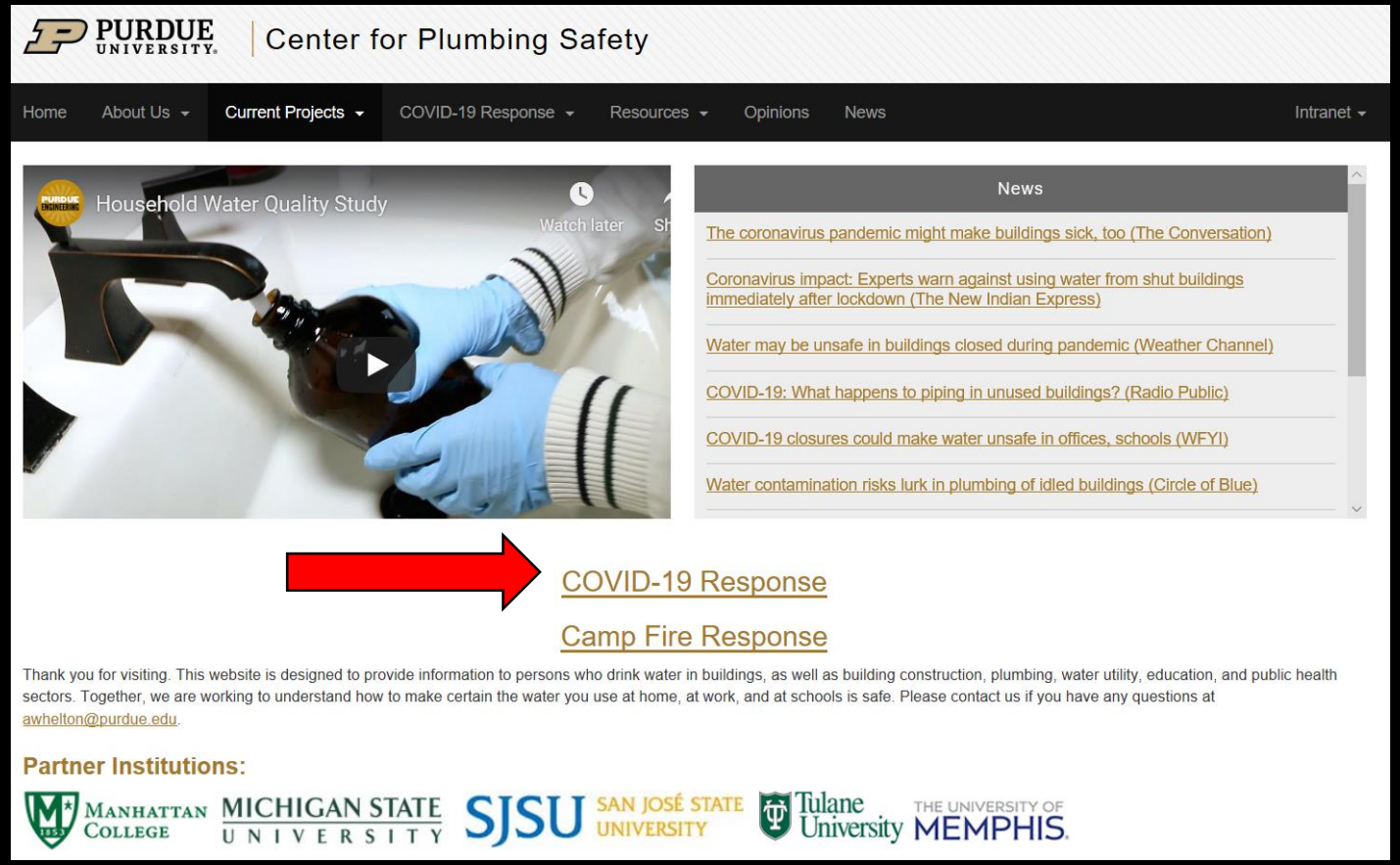
Responding to Low Building Water Use: Concerns and Best Practices for Facility Managers

Andrew J. Whelton, Ph.D.

Caitlin R. Proctor, Ph.D.

Information for Building Owners, Building Managers, Health Officials, and Building Occupants

More information here… www.PlumbingSafety.org



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Many thanks to Brad Caffery at Purdue University

COVID Specific Building Water Safety Support Resources

Restoring Water to Medical, Residential, and Commercial Buildings, Shutdowns, Unsafe Water

The COVID-19 pandemic has caused widespread building shutdowns, but also emergency restoration of water to previously closed medical facilities and homes. Several serious building drinking water safety risks exist. As people begin using the water again, they will encounter extremely stagnated water with excessive lead, copper, and bacterial concentrations, that may include harmful organisms like legionella that can cause disease outbreaks.

There are no national or industry guidelines for building reopening after extended shutdowns.

The U.S. National Science Foundation funded Purdue University researchers to rapidly address this serious public health concern. This rapid response effort involves partnerships with the American Society of Plumbing Engineers and International Association of Plumbing and Mechanical Officials and collaborations with other building water and public health experts from across North America.

[NSF government website description of this rapid response grant]

Questions

I am looking for...

- A list of your rapid response efforts in response to the COVID-19 outbreak
- Advice on what I should do as a public health official, building owner, or water utility
- Download a copy of the Experts Building Water Safety Study released April 7, 2020
- Guidance on how to create a building flushing plan
- Brief educational videos on building water safety topics

- ✓ Advice for building owners, health officials and utilities
- ✓ Building water safety education videos
- ✓ Guidance on how to create flushing plan
- ✓ Access to the Building Water Safety Study
- ✓ Guidance on building water safety from multiple nations and U.S. states

The coronavirus pandemic has prompted low to no water use in >5.6 millions buildings – in the U.S. alone

Schools, gyms, retail and arts centers, salons,
places of worship, colleges and universities, & more

