



## **Strategies to Combat Legionnaires' Disease: Preventive Policy** NCCEH Environmental Health Seminar Series

Phillip White & Christopher Radziminski | February 20, 2020



By **Antonia Zerbisias** Special to the Star  
Fri., Feb. 21, 2014 | 2 min. read

135 cases, 23 fatalities

In this 2005 file photo, medical workers at Rouge Valley Centenary Hospital treat a patient from Seven Oaks Home for the Aged, where there was an outbreak of legionnaires disease. **RON BULL / TORONTO STAR FILE PHOTO**



Source: [thestar.com/news/gta/2014/02/21/seven\\_oaks\\_home\\_for\\_the\\_aged\\_class\\_action\\_suit\\_reaches\\_12\\_million\\_settlement.html](http://thestar.com/news/gta/2014/02/21/seven_oaks_home_for_the_aged_class_action_suit_reaches_12_million_settlement.html)

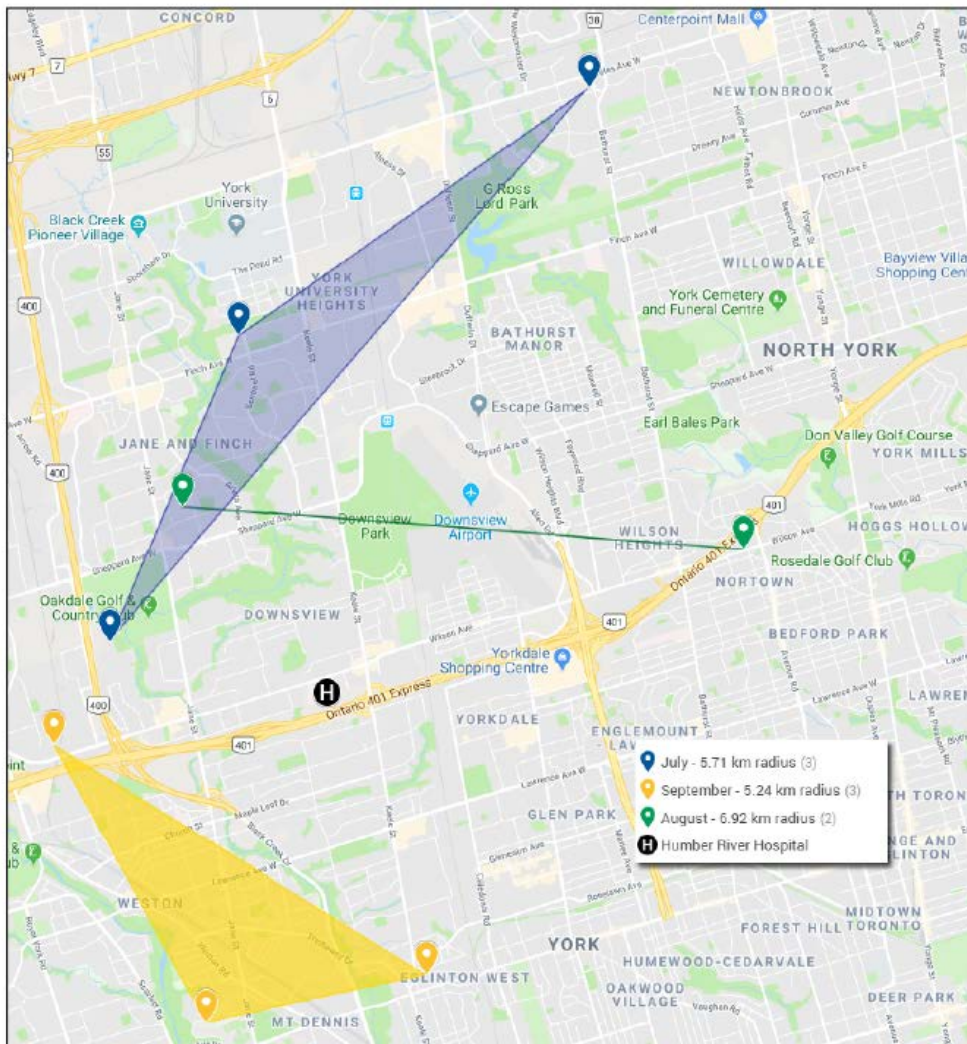


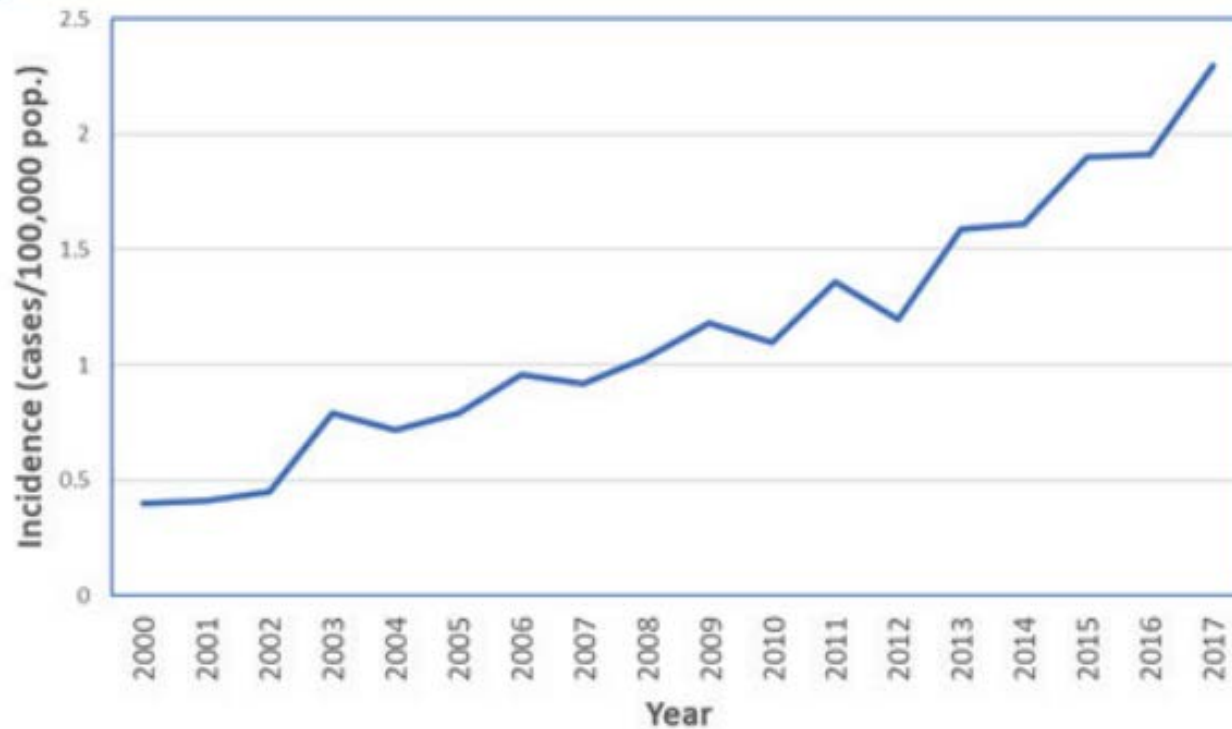
Figure 1. Legionnaires' disease outbreaks in North York, ON in summer, 2018. Colored pins represent the patients' residential addresses.

