

Tauriko West – Tupenga, SH29: archaeological assessment

**report to
NZ Transport Agency Waka Kotahi
and
BBO**

Matthew Campbell

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Prepared by:

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Reviewed by:

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Tauriko West – Tupenga, SH29: Archaeological assessment

Executive summary

- This assessment report has been prepared in support of the Tauriko West – Tupenga Project, an offline upgrade of SH29 and SH29A, which is subject to substantive application under the Fast-track Approvals Act 2024.
- The general area was intensively settled by pre-European Māori as shown by the extent and density of archaeological sites at the Tauriko Business Estate, The Lakes and in the Tauriko West Urban Growth Area.
- Archaeological evidence in the Tauriko area includes Mataraua Pā, numerous storage pit sites, implying nearby kūmara gardening, and middens. This is the kind of archaeology that might be expected to be found during the construction of the Project.
- Following the Waikato Wars the Tauriko area was subdivided for military settlers, the first intensive European settlement in the area. The area has been intensively cultivated, including contouring for orchards, in the 150 years since then.
- As a result, surface archaeological evidence has been obscured and no archaeological features were observed during field assessment.
- Seventeen sites are recorded in the Project footprint, of which 10 have been investigated as part of the Tauriko West Enabling Works and two for other development projects.
- Personal experience in this landscape demonstrates that extensive archaeological sites are almost certain to survive beneath the surface.
- It is recommended that an authority to modify or destroy any archaeological sites and features along the project route be applied for from The Environmental Protection Authority (EPA) under Section 42(4)(i) and Schedule 8 of the Fast-Track Approvals Act 2024.

1 Introduction

NZ Transport Agency Waka Kotahi are applying for substantive application under the Fast-track Approvals Act 2024 (FTAA) to construct the Tauriko West – Tupenga Project (the Project), an offline upgrade of State Highway 29 and 29A (SH29 and SH29A) at Tauriko. An archaeological and heritage assessment is required in support of the application. The purpose of this assessment is to outline the potential effects of the Project on archaeological and historic heritage values, the significance of those effects and methods for managing them, and to support the application for an archaeological authority or authorities to The Environmental Protection Authority (EPA) under section 42(4)(i) and Schedule 8 of the FTAA. This assessment will cover:

- The existing environment;
- Archaeological and heritage values and their significance;
- The effects of the Project on those values;
- Recommended measures to manage the effects; and
- The information required for the archaeological authorities.

A full description of the Project is set out in the Substantive Application Report and is summarised here. This report does not include an assessment of Māori cultural values.

The Project extends from Ōmanawa Road in the southwest to Barkes Corner in the northeast and includes the construction of new offline four-lane corridors for SH29 and SH29A, together with associated grade-separated interchanges (Redwood Lane, Takitimu Drive and Barkes Corner), the widening of the Takitimu Drive to four lanes, local road connections, realignment of the Kōpūrererua, Nanako Streams and Belk Road watercourses, and supporting transport network improvements to improve safety, reliability and freight efficiency and to enable planned urban growth in Tauriko West. Some enabling works, principally at Omanawa Bridge, the Redwood Lane interchange, a new access into the Tauriko West Urban Growth Area and intersection improvements at Cambridge Road, have been completed or are under construction.

The Project crosses varied landforms, including the sloping margins of the Wairoa Valley, level ground above the valley floor and the Kōpūrererua flood plain. This land is currently used primarily for grazing or kiwifruit, while parts of it are already developed for rural-residential, residential or industrial purposes and paved for roading.

1.1 Statutory requirements

All archaeological sites, whether recorded or not, are protected by the provisions of the Heritage New Zealand Pouhere Taonga Act 2014 (HNZPTA) and may not be destroyed, damaged or modified without an authority issued by Heritage New Zealand Pouhere Taonga (HNZPT).

An archaeological site is defined in the Heritage New Zealand Pouhere Taonga Act as:

- (a) any place in New Zealand, including any building or structure (or part of a building or structure), that—
 - (i) was associated with human activity that occurred before 1900 or is the site of the wreck of any vessel where the wreck occurred before 1900; and
 - (ii) provides or may provide, through investigation by archaeological methods, evidence relating to the history of New Zealand; and
- (b) includes a site for which a declaration is made under section 43(1).

The Resource Management Act 1991 (RMA) requires City, District and Regional Councils to manage the use, development, and protection of natural and physical resources in a way that provides for the wellbeing of today's communities while safeguarding the options of future generations. The protection of historic heritage from inappropriate subdivision, use, and development is identified as a matter of national importance (Section 6f).

Historic heritage is defined as those natural and physical resources that contribute to an understanding and appreciation of New Zealand's history and cultures, derived from archaeological, architectural, cultural, historic, scientific, or technological qualities.

Historic heritage includes:

- historic sites, structures, places, and areas

- archaeological sites;
- sites of significance to Maori, including wahi tapu;
- surroundings associated with the natural and physical resources (RMA Section 2).

These categories are not mutually exclusive and some archaeological sites may include above ground structures or may also be places that are of significance to Maori.

Where resource consent is required for any activity the assessment of effects is required to address cultural and historic heritage matters.

Under the Fast-track Approvals Act 2024 an applicant may apply to the Environmental Protection Agency (EPA) for an archaeological authority as described in the HNZPTA. Any authority is granted by the EPA but administered by HNZPT.

1.2 Qualifications, experience and Code of Conduct

This report has been prepared by Matthew Campbell.

I am the director of CFG Heritage.

I hold an MA in Anthropology from The University of Otago Ōtākou Whakahi Waka and a PhD in Archaeology from the University of Sydney. I am a member, and past President, of the New Zealand Archaeological Association.

My experience relevant to this application is as follows:

- Takitimu North Link: I was the lead archaeologist for the extensive archaeological investigations along the Takitimu North Link, Tauranga, from 2019 onwards.
- Te Tupu Ngātahi Supporting Growth: I was the lead archaeologist for the majority of the Te Tupu Ngātahi Supporting Growth projects, having oversight of the archaeological components of the projects and was the principal archaeologist for the Pukekohe section.
- Central Interceptor: I was the lead archaeologist for the Central Interceptor project, a wastewater reticulation project running from Western Springs to Māngere.
- Tauriko Business Estate: I have been lead archaeologist for Tauriko Business Estate, on the east side of SH29, since 2004 and have overseen archaeological assessment and investigation, including the excavation of Mataraua Pā.
- Tauriko West: I am the lead archaeologist for the current KA Tauriko LP housing development at Tauriko West adjacent to SH29.

Although this matter is not before the Environment Court, I confirm that I have read the Code of Conduct for expert witnesses as contained in section 9 of the Environment Court Practice Note 2023. I agree to comply with that Code. My qualifications as an expert are set out above. I am satisfied that the matters which I address in this report are within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions I express.

2 Methodology

2.1 Assessment framework

This assessment has been prepared according to the guidance and standards provided by Heritage New Zealand Pouhere Taonga (AGS2 – Guidance for writing archaeological assessments) and the NZTA *Historic Heritage Impact Assessment Guide for State Highway Projects* (Version 1 – 2015) and *P45 Heritage Specification for Land Transport Infrastructure* (Version 2 - 2024).

2.2 Desktop assessment

A desktop assessment was undertaken to obtain information and data relating to the archaeology and historic heritage sites within the proposed designation for the Project using the following information sources:

- The NZAA SRS, the national register of recorded archaeological sites (<https://nzaa-archsite.hub.arcgis.com/>)

- The HNZPT digital library, an online repository of archaeological reports (<https://www.heritage.org.nz/archaeology/archaeology-digital-library>)
- Assessment and interim reports from the Tauriko West Enabling Works at the Omanawa Brige, Redwood Lane and the Norther Access
- The Heritage New Zealand List – Rārangi Kōrero (<https://www.heritage.org.nz/places/>)
- Historic aerial photos (<https://retrolens.co.nz/>)
- Historic maps and plans, accessed through QuickMap software
- Local histories
- Tauranga City Plan
- The Western Bay of Plenty District Plan

Where applicable, these data sources have been incorporated into a GIS to produce the maps in this report.

2.3 *Field assessment*

Field assessment involved a targeted pedestrian survey of recorded and potential archaeological sites (i.e., those identified during desktop assessment). A pedestrian survey was also carried out across areas regarded as having archaeological potential based on landscape context and the known distribution of sites.

The survey involved the inspection of the ground surface for visible signs of archaeological sites. Areas of disturbed ground, for instance track cuttings, were also inspected for subsurface features and to gain an understanding of localised soil conditions. No shovel test pitting was carried out. Identified archaeological sites were recorded with GPS and photographed. Existing New Zealand Archaeological Association site record forms were updated or new ones created in ArchSite.

Not all properties known to contain archaeological sites were able to be surveyed as they could only be assessed when landowner permissions were obtained (Figure 1). Properties that had been assessed and / or investigated for NZTA's current Tauriko West Enabling Works project by other archaeologists were not visited and I rely on their reports.

3 The existing environment

3.1 *Pre-European Māori history*

A brief history of the Māori occupation of Tauranga is provided here from widely available published sources. This is provided as a background only and is not written from a mana whenua perspective. It makes no comment on the values and interests of any hapū affiliated with the Project footprint.

The Bay of Plenty was an attractive area for early Māori settlement. The abundance of marine, freshwater and estuarine resources, open sandy beaches, forests and areas of high elevation and good soils for crop cultivation would have proved invaluable. Because of its rich resources, the area was much fought over and continuously occupied by Māori since initial settlement (Stokes 1990).

Māori settlement in the western Bay of Plenty was focused on the Kaituna River mouth / Maketu and Tauranga Harbour. The earliest known inhabitants of the Tauranga district were Ngā Marama who were conquered and absorbed by later groups. All present-day tangata whenua in Tauranga trace their descent back to these original people. The first waka to arrive in Tauranga was Tainui. Although Tainui people did not settle in Tauranga, they settled nearby: Marutūāhu in Hauraki and Ngāti Hauā and Ngāti Raukawa over the Kaimais. The next waka was Te Arawa, whose people mostly settled south and east of Tauranga, apart from Waitaha. The third waka to arrive was Takitimu, which landed at Mauao. Ngāti Ranginui trace their descent to the Takitimu. Waitaha and Ngāti Ranginui conquered Ngā Marama and divided the land between them: Ngāti Ranginui to the west of the Waimapu River, and Waitaha to the east (Stokes 1980: Chapter 1; Waitangi Tribunal 2004: 28).

After several generations, Ngāi Te Rangi and Ngāti Pukenga, descended from the people of the *Mataatua* waka that had landed at Whakatane, displaced Ngāti Ranginui and Waitaha from much of Tauranga so that by about AD 1800 Ngāi Te Rangi had gained ascendancy on the coast and offshore

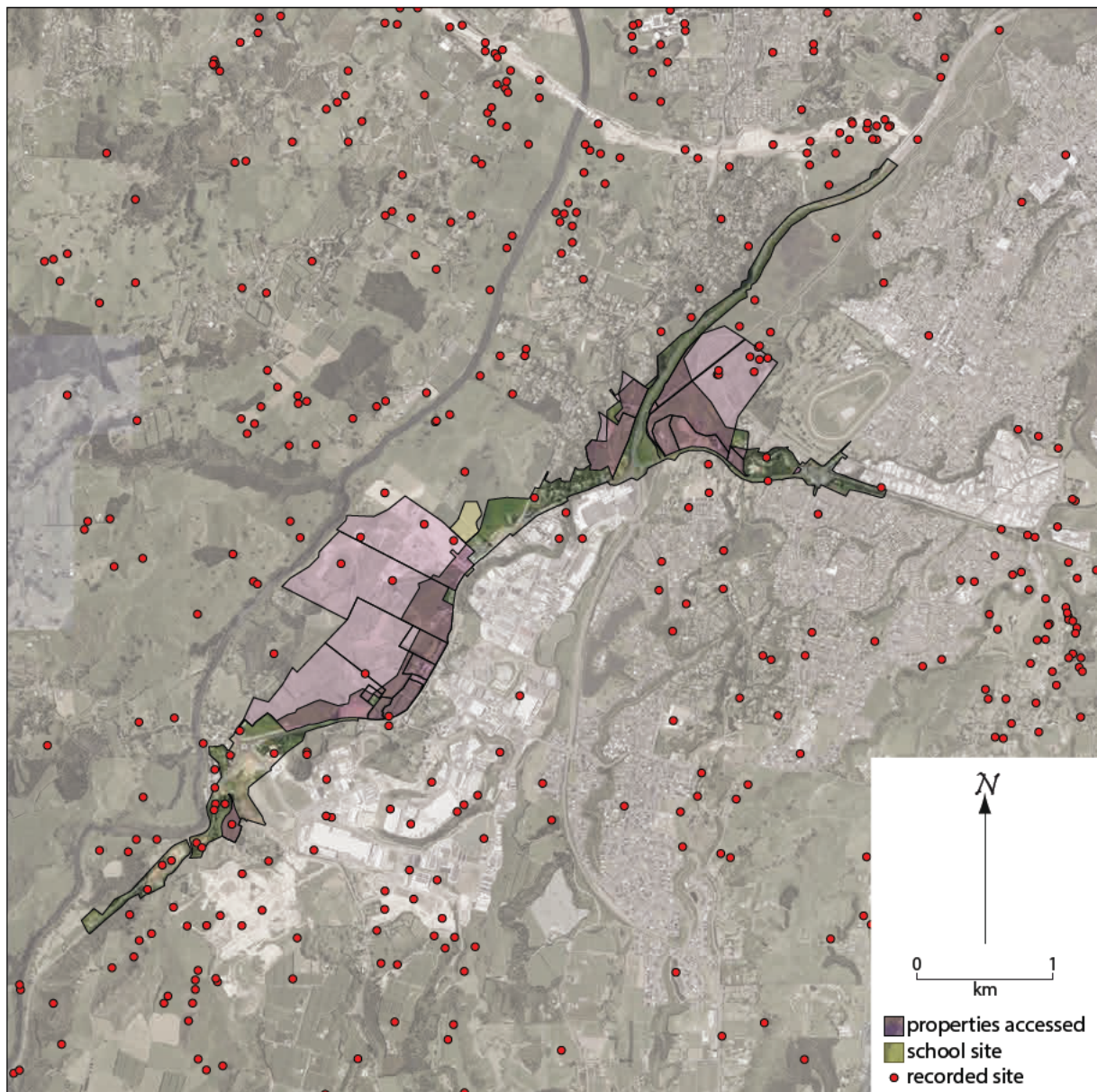


Figure 1. Properties accessed during field assessment.

islands of Tauranga while Ngāti Ranginui and Waitaha predominated inland east of the Waimapu (Waitangi Tribunal 2004: 29; Stokes 1980: Chapter 2; Stafford 1986: Chapter 22).

Tauranga supported a dense population prior to the arrival of Europeans. Coastal and inland hapū had reciprocal rights to resources and many migrated to the coast in winter and inland in summer. Early in the 19th century Ngā Puhi of Northland obtained muskets which provide them with a huge advantage in war. Tauranga was raided in 1818 and 1820. In 1828 Ngāti Maru of Hauraki attacked Tauranga, destroying Otamataha Pa and killing or enslaving the inhabitants. Tauranga Māori began to arm themselves with muskets and assisted Ngāti Hauā in expelling Ngāti Maru from Maungatautari in 1830. Further Ngā Puhi raids followed between 1830 and 1833 but these were successfully resisted. In 1836 Te Arawa took Te Tumu pā at Maketu, successfully reoccupying lands they had lost to Ngāi Te Rangi 100 years earlier. Wars and skirmishes continued through parts of Waikato / Hauraki / Bay of Plenty into the 1840s but Māori society was becoming less inclined to settle disputes through destructive musket warfare (Waitangi Tribunal 2004: 23; Stokes 1980: Chapter 3; Ballara 2003: Chapter 16).

3.2 Historic background

The first recorded European visitor to Tauranga was the missionary Samuel Marsden in 1820. He described the area as being “for the most part, fit for cultivation and ... easily be wrought by the plough” (Stokes 1992: 44). Visits by the Church Missionary Society schooner *Herald* followed in 1826 and 1828. In 1834 Alfred Nesbitt Brown established the mission station at Te Papa, and took over the running of it in 1838, until his death in 1884. In 1841 a Catholic mission was established at Otumoetai under Father Pezant (Stokes 1980: Chapter 3). The other early visitors to Tauranga were traders. As early as 1828 ships were calling at Tauranga Harbour trading powder and muskets for pigs and potatoes and James Farrow settled in the area in 1829. Philip Tapsell settled at Maketu in 1830 as a flax trader and from the early 1830s European goods became increasingly available to Bay of Plenty Māori (Stokes 1980: Chapter 4).

