

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.

Manchester Street Water Mains, Christchurch: Report on Archaeological Monitoring

Story: Archaeology

Theme: Programme Management

A report which details the archaeological investigations carried out during the course of SCIRT project 11185, water main renewal work on Manchester Street.

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













This work is licensed under a Creative Commons Attribution 3.0 New Zealand License.

The authors, and Stronger Christchurch Infrastructure Rebuild Team (SCIRT) have taken all reasonable care to ensure the accuracy of the information supplied in this legacy document. However, neither the authors nor SCIRT, warrant that the information contained in this legacy document will be complete or free of errors or inaccuracies. By using this legacy document you accept all liability arising from your use of it. Neither the authors nor SCIRT, will be liable for any loss or damage suffered by any person arising from the use of this legacy document, however caused.



Programme funded by
New Zealand Government







Fulton Hogan



MANCHESTER STREET WATER MAINS, CHRISTCHURCH: REPORT ON ARCHAEOLOGICAL MONITORING

NZHPT AUTHORITY 2012/321EQ

SCIRT 11185

HAMISH WILLIAMS, CHRISTINE WHYBREW, JILL HALEY & MARIA LILLO BERNABEU UNDERGROUND OVERGROUND ARCHAEOLOGY LTD

SEPTEMBER 2016

UNPUBLISHED REPORT FOR MCCONNELL DOWELL AND CHRISTCHURCH CITY COUNCIL

INTRODUCTION

Subsequent to the earthquake on 22 February 2011, water supply pipes in Christchurch were damaged, necessitating replacement. On 26 September 2011 New Zealand Historic Places Trust (NZHPT) issued a global authority (2012/321eq) under section 11 of the Canterbury Earthquake (Historic Places Act) Order 2011 to the Christchurch City Council. This authority was issued to allow the council, in conjunction with the Stronger Christchurch Infrastructure Rebuild Team (SCIRT), to undertake various earthworks in Christchurch. An authority was required as these earthquake related infrastructure repair works had the potential to impact upon known or unknown archaeological sites. During the course of excavations on Manchester Street for a new water mains pipe, two archaeological features were uncovered – a 19^{th} century rubbish deposit in an infilled gully or river channel, and a fire tank reservoir constructed in 1885 (Figure 1 and Figure 2). This report details the archaeological investigations of these features that took place during the course of SCIRT project 11185.



Figure 1 . Central Christchurch, showing the location of the new Manchester Street water mains pipe as shown with red line. Image: Google Maps.



Figure 2. 2016 aerial imagery of the Manchester/Gloucester Street intersection and environs, showing the location of the two archaeological features uncovered during July 2015 excavations for the new Manchester Street water mains pipe. Image: Canterbury Maps.

ARCHAEOLOGICAL MONITORING OF EARTHWORKS

Excavations for the installation of approximately 600 m of 300 mm diameter water mains pipe on Manchester Street (between Armagh Street in the north and Lichfield Street in the south) took place from July to October 2015, with Trenching Dynamix as the main earthworks and pipe installation subcontractor. Located along the eastern side of the Manchester Street roadway, this trench was approximately 1.2 m wide and excavated to 1.5 m depth. Two features were uncovered during the course of this work: Feature 1, a 19th century rubbish deposit in an infilled river channel/gully; and Feature 2, an 1885 fire tank reservoir. Both of these features were located close to the Manchester/Gloucester Street intersection, and both were investigated by Hamish Williams from Underground Overground Archaeology from 27 July to 3 August 2015 (Figure 3).



Figure 3. Plan showing the location of the two features uncovered on Manchester Street, and the locations of the stratigraphic profile drawings.

FEATURE 1: THE AVON RIVER CHANNEL

Historical background¹

Christchurch was laid out on a large swampy area of the Canterbury plains. The original town plan, plotted by Edward Jollie in 1850, was laid across the Avon River, taking advantage of this means of water supply and drainage. Inevitably the tributaries and overflow channels associated with the river ran through the streets and town sections surveyed on either side of the river, resulting in serious drainage problems (Wilson 1989: 10-11). Jollie's plan, known as the 'Black Map', indicates that a major channel ran through the city between the Avon River and the edge of Cathedral Square (Figure 4).

Figure 4. Detail of Jollie's 1850 'Black Map' showing the original platting of Christchurch and the course of the channel between the Avon River and the edge of Cathedral Square (red dotted line). Image: Jollie 1850.

In the early years of the city, the Canterbury Provincial Council attempted to address the drainage issue by establishing two major stormwater drains, on Moorhouse Avenue and Ferry Road. These were accompanied by smaller pipe, brick and open drains emptying into the Avon River. When the Christchurch Municipal Council was established in 1862, it immediately commissioned a report on necessary improvements to surface drainage and other sanitary issues. The sanitary committee made the following recommendations with regard to the filling and levelling of streets and associated hollows:

The surveyor should be particularly directed to form all the streets, where possible, at a level below that of the adjoining sections. If no immediate use be found, by filling up gravel pits or adjoining hollows, for the surplus earth from the streets thus formed, it should be temporarily deposited in the squares or other open places.

Your committee are of the opinion, that by alteration of the Municipal Council Ordinance, you should be empowered to fill up hollows on private property, in which the accumulation of stagnant water is likely to produce disease, and to recover the cost of doing so from the occupiers or owners of property.

Press 30/8/1862: 4.

¹ Online primary source material was consulted in the preparation of this narrative. This included deeds, maps, newspapers, electoral rolls and city directories. These sources were supplemented with published and unpublished secondary sources on drainage.

The council initiated a programme of street levelling (to minimise water stagnation) and the installation of open and pipe drains emptying into the rivers and creeks of the city (Wilson 1989: 14). In 1864 the City Surveyor, W. F. Moore, presented a report to the council on the drainage of the city. It was noted that the "rapid occupation of the sections and the formation of the streets" had dammed up the original channels and gullies that had provided the main drains. He made recommendations for a drainage system that included kerbs and side channels to the streets and the installation of drain and sewer pipes. He described the open ditch drains, which were located primarily in the least populated areas of the city, as "indispensable" but acknowledged that they would eventually need to be made covered drains (*Press* 19/7/1864: 2).

Part of the channel indicated on Jollie's map was located near the archaeological site at the intersection of Manchester and Gloucester streets. In 1902, a Canterbury colonist reminiscing about his childhood in early Christchurch described this section of the 'old gully' as it ran between Cathedral Square and Gloucester Street: "it ran its course through the buildings now occupied by Dalgety and Co. and the Tram Co., and entered the garden of the Late Judge Gresson, opposite the Canterbury Hall. Its course was then through the present City Council's yard" (*Press* 12/6/1902: 4). He also described "ponds" that formed in the channel that were filled with raupō. These ponds were likely to have been pools of stagnant rainwater, and combined with rubbish that would have accumulated in them, posed serious health hazards, and water-borne diseases such as typhoid, diphtheria and dysentery took their toll. By 1870 Christchurch had the highest death rate of any urban centre in New Zealand (Wilson 1989: 16).

The 1862 and 1877 maps of Christchurch show that few buildings were erected in the vicinity of the channel (Figure 5 and Figure 6). It seems likely that the problems with drainage deterred development of many of the nearby sections.

Figure 5. Detail from the 1862 map of Christchurch showing the channel (blue lines), the location of the Feature 1 rubbish deposit at the intersection of Manchester and Gloucester streets (red square) and the absence of development near the channel. Image: Fooks 1862.

Figure 6. Plan of Christchurch from 1877 showing the channel (blue lines), the location of the Feature 1 rubbish deposit at the intersection of Manchester and Gloucester streets (red square) and the absence of development near the channel. Image: Strouts 1877.

Development of the town sections south of Gloucester Street along Manchester Street took the channel into consideration and gardens were built in the problematic areas (Figure 7). Two acres (comprised of Town Sections 680 to 687) were owned by John Bealey but leased out to tenants during the 1860s and 1870s (LINZ 1850: 680, 681, 682, 683, 684, 685, 686, 687). The property was called 'The Pines', and had a large house located away from the site of the old channel (*Star* 28/12/1868: 1). Among the occupants was the Mayor of Christchurch, Henry Sawtell, who lived there in the early 1870s (*Press* 13/3/1872: 2) Town Sections 688-694 were owned by Rose in the 1850s and 1860s, and a large house was built at the corner of Worcester and Manchester streets and the remaining land made into garden (LINZ 1850: 688, 689, 690, 691, 692, 693, 694). The property was occupied by Justice Gresson until 1867 when John E. Coker took it over and turned it into a boarding house (*Lyttelton Times*: 1/7/1867: 3). The garden was open to the public and described in an advertisement as "laid out in a superior manner, with expensive shrubs and trees, having shady nooks and delightful walks, and forming a beautiful retreat" (*Lyttelton Times* 9/5/1867: 3). Coker did extensive work on the property, filling in the "stagnant pool of water which used to lie in what was once an old arm of the Avon" and laying lawn in its place (*Press* 5/10/1867: 2).

Figure 7. Development of town sections near the channel (outlined in blue) showing Coker's Hotel and Garden (outlined in green), 'The Pines' (outlined in yellow), and the location of the Feature 1 rubbish deposit (indicated in red). Image: Strouts 1877.

