

PNWS AWWA Conference
Boise, ID

From Crisis to Long-term Resilience: Reflections from Salem, OR

Delivery Team

May 8, 2025



Introductions

Tim English
Carollo Engineers
Immediate Response

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Carollo Engineers
Long-term Planning

DeEtta Fosbury
Summit Water Resources
Alternative Supply

Libby Bakke
Conсор
Communications

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Slayden Construction
Construction

Corey Kipp
Carollo Engineers
Resilience Tested

Agenda

- Introductions
- Background
- Near-term Response
- Communications Lessons Learned
- Long-term Planning and Construction
- Resilience Tested

Acknowledgements

- City Leadership
- City Engineering, Operations, Maintenance and Contracts Staff
- Contractors of Record
- Oregon Health Authority
- Vendors
- Consultants

“ You did it!!! Awesome job everyone, mission accomplished. In my 29-year career, this is the most impressive engineering and operational accomplishment that I have ever seen!”

-Brian Martin, Public Works Director
City of Salem

01

Background

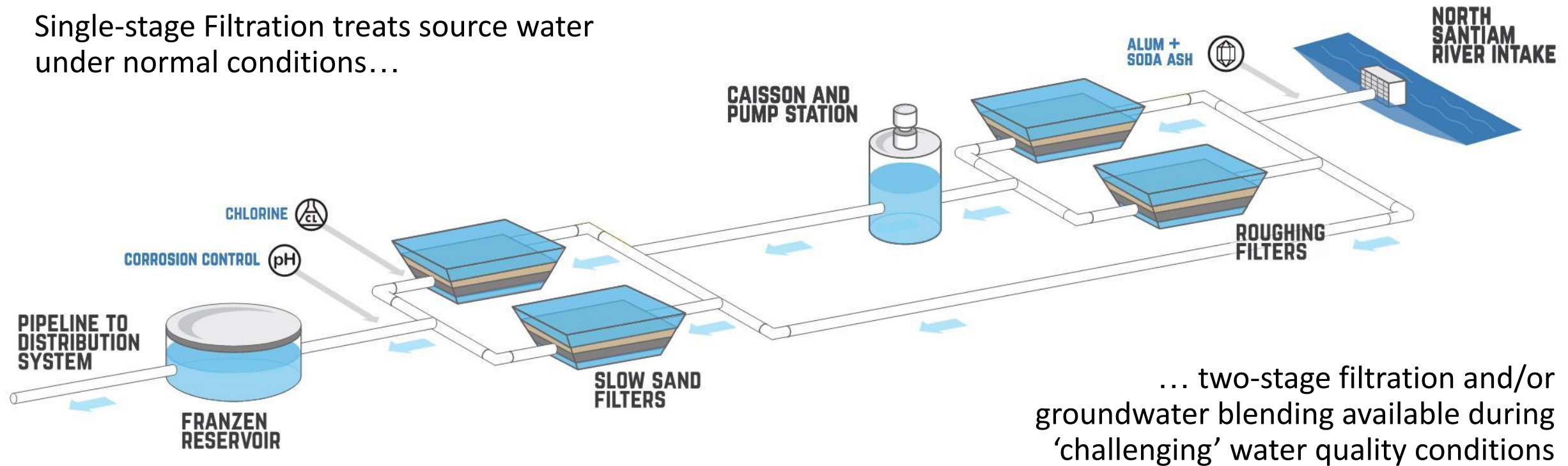
City of Salem's Water System:



Geren Island Water Treatment Plant: An elegant treatment approach

Geren Island Water Treatment Plant

Single-stage Filtration treats source water under normal conditions...



Cyanotoxin Detection in GIWTF Influent Increasing Year over Year (2013 – 2017)

	Cylindrospermopsin (ELISA) (<0.10)					Cylindrospermopsin (LC/MS/MS) (<0.005)				
Year	No. of samples	No. of Detects	Min (µg/L)	Max (µg/L)	Average (µg/L)	No. of samples	No. of Detects	Min (µg/L)	Max (µg/L)	Sample Average (µg/L)
2013	13	0	-	-	-	-	-	-	-	-
2014	4	2	0.06	0.238	0.149	33	32	0.03	0.15	0.0625
2015	-	-	-	-	-	28	23	0.01	0.12	0.0535
2016	-	-	-	-	-	15	9	0.04	0.13	0.07
2017	-	-	-	-	-	38	15	0.09	0.43	0.163

***Microcystin** was not detected in any of the 268 samples taken from GIWTP influent or effluent between 2013 and 2017.*