“... **at least three outbreaks** occurred in North York, ON in the summer of 2018.”

“Out of 33 patients tested, 9 (**28%**) were positive for *Legionella*.”

“... we believe that ... **testing of all summertime cases of pneumonia** for Legionellosis will significantly benefit community health.”

Spiegelman *et al.* (2020)  
*Int J Environ Res Public Health*  
**17: 332**



The report's authoring committee estimates that the number of persons with Legionnaires' disease in the United States ranges from **52,000 to 70,000** each year (or a rate of 20.5 to 27.4/100,000). This estimate is felt to be conservative

# Officials scrambling to pinpoint source of legionnaires' disease outbreak in Orillia

10 cases, 1 fatality

Health unit officials say focus on search for source is on downtown Orillia; All eight patients are over 50 and 'some are quite severely ill'

Oct 11, 2019 1:30 PM By: [Dave Dawson](#)



Source: [orilliamatters.com/local-news/officials-scrambling-to-pinpoint-source-of-legionnaires-disease-outbreak-in-orillia-1743716](https://orilliamatters.com/local-news/officials-scrambling-to-pinpoint-source-of-legionnaires-disease-outbreak-in-orillia-1743716)

## Moncton calls for cooling tower regulations after legionnaires' outbreak



16 cases, 15 hospitalisations

Mayor Dawn Arnold says new rules should apply across the province



[Shane Magee](#) · CBC News · Posted: Nov 08, 2019 1:53 PM AT | Last Updated: November 8, 2019



Moncton Mayor Dawn Arnold has called for the province to implement a cooling tower registry. (Pierre Fournier/CBC News)

# Cooling Towers

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- “Cooling towers were implicated or suspected in ... **60% outbreak-associated deaths** ...” (2006-2017)  
Hamilton *et al.* (2018) *Curr Environ Health Rep* **5**: 263-271
- “... relative risk of community acquired, non-travel, non-outbreak LD was **over 3.0** in people living within 0.5 km of a cooling tower compared with people living more than 1 km away.” (Glasgow 1978-1986)  
Bhopal *et al.* (1991) *BMJ* **302**: 378-383
- “... residential proximity to a [wet cooling system] may account for **19.6%** of sporadic community-acquired cases.” (England & Wales 1996-2006)  
Ricketts *et al.* (2012) *J Epidemiol Community Health* **66**: 618-623
- “... LD dispersed from cooling towers ... can be found to extend up to **12 km.**”  
White *et al.* (2013) *Epidemiol Infect* **141**: 789-799
- “Our findings ... suggest that decontaminated [cooling towers] ... can be **potentially recolonised** by contaminated aerosols from other [cooling towers].”  
Wüthrich *et al.* (2019) *Euro Surveill* **24**(4)



Source: Bolld Real Estate Management, [bolldpm.com/properties/river-district-1103-3557-sawmill-crescent-vancouver-bc/111](https://bolldpm.com/properties/river-district-1103-3557-sawmill-crescent-vancouver-bc/111)



