

An Updated Look at the Flint, MI Lead Disaster

Updated August 2017



INSIGHTS GAINED FROM WORKING ON:

FLINT WATER INFRASTRUCTURE INTEGRITY

SUBCOMMITTEE

AND

MICHIGAN DEQ OPERATOR TRAINER CONTRACT WORK

**NICK PIZZI
AQUA SERV**

Acknowledging the Committee Members



- Chair – Keith Creagh, Director, Michigan DEQ
- Jim Koski, Genesee County Representative
- Dr. Laura Sullivan, Professor, Kettering University
- Dr. Marc Edwards, Professor, Virginia Tech
- Nick Pizzi, Aqua Serv, AWWA Appointment
- Mike McDaniel, Retired National Guard Brigadier General
- Bob Kaplan, Acting Regional Administrator for EPA Region 5
- Bill Maier, Lansing Board of Water & Light (Retired)
- Jamie Curtis, Commissioner, Genesee County
- Dr. Shawn P. McElmurry, Associate Professor, Wayne State University

Flint crisis in a nutshell



- Around April of 2014, Flint MI changes its source of drinking water
 - quits taking finished water from Detroit - which it has been getting since the mid-60's and which has orthophosphate in it since the 1990's - and starts treating Flint River water and distributing it to customers
- **Water from the Flint River WTP :**
 1. Was not treated with a corrosion inhibitor
 2. The Flint River is high in chlorides, AND was treated with Ferric chloride rather than the alum that Detroit uses – so (chloride – sulphate) to carbonate ratio changed
 3. Had widely fluctuating chlorine residuals
- **Water quality deterioration takes place rapidly (Lead and Coliform)**

Flint crisis in a nutshell



- Local and state health authorities are eventually quoted as saying:
 - “As many as 12,000 children are exposed to excessive levels of Lead, and the water may have caused the Legionnaire’s outbreak that kills 12 people”
- Because State testing of children had previously taken place in 12 urban areas of Michigan – we have a baseline
 - Children in Flint who were tested for blood Lead levels in 2013 were retested in 2015
 - The amount of children with excessive blood Lead levels doubles
- In April 2016 three officials are indicted, and 6 more are indicted on 7/29/2016, and another 4 in December 2016 – and manslaughter charges are brought in 2017
- The City is still trying to recover
 - There is improvement, but excessive Lead is still found in the water of many homes
 - People are still told not to drink water unless using a filter

The long road to recovery



- December 3, 2016 article in Detroit Free Press:
 - Federal judge to Michigan: “You must deliver bottled water to Flint”
 - ✦ Flint continues to sample hundreds of homes each month for Lead
 - ✦ Flint continues to provide bottled water to the >93,000 residents (but slowing down now)
 - ✦ Flint provides and changes out filters on kitchen sinks when requested
 - ✦ The city continues in its efforts to replace all of the Lead service lines
 - Estimates are that 15,000 or so lines need to be replaced



Eric P. Rothstein is a principal at Galardi Rothstein Group, 3300 N. Lake Shore Dr., Unit 6C, Chicago, IL, and is a member of the Flint Water Advisory Task Force



“While the cascade of poor decisions, failures, and indifference in Flint was startling and ultimately heartbreaking, we cast it as an anomaly at our peril, and the peril of those whose health we serve to protect.”

“THE ISSUES IN FLINT WILL BE LONG-LASTING LOCALLY, BUT THE SITUATION ALSO HAS FAR-REACHING IMPLICATIONS FOR THE WATER UTILITY INDUSTRY AS A WHOLE.”

**ROTHSTEIN | 108:7 • JOURNAL
AWWA | JULY 2016, page 41**

Current Thought on Flint Lead Crisis and Lead in General



VARIOUS POLICY STATEMENTS AND
EXPERT POSITIONS ON HEALTH
ISSUES REGARDING LEAD

RELATIVE IMPORTANCE OF LEAD THAT
IS CONTRIBUTED BY DRINKING WATER

Center for Disease Control (CDC)

Current Policy



- **Blood Lead Levels in Children**
 - Protecting children from exposure to Lead is important to lifelong good health.
 - No safe blood Lead level in children has been identified.
 - Even low levels of Lead in blood have been shown to affect IQ, ability to pay attention, and academic achievement. And effects of Lead exposure cannot be corrected.
 - The most important step parents, doctors, and others can take is to **prevent Lead exposure before it occurs.**
- **On a related note**
 - ✦ In 2012, Congress decreases the budgetary allotment to the “Childhood Lead Poisoning Prevention Program” from \$30 M down to \$2 M dollars

Statements from Dr. Joan Rose*



- “Environmental health assessments need to look at Lead exposure pathways” ……
 - They’ve ignored water more than they like to admit as a source of elevated blood Lead levels in children
 - We have been told not to worry about our water because “your Lead problem is in your paint”
 - We don’t understand cumulative exposures unless we sample bone, which we don’t do
 - Taking blood samples for Lead only provides a “snapshot” of intermittent exposures

*Journal AWWA roundtable discussion, July 2016

Note: Dr. Rose runs the Water Quality and Microbiology Laboratory, and is a professor at MSU

Creation and Findings of the Flint Water Advisory Task Force



- In Fall 2015, the governor of MI creates the Task Force to investigate what happened - and why - and to make recommendations
- In March 2016, the report is offered by the Task Force to:
 - “Fulfill our charge of determining the causes of the Flint water crisis”,
 - “Identify remedial measures for the Flint community”,
 - “Safeguard Michigan residents”
- From the **Executive Summary** of that report:
 - “The Flint water crisis is a story of government failure, intransigence, unpreparedness, delay, inaction, and environmental injustice”

FWATF report findings



- “The Michigan Department of Health and Human Services (MDHHS) failed to adequately and promptly act to protect public health.”
- “Both agencies, but principally the MDEQ, stubbornly worked to discredit and dismiss others’ attempts to bring the issues of unsafe water, Lead contamination, and increased cases of Legionellosis (Legionnaires’ disease) to light.”

FWATF Report Findings Continued ...



- “Flint water customers were needlessly and tragically exposed to toxic levels of Lead and other hazards through the mismanagement of their drinking water supply. The specific events that led to the water quality debacle, Lead exposure, heightened *Legionella* susceptibility, infrastructure damage are a litany of questionable governmental decisions ...”

- Contains 36 findings
- Contains 44 recommendations

History and Timelines



FLINT, MI CONTAMINATION EVENT

ORIGIN OF THE
CULTURES
THAT EXISTED
AND
THE EVENTS THAT FOLLOWED

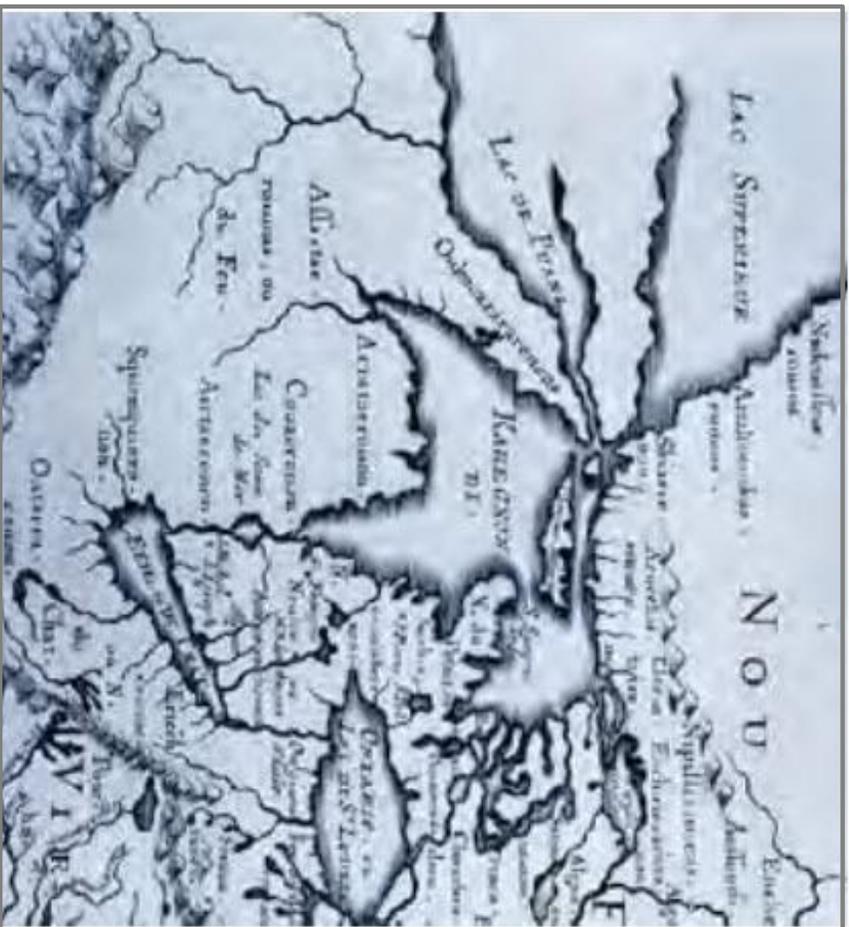
History Lesson: “Karegnondi”



○ WHAT’S IN A NAME?

- ✦ The native Huron-Petun (later known as Wyandot) people referred to Lake Huron as **Karegnondi**, translated as “big lake.”
- ✦ Cartographer Nicolas Sanson’s 1656 map of the territory bears that name for the “fresh water sea” encountered by French explorers.

Then and Now



Yesterday and today. Left: Map from 1656 drawn by noted French cartographer Nicolas Sanson showing Karegnondi (Lake Huron) as it was then conceived. Right: Water drawn from Lake Huron will be used within the Great Lakes basin.

Timelines of the Flint Lead Issue



Sources:

*Articles from New York Times,
National Public Radio,
and the Detroit Free Press*

Flint, MI city ordinance - 1897



In 1897, an ordinance is adopted that requires the use of Lead pipe for the construction of service lines for city homes and businesses

Flint, MI Timelines



- **From 1930's to 1960's**
 - Flint is a major vehicle manufacturing center - General Motors (GM) Headquartered there – once the largest manufacturing plants in the Nation – the UAW strike sets a standard still used today
 - There are 196,000 people living in Flint in 1950-1960
 - In 1963, Flint wants to stop treating Flint River Water, and so moved to build a pipeline from Lake Huron to Flint, but a profiteering scandal derailed that pipeline. This led the city to sign a contract to purchase water for 30 years from the Detroit Water and Sewerage Department on June 6, 1964
 - “White flight” commences – population shrinks to 159,000 by 1980, and to 102,000 by 2010
- **Early 2002**
 - Flint is \$30,000,000 in debt

Flint Today



- **Flint is a city of about 98,000 persons**
 - 41.2% of residents live below the poverty line .
 - the median household income is \$24,862, according to the US Census Bureau.
 - ✦ the median household income for the rest of Michigan is \$49,576.
 - The city demographics state that 56.6% of Flint residents are African – American.

Flint Timelines



- **November 29th, 2011**
 - Flint becomes the fourth Michigan City brought under the control of an Emergency Manager
 - ✦ Flint officials had been raiding the water fund to infuse cash into the general fund and to cover City shortfalls
 - Under MI law, Emergency Managers take the power away from local authorities
 - Detroit is one of those four cities under Emergency Manager control

Debt



- The state of Michigan took over Flint's finances after an audit projected a \$25 million deficit.
 - Even though Flint's water supply fund was \$9 million in the red, officials were using some of the water department money to cover shortfalls in its general fund.
 - A receivership ended in April 2015, when the water fund was declared solvent and the remaining deficit was eliminated by an emergency loan.
- In order to reduce the water fund shortfall, the city switched water sources in 2014.
- While a new pipeline connecting Flint with Lake Huron was under construction, **the city turned to the Flint River as a water source** during the two-year transition, thinking that this would cause no problems and save money.

Flint, MI Timelines



- **March 25th, 2013**
 - The Flint Emergency Manager – with approval from the State Treasurer - begins to take steps to disconnect the Flint Water System from Detroit Water and develop its own source from [Karegnondi Water Authority \(KWA\)](#)
 - ✦ Distance between Flint and Lake Huron – 70 miles
 - ✦ Karegnondi raw water line has not yet been completed (TBC 2017)
 - ✦ No transition or contingency plan was put in to place for providing safe and reliable drinking water while the raw water line was going to be built

What is Karegnondi Water Authority?



- KWA consists of Genesee County Drain Commissioner, Lapeer County Drain Commissioner, Lapeer City, Sanilac County Drain Commissioner and the City of Flint. KWA was incorporated in 2010. The purpose of the Authority is to provide and distribute raw water to the region.
 - From the KWA Website: “The pipeline will supply untreated water to the municipalities of the region.”
 - Supplying raw water from Lake Huron to Flint is approx. the same distance covered by supplying raw water from Cleveland to Ohio towns like New Philadelphia or perhaps Conneaut, or Mansfield, or Port Clinton.
- The project will require the installation of a water intake structure, 72” and 66” pipelines, and pumping stations over the next few years. The project began construction in June of 2013, with an expected completion date of Spring of 2017.

What is a Drain Commissioner? What is the culture?



- A Drain Commissioner is an elected official in county government of the U.S. State of Michigan who is responsible for planning, developing and maintaining surface water drainage systems under Public Act 40 of 1956.
- Drain Commissioners are elected on the partisan ballot in presidential election years for a term of four years.
- In counties with a population under 12,000, the office of Drain Commissioner may be abolished with its statutory duties and responsibilities performed by the county's board of road commissioners.