Although Coker fixed the issues with water on his grounds, the poor condition of the drains beyond his property continued to cause problems. On 7 January 1868, Christchurch was hit with a severe thunderstorm. For nearly half an hour there was a downpour that included three minutes of hail, and within minutes of the heavy rain starting, the sides of the streets were "filled with bounding torrents". The newspaper report of the event commented, "There is nothing like a good smart shower for finding out the weak points in the drainage of the city" (*Lyttelton Times*: 8/1/1868: 2). The side channel along Gloucester Street between Colombo and Manchester streets was identified as being particularly poor, and the report described in detail the problems it caused Coker:

This side channel, from the fact that it is neither deep enough nor wide enough, and from the additional fact that it is or was thoroughly choked up with a luxuriant crop of grass, was altogether unequal for the emergency; the consequence was that the water was thrown back on to the grounds attached to Coker's Hotel. A few months ago Mr Coker, at a very considerable expense, was compelled to fill up the old riverbed in his grounds, which many will remember as a stagnant pool of the very filthiest description. The imperfect drainage of the city in the spot we have referred to has been the cause of considerable damage to Mr Coker. *Lyttelton Times* 8/1/1868: 2.

A month later Christchurch was hit with a bigger disaster when the Waimakariri River flooded on 3 and 4 February 1868. The Avon rose quickly, and within hours had breached its bank near the Madras Street bridge. Two hours later it flowed onto Gloucester Street (*Lyttelton Times* 5/2/1868: 2).

During 1868 the council worked at alleviating the problems with drainage and installed drain pipe culverts around many parts of the city. This included the particularly problematic intersection of Gloucester and Manchester streets as well as the junction of Manchester Street and the south drain, where a double row of 15 inch pipe drain was laid (*Star* 15/12/1868: 3).

In the 1870s the council adopted a new culvert design. Although a general improvement on the old style, the "gross carelessness" with their construction meant some were not draining properly. In 1876 a culvert built at the intersection of Gloucester and Manchester streets was found to be 7 inches out of line with the Manchester Street channelling at one end and over 3 inches deeper in the centre than at the outfall end. When water in the centre exceeded 3 inches, there was no flow (*Star* 27/10/1876: 2).

Drainage continued to be a problem at that intersection until the end of the century. In 1896 a letter was sent to the *Press* complaining about the state of a drain flooded with soapsuds that was stagnant. It was, according to the writer, "the most gruesome death trap as to stench it has ever been my ill fate to know. I fear we may hear of an abundance of typhoid and gastric fever, also diphtheria, if allowed to remain" (*Press* 17/10/1896: 5).

Archaeological monitoring

Feature 1 was a 19th century rubbish deposit that was exposed by hydro excavation at a depth of 1350 mm below the road surface, and comprised a concentration of artefacts within a layer of compact grey clay (Figure 8, Figure 9 and Figure 10). These artefacts were distributed across a 2.4 metre long stretch of the trench, and the artefact-bearing grey clay was capped by six successive layers of grey clay, some of which were ash or soot stained (Figure 11 and Figure 12). A stratigraphic profile drawing of part of the west baulk of the trench was produced, but because of time constraints and health and safety considerations (owing to instability of the east baulk caused by the hydro excavation) only a 650 mm long section of the baulk was able to be drawn (Figure 13). Up to 250 mm of this base grey layer that contained the artefacts was excavated by hand until the required 1500 mm depth was reached. The bottom of this artefact-bearing layer was not reached during the course of this work, and as such artefacts from this feature remain in situ in this location below 1500 mm, as well as east and west of this location outside the trench line. The location of this rubbish deposit and the depth at which it was uncovered suggests that this material had been deposited in a low spot in the roadway either prior to, or during the course of 19th century road formation works. These works would have involved infilling (either in whole or in part) the natural gully or channel that crossed the roadway in this location. As such, this rubbish bearing deposit can be defined as a surface accumulation or ground levelling fill (after Butcher and Smith 2010: 56). Diagnostic artefacts from this feature were recovered for further analysis.

Figure 8. Looking northwest across the hydro excavated section of water mains trench as it crosses the Manchester/Gloucester Street intersection.

Figure 9. The Feature 1 rubbish deposit as first exposed near the base of the hydro excavated section of trench. The concrete bedded 225 mm diameter Gloucester Street earthenware sewer mains (installed 1905) is visible crossing the trench at far right of image.

Figure 10. Looking westwards along Gloucester Street at the Manchester Street intersection, with the water mains trench in the foreground. The spatial extent of Feature 1 exposed in the trench is indicated with the dashed white line.

Figure 11. Feature 1 at a depth of 1400 mm, showing animal bones, glass, and ceramic in the compact grey clay layer.

Figure 12. The western baulk of the excavation at the location of Feature 1. Note the rubbish deposit at base of trench, lower left of the photograph, and the ash/soot stained clay layers capping the deposit.

Figure 13. Stratigraphic profile drawing of part of the western baulk of the trench, at the location of the feature 1 rubbish deposit.

Artefact analysis

A total of 76 artefacts, from 139 fragments, were recovered from Feature 1, the artefact deposit in the infilled channel/gully. These included ceramic, faunal, glass, metal and other items (Table 1). Items were initially classified according to material class (ceramic, faunal, glass, metal, miscellaneous, shoes) before being identified to individual types and forms. Details of the analytical methods used during this process are provided in Appendix 1. The assemblage was then quantified by the number of individual specimens present (NISP), from which a minimum number of vessels (MNV) or individuals (MNI) was calculated (there is a full list of the artefacts in Appendix 2).

Table 1. Total NISP and MNI of artefacts from Manchester Street Water main, listed according to r	naterial.
---	-----------

Material	NISP	MN
Ceramic	55	29
Faunal	33	27
Glass	10	8
Metal	21	4
Miscellaneous	9	4
Shoes	11	4
Total	139	76

Ceramic

A total of 29 ceramic vessels, represented by 55 fragments were found in Feature 1. These consisted primarily of tea and table wares. The tea wares included two saucers and five teacups, while the table wares comprised eight plates, one dinner plate, one side plate, one egg cup, two jars, two unidentified hollow-ware vessels and one platter. Household items were also recovered, in the form of two chamber pots and one ink bottle. In addition, two fragments of a coarse earthenware bowl were found (Table 2 and Figure 14).

Body Type	Ware	Function	Form	MNI
ew-c	sgst	household	bowl	1
ew-r	ww	household	chamber pot	2
		table ware	dinner plate	1
			egg cup	1
			jar?	2
			plate	8
			platter	1
			side plate	1
			unid hollow-ware	2
		tea ware	saucer	2
			teacup	7
st	sgst	household	ink bottle	1
Total				29

Table 2. Ceramic vessels recovered from the site, listed according to body type, ware type, functional class and artefact form.

Figure 14. Ceramic artefacts from this Feature from left. Row 1: floral/foliage decorated saucer (SCIRT29-C-14), romantic transfer printed teacup (SCIRT29-C-9) and moulded edged and floral decorated plate (SCIRT29-C-19). Row 2: Whampoa patterned plate (SCIRT29-C-25), blue and black transfer printed plates (SCIRT29-C-21 and 26). Row 3: moulded egg cup (SCIRT29-C-23), black floral decorated jar (SCIRT29-C-21), blue transfer printed jar with floral/foliage motifs (SCIRT29-C-27). Row 4: unidentified hollow-wares (SCIRT20-C-20 and C-24) and blue decorated chamber pot (SCIRT29-C-15). Row 5: salt glazed bowl (SCIRT29-C-29) and penny ink bottle (SCIRT29-C-28).

Blue under-glaze transfer printing was the most common decorative technique identified in this assemblage (Table 3). A number of recognizable patterns were noted, including the Asiatic Pheasants, Fibre, Rhine, Vase on Wall, Whampoa and Willow patterns (Figure 14 and Figure 15). Unidentified motifs consisted predominantly of bands of flowers and/or foliage motifs decorating the rims and marleys, and scenic or 'romantic' motifs on the bodies and bases of vessels. These romantic patterns often feature a body with elements such as mountains, trees, cottages, "evoking images that excited the Victorian imagination" and became popular during the early-mid 19th century, partly in response to the classical revival of the early 19th century (Samford 1997: 13-14).

Chinoiserie motifs were also noted on several tea wares (Figure 15). Chinese inspired designs were extremely popular with Western consumers during the 19th century, particularly with those who could not afford expensive Chinese porcelains. They are characterised by the inclusion of pagodas, temples and weeping willows, along with densely printed designs – often geometric – on the rims and marleys of the vessels. Some patterns also related to a specific place, such as the Whampoa pattern identified in the assemblage, which refers to the island near Canton (Guangzhou), in China (Transferware Collectors Club 2016).

One shell-edged ceramic vessel was also identified, characterised in this case by the combination of a relief-moulded rim with blue paint along the rim (Figure 15). Shell edge was introduced as early as 1775 and continued through until the end of 19th century, although it is usually found on New Zealand sites dating prior to the 1870s. This was the least expensive decorated ware available, though an attempt was made around the 1820s to introduce more elaborate embossed shell-edged vessels (Brooks 2005: 44).

