

# FLINT WATER CRISIS: INSTITUTIONS AND INFRASTRUCTURE

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INSTITUTE OF PUBLIC UTILITIES | MSU

[ipu.msu.edu](http://ipu.msu.edu) | [beecher@msu.edu](mailto:beecher@msu.edu)

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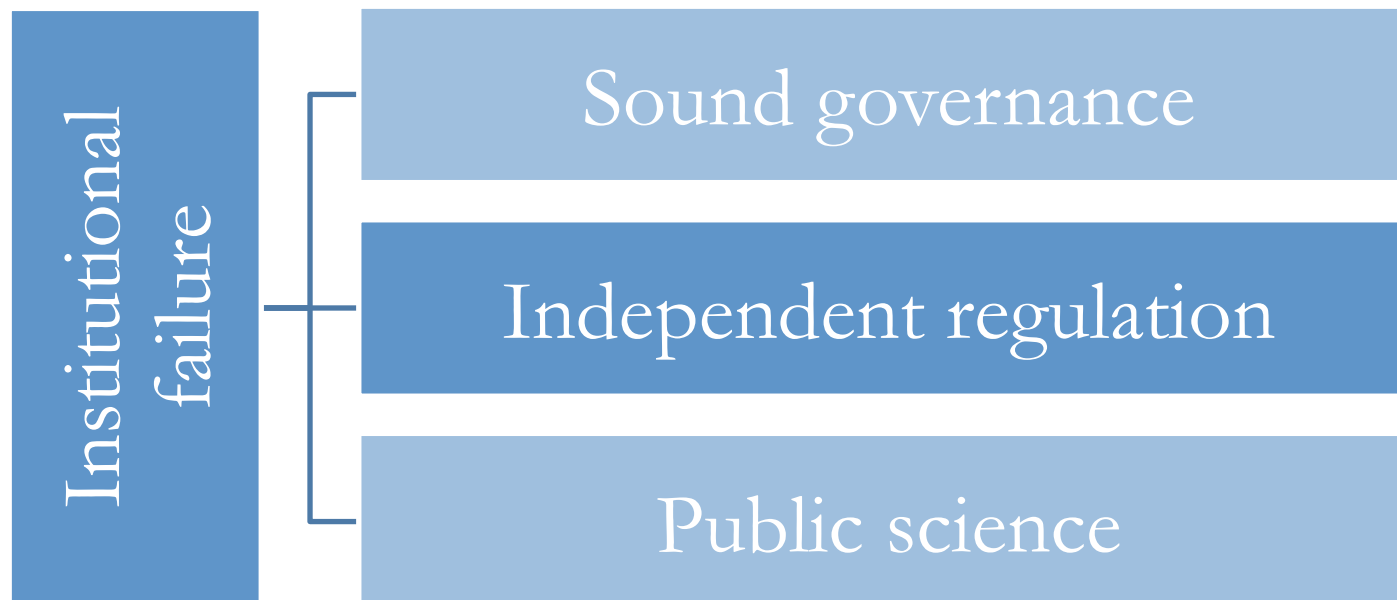
*Note: work in progress – data and analysis are preliminary*

MICHIGAN STATE UNIVERSITY

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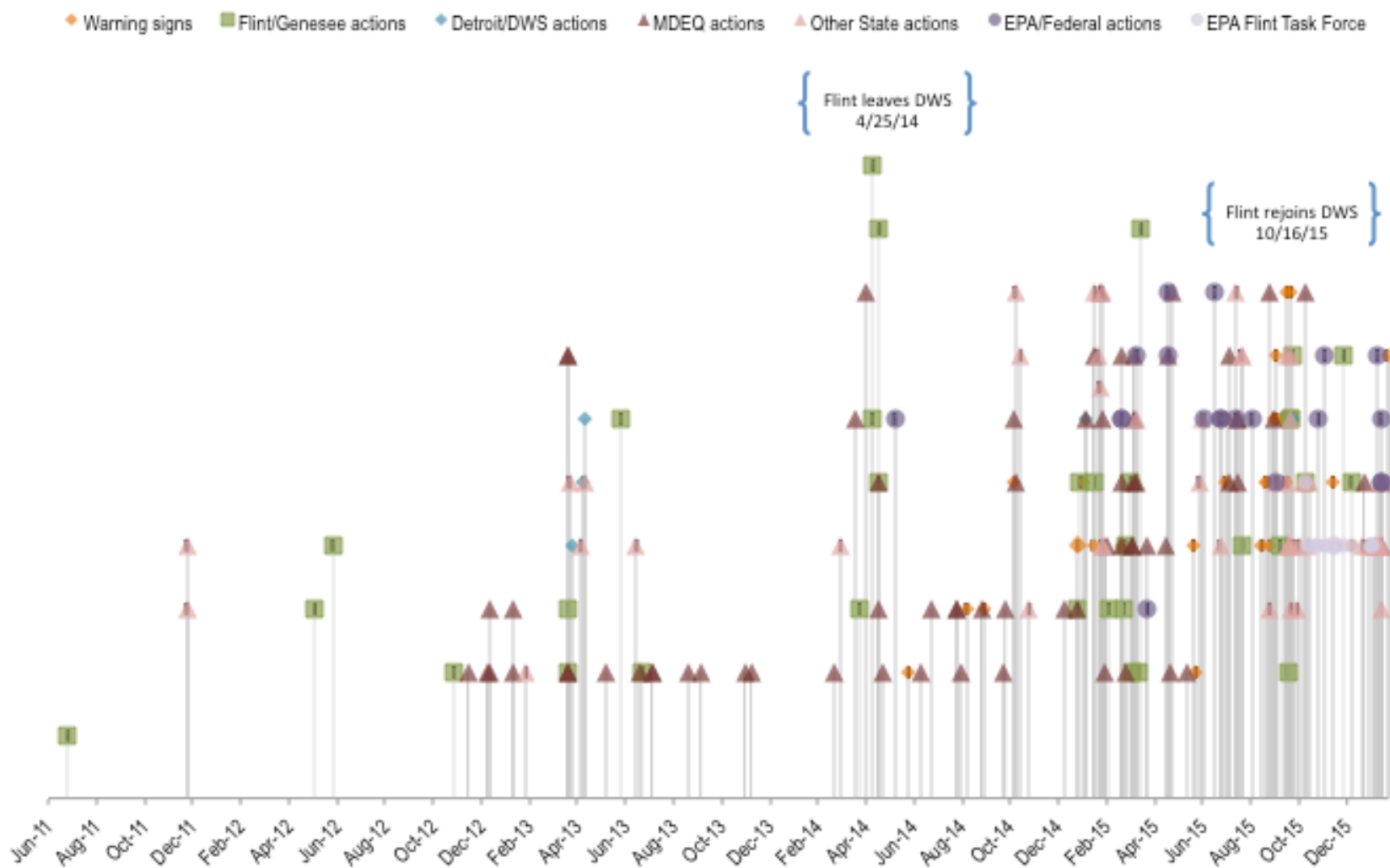
## Understanding the Flint water crisis

- Forensic policy analysis
- Reconciling policy theories
- Identifying potential solutions



# Timeline: institutional decision analysis (first cut)

## Flint water crisis timeline



# Flint as institutional failure

- Failing the letter *and the spirit of the law*
  - ▶ Implications of institutional failure
  - ▶ Beyond Michigan, Flint, and infrastructure
  - ▶ Other challenges and crises
- Policy process
  - ▶ Federalism and role clarity
  - ▶ Fiscal austerity at all levels
  - ▶ Politicization and partisanship
- Decision-making process
  - ▶ Culture and commitment
  - ▶ Information and procedures
  - ▶ Judgment and empowerment
- Regulatory process
  - ▶ Compliance
  - ▶ Enforcement
  - ▶ Response

## EPA head: 'We missed opportunities' in Flint

The Detroit News 9:52 p.m. EDT March 14, 2016



(Photo: Chip Somodevilla / Getty Images)

For the first time, the Environmental Protection Agency Chief Gina McCarthy on Monday said the

### Regulator: Michigan should have forced Flint to treat water

BY MATTHEW DALY, ASSOCIATED PRESS February 3, 2016 at 12:48 PM EDT

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officials who wouldn't add corrosion coi



The Federal Bureau of Investigation said on Tuesday it was joining a criminal investigation of lead-contaminated drinking water in Flint, Michigan, exploring whether laws were broken in a crisis that has captured international attention. Photo by Rebecca Cook/Reuters

WASHINGTON — Michigan should have required the city of Flint to treat its water for corrosion-causing elements after elevated lead levels were first discovered in the city's water a year ago, the state's top environmental regulator told Congress Wednesday.



relied on technical compliance (with the law) instead of assuring safe water," said Keith Creagh, director of the Michigan Department of Environment, Great Lakes and Energy. He called that a mistake.

