WATER MANAGEMENT PROGRAMS

Development, Implementation & Beyond

June 11, 2020

JAMIE MUNDA

- Water Safety Specialist (2019)
- Water Safety Industry Technical Consultant (2017)
- Dow Chemical – Senior Microbiologist / Industrial Hygiene Auditor (2006)
- University of Illinois – B.S. Molecular Cellular Biology
- Avid Baseball Fan
- Married to Steve
- Mom to 3

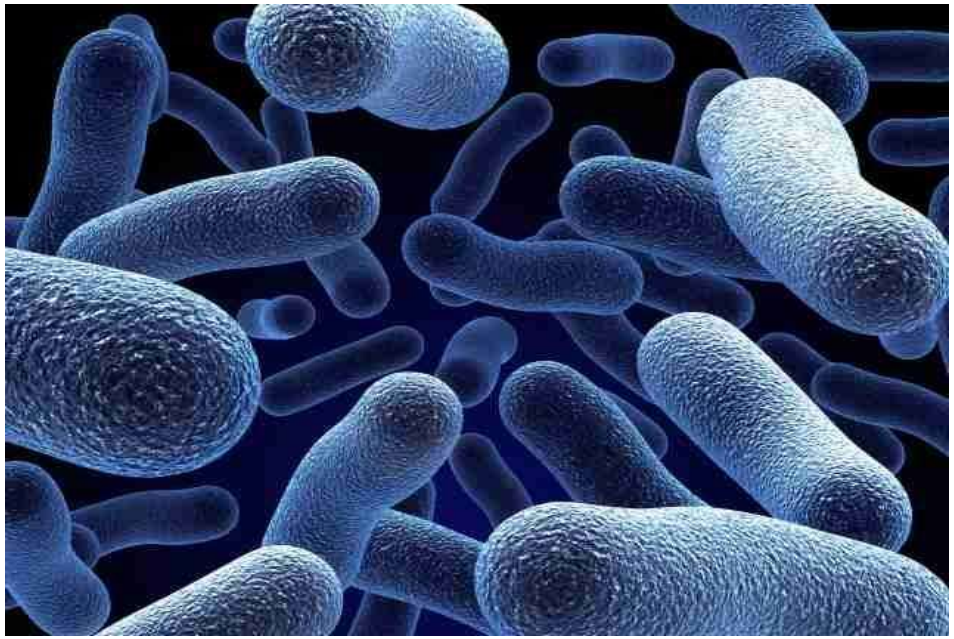
AGENDA

- *Legionella* Review
- Key Market Events
- Outbreaks, Awareness & Legislation
- Water Management Programs
- Strategies to Reduce Your Risk

1ST LEGIONNAIRES' DISEASE OUTBREAK

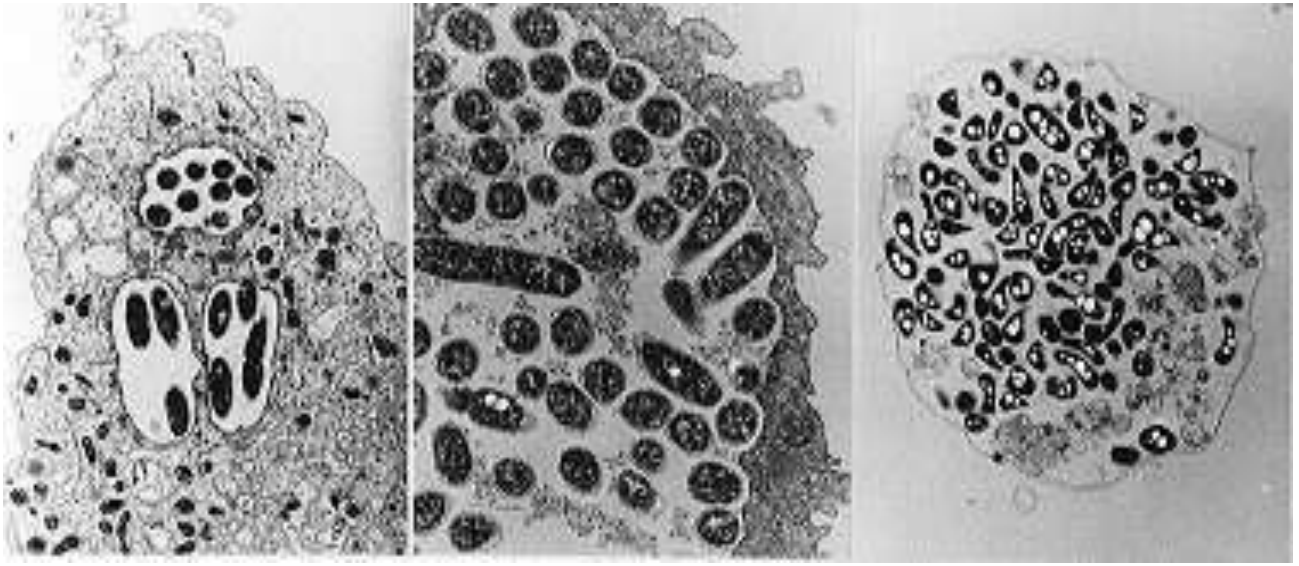
- Disease first recognized in 1976
- American Legion's convention in Philadelphia
  - 221 cases, 34 deaths
- CDC identified a bacteria as source
  - Bacteria was named *Legionella pneumophila*
- Nearby cooling tower was the source

LEGIONELLA



- Gram-negative, rod like bacterium found in fresh water environments
- > 60 species of *Legionella*
- ~90% of LD cases caused by *Legionella pneumophila*

- Grows inside amoebae which provides protection & nutrients
- Can grow & amplify in human designed water systems



LEGIONELLOSIS

Legionnaires' Disease (LD)

- Atypical pneumonia
- Hospitalization common
- Incubation: 2-14 days after exposure
- Fatality rate more than 10%

Pontiac Fever

- Less-severe influenza-like illness
- Hospitalization uncommon
- Incubation: 1-3 days after exposure
- Not typically fatal

Inhaled as an aerosol or mist

Aspirating water or ice chips has caused disease (rare cases)

Not considered contagious

Drinking contaminated water does NOT cause legionellosis

WHO IS AT RISK?

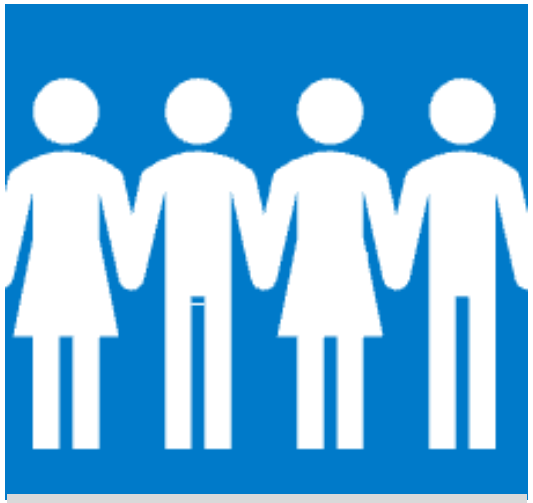
- > 50 years of age
- Smokers
- Immunocompromised
- Existing Respiratory Disease

WATER SAFETY – ESSENTIAL TO MANAGE RISK

Protecting what matters most

PATIENTS & VISITORS

EMPLOYEES



COMMUNITY

BRAND

POTENTIAL OUTBREAK CONSEQUENCES

- Outbreak Ensues Chaos
- Investigation & Remediation Costs
- Temporary Shutdown - Production & Revenue Loses
- Litigation, Fines or Civil Lawsuits
- Damage to Brand / Facility Reputation
- Increased Insurance Premium

1

MUNICIPAL WATER SOURCE

Legionella bacteria can enter the water as an “escapee” from the water treatment facility

2

WATER MAIN DAMAGE

Water infrastructure failures can allow bacteria to enter the drinking water system

3

CONSTRUCTION

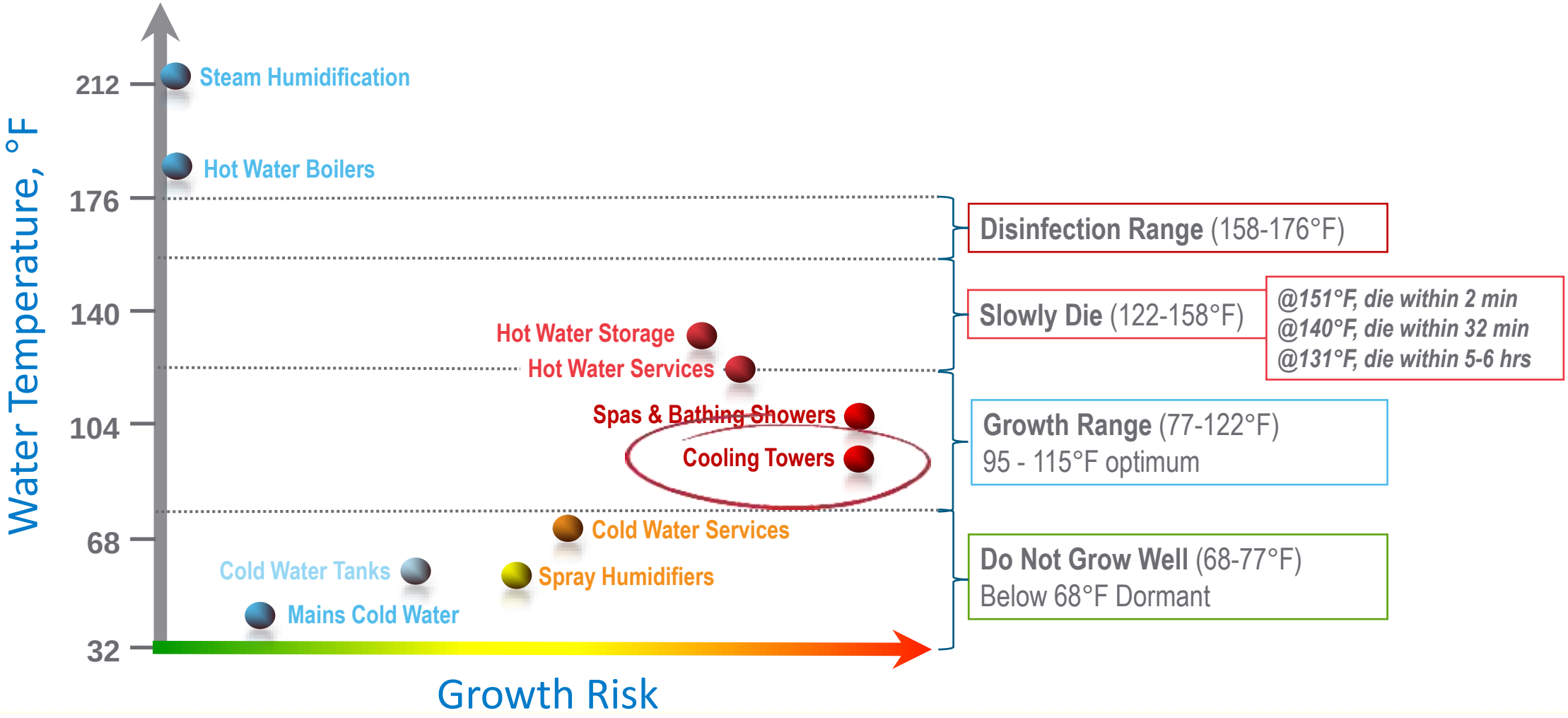
“Stowaway” *Legionella* bacteria can enter a plumbing system during installation or repair