Source: Google Earth



Source: City of Vancouver





Source: Google Street View



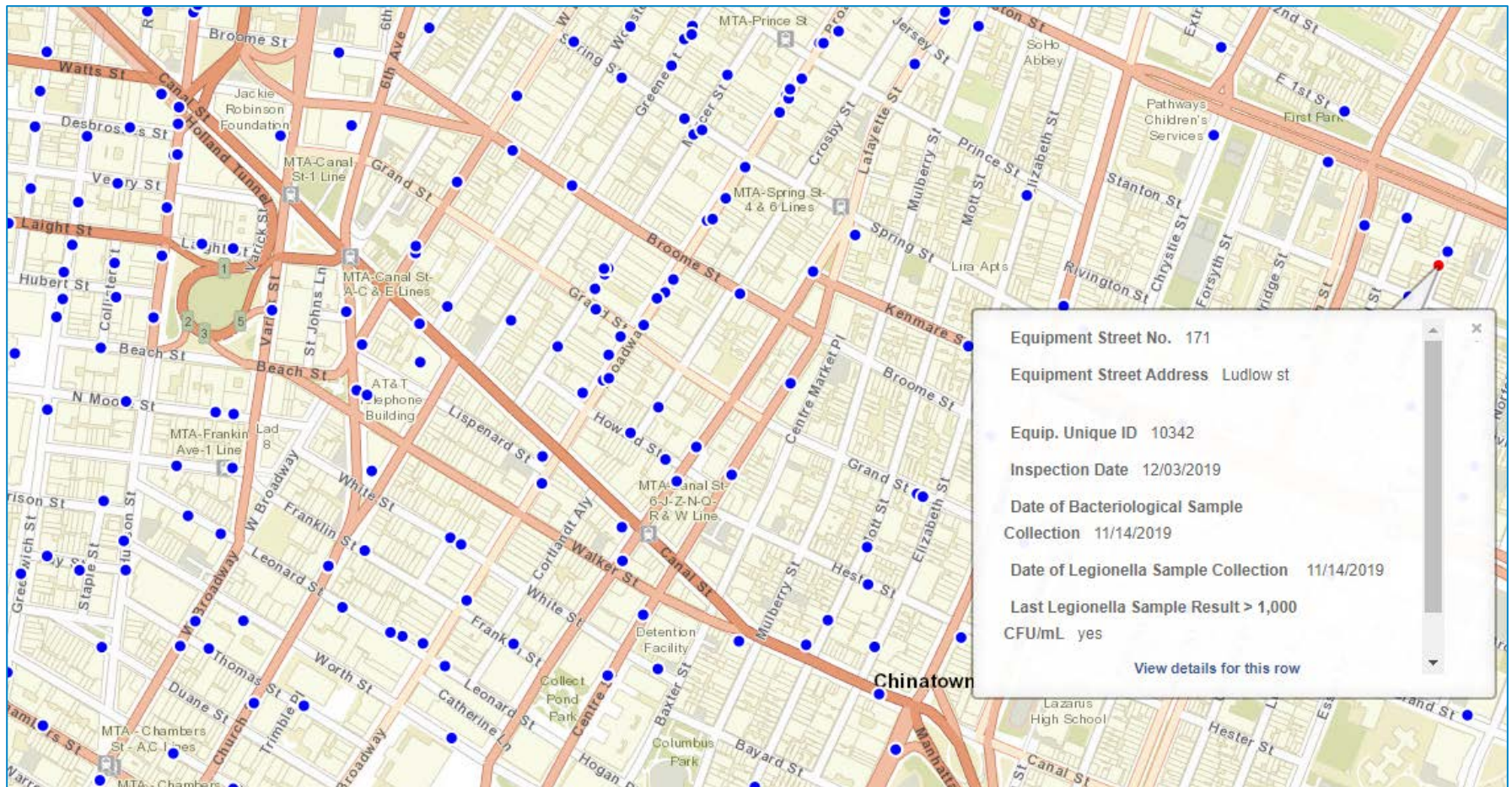
Source: Google Street View



Source: City of Vancouver

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## Registered Cooling Tower Map



Source: [health.data.ny.gov/Health/Registered-Cooling-Tower-Map/unmf-baqa](https://health.data.ny.gov/Health/Registered-Cooling-Tower-Map/unmf-baqa)

# Operating Permits

## 1 OPERATING PERMIT

Reference Section of Pool Regulation: *Section 6*

All pools in British Columbia that fall under the Pool Regulation must have a valid operating permit issued by the health authority. The regulation requires that an operating permit be posted in a prominent place on the premises



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## Elevating Devices Operating Permits

All active elevating devices (elevators, material lifts, dumbwaiters, LULAs, escalators and moving walks) must have an operating permit. It is the responsibility of the building owner to obtain an operating permit and renew it each year.

# Cooling Towers

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As of **January 1, 2020**, all new & existing cooling towers and evaporative condensers require an *operating permit*.

- [vancouver.ca/operating-permit](https://vancouver.ca/operating-permit)
- Published on the public VanMap (GIS-based).
- *Chief Building Official* to be notified within 30 days of changes.

# Third Person Dead From Legionnaires' Outbreak in Chicago Hotel

Officials tie outbreak to main fountain in lobby of JW Marriott hotel

Published Aug 31, 2012 at 5:46 PM | Updated at 8:41 PM CDT on Sep 1, 2012



114 cases, 3 fatalities

# Design

Office of Facilities Planning  
Department of Veterans Affairs

Facilities Standards Service  
Office of Construction & Facilities Management

CFM

## INDOOR WATER FEATURES, DECORATIVE FOUNTAINS: RECOMMEND NON - USE

### ISSUE:

Incidents of healthcare-associated infection by *Legionella* bacteria, the causative agent of Legionnaires' disease, have been linked to contaminated interior water features. Patients, visitors, and staff who are immunocompromised are particularly vulnerable and, if infected, can have a high mortality rate <sup>(1,2,3,4,5)</sup>.

### DISCUSSION:

Recently published articles highlight the risk of indoor water features in healthcare facilities. In one report, an indoor water feature in the lobby of a mid-west US hospital was linked to 8 cases of Legionnaires' disease; none of the 8 cases were inpatients at the facility at the time of exposure and some were visitors that likely just passed by the water feature on their way through the lobby <sup>(2,4,6)</sup>. In another report, 2 immunocompromised inpatients developed Legionnaires' disease after exposure to a contaminated water feature in a radiation oncology suite <sup>(1,8)</sup>. The fountain had been shut down for 5 months and then operational for 4 months prior to the disease cluster. In both situations, routine maintenance, cleaning and disinfection procedures did not prevent *Legionella* contamination or growth.

### CONCLUSION:

Indoor fountains and other water features present a risk in healthcare facilities <sup>(1,4,6)</sup> and should not be included in new VA healthcare interior design solutions. Where these features are currently installed, adaptive reuse of the space for another form of positive healing environment reinforcement should be considered.

### ACKNOWLEDGEMENTS:

This Design Alert was developed by a mutual collaborative effort which included the following Participants:

- CFM-Office of Facilities Planning,-Facilities Standards Service
- National Infectious Diseases Service (NIDS).
- National Center for Patient Safety

### FOR ADDITIONAL INFORMATION:

Contact Zoltan John Nagy, AIA-NCARB-AAH, Facilities Standards Service at [Zoltan.Nagy@va.gov](mailto:Zoltan.Nagy@va.gov).