Bathrooms

Water fountains

Food preparation areas

Point-of-entry devices

Point-of-use devices

Breakrooms

Point-of-use devices

Stagnation *noun*

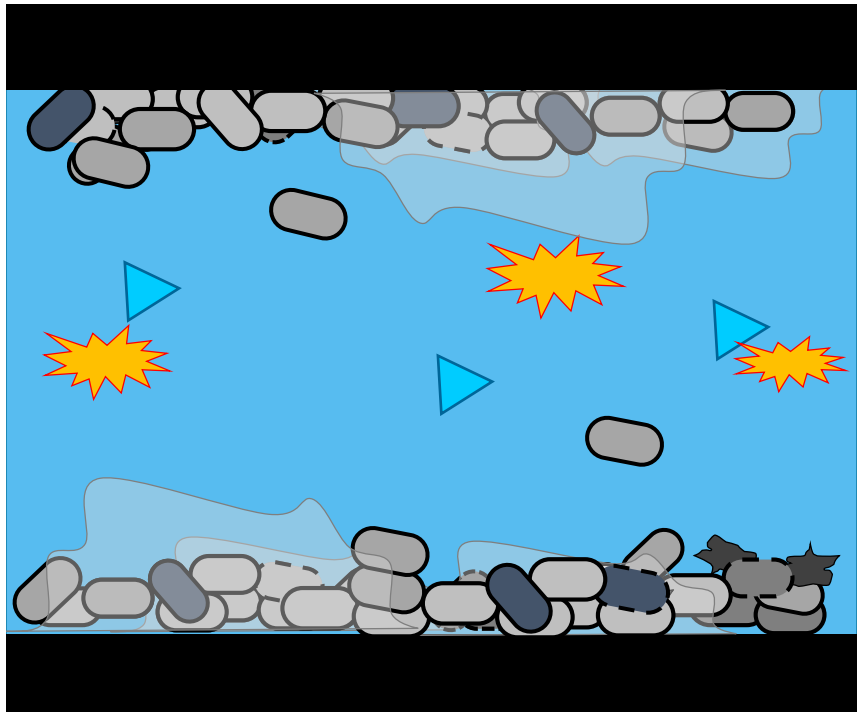
stag·na·tion | \ stag-ˈnā-shən

a state or condition marked by
lack of flow, movement

Stagnation causes water to get older

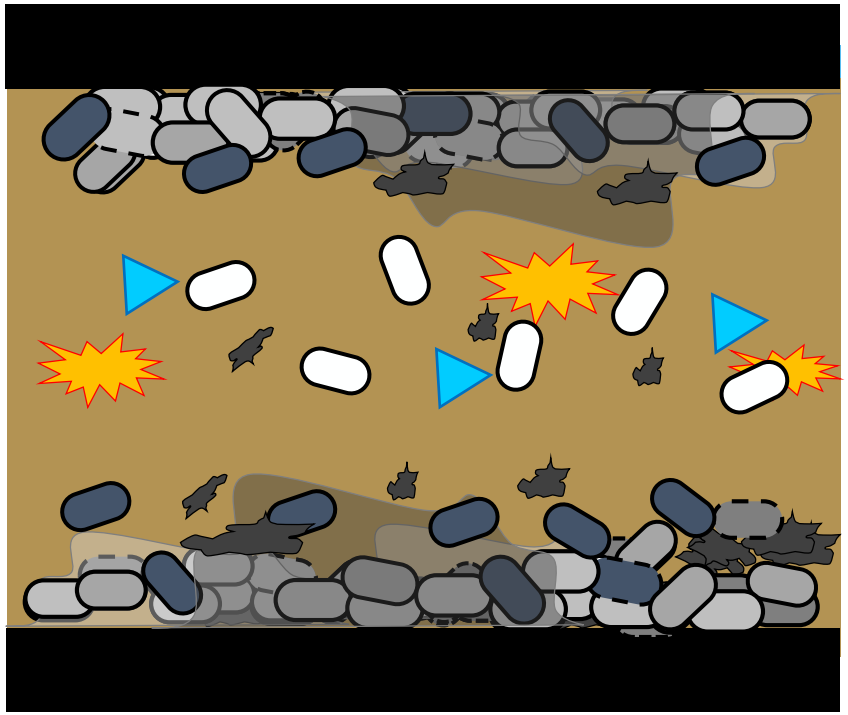
Normal water use refreshes:

- disinfectant residual &
- corrosion control



Old water (not refreshed):

- bacterial growth &
- corrosion not controlled



Disinfectant in water – used to reduce microbial growth in water, typically chlorine

Corrosion control – used to reduce metals leaching, stabilizes pH and may add chemicals

Slide adapted from our youtube video series

Prior to the pandemic, stagnation posed health risks

During <u>short-term</u> stagnation, high concentrations of metals and harmful organisms have been found in building water systems. A few issues include…

- **Copper** can leach from pipes (an exceed safe limits in just 48 hours sometimes)
  - This can increase to toxic levels causing gastrointestinal distress
- **Lead** can also leach from water system components
  - Lead causes developmental issues with children
- **Harmful organisms** (e.g., *Legionella pneumophila* and other opportunistic pathogens) grow
  - Many of these organisms cause respiratory illness
  - Other infections can occur

These reactions have not been studied in the long-term

Watch on YouTube: [Why Does Water Quality Change Inside Buildings?]

Slide adapted from our YouTube video series

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
2. Building water safety review due to prolonged stagnation with experts from 8 private and public sector organizations
3. Field testing to determine how impacted building water safety is in actual large buildings
4. Lab testing to determine how to fully recover contaminated building water system devices and equipment
5. Help transform public awareness

Helping

IAPMO

American Water Works Association

astho™

SLOAN

NRDC

Washington State Department of Health

ASDWA

Ohio Environmental Protection Agency

ASPE American Society of Plumbing Engineers

NEHA TRAINING

Whirlpool CORPORATION

SAFE WATER ENGINEERING

#2. Review paper

Collaborative effort

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William Rhoads, Ph.D., Virginia Tech

Tim Keane, Legionella Risk Management, Inc.

Maryam Salehi, Ph.D., University of Memphis

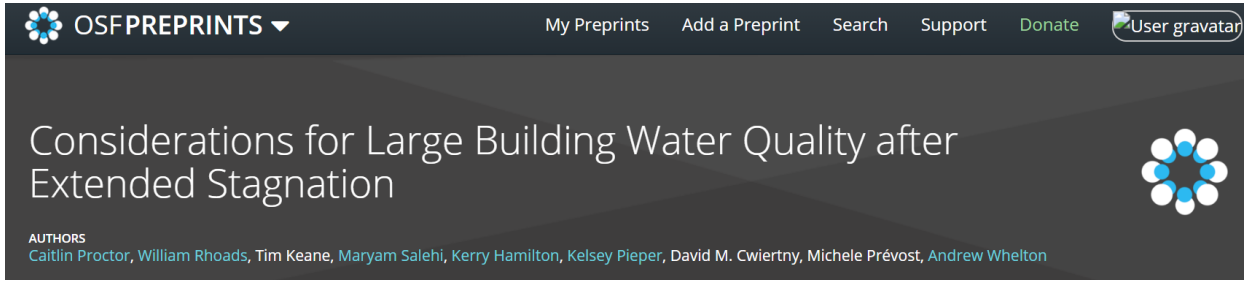
Kerry Hamilton, Ph.D., Arizona State University

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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Preprint

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

osf.io/qvj3b/

Even short-term stagnation is problematic

- Copper in water increased by 40% in a green building over *just 6 hours,* exceeded health based limit after 1 weekend (data in prep)

- With overnight stagnation, bacteria concentrations in water increase 2-3 fold and the community completely changes

- Growth of harmful organisms has been observed

Watch on YouTube: [Why Does Water Quality Change Inside Buildings?]

What actions can be taken to *prevent* water quality deterioration?

Normal use:

- Building water management plans

Extended stagnation/low-use

- Periodic flushing
- Change water heater operation
- Drain plumbing?

COVID-19 considerations:

- Utility mains also have stagnation
- Slow ramp-up of economic activity

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

How do organisms cause disease?

