

Public Health Response to a Legionnaires' Disease Outbreak in Sydney CBD, April 2025

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1 Executive Summary

On 8 April 2025 South Eastern Sydney Public Health Unit (SESPHU) commenced a public health response to a cluster of people diagnosed with *Legionella pneumophila* serogroup 1 infection who had spent time in the Sydney Central Business District (CBD) during their exposure period. This response included rapid communication to the City of Sydney Council and other relevant stakeholders, coordinated inspections of possible environmental sources, and epidemiological and genomic investigations.

The epidemiological investigation identified a total of fourteen cases with exposures in the CBD in March and April 2025, with all but one case having exposure in the northern CBD. Environmental investigations identified a northern CBD cooling tower with *Legionella pneumophila* serogroup 1 in its cooling water system. This tower was decontaminated and tested negative on repeat testing. *Legionella pneumophila* bacteria cultured from two cases was genomically similar to the bacteria that contaminated the cooling tower, however it cannot be confirmed if this cooling tower was a source of infection for the outbreak.

Importantly, no further cases linked to the outbreak were identified with exposure in the CBD after the environmental investigations were complete and the identified affected tower was decontaminated. It is believed that the public health response led to prompt termination of risk to the community.

2 Background

The Sydney CBD is defined in this report as encompassing the portion of the City of Sydney Local Government Area (LGA) bounded by Circular Quay, Darling Harbour, Central Railway Station and the Royal Botanic Gardens. In 2013, on any one day it was estimated that over 630,000 trips were made by people travelling to this area.¹ This is on top of the 2022-23 estimated resident population of 29,266 people.²

Legionnaires' disease is an infection of the lungs (pneumonia) which in its severest form also affects other organs. It is caused by one of a number of bacteria of the genus *Legionella* which are widely distributed in the natural and man-made environment where moisture is present. Legionnaires' disease may occur after a person breathes in contaminated water droplets or dust and is not spread from person to person. Although there are many different species of *Legionella* bacteria, a main cause of disease in NSW is from *Legionella pneumophila*. *Legionella pneumophila* can colonise air conditioning cooling towers, whirlpool spas, shower heads and other bodies of water. In Australia, and globally, outbreaks of Legionnaires' disease are most commonly caused by *Legionella pneumophila* serogroup 1 (LP1).

For those who develop Legionnaires' disease, symptoms occur between two to ten days after exposure to the bacteria (referred to as the exposure or incubation period) and may include fever, headache, cough, shortness of breath and muscle aches. People with significant underlying health conditions such as diabetes and chronic obstructive pulmonary disease, those over 50 years old,

¹ Transport for NSW *Sydney City Access Strategy - December 2013*
<https://www.transport.nsw.gov.au/sites/default/files/media/documents/2017/sydney-city-centre-access-strategy-final-web.pdf> (accessed 19/08/25)

² Australian Bureau of Statistics *Population estimates and components by SA2, 2022 to 2023* Released 26 March 2024.

male, and people who smoke are more likely to develop symptomatic or severe Legionnaires' disease after exposure to the bacteria.

Legionnaires' disease is diagnosed through testing of urine, sputum and/or blood samples of people with symptoms of the illness. Any laboratory that detects the presence of *Legionella* or specific antibodies in these samples is required to notify NSW Health under the *NSW Public Health Act 2010*. *Legionella* may also be detected in water and soil samples.

The *NSW Public Health Act 2010* and *NSW Public Health Regulation 2022* outline the regulatory requirements for regulated systems that may promote the growth of *Legionella pneumophila*. This includes air-handling systems, hot water systems, humidifying systems, warm water systems and water cooling systems. Each local government authority is required to maintain a register of regulated systems within its local area. The City of Sydney Council has over 500 registered water cooling towers within the Sydney CBD area.

Some water features such as decorative fountains are not regulated but can also be a source for *Legionella* growth.

This report outlines the public health response to an outbreak of Legionnaires' disease linked to people who were in the Sydney CBD during March and April 2025.

3 Investigation Methods

3.1 Clinical investigation

A *Legionella* investigation starts with a clinical investigation of patients. A doctor investigating the cause of pneumonia in a person presenting to hospital may order a *Legionella* urinary antigen test. This test is specific for infection with *Legionella pneumophila* serogroup 1. Doctors are also encouraged to collect a sputum sample from the patient, which is then cultured to see if any *Legionella* bacteria can be isolated. Growing *Legionella* allows for genetic sequencing of the bacteria, essentially identifying the DNA fingerprint of the *Legionella*.

