



# EarthTec:

**Not all copper is created Equal**

**Paul Besenti- Midwest Region- MN,WI,IL,IN,MI,OH,MO,KS,IA,NE,KY,TN**

**Ed Shimer- East Region- GA, FL**

**Allan Goldschmidt-South Region- OK, AR**

**Tim Hartman- West Region**

**David Carrington- Business Manager**

**Earth Science Labs, Inc. Since 1991**

# EarthTec Technical Team



- David Nicholas- CEO- April 2013
  - 35 years in chemical/water treatment engineering
- Dave Carrington- EarthTec Business Manager- April 2014
  - 25 years in Water/Wastewater engineering
- David Hammond- Senior Scientist- May 2014
  - PhD over Zebra Mussels
- Reid Bowman- Chemist- January 2015
  - PhD – 40 years product formulation Dow Chemical
- Fred Singleton- Micro-Biologist- September 2015
  - PhD- 35 years pesticide research at Dow Chemical
- Allan Goldschmidt- Selling EarthTec since 2005
- Paul Besenti- March 2017
  - 20+ years water/wastewater experience.
- Case Studies- Customer supplied data for most applications

# EarthTec- 2 for 1 Value



- In WTP Pipelines, Intakes and Reservoirs:
- Eliminate Zebra Mussels and Algae with a single low dose of EarthTec/EarthTecQZ
  - Eliminate zebra and quagga mussels
  - Eliminate algae from sed basins
  - Reduce taste and odor
  - Reduce TOC
  - Prevent and control cyanobacteria blooms
  - Increase filter run times

# EarthTec Chemistry

- **EPA Registered** as an Algaecide/Bactericide/Molluscicide
- Registered in **All 50 States** as Algaecide/Bactericide and in several countries. 27 states as Molluscicide
- Certified to **NSF** Standard 60 for Drinking Water
- EarthTec Is the **Easiest, Safest and Most Efficient** Method to Deliver Copper





# EarthTec Chemistry

EarthTec is:

- **Liquid** formulation containing **5% copper** by volume
- Made from copper sulfate + proprietary carrier molecule (ET-3000)
- Unique features:
  - Copper is **99.99% cupric ion form (Cu<sup>++</sup>)** so it is **readily bioavailable**
  - Durational Control- prevents and controls for 14-30 days
  - **Rapid-dispersing properties**, so no need for mixing
  - Low pH- 0.2-0.3
  - Infinitely soluble in water, stays suspended, **will not settle** out
  - Low concentrations yield high performance: **30-120 ppb copper**
    - **1 ppm EarthTec = 60 ppb copper**
    - **Most applications require 1-2 gallons/mgd depending on water quality**
    - **No immediate cell lysing**



# EarthTec Uses

EarthTec is a water pretreatment chemical:

- Used in WTP reservoirs, intakes and pipelines
- Control algae and blue-green algae (**cyanobacteria/HAB's**)
- Reduce taste and odor compounds, especially **geosmin**
- Reduce TOC
- No production of DBPs, **THMs** or **HAA5's** (regulatory issues)
- Reduce downstream consumption of:
  - **activated carbon- ozone - coagulants**
- Increase filter run times
- Reduce **biofilm/slime on pipes** (Improves pumping efficiency)
- Eliminate clogging in nozzles/sprinkler heads due to algae
- Control zebra mussels and quagga **mussels: EarthTec QZ**
- Reduce a wide range of Bacteria (non-public health)
- Wastewater filter/reuse

# Reduces Carbon and Permanganate



- Reducing Carbon by 2 ppm will pay for the cost of EarthTec.
  - EarthTec reduces T&O and algae which can lead in a 5-10 ppm or more reduction in Carbon. This can save a customer \$50-100/mgd per day.
- Reducing Permanganate by 2 ppm will pay for the cost of EarthTec.
  - Permanganate is often misapplied at the intake. Customers have to overcome the algae load in order to carry any oxidizing residual to the WTP.

# Reservoir Treatment Methodologies

- Treat Entire Reservoir
- Spot-Treat Sections of Reservoir
- Treat Area around the WTP Intake, e.g., a 30-day supply





# EarthTec Reservoir Treatment

- Copper Remains in Suspension
- No Restrictions After Application
- Low Dose Prevents Algae Blooms
- Better Water Quality at Plant Influent  
(maximize contact time where possible)
- Competition:
  - Copper Sulfate- Inefficient-Ineffective-Labor Intensive
  - PAK27- Expensive- Kills everything- Daily applications