May 2018 Detections Exceed Health Reference Levels

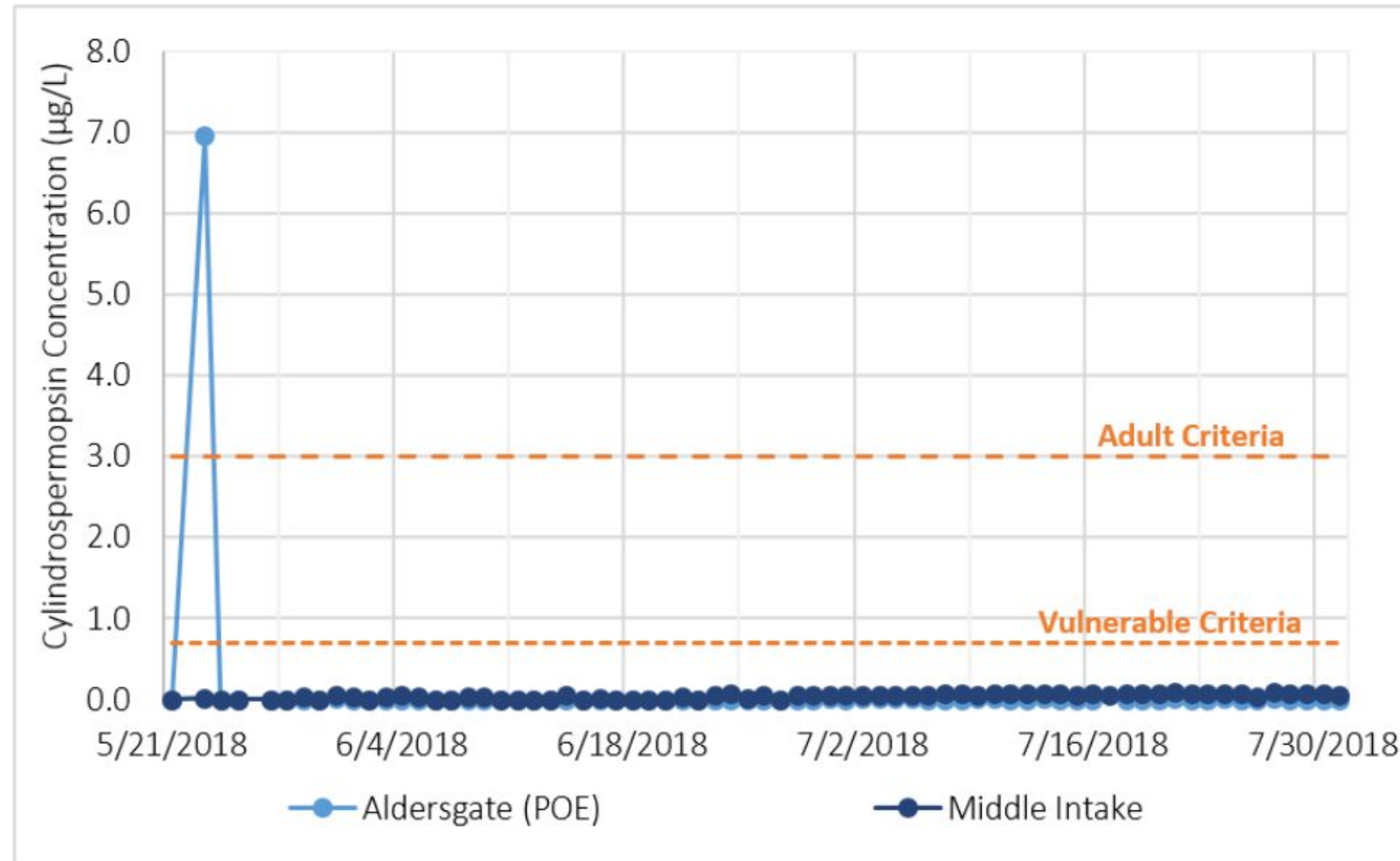


Figure 2.3 Cylindrospermopsin Concentrations at the GIWTF Intake and Aldersgate (POE)

May 2018 Detections Exceed Health Reference Levels

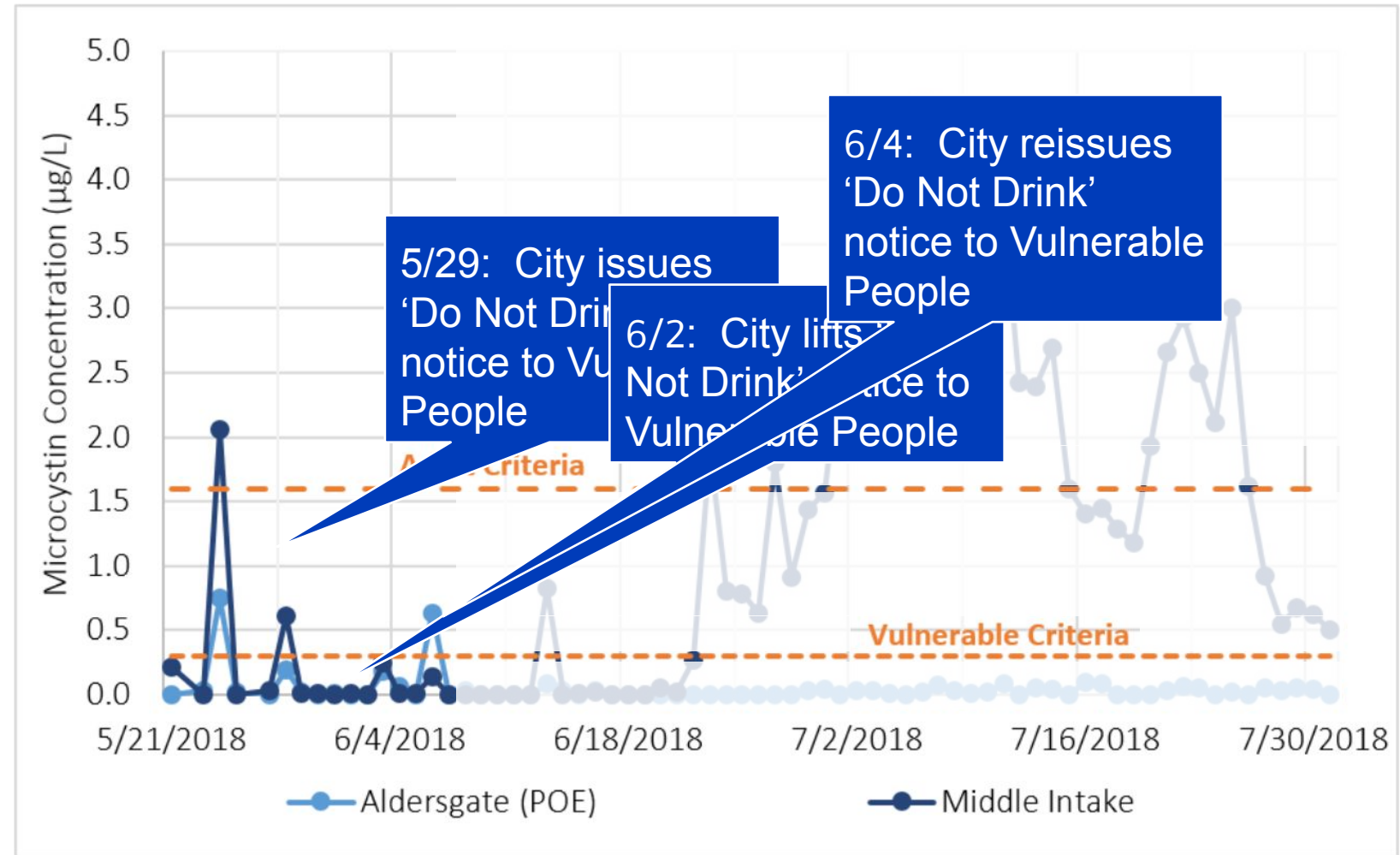


Figure 2.2 Microcystin Concentrations at the GIWTF Intake and Aldersgate (POE)

Hope seen for limited effect of algal toxins

Detroit Lake hit with 3rd warning for toxic algae

Water toxins bust limits

Sunday Statesman Journal

What city officials knew, and when

Timeline began with Tuesday findings

Salem ends alert on drinking water



Why wasn't alert sent earlier?

Officials won't say why it took 4 days to notify about water

How did algae taint the water?

Water shortage brings out Salem's best, worst

Water shortage brings out Salem's best, worst

Happy July 4th

Water advisory lifted

Happy Father's Day

State studies toxic algae-bloom response

Statesman Journal

41 water systems are at risk

41 water systems are at risk

Drinking water fouled



Water stations up in Salem, Turner

City knew last Friday it had water problem

Drinking water alert extended

Drinking water tests expanded statewide

Businesses taking a hit from Salem water crisis

No detectable toxins in latest Salem water test

Statesman Journal

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Water is still unsafe for kids, some adults

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Which lakes have most toxic algae?

