



Feature W03: Legionella Control

Part 1: Implement Legionella Management Plan

WELL v2™ pilot

Q1 2020 addenda

How to use this document:

This document is intended to serve as a guide for creating the professional narrative required for Part 1: Implement Legionella Management Plan of Feature W03: Legionella Control. This document is meant to demonstrate an acceptable degree of detail for a documentation submission. The level of detail is up to the discretion of the project team, as long as Part 1a and 1b are both sufficiently addressed.

- Part 1: Guidance on creating a Legionella management plan for an entire building.
- Part 1: An example of a professional narrative for a tenant-occupied space with a responsive building owner/manager.
- Part 1: An example of an outline for a professional narrative for a tenant-occupied space with an unresponsive building owner/manager.

Note: The variable items are highlighted in yellow throughout the document.

The text is updated to the Q1 2020 version of WELL v2 pilot, which may vary from future versions of WELL v2.

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FEATURE W03: LEGIONELLA

PART 1: IMPLEMENT LEGIONELLA MANAGEMENT PLAN EXAMPLE PROFESSIONAL NARRATIVE

Example 1: Guidelines on best practices to create a robust water safety plan for an entire building (including tenant/dwelling spaces).

- A. Below are best practices for creating a water safety plan:
- a. Large and / or complex buildings can consider hiring a water consultant to prepare a comprehensive water safety plan.
 - b. A good plan must contain all the elements listed in Feature W03: Legionella Control.
 - c. Before embarking into developing a plan and selecting a consultant, reviewing the US CDC [Legionella Toolkit](#) can provide assistance to understand the risks and recommended management strategies.
 - d. Use these guidelines in conjunction with Example 2, which contains samples of monitoring and control strategies for a fictional tenant project.
- B. Best practices for formation of a team for Legionella management in the building:
- a. Include at least the following personnel, providing at least two means of contact (work phone / cell phone / email):
 - i. Building owner
 - ii. Building Manager
 - iii. Building Engineer
 - iv. Maintenance personnel
 - v. Water specialist/consultant/plan preparer
 - vi. Cooling tower / Water heater specialists
 - vii. Plan preparer (who wrote the plan)
 - b. Specify backup personnel or roles for night shifts, weekends/holidays and vacations
 - c. The list should include the contacts for tenants' space managers
 - d. The list should be periodically updated to reflect changes in vacancy, tenants and staff
- C. Best practices for water system inventory and production of process flow diagrams:
- a. Water system inventory:
 - i. When the building is existing, consider performing a walk-through of the building. If the project is new, review the plumbing plans.
 - ii. For core and whole building projects, the inventory should reflect all changes in plumbing performed by tenants
 - iii. If necessary, confirm/update any fixtures equipment that propels or stops water (such as pumps and main check valves) in plumbing plans
 - iv. For the inventory, a non-exhaustive list of fixtures and devices that must be present are shown below. In general, all fixtures that may create water mist should be considered:
 1. Hot water heaters
 2. Drinking water tanks (usually located on the rooftop)
 3. Hot water tanks (sometimes part of the water heater device)
 4. Pumps
 5. Riser lines

- 6. Spas / steam rooms
- 7. Warm water pools
- 8. Decorative spraying fountains
- 9. Showers
- 10. Fixtures that deliver hot water or a mix of cold and hot water
- 11. Cooling towers
- b. Process Flow Diagram:
 - i. The Process Flow Diagram is a simplified schematic drawing that is easy to follow. It represents the flow of water throughout the system and represents the inventoried fixtures.
 - ii. The Process Flow Diagram is not meant to be scaled, dimensionally accurate representation of the plumbing system.
 - iii. Note: cooling towers are usually an independent loop within the building's premise plumbing and may be described in a separate diagram

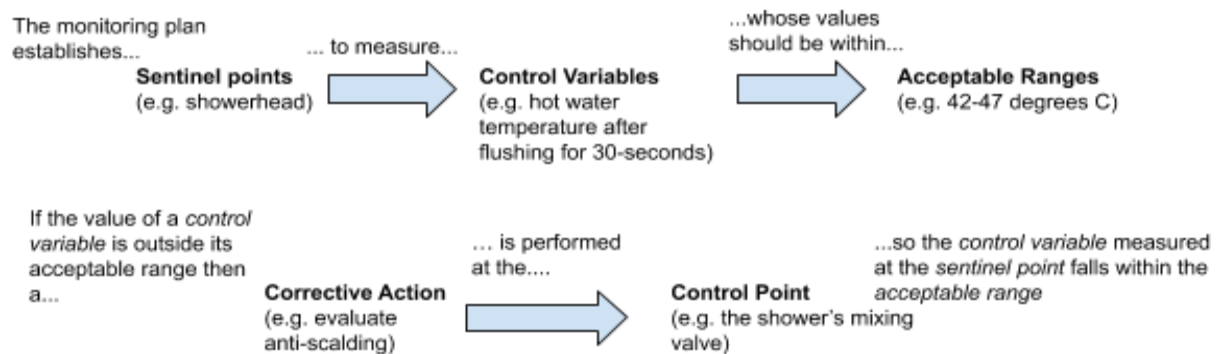
D. Best practices for hazard analysis of water assets:

