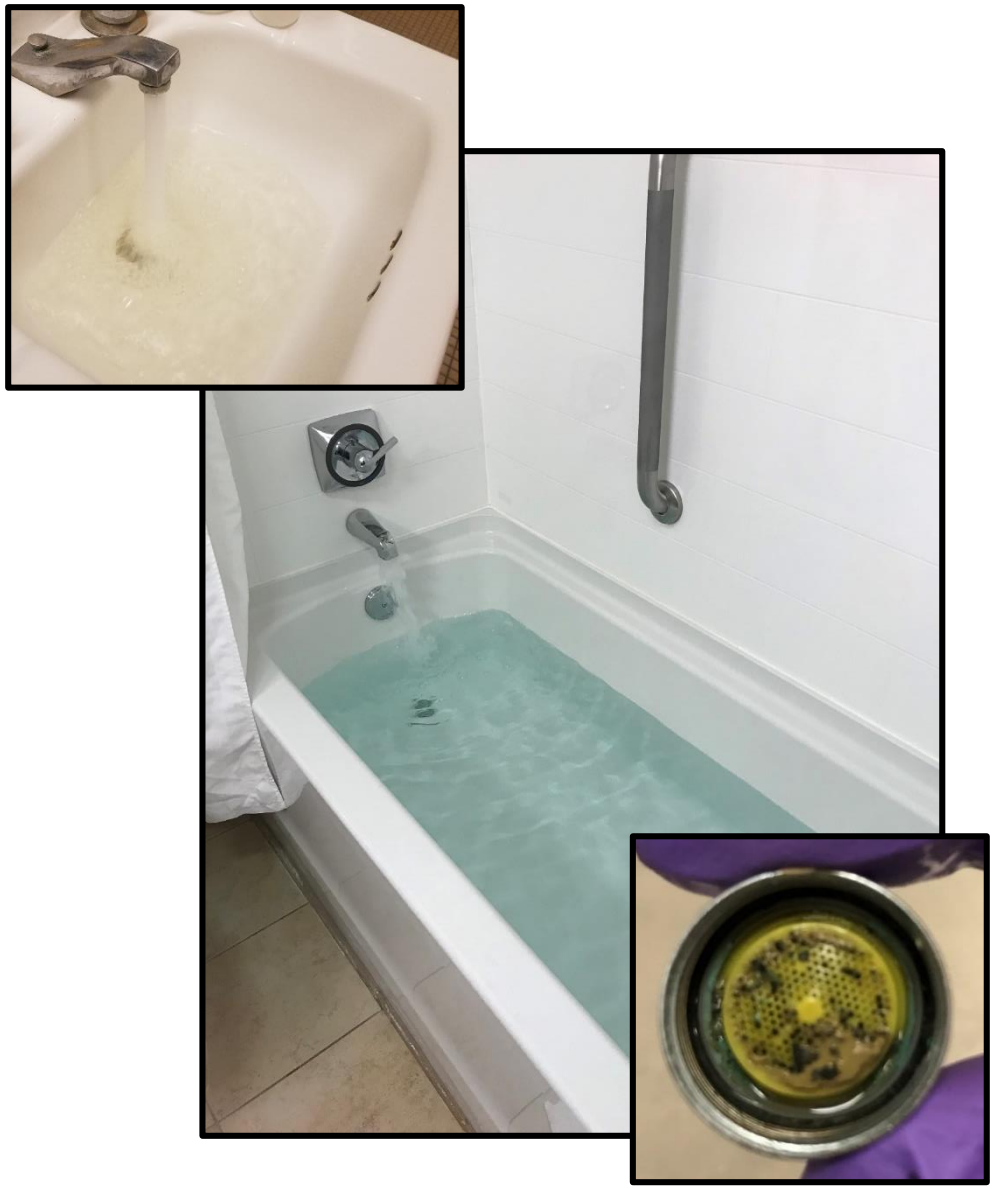


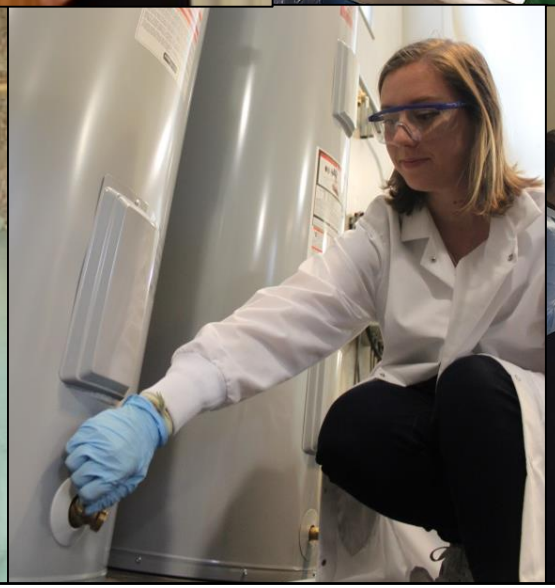
# Where Do We Go From Here?

