Tikanga in Early Māori Gardens of *Ipipiri*, The Eastern Bay of Islands

Submitted by:
Melina Rose Goddard

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Abstract

This work aims to find and define *tikanga* Māori in the archaeology of early gardens on Moturua Island in the Bay of Islands, Northland. These garden sites are in Opunga and Mangahawea Bays and have been archaeologically investigated in the past. They are defined by soil modifications, slope drains and features that represent former planting mounds (*puke*). A model is applied to the soil modifications and garden organisation at the sites. This model is based upon the practical and ritual *tikanga* aspects, that were inherent to the cultivation process. The practical reflects how people reacted and worked within their environment which influenced *tikanga*, and the ritual is based upon the practice of the values and principles of *tikanga*. An environmental reconstruction of the paleoclimate, landscape and natural soils is necessary to understand how gardens operated within their location. The values and principles of *tapu mauri,* and *kaitakitanga* are combined with the environmental reconstruction and ethnographic accounts to find *tikanga.* The study indicated that environmental *tikanga* was prevalent in soil modifications and garden organisation of the sites, and values and principles were only prevalent within garden organisation. Upon comparison differences were found between the soil modifications that may be representative of garden techniques by separate *whānau* or *hapū* groups. The use of tikanga to interpret archaeological garden sites could help to explain the variability that is seen in across sites in New Zealand. This requires an approach that reflects how Māori viewed the world, which was practiced as *tikanga*. It is shown that this approach would have to consider the environment that the gardens operated and the social values that were entwined within this environment.

Acknowledgments

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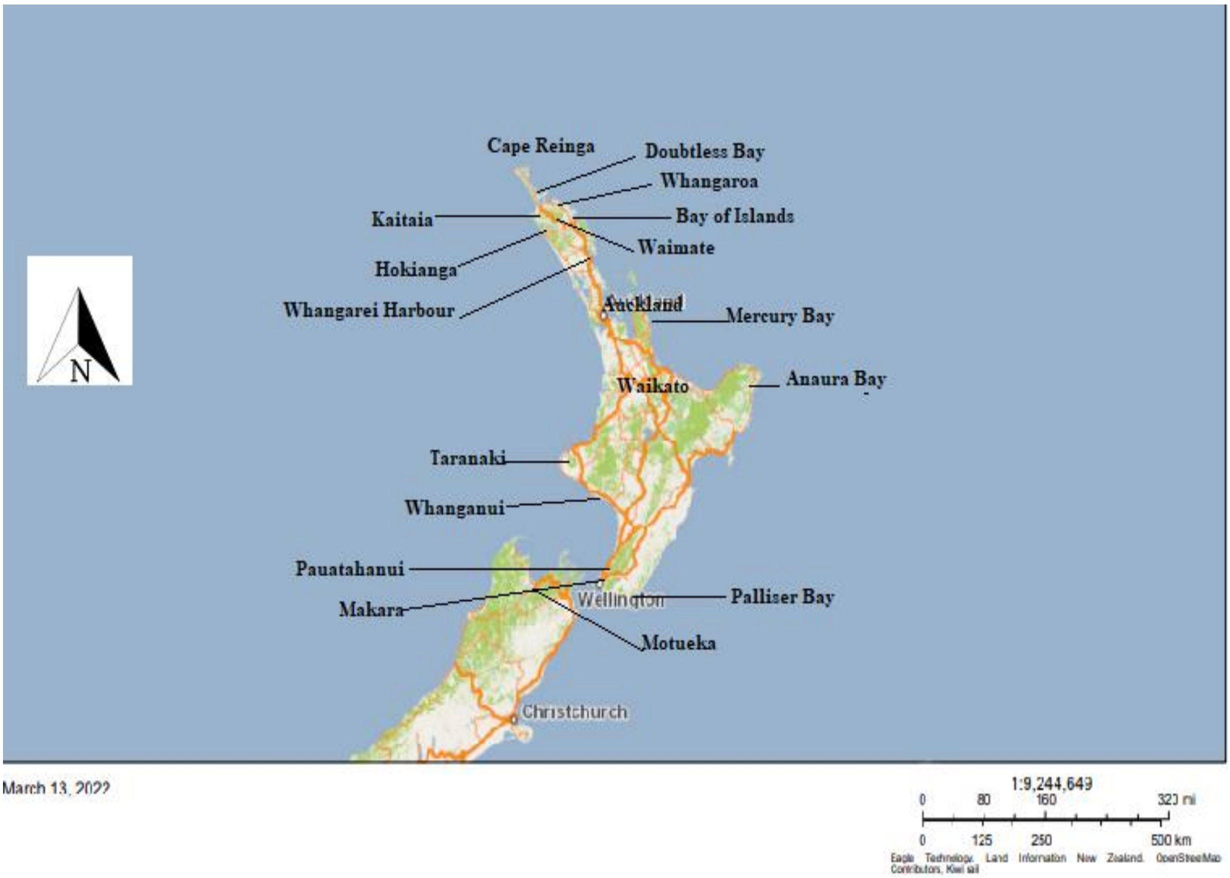

Figure 1: Main locations referred to in text

Introduction

Current approaches to the understanding of early Māori gardening in New Zealand are limited in their explanations of variability in the record and how gardens operated in their environment. The application of the social processes of *tikanga* Māori may enable different interpretations of gardens in the archaeological record that go beyond current themes. A review of *tikanga* in the literature is presented and discussed to define *tikanga* and its aspects, with the purpose of finding elements that could be connected to the archaeological record of early Māori gardening. A review of the archaeology of early Māori gardens is described with a focus on central themes and examples in the published literature and archaeological reports in New Zealand. The historical and ethnographic accounts from the 16^{th} to 19^{th} centuries of Māori gardening are analysed for *tikanga* with references to themes that are present in the accounts.

Based on the themes presented which centre on environmental knowledge and social values present in *tikanga*, a model is developed. This model is applied to the garden organisation and soil modifications at two archaeologically investigated garden sites on Moturua Island in the Bay of Islands. The aim of this model is to ascertain if *tikanga* can be viewed directly in the archaeological record and whether it can provide explanations based on the excavation results. The use of the model may also define how to approach future archaeological investigations and gain a better insight into how gardens operated in a location.

Chapter 1: Defining Tikanga: A Literature Review

Introduction

Tikanga, "tika meaning right or genuine" are tools of thought and understanding that help organise behaviour and provide templates and frameworks to guide Māori between right and wrong (Mead 2016:6-7). *Tikanga* consists of customs and traditions that have been handed down through generations and are accepted as the reliable and correct way of achieving objectives and goals for Māori (Marsden 2003:66).

Tikanga is a complex interwoven set of social processes that have evolved and developed through generations. It is a socio-cultural knowledge base developed over thousands of years. Understanding *tikanga* is not that simple and research is required to get to its knowledge foundations (Mead 2016:21). There are however key elements of *tikanga* that can be utilised to find *tikanga* in the archaeology of gardens. Diagram 1 presents these key elements and the concepts that are held within them. These concepts form the basis for the creation of a model that will be applied to the garden sites on Moturua Island to view *tikanga*. The concepts provide a medium that is not rigid and can flow and influence each other within a given context.

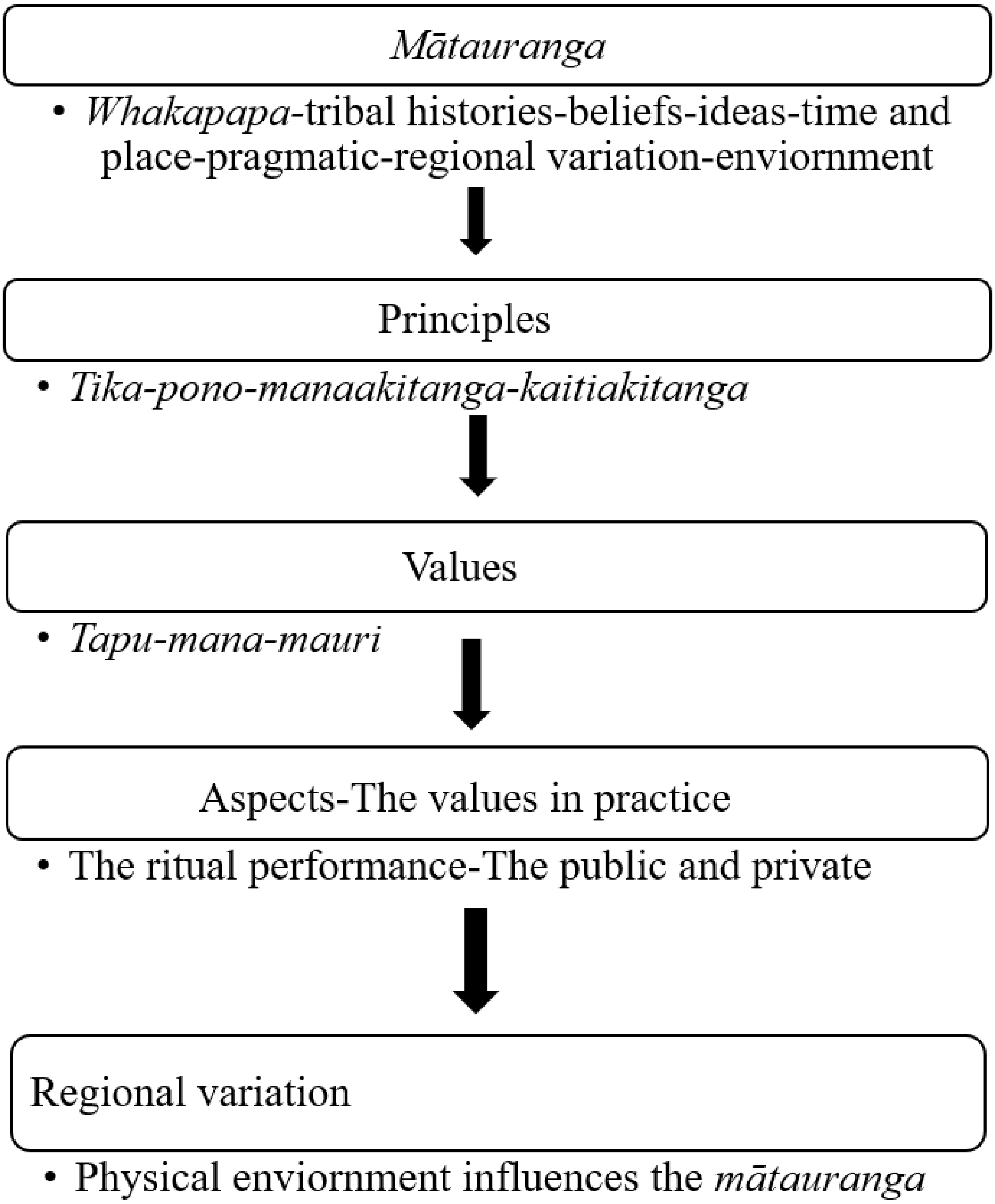

Diagram 1: Principles, values, and concepts of tikanga (Mead 2016).

1.1 *Mātauranga*

At the foundation of *tikanga* is the knowledge base or *mātauranga* and its concepts are transmitted as guiding principles (Marsden 2003:34). The *mātauranga* base is modified and added to by generations of Māori (Mead 2016:16). It seeks to explain experiences by drawing on concepts handed from one generation through *whakapapa*. It includes the history of the people and knowledge about their environment. The concepts relating to *tikanga* come out of that background (Mead 2016:21).

Concepts and principles are standards of behaviour and precedents set through time (Mead 2016:32). They are the *kaupapa,* "The ground rules" (Marsden 2003:66). Examples are *tika"* and "*pono*" meaning right and true or genuine. There is also *manaakitanga*, which is best described or understood as a basic principle of behaviour that applies to most ceremonies and should be a guiding principle for everyone. It is the nurturing of relationships, and it underpins *tikanga* Māori (Mead 2016:30-33).

Tikanga has a set of socio-cultural values shaped by the *mātauranga*. The values practiced are the reflection of traditions and customs that can be traced back to Polynesian ancestry through the *mātauranga.* Differences do exist among Māori about the range of values that underpin *tikanga* Māori, and about which values are the most important. (Mead 2016:31). The values are practiced, performed, and reiterated in various contexts of present-day life. Values can refer to an ideal way of being or a standard to strive for and contribute to how Māori view and experience the world (Marsden 2003:28).

1.2 Values of *tapu, mauri* and *kaitiakitanga*

The key values used in this work are *tapu*, *mauri,* and *kaitiakitanga,* and are most utilised in the gardening process. *Tapu* can be in places, people, buildings, things, words, and all *tikanga*.

It is inseparable from *mana, mauri*, Māori identity, and cultural practices (Mead 2016: 34). *Tapu* sets aside a person, place, or object and is dedicated to the scared, and to put it to common use will break the law of *tapu* (Marsden (2003:5-7).

An important part of the practice of *tapu* was the "purification rites" which counteracted the effects of *tapu* through cleansing and neutralising. The cleansing largely involved the use of water through sacramental means such as cooked food (Marsden 2003:7). As *tapu* could be transmitted by contact so could the opposite of *tapu* known as the *noa* or profane. For the harvesting of crops, the food first had to be cooked, usually the first crop out of the ground, to appease and give thanks to the gods, the *tohunga* ate a piece and buried the remainder. Once this ritual was complete the harvest could continue, the *tapu* being removed (Marsden 2003:8-9).

The *tohunga* and chief acted under the value of *mana,* the authority to act as the human agent of the deities. Once the human agent is the authority he is then endowed with the spiritual power and has the authority to perform the rituals of *tapu* (Marsden: 2003:4). These people are chosen to lead and act in rituals involved in the gardening process. If *tapu* is sacred then *mauri* is the life force that holds the sacred, usually in a solid object.

Kaitiakitanga represents social and environmental elements, although in the modern world it is largely used to describe environmental protection and guardianship (Kāwharu 2000:349). This value in essence includes the values of *tapu*, *mauri, mana*, and also ancestral, social, and environmental links (Kāwharu 2000:349-350). The environmental component of *kaitiakitanga* is landscape management which can be seen through the practice of local soil knowledge, crop management site and crop variety selection, and the rotation of land or soil amendments which encompasses a whole landscape approach (Roskruge 2011:203). Land management was connected to the values of *mauri* and *tapu.* These values are always entwined with the natural world. To appease the gods was the first goal and then the crops would follow. Appeasing the gods involved working in harmony with nature, the practice of *tapu* ensured the *mauri* or life force was protected.

The term *whakapapa* refers to ancestral links although it means more than just genealogy as it holds tribal histories related to people and their environment. The primary tool used in gardening was *whakapapa* and this was followed by *tikanga* (Roskruge 2011:202). Knowledge from *whakapapa* of soil types and their management was held within the *mātauranga* and would have been influential in gardening techniques.

The idea of ownership for Māori was a collective in comparison to the individual title favoured by early non-Māori in New Zealand. This was a management technique that contributed to the physical and spiritual well-being of the land and people (Roskruge 2011:209). Gardens operated communally and came under the principle of *kaitiakitanga*.

1.3 The aspects

The aspects are practical expressions of the values described and it is the practice or performance of these values that could create a physical signature in the archaeological record. Following Mead (2016) the key aspects utilised here are the ritual and the public and private which can involve groups or individuals (Mead 2016:16-18). The ritual is related to the practice of *tapu* which is shown to be the predominant value in the cultivation process. The public and private aspects are related here to the communal or the *hapū* and the family group or *whānau tikanga*, the communal would be a more public affair while the family group may operate their own set of *tikanga* based on their *mātauranga* of gardening. These aspects are described below.

The ritual aspect

The reason for a great deal of concern about *tikanga* is related to its ritual aspect. There are beliefs that if the rituals are not performed correctly that the group will suffer misfortune from the gods of the Māori world (Mead 2016:16). This highlights the importance of carrying out the aspects correctly. The performance of *tapu* is the practice of the ritual, the *tapu* rituals of a kūmara garden are performed and practiced.

Private and public *tikanga*

Some *tikanga* are public and some are private. Public *tikanga* can involve hundreds of people and private can be smaller *whānau* groups. *Tikanga* provides guidelines for behaviour within these groups and may vary based on the context. A whānau can also carry out what could be more public events and is bound by the set of beliefs and practices (Mead 2016:18). In the interest of gardening, a group may operate in a communal setting that requires a specific set of *tikanga*. A smaller whānau group may operate under their own *tikanga* which could create differences in the archaeological record.

1.4 Regional variation

In the process of assessing *tikanga* regional variation should always be considered as ideas and practices relating to *tikanga* Māori differ regionally. While there are some constants throughout New Zealand, the details of the performance differ, as may the explanations provided. There is always a need to refer to the *tikanga* of the local people (Mead 2016: 8). In considering a regions *tikanga* the aspects of the values may be expressed differently based upon the *mātauranga* of the local people. Knowledge is built up and added to during lifetimes and can also have a pragmatic aspect. Pragmatism refers to the cause and effect and is related to how the physical and social environment influences *tikanga*. The *mātauranga* is in constant adjustment to the present and the relevant, while holding onto the ancestral links, principles, and values that form its foundations.

1.5 Environmental knowledge

Māori environmental knowledge is vast, and it is largely understated as a tool for the interpretation of sites within the discipline of archaeology. It is not well understood how detailed the environmental *mātauranga* is and this knowledge is fading in the modern world and with climate change. Prior to this Māori knowledge of the physical world was incomparable. Their lessons and interactions with the environment have built a wealth of knowledge that was practiced in daily life (King 2008 et al:387-388). Knowledge was transmitted orally to select members of *whānau*, *hapū*, or *iwi* groups and practiced in daily life including gardening (King 2008 et al:387). The detail of this knowledge was shared by the people of *Te Whānau Apanui* in the Bay of Plenty, which is a highly variable environmental situation. Within this location, they have developed local weather and climate knowledge that describes the style and direction of the winds including recognition of the changing directions and arrival times of dominant winds. These winds all affected cultivation, fishing, and other activities. There were names for cloud types that were interpreted to predict upcoming weather patterns, and there were also fourteen descriptive names for local rainfall patterns. Weather trends and events are also recorded as stories and shared, as are environmental indicators that can serve as a warning based on past events (King 2008 et al:396-398).

The use of the environment for these indicators was always of importance and weather and climate could be forecast by using the moon phases, the stars, the sun, the sounds of the waves, and cloud patterns. The flowering of certain trees or fruit was used to guide kūmara planting and, if there were frosts or heavy rain this prized crop would need to be dug at once to save them from rotting or secondary growth (King 2008 et al:399-401). The weather and climate are monitored through these natural events and contributed to decisions associated with the "timing, safety and viability of daily and seasonal activities" (King 2008 et al:402).

<u>Discussion and conclusion</u>

The *mātauranga* refers to the knowledge base of Māori, it holds spiritual and physical beliefs and histories shared through *whakapapa* over generations. These all have connections to the natural world and spiritual world. This collective of concepts within *mātauranga* is transformed into *tikanga*, an umbrella for customs, traditions, and guiding principles applied to everyday life and the Māori worldview. There are three values that are practiced and performed privately by *whānau* groups or more publicly within a *hapū*, in the cultivation process, *tapu, mauri*, and *kaitiakitanga*. It is these values that may be visible within the archaeological record of early Māori gardens. Environmental knowledge is also included in the *tikanga* and influences how gardens operated within a region. The *tikanga* could change regionally based on the environment and the ritual aspect and inter-regionally depending on the belief systems of a *whānau* or *hapū* group.

Chapter 2: Tikanga and the archaeology of early Māori gardens: A review of the literature

Introduction

This section review's themes that have been and are prevalent in the interpretation of Māori gardens in New Zealand. The examples from published literature and unpublished archaeological reports are discussed. These examples, taken from archaeological evidence, centre on soil modifications and garden organisation. The aim is to find evidence that can be directly related to *tikanga* in gardens archaeologically and to highlight areas where *tikanga* could assist in further understanding of sites and contribute to interpretations beyond the current methodologies and theoretical frameworks.

2.1 Central themes in archaeology

The wider themes that form the basis for archaeological interpretation begin with discussions of first crop introductions which brought in the possibility of the climate as a basis for the success of the establishment of crops. A warmer period before the 14th century was suggested, as this would provide a more suitable climate for the growth and adaptation of kūmara (Yen 1961:346). Yen gives three models for agriculture, introductory, experimental, development, and adaptation. Adaptations include the addition of pebbles for warmth and the use of brush screens to protect from winds, and storage pits (Yen 1961:342-343). Climatic factors for the timing of established gardens in prehistory were suggested within a developmental approach by Green and Shawcross (1962). This was presented as a cultural sequence based on the Auckland province examples. These begin with the initial settlement phase that was climatically warmer than today, with a hunter-gather society heavily reliant on exploitable marine and forest resources. The warmer climate continued within the development stage which saw an introductory stage of agriculture, c. 1100- 1350 AD. The experimental phase saw the climate cooling with agriculture still developing as marine and forest resources become depleted resulting in an increased dependence on agricultural products. This was followed by the "village Māori phase" and the "classic phase" where agricultural intensification continued (Green and Shawcross 1962: 216-219). Golson (1965) critiqued the models used for climate based cultural sequences as they did not account for the complexities and variability seen in the archaeological record. (Golson 1965:83-85).

In eastern Palliser Bay gardens were investigated using climatic factors and physiological data that used ethnographic and historical sources of cultigens to inform on the archaeological record (Leach 1979:242). There was no evidence found in the form of pollen, seeds, or charcoal. Crops that may have been grown here were determined by Leach based upon possible growth requirements from the ethnographic accounts compared with the physical conditions at Palliser Bay (Leach 1979:241). Leach's argument shows the post 1960's emphasis on environment, ecology, and ethnology.

"Function" has been used by archaeologists in the attempt to understand precisely how and why cultivation soils, structural features, or systems for introduced crops operated in the limiting climate of New Zealand (Barber 2004:192). Northland has a higher number of ditch system sites as reported in a survey of drains and ditches by Barber (1989). In an attempt to ascertain function Barber classified these into four specific categories. A and B are drains or ditches on steep and gentle slopes, C were ditches that served as land boundaries and D were wetland ditches suited to drainage, water reticulation and simple irrigation. The overall interpretation of these focuses how they operated in the landscape through form, aspect, and technology. The classification aims to provide a basis for modelling operational change over time and developing further research strategies (Barber 1989:23-50).

2.2 The archaeology of gardening in New Zealand

Northland held extensive inland regions of friable volcanic loams, and large tracts of peaty and sandy peat soils, and warm north-facing slopes in many areas. A subtropical climate, and a variety of free-draining and relatively easy tillable soil. Climate and soil made this region highly suitable for introduced tropical crops (Barber 1989:27). Early Māori gardens in Northland archaeology are defined as structural features and soil modifications. The structural is represented by stone rows, stone faced terraces and mounds usually found in large garden complexes such as Pouerua pā (Sutton 2003). Stone structures are largely associated with inland volcanic soils but can exist on the coast, at a smaller scale as found at Mahinepua in Whangaroa (Blanshard and Goddard: 2009).

Ditches, drains or channels are frequent in the landscape of Northland, and are interpreted as as water drainage systems and boundary markers. These can be parallel and located on slopes (Furey 2006:53, Barber 1982:3-7), and as parallel and intersecting ditches on swamp lands (Barber 2001:43-46). Wetland ditches are found in the far north region near Kaitaia and in the Dargaville area (Furey 2006:57). These are identified on poorer draining soils. Parallel slope ditches are widely distributed in Northland with representations in the coastal Bay of Islands, the Cavalli Islands in the Whangaroa and Whangarei Harbours, (evidence based on site record forms) (Furey 2006:57). Modified soils are located inland on volcanic soils and in coastal locations as shell, sand, charcoal, and water-rolled pebble additions within the parent soils (Furey 2006:57).

How garden soils are identified and modified can vary regionally and even inter regionally. The combinations of these can vary overall and on occasion there are no additions but rather the alteration of the natural soil profile through the mixing of the topsoil with the underlying layer. (Furey 2006:46).

Taylor's 1958 publication gains insight from ethnographic literature by making inferences on the adaptations of Māori gardening from a tropical to temperate environment. He discusses the adaptation required of Māori to the soil types, landscapes and climate encountered in New Zealand in contrast to Polynesia which required a change in technique to adapt tropical crops to a temperate environment. The differing environments posed its challenges to Māori and as Taylor (1958) points out the placement of stone representations of the gods within cultivations indicated that gardening required the assistance of the spiritual world (Taylor 1958:72).

Māori had extensive knowledge of soils and "special soil treatments to meet crop requirements were well understood" (Taylor 1958:72). Soil knowledge was based on the colour, texture, consistency, moisture, organic matter, stoniness, topography, land-use, drainage, fertility, productivity, workability, structure, depth and soil temperatures (Roskruge 2011:203). Māori had for example thirty to forty separate names for natural soil types (Best 1976:42).

2.3 Archaeology of gardens in the published literature

The requirement for warmth and drainage in modified garden soils has been shown by Challis (1976) in a physical and chemical examination of a Māori gravel soil near Motueka, New Zealand. Challis contrasted "Māori gravel soils with the natural adjacent soils of a river flat and found that while there were no remnant chemical differences the modified soils had physical characteristics of warmer soil temperatures, friability, and drainage, reflecting soils suited to kūmara growth (Challis 1976:253-254).

McFadgen (1980) compared and classified five culturally modified soils from four coastal sites at Pauatahanui, Makara Beach, Okoropunga located on the lower North Island, and Clarence on the upper eastern South Island. Five modified soils from these locations were separated into two types L and M. Soil L has been defined as a transported soil that has been poorly mixed with the sedimentary or non-cultural natural layer. M is defined as soils that have been transported and well mixed with the natural layer. Of the soils, some were found to be most suitable for kūmara and some for taro. This interpretation was based upon ethnographic and historical accounts of crop planting and soils (Taylor 1958) and from Challis (1976) which suggested that sand and gravels made soils lighter and warmer and probably improved moisture retention and drainage.

A small amount of charcoal was represented in the soils, one soil had midden and bone which may indicate a type of fertiliser, by adding nitrogen, phosphorous and lime (McFadgen 1980:13). There was no indication of what may have made the areas special in terms of gardening, but all five soils were coastal even though in different climatic situations from similar soils inland. This coastal environment did mean they had easy accessibility to sand and gravel from the beaches nearby, which may be the only commonality (McFadgen 1980: 3-19). McFadgen suggested each garden had its own microclimate that does not exist now, so it is hard to piece together further reasons for the locational choices. But the physical character of the five soils may have driven the site selection in addition to an adequate supply of sand and gravel (McFadgen 1980:14).

2.4 Archaeology of gardens in the unpublished reports

Another key feature of gardens is how they were organised. Published literature focuses on how soils were modified while unpublished archaeological reports provide detailed information on features and layouts of the garden plots.

In the region of Taranaki in the lower North Island Bader (2014, 2016) identified two separate garden areas located on a coastal flat zone. The first Q19/396 included a mulching pile, nursery fields, and larger rectangular fields (plots) orientated east to west and surrounded by drainage paths (Bader 2014:30,32,39). The site was dated 1714-1764 and 1784-1831 AD (Bader 2014:35).

