Presentation for

Lead Corrosion Control Treatment Study Conclusions and Recommendations

Presented to

City of Milwaukee
Public Works Committee

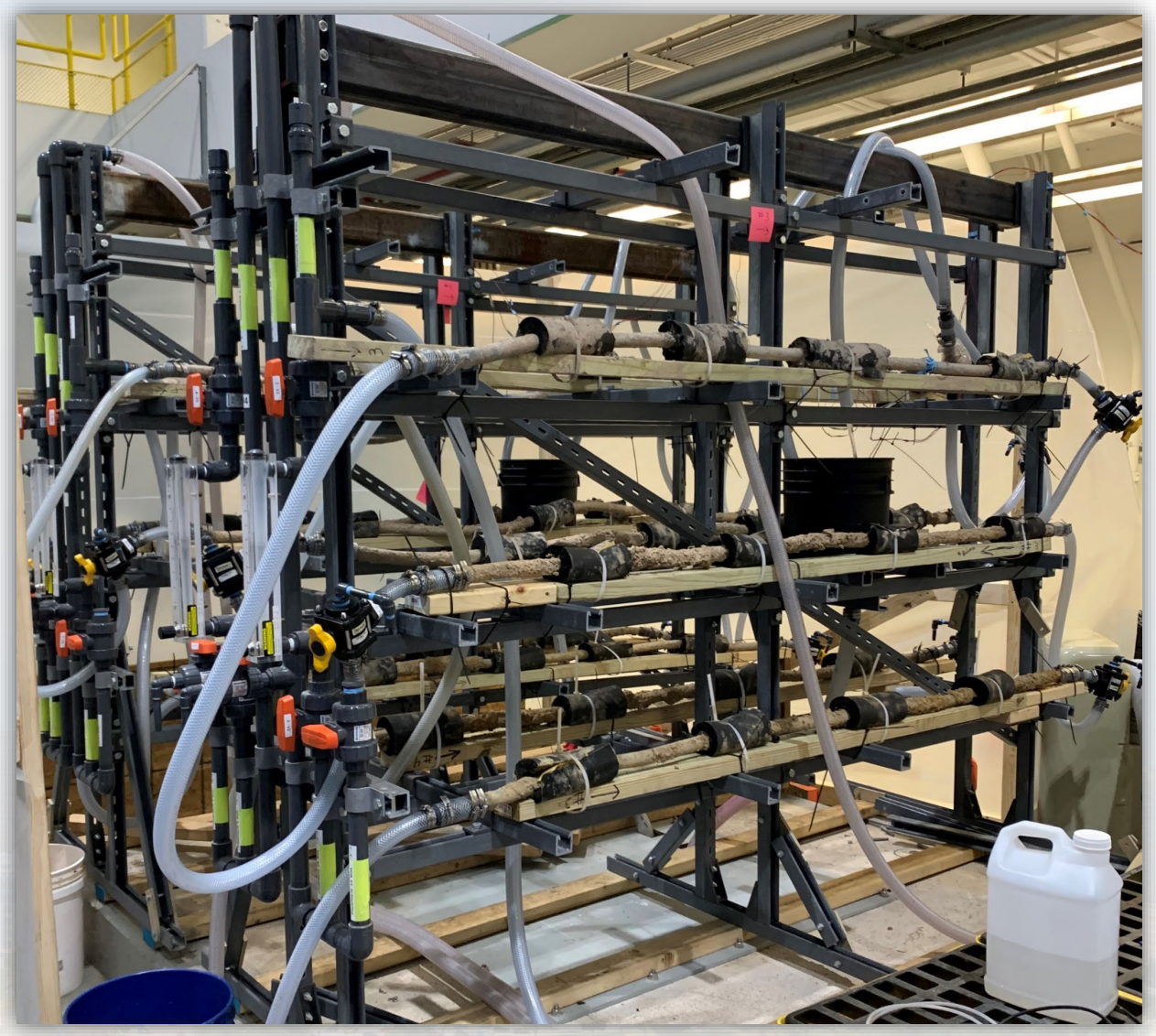
Presented by

JACOBS®

January 26, 2022

Purpose of Corrosion Control Treatment Study

- Review Milwaukee Water Works (MWW) water quality to identify feasible lead corrosion control treatment alternatives
- Conduct the Pipe Loop Test to compare alternatives to MWW's current corrosion control treatment
- Recommend a corrosion control technique that results in lowest lead levels at customers taps
- Submit a report to the Wisconsin Department of Natural Resources (WDNR) to support their determination of 'optimized corrosion control' for MWW



Experts who reviewed the corrosion control study:

Dr. Vern Snoeyink – Professor Emeritus, University of Illinois and international expert in corrosion control. Consulted with many large water utilities for lead corrosion control optimization in the US and abroad. Author of numerous publications on water chemistry and corrosion control.

