McLaughlins Quarry, Wiri: Final Report on Archaeological Investigations (Site R11/47)

In Fulfilment of NZHPT Authority No. 2007/351

Report prepared for McLaughlins Quarry Trust

By

Simon Bickler (PhD)
Rod Clough (PhD)
Barry Baquié (MA Hons)
Ben Pick (MA Hons)

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Clough & Associates Ltd.
heritage@clough.co.nz
321 Forest Hill Rd, Waiatarua
AUCKLAND 0612
Telephone: (09) 814 1946
Mobile 0274 850 059
www.clough.co.nz

EXECUTIVE SUMMARY

Background and Results

In 2007, McLaughlins Quarry Trust (MQT) obtained consent to extend their Wiri Quarry. An assessment of effects carried out by Clough & Associates (Clough 2007a) determined that several archaeological features relating to recorded archaeological site R11/47, which includes terraces, middens and gardening features, would be impacted on. An NZHPT Authority to modify part of site R11/47 was granted in October 2007 (no. 2007/351). The Authority was conditional on preservation of some zones of archaeology and the investigation of specified areas of R11/47 including Zone A and parts of Zones B and C. Archaeological monitoring of earthworks that might affect archaeological sites was also a requirement. This is the final report for the Authority and includes the results of:

Investigation of Zone B in 2008.

Archaeological monitoring of topsoil stripping for quarry activities in 2008-2009

Investigation of a garden area in Zone C in 2011.

The archaeological remains exposed were limited, but included two or three remnant pits, stone alignments and other stone features, cooking and food preparation areas represented by fire-cracked rock and midden. The remains in Zone B suggest that a small whare had been built on a knoll above a lagoon and an area of cultivation. A pit with a drain and large post hole was only 3m x 1.5m in size and represented either a food storage pit or a field shelter or small whare. Stone alignments in Zone B, Area B were relatively late in the sequence, overlying both midden and gardening soils, but their association with deep charcoal rich soils supports their interpretation as gardening features.

In Zone C, the excavations in the garden terrace did not result in any archaeological features being uncovered. However, the trenches dug into the garden slope revealed a large quantity of shell midden interspersed in the rocks, particularly in the northernmost Trench. It is probable that a cooking area may have been located at the top of the ridge with the rakeout of middens thrown down the slope.

A total of five radiocarbon dates from the excavations form a relatively tight grouping suggesting occupation during the 16th and 17th centuries AD. One sample from Zone A, Area B, Trench 3 may have been about a century earlier. The dates suggest intense occupation of the garden areas for at least 100 years and probably closer to 200 years. Soil samples analysed showed a high concentration of fragments of charcoal, reflecting human activity around the site. These activities included burning of vegetation and cooking fires.

The results of the project demonstrate the benefits of the stonefields area for Maori in prehistory, combining good gardening conditions and access to inland and coastal waterways, centred on a defendable volcanic cone.

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ACKNOWLEDGEMENTS

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- Peter Bishop (the landowner, for provision of the excavation machine);
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1. Introduction

THE PROJECT

Background

In 2007, McLaughlins Quarry Trust (MQT) obtained consent to extend their Wiri Quarry (Figure 1). An assessment of effects carried out by Clough & Associates (Clough 2007a) determined that several archaeological features relating to recorded archaeological site R11/47 (settlement remains including terraces, middens and gardening features) would be impacted on.

An Authority to modify part of site R11/47 was subsequently applied for and granted by the New Zealand Historic Places Trust (NZHPT) to MQT on 19 October 2007 (no. 2007/351). The Authority was conditional on preservation of some zones of archaeology and the investigation of specified areas of R11/47 including Zone A and parts of Zones B and C (Figure 2), as described in the Research Strategy provided with the application (Clough 2007b, 2008). Archaeological monitoring of earthworks that might affect archaeological sites was also a requirement.

This is the final report for the Authority and includes the results of:

Investigation of Zone B in 2008.

Archaeological monitoring of topsoil stripping for quarry activities in 2008-2009

Investigation of a garden area in Zone C in 2011.

Protected Areas

Figure 2 shows a plan of the McLaughlins Quarry and known archaeological features. Site R11/1632, Zone D (R11/2810[1]) and some features of Zone B adjacent to the neighbouring stonefields (R11/47) were excluded from quarrying activities.

Machinery was excluded from these areas:

The eastern portion of Zone B (stone alignments) was fenced off and the extent of the remains surveyed in on the quarry plan in accordance with Authority condition 3b.

The known extent of R11/1632 (pits/terraces/midden) was mapped out in accordance with Authority condition 3d.

Zone D (R11/2180) was fenced off with waratahs and tape.

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[1] In previous reports this site has been mistakenly associated with R11/1631.

THE PROJECT, CONTINUED

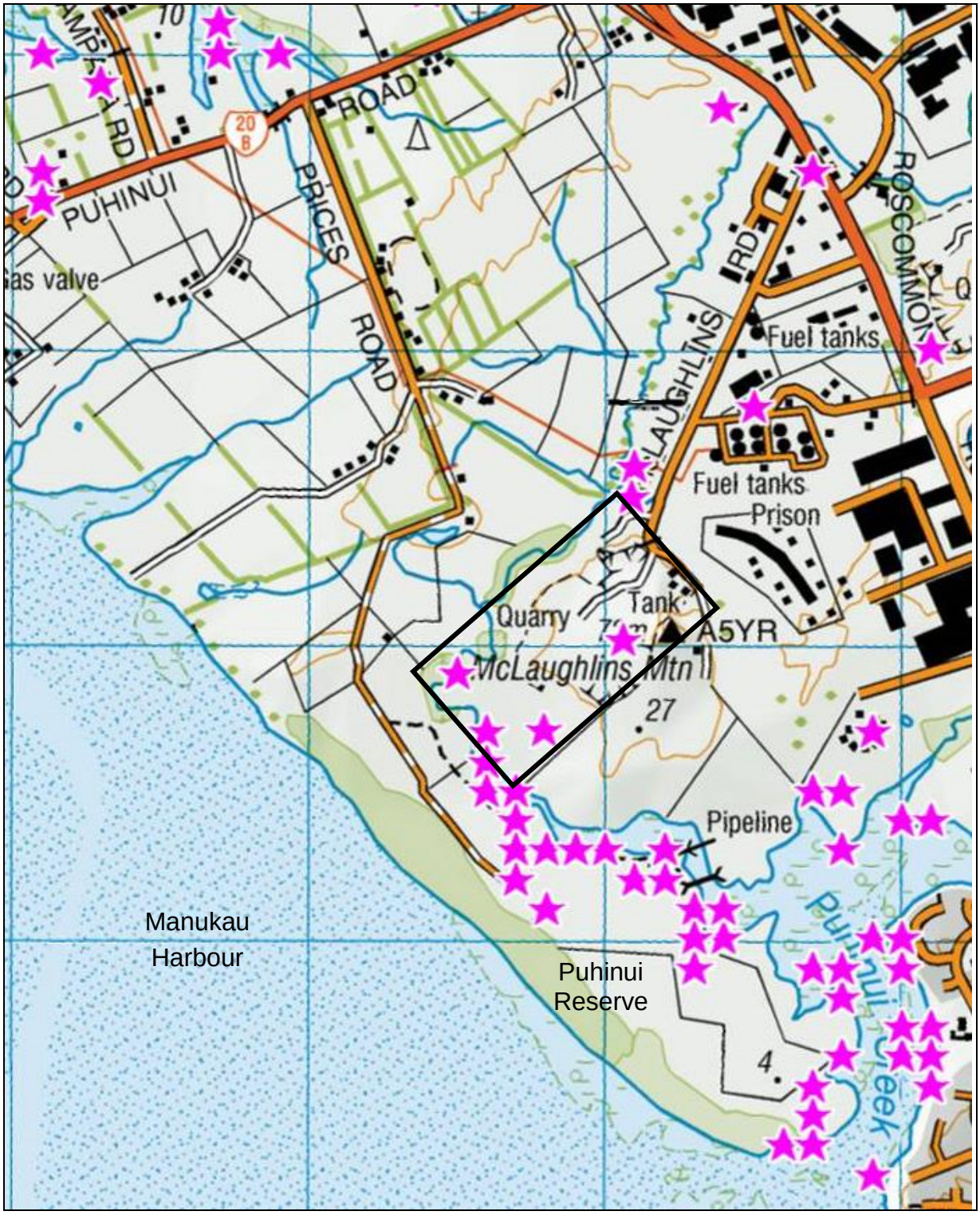

Figure 1. Distribution of archaeological sites (pink stars) in the Manukau Harbour in and near the McLaughlins Quarry property (indicated by box) (Source: ArchSite 2010). Note that locations shown are only accurate to within c.100m

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THE PROJECT, CONTINUED

Figure 2. Aerial view of quarry in 2003 (source: Auckland Regional Council), with archaeological zones and boundary between quarry and Matukurua Stonefields Historic Reserve indicated

Zone A. Stone mounds (R11/47)

Zone B. Terraces, midden and stone alignment (R11/47)

Zone C. Terraces, alignments and mounds (R11/47)

Zone D. Pit complex (R11/2810)

R11/1632 (pits/terraces/midden)

ARCHAEOLOGICAL BACKGROUND

Archaeological Landscape

The site was once part of an extensive pre-European landscape relating to former Maori occupation of the area centred on Matukutureia Pa (McLaughlins Mountain) and Te Manurewa o Tamapahore Pa (Wiri Mountain) (Figure 3). Gardens and habitation areas once surrounded the volcanic cone pa, and the plentiful surface volcanic stone was used to create structures in the form of garden walls, earth and stone garden mounds and stone walled houses within which cooking and storage sites were interspersed. The landscapes created by Maori around the cones, and added to by early European farmers who built their own stone walls, are known as stonefields (Sullivan 1975, 1989a, b; Lawlor 1981b; Clough & Plowman 1996; Clough & Turner 1998).

Once widespread around Auckland's volcanic cones, only two substantial stonefield landscapes have survived modern development – the Matukurua stonefields to the south of Matukutureia Pa (McLaughlins Mountain) and the Otuataua stonefields north of Auckland airport (Clough & Plowman 1996). Te Manurewa o Tamapahore Pa (Wiri Mountain) has been almost completely destroyed by quarrying, but a remnant of Matukutureia Pa survives.

Site R11/47 is located immediately to the west of Maunga Matukutureia (McLaughlins Mountain) and the remnant Matukurua Stonefields, which are now protected within a Historic Reserve immediately adjacent to the McLaughlins Quarry property.[2] The Matukurua Stonefields and the former pa site on Maunga Matukutureia are recorded as a single archaeological site, R11/25.

Previous Archaeological Work

Agnes Sullivan's work in the early 1970s (e.g. Sullivan 1975) has been fundamental to archaeological research in the area. This included detailed mapping of the stonefield features in the area that is now Matukurua Historic Reserve (Figure 4, Figure 5). As Lawlor (2002:32) notes: 'Subsequent work within Matukurua stonefields has built on and expanded on the pioneering work of Sullivan'.

Archaeological survey and excavations during the 1970s, 1980s and 1990s (including Lawlor 1981a,b; Bulmer 1983, 1986; Veart 1986: Clough & Turner 1998) have considerably enhanced our understanding of Maori agricultural practices in volcanic environments, and have shed light on aspects of Maori social structure and patterns of land use.

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[2] The Matukurua Stonefields have been referred to in the past as the Matukutureia or Matukuturua Stonefields, and included the neighbouring area around Te Manurewa o Tamapahore Pa /Wiri Mountain (site R11/32, previously referred to as Matukutururu). There are a number of names associated with the area and some research has been undertaken regarding these. The Auckland Council CHI record (no. 11730: see https://chi.org.nz) includes the results. The names used by historian Graeme Murdoch (ibid.) are those used in this report.

ARCHAEOLOGICAL BACKGROUND, CONTINUED

Previous Archaeological Work, *continued*

The majority of archaeological remains seen in the Matukurua Stonefields date from the 15th century onwards, after settlements on the coast became less sustainable (Clough & Turner 1998). The potential of the fertile Matukurua Stonefields for intensive horticulture, combined with access to the extensive estuarine shellfish beds and marine resources of the inner Manukau Harbour, provided Maori with a viable alternative and a more stable environment than the one they had initially selected.

Surface stone was utilized for various forms of stone walls, rows and alignments, and stone boundary markers, which served to divide the landscape and demarcate garden boundaries (Veart 1986). Earth and stone mounds were constructed both for land clearance purposes and to extend the growing season by creating a micro-environment with elevated temperatures, better moisture retention and mineral concentration; while volcanic depressions and sinkholes, where deeper soils accumulated, were utilized as discrete gardening areas (Coates 1991; Veart 1986; Albert 1987). Evidence for habitation is found throughout the stonefields, in the form of hearths and cooking remains and stone or earth and stone walls indicating both short-term field shelters, used while tending crops, and more substantial whare (Lawlor 1981b; Veart 1986; Sullivan 1974).

The areas that have been surveyed in detail and investigated include the Wiri Oil Terminal site to the northeast of the McLaughlins Quarry property (R11/1187). Detailed archaeological mapping of the features there was carried out prior to the construction of the terminal (Cramond et al. 1982), and an extensive investigation was carried out, but unfortunately no investigation report has yet been completed (some information can be found in Rickard et al. 1983; Bulmer & Lilburn 1982; Veart 1986).

Investigations were carried out at Wiri Mountain (R11/32) prior to quarrying, revealing a sequence of initial settlement concentrated on the uppermost terraces with slope gardens below. As settlement expanded the lower area was also used for habitations with gardening in the volcanic fields below (Sullivan 1974, 1975; Foster 1988).

Limited archaeological excavations of the Matukurua Stonefields (R11/25) were carried out in 1978/79, in the area that is now historic reserve on the eastern side of the Puhinui Stream, as part of the Southwestern Interceptor project (Lawlor 1981a, b). Evidence of stone heaps, a C-shaped enclosure, an L-shaped enclosure (with associated obsidian and other material) and a possible field shelter was recovered, and several radiocarbon dates were obtained. Clough and Turner (1998) subsequently carried out further investigations related to the Southwestern Interceptor, recovering information relating to the agricultural settlement of the stonefields.

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ARCHAEOLOGICAL BACKGROUND, CONTINUED

Previous Archaeological Work, *continued*

The Wiri Railway site (R11/1188) was mapped prior to excavation, and extensive stonefield features were recorded (Veart, Foster & Bulmer 1984; Rickard et al. 1983). It was excavated in 1985 by Rickard and Coates (Coates 1992), and in 1986 by Veart (Veart 1986). The investigations focused in particular on the nature of the garden mounds.

Palynological work has been carried out in the stonefields as part of research into the pre-European contact use of the area (see Horrocks & Lawlor 2006) and more recently as part of fencing between the stonefields property and the neighbouring prison property (Bickler et al. 2008). This remains, however, a potentially useful avenue for future research into the changing patterns of the environment here.

Clough and Turner (1998) also undertook some excavation in the Puhinui Reserve on the western side of Puhinui Stream, a contrasting environment of poorer clay soils as opposed to the rich volcanic loams of the eastern side. This is reflected in the lack of agricultural features on the western side of the stream. Surveys there in recent times (e.g., Clough 2004, 2005; Baquié & Clough 2006) have confirmed the presence of stream-side midden deposits, but no indication of remains located away from the stream banks.

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ARCHAEOLOGICAL BACKGROUND, CONTINUED

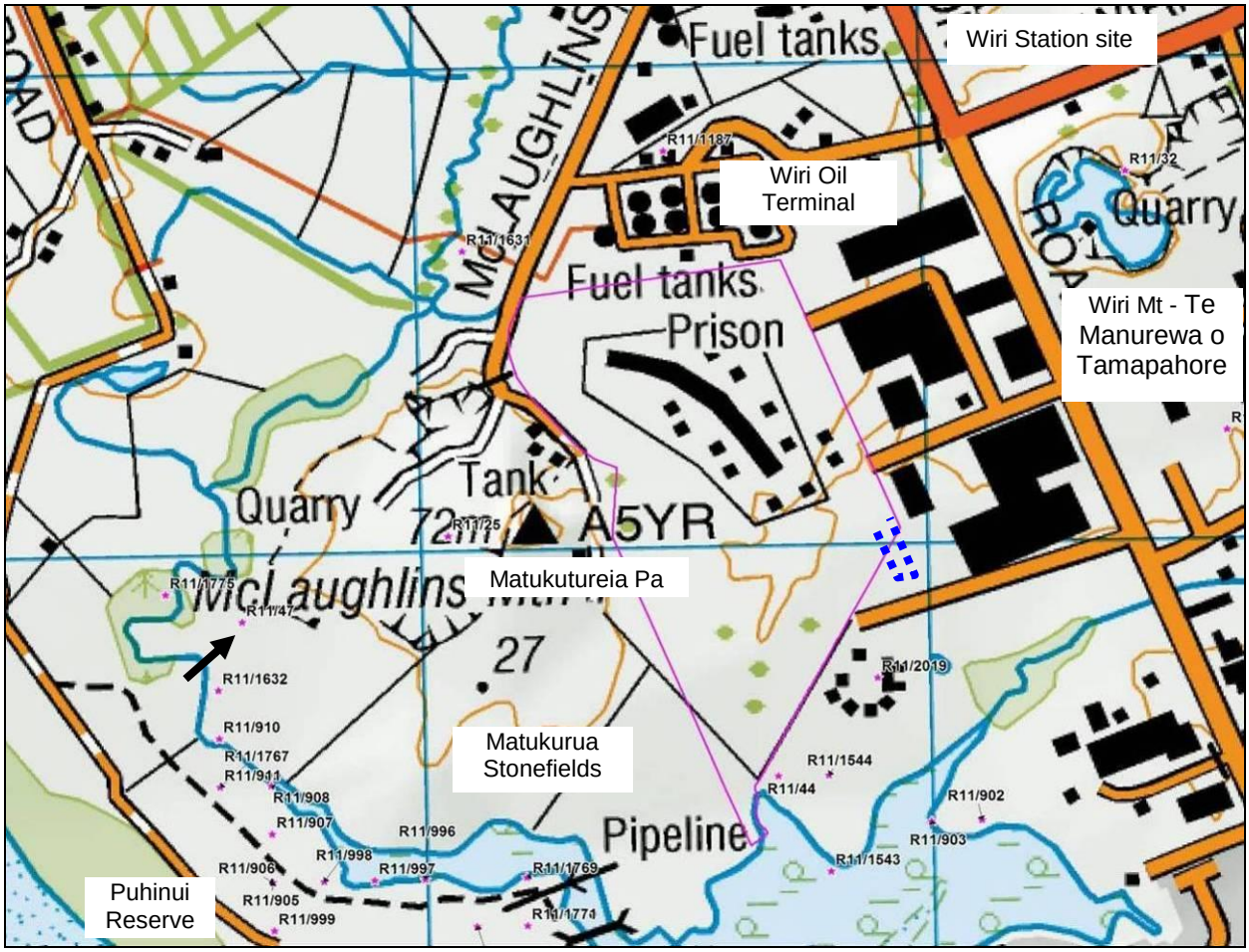

Figure 3. Showing the locations of Matukutureia Pa (McLaughlins Mountain), McLaughlins Quarry and Matukurua stonefields. Te Manurewa o Tamapahore Pa (Wiri Mountain) is to the east, Puhinui Reserve to the west, and the Wiri Oil Terminal and Wiri Railway sites to the northeast. Archaeological sites (purple stars) recorded in the vicinity including R11/47 (arrow) (source: NZAA database, locations only accurate to within c.100m)

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ARCHAEOLOGICAL BACKGROUND, CONTINUED

Figure 4. Stonefields plan by Agnes Sullivan (1989b, in NZAA site record form for R11/25; see Figure 6 for context). Note lagoon (swamp), which extends into the McLaughlins Quarry property (arrow)

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ARCHAEOLOGICAL BACKGROUND, CONTINUED

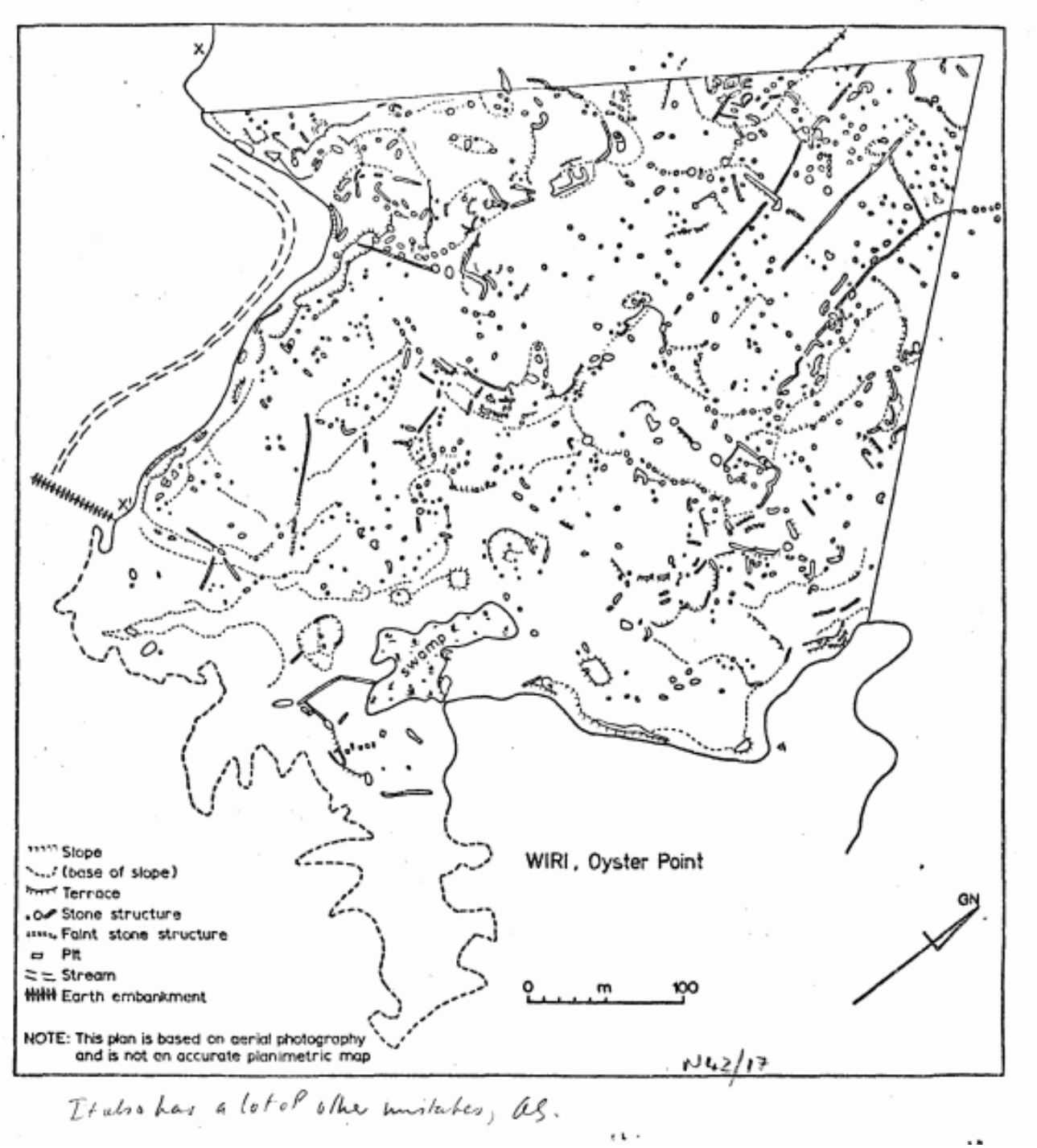

Figure 5. Stonefields plan by Agnes Sullivan from NZAA site record form for R11/25 (see Figure 6 for context)

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ARCHAEOLOGICAL BACKGROUND, CONTINUED

Matukutureia Pa and Surrounds (Site R11/25)

Site R11/25 includes both the Matukurua stonefields and Matukutureia Pa (the latter now largely destroyed by quarrying). The approximate extent of the archaeological features prior to quarrying is shown on a 1959 aerial view (Figure 6 and Figure 7). It should be noted that the boundaries are only estimated based on the aerial photograph and cannot be regarded as definitive.

