Christchurch Water Supplies Drinking Water Incident Investigation Report

L'Aube Hill Reservoir

Christchurch City Council

April 2021

Christchurch City Council

Document Review and Approval

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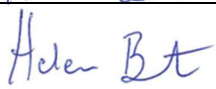
Revised after feedback from Medical Officer of Health		Helen Beaumont		19 April 2021

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1 Executive Summary

The L'Aube Hill Reservoir in Akaroa was contaminated by dead animals that had entered the tank. The presence of dead animals is associated with a risk of contamination by bacteria and protozoa. The animals in the water were discovered when a camera (on a Remote Operated Vehicle) was inserted by contractors into the reservoir on the afternoon of Tuesday 9 February 2021.

The reservoir inspection was undertaken to identify scour lines and overflow pipes, as required by the Water Safety Plan. The Akaroa/Takamātua water supply system has an approved Water Safety Plan (November 2020).

This report summarises our response to the incident and investigation into the causes. The investigation looked at a number of areas including:

- Infrastructure factors
- Environmental factors
- Network operation factors
- Process and system factors
- People factors

We have concluded that the most likely causes of the contamination of the water supply were:

- Presence of gaps between the reservoir exterior walls and the ground level
- Lack of sealing in some sheets of the reservoir's roof cladding channels
- Lack of mesh on the overflow pipes.

The identified cause of the incident was the poor condition of the reservoir that allowed animals (2 possums, 2 birds and a rat) gain entry to it. It was not possible to identify the exact location where the animals accessed the reservoir.

2 Overview of Akaroa/Takamātua water supply zone

2.1 Description

Raw water is collected from six raw water intake sources including four streams. Three of the stream intakes are gravity fed (Aylmers, Grehan and Balguerie) and one (Takamātua) is pumped from the stream. The remaining two sources are groundwater bores, one at Settlers Hill Rd and one at Aylmers Valley Rd. The wells are used to augment flows when turbidity in the streams is high and/or the quantity of water available from the streams is inadequate to meet demand. Table 2.1 identifies the components of the water supply system.

Table 2.1: Registered supplies and treatment zones for the Akaroa and Takamātua Water Supply

Community	Permanent Population	Zone	Plant	Sources
AKA001 Akaroa	820	AKA001AK Akaroa	TP00189 L'Aube Hill	S00185 Balguerie Stream S00186 Grehan Stream S00187 Aylmers Stream S00355 Takamātua Stream G01764 Settlers Hill Road Well G01805 Aylmers Well
TAK002 Takamātua	188	TAK001TA Takamātua		

Akaroa's population experiences seasonal variations and has historically required annual summer water restrictions to maintain supply over the summer holiday period. The streams are all relatively small and during dry periods the available flows are substantially less than required to meet the increased summer demand. However, there are sufficient consented water take volumes across the six water sources to meet the average demand. Table 2.2 summarises the population variation and water supply network.

Table 2.2: Summary Other Relevant Statistics for the Akaroa and Takamātua Water Supplies

Population served (TRIM 19/1111455):	
Permanent (Winter) Population	1,008
Pre-Peak Summer Population (18 Nov to 24 Dec)	2,077
Peak Summer Population (25 Dec to 7 Jan)	2,687
Number of connections to the system:	1,252
Commercial	213
Residential	988
Utility / Special Purpose	51
Average Usage (L/d/connection)	759
Maximum System Demand (m^3/day)	2,000
Number of stream intakes	4
Number of wells:	2
Number of reservoirs in the distribution:	7

2.2 Water quality

Sampling results from L'Aube Hill treatment plant and Akaroa/Takamātua network up to 10 February 2020 were all compliant with the drinking water standards (TRIM 21/193951).

Total coliforms are a useful indicator of water quality and may reveal changes over time. A high total coliform reading does not necessarily pose a risk to human health and there is no maximum value in the drinking water standards. Any significant change in total coliforms is followed up by further testing and investigation.

E Coli is the primary indicator that the drinking water supply may be contaminated by pathogens and points to contamination of the water by faecal material. Any detection of *E Coli* prompts a full incident response including further testing, investigation and remedial actions.

None of routine and non-routine testing for total coliforms and *E Coli* over the preceding 6 months showed any concerning results.