From the mid-1840s Tauranga Māori were growing wheat and pigs for the Auckland market and by 1857 they owned their own shipping and supplied Auckland with more produce than any other region (Cooper’s Settler’s Guide, quoted in Stokes 1980: 65). Disease and war had reduced the population, many were leaving for Auckland to learn European ways and the old ways of life were changing as people took up Christianity, European education and European technology (Stokes

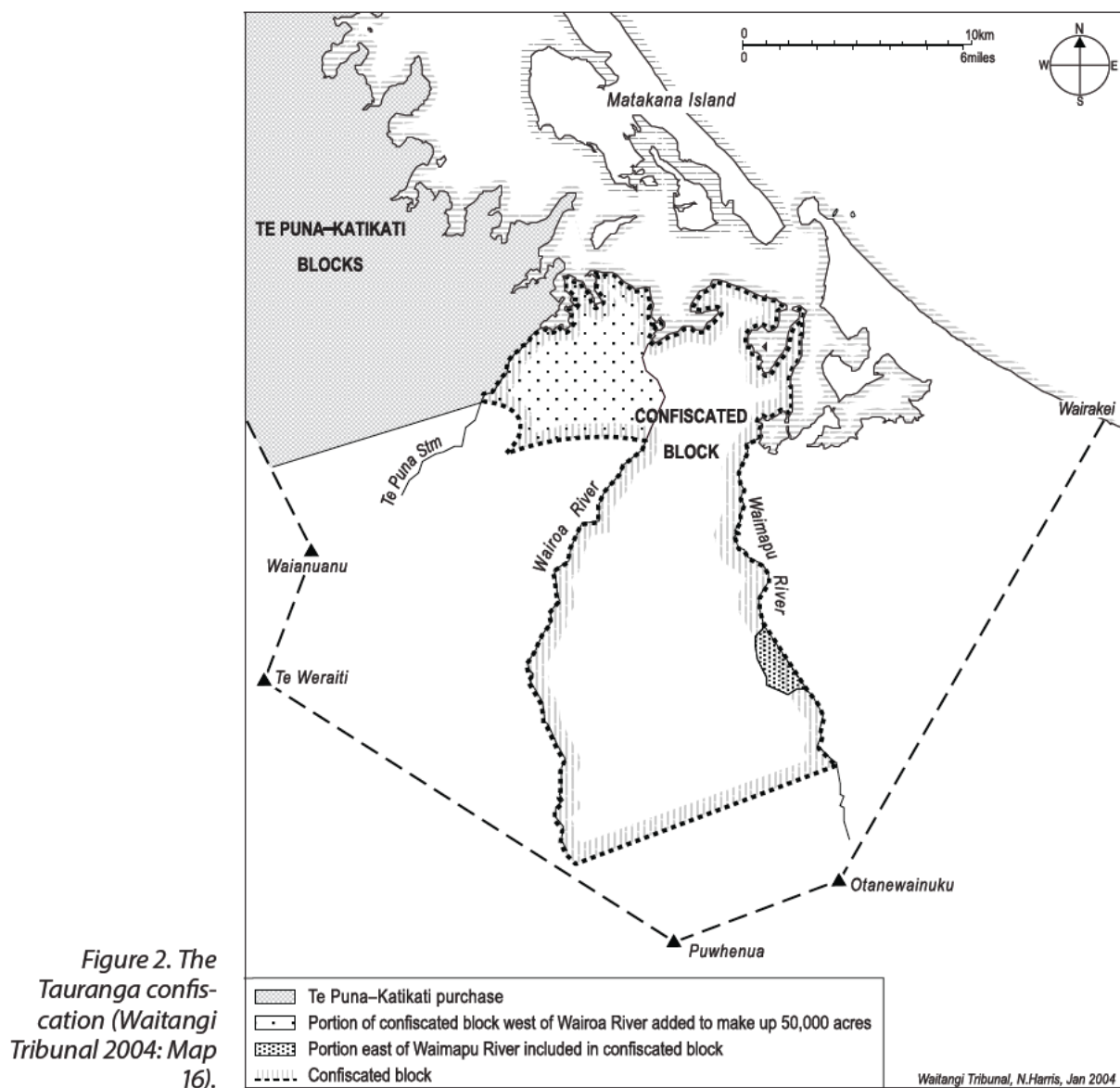


Figure 2. The Tauranga confiscation (Waitangi Tribunal 2004: Map 16).

1980: Chapter 5). Slowly Europeans were arriving in Tauranga, if only in small numbers, but that was about to change. Many Tauranga Māori had close ties to Waikato people, particularly to Ngati Haua whose chief, Wiremu Tamihana, was heavily involved in the Kingitanga. When the government went to war with Waikato many Tauranga fighters went to the aid of the Kingitanga. In 1864 government forces invaded Tauranga. They were repulsed at Pukehinahina Gate Pā on 29 April with heavy losses but during the night the Māori defenders slipped away. On 21 June government troops attacked Te Ranga Pā, which was not yet completed, and Māori suffered a heavy defeat.

Tauriko is located in an area of confiscated land taken by the colonial government in 1865 following Te Ranga. The background and events surrounding this confiscation are complex and beyond the scope of this report (see Waitangi Tribunal 2004 for a full account). Following the military victory the government proposed a military settlement on confiscated land. The first lot of military settlers arrived in May 1864. The Tauranga district was officially confiscated in May 1865 by an Order in Council. The western boundary of the confiscation was the Wairoa River, placing all of Tauriko and the Project footprint within the confiscated block (Figure 2) (see Campbell and Craig 2017 for a full history of 19th century landholding in Tauriko West including significant parts of the Project footprint).

In anticipation of the confiscation, Theophilous Heale, the Government surveyor, began survey sections for the military settlers of the 1st Waikato Regiment. By April 1865 he had subdivided land near Te Papa and Otumoetai, which included Tauriko and land within the Project footprint, into 50 and 100 acre blocks. By the end of 1866 almost all the land between the Wairoa and Waimapu Rivers had been surveyed and the military settlement began with a ballot to determine which companies of the 1st Waikato Regiment would be allotted land at Tauranga. The way the land was then distributed came under some scrutiny however, with the staff, other officers and non-commissioned officers being given first choice despite their enrolment contract that said the land was to be distributed by lot.

Heale's surveys resulted in the maps used to locate the first Lots at Tauriko. SO 436, *Plan of Military Sections On East Side of Wairoa River, Tauranga, Parish of Te Papa, Cook's County*, dates to November 1866. Several of the Lots in the Project footprint are shown on this plan (Lots 85, 85A, 87, 88, 88A, 89, 89A-B, 90 and 90A). The first grantees of these Lots correspond exactly to this plan so it is an accurate picture of the first grants in the area, if not who actually occupied the land. The next is SO 434, *Plan of Part of Otumoetai [sic], Parish of Te Papa, Cook's County* dating to January 1867 which covers Lots 71, 72 and 86. Although it is not explicitly a map of military sections, the fact that this block of land was confiscated for the express purpose of military settlement suggests this is what it was and some of the grantees have their military rank given – Sergt. J.G.W. Cann was granted Lot 71 and Lieut. Col. G.D. Pitt was granted Lot 75.

Although the entire Tauranga area was confiscated, the Crown planned to return three quarters of it to Māori. The 50,000 acre block in the centre of the district, between the Wairoa and Waimapu Rivers, was considered to be the quarter the government would retain and the rest of the area was to be handed back. There were also 'reserves' set aside within the confiscated block that were meant to be given back to Māori who had been loyal to the Crown or were otherwise deserving. On SO 436 two Lots are shaded pink and marked 'Reserve' – Lots 85B and 88. They were not granted in the usual way and weren't sold until 1882 and 1879 respectively, but they don't appear to have gone to Māori either. This, and the fact that other reserves are marked for other purposes on the maps, reinforces the Waitangi Tribunal report that much of the land returned to Māori, both outside and inside the confiscated block was rapidly alienated through sales to the Crown or private purchasers, frequently under pressure.

These Lots had a rapid turnover at times, and several were bought and sold at least twice before they were formally granted to someone who presumably was long gone from the district. Several people brought up large numbers at once only to sell them off again piecemeal. At one time or another most of the Lots were owned in conjunction with at least one other Lot. Where this has happened the information in common is discussed below under the first Lot number and a reference to that location is given for the other Lots. Some Lots were part of more than one grouping so the information within the Lot section may jump in time.

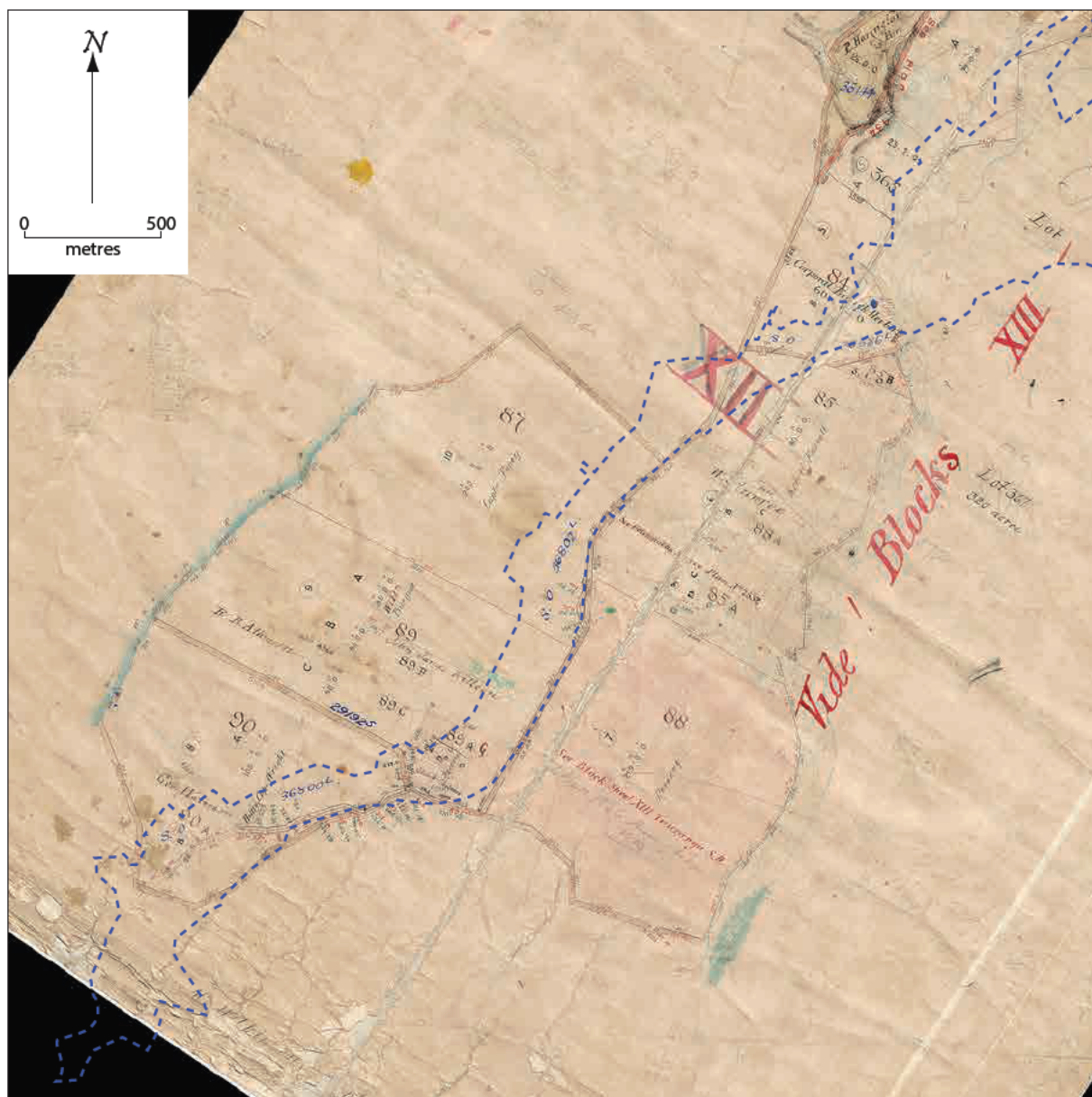


Figure 3. Detail of SO 436, Plan of Military Sections On East Side of Wairoa River, Tauranga, Parish of Te Papa, Cook's County, dated to November 1866, with the designation overlaid.

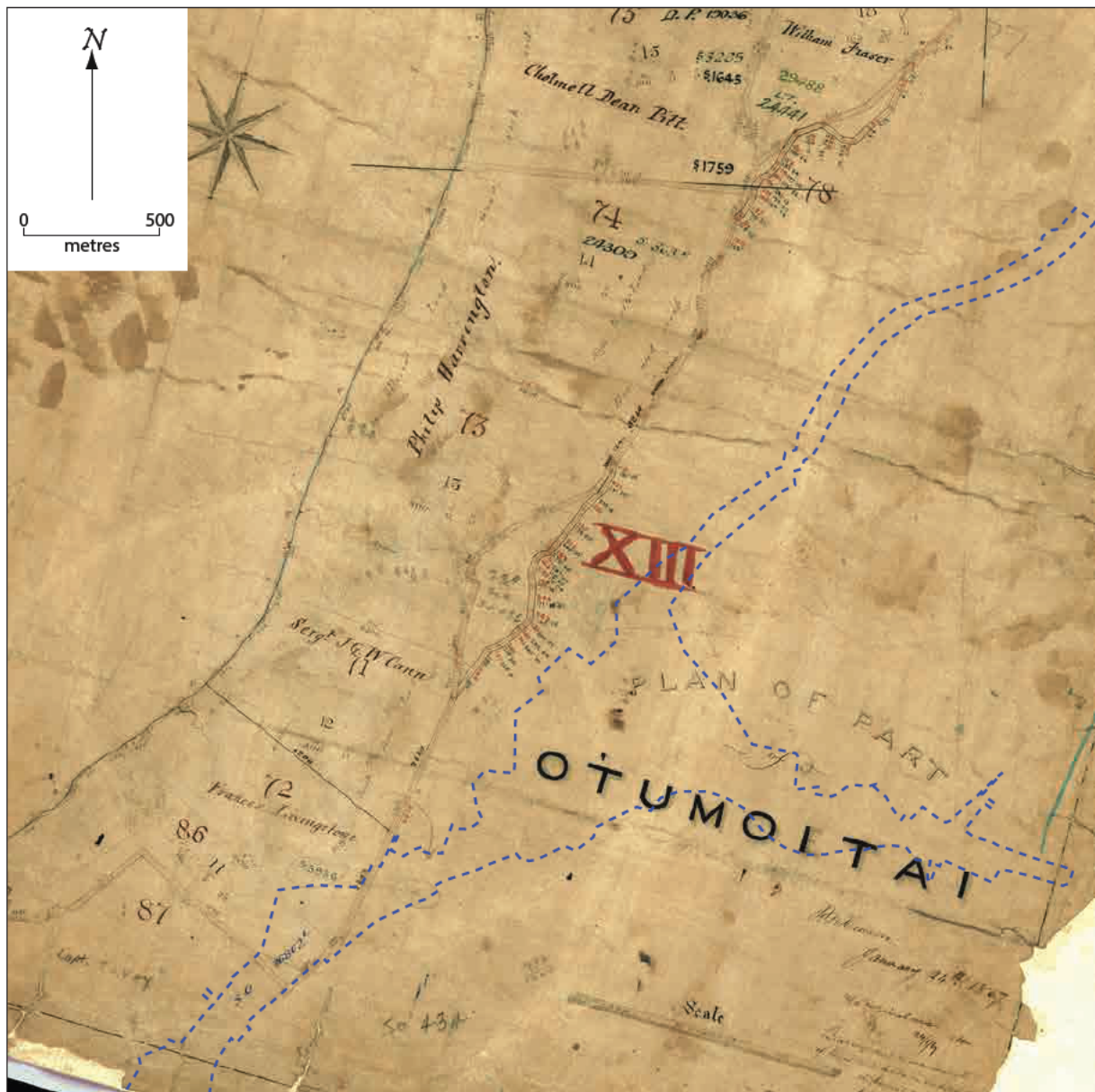


Figure 4. Detail of SO 434, Plan of Part of Otumoitai, Parish of Te Papa, Cook's County, dated to January 1867, with the designation overlaid.