Which lakes have most toxic algae?

Water tests give hope



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Immediate
Technical and
Public
Response
Required...

...but City
caught
unprepared!



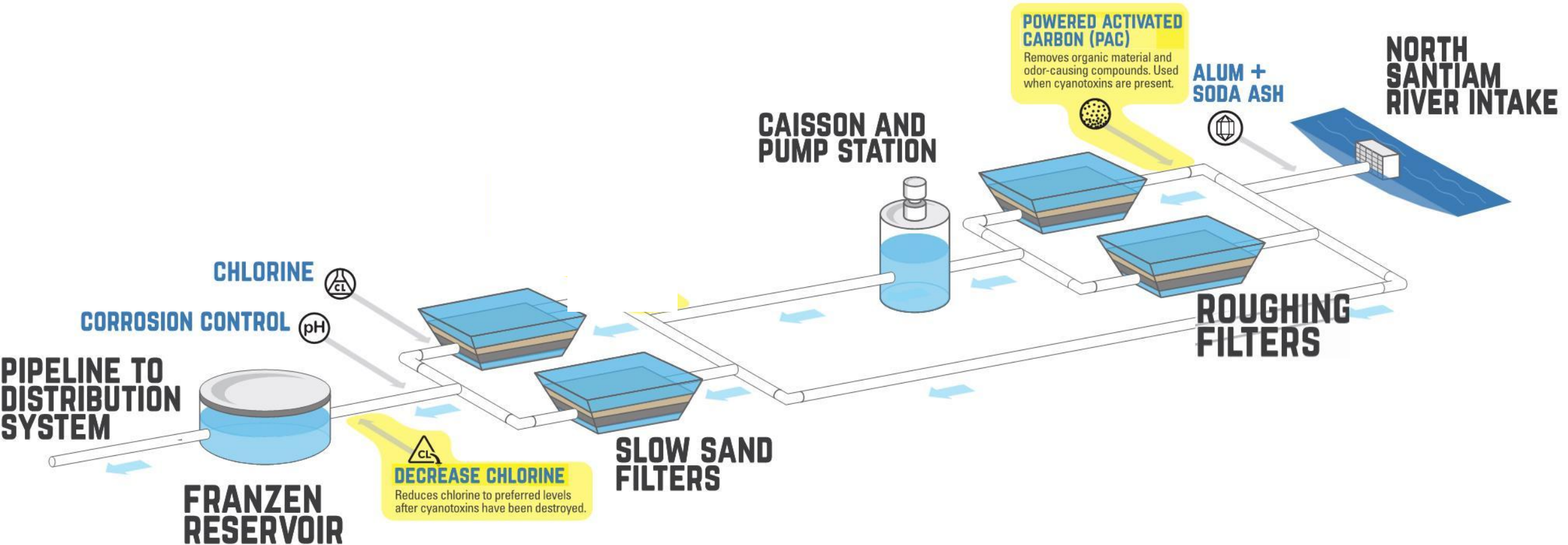
02

Near-term Response

Accelerated Technical Response



PAC: Near-term Improvements for Cyanotoxins



Rapid Bench Scale Testing

SCHEDULE: Day 1 – Day 14

Key Questions Were Answered:

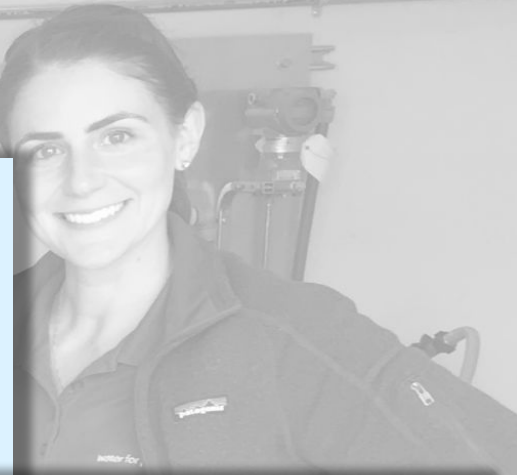
- How much PAC is required (mg/L) to be effective for algal toxin removal? (specifically MCN & CYL)
- Are certain types of PAC better suited to removal than others?
- Will the PAC settle on its own or is alum/polymer required?
- If alum/polymer is required, how much to aid in rapid PAC settling?
- Are we going to starve the slow sand filters?
- What can we expect longer-term solutions to achieve?

Rapid Pilot-scale Testing

SCHEDULE: Day 10 – Day 24

Key Questions Were Confirmed:

- Confirm removal of algal toxins with ben.
- Determine extent of BDOC removal due to
- Optimize carbon dose (acetic acid) to pilot filter
- Identify and mitigate any regulatory performance i (coliform, e-coli, etc.) as well as operational perform (accumulation, etc.)