On Matukutureia Pa archaeological terracing was clearly visible around the main peak and along the ridge running to the southwest in the 1959 aerial (Figure 7). This ridge has since been completely quarried away. The stonefield features were also clearly visible surrounding the pa in 1959 (Figure 6), including within the area to the west of the pa.

It is likely that much of the area between R11/25 (Matukutureia Pa) and R11/32 (Te Manurewa o Tamapahore Pa) was utilised by Maori for gardening. Now, however, extensive quarrying has destroyed a substantial portion of the stonefield features, and only a small area of stonefield remains survive in the southern part of the area, most of the remains being located within the Matukurua Historic Reserve next to the current McLaughlins Quarry property. No complete plan of the entire extent of the site is available today.

A 1952 photograph (Figure 8) reveals the scale and complexity of the former pa site (Matukutureia) prior to quarrying. The recently removed water reservoir was already in place, but quarrying had not begun. Numerous terraces can be observed (particularly on the western side) and these were used for the construction of living and storage houses. The northern side, although not visible in the photograph, would have been similarly sculpted, while the south facing slope below the water reservoir has few visible features. The mountain would have afforded strategic views of the Manukau and other pa around the Tamaki isthmus (for example Maungarei, Mangere, Maungakiekie). In the fields on the southern lava flow, stone features such as mounds and walls can be discerned and many of these features can still be identified today.

Today, the only section of the mountain still standing is the small cone shown beneath the water reservoir in Figure 9, and even this remnant has been extensively benched during quarrying. Prior to that, the top had been levelled for the construction of the water reservoir and two deep pipe trenches were excavated to carry water to and from the reservoir. As a result of this activity the mountain is heavily modified, with active erosion. Only small parts of the eastern slopes may retain some of their original contour. The reservoir was removed in 2010, but no surviving archaeological evidence was found under the concrete structure (Foster in ArchSite Site Record Form R11/25).

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ARCHAEOLOGICAL BACKGROUND, CONTINUED

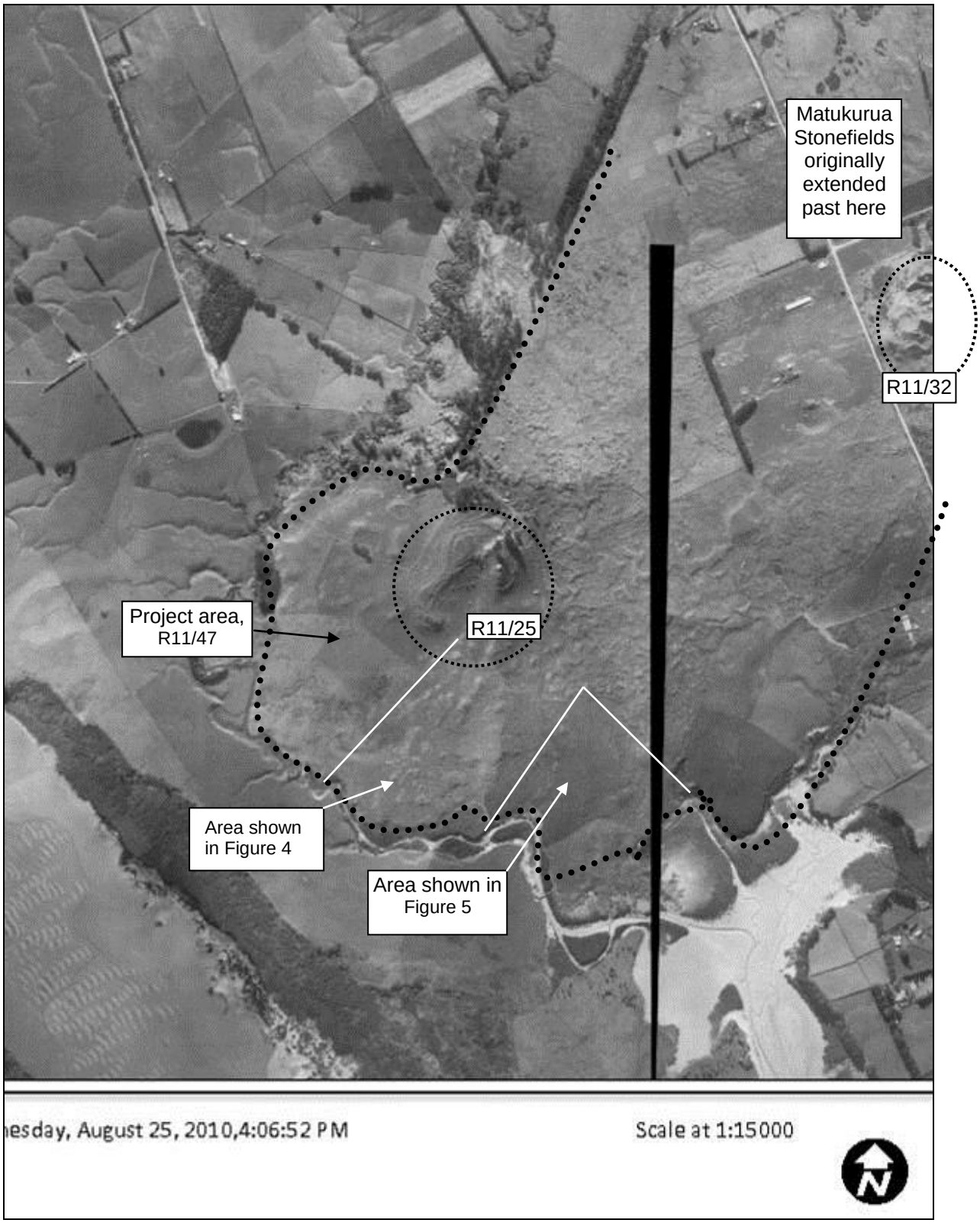

Figure 6. View of Matukutureia pa and stonefields (site R11/25) and Te Manurewa o Tamapahore Pa (R11/32) in 1959 in relation to the project area. Approximate extent of features identified (dotted lines)

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ARCHAEOLOGICAL BACKGROUND, CONTINUED

Figure 7. View of Matukutureia pa (part of site R11/25) in 1959 (from ALGGI Mapping Portal)

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ARCHAEOLOGICAL BACKGROUND, CONTINUED

Figure 8. Aerial view of the Puhinui Stream and Matukutureia prior to quarrying (Air Logistics 1952). Looking north

Current area of quarrying (area below arrow not quarried)

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Figure 9. Remnant of Matukutureia to the east of McLaughlins Quarry zone (photo: 2001)

Previously Recorded Sites

The archaeological remains previously recorded around Matukutureia/ McLaughlins Mountain logically all fall within a single archaeological landscape and could have been recorded as one site. However, historically they have been recorded as a number of sites which combine to cover the settlement on the lava flow of Matukutureia. The sites recorded on the MQT property (Figure 10) comprised:

R11/25 (Matukutureia and the associated stonefields settlement), a dense complex of archaeological features relating to gardening and occupation, which can be observed on the adjacent Historic Reserve.

R11/47, recorded as a settlement site (ploughed out/destroyed according to the site record) and relating to much of the MQT property. New features recorded during surveys of the property undertaken by Clough & Associates in 2001 and 2007 (Clough 2007a) were recorded under this number.

R11/2810, a midden site in the northwest of the property noted during the 2001 and 2007 surveys, but mistakenly associated with R11/1631. It is on the southern side of the stream and outside of the quarry zone.

R11/1632, a collection of pits, terraces and midden recorded on and above the banks of the Puhinui Stream and on the quarry property.

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ARCHAEOLOGICAL BACKGROUND, CONTINUED

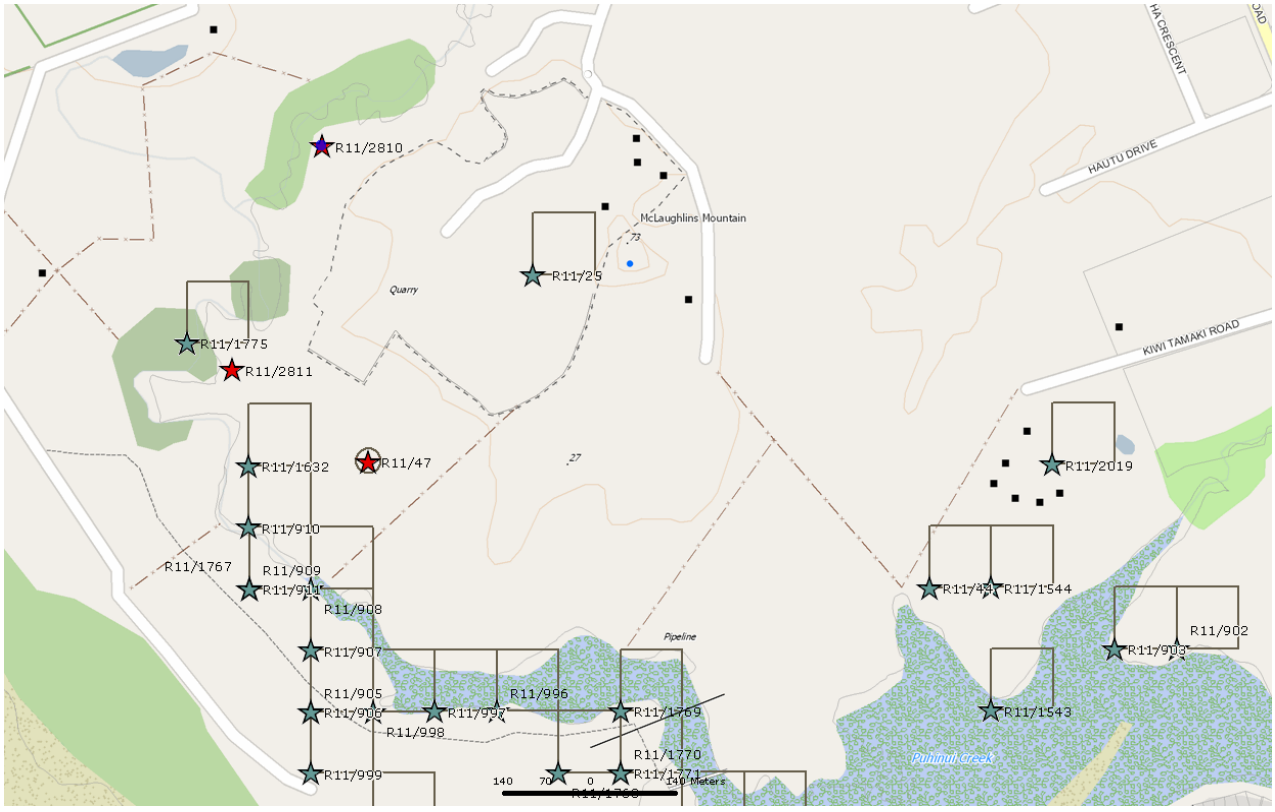

Figure 10. Recorded archaeological sites around the quarry (ArchSite 2012). R11/2811 was recorded during the project in 2008

Effects of European Settlement

European farming of the Puhinui area began in 1845 when T.M. McLaughlin purchased over 1000 hectares of the Clendon Grant (Figure 11). Prior to 1840 it had been part of the extensive Fairburn Claim (Lawlor 1981b). The stony nature of the ground – its rocks and lava outcrops – prevented the use of the plough (Sullivan 1975). Although the Europeans cleared surface rocks for convenience and for the construction of stone walls, the earlier archaeological features were relatively well preserved, apart from stock damage. The historic stone walls are also archaeological features.

By 1960 large scale quarrying of the two cones (Maunga Matukutureia/McLaughlins and Te Manurewa o Tamapahore Pa/Wiri Mountain) was underway, although this process had started in 1915 at Wiri (Lawlor 2002:6). This quarrying has destroyed most of the archaeology on the pa at Maunga Matukutureia, most of the archaeology on the pa at Te Manurewa o Tamapahore Pa, and over 80% of the associated agricultural field systems.

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ARCHAEOLOGICAL BACKGROUND, CONTINUED

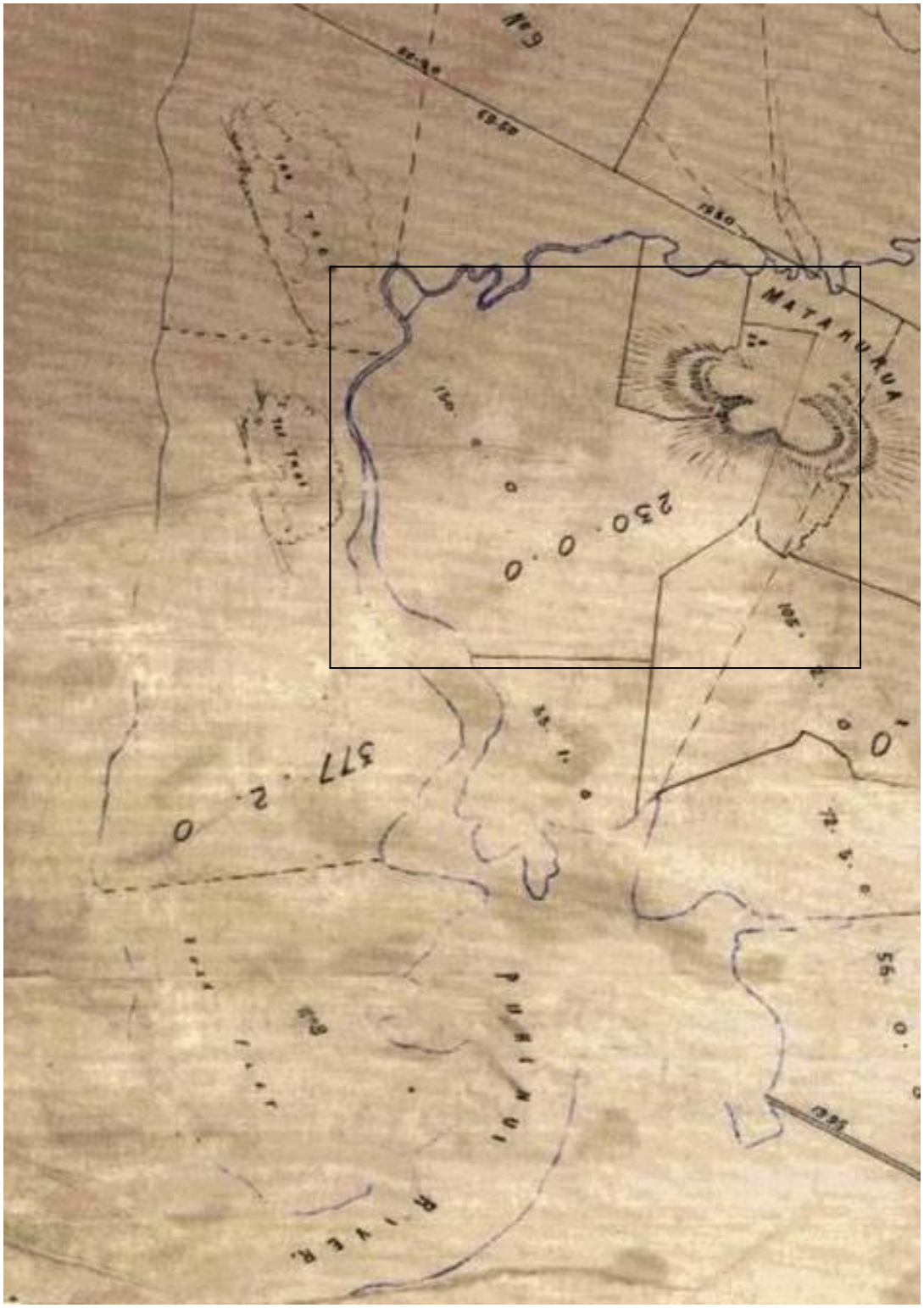

Figure 11. Part of SO1122E dated 1897

ASSESSMENT

Archaeological Assessment Prior to Quarry Extension

The assessments carried out prior to extending the quarry noted that the main part of Matukutureia pa that was in the McLaughlins Quarry zone had been quarried away (Figure 2) and that the lava flows on the western side between the former mountain and the Puhinui Stream did not appear to have the complexity of stone features visible on the adjacent historic reserve to the south of the mountain (Clough 2007a). It was considered likely that stone features also occupied the western paddocks, but that they could well have been removed by farming activities.[3]

The site record for R11/47 reported this area as 'ploughed out' and had been stamped 'destroyed'. However, the 2000 and 2007 surveys (Clough 2000, 2007a) indicated that while the bulk of the pasture had had most surface rock removed and had undoubtedly been disced, a number of archaeological features were still visible around the periphery of the area. Consequently, the site record for R11/47 was updated to record settlement remains observed during those surveys. The features are described below.

Zone A, Stone Mounds (R11/47)

Immediately to the south of the operational quarry area was a portion of remnant pasture with two, possibly four, stone mounds (see Figure 2). Two of these also had small quantities of shell midden near the surface. The trenches excavated by the quarry operators in this area had not caused damage to any archaeological features, nor was any archaeological evidence visible in their exposed sections or spoil heaps. One of the sections had a concentration of subsurface rocks (Figure 12), but it could not be determined whether this was natural or of cultural origin.

Zone B, Stone Alignments, Terraces, Midden (R11/47)

Near the southeastern boundary to the north of the lagoon three stone mounds, a stone alignment and a shallow drain were observed (see Figure 2 for location). No shell was evident in the stone mounds (Figure 13). The mounds and stone alignments surrounded a shallow depression, which appeared clear of surface stone, and cleared sunken areas surrounded by stone clearance mounds are characteristic of gardening areas. To the west of this depression and just north of and above the lagoon was a spur with several built terraces. One of these was modern, but two to three more obscure terraces were considered likely to relate to the Maori occupation of the area, particularly as there was dark soil and midden located below the terraces.

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[3] Ian Wedding (former quarry owner) suggested that a great deal of surface rock had been removed using cheap labour during the war.

Zone C, Stone Aligned Terraces (R11/47)

In the southwest, above the stream, was a series of narrow or shallow terraces with apparent stone alignments and some stone mounds (Figure 2, Figure 14). These included a rocky slope overlooking the Puhinui stream where small terraces could be discerned. Some of the terraces were stone faced, and two stone piles and a low stone alignment were in close proximity. These features had not been specifically recorded in the past but were considered likely to relate to Maori settlement in the general area recorded as R11/47.

Zone D, Pits and Midden

In the northwest of the property, but outside of the area proposed for quarrying, an intact storage pit complex had been observed around 2000 (Figure 2). This was located on a small spur, elevated above and surrounded by the Puhinui Stream and contained the remains of at least 15 kumara pits and two possible terraces located on top of the knoll. At the time this was confused with R11/1631, but that site is located on the western side of the stream, and this group of features was considered to be part of site R11/47. It has since been recorded as R11/2810. The site was avoided by the project.

R11/1632, Pits, Terraces and Midden

In the southwestern spur of the proposed quarry area there was a series of features on a spur overlooking the Puhinui Stream (Figure 2, Figure 15, Figure 16). These included two large pits (c.3m x 6m), a smaller vague depression (c.4m x 2m) immediately to the south, a large terrace (c.10 x 5m) and a long narrow terrace (c.14m x 2m) located to the front edge of the spur with dark soil and shell eroding out of the embankment below and to the west. A shallow depression relating to a 20th century pipeline defined the eastern limit of the visible features. Across a small gully to the north of these features two irregular depressions were observed adjacent to a midden site (black soil and shell) eroding out of the stream embankment and a terrace on the embankment. These features were recorded under site record R11/1632. It is possible that the irregular depressions relate to this site, but their characteristics, in particular their irregularity, did not indicate Maori origin and they may relate to tree throws or earlier cattle activity. The terraces, pits and midden are a small, but significant complex of features representing occupation along the edge of the Puhinui Stream.

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Figure 12. Zone A (R11/47), subsurface concentration of rocks in quarry trench (photo: 2001)

Figure 13. Zone B (R11/47), from east showing the knoll (left, below mountain remnant). Lagoon green in mid photo and on right (photo: 2007)

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Figure 14. Zone B, spur from knoll leading into lagoon , stone alignment and possible terrace (photo: 2007)

Figure 15. R11/1632, storage pits immediately south of small gully (photo: 2007)

Figure 16. R11/1632, terrace overlooking Puhinui Stream (photo: 2007)

OVERVIEW OF WORK CARRIED OUT

Monitoring and Investigation

The work presented here spanned three years and was carried out in three overlapping stages. Monitoring of works started in early 2008 and continued through to 2011. This involved visits to the various works associated with the quarry extension in areas where archaeological features had not previously been identified, but it was considered possible that features might be present.

