Lead in tapwater

NZASE news article

Karitane Peninsula (mid- shot), with Waikouaiti at the rear across the bay. Photo: Mike Stone.

News of lead in tap water surfaced recently in three small Otago towns, and is a useful context for exploring chemistry. By NZASE Science Communicator Mike Stone.

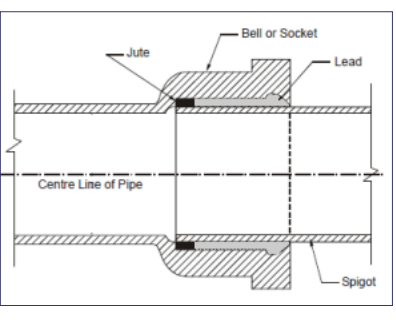
History of the issue

On February 2, 2021, residents of Karitane, Waikouaiti and Hawksbury were told to stop using tap water for drinking, cooking or preparing food, after tests showing lead in the water supply. The 1,500 residents were also told that boiling the water would not remove lead, but instead increase its concentration.

As reticulation from Dunedin stops at Seacliff, the water for these towns is drawn from the Waikouaiti River to a raw water reservoir. It is then sent to a water treatment plant (WTP) for processing before piping the water to the three townships.

Below: *Brass tap fitting.*

Centre: *A bell and spigot joint in cast iron pipes.*



Bottom: *Joint diagram showing places where molten lead is poured in to seal the joint.*

WTPs add substances to reduce the chance of metals contaminating our water supply. To determine the levels of these substances needed for a WTP upgrade, Dunedin had started measuring the levels of metals in the town supply.

Since July 2020, six out of 90 readings showed spikes in lead levels. Then on December 8, the lead level was measured at 0.39 milligrams per litre of water (mg/L) at the Waikouaiti Golf Club (WGC) and 0.07 mg/L at the Karitane Bowling Club (KBC).

Although WGC was 40 times the acceptable level, the email was not acted on until January when its recipient returned from holiday. Then more tests were done. On February 2, data was released to Dunedin City Council (DCC) showing that the raw water reservoir also had high lead levels, and so the townships were issued with the water contamination notice.

Residents in Waikouaiti, Karitane and Hawksbury Village were offered free water supplies and free fruit and vegetables. Their blood was tested and some high levels found. The DCC conducted a thorough investigation to find what caused these contamination events.

Effects of lead

Lead is a neurotoxin that can be absorbed from food and water, more readily when people's iron and calcium intake is low. Exposure to high levels of lead in children can cause immediate stomach upsets or difficulty sleeping, and long-term can lead to slowed growth, learning difficulties and decreased IQ.

In adults, it can cause nausea, diarrhoea and headaches, and over a longer time increase blood pressure, shorten the lifespan of red blood cells, and poison the kidneys (which remove lead from the blood). Children and pregnant women are more susceptible to these toxic effects.

Legal maximum exposure

The maximum accepted level of lead in drinking water is 10 micrograms per litre (µg/L) – equating to 0.01mg/L and 0.24 µmoles/L. The allowable level of lead in urban soil is 210mg/kg. However, lead is so toxic the World Health Organization deems no level of exposure to be safe.

Plumbers are concerned about the lead in our taps and pipes. Independent testing of five

tapware products sold here found the level of lead leaching from one to be 70 percent higher than the legal limit. And we allow higher levels of lead than do Australia, Sweden, Canada and the USA.

Contamination source

Most residents in the three townships were told they could use tap water again on July 28. According to DCC chief executive Sandy Graham, their investigation suggested the problem was most likely caused by pipes and fittings on private properties.

Extensive testing eliminated many potential causes. DCC found that the brass manifolds (which connect the customer to the mains) at both the WGC and the KBC leached significant amounts of lead, with outflow water having more lead than inflow water.

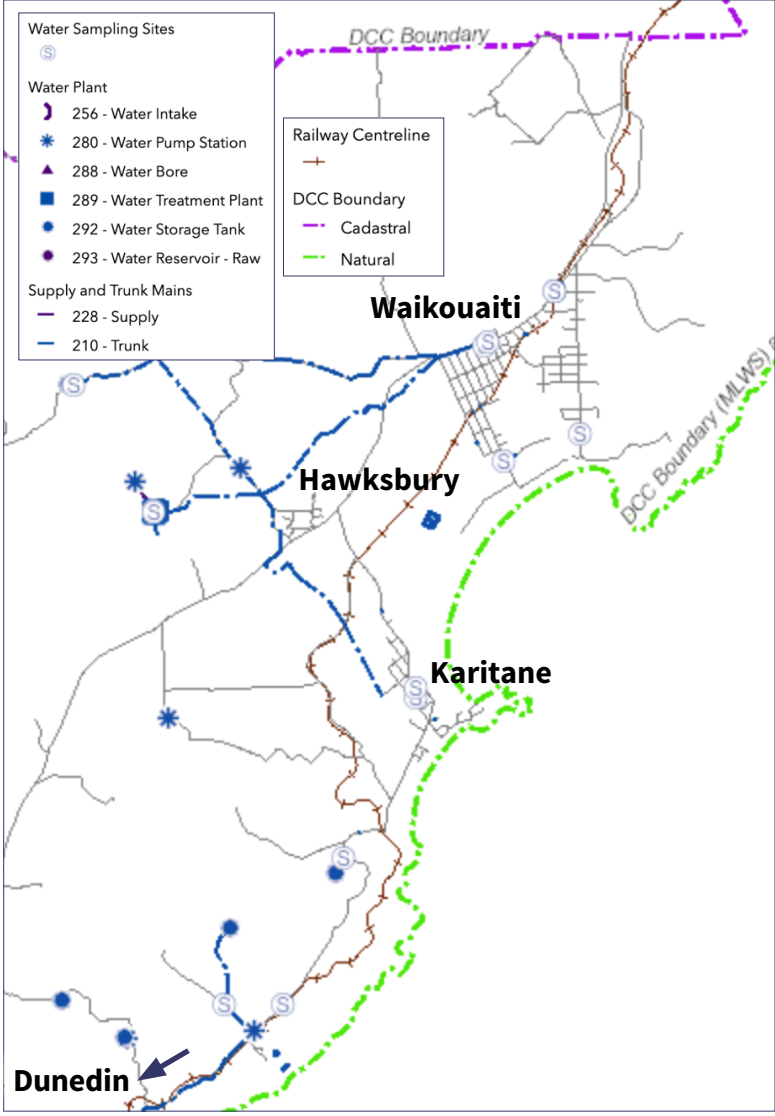
Once dedicated sampling sites were installed upstream, there were no further high lead levels recorded. The raw water reservoir had high levels on January 20 due to particulates in the sediment, at a time when reservoir level was low and the water quite acidic. These flecks are removed at the WTP so cannot get into the town supply.

