

Flint River Water Switch Increased Propensity of *Legionella pneumophila* Growth in Premise Plumbing

REBEKAH MARTIN, OWEN STROM,
AMY PRUDEN, MARC EDWARDS



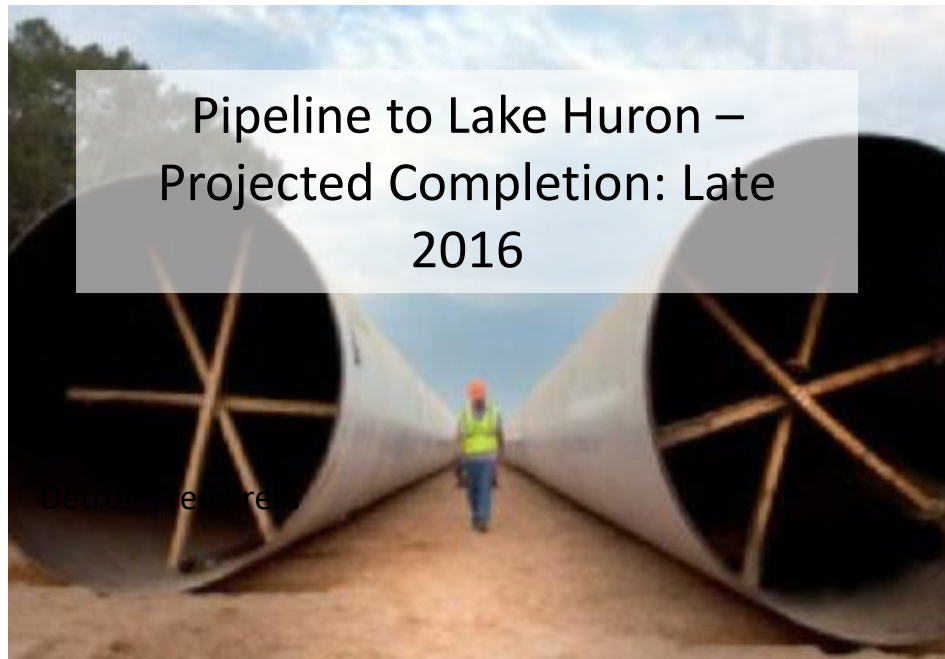


Historic Flint
Drinking
Water Source
(CCT)



Flint River – Drinking
Water Source: April 25,
2014

AP/Paul Sancya



Pipeline to Lake Huron –
Projected Completion: Late
2016

Detroit Free Press



Samuel Wilson / The Flint Journal

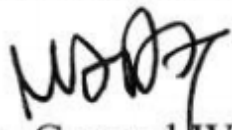


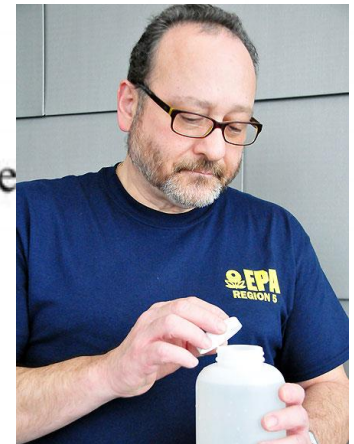
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

“A major concern from a public health standpoint is the absence of corrosion control treatment in the City of Flint”

MEMORANDUM

SUBJECT: High Lead Levels in Flint, Michigan – Interim Report

FROM: Miguel A. Del Toral 
Regulations Manager, Ground Water and Drinking Water



Lack of corrosion control = Higher *Legionella*

1. More bacteria “food” in river
2. Iron corrosion = more iron entering buildings’ pipes
3. High iron corrosion removed chlorine disinfectant

