Developing a Building Water Management Plan

August 2020

NYC Health

Introduction

Effectively managing your building's water system can help you protect your residents from Legionnaires' disease and Pontiac fever, illnesses that can be caused when *Legionella* bacteria grow in building plumbing or fixtures. The New York City Department of Health and Mental Hygiene (NYC Health Department) investigates illnesses caused by *Legionella* bacteria and may require a building owner to test their water for these bacteria and develop a building water management plan to protect residents.

This guide provides a framework to help you develop a water management plan tailored to your building. If you need additional information, please contact the NYC Health Department's Office of Building Water Systems Oversight at BWEvaluation@health.nyc.gov or 718-310-2850.

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SECTION 1: Overview

An effective water management plan (WMP) applies the principles of hazard analysis and critical control points (HACCP) to effectively control *Legionella* bacteria. The HACCP process aims to identify potential hazards in a building's water system that could create conditions where *Legionella* bacteria could grow and to establish operations and maintenance procedures to prevent or eliminate these potentially hazardous conditions or reduce them to an acceptable level. The HACCP approach is most valuable when it considers the site-specific features of a building.

To implement a HACCP plan, your WMP must include:

- **A detailed description of your building's water system**: Address both potable and non-potable components of your system. Ask yourself: *What are the major features of the building's water system and how does water flow through them and throughout the building?*

- **An assessment of potential hazards**: Identify hazards that could result in poor water quality and other conditions that allow for *Legionella* growth. Ask yourself: *What parts of the building's water system are vulnerable and could potentially promote Legionella growth?*

- **A risk assessment and risk management plan:** Assess the level of risk for each identified hazard and create a plan and schedule of treatments and responses to control each risk. Ask yourself: *What means and methods will I use to control risk?*

SECTION 2: Plan Cover

The cover sheet of the WMP should include the following information:

Building name:	
Building address, borough, ZIP code:	
Contact name:	
Contact title:	
Contact organization:	
Contact email:	

Plan prepared by:	
Plan preparer name:	
Preparer address:	
Preparer phone:	
Preparer email:	
Date submitted:	
Version number:	

SECTION 3: Water Management Team Roles and Responsibilities

An effective WMP clearly identifies a water management team and sets out roles and responsibilities.

- Select people with appropriate experience, skills and training to develop and implement your WMP. Team composition may vary, but a team will typically include:
  - Building managers or administrators
  - Maintenance or engineering staff
  - Certified industrial hygienists
  - Licensed master plumbers
  - Mechanical service contractors
  - Water treatment companies
  - Environmental health specialists
  - Risk managers
  - Health and safety officers

- Identify a program manager for the team and clearly define each team member's roles and responsibilities. Provide contact information for each team member to facilitate communication.

Table 3.1 Example: Water Management Team Members and Responsibilities

Name	Organization	Title	*Legionella* Risk Management Responsibilities	Contact Information
Primary Program Manager or Project Coordinator				
Kazuo Ishiguro	*Riverhead Corp.*	*Director of Safety*	*WMP review*	*718-555-5555, ext. 555 splath@riverhead.com*
Other Team Members				
Emily Dickinson	*Mobile Mechanical*	*Licensed Plumber*	*Plumbing repairs*	*917-999-9999 edoe@moblemech.com*
F. Scott Fitzgerald	*Fitzgerald Applications*	*Chemical Applicator*	*Chemical treatment*	*646-555-5555 fsfitz@fitz.com*
Isabel Allende	*OMS Building Management*	*Super-intendent*	*Water system oversight*	*123-456-7890 iall@oms.com*
Toni Morrison	*Morrison Engineering*	*Licensed Engineer*	*Water system oversight*	*514-123-5555*
Han Kang	*Riverhead Corp.*	*Operator*	*Kitchen Supervisor*	*718-123-5555*

SECTION 4: Building Description and Water System Characteristics

The foundation of an effective WMP is a clear understanding of your building water system. This section provides detailed instructions to collect the information needed for the HACCP process.

General Building Description and Occupancy

- Provide an overview of your building, including its use and occupancy classification.
  - Include all buildings that share a common hot water system (such as one water system across multiple buildings).
  - Add columns, as needed, for multiple buildings or multiple zones (such as multiple water systems in a single building).
  - If there are other addresses at the borough, block and lot that are independent from the hot water system, summarize in a *Notes* section.