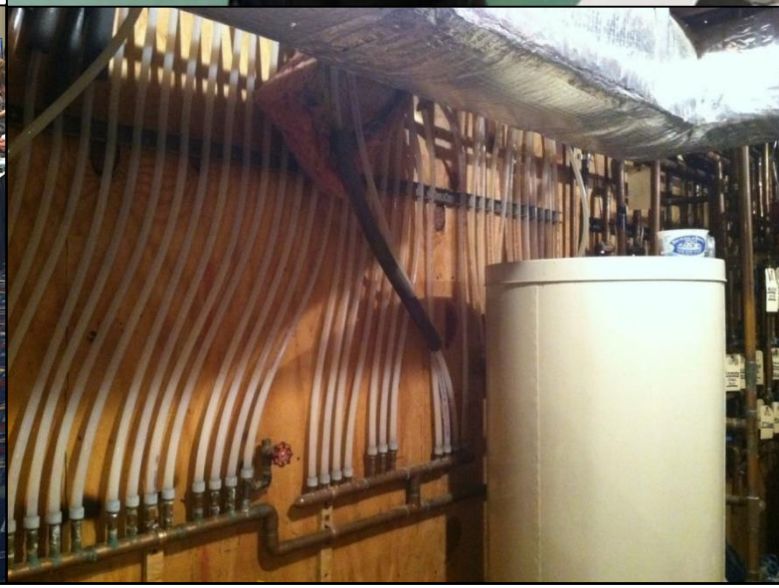
Andrew J. Whelton, Ph.D.

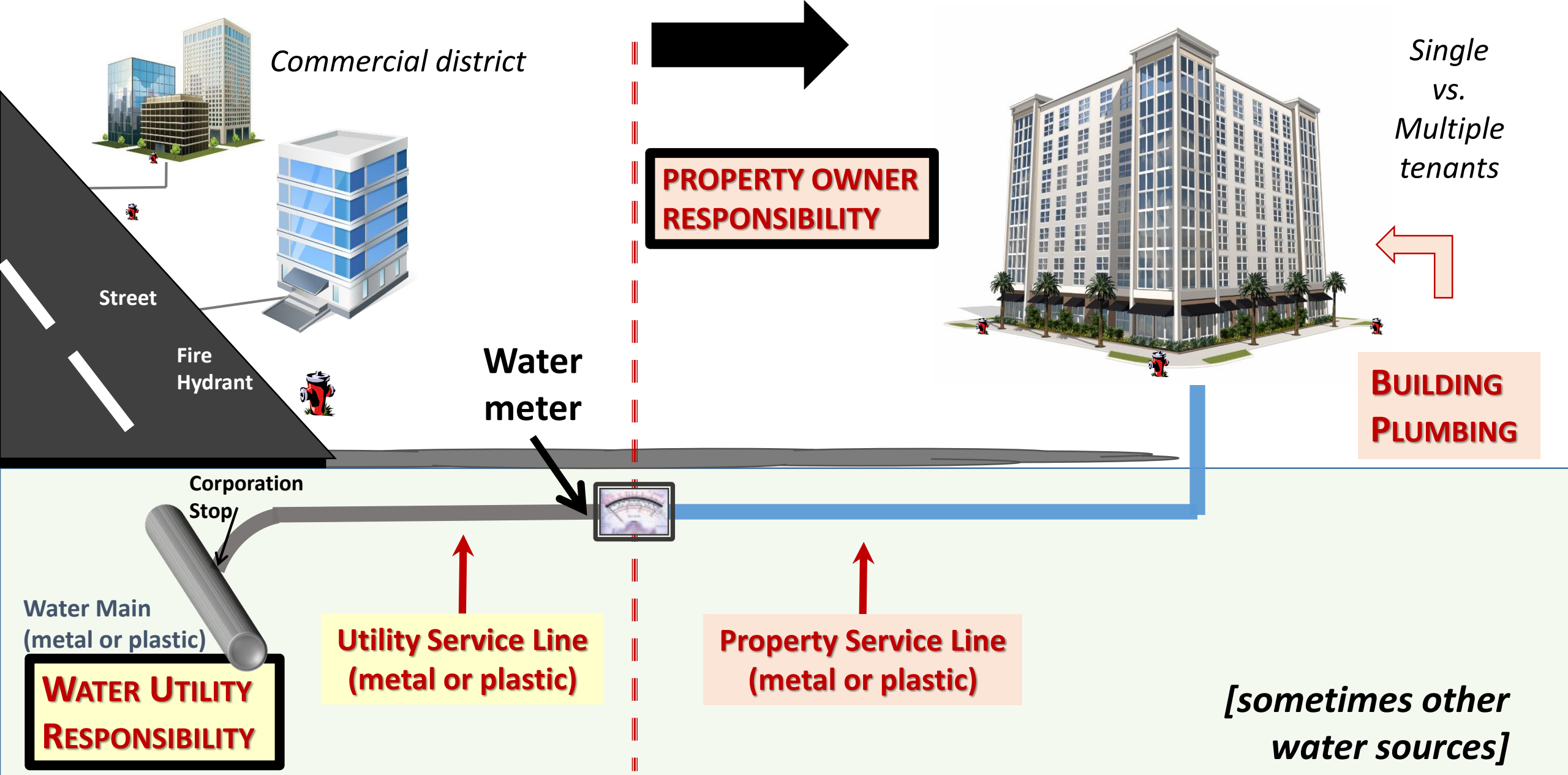
Civil, Environmental, and Ecological Engineering


THE SEAL OF THE GOVERNOR OF WEST VIRGINIA


ZONE 5






Commercial district
Single vs. Multiple tenants
PROPERTY OWNER RESPONSIBILITY
Street
Fire Hydrant
Water meter
BUILDING PLUMBING
Corporation Stop
Water Main (metal or plastic)
WATER UTILITY RESPONSIBILITY
Utility Service Line (metal or plastic)
Property Service Line (metal or plastic)
[sometimes other water sources]