(continued)

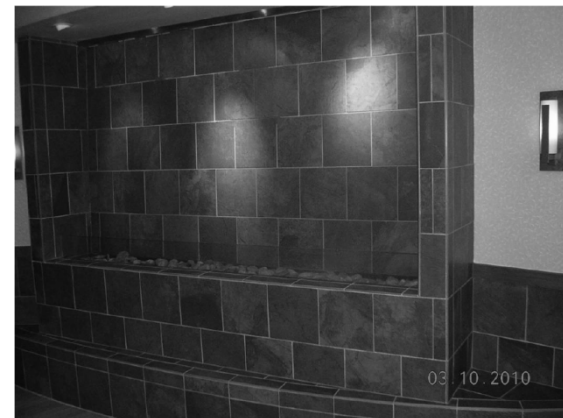
April 19, 2012  
003C2B-DA-138



O'Loughlin *et al.* (2007)

*BMC Infect Dis* 7: 93

18 cases



Haupt *et al.* (2012)

*Infect Control Hosp Epidemiol* 33: 185

8 cases

# Decorative Features

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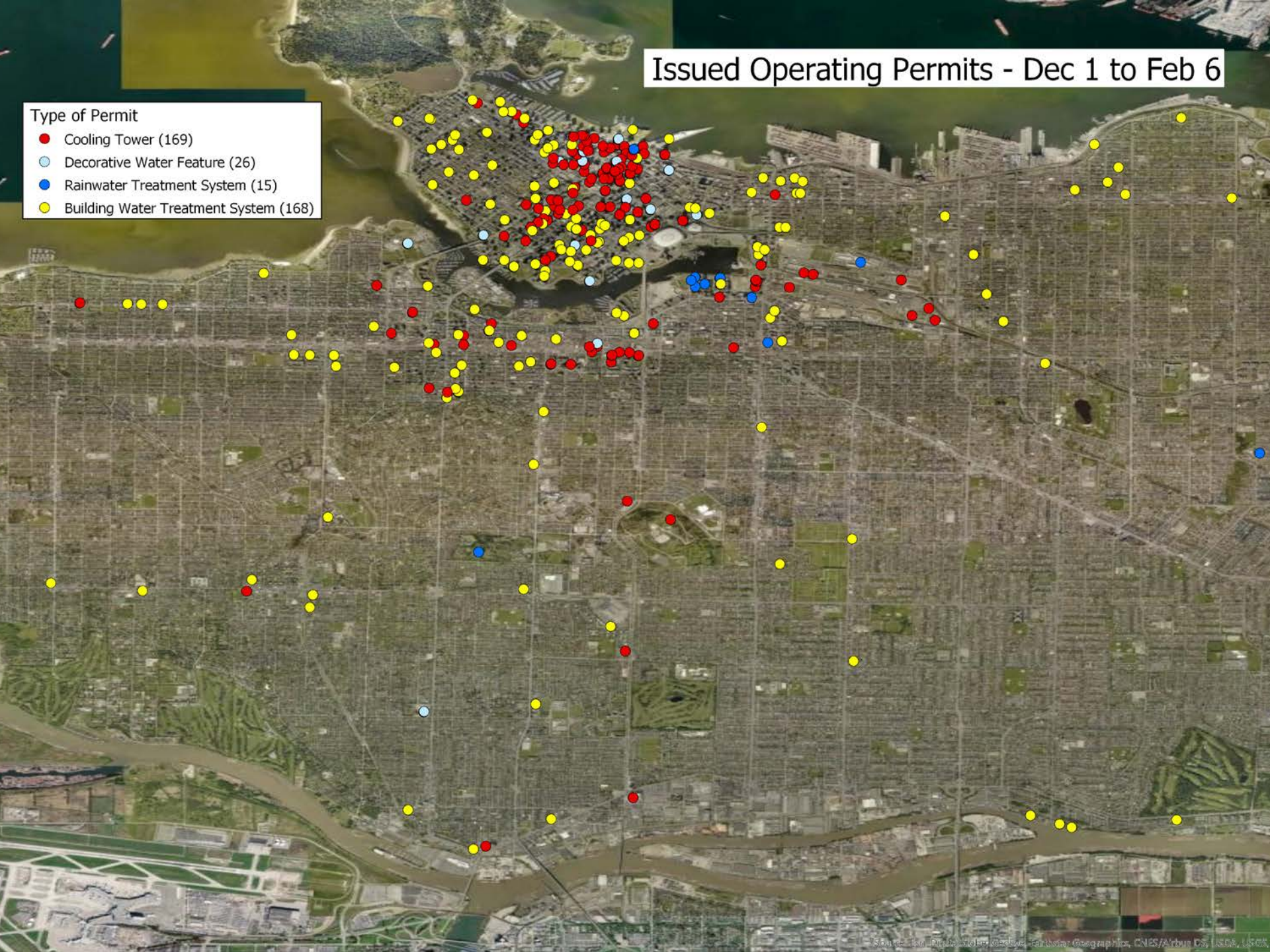
As of **July 1, 2020**, all new & existing decorative water features require an *operating permit*.

- [vancouver.ca/operating-permit](https://vancouver.ca/operating-permit)
- **Includes:** indoor and outdoor features.
- *Chief Building Official* to be notified within 30 days of changes.
- **Exempt:** single/dual family homes, triplexes, fourplexes.

## Issued Operating Permits - Dec 1 to Feb 6

## Type of Permit

- Cooling Tower (169)
- Decorative Water Feature (26)
- Rainwater Treatment System (15)
- Building Water Treatment System (168)



Mail 12:34 PM  
linkedin.com


Search

**Damian Stathonikos, CAE**  
President at BOMA BC  
4d

An important reminder -- our members are happy to work with the [City of Vancouver](#) to protect public safety and prevent public health outbreaks such as Legionella.