This orientation of gardens was reported ethnographically by Best (1976) as a preferred plot direction (Best 1976:153). A probable path located on the eastern outer edge of the garden was identified and compared to accounts by Best (1941:376), who reports seed tubers being laid to the eastern side of the garden plots and shallow ditches separating the garden plots (Bader 2014:30). The garden areas described are shown in Figure 2.

Figure 2:Garden system interpretation of Q19/396, garden beds (gb) and paths (Bader 2014:Figure 27)

Soil modifications at this site show a "banding'' of layers where topsoil and subsoil are mixed with charcoal to create the effect seen in the eastern profile (Figure 3). The soil is attributed to garden soil and a particular method of gardening (Bader 2014:20-23). This modified soil signature was also identified at a later excavation in Taranaki (2016) as described below.

Figure 3: Profile of modified soils at Q19/396, shows the banding pattern evident (Bader 2014: Figure 13)

The second excavation by Bader (2016), was of Q19/439 where Bader found garden plots laid out in rectangular and long rows. The rows, ten of them, were shown as shallow backfilled ditches and nine of them were oriented roughly in a north to south direction and are likely the remains of planting areas. The rectangular drainage ditch likely surrounded a traditional style garden plot, as is seen in other sites in Taranaki (Bader 2016:17). The differing garden organisations of rectangular and linear rows are side by side with no overlay and suggest that two types of garden areas, traditional rectangular gardens and European "market style gardens" existed at this site (Bader 2016:3).

Figure 4:Garden system layout of Q19/439, shows the long rows, rectangular drain feature and fire events (Bader 2016:Figure 6)

Evidence for fire scoops and *hāngī* suggests domestic and ritual activity occurred on the edge of the garden to the west and south of the garden beds (Figure 4). These *hāngī* /fire events are close to the gardens but not within the direct outer areas of the plots indicating the Māori tradition of keeping domestic activities outside gardens during cropping seasons (Bader

2016:17). Water rolled stones that do not fit the geology of the location were found in a pile, likely indicating the traditional way of marking the edge of the field system also known as *mauri* stones (Bader 2016:17).

Soils at this site parallel the “banding” or layering seen in the Q19/396 soil modifications described where mixing is seen in a diagonal strip in the topsoil and sub soil (Figure 5), this is identified as the building up of layers with charcoal banding in the profiles. The garden soil here was dug and then back filled. This suggests soil modifications that may be specific to a certain soil type (Bader 2016:27-29). This contrasts with Best (1941), who states that soils were not turned over only loosened (Best 1941 vol II:359).

Figure 5:Profile of modified soils at Q19/439, shows the "banding" or alternating soil layers (Bader 2016:Figure 19)

Gumbley’s archaeological investigations in inland Waikato region provides in depth geological studies of the landscape and its formation. Described are major soil areas such as the Bruntwood silt loams, the Te Kowhai silt loams, and the Horotiu sandy loam, the latter the more well-draining soil type. There is also the Tamahere loam identified as Māori gardening soil of a gravelly sandy loam (Gumbley 2000:10). Gardening sites are spread across these soil types but overall, it was found that there is a lower frequency of gardens in the poorer draining soils (Gumbley 2013:4).

Gumbley describes two different techniques of soil modifications lithic mulching and soil mixing and deepening without any additions (Gumbley:2013:31). Area A of S14/194 consisted of a lithic mulch, a deposit of sand and gravel. The mulch was located on the lower lying, poorly drained Te Kowhai silt loam and was typically between 120 - 220 mm thick (Gumbley 2013:27).

Adjacent to this site in the same excavated area was mixed soils that were mottled and irregular in depth at the base. This soil has been interpreted through the soil creation process of mixing the lower layer or sub soil with the topsoil. Here there was no lithic mulch top layer, it is suggested that it may have been removed for some reason such as via modern disturbances (Gumbley 2013:31). But it is "equally possible that this area of mixed soils represents a separate technique" (Gumbley:2013:31).

The site of S15/195, had tracts of soils that that were mixed or "artificially deepened" these garden soils were located on the Horotiu sandy loam soils which is a friable and better draining soil (Gumbley 2013:59). Here the two soils horizons were mixed, the upper and lower horizons, the mixing has been described as more thoroughly mixed in some parts than others. This mixed layer did not contain sand and or gravel additions (Gumbley 2013:59). The use of the lithic mulch on the poorer draining soils could indicate adaptations made for better drainage and warmth which were not required on the sandy loam soils at S15/195, indicating a technique directly related to environmental *tikanga.*

Excavations by Gumbley in 2013, 2019, and 2000 in the Waikato found crop planting features specified as "bowl shaped features" and bowl-shaped depressions" BSH are circular features with a bowl-shaped profile, they are typically 30-55cm in diameter and 10.25cm depth. Bowl shaped depressions are generally oval but can also be irregular or circular. These are larger than the bowl-shaped hollows and can range from 0.4m to 4m (Gumbley and Hoffman 2013:23). An example of these bowl-shaped hollows is from S14/194 (Figure 6), these are shown as laid out in rows in a linear pattern with a fill of sand and gravel (Gumbley 2013:40). The profile indicated the bowls tend to be larger at the surface and the taper into a bowl shape at the bottom (Figure 7).

Gumbley 2000 found bowl-shaped hollows that were set out in a quincunx pattern in two adjacent sets, a northern and a southern, the sets showed varied spacing between the hollow features, and the plots were angled differently (Figure 6,7). The northern set of hollows show an east to west orientation that diverged to the north slightly with a spacing of 0.5m (Figure 8). The southern set was directly east to west with a spacing of 0.43m (Gumbley 2000:22). Quincunx is a pattern that requires planters to be in a diagonal formation for planting, As described by Leach (1984), "The quincunx pattern is basically that of the "five" side of the dice and when repeated it takes the form of alternating off-set rows" (1984:65).

Figure 6: Bowl shaped hollows S14/194 (Gumbley 2013: Figure 24)

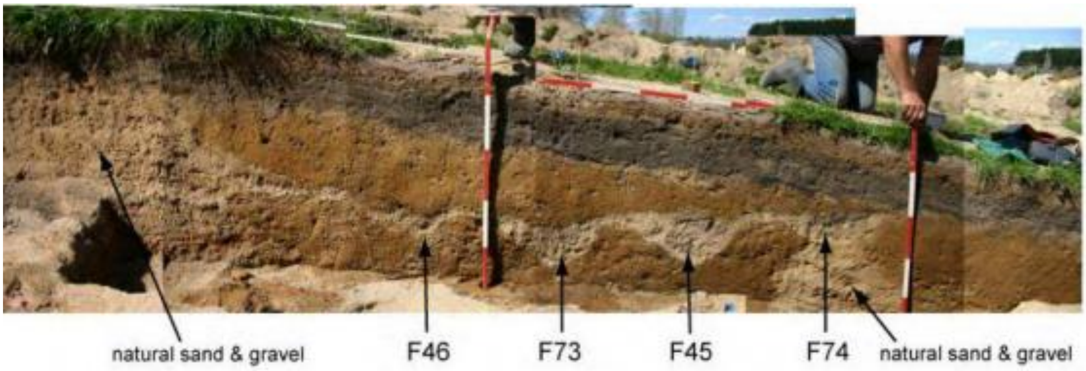

Figure 7: Profile view bowl shaped hollows S14/194 (Gumbley 2013b:Figure 23)

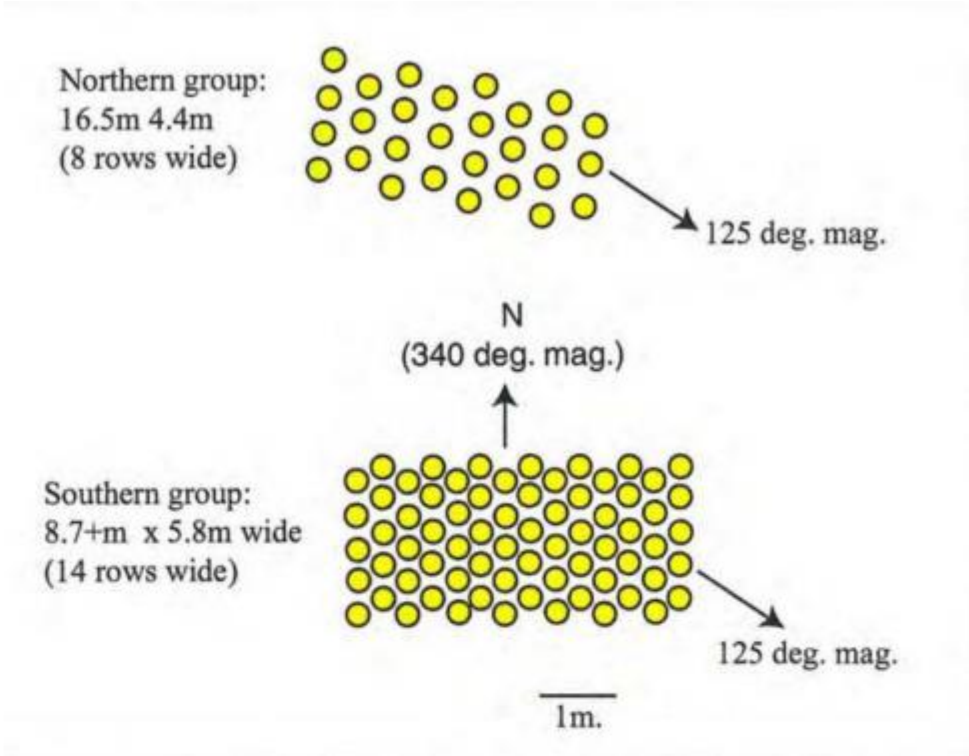

Figure 8: Northern and southern bowl-shaped hollows (Gumbley 2000:Figure 10)

Starch grain analysis of the features was not carried out, but they are likely to be kūmara puke (Gumbley 2000:36-37). Gumbley and Laumea (2019) found further BSH at site S15/465. Two plots were identified in Areas 1 and 4 that indicated variable orientations, with hollows set out in rows or in a linear pattern (Figure 9,10). Plot one shows rows in an east to west direction and plot 2 in a north-west to southeast alignment (Gumbley 2019:39). Fire events, indicating domestic or ritual activities at sites excavated in 2000 and 2019 were found to be an uncommon feature within garden plots (Gumbley 2000: 22).

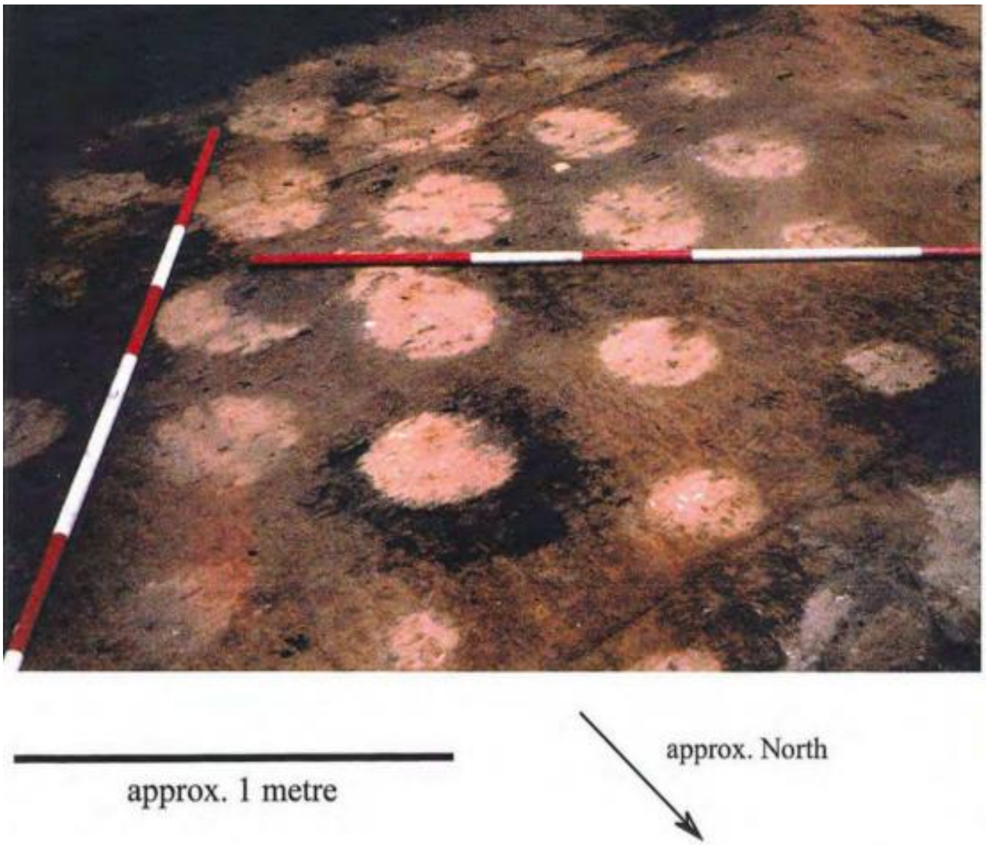

Figure 9:Northern bowl-shaped hollows in quincunx formation (Gumbley 2000:Figure 9)

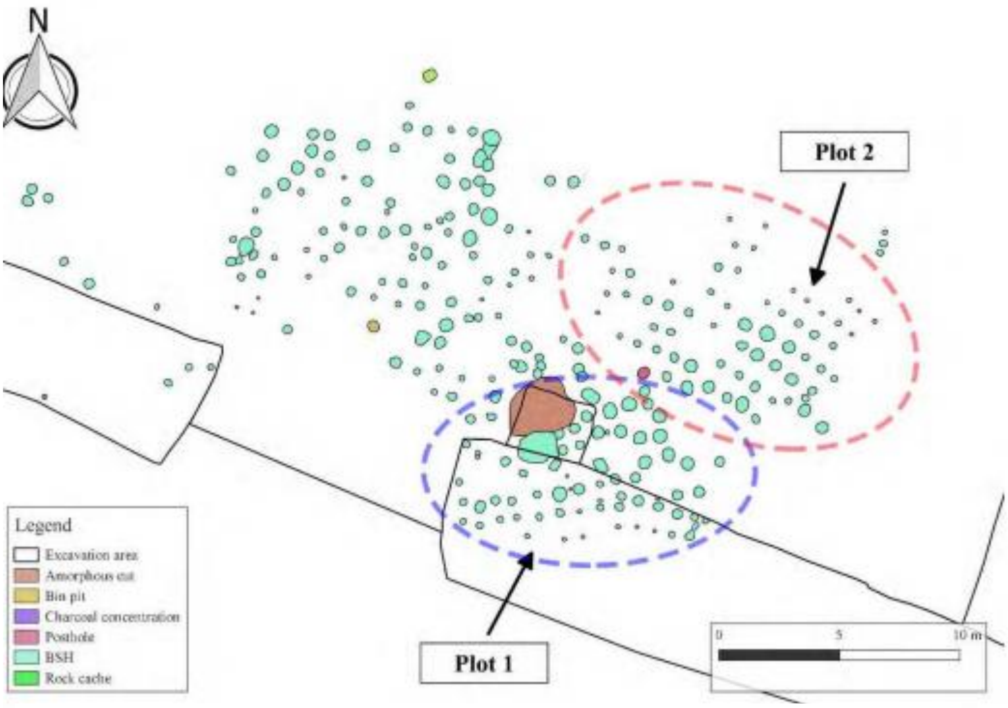

Figure 10:Plot 1 and 2 showing orientation of bowl-shaped hollows S15/465 (Gumbley and Laumea 2019:Figure 29)

Discussion and conclusion

Garden organisation at Taranaki sites Q19/439 and Q19/396, indicate links with the ethnographic literature of how gardens were organised, through paths, and orientations, *mauri* stones and *tapu* preventing domestic activities and fires to take place within the garden area. The soil modifications show a similar soil modification technique across both sites and within the same region show parallels through the soil modification and garden organisation.

The elements of garden organisation at the Waikato sites of fire events related to domestic or ritual activity, orientations, and crop layouts all show variation between sites. The differing techniques are generally associated with the parent soil type. These choices in technique indicate a knowledge of soil types and what is required for the growth of crops. More unclear was the spacing between the bowl-shaped hollows between adjacent plots, variations in orientations, and the use of rows versus quincunx. Such differences could be attributed to the *tikanga* of the *whānau* group or separate crop type requirements.

In consideration of the published literature and the central themes in the archaeology of gardens there are two key areas that the application of *tikanga* could address, the variability that is seen archaeologically and the function of features. A full environmental study would be beneficial if "function" and variability in the archaeological record is to be understood. This is done by looking at traditional Māori knowledge systems at a local level and within the given context (DeWalt:1994:125). In contrast to a traditional scientific approach which as suggested by Kloppenburg (1991) tends to break down data into discrete components analyse and interpret these in isolation from each other (Kloppenburg cited in DeWalt 1994:124). This approach creates information that can be "transferred without transformation" to any area or social group

(Latour cited in in DeWalt 1994:124) and creates models and sequences that do not change depending on the context (DeWalt 1994:124).

To understand the archaeology of gardens environmental reconstructions of the locality could contribute to viewing *tikanga*, the practical and ritual aspects creating an archaeological signature based upon the regions *tikanga.* Gardens can only be understood if they are set in the physical context within which they operated and within the context of the values that were applied with *katiakitanga* and the Māori world view approach. Another tool for assessing gardens is the information provided by the historical and ethnographic accounts. These work in favour of bridging the gap that exists between *tikanga* and archaeology.

Chapter 3:Tikanga in the historical and ethnographic accounts of early Māori gardening

Introduction

A review of the historical and ethnographic literature explores the early accounts for descriptions of gardens and the gardening process in the European accounts to find *tikanga* that could be tangible in the archaeological record. These are descriptions that can be connected to the ritual and environmental *mātauranga* that are practiced through the aspects of *tikanga*.

The historical accounts are separated into two periods. The "exploration phase" and the "settlement phase" after Smith (2020:38). The exploration phase (1769-1791) was that of discovery and exploration, and visitors spent most of their time living on ships and any shore camps were generally subsidiary (Smith:2020:38). These accounts only offer a snapshot of pre-European gardens and the exploration phase accounts are generally brief and observational and *tikanga* may not be identifiable.

The settlement phase (1791-1860) marks the beginning of first known settlements or occupations and ends in the time when Europeans were numerically dominant over Māori (Smith 2020:8). In this phase accounts are detailed due to greater lengths of time spent interacting with Māori, in the form of missionary settlements, and exploration trips.

3.1 The Exploration Phase

The exploration phase begins with Abel Tasman in 1642 who viewed gardens from afar, likely in the area around Cape Maria Van Diemen, near Cape Reinga, they were too far away to discern what was being cultivated but commented "they saw everywhere square beds looking green and pleasant" (McNab 1914:29). Tasman never stepped ashore but in 1769 Captain Cook and his crew on the Endeavour made the first of three voyages in New Zealand and made observations of cultivated foods and garden structure. The key garden accounts are in Anaura Bay, Bay of Islands, and Doubtless Bay.

Joseph Banks, who was on board the Endeavour in 1769, reports on gardens seen in "Tegadu Bay", now identified as Anaura Bay, in the Gisborne region (Morrell 1958:58). It was the 20th day of Oct 1769, and early in the planting season. Banks and Dr. Solander went ashore to look at birds and other native plants. They described crops of sweet potato, cocos (taro), and the cucumber (the gourd) (Morrell 1958:59). They described kūmara (sweet potato) as planted in "small hills", taro as planted on the flat lands and the gourd and taro as planted in hollows or dishes. (Morrell 1958:59). These small hills are known as the *teahu*, or *puke* and are mounds of earth that yam and kūmara were planted in (Figure 11).

The general visual appearance of garden plots is described as neat, orderly and weed free. Banks commented on how well the ground was tilled and Monkhouse commented on the weed free state of the gardens (Morrell 1958:58-59, Beaglehole 1968:583-4).

Banks accounts that "In them [the gardens] were planted sweet potatoes…….the first of these were planted in small hills in regular quincunx [formation]. That was laid out by a line (Morrell 1958:59), and Monkhouse, "The sweet potatoes are set in distinct little molehills, some in straight lines, others in quincunx" (Beaglehole 1968:583-4). The use of the planting layout of rows and quincunx in the same garden area could be due to different crops that were given a specific treatment or to different planting techniques by family groups.

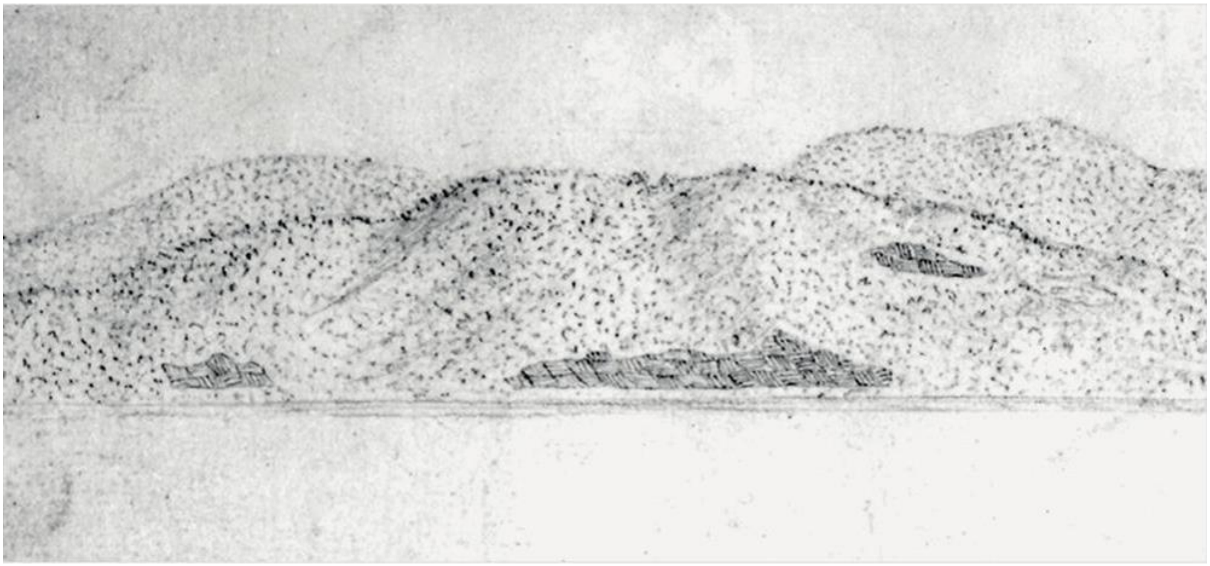

Figure 11: Gardens in Anaura Bay (enlargement of H Sporing's panorama of Anaura Bay 20th October 1769:British Museum London

As described by Leach (1984), Bank's description of gardens in Anaura Bay were of varying stages of growth, some were freshly dug still laying in "furrows" other plots had plants growing both young and mature This suggests "individual family holdings" or planting schedules (Beaglehole 1963 cited in Leach 1984:66).

Accounts of garden tools largely refer to "sticks". Sticks that serve instead of spades (McNab 1914:213). These are likely to be the traditional *kō*. One of the most important wooden garden implements, and one of the mainstays, these are described further in the ethnographic section.

From early explorers we learn about garden sizes. Banks comments on garden size that ranged from 1 or 2 to 8 or 10 acres each in Anaura Bay, and all up there might be 150- 200 acres of cultivation each distinct pattern was fenced in generally with reeds"(Morrell 1958:58-59). On De Survilles voyage in 1769, L'Hornes describes only small patches under cultivation, the region uncertain but in the far north area (McNab 1914:335). Plantations of sweet potatoes near their houses were reported as "long and small in general" (McNab 1914:213).

3.2 The Settlement Phase

During the settlement phase missionaries and early explorers are in frequent contact with Māori for extended periods of time being nine months or more. The regions used here are the Hokianga and the Bay of Islands, where the largest number of accounts are derived. The settlement phase is useful as a contrast with the exploration phase as European accounts move from observations to detailed descriptions of early Māori gardening. The crop types, their treatment and garden organisation form the central theme of the settlement phase. Accounts that centre on these themes will be investigated for links to the *tikanga* values of *tapu* and *kaitiakitanga.*

Notably in the settlement phase accounts there are European influences and in contrast with exploration phase garden size begin to increase, and the adoption and spread of the European and its cultivation becomes common. These changes require consideration as they could affect the interpretation of traditional *tikanga* in the archaeological record and poses the question are earlier *tikanga* values still in the Bay of Islands archaeological landscape.

3.3 Kūmara and *tapu*

For accounts on gardens in the settlement phase we hear from early explorers R.A Cruise (1824), John Polack (1831-1837), Augustus Earle (1827), and John Savage (1805), who spent up to nine months or more exploring the northern region of New Zealand. Missionaries also add to the accounts of early Māori gardening including those written by Samuel Marsden, Father C. Servant, and Reverend Richard Taylor, who were in close contact with Māori groups for extended periods of time.

Accounts from R.A Cruise (1998:14, 36, 37) and Augustus Earle (1832:21) are some of the earliest accounts of *tapu* in relation to Māori gardens. Earle and Cruise both described *tapu* or "tabooed or consecrated" gardens. The first by Cruise in the Waikare region (Inland Bay of Islands) (Cruise 1998:14).

> "The kūmara harvest" The labour of gathering it supersedes all other occupations. The process begins with the blessing of the priest for its success and terminated with its "tabooing" or making it *tapu* from intrusion. As well as the gardens being strictly *tapu* the people who cultivated it were. They are unable to leave the grounds until the work was done and temporary huts were constructed within as they could not leave or pass the boundary" (Cruise 1998:36-37).

Augustus Earle, a freelance painter who spent eight to nine months in New Zealand in 1827, travelled in the Bay of Islands and the Hokianga. Earle reports on the value of *tapu* in the cultivation of kūmara.

> "The New Zealanders here have established a wise custom, which prevents a great deal of waste and confusion and generally preserves to the planter a good crop, in return for the trouble of sowing. Namely as soon as the ground is finished and the seed is sown, it is tabooed, or rendered sacred by men appointed for that service, and it is death to trample over or disturb any part of this consecrated ground. The wisdom and utility of this regulation must be obvious to everyone" (Earle 1832:21).

As described by Polack the kūmara was a most valuable crop to the Māori and were "attached with religious veneration" (Polack 1974 vol I: 397). On planting the kūmara the land becomes *tapu* in addition to the planters engaged in sowing the seed (Polack 1974 vol I:289**).**

During Polack's travels in the Hokianga on the west coast of Northland, Polack and his companions reached a *kainga* and walked through plantations of corn and kūmara. The caretaker pointed to a piece of human hair stuck to a cabbage tree, "denoting the strictness of *tapu*" (Polack 1974 vol I: 67). Commonly a small quantity of human hair stuck to a tree or stick is a sign of a *tapu* area (Polack 1974 vol II:252-253)

Hair rarely survives in the archaeological record of New Zealand, but another natural medium used to symbolise *tapu* were *mauri* stones these were a special stone used as markers. The Reverend Taylor describes the use of these stones to create landmarks between and surrounding garden plots. These were markers and to move one would mean serious consequences (Taylor 1855:385). Although not described as *mauri* stones by Taylor, it is likely these are representative. They are set up as a "mascot" or "charm" (Aoterangi:1923:8) and are generally left in place. The serious consequence of their movement is based upon the *tapu* of the *mauri* stone and the superstitious beliefs surrounding the value. Taylor remarks that "stones of ancient kūmara grounds remained" (Taylor 1855: 385). This is true for the current day where *mauri* stones, if correctly recognized are still present in archaeological gardening sites.

