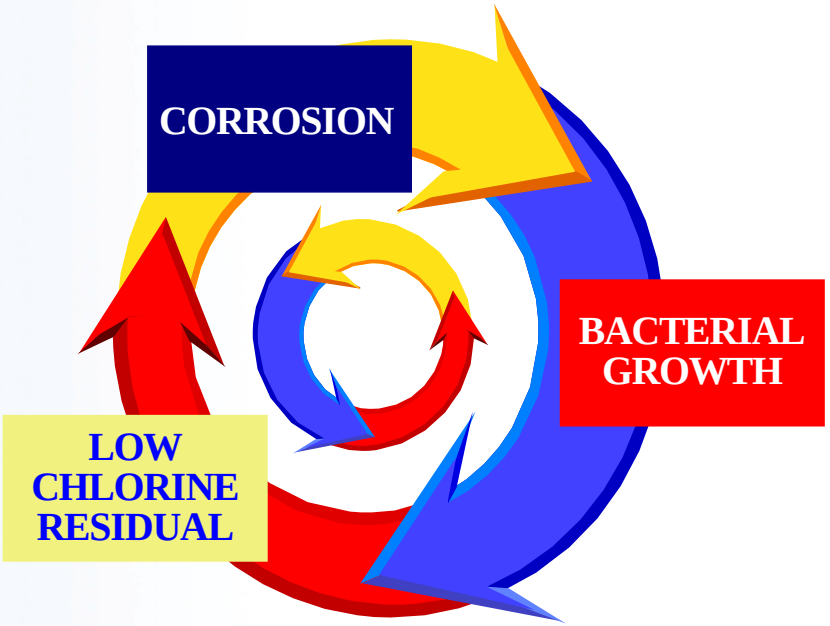
# Were the Impacts of the Proposed Action Evaluated in Terms Of...

- Applicable primary and secondary WQ goals
- Overall facility capacity
  - redundancy, reliability
- Compatibility/interactions with existing unit process operations
- Impact on residuals quantity/characteristics
- Compatibility with distribution system operations
- Consecutive system requirements

# Wrap-Up

# Negative Water Quality Impacts Can Result from a Diverse Array of Changes

- Source Water
  - New Source
  - Source Blending
- Treatment
  - Major unit process modifications/additions
  - Oxidants/disinfectants
  - Shifts in ORP, dose
  - $O_3$, chlorine dioxide, or UV
  - Enhanced/modified coagulation
  - Modified CCT
- Distribution System
  - Conversion to chloramines
  - Switch from $Cl_2$ gas to NaOCl
  - Nitrification
  - Nitrification control



# Numerous and Subtle *Secondary Impacts* Increasingly Constrain Water System Operations

**Hardness**
**Taste & Odor**
**Iron/manganese**
**"Dirty Water"**
**Degradation of Filter Performance**

**Scale Stability & Metals Release**
**Nutrients and Regrowth Problems**
**Residuals Issues (As, Rads)**
**WWTP conflicts**

**Blending of source/finished waters**
**Changes in flow, direction and pressure**
**Cross connection control**
**Flushing and other maintenance activities**

# Take Away

- Utilities/regulators need to recognize and assess <u>changes</u> with the potential to impact:
  - *source of supply*
  - *water quality performance*
  - *treatment process effectiveness*
  - *distribution system pH, disinfectant concentrations*
  - *corrosion control treatment*

  ….<u>this is "**simultaneous compliance planning**."</u>
- Significant water quality monitoring, treatability, or process evaluation may be necessary to assessment efforts
- Utility compliance responses are sometimes constrained by "aesthetics/secondary" issues
- Webinar #4 will cover more distribution system WQ challenges.
- Technical resources are available.

# Resources

- USEPA. January 2009. Ground Water Rule (GWR) Implementation Guidance
- USEPA. November 2008. Ground Water Rule Corrective Actions Guidance Manual. EPA 815-R-08-011
- USEPA. October 2008. Sanitary Survey Guidance Manual for Ground Water Systems
- USEPA. March 2007. Simultaneous Compliance Guide for the Long Term 2 and Stage 2 DBP Rules. EPA 815-R-07-017
- AWWA 2005. "*Managing Lead and Copper Rule Corrosion Control Practices to Avoid Unintended Consequences*"
- WRF 3115 "Simultaneous Compliance Tool" 2009.
- EPA 1999. Microbial and Disinfection Byproduct Rules Simultaneous Compliance Manual. EPA 815-R-99-015
- WRF "Balancing Multiple Water Quality Objectives," 1998.

# Discussion

# Q&A