Technique	Pattern Name/Motif	Form	Ware	MNI
moulded	shell edge	plate	ww	1
		egg cup	ww	1
		unid hollow-ware	ww	1
moulded/ugtp	unid: floral/foliage	plate	ww	2
painting	unid	teacup	ww	1
ugtp	Asiatic Pheasants	plate	ww	1
	chinoiserie	saucer	ww	1
		teacup	ww	2
	Fibre	teacup	ww	1
	Rhine	plate	ww	1
		teacup	ww	1
	unid: floral/foliage	jar?	ww	1
	unid: floral/foliage/ architecture/trees	chamber pot	ww	1
	unid: floral	saucer	ww	1
		plate	ww	1
	unid: foliage	plate	ww	1
		unid hollow-ware	ww	1
	unid: foliage/birds	chamber pot	ww	1
	unid: geometric	chamber pot	ww	0
	unid: trees/architecture	teacup	ww	1
	Vase on Wall	plate	ww	1
	Willow	dinner plate	ww	1
		platter	ww	1
		side plate	ww	1
ugtp/painting?	unid: floral/foliage	jar?	ww	1
Total				29

Table 3. Ceramic artefacts found in this Feature, listed according to decorative technique, pattern name/motif, artefact form ad ware type.

Figure 15. Patterned ceramics from the site. Row 1 from left: Asiatic Pheasants plate (SCIRT29-C-7), Fibre teacup (SCIRT29-C-8), Rhine plate (SCIRT29-C-4) and Rhine teacup (SCIRT29-C-4). Row 2: Vase on Wall plate (SCIRT29-C-12), Willow dinner plate (SCIRT29-C-2) and Willow side plate (SCIRT29-C-3). Row 4: chinoiserie teacups (SCIRT29-C-10) and saucer (SCIRT29-C-11) and shell edged plate (SCIRT29-C-16).

Faunal

Twenty-seven faunal elements were recovered from Feature 1, represented by 33 fragments, identified as cow and sheep, although the latter was the most common (Table 4).

Species common name	Element	MNE
cow	lumbar vertebrae	1
	radius	1
	rib	2
	sacrum	1
sheep	femur	6
	humerus	3
	mandible	1
	metacarpal	2
	metatarsal	2
	pelvis	1
	radius	1
	rib	2
	scapula	2
	tibia	2
Total		27

Table 4. NISP and MNE of faunal material from the site, listed according to species common name and element.

Eleven butchery units were represented (Table 5). There was evidence of the purchase of short lengths of ribs. The rest of the butchery units were sheep: one chuck, two foreshanks, four hindshanks, one loin/rump and one skull. Bones from the sheep skull may suggest the consumption of cheaper cuts of meat or the possibility of on-site/nearby butchery. The fore and hindshanks were the most common cuts, both of which are relatively inexpensive cuts of meat, typically used for soups, stocks or stew (Colley 2006). All of these faunal elements were burned and they were likely to have been food waste. It was possible to establish the age of death of the sheep represented, which were more than 3.5 years old, according to the fused bones of the coxae and the distal end of the femur bones.

Species common name	Butchery unit	MNBU	MNE
cow	foreshank	1	1
	loin	1	4
sheep	chuck	1	2
	foreshank	2	6
	hindshank	4	10
	loin/rump	1	3
	skull	1	1
Total		11	27

Table 5. Minimum number of butchery units represented in the feature, listed according to species and butchery unit.

Glass

A small assemblage of glass artefacts was recovered from the feature. The artefacts comprised three black beer bottles, one of which was large sized, one sauce bottle, one unidentified round sectioned bottle and three tumblers (Table 6 and Figure 16).

Table 6.	Glass artefacts	from the site,	, listed according to	o class and common name

Class	Class Common name		
	black beer	2	
alcohol	black beer (l)	1	
condiment	sauce bottle	1	
non-alcoholic	unid ro c/s	1	
table ware	tumbler	3	
Total		8	

The lack of embossing or labels on the bottles makes it difficult to identify the original contents. While black beer bottles were often associated with both wine and beer, they may have been reused for a variety of products during their uselife. Aqua green light bottles have been seen elsewhere with labels denoting food, rather than alcohol and related contents (Garland 2014: 146).

Evidence of dip moulding was noted on all the glass bottles. This manufacturing method was common during the 19th century. Additionally, the sauce bottle was formed using a two-piece mould, as were two of the panelled tumblers found. The third tumbler was press moulded with cut glass decoration and a starburst on its base. Overall, press moulded table ware artefacts occurred frequently on sites from the mid-19th century through the 20th century.

Figure 16. Glass artefacts from Feature 1. Row 1 from left: two black beer bottle bases (SCIRT29-G-1 and G-2) and large black beer finish (SCIRT29-G-3). Row 2: press moulded sauce bottle (SCIRT29-G-5) and sauce bottle finish with cork (SCIRT29-G-6) and unidentified rounded cross section bottle (SCIRT29-G-4). Row 3: press moulded tumblers (SCIRT29-G-7 and G-9) and cut moulded tumbler (SCIRT29-G-8).

Metal

Four metal artefacts were recovered from Feature 1. With the exception of one pot fragment, the rest of the items were impossible to identify due to their level of fragmentation and corrosion (Table 7 and Figure 17).

Table 7.	Metal	artefacts	found on	this F	Feature.	listed	according to	o material.	class and	artefact form.
Tuble / I	metai	arteracts	iouna on		cuture,	iii seca	accoraing to	,	ciuss ana	

Material	Class	Form	MNI
ferrous	container	pot	1
	strip	unid	2
zinc/tin?	sheet	unid	1
Total			4

Figure 17. Metal artefacts from the site. Clockwise from top left: ferrous strip (SCIRT29-M-2) and several fragments of ferrous strip (SCIRT29-M-1), zinc sheeting (SCIRT29-M-3) and ferrous pot (SCIRT29-M-4).

Miscellaneous

Several miscellaneous items were recovered from Feature 1, including small brick fragments, one cork, part of a wooden tap that might have been for a barrel, a fragment of chalk and the remnants of a rope (Table 8 and Figure 18). However, no further information could be found about them, due to the size and condition of the fragments.

Table 8.	Other items	recovered from	hthe site, lis	sted according t	o material and	artefact form.
	••••••		,			

Material	Artefact	MNI
clay	brick	1
cork	stopper	0*
wood	tap	1
limestone	chalk	1
fibre	rope	1
Total		3

* MNI is 0 because the cork is considered part of the bottles found.

Figure 18. Other items found in the feature. From left: wooden tap for a barrel (SCIRT29-MC-2), chalk (SCIRT29-MC-3) and small fragments of bricks (SCIRT29-MC-4).

Shoes

A minimum of four shoes were recovered from the feature, including the upper of a boot (Table 9 and Figure 19). All of them were adult sized. Toe shapes could only be determined for one of the shoes: this was squared shaped, a style that was most common on women's and men's shoes from the 1850s through to the 1870s (Stevens and Ordonez 2005: 17).

Two manufacturing techniques were noted within the assemblage, including the use of pegs between heel, outsole and insole and two examples of machine stitching between the insole and outsole and on the upper. In the 19th century shoemakers mainly used pegs for common shoes until the demand for this type died out in the late 1870s. The trade magazine *The Shoe and Leather Reporter* (1842-1884) noted that both men's and women's shoes were pegged during the mid-19th century. Heavy boots and cheaper shoes had either pegs or nails, while the finer and costlier shoes had welts (Stevens and Ordonez 2005: 14).

All the shoes were also reinforced throughout the sole using pegs. The thread of the stitched shoes was gone, but the holes remained. These are generally much smaller than those left in pegged shoes and are slightly oval (Anderson 1968: 62).

Table 9. Shoes recovered from the Feature, listed according to class, portion, size/wear, type/style and manufacturing process.

Class	Portion	Size/	Type/style	Heel	Sole/insole	Upper	Reinforcing	MN
		wearer						
boot	upper	adult	n/a	n/a	n/a	machine	n/a	
						stitched		1
shoe	lifts	n/a	n/a	pegged	n/a	n/a	several pegs	1
	sole	adult	n/a	pegged	machine	n/a	n/a	
					stitched			1
					pegged	n/a	pegs on sole	
							and heel	1
Total								4

Figure 19. Remnants of shoes recovered from the feature. Clockwise from top left: pegged sole (SCIRT29-S-3), machine stitched sole (SCIRT29-S-2), partial pegged heel (SCIRT29-S-4) and fragments of stitched upper (SCIRT29-S-1).

Discussion

The artefacts from this Feature 1 assemblage are all typical of domestic material and/or commercial material found on 19th century sites elsewhere in New Zealand. The high proportion of blue and white patterned ceramics, particularly chinoiserie and romantic styles is quite distinctive and may suggest an earlier date of deposition, c. 1870s or earlier. Similar assemblages and styles have been found on Christchurch sites dating to the 1860s and early 1870s, including one nearby on Armagh Street (Garland et al. 2015, Mitchell et al. 2014). This is also supported by the presence of pegged and stitched shoes in the assemblage, both of which can be characteristic of early Christchurch sites.