Servant, a missionary priest stationed in the Hokianga (west coast of Northland) from 1838 to 1842 details the cultivation of kūmara and how *tapu* is part of every phase of the cultivation process. "The workers are *tapu* during the digging, planting and weeding process, and only the persons who are appointed to the tasks may undertake it. The gardens will remain *tapu* until a certain time" (Simmons 1973:34-35). This is the harvest time, and when the priest lifts the *tapu* from the plot. *Tapu* had a very important role in kūmara gardening, if there was any violation then this could bring about the loss of the plants (Simmons 1973: 34-35).

3.4 Crop growth requirements

In addition to describing the *tapu* nature of gardens missionary accounts provide information on growth requirements for the kūmara, taro and the potato. The Reverend Richard Taylor spent time at the missions at Waimate North in the Bay of Islands and Whanganui during 1839 to 1855.

> "For optimal growth kūmara requires a "warm aspect" and artificial soil which includes sand or gravel being laid on the ground to a depth of 6 inches. The taro needs the aid of "bush screens" and other expedients to make it flourish. To acquire the warm aspect kūmara, taro and potato grounds are generally selected on the sides of hills with a northern aspect, that gives the gardens extra heat" (Taylor 1855:378) .

Interestingly in Māori mythology as described in Taylor (1855), we can see the link between mythology and the warm aspect of the landscape. This is an example of a link between the *mātauranga* and the environment.

> The offspring of *Rangi* and *papa* were first the kūmara which came from the face of heaven, being a plant, which requires heat, next came the fern root, which sprung from the back of *Rangi* imitating its hardy nature, being found on the cold hills and needing no sun to make it grow (Taylor 1855:18).

3.5 European influences on traditional *tikanga*

European influences on traditional gardening needs to be addressed when attempting to view elements of tikanga in the archaeological record. The volume of accounts that refer to the potato is a key consideration when looking for tikanga given the *tapu* nature of kūmara, could we have expected the potato to be treated in the same manner? The archaeological landscape of the Bay of Islands could represent these changing factors occurring within the settlement phase.

The potato

The introduction of the potato has generally been attributed to Captain Cook, for example it is stated by White (1888) that Captain Cook introduced potatoes at Mercury Bay on his first voyage (White 1888 cited in Smith 2020:61). As stated by Shawcross (1966), Cook left neither plants nor animals in his first visit to New Zealand and that it wasn't until his second voyage in 1773 that they were left (Shawcross 1966:138: note 51) . Although the scope of this work does not involve extensive tracing of the introduction and adoption of the potato to New Zealand, its consideration is relevant for the Bay of Islands context. Understanding its adoption and spread in the Bay of Islands can tell us how early European influence in gardening may have begun for this region and whether this could affect *tikanga*.

The introduction of the potato versus the timing for the adoption and spread in the Bay of Islands may have been in 1793 when Tuki and Huri on their return from Norfolk Island received the gift of potatoes from Governor King (McNab 1908:263). It was also indicated in a letter from the Bay of Islands Chief Te Pahi, that claims in the early 19th century that the potato was only grown by them and spread amongst them after Governor King had given potatoes to Huri and Tuki of the Northern region in 1793 (Shawcross 1966:139-142). Here we can gauge a late 18th century timeframe for the adoption and spread of the potato in the Bay of Islands region. Further to this in 1803-05 whalers calling into Doubtless Bay (far north) and the Bay of Islands were able to obtain potatoes from the local Māori (McNab 1914: 99-100).

One of the earliest accounts of the potatoes from explorer John Savage who travelled around New Zealand and particularly the Bay of Islands in 1805. He describes the potato as the "only vegetable cultivated by the Māori, although they have the seed of several others". He goes on to say that as they are found to be "ill-calculated for trade, they have been neglected [likely the kūmara]" (Savage 1966: 57). In addition to this the Reverend Taylor states that the potato is far more universally cultivated than the kūmara, due to decreased labour to plant and as it yields a better return (Taylor 1855:377). Wright (1959) states that the taro and yam were replaced by the potato immediately (Wright 1959:70). For further accounts that describe the potato as dominant over other crops see (Darwin 1839:504, Jameson 1842: 324).

The question then, is how dominant was the potato in Māori gardening in the late 18th and early 19th centuries, and if the potato was taking over the kūmara as is stated in the accounts could we find any *tapu* in gardens and therefore in the archaeological remains? As Best (1941) states "We have no knowledge as to any *tapu* functions pertaining to the planting of products other than the sweet potato. It is around the origin of this tuber that so many myths have gathered"(Best 1941:392).

The following accounts indicate that the kūmara had not been supplanted by the potato but gardened alongside each other. R.A Cruise describes seeing the ground planted with common potato and sweet potato (Cruise 1998:14), while travelling in the Bay of Islands. Augustus Earle sees "small patches of cultivated ground with common potato and sweet potato" (Earle:1832:21). At Te Puna in the Bay of Islands the land is described as chiefly planted with sweet potatoes "which constitutes the choicest food of the natives"(Marsden 1932:165).

Based on the evidence presented, the potato was largely used for the purpose of trade with Europeans and did not replace the kūmara. While Savage's statement suggests that they are neglected as they are "ill-calculated" for trade (Savage 1966: 57), Shawcross (1966) indicates that there is an increase in kūmara gardening in the 1820's and 1830's at the Bay of Islands (Shawcross 1966:144), that likely coincides with the musket campaigns (Shawcross 1966:269).

The kūmara was still cultivated from 1821-1828 in the Bay of Islands region and in large quantities as shown in the increase in the size of Māori cultivations in the Bay of Islands

(Shawcross 1966:268). These gardens also included taro, and potatoes and European introductions. We can assume that as potato was mostly sold or traded with the Europeans, then kūmara was for the Māori diet (Shawcross 1966:144).

The accounts show that the cultivation of the potato was attached largely to another agenda, trade with Europeans and as an additional food source during seasonal gaps (Simmons 1973:62-63). During the settlement phase kūmara was still cultivated alongside the potato even though accounts suggest the discontinuation of kūmara cultivation by Māori to an extent. Māori did not give up the traditional foods completely, but they were perhaps less extensively relied upon (Hargreaves 1963:106).

There is evidence that practical knowledge of kūmara cultivation may have been applied to the potato, as suggested by Hargreaves (1963) "Māori needed no instruction on how to grow the potato as the kūmara cultivation methods could be transferred with little modification" (Hargreaves 1963:104). Best (1925) describes that Māori soon became an expert in potato cultivation and introduced methods of their own such as planting in quincunx, a formation sighted by the early explorers (Best 1925:152) According to Best they also used the ritual practice of the *māra tautāne* for potatoes, this is a scared plot that acted as an offering before the main cultivations commenced under the name of *huamata* (Best 1930:361). The adoption of one did not mean the loss of another. Māori adopted potato as they saw its value in trade and as an additional food source that could be grown similarly to kūmara.

Changes in the appearance of garden layout

Statements that gardens have become “slovenly” are a marked contrast from the accounts of the explorations and settlement phases of neatness and order. Best (1924) informs that the neatness and order of gardens diminished in the later days when the old social systems of the Māori were falling apart under the pressure of new usages and new ideas introduced by Europeans (Best 1924:357). Savage (1966) describes how skilled Māori are in potato cultivation, but that their potato gardens are not planted with European regularity, but they are productive (Savage 1966: 54-55). This neatness and order seen in the exploration phase could reflect the use of *tapu* in gardens and later the appearance of gardens change with the gradual loss of social systems.

There are accounts that some Māori were taught European farming techniques through employment at various mission stations, particularly at Waimate North (inland Bay of Islands) However, casual instruction from whalers and other European settlers often resulted in imperfect and careless cultivations (Hargreaves 1963:114-115).

The protection of growing crops by *tapu* continued at least to the 1830’s in parts of the Bay of Islands and 1840 in other regions (Hargreaves 1963:103). Then it is suggested there was a loss of the social system as it relates to gardening, the *tapu*. The removal of *tapu* occurred through the lessening of chiefly authority, and the breakdown of the communal authority (Hargreaves 1963:113). The “Communal authority” relates to *kaitiakitanga*. Another factor in the breakdown of the social systems was the younger generation who rebelled against *tapu* preferring European manufactured goods, and thus causing a changes to Māori agriculture (Hargreaves 1963:113).

Changes in the appearance of garden size

With the adoption of the potato and a focus on trade garden areas were increasing in size and expanding into new areas. Beginning in the early 19th century, Polack (1976) remarks on "changing gardening behaviours" small garden patches were now replaced with the cultivation of large tracts of land to supply not only their families but the many European families residing on the land and for export to the Australian markets (Polack 1976, vol II:108). For the Bay of Islands, the produce was ready well before other regions due to its climate and favourable locality (Polack 1976, vol II:198; Marsden 1932:151-153).

Further discussions on increases in the size of gardens comes from Shawcross (1966). From 1814 onwards there is a "spectacular" increase in the size of Māori cultivations in the Bay of Islands (Shawcross 1966:268). Shawcross bases her evidence on accounts from 1814 up to 1828 when the cultivations increased from a 40 acre block seen in Waimate, up to 100 acres by 1828 in Waimate and the Taiamai plains. Crops were potatoes, kūmara, and other European introductions (Shawcross 1966:table XV).

The size of the plot per village in less fertile areas was also undergoing a marked expansion (Shawcross 1966:269). Māori at this time were also supplying missionaries with crops for their own consumption and for prisoners of war who were now actively helping in the gardens. These factors and the high price for European goods, is reflected unsurprisingly in the exponential growth in gardens (Shawcross 1966:Fig xiii).

Iron tools also contributed to increases in garden sizes. The largest amount of evidence for the increase in garden size due to iron tools is found in the accounts from Samuel Marsden. The Reverend Marsden established the first mission settlement in the Bay of Islands (Oihi) under the *mana* of chief *Ruatara*. Although Marsden did not live at the station, he spent time interacting and with the Māori, viewing them and gaining their trust and friendship. He made the following statement which relates to tools and the expansion of gardens.

> "I believe there is ten times more land in cultivation at the present time in the districts around the Bay of Islands than there was in 1814 when the missionary settlement was first formed. This improvement in cultivation is wholly owing to the tools [and albeit hard labour] of agriculture which have been sent out from time to time by the Church Missionary Society" (Marsden 1932: 176).

Although it is not certain that the CMS can claim complete credit for the expansion of gardens with their gifts of iron tools to the Māori, they were a popular commodity. Accounts from 1805 report on the growing popularity for European iron garden tools. "They would suffer almost any inconvenience, for the possession of it [iron]" (Savage 1966:56).

The main Māori garden tools were the *kō*, the *kaheru*, the *pinaki* and the *timo timo* all in various styles. The *kō* was the principal tool, this implement was one piece with a footrest lashed to its lower portion. The blade at the ground end was three inches wide and pointed. The *kō* in was used to loosen the soil. It was plunged into the ground and then levered upwards, this could be three to four times in the location where the mound was to be made (Best 1941 vol II:366). The *kaheru* was a wide bladed wooden implement and the *pinaki*, was a paddle shaped implement, the *timo timo* a wooden grubber (Best 1941 vol II: 369-368), (Figure 12). European tools allowed the Māori to cultivate more land and expand into areas previously un-used.

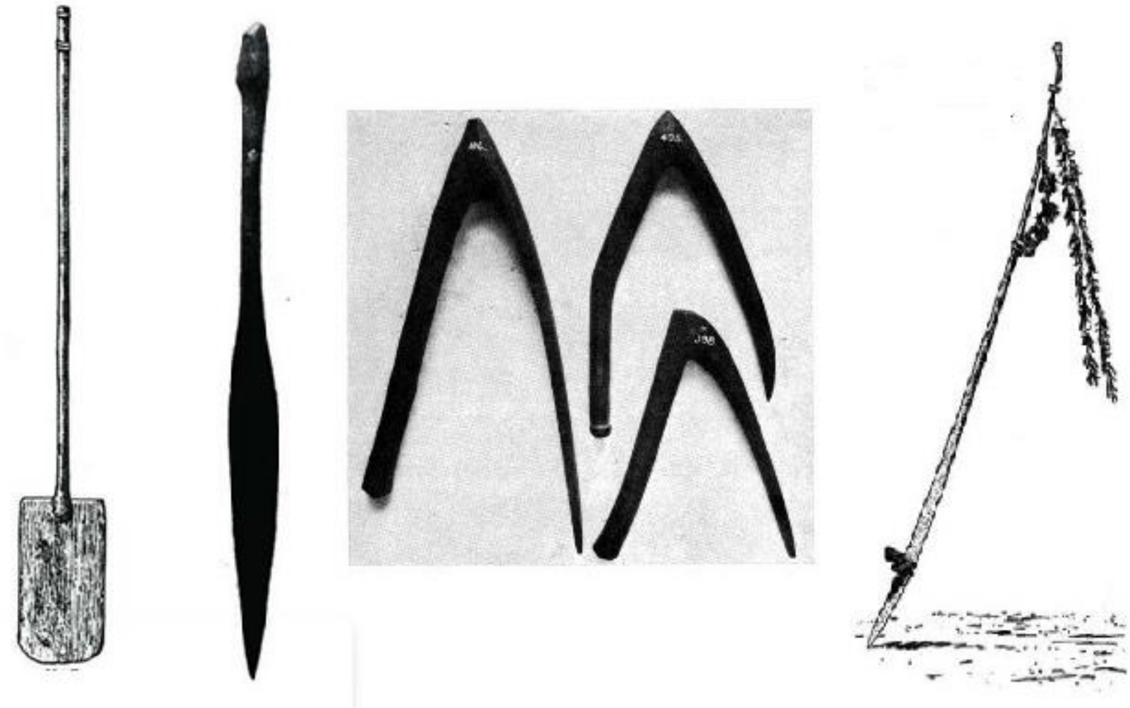

Figure 12: From left to right: the *kaheru,* the *Pinaki, the timo-timo,* the *kō* with ceremonial attachments (Best 1976:Figure 16, Miss E. Richardson, Dominion Museum Collection. Figure 19, Dominion Museum Collection. Figure 37, Dominion Museum Collection. Figure 28, Miss E. Richardson).

The implements were still in use during the early 19th century in the Bay of Islands. On a visit to *Te Puna* Marsden describes numbers of them [Māori] at work in their respective allotments, some with spades and hoes that they had been given by us [missionaries] and some using the traditional Māori gardening tools. Marsden describes the wooden "spades" and spatula's" as "can only be used where the land is light and has been previously turned up" (Marsden 1932:165).

It is therefore likely that European tools did not completely overtake the traditional wooden garden tools even in the Bay of Islands where the most expansion was occurring. Other areas of the North Island certainly did not see iron tools in the early 19th century as frequently as the Bay of Islands (Hargreaves 1963:110). Archaeologically we could expect to see garden size as the major contributing factor to changes in traditional *tikanga*. Location could also be a factor within this change, where areas not previously utilised due to unfavourable soils may now have been under cultivation.

3.6 Discussion

The historical accounts of early Māori gardening in New Zealand in the exploration phase do not directly describe *tikanga* but there are descriptions that provide themes that will be developed upon. These are how crops were planted, and how they were set out in rows or quincunx. Small *whānau* groups may have had their own gardens within a communal garden setting that is underpinned by the value of *kaitiakitanga* and could reflect a garden which operated as a socially driven collective (Roskruge 2011:209).

Based on the evidence we can say that in the early 19th century in the Bay of Islands traditional *tikanga* was still present and opens the possibility that it can still be viewed in the archaeological record. Evidence from the accounts show that the potato was an important crop but largely for trade and kūmara was still cultivated in the Bay of Islands. The historical accounts show that *tapu* was still important, but changes in garden appearance do suggest the slow breakdown of its practice with a transition from the traditional *tikanga* to a new way of gardening that displayed European influences.

3.7 Tikanga in the ethnographic accounts

Introduction

Ethnographic accounts detail aspects of early Māori gardens in the late 18th century to the early to the mid-19th century (Best (1976) Colenso (1880), Walsh (1902), and Firth (1959). In addition, accounts of Māori from missionaries who lived closely with Māori for extended periods during the early 1800s-1900s contribute to this section. These early settlers and explorers were able to build relationships and gain insights into parts of Māori *tikanga*. The ethnography is approached from building on the themes of garden organisation and soil modifications from the historical accounts.

Walton (1982) argued ethnographic accounts in New Zealand are not reliable as it is not known if they are a direct account, that of an informant, or taken from another's work. There is also the view that what is in the ethnographic literature may not apply to what is seen archaeologically as the past is continually changing and what may be described ethnographically, may only be a partial reconstruction in the archaeological record (Shawcross 1966:296-297).

The application of the ethnographic and historical accounts is used as a bridge between the *tikanga* and the archaeology. To find links between the aspects of *tikanga* and the archaeological record and used in place of oral accounts when information from *hapū* groups is not available or forthcoming.

3.8 Ethnography

Elsdon Best was New Zealand's foremost ethnographer. Best's work is based upon first-hand knowledge, reading, and discussions of the Māori way of life for over 20 years, in the late 19th and 20th centuries. His research and writings on traditional Māori life are invaluable however in some cases provenance of the accounts remains unknown.

Raymond Firth's anthropological study of the economics of the Māori was published in 1929 reviewed and updated in 1959. Firth was especially interested in the role of "magic" in economic life and the social aspects of economics. He felt that the western economic models cannot be easily applied to societies where economics was intimately inter-twined with all other aspects of society including religion and social relationships. This accounts for his interest in the "magic" and not just the ecology and simple economics.

According to Firth the magic and the work are always part of the technical or practical components, and it is underpinned by the *tikanga* of a group (Firth 1929: 234). If we look back to "understanding *tikanga*" it was shown that all the aspects and values are woven together with the *mātauranga.*

Firth (1929) created a table that lists the main phases as applied to the kūmara cultivation process. Firth separates the "magical ceremonies" from the "work" or the technical. He uses the term "magic" to describe the ritual or ceremonial aspect and the work refers to the practical side (Firth 1929: 234).

The ethnographic accounts provide details of the cultivation process, the planting, and the harvesting. Firths table documents the process but with the intention of displaying how the "work" and the "magic" aligned together throughout the stages of cultivation. Through this process, we may find elements of *tikanga* that can be linked to early Māori gardening (Figure 13).

3.9 The cultivation process

The cultivation process has been divided into four main phases, 1. preparation of the ground, 2. the planting, 3. the cultivating or tending of the crop, and 4. the harvest. Associated with these is the “magic”, which consists of the ritual chants or *karakia*. The four stages are described and elaborated upon, to gain insight into the rituals associated with the *tapu* of gardening that could be viewed archaeologically. It should be stated that this example of the process may not be the same for every *hapū* for every region and variation based upon the *tikanga* of a group could be expected.

Work.	Magic.
Preparation of ground :—	Digging chants—sometimes with magical influence.
Clearing of brush, etc.,	
Breaking up ground,	
Digging over soil,	
Pulverising soil,	
Gravelling soil,	
Loosening soil,	
Throwing into hillocks.	
Planting :—	*Magic of Planting* :—
	Preparation of *mara tautane* (the sacred plot).
	Magic of weaving sacred basket, *a*.
	Magic of distribution of seed, *b*.
	Magic before planting field—offering to gods.
Distribution of seed-tubers,	Magic of distribution of seed,
	Ritual chant during planting,
Planting of seed-tubers,	Ritual chant during covering of seed,
Covering of seed-tubers.	Ritual chant at completion of planting.
	Lifting *tapu* from workers,
	Setting of *taumata*—representations of the gods—in the field,
	Ritual feast after planting, *c*.
Cultivating crop :—	*Magic of growth* :—
	Magic for rain,
	Magic against frosts,
Tilling the soil,	Magic against pests,
Dispersal of superfluous rain-water,	Magic to promote growth,
Weeding,	Ritual offering of food to Pleiades,
Tending of runners,	
Erecting of breakwinds.	Magic for broken tubers, *d*.
Harvest :—	*Magic of Harvest* :—
Inspection of crop,	
Preparation of store-pits,	
Lifting of crop,	*Pure* ceremony—lifting of *tapu* from crop,
	Offering of first fruits,
	Ceremonial binding of shoots, *e*.
	Digging of hillock, *f*.
	Burying of tubers, etc., *g*. Crop dug.
	Unearthing of buried tubers, etc., *h*.
Sorting and storing of crop.	Magic of storing to ensure preserva-

Figure 13:The cultivation process (Firth 1929:254)

Preparation of the ground

Fire was the main agent for the initial clearance of the area set out for cultivation (Best 1976; 140-144). The clearance of land and preparation of the ground consisted of the removal of trees, roots and scrub, these also served to fertilise the ground. (Simmons 1973:12; Walsh 1902:14-15). An area was generally cropped for three years and then left. Any growth would be eventually burnt off. The magic is described as ritual chants associated to this phase of the work.

The main tool used for the soil preparation was a *kō* for the breaking up of the ground. This was thrust into the ground and used to lever the soil (Walsh 1902:15). The soil was loosened with the *kō* to create the puke holes (Best 1976:148). When the ground was too hard it was pulverised with the hands (Yates 1835:156). The "graveling of the soil refers to the addition of gravels and beach pebbles to improve drainage and provide additional warmth to the growing kūmara.

The loosened soil is then made into mounds where the kūmara seed is placed. *Tupuke* (to mound up) *tukari* (to dig and mound up), and *ahu* (to tend) are all words that describe the formation of the mounds (Best 1976:150). Archdeacon Walsh describes that "When the soil was worked up fine and perfectly clean it was formed up into little round hills called *tupuke* (9 inches high, 20-24 inches in diameter) and set quite close together (Walsh 1902:16).

Planting

When the seed tuber was planted it is said that the sprout end was placed facing east, and as the season advanced the seed was placed “a little further north”, until at the close of the planting season the seed was directed to the north. This was done with the idea of following the sun (Best 1976:146). There are words for “to plant” and “to transplant” and the planting out of young shoots of kūmara to result in new plants is called *whakateretere* (Best 1976:148-149).

Prior to the commencement of the planting the magic was performed, with spells in the form of invocations to the presiding gods and generally accompanied by some form of offering. This was to secure the favour of these deities while the work was proceeding. At the end of the planting a ritual chant was directed toward *Rongo*, the god of the kūmara, with the aim of causing the crop to flourish and warding off any mishap (Firth 1929:255).

This type of ritual cannot be seen in the archaeological record, but it certainly organises and sets the tone for the work. The social value of *tapu* is what aided in the completion of work to a high standard, and it is likely *tapu* was responsible for the order and neatness of plots as described by early explorers.

The *tohunga* or Māori priest played a large part in the cultivation process and exerted the influence of *tapu* and *mauri*. They took part in the labour of digging and planting, acting as both the performer of magical ceremonies and as director-in-chief of the practical side of the activity. In operations such as agriculture the two functions went hand in hand (Firth 1929:256).

Before the main planting commenced the *māra tautāne* took place. This was the sacred plot dedicated as an offering to the gods and first yield. The scared plot was set on the outer edge of the main garden and described as a smaller version of a standard plot size (Firth 1929:255-256). Mohi Turei (1913) provides first-hand knowledge of the practice:

> The sacred plot was located at the margin of the main plot, the process was not done in a day but rather over a few days and all the *hapū* contributed to the sacred plot. Two seeds for each person would be placed in the sacred basket. When the soil was ready and the kūmara mounds were formed the planting would begin the following day. Ceremonial fires were lit, and the planters were required to wear special attire. The *tohunga* was responsible for placing the kūmara in the first mound, and the planters would plant the seed tubers from the sacred basket, which was then pulled to pieces and buried at the margin of the plot. Once the plot was completed the work would begin in their own fields working till all the fields were planted. (Turei 1913:36-41).

The *māra tautāne* has a purely ritual role; however, the practical is still present with the land preparation and the creation of the planting mounds. A smaller plot located on the outer edges of larger plots may be the only key to finding this archaeologically. In addition to the ritual, the *māra tautāne* shows a way of gardening that reiterates communal authority. Individuals would contribute to the sacred plot and once the plot was complete, they would begin work in their fields.

Following on from further ritual activities the *tapu* was lifted from the workers and the final phase in planting was the setting of the *taumata,* the representations of the gods in the fields. This involved the instilling of the value of *mauri* into objects. To ensure the protection and the welfare of the cultivation grounds (Best 1976:201,209). Physical mediums used were large stones that could be carved or plain and wooden carvings, all a likely representation of the kūmara god *Rongo* (Best 1976:202). Other objects used to instill the *mauri* of a cultivation ground were sticks put in the ground placed on the eastern side of the field. (Best 1976:147). Bones of ancestors were sometimes used when a crop was not faring well. These were placed within the cultivations. The human bones were removed as were the carved items, at some point during the process but the stones remained in place long after the harvest was complete as below:

> "Their kūmara and taro grounds are generally contiguous and divided into lands. These are also marked with a stone over which incantations have been uttered which render them so sacred that to move one was supposed to be sufficient to cause death such a death would be the result of the magic spells repeated over the stones" (Best 1976:127).

Cultivating the crop

The cultivating of the crop is the general care and maintenance of the seed tubers once planted. Involved was the tilling of the soil, the removal of clods, and keeping the soil soft and the puke was constantly being loosened to ensure aeration (Walsh 1902:19). This included weed removal which was a comparatively light task until European settlement introduced invasive weed species (Walsh 1902:19). It was carried out in the dry summer with small wooden spades like a short paddle, possibly a *kaheru* (Walsh 1902:19). Described by Firth is the dispersal of superfluous rainwater. Gardens were generally not watered. "They also never watered their plants, not even in times of great drought" (Colenso 1880:11).

When the crop runners of the plants began to grow over the mounds the soil work ceased to prevent any damage (Best 1976:170). It was then the runners that would be constantly tended to. If it was found that runners were resting on the soil after rains where no gravel had been laid, then herbage would be placed under them. If there were pools of water, then a *kō* was used to loosen and drain off the water (Best 1976:170).

Break-winds were installed to shelter the crop from strong winds, these were formed of fern or tee tree fronds stuck in the ground and set up in lines across the plantation. (Best 1976:133-

134). Ritual chants and offerings to the gods were carried out for protection against heavy rains, frosts, and pests, and for the promotion of growth.

Harvest

For the harvest, the table lists the inspection of the crop, the preparation of the store pits, and the lifting of the crop. This phase has a high amount of ritual or ‘magic’ involved in the elements. The time for harvest began with the *maramataka*, the Māori lunar calendar. The *maramataka* is not described by Firth, but it was an important part of the cultivation process, as it was the guide for the beginning of the cultivation process and for its end.