Rich Giani – Technical Drinking Water Coordinator for Jacobs water operations. Author of AWWA Manual 58 - Internal Corrosion Control in Water Distribution Systems. Former water quality manager for DC Water in Washington DC.

Monique Waller – Global technology leader for distribution system water quality for Jacobs. Worked with many water utilities to optimize lead and copper corrosion control in similar water systems.

Corrosion Control Study Components

1. MWW Water Quality Review and Pipe Loop Test Plan
2. Pipe Loop Testing
3. Pipe Scale Analysis
4. Conclusions and Recommendations

The **Corrosion Control Best Practices Evaluation** was conducted in 2020.

The evaluation found that MWW is currently using many best practices for lead control.

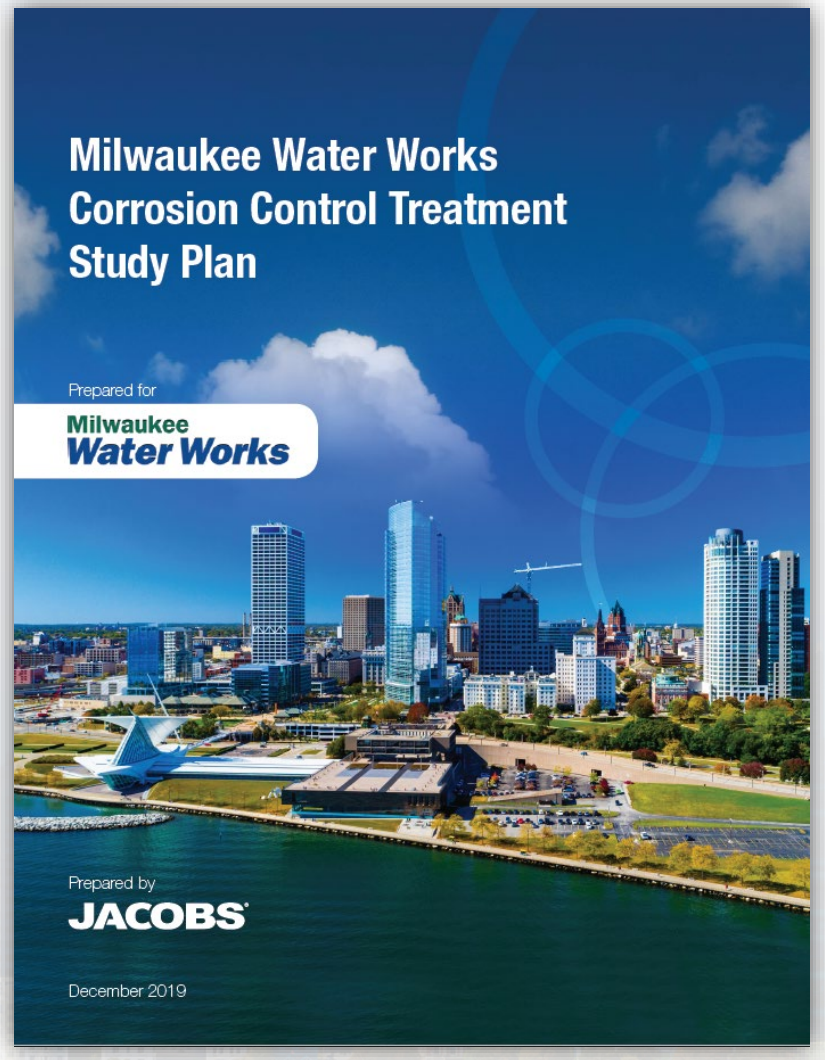
MWW Water Quality Review and Test Plan

MWW Water Quality Review Outcomes

- Water quality is excellent and stable
- Corrosion control practice of adding orthophosphate has reduced lead levels by more than 50% since 1996
- Routine water quality monitoring far exceeds regulatory requirements