Table 4.1 Example: Description of Building(s)

Description	*[Building 1 Name]*	*[Building 2 Name]*
Building address or location	*111 Lincoln St.*	*113 Lincoln St.*
NYC building identification number	*1234567*	*2345678*
Building owner	*Pablo Neruda* *123 Main St.* *New York, NY 10000* *ws@gmail.com*	*Pablo Neruda* *123 Main St.* *New York, NY 10000* *ws@gmail.com*
Property management	*Charles Dickens Realty* *456 6th Ave.* *New York, NY 10123* *cd@realty.com*	*Charles Dickens Realty* *456 6th Ave.* *New York, NY 10123* *cd@realty.com*
NYC building classification	*R3*	*O6*
Year of construction	*1920*	*1935*
Number of floors	*3*	*10*
Number of units per floor	*20*	*35*
Approximate number of vacant units	*None*	*10*
Approximate number of units vacant for greater than one month	*None*	*2*
Notes:		

- Summarize the occupants who use the water in your building.

Table 4.2 Example: Building Occupants

Occupant Type	Estimated Daily Number
Staff	*10 staff members*
Residents, Tenants	*200 residents, tenants*
Guests	*50 guests; typical stay two to three days*
Visitors	*50 visitors per day*

Understanding Your Building Water System

Premise Plumbing

- Establish how both hot and cold water flow throughout the building.
  - Consult your water management team, such as the master licensed plumber or maintenance or engineering staff, who are knowledgeable about the piping configurations of the building, some of which may be behind walls and not visible.
  - Review design, as-built and construction diagrams, as these will provide additional information.
- Describe your water system characteristics.
  - Attach your building's plumbing riser diagram. Depending on your building's age, this diagram may be found in the plumbing construction diagrams.
    - The plumbing riser diagram must identify the various risers and branches of piping and indicate to what these pipes are attached (for example, appliances, drains, other building systems).

Table 4.3 Example: Plumbing Riser Diagram

Description	***[Building Name 1]*** Include all buildings that share a common hot water (HW) system (such as one water system across multiple buildings).	***[Building Name 2]***	Add columns for multiple buildings and multiple zones (such as multiple water systems in a single building).
Number of potable cold water supply risers	*5*	*8*	
Number of potable hot water supply risers	*5*	*8*	
Number of potable hot water return risers	*2*	*4*	
List of units that share risers	*1A and 1B share bathroom HW riser.*	*"C" line and "D" line all share bathroom HW risers.*	
Plumbing riser diagram (attach):			

- Summarize available engineering and architectural plans for your building and plumbing system(s), as-built drawings, and building water system(s) schematic.
- Specify any known limitations or vulnerabilities identified for the building water system.
- Describe any maintenance or construction work to the building water system.
  - Include both routine and emergency repairs and system renovations that could cause service disruptions, changes to the flow of water, or changes in the overall building water quality. These include replacing, modifying, adding or removing piping, pumps, tanks, valves, equipment, connections or other components, and overall changes in water treatment.
- Describe any history of bacterial contamination and corrective actions taken.

Table 4.4 Example: Plumbing Design and Construction Documents

Document Type	Date	Reviewed By	Review Date	Comments
Premise Plumbing Plan	*5/7/1980*			
As-Built Plumbing Diagrams	*9/10/1982*			
Plumbing Modification Plans	*10/18/2010*			
Hot Water Heater Replacement Specifications	*5/30/2015*			
Plumbing Schematic	*6/13/1980*			
Discussion With Master Plumber				*Mr. John Doe provided a description of the riser configuration for Building A.*
Known limitations: *As-built drawings from original construction in 1920 are not available.* *Plumbing modifications in individual units are not known.*				
Scope and schedule for any water system maintenance or construction work:				
History of bacterial contamination and corrective action taken:				

- Provide a full inventory of water systems components and equipment, collectively known as process points**.**

Table 4.5 Example: Inventory of Building Water System Components

Component Type	Installed Location Provide Details (Floor, Area or Equipment Served)	Manufacturer	Model Number	Serial Number	Installation or Replacement Date	Capacity	Component Details
Hot Water Heaters (for example, boilers, water heaters, instantaneous heat exchangers)							
							Provide details about operation schedule (standby), heating source, maximum temperature, set temperature
Hot Water Storage (for example, storage tanks)							
							Provide details about materials of construction.
Cold Water Storage (for example, drinking water tanks, emergency water reserves)							
							Provide details about materials of construction.

Component Type	Installed Location Provide Details (Floor, Area or Equipment Served)	Manufacturer	Model Number	Serial Number	Installation or Replacement Date	Capacity	Component Details
Chillers (for example, centrifugal, absorption, modular, etc.)							
							Provide last cleaning or service date, cleaning or maintenance frequency. Make sure mechanical vendor is listed in Table 2.1.
Heat Exchangers (for example, plate and frame, shell and tube, etc.)							
							Provide last cleaning or service date, cleaning or maintenance frequency. Make sure mechanical vendor is listed in Table 2.1.
Thermostatic Mixing Valves (TMVs) or Tempering Valves							
Include valves in the mechanical area and those on point-of-use fixtures.							Provide number of valves, distance from outlets, date of last service, accessibility and temperature set limits.

