WATER MANAGEMENT PROGRAM TEMPLATE

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INTRODUCTION

What is a Water Management Program?

Purpose and Use

Legionnaires' disease is a serious illness that often results in hospitalization, and sometimes death, of many people throughout the United States every year. In the June 2017 Vital Signs article, CDC stated that 9 out of 10 Legionnaires' disease outbreaks could have been prevented with better water management programs. Over the last few years water management programs have become a prevailing industry standard, with standards like ASHRAE 188 and VA DIR 1061 making headway as reference material. Every type of facility, even those that do not service a high-risk population, could benefit from the implementation of a water management program that identifies areas or devices in the building where *Legionella* might grow or spread to people. This template will help you develop and implement a water management program to reduce your facility's risk for growing and spreading *Legionella*.

How to Use This Template

Whether you are starting from scratch or looking to improve your existing water management program, this template is designed to be a tool for you to use as it fits best to your facility. Creating a water management program is never a one-size-fits-all situation, so not all sections of the template will be relevant to your facility. The first thing to know is that if you feel like this is something you may not be able to tackle on your own, review the "Selecting a Water Management Consultant" document in Appendix C so you can know how to hire the best consultant to fit your needs. You can also go through CDC's online PreventLD training and CDC's Water Management Program Toolkit before you get started on your own template so you have a better idea of how it works.

The next step is to work your way through the document, filling out any sections and appendices that are suitable to your facility's design and maintenance wishes. All of the tables that are included can be edited so you can add/delete rows and columns as you see fit. All of the material presented in the blue boxes is informative or background, while the fillable tables will be below that information. You may also find it beneficial to contact your local or state jurisdiction to identify specific regulations or requirements that will affect the content of your program, such as *Legionella* testing or reporting requirements, cooling tower maintenance requirements, or healthcare facility requirements.

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Legionella and Legionellosis

A. Etiologic Agent

Legionellosis (Legionnaires' disease and Pontiac fever) is caused by the *Legionella*, gram-negative bacteria commonly found in natural freshwater environments (e.g. lakes and streams), most often in warm water (77-108°F). Numerous species and subtypes of *Legionella* have been identified, however *Legionella pneumophila* serogroup 1 causes approximately 80% of cases of human disease.

The bacteria can become a health concern when they grow and spread in human-made building water systems. After *Legionella* grow and multiply in a building water system, water containing *Legionella* then has to spread in droplets small enough for people to breathe in. People can get legionellosis when they breathe in small droplets of water in the air that contain the bacteria. Less commonly, people can get sick by aspiration of drinking water containing *Legionella*. This happens when water accidentally goes into the lungs while drinking (i.e., "goes down the wrong pipe"). *Legionella* spread from person-to-person is not a meaningful route of transmission. Human-made water systems that can transmit *Legionella* include:

- Showerheads and sink faucets
- Cooling towers (structures that contain water and a fan as part of centralized air cooling systems for building or industrial processes)
- Hot tubs that aren't drained after each use
- Decorative fountains and water features
- Hot water tanks and heaters
- Large plumbing systems

Of note, home and car air-conditioning units do not use water to cool the air, so they are not a risk for *Legionella* growth.

Legionella tend to grow in biofilms or slime on the surfaces of lakes, rivers and streams, and they are not eradicated by the chlorination used to purify domestic water systems (Figure 1). Low and even non-detectable levels of the organism can colonize a water source and grow to high concentrations under the right conditions.

Figure 1.Cross-section of pipe containing biofilm and *Legionella*

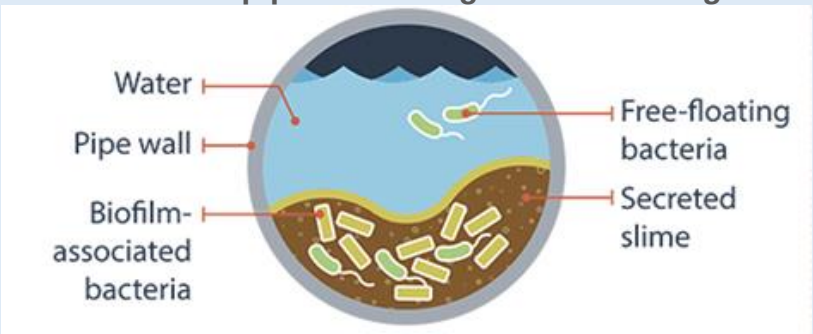


Image from: https://www.cdc.gov/legionella/wmp/overview/growth-and-spread.html

Water conditions that tend to promote the growth of *Legionella* include:

- Stagnation, low water flow
- Temperatures between 68° - 122°F (optimal range 95° - 115°F)
- pH between 5.0 and 8.5
- Sediment, that can promote growth of commensal microflora
- Growth of micro-organisms including algae, flavobacteria, and Pseudomonas, which supply essential nutrients for growth of *Legionella* or harbor the organism (amoebae, protozoa).

Figure 2. *Legionella* in building water systems

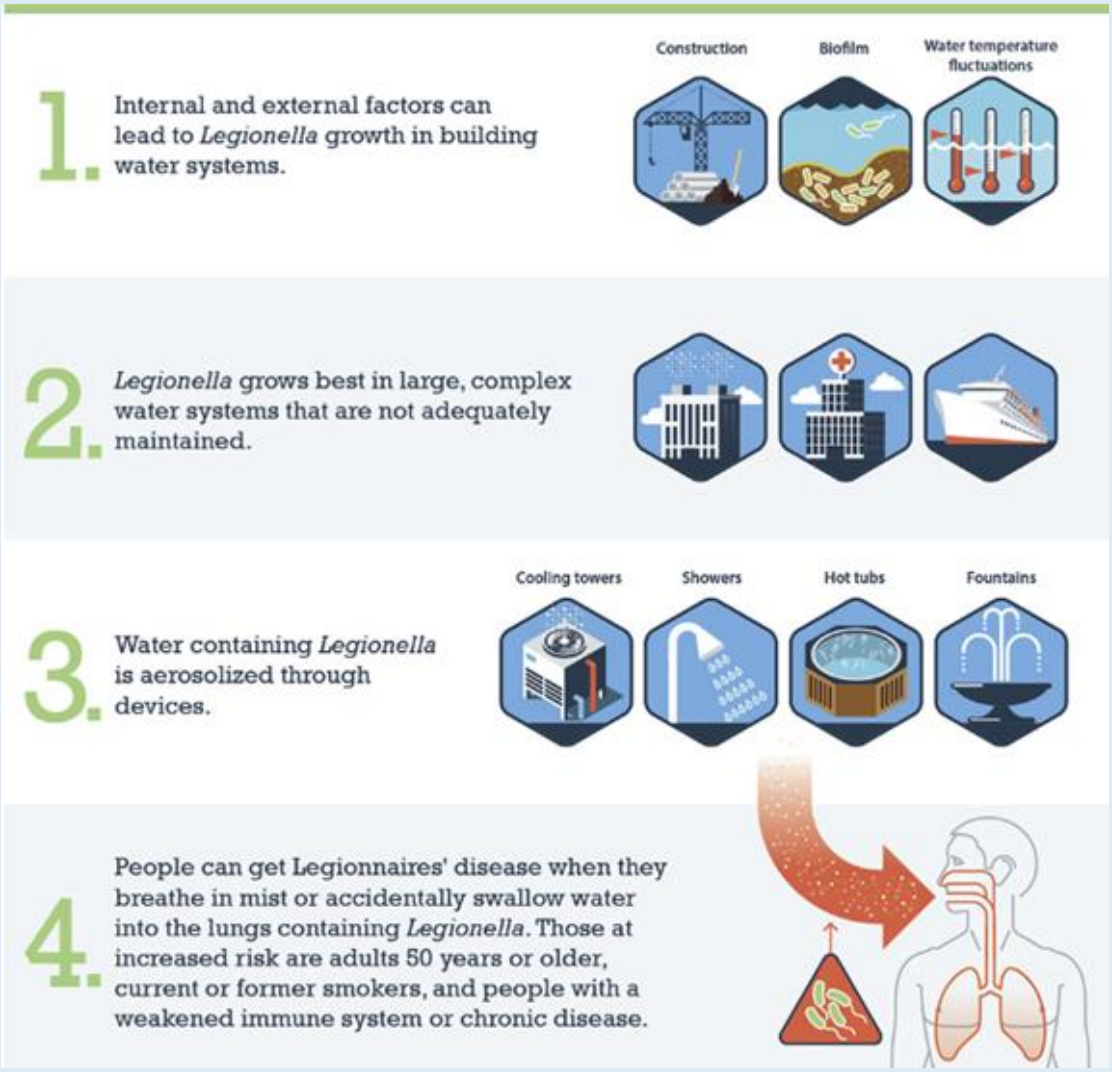


Image from: https://www.cdc.gov/legionella/infographics/legionella-affects-water-systems.html

B. Spectrum of Clinical Disease and Risk Factors

Infection with *Legionella* bacteria can cause three distinct clinical presentations:

1. **Legionnaires' disease (*Legionella* pneumonia)**
   a) Symptoms: fever, myalgias, cough, shortness of breath, clinical or radiographic evidence of pneumonia; associated nausea, vomiting, diarrhea, headache or confusion may be present
   b) Incubation period: 2–10 days (average 5–6 days)
   c) Outcome: hospitalization is common; case-fatality rate is 10% (25% for healthcare-associated cases)
2. **Pontiac fever**
   a) Symptoms: fever, chills, headache, myalgia, fatigue (NO respiratory symptoms or radiographic evidence of pneumonia)
   b) Incubation period: 24–72 hours
   c) Outcome: self-limited illness; case-fatality rate is extremely low
3. **Extra-pulmonary infection**
   a) Symptoms: variable, depending on location of infection; myocarditis and pericarditis, sinusitis, septic arthritis, cellulitis and others have all been reported in the medical literature
   b) Incubation period: variable
   c) Outcome: variable; extremely rare

Most healthy people exposed to *Legionella* do not get sick. People at increased risk of infection from *Legionella* include:

- People 50 years or older
- Current or former smokers
- People with a chronic lung disease (like chronic obstructive pulmonary disease or emphysema)
- People with weak immune systems or who take drugs that weaken the immune system (like after a transplant operation or chemotherapy)
- People with cancer
- People with underlying illnesses such as diabetes, kidney failure, or liver failure

C. Diagnosis and Treatment

Possible laboratory tests to confirm the diagnosis of legionellosis include a positive urine antigen, culture, direct fluorescent antibody (DFA) staining of respiratory samples and tissue, PCR assays of urine, respiratory samples, or blood (Table 1). Serologic tests of antibodies are only diagnostic with a 4-fold or greater rise in antibody titer in paired (acute and convalescent) antibody tests collected 4-8 weeks apart. **Serologic testing is not recommended for clinical or public health purposes** because of the delay inherent in convalescent testing.

The preferred diagnostic tests for legionellosis are culture of lower respiratory secretions (e.g., sputum, bronchoalveolar lavage) on selective media (Buffered Charcoal Yeast Extract Agar [BCYE]) **and the *Legionella* urinary antigen test**. Best practice is to obtain both sputum culture and the urinary antigen test concurrently, ideally before antibiotic administration (antibiotics should not be delayed to facilitate specimen collection). The urinary antigen test may detect *Legionella* infections for days to weeks after treatment.

Table 1. Available diagnostic tests for *Legionella infection*

Test	Sensitivity	Specificity	Advantages	Disadvantages
Culture	20–80%	100%	Detects all species and subgroups; can compare clinical and environmental isolates	Technically difficult; slow to grow (>5 days); sensitivity dependent on technologic skill; requires BCYE agar
Urinary Antigen	70–100%[1]	95–100%	Rapid (same-day)	Only detects Lp1; does not allow for molecular comparison of clinical and environmental isolates
Serology (Paired)	80–90%	>99%	Possible to detect species and serogroups other than Lp1	Requires paired sera collected at acute onset to 2 weeks and 3–6 weeks later; 5–10% of the population has a titer of ≥1:256
Direct Fluorescent Antibody (DFA)	25–75%	≥95%	Can be performed on pathologic specimens (e.g. lung tissue); possible to detect species and serogroups other than Lp1	Technically difficult; reagents may not be readily available
Polymerase Chain Reaction (PCR)	95–99%	>99%	Can be performed on pathologic specimens (e.g. lung tissue); rapid; possible to detect species and serogroups other than Lp1	Assays vary by laboratory; may not be commercially available in the United States

[1]Sensitivity for *Legionella pneumophila* serogroup 1 (Lp1)

D. National Epidemiologic Trends

The incidence of legionellosis has grown by nearly five and a half times since 2000, with approximately 7,500 cases reported in 2017 (Figure 3). However, because Legionnaires' disease is likely underdiagnosed, this number likely underestimates the true incidence.

Figure 3. Incidence of legionellosis (number of cases per 100,000 persons) in the United States from 2000-2017.

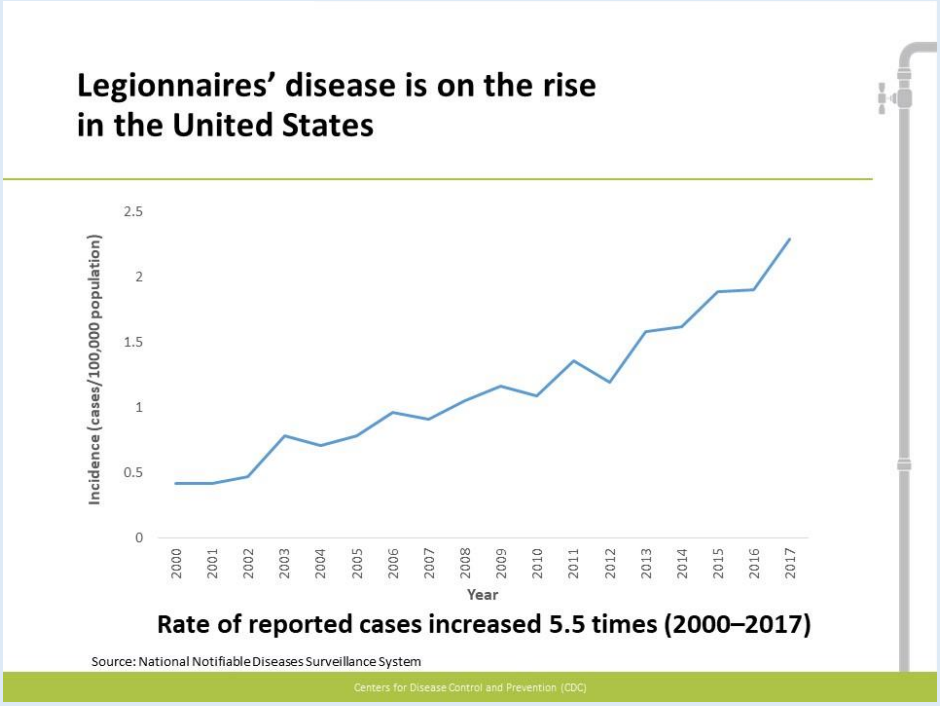


Image from: https://www.cdc.gov/legionella/images/national-incidence.jpg

E. Case Definition

Clinical Criteria

1. Legionnaires' disease: fever, myalgia, cough, and clinical/radiographic pneumonia
2. Pontiac fever: milder illness without pneumonia

Travel-Associated

1. A case that has a history of spending at least one night away from home, either in the same country of residence or abroad, in the ten days before onset of illness, which meets either the suspected or confirmed case classification criteria above.