[See a map that explains Flint's lead testing results](#)

is the first on Capitol Hill since the lead contamination crisis in Flint made headlines last year, and frustrated Democrats complained that the Republican-led House didn't ask the state's GOP governor to explain what happened.

## Contributing and interactive factors



# Water federalism and regulation in the U.S.

	<b>Water quality</b>	Water quantity	Water funding	Water prices
Federal	<b>Congress and EPA</b>	Court review as applicable	Congress and EPA	Judicial review
Interstate	Basin commissions	Basin commissions	<i>n/a</i>	<i>n/a</i>
States	<b>Primacy agencies (health &amp; environmental)</b>	Resource agencies	Revolving loan funds (SRF)	PUCs and/or judicial review
Substate	Management districts (varies)	Management districts (varies)	<i>n/a</i>	<i>n/a</i>
Local	<b>Local health departments</b>	Local zoning and fire officials (pressure)	Local financing (bonds)	Municipal and other local boards

# Federal water-quality legislation and goals

## Clean Water Act

Achieving “fishable and swimmable waters” through pollution control, wastewater treatment, and stormwater management



## Safe Drinking Water Act

Achieving a quality of drinking water that is as close as feasible to where there will be no known or anticipated adverse impacts on human health with an adequate margin of safety.

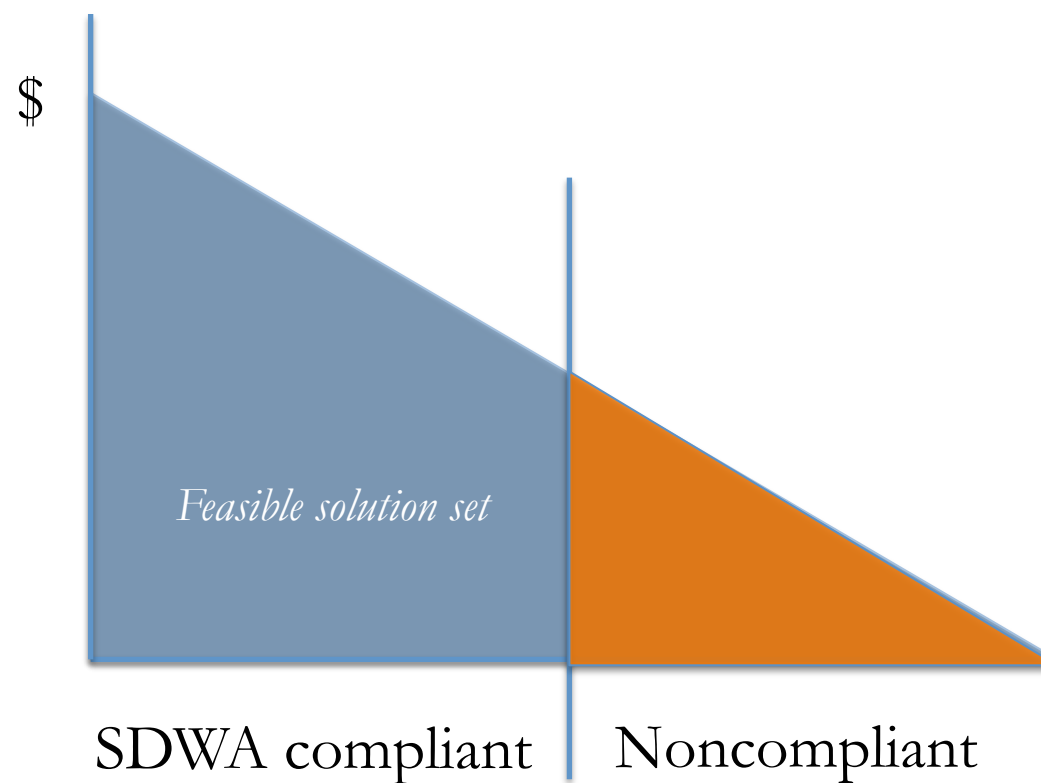
## Federal Safe Drinking Water Act (SDWA)

- SDWA is democratically established federal law (1974, 1986, 1996)
- Federal drinking water regulation reflects the “precautionary principle”
  - ▶ Equal protection under uniform preventive standards and multiple barriers to contamination informed by public-health and environmental science
  - ▶ While there is no “right” to drinking water there is an obligation to deliver compliant water
  - ▶ Compliance is not discretionary, regardless of structural or fiscal conditions
  - ▶ Variances and exemptions are narrow and uncommon (Michigan reported none in 2014)
- The goal is to achieve a level of drinking water quality as close as feasible to that at which there are **no known or anticipated adverse impacts to human health including an adequate margin of safety**



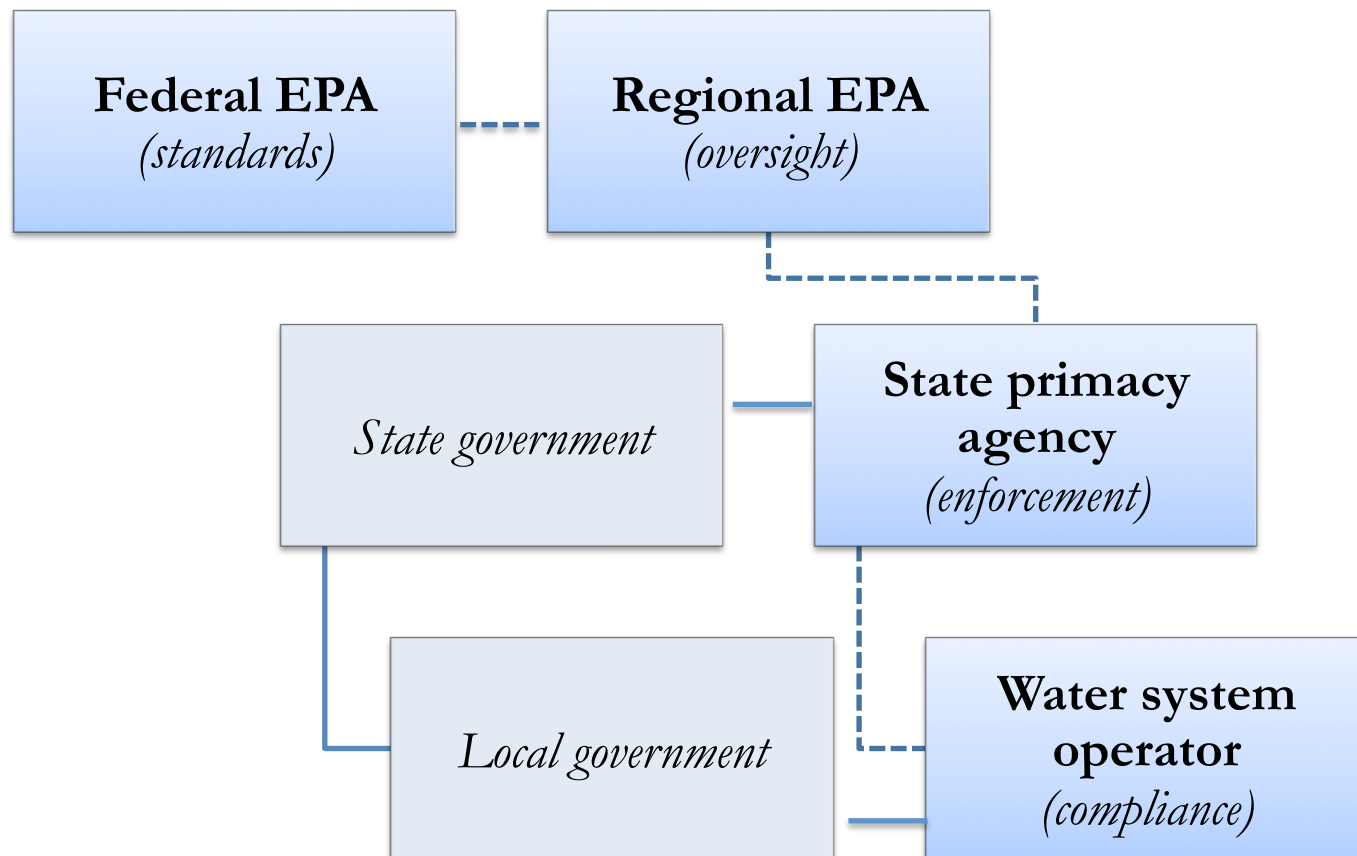


# Regulatory compliance as decision-making constraint



## Regulatory chains of command

- A culture of compliance foregoes the need for oversight and enforcement
- Weak links and denial of urgency argue for institutional reform



