

COVID-19: Reopening Buildings and Challenges with Building Water Safety



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Onsite Education & Plumbing Safety
YouTube Channel



Nearby Innovation Partner with
Full-Scale Testing Facility



Plumbing Testing Facility at Purdue



Onsite Testing and Technical Support

More information here... www.PlumbingSafety.org



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Household Water Quality Study Watch later

News

- [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 closures could make water unsafe in offices, schools \(WFYI\)](#)
- [Water contamination risks lurk in plumbing of idled buildings \(Circle of Blue\)](#)

[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

A Resource for All

- ✓ Plumbing news
- ✓ Plumbing education videos
- ✓ Plumbing explainers
- ✓ List of projects
- ✓ Scientific opinions
- ✓ Resources → presentations
- ✓ Scientific reports
- ✓ External plumbing docs



*Many thanks to
Brad Caffery at
Purdue University*

*Access to world-class expertise, capabilities,
and education in and outside Purdue*

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



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2017
CMS Memo:
Legionella
Risk in
Healthcare
Facility
Water
Systems

2017
Plumbing Industry
Research Workshop:
Identify Knowledge
Gaps & Risks
Associated with
Premise Plumbing
Drinking Water Quality

2019
Rapid response to
the Camp Fire:
Widespread Water
System, Residential
& Commercial
Plumbing
Contamination

2019
Camp Fire
Building Water
System Testing
Guidance

2019
Camp Fire
Plumbing
Safety
Education
Workshop for
survivors

2020
NSF RAPID
response:
Building
water system
stagnation
and recovery

2017
USEPA funds
2 National
Priority
studies on
building
plumbing



2018
ASHRAE 188
Legionellosis:
Risk
Management
for Building
Water
Systems



2018
Measurement
Science Roadmap
Workshop for Water
Use Efficiency and
Water Quality in
Premise Plumbing
Systems



2019
Implications of the
California Wildfires
for Health,
Communities, &
Preparedness:
Proceedings of a
Workshop



2019
Mgmnt. of
Legionella
in Water
Systems



2020
COVID19: Impact of
prolonged stagnation
on building water
quality and safety





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



Schools, gyms, retail and arts centers, salons, places of worship, hotels, casinos, government, sports and entertainment, colleges and universities, & more



Bathrooms



Water fountains



Food preparation areas



Point-of-entry devices



Breakrooms



Point-of-use devices



Point-of-use devices

There are several key components of building systems

Water source

Service line

Safety devices including valves

Water treatment devices

Water service and distribution
piping and faucet connectors

Hot water heating, recirculation
system

Fixture and fixture fittings

Pumps, tanks

Point-of-use devices

Table 1. Types of building plumbing components

Components	Description
Water source	Municipal water, onsite well, treated surface water, rainwater.
Service line	Pipe system that carries water from the source to the building water system. Service line materials are variable and may or may not be the same as indoor pipes.
Safety devices including valves	Pressure relief valve, pressure reduction valve, isolation valve, mixing valve, thermostatic mixing valves, backflow prevention device, water hammer arrestors. Materials can include aluminum, brass, copper, lead, plastic, and stainless steel.
Water treatment devices	Filter, strainer, water softener, chemical addition equipment for disinfection and corrosion control.
Water service and distribution piping and faucet connectors	Various material types have been used to include acrylonitrile butadiene styrene (ABS), brass, cast iron (CI), chlorinated polyvinyl chloride (CPVC), copper, crosslinked polyethylene (PEX), ductile iron (DI), high density polyethylene (HDPE), lead, lead lined steel, multilayer pipes, polyethylene raised temperature (PERT), polypropylene (PP), unplasticized polyvinyl chloride (uPVC), polyvinylidene fluoride (PVDF), black steel, stainless steel.
Hot water recirculation system	Hot water is pumped through primary and secondary water heater loops, which serve different building zones to reduce delivery time of hot water. These have to be hydraulically balanced. Equipment includes master mixing valves, local mixing valves, flow balancing valves, pressure reducing valves, hot water return pumps and water heaters. Multiple temperature loops may exist. Operation of pumps may be intermittent in some systems.
Fixtures and fixture fittings	Aerator, air washers, atomizers, bathtub, bidet, decorative fountains, dishwasher, drinking fountain, eyewash stations, manual faucet, electronic faucet, faucet flow restrictors, hoses, point of use mixing valves, hot tubs, humidifiers, ice machines, misters, shower head, shower wand, sink, tub spout, toilet, urinal, washbasin
Pumps	Pumps are often used for pressure boosting within the building (i.e., for multi-story buildings) where water pressure entering the building is not adequate for water use at distal locations. Pumps are also used for hot water recirculation systems.
Tanks	Standard water heater, pressure tanks, on-demand water heater, hydropneumatic tanks, cold water supply storage tank. Water heaters can contain Mg or Al sacrificial anodes and plastic dip tubes.
Point-of-use devices	On-faucet treatment system, under sink treatment system.