Table 2.3: Analysis results summary

Determinand	Number of analysis: 10 August 2020 to 10 February 2021	Results	MAV*
E.Coli	302	All results <1 MPN/100ml	<1 MPN/100ml
Total Coliforms	302	Between <1 and 5 MPN/100ml	N/A
Free Available Chlorine	309	Between <0.10 and 1.9mg/l	5mg/l ClO_2
Trihalomethanes (THM)*	4	Between 0.1 and 0.4 (THM ratio)	1

*Maximum Acceptable Value as per Drinking Water Standards New Zealand 2005 (Rev.2018)

In response to the contamination event CityCare was instructed, on 12 February, to slightly increase the chlorine dose to ensure an adequate residual throughout the network. Water sampling was increased to daily testing at the reservoir (from 12 February) and the network (from 13 February) until 26 March 2021. Twice daily chlorine testing was also undertaken during this time.

Protozoa are single celled micro-organisms that are somewhat larger than bacteria – *Giardia* and *Cryptosporidium* are of particular concern in drinking water. Protozoa have a tough outer coat and, unlike *E Coli* and other bacteria, they are resistant to chlorination. Protozoa testing is not part of our routine water quality monitoring programme – direct testing is difficult and not practical for routine surveillance. Four samples were collected across the network on 22 February 2021 and the results were received on 26 February. None of the samples returned a positive result for protozoa.

3 Incident response

This section provides a summary of key events that were undertaken from notification of the contamination event.

3.1 Discovery of animals in the reservoir and immediate actions

On the morning of Tuesday 9 February 2021 a detailed inspection of the L'Aube Hill reservoir, using a camera inserted into the reservoir, identified a dead animal in the water. The inspection was carried out by a contractor, Detection Services (south Island Limited), with CityCare providing on-site support. The contractor carrying out the survey informed Council's Water and Wastewater Operations Team.

The reservoir inspection also identified the location of the overflow pipe, followed it to the outside of the tank and noted that there was no mesh over the outlet.

Immediately following the notification Council staff contacted CityCare and asked them to arrange for the removal of the animal and to fit mesh over the (now located) overflow pipe. CityCare staff visited the site on Tuesday afternoon and reported that the possum was on the bottom of the reservoir.

On Wednesday 10 February 2021, CityCare staff recommended that a sucker truck would be the best option to remove the animal. A brand new pipe was sourced for the sucker truck to ensure a hygienic extraction process. Stainless steel mesh was installed on the outlet of the overflow pipe.

The dead animals were removed on Thursday 11 February by cutting through the walls of the reservoir to provide access for the extraction. Two possums and two birds were removed from the reservoir.

On Wednesday 17 February an inspection of the second chamber of the L'Aube Hill reservoir identified additional animals (two rats). A kayak was used to remove one rat on Thursday 18 February, the second rat was left in place at the bottom of the tank to avoid the risk associated with disturbing the carcass.

3.2 Initial communications

Council informed the Drinking Water Assessor (Wai Comply) of the contamination of the reservoir at 3pm Friday 12 February.

The Drinking Water Assessor notified the Canterbury Medical Officer of Health (just before 5pm), who advised that a precautionary Boil Water Notice be issued, this advice was received. Council staff were advised by the Drinking Water Assessor at 5.15pm the same day. The boil water notice was imposed due to the risk from protozoa which are not eliminated by chlorine treatment.

A Civil Defence Emergency Mobile Alert was used, 7 to 9pm Friday 12 February, advising of the precautionary Boil Water Notice. Newsline articles, Council's Facebook page, radio advertising all weekend, stories to mainstream media, TV1, TV3 and electronic signs at Takamatua and Akaroa were also used.

Council staff briefed the Banks Peninsula Community Board on Monday 15 February.

Council staff continued to work closely with the staff from Community and Public Health, Canterbury District Health Board, to ensure that residents and visitors were aware of the importance of boiling all drinking water.

3.3 Interim safe drinking water measures

Two large water tankers were set up in accessible central locations in Akaroa – in place from the morning of Saturday 13 February. These tankers supplied water sourced from the Christchurch supply and were being regularly monitored and tested. On 25 February the tankers were replaced with two 10,000 litre tanks in Akaroa and a 1,100 litre tank in Takamatua.

Twenty litre containers were delivered to hospitality related businesses on Saturday 13 February. Bottled water was supplied to Akaroa Health Centre, Pompallier Village and Akaroa Area School on Saturday 13 February. Small water tanks were sourced for these sites and the Akaroa Heartland Services. Council staff were in communication with these centres to confirm their need and identify the appropriate locations to site the tanks. The small tanker for Akaroa School was put in place on Friday 19 February 2021.