# Stagnation *noun*

stag·na·tion | \ stag-ˈnā-shən

a state or condition marked by lack of flow, movement

Merriam-Webster®

When water does not flow well; areas of stagnant water encourage biofilm growth and reduce temperature and level of disinfectant

CDC
CENTERS FOR DISEASE™ CONTROL AND PREVENTION

U.S. National Science Foundation RAPID Award 2027049

# Shutdowns and Consequences - Extreme Plumbing Stagnation and Recommissioning

1. Support to the plumbing and public health sectors on building water safety guidance and decisions, ***ongoing***
2. Building water safety review due to prolonged stagnation with experts from 8 private and public sector organizations, ***ongoing***
3. Field testing to determine how impacted building water safety is in actual large buildings, ***ongoing***
4. Lab testing to determine how to fully recover contaminated building water system devices and equipment, ***planned***
5. Help transform public awareness, ***ongoing***

Helping

IAPMO

American Water Works Association

astho™

NRDC

Washington State Department of Health

ASDWA

Ohio Environmental Protection Agency

ASPE American Society of Plumbing Engineers

NEHA

SLOAN

Whirlpool Corporation

SAFE WATER ENGINEERING

# #2. Building water safety review due to prolonged stagnation with experts from 7 private and public sector organizations

## Collaborative effort


Caitlin R. Proctor, Ph.D., Purdue University

William Rhoads, Ph.D., Virginia Tech

Tim Keane, Legionella Risk Management, Inc.

Maryam Salehi, Ph.D., University of Memphis

Kerry Hamilton, Ph.D., Arizona State University

Kelsey J. Pieper, Ph.D., Northeastern University

David R. Cwiertny, Ph.D., University of Iowa

Michele Prévost, Ph.D., Polytechnique Montreal

Andrew J. Whelton, Ph.D., Purdue University

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2. Virginia Tech, Department of Civil and Environmental Engineering, 1075 Life Science Circle, Blacksburg, VA 24061, wrhoads@vt.edu, T: (417) 437-2550
3. Consulting Engineer, Legionella Risk Management, Inc., 31 Marian Circle, Chalfont, PA 18914, timke@verizon.net, T: (215) 996-1805
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8. Professor and Principal Chairholder, NSERC Industrial Chair on Drinking Water, Civil, Geological and Mining Engineering, Polytechnique Montreal, CP 6079 Succ Centre-ville, Montréal, Québec, Canada H3C 3A7, michele.prevost@polymtl.ca, T: (514) 340 4778
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* Caitlin Proctor and William Rhoads contributed equally to this work.

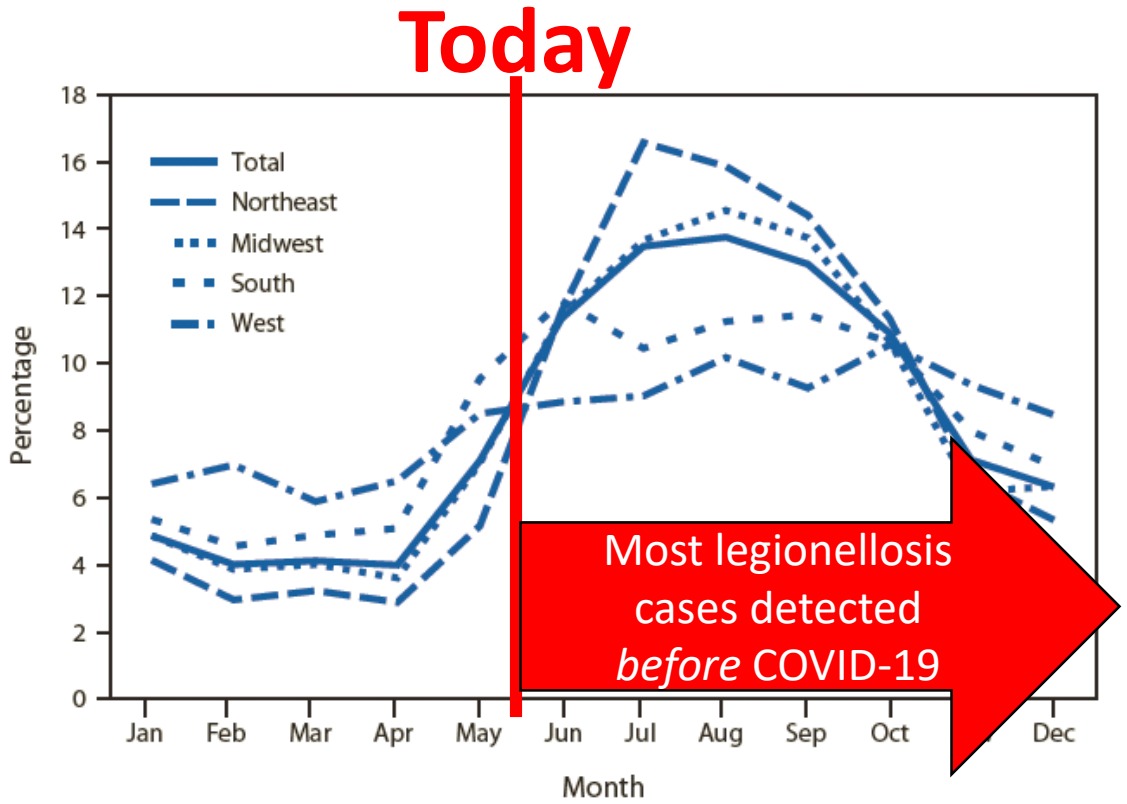
* Corresponding author: Andrew J. Whelton, awhelton@purdue.edu