Based on the phases of the moon and its waxing and waning, it was used as a guide for planting, fishing, and other activities (Best 1976:145-146). Each moon phase had its own name, and *ōue*, *Ari*, *Rakāu-nui*, and *Rākau-matohi* were nights when the kūmara were planted (Best 1976:145-146). There were four stars closely observed in connection with the cultivation of kūmara. These four stars are the *matariki*, *tautoru*, *puanga* and *whakaahu*. These stars would foretell a prosperous season or a “backward” season. If it was the former, then the kūmara would be planted in September and if the latter then planting was delayed until October (Best 1976:144). When the star *whānui* appeared the lifting of the crop would begin.

The *tohunga* checked the crops for readiness by digging the first hillock with a broken stick, not a carved tool. According to Walsh (1902), the crop was lifted around March-April on a dry sunny day, to avoid the effects of dampness on the kūmara (Walsh 1902:20). On a practical side when the leaves of the kūmara became brown, it was also a sign that the crop was matured (Best 1976:171).

An account by the Reverend Morei Turei (1913), describes how the *tohunga* would begin the harvest by digging the first kūmara and reburying it while reciting *karakia.* Then the lifting of the whole crop would begin. Once the kūmara was harvested the kūmara of the first hillock would be unearthed again (Turei:1913:38).

The collectors placed the kūmara in the *awa* (space between the rows) and then another person would gather them up into the baskets for the store pits (Best 1976:170-171). There are modern accounts that state no tools were used for the harvest only hands, in fear of breaking or damaging the tubers (Lowe and Puke 2018). But others state that "with a small wooden spade they would gently loosen the earth and feel underground for the largest root- [this was] called the *whakatau kit e arā* meeting [the crop] on the road", (Walsh 1902:20).

<u>3.10 Garden organisation</u>

Garden organisation refers to plot orientation, location, and the layout of the plants, which can be quincunx or rows. The location of cultivations was reported as a small plot near a residence and larger "main crops" located further away (Yates 1835:155). East facing was described as the best for the kūmara, taro, and potato, on hill slopes with a dry northerly aspect (Taylor 1855:378, Walsh 1902:13-14).

The sides of the garden plot were named the *upoko* for the head which faced east, and the *remu* for the tail of the field which was orientated west (Best 1976:153). Weeds and clods of soil were never placed at the *upoko* of the field, as this could disrupt the airflow and warmth to the plants. The entrance to the plot was on the northern side of the field and brought warm airflow to the kūmara plants, only *tapu*persons could enter here. If a person entered from the east and west sides of the garden, it could cast a shadow in front of the sun and when entering from the south it could bring the cold southerly's (Walsh 1902:19).

A description of the quincunx formation is provided by Best (1976). The workers began at the *remu* (tail) of the field in a diagonal formation. The *upoko* (head) was where the planter always faced in an easterly direction and where the crops were planted towards (Figure 14). Once they reached the end of their lines they turned north and went in reverse back down towards the *remu*, always facing east (Best 1976:153).

Planting the seed tubers was done in time with each other and very methodically. Every mound was made to touch the two mounds in the next row creating the quincunx pattern (Walsh 1902:16). This order and method of planting created the extreme regularity seen by early explorers as quoted in the historical accounts (Best 1976:149).

One of Best's informants in Poverty Bay states that in his district, the kūmara is not planted in the quincunx order but that it was formerly planted in a different manner (Best 1976:152). The planting of quincunx versus rows may just be for preference and the *tikanga* of a group.

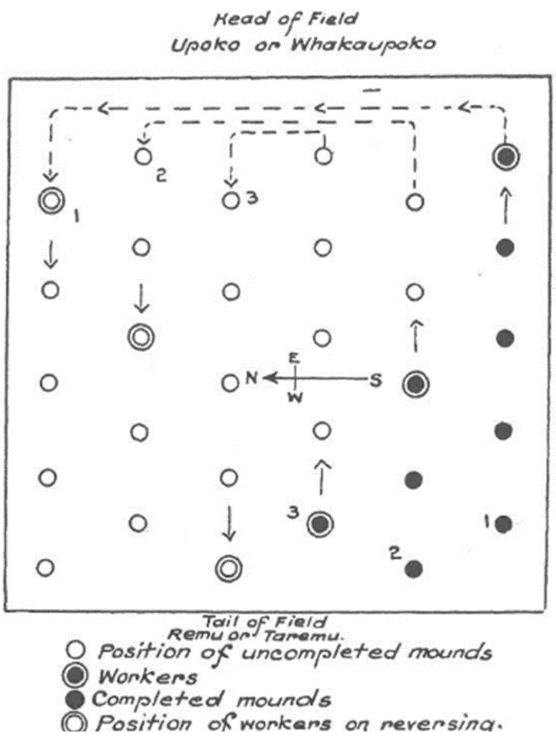

Figure 14:Quincunx method of planting the kūmara (Best 1976:figure 43)

The use of a line seems to have been present in some regions, which could contribute to the garden's orderly manner. As stated by Best (1976) it seems that this is clear proof of a line or at least pegs to mark the *puke* positions, in this region (Best 1976:151). One of Best's informants *Harae Puke Tapu*of *Te Wairoa* asserts that no cord was used, that the diggers and planters kept in formation and exercised care then the correct alignment would be kept (Best 1976:150-152). The use of lines to measure out the locations of the plants may be a regional practice.

3.11 Crops and soil modifications

The main cultivated crops of Māori were kūmara, gourd, taro, and yams, but it is the kūmara that is largely associated with the value of *tapu*. For the other crops, only the gourd is reported as having religious observances attached (Best 1976:228). The taro ceremonies may have been minimal as "ceremonial performances that pertained to the planting and cultivation of the taro tends to show it was not held in the same esteem as the kūmara" (Best 1976:238).

The gourd was honoured in Māori myth with a personified form such as *Rongo* was for the kūmara. The way in which the gourd was planted is commented upon by Best, from his informant *Tuta Nihoniho* of *Ngari Porou.* He describes that the gourd was planted at the full moon in little heaps of earth and facing east (Best 1976:245).

As described in the historical accounts the soil in which the kūmara thrives is light and sandy and where this is not the nature of the soil, then additions of sand or small gravel are made to improve drainage to a clay-based soil. (Walsh 1902:14). In contrast, the Māori gourd required a damp rich soil with a warm aspect and was set in "little hollow dishes".

The gourd was often planted next to taro plantations and sometimes on the outside of the woods or thickets. (Best 1976:245). The taro required a damp soil that was light and deep yet loamy or alluvial. They were placed often on the banks of streams or lagoons and sometimes at the foot of high cliffs near the sea (Best 1976:134). One of Best's informants from *Ngati Porou* describes that taro was planted in straight lines within holes or *pārua* with gravel placed within and on top. When the young shoots grew up some of the gravel lying on the brink of the hole was raked in with the hand and put round the growing shoots; this process was repeated several times (Best 1976 234-243). The great labour of growing the Māori taro caused it to be abandoned when the taro *merekeno* a European variety was introduced being hardy and easy to cultivate (Best 1976:241).

Discussion and conclusion

Raymond Firth's anthropological studies of Māori societies show that the practical and the ritual always operated alongside each other as the "work" and the "magic" and they were influenced by the *tikanga* of a group (Firth 1929: 234). By including Firth's work, we can see that understanding *tikanga* is to know that the environment and values are woven together in the *mātauranga.* We can certainly pull these apart to gain further understanding, but they are best understood as a whole, the "work" and the "magic" always work alongside each other, and essentially, in Māori belief could not operate without the other. But we can separate the ritual performance of the values with the practical of the environment to an extent and apply these to the archaeological record to look at the whole landscape.

The evidence presented suggests tangible and intangible links to *tikanga* in gardening that could be viewed archaeologically. The tangible is the physical manifestations of *tikanga,* and the intangible is where the *tikanga* cannot be directly seen in the archaeological record but there is still a link present that can influence elements of the gardening system.

The tangible is the stone objects instilled with *mauri* which may still be present in an archaeological site. Plot orientations within the landscape were related to winds and warmth and were instilled with *tapu* to achieve optimum growth and crop survival. These sides may be able to be viewed archaeologically. The *māra tautāne* could be present at archaeological garden sites, defined as a smaller plot on the boundaries of larger plots.

The intangible *tikanga* is the *maramataka*, and the ritual *karakia* and are essential to the cultivation process. We are unable to view these directly in the archaeological record, but they still play a large part in the cultivation process. The ritual practice of *tapu* kept order and may be related to the orderly and tidy appearance of gardens that are prevalent in the early historical accounts. As Firth describes "*Tapu* in its economic aspect shows that it has distinct practical effects. As a social value it regulates conduct in work and a concentration of energy for the upmost important tasks" (Firth 1929:238).

To view *tikanga* in the gardens of the Bay of Islands a reconstruction of the environmental setting in the 18th and 19th centuries is presented. The environment is defined through the geology of soil, the local climate, and landscape. These are assessed and then compared with what the key crops (potato and kūmara) grown in the 19th century required for optimal growth. The values of *tapu*, *mauri,* and *kaitiakitanga* are applied to the environmental picture. These may be identifiable through the organisation of gardens and how the plots sit within the landscape. Soil modifications are most likely to be attributed to environmental factors, but they could also be linked to the aspect of the public and private *tikanga*, where smaller *whānau* groups were operating under their own *tikanga*.

Chapter 4: Tikanga in Early Māori Gardens of the Bay of Islands

Introduction

Early Māori garden sites in the Bay of Islands are used as a case study for viewing *tikanga* in the archaeological record. To begin a background study is conducted of the archaeological garden sites in the eastern Bay of Islands, to create a context for the key sites in Opunga and Mangahawea Bays. Included in this background study are the historical accounts associated with gardens in the Bay of Islands and Māori Land Court records. The key sites of Opunga and Mangahawea Bay on Moturua Island are described with emphasis on the soil modifications and garden organisation that is represented. A model is then presented that will be applied to these sites to find *tikanga.*

The model consists of a broad approach that follows the ritual and practical parts of the cultivation process following Firth (1929,1959). The ritual is defined as the social values of *tapu, mauri,* and *kaitiakitanga,* and these are considered as the main values associated with early Māori gardens. The practical is defined as the environment that the gardens were set in. This requires an environmental reconstruction of the soils, paleoclimate, and landscape of the eastern Bay of Islands.

A comparison study of the environmental reconstruction findings and the soil modifications and garden organisations with optimum kūmara and potato growth requirements is conducted. This will help to define direct *tikanga* that could be related to an environmental response and therefore an environmental *tikanga*, *tikanga* that can be related to the social values, and the ritual *tikanga*. We may also be able to see *tikanga* that could be related to a specific *whānau* group or *hapū* that have developed their own gardening techniques, that stems from variations in *mātauranga.*

4.1 The Bay of Islands

The Bay of Islands is a natural deep-water harbour and one of the largest along this coastline (Streiwski 1999:93) Within this harbour are six easternmost Islands. Urupukapuka, Moturua, Waewaetorea, Motukiekie, Motuarohia and Okahu Islands. The islands range from steep to moderately steep with rocky cliff flanks, slopes, saddles, sandy bays and freshwater streams. The bays predominantly consist of a back beach and high surrounding slopes, which offer numerous sheltered bays that are east and north-facing (Figure 15).

Figure 15:Bay of Islands location map with inset of the North Island (ARCHSITE)

The eastern Bay of Islands is a rich archaeological landscape characterised by headland pa, terraces, pits, midden, and garden sites. The garden sites are represented as slope and flat land drains, modified soils, and remnant taro. In addition to well represented sites of the pre-

European period, the Bay of Islands also has a rich historic period that continued to the mid to late 19th century.

4.2 Historical accounts

In November 1769, the Endeavour anchored near Motuarohia Island, in the Bay of Islands. Captain Cook noted that the population was much larger than earlier locations they had visited. (Beaglehole 1968: 218-219). On the 1st of December 1769, Banks and Dr Solander went ashore to an island which was described as having "very large plantations of sweet potato, yams and c [cocos], or taro, all about their village" (Morrell 1958:87). Although it is unclear which island, it is likely to be either Motuarohia or Moturua. On the morning of the 3rd of December Banks and Solander went ashore to an island and were shown the cultivations of yams, kūmara and taro. It was here they were shown "the *Aouta* from whence they made cloth" (Morrell 1958: 88). This is the *Aute* or paper mulberry plant, brought by the first inhabitants from tropical Polynesia. During the visit they also described garden sizes as having 40 to 50 acres of root crops (Spencer 1979: 12).

The next set of accounts comes from the early explorer ships the *Mascarin* and *Marquis de Castrin* in 1772. Marion Du Fresne and his crew spent three months in the Bay of Islands and made a shore camp on Moturua Island, in Waipao Bay. Garden descriptions from Du Clesmeurs, the captain of the *Marquis de Castries* described the land around the Bay of Islands, as "slopes that were cultivated with great care. They produced sweet potatoes, and pumpkins and cultivate a species of vacoua that grows in marshy places (taro). They described the soil being tilled with a long stick, likely to be the *kō*" (McNab 1914:475). In addition, he describes their diet as fern root, sweet potato, fish, and shellfish (McNab 1914:473).

During the French stay Crozet established on Moturua Island, presumably in Waipao Bay, near their shore camp, where they planted wheat, maize, potatoes, and various kinds of nuts. This was primarily to supply fresh food for the French expedition but, as another member of the expedition noted, the French also attempted to convince Māori that the crops "might be very useful to them" … The natives seemed highly pleased and informed us that they would take care of our cultivations (Kelly 1951:61). Urupukapuka Island was described as an "island with a great deal of cultivated lands and townes on it" (Pickersgill cited in Salmond 1991:233).

The accounts indicate the root crops that were planted on the islands and that gardens archaeologically would be well represented here. The full list of sites recorded as representing garden sites is described in the archaeological background of the Bay of Islands.

4.3 Māori Land Court Records

The Northern Minute Books provide some descriptions of the land use of the eastern Bay of Islands, the aim was to find insights on gardens here and associated *tikanga.* Specific gardening techniques were not described but excerpts talk of crops and the land use overtime. These indicate continual reuse of locations for gardening that may have extended into the mid to late 19th century even the 20th century. The passages from the books are provided, in some cases the words or letters were undecipherable due to the writing style of the minute taker. The word "cultivation" has been shortened by the minute taker at times to "culted" and "cult".

On the island of Okahu cultivating was done for the purpose of a feast in Te Kerikeri. "Tawa: my father built a home at Okahu for a feast to live in while we cultivated here. This site is still visible we cultivated [……….], […]Okahu for a feast at Te Kerikeri that is why we went there to cultivate [……] (NMB25 1898:111).

Otupoho bay on Moturua was described as having gardens of kūmara for whalers, "Te Rangi and his wife culted [cultivated] kūmara at Otupoho on Moturua but that cultivation was made for the whaling [……]". He has culted and ran cattle on these islands 3 times [………]of the operations were in the nature of permanent operations" (NMB25 1898:143)

At Waewaetorea Island what is likely to be two to three separate gardening events associated to potatoes by two separate persons (NMB25 1898:111).
"Mita[?] ei tai went [……] to Waewaetorea to plant potatoes, I also went here to plant potatoes at the same time and our cultivations can be distinguished now" (NMB25 1898:112).

“Hare Warena [?] was really only about 3 weeks cultivating on Waewaetorea” (NMB25 1898:133).

“Ihaka told me Te Hakuene[?] had culted at Otawaki- we were catching pigs there. Ihaka worked on Waewaetorea at Otawaki he worked there with his father Te Hakuene[?]” (NMB 1898:140). Otawaki may be a place name on Waewaetorea or another name used for the island. Pigs are not known to have ever been on these islands, this a noteworthy comment open for interpretation.

The bays of Moturua are named along with names to whom the cultivations belong to. Although difficult to decipher the Māori spelling of names by the minute taker, the bays of Mangahawea, Opunga, Awaawaroa, Wai-iti and another unclear name is described as having cultivations. “Opunga a cull of the same” (NMB 1898:173). The descriptions are not of any detail, just “a cultivation” or a “cull” The use of “the same” is repeated and may be referring to the same name as a previously listed cultivation description. Mangahawea “A cull of mine here – Puatea Potama [?]” (NMB 1898:173). This name although unclear seems to claim a large amount of the cultivations on Moturua Island.

The evidence from these records of the eastern Bay of Islands suggests that the gardening on the islands of Moturua, Okahu, and Waewaetorea may have been representative of mid to late 18th-century gardening. This could indicate the intermittent re-use of locations over time in the Bay of Islands, and therefore interpreting gardens as pre-historic only does not suit the how Bay of Islands was used and occupied.

There is a pattern in these accounts that attributes a person or a family to cultivations in the separate bays. This could present evidence in the archaeological record of the gardens where a family group or person may have a certain gardening technique that can be seen in garden organisation and soil modifications.

4.4 The archaeology of the Bay of Islands garden sites

Archaeological field surveys of these islands were conducted in 1976 by Leahy and Walsh and in 1983 by Kathryn Rountree. The most recent field survey was in 2009 by Blanshard and Goddard on Urupukapuka Island, which updated the sites recorded in 1976 and 1983. The sites identified on the islands are related to gardens and are presented in Tables 1- 4 and shown in Figure 16. These garden sites are represented by soil modifications and features that identify with gardens, such as drainage systems. These features are directly associated with garden organisation soil modifications. These are described with the aim of contextualising and providing contrasts to the case study sites in Mangahawea and Opunga Bay.

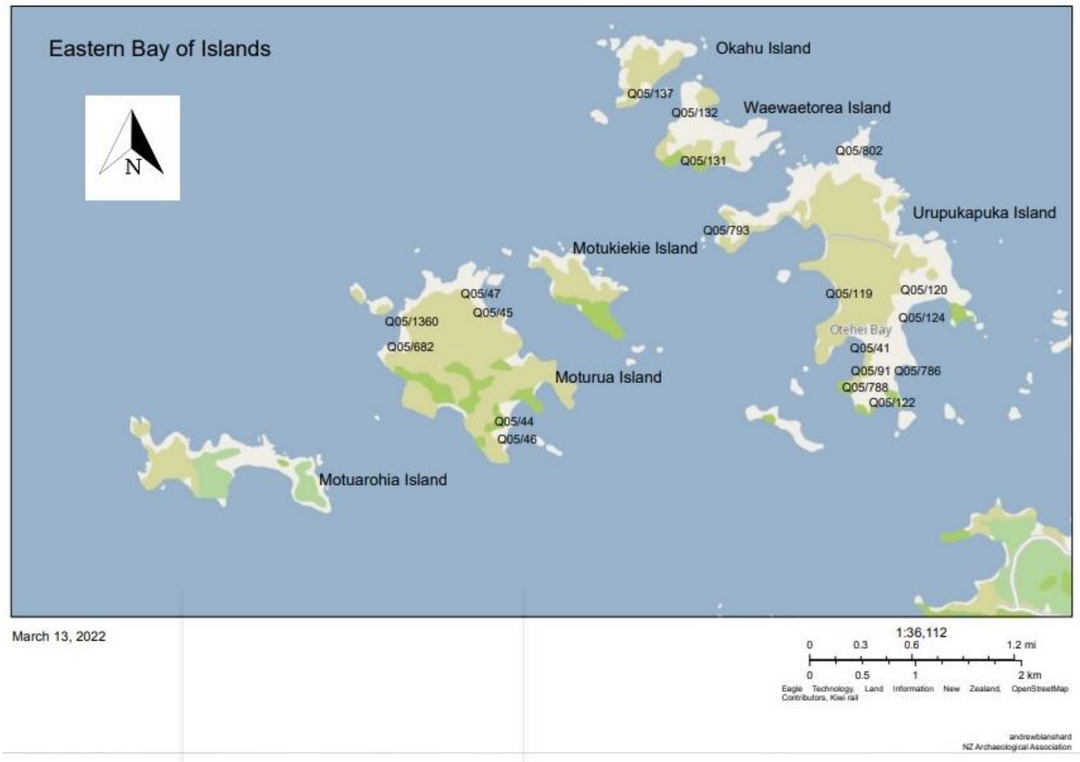

Figure 16: Archaeological Garden sites in the Bay of Islands as listed and described in tables 1-4 (map ARCHSITE)

Moturua Island recorded garden sites (ARCHSITE)		
Site record number	**Site type**	**Brief description**
Q05/1360	Cultivation soil	Pebbles, shell mixed within the topsoil Northern slope of Mangahawea Bay facing south-west (Blanshard 2007)
Q05/682	Cultivation soils and early settlement site	Mangahawea Bay. Research excavations
Q05/47	Field system	Flat land drains Army Bay (Peters 1968)
Q05/45	Slope drains	Slope drains located on the southern side of Army Bay east facing (Peters 1968)
Q05/44	Slope drains and cultivation soils	Slope drains on the southern end of Opunga Bay, cultivation soils (pebbles, shell and topsoil mix) (Groube 1968, Peters 1975, Johnson 1997)
Q05/46	Cultivation soils and early settlement site	Cultivation soils, Opunga Bay beach flat (pebbles, shell mixed with topsoil), artefacts representing early settlement (Peters 1975, Johnson 1997)

Table 1:Recorded archaeological sites on Moturua Island (ARCHSITE)

Okahu Island recorded garden sites (ARCHSITE)		
Site record number	**Site type**	**Brief description**
Q05/137	taro plants	Small clump of remnant taro

Table 2:Recorded archaeological sites Okahu Island (ARCHSITE)

Waewaetorea Island recorded garden sites (ARCHSITE)		
Site record number	**Site type**	**Brief description**
Q05/132	Drains	On the flat
Q05/131	Taro plants	Remnant taro growing in the stream (noted as the small type)

Table 3:Recorded archaeological sites on Waewaetorea Island (ARCHSITE)

Urupukapuka Island recorded garden sites (ARCHSITE)		
Site record number	**Site type**	**Brief description**
Q05/793	Slope drains Cultivation soils	Slope drains located in western bay, cultivation soils seen in the track profile (pebbles, shell mixed with topsoil)
Q05/802	Flat cultivated areas	Possible defended located on eastern side and west facing, 3 large areas that look to have been artificially modified.
Q05/119	Drains and terraces	Drains and terraces, intersecting drains of a field system, west facing on the eastern side of Paradise Bay
Q05/120	Drains	Interconnected drain system on the flat of Urupukapuka Bay
Q05/124	Drains	Drains on the flat Urupukapuka Bay
Q05/121	Slope drains and terraces	Slope drains east facing Urupukapuka Bay
Q05/41	Drains	Slope drains and parallel drains on the flats (the latter likely European) Otehei Bay
Q05/91	Terraced knoll complex	Excavated and interpreted as gardens. Knoll overlooking Otehei Bay
Q05/788	Taro plants on terraces	Remnant taro slopes of Otehei Bay

Q05/122	Modification soils	On beach flat of cable Bay (pebbles, charcoal and shell)
Q05/786	Slopes drains	4 slope drains east facing slope

Table 4: Recorded archaeological sites on Urupukapuka Island (ARCHSITE)

The modified soil sites of Q05/1360, Q05/44, Q05/46, Q05/793, Q05/122 contain beach pebbles, fragmented shells, and some charcoal, which are well mixed into the soil. The depth and spans range from 300-500mm. These modified soils have been found in bays on the beach flats and surrounding slopes. This modified soil mix has been closely associated with kūmara soils ethnographically.

The modified soils of Q05/91 and Q05/682 vary to this soil mix. Q05/91 soil was described as black and greasy with charcoal and no other additions (Bader 2010). This site was located on a high natural knoll on Urupukapuka Island a natural feature that is common on these islands and further investigation of 'knolls' would be beneficial for comparison. This modified soil does not fit with the soils described for kūmara growth. The area surrounding the modified soil was found to be heavily palisaded, indicating defended gardens (Bader 2010).

Q05/682 in Mangahawea Bay is located on a beach flat that has been geologically recognised as marine terrace on the western side of Moturua Island. Eleven trenches were excavated during the 2019 and 2020 excavation seasons. The trenches displayed a variety of garden soil mixes which are described and analysed in the soil modifications subsection to follow.

Slope drains are essentially parallel ditches that begin near the top of a slope and end near the foot of a slope. Flat-land drains generally consist of different formations that can intersect and run parallel to each other. Interpretations of these vary but they are generally assigned to the purpose of water draining and/or boundary marking (Barber 1989:3-7).

There are eight slope drain sites recorded on five of the six islands. These are classed as being on a gradient greater than 15 degrees, after Barber's 1989 classification system for drains in Northland. Drain numbers within sites range from four to nine drains within a site, not all drains are counted in the site record forms. The post-depositional processes that can affect drains and their visibility and form in the landscape can affect the representations. Some drains may have been created over time through water flow channels scouring out new drains in the landscape or modifying current ones presenting difficulties if applying a functionalist approach.

4.5 The model

Environmental reconstruction of Moturua Island

To understand how gardens operated within their physical setting an environmental study of the Bay of Islands is conducted. This consists of a paleoclimatic reconstruction and a study of the soils and landscape of the Bay of Islands. The time period that is focussed upon is between the 18th and 19th centuries. This time slice is in line with the evidence that has been presented in the accounts, and the Māori land court documents. Accounts of the climate are also available for this time period in the Bay of Islands region. Furthermore, the current archaeological landscape in the eastern Bay of Islands is likely to be largely representative of this time period, as is suggested from the historical accounts and the Māori Land Court records.

Climatic factors play an important role in early Māori gardening and key weather factors that early gardeners needed to contend with were rainfall, wind, and temperature, and techniques in gardening needed to be developed and tested for optimal crop growth. We may see the response to the climate and local weather patterns in the archaeology of garden organisation and soil modifications.

A geological study with a focus on soils in the Bay of Islands, their properties, and formational processes is presented. The natural soils of the Bay of Islands will be compared to optimum soil growth requirements of the kūmara and potato from historical ethnographic accounts, experimental archaeology, and technical horticultural publications. This will test how suitable the soils and climate were at Opunga and Mangahawea Bays, and if modifications and adaptations could be expected.

The results of the comparison are contrasted with an analysis of three soil samples from Mangahawea Bay (2019,2020) and the soil modifications at Opunga Bay (1997) on Moturua Island, to find environmental *tikanga.*

The social values

The practice of the social values, *tapu,* and *mauri* may be physically manifest in the archaeological evidence. The values are likely to be present in the garden organisation through the presence of *mauri* stones and in plot orientations. *Kaitiakitanga* includes the communal authority, and the care of the land and the people. The family group *tikanga* is also considered. This is described as garden techniques that may be specific to a *whānau* group, or *hapū*.

4.6 Environmental reconstruction

Paleoclimate of the Bay of Islands

There has not been a published local study utilising paleoclimatic techniques for the eastern Bay of Islands. But indirect evidence of temperature, wind, and rainfall patterns from Waimate North and the Northland region is utilised and compared to modern data for the Bay of Islands, to develop a climatic picture for Moturua Island in the 18th and 19th centuries. Meteorological observations in the early to mid-19th century at Waimate Mission Station west of the eastern Bay of Islands and other paleoclimatic studies of the Northland show wider trends in weather patterns can be extrapolated to a local environment. The seasons that are focused upon is the kūmara cropping period that begins from October to March, in New Zealand, this is spring to late summer. The weather patterns during this time would be influential to garden organisation and soil modifications.

