



**University of Toronto**  
**Utilities and Building Operations**

**Water Maintenance Program**  
**(Potable Water)**

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## **University of Toronto - Water Maintenance Program**

### **Purpose of Maintenance Program**

The purpose of each of the Maintenance Procedures described in this document is to confirm the system is functioning effectively, which means the following:

- Potable water is distributed to the point of use in a manner ensuring safety of the user.
- Contaminants in the water are controlled to concentrations below the standards set in the Ontario and Health Canada Drinking Water Guidelines inclusive of lead and *Legionella*.

### **Lead**

Potable water on the campus's has been confirmed through testing to have concentrations below the standards set in the Ontario and Health Canada Drinking Water Guidelines. Regulatory changes in 1955 prohibited the use of lead in plumbing applications used for potable water. The University has proactively removed all known lead piping since 1955. To the University's knowledge, no piping containing lead is used for potable water on site. A further regulatory change in 1990 prohibited the use of lead solder in pipe connections. Again, the University has proactively removed known lead solder connections from site when encountered.

### **Lead Surveillance**

The University started to do comprehensive testing for lead in 2013. Over the following years the University tested most buildings on the St. George campus and closed or remediated any systems that were contributing to lead in water. The sampling is conducted using the UofT Lead in Water Sampling Standard Operating Procedure (SOP). The areas where issues were identified were few and concentrated in buildings built prior to the 1950's when lead piping was still legal for use. At present, the problem sources have been remediated and sampling will be conducted on an as requested basis.

### **Legionella**

#### **Procedures within Maintenance Program**

The Maintenance Program is composed of three procedures, each of which is further described below:

1. Preventative Maintenance Procedure - ongoing maintenance on a fixed schedule to ensure ongoing asset integrity.
2. Predictive Maintenance Procedure - a risk-based predictive approach to systematically ensure the minimization of *Legionella* bacteria in the campus potable water systems ongoing. This is based on trended data variance analysis indicating presence of *Legionella* and risk environments.
3. Re-Entry Maintenance Procedure - protocol to be followed if a low-flow or shutdown condition has existed for 4 consecutive weeks within a specific building or in the event of a mass re-entry following a low-flow or shutdown of a significant number of campus buildings.



### **Scope of Water Maintenance Program**

This Maintenance Protocol is specific to the University of Toronto potable hot and cold water only. The ongoing operational maintenance at the point of use such as drinking fountains and water refill stations is not included in this scope.

### **Waterborne Pathogens**

The most common waterborne pathogen is *Legionella*, and therefore guidance for preventing waterborne pathogens is built around guidance for preventing *Legionella*. Although there are many other bacteria that are pathogens the most common bacteria requiring control in building potable water systems requiring control is *Legionella*. The risk of *Legionella* is most apparent in Building Potable Water Systems (BPWS) providing hot water.

The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) provides guidance on water system maintenance including Guideline 12: Minimizing the Risk of *Legionellosis* Associated with Building Water Systems. The Guideline states, "The most effective control for most diseases, including *Legionellosis*, is prevention of transmission at as many points as possible in the disease chain of transmission". A good flushing program is intended to remove contaminants from the system, not relocate them within the system. This is the approach taken by the University as described in these Procedures.

## 1. Preventative Maintenance Procedure

Ongoing, regular maintenance of the potable water system is required to ensure the integrity of the water system as an asset of the University of Toronto. Preventative maintenance follows a fixed schedule that is asset-specific and provides the foundational requirements for ongoing operations.

### **Scheduled Preventative Maintenance Tasks and Frequency**

#### Annual

- a) Drain, flush and clean hot water tanks

#### Monthly

- a) Verify hot water storage maintained at 60°C (140°F), 50°C (123°F) in the distribution system, and point of use at 43°C (110°F) at last point of use in the distribution system
- b) Verify cold water storage and distribution below 20°C (68°F)
- c) In buildings with indicative low flow conditions in the extended distribution system inclusive of hot and cold water systems to be flushed for ½ hour at all points of use.

### **Scheduled Preventative Verification (monitoring for presence of *Legionella*)**

Verification is performed using q PCR DNA *Legionella* Test method to understand presence and/or concentration of Colony Forming Units (CFM) present in the water. The q PCR DNA *Legionella* Test method will be verified by a 3<sup>rd</sup> party laboratory using culture methodology on a number of occasions annually based on frequency of testing.

#### Monthly

- a) Locations with hot water storage below 50°C (122°F) verified at the storage tank

#### Bi-Annual

- a) Shower facilities verification at the most remote shower in the distribution system in the absence of showers the most remote fixture annually.

