NJHealth
New Jersey Department of Health
Communicable Disease Service

Responding to Post-Remediation Environmental *Legionella* Detections

When performing a chemical shock remediation in response to a Legionnaires' disease investigation, facilities must conduct post-remediation environmental sampling for *Legionella* to validate the effectiveness of the remediation and long-term prevention strategies. If the root causes of *Legionella* growth are not identified and addressed, *Legionella* can rebound within weeks.

NJDOH recommends conducting post-remediation environmental sampling for *Legionella* 3 to 7 days after the chemical shock remediation has been completed (no sooner than 48 hours after returning to normal operating conditions). Sampling should occur every 2 to 3 weeks. Once there are three consecutive sampling events with no detectable levels of *Legionella*, the facility can transition to monthly sampling after consulting with the Local Health Department. If monthly sampling shows no detectable levels of *Legionella* for three consecutive months, the facility can discontinue investigative sampling.

The identification of any *Legionella* species during post-remediation sampling indicates that the environmental conditions favorable for growth. If *Legionella* is detected in any post-remediation sample—regardless of species or concentration—the facility must immediately re-evaluate their Water Management Program (WMP) **before** the next sampling event. Corrective actions must be taken when any control measure (i.e., action taken to limit the growth and spread of *Legionella*, such as adding disinfectant, or cleaning) is outside of the targeted range. Additionally, new control measures may be needed to address ongoing *Legionella* detections and mitigate hazardous conditions promoting microbial growth in the building water system.

It is expected that facilities implement control measures and/or corrective actions within 14 days of receiving environmental *Legionella* sampling results. **After implementation, wait at least 48 hours for the building water system to stabilize and return to normal operating conditions before the next environmental sampling event.** If *Legionella* persists despite implemented control measures, repeat remediation(s) may be necessary. Any subsequent remediation will reset the sampling schedule.

Fluctuations in water temperature, flow, pressure, quality, or use-patterns can lead to conditions that promote *Legionella* growth. Inadequate residual disinfectant and building water system age can also contribute. It is important to use building schematics of the entire potable water distribution system to create a water quality profile by visually mapping water quality parameters and *Legionella* detection data. This approach helps determine whether issues are localized to specific areas or systemic throughout the entire building water system. The following page outlines common factors contributing to *Legionella* growth.

There are instances when *Legionella* levels increase immediately following a remediation due to disrupted biofilm being flushed out of the system. If this occurs, it is important to thoroughly flush the water from the system and replace it with fresh water to ensure *Legionella* does not recolonize the system. Consider flushing primary water pipes (e.g., risers, branches, horizontal headers) to speed up the delivery of fresh water to points of use. It is beneficial to remove the aerators and showerheads while flushing at points of use, as these devices restrict flow and can become colonized with dislodged biofilm.

Commonly Seen Contributing Factors for *Legionella* Growth

Disclaimer: This list is not exhaustive but provides building owners and operators with an overview of common issues identified in Legionnaires' disease outbreak investigations. Keep in mind that each building's water system is unique. It is the facility's responsibility to mitigate Legionella growth, which may require a licensed plumbing engineer to identify and address contributing factors.

Inadequate Remediation Procedure

- **Dead legs were not removed** prior to the remediation; therefore, the applied disinfectant could not reach all points of the potable water system.
- **Water tanks were not drained, cleaned, flushed, and disinfected** prior to the remediation. Sedimentation at the bottom of tanks can harbor *Legionella* and provide it shelter from high levels of disinfectant.
- **Disinfectant residual was not monitored at all points of use throughout the building distribution**. Disinfectant residual may have dropped below the target value allowing *Legionella* to persist in undetected locations.
- **Showerheads and aerators were not removed** during the process; therefore, dislodged biofilm could not be flushed out of the system.
- **In some instances, the burden of biofilm is so extensive that multiple rounds of remediation are needed to achieve adequate reduction.**

Inadequate Hot and Cold Water Temperatures

- **Hot water temperatures fall within the range that supports *Legionella* growth** (between 68-120°F, with an optimal growth range of 77-113°F). Long-term care facilities often have regulations limiting hot water temperatures to 110°F in resident areas to prevent scalding. In these cases, installing thermostatic mixing valves (TMVs) at points of use, rather than a centralized TMV near the water heater, can reduce *Legionella* risk by maintaining hot water throughout the distribution at or above 120°F. If this isn't possible, alternative control measures may be needed to ensure hot water temperature compliance with federal, state and local regulations.
- **The hot water storage tank has temperature stratification**, where warmer water rises to the top and cooler water remains at the bottom. To ensure adequate temperature control, all stored hot water should be maintained at or above 140°F. Consult with a plumbing engineer to implement strategies for addressing and preventing temperature stratification.
- **Cold water pipes are located near steam pipes, hot water pipes, or other heat sources allowing heat gain and uninsulated hot water pipes are experiencing temperature fluctuations by heat loss.** Installing pipe insulation can help maintain water temperatures outside the range that may support *Legionella* growth due to minimizing heat transfer to or from an external source.
- **A common issue in facilities that use heat trace systems to maintain the temperature of hot water pipes is ensuring the system is installed correctly and functions properly.** Heat trace systems, often found in new construction projects, eliminate the need for a hot water recirculation loop by applying heated electric cables along the pipe to maintain the desired temperature within setpoints.