3.2 Case notification

In Australia all cases of Legionnaires' disease are notified to the relevant state and territory public health authority by law. State and territory public health authorities follow nationally agreed guidelines on how to investigate cases of Legionnaires' disease, including their source of infection. For cases of Legionnaires' disease caused by LP1, local public health unit staff interview the case to identify all movements and higher-risk activities undertaken by the case during their exposure period, with the interview comprising questions as outlined in the National *Legionellosis Investigation Form*.³ These include clinical symptoms experienced, risk factors, and environmental exposures (where the case had been) two to ten days prior to symptom onset, including workplace, social, sporting, travel and healthcare-related exposures. Any exposures that are identified outside the local public health unit geographical region (such as an interstate exposure) are reported to the relevant state or territory public health authority through a nationally agreed communication process. Under International Health Regulations, cases of Legionnaires' disease diagnosed in overseas residents with exposure in Australia are also notified to Australia's National Focal Point and then to relevant state or territory health authorities. In this way, SESPHU, the public health unit

³ <https://www.health.gov.au/sites/default/files/documents/2020/02/legionellosis-cdna-national-guidelines-for-public-health-units-legionellosis-investigation-form.pdf> (accessed 23/05/2025)

that covers Sydney CBD, is made aware of any diagnosed cases of Legionnaires' disease that visited the Sydney CBD during their exposure period.

As per the NSW Legionnaires' disease control guideline, a *Legionella* outbreak is defined as two or more cases where the onset of illness is closely linked in time (weeks rather than months) and where there is epidemiological evidence of a common source of infection, with or without microbiological evidence.⁴

Three LP1 cases were notified to SESPHEU between 4 and 7 April 2025, with the first case notified on 4 April and two cases notified on 7 April. A cluster of case exposures in Sydney CBD was identified on 8 April and a further two cases with CBD exposure were also notified, triggering commencement of the public health response. The City of Sydney and NSW Ministry of Health were informed and an outbreak management team (OMT) established, with the first OMT meeting held the same day. An alert was also sent to all NSW public health units on 8 April so that exposures in the CBD could be quickly recognised when interviewing new LP1 cases. On 9 April, alerts were issued to NSW hospitals and GPs with a request that appropriate testing be undertaken for suspected cases. Other states and territories were alerted via the Communicable Diseases Network of Australia. Media releases were issued by South Eastern Sydney Local Health District on 10 and 17 April to alert and update the public.

On 9 April, building managers in the northern CBD area of investigation were notified of the cluster of cases and reminded of their duties to maintain cooling water systems in accordance with public health regulations. Building managers in a broader southern CBD area of investigation were notified on 10 April.

From 9 April to 29 April 2025 a further nine LP1 cases with exposure in Sydney CBD were notified to SESPHEU and included in this outbreak investigation (Appendix A).

3.3 Epidemiological investigation

All cases (or a suitable person such as a next of kin if necessary) were interviewed by public health authorities to determine their environmental exposures (where the case had been) two to ten days prior to symptom onset. These environmental exposures were used to determine the case's detailed movements through the CBD. Case movements were mapped using QGIS v3.24.0, with a 500m buffer created around their movement locations (Appendix C). Buffers from each case movement were overlaid to refine a likely *Legionella* source area.

A CBD area of interest for the investigation was determined based on the overlay of buffer zones created from case 1 to 5's movements (Figure 1). A priority area of investigation was bounded by Macquarie Street to the east, Hunter Street and Martin Place to the south, York, Clarence and Cumberland Street to the west and Circular Quay to the north (Figure 2 – dark blue shaded area). A broader area of CBD investigation was bounded by King St to the south, Macquarie St to the east and the city shoreline to the west and north (Figure 2 – light blue shaded area).

⁴ NSW Health *Legionnaires' disease control guideline*
<https://www.health.nsw.gov.au/Infectious/controlguideline/Pages/legion.aspx> (accessed 19/08/25)