3.3 Archaeological background

A field survey project was undertaken throughout Tauranga County by a team of students under the supervision of Bruce McFadgen of the New Zealand Historic Places Trust (NZHPT) between 1982 and 1985, recording 4500 archaeological sites. The data from this project was analysed by Mary O’Keeffe – she concluded that the main constraints on site location were topography (elevation and steepness) and resource availability. The Wairoa River was a major influence on site location: “The edges above the valley formed by the river were utilised for settlement and for strategic placing of defended sites” (O’Keeffe 1991: 147). In the general area of modern Tauranga, including Tauriko and the Project area, access to resources dictated settlement, with settlement along the river, streams and harbour and horticultural sites located inland (O’Keeffe 1991: 148).

The earliest recorded pre-European site in Tauranga is Waikoriri / The Pilot Bay site, U14/363, on the harbour side of the tombolo at Mount Maunganui. The early period component of the site consists of an artefact rich, charcoal stained midden dated to the early 14th–early 15th centuries AD (see Holmes et al. 2015 for a summary). Other early period sites are known at Bowentown and Maketu (Moore 2004, 2008; Moore et al. 2009; Campbell 2013) but none of these appear to be substantial sites, and they may have been ‘satellites’ of a larger, as yet unidentified base camp or camps.

The harbour remained a focus of settlement throughout the pre-European period but by around AD 1450 settlement had spread inland to the valleys that run into the harbour as well as east along the coast at Papamoa. Sites in the Waimapu Valley / Oropi, the Kaitemako Valley / Ohauti and the Koperuerua Valley / Tauriko / Te Papa were mainly occupied over 200 years, from about AD 1450–1650 (Campbell 2003, 2004a, 2004b, 2005; Furey 2004; Campbell and Harris 2007; Campbell and Hudson 2008). Later occupation was probably further inland but is not well researched archaeologically. Occupation of the dunefields extending from Mt Maunganui to Maketu, best known archaeologically from Papamoa, begins at much the same time but extends for a further 100 years, from around AD 1450–1750. Settlement patterns at the time of European contact centred around major fortified pā on the harbour with “minor pā and other settlement components” on the harbour and inland bushline, about 30 km from the harbour edge (Kahotea 1983: 94).

3.3.1 Tauriko and the Koperuerua Valley

Archaeological investigation in the vicinity of the Project has focused on the Tauriko Business Estate between the current SH29 to the west and the Koperuerua Stream to the east, and The Lakes residential development to the east of the Koperuerua. The Tauriko West Urban Growth Area has also been assessed, and archaeology has begun under the direction of Matthew Campbell as earth-works for housing have commenced, but has not been reported yet.

3.3.2 Tauriko Business Estate

The Tauriko Business Estate has been developing for over 20 years and numerous sites have been investigated. A summary of representative sites is given here. The largest site excavated at the Tauriko Business Estate was U14/2351, Mataraura Pā on a north-facing spur of the ‘Gargan Plateau.’ The central part of the site had been destroyed when it was levelled to create an airstrip in the 1940s or 50s and was subsequently contoured for kiwifruit orchards. A defensive ditch or bank is visible in 1943 aerial photos of the southern end of the pā, but no evidence of this remained on the surface and it was not found during excavation. The first season of excavation in 2007, at the northern end of the site, found intercutting pits indicating three phases of occupation, along with a remnant probable house. Stage 2 excavations took place south of the destroyed defensive ditch / bank in 2011 and found fifteen rectangular pits in two phases. The site was dated to the mid-15th–early 17th centuries (Campbell and Hudson 2009; Campbell and Harris 2012).

U14/2402, located on the top of an isolated hill, was investigated in 2008. The site was dominated by numerous oven scoops and postholes, with 11 small rectangular pits. The site was dated to the mid-16th–late 17th centuries (Harris 2009).

U14/3404 was excavated in 2012. U14/3404 consisted of six large and six small pits that had unusually been left open to fill naturally. Ten metres to the west of the pits was a set of nine fire scoops indicating a separate cooking area. The site was dated to the early 16th–mid-17th centuries. U14/3405, on a nearby spur, was an isolated midden dominated by tuangi and pipi, dated to the mid-16th–late 17th centuries (Harris 2012a).

Site U14/2343 (the Belk Road site) was excavated in 2011 when excavation uncovered a patch of shell near the top of a hill. Four pits, some intercutting, were excavated along with a firescoop. The site dated to the 14th–15th centuries AD, earlier than any other excavated sites in the area (Harris 2012b).

U14/2341 was excavated in 2021. It consisted of 21 pits, six midden deposits, and four fire scoops, along with one partial kōiwi (Māori human remains) burial. One of the pits was about 2 m deep but was not fully excavated. The site dated to the mid-15th to early 17th centuries, with one feature dating to the 14th century (Arrell et al. 2024).

U14/3851 was excavated in 2023 on the top of a small hill. It contained 17 rectangular pits, some intercutting, and dated to the late 15th to mid-17th centuries (Kneebone 2023).

U14/2361 was excavated in 2024. Although there appeared to be substantial midden on top of the hill this had all been disturbed. Some small intact middens and a small pit were found on the north facing slope of the hill. The site dated to the mid-15th to early 17th centuries (Arrell and Campbell 2025). This site is in the Project footprint – it was investigated as the hill was being taken for fill for the Tauriko Business Estate.

U14/4006, 22 pits and two middens, and U14/4092, two pits and midden, were excavated in 2025 but analysis and reporting of these sites is not yet complete (Arrell and Young 2025; Arrell 2026).

3.3.3 Tauriko West Urban Growth Area

Recent excavations conducted by CFG Heritage in the Tauriko West Urban Growth Area have uncovered five pit sites (U14/3506, U14/4074, U14/4075, U14/4077 and U14/4080), but these excavations are not yet complete. No analysis has been undertaken and no reports have been prepared yet.

The Tauriko West Urban Growth Area, between SH 29 and the Wairoa River, is a large Structure Plan area primarily aimed at housing. Of the 15 sites recorded in the Tauriko West Urban Growth Area, only eight were accessible during field assessment by Matthew Campbell and of these only two were definitively re-recorded – a 19th century house (U14/638) and a midden (U14/639) beneath it. Two new sites were recorded, a pit site and a largely destroyed midden (Campbell and Craig 2017).

3.3.4 East of Kopurererua Stream

To the east of the Kopurererua Stream several sites have been investigated in association with The Lakes development, but these have not yet been reported. Site U14/3442 at Hastings Road, a cluster of nine pits on a hilltop, was investigated in 2015 (Cruickshank 2016).

3.3.5 Tauriko West Enabling Works

Other than the investigations at the Tauriko Business Estate, several authorities have been issued within the footprint of the designation (Figure 5). Authorities 1998/46 and 2002/48 were also issued for the construction of Route K / Takitimu Drive but no final reports have been located and as far as I am aware no archaeology was affected although the western base of the hill that Puketoromiro Pā U14/326 sits on was excavated.

Three authorities were issued for Tauriko West Enabling Works:

- 2024/245 for the northern access works around Cambridge Road;
- 2023/545 for works around Redwood Lane; and
- 2025/472 for works around Omanawa Road.

An interim report is available for the Redwood Lane works (Keith and Sutherland 2025) that briefly describes two newly recorded sites. U14/3976, south of Redwood Lane consisted of two areas of fire features and middens. U14/3977, north of Redwood Lane, contained 14 rectangular kūmara

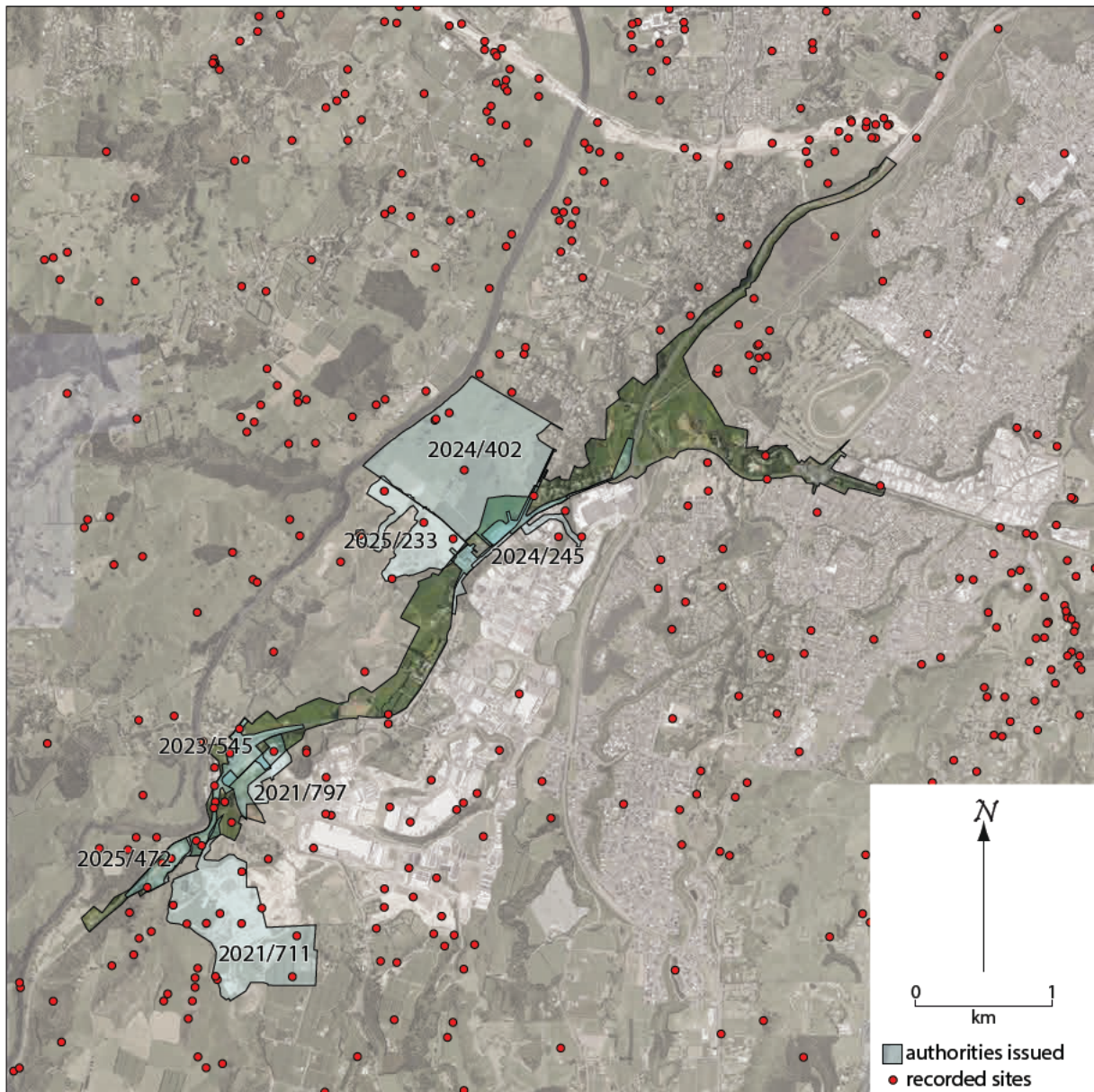


Figure 5. Authorities issued within the footprint of the designation.

storage pits and associated internal features and Keith and Sutherland noted that the area had been heavily truncated.

At Omanawa Road Phillips and McCaffery (2026) recorded three new sites. U14/4108 and U14/4109 are located to the south of the Omanawa River and were discovered by trenching and were described as “modified soil profiles consistent with Māori cultivation practices, likely associated with the growing of tuber crops such as kūmara.” U14/4108 contained pipi shell dispersed through the modified soil. U14/4110 is located north of the Omanawa River and was a small pit site, with one larger pit and three small bin pits. Midden U14/2340 could not be relocated. These sites have now all been destroyed by earthworks.

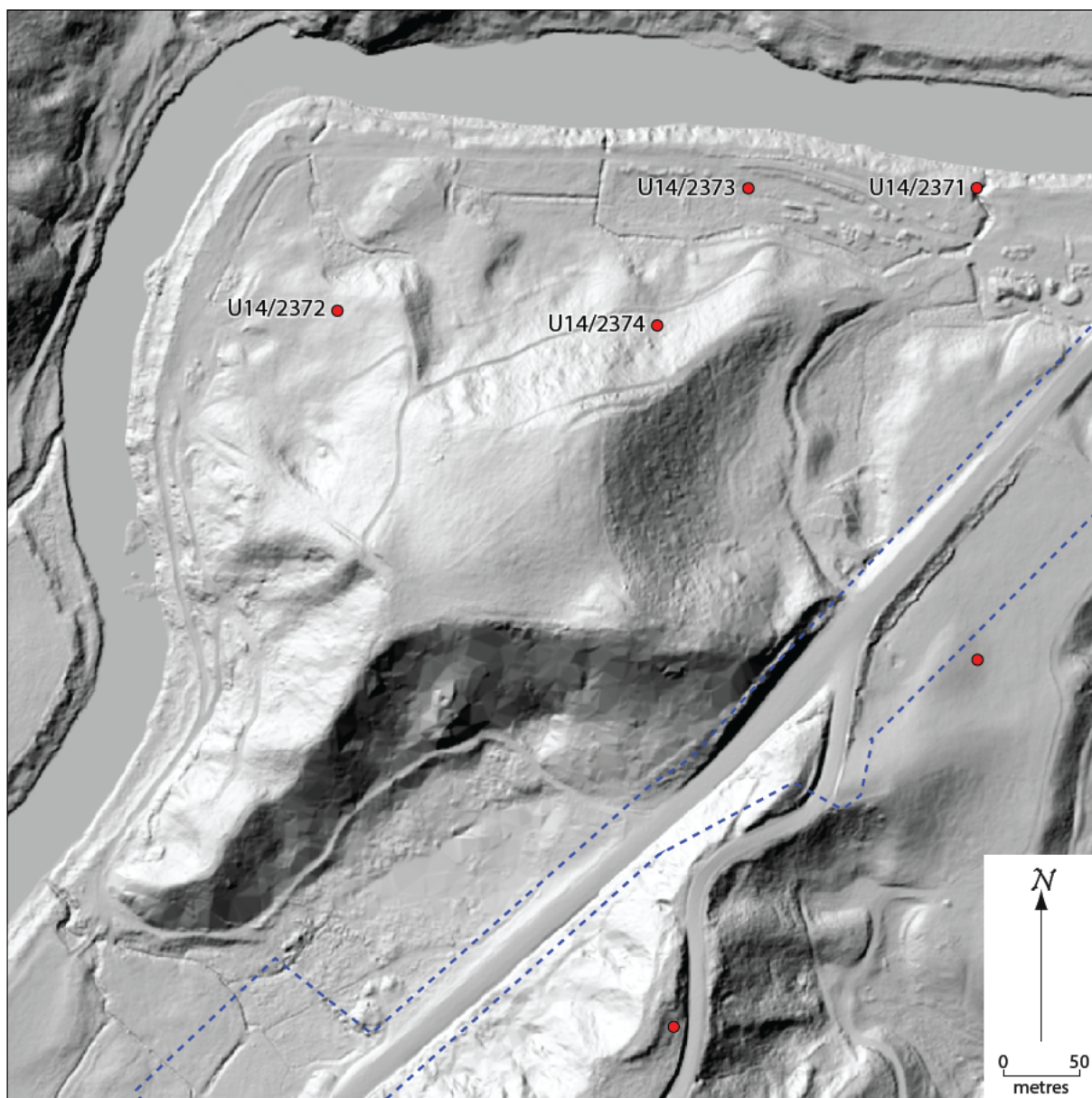


Figure 6. LiDAR derived hillshade model of Tupenga Pā.

3.3.6 Tupenga Pā

Tupenga is the name gifted to the Project by the collective hapū group (Te Rōpū a Tupenga).

Tupenga Pā is a culturally significant site of Ngāti Hangarau, located on an isolated hill in a bend of the Wairoa River (Kalani Tawara, Kōrero Whakataki, 11 March 2026). No earthworks are currently visible for the pā either on the ground or in LiDAR derived hillshade models (Figure 6), and it is not recorded as such in the SRS. U14/2372 and U14/2374 are recorded as terraces on the hill, and U14/2371 and U14/2373 are recorded as middens on the banks of the Wairoa. The pā would have covered much of the hill but earthworks have probably been infilled by farming, although they can be expected to survive well beneath the surface. The pā and the hill it is on are outside the designation and will not be directly affected by the proposed works.

