

Rockwood Pipe Loop Study

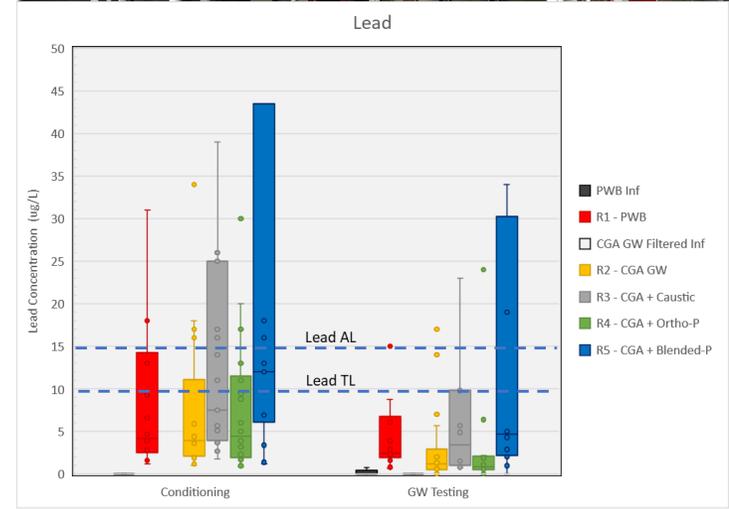
Pilot Testing Challenges for Corrosion Control Optimization

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AGENDA

- 01 Background
- 02 Pipe Loop Study Overview
- 03 On going Results
- 04 Lessons Learned



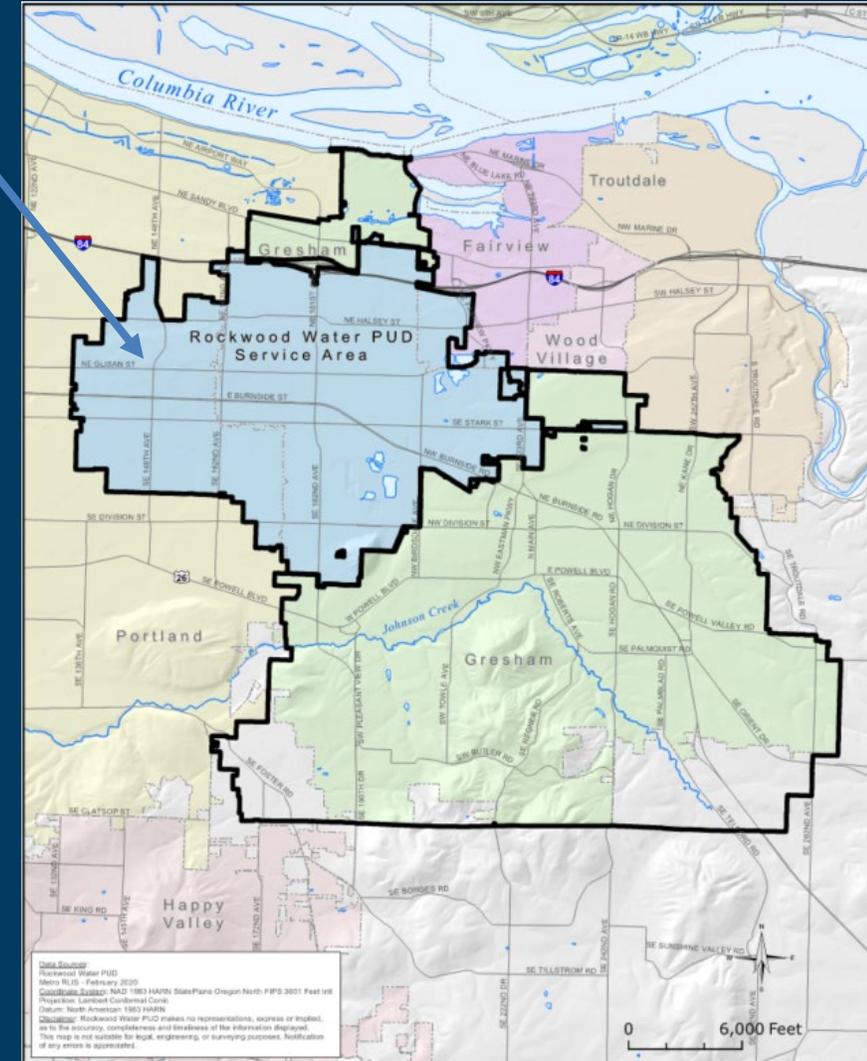
Background



Rockwood Water People's Utility District (RWPUD)

Existing System Background

- 14,000 service connections serving ~65,000 residential, commercial, and industrial customers in Portland, Gresham, and Fairview
- 9.75 square miles
- 4 pressure zones
- 7 MGD average system demand
- Wholesale purchase majority of our water from Portland Water Bureau (PWB)
 - Augment supply with our 3 production wells throughout summer months
 - Both PWB and RWPUD sources contain elevated manganese
 - Causes distribution scale formation
 - Requires regular flushing



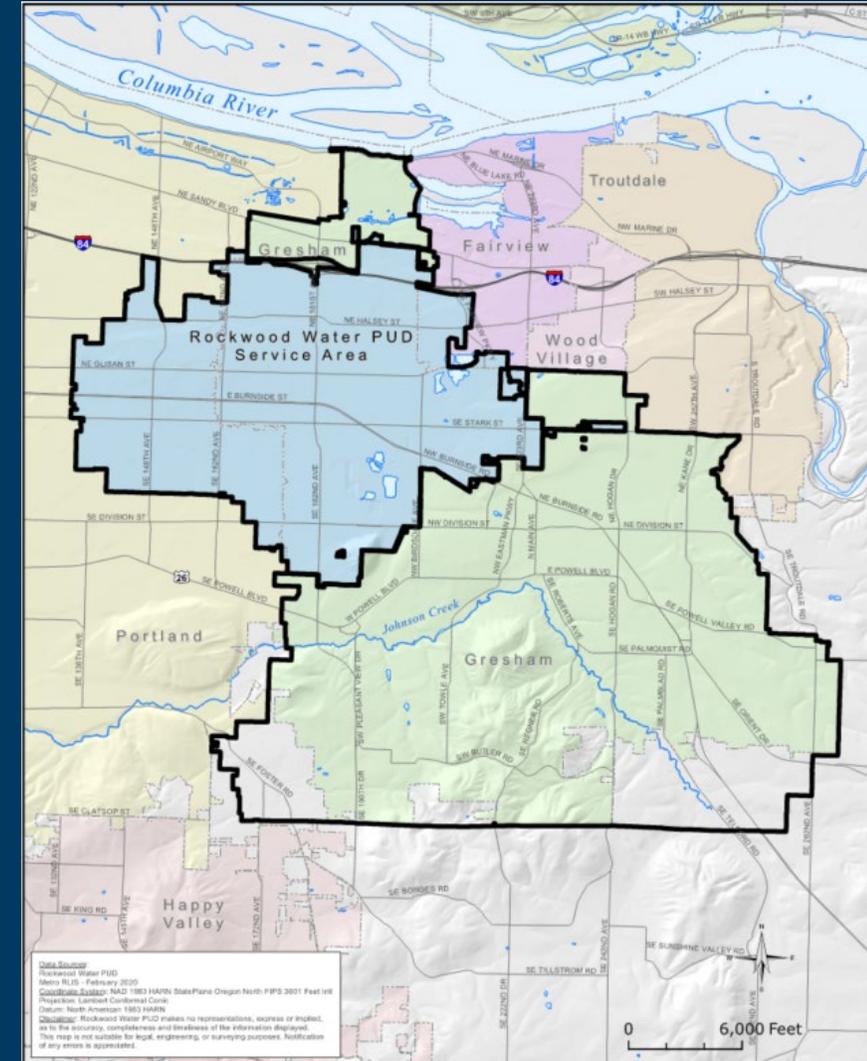
100% Bull Run	100% PWB GW	CGA GW	EPA SMCL	BMPG
0.008 mg/L	0.018 – 0.062 mg/L	0.06 – 0.13 mg/L	0.05 mg/L	0.02 mg/L