- a. The main source of risk for Legionella colonization is typically the presence of water without disinfectant at a temperature between 85°F (30°C) and 110°F (43°C), particularly if left stagnant. This water may prompt the development of biofilms that can contain Legionella. The risk analysis should identify where such a situation can occur and propose monitoring and control measures to prevent it.
- b. Elements that must be considered when conducting a hazard analysis include:
 - i. Presence of vulnerable populations (elderly, smokers, immunocompromised)
 - ii. Vacancy (e.g., tenant turnover, room occupancy in hotels/hospitals) that may lead to stagnation of water
 - iii. Plumbing modifications that may produce dead legs (i.e., unconnected sections of plumbing where water does not circulate)
 - iv. Usage patterns that may produce temporal water stagnation, like weekends in office buildings or seasonal hotel residencies
 - v. Any device that recirculates water and may produce mist (water aerosols)
- c. A non-exhaustive list of questions that a risk analysis should address include the following:
 - i. Can drift from the building's cooling towers (or from other nearby structures) enter the ventilation system?
 - ii. Are all recirculating waters treated (spas, pools, water fountains, cooling towers, etc.)?
 - iii. Does the building have a recirculating hot water system or residential on-demand heaters near the points of use?
 - iv. Are there any fixtures that experience limited use?
 - v. For showers and bathroom fixtures, is water mixed at the source (i.e., right after the heater) or at the point of use (say, at the shower valve)?
 - vi. Are the hot water lines properly insulated?

E. Best practices for maintenance and control measures, monitoring, establishment of performance limits and corrective actions, and identification of critical control points:

- a. The risk analysis is used to determine a set of monitoring (control) variables and actions to ensure the proper functioning of the plumbing system and minimize the risk of exposure to Legionella. If a measurement of a control variable is within a range of values deemed acceptable, then no action is needed other than documenting the reading. If the control variable is outside the range, then one or a set of actions need to be performed in order to

bring the control variable back to its intended range. A graphical explanation, along with common terms used in the trade, is shown below:



- b. On a routine basis, the Legionella management plan should establish *control actions* and measurement of *control variables* at *sentinel points*:
 - i. *Control actions* are sets of procedures designed to maintain the control variables within the desired range. These actions are performed at the *control points*, which may or may not be the same as the sentinel points.
 1. For instance, in a hotel that experiences extended vacancy, flushing a showerhead on a weekly basis for 5 minutes is an example of a control action.
 2. Addition of disinfectants to spas, cooling towers and the like are other examples of control actions, so is the routine checking of pumps and boilers.
 3. Periodic draining of the bottom of the hot water storage tanks is advisable to prevent sediment accumulation and remove areas that may foster biofilm formation.
 - ii. *Control (monitoring) variables*: measurements that assess the status of the plumbing system and their target ranges. These are parameters that, when routinely measured, inform the status of the plumbing system.
 1. For instance, one variable is the hot water temperature. Another example is the target concentration of chlorine in the water of a decorative fountain
 - iii. *Sentinel (measuring) points*: specific locations where the control variables are measured.
 1. In the case of the hot water temperature, a sentinel point could be at the hot water return in a recirculating water loop, before re-entering the boiler
 - iv. For each *control variable* measured at a *sentinel point*, a *range of accepted values* (performance limits) need to be provided. For instance, the water temperature at the hot water return should not be below 115°F / 45°C. If the measured value of the control value falls beyond the limits, corrective actions are sets of procedures designed to return control variables within the desired range.
 1. For instance, if the water temperature at the hot water return is below 115°F / 45°C, then the following actions will be performed in this order:
 - a. Evaluate the piping for leaks and quality of insulation
 - b. Measure the temperature delivered by the hot water heater
 - c. Check the heater's settings
 - d. Call the boiler specialist

- e. Example 2 shows additional samples of monitoring actions, variables and corrective actions, for a fictional tenant space

F. Best practices for documentation, verification and validation procedures:

- a. A water safety plan must include templates for documenting all scheduled actions (monitoring and control) as well as recorded values. If a control variable falls beyond the acceptable range, all corrective actions should be documented. In the long run the documentation should inform the building engineer whether the selection of control variables and acceptable ranges is adequate. A good plan should be able to maintain the control variables within range
- b. Verification refers to the internal audit to the plan, confirming that all the procedures have been implemented as designed.
- c. Validation refers to an external audit of the plan. A classic example is testing for Legionella performed by an external party. If the plan is adequate, then the Legionella results should not suggest that the building has issues of Legionella amplification. If that is the case, the contents of the plan must be evaluated and updated to better reflect the system, potential Legionella risks and regular maintenance practices.