## Core elements of the SDWA

Microbial contaminants

Chemical, metal, and radiological contaminants

Disinfectants and disinfection byproducts

Contaminant candidate listing

Monitoring and reporting

Public information and notice

System capacity and planning

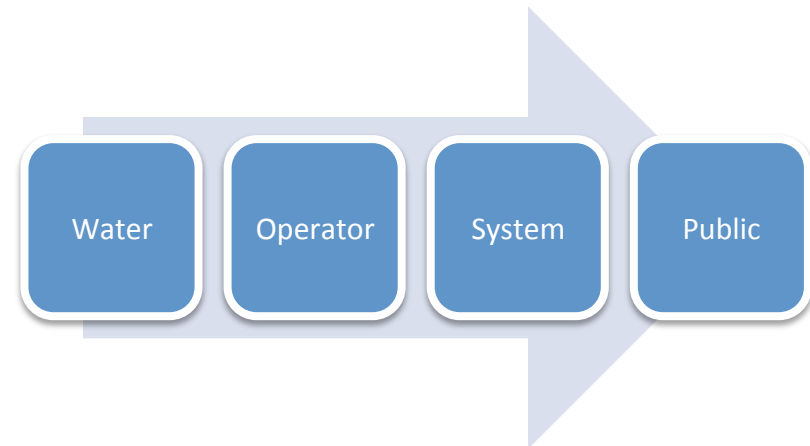
Funding (DWSRF) and incentives

Variances and exemptions

Six-year regulatory review

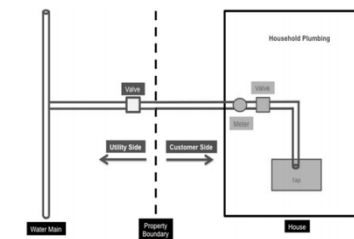
# Regulating water contaminants under the SDWA

- **Regulatory framework**
  - ▶ National Primary Drinking Water Regulation – legally enforceable standards
  - ▶ National Secondary Drinking Water Regulation – non-enforceable guidelines
  - ▶ Maximum Contaminant Level Goal (MCLG) – non-enforceable goals
  - ▶ Maximum Contaminant Level (MCL) – enforceable
  - ▶ Treatment Technique – enforceable
- **Evaluation of contaminants**
  - ▶ Adverse health effects
  - ▶ Carcinogenicity
  - ▶ Sensitive sub-populations
- **Multiple barriers to contamination**
  - ▶ Source water assessment and protection
  - ▶ Qualified water treatment operators
  - ▶ Integrity of water distribution systems
  - ▶ Informed public (notice, CCR reports)



# Lead and Copper Rule (LCR)

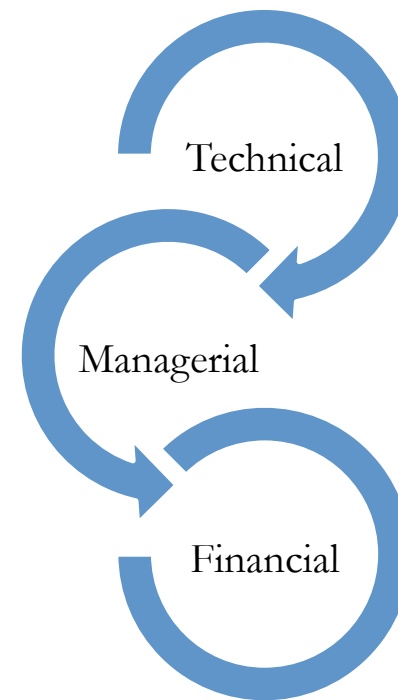
- Vexing and persistent challenge of lead
  - ▶ MCLG for lead is 0 and there is no MCL
  - ▶ Concerns about clarity of testing protocols and loopholes
  - ▶ Action level (AL) requires treatment in the form of optimized corrosion control
  - ▶ Corrosion control is well known and accepted practice
  - ▶ SRF funding can be used for lead pipe removal and replacement
  - ▶ NDWAC urged a proactive approach in December 2015
  - ▶ EPA has enhanced LCR oversight and will revise the rule in 2017
  
- Government, regulatory, and water industry responsibilities
  - ▶ Operational practices and infrastructure affect water quality
  - ▶ Remediation is complicated by service line ownership and property rights
  - ▶ Lead has not been addressed primarily due to lack of political will at all levels



Source: Adapted from Hayes 2010  
 Figure 1.1 Depiction of water main in street, household plumbing, and the service line owned by utility to the property line and the remainder owned by customer

## Capacity assurance requirements

- States must ensure that all new community and nontransient noncommunity water systems demonstrate technical, managerial and financial capacity for compliance prior to start-up
- States must develop and implement a strategy to assist existing public water systems in acquiring and maintaining technical, managerial, and financial capacity, including
  - ▶ Methods or criteria to identify systems and prioritize need
  - ▶ Factors that encourage or impede capacity development
  - ▶ Authority and resources to:
    - Provide assistance for compliance
    - Encourage partnerships
    - Promote training and certification



# Capacity development for existing systems

- Michigan strategy
  - ▶ Reactive based on noncompliance
  - ▶ Noncompliance triggers financial assessment
  - ▶ Systems must accept assistance
  
- Enhancing capacity development
  - ▶ Proactive engagement with communities
  - ▶ Fiscally distressed list on a watch list
  - ▶ Support for sustainable infrastructure

Michigan Department of Environmental Quality  
Drinking Water and Radiological Protection Division

## CAPACITY DEVELOPMENT STRATEGY FOR EXISTING PUBLIC WATER SYSTEMS

August 1, 2000

**Michigan's Decision Model**

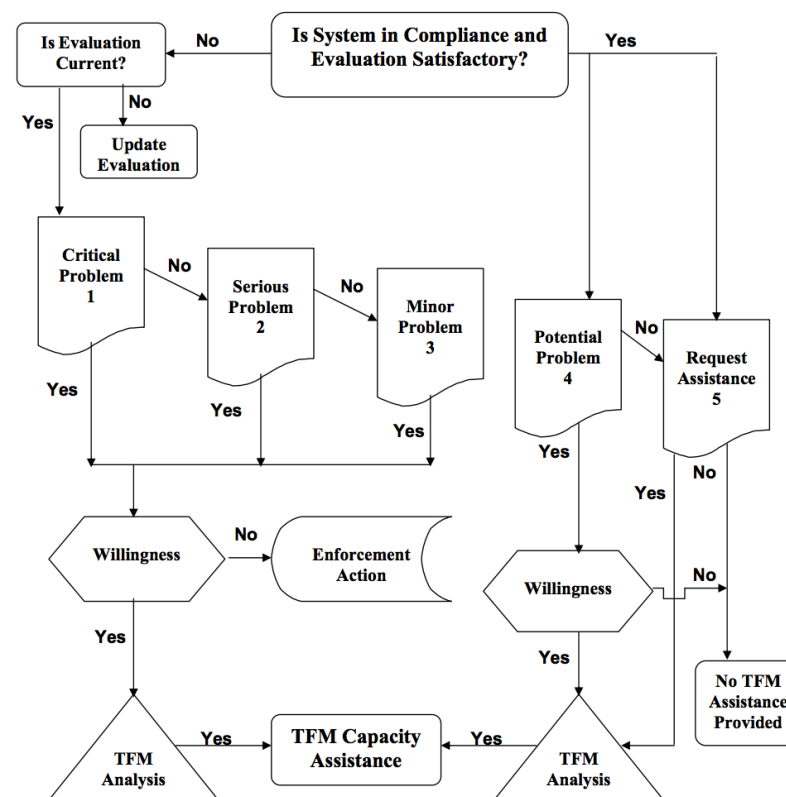
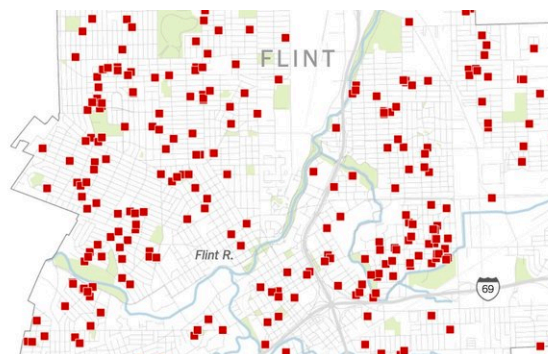
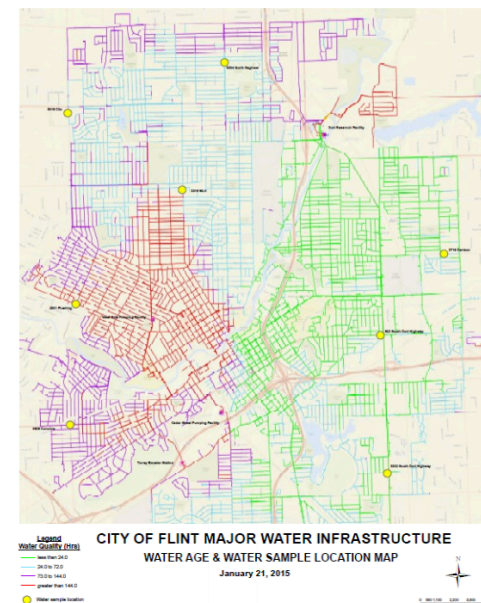