The archaeological context of this material, identified as a rubbish deposit in a natural river channel or gully that was infilled in the 19th century, suggests that the material may have accumulated over time. Alternatively, the material may have been deposited in the gully as a single dumping event, or was dumped somewhere else and then redeposited in the gully when it was filled in. Manufacturing dates based on the glass artefacts and shoes along with ceramic patterns are consistent with gradual or single event deposition during the 19th century. It is impossible to know for certain who this material originally belonged to, or was discarded by, but this material may have been associated with any one of the residences or business located along this part of Manchester Street during this period.

The assemblage is considered to be of low to medium significance by itself, based on the criteria outlined in Table 10. The significance value may also change in future if any other material is recovered from the feature.

Criteria	Value
Condition	Low. Material fragmented.
Context	Low. Uncertain when or how material was deposited, although the assemblage
	has a good archaeological context and known TAQ.
Rarity	Medium. Material appears to date from the first two or three decade of
	Christchurch settlement, a period not well represented by material culture in the
	archaeological record.
Information potential	Low-medium. Assemblage is too small and lacks the product information
	necessary to provide any meaningful information.
Cultural associations	None known.
Amenity	Low. Assemblage too typical and fragmentary.

Table 10. Assessment of significance for artefact assemblage recovered from Manchester Street Water main, according to archaeological criteria.

FEATURE 2: THE MANCHESTER STREET FIRE TANK

Historical background²

Fire in central Christchurch during the colonial era was a serious and recurrent issue due to the predominance of timber buildings. With no reticulated water supply, property owners fought fires themselves with buckets filled with water from wells or the Avon River (Phillips 2010: 7). The Christchurch Volunteer Fire Brigade was founded in 1860, based in a temporary station on the corner of Cashel and High Streets (Phillips 2010: 7, Wilson 1995: 59). The first fire engine was a small, wooden hand-drawn engine donated by an insurance company (Phillips 2010: 7). In 1865 the Christchurch City Council purchased a steam fire engine for the Christchurch Volunteer Fire Brigade and took over

² Online primary source material was consulted in the preparation of this narrative. This included deeds, maps, newspapers, electoral rolls and city directories. Secondary sources, *Always Ready: Christchurch Fire Brigade: 1860-2010* by Tony Phillips and John Wilson's "Contextual Historical Overview for Christchurch City" were consulted for their accounts of the formation and activities of the Christchurch fire service and the history of fire prevention and firefighting in central Christchurch.

running of the fire service in 1867. The Council operated the fire service until 1907 when it was taken over by the Christchurch Fire Board (Wilson 1995: 59).

Prior to the development of the city's water reticulation network in 1909, the fire service was challenged by the lack of a high pressure water supply for firefighting (Wilson 1995: 60). A reservoir for firefighting purposes was recommended by the City Surveyor in 1864, envisaged to supply 48,000 gallons in an above ground tank. He also proposed permanent tanks that could supply five to six engines for up to six hours. These tanks were expected to be a visual ornament to the "long and dusty streets" of the city with a decorative "iron railing [and] a fountain playing in the middle" (*Press* 19/4/1864: 2). In 1871 above-ground fire tanks were constructed by the Christchurch City Council at the south-east corner of Cathedral Square and another two on High Street at the corners of Lichfield and Tuam streets (*Press* 14/3/1871: 2, *Star* 30/5/1871: 3, *Press* 8/2/1871: 2). A fourth tank was constructed on the corner of Whately Road and Peterborough Street (*Press* 24/10/1871: 2). These tanks were installed on reserve land and are indicated on the 1877 Strouts plan of Christchurch (*Press* 22/9/1877: 1, Figure 20 and Figure 21).

Each tank was capable of supplying 20,000 gallons (76,000 litres) of water, but from the onset were mostly used for filling water carts (*Star* 6/10/1871: 2, *Star* 25/6/1913: 4; Figure 22). Rather than an ornament to the city, the tanks were found to be unattractive and prone to leaking. However, the council was pressured by residents, insurance companies and the fire brigade to increase the size and number of tanks in the central city (*Press* 31/1/1876: 3, *Star* 30/5/1871: 3, *Star* 31/1/1872: 2, *Star* 28/3/1873: 2, *Star* 29/7/1881: 3). The cost of constructing additional or larger tanks met with some ratepayer resistance, though, as the cost of construction was incommensurably high in relation to the value of property in the city (*Press* 29/12/1884: 2). It was also proposed that improved water pressure could be obtained by pumping directly from the city's artesian wells (*Press* 28/11/1879: 3).

In December 1884 the council resolved to construct six underground tanks and to sink associated wells to supply them (*Press* 9/12/1884: 2). The tanks were situated at the junctions of Durham and Salisbury streets (recorded in ArchSite as archaeological site M35/1716), Cashel and Barbadoes streets (M35/1715), Lower High and Barbadoes streets (M35/1713), Montreal and St Asaph streets (M35/1714) and Manchester and Gloucester Street. The location of the sixth tank, though not identified in this report, was on Gloucester Street close to the intersection with Colombo Street (*Star* 30/11/1887: 3, site M35/1661). Each tank had a capacity of 25,000 gallons (approximately 114,000 litres) and was capable of supplying water over a radius of 1,000 feet (305 metres). Council approved expenditure of £1,800 on the fire tanks (£300 for each tank), funded through a Municipal Loan draw down to fund a number of major infrastructure projects in the city (*Press* 16/1/1885: 3 and 14/4/1885: 4). However, some councillors feared the tanks "would be like those [installed in the 1870s] which proved such failures" (*Star* 16/1/1885: 4).

The tank at Manchester and Gloucester streets was situated south of the intersection, on the eastern side of Manchester Street (Figure 23). It is recorded on the Christchurch City Council's infrastructure asset database as Water Supply Structure ID # 699 (SCIRT n.d.). No tender notice can be found for the construction of the tank, but it was completed by September 1885 (*Star* 22/9/1885: 4). It was filled through an adjacent artesian well and overflow from the Crown Iron Works on the corner of Manchester and Armagh streets (*Press* 10/2/1908: 8). The Manchester Street tank was selected for testing to demonstrate the efficacy of the completed fire tank system (*Star* 23/9/1885: 2). The test was conducted, with some ceremony, on 28 September 1885 and was found to exceed the anticipated flow of supplying two engines at a total capacity of 750 gallons (3,410 litres) per minute. The entire tank was emptied in 31 minutes, although inflow from the artesian supply continued to enter the tank (*Star* 29/9/1885: 4).

The Manchester Street tank was in close proximity to the Chester Street fire station, situated on the banks of the Avon River on Oxford Terrace (the portion then known as Chester Street), adjacent to the Oxford Hotel (Figure 24). The building was extant at the time of the Canterbury earthquakes and was demolished soon after. From 1886 to 1889 the building was Christchurch's sole station, housing the brigade's three steam engines, and first chemical engines, *Pioneer* (Phillip 2010: 20-22). The Manchester Street fire tank was in regular use from 1885 to the early 1900s to fight fires in the northeast of the city, often in conjunction with the Cathedral Square tank (*Press* 17/11/1886: 2, 11/3/1895: 5, 8/4/1902: 3, *Star* 5/12/1888: 4, 24/10/1885: 3). The tanks were efficient in fighting fires, but had a tendency to overflow, requiring supply to the tanks to be stopped periodically (*Press* 12/1/1886: 2).

In 1909 the high-pressure reticulated water system was introduced in central Christchurch. Prior to that, on 6 February 1908 a significant fire destroyed a number of buildings between Lichfield and High streets (Wilson 2005: 60). Although the supply of water was found to be adequate from the tanks and the river, time was lost in relocating the fire engines between tanks when each was pumped dry (*Star* 7/2/1908: 1). In response to that, the Christchurch Fire Board recommended that the underground tanks be connected through a network of drainage pipes to ensure their continual supply (*Press* 10/2/1908: 8). It was further advocated that the underground tanks be retained as a back-up fire prevention system in anticipation of the inauguration of the high pressure water supply (*Press* 10/2/1908: 8). After the city's high pressure water supply was introduced, the Christchurch Fire Board continued to express concerns that the water supply was inadequate for firefighting (*Star* 29/9/1909: 1). The above ground tanks were removed in the early 20th century, but the underground tanks were retained in situ (*Press* 15/9/1920: 3, *Star* 25/6/1913: 4).

Figure 20. Cathedral Square and High Street fire tanks, 1877 (identified by red rings). Image: Strouts' 1877 map of central Christchurch, Alexander Turnbull Library.

Figure 21. Whately Road and Peterborough Street fire tank, 1877 (identified by red ring). Image: Strouts' 1877 map of central Christchurch, Alexander Turnbull Library

Figure 22. Detail from "4983 – Christchurch from the Cathedral Tower", c.1885, Burton Brothers photograph, Museum of New Zealand Te Papa Tongarewa. Ref C.011637. Cathedral Square fire tank in foreground (identified by red arrow) with horse-drawn water carts being filled.

Figure 23. Plan showing location of Manchester Street fire tank (red ellipse), undated plan [20th century], Christchurch City Council.

