This document provides general guidance on the content and structure of a waterborne pathogens management program (WPMP) drawing upon principles and concepts contained in ANSI/ASHRAE Standard 188-2015 and other guidance documents. This six-step model is intended to guide the development of WPMPs. It is general in nature, and does not represent to identify all provisions of ASHRAE 188-2015 or all possible actions that may be taken to reduce risks *Legionella* or other waterborne pathogens in building water systems.

Step #1 — Form a Water Management Team & Create a Written Program

The written program should include:
- the purpose, basis, and limitations of the program;
- Water Management Team (WMT) structure/membership;
- a summary of the building water systems;
- a description of the program development process; and
- supporting documents determined by the WMT as appendices (see subsequent development steps below).

The WMT should include a "core team" that meets on a regular schedule, records meeting minutes and for which member participation in every meeting is required. In addition "extended team" members should be identified who are brought in as needed to address specific issues. Extended team members are likely to be called upon frequently early on in the development process, and less frequently as the program matures. The following table illustrates common WMT members and their roles:

Basic WPMP Development Process
☑ *1. Form a Water Management Team to develop and oversee the program*
☑ *2. Characterize water systems and conduct risk assessment*
☑ *3. Create a Hazard Control Plan with measures to manage identified risks*
☑ *4. Create supporting forms and procedures to document actions*
☑ *5. Retain and analyze program data to support WPMP verification/validation*
☑ *6. Adjust program elements to improve performance over time*

WMT Core Team Members *(required for all meetings)*	WMT Extended Team Members *(participation as needed)*
Team Lead *Typically facilities or senior leadership representative. Leads team and holds members accountable.*	**Environmental Services/Custodial** *Typically manager/supervisor. Provides information on activities and helps coordinate staff actions (typically around flushing/cleaning).*
Facilities Water Systems *Typically plant operations staff. Provides front line knowledge of facility water systems and related maintenance activities.*	**Systems Design/Engineering Expertise** *Typically engineering consultant. Helps diagram water systems and assess the feasibility and impacts of changes.*
Senior Leadership Representative *Communicates WMT activities to leadership team, authorizes procedures/staff actions, and helps secure funding for program initiatives.*	**Environmental Health Expertise** *Typically CIH, EH&S/consultant. Helps evaluate risks and controls, provides independent verification and performs validation sampling.*
Infection Prevention (hospitals only) *Typically IP professional. Provides knowledge of patient and staff risk factors, access to case records, and clinical/technical expertise.*	**Treatment/Filtration Support** *Typically outside vendor. Presents options and their costs/benefits, installs and maintains control systems.*
Administrative Support *Records meeting minutes, manages team schedule, coordinates communications and supports program record keeping.*	**Water Systems Maintenance Support** *Typically outside contractor. Provides inspection, cleaning, and maintenance services. Advises on current conditions and proposed controls.*

Step #2	Create Water Systems Diagrams & Conduct Risk Assessment
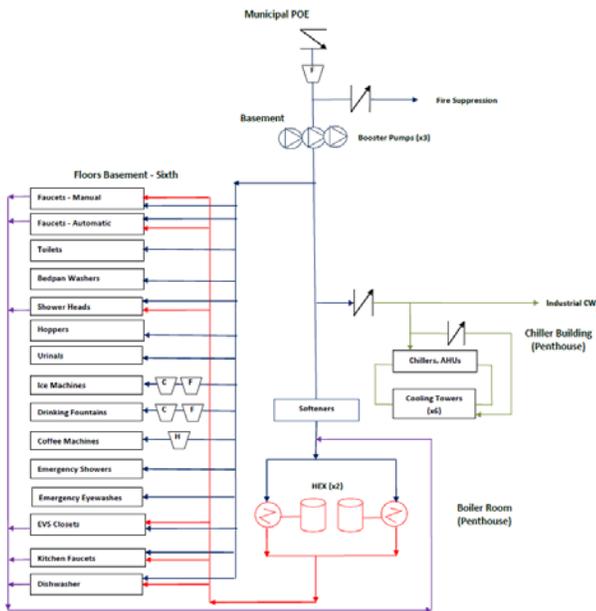
The WMT should develop a simple process flow diagram that describes how water is processed in the building from incoming source connection to final points of use. This should include, but is not limited to: backflow preventers, booster pumps, water softeners, heat exchangers, storage tanks, expansion tanks, central mixing valves, cooling towers, fountains, and general points of use. In addition, diagrams of how hot and cold water is routed through the building should be displayed on floor plans along with the locations of key water system components.

