WHEN TO MAKE A CORROSION CONTROL TREATMENT (CCT) CHANGE

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Thanks to

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WQTC

November, 2019

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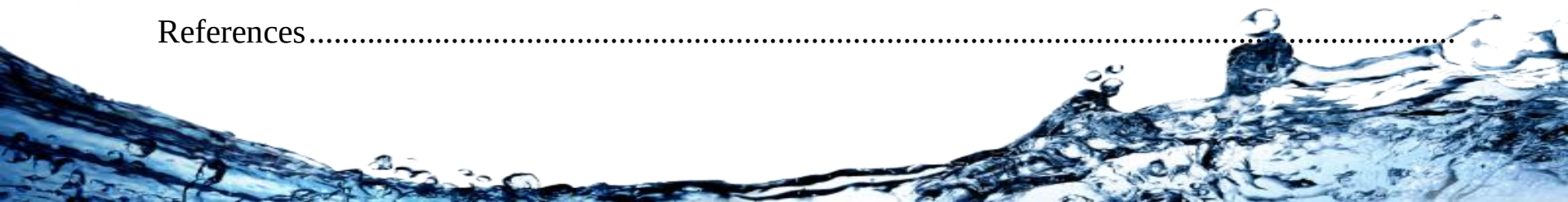
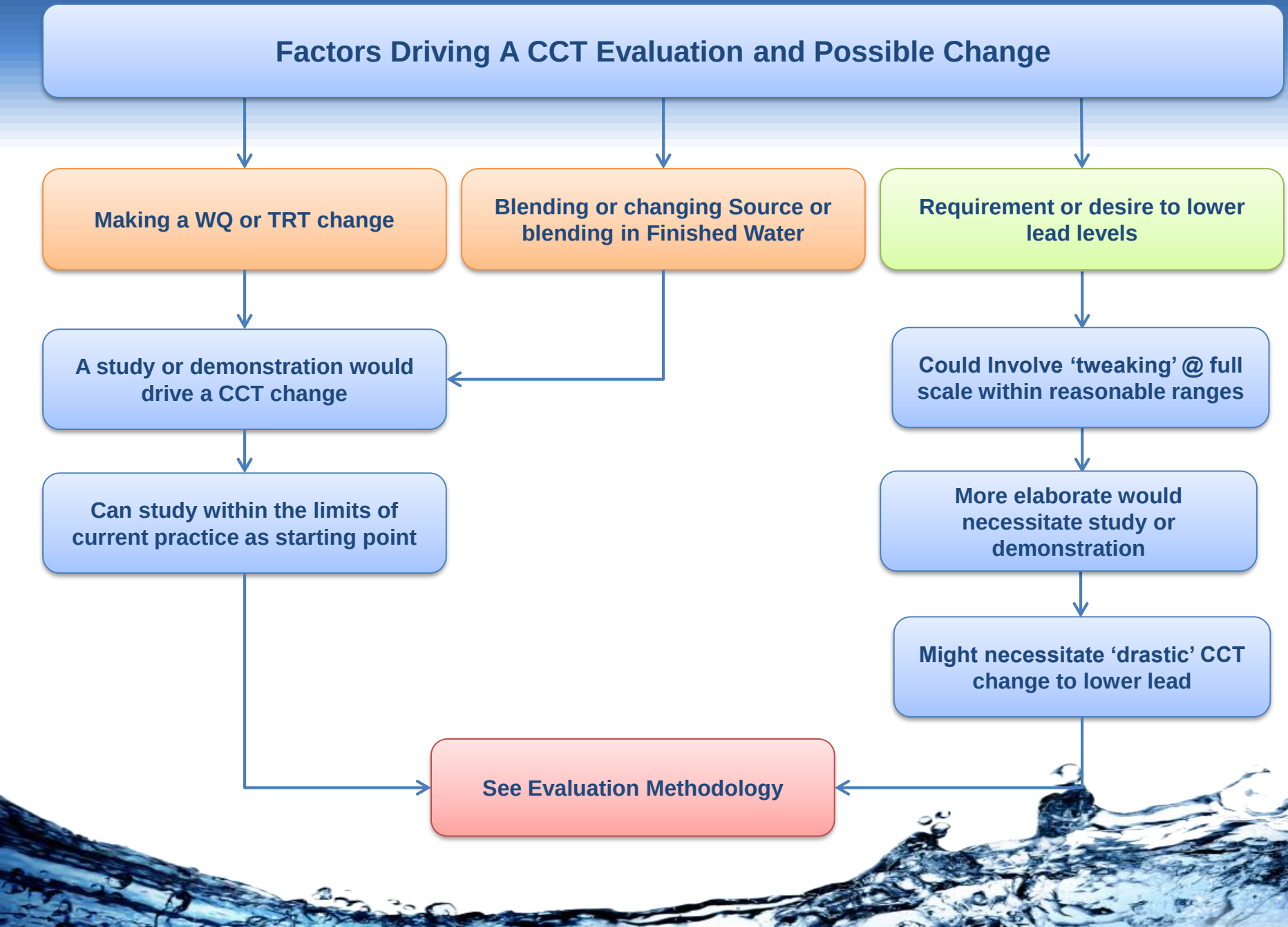
OUTLINE OF REPORT