Cascade Groundwater Alliance (CGA)

Future System Plans

Combined service between RWPUD and City of Gresham

- ~140,000 customers
- Partnership to develop groundwater as primary water source
- Main System
 - 5 new wells (8 total), transmission, piping, storage, disinfection & manganese removal treatment
 - 25 MGD by 2025, 32 MGD at buildout
- Two smaller systems totalling 10 MGD capacity

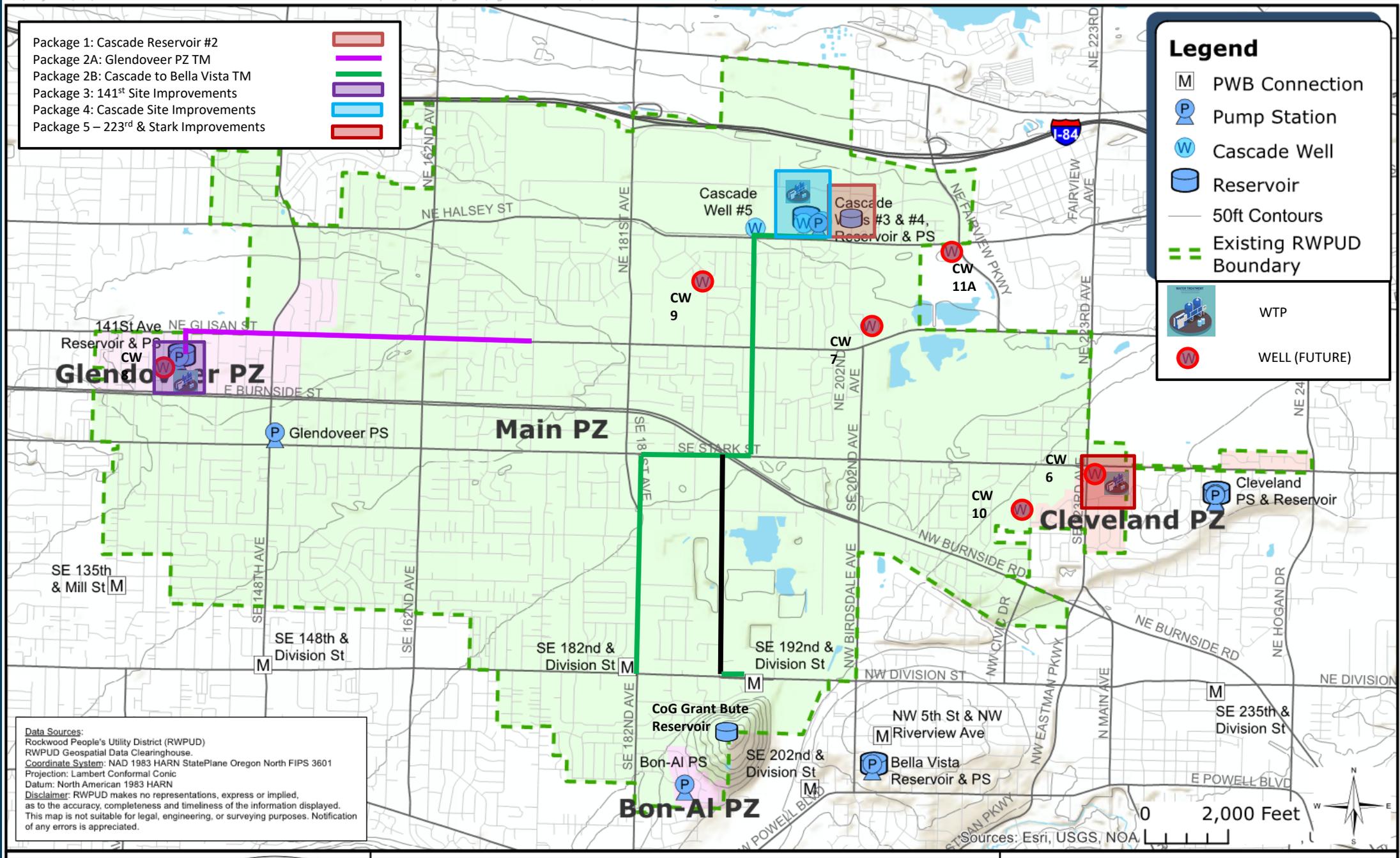


- Package 1: Cascade Reservoir #2
- Package 2A: Glendoveer PZ TM
- Package 2B: Cascade to Bella Vista TM
- Package 3: 141st Site Improvements
- Package 4: Cascade Site Improvements
- Package 5 – 223rd & Stark Improvements

Legend

- M PWB Connection
- P Pump Station
- W Cascade Well
- R Reservoir
- 50ft Contours
- - - Existing RWPUD Boundary

- WTP
- WELL (FUTURE)



Data Sources:
 Rockwood People's Utility District (RWPUD)
 RWPUD Geospatial Data Clearinghouse.
Coordinate System: NAD 1983 HARN StatePlane Oregon North FIPS 3601
 Projection: Lambert Conformal Conic
 Datum: North American 1983 HARN
Disclaimer: RWPUD makes no representations, express or implied, as to the accuracy, completeness and timeliness of the information displayed. This map is not suitable for legal, engineering, or surveying purposes. Notification of any errors is appreciated.

Pipe Loop System/Study Overview

Pipe Loop Study Overview

Key Drivers

Water Source – switching from PWB to CGA water

- Surface water to groundwater
 - Higher alkalinity, hardness, TDS, silica
- Chloramine to free chlorine disinfectant

How will this affect metals levels in distribution system?

- Scale release (Mn & Fe) in system mains
- Corrosion (Pb & Cu) in premise plumbing
 - Will corrosion control be required?

Worst-case conditions



Native pipe harvesting



New copper pipe with lead solder

Tools to Assess Distribution System Corrosion Impacts

Desktop Study

- Use of modeling software coupled with water quality
- Based on documented analogous treatments with other systems of similar size, water chemistry, and distribution system configuration

Demonstration Study

- Metal coupon tests
- Pipe loop tests
- Partial system tests
- Demonstration of water quality/treatment changes on impacts to corrosion

←

Least Realistic

→

Most Realistic

Planning

Pipe Loop Study Overview

Pipe Loop Test Plan

- Plan of action tech memo - defined
 - Defined goals of study
 - Pipe loop setup plan
 - Pipe harvesting best practices
 - Pipe scale analysis plan
 - Pipe loop operation plan
 - Pipe loop sampling and testing protocols
 - Schedule

Coordination

- Workshop with RWPUD and City of Gresham
- Pipe loop construction with RWPUD operators
- Pipe harvesting – in conjunction with pipe loop construction completion
- Startup sampling and testing training