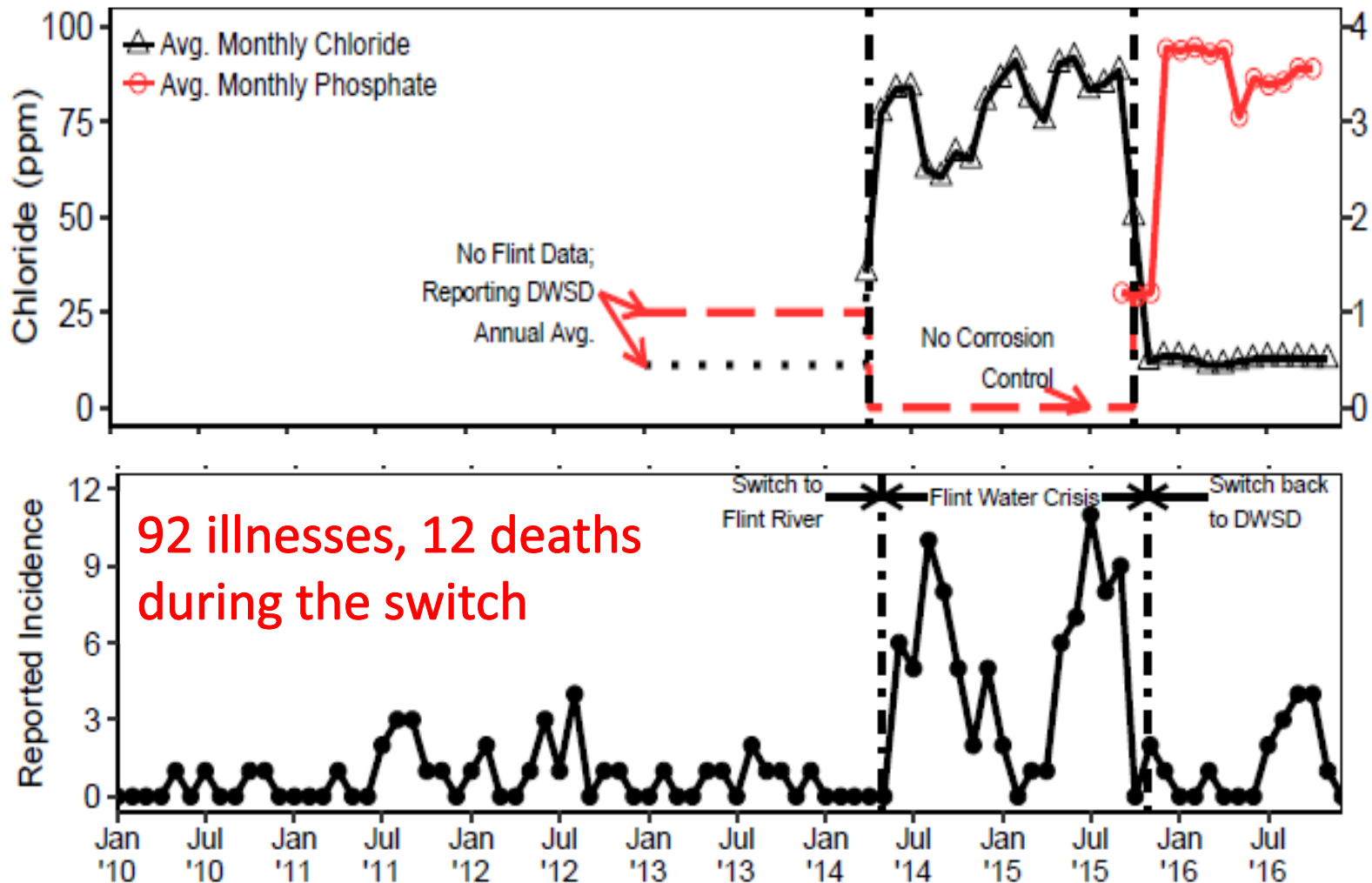


**2015: Flint River
without
Corrosion
Control**



**2016: Detroit
Water with
Corrosion
Control**

Legionnaires Disease in Flint



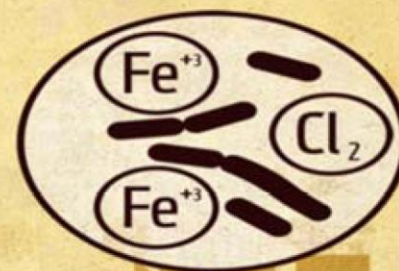
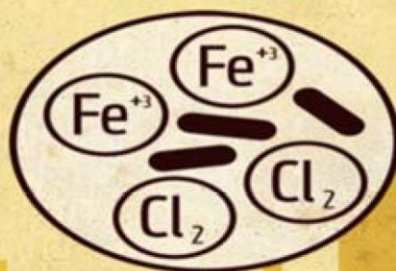
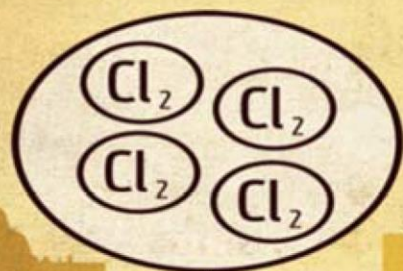
ENVIRONMENTAL

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LACK OF CORROSION CONTROL LINKED TO HIGH *LEGIONELLA* IN FLINT MICHIGAN



PCR screening of *Legionella* isolates or mixed cultures from tap water collected in Flint during March 2016 testing positive for *L. pneumophila*, *L. pneumophila* Serogroup 1, or *L. pneumophila* Mab2

Building type	<i>L. p.</i>	% Sites	Sg1	% Sites	Mab2	% Sites
Small (n=6)*	5	36	0	0	0	0
Large (n= 65)*	46	42	15	29	10	21

*n values representing number of cultured samples from each building type analyzed to date. qPCR analysis of non-culturable samples has confirmed the presence of *L. pneumophila* in one additional small building site and 5 additional large building sites.

“Lapse in Municipal Water Corrosion Control Linked to Elevated *Legionella* Levels in Building Plumbing”

Schwake, Garner, Strom, Pruden, Edwards

*Recreating the
Conditions of the
Flint Legionnaires'
Disease Outbreak
in the Lab*

Hypotheses

Source Water

Iron Main

Plumbing

**Hypothesized
Outcome**

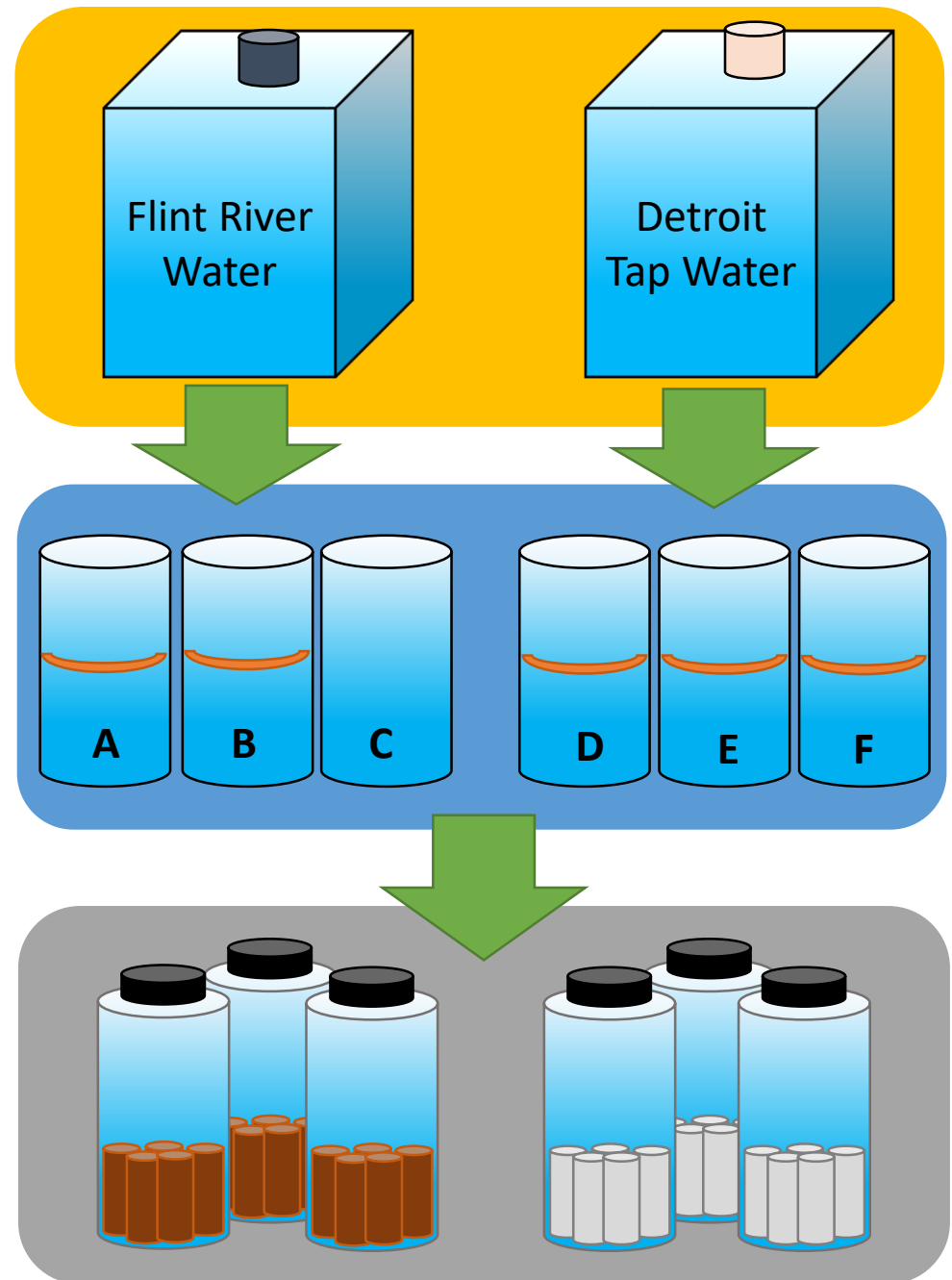
Flint River
Water (No
Corrosion
Control)