Drain Commissioner Culture



- **Duties and powers**
 - It is the only elected office in Michigan that can directly levy taxes and borrow money without a vote of the people.
 - ✦ This led one Drain Commissioner to declare he is more powerful than the governor.
 - ✦ While the powers of the Drain Commissioner are immense, the office has become [sinecure](#) in some counties
 - Nevertheless, Drain Commissioners are responsible for overseeing the county's drains.
 - ✦ In Michigan, a **drain** may be a natural or artificial creek or ditch, or a massive pipe for carrying water. The territory served by a particular drain, its [watershed](#), is typically organized as a **drainage district** and the Drain Commissioner levies tax assessments and directs construction or maintenance of drains and culverts on behalf of each district.

Back to Timelines



- **Between March 2013 and April 2014**
- Flint, still relying on its master metered account from Detroit, is notified that they will have to pay a premium for water due to agreement with Detroit (the contract had expired in 2000)
- Detroit is angry that they are losing this customer, and asserts its right to charge extra per the contract
- Remember - KWA is not scheduled to complete the Lake Huron supply line to Flint until 2017

Flint, MI Timelines



- **April 25, 2014**
 - The Flint City Emergency Manager weighs the choice of staying on Detroit's higher rate vs. firing up the existing Flint WTP
 - ✦ He is in negotiations with the Detroit Emergency Manager
 - Neither of the two men is a drinking water professional
 - On orders from the Emergency Manager, the city switches its water supply from Detroit's system to the Flint River WTP.
 - Soon after, residents begin to complain about the water's color, taste and odor, and to report rashes and concerns about bacteria.

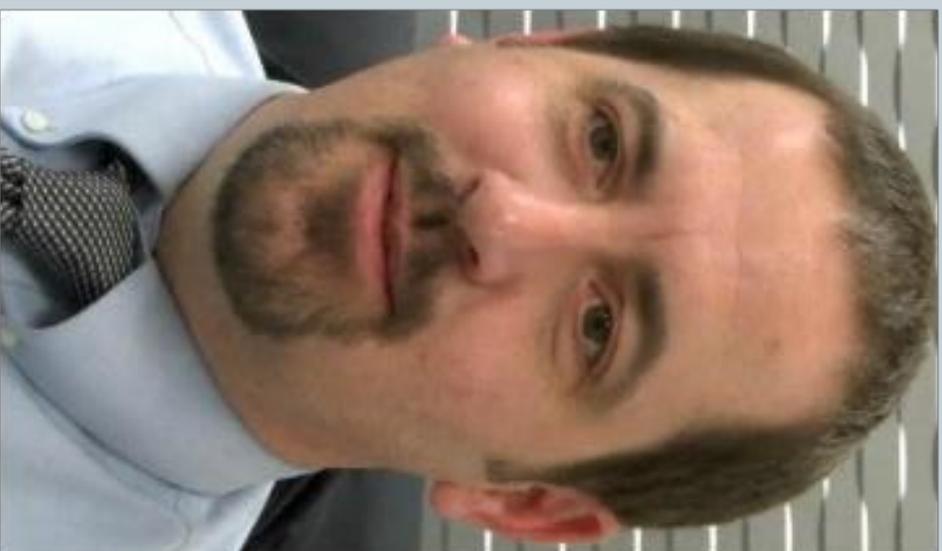
Key individuals identified



Prysby



Busch



Glasgow

Plant Manager Mike Glasgow is indicted



- Michael Glasgow, the former Flint water utility manager, is charged with a felony in connection with the city's water crisis
 - He eventually reaches a deal with prosecutors.
- The Michigan Attorney-General states that “Glasgow tampered with a 2015 report, ‘Lead and Copper Report and Consumer Notice of Lead Result,’ and failed to perform his duties as a treatment plant operator”
- Under the terms of the plea deal, the felony charge of tampering with evidence was dismissed.

Glasgow speaks to the Press



- "I was a key figure in this -- I am operating the treatment plant and seeing some of the sampling," he told CNN in March, before the charges were filed.
- But Glasgow said then that he had always tried to do the right thing, raising concerns to those above him at the city and state level. But he said he felt he did not have the authority to override the decisions that eventually led to Flint's toxic water.
 - Mike – in his late 30's at that time, has a wife and young baby at home during this period and like most individuals in that situation, needed that paycheck

Flint Timelines – Flint WTP Manager Mike Glasgow



- In an email sent April 17, 2014 -- eight days before Flint switched its water source -- Mike Glasgow mentions problems with the monitoring schedule and his staffing ahead of the switch.
 - "I do not anticipate giving the OK to begin sending water out anytime soon. If water is distributed from this plant in the next couple weeks, it will be against my direction," Glasgow wrote to state officials, including Busch and Prysby. "I need time to adequately train additional staff and to update our monitoring plans before I will feel we are ready. I will reiterate this to management above me, but they seem to have their own agenda."
- In an interview with CNN, Glasgow alleges that DEQ employees Busch and Prysby told him to alter water quality reports and remove the highest lead levels.*

○ *CNN - Updated 11:45 PM ET, Wed April 20, 2016

Refresh your memory on the Lead & Copper Rule



- Back in the 1990's:
 - A system had to take 2 sets of first-draw samples from residences for two periods
 - ✦ Table-top study – tell EPA about your treatment strategy
 - ✦ Sample periods were 6 months - number of samples based on population – prove or disprove your strategy
 - Required to identify Tier 1 homes if possible
 - ✦ (Lead service lines, or homes built during the few years prior to 1987 when Lead solder banned)
 - After two periods –sample results were tabulated:
 - ✦ If 90th percentile was met, you kept with the program
 - ✦ If 90th percentile exceeded, you had to do a corrosion study to determine new treatment scheme

During this time, you did not have a violation regardless the sample results

Table - Top Study for Lake Erie Plants



**STUDY WHICH I SUBMITTED IN 1990'S FOR
THE LAKE COUNTY SYSTEM PLANTS**

Corrosion control for Lead



- From an operational perspective, and for any given drinking water, lead dissolution is mostly dependent on:
 1. the pH of the water
 2. alkalinity or Dissolved Inorganic Carbon (DIC),
 3. the ionic strength
 4. the temperature
 5. the presence of phosphate
- The role of the operator is to produce a finished water that minimizes the chance that lead will dissolve
 - Manipulate what parameters you are able, and educate the consumer on the rest

Lead solubility and temperature



- Typically, warmer water drives chemical reactions more quickly than colder water
 - lead dissolution is a chemical reaction
 - As might be expected, warmer water can dissolve lead more quickly and in higher quantities than colder water
 - ✦ That's why we tell people not to drink warm water from the tap, or leave hot water in the faucet
 - ✦ That's why regulations typically have us sample for lead in the warmer months

Lead solubility and DIC

pH and alkalinity



- The pH and alkalinity of water are measures of the hydrogen ion activity and the buffering capacity of the water respectively
 - they directly influence lead solubility
 - they are easily measured in the water plant lab, and can be controlled or at least influenced by the operations staff through use of coagulants and pH adjustment chemicals such as NaOH
 - These two parameters can change as water travels through the distribution system, and so can have an effect on the otherwise optimized dosage of corrosion chemicals used
 - Corrosion chemicals such as orthophosphate are designed to work in certain ranges of pH, and so a change in pH may harm or help the corrosion process
- These two parameters are used to determine the Dissolved Inorganic Carbon (DIC) of the water
 - The DIC of the water is the measure of the inorganic carbon species of the water including Carbon Dioxide, Carbonic acid, and the carbonate and bicarbonate alkalinity components

Lead solubility and Total Ionic Strength



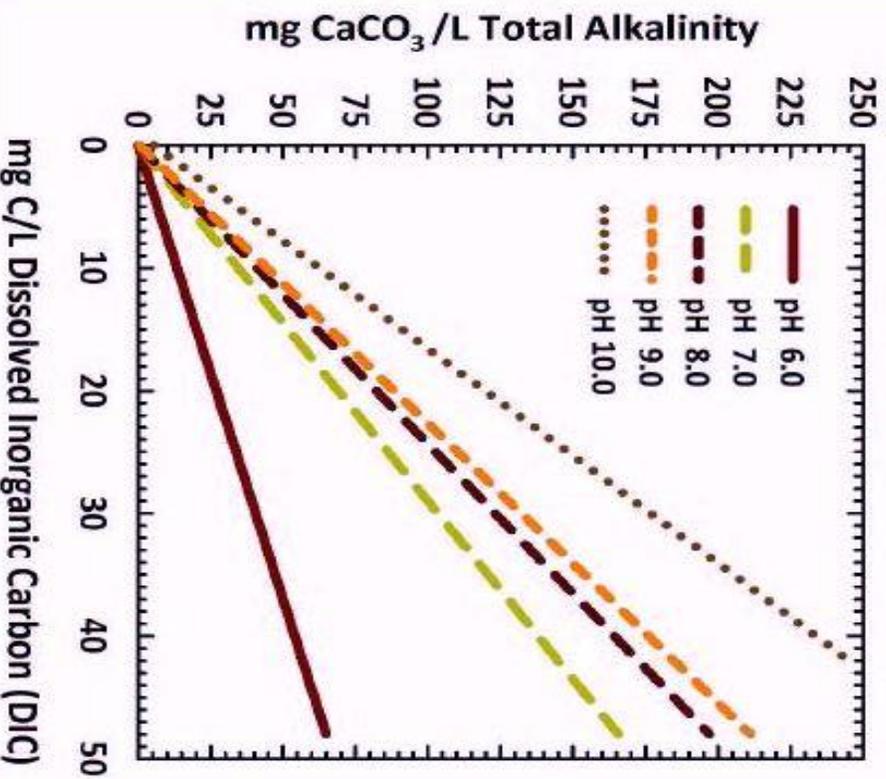
- The total ionic strength of the water, I, is a measure of the ionic activity of the water – the amount of ions that are dissolved
 - Ionic strength is greater in water where more ions are found in it, as opposed to, say, rainwater, which is low in ionic strength
 - Solubility charts and table for lead can be found for various ionic strengths

Source	TDS	Ionic strength
DeminerIALIZED water open to atmospheric CO ₂	0.5	0.000012
Soft groundwater	20	0.0005
Low to moderate hardness surface water	40	0.001
High hardness surface or groundwater	200	0.005
Very hard and brackish water	400	0.01
Seawater	35,000	0.68

How to determine DIC

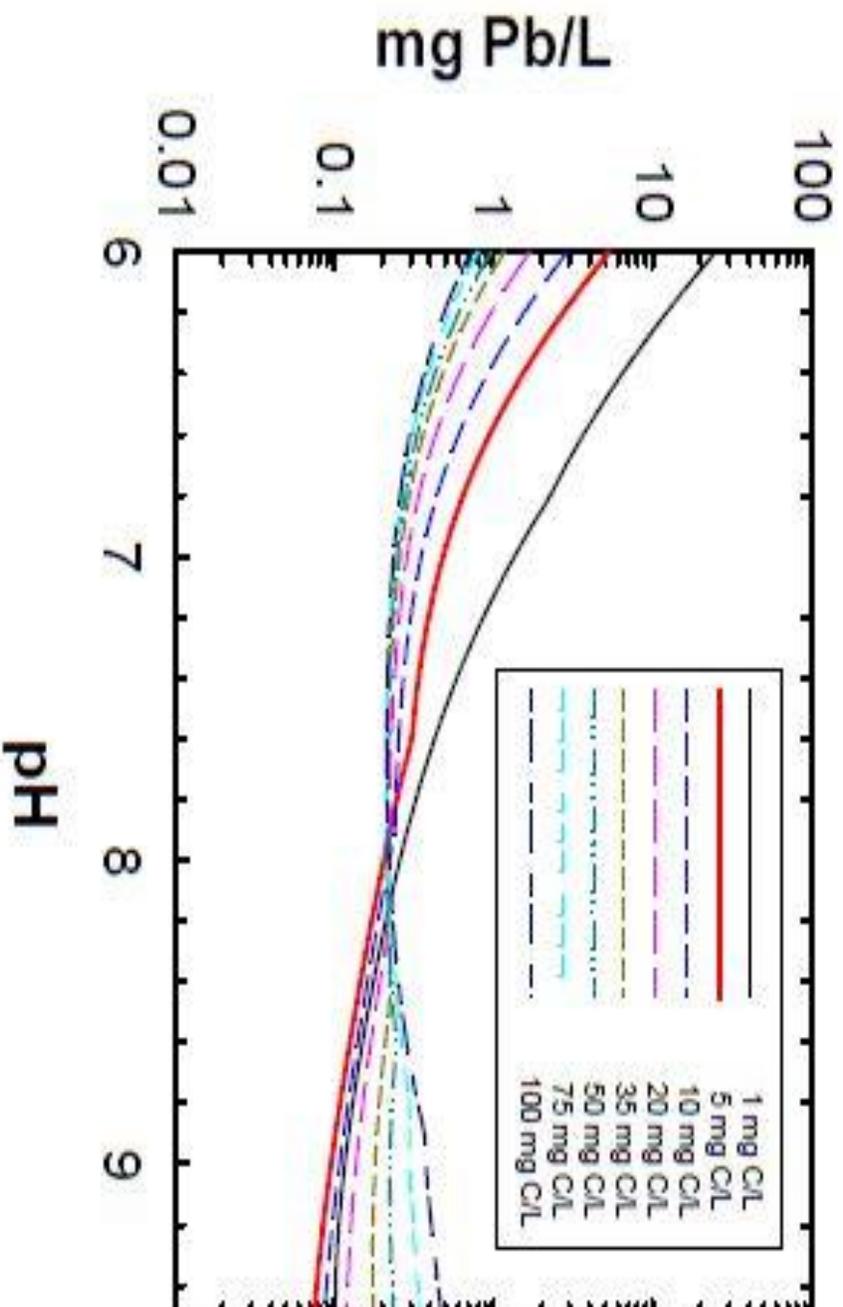
Alkalinity/DIC Relationship

$I=0.005, 25^{\circ}\text{C}$



- Note that this chart is for waters that have an ionic strength of 0.005
- Chart is for warm water conditions
- How much DIC is there in the incoming Lake Erie supply?