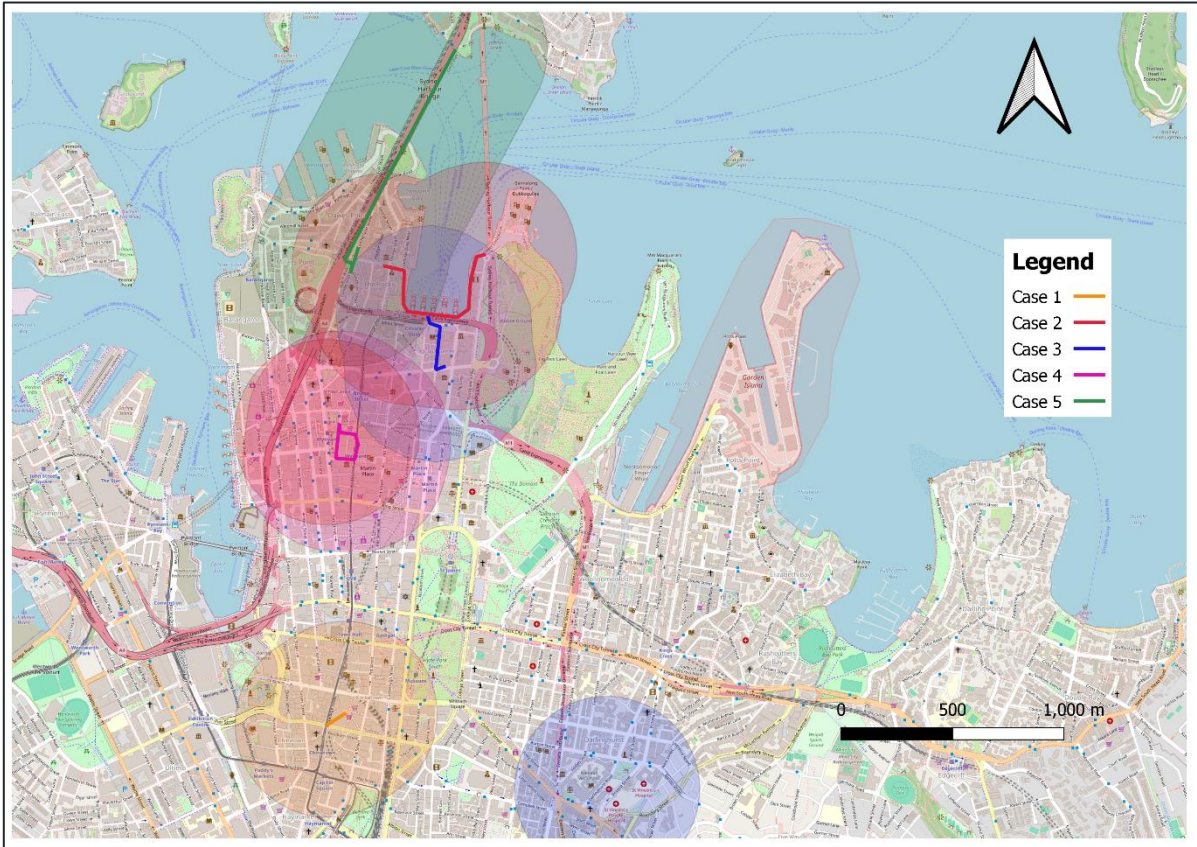


Figure 1. Overlay of case 1 to 5's movements with 500m buffer zones

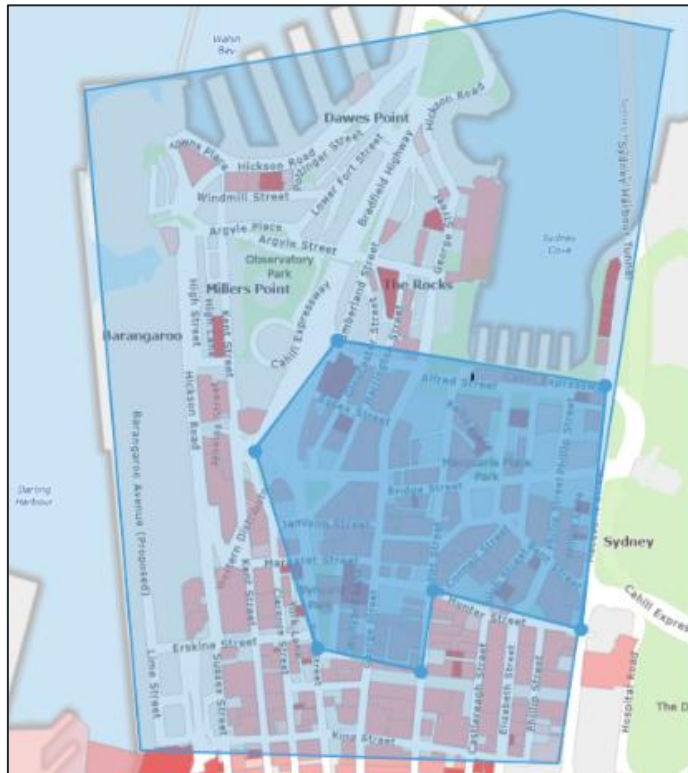


Figure 2. CBD area of investigation (priority area- inner dark blue shaded area; broader area- outer light blue shaded area)

3.4 Environmental investigation

The environmental investigation involved a collaboration between NSW Health and the City of Sydney, with a field team of 21 environmental health officers (EHOs) across both agencies.

All cooling water systems located within the priority investigation area (Figure 2 - dark blue shaded area) were physically inspected and a sample of water was collected. These inspections commenced on 9 April and were completed on 17 April. All water samples were sent to the Legionella Reference Laboratory, ICPMR, NSW Health Pathology at Westmead Hospital for *Legionella* culture.