PART 01: IMPLEMENT LEGIONELLA MANAGEMENT PLAN

EXAMPLE PROFESSIONAL NARRATIVE

Example 2: A Professional Narrative for a tenant-occupied space with a responsive building owner/manager. In this hypothetical case, the project occupies the fourth floor of a 10-story building.

Water Management Team

[Note, the table below includes examples of team roles. Each project team will need to evaluate the appropriate team roles for their project.]

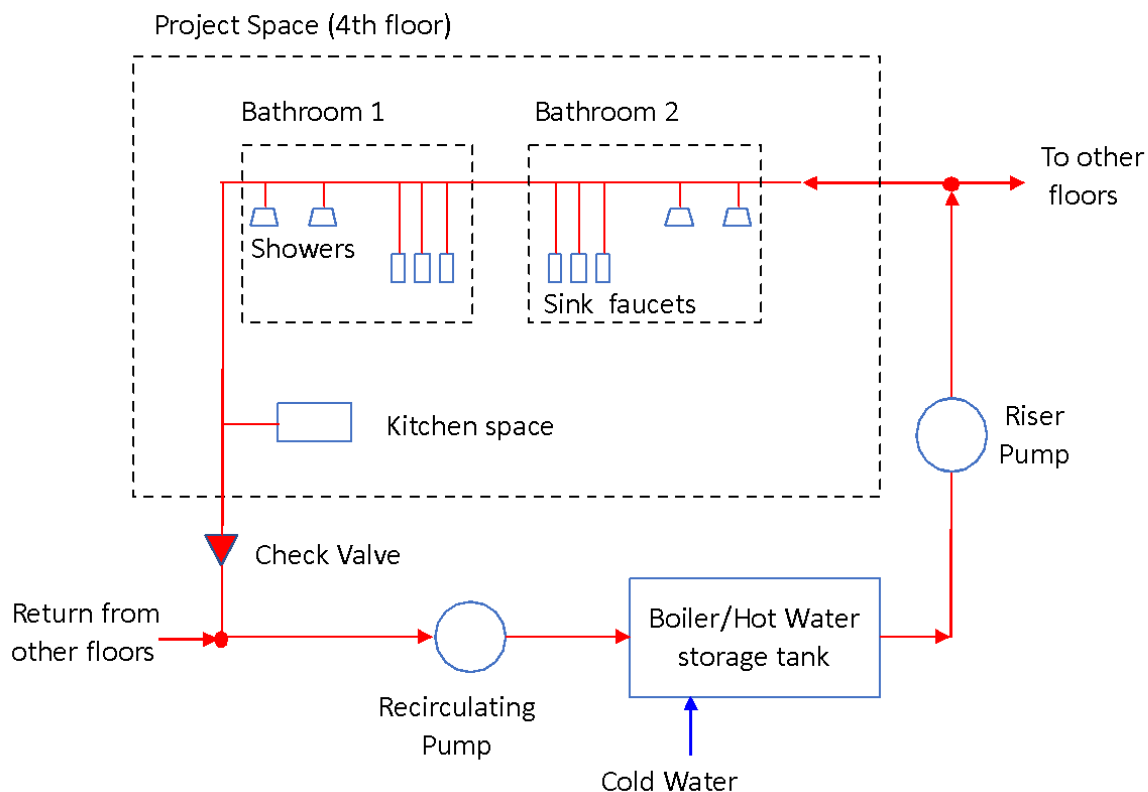
Name	Title	Role	Phone	Email
<NAME>	Building Manager	Leads water management team, procures services (incl. water and plumbing consultants).	<#>	<EMAIL>
<NAME>	Building Engineer	On-site responsible for HVAC and hot water delivery, maintains shared facilities, common areas. Implements building's water management plan	<#>	<EMAIL>
<NAME>	Office space manager	Maintains plumbing within the tenant space	<#>	<EMAIL>
<NAME>	Building water consultant	Contractor to implement / evaluate water management plan	<#>	<EMAIL>
<NAME>	Building Maintenance Associate / Evening shift	Backup Emergency point of contact	<#>	<EMAIL>
<NAME>	Building security / Night shift	Emergency point of contact – midnight	<#>	<EMAIL>
<NAME>	Plan preparer	Person who wrote the plan and is knowledgeable of the building	<#>	<EMAIL>

Water System inventory

[Note, the inventory below, including the detail drawing are examples of a fictional project. Each project team will need to evaluate the appropriate inventory for their project.]