Factors Driving A CCT Evaluation and Possible Change
Making a WQ or TRT change
Blending or changing Source or blending in Finished Water
Requirement or desire to lower lead levels
A study or demonstration would drive a CCT change
Could Involve 'tweaking' @ full scale within reasonable ranges
Can study within the limits of current practice as starting point
More elaborate would necessitate study or demonstration
Might necessitate 'drastic' CCT change to lower lead
See Evaluation Methodology

EXAMPLE CHANGES THAT WARRANT A CCT EVALUATION

1. Water Sources
Change source water
2. Blending Source or Finished Water Seasonally
Blending of different source waters
Blending of different finished waters
3. Disinfection
Change in disinfectant type or disinfection strategy
4. WQ Parameters Directly affecting CCT
Change in pH or alkalinity
Change in inhibitor type (e.g., changing any combination of polyphosphate, blended phosphate, or orthophosphate; as well as adding any P-containing product when no ortho- or poly-phosphate was added before)
Change of blended or polyphosphate inhibitor product or supplier
5. Treatment Changes
Change in coagulant type (e.g., Fe-based to/from Al-based, or Cl-based to/from SO4-based)
Change in treatment process that increases NOM
Change or addition of new oxidant (e.g. adding ozone)
Addition of ion exchange (IX)

EXAMPLE CHANGES THAT DO NOT WARRANT A CCT EVALUATION EXCEPT DESKTOP OR SOLUBILITY

1. Change in blending/ seasonal impacts that have historically occurred specifically within allowed WQPs
2. Inhibitor
Change in orthophosphate dose, but solubility study helpful
Change in orthophosphate vendor (not blended or polyphosphate,see above)
3. Treatment
Membrane filtration as long as WQ at tap does not change
Change in softening agent
Addition of GAC if pH doesn't change

EVALUATION METHODOLOGY

- Evaluate Current Status
- What WQ Parameters Are Changing
- Determine Level of Investigation Needed
- Determine if New CCT is Warranted
- Cautions on Making a CCT Change

EVALUATE CURRENT STATUS-ACTIONS

- Trend and Evaluate Data
- Map Lead lines/Older Housing
- Evaluate Presence of Biofilms
- Conduct Profile Sampling
- Define Current CCT

EVALUATE CURRENT STATUS- OUTCOMES FROM FIND AND FIX FOR Pb REDUCTION

- Could Result in Lead Reduction-----Ending Further Actions

- But, Could Require Further Actions…..

Evaluation Methodology

- Evaluate Current Status
- What WQ Parameters Are Changing—Narrow Down Study Area to Defined Changes
- Determine Level of Investigation Needed
- Determine if New CCT is Warranted
- Cautions on Making a CCT Change

BASED ON CHANGE-DEFINE WQP CHANGING

Change	Possible changes in corrosion-related water quality parameters								Potential impacts scale	
	Change in finished water pH	Change in DIC/Alkalinity	Change in $Cl:SO_4$	Change in ORP	Change in NOM	Change in Biofilm	Change in Temp	Change in Al/Fe/Mn	Change in solubility	Change in redox potential
Addition of a new source of supply	•	•	•		•		•	•	•	
Blending of different source waters	•	•	•		•		•	•	•	
Blending of different finished waters	•	•	•		•	•	•	•	•	
Change in free chlorine dose	•			•		•			•	•
Change from chlorine gas to hypochlorite	•		•						•	
Addition of other oxidants/disinfectants			•	•	•	•		•		•
Conversion to chloramines	•			•		•			•	•
Enhanced coagulation for NOM removal	•	•	•	•	•	•		•	•	•

Evaluation Methodology

- Evaluate Current Status
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MANY MECHANISMS CAN IMPACT Pb