Detroit Water
(Corrosion
Control)

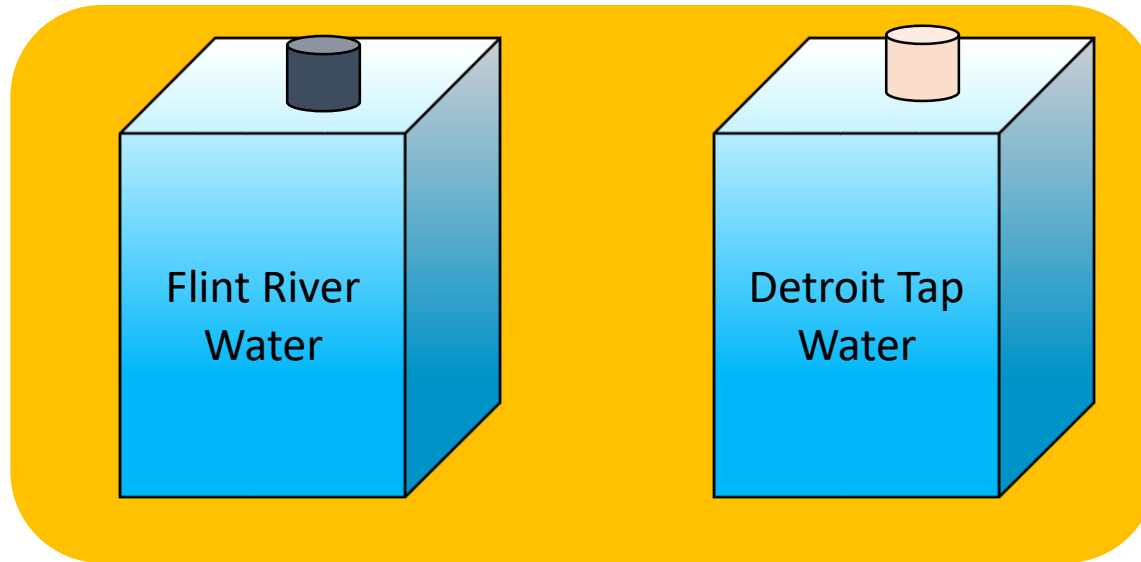
Experiment Overview

Simulated
Distribution
Systems

Premise
Plumbing
with Cu/PVC

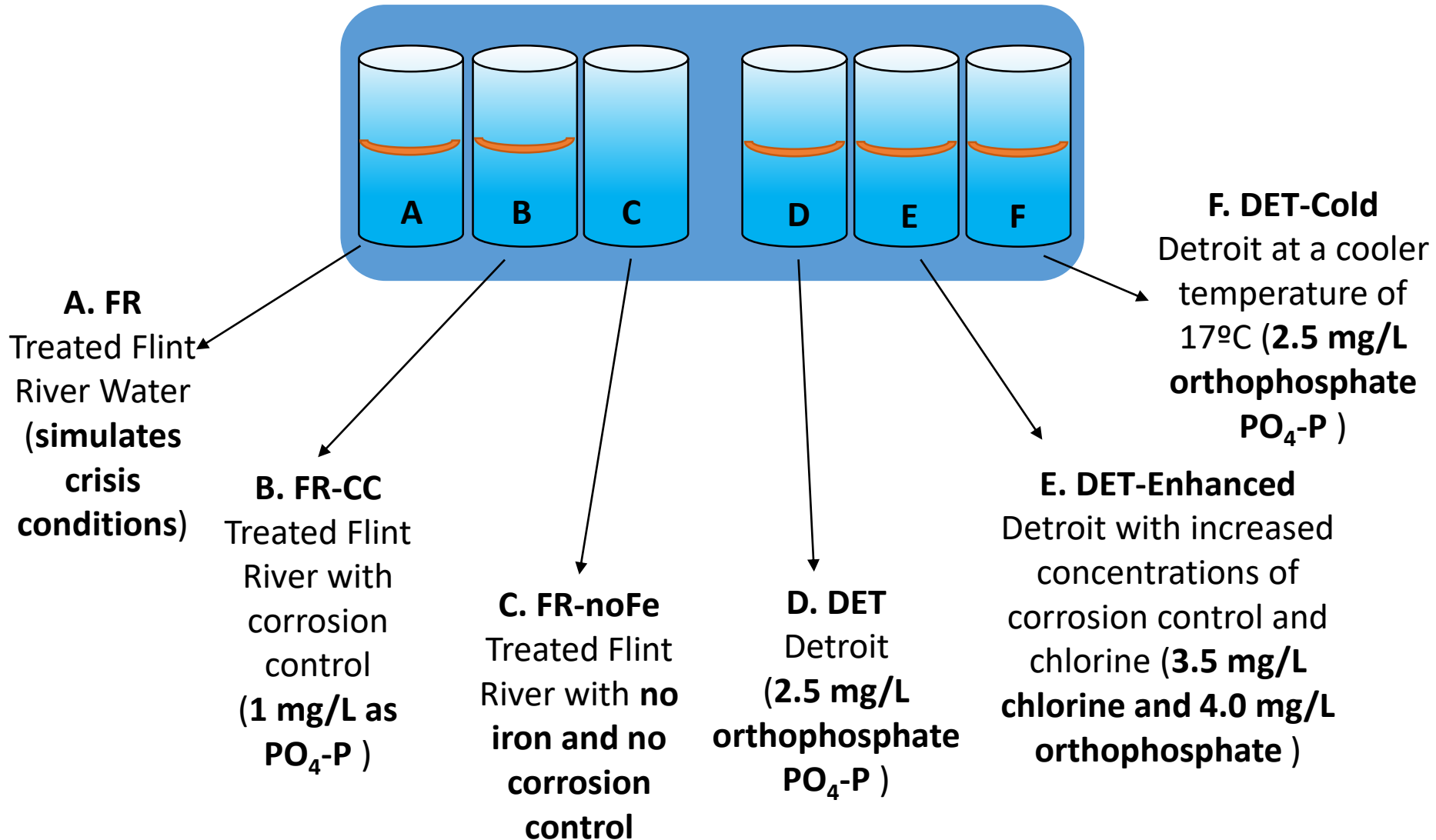


Water Treatment Step



- Flint river water treated and filtered (coagulation and glass wool)
- Bulk water chlorinated
- Water split into each distribution condition

Distribution Step and Aging