The Reverend Richard Davis who was stationed at the Waimate North mission station, inland Bay of Islands conducted meteorological recordings at Waimate from 1839 to 1851. His records include up to 13,000 meteorological measurements and local environmental observations. Quantitative measurements of temperatures at 9am and 12pm and qualitative observations of wind direction, associated with eight basic compass bearings relative to true north with the addition of variable (multi-directional) winds.

Weather patterns include descriptions of frost, ice, wind, rainfall, hail, thunder, lightning, and snowfall. The description of “dirty weather” refers to easterly and northerly flows with southerlies that were strong and blustery with rainfall and low cloud cover (Lorrey *et al* 2016:558).

The following is data derived from Lorrey *et al* 2016 study of the Reverend Davis's recordings. Indicated are temperatures, wind direction, and rainfall for only the period of kūmara cropping from October (planting time) and March (harvest time). Also of interest are other observations that were made by Davis, on frosts, fine and calm days, "dirty weather" and climatic events such as floods and snowfall.

Temperatures

Daily temperatures were recorded at 9am and 12pm from 1839 to 1851 by Davis. Lorrey *et al* (2016:561), provides a monthly average for these temperatures during this span of time as shown in table 5. Table 6 represents the mean monthly temperatures for the period of 1839-1851 (Lorrey *et al* 2016:562). Lorrey *et al* 2016:562 has contrasted the mean temperatures of maximum and minimum from the Davis era to modern mean temperatures for the period of 1972-2012 for the same region (table 6).

Averaged monthly temperature (1839-1851)		
Time of day/month	9am	12pm
October	13.6	16.0
November	16.1	18.4
December	18.4	21.0
January	19.5.	22.2
February	19.2	21.6
March	18.3	20.7

Table 5:Averaged monthly temperatures Waimate North 1839-1851 (Lorrey et al 2016:table 1)

Mean monthly temperature 9am (1839-1851)		
Cropping month	Davis mean/VCSN mean (D=Davis V=VCSN)	Difference
October	(13.8D) (13.5V)	0.3/warmer
November	(15.9D) (15.2V)	0.7/warmer
December	(18.3D) (17.1V)	1.2/warmer
January	(19.5D) (18.6V)	0.9/warmer
February	(19.4D) (19.1V)	0.3/warmer
March	(18.5D) (17.9V)	0.6/warmer

Table 6:Mean monthly temperatures Davis versus Modern (Lorrey et al 2016: Table 3).

As shown in Table 6 the cropping season had comparably warmer temperatures than the modern-day VCSN mean. In such a large sample size there is expected to be associated errors. Therefore, Lorrey *et al* place no significance on temperatures with more than a ±0.5 ◦C difference between the reconstructed Davis monthly temperature values and the VCSN. Nevertheless, the Tmaximum , Tminimum and Tmean for December, January and March (and Tmax and Tmean for November) appear warmer in the Davis record relative to the present day, while May-August are categorically cooler (Lorrey *et al* 2016:562).

Rainfall

The summation of Davis's comments on rainfall is based on percentages derived from Lorrey *et al* 2016 (Figure 5, 564). The table shows that December, January, February, and March were the driest months, with the beginning of the planting season as having the highest precipitation, which is characterised as "some form of precipitation". The table also shows other weather patterns defined as a clam, fine, dry days, frosts and, dirty weather (Lorrey *et al* 2016:562).

Frost days are most common in October. Overall, the weather is settled during the cropping months with the precipitation as the highest factor for gardeners to consider. However, precipitation does not indicate rainfall only and can refer to showers and dew. Based on a calculation of the precipitation percentages Table 7,8 shows that the highest amount of precipitation during the planting season were the months of October and November.

Weather patterns (1839-1851)				
Cropping month	Rainfall/precipi-tation	Calm/fine/dry days	Frost	"Dirty weather"
October	54%	35%	5%	20%
November	45%	37%	1%	10%
December	33%	50%	1%	1%
January	35%	50%	0%	4%
February	29%	43%	1%	6%
March	35%	46%	2%	4%

Table 7:Weather patterns for the cropping months at Waimate North (Lorry *et al* 2016:figure 5)

Cropping month	**Precipitation days**
October	16.2
November	13.5
December	9.9
January	10.5
February	8.7
March	10.5

Table 8:Calulated precipitation days during the cropping months at Waimate North (based on table 7)

Wind

Davis's comments on winds have been averaged by season and presented as percentages per month by Lorrey *et al* (2016:563). For the cropping months the most common winds recorded are southerly, south-westerly, and westerly winds during the 19th century (Table 9). These are indicated in bold.

Modern wind flow consists of south-westerly flows in winter, spring, and summer with easterlies in early autumn largely in eastern areas (Chappell:2013:15). Southerlies were however more common across the seasons during Davis's data collection period (Lorrey *et al* 2016:563).

Wind directions (1839-1851)									
Month winds	N	NE	E	SE	S	SW	W	NW	Variab -le
Oct	9.3%	2.4%	6.5%	5.2%	**13.7%**	**16.5%**	**23.8%**	16.1%	6.5%
Nov	17.1%	7.9%	3.8%	3.8%	**10.0%**	**13.8%**	**21.3%**	12.1%	10.4%
Dec	7.7%	8.5%	11.3	4.8	**12.5**	**13.7**	**17.7**	7.3	16.5
Jan	11.1%	2.9%	10.0	5.0	**14.3**	**16.8**	**14.7**	6.5	18.6
Feb	10.2%	5.9%	11.4	13.0	**16.5**	**12.2**	**9.1**	5.5	16.1
Mar	7.9%	4.3%	16.1	12.2	**15.4**	**14.3**	**12.2**	6.5	11.1

Table 9:Wind directions Waimate North 1839-1851 (Lorrey *et al* 2016:table 4)

A more southerly flow than present day would bring cooler temperatures and “dirty weather”, and Davis’s accounts are likely to signal eyewitness observations for the end of the Little Ice Age in New Zealand (Lorrey *et al* 2016:571). During this time there were significant climate occurrences that were more frequent and larger scale than is experienced today (Lorrey *et al* 2016:571).

Climatic events

Davis makes observations of climatic events that may have posed significant impact to gardens during the cropping period. Hail, ice, and frost are commonly documented in the winter months, not the cropping months. Reports of frosts with ice of 1.2mm thick in June 1834 and on July 1839 ice 6.35mm thick and frost is noted 106 times over the span of 9 years. This is contrasted with modern day frost records from Kerikeri where frost is uncommon from November to April although October does record an average of 0.3 for an average of frost days during this month (Chappell 2013:27). Frost is recorded largely on flat lands, valleys and in sheltered inland areas, a landscape description attributable to Waimate North. Snowfall was also mentioned as an isolated event occurring in July 1849 for two days. “The hills were covered in snow the first ever seen by the natives inhabiting this part of New Zealand” (Lorrey *et al* 2016:564-565). Snowfall provides evidence of the cooler climates to be expected during the Little Ice Age.

Reports of “rivers in flood” could have posed a significant threat to living gardens. The cropping month of December was the most common month for floods, followed by February and November (Lorrey *et al* 2016:564,Figure 6).

Climatic events in the modern data for the north show tropical cyclones that can bring heavy periods of rain that occur twice a year between December and April (Chappell 2013:9) This contrast poses some similarities in a broader sense with the Davis era.

For the wider Northland region in the 18th and 19th centuries, there are two studies that can be looked at for comparison to the Davis data period. The first is from Salinger (1994) who conducted a multi-species study on tree ring growth to reconstruct past temperature and wind flows. Specifically, southwesterlies and westerlies across the North Island and in Northland from 1731 to 1976. For Northland, *Agathis Australis* ring growth was used to look at the seasons between and including November to March (Salinger 1994:1137). These general temperature trends and wind flows are presented in the tables 10 and 11.

Temperatures for November to March	
1731-1790	Cool
1800-1810	Warm
1810-1820	Cool
1820-1830	Warm

Table 10:Temperature estimates from 1731-1830 for Northland (Salinger 1994:1142)

The study shows fluctuations between warmer and cooler temperatures during the 18th and 19th centuries. The patterns of southerly and westerly winds show a stronger southerly flow that is present during the first half of the 19th century, with trends of interannual variability in the 18th century and temperature variability during the 18th to 19th centuries.

Southwesterlies and westerlies November to March	
1731-1770	Increased westerlies. No trends in early data but southerlies show interannual variability
1800	Stronger southerly flow in first half with a decrease in the latter half of the 19th century
1830	Westerlies decrease

Table 11:Windflows of the period 1731-1830 for Northland (Salinger 1994:1143-1147)

The second study is from Lorrey *et al* (2007), who looked at spatial patterns in the weather regime classifications and applied these to a regional-scale collection of multi-proxy data. This derived atmospheric circulation reconstructions for three palaeo climatic "timeslices" for the period of 1000AD, and 1AD/BC, 1750AD. Relevant to this study is 1750AD which indicated dry conditions for the North Island (Lorrey 2007:421).

The evidence presented can be looked at within the study of climate drivers. These are represented as three synoptic types: trough, blocking and zonal. These types are influenced by climate drivers to create frequency changes in weather patterns that are seasonal and regional. These drivers combine in diverse ways to generate synoptic type frequency changes (Jiang *et al*:2012 cited in Lorrey *et al* 2013:4). These synoptic types were defined for New Zealand by Kidson (2000) who then aggregated them into the three regimes that are outlined in table 12, as derived from Lorrey *et al* (2007:411, 413).

Synoptic types			
Trough	Wetter across New Zealand	Colder than average across New Zealand	Mixed (positive SOI La Nina)
Zonal	Dry for the North Island	Warmer in northern and eastern regions	Westerly and south westerly (negative SOI El Nino)
Blocking	Wetter in northern and eastern areas	Warmer than average across New Zealand	Northerly and easterly (positive SOI during summer)

Table 12:Synoptic types as derived from Lorrey et al (2007:413).

The climate drivers are known as the southern oscillation (SOI) which measures tropical circulations of ENSO (El Nino) and are the factors that affect northerly and easterly winds, and the interdecadal ‘pacific’ oscillation (IPO) causes shifts in circulation over multiple decades. The southern annular mode (SAM) measures air pressure that affects westerly and southerly wind flows and when SOI is positive (the La Niña state), and SAM is positive, tropical air reaches New Zealand with northerlies and easterlies that block the prevailing westerly flow, the blocking regime. When SAM remains positive, but SOI is negative (the El Niño state) the zonal westerly flow is enhanced, and when SOI and SAM are both in a negative state, then conditions turn cold and unsettled with prevailing south westerly and southerly winds (Anderson 2016:4).

For the Davis period 1839-1850 the ENSO, indicates swings between El Nino and La Nina patterns for the early to mid-1800’s period of observations made by Davis (Lorrey *et al* 2016:568). Indicating the synoptic weather types of trough and zonal for Northland. While in trough it is wetter across New Zealand and colder than average with mixed winds, in zonal it is drier for the North Island and warmer in the eastern regions.

The wider studies show the 18^{th} century as experiencing dry conditions in 1750, with cooler temperatures from 1731 to 1790. Dry could indicate zonal conditions but this does not match with the expected temperatures for this period which reflect a more trough state. There could have however been short periods (seasons) within the 18th century such as 1750 where temperatures were warmer within an overall cooler period.

The trends in wind flow throughout the 18^{th} and 19^{th} centuries remains relatively constant across the region and westerlies and southerlies dominate. We should expect that there will be regional variation between Waimate North and the Bay of Islands as it is certainly indicative in the modern data as shown below.

4.7 Predicted weather patterns for the Bay of Islands

The modern sunshine hours from 1981-2010 show 1700 hours for the Bay of Islands and 1900 hours for Waimate North (Chappell 2013:fig 21:28). The differences in the sunshine hours between Bay of Islands and Waimate could be applied to temperature considerations for the Bay of Islands. Waimate North may have reached higher maximum temperatures than seen at the Bay of Islands. Factors affecting temperature variations between the two locations could be the locational dynamics of the landscape.

The Bay of Islands topography where living gardens were situated were sheltered by high cliffs and rocky outcrops and may have spent more time in shade than the open plains of Waimate North. On the other hand, the islands are sheltered from a high proportion of the southerly and westerly winds that that feature prominently during the 18^{th} and 19^{th} centuries.

Modern rainfall data for the Bay of Islands shows 1200mm annually compared to Waimate North which records 1600-1800mm annually (Chappell 2013,fig 12:17). Similarities exist between rainfall in the Davis era and modern data for the months of January and February at Waimate (Lorrey *et al* 2016:562). Based on these similarities we could expect similar or lower precipitation for the Bay of Islands additionally.

Overall evidence suggests that the Bay of Islands was cooler than the mainland, but not greatly and with lesser precipitation than has been recorded at Waimate. As with wider Northland trough and zonal synoptic types would have been dominant matching the la Nina and El Nino shifts that occurred in the Little Ice Age. As both Waimate and the Bay of Islands are eastern areas then we may not expect a great difference as is seen on opposite sides of the axial line of the North Island. But we cannot rule out local anomalies and synoptic type variability between both areas. A key difference between the area is likely to be the topography, and how this influenced, precipitation, temperatures, and wind flow.

What is of significance is that Davis experienced a relatively higher proportion of what are normally uncommon occurrences of frost and rare events such as snow that do not typify the modern climate and weather of Northland (Lorrey *et al* 2016:571). For the growing period a major event that could affect crops would be floods. These were reported as most common in December followed by February, and November, of the cropping season. We could expect gardens that were prepared for these heavy periods of rain, and this may be most visible through drainage techniques.

The Bay of Islands over the 18th and 19th centuries would have been a highly variable environment. Conditions may have been drier than the mainland with less warmth from sunshine to warm the kūmara beds. Less rainfall may not have been a problem as watering was not essential for optimum growth, but southerly and westerly winds were not favourable to growth and locations would have been carefully selected on northern slopes, if this was not an option then other adaptations such as wind breaks and the warming of soils through additions.

The winter months were cooler in Waimate than the modern day, with more frequent frosts although these were not experienced at a high degree in the cropping period. It could be suggested that although the days were warmer in the cropping period compared to the modern data, the nights may have been cooler and reflective of the Little Ice Age. Adjustments would need to be made to the soils to carry over the heat of the day into the night.

The gardens in Opunga Bay were east facing and well protected from the winds, Mangahawea Bay although sheltered from southerly winds, faced west and could have experienced strong westerly winds that were prevalent in the 18th and 19th centuries. We may see a difference in soil modifications and garden organisation between the bays based on this environmental factor.

Frost is represented in October at Waimate, but this may not be the case for the Bay of Islands as coastal sites by the sea tend to be frost free (Taylor 1958:73). “Dirty weather” does not feature highly in November to March and calm/fine/dry days make up a high percentage of the cropping months.

The 18th and 19th centuries were a highly variable environment with frequent climatic events. It will be tested through the soil modifications and garden organisation if this climatic variability is reflected in the archaeological record of the chosen sites.

4.8 Soils and geology of the Bay of Islands

The Bay of Islands soils are classed as the marua light brown clay loams of the rolling hilly lands. They are yellow brown earths related to steep-land soils as sown in the NZMS 290 sheet Q04/05. They are layered as brown or yellow/brown subsoil below a dark grey, brown topsoil and there can be mottling between the layers.

The rocks are greywacke formed in the Permian to Jurassic. (Striewski 1999: fig 4.3). The soils are strongly weathered with clay subsoils, usually more than a metre in depth. This coupled with steep slopes causes widespread slope instability and an environment prone to erosion (Striewski 1999:107).

The fundamental soil layers for the eastern Bay of Islands have been sourced from Landcare Research, of particular focus are the chemical attributes the physical characteristics and the soil drainage parameters. The temperature for the soils is described as thermic at 15-22C, although differences could be expected for temperatures in the 18^{th} to 19^{th} centuries.

The fundamental soil layers

Key chemical attributes for consideration is the soil Ph which is the measure of acid and alkaline, the cation exchange capacity which gauges the ability of soil to retain added nutrients of calcium, magnesium, and potassium and the phosphate retention which gauges the ability of soils to make phosphate unavailable to plants. Table 13 shows these attributes for the Bay of Islands soils.

The soil physical characteristics for consideration is the soil particle size which shows the proportions of sand, silt, and clay in the fine earth fraction of the soil. The soil drainage parameters of permeability which measures the rate at which water moves through saturated soil, the ease of drainage and the risk of waterlogging. Soil drainage indicates how long a soil or part of a soil is saturated and how quickly it can rid itself of excess water. Drainage is important for the supply of oxygen to the plant root zone.

Soil chemical attributes (Landcare research)	***Bay of Islands soils***
Minimum soil Ph	Low to neutral
CEC- cation exchange capacity	12-24 (mid-range)
Phosphate retention	High- 60-84%
Soil physical characteristics	***Bay of Islands soils***
Soil particle size	Loam or sandy peat with organic matter 30-50%
Soil drainage parameters	***Bay of Islands soils***
Soil permeability	Moderate
Soil drainage	Imperfectly drained
Soil temperature	Thermic (15-22C)

Table 13:Fundamental soil layers Bay of Islands: Chemical attributes (Landcare Research)

The fundamental soil layers indicate acidic soils that are mid-range for the retention of nutrients. Phosphate retention is high. The soil particle size shows nearly half of the soil is a loam or sandy peat which is moderately good for kūmara growth. Permeability and drainage are also mid-range. These soil attributes are compared to information derived on the optimum soil growth requirements for the kūmara and potato.

4.9 Optimum kūmara and potato growth requirements

To establish environmental *tikanga* optimum kūmara and potato growth requirements are compared to the environment and archaeology of the Bay of Islands. Key growth requirement are factors of soils, wind, and warmth for growing crops as sourced from the ethnographic and settlement phase accounts, examples from experimental gardens, and technical horticultural publications.

Key growth requirements for kūmara

The ethnographic and historical accounts describe three main requirements for kūmara growth, soils, wind and warmth. These themes are followed and looked at more closely through modern experimental archaeology and horticultural publications of the kūmara. Winds are not specifically focused upon in these studies, so the ethnographic accounts of favourable and unfavourable wind-flows provide the basis.

Experimental gardens using the pre-European variety of kūmara *taputini* indicate high crop yields can be achieved in sandy silty soil, with little or no water, and a low soil nutrient level (Burtenshaw & Harris 2007:236-244). The project used archaeological, ethnographic and historical descriptions of soil types and quincunx layout to recreate two gardens, one on a yellow clay loam the other a sandy silt (Burtenshaw & Harris 2007:242). The variety of *taputini* is one of four early pre-European varieties that were found to remain and was sourced in the Northland region. (Burtenshaw & Harris 2007:236, Yen 1963:37).

The study found that the friable sandy silt required less effort to tend as opposed to the clay soils (Burtenshaw & Harris 2007:240). *Taputini* can grow good yields of 14 ton per metric hectare in a sandy slit soil compared to the yellow clay loam which yielded 10 ton per metric hectare. Both soils were nutrient deficient specifically in phosphorus and potassium

(Burtenshaw & Harris 2007:241-242), and no fertilisers or organic material were added over the four-year period (Burtenshaw & Harris 2007:240). The drought tolerance of *taputini* was shown during a significant dry period, in a region that receives usually 748mm compared to 249mm. This coupled with no irrigation still gave a productive yield (Burtenshaw & Harris 2007:244). The study did not indicate favoured growth temperatures.

Coleman (1972) describes the optimum soil temperature for kūmara at 21C and Lebot (2008) indicates good growth and yield is best at temperatures above 24 degrees, with cooler air night air temperatures of 20 degrees being advantageous for producing early maturation and higher yields (Lebot 2008:132).

The experimental gardens of *taputini* were not fertilised and no organic matter was added. This still produced a crop considered to be a high yield and suggests a low fertility requirement. However, potassium is described as a requirement for good development of the storage root (Lebot 2008:133). Potassium plays a crucial role in growth of the kūmara root and offers protection from high amounts of nitrogen in the soil, which can cause adverse effects (Lebot 2008:133-134).

Lebot (2008) describes optimum soils as light, dry, sandy loams, and well drained aerated soils. Mounds and ridges are described as common planting mediums as height is important for drainage and harvesting (Lebot 2008:134,139). Watering is described as more complex and water control at certain times within the season can bring differing results. These can be looked at in though the growth cycle of the initial phase, the intermediate phase, the final phase and regeneration phase (Lebot 2008:127).

Initial phase	growth of roots. Slow vine growth
Intermediate phase	Rapid growth of vines. Initial storage root development
Final phase	Vine growth stops. Root bulking begins
Regeneration phase	Sprouting from roots

Table 14: Growth cycle of the kūmara (Lebot 2008:127)

Wet conditions that bring moisture to the soil is required at planting time, this will secure root growth (Lebot 2008:134,142). Soils that carry over the moisture from spring and winter rainfall are important for good development of storage roots, but excess water can result in poor aeration (Coleman 1972:7), and kūmara cannot tolerate dry conditions at planting time (Lebot 2008:134). While the kūmara is drought tolerant as demonstrated by Burtenshaw & Harris (2007), growth needs to be well advanced, or the yield can be low and the quality impaired (Coleman 1972:7).

Over irrigation reduces storage root yield in areas with high rainfall, and temporary drought stress appears to stimulate root development when vine growth is stopped for a short duration (Lebot 2008:135). Excess water however can cause the tubers to crack (Coleman 1972:7).

Lebot (2008), specifically focuses on factors for kūmara growth as related to cuttings whereas descriptions from Coleman (1972) and Burtenshaw (2007) are based on the planting of the tuber roots of an old variety used by Māori. We could then expect variations that are related to the phases represented.

The drought tolerance and low fertility requirement of the *taputini* has been highlighted by experimental garden, but these methods of gardening may not have been how early Māori operated, and it is likely that maximum care was taken to achieve better quality kūmara with higher yields on a variety of soils. The requirements for a quality crop for food, storage and higher yields combined with the value of *tapu* would indicate that all factors of soil, water and temperature would be considered and mitigated through environmental knowledge, and the values of *tikanga*. Table 15 combines the optimum growth requirements for kūmara. The requirements are shown alongside the adaptions and additions to reach optimum growth.

Ideal rainfall for kūmara is a well distributed at 1000-2000mm annually and is said to have the highest yield potential (Lebot 2008:139). The Bay of Islands in the 18th and 19th centuries is suggested to be similar to modern data at 1200mm of precipitation annually or less, a rainfall pattern that suited the kūmara. Daily averages from Waimate show that at midday optimum kūmara growth temperatures are reached for kūmara during December to February of the cropping months.

For the Bay of Islands temperatures could have been relatively cooler, this is based on modern comparisons to Waimate North which receives 200 more sunshine hours than the Bay of Islands. It is likely that temperatures reached 21 degrees or more in the Bay of Islands but due to the cooler night temperatures of the Little Ice Age and more climatic extremes we could expect adaptations and additions to be present archaeologically for optimum growth requirements.

Optimum growth requirements for kūmara	
Warmth	**Adaptations and additions**
21 – 24 degrees suggested for growth and 20 degrees at night	Stones and pebbles used as heat retainers, charcoal to blacken soil
Protection from cold winds	Reed and brush fencing, garden location east or north facing.
Key wind requirements of kūmara	**Adaptations and additions**
Warm northerlies and easterlies	Garden locations preferred in this wind flow-for aeration
Key soil requirements for kūmara	**Adaptations and additions**
Well drained, light, and sandy soil	If required pebbles, and sand added
Low to moderate fertility	Charcoal used for fertilizer adds phosphorus, calcium, magnesium and potassium to soils and possibly marine shell used for lime and calcium
Potassium for root growth	From charcoal, if not present in the natural soils
3-4 years cropping on same soils	Fertilisation required for long term
Low water requirement	Wet conditions at planting time required, otherwise water not essential and can cause damage to the root, drought can stimulate root development

Table 15:Optimum growth requirements for the Kūmara(sourced from Walsh 1902, Taylor 1955 1955,Taylor 1958, Best 1976, Firth 1959. Cameron, Coleman 1972, Lebot 2008, Burtenshaw 2007).

Based on the water requirement for the kūmara the month of October indicates the highest amount of rainfall, which parallels with the requirement for wet conditions at planting time, rainfall then decreases for the rest of the cropping period. This ensured good root development and protection from cracking due to excess moisture. Heavy rainfall events that were common during this time within the cropping months and would have required environmental monitoring and action, which could be seen in the archaeological record.

Key growth requirements for potato

Ethnographic accounts report the planting of potatoes as identical to that of kūmara methods and easily adopted (Best 1925:99). There are some key differences in requirements for the potato versus the kūmara as described (Table 16). For the potato accounts describe them as planted only on freshly cleared ground, on the side of a forested area, where nothing has been planted before. The area is burnt, and the potatoes are planted within the tree roots (Yate 1835:156-157). This situation was best for potatoes which utilised the rotten leaves and branches of trees and shrubs and potatoes would utilize nitrogen from decaying organic material (Cameron 1964:102-103).

The use of manure to Māori was abhorrent but the potato favoured a virgin or strongly manured soil, but Māori rather chose to prepare a fresh ground every year generally by felling and burning on the outskirts of forests (Colenso 1880:11).

Optimum growth requirements for potato	
Warmth	**Adaptations and additions**
Not specified but cool moist soils preferred	Unknown
Protection from cold winds	Not specified
Key soil requirements for potato	**Adaptations and additions**
High fertility-including Phosphate, nitrogen, potassium. Acidic soils best	Charcoal Frequent rotation of garden beds required

Table 16:Optimum growth requirements for the potato (Yates 1835, Cameron 1964, Colenso 1880, Hargreaves 1963).

4.10 Mangahawea and Opunga Bay, Moturua Island: Archaeological background

The archaeological investigations in Opunga and Mangahawea Bay offer elements of garden organisation and soil modifications that can be interpreted using *tikanga*. The archaeological background of these sites are described with emphasis on garden organisational elements and soil modifications.

Figure 17: Moturua Island, the bays described in the text (google maps)

Opunga Bay Q05/44, Q05/46

Opunga Bay is located on the eastern side of Moturua Island and within this bay are two sites that have been archaeologically excavated. The excavation information details soil modifications and slope drains. Opunga Bay was first excavated by Groube in 1965 as part of a project that focused on the excavation of Paeroa Pa. The pa was recorded 1772 by the French during the 2 month stay in the Bay of Islands. Groube's aim was to relocate the features associated to the sketch plan made by the French. He found however that the pa, after an abandonment period was covered in modified soils. Groube's excavation reports are not extensive, but he does describe slope drains that have been cut into an earlier modified soil that were different in texture and content than the more recent overlying garden soil (Groube 1966:111).

This potentially older soil was buried by a clay slip, and the formation of a deep natural soil horizon above the slip indicated that a considerable time-gap separated the two modified soils. Age estimates of radiocarbon dated charcoal were taken from this older buried modified soil by Groube was 1150 BP (Peters 1975:171), or 800 + 90 AD (Groube 1966:112). These were deemed unreliable as the material was an unidentified carbonised wood sample. This indicated a significant inbuilt age was likely (Robinson et al 2019:7-8). Irregular holes were found at the base of the lowest modified soil layer and interpreted by Groube as the former planting basins/hollows of taro (Groube 1966:111-113).