Figure 24. Proximity of Chester Street Fire Station (red ring) to approximate location of Manchester Street fire tank (red arrow). Image: Strouts' 1877 map of central Christchurch, Alexander Turnbull Library. Current street alignments overlaid.

Feature 2

Feature 2 was the fire tank reservoir built in 1885. It measured 37.7 m in length, and had an internal width of 2.2 m. The tank was of standard barrel vaulted construction – its roof and side walls were formed of a simple semi-circular brick arch which was of triple brick thickness, sprung off a rudimentary concrete footing less than 200 mm in height (Figure 25 and Figure 26). The bricks were laid in a common running bond.

Figure 25. Stratigraphic profile drawing of Feature 2, the 1885 fire tank.

Figure 26. The northern end of the fire tank after breaking through the brick crown. Note the three layers of brick, and the unreinforced concrete either side of the arch.

The end walls were unreinforced concrete, 500 mm thick, with broken red brick incorporated into the concrete as an aggregate component (Figure 27 and Figure 28). The tank had two manhole access points, located directly atop each of the concrete end walls, which were recessed below where these manholes were located (Figure 29). The inside of the tank had been rendered with a thin layer of cement mortar, presumably as a waterproofing measure.

Prior to breaking into the tank, a pump was used to remove the majority of the water inside – which prior to the commencement of pumping reached to within 400 mm of the soffit. Despite continued pumping, it was not possible to remove all the water (Figure 30). Because of this, the base of the tank was obscured for the entire duration of the work. The base of the tank was presumed to be of concrete and/or brick construction, and although this was not able to be inspected because it was underwater, the bottom of the tank was not impacted by the installation of the water mains pipe and remains in situ. As no water was observed to be coming out of the tank, it is presumed that this water was derived through the northern and southern end walls of the tank, it is presumed that this water was derived from groundwater infiltration (Figure 31).

Figure 27. The northern end of the fire tank, looking north.

Figure 28. The northern end wall of the fire tank, showing the concrete of 500 mm thickness, and bricks incorporated as aggregate.

Figure 29. The northern end wall of the fire tank, showing the tapering of the concrete associated with the manhole access point in this location.

Figure 30. Looking south along the fire tank works area. Note the water within the tank.

Figure 31. An internal view of the northeast corner of the fire tank, showing the 80 mm diameter iron inlet pipe projecting through the northern end wall.

The new water mains was laid along the entire length of the fire tank, necessitating the removal of a 1.1 m wide section of both the northern and southern end walls, as well as the upper most part of the crown arch along its full length (Figure 32). The amount of the crown that needed to be removed to lay the new water mains pipe through the feature varied along the length of the tank. Where the tank was first broken into at the northern end, a 1.7 m wide section of the crown was removed. For the rest of the length of the tank, however, up to a 1.5 m wide section of the crown was removed. Compacted AP65 hard fill laid atop bidim geotextile cloth was used to build up the inside of the tank to the requisite height, prior to laying the new water mains pipe (Figure 33 and Figure 34).

Figure 32. The removal of the crown arch of the fire tank, looking south.

Figure 33. Looking northwards along the trench line at the northern end of the tank, after the tank had been filled with compacted AP65 aggregates to 1.5 m depth.

Figure 34. Looking north along the trench line from the southern end of the tank after the feature had been filled with compacted AP65 aggregates to 1.5 m depth.

As excavations proceeded, it became apparent that the tank had not been laid level, but sloped southwards. At the northern end of the feature, the tank had approximately 420 mm cover, whereas at the southern end of the feature the tank had approximately 1000 mm cover (Figure 35 and Figure 36).

Figure 35. Stratigraphy of the east baulk of the excavation above the tank at the northern end of the feature, where the depth of cover was 420 mm.

Figure 36. The southern end of the tank, looking south. Here the depth of cover atop the crown is 1000 mm.

Unreinforced concrete with rounded aggregates had been laid atop the crown of the tank, evidently to provide added strength to the structure and to help it resist top loading stresses from road traffic. At the northern end of the tank the concrete had only been laid either side of the arch, whereas towards the southern end of the tank the concrete fully covered the arch, up to 300 mm thick. Three

relict 100 mm diameter earthenware pipelines (fully encased in concrete) crossing over top of the tank in an east-west direction were cut during the course of excavations (Figure 3, Figure 37). It is suspected that these pipelines are 19th century wastewater laterals which connect with the Manchester Street wastewater sewer main, which was installed in 1882, and is located below the western side of the roadway (Hercus 1942: 82). Christchurch City Council records show three relict 19th century wastewater laterals crossing the tank in this location (SCIRT n.d.).³ If these laterals were installed prior to 1885, then these would have had to have been temporarily relocated when the tank was under construction in 1885, before being relaid (embedded in the fire tank concrete) after completion of the tank. It was not possible to closely inspect any of these laterals, although parts of these still remain in situ, embedded in the concrete.

Figure 37. One of the possible 19th century wastewater lateral pipes embedded in the concrete capping the fire tank.

An iron pipe of approximately 150 mm diameter was found crossing through the middle of the tank in an east-west direction (Figure 3 and Figure 38). The rough appearance of the concrete where the pipe projects through the side walls of the tank confirms that this pipe post-dates the 1885 construction of the tank, though it is unclear whether the pipe dates to the 19th or 20th century. The latter is probably more likely to be the case, and it is suspected that it is either an old water or gas mains pipe. It remains in situ.

A very compact, blue-grey clay was exposed across the fire tank excavation area. This was up to 450 mm thick and had been deposited atop the unreinforced concrete that capped the crown arch of the tank (Figure 35 and Figure 39). It is not clear whether this blue-grey clay represents the natural clay substrate excavated from this area during the 1885 excavations for the tank, stockpiled on site and then backfilled after completion of the tank, or whether this clay was brought in from elsewhere for specific use as a waterproof clay capping layer. The latter is perhaps more likely to be the case.

³ These are listed on CCC records as wastewater lateral IDs 105338, 105336, and 105333 and served 198 and 204 Manchester Street (SCIRT n.d.). These laterals have all been abandoned and are no longer in use.

Figure 38. Looking south down the fire tank, showing the 150 mm diameter iron pipe laid through the tank. This is possibly an old gas or water mains pipe.

Figure 39. The east baulk of the fire tank excavation area, 15 metres from the southern end of the tank. Note the blue-grey clay capping the concrete laid atop of the arch.

Standard sized machine pressed bricks marked W NEIGHBOURS / CHCH 1885 were used in the construction of the fire tank, and these had been laid in a standard running bond (Figure 40). These bricks had a fine-grained red body, and were very well fired, and were manufactured by William Neighbours, who began producing bricks in Christchurch in 1863. Neighbours first began to advertise machine pressed bricks in late 1883 (M. Hennessey, pers. comm., 7/9/2016).

Figure 40. Machine pressed W Neighbours brick from Feature 2.

DISCUSSION AND CONCLUSION

The 2015 excavations for the installation of a new water mains pipe along the eastern side of Manchester Street uncovered two archaeological features dating to the 19th century. Feature 1, a deposit of rubbish that was dumped in a natural river channel or gully that was infilled in the 19th century, is an interesting feature that speaks of how the natural topography of central Christchurch changed in the first few decades of settlement. It is suspected that the natural drainage channel/gully that crossed the Manchester/Gloucester Street intersection must have been filled in, either in whole or in part, at an earlier rather than later period in the history of the settlement, possibly in the 1860s or early 1870s. This date is supported by evidence from the artefacts that were recovered from this feature, specifically the decorative patterns and motifs on the ceramics (of types which were popular in this pre-1870s period) as well as the manufacturing evidence of the leather footwear. Further excavations in this area have the potential to shed light not only on the spatial extent of this natural drainage feature, but also on early road formation processes.

Feature 2, the fire tank reservoir built in 1885, was an interesting feature that is the first feature of its kind to be investigated archaeologically in Christchurch. As such, prior to this work, little was known about these reservoirs. 19th century subsurface features of barrel vaulted construction, however, are not unknown in Christchurch, and several have been investigated during the course of the SCIRT programme – all of these being brick barrel stormwater and wastewater conduits associated with the post-1875 development of Christchurch's drainage system (for some examples see Williams 2015, Williams 2016). The barrel vaulted arch of the Manchester Street fire tank was no doubt constructed using a similar technique as that employed in the construction of the city's brick barrel sewers – with bricks being laid atop a temporary semi-circular shaped timber formwork that would have been removed (or relocated) once the mortar had sufficiently hardened. It is also suspected that some form of subsoil pipe drain would have had to have been installed in order to remove groundwater from the works area when the tank was being built. As the Manchester Street wastewater sewer was installed in 1882, it is possible that a temporary connection would have been made into this existing sewer, in order to sufficiently dewater the works area. It is possible that evidence of such a drain remains in situ

below the concrete base of the tank, as well as possibly an east-west orientated pipe connection between this excavation area and the wastewater sewer main.

Evidence of the inlet pipes which supplied the tank with artesian water was found during this work, though it is not known to what extent any parts of these pipes remain in situ outside the footprint of the tank (i.e. below the adjacent footpath). However, no evidence of any form of overflow/outlet pipe was found during this work. Because of this, it is suspected that the inlet pipes would have had some form of valve to control the flow of water into the tank. If there was no overflow pipe or inlet valve to control the amount of water flowing into the tank, it is suspected that water would have come up through the manholes and across the unsealed roadway.