SYSTEMS CAN SUPPORT GROWTH

Improperly engineered & managed Building Water Systems result in:

- Poor Temperature Controls
- Lack of Residual Disinfectant
- Water Stagnation

WATER TEMPERATURE & *LEGIONELLA*



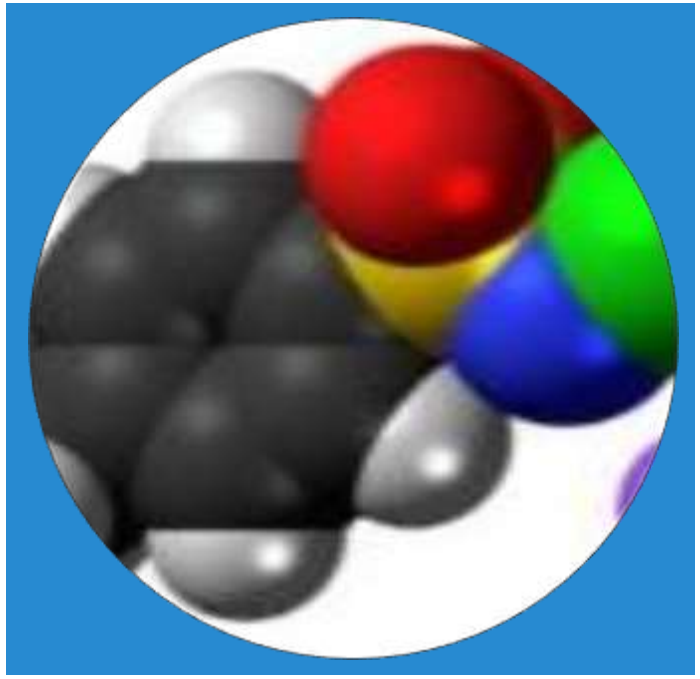
POTABLE WATER OXIDANT RESIDUALS

CHLORINE

0.5 to 1.0

0.3 to 0.5 mg/L

CHLORAMINE



1.0 to 1.5

0.5 to 1.0 mg/L

CHLORINE DIOXIDE

0.3 to 0.5

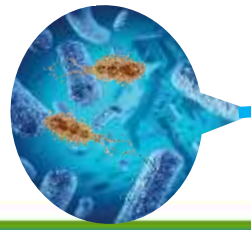
0.1 to 0.3 mg/L

LEGIONELLA PATHOGEN GROWTH MODEL

Consider water with 10 CFU/mL of aerobic bacteria

10 Bacteria/mL
X 3,785 mL/Gal
X 100,000 Gal/Day

~ 3.8 billion bacteria enter the building water systems per day!



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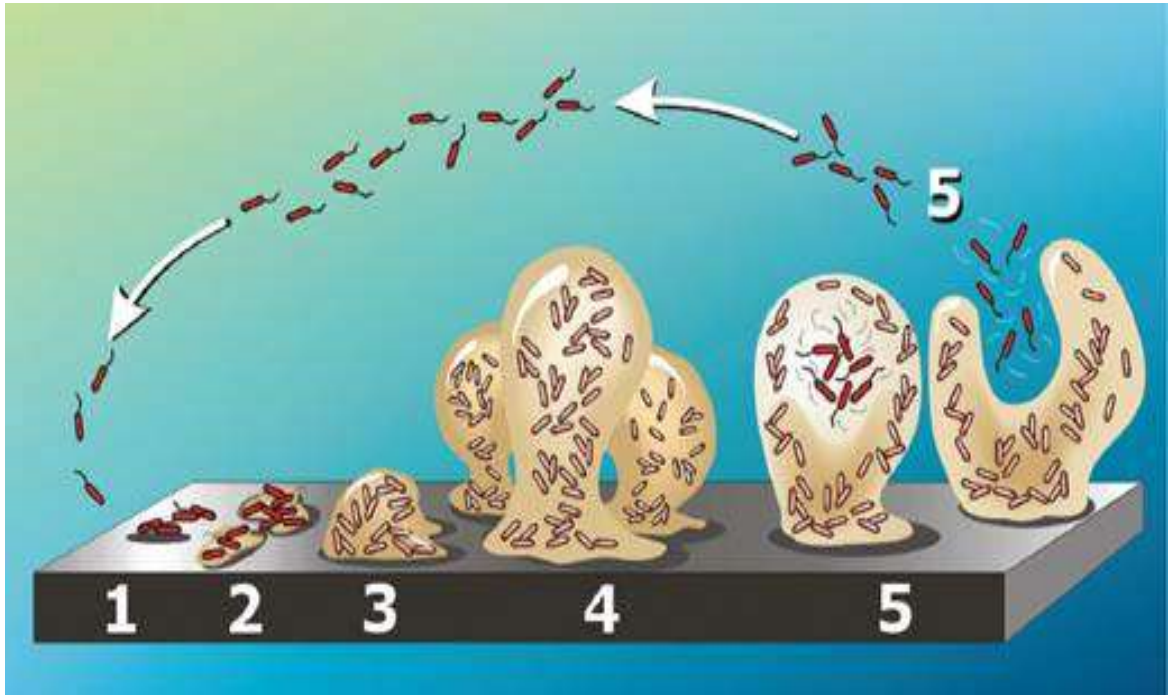


Can Lead to Biofilm Formation = Exposure Risk to Person Using the Outlet

Legionella can thrive in building water systems and can become pathogenic when aerosolized and inhaled by susceptible individuals.

Case History

2012, Pittsburgh, PA

- Hospital-acquired LD
- 21 cases, 5 deaths
- Widespread colonization
  - ✓*Patient care areas*
  - ✓*Sink in ICU*
  - ✓*Shower in room used by liver transplant patients*
  - ✓*Sand filter of decorative fountain*

Source: CDC Testimony before House Committee on Veterans' Affairs Feb 5, 2013

Case History

2016, Quincy, IL

- Veterans' Home
- 56 cases, 14 deaths
- Linked to premise plumbing over several years

Source: Haupt et al, 2012 Inf. Ctrl. Hosp. Epidem. 33: 185-91

Case History

2015, Atlanta, GA

- Hotel
- 74 cases, 1 death
- Linked to decorative fountain and cooling tower

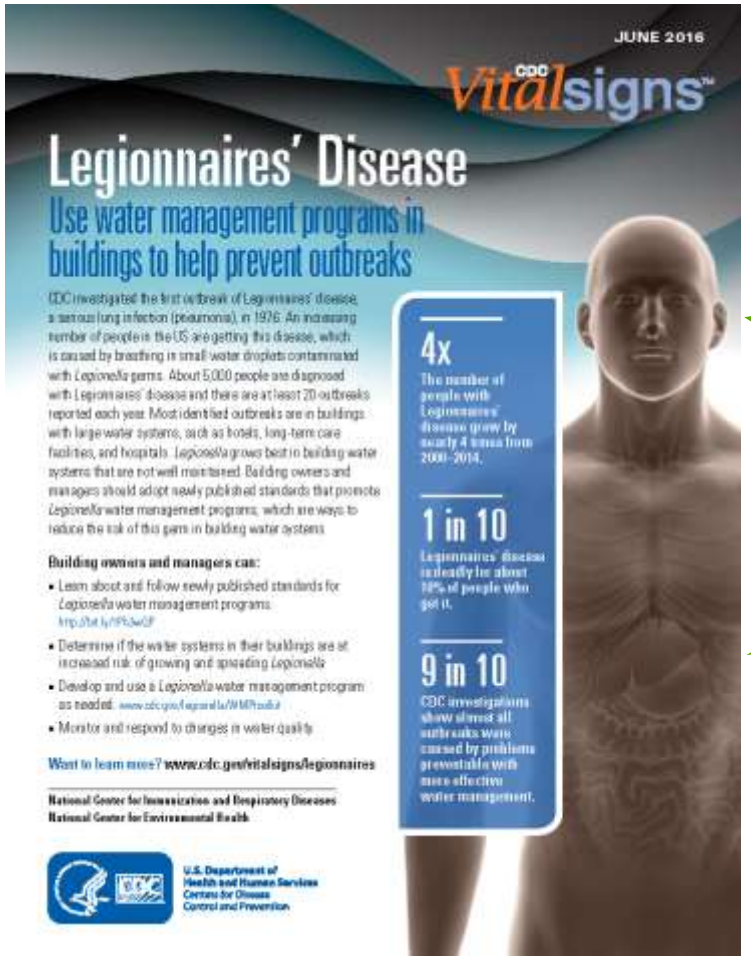
Water entering a building is not sterile