How pH and DIC affect Pb solubility



Source: Adapted from Schock and Lytle 2011

Figure 1.4 Theoretical impact of pH and DIC on lead solubility in drinking water under ideal equilibrium conditions - assumes Pb(II) and no orthophosphate

Phosphate – how much is enough?

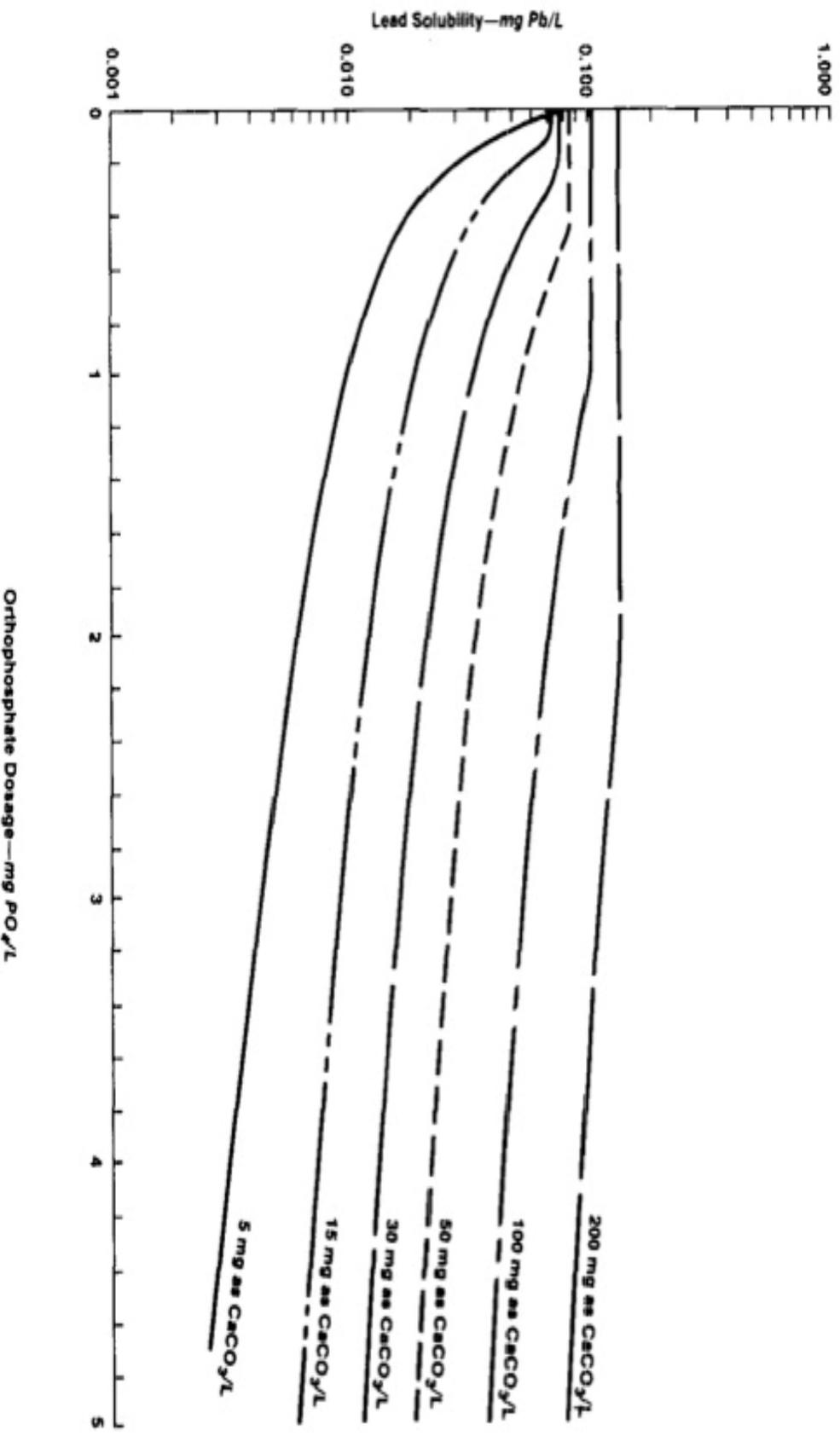
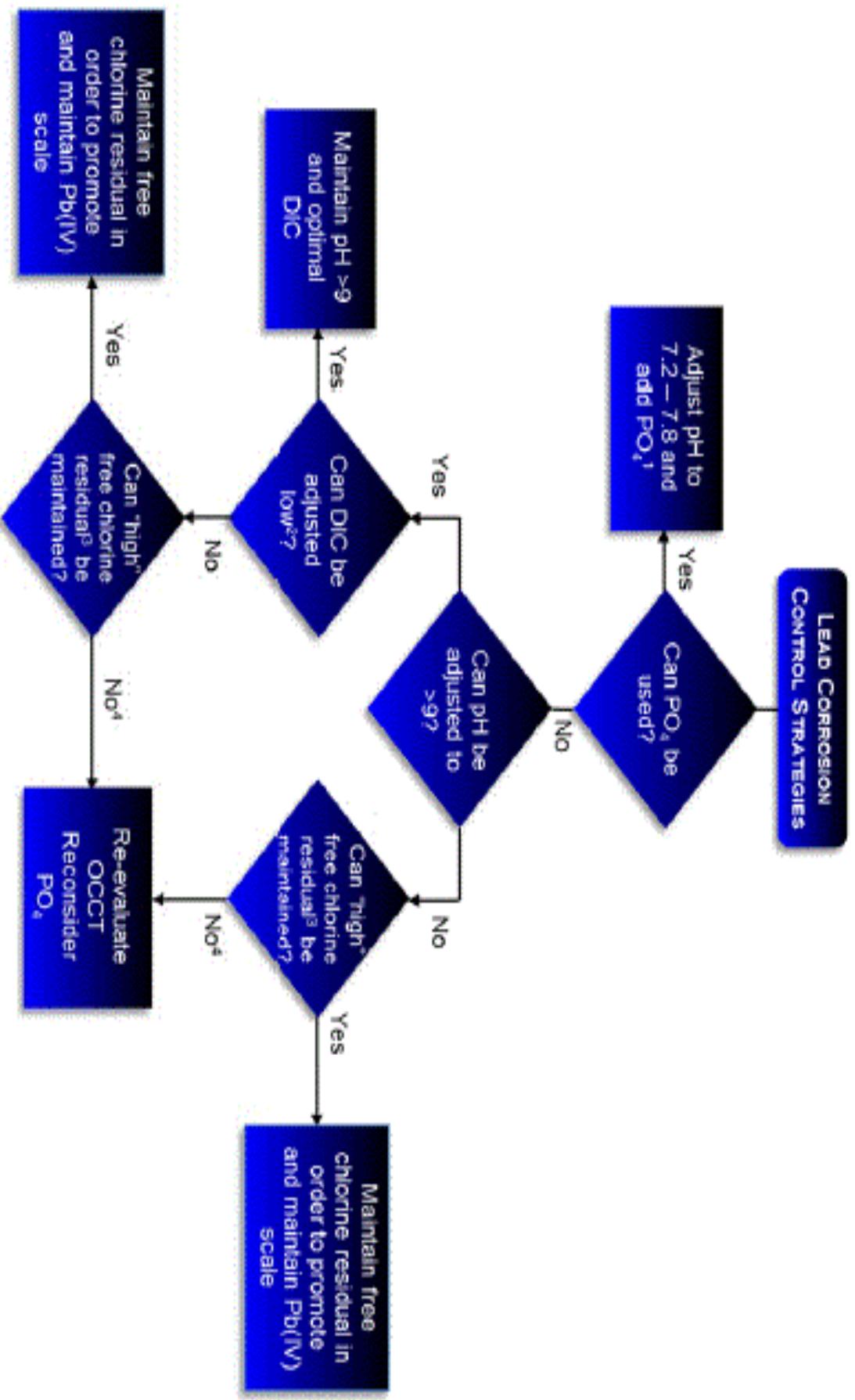


Chart shows lead solubility at pH 7.5 with various phosphates dosages and alkalinity values.

Simplified decision tree for operational strategy



A Gray Area



- Choices made by Utilities and Regulators regarding the Lead and Copper Rule are seldom “black and white” or well delineated
- Let’s examine how the choice was made to choose which Lead samples for reporting in Flint which resulted in the indictment of Glasgow, Busch and Prysby....
- Let me first ask this: Do you think these three people deliberately altered the results of the report in order to keep the Lead issues from the public?

★ Next slide

Data Difference – 60 samples required **but** 72 samples were taken
90%tile of 72 means that 7 can be high, but not 8

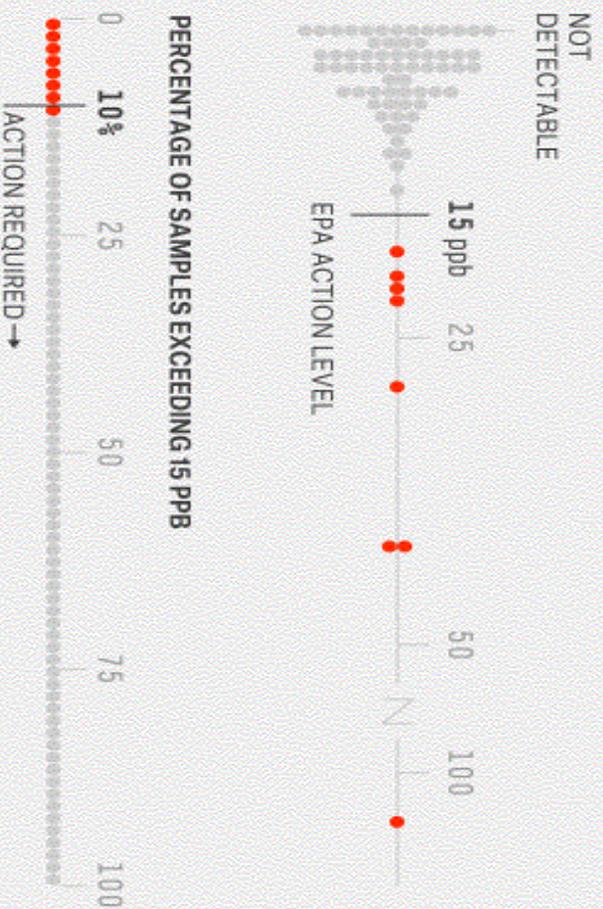


The difference two data points can make

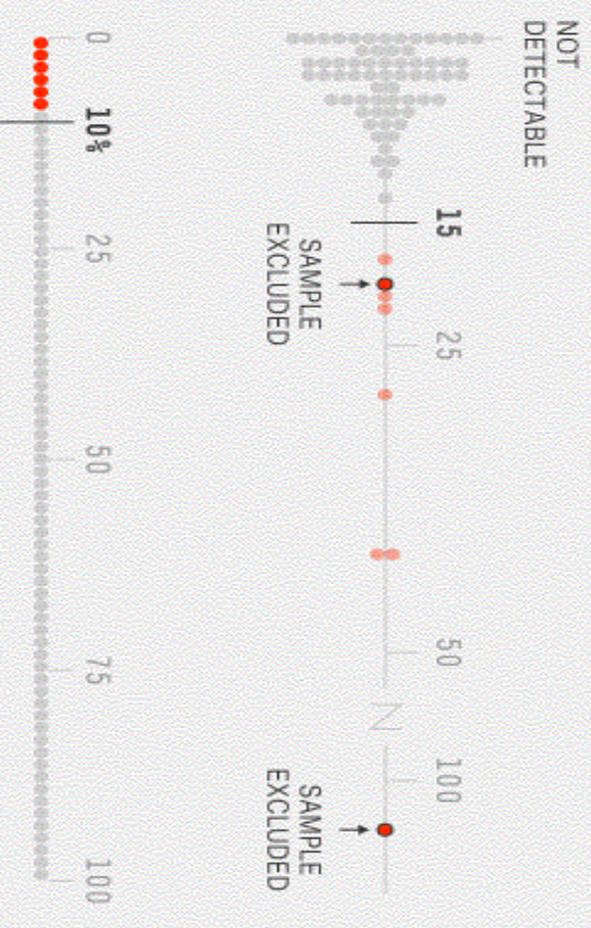
The Michigan Department of Environmental Quality's analysis of Flint's water supply

If the DEQ had **included all of the water samples it took**, federal law would have demanded further steps ...

LEAD LEVELS IN WATER SAMPLES



... but the **exclusion of two high-lead samples** put the city's water supply below the threshold for mandatory action.



