

Lessons learned from one of New Zealand's most challenging civil engineering projects: rebuilding the earthquake damaged pipes, roads, bridges and retaining walls in the city of Christchurch 2011 - 2016.

Having a blast in the past

Story: Archaeology

Theme: Programme Management

A document which describes SCIRT's discoveries and processes regarding archaeological finds on worksites.

This document has been provided as an example of a tool that might be useful for other organisations undertaking complex disaster recovery or infrastructure rebuild programmes.

For more information about this document, visit www.scirtlearninglegacy.org.nz

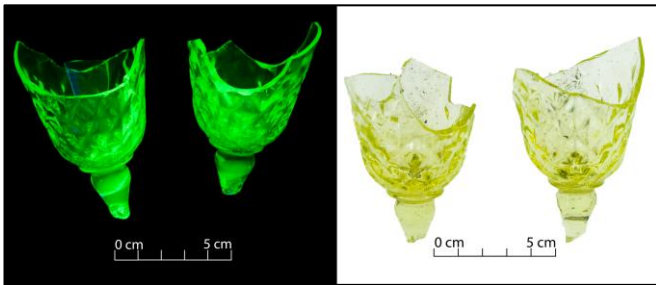


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Having a blast in the past

From “glow in the dark” glass to a moa toe bone, the rebuild of Christchurch’s horizontal infrastructure uncovered a remarkable array of artefacts.



Elemental discovery: Uranium glasses discovered in suburban Christchurch glow under black light, but display only a greenish tinge in normal light.

Referring to the “uranium glass” discovery in suburban Richmond in late 2016 in its online blog, Christchurch-based Underground Overground Archaeology said there was “nothing like a little radioactive material to brighten up the day”.

Underground Overground Archaeology worked with SCIRT throughout the horizontal infrastructure rebuild, identifying items and structures found during worksite excavation.

Director Katharine Watson said uranium was used as a “colouring agent” in uranium glass to “create a distinctive yellow or yellow-green colour”.

All aglow

The glass glowed bright green under an ultraviolet light because of the uranium oxide added to the glass in its molten state.

“Uranium glass became quite popular during the 19th century, from the 1830s onwards, although it was an unusual find here in Christchurch,” Watson said.

Despite the use of uranium, the “radioactivity of the glass was negligible”.

The discovery also illustrated the importance of robust archaeological protocols within the rebuild environment.

SCIRT, together with the Christchurch City Council, Environment Canterbury and Heritage New Zealand, established a suite of global consents to enable the organisation to carry out infrastructure repair and rebuild work quickly and efficiently. For further information about these consents, see [SCIRT Global Resource Consents](#).

The consents included archaeological “authorities” that detailed the conditions under which an archaeological site could be destroyed, damaged or modified. When working on low-risk sites, SCIRT workers followed an “accidental discovery protocol”. All work was stopped within a 20-metre radius of a new “find” and an archaeologist was contacted.

Protocol and process

However, the protocol was different for high-risk sites. In those cases, an archaeologist and a representative of local rūnanga might monitor the area at all times.

“We were first approached about the rebuild work in mid-2011 and attended a Christchurch City Council meeting on environmental planning,” Watson said.

“We put together applications for archaeological authorities – [one for the harbourside settlement of Lyttelton](#) and one for [Christchurch city](#).”

Seaside site

Closer to New Zealand’s natural environment, SCIRT team members found the moa bone while working on the Main Road wastewater pipe in seaside Redcliffs.

Redcliffs was already acknowledged as an area of “high archaeological sensitivity” because of the evidence of early Māori occupation. The sea and rivers provided canoe routes, and stone materials could be taken from the rocky cliffs for tool manufacture.

“One of the casualties of the Canterbury earthquakes was a sewer main that ran beneath Main Road from Barnett Park to McCormacks Bay,” Watson said. “Putting in its replacement provided a unique opportunity to learn more about the early Māori settlement.”

Prior to the rebuild work, an archaeologist was brought in to monitor excavation work in Moncks Spur, Redcliffs. The archaeological consultant found evidence of early Māori occupation, dating back about 700 years to the middle of the 14th century.

Food for thought

“The inhabitants had left a range of materials, from which we were able to get some idea of what they ate and what they were doing here,” Watson said.

These included an earth oven (hāngī) and the remains of cooked food.