Lead seals in cast-iron water pipes might seem an obvious source in town supply. However, when in good repair (and the ones tested by DCC were) the lead does not touch the water. And most pipes in the area were not cast iron and did not have these joins.

Some of these residents might use water supplied by rainwater tanks and this water can contain lead if there is lead paint, nail-heads or flashing on their roofs.

We can find lead at home too. In older houses, lead can be found in lead-based paint and in dust from sanding during renovation, or in ash from burning this wood. Lead can also be in garden soil as a legacy of leaded petrol. (We stopped using lead in our paint in 1979 and in our petrol in 1996.)

While some wondered if OceanaGold's Macraes open pit mine 50km northwest could be implicated, the company says not. The rock the company mines contains no lead, and no trace has been found in water tested around the mine site. However the schist in the spoil can sometimes shed lead-containing particles in heavy rain.



Water services map, showing the three townships serviced from water storage tanks.

Māori relationship with water

Wai is a taonga of paramount importance to Māori – many sacred rituals are conducted using water. Water has mauri and must be kept in its natural state as far as possible. Most iwi have a body of water they use as a food source and act as guardians for – a river, lake, sea or spring. Iwi kaitiaki and taniwha will protect water. In some parts of the country iwi have taken over responsibility for testing water quality.

From July 1, Taumata Arowai, a new regulatory body, became responsible for the infrastructure and services for our drinking water, wastewater and stormwater. This body is required to work with local government and mana whenua. Iwi, rūnanga and hapū across the country are increasingly playing a key role in water management and restoration projects.

Chemistry of water supply

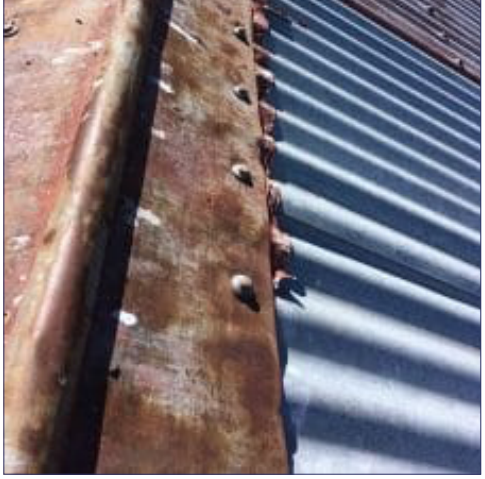
Most of the water supplied in New Zealand is slightly acidic, and this can dissolve lead and other heavy metals such as nickel, cadmium and copper. The amount of lead that will dissolve depends on -

- How acidic the water is (which depends on the amount of dissolved calcium and magnesium)
- The temperature of the water
- The composition of the plumbing fittings
- How long the water has been in contact with it.

This means if water is sitting for hours in household pipes, small amounts of heavy metals can leach from lead seals or brass fittings into the water supply. The Ministry of Health suggests running tap water for 30 seconds before ingesting it.

Classroom ideas

- Explain how each factor in the list above has its effect on lead concentration in water.
- Find out what hard and soft water are. Which type of water is preferable to reduce the problem with lead?
- Why is lead used for roofing nails and flashing?
- Is 30 seconds enough? How would you work out how long you need to flush the taps in your house to remove all the water that stood in the pipes overnight?
- Why would boiling water not remove the lead? What contamination would this remove?
- Flint Michigan (USA) also has a problem with lead in its water at a level of 13,000 parts per billion. If 1 ppb = 1 µg/L, convert this to mg/L. How does this compare to the Otago levels?
- How could you test the water coming out of the lab taps to show whether it contains lead?
- Look at this poster on Nga momo wai. Which word would best describe this lead-contaminated water?
- Find out more about mauri and discuss the concept as it applies here.
- Find 10 places with wai in their name and work out their meaning (including Waikouaiti). What does this indicate about Māori relationships with water?



Lead nail heads and roof flashings are a hazard for rainwater supply, and for kea on tramping huts.

- List the things that we need/use water for. Which are affected if it is contaminated?
- As citizens, how can we minimise our exposure to lead?

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Thanks to Nick Bryant, Jim O'Malley and Kate Rice for their help with this article.

Ngā Kupu

Kaitiaki – Guardian
Konganuku taumaha – Heavy metal
Konumatā – Lead (Pb)
Kōrere – Pipe, funnel, spouting
Mauri – Life force
Pūnaha wai – Water system
Taniwha – Water spirit
Taonga – Treasure
Wai – Water.

From Te Aka Maori Dictionary and Paekupu