May 4th, 2017

Mike Glasgow has his charges dropped

"Mr. Glasgow attempted to call the police -- that would have been the (Michigan Department of Environmental Quality) -- and they never responded," said Ruth C. Carter, special assistant Michigan attorney general.

"Mr. Glasgow sent the flares up when nobody else did. He's the reason that we were able to get started because he did try, and no one responded to him. "

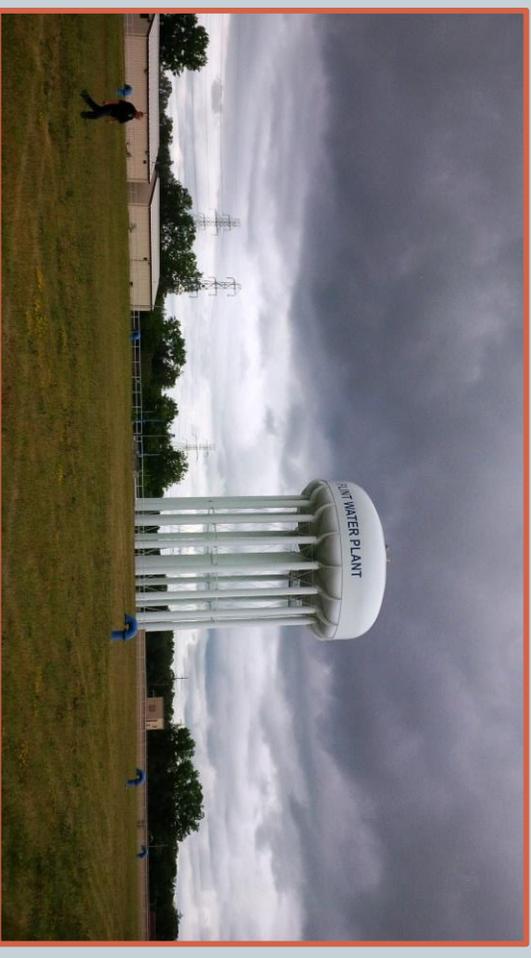


"A judge has dismissed the criminal case against former Flint utilities Administrator Michael Glasgow after prosecutors requested it, saying he has "cooperated significantly" with their investigation into the city's water crisis."

www.Mlive.com – May 4, 2017

Flint WTPP

- Is a turbidity removal / lime softening plant retrofitted in 2000
 - Ozone, Ferric Chloride, rapid mix/flocs and plate settlers for turbidity, GAC filters
 - Lime softening and recarbonation for hardness removal
 - Since the retrofit, it had been operated only 4-5 days at a time about three times a year
 - ✦ It did not put finished water into the system during those times
 - ✦ **Staff was not prepared for 24/7 OPS**



Flint River Issues

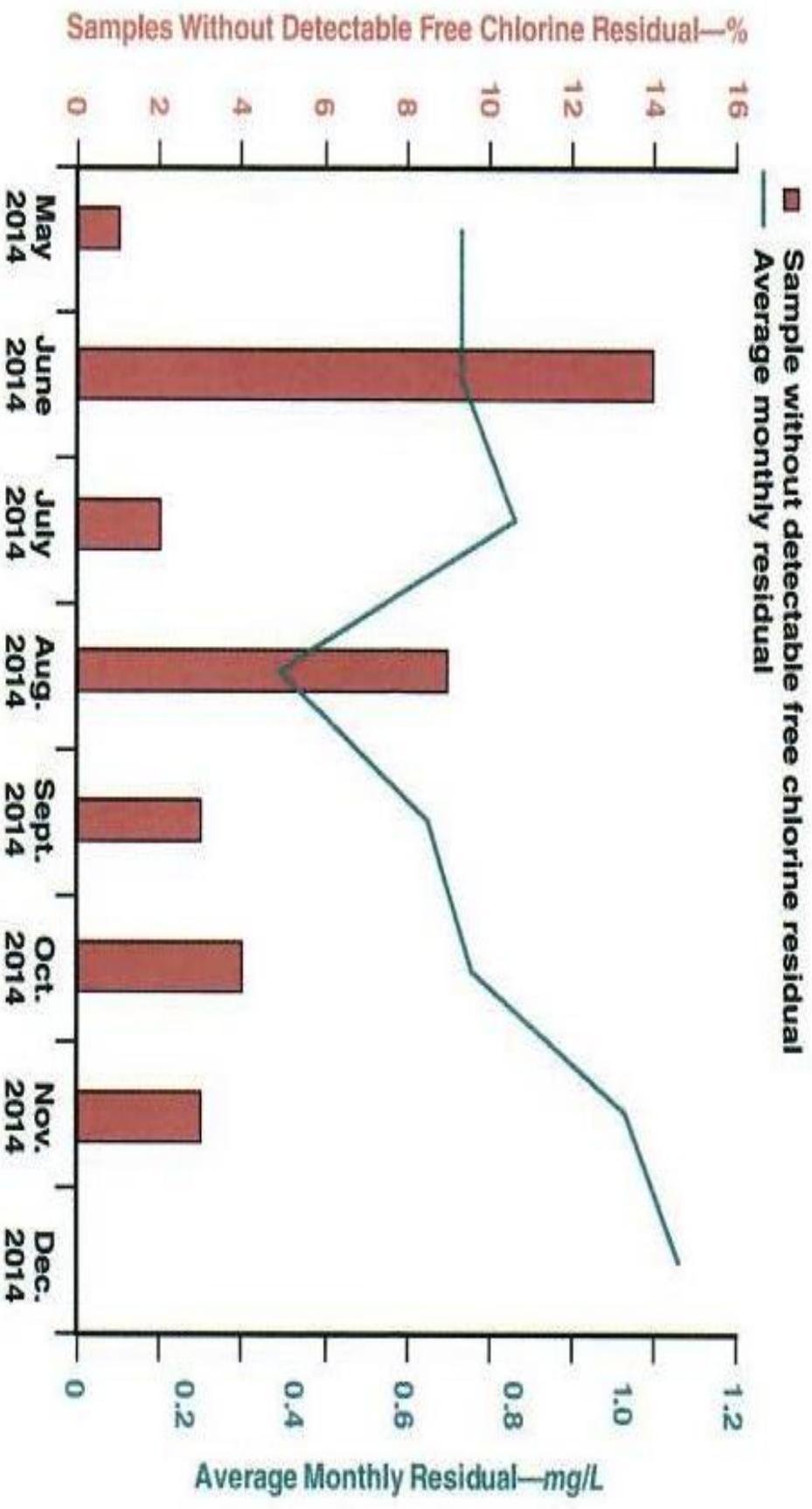


- Historically, the water in the Flint River upstream of Flint has been of poor quality.
- It was severely degraded during the 1970's due to the presence of fecal coliform, low DO, plant nutrients, oils and toxic substances.
- In 2001, the state ordered the monitoring and cleanup of 134 polluted sites within the Flint River watershed, including industrial complexes, landfills and farms laden with pesticides and fertilizer.

Plant Status as of Start-up (April 25)

- Plant had 4 to 5 days of polymer on hand
- Plant SCADA was incomplete and out for bid
- Filter head loss meters not operational
- Chlorine residual monitoring equipment not installed at the point of entry to distribution system
- Chlorination after filter not used until May 17
- Fluoridation not available until July 2
- **No corrosion control plan or equipment**
- No treatability study had been done
- Ferric chloride was only coagulant – which added to the chloride-sulphate/ CO_3^- problem
- Ozone feed not able to be controlled sufficiently – bromates were produced in excess of MCL
 - In spite of all this and more, the emergency manager forces the operators to start the plant

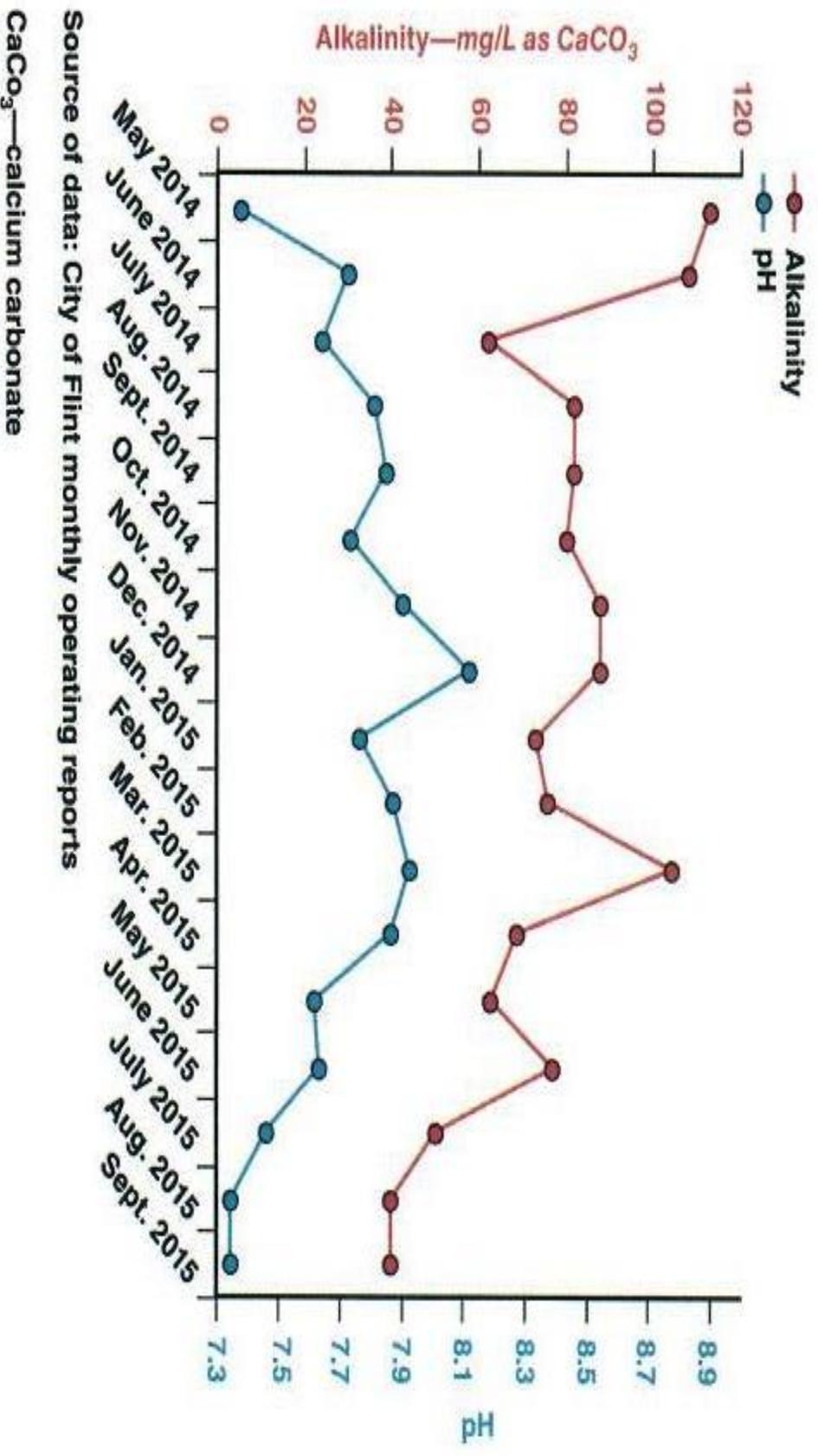
FIGURE 6 Chlorine residuals at monitoring sites in the Flint distribution system



Source of data: City of Flint monthly operating reports



FIGURE 7 Monthly average pH and alkalinity in the treated Flint River water



Flint Timelines



- **August and September 2014**
 - City officials issue boil-water advisories after coliform bacteria are detected in tap water.
- **October 2014**
 - The Michigan Department of Environmental Quality blames aging pipes and a population decline for pockets of bad WQ
- **October 2014**
 - A General Motors plant in Flint stops using municipal water, saying it corrodes car parts.

Flint Timelines



- **January 2015**
 - Detroit's water system offers to reconnect to Flint, waiving a \$4 million connection fee. Three weeks later, Flint's state-appointed Emergency Manager, Jerry Ambrose, declines the offer.
- **February 2015**
 - In a memo for the governor, officials play down problems and say that the water is not an imminent "threat to public health."



Ms. LeeAnne Walters

Shown here with two of her children – the twins.

She is the mother of four kids – an 18 year old daughter, a 14 year old son, and the twins Gavin and Garrett.