In 2008 excavation was carried out in Zone B, focussing on possible archaeological features such as midden and stone alignments to provide archaeological information regarding settlement and gardening activities in the stonefields.

In 2011 excavation of possible features in Zone C, associated with a high natural terrace looking across to the Puhinui Stream, was carried out.

Investigation of the Zone A mounds was not possible as this area had been modified before it could be examined.

The location of the sites and investigations are shown in Figure 17.

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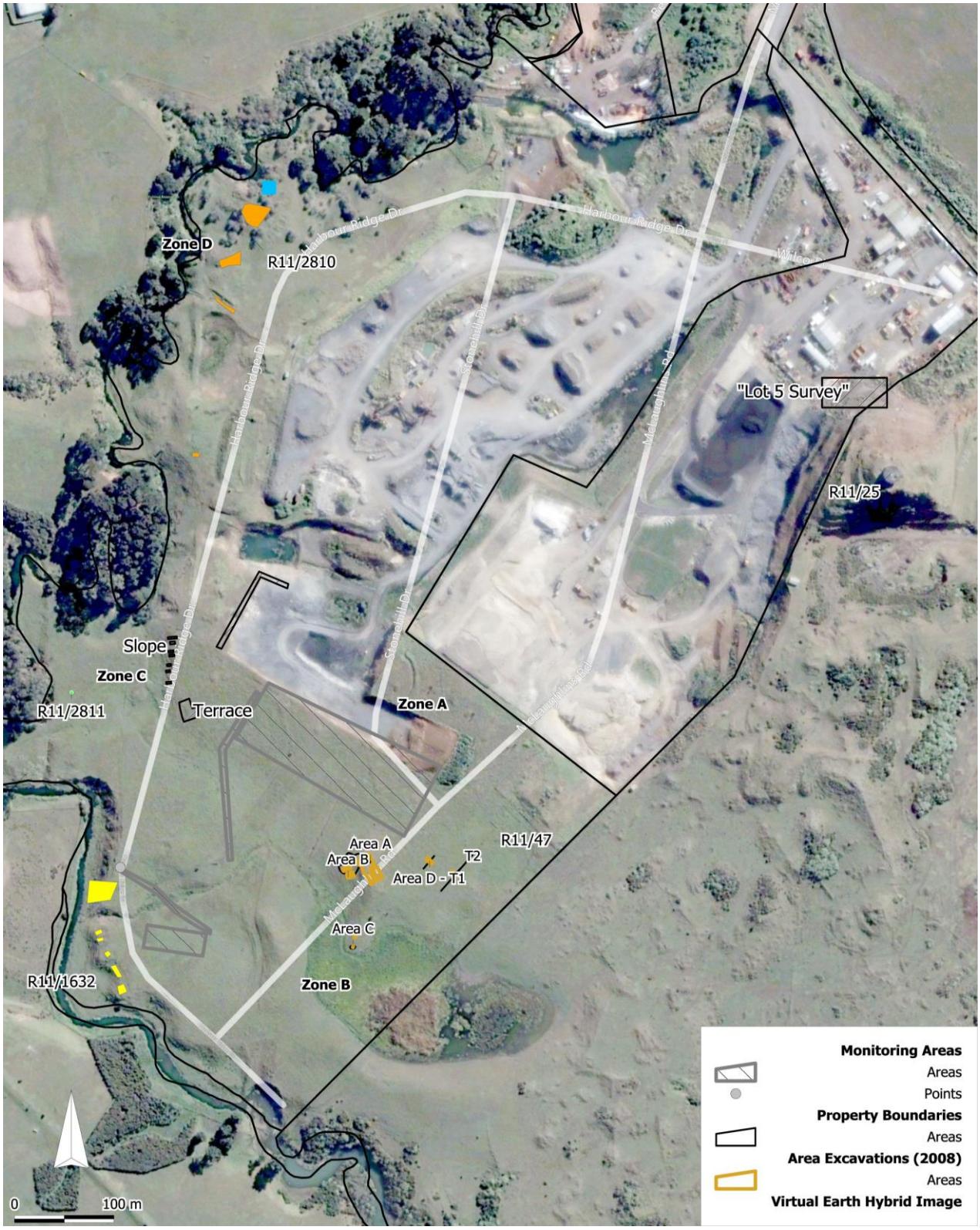

Figure 17. Location of project works

2. Investigations 2008-2009

INVESTIGATION OF ZONE B

Methodology

Excavation of Zone B ahead of quarrying was carried out in September 2008. The stone alignments in the eastern part of Area B were excluded from the investigation as they will not be affected by quarrying. Zone B was divided into four excavation areas, A-D (see Figure 18).

Trenches were opened up to expose subsurface features. Excavation areas A and part of Area B were machine stripped, exposing a few subsurface features, which were then excavated manually. Other parts of Area B and Area C (both with surface stone alignments) were turfed and manually excavated, while in area D a machine trench was excavated to examine the cross section of a stone alignment. Plans of all areas and features excavated were drawn, and soil and midden samples were taken for dating and environmental analysis.

The excavation was supervised by Rod Clough and the team consisted of five archaeologists (Ben Thorne, Colin Sutherland, Pen Pick, Andrew Shaw, and Juliet McClymont).

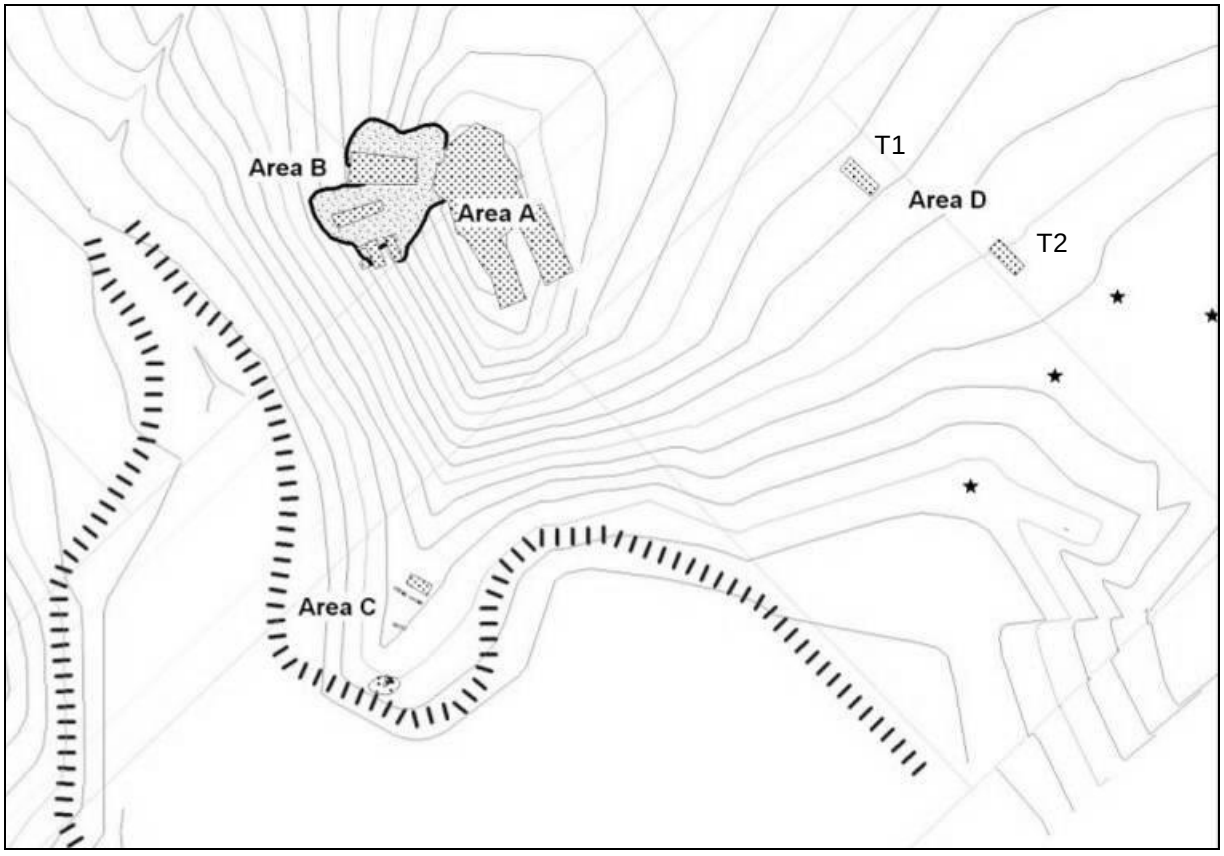

Figure 18. Zone B, excavation areas A-D

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Area A

Area A (Figure 19) contained two very shallow pits and a possible third, containing dark soil, shell scatter, rock and charcoal, but no intact midden. A smaller pit (Feature 1) was located further to the south.

Feature 1 was a small pit (Figure 20, Figure 21) or possible hangi approximately 15cm deep and 0.5-0.5m in diameter. It was cut into orange brown clay typical of the site, and was filled with a charcoal stained loamy soil. A charcoal filled burnt red soil lens was visible in the base and to one side of the pit, indicative of in situ burning.

Feature 2 was a shallow pit (3m x 1.5m) with one large post hole (Figure 22) and a drain in the north-west corner (Figure 23). The drain was filled with rocks. Five obsidian flakes were found close to the drain at a depth of c.10cm, suggesting that the manufacture or maintenance of tools was carried out nearby.

The pit was dug into orange brown sandy clay, and the fill was a dark soil with some scattered shell (oyster and cockle, Figure 23), and a very small amount of charcoal.

Feature 3 comprised a series of intercutting shallow and vague features, one of which was a possible pit approximately 3m x1m, varying between 10cm and 20cm in depth and with a possible post hole. More than half of the pit was overlaid with a large, thin scatter of shell (Figure 19, Figure 24) (cockle, oyster, cat's eye). The pit was difficult to define due to intercutting and various subsequent activities in the area. Another possible pit lay immediately to the north, but was even more difficult to define.

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INVESTIGATION OF ZONE B, CONTINUED

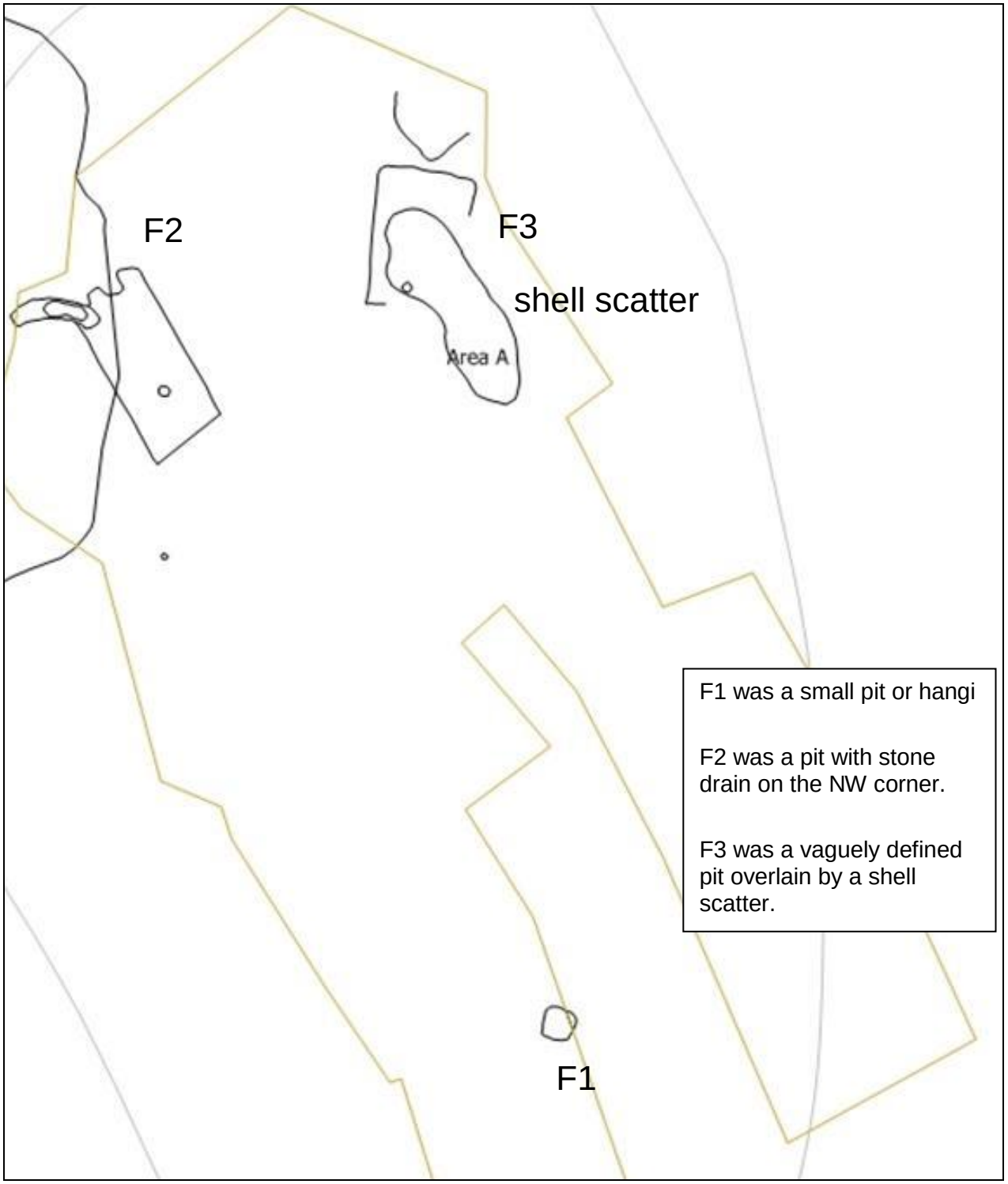

Figure 19. Plan of Area A, Zone B

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INVESTIGATION OF ZONE B, CONTINUED

Figure 20. Area A, Feature 1, small pit with evidence of burning

Figure 21. Close up of in situ burning, Feature 1 Area A

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INVESTIGATION OF ZONE B, CONTINUED

Figure 22. Area A, Feature 2, shallow pit with a large post hole and a stone-filled drain on the NW corner (looking north)

Figure 23. Area A, Feature 2, looking south, showing the stone drain leading from the pit, down the slope in the bottom right corner

Continued on next page

INVESTIGATION OF ZONE B, CONTINUED

Figure 24. Area A: Feature 3, a vaguely defined pit partly overlain by a shell scatter, is arrowed; Feature 2 is at left

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Area B

Three areas were opened up in Area B (Figure 25). Large areas were stripped by machine, exposing midden, but areas with surface stone were turfed and excavated by hand. An extensive spread of midden, charcoal rich soil and some stone alignments and other stone features were exposed.

Trench 1 (made up of three smaller trenches) was excavated and exposed a stone alignment running NE-SW (Figure 25). There was also a possible rectangular alignment of stones (Figure 26). The depth of deposits was variable, 2-10cm of topsoil, overlying 2-10cm of midden. The stones and the midden overlay a deep deposit (c.10-25cm) of dark charcoal rich soil. Midden, consisting largely of cockle, with oyster and scallop, was intermixed with a fine, greasy, black soil. As the scarp dropped away, the stones became more plentiful and formed a facing to the scarp (Figure 26, Figure 27).

Trench 2 (Figure 28, Figure 29) revealed 10cm of topsoil above a variable layer of crushed and largely scattered midden (primarily cockle and oyster) among fire cracked rocks. A deep (c.10-25cm) deposit of dark charcoal rich soil underlay the midden, as in Trench 1. The depth of the topsoil varied between 5cm and 7cm and became thinner as the scarp descended. Along a possible terrace at the base of the trench an alignment of large rocks (up to 30cm across) ran NE-SW. The stone alignment in this area did not appear to have any relationship with that in Trench 1, but had a similar orientation (see Figure 25). The stone scarp facing observed in Trench 1 did not extend into Trench 2.

Trench 3 (Figure 25) uncovered the largest deposit of midden, in good condition with a high proportion of whole shell (Figure 30, Figure 31). The topsoil was a variable layer of medium dark soil approximately 5-7cm, lying on a 5-15cm layer of midden. The midden comprised cockle, oyster, scallop, catseye, charcoal, obsidian, fire-cracked rocks and kiore remains, over an orange brown clay natural. Some shell was found in round depressions dug into the natural.

Later probing indicated that the midden was part of an extensive but patchy deposit over most of Area B (Figure 32). The stone features overlay midden, but in Trenches 1 and 2 also overlay a dark greasy soil with very little (and in parts no) shell. The stone alignments definitely post-dated the deposition of midden and dark greasy soil. However, in Trench 3, the densest part of the midden overlay a natural subsoil and subsequent stripping did not reveal any subsurface features. The lack of a dark charcoal rich soil under the midden in Trench 3 indicated that the midden represents one of the first activities in this part of Area B, while immediately to the south in Trench 1 and Trench 2 the deposition of a very dark soil represents the earliest activity.

The midden deposit was thickest nearer the top of the slope and Area A, and this suggests that the food preparation was carried out on top of the knoll. Subsequent removal of the midden and stone features provided no indication of a constructed terrace below the knoll.

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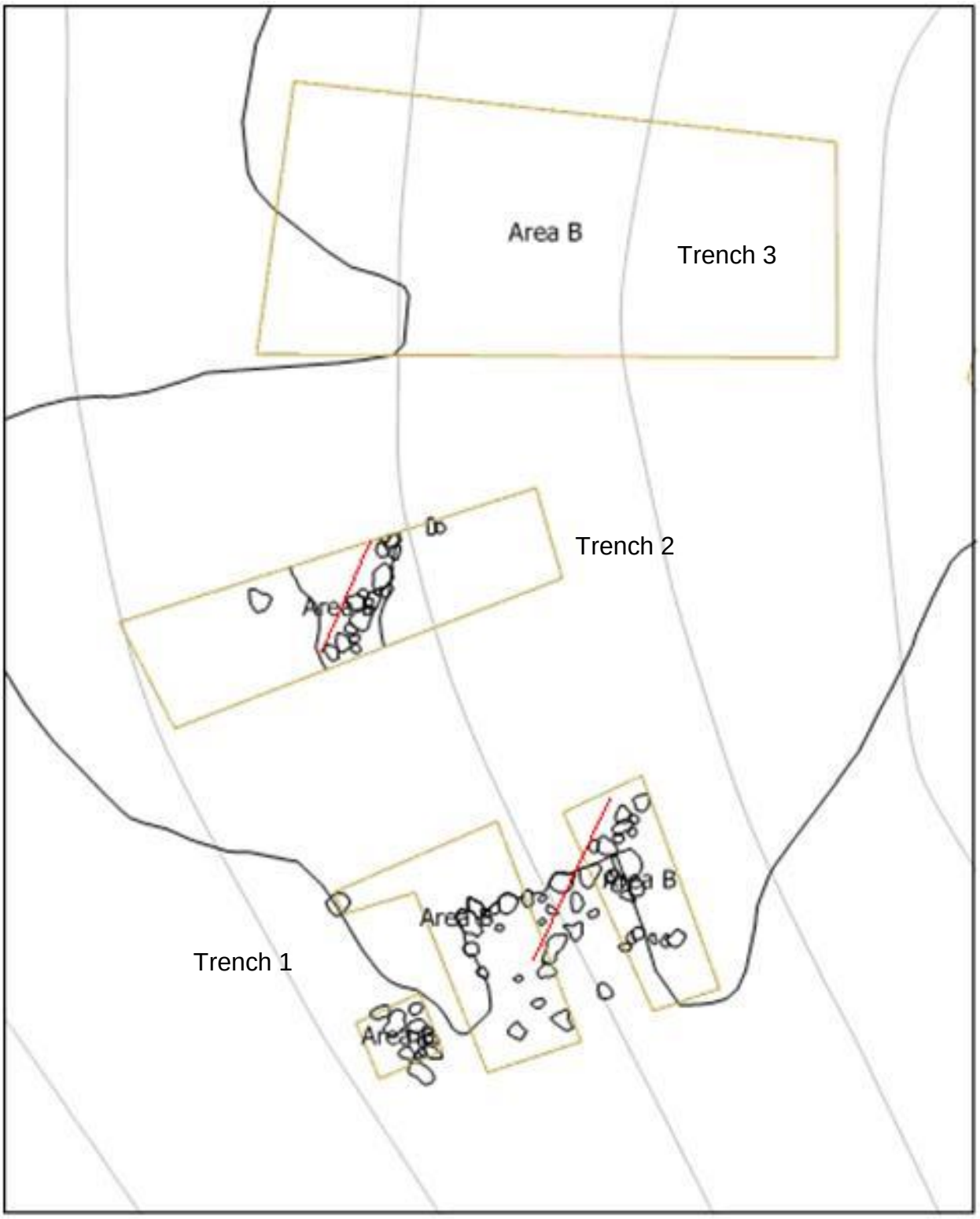

Figure 25. Trenches in Area B. Red lines added to show similarity in direction of stone alignments in trenches 1 and 2

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INVESTIGATION OF ZONE B, CONTINUED

Figure 26. Area B Trench 1 showing possible rectangular alignment (above) and stone facing on the scarp (below)

Figure 27. Close up of the stone facing

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INVESTIGATION OF ZONE B, CONTINUED

Figure 28. Area B showing Trench 2 on the right, and Trench 1 on the left, looking southwest

Figure 29. Area B, Trench 2 showing stone alignment

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INVESTIGATION OF ZONE B, CONTINUED