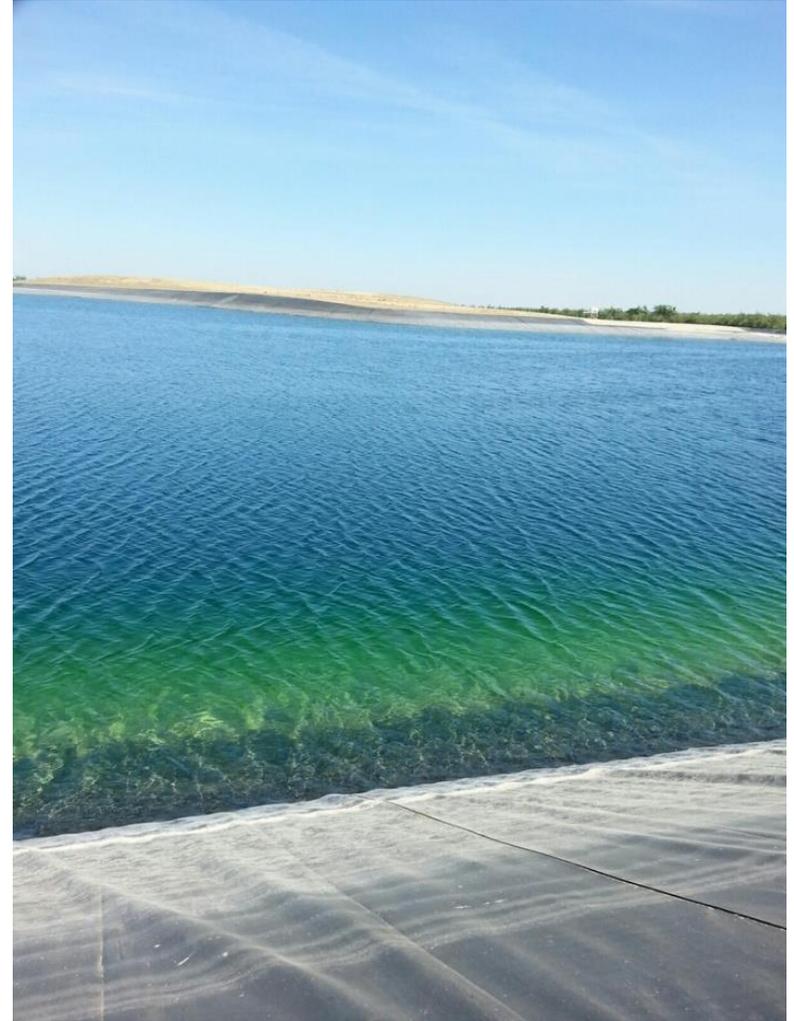
# PAK-27 and Peroxide Products



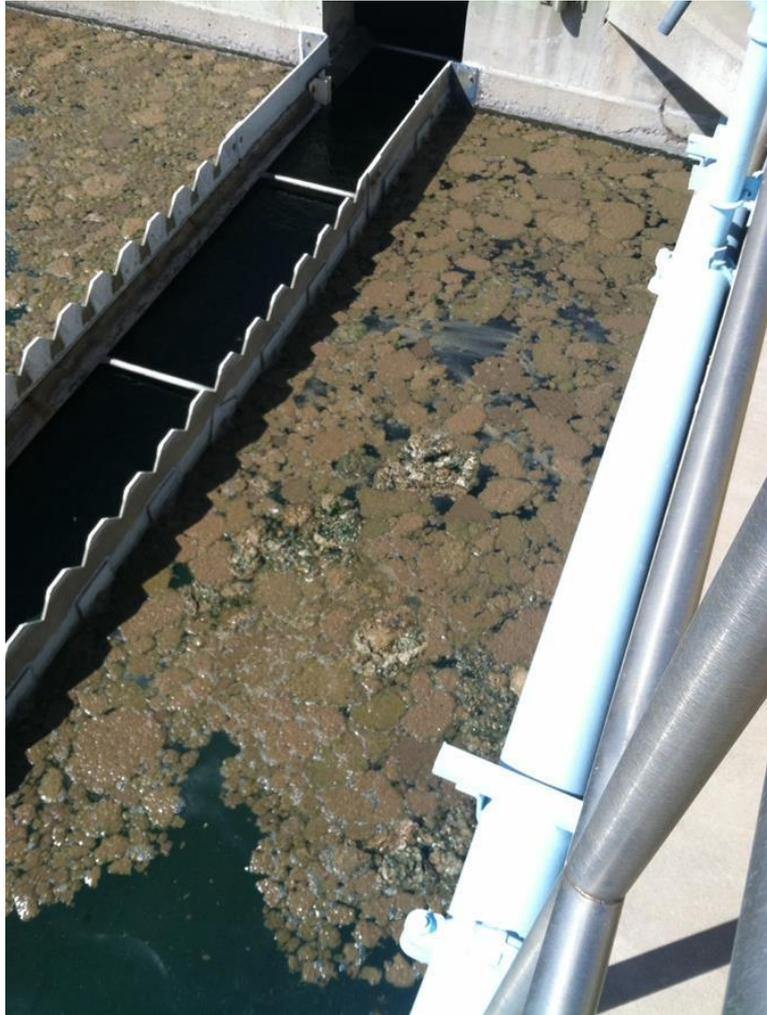
- EarthTec will control existing algae and prevent new algae in reservoirs for 14-30 days. (Durational Control)
- EarthTec is 50-75% less cost.
- Peroxide products kill everything in the water (Biocide) and only last for 2-5 days before repeat applications are necessary.
- EarthTec will not rupture the algal cell or increase the cyanotoxin levels.
- Peroxide followed by EarthTec can be a great 1-2 punch

# Reduces Algae

**EARTHTEC**<sup>®</sup>



# EarthTec use in WTPs



Before

# EarthTec use in WTPs



After





# Algae Kill Rates

- EarthTec starts killing immediately.
- Algae usually dies in 12-24 hours
- Heavy algal mats often take 3-7 days in order to kill all the way to the walls.
- 30 ppb EarthHtec copper residual will prevent new algae growth.

# EarthTec use in WTPs



**Before**

# EarthTec use in WTPs



After

# Treatment Example

## Texas, 50 MGD

### QUALITATIVE ASSESSMENT



#### Before EarthTec:

- Algae Mats Floating in Clarifiers
- Algae on Steel (Needed Skin Divers to Clean Framework)
- Algae present in Outdoor Filters (Short Filter Runs)
- Feeding Copper Sulfate Crystals
- Feeding 12 ppm PAC

#### With EarthTec:

- Clarifiers Clear of Algae
- Algae No Longer Adhered to Structural Steel
- Outdoor Filters Free of Algae and more regular filter runs
- Discontinued Copper Sulfate
- Only Feeding PAC when needed, <3 ppm



# Treatment Example

## Texas, 50 MGD

### COST-BENEFIT ASSESSMENT



- **Before EarthTec:**
  - PAC at 12ppm,  $\$1.00/\text{lb} \times 5,000 \text{ lbs/d} = \$5,000/\text{d}$
  - Copper sulfate at  $\$1.50/\text{lb} \times 100 \text{ lbs/d} = \$150/\text{d}$
  - Total treatment for 50 MGD =  **$\$5,150/\text{d}$**
- **With EarthTec:**
  - PAC at <3ppm as needed,  $\$1.00/\text{lb} \times 1,250 \text{ lbs/d} = \$1,250/\text{d}$
  - No copper sulfate
  - EarthTec =  $\$400/\text{d}$
  - Total for 50 MGD =  **$\$1,650/\text{d}$**
- EarthTec saving them  **$\$3,500/\text{d}$**  during season