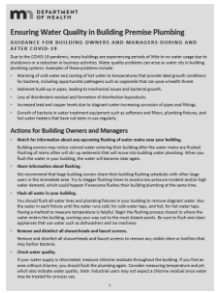

https://doi.org/10.31219/osf.io/qvj3b

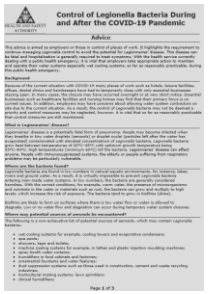
# Available information only pertains to less than 2 weeks of stagnation or low water use

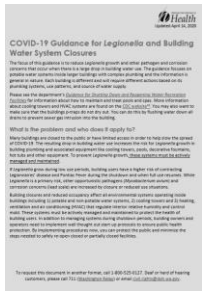
- **Copper** can leach
  - Nausea, vomiting, diarrhea, abdominal cramps
- **Lead** can leach
  - Nausea, vomiting, diarrhea, abdominal cramps, longer-term developmental issues with children
- **Scale** can be suspended
- **Harmful organisms** (e.g., *Legionella pneumophila* and other opportunistic pathogens) can grow - better
  - Many organisms cause respiratory illness, and other infections can occur

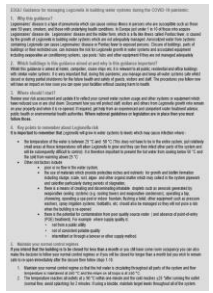



*Exposure Routes of Concern: Ingestion, Dermal, Inhalation*

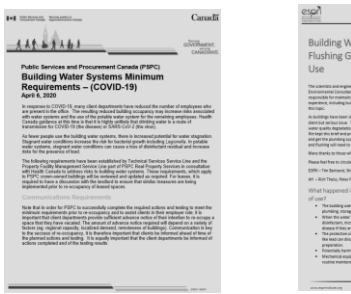

Ensuring Water Quality in Building Premise Plumbing

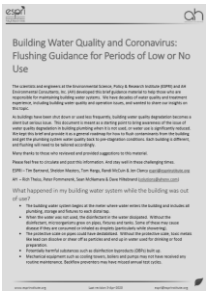

Control of Legionella Bacteria During and After the COVID-19 Pandemic

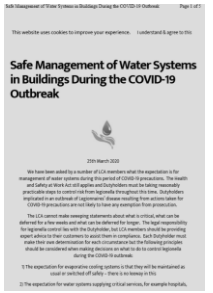

COVID-19 Guidance for Legionella and Building Water System Closures

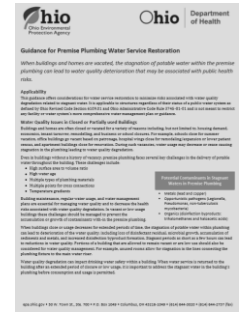


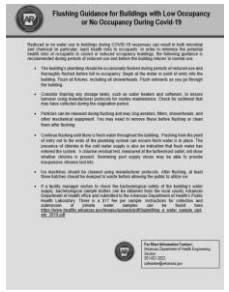

Public Health England


Public Services and Procurement Canada (PSPC)
Building Water Systems Minimum Requirements – (COVID-19)

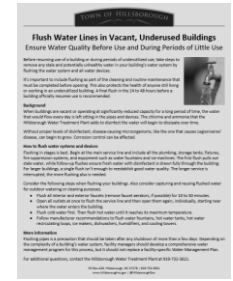


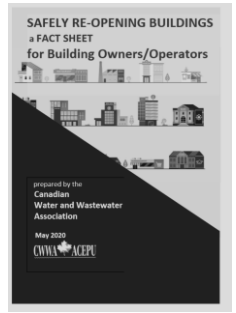

Safe Management of Water Systems in Buildings During the COVID-19 Outbreak


Ohio Department of Health
Guidance for Premise Plumbing Water Service Restoration

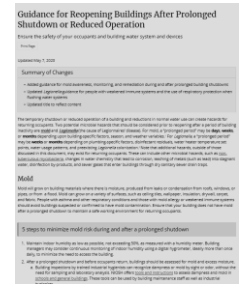

Flushing Guidance for Buildings with Low Occupancy or No Occupancy During Covid-19

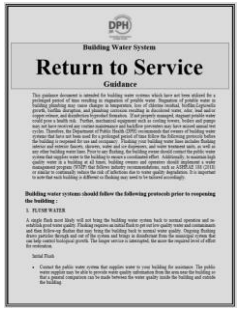
Since March 2020, there have been more than ***45+*** guidance documents telling building owners what they could do to prevent and deal with stagnation situations.


Flush Water Lines in Vacant, Underused Buildings
Ensure Water Quality Before Use and During Periods of Little Use


SAFELY RE-OPENING BUILDINGS
a FACT SHEET
for Building Owners/Operators
prepared by the Canadian Water and Wastewater Association
May 2020

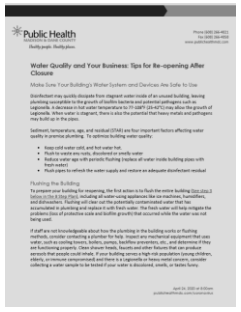
Many differ quite dramatically. Some lack key info (safety, devices, sensitive populations, etc.).

