Lake Pounui towards Onoke Lagoon, Lake Onoke and the coast.

APPENDICES

APPENDIX 1: CULTURAL HISTORY

While the Wairarapa, administratively, is part of the Greater Wellington Region, it is in landscape terms, a separate 'region' with its own identity. The combined area of the three Wairarapa territorial authorities - Masterton, Carterton and South Wairarapa - make it the third largest district in New Zealand (approximately 6 million hectares).

The landscape is recognisably different from the neighbouring districts and this study seeks to explain what gives the Wairarapa its particular identity and to describe its varied landscape character. The evaluation that will be subsequently completed will identify what parts of the Wairarapa deserve to be given special recognition and careful management.

WAIRARAPA MAORI AND LANDSCAPE[1]

INTRODUCTION

The word 'landscape' encapsulates so much that is important to Wairarapa Maori. From a Maori viewpoint, whether it is a mountain range, river valley, a hill slope, or a particular tree, each has its own kawa or process to follow and each part has a connection to everything around it. While features such as the Tararua Ranges, Lake Wairarapa and Castlepoint (Rangiwhakaoma) are well known, amongst the hills and plains there are many landscapes and places that are important to different whanau, hapu and iwi.

For Maori, landscapes are often the basis for stories passed down from ancestors. Monumental events, tragedies and the happenings of everyday life occur within a landscape. To attain the knowledge that would help to sustain families, successive generations had to understand how the land and sky were structured and therefore the life cycles of flora and fauna that dwelt within different zones.

So that families and hapu knew where they could make decisions over land, sea and waterways, boundaries were applied. One means by which a family could confirm that an area was theirs was through knowledge of natural features such as hills and streams. Senior members could not only recite the boundary markers but also historical events and ancestors that tied a family to one place or another.

The concept is no different in coastal areas, except the landscapes are submerged beneath water, and extend way out into the ocean. The concept of mana whenua, mana moana, mana tangata defines the area over which whanau and hapu have decision making rights. Just like the land and sea are not severed by the tides nor are mana whenua, mana moana, mana tangata.

1 This section is an edited version of material prepared by Joseph Potangaroa.

Kaumatua maintain that if you start with the gods and come down to today everything is in the correct order. With the exception of Papatuanuku and Ranginui and first people, whakapapa is used to illustrate when a tupuna lived or when an iwi became established in the Wairarapa. The number of generations between a child of 2009 and Kupe are used to established how many generations ago are referred to. The generation given refers to the lifetime of a central tupuna whose leadership led to permanent occupation, not necessarily the person after whom the iwi takes a name.

CULTURAL ASSOCIATIONS AND SETTLEMENT HISTORY

Maori interpret their surroundings in the same way as all other cultures in the world. They personify features, and attribute great mythological feats to their atua (gods). Where Maori differ from many other cultures is that they tied themselves directly to the land and to the deities through whakapapa (genealogical connection). This gives them an inherent connection to the land and also an inherent responsibility to care for the land as you would a precious elder or ancestor.

Landscapes and landmarks were key identifiers for iwi, hapu and whanau. They were also connection points between iwi, hapu and whanau. Wairarapa has some clear examples of these 'connectors'.

Sites associated with Maui and Kupe connected Wairarapa Maori to all iwi. Te Ika a Maui relates to landscapes across Aotearoa and connect Maori to those places as well. In turn, sites associated with Maui resonate strongly with all iwi as they make up the key components of the land. The Wairarapa constitutes arguably the most significant part of the fish of Maui being (part of) the head and associated features. Thus other iwi around the country recognise the cultural significance of the landscapes located in the Wairarapa.

Similarly, Kupe is a significant ancestor and character in the story of Aotearoa. He is credited with discovering and naming Aotearoa. As such, his name is associated with many sites around Aotearoa and with iwi, hapu around the country as well. These sites tie Wairarapa iwi to other iwi around the country.

Landscapes were used to identify demarcation of tribal interests between iwi and/or hapu. One example of this was the identification of the Remutaka (sic) Ranges as the site that binds the iwi of Wellington (Te Whanganui o Tara) to Wairarapa following a peace agreement in 1840, which led to the return of Wairarapa hapu from Mahia.

Papatuanuku and Ranginui

The land and seabed are the body of Papatuanuku (the earth mother) and therefore all landscapes are a part of her. All life on Papatuanuku dwell

View from Black Rock Road subdivision, north- east of Masterton.

on a part of her body. The annual cycles of the sun, moon and stars that dwell upon Ranginui, (the sky father), determine when activities should occur on Papatuanuku. Atua are believed to dwell in the skies because the stars and elements are immortal whereas aspects of land erode and humans die.

Maui (approx 58 generations ago)
Maui, an ancient ancestor of many Wairarapa Maori, discovered these islands. The story is commemorated in the legend of Te Ika A Maui – The Fish of Maui. The Wairarapa view is that we live on Te Upoko o te Ika - The head of the fish, and Wairarapa Moana is Te karu o te ika or 'the freshwater eye of the fish'. The other eye is Wellington Harbour. Kawakawa - Palliser Bay is Te Waha o Te Ika a Maui or 'the mouth of the fish'. Turakirae Head and Matakitaki a Kupe (Cape Palliser) are known as the 'jaws of the fish'. The combined Rimutaka, Tararua and Ruahine ranges are referred to as the 'spine of the fish'. Hapuakorari, the lake of the flax sticks in the Tararua Ranges is known as 'the pulse of the fish'.

Kupe(28 generations ago)
The explorer Kupe called in to Castlepoint and as was his peoples' custom, established ownership rights by declaring that the most prominent landmark was his head, which is why a man's head can still be seen on Matira - Castle rock with the remainder of his body extending along the reef to the north. He used personification of a natural occurrence to name the place. In this way Rangiwhakaoma –'where the sky runs' - was named.

As he had done at other places throughout the Pacific Ocean where dangerous whirlpools, rips, rocks and currents were present, at Rangiwhakaoma, Kupe left a tale of a giant octopus whose tentacles would kill people if they were not careful. Waves and strong currents at Castlepoint have claimed many lives over the centuries. From this initial point of contact, Kupe named numerous landmarks along the Wairarapa coast and several inland locations.

First people (more than 28 generations ago)
The first people to occupy the Wairarapa lived in coastal areas. Early people lived beside, and based their economies on, river valleys around the coast.

Descendents of Toi te Huatahi(26 generations ago)
The first descendents of Toi te Huatahi in the Wairarapa were known as Te Tini o Awa. Thereafter the descendents of Whatonga, Toi te Huatahi's grandson, became known as the people of Ngai Tara and Rangitane. Tara Ika (Ngai Tara) and Rangitane were the son and grandson of Whatonga. While Ngai Tara and Rangitane people became established during the lifetimes of the eponymous ancestors, prominent Whatonga descendents were still arriving 11 generations ago.

Descendents of Te Aomatarahi (12 generations ago)
The Ngati Ira and Ngai Tahu people are descendents of Te Aomatarahi. Several major Ngati Ira hapu are still recognised as the main groups that tie descendents to land in the Wairarapa. Ngai Tahu of the Wairarapa is descended from different tupuna than the prominent iwi of the South Island with the same name. There was also more than one Ngati Ira although the descendents of Te Aomatarahi are the main ones. Ngati Ira and Ngai Tahu whakapapa is particularly prominent in the southern Wairarapa.

Descendents of Kahungunu (approximately 11 to 15 generations ago)
The Takitimu waka is the ancestral canoe of the Ngati Kahungunu people. Tupai, a tohunga aboard the Takitimu, stayed in the Wairarapa for some time, as did Rongokako the son of Tamatea Arikinui (25 generations ago), captain of the Takitimu. Tradition also shows that Taraia, the great grandson of the tupuna Kahungunu passed through the region while successfully engaging in a series of skirmishes.

Whakapapa shows that the people who came to be known as Ngati Kahungunu ki Wairarapa arrived in a series of migrations over several generations.

Early 1800s (8 generations ago)
The introduction of muskets during the first decades of the 19th century was a key factor that saw many iwi displaced from their traditional homelands. Iwi that originated from further up the North Island soon made their way into the Wairarapa. Ngati Toa, Ngati Raukawa, Te Ati Awa, Ngati Mutunga and Ngati Tama are iwi that stayed for a number of years at various locations around southern and central parts of the region. Korero about where they lived and how they utilised the land during their stay has been handed down. With the exception of three hapu, most tangata whenua left the region but came back after peace agreements had been reached.

Maori (6 generations ago)
In terms of landscape and Wairarapa Maori, or the combination of mana whenua and Maori who originated from different places, the late nineteenth and twentieth centuries are transitional times for the land and Maori. By the late 19th century Maori from all over New Zealand were coming to the Wairarapa in search of work.

Mana whenua only retained small mostly uneconomic blocks of land by this point. So to survive they became the labour force for the government and new owners of private land. This was not the desire of the people but a reality if they wanted to feed and clothe families.

NAMES

Landscapes and landmarks provide the background to names such as Wairarapa. The term Wairarapa only came into being after provincial councils were created during the 19th century. Traditionally, Wairarapa referred to the Ruamahanga River valley from immediately around Wairarapa Moana as far north as the area between the Tauherenikau and Waiohine rivers. The land north of the Waiohine to Pukaha Mount Bruce was known as Te Kauru or the upper valley. Within both there were numerous features.

NAVIGATION

The journey of Haunuiananaia(25 generations ago) chasing and finally catching up with his errant wife Wairaka has been told many times. He started at Heretaunga - Hawkes Bay, walked to Rangitikei on the west coast, down to Porirua and then through the Ruamahanga River valley. All the way he named landmarks after situations that he found himself in. The names in various forms are still in use today.

In the Wairarapa segment of his walk he left a map for all people that came after him. Starting at Remutaka (sic) maunga (Rimutaka mountains) -to sit down, he saw Lake Wairarapa (Wairarapa Moana) -waters that made his eyes glisten below him. After descending down into a valley he came to and named the Tauwharenikau awa (Tauherenikau river) -house made of nikau, then the Waiohine o Wairaka awa (Waiohine river) -water for his woman, then to Waiawangawanga awa (Waingawa river) -confused waters, next to Waipoua awa(water where he tested the depth with his walking stick) and finally to the Ruamahanga awa (twin forks after a bird snaring trough in a forked tree branch). All the while he looked

for Te Rangitumau maunga (holding up the sky) that he had seen from Remutaka (sic). Anyone who was told this story during the times when the Ruamahanga River valley was a patchwork of forest, swamp and grassy plains could navigate their way through the valley.

MARKERS

Prominent hills, rocks and trees were used to indicate where sea landscapes were. Lining up two points could tell a canoe crew where a rock was that they would want to avoid, where a good fishing hole was, or that they were coming onto a reef. Often the method was to head straight out from a marker and as soon as this point was lost to sight it was time to start fishing.

A straight imaginary line between a prominent rock in the sea and a hill on land could indicate a fishing boundary between families.

A landscape feature could be dangerous. So a story would be created to act as a warning. In these situations the words tapu – sacred, rahui – prohibited area or taniwha –unusual creature, might be applied to ensure that the place was treated with caution. The means of conveying the message could be through a story, a directive or a manmade object such as a post. Examples are dangerous stretches of water, bluffs and quicksand.

ECONOMY

When living in a situation where trade was limited to exchange through hospitality, infrequent warfare, and swapping of excess goods or materials for those that were non-existent or scarce, each individual in a whanau or hapu group had to know their land in detail.

If a whanau held mana whenua over a landscape that took in all the land that they could see, they would need to know each ecosystem within the landscape. They would need to understand how each being within that ecosystem coexisted or was influenced by other elements.

When they needed to make a new item that required say cutting down a tree, planning took into account how the job would affect other life forms, including land around the tree. This meant not only ensuring that people were safe by excluding all but specialist work crews from a defined area but also how other trees both big and small might be injured. Would insects, birds or rats be put out? Would the disappearance of a large tree create too much light in the understory or be of benefit? If a log needed to be floated down a river, would land between where the tree stood and the river be scarred? If fire was used to cut the tree, what was the potential for the fire to get out of control? These factors and others needed to be thought through before a tree was chosen because any one could change the land. If a problem occurred the people could suffer as a consequence of not caring for Papatuanuku and her mokopuna.

HOMES

An annual migratory cycle was established after the first people moved further inland. Groups began walking, or where practicable used waka on rivers, to move between inland areas and the coast. During autumn and winter the treasures of river flats, forest and swamp were utilised while the resources of the coastal areas were exploited during summer. Spring was a time of preparation for the coming year.

The landscape had to be observed to decide where the best place for papakainga – unfortified villages, and pa – fortified villages should be built. Although style of village complex and even building design changed over centuries in response to changing social and climatic situations, basic planning tools were consistent.

People wanted to be near food, water and resource sources but they did not want to be unhygienic, damp, cold, or in areas prone to flooding. Pa were built on defensible parts of hills and normally only used in times of need. Most of life was spent in papakainga on flat land nearer to rivers or coastal streams. But no matter where people were situated they calculated things such as where prevailing winds came from, how the sun would nurture or ruin crops, whether annoying insects might be close and how sanitation would be maintained without detrimentally affecting the surrounding land. Knowledge of landscape had a significant bearing on these decisions.

TE URUROA

It was Te Ururoa or the foothills and valleys, essentially the favoured home of nga manu – the birds, where human's chose to live. If birds were present there would be trees that they ate from and most of the trees had parts that humans could use for various purposes.

Kiore - the rat was a staple food that ate from the same trees. By moving to the coast at a certain time the people not only got optimum nutritional value from fish species, they also gave the inland food sources a chance to breed and grow. By the time that the people arrived back into the valleys, autumn was approaching and it was time to prepare for catching migrating eels. Eels were available all year round but autumn was the time for the annual harvest which put greater emphasis on the importance of the waterways.

CURRENT ISSUES

Broadly, there are several issues that concern Maori at whanau, hapu and iwi levels in relation to landscapes in the Wairarapa; these include:

- Subdivision, especially where there is alteration or destruction of waahi tapu, effects on access to mahinga kai and kai populations, visual effects on landscapes and landmarks important to iwi;
- Water quality, pollution, and effects of land use and development on waterways;
- Waitangi Tribunal Claims (Wairarapa iwi are seeking return of places such as Wairarapa Moana, Pukaha Mount Bruce and Ngaumu Forest);
- Official recognition of associations and or changes, to management regimes of specific features highly significant to whanau, hapu and iwi;
- Restoration of areas such as along waterways and native forest.

GLOSSARY

- atua = god
- awa = river
- hapu = clan
- iwi = confederation of clans
- kai = food
- kaumatua = elder
- mahinga kai = food gathering area
- marae = meeting place
- matira = lookout
- maunga = hill, mountain, mountain range
- mokopuna = descendent
- tikanga = customs, values and practices
- tupuna = ancestor
- waahi tapu = sacred or significant places
- waiata = songs
- waka = canoe
- whanau = family or extended family

EUROPEAN SETTLEMENT IN THE WAIRARAPA*

EXPLORATION

The first European explorer to sight Wairarapa was James Cook in 1770 (Tasman only sailed on the western side of Aotearoa followed by Russian navigators Bellingshausen and Lazarev in 1820, and the Frenchman Dumont D'Urville in 1827 (Bagnall, 1979).