Laboratory Criteria for Diagnosis

Suspect	• **By seroconversion: fourfold or greater rise in antibody titer to specific species or serogroups of Legionella other than *L. pneumophila* serogroup 1 (e.g., *L. micdadei*, *L. pneumophila* serogroup 6).** • **By seroconversion: fourfold or greater rise in antibody titer to multiple species of *Legionella* using pooled antigen and validated reagents.** • **By the detection of specific *Legionella* antigen or staining of the organism in respiratory secretions, lung tissue, or pleural fluid by direct fluorescent antibody (DFA) staining, Immunohistochemistry (IHC), or other similar method, using validated reagents.** • **By detection of *Legionella* species by a validated nucleic acid assay.**
Confirmed	• By culture: isolation of any *Legionella* organism from respiratory secretions, lung tissue, pleural fluid, or other normally sterile fluid. • By detection of *Legionella pneumophila* serogroup 1 antigen in urine using validated reagents. • By seroconversion: fourfold or greater rise in specific serum antibody titer to *Legionella pneumophila* serogroup 1 using validated reagents.

Note: DFA and PCR tests for *Legionella* are not considered confirmatory for determining the case classification of Legionellosis cases.

Case Classification

Suspect	• **A clinically compatible case that meets at least one of the presumptive (suspected) laboratory criteria.** • **Travel-associated: a case that has a history of spending at least one night away from home, either in the same country of residence or abroad, in the ten days before onset of illness.**
Confirmed	• A clinically compatible case that meets at least one of the confirmatory laboratory criteria. • Travel-associated: a case that has a history of spending at least one night away from home, either in the same country of residence or abroad, in the ten days before onset of illness.

Water Management Program

[Facility Name]

[Facility Address]

[Facility Phone Number]

Updated [Date]

Facility and Water Management Team

Summary of Actions:

- Nominate water program management team members
- Those who might be a part of your water management team could include building manager/administrator, maintenance or engineering, infection preventionist, clinician with expertise in infectious disease, risk management/safety officers, state or local public health, certified industrial hygienists, environmental health specialist, and microbiology expert.
- Identify a team leader or team hierarchy
- Record why team members have been selected to participate in Legionella risk management.
- Clearly articulate the responsibilities of each member of the water management team.
- All information about the Water Management Team should be noted in Table 2.

Table 2. Water Management Team

Name	Organization	Position	*Legionella* Risk Management Responsibilities	Skills, knowledge, and experience (reasons for being in team)	Phone Number	Email Address

Inventory of System Components

Environmental Risk Analysis

Summary of Actions- (fill out in Table 3 below)

- Gather information on the water supply system.
- Gather information on the water uses and users within the facility.
- Describe the system (including treatment).
- Discuss the quality of incoming water.
- Identify hazards associated with the facility's water supply system. These areas may include areas where:
    - Medical procedures may expose patients to water droplets, such as hydrotherapy.
    - Patients are more vulnerable to infection, such as bone marrow transplant units, oncology floors, or intensive care units.
- Identify existing control measures.
- Perform environmental risk assessment.

System Description

Uses of Water- (fill out in Table 3 below)

- Drinking and food preparation (includes water being fed into ice machines and water/soda dispensers)
- Clinical uses such as dialysis, hydrotherapy, dental chairs, birthing tubs, and cardiac bypass units
- Showers/sinks
- Toilet flushing
- Laundry
- Sprinklers (fire suppression and irrigation)
- Decorative fountains
- Heating or cooling units (cooling tower, swamp cooler, humidifier)
- Recreational water (pool, hot tub)

Users of Water- provide details about the people who use the water in your facility (fill out in Table 4 below)

- Facility population/number of beds
- Clinical functions (maternity, intensive care)
- Specialist functions (dental)
- Residential functions (number of residents)

Incoming Water- provide details of incoming water, both potable and non-potable (fill out in Table 3 below)

- What is the source of the incoming water (e.g. bore, surface, rainwater)?
- What treatment processes (filtration, chlorine/monochloramine disinfection) does the incoming water undergo before entry into the facility?
- Where are the entry points for the incoming water into the facility?
- How reliable is the incoming water?
    - Are there often water shut offs, loss of pressure, burst pipes...etc.?
- Is the water treated within your facility, like a secondary disinfection system?
- Is there an emergency supply of water like in water storage tanks?
    - What is the source and quality of this water?

Quality of Incoming Water- Describe the typical water quality characteristics of the incoming water (fill out in Table 3 below)

- Disinfection residual in the water entering the facility
- Temperature
- pH
- Bacteriological quality

System Details- Provide an overview of the water system (in Table 5), for example:

- Incoming water is supplied to a __ gallon water heater, set at ___ degrees F.
- Water coming into the system is treated with _____ (chlorine, monochloramine) and is treated within the system with _____ (copper silver ionization, chlorine dioxide).
- Heated water is supplied to outlets in two ICU rooms and 5 general wards.
- Outlets consist of showers, baths, wash basins, and sinks.
- Each outlet has a thermostatic mixing valve (TMV) with the maximum distance between heater and TMV of ___ feet

Table 3. Inventory of System Components (edit, add, or delete as needed)

System Component	Characteristic	Details
Hot water heater(s)	Number	
	Location	
	Capacity	
	Type of heating	e.g. solar, gas, instant
	Max temperature	
	Average temperature	
	Age of units	
Cold water storages(s)	Number	
	Location	
	Capacity	
	Material	e.g. concrete, steel, plastic
	Water age (time since disinfection)	
Incoming water treatment	Company name	e.g. water utility company
	Source	e.g. reservoir, pond, rainwater
	Disinfection type	e.g. chlorine, monochloramine
Facility water treatment	Type	e.g. chlorine dioxide
	Location	
	Dose rate (if chemical treatment)	e.g. X mg/L
	Target residual at most distal point in water system (if chemical treatment)	e.g. X mg/L
Pipework	Age	
	Material	
	Type and extent of insulation	

	Number of dead legs and their locations	
	Areas of low flow	
	% of pipework that is accessible	
Hot water outlets	Number, type, and location	e.g. 5 sinks and 5 showers in 1st floor bathroom,
		2 sinks in kitchen, 2 sinks in 2nd floor bathroom,
Cold water outlets	Number, type, and location	
Warm water outlets	Number, type, and location	
TMVs and tempering valves	Type, number, age, and location	
	Distance from outlets	
	Date of last service	
	Accessibility	
	Maximum temperature at outlet	
Other components	Ice machines	
	Cooling towers	
	Fire suppression system	
	Irrigation system	
	Hydrotherapy/birthing tubs	
	Decorative water fountain	
Backflow prevention	Number and location	
	Date of last inspection	

**Information about water features will be completed in later sections.

Table 4. Users of Water (edit, add, or delete as needed)

Description	Estimated Daily Number
Ex: Staff	Ex: 10 staff members
Ex: Residents	Ex: 20 residents
Ex: Guests/Visitors	Ex: 50 visitors/day

Table 5. Additional System Details (edit, add, or delete as needed)

Component	Note
Ex: Incoming Water	Supplied to an __ gallon water heater, set at ___ degrees F.
Ex: Water Treatment	Water coming into the system is treated with _____ (chlorine, monochloramine) and is treated within the system with _____ (copper silver ionization, chlorine dioxide).
Ex: Heated Water	Supplied to outlets in two ICU rooms and 5 general wards.

Process Flow Diagram

Insert a flow diagram/schematic drawing/plan of your facility's water system. This drawing will help you understand how your water system is connected, and which components to account for in Table 3. Below you will find a few examples of schematic drawings for reference.

Figure 4. Example of a schematic drawing of a facility water delivery system

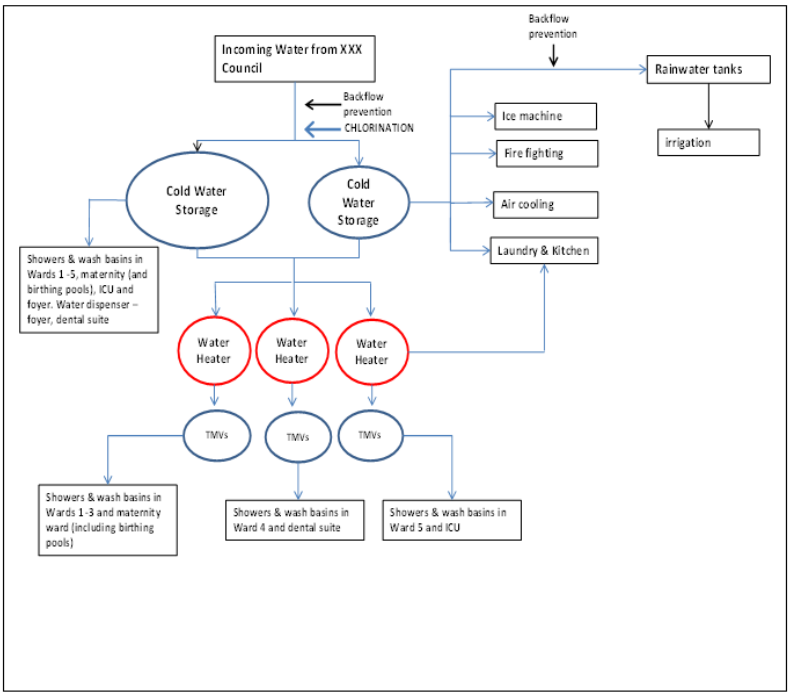


Figure 5. Example of a simple schematic water system for a single building

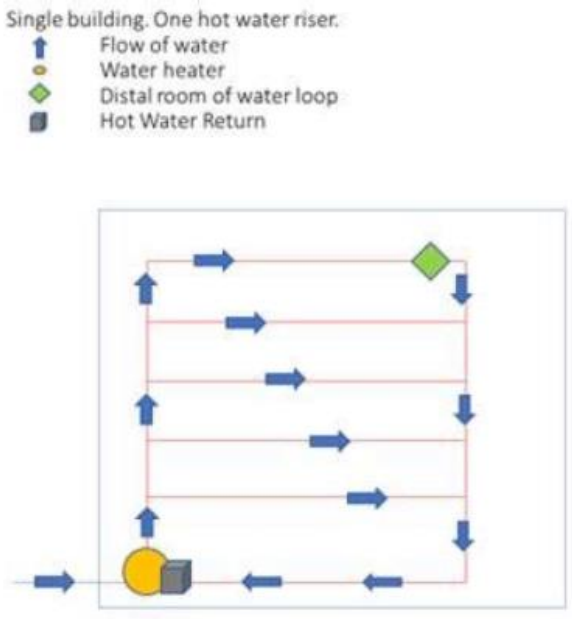
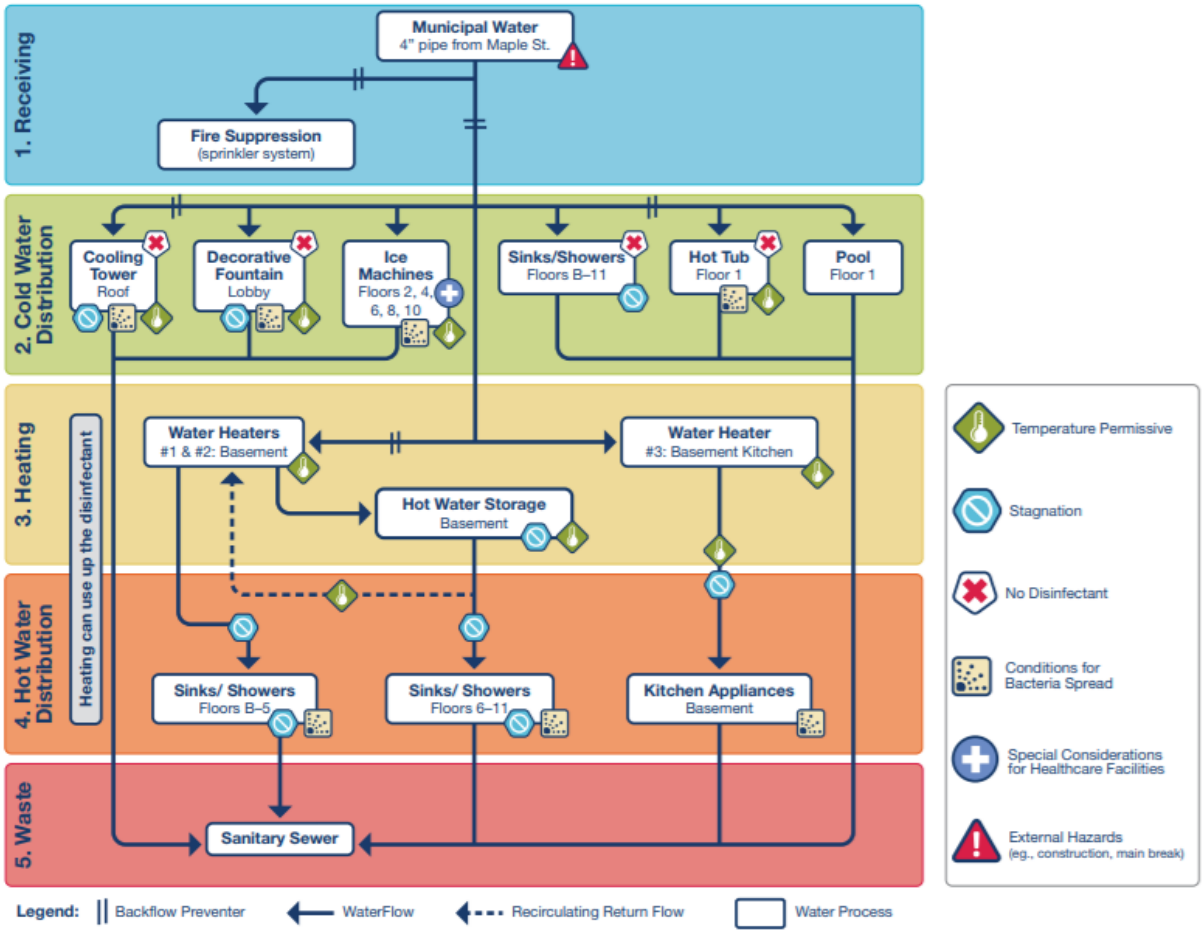


Figure 6. Example of a schematic drawing of a building water system



Environmental Risk Assessment

Hazard Identification and Environmental Risk Assessment

Hazard Identification

- Identify the hazards that could affect the water quality within the described water supply system, promoting *Legionella* colonization and growth, along with their corresponding control measures. Table 6 below lists some examples of potential hazardous events commonly associated with a facility's water system.