**A 2 ppm reduction in consumption of PAC (Powdered Activated Carbon) offsets cost of 1 ppm EarthTec**



# Treatment Example

## Texas, 50 MGD

### Average TOC Removal Without and With EarthTec



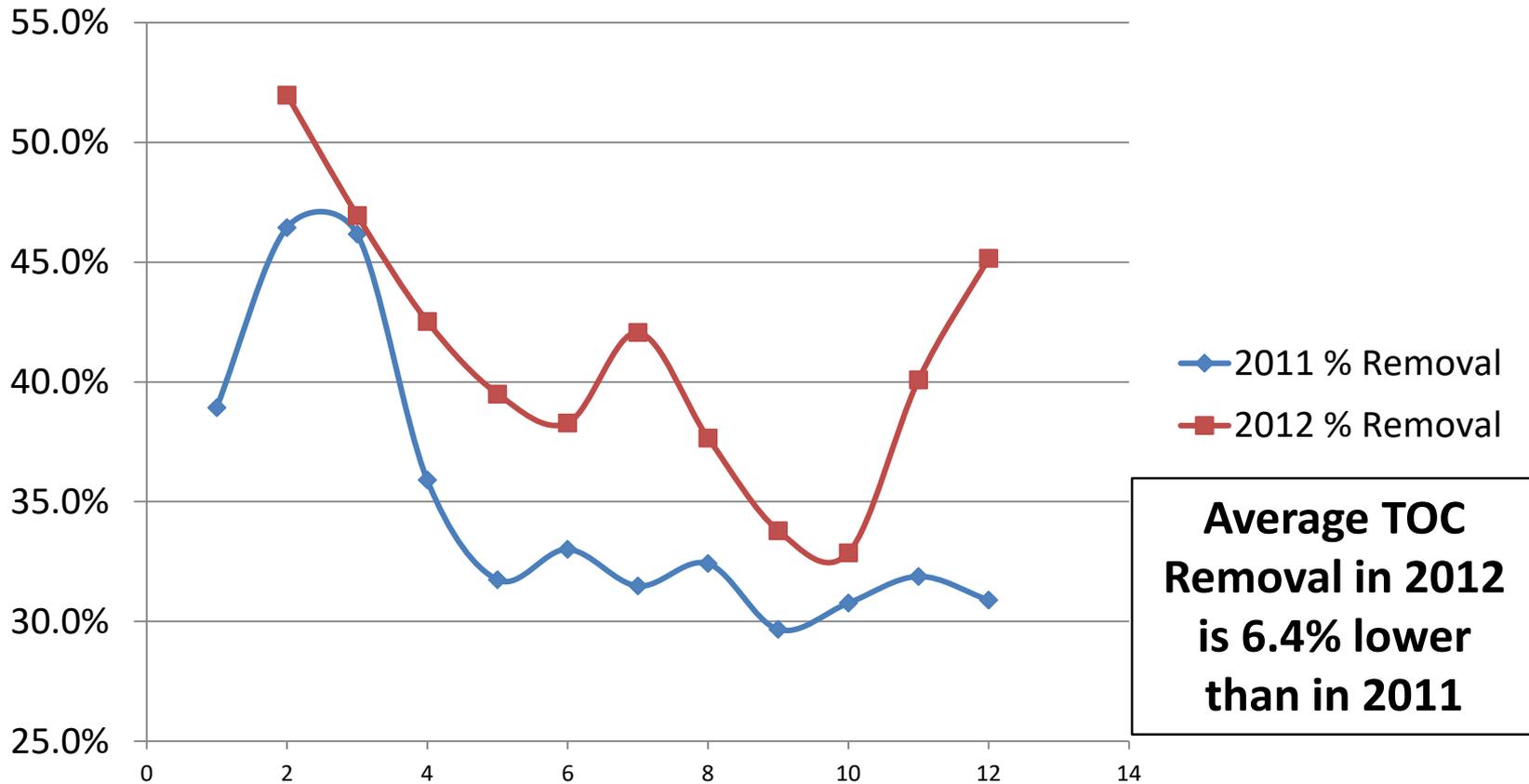
Average TOC Removal without EarthTec				Average TOC Removal with EarthTec				Year-over-Yr Improvement
2011	Raw	Treated	% Removal	2012	Raw	Treated	% Removal	
Jan	4.65	2.84	38.9%	February	5.08	2.44	52.0%	5.5%
Feb	5.47	2.93	46.4%	March	5.56	2.95	46.9%	0.8%
March	5.22	2.81	46.2%	April	5.88	3.38	42.5%	6.6%
April	4.93	3.16	35.9%	May	5.14	3.11	39.5%	7.8%
May	5.45	3.72	31.7%	June	4.78	2.95	38.3%	5.3%
June	5.18	3.47	33.0%	July	4.47	2.59	42.1%	10.6%
July	5.4	3.7	31.5%	August	4.78	2.98	37.7%	5.2%
August	5.46	3.69	32.4%	September	4.41	2.92	33.8%	4.1%
September	5.46	3.84	29.7%	October	4.29	2.88	32.9%	2.1%
October	4.29	2.97	30.8%	November	4.64	2.78	40.1%	8.2%
November	3.67	2.5	31.9%	December	4.85	2.66	45.2%	14.3%
December	3.82	2.64	30.9%					
January	4.21	2.66	36.8%					
<b>Average without EarthTec</b>			<b>35.1%</b>	<b>Average with EarthTec</b>			<b>41.0%</b>	<b>6.4%</b>



# Treatment Example

## Texas, 50 MGD

### Average TOC Removal Without (2011) and With (2012) EarthTec



# Copper Comparison



- EarthTec starts working immediately with results usually with 24 hours
- EarthTec outperforms other copper products containing 2x-5x the amount of copper.
- EarthTec is much more efficient at delivering copper to algae/bacteria
- EarthTec does not waste any copper as it will stay in suspension until consumed by algae, bacteria or organics.

# Dispersion Video



# Copper Sulfates vs. EarthTec



	Copper Sulfate	Chelated Copper	EarthTec	
% Copper	25%	9-10%	5%	
BioAvailable CU++	2.5%	20-50%	100%	
Self Mixing	No	No	Yes	
Distribution	Bottom	Slow	Immediate	
pH	2-3	2-3	0.3	