The establishment of the New Zealand Company's Wellington settlement in 1840 led to the inland exploration of the Wairarapa area, the pressure for grazing land leading to a number of expeditions taking place in the early 1840s. The first significant trip was by surveyor Robert Stokes and companion JW Child and two Maori guides in November 1841 followed by a second larger expedition in May 1842 led by assistant surveyor Charles H. Kettle and Cadet Arthur Willis. Other parties followed, and reports to the Company urged the opening of the Wairarapa to settlement.

LAND LEASES

Maori were keen for pakeha settlers and, rather than wait for the New Zealand Company to acquire land in the Wairarapa, four entrepreneurs – Charles Clifford, William Vavasour, Henry Petre, and Frederick Weld negotiated in March 1844 for the lease of the open country to be known as Wharekaka Station for £12 per annum. Other leases soon followed and in April 1845 twelve stations were listed in a Wellington Independent table with between forty and fifty Europeans living in the district (Bagnall, 1976).

Once farming became established, wool was quickly the main export item.

According to Ben Schrader (2009) in the article 'Wairarapa region - European settlement':

The runholders' relations with their landlords were cordial. Maori sought Pakeha neighbours because it gave them mana (status), trading opportunities and protection from enemies. Pakeha depended on Maori for food, labour and transport.

Although the leasing system seemed to suit both leaseholders and their landlords, it was illegal under the Native Land Purchase Ordinance of 1846, designed to facilitate the sale of land to the Government for new settlers.

LAND PURCHASE

From mounting pressure and on recommendations of surveyors S. C. Brees and H. S. Tiffen, the New Zealand Company obtained authority for purchase of 250,000 acres for a Church of England settlement in the Wairarapa. The first attempt at negotiating a purchase in 1847 failed. The leases in place provided Maori with steady income, and they were strongly opposed to sale. A second attempt by Native Secretary Henry T. Kemp followed in 1848 and local Maori agreed to sell but at a price the buyers would not pay and the Church of England settlement was established in Canterbury.

To deal with the cause of the failure of purchase, no new leases were meant to be taken up but in fact the area leased expanded and rental income rose.

The majority of the leaseholders in the Wairarapa appealed to Government for some legal authority to be established as there was method of resolving land disputes between Maori and their tenants, and between the tenants. They said the longer purchase was postponed the more averse to sale the Maori were.

The first Government purchase of a quarter million acres in the Wairarapa was negotiated by Donald McLean on the back of Hawkes Bay purchases and was signed on 22 June 1853 by Wiremu Te Potangoroa. The price was £2,500 and the block included the coast between the Waimata Stream and Whareama River, reaching inland to the Wangaehu (sic) and Ihuraua River. Sir George Grey personally travelled to Wairarapa to negotiate further sales and his personal mana meant further sales followed, including 350,000 acres around Lake Wairarapa, (Wairarapa Moana) 40,000 acres of the Tuhitarata Block, 40,000 acres on the western side of the valley, and a number of homestead purchases (Bagnall, 1976).

Around the same time the Small Farms Association was formed (Schrader, 2009),

"Out of concern that large runholders were stopping working people from accessing Wairarapa farmland, Joseph Masters lobbied to set up a 100-acre town on the Wairarapa plain where citizens would own a one-acre town section and a 40-acre dairy farm. By the end of the year the government had approved two settlements. The association would buy and sell the town sections; farms would be bought directly from the Crown".

Of the first towns, Greytown, was sited on the recently purchased Tauherenikau Block. After negotiations with Ngāti Hamua leader Te Retimana Te Korou, land beside the Waipoua River was bought for Masterton. The first small farmers arrived in 1854. The Association was dissolved in the early 1870s, and surplus town sections were put into land trusts to benefit each community.

These settlements were the first planned inland towns in New Zealand. Featherston and Carterton followed in 1857 and Martinborough was set out by the Hon. John Martin in 1881. Bagnall (1976) states that,

"By 1865 settlers in Featherston, Greytown, Carterton and Masterton were managing to survive with less hardship from their established cultivation and a little reciprocal trade. There was at least one main street in each, with the promise of homes, even shops, to fill out the vacant sections."

ACCESS

The Rimutaka Road opened on 10th June 1856 after 10 years of construction and cost £35,000 (Bagnall, 1976). In 1871, Scandinavian and other immigrant settlers were recruited by the government to build roads and railways in the heavily forested Te Tapere Nui a Whatonga, Seventy Mile Bush. In exchange for work the immigrants would be given 40 acres of farmland (Schrader, 2009).

The Scandinavian settlers built the road from Kopuaranga to the north. Work on the improvement of the Featherston - Masterton road started in 1862 and district roads branching east and west from this road followed, the road to Castlepoint being completed in 1879 (Bagnall, 1976).

**This section was prepared by Edita Babos, Carterton District Council, reviewed by Gareth Winter, Wairarapa Archive*

Long after the completion of the Castlepoint Road, coastal shipping was most often used to reach the coast, most goods being transported this way well into the 20th century. Ferries operated at Lake Onoke (Lake Ferry), and the Whareama, Owahanga and the Akitio River mouths, usually with associated hotels. Safety of sea travel was improved with the lighthouse at Cape Palliser in 1897 and at Castlepoint in 1912 (Bagnall, 1976).

Proposals for a rail line from Wellington to the Wairarapa were first considered in 1863. The government took up the programme in the early 1870s and the Wellington-Hutt line was completed by autumn 1874. However, it took a further four years for the line to reach Featherston over the Rimutaka Incline, and another two years until the Masterton opening in November 1880. The Incline route had its limitations and alternatives were explored as early as 1899. However, it took until 1955 for the current single tunnel line to be completed (Bagnall, 1976).

Masterton developed more rapidly due to its geographical advantages and "*slight edge in personal leadership*". Greytown and Carterton followed closely, then Featherston, and last Martinborough (Bagnall, 1976). Smaller villages, such as Mauriceville and Tinui, were established as rural service centres.

Today the Wairarapa has a population of 44,817, of which 88.2% are of European descent. Masterton is the region's centre with a population of 19,500 (2006 Census).

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The settlement of Carterton looking east, was established in 1857 as a base for workers building the road from Greytown to Masterton.

LAND USE[2]

Land use varies across the Wairarapa and is direcly influenced by topography, geology, soils and climate. The western areas comprise young soils derived from Rimutaka and Tararua greywacke and argillite. The central plains are also young – formed in the last million years by alluvial gravels from the ranges, and comprise large fans, terraces and flood plains. The eastern uplands consist of uplifted sandstone, mudstone and limestone and feature broad valleys and steep, erosion-prone hill sides.

The climate is generally warm and dry, with over 2,000 hours average sunshine per annum. Rainfall diminishes west to east, ranging from 1200 to 800 millimetres per year. Winters are cool with frosts common from April to October, and possible most months.

Before the arrival of man much of the district was covered in forest, either conifer-broadleaf or beech. Maori, who settled the district nearly 1,000 years ago, were the first horticulturists. The remains of their extensive gardens can be seen at scattered locations on the south and east coasts. Their primary crop was kumara although they also cultivated hue, or gourd.

By the time European settlers arrived in the Wairarapa, fires, started by Maori and natural outbreaks, had substantially altered the vegetation. There were large areas of grassland and fern on the plains, while much of the eastern hill country was scrub and fern covered. The wetter western areas and the northern portion of the district were unaffected, and were still substantially forested.

Some of New Zealand's first extensive pastoral enterprises were undertaken on the Wairarapa plains. Driving their sheep around the coast from Wellington, the pioneer pastoralists, cousins Frederick Weld, Charles Clifford, and William Vavasour, established the first sheep run in the district at Wharekaka, south of Martinborough in 1844. They were followed by others in quick succession and much of the plain and the eastern hills were being leased from their Maori owners for sheep and cattle runs by the early 1850s.

In 1854 the twin small farm settlements of Greytown and Masterton were founded. The two villages, established by members of the Small Farms Association, and the Government-sponsored towns of Carterton and Featherston which followed shortly, were created to allow men of limited capital to purchase enough land to form small farms.

The pattern of agricultural development in the Wairarapa was strongly influenced by soil type and climatic considerations. The eastern hill country was slowly cleared of most remaining native forest and converted to grassland. It generally sustained extensive sheep and beef producing stations, many of which had to shift their produce by sea, the double handling involved adding to the cost of transport. Many of these large holdings were broken up in the early 20th century, by a combination of Government acquisition and family subdivision.

The land in the valley and in the wetter western foothills was traditionally farmed in much smaller blocks, with lamb fattening, dairying and cropping, often in conjunction with each other, being more important.

New Zealand's fourth co-operative dairy company opened in Greytown in January 1883, followed by more than fifty other factories. As roads improved and large scale milk tankers became operational, the companies amalgamated. There were only four by the mid 1970s and dairying seemed to be in decline. Since that time all the Wairarapa factories have closed but dairying has assumed a more important role.

Cropping was strong on the floor of the plains at times but has never had the importance of more traditional areas such as Canterbury. In the past, wheat and oats were major crops but now mixed cropping (mainly barley and peas) predominates and arable farming accounts for less than 2% of the Wairarapa land use.

Horticulture was an important industry in the region, especially on the rich alluvial soils. As well as extensive market gardens, a large number of berry and pip fruit orchards were established. One grower, James Hutton Kidd, laid the foundation for New Zealand apple breeding in the 1920s by introducing a number of important new varieties, including 'Gala'. The Greytown fruit industry flourished, but rising costs and poor returns have seen this industry shrink in importance.

The Wairarapa region is New Zealand's sixth-largest winemaking region, concentrating on producing premium wines. In 2007 there were 829 hectares in grapes, about 6% of New Zealand's total. The wine industry is concentrated on the gravel soils and dry climate of Martinborough, although there are also plantings in East Taratahi and at Opaki, north of Masterton. There are also about 200 hectares of olive trees producing about 15% of New Zealand's olive oil.

Wairarapa's hill country was extensively developed in the period following World War Two. Government rehabilitation schemes settled farmers on comparatively small blocks and generous subsidies encouraged the development of pasture on scrub covered lands. The development of aerial topdressing with lime and superphosphate enabled increased production.

The removal of subsidies in the mid-1980s changed the direction of hill country farming. Farmers were unable to maintain costly marginally economic pastures and stocking rates declined. Some recently converted land reverted to scrub, while other land was converted to plantation forestry.

Large scale forestry was first introduced to the Wairarapa in the 1940s when the Government started planting the Ngaumu block to help stabilise erosion prone land and to provide housing timber. Planting doubled in the 1990s but in recent years forestry planting has been curtailed and now planting and harvesting rates are in equilibrium.

THE PRESENT

The 2007 Agricultural Census recorded 1438 farms in the Wairarapa. Approximately 73% of the farmed land is reported as being in grass (Figure1), reflecting the dominance of pastoral agriculture in the region. Although having a high profile and contributing significantly to the economy, horticulture and fruit growing (including wine growing) comprise less than 1% of the total land area. Plantation forestry accounts for 12% while mature and regenerating native forests contribute a similar amount. The percentage of land used for arable farming is very small.

[2] This section is an edited version of material by Gareth Winter, Archivist, Masterton District Council.

The significant number of smaller properties on the urban fringes accounts for the relatively high percentage of farms of less than 20 hectares (Figure 2). There were 20% between 20 and 100 hectares, and 45% over 100 hectares.

These statistics reflect the dominance of the larger pastoral farms as a percentage of land, suggesting extensive pastoralism is the dominant landscape effect in the eastern hill country, while the more intensively farmed smaller holdings are to be found in the central lowlands, especially close to the towns.

The dominance of livestock farming is also reflected in the farm type by farm number figures, with 71% of farms engaged in livestock farming (Figure 3).

THE FUTURE

The fluctuating state of farm economics makes it difficult to predict how agriculture will affect the landscape in the future, even in the medium term. In recent years forestry and dairy have both undergone major swings in fortune, while some aspects of sheep and beef farming have come under severe financial pressure.

The impact of the proposed central valley irrigation project could change the degree of arable farming on the plains, allowing more horticultural crops to be raised, and offering the opportunity for high value intensive seed production. The proposed irrigation project has the potential to increase the amount of land suitable for dairying.

The role of wool, once the mainstay of the Wairarapa economy, has diminished to the extent that it is now little more than a by-product of the lamb meat industry. This has encouraged farmers to change their farming practices to produce more high quality meat and many have replaced dual-purpose sheep with breeds better suited to meat production.

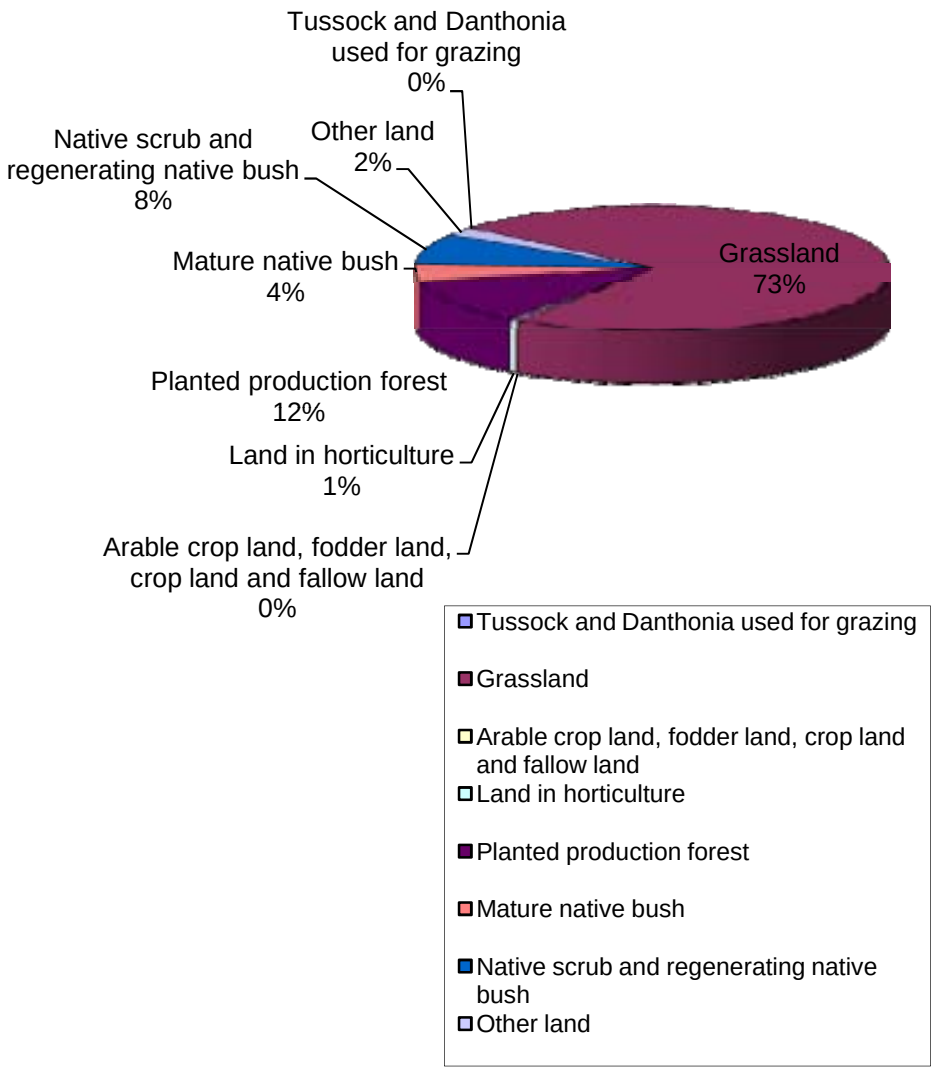


Figure 1: Wairarapa agricultural areas in hectares, by useage at 30 June 2007. Source, 2007 Agricultural Census, Statistics New Zealand

Since 1990 the Wairarapa's sheep numbers have fallen by nearly 30%, reflecting a fundamental change in livestock production, with an emphasis on highly productive stock. This has occurred by the infusion of improved genetics, both from new sheep breeds and by extensive use of high-performing sires to improve productivity and profitability. The Wairarapa Romney Improvement Group has been locally important.