Table 2 | Pipe Loop Design Framework

Pipe Rig No.	1	2	3	4	5
Objective	Control, Evaluate PWB water as baseline	Evaluate switch to treated CGA groundwater			
		w/o corrosion control (CC)	w/ pH <u>increase</u> as CC	w/ PO ₄ as CC	w/ Blended Phosphate as CC
Physical Characteristics					
Configuration	Flow-through				
Test materials	Copper: 0.5" OD, 160" <u>length</u> Lined Cast Iron: excavated, 4" OD, 1.5' length				
Hydraulic Conditions					
Stagnation Time	Copper Loops: 7.5 h Iron Main: 8 h				
Flow Time	Copper Loops: 0.5 h Iron Main: 16 h				
Flow Vel. Target	1 ft/s (copper <u>loops</u>) 0.025 ft/s (cast iron main)				
Flow Rate Target	0.61 <u>gpm</u> (0.5" OD copper pipe)		Total flow per rig: 1940 gpd		
	0.98 <u>gpm</u> (4" OD cast iron pipe)		Total flow: 9,699 gpd		
System Pressure	25 – 30 psi				
Quality Assessment					
Study Duration	11-15 months				
Study Phases	Startup: <1 <u>month</u> Conditioning: 1-3 months Testing: 9-12 months (3 month segments)				
Water Quality Parameters	<u>General</u>	<ul style="list-style-type: none"> ▪ pH ▪ Temperature ▪ ORP 	<ul style="list-style-type: none"> ▪ Alkalinity ▪ Turbidity ▪ Nitrite & Ammonia¹ 	<ul style="list-style-type: none"> ▪ Silica ▪ Orthophosphate ▪ Chlorine residual 	
	<u>Metals</u>	<ul style="list-style-type: none"> ▪ Manganese (total and dissolved)² ▪ Iron (total)² ▪ Aluminum (total)² 	<ul style="list-style-type: none"> ▪ Lead (total)³ ▪ Copper (total)³ 		

1. For PWB water only, to test for nitrification
 2. Only for harvested cast iron pipe
 3. Only for copper pipe

Pipe Loop Conditions

Pipe Loop Study Overview

Allows pipe walls/scale to reach equilibrium, baseline data

Different Rigs to reach new equilibrium with different water chemistries

Rig No.	Water Chemistry (Conditioning Phase)	Water Chemistry (Testing Phase)	Intended Result
1	PWB	PWB	Control
2	PWB	CGA	Evaluation of no corrosion control
3	PWB	CGA + Caustic Soda	Elevated pH to suppress Pb solubility
4	PWB	CGA + Orthophosphate	Reduce Pb & Cu solubility
5	PWB	CGA + Blended Phosphate	Reduce Pb & Cu solubility AND Sequester Mn scale release events



System Description

Pipe Loop System Overview

Flow Characteristics

Copper Loops

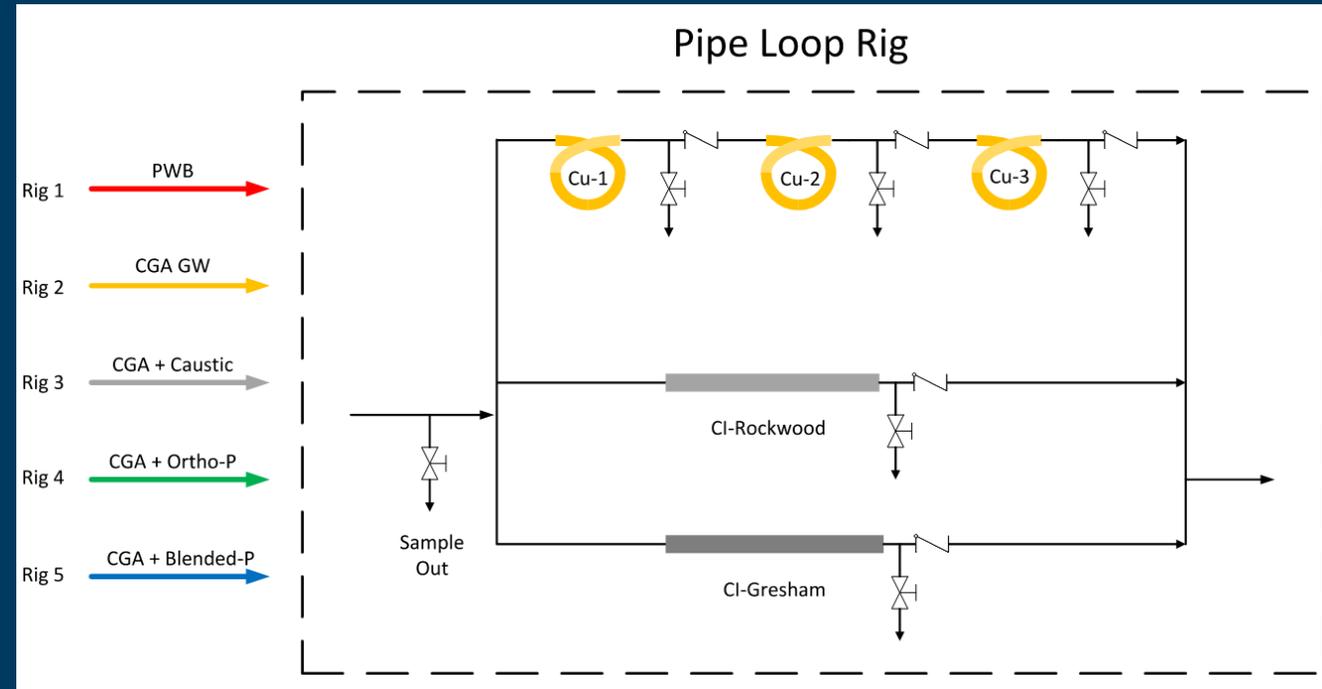
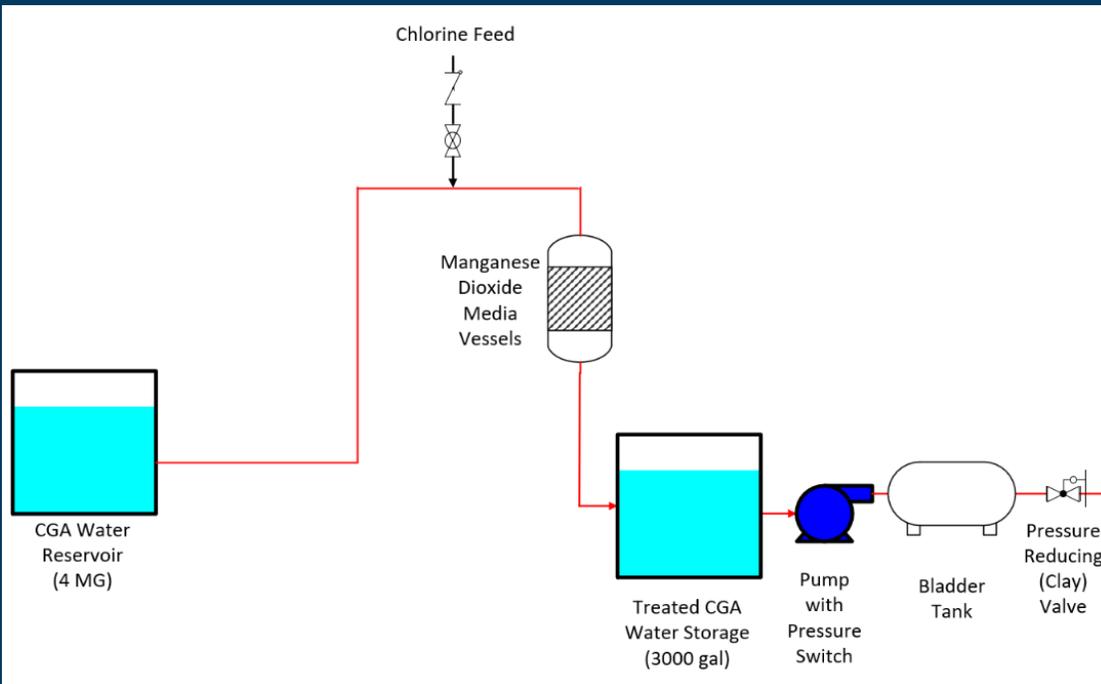
Stagnation: 7.5 h