Multiple exposure routes

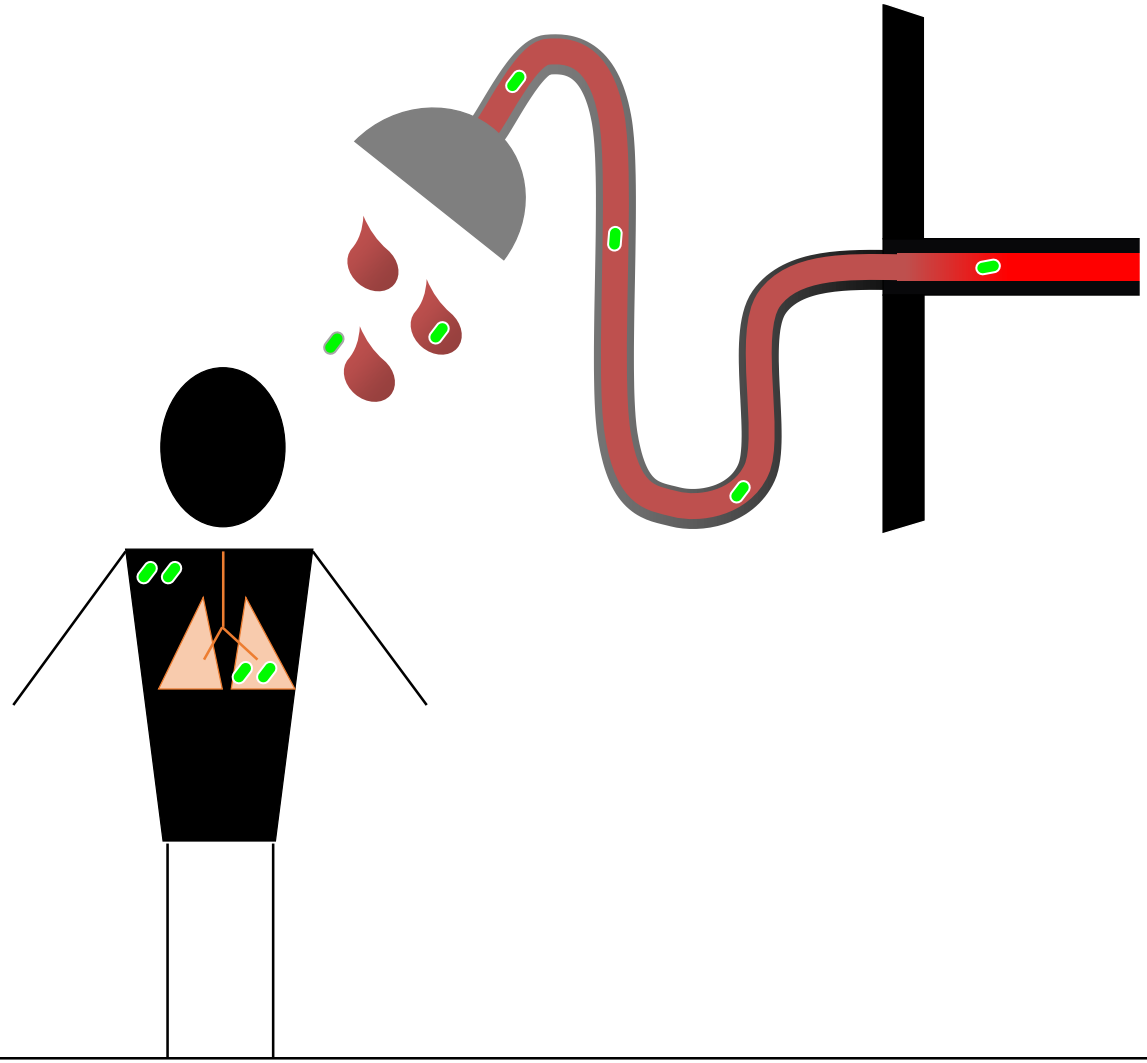
- Drinking
- Inhalation
- Dermal (skin, eyes, wounds)

Multiple exposure activities

- Showering
- Anything with splashing/aerosols

Typically affect only vulnerable populations, but anyone can be affected

- Immunocompromised
- Certain pre-existing conditions
- Elderly



Precautions

- Personal protective equipment (PPE)
  - OSHA and other agencies recommend respirators *if* Legionella is suspected
- Reducing exposure
  - During flushing (especially initial), many “tricks” to reduce exposure
  - Cover toilets, showerheads, faucets, reduce splashing
- Temporary closures of facilities
  - Temporarily forbidding high-risk exposure activities (showering)
  - Temporarily closing facilities to concentrate use
- Technical considerations
  - Flooding, cross-connections, dealing with waste
  - Pressure issues with high flowrate flushing

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Who should be involved?

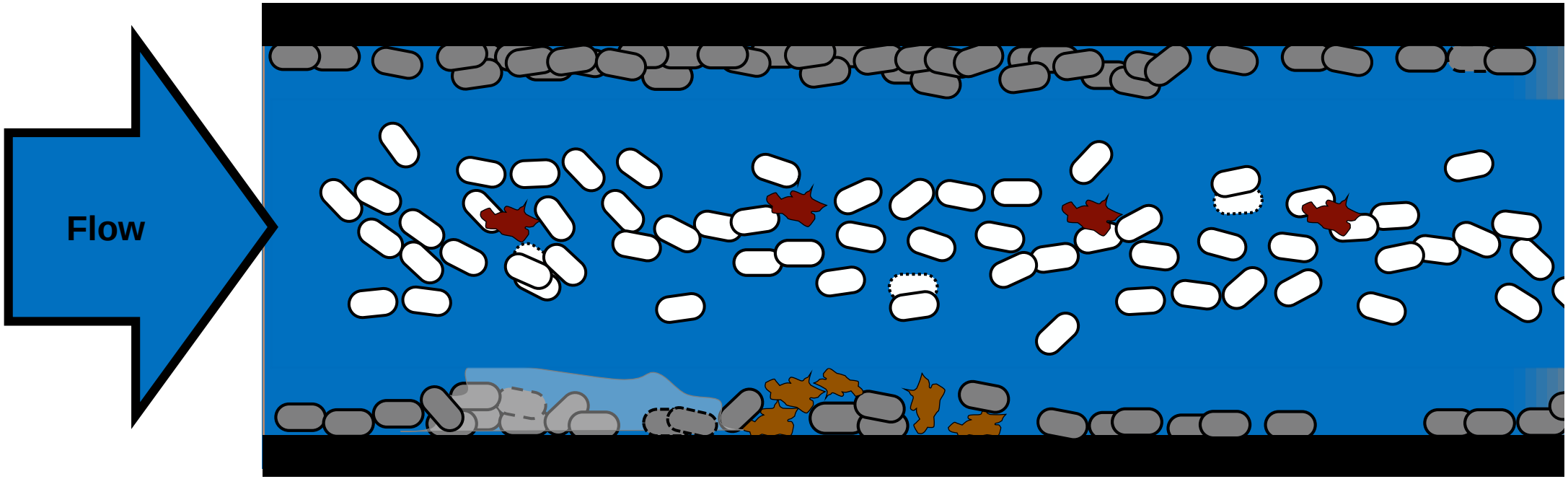
- Developing guidance
  - Many government (and non-government) agencies doing this
- Communication about risks
  - Public health officials
  - Building owners?
  - Utilities
- Taking action (flushing, disinfecting)
  - Building owners can task maintenance/facilities managers
  - Plumbers, contractors, engineers may need to be involved