Table 6. Potential Hazardous Events

System Components	Event	Control Measure(s)
Incoming water	Incoming water contamination	
	Loss of supply	
	Failure of backflow prevention device	
Solar preheat systems	Water stored at or below 140 degrees F	
	Booster failure	
Hot water storage	Heater failure or under capacity	
	Build up of sludge in tank	
	Thermal stratification	
	Storage temperature too low (below 140F)	Ex: Increased stored water temperature
Cold water storage	Water stagnation	
	Contamination of storage tank	
	Build up of sludge in tank	
	Water temperature above 68F	
Pipework/plumbing	Dead legs and capped pipes	
	Cross connections between potable and non-potable pipes	

	Deterioration of insulation (lagging) around pipes	
	TMV malfunction or inadequate maintenance	
	Long distances between TMVs or tempering valves and outlets	
	Corrosion due to deterioration of materials	
	Pipe leaks due to age	
	Heating of cold water in pipes (>68F)	
	Low flow in recirculating loops	
	Lack of accessibility for repairs and maintenance	
Outlets	Poorly maintained outlets	
	Unused outlets	
	Flow restrictors	
	Aerators	Ex: remove aerators
	Outlets that hold water after use (e.g. shower heads or hoses)	
Treatment systems	Dosing failure	
	Insufficient dosing	Ex: Increase dosing frequency
	Running out of disinfectant	

Environmental Risk Assessment

- This section includes qualitative measures of likelihood and consequence to allow you to calculate the level of risk for different potential adverse outcomes in your facility. Remember that some controls will be insufficient in themselves to get the level of risk down to low, so keep adding controls until the risk is acceptable.

Table 7A. Qualitative Measures of Likelihood

Level	Descriptor	Example description
A	Almost certain	Is expected to occur in most circumstances
B	Likely	Will probably occur in most circumstances
C	Possible	Might occur or should occur at some time
D	Unlikely	Could occur at some time
E	Rare	May occur only in exceptional circumstances

Table 7B. Qualitative Measures of Consequence or Impact on Facility

Level	Descriptor	Example description
1	Insignificant	Insignificant impact, little disruption to normal operation, low increase in normal operating costs (e.g. temporary low chlorine residual that can be resolved via increased flushing)
2	Minor	Minor impact for part of facility, some manageable disruption to normal operation, some increase in operating costs (e.g. several rooms or one wing with total bacterial count >500 colony forming units (CFU)/mL, requiring more frequent flushing to maintain chlorine residuals)
3	Moderate	Minor impact for most of facility, significant but manageable modification to normal operation, increase in operating costs, increased monitoring (e.g. extensive bacterial growth with some *Legionella*, requiring extensive flushing and additional controls)
4	Major	Major impact for part of facility, systems significantly compromised, abnormal (if any) operation, high level of monitoring required (e.g. temporary closure of part of facility requiring extensive disinfection)
5	Catastrophic	Major impact for whole of facility, complete failure of systems (e.g. extensive *Legionella* colonization, with possible cases of Legionnaires' disease)

Table 7C. Qualitative Risk Analysis Matrix – Level of Risk

Likelihood	Consequences				
	1 (Insignificant)	2 (Minor)	3 (Moderate)	4 (Major)	5 (Catastrophic)
A (Almost certain)	Moderate	High	Very High	Very High	Very High
B (Likely)	Moderate	High	High	Very High	Very High
C (Possible)	Low	Moderate	High	Very High	Very High
D (Unlikely)	Low	Low	Moderate	High	Very High
E (Rare)	Low	Low	Moderate	High	High

Table 8. Example of Hazard Identification and Environmental Risk Assessment Table (add, edit, or delete as needed)

System component	Hazard and hazardous event	Risk score	Possible control measures
Incoming water	Supply of water with low chlorine residual	Medium	Install onsite chlorination to achieve 0.5 mg/L at all high risk outlets
Hot water system	Water temperature too low (to inhibit growth of *Legionella* and other opportunistic pathogens)	Medium	Measure temperature daily and adjust if too low
Warm water system	Distance from TMV to outlet > 6 m leading to *Legionella* detections in high risk location	High	Move TMV closer to outlet or install point of use filter on outlet
Pipework	Low flow in several areas (allows adherence and proliferation of *Legionella* and other opportunistic pathogens)	High	Weekly flushing of water in areas of low use

Environmental Risk Management

Summary of Actions- (fill out in Table 9 below)

- Identify and implement control measures for management of risks.
- Establish an operational monitoring program.
- Develop written procedures for required actions.
- Determine and implement corrective actions for exceedance of critical operational limits.
- Establish a verification monitoring program.
- Determine and implement responses to exceedances of limits in the verification monitoring program.

Control Procedures

- All control measures and monitoring activities, whether they are regular maintenance, operational practices, or corrective actions, require written procedures detailing how to undertake the required tasks.
- Complete Table 9 below with control measures identified in the hazard identification and risk assessment table and operational procedure.

Table 9. Example of Environmental Risk Management Program Procedures (add, edit, or delete as needed)

System component	Control measure	Procedure
e.g. pipework	Regular (weekly) flushing of low use areas	e.g. Flushing of pipes in Wing 2
e.g. treatment	Changing dose rate of disinfectant	e.g. Adjustment of chlorine dose
e.g. outlet — TMV	Regular maintenance of TMV	e.g. Cleaning of TMV and thermal disinfection of all pipework and outlets downstream of TMV - yearly
e.g. outlets	Collecting water samples for *Legionella* testing	e.g. Sample collection for *Legionella* – water **AND** e.g. sample storage and transportation to a laboratory

Monitoring

Operational Monitoring

- Many control measures that manage risk in the water supply are in fact corrective actions to measured parameters at particular frequencies and locations when such parameters exceed a critical limit.
- Fill out Table 10 below with all the operational (i.e. 'real time') monitoring undertaken in the facility.

Table 10. Example of Operational Monitoring (add, edit, or delete as needed)

System component	Risk	Parameter	Frequency	Location	Critical limit	Record *(where is the measurement recorded)*	Corrective action *(all corrective actions listed here should have a procedure listed in Table 6)*
Incoming water	Low disinfectant residual	Chlorine residual	Weekly	Point of entry into facility	Less than 0.5 mg/L	Chlorine residual record sheet	Increase chlorine dose within facility
Hot Water	Low temperature	Temperature	Weekly	Hot water Outlet in kitchen (sink tap at far right corner)	Temperature less than 140 °F	Weekly temperature kitchen record sheet	Increase temperature of water heater
Warm water	Water temperature that supports *Legionella* growth	Temperature	Daily	Outlet furthest from water heater (wash basin tap in room xx)	Temperature greater than 68 °F and less than 140 °F	Daily temperature – ward 2 record sheet	Check heater temperature and adjust if required, check pipework for loss of heat, check operation of TMV

Verification monitoring and responses

- Verification monitoring involves the taking of samples for analysis of a particular parameter. The results of the samples confirm that control measures are effective and water quality risk is being managed.
- All verification monitoring results that are outside quality standards or critical limits, and confirmed cases of legionellosis, require responses.
- Fill out Table 11 below with all the verification monitoring undertaken in the facility.

Table 11. Example of Verification Monitoring (add, edit, or delete as needed)

Parameter	Frequency	Location	Limit	Reported to	Operational response to exceedance of critical limit	Clinical response to exceedance of limit
Heterotrophic plate count	Monthly	Distal warm water taps — wash basins in rooms xxx	Greater than 500 CFU/mL	Building, engineering and maintenance services (BEMS) supervisor	1. Check operational measurements (temperature, pH, turbidity, disinfectant residuals and dose), maintenance schedules, and structural integrity 2. Flush water through until sufficient disinfectant residual is achieved 3. Resample after responses are completed	None
Legionella spp.	Quarterly	Distal warm water taps – wash basins in room with low risk patients	Greater than 10 CFU/100 mL	BEMS manager and CEO	1. Check operational measurements, maintenance schedules and structural integrity of system 2. Clean and sanitise TMV and outlet fitting 3. If resample positive, move to next row	Remove patient/s from affected room
Legionella spp.	Quarterly	Distal warm water taps — wash basins in room with high risk patients	Greater than 10 CFU/mL	BEMS manager and CEO	1. Check operational measurements, maintenance schedules and structural integrity of system 2. Clean and sanitise TMV and outlet fitting 3. Clean pipework 4. Hyperchlorinate system	Remove patient/s from affected room

Responding to Detections or Cases

Summary of Actions

- Identify measures for responding to *Legionella* detections and cases in various scenarios.
- Identifying key people and their responsibilities and authorities when responding to detections or cases (Table 2).
- Develop written procedures for required actions.

Response Procedures

- Response activities, whether they are investigations, remedial action, or stakeholder liaisons, require written procedures detailing how to undertake the required tasks. Complete Table 12 below that matches responses identified in the incident response measure identification process.
- Some of these responses will be sequential and will require information obtained following the implementation of other proceeding procedures. It may also be useful to prepare flow charts showing the sequence of actions required in various incident scenarios.

Table 12. Example of Incident Response Procedures (add, edit, delete as needed)

Incident	Responses	Procedure name
e.g. isolated *Legionella* species detection	Water sampling or system evaluation	e.g. Undertaking a *Legionella* colonisation investigation
e.g. isolated *Legionella* species detection	Localised partial system decontamination	e.g. Assess and undertake appropriate local partial system decontamination
e.g. single confirmed Legionnaires' disease case linked to facility	Case activity investigation	e.g. Assess potential case exposures during incubation period
e.g. single confirmed Legionnaires' disease case linked to facility	High risk patient identification	e.g. Undertaking a high risk patient identification
e.g. single confirmed Legionnaires' disease case linked to facility	Implementation of high risk patient protection procedures	e.g. Protecting identified high risk patients

Recreational Water Risk Assessment

Summary of Actions

- This section includes qualitative measures of likelihood and consequence to allow you to calculate the level of risk for recreational water sources in your facility.
- Recreational water risk assessments should be completed at least annually, or more often if information changes

Table 13: Risk Type Categorization of Aquatic Facilities

Risk Category	Description	Example Frequency of Inspections #/Yr
1	Examples: • Summer venue only, and has excellent sequential (previous) inspection reports • Establishments that would otherwise be group in Category 2 but have shown through historical documentation to have achieved active operational control of illness and injury risk factors	1
2	Examples: • Pools with limited prior history of non-compliance with provisions related to illness/injury risk factors or critical items • Establishments that would otherwise be grouped in Category 3 but have shown through historical documentation to have achieved active operational control of illness and injury risk factors • Summer or year-round operation	2
3	Examples: • Pool serving populations at increased risk of illness such as diaper-aged children (children <5 years old) or older people (<50 years old) • Pools serving large numbers of people • History of waterborne illness, injuries and/or complaints • History of non-compliance with provisions related to illness/injury risk factors or critical items • Year round operation • Aquatic venues which have been shown in national studies to have more pool violations	3

Table 14: Recreational Water Facility General Information

Category	Response				
Venue Type (circle one)	Pool	Hot tub/Spa	Wading Pool	Water Feature	Other
Risk Category (Table 13, circle one)	1		2		3
Venue Size (in gallons)					
Filter Type (e.g. sand, cartridge)					

Table 15: Recreational Water Facility Risk Assessment

Item		Descriptions (Bold= critical violations)	Points	In Compliance	Out of Compliance	N/A	N/O
1	**Pool/Spa Area**	**Enclosure: fencing, walls, gates, doors in good repair**	**10**				
2		**Self-closing/Self-latching gates or doors operational**	**10**				
3		**Protected overhead electrical wires/GFCI electrical receptacles**	**10**				
4		Grab rails, ladders secured; shell, deck in good repair	5				
5		Float/safety line clearly present	5				
6		"Depth" & "No diving" markers; stair stripes, in good repair and visible	5				
7		Skimmers: Weirs and baskets installed; clean and operating; covers in good repair	5				
8		Recirculation inlets functional	5				
9		**Main drain grate secured in place & in good repair**	**10**				
10		**Water is clear, main drain is visible**	**10**				
11		Starting blocks removed, covered, or access blocked	5				
12		Pool deck free from obstructions; emergency exit marked	5				

13		Emergency phone or other communication device available and well-marked	5				
14		First Aid Kit available	5				
15		**Appropriate safety equipment present and in good repair**	**10**				
16		**Adequate supervision of the aquatic facility**	**10**				
17		Signs: legible and in good repair	5				
18		**Spa temp <=104F**	**10**				
19	**Water Chemicals**	Approved NSF/ANSI Standard 50 DPD test kit	5				
20		**Proper disinfectant level**	**10**				
21		**Proper pH level**	**10**				
22		Combined chlorine <0.4 ppm	5				
23		Cyanuric acid <= 100 ppm	5				
24	**Equipment/Chemical Room**	**Automated feeder operable**	**10**				
25		Automated controller operable	5				
26		Piping and valves identified and marked	5				
27		Flow meter present and operating	5				
28		**Recirculation pump: approved, good repair, operating**	**10**				
29		**Filter: approved, good repair, operating**	**10**				
30		Pump strainer: baskets in good condition, not clogged	5				
31		Filter gauges operable: filter inlet and outlet, strainer, sight glass	5				
32		Proper functioning UV system; ozone system	5				

33		**Chemicals: labeled, stored safely, secured**	**10**				
34		Appropriate PPE available	5				
35	**Hygiene Facilities**	Diaper-changing station present; sink, adjacent trash can, sanitizer	5				
36		Used equipment separated from cleaned equipment	5				
37		Toilets: clean, good repair, bathroom appropriately shocked	5				
38		Rinse showers: good repair, accessible	5				
39		Cleansing showers: Warm, non-scalding water available; good repair; soap	5				
40	**Records Room**	Operator training certification available onsite	5				
41		Lifeguard training certification available onsite	5				
42		Inspection report conspicuously posted at each entrance	5				
43		Operator inspection daily items: checklist used daily	5				
44		Operator inspection items: evidence of appropriate steps promptly taken	5				
45		Chemical records: filled out daily	5				
46		Chemical records: evidence of appropriate steps taken	5				
47		Emergency Action Plan available on site	5				
48	**General**	**Substantial unauthorized alterations/equipment replacement**	**10**				
49		**Other: Imminent Health Hazards are a 10-point critical violation**	**5 or 10**				
		Points: add points for all scored categories; for in and out of compliance					

*Explanation of items can be found at https://www.cdc.gov/mahc/pdf/mahc-aquatic-facility-inspection-report-cheat-sheet.pdf

Table 16: Water Quality Readings

Item	Reading
Free Chlorine	**ppm**
Free Bromine	**ppm**
pH	
Total Alkalinity	**ppm**
Calcium Hardness	**ppm**
Cyanuric Acid	**ppm**
Water Temperature	**F**

Risk Assessment Interpretation

Numeric Inspection Score: _____

1. Add up all of the points of inspected items found to be in compliance to calculate total compliance points.
2. Add up all points of inspected items found to not be in compliance to calculate total non-compliance points.
3. Do not add points of inspected items that are not applicable (N/A) or not observed (N/O).
4. Divide total compliance points by the sum of total compliance points and total non-compliance points.
    A. **Numeric Inspection Score % =** (total compliance points) / (total compliance points + total non-compliance points)

Grading System (circle score)

A= 95-100%
B= 85-94%
C= 75-84%
D= 65-74%
F= 64% or less

General Building

Summary of Components

- Inventory each building and the water distribution system within them.
    - This includes water sources like decorative water fountains and cooling towers, however you will describe those sources in the relevant chapters further down in the template.
- Describe and inventory hot water system.
    - This includes written details regarding the proper use of chemicals, records of repairs/alterations, operating times, monitoring, and inspections.
- Inventory and describe potable water system.
    - This includes identifying dead legs and rubber parts (e.g., diaphragms, gaskets, washers).
- Establish and implement policy for construction, improvement, or maintenance of water systems to reduce risk of waterborne pathogens.
    - This includes policies regarding dead legs, aerators, thermostatic mixing valves, and other types of equipment.