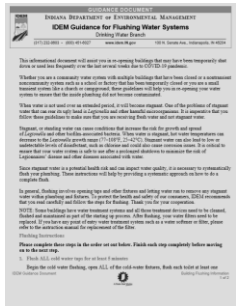

Guidance for Reopening Buildings After Prolonged Shutdown or Reduced Operation

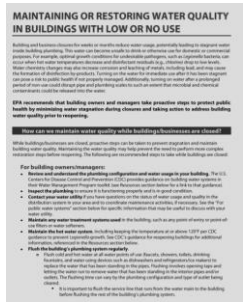

Building Water System
Return to Service
Guidance

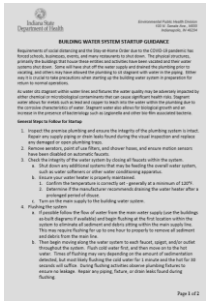

BUILDING PERFORMANCE
ENSURING THE SAFETY OF YOUR BUILDING WATER SYSTEM POST COVID-19 LOCKDOWN

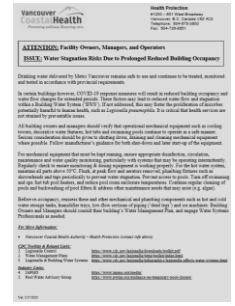

AMERICAN WATER
HAS YOUR FACILITY BEEN CLOSED FOR WEEKS? FLUSH THE PIPES.

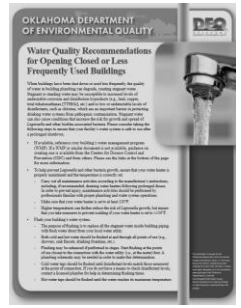

Public Health
Water Quality and Your Business: Tips for Re-opening After Closure


INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
IDEM Guidance for Flushing Water Systems
Drinking Water Branch

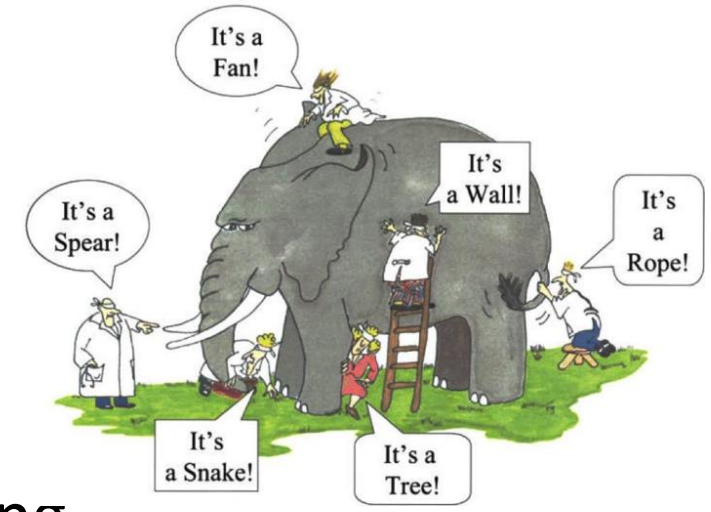

MAINTAINING OR RESTORING WATER QUALITY IN BUILDINGS WITH LOW OR NO USE




Vancouver Coastal Health
BUILDING WATER SYSTEM STARTUP GUIDANCE


OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY
Water Quality Recommendations for Opening Closed or Less Frequently Used Buildings

# Why are they so different?




- Different perspectives - *sides of the elephant*
- Guidance targeted for different readers
- Different starting info. about water safety & plumbing
- Prescriptive step-by-step documents vs. general advice
- Some are derivatives of others, and others…and others!
- Some have been revised (version 3 since March 2020)
- Media, water utilities, and associations issuing very brief messages

***Awareness vs. Informational vs. Warnings vs. Actions***

# How will we know if by following guidance documents we *avoid or cause* waterborne illness?

## Water Supplier

- Review water meter records
- Relentlessly educate customers
- Temporarily expand disinfectant residual testing and flushing
- Temporarily increase disinfectant level

## Health Department

- Relentlessly educate building owners
- Temporarily require water use and action reporting to maintain cert. of occupancy
- Directly advise building owners
- Pay attention to sensitive populations
- Notify laboratories about water testing

## Building Owner (may or may not know water)

- Contact the health department (EH) for guidance
- Contact the water supplier about the incoming water
- Keep water fresh, clean plumbing, don’t allow prolonged stagnation
- Test temperature and disinfectant levels
- Create and maintain water use, flushing, and testing records
- Contact external experts for help