Flushing achieves 3 goals

Goal 1: Remove materials that accumulate in water during stagnation

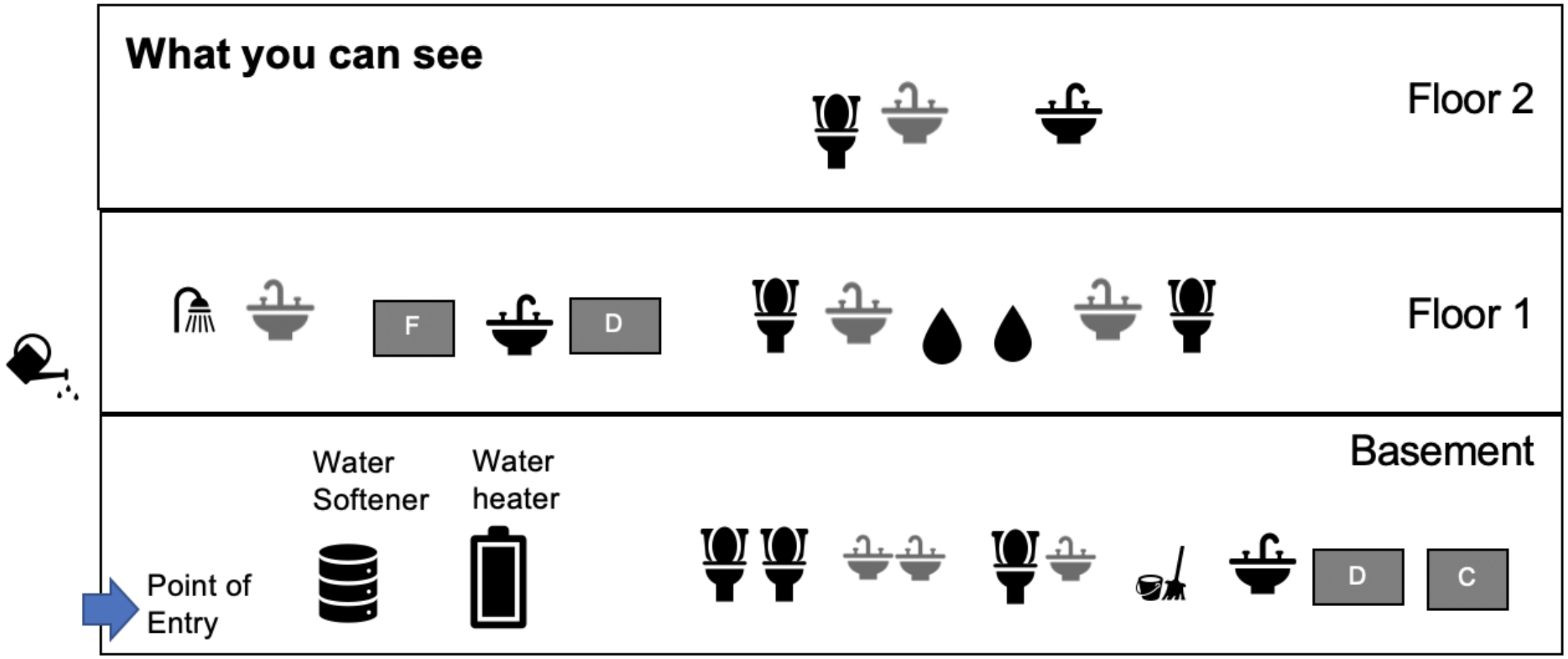
Goal 2: Remove some biofilms and sediments,
(if done at sufficiently high enough speeds)