**BOMA BC**  
869 followers

DYK: As of Jan 1, 2020, you need to register any cooling towers or water treatment systems with the City of Vancouver and apply fo ...more

 **CITY OF VANCOUVER**

**VANCOUVER**

**Member Enews**  
Information for members to be in the know

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VANCOUVER  
FESTIVAL**



**CITY OF VANCOUVER NEW OPERATING PERMITS REQUIRED**

As of January 1, 2020, requirements are in effect to register cooling towers, building water treatment systems, and rainwater harvesting systems. This requirement will also apply to decorative water features as of July 1, 2020.

[Permit Information](#)



Dr. Patrick Breyse of the U.S. Centers for Disease Control and Prevention (CDC) delivers the keynote address at Legionella Conference 2019. Photo credit: NSF International

Nationally, water management programs are being implemented but aren't yet widespread, according to Dr. Breyse, who added promising developments include the:

- Centers for Medicare & Medicaid Services June 2017 memo requiring water management plans in hospitals and long-term care facilities
- Cooling tower registry and regulation in New York City and throughout New York state, as well as the potable water regulations in health care facilities in New York state
- Cooling tower and decorative fountain registry in Vancouver, Canada

Source: [globenewswire.com/news-release/2019/09/30/1922654/0/en/Legionella-Conference-2019-Water-Management-Programs-Policies-Communication-and-Regulation-Needed-to-Stem-Spread-of-Legionnaires-Disease.html](https://globenewswire.com/news-release/2019/09/30/1922654/0/en/Legionella-Conference-2019-Water-Management-Programs-Policies-Communication-and-Regulation-Needed-to-Stem-Spread-of-Legionnaires-Disease.html).

# Cooling Towers

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New York City Council  
Transcript



## Alliance to Prevent Legionnaires' Disease

Alliance to Prevent Legionnaires' Disease, Inc.  
1200 G Street NW, Suite 800 | Washington, DC 20005  
[preventlegionnaires.org](http://preventlegionnaires.org) | 1-202-434-8757

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Chairperson  
Levine: I do think it would be fair to establish the name of your entity  
The Alliance to Prevent Legionnaires' Disease. I mean, you  
**definitely are not looking to focus on cooling towers**, right?  
(p. 93)

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Chairperson  
Levine: I understand but I think it's important to know that  
the **cooling tower industry is largely behind this**  
and we don't minimize

Daryn Cline: **Fair enough**, we're the experts in the field.  
(p. 94)

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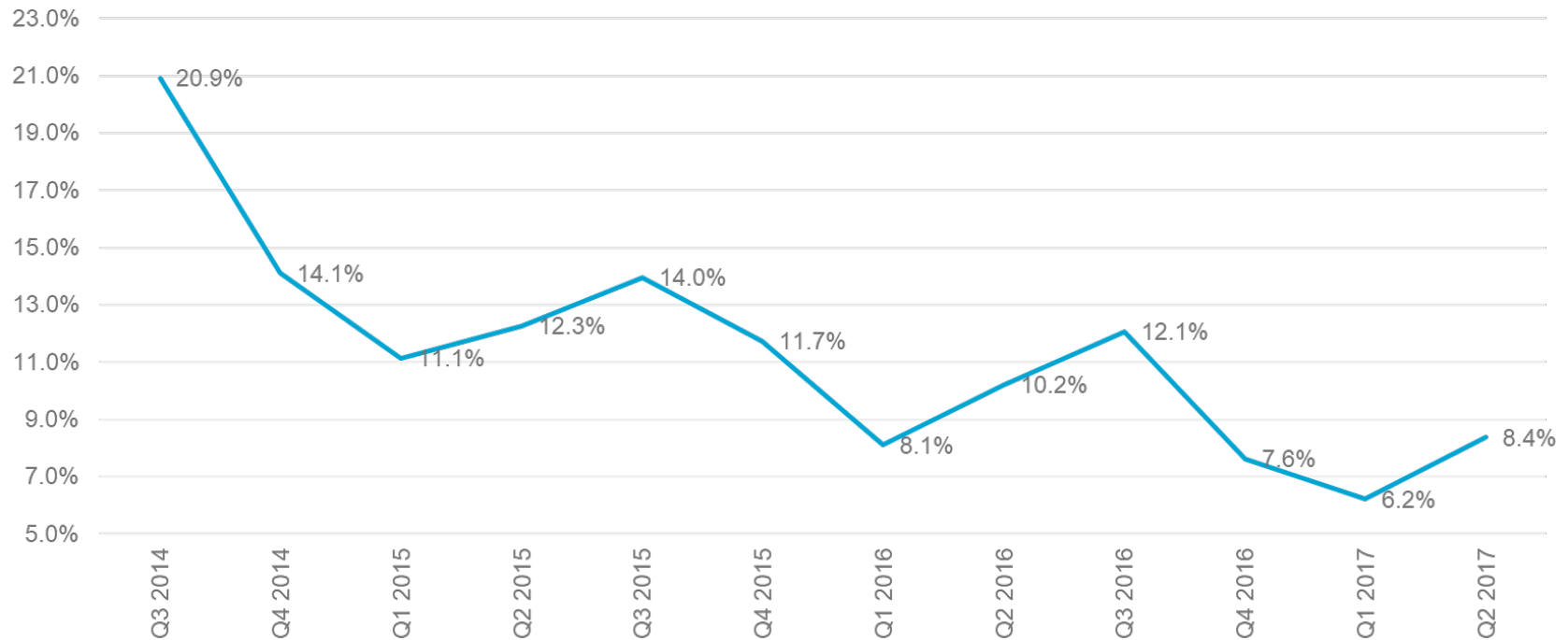
# Proposals for January 1, 2021

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- **Require** a one year maintenance contracts for new cooling towers.
- **Require** on site maintenance logs.
- **Require** a new Building Water System Operator certification (Environmental Operators Certification Program).
  - Launching fall 2020
  - 2 day course (water quality, sampling, treatment)
  - EOCP exam
  - Ongoing continuing education requirement
- **Require** *Legionella pneumophila* testing and reporting.
  - Monthly for cooling towers.
  - Every two months for decorative water features.
  - Prescribed corrective actions  
(based on the federal MD-15161 standard).