Simulating Reactions Occurring During Water Distribution



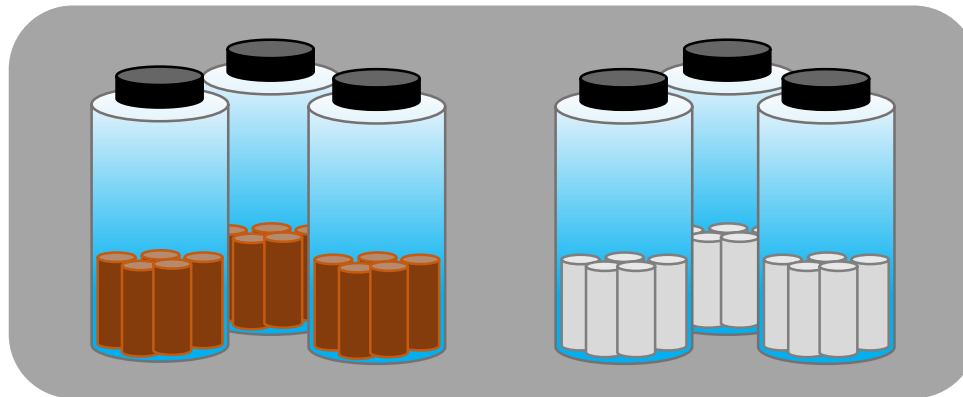
Water allowed to age and stir for 3 hours with the iron wire simulating reactive unlined iron

Simulated Plumbing Reactors

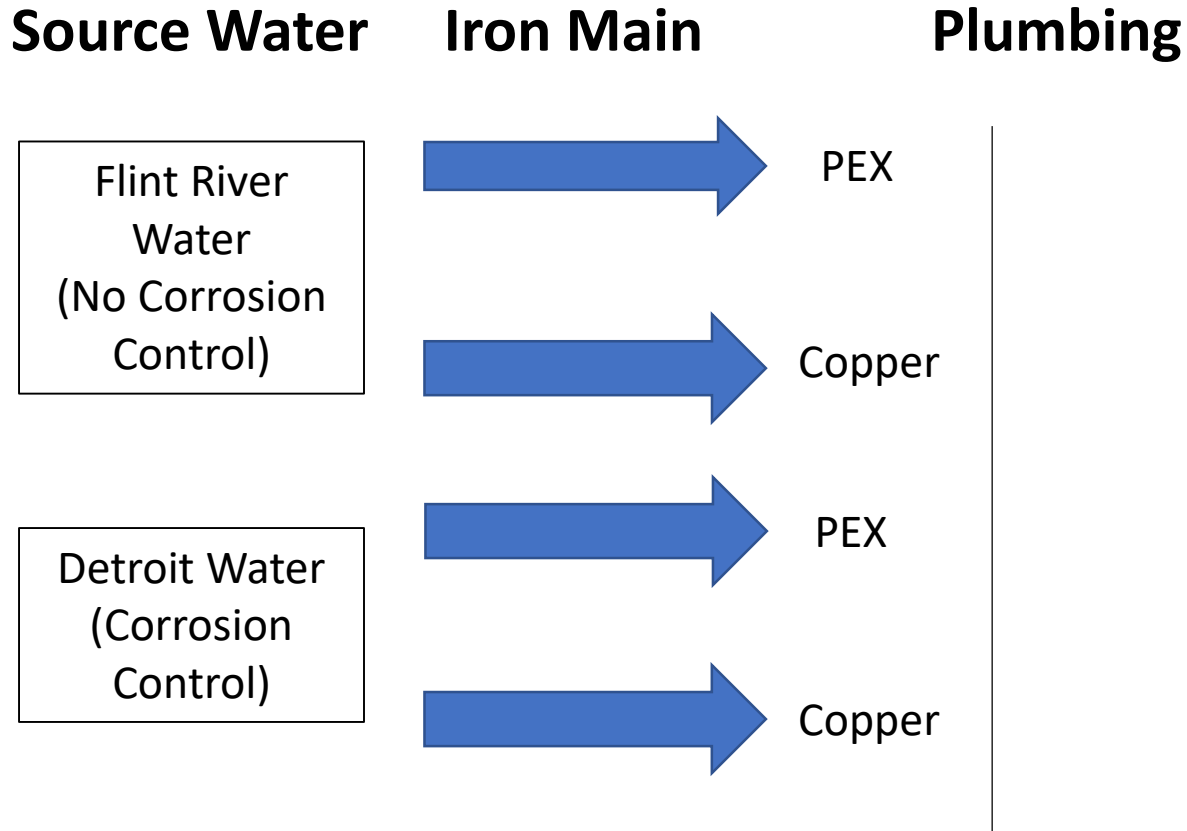


Water from each distribution condition is added to glass bottles with either PEX or copper pipe pieces.