The space occupies the totality of the fourth floor of the whole building, which has 10 floors above ground. The internal layout is open plan, with its north-west portion having a small kitchen and having two bathrooms placed near the elevator bank. Each bathroom has two showers, three toilets and a single sink with three faucets.

The sink faucets provide warm water (hot/cold mix). The showers have a single faucet with controllable temperature and flow. A centralized recirculating hot water system delivers water to the office. The building has a cooling tower that provides heat rejection for the AC system. No bathtubs/spas or spraying misting fountains are part of the project, nor are present in the building's common entryways. Based on the recommendations set in the [Legionella Toolkit](#) developed by the US Centers for Disease Control and Prevention the tenant's water safety plan should address risk related with the cooling tower and the hot water distribution system. The simplified process flow diagram shows the main components of the hot water supply and delivery to the tenant space.



Hazard Analysis and Risk Management

[Note, the hazard analysis, risk management and control measures section below is based on a fictional project. Each project team will need to evaluate the appropriate hazard analysis, risk management and control measures for their project.]

The project is an office space with a regular weekly occupancy of 50 people of approximate ages ranging 20-70. Facilities are to be used primarily during weekdays 8:00 – 18:00. Each showerhead is expected to be used 10 times a week on average, mainly during mornings by bike commuters. There are some occupants of age groups with higher incidence of Legionnaires disease (see US CDC Legionella toolkit for further reference, basic clinical information can be found [here](#)).

The building is fed by municipal tap water that uses chloramines as the primary disinfectant. A core building Legionella management plan is available to tenants upon request. It describes sentinel and control measures towards managing the building's cooling tower (including sampling), periodic

maintenance of the cold water tank, and features in the lobby/first floor. A copy of the plan, dated 01/02/18, is appended to this document. The building performs weekly monitoring of the hot water temperature at an unmixed basement tap to confirm the hot water delivery temperature. Records as of September-2018 show hot water delivered of 140°F / 60°C. Since there is no thermostatic mixing before this temperature is unlikely to foster Legionella amplification as it is well above its development range. A walk through the basement showed good pipe insulation. The plumbing for the project has all fixtures (showerheads and faucets) installed with thermostatic mixing valves set at a maximum temperature of 110°F (43°C) to prevent scalding.

Records of quarterly Legionella sampling of the cooling tower system are available as well as all maintenance activities; the latest report, dated 7/10/2018, showed 10 CFU/mL of Legionella pneumophila serogroup 1, while prior tests were non-detect. No maintenance activities have been recorded at the cooling tower since. The rooftop air intakes are located away and protected from drift from the cooling towers.

Overall, the main risks for contamination come from the stagnation of water in showerheads and handwashing facilities after the weekend recesses. There is a slim risk for intrusion of Legionella from the cooling tower drift into the air conditioning system. Since the hot water is delivered at 140°F (60°C) and mixed at the point of use, there is little risk of Legionella amplification from the core building plumbing. However, periodic testing of the time that the warm water takes to reach its maximum temperature (theoretically 110°F / 43°C) is recommended to monitor the quality of the hot water delivery. In addition, tracking shower usage patterns should inform potential risks of bacterial growth due to water stagnation.

Suggested control measures include:

- A. Routine disassembling and bleach cleaning of showerheads and faucet aerators in both bathrooms and the kitchen sink.*
- B. Periodic flushing of showers prior to the beginning of the work week*
- C. Ensuring the proper management of the cooling towers by the core building engineering by checking records on a monthly basis during the cooling season*

Monitoring (sentinel) plan - Identification of variables and ranges that indicate the adequacy of the water safety, and testing actions)

[Note, the values in the table below are based on a fictional project and not meant to imply any WELL requirements. Each project team will need to evaluate the appropriate values for their particular project.]

Control Variable	Location	Target Value	Frequency	Corrective Action(s)
Time that water takes to reach maximum temperature*	All fixtures	≤ 20 seconds	Bimonthly	<ul style="list-style-type: none"> • Inform building manager • Check pipe insulation and building records
Maximum temperature delivered by fixture*	All fixtures	110 ± 5 °F	Bimonthly	<ul style="list-style-type: none"> • Check thermostatic valve • Inform building manager • Check building records for hot water temperature delivery
Total and combined chlorine (after 30 second flush)	Kitchen, one sink faucet and one shower per bathroom	Total Chlorine ≤ 4 mg/L Residual Chlorine ≥ 0.2 mg/L	Monthly	<ul style="list-style-type: none"> • Review flushing frequency and fixture usage rates • Inform building manager

*Measured 'first draw' (before the first occupant uses the fixture)

Critical control points - Points where actions are taken to keep the control variables within desired ranges:

[Note, the control points below are based on a fictional project. Each project team will need to evaluate the appropriate control points for their project.]