## *Legionella pneumophila* (SG 1-14) Results > 10 CFU / mL



“[t]he authors assert that one of the **key driving forces to the improvement** ... was the mandate to sample for *Legionella*.

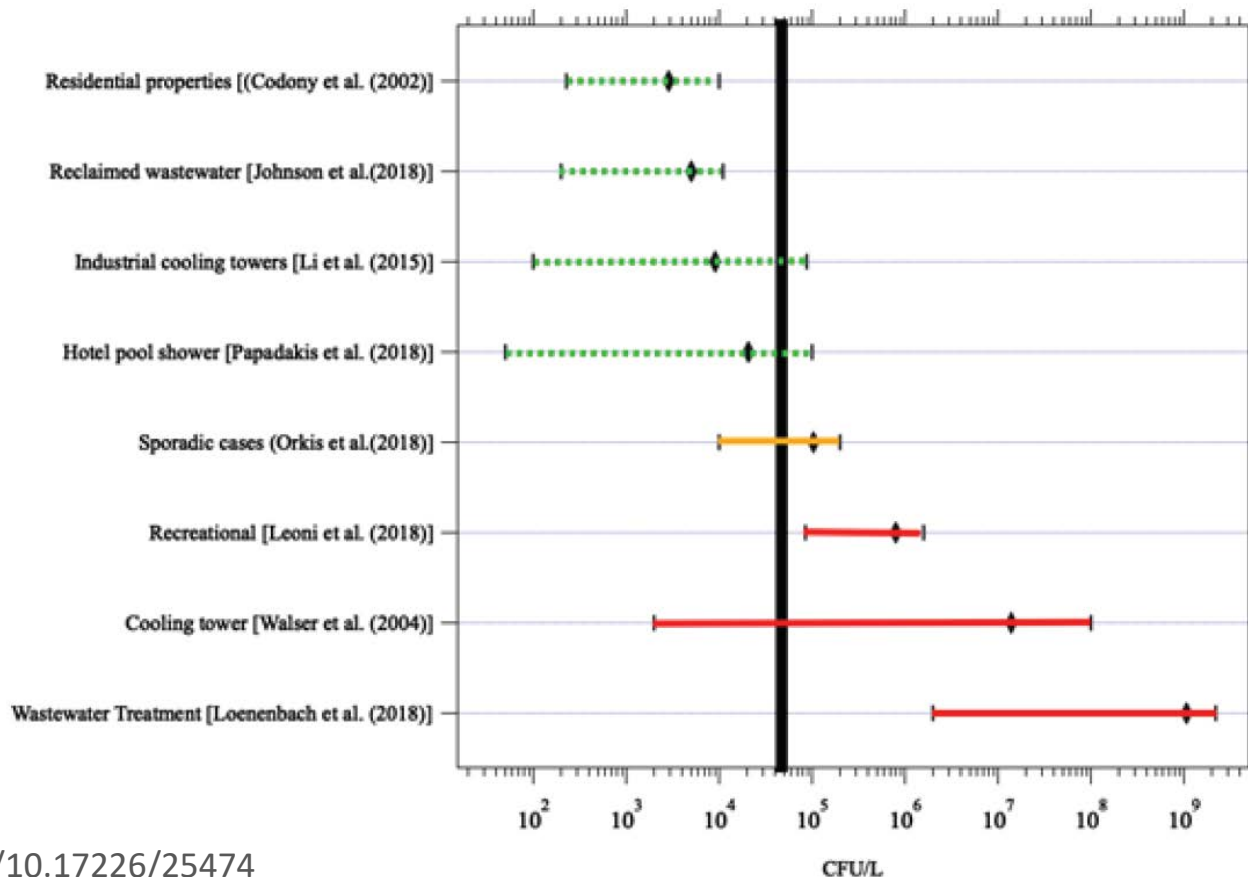
“The awareness of these results combined with the regulatory requirement to react to such results was the catalyst for systems improvement.”

Racine *et al.* (2019) ASHRAE Conference Proceeding, AT-19-C042

Racine (2019) *Cooling Technology Institute* paper TP19-06 (emphasis added)

“... *Legionella* concentration of  $5 \times 10^4$  CFU/L [**50 CFU / mL**] should be considered an “action level” — that is, a concentration high enough to **warrant serious concern** and to move remediation forward immediately.

“A lower action level may be necessary to protect those at higher risk for legionellosis ...”





Source: City of Vancouver



Source: City of Vancouver

## Legionnaires' disease exposure from contaminated water vapour

### What is the potential risk?

Workers exposed to water vapour containing Legionella bacteria may be at risk of developing Legionnaires' disease. Legionella bacteria multiply in warm water and may be found in swimming pools, hot tubs, water tanks or cooling towers used in residential or commercial buildings. If the water containing the bacteria becomes airborne, such as via mist or vapours from water jets, showers, faucets, or air conditioning and ventilation systems, it may be inhaled by workers or members of the public.

Legionnaires' disease cannot be transmitted from human to human. People with the disease have symptoms similar to pneumonia and can be effectively treated with antibiotics.

Scientific literature shows that the incidence of Legionnaires' disease in North America is increasing. People with decreased immune function or chronic lung problems are at an increased risk of developing Legionnaires' disease if they are exposed to the bacteria.

Workers at risk of developing Legionnaires' disease may include those who work in recreational (swimming pool) facilities or in buildings using water tanks or cooling towers.