Design and use supports biofilm

Pathogens may be present in biofilm

Water can be a source and vector of infection

Infection risk can be reduced

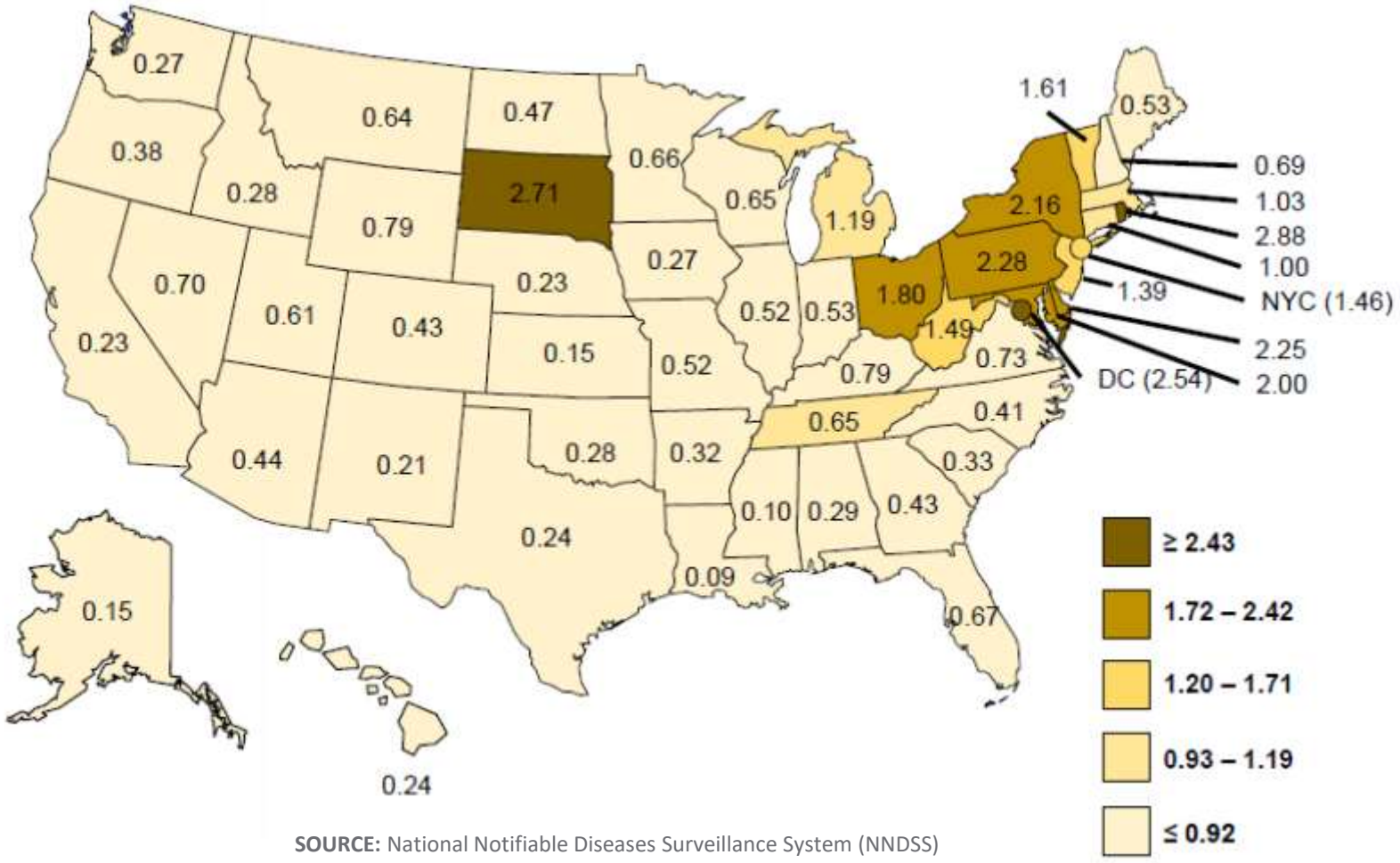


9 in 10

CDC investigations show almost all outbreaks… were preventable

2005 LEGIONELLOSIS CASES

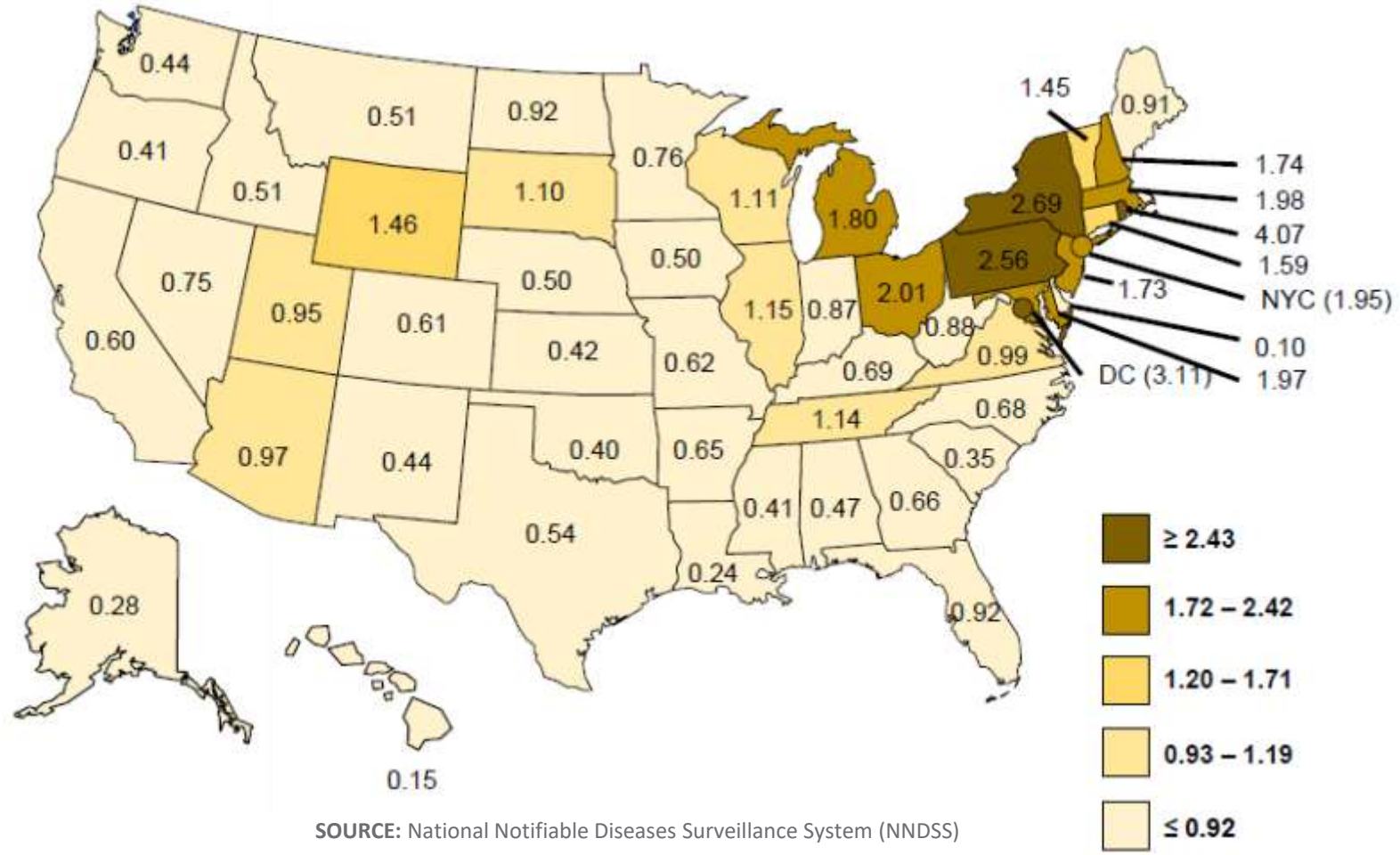
Rates of reported legionellosis cases by state / 100,000 Population



SOURCE: National Notifiable Diseases Surveillance System (NNDSS)

2010 CASES - INCREASE APPARENT

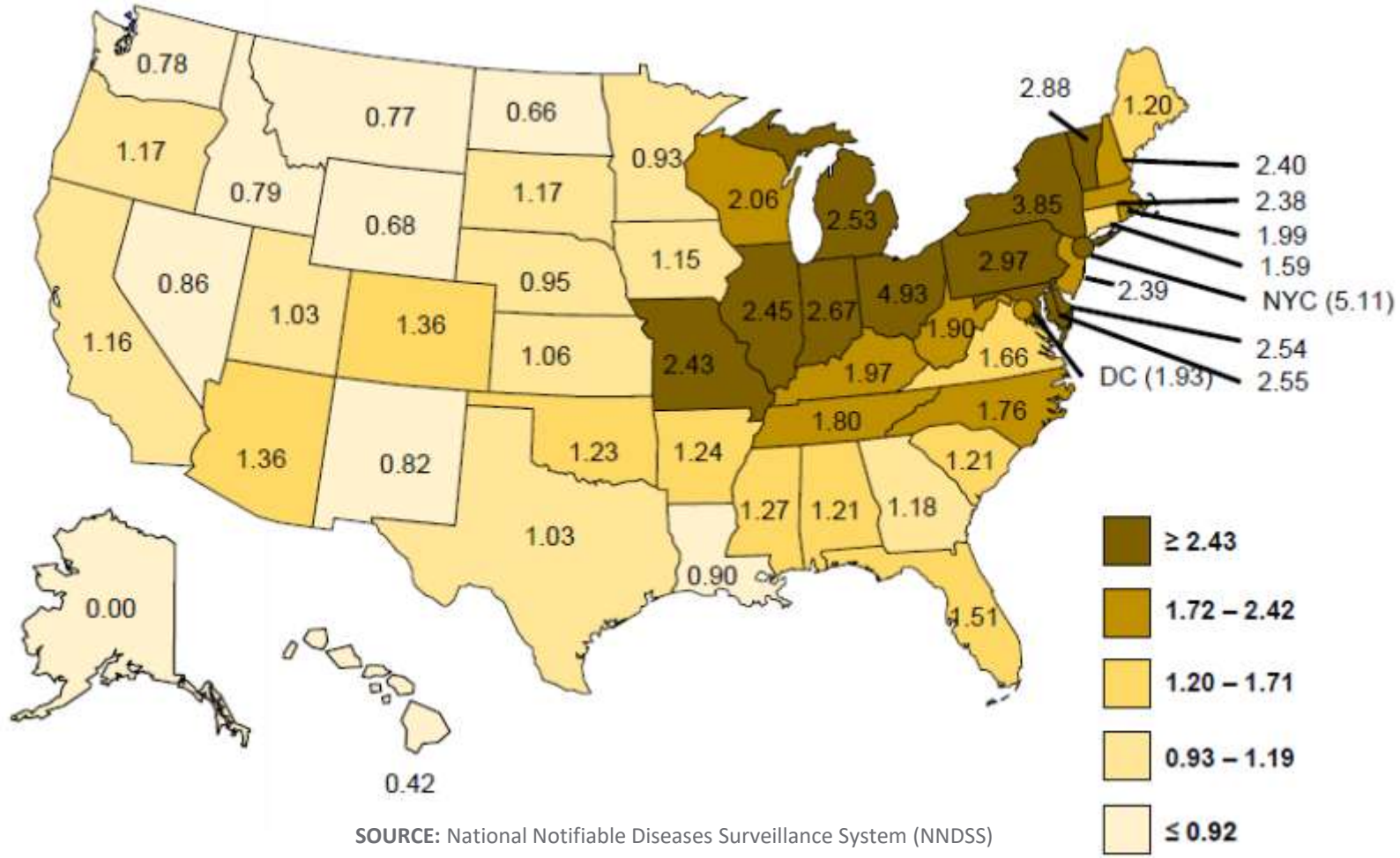
Rates of reported legionellosis cases by state / 100,000 population