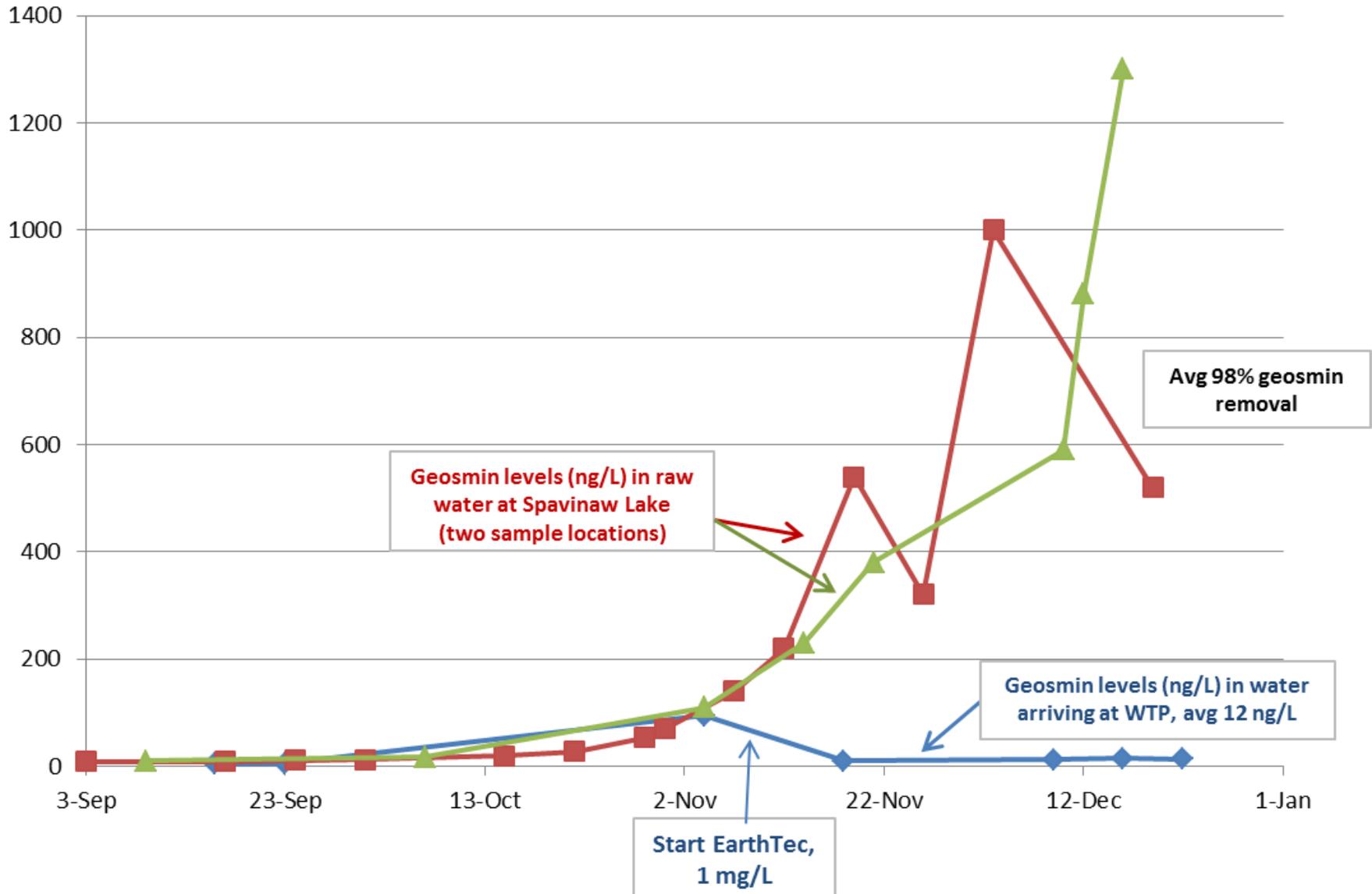
## Treatment Example

### Tulsa, OK

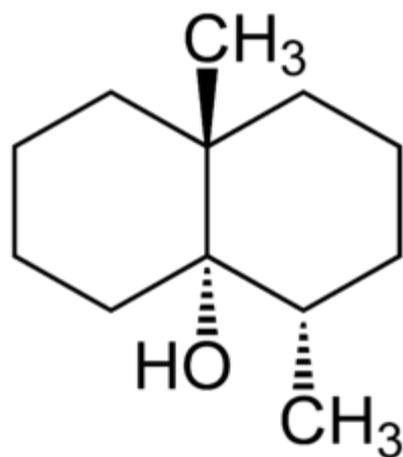


- Source water: Lake Spavinaw and Eucha
- Geosmin at intake often  $>1,000$  ng/L
- Apply 1 ppm EarthTec at 50 mile pipeline intake
- Geosmin at pipeline outfall  $<30$  ng/L

# Tulsa, Dec 2013



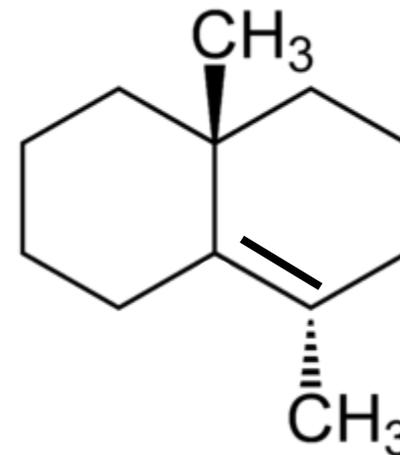
# Proposed Mechanism for Destruction of Geosmin



**Geosmin**

trans-1,10-dimethyl-trans-9-decalol  
182 g/mol.  
Boiling point: 270 °C

Acidic Dehydration



**Argosmin C**

1, 10-dimethyl-l(9)-octalin  
182 g/mol.  
Boiling point: 230 °C

# Treatment Example

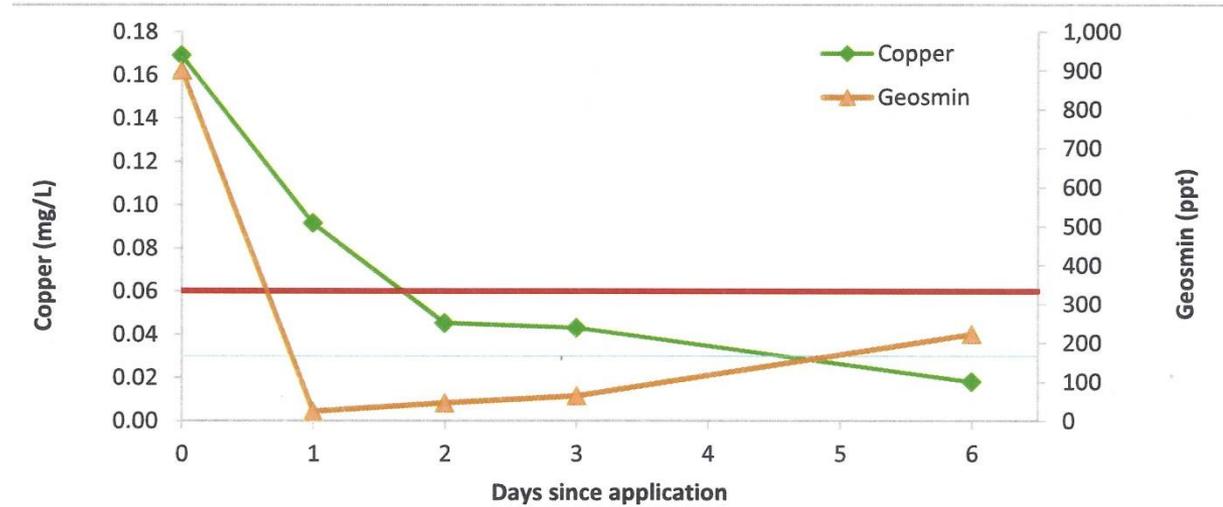
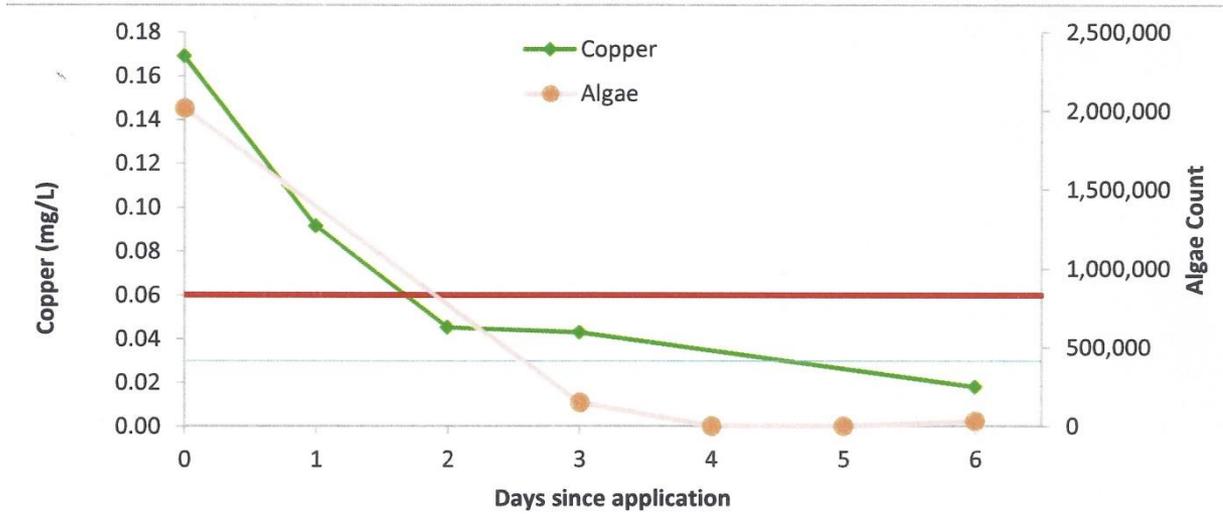