Flow: 0.5 h

Iron Mains

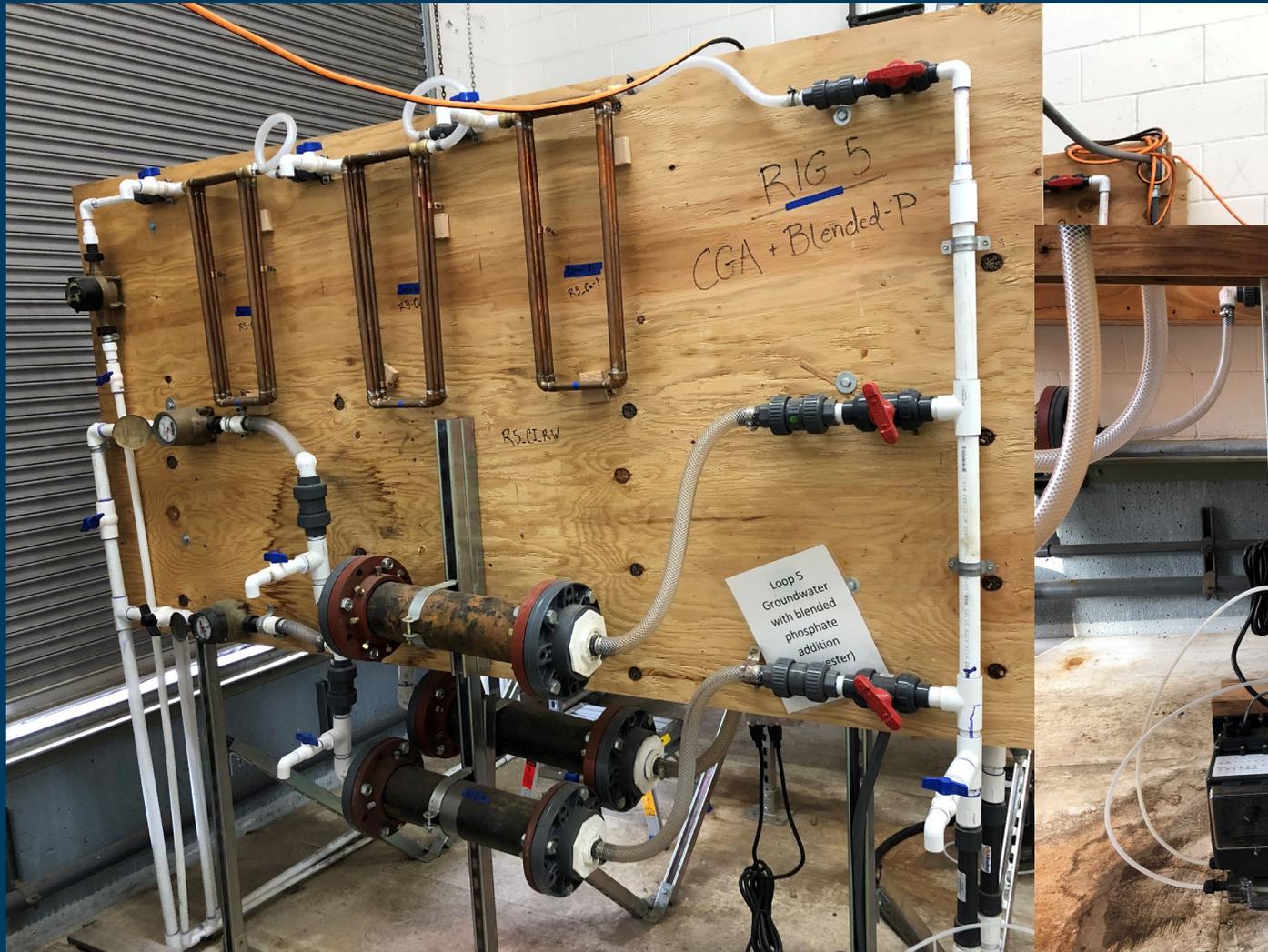
Stagnation: 8 h

Flow: 16 h



System Description

Pipe Loop System Overview



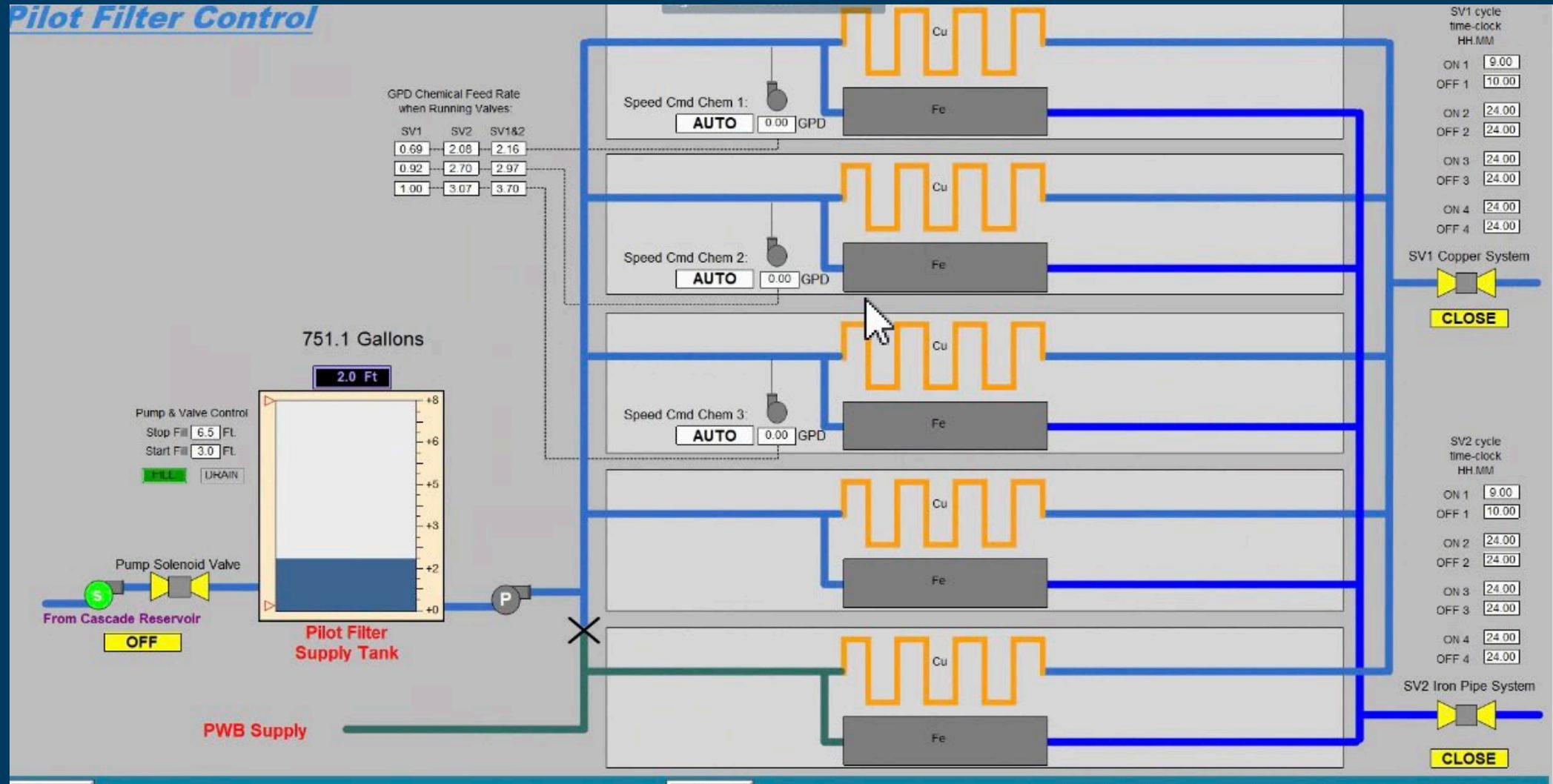