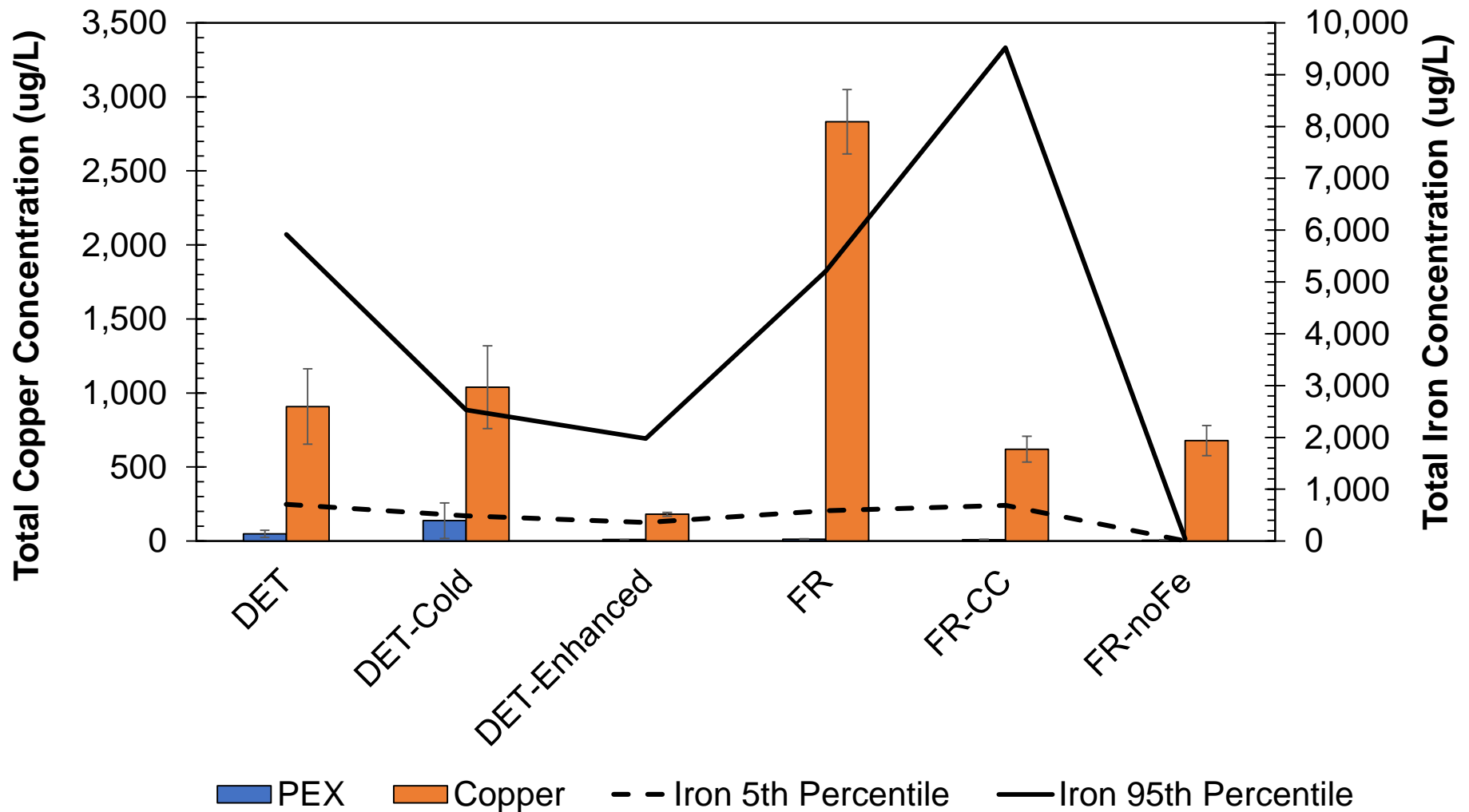
- Reactors incubate at 98.6 F (37 C) between changes
- Water changes occur every 3-4 days