## Tampa



- Source water: Slow-moving river
- Geosmin at time of dose 900 ng/L
- Applied 1 ppm EarthTec at water surface
- Geosmin at 24 h <30 ng/L

# Tampa, Feb 2015



# Cyanobacteria

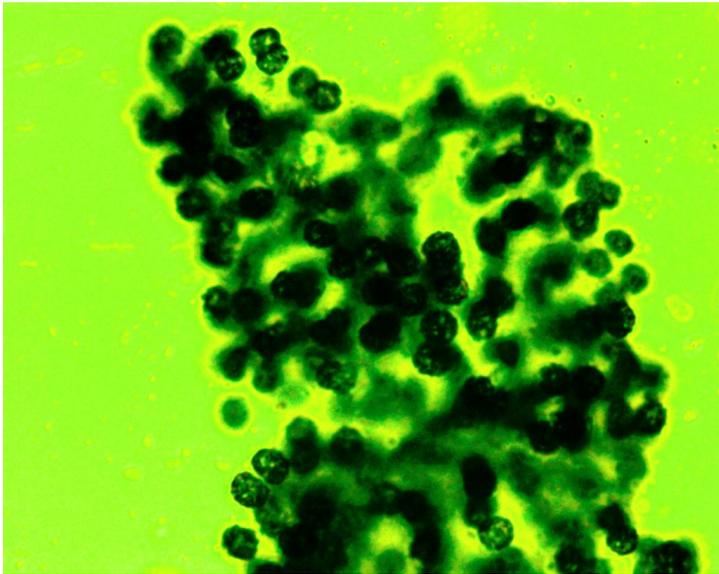
- EarthTec does not rupture algal cells at our low dose of 1-3 ppm.
- EarthTec selectively goes after cyanobacteria at these doses allowing good bacteria to consume intracellular contents.



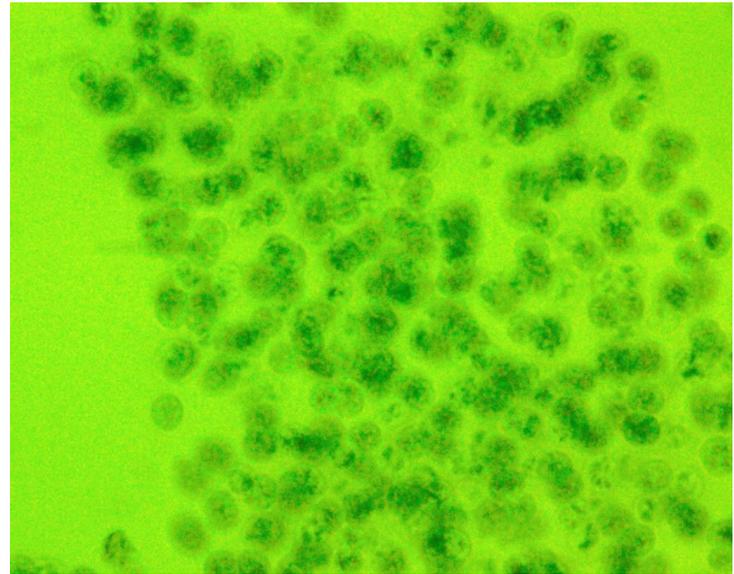
# Effect of 120 ppb $\text{Cu}^{++}$ (in EarthTec) on morphology of *Microcystis* sp. In marina water (Mag. = 400X)



Time = 0

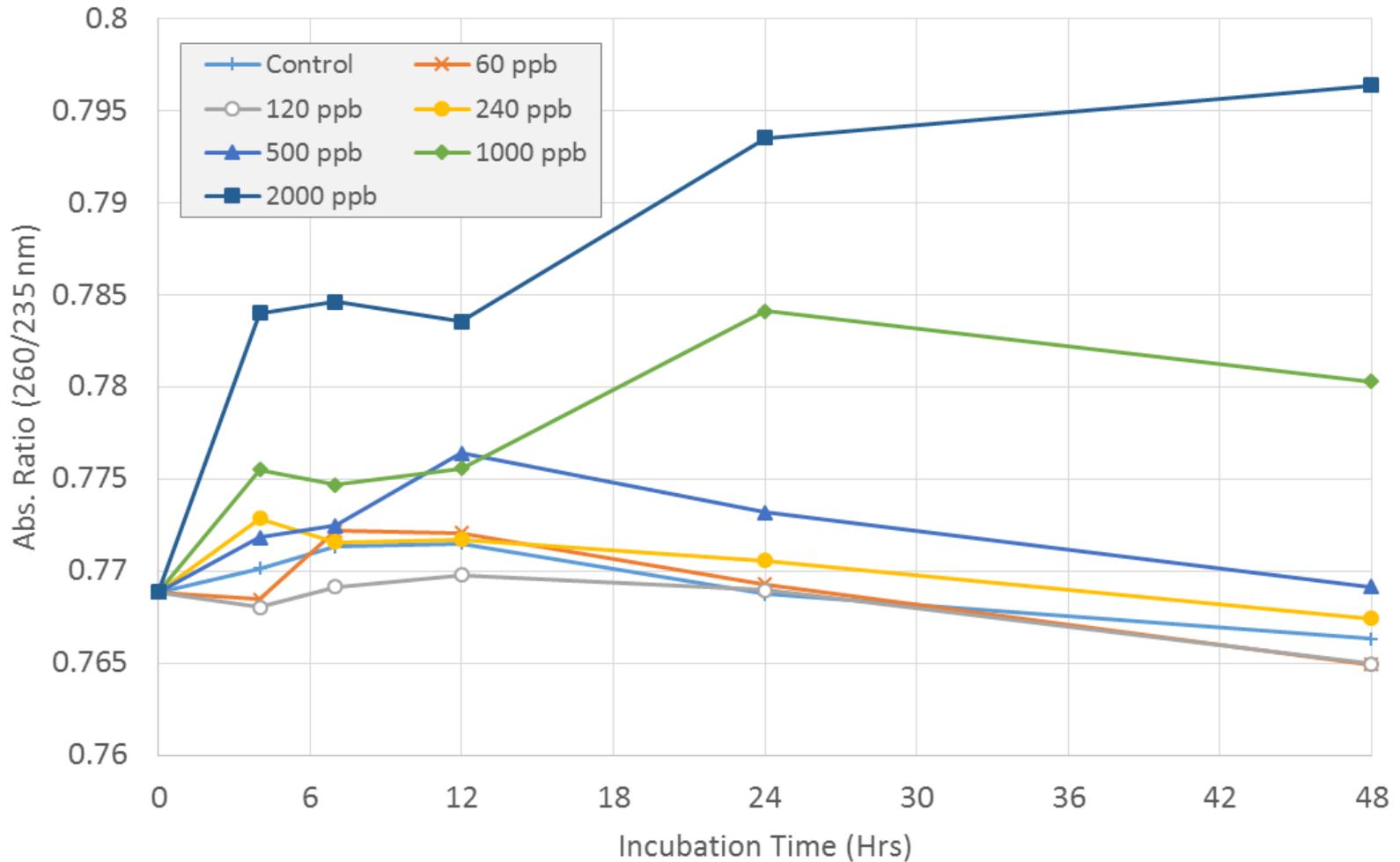


Time = 18 hr



- Cell morphology changed -- spherical to flat
- 3-D morphology of cell cluster lost – globular to single layer of cells

Change in Relative Concentrations of Dissolved Organics in Marina Water (*Microcystis* Bloom) Treated with Selected Concentrations of Cu (EarthTec). Wavelengths = 260 and 235 nm as indices of Nucleic Acids and Carbohydrates, respectively.