- Lead Solubility
- Galvanic Corrosion
- Sequestrant Presence
- ORP
- Ca, Al, Fe, Mn
- Water use Rate
- Water Flow Rate in Pipes/Plumbing
- Scale Disruption
- Microbial Growth

A DIVERSION INTO THE LT LCR PROPOSAL

- Proposal states loops must be used because of scale impacts and coupons only screen & not set OCCT
- What does the proposal mean by a “loop” study-assume---flow through harvested material study

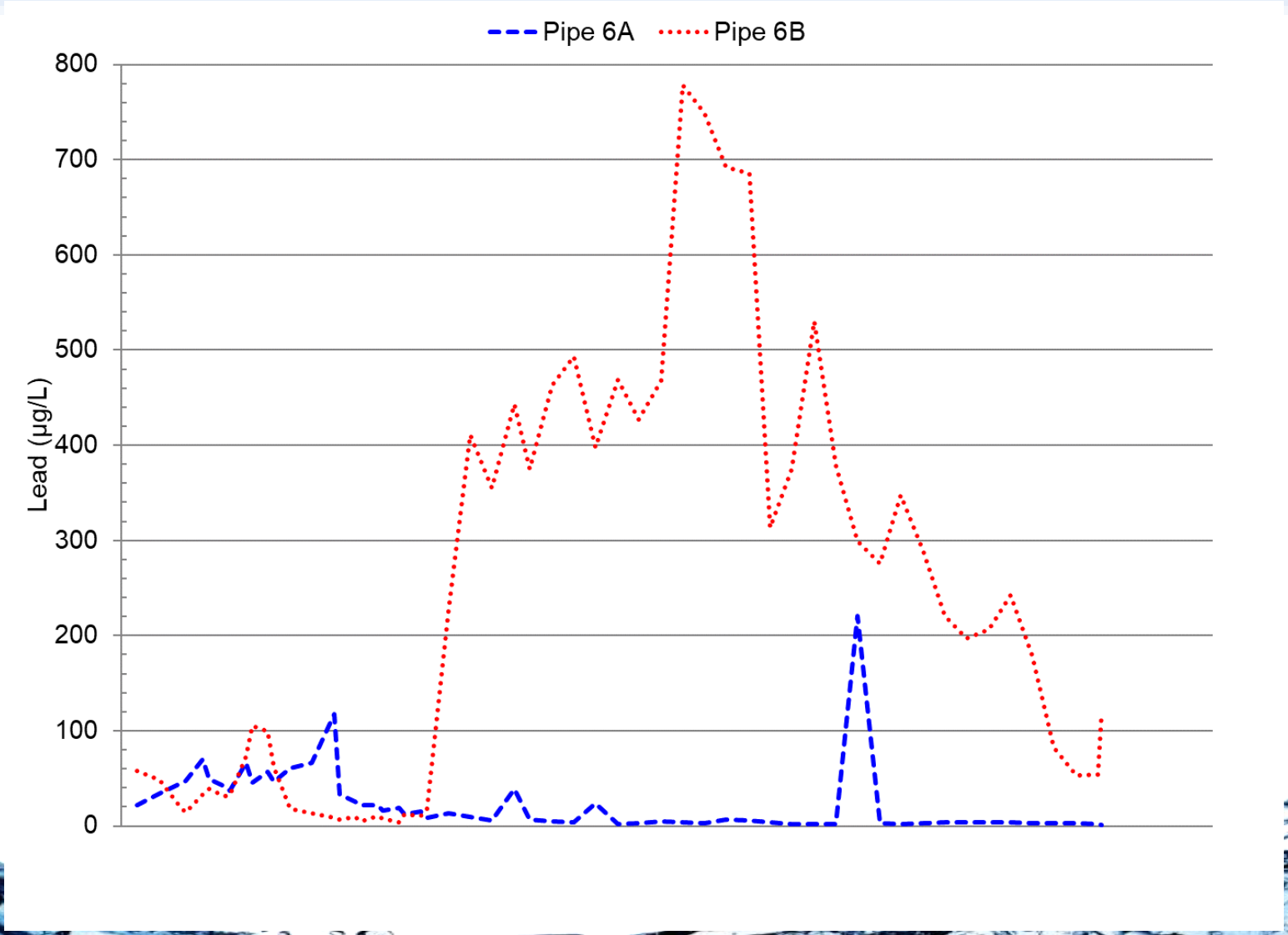
BUT: TOOLBOX OF AVAILABLE STUDY METHODS

	Solubility	Galvanic	Sequestrant	ORP	Ca, Al, Fe, Mn	Water Use and Rate	Scale Disruption	Microbial
Theoretical Solubility	M			M				
Research Actual Solubility	M+			M+				
Batch Coupon Weight Loss								
Batch Coupon Solubility	H		H	M			L	
Batch Harvested Pipe	H-	H	H-	M	M		M	
Batch Galvanic Tests		M						
“Loop” Virgin Pipes	M	H	L	L	L		L	
“Loop” Coupons	M	H	L	L	L		L	
Flow Through Harvested Pipe	L+	H	L+	H	H	H	H	
Scale Analysis	M	M	H	H	H		M	