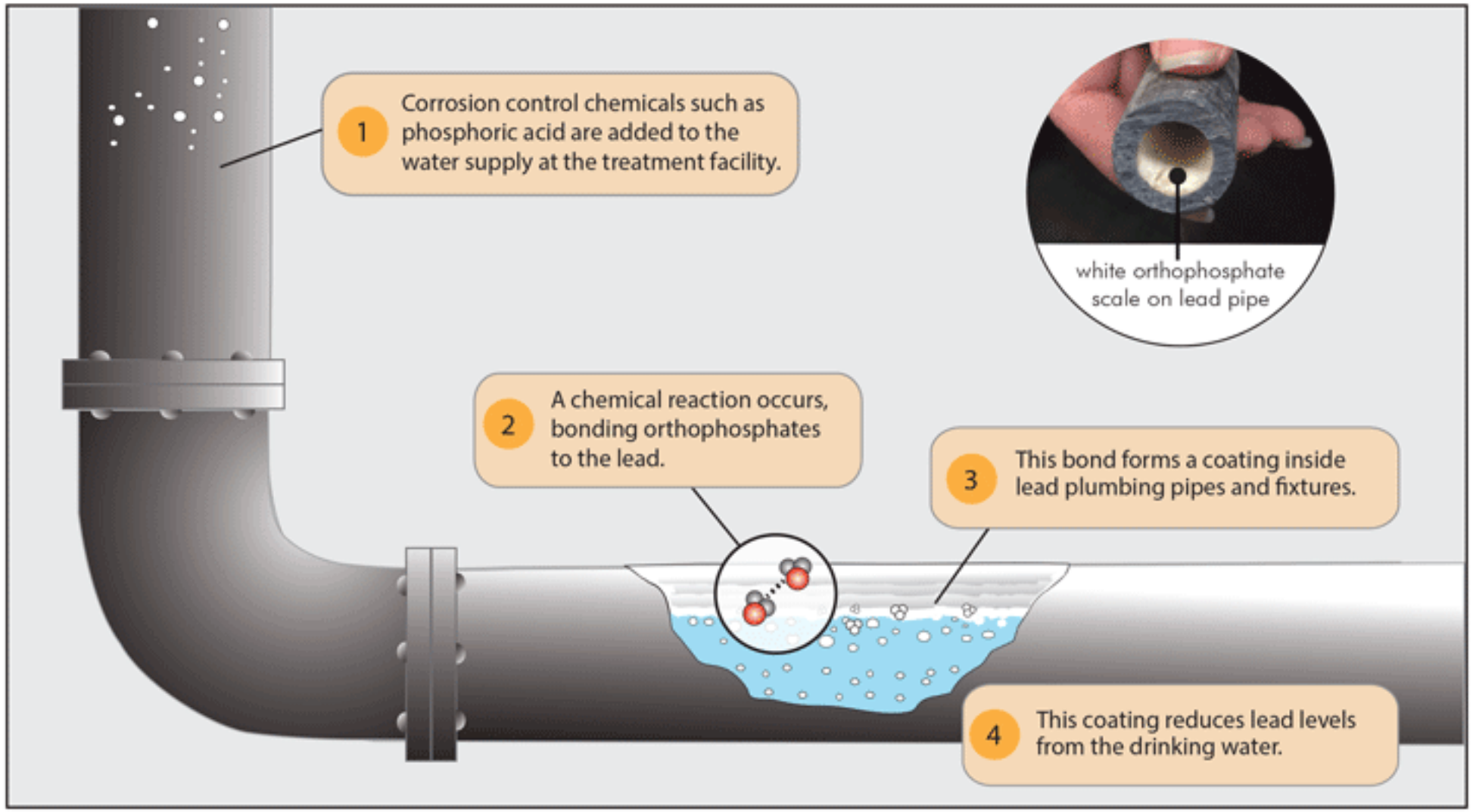
Pipe Loop Test Plan Objectives

- Determine whether changes in orthophosphate dose can further reduce lead levels
- Evaluate lead levels if corrosion control treatment is interrupted



How orthophosphate coats and protects water pipes

- The EPA recommends a pH range of 7.2 to 7.8 for optimum orthophosphate performance.
- MWW treated water and distribution water is consistently in this optimal pH range.