SOURCE: National Notifiable Diseases Surveillance System (NNDSS)

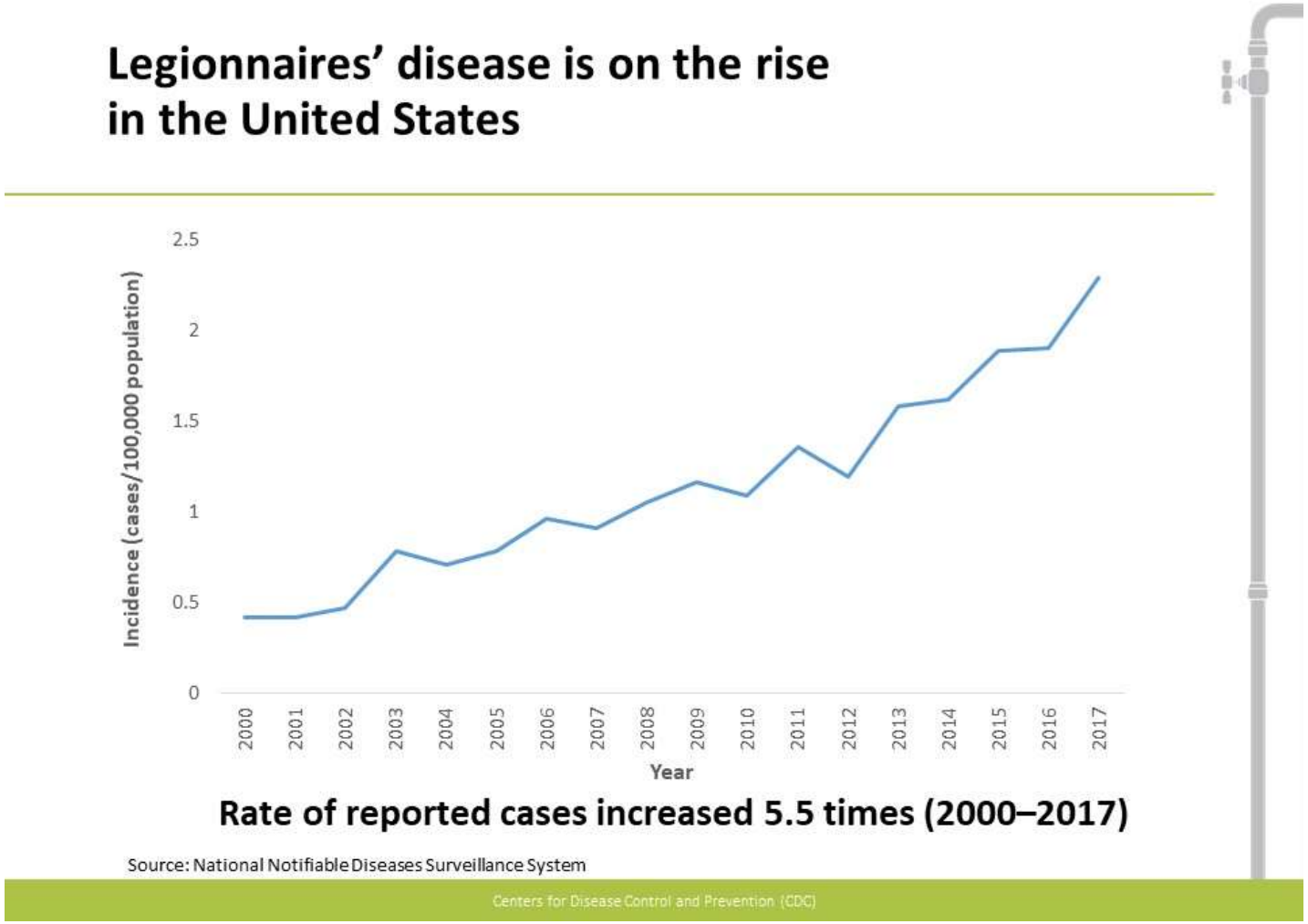
2015 CASES - INCREASE CONTINUES

Rates of reported legionellosis cases by state / 100,000 population



SOURCE: National Notifiable Diseases Surveillance System (NNDSS)

LEGIONNAIRES DISEASE IS ON THE RISE



Possible Reasons

- Urine antigen test
- Increased awareness, more testing
- Aging population, more immunocompromised people
- More engineered water systems
- Aging infrastructure
- Water-saving building modifications

WISCONSIN OUTBREAKS (2009-2017)

Outbreaks per State

Display: U.S. Map

Quick Stats - Current Filters

6	Outbreaks
24	Illnesses
19	Hospitalizations
0	Deaths

Quick Stats - Overall

46,024	Outbreaks
1,177,980	Illnesses
31,109	Hospitalizations
1,474	Deaths

Source: https://wwwn.cdc.gov/norsdashboard/

LEGIONELLA: OUTBREAKS

LINKING COOLING TOWERS AND PATIENTS BY DNA

- **Google Earth** quickly identifies all the Cooling Towers in a given geography
- **DNA fingerprinting** was used to match the *Legionella* strain found in the cooling tower of a hotel with the strain found in patients

Affected Area

OUTBREAK PATTERN FOUND

Opera House Hotel Cooling Tower

Patients (with *Legionella* DNA results)*

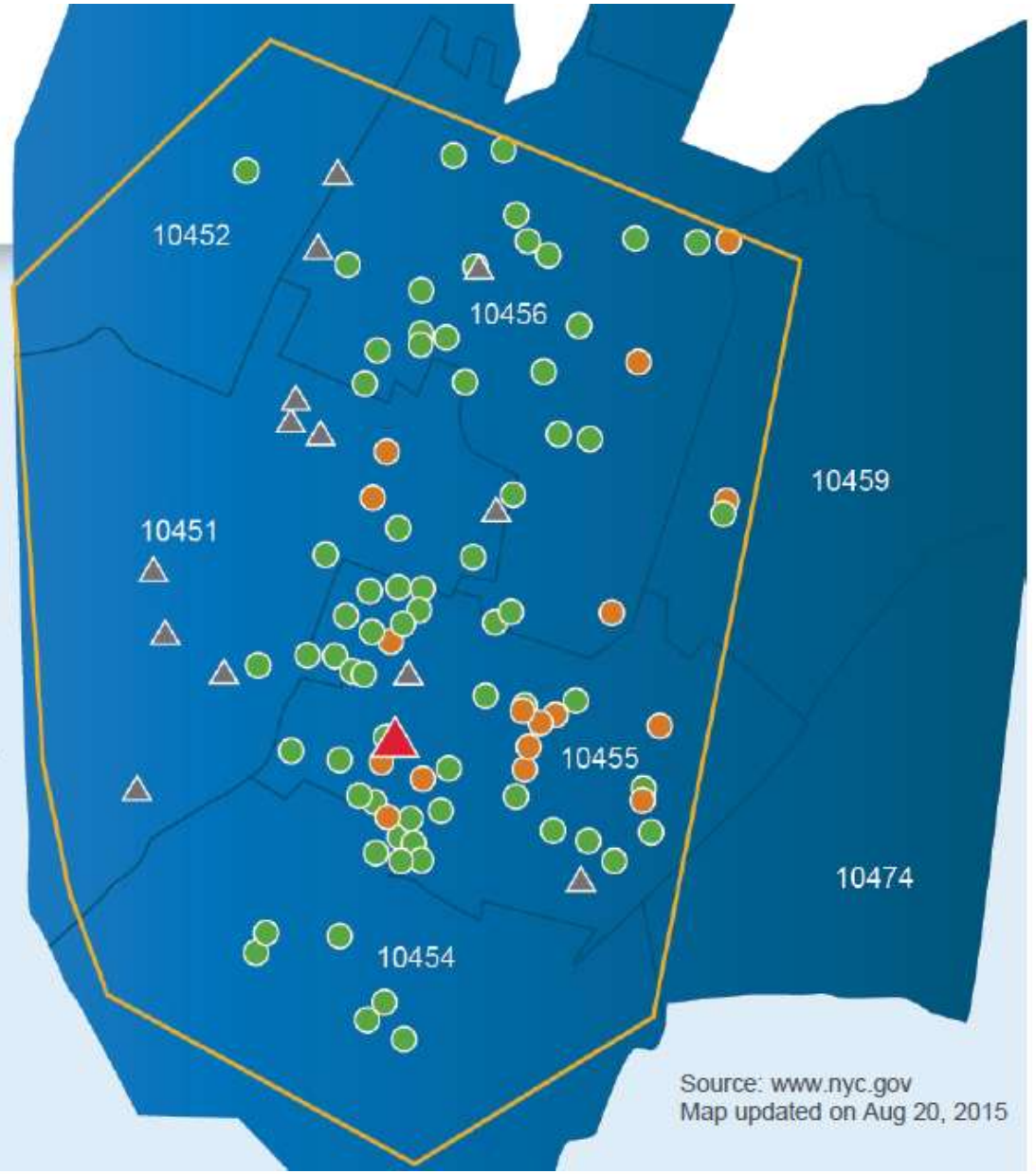
OUTBREAK PATTERN FOUND

Cooling Towers†

Patients (without *Legionella* DNA results)*

*As of last update, all patients results match the outbreak pattern.