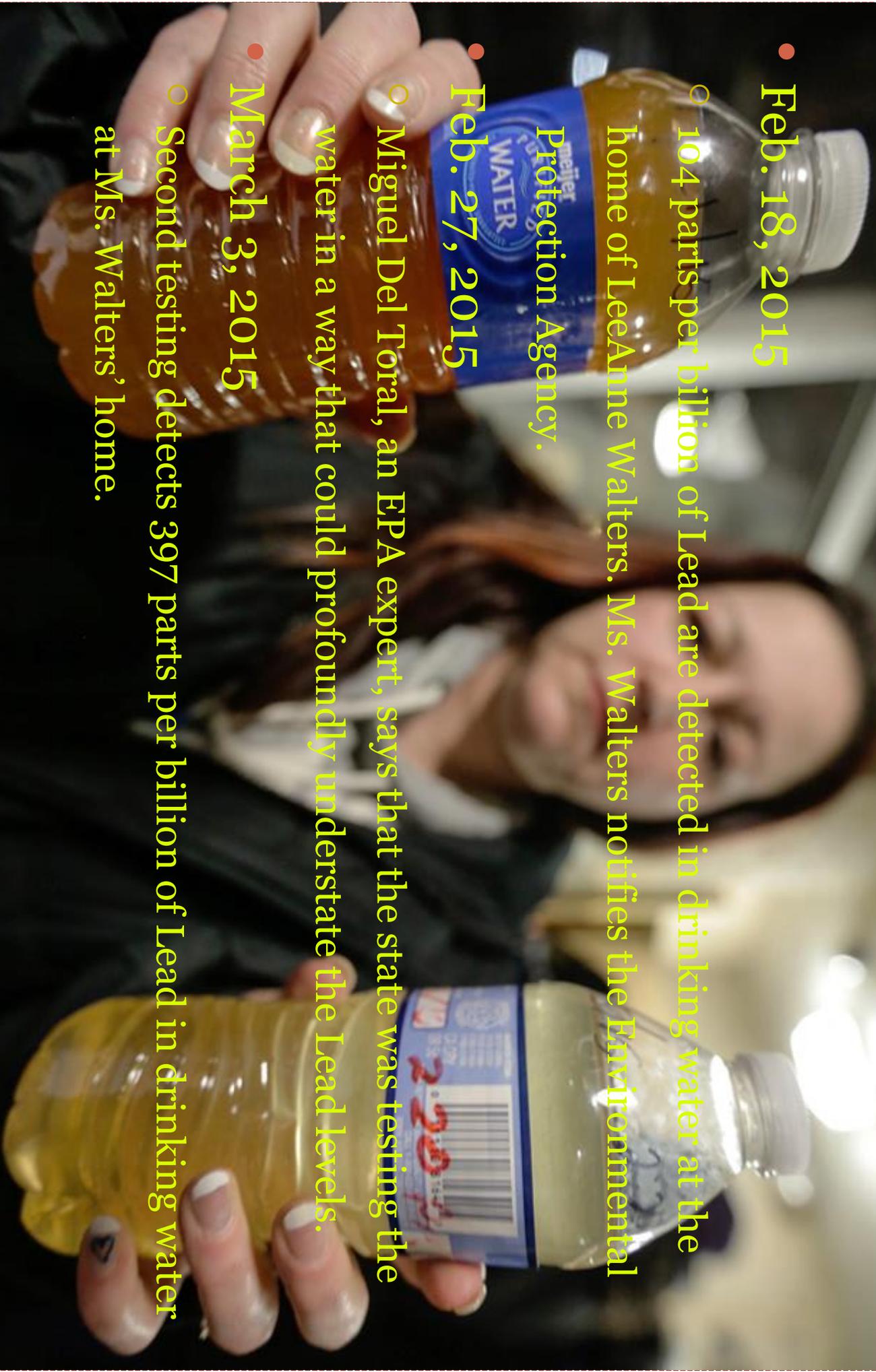
Gavin has stopped growing, and the daughter's hair fell out while taking a shower.

Ms. Walters lost her eye lashes at one point.



Flint Timelines

- Feb. 18, 2015
 - 104 parts per billion of Lead are detected in drinking water at the home of LeeAnne Walters. Ms. Walters notifies the Environmental Protection Agency.
- Feb. 27, 2015
 - Miguel Del Toral, an EPA expert, says that the state was testing the water in a way that could profoundly understate the Lead levels.
- March 3, 2015
 - Second testing detects 397 parts per billion of Lead in drinking water at Ms. Walters' home.



Flint Timelines



- **March 12, 2015**
 - Veolia, a consultant group hired by Flint, reports that the city's water meets state and federal standards; it does not report specifically on Lead levels.
 - ✦ “The review of the water quality records during the time of Veolia’s study shows the water to be in compliance with State and Federal regulations, and, based on those standards, the water is considered to meet drinking water requirements.” ----- [Flint MI Water Quality Report, Veolia, 3/12/2015](#)
 - The Mayor of Flint uses this report to state publicly that the water is safe

Flint Timelines



- **July 2, 2015**
 - An EPA administrator tells Flint’s mayor that “it would be premature to draw any conclusions” - (based on a leaked internal EPA memo regarding Lead).
- **July 22, 2015**
 - Dennis Muchmore, Governor Rick Snyder’s Chief of Staff, expresses concern about the Lead issue in an email, and asks about Flint test results, blood testing and the State’s response.

Flint Timelines



- **Aug. 17, 2015**
 - Based on results showing Lead levels at 11 parts per billion from January to June 2015, the Department of Environmental Quality tells Flint to optimize corrosion control.
- **Sept. 2, 2015**
 - Marc Edwards, an expert on municipal water quality and professor at Virginia Tech, reports that corrosiveness of water is causing Lead to leach into the supply. Soon after, the Department of Environmental Quality disputes those conclusions.

Flint Timelines



- **Sept. 24-25, 2015**
 - A group of doctors led by Dr. Mona Hanna-Attisha of Hurley Medical Center in Flint urges the city to stop using the Flint River for water after finding high levels of Lead in the blood of children. State regulators insist the water is safe.
- **Sept. 28, 2015**
 - The governor is briefed on Lead problems in a phone call with the state environment department and federal officials.

Flint Timelines



- **Oct. 1, 2015**
 - Flint city officials urge residents to stop drinking water after government epidemiologists validate Dr. Hanna-Attisha's finding of high Lead levels. Governor Snyder orders the distribution of filters, the testing of water in schools, and the expansion of water and blood testing.
- **Oct. 16, 2015**
 - Flint reconnects to Detroit's water. Residents are advised not to use unfiltered tap water for drinking, cooking or bathing.

Flint Timelines



- **Oct. 19, 2015**
 - The Department of Environmental Quality director, Dan Wyant, reports that his staff used inappropriate federal protocol for corrosion control.
- **Oct. 21, 2015**
 - Governor Snyder announces that an independent Water Advisory Task Force will review water use and testing in Flint.
- **Dec. 9, 2015**
 - Flint adds additional corrosion control chemicals.
- **Dec. 14, 2015**
 - Flint declares an emergency.

Flint Timelines



- **January 2016**
 - MDEQ is testing (Sentinel) the water at more than 600 homes. Some results top 600 ppb Lead
 - USEPA Region 5 Administrator Susan Hedman resigns her position due to this crisis
- **Jan. 16, 2016**
 - President Obama declares a state of emergency in the city and surrounding county, allowing the Federal Emergency Management Agency to provide up to \$5 million in aid
- **Jan. 21, 2016 – Veolia report resurfaces – Detroit Free Press headline:**
 - March 2015 [Veolia report urged corrosion control](#) but made no mention of Lead leaching into the water and did not cite health concerns, only aesthetic ones. Its recommendation to add phosphates to treat the water would have cost a tiny fraction of today's mounting costs to address the Flint drinking water crisis, but it went unheeded by the city's state-appointed Emergency Manager

State of Michigan Audit of DEQ



- **In March of 2016, MI issues an audit report:**
 - “MDEQ does not verify that water samples for Lead come from the right homes”
 - “MDEQ doesn’t have a procedure for determining the population served by a water system”
 - “MDEQ didn’t follow its own policy for water system visits and detailed surveys”
 - “MDEQ fees do not cover the costs of oversight”
 - “Audit also faults federal Lead and Copper Rule”
- **Water Infrastructure Committee begins its work**

Flint Timelines



- April 2016
 - Flint Water Advisory Task Force issues its final report
 - ✦ As mentioned, it blames the crisis on governmental failure at many levels
 - ✦ **Some tasks are assigned to our sub – Committee according to experience**
 - Three people – a Flint utility employee (Glasgow) and two MDEQ employees are indicted
 - ✦ Another Flint employee is found dead

First 3 Flint Indictments



- Michigan Attorney General Bill Shuette indicts government employees: *
 - A district water supervisor for the Michigan Department of Environmental Quality, and a district water engineer, each face six charges.
 - ✦ Accusations include misleading federal regulatory officials, manipulating water sampling and tampering with reports.
 - A former laboratory and water quality supervisor who served as the city's utilities administrator, is accused of tampering with a lead report.
 - ✦ He is charged with tampering with evidence, a felony, and willful neglect of duty, a misdemeanor.

✦ *Detroit Free Press, April 2016

Flint timelines



- June 2016 – two engineering firms are sued by the State of Michigan

- Veolia

- Lockwood, Andrews & Newnam (LAN)

- According to Michigan Attorney General:

- The companies, Veolia North America and Lockwood, Andrews & Newnam, or LAN, were awarded contracts to advise the city about using the Flint River as its drinking water source. But, Mr. Schuette said, each failed to sound alarms about lead contamination, overlooked obvious problems and were complicit in the series of events that caused lead to leach from pipes and poison children. *

• *DETROIT FREE PRESS, JUNE 22, 2016

Flint Timelines



- **July 29th, 2016**
 - Six more DEQ and State employees are criminally charged by the Michigan
- As of this presentation – July 2017 – the charges are ongoing, and 13 persons have been indicted
- When indicting these six State employees, Shuette is quoted as saying:
 - "They had knowledge and ability to stop the problem, but they failed"
- ★ The following press releases were taken from the Detroit Free Press on 7.29.2016

July Indictments 1 (total of six)



- Former chief of the Michigan Department of Environmental Quality's Office of Drinking Water and Municipal Assistance
- Charges: One felony count of misconduct in office, which carries a penalty of five years in prison and/or \$10,000 and one misdemeanor count of willful neglect of duty, according to a news release from Attorney General Bill Schuette's office.
- Allegations: It's alleged that despite notice from citizens about water quality and being aware of an outbreak of Legionnaires' disease, the chief "not only allegedly failed to take corrective action or notify public health officials but, in fact took steps to mislead and conceal evidence from health officials in phone calls revealed by the investigation," the release says.

- **Work status: Fired**

July Indictment 2



- MDEQ water quality analyst
- Charges: Three felony charges -- one count of misconduct in office, which carries a penalty of five years in prison and/or \$10,000; one count of tampering with evidence, which carries a penalty of four years and/or \$5,000; and tampering with evidence, which carries a penalty of four years and/or \$10,000. He is also facing a misdemeanor charge of willful neglect of duty.
- Allegations: It's alleged that the analyst "was warned by Flint Water Treatment Plant officials that they were not ready for operations and was later warned by the EPA that high levels of lead us usually due to particulate lead, signaling a corrosion problem," the news release from the Attorney General's Office says. He is accused of participating in the manipulation of lead testing results.
- **Work status: Suspended without pay**

July Indictment 3



- MDEQ specialist for the Community Drinking Water Unit
- Charges: One felony count each of misconduct in office and conspiracy, both of which carry penalties of five years in prison and/or \$10,000; and one misdemeanor count of willful neglect of duty.
- Allegations: It's alleged that the specialist was aware of water problems in Flint, "but allegedly took no corrective action in his duty to ensure the provision of clean, safe drinking water in Flint" and also is accused of misleading the Environmental Protection Agency about the necessity of using corrosion control treatments, the release from the Attorney General's Office says.
- **Work status: Suspended without pay**

July Indictment 4



- Director of the Michigan Department Health and Human Services program for maternal, infant and early childhood home visiting
- Charges: One felony count each of misconduct in office and conspiracy, both of which carry penalties of five years in prison and/or \$10,000; and one misdemeanor count of willful neglect of duty.
- Allegations: It's alleged that the director requested a report on blood lead level data on Flint children, but the report -- created in July 2015 and showing a spike in blood lead tests for Flint children -- was "buried," the news release from the Attorney General's Office says. It's alleged that he and another health department employee created another report that "falsely indicated no statistically significant rise in blood lead levels of children in the summer of 2014," according to the release.
- **Work status: Suspended without pay**

July Indictment 5



- Data manager for the MDHHS Health Homes and Lead Prevention program
- Charges: One felony count each of misconduct in office and conspiracy, both of which carry penalties of five years in prison and/or \$10,000; and one misdemeanor count of willful neglect of duty.
- Allegations: It's alleged that the manager, along with a director, created a report that "falsely indicated no statistically significant rise in blood lead levels of children in the summer of 2014," the Attorney General's Office news release says.
- **Work status: Suspended without pay**

July Indictment 6



- Former director of the Bureau of Epidemiology and State Epidemiologist
- Charges: One felony count each of misconduct in office and conspiracy, both of which carry penalties of five years in prison and/or \$10,000; and one misdemeanor count of willful neglect of duty.
- Allegations: It's alleged that the director received a first report regarding blood lead levels in Flint children, "but instructed others not to take action, rebuffing other employees who asked about next steps of action," the news release says.

"The charges allege that the director later instructed another MDHHS employee to delete emails concerning the original blood lead data report from July 28, 2015."
- **Work status: Suspended without pay**

December 2016 indictments – 4 more



- On December 19th, 4 more individuals were indicted
 - **Darnell Earley** -
 - ✦ He was the state-appointed emergency manager in charge of Flint in April 2014, when the city switched its water source from Lake Huron water provided by the Detroit water system and began drawing water from the Flint River.
 - **Gerald Ambrose** –
 - ✦ He was the state-appointed emergency manager who took Earley's place, and he rejected a Flint City Council vote to return to Detroit water.
 - **Howard Croft** –
 - ✦ He was Flint's public works director at the time of the lead contamination. Croft held the post from December 2011 to November 2015
 - **Daugherty Johnson** –
 - ✦ He was Flint's utilities administrator at the time of the lead contamination.