# Lake Management



- Easy to apply, no spraying necessary
- If sprayed, batches well with herbicides
- Preventative, long term durational control
- Irrigate immediately
- Irrigation lines – keep clean
- Bacteria control – condo lakes etc.



# SURVEY FORM



Date: \_\_\_\_\_ **PRE-TREATMENT PROCESS SURVEY**

Facility: \_\_\_\_\_

Address: \_\_\_\_\_

Phone: \_\_\_\_\_ Fax: \_\_\_\_\_

Contact Person: \_\_\_\_\_

Raw Water Source: River\_\_ Lake\_\_ Reservoir\_\_ size in acres \_\_\_\_total gallons \_\_\_\_\_

Distance from Raw Source to Influent of Plant: \_\_\_\_\_

Number of Gallons Treated per Day: Winter \_\_\_\_\_ Summer \_\_\_\_\_

T and O: \_\_ Yes \_\_ No \_\_ Geosmin \_\_ MIB Time of Year: \_\_\_\_\_

Raw pH                      Low \_\_\_\_\_ High \_\_\_\_\_

Raw Alkalinity            Low \_\_\_\_\_ High \_\_\_\_\_

Raw Ca Hardness        Low \_\_\_\_\_ High \_\_\_\_\_

Raw TOCs                 Low \_\_\_\_\_ High \_\_\_\_\_

TOCs % Removal Required \_\_\_\_\_

TOCs % Removal Achieved \_\_\_\_\_

THM Counts \_\_\_\_\_

HAA Counts \_\_\_\_\_

Other Chemicals (with Dosages) Being Fed Between Source Water and Plant: \_\_\_\_\_

\_\_\_\_\_

Notes: \_\_\_\_\_

\_\_\_\_\_

\* Draw map on reverse side indicating flow diagram from source to plant with application points of other chemicals.



**EarthTec QZ successfully controls zebra mussels at the intake of a major municipal water treatment plant**

David Hammond, PhD,

Senior Scientist, Earth Science Laboratories, Inc.

# EarthTecQZ



- Eliminate Quagga and Zebra Mussels with EarthTecQZ
  - 20-30 Installations and growing quickly
  - Low dose of 1-4 ppm as QZ achieves 100% mortality
  - WTP intakes and pipelines
  - Fish hatcheries
  - Pond and reservoir eradication
  - Emergency response at lakes
  - Requires additional service and monitoring