3.3.7 Summary

In general, occupation at Tauriko dates from the mid-14th century to as late as the early 19th century, though mostly in the middle of that range. Artefacts are few, mostly flakes of obsidian from Tūhūa and occasionally the Coromandel. Middens are dominated by pipi and tuangi, with occasional fish – mackerel (*Trachurus* sp.), gurnard (*Chelidonichthys kumu*) and snapper (*Chrysophrys auratus*). Tauriko and the Kopurererua Valley were extensively settled by pre-European Māori, where most of the archaeological evidence is in the form of kūmara storage pits, indicating extensive gardening, although no garden soils have survived a century and a half of ploughing and contouring. The Wairoa River and Kopurererua Valley would have provided communication routes between the coast and inland and the presence of pā such as Mataraua and Puketoromiro show that these routes were defended. However, any direct relationships between the Wairoa and occupation remain to be explored. Early settlement in the Western Bay of Plenty was on the coast while the archaeology of Tauriko shows that occupation rapidly spread inland. Tauriko is a significant archaeological land-

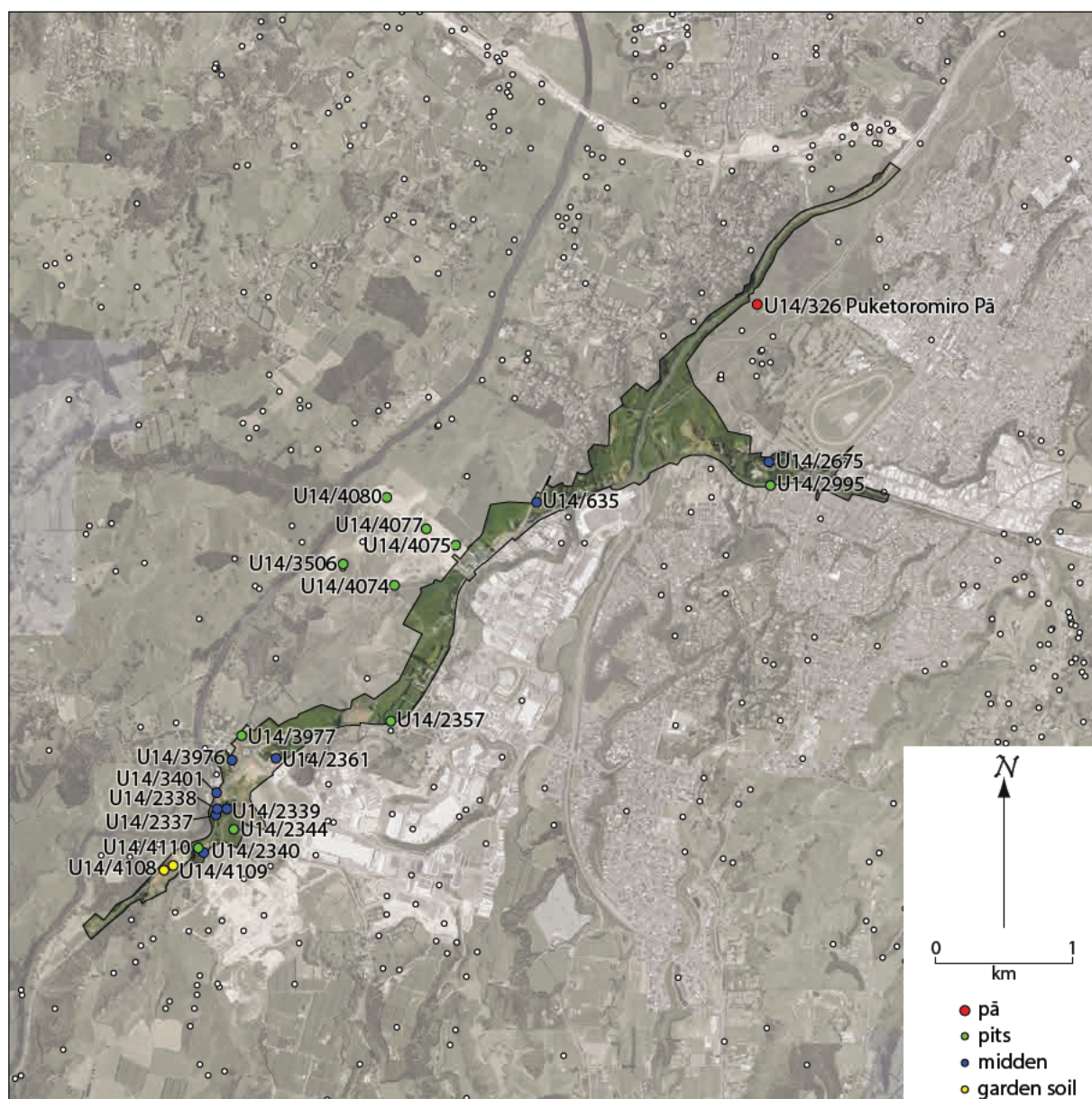


Figure 7. Sites recorded in the project footprint, including sites in the Tauriko Growth Area.

scape, one that is coming into increasingly clear focus as archaeological investigation has proceeded in the past two decades.

While 17 archaeological sites are recorded in the designation footprint (Figure 7), 10 of these fall under existing authorities for Tauriko West Enabling Works while U14/2361 was investigated for the Tauriko Business Estate (Arrell and Campbell 2025) and U14/2995 was recorded as it was being destroyed by earthworks. The remaining sites are: U14/2675, U14/2336, U14/2338, U14/2357 and U14/2344 (Table 1).

Table 1. Summary of sites recorded in the Project footprint

Site	Type	Description
Investigated during Tauriko West Enabling Works, presumed destroyed		
U14/635	midden	Recorded 1983, not relocated 2025, presumed destroyed by Tauriko West Enabling Works at Cambridge Road, no report
U14/3976	midden	Two areas of fire features and middens (Keith and Sutherland 2025)
U14/3977	pits	14 rectangular kūmara storage pits and associated internal features (Keith and Sutherland 2025)
U14/3401	midden	Recorded 2015 when it was eroding, not reported by Keith and Sutherland (2025)
U14/2339	midden	Recorded 1985, updated 2015 when it was eroding, not reported by Keith and Sutherland (2025). Probably same site as U14/2336, U14/2337 and U14/2338
U14/2337	midden	Recorded 2015, not reported by Keith and Sutherland (2025). Probably same site as U14/2336, U14/2338 and U14/2339
U14/4110	pits	Cluster of pits and bin pits (Phillips and McCaffery 2026)
U14/4109	garden soils	Soil profiles observed during trenching (Phillips and McCaffery 2026)
U14/4108	garden soils	Soil profiles observed during trenching (Phillips and McCaffery 2026)
U14/2340	midden	Not relocated (Phillips and McCaffery 2026)
Investigated under other authorities, presumed destroyed		
U14/2995	pit/terrace	Recorded 1996, prior to development that destroyed the site.
U14/2361	midden	Disturbed middens and small pits (Arrell and Campbell 2025)
Not investigated		
U14/2675	midden	Recorded 1985. Midden scatter in poor condition. Not relocated in 2002.
U14/2336	midden	Recorded 1985 in poor condition, not relocated in 2015. Probably same site as U14/2337, U14/2338 and U14/2339
U14/2338	midden	Recorded as redeposited 1985, not relocated in 2015. Probably same site as U14/2336, U14/2337 and U14/2339
U14/2357	pit/terrace	Recorded 1984. Circular depression in rough pasture.
U14/2344	pit/terrace	Recorded 1984. Terrace on hillslope.

4 Field assessment

I carried out site visits across several properties, where landowner permission had been obtained, affected by the Project footprint (Figure 1). The properties were assessed based on the likelihood of archaeology surviving. The areas examined constitute a representative sample of the archaeological landscape within the Project footprint.

The areas of the Project subject to the Tauriko West Enabling works, which were archaeologically investigated under authority, were not assessed (Section 4.3.5, most of these areas are now paved). The results of field assessment are described roughly north to south and include assessment of Puketoromiro Pā although the site lies outside the designation and will not be directly affected.

4.1 Puketoromiro Pā (U14/326)

Puketoromiro Pā U14/326 is on top of a hill approximately 190 x 125 m immediately east of the designation projecting into the Kopurererua flood plain. The construction of Takitimu Drive cut this hill in two so it appears to be isolated, but it would have originally joined directly to the higher ground between Takitimu Drive and Cambridge Road. The pā terraces and defences are clearly visible in LiDAR derived hillshade models (Figure 8) but the original extent of the site is unclear. No features are visible in the LiDAR west of Takitimu Drive and landowner permission was not obtained to visit this property.

At this point Takitimu Drive needs to be widened and the carriageway raised to achieve the necessary width for four lanes. I have worked with the engineers and designers to ensure the pā is avoided by the works, with the designation matching the recorded extent. Raising the carriageway will minimally impact the pā and will have a considerably lesser effect than widening the existing cut.

4.2 North of SH29A

Parts of the Tauranga City Council Reserve in the designation, north of SH29A and east of Takitimu Drive, are low lying and swampy, part of the Kopurererua floodplain. This land may have been exploited for resources such as fish, birds and harakeke, or for growing taro, but these activities would not have left any archaeological footprint (Figure 11). Several pit sites are recorded on the low hills just north of the designation. These recorded pits were assessed but in only one case was a potential pit visible. Nonetheless, they are indicative of similar evidence on low hills in the designation.

Properties adjacent to SH29A contain higher ground that may potentially have been used for crop storage. High flat ground here was under pasture and ground surface visibility was good. These areas may have been cultivated, filling in and obscuring any surface archaeological evidence, and no archaeology was observed (Figure 12).

To the west of Takitimu Drive the swampy Kopurererua floodplain continues. This area is grazed for horses. There is occasional high ground under pasture with good surface visibility, but no archaeology was observed.

U14/2675, south of Marshall Ave, was a midden of sparse, redeposited pipi recorded in 1984. It was not found in 2002 and is probably destroyed.

4.3 Tauriko West Urban Growth Area

U14/635 is a midden recorded adjacent to Cambridge Road. It was investigated under authority 2024/245 for the Tauriko West Enabling Works but reporting is not available yet.

Proceeding south, much of the Tauriko West Urban Growth Area blocks have been assessed and reported previously by the author (Campbell and Craig 2017, 2024). While little archaeology was recorded during these surveys it was assumed that sites would survive well beneath the surface, as recent works on Tauriko Property Group land and at Redwood Lane have shown (Section 4.3.5). One such area is the proposed school site on Ferncliffe Farm (764A SH29) but this was not accessed during the current assessment as it was under maize (Figure 14). I have assessed this area before for both

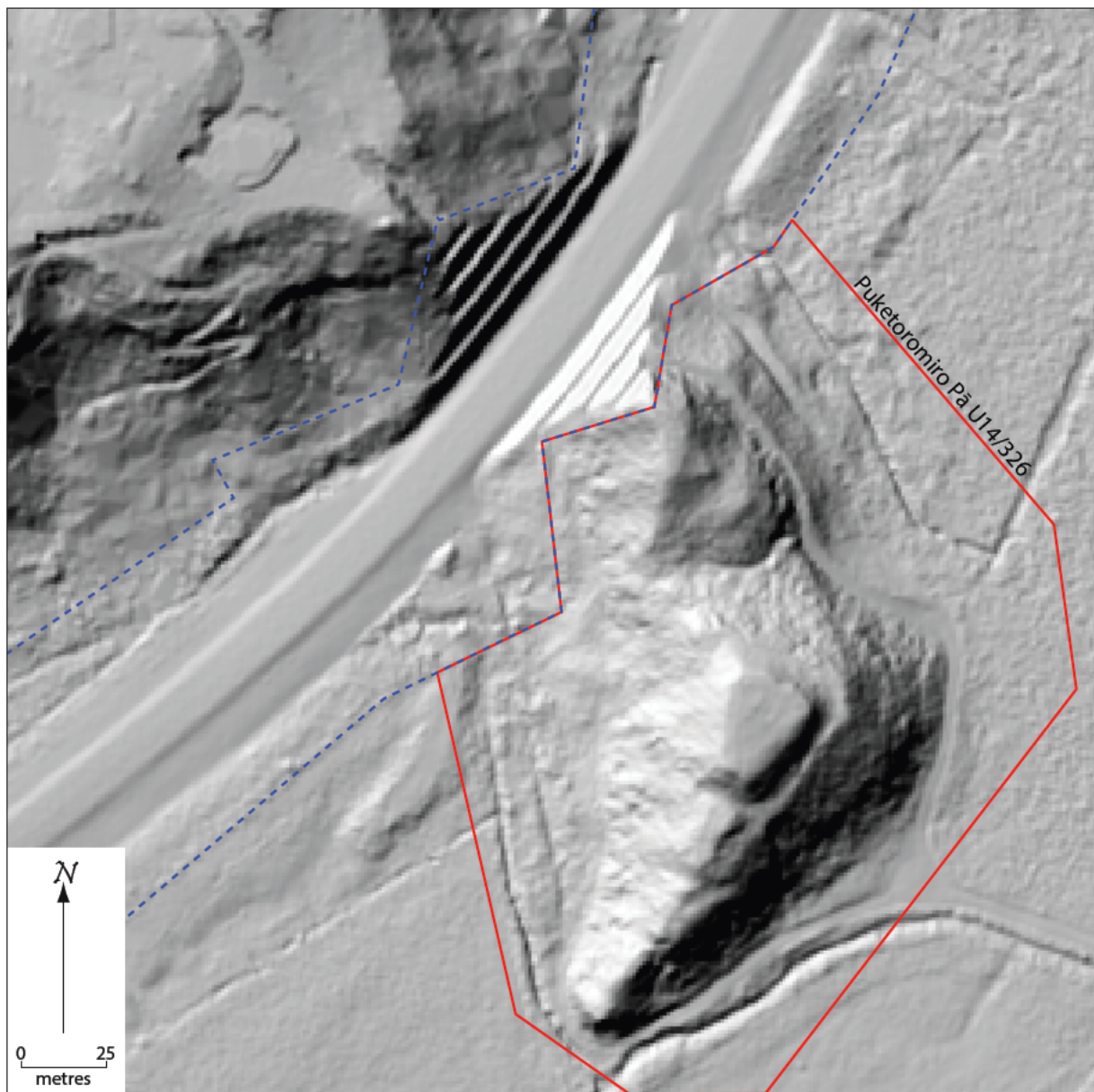


Figure 8. Hillshade model of Puketoromiro Pā U14/326 adjacent to the designation.

the Tauriko West Urban Growth Area and Ferncliffe Farms development and, while it has potential to contain subsurface archaeological features, I am confident that no surface evidence of archaeology is visible. Adjacent to SH29 there is high, level land, but no archaeological sites were observed. Some of this land has already been earthworked for the Tauriko West Enabling Works but other high points remain under pasture (Figure 15).

U14/2357 was recorded in 1984 as a pit, a 'circular depression 2m in diameter and 0.5m deep.' It is unclear from the description if this is, in fact, an archaeological site. It is located in a kiwifruit orchard that has been minimally contoured (Figure 16), which would have filled any surface evidence and no archaeological sites were observed.

U14/2361 was investigated under authority 2021/797 (Section 4.3.2).

Ten sites, U14/635, U14/3976, U14/3977, U14/3401, U14/2339, U14/2337, U14/4110, U14/4109, U14/4108 and U14/2340, were investigated under authority for the Tauriko West Enabling Works (Section 4.3.5).



Figure 9. Cross section of the proposed raised carriageway at Puketoromiro Pā U14/326, looking north with the pā on the right.