Goal 3: Bring fresh water into pipes

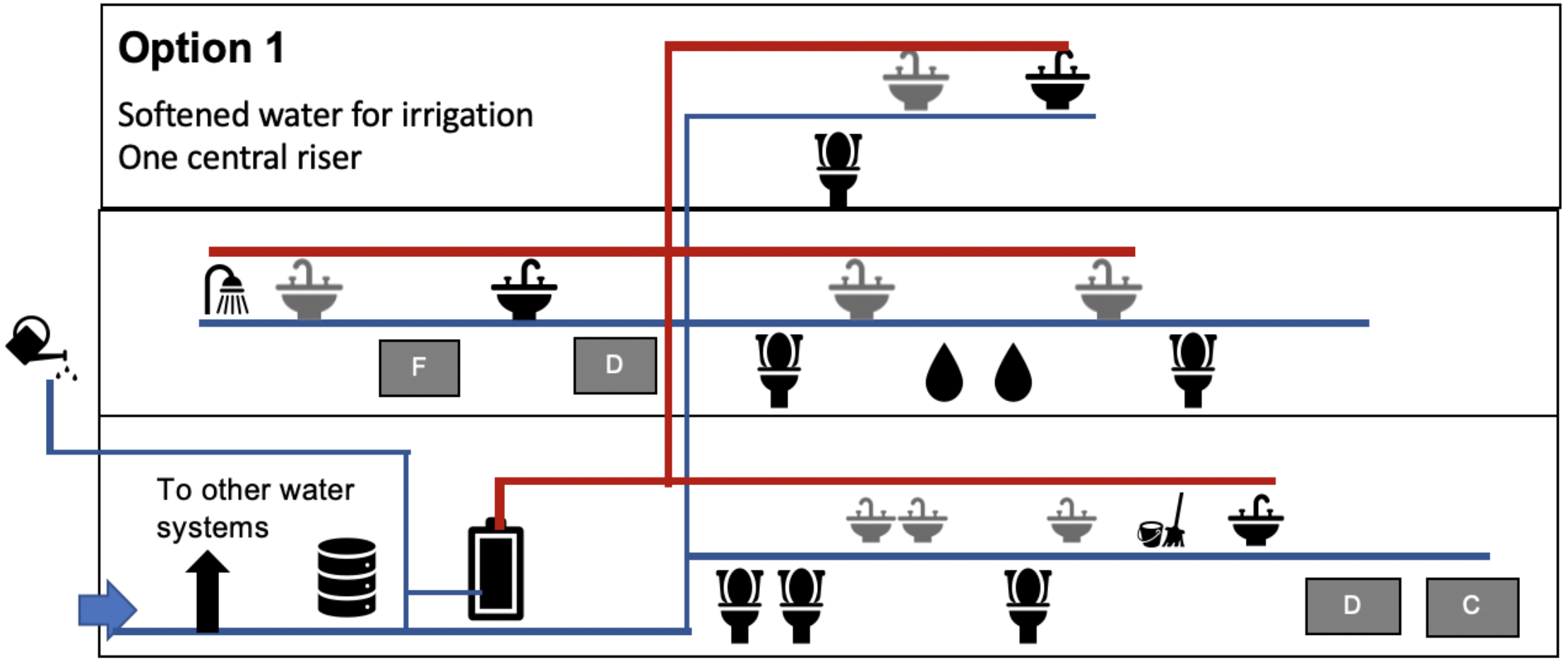


Slide adapted from our YouTube video series

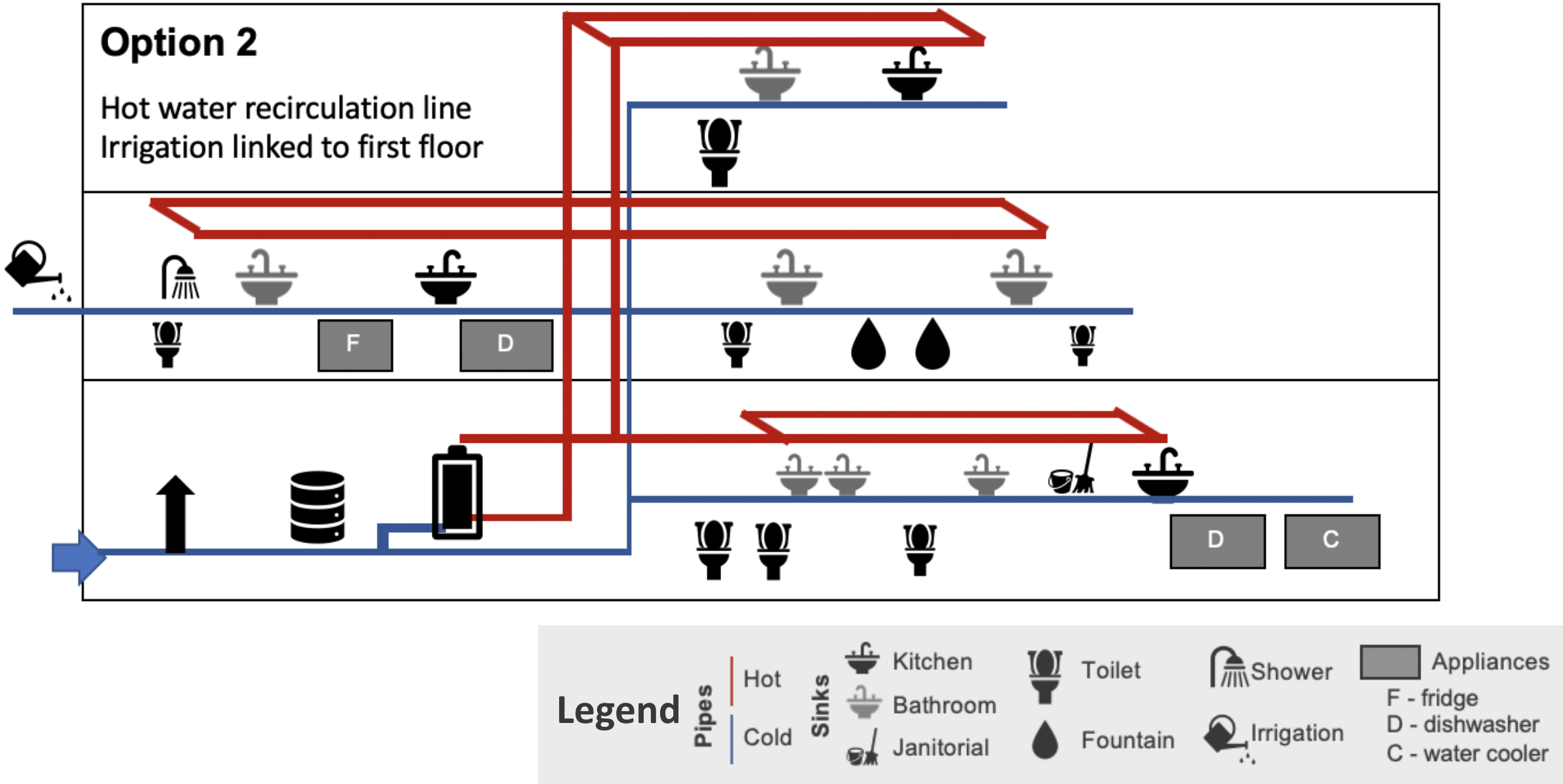
Understanding plumbing configuration



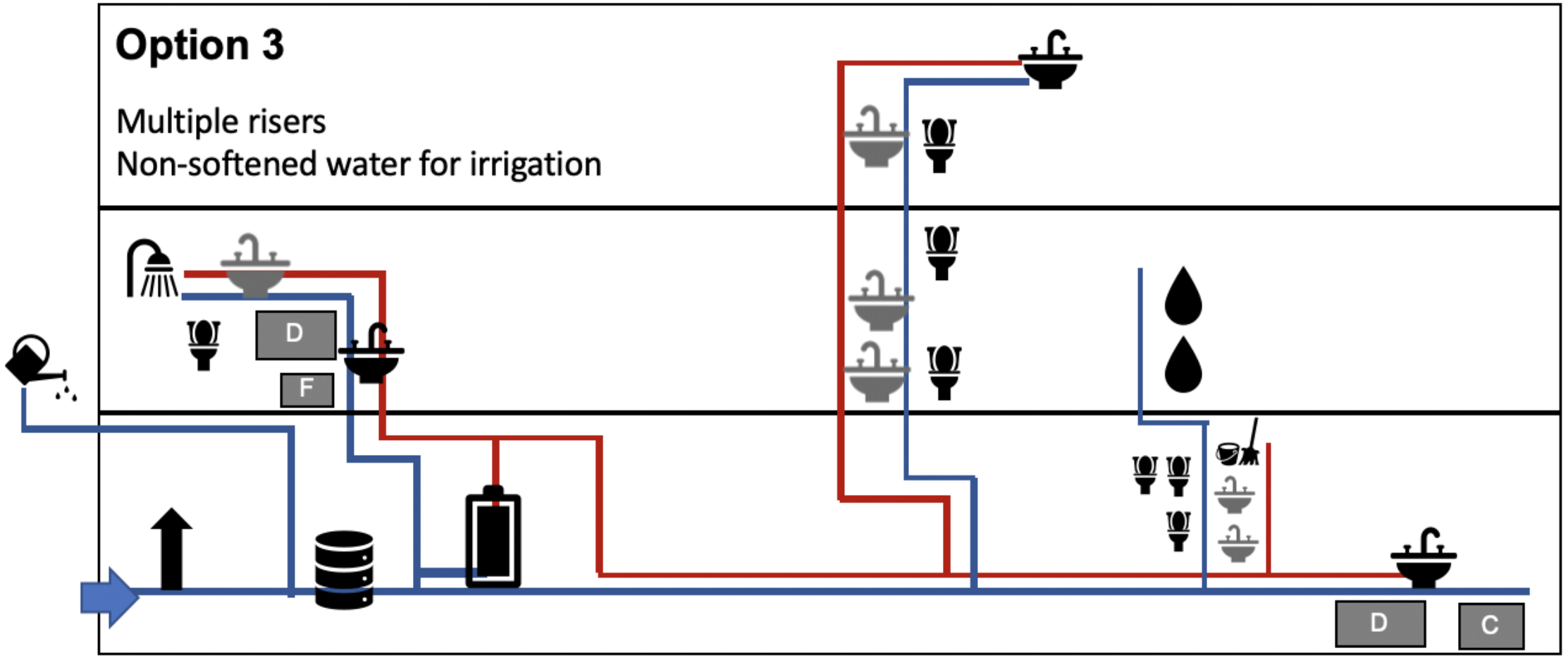
Understanding plumbing configuration



Understanding plumbing configuration

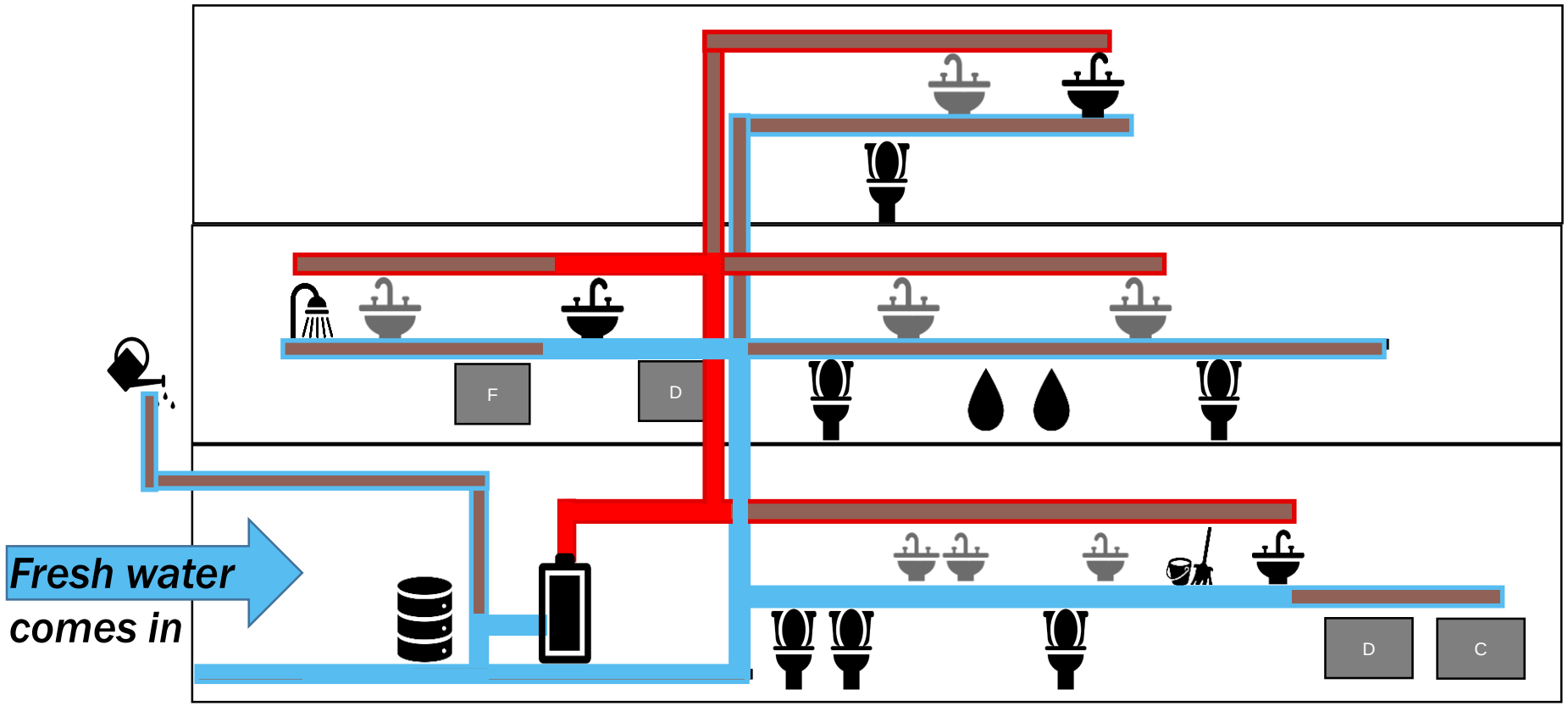


Understanding plumbing configuration



Incomplete flushing

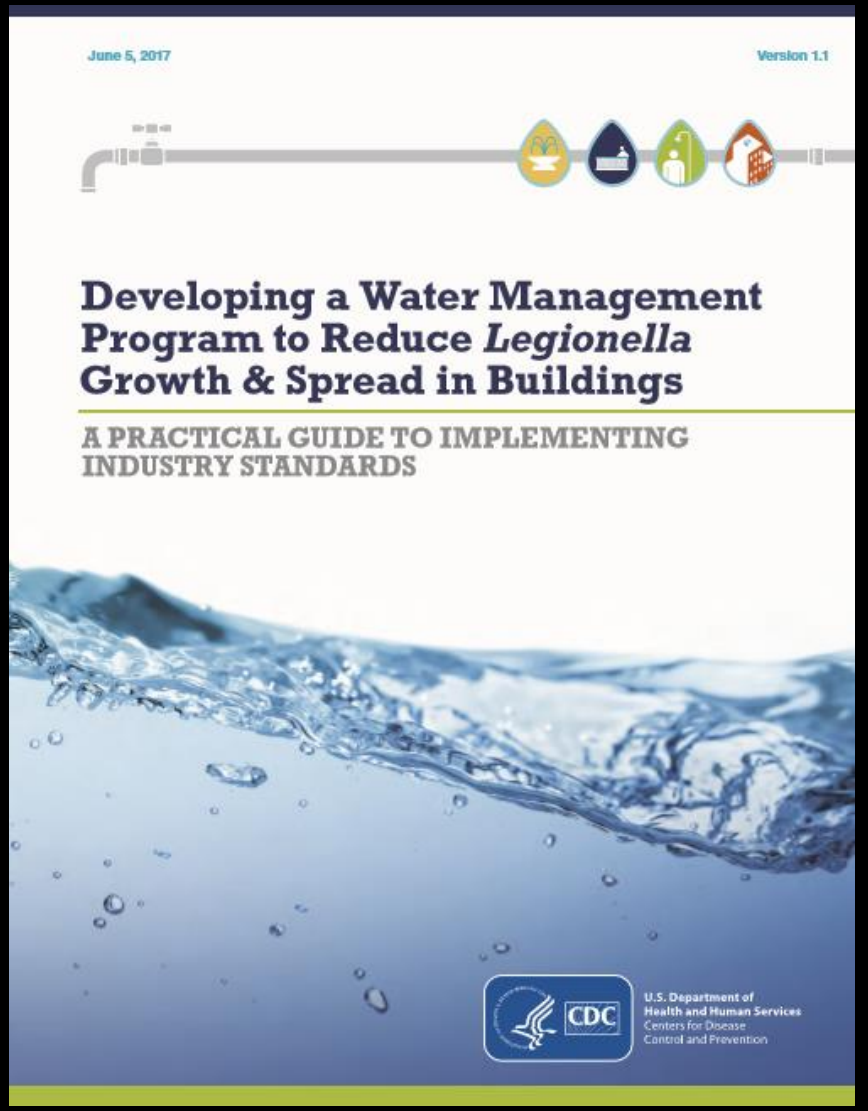
Incomplete flushing fails to get fresh water all the way to all water outlets



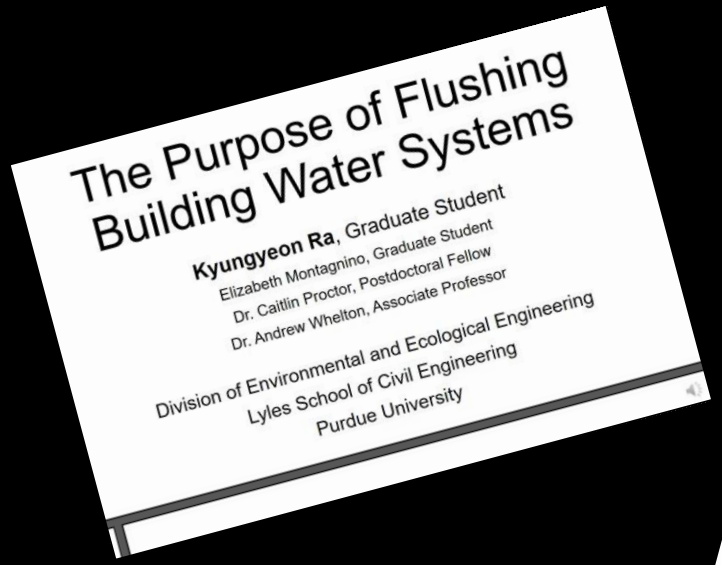
Slide adapted from our youtube video series

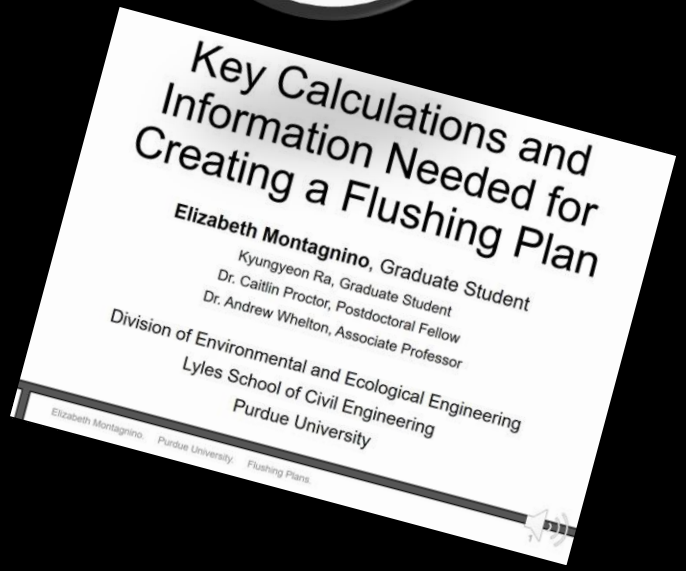
10 actions building owners should consider

1. Contact your government public health department, they may have specific requirements.
2. Communicate info provided by the health department to your occupants.
3. Don't have a building water management plan? Document everything, that's a start.
4. Flush at least weekly. *More frequent is better.* Document! Create a flushing plan.
5. Conduct maintenance: Aerators, POU/POE treatment devices, water heaters, showerwand tubing, etc.
6. Start an inventory of building water system components
7. Use an inexpensive digital handheld disinfectant analyzer to monitor in-building levels. Document!
8. Contact a plumber or engineer for assistance
9. Do not shock disinfect, drain plumbing, shut off water heaters and recirculation loops without expert help. These can have potential health implications.
10. Reach out to us if you have questions.

