

 <p>HARVARD CAMPUS SERVICES</p> <p>ENVIRONMENTAL HEALTH & SAFETY</p>	<p>COVID-19</p> <p><u>Reopening Guidance: Prolonged Facility Shutdown/Reduced Operations</u></p> <p>Audience: Building & Facility Managers</p>	
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Introduction

This document provides reopening guidance for facility managers after a prolonged facility shutdown/reduced operation.

Three key areas for review and recommended inspections are:

Microbial and Bacterial Hazards

The temporary shutdown or reduced operation of a building and reductions in normal water use can create hazards for returning occupants.

Two potential microbial hazards that should be considered prior to reopening after a period of building inactivity are mold and *Legionella*. Additional guidance has been developed by the Centers for Disease Control and Prevention (CDC) for specialized equipment and water sources commonly associated with *Legionella*.

Integrated Pest Management

Buildings or spaces that have been unoccupied and unsupervised may be at enhanced risk from rodents and insect pests. Pest control services should continue in facilities during shutdown/reduced operation, and you should pursue additional precautions concerning rodents and other pests as you prepare to move back into your buildings.

The [Integrated Pest Management Chart](#) details proactive and preventative steps to help evaluate and reduce pest-associated risks.

Operational Inspection of HVAC Units

Where heating, ventilation, and air conditioning (HVAC) systems were shut down or use was significantly dialed back, documented inspection is a critical step in the preparation for re-occupancy. Inspection will help to ensure that units are clean, functioning, and ready for use.

Facilities personnel should be prepared to field questions from occupants around the steps taken to prepare their HVAC units for return to normal operations, and any improvements (if applicable) that may have been made to enhance indoor air quality (IAQ) in the building.



Microbial and Bacterial Hazards

The temporary shutdown or reduced operation of a building and reductions in normal water use can create hazards for returning occupants. Two potential microbial hazards that should be considered prior to reopening after a period of building inactivity are mold and *Legionella*.

Mold

Mold will grow on building materials where there is moisture, produced from leaks or condensation from roofs, windows, or pipes, or from a flood. Mold can grow on a variety of surfaces, such as ceiling tiles, wallpaper, insulation, drywall, carpet, and fabric.

If dampness or mold is detected, address the source of water entry first. Clean-up and remediation should then be conducted before the building is reoccupied. Plan the remediation before beginning work with your [Designated Safety Officer \(DSO\)](#).

Legionella/Other Bacteria

Stagnant or standing water in a plumbing system can increase the risk for growth and spread of *Legionella* and other biofilm-associated bacteria. When water is stagnant, hot water line temperatures can decrease leading them to fall within the *Legionella* growth range (77–108°F, 25–42°C). Stagnant water can also lead to low or undetectable levels of disinfectant, such as chlorine.

Ensure that your water system is safe to use after a prolonged shutdown to minimize the risk of Legionnaires' disease and other diseases.

This flushing guidance is based on flushing guidelines for premise plumbing and service lines to avoid or address a drinking water advisory. **The flow rates below are examples only** – you can calculate building specific flow rates based on the formulas below or apply industry standard practices.

Mechanical drawings of your building's plumbing design are recommended to develop and calculate proper flush times and flow rates. You may need an engineer to assist with the development of your building's specific flushing plan.



General Flushing Protocol

1. Cold water plumbing should be thoroughly flushed before the hot water plumbing is flushed or used in any way.
2. Avoid running water through endpoint devices (e.g., dishwashers, clothes washers, point-of-use (POU) devices, refrigerators, and ice machines) until the cold-water plumbing has been thoroughly flushed.
3. If the house has a point-of-entry filter, isolate the unit from the water system before beginning the flush protocol.
 - If POU filters being used, ensure that the filter is being bypassed.

Cold Water Flushing

1. Begin by running the cold-water faucet closest to the point of entry.

Progressively, from closest to point of entry to furthest, open all the other cold-water fixtures and allow the water to run for at least twenty minutes.

2. Starting from the tap closest to the point of entry should avoid spreading the contaminant throughout the building plumbing. Remove and clean all aerators where possible.
3. In bathrooms, begin by flushing toilets at least once.

If a bathtub has bath tap and shower head, direct flow through the bath tap.

Flush all external spigots for at least ten minutes.

4. After flushing all cold taps, re-direct bathtub tap flow to shower head, if applicable.
5. These steps should remove contaminated water from the service line and cold-water premise plumbing.

Hot Water Flushing

1. Once the cold-water pipes have been flushed, run the hot water tap closest to the hot water heater and proceed to simultaneously open all hot water fixtures.



2. For the hot water flush, if a bathtub has bath tap and shower head, direct flow through the shower headfirst.
3. Allow the hot water to run for enough time such that a complete flush of any hot water system (water heaters or storage tanks, supply lines, etc.) for and then turn off the faucets.