Figure 30. Area B, Trench 3 contained a large amount of midden

Figure 31. Area B, Trench 3 section

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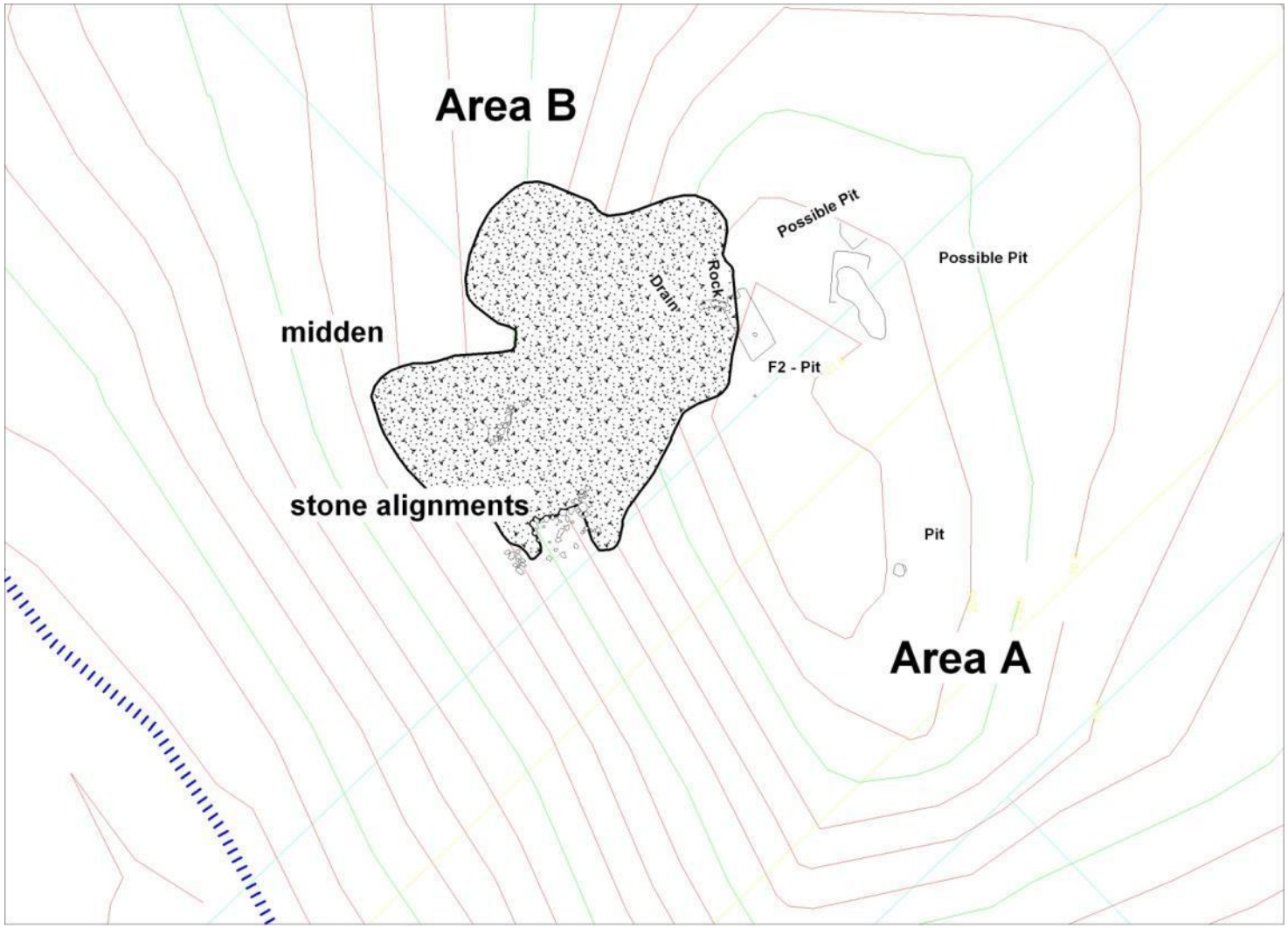
Figure 32.
Extent of midden in excavation Area B



Area C

Area C was located 45m to the south of Areas A and B and consisted mainly of a rock alignment (Figure 18, Figure 33). The alignment did not appear to relate to anything around it, and further subsurface testing did not reveal any more rocks in the general vicinity. Sparse and highly fragmented midden (due to stock trampling) occurred to the south, and consisted of cockle and oyster shells.

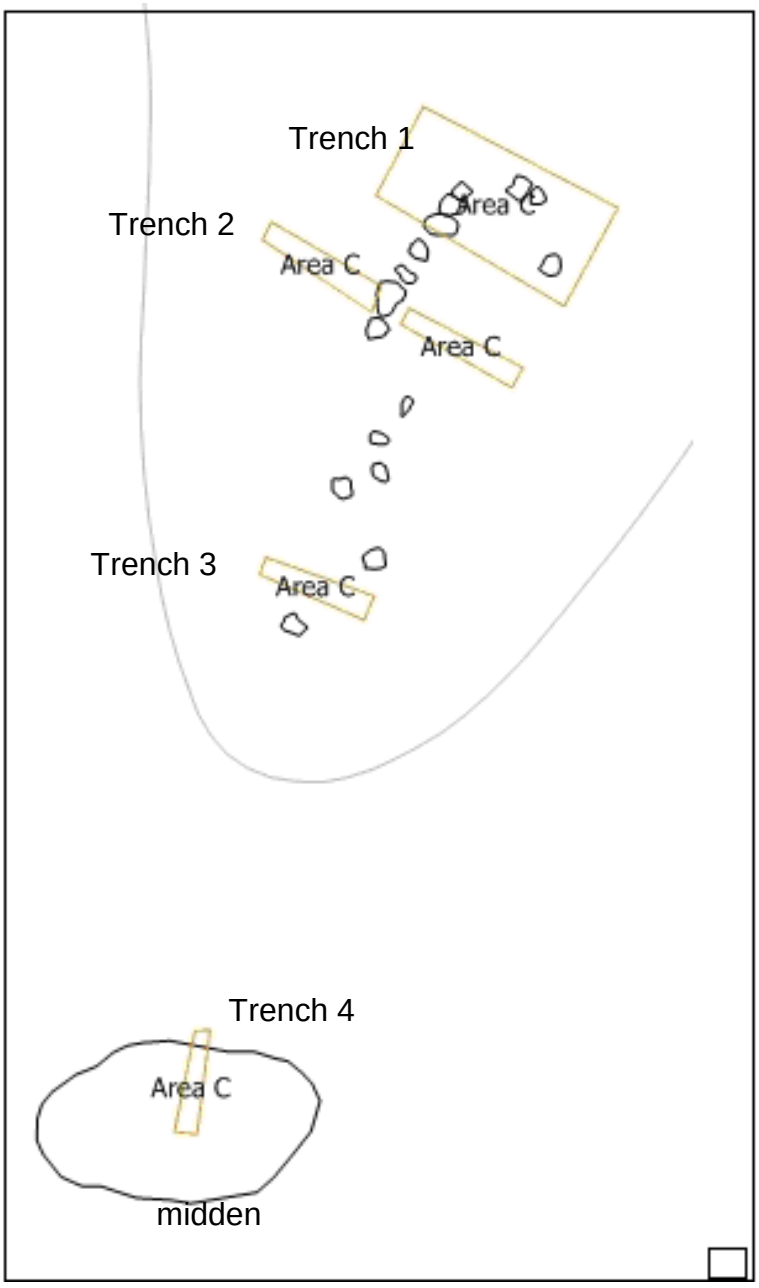


Figure 33. Plan of area C showing rock alignment, and an area of midden to the south

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INVESTIGATION OF ZONE B, CONTINUED

Figure 34. Area C Trench 1, looking south to lagoon, showing the rock alignment

Figure 35. Area C, rock alignment, looking north (Trench 1 above, Trench 2 below)

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INVESTIGATION OF ZONE B, CONTINUED

Area D

Two stone alignments were investigated in Area D, 50m to the east of Area A. Two trenches were dug across the alignments (Figure 18), but revealed no additional archaeological information. Sections showed topsoil overlying sterile clay (Figure 36, Figure 37). In Trench 1 the stones appeared to have been placed on the surface and the profile was flat, while in Trench 2, the stones were within a small depression and topsoil was built up a bit on the northern side. However, the profile of the land in general was quite flat.

Figure 36. Area D west section Trench 1

Figure 37. Area D east section Trench 2

MONITORING 2008-2009

Areas Monitored

Stripping of the overburden in advance of quarrying and associated infrastructure was monitored. This was largely carried out during four visits both before and after the main excavations in Zone B.

April 2008 – Silt Pond

June 2008 – Auckland Regional Council (ARC) Bund

July 2008 – new quarry area

January 2009 – 'Lot 5'.

The locations of the areas monitored in 2008 are shown in Figure 38 while the January 2009 monitoring location (see Figure 17) was to the east and is discussed below.

Figure 38. Location of features in monitoring

April 2008

A silt pond was excavated at the southwestern side of the quarry property (Figure 38 and Figure 39). The silt pond required digging to a depth of around 2.5m and a bund was constructed along the northern side (Figure 40). A scatter of cockle was observed at the northwestern end of the bund (Figure 41 and Figure 42), but was very scattered and not sampled. No other archaeological indicators were observed here.

Continued on next page

Figure 39. Monitored area mined with topsoil removed, and excavation removing boulders to depth down to 2.5m

Figure 40. Silt pond and bund

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Figure 41. Silt pond bund showing location of cockle scatter at nearest end

Figure 42. Cockle scatter in mud at end of silt pond bund

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June 2008

On 4 June 2008, the construction of a new bund required by the Auckland Regional Council (the 'ARC Bund') was monitored.[4] The original bund was in an area where a smaller and lower bund had previously been constructed. No archaeology had been previously recorded.

The bund measured 80m around its curve and was approximately 1m high and composed of soil and rock scraped from the area immediately to the south (Figure 43). No visual indications of shell midden were noted or other heritage features. The bund and immediate surroundings were covered with scattered hay.

July 2008

On 22 July 2008 a midden location and probable remnant stone piles were noted during monitoring of earthworks (Figure 44). The midden was located on the eastern edge of the undeveloped area, and next to an access roadway for the earthworks. The monitored area measured some 300m x 100m (Figure 44), where the surface pasture grasses covering the space had recently been mowed. An excavation machine was used to strip off the topsoil (Figure 45) and then excavate the underlying scoria.

Several patches of small stone were identified each measuring approximately 10m in diameter (Figure 46). These may have been stone piles created when the area was cleared for pasture or the remains of destroyed stone heaps used by Maori for gardening. These stones had been spread out and had no structure to them.

The midden area measured approximately 10m x 10m and contained four concentrations of shells (Figure 47, Figure 48). Each concentration contained cockle (*Austrovenus stutchburyi*) and rock oyster (*Saccostrea cucullata*) shell which was crushed, broken, and whole. The deposits were in a dark greasy soil matrix although no visible charcoal deposits were discernible. The shell was mixed amongst small stone and measured up to 150mm in thickness below similarly thick topsoil (Figure 49). A sample of cockle (*Austrovenus stutchburyi*) shell was sent to the Waikato Radiocarbon Dating Laboratory (see below).

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[4] The GPS points at either end being: NZMG E 2674148 N 6463635 and E 2674092 N 6463586+5m.

MONITORING 2008-2009, CONTINUED

Figure 43. Newly formed bund (June 2008)

Figure 44. Northern end of topsoil stripping with midden deposits at right of excavation

Figure 45. Depth of loose topsoil above sub-soil rock: 150-200mm thick

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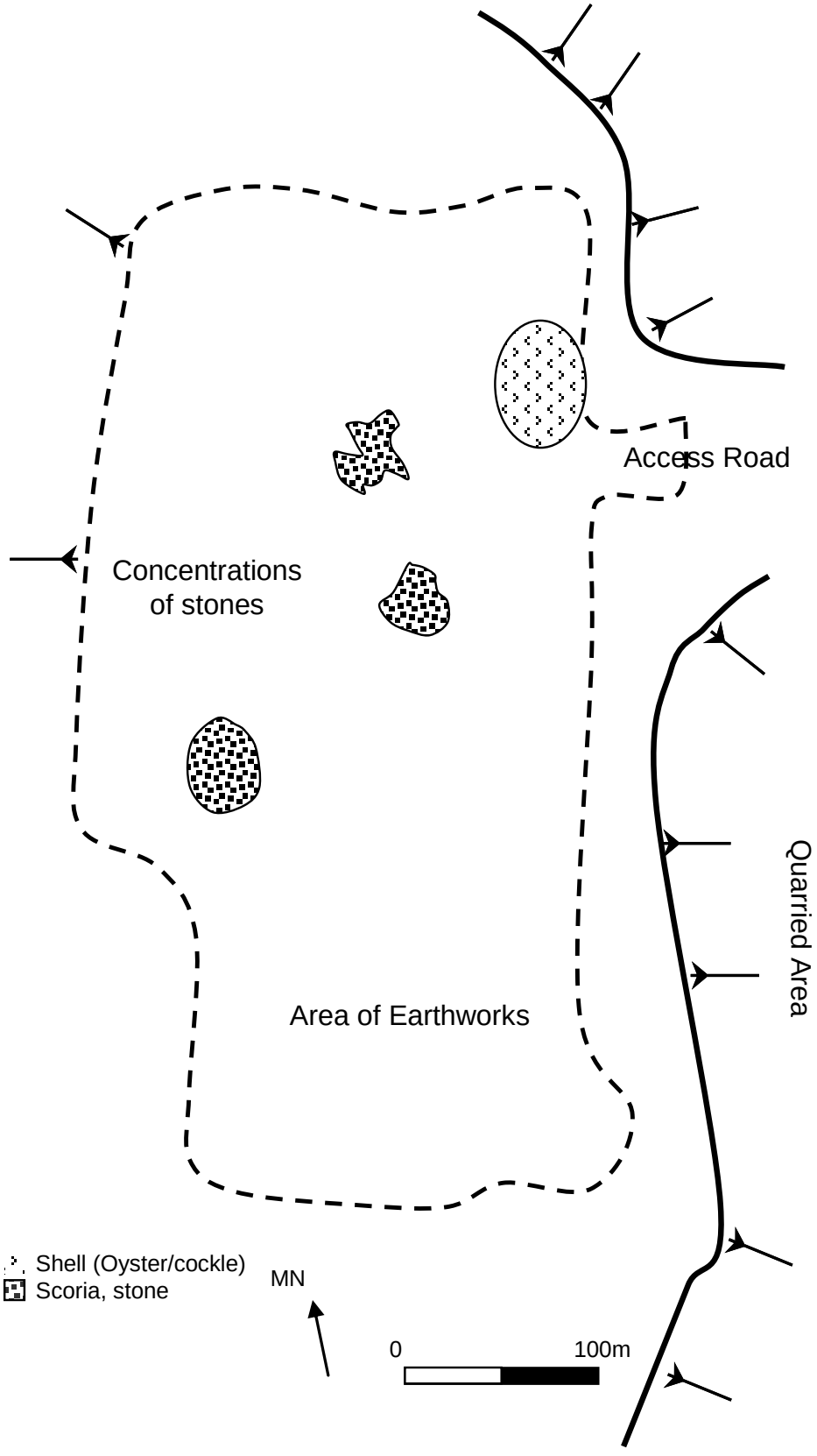

Figure 46. Sketch plan of monitored works July 2008 showing midden location and stone concentrations

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Figure 47. Smaller of the midden deposits measuring 750mm x 500mm consisting of cockle and oyster

Figure 48. Larger of the midden deposits measuring 1600mm x 500mm consisting of cockle and oyster

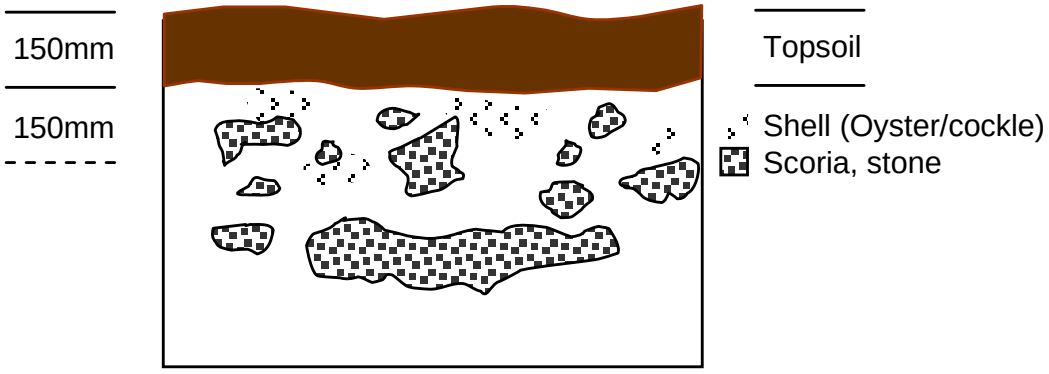

Figure 49. Section drawing from typical midden deposit

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January 2009
'Lot 5' R11/25

An inspection of the Lot 5 area next to McLaughlins Mt was carried out on 21 January 2009 (Figure 50, Figure 51). Particular attention was paid to the area adjoining the toe/foot of the remnant mountain (R11/25) and the boundary (marked in blue). The area is currently in use by McConnell Dowell.

The area within the McConnell Dowell work space has been quarried up to the boundary fenceline, also the blue line, and now supports the buildings, machinery, and offices of the company. The area on the mountain side of the fence and blue line has also been quarried down to the present ground level such that a sheer rock face is present particularly on the western side of the boundary (Figure 52). The eastern side of the property, particularly on the mountain side of the boundary fenceline, has also been quarried down to the ground level, but is more distant from the boundary.

No surface archaeological indicators were visible along the boundary line, particularly on the northern side where the area shows compacted backfill. The mountain side of the boundary is presently overgrown, but shows obvious indicators that the mountain toe/foot has been seriously modified through previous quarrying activities (Figure 53). No archaeological indicators or artefacts including shell midden were visible during the inspection.

Discussion with one of the long-time office workers for McConnell Dowell noted that the work yard was previously quarried away and backfilled up to the boundary, and also noted that the base of the mountain had also been quarried.

Figure 50. View eastwards showing McConnell Dowell work yard in proximity to mountain foot

Continued on next page

Figure 51. Lot 5 on the northwestern side and at the foot of the remnant mountain (see Figure 17)

Figure 52. View of boundary fenceline and quarried face of mountain toe/foot

Figure 53. Quarried area immediately beyond the boundary fenceline

SITE MAPPING

Sites Recorded

Condition 3(d) of the Authority specified that site R11/1632 should be archaeologically surveyed to its full extent. This was carried out at the same time as the investigations described above. In addition, the remaining area excluded from earthworks along the banks of the stream was resurveyed. The extent of the features apparent in Zone D was mapped, and the site was recorded as a separate site (R11/2810), having previously either been confused with R11/1631 on the opposite side of the bank, or included as part of R11/47. An additional midden site was noted during the survey and recorded as R11/2811.

R11/1632

Midden was found on the bank above the stream near the previously recorded site R11/1632 (Figure 56) near the Silt Pond. Patches of mostly destroyed midden were found by probing within 2-3m of the edge of the bank above the stream (Figure 54) with more substantial deposits in the slumping above the stream (Figure 55). The midden is associated with the pits and possible terracing found nearby to the south.

The majority of deposits have already slumped down the bank.

Figure 54. Area where remains of midden were identified

Figure 55. Slumped midden in bank above stream

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SITE MAPPING, CONTINUED

Figure 56. Surveyed plan of R11/1632 (yellow) with R11/2811 to the north (blue)

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Midden Site R11/2811

A small scatter of midden was found on the flat area above the stream along the western side of the property and covering an area of around 4m x 3m (Figure 56, Figure 57). It is approximately 25m from the edge of the stream.[5] The midden consisted of heavily crushed cockle shell with small amounts of charcoal. The area may have been suitable for a small encampment so other subsurface features might be present in this area, but would only be detectable with further testing.

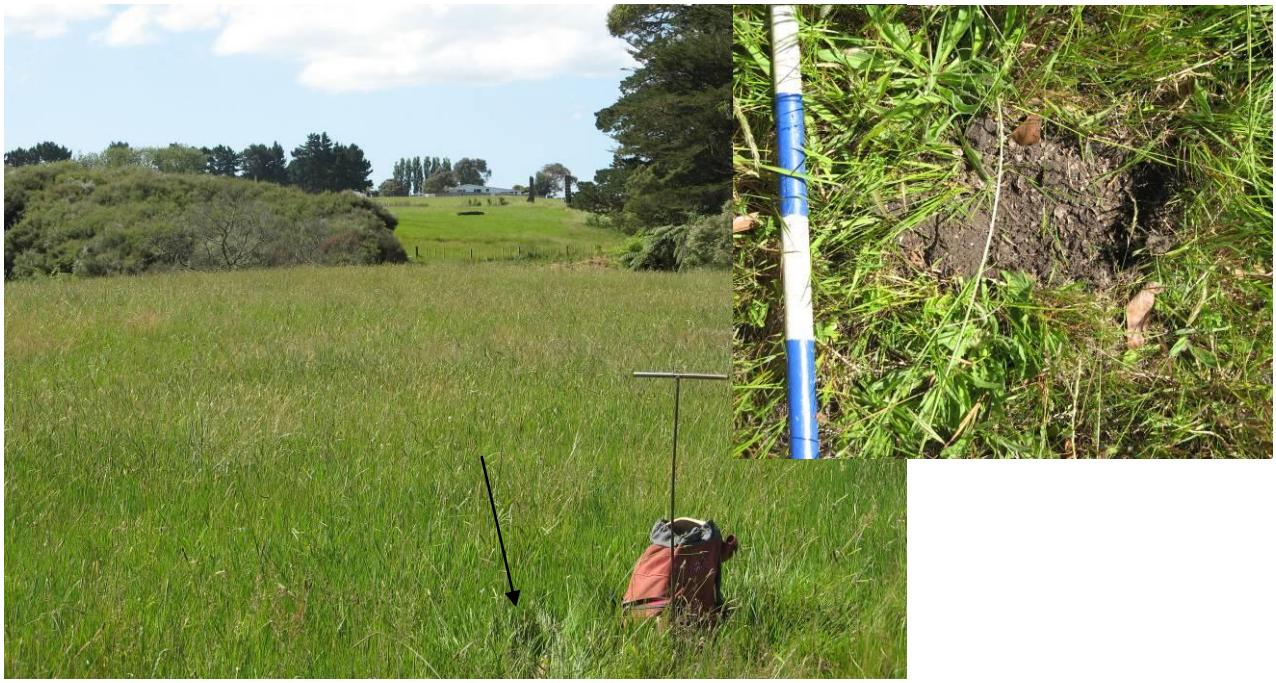

Figure 57. Patch of midden found near western side of property, recorded as R11/2811

R11/2810[6]

Several shallow pits and two possible terraces were observed in Zone D in 2000, when there was low ground cover (Clough 2000, 2007a). A pou was subsequently placed to mark one of the pits, but this had been removed and it was not possible to relocate the pits due to vegetation cover. However, midden was found spread out in at least two large areas on the east side of Puhinui Stream on the grassy flat between the quarry and the stream. The extent of the midden established by probing was surveyed in 2009 (Figure 58, Figure 59). An old concrete drain was also present at the southern end of the site (Figure 60).