In some instances, plans may not be available that identify the specific routing of hot and cold water piping. In these instances, building engineering staff can identify areas of uncertainty, make estimates based on experience and improve upon the diagrams as better information is developed over time.

Key points of risk and control (e.g., temperature gauges, near/distal points of use, at-risk occupants) should be indicated on the diagrams to help in the identification and management of water system risks. In addition, having these simplified diagrams available for reference during contingency planning or in the event of a water system incident can speed the identification and implementation of response actions.

Using these diagrams, a risk assessment is then conducted to identify where in the water systems risks may be present or may develop. Although current guidance documents call for a risk assessment, there is little guidance to define what it is or how it should be performed. As such it is imperative that the WMT engage team members knowledgeable and experienced in environmental health risk assessment, and who are familiar with specific guidance related to WPMP development (i.e., 2015 AIHA "Recognition, Evaluation and Control of Legionella in Building Water Systems").

Step #3	Create a Hazard Control Plan

The hazard control plan serves as the backbone of the WPMP. It identifies the various locations of potential hazards and their relative risk (e.g., high, medium, low). For each identified hazard, specific measures are spelled out to control them. Each control measure has an associated control parameter for which limits are established. These control parameters are monitored on an established frequency and the plan contains corrective actions to be taken if the measured parameter is out of the defined control limits. Finally, the plan defines documentation provisions along with the persons responsible for implementing the control measure.

It is essential that the hazard control plan include the verification and validation measures needed to assess program efficacy. These measures may be included in the discussion of each individual control measure or separated as distinct control measures related to program auditing and review.

Hazard control plans are typically subdivided by major water system components with the various control measures contained in each section. An example Hazard Control Plan matrix with some common hazard/control elements is shown below:

Hazard/Control Element	Risk Rank	Control Measure	Parameter & Limits	Monitoring Frequency	Corrective Actions	Forms, Logs, Procedures	Responsible Party
Potable Water System							
General Conditions (e.g., temperatures, oxidants, flow)							
Incidents/Events (e.g., start-up/shut down, breaks, disruptions)							
Central Equipment (e.g., BFPs, heaters, storage tanks, gauges)							
Points of Use (e.g., ice machines, shower heads, eyewashes)							
Cooling Towers							
Inspection, treatment, cleaning, start-up/shut down							
Whirlpool Spas							
Inspection, treatment, cleaning, start-up/shut down							
Ornamental Fountains							
Inspection, treatment, cleaning, start-up/shut down							
Other Aerosol Sources							
Inspection, treatment, cleaning, start-up/shut down							
Infection Control							
Notifications, surveillance, at-risk occupant & equipment controls							
Other Items							
Risk Assessments (e.g., recurrent, responsive)							
Incidents/Events (e.g., positive samples, reported cases)							
Program Admin (e.g., training, verification audits, validation sampling							

When developing control measures, it should be recognized that there is no "silver bullet" control measure that by itself can prevent the amplification of agents of concern. Commonly touted treatment technologies may be a critical component in managing risks, however their benefits cannot be realized, and their downsides not controlled, without a robust compliment of other control measures and the diligent oversight of a balanced and engaged multidisciplinary water management team.

| Step #4	Create Supporting Forms & Procedures

The implementation for each control measure (or row) in the Hazard Control Plan should be documented through the use of supporting forms or logs which indicate parameter readings, compliance with set limits, and any corrective actions taken. In addition, more specific step-by-step procedures related to implementation of the control measure may be created as well. Some supporting forms typically found in a WPMP include, are not limited to: daily temperature/oxidant logs, flushing logs, cooling tower/fountain inspection & treatment logs, and plumbing system component maintenance logs (blowdown, cleaning, disinfection).