“The remains showed that the main food was moa, followed closely by shellfish, principally cockles and, surprisingly, tuatua,” she said.

“Other birds included spotted shags, paradise shelducks, penguins, weka, oyster catchers, and swans. Fur seals and Polynesian dogs (kurī) were also consumed.”

The other finds included a bead made out of a fossilised shell and a workshop area where stone adze heads (toki) were crafted.

Dan Witter and Jeremy Habberfield-Short, working in association with Underground Overground Archaeology at Moncks Cave, were able to confirm the presence of a previously unrecognised stone-working technology, most likely used by Māori women to produce tools for working flax.

Another significant discovery was part of a small clay ball that had been baked in a fire. An unusual find, it was the first one of its kind dug up in Redcliffs.

Wall of discovery

Some of Christchurch’s most important infrastructure was historical, dating from the late 1800s. In Lyttelton, prisoners sentenced to hard labour were put to work on

public works, such as road formation and retaining wall construction. The first permanent goal buildings in the settlement were constructed between 1851 and 1861 in Oxford Street.

“Lyttelton was of particular interest because of its retaining walls,” Watson said.

“In particular, the red volcanic retaining walls constructed during this period have been described as a distinctive part of the townscape.

“Prisoners made a considerable contribution to the development of the town through the construction of infrastructure. Despite the recent changes to the townscape, the influence of the gaol remains a visible part of Lyttelton’s heritage.”



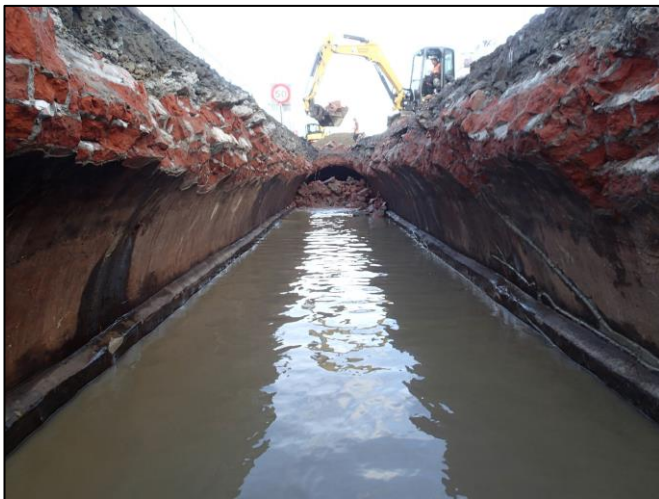
Another brick in the wall: A “red rock” retaining wall in Lyttelton reveals several crumbling layers.

Brick barrel drains

One of Christchurch's most impressive "finds" was the drainage network. In the city, the brick barrel drains were "remarkable from the historical infrastructure viewpoint". While their presence was known, SCIRT work provided archaeologists with rare access to the sites.

Watson also pointed out that there "were many parallels in SCIRT's programme of work", particularly when it came to a first-class drainage system.

"In the late 1870s, Christchurch was the deadliest city in New Zealand," Watson said.



Down the barrel: Repairs get under way on a storm water brick barrel pipe in Christchurch.

Christchurch's annual death rate was 30.4 per 1000 – almost double the national figure. Among the many diseases and illnesses affecting the city, "typhoid and cholera cases were rife". In 1875 alone, typhoid killed 49 people.

Such infectious diseases were transmitted by contact with excrement.

City fathers anxiously sought solutions, concerned that the new city was taking a very "old world" approach to sanitation.

After multiple feasibility studies and engineers' reports, a brick barrel drainage scheme was selected as the answer to society's ills. No longer would the senses of

citizens be assaulted on a daily basis.

Following the formation of the Christchurch Drainage Board in 1875, and the development of an engineering solution, a sewerage system was in operation by September 1882.

During the course of the SCIRT infrastructure work in the central city, Underground Overground Archaeology "was able to get up close and personal with the 19th century drainage system".

"It could be considered – by the standards of the day – to be one of the finest in the world," Watson said. "We've learnt a great deal about how the system was built, how it functioned, and how this system expanded and changed over time.

"The way the city's drainage infrastructure was designed and built more than 130 years ago had a direct impact on how to approach repairs in the present day. Cracked sewers were relined. The non-invasive technique ensured the historical sewers could remain operational for perhaps another 130 years or more."