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[5] GPS NZMG E2673973 N6463556 ±4m (NZTM E1763574 N5901872)

[6] In some earlier assessments, this site was equated with R11/1631 but that site is further north and on the western side of the stream.

Figure 58. Extent of R11/2810 – orange area midden, grey area is old concrete drain, blue marker is approximate location of pits previously observed. However, these could not be identified in 2008-9 due to dense vegetation cover (Google oblique view)

Continued on next page

Figure 59. Grassy area at northern end of R11/2810 where midden was identified

Figure 60. Old concrete drain at south of site

3. Zone C - Garden and Midden Investigation 2011

INTRODUCTION

Introduction

On 2-3 August 2011, two areas along the western fringe of the Matukutureia/McLaughlins Mountain quarry were investigated by Barry Baquié and Ben Pick. The locations had previously been noted as possible archaeological sites and identified as Zone C.

The two areas under investigation during this time were:

A possible gardening terrace

A possible gardening slope.

Methodology

The two areas investigated (a possible gardening terrace and a west-facing rocky slope with probable gardening locations) are shown in Figure 61.

The terrace site was hand stripped of the turf layer and an exploratory trench hand-dug to determine existing stratigraphy, after which a mechanical excavator was used to further investigate the subsurface and surrounding area.

The rocky slope was investigated with seven trenches (T1-7) cut down the slope to determine the likelihood of any subsurface remains. However, the rocky nature of the slope did not allow close examination of any clean stratigraphy.

Photographs and sketches were made of the areas, and shell deposits and soil samples collected for further analysis.

Continued on next page

INTRODUCTION, CONTINUED

Figure 61. Locations of the two areas investigated: Trenches 1 (south) to 7 (north), and the Garden (Terrace) Area

THE GARDEN TERRACE

Initial Investigation

This area is located to the west of the present quarry works and within a farmed area between the quarry and the Puhinui Stream. At the time of the investigation the ground surface was under grazed pasture with exposed surface rock. The flat terrace, which measured visibly 4.4m x 3.1m, lay to the west of an apparent low rock wall alignment, this being approximately 5m long and 0.55m high (Figure 62).

The turf layer of the terraced area was removed by hand to expose in the topsoil any possible sub-features such as postholes, pit outlines, trenching, or midden deposits.

There were no apparent features visibly exposed in the excavation.

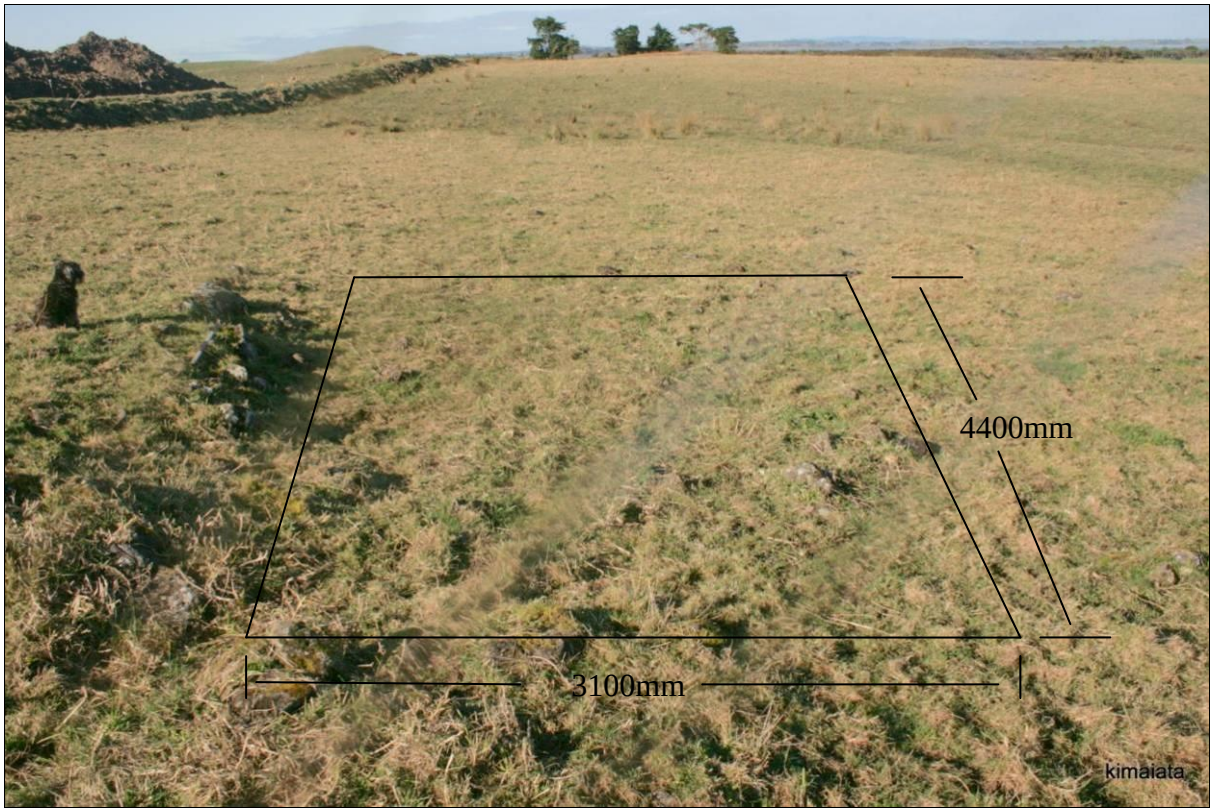

Figure 62. The indicative terrace location lies to the right of the exposed rock

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THE GARDEN TERRACE, CONTINUED

Test Trench

A test trench[7] was dug at right angles from the middle of the rock wall alignment across the terraced area (Figure 63) The subsoil was clean, brown, friable topsoil devoid of any shell. There were several small pieces of random, archaeologically undiagnostic stone in the layer (Figure 63–Figure 65). The test trench measured 3m long, 250mm wide, and was excavated 400mm down to the natural basal subsurface light yellow, whitish ash-clay. Towards the western end of the trench, a minor rock alignment was identified angling across the terrace at approximately 45^{o} (Figure 64), and was seated on the basal layer.

Figure 63. Test trench dug across the turfed terrace (view westward)

Figure 64. View of the angled stone alignment (45^{0}) across the test trench

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[7] NZTM E1763661 N5901856 ± 3m

THE GARDEN TERRACE, CONTINUED

Figure 65. View westward of the garden test trench showing rock wall alignment (at front) and buried stone alignment (at rear) with random small stone in the topsoil (on sides of trench)

Continued on next page

THE GARDEN TERRACE, CONTINUED

Machine Stripping

Following the initial investigation of the garden site, a mechanical excavation machine was employed to strip back the surrounding topsoil through to the basal subsoil in a series of carefully controlled scrapes (Figure 66). It was during this exercise that features including the structure of the rock wall, the stone alignment noted in the trench, and other protruding rock in the approximate vicinity were properly identified. No post holes or other subsurface features such as pits, soak holes, midden, or trenching were present in or through any of the excavation. The topsoil was 400mm thick at the rock alignment and tapered to 150mm at the western and southern extents of the excavation over a distance of 8m and 9m respectively. In all cases the soil was clean friable topsoil with only occasional random stones, except in the area near the rock alignment and northern and eastern areas where thick deep concentrations of rock were present. Even in these concentrations of rock there were no indicators of previous Maori or historic European occupation.

Four areas below the topsoil, which appeared to have possible subsurface form, were test-pitted but showed no archaeological features.

Figure 66. Garden area and surrounds cleared to establish likelihood of any visible heritage remains

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THE GARDEN TERRACE, CONTINUED

Summary

An apparent rock wall alignment along the eastern side of the terrace was 550mm above the turf with a raised face along the eastern end of the terrace. The terraced area was stripped of the turf layer and a test trench dug to ascertain the subsoil structure. Topsoil was measured at 400mm thick on top of a basal ash-clay at the rock alignment and tapered towards the natural slope to the west where topsoil was 150mm thick. Also noted was a sub-surface stone alignment angling across the test trench. No other features were recorded in the area. Four test pits were dug to confirm surface anomalies, which were shallow hollows in the subsoil surface and not archaeological.

A GPS location was recorded at the test trench; and soil samples taken from the trench as well as from the western boundary of the excavation to establish a comparison between the probable garden area and the location westward where further gardening activities may have occurred (Figure 67).

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THE GARDEN TERRACE, CONTINUED

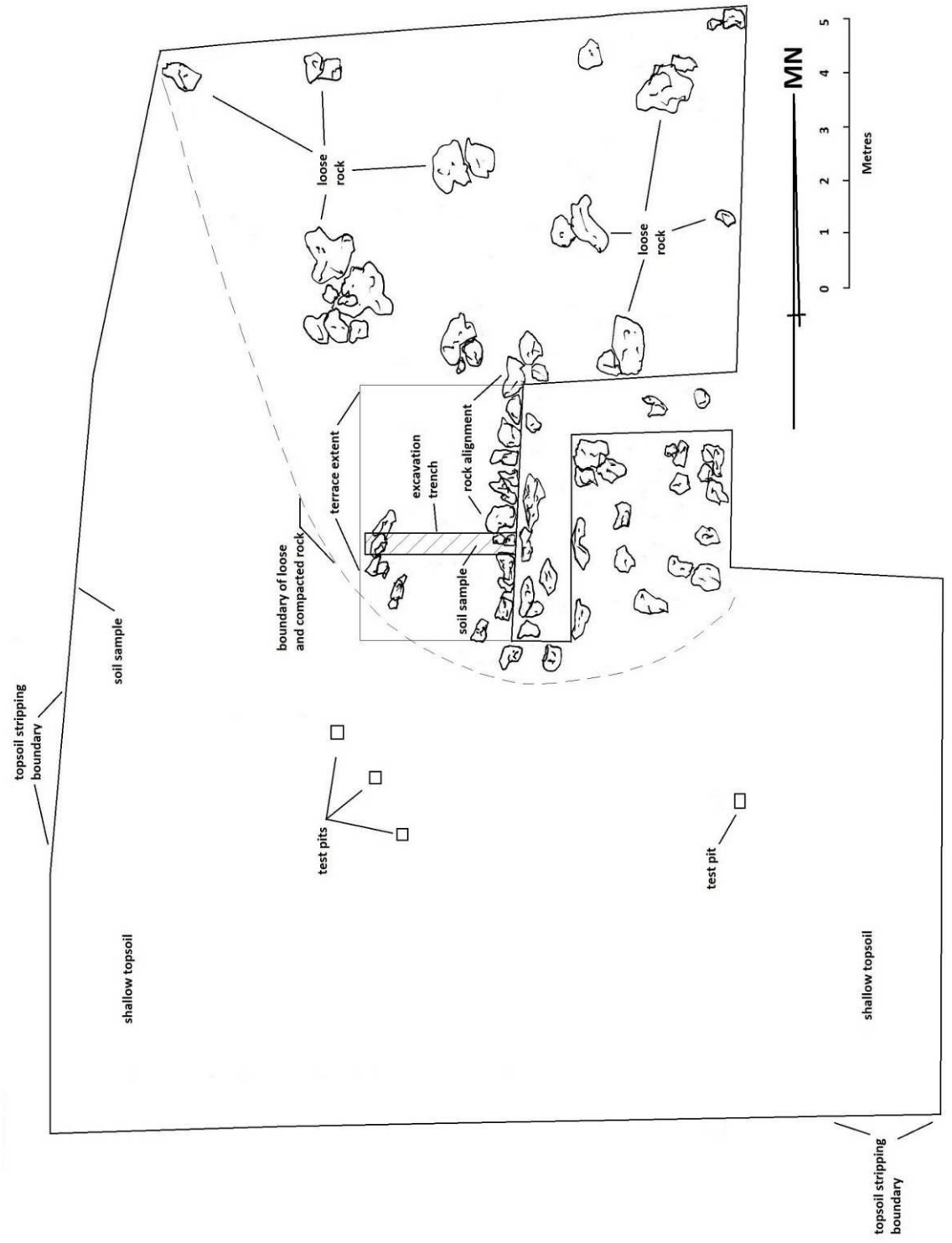

Figure 67. Sketch Plan of garden excavation showing limits of excavation, exploratory trenching, test pitting, and locations of soil sampling

THE GARDENING SLOPE

Gardening Slope

Twenty-five metres to the north the land dropped westward towards a shallow tributary draining into the Puhinui Stream. This area consisted of a slope covered with volcanic rock outcrops which were securely embedded into the topsoil and below into the basal ash-clay. There were no apparent terraces or other surface features visible to suggest the slope was part of an agricultural system, although stock farming activities may easily have modified the slope. The area at the top of the slope had been used as a farm track/access way into the surrounding paddocks, and quarrying stockpiling was occurring along the western fringes of this flatter area. No surface indicators of any heritage features were visible along the upper area of the possible west-facing slope.

Down this slope seven trenches (T1-T7) were systematically excavated by a mechanical excavation machine using a 2m wide weed bucket (Figure 68) to determine the possible presence or otherwise of any gardening activities or remnant indicators of previous human habitation. The exploration of each trench depended on the slope, as well as the depth and difficulty of removing rock boulders. GPS readings were recorded from the middle of each trench (Table 1).

Of the seven trenches excavated two had remnants of shell midden deposit. T4 contained a small scatter in the topsoil, as did T7, although the latter was larger and more concentrated and compact.

Figure 68. The westward facing slope showing the seven exploratory trenches T1-T7 (looking east)

Table 1.GPS co-ordinates of the seven trenches

Slope Trench #	GPS Coordinates		±m
	Easting	Northing	
1	1763652	5901877	4
2	1763650	5901886	4
3	1763650	5901891	5
4	1763651	5901899	4
5	1763650	5901902	4
6	1763650	5901909	4
7	1763650	5901913	3

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Trench T4

The small midden deposit occurred 2m from the top of the 5m long x 2m wide trench and consisted of a scatter over 500mm in the topsoil (Figure 69–Figure 71). The deposit was fragmented and sun-bleached, and comprised mostly cockle (*Austrovenus stutchburyi*) with broken and crushed Bluff oyster (*Tiostrea chilensis lutaria*).

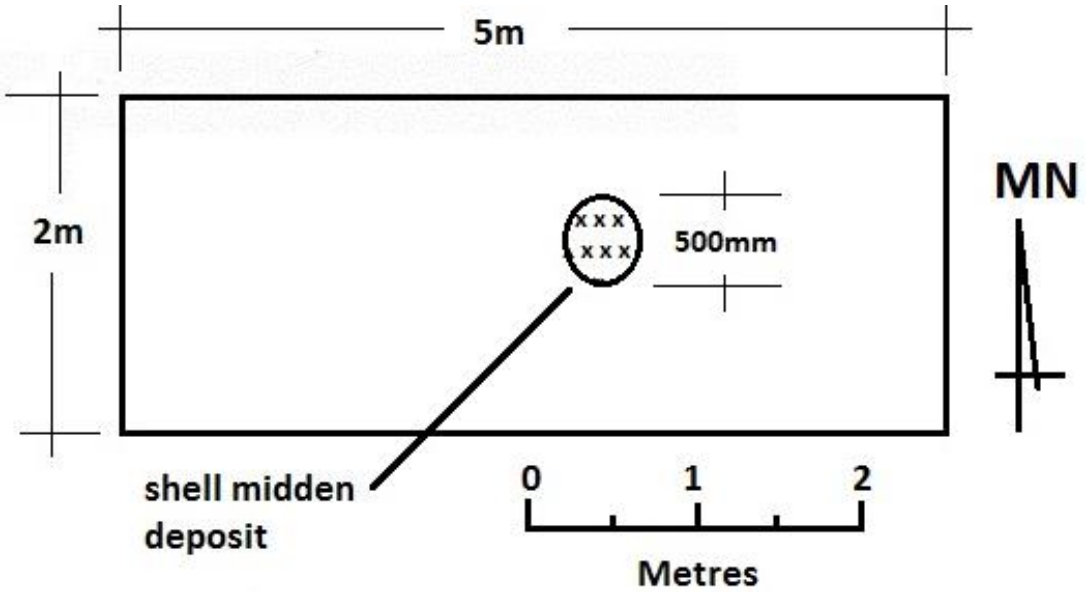

Figure 69. Plan view of the location of Trench 4 shell midden deposit

Figure 70. Trench T4 showing fragmented and scattered nature of midden deposit in topsoil

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THE GARDENING SLOPE, CONTINUED

Figure 71. Trench T4 showing the rocky nature of the surface and sub-surface

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Trench T7

Trench 7 was the longest trench, excavated downslope over a distance of 9m and was 2m wide (Figure 61). The midden deposit was initially noted 5m down from the top of the trench and along the southern baulk. However, further investigation showed the deposit to be spread further into the baulk, eventually measuring 1.5m x 1m and in a 50mm thick mixed soil and shell layer (Figure 72–Figure 74). The dimensions of the deposit were determined by probing and spade testing into the topsoil and rock down to the sub-layered ash-clay. The deposit consisted mostly of cockle (*Austrovenus stutchburyi*), Bluff oyster (*Tiostrea chilensis lutaria*) and rock oyster (*Saccostrea cucullata*) with several gastropods. No charcoal, hangi stone, or fishbone were visible. A considerable sample of this midden deposit was collected for further analysis.

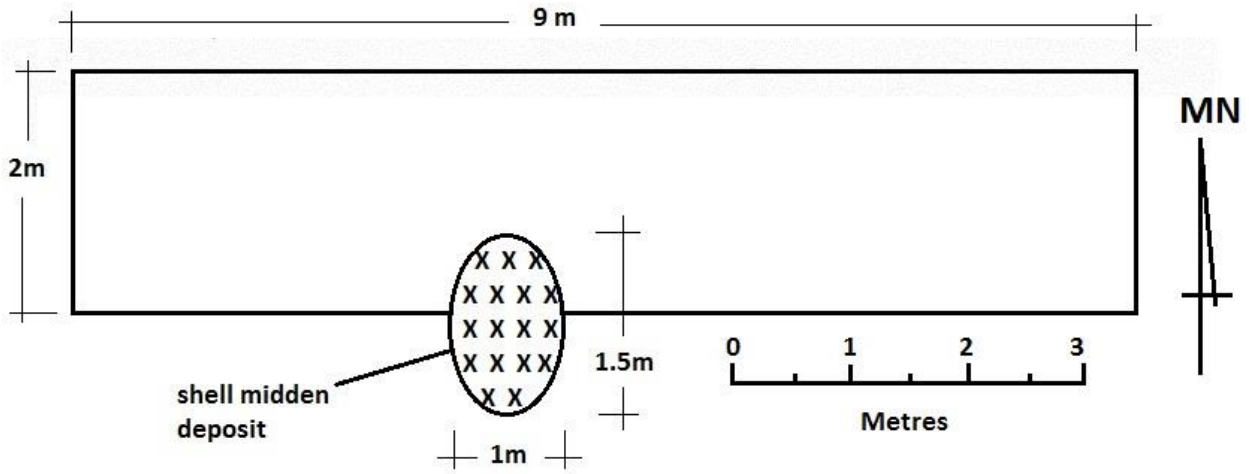

Figure 72. Plan view of the location of Trench 7 shell midden deposit

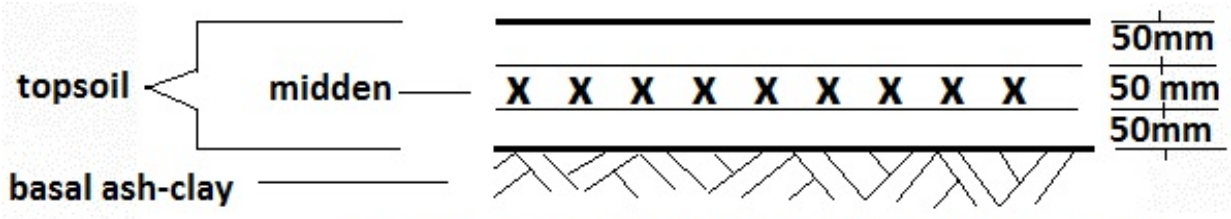

Figure 73. Section view of the Trench 7 shell midden deposit

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THE GARDENING SLOPE, CONTINUED

Figure 74. Surface scatter of midden deposit amongst topsoil and volcanic rock

4. Analysis

MIDDEN

Midden Analysis Season 1

Analysis of midden from Zone B, Areas B and C indicated that cockle (*Austrovenus stutchburyi*), Bluff oyster (*Tiostrea chilensis lutaria*) and scallop (*Pecten novaezelandiae*) were the predominant species exploited (Table 2). Cockle indicates exploitation of estuarine mud flats and harbour beaches; the oyster that of muddy shore environments; while the scallop are more mid-harbour species. Small quantities of other species (often individual specimens) were also recovered. These included speckled whelk (muddy shore), siphon whelk (rocky shore), cats eye (rocky shore), turret shell (muddy shore), horn shell (muddy shore), spotted topshell (rocky shore), oval trough shell (muddy shore) and oblong venus shell (muddy shore).

A small amount of rat bone was recovered from the midden in Trench 3, Area B, Zone B. The bone was analysed by Sheryl McPherson of Faunal Solutions (see Appendix). A minimum number of two individuals, at least one of which was juvenile, was identified from a total of 38 fragments. The size of the elements fell within the size range of the kiore (*Rattus exulans*), though the possibility that they were from *Rattus norvegicus* could not be completely excluded.

Midden Analysis Season 2

Two midden deposits one each from Trench 4 and Trench 7 were analysed for shell species. The predominant shell species in both deposits was cockle with Bluff oyster and/or Rock oyster (*Saccostrea cucullata*), scallop, mudsnail (*Amphibola crenata*), and a variety of whelks in Trench 7 (Table 3). The analyses show that shellfish supplies were gathered from mostly sandy/muddy shoreline locations, no doubt along the fringes of the Manukau Harbour and Puhinui Stream estuary.

Summary

The results of the midden analysis identified the common species available in the Manukau Harbour. Access to the shellfish would have been straightforward via canoe (as evidenced by the mid-harbour species) and by foot with the gathered shellfish brought back and cooked near both gardening and habitation areas. No structural remains of the cooking were found.