Welfare checks of at risk groups took place on Saturday 13 February with support from the Council's Response Team. There was ongoing communication with the Akaroa Health Centre, Pompallier Village, the Akaroa Area School and Akaroa Heartland Services to assist us in the assessment of the community's needs.

Conducted a sanitary survey of all reservoirs on Banks Peninsula (19 February) to ensure they were secure from vermin, and took remedial action where required.

3.4 Reservoir bypass and temporary storage solution

In order to remove the boil water notice we needed to bypass the reservoir and provide temporary storage to ensure continuity of supply to Akaroa. The commissioning plans were submitted to the Drinking Water Assessor on 8 March 2021 for approval of the bypass, the temporary tanks farm and associated equipment.

A small tank farm, with fourteen 30 cubic metre tanks, was set up adjacent to the old reservoir. The change over from the reservoir to the tank farm took place on 16 March 2021.

Following approval of the commissioning plan and satisfactory results from the monitoring of the water quality from the tank farm the Medical Officer of Health approved the lifting the boil water notice at 3pm on 17 March 2021.

3.5 Communicable Disease Surveillance

The Medical Officer of Health, Dr Cheryl Brunton, advised Council staff on Friday 12 February, at approximately 7.00pm, that there had been no reports of water related communicable disease in Akaroa or surrounding areas in the last week. Community and Public Health sent out an alert to the Akaroa Health Centre advising them of the water contamination and requesting staff there to notify any cases of gastrointestinal illness.

Staff requested an update from Medical Officer of Health on 23 March. Dr Cheryl Brunton advised that 3 cases had been registered in their system, 2 cases of Giardiasis and 1 case of Cryptosporidiosis. The 3 cases had visited Akaroa – one on 16 January (symptoms 17 January), one on 6 and 7 February (symptoms 13 February), and one on 12 to 15 February (symptoms 17 February). She also noted that the 3 cases who had visited Akaroa had no other identified risk factors.

Dr Brunton also provided data on the incidence of Cryptosporidiosis and Giardiasis for the 2020 calendar year and for the year to the end of February 2021 for the Canterbury District Health Board and New Zealand as a whole.

No. Cases	Canterbury DHB	NZ
Full Year (2020)		
Cryptosporidiosis	56	735
Giardiasis	106	1140
Feb 2020 to Feb 2021		
Cryptosporidiosis	41	756
Giardiasis	96	1159

Dr Brunton said "We see seasonal peaks in the incidence of both diseases: in spring, notably in relation to calving, and an increased incidence in summer months associated with recreational water exposures.

3.2 Communications

There was a comprehensive communications effort to ensure that residents and visitors to Akaroa and Takamatua understood the situation and the plans to resolve it. These included:

- Newsline stories x2 (and ongoing blog with weekly updates)
- Website updates (e.g. homepage alert banner, water restrictions webpage)
- Media liaison and interviews (e.g. TV1 and 3)
- Radio advertising on The Breeze and More FM (was ongoing)
- Verbal briefing to Banks Peninsula Community Board
- Community meeting at the Gaiety to provide an update and respond to questions
- E-newsletters x2 to Banks Peninsula Community Board subscribers (with weekly updates)
- Direct emails to stakeholders (e.g. Onuku Runanga, Robinsons Bay Residents Association, Takamatua Ratepayers Association)
- Facebook updates
- Call Centre Q&As and updates
- Electronic signs
- Flyers and posters for local businesses
- Posters for water tankers.

4 Investigation

4.1 Infrastructure Factors

The Akaroa Water Treatment Plant at L'Aube Hill was built in 2015 and replaced the two previous Akaroa plants (L'Aube Hill Water Treatment Plant and Aylmers Valley Water Treatment Plant) and the Takamātua plant. The centralised plant was designed and constructed to achieve compliance with the requirements of the Drinking Water Standards for New Zealand 2005 (revised 2018) to provide 4 log credits Protozoa removal.

In the design an area was set aside for installation of a new post treatment reservoir but this did not form part of the construction project.

The largest reservoir is at L'Aube Hill – a 2080 cubic metre concrete structure with iron cladding forming the roof and upper walls (see Figure 4.1). The structure is partitioned into two tanks with volumes of 1660m^3 and 420m^3. The reservoir was built in 1974 and the lining of the concrete tank was upgraded in 2012.