# Conclusions

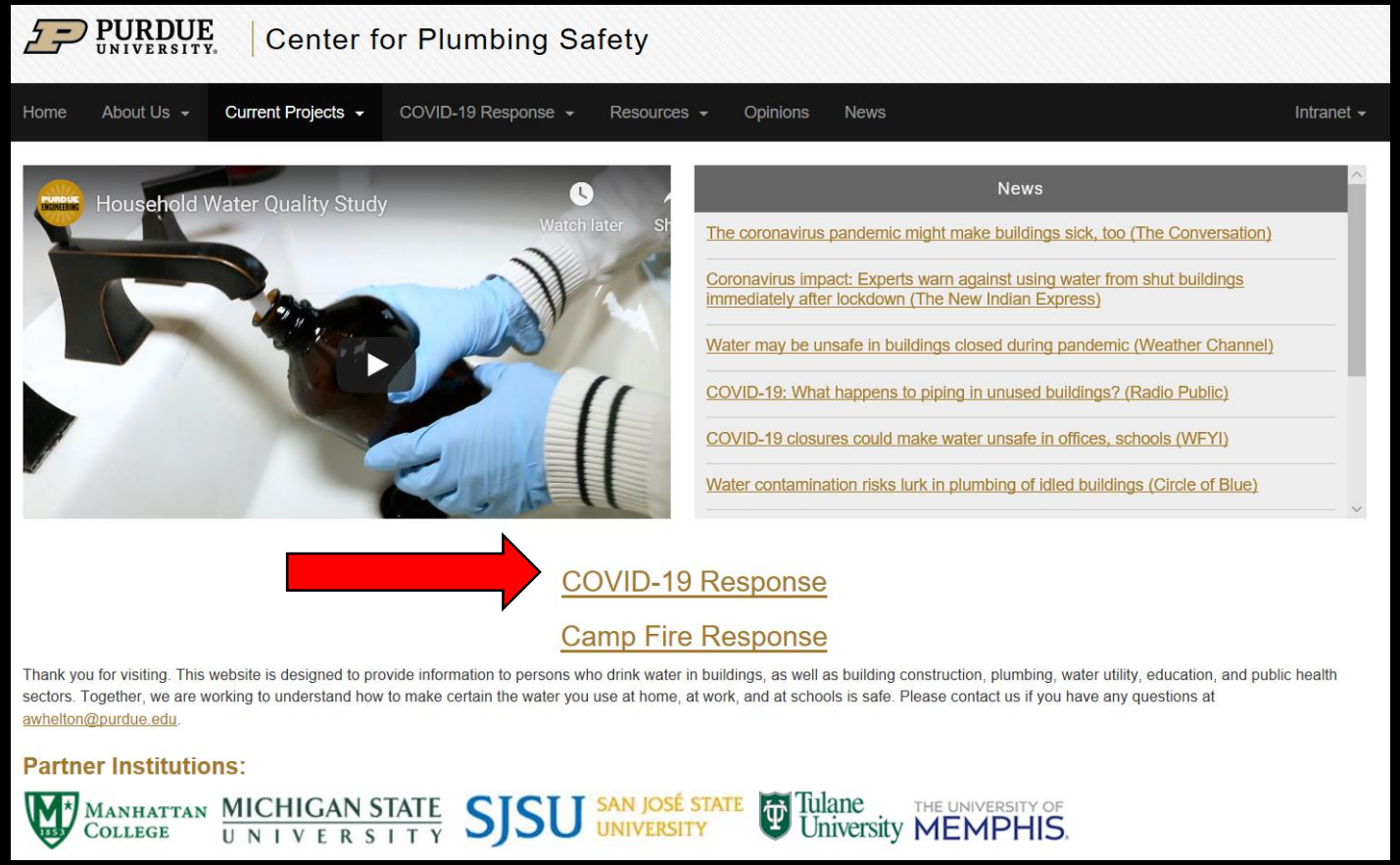
1. Low water use and stagnation poses serious health risks. Keep water fresh.

2. Much of the building water system guidance issued since the pandemic is projected from short-term stagnation studies. Best to review multiple documents, not 1 as many omit key information.

3. **The only way to know if guidance works is to test.**

4. Reach out to us if you have questions or need help.

# *Thank you…* www.PlumbingSafety.org




- ✓ Plumbing education videos
- ✓ Flushing plans
- ✓ Plumbing explainers
- ✓ Plumbing online trainings
- ✓ Scientific opinions
- ✓ Resources ➔ presentations
- ✓ Scientific reports
- ✓ External plumbing docs
- ✓ YouTube Channel


Andrew Whelton, Ph.D. awhelton@purdue.edu
@TheWheltonGroup

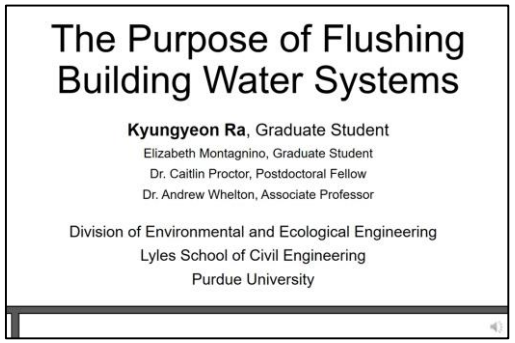
# Extra Slides

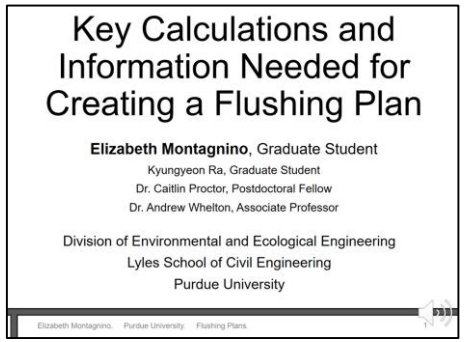
# How could we *prevent* water quality problems?