Figure 1

# Technical issues in Flint

- Qualifications and experience of internal staff
- Testing and monitoring protocols
- Complex treatment challenge
- Need for corrosion control study
- Consulting studies and reports
- Application of accepted practices
- Professional support networks (AWWA)

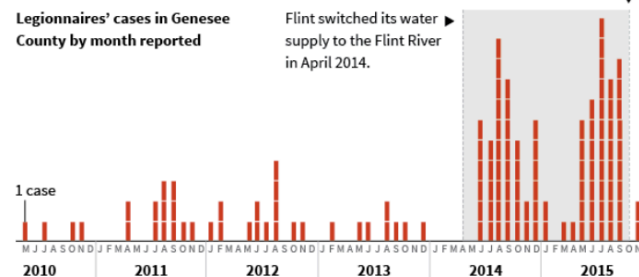


No official link has yet been detected between the city's water supply switching to the Flint River and the uptick in cases, but dozens have been sickened since April 2014.

City's water supply was switched back to Lake Huron.

Legionnaires' cases in Genesee County by month reported

Flint switched its water supply to the Flint River in April 2014.

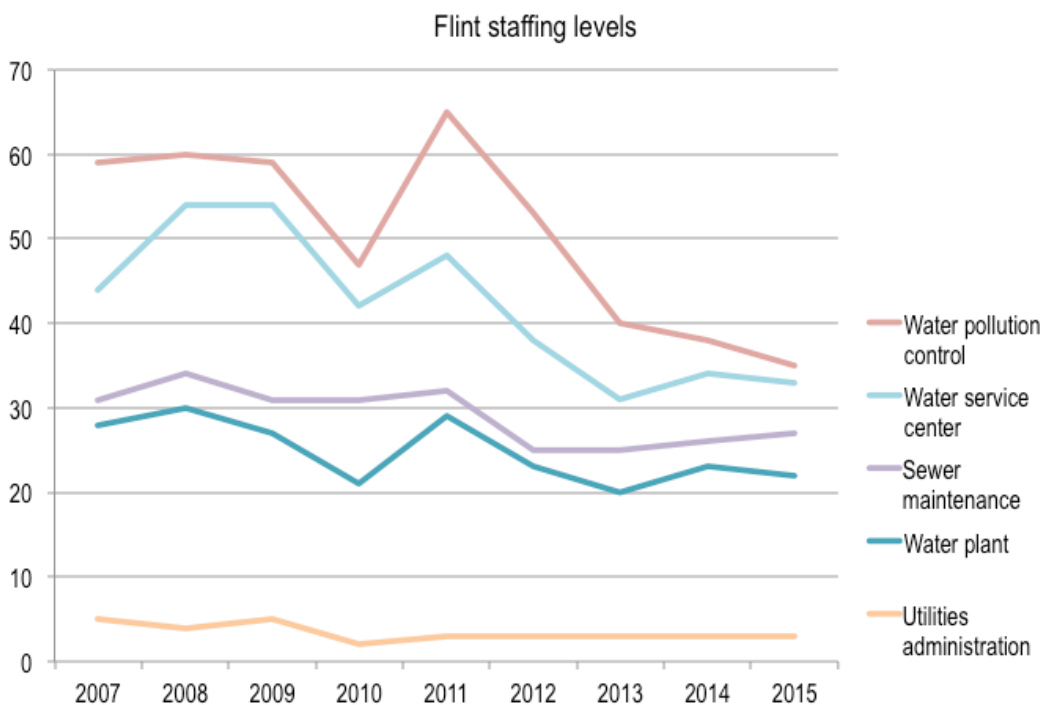


Note: Monthly case values are approximated for May/June 2015 and August/September 2015.

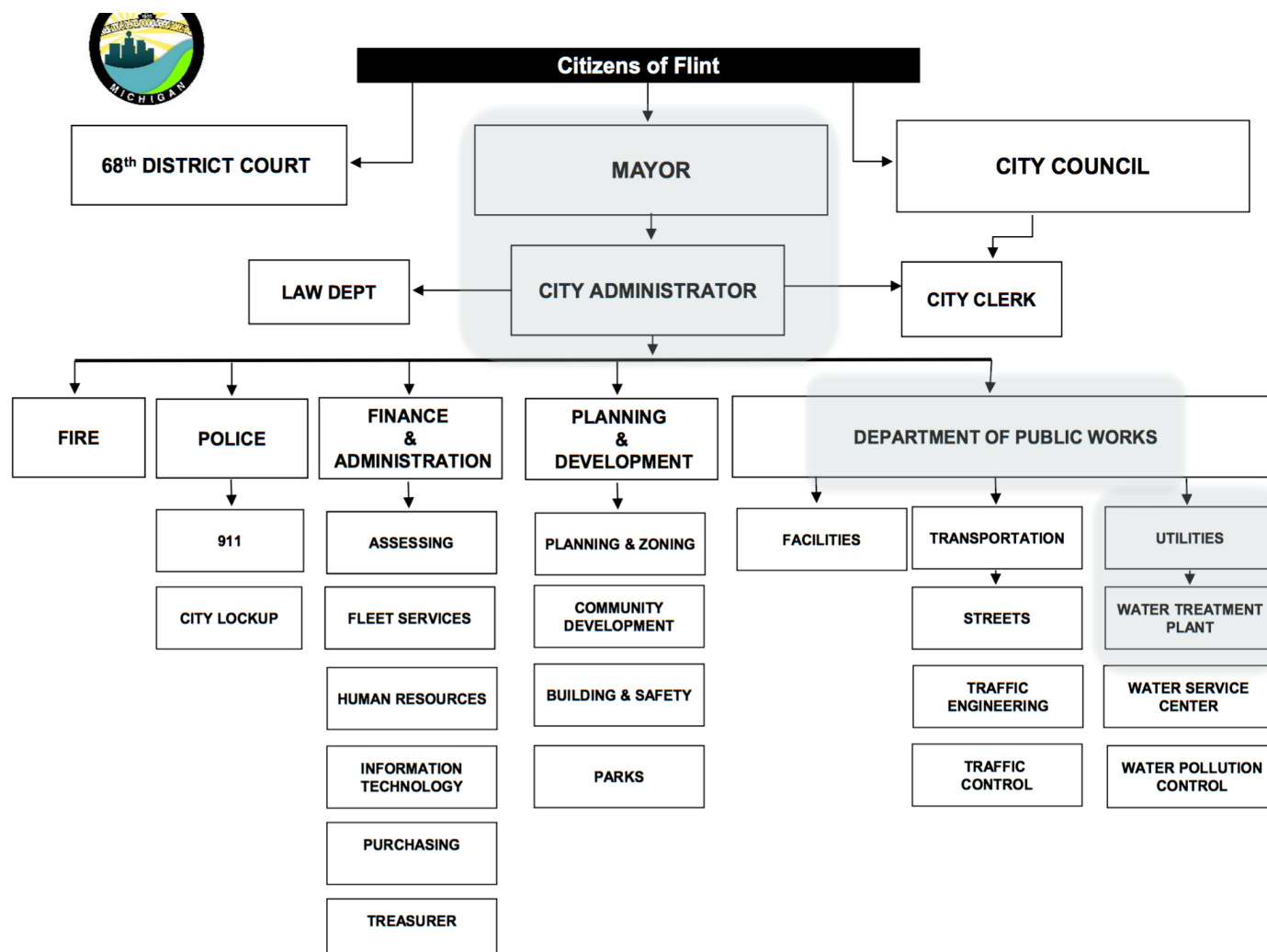


## Managerial issues in Flint

- Professional staffing levels
- Operator certification and experience
- Empowerment to act