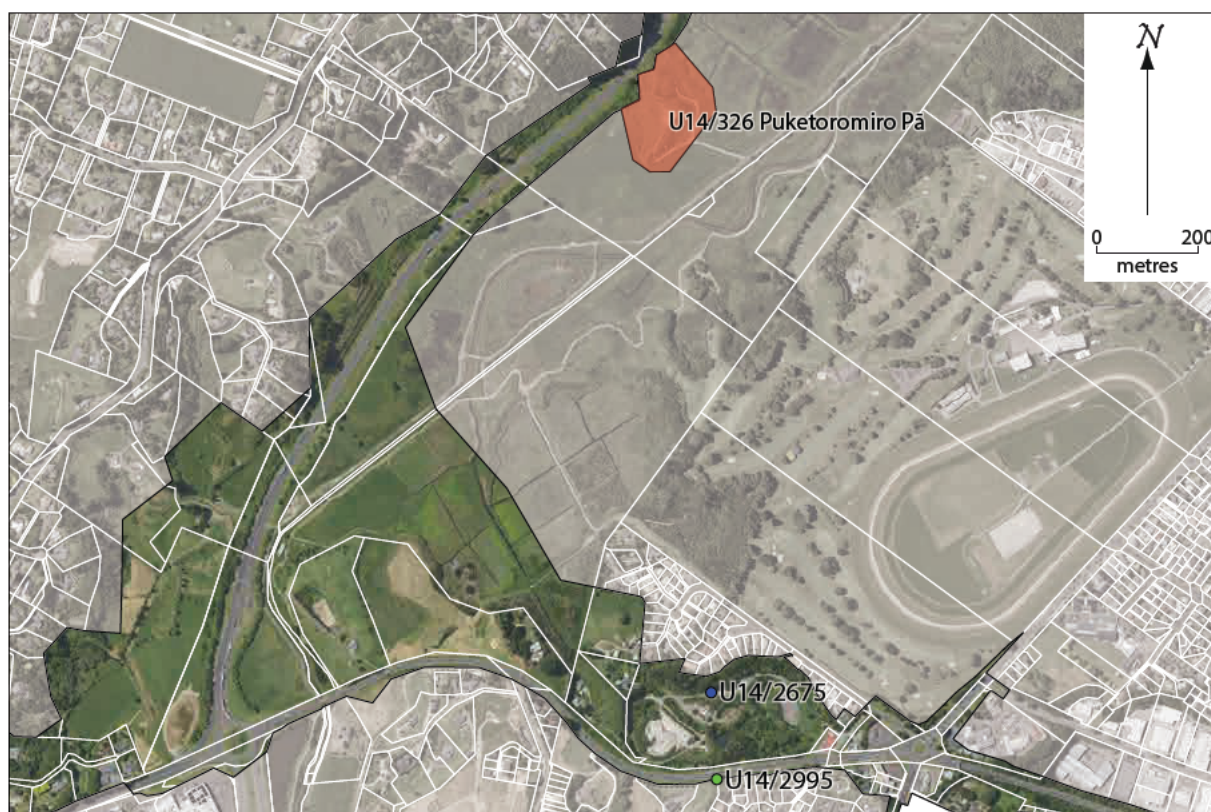


Figure 10. Recorded sites in the designation north of SH29A, including Puketoromiro Pā.



Figure 11. Low lying, swampy land of the Kopurererua flood plain in the Council Reserve between Takitimu Drive and SH29A.



Figure 12. Level hilltop just north of SH29A, with no archaeology visible.

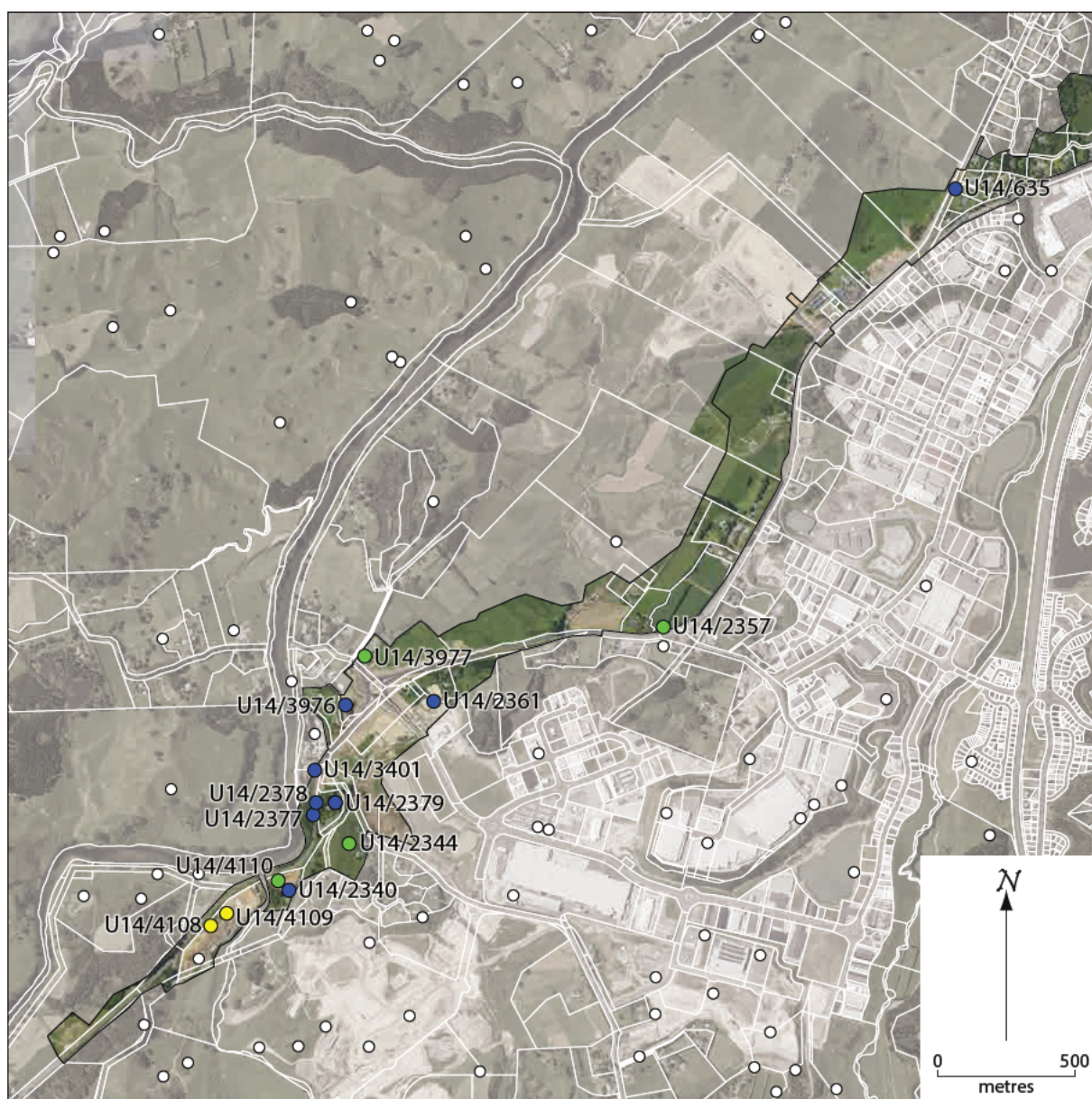


Figure 13. Recorded archaeological sites in the designation in or close to the Tauriko Growth Area.



Figure 14. Proposed school site under maize.



Figure 15. Typical view across high points of land adjacent to SH29.



Figure 16. Minimal contouring in the Trinity Lands kiwifruit block.



Figure 17. Location of U14/2344.

U14/2344 was recorded in 1984 as a 10 x 6 m terrace 'cut into ridge slope.' No terrace was observed although the ridge top would be a typical location for kūmara storage pits, although it appears to have been disturbed by minor earthworking. Some redeposited midden was observed in an accessway cutting just outside the designation which is a further indication of probably intact archaeology nearby (because it is disturbed, this midden was not recorded as a site).

4.4 Ground Penetrating Radar (GPR) assessment

A GPR survey of the playground behind the Tauriko school was conducted by Emma St Pierre of Radarch. This level area was, based on past experience in the wider Tauriko area, considered a likely location for subsurface evidence of kūmara storage pits. Two grids were surveyed (Figure 18). Given the compaction of the soils and the activities of the school (established ca 1917) over the last century, the area is very disturbed and the results are not definitive, but some areas of interest were noted. The full Radarch report is appended to this report.



Figure 18. Areas surveyed by GPR.

4.5 Summary

Although 17 sites are recorded in the designation, 12 of which have been investigated or destroyed by development, no confirmed archaeological features or sites were observed during field assessment. Archaeological investigation in the wider Tauriko area, including recent works within the Tauriko West Urban Growth Area and at Redwood Lane (as part of the Tauriko West Enabling Works) have shown, that extensive archaeological sites often survive beneath the surface, obscured by a century and a half of cultivation, including contouring for orchards. This is very likely to be the case for this Project, particularly on areas of level, high ground. These areas are listed in Table 2 and shown in Figure 19, though there is still a chance of archaeological evidence being present on lower ground.

Table 2. Lots containing high risk areas.

Legal Description	Address	CT
Lot 4 DP 457710	30A Belk Road, Omanawa 30 Belk Road, Omanawa	593887
Lot 4 DP 512150	954 State Highway 29, Tauriko, Tauranga 956 State Highway 29, Tauriko, Tauranga 28 Redwood Lane, Tauriko, Tauranga	788676
Lot 1 DP 512150	78B State Highway 29, Tauriko, Tauranga	788673
Lot 1 DPS 82791	928 State Highway 29, Tauriko, Tauranga	SA65D/74
Lot 2 DPS 87023	Parcel ID: 4339010	SA68D/533
Lot 3 DP 512150	880 State Highway 29, Tauriko, Tauranga 878 State Highway 29, Tauriko, Tauranga	788675
Lot 2 DP 512150	878A State Highway 29, Tauriko, Tauranga	788674
Lot 1 DPS 33435	856 State Highway 29, Tauriko, Tauranga	SA31B/891
Lot 7 DP 512150	820 State Highway 29, Tauriko, Tauranga	788679
Part Lot 1 DPS 4793	810 State Highway 29, Tauriko, Tauranga	SA1488/88
Lot 1 DPS 81135	808 State Highway 29, Tauriko, Tauranga	SA63B/62
Allot 797 Te Papa PSH	Parcel ID: 4476423	SA25B/1242
Part Allot 87 Te Papa PSH	768 State Highway 29, Tauriko, Tauranga	SA360/95
Part Allot 87 Te Papa PSH	766 State Highway 29, Tauriko, Tauranga	SA476/196
Paper Road		
Part Allot 86 Te Papa PSH	740 State Highway 29, Tauriko, Tauranga 764 State Highway 29, Tauriko, Tauranga	SA476/196
Lot 5 DPS 47965	610 State Highway 29A, Tauriko, Tauranga	SA42D/234
Lot 6 DPS 47965	580 State Highway 29A, Tauriko, Tauranga	SA42D/235
Lot 2 DPS 60348	491 Cambridge Road, Tauriko, Tauranga	SA49B/296
Part Lot 3 DPS 60348	Parcel ID: 6760313	SA49B/297

5 Assessment

The following assessment of values and significance relates only to potential archaeological values. Other interested parties, in particular mana whenua, may hold different values regarding the sites and proposed development.

5.1 Assessment of values

The following assessment of archaeological values is based on the criteria set out in the HNZPT (2019). This assessment applies to Puketoromiro Pā U14/326, the five recorded sites in the Project footprint that are not yet investigated, as well as generic values assessment of potential archaeology, principally kūmara storage pit (rua) complexes, and is based on the author's extensive experience at Tauriko.

Investigations for the Tauriko West Urban Growth Area and Tauriko West Enabling Works recorded five new sites and failed to find several more that had been recorded between 10 and 40 years ago. A similar situation is likely to be the case for the Project.

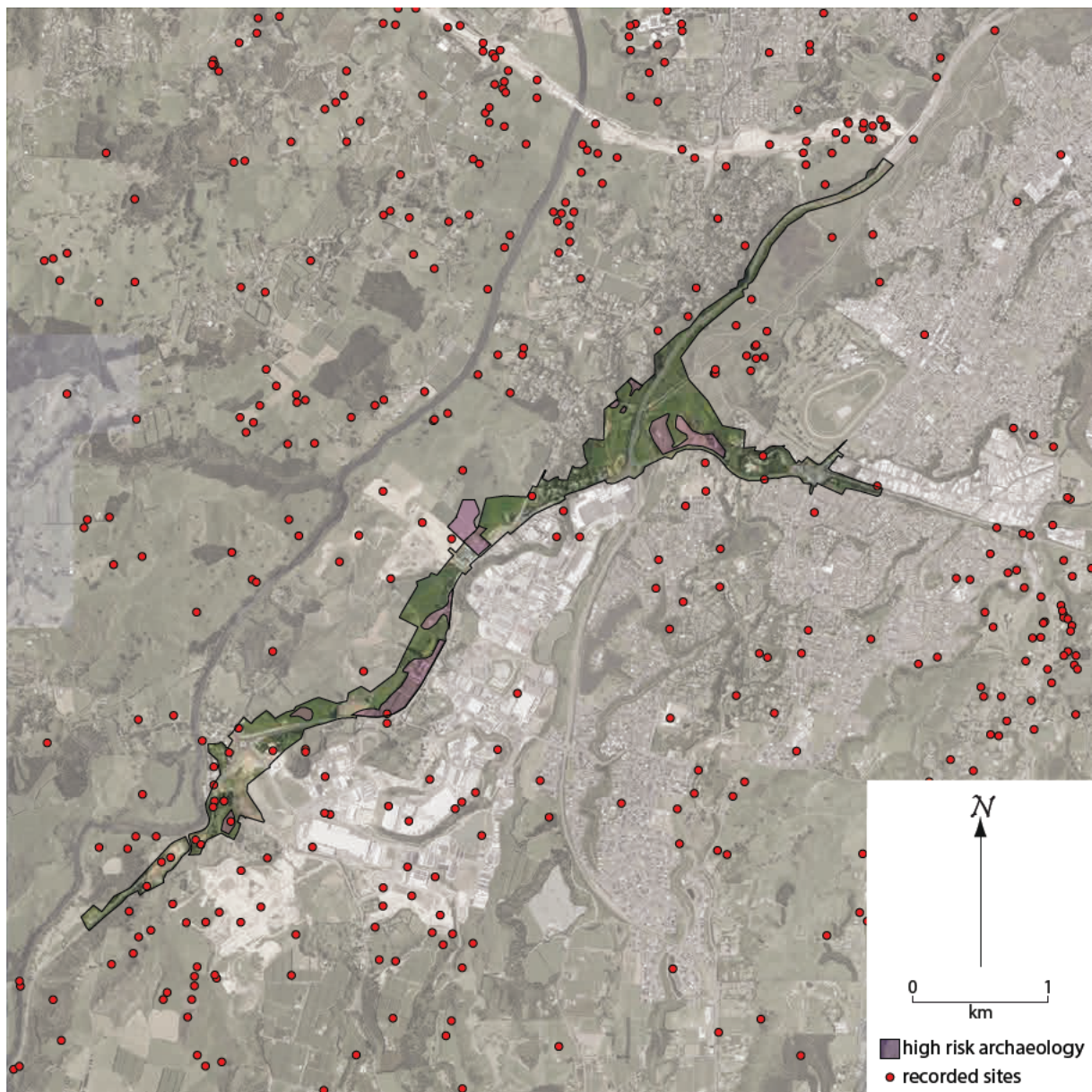


Figure 19. Areas of high, level ground with greater risk of archaeology being present.

5.1.1 Puketoromiro Pā U14/326

Condition	The original extent of Puketoromiro is unclear but the hill on which it sits has been extensively cut by the construction of Takitimu Drive. The fortified part of the pā appears to be intact but this is uncertain. While the remaining features are visible and in good condition, some parts of the site may have been destroyed, and associated features outside the defended area may have been damaged or destroyed by the cut.
Rarity	Pā are a common site type locally and throughout much of the North Island.
Context	Puketoromiro retains its contextual relationships with the Tauriko landscape, although this has been heavily modified by development, with the Wairoa River and Kopurererua Valley, and with the well recorded archaeological landscape of Tauriko.
Information	While no earthwork's on the surviving parts of the pā are proposed, the remaining features are in good condition and have considerable potential to provide archaeological information on the nature and timing of the occupation of the site, and con-

tribute to the archaeological understanding of Tauriko and the Western Bay of Plenty. Archaeological investigation has been conducted at Tauriko for over 20 years which makes it one of the best investigated archaeological landscapes in Aotearoa. The archaeology of Project will contribute to the developing understanding of the wider landscape in which Puketoromiro is situated.

Amenity	The main features of Puketoromiro remain visible and can be easily interpreted to the public. Raising the carriage way will have only a minor effect on this amenity.
Cultural	Cultural values can only be assessed by mana whenua.