- A. All Bathroom and kitchen faucets
- B. All Showerheads

Control measures - Actions performed at the control points to maintain desired control variables within range. A corrective action is performed when the variable is beyond acceptable limits:

[Note, the control measures below are based on a fictional project and not meant to imply any WELL requirements. Each project team will need to evaluate the appropriate control measures for their project.]

Action	Frequency
<p>Flush all fixtures (showers, bathroom and kitchen faucets):</p> <ul style="list-style-type: none"> A. Open the valve to full flow and set it to its maximum temperature B. Wait until reaches its maximum temperature. Check temperature with hand contact (no thermometer needed) C. Flush for 1 minute 	Weekly, before the beginning of the first workweek day (e.g., Monday morning before the first occupant arrives)
<p>Clean aerators of bathrooms and kitchen faucets:</p> <ul style="list-style-type: none"> A. Unscrew aerators and immerse them in a 1% bleach solution for 10 minutes. Rinse in cold water when done. B. Examine fixtures with the aerator removed for presence of slime and residue. Corrective action: If slime is found, use a scouring pad or a pipe scrub brush dipped in a 1% bleach solution to clean the pipe. When done, open the valve to full flow, set at cold water, for one minute. C. Replace aerator and run the tap for 30 seconds in cold water 	Monthly
<p>Clean showerheads:</p> <ul style="list-style-type: none"> A. Unscrew aerators and immerse them in a 1% bleach solution for 10 minutes. Clean any visible trace of slime or residue and rinse in cold water B. Examine pipes with the aerator removed for presence of slime and residue. Corrective Action: if slime is found, use a scouring pad or a pipe 	Monthly

scrub brush dipped in a 1% bleach solution to clean the pipe. When done, open the valve to full flow, set at cold water, for one minute. C. Screw back aerators and run the shower with cold water for 30 seconds.	
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In addition to these control measures, monthly review of the building's cooling tower operational records is scheduled to ensure its appropriate management.

Recordkeeping

[Note, the record keeping details below are based on a fictional project. Each project team will need to evaluate the appropriate record keeping processes for their project.]

Monitoring, Control and Corrective actions must be documented in a log, along with all monitoring results, relevant plumbing repairs, and other service disruptions. Sample logs are shown below. Documentation of all work orders are copied and attached to this plan.

Operations Log

Date	Start time	Action	Performed by (initials)	Notes
03/03/18	13:00	Clean fixtures (showerheads and faucets)	<INITIALS>	Men's sink #2 found with slime and cleaned

Monitoring

<i>Date</i>	<i>Time</i>	<i>Location</i>	<i>Parameter</i>	<i>Value</i>	<i>Taken by (Initials)</i>	<i>Notes</i>
02/02/18	10:00	Kitchen Faucet	Max. Temperature	40°C	<INITIALS>	Within range
02/02/18	10:00	Kitchen Faucet	Time to reach temperature	3 minutes	<INITIALS>	Called office space manager to contact plumber

PART 01: IMPLEMENT LEGIONELLA MANAGEMENT PLAN
EXAMPLE PROFESSIONAL NARRATIVE

Example 3: Modified version of Example 2 in which a tenant-occupied space is working with an unresponsive building owner/manager.

Water Management Team

[Note, the table below includes examples of team roles. Each project team will need to evaluate the appropriate team roles for their project.]

Name	Title	Role	Phone	Email
<NAME>	Building Manager	Leads water management team, procures services (incl. water and plumbing consultants).	<#>	<EMAIL>
<NAME>	Building Engineer	On-site responsible for HVAC and hot water delivery, maintains shared facilities, common areas. Implements building's water management plan	<#>	<EMAIL>
<NAME>	Office space manager	Maintains plumbing within the tenant space	<#>	<EMAIL>
<NAME>	Building water consultant	Contractor to implement / evaluate water management plan	<#>	<EMAIL>
<NAME>	Building Maintenance Associate / Evening shift	Backup Emergency point of contact	<#>	<EMAIL>
<NAME>	Building security / Night shift	Emergency point of contact – midnight	<#>	<EMAIL>
<NAME>	Plan preparer	Person who wrote the plan and is knowledgeable of the building	<#>	<EMAIL>