†Includes all cooling towers in which the outbreak pattern could not be determined and whose with pending results.



Source: www.nyc.gov
Map updated on Aug 20, 2015

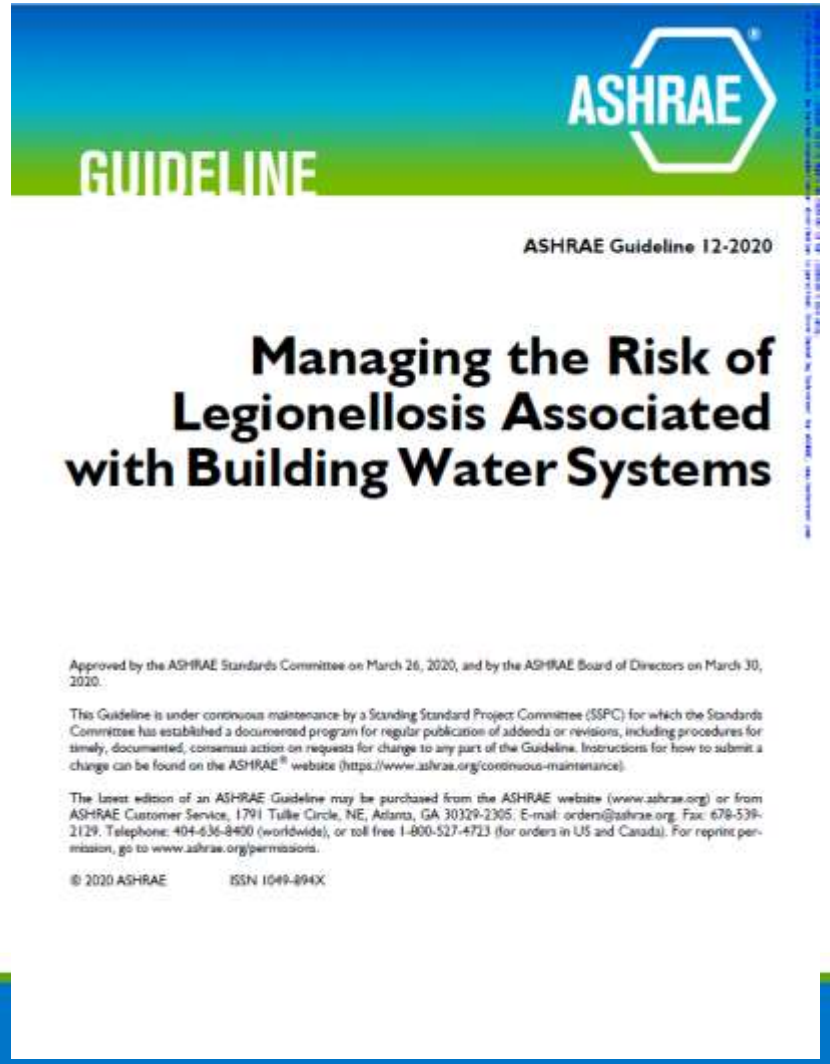
Key Market Events

- ASHRAE Guideline 12
- ASHRAE Standard 188
- Centers for Medicare/Medicaid Services Requirement
- Veterans Health Administrations Directive
- Vancouver, British Columbia Regulations

ASHRAE GUIDELINE 12-2020

AMERICAN SOCIETY OF HEATING, REFRIGERATING, AND AIR-CONDITIONING ENGINEERS

Provides information and guidance to assist in control of legionellosis associated with building water systems. It also provides guidance useful in the implementation of ASHRAE Standard 188.



ASHRAE STANDARD 188 – JUNE 2015

American Society of Heating, Refrigerating and Air-Conditioning Engineers

Mandates building owners and managers to establish a **water management program**

Applies to almost every type of human-occupied building

Intended for use by owners and managers of buildings

Intended for those involved in the construction, commissioning, maintenance, and service of building water systems

OTHER KEY MARKET EVENTS

VHA Directive 1061:2014

- Established policy for the prevention and control of healthcare-associated *Legionella* disease in VHA-owned building in which patients, residents, or visitors stay overnight.

Vancouver, British Columbia

- In May 2018, proposed legislation that would include annual operating permits for the operation and maintenance of cooling towers and decorative fountains.
- Future steps likely to include a risk-based Water Management Plan and ongoing monitoring and testing requirements.

CMS REQUIREMENT S&C 17-30

Centers for Medicare and Medicaid Services (CMS)

- Developed to prevent illness caused by *Legionella* and other opportunistic pathogens in water
- A facility must
  - ✓Conduct a Risk Assessment
  - ✓Implement a Water Management Program per ASHRAE Standard 188 & CDC Toolkit
  - ✓Define and specify testing protocols, control measures/limits & document specific actions

THE JOINT COMMISSION

Relevant Standards to Address Infection Prevention & Control

Standard	Definition
EC.01.01.01	Hospital has written plan for managing utility systems
EC.02.01.01	Organization manages safety & security risks
EC.02.05.01	Organization manages risks associated with utility systems
EC.02.05.05	Organization inspects, tests & maintains utility systems
IC.01.03.01	Organization identifies risks for acquiring & transmitting infections
IC.01.05.01	Organization has an infection prevention (IP) & control plan
IC.02.01.01	Organization implements its IP & control plan
IC.03.01.01	Organization evaluates effectiveness of its IP & control plan

THE JOINT COMMISSION

Demonstrating Compliance

FACILITY RISK ASSESSMENT

1

IDENTIFY WHERE BACTERIA COULD GROW & SPREAD

WATER MANAGEMENT PROGRAM

2

CONSIDER ASHRAE STD 188 & CDC TOOLKIT

DEFINED TESTING PROTOCOLS & ACCEPTABLE RANGES

3

RESULTS OF TESTING & CORRECTIVE ACTIONS

THE JOINT COMMISSION

Consistent Interpretation Focus

- Monthly column published by JC
- January 2020 – Consistent Interpretation focused on waterborne pathogens
- Elements of Performance were considered, not high rates of noncompliance

Consistent Interpretation

Joint Commission Surveyors' Observations Related to Waterborne Pathogens

The monthly **Consistent Interpretation** column is designed to support organizations in their efforts to comply with specific Joint Commission requirements. Each installment of the column draws from a database of surveyors' de-identified observations (in the column to the left) on an element of performance (EP)—as well as guidance from the Standards Interpretation Group on interpreting the observations (in the column to the right).

The requirements in this column are not necessarily those with high rates of noncompliance. Rather, they are EPs with the potential to negatively affect care or create risk if out of compliance. That is, they may appear in the upper right corner of a *Survey Analysis for Evaluating Risk*® (*SAFER*™) Matrix if cited on survey. Featured EPs apply to the hospital program; however, the guidance in this column may be extrapolated to apply to other accreditation programs with similar services and populations served.

Water can harbor and proliferate microorganisms that can lead to illness and even death. The US Centers for Disease Control and Prevention (CDC) estimates that 9 out of 10 health care–acquired cases of *Legionella* could have been prevented with implementation of a water management program.[1] The most common sources of *Legionella* are showers, cooling towers, decorative fountains, and hot tubs, but anything that can create droplets or aerosols could become a source. *Legionella* is not the only infection risk related to health care water systems and equipment. Twenty-two percent of consultations conducted by the CDC's Division of Healthcare Quality Promotion were water related.[2] Causes of patient infections were identified as preventable, had the health care organization properly used available information and implemented an effective water management plan.

This month, **Consistent Interpretation** emphasizes the need to ensure that all utility systems and components, as well as furnishings and equipment that use or contain water, are identified and maintained in a safe and effective way according to regulations, US Centers for Medicare & Medicaid Services (CMS), manufacturer's instructions, and evidence-based guidelines such as those promulgated by the CDC and ASHRAE.

Note: *Interpretations are subject to change to allow for unique and/or unforeseen circumstances.* P

References

1. Centers for Disease Control and Prevention. Vital Signs: Legionnaires' Disease. Jun 7, 2016. Accessed Dec 19, 2019. https://www.cdc.gov/vitalsigns/pdf/2016-06-vitalsigns.pdf.
2. Perkins, et al. Investigation of healthcare infection risks from water-related organisms: Summary of CDC consultations, 2014–2017. *Infect Control Hosp Epidemiol*. 2019 Jun;40(6):621–626.