**Zebra mussels have historically infested the intake structure of a major  
municipal WTP in the Midwest  
2015-16**

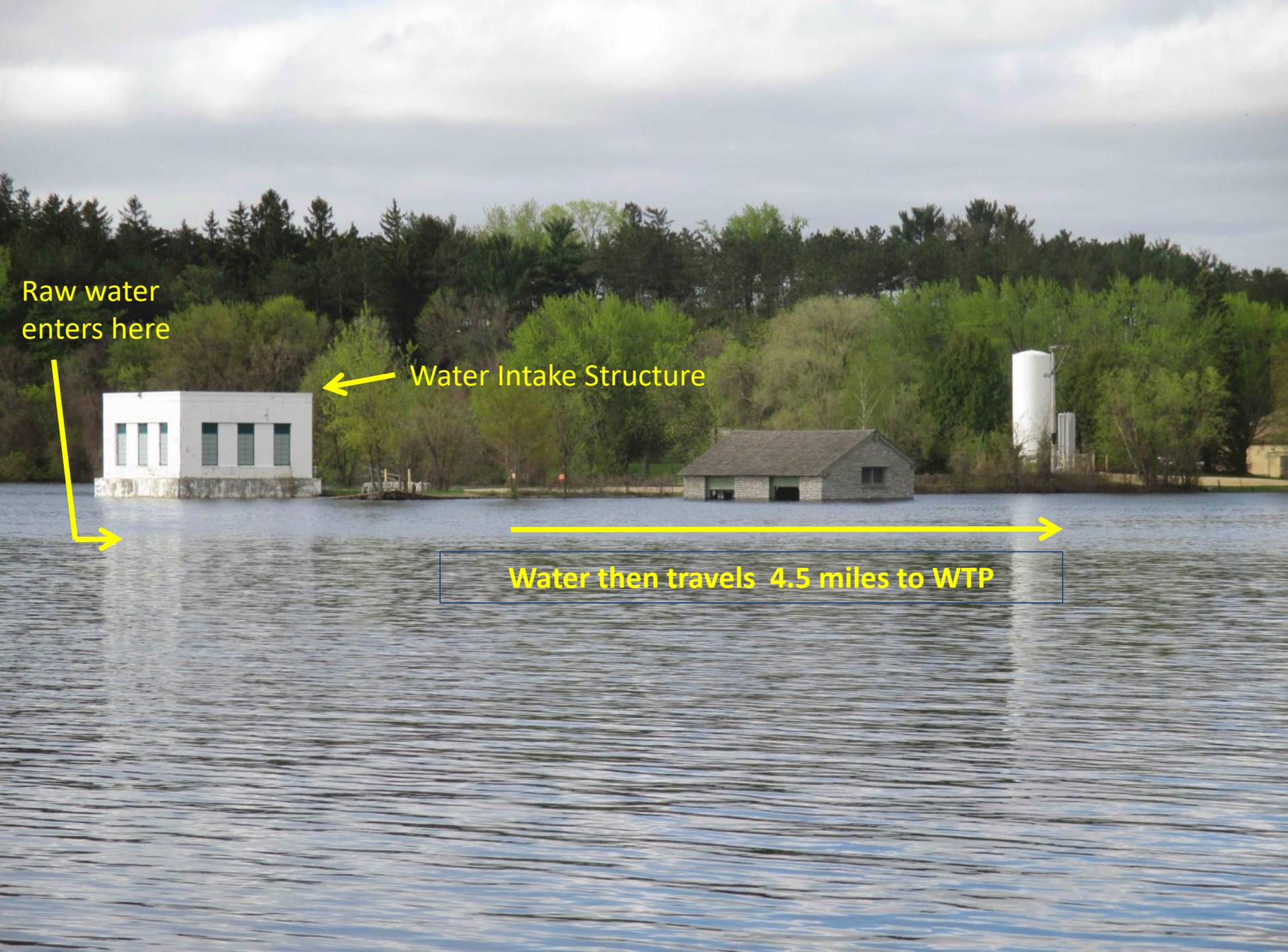


**Raw Water Intake Structure for a 60 MGD Municipal WTP**

Raw water enters here

Water Intake Structure

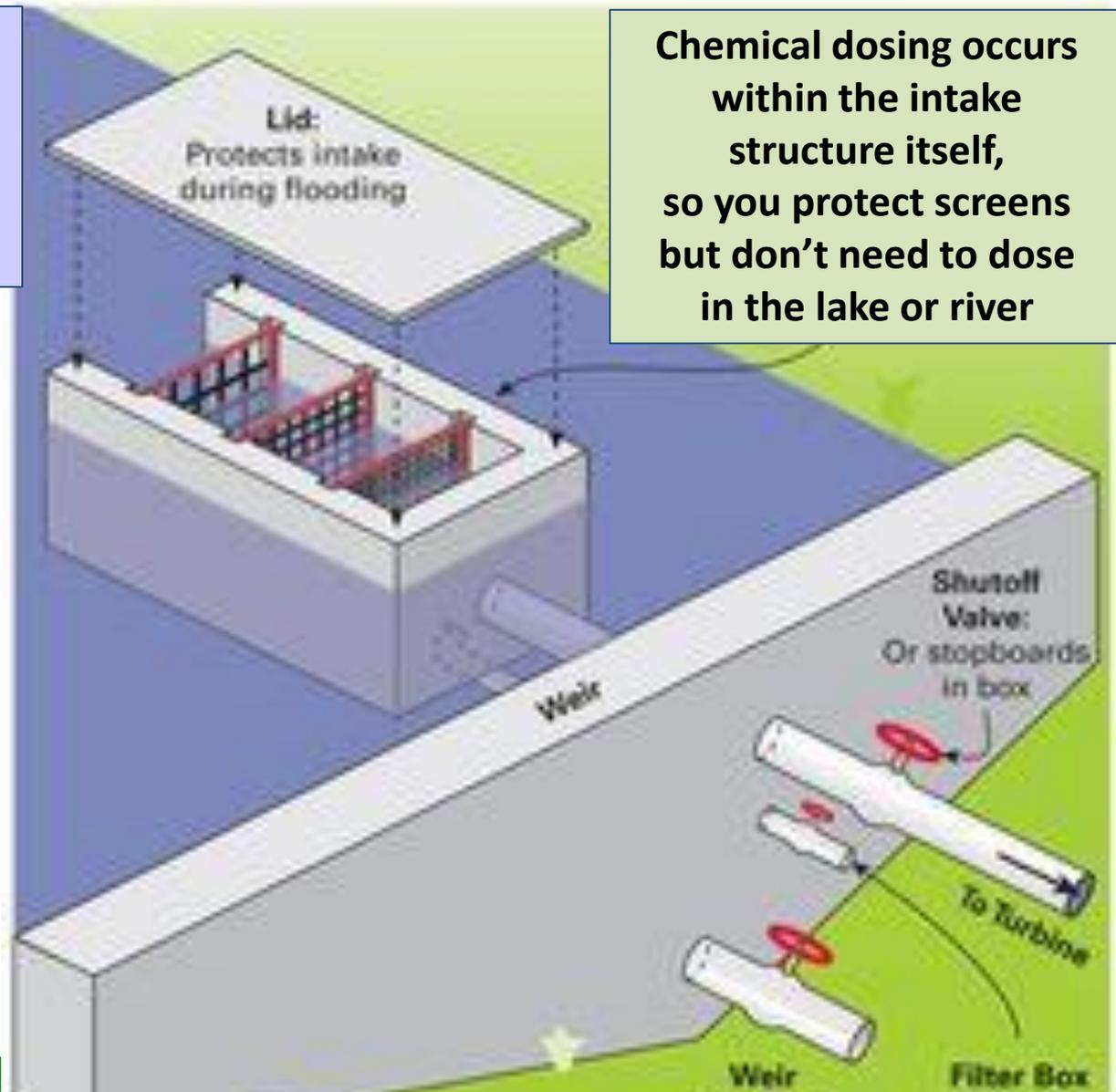
Water then travels 4.5 miles to WTP



# Design of an intake that allows dosing to protect intake screens 2015-16

Raw water enters through openings large enough that they can't clog

Chemical dosing occurs within the intake structure itself, so you protect screens but don't need to dose in the lake or river





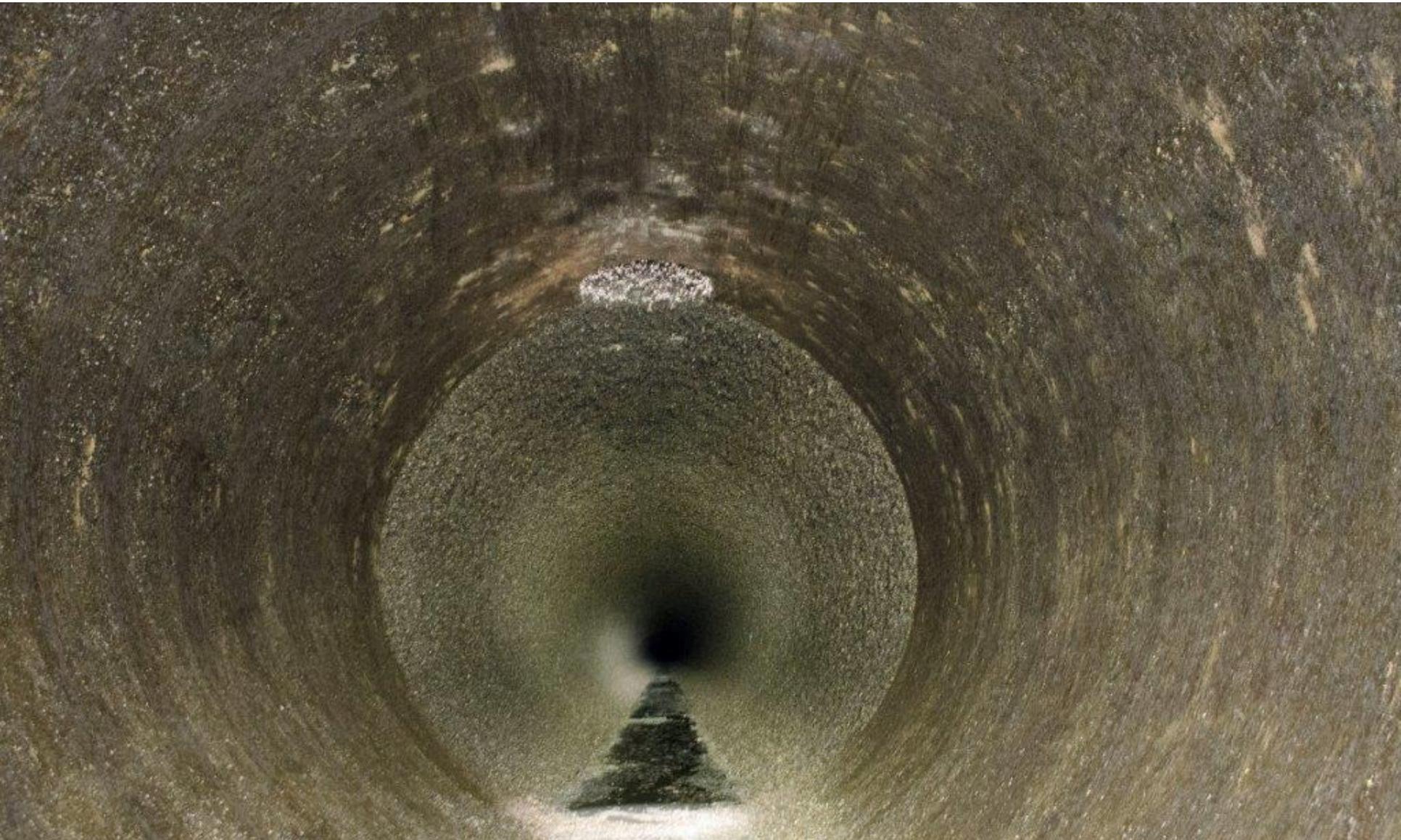
This is what the clean screens look like