HARVESTED MATRIAL FLOW THROUGH TEST LIMITATIONS

- Loop studies have not been successful in evaluating different CCT methods on harvested premise materials like copper/lead solder or faucets—too much variability in materials
- *plus* Harvesting premise pipes from INSIDE a house has liability issues and unintended consequences
- So, we have ~70% of CWS w/o LSL where harvested flow through studies aren't particularly good
- Many changes don't affect LSL scales
- LSL pipe studies are also variable and take a long time to settle down

TWO COPPER/SOLDER PIPES FROM SAME HOUSE



- Loops have large variability even with LSLs making it hard to compare different test conditions
- Note the high 2SD values making a distinction in test conditions difficult
- These are values after the pipes have "settled" down

PO4 Dose	1.2 mg/L	2.5 mg/L	3.0 mg/L	3.5 mg/L	4.0 mg/L	5.0 mg/L
Mean ppb	2.9	10.5	5.2	3.8	3.6	3.0
2 SD ppb	3.4	3.4	15.8	5.0	24.8	7.8

	location 5		
Dose	Ortho 1	Ortho 2	Ortho 3
Mean ppb	16.0	30.7	35.9
2 SD ppb	118.0	52.0	64.6

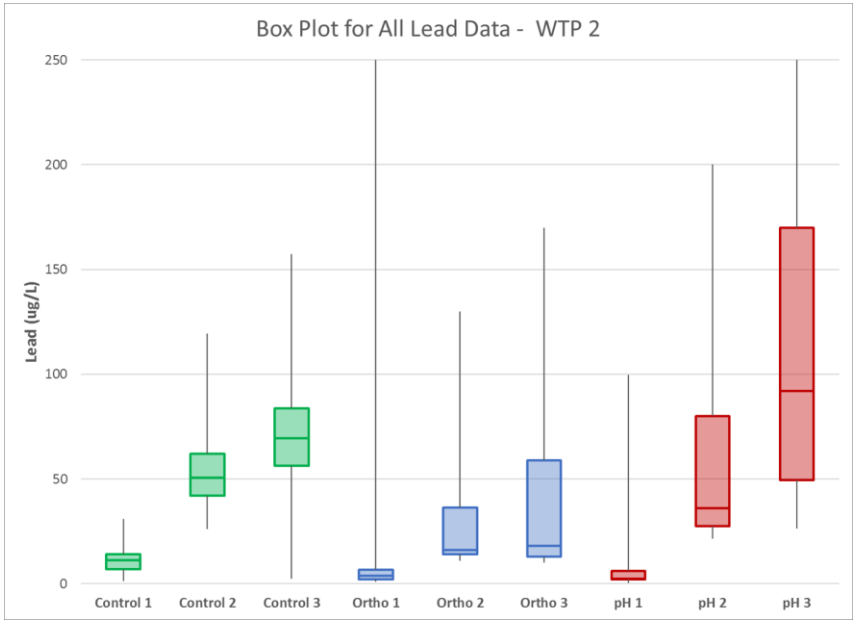
		Location 2				
Loop	Loop 1	Loop 2	Loop 3	Loop 4	Loop 5	Loop 6
Mean ppb	436.9	544.8	682.4	357.7	137.1	81.5
2 SD ppb	320.0	622.0	374.0	300.0	180.0	70.0