A significant proportion of the central city's wastewater (5.2 kilometres) and storm water (6.9km) network was made up of the "brick barrels". These beautifully crafted pipes often were located at depths more than 2.5 metres below ground level. Remarkably, they could be repaired and continued to be used. The wastewater barrels were oval or egg shaped, and the storm water barrels were circular, ranging from 600 millimetres to 1300mm in diameter. The arched form of some of these brick barrels was achieved by using special tapered bricks. The earthquakes of 2010 and 2011 broke or loosened the mortar joints between the bricks, allowing sand and silt to enter.

Glazed earthenware pipes up to 460mm in diameter were used to construct the smaller branch sewers that connected to the brick barrels.

"One of the key things about the system was that it separated storm water and wastewater," Watson said." It was one of the underlying principles that made the system different compared with work being done elsewhere at the time.

"SCIRT replaced some sections but, basically, it was a



Well-disposed to discovery: A brick-lined well in Richmond reveals archaeological treasures.

repair job. It's incredible. In the 1800s, different streets were given to different contractors and built in different ways, shapes and forms. The excavations allowed us to build up a better picture of early Christchurch."

SCIRT discovered the remains of probably the oldest brick barrel sewer pipe in Christchurch. In the course of digging in Tuam Street, east of Fitzgerald Avenue, for the laying of a new water main, a SCIRT team discovered slightly curved brick walls. Historical research confirmed the walls were likely to be part of the city's original sewerage system.

Piped across the seas

However, there was one major surprise for archaeologists when investigating the drainage system: the sewer pipes were not made locally. In the late 1800s, tenders were sought by the council to supply pipes and imports won out.

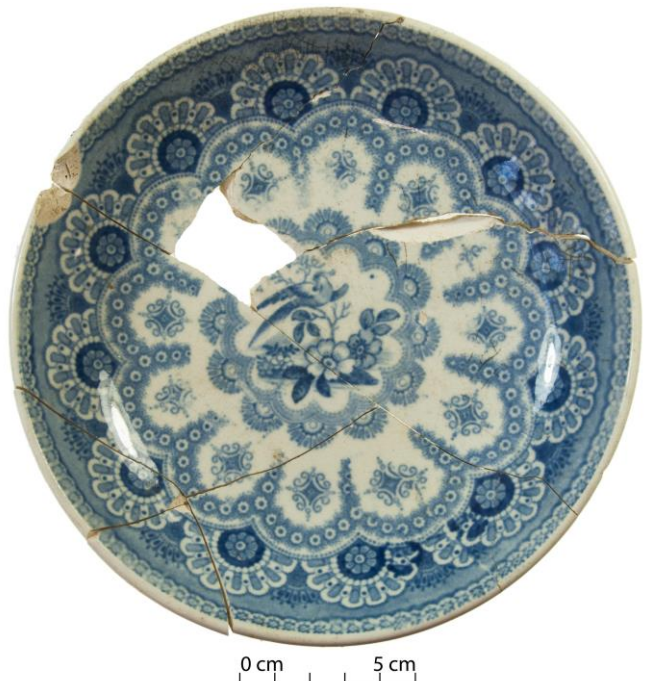
"A Scottish manufacturer (James Binnie's Gartcosh Fireclay Works) was selected, even though pipes were being made locally," Watson said. "The pipes would break in transit and there would be delays, making the overall cost higher."

Among the other horizontal infrastructure "finds" was the discovery of tram rails. From 1880, the people of Christchurch could travel by tram. Underground Overground Archaeology found the remnants of a 19th century tramway in Tuam Street. It formed part of the Canterbury Tramway Company's Addington line, which opened in January 1882.

Out in the suburbs, numerous items were discovered. Quality 19th century ceramics and glassware – including the uranium glass – were found more than 1.5m underground in Richmond. Deep inside a brick-lined well a SCIRT crew preparing to build a manhole found ceramics and glass bottles, ash, charcoal and the bones of animals. The selection of ceramics – including tea and tableware and elaborate serving dishes – displayed decorative styles popular about the mid-19th century.

"We don't often find rubbish pits below the road," Watson explained.

"It all adds to a sense of discovery."



A lot on their plates: Archaeologists have been kept busy on multiple Christchurch sites as the rebuild reveals items from the past, including a saucer decorated with a Dresden Vignette pattern. A maker's mark on the base identifies the saucer as being made by William Smith and Co. in Yorkshire, dating the manufacture to between 1825 and 1855.