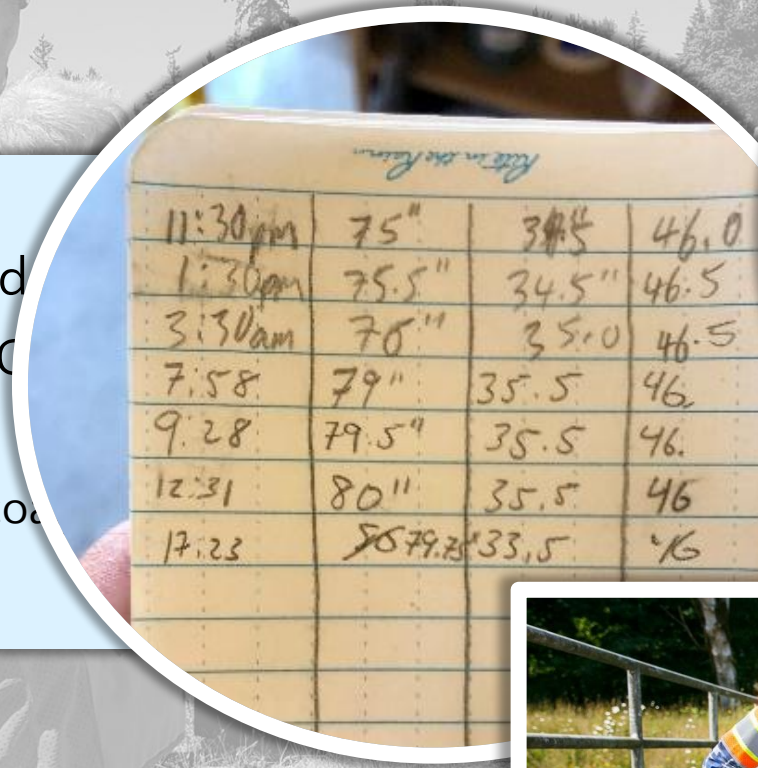


Abbreviated Demonstration Testing

SCHEDULE: Day 25 – Day 31

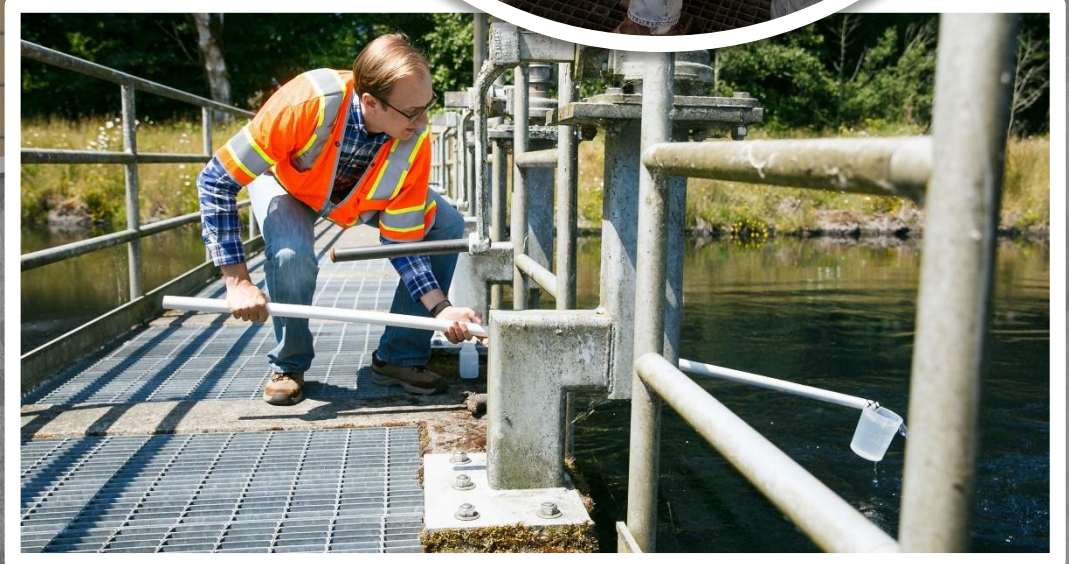
Key Questions Were Confirmed

- Performance Similitude was Confirmed
 - » PAC adsorption
 - » Ability to add, suspend, coagulate, and filter



Rate in the Room

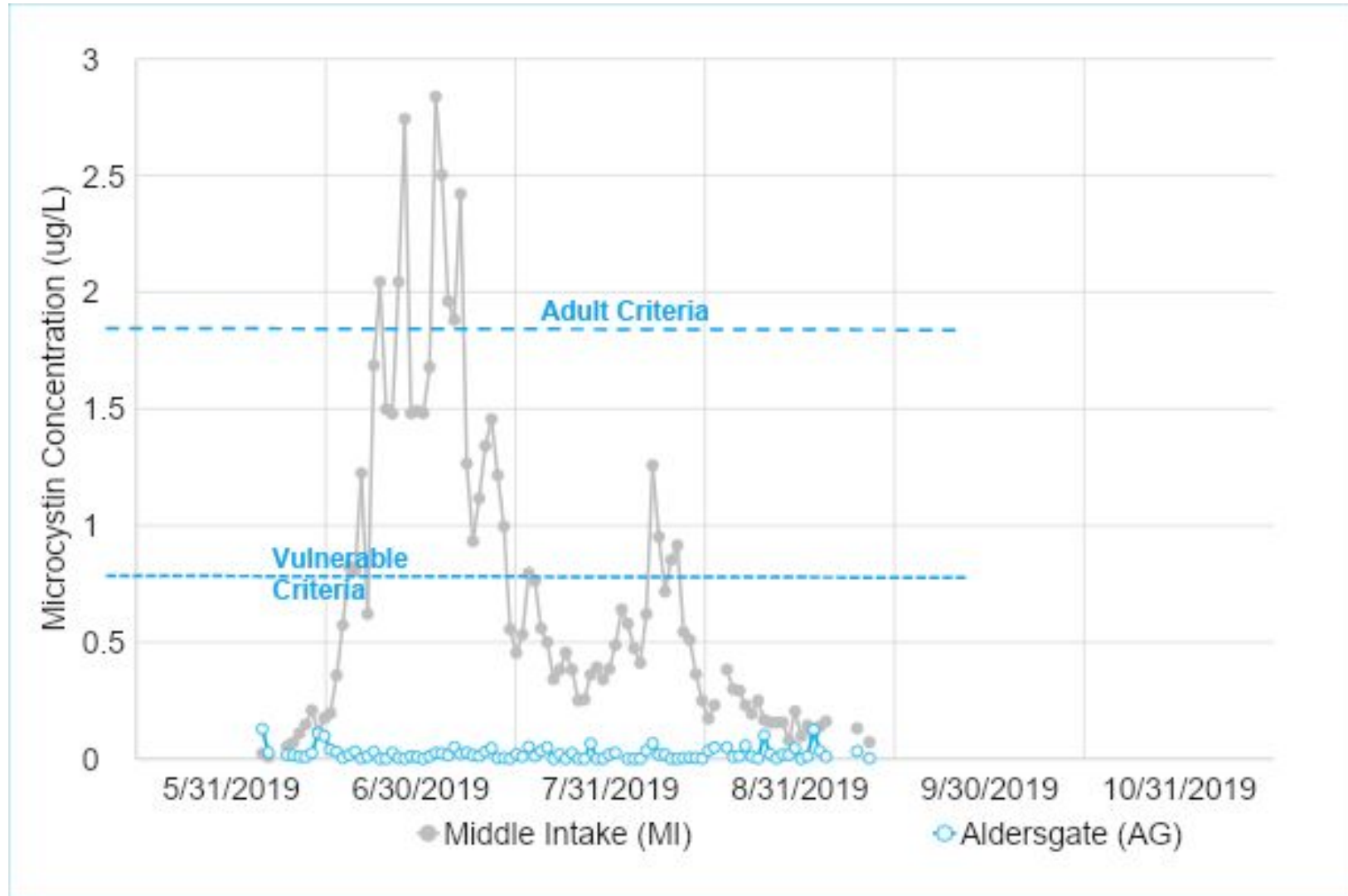
11:30am	75"	34.5	46.0
1:30pm	75.5"	34.5"	46.5
3:30am	76"	35.0	46.5
7:58	79"	35.5	46
9:28	79.5"	35.5	46
12:31	80"	35.5	46
17:23	79.5" 79.5"	33.5	46



Full-Scale Implementation



Near-term Solution Worked Throughout the 2019+ Cyanotoxin Season



03

Communications Lessons Learned

Communications Lessons Learned:

Six Things You Can Do Today to Prepare

1. **Select a spokesperson and create a communications plan**
2. **Prepare talking points** and other communications pieces
3. **Create a webpage** with testing information—post results. (Have an offline backup page ready to go if you exceed limits.)
4. **Make a list of credible sources of information** from outside their organization. Get to know them now.
5. **Build relationships** with public/consumers and local reporters
6. **Educate policymakers** on the issue.