Peters (1975) re-excavated this site with two main goals, to ascertain further dates in comparison with Groube's, and to check the irregular holes related to taro gardening. Four slope drains were recorded on the south slope of Opunga Bay on a 20-degree angle. No measurements were taken of the drains, but there is a sketched map of the slope excavation (Figure 18). Peters placed six squares on the slope between drain C and D and across the lower slope he ran ten squares, approx. 2x1m.

Peters (1975) argued that the slope drains were more likely to be boundary markers as they did not appear to drain the gardens in any specific way. "Horizontal cross drains should be expected at the top and the bottom of the slope, to channel the water into the drains and away from the flat land gardens" (Peters 1975:178).

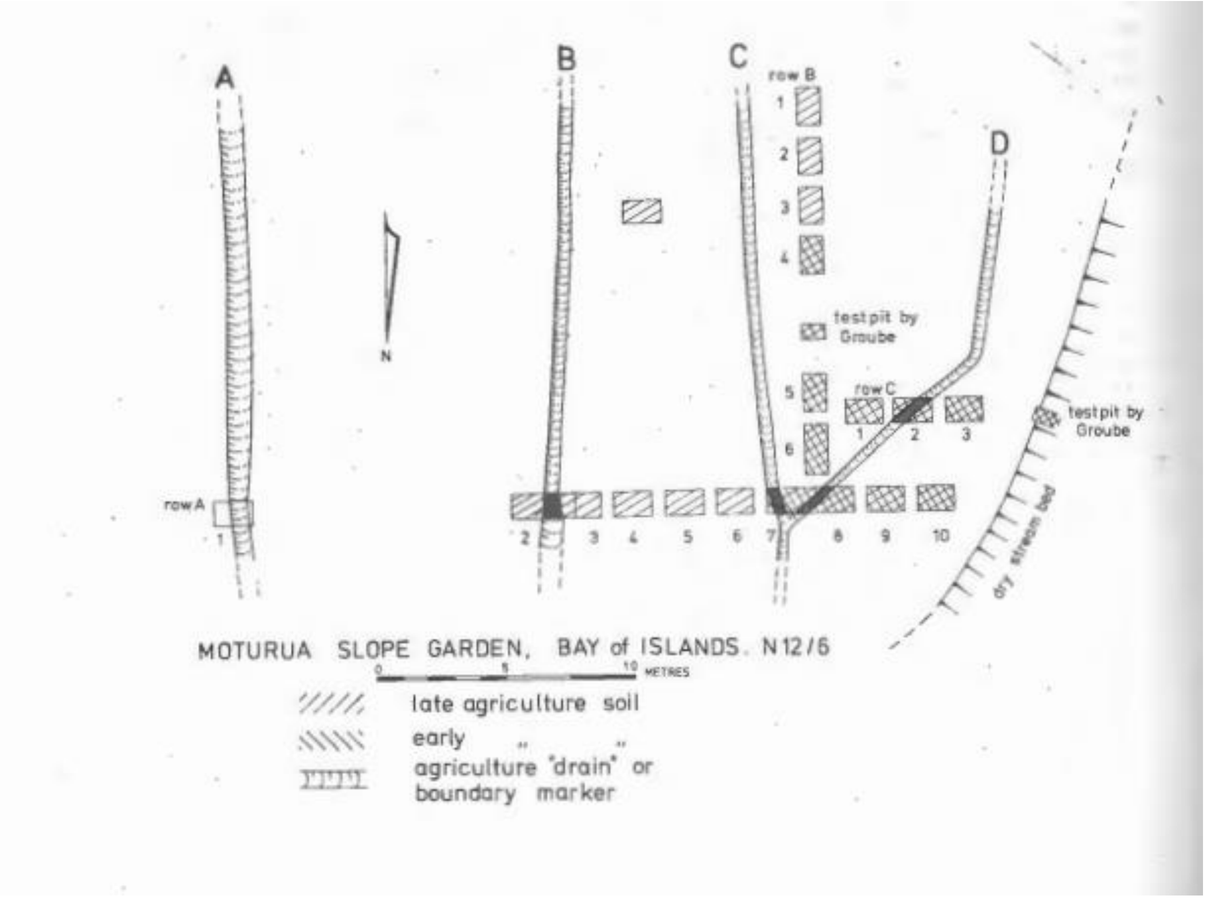

Figure 18:Archaeological excavation of the slope gardens (Q05/44, Peters 1975:172)

The stratigraphic sequence for the slope drains are shown in table 17 (1975:173). Layer two and layer five modified soils are identical except that layer five has parts of layer 6 incorporated. Layer five had the irregular holes at its base, these were suggested as planting holes for the taro by Groube (1966:112). Peters has re-interpreted these as digging stick marks likely made by the *kō* or from initial ground clearance (Peters 1975:173). Additionally, taro preferred swampy ground, which seems unlikely on a slope, without some sort of terracing for water to sit in.

The modified soil of layer 2 was found within and between the drains. The drains were described as cut through layer five modified soil by Groube, and overlying layer 5 was the clay slip layers. The slip was interpreted by Groube and Peters as a period of abandonment that may have been quite substantial based on a possible palaeosol that had formed on the clay slip (layer 3b) (Peters 1976:171-175, Groube 1966:111-112). The new radiocarbon dates from Peters indicated a date of 1360-1632 AD for layer 5 and a date of 1171-1440 AD for layer 6.

Stratigraphic sequence of the slope drains in Opunga Bay (Q05/44) Peters 1975	
Layer 1	Topsoil
Layer 2	Modified soil of beach pebbles, dark grey brown sand, shell and charcoal
Layer 3a	Mixture of layers 2 and 3
Layer 3b	Clay slip
Layer 4	Mixture of clay and modified soil of layer five
Layer 5	Modified soil of brown/grey soil, mixed with beach pebbles, fragmented shell
Layer 6	Greyish/brown soil, with charcoal and sand.
Layer 7	Natural yellow greywacke clay

Table 17:Slope drain stratigraphic sequence of Q05/44 (Peters 1975:173)

Below the slope drains is a beach flat area sheltered by surrounding slopes. Peters (1975:177) found that the modified soil of layer two of the slope drains extended onto the beach flat, as it consisted of a layer of beach pebbles, shell and charcoal mix (Table 18). Artefacts were more frequent compared to the slope drains and obsidian flakes, chert flakes, dog canine, other indistinguishable bone, provenance of the artefacts were not recorded. A broken basalt adze quadrangular in shape and partly polished was found at the bottom of layer 3, indicating it could relate to a settlement present here before the garden soil was established. These artefacts indicate an earlier settlement was located on the beach and before the gardens were established.

Stratigraphic sequence of the beach flat in Opunga Bay (Q05/46) Peters 1975	
Layer 1	Topsoil
Layer 2	Black charcoal-stained soil, mixed with pebbles, shell, sand
Layer 3	More compact and mixed with yellow clay lumps
Layer 4	Yellow sand mixed with charcoal, some shell and clay
Layer 5	Yellow sand and shell

Table 18:Beach flat stratigraphic sequence of Q05/46 (Peters 1975:176)

These two sites in Opunga Bay were re-investigated by Johnson in 1997 as part of an authority to modify. Johnson investigated seven areas on the beach flat and surrounding slopes (Figure 19). Modified soils were present in area's one to six described as modified soils of shell, pebbles and charcoal additions, the depth of garden soil was ranged from 35-40cm (Johnson 1997:8-17), and attributed to kūmara growing

Area one had early Māori settlement remains underlying the modified soils identifiable by the shell midden, fishbone, sea mammal remains, chert, basalt, argillite and obsidian flakes and earth ovens at a depth of 40 cm (Johnson 1997:10). The historic period is also represented in the topsoil of area one with clay pipes, tin or iron and bottle fragments (Johnson 1997:37).

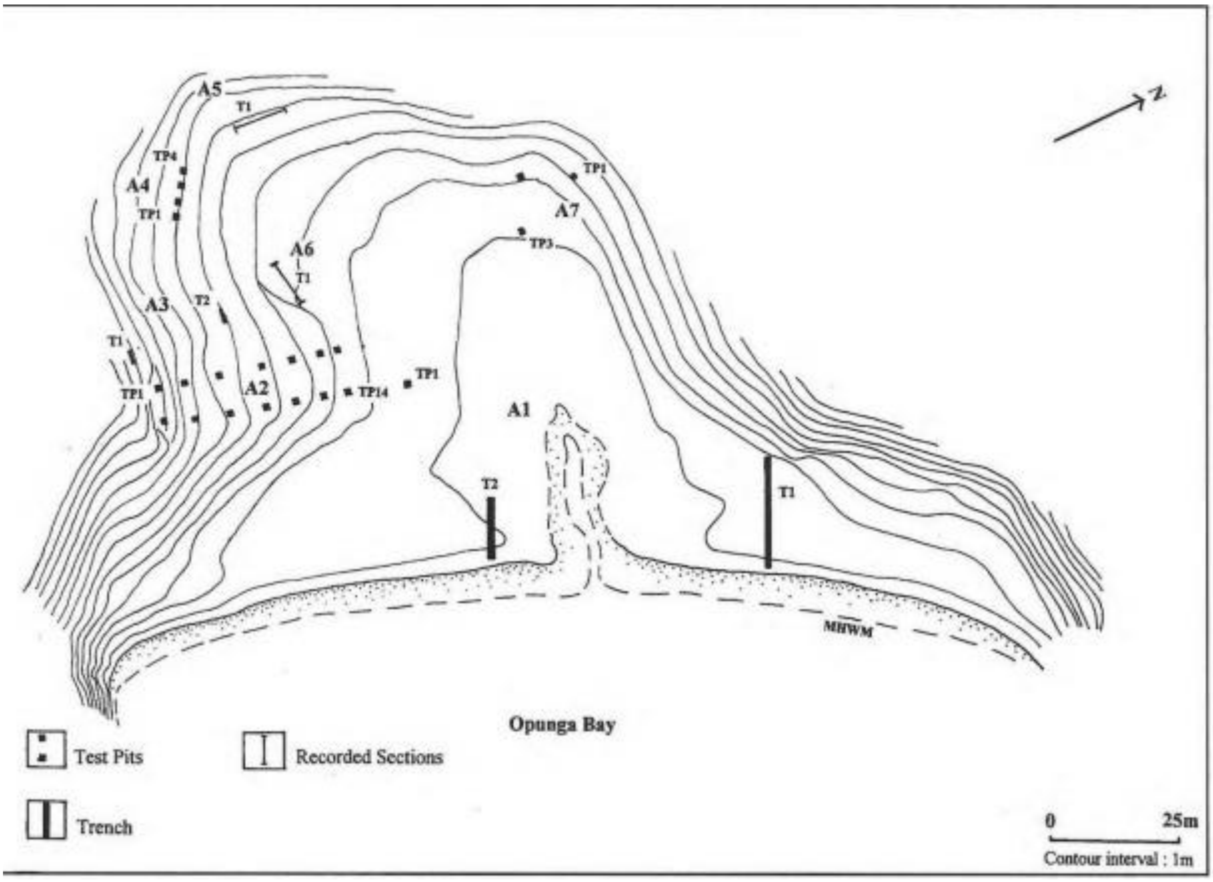

Figure 19:locations of investigation areas Opunga Bay (Johnson 1997:Figure 2)

The modified soil additions were found to be identical to the beach deposit of pebbles and shell as tested through the fine sieving of both the modified soils and beach deposit. Indicating the natural beach resource was utilised for the creation of the modified soils. Water rolled obsidian flakes found in the modified soils, likely gathered from the foreshore with the shell, sand and pebble when creating the modified soils also indicates earlier usage of the bay before garden soils were created here (Johnson 1997:28).

Johnson identified nine slope drains three of which were investigated. These were ranged from 95cm-1.4m in width and 35cm depth on a slope of 25-35 degrees and running 30m uphill located on the north and east facing slopes (Johnson 1997:31-33). The drains were assessed as likely fitting the purpose of draining water during periods of excessive rainfall, as opposed to boundary markers as suggested by Peters (1975:178). This is based upon the individual sizes and the large amount of the area that is taken up by open channel drains which would seem excessive as boundary markers. Boundary markers could easily and perhaps better serve as above ground features (Johnson 1997:41).

Johnson (1997) addressed the post depositional processes that would occur in a slope environment and found evidence in ditch 3 (Figure 20). The ditch/drain cannot be seen on the surface and shows that "existing surface and subsurface structures, their configuration and developmental sequence are a product of some 250 years of natural drainage triggered off by the construction of the ditch in the 17th century" (Johnson 1997:41).

This is evident similarly where there has been movement of the original drain line through natural processes and highlights the difficulty of interpreting the function of drains. The fill of the ditches could reflect a process over time of blockage and filling of the original ditch and successive episodes of re-channelling and filling on an intermittent basis. "A process that can only have been evident when the ditches were established in a functioning hill-slope agricultural system and serves to again reinforce that the ditches would channel water during periods of rainfall" (Johnson 1997:41).

Figure 20:profile of ditch 3 Opunga Bay (Johnson 1997:plate 9)

The settlement history of the bay was difficult to determine as some areas had been cleared of vegetation removing any layers above the modified soils. On the lower slopes and back beach, the presence of European artefacts and relatively limited topsoil development overlying modified soil made it difficult to determine whether the episode of gardening was a single episode in the bay that had occurred in late prehistory or the early historic. In area one there was a sterile sand layer separating the modified soil and historic artefacts. Suggesting that gardening here occurred late in the prehistoric sequence (Johnson 1997:36).

Past investigations have placed the slope excavation by Peters (1975) in northern Hahangarua Bay adjacent and down from Paeroa pa and Johnson's (1997) report is based on the interpretation that the slope drains in Opunga bay had not been excavated previously. Groube and Peters never recorded the name of the bay or provided a site location map and Groube only described them as "nearby [to Paeroa pa] agricultural drains" (Groube 1968:111). This created an ambiguous location for their excavations and resulted in incorrect site relocations by past surveyors. Rountree (1984), placed the beach flat excavation described, in Otupoho Bay mixing up the site coordinates as pointed out by Johnson (1997:5).

The following evidence indicates the likelihood that no excavation by Groube and Peters took place in Hahangarua Bay. Firstly, the site record forms of the slope drains (Q05/44) and the beach flat (Q05/46) are both described as in "The little bay to the south of William Goodfellows Bay". The Goodfellows Bay is northern Hahangarua, directly down from Paeroa pa "the little bay to the south" could only be Opunga Bay.

The second line of evidence is from Peters (1975), who at no point states he is excavating in a separate bay to the slope drains (Q05/44), but rather he describes how an attempt was made to link stratigraphically via test pits, the slope gardens, and the excavations of the beach flat. It is unlikely he was trying to link two excavations areas in separate bays unless he ran tests pits from one bay to another which seems unlikely. Based on this evidence we can say excavations by Groube (1965) and Peters (1975) occurred in Opunga Bay. They both excavated the slope drains here and these were again investigated by Johnson in 1997. The placement of Peters 1975 beach flat investigation in Otupoho Bay needs to be corrected in Archsite.

Taking this evidence into account the 1997 excavations and interpretations of the slope drains is based on features and soils that were thought to have been undisturbed. Interpretations of the data provided by Johnson may be skewed by this fact. The large focus on post depositional processes by Johnson could include disturbance from past excavations. Although not discounted, the post depositional processes may not have been as extreme as described. The clarification of this site information is important for the integrity of the data utilised.

The layer 6 dates are likely to contain inbuilt age errors. Layer 6 is unlikely to be an anthropogenic layer but rather the bottom of the layer 5 interface. The samples could easily be from old wood from natural fires or initial land clearances, that could have washed down to rest in the slope and been disturbed by creation of the garden soil of layer 5 where the digging stick has lifted the charcoal up into the modified soils. The modified soil of layer 5 is somewhat identical to the modified soil of layer 2 and could have quite easily have been created at the same time, but a slip covered the modified soil. The earlier dates giving the impression that the clay slip covering the soil was of significant antiquity. Johnson provided dates of area one, the earlier settlement of 1440 AD and the modified soils on the beach flat to 1641AD (Johnson 1997:34-35).

Due to the unreliability of the dates the stratigraphic sequence is re-interpreted as follows; the modified soil of layer 5 was covered by a slip which was shortly afterward re-established as a garden. If this does reflect any degree of historical reality, as the somewhat identical nature of soil modifications suggest then the supposed 8th century gardening in Opunga Bay would appear more likely associated with the undated Layer 2 which, as Barber (1989: 30) outlines, Peters still felt was prehistoric but which Davidson (1984: 120) outlined is equally likely to be 19th century in origin. (Johnson 1997:43).

Mangahawea Bay Q05/682

Mangahawea is a sheltered bay surrounded by bush clad slopes located on the west coast of Moturua Island. The bay is a “marine terrace” (Dr. Ross Ramsey, pers comm), of 3 ha with a 200m long beach front, it is as deep as it is wide, bisected by a seasonal stream on the southern end of the bay and there is evidence for a paleo stream on the northern end of the bay (Robinson *et al* 2019:2). It is one of the least sheltered of the bays, facing west to an open sea and exposed to strong westerlies. It is however protected from most of the southerlies, by a small island situated on the northern end of the bay. Site Q05/682, located at the southern end of the bay was recorded in 1980 as a midden eroding out from the bank of the stream, from this largely sand deposit, there was moa, dog, seal, chert obsidian, cook strait limpet found. These items indicated an early date in prehistory for this site.

Excavations here in 1981 found further evidence for early occupation that included fireplaces, midden deposits of fish, mammal, and bird bone. The recovered artefacts included one piece bone fishhooks, lures, obsidian and chert flakes and a shell pendant. Moa bone artefacts and food remains were present and a single oyster shell sample (Wk-22364) produced a calibrated age range (95.4 per cent confidence), of 1223-1417 AD (Robinson 2019:3,8,Table 3).The upper levels of the site contained fragments of clay tobacco pipes and weathered bottle glass indicating a long history of occupation in the bay (Robinson 2019:3).

The site was reinvestigated in 2017 in a collaboration of Heritage New Zealand, Department of Conservation and Ngāti Kuta and Patu Keha. Four new radiocarbon dates of charcoal confirmed that people were active here from the 14th century up to the 15th century (Robinson 2019:8-10, Table 3). Both the stratigraphy and radiocarbon samples support the interpretation that the first occupation may have spanned decades or have involved more than one set of events. There was no evidence for sustained, long-term occupation of site Q05/682 (Robinson 2019:8).

Investigations again in 2019 and 2020 extended out from the early occupation site on the stream mouth. During these field seasons a total of 11 areas were excavated to the north of the early occupation site, exposing areas of modified soils that could be attributed to gardening.

The results of these garden soils are yet to be published and dated using radiocarbon dating and pollen analysis. The stratigraphic recordings were done using a camcorder and these at present were unable to be attained. However, overlay and profile pictures of the garden areas excavated along with their soil samples are presented here and are sufficient for this study.

4.11 Soil modifications

A comparison of the fundamental soil layers of the Bay of Islands to the optimal kūmara growing requirements is shown in tables 19 and 20. From this contrast the work that may have been required, to reach optimum growth requirements is shown for Opunga Bay and Mangahawea Bay.

Opunga Bay

Kūmara requirements	**Environment of landscape, climate and natural soils**	**Work required?**
Well-draining	Imperfectly drained, moderate permeability	Yes-soil additions
well-aerated	Not specified	Likely
Warmth day and night over 21 degrees	Soil described as thermic 15-22 cooler paleo climatic temperatures overnight	Yes-soil additions
Low to moderate fertility	Soils are acidic, mid-range for retaining added nutrients	Likely
Low water requirement	Heavy rainfall occurs in the cropping months	Yes- in terms of drainage
Protection from cold winds	Opunga Bay landscape offers protection	Minimal (not exposed to southerlies)
Frost free	Frost frequent at the end of the little ice age but unlikely in a marine/coastal environment	No

Table 19: Opunga bay optimum growth conditions requirements

The natural landscape of the Bay of Islands provided sheltered bays, and Opunga bay was ideally situated. Mangahawea Bay faced the west may have been exposed to strong westerlies that were prevalent in the 18^{th} and 19^{th} centuries.

As discussed, Mangahawea Bay is a marine terrace and geologically differed from the eastern side of Moturua Island. The key differences are the absence of the underlying clay base that is seen in Opunga Bay and the presence of pebbles and shell which are naturally occurring in the soil/sediment composition, and this was evident in the natural sample taken from Mangahawea Bay excavations. The information taken of the fundamental soil layers from Landcare Research may not take this marine terrace into consideration. The key difference then would be that good drainage may have been present naturally.

The addition of the natural beach deposit to the soils in Opunga Bay was required to improve drainage and aeration to the natural soil, and additions of charcoal found within the soil is likely to have contributed to fertility requirements. Although it has been shown that kūmara soil did not need high fertility to reach a satisfactory growth, fertility additions were required when the area was cropped for long periods (Taylor 1958:73). But in general, three years cropping was all that could be obtained from one location and a period of abandonment was required of usually 7 to 14 years (Taylor 1958:76), this could however vary regionally.

Opunga Bay is likely to have required minimal protection from southerlies and strong westerlies due to its easterly orientation. This may have compensated for work required based on warmth and shelter. However not all winds were undesirable and easterly and northerly flows were beneficial to aeration and warmth. The drainage of the site beyond soil modifications will be addressed in the garden organisation section.

Mangahawea Bay

Kūmara requirements	**Environment and natural soils**	**Work required ?**
Well-draining	Yes-marine terrace	Minimal
Well-aerated	Yes-marine terrace	Minimal
Warmth day and night over 21 degrees	Soil described as thermic 15-22- cooler paleoclimatic temperatures overnight-presence of pebbles warm the soil	Yes-pebbles add warmth but exposed nature of bay to westerlies suggest work required
Low water requirement	Heavy rainfall occurs in the cropping months	Yes
Protection from cold winds	Westerly winds prevalent	Yes-fencing
Low to moderate fertility	Soils are acidic, mid-range for retaining added nutrients. Unsure if this is also true for marine terraces	Yes
Frost free	Frost more frequent at the end of the little ice age but unlikely in a marine/coastal environment	No

Table 20: Mangahawea Bay optimum growth conditions requirements

The marine terrace of Mangahawea Bay has differing sediments to Opunga Bay and suit those described by Taylor (1958), as yellow/brown sands with fine gravels well suited to agricultural (Taylor 1958:73) The soil here would have been easy tilling and the pebbles already present would have been advantageous. This bay would have seen strong westerly winds and may have been colder than the eastern side of the island due to this. A comparison of the modified soils from both bays may show these differences in environmental settings.

4.12 Mangahawea Bay soil analysis

The soil analysis consists of three samples from Mangahawea Bay that were interpreted as gardening soil from Area’s 9 and 10 (Figure 21). The soil analysis method was developed from Environmental Archaeology, manuals in archaeological method theory and technique (Reitz *et* *al* 2012). An analysis was created based on standard sediment and soil analysis techniques that are conducted on archaeological deposit with the addition of a more geologically focussed construction. The aim, to get a detailed and testable picture of the archaeological sediments and additions of the modified soils analysed in Mangahawea Bay.

The analysis centres on the composition, texture, and colour of the sample. The composition refers to the main archaeological sediments and minerals or clastics. Which are defined as sand, silt, clay, scree, and gravel. These are gauged visually and through a "wet test". This will be complemented with an evaluation of the anthropogenic non sediment and mineral additions.

The texture of the sample is assessed through the proportion of differing particles. Differing particles are found in size and shape, their cohesion of wet and dry and how well these particles are sorted. The proportions of the particles are given a percentage estimate using the "Chart for estimating proportions of mottles and coarse fragments" from Munsell (1994:9-10). The grain particle size is evaluated using the "Granular crumb structures" from Munsell (1994:5). This provides a comparison table of very fine to very coarse sediments.

The sorting of particles relates visually to how well the sediments within the sample are mixed, the proportion and number of size classes gives a range from poorly sorted to well sorted (Reitz *et al* 2012:133-134, fig 5.6). The particle shape refers to the form of the sediments within the sample that range from rounded to very angular. This is assessed using a comparison table (Reitz *et al* 2012:134, figure 5.7).

Described in Reitz *et al* (2012) is a combination of deposits that can occur naturally. These can be assessed visually but by also adding a small amount of water to part of the sample. This aims to give a percentage of the sediment mix based on how it reacts to water. The reaction to water for each sample gives the soil type and its composition in the results tables (Table 21).

Soil analysis chart		
Sediments	**Percentage composition**	**Reaction to water**
Sandy loam	• 50% sand with enough silt • 30% and clay • 20% to be cohesive	Forms a cast but cast easily broken
Loam	• Gritty, slightly smooth and plastic. • Contains nearly equal parts silt and sand with 50% clay.	Forms a good cast
Silt loam	• Slightly silky feel and forms clods when dry. • Clods easily broken, soft and floury. • Contains 50% sand and silt combined with 12%-25% clay	Forms a thick sludge, makes good casts
Clay loam	• Fine textured and readily breaks into clods or lumps that are hard when dry. • Contains nearly equal parts sand and clay.	Plastic and cohesive when moist
Colour	• Munsell 1994 colour chart	

Table 21: Soil analysis table following Reitz *et al* (2012)

Figure 21:Excavation areas Mangahawea Bay (Arakite Charitable Trust)

Area 10/Level 1

Area 10 (Figure 21) was interpreted as garden soils for potatoes (Robinson, J, pers comm). The soil is at 300mm depth and is a loam consisting of sand that suits the purposes of gardening (Taylor 1958:73). As shown in Table 20 work was still required to reach the requirements of an optimum growing environment. The sample was classed as well to moderately sorted and signals that the drainage was not a key feature supported by the low presence of pebbles (Table 22, figure 22, 23).

The presence of pebbles and sand as naturally occurring in this soil sample is likely, meaning the export of beach deposits may not have occurred, like that in Opunga Bay. The high presence shell in this sample compared to pebbles and other additions suggests these were soil additions. The shells in this sample were burnt and well worked into the soil, it is likely that the shell is the remains of a midden, burnt bird(?) bone fragments were also present in the sample.

Soil analysis results (Area 10/Level 1)	
Sediments	**Percentage composition**
Composition	• Sandy loam (forms a cast but easily broken) • Additional mineral of shell and pebble
Textures Sediments Minerals Anthropogenic	Proportions • Sand and silt 65% • Shell 30% • Pebbles 15% • 4 bone fragments- possible burnt appearance
Size of particles	Sand and silt- very fine-less than 1mm diameter Shells – very fine to coarse less than 1mm to 5-10mm diameter Pebbles – very fine to coarse less than 1mm to 5-10mm diameter Bone – 3 fish and 1 bird 5-10mm to 2.5mm length •
Shape of particles	Sand and silt- well rounded Pebbles- well rounded and worn Shells- sharp and angular- fragmented and brittle •
Cohesion	• Dry and extremely friable
Particle sorting	• Well to moderately sorted
Colour	• Dark grey 10R/4/1

Table 22: Soil analysis results from Area 10 level 1 sample 139, Mangahawea Bay 8/1/2020

Figure 22:Soil sample analysis area 10 level 1 sample 139 top to bottom- representative sample, burnt bone, burnt shell (sourced from J. Robinson Heritage NZ, Northland)

Figure 23:Soil profile of area 10 layer 1 (Dieter-Bader 2020).

Area 9/level 1

Area 9 (Figure 21) was described as a “*puke* holes”. These puke holes were formerly *puke*/*te ahu* planting mounds. It is possible that once the crop was harvested the sediments of the planting mound dropped overtime into the space made by the tuber roots and thus may have created the fill seen in the “b owl-shaped hollows”.

The bowl-shaped hollows (after Gumbley 2000) were interpreted as the remains of a potato soils/sediments (Robinson, J pers comm). The fill consists of large smooth beach pebbles which are likely to have covered the puke mounds for warmth (Table 23, figure 24,25). They could also be for the protection of the crop leaves. Preventing them from resting wet soils. Due to their size it may be more likely they were used as heat retainers given herbage or small pebbles could have suited this purpose also (Best 1976:170).

Soil analysis results (Area 9/Level 1)	
Sediments	**Percentage composition**
Composition	• Dry free flowing no clay or silt. Pebbles, sand and shell (natural beach deposit)
Textures Sediments Minerals Anthropogenic	Proportions • Pebbles- 50% • Shells 40% • Sand 10%
Size of particles	• Pebbles- very to very coarse 1mm to more than 10mm • Shells – very fine to coarse 1mm to 10mm
Shape of particles	• Pebbles – rounded well worn • Shells – sub rounded to well rounded
Cohesion	• Dry
Particle sorting	• Poorly sorted
Colour	• Gray and white representing shells and pebbles

Table 23: Soil analysis results from area 9 level 1 sample 187, Mangahawea Bay 16/1/2020.

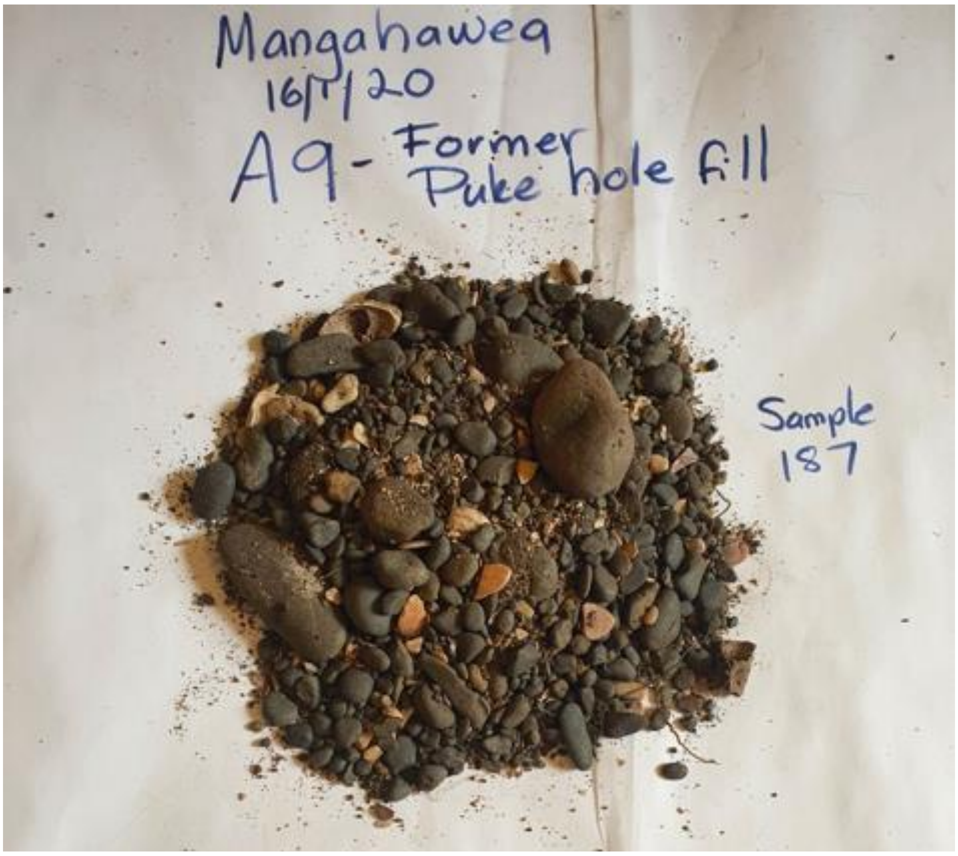

Figure 24:Soil sample analysis area 9 sample 187, puke hole fill (sourced from J.Robinson Heritage NZ, Northland)

Figure 25:Soil profile of area 9 level 1 and 2, shows puke holes of level 1 (Bader 2020)

Area 9 level 2

Directly underlying the puke holes of layer 1 is a silt loam described as kūmara soils (Robinson, J pers comm). This layer could be a part of the soil that made up the *puke* mound underlying the stone covering and the area that the roots penetrated or grew in.

The composition is loose, free flowing and well sorted, indicating the likelihood of good drainage and this is emphasised with the high percentage of pebbles represented. It fits as a light sandy soil that is a requirement for kūmara soils. Shell and charcoal were of low representation and indicates that fertility was not a requirement which suits kūmara, or that a level of fertility was already present in the soil, as an organic matter that is not visible archaeologically. Alternatively, it could have been representative of single cropping period which does not require additional fertility, as longer cropping periods do. Another interpretation is that this layer represents a separate gardening episode of kūmara underlaying layer 1 (Table 24, figure 25,26).

Soil analysis results (Area 9/Level 2)	
Sediments	**Percentage composition**
Composition	• Silt loam, loose dry, free-flowing sandy silt (Forms a thick sludge, makes good casts)
Textures Sediments Minerals Anthropogenic	Proportions • Sand and silt 50% • Pebbles 45% • Shell and charcoal fragments 5% • 1 bird bone fragment
Size of particles	• Silt and sand- very fine less than 1mm diameter • Shell- very fine to coarse less than 1mm to 5-10mm diameter • Pebbles- very fine to coarse less than 1mm to 5-10mm (one angular rock 5-10mm, unlikely fire-cracked) • Charcoal piece- 2.5mm diameter • 1 bird bone fragment 2.5mm diameter
Shape of particles	• Pebbles – rounded well worn • Shells – angular to sub-rounded- natural appearance (unburnt)
Cohesion	• Dry and friable
Particle sorting	• Well sorted
Colour	• 10YR/4.2 dark greyish brown

Table 24: Soil analysis results from area 9 level 2 sample 177, Mangahawea Bay 16/1/2020

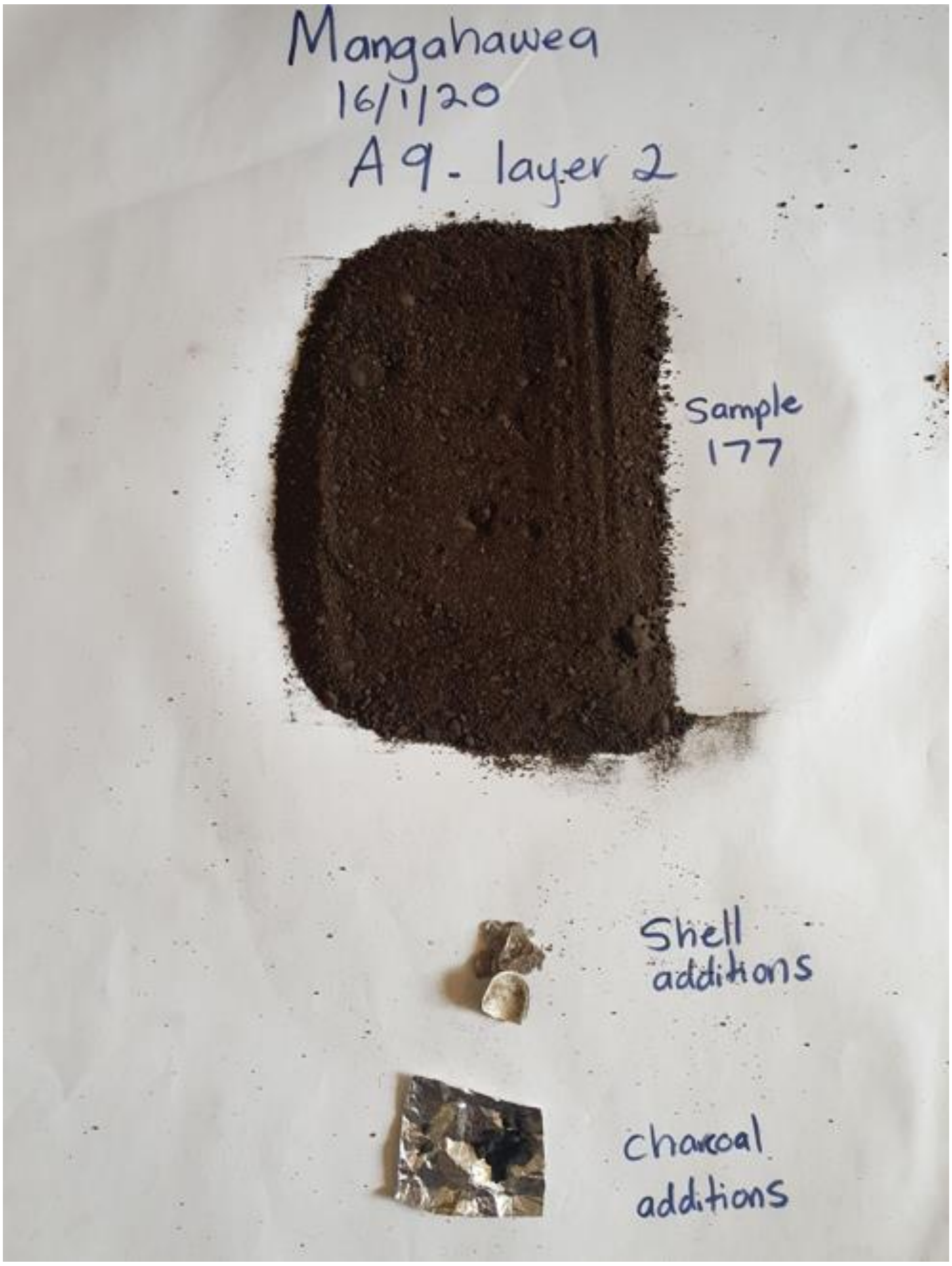

Figure 26: Soil sample analysis Area 9 level 2 sample 177, top to bottom representative sample, shell additions unburnt, charcoal (sourced from J. Robinson, Heritage NZ, Northland)

4.13 Results and discussion

The three samples analysed from Mangahawea Bay excavations show garden soils that have differing sediments and compositions. The samples themselves are discussed and compared to each based on the information from optimum growth requirements, the natural soils present and the climate that may have also influenced the mix and additions of the samples.

Area 10 is well suited to descriptions of potato soils. This is based on the low presence of pebbles, which in a kūmara soil could be higher for drainage and warmth purposes. The sample is also only well to moderately sorted which could also suggest drainage was not a priority. These factors could have been intentional to hold more moisture, and for a cooler soil of which potatoes required.

The presence of the burnt midden shells mixed into the soils could be related to fertility. This is a *tikanga* or way of gardening that has not been described in the garden soils of the Bay of Islands previously. Unburnt shells sourced from the beach are usually the common feature in modified soils. Although it may be hard to know if this was an intentional addition, marine shell is a source of lime or calcium carbonate. Calcium is beneficial for plant growth and makes nitrogen, phosphorous, and potassium more available in soils. Shells are also known to raise the PH (alkalinity) in soils and improves soil textures by making clays more friable and sands more compact. (Follett *et al*. 1981 cited in Ceci 1984:76) It is reported that acidic soils are best for potato, which suits the soils of the Bay of Islands, but the requirement of fertility for potato may have been more important than keeping soils overly acidic.

A lack of charcoal in the samples suggests that the soils did not require additional fertility or other means of fertilization was used. Area 9 layer 2 has below 5% represented for charcoal and Area 10, had no charcoal. For Area 10 the burnt shell could have been utilised as a form of fertilisation and this may have been a preferred option at the time and rather than burning for charcoal.

In contrast to Area 10, Area 9, layer 2 has a higher percentage of pebbles at 40% compared to 30%, which indicates better drainage and warmth factors. The soil is a loose sandy silt that is well sorted and matches the requirements for a good kūmara soil. As discussed, the low percentage of charcoal and shell in this sample indicates that soil fertility may not have been an issue or requirement.

Area 9 Layer 1 may be the most indicative of a climatic response using the larger pebbles for heat retention and is well suited to the warmth requirements of kūmara. This certainly fits with the climate in the 18th and 19th centuries that indicate colder overnight temperatures and strong westerlies that were frequent in Mangahawea Bay. It is unlikely that these *puke* holes were related to potato gardens and suit the optimum growth requirements of the kūmara.

Environmental and values of modified soils

Ritual *tikanga* in soil modifications is not shown to be directly viewable. There is one link that can be drawn upon from the historical accounts which describes that kūmara and potato were gardened side by side in the Bay of Islands, this is likely to be shown at Mangahawea Bay. Confirming the contemporaneity of the garden areas and the crops planted here would confirm this.

Environmental *tikanga* is the most direct in Area 9, Layer 1, which could show a reaction to a colder cropping season, with the use of larger pebbles as heat retainers on the *puke* mounds. The three different garden soils that the samples represent are likely to be indicative of different crop requirements and local weather patterns. Also present could be different ways of gardening by various *whānau* groups, to determine this, the evidence would need to identify areas that could not be easily explained by the environmental factors (Bader 2016:30).

4.14 Garden organisation

Garden organisation represents the ritual and the practical elements of the cultivation process following the concepts of Firth (1929). The location of modified soils, slope drains and crop planting features in the archaeological record is influenced by the given or chosen environmental setting, and knowledge of this environment is applied practically and ritually. It is through these that we may be able to interpret how gardens operated to achieve optimum growth requirements.

The ritual *tikanga* is defined by the values of *tapu, mauri* and *kaitiakitanga* and have the highest potential to be tangible in garden organisation through plot orientations, and markers such as *mauri* stones. The *tapu* laws attached to plots guided layout and orientations against cold winds. The garden organisational elements that pertain to winds and warmth is assessed for Opunga and Mangahawea Bay. These are connected to optimum growth requirements of kūmara and potato.

The slope gardens in Opunga Bay are interpreted using knowledge of the local landscape, soils and paleoclimate with the key value of *kaitiakitanga*. The flat gardens of Mangahawea Bay are interpreted within their location with links to the ethnographic accounts that describe orientations and plot formations.

Opunga bay garden organisation

The landscape of the bay consists of a beach flat with surrounding high slopes. The bay is orientated to south-east but is largely sheltered by the southerly winds by the adjacent mainland. The excavations by Johnson (1997) and Peters (1975) show two forms of garden organisation. The garden on the beach flats, with modified soils and no apparent garden features and the slope garden, identified by drains running down the northern facing slope with modified soils present.

The excavation of the beach flat gardens described no features that could be attributed to plot layouts and orientations. These can be hard to discern within a relatively uniform modified soil and the harvest process can further diminish identification. Although there are no plot areas to determine, the bay was naturally orientated to the east with a small degree of divergence to the south. Making it an ideal bay for gardens to be situated.

The modified soils of the beach flat were largely located on the southern side of the bay, no modified soils were found by Johnson (1997) on the northern side. This side is blocked by a high cliff face and indicates that only the southern side of the bay that is open to the north was suitable for gardening due to a warmer aspect.

The slope drains, located on the northern slope were assessed by Peters (1975) as boundary markers as they “Do not appear to drain the gardens in any obvious way”. A horizontal top drain was expected to run along the upper drains to help divert the water flow away from the lower gardens (Peters 1975:178). Cross drains on slope gardens are not a feature seen in the site record forms and during foot surveys in the Bay of Islands. The absence of these does not equate definitively to drains not operating as water control features and if we look at the geology and local paleoclimate of the Bay of Islands these drains could have operated as water and erosion control features.

The geology of the Bay of Islands suggests a landscape that was relatively unstable specifically on slopes with clay subsoils. The paleoclimate was variable and alternated between trough and zonal synoptic types (wet and dry) throughout the 18th and 19th centuries. The effect on clay that is exposed to long dry and wet periods can contribute to this unstable slope environment.

For the benefit of mitigating a possible oversimplification of the climatic picture we can look at evidence for floods that were a common occurrence during the cropping season (December). These may have also played a part in the formation of drains on the slopes. The stratigraphic sequence from this site shows a clay slip had occurred and covered the garden soils of layer 5. The drains were described as cut through layer 5 and the clay slip layers, with layer 2 covering these layers (Groube 1968:111).

Doubts around the insecure context of the early radiocarbon date of layer 5 suggests that it is just as likely that after the clay slip covered the modified soils on the slope the modified soils of layer 2 could have been established relatively recently after the slip, with drains cut through the underlying layers, to counteract any further slips.

The unstable nature of the slope could address the question of why there was an area of 150m from the foot of the slope to where the modified soils began on the beach flats. As described by Peters (1975) he attempted to link the two garden areas through series of test pits and found that there was a gap of 150m between the garden soils of layer 2, on the slopes and beach flat (Peters:1975:176). This "gap" is suggested here as intentional by the gardeners based on the instability of the slope and it is likely that gardens located at the foot of a slope, that is prone to erosional slips and where water would run down and sit, would not be a beneficial way to organise garden plots.

Other considerations for drains beyond a water control feature is the requirement of crops to be situated on a *puke* mound, for aeration and drainage purposes and easy harvesting. The ridges that are created when drains are dug also provide this planting medium and kūmara would have benefited in this situation in addition to the dry warm aspect that a north facing slope created. These slope garden factors also contribute to understanding why there was no modified soils found at the foot of the slope for 150m, within this landscape of high surrounding slopes the back beach may have been too cool and damp for kūmara gardens.

The presence of the key values when viewing the archaeology of this site is hard to distinguish. This is based on asking the question of, are these values visible before and during excavation, *tapu* can take on the physical form of *mauri* stones and the *māra tautāne* but distinguishing the *māra tautāne* from other plots without large scale excavation may not be possible. It can be assumed that based on the importance of *tapu* during the cultivation process that it was present but un-viewable in the archaeology of this site.

Kaitiakitanga includes the principle of communal gardening and rules out the western sense of plots under individual holdings. Using this value in line with the environmental picture of this bay we can then look past the current interpretations of the site and view slope gardens within the context of *tikanga*. The drains were centred around the optimum growth requirements of kūmara as opposed to operating as boundary markers. Markers may have been present in the form of *mauri* stones or through means that are not visible today. As pointed out by Johnson (1997) smaller and above surface boundary markers would suit this purpose better than open drains (Johnson 1997:41).

The presence of items relating to the European exploration and settlement phase were found in the limited topsoil of area one (Johnson 1997:35-36). This made it difficult to determine if the modified soils were from the prehistoric or the historic period. It was suggested that the modified soils were likely to have been from a single episode of gardening. Ethnographic and

Māori Land Court accounts suggest that a single gardening occupation is unlikely and given the long history of Moturua and the Bay of Islands up to the settlement phase (historic period) and re-use of the gardens occurred.

The Māori Land Court records of the Bay of Islands provide the most tangible evidence for reuse and creation of gardens in the 19th century. 1898 accounts refer to cultivations located in Opunga Bay in addition to Otupoho Bay to the north, on Moturua. In Otupoho Bay there were cultivations of kūmara that existed to supply the whalers, who began to frequent the Bay of Islands at around the late 18th to 19th centuries. This certainly suggests re-use and occupation although possibly intermittent gardening in these bays during the Māori period up to the mid to late 19th century. The bays on Moturua and on the other islands here offered their own unique situations and microclimates, and this was well understood on how to maximise on this for the benefit of the crops. The landscape depicted how the gardens were created, and Mangahawea Bay provides further evidence for this.

Mangahawea Bay garden organisation

Mangahawea Bay as described faces the west, out to the open sea it is sheltered from receiving southerly flows, but westerly winds can be strong at certain times of the year, and these were prevalent in the 18th and 19th centuries. The garden locations in this bay are located on the slopes and the marine terrace.

The slope gardens of Q05/1360 are located on the northern slope of the bay these were not investigated but are visible in the profile of the walking track. These begin from 5m up the slope and extend roughly 20-50m high. These slope gardens face the southwest and are largely sheltered from the southerlies. The north facing slope of the bay has no evidence for modified soils as seen in the walking track that exists midway up the slope.

The larger focus in Mangahawea Bay goes to the gardens located on the marine terrace. There are three areas that were chosen as they show features associated to *puke* mounds therefore directly related to garden organisation and provide a set that can be viewed to evaluate feature layouts and plot orientations.

Area 9 Level 1

The trench overlay is associated to the soil sample of table 23, the circular features are interpreted as the *puke* holes. These exhibit parallels to the “bowl shaped hollows” from the Waikato as excavated and recorded by Gumbley (2000, 2013, 2019). The Waikato examples were “bowls” filled with sand and gravels that had been dug into the subsoils (Gumbley 2000:22). These were likely created to improve drainage and warmth. They were found in parallel rows or quincunx formation and are interpreted as the remains of structures used for the growth of the individual plants. These were raised above the ground as puke or mounds, and it is within these *puke* mounds that the plants were placed (Gumbley 2019:17).

The circular hollows of Area 9 at Mangahawea Bay were 50cm and the plot layout is shown to be in a row formation (Figure 27). In the Waikato row and quincunx formations tended to be present in the excavated areas overall (Gumbley 2000 2013, 2019). As we know from the historical accounts *puke* mounds were seen in straight lines, and others in quincunx at Anaura Bay (Beaglehole 1968:583-4). The purpose and preference of these are not certain, it could be based on the preference of a group, the crop being planted, and the results required of a crop. Further studies associated with crop types, soils and overall environment could be beneficial. The excavation trench of Area 9 was oriented east to west as shown in Figure 21. The rows in the trench show a slight difference to this and deviate slightly in a south-westerly direction (Figure 27).

Figure 27: Overlay of area 9 level 1, Mangahawea Bay (Bader 2020)

Area 10 Level 2

This trench has features shown but a plot layout is indistinguishable, without crop features or plot boundaries interpreting garden organisation is difficult. Given the bay is naturally orientated east to west then we can expect it has similar orientations to Area 10 features (Figure 28).

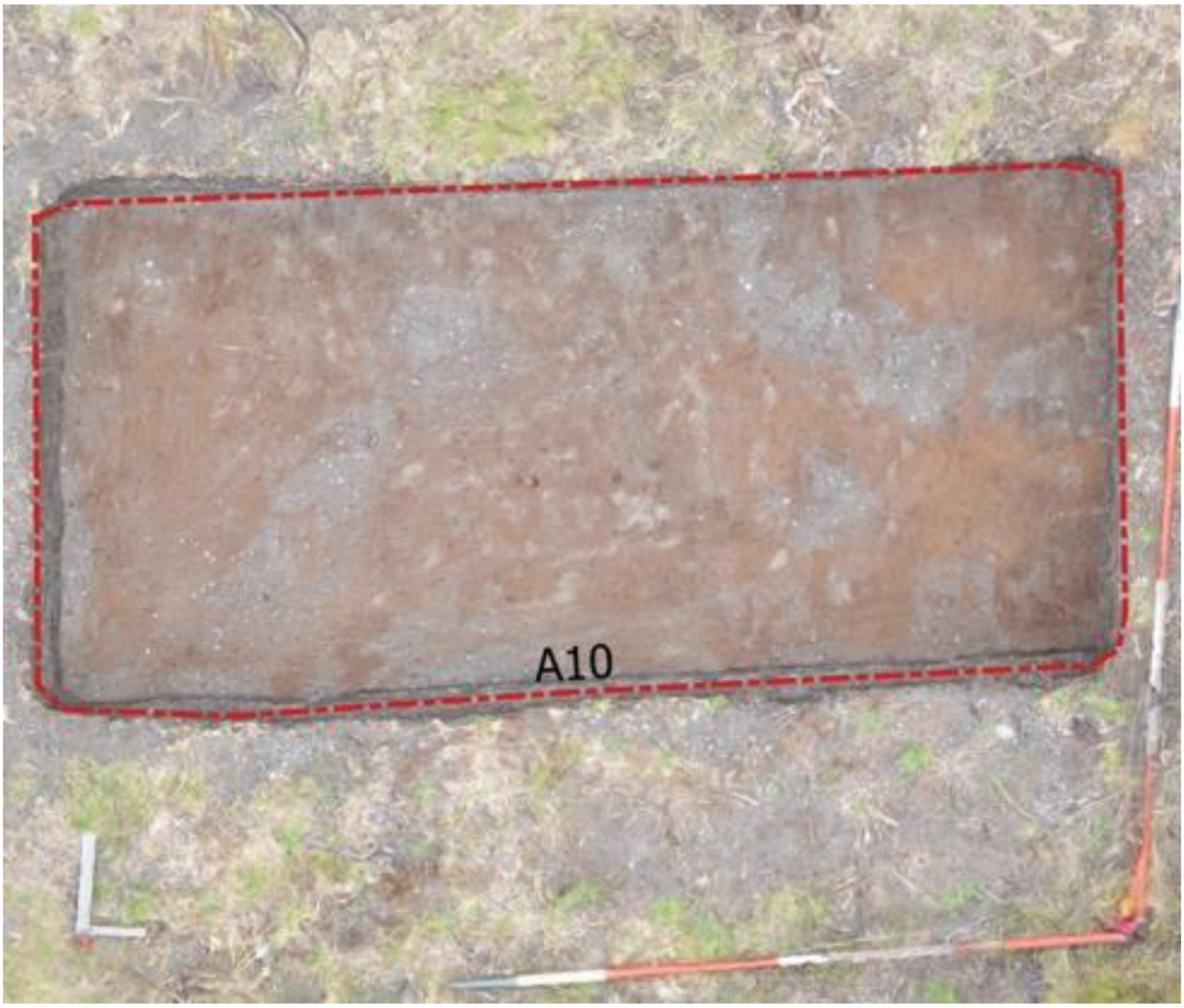

Figure 28: Overlay Area 10 Mangahawea Bay (Bader 2020)

4.15 The presence of values

The key value that is directly viewable in Mangahawea Bay is *mauri* stones marking the corners of plots symbolising the *tapu* nature of the plots (Figure 29). Under these stones was a small patch of charcoal and bird or fish bone fragments likely an offering (Kipa Munro, pers comm). An exceptional feature of the overall relationship to domesticate or living areas in comparison to gardened areas is the relationship between the early occupation trenches and the gardens.

The early occupation of Q05/682 has not been disturbed by gardening activities; this contrasts with Opunga Bay which shows gardens created over the early occupation site. It is worth asking the question under the use of the value *tapu* if this area was intentionally preserved by the early occupiers, based upon ancestral links and the *tapu* attached.

Figure 29:Mauri stone area 16, facing north (Goddard 2020)

4.16 Results and discussion

To find *tikanga* in the archaeological record the environment and social values were applied to the soil modifications and garden organisation of Mangahawea and Opunga Bays. A direct relationship between the social values and soil modifications has shown to be un-identifiable archaeologically. How gardens were organised does have tangible links to the practice of the social values *tapu, mauri* and *kaitiakitanga.* At Mangahawea Bay these are the garden orientations, locations, and the *mauri* stones. At Opunga Bay orientations and locations of the plots are the only indicators archaeologically that can be connected to *tapu.* The slopes drains are representative of a tangible connection to *kaitiakitanga.*

The environment plays a large part in the influence of the soil modifications and organisation of gardens. Differing soil additions in the bays are shown to be associated to the environment of the landscape, climate, and the natural soils present. Opunga Bay shows a relatively uniform modified soil mix across the bay and shows similarities with modified soil sites on Urupukapuka Island (Table 4).

In contrast Mangahawea Bay shows soil modifications that may be suited to a cooler microclimate present in this bay. This is shown in the pebble cap that covered the mounds in of Area 9, level 1, that could have suited the purpose of heat retention. This pebble cap could also have acted as protection from heavy rain but also for retaining moisture in the soils. Within the variable environment the 18th and 19th centuries these may have all been a possibility. The use of burnt shell or former midden as an inclusion into garden soils is unique on comparison with other modified soils sites of the Bay of Islands.

The environmental and the social values are most tangible within garden organisation. The application of the model to Opunga Bay slope drains indicated that these were specifically constructed for rainfall, aeration of the soils for kūmara and erosion control, a direct environmental *tikanga*. The use of the principle of *kaitiakitanga,* created a viewing tool for the slope drains that interpreted them not as boundaries markers but as drains that operated within the given environmental context.

At Mangahawea Bay organisational elements were less discernible and could be due in part to excavation techniques that were not focused upon answering questions of *tikanga.* Nevertheless, there were key features that could be connected to *tapu*. These were the *mauri* stones found within the modified soil trenches and as recorded in the ethnographic accounts. *Mauri* stones always remained long after the gardens were abandoned, due to the *tapu* surrounding them. The possibility that the early Polynesian settlement (Q05/682) was purposefully un-gardened indicates a *tapu* connection known only to the ancestors of this site.

Mangahawea Bay orientations seemed to be governed by the landscape and the natural orientations of the bay, which are naturally east to west, a preference reported in the ethnographic literature and shown at Taranaki and Waikato garden sites. This is also comparable with the locations and orientations at Opunga Bay. The bay already faced the favoured easterly direction and garden drains were only found on the north facing slope.

Overall, there are similarities between the gardens such as the preference of orientations and the soil modifications best suited to optimum growth. Adaptations were made to soil modifications and garden organisation regionally to suit the environmental setting, but there is another element of *tikanga* that may be evident through the comparison of Opunga and

Mangahawea Bay. This is the tikanga of a separate group of people who bring a different *mātauranga* to the gardening techniques. This can be attributed to behaviour as suggested by Bader (2016:30-31). This behaviour is defined by an archaeological signature that cannot be easily explained by the environment and post depositional processes (Bader 2016:31), and to an extent the social values.

Mangahawea Bay exhibits an archaeological signature that could be linked to a different *tikanga*, and this is most evident when compared to other modified soils recorded in the eastern Bay of Islands. The use of burnt shell in modified soils and the bowl-shaped hollow features are unique to Mangahawea Bay within an eastern Bay of Islands context. Environmental factors and social values do not explain these features and additions, and these may be attributable to a *whānau* group with a different set of gardening techniques.

Further studies are required to find out the crops represented in the garden areas here. As comparison of soil modifications between crops would be beneficial for defining *tikanga* that is associated to the environment, the values or behaviour. Additionally archaeological investigations need to look at the whole system where features are not just focused upon individually but their relationship to each (Bader 2016:13-14).

Conclusions

The ability to view tikanga in the soil modifications and organisations of gardens is possible through environmental reconstructions and the use of social values. This has been developed from understanding Māori *tikanga* and the garden accounts in the historical and ethnographic records. The work of Raymond Firth and the cultivation process assisted in understanding how tikanga in early Māori gardening was a combination of ritual and practical. This led to the development of the premise that the creation of gardens was influenced by the local climate, soils landscape and the social values of *tapu, mauri* and *kaitiakitanga* therefore gardens in archaeology should be interpreted on this basis.

A model that included an environmental reconstruction and the use of key social values was applied to the archaeological garden investigations at Opunga and Mangahawea Bay's on Moturua Island. The results indicate that Opunga Bay slope drains were specifically constructed for rainfall, aeration of the soils for the kūmara and erosion control, a direct environmental *tikanga*. Under the principle of *kaitiakitanga* it was revealed that boundary markers were unlikely within this bay due to a communal situation between *whānau* groups and the use of drains as boundary markers did not fit practically in this environment.

In Mangahawea Bay we see modified soils and crop features that are unique to that bay. This could be attributed to the environment, but other factors suggest that the *tikanga* of a group can also create differences archaeologically that cannot be solely attributed to the environment and social values of the model.

The environmental factors defined in the model contribute to the variability that is represented in the archaeological record but also, and perhaps not considered enough is that the *mātauranga* of a group or individual can also influence how gardens are created.

For future research excavations of early Māori gardens a whole system approach needs to be applied. This could be the use of the model presented combined with excavations techniques that focus on the entire garden system, as features may be better understood within the context they operated. The inclusion of local *hapū* whom *whakapapa* to sites could also provide invaluable insights and information about how their ancestors gardened.

Appendices

Appendix: 1:NZAA Site Record Form N12/372 (Q05/682), Mangahawea Bay. ARCHSITE

AAANAAOCAAAL

NEW ZEALAND ARCHAEOLOGICAL ASSOCIATION

SITE RECORD FORM

Map number N12
Map name Bay of Islands
Map edition 2nd Ed. (1970)
Grid Reference 690574
E169000 N857400

SITE NUMBER N12/374

SITE NAME: MAORI
OTHER

SITE TYPE Midden

1. Aids to relocation of site South end of Mangahawea Bay, Moturua Island. Near mouth of small stream, in 3.5m high bank on north side

2. State of site; possibility of damage or destruction Eroding rapidly; some fossicking likely

3. Description of site (NOTE: This section is to be completed ONLY if no separate Site Description Form is to be be prepared.)

Lens of shell midden, max. 10cm thick, at top of 3.5m high bank containing mainly mussel (Perna) hangi stones and charcoal, with common Lunella, and also Nerita, paua, dog cockle, pipi, Haustrum, Thais, fish bone, Cominella, cockle, Cellana (radians and denticulata), Ostrea. More diffuse midden with bone 40cm below main lens.

4. Owner Crown
Address Bay of Islands Maritime & Historic Park.
Attitude

Tenant/Manager
Address
Attitude

Permit 1981/20 issued to J McKay HP File 12/8/78

5. Methods and equipment used

Photographs taken: Yes/No (Describe on Photograph Record Form)
Date recorded 8 Jan 1980

6. Aerial photograph or mosaic No.

Site shows: Clearly/badly/not at all

7. Reported by P.R. Moore
Address N.Z. Geological Survey Box 30-368, Lower Hutt
Date 22.2.80

Filekeeper [signature]
Date 1/4/80

Appendix: 2: NZAA Site Record Form Q05/1360, Mangahawea Bay . ARCHSITE

NEW ZEALAND ARCHAEOLOGICAL ASSOCIATION **SITE RECORD FORM (NZMS260)** NZMS 260 map number Q05 NZMS 260 map name Bay of Islands NZMS 260 map edition 2000	NZAA METRIC SITE NUMBER Q05/1360 DATE VISITED 15/11/06 SITE TYPE Garden Soil SITE NAME: MAORI Mangahawea Bay, Moturua OTHER Island

Grid Reference Easting .2618687, Northing .6663655

1. Aids to relocation of site *(attach a sketch map)*

The Site is situated on the edge Northern Edge of Mangahawea Bay, Moturua Island, on a south west facing slope where the beach plateau meets the regenerating scrub bush

2. State of site and possible future damage

Site was uncovered due to track upgrade working being carried out as part of a island wide project undertaken by the Department of Conservation.

3. Description of site *(Supply full details, history, local environment, references, sketches, etc. If extra sheets are attached, include a summary here)*

The site is made up of a distinct layer of finely broken shell and beach pebble. It was probably some form of garden soil, the original extent of the layer is hard to estimated, although chances are it was some 16m wide by 30m long. It sits directly below the top soil, approximately 20-30cm below ground surface, and directly on the clay bedrock. Although generally uniform the layer thickness is about 20cm. There is at least one location where there is a pit feature. In certain locations within the layer there are charcoal inclusions.

4. Owner Department of Conservation
Address Bay of Islands Area Office,
PO. Box 128,
Kerikeri

Tenant/Manager Department of Conservation
Address Bay of Islands Area Office,
PO. Box 128,
Kerikeri

5. Nature of information *(hearsay, brief or extended visit, etc.)*: Site was recorded of the space of a day.

Photographs *(reference numbers and where they are held)*: A Historic Places trust site damage report was filed, and archive pictures are held at the Bay of Islands office of the Department of Conservation.

Aerial photographs *(reference numbers and clarity of site)*: None

6. Reported by Andrew Blanshard
Address Historic Ranger
Bay of Islands Area Office,
PO. Box 128,
Kerikeri

Filekeeper [signature]
Date 21/12/06

7. Key words Maori, Garden Soil

8. New Zealand Register of Archaeological Sites *(for office use)*
NZHPT Site Field Code

Latitude S

Longitude E

|H|A| Type of site

|A|D| Present condition & future danger of destruction

| | | Local environment today

| | | Security code

|R|C| Land classification

|M|A| Local body

Appendix: 3:Site Record Form N12/6 (Q05/44), Opunga Bay.
ARCHSITE

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NEW ZEALAND ARCHAEOLOGICAL ASSOCIATION

SITE RECORD FORM

Map number N12
Map name BAY OF ISLANDS
Map edition
Grid Reference 781 573

SITE NUMBER N12/6

SITE NAME: MAORI
OTHER

SITE TYPE FIELD SYSTEM

E170100 N857300

1. Aids to relocation of site Little bay south of Sir William Goodfellow's bay (Paeroa pa)
Field system on south slope (Left hand facing beach from sea)

2. State of site; possibility of damage or destruction Good

3. Description of site *(NOTE: This section is to be completed ONLY if no separate Site Description Form is to be prepared.)*

Excavated in November 1968 by K.M.Peters. See report to be published in N.Z.A.A. Newsletter Jan. 75.

4. Owner Lands & Survey Dpt.
Address Maritime Park ?
Attitude

Tenant/Manager
Address
Attitude

5. Methods and equipment used
Photographs taken: Yes/No (Describe on Photograph Record Form)
Date recorded Dec. 1965 (L. Groube)

6. Aerial photograph or mosaic No.
Site shows:
Clearly/badly/not at all

7. Reported by K.M.Peters.
Address Dept. Anthropology
University of Auck.
Date 26.9.74.

Filekeeper [signature]
Date 29/9/74

Appendix: 4: Site Record Form N12/8 (Q05/46) Opunga Bay.
ARCHSITE

BLAXAQ-- AAAL

NEW ZEALAND ARCHAEOLOGICAL ASSOCIATION

SITE RECORD FORM

Map number N12
Map name Bay of Islands
Map edition NZMS1
Grid Reference 701572

SITE NUMBER N12/8

SITE NAME: MAORI
OTHER

SITE TYPE Field System
Prehistoric Garden

E170100 N857200

1. Aids to relocation of site Little bay south of Sir William Goodfellow's bay, on flat behind beach.

2. State of site; possibility of damage or destruction
No surface evidence.

3. Description of site *(NOTE: This section is to be completed ONLY if no separate Site Description Form is to be prepared.)*

4. Owner Lands & Survey Dept.
Address Maritime Park. ?
Attitude

Tenant/Manager
Address
Attitude

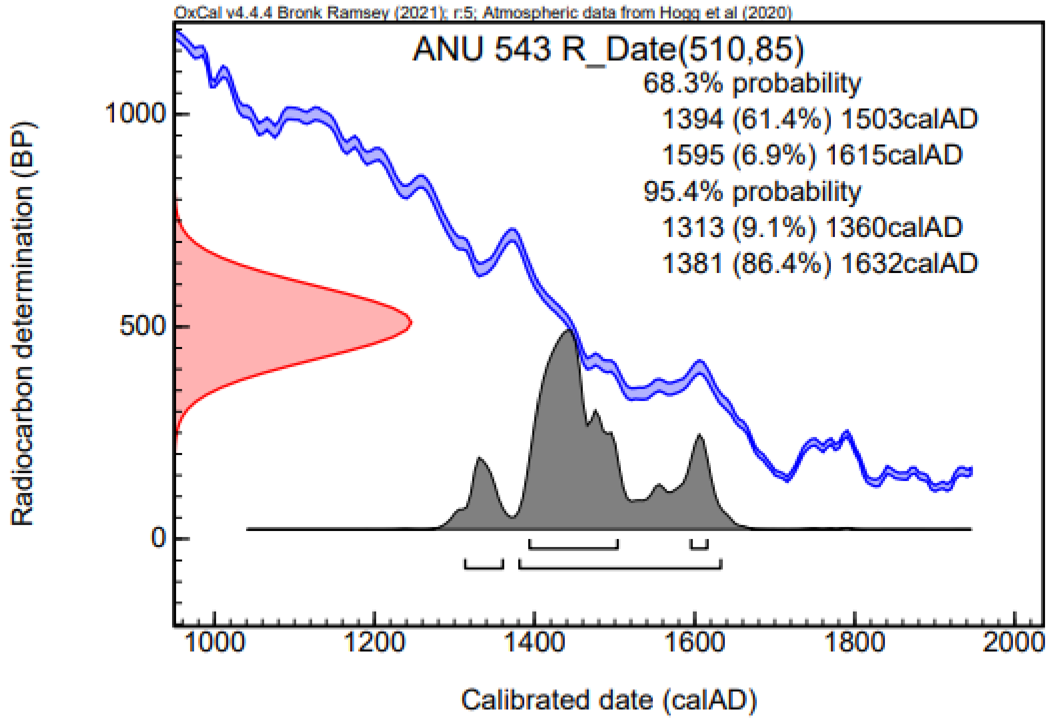
5. Methods and equipment used Four squares excavated Nov. 1968. Report to be published in NZAA newsletter Jan 1975.
Photographs taken: Yes/No (Describe on Photograph Record Form)
Date recorded November 1968

6. Aerial photograph or mosaic No.
Site shows:
Clearly/badly/not at all

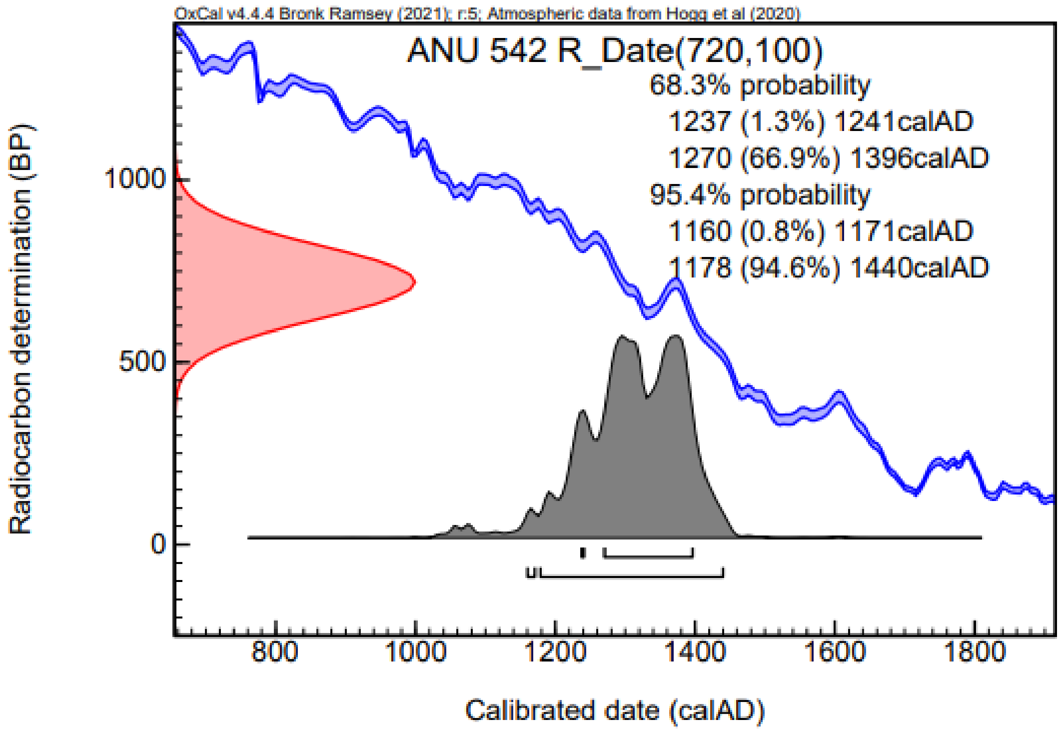
7. Reported by K.M.Peters.
Address Dept. Anthropology.
University of Auck.
Date 26.9.74.

Filekeeper [signature]
Date 29/9/74.

Appendix 5: Calibration of Peters 1975 dates Anu 543 is layer 5 slope gardens Q05/44, Opunga Bay. Calibrations by P. Sheppard 2021.

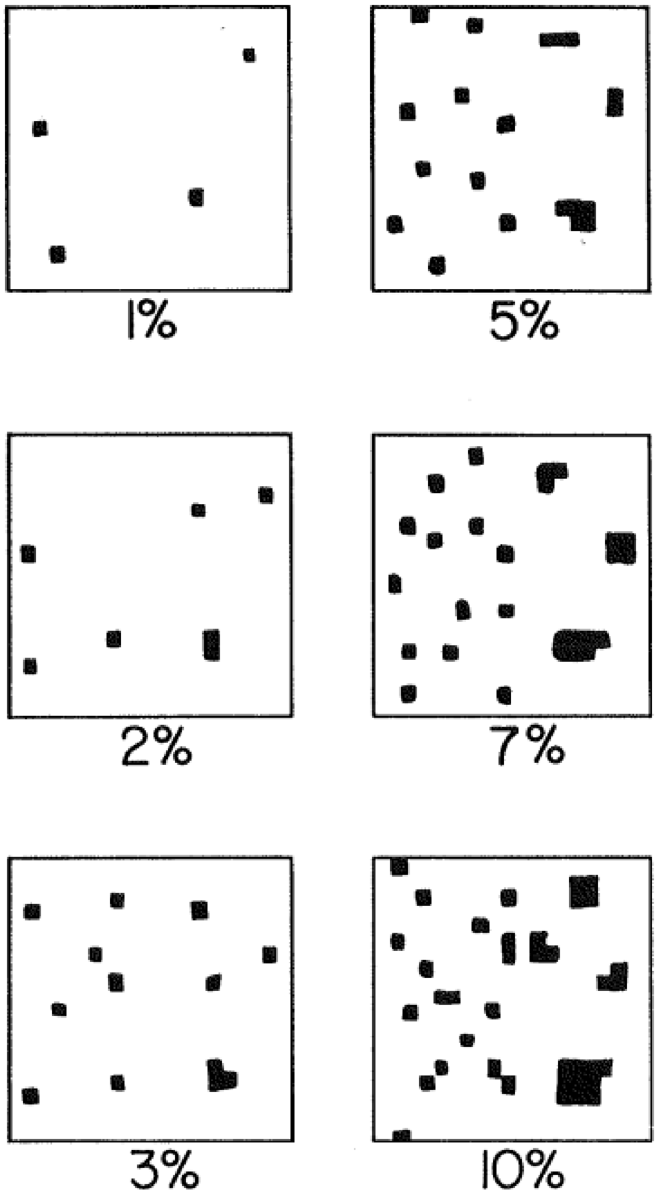


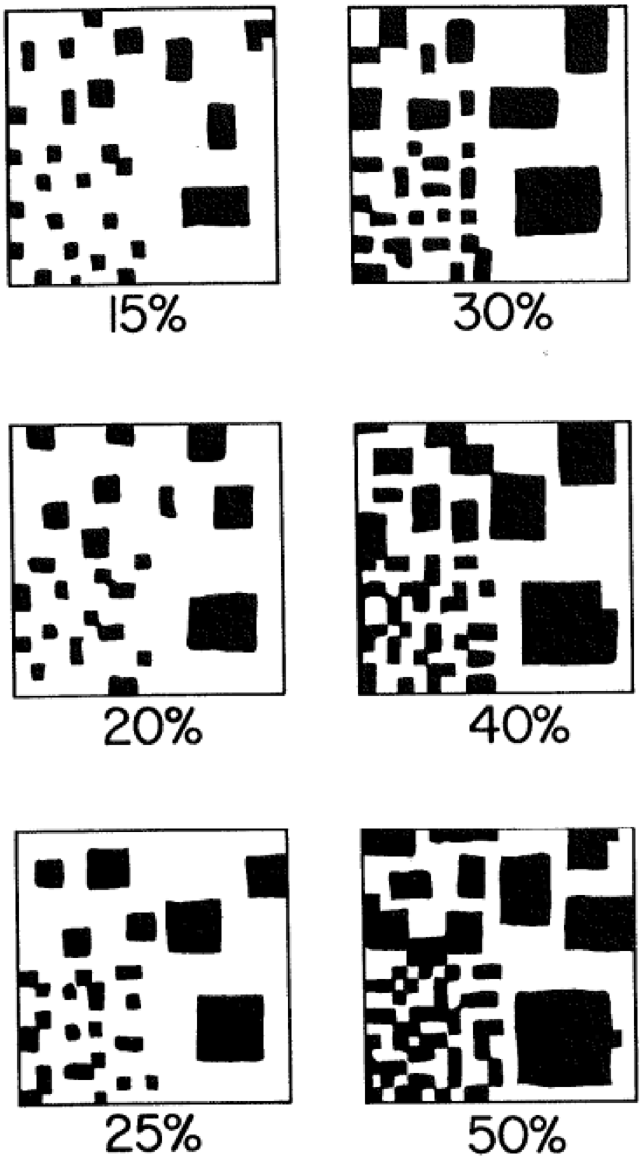
Appendix 6: Calibrations of Peters 1975 dates Anu 542 is layer 6 slope gardens Q05/44, Opunga Bay Calibrations by P. Sheppard 2021



Appendix: 7: Chart for estimating proportions of mottles and coarse fragments (Munsell 1994:9-10)

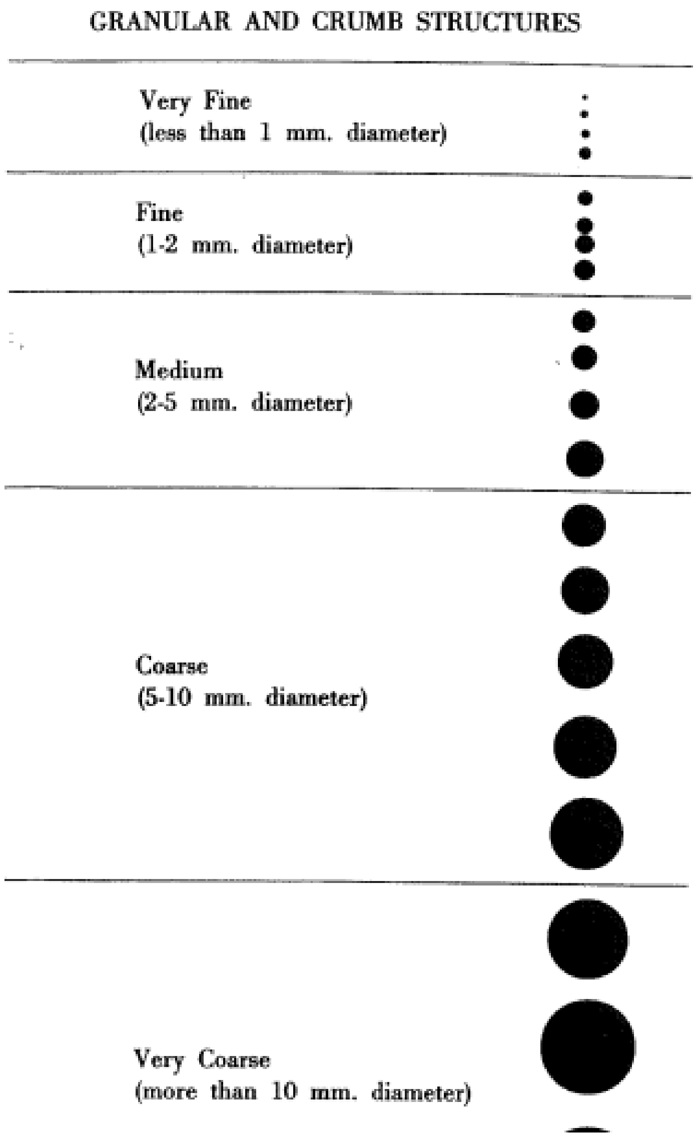
CHARTS FOR ESTIMATING PROPORTIONS OF MOTTLES AND COARSE FRAGMENTS



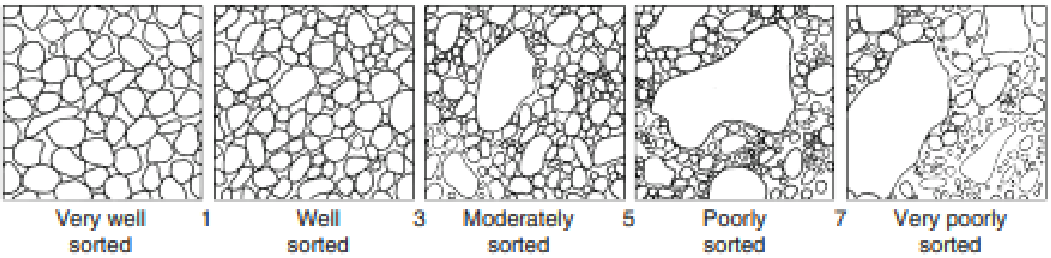


Each fourth of any one square has the same amount of black

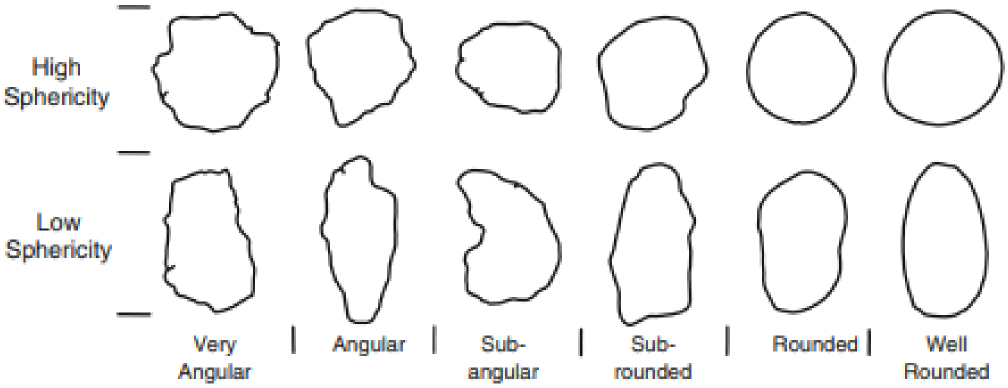
Appendix: 8:Chart for estimates of granular and crumb structure (Munsell 1994:5)



Appendix: 9: The sorting of particles assessment (Reitz et al 2012:133-134, fig 5.6).



Appendix: 10: The particle shape assessment (Reitz et al 2012:134, figure 5.7).



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