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

Stagnation *noun*



stag·na·tion | \ stag-'nā-shən

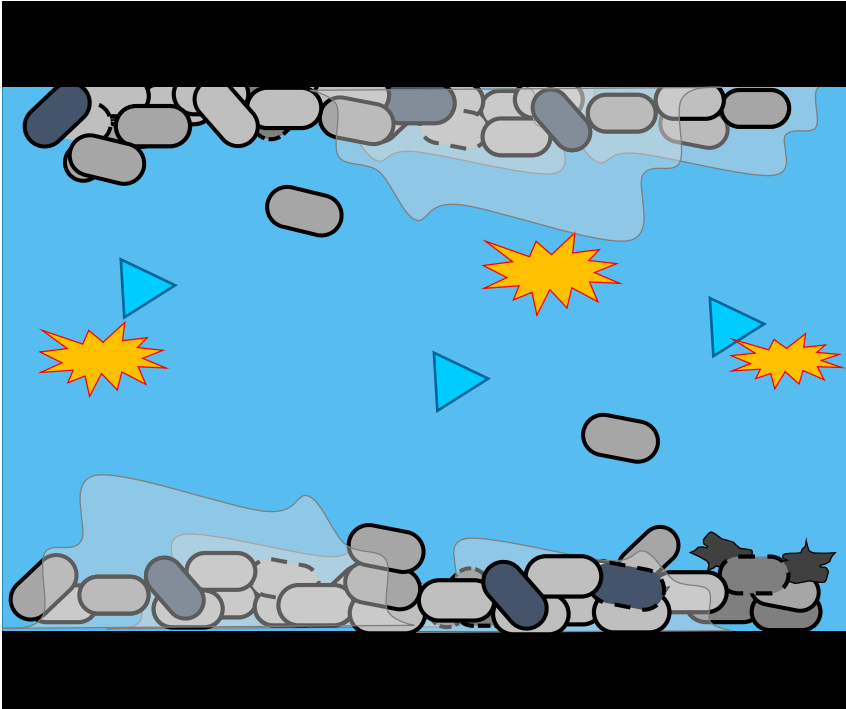
a state or condition marked by
lack of flow, movement





Stagnation causes water to get older

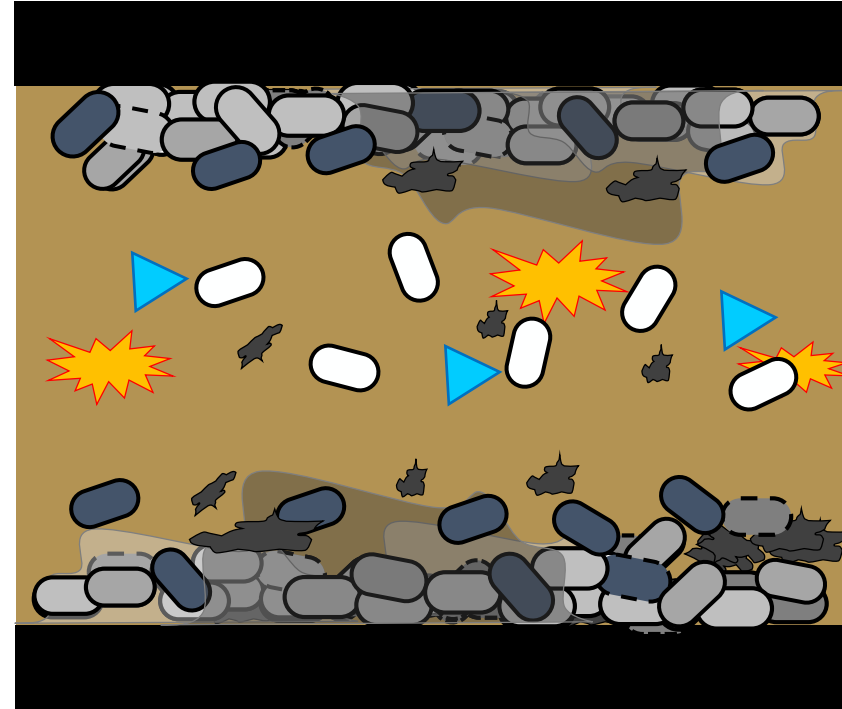
Normal water use refreshes:

- 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

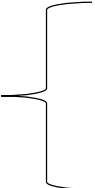
Corrosion control – used to reduce metals leaching, stabilizes pH and may add chemicals

Prior to the pandemic, stagnation posed health risks

During short-term 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)
 - Many of these organisms cause respiratory illness
 - Other infections can occur