Component Type	Installed Location Provide Details (Floor, Area or Equipment Served)	Manufacturer	Model Number	Serial Number	Installation or Replacement Date	Capacity	Component Details
Backflow Prevention and Cross-Connection Control Device(s)							
Include devices used for fire suppression and cooling towers, if applicable.							Provide date of last service or inspection.
Pumps (for example, circulation pumps, chemical metering pumps, booster pumps)							
							Provide date of last service/inspection.
Other Heating, Ventilation and Air Conditioning Equipment (for example, water source heat pumps)							
							Provide last cleaning or service date, cleaning or maintenance frequency. Make sure mechanical vendor is listed in Table 2.1.
Other Plumbing Fixtures							
Water-hammer arrestors							Provide date of last service or inspection.

Component Type	Installed Location Provide Details (Floor, Area or Equipment Served)	Manufacturer	Model Number	Serial Number	Installation or Replacement Date	Capacity	Component Details
Expansion tanks							
Water filters							
Aerators							
Faucet flow restrictors							
Hoses							
Pipes, valves and fittings							
Any devices that may spread *Legionella* through aerosols or aspiration (CDC, 2017)							
Electronic and manual faucets							Provide date of last service or inspection.
Showerheads							
Centrally installed misters, atomizers, air washers and humidifiers							

Component Type	Installed Location Provide Details (Floor, Area or Equipment Served)	Manufacturer	Model Number	Serial Number	Installation or Replacement Date	Capacity	Component Details
Non-steam aerosol-generating humidifiers							
Infrequently used equipment, including eyewash stations							
Ice machines							
Hot tubs							
Decorative fountains							
Cooling towers							
Medical devices (such as continuous positive airway pressure (CPAP) machines, hydrotherapy equipment, bronchoscopes)							

Component Type	Installed Location Provide Details (Floor, Area or Equipment Served)	Manufacturer	Model Number	Serial Number	Installation or Replacement Date	Capacity	Component Details
Pools (swimming, wading, spa pool such as hot tub or whirlpool, or special purpose pools)							
Steam room							
Spray grounds							

- Summarize any supplemental water treatment systems, including softening, disinfecting and filtering systems.

Table 4.6 Example: Supplemental Water Treatment Systems (only if applicable)

Type of System	Location	Date Installed	Maintenance Procedures Include Last Cleaning / Service Date
Disinfection System (such as chlorine, chlorine dioxide, monochloramine)	*Building A Basement; Mechanical Room*	*1/2018*	*Biannual cleaning and service. Consultant checks chemical levels once per week Last Serviced: 12/15/19*
Disinfection System (such as copper-silver ionization)	*Building B: 24th Floor Mechanical Room*	*6/2015*	*Metal sampling to check system dose once per month Copper and silver electrode check and cleaning quarterly. Electrode replacement as needed. Last Serviced: 12/01/19*
Water Softening System	*Building C Basement; Mechanical Room*	*5/2017*	*Check control settings and salt levels monthly Resin bed cleaning twice per year System regeneration annually Last Serviced: 7/15/2019*

Building Water System Description and Process Schematic

- Describe your building water system to show how hot and cold water flows throughout the building, both vertically (up and down between floors) and horizontally (across each floor).
  - Include how many hot and cold potable water supply and return risers comprise the system and indicate their locations.
  - Specify whether the system recirculates.
- Document the process flow and schematic diagram to clearly illustrate the process points.
  - Identify the process points of incoming water, hot water storage, hot water heating, cold water storage pipework and plumbing, layout and configuration of building water system risers, supplementary treatment, and points of use.
  - Include a copy of building plumbing diagrams, if available.

SECTION 5: Hazard Identification, Risk Assessment and Risk Management

Creating this section of the WMP requires a deeper review of the process points known as critical control points **(**the areas of your building water system where potentially hazardous conditions could result in the growth and spread of *Legionella)*. Common hazards that must be considered are discussed in Section 11.

Hazard Identification

- Determine the critical control points of your building water system.
- For each critical control point, identify potentially hazard conditions for *Legionella* growth. Assess the level of risk that each hazard condition poses (low, medium, high).
- Create a management plan to address the risks for each critical control point, including control measure, control limits, control monitoring and corrective actions triggered if outside control measures are outside of control limits.
    - **Control measures***:* Include routine and preventive maintenance and other procedures to maintain water quality. A good way to determine whether a control measure is clear and specific is to ask a maintenance technician to perform it. If the technician cannot easily determine what needs to be done, the measure is not specific enough.
    - **Control limits***:* Establish an acceptable range for, at a minimum, temperature, pH, chlorine and any other chemicals that are added to the water. A single water system component may need multiple control limits defined. For example, distal showerheads (from showers that are farthest from the hot water heater) may be measured for temperature and treatment residual.
    - **Control monitoring***:* Establish the means, method and frequency to monitor the control measures.
    - **Corrective actions***:* Indicate how to find corrective action procedures, if needed (see list below).