All cooling water systems in the CBD area of investigation (Figure 2 – dark blue and light blue shaded areas) were assessed by a desktop investigation undertaken by EHOs. This included a review of the current risk management plan (RMP) and audit report, and cleaning and maintenance records and microbial sampling results for the previous 3 months for each cooling water system.

Two cooling water systems in the CBD but outside the identified area of investigation were also flagged for inspection and sampling due to failed inspections reported by the operator's water treatment company, which included issues such as a leak that caused overflow and a reduction in biocide levels.

Concurrently to the CBD investigation, environmental investigations were also undertaken in several areas outside of the CBD where more than one case reported exposure, to investigate for possible sources of infection. These investigations are not considered further in this report.

3.5 Genomic investigation

Genomic investigation is undertaken to determine the likelihood of an environmental *Legionella* isolate being the source of a case's infection. This is determined by examining the similarity in the whole genome sequence of any *Legionella* isolates recovered from respiratory tract specimens and from environmental samples.

All clinical and environmental LP1 isolates identified during the investigation were sent to the Centre for Infectious Disease and Microbiology Laboratory Services, ICPMR, NSW Health Pathology at Westmead Hospital for whole genome sequencing.

Sequencing was performed on NextSeq (Illumina), and assembled sequences were genotyped using the Legionella Sequence Based Typing (SBT) scheme.⁵ Sequence relatedness and phylogeny was determined by comparison of core sequence nucleotide polymorphisms (core SNPs) using Snippy⁶ and a curated recombination-masked LP1 SBT211 reference genome. All available historical SBT211 sequences from clinical and environmental isolates sequenced at ICPMR were included in the cohort analysis for context.⁷

⁵ Gaia V, Fry NK, Afshar B, Lück PC, Meugnier H, Etienne J, et al. Consensus Sequence-Based Scheme for Epidemiological Typing of Clinical and Environmental Isolates of *Legionella pneumophila*. *Journal of Clinical Microbiology*. 2005;43(5):2047-52.

⁶ <https://github.com/tseemann/snippy> (accessed 03/06/2025)

⁷ Timms VJ, Rockett R, Bachmann NL, Martinez E, Wang Q, Chen SC-A, et al. Genome Sequencing Links Persistent Outbreak of Legionellosis in Sydney (New South Wales, Australia) to an Emerging Clone of *Legionella pneumophila* Sequence Type 211. *Applied and Environmental Microbiology*. 2018;84(5):e02020-17.

4 Results and further action

4.1 Clinical and epidemiological investigation

A total of sixteen cases were considered during the investigation; however one case (case 7) was excluded on further testing and one case (case 8) was excluded as they did not have CBD exposure.

The fourteen cases included in the outbreak had all spent time in the Sydney CBD in their exposure periods between March and April 2025, with thirteen cases having exposure in the northern CBD. Symptom onset dates ranged from 20 March to 18 April (Figure 3). Nine cases were NSW residents, two cases were interstate visitors and three cases were overseas visitors. All cases had also spent time in locations outside the CBD during their exposure period.

Thirteen of the fourteen outbreak cases were considered confirmed cases and diagnosed via LPI urinary antigen. One case was considered a probable case and diagnosed via sputum polymerase chain reaction (PCR). Eight cases had a sputum sample collected, of which four were successfully cultured to grow *Legionella pneumophila* colonies.

Thirteen cases were hospitalised and one case died. All cases had at least one risk factor making them more susceptible to *Legionella* infection. The median age of cases was 70 years with a range of 46 – 86 years, and eight cases (57%) were male. The dates of case notification to SESPHU and their CBD exposures are shown in Appendix A and C respectively.