Source: U.S. Environmental Protection Agency, Optimal Corrosion Control Treatment Evaluation Technical Recommendations for Primary Agencies and Public Water Systems

Pipe Loop Testing aims to reflect conditions in MWW homes

Key Aspects of MWW Pipe Loop Testing

- Lead pipes from three Milwaukee homes were excavated and used in the Pipe Loop Test.
- Water flow through the Pipe Loop Test apparatus mimicked residential water patterns. Periods of water stagnation represented residents sleeping or going to work.
- Water samples were collected after water stagnation to capture the highest lead levels possible.

Pipe Loop Test evaluated 3 treatment options

	Corrosion Treatment Practice	Corrosion Control Chemical	Chemical Dose
1	MWW's Current Practice	Orthophosphate	1.9 mg/L
2	Lower Dose	Orthophosphate	1.0 mg/L
3	Higher Dose	Orthophosphate	3.0 mg/L
4	Worst Case Scenario – No Corrosion Control	None	0 mg/L

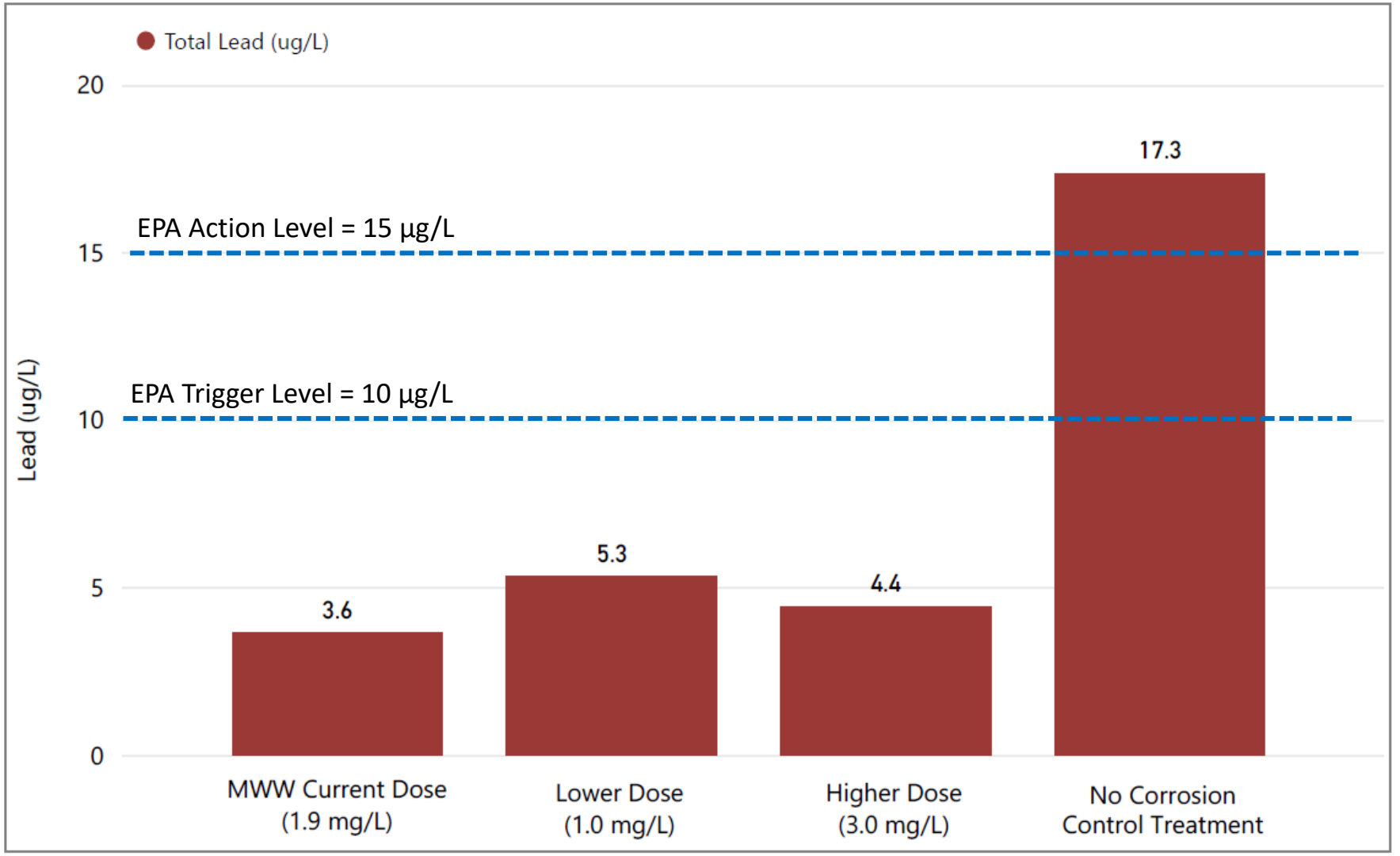
mg/L – milligram per liter

A "worst-case scenario" condition was tested to simulate what would happen if corrosion treatment was interrupted.