Legionnaire's Deaths - Manslaughter Charges Brought



- June 2017
- ***“5 Charged With Involuntary Manslaughter in Flint Water Crisis”***
 - *New York Times, June 14th, 2017*
 - ✦ Nick Lyon, the director of the Michigan Department of Health and Human Services, was charged with involuntary manslaughter and misconduct in office, felonies that could lead to as much as 20 years in prison.
 - ✦ Dr. Eden V. Wells, the chief medical executive for the department, was charged with obstruction of justice and lying to a peace officer, and could face up to seven years if convicted.

Manslaughter Charges Explained by Bill Schuette



- In charging Mr. Lyon, and four others who already faced other charges in the water case, with involuntary manslaughter, Mr. Schuette said they had failed to properly alert the public about increases in Legionnaires' cases, allowing the problem to continue and withholding crucial information from residents, who might have avoided the water had they known.
- An examination of government emails from 2014, 2015 and 2016 [revealed that officials were aware](#) of the pattern of Legionnaires' cases, but that they failed to act swiftly on the revelations and tended to become mired in jurisdictional battles over protocol and responsibility.
- Mr. Lyon knew of the Legionnaires' outbreak by late January 2015, court documents claim, but did not notify the public for another year. At one point, the documents allege, he said that “he can’t save everyone” and that “everyone has to die of something.”

State DEQ sues Flint City Council



- On June 28th, 2017 the Michigan Department of Environmental Quality brings a lawsuit against Flint City Council

- The suit alleges that City Council's refusal to back a long term deal with GLWA for drinking water is endangering public health
- The State does not want Flint to make a change in water source a THIRD time, arguing that there is no other viable choice

Task Force and Committee Work



“FLINT WATER CUSTOMERS WERE NEEDLESSLY
AND TRAGICALLY EXPOSED TO TOXIC LEVELS OF
LEAD AND OTHER HAZARDS THROUGH THE
MISMANAGEMENT OF THEIR DRINKING WATER
SUPPLY”

EXCERPT FROM TASK FORCE REPORT

Creation of Committee



- **The State of Michigan – Executive Office**
 - January 11th, 2016 - EXECUTIVE ORDER No. 2016-1 - CREATION OF FLINT WATER INTERAGENCY COORDINATING COMMITTEE (FWICC)
- **The Coordinating Committee became a function of the Michigan State Police and the Michigan Department of Environmental Quality**
- **Duties of the Coordinating Committee:**
 - (paraphrasing) shall advise the governor ..and propose statutory, regulatory, or contractual actions necessary ...for making recommendations for:
 - ✦ acceptable standards for potable water
 - ✦ the health impacts for the affected population
 - ✦ the assessment of the status of infrastructure
 - ✦ the determination of feasible actions to upgrade the water system.

The FWICC creates 5 sub-committees



- One of which is the Water Infrastructure Integrity Committee
 - Tasks:
 - ✦ Assess the condition and functionality of the overall distribution system
 - ✦ Determine the right-sizing of the water infrastructure system to support the needs of the City
 - ✦ Create a plan for addressing the needs as defined in the overall assessment
 - ✦ Determine a viable-backup emergency water source
 - ✦ Develop a comprehensive Lead line replacement program that takes all needs into consideration such as at-risk populations
 - Meanwhile

Findings of the Flint Water Advisory Task Force



- F-1. MDEQ bears primary responsibility for the water contamination in Flint.
- F-2. MDEQ, specifically its Office of Drinking Water and Municipal Assistance (ODWMA), suffers from cultural shortcomings that prevent it from adequately serving and protecting the public health of Michigan residents.
- F-3. MDEQ misinterpreted the LCR and misapplied its requirements. As a result, Lead-in-water levels were under-reported and many residents' exposure to high Lead levels was prolonged for months.
- F-4. MDEQ waited months before accepting EPA's offer to engage its Lead (Lead) experts to help address the Flint water situation and, at times, MDEQ staff were dismissive and unresponsive.
- F-5. MDEQ failed to move swiftly to investigate, either on its own or in tandem with MDHHS, the possibility that Flint River water was contributing to an unusually high number of Legionellosis cases in Flint.

MDEQ's Failures and Intransigence



When considering Flint's conversion from DWSD to the Flint River water, MDEQ had multiple communications and meetings with Flint Utilities Department staff and their consultants.

- When asked by Flint water plant personnel about adding phosphate in the treatment process, as DWSD does for corrosion control, MDEQ said that a corrosion control treatment decision would be made after two 6-month monitoring periods were conducted to see if corrosion control treatment was needed.
- ODWMA anticipated that use of Flint River water would be problematic but deferred to state Emergency Manager decisions to proceed.
- Subsequently: MDEQ advised Flint WTP staff, in contradiction to longstanding federal policy under the LCR, that corrosion control treatment was not required.
- MDEQ insisted, even after compelling evidence of Lead poisoning of children was presented, that Flint water quality met applicable SDWA standards.

FWATF Findings and Recommendations



FOCUSING ON THE ONES THAT ARE AIMED AT THE MDEQ, AND
THEREFORE PERTAIN TO THE FWICC COMMITTEES -
INFRASTRUCTURE INTEGRITY COMMITTEE, WATER QUALITY
COMMITTEE, ETC.

(SOME FINDINGS AND RECOMMENDATIONS ARE AIMED AT, FOR
EXAMPLE, THE GOVERNOR'S OFFICE, OR THE HEALTH
DEPARTMENT)

**THE GOVERNOR WAS REQUIRING THAT THE MDEQ RESPOND TO THE
RECOMMENDATIONS QUICKLY**

Lead service line replacement



- Flint took the recommendation to perform total Lead service line replacement as opposed to partial
 - How do you advise Flint which lines to replace first?
 - ✦ It can't be done in a day or a week or a month
 - ✦ Who gets to go first – who goes last?
 - A tiered approach is being used
 - ✦ Results of water samples, locations of children
 - For those on the waiting list, temporary remedial action is given

Flint Began Replacement in March, 2016



- 30 were scheduled in first month – we needed to establish a unit cost
 - 20 got done
 - ✦ Weather - Multiple connections off one line – bad records
 - Another 13 were completed in April
- A unit cost of approximately \$4,500 was determined
- Committee recommended, and the City started on the next 500 lines
 - RFP for this work was let out in June 2016 - \$20,000,000 was allotted
 - Homes picked using GIS, Census data, Density of population and children
 - ✦ Choosing Lead – to – Galvanized service lines
 - Bids came in at unit cost of \$9,000 per line

Service lines in Flint



- The city records show that flint water customers are served through
≈ 30,000 service lines
- The records indicate that over 15,000 of them are Lead
 - There is some conjecture that a number of those are simply services with a Lead gooseneck
 - As of July 12th, 2017 – the city has replaced >2,180 Lead service lines*
 - ✦ The City has accelerated its efforts now that Federal funding has been allocated
 - ✦ They hope to do 6,000 this year
 - Recently (Jan 11 Town Hall Meeting) the city stated it will take perhaps three years to replace all the service lines

***"Flint says 2,181 lead pipes replaced" - The Detroit News, July 11, 2017**

Madison, WI Lead study and replacement

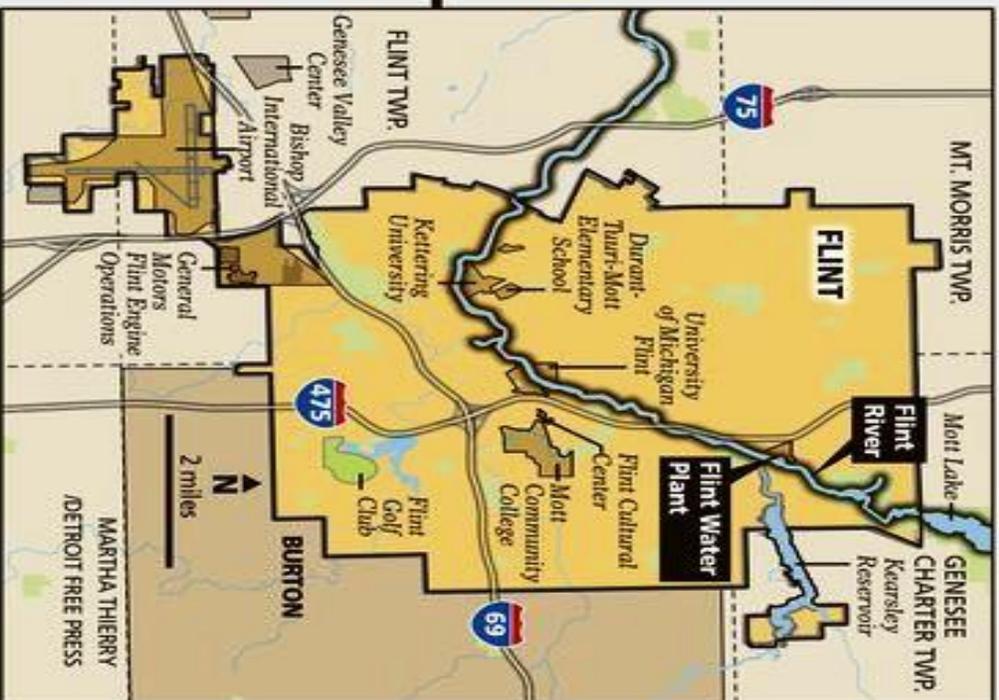


- Madison began to fully replace Lead service lines in 2001
 - About 8,000 lines were found
 - Cost estimated at \$15.5 Million
 - ✦ The City faced problems because the service lines are private property and the public balked at using public funds for the replacements
- The study revealed:
 - ✦ After replacement, it took 4 years before major spikes of Lead were no longer seen
 - ✦ Where service lines were Lead coupled to galvanized
 - Removal of the Lead portion caused the iron oxide to absorb Lead, then release it slowly – it took 8 years for lines to get below 5 ug/L

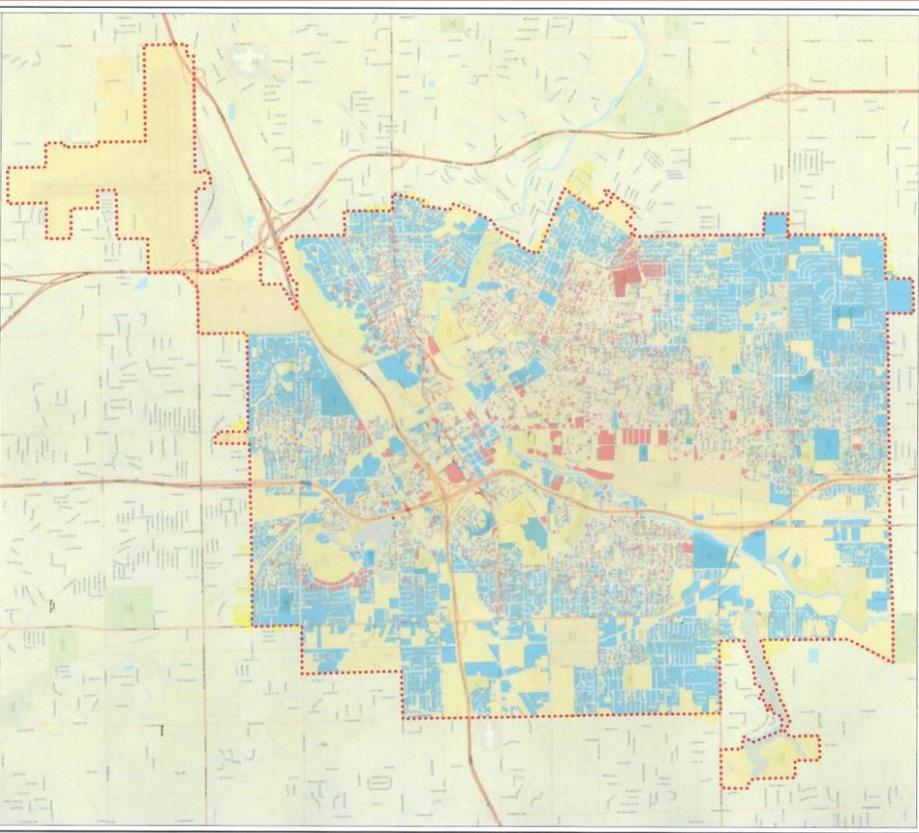
Where are the Lead service lines?



SOURCE: Google Maps



Service Line Material by Parcel (as of 1/28/2016 at 1500)



Legend
Flint City Boundary
State of Michigan Boundary
Service Line (Material)
Lead
Copper
Galvanized Steel
Unknown



Lead service lines in this Country



- According to a recent national estimate, a total of 6.1 million LSLs—either full or partial—are in place today in US community water systems (CWSs)
 - Providing water to an estimated 15 million to 22 million people (Cornwell et al. 2016)*.
- Lead is present in private plumbing systems, primarily in housing stock developed before 1986 when the use of Lead pipe was banned.

*Cornwell, D.A.; Brown, R.A.; & Via, S.H., 2016. National Survey of Lead Service Line Occurrence. Journal AWWA, 108:4:E182.

<http://dx.doi.org/10.5942/jawwwa.2016>

FWATF Finding F-1 and Recommendation R-1



- **F-1.**
 - MDDEQ bears primary responsibility for the water contamination in Flint.
- **R-1**
 - Implement a proactive, comprehensive cultural change program within MDDEQ, specifically its Office of Drinking Water and Municipal Assistance (ODWMA), to refocus the department on its primary mission to protect human health and the environment.