Corrective Action

- Establish corrective action procedures for when any monitored control measures are not within control limits for each critical control point.
    - Identify communication procedures and the responsible management team members for implementing the corrective actions.
    - A corrective action should include approaches to determine the root cause of the problem.

Table 5.1 Example: Hazard Identification and Risk Assessment / Management

Critical Control Point	Identified Hazard Condition and Risk Assessment	Control Measure	Control Limit	Control Monitoring			Corrective Action Procedure (see Table 5.2)
				Means	Method	Frequency	
Hot water storage tank	*LOW RISK: Heat losses in hot water storage tank are typically minimal since mechanical room is insulated and hot water storage tank is new as of 2018. Storage temperatures are typically not at levels that lead to favorable temperatures for the growth of* Legionella *bacteria.*	*Temperature*	*Minimum temperature setting*	*Keep water in storage tanks at a minimum temperature of 140 degrees Fahrenheit. Setting the Model 345 master thermostatic mixing valve for the water heater to lower the temperature to 130 degrees Fahrenheit prior to circulation in the building to prevent scalding.*	*Building superintendent to check temperature setting of hot water storage tank and Model 345 mixing valve.*	***Weekly** check of temperature settings on hot water storage tank and mixing valve.*	*1*
Distal point of use showerhead at Apt 24H	*HIGH RISK: Maintain residuals in the cold water distribution system to prevent* Legionella *growth.*	*Disinfection*	*Chlorine residual*	*Measure chlorine residual at distal showerhead.*	*Determine chlorine residual (ppm) by using Hach DR300 Pocket Colorimeter.*	***Monthly** measurement of chlorine residual.*	*2*
Incoming water main	*LOW RISK: Microbial populations harboring* Legionella *may enter building water through the water supply.*	*Cleaning*	*Cleaning of backflow prevention device*	*Removal of backflow prevention device and flushing per original equipment manufacturer.*	*Performed by licensed plumber.*	***Annual** cleaning of backflow prevention device.*	Insert procedure number

Critical Control Point	Identified Hazard Condition and Risk Assessment	Control Measure	Control Limit	Control Monitoring			Corrective Action Procedure (see Table 5.2)
				Means	Method	Frequency	
Plate and frame heat exchanger	*HIGH RISK:* Legionella *can grow on plate surfaces of the heat exchangers, especially during low flow or stagnant conditions.*	*Inspection and equipment maintenance*	*Pressure and temperature differentials* [define per manufacturer's specification]	*Plate cleaning per manufacturer's specifications.*	*Performed by mechanical service contractor, ABC Mechanical.*	*Annual inspection, cleaning as needed. Take heat exchanger offline for internal inspection and cleaning every five years.*	Insert procedure number
Plate and frame heat exchanger	*MEDIUM RISK: Failure of gaskets, causing cross contamination.*	*Inspection and equipment maintenance*	*Inspection of heat exchanger gasket replacement*	*Inspect heat exchanger for leaks, wear or breakage.*	*Performed by mechanical service contractor, ABC Mechanical.*	*Monthly heat exchanger inspection and performance checks.*	Insert procedure number
Hot water distribution system	*HIGH RISK: Heat losses in the hot water distribution system, including the longest circulation loop (Loop B) may lead to favorable temperatures for the growth of* Legionella *due to hot water return at lower temperatures.*	*Temperature*	*Minimum temperature setting*	*Setting the Model 123 master thermostatic mixing valve for the water heater system at 130 degrees Fahrenheit.*	*Building superintendent to check temperature in hot water return line sample port A and distal showerhead location. Measurement to be taken after 60second flush.*	*Weekly temperature checks in hot water return line and distal showerhead location.*	Insert procedure number
[Add additional CCP, as applicable.]							