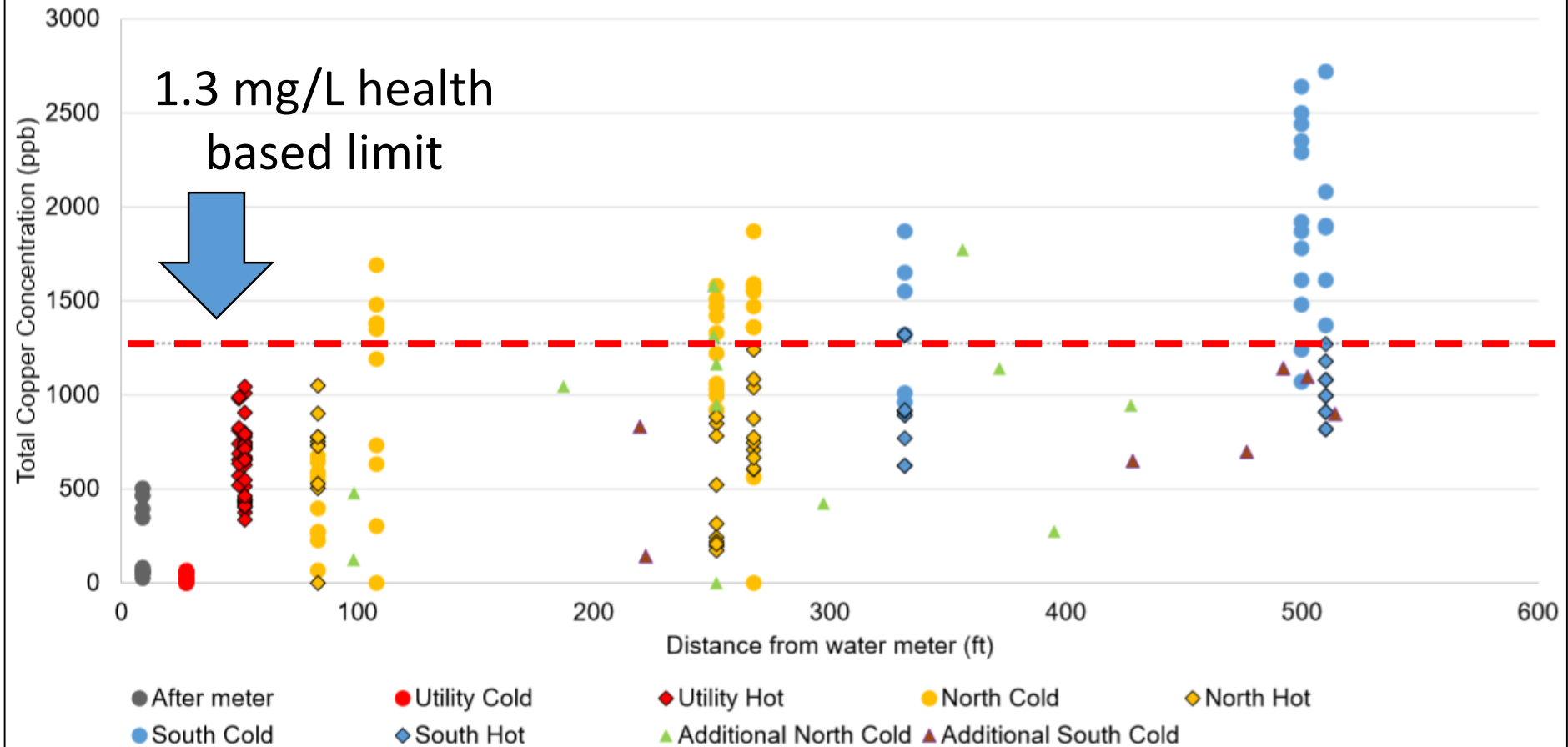
Exposure
Routes



- Ingestion
- Dermal
- Inhalation

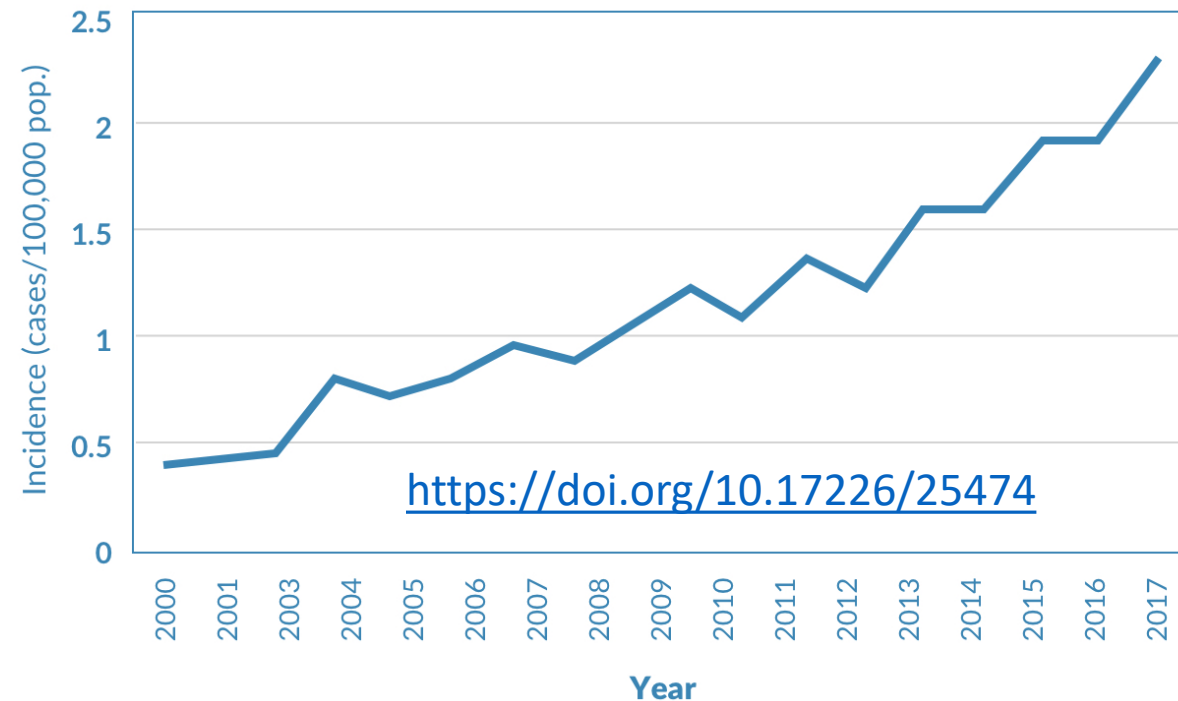
Most building water systems we've encountered often go untested, lack water management plans. Phenomena have not been studied in the long-term.

Copper vs. Distance from Water meter





- ✓ Drinking water systems that support biofilm growth to include cooling towers, hot tubs, fountains, and building plumbing systems and their outlets like faucets and showerheads.
- ✓ Warm temperatures + stagnant water + and no chemical disinfectant
- ✓ Exposure route: *Inhalation* of contaminated aerosols



Precautions Are Needed for COVID-19 Patients with Coinfection of Common Respiratory Pathogens

24 Pages • Posted: 12 Mar 2020

Quansheng Xing

Qingdao University - Qingdao Women and Children's Hospital

Guo-ju Li

Qingdao University - Qingdao Women and Children's Hospital

[More...](#)

[2020 Preprint]

THE LANCET

<http://dx.doi.org/10.2139/ssrn.3550013>

“The most common respiratory pathogens detected in Qingdao COVID-19 patients were influenza virus A (60.00%) and influenza virus B (53.30%), followed by *mycoplasma pneumoniae* (23.30%) and ***legionella pneumophila* (20.00%).**”



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



SAFE WATER ENGINEERING

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

Collaborative effort

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