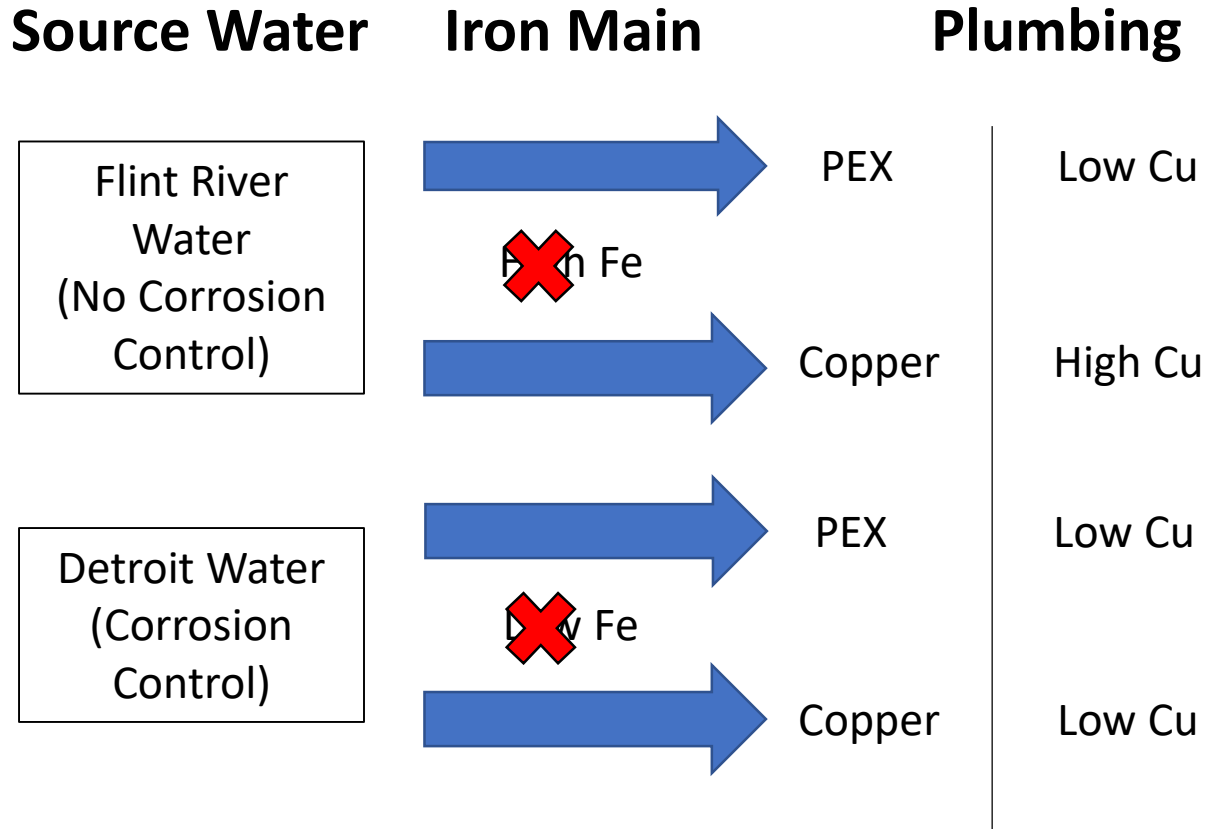
Building our Hypotheses



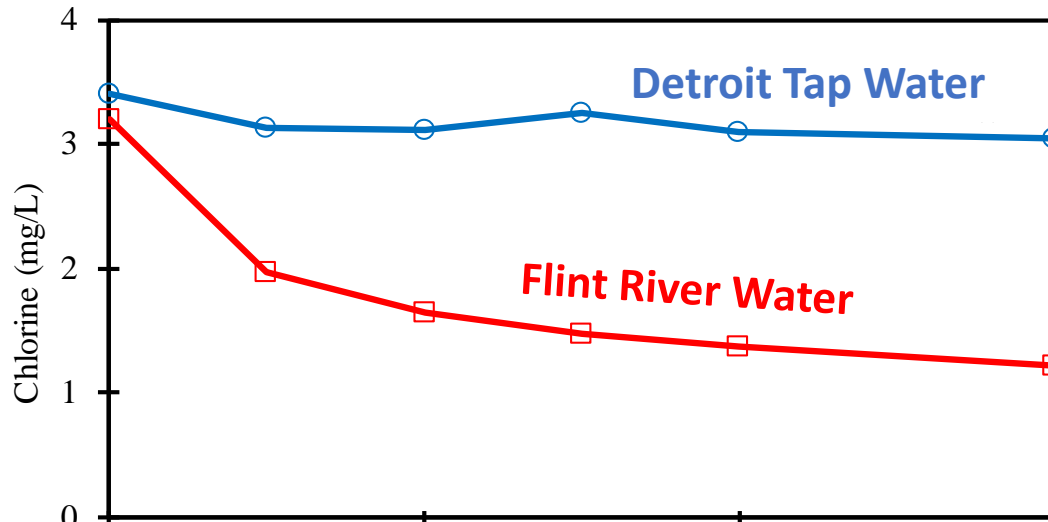
Copper and Iron Concentrations



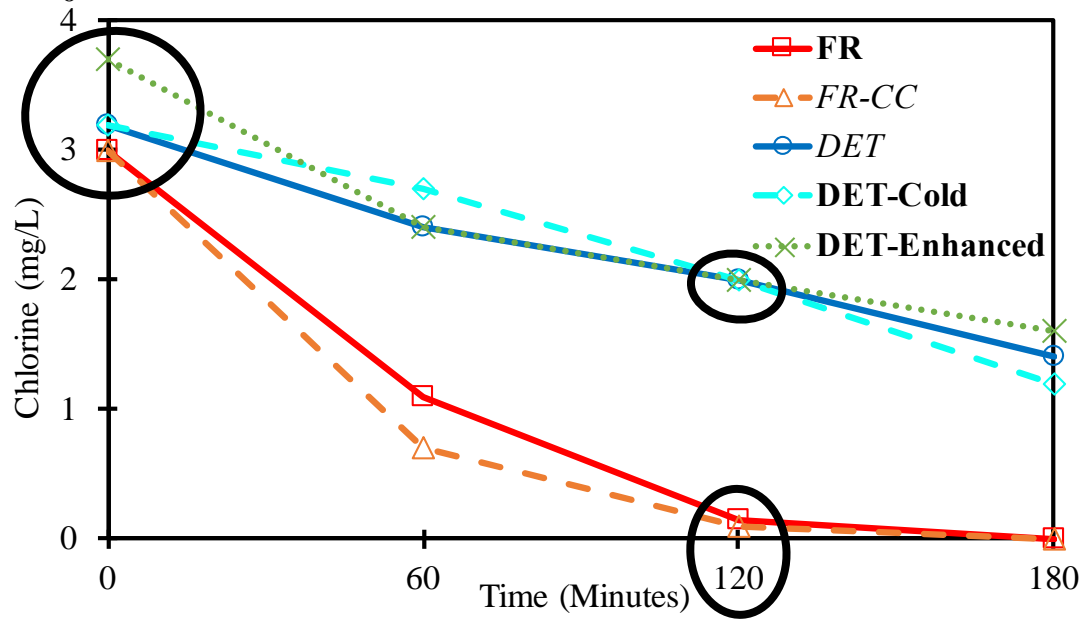