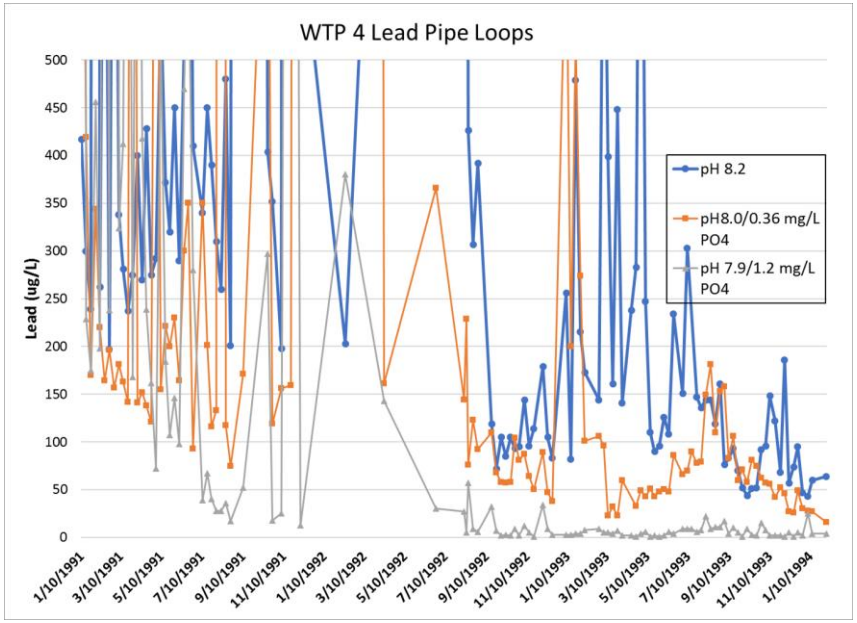
It is really hard to tell differences in TRT with loops

WHAT FLOW THROUGH HARVESTED PIPE RESULTS LOOKS LIKE

An example different City-All TRT tests showed 1 low pipe and some high pipes

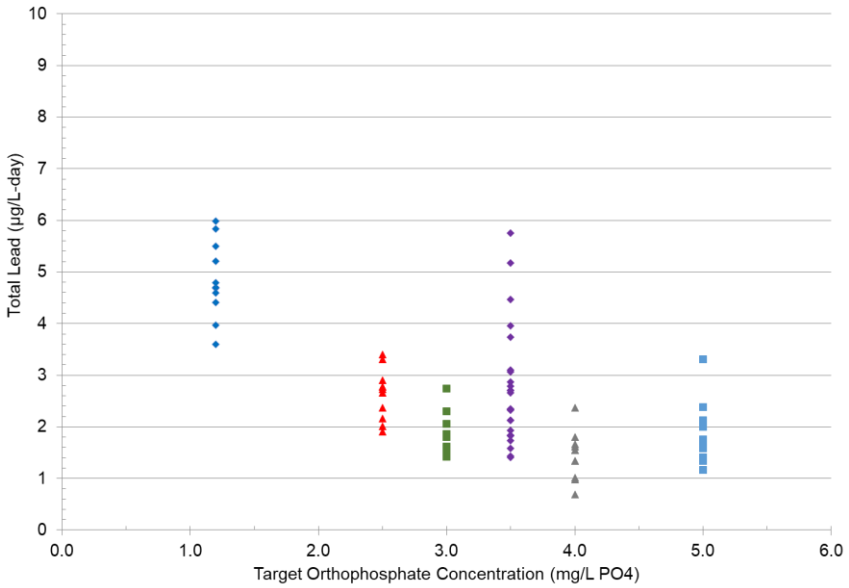
~ 2 years to settle down



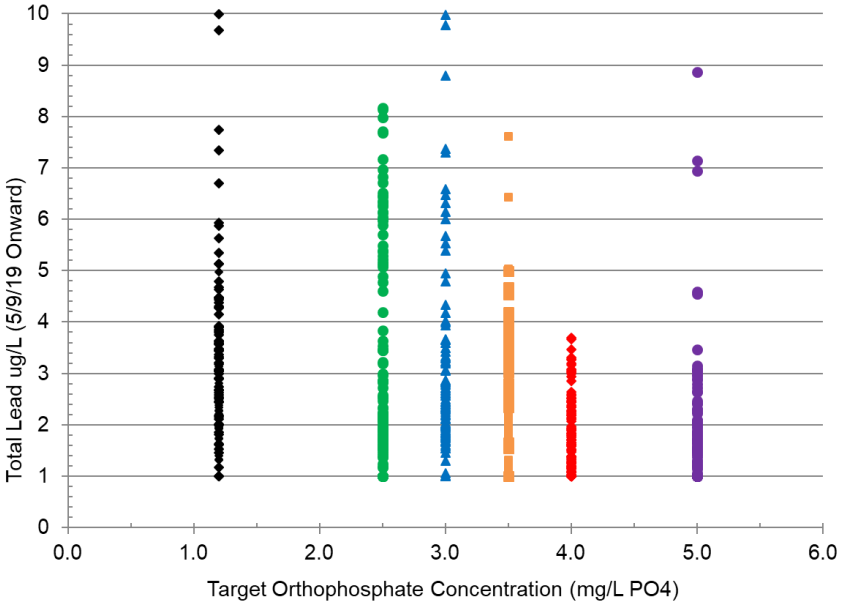


FLOW THROUGH HARVESTED PIPE STUDIES AND COUPON SOLUBILITY STUDY

Side by side coupon solubility study



Harvested Pipe Data after one year from start and onward-took over a year to settle down