A part of the concrete tank portion of the reservoir may date back to 1911 when Akaroa became one of the first Canterbury towns to have a public electricity supply. Water was fed from a concrete reservoir on L'Aube Hill down a pipeline to a generator in a small, brick power house.

A detailed reservoir condition assessment had not been undertaken since the L'Aube treatment plant upgrade. The most recent inspection of reservoir was carried on September 2020 as part of an audit of the operation of the treated water reservoir (TRIM 21/166262). This included external and internal inspections that noted the potential for contamination from dust, dirt, pests, insects, foliage and other organic matter. No animals were observed within the reservoir at the time of this inspection. An action list detailing works and/or further investigation in relation to the reservoir was drawn up.

Figure 4.1: Treated Water Storage Reservoir

Despite regular monthly checks by CityCare there was a failure to identify critical maintenance tasks. This was evidenced by an independent report in late 2020. Poor condition of the exterior, small gaps in metal flashings and the lack of awareness of any overflow pipe all contributed to animal accessing the reservoir.

A condition assessment of the (now located) overflow pipe (in February 2021) indicated the cast iron pipe was at the end of its life and this pipe has since been replaced.

Recommendations:

Undertake a condition assessment of the reservoir and evaluate the options for upgrade or replacement.

Review and improve the site checklist templates for all routine reservoir inspections to ensure adequate coverage of potential risks to water security.

Formal contract communications to be sent to CityCare outlining qualifications and experience requirements of water treatment operators and highlighting the importance of monthly checks.

4.2 Environmental Factors

In 2020, Akaroa's cumulative rainfall was the lowest it has been in a decade, putting extra pressure on the community water supply. As at 15 December 2020, the total rainfall for the year was 554mm – about half the 10-year average of 957mm. As a result, the streams that supply drinking water to Akaroa and Takamātua were especially low in the lead-up to summer and they've continued to drop. The lack of water in the area and dry conditions is likely to have caused wildlife to seek out water.

The post-treatment reservoir is located within close proximity to L'Aube Hill Reserve and is surrounded by areas of bush (see Figure 4.2). The bush is in close proximity to the reservoir with a number of trees overhanging the roof.

Figure 4.2: Location of Treated Water Storage Reservoir

4.3 Network operation factors

The treatment plant was operating as intended and there were no issues identified within the reticulation system that would have contributed to the contamination event.

4.4 System and process factors

The Water Safety Plan for Akaroa/Takamātua identified a risk of contamination of the reservoirs by animals and noted that there were sites where vents and/or overflows could not be found. The maximum (unmitigated) risk was assessed as high. With the existing preventative measures in place – regular checks, locked and alarmed access hatches and a chlorine residual – the residual risk was considered medium and unacceptable.

The key actions identified to reduce this unacceptable risk were detailed inspections of the reservoirs followed by placing mesh on vents and overflows. The reservoir was scheduled for a detailed condition assessment as part of the Council's reservoir improvement programme.

The audit of the operation of the treated water reservoir in September 2020 identified a number of actions that were listed in an MS Excel spreadsheet. Individual work requests were then sent to CityCare to be actioned.

The volume of improvement actions resulting from the independent site audit programme (encompassing Banks Peninsula water operation sites) was more than Council and CityCare had capacity to manage and promptly address. The programme has over 500 improvement actions ranging in type, size and complexity of works required. The failure to prioritise the remedial actions to prevent animals entering the reservoir contributed to this contamination incident.

Recommendations:

Review the actions across the water supply networks, drawing on the audit programme and the improvement actions identified in the water safety plans, and dedicate a project manager to delivery of the works.

Review the capacity of CityCare to deliver the improvement actions within the required timeframes and, if necessary, reallocate some of this work.

Standard procedures for incident response are in place, documented in Promapp and reviewed on a regular basis. In this case it was clear that there was a failure to escalate to senior staff promptly and this delayed the issuing of the boil water notice. Although our processes make it clear when staff should escalate if an adverse water monitoring result is received it is less clear when escalations should occur when assessing other contamination incidents or risks.

Recommendation:

Review contamination and transgression response process documentation to ensure that it is clear and easily understood.

City Care are required to have a Contractors plan for operation and maintenance of all water and wastewater treatment plants. The plans are required to be updated on a regular basis. The Akaroa contractor plan was updated in 2020 but didn't specifically refer to the revised and recently approved Water Safety Plan.