04

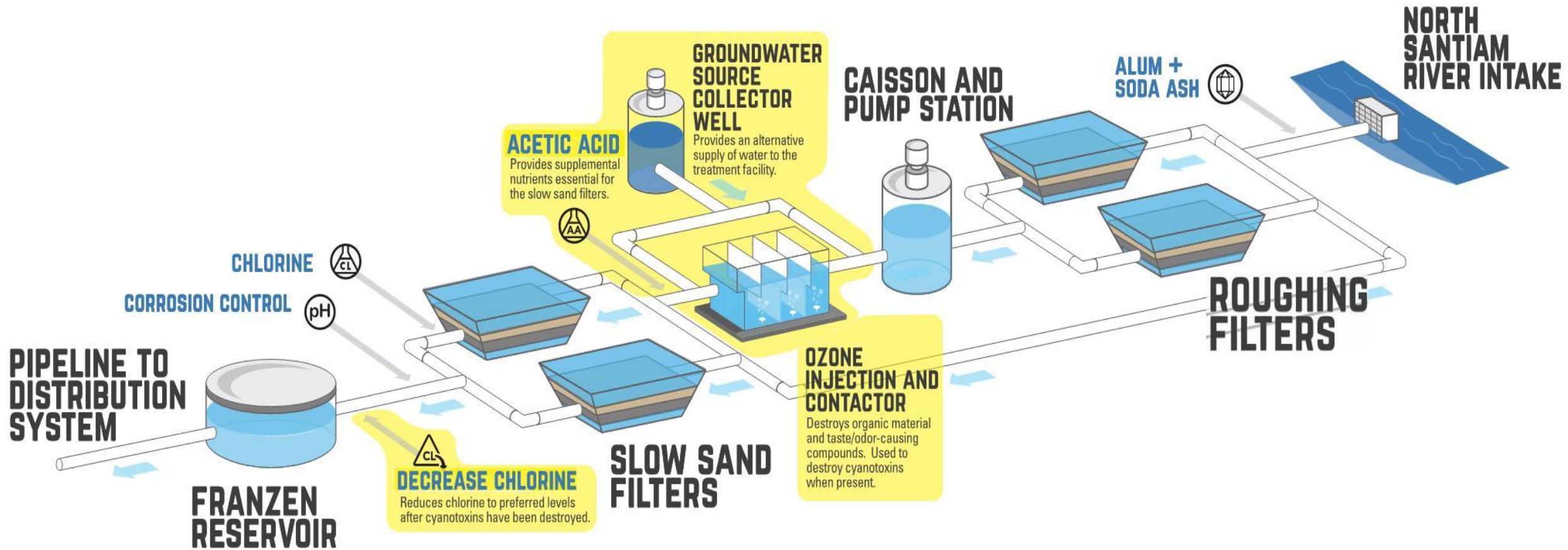
Long-term Planning and Construction

Measured Approach to Implementing Long-term Solution

	2018	2019					2020				2021	
Activity	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	
Wrap Up Ongoing Work	<div></div>		<div></div>	<div></div>	<div></div>		<div></div>	<div></div>	<div></div>		<div></div>	
Peer Review	<div></div>		<div></div>	<div></div>	<div></div>		<div></div>	<div></div>	<div></div>		<div></div>	
Near-Term CIP	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>		<div></div>	<div></div>	<div></div>		<div></div>	
Select Design Consultant	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>		<div></div>	<div></div>	<div></div>		<div></div>	
Prepare Preliminary Design			<div></div>	<div></div>	<div></div>		<div></div>	<div></div>	<div></div>		<div></div>	
Select CM/GC			<div></div>	<div></div>	<div></div>		<div></div>	<div></div>	<div></div>		<div></div>	
Prepare Final Design			<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>		<div></div>	
Procurement/Construction			<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	
Comminssioning/Start-Up			<div></div>	<div></div>	<div></div>		<div></div>	<div></div>	<div></div>		<div></div>	

*City committed to implement treatment scheme that will provide multiple treatment barriers for algal toxins, as well as other 'future' water quality challenges, **including fires in the watershed.***

Ozone: Long-term solution for Cyanotoxins



Ozone Improvements: On-line April 2021





GIWTP
OZONE FACILITY
2020.02.21

mwa architects



FRANK MAULDIN
OZONE TREATMENT
FACILITY



GIWTP
OZONE FACILITY
2019.11.26

mwa architects



Technical Lessons Learned:

- “Raw water quality and finished water quality goals define treatment process.”
 - » Rearview mirror no longer works; additional input / anticipation of future unknowns is required for infrastructure planning.
- Contaminants are ‘emerging’ too quickly – regulators can’t keep up.
 - » First community to implement notification protocols; lack of precedent and guidance caused internal and external confusion.
- Just knowing a lot about the risk failed to prepare them for addressing the risk.

05

Resilience Tested

Wildfires

Pants on fires

Round 1

XXX

0

TEAM 1



0

TEAM 2

Chemical Shortage

20

COVID

15

Wildfire

20

Supply Chain

10

Ice Storm

15

Cyber Attack

4

Heat Dome

15

???