Because this is the first fire tank reservoir feature in Christchurch to be subject to archaeological investigation, and no contemporary 'as built' construction plans of this tank are known to exist, it is unclear whether the six fire tanks constructed in 1885 were of the same size/form/construction. As such it is not clear whether this tank can be considered representative of the other five tanks that remain in situ. As a result of this work, the 19th century rubbish deposit in the infilled river channel/gully has been recorded as site M35/1378 and the 1885 Manchester Street fire tank reservoir as M35/1383.

REFERENCES

- Anderson, A., 1968. The Archaeology of Mass-Produced Footwear. *Historical Archaeology*, Vol. 2: 56-65.
- Brooks, A., 2005. *An Archaeological Guide to British Ceramics in Australia 1788-1901*. The Australasian Society for Historical Archaeology & La Trobe University, Australia.
- Butcher, M., and Smith, I.W.G. 2010. Talking Trash: Classifying Rubbish-bearing Deposits from Colonial New Zealand sites. *Journal of Pacific Archaeology* 1(1) 53-61.
- Canterbury Maps [online], Environment Canterbury. Available at http://canterburymaps.govt.nz/
- Coysh, A. W. and Henrywood, R. K., 1982. *The Dictionary of Blue and White Printed Pottery 1780-1880, Volume I.* Antique Collectors' Club, Suffolk.
- Coysh, A. W. and Henrywood, R. K., 1989. *The Dictionary of Blue and White Printed Pottery 1780-1880, Volume II.* Antique Collector's Club, Suffolk.
- Department of Lands and Survey, 1897. *Plan of the city of Christchurch, Canterbury, N.Z.* Map. Alexander Turnbull Library, Wellington. Available at <u>http://ndhadeliver.natlib.govt.nz/delivery/DeliveryManagerServlet?dps_pid=IE459278&d</u> <u>ps_custom_att_1=ilsdb</u>
- Fooks, C. E., 1862. Christchurch, Canterbury, New Zealand, 1862. Cartographic material. Christchurch [N.Z.]: C.E. Fooks. File Reference: CCLMaps 212667.
- Garland, J., Carter, M. and Geary Nichol, R., 2014. The Terrace, M35/1050, Christchurch: Report on Archaeological Investigations, Vol. 1. Unpublished report for Hereford Holdings.
- Garland, J., Webb, K.J., Haley, J. and Bone, K., 2015. The Music Centre, 150, 156 and 158 Armagh Street: Report on Archaeological Investigations, Volume 1. Unpublished report for the Music Centre and Heritage New Zealand Pouhere Taonga.
- Hercus, A. 1948. A City Built Upon A Swamp: The Story of the Drainage of Christchurch, 1850-1903: With Epilogue 1903-1938. Christchurch NZ: Christchurch Drainage Board.
- Jollie, E., 1850. Black Map of Christchurch, March 1850, Sheet 3. [map]. [online] Available at: http://archives.govt.nz/gallery/v/Online+Regional+Exhibitions/Chregionalofficegallery/sss /Black+Map+of+Christchurch/CH1031-180 +273 +Black+Map+Christchurch+1850+ Copy+2 + 2 .JPG.html?g2_imageViewsInd ex=0 [Accessed August 2016].
- Jones, O., Sullivan, C., Miller, G., Smith, E. A., Harris, J. and Lunn, K., 1989. *The Parks Canada Glass Glossary: For the Description of Containers, Tableware, Flat Glass and Closures.* Canadian Government Publishing Centre, Quebec.
- LINZ, c. 1850. Deeds Index A Christchurch town sections and town reserves. Archives New Zealand, Christchurch Office.

Lyttelton Times. [online] Available at: www.paperspast.natlib.govt.nz [Accessed August 2016].

- Mitchell, P., Geary Nichol, R. and Garland, J., 2014. 165 Cashel Street, Christchurch: Report on Archaeological Monitoring. Unpublished report for Dominion Constructors and Heritage New Zealand Pouhere Taonga.
- Phillips, T., 2010. *Always Ready: Christchurch Fire Brigade: 1860-2010.* Christchurch: New Zealand Fire Service, Transalpine Fire Region.
- Press. [online] Available at: www.paperspast.natlib.govt.nz [Accessed August 2016].
- Samford, P. M., 1997. Response to a market: Dating English underglaze transfer-printed wares. *Historical Archaeology* 31 (2): 1-30.
- SCIRT (n.d.) SCIRT Spatial Data room. Restricted access web app. [Accessed July 2016].
- *Star*. [online] Available at: <u>www.paperspast.natlib.govt.nz</u> [Accessed August 2016].
- Stevens, S. C. and Ordonez, M. T., 2005. Fashionable and Work Shoes from a Nineteenth-Century Boston Privy. *Historical Archaeology*, Vol. 39 (4): 9-25.
- Strouts, F. S., 1877. *Christchurch, Canterbury, 1877*. Compiled from data supplied to City Council and District Drainage Board by Frederick. Strouts. Cartographic material. Christchurch, NZ: Ward and Reeves. File Reference: ATLMAPS ATL-Acc-3158.
- Tasker, J., 1989. Old New Zealand Bottles and Bygones. Heinemann Reed, Auckland.
- Williams, H. 2015. Moorhouse Avenue Wastewater Brick Barrel, Christchurch: Report on archaeological monitoring. Unpublished report for Downer and Christchurch City Council.
- Williams, H. 2016. Ferry Road Stormwater Brick Barrel, Christchurch: Report on archaeological monitoring. Unpublished report for McConnell Dowell and Christchurch City Council.
- Wilson, J. 1989. *Christchurch: Swamp to City: A Short History of the Christchurch Drainage Board* 1875-1989. Lincoln: Te Waihora Press.
- Wilson, J., 2005. Contextual Historical Overview for Christchurch City. Unpublished report for Christchurch City Council.

APPENDIX 1: METHODS OF ARTEFACT ANALYSIS

All data relating to artefacts was entered into a Microsoft Excel spreadsheet. Photographs were taken of notable, interesting and/or dateable artefacts, or artefacts crucial to understanding this site.

Dating: the TPQ method

Ceramic, glass and metal artefacts were commonly embossed or printed with information concerning the manufacture of the vessel or the product the vessel contained. These manufacturers can often be identified and the period of their operation dated. The specific sources used for this process are discussed above for each material category. This information allows for the calculation of a *terminus post quem* (limit after which) for each feature that is associated with a dated artefact. A *terminus post quem* (TPQ) is the earliest date at which an archaeological feature could have been deposited. It is derived from the date range of the youngest artefact in the feature. For example, if a manufacturer identified on a ceramic vessel is known to have operated between 1865 and 1880, and this is the latest date range identified in the feature, the TPQ for that feature is 1865.

Establishing a TPQ is useful because it can be used to associate deposition with a specific period of a site's occupation. However, it should be emphasised that the TPQ is the earliest possible date for a feature, not the definite date at which deposition occurred. The time between the manufacture and disposal of an artefact must be taken into account. Various factors influence this period. For example, a ceramic vessel is likely to proceed through a number of stages between creation and disposal. These include the time is takes for a vessel to be packed and processed in Britain, then shipped to New Zealand, and then more time in retail before its eventual purchase. After this process, the vessel was most likely used for a period of time before its disposal. This period is termed a vessel's 'use-life'. Therefore, it could be many years between the date at which a vessel was produced and the date at which a vessel was added to an archaeological assemblage.

Ceramic artefacts

A number of references were consulted during the analysis of the ceramic assemblage. Brooks (2005) was the principle reference used for the analysis of material ware, form and decorative technique. Samford (1997) was consulted in relation to decorative patterns and colours and internet resources such as The Potteries website were also utilised. Maker's marks were identified using Godden (1991) and The Potteries website. These resources contribute to the internal database maintained by Underground Overground Archaeology Ltd which records both identified ceramic maker's marks and patterns recovered from previous archaeological sites in Canterbury.

Ceramics were analysed according to a standard set of attributes and the specific categories are listed below. Some of these attributes and categories have been removed from the spreadsheets in Appendix 2 due to the constraints of printing on an A4 page. The columns left out were those in which no data was entered during the analysis, or where the data was not crucial to this report. Photographs were taken of all unidentified ceramic patterns and have been retained on file. These are available on request.

Bag ID	Material	Quantity	Decoration	General information
Site	Body type	NISP	Technique	Notes
Code	Glaze	MNI	Colour	References
Box number	Ware		Pattern name/motif	Photo number
Bag number	Function		Maker's mark	
Provenance	Form			
	Portion			

Faunal material

Methods of analysing the faunal material drew on those outlined in Watson (2000). The faunal material was identified to taxonomic category and, where possible, mammal and bird bones were identified to species. Underground Overground Archaeology holds a reference collection of European mammal bones, and the bird bone reference collection at the Canterbury Museum was used to identify bird bones.

A MNE (minimum number of elements) was generated from the NISP (number of individual specimen present). The attributes recorded during the analysis of the faunal material are listed below and include skeletal details, taphonomic processes and, where possible, any butchery marks on the material were recorded. Minimum number of butchery units (MNBU) was also recorded to represent cuts of meat targeted (Watson 2000).