Building our Hypotheses



Chlorine Decay in Simulated Distribution Systems



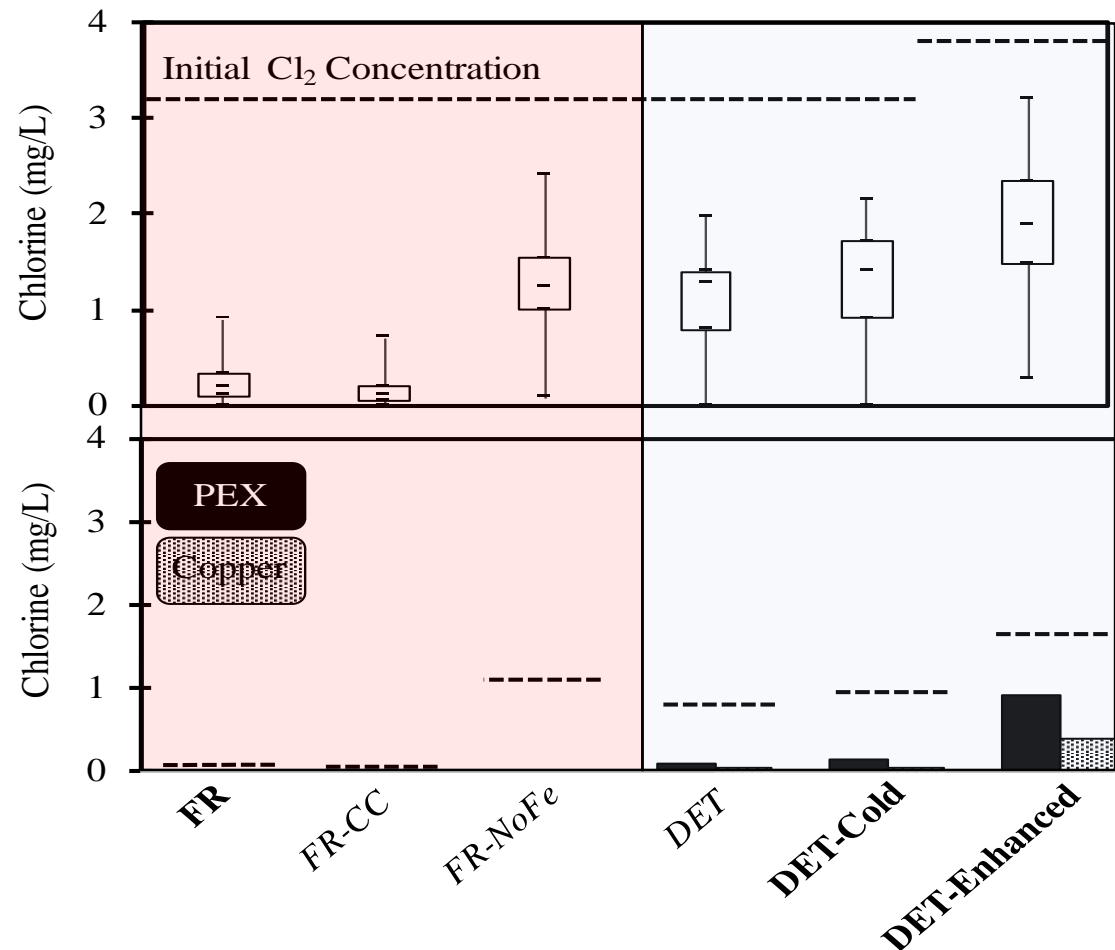
Total Organic Carbon:
Detroit Tap Water
1.2 mg/L
Flint River Water
5.0 – 6.1 mg/L