Table 5.2 Example: Corrective Action Procedures

Corrective Action Procedure Number	Critical Control Point Out of Control Limits	Procedures
1	*Hot water heater out of appropriate temperature range*	*1. Check hot water recirculation pumps for proper operation and confirm proper valving.* *2. Ensure heater is functioning properly. Contact the device manufacturer to inspect the device and perform preventive maintenance, if needed.* *3. Evaluate hot water heater generation set points and adjust if necessary. Measure temperatures following adjustment to confirm effectiveness.* *4. Evaluate the hot water heater for any evidence of malfunction if adjustment does not result in temperature measurements within the control limits.* *5. Check hot water temperatures 24 hours after making adjustments to confirm effectiveness.* *6. Record all actions taken in preparation of, during and following this corrective action.* *7. Submit report to the program team about corrective action activities and findings.*
2	*Hot water distal outlet out of appropriate temperature range*	*1. Inspect the outlet where the violation occurred for any additional signs of ineffective operation:* *a. Low water pressure or flow rate* *b. Inconsistent water temperatures* *c. Leaking fixture* *d. Evidence of atypical scale, corrosion or discoloration* *e. Mixing valves* *2. Inspect the area around outlet where the violation occurred for signs of cross-connections:* *a. Custodial and mop sinks, particularly those with chemical injection systems* *b. New plumbing that may be connected improperly* *c. Equipment with mixing valves that may not be functioning, such as emergency showers or eye washes, laboratory equipment, medical equipment, dialysis machines, etc.* *3. Inspect pipe chases to determine if pipe insulation has failed.* *4. Evaluate and adjust mixing valve set points, if present.* *5. Evaluate hot water heater generation set points and recirculation pumps and adjust if necessary.* *6. Perform temperature measurement 24 hours following any adjustment to confirm effectiveness.* *7. Evaluate findings with the program team and develop a mitigation plan if hot water temperatures cannot be established within the control limits. Mitigation plan may include consideration of system maintenance, equipment replacement, time schedules and available resources.* *8. Record all actions taken in preparation of, during and following this corrective action.* *9. Submit report to the program team about corrective action activities and findings.*
3		Insert additional rows for your building that correspond to Table 5.1.

SECTION 6: Verification and Validation

Verification and validation allow the water management team to know whether the monitoring and maintenance processes described in the WMP are working as intended.

Verification is the overarching, ongoing process of making sure that at each critical control point, the control measure, control limits, control monitoring and corrective actions are adequately controlling the risk of *Legionella* growth.

Part of verification is **validation** (that is, collecting and evaluating scientific data to determine if the WMP is controlling the identified hazards). Validation includes confirming that physical and chemical conditions throughout the system are within control limits, as evidenced by monitoring at critical control points and distal and proximal locations. If any validation testing results are outside quality standards or validation limits, the control limits and control limit monitoring procedures in the WMP must be revisited and reassessed.

Validation Procedures: Water Quality Monitoring

- List the water quality measurements for the chemical and physical parameters you are monitoring.
- Provide details about the field instruments used to take measurements, the frequency of measurements, applicable validation (control) limits and the person responsible for monitoring.
- Make sure that measurements taken represent a comprehensive cross-section of the building's water system. At a minimum, take measurements at these locations:
  - Municipal water entry to building
  - Hot water heater
  - Hot water recirculation line just prior to entering the hot water heater
  - Hot water storage tanks
  - Proximal location(s) for hot water distribution
  - Distal location(s) from the hot water heater and hot water storage tanks
- Note the monitoring locations on a plumbing riser diagram to confirm that sampling is conducted at independent risers where water quality may vary.

Table 6.1 Example: Water Quality Monitoring

Monitoring Parameter	Monitoring Procedures				Validation Location [Floor Location, Room Location, Description]						
	Measure-ment	Frequency	Validation Limit	Responsible Person	*Basement Mechanical Room Municipal water supply*	*Basement Mechanical Room Hot water inlet after mixing valve*	*Basement Mechanical Room From hot water storage tank 1*	*Basement Mechanical Room After outlet of hot water heater 1*	*Basement Mechanical Room Hot water return line*	Add proximal and distal points (based on Riser Diagram)	Add columns for additional locations for your building
Temperature	*Field Meter (Make and Model)*	*Weekly*	*Cold water < 77 degrees Fahrenheit; Hot water > 122 degrees Fahrenheit*	*Building Engineer*	*X*	*X*	*X*	*X*	*X*	*X*	
pH	*Field Meter (Make and Model)*	*Weekly*	*Between 6.8 and 8.2*	*Building Engineer*	*X*	*X*	*X*	*X*	*X*	*X*	
Chlorine Residual	*Field Meter (Make and Model)*	*Weekly*	*Between 0.2 and 1 mg/l*	*Building Engineer*	*X*	*X*	*X*	*X*	*X*	*X*	
Turbidity	*Field Meter (Make and Model)*	*Monthly*	*< 1 NTU*	*Building Engineer*	*X*						
Conductivity	*Field Meter (Make and Model)*	*Monthly*	*Between 200 and 800 µS/cm*	*Building Engineer*	*X*						
Insert additional rows for your building											

Validation Procedures: Microbiological Testing

- Describe the microbiological testing that will be done on the environmental samples.
- Provide details about sample collection procedures, the frequency of sampling, applicable validation (control) limits and the person responsible for conducting the sampling.
- Make sure that measurements taken represent a comprehensive cross-section of the building's water system. At a minimum, take water samples at these locations:
    - Municipal water entry to building
    - Hot water heater
    - Hot water recirculation line just prior to entering the hot water heater
    - Hot water storage tanks
    - Proximal location(s) for hot water distribution
    - Distal location(s) from the hot water heater and hot water storage tanks
- To properly implement the microbiological testing, develop a plan to sample for *Legionella* and conduct culture testing. Perform sampling only after completing a thorough risk assessment and developing validation sampling procedures.