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

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Northeastern
University



POLYTECHNIQUE
MONTREAL



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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
9. Purdue University, Lyles School of Civil Engineering, Division of Environmental and Ecological Engineering, 550 Stadium Mall Drive, West Lafayette, IN 47906; awhelton@purdue.edu; T: (765) 494-2160

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

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?

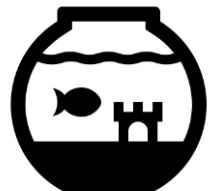
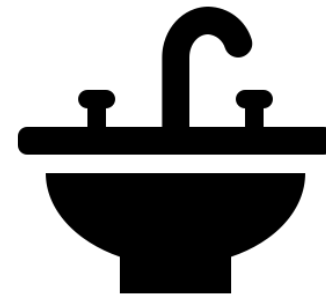
COVID-19 considerations

- 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



Safety: Engineering, Administrative, and Personal Protective Equipment (PPE) Controls

PPE

- OSHA and other agencies recommend respirators *if Legionella is suspected or possible*

Reducing exposure

- During flushing (especially initial), many methods 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

- Fill sink and floor drains traps with water
- Flooding, cross-connections, dealing with waste
- Pressure issues with high flowrate flushing



N95 respirators, but recommends voluntary use of N100 “if *Legionella* contamination is possible”.



Protecting Worker Health

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

Who should be involved in monitoring and/or returning the building water system to use?