Water System Design Recommendations

- Remove all deadlegs and shock absorbers that may act as deadlegs.
- Replace rubber parts such as washers and expansion tank bladders with antimicrobial parts if available, otherwise replace with synthetic parts.
- When replacing old fixtures, select washerless version when possible.
- When replacing shower heads, select all metal versions.
    - Replace or disinfect quarterly at a minimum.
- Remove aerators if possible to reduce aerosolization of water.
    - If not removed, replace or disinfect according to manufacturer's guidelines.
- Install anti-scald (thermostatic mixing) valves on all hot was runs close to each outlet so that water temperatures in the distribution system may be set high enough to control *Legionella* growth.
- Remove plumbing that is abandoned or no longer in use to get rid of dead legs.
    - If non-use, install a shut off at the active line and drain the unused plumbing.
- Replace all check valves between a wet fire sprinkler system and potable water system with Reduced Pressure Zone (RPZ) backflow preventers.
- Design the hot water distribution system with continuously recirculating loops to minimize stagnation, which promotes microbial growth.

Construction and Water Service Events

- Be sure to thoroughly document all construction or events (planned and unplanned) that impact the facility's water system.
  - This includes new construction, plumbing repairs, disruptions to water system (pipe break/shut off), or treatment.
- Routinely update documentation about constructions and water service events to ensure up-to-date information is available.
  - Use Table 17 below to document each construction/water service event.

Table 17: Construction/Water Service Event Documentation

Component	Response
Name of new or affected building	
Date construction/event began	
Completion date/expected completion date	
Date water service began or was restarted	
Relationship to existing potable water system	Ex: New/Independent Ex: Extension of existing system
Number of stories involved	
Was temporary water service provided to the construction area? If yes, explain.	Ex: Separate meter used for new construction
Was jackhammering or piledriving used?	
Did the potable water change in terms of taste and/or color?	
Before occupying any new/remodeled area, was a commissioning/walk-thru process undertaken?	
Do you have a Standard Operating Procedure for shutting down, isolating, and refilling/flushing water service areas that were impacted?	
In the past 6 months, have there been any interruptions of service, potable water malfunctions, or nearby water main breaks or repairs?	

Table 18: Facility Building Description (add, edit, or delete as needed)

Building Name	Ex: Building 1	Ex: Building 2
Address/Location		
Year built		
Number of floors		
Number of water risers		
Floors per water riser		
List water features present*	Ex: Ice machine on floor 1 and 2, pool on floor 1, decorative water feature on floor 1	
Type of cooling system used	Ex: cooling tower	Ex: central AC
Type of central humidifier used	Ex: none	Ex: whole building humidifier
Type of emergency water systems	Ex: fire sprinklers, safety shower, eye wash station	Ex: none

*Refer to Water Features section of template on page 40, to further describe these features

Table 19: Source Water (add, edit, or delete as needed)

Component	Response
Type of water system used	Ex: public, facility-owned well, public-owned well
Name of water supplier	
Water supplier contact information	
Type of disinfection system	Ex: chlorine, monochloramine
Has water treatment changed in the last 6 months? If yes, explain.	
Have there been any pressure drops, boil water advisories, or water disruptions in the past 6 months? If yes, explain.	

Table 20: Hot Water System Description (add, edit, or delete as needed)

Component	Response
Are cisterns and/or water storage holding tanks used to store potable water before it is heated? If yes, explain.	
Is there a recirculation system? If yes, describe where it runs and delivery/return temperatures if they are measured.	
Are thermostatic mixing valves (TMV) used? If yes, describe where they are located.	
Type of system	Ex: instantaneous heater, hot water heater, solar heating…etc.
Describe the manufacturer details about the system. Include manufacturer, serial number and date of installation.	
Total capacity	gallons
Usual temperature setting	^{o}F
What is the maximum hot water temperature at the point of delivery permitted by state/local regulations?	
Are hot water temperatures ever measured at the points of us? If yes, use Table 23 to record.	

Table 21: Potable Water System Monitoring

Component	Response
Are cold water temperatures ever measured at the points of use? If yes, use Table 23 to record.	
Do you have a supplemental disinfection system? If yes, use Table 24 to describe.	
Are potable water disinfectant levels ever measured at the points of use? If yes, use Table 23 to record.	
Are potable water pH levels ever measured at the points of use? If yes, use Table 23 to record.	
Do you perform routine flushing of the water system?	
Do you perform routine *Legionella* testing?	

Table 22: Potable Water System Monitoring Frequency

Activity Title	Description of Service	Frequency (e.g. daily, weekly, monthly, quarterly, annually)
System Flushing		
Temperature Monitoring		
Disinfectant Monitoring		
pH Monitoring		
Legionella Testing		

Table 23: Potable Water System Monitoring Log

Date	Location/Source	Time	pH	Temp (F)	Cl (mg/L)	Flushing (Y/N)	Staff Initials	*Legionella* result

Table 24: Supplemental Disinfection System Description

Buildings with supplemental disinfection	Type of system (e.g., chlorine, chlorine dioxide, copper-silver)	Date installed	Describe any maintenance in the past year

Multi-Unit Buildings (Apartments, Hotels, Dorms, Healthcare facilities with overnight stays, etc.)

Background

- Multi-unit buildings such as apartments, hotels, dorms, and healthcare facilities can introduce additional risk to guests/tenants that are exposed to water sources.
  - Irregular or seasonal use of rooms/facilities could increase likelihood of issues such as stagnant water or improper cleaning/disinfection timelines.
    - Using Table 25, describe policies and protocols for vacant/unoccupied rooms.
    - Check to see if your jurisdiction has specific requirements for maintaining vacant rooms.
  - Tenants of these facilities are likely to have prolonged exposure to water features including sinks, showers, cooling towers/swamp coolers, ice machines, and recreational water sources.

Documentation

- Using Table 27, identify which room numbers employ each style of floorplan (if multiple types of floor plans).

Table 25: Example of Protocols for Vacant or Unoccupied Rooms (add, edit, or delete as needed)

Staff Responsible: _____

Component	Response
Maximum number of days a room is allowed to be vacant without action:	Ex: 5 days
Describe protocols for rooms recently vacated:	Ex: Open every fixture in room on max hot setting for 1 minute, open every fixture in room on max cold setting for 1 minute, flush toilet 1 time, clean and disinfect faucets, showerheads, and jets. Document activity in Table 26.
Describe protocols for rooms vacant more than ___ days:	Ex: Open every fixture in room on max hot setting for 2 minutes, open every fixture in room on max cold setting for 2 minutes, flush toilet 2 times, clean and disinfect faucets, showerheads, and jets. Document activity in Table 26.
Describe protocols for using/renting unoccupied rooms:	Ex: Vacant rooms will be monitored for the time each room has remained unoccupied, vacant rooms will be placed on a renting rotation, guest rooms, which have been vacant the longest will be rented first, prior to renting a vacant room staff will verify flushing protocol has been followed.

Table 26: Example of Activity Log for Flushing Vacant/Unoccupied Rooms (add, edit, or delete as needed)

Date	Time	Staff Initials	Room Number	Floorplan Style	Hot Flush?	Cold Flush?	Toilet Flush?	Cleaned?

Table 27: Example of Multi-Unit Building Description (add, edit, or delete as needed)

Floorplan Name	Room Number(s)	Total Number of Rooms	Number of Sinks	Number of Showers	Number of jetted Bathtubs	Number of Standard bathtubs	Number of Ice Machines	Cooling Tower or Swamp Cooler?	Humidifier?
Total									

Healthcare Facilities

Background

- It is especially critical that healthcare facilities complete an environmental risk assessment (Section 6 above) prior to developing a water management plan.
- Healthcare facilities should exert special caution when completing their water management program due to the high-risk population that is typically staying in or visiting that facility. Make sure to reference your environmental risk assessment to help better classify the risk in your facility.
- Additional components that should be included in a healthcare facility water management plan are: General Building (Section 7), Multi-Unit Buildings (Section 8), and Water Features (Section 10).
- Healthcare facilities may also be subject to additional rules and regulations depending on the type of care provided as well as state or local rules.
    - Additional rules or regulations that apply may include sampling/testing protocols (frequency, number, type of testing), temperature limits in sources like sinks and showers, decorative water displays, and more.
    - Refer to the Centers for Medicare and Medicaid Services Memo about water management program requirements for hospitals, critical access hospitals, and long-term care facilities.

Table 28: Healthcare Facility Contacts (add, edit, or delete as needed)

Contact		Response
Director of Nursing	Name	
	Email	
	Phone Number	
Infection Preventionist	Name	
	Email	
	Phone Number	
Medical Director	Name	
	Email	
	Phone Number	

Table 29: Healthcare Facility Characteristics

Component	Response		Locations
Type of healthcare facility			
Total number of beds			
Number of intensive care unit beds (including surgery, coronary care, etc.)			
Do you have a solid organ transplant program? (circle)	Yes	No	
Do you have a bone marrow transplant program? (circle)	Yes	No	
Can windows in patient rooms be opened? (circle)	Yes	No	
If windows in patient rooms can be opened, are cooling towers visible from these windows? (circle)	Yes	No	
Are patients exposed to portable humidifiers? (circle)	Yes	No	
Do any patients use aerosol generating devices, such as CPAP, BiPAP, or nebulizers? (circle)	Yes	No	
Are there therapeutic whirlpools/spas on site? (circle)	Yes	No	
Has your facility previously experienced Legionnaires' disease cases that were "possibly" or "probably" facility acquired? (circle)	Yes	No	
If yes to a Legionnaires' disease case, enter the YEAR of the most recent case.			

Water Features

Recreational Water Facilities (i.e. pools, hot tubs, splash pads, hot springs)

Roles and Responsibilities

- It is important to document all internal and external staff that are responsible for maintaining recreational water facilities.
  - Using Table 30, note details about the Certified Pool Operator (CPO) who is responsible for maintaining your recreational water sources. If you have more than one CPO, duplicate the table and complete for each CPO. Be thorough when describing specific duties each person is accountable for.
  - Using Table 31, note details about maintenance staff employed by your facility who are responsible for maintaining your recreational water sources. If there is more than one person, duplicate the table and complete for each person. Be thorough when describing specific duties each person is accountable for.
  - Using Table 32, note details about any external consultants that your facility pays to maintain any aspect of your recreational water sources. If there is more than one person or company, duplicate the table and complete for each person/company. Be thorough when describing specific duties each person/company is responsible for.
- Decide on duties that your CPO, internal maintenance staff, or external consultant will perform on a **daily** and **weekly** basis.

Table 30: Certified Pool Operator Information

Component	Response
Name	
Phone Number	
Email	
CPO Certification #	
Date of Certification Expiration	

Table 31: Recreational Water – Internal Maintenance Staff

Component	Response
Name	
Job Title	
Phone Number	
Email	
Work Schedule	
Duties Performed	

Table 32: Recreational Water – External Consultants

Component	Response
Company Name	
Phone Number	
Personal Contact Name	
Personal Contact Phone Number	
Personal Contact Email	
What services does this company provide?	
How often do they provide the service(s)?	

Briefly describe the <u>daily</u> duties of the pool operator including testing, maintenance, and upkeep:

_____
_____
_____

Briefly describe the <u>weekly</u> duties of the pool operator including testing, maintenance, and upkeep:

_____
_____
_____

Water Feature Description

- In Table 33, you will describe specific details and features of each recreational water source in your facility.
  - Routinely update this table to ensure accurate information is kept regarding dates of maintenance protocols, types of materials used (filter type), and equipment function.

Table 33: Recreational Water Feature Descriptions

Water Feature Questions	Descriptor/Location			
Indoor or Outdoor				
Max Bather Load				
Filter Type				
Date filter was last changed				
Date of last filter backwash				
Compensation tank present?				
Type of disinfectant used (include chemical name, formulation, and amount used)				
Desired disinfectant range (ppm)				
Desired pH range				
Method used for adding disinfectant				
Method used for monitoring and maintaining disinfectant and pH levels				
Date last drained and scrubbed				
Was there a recent disinfectant "shock" treatment?				
Operating as designed and in good repair? If no, describe issues.				
Operates continuously or intermittently				
Heat source				

Acceptable Chemistry Ranges

- Check with your local regulatory agency to determine if there are city, county, or state requirement for acceptable chemistry ranges.
  - Note these regulatory ranges in Table 34.
  - If your jurisdiction does not have any requirements, use the ideal ranges stated in Table 34, which are the ranges recommended in CDC's Model Aquatic Health Code (MAHC).