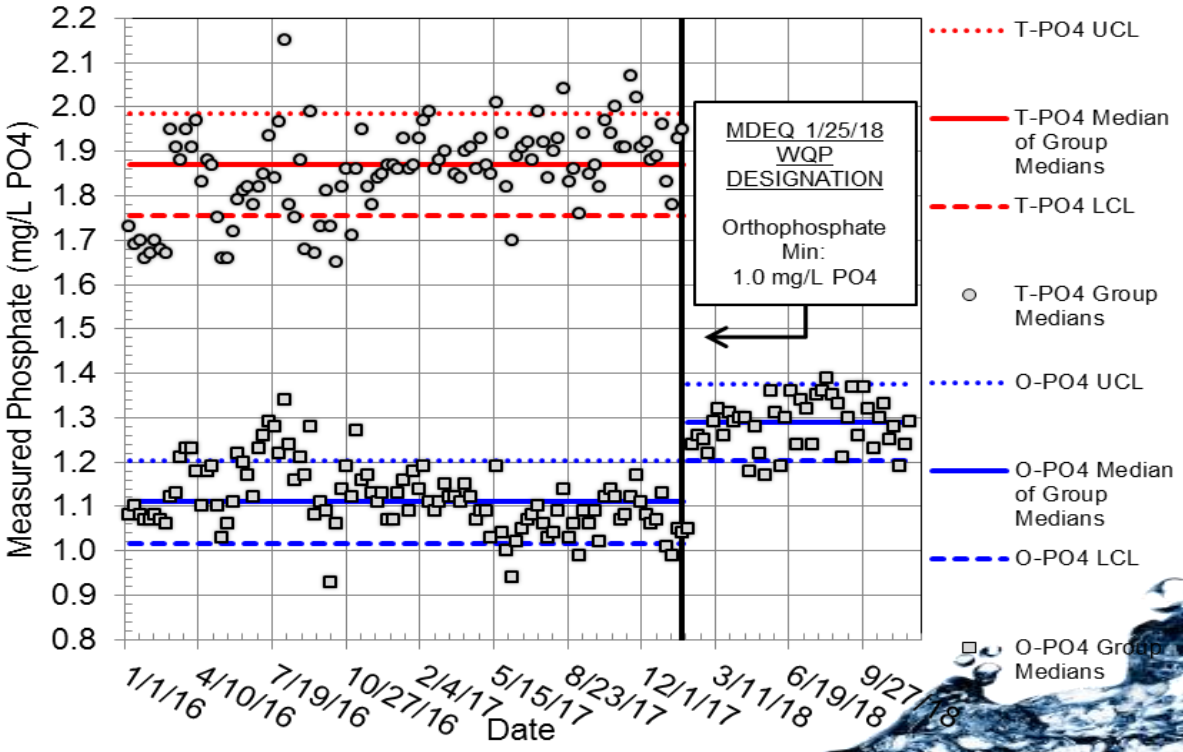


KEY POINTS

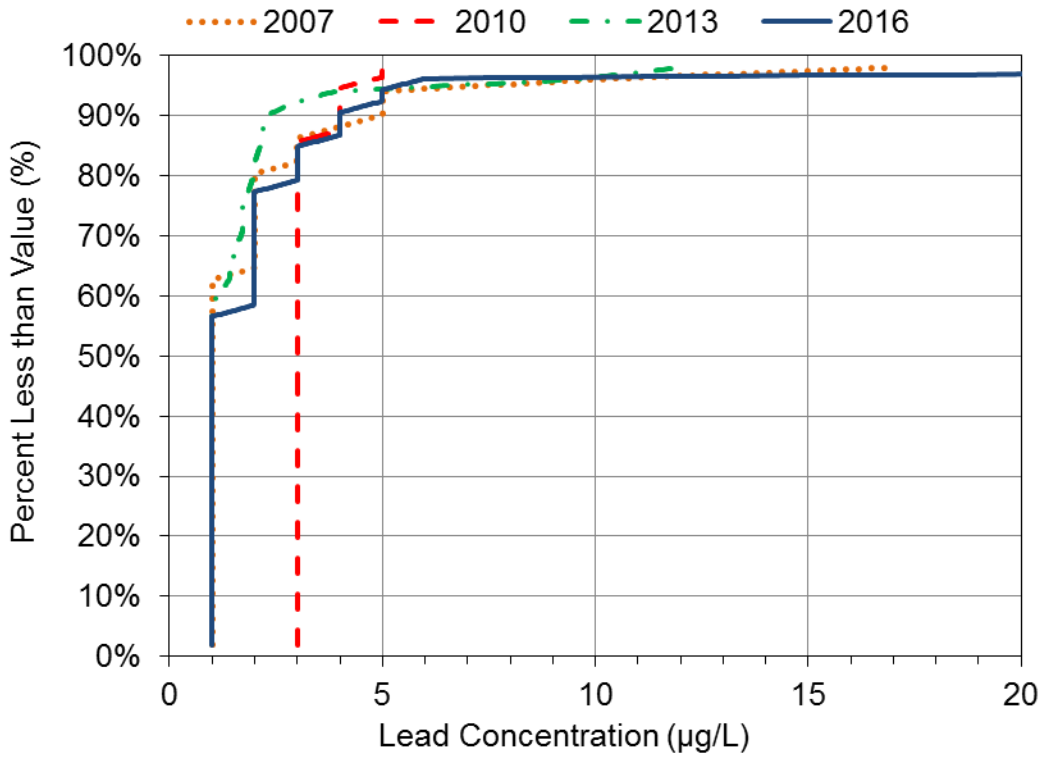
- Additional study on scale impacts has a place when scales could be disrupted-flow through harvested pipes are one option *but other options are available and more being researched*
- Coupon solubility tests are very good for lead solubility testing which in many cases is all that is needed or might be needed for quick CCT change when over AL or when there aren't LSLs or galvanized pipes
- A toolbox approach would seem to be a valid approach to types of studies available and appropriate

GRAND RAPIDS, MI AS AN EXAMPLE

- Serves 280,000 population
- Lake Michigan water source
- Fairly conventional WTP using alum
- Have used a 50/50 polyphosphate blend with a goal of about 1 mg/L PO4 (ortho portion)
- Desire to eliminate poly due to transmission capacity loss