- Public health departments, environmental health
- Communication about risks
 - Public health departments
 - Building owners [should seek advice from public health departments]
 - Utilities [generally don't understand plumbing]
- Taking action (flushing, disinfecting)
 - Building owners can task maintenance/facilities managers
 - Plumbers, contractors, engineers may need to be involved

When the pandemic struck, *no* guidance documents about building plumbing stagnation and recommissioning existed.

ZERO.

Today, more than 45 *different* building water system stagnation and recommissioning “guidance” docs have been created by

National governments

State governments

City governments


Public and private utilities

Private contractors

Trade industry associations

Nonprofit organizations

Device manufacturers



Ensuring Water Quality in Building Perme Plumbing

AFTER COVID-19

As the COVID-19 pandemic continues, the health and safety of the community is a top priority. Ensuring the quality of water in buildings is a critical part of this effort. The following are some key steps that building owners and managers should take to ensure the safety of their water supply.

1. **Test for lead and copper.** Lead and copper are two common contaminants found in water. They can be harmful to health, especially for children. Building owners should test for lead and copper in their water supply at least once a year. If the results show that there is a problem, they should take steps to fix it.
2. **Check for cross-connections.** A cross-connection is a connection between a potable water supply and a non-potable water supply. This can happen if a building has a backflow prevention device that is not working properly. Building owners should check for cross-connections and fix them if they are found.
3. **Inspect for leaks.** Leaks can cause water damage and can also lead to the growth of mold and bacteria. Building owners should inspect for leaks regularly and fix them as soon as they are found.
4. **Use certified plumbers.** Building owners should hire certified plumbers to install and maintain their plumbing systems. This will help to ensure that the systems are installed correctly and that they are maintained properly.

Actions for Building Owners and Managers

Building owners and managers should take the following actions to ensure the safety of their water supply:

- Test for lead and copper in their water supply at least once a year.
- Check for cross-connections and fix them if they are found.
- Inspect for leaks regularly and fix them as soon as they are found.
- Hire certified plumbers to install and maintain their plumbing systems.


By taking these steps, building owners and managers can help to ensure the safety of their water supply and protect the health of their community.

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

This website can be used to improve your response to a water supply interruption.

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



22th March 2020


We have been advised by the UK's Drinking Water Inspectorate that the safe management of water systems during the COVID-19 outbreak is of paramount importance. We have put together a website that contains information that will be particularly useful to those concerned about the long-term integrity that this important asset is subjected to during the outbreak. Advice resulting from COVID-19 guidance can not only help you to ensure any emergency from the COVID-19 pandemic is managed, but also ensure that water supply interruptions are avoided for as short a time as possible to be delivered to your customers.

The UK's general water supply legislation states that water supply interruptions are to be avoided for as short a time as possible to be delivered to your customers. As a result, water supply interruptions are to be avoided for as short a time as possible to be delivered to your customers. As a result, water supply interruptions are to be avoided for as short a time as possible to be delivered to your customers.


Being a UK water supply company, you will be aware that the UK's general water supply legislation states that water supply interruptions are to be avoided for as short a time as possible to be delivered to your customers. As a result, water supply interruptions are to be avoided for as short a time as possible to be delivered to your customers.

The importance for water supply companies is that they are able to ensure that water supply interruptions are to be avoided for as short a time as possible to be delivered to your customers. As a result, water supply interruptions are to be avoided for as short a time as possible to be delivered to your customers.

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Ohio
Division of
Public Safety



Ohio
Division of
Public Safety

Guidance for Premise Plumbing Water Service Restoration

When buildings and homes are damaged, the interruption of public water service can result in health and water quality deterioration that may pose serious risks.

Applicability

This guidance applies to all other jurisdictions for water service restoration following a public water supply interruption. It is intended to be used by the local health department and the local water utility. This guidance was developed by the Ohio Department of Health (ODH) and the Ohio Department of Public Safety (ODPS) in 2014.

Water Supply Interruption is Categorized as Public and/or Building

Public water supply interruption is categorized by the local health department and the local water utility. Public water supply interruption is defined as a water supply interruption that affects a large number of buildings, often affecting an entire town or village. Building water supply interruption is defined as a water supply interruption that affects a single building.

When a building water supply interruption occurs, the local health department and the local water utility should follow the guidance in this document.

When a public water supply interruption occurs, the local health department and the local water utility should follow the guidance in this document.

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SAFELY RE-OPENING BUILDINGS
a FACT SHEET
for Building Owners/Operators

prepared by the
Canadian
Water and Wastewater
Association

May 2020

CWWA  **WWTWA**

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

Make Sure Your Building's Water Supply and Devices Are Up to Standard

When you open your building doors to regular water use after a long period of closure, there are a number of things you should check to make sure your water supply and devices are up to standard. This includes checking the water supply, the water pressure, the water quality, and the water treatment equipment. If you have any of these items, you should check them before you open your building doors to regular water use.