## 2. Predictive Maintenance Procedure

The Predictive Maintenance Procedure uses a risk-based predictive approach to systematically ensure the minimization of *Legionella* bacteria in the campus potable water systems operationally ongoing. This is based on the trended presence of *Legionella* identified by prior predictive investigations and risk environments. This approach is also used to prioritize re-entry maintenance after a prolonged shutdown, construction or low-flow situations that exceed four weeks.



The methodology will include identification of “**Risk Based Predictive Indicators**” for all buildings on site using the criteria immediately following. The buildings will then be categorized using the “**Overall Building Risk Categorization**” to prioritize the individual buildings. This will directionally indicate the criticality of building susceptibility to Legionella contamination enabling setting of priority and building sequence for testing.

**Risk Based Predictive Maintenance Indicators**

Individual buildings are assessed for inherent contamination risks, as listed, specific to both hot and cold water systems with acknowledgement to building age and plumbing life cycle to set the schedule.

Hot Water

a) Hot water storage temperature 60°C (140°F) or above	<b>Risk</b> Low
b) Hot water Storage temperature 50°C (122°F) to 60°C (140°F)	Medium
c) Hot water Storage temperature below 50°C (122°F)	High
d) Water distribution temperature below 50°C (122°F)	High
e) Prolonged period of low flow	High
f) No water recirculation loop	High
g) Showers facilities (excluding emergency showers)	High

Cold Water

a) Cold water storage temperature below 20°C (75°F)	<b>Risk</b> Low
b) Cold water temperature 20°C (75°F) to 35°C (95°F)	Medium
c) Water storage and/or distribution temperature above 24°C (75°F)	High
d) Prolonged period of low flow	Low-Medium
e) Potential for potable and process water cross contamination	High

**Building Prioritization Categorization**

The identified building risk levels are then categorized and sorted using low, medium, and high as follows

**Overall Building Risk Categorization**

Characteristics

1. Identification of any high risk characteristics	<b>Building Risk</b> High
2. Identification of low – medium and medium risk characteristics	Medium
3. Identification of low risk characteristics	Low



### **3. Re-Entry Maintenance Procedure**

The procedure is to prepare the University of Toronto potable water systems serving the campus buildings for re-entry after a prolonged shutdown or low-flow situation that exceeds four weeks.

The City of Toronto Water service is continually in use, as such not considered stagnant. The immediate building feed from the City water main to the building is continuously moving as illustrated by monthly City Water Billings. The location of possible water stagnation is internal to the individual buildings, and accordingly flushing will focus on that aspect.

#### **Facilities to apply Flushing Procedure**

Since the main pathway for exposure to *Legionella* is breathing aerosols the risk arises from activities creating small droplets (aerosols) inhaled by the individual. As such, the areas of flushing to remove or minimize the legionella risk are as follows.

1. Sinks or hand/face wash facilities, custodial sinks, ice machines, hose bibs, generally all outlets creating mist. (Spray from taps and steam)
2. Food Preparation
  - a. Serveries (Spray from taps, coffee machine)
  - b. Kitchenettes (Spray from taps, coffee machines)
3. Showers or bath areas due to creation of steam / mist
4. Toilet or Urinal facilities (swirling action of flushing)
5. Drinking Fountains

#### **Flushing Procedure:**

Step 1 - Identify all risk locations as described that have not been used in the last four weeks (PPE requirements identified further in the document)

Step 2 – Remove all components from the fixtures that create the risk.

- a. Shower Heads
- b. Faucet Aerators

Place the removed components in solution containing 2.25% sodium hypochlorite solution during the step 3 activities to remove any contaminants.



Step 3 - Commence flushing depending on specific facilities as follows:

**a. Sinks or Hand/Face wash Facilities/Food Preparation Areas\***

1. Cold Water

Flush cold water until the water is clear, and once clear, for a further 10 minutes. If water becomes turbid (discoloured) during flushing, continue flushing until it becomes clear again, and for a further 10 minutes once clear. To minimize splashing place a cloth or shroud over the faucet enabling the water to drop to the drain contained in the shroud.

2. Hot water

After cold water flush, flush hot water at 50°C (122°F) for 15 minutes. If the water becomes turbid, flush until water becomes clear, and for a further 15 minutes once clear. To minimize splashing place a cloth or shroud over the faucet enabling the water to drop to the drain contained in the shroud.

**\*Food preparation areas** as described above to be flushed using the same methodology as ‘Sinks or Hand / Face Wash Facilities’. Any equipment left undrained during last 4 weeks must be drained then cleaned in accordance with the original manufacturer’s instructions.