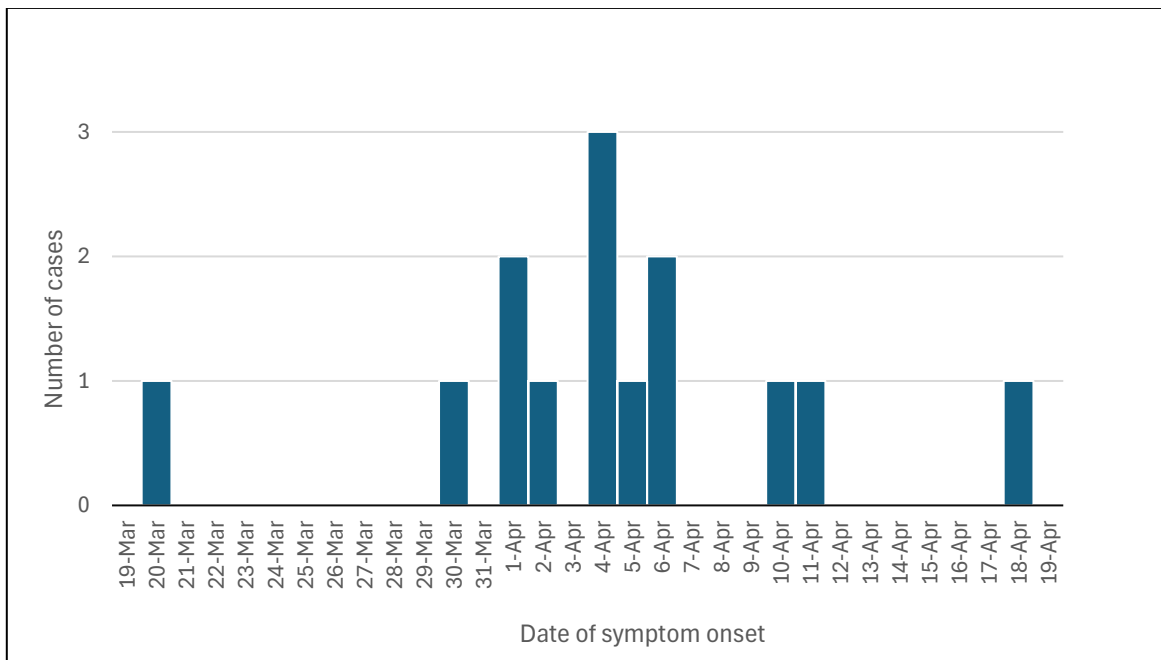


Figure 3. Epidemic curve of Sydney CBD Legionella outbreak, March – April 2025

4.2 Environmental investigation

One hundred and sixty-five cooling water systems in the priority investigation area were physically inspected and sampled. This resulted in the detection of microbial contamination in three cooling water systems (Appendix B), however only one of these detections was for *Legionella pneumophila*.

A presumptive positive *Legionella pneumophila* result was received on 16 April for a cooling tower in the priority investigation area (referred to as Tower A in Appendix B and location shown in Appendix C). The result was confirmed on 17 April. This system had been inspected and sampled on 10 April and at this time, had appeared well-maintained with no visible issues. In response to the *Legionella pneumophila* detection, City of Sydney issued an Improved Notice on 17 April which required the system to undergo online decontamination and a review of operating procedures. A re-inspection was also conducted on 17 April with the assistance of the water treatment company to turn off the system. This revealed sediment buildup in the filters, which had caused sensor interference and potentially contributed to *Legionella* growth. This issue was not detectable during the initial visit as dismantling the filters required the service company's assistance. Two repeat samples collected on 22 April after decontamination were negative for *Legionella*. Compliance with the Improvement Notice was confirmed on 16 May. The desktop review of this system identified no failed results from the previous 3 months' mandatory sampling program or elevated heterotrophic colony count that would have required occupiers to take remedial action.

An Improvement Notice was also issued for a separate cooling tower in the priority investigation area due to maintenance issues identified on inspection, with no *Legionella* detected on water sample testing.

4.3 Genomic investigation

Four clinical and seven environmental LP1 isolates were available for genomic sequencing. The four clinical isolates were from cases 4, 5, 6 and 15 and the seven environmental isolates were from the single cooling tower with *Legionella pneumophila* detected (Appendix A and B).

Genomic sequencing of these eleven isolates identified three distinct groups of *Legionella*, Bayesian Analysis of Population (BAPS) Groups 1, 4 and 6.

In total, three clinical and four environmental isolates collected during this investigation were assigned to LP1 BAPS Group 4, sequence-based type (SBT) 211, which is known to be endemic in Sydney's CBD. Two SBT211 clinical isolates, from cases 4 and 6, were genomically indistinguishable on single nucleotide polymorphism (SNP) analysis (0 SNPs different). These were closely related (2-3 SNPs different) to two environmental isolates collected in this investigation as well as 1-3 SNPs different to several clinical and environmental isolates of SBT211 recovered in 2023 and 2024 (Figure 4). The two other SBT211 environmental isolates collected in this investigation were genomically different (21 SNPs apart) from the two clustered clinical isolates of case 4 and case 6. The other SBT211 clinical isolate from case 15 was also genomically different, at 12 SNPs different from the two clustered clinical isolates and up to 16 SNPs different from the environmental isolates.

One clinical isolate (case 5) was assigned to BAPS Group 1 and distinct from all other LP1 isolates collected in this investigation.

Three environmental isolates from the contaminated cooling tower were assigned to BAPS Group 6 and not linked to any clinical isolates collected in this investigation.