Check the water supply. The water supply is the most important factor affecting water quality. If the water supply is not up to standard, the water quality will be poor. Check the water supply by looking at the water meter and the water pressure. If the water pressure is low, the water supply may be inadequate. If the water pressure is high, the water supply may be excessive. Check the water quality by looking at the water color, odor, and taste. If the water is discolored, has a strong odor, or tastes bad, the water quality may be poor. Check the water treatment equipment. If you have any water treatment equipment, you should check it before you open your building doors to regular water use. This includes checking the filters, the membranes, and the UV lamps. If any of these items are old or damaged, you should replace them before you open your building doors to regular water use.

Flushing the Building

Flushing the building is the process of running water through the pipes and fixtures to remove any stagnant water. This is important because stagnant water can become contaminated with bacteria and other microorganisms. Flushing the building can help to reduce the risk of contamination. To flush the building, you should run the water for a few minutes before you use it. This will help to remove any stagnant water and replace it with fresh water. The fresh water will help to reduce the risk of contamination. Flushing the building is also important for the water quality. Stagnant water can become discolored and have a strong odor. Flushing the building can help to remove the discoloration and the odor. Flushing the building is also important for the water pressure. Stagnant water can cause the water pressure to drop. Flushing the building can help to increase the water pressure. Flushing the building is also important for the water treatment equipment. Stagnant water can cause the filters, membranes, and UV lamps to become clogged. Flushing the building can help to keep the equipment clean and working properly.

Check the Water Quality

Check the water quality by looking at the water color, odor, and taste. If the water is discolored, has a strong odor, or tastes bad, the water quality may be poor. Check the water treatment equipment. If you have any water treatment equipment, you should check it before you open your building doors to regular water use. This includes checking the filters, the membranes, and the UV lamps. If any of these items are old or damaged, you should replace them before you open your building doors to regular water use.

Check the Water Pressure

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Page 2 of 2
Printed on 20/01/2018 at 10:00 AM

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**OKLAHOMA DEPARTMENT
OF ENVIRONMENTAL QUALITY**

Water Quality Recommendations for Opening Closed or Less Frequently Used Buildings

When building has been closed or less frequently used, the quality of the indoor environment in the building may have deteriorated. The following recommendations are intended to help you determine the quality of the indoor environment and to help you decide what actions to take to improve the indoor environment. The recommendations are based on the assumption that the building has been closed or less frequently used for at least 30 days. The recommendations are based on the assumption that the building has been closed or less frequently used for at least 30 days. The recommendations are based on the assumption that the building has been closed or less frequently used for at least 30 days.

1. Establish a ventilation schedule to increase outdoor air intake. The ventilation schedule should be based on the number of people in the building and the number of people in the building. The ventilation schedule should be based on the number of people in the building and the number of people in the building.
2. Change outdoor air intake of the heating, cooling and ventilation system to increase outdoor air intake. The outdoor air intake should be based on the number of people in the building and the number of people in the building.
3. Check for air leaks in the building. The air leaks should be based on the number of people in the building and the number of people in the building.
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10. Check for air leaks in the building. The air leaks should be based on the number of people in the building and the number of people in the building.

Do not inhale vapors or fumes.

The following recommendations are intended to help you determine the quality of the indoor environment and to help you decide what actions to take to improve the indoor environment. The recommendations are based on the assumption that the building has been closed or less frequently used for at least 30 days. The recommendations are based on the assumption that the building has been closed or less frequently used for at least 30 days. The recommendations are based on the assumption that the building has been closed or less frequently used for at least 30 days.

Painting new buildings and buildings that have been closed or less frequently used. The following recommendations are intended to help you determine the quality of the indoor environment and to help you decide what actions to take to improve the indoor environment. The recommendations are based on the assumption that the building has been closed or less frequently used for at least 30 days. The recommendations are based on the assumption that the building has been closed or less frequently used for at least 30 days. The recommendations are based on the assumption that the building has been closed or less frequently used for at least 30 days.

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These NEW documents have been informed by our paper, the document writer's firsthand experience, extrapolated from short-term evidence, and/or documents issued by others.

But, some lack key info.

HOT TOPIC: How do we avoid “recommissioning” the building water system due to low or no use?