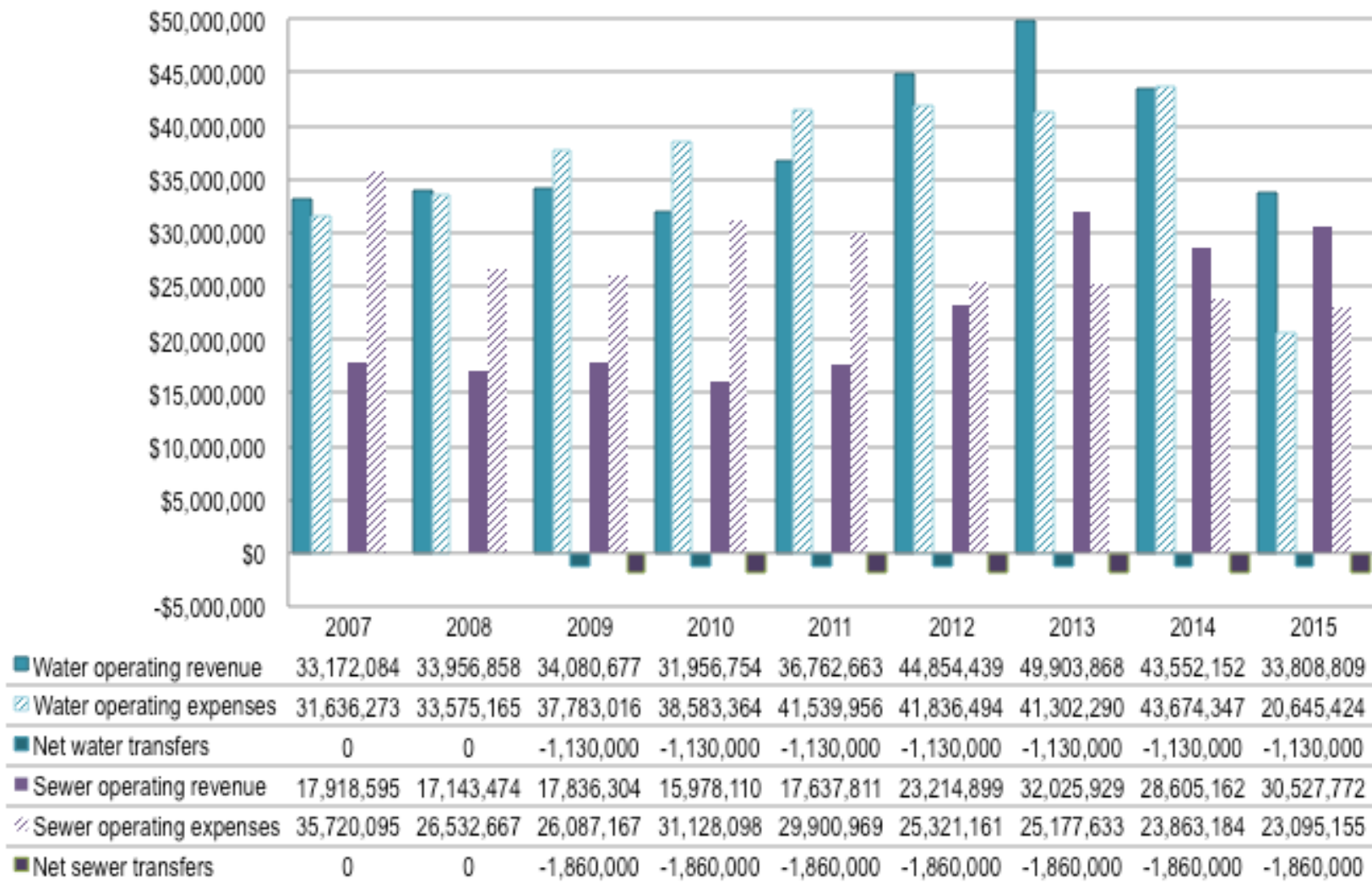


# Flint organizational chart



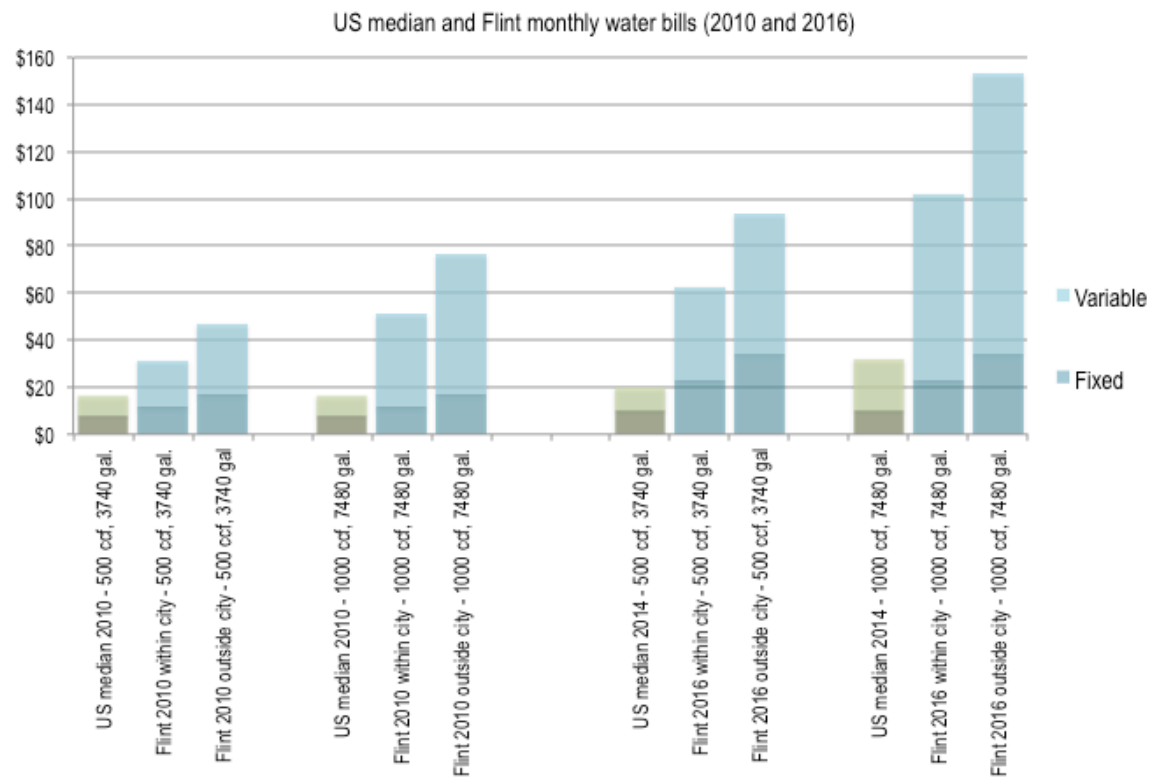
# Financial issues in Flint

Flint water and sewer finances



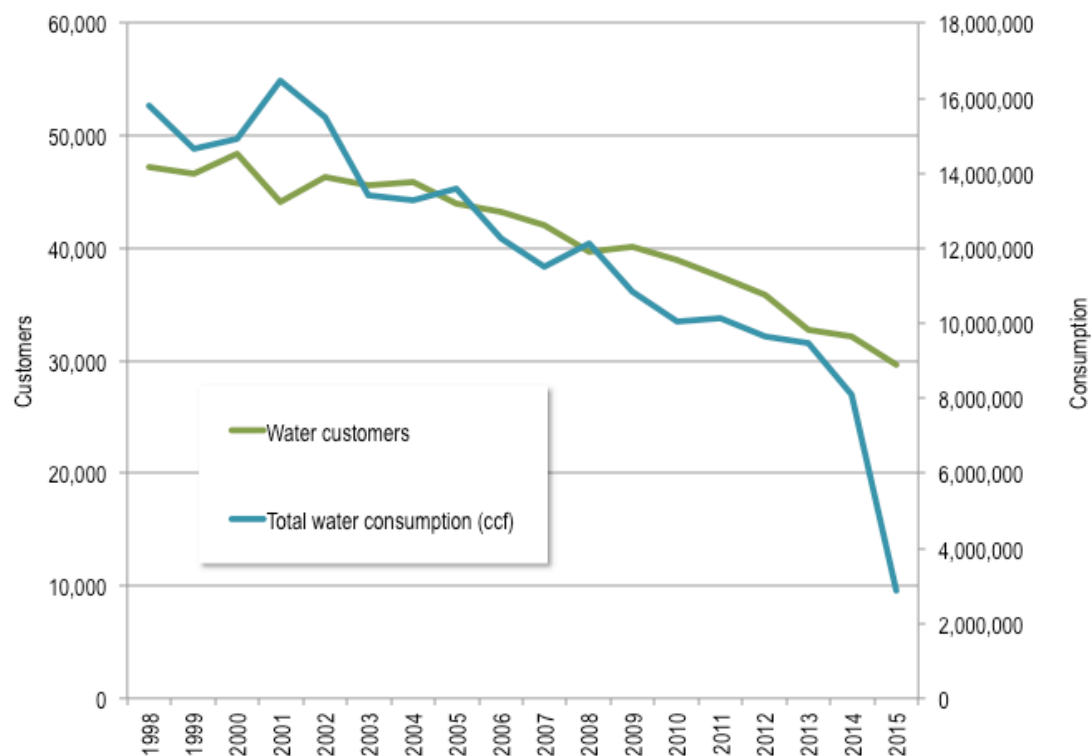
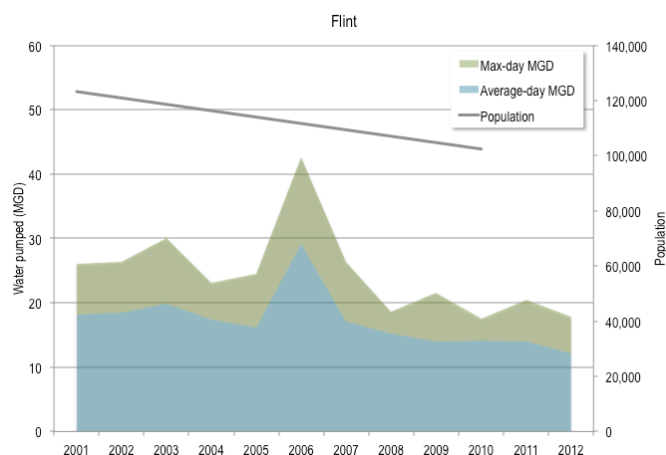
# Flint water rates

- All utility rates have regressive impacts and affordability must be addressed
- Rates should not be used as a taxing mechanism