## Keep the water moving! ≠ stagnation

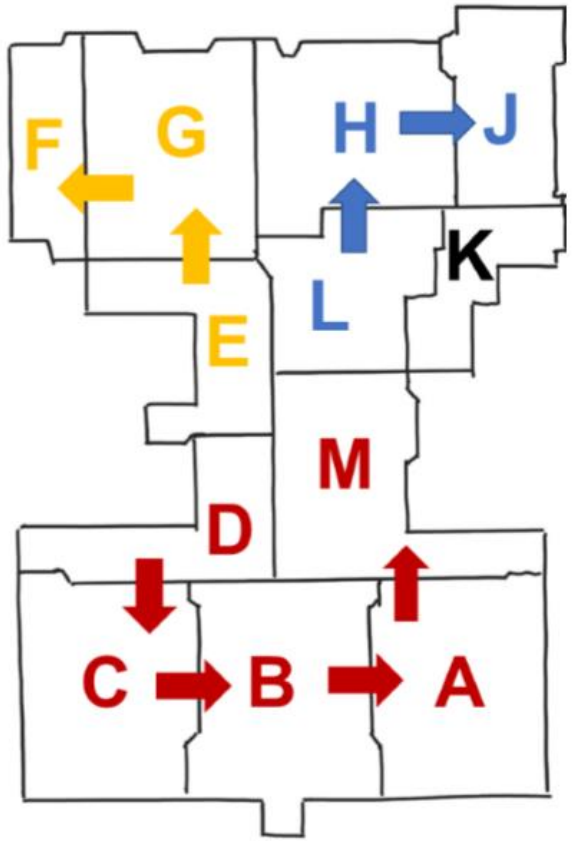
- Source water must be fresh (utility, onsite well, Source may need to flush!)
- Clean devices and equipment
- Flushing – Keep water fresh
- Water heater and recirculation loops – Keep hot water hot, Keep cold water cold

*Our YouTube Channel* ➔




## *Flushing Plans*



# What actions can be taken to *deal with* water quality deterioration?

- Recommissioning plumbing
  - System integrity checks
  - Flushing (and cleaning)
  - Shock disinfection
  - Testing
- Professional help might be needed
  - Address complex mechanical and treatment equipment
  - Develop effective flushing plans
  - Perform shock disinfection safely (thermal or chemical)
  - Perform accurate testing

# Flushing and More Intensive System Cleaning Could Make People Sick

## Engineering Controls

- Fill sink and floor drains traps with water
- Maintain pressure when flushing
- During flushing (especially initial), many methods to reduce exposure: Cover toilets, showerheads, faucets, reduce splashing, use hoses
- Flooding, cross-connections, dealing with waste

## Administrative and Work Practice Controls

- Temporarily forbidding use of high-risk exposure items (showers, hot tubs, decorative fountains)
- Temporarily closing facilities to concentrate use

## Personal Protective Equipment (PPE)

- Protect against scalding
- Protect against chemical exposure
- OSHA and other agencies recommend respirators *if* Legionella is *suspected or possible*

OSHA

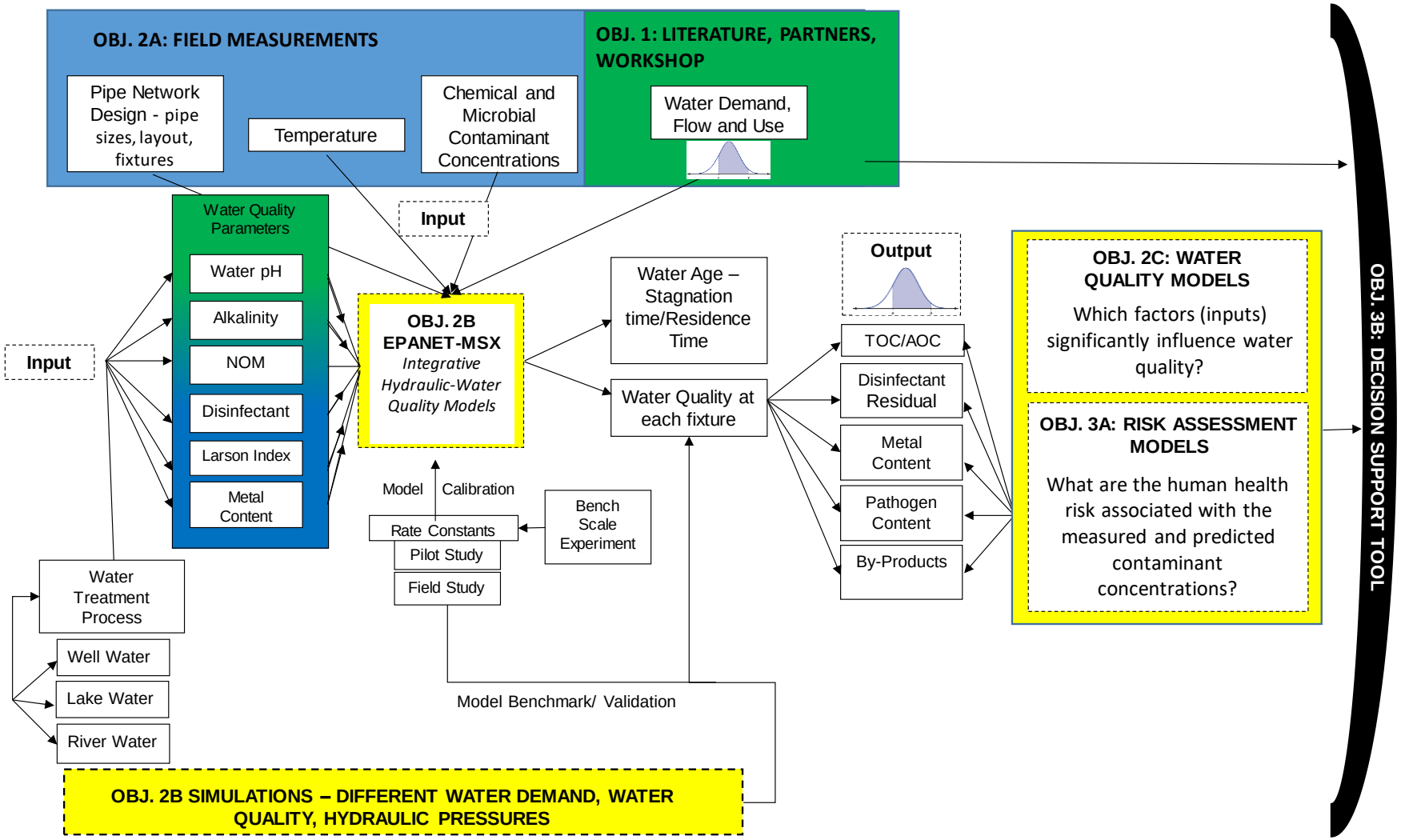
N95 respirators, but recommends voluntary use of N100 "if *Legionella* contamination is possible"