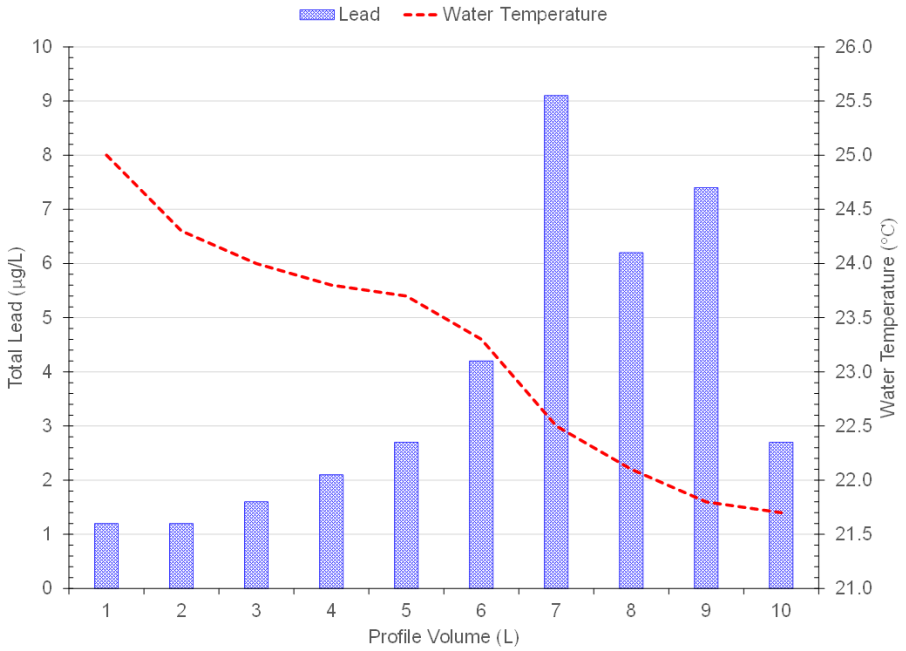


HISTORICAL LEAD HAS BEEN LOW: NOTE GR HAS LSLS



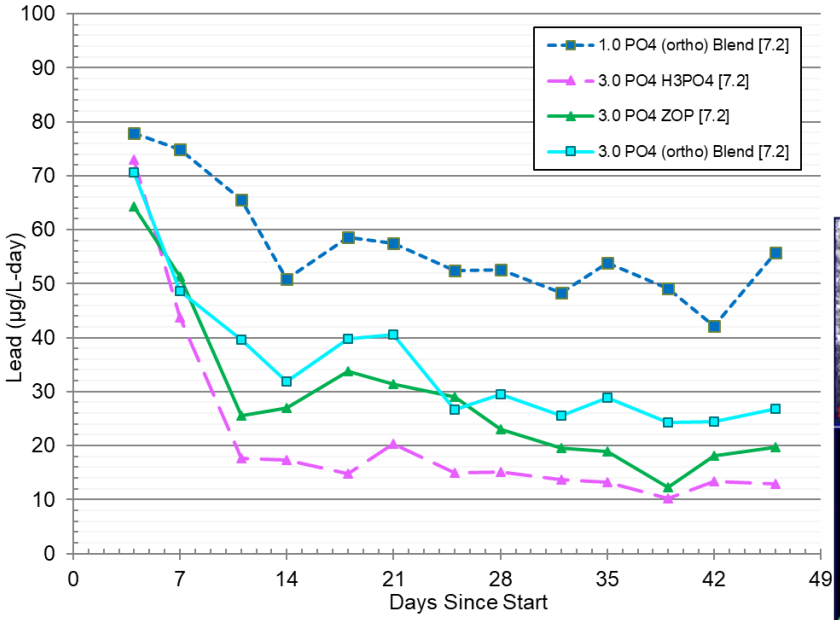
PROFILE SAMPLING ALSO SHOWED LOW LEAD LEVELS

Hence a strategy worked out with EGLE was to move CAUTIOUSLY



KEY STUDIES AT GR TO DATE

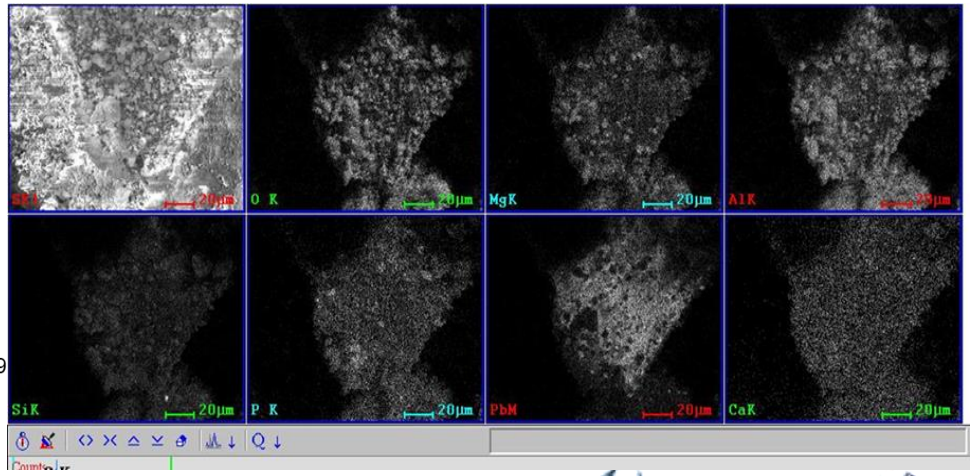
Lead solubility coupon studies showed ortho better



But scale studies cautioned switching

Lots of amorphous AL-OH and poly P

Also lots of Lead 4



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Highlighted Items of Concern for GR

SO IN GRAND RAPIDS

- With close EGLE-City coordination all have agreed in this case to move cautiously, no apparent immediate need to switch and scales might be impacted
- In this case additional scale analysis is planned, further refinement using coupons and a scale impact study of method TBD

Evaluation Methodology

- Evaluate Current Status
- What WQ Parameters Are Changing
- Determine Level of Investigation Needed
- Determine if New CCT is Warranted—I've Done a CCS—Does the Data Justify a Change
- Cautions on Making a CCT Change

Evaluation Methodology

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MONITORING POST CCT CHANGE

- Sentinel homes
  - Locate homes with representative material
  - Conduct regular lead monitoring
- Profile Follow Up
  - Allows for more detail assessment of improvement
  - Could be at sentinel homes
- Increased WQP
  - Tighter goals
  - Increased number of sites
  - Increase frequency

SO WHERE ARE WE

- There are no easy answers—It's not a Cookbook approach
- Can't Emphasize Enough to Use Caution –Error on the side of not making a change
- For the CCS methods in LT LCR move toward a toolbox approach