- Financial and rate reforms are needed

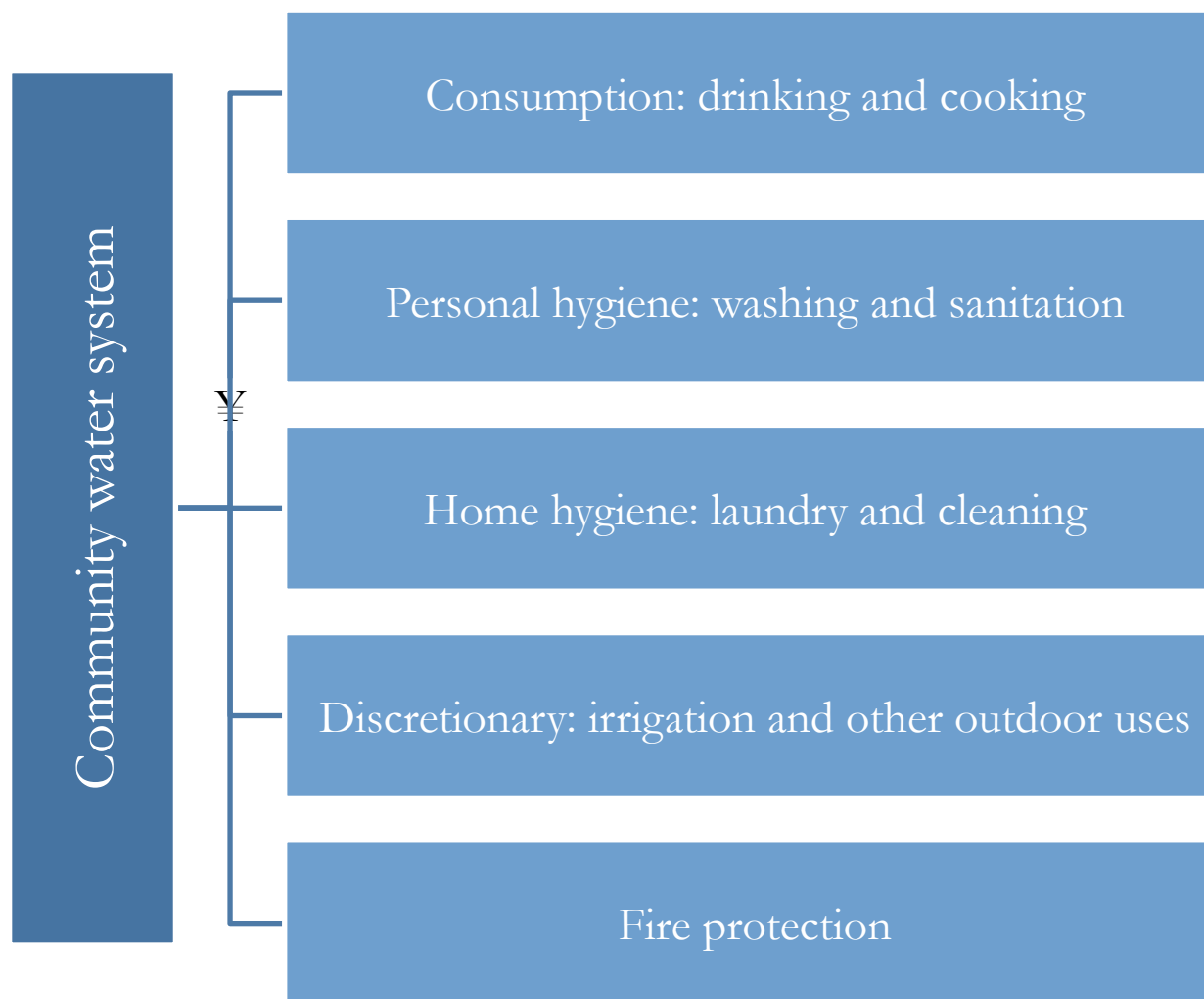


# Flint customers and consumption

- Water usage is declining everywhere due to efficiency
- Legacy cities have also lost economic activity and population
- Sales in Flint have plummeted – state is providing \$30 mil. in bill relief
- Flint appears to have favorable capacity factors (demographics and price)