Bag ID	Description	Detailed analysis	General information
Site	Species	Taphonomy	Notes
Code	Element	MNBU	Photo number
Box number	Side		
Bag number	Portion		
Provenance			

Glass artefacts

Glass vessels were sorted by provenance and analysed according to the process outlined in Smith (2004). This included recording glass colour, finish, base type and any marks present. Further information concerning the bottle and product manufacturers identified by marks was supplied when possible. Internet research provided the majority of this information but Donaldson et al. (1990) and Lindsey (2012) also proved useful.

Some glass vessels could be identified to type by their form or their embossing. This information identifies the original contents of the bottle. However, identification of the original contents of a bottle does not necessarily connect the occupants of a site with the consumption of that product. Reuse of glass bottles for different products was a common practice in New Zealand in the 19th century, as there was no glass bottle production in New Zealand until the 20th century. All bottles had to be imported, which resulted in a scarcity of glass containers. However, the identification of reuse in an archaeological context is difficult. As such, glass vessels are discussed in relation to their original contents.

Bag ID	General description	Quantity	Manufacture	Identification details
Site	Colour	NISP	Туре	Embossing
Code	Portion	MNV	Marks	Notes
Box number	Class			Reference
Bag number	Common name			Photo ID
Provenance	Details			

Metal artefacts

Metal artefacts were analysed and recorded by their material type, form and measurements. If the artefact could not be identified by form a description of its appearance was included.

Bag ID	Description	Quantity	Identification details
Site	Material	Measurements	Notes
Code	Form	NISP	Reference
Box number	Details	MNI	Photo ID
Bag number Provenance	Portion		

Miscellaneous artefacts

Miscellaneous artefacts included building materials and all other recovered artefacts not relevant to the already established material categories. Artefacts were cleaned and then analysed according to material type. Those that could be identified to form were recorded as such.

Bag ID	Description	Quantity	Information
Site	Material	Measurement	Notes
Code	Artefact	NISP	ID
Box number	Portion	MNI	
Bag number	Description		
Provenance			

Discard protocol

Underground Overground Archaeology uses a discard protocol involving the discard of non-diagnostic artefact fragments. A note is made in the artefact spreadsheet if an artefact is discarded. Copies of the artefact discard protocol are available upon request.

Abbreviations

Ceramic	
b & b plate	bread and butter plate
Bbe	buff bodied earthenware
Bc	bone china
Bd	body
Bgst	bristol glaze
Bs	base
Cl	clear
ew-c	coarse earthenware
Dbw	dyed body ware
Fb	flow blue
ew-r	refined earthenware
Н	handle
porc-h	hard paste porcelain
porc-s	soft paste porcelain
Pw	pearlware
R	rim
Rre	red refined earthenware
Rt	rockingham type
Sgst	salt glaze
St	stoneware
Svww	Semi-vitrified whiteware
Ugtp	underglaze transfer print
Unid	unidentified
Wg	white granite
Ww	whiteware
Yw	yellowware
Faunal	
C	complete
C*	complete, missing 1 epiphysis
C**	complete, missing 2 epiphyses
Ρ	complete proximal portion of the bone
P*	complete proximal portion but missing the unfused epiphysis
PE	the unfused proximal epiphysis
PS	proximal shaft
MS	shaft
DS	distal shaft
D	complete distal portion of the bone
D*	complete distal portion but missing the unfused epiphysis
DE	the unfused distal epiphysis
Glass	
1pc dm	one piece dip mould

one piece dip mould

2рс	two piece mould
2pc w cb	two piece mould with cup bottom
2pc w pb	two piece mould with post bottom
3pc dm	three piece dip mould
ab	amber brown
ag	aqua green
Bd	body
Bs	base
bv1	blake variant one
cb	cobalt
	concave
Cl Cmml	colourless
chipi c/s	complete cross section
C/S	cross section
-4	dark
Drc	dished curved
Dft	dished flat
Dm	dip mould
F	finish
Fg	forest green
Eg	emerald green
Ft	flat
Hs	seams horizontal on shoulder
hs/vb	seams horizontal on shoulder, vertical on body
hs/vbs	seams horizontal on shoulder, vertical on body and shoulder
hs/vs	seams horizontal on shoulder, vertical on shoulder
Hz	horizontal
Kbe	kickup bell shaped
Kom	kickup conical with mamelon
Kch	kickup conical
Kuo	kickup uomeu
krc	kickup parabolic
-	light
Mm	machine made
N	neck
nil	nil seams
og	olive green
rcb c/s	round cornered blake cross section
Ro	rounded
S	shoulder
Sc	scooped
St	straight
Sts	straight short
ld tal (u /basad	tapered down
td/u/bead	tapered down/u-snaped groove/bead
	tapered down/v-snaped groove/skirt
τμ	tapered up
Tus	tapered up short
turn-b	turn marks on the body
turn-l	turn marks on the lip
vh/hh	seams vertical on heel, horizontal on heel
vh/tb	seams vertical on heel, transverse on base
vh/tf/cb	seams vertical on heel, horizontal on foot, circular on base
v3h/t3f/cb	seams 3 vertical on heel, 3 transverse on foot, circular on base
vbs	seams vertical on body and shoulder
v3bs	seams 3 vertical on body and shoulder
vcn	seams vertical complete on neck
v3cn	seams 3vertical complete on neck
vpn wranch n	seams vertical partial on Neck
wiench-fl	
Metal	
н	Head
pt	Point
S	Shaft

APPENDIX 2: ARTEFACT SPREADSHEETS

Due to the constraints of printing on an A4 page, the following artefact spreadsheets have been condensed (as noted in the footnotes for each table). For full spreadsheets please contact Underground Overground Archaeology.

At the time of writing, the artefacts were stored at Underground Overground Ltd offices at 31 Stevens Street, Waltham, Christchurch.

Ceramic⁴

Bag	Prov	Body	Glaze	Ware	Function	Form	Portion	NISP	MNI	Technique	Colour	Pattern Name/Motif	Notes (incl date range)	Reference
1	F1	ew-r	cl	ww	table ware	platter	bs	1	1	ugtp	blue	Willow		
2	F1	ew-r	cl	ww	table ware	dinner plate	r-m-bd- bs	4	1	ugtp	blue	Willow		
3	F1	ew-r	cl	ww	table ware	side plate	r-m-bd- bs	8	1	ugtp	blue	Willow		
4	F1	ew-r	cl	ww	table ware	plate	r-m	2	1	ugtp	grey	Rhine		
5	F1	ew-r	cl	ww	tea ware	teacup	r-bd	2	1	ugtp	grey	Rhine		
6	F1	ew-r	cl	ww	tea ware	teacup	r-bd	1	1	tp or painting?	blue	Rhine	remnants of blue. I don't know if the transfer printing Is failed or if it is painting, although I can't touch over. I'm sure is under glaze	
7	F1	ew-r	cl	ww	table ware	plate	bs	1	1	ugtp	blue	Asiatic Pheasants		
8	F1	ew-r	cl	ww	tea ware	teacup	bd	1	1	ugtp	green	Fibre		
9	F1	ew-r	cl	ww	tea ware	teacup	bs	1	1	ugtp	blue	unid: trees/architecture	stairs with an architecture element like an arch in the background. Vase on the centre of the scene. Several trees sourrounding.	
10	F1	ew-r	cl	ww	tea ware	teacup	bd-bs	5	2	ugtp	flown blue	chinoiserie		
11	F1	ew-r	cl	ww	tea ware	saucer	bd-bs	3	1	ugtp	flown blue	chinoiserie		
12	F1	ew-r	cl	ww	table ware	plate	bs	1	1	ugtp	blue	Vase on a wall		
13	F1	ew-r	cl	ww	tea ware	teacup	bs	1	1					
14	F1	ew-r	cl	ww	tea ware	saucer	r-bd	3	1	ugtp	blue	unid: floral/garland		
15	F1	ew-r	cl	ww	household	chamber pot	r-bd	2	1	ugtp	blue	unid: floral/foliage/garland/architecture/trees	garland with floral and foliage motifs. Building and trees outer body	
16	F1	ew-r	cl	ww	table ware	plate	r-m	1	1	moulded	blue	shell edge		
17	F1	ew-r	cl	ww	household	chamber pot	r-bd	1	1	ugtp	blue	unid: foliage/birds	tree outer body and rim decorated with leaves, flowers and two birds eating small circular fruit	

⁴ The following columns have been removed from this table: Site, code, class, SCIRT box# (all are stored in SCIRT29) and photo ID.