Routine Monitoring

- Daily and weekly monitoring of recreational water sources in crucial to ensure proper chemistry levels. Using Table 35 and Table 36, log routine monitoring records.

Table 34: Acceptable Regulatory Ranges and Limits (varies by state)

Parameter	Required PPM*		Ideal PPM**	
	Min	Max	Min	Max
Free Chlorine (pool)			2.0	10.0
Free Chlorine (spa)			3.0	10.0
Combined Chlorine				1.0
Bromine (pool)			3.0	8.0
Bromine (spa)			3.0	8.0
Total Alkalinity (CaCO3)			60	180
pH			7.2	7.8
Calcium Hardness			200	1000
Temperature (pool)				104F
Temperature (spa)				104F
O.R.P. (in mv)			600	900
Saturation Index			-0.2	+0.2
Cyanuric Acid (ppm)			20	100

*Check state and local regulations to determine required limits, if stated, and input into table

**Recommended limits based on Model Aquatic Health Code (MAHC)

Table 35: Example of Daily Testing Log (add, edit, or delete as needed)

			TEST DAILY								
	Date	Time	Maintenance	Flow Rate	Free Cl /Br	Total Cl	Combined Cl	pH	Temp (F)	Main Drain	
										Secure	Visible
MONDAY											
TUESDAY											
WEDNESDAY											
THURSDAY											

FRIDAY											
SATURDAY											
SUNDAY											

*Check your jurisdiction's regulatory requirements to determine the required frequency at which testing needs to occur. This often changes depending on the source (pool vs hot tub)

Table 36: Example of Weekly Testing Log

Test Weekly	Date	Time	Result
Alkalinity			
Calcium Hardness			
Cyanuric Acid			

Cooling System (i.e. Cooling Towers/Swamp Coolers/Evaporative Condensers)

Background

- Cooling towers (CT) are heat rejection devices that transfer heat to the atmosphere through evaporative cooling processes.
- CT vary in size, design, and application.
  - Air conditioning.
  - Removing heat from commercial and industrial processes.
- Improperly maintained CTs pose a hazard for *Legionella* colonization and amplification.
  - Stagnation
    - Encourages biofilm growth and reduces temperature and levels of disinfection.
  - Increased/fluctuating water temperature
    - *Legionella* grows best between 77-108F.
  - Inadequate microbial treatment
    - Does not kill or inactivate *Legionella*.
  - Biofilm
    - Protects *Legionella* from heat and disinfection.
    - Provides food and shelter to germs.
    - Grows on any surface that is constantly moist and can last for decades.
  - Scale and sediment
    - Uses up disinfectant and creates a protected home for *Legionella* and other germs.
  - pH
    - Disinfectants are most effective within a narrow range (approximately 6.5-8.5).
- Colonized CTs pose a risk for human health.
  - Drift: aerosolized water droplets coming off CTs can travel up to a few miles, depending on environmental conditions.
- Outbreaks of Legionnaires' disease have been linked back to contaminated CTs
  - According to a study looking at CDC outbreak investigations over a 15 year period, CTs were the second most common source of exposure following potable water. However, CTs were associated with larger number of cases relative to other outbreak exposures.

Cooling System - Roles and Responsibilities

- It is important to document all internal and external staff that are responsible for maintaining cooling systems.
  - Using Tables 37A-D, note details about key individuals who are responsible for the upkeep and maintenance of the cooling systems.

Table 37A: Cooling System Responsible Person (Daily Oversight)

Component	Response
Name	
Company	
Phone Number	
Email	
Duties Performed	Such as: performs duties including filling out Water Quality Parameter Log and Routine Monitoring Checklist

Table 37B: Cooling System Qualified Person (Inspection/Guidance)

Component	Response
Name	
Company	
Phone Number	
Email	
Duties Performed	Such as: performs inspections and fills out Compliance Inspection Checklist, as well as emergency/other inspections as needed

Table 37C: Cooling System Cleaning/Chemical Application Person

Component	Response
Name	
Company	

Phone Number	
Email	
Duties Performed	Such as: performs at least twice per year cleaning and oversees application of daily or other approved chemical treatment procedures

Table 37D: Cooling System Other (environmental consultant…etc)

Component	Response
Name	
Company	
Phone Number	
Email	
Duties Performed	Such as: executes other plan components or tasks as needed

System Description

- It is important to document all key parameters of the cooling system(s) such as manufacturer details.
  - Using Table 38, note details about the cooling system.

Table 38: Cooling System Key Parameters

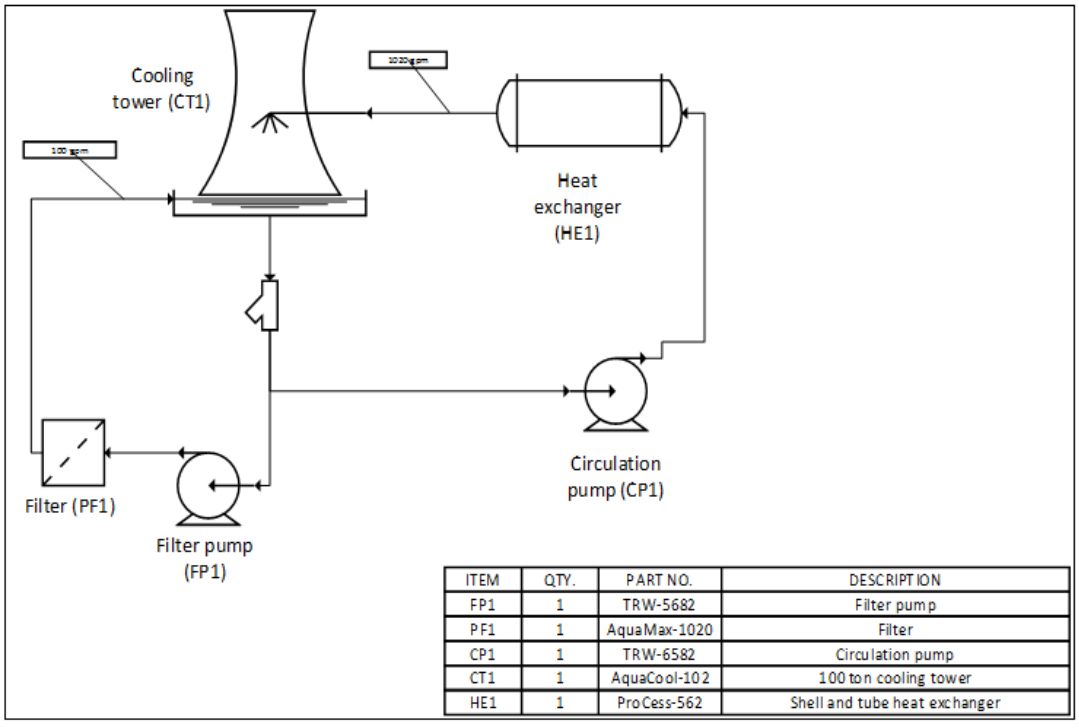
System			
Cooling System Name			
Location			
Number of Cells			
Time of Operation (Months/Year)			
Makeup Source			
Purpose (e.g. refrigeration or residential cooling)			

Cooling System Schematic/Flow Diagram

- Include the following components in your cooling equipment flow/schematic diagram:
  - Cooling towers with their individual number of cells and circulation pumps marked
  - System pump and control valves
  - Standby equipment, e.g. spare pumps
  - Location of system bleed valves
  - Associated storage tanks
  - Associate pipework
  - Location of chemical dosing points and/or injection points
  - Location of System drain valve
  - Any parts that may be temporarily out of use
  - Other systems
  - Water quality monitoring points for water quality measurements, bacteriological indicator sampling, and *Legionella* sampling

Figure 7: Example of Cooling Tower Schematic Drawing

Process Schematic Example



ITEM	QTY.	PART NO.	DESCRIPTION
FP1	1	TRW-5682	Filter pump
PF1	1	AquaMax-1020	Filter
CP1	1	TRW-6582	Circulation pump
CT1	1	AquaCool-102	100 ton cooling tower
HE1	1	ProCess-562	Shell and tube heat exchanger

Cooling System Process Control Measures

Routine System Monitoring- Responsible person for each cooling system should monitor the system on a routine basis, e.g. weekly. The responsible person should conduct routine monitoring by:

- Using written or electronic checklist to record visual observations of the cooling tower system and associated equipment.
- Observing all wetted surfaces (safely visible during tower operation), tower basins and drift eliminators and recording the presence of organic material, biofilm, algae, scale, sediments, and silt/dust deposits, organics (oil and grease), and other visible contaminants.
- Performing a check of chemical dosing and control equipment, including sufficient storage and delivery of treatment chemicals, and the bleed-off system.
- Reporting any system anomalies or problems to the management and maintenance team for immediate corrective action.

Compliance Inspection- The qualified person should conduct a compliance inspection on a routine basis, e.g. quarterly, while the cooling tower is in operation. The qualified person who complete written or electronic checklist and keep this on-site. The checklist could reflect observations and findings, including:

- **Routine Maintenance and Part Replacement-** Ensure appropriate general maintenance and part replacement. Routine maintenance activities must conform to manufacturers' recommendations, including, but not limited to, general system cleanliness, drift eliminator and fill material condition, overall distribution operation, water treatment system, basin/remote sump cleaning, and purging of stagnant and low-flow zones.
- **Cleaning-** The cooling equipment must be cleaned whenever routine monitoring and inspections indicate a need for cleaning, but no less than (X) times a year, in accordance with the manufacturer's recommendations.
    - Describe routine cooling equipment cleaning schedule including pack areas where scale, debris, and biofilm are likely to accumulate.
- **Cooling System Aerosol Control**
    - Keep cooling equipment operating at all times to minimize formation and release of aerosols and mist.
    - Install and maintain drift eliminators in accordance with manufacturer's specifications.
- **System Shutdown and Startup-** Procedures to shut down a cooling system should conform to the manufacturers' recommendations. When shut down the system should be completely drained, and protected from offline contamination.
    - Provide detailed procedures for system shutdown and startup

Table 39: Daily Cooling System Treatment Specifications

Component	Response
Does the system have automatic, daily biocide treatment? (circle)	Yes No
If yes, describe it:	Ex: ORP-feedback Ex: time dosing
If no, describe it:	

Table 40: Detailed Cooling System Treatment Description

Component	Description
Chemicals and Biocides	Describe all chemicals and biocides applied to the system and target biocide levels
Feeding	Describe chemical and biocide feeding mechanism, location, frequency, set timer system, duration, and feed rate.
Corrective Actions	Describe trigger events and chemical biocide corrective action implementation procedures.

Table 41: Cooling System Recirculating System

Component	Response
Does the cooling system have a continuous recirculating system? (circle)	Yes No
If no, describe the operating program/rules. Specifically, explain how effective chemical treatment will occur when part of all of the system is idle at the time of a scheduled chemical application:	

Table 42: Cooling System Hyperhalogenation Disinfection

Component	Description
Referenced Standards/Protocols	
Minimum Concentrations	
Holding Times	
Monitoring Procedures	

Cooling Equipment Water Quality Monitoring

- Indicate your plan for monitoring the water quality in your cooling system.
- Make sure to describe your specific plan, including:
  - Where, when, and how often you will monitor the specific parameters.
  - What parameters you will monitor, such as pH, temperature, conductivity, and biocidal indicator.
  - Corrective actions you will take when deviations in monitoring are recorded.

Table 43: Cooling System Monitoring Plan Description

Source	Response
Location(s)	
Frequency	
Corrective Actions	

Table 44: Cooling System Water Quality Parameter Monitoring (add, edit, or delete as needed)

Component	Response
Date/Time	
Location	
pH	
Temperature	
Conductivity	
Biocidal Indicator	

Table 45: Cooling System Bacteriological Indicator Sampling

Will heterotrophic plate count (HPC) be used as a bacteriological indicator? (circle) Yes No

If yes, complete the table below:

Component	Response
Responsible party for indicator collection	Describe who is responsible for indicator collection.
Indicator collection location(s)	Describe where in the cooling system the sample(s) will be taken from
Indicator sampling protocol	Describe how the *Legionella* sample(s) will be taken and managed (identify lab)
Responsible party for corrective action(s)	Describe who is responsible for interpreting results/performing corrective action(s)
Corrective action(s) and timeline	Describe corrective action(s) and timeline, along with documentation procedure

Table 46: Cooling System *Legionella* Testing

Will *Legionella* culture testing be performed? Yes No

If yes, complete the table below:

Component	Response
Responsible party for *Legionella* sample collection	Describe who is responsible for *Legionella* sample collection.
***Legionella* sample collection location(s)**	Describe where in the cooling system the sample(s) will be taken from.
***Legionella* sampling protocol**	Describe how the *Legionella* sample(s) will be taken and managed. Identify lab. (see page 69)
Responsible party for corrective action(s)	Describe who is responsible for interpreting results/performing corrective action(s).
Corrective action(s) and timeline	Describe corrective action(s) and timeline, along with documentation procedure (See cooling tower section under Mitigation and Remediation on page 76).

Table 47: Cooling System Activity Frequency

Activity Title	Description of Service	Frequency (e.g. seasonal startup, daily, weekly, monthly, quarterly, annually)
Routine Monitoring		
Compliance Inspection		
Cleaning		
Equipment Startup		
Water Quality Monitoring		
Bacteriological Indicator Sampling		
***Legionella* Sampling**		

Table 48: Daily Cooling System Water Quality Parameter Log

Monitoring Person: _____

Month, Year: _____

Day	Location	Time	pH	Temp (F)	Biocide Residual	Conductivity (mS)	Staff Initials	Comments
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								

15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								
31								

Table 49: Cooling System Routine Monitoring Checklist

Inspection Staff: _____

Date (MM/DD/YYYY): _____

Aspect	Yes	No	Comments – Further Action Required
Wetted surfaces (safely visible during cooling system operation) are free of organic material, biofilm, algae, scale, sediment and silt/dust deposits, organics (oil and grease), and other visible contaminants			
Drift eliminators are free or organic material, biofilm, algae, scale, sediment and silt/dust deposits, organics (oil and grease), and other visible contaminants			
Chemical dosing and control equipment is sufficient			
Storage and delivery of treatment chemicals is sufficient			
Bleed-off system is sufficient			

Table 50: Cooling System Compliance Inspection Checklist

Inspection Staff: _____

Date (MM/DD/YYYY): _____

Aspect	Yes	No	Comments – Further Action Required
Cooling system equipment and basin free of visible contaminants			
Cooling system general condition observed as satisfactory			
Basin observed as satisfactory			
Packing material observed as satisfactory			
Drift eliminator observed as satisfactory			

Quality of the water make-up connections and control maintained			
Proper functioning of the conductivity control maintained			
Proper functioning of all dosing equipment (pumps and strain gauges) maintained			
Routine maintenance records reviewed to ensure proper implementation of required activities (including those specified previously) and corrective actions as needed			

Decorative Water Displays

- Decorative water displays, such as decorative water fountains, can also serve as a source of *Legionella* capable of infecting people who are exposed to aerosolized spray.
- It is important to regularly maintain decorative water features to inhibit growth of algae and biofilm that may encourage bacterial growth.
- Use Tables 51 and 52 below to document routine maintenance protocols.