Example: At least 75 minutes for 80-gallon water heaters (see [Determining Flush Times Example formulas](#)).

4. This should drain the contaminated water from the heater and refill the tank with freshwater.
 - Direct shower head flow to bathtub tap, if applicable.
5. These steps should be effective at removing contaminants from the water heater. However, for information on draining and cleaning the water heater please consult the manufacturer.
6. After flushing hot water pipes and the water heater, run empty dishwasher, and washing machine and once on rinse cycle only.

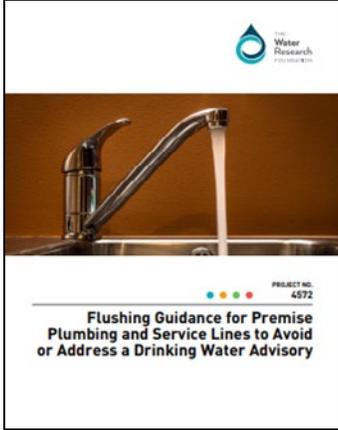
Additional Considerations

- Replace all water filters (e.g., whole-building filter, refrigerator filter, etc.) and empty ice from ice maker bin; run ice maker and discard two additional batches of ice.
- During the flushing, if a perceptible drop in pressure is evidenced by a decrease in flow, then flush each line and close the tap before opening the next tap.
- For multifamily residences, the same flushing procedure should be used. However, for larger buildings with distinct pressure zones, each pressure zone should be flushed separately using the protocol outlined above.
- The minimum flushing time to clear the service line would be two minutes. Since contaminant properties, building materials and plumbing configurations can vary widely, a safety factor of ten and five was used for indoor faucets and outside spigots respectively. Therefore, a flushing time of twenty minutes and ten minutes was recommended for indoor faucets and outside spigots, respectively.
- The same procedure described above can be used for developing flushing guidance for commercial and multifamily buildings.



Determining Flush Times

Example



[Flushing Guidance for Premise Plumbing and Service Lines to Avoid or Address a Drinking Water Advisory, Page 33](#)

Justification

Determination of Faucet Flushing Time

The minimum flushing time is determined by the time required to transport clean water from the distribution main to faucets in the building. Assuming four faucets in the building, a flow rate of 0.8 gallons per minute (gpm) for each faucet, a service line length of 150 feet, and a pipe diameter of 1 inch, the minimum flushing time can be calculated as follows (Burlingame et al. 2012):

$$\text{Flushing Time} = \frac{7.48 \text{ gal}}{1 \text{ ft}^3} \times \frac{3.142 \times \left(\frac{\text{Service Line Diameter (ft)}}{2}\right)^2 \times \text{Length (ft)}}{\text{Number of faucet} \times \text{Flow Rate (gpm)}}$$

$$\text{Flushing Time} = \frac{7.48 \text{ gal}}{1 \text{ ft}^3} \times \frac{3.142 \times \left(\frac{1}{12} \text{ ft}\right)^2 \times 150(\text{ft})}{4 \times 0.8 \text{ gpm}}$$

Flushing Time = 2 Minutes

The minimum flushing time to clear the service line would be two minutes. Since contaminant properties, building materials and plumbing configurations can vary widely, **a safety factor of 10 and 5 was used for**



indoor faucets and outside spigots respectively. Therefore, a flushing time of twenty minutes and ten minutes was recommended for indoor faucets and outside spigots, respectively. The same procedure described above can be used for developing flushing guidance for commercial and multifamily buildings.

Determination of Water Heater Flushing Time

Assuming that the water heater hydraulics are similar to a continuously stirred tank reactor, the minimum flushing time required to reduce the concentration of a given contaminant by 90% can be calculated as follows (Casteloes et al. 2015):

$$\frac{C}{C_0} = e^{-\frac{(nQ)}{V}t}$$

where:

C = Final concentration

C₀ = Initial concentration in the tank

n = Number of faucets

Q = Flow rate=0.8 gpm; including aerator restricted flow

V = Tank volume=80 gallons

t = Flushing time, minutes

$$t = \frac{V \ln|0.1|}{nQ}$$

$$t = \frac{V \times \ln|0.1|}{nQ} = \frac{80 \times \ln|0.1|}{4 \times 0.8} = 58 \text{ minutes}$$

References

- [CDC: Guidance for Reopening Buildings After Prolonged Shutdown or Reduced Operations](#), Retrieved May 14, 2020



- [Flushing Guidelines for Premise Plumbing and Service Lines to Avoid or Address A Drinking Water Advisory](#), Retrieved May 14, 2020
 - Chapter 4 provides detailed methods
- [Water Quality in Low Occupancy and Shutdown Buildings](#), Retrieved May 14, 2020
- [Cooling Technology Institute: Guideline: Best Practices for Control of Legionella](#), Retrieved May 14, 2020

Integrated Pest Management

Buildings or spaces that have been unoccupied may be at increased risk from rodents and insect pests. You should maintain your pest control services during shutdown/reduced operations. Consider additional pest monitoring and mitigation efforts as you prepare to move back into your buildings.