1

Wildfires

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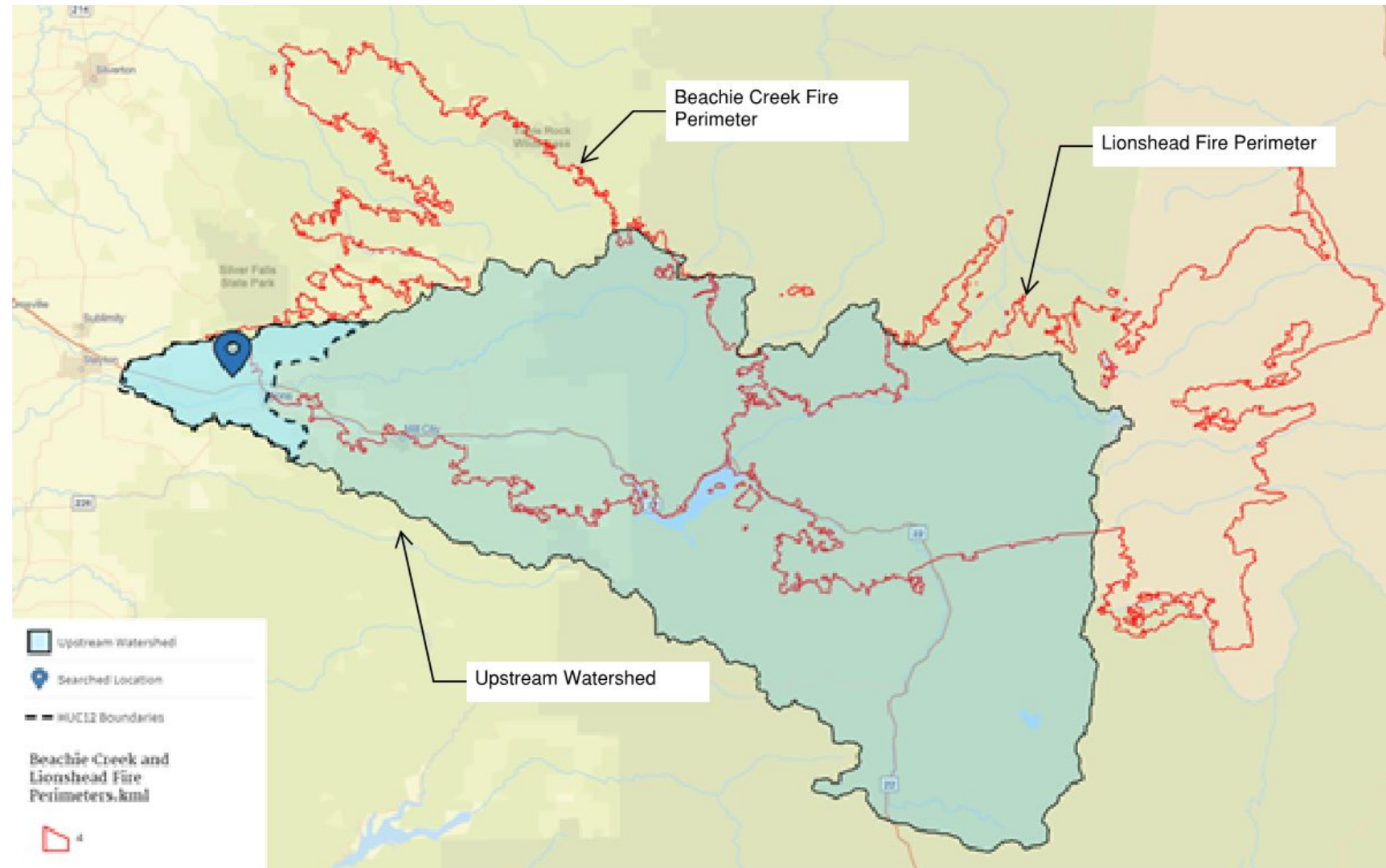
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2020 Wildfires

- Fire Reached within Miles of GIWTP
- Over 50% of Watershed within Burn Extents



Source: U.S. Geological Survey (Dec. 17, 2021) and National Interagency Fire Center (Jan. 28, 2022).

Typical Wildfire

- Water quality:
 - » Sediments
 - » Nutrients
 - » Total Metals

- Increase in base and peak flows (3–5 years)
- Most watersheds recover within 5 years