Sampling

Pipe Loop System Overview



Controls

Pipe Loop System Overview

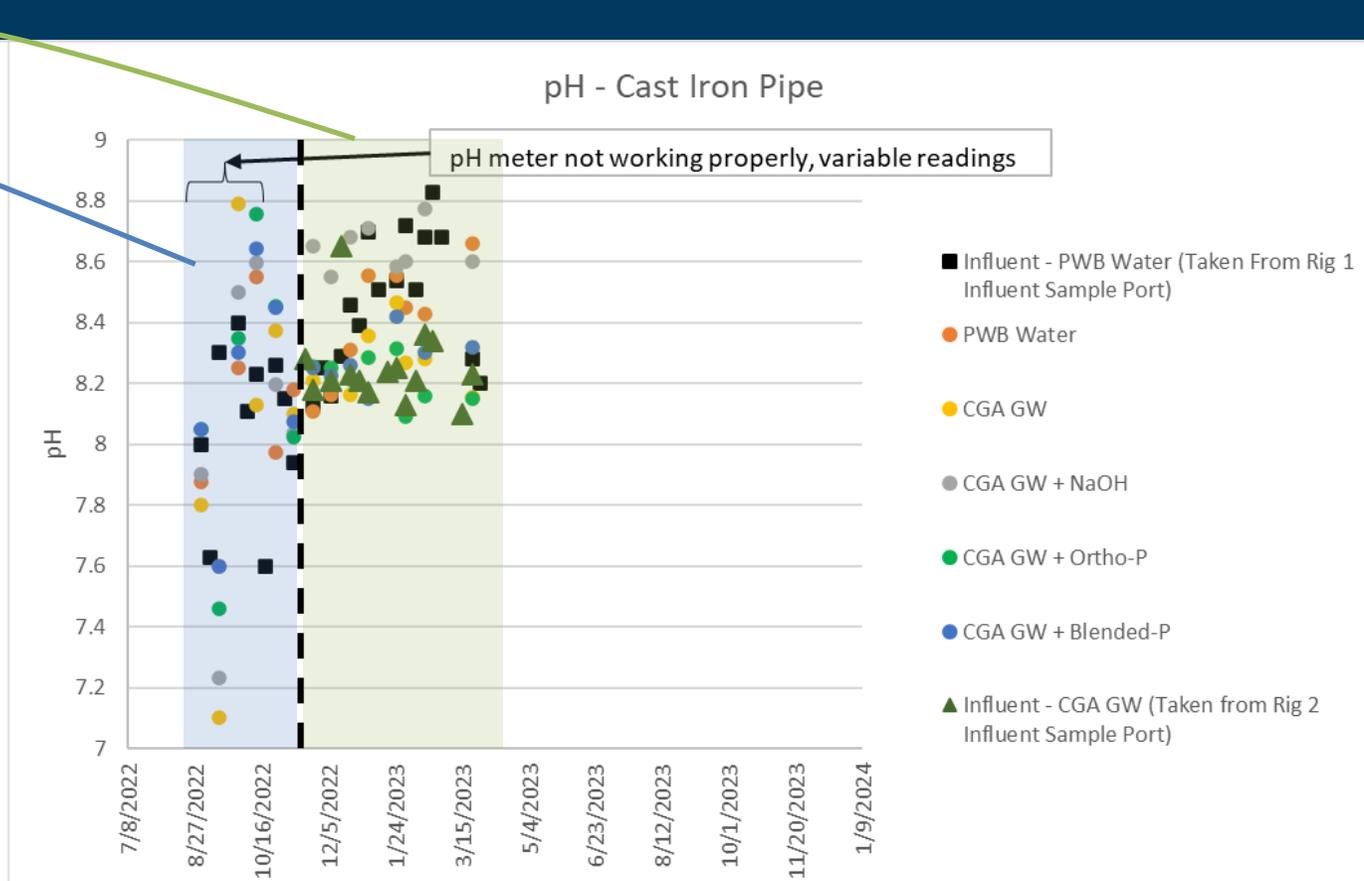
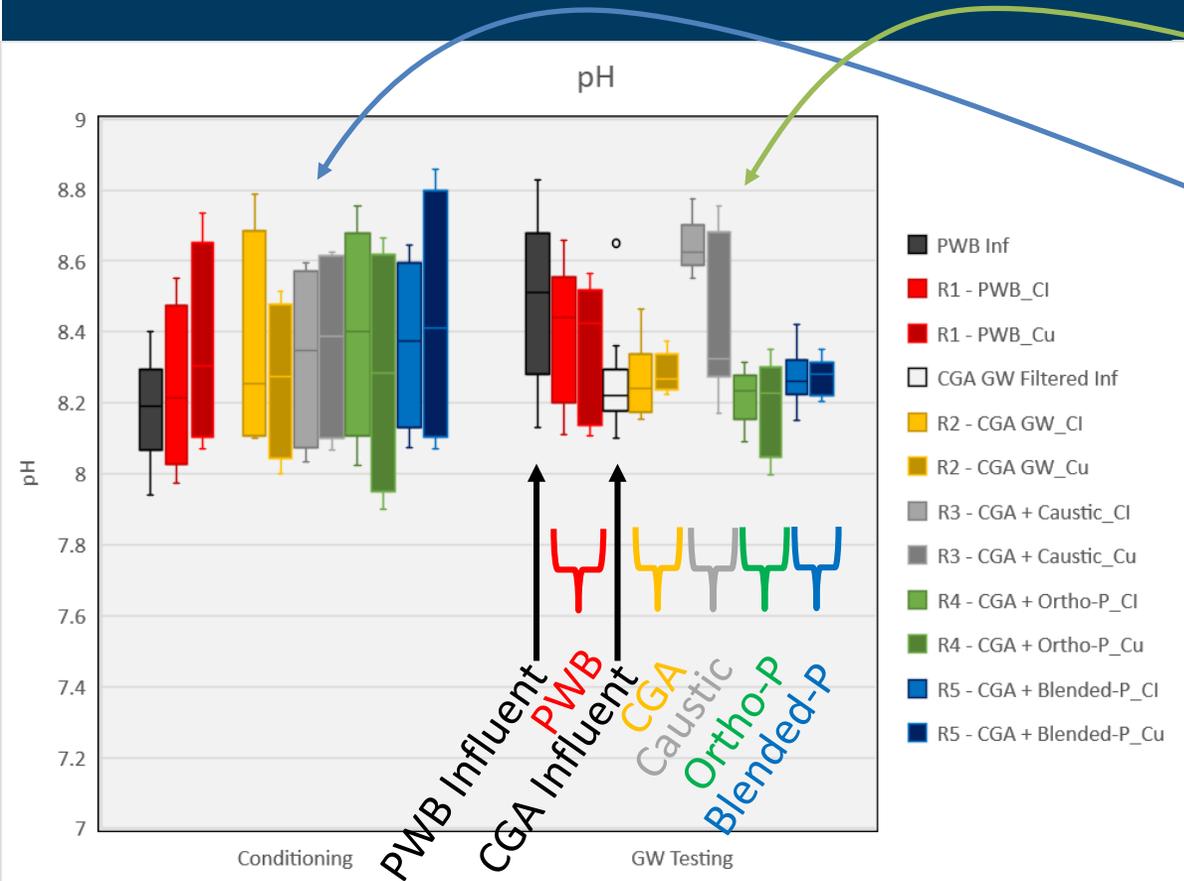