Table 51: Decorative Water Feature Maintenance Protocols

Aspect	Response
Wetted surfaces are free of organic material, biofilm, algae, scale, sediment and silt/dust deposits, organics (oil and grease), and other visible contaminants	Yes No
Minimum acceptable halogen level (i.e. chlorine, bromine)	mg/L
Acceptable pH range	
Acceptable temperature range	
Frequency of cleaning and disinfection (i.e. daily, weekly)	
Type of disinfectant used in cleaning/disinfection	
Describe cleaning protocols	

Table 52: Decorative Water Feature *Legionella* Testing

Will *Legionella* culture testing be performed? Yes No

If yes, complete the table below:

Component	Response
Responsible party for *Legionella* sample collection	Describe who is responsible for *Legionella* sample collection.
***Legionella* sample collection location(s)**	Describe where in the decorative water feature system the sample(s) will be taken from.
***Legionella* sampling protocol**	Describe how the *Legionella* sample(s) will be taken and managed. Identify lab. (see page 69)
Responsible party for corrective action(s)	Describe who is responsible for interpreting results/performing corrective action(s).
Corrective action(s) and timeline	Describe corrective action(s) and timeline, along with documentation procedure (See decorative water feature section under Mitigation and Remediation on page 74).

Table 53: Decorative Water Feature Monitoring Log

Monitoring Person: _____

Week, Month, Year: _____

Day	Feature	Time	pH	Temp (F)	Halogen Residual (mg/L)	Cleaned (Y/N)	Staff Initials	Comments
1								
2								
3								
4								
5								
6								
7								

Ice Machines

- Ice machines are included as water sources where waterborne pathogens such as *Legionella* have been known to survive and grow.
- In order to ensure ice machines are maintained properly to minimize risk of bacterial colonization and growth, document descriptive information for each machine as well as maintenance protocols.

Table 54: Ice Machine Description

Description	Response
Building/location	
Manufacturer	
Model	
Filter type (e.g. stainless steel, pleated, carbon)	
Filter's micron cut-off	
Is this machine also a water dispenser?	Yes No

Table 55: Ice Machine Maintenance Protocols

Protocol	Description
Who is responsible for maintaining ice machines?	
How often are ice machines cleaned? (e.g. daily, weekly, monthly)	
What are the cleaning protocols, including description of steps taken and chemicals used?	
How often are ice machines sanitized?	
What are the sanitization protocols, including description of steps taken and chemicals used?	

Table 56: Ice Machine Maintenance Checklist (add, edit, or delete as needed)

Date	Time	Location	Cleaned	Sanitized	Staff Initials	Comments

Medical Devices (i.e. respiratory therapy equipment)

Care of Respiratory Equipment

- Healthcare facilities should refer to the manufacturer's instructions for use for proper cleaning and disinfection instruction of respiratory therapy equipment.
- Additional guidance can be accessed at:
  - **CDC's Guidelines for Preventing Healthcare-Associated Pneumonia, 2003**
  - **WHO's Infection Prevention and Control of Epidemic- and Pandemic-Prone Acute Respiratory Infection in Health Care**

Checklist

- In addition to following manufacturer's guidelines for cleaning and use of respiratory therapy equipment, use the checklist below and Tables 57A-C to ensure proper hygiene protocols are followed.

Respiratory Therapy Use Checklist

- □ Staff performed hand hygiene before and after respiratory care or contact with respiratory equipment
- □ Staff used appropriate PPE before and during use of respiratory equipment
- □ Only sterile solutions are used, such as sterile water or saline
- □ Single dose nebulizer vials are used for only one resident
- □ If multi-dose nebulizer vials are used for more than one resident, vials are dated when initially accessed, stored appropriately, and do not enter the immediate resident treatment area
- □ Clean, working suction equipment is available to a source of emergency power and is available for immediate use

Table 57A: Respiratory Therapy Use, Respiratory Aerosolized Care (nebulizer, inhaler)

Protocol	Response
What sterile solutions are used for nebulization?	
If multi-dose vials are used, describe manufacturer's instructions for handling, storing, and dispensing the medications.	
Are jet nebulizers used for only one resident?	
How are jet nebulizers cleaned, dried, and stored?	
How are mesh nebulizers that remain in the ventilator circuit cleaning, disinfected, and changed?	
Who is responsible for maintaining aerosolized care equipment?	

Table 57B: Respiratory Therapy Use, Oxygen

Protocol	Response
How is oxygen equipment cleaned, and sanitized?	
Who is responsible for cleaning and maintaining oxygen equipment?	

Table 57C: Respiratory Therapy Use, Mechanical Ventilation or Tracheostomy

Protocol	Response
Describe protocols for ensuring condensate does not drain towards the resident.	
Are single-use open-system suction catheters used?	
Describe protocols for how sterile fluid is used to remove secretions from the suction catheter if the catheter is used for re-entry into the resident's lower respiratory tract	
How are machines or equipment maintained and cleaned?	
Who is responsible for cleaning and maintaining equipment?	

Environmental Sampling and Testing

Environmental Sampling

Sampling Plan

- **Facilities should refer to their jurisdictional regulations to determine if there are standards (i.e., appropriate sampling size, amount of samples, etc.) for sampling**. Facilities may also decide to work with a water consultant to develop a sampling plan.
- The sampling of outlets should be representative of the various functions of the rooms in the facility as well (e.g. patient rooms, bathrooms, procedure rooms, janitors closet, etc.).
    - **Number of Samples:** It is recommended to sample 10 percent of outlets in facilities with fewer than 500 outlets; 8 percent if number of outlets range from 500 to 1000; 5 percent if more than 1000 outlets. Refer to your jurisdictional requirements for minimum acceptable numbers.
    - **Frequency of Sampling:** It is recommended to sample a minimum of once per year, however facilities with higher risk populations should consider sampling more frequently such as quarterly. Refer to your jurisdictional requirements for minimum acceptable timelines.

Sampling Supplies

- It is important to make sure you have all of the supplies you will need to take the number of samples indicated in your sample plan. Before sampling, you should go through your environmental risk assessment to identify water sources and specify which sites will be samples during each sampling round. Use the checklist below each time to ensure all supplies are gathered and then use Tables 58A-D to determine exactly how many samples total you will collect.

Sampling Supplies Checklist

- □ Sterile plastic 1 L bottles. (Glass bottles are not recommended, due to risk of breakage during transport.)
- □ Sterile plastic 15 mL screw top tubes (with a tube rack) for biofilm swabs.
- □ Disposable dacron/polypropylene-tipped swabs with wooden or plastic stems. **Do NOT use cotton-tipped swabs as they inhibit *Legionella* growth**.
- □ Test tube/bottle labels
- □ 0.1N solution of sodium thiosulfate (Na2S2O3) (15.81 g/L in distilled water, filter sterilize, replace every 12 months).
- □ Pipettes and bulbs for adding 0.5 mL of 0.1N sodium thiosulfate solution into 1 L water samples.
- □ Sterile plastic 500 mL or 1 L bottle for testing chlorine level, pH, and temperature.
- □ pH test kit.
- □ Chlorine test kit sensitive enough to detect chlorine level below 1 ppm and up to 100 ppm (may need two kits). Free chlorine may be measured when it is known that chlorine is the method of disinfection (as opposed to monochloramine, bromine, or another disinfectant). Other, measure total chlorine.
- □ Thermometer.
- □ Sample data sheet (example below) and pens/sharpies.
- □ Large cooler, preferably with wheels. A 70 quart (66.2 L) horizontal cooler (a standard large picnic cooler) should fit twenty-five 1 L bottles, twenty-five 15 mL plastic tubes for biofilm swabs, thermometer, pH, and chlorine test kits. For sampling of a larger facility (60-100 samples total), a second cooler that holds nothing but bottles, swabs, and tubes may be needed. The cooler may be packed ahead of time and stored at ambient temperature for an unlimited time as long as the sodium thiosulfate is replaced every 12 months.
- □ If cooler is being mailed you will also need tape and scissors for sealing the cooler.
- □ Biohazard waste bags for collecting trash.
- □ Gloves.
- □ N95 respirator. *These are appropriate when sampling cooling towers if the fans cannot be turned off, or in enclosed spaces with an aerosol-generating device that cannot be turned off. Respirators must be used in accordance with a comprehensive respiratory protection program, which includes fit testing. Training, and medical clearance ahead of their use (see OSHA standard 29 CFR 1910.134). For more information about N95 respirators, visit the National Institute for Occupational Safety and Health (NIOSH) website.*
- □ Other (specify): _____
  _____
  _____

Sampling Considerations

- In most situations, it is appropriate to sample only the hot water. However, there are situations where taking some cold water samples is helpful. For example, in hot climates, the cold water may be warm enough for rapid *Legionella* amplification (>77°F). Desalination may also elevate cold water temperature. Cold water could also be warm due to lack of insulation between hot and cold water pipes.
- In order to determine how many samples should be collected from each source (i.e., shower, sink, water heater…etc.) please refer to Tables 58A-D below.
- It is important to keep track of all of the samples you are collecting as well as additional information about each sample such as the type of specimen, temperature, and disinfectant level. Use Table 59 below to record this information.

Table 58A: Potable Water Sampling Sites

Site	Approximate number of samples	Type of samples
Incoming water main (where water enters the facility/campus/building from the municipality)	1	1L bulk water
Every well and water tower that supplies water to the facility/campus/building	1 per well or water tower	1L bulk water
Every holding tank or cistern	1 per holding tank/cistern	1L bulk water
Centralized water heater	1	1L bulk water (a biofilm swab if drained)
Expansion tank for hot water (absorbs excess water pressure caused by thermal expansion within the hot water heater)	1	1L bulk water
Hot and cold water returns	1 each for hot and cold	1L bulk water
For buildings with water softeners, special filters, and disinfection systems, sample water before and/or after these processes		1L bulk water

Shower	2 per shower	1 biofilm swab and 1L bulk water
Faucet	2 or 3 per faucet	1 biofilm swab inside the faucets, (1 biofilm swab of the inside of the aerator if visual inspection indicates that it's overgrown with biofilm), 1L bulk water
Whirlpool baths (i.e., Jacuzzis)	1	1 biofilm swab inside the jets

Table 58B: Cooling Tower and Swamp Cooler Sampling Sites

Site	Approximate number of samples	Type of samples
Make-up water (water added to replace water loss because of evaporation, drift, or leakage)	1	1L bulk water
Collection basin (an area below the tower where cooled water is collected and directed to the sump)	2	1L bulk water and a biofilm swab at the water line
Sump (a depressed chamber contiguous to the basin, where water flows to facilitate pump suction; may also be used as collection point for silt and sludge)	2	1L bulk water and a biofilm swab at the water line
Storage tank or reservoir in the system	1	1L bulk water
Drift eliminators or other surfaces that remain moist	1	1L biofilm swab
Heat sources (e.g., chillers)	1	1L bulk water

Table 58C: Whirlpool Spa/Hot Tub or Pool Sampling Sites

Site	Approximate number of samples	Type of samples
Water in the tub	1	1L bulk water
Biofilm at the water line	1	Biofilm swabs (the quantity depends on the size of the tub)
Water Jets	1	Biofilm swabs of several jets

Filter	1 per filter	Combination of water and a filling (sand in sand filters, diatom powder in DE filters, or polyester filling in cartridge filters) to keep the filling moist during transport
Compensation tank	1	1L bulk water
Pump	1	1 biofilm swab
Filter basket	1	1 biofilm swab per basket

Table 58D: Other Sampling Sites

Site	Approximate number of samples	Type of samples
Decorative fountains	2	1L bulk water and a biofilm swab (number of swabs dependent on size and complexity of the fixture)
Sprinkler systems	>2	1L bulk water and one or several biofilm swab(s) of the sprinkler jets
Safety showers and eye wash stations	2	1L bulk water and a biofilm swab
Humidifiers	2	Bulk water (as close to 1L as possible) and at least one biofilm swab of moist surface
Nebulizers, hand-powered resuscitation bags, intermittent positive pressure breathing ventilators, and other respiratory care equipment that uses water for filling or cleaning	>2	1L bulk water used to clean the device and biofilm swabs of moist surfaces

Table 59: Example Sample Data Collection Sheet (add, edit, or delete as needed)

Sample ID	Date Collected	Collected by	Specimen Type (e.g., water, swab, filter)	Sample Description (e.g., room 253 shower)	Temp (F)	Time to Temp	Free Cl (ppm)	Total Cl (ppm)	pH
1	05/01/19	AB	Water	Hot tub water	103.5	------	3.5		7.5
2	05/01/19	AB	Swab	Room 1123 shower swab	118	12 s	0.3		7.2

Sampling Protocols- Showers and Sinks

Collect one biofilm swab and one bulk water sample from each sampling site (i.e., each showerhead or faucet).

1. For showers, remove the showerhead. For faucets, remove the aerator.

Take biofilm swabs:

2. Turn on the water for a couple of seconds to moisten the pipe, and then turn it off. Insert a sterile Dacron- or polypropylene-tipped swab deep into the faucet/pipe. Try to get beyond the bend and swab around the inside surface firmly without breaking the swab stem. (If there is visible biofilm on the inside of the showerhead or faucet aerator when these are removed, they can also be swabbed.)
3. Place the swab into a 15 mL sterile plastic tube and add 3–5 mL of water from the same faucet to keep the swab tip moist during transport. Snap the wooden or plastic swab stem approximately 1 in. from the top of the tube. Add a drop of 0.1N sodium thiosulfate solution to neutralize residual disinfectants. Tighten the tube top to prevent leakage.
4. Label the tube with a unique identifier. Record the type and location of the sample on a Sample Data Sheet, and place the tube into a cooler.