These better performing animals require better nutrition, and farming systems have evolved to make full use of their potential. Farmers are resowing pastures with higher performing grasses and intensifying their animal management systems by better internal subdivision. There has been a marked increase in the use of nitrogenous fertilisers and many properties now finish their own lambs.

These processes are less economically sustainable on steeper country and it seems likely more marginal land will be withdrawn from pasture, perhaps being converted to plantation forestry, or being allowed to revert to native forest.

The potential for climate change to affect the eastern hill country should not be underestimated, however. The consensus is that rainfall will increase in western areas and will diminish in the east, with the possibility of worsening and more regular droughts. This would militate against more intensive livestock farming.

Deer farming has proven prone to cycles of boom and bust. There is currently little likelihood of expansion as financial returns have been poor and the Wairarapa herd has fallen by 50% in the past five years.

Arable farming is a minor activity in the Wairarapa, accounting for less than 2% of land use. It requires large scale operations to be economically feasible and it is unlikely there will be substantial expansion without increased irrigation.

Dairy farming has made a resurgence in those parts of the district where climatic conditions are suitable. There has been an increase of 50% in dairy cattle numbers since 1990, although there has been a slight fall in numbers since 2002. The average farm size and herd size has increased, larger operations being more economically sustainable. Some South Wairarapa herds have become certified as organic.

Extensive horticulture has been in decline in the Wairarapa for some years, with large-scale apple and pear growing almost disappearing. Vegetable growing, once extensive in the valley, has ceased due to small units being economically unsustainable.

Viticulture has expanded in the past thirty years but requires very particular soil types and climates, and further extensive expansion seems unlikely.

The forestry industry may have a larger role to play in the near future as public attitudes change. Forests will be regarded as more than a supply of wood. Their role in carbon sequestration and storage, and their use for erosion control and the maintenance of biodiversity and water quality

will add to their value.

The New Zealand agricultural sector currently produces a large amount of greenhouse gases which could be offset by planting exotic forests. Such plantings would seem likely in the more erosion-prone eastern hill country especially on land that is economically marginal for livestock farming. Climate change could threaten this expansion, as an increasingly dry climate and rising wind flows would make growing conditions less favourable.

The long-term future of farming in the Wairarapa will be based on livestock farming and forestry. The state of economic returns for meat and wool in the foreseeable future make it unlikely there will be any large development of marginal hill country for livestock production, nor a reversal of the trend for marginal country to be planted in exotic forests.

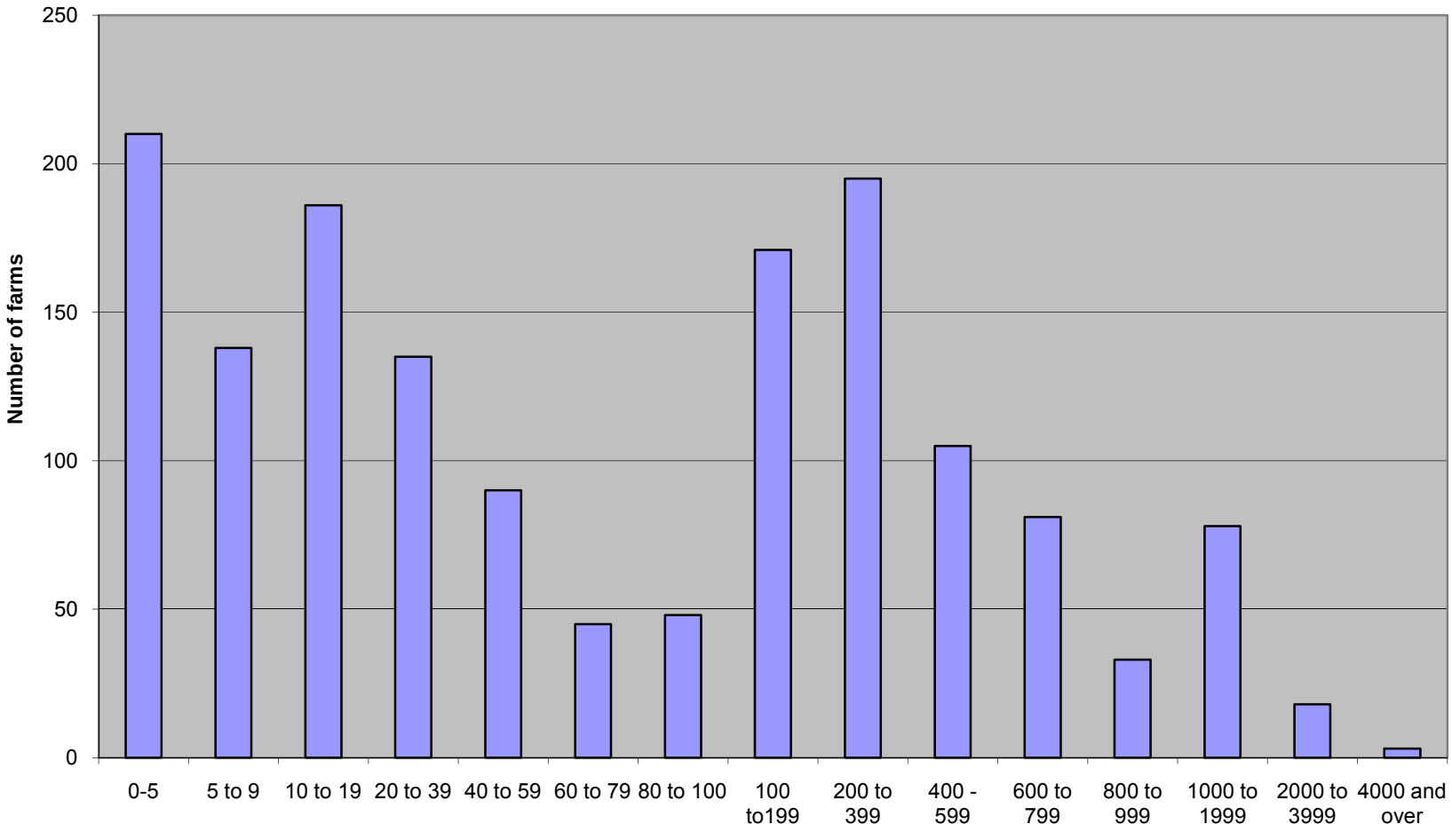


Figure 2: Wairarapa farms by farm size at 30 June 2007. Source: 2007 Agricultural Census, Statistics New Zealand

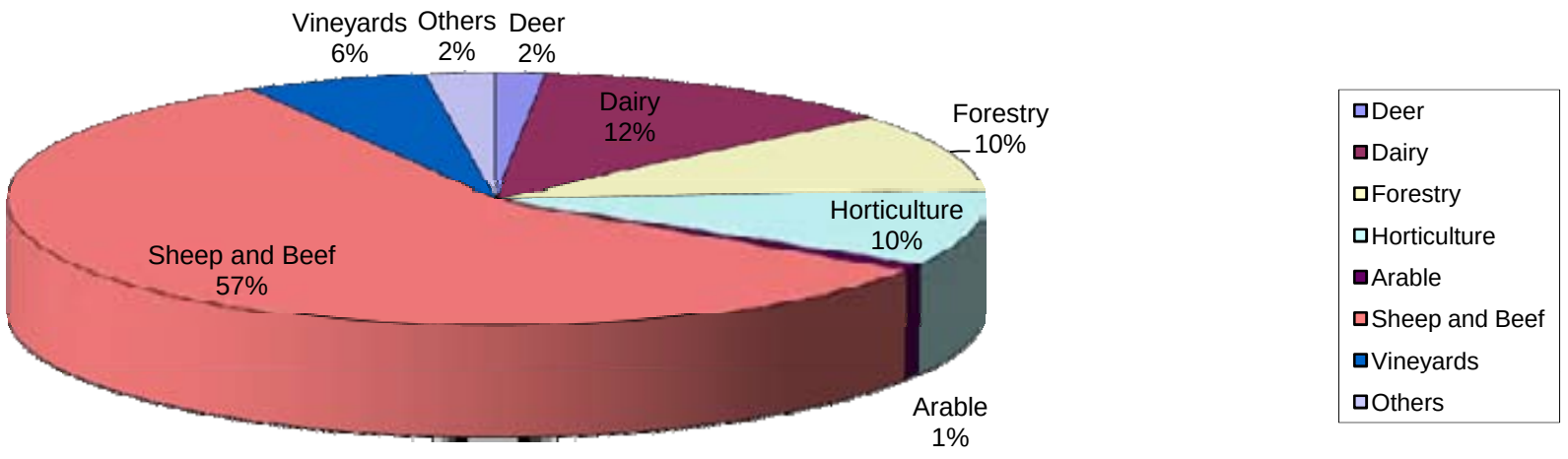


Figure 3: Wairarapa farms by Farm Type (ANZSIC06). Source, 2007 Agricultural Census, Statistics New Zealand

APPENDIX 2: GEOLOGY

The Wairarapa contains a record of upheavals which have reshaped the Earth's crust and many of these are evident in today's landscape. The landscape consists of a diverse range of landforms from the high western Tararua and Rimutaka Ranges, the broad central river plains, and the dissected eastern hill country to the narrow coastal platforms and escarpments.

The Wairarapa is characterised by intensive faulting, tilting and uplifting of a similar range of basement rocks extending from Marlborough to East Cape. The West Wairarapa Fault that forms the eastern margin of the Rimutaka and Tararua Ranges is a continuation of the Clarence Fault that extends through Marlborough to the south. Similarly, the East Wairarapa fault appears to be a continuation of the Hope-Kaikoura fault.

The origins of the Wairarapa landscape date back to 120 million years ago with the accumulation of thousands of metres of sand and silt on the sea floor and occasional submarine eruptions. Over time, the deeply buried sand and silt were transformed into the hard greywacke that comprises the Tararua, Rimutaka and Aorangi ranges; about 20 million years ago the hard greywacke that forms these ranges was uplifted.

The plains have been built up from the aggregation of gravels through erosion of the ranges. Most of the coastal hill country consists of a complex of softer rocks and bands of limestone with mudstones and conglomerates scattered throughout.

The pronounced north-east/south-west trend of axial ranges, inland valleys and coastal hills results from the 'concertina like' convergence, in the collision of the Pacific and Indian-Australian Plates. As a result, the landscape of the Wairarapa has a distinctive north-east/south-west alignment.

TAIPO

The Taipo landforms are a distinctive characteristic of the Wairarapa Hill country, but do also occur in other parts of New Zealand, such as the east coast hill country.

Taipo is the name given to the distinctive steep jagged hills that occur in the eastern Wairarapa hill country. Examples of these are Tinui Taipo and the nearby Mangapakeha Taipo, Te Maipa Taipo, (near Stronvar) and the Taipo in the Rocky Hill Road area. These particular Taipos are relatively well known due to their accessible locations in easy view from public roads. Their dramatic visual character is largely due to the steep serrated rocky ridges, made all the more distinct by the lack of substantial vegetative cover such as forest. The Rocky Hills Sanctuary (DoC Reserve) and Taipo Minor are notable exceptions, both supporting mature podocarp/hardwood forest.

Taipos are a prominent feature along the length of the Wairarapa eastern hills and are associated with Land Type 7 (Cretaceous Hard Rock and Steeplands) which make up 11.6 % of total area of Wairarapa. Land type 7 occupies a relatively narrow band of the eastern hill country running parallel and close to the coast.

The Taipo landforms result from the differential erosion of raised and tilted blocks of sandstones and mudstones. The variation in erosion resistance of soft and hard rocks is reflected in the steep and craggy rocky formations.