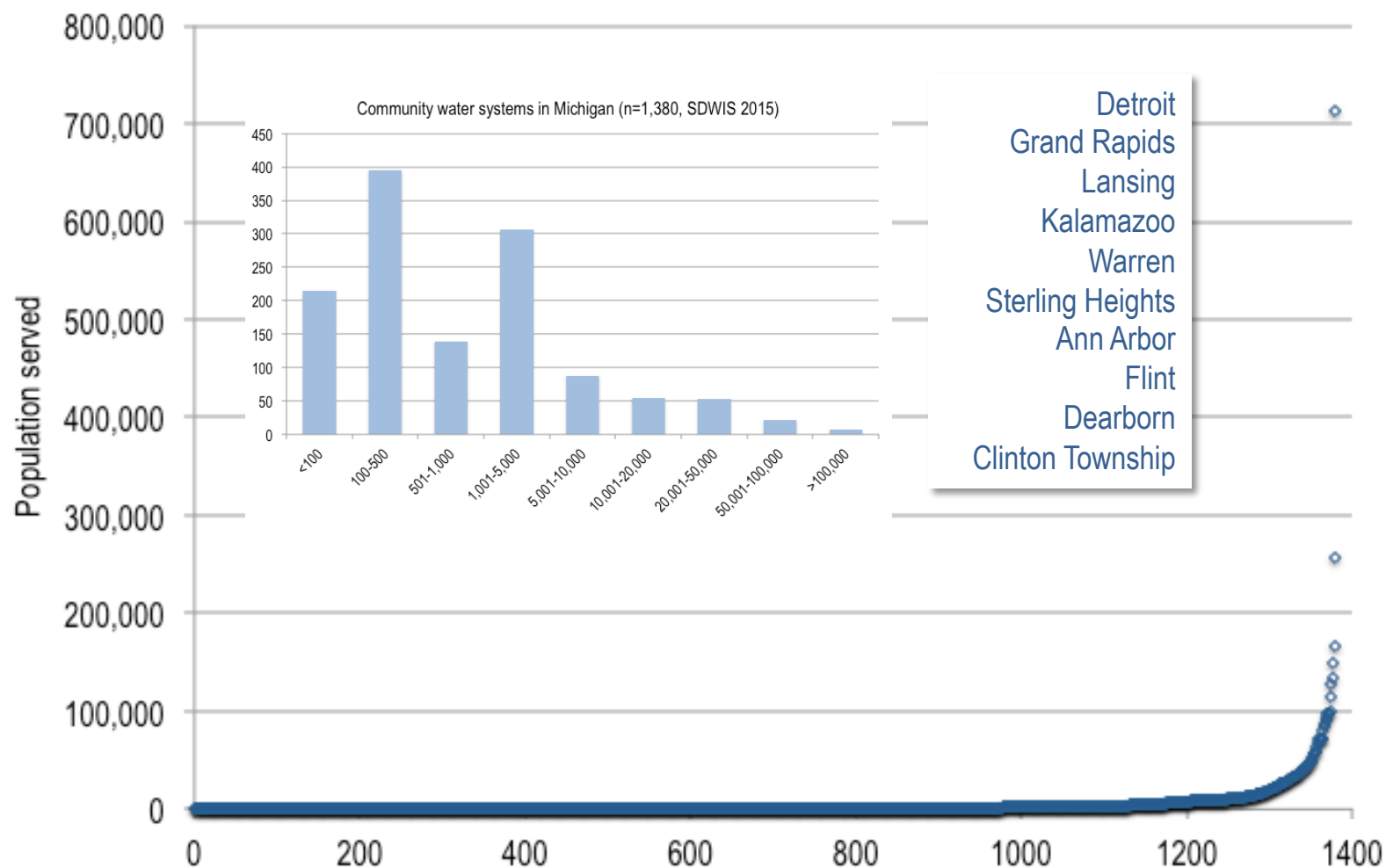


## Water systems: five products, one set of pipes



# Community water systems in Michigan

Community water systems in Michigan (n=1,380, SDWIS 2015)



# Water infrastructure needs

- Invisible water infrastructure is aging
  - ▶ Loss of both water and energy
  - ▶ Main breaks also jeopardize quality
- Michigan's 20-year water infrastructure need (EPA, 2011)
  - ▶ A state with significant needs
  - ▶ \$13.8 billion total
  - ▶ \$9.5 billion in transmission and distribution

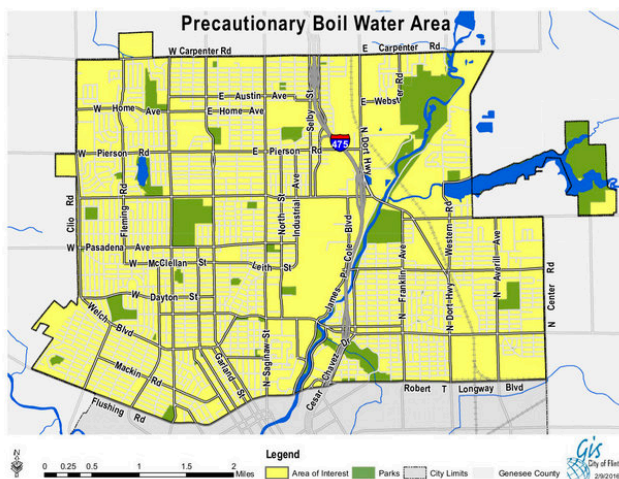
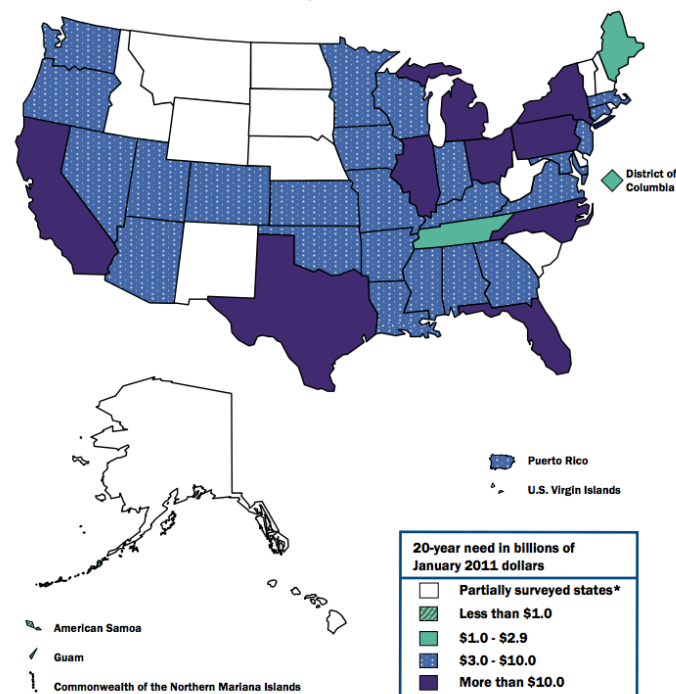


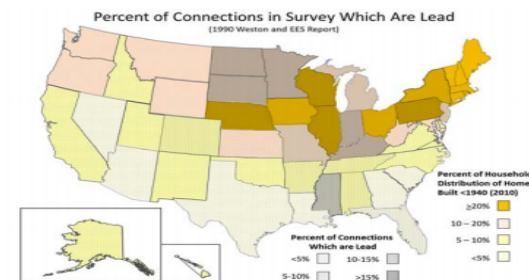
Exhibit 2.3: Overview of 20-Year Need by State





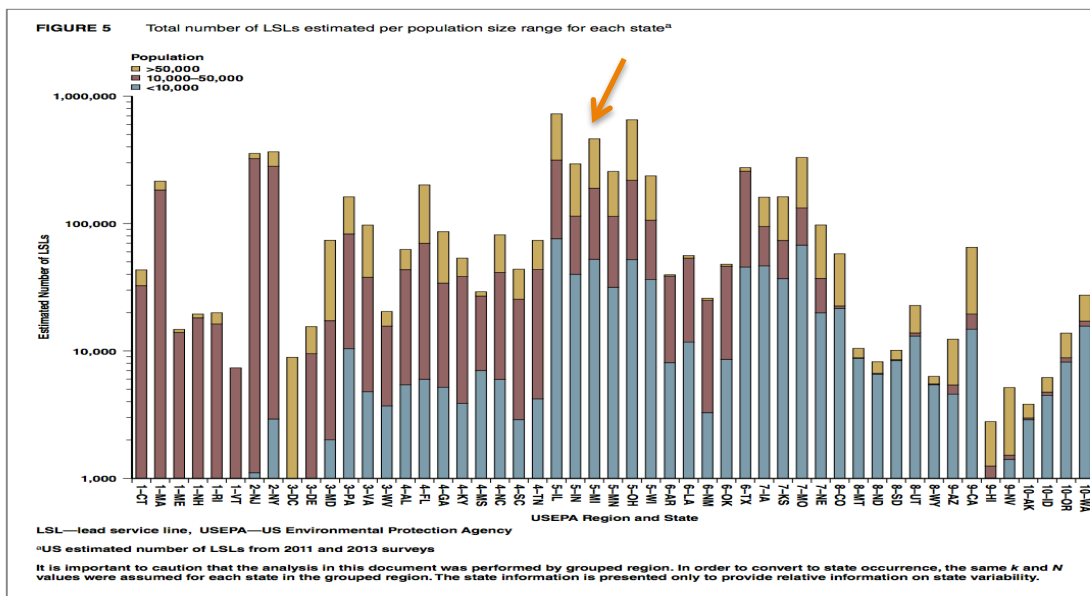
# Financing lead service-line replacement

- Environmental remediation funds (“superfund”)
- Federal or state tax credits
- City or utility financed with low-cost loans
- Customers on their own or shared
- Transfer ownership to utility (ratepayers)
- Finance and recover in utility revenue requirements