Note: No Single Fire Experiences
More Than One Water Quality
Challenge at a Time

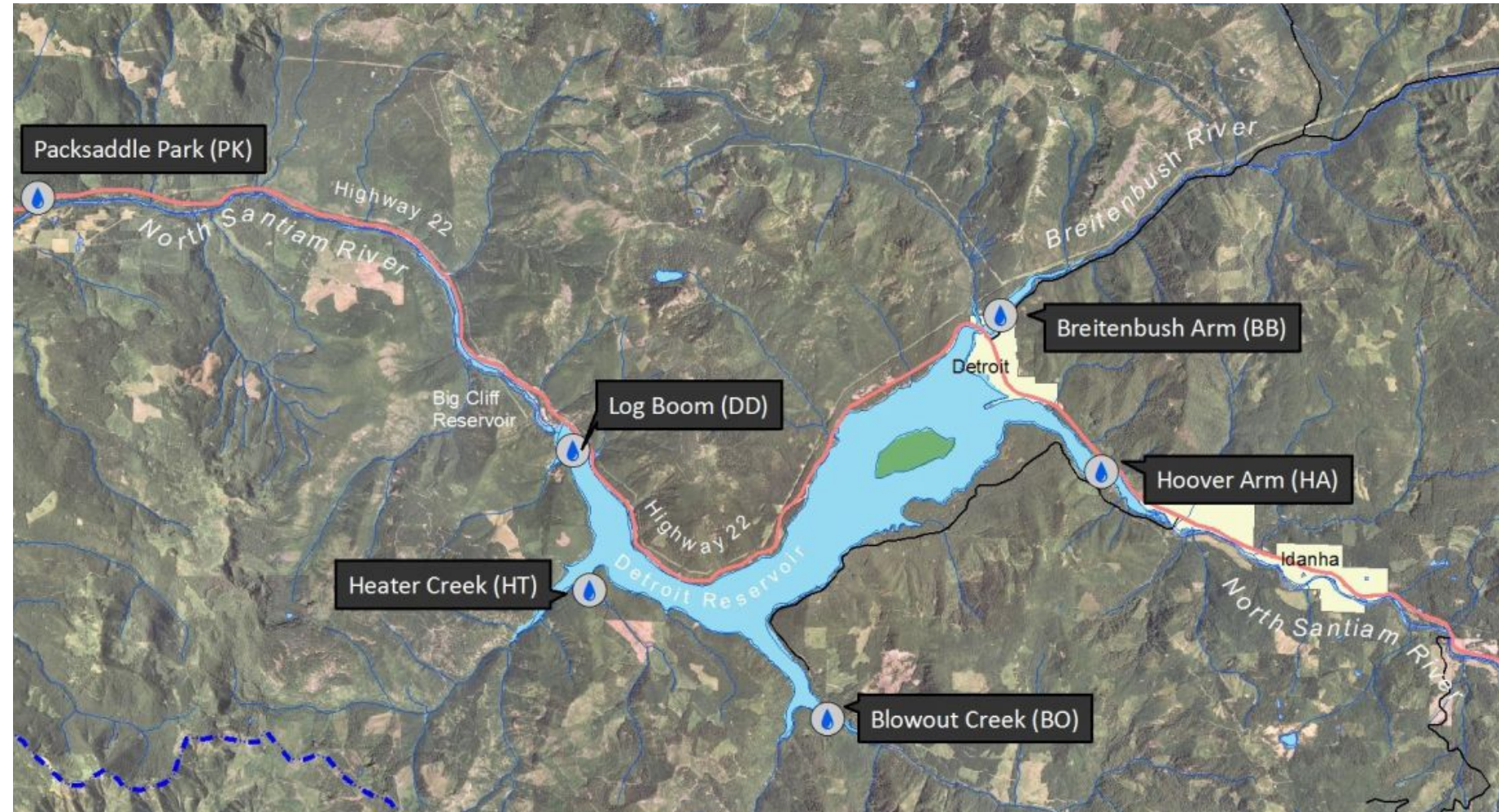


Typical PNW Burn Intensity – A Mosaic



Increased Monitoring following Wildfire

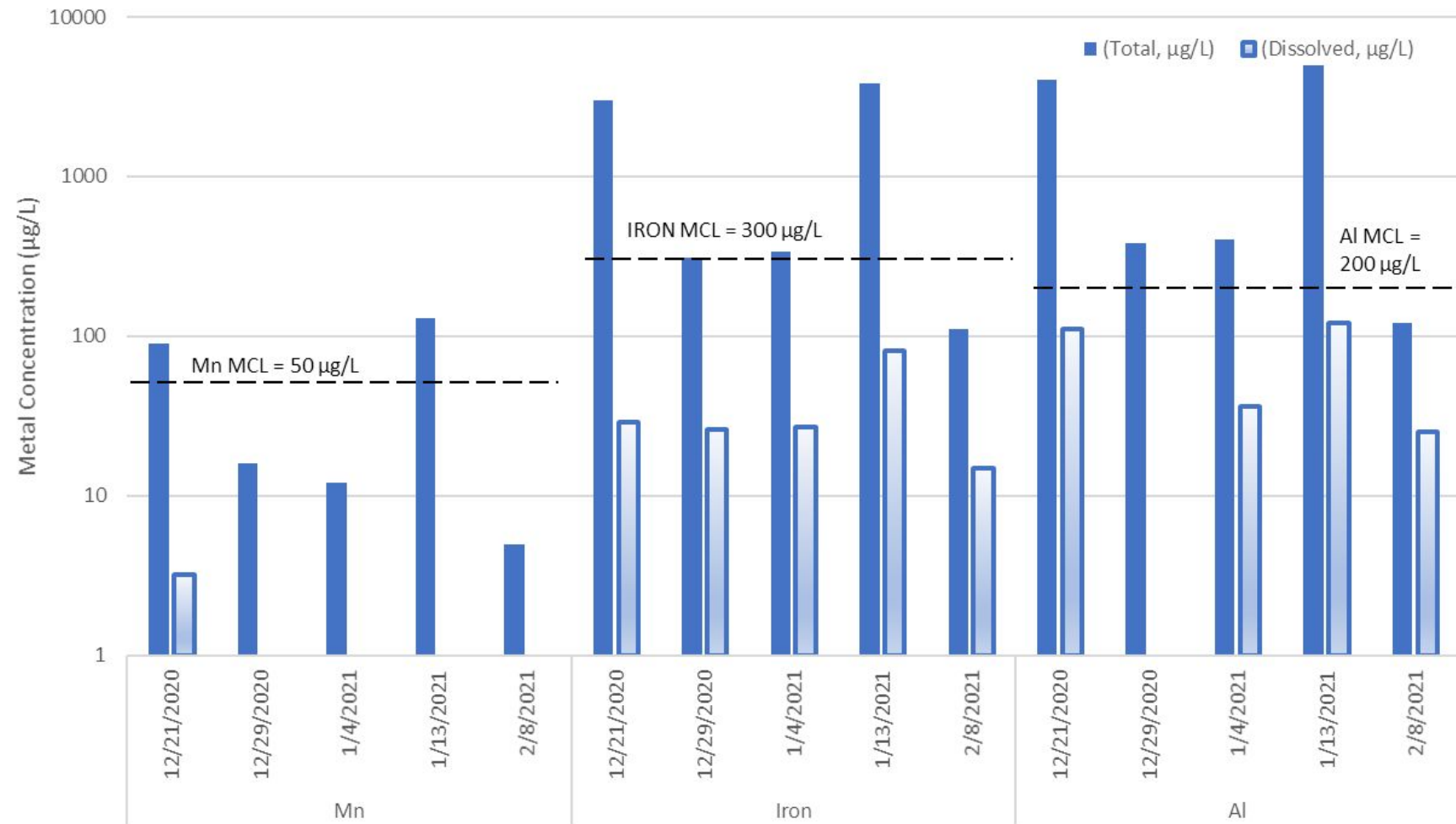
- Increased monitoring throughout watershed, GIWTP, and in distribution system
- Analyzed for variety of parameters, including TOC, nutrients, metals, and disinfection by-products



Source: City of Salem Drinking Water Monitoring Program (cityofsalem.net/drinking-water-monitoring-program.aspx)

High Metals Concentrations Increase following Wildfires

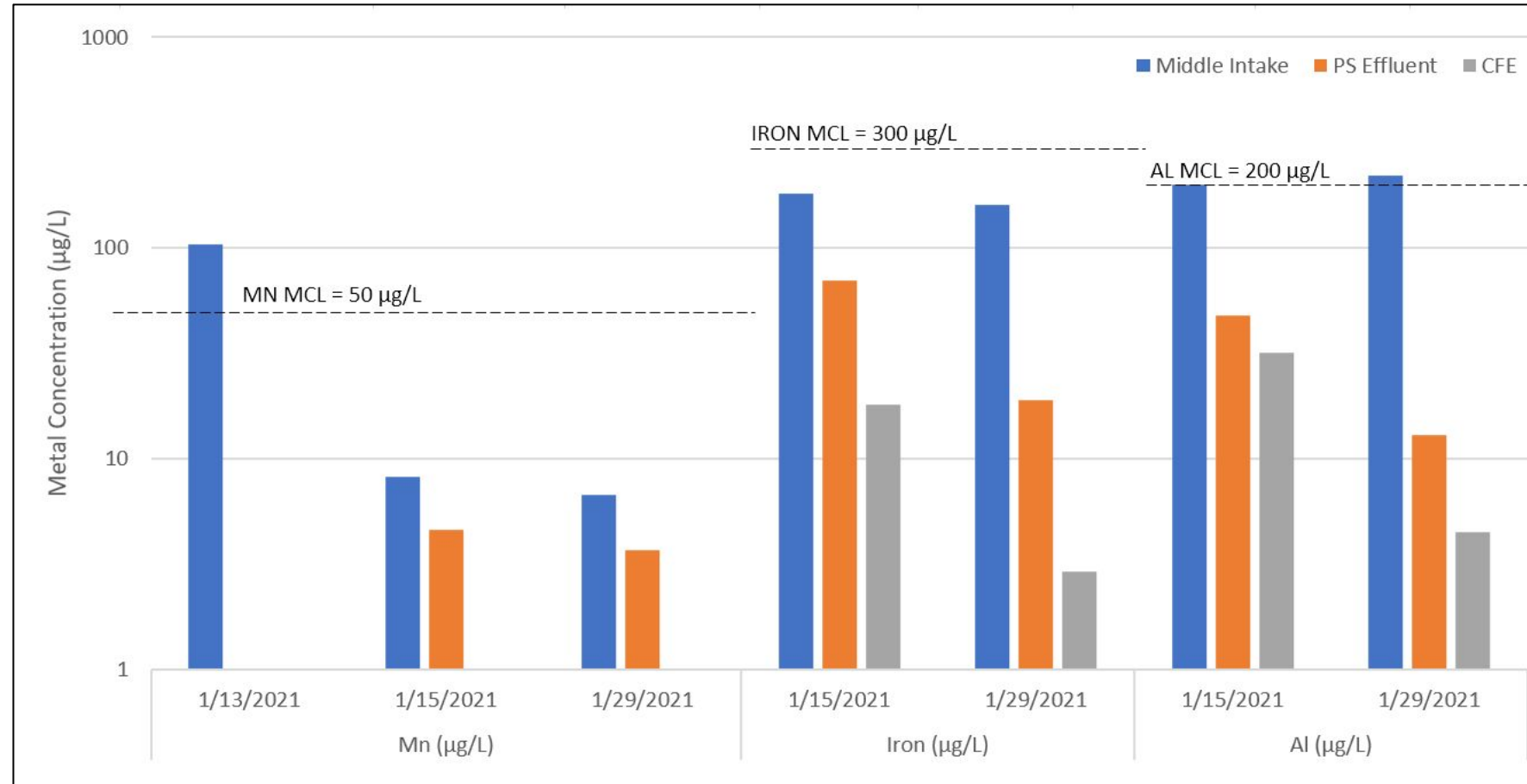
- High metal concentrations following wet weather events
 - » Manganese, iron, and aluminum
- Dissolved metal concentrations much lower than total
 - » Note graph in logarithmic scale