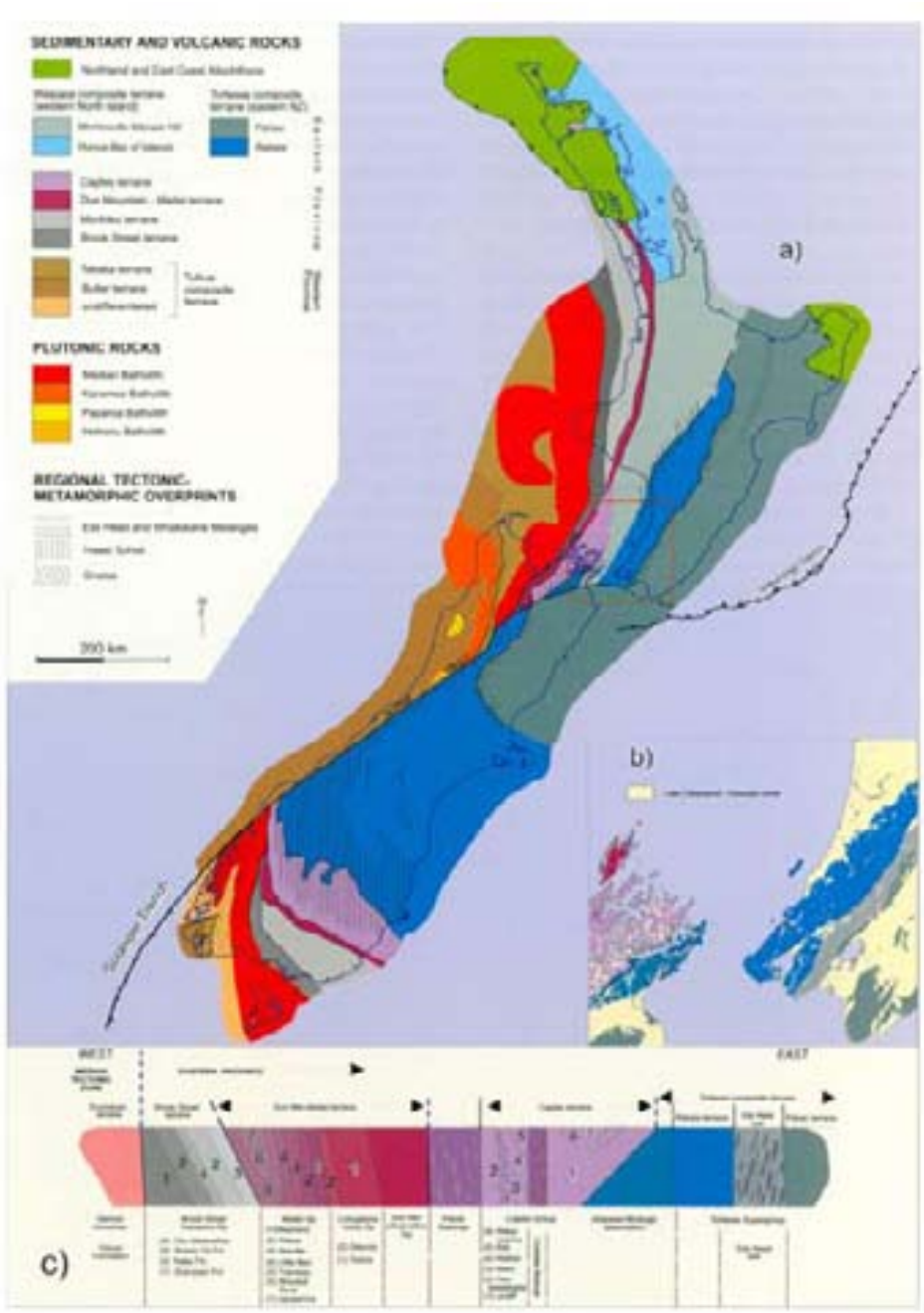


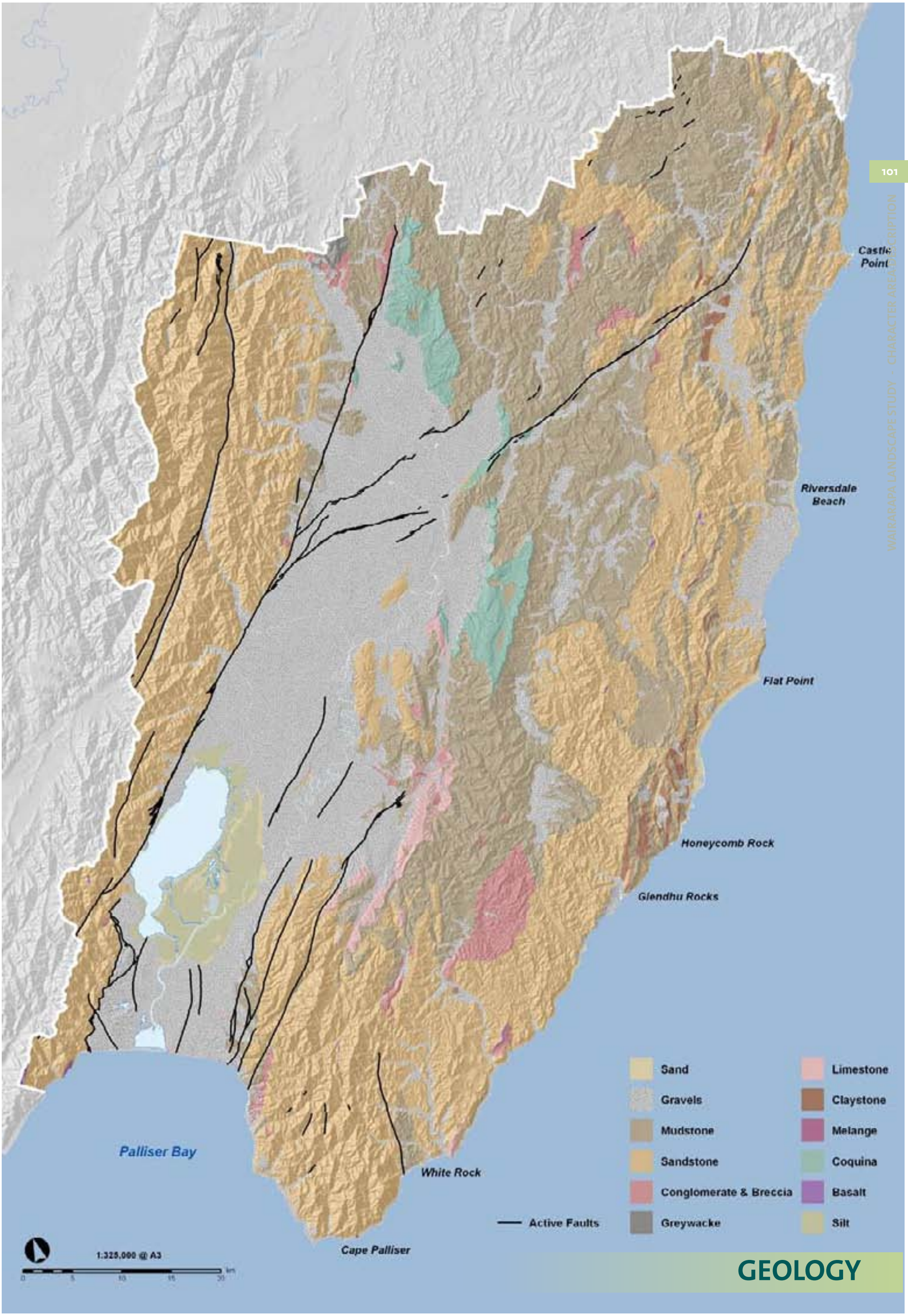
Figure 8a) Basement (pre-Late Cretaceous) geological map of New Zealand. Units are grouped according to major, rather than sole, rock type. Nomenclature and boundaries of North Island Torlesse and Waipapa terranes are controversial; parts of Morrinsville-Manaia Hill and Pahau units may be correlative. Northland and East Coast Allochthons were emplaced in the Early Miocene; all other units were in mutual juxtaposition by the Late Cretaceous. Adapted from Black (1994), Mortimer (1995), Mortimer *et al.* (1997, 1999) and references therein.
b) Basement rocks subdivided into tectonostratigraphic terranes for the Wellington area.
c) Cartoon cross section through basement rocks of Marlborough/Wellington area illustrating structural style and relationships.

Source: Institute of Geological and Nuclear Sciences Ltd. (2000) Geology of the Wellington Area. Begg. J & Johnston. M (compilers).

Local maori called the landforms Taipo; meaning demon or devil. Traditional stories of local maori associates particular powers to the taipos.

http://www.rangitane.iwi.nz/education/index.php/stories/traditional/the-taipo-of-tinui

GIS Data set used: Geopreservation Sites _ Geological Society of New Zealand Science


Castle Point
Riversdale Beach
Flat Point
Honeycomb Rock
Glendhu Rocks
White Rock
Palliser Bay
Cape Palliser
Active Faults
Sand
Gravels
Mudstone
Sandstone
Conglomerate & Breccia
Greywacke
Limestone
Claystone
Melange
Coquina
Basalt
Silt
1:325,000 @ A3
0
5
10
15
20
km

GEOLOGY

APPENDIX 3: GEOPRESERVATION SITES

The New Zealand Geopreservation Inventory[1] highlights the 'best examples of the wide diversity of natural physical features and processes that together characterise each part of New Zealand and document its long complex geological history, the formation of its landforms and evolution of its unique biota'.

New Zealand has unique and diverse range of natural landforms, geology and soil heritage, due to its location and formative processes. The New Zealand Geopreservation Inventory 'aims to identify and list information about all the internationally, nationally and many of the regionally important earth science sites throughout New Zealand, irrespective of their current protected status'.

Within the Wairarapa there are 38 recognised sites of geological importance, ranging from historic areas of mining to marine terraces, fault scarps, taipo , fossil forests and sand dunes.

Each site is listed for its importance and significance.

For importance, the inventory categorises the sites into three levels (A-C):

A: international: site of international scientific importance.

B: national: site of national scientific, educational or aesthetic importance.

C: regional: site of regional scientific, educational or aesthetic importance.

For vulnerability, each site has been classified (1-5) depending on its perceived vulnerability to human activities:

1 Highly vulnerable to complete destruction or major modification by humans

2 Moderately vulnerable to modification by humans

3 Unlikely to be damaged by humans

4 Could be improved by humans activity

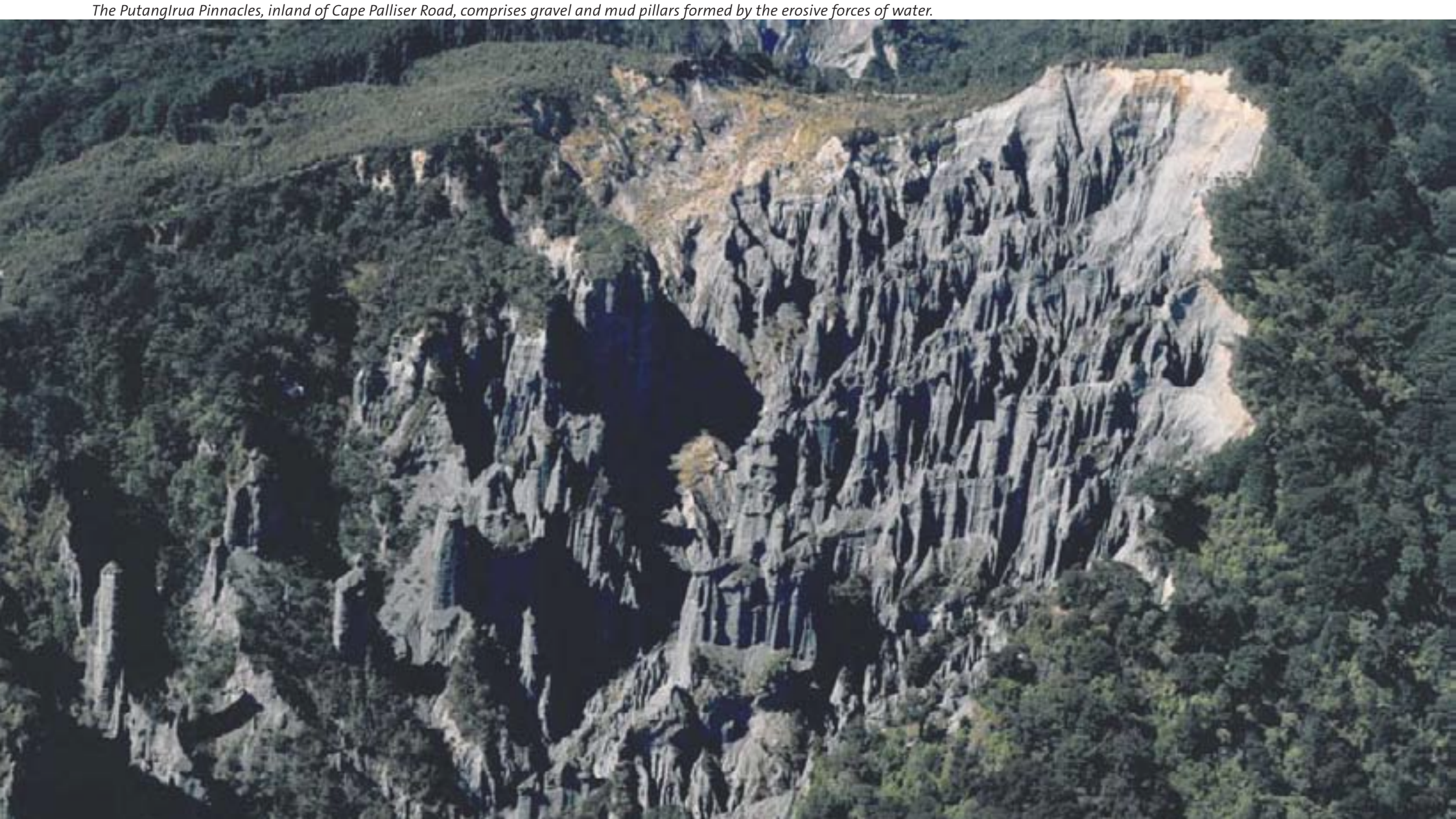
5 Site already destroyed (not necessarily by human activity)

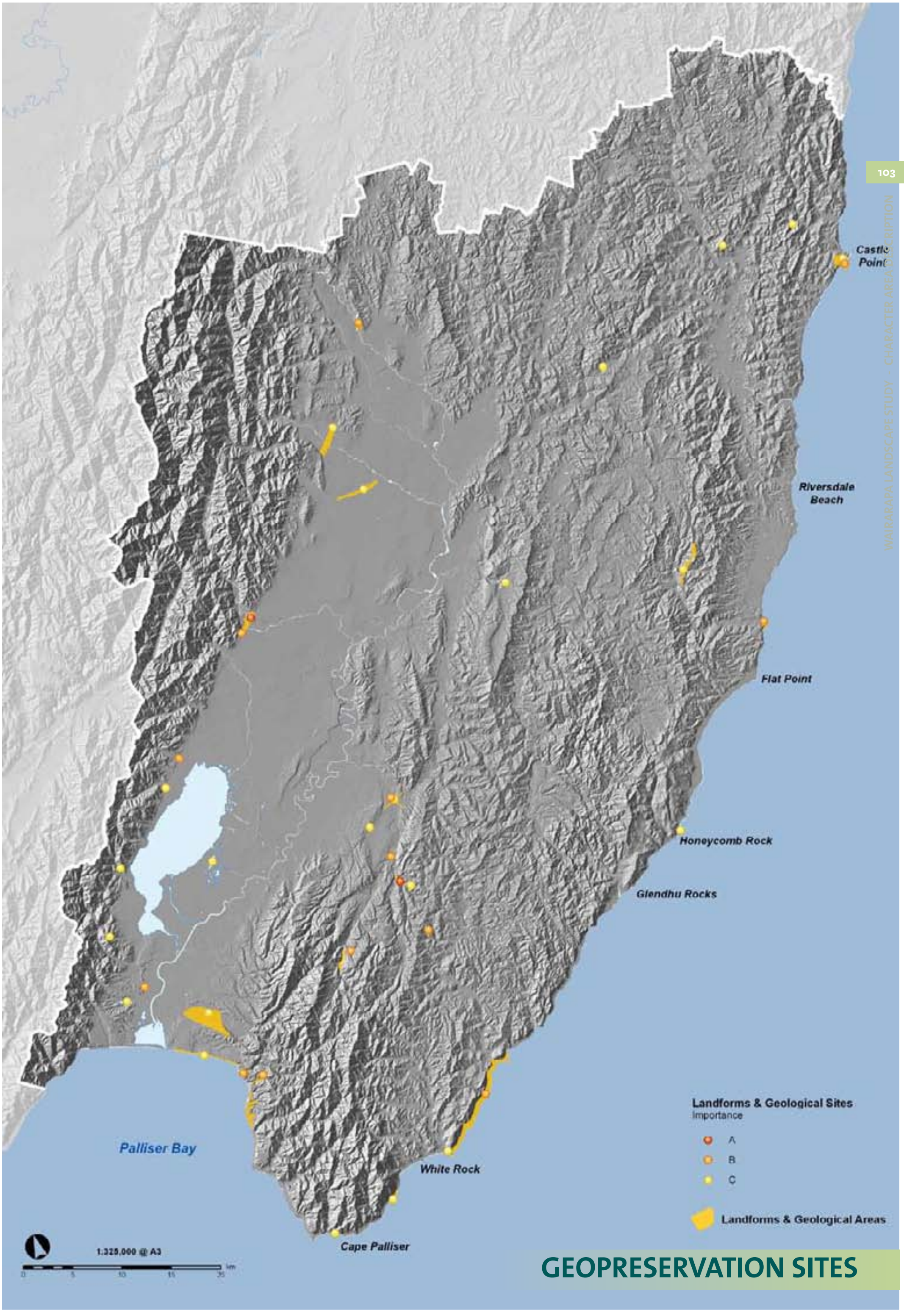
The full list of sites, their location and details are contained overleaf.