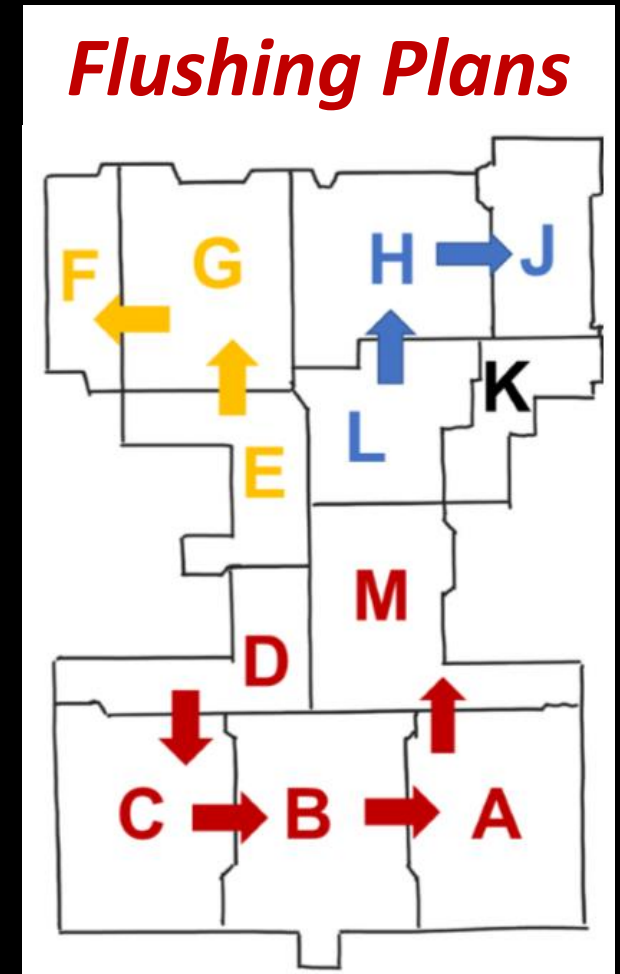
Keep the water moving! ≠ stagnation

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



HOT TOPIC: What plumbing recommissioning actions are needed after low to no water use?

What needs to be done when? – Evidence is lacking.

for perspective: ASHRAE 188 for NEW CONSTRUCTION

Shock disinfection should occur within 3 weeks of planned occupancy.

If occupancy is delayed >4 weeks, another shock disinfection is required prior to occupancy.

Key Considerations

1. System integrity, clean devices and equipment
2. Flushing
3. Shock disinfection (chemical, thermal)
4. Testing with a purpose and plan
5. Communicate with a purpose



Learn how to create a building flushing plan

The Purpose of Flushing Building Water Systems

Kyungyeon Ra, Graduate Student
Elizabeth Montagnino, Graduate Student
Dr. Caitlin Proctor, Postdoctoral Fellow
Dr. Andrew Whelton, Associate Professor

Division of Environmental and Ecological Engineering
Lyles School of Civil Engineering
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Key Calculations and Information Needed for Creating a Flushing Plan

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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)

Health departments: **Short-term**

1. **Determine the threshold that would prompt you** to require restrictions on water use in buildings with low or no occupancy such as: Handwashing Only, Do Not Drink Water, Do Not Use Water.
2. **Prepare communication materials** for building owners to distribute to occupants regarding water quality in buildings with low or no occupancy. These may include signs to post at water outlets to alert occupants about the status of the plumbing.
3. **Identify and alert regional labs** about a potential surge in the need for metals and harmful organism analysis.
4. Make certain they possess trained personnel, tools, and resources to assist society with re-occupancy efforts.
5. **Prepare to deliver guidance** to building owners and managers re-occupying buildings. Create a checklist for building water system re-occupancy approvals.
6. **Recommend building owners refresh their plumbing** by flushing fixtures to bring in fresh water. This can help prevent harmful organisms from growing in plumbing, and dispose of water with unacceptable levels of lead and copper.
7. **Prepare to assist building owners** assess potential health risks. This includes determining whether to require water testing, when and to collect water samples to assess human health risks.

Health departments: **Longer-term**

1. **Prioritize oversight of water being restored** to decommissioned health facilities, clinics, and long-term care facilities, and buildings serving vulnerable populations.
2. **Notify building owners** about the process your department has established for certifying or consenting to plumbing use where there's been low or no occupancy. Not all buildings, or even of the same type, will undergo the same process for restoring water quality.
3. **Determine the threshold that would prompt you** to require recommissioning actions such as flushing, fixture cleaning, disinfection, as well as chemical and microbiological testing.
4. **Prepare to deliver guidance** to building owners and managers re-occupying buildings. Create a checklist for building water system re-occupancy approvals.
5. **Remind regional labs** about a potential surge in the need for metals and harmful organism analysis.
6. **Reconfirm** the Health Department possesses trained personnel, tools, and resources to assist society with re-occupancy efforts.

**Many building
owners need
public health
support.**

Is legionella the only health risk?

Will the hospital / doctors detect legionella outbreaks?

Where do I find building water system reopening guidance?

What are the health risks of flushing?

What does a building water system flushing plan look like?

How long does each faucet need to flush?

How should the water be tested?

What legionella test method should I use?