The small amount of fishbone found (not identifiable to species) is typical and fish is probably under-represented here as preservation conditions for the fishbone were relatively poor. The kiore sample was small, and it is unclear whether the bones represented part of the diet or resulted from subsequent burrowing into the midden.

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MIDDEN, CONTINUED

Table 2. Main species recovered from midden in Zone A, areas B and C

Bag ID	Gross Weight	Cockle (*Austrovenus stutchburyi*) - muddy shore	Bluff Oyster (*Tiostrea chilensis lutaria*) muddy shore	Scallop (*Pecten novaezelandiae*) sandy/muddy shore	Mudsnail (*Amphibola crenata*) muddy shore	Crushed shell fragments	Rock	Charcoal	Bone	Comments
Area B, Trench 1, Lower Scarp	1600g	MNI 110 72g very crushed, mostly hinges	MNI 1 12g	MNI 2 30g		1110g	178g			Slightly charcoal stained loamy soil matrix. Contains very crushed shell with some whole/broken shell. Contains root matter.
Area B, Trench 1, Upper Scarp	1460g	MNI 22 188g	MNI 5 184g	MNI 3 90g		674g	144g			Moderately charcoal stained loamy soil matrix. Midden comprises predominantly very crushed shell with no charcoal pieces of fishbone. Contains root matter.
Area B, Trench 2	1820g	MNI 42 76g	MNI 5 174g	MNI 2 72g	MNI 1 <2g	1080g	46g	<2g	Fishbone <2g undiagnostic vertebrae	Charcoal stained loamy soil matrix containing very crushed shell midden with minimal fishbone and rock. Contains root matter.
Area B, Trench 2, Terrace	1870g	MNI 63 82g (10-20mm 40% 20-30mm 60%)	MNI 1 46g	MNI 4 160g		806g	308g		Fishbone 6g	Charcoal stained loamy soil matrix containing very crushed shell midden with some fishbone and rock. Contains

Bag ID	Gross Weight	Cockle (*Austrovenus stutchburyi*) - muddy shore	Bluff Oyster (*Tiostrea chilensis lutaria*) muddy shore	Scallop (*Pecten novaezelandiae*) sandy/muddy shore	Mudsnail (*Amphibola crenata*) muddy shore	Crushed shell fragments	Rock	Charcoal	Bone	Comments
										root matter.
Area B, Trench 3	1475g	MNI 146 284g (10-20mm 70% 20-30mm 25% 30+mm 5%)	MNI 5 226g	MNI 1 8g	MNI 7 14g	448g	64g	2g	4g	Slightly charcoal stained loamy matrix. Dense shell predominantly cockle with other muddy shore species (some articulated cockle). Also includes minimal rock, charcoal and bone. Not as crushed as other samples. Contains root matter.
Area B, Trench 3 with charcoal	2248g	MNI 185 380g (10-20mm 30% 20-30mm 60% 30mm+ 10%)	MNI 5 238g	MNI 1 22g	MNI 3 12g	726g		6g	Fishbone 4g	Charcoal stained loamy soil matrix with clumps of clay and some charcoal pieces. Contains very crushed shell midden with some whole shell - predominantly cockle. Contains root matter.
Area C, Trench 4	2050g	MNI 186 148g Very crushed, mostly hinges	Present 4g			930g				Slightly charcoal stained claggy soil matrix. Contains very crushed shell midden. Sample was wet sieved due to dense soil matrix. Contains root matter.

Continued on next page

MIDDEN, CONTINUED

Table 3. Midden analysis for Trenches 4 and 7, Zone C

Trench	Gross Weight	Cockle (*Austrovenus stutchburyi*)		Oyster Bluff (*Tiostrea chilensis lutaria*)		Oyster Rock (*Saccostrea cucullata*)		Scallop (*Pecten novaezelandiae*)		Mud snail (*Amphibola crenata*)	Whelk Siphon (*Penion sulcatus*)	Whelk Spotted (*Cominella maculosa*)	Whelk ?	Comment
T4	633gms	38gms		50gms										Much of the oyster shell was fragile and flaky with suspect hinge identification. Measurement of shell size and valve siding was not possible. The cockle sizes varied from 19mm to 44 mm
		MNI 5		MNI 2										
Valve sides		Left 5	Right 9											
T7	2250gms	432gms		38gms		12gms		11gms		10gms	57gms	49gms	22gms	Cockle sizes varied from 16mm to 38mm. Oyster, scallop, and mudsnail were minor in quantity as were the whelks, although one was not identified
		MNI 69		MNI 3		MNI 4		MNI 3		MNI 5	MNI 3	MNI 1	MNI 1	
Valve sides		Left 69	Right 73	Top 0	Base 3	Top 0	Base 4	Top 3	Base 0					

SOIL ANALYSIS

Soil Samples

A total of 5 soil samples from the excavations (Figure 75) were analysed by Mark Horrocks (see Appendix). These were:

Zone B Area B Lower scarp Trench 1

Zone B Area B Terrace

Zone C Trench 7

West edge of quarried zone

Zone C Garden Terrace.

The samples contained a high concentration of microscopic fragments of charcoal, reflecting human activity around the site. These activities included burning of vegetation and cooking fires. The samples were dominated by grass pollens (Poaceae) and bracken spores (*Pteridium*). Hornwort spores (Anthocerotopsida) were also identified along with of tutu (*Coriaria*) shrubs and puha/dandelion (*Sonchus*/*Taraxacum*) pollen.

Bracken, an invasive ground fern, is often abundant in New Zealand pollen spectra of the last millennium and frequently associated with large-scale burning of forest by Maori. Hornworts are also associated with forest burning. Manuka/kanuka, grasses and edible herbs (puha/dandelion) were also present in the deposits, likewise indicating vegetation disturbance. The leaves and young shoots of puha were a food source for Maori (Crowe 1990). The grass phytoliths confirm the pattern of vegetation clearance.

Pollen from European-introduced pine (*Pinus*) trees and plantain (*Plantago*) weeds in the samples reflects soil disturbance by people into the European era or pollen percolation due to the porous nature of the local soils.

Nikau (*Rhopalostylus*), kumara (*Ipomoea batatas*) and corm of taro (*Colocasia esculenta*) were all identified in the samples. The kumara and taro were grown in the garden areas with nikau probably planted and managed as an important resource.

Fragments of sponge spicules indicated use of aquatic resources, according to Horrocks, and the location makes this unsurprising.

Continued on next page

SOIL ANALYSIS, CONTINUED

Figure 75. Location of soil samples

OTHER

Charcoal

A very small amount of charcoal was recovered from the fill of the shallow pit (Feature 2) in Area A of Zone B, about 1cm from the base of the feature. It was examined by Dr Rod Wallace (Department of Anthropology, University of Auckland), who established that it contained only Puriri (*Vitex lucens*).

Obsidian

Five obsidian flakes were also found in Area A, Feature 2 close to the rock-filled drain in the northwest corner of the pit at a depth of c.10cm. They consisted of one large (c.7cm x 5cm) and three small flakes of Mayor Island obsidian, and one small thumb sized flake of clear grey obsidian likely to be from Great Barrier Island. The presence of obsidian flakes suggests that the manufacturing or maintenance of tools was carried out close to the pit.

RADIOCARBON DATES

Radiocarbon Age Determinations

A total of five radiocarbon dates from the excavations were obtained (see Table 4, Figure 76 and Figure 77).[8] The dates form a relatively tight grouping suggesting occupation during the 16th and 17th centuries AD. Sample Wk25068 from Zone A, Area B, Trench 3 does appear to be about a century earlier. The dates suggest intense occupation of the garden areas for at least 100 years and probably closer to 200 years. Whether the area was occupied intermittently, seasonally or continuously is not known.

Table 4. Radiocarbon dates from project (Area B and C samples are from Zone B)

Sample No	Material	CRA Years BP	+/-	Sample	Calibrated Age (AD)			
					-2σ	-1σ	1σ	2σ
Wk23691	Shell	635	34	R11/47-B220208	1520	1560	1720	1820
Wk25067	Shell	662	38	R11/47- Area B T-2	1495	1558	1685	1805
Wk25068	Shell	804	35	R11/47- Area B T-3	1427	1447	1554	1640
Wk25069	Shell	631	35	R11/47- Area C T-4	1520	1561	1718	1825
Wk32632	Shell	694	30	R11/47-T7	1489	1544	1658	1694

Figure 76. Location of radiocarbon dating samples from the project (Wk sample numbers)

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[8] See Appendix for full results

RADIOCARBON DATES, CONTINUED

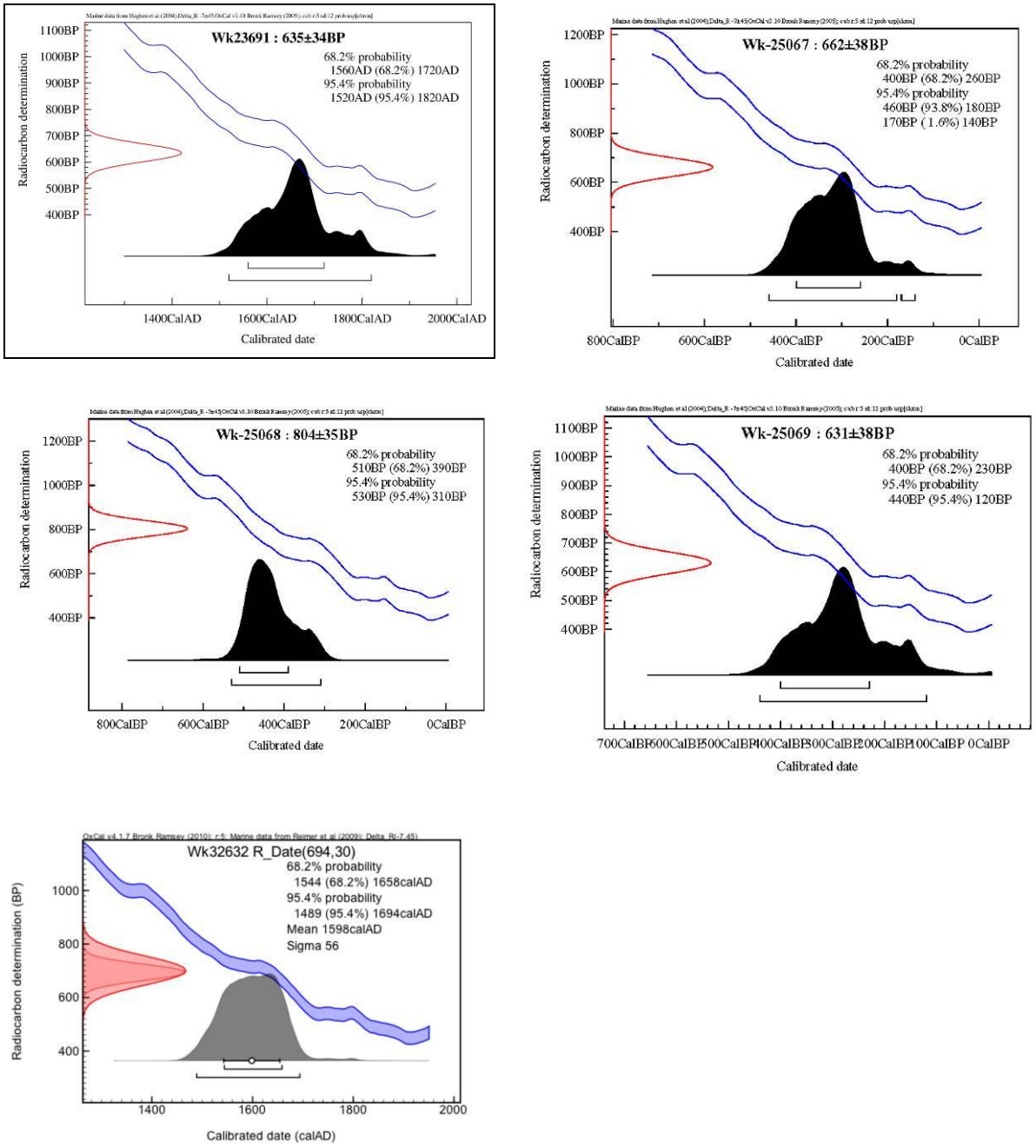

Figure 77. Calibrated radiocarbon dates from project

5. Discussion and Conclusions

DISCUSSION

Interpretation of Results

The archaeological remains exposed were limited, but included two or three remnant pits, stone alignments and other stone features, cooking and food preparation areas represented by fire-cracked rock and midden, and obsidian flakes.

The remains in Zone B suggest that a small whare was built on a knoll above a lagoon and an area of cultivation. The pit with a drain and large post hole was only 3m x 1.5m in size and represented either a food storage pit or a field shelter or small whare. The other more vaguely defined pits adjacent to it may also have been food storage pits. If these features do represent food storage, then the facilities here were insubstantial compared with those of nearby sites R11/2810 and R11/1632, where pits are more numerous, larger and deeper. The stone alignments in Zone B, Area B are relatively late in the sequence, overlying both midden and gardening soils, but their association with the deep charcoal rich soils supports their interpretation as gardening features.

In Zone C, the excavations in the garden terrace did not result in any archaeological features being uncovered. However, the trenches dug into the garden slope revealed a large quantity of shell midden interspersed in the rocks, particularly in the northernmost Trench. However, the rocks did not form obvious structures and it seems likely that these rocks had been moved around both in prehistoric and European times. This makes detailed understanding of the site difficult. However, it is probable that a cooking area may have been located at the top of the ridge with the rakeout of middens thrown down the slope. Below this area, on a flat grass paddock near the stream, more midden in the soil was identified during probing and suggests occupation here as well.

Environment

The soil samples analysed by Mark Horrocks (see Appendix) all contained a high concentration of microscopic fragments of charcoal, reflecting human activity around the site. These activities include burning of vegetation and cooking fires. The samples were dominated by grass pollens (*Poaceae*) and bracken spores (*Pteridium*). Bracken, hornworts and the grass phytoliths all confirm the pattern of vegetation clearance. Other pollen from European-introduced pine (*Pinus*) trees and plantain (*Plantago*) weeds reflect changes during the European era.

Nikau (*Rhopalostylus*), kumara (*Ipomoea batatas*) and corm of taro (*Colocasia esculenta*) were all identified in the samples. The kumara and taro were grown in the garden areas, with nikau probably planted and managed as another food resource.

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Gardening

Furey (2006:24ff) summarises the archaeology of Maori gardening and highlights Sullivan's work on the Auckland volcanic fields of East Tamaki and Wiri. As Furey (following the work of Sullivan 1974 and Veart 1986) notes, the stone rows associated with the volcanic cones tended to radiate out into the surrounding lava fields from the lower slopes. Subdivision of these wedges created separate garden plots and may provide an indication of social structure related to the size of the plots and proximity to the cone. However, the influence of the natural topography gave the pattern an increasingly haphazard look as the distance from the central cone increased (Veart (1986: 231).

However, at Matukureia this patterning is evident neither in the 1950s aerial nor in the mapping carried out by Sullivan – there is no discernible pattern radiating out from the cone. Variations in soil conditions away from the cone (see e.g., Figure 78) could explain some of the field boundaries, but there is no obvious indication of social structures reflected in the field boundaries. The drier, rockier lava fields associated with Maunga Matukutureia give way to more clayey soils around the Puhinui Stream. Kumara and other crops such as gourds would have preferred the volcanic soils, with wetter areas near the stream providing micro-climates for taro.

On the western side of the Puhinui Stream, the archaeological evidence changes, with a significant number of small midden sites along the western banks all the way down to the harbour, but only a few indications of habitation sites, and no obvious evidence of gardening (Clough & Turner 1998). The wet swampy clay soils in the area of the Puhinui Reserve were probably poorly suited to successful horticulture.

A few stone alignments were identified within the quarry area, but remained difficult to attribute to a particular function. No definitive stone mounds were excavated to provide evidence of gardening.

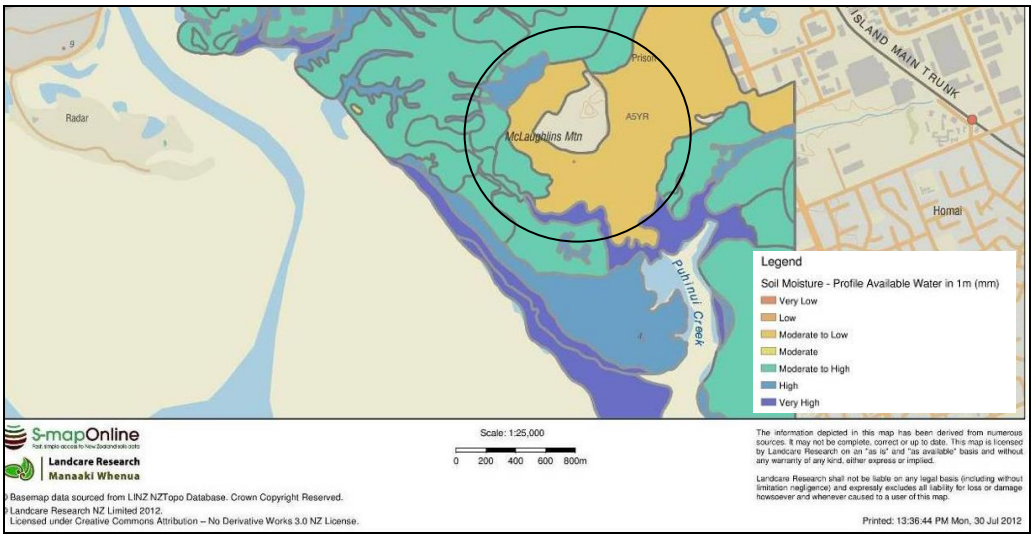

Figure 78. Soil moisture in project area (Source: Landcare Research SmapOnline)

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Aquatic Resources

Fragments of sponge spicules indicated use of aquatic resources (Horrocks, see Appendix), which is not surprising in view of the location of the site. Shell midden was dominated by cockle, with other easily accessible species present in smaller amounts. A paucity of fishbone recovered from samples should not be taken as a lack of fishing, but as reflecting the conditions of preservation and taphonomic processes in the stonefields.

The presence of fish weirs (Lawlor 1981b) and other midden sites along the Puhinui Stream emphasises the complementary importance of the marine resources to the gardening activities at Matukutureia.

Chronology

Earlier investigations around the stonefields have produced a number of radiocarbon dates, although none in the current project area. The excavations reported here therefore represent an important contribution to the archaeology of the stonefields. The five radiocarbon dates from R11/47, suggesting occupation during the 16th and 17th centuries AD, were compared with dates from the following projects:

- Te Manurewa o Tamapahore Pa/Wiri R11/32 (NZ Radiocarbon Database[9])
- The Wiri Oil Terminal Project (site R11/1187) (NZ Radiocarbon Database)
- The Wiri Railway site (R11/1188) (NZ Radiocarbon Database)
- The Puhinui excavations (R11/25) (Lawlor 1981a,b) relating to the Southwestern Interceptor project within the area that is now Historic Reserve (Figure 79).

Radiocarbon dates from Te Manurewa o Tamapahore Pa (R11/32) at Wiri have been rejected in this analysis as the sample species are mostly long-lived tree species and have large error ranges associated with them; they are therefore not considered reliable. The rest of the dates were recalibrated using OxCal 4.10 to reflect current practice and are illustrated in Figure 80. The data have been summarised in Table 5.

The dates obtained from the various investigations range from around 1300AD to 1800AD with most dates after 1500AD. The earliest date is best treated with caution as it comes from gardening soil near a stone wall and the charcoal may itself be older than the creation of the soil and walls. Additional dates from the area would be required to confirm whether the occupation extends back to the 14th century.

Continued on next page

[9] http://www.waikato.ac.nz/waikato/nzcd/index.html.

DISCUSSION, CONTINUED

Chronology, *continued*

The results show that the use of the area during the 16th and 17th centuries is well established. The dates from the Wiri Oil Terminal and Wiri Railway sites were remarkably consistent and fall in the early 1500s AD. Dates from the opposite side of stonefields (at site R11/47) are generally later – in the 1600s AD – but at least one date matches that earlier period. The dates from the stonefields to the south at R11/25 (and probably from R11/32 as well) also suggest during that it is possible that activity in the stonefields peaked during the period 1500-1700 AD, but continued to be used later. Unfortunately no dates exist for the pa on the maunga itself so it not known when the development of defences there took place. However, if evidence from the other volcanic cone pa sites in Auckland is repeated (e.g., see Schmidt 1996), this may have started during this peak gardening period and continued into the 1800s.