GIS Data set used: Geopreservation Sites - Geological Society of New Zealand

1 *Geological Society of New Zealand. 1996.*

The PutangIrua Pinnacles, inland of Cape Palliser Road, comprises gravel and mud pillars formed by the erosive forces of water.





GEOPRESERVATION SITES

GEOPRESERVATION SITE DETAIL

Geopreservation Site detail			
Name	**Location**	**Importance**	**Vulnerability**
Kupe's Sail sandstone slab	At the mouth of Little Mangatoetoe Stream, 1 km west of Cape Palliser.	C	3
Ngapotiki alluvial fan	2.5 km south of the end of Ngapotiki Road at the mouth of Mataopera Stream.	C	3
Te Kaukau Point Paleocene Amuri Group sediments	On the Wairarapa Coast, about 2 km east of White Rock.	C	3
Pukemuri Stream uplifted marine benches	East Wairarapa coast, from Te Kaukau Point to Manurewa Point.	B	2
Putangirua Pinnacles	One major area and several subsidary areas about 2 km up the Putangirua Stream, east coast of Palliser Bay (Te Kopi).	B	2
Palliser Bay Miocene transgressive sequence and diverse macrofauna	Stream and coastal cliffs around eastern side of Palliser Bay.	B	2
Palliser Bay Plio/Pleistocene section	Northern cliffs of Palliser Bay from Lake Ferry eastwards for about 4 km.	C	3
Eparaimu uplifted marine benches, Palliser Bay	East flank of S. Ruamahanga Valley.	C	3
Big Hill earth pillars, rills and gullies	Between Paruwai Road and White Rock Road, 1 km south of Big Hill trig.	B	3
Haurangi Hairpin Plio-Pleistocene limestone	Haurangi Hairpin, upper Ruakokopatuna Valley, south Wairarapa.	B	3
Glenburn dike	1 km north of Honeycomb Rock.	C	3
Lake Pounui gravel-dammed lake	500 m west of Western Lake Road between Lake Wairarapa and Lake Onoke and 1.5 km west of Battery Hill.	C	3
Battery Hill abandoned gravel bar	Under Western Lake Road, 300 m NE of Battery Hill, between Lake Onoke and Lake Wairarapa.	B	2
Sunnyside Miocene conglomerate	Tributary of Mangaopari Stream, opposite Sunnyside homestead, locally known as McLeods Creek.	C	3
Mangaopari Miocene-Pleistocene paleomagnetic section	Bell's Creek, Mangaopari Stream and Makara River. 4 km of sequence.	A	3
Huangarua River cyclothems	Banks of Huangarua River, 400 m downstream from junction of Ruakokopatuna and Makara Streams.	B	3
Galatea Mine gold	In Rimutaka Ranges, approached from Wairarapa side.	C	3
Dry River Fault, White Rock Road scarp	Martinborough-Awhea Road (White Rock Road), 6.8 km from Martinborough Square.	C	3
Huangarua Fault	Te Muna Road-Huangarua River.	C	3
Huangarua Syncline flexural slip faults	Just W of Martinborough-Masterton Road, c.4 km SE of Martinborough.	B	3
Lake Wairarapa sand dunes	Between Allsops Bay and Mangatete Stream in a 15 x 3 km belt.	C	2
West Wairarapa Fault, Burlings Stream	Slopes on N side of Burlings Stream, c.1 km west of Lake Wairarapa.	C	3
Kaiwhata River mouth fossil forest and Miocene flysch sequence	For 100 m on either side of Kaiwhata River mouth, north of Flat Point, Wairarapa coast.	B	3
West Wairarapa Fault - Cross Creek horst dam	Where Cross Creek Rd cuts across fault trace; 2-3 km west of north end of Lake Wairarapa.	C	1
West Wairarapa Fault, 1855 scarp	Pigeon Bush, southern Wairarapa Valley.	B	2
Kaiwhata Stream sills	Kaiwhata Stream, east of Ngahape.	C	2
Kourarau freshwater fossils	Road cutting on south side Tupurupuru-Te Wharau Rd, 200 m west of Puketiro Rd junction.	C	1
South Waiohine fault bulge	On uplifted north-west side of West Wairarapa Fault, 500 m west of Waiohine Valley Rd, about 1 km north of Woodside Station.	B	2
West Wairarapa Fault, Waiohine River faulted terraces	North side of mouth of the Waiohine Gorge, c.4 km NW of Greytown.	A	2
Masterton Fault (Waingawa Fault)	North side of Waingawa Freezing Works, Masterton.	C	2
Carterton Fault, Blairlogie Road trace	Blairlogie Road, c.2 km W of Awatoitoi.	C	3
Castlepoint Pleistocene sediments	Wairarapa coast east of Tinui.	B	3
Castlepoint marine terraces	Castlepoint, coastal Wairarapa.	C	3
West Wairarapa Fault, Waingawa River faulted terraces	Waingawa River - Upper Plain Road at foot of Tararua Range.	C	3
Kerosene Bluff black shale	In road cutting on south side of Castlepoint Rd, about 5 km from coast.	C	2
Tinui taipo	2 sq km hill and ridge centred around Maunsell Trig (359 m high), 2 km north of Tinui township.	C	3
McClouds Trig rock slump	Near McClouds trig, 30 kms north of Masterton on the Ruamahanga River.	B	3

APPENDIX 4: SOILS

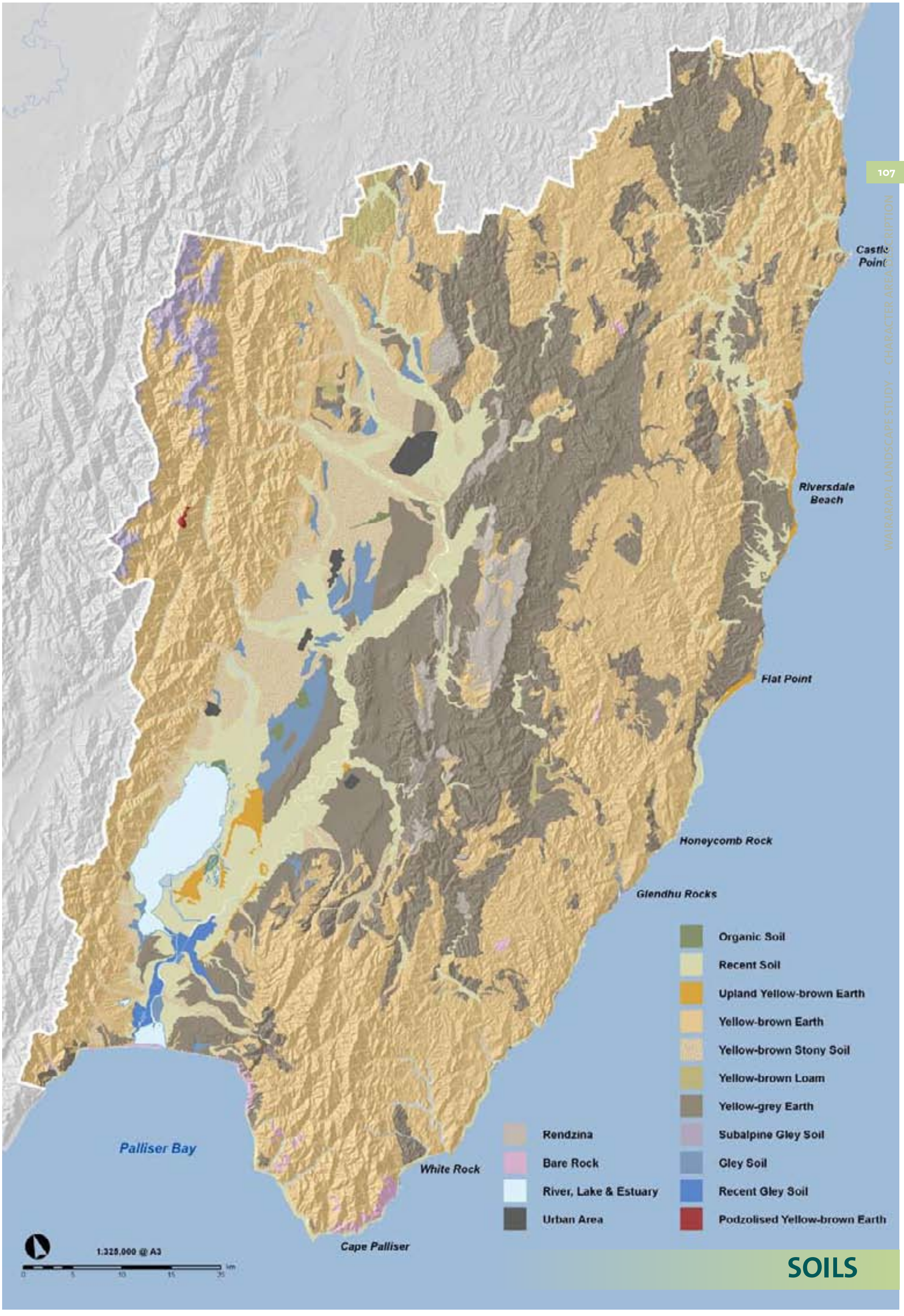
The soils of the Wairarapa reflect the geological processes that have created them. The varied land uses throughout the area are largely dependent on the soil types, topography and climate.

In broad terms, the Wairarapa soils can be considered as two general groups; the more fertile soils associated with the plains, river systems and lowlands, and the relatively less fertile soils associated with the hills and steeplands of the ranges and eastern hill country.

The plains and lowlands soils are dominated by recent and recent gley soils, yellow-grey earths, and yellow-brown stony soils. Recent and recent gley soils have developed on silty and sandy gravels or alluviums of the plains and are derived from the greywake material transported from the western ranges by the Ruamahanga River and its western tributaries. The lowlands in the eastern plains are predominantly yellow-grey earths developed on loess, in areas of relatively low rainfall (1000-1140 mm p.a.) with a summer dry period. Yellow-brown stony soils, also derived from greywake alluviums and gravels, have developed on the western side of the plains, where there is relatively high rainfall on old floodplain areas. The climate and flat to rolling topography together make various parts of the plains and lowlands suitable for arable and pastoral farming and forestry.

The eastern hill country is predominantly yellow-brown earths interspersed with small pockets of intergrade between yellow-grey and yellow-brown earths. Yellow-brown earths and related steepland soils are developed on greywake loess as well as mudstone and siltstone in areas of moderate rainfall and are weakly or strongly leached. The soils of the eastern hill country together with the climate, and also the hilly to very steep topography, make the land suitable for pastoral farming and forestry.

GIS Data set used: Soils - Landcare Research


Castle Point
Riversdale Beach
Flat Point
Honeycomb Rock
Glendhu Rocks
Palliser Bay
White Rock
Cape Palliser
1:325,000 @ A3
km
0
5
10
15
35
Organic Soil
Recent Soil
Upland Yellow-brown Earth
Yellow-brown Earth
Yellow-brown Stony Soil
Yellow-brown Loam
Yellow-grey Earth
Subalpine Gley Soil
Gley Soil
Recent Gley Soil
Podzolised Yellow-brown Earth
Rendzina
Bare Rock
River, Lake & Estuary
Urban Area

SOILS

APPENDIX 5: ELEVATION & SLOPE

Elevation and slope are highly variable given the topography which varies from high axial ranges, wide river flood plains, and dissected steep coastal hills to narrow uplifted coastal platforms and associated escarpments.