FWATF Finding F-3 and Recommendation R-3



- F-3.
 - MDEQ misinterpreted the LCR and misapplied its requirements. As a result, Lead-in-water levels were under-reported and many residents' exposure to high Lead levels was prolonged for months.
 - ✦ “MDEQ discounted evidence of dangerous water quality problems, even manipulating sampling procedures mandated by the LCR. The US Environmental Protection Agency (USEPA), on learning of these transgressions, waited months to act.”*

*July 2016 Journal AWWA

FWATF Finding F-4



- **F-4**
 - MDEQ waited months before accepting EPA's offer to engage its Lead (Lead) experts to help address the Flint water situation and, at times, MDEQ staff were dismissive and unresponsive.

FWATF Recommendation R-19



- R-19 (not tied to a specific finding)
 - Review budget requests for MDEQ to ensure adequate funding is provided to the ODWMA. EPA audit and interviews indicate that Michigan’s drinking water program might have one of the lowest levels of financial support within EPA Region V while having one of the largest, if not the largest, number of community water systems (CWS) to regulate.
 - ✦ From 2010 to 2016, MDEQ lost 12 field engineering positions due to budget decreases and attrition
 - The number of Full Time Equivalents (FTE’s) has decreased

R-19 PWS to FTE comparisons in USEPA Region V
Based in part on 2011 ASDWA Report



- **Michigan**
 - Population 9.9 million
 - 1,425 PWS
 - ✦ 85 Full time equivalents
 - ✦ Ratio of PWS to FTE = 16.8
- **Ohio**
 - Population 11.5 million
 - >4,800 PWS
 - ✦ 147.5 Full time equivalents
 - ✦ Ratio of PWS to FTE = 32.5
- **Minnesota (best in region)**
 - Population 5.3 million
 - ≈ 1,000 PWS
 - ✦ 112 Full time equivalents
 - ✦ Ratio of PWS to FTE = 8.9
- **Indiana (worst in region)**
 - Population 6.6 million
 - 4,105 PWS
 - ✦ 51.5 Full time equivalents
 - ✦ Ratio of PWS to FTE = 79.7

FWATF Finding F-2 and Recommendation R-2



- **F-2.**
 - MDDEQ, specifically its Office of Drinking Water and Municipal Assistance (ODWMA), suffers from cultural shortcomings that prevent it from adequately serving and protecting the public health of Michigan residents.
 - ✦ MDDEQ isn't training operators – nor being trained by operators
 - ✦ MDDEQ answered “this was an important part of MDDEQ staff training and it provided opportunities for contact with operators. However, due to increased workloads, staff are not as engaged as they once were”

FWATF Finding F-2 and Recommendation R-2



- **R-2**
 - Establish an apprenticeship/certification program for MDEQ ODWMA employees that requires direct, hands-on experience with public water system operations. MDEQ ODWMA employees responsible for water system regulation and SDWA enforcement should be, or have access to, certified operators and subject matter experts
 - After my response to the MDEQ outlining the cultural issue, I was assigned to work with MDEQ staff to develop training guidelines
 - When that was complete, I was given a contract to train the Flint WTP operators and the MDEQ field engineering staff on the major unit processes that will be employed

My contract stipulations



- **In part, I was told to**
 - Review existing production facilities, operator tasks and procedures
 - Develop an understanding of the treatment processes and chemical feeds that will be employed once raw water from Lake Huron will be made available
 - Teach classes
 - Develop SOPs for plant operation evaluate personnel and treatment alternatives
- **If they decide to treat Lake Huron Water, I will be given an amendment to....**
 - Assist with plant startup during the USEPA- mandated “performance period”

DEQ Staff and Flint Operator Training



- I have provided operator classes for the processes of:
 - Filtration, rapid mixing/coagulation, flocculation, sedimentation, disinfection
- I taught the first classes the week of 11/28, and again in Jan, Feb, Mar, and April 2017 – I began training new Ops in July 2017
 - I have learned that:
 - ✦ There are good and smart people working for both organizations
 - These are people who had either nothing to do with the decisions back in 2014, or they were in no position to do anything about them
 - ✦ They are keenly aware of the fact that many people from the outside world look unfavorably upon them
 - ✦ This is a source of ongoing pain for many of them - they know that all water systems in the country are under scrutiny because of what happened in Flint

Newly Hired Operators



- New staff are being added
- Since Flint pays new operators only \$13 - \$14 per hour:
 - They get people who have no water experience
 - They get people with no operator license
 - ✦ Since the plant has been reclassified from an “F” plant to an “D” plant, there is limited choice for an operator to get a treatment license
 - I teach remedial math to the new staff before I can teach chemical feeds to them

Sampling Programs and Results



INCLUDING STATE AND CITY EFFORTS

Data From Ongoing Sampling Programs



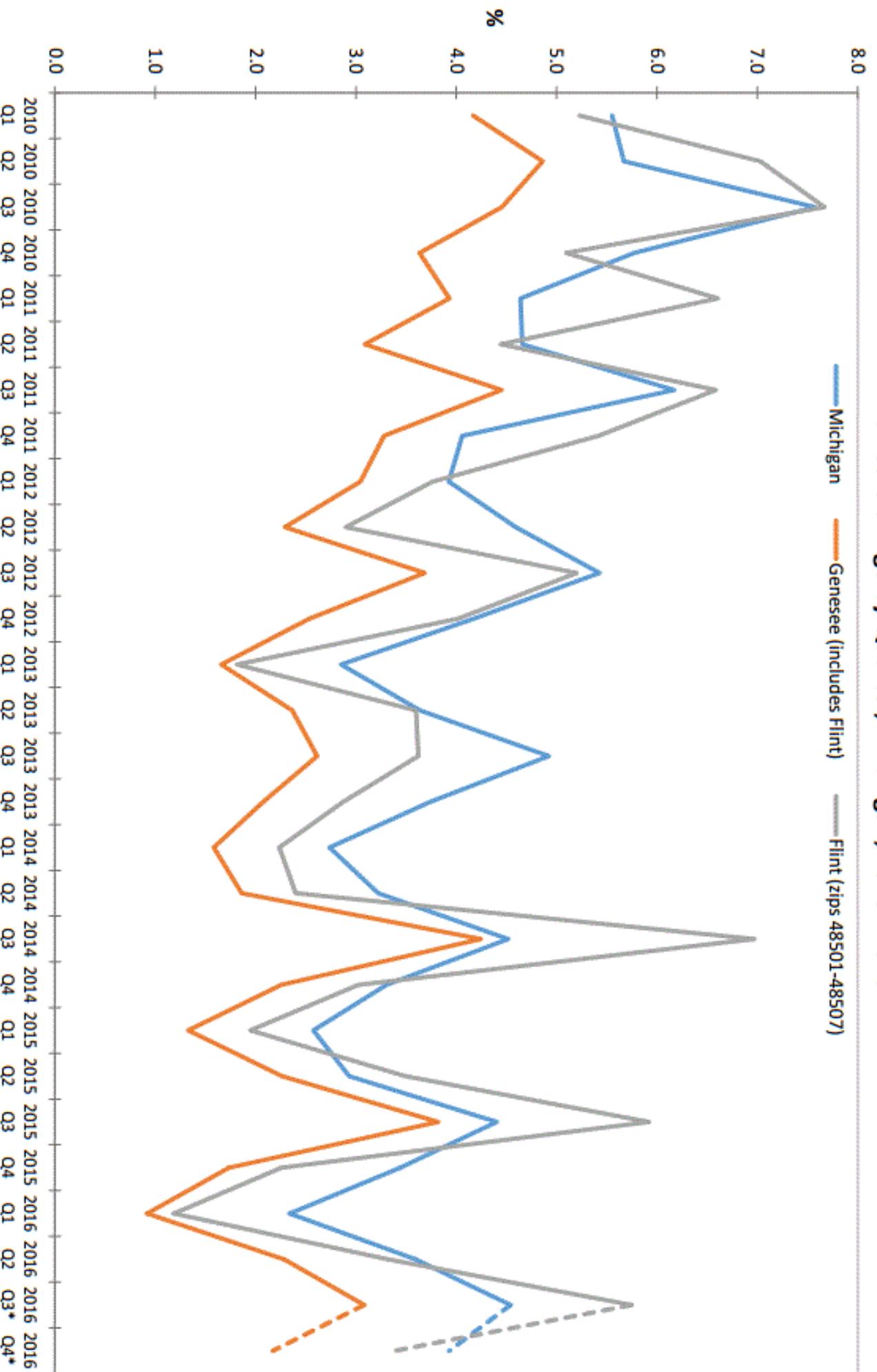
- **Children’s Blood Levels**
 - Report is generated by MDHHS to track Blood Lead Level test results in Flint, Michigan
 - Between 10/1/2015 and 5/27/2016, an additional 24,999 people were tested in Flint
 - A child on Medicaid is required to be screened for blood Lead levels
- **Sentinel Sampling Results and CLEAR test results**
 - Sentinel Testing Conducted Monthly by Michigan DEQ – 600 locations
 - CLEAR – Confirming Lead Elimination After Replacement
- **School Drinking Fountain Testing Results**
 - Conducted by Michigan DEQ – all City Schools
- **City of Flint WTP Orthophosphate – and the pH / chlorine issue – ordered by USEPA**
 - Conducted by plant staff

Blood Lead Levels



- Continued testing efforts by Genesee County Health Department, MDHHS, and local medical personnel have identified 160 children under age 18 in Flint with blood Lead levels greater than or equal to 5 mcg/dL (micrograms Lead per deciliter of blood) since 10/1/2015.
- Of children younger than 6 years old tested between 10/1/2015 and 5/27/2016, 2.2% had blood Lead levels greater than or equal to 5 mcg/dL.
- Nineteen of the 46 children (41.3%) younger than 6 years old with an elevated blood Lead level (tested between 4/1/2016 and 5/20/2016) had a previous test result greater than or equal to 5 mcg/dL.

Annual Incidence of Elevated Blood Lead ≥ 5 mcg/dL among Children <6 Years of Age by Quarter, Michigan, 2010 - 2016

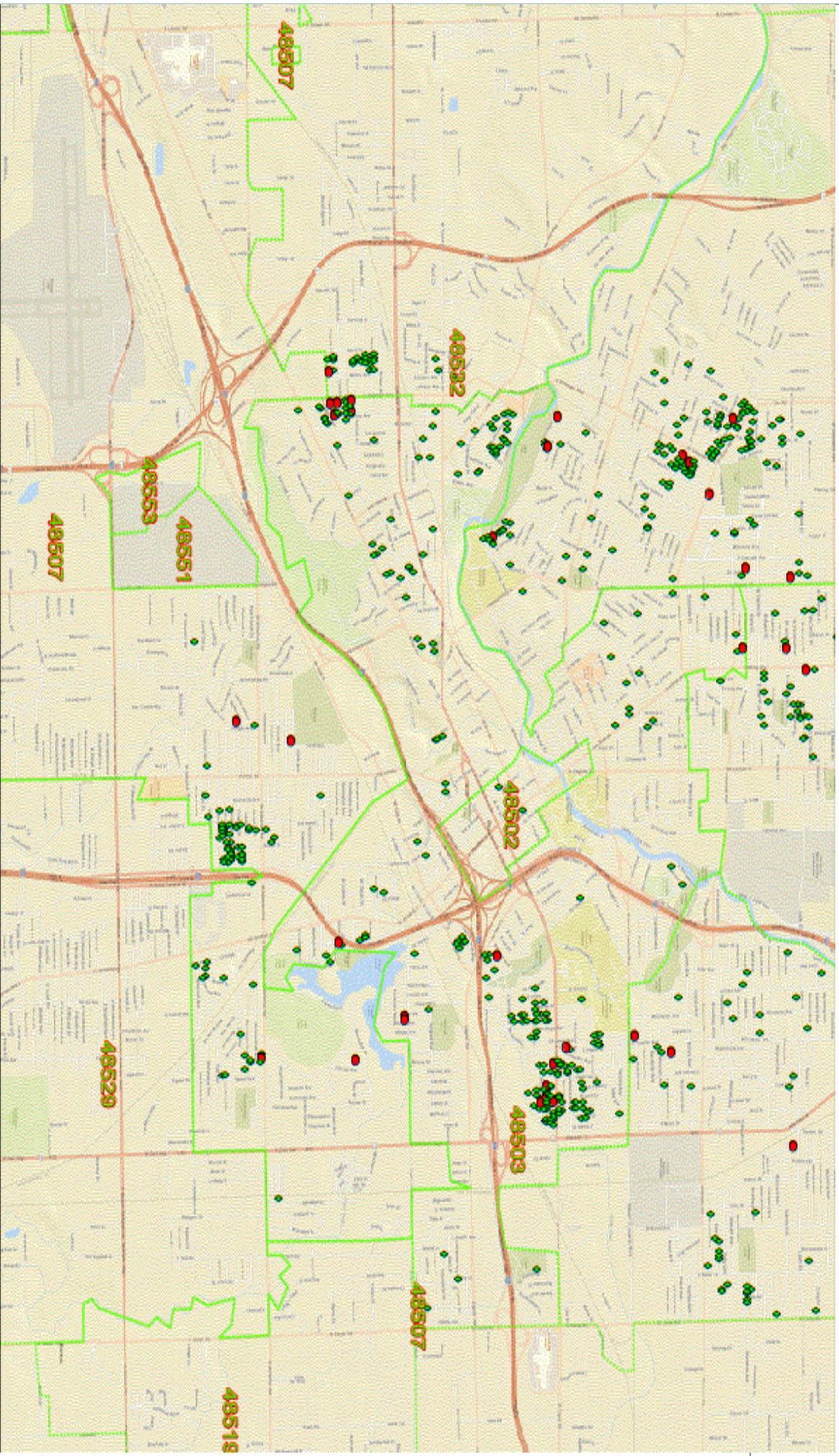


Lead Sampling – Sentinel Program



- Approximately 600 homes were being sampled for Lead contamination in the water supply
 - The worst case scenario sites were chosen for sampling
- The database is a public record and can be viewed at:
 - <http://www.michigan.gov/flintwater/>
- As of May, 2016, there were still some sites showing in excess of 20,000 ug/L
 - Sites that are just Lead service lines showed more rapid improvement over sites with Lead solder and brass fittings which are slower to improve