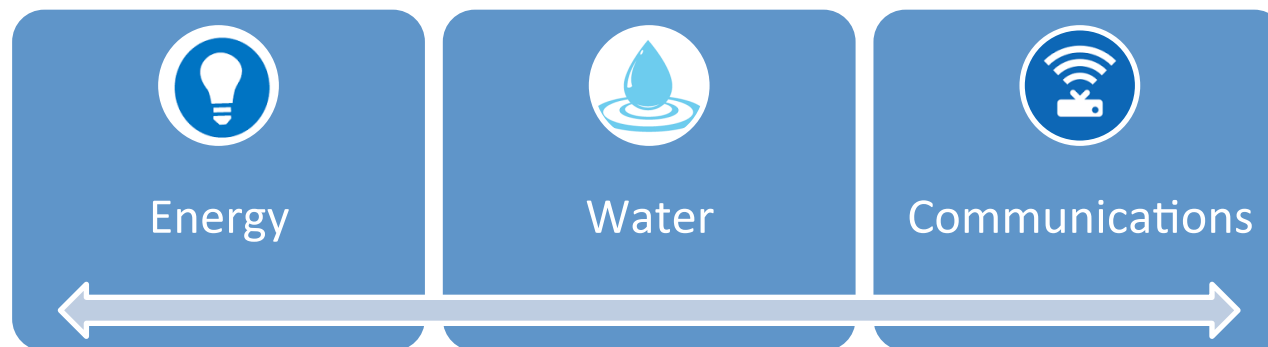
Source: Weston and EES 1990

Figure 3.1 Age of building and proportion of LSLs by state



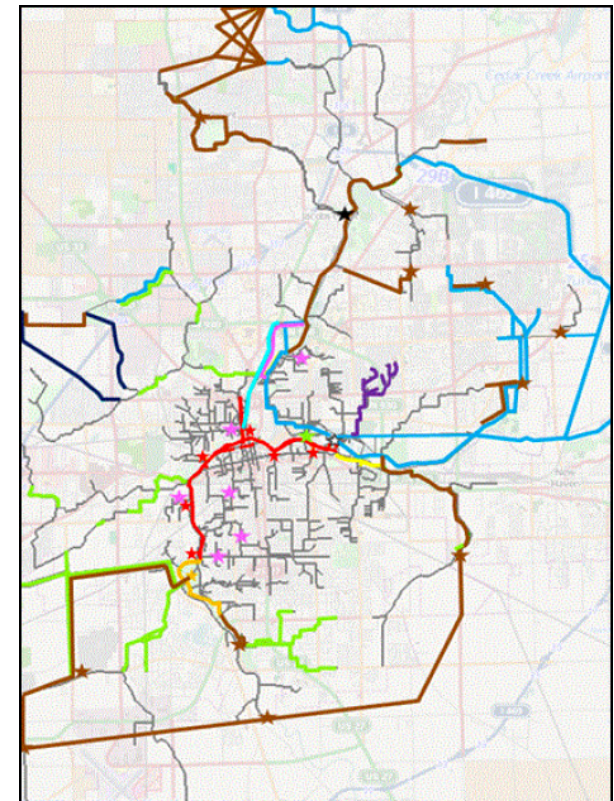
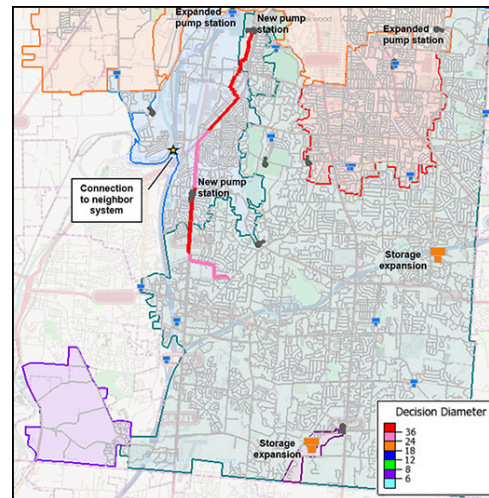
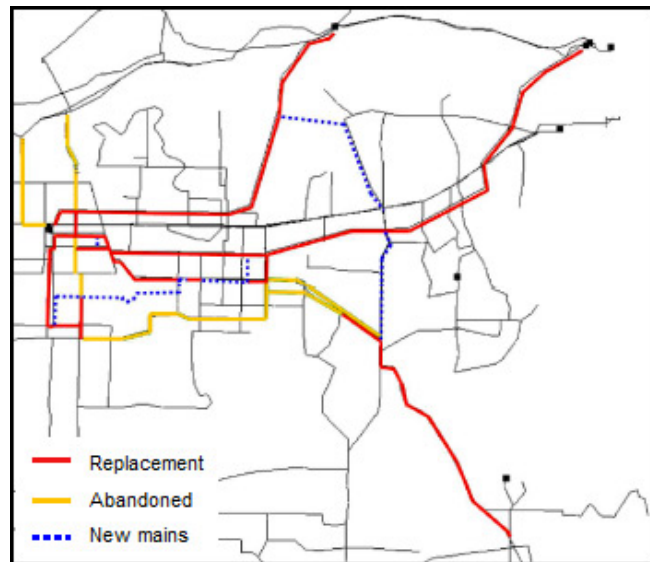
# Flint forward: building tomorrow's infrastructure

- Sustainable infrastructure supports healthy and prosperous communities
  - ▶ Recognize that infrastructure supply and demand are dynamic
  - ▶ Don't build tomorrow's infrastructure for yesterday's demand
  - ▶ Place a priority on public health and welfare
- Strategies
  - ▶ Optimize systems in the course of infrastructure renovation
  - ▶ Leverage investment resources across infrastructure types
  - ▶ Modernize the infrastructure with available technologies
  - ▶ Integrate infrastructure planning and projects
  - ▶ Coordinate infrastructure oversight across agencies



# Infrastructure optimization

- Engineering as both problem and solution
  - ▶ Impulse to replace everything in kind (pipe for pipe)
  - ▶ Need for prudent investment (possibly economic regulation)
  - ▶ Genetic algorithm optimization models



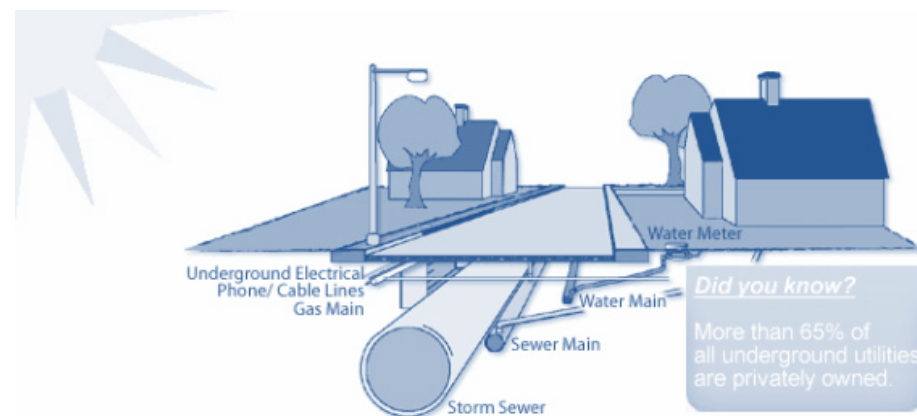
# Sustainable water systems

- Sustainable systems live within ecological, economic, and equity tolerances
- Optimal service level is constrained by compliance with mandates and standards

Price revenues relative to expenditures	Expenditures relative to optimal compliant service level		
	< 1 expenditures are below optimum (“cost avoidance”)	= 1 expenditures are optimal	> 1 expenditures are above optimum (“gold plating”)
< 1 price revenues are below expenditures (“price avoidance”)	Deficient system	Subsidized system	Budget-deficit system
= 1 price revenues are equal to expenditures	Underinvesting system	<b>SUSTAINABLE SYSTEM</b>	Overinvesting system
> 1 price revenues are above expenditures (“profit seeking”)	Revenue-diverting system	Surplus system	Excessive system

## Thinking about a new drinking water paradigm

- Aspire to affordable universal service
- Plan to reoptimize and modernize systems
- Provide economic fire protection
- Install advanced metering systems
- Price fire protection costs based on property size or value
- Meet basic needs as a “byproduct”
- Price outdoor usage aggressively and encourage alternatives
- Coordinate with other infrastructure providers



## Lessons learned

- Regulatory institutions are much maligned until we experience crisis
  - ▶ Flint is now the quintessential example
- Institutional failure has consequences – measured in lost security, trust, and lives
  - ▶ Our institutions are only as good as the people we entrust to serve them
  - ▶ Integrity of people and infrastructure are connected
- Institution introspection in the face of failure is a step toward justice
  - ▶ Better institutions can support better infrastructure