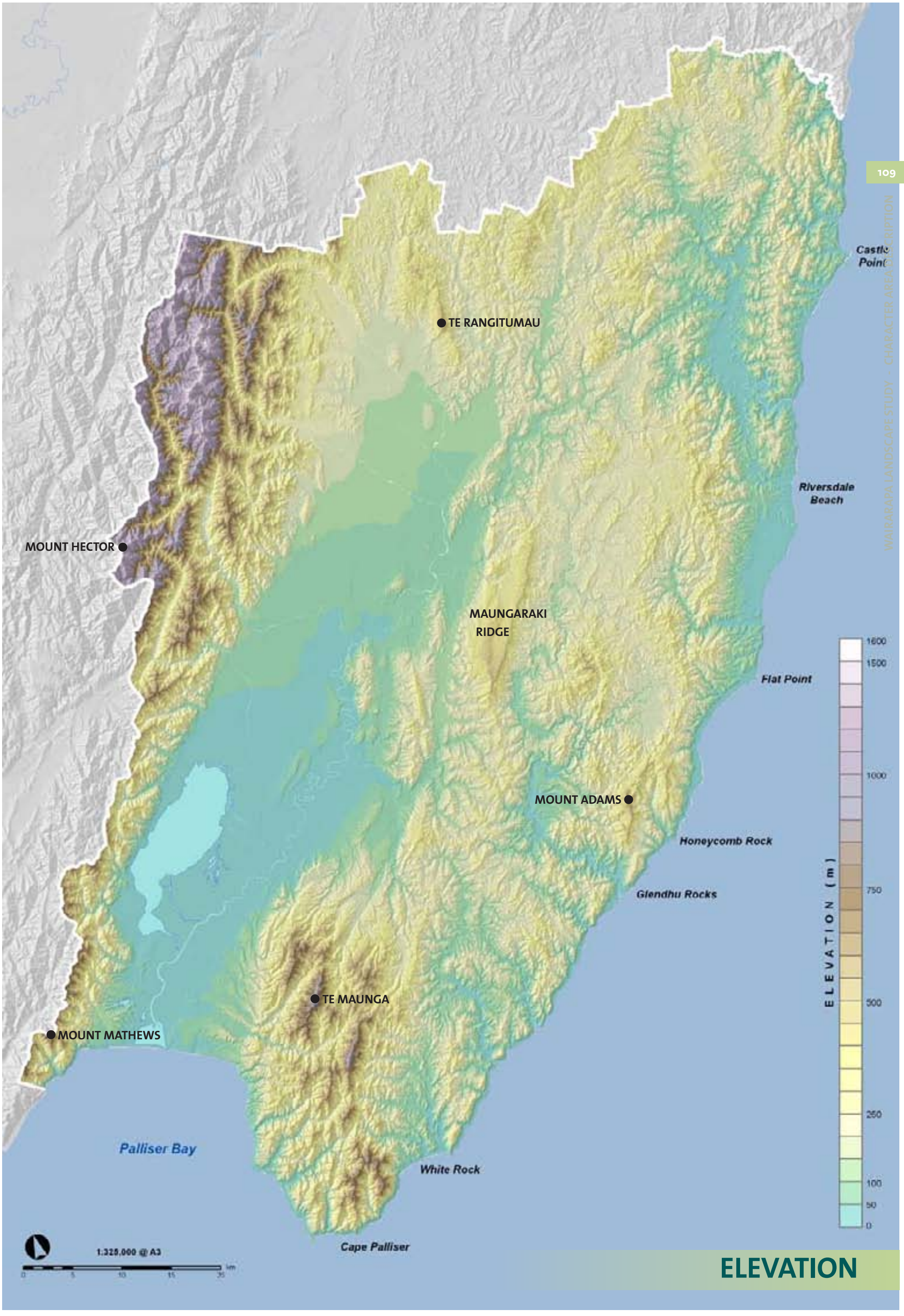
The Tararua Ranges has several ridges and peaks rising to over 1000m with Mt Hector the highest point at 1529m. The Rimutakas are generally lower with Mt Mathews the high point at 940m. The Aorangi Ranges reach similar elevations to parts of the Rimutaka Ranges with three ridges over 800m in height and the high point, Te Maunga at 979m. The ranges have predominantly steep to very steep topography with a network of sharp ridges, pointed hill and mountain tops and steep-sided stream and river gullies. The foothills to the ranges are lower, more rounded and vary from hilly to steep topography.

The plains include flat, undulating and sometimes rolling land and descend from 140m asl at Opaki, north of Masterton, to near sea level at Lake Onoke (over a distance of 75 km). The plains also have a definite downward tilt from the west to the east. This tilt is clearly expressed in the pattern of rivers that cross the plains from the Tararua Ranges to the Ruamahanga River that follows the toe of the eastern hills to the sea.

The hill country to the north and east of the plains is a complex of hills, mountains and river valleys that range from very steep slopes to quite broad flat valley floors. There are several ridges and mountains above 500m including Mt Adams (the highest at 664m), Maungaraki Ridge (560m). Te Rangitumau (604m) is the high point of the hill country north of the Aorangi Ranges, but generally the hill tops and ridges range between 300m and 400m.

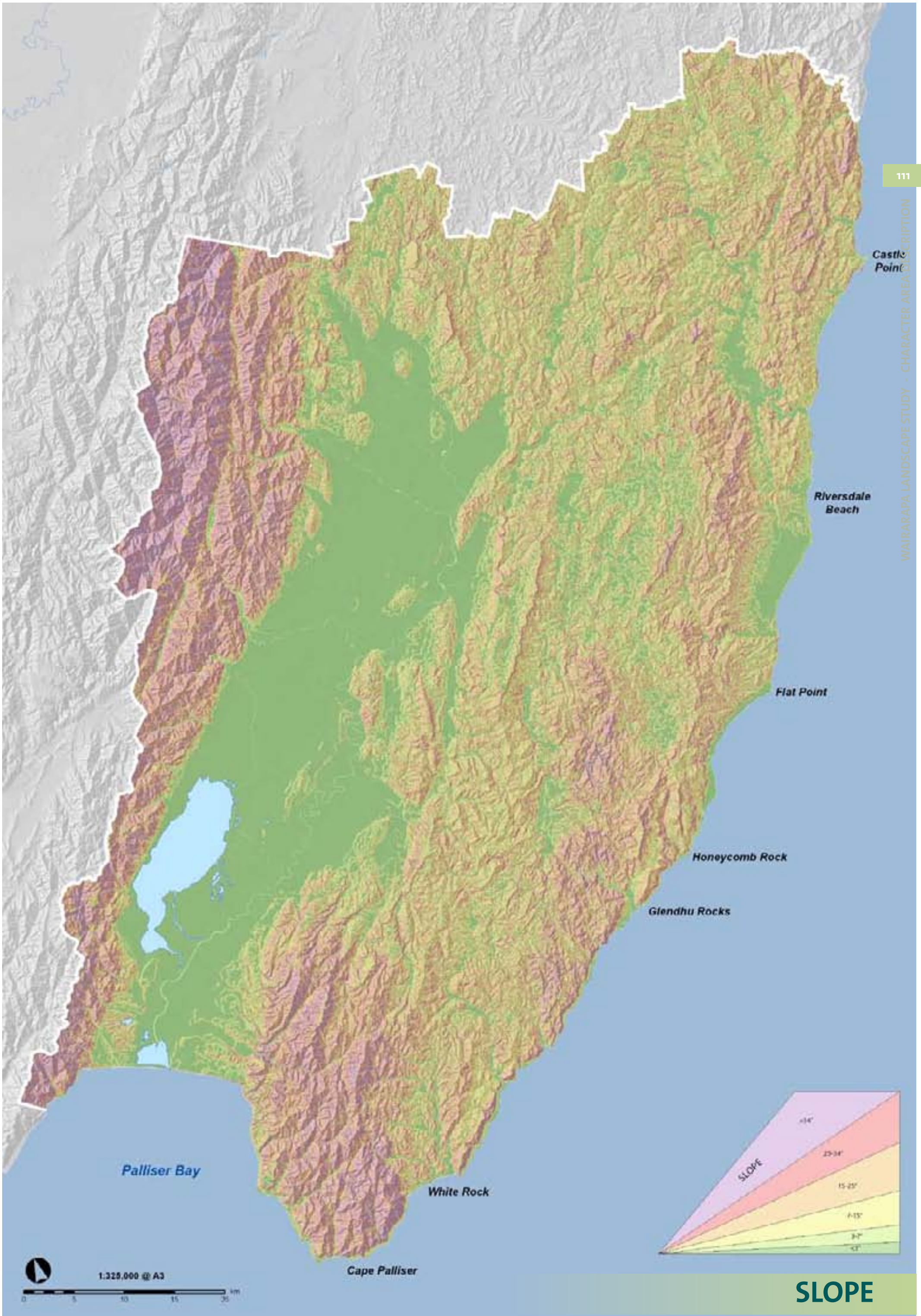
There is approximately 200km of coastline in the Wairarapa. The majority of the coast comprises a narrow coastal platform defined by steep and usually high coastal escarpments or hills. Exceptions to the narrow coastal platform occur at river mouths such as the Opouawe, Pahaoa, Kaiwhata and Whareama rivers where the enclosing slopes give way to more open river valleys and alluvial flood plains. The Homewood coastal plains are the only sizable area of flat to rolling land adjacent to the coast.

GIS Data set used: derived from digital elevation model, Land Information New Zealand


TE RANGITUMAU
MOUNT HECTOR
MAUNGARAKI RIDGE
MOUNT ADAMS
TE MAUNGA
MOUNT MATHEWS
Castle Point
Riversdale Beach
Flat Point
Honeycomb Rock
Glendhu Rocks
White Rock
Cape Palliser
Palliser Bay
ELEVATION (m)
1600
1500
1000
750
500
250
100
50
0
1:325,000 @ A3
km
0
5
10
15
35

ELEVATION

The Rocky Hills area, near Te Wharau, have a distinctive conical shape due to the hard underlying parent material (Land Type 7). Maungaraki Ridge is visible in the left of the background.


Castle Point
Riversdale Beach
Flat Point
Honeycomb Rock
Glendhu Rocks
Palliser Bay
White Rock
Cape Palliser
SLOPE
1:325,000 @ A3
km
0
5
10
15
35

SLOPE

APPENDIX 6: LAND COVER

Many factors influence the land use patterns including geology, soils, topography, climate, existing land cover, and economic factors.

Today agricultural uses are by far the most prevalent land cover types in the Wairarapa. Improved pasture and grassland covers nearly all of the plains, lowlands and much of the hill country. Vineyards, horticultural crops and arable crop land are very minor land uses in terms of total area, and are concentrated in the eastern and north plains area.

Indigenous forest covers the second largest area of land. The native forest is mainly confined to the Tararua, Rimutaka and Aorangi Ranges; there are also several moderately- sized isolated remnant native forest areas amongst the exotic forests on the eastern hills. There are no sizable areas of indigenous vegetation remaining on the lowlands or plains, but many small fragments are scattered throughout the farmland.

Extensive areas of exotic production forest have been established in the eastern part of the hill country north of about Hinakura. Smaller plantations are also established on the western foothills west of Carterton and Masterton. Small exotic woodlots and shelterbelts are common throughout the hill country and lowlands adjacent to the plains.

Large tracts of the eastern hill country support native kanuka- dominated scrub, exotic scrub (gorse and broom) and regenerating native forest. These often steep and inaccessible areas, originally cleared of native forest for grazing, are now reverting to native vegetation. The changing economics of sheep and beef farming are not currently profitable on this country, consequently large areas have been retired from grazing or have been planted in exotic forest.

GIS Data set used: LCDB 2 Terralink International

Some of New Zealand's first extensive pastoral enterprises were undertaken on the Wairarapa plains, and grasslands continue to be the dominant land cover today.


Castle Point
Riversdale Beach
Flat Point
Honeycomb Rock
Glendhu Rocks
White Rock
Palliser Bay
Cape Palliser
Alpine Vegetation, Gravel & Rock
Indigenous Forest
Exotic Forest
Native Shrubland & Fernland
Exotic Shrubs & Shelterbelts
Tussock Grassland
Low Producing Grassland
High Producing Exotic Grassland
Vineyards, Orchards & Crops
River, Lakes & Wetlands
Coastal & Estuarine
Man-made Environment
1:325,000 @ A3
km
0
5
10
15
35

LAND COVER

APPENDIX 7: RECORDED NATURAL AREAS

A sizable area (140,251 hectares) of the Wairarapa is identified in the GIS data sets as being indigenous vegetation or habitat, some of which are formally protected.

Most of the protected indigenous habitat/vegetation lies within the rugged ranges and eastern hill country. The Rimutaka, Tararua, and Aorangi Forest Parks, which are administered by Department of Conservation comprise a significant part of the bush-clad ranges. Other smaller areas of protected native forest in the eastern hills are also protected and managed by DoC, including the Rewa Bush Conservation area (1265 ha west of Riversdale), Rocky Hills Sanctuary (418 ha), Oumukura Scenic Reserves (148 ha), and Tora Bush Scenic Reserve (549 ha).

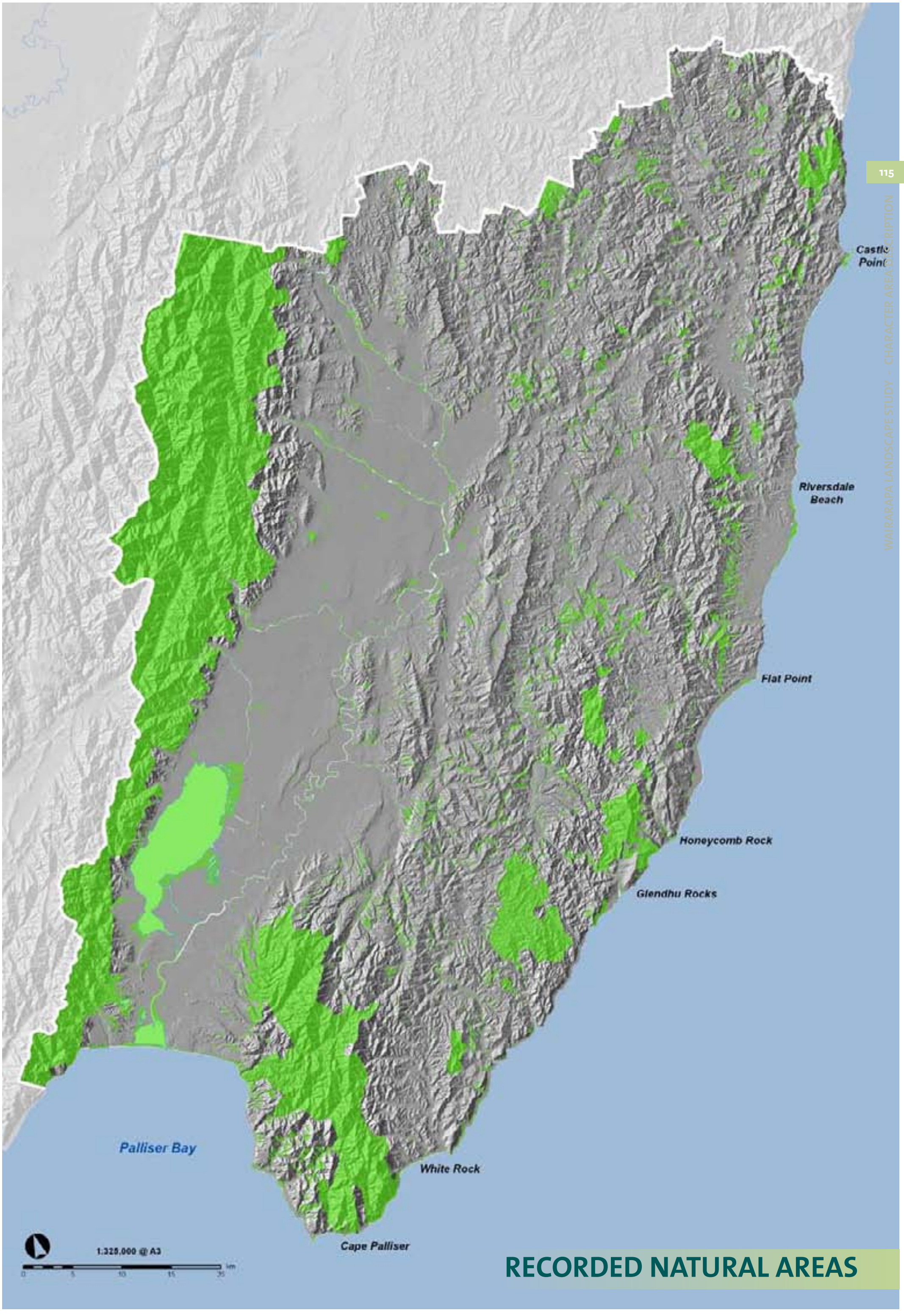
Apart from these areas, only small fragments of indigenous vegetation or habitat remain in the Wairarapa. While some of these fragments are protected as reserves, QE II open space covenants, or conservation covenants under the Reserves Act, many have no protection. While there are many sites identified as Recommended Areas for Protection (RAPs) and indigenous threatened habitat sites, these areas have no protective status.