Sentinel Sites Map



Legend

- Lead_PPB
- 586 Results less than or equal to 15 parts per billion of Lead
- 40 Results greater than or equal to 16 parts per billion of Lead
- Flint Area Zip Codes



Two years after WTP startup

20 Highest Results for Sentinel Households



Sample Number	Date Submitted	Analysis (Lead)	Lead (ppb)
LG37030	4/18/2016	Lead	22,905
LG42004	5/3/2016	Lead	13,295
LG20041	3/4/2016	Lead	11,846
LG31194	4/2/2016	Lead	11,070
LG11253	2/9/2016	Lead	10,467
LG37991	4/21/2016	Lead	10,450
LG39875	4/27/2016	Lead	10,306
LG21835	3/9/2016	Lead	9,416
LG48019	5/26/2016	Lead	9,032
LG17956	2/24/2016	Lead	7,391
LG06432	1/30/2016	Lead	6,290
LG02507	1/22/2016	Lead	5,447
LG18457	2/26/2016	Lead	5,254
LG01574	1/21/2016	Lead	5,013
LG30993	4/1/2016	Lead	4,931
LG01371	1/21/2016	Lead	4,247
LG29472	3/29/2016	Lead	3,343
LG17488	2/24/2016	Lead	3,207
LG43586	5/10/2016	Lead	3,008
LG28235	3/25/2016	Lead	2,562

1,500 times
the AL of 15
ug/L

600 times
the AL of 15
ug/L

200 times the
AL of 15 ug/L

More Recent High Results for Sentinel Households - Improvement



LG75292	21-Sep-16	Lead	10
LG75363	21-Sep-16	Lead	12
LG75350	21-Sep-16	Lead	12
LG75393	21-Sep-16	Lead	13
LG76088	22-Sep-16	Lead	13
LG75312	21-Sep-16	Lead	16
LG75403	21-Sep-16	Lead	19
LG75369	21-Sep-16	Lead	21
LG75281	21-Sep-16	Lead	27
LG75341	21-Sep-16	Lead	39
LG75352	21-Sep-16	Lead	41
LG76087	22-Sep-16	Lead	60
LG75360	21-Sep-16	Lead	67
LG75382	21-Sep-16	Lead	68
LG75388	21-Sep-16	Lead	158

More recent round of testing for about 158 homes shows that 10 are higher than AL

More recent cold water months sampling – 250 mL bottle



Date Submitted	Analysis (Lead)	250 ml Bottle (PPB)
2/16/2017	Lead	200
2/13/2017	Lead	119
2/9/2017	Lead	108
1/26/2017	Lead	106
2/9/2017	Lead	106
1/19/2017	Lead	36
2/9/2017	Lead	36
2/16/2017	Lead	32
2/13/2017	Lead	28
2/9/2017	Lead	24
2/9/2017	Lead	23
1/19/2017	Lead	22
2/9/2017	Lead	22
1/23/2017	Lead	21
1/19/2017	Lead	20
1/4/2017	Lead	19
1/4/2017	Lead	17
2/9/2017	Lead	17
2/16/2017	Lead	15

More recent round of testing looking at the first 250 mLs
18 of them above 15 ug/L

More recent sampling warmer water months – 250 mL bottle



Date Submitted	Analysis (Lead)	250 ml Bottle (PPB)
4/20/2017	Lead	813
3/9/2017	Lead	656
4/20/2017	Lead	619
4/6/2017	Lead	533
3/2/2017	Lead	278
3/30/2017	Lead	253
3/30/2017	Lead	246
4/3/2017	Lead	245
5/1/2017	Lead	245
4/27/2017	Lead	233
3/6/2017	Lead	199
5/1/2017	Lead	182
5/25/2017	Lead	172
3/9/2017	Lead	159
4/27/2017	Lead	152

More recent
round of testing
looking at the
first 250 mLs

Compliance monitoring



- While this Sentinel sampling is ongoing, the system has to sample the tier 1 homes for Lead and Copper
 - The DEQ is providing this service for the water department
 - Not an easy task for sampling teams because two things are happening:
 - ✦ The Tier 1 sites are dwindling because Lead service lines are being replaced
 - ✦ All these Sentinel homes have filters on the faucets, so they have to be taken off by the teams, then reinstalled

Recent Improvement and Progress



- Michigan's Department of Environmental Quality released results in December 2016 showing 96 percent of samples taken November from
 - Samples at 83 Tier I sites returned lead readings of 15 parts per billion or less — which is the AL for Lead.
- The DEQ reports the 90th percentile of water samples — the threshold to determine compliance — dropped to 8 parts per billion in November 2016, down from 40 parts per billion in February.
- The 90th percentile for first six months of 2017 is 7 parts per billion
 - Flint is now back to Lead levels that compare with other older cities of its size

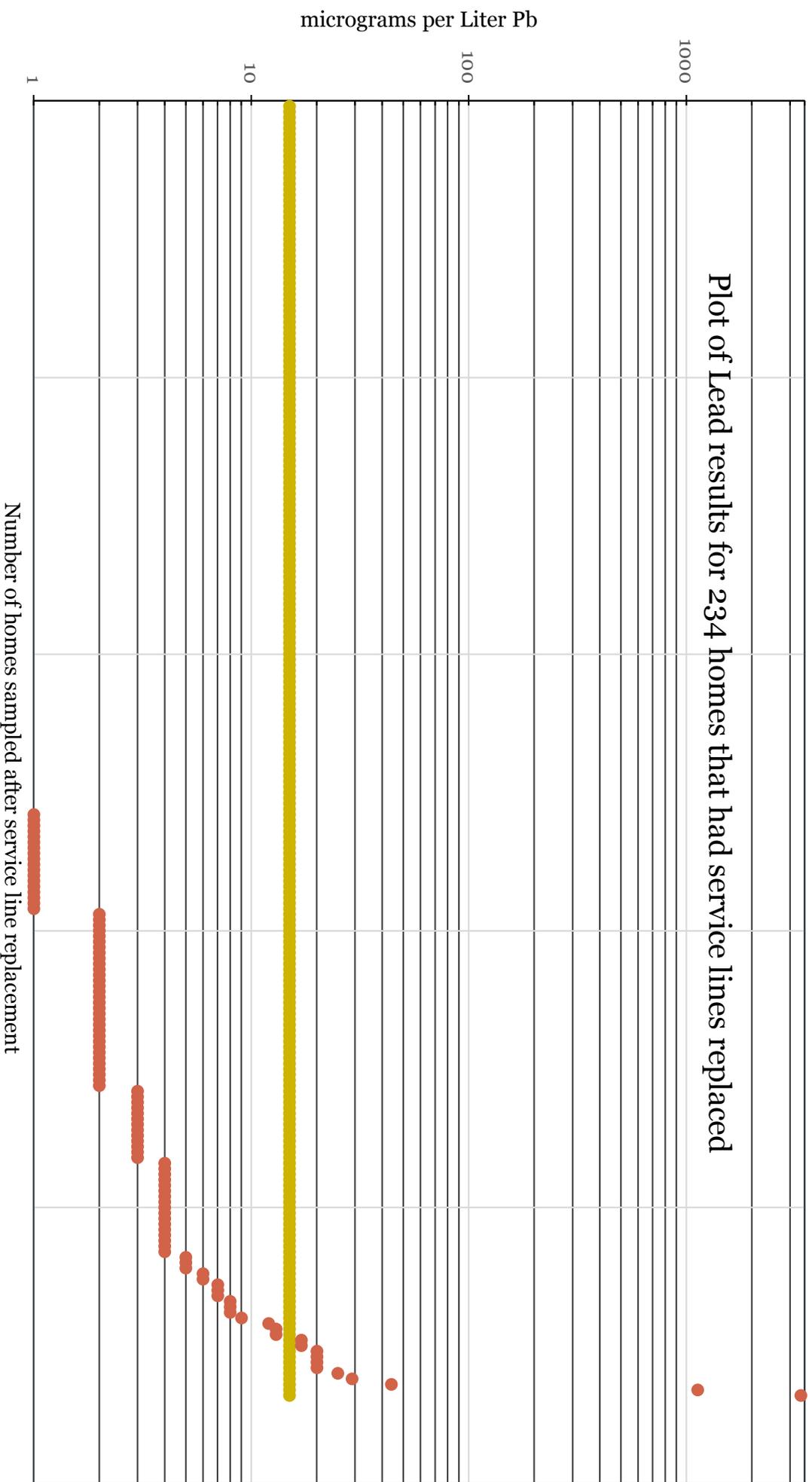
Sampling for 1st Half 2017



- Lead and Copper Report for the period January 1st to June 30th, 2017
 - 383 Tier 1 samples were taken from the original Sentinel sites
 - ✦ 1 Liter samples taken
 - 383 X 10% allowable level means that 38 samples can be over 15, but not 39
 - 21 sites showed Lead values above the action level of 15 ug/L
 - The 90thtile worked out to be 7 ug/L, so they are good for this round

CLEAR Test Results (after Pb line replacement)

234 sites sampled after service line replacement – 11 of them were over the AL of 15



School drinking fountain tests



- The City schools were tested, each with many drinking fountains and sinks
 - Samples are drawn for the first 125 mLs, and then the next 125 mLs
 - The fountain is then flushed for 30 seconds and sampled, then flushed for two minutes and sampled
 - Ten 1 Liter samples are also obtained from the service lines of the schools
- As an example, one of the schools – Pierce Elementary School – has 34 faucets/fountains that are tested

Example Faucet Results for Pierce Elementary School



Outlet: Bubbler Fountain (01DW019)

Location: Classroom 302, southwest wall

Results: P1=220 parts per billion, P2=23 parts per billion
F01=3 parts per billion, F02=2 parts per billion

These results suggest the highest contribution of lead may be from the bubbler and its connecting plumbing. This bubbler fixture is made of chrome-plated brass, with a brass operating valve, and a brass connector on the underside of the sink. Connecting plumbing in the cabinet under the sink should be checked for brass components and copper piping with lead solder.



Replacement of this bubbler tap and its connecting plumbing with lead-free materials will significantly reduce lead exposure at this location. If replacement is not currently feasible, sample results indicate that flushing this tap for three minutes following periods of stagnation is likely to reduce lead concentrations and lead exposure.

City of Flint WTP OPS



- Was ordered by USEPA to augment City of Detroit Water with an extra orthophosphate
 - Levels to be kept at 3.1 mg/L
- Was then ordered by USEPA to add additional chlorine, and caustic soda if needed
 - Extra 0.3 mg/L chlorine and keep pH at range of around 7.3 to 7.8
 - ★ Water comes in from Detroit at 7.3 or so pH
- Was ordered by USEPA to produce a treatment plan and SOPs, and to prove that Huron water can be treated in satisfactory fashion if the City chose that source

Flint WTP

current USEPA mandated chemicals
Temporary feed equipment



Phos Acid ↓

Caustic ↓



Hypo ↓

July 2016 Journal AWWA Roundtable



- Moderator Mike McGuire:
 - How in the world did this happen?
- Participants:
 - Joan Rose – “Complacency, lack of communication, lack of diagnostic testing. Failure to listen, and political pressures”
 - Janice Beecher – “At its core, the Flint Water Crisis constitutes serial regulatory failure leading to operational failure”
 - Mona Hanna-Atisha – “There are people and agencies at the county, city, state, and federal levels whose main job is to make sure the water that comes out of your tap is good and that the populations are protected and Lead levels are tracked. Everyone failed the people of Flint.”

Final Thoughts



- **Back in time to the early 1990's**
 - American Water Works Association argued against Lead service line replacement by Utilities
 - ✦ It lobbied the political establishment, stating:
 - The cost would be prohibitive to customers
 - Service line ownership is a confused jumble of rules that differ from one Utility to another – no “one size fits all”
 - The technology existed (orthophosphates) to passivate the Lead in service lines rendering them harmless
 - We now know of the dangers of interruption of phosphate feed and danger of fluctuating DIC levels, and so AWWA has changed its policy

Final thoughts



- **Nationwide, there are aggressive efforts**
 - there are law firms looking at the practices of utilities to see if there is the potential to bring a lawsuit
 - ✦ They look for clues: population concentration of low-income families, old neighborhoods likely to have Lead plumbing, Lead and Copper reports that show a pattern for several years
 - There are companies that manufacture Lead testing kits, and they are talking directly to your customers to try to get them to take samples and mail them in
 - ✦ They look for clues: CCR, source water chemistry, Lead and Copper reports that show a pattern for several years
- **Commonality? – they use the fears of the public to divide and conquer**
 - Utilities should prepare