Inadequate or Inconsistent Disinfectant Residual Levels

- **Water system components are speeding the decay of disinfectant residuals**, such as UV devices, water softeners, carbon filters, and water heaters. Measure the disinfectant residual immediately before and after water is processed by the device to determine which components may be impacting residual levels.
    - Disinfectant residual levels naturally decrease as water moves through the building, but significant fluctuations beyond the expected decline should be investigated to identify the cause.
- **There is insufficient or inconsistent disinfectant in the incoming cold water from the public water system** (if applicable). To obtain an accurate disinfectant residual reading, thoroughly flush the service line before measuring. Ensure you are measuring the appropriate disinfectant type, typically either chlorine or monochloramine. If any issues are identified, contact the water utility company.

Low Water Usage and Low Flow

- **There is increased water age and stagnation due to low water usage and/or flow**, which can negatively affect water quality and promote *Legionella* growth. If it takes longer than 60 seconds for hot water to reach its maximum temperature at points of use, this may signal a localized issue or system imbalance. Additionally, devices such as flow restrictors, electronic faucets, and metered faucets can affect water flow. Routine flushing is essential to mitigate this risk.
- **There are no flushing protocols for the facility's hot and cold water systems, or the existing protocols are ineffective.** Review and update the flushing protocols to ensure a systematic approach for both the hot and cold water systems. Flushing usually involves sequentially opening points of use (e.g., faucets, showers, toilets, drinking fountains, eye wash stations, refrigerators/ice machines, and dishwashers) or flushing in segments based on the plumbing design and water pressure. For example, flushing may begin at the closest point to the water entry and progress to the farthest points. Consult an expert to establish proper protocols, as improper methods can be ineffective or cause damage. The below practices can help optimize flushing protocols.
    - Identify all outlets in the building (e.g., sinks, showers, tubs, janitorial sinks, eyewash stations, etc.) and assess their usage frequency. Ensure that unused or infrequently used outlets are flushed minimally at least once a week (or twice a week for healthcare facilities). Sections of the system with poor water quality may require more frequent flushing.
    - Flush the incoming cold water service line(s) from the water main to the building before flushing the rest of the building’s distribution system.
    - Incorporate flushing of mechanical equipment associated with building water systems such as water heaters, storage tanks, circulatory/booster pumps, water treatment devices, in-line filtration including strainers, and pressure/expansion tanks.
    - If the building has a hot water recirculation system, flushing should also occur near the return point for hot water.
    - Most building water systems have a limited number of larger water pipes that deliver water to smaller diameter piping throughout the building. Flushing these larger pipes, if possible, will speed up delivery of fresh water to point of use outlets. This step may not be necessary for smaller buildings or simpler water systems.

- Flushing can be automated using solenoid valves and timers. Consult a plumbing engineer to find appropriate locations for these and a licensed plumber for installation if this is a desired approach.

Potable Water System is Unbalanced

- **Water systems with multiple loops, zones, or risers may need balancing to ensure even distribution throughout the building.** This is typically done with balancing valves during construction. However, over time, unbalanced systems can result from valve malfunctions, plumbing modifications, changes in water use, or calcification, leading to poor water flow, temperature fluctuations, and other water quality issues.
  - Hot water recirculation can be checked by flushing the hot water at outlets without point-of-use thermostatic mixing valves (i.e., double handle fixture with non-tempered hot typically found at utility sinks) and recording the hot water temperature after temperature has stabilized. An unbalanced system may result in inconsistent hot water temperatures during flushing, fluctuating steady-state temperatures, and/or varying times to reach the final steady temperature.
  - If balancing issues are detected, a plumbing engineer or specialized plumber, with the necessary knowledge and tools to accurately calculate and adjust water flow throughout the system using balancing valves, may be needed.
  - Other useful actions include ensuring each pump is functional, installed correctly, and appropriately sized (due to renovations, pumps may become over- or under-sized over the life of a building).

Improper Maintenance of Building Water System Components:

- **Water Softener and Conditioning Systems:** These systems can increase the surface area for biofilm growth and reduce incoming disinfectant residual before water reaches the building distribution system if not properly maintained.
- **Backflow Prevention Devices:** These devices prevent contaminated water from entering the potable water system. Test and inspect regularly per manufacturer's instructions and local codes.
- **Expansion Tanks, Pressure Tanks, and Water Hammer Arrestors:** These devices protect the building water system from excessive pressure shocks and maintain water pressure but can promote water stagnation and foster *Legionella* growth.
- **Water Heaters and Hot Water Storage Tanks:** These water system components are susceptible to sediment buildup and scaling, which can damage elements and foster *Legionella* growth.
- **Thermostatic Mixing Valves:** These valves prevent scalding but can harbor *Legionella*. Follow manufacturer's instructions for maintenance, including cleaning of internal components.
- **Filters (Point of Entry, In-line, Point of Use, and Strainers):** Poorly maintained filters can deplete disinfectant and support *Legionella* growth.
- **Showerheads and Aerators:** These devices can trap debris and minerals, creating conditions for *Legionella* growth.
- **Electronic Faucets:** These complex fixtures may need more frequent flushing and cleaning to prevent *Legionella*.