Ongoing Results



pH Results

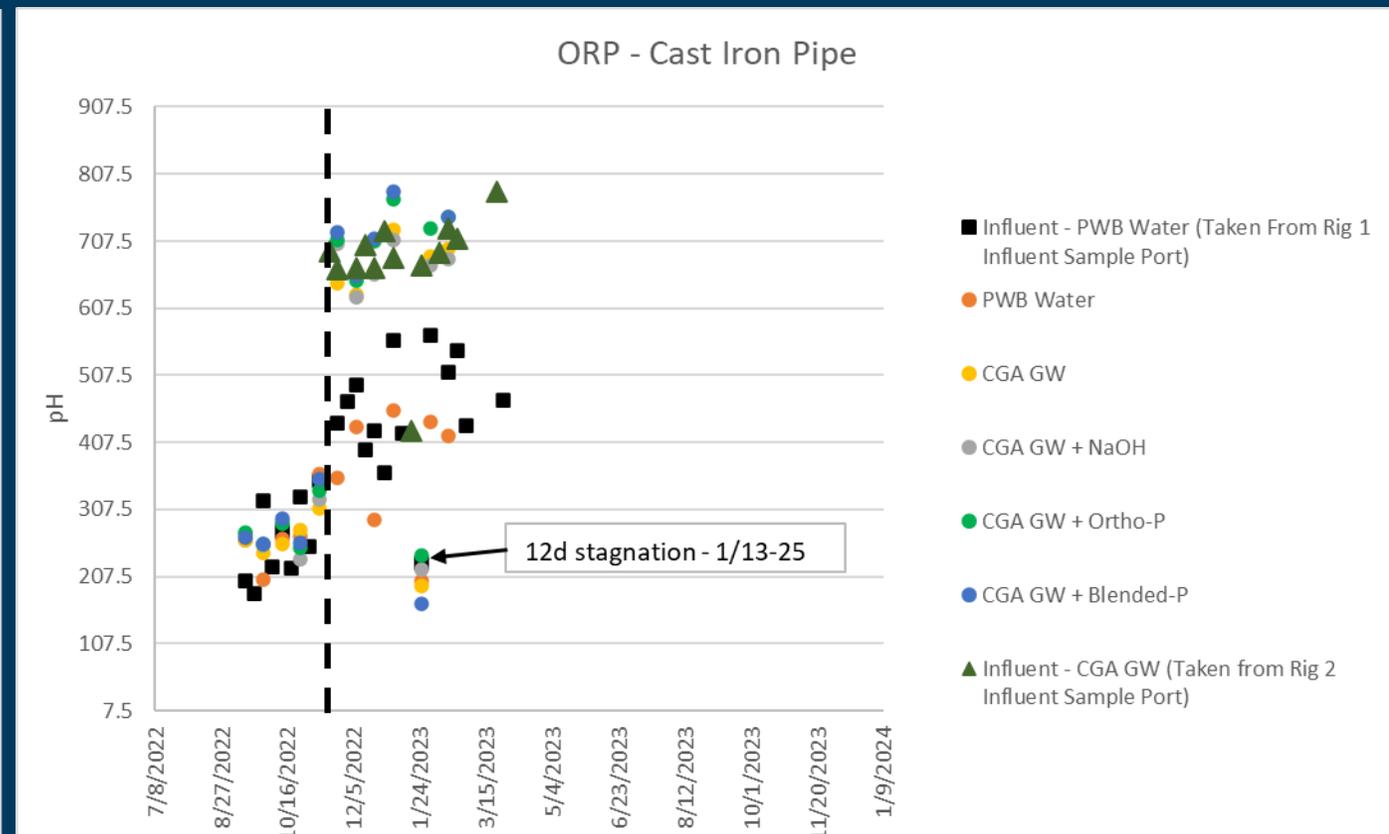
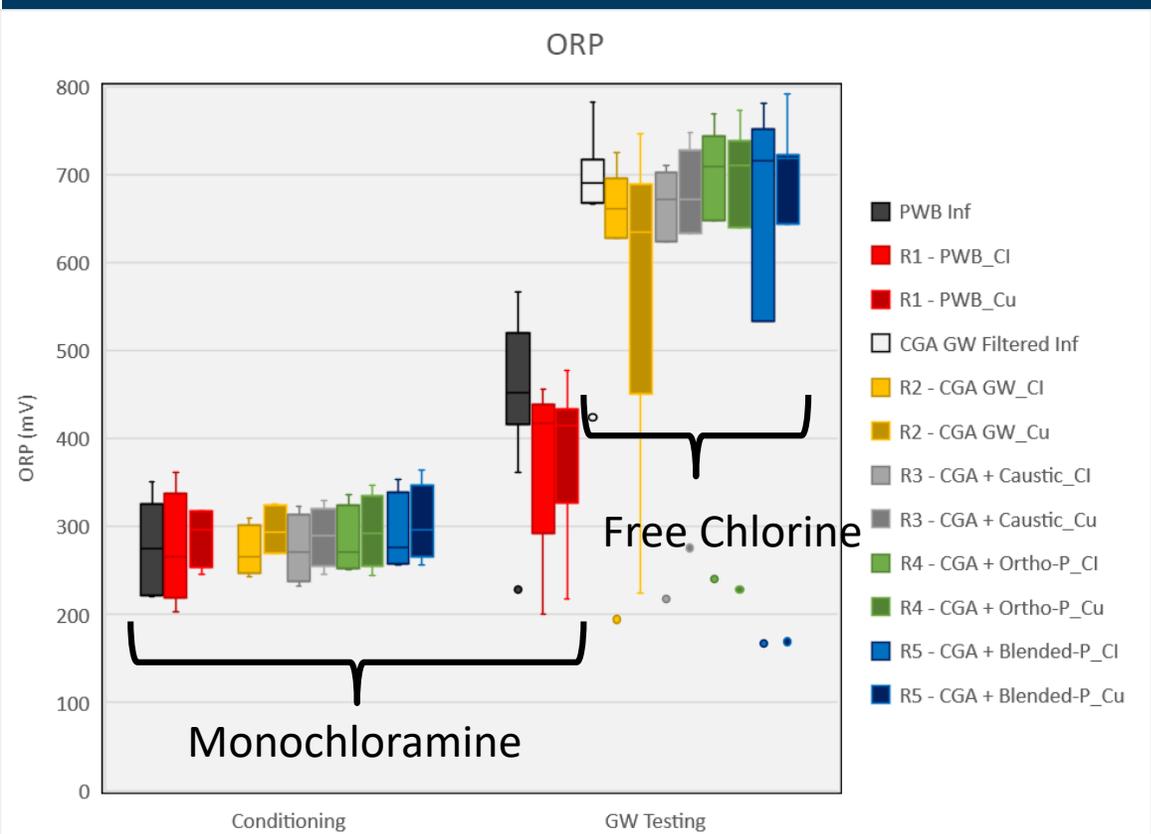
– Helpful indicator of conditions



Oxidation Reduction Potential (ORP)