Recommendation:

CityCare to review all contractor plans to ensure alignment with the requirements of the applicable Water Safety Plan.

4.5 People factors

The animals were found in the reservoir on Tuesday 9 February and shared between operational staff from CityCare and Council. However senior staff were not advised until Friday 12 February. The delay between the discovery of the dead animals, the escalation to senior staff and the issuing of the boil water notice was unacceptable.

An internal review found that there was mixed awareness and knowledge of the escalation required for this type of contamination event. Escalation occurred verbally, without written follow-up, which contributed to some confusion and misunderstanding about the location of the animals (in overflow pipes or in the water), which reservoir was affected (offline or online), and who was notified and when.

> ***Recommendation:***
>
> *Run regular workshops for both Council and CityCare staff to ensure a high level of awareness and good understanding of the incident response processes.*

Once senior staff had clear information about the event the response was well communicated and properly resourced. The Drinking Water Assessor was informed immediately and the response plan was activated.

A formal human resources disciplinary process was followed with council employees and appropriate action taken. Senior Council staff requested that City Care undertake a similar review and act appropriately.

5 Conclusion

All identified causes and factors contributing to the contamination events are listed and evaluated in Table 5.1.

Table 5.1: Possible causes of contamination

Risk Event	Evaluation	Likely cause
Contamination of source water	The event was the finding of animals into the reservoir. All analysis results were compliant.	No
Vandalism or sabotage	Visual inspections and photographs show no evidence of damaged or forced entry.	No
Animal ingress via reservoir overflow	Lack of mesh in the overflow pipe.	Likely
Animal ingress via roof	Lack of sealing in some sheets of the reservoir's roof cladding channels	Likely
Animal ingress via wall holes	Presence of gaps between the reservoir exterior walls and the ground level	Likely
Animal ingress via opened hatch	Doors and access hatch alarms are in place and working.	No
Contractor and Management issues	City Care didn't identify critical issues during monthly reservoir inspections.	Likely
Contractor and Management issues	City Care don't have an appropriate level of qualified and experienced treatment operators.	Likely

The primary cause of the incident was the poor condition of the reservoir that allowed animals (possums, birds and rats) gain entry to it. This was allowed to continue due to the failure to carry out reactive maintenance of the structure and the lack of a prioritised work programme to action improvement items following audits and inspections.

The entry of animals into the reservoir was a significant contamination event and a serious risk to the safety of the drinking water. The presence of free available chlorine in the reservoir provided a partial barrier – no total coliforms and no *E Coli* were detected in the drinking water – however chlorine is not effective against protozoa. There were 3 reported cases water borne disease, by people who had visited Akaroa, that could be related to this incident. However we did not see a significant increase in the total number of cases when comparing data across the year.

6 Remedial actions

Eight remedial actions that are required to reduce the likelihood of a similar incident have been identified as part of the Council's investigation. The actions are summarised in Table 6.1.

Table 6.1: Remedial actions

#	Description	Responsible Team	Due Date/ Status
1	*Undertake a condition assessment of the reservoir and evaluate the options for upgrade or replacement.*	3 Waters	28 May 2021 (Started)
2	*Review and improve the site checklist templates for all routine reservoir inspections to ensure adequate coverage of potential risks to water security.*	Water and Wastewater Operations	30 June 2021 (Started)
3	*Review the actions across the water supply networks, drawing on the audit programme and the improvement actions identified in the water safety plans, and dedicate a project manager to delivery of the works*	Quality and Compliance	30 June 2021 (PCG started)
4	*Review the capacity of CityCare to deliver the improvement actions within the required timeframes and, if necessary, reallocate some of this work.*	Service Excellence	28 May 2021 (Started)
5	*Review contamination and transgression response process documentation to ensure that it is clear and easily understood*	Quality and Compliance	Completed (Future ongoing reviews after each event)
6	*CityCare to review all contractor plans to ensure alignment with the requirements of the applicable Water Safety Plan.*	City Care	30 June 2021
7	*Run regular workshops for both Council and CityCare staff to ensure a high level of awareness and good understanding of the incident response processes.*	Quality and Compliance / City Care	One complete. Future workshops scheduled.
8	*Formal contract communications to be sent to City Care outlining qualifications and experience requirements of water treatment operators and highlighting the importance of monthly checks.*	Service Excellence	30 April 2021