**b. Showers and Bathing Areas:**

1. Remove the showerhead and the faucet aerator, then place them in a 2.25% sodium hypochlorite solution. Affix a hose over the shower pipe to empty directly to the floor drain. Place a towel over the hose at the floor drain to eliminate possibility of spray or splash back. Flush the faucet at the same time as the shower; ensure splashing is minimized by using a shroud.

Cold Water

2. Flush cold water until the water is clear, and once clear, for a further 10 minutes. If water becomes turbid (discoloured) during flushing, continue flushing until it becomes clear again, and for a further 10 minutes once clear. To minimize splashing place a cloth or shroud over the faucet enabling the water to drop to the drain contained in the shroud.



Hot water

3. After cold water flush, flush hot water at 50°C (122°F) for 15 minutes. If the water becomes turbid, flush until water becomes clear, and for a further 15 minutes once clear. To minimize splashing place a cloth or shroud over the faucet enabling the water to drop to the drain contained in the shroud.
4. Remove towel and or shroud and place it in the bleach solution. Remove hose and place it in the bleach solution to remove possible contaminants.
5. Replace the showerhead and aerator; turn on water to ensure it is not leaking.

**c. Toilets and urinals:**

1. The toilets and urinals operate using cold water provided by the City of Toronto at approximately 8°C (46°F). Legionella is considered a low risk in water colder than 20°C (75°F). If the facilities have not been used or cleaned in the past four weeks, the facilities to be flushed twice to remove line debris.

**d. Drinking Fountains:**

1. Drinking fountains are operated using cold water, less than 20°C (75°F), and therefore legionella is considered a low risk. Fountains should be flushed for 10 minutes to clear the system including any accumulated debris that might exist. The ongoing operational maintenance at the point of use such as drinking fountains and water refill stations is not included in this scope.

**Required Personal Protective Equipment (PPE):**

The individuals performing the described flushing (except water fountains) are required to use the following PPE.

1. Gloves (Green Nitrile Examination Gloves – powder free & latex free)
2. Fit tested respirator with P100 filtration.

**Verification of procedure effectiveness:**

Buildings that have been subject to the above procedure will be randomly tested using an appropriate sampling system using a legionella quick test methodology performed by a competent trained individual, overseen by the University EHS Department. The preferred testing in accordance with ISO 11731-1998 and 150/TTS 11731-2-2004 uses the qualitative polymerase chain reaction (q-PCR DNA) methodology.



**Results of Verification testing (Response Protocol):**

The use of the q PCR DNA *Legionella* Test in accordance with ISO 11731-1998 and ISO/TTS 11731-2-2004 provides a measurement of live *Legionella* Colony Forming Units (CFU). The measurements are categorized into different levels based on the concentration of CFU found, as follows:

1. Green - (0 to 10 CFU per ML)
2. Orange - (11 to 100 CFU per ML)
3. Red - (101 to 1000+ CFU per ml)

**Remedial Action based on Categorization:**

Based on measurements using the q PCR DNA methodology remedial activity is guided by the following two sources:

- **Public works and Government Service Canada**  
MD15161-2013 Control of Legionella in Mechanical systems
- **Ontario Agency for Health Protection and Promotion (Public Health Ontario)**  
*Legionella: Questions and Answers* 2<sup>nd</sup> Edition Toronto ON; Queens Printer for Ontario: 2019

Based on the categorization of results, remediation is required through response protocols described below. The streamlined (Green, Orange, Red) categorization aligns to the remediation methodology employed by the University. The Green requires no remediation, Orange and Red requires thermal shock (hot water) as described. Hyperchlorination as described is an unacceptable method in the University environment, the plumbing systems designed for institutional use cannot be relied to fully remove residual high concentrated chlorine. This exposes the system user to the possibility of unintended exposure.

Note the previous Standard Operating Procedure delineated a Yellow category (11 to 100 CFU), this has been defined as the Orange category with the Red (101 to 1,000+) to ensure proactive thermal treatment as all findings exceeding normal operations and maintenance.

- 1. Green**
  - *Legionella* Bacterial Count less than 10 CFU per ML

**Response Protocol**

- Continue with normal operations and maintenance

- 2. Orange**
  - *Legionella* Bacterial Count 11 CFU to 100 CFU per ml



### Response Protocol

- Continue with normal operations and maintenance
- Verify storage tank operating temperature minimum 60° (140°F)
- Immediately flush at point of use as follows:
  - ✦ Remove water mixing valve and faucet aerator at point of use. Place both mixing valve and aerator into container with solution of water and minimum of 2.25% hypochlorite, for one hour.
  - ✦ Flush cold and hot water for 1 hour each.
  - ✦ After flush, replace mixing valve and faucet aerator then flush with cold water for 10 – 15 minutes to remove bleach from system.
- Retest 36 hours later

### **3. Red**

- *Legionella* Bacterial Count 101 CFU to 1000+ CFU per ML

### Response Protocol

- Isolate the point of use location from public usage
- Flush the point of use location using described level orange procedures
- Disinfect the storage tank in accordance with the following disinfection methodology:

**Communication:** Occupants will be advised of orange and red *Legionella* test results through Facilities and Services alerts. Identification will be placed at point source for red results only using signage and caution tape.