Results

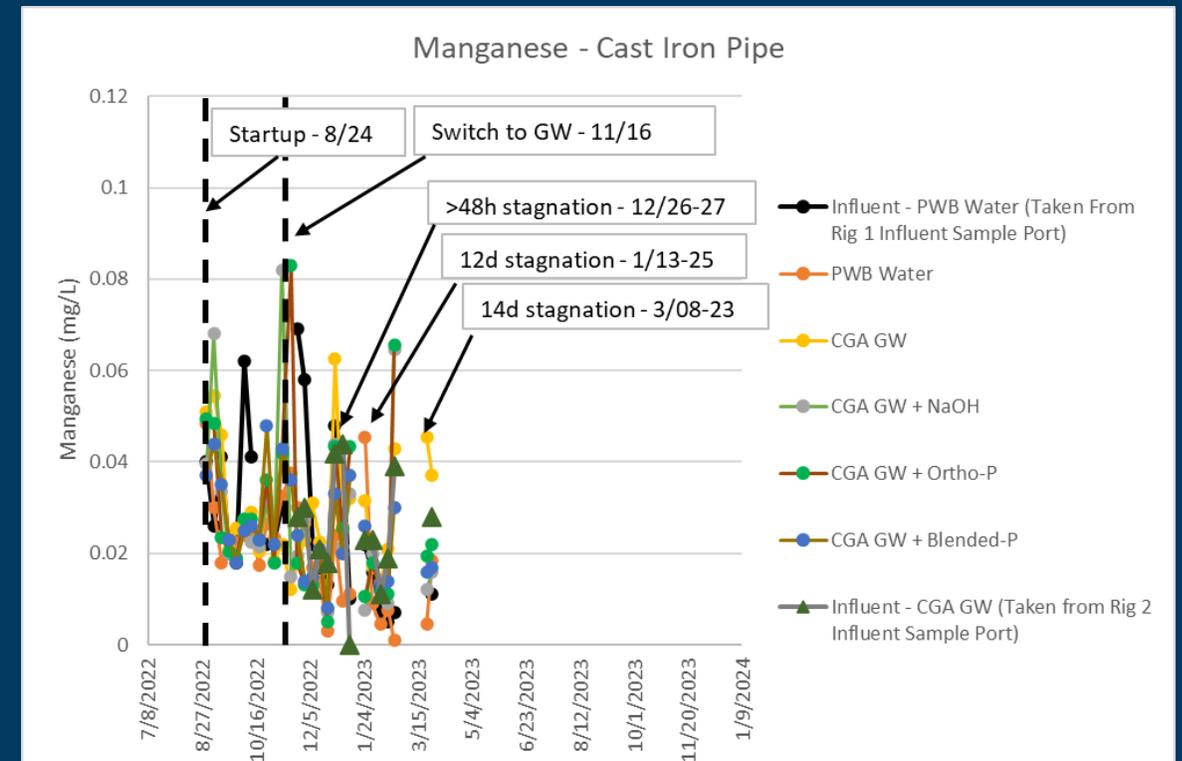
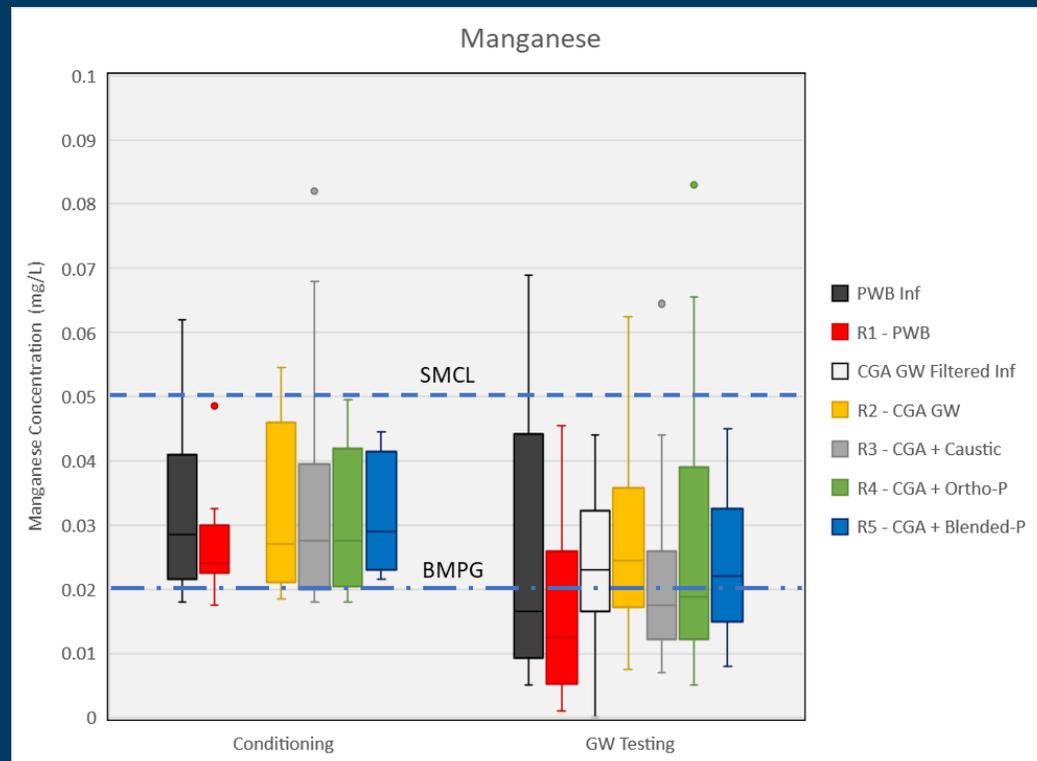
– Helpful indicator of conditions



Manganese (Cast Iron Pipe)