Pipe Loop Test Results

Test Results

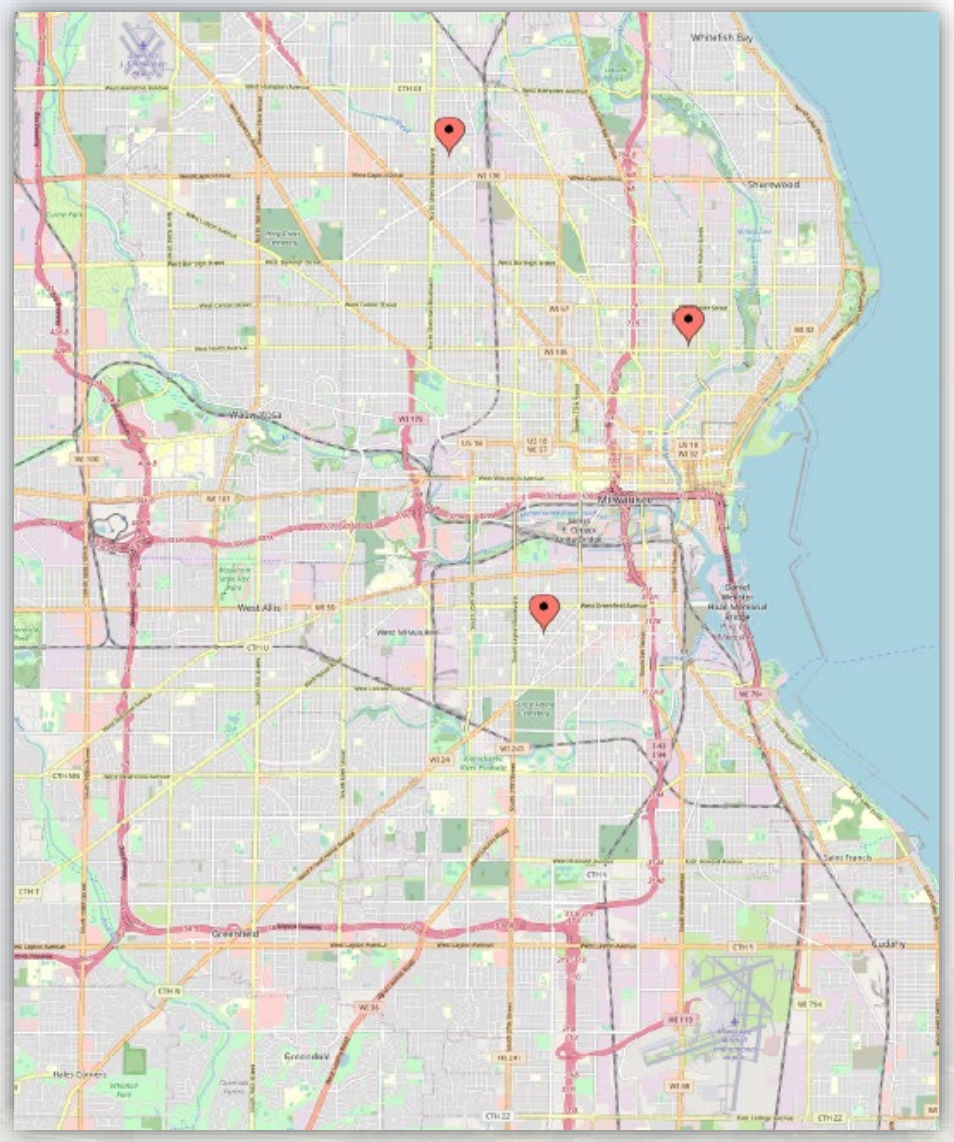
- MWW's current corrosion control treatment practice resulted in the lowest lead levels.
- Lead levels increased after approximately 4 weeks of no corrosion control treatment.