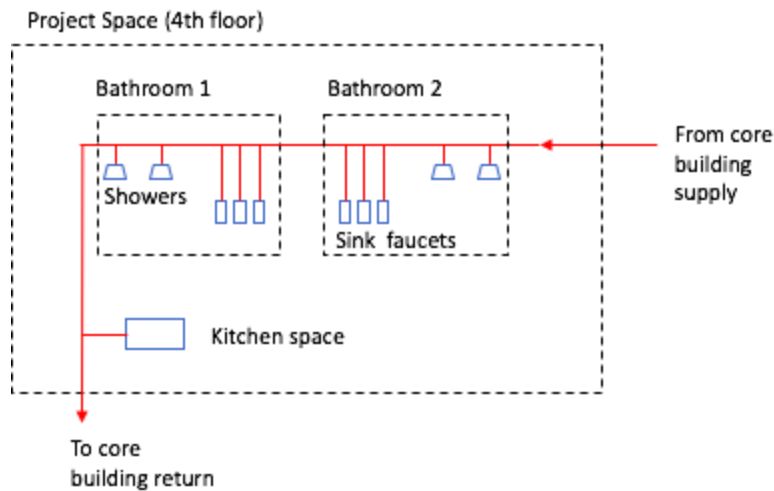
Water System inventory

[Note, the inventory below, including the detail drawing are examples of a fictional project. Each project team will need to evaluate the appropriate inventory for their project.]

The space occupies the totality of the fourth floor of the whole building, which has 10 floors above ground. The internal layout is open plan, with its north-west portion having a small kitchen and having two bathrooms placed near the elevator bank. Each bathroom has two showers, three toilets and a single sink with three faucets.

The sink faucets provide warm water (hot/cold mix). The showers have a single faucet with controllable temperature and flow. A centralized recirculating hot water system delivers water to the office. The building has a cooling tower that provides heat rejection for the AC system. No bathtubs/spas or spraying misting fountains are part of the project, nor are present in the building's

common entryways. Based on the recommendations set in the [Legionella Toolkit](#) developed by the US Centers for Disease Control and Prevention the tenant's water safety plan should address risk related with the cooling tower and the hot water distribution system. However, the building owner/manager did not provide access or information regarding the hot water system or the maintenance of the cooling tower. Based on the available information, the simplified process flow diagram shows the main components of the hot water supply and delivery to the tenant space.



Hazard Analysis and risk management

[Note, the hazard analysis, risk management and control measures section below is based on a fictional project. Each project team will need to evaluate the appropriate hazard analysis, risk management and control measures for their project.]

The project is an office space with a regular weekly occupancy of 50 people of approximate ages ranging 20-70. Facilities are to be used primarily during weekdays 8:00 – 18:00. Each showerhead is expected to be used 10 times a week on average, mainly during mornings by bike commuters. There are some occupants of age groups with higher incidence of Legionnaires disease (see US CDC Legionella toolkit for further reference, basic clinical information can be found [here](#)).

The building is fed by municipal tap water that uses chloramines as the primary disinfectant. Details of the base building operations The hot water enter the project through a connection that No maintenance or operational records were provided by the building management upon request. Records as of September-2018 show hot water delivered of 140°F / 60°C. Since there is no thermostatic mixing before This temperature is unlikely to foster Legionella amplification as it is well above its development range. A walk through the basement showed good pipe insulation. The plumbing for the project has all fixtures (showerheads and faucets) installed with thermostatic mixing valves set at a maximum temperature of 110°F (43°C) to prevent scalding.

Example 4: Basic building water safety plan for core building

A. Formation of a Legionella team

Example: Team template

Name	Title	Role	Phone	Email
<NAME>	Building Manager	Leads water management team, procures services (incl. water and plumbing consultants).	<#>	<EMAIL>
<NAME>	Building Engineer	On-site responsible for HVAC and hot water delivery, maintains shared facilities, common areas. Implements building's water management plan	<#>	<EMAIL>
<NAME>	Office space manager	Maintains plumbing within the tenant space	<#>	<EMAIL>
<NAME>	Building water consultant	Contractor to implement / evaluate water management plan	<#>	<EMAIL>
<NAME>	Building Maintenance Associate / Evening shift	Backup Emergency point of contact	<#>	<EMAIL>
<NAME>	Building security / Night shift	Emergency point of contact – midnight	<#>	<EMAIL>
<NAME>	Tenant #1 contact	Tenant 1 facilities manager	<#>	<EMAIL>
<NAME>	Tenant #2 contact	Tenant 2 facilities manager	<#>	<EMAIL>
<NAME>	Plan preparer	Person who wrote the plan and is knowledgeable of the building	<#>	<EMAIL>