### What industries may be at risk?

- Pool cleaning
- Pool equipment service and repair
- Pool installation or structural repair

- Pool maintenance
- Pool, spa, or hot tub installation or structural repair
- Pool, spa, or hot tub service
- Services
- Swimming pool

### How can I reduce the risk in my workplace?

As an employer, you need to know if there is the potential for the risk identified in this advisory to be present in your workplace. It's your responsibility to regularly inspect your workplace, and to ensure that your safety procedures and practices control the risk. The following information highlights some of the sections of the Occupational Health and Safety (OHS) Regulation and Guidelines that are most relevant to this risk.

Section 4.78 of the OHS Regulation requires employers to maintain acceptable air quality. This includes inspecting for conditions that would promote the growth of micro-organisms, such as water leaks or stagnant water pools, and ensuring there is adequate treatment of open-water systems associated with ventilation equipment, such as cooling towers and humidifiers, to control biological growth.

Under section 4.79 of the Regulation, the employer must ensure that the indoor air quality is investigated when complaints are reported. The investigation may include sampling for airborne

## Legionnaires disease

## Preventing Legionnaires' disease from cooling towers and evaporative condensers

**Legionella bacteria can infect humans and cause legionellosis and Legionnaires' disease. The bacteria can grow on the wet surfaces of cooling towers, evaporative condensers (cooling plant) and scrubbers. Poorly positioned air intakes for air conditioning units can also capture the bacterial plume and draw it into buildings.**

We have produced guidance for PCBU's that have cooling towers or evaporative condensers (cooling plant) on how to minimise or eliminate the risk of Legionella bacteria growing in their workplace.

Preventing Legionnaires' disease from cooling towers and evaporative condensers provides advice on the roles, duties and extent of influence/control held by different PCBU's and guidance for installing a new cooling plant or maintaining an existing plant.

This fact sheet provides advice to persons conducting a business or undertaking (PCBU's) who have cooling towers or evaporative condensers (cooling plant). This includes (but is not limited to) cooling plant that is part of: any building air conditioning system, commercial premises with refrigeration plant (eg bulk storage of chilled or frozen food), or industrial process.

Legionella bacteria grow on the wet surfaces of cooling towers, evaporative condensers (cooling plant) and scrubbers, and can cause a pneumonia called Legionnaires' disease. Legionnaires' disease is often severe and can be fatal. Those at higher risk of becoming infected are adults over 50, males, smokers, people with lung disease or low immunity.

Legionella become airborne when fine water droplets (aerosols) carrying the Legionella bacteria are expelled from the exhaust fans of this equipment and may be inhaled by those nearby. Poorly positioned air intakes for air conditioning units can also capture the bacterial plume and draw it into buildings.

PCBU's whose work involves buildings, industrial or commercial premises that operate one or more cooling towers or evaporative condensers (cooling plant) must eliminate the risks from Legionella colonisation and dissemination so far as is reasonably practicable. If a risk can't be eliminated, it must be minimised, so far as is reasonably practicable.

In relation to cooling plant, there will be different PCBU's with overlapping health and safety duties. When this happens, PCBU's must, so far as is reasonably practicable, consult, co-operate and co-ordinate activities. The extent of the duty to manage risks depends on the ability of each PCBU to influence and control the matter. Table 1 describes the different types of PCBU's that may be involved, their duties and likely extent of their influence or control.



**Davis Event Center**

**Western North Carolina Agricultural Center**

Source: [wncagcenter.org/p/getinvolved/246](http://wncagcenter.org/p/getinvolved/246)



NC DEPARTMENT OF  
**HEALTH AND  
HUMAN SERVICES**

**ROY COOPER** • Governor

**MANDY COHEN, MD, MPH** • Secretary

**BETH LOVETTE, MPH, BSN, RN** • Acting Director

Division of Public Health

**Interim Report: Outbreak of Legionnaires' disease associated with the NC Mountain State Fair,  
September – October, 2019**

| <b>Case Characteristics</b> |            |
|-----------------------------|------------|
| Male                        | 77 (57%)*  |
| Female                      | 58 (43%)*  |
| Median age in years (range) | 61 (24-91) |
| Hospitalizations            | 96 (71%)*  |
| Deaths                      | 4          |
| Legionnaires' Disease       | 135 (99%)  |
| Pontiac Fever               | 1 (1%)     |



## Legionellosis Risk Mitigation for Temporary Event Vendors

Certain activities at outdoor temporary events may pose a risk for Legionnaire's disease, a potentially serious respiratory illness caused by inhaling tiny water droplets contaminated with *Legionella* bacteria. As a vendor, there are precautions that can be taken to help reduce the risk of exposure to *Legionella* bacteria. Please contact the local health department for questions regarding Legionnaire's disease and *Legionella* exposure risk.

### Hot Tub and Whirlpool Vendors

To minimize the risk of exposure to *Legionella*, please follow these recommendations when setting up whirlpool or hot tub displays containing water at temporary events, **even if the hot tub or whirlpool is for display only**. Full cleaning protocol is included in the CDC reference below.

1. Fill and hyperchlorinate using 20 ppm free chlorine. Keep the hydrotherapy jets off and let the hyperchlorinated water circulate for one hour in all components of the hot tub including the compensation/surge tank, filter housing, and piping. Turn on the hydrotherapy jets to circulate the hyperchlorinated water for nine additional hours. Maintain 20 ppm of free chlorine in the system for the entire 10 hours.
2. Flush the system before refilling with water and maintain at least two ppm free chlorine during display. Maintain records of free chlorine and pH of water as well as disinfection and cleaning records.
3. Between vendor events, drain the hot tub or whirlpool, removing as much stagnant water in the system as possible. Filters should be removed and left to dry and cleaned before reuse. The hot tub or whirlpool should be kept as dry as possible between events.

### Outdoor Misters and other Spray Cooling Equipment

Cooling equipment such as misters or other spray devices are used at events when outdoor temperatures are high. Follow these recommendations to keep this equipment clean and minimize the risk of exposure to *Legionella*.