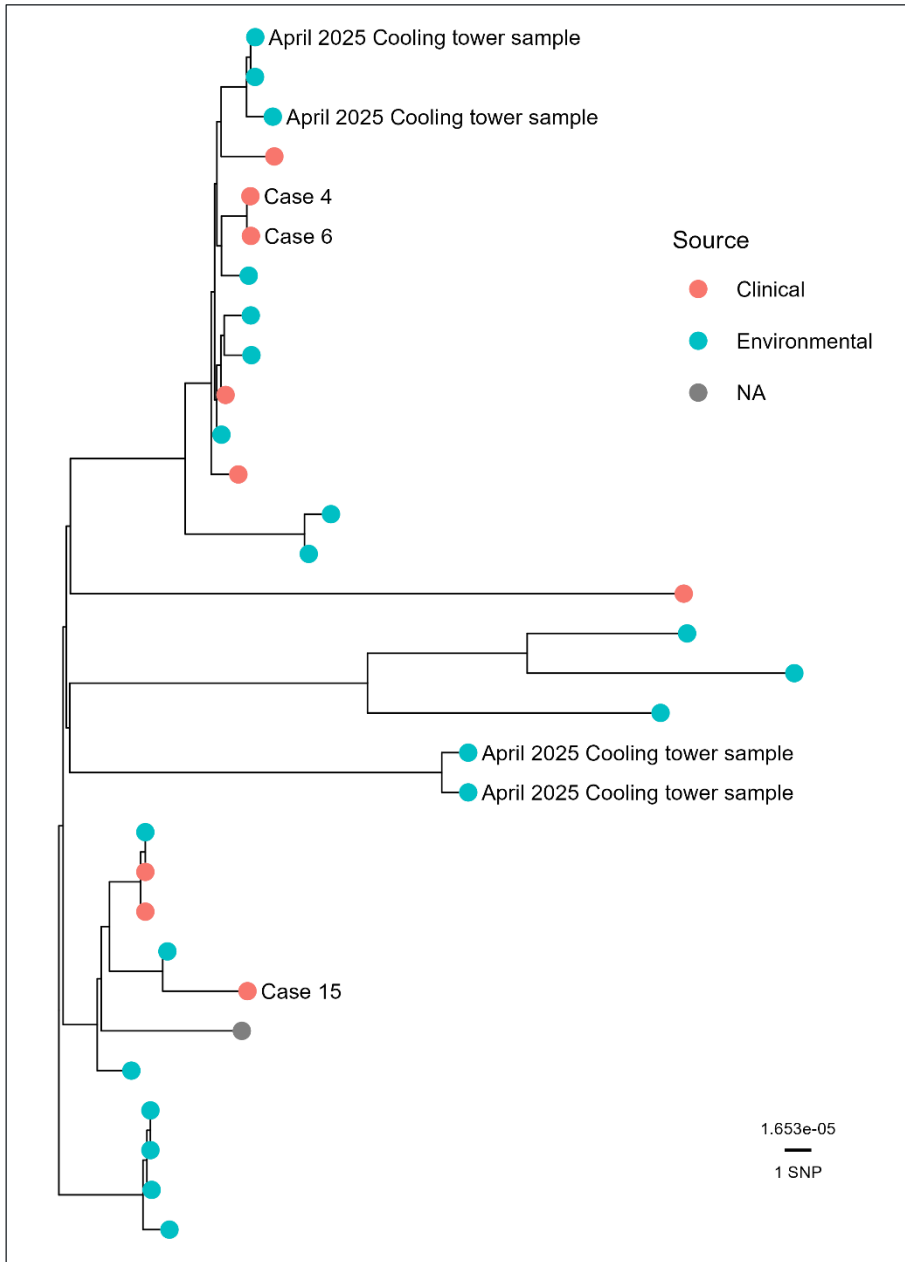


Figure 4. Phylogenetic analysis of BAPS Group 4 isolates from Sydney CBD collected during this investigation and compared with historical SBT211 isolates

The unlabelled clinical and water samples are isolates from previous investigations and are included to provide context for the relatedness of the current isolates.

5 Discussion

A total of fourteen LP1 cases were epidemiologically linked to the Sydney CBD during this outbreak. A large public health response was rapidly initiated upon identification of a cluster of CBD exposures amongst LP1 cases, with communication and alerting of a number of key stakeholders and the public. This assisted with case finding and ensured building managers in the CBD were aware of the cluster and their duties to maintain cooling water systems in accordance with public health regulations. The environmental investigation identified a single cooling tower in the CBD with *Legionella pneumophila* contamination of its cooling water system, with prompt decontamination and appropriate remediation action undertaken. No further cases were linked to the outbreak after the environmental investigation was complete, indicating that the public health response effectively terminated the risk to the public.

A public health response relies on a number of tools to provide insight into an outbreak, all of which have limitations. To overcome these limitations, multiple lines of evidence are considered, including clinical and environmental sampling along with epidemiological and genomic investigations.