B. Water system inventory and production of process flow diagrams

Example: System Inventory narrative for a fictional building

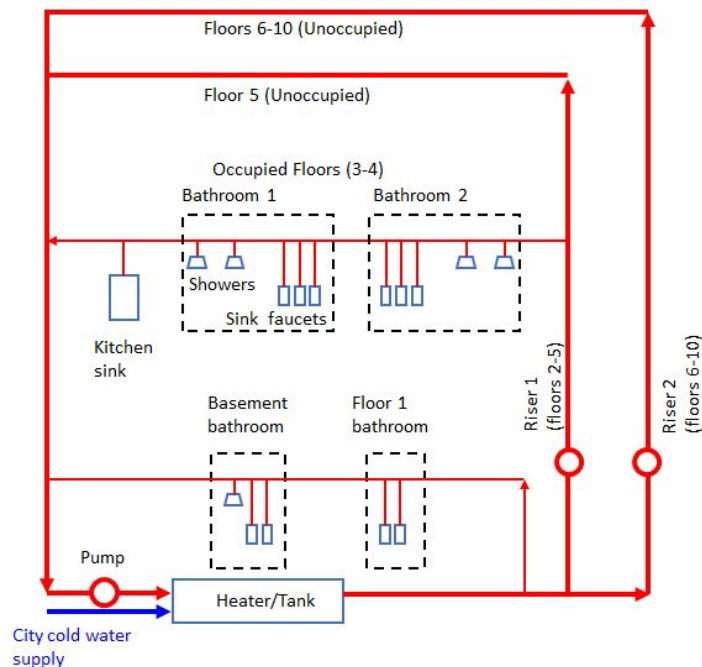
[Note, the inventory below, including the detail drawing are examples of a fictional project. Each project team will need to evaluate the appropriate inventory for their project.]

The building has 10 floors above ground and one basement. The basement and floor 1 are part of the core facility. Floors 2 and 3 are occupied by tenants, floors 4 to 10 are vacant. Hot water supply to all spaces is through a common recirculating system consisting in two independent riser lines, one feeding floors 1-5 and the second feeding floors 6-10. Tenants in Floors 2 and 3 have 2

bathrooms with 2 showers and 3 sinks each, plus one kitchen sink per floor. At this time, the riser loop feeding floors 5-10 is untapped. The hot water supply in the common areas is fed by a lateral line that runs below the roof of the basement and feeds two bathrooms, one equipped with two handwashing sinks and the second having two sinks and one shower. The sink faucets provide warm water (hot/cold mix). The showers have a single faucet with controllable temperature and flow. No spas or spraying misting fountains are part of the project, nor are present in the building's common entryways. Air conditioning is provided by packaged rooftop heat and AC units. Finally, all potable water (for hot and cold water) enter the building and is delivered to a rooftop cold water tank, which supplies the water heater.

Based on the recommendations set in the [Legionella Toolkit](#) developed by the US Centers for Disease Control and Prevention, the tenant's water safety plan should address risk related with the hot water distribution system. The simplified process flow diagram shows the main components of the hot water supply and delivery.

Example: Process Flow Diagram for fictional building



C. Hazard analysis of water assets.

Example: fictional core building partially occupied

The project encompasses a new office/commercial building with 9 tenant floors, a common lobby and a basement. Each floor is 300 m² in area. At this time, 2 floors are rented and 7 do not have internal plumbing other than the main hot and cold water loops, running exposed on each roof. Facilities are to be used primarily during weekdays 8:00 – 18:00. There are two bathrooms in the core area, in the lobby and another one in the basement, the latter furnished with a shower. Both primarily serve the core building personnel. There are some occupants of age groups with higher incidence of Legionnaires disease (see US CDC Legionella Toolkit for further reference, basic clinical information can be found [here](#)).

The building is fed by municipal tap water that uses chloramines as the primary disinfectant. A cold water tank is located on the rooftop; maintenance is performed twice a year by a certified company (records are attached to this plan in the Documentation section). The hot water boiler/tank was put into service 5 months ago. It is serviced on a quarterly basis. Its target delivery temperature is 140°F / 60°C. Temperature at the hot water return was found at 130°F / 54°C, which shows relatively good insulation. Since there is no thermostatic mixing before the point of use of hot water, it seems unlikely that the system fosters Legionella amplification as the hot water circulates above its development range. A walk through the basement confirmed that the insulation was in good shape. The plumbing for the project has all core and tenant fixtures (showerheads and faucets) installed with thermostatic mixing valves set at a maximum temperature of 110°F (43°C) to prevent scalding.

Overall, the main risks for contamination come from the stagnation of water in showerheads and handwashing facilities after the weekend recesses. Since the hot water is delivered at 140°F (60°C) and mixed at the point of use, there is little risk of Legionella amplification from the core building plumbing. However, periodic testing of the time that the warm water takes to reach its maximum temperature (theoretically 110°F / 43°C) is recommended to monitor the quality of the hot water delivery. In addition, tracking shower usage patterns should inform potential risks of bacterial growth due to water stagnation.

Suggested control measures include:

- A. Routine disassembling and bleach cleaning of showerheads and faucet aerators in bathrooms and kitchen sinks in tenant spaces
- B. Periodic flushing of showers prior to the beginning of the work week
- C. Program validation by periodic (at least twice a year) Legionella sampling is recommended.

D/E. Identification of critical control points & Maintenance and control measures, monitoring, establishment of performance limits and corrective actions.