1. Water sprayed in a mister should be drinking water quality.
2. Never allow the water in the sprayer system to be stagnant for more than six hours.
3. Water reservoirs should be drained at least once every 24 hours.
4. Cleaning of misting systems should include soaking all aerators and sprayers in a chlorinated solution for 10 minutes. Chlorine disinfectant can be made by mixing 1/3 cup of household bleach with one gallon of water (1,000 ppm chlorine). Hoses should also be flushed, dismantled and kept clean.
5. Misters and cooling equipment should be stored dry and cleaned as described above before reuse.

### Display Fountains, Small Water Features or Other Display Products with Water Spray

1. It is recommended that display fountains, small water features or other spray reservoirs be drained and cleaned weekly and disinfected with 3-5 ppm free chlorine (or equivalent) for one hour each day. Free chlorine concentration should be verified with pool and spa water test strips.
2. Between displays, or when water features have been inactive for more than three days, thoroughly scrub and disinfect water features or display fountains with 3-5 ppm free chlorine. Ensure fountains are stored completely dry.
3. If water becomes cloudy, the display fountain or water feature should be drained, scrubbed and disinfected.
4. Maintain cleaning and disinfection records for any display fountain or small water feature.

#### Sources:

<https://www.cdc.gov/legionella/downloads/hot-tub-disinfection.pdf>  
<https://www.specialpathogenslab.com/perch/resources/2014finallegionellaequidelinesforwestemopa.pdf>  
<https://www.condair.com/mv0/water-misting-system-for-adiabatic-outdoor-cooling-in-hot-and-dry-areas-general.pdf>



# Summary: Public Health Policy

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- “... outbreak in Bremen in 2016-17, with 45 confirmed cases and three fatalities, **lasted for 5 months** as the local public health authority was unable to identify the infection source because of the **lack of a cooling tower register.**”

Paschke *et al.* (2019) *Lancet* **7**: 378-380

**Register and Monitor Cooling Towers.** Regulations and guidelines requiring the registration of cooling towers provide a demonstrable public health benefit with minimal regulatory burden to building owners and managers. Cooling tower registries enable a rapid public health response to community clusters of legionellosis cases, including timely remediation of possible sources of infection, and they can also be used to assess the contribution of cooling towers to overall disease incidence. In addition, regulations requiring ongoing *Legionella* monitoring of cooling towers have been shown to reduce cooling tower colonization rates in jurisdictions where they have been implemented (e.g., Quebec and Garland, Texas).

Source: National Academies of Sciences, Engineering, and Medicine (2019).

*Management of Legionella in Water Systems.* Washington, DC: The National Academies Press.

- Cooling tower registry template: [usdn.org/products-water.html](https://usdn.org/products-water.html)



Source: Capital Regional District

# Acknowledgements

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- Health Authorities:
  - Vancouver Coastal Health (Randy Ash, Shelley Beaudet, Linda Dix-Cooper, Arne Faremo, Jessica Ip, David Jantzen, Emily Peterson, Michael Schwandt, Michael Wu)
  - BC Centre for Disease Control (Eleni Galanis, Linda Hoang, Natalie Prystajek, Christine Tchao, Esther Tong, Frankie Tsang)
  - U.S. Centers for Disease Control & Prevention (Laura Cooley, Claressa Lucas)
  - New York City Department of Health & Mental Hygiene (Christopher Boyd)
- City of Vancouver (Kimberley Beck, Darren Perrett)
- Public Services and Procurement Canada (Jeff Moffat)
- Granting Agencies & Funding:
  - Urban Sustainability Directors Network (Peer-Exchange Grant, Innovation Fund Grant)
  - NSF International (Alextia Armstrong, Christopher Boyd, Jason George, Dann Holmes, Robert Murphy, Andrew Ward)
  - Federation of Canadian Municipalities (Green Municipal Fund)

# Contacts

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[vancouver.ca/operating-permit](https://vancouver.ca/operating-permit)

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- Christopher Radzinski, MAsC, PEng, RPBio  
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Building Policy Engineer  
604 873 7453 | [chris.radzinski@vancouver.ca](mailto:chris.radzinski@vancouver.ca)

# Proposals for January 1, 2021

Table 2.2.11.6.  
Required Response to Failure to Meet *Legionella* Standards  
Forming part of Sentence 2.2.11.6.(7)

| <u>Test Type</u>                      | <u>Test Result</u>  | <u>Required Response</u>  |
|---------------------------------------|---|---|
| <u><i>Legionella</i> Culture Test</u> | <u>Greater than or equal to 10 CFU (colony forming units) / mL and less than or equal to 1,000 CFU / mL</u> | <u>1. The owner shall give notice to the <i>Chief Building Official</i> within 24 hours.</u><br><u>2. The owner shall, within 24 hours, either</u><br><u>    a) shut down the <i>cooling tower</i> system and perform offline cleaning and disinfection, or</u><br><u>    b) perform online remedial treatment<sup>(1)</sup> and within 7 days shut down the <i>cooling tower</i> system and perform offline cleaning and disinfection.</u><br><u>3. The owner shall wait 24 hours after cleaning and disinfection and then perform a <i>Legionella</i> culture test.</u> |

# Proposals for January 1, 2021

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Table 2.2.11.6.  
Required Response to Failure to Meet *Legionella* Standards  
Forming part of Sentence 2.2.11.6.(7)

| <u>Test Type</u>                          | <u>Test Result</u>                 | <u>Required Response</u>  |
|---|------------------------------------|---|
| <u><i>Legionella</i><br/>Culture Test</u> | <u>Greater than 1,000 CFU / mL</u> | <u>1. The laboratory shall immediately give notice<sup>(2)</sup> to the owner, the <i>Chief Building Official</i> and the medical health officer.</u><br><u>2. The owner shall immediately implement measures that will eliminate water dispersion by aerosol from the affected <i>cooling tower</i> system and then perform offline cleaning and disinfection of the system before putting the system back into service.</u><br><u>3. The owner shall wait 24 hours after cleaning and disinfection and then perform a <i>Legionella</i> culture test.</u> |