Table 6.2 Example: Microbiological Testing

Micro-biological Testing Parameter	Sampling Procedures				Validation Location [Floor Location, Room Location, Description]						
	Measure-ment	Frequency	Validation Limit	Responsible Person	*Basement Mechanical Room Municipal water supply*	*Basement Mechanical Room Hot water inlet after mixing valve*	*Basement Mechanical Room From hot water storage tank 1*	*Basement Mechanical Room After outlet of hot water heater 1*	*Basement Mechanical Room Hot water return line*	Add proximal and distal points (based on Riser Diagram)	Add columns for additional locations for your building
Legionella	First Draw	Quarterly	< 1 colony-forming unit (CFU)/ milliliter (ml)	Environmental Consultant	X	X	X	X	X	X	X
Legionella	Post Flush	Quarterly	< 1 CFU/ml	Environmental Consultant					X		
Legionella	Swab	Quarterly	< 1 CFU/cm^2	Environmental Consultant						X	
Heterotrophic plate count	Dip Slide	Weekly	< 500 CFU/ml	Building Engineer					X	X	
Add rows for additional parameters for your building											

Table 6.3 *Legionella* Sampling Plan

Building Location: _____

Sampling Date: _____

Sampler: _____

Sample ID	Validation Location [Floor Location, Room Location, Description]	Sample Type [W = Water S = Swab]	Sample Collection [First Draw or Post Flush]	Sample Time [HH:MM]	Water Quality Parameters							Laboratory Analysis	
					Pre-Flush			Time to Temp (seconds)	Post-Flush			HPC	LCT
					pH	Temp °F	Chlorine Residual (mg/l)		pH	Temp °F	Chlorine Residual (mg/l)		

SECTION 7: Remediation Plan for *Legionella*

The WMP must contain remediation plans in the event that *Legionella* contamination is found. Remediation may include both an acute measure (short-term treatment) and long-term treatment. The remediation plan must include written procedures for:

- **Who** are key personnel and their responsibilities
- **Which** remediation technology will be used
- **What** notifications are required for building occupants
- **When** remediation will be conducted
- **Where** the remediation technologies will be applied
- **How** remediation activities will be implemented, monitored for efficacy and documented

See Section 11 for an overview of remediation technologies.

SECTION 8: Record-Keeping

The WMP must include record-keeping procedures.

- Identify the person or people on the water management team responsible for recordkeeping.
- Describe where the records are kept.
- Identify timeframe for record-keeping, as determined by the Health Department and other applicable laws.
- List the records to be kept, which must include documentation of:
  - Monitoring, compliance and corrective actions
  - Validation activities
  - Maintenance and operation procedures, including planned and unplanned events that could impact the building's water system
- Include instructions to provide records to the Health Department on request.

SECTION 9: Addendums

If your building maintains other equipment or facilities that create risks for *Legionella* growth — such as a **cooling tower**, **water treatment system** or **bathing establishment** — include the relevant *Legionella* control documents for those items as an addendum to your WMP. For example, if your building has a cooling tower, attach as an addendum the sections of your Maintenance Program and Plan (MPP) that address *Legionella* control.

See Section 11 for additional New York City and New York State regulations that may apply.

SECTION 10: Definitions

Aerosol means a suspension of particles in air or another gas.

Air washer means a water spray device that removes dust and particulates from the air. This water spray also humidifies the air. Air washers are a potential source of *Legionella* because they aerosolize water. They range in size from small appliances for individual rooms to large industrial equipment capable of treating an entire building.

Atomizer means a device for emitting water or other liquids as an aerosol. It is often used in the home as a small appliance that humidifies or disperses aromatics. See also **humidifier**.

Backflow preventer means a device that prevents water from flowing against the normal direction of flow (or "backward") in a pipe as a result of pressure changes. Backflow preventers ensure that water contaminated with waste or chemicals (from sewer lines, etc.) cannot flow back into clean water lines. There are many different types of backflow preventers, ranging in complexity from simple "air gaps" to reduced pressure zone devices (RPZ).