DEPARTMENT OF SAFETY & PROFESSIONAL SERVICES

SPS 382.50 (3)(b)6

Hot water distribution systems (in hospital, community-based residential facility, inpatient hospice and nursing home water supply systems) shall be installed and maintained to provide bacterial control by one of the following methods:

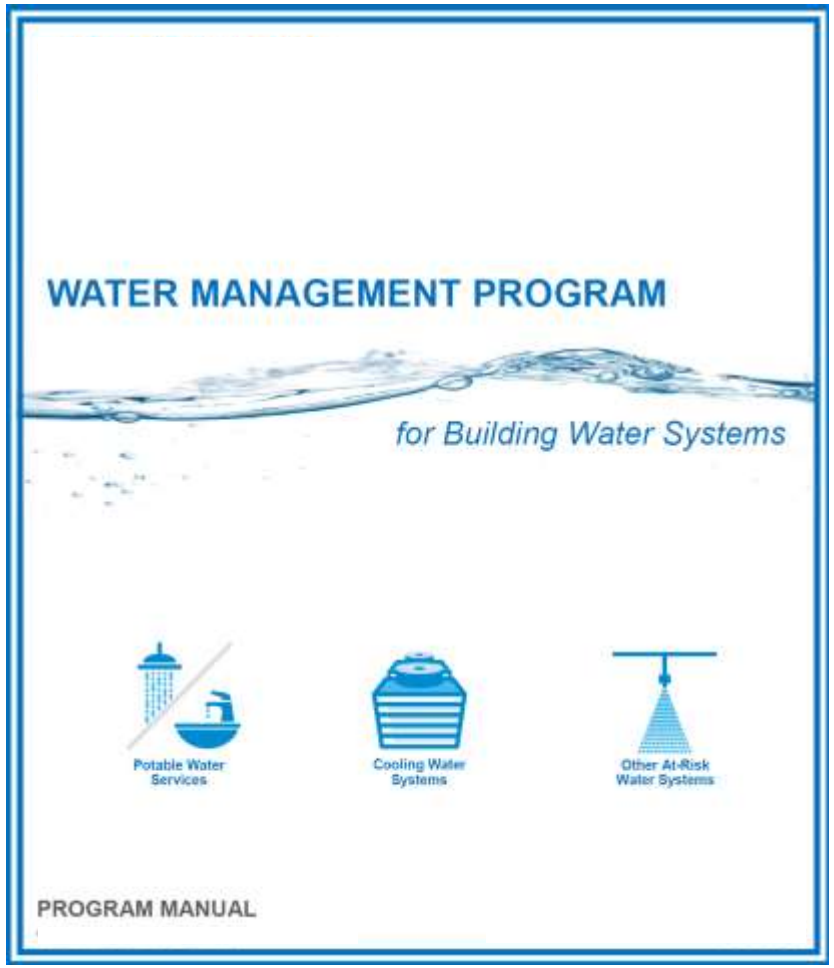
a) Water stored and circulation initiated at a minimum of 140°F and with a return of a minimum of 124°F.

b) Water chlorinated at 2 mg/L residual.

c) Another disinfection system approved by the department (such as maintaining a 0.5 mg/L chlorine residual).

WATER MANAGEMENT PROGRAMS

WATER MANAGEMENT PROGRAM



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Complete guide for the prevention and control of *Legionella* within building water systems.

ELEMENTS OF A WATER MANAGEMENT PROGRAM

Per ASHRAE Standard 188

1. Organize a Program Team
2. Describe Your Water Systems & Flow Diagrams
3. Analyze System Hazards
4. Define Control Measures & Monitoring Requirements
5. Define Action to Intervene When Limits are Not Met
6. Review & Confirm the Program
7. Document, Communicate & Adjust

Prevention vs. Response

All Too Often We Focus On Response!

Hat
$25

Shovel
$30

Jeans
$30

Helmet
$279

Mask $380

Cylinder
$6,500

Axe
$75

Gloves $150

Boots $450

Jacket
$1,800

GENERAL STRATEGY FOR POTABLE WATER

KEEP IT COLD

At or below
25°C (77°F)

This may not be feasible in warmer climates; hence disinfectant residual is critical

KEEP IT HOT

Store at or above
50°C (140°F)

Deliver up to the outlet at or above
49°C (120°F)

KEEP IT MOVING

Avoid stagnation and dead-legs

Flush vacant areas

Commission before beneficial occupancy

KEEP IT CLEAN

Inspect showerheads, outlets, storage tanks, etc. and clean & sanitize as necessary

Add supplemental disinfectants to maintain

KEY STRATEGIES TO REDUCE RISK

- Risk Management
- Pathogen Analytical
- Short Term Remediation
- Long Term Control Strategies

WATER MANAGEMENT PROGRAM

Risk Management

TEMPERATURE & OXIDANT PROFILING

How Water Moves Once It Enters Your System

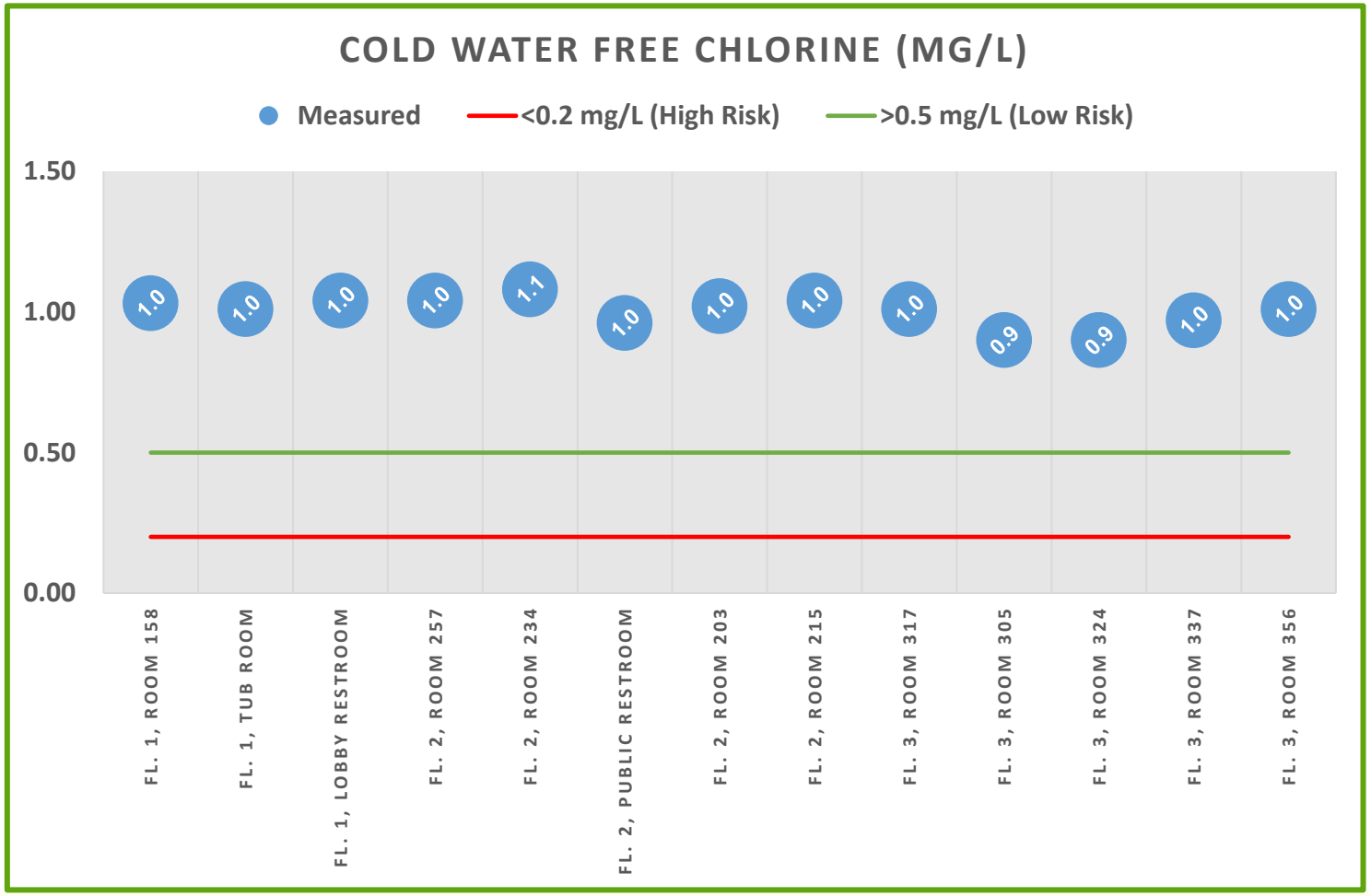
- Highlight areas of stagnation and low-use
- Identify cross connections between hot and cold water systems

PROCESS:

- Temperature and Chlorine levels are recorded throughout the entire facility
- Results are plotted on a graph
- Compare systems, buildings, floors, risers, loops to find trends and help identify areas that may be of concern