Figure 79. Location of radiocarbon dates discussed in analysis (dates from other projects dispersed in approximate location for illustration purposes only)

Continued on next page

DISCUSSION, CONTINUED

Table 5. Re-calibrated radiocarbon dates from Puhinui (Matukutureia stonefields), McLaughlins Quarry, Wiri Oil Terminal and Wiri Railway excavations

Lab Code	Material	CRA	Error	Sample			-2σ	-1σ	1σ	2σ	Notes	Feature Type
NZ1887	Charcoal	344	132	R11	32	Te Manurewa o Tamapahore Pa, Wiri	Not Recalibrated				Charcoal (*Podocarpus totara/hallii; Dysoxylum* sp., P*aratrophie microphylla, Melicytus ramiflorus*, unidentifiable hardwood fragments)	Charcoal layer
NZ1888	Charcoal	727	156	R11	32						Charcoal (*Dacrydium colensoi, Dysoxylum* sp., *Nightia excelsa, Beilschmiedia* sp., *Hedycarya arborea, Paratrophis microphylla, Melicytus ramiflorus, Plagianthus/Hoheria* sp., *Pteridium aquilium var. esculentum*, unidentified hard and soft wood	Midden
NZ1889	Charcoal	284	83	R11	32						Charcoal (unidentifiable)	Firepit
NZ1890	Charcoal	396	89	R11	32						Charcoal (*Dacrydium cupressinum, Dacrydium colensoi, Olria* sp., *Beilschmiedia* sp., *Neopanax* sp., *Metrosideros* sp., *Cassinia* sp.)	Terrace
NZ1909	Charcoal	804	324	R11	32						Charcoal (*Agathis australis, Podocarpus totara/hallii*)	Soil layer
NZ5043	Shell	690	32	R11	25	u/33-1-7	1525	1565	1656	1677	Area J, Square u/33, Sub-square 1/7 - midden packed into posthole	posthole fill
NZ5164	Charcoal	305	76	R11	25	v21-3/1	1453	1500	1797	1952	Area E, Square v/21, Sub-square 3/1. Sample from brown loam, to date the construction of a stone row. Charcoal (*Myoporum laetum, Melicytus* sp. [probably *ramiflorus*] - codominant)	stonewall
NZ5165	Charcoal	333	56	R11	25	u32-8/3	1457	1503	1648	1797	Area J, Square u/32, Sub-square 8/3 - hearth of brown-black loam soil, charcoal and crushed midden. Charcoal (*Myoporum laetum* - dominant; *Melicytus* sp. [probably *ramiflorus*] - minor)	hearth
NZ5166	Charcoal	207	75	R11	25	w11-5/3	1516	1652	1951	1955	Area A, Square w/11, Sub-square 5/3. Sample is from within a shallow pit depression located on the edge of a terrace above Puhinui Stream. Charcoal (*Myoporum laetum* - dominant; *Melicytus* sp. [probably *ramiflorus*] - subdominant; *Hebe* sp. - trace)	Pit-depression
NZ5167	Charcoal	566	85	R11	25	u19-10/1	1282	1317	1456	1619	Area D and E, Square u/19, Sub-square 10/1. Sample is from the base of a brown loam agricultural soil which was dumped on top of a yellow-brown scoriaceous loam base Charcoal (*Leptospermum* sp. [probably *scoparium*	garden soil
NZ5168	Charcoal	305	75	R11	25	s21-3/1	1453	1501	1797	1952	Area E, Square s/21, Subsquare 3/1. Sample from brown-black loam in a stone row. Charcoal (*Podocarpus totara/hallii* - dominant; *Leptospermum* sp. [probably *scoparium*] - trace) (NB identified in article as Stem wood - but number 290 NZ5169 rejected as most	stone row
NZ5170	Charcoal	352	56	R11	25	v12-6/6	1455	1501	1639	1664	Area A, Square v/12, Sub-square 6/6. Sample from the base of a stratified midden deposit. Charcoal (Hebe sp. - dominant; *Melicytus* sp. [probably *ramiflorus*] - trace)	midden
NZ6198	Shell	596	40	R11	25	u/25-10/3	1591	1655	1804	1837	Area H, Square u/25, Sub-square	midden

Lab Code	Material	CRA	Error	Sample			-2σ	-1σ	1σ	2σ	Notes	Feature Type
											10/3. Sample from a midden that lies within a garden soil.	
NZ6199	Shell	734	32	R11	25	t11-2/5	1491	1523	1621	1653	Area A - terrace, Square t/11, Sub-square 2/5 - midden.	midden
NZ6818	Shell	732	33	R11	1187	F863/864	1471	1515	1635	1671	Shell midden 8-10 cm below the surface of the house floor (Feature 863/864	midden
NZ6819	Shell	745	27	R11	1187	F864/4	1467	1503	1621	1662	Area AB, shell midden lens on the surface of layer 1d - topsoil zone of paleosol. Sample in dark yellow-brown soil.	midden
NZ6830	Shell	792	32	R11	1187	house Wall	1438	1455	1566	1643	Shell under house wall, previously mixed with charcoal and stone.	house
NZ7010	Shell	737	36	R11	1188	Terrace-1A	1466	1510	1631	1671	Small terrace, sample from a small, scattered midden in layer 1A.	Terrace midden
NZ7019	Charcoal	372	60	R11	1188	Area 1025	1449	1496	1627	1651	Area 1025 - constructed mound on lava flow spur. Sample from layer 1B, 50cm below the surface.	Mound
Wk23691	Shell	635	34	R11	47	FN-B220208	1520	1560	1720	1820	Quarry monitoring Zone C	midden
Wk25067	Shell	662	38	R11	47	MQT Area B T-2	1495	1558	1685	1805	MQT Zone B, Area B T-2	midden
Wk25068	Shell	804	35	R11	47	MQT Area B T-3	1427	1447	1554	1640	MQT Zone B, Area B T-3	midden
Wk25069	Shell	631	354	R11	47	MQT Area C T-4	1520	1561	1718	1825	MQT Zone B, Area C T-4	midden
Wk32632	Shell	694	30	R11	47	T7	1489	1544	1658	1694	MQT Zone C Trench 7	midden

Source of R11/25 dates (Puhinui/Matukurua): NZ Radiocarbon database; Lawlor 1981a

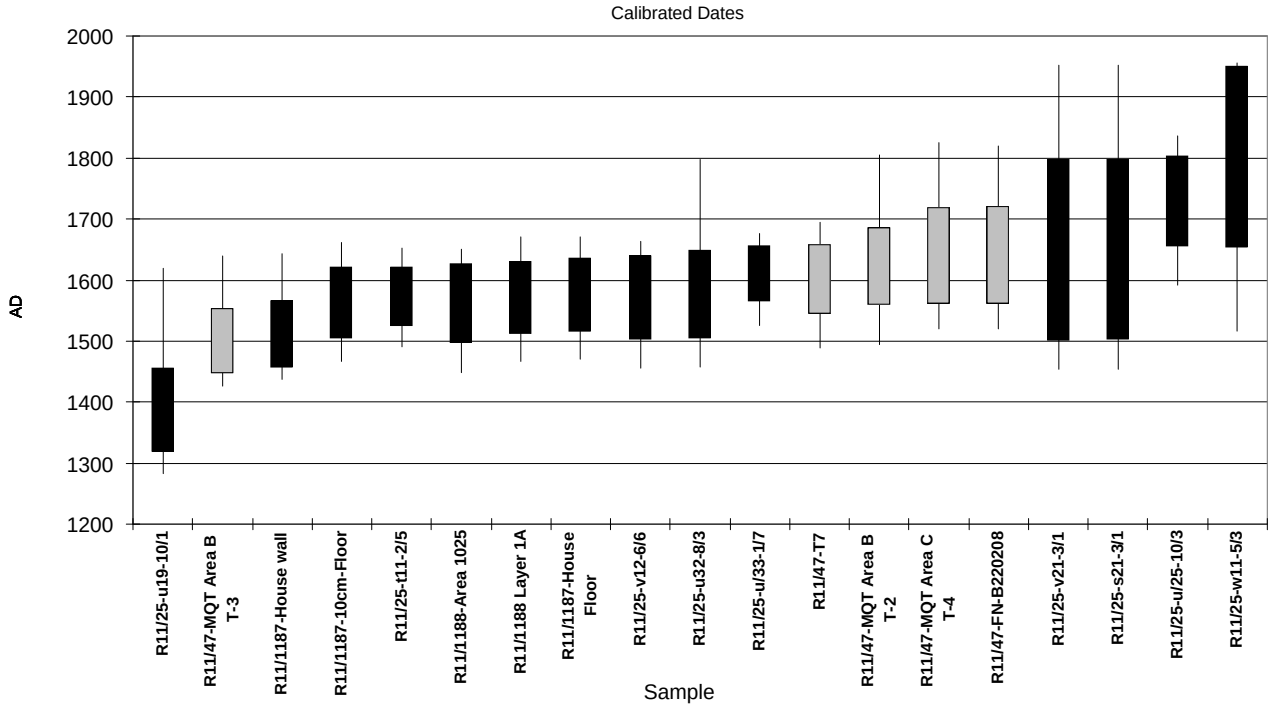

Figure 80. Calibrated radiocarbon dates from Puhinui/Matukurua stonefields (from Lawlor 1981a), Wiri Oil Terminal Excavations, Wiri Railway excavations and recent work in McLaughlins Quarry (grey shading) (NZ Radiocarbon Database)

CONCLUSIONS

The R11/47 Investigations

The archaeological evidence from R11/47 is dispersed rather than intensive, but does show at least three phases of occupation or use. Although the evidence recovered from the current investigations was relatively limited, it has added to the story of stonefield settlement. These and earlier investigations have shown that the stonefields in this area are a palimpsest with overlapping periods of usage at least from the end of the 14th century onwards (and perhaps during the 14th century), with dates from the current investigations indicating occupation during the 16th and 17th centuries. From archival sources, we know that settlement of the stonefields extended into the 19th century. This shifting usage has continually overwritten some (but not all) of the previous signs of human occupation. The areas investigated to date are a component of what was once a much more extensive settlement system.

This overwriting of the stones makes archaeology in the stonefields difficult to decipher. Excavations on a possible gardening terrace in Zone C in 2011 revealed no archaeologically identified features. This does not preclude gardening having been carried out here but no structural remains were identified, and the soil sample was similar to those found elsewhere in the project area. The nearby excavations along the slope recovered a large spread of midden among the rock debris, but the presence of the shell here suggests habitation rather than gardening. However, as noted in Zone B, habitation and likely gardening features are often overlaid, suggesting shifting use across the area through time.

The main indicators of food storage appear to be located in the easier clayey soils near the Puhinui Stream (R11/1632, R11/2180) and the flat terracing near the Stream would have offered good locations for whare and cooking facilities. A number of these sites remain relatively intact and future investigation may establish how they related to the activities closer to the maunga.

The shell midden found across the landscape demonstrate the benefits of the location of the stonefields – an area which combined good gardening conditions with access to inland and coastal waterways and was centred on a defendable volcanic cone.

The investigation results are consistent with those of other investigations around the maunga. Collectively the research provides evidence of an extensive agricultural settlement with whare or field shelters dispersed throughout a landscape of agricultural features such as stone walls, mounds, terraces and storage features, surrounding the most intensive evidence of settlement on the pa itself.

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Appendices

MICROFOSSIL ANALYSIS

Microfossil Research

Dr Mark Horrocks
Microfossil Research Ltd
31 Mont Le Grand Rd,
Mt Eden, Auckland 1024, New Zealand

Ph: 64 - 9 - 630 5787
Mob: 64 - 21 - 178 0957
info@microfossilresearch.com
www.microfossilresearch.com

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Plant microfossil analysis of archaeological samples from Mclaughlins Quarry, South Auckland

Methods

A sample from each of two trenches (Lower Scarp Trench 1 and Terrace Trench 2) in Area B, McGlaughlins Quarry, South Auckland was analysed for plant microfossils to provide records of past vegetation, environments and human activity. The samples were analysed for pollen, phytoliths and starch remains. These types of analyses are described as follows:

Pollen analysis

Pollen analysis includes pollen grains of seed plants and spores of ferns. It provides insight into past vegetation and environments and in New Zealand allows the differentiation of sediments deposited in pre-settlement, Polynesian and European times (Hayward et al., 2004; Matthews et al., 2005). Pollen may also provide direct evidence of Polynesian introduced plants, namely bottle gourd (*Lagenaria siceraria*) and paper mulberry (*Broussonetia papyrifera*), and European crops such as maize (*Zea mays*) (Horrocks, 2004; Horrocks et al., 2008).

Samples were prepared for pollen analysis by the standard acetylation method, with the hydrofluoric acid step replaced by density separation using sodium polytungstate (Moore et al., 1991; Lentfer and Boyd, 2000). Approximately 150 pollen grains and fern spores were counted per sample and slides scanned for types not found during the counts. Microscopic fragments of charcoal are extracted along with pollen during preparation, providing evidence of fire.

Phytolith analysis

Phytoliths are particles of silica formed in inflorescences, stems, leaves and roots of many higher plants (Piperno, 2006). Phytolith analysis compliments pollen analysis, especially regarding grasses (Poaceae). Grass phytoliths are much easier to differentiate below the family level than grass pollen. Phytoliths (like pollen) may provide direct evidence of bottle gourd and paper mulberry (Horrocks, 2004). Other types of microscopic biogenic silica, notably diatoms and sponge spicules, are extracted along with phytoliths during preparation. Diatoms are unicellular algae found in aquatic and sub-aquatic environments and have cell walls composed of silica. Sponges, exclusively aquatic, are multi-cellular animals with an internal skeleton often composed of siliceous spicules. Diatoms and sponges are found in both marine and freshwater environments.

Samples were prepared for phytolith analysis by density separation with sodium polytungstate (Horrocks, 2005). Approximately 150 phytoliths were counted per sample and slides scanned for types not found during the counts. Other types of biogenic silica (in this case, sponge spicules) were not included in the count. They are still however expressed as a percentage of the base count therefore the total of the values of the counted samples in the phytolith diagram may exceed 100%. Phytoliths categorised as "degraded" in the phytolith diagram were too corroded to assign to any other type

Analysis of starch and other residues

This analysis includes starch grains and other plant material such as raphides (needle-like calcium oxalate crystals) and xylem (Torrence and Barton, 2006; Horrocks et al., 2007). Starch is the main substance of food storage for plants and is mostly found in high concentrations of microscopic grains in underground stems (e.g. tubers, corms), and roots and seeds. Raphides are found in both the aerial and subterranean parts of many plant species. Xylem is a vascular tissue through which most of the water and minerals of a plant are conducted. The principle conducting

cells are the tracheary elements, of which there are two types, the tracheids and the vessel elements. The latter are joined into long, continuous tubes called vessels, whereas the long tapering tracheids overlap with one another at their ends. Starch analysis may provide direct evidence of Polynesian introduced starch crops, namely kumara (*Ipomoea batatas*), taro (*Colocasia esculenta*) and yams (*Dioscorea*), and European introduced crops such as potato (*Solanum tuberosum*) (Horrocks et al., 2007, 2008).

Starch and other residues were prepared for analysis by density separation with sodium polytungstate (Horrocks, 2005). A tablet containing a known quantity of exotic *Lycopodium* spores was added to each sample to allow absolute counts (volumetric) of starch and associated remains. Tablets were dissolved in 10% hydrochloric acid before adding to the samples.

Results

Pollen

Numerous microscopic fragments of charcoal were found in the Mclaughlins Quarry samples. The pollen assemblages are dominated by bracken (*Pteridium*) spores (Fig. 1). Pollen of manuka/kanuka (*Leptospermum/Kunzea*), grasses, puha/dandelion (*Sonchus/Taraxacum*) and spores of hornworts (Anthocerotae) also feature. In addition, pollen of European introduced pine (*Pinus*) and plantain (*Plantago lanceolata*) were found in the samples. Pollen of indigenous tall trees was not observed in either sample.

Phytoliths

The phytolith assemblages are dominated by nikau, spherical verrucose, festucoid and bulliform types (Fig. 2). Spherical nodular and spherical smooth types also feature. A phytolith of European introduced Bambusoideae, a grass sub-family that includes bamboo, was found in the Lower Scarp sample. Of the other types of

biogenic silica, sponge spicules were noted in both samples.

Starch and other residues

Analysis of starch and associated material revealed numerous, microscopic, soil stained objects in the both samples. These appear to be degraded starch grains and are present in concentrations of approximately 2000-3000 per c.c. of sample (Fig. 3). The putative starch grains show features similar to those of the tuberous root of kumara. Smaller concentrations (<500 per c.c.) of degraded c.f. starch storage cells (each containing hundreds of starch grains) and xylem vessel fragments, likewise consistent with tuberous kumara roots, were also found in the samples.

Interpretation

Together with the charcoal and bracken spores, the apparent absence of indigenous tall tree pollen in the Mclaughlins Quarry samples reflects burning of vegetation in the area (Fig. 1). Bracken, an invasive ground fern with widely dispersed spores, is often abundant in New Zealand pollen assemblages of the last millennium and is commonly associated with large scale, repeated burning of forest by people. It may form dense stands, averaging 1-2 m tall, over extensive areas. Hornwort spores also indicate large scale burning. The latter are very small, inconspicuous plants that colonise freshly exposed soils. Pollen of manuka/kanuka (small trees), grasses and puha/dandelion (edible herbs) also indicates vegetation disturbance. Notwithstanding this evidence of forest disturbance, the relative abundance of fern spores in the sample is partly due to their superior resistance to degrading micro-organisms compared to pollen.

The presence of pollen of European exotics, namely pine trees and plantain (an invasive rosette weed of pasture and other disturbed areas), suggests that the sampled deposits are of European age (Fig. 1). An alternative explanation is that prehistoric and modern deposits have been mixed by percolation, bioturbation or mechanical disturbance by people. Also, there are European introduced, as well as indigenous

species of puha (*Sonchus*). The pollen of the closely related, European introduced dandelion (*Taraxacum*) is difficult to distinguish from that of puha. In addition, the grass pollen in the samples may be from European introduced pasture species as well as indigenous species.

Phytoliths in the samples provide further insight into the local vegetation at the time (Fig. 2). Nikau palm is one of the few indigenous New Zealand taxa that can be identified to species level using phytoliths. Nikau phytoliths are spherical spinulose and this type occurs only in palms (Arecaceae) and bromeliads (Bromeliaceae) (Kondo et al., 1994; Piperno, 2006). New Zealand has no indigenous bromeliads and nikau is the only species of palm. Spherical verrucose phytoliths are common in rewarewa (*Knightia*) and *Fuscospora* (beech species other than silver beech). Forest remnants in the sampled area at the time thus included nikau palm and rewarewa trees (beech declined in the area at the beginning of the Holocene, c. 10,000 years ago (Sandiford et al., 2003)).

Little is known of the range of plants that produce spherical nodular phytoliths; unlike pollen, phytoliths are relatively under-researched in New Zealand. Of the grasses, festucoid phytoliths are found commonly in the Pooideae sub-family (e.g. *Poa*, *Festuca*). Bulliform grass phytoliths in New Zealand originate commonly from *Rhytidosperma*. The low values of fern phytoliths, which appear at odds with the pollen results (abundant fern spores), are not unusual because ferns are under-represented in New Zealand phytolith spectra. As with the pollen, the presence of a phytolith of a European exotic, namely Bambusoideae, suggests that the sampled deposits are of European age or that prehistoric and modern deposits have been mixed. Of the other types of biogenic silica found, the sponge spicules in the samples probably reflect the use of aquatic resources by local people.

Starch remains of c.f. kumara in the Mclaughlins Quarry samples suggest that the associated deposits were used for the cultivation or preparation of this crop. Kumara is part of the small group of six introduced plant species cultivated by Maori at the time of European contact in the late 18th century. Most of the many plant species (72) identified as intentionally introduced to Polynesia by prehistoric people (Whistler, 1991) are native to various regions within the area from Southeast Asia to

Papua New Guinea. Kumara however, known elsewhere as sweet potato, originated in South America, its introduction to the Pacific a result of Polynesian contact (Hather and Kirch, 1991). Identifying kumara (*Ipomoea batatas*) starch is complicated by the presence of two other *Ipomoea* species found in New Zealand, *I. pes-caprae* and *I. cairica*. However, these can be ruled out in this case because the former is restricted to the Far North (Cooper, 1967) and the apparent southern limit of the latter is 45 km north of Mclaughlins Quarry at Tiritiri Matangi Island in the Hauraki Gulf (Ewen Cameron, Auckland War Memorial Museum, pers. comm.).

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Fig. 1 Percentage pollen diagram from Area B, McGlaughlins Quarry, Auckland (LS = Lower Scarp, T = Terrace, + = found after count, ++ = abundant)

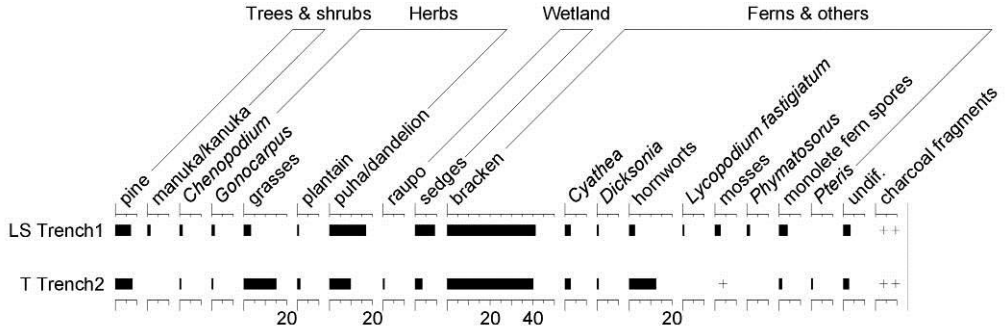


Fig. 2 Percentage phytolith diagram from Area B, McGlaughlins Quarry, Auckland (LS = Lower Scarp, T = Terrace, + = found after count)

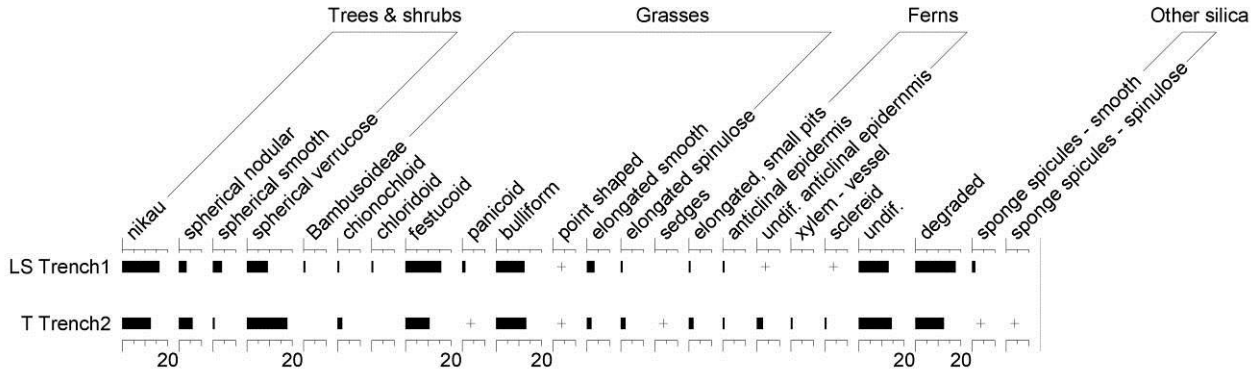
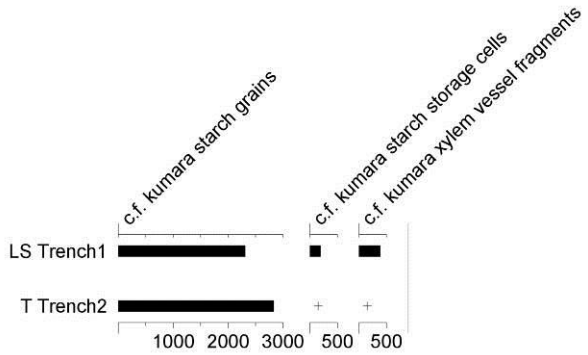


Fig. 3 Concentration (per c.c.) starch diagram from Area B, McGlaughlins Quarry, Auckland (LS = Lower Scarp, T = Terrace, + = found after count)



Dr Mark Horrocks
Microfossil Research Ltd
31 Mont Le Grand Rd,
Mt Eden, Auckland 1024, New Zealand

Ph: 64 - 9 - 630 5787
Mob: 64 - 21 - 178 0957
info@microfossilresearch.com
www.microfossilresearch.com

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Plant microfossil analysis of archaeological deposits at Matukutureia, South Auckland

Summary

Plant microfossil analysis of samples shows large scale forest clearance by early Maori and provides direct evidence of local gardening of introduced kumara and taro.