AIHA
Protecting Worker Health

P100 HEPA filter respirators when sampling building water and *Legionella* may be present

# The FUTURE? Predict water quality at the tap

Ongoing Residential Home Study Funded by EPA




PURDUE UNIVERSITY

MICHIGAN STATE UNIVERSITY

MANHATTAN COLLEGE

Tulane University

THE UNIVERSITY OF MEMPHIS

# Documents to consider to DEVELOP guidance

** Guidance evaluation tool: Virginia Tech, Polytechnique Montreal, Purdue University, Northeastern University*

**2020** Peer-reviewed report: Prolonged stagnation *[All contaminants]*
https://www.doi.org/10.31219/osf.io/qvj3b

**2020** COVID-19 Building Water System Guidance Evaluation Tool *[All contaminants]*
https://engineering.purdue.edu/PlumbingSafety/covid19/Guidance-Evaluation-Tool.pdf

2020 Consider select documents

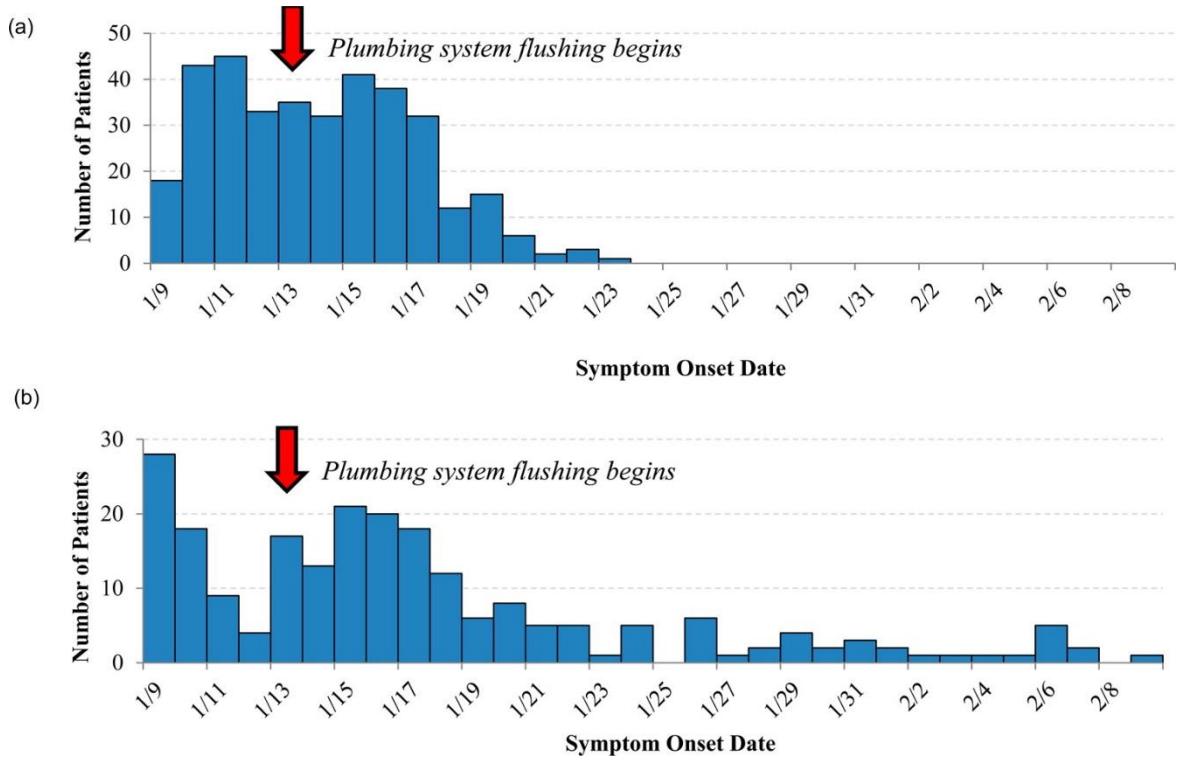
**2019** NASEM 2019 Management of Legionella in Water Systems *[Legionella specific]*
https://www.nationalacademies.org/our-work/management-of-legionella-in-water-systems

**2018** ASHRAE 188 Legionellosis: Risk Management for Building Water Systems *[Legionella specific]*
https://www.ashrae.org/File%20Library/Technical%20Resources/Bookstore/86611_188-2018preview.pdf

**2017** CDC Water Management Plan Toolkit *[Legionella specific]*
https://www.cdc.gov/legionella/downloads/toolkit.pdf

# A look back: Residential building water system flushing guidance made people sick

https://doi.org/10.1021/es5040969




2014 WV chemical spill – illnesses caused by flushing guidance

2015 Purdue critical review of past residential flushing guidance shows the absence of a scientific foundation

2017 Purdue water heater flushing study

2018 MetroCOG, CEC LLC, and Purdue provide foundational flushing guidance

2018 USEPA flushing study shows weeks to months needed to decon some plastic plumbing pipes

2019 Camp Fire: USEPA and Purdue estimate months needed to decon HDPE plastic plumbing pipes