Zebra mussels fouled the intake screens of the WTP  
2015



Screen fouled with  
zebra mussels, 2015

# Zebra Mussels Infesting the 92" Raw Water Pipeline 2015



92" pipeline in the process of being manually cleaned 2015

# Zebra Mussels Infesting the 92" Raw Water Pipeline

## 2015



# Zebra mussels being removed from the raw water pipeline 2015



Manual cleaning represents a worker safety hazard, requiring Tyvek suits and respirators

## Zebra mussels removed from the pipeline and screens



Mussels are removed by the dumpster load

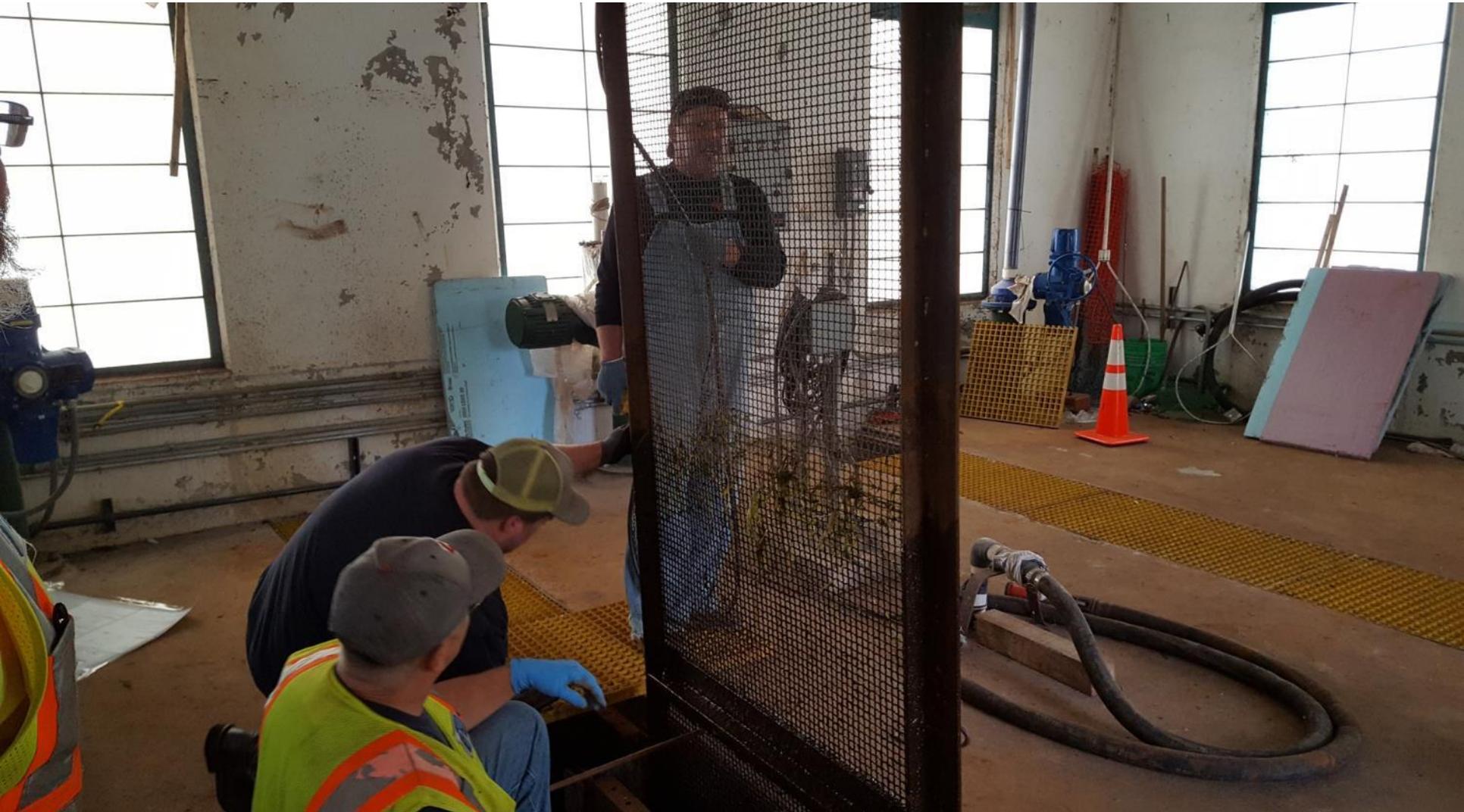
# Zebra Mussel Control

## Summer, 2016



**Bulk storage tank for EarthTec QZ -- 5,500 gallons**

**Treatment with 1ppm QZ ensured intake screens are free of zebra mussels**  
September, 2016



**Treatment with 1ppm QZ ensured intake screens are free of zebra mussels**  
September, 2016



**EarthTec QZ successfully prevented biofouling in Summer-Fall of 2016**

**Treatment with 1ppm QZ ensured pipeline remained free of zebra mussels**  
September, 2016



**1 ppm dose as QZ  
= 60 ug/L as copper  
sufficient to achieve  
complete control**

**EarthTec QZ successfully prevented  
biofouling in Summer-Fall of 2016**

Treatment with 1ppm QZ ensured intake gates remained free of zebra mussels

September, 2016

6 ft x 4 ft intake gate

1 ppm dose as QZ  
= 60 ug/L as copper  
sufficient to achieve  
complete control

EarthTec QZ successfully prevented  
biofouling in Summer-Fall of 2016



Treatment with 1ppm QZ ensured intake gates remained free of zebra mussels

September, 2016



6 ft x 4 ft intake gate

1 ppm dose as QZ  
= 60 ug/L as copper  
sufficient to achieve  
complete control

Note that mussels  
were only able to  
colonize a few spots  
within eddies of  
unmixed water,  
such as the feed  
line itself.

EarthTec QZ successfully prevented  
biofouling in Summer-Fall of 2016



## Copper concentration (ug/L = ppb) in treated water reaching the municipal WTP, summer of 2016

Dose applied at pipeline intake = 1 ppm as QZ = 60 ug/L as copper, yet copper residual in water reaching the WTP averages < 1 ug/L.

Date	WTP
6/14/2016	0
6/23/2016	2
6/30/2016	0
7/7/2016	3
7/14/2016	4
7/21/2016	1
7/28/2016	0
8/11/2016	0
8/18/2016	1
8/25/2016	0
8/31/2016	0
9/15/2016	0
<b>Average:</b>	<b>0.92</b>

Copper is consumed by biological background demand in the pipeline

Questions?