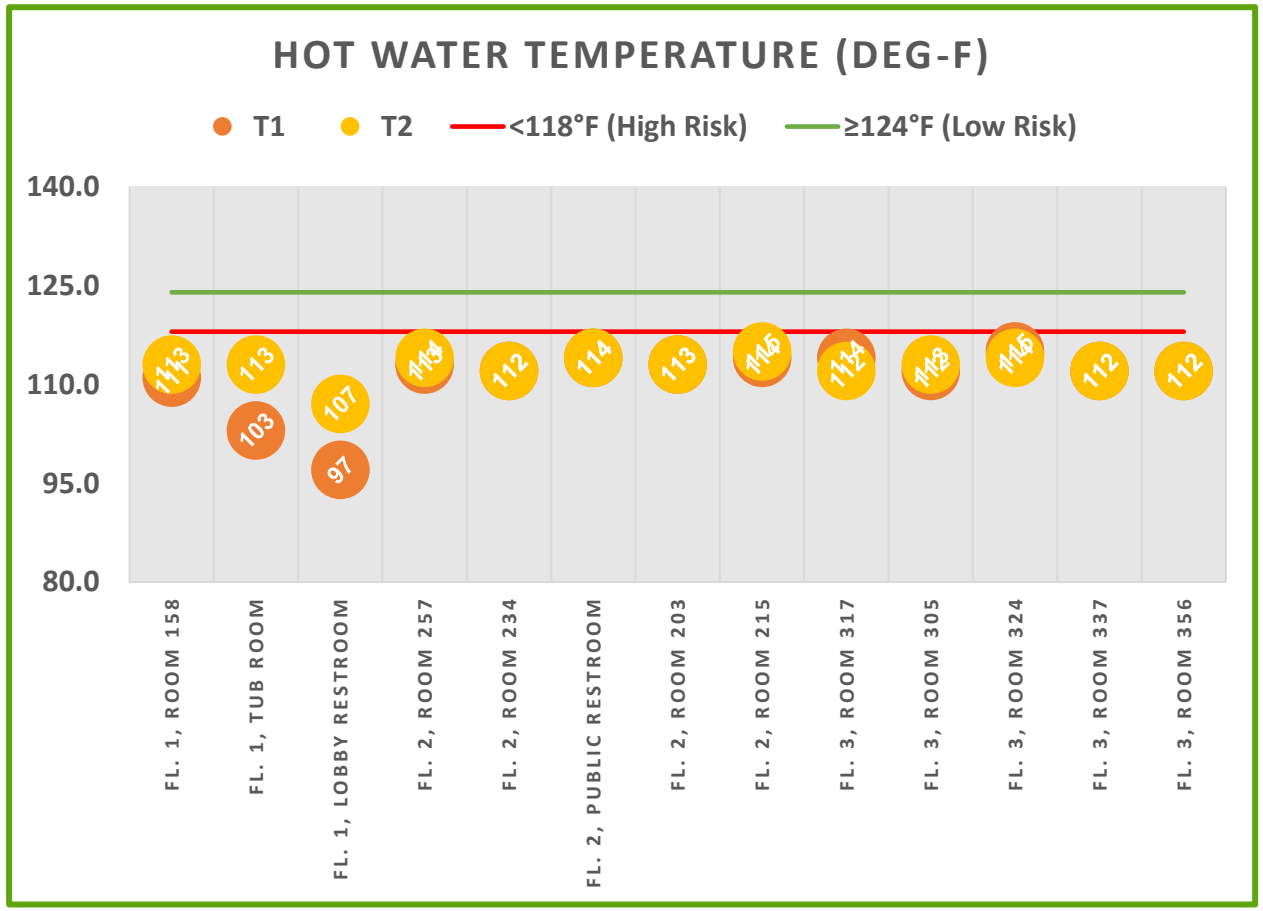
INVESTIGATING SYSTEM PROFILES

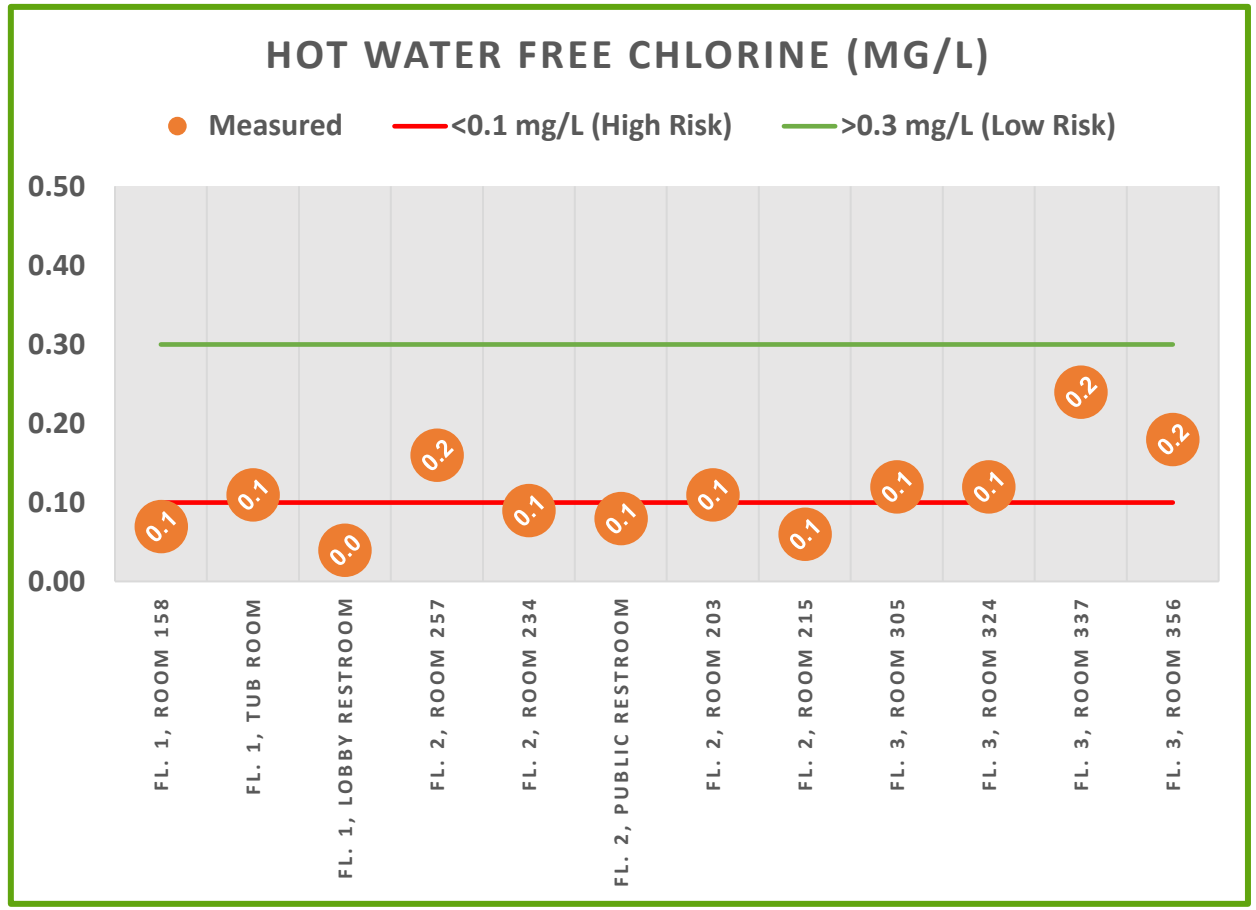
Real-Life Example



INVESTIGATING SYSTEM PROFILES

Real-Life Examples



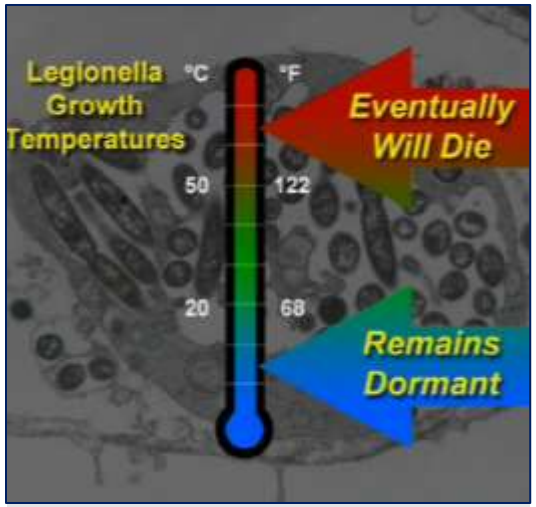


WATER MANAGEMENT PROGRAM

Pathogen Analytical

- Testing plans are a method to validate the Water Management Program is working to control the hazard
- Proactive measure to
  - Identify potential sources of growth
  - Confirm efficacy of remedial procedures
  - Manage and reduce risk

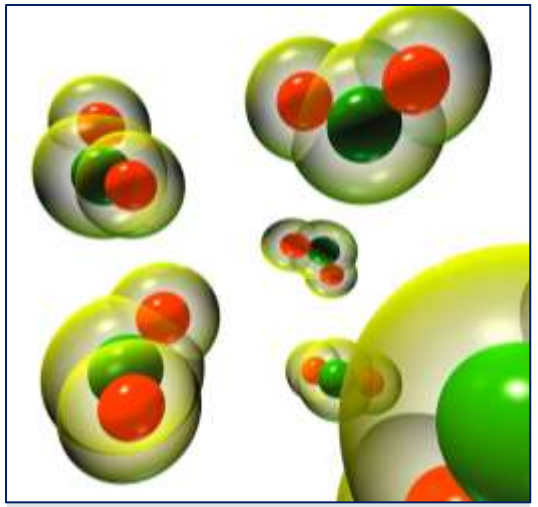
CONFIRM YOUR POTABLE WATER STRATEGY



TEMPERATURE

Water Heaters (Storage, Supply, Return, Mixed)

Points-of-Use (Outlets) at locations near and distal from source



DISINFECTANT

Points-of-Use (Outlets) at locations near and distal from source

At the point-of-injection if applying a supplemental disinfectant (Per SDWA)

LEGIONELLA

Points-of-Use (Outlets) at locations near and distal from source

DOCUMENTATION

The evidence to…

validate the Program controls hazardous conditions

verify the Program is followed as designed

TYPES OF ENVIRONMENTAL SAMPLING

CULTURE TEST ISO 11731

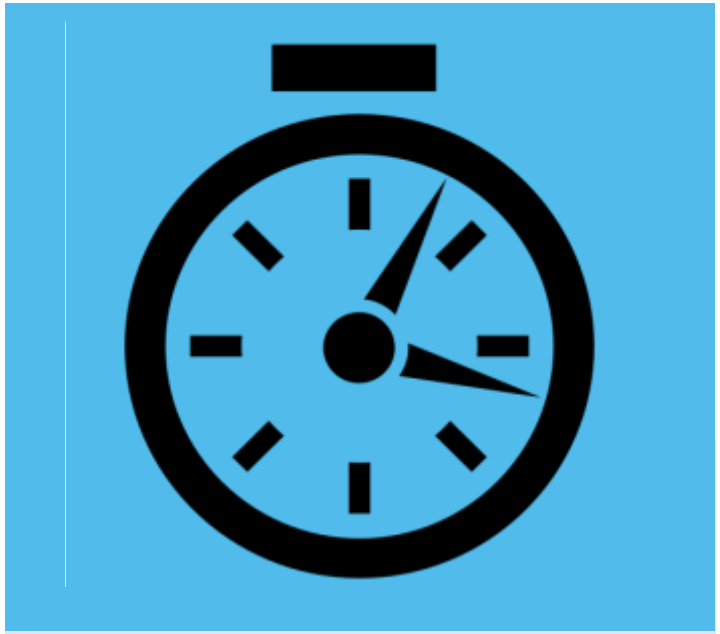
Industry accepted

“Gold Standard”

qPCR

(QUANTITATIVE POLYMERASE CHAIN REACTION)

Rapid method used to detect & quantitate bacteria, used as a positive or negative screen



OTHER RAPID METHODS

Emerging methods that may have limitations to detect low levels and limited to one or a few species.