MWW lead pipes have protective pipe scales

Pipe Scale Analysis Conclusions:

- Lead pipe scales from three Milwaukee residences were very similar. This suggests that MWW water quality is both consistent across the distribution system and chemically stable.
- Lead pipes from three Milwaukee residences contained a similar protective orthophosphate scale that reduces lead release.
- Continuing to add orthophosphate during the Pipe Loop Test maintained this protective scale.



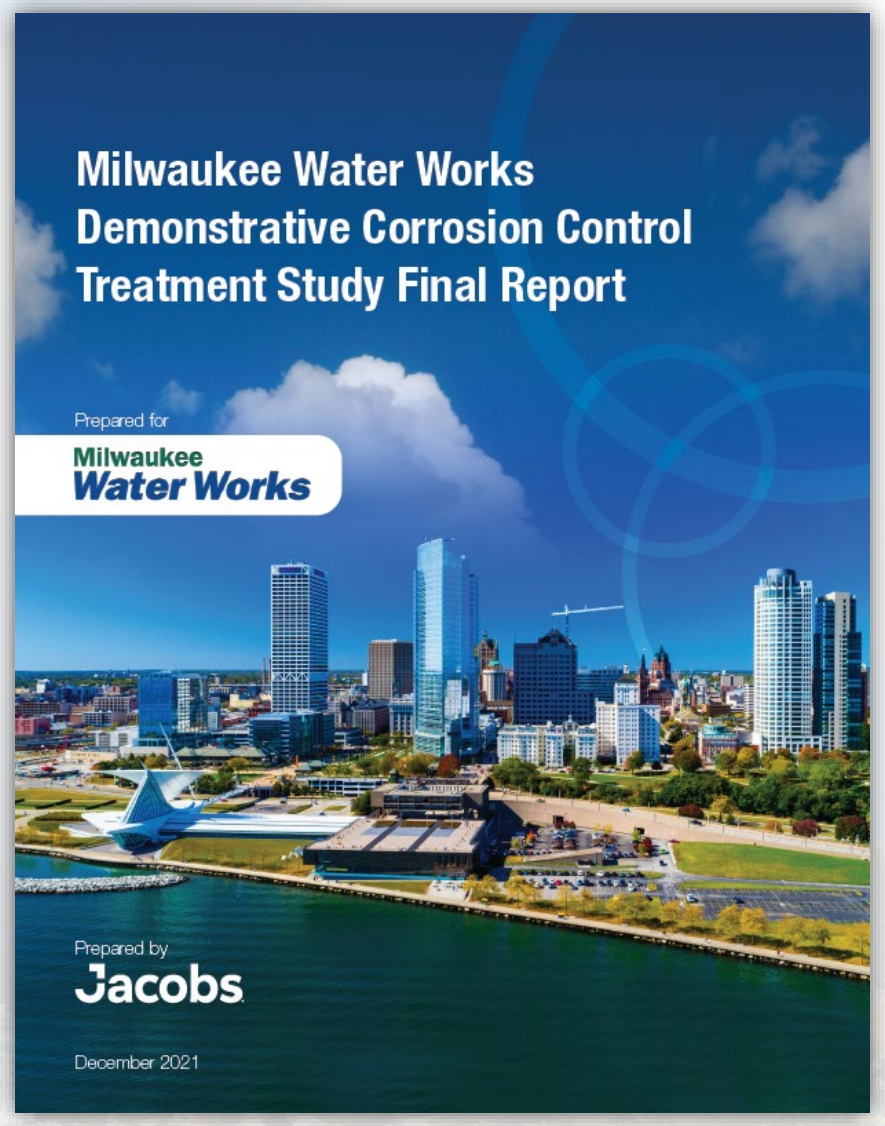
Conclusions and Recommendations

Conclusions

- With orthophosphate addition over the past 25 years, protective scales have formed on lead pipes that minimize lead levels at customers taps.
- MWW water quality monitoring practices far exceed federal and state requirements.
- Pipe Loop Test results indicate that MWW's current lead corrosion control practice of adding 1.9 mg/L orthophosphate and maintaining treated water pH of 7.2 to 7.8 results in low lead levels.
- Pipe Loop Test results align with Best Practices Evaluation.

Recommendations

- Maintain current optimized lead corrosion control and water quality monitoring practices.
- Continue removing lead service lines.



Corrosion Control Treatment Study

Questions