5.1.2 U14/26755, U14/2336, U14/2338, U14/2357 and U14/2344

Condition	Some sites and features may have been destroyed or severely damaged in the last 40 years since the sites were first recorded. Others may survive with just the surface expression of features obscured. The condition of any features or deposits beneath the surface is likely to be fair to good. Surface evidence has been ploughed or contoured, which will have destroyed shallow features but the bases of pits and the features in the bases will survive well.
Rarity	Pit complexes and middens are a common site type locally and throughout much of the North Island.
Context	The sites retain their contextual relationships with the Tauriko landscape, although this has been heavily modified by development, with the Wairoa River and with the well recorded archaeological landscape of Tauriko.
Information	The sites have the potential to contribute to the archaeological understanding of Tauriko and the Western Bay of Plenty. Archaeological investigation has been conducted at Tauriko for over 20 years which makes it one of the best investigated archaeological landscapes in Aotearoa. The archaeology of Project will contribute to the developing understanding of this landscape.
Amenity	Any subsurface archaeological features or deposits are not currently visible and cannot be interpreted to the public in their current form.
Cultural	Cultural values can only be assessed by mana whenua.

5.1.3 Potential archaeology in the designation

Condition	The condition of any features or deposits beneath the surface is likely to be fair to good. Surface evidence has been ploughed or contoured, which will have destroyed shallow features but the bases of pits and the features in the bases, along with garden soils and deep postholes will survive well.
Rarity	Pit complexes are a common site type locally and throughout much of the North Island.
Context	Any surviving pit complexes retain their contextual relationships with the Tauriko landscape, although this has been heavily modified by development, with the Wairoa River and with the well recorded archaeological landscape of Tauriko.
Information	Any surviving pit complexes have the potential to contribute to the archaeological understanding of Tauriko and the Western Bay of Plenty. Archaeological investigation has been conducted at Tauriko for over 20 years which makes it one of the best investigated archaeological landscapes in Aotearoa. The archaeology of Project will contribute to the developing understanding of this landscape.
Amenity	Any subsurface archaeological features or deposits are not currently visible and cannot be interpreted to the public in their current form.
Cultural	Cultural values can only be assessed by mana whenua.

5.2 Assessment of effects

Although final design has not yet been prepared it is to be expected that the construction of the Project will involve extensive cut and fill earthworks that will destroy any archaeology within the Project footprint.

This site destruction can be mitigated through archaeological investigation under HNZPTA authority.

6 Recommendations

These recommendations are made on the basis of the archaeological values that have been outlined above. Any other values associated with special interest groups, including mana whenua can only be determined by them. It is recommended that:

- an authority (or authorities) to modify or destroy any archaeological features in the Project footprint be granted for the whole Project footprint, under Section 42(4)(i) and Schedule 8 of the Fast-Track Approvals Act 2024 ;
- an Archaeological Management Plan and Archaeological Research strategy be prepared to accompany the authority application, which sets out appropriate methods for managing any effects on the sites during construction;
- appropriate tikanga (protocols) should be followed during works – mana whenua may make recommendations outlining these;
- in the event of kōiwi (human remains) being uncovered during any future construction, work should cease immediately and mana whenua should be contacted so that suitable arrangements can be made;
- since archaeological survey cannot always detect sites of traditional significance to Māori, or wāhi tapu, the appropriate tangata whenua authorities should be consulted regarding the possible existence of such sites, and the recommendations in this report.

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Appendix. Ground Penetrating Radar report

Ground-Penetrating Radar Investigations, Tauriko School, Tauriko



Prepared for CFG

Dr Emma St Pierre

March 2026

This report (including any attachments) has been prepared by Radarch Archaeological and Geophysical Consulting for the exclusive use and benefit of the CFG and solely for the purpose for which it is provided. The professional advice and opinions contained in this report do not constitute legal advice. We do not accept any liability if this report is used for an alternative purpose from which it is intended. Information contained in the report is current as at the date of the report and may not reflect any event or circumstance which occurs after the date of the report.

Citation:

St Pierre, E. 2026. *Ground-Penetrating Radar Investigations, Tauriko School, Tauriko*.
Report prepared for CFG.

Front Cover: GPR Grid 1 at Tauriko School

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1 Introduction

Radarch Archaeological and Geophysical Consulting (hereafter Radarch) was engaged by CFG Heritage Ltd (hereafter CFG) to undertake ground-penetrating radar (GPR) investigations at Tauriko School, Tauriko (the study area) (Figure 1). The aim of the GPR investigations was to determine whether subsurface archaeological features indicating Māori occupation, particularly storage pits, could be identified for appropriate heritage management prior to land development. The GPR survey was undertaken on the 7th March 2026 by Dr Emma St Pierre (Director, Radarch), with the assistance of Dr Matthew Campbell (Director, CFG).

1.1 Environmental, Archaeological and Land Use Context

The study area is located on a plateau east of the Wairoa River, and approximately 160 m west of a steep-sided scarp. The underlying geology of the study area are the Middle-Pleistocene age Chimp Formation ignimbrites of Ohakuri, Kapenga and Rotorua Volcanic Centres (GNS 2026). These are described as non-welded, poorly-consolidated rhyolite ignimbrite, commonly with nearly aphyric pumice and minor fall deposits of lapilli and ash (GNS 2026).

The study area is located within the Otorohanga soil family (Otorohanga 83a.3 soil sibling), which belongs to the Allophanic soil order of the New Zealand soil classification (Hewitt et al. 2021). Allophanic soils are dominated by allophane minerals formed from weathering of volcanic ash and volcanic parent rocks and have low density structure (Hewitt et al. 2021). Otorohanga soils are deep (extending more than 1 m), stoneless and have a loamy texture comprised of approximately 10-25% clay, 45-55% silt and 10-45% sand (Manaaki Whenua Landcare Research 2026). Generally, Otorohanga soils are well drained, with rapid permeability and have moderate water holding capacity (Manaaki Whenua Landcare Research 2026). These soils should allow moderate penetration of electromagnetic energy due to their relatively low clay content; however this will depend on their saturation.

Tauriko School was established over 100 years ago, and the broader region has been subject to farming since the late 1800s. A review of historical aerial and satellite imagery indicates that the study area has been subject to land clearance since at least 1943, but likely much longer. No structures appear within the GPR survey areas in any historical photographs. The land immediately surrounding the study area is currently used as farmland, including crops.

A summary of Māori and European occupation of the broader study area is provided Arrell et al. (2024) and Campbell and Hudson (2009). No Māori archaeological sites have been recorded in the study area, however archaeological features encountered in the broader landscape include pits (both large and small), postholes, fire pits and shell middens among others. Pits in this region are generally rectangular, often have internal postholes and sometimes other internal features such as steps and sumps, and range in size up to 4.8 m long and depths of over 1.2 m (Arrell and Young 2025, Arrell et al. 2024). These types of archaeological features may be present within the study area due to its location in a favourable landform.

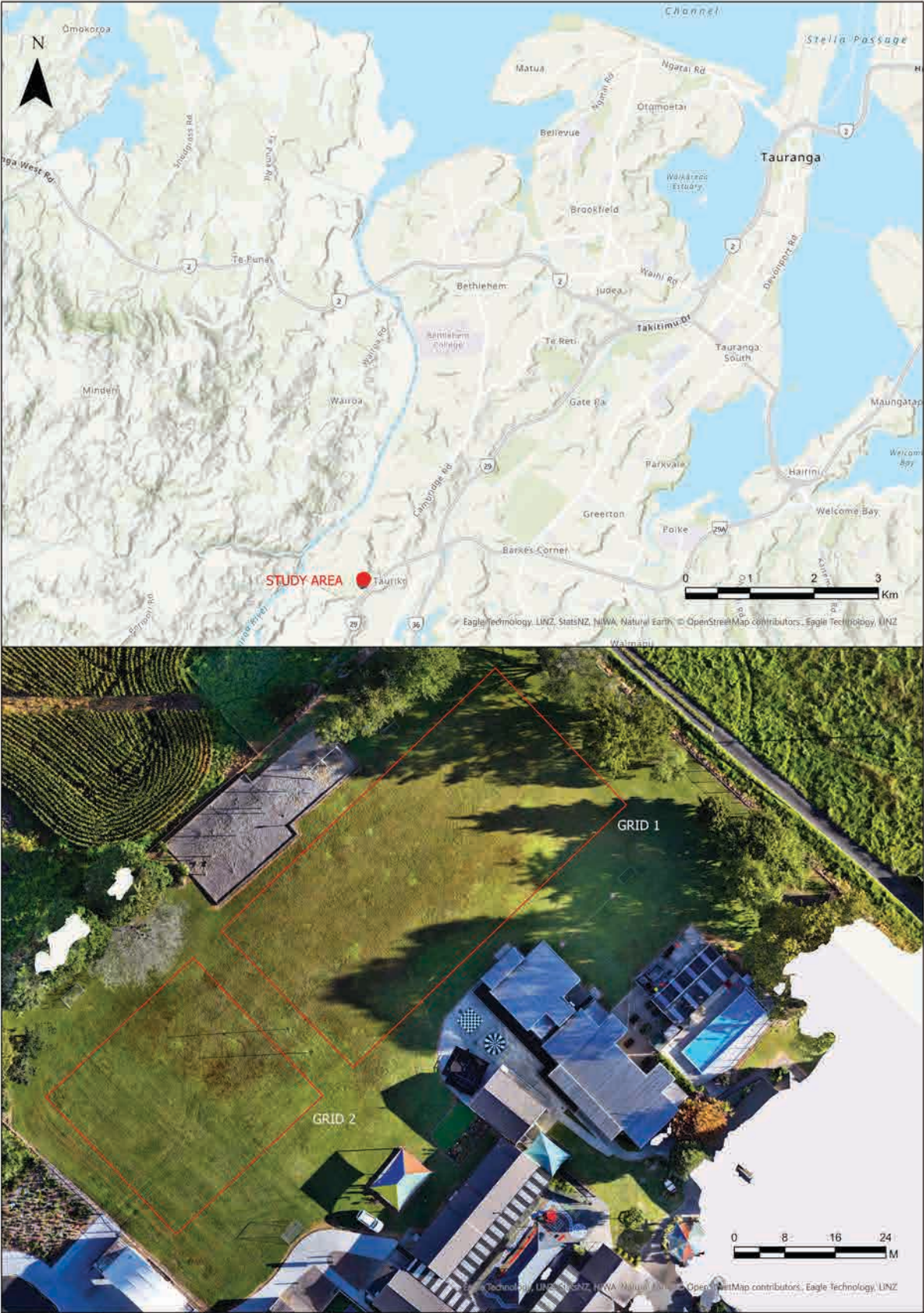


Figure 1. Location of study area and GPR grids at Tauriko School, Tauriko.



Figure 2. Aerial imagery from 1943, with location of study area in red (source: retrolens.nz and licensed by LINZ CC-BY 3.0).

2 Methods and Limitations

Ground-penetrating radar is a non-invasive geophysical technology that transmits electromagnetic energy (radar waves) from surface antennas into the ground. As radar waves of various wavelengths propagate (spread) outwards and move into the ground, they reflect from buried objects, features, or bedding surfaces, back to the surface antenna. Some reflected radar waves will travel back to the ground surface and receiving antenna, while the remaining energy continues to propagate and can continue be reflected from additional buried features until the energy finally disperses with depth (called attenuation). Only the reflected energy that travels back to the surface antenna is recorded as an image and can be interpreted.

The amplitude (strength) of a reflected radar wave is also important because their relative variations are directly related to changes in the physical and chemical properties of different materials in the ground. For example, energy will penetrate through sand far more readily than some clays, which will attenuate energy rapidly. The velocity (speed) of travelling radar waves will also vary, depending on the physical and chemical properties of the materials in the ground. The velocity of energy transmitted into the ground can be calculated and reflected radar wave travel times - measured in nanoseconds (ns) - converted to distance (i.e. depth) (Conyers 2012: 25). The velocity of the medium is equal to the speed of light (c) divided by the square root of the relative dielectric permittivity (RDP), also called the dielectric constant.

RDP is a measure of the ease with which a material is polarised by an electric field relative to the vacuum of ground conditions. Generally, the lower the RDP, the faster energy will move through the medium; the higher the RDP, the slower it will move. For example, air has an RDP of 1 while freshwater has an RDP of 80. Sand generally has a low RDP of around 5, while clays range widely between 5 and 40 (Conyers 2023: 56). Because water has a high dielectric constant of 80 and therefore moisture content of soils and objects will influence the velocity and contrast between buried deposits. The RDP of ground conditions is measured by hyperbola fitting. A hyperbola is the shape of reflections generated from "point sources" in the ground, caused by the propagation of radar energy as it moves deeper in the ground from a surface antenna.

To collect data the GPR antennas are typically moved along lines (called survey transects) within a survey grid so that the exact location of where the reflected data were collected is known and can be plotted on a map. Distance along transects is measured using a survey wheel attached to the antennas. As the antennas are moved along the ground surface, individual reflections are recorded approximately every 2 to 10 cm along each parallel survey transect. The structure of each reflected radar wave (called a waveform) that is received by the GPR computer system is digitised into a reflection trace, which is a series of waves reflected to one surface location from many depths in the ground.

When many traces are stacked next to each other sequentially, a two-dimensional vertical profile is produced along the survey transect, which produces two-dimensional images, just like viewing layers in a vertical road cut or excavation section. These are radar profiles. When

many two-dimensional reflection profiles (each of which contain thousands of reflection traces) are collected within a grid, these data can be used to produce a variety of two and three-dimensional images that aid in the interpretation of reflections. These are amplitude maps, two-dimensional plan maps of a grid showing the different strengths (amplitudes) of reflections at a range of selected horizontal depths. However, the analysis of individual profiles is critical for the interpretation of archaeological features. This is because many of these subsurface features may not be visible in amplitude maps or may be interpreted incorrectly based on amplitude maps alone, which may slice through features and show only a portion of the information. Additionally subtle reflections that are seen in profiles may not be visible in amplitude maps and may be more relevant to the goals of the project than strong reflections. The reflections of different disturbances/objects may present in the same way, and therefore the archaeological, historical and geomorphological context of a site, if known, is of critical importance for interpretation.

2.1 GPR Survey at Tauriko School, Tauriko

The GPR survey was undertaken on the 7th March 2026. Two grids were established within the study area, in consultation with Dr Matthew Campbell (Director, CFG). Data were collected with the zig-zag method and survey transects were spaced 50 cm along the X axis. GPR reflections were collected using a 400 MHz antenna, which can transmit energy to approximately 2 to 3 m depth with a subsurface resolution of approximately 25 cm, depending on the types of deposits. A GSSI SIR-3000 system was used for data collection, and data was processed using the software GPR Viewer, GPR Process, and Surfer 12 to produce reflection profiles and amplitude maps (Conyers 2012, 2023). Data were collected in a 31 ns time window for Grid 1 and 28 ns for Grid 2. Amplitude maps with time slices of varying depths were produced for each grid, and a detailed analysis of all profiles was undertaken to identify elements that may indicate the presence of archaeological features, particularly pits.

3 Results and Interpretation

A total area of 2,760 m² of GPR data were collected in two grids, including over 5.6 km of survey transect profiles. Analysis of hyperbola reflections across both grids produced an average dielectric constant of 10, indicating that the electromagnetic wave propagation velocity through deposits averages approximately 0.095 m/ns. The results for each grid are discussed below.

The main cultural features we might expect to find in the study area are pits (both large and small) with associated postholes, and shell middens. Pits should be recognisable in the GPR data as disrupted stratigraphy, with hyperbola reflections from the edges of the pit, and potentially a compact base seen as a high-amplitude reflection. The backfill within the pit may or may not be distinguishable from the surrounding matrix, depending on its composition. If fill is comprised of similar materials, it may be impossible to identify the pit as the reflections will look the same as the surrounding matrix. Loose backfill may present as multiple extremely complex reflections, homogenous fill (e.g. sand) will provide almost no reflections, and differing compositions may increase or decrease moisture holding capacity which may create a stronger or weaker signals.

3.1 Grid 1

Grid 1 (30 m x 60 m) is located at the northeastern end of the school playing field and is relatively flat, with a turf surface. The GPR data from this large survey area very complex, with a multitude of chaotic point source reflections and changes in stratigraphy. Of note is a change in contrast between stratigraphic layers at a depth of approximately 50-80 cm. Complex hyperbola reflections of various shapes indicate this layer is undulating and, in some areas, likely disturbed. The strength of these reflections becomes very high and uniform, on the northeastern side of the grid (Figure 4 and Figure 3), indicating this area could be compacted. Several surface and near surface pieces of metal were noted in the profiles, including one at 30 cm depth, and at least some of the upper deposits are disturbed, likely relating to levelling of the school playing field.