Collection of appropriate respiratory tract specimens from symptomatic cases is crucial during a *Legionella* outbreak to allow examination of genomic links between cases and to any environmental cultures. In this outbreak, sputum samples were collected from eight of the fourteen cases, and of these only four samples had *Legionella pneumophila* successfully cultured. In some instances, the case could not produce any sputum and in one case *Legionella* culture was not requested. During an outbreak, messaging to clinicians should continue to include the recommendation for sputum to be collected from cases whenever possible and *Legionella* culture requested.

A limitation of this response was that environmental sampling likely occurred after CBD building managers were made aware of the cluster of cases. This may have led to cooling towers being disinfected and any *Legionella* that may have been present removed prior to sampling. This limits the ability of public health authorities to identify all cooling towers that may have contributed to the outbreak; however, as the main aim of a public health response is to stop the outbreak by controlling all sources of *Legionella* as quickly as possible, this is considered an acceptable limitation to achieve the desired outcome. This is particularly pertinent in an area such as the CBD, where environmental field investigations may take several days due to the large number of cooling towers requiring inspection.

The epidemiological investigation linked a cluster of people through place and time, in this instance exposure in the Sydney CBD between March and April 2025 in the two to ten days before their symptom onset. While all fourteen cases met this criterion, they had also all visited other locations outside the CBD during their exposure period. The identification of two cases that were genomically indistinguishable supports a common source of *Legionella* infection for these two cases (case 4 and case 6), with the CBD being their only exposure in common and therefore likely source of infection. For other cases epidemiologically linked to the outbreak, it is possible they were exposed from an unidentified source either within the CBD or at another location outside the CBD.

The genomic investigation showed a diversity in LP1 isolates collected from cases epidemiologically linked to the outbreak and from within a single cooling tower in the Sydney CBD. The findings are consistent with long-term environmental persistence of the endemic clone of LP1 BAPS Group 4 SBT211 in metropolitan Sydney, with genomic diversity identified even amongst SBT211 isolates collected during this investigation. Two of the environmental SBT211 isolates identified in this investigation were genomically similar to the two clustered clinical isolates, however, these clinical isolates were also similar to other clinical and environmental isolates from CBD *Legionella* investigations in 2023 and 2024. It cannot be known for sure whether the contaminated tower that was identified during this investigation was the source of infection for any cases linked to this outbreak. Given the endemic nature of SBT211 in the Sydney CBD and diversity of genomic strains amongst cases, it is possible that there were multiple environmental sources of *Legionella* that were not identified. Equally, given the genetic diversity of *Legionella* demonstrated within the cooling tower, it could be argued that other genomic strains of *Legionella* may have co-existed within this

system, but sampling was not extensive enough for them to be identified. Given no further cases have been identified, if other sources of infection were present in the CBD during this outbreak, they are likely to have been treated.

Finally, this outbreak demonstrates the potential severity of LP1 infection, with all but one affected person requiring hospitalisation and one death. The investigation highlighted the importance of maintaining cooling water systems in accordance with public health regulations to prevent *Legionella* growth and reduce risk to the community.