If legionella is found, what should be done?

What is the right water heater temperature?

Can the water be treated in the plumbing without flushing it?

What needs to be done to the filters and other devices?

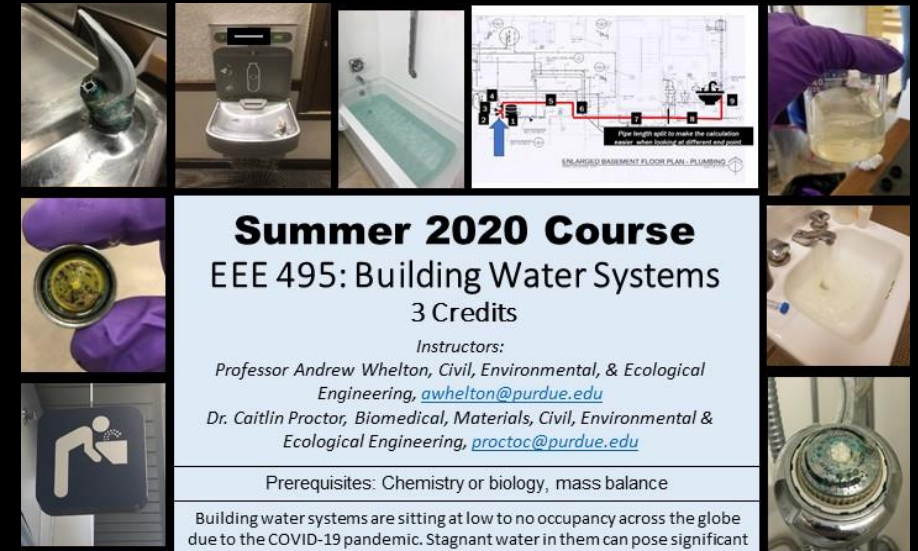
When is shock disinfection recommended?

How do I clean *[insert name]* device?

We are very interested learning about your experiences, your needs, the questions you have received, and helping you.

Thanks for doing what you do.

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



Summer 2020 Course
EEE 495: Building Water Systems
3 Credits

Instructors:
Professor Andrew Whelton, Civil, Environmental, & Ecological Engineering, awhelton@purdue.edu
Dr. Caitlin Proctor, Biomedical, Materials, Civil, Environmental & Ecological Engineering, proctoc@purdue.edu

Prerequisites: Chemistry or biology, mass balance

Building water systems are sitting at low to no occupancy across the globe due to the COVID-19 pandemic. Stagnant water in them can pose significant human health risks due to chemical and microorganism accumulation and exposure. Students will be introduced to engineering and science principles underlying building water systems, current issues associated with the pandemic, and how prior disasters affected water systems.

The learning objectives are to:

1. Describe the chemical and microbiological contaminants common to building water systems,
2. Explain the factors that control contaminant accumulation in building water systems,
3. Apply mass balance principles to predict contaminant levels and exposure concentrations,
4. Identify remediation practices for reducing contaminated water from the systems, and
5. Use as-built construction drawings to determine how to avoid and remediate water quality problems.

Students will:

1. Complete out of class learning assignments,
2. Participate in mediated discussions with the Instructors, and
3. Create a final project. This will include creating a flushing plan for a specific building and evaluating officially issued guidance. Students will read and interpret construction drawings, calculate volumes and flowrates, and use Microsoft® Excel.

Extra Slides

What do I test for?

BASIC PARAMETERS

Cold water =
disinfectant concentration,
temperature

Hot water =
temperature

For others, you need a
plan about what you will
do if you test: Lead,
copper, legionella, and
more

Section 3.185 Table 6: European Union Action Levels for *Legionella* in Potable Hot and Cold Water Systems

<i>Legionella</i> CFU/Liter	Action Required
Not Detected	Acceptable – continue monitoring
< 100 to 1,000	Refer to responsible person and assure water quality values are within target
> 1,000 to < 10,000	i) Resample if small percentage (10-20%) are positive; review control measures ii) If >20% positive may indicate low level colonization, disinfection of system, and risk assessment to determine additional actions
≥ 10,000	Resample, immediate review of control measures, disinfection of whole system

Source: EU (2017).

The EU guidelines emphasize the goal to achieve no cultural *Legionella*, but acknowledge that occasional detection (<20%) of low levels of *Legionella* (< 1,000 CFU/L) may be acceptable provided that other water quality values (e.g., temperature, disinfectant) and operational parameters are within the water management plan guidelines. Intermediate levels (> 1,000 to < 10,000 CFU/L) and high levels (≥ 10,000 CFU/L) trigger a series of actions including resampling, remedial measures such as disinfection, and overall review of the water management plan program.

10 actions building owners should consider

1. Contact with the 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.