WATER MANAGEMENT PROGRAM

Short-Term Remediation Strategies

- Contingencies to regain control
- Reactionary measures - Does not resolve root cause!

Remedial Cleaning & Disinfection

Outlet Flushing

Hyper-chlorination

Thermal Disinfection

Point-of-Use Water Filters

WATER MANAGEMENT PROGRAM

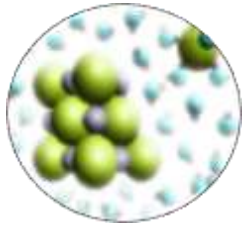
Long-Term Control Strategies

- Supplemental Disinfection

Chlorine Dioxide

Chlorine

Chloramine



Cu-Ag Ions

- Point-of-Use Filters

SUPPLEMENTAL DISINFECTION STRATEGIES

CHLORINE DIOXIDE

- EPA approved
- On-site generation using sodium chlorite + chlorine + acid
- On-site generation from sodium chlorite

CHLORINE

- EPA approved
- Liquid Chlorine
- On-site generation (higher stability)

CHLORAMINE

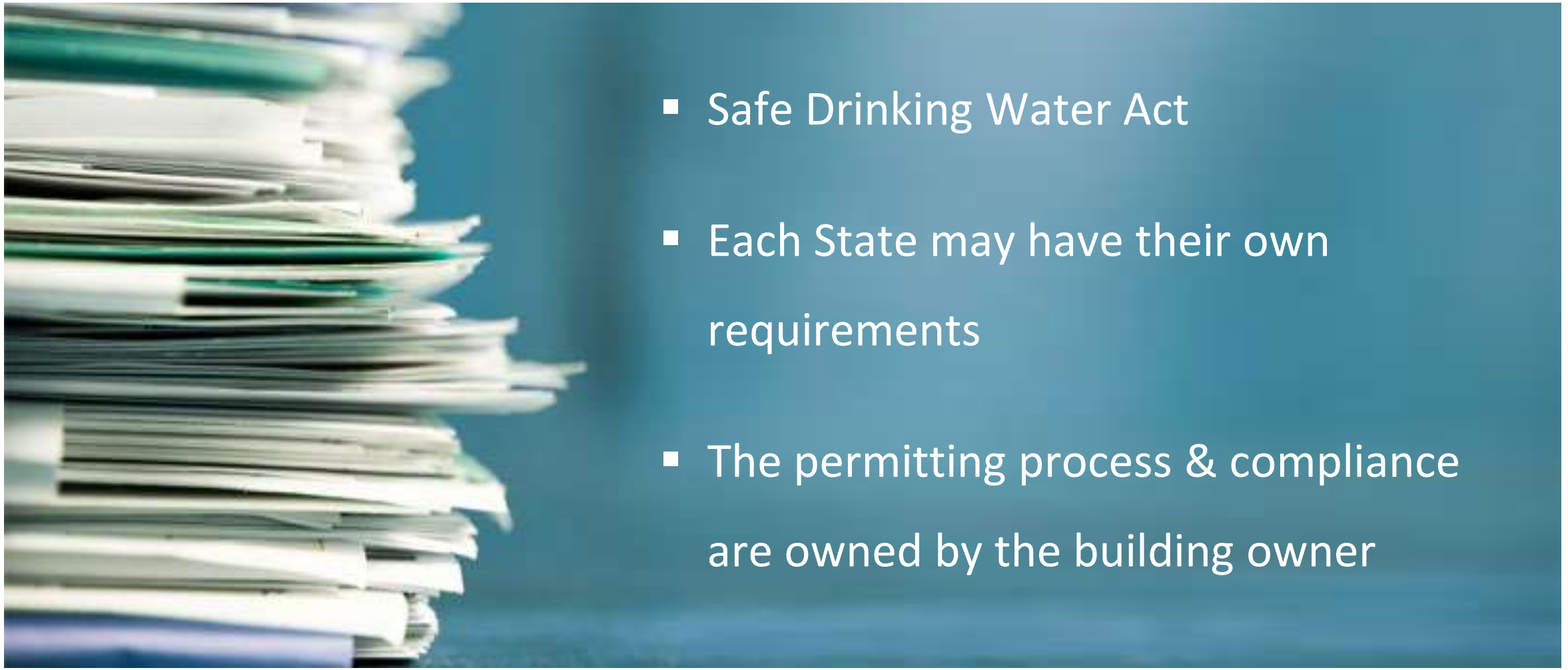
- EPA approved
- On-site generation using liquid chlorine + liquid ammonia

COPPER-SILVER

- Regulated as a contaminate by US-EPA under FIFRA*
- Cu-Ag ions from Cu-Ag electrodes

* Federal Insecticide, Fungicide, & Rodenticide Act

SUPPLEMENTAL DISINFECTION COMPLIANCE



- Safe Drinking Water Act
- Each State may have their own requirements
- The permitting process & compliance are owned by the building owner

WISCONSIN DSPS REQUIREMENTS

Department of Safety & Professional Services

- Any modifications to the plumbing systems shall have plumbing plan review and approval from the Wisconsin DSPS
- Any bacterial control system that is injecting a chemical into the water distribution system shall have plumbing plan review and approval from the Wisconsin DSPS

WISCONSIN DSPS MONITORING

Monitoring Requirements vary upon treatment method being used

CHLORINE

1

- Daily free chlorine residual nearest injection point
- Daily free chlorine residual furthest injection point
- Daily pH
- Quarterly disinfection by-products (THM, HAAs)

CHLORINE DIOXIDE

2

- Daily sample nearest injection point for chlorine dioxide and chlorite
- Daily sample furthest injection point for chlorine dioxide and chlorite
- Monthly additional sample of chlorine dioxide and chlorite

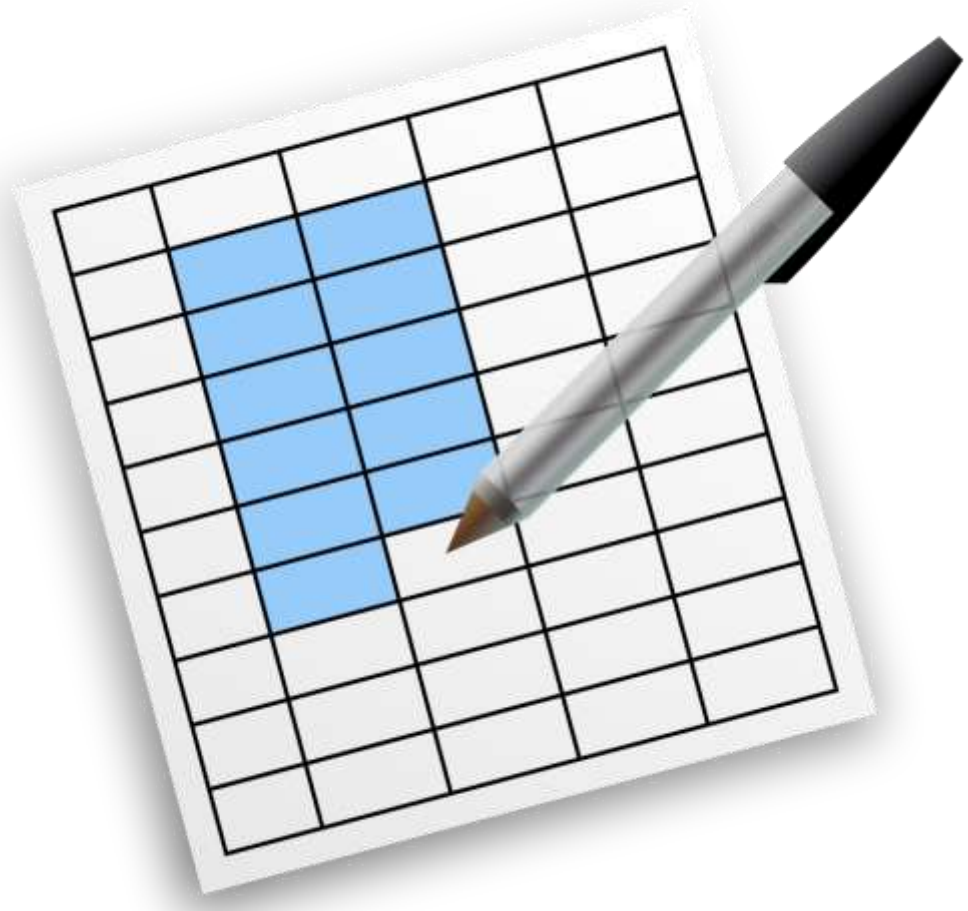
COPPER SILVER

3

- Residual Copper must be ≥0.88 mg/L and < 1.3 mg/L
- Residual Silver must be ≥0.50 g/L and < 100 µg/L
- Residuals must be maintained on ongoing basis to achieve bacterial reduction performance
- Weekly evaluation by manufacturer
- Weekly Copper testing after commissioning

ROUTINE MONITORING DATA

- Temperature Logs
- Chlorine Residuals
- Outlet Flushing Logs
- Emergency Eye Wash/Shower Flushing Logs
- *Legionella* Sampling



DIGITAL TRENDING OF DATA

- Timely and relevant data
- Enables complete visibility into system
- Identify system upsets
- Powerful tool to identify asset failures or design improvements

PROGRAM REVIEW MEETINGS

- Management Team reviews routine monitoring data and *Legionella* test results
- Discuss data results and any necessary actions that have been, or need to be taken
- Document any necessary changes for the Water Management Program

IN SUMMARY…

- *Legionella* poses a health risk within building water systems
- Having an effective Water Management Program is essential
- Strategies exist to mitigate the risk
- Working together is key!

SUPPORT WHEN YOU NEED IT

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