6 Appendices

6.1 Appendix A - Line list of LP1 outbreak cases, ordered by date of notification to SESPHEU

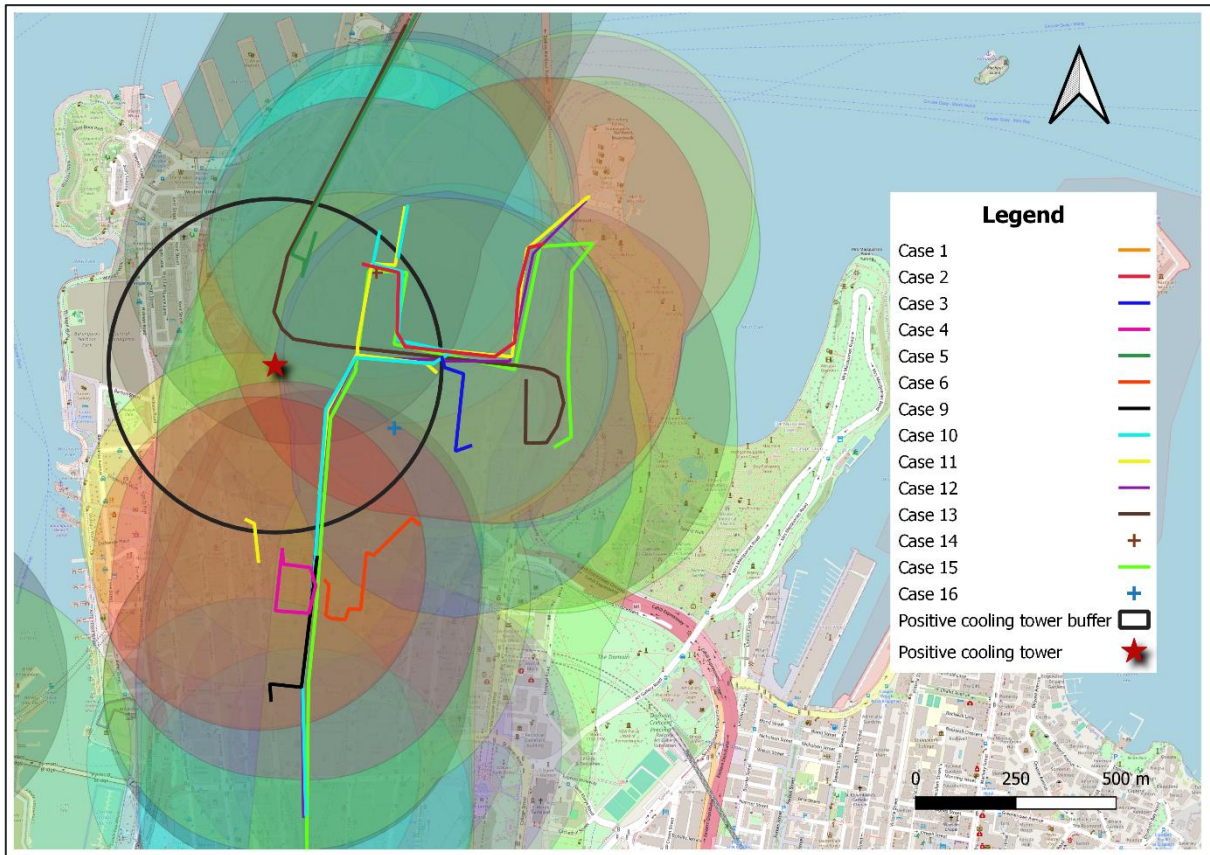
Case*	Notification date	Symptom onset date	Hospitalisation	LP1 urinary antigen	Sputum sample collected	LP1 genotype
1	4/04/2025	30/03/2025	Yes	Positive	No	
2	7/04/2025	4/04/2025	Yes	Positive	No	
3	7/04/2025	1/04/2025	Yes	Positive	Yes – LP1 not cultured	
4	8/04/2025	4/04/2025	Yes	Positive	Yes – LP1 cultured	BAPS Group 4, SBT211
5	8/04/2025	2/04/2025	Yes	Positive	Yes – LP1 cultured	BAPS Group 1, novel SBT
6	9/04/2025	6/04/2025	Yes	Positive	Yes – LP1 cultured	BAPS Group 4, SBT211
9	14/04/2025	20/03/2025	Yes	Positive	No	
10	15/04/2025	5/04/2025	No	Positive	No	
11	15/04/2025	4/04/2025	Yes	Positive	No	
12	15/04/2025	1/04/2025	Yes	Positive	No	
13	16/04/2025	10/04/2025	Yes	Positive	Yes – LP1 not cultured	
14	20/04/2025	6/04/2025	Yes	Positive	Yes – LP1 not cultured	
15	23/04/2025	18/04/2025	Yes	Positive	Yes – LP1 cultured	BAPS Group 4, SBT211
16	29/04/2025	11/04/2025	Yes	Unknown	Yes – LP1 not cultured	

*Total number of outbreak cases = 14, as case 7 and case 8 were excluded.

6.2 Appendix B - List of cooling towers with positive water sample cultures

Reference	RMP Risk rating	Initial inspection date	Sample date	Presumptive initial result (Total <i>Legionella</i> CFU/ML)	FINAL RESULTS - CFU/ML					Notes
					Total <i>Legionella</i>	<i>Legionella pneumophila</i>		Other species	LP1 genotype	
						Serogroup 1	Serogroup 2-14			
Tower A	High	10/04/2025	10/04/2025	>1000	2360	360	<10	2000	BAPS Group 4, SBT211 (4 isolates) BAPS Group 6, untypeable SBT (3 isolates)	Positive for <i>Legionella pneumophila</i> serogroup 1
Tower B	Medium	9/04/2025	9/04/2025	>10 and <100	20	<10	<10	20	N/A	Positive for <i>Legionella</i> spp. not pneumophila
Tower C	Medium	10/04/2025	10/04/2025	N/A	<10	<10	<10	<10	N/A	Positive for <i>Pseudomonas aeruginosa</i> >1000 cfu

6.3 Appendix C - Map of Sydney CBD locations visited by outbreak cases and *Legionella pneumophila* positive cooling tower with 500m radius boundaries



South Eastern Sydney Local Health District

Locked Bag 88
Randwick, NSW, 2031

T: 02 9382 8333