Branches (also known as lateral lines) are defined by the New York City (NYC) Plumbing Code as any part of the piping system that extends to fixtures on two or less consecutive floors except a riser, main or stack.

Cogeneration (Cogen) (also known as **Combined Heat and Power**) means the use of an engine or power plant to generate electricity, while using the waste heat from this process to heat hot water. Many individual buildings have their own cogeneration plants. Heat exchangers and cooling towers are common components of cogen plants.

Cooling tower means a heat rejection device, which extracts heat to the atmosphere through the cooling of a water stream to a lower temperature. The term "cooling tower" is inclusive of any evaporative cooling equipment with recirculating water, including direct (open circuit) and indirect (closed circuit) cooling tower, evaporative condenser, or evaporative spray fluid cooler capable of aerosolizing water. Common applications of cooling towers are for air conditioning, refrigeration, industrial and manufacturing processing, or electric power generation.

Distal means far from the source. In a building where the hot water heater is in the basement and the risers distribute water upwards, a shower on the top floor of the building would be a distal point for the hot water system. The greater the distance that water has to travel to reach a point in the distribution system, the more "distal" that point is.

Heat exchanger means a device designed to transfer or exchange heat from one location to another, such as shell and tube, plate and frame, plate fin and fluid heat exchangers.

Heterotrophic plate count (**HPC**) means a method that measures colony formation on culture media of heterotrophic bacteria that can be used to measure the overall bacteriological load in a water sample. HPC is reported in colony-forming units per milliliter (CFU/ml).

Humidifier means a device that emits aerosolized water into the air in order to increase humidity. They are available as appliances for individual rooms or as components of centralized HVAC systems.

Legionella is the genus of a type of bacteria, found in aqueous (of, relating to or resembling water) environments such as in the recirculated water of a building water system that is not properly or regularly maintained. There are more than 60 different species of *Legionella* bacteria, all of which are potentially pathogenic.

***Legionella* culture sample** (**LCT**) means a water sample to be examined for the presence of *Legionella* bacteria. *Legionella* culture samples must follow the quality system and control requirements for microbiological testing as required by the New York State Environmental Laboratory Approval Program (ELAP) and set forth in the standards established by the National Environmental Laboratory Accreditation Program (NELAC) Institute (TNI).

Main is defined by the NYC Plumbing Code as the principal pipe artery to which branches are connected.

Proximal means close to the source. In a building where the hot water heater is in the basement and the risers distribute water upwards, a shower on the first floor of the building would be a proximal point for the hot water system. The less distance water has to travel to reach a point in the distribution system, the more “proximal” that point is.

Reduced pressure zone device (**RPZ**) means a testable backflow preventer that offers a high degree of redundancy and protection. It consists of two check valves with a chamber between them. The chamber has a relief valve that will open to a drain under backflow conditions. Under normal flow conditions, the water flows past the first check valve, through the chamber, and past the second check valve. Under backflow conditions, even if the check valves fail or are wedged open, backflowing water will be discharged to a drain through the relief valve in the middle chamber and will not be able to flow back past the RPZ.

Risers are defined by the NYC Plumbing Code as water pipes that extend one full story or more and convey water to a group of fixtures (like baths, sinks, showers and lavatories) or to branches that extend to fixtures on two or fewer consecutive floors.

Stacks are defined by the NYC Plumbing Code as any vertical lines of soil, waste, vent or inside conductor piping that extend through at least one story with or without offsets.

Thermostatic mixing valve or tempering valve means a valve that mixes hot and cold potable water in order to ensure safe temperatures for use and prevent scalding. These valves can be located anywhere in the hot water distribution system. Large mixing valves are often found after the heat source in order to mix the water, leaving the device at a temperature appropriate for circulation throughout the building (from 160 degrees Fahrenheit to 140 degrees Fahrenheit, for example). Smaller mixing valves can also be found on individual fixtures in order to provide redundancy or further reduce water temperatures to levels safe for use (from 140 degrees Fahrenheit to 120 degrees Fahrenheit, for example).

Water tank means a large tank made of an impermeable material, such as wood, concrete or metal, and used to store hot or cold water. The most common examples are wooden rooftop gravity tanks and metal hot water storage tanks.

SECTION 11: Additional Information and Resources

Common Hazards to Look for in Building Water Systems

Fluctuations in water temperature, flow, pressure or quality can lead to conditions that promote *Legionella* growth. Inadequate residual disinfectant and plumbing age can also be contributors.