Take bulk water samples:

5. After the biofilm swab is collected, turn on the water and let it run for a few minutes until the water is warm but not hot. The goal is to obtain water currently in the distribution system along with any material shed from biofilm. Avoid heating water excessively (approximately 122°F or higher) since free-floating Legionella will die quickly at elevated temperatures. Collect 1 L of water from the faucet into a sterile 1 L bottle, leaving a 1 in. space at the top.
6. Add 0.5 mL of 0.1N sodium thiosulfate solution to the water sample to neutralize residual disinfectants. Tighten the bottle top to prevent leakage.
7. Label the bottle with a unique identifier. Record the type and location of the sample on the Sample Data Sheet, and place it into the cooler.

Measure water parameters:

8. Run the hot water until it is as hot as it will get. Collect 100–300 mL of water in a separate plastic sampling bottle. The same bottle can be used for measuring water parameters at every sampling site. Measure temperature, pH, and chlorine level of the sample. Record all measured data in the Sample Data Sheet in Table 59.

Sampling Protocol- Hot Water Heaters

1. Collect a bulk water sample; it is rare that a biofilm sample can be obtained from a water heater since this would require completely draining the tank.
2. Open the drain valve of the hot water heater and collect 1 L of water into a sterile 1 L bottle, leaving a 1 in. space at the top.
3. Add 0.5 mL of 0.1N sodium thiosulfate solution to the water sample to neutralize residual disinfectants. Tighten the bottle top to prevent leakage.
4. Label the bottle with a unique identifier. Record the type and location of the sample on the Sample Data Sheet, and place it into the cooler.
5. Always measure and record the temperature, pH, and chlorine level of a bulk water sample collected from a hot water heater.

Sampling Protocol- Whirlpool Spas/Hot Tubs

1. Take biofilm swabs from inside several jets and at the water line.
2. Place each swab into a 15 mL sterile plastic tube (one swab per tube) and add 3–5 mL of water from the whirlpool spa tub to keep the swab tip moist during transport. Snap the wooden or plastic swab stem approximately 1 in. from the top of the tube. Add a drop of 0.1N sodium thiosulfate solution to neutralize residual disinfectants. Tighten the tube top to prevent leakage.
3. Label each tube with a unique identifier. Record the type and location of the sample on a Sample Data Sheet, and place the tube into a cooler.
4. If the spa tub is not drained, collect a 1 L bulk water sample in a 1 L bottle. If the pool is partially drained, a sterile 15 mL tube may be used to collect the remaining whirlpool water. If the spa has been completely drained, ask facility maintenance personnel for access to the compensation tank (for collection of overflow water) and take a bulk water sample from there.
5. Add 0.5 mL of 0.1N sodium thiosulfate solution to neutralize residual disinfectants. Tighten the bottle top to prevent leakage.
6. Label the bottle with a unique identifier. Record the type and location of the sample on the Sample Data Sheet, and place it into the cooler.
7. Collect 100–300 mL of water from the whirlpool spa tub (or the compensation tank if drained) in a separate plastic sampling bottle. Measure temperature, pH, and free chlorine or bromine level of the sample. Record all measured data on the Sample Data Sheet.
8. It is very important to collect a filter sample from whirlpool spas. Request access to the filter (which is usually located in a separate maintenance room) from the facility maintenance personnel. Gloves should be worn due to heavy organic loads typically found in filters and the abrasive or caustic

nature of some filter filling material. The methodology for filter sample collection depends on the filter type.

a) **Sand filters**: Collect some sand and enough water from the filter to cover the sand and keep it moist. Collect 300–500 mL of water from the filter chamber into a sterile 1 L bottle. Use the same or a new bottle to scoop sand from the chamber, and pour the sand into the bottle making sure that it is completely covered by water.

b) **Cartridge filters**: Cut a portion of the filter to fit inside a 1L bottle; add enough water from the chamber to cover and keep it moist.

c) **Diatomaceous earth filters**: Collect 300–500 mL of water from the filter chamber into a 1 L bottle and use a swab to scrape diatom powder from the grid. Place the powder into the bottle making sure that it is completely covered by at least 1 in. of water.

d) Add 0.5 mL of 0.1N sodium thiosulfate solution. Tighten the bottle top to prevent leakage.

e) Label the bottle with a unique identifier. Record the type and location of the sample on the SDS, and place it into the cooler.

Environmental Testing

- Although *Legionella spp*. live in a wide variety of freshwater habitats, they can be difficult to isolate in environmental samples. Culture of *Legionella* from environmental sources can involve several steps including concentration of the bacteria, resuspension, selective pre-treatments, and the use of complex media. Use of a suitable isolation protocol is critical for determining whether *Legionella* is present in a sample.
- The Environmental *Legionella* Isolation Techniques Evaluation (ELITE) Program was created as a way for laboratories to test their *Legionella* isolation techniques against standardized samples. Participating labs receive a panel of lyophilized test samples twice each year. The test samples are divided between *Legionella* positive or negative and may be mixed with other organisms commonly found in water. After reconstituting the test samples, participants process them according to their protocols and report their results. Laboratories that correctly identify *Legionella* from the test samples in two consecutive panels receive a certificate of proficiency and are listed among ELITE Members.
- In addition to *Legionella* culture, which is considered the gold standard in testing, PCR testing can also be used for environmental *Legionella* identification. PCR can be a useful first-line test to quickly identify the presence of *Legionella* in samples, however, special caution should be used in interpreting PCR-only results. PCR testing does not have the ability to distinguish whether the *Legionella* is live or dead, so reflex culture should be used to distinguish.

Mitigation and Remediation

Mitigation and Remediation

- Check with your local jurisdiction to identify any regulatory requirements and limits that may impact the level or type of mitigation that occurs. If you do not have any specific regulatory requirements, here are some recommended mitigation strategies for various types of water systems and features.
- Only qualified personnel experienced in the procedures listed below should carry out the described protocols to ensure safety. If your facility does not have qualified staff, or you are required by your jurisdiction to hire an outside vendor, please refer to Appendix C when choosing a consultant.

Building Water System

Heat and Flush

1. Check if thermostatic mixing valves are present. If yes, either remove or bypass them.
2. Remove aerators from faucets.
3. Raise hold water temperature to 160-170F.
4. Open all hot was faucets and water sources and let the hot water run at a low flow to bring the hot water to the taps.
5. Starting at the outlets in the water system closest to the water heater, start running taps to distribute hotter water throughout for a minimum of 5 minutes for routine mitigation or a minimum of 10 minutes if in response to a case of Legionnaires' disease.
    A. Use a thermometer to measure and document the temperature, tap location, and time of initial reading to ensure proper temperature is maintained. Use Table 60 to record this information.
    B. The number of outlets that can be flushed simultaneously will depend on the capacity of the water heater and the flow capacity of the system.
    C. Local building and sanitary codes should be checked for any temperature limits of water discharged to the sewer.
    D. Appropriate safety procedures to prevent scalding are essential.
        a) If possible, flushing should be performed when the fewest building occupants are present, such as nights or weekends.
        b) Signs should be posted to indicate the elevated temperature of the water.
        c) Residents or guests of the building should be notified.

Superheating

1. Check if thermostatic mixing valves are present. If yes, either remove or bypass them.
2. Remove aerators from faucets.
3. Raise hold water temperature to 160-170F.
4. Open all hot was faucets and water sources and let the hot water run at a low flow to bring the hot water to the taps.
5. Turn off the taps and hold the hot water in the system for a minimum of 2 hours. Add 1 hour for every 10 years of age of the building.
6. After the holding period, starting at the outlets in the water system closest to the water heater, start running taps to distribute hotter water throughout for a minimum of 10 minutes if in response to a case of Legionnaires' disease.
    A. Use a thermometer to measure and document the temperature, tap location, and time of initial reading to ensure proper temperature is maintained. Use Table 60 to record this information.
    B. The number of outlets that can be flushed simultaneously will depend on the capacity of the water heater and the flow capacity of the system.
    C. Local building and sanitary codes should be checked for any temperature limits of water discharged to the sewer.
    D. Appropriate safety procedures to prevent scalding are essential.
        a) If possible, flushing should be performed when the fewest building occupants are present, such as nights or weekends.
        b) Signs should be posted to indicate the elevated temperature of the water.
        c) Residents or guests of the building should be notified.

Table 60: Example of Building Water System Superheating or Heat and Flush Monitoring

Tap Location	Date	Flush Start Time	Flush End Time	Time of Reading	Temperature (F)
Room 14 Sink	05/01/19	8:45 pm	8:50 pm	8:45 pm	163.2
Room 14 Shower	05/01/19	8:45 pm	8:50 pm	8:46 pm	164.8

Hyperchlorination (Building Water System)

1. Remove aerators from faucets.
2. Chlorine should be added to achieve a free chlorine residual of at least 2 mg/L throughout the system.
    A. This may require chlorination of the water heater or tank to levels to 20 to 50 mg/L.
3. The pH of the water should be maintained between 7.0 and 8.0.
4. Each outlet should be flushed until the odor of chlorine is detected.
5. The chlorine should remain in the system for a minimum of 2 hours, but no more than 24 hours.
    A. High levels of chlorine can cause corrosion of metal pipes and precautions should be taken if using this mitigation method.
    B. Appropriate safety procedures to prevent injury are essential.
        a) If possible, hyperchlorination should be performed when the fewest building occupants are present, such as nights or weekends.
        b) Signs should be posted to indicate the elevated chlorine concentration in the water.
        c) Resident or guests of the building should be notified.
6. Record start/stop times and measured chlorine/pH levels in Table 61 below.
7. The system should then be flushed to restore chlorine levels to their standard concentration.

Table 61: Example of Building Water System Hyperchlorination Monitoring

Tap Location	Date	Start Time	End Time	Time of Reading	Chlorine level (mg/L)	pH
Room 14 Sink	05/01/19	9:00 pm	1:00 am	10:00 pm	2.8	7.6

Point-of-Use Filters

- When hyperchlorination or superheating are not possible in a building water system, point-of-use (POU) *Legionella* filters may be installed in sink faucets, shower heads, and ice machines to reduce risk.
- Contact your jurisdiction to identify any specific requirements regarding POU *Legionella* filters, as well as manufacturer guidelines for upkeep.
    1. POU filters require regular maintenance and replacement which varies depending on the brand that is used.
        A. Some filters are meant for short-term use, sometimes as short as 7 days.
        B. Others can be rated for longer term use such as 90 days to 6 months.
    2. POU filters should be rated for the removal of waterborne pathogens including *Legionella.*

Physical Features Disinfection- shower heads, sink faucets, ice machines, decorative water fountains

1. Using a 50 mg/L chlorine bleach solution, scrub water features to remove biofilm and algae accumulation.
2. After scrubbing is complete, rinse the features to remove the bleach residue and biofilm remnants.
    A. Appropriate safety procedures to prevent chemical injuries or inhalation of harmful materials are essential.
        a) An appropriately fitting mask capable of mitigating risk of inhaling pathogens and gloves should be worn during the duration of the disinfection process.
        b) If possible, disinfection should be performed when the fewest building occupants are present, such as nights or weekends.

Recreational Water- Pool and Hot Tub

1. Close the hot tub and pool.
    A. Shut down the hydrotherapy jets and circulation pumps, but do not drain the water.
2. Drain all of the water from the hot tub.
    A. **Pools are not required to be drained and special care should be taken if the pool is going to be drained to prevent damage to equipment.**
    B. Dispose of the water to waste or as directed by the local regulatory authority.
3. Vigorously scrub all surfaces, skimming devices, and circulation components.
    A. Use water with free chlorine at a minimum concentration of 5 parts per million (ppm) to remove any biofilm (slime/algae).
    B. After scrubbing, rinse with clean water and flush to waste.
4. Replace filters (for cartridge or diatomaceous earth filters) or filter media (for sand filters).
    A. Bag these and dispose as normal solid waste.
5. Make any needed equipment repairs or replacement.
    A. Inspect thoroughly for any broken or poorly functioning components such as valves, sensors, tubing, or disinfectant feeders.
6. Refill and hyperchlorinate using 20 ppm free chlorine.
    A. Keep the hydrotherapy jets off and let the hyperchlorinated water circulate for 1 hour in all of the components including the compensation/surge tank, filter hosing, and piping.
    B. Turn on the hydrotherapy jets to circulate the hyperchlorinated water for 9 additional hours.
        a) Maintain 20 ppm free chlorine in the system for the entire 10 hours. Use Table X to document chlorine levels over the 10 hours.
7. Flush the entire system.
    A. This removes the hyperchlorinated water from all equipment.
8. Ensure water quality prior to reopening for use.
    A. Ensure that chemistry levels (halogen, pH, alkalinity..etc) meet local and state standards.

Table 62: Example of Recreational Water Hyperchlorination Monitoring

Source	Date	Start Time	End Time	Time of Reading	Chlorine level (ppm)	pH
Pool	05/01/19	6:00 am	4:00 pm	6:00 am	20.4	7.4
				8:00 am	20.2	7.4
				10:00 am	20.2	7.5
				12:00 pm	20.3	7.4
				2:00 pm	20.2	7.5
				4:00 pm	20.4	7.6

Cooling Towers- check requirements for your jurisdiction, or use the protocols listed below.

Category 1- *Legionella* culture result <10 CFU/mL or heterotrophic plate count (HPC) result <10,000 CFU/ml.

1. Maintain water chemistry and biocide levels.

Category 2- *Legionella* culture result between >=10 to <100 CFU/mL or HPC result between >=10,000 to 100,000 CFU/mL.

1. Initiate immediate disinfection by increasing biocide concentration or using a different biocide within 24 hours.
2. Review treatment program.
3. Retest water within 3-7 days.
    a) Subsequent test results should be interpreted until Category 1 is reached.

Category 3- *Legionella* culture result between >= 100 to <1000 CFU/mL or HPC result between >=100,000 to 1,000,000 CFU/mL.

1. Initiate immediate disinfection by increasing biocide concentration levels or by using a different biocide within 24 hours.
2. Review treatment program.
3. Perform visual inspection to evaluate need to perform cleaning and further disinfection.
4. Retest water within 3-7 days.
    a) Subsequent test results should be interpreted until Category 1 is reached.

Category 4- *Legionella* culture result >1000 CFU/mL or HPC result >100,000 CFU/mL.

1. Initiate immediate disinfection by increasing biocides within 24 hours.
2. Within 48 hours perform full remediation of the tower by hyperhalogenating, draining, cleaning, and flushing.
    a) At a minimum, dose the cooling tower water system with 5 to 10 ppm Free Halogen Residual for at least 1 hour.
    b) Maintain pH between 7.0 to 7.6.
3. Review treatment program.
4. Retest water within 3-7 days.
    a) Subsequent test results should be interpreted until Category 1 is reached.

Table 63: Example of Cooling System Mitigation Monitoring

Cooling System	Date	Staff Initials	Start Time	End Time	Time of Reading	Biocide Level (ppm)	pH

APPENDIX A: GLOSSARY OF COMMON TERMS

Analysis of Building Water Systems: the systematic evolution of potentially hazardous conditions associated with each step in the process flow diagrams.