Chlorine Concentration in Simulated Plumbing Reactors

Prior to adding
to the SPR

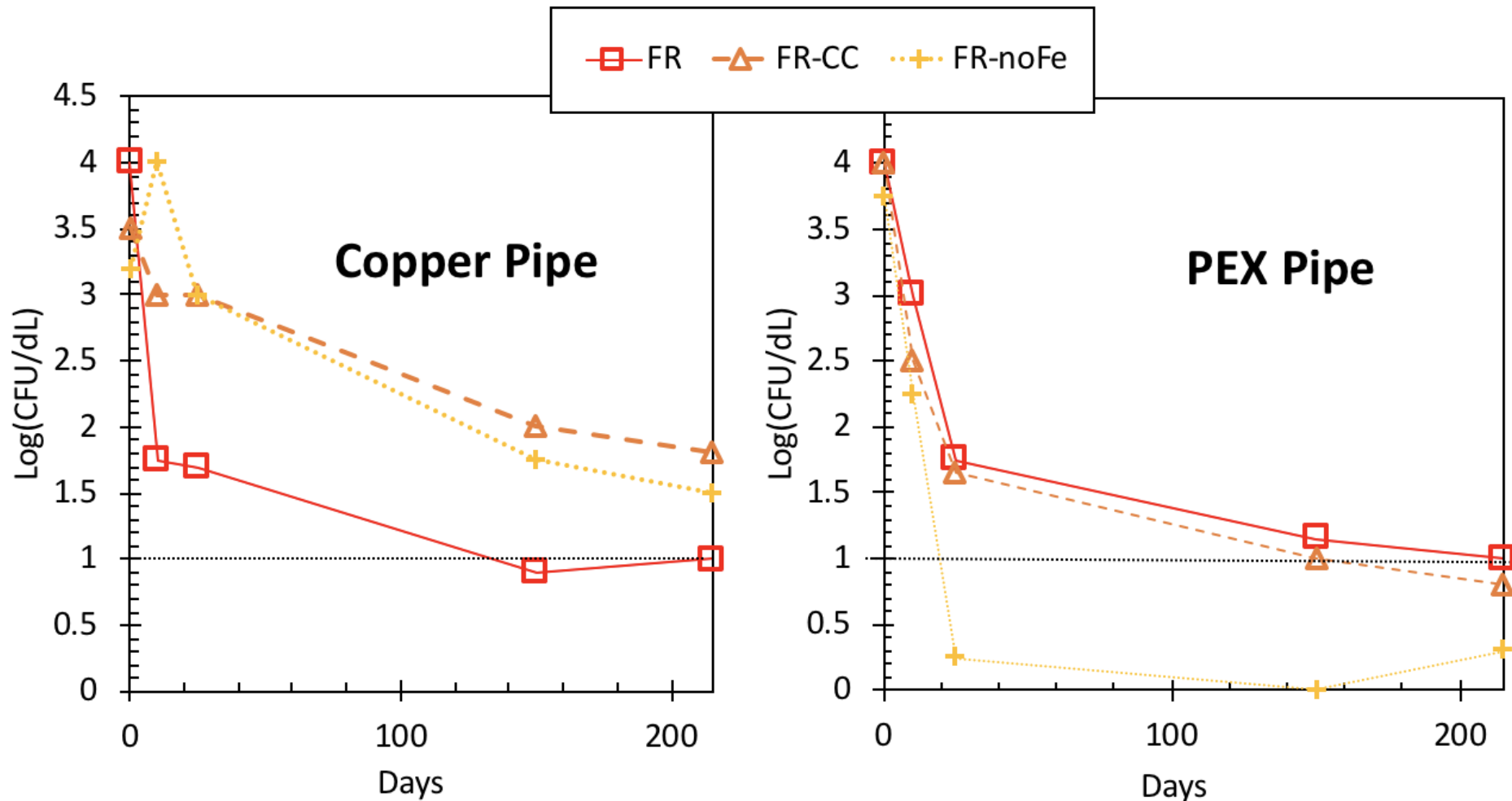
After 120 minutes
in the SPR



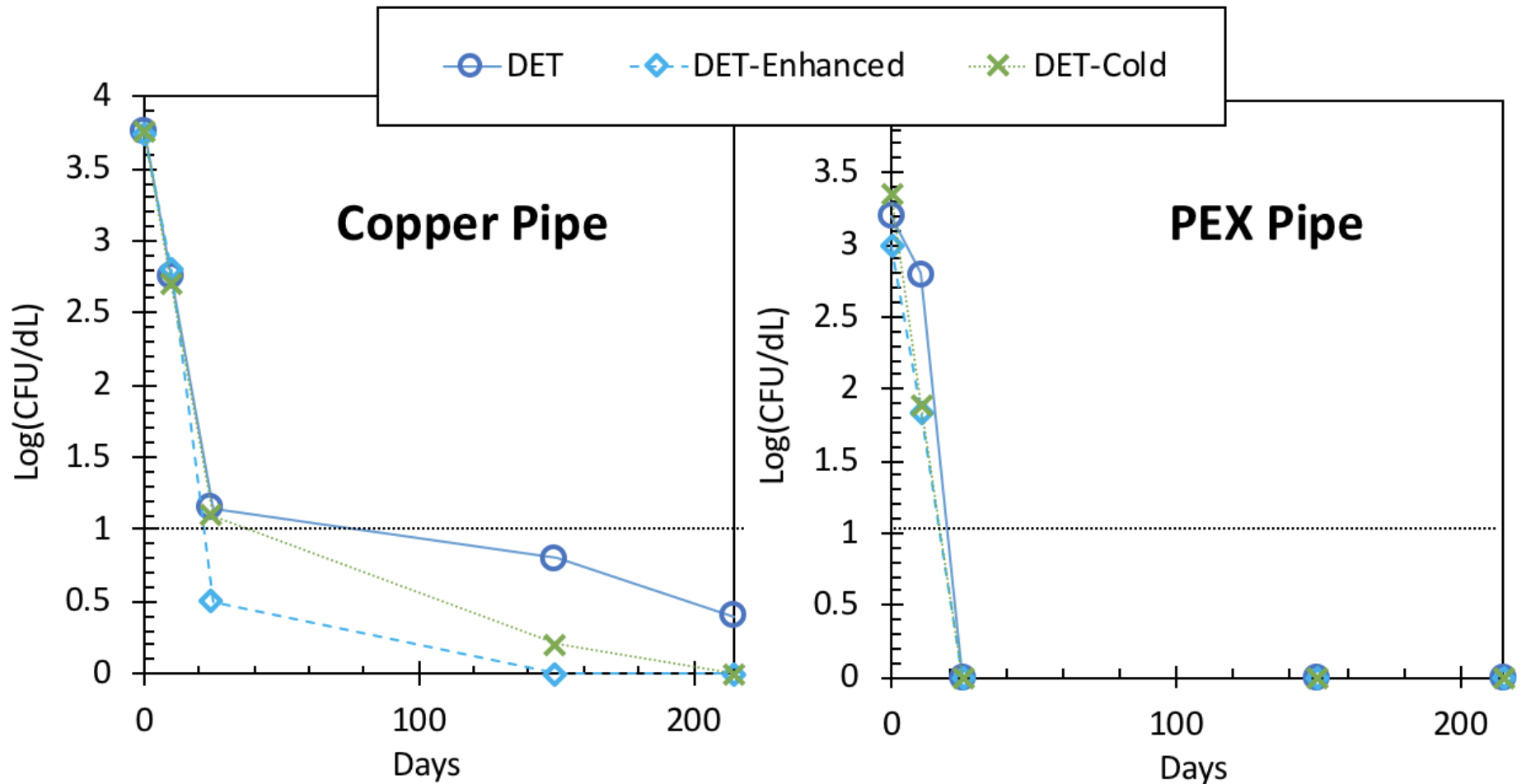
Hypotheses

Source Water	Iron Main	Plumbing	Hypothesized Outcome
Flint River Water (No Corrosion Control)	Low Cl ₂ , High Fe	PEX	Survival
		Copper	Controlled
Detroit Water (Corrosion Control)	High Cl ₂ , Low Fe	PEX	Controlled
		Copper	Survival



Culturable *L. pneumophila* in the Flint Conditions



Culturable *L. pneumophila* in the Detroit Conditions



Conclusions

Source Water	Iron Main	Plumbing	Hypothesized Outcome	Observed	
Flint River Water (No Corrosion Control)	 Low Cl ₂ , High Fe	PEX	no/low Cl ₂ , Low Cu	Survival	FR
		Copper	no/low Cl ₂ , High Cu	Controlled	FR
Detroit Water (Corrosion Control)	 High Cl ₂ , Low Fe	PEX	High Cl ₂ , Low Cu	Controlled	DET DET-Cold DET-Enh
		Copper	Low Cl ₂ , Low Cu	Survival	DET

Questions?



ICTAS

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