1) **Low water flow or pressure** can result in hazardous conditions from fouling and microbial growth. Situations in which this can occur include:
   a) Presence of water in dead legs or other unused piping and fittings
   b) Presence of storage tanks, filtration devices or any other components with wet surfaces that are not consistently cleaned or flushed
   c) Point-of-use fixture such as auto sensor fixtures that have low flow
   d) Improperly sized storage capacity that may result in stagnation
   e) Occupancy considerations such as vacancy and percent occupancy
   f) Operational fluctuations and varying seasonal use (for example, using more hot water in the winter season)
2) **Warm water temperatures** in a building water system may allow for the growth of *Legionella*. In general, keep water temperatures hot or cold. The hot water system is a particular hazard because the water is circulated and may return with reduced or no disinfectant and reduced temperature, which may lead to bacterial growth, and then is recirculated back through the building. Temperature concerns include:
   a) Any areas where water temperature is between 77 degrees Fahrenheit to 122 degrees Fahrenheit (25 degrees Celsius to 50 degrees Celsius)
   b) Temperature set points that limit hot water heaters from heating water above 122 degrees Fahrenheit
   c) Plumbing configurations that result in heat loss during recirculation of hot water
   d) Localized thermostatic mixing valves that result in mixing hot and cold water to a warm temperature
3) **Plumbing age and building construction** may also introduce hazards such as:
   a) Underlying building conditions such as piping or component age
   b) Plumbing issues from poor construction design
   c) Physical damage of piping or components
   d) Access limitations for maintenance procedures
4) **Low disinfectant residuals** may occur in the building water system. Adequate residual is needed to prevent the growth of *Legionella*. Disinfection methods should consider:
   a) Measurement to monitor that halogen residual and other applicable water quality parameters are within control limits. For example, hot water may render disinfectants less effective and certain pH ranges may also limit

disinfectant effectiveness.
   b) Possibility of short-circuiting of treatment chemicals that may result in ineffective disinfection.
5) **General water quality** shall be evaluated for**:**
   a) Characteristics of source water (physical, chemical and microbiological)
   b) Use of alternative source water, if applicable
   c) Presence or accumulation of fouling (slime, mold, fungi, algae, biofilm, plant and other organic materials), oil and grease, corrosion products, scale, debris, rust, sludge, silt, sediments, non-organic materials and other contaminants observed at any point through the system

Overview of Remediation Technologies in Building Water Systems

The Environmental Protection Agency (EPA, 2016) has summarized the remedial technologies available for addressing *Legionella* in building water systems.

- Chemical Disinfection
  - Chlorine
  - Monochloramine
  - Chlorine Dioxide
- Copper-Silver Ionization
- Ultraviolet Light Disinfection
- Ozone Disinfection
- Emergency Remediation
  - Superheat-and-Flush Disinfection
  - Shock Hyperchlorination
  - Point-of-Use Filtration

The Health Department recommends that you consult with a professional with experience in *Legionella* risk mitigation to select the remedial treatments suitable for your building.

Applicable New York City and New York State Regulations

Below is a list of regulations that may be relevant to your WMP. This is not a complete list and building owners are responsible for knowing the applicable laws and regulations.

- General
  - New York City Plumbing Code (Administrative Code of the City of New York, title 28, chapter 6) PC Chapter 6, Section 601 (NYC Admin Code 28-601)
- For health care fixtures and equipment
  - New York City Plumbing Code, (Administrative Code of the City of New York, title 28, chapter 6) PC Chapter 4, Section 422 (NYC Admin Code 28-422)

- For water heaters
    - New York City Plumbing Code, (Administrative Code of the City of New York, title 28, chapter 6) PC Chapter 5 (NYC Admin Code 28-5)
- For hot water supply
    - New York City Plumbing Code, (Administrative Code of the City of New York, title 28, chapter 6) PC Chapter 6, Section 607 (NYC Admin Code 28-607)
    - New York City Housing Maintenance Code (Administrative Code of the City of New York, title 27, chapter 2) §27-2031 (NYC Admin Code 27-2031)
- For disinfection of potable water systems
    - New York City Plumbing Code, (Administrative Code of the City of New York, title 28, chapter 6) PC Chapter 6, 610 (NYC Admin Code 28-610)
    - New York City Health Code §141.11 (24 RCNY §141.11)
    - New York State Sanitary Code, (New York Code, Rules and Regulations, title 10, part 5) Subpart 5-1 (10 NYCRR, Subpart 5-1)
- For buildings with a bathing establishment
    - New York City Health Code, §165 (24 RCNY §165)
- For buildings with a drinking water storage tank
    - Title 24 of the Rules of the City of New York, Chapter 31: Drinking Water Tank Inspections
    - New York City Health Code, §141.07: Drinking Water Storage Tanks
    - New York City Health Code, §141.09: Building Water Tank Cleaning, Painting and Coating
- For buildings with a cooling tower
    - Title 24 of the Rules of the City of New York Chapter 8: Cooling Towers

Additional Resources (current at time of publication)

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