The [Environmental Health and Safety \(EH&S\) Environmental Public Health \(EPH\) Pest Control Program](#) provides oversight for the prevention and elimination of pests on campus, helping to enhance the living and working conditions for all members of the Harvard community. Our goal is to ensure that requests for assistance are addressed in a timely fashion through our licensed vendors.

The [Integrated Pest Management Chart](#) details proactive and preventative steps will help evaluate, control, and reduce the overall pest risk.



Integrated Pest Management Chart

Category	Problem	Recommendations
Plumbing Traps	Evaporation permits sewer gases and pests to pass unabated.	<ul style="list-style-type: none">• Rehydrate every drain twice per month.• Run each faucet for sufficient time to fill the plumbing trap (~15 seconds for a sink and tub/shower drains).• Add water manually to each floor drain/floor sink (~1 gallon each).• Flush toilets monthly and add ~1 quart of water to urinals.• Add EverPrime to drains to retard evaporation.
Plumbing Traps	Stagnant water and organic material supports thriving populations of flies and other pests.	<ul style="list-style-type: none">• Ensure drains (including plumbing traps) are clean of organic material.• Pest management vendor or custodians may apply a foaming enzymatic bio-cleaner to drains.



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Category	Problem	Recommendations
Ejector Pits and Sumps	Stagnant water will support populations of flies and roaches.	<ul style="list-style-type: none">• Running faucets in building will help dilute and purge contents of ejectors.• Ensure pest control vendor inspects each pit for pests. Pits may be treated if appropriate.• Clean and seal or cover pit/sump lids to prevent passage of pests.
Grease and Oil Interceptors	Stagnant water will support populations of flies and roaches.	<ul style="list-style-type: none">• Ensure each interceptor is pumped/cleaned.• Running water will help maintain these hydrated.
Trash	Organic residue in waste, recycling, and compost receptacles will attract and nurture pests.	<ul style="list-style-type: none">• Clean each receptacle well and store dry.• Clean trash rooms well, and keep doors closed at all times. Ensure doors are fitted with rodent-resistant sweeps.



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ENVIRONMENTAL HEALTH & SAFETY

Category	Problem	Recommendations
Food/Candy	Foods, candies, dry beverages, fruits, cough drops, and other nutritious items left on shelves, desktops, or in drawers, cabinets, and elsewhere will attract and nourish pests.	<ul style="list-style-type: none">• Inspect areas for pests frequently (at least twice per month).• Dispose of any abandoned food items that are not securely contained.• Be mindful of items hidden from view are attractive and accessible to pests.
Kitchenette/Office Appliances	Stored foods in refrigerators will become foul. Food crumbs and debris will attract pests.	<ul style="list-style-type: none">• Empty all kitchenette/office refrigerators of food. Turn off these appliances (to save energy), clean the interiors well, and block the doors ajar so that the units remain dry and will not support mold growth.• Unplug, empty and clean toasters, ovens, etc.
Doors	Rodent and insect pests will attempt to enter buildings beneath exterior doors.	<ul style="list-style-type: none">• Inspect each exterior door and threshold. If a standard wood pencil fits beneath, then mice can pass.• Consider appropriate steps to mitigate (e.g., rehang door, install/repair threshold, or rodent-resistant sweep).



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Category	Problem	Recommendations
Windows	Open windows may permit invasion by pests and rain.	<ul style="list-style-type: none">• Check that windows are closed and/or otherwise protected by properly fitted screens that are in good condition.
Pest Monitoring/ Interventions	Pests may increasingly try to invade and may thrive in the absence of human activity.	<ul style="list-style-type: none">• Ensure that the pest management vendor visually inspects the premises and services traps and other devices.• In areas where textiles (including clothing, rugs, and artifacts) are present, consider having the pest management vendor deploy pheromone traps for textile-damaging pests.• Consider having the pest management vendor deploy secure rodenticide stations during long shut down intervals. Each station should be labeled, and the position documented. These should be examined periodically by the vendor and removed at least one week prior to reopening of the facility.
Food Facilities	Pests will attempt to invade stored foods (including dry foodstuffs and contents of standing and walk-in cold boxes).	<ul style="list-style-type: none">• Ensure that all foods are in pest-secure containment.• Rodents will attempt to breach refrigerators and freezers (and walk-in cold boxes) by gnawing through door gaskets. Inspect contents periodically.• Ensure gaskets are secure and effective.