Results

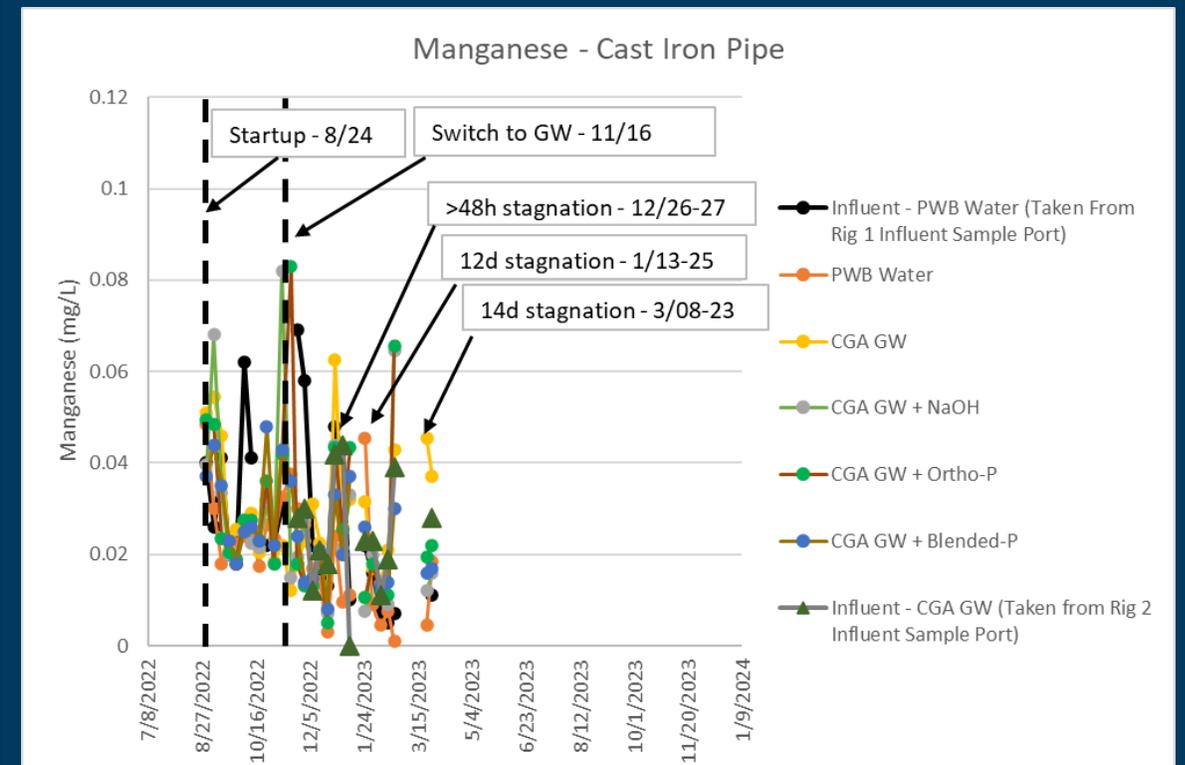
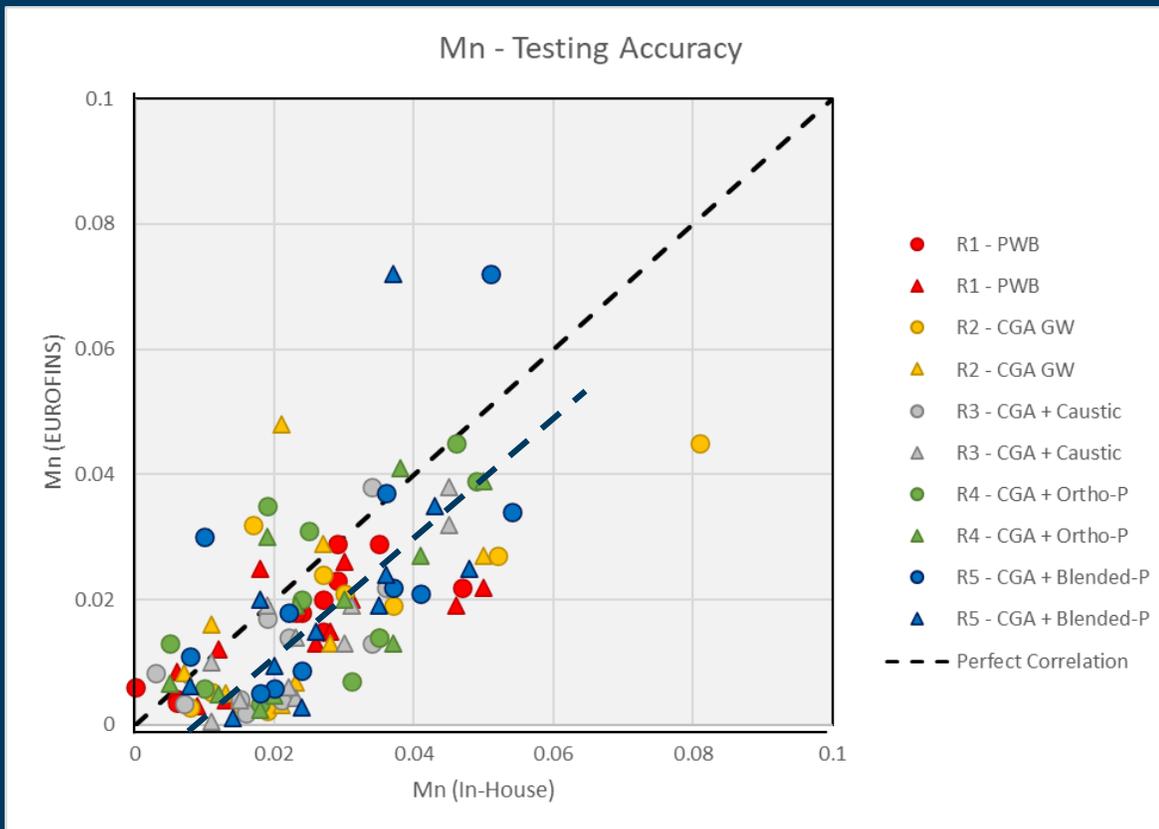
- Mn exiting pipe loop resembles influent (“background”) Mn levels
- Elevated Mn during some stagnation events, not necessarily correlated to Mn release
- Field Mn (Hach) tests over-detect at low Mn levels



Manganese (Cast Iron Pipe)

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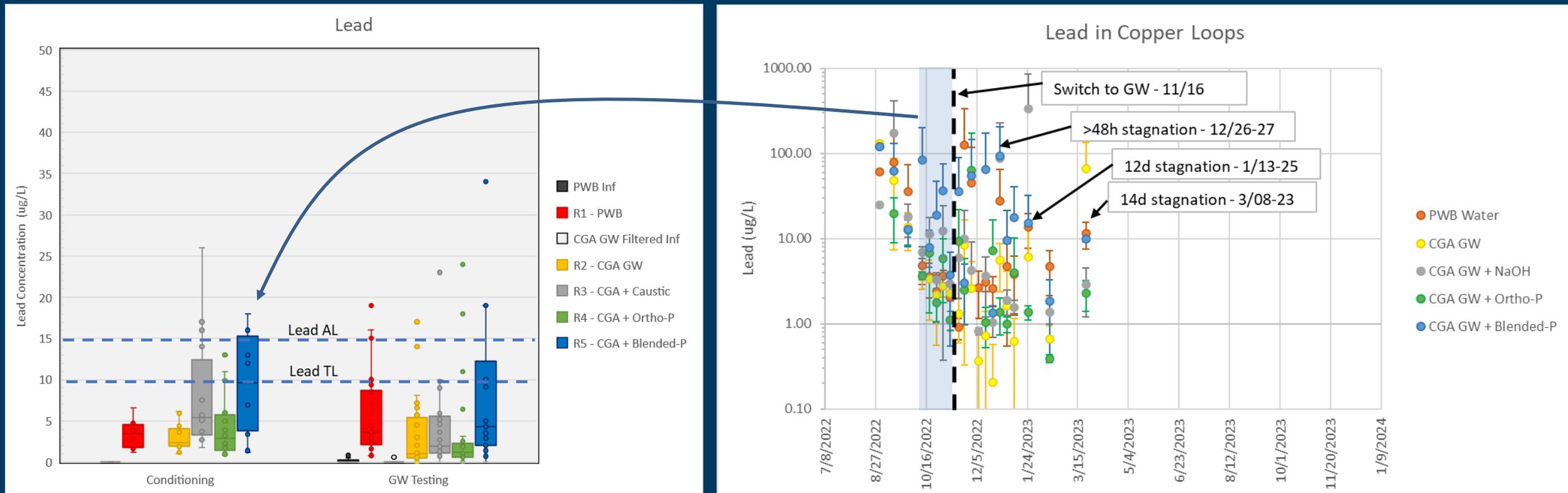
- Mn exiting pipe loop resembles influent (“background”) Mn levels
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Lead (New Copper Pipe)

Results

- Control lead levels in conditioning phase varied across rigs
- Took ~1.5 months for lead levels to bottom out after startup
- CGA GW w or w/o caustic or ortho-P show improvements wrt control (PWB)



Conclusions & Recommendations

Manganese

- Release does not occur under normal operating conditions with new GW; may spike with long water age, but no more than current water source
- Corrosion control does not provide benefit

Lead

- Need to analyze statistical significance of lead release compared with PWB control
- Switch to GW without corrosion control – Pb release appears to remain steady
- Pb release appears to decrease with increased pH and orthophosphate

Recommendation

- District to move forward without corrosion control

Lessons Learned

Lessons Learned

Planning and coordination

- Action plan
- Coordination

Construction events that caused extended stagnations

- Took advantage of situation to simulate long water age

Controls system

- Automation reduces operator burden, easy adjustability

Lead soldering

- Consistent application needed to achieve reproducible results

Overall level of effort

- More than expected, but worth the peace of mind

Thank you!

Questions?