- **Pumps:** Check pumps regularly to make sure water flows correctly, circulates well, and rotates in order to avoid them sitting idle or in backup mode.

Inadequate Operation of the Supplemental Disinfection System

- **Disinfectant is not being consistently monitored throughout the building's water system**. It is crucial to verify that disinfectant reaches all points of use to maintain its effectiveness.
- **Low or unbalanced water flow is preventing the disinfectant from reaching all points of use in the building's water system.** It is important to review water quality logs and optimize the facility's flushing protocols to ensure the supplemental disinfection system is operating effectively.
- **The supplemental disinfection system is not automated.** CDC recommends that supplemental disinfection systems be automated rather than manual to ensure consistent operation and real time monitoring of controls and disinfectant concentration.
- **Disinfectant levels are inappropriate for the building water system and piping materials**. Overtime, chemical disinfectants can lead to corrosion and pitting of pipes, which creates an environment conducive to biofilm and *Legionella* growth.
- **The supplemental system is not effectively controlling hazardous conditions.** Ensure the water treatment consultant has the technical expertise, skills, and experience to oversee all aspects of the treatment process, including implementation, installation, system start-up, confirmation of post-treatment water chemistry and disinfection byproducts, as well as providing training and ongoing support.

Inadequate Policies, Procedures, and Documentation

- **There is no documentation verifying the implementation of the Water Management Program.** Without proper records, such as maintenance logs, flushing protocols, and water quality monitoring data, it's difficult to identify lapses that could allow *Legionella* growth.
- **Building water system riser diagrams are unavailable.** These diagrams are crucial for understanding how water flows through the building, which helps identify potential problem areas where *Legionella* may proliferate. Hiring an engineer with plumbing design experience may be necessary.
- **Staff do not receive adequate training in *Legionella* prevention and control.** Effective communication and ongoing education are critical to ensuring staff are equipped to recognize and address potential *Legionella* risks.

Examples of Corrective Actions for Out-of-Range Control Measures
(Water Temperature and Disinfectant Residual)

Example #1:

A facility has set their circulating hot water temperature between 120-130°F. During monitoring, they notice that a shower in a guest room is several degrees below 120°F. To investigate, they take these steps:

1. **Inspect the outlet for issues:**
   - Low water pressure or flow rate
   - Faulty pressure, thermostatic, or diverter valve
   - Possible inter-connections nearby
2. **Check temperatures in nearby areas:** Measure the water temperature upstream and downstream on the same pipe to understand how widespread the issue is.
3. **Adjust the thermostatic valve:** If there's a thermostatic valve, adjust its settings to ensure it's delivering the right temperature.
4. **Replace faulty valves or fixtures:** If any valves or fixtures are faulty, replace them.
5. **Check the water heater:** Review the water heater's temperature setting and adjust it if needed.
6. **Inspect or add pipe insulation:** Install or check insulation on both cold and hot water pipes to reduce heat loss or transfer.
7. **Re-check temperatures:** After 24 hours, take another temperature reading at the shower outlet to confirm the fix worked.
8. **Document actions**: Record everything done and submit a report to the Water Management Program Team and the Local Health Department.

Example #2:

A facility installed a supplemental disinfection system to keep chlorine levels between 0.5 to 1.0 parts per million (ppm) in the hot water. However, they found that the chlorine levels were fluctuating a lot, with some areas not meeting the target range. To fix the problem, they took these steps:

1. **Monitor more locations:** Check the chlorine levels at key points before and after the injection system, as well as in other areas throughout the building.
2. **Look for patterns:** Plot the chlorine readings on a system map to see if the problem is isolated to certain areas or affecting the whole system.
3. **Check low flow areas:** Review areas with low water flow and flushing logs to see if there were any issues.
4. **Check pH and temperature:** Make sure the water's pH and temperature are within the right ranges to keep chlorine effective.
5. **Inspect equipment**: Check the chemical pumps, valves, and sensors to ensure they are working and calibrated properly.
6. **Check chemical inventory**: Make sure there's enough disinfectant in stock.
7. **Check dosing system:** Ensure the automated system is working properly and adjust settings if needed.
8. **Inspect physical equipment:** Visually check the system's components and chemical tanks for any damage or malfunction.
9. **Re-monitor:** After 24 hours, check the chlorine levels again to make sure they are back in the target range.
10. **Document everything:** Record all actions taken and share the report with the Water Management Program Team and the Local Health Department.