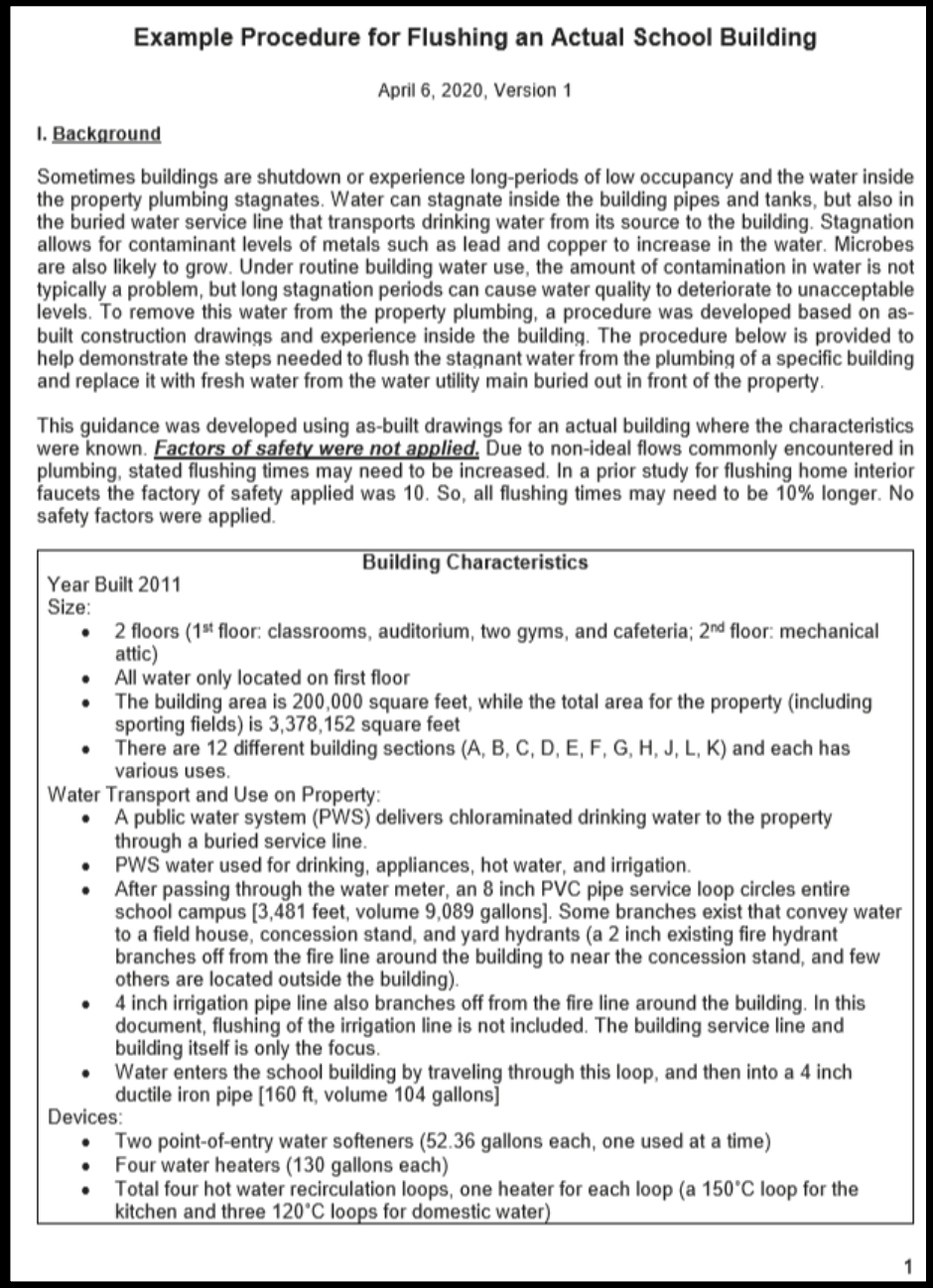


Learn how to create a building flushing plan





Visit our Plumbing Safety YouTube Channel for Short Education Videos



Example Procedure for Flushing an Actual School Building

April 6, 2020, Version 1

I. Background

Sometimes buildings are shutdown or experience long-periods of low occupancy and the water inside the property plumbing stagnates. Water can stagnate inside the building pipes and tanks, but also in the buried water service line that transports drinking water from its source to the building. Stagnation allows for contaminant levels of metals such as lead and copper to increase in the water. Microbes are also likely to grow. Under routine building water use, the amount of contamination in water is not typically a problem, but long stagnation periods can cause water quality to deteriorate to unacceptable levels. To remove this water from the property plumbing, a procedure was developed based on as-built construction drawings and experience inside the building. The procedure below is provided to help demonstrate the steps needed to flush the stagnant water from the plumbing of a specific building and replace it with fresh water from the water utility main buried out in front of the property.

This guidance was developed using as-built drawings for an actual building where the characteristics were known. ***Factors of safety were not applied.*** Due to non-ideal flows commonly encountered in plumbing, stated flushing times may need to be increased. In a prior study for flushing home interior faucets the factory of safety applied was 10. So, all flushing times may need to be 10% longer. No safety factors were applied.

Building Characteristics

Year Built 2011
Size:
- 2 floors (1st floor: classrooms, auditorium, two gyms, and cafeteria; 2nd floor: mechanical attic)
- All water only located on first floor
- The building area is 200,000 square feet, while the total area for the property (including sporting fields) is 3,378,152 square feet
- There are 12 different building sections (A, B, C, D, E, F, G, H, J, L, K) and each has various uses.

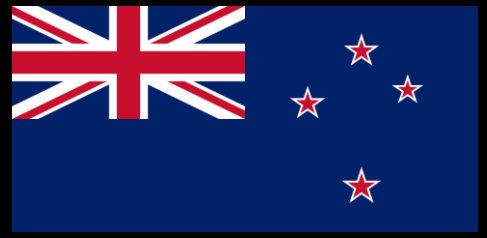
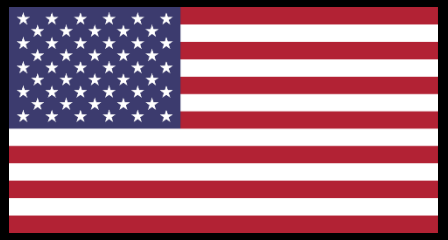
Water Transport and Use on Property:
- A public water system (PWS) delivers chloraminated drinking water to the property through a buried service line.
- PWS water used for drinking, appliances, hot water, and irrigation.
- After passing through the water meter, an 8 inch PVC pipe service loop circles entire school campus [3,481 feet, volume 9,089 gallons]. Some branches exist that convey water to a field house, concession stand, and yard hydrants (a 2 inch existing fire hydrant branches off from the fire line around the building to near the concession stand, and few others are located outside the building).
- 4 inch irrigation pipe line also branches off from the fire line around the building. In this document, flushing of the irrigation line is not included. The building service line and building itself is only the focus.
- Water enters the school building by traveling through this loop, and then into a 4 inch ductile iron pipe [160 ft, volume 104 gallons]

Devices:
- Two point-of-entry water softeners (52.36 gallons each, one used at a time)
- Four water heaters (130 gallons each)
- Total four hot water recirculation loops, one heater for each loop (a 150°C loop for the kitchen and three 120°C loops for domestic water)

1

A variety of countries and U.S. organizations have issued building water system guidance documents in response to the pandemic…



Arkansas
Connecticut
Indiana
Minnesota

Oklahoma
Oregon
Washington

Private Companies

Nonprofit Organizations

But, some lack critical information & do not address some hazards like worker safety & devices

Building Water System
COVID-19 Guidance Document
Evaluation Tool

last updated 4/22/2020

by William Rhoads (Virginia Tech), Andrew Whelton (Purdue University), Caitlin Proctor (Purdue University)

Recommissioning and routine flushing guidance for building plumbing systems are being rapidly developed and disseminated to the public. This document provides an evaluation tool to aid building owners, public health officials, and private sector organizations identify information to consider including in those guidance documents. Information contained in this document can serve as a tool for end users to evaluate the applicability of existing building water system guidance documents for various purposes.