Lakes Wairarapa and Onoke have been identified as potential RAMSAR sites.

GIS Data sets used:

- *RAP sites (DoC)*
- *Protected Private Land (DoC) Estate- DoC*
- *DoC Reserves*
- *QEII National Trust open space covenants*
- *Indigenous threatened environments (DoC)*
- *RAMSAR Candidate sites- (DoC).*

The forest remnant at Tora is a rare example of protected indigenous coastal vegetation in the Wairarapa.



RECORDED NATURAL AREAS

APPENDIX 8: INDIGENOUS VEGETATION IN THE WAIRARAPA*

The Wellington Regional Native Plant Guide[1] divides the Wairarapa into 8 ecological zones and provides some basic information about past indigenous vegetation cover – "an historical picture of what these zones might have looked like before forest clearance and landscape modification".

Most of the Wairarapa coast is zoned as *Rocky Coastal* zone and past landscapes included wind and salt resistant shrubland dominated bluffs and steep escarpments. In gullies and more sheltered coastal areas originally there was a mixed forest of trees adapted to the stresses of excessive drainage and salt.

The Riversdale coastline is zoned as *Duneland,* with the past landscape being a highly diverse area of wetland/dry dune habitat where grass and shrubland dominated the younger dunes and forest covered the old dunes.

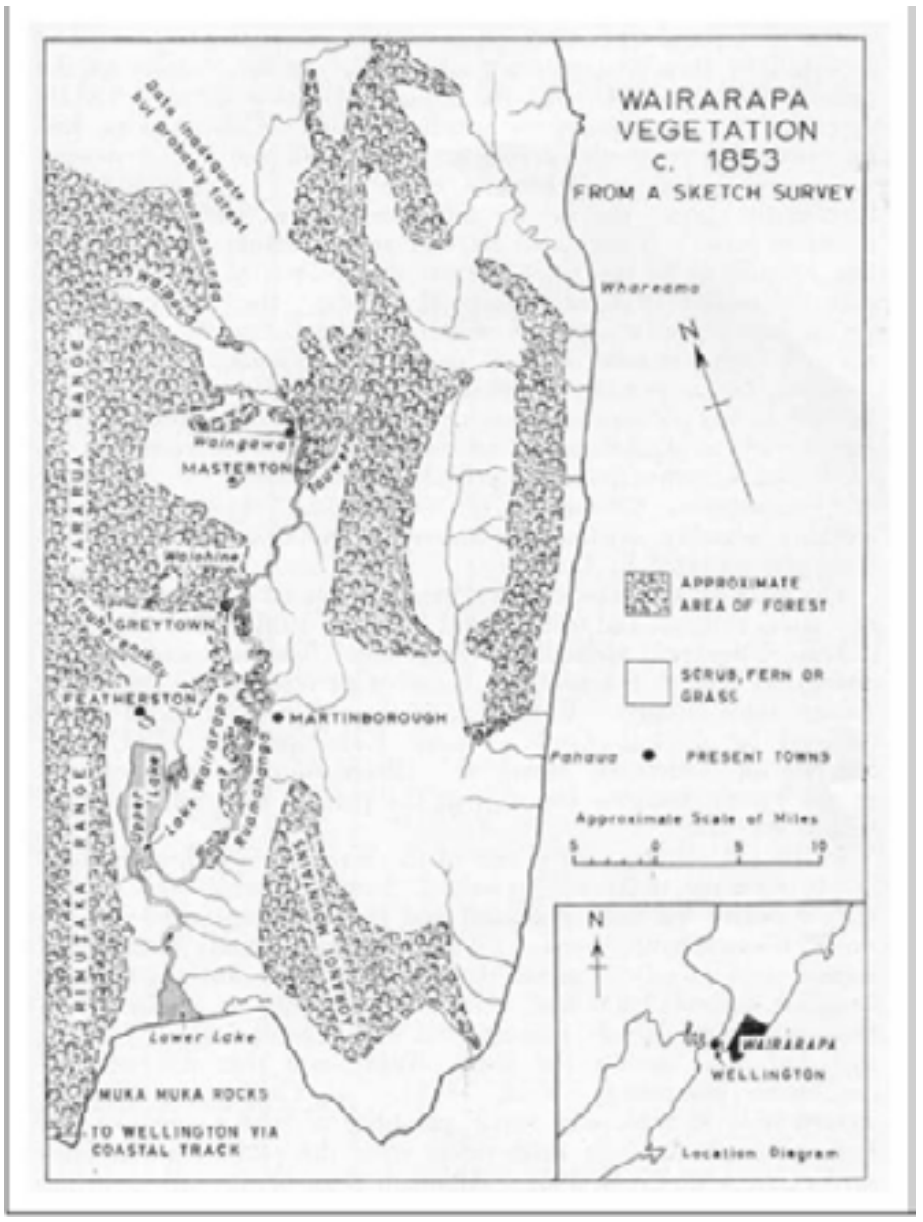
Tauweru River, Gladstone and Ponatahi areas are zoned as *Eastern Wairarapa Foothills*. Past landscapes were dominated by kanuka associations and totara. Titoki and ngaio dominated the relatively frost-free areas.

The *Northern Wairarapa* ecological zone covers Mauriceville, Bideford, Mt Bruce (Pukaha), Mataikona River and Kopuaranga areas. Historical habitats through the hill country were diverse with heavy podocarp forest in higher rainfall areas, while to the east the vegetation was dominated by mixed forests of rimu, rata and matai.

Tinui, Whareama, Homewood, Te Wharau, Pahaoa and Tuturumuri areas are in the *Eastern Wairarapa Dry Hill Country* zone. Past landscapes were diverse habitats: hill country, steep escarpments along incised rivers, and old raised river terraces. This area was forested throughout with species tolerant of drought. Divaricating, small-leaved shrubs dominated the undergrowth. Kowhai and ngaio were dominant on the frost-free river escarpments. The *Southern Wairarapa Plains* zone includes Whangaimoana-Pirinoa, Lake Wairarapa, Pounui, Kahutara and Tuhitarata area. In the past, these landscapes of terraces and rolling hills were dominated by beech forest, swamp forest and wetland plants in the wetter lakeside soils.

Featherston, Greytown, Carterton, Masterton, Te Ore Ore, Opaki and Martinborough are in the *Central Wairarapa Plains* zone. Historical vegetation consisted of drought and frost-tolerant podocarps in the well-drained stony soils.

The *Inland Wairarapa Hill Country* zone covers Hinakura, Tablelands, Ngaumu, Wainuioru and Ruakokoputuna (Ruakokopatuna). Past landscape were hillslopes with rata-rimu-tawa-broadleaf forest with beech species dominating the drier spurs.



Vegetation of the Wairarapa in Mid-Nineteenth Century. Tuatara: Volume 11, Issue 2, June 1963

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1 The Wellington Regional Council, *Wellington Region Native Plant Guide*. Wellington, New Zealand, 1999

**This section was prepared by Edita Babos, Carterton District Council*

THE VEGETATION OF THE WAIRARAPA IN MID-NINETEENTH CENTURY*

Hill (1963) describes the vegetation pattern of the Wairarapa in early European times (c. 1843). He notes that grassland covered 200,000 acres, forest 80,000 acres, fern and scrub covered 25,000 acres and swamp 20,000 acres. Hill describes the forest as:

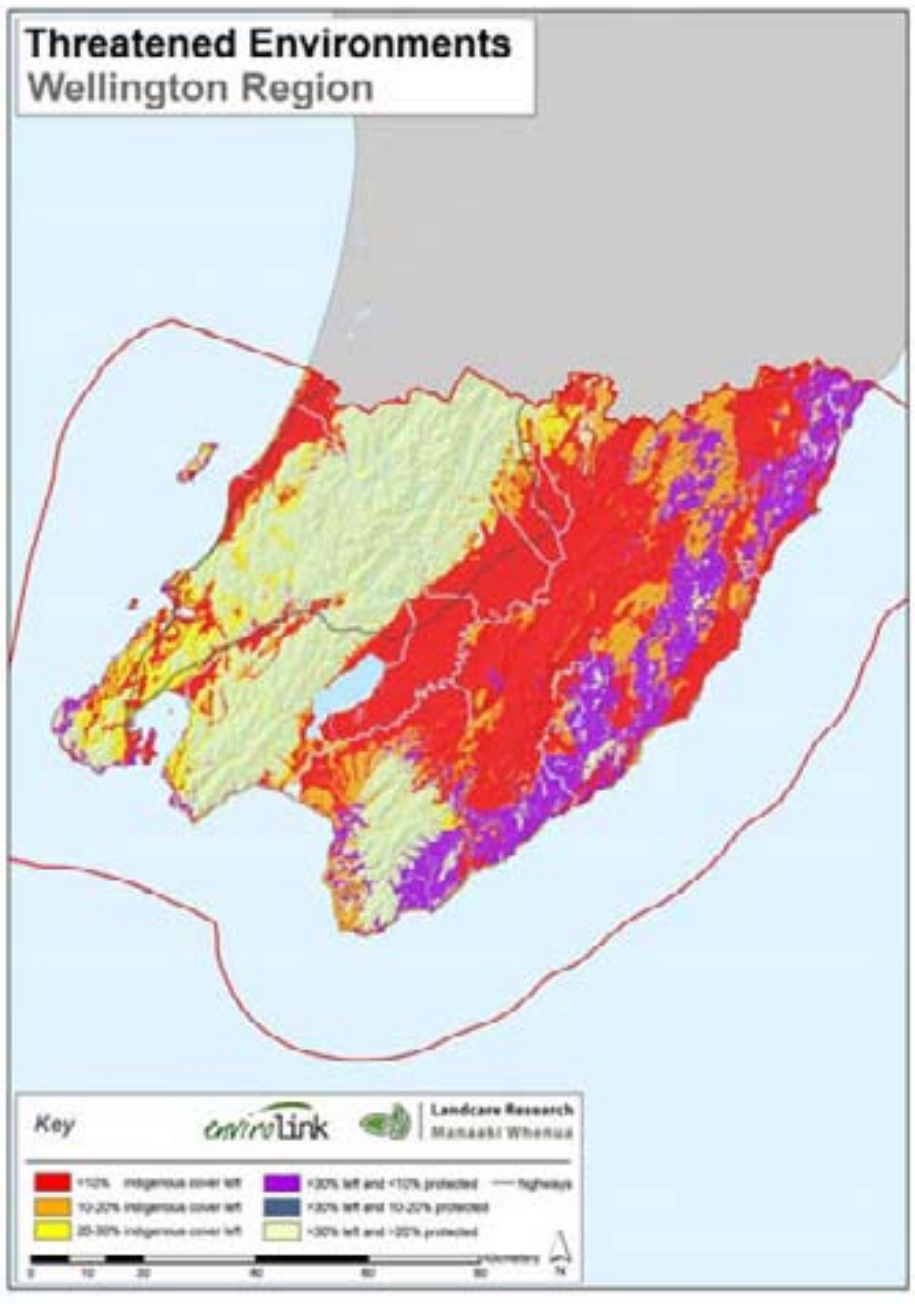
> *"To the west of Lake Wairarapa, the mixed podocarp/broadleaf forest extended down from the Rimutaka Range to reach the lake margin and similar salients of bush extended into the valley at several points, notably in a 20,000 acre block between the Waingawa and Waiohine Rivers. At its northern end the valley was closed off by an area of bush-clad hills and down-land that extended with little break to a clearing in the vicinity of the Manawatu Gorge. Bush then continued as far as the margins of the tussock lands of the Ruataniwha/Takapau basin."*[2]

And the extensive eastern hill country as:

> *"In the hill country to the east of the Wairarapa Valley, the four major elements of forest, grassland, fern and scrub and swamp were repeated but with grassland and swamp being found only in small discontinuous patches. The Haurangi and Maungaraki Ranges were largely in mixed podocarp/broadleaf forest with some beech at around 2,500 feet. However, the hills, as distinct from the ranges, were largely fern-clad but with a good deal of Angelica spp. and grass among the fern. Weld noted that this was the case near Whareama (Weld, 1844). At Castlepoint the hills were mainly in grass with small quantities of toe-toe, manuka and fern, although the hills furthermost from the coast were in bush (D'Urville, 1826-27, p. 104), Although most of the valleys in the area are steep and narrow, some of the larger valleys were sufficiently broad to contain a good deal of swamp. The lower Whareama Valley, for instance, was 'swampy and ankle-deep in water, full of pig ruts and covered in toe-toe' (Weld, 1844). At Porangahau the valley was less swampy and contained about 3,000 or 4,000 acres of grass (Thomas and Harrison, 1845). Grass extended inland from Porangahau in a broad strip that reached the Ruataniwha basin (Colenso in Bagnall and Peterson, 1948, pp. 217, 268). Such was the lack of firewood here that Colenso's exploring party had to make do with tufts of grass for fuel."*[3]

He concludes by describing the damage caused to the native vegetation by the European settlers:

> *"The broadleaf forest shrubs and juvenile trees were reported as being 'eagerly devoured' by cattle (Allom, 1849, p. 201), karaka (Corynocarpus laevigatus) being particularly favoured. Cattle thus had significant effects upon the species composition of all forest areas to which they had access, and in the absence of fences, these areas must have been quite extensive. The fern and scrub was also opened up by trampling and thus made available for sheep. 'Cattle speedily destroy the fern and grass takes its place ... the fern has, in many parts, disappeared, and thousands of acres of the native rye-grass, and other grass are now to be found' (Allom, 1849, p. 21). The grazing of sheep rapidly destroyed a number of species. Both Angelica and Aciphylla were eaten avidly by sheep, the latter in its flaccid, juvenile form. Other plants to suffer were the coastal fern (Anogramma leptophylla), the native carrot (Daucus brachiatus), Lepidium oleraceum and Senecio greyii (Thomson, 1922, pp. 517-518, 521-522)."*[4]



The Threatened Environment Classification has been developed by Landcare Research – Manaaki Whenua to help identify areas in which much reduced and poorly protected terrestrial indigenous ecosystems are most likely to occur.

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Ministry for the Environment – National Priority Regional and District/ City Council Maps, updated 19 December 2007. URL:http://www.mfe.govt.nz/issues/biodiversity/rare/index.html

2 R. D. Hill (1963) The Vegetation of the Wairarapa in Mid-Nineteenth Century. *Tuatara: Volume 11, Issue 2, June 1963*

3 R. D. Hill (1963)The Vegetation of the Wairarapa in Mid-Nineteenth Century. Tuatara: Volume 11, Issue 2, June 1963

4 Ibid.

*This section was prepared by Edita Babos, Carterton District Council

APPENDIX 9: IDENTIFIED HERITAGE SITES

Historic heritage includes sites where physical traces of a past activity remain such as buildings, sites of human occupation, burial and archaeological sites. It also includes sites that are significant for their spiritual or historical associations. Heritage sites are important linkages to the past and provide insight into the way Wairarapa's communities and settlements have developed. They also contribute to the character and amenity value of a location or area. Useful background detail of Maori association with, and European settlement of the Wairarapa landscape is provided in Section B of this report.