Example: Establishment of control actions, variables and points for a fictional building

A. Monitoring (sentinel) plan

[Note, the values in the table below are based on a fictional project and not meant to imply any WELL requirements. Each project team will need to evaluate the appropriate values for their particular project.]

A list of variables and ranges that indicate the adequacy of the water safety, and testing actions, to bring the control variables within target values (when needed), is shown below:

Control Variable	Location	Target Value	Frequency	Corrective Action(s)
Time that water takes to reach maximum temperature*	All fixtures	≤ 20 seconds	Bimonthly	<ul style="list-style-type: none"> Check pipe insulation and building records
Maximum temperature delivered by fixture*	All fixtures	110 ± 5 °F	Bimonthly	<ul style="list-style-type: none"> Check thermostatic valve Check building records for hot water temperature delivery trends

Total and combined chlorine (after 30 second flush)	Kitchen, one sink faucet and one shower per bathroom	Total Chlorine ≤ 4 mg/L Residual Chlorine ≥ 0.2 mg/L	Monthly	<ul style="list-style-type: none"> Review flushing frequency and fixture usage rates
Turbidity of hot water (after 1-minute stagnation)		<5 NTU	Monthly	<ul style="list-style-type: none"> Drain hot water tank
Hot water return temperature	Before entering the heater	>50 C / 122 F		<ul style="list-style-type: none"> Review insulation Review riser pump balance and heads of all pumps Request information from tenants about vacancy / extended use Check for cold water crossovers

**Measured 'first draw' (before the first occupant uses the fixture)*

B. Identification of critical control points and measures

[Note, the control points and measures below are based on a fictional project and not meant to imply any WELL requirements. Each project team will need to evaluate the appropriate control measures for their project.]

Points where actions are taken to keep the control variables within desired ranges:

- A. All Bathroom and kitchen faucets
- B. All Showerheads
- C. Water Heater/Tank
- D. Pumps

Measures taken at these control points are detailed below:

Action	Frequency
Flush all fixtures (showers, bathroom and kitchen faucets): <ol style="list-style-type: none"> A. Open the valve to full flow and set it to its maximum temperature B. Wait until reaches its maximum temperature. Check temperature with hand contact (no thermometer needed) C. Flush for 1 minute 	Weekly, before the beginning of the first workweek day (e.g., Monday morning before the first occupant arrives)
Clean aerators of bathrooms and kitchen faucets: <ol style="list-style-type: none"> A. Unscrew aerators and immerse them in a 1% bleach solution for 10 minutes. Rinse in cold water when done. 	Monthly

<p>B. Examine fixtures with the aerator removed for presence of slime and residue. Corrective action: If slime is found, use a scouring pad or a pipe scrub brush dipped in a 1% bleach solution to clean the pipe. When done, open the valve to full flow, set at cold water, for one minute.</p> <p>C. Replace aerator and run the tap for 30 seconds in cold water</p>	
<p>Clean showerheads:</p> <p>A. Unscrew aerators and immerse them in a 1% bleach solution for 10 minutes. Clean any visible trace of slime or residue and rinse in cold water</p> <p>B. Examine pipes with the aerator removed for presence of slime and residue. Corrective Action: if slime is found, use a scouring pad or a pipe scrub brush dipped in a 1% bleach solution to clean the pipe. When done, open the valve to full flow, set at cold water, for one minute.</p> <p>C. Screw back aerators and run the shower with cold water for 30 seconds.</p>	Monthly
Inspect cold water (certified water company)	Twice a year

F. Documentation, verification and validation procedures.

Example: Narrative describing verification and validation procedures for a fictional project

[Note, the narratives below are based on a fictional project and not meant to imply any WELL requirements. Each project team will need to evaluate the appropriate control measures for their project.]

Verification

This plan was audited by the water consultant **XYX** and verified on-site by the building engineer **XYZ** on date **XX/YY/ZZ**. The locations suggested for monitoring and control are available for the building staff, sampling points at both ends of the water heater/storage unit are available, and pump controls are accessible. Control samples were measured on date **XX/YY/ZZ** and confirmed to be within the established ranges. Copy of the control sample results is appended in the documentation section.

Validation

On a quarterly basis, starting on date **XX/YY/ZZ**, legionella testing is contracted to company **BUG**. The company withdraws one water sample per each occupied floor and one at the hot water return. The results are appended to this document. As of date **XX/YY/ZZ**, no Legionella has been detected in the plumbing system

Documentation and recordkeeping

Table of contents:

- A. Plan revisions (include dates, performer, reason and changes)*
- B. Routine Monitoring Log*
- C. Plumbing Repair and Maintenance Log*
- D. Corrective Action and follow-up measurements log*
- E. Water Tank Maintenance Records*
- F. Water Heater Maintenance Records (including draining)*
- G. Legionella test results*