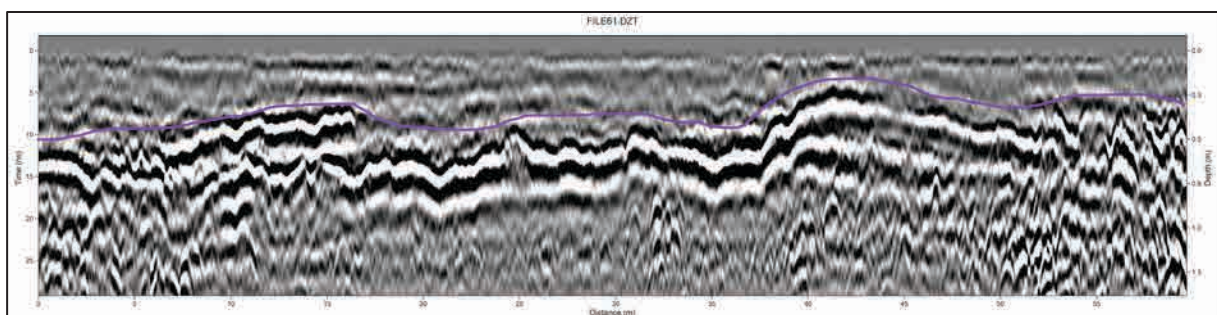


Figure 3. High amplitude reflection across the grid indicating change in stratigraphy, and potentially compacted surface (purple line).

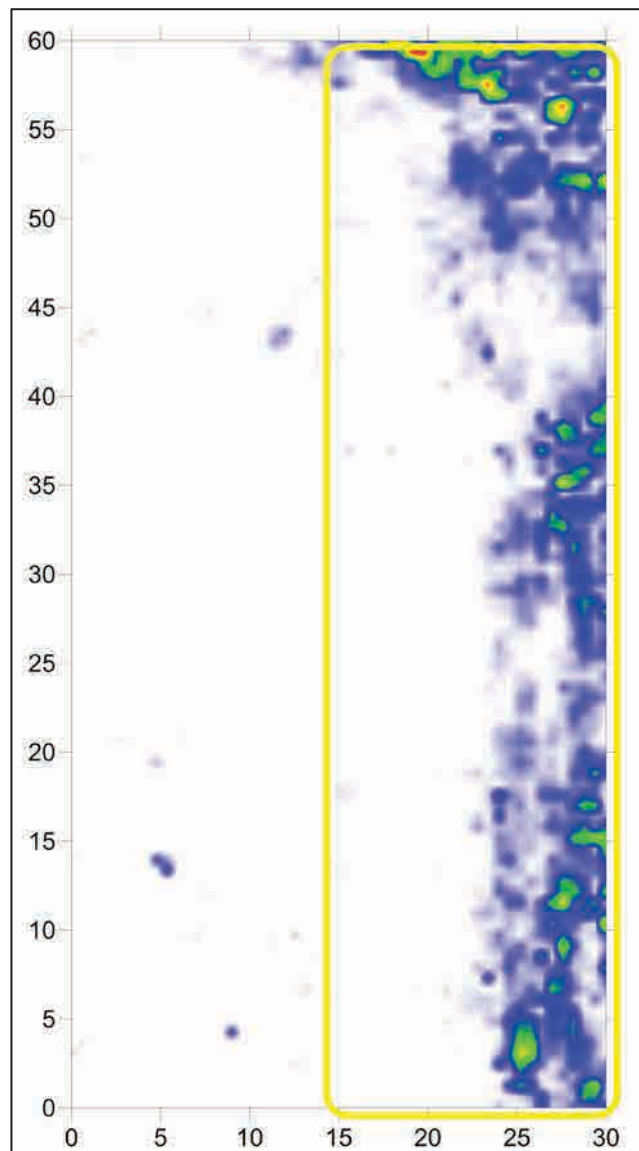


Figure 4. Grid 1 Amplitude map stratigraphic feature shown in yellow box (~45-67 cm depth; top of grid is northeast).

Many distinctive hyperbola reflections, indicating point sources, are present within this layer and below. Native soils are considered stoneless, most of the grid is far from large tree root zones (except the northeastern end of Grid 1), and there was no surface evidence for burrowing animals, therefore it is likely that many of these reflections relate to complexities in the stratigraphy, particularly if there has been ground disturbance and imported fill. However, a cultural origin for some of these reflections cannot be dismissed.

No reflections indicative of pits were observed in the GPR data. However, Feature 1 (Figure 6) is indicative of what you might see as a cut and fill feature (like a pit). Although this feature is only seen in one profile of the grid, and you would expect to see these features across multiple profiles to indicate a pit, it may still be worth investigating. Several other areas of interest are noted in Table 1 and shown in Figure 1.

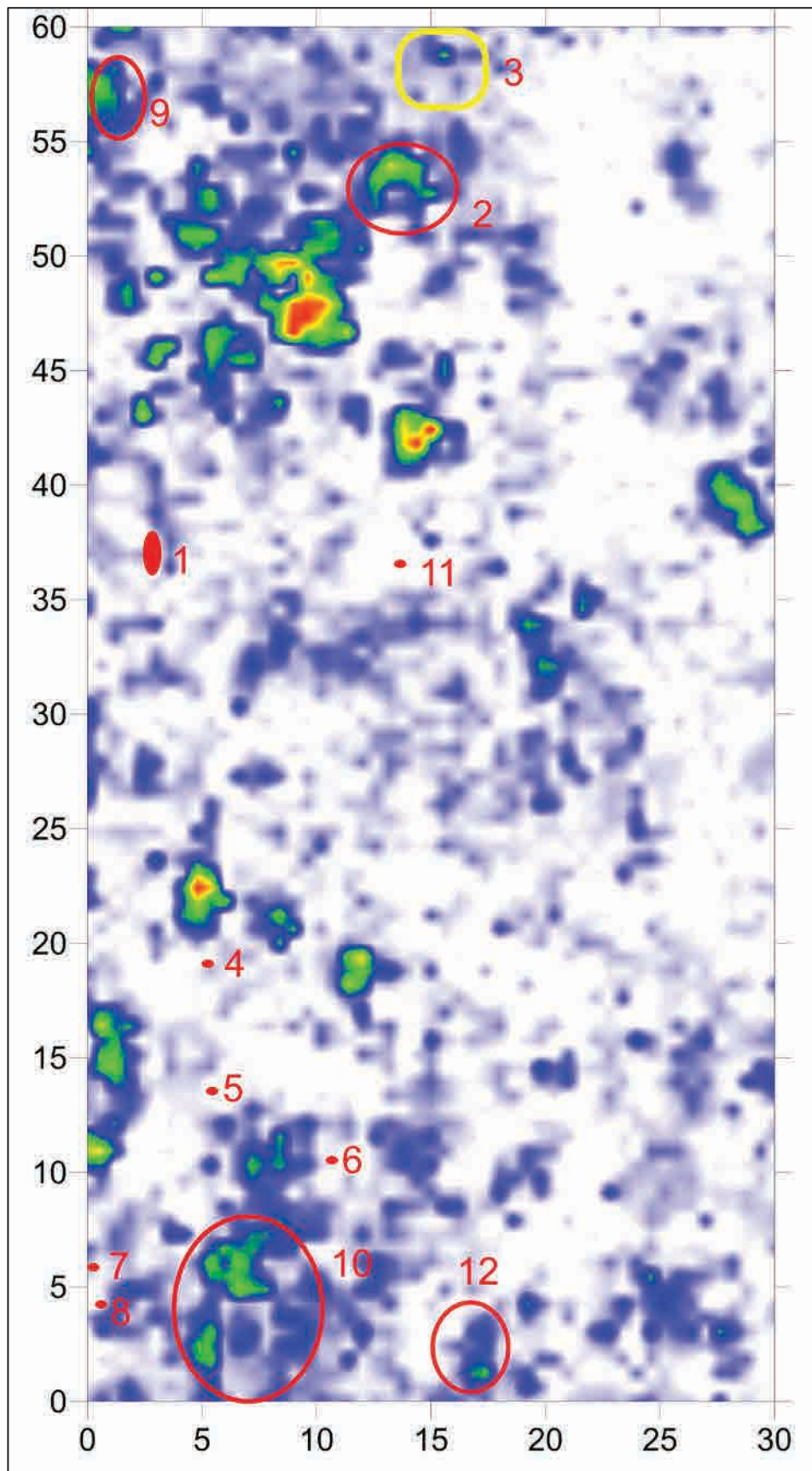


Figure 5. Grid 1 amplitude map with areas of interest marked (~22-45 cm; top of grid is northeast).

Table 1. Areas and features of interest in Grid 1.

Feature #	Description
1	Reflections indicative of a cut (Figure 5).
2	Cluster of high-amplitude point source reflections (Figure 7).
3	Stratigraphic profile change with fill (Figure 7).
4	High-amplitude slightly concave reflection approximately 1 m wide (Figure 8).
5	High-amplitude slightly concave reflection approximately 1 m wide (Figure 8).
6	High-amplitude point source reflection.
7	High-amplitude point source reflection.
8	High-amplitude point source reflection.
9	Cluster of high-amplitude point source reflections.
10	Large cluster of point source reflections.
11	Two high-amplitude point source reflections.
12	Complex cluster of high-amplitude reflections.

Single high-amplitude point source reflections seen as hyperbolas generally indicate the presence of an object, but can also be reflected from the edge of a feature. It is likely that many of the smaller and weaker point source reflections seen in the data are related to reflections from complex deposits (e.g. clumps of dirt). However, the larger, high-amplitude point source reflections listed above are likely to be something different and a sample of these may be worth investigating in the event they are of cultural origin. Complex clusters of point source reflections can indicate disturbed soil profiles and complex deposits, however similar reflections are seen with shell midden deposits. It therefore may also be worth investigating one of these areas to identify the nature of these reflections.

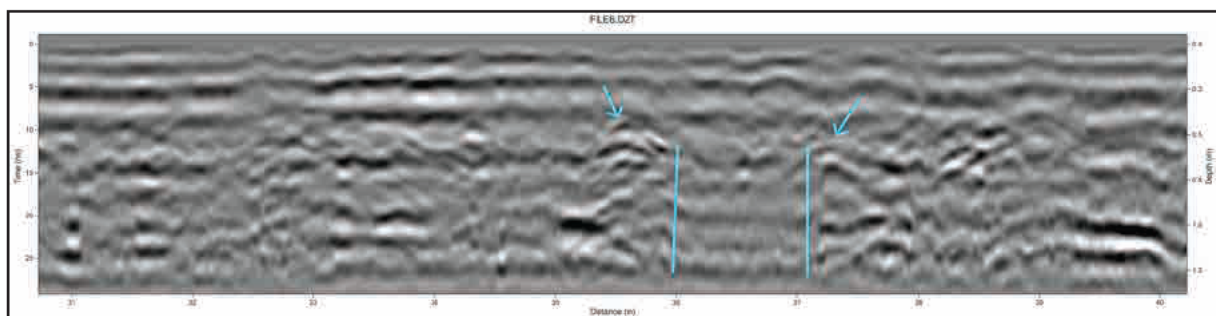


Figure 6. Grid 1 profile showing Feature 1.

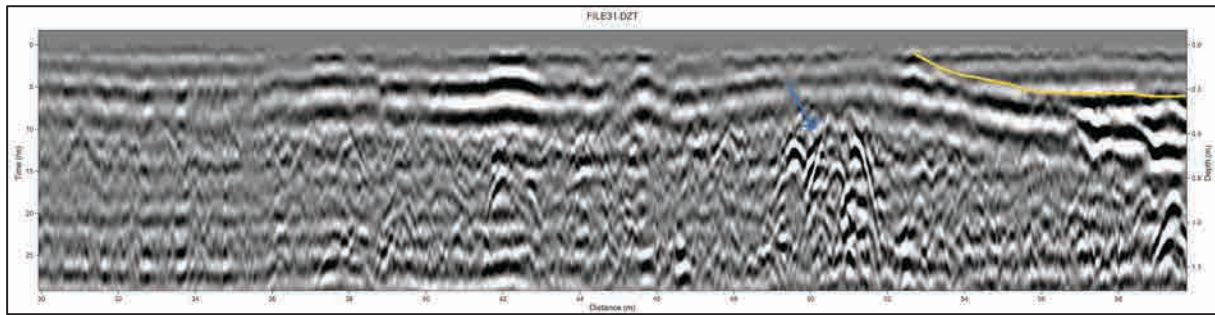


Figure 7. Grid 1 profile showing Feature 2 (blue arrow) and Feature 3 (yellow line).

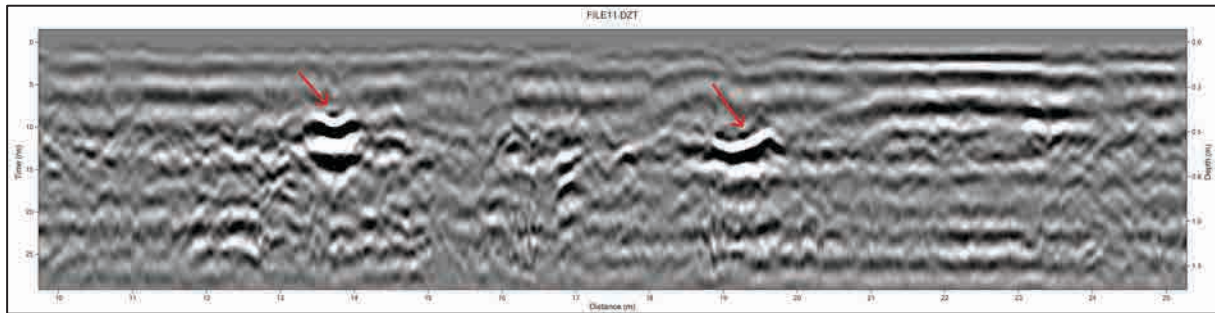


Figure 8. Grid 1 profile showing Features 4 and 5 (red arrows).

3.2 Grid 2

Grid 2 (30 m x 32 m) is located at the southwestern end of the school playing field and like Grid 1 is relatively flat and turfed, however slight undulations on the surface were noted across the southwestern half of the grid (Figure 9). The GPR data indicates that a large portion of the grid is highly disturbed. GPR data is dominated by high amplitude reflections indicating at least 9 rows of pipes spaced approximately 2 m apart in a roughly east-west direction, and two more pipes perpendicular to these (refer to Figure 11 and orange dots in Figure 12). These reflections are likely related to a feature such as a septic leach field or tile drains. The subtle undulations on the surface support the interpretation that trenching was undertaken in the area, and field observations and aerial imagery show that the turf is greener and thicker in this area indicating higher moisture content in the soils.

Other modern features in the GPR data include a very high amplitude, near-surface (approximately 20 cm deep) planar reflection that is located between two drain trenches, approximately 2 m x 5.5 m (Feature 13 in Figure 13). This feature is likely concrete (or other highly contrasting material) and may be associated with the septic/drainage system. Near-surface metal debris were also identified in several locations with evidence of high amplitude 'barber pole' reflections which 'ring' down through the data due to the highly-conductive nature of metal (red dots in Figure 12).



Figure 9. Grid 2.



Figure 10. Grid 2 with healthier turf above red line.