18	F1	ew-r	cl	ww	household	chamber pot	bs	1	0	ugtp	blue	unid: geometric	footring decorated with repetitive motifs. It could be part of one of the other chamber pots
19	F1	ew-r	cl	ww	table ware	plate	r-m-sh	2	1	ugtp	blue	unid: garland/floral	floral garlan on the marley filled with geometric motifs like irregular poligonal shapes. Small and detailed flowers and it appears to have bd and bs decorated as well
20	F1	ew-r	cl	ww	table ware	unid hollow- ware	bd	1	1	moulded			
21	F1	ew-r	cl	ww	table ware	jar?	bd	1	1	ugtp	black	unid: floral/foliage	bevelled body
22	F1	ew-r	cl	ww	table ware	plate	bs	1	1	ugtp	black	unid: foliage	different leaves formin as a climbing plant
23	F1	ew-r	cl	ww	table ware	egg cup	bd	1	1	moulded			vertical moulding forming as panels
24	F1	ew-r	cl	ww	table ware	unid hollow- ware	bd	1	1	ugtp	blue	unid: foliage	big printed leaves and other ones smaller and more schematics, like fibres
25	F1	ew-r	cl	ww	table ware	plate	r-m-sh	2	1	moulded/ugtp	blue	unid: floral/foliage	
26	F1	ew-r	cl	ww	table ware	plate	r-m-sh	2	1	moulded/ugtp	blue	unid: floral/foliage	flowers with thorns on the stems
27	F1	ew-r	cl	ww	table ware	jar?	bd	2	1	ugtp/painting?	blue	unid: floral/foliage	it looks like transfer printed but appears to have an overglazed painting or engraving on the previous printing
28	F1	st	salt	sgst	household	ink bottle	cmpl	1	1				50 mm length
29	F1	ew-c	salt	sgst	drainage	pipe	bd	2	1		brown		

<u>Faunal</u>

Site	Code	Box	Bag	Provenance	Species	Element	Side	Portion	Butchery unit	Taphonomy	NISP	MNE	MNBU	NOTES
MSW	SCIRT29	F	1	F1	sheep	femur	left	cmpl	hindshank		2	2	2	burned 190 mm
														length
MSW	SCIRT29	F	2	F1	sheep	metacarpal	left	cmpl	foreshank		2	2	2	burned 135 mm
														length
MSW	SCIRT29	F	3	F1	sheep	tibia	right	cmpl except condyles	hindshank		1	1	0	burned 215 mm
														length
MSW	SCIRT29	F	4	F1	sheep	humerus	right	cmpl except tuberosities and head	foreshank		2	2	0	burned
MSW	SCIRT29	F	5	F1	cow	rib		head, neck, tubercle, anterior border	loin	sawn	4	2	1	Burned
MSW	SCIRT29	F	6	F1	sheep	mandibula	right/left	condyle, angle, condyloid, m2, m3, m1,	skull		2	1	1	burned 160 mm
								p3, p1, symphyseal surf, med, angle						length
MSW	SCIRT29	F	7	F1	cow	radius	left		foreshank	sawn	1	1	1	Burned
MSW	SCIRT29	F	8	F1	cow	sacrum		articular processes, dorsal sacral	loin	chopped	1	1	0	burned chooped in
								foramen, wing						the middle of crest
MSW	SCIRT29	F	9	F1	cow	lumbar vertebrae		body, transverse process	loin	sawn	2	1	0	Burned
MSW	SCIRT29	F	10	F1	sheep	humerus	left	cmpl	foreshank		1	1	0	burned 160 mm
														length
MSW	SCIRT29	F	11	F1	sheep	femur	left	neck, trochanter, lat border	hindshank	broken	1	1	1	Burned

MSW	SCIRT29	F	12	F1	sheep	femur	right	supracondyloid, epicondyle	hindshank	sawn, small	1	1	0	Burned
										cuts				
MSW	SCIRT29	F	13	F1	sheep	femur	right/left	trochlea, condyles	hindshank		2	2	0	Burned
MSW	SCIRT29	F	14	F1	sheep	scapula	right/left	cmpl except ant/post angle	chunk		2	2	1	Burned
MSW	SCIRT29	F	15	F1	sheep	tibia	left	crest	hindshank	Sawn	1	1	0	Burned
MSW	SCIRT29	F	16	F1	sheep	radius	right		foreshank	cut and	1	1	0	Burned
										chopped				
MSW	SCIRT29	F	17	F1	sheep	metatarsal	right		hindshank	small cuts	2	2	1	Burned
MSW	SCIRT29	F	18	F1	sheep	pelvis	right	coxe	loin/rump	cut	1	1	1	Burned
MSW	SCIRT29	F	19	F1	sheep	rib		fragments	loin		4	2	0	burned

<u>Glass⁵</u>

Bag	Prov	Colour	Portion	Class	Common	Details	NISP	MNE	MNV	Туре	Marks	Notes	Reference
					name								
1	F1	og-d	Bs	alcohol	black beer	ro heel, krc	1	1	1	dm		75 mm diameter bs remnants of pontil mark?	
2	F1	og-d	bd-bs	alcohol	black beer	st bd, ro heel, krc bs	2	1	1	dm	vb, hb	75 mm diameter bs remnants label on body and	
												three pimples on bs	
3	F1	og-d	Finish	alcohol	black beer (I)	ap ft/v/skirt, cv n	1	1	1		vn	90 mm length and the cork remains	
4	F1	ag-l	bd-bs	non-alcoholic	unid ro c/s	st bd, ab heel, dcc bs	1	1	1	dm	vb, hb, air bubbles	77 mm diameter bs	
5	F1	ag-l	bd-bs	condiment	sauce bottle	press moulded bd, ab heel, dft bs	1	1	1	2 pc dm	hb, air bubbles	70 mm diameter bs, press moulded	
												triangles/mitres on bd	
6	F1	ag-l	Finish	condiment	sauce bottle	ap bead/u/bead, st n	1	1	0		wrench-n	the cork remains, flutted neck or panelled?	
7	F1	cl	bd-bs	table ware	tumbler	panelled bd, ab heel, dcc bs	1	1	1	press mould	hb, small air bubbles	65 mm diameter bs, polishment on bd and bs. 8	
												panels, indent in centre of bs	
8	F1	cl	bd-bs	table ware	tumbler	panelled bd, ab heel, dft bs	1	1	1	press mould	vb	65 mm diameter bs	
9	F1	cl	bd-bs	table ware	tumbler	panelled bd o es diu bevelled?, ab	1	1	1	cut mould	hb, air bubbles	panels w mitres between each two	
						heel, starburst bs							

<u>Metal</u>

Site	Code	Вох	Bag	Prov	Material	Class	Form	Details	Portion	Measurements	NISP	MNI	Notes	References
MSW	SCIRT29	М	1	F1	ferrous	strip	rectangular		fragment	22 mm wide, 1 mm thickness	11	1		
MSW	SCIRT29	М	2	F1	ferrous	strip	rectangular c/s but shaped curve in one side	broken	fragment	190 mm length, 30 mm wide, 2 mm	1	1		
										thickness				
MSW	SCIRT29	М	3	F1	zinc/tin?	unid	unid	crumpled/folded	fragment	1 mm thickness, moldable	8	1		
MSW	SCIRT29	М	4	F1	ferrous	pot	curve shaped		r-bd fragment	6 mm thickness rim, 2 mm thickness	1	1	pot for cooking	
1										bd				

<u>Miscellaneous</u>

Site	Code	Вох	Bag #	Provenance	Material	Class	Artefact	Portion	Description	Measurements	NISP	MNI	Notes	Reference
MSW	SCIRT29	MC	1	F1	cork		stopper			35mm x 30mm x 25mm	1	0	part of one of	
													the bottles	

⁵ The following columns have been removed from this table: Site, code, class, SCIRT box# (all are stored in SCIRT29) and photo ID.

MSW	SCIRT29	MC	2	F1	cork		stopper	ro c/s w hole in the middle in which	40 mm length x 55 mm wide (remained)	1	0	part of one of	
								another cork element has been insert as a				the bottles	
								kind of handle?					
MSW	SCIRT29	MC	3	F1	limestone	household	chaulk	oval shaped	50 mm length 22 wide	1	1		
MSW	SCIRT29	MC	4	F1	clay	structural	brick	rectangular c/s but they are very	55 mm x 50mm x 30mm	5	1		
								fragmented and small, so unidentified					
MSW	SCIRT29	MC	5	F1	fibre		rope	very bad conditions		1	1		

<u>Shoes</u>

																-				
Ва	Provena	Mate	Cla	Portio	Size/we	Type/s	NI	м	Toe	Heel	Lif	Clos	Decora	Heel	Sole/insole	Upper	Reinforcing	Rep	Notes	Measurements
g	nce	rial	SS	n	arer	tyle	SP	Ν	shape	type	ts	ure	tion					air		
		leath	bo								n/					machine				
1	F1	er	ot	upper	adult	n/a	5	1	n/a	n/a	а	n/a	n/a	n/a	n/a	stiched	n/a	n/a		
		leath	sho								n/			pegg	machine					210 mm length, 40 mm
2	F1	er	e	sole	adult	n/a	1	1	square	ro	а	n/a	n/a	ed	stitched	n/a	n/a	n/a		wide arch
		leath	sho	sole,										pegg			pegs on half sole		fabric as	
3	F1	er	е	rand	adult	n/a	2	1	cut	ro	3	n/a	n/a	ed	pegged	n/a	and heel	n/a	filler	40 mm wide arch
		leath	sho											pegg						
4	F1	er	e	lifts	n/a	n/a	3	1	n/a	ro	3	n/a	n/a	ed	n/a	n/a	several pegs	n/a		