An example form for the recording of daily water system temperatures is shown below:

Daily Temperature Log

#	Area	Location	Goals (ideal/avoid)	Normal Range	M	Tu	W	Th	F	Sa	Su
Building 100											
1	Equip Rm. #3	Heat Exchanger #1--Gauge	>140°F/<120°F	145-150°F							
2	Equip Rm. #3	HW Storage Tank #1--Gauge	>140°F/<120°F	140-145°F							
3	Equip Rm. #3	HW Supply (after mix valve)--Gauge	120°F /<113°F	119-121°F							
4	Equip Rm. #3	HW Return--Gauge	120°F /<113°F	116-118°F							
END											
		Any location parameters out of normal range? (Yes/No)									
		Response documented in Corrective Action Log? (Yes/No/na)									
		Initials:									

Daily Readings (enter date in blue readings below)

Step #5	Supporting Data Retention & Analysis

Data on the identified control measures and related parameters should be collected and stored in a manner that allows for ongoing analysis to identify trends and conditions. This analysis drives decisions on risk ranking, program improvements, and provides documentation of the impact of actions taken. In addition, archived data should be readily available for review by auditing entities as part of ongoing compliance or in response to reported cases of illness.

FACSTrack©: Daily Temperature (°F)
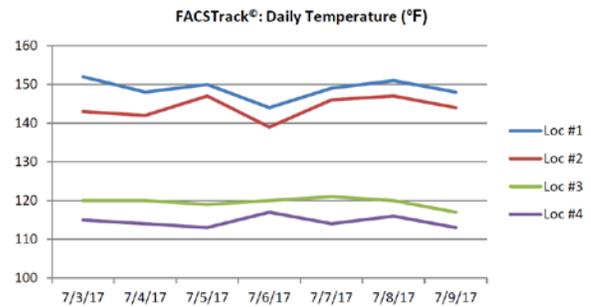
The ability of internal and external WMT members to promptly and effectively respond to adverse conditions or cases of illness can be enhanced by the degree which this data can be readily accessed and managed. Examples of data collection and retention approaches are provided below in order of increasing sophistication:

- Data is recorded on paper forms and stored in binders or files;
- Data is recorded on paper forms and manually input into a managed database;
- Data is recorded on electronic tablets and uploaded into a managed database; and
- Data is recorded automatically by cloud-linked sensors and uploaded into a managed database.

Step #6	Continuous Improvement

Regardless of the underlying architecture and provisions of a WPMP, its ultimate success in reducing risks depends on how diligent and responsive to data the water management team is over time. Therefore it is critical that the WMT verify the proper implementation of identified control measures and ensure the reliable collection of validation samples to evaluate if the agents of concern (e.g., *Legionella*) are being controlled as desired. Armed with these inputs, the water management team can adjust practices and respond to dynamic conditions over time. In addition, changes to the WPMP may result in changes to the expertise needed on the water management team.

FACS	Supporting Your Team

FACS's team of environmental health experts are ready to assist your facility water management team in developing and supporting an effective WPMP through facilitation of program development, risk assessment and control consultation, data collection and interpretation, and FACSTrack© data management services.

Key References:
- American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE): "ANSI/ASHRAE Standard 188-2015 Legionellosis: Risk Management for Building Water Systems" (2015)
- United States Centers for Disease Control (CDC) "Developing a Water Management Program to Reduce Legionella Growth & Spread in Buildings: A Practical Guide to Implementing Industry Standards, Version 1.0" (6/6/16)
- American Industrial Hygiene Association (AIHA): "Recognition, Evaluation and Control of Legionella in Building Water Systems (2015)
- American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE): "ASHRAE Guideline 12-2000: Minimizing the Risk of Legionella Associated with Building Water Systems (2000)
- Cooling Tower Institute (CTI): "*Legionellosis* Guideline: Best Practice for the Control of Legionella" (CTI Guidelines WTB-148) (July 2008)