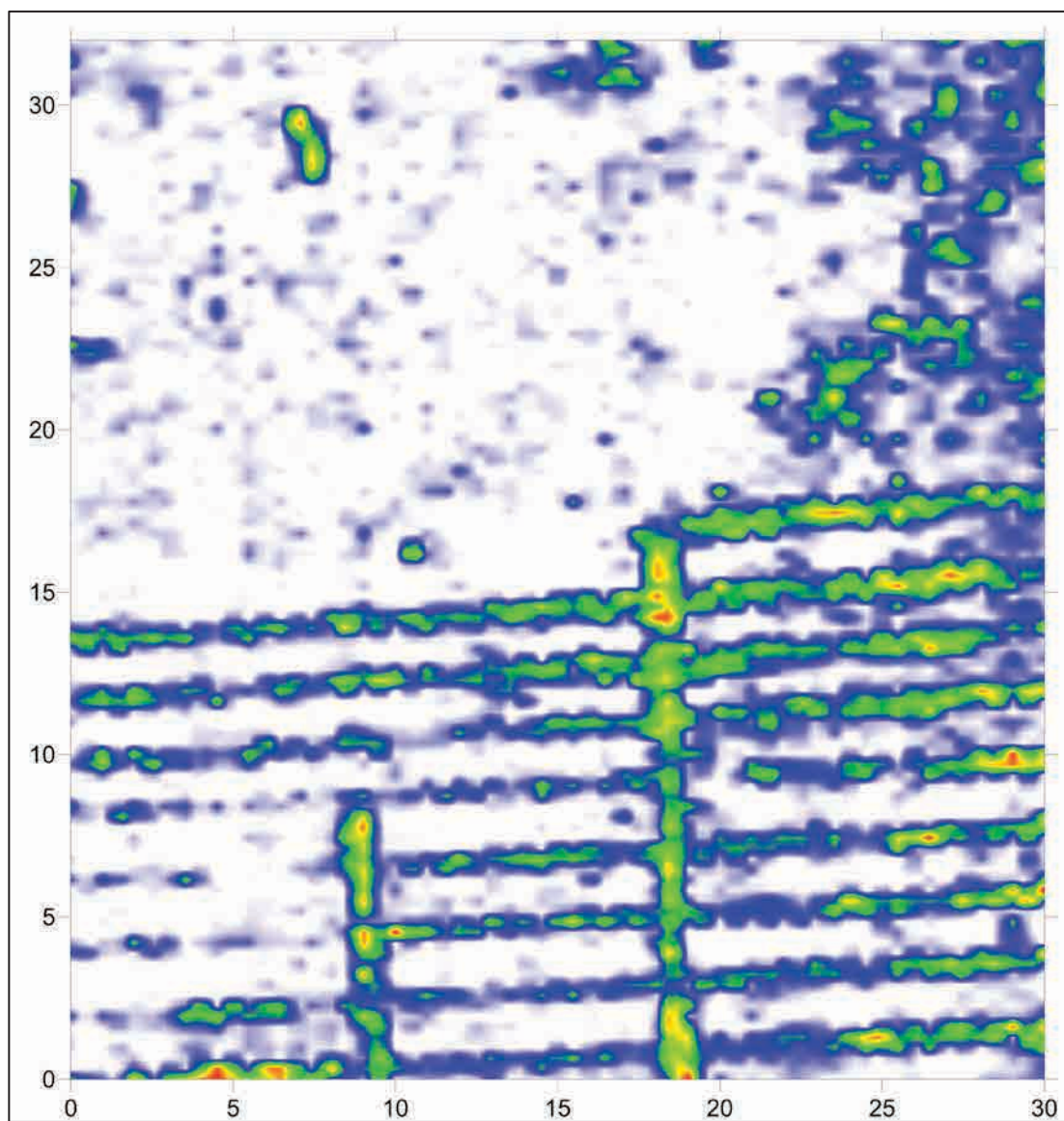


Figure 11. Amplitude map showing at least nine rows of pipes (~102-120 cm; top of grid is northeast).

Like Grid 1, the GPR reflection data in this grid is highly complex and the same change in contrast between stratigraphic layers at approximately 50-80 cm depth also is evident. Complex hyperbola reflections of various shapes indicate this layer is undulating and, in some areas, likely disturbed (purple line Figure 14), however like Grid 1 the reflections become more planar and less complex on the northeastern boundary (yellow box in Figure 13).

Again, as with Grid 1 several distinctive hyperbola reflections, indicating object point sources, are present within this layer and below. These likely relate to complexities in the stratigraphy, particularly if there has been ground disturbance and imported fill, however several features and areas of interest are noted below.

Table 2. Grid 2 areas and features of interest.

Feature #	Description
14	High-amplitude reflection approximately 1x2 m
15	Small high-amplitude reflections approx. 70-80 cm deep, indicative of an object at the base of a cut (Figure 13).
16	Cluster of high amplitude point source reflections ~50-100 cm deep.
17	Cluster of high amplitude point source reflections ~50-80 cm deep
18	Cluster of high amplitude point source reflections ~50-110 cm deep
19	Cluster of high amplitude point source reflections ~70-100 cm deep
20	High-amplitude point source reflections at least 1.5 m long.

Features 16, 17, 18 and 19 are clusters of high-amplitude point source reflections. Complex clusters of small point source reflections, such as those seen in Feature 17, can be indicative of dense midden shell but equally may indicate disturbed soil profiles. Clusters of larger point source reflections, like those seen in Features 16, 18 and 19, may also indicate disturbed soil profiles, but may be indicative of buried objects.

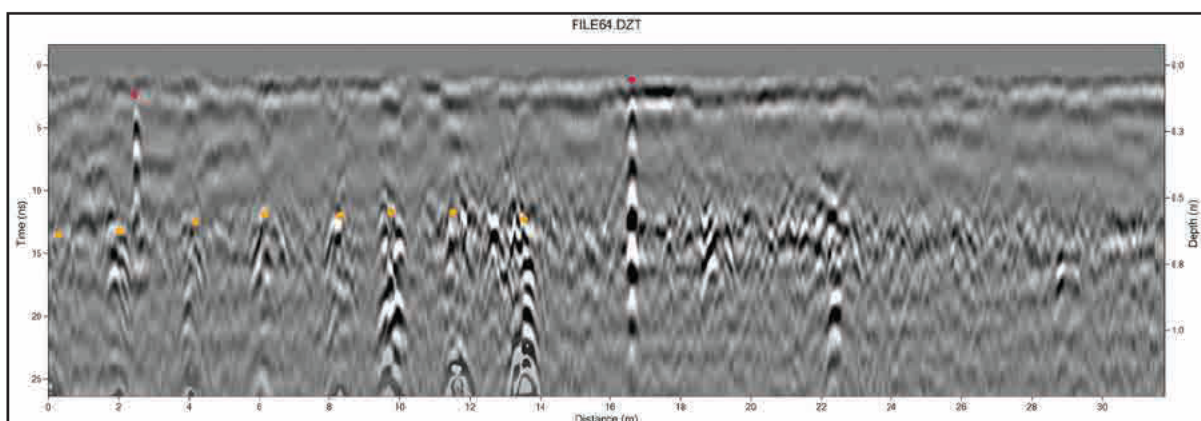


Figure 12. Grid 2 profile with near-surface metal 'ringing' down through GPR data (pink dots) and drainage lines (orange dots) associated with potential septic leach field.

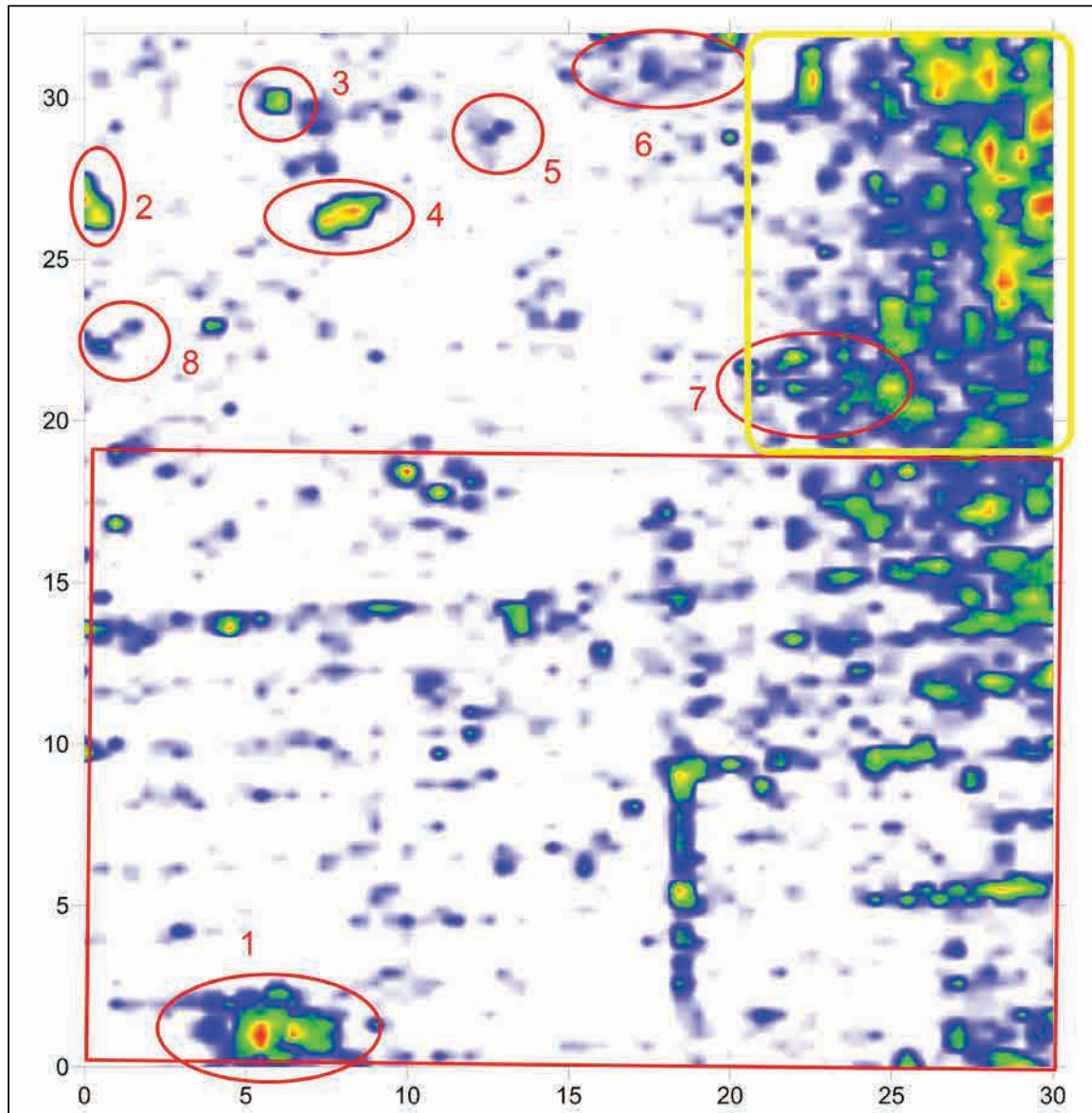


Figure 13. Amplitude map (~68-102 cm) the large red box indicates an area of high disturbance (top of grid is northeast).

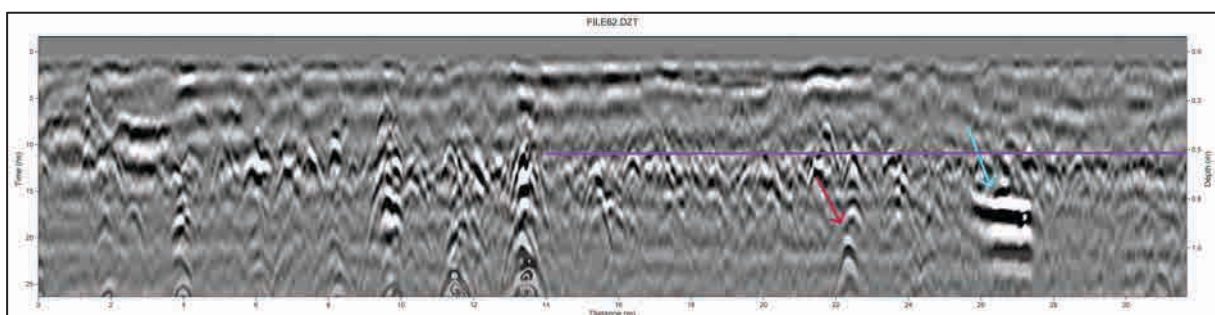


Figure 14. Grid 2 profile featuring stratigraphic change (purple line), Feature 2 (blue arrow) and Feature 8 (pink arrow).

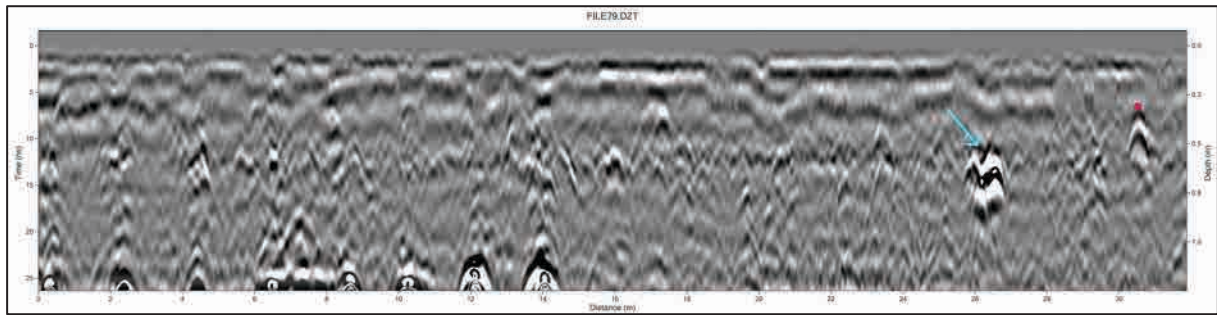


Figure 15. Grid 2 profile showing Feature 4 (blue arrow) and single shallow point source reflection (pink dot).

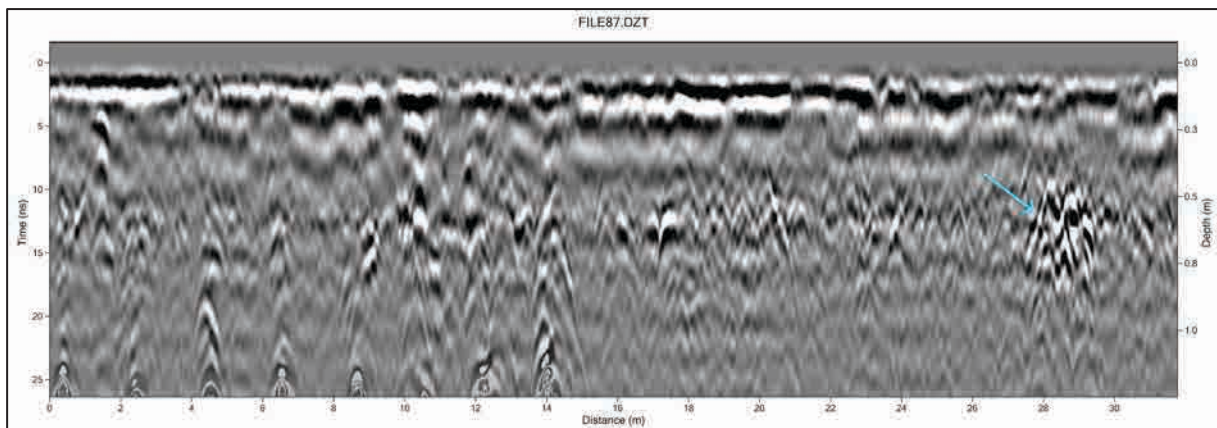


Figure 16. Grid 2 profile showing Feature 5 (blue arrow).

4 Conclusions

The following summary and conclusions are made based on the detailed analysis of the GPR data from the study area:

- Radar reflections were collected to a depth of 120 to 150 cm. If archaeological features are present below this depth, they were not detected with GPR.
- The GPR reflection data are complex, with many reflections creating “busy” profiles for data analysis.
- Both grids have evidence of disturbance to the upper deposits (to at least 30 cm in some places), likely relating to previous land use practices including vegetation clearance, landscaping and infrastructure installation.
- At least half of Grid two is highly disturbed to depth due to the installation of pipes for what is likely a septic leaching field or other drainage system. Although not impossible, it is unlikely that archaeological features will remain in this area.
- A distinct change in stratigraphy was noted across the site at a depth of ~50-80 cm. On the northeastern boundary of both grids, but particularly Grid 1, the strength of these reflections was high, and their structure more planar, indicating this layer may be compacted, and could be related to the school infrastructure.
- No reflections obviously associated with pits were noted in the GPR data. This does not mean that pits may not still exist within the study area, particularly if the fill within the pit does not contrast significantly enough to create a change in reflection amplitude and structure observable in the data.
- Several features and areas of interest were noted in both grids, and it may be worth sampling these with excavation to understand their nature. These include high-amplitude point source reflections which may indicate objects, and clusters of high-amplitude reflections that may indicate a feature such as midden material but could equally be a product of complex soils or soil disturbance.
- Outside the areas of interest outlined in this report, it is possible that archaeological features and objects exist, particularly low-density and/or disturbed midden deposits, which would not create reflections that can be differentiated from disturbed soils, small artefacts and other subtle features.

5 References

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