Considerations outlined in this document were synthesized based on our recent paper, "Considerations for Large Building Water Quality after Extended Stagnation" co-authored by 9 plumbing, water quality, and public health experts and conversations with various public health and environmental quality public servants, which can be downloaded here: https://www.doi.org/10.31219/osf.io/qvj3b.

How to use this document

For users that are developing or have developed COVID response guidance, this document can be used to inform internal conversations about the scope, applicability, and practicality of documents being disseminated to building owners and the public. We encourage protocol developers to consider revising existing guidance if there are ways to improve it.

For users that are implementing protocols issued by others, this document can serve as an evaluation tool to help identify topic(s) that may be lacking or unclear. Users of this document are encouraged to contact the entity that developed the building water system protocols for clarification. Users of this document can also develop their own protocols that address important considerations of building water safety.

The contents of this document address the clarity and specificity of the following items:

1. A guidance document's scope and applicability
2. Considerations for routine flushing to keep water moving through plumbing systems
3. Considerations for recommissioning to reduce exposure to health risks that developed during stagnation
4. Considerations for evaluating building water safety
5. Considerations for worker safety
6. Considerations for communication between stakeholders

Learn how to create building water system recommissioning guidance

Virginia Tech (lead) &
Purdue University

Download the Tool at www.PlumbingSafety.org

Resources in Indiana!

Indiana State Department of Health

Environmental Public Health Division
100 N. Senate Ave., N855
Indianapolis, IN 46204

BUILDING WATER SYSTEM STARTUP GUIDANCE

Requirements of social distancing and the Stay-at-Home Order due to the COVID-19 pandemic has forced schools, businesses, events, and many restaurants to shut down. The physical structures, primarily the buildings that house these entities and activities have been vacated and their water systems shut down. Some will have shut off the water supply and drained the plumbing prior to vacating, and others may have allowed the plumbing to sit stagnant with water in the piping. Either way it is crucial to take precautions when starting up the building water system in preparation for return to normal operations.

As water sits stagnant within water lines and fixtures the water quality may be adversely impacted by either chemical or microbiological contaminants that can cause significant health risks. Stagnant water allows for metals such as lead and copper to leach into the water within the plumbing due to the corrosive characteristics of water. Stagnant water also allows for biolog… increase in the presence of bacteriology such as Legionella and other bio-fi…

General Steps to Follow for Startup

1. Inspect the premise plumbing and ensure the integrity of the p… Repair any supply piping or drain leaks found during the visual … any damaged or open plumbing traps.
2. Remove aerators, point of use filters, and shower hoses, and e… have been disabled on automatic faucets.
3. Check the integrity of the water system by closing all faucets w…
   a. Shut down any additional systems that may be feeding th… such as water softeners or other water conditioning appa…
   b. Ensure your water heater is properly maintained.
      1. Confirm the temperature is correctly set - generally at…
      2. Determine if the manufacturer recommends draining … prolonged period of disuse.
   c. Turn on the main supply to the building water system.
4. Flushing the system
   a. If possible follow the flow of water from the main water s… as-built diagrams if available) and begin flushing at the fir… system to eliminate all sediment and debris sitting within… This may require flushing for up to one hour to properly t… and debris from the main line.
   b. Then begin moving along the water system to each faucet… throughout the system. Flush cold water first, and then r… water. Times of flushing may vary depending on the amo… detected, but most likely flushing the cold water for 1 mi… seconds will suffice. During flushing activities observe plu… ensure no leakage. Repair any piping, fixture, or drain lea… flushing.

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- Building Water Safety FAQ
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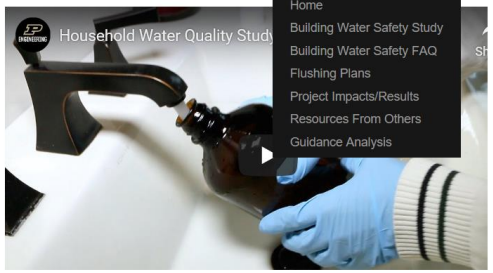

News

- COVID-19 & commercial drinking water quality concerns (WQP)
- As lockdowns lift, new hazards lurk in the water (Nature)
- The coronavirus pandemic might make buildings sick, too (The Conversation)
- Coronavirus impact: Experts warn against using water from shut buildings immediately after lockdown (The New Indian Express)
- Water may be unsafe in buildings closed during pandemic (Weather Channel)
- COVID-19: What happens to piping in unused buildings? (Radio Public)

COVID-19 Response

Camp Fire Response

Thank you for visiting. This website is designed to provide information to persons who drink water in buildings, as well as building construction, plumbing, water utility, education, and public health sectors. Together, we are working to understand how to make certain the water you use at home, at work, and at schools is safe. Please contact us if you have any questions at awhelton@purdue.edu.

Partner Institutions:

Manhattan College | Michigan State University | SJSU San José State University | Tulane University | The University of Memphis

GUIDANCE DOCUMENT

IDEM

INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

IDEM Guidance for Flushing Water Systems

Drinking Water Branch

(317) 232-8603 • (800) 451-6027 www.idem.IN.gov 100 N. Senate Ave., Indianapolis, IN 46204

This informational document will assist you in re-opening buildings that may have been temporarily shut down or used less frequently over the last several weeks due to COVID-19 pandemic.

Whether you are a community water system with multiple buildings that have been closed or a nontransient noncommunity system such as a school or factory that has been temporarily closed or you are a small transient system like a church or campground; these guidelines will help you in re-opening your water system to ensure that the inside plumbing did not become contaminated.

When water is not used over an extended period, it will become stagnant. One of the problems of stagnant … head is *Legionella* and other harmful microorganisms. It is imperative that you … make sure that you are receiving fresh water and not stagnant water.

…r can cause conditions that increase the risk for growth and spread …biofilm-associated bacteria. When water is stagnant, hot water temperatures can … growth range (77–108°F, 25–42°C). Stagnant water can also lead to low or …nfectant, such as chlorine and could also cause corrosion issues. It is critical to …tem is safe to use after a prolonged shutdown to minimize the risk of … other diseases associated with water.

…otential health risk and can impact water quality, it is necessary to systematically …e instructions will help by providing a systematic approach on how to do a …

…es opening taps and other fixtures and letting water run to remove any stagnant …d fixtures. To protect the health and safety of our consumers, IDEM recommends …d follow the steps for flushing. Thank you for your cooperation.

…ve water treatment systems and all those treatment devices need to be cleaned, … part of the starting up process. After flushing, your water filters need to be …point of entry water treatment system such as a water softener or filter, please …nual for replacement of the filter.

…ps in the order set out below. Finish each step completely before moving …

…r taps for at least 5 minutes

…lushing, open ALL of the cold-water fixtures, flush each toilet at least one …

A State that Works

Professionals like you have a key role to play in keeping building water safe

1. Millions of buildings across the U.S. have now been affected by low to no water use.
2. Care must be taken to minimize building water system stagnation and water quality impacts.
3. Building owners should consult their health departments.
4. Our website contains education materials and guidance documents.
5. If you have a question reach out. You’re not alone.

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Learn more at: www.PlumbingSafety.org

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Extra slides

Onsite Education & YouTube Channel

Nearby Innovation Partner with Full-Scale Testing Facility

Plumbing Testing Facility at Purdue

Onsite Testing and Technical Support

Food Prep Facility

Stagnation has impacted various buildings

Gyms
Salons
Offices
Restaurants
Retail
Daycares
Schools
Government Buildings
Colleges & Universities
Hotels & Motels
Sports & Entertainment Venues
Casinos
and more…

Domestic Hot Water

Industrial Facility

Cartridge Filters

Courtesy of: Gordon & Rosenblatt, LLC