Methods

Three samples from a suspected gardening area at Matukutureia, South Auckland, were analysed for pollen, phytoliths and starch to provide a record of past vegetation, environments and human activity. Detailed methods of analysis are described in the Appendix.

Results and interpretation

All three of the Matukutureia samples contain a high concentration of microscopic fragments of charcoal, reflecting human activity around the site, namely burning of vegetation and cooking fires. The samples are dominated by pollen of grasses (Poaceae) and spores of bracken (*Pteridium*) (Fig. 1). Spores of hornworts (Anthocerotopsida) also feature. Bracken, an invasive ground fern with widely dispersed spores, is often abundant in New Zealand pollen spectra of the last millennium, almost always associated with large scale repeated burning of forest by early Maori. It may form dense stands, averaging 1-2 m tall, over extensive areas. Hornworts are small inconspicuous plants that colonise freshly exposed soils and are also associated with forest burning in pollen spectra of the same time span. Pollen of tutu (*Coriaria*) shrubs and puha/dandelion (*Sonchus/Taraxacum*) weeds is also present in the deposits, likewise indicating vegetation disturbance. The leaves and young shoots of puha were a food source for early Maori (Crowe 1990). The presence

of pollen of European-introduced pine (*Pinus*) trees and plantain (*Plantago*) weeds in the samples reflects soil disturbance by people into the European era or pollen percolation due to the porous nature of the local soils.

Phytoliths provide further insight into the local environment (Fig. 2). All three samples are dominated by grass phytoliths, providing additional evidence of forest clearance. Tree and shrub phytoliths also feature, in particular nikau (*Rhopalostylus*). This forest palm is one of the few New Zealand plants that allow phytolith identification to species level (Kondo et al. 1994). Other types of biosilicate remains identified, namely fragments of sponge spicules, indicate use of aquatic resources at the site by local people.

Starch and associated plant material consistent with the tuberous root of kumara (*Ipomoea batatas*) and corm of taro (*Colocasia esculenta*) were identified in the Matutkutureia samples (Fig. 3). These food crop remains provide direct evidence that the sampled deposits are associated with Maori gardening. Kumara and taro are part of the small group of six introduced species cultivated by Maori at the time of European contact in the late 18th century. Almost all the many plant species (72), including taro, identified as intentionally introduced to Polynesia by prehistoric people (Whistler 1991), are native to various regions within the broad area from Africa to Melanesia. Kumara (known elsewhere as sweet potato) however, originated in South America, its introduction to the Pacific a result of Polynesian contact (Hather and Kirch 1991).

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Appendix: Plant microfossil methods.

Pollen analysis

Pollen analysis includes pollen grains of seed plants and spores of ferns and other plants. It provides insight into past vegetation and environments and in New Zealand allows the differentiation of sediments deposited in pre-settlement, early Maori and European times (Hayward et al. 2004, Matthews et al. 2005). Pollen may also provide direct evidence of Polynesian introduced plants, for example bottle gourd (*Lagenaria siceraria*) and paper mulberry (*Broussonetia papyrifera*), and European crops such as maize (*Zea mays*) (Horrocks 2004, Horrocks et al. 2008).

The samples were prepared for pollen analysis by the standard acetylation method (Moore et al. 1991). At least 150 pollen grains and spores were counted for each sample, and slides were scanned for types not found during the counts. Microscopic fragments of charcoal are extracted along with pollen during preparation, providing evidence of fire.

Phytolith analysis

Phytoliths are particles of silica formed in inflorescences, stems, leaves and roots of many plants (Piperno 2006). Phytolith analysis compliments pollen analysis and (like pollen) may provide direct evidence of bottle gourd and paper mulberry (Horrocks 2004). Other types of microscopic biosilicates, notably diatoms, radiolarians and sponge spicules, are extracted along with phytoliths during preparation. Diatoms are unicellular algae and have cell walls composed of silica; radiolarians are a type of amoeboid protozoa with siliceous skeletons; sponges are multi-cellular animals with skeletons often composed of siliceous spicules. Diatoms are found in aquatic and sub-aquatic environments; radiolarians and sponges are exclusively aquatic. Diatoms and sponges are found in both marine and freshwater environments; radiolarians are exclusively of marine origin.

The samples were prepared for phytolith analysis by density separation with sodium polytungstate (Horrocks 2005). At least 150 phytoliths were counted for each sample, and slides were scanned for types not found during the counts. Other biosilicates, in this case sponge spicules, were not included in the calculations from

which the percentages were derived.

Analysis of starch and other plant material

This analysis includes starch grains and other plant material such as calcium oxalate crystals and xylem (Torrence and Barton 2006). Starch is the main substance of food storage for plants and is mostly found in high concentrations of microscopic grains in underground stems (e.g. tubers, corms), and roots and seeds. The grains may be identified as individuals or in large groups densely packed in amyloplasts, which are specialised cells that synthesise and store starch. The crystals, comprising raphides which are needle-like and druses which are compound and chunky, are found in both the aerial and underground parts of many plant taxa. Xylem is a vascular tissue comprising elongated cells through which most of the water and minerals of a plant are conducted. Starch analysis may provide direct evidence of Polynesian introduced starch crops, namely kumara (*Ipomoea batatas*), taro (*Colocasia esculenta*) and yams (*Dioscorea*), and European introduced crops such as potato (*Solanum tuberosum*) (Horrocks et al. 2007, 2008). Starch and other remains were prepared for analysis by density separation with sodium polytungstate and presence/absence noted (Horrocks 2005).

Fig. 1 Pollen percentage diagram from Matukutureia, South Auckland (+ = found after count)

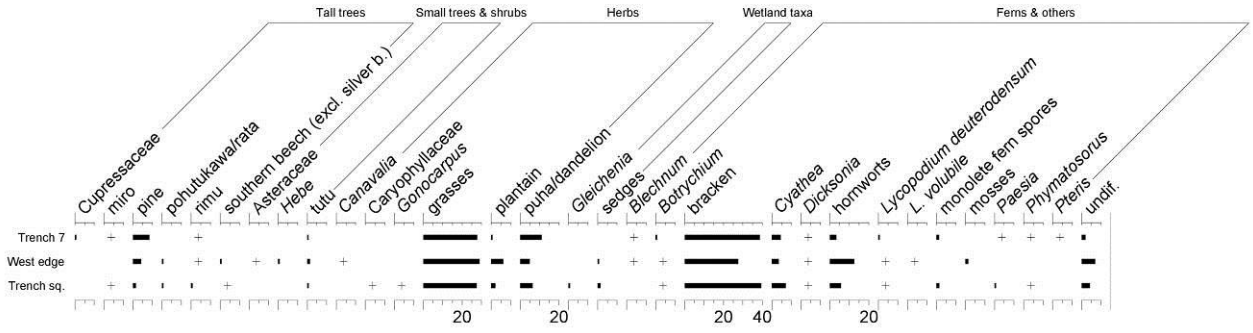


Fig. 2 Phytolith percentage diagram from Matukutureia, South Auckland (+ = found after count)

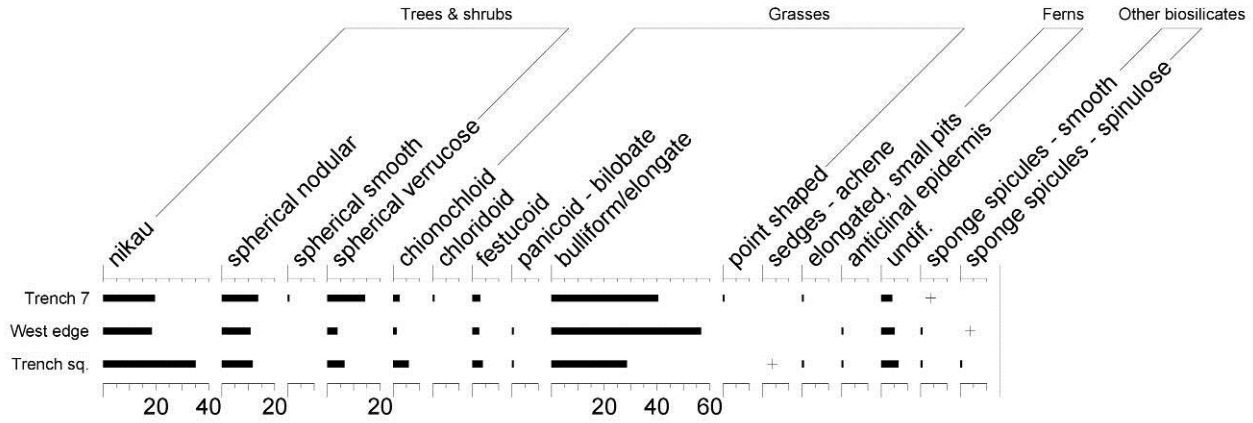
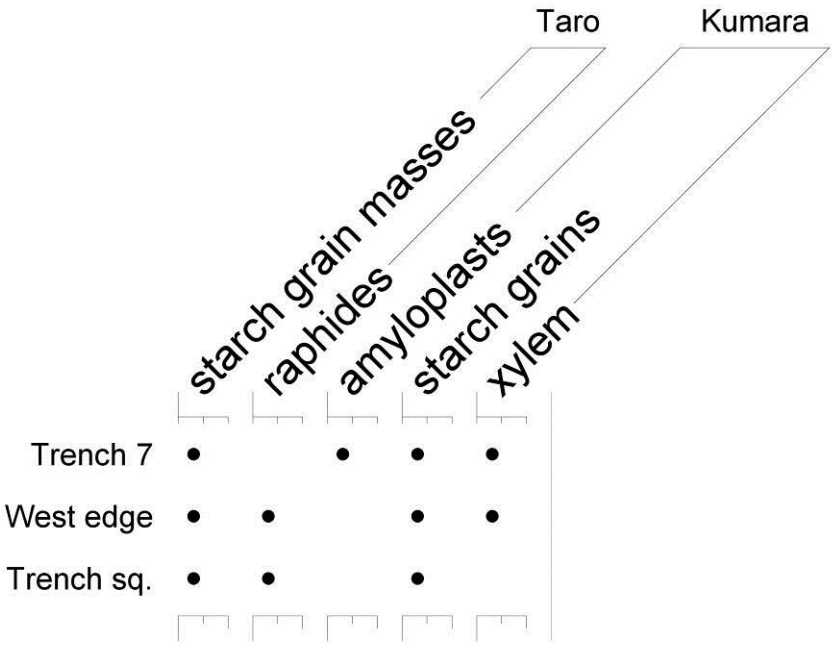


Fig. 3 Starch diagram from Matukutureia, South Auckland (see Appendix for definitions)



FAUNAL ANALYSIS

Introduction

This brief faunal report discusses the skeletal analysis of rat bone excavated from McLaughlin's Quarry, Wiri, South Auckland.

Method

The faunal analysis was carried out by Faunal Solutions Limited in the Dunedin laboratory. Identifications were made using the University of Otago Reference Collection located in the Department of Anthropology and Archaeology at the University of Otago.

The methods used in the processing the faunal material is based on standard Otago Archaeology Laboratory (O.A.L) protocols (Walter et. al.1996, Reitz and Wing 1999). The O.A.L. protocols involve a two stage process. The first stage involves sorting the bones into primary anatomical units which are defined as the sided element. In the second stage these units are identified to the lowest taxonomic level. These become the basic analytical units which are used for quantification purposes.

Bones were sorted into primary anatomical units and identified to the lowest taxonomic level. Where possible, material was aged and sexed using standards methods developed by Silver (1969), Ruscillo (2002) and The and Trouth (1976). Skeletal material was also examined for taphonomy (attrition, burning and butchery) and weathering using Behrensmeyer's taphonomy scale (1978).

The faunal material was received in a single zip lock bag labelled with provenance details.

1

Results

A total of 38 fragments have been analysed from this assemblage. This total consists entirely of rat skeletal material and one cockle shell fragment. A full listing of identifications is illustrated below in Table 1.

Table 1 Skeletal identifications and basic quantification of the material received from McLaughlin's Quarry.

Taxa	Species	Element	Side	Portion	NISP	MNE
Mammal	cf Rattus exulans	Mandible	Right	NRP	1	
Mammal	cf Rattus exulans	Mandible	Left	NRP	2	
Mammal	cf Rattus exulans	Tooth: Incisor	Unsided	Complete	3	
Mammal	cf Rattus exulans	Maxilla	Left	Fragment	2	
Mammal	cf Rattus exulans	Tooth: Molar	Unsided	Complete	1	
Mammal	cf Rattus exulans	Maxilla	Right	Fragment	2	
Mammal	cf Rattus exulans	Skull	n/a	Fragment	22	
Mammal	cf Rattus exulans	Tibia	Right	Complete	3	1
Mammal	cf Rattus exulans	Tooth: Incisor	Unsided	Fragment	1	
Shell	Cockle	Bivalve	n/a	Hinge	1	
TOTAL					**38**	

Two individuals are represented in this assemblage. The majority of the skeletal material is skull fragments and there is one unfused tibia indicating at least one of the individuals are juvenile. In regards to specific rattus species, the size of the elements examined fall within the size range of the kiore (*Rattus exulans*) however the size range of rat species works as a continuum with *Rattus exulans* at one end and *Rattus norvegicus* at the other with a cross over zone in the middle. At present there has been no research that specifically determines the size ranges of these two species and where they cross over. The morphological size of these skeletal remains fall at the smaller size end of the continuum and, therefore, have been identified as cf. *Rattus exulans*.

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RADIOCARBON DATES

The University of Waikato

Radiocarbon Dating Laboratory

Private Bag 3105
Hamilton,
New Zealand.
Fax +64 7 838 4192
Ph +64 7 838 4278
email c14@waikato.ac.nz
Head: Dr Alan Hogg

Report on Radiocarbon Age Determination for Wk- 23691

Submitter	B. Baquie
Submitter's Code	FN-B220208
Site & Location	McLachlan Mountain Quarry; Wiri; Manukau City; Auckland, New Zealand
Sample Material	Cockle
Physical Pretreatment	Surfaces cleaned. Washed in an ultrasonic bath. Tested for recrystallization: aragonite.
Chemical Pretreatment	Sample acid washed using 2 M dil. HCl for 300 seconds, rinsed and dried.

$\delta^{13}C$	1.0 ± 0.2	‰
$D^{14}C$	-76.0 ± 3.9	‰
$F^{14}C\%$	92.4 ± 0.4	%
Result	**635 ± 34 BP**	

Comments

28/7/08

- Result is *Conventional Age or % Modern* as per Stuiver and Polach, 1977, Radiocarbon 19, 355-363. This is based on the Libby half-life of 5568 yr with correction for isotopic fractionation applied. This age is normally quoted in publications and must include the appropriate error term and Wk number.
- Quoted errors are 1 standard deviation due to counting statistics multiplied by an experimentally determined Laboratory Error Multiplier.
- The isotopic fractionation, $\delta^{13}C$, is expressed as ‰ wrt PDB.
- $F^{14}C\%$ is also known as pMC (percent modern carbon).

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Report on Radiocarbon Age Determination for Wk- 25067

Submitter	C Judge
Submitter's Code	MQT Area B T-2
Site & Location	McLaughlins Quarry, New Zealand
Sample Material	Cockle
Physical Pretreatment	Surfaces cleaned. Washed in an ultrasonic bath. Tested for recrystallization: aragonite.
Chemical Pretreatment	Sample acid washed using 2 M dil. HCl for 180 seconds, rinsed and dried.

$\delta^{13}C$	0.3 ± 0.2	‰
$D^{14}C$	-79.1 ± 4.4	‰
$F^{14}C\%$	92.1 ± 0.4	%
Result	**662 ± 38 BP**	

Comments

26/2/09

- Result is *Conventional Age or % Modern* as per Stuiver and Polach, 1977, Radiocarbon 19, 355-363. This is based on the Libby half-life of 5568 yr with correction for isotopic fractionation applied. This age is normally quoted in publications and must include the appropriate error term and Wk number.
- Quoted errors are 1 standard deviation due to counting statistics multiplied by an experimentally determined Laboratory Error Multiplier.
- The isotopic fractionation, $\delta^{13}C$, is expressed as ‰ wrt PDB.
- $F^{14}C\%$ is also known as pMC (percent modern carbon).

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Report on Radiocarbon Age Determination for Wk- 25068

Submitter	C Judge
Submitter's Code	MQT Area B T-3
Site & Location	McLaughlins Quarry, New Zealand
Sample Material	Cockle
Physical Pretreatment	Surfaces cleaned. Washed in an ultrasonic bath. Tested for recrystallization: aragonite.
Chemical Pretreatment	Sample acid washed using 2 M dil. HCl for 180 seconds, rinsed and dried.

$\delta^{13}C$	0.4 ± 0.2	‰
$D^{14}C$	-95.2 ± 4.0	‰
$F^{14}C\%$	90.5 ± 0.4	%
Result	**804 ± 35 BP**	

Comments

AGHogg

26/2/09

- Result is *Conventional Age or % Modern* as per Stuiver and Polach, 1977, Radiocarbon 19, 355-363. This is based on the Libby half-life of 5568 yr with correction for isotopic fractionation applied. This age is normally quoted in publications and must include the appropriate error term and Wk number.
- Quoted errors are 1 standard deviation due to counting statistics multiplied by an experimentally determined Laboratory Error Multiplier.
- The isotopic fractionation, $\delta^{13}C$, is expressed as ‰ wrt PDB.
- $F^{14}C\%$ is also known as pMC (percent modern carbon).

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Head: Dr Alan Hogg

Report on Radiocarbon Age Determination for Wk- 25069

Submitter	C Judge
Submitter's Code	MQT Area C T-4
Site & Location	McLaughlins Quarry, New Zealand
Sample Material	Cockle
Physical Pretreatment	Surfaces cleaned. Washed in an ultrasonic bath. Tested for recrystallization: aragonite.
Chemical Pretreatment	Sample acid washed using 2 M dil. HCl for 180 seconds, rinsed and dried.

$\delta^{13}C$	1.0 ± 0.2	‰
$D^{14}C$	-75.5 ± 4.4	‰
$F^{14}C\%$	92.4 ± 0.4	%
Result	**631 ± 38 BP**	

Comments

26/2/09

- Result is *Conventional Age or % Modern* as per Stuiver and Polach, 1977, Radiocarbon 19, 355-363. This is based on the Libby half-life of 5568 yr with correction for isotopic fractionation applied. This age is normally quoted in publications and must include the appropriate error term and Wk number.
- Quoted errors are 1 standard deviation due to counting statistics multiplied by an experimentally determined Laboratory Error Multiplier.
- The isotopic fractionation, $\delta^{13}C$, is expressed as ‰ wrt PDB.
- $F^{14}C\%$ is also known as pMC (percent modern carbon).

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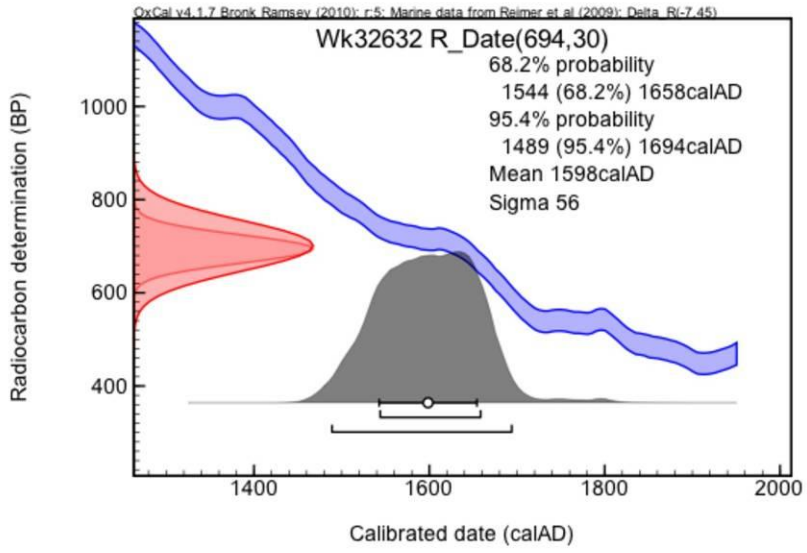
Report on Radiocarbon Age Determination for Wk- 32632

Submitter	B Baquie
Submitter's Code	R11/47_T7
Site & Location	Matukutureia/McLaughlin's Mt Wiri Auckland; in vicinity of Puhinui Stream; and Manukau Harbour, New Zealand
Sample Material	Cockle shell
Physical Pretreatment	Surfaces cleaned. Washed in an ultrasonic bath. Tested for recrystallization: aragonite.
Chemical Pretreatment	Sample acid washed using 2 M dil. HCl for 120 seconds, rinsed and dried.

$\delta^{13}C$	0.3 ±	0.2 ‰
$D^{14}C$	-82.7 ±	3.5 ‰
$F^{14}C\%$	91.7 ±	0.3 %
Result	**694 ± 30 BP**	

Comments



29/08/12

- Result is *Conventional Age or Percent Modern Carbon (pMC)* following Stuiver and Polach, 1977, Radiocarbon 19, 355-363. This is based on the Libby half-life of 5568 yr with correction for isotopic fractionation applied. This age is normally quoted in publications and must include the appropriate error term and Wk number.
- Quoted errors are 1 standard deviation due to counting statistics multiplied by an experimentally determined Laboratory Error Multiplier.
- The isotopic fractionation, $\delta^{13}C$, is expressed as ‰ wrt PDB.
- $F^{14}C\%$ is also known as *Percent Modern Carbon (pMC)*