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Category	Problem	Recommendations
Food Facilities	Pests will gnaw/scrape accumulated grease and food debris.	<ul style="list-style-type: none">• Take the opportunity to deep clean otherwise difficult-to-reach areas beneath and behind equipment.• Ensure that fryers are drained of oil and are completely cleaned.
Fireplaces	Bats and birds (and some insects) may enter buildings via open flues.	<ul style="list-style-type: none">• Ensure chimneys are protected by screened caps.• Close all fireplace dampers.
Rugs	Carpet moths and beetles thrive on organic debris (food crumbs, leaf fragments, shed skin flakes, etc.) accumulated in rugs.	<ul style="list-style-type: none">• Vacuum well all rugs, particularly around the edges of rooms and furniture. Note that vacuum beater brushes tend not to effectively reach walls and room corners. Use a hose and nozzle to thoroughly clean these spaces.• Where appropriate, consider the opportunity of shampooing and/or steaming the carpets to thoroughly clean them, and dry them well.
Fixed Treatment Units (FTU)/Fixed Control Units (FCU)	Pipe penetrations leading to these units are frequently used by mice and other pests. Dust and debris within units reduces heat transfer.	<ul style="list-style-type: none">• Inspect and clean the interiors (and heat-transfer fins of all units).• Seek and seal all penetrations using rodent-resistant materials (not expanding foam).



HVAC Unit Operational Inspection

Following prolonged periods of limited occupancy or facility closure it is critical that building HVAC systems are inspected, serviced, and operated prior to re-occupancy.

This checklist provides a framework for preparing the HVAC systems in general occupancy facilities to return to service. This should be completed prior to return of non-essential occupants to your buildings by appropriate trades personnel. This checklist assumes that all relevant industry standards are already met.

Low Occupancy

Run systems periodically to ensure proper operation and prevent adverse IAQ effects.

Prep for Reoccupancy

Prior to reopening, all systems should be enabled for a period of 24-48 hours, inspected for proper operation, and allowed to flush the building with fresh air (based on system design). Restart systems methodically to prevent overload from simultaneous start.

HVAC Systems Checklist

Topic	Description
Filtration	<ul style="list-style-type: none">• Filters are of a minimum efficiency reporting values (MERV) rating appropriate for the equipment.• Filters have been replaced within the appropriate time period and are clean• Inspect filter areas and vacuum if needed.• Inspect and confirm proper fit/seal of filters to prevent air from bypassing filters.• Inspect filters and confirm correct direction of airflow.



Topic	Description
Condensate	<ul style="list-style-type: none">• Condensate drain pans are properly pitched, clean and free of debris.• Condensate drain pans have fresh anti-microbial treatments.• Condensate lines are properly pitched, free of obstructions and drain freely.
Coils	<ul style="list-style-type: none">• Inspect hot water/chilled water (HW/CW) coils and clean if needed.
Fresh Air (<i>for facilities with mechanical ventilation</i>)	<ul style="list-style-type: none">• The percentage of fresh air is appropriate for the capabilities of the HVAC system (given balance, humidity considerations).• Inspect outside air dampers for proper operation.• Inspect outside air intakes: Verify no obstructions, debris, clogs, or pollutant sources; Screens are clear.
Exhaust	<ul style="list-style-type: none">• Inspect exhaust fans (functioning, belt wear and proper tension).• Test exhaust airflow at exhaust vents inside with tissue paper.• Pollutant sources from bathrooms and kitchens are controlled by keeping these spaces under negative pressure.
Refrigerant (<i>direct expansion (DX) systems</i>)	<ul style="list-style-type: none">• Check refrigerant levels and adjust if needed.
Preventive Maintenance	<ul style="list-style-type: none">• A schedule is developed and implemented for preventive maintenance of HVAC equipment.
Building Management Systems (BMS) (<i>if equipped</i>)	<ul style="list-style-type: none">• Review graphics to confirm set points are being met (i.e., discharge air set points, static air pressure controls).• Review system, address and clear all automation alarms.• Confirm occupied/unoccupied schedules.



Topic	Description
General	<ul style="list-style-type: none">• Adjust standalone temperature controls.• Inspect moving parts and lubricate where needed.• Inspect chilled water and hot water pumps and seals upon restart.• Mechanical rooms are clean, free of leaks, spills, and odor-producing sources.• HVAC systems are appropriately enabled for the anticipated level of occupancy. Continue to communicate with department managers to plan for incoming phases.
Optional strategies for improving IAQ to consider (<i>where feasible</i>)	<ul style="list-style-type: none">• Cubic feet per minute (CFM) per occupant has been considered and optimized based on system capabilities.• Verify ventilation performance with real-time monitoring of carbon dioxide (CO₂).• Increase MERV rating of your filtration where appropriate.