Wairarapa contains many sites of historic, cultural and spiritual heritage significance to both Maori and Europeans. The heritage sites that have been identified include:

- Historic buildings , features and trees;
- Archaeological sites and;
- Sites of significance to Maori including wahi tapu;
- Precincts- areas of buildings or other features that collectively have significant historic heritage values.

ARCHAEOLOGICAL SITES

Archaeological sites are places where human activity, pre 1900, has left behind some physical trace. In Wairarapa, 337 archaeological sites have been identified with the majority being of Maori origin located mainly on or near the coast and the eastern edge of the plains. The Maori sites include a wide range of themes such as sites of: defensive pa's, urupa, horticulture, middens/ovens, and dendroglyphs. European archaeological sites are few and include, monuments and defensive stockades and infrastructure sites such as railway tunnels and brick kilns.

The Department of Conservation report, *Archaeology of the Wellington Conservancy: Wairarapa A study in tectonic archaeology* provides valuable background to the archaeology of the Wairarapa, and describes the pre European Maori archaeology of the Wairarapa. Excerpts from the abstract and introduction of the report are reproduced, (in part) below.

The Wairarapa region is a tectonic landscape at the south eastern corner of the North Island of New Zealand. Seismic events are an important key to its natural and cultural character. Archaeological sites and environmental events are dated by their stratigraphic relationship to earthquake-uplifted shorelines, and with dune-building phases and alluvial deposition episodes thought to be triggered by earthquakes.

Two cultural periods are recognised: early and late. Early period sites are older than or contemporary with a period of seismic activity dated to about the late 15th Century AD. The inferred early settlement pattern was coastal. At the time of Maori settlement the coast was largely forested with extensive lagoons between uplifted beach ridges, and it had been stable for at least 800 years. Economic pursuits, in particular gardening, were related to the geological nature of the coast. Gardening was common where a hard rock platform and coastal sediments of greywacke or limestone resistant to wave erosion occurred in front of the coastal hills. It was virtually absent from parts of the coast where the coastal hills were easily eroded mudstones fronted by soft rocks and coastal sediments poorly resistant to wave erosion. Parts of the coast were abandoned following uplift of the coast that drained lagoons, silted up streams, and reactivated building of stream fans on the coastal platform.

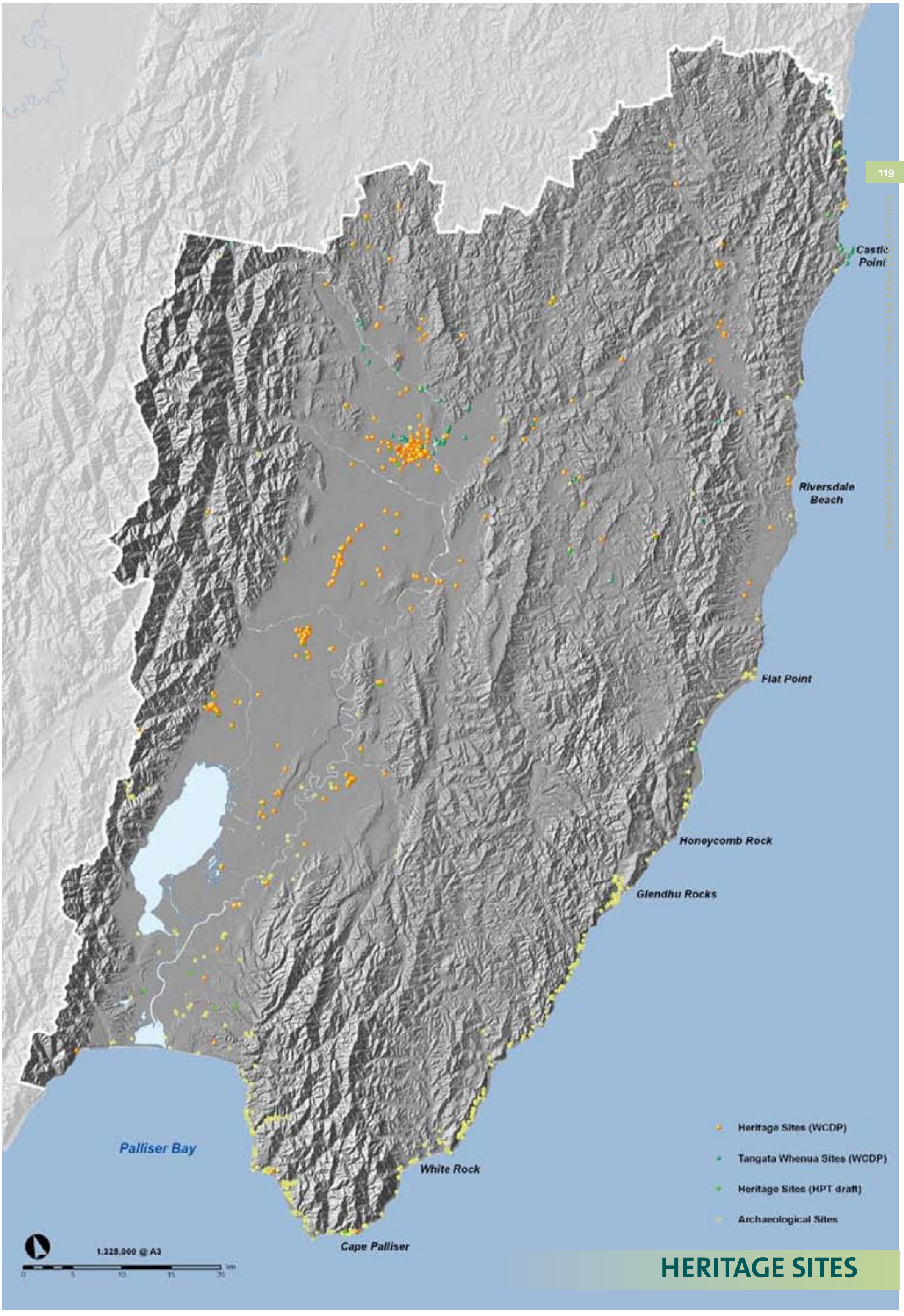
During the late period the focus of occupation moved to the main Wairarapa valley. Gardening was practised in the southern part of the valley and settlement sites tended to be concentrated on the eastern side of the valley. Forest clearance, however, focused on the extensive gravelly soils of the Waiohine fans that were deposited from the mountain ranges on the western side of the valley at the end of the last glaciation.

HERITAGE SITES

The Wairarapa Combined District GIS dataset identifies 404 heritage sites. However, many of these are located within the urban areas of the towns and are therefore not included in the study area. The list includes, houses, woolsheds, monuments, churches, cemeteries, and pa sites. The Historic Places Trust's register lists 67 heritage sites in the Wairarapa including pa, homesteads, churches and woolsheds.

GIS Data sets used:
Draft Historic Places Trust Listed Sites- New Zealand Historic Places Trust
New Zealand Archaeological Sites- New Zealand Archaeological Association
Local Heritage sites- GWRC and Wairarapa Combined District Plan

Kupe's Sail, or Nga-ra-o-Kupe, is the name that was originally applied to two triangular planes of light-coloured cliff on the eastern shore of Palliser Bay. One local story links the site with Kupe and his companion Ngake who were camped here on one occasion, and held a competition to find out who could construct a canoe sail first. According to this legend Kupe won and the sails were then hung up against the cliffs .



HERITAGE SITES

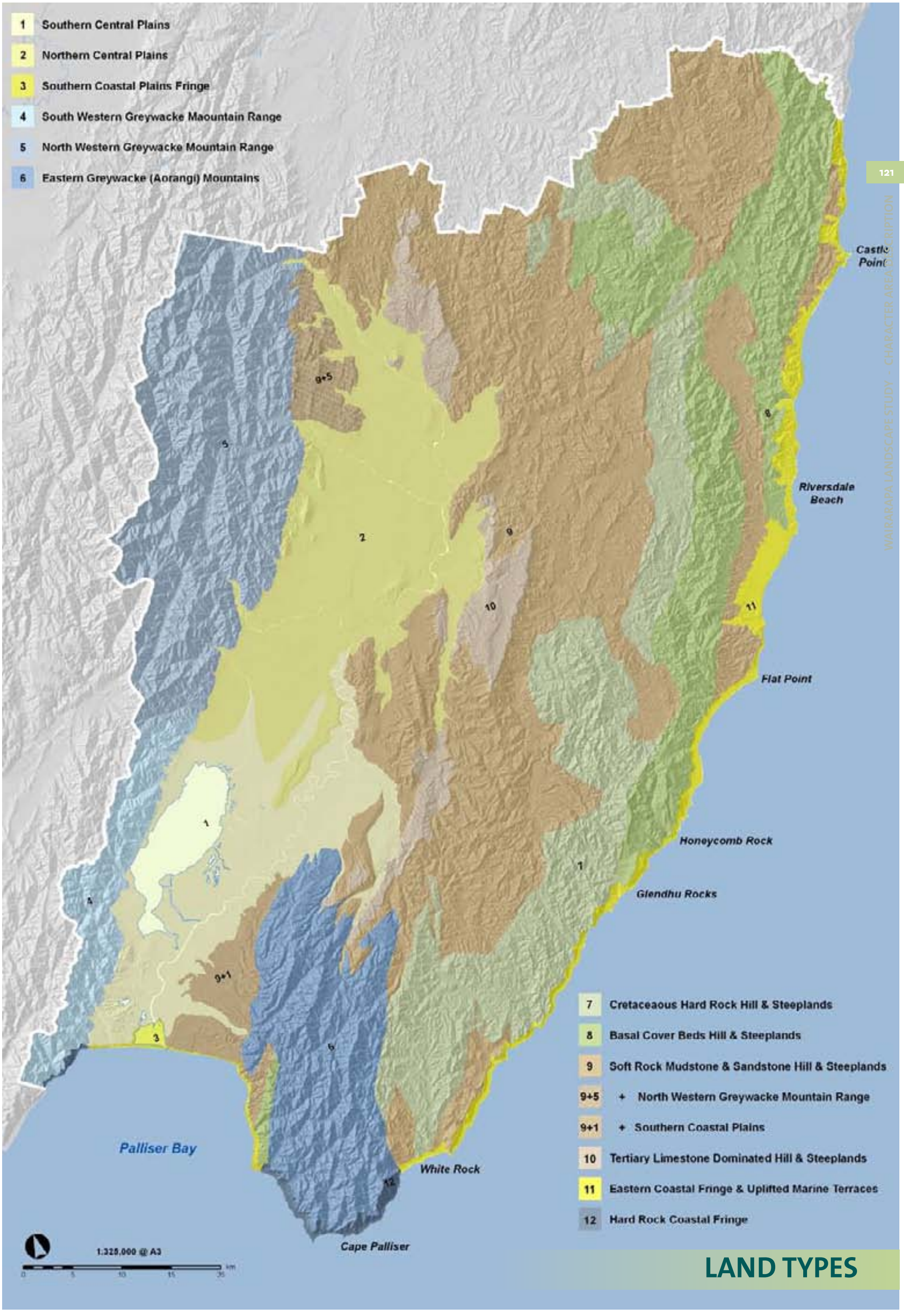
APPENDIX 10: LAND TYPES

The Wairarapa landscapes can be subdivided into a series of 'natural segments' or land types based on a range of biophysical factors. As a starting point to the Wairarapa Landscape Study, Landcare Research was engaged to delineate land types of the Wairarapa (the full report follows).

Twelve land types were identified. The division into land types is based on a detailed analysis of a range of data sources including scientific papers, geological and topographical maps, Protected Natural Area surveys, joint Earth Science Society inventories, and expert scientific knowledge. Landcare Research has undertaken similar land typing exercises for other regions and districts in various parts of New Zealand.

Each land type is described in terms of landform components, geological formation, elevation, remnant native vegetation and present land use. The 12 land types are listed below and shown on the adjacent Map. The land types are referred to by their number throughout the character area descriptions of this report.

1. **SOUTHERN CENTRAL PLAINS**
2. **NORTHERN CENTRAL PLAINS**
3. **SOUTHERN COASTAL PLAINS FRINGE**
4. **SOUTH WESTERN GREYWACKE MOUNTAIN RANGE**
5. **NORTH WESTERN GREYWACKE MOUNTAIN RANGE**
6. **EASTERN GREYWACKE [AORANGI] MOUNTAINS**
7. **CRETACEOUS HARD ROCK HILL AND STEEPLANDS**
8. **BASAL COVER BEDS HILL AND STEEPLANDS**
9. **SOFT ROCK MUDSTONE AND SANDSTONE HILL AND STEEPLANDS**
10. **TERTIARY LIMESTONE DOMINATED HILL AND STEEPLANDS**
11. **EASTERN COASTAL FRINGE AND UPLIFTED MARINE TERRACE**
12. **HARD ROCK COASTAL FRINGE**


1 Southern Central Plains
2 Northern Central Plains
3 Southern Coastal Plains Fringe
4 South Western Greywacke Maountain Range
5 North Western Greywacke Mountain Range
6 Eastern Greywacke (Aorangi) Mountains
Castle Point
Riversdale Beach
Flat Point
Honeycomb Rock
Glendhu Rocks
White Rock
Cape Palliser
Palliser Bay
9+5
9+1
1:325,000 @ A3
km
0
5
10
15
35
7 Cretaceaous Hard Rock Hill & Steeplands
8 Basal Cover Beds Hill & Steeplands
9 Soft Rock Mudstone & Sandstone Hill & Steeplands
9+5 + North Western Greywacke Mountain Range
9+1 + Southern Coastal Plains
10 Tertiary Limestone Dominated Hill & Steeplands
11 Eastern Coastal Fringe & Uplifted Marine Terraces
12 Hard Rock Coastal Fringe

LAND TYPES

LAND TYPES OF THE MASTERTON, CARTERTON AND SOUTHERN WAIRARAPA DISTRICTS

PREPARED BY IAN H. LYNN, LANDCARE RESEARCH

Land Types of the Masterton, Carterton and Southern Wairarapa Districts

Ian H. Lynn






Landcare Research
Manaaki Whenua

Land Types of the Masterton, Carterton and Southern Wairarapa Districts

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Landcare Research Contract Report: LC0910/036

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DATE: October 2009

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Grant G. Hunter Scientist Landcare Research	Alison Collins Science Team Leader Soil and Landscapes

Contents

Summary

Project and Client

Landcare Research, Lincoln, delineated and documented 'land types' of the Masterton, