Appendix 4 - Waitārere Beach Archaeology Scoping Report & Addendum

Waitarere Beach Master Plan: An Overview of Archaeological Risk

Prepared by:

inSite Archaeology Ltd
48 Liverpool Street
Levin, 5510
phone: (027) 421-0803
email: daniel@insitearchaeology.com

Date: February 2019

QUALITY INFORMATION

Title: Waitarere Beach Master Plan: An Overview of Archaeological Risk

Reference: iSA19_01

Author(s): Daniel John Parker

Revision History:

Draft	14 January 2019	Parker
Review	8 February	Katrina Gray (HDC)
	8 February	Dan Males (Local Collective)
	8 February	Graeme McIndoe (McIndoe Urban)
	21 February	Parker
Final		Parker

EXECUTIVE SUMMARY

- The Horowhenua District Council (HDC) commissioned inSite Archaeology Limited (iSA) to provide a scoping assessment of archaeological risks within the land area identified for future residential development in the Waitarere Beach Master Plan (the "Project"). The dune lands of the Horowhenua have been intensively occupied since Māori first arrived in New Zealand and there are a substantial number of known archaeological sites along this stretch of coast.
- City, District and Regional Councils are required to manage the use, development and protection of historic heritage under the Resource Management Act 1991 (RMA) and the protection of historic heritage from inappropriate subdivision, use, and development is identified as a matter of national importance (section 6f). However, the primary legislation in New Zealand that controls work affecting archaeological sites is the Heritage New Zealand Pouhere Taonga Act (HNZPTA) 2014. Heritage New Zealand (HNZ) administers the HNZPTA and a consent (authority) process for any work affecting archaeological sites.
- An archaeological site, defined in the HNZPTA legislation, is:
    - Any place in New Zealand, including any building or structure (or part of a building or structure), that -
    - Was associated with human activity that occurred before 1900 or is the site of the wreck of any vessel where the wreck occurred before 1900; and
    - Provides or may provide, through investigation by archaeological methods, evidence relating to the history of New Zealand; and
    - Includes a site for which a declaration is made under section 43(1).
- The Project is entirely within the coastal dune belt, which is a geologically diverse area with sandy soils of various ages. Archaeological evidence in the northern Horowhenua District indicates the sand dunes in the Project area formed after human arrival, likely in connection with early vegetation clearance. Archaeological materials may be located within and below any of the soil horizons of the dunes: i.e., from the topsoil to below the bottomset bed.
- Archaeological evidence, court records and Māori oral histories indicate multiple migrations into the region – either by conquest or assimilation – in the period before colonisation by the British Crown (Adkin, 1948:108-29), though the evidence for this has not yet been given a serious academic treatment. The most recent of these Māori migrations dates to the 1830s.

The Ngāti Toa had arrived the previous decade and settled over much of the southern land previously occupied by the Muaūpoko and their related allies. Te Rauparaha, the Ngāti Toa chief, invited Ngāti Raukawa to establish settlements in the land, but it was only upon receiving a later invitation from his sister, Waitohi – who shared Ngāti Raukawa descent through her mother, Parekohatu – that they agreed to come and settle in the Horowhenua.

- Although there are historic European sites in the coastal dune belt, for the most part the development related risks for these sites are fewer than for sites related to the more developed Māori history that may be impacted by any future earthworks.
- While the focus of this scoping report is on the identification of potential archaeological risks within the Project area, this report draws on a much wider body of archaeological material extending from the Hokio Beach settlement to north of Waitarere to account for a potential site identification bias. The number and location of identifed sites appears to strongly correlate to an area of dunes that were eroded and mobilised during the late 19th/early20th centuries. South of the Project area the sand drifts extend more than 1.5 km inland, but reach only 1/3 as far inland in the Project area and further north. It is possible that the site distribution is without, or with relatively little, bias but there is insufficient information to determine either way at this point. In the absence of this information it is prudent to consider both options.
- Shell middens are the most ubiquitous site type. There are nineteen known middens within the Project area, however, other middens are likely to be present in this area that are currently hidden beneath the surface on both the dunes and sand plains.
- South of Waitarere Beach Road, the dominant landform on the eastern margin of the Project area is the Otororoa Ridge: a series of interconnected parabolic dunes extending between the Hokio and Wairarawa streams. Shell middens are the most numerous site type on the ridge, but the ridge is better known for the burials that have been found there. Like the middens, burials were exposed at various places along ridge by the drifting sands. Of the five burial locations identified on the ridge, one is located within the Project area. There is a high probability that other burials are located on the Otororoa Ridge. Burials are generally held to be sites of the highest cultural significance by iwi and are of potentially similarly high value to archaeologists.
- While burials and midden are distinct archaeological sites, they are also an indicator of other activities taking place in the immediate vicinity or wider landscape. With the information that we currently have it is not possible to say exactly what these other activities are, nor identify the unseen sites that are likely to be present within the Project area. However,

we know that occupation tends to have concentrated about the ridges and plains adjacent to the former swamps and lagoons.

- While the Project is located in an area where there is a widespread high risk of disturbance to archaeological sites, this should not be taken to imply that any and all development in this area should be abandoned. Rather, it merely indicates there is a high degree of archaeological risk associated with much of the Project area and that this risk will need to be appropriately managed. Provision for the management of archaeological risks is primarily included in the HNZPTA and the archaeological authority process, though there are also relevant provisions in the RMA.

- There is a strong risk that archaeological sites would be affected by earthworks associated with both roading/services and residential construction within the Project area. An archaeological authority will be required for any earthworks/construction within the Project area. Depending on how this is managed, regulatory risks associated with the HNZPTA may continue to apply to future property owners and present an ongoing burden. While the HNZPTA provides a legal framework for the management of archaeological risk, where possible Heritage New Zealand favours development strategies that avoid or minimise adverse effects.

- A majority of the Project area is classed as having low or low-to-medium intra-site values. Though significant archaeological finds have occurred in former lagoon or wetland areas throughout the Horowhenua and wider New Zealand, drainage is likely to have negatively affected condition of all but the deepest of buried objects and the information value of individual finds is expected to be low. On the low dunes and older sand plains to the north and west of the Project area the low-to-medium value reflects potential variability in the rarity and information value of the shell middens that are the main site type expected here. Where these areas have been intensively planted in pines the value is reduced due to likely adverse effects to site condition caused by root disturbance. An isolated high dune north of Waitarere Beach Road is rated a medium value as the presence of a probable storage pit suggests there may be more substantial features in this area of higher rarity and information value. The presence of both burials and shell middens along the Otororoa Ridge sees this assigned a high value, though the southernmost extent is reduced to a medium-to-high value due to likely adverse effects to site condition caused by potential root disturbance of the existing pine forest.

- The distribution of contextual class values is substantially simpler than the intra-site class values. Iwi have unanimously indicated that cultural association values are high across the entire Project area; contextual and amenity values are expected to range between high and low values but more detailed site information would be required in order to better

differentiate value areas. With one of the three values a blanket high and the remaining two having an unknown distribution between high and low values, a baseline medium value has been applied to the entire Project area. A small area of land already in residential development to the southeast has low amenity and contextual values, therefore the base score in this area is reduced to a low value. Conversely, the entire Otororoa Ridge has a high contextual value and a potentially high amenity value, therefore this area is raised to a high overall value .

- There is a high risk that archaeological sites would be affected by earthworks associated with roading, services and residential construction within the Project area. An archaeological authority should be required for any earthworks/construction within the Project area. Depending on how this is managed, regulatory risks associated with the HNZPTA may continue to apply to future property owners and present an ongoing burden. While the HNZPTA provides a legal framework for the management of archaeological risk, where possible HNZ favours development strategies that avoid or minimise adverse effects to archaeological sites and their values.

- Potential cumulative impacts should be taken into consideration for future planning, in particular regarding the Otororoa Ridge. A large proportion of the coastal archaeological record between the Hokio and Waitarere beach settlements is likely to have been substantially damaged or destroyed by the erosion and subsequent stabilisation of the dunes with plantation forest. The high dunes of the Otororoa Ridge towards the east of the low density and greenbelt deferred residential areas, south of Waitarere Beach Road, are the best preserved and least damaged/modified remaining portion of this archaeologically and culturally important dune ridge. The avoidance or minimisation of any adverse effects to these dunes should be given strong consideration in any planning for the future development of this area.

- There are archaeological constraints that need to be addressed in order to progress intensive or semi-intensive residential development in the Project area and further research looking into the archaeological matters in greater detail will be required to advance development proposals at later stages. Priority should also be given to consultation and discussion with affected iwi as their engagement and cooperation will help to smooth the progress of any proposed developments through the HNZPTA archaeological management process.

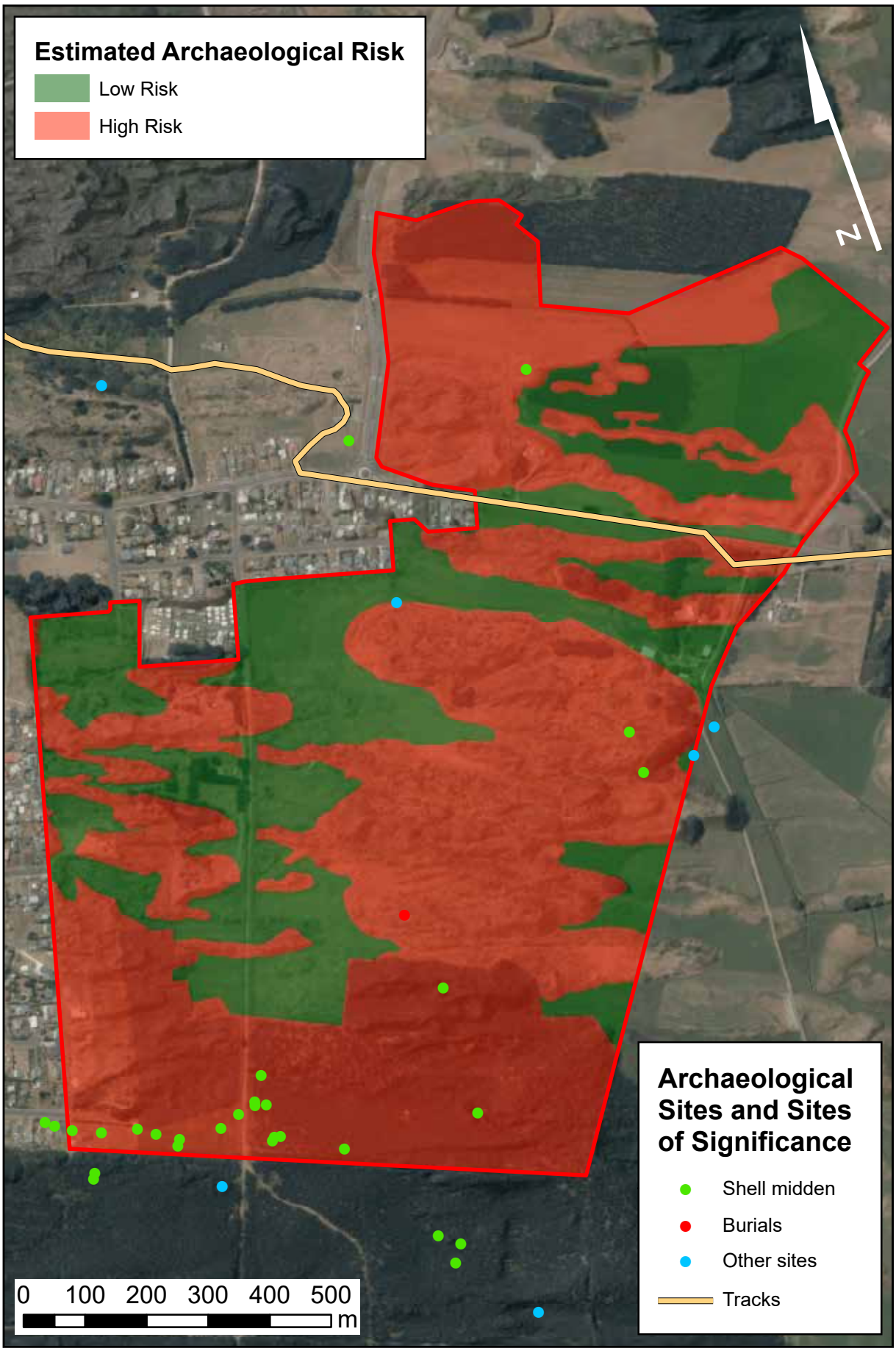


Figure i: Estimated archaeological risk within the Project area. Historic occupation is expected to be concentrated on high dunes and older sand plains; fewer sites are expected in lower lying areas where lagoons and wetlands once existed.

CONTENTS

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

The Horowhenua District Council (HDC) commissioned inSite Archaeology Limited (iSA) to provide a scoping assessment of archaeological risks within the land area identified for future residential development in the Waitarere Beach Master Plan (the "Project"). The dune lands of the Horowhenua have been intensively occupied since Māori first arrived in New Zealand and there are a substantial number of known archaeological sites along this stretch of coast. The protection of historic heritage is recognised by the government as a matter of national importance and this assessment provides an overview of the known archaeological risks within the Project area to assist HDC future planning in respect of this requirement. This is not a formal archaeological assessment for environmental effects reporting within a statutory process. Further research and in-depth reporting will be required for that purpose.

This report makes no attempt to engage with the cultural and/or spiritual aspects of the Māori worldview that extend beyond the purely material domain of archaeological enquiry. Iwi may have concerns or opinions about cultural sites that draw on elements of Māori thought and knowledge that are beyond the purview of this report and inquiry in regards to these aspects should be directed to the relevant iwi authorities.

STATUTORY CONSIDERATIONS

There are requirements for City, District and Regional Councils to manage the use, development and protection of historic heritage under the Resource Management Act 1991 (RMA) and the protection of historic heritage from inappropriate subdivision, use, and development is identified as a matter of national importance (section 6f). However, the primary legislation in New Zealand that controls work affecting archaeological sites is the Heritage New Zealand Pouhere Taonga Act (HNZPTA) 2014. Heritage New Zealand (HNZ) administers the HNZPTA and a consent (authority) process for any work affecting archaeological sites, where an archaeological site is defined as:

- Any place in New Zealand, including any building or structure (or part of a building or structure), that -
- Was associated with human activity that occurred before 1900 or is the site of the wreck of any vessel where the wreck occurred before 1900; and
- Provides or may provide, through investigation by archaeological methods, evidence relating to the history of New Zealand; and

- Includes a site for which a declaration is made under section 43(1)

Any person intending to carry out work that may modify or destroy an archaeological site, must first obtain an authority from Heritage New Zealand. The process applies to sites on land of all tenure including public, private and designated land. Breaches of the HNZPTA are a criminal offense and the act allows for significant monetary and custodial penalties to be imposed for unauthorised site damage or destruction. The archaeological authority process applies to all archaeological sites, regardless of whether:

- The site is recorded in the NZ Archaeological Association Site Recording Scheme or included in the Heritage New Zealand List,
- The site only becomes known about as a result of ground disturbance, and/ or
- The activity is permitted under a district or regional plan, or a resource or building consent has been granted

Heritage New Zealand also maintains the New Zealand Heritage List/ Rarangi Korero of Historic Places, Historic Areas, Wahi Tupuna, Wahi Tapu and Wahi Tapu Areas. The List can include archaeological sites. Its purpose is to inform members of the public about such places.

Separate approvals may be required under the provisions of the RMA to address cultural and historic heritage matters (RMA 4th Schedule and the district plan assessment criteria).

PHYSICAL ENVIRONMENT

The Project is entirely within the coastal dune belt, which is a geologically diverse area with sandy soils of various ages. Understanding the background geology is essential to the analysis of the archaeological record in this environment because the geological context not only informs the potential age and preservation of the archaeological record, but also its distribution. In particular, understanding the phasing and dynamic nature of the Horowhenua dune belt establishes a guide to the depth at which earthworks may no longer be exposed to the risk of archaeological discovery. Following Cowie (1963; Cowie, Fitzgerald, and Owers, 1967), land for the proposed development consists of Holocene dune deposits belonging to at least three different developmental phases (Figure 1):named here in order of increasing age, Waitarere, Motuiti and Foxton.

The oldest dune sands of the Foxton phase are estimated to have formed and stabilised between 4,000-2,000 years BP and are approximately 1,000 years older than any scientifically documented evidence for the human occupation of New Zealand. Absent later localised erosion/deposition events affecting previously stabilised surfaces, evidence for archaeological materials located on

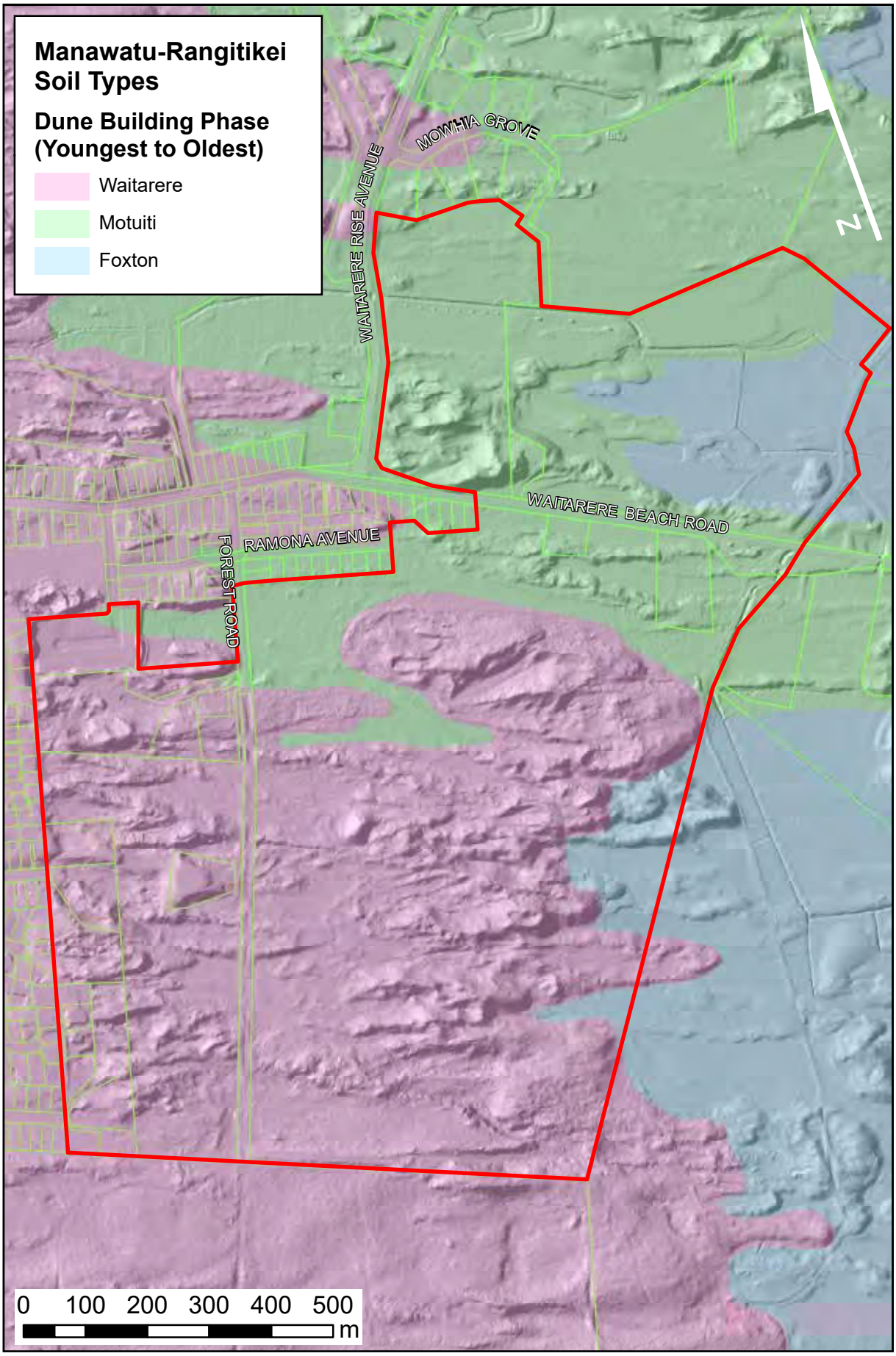


Figure 1: Soils, grouped by dune phase, in the Waitarere Future Development zone (Cowie 1963). Archaeological materials are generally found at shallow depths on Foxton soils but may be found at any depth, including being deeply buried, under more more recent soils.

these sands would be expected to be evident in the upper soil horizons of the top- or sub-soil.

West of the Foxton dunes, and mostly north of Waitarere Beach Road, are dunes belonging to the Motuiti phase[1]. Archaeological evidence in the northern Horowhenua District indicates that the formation of these dunes started after human arrival, likely in connection with early vegetation clearance, and eventually stabilised around 500 years BP (Cowie, 1963; Lockerbie, 1959; McFadgen, 1972). Regardless of localised erosion/deposition events affecting previously stabilised surfaces, archaeological materials may be located within and below any of the soil horizons of the Motuiti dunes: i.e., from the topsoil to below the bottomset bed into the Foxton dunes (Cowie, 1963: 273-4).

The westernmost dunes, belonging to the Waitarere phase, started to form in the late 19th century and though largely stabilised inland, dune formation continues along the coastal margins. Cowie (1963) states that the Waitarere dune formation was attributable:

> partly to overgrazing and burning of the original vegetation on previously stabilised dunes, and partly to the accelerated erosion inland due to clearing and burning causing increased accumulation of sand along the beaches.

Inland movement of the Waitarere sands has resulted in there being substantial areas where earlier archaeological landscapes are completely buried beneath the new dunes (Figure 2). In particular, much of the westernmost chain of wetlands and lagoons that existed up to the later decades of the 19th century is now buried under several metres of sand. Within the Project area, evidence for buried landscapes is strongest to the south of the Wairarawa Stream where the plan SO 11422 (dated 1877) shows potentially extensive areas of buried swamp deposits. Fewer archaeological risks are expected within the former lagoons and wetlands[2], instead the risk is expected to be concentrated on the drier margins around these places. As with the Motuiti, archaeological materials may be located within any of the soil horizons of the Waitarere dunes and also below the Waitarere bottomset bed into the preceding dune phases.

Aerial photography from 1939 shows the dunes in the project area mostly stabilised (Figure 2), a marked contrast to the expansive areas of bare, drifting sand directly to the south and west. At the present time the land is largely in grass, with small areas in pine and light residential occupation.

1 Some of Leslie Adkin's conclusions in regards to dating the material culture found in association with the burials and midden on the Otororoa Ridge imply a greater southern extent for the Motuiti dunes: i.e., that the Otororoa Ridge initially formed and stabilised during the Motuiti, but resumed drifting during the Waitarere. However, these conclusions have not received adequate scientific testing to establish any such claim.

2 The preservation of ancient organic materials is an archaeological risk associated with wetlands and marine environments, though their survival requires several specific environmental conditions to be meet. The risk of encountering preserved organic materials in buried or partially drained wetland deposits is non-negligible, though the risk of uncovering archaeological materials outside of wetland contexts is likely to be much greater. Any organic materials uncovered would be of very high archaeological (and likely cultural) value.

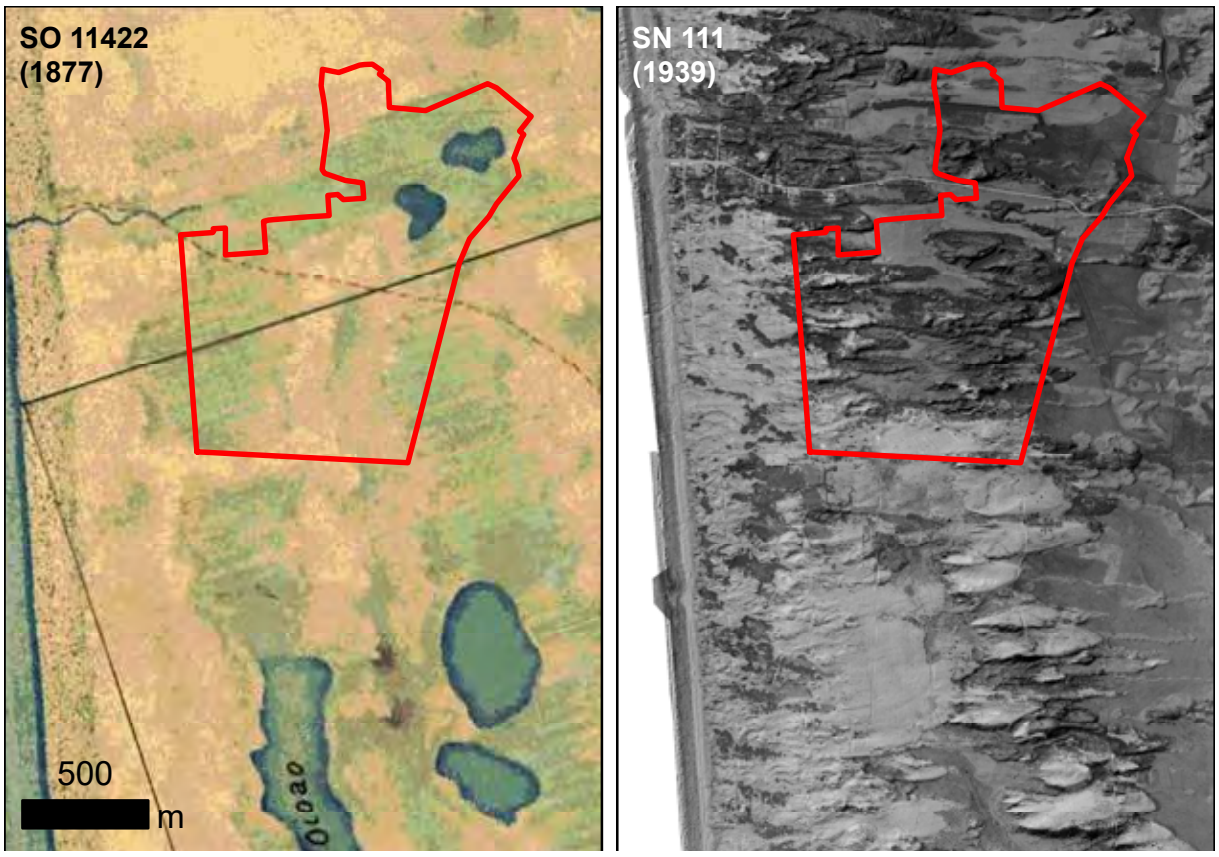


Figure 2: Rapid environmental change has occurred along the Hokio-Waitarere coast over the last 150 years. Wetlands and lagoons that were present in 1877 had largely disappeared by 1939 under extensive sand drifts or been drained to increase land for grazing. The extent of landscape change is particularly notable to the south of the proposed future development zone.

HISTORICAL BACKGROUND

Radiocarbon (C14) determinations from coastal sites to the north and south indicate that Māori have occupied this part of the New Zealand coast for more than 700 years[3]. Within a relatively compressed landscape between the coast and the Tararua Ranges, there was a diverse mix of faunal and floral resources (Bevan sen., 1907: 10-11; O'Donnell, 1929: 5). Until the late-19th century, the major settlements and occupation sites of the various local iwi were predominantly located in the coastal dune belt and adjacent to the major rivers, streams, swamps, lagoons and inland lakes. The general disposition of Māori settlement in the district is succinctly illustrated by Keepa Rangihiwinui (Major Kemp), a chief of Muaūpoko, who when asked where on the Horowhenua Block Muaūpoko had historically lived, replied:

> On No. 11 alongside the [west of] lake [Horowhenua], from their ancestors down to the present day… They have permanent whares there; there are fortified pas [sic] there too. You could see the heaps of shells handed down from past

3 See reference dates WK1757 and NZ0682 from the NZ Radiocarbon Database, at www.radiocarbondating.

> generations; the other portion [i.e., the forest east of Lake Horowhenua] the birds and the rats occupied."[4]

The forested land to the east of the district was not unoccupied, but traditional Māori and European historical accounts indicate that it was not intensively settled until after the completion of the Wellington-Manawatu Railway in 1886. Prior to this, the forest was used primarily for resource gathering, including bird snaring, collecting forest fruits and obtaining timber. Tracks out of the district also passed through the forest. The thickness of the forest, outside of clearings and tracks, made navigating through the forest almost impossible and:

> "people [were] apt to walk in circles and become lost in a few acres. From time to time the mill-hands would go pig or cattle hunting and be missing for a night or even two." (Wilson, 1959: 116)

Forest sites relating to Māori occupation during this period were generally located in small clearings (both natural and man-made), areas of raised ground, or along the margins of the streams and tracks that crossed the forest. The largest of these clearings, some of which contained sizeable settlements, were for the most part located west of State Highway 1.

Archaeological evidence, court records and Māori oral histories indicate multiple migrations into the region – either by conquest or assimilation – in the period before colonisation by the British Crown (Adkin, 1948:108-29), though the evidence for this has not yet been given a serious academic treatment. The most recent of these Māori migrations dates to the 1830s. The Ngāti Toa had arrived the previous decade and settled over much of the southern land previously occupied by the Muaūpoko and their related allies. Te Rauparaha, the Ngāti Toa chief, invited Ngāti Raukawa to establish settlements in the land, but it was only upon receiving a later invitation from his sister, Waitohi – who shared Ngāti Raukawa descent through her mother, Parekohatu – that they agreed to come and settle in the Horowhenua.

Muaūpoko maintained a presence in the wider district and were direct descendants of the first Māori to occupy the Horowhenua region, but in its 1873 judgement regarding the contested Manawatu Kukutauaki claim the Native Land Court awarded much of the northern land in their traditional rohe to Ngāti Raukawa. The land in question for the proposed development is located directly to the north of the court-imposed boundary between the Muaūpoko and Ngāti Raukawa lands of the Horowhenua and Manawatu Kukutauaki 7D blocks, respectively. Two historic Māori land blocks are associated with the project land: Kahukura, a subdivision of the Manawatu Kukutauaki 7D, and Wairarawa, also called Manawatu Kukutauaki 7H (Figure 3). Land Court records often contain detailed description and debate about the 19th century occupation by various hapū and personages of Ngāti Raukawa. Outside of the Horowhenua Block there is not the same depth of written records for Muaūpoko occupation, though oblique references to earlier Muaūpoko occupation do occur in some of the Ngāti Raukawa court records.

The first Europeans to settle on the Horowhenua coast were predominantly whalers or traders

4 Testimony of Major Kemp, quoted during the examination of Alexander McDonald by the Horowhenua Commission (AHJR 1896: 78).

Figure 3: Detail from Maori Land plan 363 and showing historic land blocks within and adjacent to the proposed future development zone.

who arrived in the early decades of the 19th century (Bevan sen., 1907:18; O'Donnell, 1929). These hardy settlers lived in or nearby the Māori settlements among the coastal dune belt and with whom they traded for raw materials that could be on sold in the Wakefield settlements or exported to the booming markets in Sydney (Bevan sen., 1907:24; Dreaver, 1984:34). The relationship between settler and Māori was relatively harmonious, barring occasional minor incidences (Bevan sen., 1907). With the establishment of the Wellington-Manawatu railway the settlers shifted inland to be nearer the railway line which had become the primary transportation, trade and communication route. An influx of new settlers, attracted by extensive tracts of land made available by the government, established themselves at the burgeoning settlements of Otaki, Manakau, Ohau, Levin, and Shannon. Felling of the dense lowland forests by the settlers, in order to fulfil their obligations to the government to 'improve' the land, resulted in a rapid transformation of the Horowhenua landscape. So dramatic was this change in such a short space of time that Park (1995: 269) states:

> "Never before or since has a New Zealand landscape been so quickly and ruthlessly 'cleared'. Within 20 years of the forest tunnel [Wellington-Manawatu Railway] being cut, only nature's geological lineaments were still there."

Arriving at Rangiuru, Otaki, in 1832, Hector McDonald was the first European settler to the Horowhenua. He later moved north to the mouth of the Hokio Stream where he established an accommodation house and leased substantial tracts of land from local Māori. While the pace of European settlement increased after the signing of the Treaty in 1840 few held land outside the main Māori or colonial settlements. By the early 1870s just six men held leases, from local Māori, for the whole of the coastal land from Otaki to the Manawatu (O'Donnell, 1929: 2). Thomas Cook held the first lease at Poroutawhao in the 1850s, which was transferred to Albert Nicholson the following decade. In 1872 the lease was transferred once more, this time to John Davis. While the leases and livestock were held by the settlers, their management was a collaborative effort as it was local Māori that provided the labour that kept the runs functional.

Although there are historic European sites in the coastal dune belt, for the most part the development related risks for these sites are fewer than for sites related to the more developed Māori history that may be impacted by any future earthworks. Leslie Adkin's ethnographic maps show several structures of possible European origin within the Project area, but it is not certain that any of these pre-date 1900. An historic cart track, a likely expansion of an already existing Māori track, beginning at the mouth of the Wairarawa Stream and connecting to the main inland road at Poroutawhao – where State Highway 1 currently runs – likely follows the alignment of Waitarere Beach Road through the Project area. Any physical remains of the track would qualify for statutory archaeological site protection, but in practice any archaeological remains associated with this are more likely to be related to activities taking place alongside the track rather than the track itself. For these reasons the primary emphasis of this report is on defining the nature and potential impacts on sites related to the Māori occupation.

ANALYSIS OF ARCHAEOLOGICAL RISKS AND VALUES

The most comprehensive 'archaeological' survey of the Horowhenua was undertaken by the farmer and amateur archaeologist, George Leslie Adkin. The results of his survey, conducted over many years during the early decades of the 20th century, were published in his nationally recognised work, *Horowhenua: its Māori place-names and their topographic and historical background* (1948). An area of particular interest to Adkin was the dune system between the Hokio and Waitarere beach settlements that he and others explored in a number of 'expeditions' that are documented in his diaries and notebooks. The extensive drifts of formerly stable dunes exposed a number of archaeological sites that had previously been buried and it was these newly uncovered sites that Adkin examined and documented.

Following Adkin, two archaeological surveys of the Waitarere Forest have been undertaken, the most recent in 2001 (Forbes, 2001; Nevin and Nevin, 1979). The main result of these surveys was the identification of additional shell midden, though some of these sites may be re-identified Adkin midden. North of Waitarere Beach Road, an archaeological assessment was prepared for the Waitarere Rise Development subdivision. However, a final archaeological report has not been prepared and most of the earthworks and construction in this subdivision were undertaken without archaeological oversight.

The following builds upon this prior research to discuss the archaeological risks and values in the Project area. As previously mentioned, as a scoping assessment this report provides only a coarse and very generalised overview. The in-depth research that will be required as part of any development will undoubtedly bring out further details and nuances that are relevant to these issues.

Archaeological Risks

When assessing archaeological risk, it is important to consider both the known and unknown site risks. Though the focus of this scoping report is on the identification of potential archaeological risks within the Project area defined in the Waitarere Beach Master Plan, the following draws on a much wider body of archaeological material extending from the Hokio Beach settlement to north of Waitarere. The results of recent large-scale archaeological investigations in similar dune-based landscapes on the Kapiti coast are also incorporated in this assessment. Establishing a broader area of analysis reduces the potential for visible surface features in the Project area to bias the assessment in a manner that may result in a false negative or overstate a known positive[5].

5 Some site types or occupation patterns that are only visible in the wider landscape will also be present inside the Project area but as an invisible and as yet unknown risk. With the vast majority of the worlds archaeological sites unknown and invisible to human perception, due to their being hidden beneath the earth's surface, resolving the problem of site (in)visibility has been a challenge that archaeologists have grappled with for many decades. Since the 1960s, landscape-based studies have been the preferred scale of analysis for archaeologists researching a range of questions (Kluiving and Guttmann-Bond, 2012:9), including the

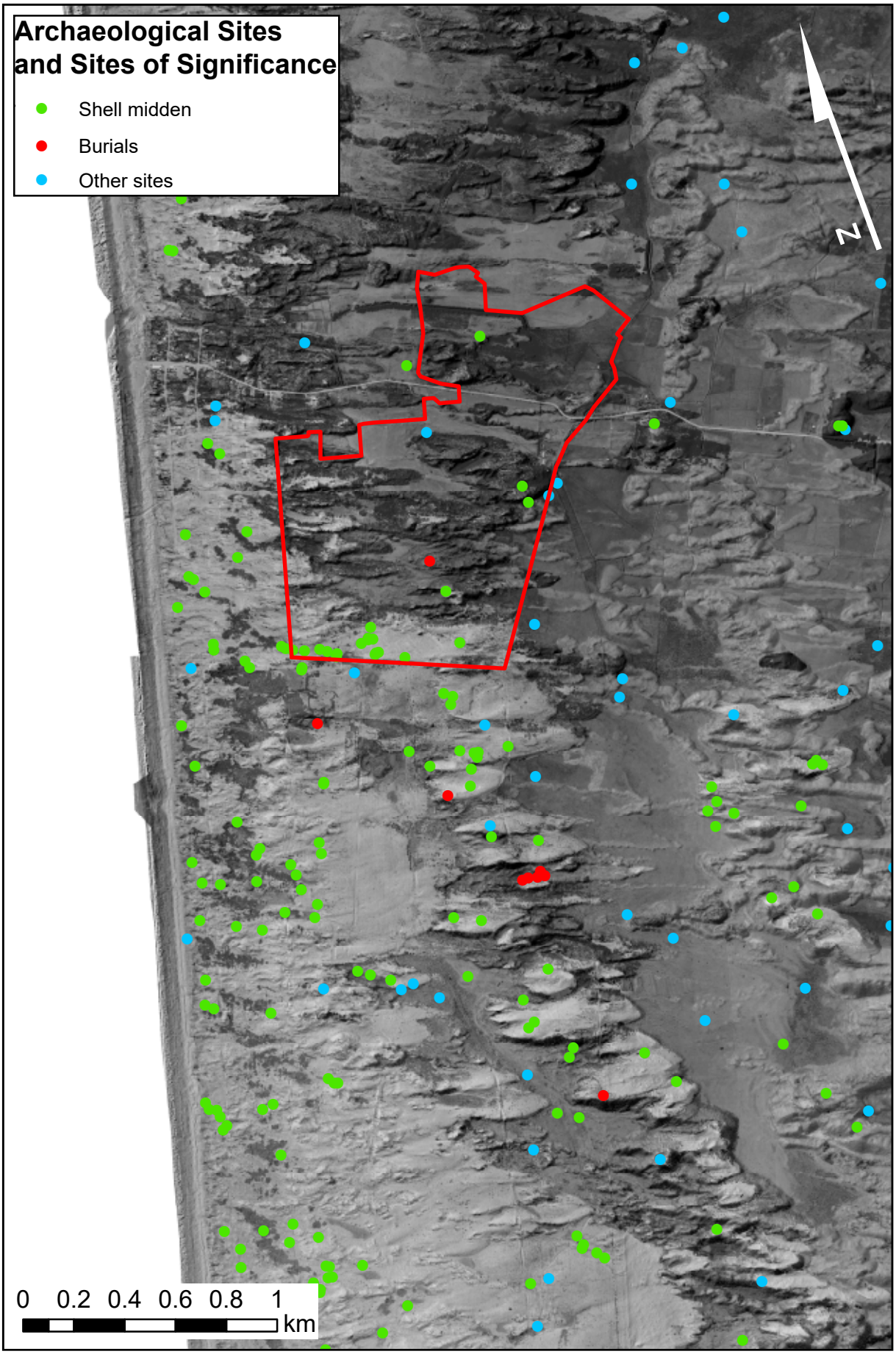


Figure 4: Contrasts in the distribution of identified sites between the largely stable dunes within the proposde future development zone and the drifting sands to the south. Dune erosion appears to correlate with increased site visibility.

Figure 4 shows over 200 archaeological sites, or landscape features with known or likely archaeological values, extending almost 2 km inland between the Hokio and Waitarere beaches. Represented are sites and landscape features recorded on historic survey plans, Adkin maps, New Zealand Archaeological Association site records and sites identified by this author from early aerial photographs[6]. The predominant site type is shell midden, with a clear trend towards greater numbers of sites being identified in areas of bare or drifting sand. Of the 22 sites within the Project area, 20 were identified on exposed sand drifts and of these 16 are located within the most extensive drift at the south boundary of the Project area. South of the Project area the sand drifts extend more than 1.5 km inland, but reach only 1/3 as far inland in the Project area and further north. It is possible that the site distribution is without, or with relatively little, bias but there is insufficient information to determine either way at this point. In the absence of this information it is prudent to consider both options.

The potential scope of the unknown site risk is highlighted by recent archaeological investigations undertaken as part of the New Zealand Transport Agency's Mackays to Peka Peka Expressway project. Eighteen kilometres of new Expressway were built through the comparable dune landscape of the Kapiti coast. While formal reports are still being prepared, early indications are that the number of previously unknown sites discovered during construction was substantially greater than the number of sites known beforehand (Figure 5). Prior to

detection of unknown sites (e.g., Bintliff, Howard, and Snodgrass, 1999; Campana, 2009). Internationally, the extent of landscape analysis beyond the design boundaries of major industrial/infrastructure projects varies in scale from hundreds of metres to kilometres in size (e.g., DOE and MDOC, 2009:4.9-1-4.9-9; Lambert, Newman, and Oliver, 1996).

6 New Zealand Aerial Mapping, flight run SN 111 (March, 1939).

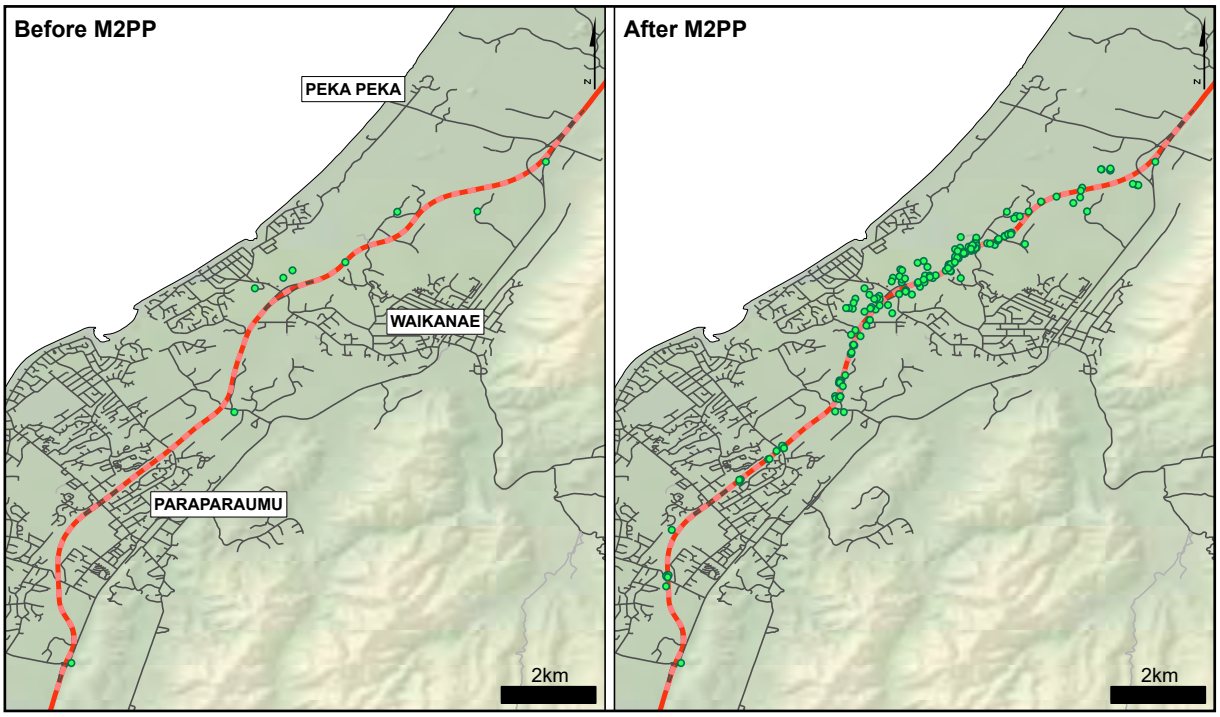


Figure 5: Two maps showing all archaeological site records held by the NZAA that are located within 500 m of the recently constructed Mackays to Peka Peka Expressway. (left) All site records created before route investigations and construction. (right) Total number of sites after route investigations and construction. More than 100 additional sites, pending approval, remain to be added to the NZAA records as a result of this project.

preliminary route investigations for the Mackays to Pekapeka Expressway being undertaken only nine archaeological sites had been identified within 500 m of what would be the eventual route. Twenty-two new sites were identified by the project archaeologists prior to construction, with a further 200 new sites identified during the construction of the Expressway. Though the effect of the Expressway is spread out over a much larger area than the proposed Project, it is an excellent illustration of the potential variance between what may be known or expected before any earthworks disturbance occurs and what is actually found to be present after construction is completed. Failure to adequately account for the unknown site potential may result in significant financial or legal risks for developers and future landowners.

While a wide range of activities and behavioural patterns have structured the archaeological record of the coastal dunes, as Figure 4 makes apparent, the physical evidence of this history in the Hokio-Waitarere has generally been recognised in one of two forms: shell midden and burials. These are the predominant known archaeological risks within the Project area.

Shell Midden

As previously mentioned, shell middens are the most ubiquitous site type and account for more than 150 of the approximately 200 sites within the study area (Figure 4). Twenty known middens are within the Project area. Other middens are likely to be present in this area hidden beneath the surface and they may be found on both the dunes and sand plains.

On the basis of their material composition, Adkin (1948: 38-63) classified the middens of the district into one of two age classes. The youngest group consisted of loose tuatua and tohemanga shell located within a few hundred metres of the coast. Those he identified as being older were compacted middens of tuatua, tipatipa and kaikaroro shell extended between 600 m to 2 km inland and were often found in association with oven stone, bone and stone artefacts. Adkin's theory of classification has not been scientifically tested and many of the middens this was based on are likely to have been substantially damaged or destroyed by the subsequent Waitarere State Forest or private forest plantations. Of the potential unknown sites that might be encountered within the Project area, shell midden are likely to be the most numerous.

Burials

South of Waitarere Beach Road, the dominant landform on the eastern margin of the Project area is the Otororoa Ridge: a series of interconnected parabolic dunes extending between the Hokio and Wairarawa streams. Shell middens are the most numerous site type on the ridge, but the ridge is better known for the burials that have been found there. Like the middens, burials were exposed at various places along ridge by the drifting sands. Of the five burial locations identified on the ridge, one is located within the Project area.

Adkin (1948: 63-79, 108-126) showed a particular interest in the traditional Māori burials that were uncovered in the wider district and used their association with items of material culture as evidence for a series of migrations into the district by distinct cultural/people groups. Although the conclusions Adkin arrived at are not widely held today, his notes and observations remain

Table 1: Summary of "native burial" locations and their description, as recorded by Adkin (1948).

BURIAL #	LOCATION	DUNE POSITION	NUMBER OF BODIES	DETAILS
1	Otororoa Ridge	Unknown	Unknown Multiple	Wind eroded site with scattered human remains and likely fossicked of grave goods
2	Otororoa Ridge	Summit	1	In fetal position with grave goods
3	Otororoa Ridge	Summit	1	In fetal position with finely decorated grave goods. Skull sent to Dominion Museum [Te Papa]
4	Dune ridge north of the Waitohu Stream (Otaki)	Summit	Unknown Multiple	One individual in fetal position found without grave goods. Traces of other burials in the same vicinity
5	Low dunes west of the Otororoa Ridge	Unknown (deflated dune)	Unknown	Fragmentary human remains from "severely eroded blown sand about half-way between Otororoa ridge and the present shore-line"
6	Otororoa Ridge	Summit	3	Two bodies prone and a third in fetal position, all without grave goods
7	Otororoa Ridge	Summit	1	Severely eroded, only teeth remaining, with adze grave good
8	Dune ridge south of the Waikawa River (Manakau)	Unknown	Unknown Multiple	Wind eroded site, scattered fragments of human remains with possible scattered grave goods
9	Unknown	Unknown	1	Fragment of human jaw bone found in unknown context
10	Okaka Ridge (Manakau)	Summit	1	In fetal position and without grave goods

a valuable source of information. A summary of the traditional Māori burials documented by Adkin, throughout the entire Horowhenua District, is presented in Table 1.

Ten burial sites from five different known locations, with at least 15 individual interments, were described by Adkin. Four of the burial sites were so severely eroded that it was not possible to determine their original context, but the remaining six sites were located along ridgelines or summits of dunes. More recently, another traditional burial was uncovered near the summit of a high dune during sand mining earthworks near Whirokino (Collis and Beckman, 2018).

Burial number three, which is located within the Project area, was judged by Adkin (1948: 69) to be "the grave of the most important personage" of all the burials he had documented. The grave-goods and skull from this burial were sent to the Dominion Museum (i.e., Te Papa), the remainder of the body being left in situ. There is a high probability that other burials are located on the Otororoa Ridge and preliminary discussions with local iwi representatives indicate that burials are likely to be present at other locations within the Project area.

Other Sites

While burials and midden are distinct archaeological sites, they are also an indicator of other activities taking place in the immediate vicinity or wider landscape. With the information that we currently have it is not possible to say exactly what these other activities are, nor identify the unseen sites that are likely to be present within the Project area. However, we know that occupation tends to have concentrated about the ridges and plains adjacent to the former swamps and lagoons. The site potential in this area ranges from smaller resource collection/hunting 'camps' to large scale settlements such as pa and kainga.

Summary of Archaeological Risk

With a desktop-based study it is difficult to provide detailed analysis of both known and unknown archaeological risks at a fine-grained spatial scale. Certain field-based methods are available that may help to better identify potential unknown risks, though even these are not without their own weaknesses. Relative to the size of the Project area, there are few known risks. However, the analysis of known risks along a wider stretch of the local coast (Figure 4) and results of recent large-scale projects in a similar historic environment on the Kapiti coast (Figure 5) suggest that the overall degree of archaeological risk in the Project area is likely to be much higher and more widespread.

In the absence of more intensive landscape studies and field investigation archaeological risk is best represented as two classes distinguished on the basis of landform (Figure 6). The first class is estimated to be low risk and incorporates all areas of former lagoon or wetland that were occupied by Māori in a less intensive manner (cf. Figures 2 and 3). Generally speaking, archaeological sites are not expected to be found in these areas, though there is a history of cultural materials being recovered from current and former wetlands in the Horowhenua and wider New Zealand[7]. Younger sand plains are also included in this first class due to the reduced

7 A specific set of stable environmental conditions are required for their to be a greater than minor risk. Given

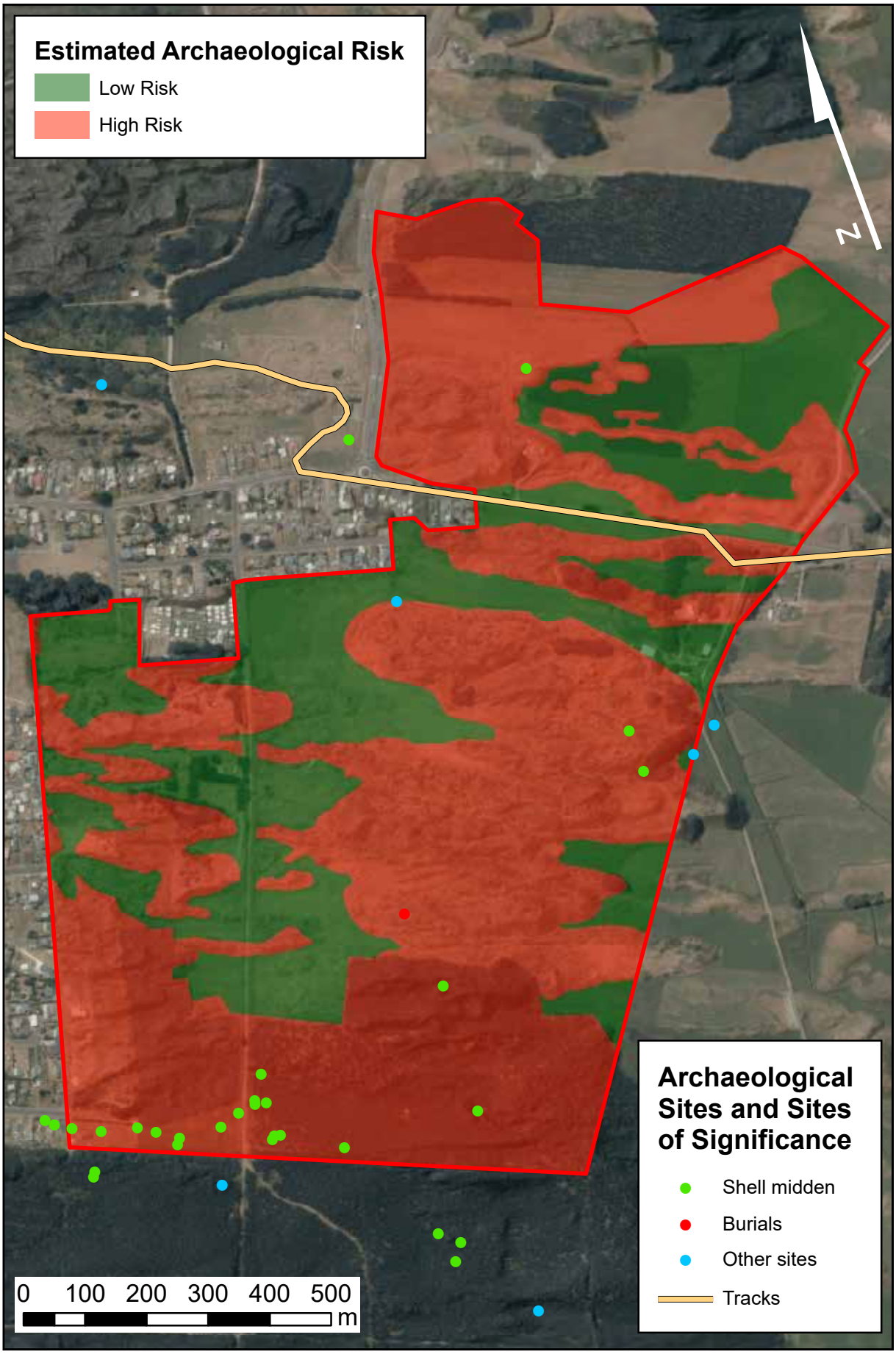


Figure 6: Estimated archaeological risk within the Project area. Historic occupation is expected to be concentrated on high dunes and older sand plains; fewer sites are expected in lower lying areas where lagoons and wetlands once existed.

amount of time for archaeological sites to have accumulated on these surfaces since their formation.

High dunes and older sand plains are adjudged to be of high archaeological risk. These landforms were more intensively occupied by Māori and are where most daily activity would have taken place. A substantial majority of the known archaeological sites on the Horowhenua coast are located on these landforms. Common farming practices, which includes extensive areas of current or former pine forest, are not expected to effect archaeological risk, though they are expected to have affected some aspects of archaeological value. Two exceptions to the general class/landform rule are included in the high risk areas: sand plains belonging to older dune formation phases located at the northern extent of the Project area are included due the extended length of time for archaeological sites to have accumulated on these surfaces; and, low-lying sand plains to the south due to the number of known sites that are present in this area.

While Figure 6 indicates that the Project is located in an area where there is a widespread high risk of disturbance to archaeological sites, this should not be taken to imply that any and all development in this area should be abandoned. Rather, it merely indicates there is a high degree of archaeological risk associated with much of the Project area and that this risk will need to be appropriately managed. Provision for the management of archaeological risks is primarily included in the HNZPTA and the archaeological authority process, though there are also relevant provisions in the RMA. Within the HNZPTA process, future development in the Project area will need to discuss the benefits or disadvantages of the selected design, and any alternatives considered, in regards to the management of the archaeological risks. Where possible, HNZ favours development strategies that avoid or minimise adverse effects.

Archaeological Values

When an archaeological site or risk of encountering a site has been identified consideration must then be given to the heritage values of the site or potential risk that may be affected. Heritage New Zealand provides guidelines for the assessment of archaeological values and these are attached to this report as Appendix 1. There are six categories of value, divided into two broad classes. The first class considers sites as discrete entities and evaluates their distinct, intra-site values such as condition, rarity or uniqueness, and information potential. The second class evaluates sites in a broader context that considers their relationships to other sites and people, both past and present, as archaeological landscape/contextual, amenity and cultural association values.

It is not within the scope of this report to go into a detailed analysis of the values associated with the known archaeological sites in the Project area. However, the HNZ guidelines provide sufficient direction to enable the archaeological values for both the known sites and unknown

the degree of landscape modification through late 19th and early 20th century farming practices this risk is generally expected to be less than minor. Further research and field testing will be required to precisely determine the nature and extent of this risk.

Table 2: Estimated archaeological values for known and unknown shell middens within the Project area.

SITE	VALUE	ASSESSMENT
Shell midden	Condition	Values will be variable and dependent on landform history/ modification. Shallow midden under pine forest are expected to have a low value as will deflated midden that have accumulated on erosion surfaces. Where ground surfaces have remained stable and farming practices have not been excessively intrusive values are expected to be high.
	Rarity/ Uniqueness	Shell middens are the most numerous known site type along the Hokio-Waitarere coast and are also expected to represent a substantial majority of the unknown site risk. Where midden are found in association with other artefacts this value may be moderate, or even high, but in general midden are expected to have a low value.
	Information Potential	As mentioned above, Adkin (1948) defined two types of shell midden: midden of loose shell located within a few hundred metres of the coast and compacted middens of shell extending inland and found in association with oven stone, bone and stone artefacts. The former are likely to be of low value, while the latter are likely to be of moderate or high value. The cumulative information potential of all affected midden is likely to be high.
	Contextual Values	Likely to vary from low to high. Depending on their spatial and temporal relationships with other sites some, but not all, shell midden will derive and impart meaning to and from a multitude of sites in the wider landscape: these sites will have a high value.
	Amenity Value	Likely to vary from nil to high. There may be the potential for some midden to be incorporated into development plans as reserve features. However, integration in an urban context may also increase the risk of illegal fossicking and damage to other values.
	Cultural Associations	Multiple iwi representative bodies have indicated that all archaeological sites in the Project area are of high cultural value. Further discussion with iwi about specific sites and/or risks may help to identify potential value differences.

Table 3: Estimated archaeological values for known and unknown burials within the Project area.

SITE	VALUE	ASSESSMENT
Burials	Condition	Values will be variable and dependent on landform history/ modification, though burials are likely to be less affected than shell midden. Shallow burials under pine forest may have a lower value as will deflated burials that have accumulated on erosion surfaces. Where ground surfaces have remained stable and farming practices have not been excessively intrusive values are expected to be high.
	Rarity/ Uniqueness	Though burial sites are relatively geographically wide spread, numerically they are among the rarest of sites on the Horowhenua coast. Burial grounds with traditional Māori crouch or foetal position burials are among the rarest of known sites in New Zealand. The known burials on the Otororoa Ridge and any unknown burials in the wider Project area will be of high value.
	Information Potential	This value is variable depending on iwi preferences. If iwi are comfortable with recovered burials undergoing scientific analysis then they are of high value. If iwi would prefer that burials are reinterred or left in place without scientific analysis they will be of low value.
	Contextual Values	Values are expected to be high, with burial sites deriving and imparting meaning from a multitude of other sites in the wider landscape.
	Amenity Value	While sensitivities around the burial sites themselves are likely to preclude a high value, there may be the potential for the wider burial ground environment to be incorporated into development plans as reserve features.
	Cultural Associations	Multiple iwi representative bodies have indicated that all archaeological sites in the Project area are of high cultural value. Burials are generally held to be sites of the highest cultural significance by iwi.

Table 4: Estimated archaeological values for other sites unknown risks within the Project area.

SITE	VALUE	ASSESSMENT
Other Site and Unknown Risks	Condition	Values will be variable and dependent on landform history/ modification. Shallow sites under pine forest are expected to have a low value as will those that have accumulated on erosion surfaces. Where ground surfaces have remained stable and farming practices have not been excessively intrusive values are expected to be high.
	Rarity/ Uniqueness	Generally expected to be at the lower end of the value scale, though higher value sites may be encountered. Further field and documentary research may help to clarify this.
	Information Potential	As with rarity/uniqueness, the information potential for individual sites is generally expected to be at the lower end of the scale, though there are may be sites of higher value. The cumulative information potential of all affected sites is likely to be high.
	Contextual Values	Likely to vary from low to high. Depending on their spatial and temporal relationships with other sites some, but not all, sites will derive and impart meaning to and from a multitude of sites in the wider landscape: these sites will have a high value.
	Amenity Value	Will vary from nil to high. There may be the potential for some sites to be incorporated into development plans as reserve features. However, integration in an urban context may also increase the risk of illegal fossicking and damage to other values.
	Cultural Associations	Multiple iwi representative bodies have indicated that all archaeological sites in the Project area are of high cultural value. Further discussion with iwi about specific sites and/or risks may help to identify potential value differences.

archaeological risks to be evaluated in a general manner. This information is provided below in the tabular format preferred by HNZ. As the following tables provide only a preliminary evaluation of potential values it is important to remember that the values associated with specific sites or risks may change following further research and consultation.

Summary of Archaeological Value

Following the two broad classes of archaeological values defined by HNZ, outlined above and in Appendix 1, Figures 7 and 8 provide an estimate of the distribution of the average archaeological values for each class. Figure 7 aggregates and averages the condition, rarity or uniqueness and information potential values. Figure 8 aggregates and averages the contextual, amenity and cultural association values. Again, it is important to recognise that these mapped values are only estimates based on a very preliminary review of the available data and they should not be presumed to represent the values held by iwi with an interest in this area. These figures are an attempt to represent the known and potential unknown archaeological values within the Project area as they are likely to be evaluated under the legal framework of the HNZPTA.

A majority of the Project area in Figure 7 is classed as having low or low-to-medium intra-site values. Though significant archaeological finds have occurred in former lagoon or wetland areas throughout the Horowhenua and wider New Zealand, in this instance drainage is likely to have negatively affected condition of all but the deepest of buried objects and, while spectacular rare finds are possible (e.g., the Kaitaia carving), the information value of individual finds is expected to be low. On the low dunes and older sand plains to the north and west of the Project area the low-to-medium value reflects potential variability in the rarity and information value of the shell middens that are the main site type expected to be found here. Where these areas have been intensively planted in pines the value is reduced to low due to likely adverse effects to site condition caused by root disturbance. An isolated high dune to north of Waitarere Beach Road is rated a medium value as the presence of a probable storage pit, the only one of its kind noted in the area to date, suggests there may be more substantial features in this area of higher rarity and information value. The presence of both burials and shell middens along the Otororoa Ridge sees this assigned a high value, though the southernmost extent is reduced to a medium-to-high value due to likely adverse effects to site condition caused by potential root disturbance of the existing pine forest[8].

The distribution of contextual class values in Figure 8 is substantially simpler than the intra-site class values of Figure 7. Iwi have unanimously indicated that cultural association values are high across the entire Project area; contextual and amenity values are expected to range between high and low values but more detailed site information would be required in order to better differentiate value areas. With one of the three values a blanket high and the remaining two having an unknown distribution between high and low values, a baseline medium value has been applied to the entire Project area. A small area of land already in residential development to the southeast has low amenity and contextual values, therefore the base score in this area is

8 Root disturbance is expected to have an unequal adverse effect with shell middens being more affected than burials.

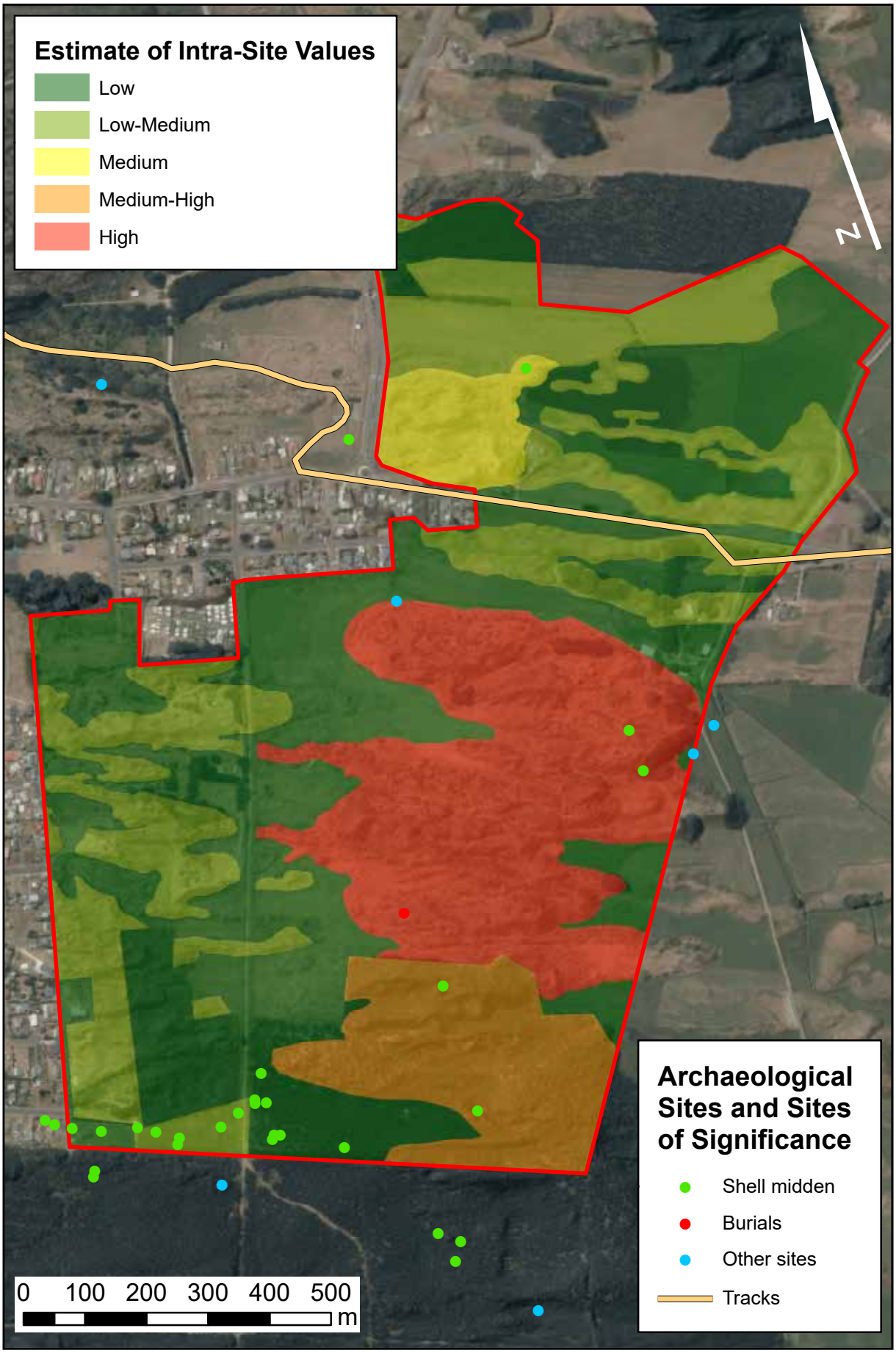


Figure 7: Averaged estimates of intra-site archaeological values within the Project area. Included in the intra-site class are condition, rarity/uniqueness and information values.

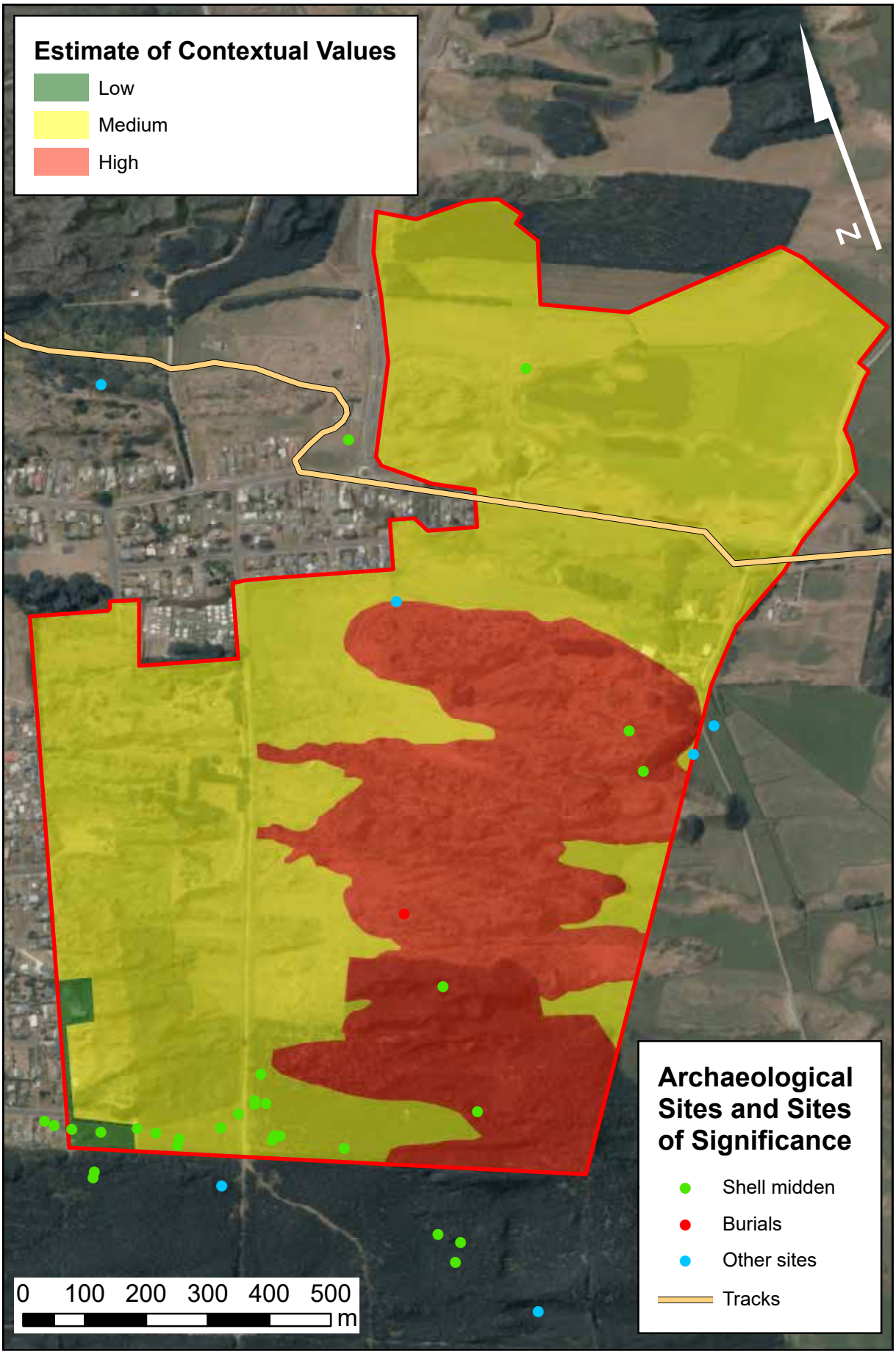


Figure 8: Averaged estimates of contextual archaeological values within the Project area. Included in the conditional class are the archaeological landscape/contextual, amenity and cultural associations values.

reduced to a low value. Conversely, the entire Otororoa Ridge has a high contextual value and a potentially high amenity value, therefore this area is raised to a high overall value[9].

At the present time the intra-site values, in conjunction with the risk assessment, provide the most scope for differentiating areas of land that may be suitable for future development. However, it should also be noted that the potential cumulative effect of extensive development within the Project area may justify some lower intra-site value areas being re-evaluated to a higher value level. Just as HNZ prefers development strategies that avoid or minimise adverse effects, where this cannot be avoided their general preference is for development strategies that avoid or minimise adverse effects to higher valued sites. This is not to say that any and all development that may affect high value sites cannot take place, rather that there are likely to be significant challenges and a high bar to be crossed in order to bring this into effect. Specifically, in regards to the Project area it is unlikely that residential development would be approved on the Otororoa Ridge given the archaeological and cultural values in play.

CONCLUSION

There is a high risk that archaeological sites would be affected by earthworks associated with roading, services and residential construction within the Project area. An archaeological authority should be required for any earthworks/construction within the Project area. Depending on how this is managed, regulatory risks associated with the HNZPTA may continue to apply to future property owners and present an ongoing burden. While the HNZPTA provides a legal framework for the management of archaeological risk, where possible HNZ favours development strategies that avoid or minimise adverse effects to archaeological sites and their values.

The areas of lowest risk and value are located between the dune ridges south of Waitarere Beach Road and west of the Wairarawa Lagoon to the north: Survey Office plan 11422, dated 1877, suggests that all or much of this land was formerly lagoon or wetland and the archaeological sites in these locations are generally expected to be of lower rarity and information value. However, development in these low-lying areas closest to the water-table may not be practically possible without substantial in-filling. The most logical source of fill would be the adjacent dunes where the archaeological risk is much higher, though the archaeological values of sites in these areas are also expected to be relatively low. Western areas of dune formerly planted in pines are also expected to be at the lowest end of the value scale due to the compounding adverse effect of root intrusion on their condition values.

Archaeological risks and values are greatest on the high dunes to the east of the Project area. North of Waitarere Beach Road there are surface features that may indicate intensive occupation of a nature that has not previously been identified in this part of the local coast. The dune soils

9 Contextual class values are not significantly adversely affected by any damages caused by the pine plantation.

at this location belong to a formation phase of an age where archaeological materials may have accumulated on this surface over many centuries. The same applies to the Otororoa Ridge, south of Waitarere Beach Road, which is the area of greatest risk and highest known archaeological value. Ideally, development would be avoided in these areas.

Potential cumulative impacts should also be taken into consideration for any future planning (Figure 9), in particular regarding the Otororoa Ridge. A large proportion of the coastal archaeological record between the Hokio and Waitarere beach settlements is likely to have been substantially damaged or destroyed by the erosion and subsequent stabilisation of the dunes with plantation forest. The high dunes of the Otororoa Ridge towards the east of the low density and greenbelt deferred residential areas, south of Waitarere Beach Road, are the best preserved and least damaged/modified remaining portion of this archaeologically and culturally important dune ridge. The avoidance or minimisation of any adverse effects to these dunes should be given strong consideration during planning for the future development of this area.

There are archaeological constraints that need to be addressed in order to progress intensive or semi-intensive residential development in the Project area and further research looking into the archaeological matters in greater detail will be required to advance development proposals at later stages. Priority should also be given to consultation and discussion with affected iwi as their engagement and cooperation will help to smooth the progress of any proposed developments through the HNZPTA archaeological management process.

Figure 9: Impacts of the Waitarere State Forest and coastal development. Large portions of the archaeological record and dune system have been substantially damaged, modified or destroyed since the 20th century.

REFERENCES

Adkin, G. L. (1948). *Horowhenua: Its Maori place-names and their topographical and historical background*: Wellington : Department of Internal Affairs.

Bevan sen., T. (1907). *Reminiscences of an Old Colonist*. Otaki.

Bintliff, J. L., Howard, P., and Snodgrass, A. (1999). The hidden landscape of prehistoric Greece. *Journal of Mediterranean Archaeology*, 12(2), 139-168.

Butts, D. J. (1981). Preliminary Report on the Excavation of Muhunoa West Midden, Horowhenua. *New Zealand Archaeological Association Newsletter*, 24(4), 263-267.

Butts, D. J. (1982). Faunal Identifications From Muhunoa West Midden (N152/50), Horowhenua. *New Zealand Archaeological Association Newsletter*, 25(3), 191-194.

Campana, S. (2009). Archaeological Site Detection and Mapping: some thoughts on differing scales of detail and archaeological 'non-visibility'. In S. Campana & S. Piro (Eds.), *Seeing the unseen. Geophysics and Landscape Archaeology* (pp. 5-26). London, UK: CRC Press.

Collis, A., and Beckman, S. (2018). Work halted on part of Whirokino Trestle project after Maori remains uncovered nearby. *Horowhenua Chronicle*. Retrieved from https://www.nzherald.co.nz/nz/news/article.cfm?c_id=1&objectid=12062097

Cowie, J. D. (1963). Dune-building phases in the Manawatu district, New Zealand. *New Zealand Journal of Geology and Geophysics*, 6(2), 268-280.

Cowie, J. D., Fitzgerald, P., and Owers, W. (1967). *Soils of the Manawatu - Rangitikei Sand Country*. Wellington: New Zealand Department of Scientific and Industrial Research.

Dreaver, A. (1984). *Horowhenua County and its People: A Centennial History*. Palmerston North: The Dunmore Press.

Forbes, S. (2001). *Waitarere Forest, Levin: Archaeological Assessment*. unpublished research report.

Kluiving, S. J., and Guttmann-Bond, E. B. (Eds.). (2012). *Landscape Archaeology between Art and Science: From a Multi- to an Interdisciplinary Approach*. Amsterdam, Netherlands: Amsterdam University Press.

Lambert, J., Newman, R., and Oliver, A. (1996). *Transect Through Time: The Archaeological Landscape of the Shell North Western Ethylene Pipeline*. Lancaster: Lancaster University Archaeological Unit.

Lockerbie, L. (1959). From Moa-Hunter to Classic Maori in Southern New Zealand. In J. D. Freeman & W. R. Geddes (Eds.), *Anthropology in the South Seas* (pp. 75-110). New Plymouth: Thomas Avery & Sons.

McFadgen, B. G. (1972). *Palaeoenvironmental studies in the Manawatu sand plain, with particular reference to Foxton*. Unpublished MA Thesis, University of Otago, Dunedin.

Nevin, D., and Nevin, G. E. (1979). *Archaeological Site Survey, Waitarere State Forest No. 128*. unpublished research report.

O'Donnell, E. (1929). *Te Hekenga : Early Days in Horowhenua, being the Reminiscences of Mr. Rod. McDonald* Palmerston North: G.H. Bennett and Co.

Park, G. (1995). *Ngā Uruora: The Groves of Life - Ecology and History in a New Zealand Landscape*. Wellington, N.Z.: Victoria University Press 1995.

Taylor, M., Sutton, A., and Parker, D. (2004). *Preliminary Report on Archaeological Monitoring and Excavation at the Levin Landfill Site, NZHPT Authority 2004/78*. Unpublished

Research Report.
United States Department of Energy (DOE) and Minnesota Department of Commerce (MDOC) (2009). *Mesaba Energy Project: Final Environmental Impact Statement (Vol. 1)*: U.S. Department of Energy and the Minnesota Department of Commerce.
Wilson, H. (1959). *My First Eighty Years*. Hamilton.

APPENDIX 1:

ARCHAEOLOGICAL VALUES ASSESSMENT CRITERIA

The following describes the criteria used to assess the archaeological values presented in this report. This assessment follows guidelines set down by Heritage New Zealand, formerly the New Zealand Historic Places Trust (NZHPT), which have been specifically formulated for the evaluation of values relating to archaeological sites.

Assessment Criteria

> "Archaeological values relate to the potential of a place to provide evidence of the history of New Zealand. This potential is framed within the existing body of archaeological knowledge, and current research questions and hypotheses about New Zealand's past. An understanding of the overall archaeological resource is therefore required." NZHPT 2006

Following Gumbley (1995) and Walton (2002), archaeological values can be divided into two contextual categories. The first looks at the intra-site context and evaluates a site as a distinct and discrete entity.

- Condition:

  How complete is the site? Have parts of the site been damaged or destroyed? A complete and undamaged site has a high value, a partially destroyed or damaged site has a moderate value and a site which has suffered significant damage or destruction will have a low value.

- Rarity/Uniqueness:

  Rarity is classified into local, regional and national contexts. Sites that are rare at a local level only are afforded a low significance, those that are rare at a regional level are given a moderate value, and sites that are rare nationwide are held to have a high significance. Sites that are not rare at any of these spatial levels have no significance in this category.

- Information Potential:

  Does the site have the potential to contribute to the expansion of human knowledge about our past? For sites where the expected feature set is predicted to support questions of a purely local interest the information potential is low. Where the archaeology may contribute to the resolution of questions of a national interest level the potential is considered to be moderate. The highest level of information potential is reserved for those sites that may be able to contribute information to research themes that are of a global interest.

The second set of archaeological values relate to the inter-site contexts that evaluate individually distinct and discrete sites as subsets of a great whole.

- Archaeological Landscape/Contextual Value:

  What is the context of the site within the surrounding archaeological landscape? Does the site derive all or part of its meaning from, or impart meaning to, other sites within the wider landscape? If a site is one of many amongst other sites of a similar nature the contextual value is low. Where a site imparts additional meaning to, or derives additional meaning from, one or more other sites by virtual or landscape, structural, historic, cultural or other relationships the contextual value of those sites is collectively

high.

- Amenity Value:

  Amenity value is a synthesis of the above criteria framed as a measure of a sites potential to reach beyond a purely scientific audience and communicate its multiplicity of values to a wider public audience. This measure particularly favours dominant sites that define the context of the wider landscape, and those with visible surface features in a good condition of preservation, with high values. Sites that derive their value through their relationship to more dominant sites, and those with little or no visible surface features, will have a low amenity value.

- Cultural Association:

  How are the past and the present connected through the relationship of the historic site to the people of the present, be they tangata whenua, other descendant groups or the general public? The highest values are afforded to sites that are the nexus of a direct relationship between important historic events and the social memory of the descendants who played out those events. Moderate values more generally apply to sites where one part of this relationship, important historic events or social memory, is retained. Where neither aspect of to this relationship are found a low value is applied.

Other values can also include ((NZHPT), 2004):

1. Architectural
2. Historic
3. Scientific
4. Technological
5. Aesthetic/Visual impact
6. Cultural

The last of these relates to any potential impact on Māori cultural values. This report makes no attempt assess Māori cultural values, but notes that such values are likely to be affected when sites with tangata whenua associations are impacted.

Where multiple similar sites will be affected it is also appropriate to consider the values of the group rather than individual sites.

INSITE ARCHAEOLOGY LTD
ARCHAEOLOGY & HERITAGE MANAGEMENT SERVICES
Phone: 027-421-0803 Email: info@insitearchaeology.com
48 Liverpool Street, Levin (5510)

24 June 2020

Katrina Gray
Strategic Planner
Horowhenua District Council
Private Bag 4002
LEVIN 5540

Tena koe Katrina,

And thank you for your questions regarding the addition of a property, 263 Waitarere Rise Avenue, to the Waitarere Beach Master Plan area. The added property is of a sufficiently similar location and character to the original study area that a new report is not required and the new addition can be addressed with a short note to be included as an addendum to the original report.

The report on the archaeological risks within the original Master Plan area addressed three aspects of archaeology at Waitarere:

1. Archaeological risk
2. Intra-site archaeological values
3. Contextual archaeological values

As a largely desktop-based study, the reporting on these aspects was framed in terms of estimates of risk and value.

Before addressing the new property, I would like to mention that recent research, though of a very limited extent, has largely borne out the assumptions of my earlier report. Specifically, recent earthworks at the southern end of 220 Waitarere Rise Avenue uncovered evidence for multiple shell midden and small fires within the upper soil horizons of the dunes, while evidence for widespread fires – probably associated with landscape clearance – were identified within buried horizons approximately 6 m below the surface. Further layers of archaeological material buried at even greater depths may be present at this location. Due to the COVID-19 lockdown, analysis and reporting on this excavation has not been completed, but a full report should be available towards the end of this year.

Additional research and on-site monitoring for the extension of a subdivision at Mowhia Grove has provided further information on the low-lying sand plains in this area that were identified as

swamp land in historic 19th century plans. Soil profiles in multiple test pits indicate that these plains were more like an ephemeral wetland than an inundated swamp and that the surface was likely to be dry for a substantial part of the year: however, wetter and deeper peat swamps are likely to be present in other parts of the Master Plan area. While the soil profiles suggest that the plains could have been periodically transited and occupied relatively intensively, a geophysical survey and monitored earthworks did not identify any archaeological sites in these areas.

With regards to 263 Waitarere Rise Avenue, I would assess the following:

1. Archaeological risk is high on the low dunes on the southern most two thirds of the property. On the northern third of the property, where the Wairarawa Stream crossed a former swamp or ephemeral wetland, the archaeological risk is low.

2. Intra-site values are generally expected to be low to medium, depending on the level of disturbance/damage that may have been caused by pine plantations. The property does not appear to have been planted in pines, suggesting the values may be more towards the mid-point of the scale, though my photographic records are not exhaustive. If the property has been through multiple rotations under pines the values are expected to be low and, in some cases, they may be negligible or nil. The potential for buried sites below the reach of tree roots appears to be limited at this location, but if so, these sites would be expected to retain moderate to good intra-site values regardless of the property's planting history.

3. As with the wider project, contextual values are difficult to assess so an overall medium value is appropriate for most instances. The exception to this would be for the house site towards the western boundary of the property, which is expected to have high contextual values and with further investigation could possibly be traced to a named individual.

As shown in the attached figure, three sites of archaeological significance have been identified within the bounds of the property:

- A shell midden, identified and mapped by Leslie Adkin
- A walking track starting from the coast, by the mouth of the Wairarawa Stream, and leading inland to Poroutawhao
- A house, dating to at least 1872 and recorded in Walter Alzdorf's field book (WN0260) on the edge of the Wairarawa swamp/wetland. Presumably the house is built in a European fashion, but may have been occupied by Māori. This would be a site of high archaeological value and I would recommend further investigation to identify the exact location and extent of this house so that it could be appropriately protected or documented in keeping with Heritage New Zealand's expectations should the site be

earmarked for development.

Overall, the recommendations for 263 Waitarere Rise Avenue are the same as those previously identified for the wider Master Plan project:

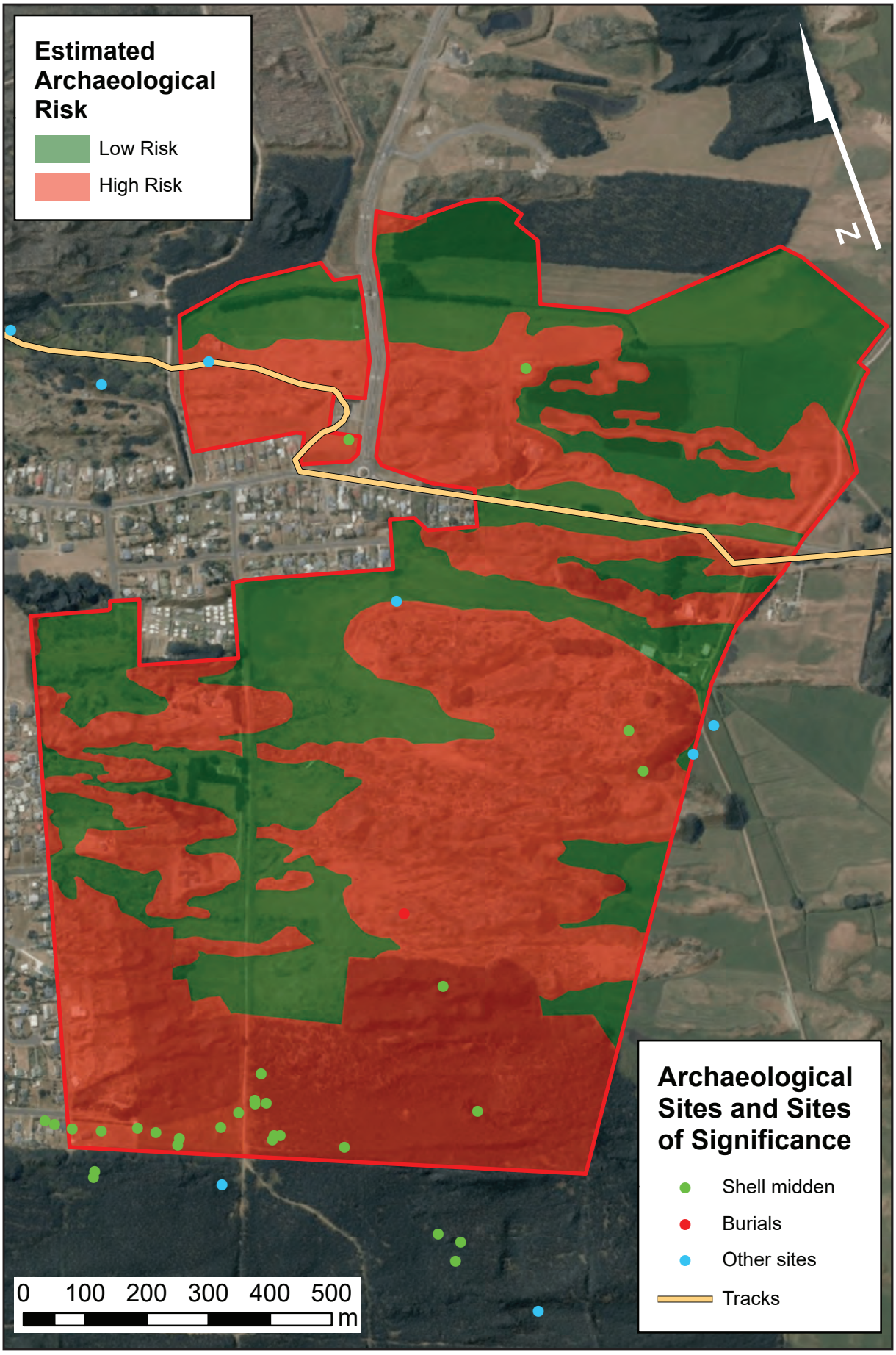
> *There is a high risk that archaeological sites would be affected by earthworks associated with roading, services and residential construction within the Project area. An archaeological authority should be required for any earthworks/ construction within the Project area. Depending on how this is managed, regulatory risks associated with the HNZPTA may continue to apply to future property owners and present an ongoing burden. While the HNZPTA provides a legal framework for the management of archaeological risk, where possible HNZ favours development strategies that avoid or minimise adverse effects to archaeological sites and their values.*

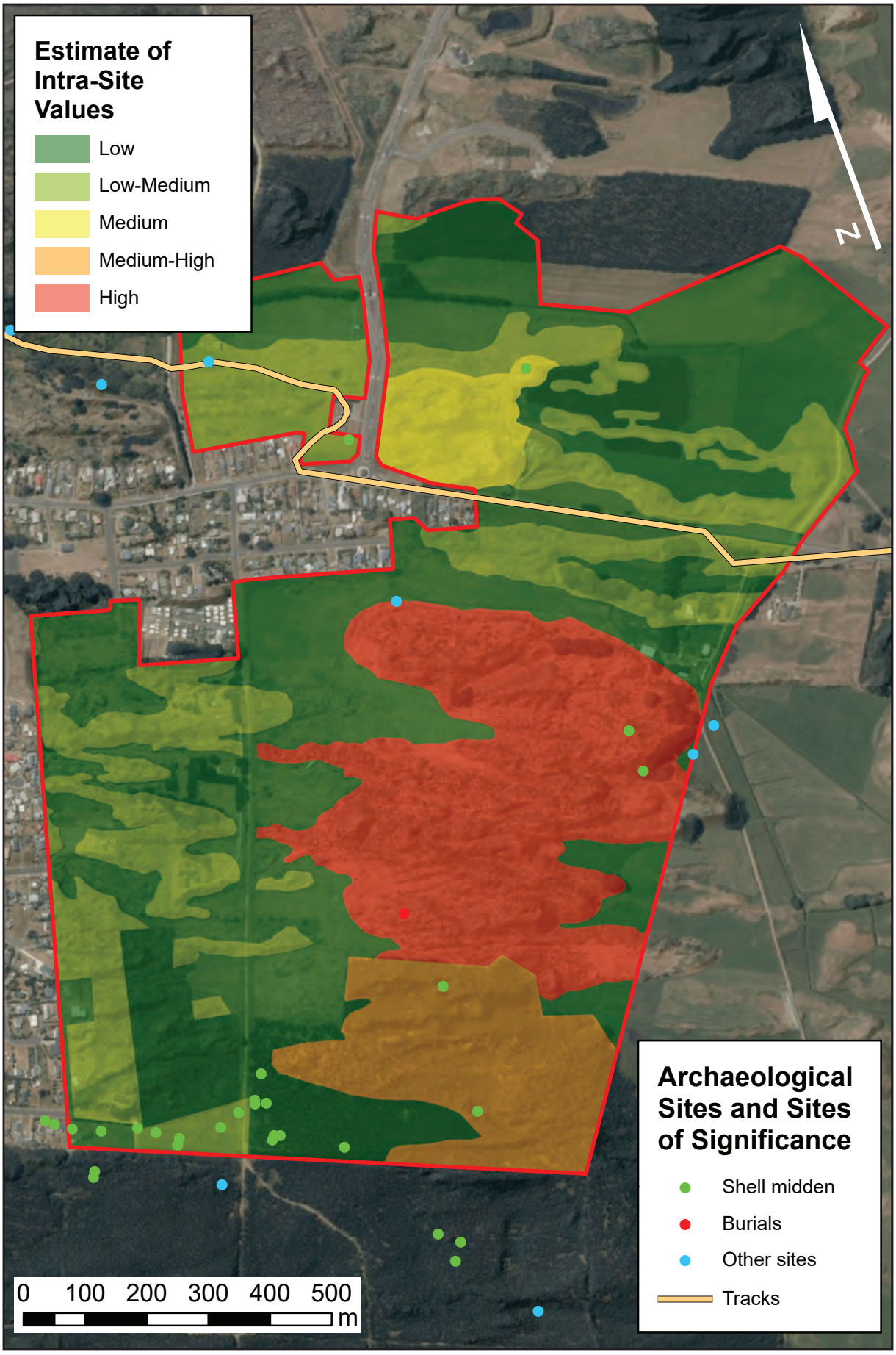
I have also attached revised figures for the estimates of archaeological risk and intra-site and contextual values that include 263 Waitarere Rise Avenue and are in keeping with the information outlined above. Sand plains to the north of the Master Plan area that have been excavated or investigated are classed a low risk and low value. Low-lying dunes at 263 Waitarere Rise Avenue are classed as high risk, with low to medium intra-site value and medium contextual value. Higher intra-site and contextual values relating to the 1872 house, adjacent to the Wairarawa swamp/wetland, have not been shown as further investigation is required to more accurately define the location of this site. The high dunes on the southwest corner of 220 Waitarere Rise Avenue remain a high risk and medium intra-site and contextual value, despite the recent earthworks, as there are intact deposits remaining on the property and the potential for new sites to be uncovered at greater depths. All other areas remain as first mapped in the primary report.

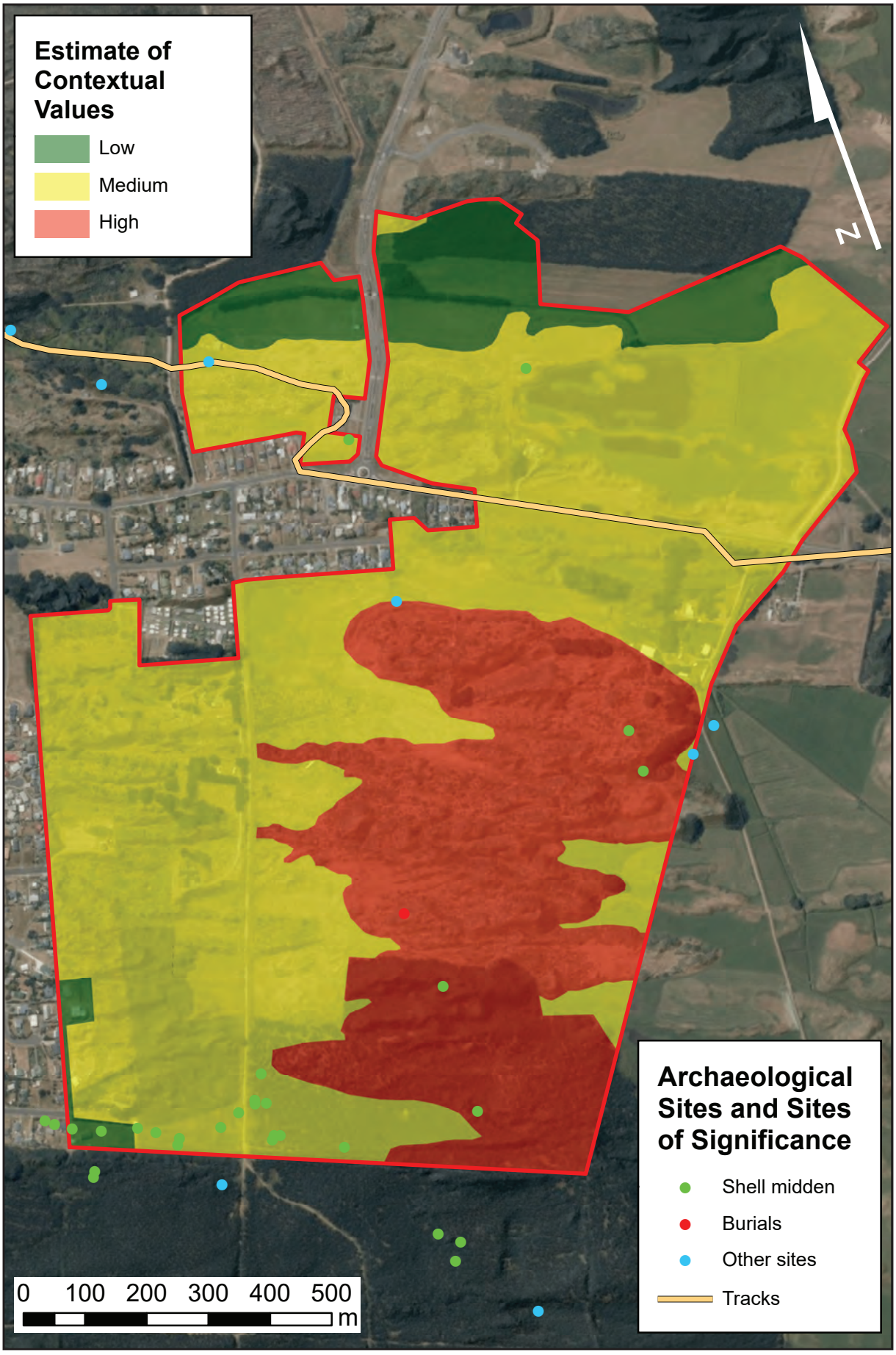
Regards,

Daniel Parker
inSite Archaeology


House (pre-1872)
N
0 20 40 60 80 100
m
Archaeological Sites and Sites of Significance
Shell midden
Burials
Other sites
Tracks


Estimated Archaeological Risk
Low Risk
High Risk
N
Archaeological Sites and Sites of Significance
Shell midden
Burials
Other sites
Tracks
0 100 200 300 400 500
m


Estimate of Intra-Site Values
Low
Low-Medium
Medium
Medium-High
High
N
0 100 200 300 400 500
m
Archaeological Sites and Sites of Significance
Shell midden
Burials
Other sites
Tracks


Estimate of Contextual Values
Low
Medium
High
N
Archaeological Sites and Sites of Significance
Shell midden
Burials
Other sites
Tracks
0 100 200 300 400 500
m

Appendix 5 - Waitārere Beach Commercial Land Assessment

Waitarere Beach Commercial Land Assessment

Final Report

August 2020

Urbacity

Table of Contents

List of Tables & Figures

1 Growth & Household Dynamics

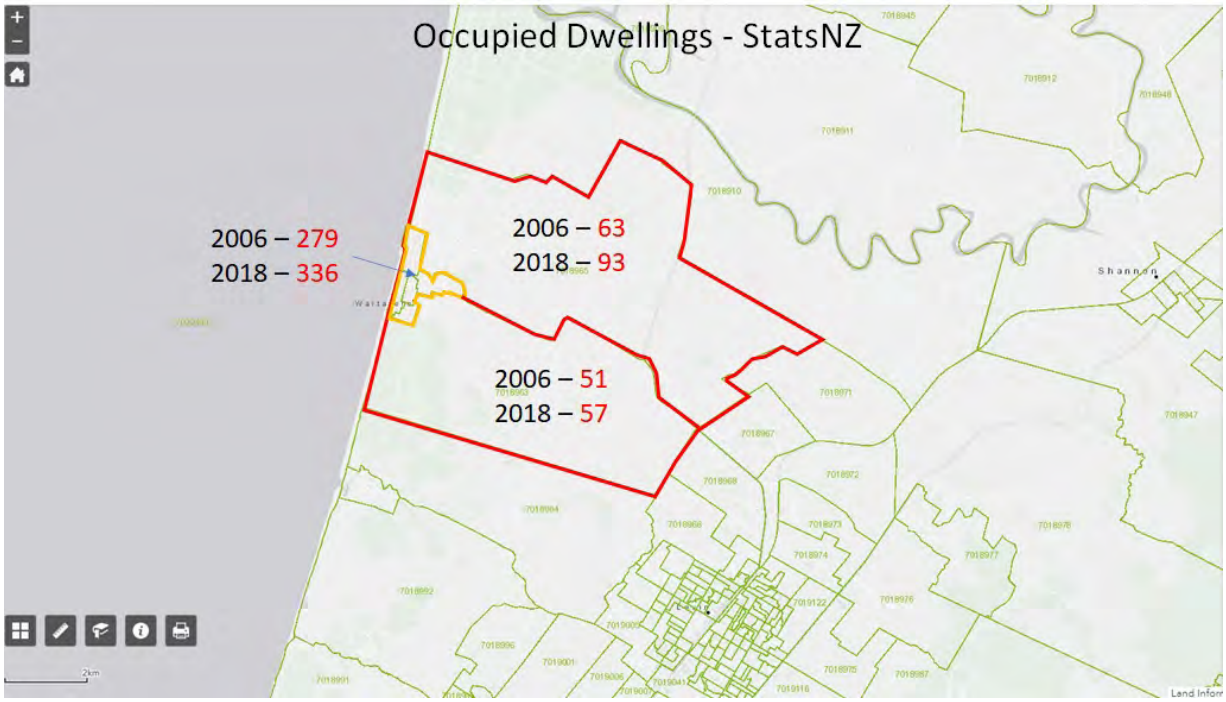
> **The purpose of this document is to review current commercial land use zones and their potential to improve the levels of commercial services to the community of Waitarere Beach.**

1.1 Growth

Waitarere Beach is a small, beachside settlement some 14 kilometres drive from Levin (less than 15 minutes drive to Levin town centre).

The settlement has grown over time, more recently at pace, and the community has a variety of additional land at various levels of approval set aside for future residential development. More recently, the quality and status of housing construction at the beach has changed as a consequence of the comprehensive "lifestyle" development of Waitarere Rise, which has and will continue to influence the traditional view of the beach as a holiday house and retirement settlement. These potential new development areas could add up to another 800 dwellings to the beach. The areas counted for the projections are meashblocks defined by Statistics NZ are shown below.

Figure 1 - Waitarere Beach Gowth Areas



The zones capture the beach settlement, the Waitarere Rise development and all the designated growth zones shown subsequently in this report (Figure 3). However, as meshblocks go some distance east toward Levin and so a proportion of the households in

each zone are less likely to visit the Beach. The growth in these areas though will be almost entirely concentrated around the beach settlement, as shown in Figure 3.

Table 1 - Waitarere Beach Characteristics of Growth

Waitarere Beach	2006C	2013C	2018C	2039P	2043P
Total Dwellings	870	930	993	1,650	1,650
Total Occupied Dwellings	393	417	486	990	990
Occupied Dwelling Ratio	45%	45%	49%	60%	60%
Dwelling Construction p.a.		9	19	30	20
Total Population	900	882	1,038	2,100	2,100
Population Growth	n/a	-18	156	1,062	1,062
Household Occupancy Ratio	2.3	2.1	2.1	2.1	2.1

Source: Statistics NZ Census. Urbacity (Projection)

The rate of growth will influence the size and status of the future aitarere Beach centre, as well as the timing of an expanded centre.

At 30 dwellings per annum construction rate, the settlement would have used most of the proposed housing land by 2039. The land subject to growth is mostly that in the red zones in Figure 1 and is subject to a range of planning controls.

Waitarere median age has increased from 45 years in 2006 (NZ 36) to 52 years in 2018 (NZ 37). The percentage change of resident populations over 65 has gone from 16% in 2006 to 28% in 2018. Clearly, the area currently appeals to retirees. However, the larger Waitarere SA2 area has very different household and much younger age differences from the beac community. The appeal of Waitarere to retirees will no doubt continue. Still, the settlement will also likely attract a more youthful and family-oriented age group in the coming years, as vacant land becomes available at a range of densities and the housing stock becomes more modern and bespoke.

The 2039-43 population and household projection in Table 1 assume a slight increase in housing occupancy ratios, as the area becomes more settled with new housing and housing estates. As the housing retreats (geographically) from the beach, household occupancy ratios are also more likely to increase. To test whether this assumption is reasonable, we can look to other beachside communities in Horowhenua and Kapiti - as shown in Table 2 below.

Table 2 - Comparable Beach Community Occupancy Ratios 2018 Census

Location	Occupied	Unoccupied	Occupancy Ratio
Waikawa Beach	333	342	49%
Foxton Beach	837	657	56%
Waikanae Beach	1,428	657	68%
Otaki Beach	777	315	71%
Raumati Beach	1,164	156	88%
Paraparaumu Beach	1,119	54	95%

Source: Statistics NZ Census.

Waitarere Beach housing occupancy ratio has been trending up from 45% in 2006 and 2013, to 49% in 2018. With new sections coming online in the next 20 years, this upward trend we expect to continue, but we have capped the increase at 60%, which may be conservative.

Foxton Beach is slightly smaller than the projected Waitarere dwellings for 2039-43 and is at 56% occupancy. Otaki Beach is also smaller than the current Waitarere Beach settlement. It is at 71% occupancy, although it like could be argued that it is a suburb of Otaki, as with Raumati and Paraparaumu beaches could also be viewed as urban extensions of their adjacent towns.

Waitarere is separated from an urban area and is a distinctive beachside community, which tends to improve capture rates for retail from the local community.

We believe that the occupied dwellings will continue to rise and may likely settle at around 60%.

The trend evident in the household composition and growth statistics suggests that Waitarere is becoming an attractive destination for new home buyers and those seeking a seachange lifestyle. Growth in housing values, as outlined in Table 3, confirms this observation

Table 3 - Changes in Waitarere Housing Values

Waitarere Beach	2013	2017	2020
Average Dwelling Value	$198,426	$258,047	$412,565
Change in Value between Periods		+30%	+59%
Total Change in Value 2013-2020			+107%

Source: QV.co.nz.

The increases in residential house values is likely a combination of three factors:

1. The observed trend of increased values of coastal housing radiating north from Wellington;
2. The quality of new homes;
3. The attraction and demand for Waitarere housing for higher income groups and wealthier retirees;
4. Growing recognition of the future role of O2NL for access to and from the Wellington market.

A further influence might be that those with high disposable income are time poor and not within Waitarere Beach during the day, and those that are not time-poor but have less disposable income but are in the settlement during the day (many of these would be retirees).

Table 4 - Median Personal Incomes

Location	2013	2018	Increase
Waitarere SA1	$26,900	$30,000	11.5%
Horowhenua	$21,800	$23,900	9.6%
New Zealand	$28,500	$31,800	11.6%

Source: Statistics NZ Census.

In summary, trends in Waitarere beach show that the catchment is growing, and is about to outgrow the current retail assets in the commercial zone. The catchment is relatively quite affluent and with the ongoing take up of new residential sections will likely transition from holiday-dominant community to a residential-dominant community. Within the Levin market and for the next 20 years, Waitarere beach offers an alternate residential option to the occasional Levin fringe and infill development, and to that of Gladstone Green. Assuming dwelling growth as projected in Table 1, Waitarere beach will provide around 13% of total growth within Horowhenua to 2040 and a different residential context that will broaden the appeal for people choosing to live in Horowhenua.

1.2 Implications for Centre Planning & Commercial Zones

The current (2020) occupied dwelling count is likely around 500, generating a permanent population of around 1,050 people. The daily population of the settlement would double in holidays, as unoccupied dwellings become occupied holiday houses. This raises the issue of an average daily population, reflecting seasonality in housing occupation, public holidays and weekends away.

To determine an “average daily dwelling count” or population count, we need to increase the occupied dwelling count by around 12%. This adjustment reflects occupancy increases during public holidays, school holidays and occasional weekends.

Reflecting an average daily dwelling count is essential when considering thresholds for retail provision.

Currently, we estimate that the average daily “occupied” dwelling count would be 560, and in 2039-43 would be around 1,110 dwellings.

At between 800 and 1,000 occupied dwellings we are likely to find a performance threshold for a reasonable sized supermarket or superette of between 800 and 1,000 square metres. Also, we are also meeting the threshold for a few other full-time service providers (hairdresser, beauty etc) and specialty shops (cafe, restaurant/takeaway, bakery etc.). The provision would likely sit between 1,200 and 1,800 square metres gross leasable area, depending on the preferred size of the superette. At this level of population and retail provision, the travel load for residents to retrieve everyday items would drop substantially. Subject to a street-based (not car parks to front the street) amenity design proposition for the centre, social exchange and sense of place (and pride of place) would also increase.

On this basis, the centre would need around 2,500-3,000 square metres of land area, and therefore, if based around the current centre would need to colonise a couple of properties with houses to the east.

Ideally, centre placement influences for this small centre would include

- On the going-home side of the road (very significant)
- At the point where all movement (pedestrian and vehicular) is most substantial;
- Site configuration, flexibility and capacit
- Implementation (who is going to invest in and deliver the centre?).

2 Existing Commercial Land & Centre Development

> **The purpose of this section is to review the current land supply for commercial uses in Waitarere Beach and to test its long term suitability as a consequence of growth.**

2.1 The Commercial Zone

The Waitarere Beach commercial zone extends some 300 metres (approx) along the southern side of Waitarere Beach Road. Most of the zone is occupied by houses, most of which appear to have been on site for decades. The following diagram shows Council's Commercial Zone at Waitarere Beach, current commercial uses, nominally vacant land and houses within the zone.

Figure 2 - Waitarere Beach Commercial Zone

There are two separate commercial premises within the zone, both shown in red in the diagram above, with a large dairy (and a couple of shops at the rear) on the eastern corner of Kahakura Ave, and a restaurant/bar on the south-east corner of Rua Ave.

The zone is capable of accommodating an extensive range of commercial activity, with the redevelopment of existing dwellings and/or development of commercially zoned, vacant land. However, the zone as a quantum is more extensive than needed given the projected population of Waitarere and most sites have houses.

As discussed, the commercial zone/land area required for the centre's ultimate population sits between 2,500 and 3,000 square metres.

2.2 The "New" Village Centre

Much of the growth to date has occurred in the "Greenbelt Residential Waitarere" zone to the north-east of the settlement (coloured purple in Figure 2 below). However, the rate and quantum of growth will be contingent upon:

- Ongoing sales of the current greenbelt zone off aitarere Rise (currently has around 66 undeveloped lots);
- The speed of approvals for the other "greenbelt" residential zones on the north side of Waitarere Beach Rd and;
- The rate at which the 600 lot "Master Plan" area can be brought to market.

Figure 3 - Waitarere Beach Future Residential Capacity

The consolidated commercial zone on which the current dairy and others sit is 2,590 square metres, but three houses in this zone further compromise ease of development. One is only recently built and appears to be a subdivision of 651 Waitarere Beach Road. The site opposite on the western corner of Kahakura Ave and Waitarere Beach Road (653 Waitarere Beach Rd) is 1,077 square metres, and next door (657) is 1,323 square metres. However, 653 and 657 each have a house on site.

Some further subdivision of 651, 649 (with an access easement) and acquisition of 647 would deliver the supermarket or the specialty shops, requiring the purchase of only one house. The rest of the shops and the majority of parking could then sit on the opposite side of Kahakura Ave.

The resultant development would occupy around 4,000 square metres, as shown below (with the houses indicated). A similar proposition exists further west with two sites on each side of Park Avenue. One site is currently vacant and the other appears to be occupied by municipal infrastructure (see Figure 1).

Figure 3 - Waitarere Beach Future Centre Options within the Commercial Zone

The drivers of the expanded village centre should be fourfold:

1. A decent size grocery offer commensurate with the size of the settlement that reduces the need to leave the settlement for everyday goods and services;
2. A distinctive urban village, with a north-facing aspect, where residents can sit, enjoy a coffee, or chat with family and friends
3. A quality, high urban amenity destination within easy walking distance of the majority of Waitarere Beach residents;
4. An inspirer of more diverse (and more dense) housing typologies.

The last of these (the typology variation) would sit well with the adjacent housing overlay.

We understand that a commercial zone has been proposed on the northern side of Waitarere Beach Road on the intersection with Waitarere Rise Ave (263 Waitarere Rise Ave). We are unsure as to whether the owner proposes this site as the village centre. Still we understand the zone proposition covers around 4,000+ square metres of land area and the proposition is not just for commercial activity.

Figure 4 shows three village site options. We believe that these are the only realistic centre location options available. A further option suggested is for commercial development to occur on the existing Surf Club site once the Surf Club is relocated. However, the site has poor accessibility, is not on the way to anywhere (other than to the beach), would require the purchase of several houses and is generally unsuited to the role of a village centre.

Figure 4 - Waitarere Beach Future Centre Location Options

Research over decades by organisations such as Space Syntax (London) has proven that the performance of a centre as an urban, social and economic asset is contingent upon it being at the epicentre of all modes of movement. In Waitarere Beach, the point at which multi-modal movement is strongest is at the intersection of Waitarere Beach Rd and Kahakura Ave. It is also essential that a centre of village size or status, such as this centre, is on the going home side of the road, which reduces the conflict of vehicles turning right into parking areas and makes access to grocery shopping on the way home easy.

To foster social exchange, the centre should be urban (as in built predominantly to the street, with street parking and consolidated parking behind) reinforcing that people walking are more important for village life and social exchange than car parks. In Waitarere, the southern side of the street is more suited to an amenity interface, being north facing. This encourages, if not requires, buildings to address the street and offers a better opportunity for food services and builds the amenity of the village centre, making it a more attractive walking destination.

The Waitarere Rise centre location option is on the wrong side of the street for access and the wrong side for the sun. Any centre development on this site would be either south facing, east facing, (south or east orientations are less desirable than north or west) or the

buildings of the centre would need to turn their backs to the street. These effects reduce its potential as a walking destination and reduce the amenity of Waitarere as a place to live. Residential value is in part a reflection of the quality of the public elements of a settlement, including the appeal of a highly attractive and urban, village centre. The site is at the entrance to the settlement, not in the middle, and has a weak walkable catchment.

The site may suit a destination use, such as a restaurant, but not a village centre.

2.3 Implementation Hurdles

The necessary conclusion is that the commercial zone is large enough for future requirements to 2040 and beyond, but all the land required for any expansion within the zone is under occupation by housing. 263 Waitarere Rise Ave is at the edge of the village, not at its centre, has weak urban relationships and is on the wrong side of the road.

There are site consolidation options available now to grow the village centre within the zone to its requisite size, but all require occupied site purchases.

The development of the centre at the ultimate scale is not required now, however, the current Four Square is probably not large enough to appropriately serve the current size of the market. That said, it is not practical or reasonable to suggest an interim expansion of the site without some due diligence around the location, configuration and development strategy for the ultimate village centre.

Growth will increase the demand for the larger village centre and also improve the feasibility for the development of such a centre. Ignoring all constraints, the best location for the centre is in and around the existing small centre with the Four Square store.

The future village centre development proposition may include a small town plaza and apartments, which would also positively affect the Council s housing density overlay. But the market for such a development is probably at least 10 years away. If such a proposition also requires utilising current housing land, it should be permitted, given the benefits that would accrue.

Of interest over the next 10 years will be not only the growth of the settlement but the quality of new housing and rebuilds of existing housing. If the overall quality improves and dwelling occupancy increases, then the feasibility threshold for the expanded centre will improve. However, any material improvement of houses within the desired centre zone will also reduce development feasibility.

2.4 Recommendation

At this point, we have established the basis for and apparent size of the village centre, along with its preferred location (within the current commercial zone and somewhere between the east side of Kahukura Road and the west side of Park Avenue). What we haven't established is a design proposition that would better inform us (and the community) of what such a development might look like and how it might work. Nor have we established the method by which the preferred site/s might be consolidated and developed.

We recommend a more detailed design exercise looking at site alternatives and development propositions. For the sake of completeness, this may also include the role of the 263 Waitarere Rise site.

In our view, the size of the Waitarere Rise proposed zone (4,000+ square metres) is too large and has the potential to facilitate the development of the future village centre in an area that would not provide the best outcome for the wider settlement for the reasons outlined above. Any commercial use on the corner of Waitarere Rise Ave and Waitarere Beach Road should be restricted to activities that would be complementary to the Village Centre, such as a restaurant or perhaps a cafe. Parking for any commercial development therefore should be on-street. We would, however, prefer such a use in the village centre but accept that property constraints and the likely on-site parking requirement of the primary use (the small supermarket) may render such a use as more difficult As we would see the "commercial" component as minor and complementary to that which should evolve within the existing zones, it may be more appropriate to encourage a consent within the existing residential zone and requiring a site plan and an accompanying specific design proposition.

We recommend therefore, that rather than Council allowing a land use zone at 4,000+ square metres, with no in-depth understanding of what will be developed, that the size of the zone proposition is tied to a site plan showing the range and extent of commercial uses, and that the use or uses and their scale are complementary to the village centre.

Appendix 6 - Liquefaction Assessment

6 Waitarere Beach

6.1 Site description

The site includes the entire current Waitarere Beach Township and covers an area of approximately 532 hectares. Several ponds/small lakes are scattered across the eastern to north-eastern side of the site, and a stream runs east-to-west through the centre of the site. The ocean is located approximately 150 m to the west. The western side of the site is generally occupied by residential and commercial properties. The remainder of the site consists of undeveloped farmland or areas of forestry, with scattered residential dwellings and structures associated with farming. The topography is dominated by rolling sand dunes.

6.2 Ground and ground water conditions

6.2.1 Geology and topography

The published geological map of the area[6] indicates that the site is underlain by Holocene aged stable, aeolian sand dunes (Q1d). The location of the site in the context of the regional geology is presented in Figure 6.1 below.

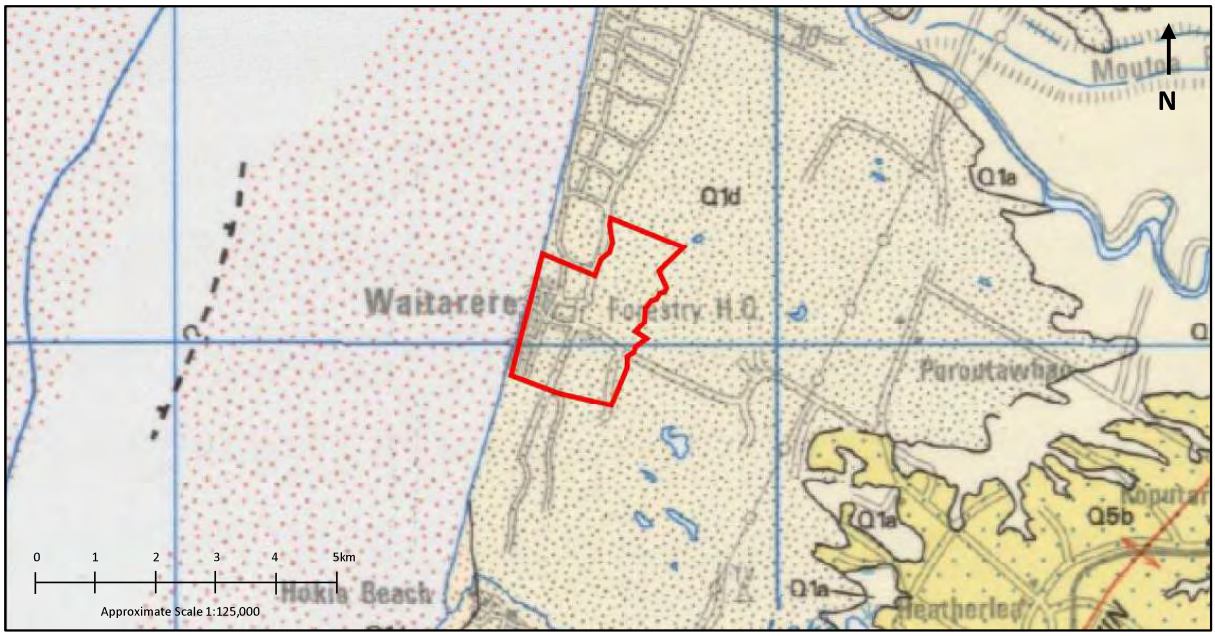


Figure 6.1: Waitarere Beach geological setting (approximate site location outlined in red).

Legend

	Approximate site boundary
Q1d	Stable, aeolian sand dunes

LiDAR data provided by HDC has been used to establish the topography of the site. Generally the ground elevation varies between sand dune ridges and low-lying dunes. The sand dune ridges vary in height and are up to 20 m higher than the adjacent low-lying dune areas. The ground surface gently slopes down to the developed area in the west, which is approximately 5 m lower in elevation than the general low-lying dune areas. The LiDAR data has been used to generate 2 m contours across the site, which is presented in Figure A5.1, in Appendix A.

6.2.2 Geotechnical model

The ground model at the site (Q1d) is expected to comprise medium dense-to-very dense sand to depths greater than 15 m, with pockets of silt or swamp deposits possibly present in low lying areas.

6.2.3 Groundwater

Along the vertical centre of the site, the groundwater level is typically 6.5 m R.L, and is expected to be relatively consistent across the site area. This is based on the depth to groundwater recorded during CPT investigations, and a well located in the southeast. Groundwater was generally encountered between RL 6 m and RL 7 m which is approximately 2 m below the low lying dune areas. Similar groundwater conditions were assumed in the previous assessment by T&T[3], in which the depth to groundwater used in the liquefaction assessment varies based on the ground surface elevation.

6.3 Liquefaction assessment

6.3.1 Results summary

The Waitarere Beach site has been split into two categories, as shown on Figure A5.2 in Appendix A.

- *Low Elevation Area* – ***Liquefaction Damage is Possible****, and*
- *High Elevation Area* – ***Liquefaction Damage is Possible****.*

The currently available ground information is not sufficient to further categorise the site into the more precise liquefaction vulnerability categories presented in the bottom row of Table 1.1. However, if the general trends observed in the current data are confirmed with more detailed information, our preliminary expectation is that:

- *Low Elevation Area* – might eventually be categorised as ***High Liquefaction Vulnerability***; and
- *High Elevation Area* – might eventually be categorised as ***Low*** or ***Medium Liquefaction Vulnerability***.

The variation in expected eventual liquefaction vulnerability categorisation between these two areas is due to the greater crust thickness and greater depth to groundwater in the high elevation area.

The Waitarere Beach liquefaction assessment is considered to be a Level A *"Basic desktop assessment"* based on Table 3.3 of the MBIE guidance[1].

A detailed summary of the liquefaction analysis methodology and results is presented in Appendix C.

6.3.2 Lateral spreading assessment

Land within 100 m of a free face are areas assumed to be potentially susceptible to lateral spreading. This assessment is based on the simple geomorphic screening for lateral spreading presented in Section 4.4.3 of the MBIE guidance[1]. Simple geomorphic screening has been completed assuming a free face height of less than 2 m. The following free face sources were identified during our lateral spreading assessment:

- Land adjacent to the ponds located within the eastern to north-eastern side of the site;
- Land adjacent to the stream located at the centre of the site; and
- Land adjacent to the coast located adjacent to the western site boundary.

Lateral spreading is expected to occur during 500-year level shaking. Lateral spreading may occur under lower levels of seismic shaking; however, our current assessment is not sufficiently detailed to determine the likely triggering levels for lateral spreading at this site. A detailed lateral spreading risk assessment should be completed as part of any future development works for this site.

A detailed lateral spreading assessment may reduce the area that is assessed as susceptible to lateral spreading if the free face is lower that assumed, near surface liquefied layers are not continuous, or the near surface layers are not expected to liquefy. It is possible that the area assessed as susceptible to lateral spreading could increase during a detailed assessment if the free face is shown to be higher than expected or near surface liquefaction is worse than expected.

6.3.3 Key uncertainties

The key uncertainties associated with our liquefaction assessment are the variation in subsoil profile over the site, variation in groundwater level, and the height of the potential free faces.

Additional site specific geotechnical investigations comprising BH's and/or CPTs would be required to properly characterise the variation in subsoil profile over the site. A suitably detailed investigation would be expected to enable categorisation of the site into the more precise liquefaction vulnerability categories presented in the bottom row of Table 1.1.

Variations in the depth to groundwater over the site are expected to be largely due to variations in the ground surface level. Piezometers installed within borehole investigations should be used to measure the groundwater level at the site over time. CPT investigations may provide an indication of the depth to groundwater at the time the investigation was undertaken. A more detailed understanding of the variation in groundwater level over time at the site is expected to allow for categorisation of high elevation areas into the more precise liquefaction vulnerability categories.

The height of any potential free faces has a large impact on the expected extent of lateral spreading and the magnitude of lateral spreading. An onsite assessment of free face height should be completed as part of detailed geotechnical investigation works to enable a better assessment of the potential extent and severity of lateral spreading.

13 Site development considerations

13.1 Overview

The study areas have generally been classified into areas where *liquefaction damage is unlikely* or, *liquefaction damage is possible.* In areas where liquefaction damage is possible a number of options are available for liquefaction mitigation and lateral spread mitigation. These options are grouped into:

- Enhanced Foundations (e.g. a waffle slab, enhanced lightweight foundation on timber piles, timber piles on a reinforced concrete slab, or deep piles.)
- Ground Improvement (e.g. hardfill raft, soil-cement raft, stone columns, or columns of highly compacted aggregate)

Development of the site would be appropriate subject to the options provided. Site specific assessments required for design will provide greater clarity for foundation design and ground improvement requirements for individual lots. This assessment does not remove any requirements for site specific assessment for detailed design. All normal requirements for earthworks and building design still apply (e.g. as stated in NZS 3604).

13.2 Ground improvement and foundation options

The current level of assessment allows for general ground improvement and foundation options to be presented for the areas categorised as liquefaction damage is unlikely or possible. Further distinction between areas of very low to high vulnerability should be established through a "Level C" assessment in terms of the MBIE liquefaction planning guidance, as recommended in section 8.

Generally, liquefaction mitigation on land where "*liquefaction damage is possible"* (medium or high category land) can be undertaken either on a house-by-house basis, or as part of area-wide ground improvement, depending on the level of resilience required from the development.

Liquefaction mitigation on a house-by-house basis is generally less effective and leaves a higher risk of disruption to the community in a large earthquake (e.g. due to damaged roads and services). Therefore consideration should be given to requiring area-wide ground improvement as part of subdivision construction.

Development options which could be selected for development are summarised in Table 13.1 below.

The descriptions of damage to services in Table 13.1 assume that no additional protection is provided to road networks or buried services. Additional resilience to roads and services could be provided by implementing localised ground improvement as described in Section 9.4.

Table 13.1: Expected performance of development options: away from lateral spreading areas

Development option	Liquefaction damage is unlikely (Very Low/Low Liquefaction Category)	Liquefaction damage is possible (Medium/High Liquefaction Category)
	500-year earthquake shaking	500-year earthquake shaking
(1) Standard NZS 3604 foundation with no ground improvement	Minor to Moderate settlement of dwellings, could be expensive or not possible to repair. Damage to roads and public and private services.	Moderate to severe settlement of dwellings, may or may not be repairable. Significant to Widespread damage to roads and services.
(2) Enhanced foundation with no ground improvement [7]	Minor to moderate settlement of dwellings, likely to be readily repairable. Damage to road and public and private services.	Minor to major settlement of dwellings, repair probably feasible but could be expensive. Significant to Widespread damage to roads and services.
(3) Enhanced foundation with ground improvement beneath dwelling footprint only	Minor settlement of dwellings, likely to be readily repairable. Damage to roads and services apart from those adjacent to dwellings.	Minor to moderate settlement of dwellings, likely to be readily repairable. Significant to Widespread damage to roads and services.
(4) Enhanced foundation with area-wide ground improvement	Minor settlement of dwellings, and minor damage to roads and services, all likely to be readily repairable.	Minor settlement of dwellings, likely to be readily repairable. Moderate damage to roads and services.

Table Legend:

Yellow shading *Unlikely to meet Building Code requirements*
White shading *Likely to meet Building Code requirements*
Blue shading *Provides additional community resilience beyond minimum Building Code requirements*

The split-colour shading for some cells recognises that there remains substantial residual uncertainty in the liquefaction assessment undertaken to date. More detailed liquefaction assessment would be required to confirm foundation requirements.

[7] For land identified as *liquefaction is possible*, enhanced foundations with no ground improvement may require a more robust foundation solution to meet Building Code requirements (e.g. piles). In this case costs will be dependent on the specific ground and building details for each property, but will likely be higher than for Medium Category.

13.3 Lateral spread mitigation options

Table 13.2 below summarises the options available for development of land at risk of lateral spreading. Refer Figures A1 to A10, in Appendix A, for the extent of land at risk of lateral spreading at each site.

Lateral spreading mitigation on a house-by-house basis is generally less effective and leaves a higher risk of disruption to the community in a large earthquake. Therefore consideration could be given to a 'Perimeter Treatment'.

A perimeter treatment would involve ground improvement of a strip of land parallel to the edge of watercourse. Such ground improvement would need to be deep enough to create a break in the otherwise continuous liquefiable layer (i.e. 4 to 6 m deep stone columns or columns of highly compacted aggregate).

Table 13.2: Expected performance of development options: within lateral spreading areas

Development option	**Liquefaction damage is unlikely (Very Low/Low Liquefaction Category)**	**Liquefaction damage is possible (Medium/High Liquefaction Category)**
	500-year earthquake shaking	**500-year earthquake shaking**
No specific mitigation; standard NZS 3604 foundations (see also Option 1 in **Table 13.1**)	Lateral spreading not reduced. Dwellings distorted due to ground stretching across dwelling footprint (possible collapse risk), which would be expensive or not feasible to repair. Underground services stretched or disconnected at junctions. Cracks up to 100 mm wide may form in roads and pavements.	Lateral spreading not reduced. Dwellings distorted due to ground stretching across dwelling footprint (possible collapse risk), which would be expensive or not feasible to repair. Underground services stretched or disconnected at junctions. Cracks greater than 100 mm wide may form in roads and pavements.
Enhanced foundations with no ground improvement (similar to Option 2 in **Table 13.1**, but with specialised deformation-tolerant foundation options)	Lateral spreading not reduced. Dwelling foundations resist stretching, reducing building damage and simplifying repair. Underground services stretched or disconnected at junctions. Cracks up to 100 mm wide in roads and pavements.	Lateral spreading not reduced. Dwellings may or may not resist stretching, may result in distortion due to ground stretching across dwelling footprint (possible collapse risk), repair may or may not be feasible. Underground services stretched or disconnected at junctions. Cracks up to or greater than 100mm may form in roads and pavements
Enhanced foundations with shallow ground improvement (see also Options 3 and 4 in **Table 13.1**)	Lateral spreading not reduced. Dwelling foundations resist stretching, reducing building damage and simplifying repair. Underground services stretched or disconnected at junctions. Cracks up to 100 mm wide around edges of improved areas.	Lateral spreading not reduced. Dwelling foundations resist stretching, reducing building damage and simplifying repair. Underground services stretched or disconnected at junctions. Cracks up to or greater than 100 mm wide around edges of improved areas.

Table 13.2 (continued)

Development option	Liquefaction damage is unlikely (Very Low/Low Liquefaction Category)	Liquefaction damage is possible (Medium/High Liquefaction Category)
	500-year earthquake shaking	**500-year earthquake shaking**
'Perimeter treatment' with deep ground improvement (e.g. 10 to 15 m wide, 600 m long zone of 4 to 6 m deep stone columns, between watercourse and new development)	Lateral spreading reduced (but not eliminated). Dwelling foundations, underground services, roads, and pavements subject to reduced stretching, but still subject to general liquefaction damage – refer Table 5.1 to for mitigation options.	Lateral spreading reduced (but not eliminated). Dwelling foundations resist stretching, reducing building damage and simplifying repair. Underground services stretched or disconnected at junctions. Cracks up to 100 mm wide around edges of improved areas.
Area-wide treatment with deep ground improvement (e.g. 4 m deep stone columns) (see also Option 4 in Table 5.1)	Lateral spreading and liquefaction reduced (but not eliminated). Dwelling foundations, underground services, roads, and pavements subject to reduced stretching and liquefaction-induced settlement.	Lateral spreading and liquefaction reduced (but not eliminated). Dwelling foundations, underground services, roads, and pavements subject to reduced stretching and liquefaction-induced settlement.

Table Legend:

Yellow shading *Unlikely to meet Building Code requirements*
White shading *Likely to meet Building Code requirements*
Blue shading *Provides additional community resilience beyond minimum Building Code requirements*

The split-colour shading for some cells recognises that there remains substantial residual uncertainty in the liquefaction assessment undertaken to date. More detailed liquefaction assessment would be required to confirm foundation requirements.

13.4 Infrastructure protection options

If area-wide ground improvement is not undertaken (e.g. for options with enhanced foundations or ground improvement under the dwelling footprint only), then buried services and pavements outside the treated areas would be susceptible to liquefaction and lateral spreading induced damage.

The resilience of infrastructure networks could be increased by:

- Undertaking localised ground improvement along infrastructure corridors, and/or
- Using flexible pipes, flexible connections, and pressurised (rather than gravity-driven) networks

These options are expected to reduce the risk of liquefaction-induced sand boils, localised differential settlement, and reduce the impact of any settlement on the infrastructure. Overall these options improve the likelihood of infrastructure remaining functional after an earthquake. A targeted approach as outlined in Section 9.3, above, may be considered to manage the effects of lateral spreading. These options are not expected to completely protect infrastructure from liquefaction and lateral spreading induced damage. Pavements and buried services constructed using these options on medium and high risk land may still need significant repair or replacement after large earthquakes in order to meet their required levels of service.

14 Applicability

This report has been prepared for the exclusive use of our client Horowhenua District Council, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

We understand and agree that this report will be used by Horowhenua District Council in undertaking its regulatory functions in connection with the identified future growth areas.

Tonkin & Taylor Ltd

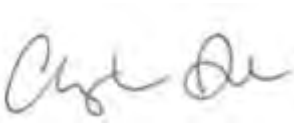
Report prepared by:

.....

Anthony Rolfe

Geotechnical Engineer

Report reviewed by:

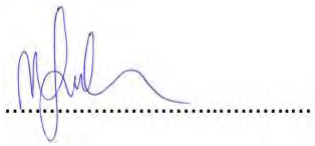


.....

Christopher Sandoval

Geotechnical Engineer

Authorised for Tonkin & Taylor Ltd by:



.....

Mike Jacka

Project Director

ANRO
c:\users\cvs\documents\temp\hdc\reports\14092020\1009677_hdc_liquefaction assessment report_v2_draft_b.docx

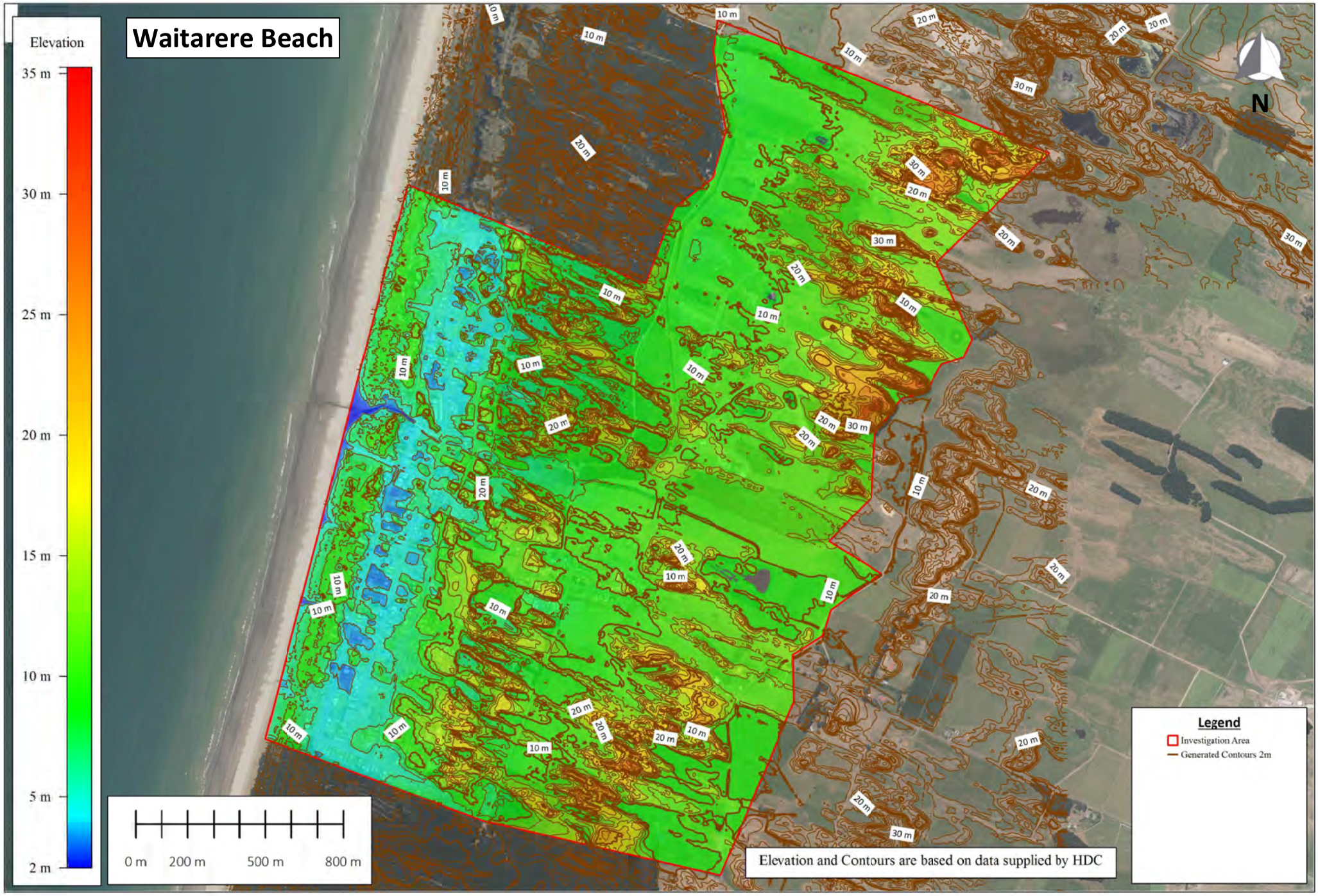
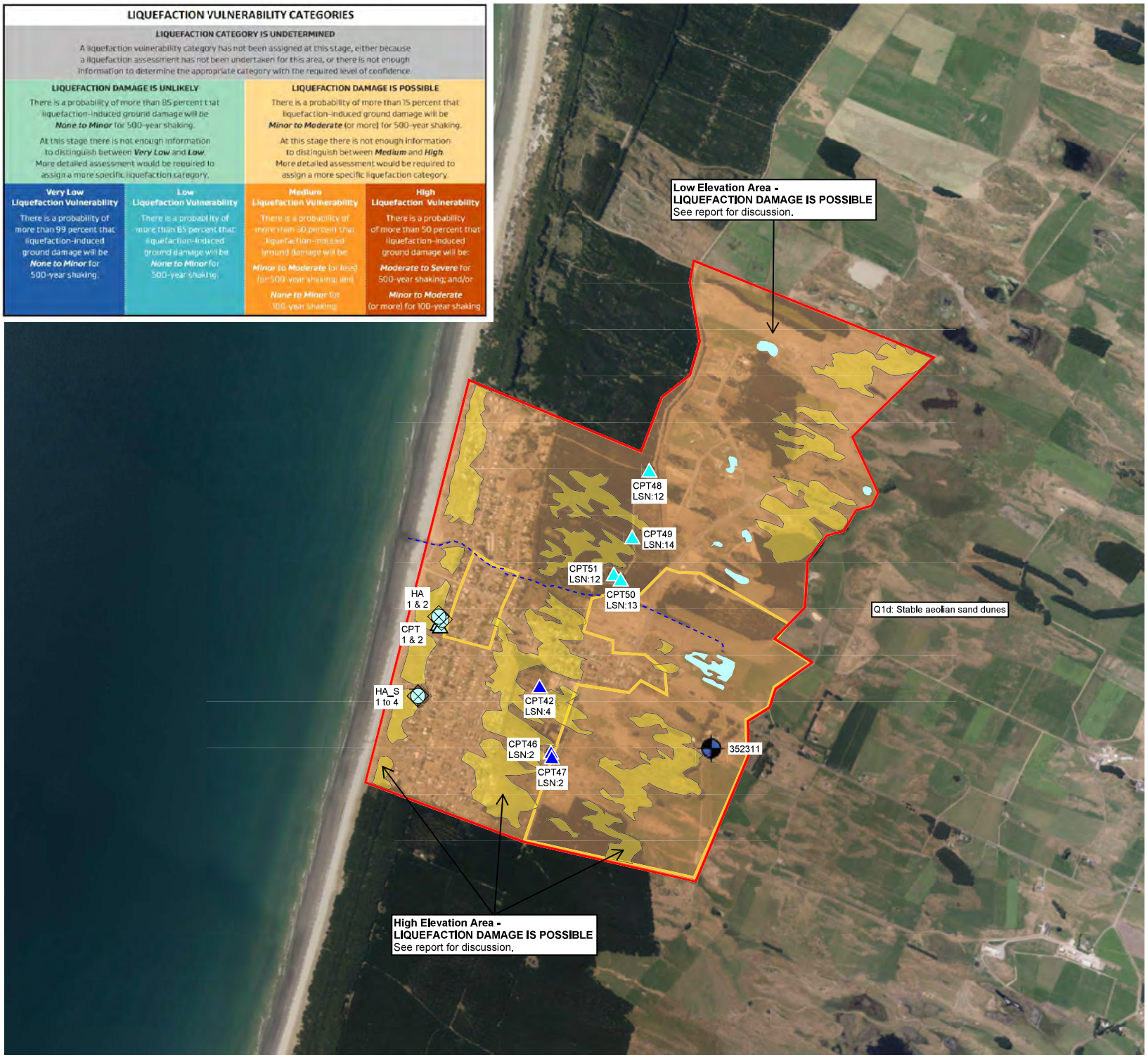


Figure A5.1: LiDAR



LEGEND

Public Investigations (NZGD)

Investigation Type

- Cone Penetrometer Test (by Opus)

CPT numbers as originally numbered, Liquefaction Severity Number (LSN) is for a 500-year return period at the assumed groundwater level for the investigation location.

Investigation data provided by HDC (not on NZGD)

- Cone Penetrometer Test (by Cook Costello - no raw data)
- Hand Auger Scala (by Miyamoto & Cook Costello)
- Groundwater levels: Horizons database

Liquefaction assessment details

- Approximate site boundary (Level A Assessment)
- Site boundaries for future assessments
- **Low Elevation Area**
  LIQUEFACTION DAMAGE IS POSSIBLE
  Area is at low elevation relative to surrounding ground.
  There is a probability of more than 15 percent that liquefaction-induced ground damage will be **Minor** to **Moderate** (or more) for 500-year shaking.
  See report for discussion.
- **High Elevation Area**
  LIQUEFACTION DAMAGE IS POSSIBLE
  Area is at high elevation relative to surrounding ground.
  There is a probability of more than 15 percent that liquefaction-induced ground damage will be **Minor** to **Moderate** (or more) for 500-year shaking.
  See report for discussion.
- Ponds
- Approximated river/stream profile

A3 SCALE: 1:20,000

0 210 420 630 840 1,050 (m)

N

1. Geological Boundaries GNS Science, Lower Hutt, New Zealand.
2. World Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Created On:	26/11/2019
Created By:	ARolfe
Approved By:	
TT Proj Ref:	1009677
TT Map Ref:	TTMAPREF1433463001.902

Tonkin+Taylor
105 Carlton Gore Road, Newmarket, Auckland
www.tonkintaylor.co.nz

HDC
WAITARERE BEACH
Level A Liquefaction Assessment

FIGURE No. A5.2

Appendix 7 - Horowhenua Socio-Economic Projections: Update May 2020

Horowhenua Socio-Economic projections

Summary and methods

Projections update report, May 2020

SENSE PARTNERS
DATA LOGIC ACTION

Summary of projections

This update report presents long term population and economic projections for Horowhenua District.

Strong growth expected

Horowhenua's population is projected to grow:

- by 1.8% per year, over the next 10 years
- more quickly than the national population (1.2% per year)
- more quickly than the average of the past 10 years (1.5% per year)
- more slowly than the average of the past 6 years (2.1% per year).
- substantially more quickly than in our previous projections (0.5% per year).

TABLE 1: POPULATION PROJECTIONS[1]

Population

	5th percentile	25th percentile	50th percentile	75th percentile	95th percentile
2019	34,956	34,956	34,956	34,956	34,956
2029	39,983	41,022	41,896	42,941	44,968
2039	40,822	44,138	47,006	50,913	59,010
2049	39,542	45,188	51,862	59,250	79,243
2059	37,741	45,443	55,626	69,501	105,044
2068	35,301	45,185	59,172	78,168	131,741

Population growth, compound annual average growth rate

	5th percentile	25th percentile	50th percentile	75th percentile	95th percentile
2019					
2029	1.4%	1.6%	1.8%	2.1%	2.6%
2039	0.2%	0.7%	1.2%	1.7%	2.8%
2049	-0.3%	0.2%	1.0%	1.5%	3.0%
2059	-0.5%	0.1%	0.7%	1.6%	2.9%
2068	-0.7%	-0.1%	0.6%	1.2%	2.3%

[1] The percentiles presented in Table 1, and elsewhere in the report, are calculated by simulating population change while varying the main drivers of population growth, such as immigration rates. These simulations are calibrated based on historical variations. This produces a range of results which is summarised by ranking the projections and presenting them according to their ranking or percentile.

Growth driven by strong domestic immigration

Horowhenua's strong population growth is driven by a continued substantial inflow of migrants from other parts of New Zealand.

We are forecasting a net inflow of 650 domestic migrants per year over the next 10 year. This is a substantial upward revision, from 270 migrants per year in our 2019 forecasts.

In our 2019 forecasts we noted that

> *"it appears that domestic migration into Horowhenua has been higher than we or other experts, such as Statistics New Zealand, would have predicted three or four years ago. This is likely to be due to a combination of factors including:*
>
> - *improved accessibility from the expressways that have been built to the south of the District*
> - *increased costs of living, especially house price inflation, in most urban centres including Palmerston North and Wellington*

We also noted that we did not yet have sufficient up-to-date data, such as from the census, to account for observed increases in domestic migration.

Since the 2018 census data has become available and estimates of Horowhenua's population have been revised up yet again, it has become even more apparent that we needed to revise our projection methods and so we have done this.[2]

Our forecasts of Horowhenua's population growth are also affected by assumptions about the effects of border closures on outward international migration. An extended period of border closures is expected to boost Horowhenua's population growth as fewer people leave the district to move overseas.

COVID-19 brings new sources of uncertainty

While our previous projections were subject to several significant sources of uncertainty, such as policy change and a deficit of data[3], these 2020 projections must contend with the effects of a global pandemic.

Our forecasts assume the following effects from COVID-19:

---

[2] The census led to substantial increase in estimates of Horowhenua's population. Although, ironically, our new projections of domestic migration are only partly based on census data. The census data on internal migration has been rated as "very poor", after the question relating to prior address was dropped from the census in favour of linking data between censuses.

[3] At the time of our previous update (July 2019) problems with the 2018 census meant that data from the census was not yet available. Even now, a substantial amount of census data has not been publicly released, even though it has been more than 2 years since the census. This means that estimates and forecasts of the following variables should be considered provisional and subject to revisions once census data is available: households (number and type), labour force status (i.e. labour force participation and unemployment status), household incomes.

- international borders closed to migrants for the 12 months to March 2021[4]
- a sharp but reasonably short-lived economic shock, based on the New Zealand Treasury's Budget Economic and Fiscal Update (May 2020), where:
  - the national unemployment rate rises to 8.3% in June 2020, from 4.0% in 2019, and then falls to 7.6% in the June quarter 2021
  - real GDP growth falls 4.6% in the year to June 2020 and -1.0% in the year to June 2021 before recovering in 2022

We tend to the view that these economic assumptions are optimistic. However, as they are Budget numbers, they provide a useful benchmark – especially at a time when forecasters are revising their views daily.

These economic shocks are expected to cause average household incomes to decline, on average, over the next 10 years.

TABLE 1: GROWTH IN AVERAGE HOUSEHOLD INCOMES, AFTER INFLATION

Annual average growth between dates

	5th percentile	25th percentile	50th percentile	75th percentile	95th percentile
2019	--	--	--	--	--
2029	-1.5%	-0.8%	-0.4%	-0.1%	0.5%
2039	0.7%	0.9%	1.0%	1.1%	1.2%
2049	0.1%	0.3%	0.4%	0.4%	0.4%
2059	0.7%	1.0%	1.0%	0.7%	1.1%
2068	0.5%	0.2%	0.4%	0.7%	0.6%

It is quite possible that these COVID-related economic shocks, or larger ones, could cause a significant shift in population growth dynamics in Horowhenua and throughout New Zealand. Importantly, the uncertainty ranges in our projections do not account for the possibility of such shifts. That being so, the level of uncertainty quantified in our near-term projections is under-stated.

Given this unquantified uncertainty it would be unwise to speculate about potential further positive effects on population growth from transport projects (such as Transmission Gully and the Otaki to Levin link) – as was done in our previous projections.

That said, our revised projections are higher than previous forecasts that accounted for the effects of transport projects. Recent population growth in Horowhenua has, at least partly, results from increased accessibility due to roading projects. This lift in attraction to Horowhenua is now factored directly into the population growth forecasts.

[4] We assume closure to 95% of all migrant flows i.e. immigrants to New Zealand and emigrants from New Zealand.

Our 2020 forecasts for Horowhenua will feed into the development of scenarios for future growth and economic development. These scenarios, which are yet to be produced, will consider the potential for alternative futures for Horowhenua based on economic trends and the potential for positive or negative economic shocks.

Comparisons against Statistics New Zealand projections

The population projections presented in this report are higher than Statistics New Zealand projections for the Horowhenua released in 2017. The differences are summarized in Table 5.

TABLE 5: COMPARISON WITH STATISTICS NEW ZEALAND PROJECTIONS

POPULATION PROJECTIONS ('MEDIUM' SCENARIOS)

	Year	Age: 0-14	Age:15-39	Age:40-64	Age:65+	All ages
Statistics New Zealand	2013	6,020	7,490	10,380	7,280	31,170
	2018	5,900	8,060	10,250	8,050	32,260
	2023	5,800	8,050	9,660	8,920	32,430
	2028	5,680	7,940	8,950	10,000	32,570
	2033	5,580	7,320	8,660	10,860	32,420
	2038	5,310	6,850	8,580	11,310	32,050
	2043	4,990	6,630	8,520	11,350	31,490
Sense Partners	2013	6,020	7,490	10,380	7,280	31,170
	2018	6,300	8,500	11,000	8,500	34,300
	2023	7,270	10,045	11,306	9,319	37,940
	2028	8,298	11,002	11,536	10,437	41,273
	2033	9,088	11,395	12,288	11,441	44,211
	2038	9,169	11,966	13,116	12,333	46,583
	2043	9,045	12,874	14,143	12,868	48,929

ANNUAL AVERAGE GROWTH RATES

	5 Years to:	Age: 0-14	Age:15-39	Age:40-64	Age:65+	All ages
Statistics New Zealand	2018	-0.4%	1.5%	-0.3%	2.0%	0.7%
	2023	-0.3%	0.0%	-1.2%	2.1%	0.1%
	2028	-0.4%	-0.3%	-1.5%	2.3%	0.1%
	2033	-0.4%	-1.6%	-0.7%	1.7%	-0.1%
	2038	-1.0%	-1.3%	-0.2%	0.8%	-0.2%
	2043	-1.2%	-0.7%	-0.1%	0.1%	-0.4%
Sense Partners	2018	1.0%	2.5%	1.1%	3.1%	1.9%
	2023	3.0%	3.3%	0.5%	1.8%	2.0%
	2028	2.6%	1.9%	0.4%	2.3%	1.7%
	2033	1.9%	0.7%	1.4%	1.9%	1.4%
	2038	0.2%	1.0%	1.3%	1.5%	1.1%
	2043	-0.4%	1.5%	1.5%	1.0%	1.0%

The difference between Sense projections and Statistics New Zealand's projections are differences in views about international migration and different assumptions regarding rates of domestic migration into Horowhenua. Our assumptions about fertility and mortality rates are very similar.

Method

These projections should be interpreted as potentials. The projections do not, for example, take account of national or local policy changes which can affect actual population and economic growth.

Demographics

The method used to produce the population projections is a conventional population projection model, with a few relatively novel aspects.

The model simulates populations by age, by sex by District.

Fertility and mortality rates are projected using the same methods that Statistics New Zealand uses to project age- and sex-specific mortality rates.[5, 6]

International migration is predicted at the national level using a model of migration which accounts for trends and patterns in growth in arrivals from different types of countries in conjunction with changes in outward migration and economic conditions in New Zealand and Australia (unemployment rates and real exchange rates).[7]

Ages of migrants and domestic destinations of international migrants are determined based on observed historical probabilities that migrants are of a given age and the propensities these migrants must move to particular parts of New Zealand (in this case Districts).

Internal domestic migration is based on age- and origin- and destination-specific probabilities of observed migration in each of the censuses from 2001 to 2013[8] and experimental origin-destination domestic migration data for the period 2013-2017. So, each District's inward domestic migration reflects the size and age distribution of other Districts from which it traditionally sources migrants.

At the household level, living arrangements are based on methods used by Statistics New Zealand. Each age and gender has an observed historical (Census-based) probability of residing in a different household type. The probabilities used here are national-level probabilities.[9]

---

[5] Demography package for R, by Rob J Hyndman with contributions from Heather Booth, Leonie Tickle and John Maindonald.

[6] Actual data on age-specific rates at the district level are limited and so these are inferred using splines to interpolate between ages where age-group data is available.

[7] To be precise, the model is a mean of forecasts from 3 different types of models: a set of univariate time series model, a vector-autoregression, and a vector-error correction model with economic components. The latter includes cluster analysis of arrivals from different countries which allows grouping of countries into 4 different groups which tend to move together.

[8] The number of observations here is limited but the probabilities have proved to remain remarkably stable over time.

[9] Except that, in the national context, projections for Auckland include adjustments to reflect the large numbers of multi-family households in Auckland This overall approach, using national 'living arrangement

Economic projections

The economic projections are based on a 'growth accounting' method, whereby growth is predicted based on growth in the working age population, labour force participation rates, unemployment rates, and productivity.

Here labour force participation rates are modelled at the national level and district rates are estimated based on typical age-specific deviations from national rates.[10]

Unemployment rates are also modelled at the national level and age-specific deviations from national rates are used to model persistent differences in unemployment rates at different ages in different districts.

The model used to predict unemployment rates at the national level takes account of changes in labour force growth and other economic factors on unemployment rates. It also includes a measure of labour productivity.[11] Predictions of productivity growth come from this model.

There is no attempt to model district-level productivity growth, rather districts are assumed to face random fluctuations in productivity which move around the national average.

Industry projections are based on a model of trends in industry shares of GDP. At the district level, industry output is then projected using historical correlations between movements in national output and district output. So, the district's fortunes are attached to national trends, but also reflect local cycles and comparative advantages.

Randomness

To run simulations and produce ranges for projections we use the observed errors in our models and underlying variation in the variables we are modelling to produce 'prediction intervals'. In each simulation, we draw randomly from these prediction intervals.

Not all variables are subject to this randomness directly[12] and some variables do not fluctuate a great deal. The most volatile components of the projections are: migration, productivity, and industry GDP growth shares.

---

type rates' is a weakness in this modelling method but is accepted for the time being in the absence of better data to discriminate 'living arrangement type rates' by district.

[10] The national rates are modelled using logistic growth curves which help to capture the rising, but ultimately limited, rates of participation of older age groups.

[11] The national model of unemployment rates is a vector auto-regression of unemployment, CPI, labour force, interest rates, and earnings per hour ('labour productivity). The use of vector auto-regressions helps ensure that we extract underlying trends in variables and means that the model can capture the effects of economic cycles over a 1- to 2-year horizon. After that the model reverts to trends. Although randomness is added to reflect uncertainty, there are no economic cycles in the model beyond the first 1 to 2 years.

[12] All age-specific probabilities used in the model are fixed, for example.

SENSE PARTNERS

DATA LOGIC ACTION

Appendix 8 - Stormwater Catchment Management Plan Summary

EXECUTIVE SUMMARY

Horowhenua District Council has commissioned a Stormwater Catchment Management Plan (CMP) for the Waitarere Beach catchment as part of a series of nine CMPs for the main urban and township communities in the District.

Waitarere Beach Village is located on the western coastline to the north-west of Levin. It has developed as a coastal settlement with a high proportion of semi-permanent or seasonal holiday homes, although in recent times, its proportion of permanent residences has increased due to its attractiveness as a retirement location and ease of commute to Levin, Foxton and Palmerston North.

The principle drainage feature is the Wairarawa Stream which runs roughly east to west approximately one block north of the main road in to the village (Waitarere Beach Road). The landscape in the area is generally flat behind dune formations on the coastal margins. Beyond the township, the predominant land use is agricultural with some areas of forestry.

The stormwater system is a mixture of piped and open channel / swale infrastructure in separate sub-catchments with multiple discharges to the coastal environment (foreshore) and Wairarawa Stream. There are also several pump stations and soak pits within the system.

In terms of stormwater quality issues, there are no known issues although there has been no specific stormwater monitoring undertaken. State of the Environment monitoring of the foreshore and Stream for recreational water quality indicates that the coastal waters are low risk, but the Stream water quality does not meet contact recreation standards. For the land uses which are within the stormwater area, it is considered unlikely that stormwater discharges will cause One Plan water quality targets to be exceeded after reasonable mixing.

Horowhenua District Council's Growth Strategy 2040 has projected a demand for 165 additional residential lots within Waitarere Beach and 157 additional greenbelt residential lots. This demand is able to be met within the existing zoned areas with an over-supply of 17.5 ha of residential land and 55.9 ha of greenbelt residential land.

Modelling has indicated that the existing network is generally able to meet the year design standard, however there are some areas of low lying land which are expected to have ponded water in the design events, largely as a result of the topography of the area and that there are few natural flow paths for drainage of stormwater. Flooding in low lying properties is predicted in some areas up to 0.5 m in depth during the peak of the rainfall events. While model indicates that there are no significant works required to meet the Council's primary or secondary level of service, it may be appropriate for further investigation on-property drainage in problematic areas which may include assessment of on-site soakage and / or floor level surveys to ascertain if there are flooding risks to particular properties.

The key issue for the management of Waitarere Beach stormwater is that there are no clearly defined flow paths and there are limited stormwater assets to convey stormwater. Stormwater management relies on groundwater soakage which is likely to become increasingly problematic as shallow groundwater levels rise with sea level rise impacts of climate change. Stormwater management is generally not considered a constraint on future development at the levels projected. Any building works or development should ensure that properties retain sufficient space for soakage and / or ponding / attenuation away from dwellings and structures so that ponding can occur for short durations where rainfall rates exceed infiltration capacity of the soils. In order to avoid or delay the need to install a fully reticulated stormwater system at significant costs to the community, it is recommended that all efforts be made to retain the ability to manage stormwater on site. This includes ensuring that low lying areas are not built over so that there is provision for ponding / attenuation during rainfall peaks to allow soakage to occur over longer time periods.

Within the Waitarere Rise area there are several attenuation areas and lagoons which are necessary stormwater features which should be retained as the area is developed. These appear to be located within areas set aside for Open Space in the Structure Plan for the area and therefore should be protected. Should the W1 growth area proceed, it is recommended that the Structure Plan be updated to address linkages to the W1 growth area including avoidance of development in attenuation areas identified in the buffer zone between these two areas and to provide explicit recognition of drainage and stormwater features within the Waitarere Rise Area.

Stormwater discharges to the Coastal Marine Area (foreshore) will require resource consent and it is recommended that a single consent be sought to cover all of the foreshore discharges. Discharges to the Wairarawa Stream are expected to meet permitted activity status and consent is not required.

It is recommended that Council ensure that an Operational / Maintenance plan is in place which provides for frequency clearing of outlet blockages and also to ensure that structure maintenance is carried out at times consistent with the restrictions regulated in the One Plan. Alternatively, the consent application sought for the foreshore discharges should also seek ability to maintain structures during restricted times of the year if this is considered necessary.

It is also noted that the Government's Action Plan for Healthy Waterways programme is expected to introduce requirements for a Stormwater Risk Management Plan, a need to report annually on nationally prescribed environmental performance measures and follow best practice for network management. The exact details of these proposals and requirements are not yet known but will need to be addressed by Council on all of its stormwater systems throughout the District.

Catchment based model: Result valid on catchment basis; not to be used for assessing individual properties.

N

REV.	AMENDMENTS	BY.	APPD.	DATE.
B	Post 29 Oct Workshop	WDU		Nov 19
A	For Client Review	WDU		Oct 19

		NAME	DATE
DRAWN	WDU	WDU	Nov 19
DESIGNED	-	-	-
CHECKED	-	-	-
APPROVED			

goodearthmatters
sustainable solutions enabling communities

CLIENT	Horowhenua District Council	SCALE	A1	ORIGINAL
PROJECT	Catchment Management Plans		A3	1 : 15000 A3
TITLE	Waitarere Beach Stormwater Model Results - 100 year event Climate Change - 16% Increase in Rainfall	PROJECT	27025	DATE ISSUED
		SHEET No	825	
		REVISION No	B	Nov 19

Catchment based model: Result valid on catchment basis; not to be used for assessing individual properties.

N

Legend

Flood Depth

0.05

0.25

0.5

1

2.5

Park Avenue
Kent Avenue
Gloucester Street
Kahikara Avenue
Rata Avenue
Windsor Street
Tainui Street
Matakane Street
Aranui Avenue
Takitimu Street
Alpine Grove
Hydroboat Drive
Alan Lindsay Avenue
Ramona Avenue
Forest Road
Kanuka Grove
Te Arohi Drive
Wata's Tree Place
Waitarere Rise Avenue
Quail Way
Mawhai Grove
Waitarere Beach Road

REV.	AMENDMENTS	BY.	APPD.	DATE.
B	Post 29 Oct Workshop	WDU		Nov 19
A	For Client Review	WDU		Oct 19

DRAWN	WDU	Nov 19
DESIGNED	-	-
CHECKED	-	-
APPROVED		
	NAME	DATE

goodearthmatters
sustainable solutions enabling communities

CLIENT	Horowhenua District Council	SCALE	A1	ORIGINAL
PROJECT	Catchment Management Plans		A3	1 : 15000 / A3
TITLE	Waitarere Beach Stormwater Model Results - 10 year event Climate Change - 24% Increase in Rainfall	PROJECT	27025	DATE ISSUED
		SHEET No	831	
		REVISION No	B	Nov 19

Catchment based model: Result valid on catchment basis; not to be used for assessing individual properties.

N

REV.	AMENDMENTS	BY.	APPD.	DATE.
B	Post 29 Oct Workshop	WDU		Nov 19
A	For Client Review	WDU		Oct 19

DRAWN	WDU	Nov 19
DESIGNED	-	-
CHECKED	-	-
APPROVED		
	NAME	DATE

goodearthmatters
sustainable solutions enabling communities

CLIENT	Horowhenua District Council	SCALE	A1	ORIGINAL
PROJECT	Catchment Management Plans		A3	1 : 15000 A3
TITLE	Waitarere Beach Stormwater Model Results - 100 year event Climate Change - 24% Increase in Rainfall	PROJECT	27025	DATE ISSUED
		SHEET No	835	
		REVISION No	B	Nov 19

					DRAWN	WDU	Dec 19	goodearthmatters sustainable solutions enabling communities	CLIENT	Horowhenua District Council	SCALE	A1		ORIGINAL
					DESIGNED	-	-		PROJECT	Catchment Management Plans		A3	1 : 15000	A3
					CHECKED	-	-		TITLE	Waitarere Beach Stormwater Model Results - 10 year event Climate Change - 1m Sea Level Rise and 16% Increase in Rainfall	PROJECT		27025	DATE ISSUED
A	For Client Review	WDU		Dec 19	APPROVED						SHEET No		851	
REV.	AMENDMENTS	BY.	APPD.	DATE.		NAME	DATE				REVISION No		A	Dec 19