### **Thermal Shock – initial methodology**

- Increase Storage Tank Temperature to 77°C (170°F) for 24 hours.
- Remove water mixing valve and faucet aerator or shower head at point of use. Place both mixing valve, aerator or shower head into container with solution of water and minimum of 2.25% hypochlorite, for one hour.
- Flush all outlets on system for 20 minutes using hot water.
- Retest system 36 hours later.
- Provided test results confirm reduction of CFU to acceptable levels, replace mixing valve and faucet aerator then flush with cold water for 10 – 15 minutes to remove bleach from system.
- Points of use to be isolated from public use until test results confirm reduction of CFU to acceptable levels.



**Hyper chlorination - methodology to be followed if initial methodology did not result in reduction of CFU to acceptable levels**

- Use chlorine approved for use with potable water and use in accordance with directions from the supplier/service provider.
- Add chlorine to the system at the holding tank.
- Close all system outlets.
- Disinfect with chlorine for minimum of 2 hours not to exceed 24 hours.
- Flush entire system including any dead-end lines for 30 minutes to remove chlorine residual in system.
- Measure chlorine level in water at points of use to confirm concentration below potable heater regulated levels.
- Retest 36 hours later
- Provided test results confirm reduction of CFU to acceptable levels, replace mixing valve and faucet aerator then flush with cold water for 20 minutes to remove hypochlorite from system.
- Retest system 7 days later to verify maintained reductions of *Legionella* CFU.
- Points of use to be isolated from public use until test results confirm reduction of CFU to acceptable levels.



## **APPENDIX**

### **Links Below**

#### **Document 1**

Public Works and Government Services Canada MD15161-2013 Control of

*Legionella* in Mechanical Systems <https://www.tpsgc-pwgsc.gc.ca/biens-property/documents/legionella-eng.pdf>

#### **Document 2**

Ontario Agency for Health Protection and Promotion (Public Health Ontario)

*Legionella*: Questions and Answers 2<sup>nd</sup> Edition, Toronto, ON Queens Printer for Ontario, 2019  
<https://www.publichealthontario.ca/-/media/documents/F/2019/faq-legionella.pdf?la=en>



**Document Change Control**

The document is change controlled by the signatory committee identified on the title page. All changes to this document must be justified and approved by Director Utilities and Building Operations, Director Research Safety & Compliance and Exec. Director Occupational Health. The changes/revisions will be documented in the following table.

This document will be reviewed and edited as required using Change Control every five years.

Document Section Revision	Revision Description	Date
Scope of Water Maintenance Program	Addition – The ongoing operational maintenance at the point of use such as drinking fountains and water refill stations is not included in this scope.	14 September 2022
(2) Preventative Maintenance Program (PM) (Risk Based PM Indicators) (9) Hot Water	Addition – (Excluding emergency showers)	14 September 2022
(2) Preventative Maintenance Program (PM) (Risk Based PM Indicators) (F) Cold water	Remove – Shower facilities eye wash stations are flushed weekly) - High	14 September 2022
(3) Re-entry Maintenance Procedure (Drinking Fountains)	Addition – The ongoing operational maintenance at the point of use such as drinking fountains and water refill stations is not included in this scope.	14 September 2022
(3) Re-entry Maintenance Procedure (Required personal protective equipment (PPE) (Results of verification testing (Response Protocol)	Correction – 150/TTS 11731-2-2004 to ISO/TTS 11731-2-2004	14 September 2022
(3) Re-entry Maintenance Procedure (Remedial Action Based on Categorization (Red) (Communication)	Correction – Occupants will be advised of orange and red <i>Legionella</i> test results. Notifications will occur through existing facilities management notification processes. Signage will be posted at point of source location for red level test results.  To  Occupants will be advised of orange and red results through Facilities and Services alerts. Identification will be placed at point of source for red results only using signage and caution tape.	14 September 2022
Document Change Control	Correction – All changes to this document must be justified and approved by Director Utilities and Building Operations, Director Research Safety and Compliance, Director Occupational Health and Safety, Chemical & Laboratory Safety Specialist, and site Senior Bio-Safety Officer.  To  All changes to this document must be justified and approved by Director Utilities and Building Operations, Director Research Safety and Compliance and Exec Director Occupational Health and Safety	14 September 2022