Source: City of Salem Drinking Water Monitoring Program (cityofsalem.net/drinking-water-monitoring-program.aspx)

High Metals Concentrations Increase following Wildfires

- Good removal of metals observed through filtration
- GIWTP effectively treated water



Wildfire: Lessons Learned

- Huge increase in metal concentrations following wet weather events
 - » *Manganese, iron, and aluminum*
- Vast majority of metals not dissolved
- Particulate metals are filterable
- Ozone provided strong oxidant for soluble metals and elevated TOC/taste and odor

USACE – Changes in Operations (Pants on Fires)

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Anticipated Detroit Reservoir Deep Drawdown

- Emerging challenge – source elevated turbidity



Willamette Valley System (WVS) Drawdowns

Reservoir Drawn	Outlet Stream Turbidity (FNU/NTU)	Downstream Water Treatment Plants	Treatment Plant Technologies
Fall Creek	501-814	No known WTP impacts	N/A
Green Peter	Sustained >> 100+ Peak >> 200+	Cities of Lebanon and Sweet Home WTPs	Membrane (Lebanon) Filtration (Sweet Home)
Cougar	Sustained >> 50-200 Peak >> 200-400	Eugene's Hayden Bridge WTP	Conventional
Detroit	TBD	Salem's Geren Island WTP	Slow sand filtration

- Future water source challenges?
 - » Wildfires?
 - » Industrial development
 - » Logging?
 - » Drought?
 - » Land use?

Willamette Valley System (WVS) Drawdowns

- Extended duration turbidity challenge expected
 - » Draining reservoir, reservoir bank exposure, downstream solids deposition
 - » Storage unable to supply entire demand for event duration



Fall Creek Reservoir Deep Drawdown



Green Peter Reservoir Deep Drawdown



Cougar Reservoir Deep Drawdown

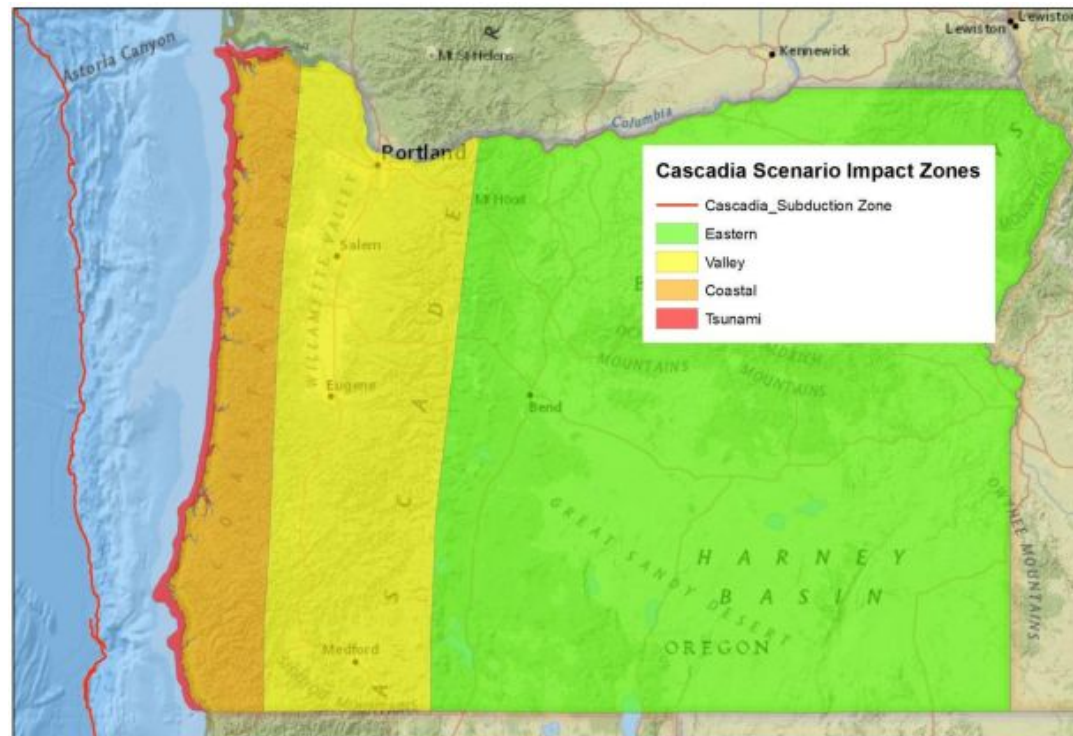
Graphics from:

>> Anderson, C. W. (2007). *Influence of Cougar Reservoir Drawdown on Sediment and DDT Transport and Deposition in the McKenzie River Basin, Oregon, Water Years 2002-04* (No. 2007-5164). Geological Survey (US).

>> US Army Corps of Engineers (2023). *Willamette Valley Injunction & Green Peter Deep Reservoir Drawdown Briefing*.

Resiliency Challenges

- Seismic Resiliency
 - » Intake
 - » Treatment plant
 - » Finished water distribution header
- Flooding
 - » Modern flood plains



Magnitude 9.0 Cascadia Earthquake Impact Zones

Questions?