At-Risk: any person who is more susceptible than the general population to developing legionellosis because of age, health, medication, occupation, or smoking.

Authority Having Jurisdiction: an organization, office, or individual responsible for enforcing the requirements of this standard.

Beneficial Occupancy: stage of construction when all or part of a building is to be occupied for the purpose for which it was constructed, whether before or after completion.

Building Water Systems: potable and non-potable water systems in the building or on site.

Capped Pipe: any unused water supply pipe fitted with an exterior cap.

Centralized Building Water System: any system that distributes water to multiple uses or multiple locations within the building site.

Colony Forming Units: a unit used to estimate the number of viable bacteria or fungal cells in a sample.

Control: to manage the conditions of an operation in order to maintain compliance with established criteria.

Control Location: a point where a physical, mechanical, operational, or chemical control measure is required.

Control Limit: a maximum value, a minimum value, or a range of values to which a chemical or physical parameter associated with a control measure must be monitored and maintained, in order to reduce the occurrence of a hazardous condition to an acceptable level.

Control Measure: a disinfectant, heating, cooling, filtering, flushing, or other means, methods, or procedures used to maintain the physical or chemical conditions of water within control limits.

Corrective Action: action to be taken to return control values to within established limits when monitoring or measurements indicates the control values are outside of the established control limits.

Dead Leg: areas of a piping system that experience reduced water flow.

Designee: the individual designated by the building owner to meet the requirements placed on the owner by ASHRAE 188-2015.

Disinfectant: a chemical agent or physical treatment used to kill or inactivate pathogens.

Disinfection: the process of killing or inactivating pathogens.

Disinfectant Residual: the net amount of a chemical disinfectant remaining in treated water after chemical demand exerted by the water is satisfied.

Distal Room: the last room on a water riser to receive hot water from the water heater.

Hazard*:* *Legionella* bacteria in a building water system that, in the absence of control, can cause harm to humans.

Hazardous Condition: a condition that contributes to the potential for harmful human exposure to *Legionella*.

Hot Water Return: the point at which the unused hot water returns to the water heater.

HVAC&R: heating, ventilating, air conditioning, and refrigeration.

Immunocompromised: a condition describing an individual who has increased susceptibility to infections due to existing human disease, medication regimens, or other types of medical treatment. (See At-Risk)

Legionella: the name of the genus of bacteria that was subsequently identified as the causative pathogen associated with the 1976 outbreak of disease at the American Legion convention in Philadelphia. *Legionella* are common aquatic bacteria found in natural and building water systems, as well as in some soils.

Legionellosis: the term used to describe Legionnaires' disease, Pontiac Fever, and any illness caused by exposure to *Legionella* bacteria.

Mitigation: steps taken to minimize bacteriological contamination in water systems.

Monitoring: conducting a planned sequence of observations or measurements of the physical and chemical characteristics of control measures.

Multiple Housing Units: a classification of housing where multiple separate housing units for residential and commercial inhabitants are contained within one building or several buildings within one complex.

Non-potable: water that is not safe for drinking or for personal or culinary use and that has the potential to cause harmful human exposure to *Legionella* bacteria.

Parts Per Million (ppm): the measurement of the mass of a chemical or contaminate per unit volume of water.

Process Flow Diagram: a step-by-step drawing of a building water system that includes the location of all water processing steps — including but not limited to conditioning, storing, heating, cooling, recirculation, and distribution — that are part of the building water systems.

Potable-Water System: a building water distribution system that provides hot or cold water intended for direct and indirect human contact or consumption.

Program: the water management program.

Program Team: the group or individual designated by the building owner or designee to be responsible for developing, implementing, and maintaining the Program.

Proximal Room: the first room in water riser to receive hot water from the water heater.

Risk: the potential for harm to humans resulting from exposure to *Legionella*.

Risk Management: systematic practices to reduce risk.

Testing: conducting a planned sequence of observations or measurements of physical, chemical, or microbial characteristics of water or assess whether conditions throughout building water systems meet the goals set by the Program Team.

Validation: initial and ongoing confirmation that the program, when implemented as designed, effectively controls the hazardous conditions throughout the building water systems.

Verification: initial and ongoing confirmation that the program is being implemented as designed.

Water Management Program (Program): the risk management plan for the prevention and control of legionellosis associated with building water systems, including documentation of the plan's implementation and operation.

Water Riser: A supply line that provides water to multiple areas in a building.

Water Service Disruption: planned or unplanned events that reduce water delivery pressure below 20 psi (140 kPA) and that are caused by, but not limited to, new construction tie-ins; replacement of valves, hydrants, or meters; pumping failures; pipelines breaks; and other system repairs or emergency conditions.

Water Use End Points: the points at which water exits from all potable and non-potable building water systems, fixtures, and equipment.

APPENDIX B: INCIDENT REPORT TEMPLATE

This table is used to:

1. Capture recent changes to the facility's potable water system or water features, as well as near-by events that may have caused a disruption to the water system
2. Report notable incidents, including *Legionella* sampling exceedances and legionellosis cases

Legionella Incident Report

Please keep this form for your records and/or submit to [your local health department] if required.

Date:

Incident Type (check all that apply)

□ *Legionella in potable water system*
□ *Legionella* in cooling tower
□ *Legionella* in water feature
□ 1 or more cases of legionellosis associated with facility

Facility Name	
Address	
Primary contact name, title	
Primary contact phone, email	
Secondary contact name, title	
Secondary contact phone, email	
Date of onset	
Initial sampling date, results	
Remedial actions taken	
Follow-up sampling date, results	

Please provide a short text description of the incident:

Factors that may have contributed to the incident (check all that apply):

□ Disruption to the public water supply (e.g. upstream fire, construction, etc.)
□ Disruption to the building/feature water system (changes in water temperature, residual, etc.)
□ Changes in equipment maintenance
□ Inadequate maintenance protocol
□ Contamination of water system
□ Other (please describe):

APPENDIX C: SELECTING A WATER MANAGEMENT CONSULTANT

Background

You may consider working with one or more *Legionella* consultants in creating or improving your water management program. Deciding whether to work with consultants at all, and if so, the exact type and number of consultants you decide to use, will depend on your situation and the consultant's area of expertise.

Considerations

Level of experience

- What kind of *Legionella*-specific experience do the employees of this company have?
- Do the employees have appropriate training in critical fields (engineering, environmental health or industrial hygiene, water treatment, plumbing, microbiology)?
- Does the company have *Legionella*-specific experience with a facility of your size/type?
- Do they have experience with water system remediation, implementation of water management programs to prevent Legionnaires' disease, or both?

Laboratory expertise

- Is the laboratory they use accredited for environmental testing?
- Is the lab ELITE certified?
- Does it participate in a proficiency testing program for *Legionella*?
- What kind of environmental testing for *Legionella* does their laboratory use?
- Does their laboratory perform culture for *Legionella*, which is particularly important following remediation to ensure adequacy of the remediation progress?
- Does their laboratory perform PCR testing for *Legionella* which can be useful in quickly identifying areas of contamination?
- What level of identification (species/serogroup) can their laboratory perform?
- Is their laboratory willing to save samples and isolates and share them with public health laboratories if requested during an outbreak investigation?

Environmental assessment expertise

- How much experience does the company have with environmental assessments and/or sampling for *Legionella*?
- Can they describe situations where they performed an environmental assessment and/or *Legionella* sampling in a facility of your size/type?

Remediation expertise

- How frequently does the company provide remediation services and can they describe situations where they remediated *Legionella* from a building water system in a facility of your size/type?

- Can the company discuss the benefits and challenges associated with multiple approaches to remediation?

Water management expertise

- How much experience does the company have creating water management programs compliant with industry standards for a facility of your size/type?
- What level of support does the company provide with creation and implementation of water management programs?
- What is the spectrum of services they offer once the water management program is established?

Knowledge of codes, standards, and regulations

- Does the company have previous experience working in your state and/or jurisdiction?
- How familiar is the company with state and local building codes in your jurisdiction, water treatment regulations, healthcare accreditation and survey requirements, and public health reporting requirements?
- Local building code officials or your health department may be good resources for knowledge about existing codes, standards, and regulations.

Potential conflicts of interest

- Does the company have interest in promoting specific services or products?

APPENDIX D: STANDARDS, REGULATIONS, AND GUIDANCE

ASHRAE 188-2015, Legionellosis: Risk Management for Building Water Systems

> **Summary:** Establishes minimum legionellosis risk management requirements for building water systems.
>
> **Link:** https://www.ashrae.org/technical-resources/standards-and-guidelines/guidance-on-reducing-the-risk-of-legionella

ASHRAE 12-2000, Minimizing the Risk of Legionellosis Associated with Building Water Systems

> **Summary:** Provides information and guidance in order to minimize *Legionella* contamination in building water systems.
>
> **Link:** https://www.ashrae.org/technical-resources/standards-and-guidelines/guidance-on-reducing-the-risk-of-legionella

VA DIR 1061, Prevention of Healthcare-Associated *Legionella* Disease and Scald Injury from Potable Water Distribution Systems

> **Summary:** Establishes policy for the prevention and control of healthcare-associated *Legionella* disease in VHA-owned buildings in which patients, residents, or visitors stay overnight.
>
> **Link:** https://www.va.gov/VHApublications/ViewPublication.asp?pub_ID=3033

WRF Project No. 4664, Customer Messaging on Opportunistic Pathogens in Plumbing Systems

> **Summary:** A series of messages for the water community to use when communicating with different audiences about *Legionella* in building water systems. Also includes recommendations for the best practices of reaching various audience segments, along with samples of each tactic.
>
> **Link:** http://www.waterrf.org/PublicReportLibrary/4664.pdf

CDC PreventLD, Preventing Legionnaires' Disease: A Training on *Legionella* Water Management Programs

> **Summary:** Online training aiming to outline how to reduce risk for *Legionella* in facilities through water management programs that align with industry standards such as ASHRAE 188-2015.
>
> **Link:** https://www.cdc.gov/nceh/ehs/elearn/prevent-LD-training.html

CDC Developing a Water Management Program to Reduce *Legionella* Growth and Spread in Buildings: A Practical Guide to Implementing Industry Standards

> **Summary:** Toolkit designed to help develop and implement a water management program to reduce risk for growing and spreading *Legionella* in building water systems.
>
> **Link:** https://www.cdc.gov/legionella/downloads/toolkit.pdf

WHO guidance

APPENDIX E: RESOURCES

1. ASHRAE. Legionellosis: risk management for building water systems. ASHRAE standard 188. Atlanta, GA: ASHRAE; 2015.
2. ASHRAE. Minimizing the Risk of Legionellosis Associated with Building Water Systems. ASHRAE standard 12. Atlanta, GA: ASHRAE; 2000.
3. CDC. Developing a Water Management Program to Reduce *Legionella* Growth and Spread in Buildings: A Practical Guide to Implementing Industry Standards. Atlanta, GA. 2017.
4. CDC. Disinfection of Hot Tubs that Contain *Legionella*. Atlanta, GA.
5. CDC. Environmental *Legionella* Isolation Techniques Evaluation (ELITE) Program. Atlanta, GA.
6. CDC. Model Aquatic Health Code (MAHC): An All-Inclusive Model Public Swimming Pool and Spa Code. Atlanta, GA.
7. CDC. Preventing Legionnaires' Disease: A Training on *Legionella* Water Management Programs (PreventLD Training). Western Region Public Health Training Center, University of Arizona. 2018.
8. Centers for Medicaid & Medicare Services. Requirement to reduce *Legionella* risk in healthcare facility water systems to prevent cases and outbreaks of Legionnaires' disease (LD) [Memorandum dated June 2, 2017]. Baltimore, MD: US Department of Health and Human Services, Centers for Medicaid & Medicare Services, Center for Clinical Standards and Quality/Survey & Certification Group; 2017.
9. Council of State and Territorial Epidemiologists. Public health reporting and national notification for legionellosis. Position statement no. 09-ID-45. Atlanta, GA: Council of State and Territorial Epidemiologists; 2010.
10. Doebbeling BN, Wenzel RP (1987). The epidemiology of *Legionella pneumophila* infections. Seminars in Respiratory Infections 2:206–21.
11. Fields BS, Benson RF, Besser RE. *Legionella* and Legionnaires' disease: 25 years of investigation. Clin Microbiol Rev 2002;15:506–26.
12. Garrison LE, Kunz JM, Cooley LA, et al. Vital Signs: Deficiencies in Environmental Control Identified in Outbreaks of Legionnaires' Disease - North America, 2000-2014. MMWR Morb Mortal Wkly Rep. Jun 10 2016;65(22):576-584.
13. Kanamori H, Weber DJ, Rutala WA. Healthcare outbreaks associated with a water reservoir and infection prevention strategies. Clin Infect Dis 2016;62:1423–35.
14. Mercante JW, Winchell JM. Current and emerging *Legionella* diagnostics for laboratory and outbreak investigations. Clin Microbiol Rev 2015;28:95–133.
15. Murdoch DR. Diagnosis of *Legionella* infection. Clin Infect Dis 2003;36:64–9.
16. Queensland Government – Queensland Health. Guidelines for *Legionella* Control in the operation and maintenance of water distribution systems in health and aged care facilities. Queensland, Australia, 2015.
17. Queensland Government – Queensland Health. Risk management plan for *Legionella* control in the operation and maintenance of the water systems. Queensland, Australia, 2015.
18. Soda EA, Barskey AE, Shah PP, et al. Vital Signs: Health Care–Associated Legionnaires' Disease Surveillance Data from 20 States and a Large Metropolitan Area — United States, 2015. MMWR Morb Mortal Wkly Rep 2017;66:584–589.
19. The Water Research Foundation. Customer Messaging on Opportunistic Pathogens in Plumbing Systems (Project No. 4664). 2018.
20. World Health Organization. *Legionella* and the prevention of legionellosis. Geneva, Switzerland: World Health Organization; 2007.

APPENDIX F: CONTRIBUTIONS

The following agencies contributed to the creation of this template.

Name
Colorado Department of Public Health and Environment
Georgia Department of Public Health
Los Angeles County Department of Public Health
Michigan Department of Health and Human Services
Minnesota Department of Health
New Jersey Department of Health
New York State Department of Health
Philadelphia Department of Public Health
Southern Nevada Health District
Tennessee Department of Health
Washington State Department of Health

Listed in alphabetical order

APPENDIX G: ACKNOWLEDGMENTS

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Name
Centers for Disease Control and Prevention (CDC)
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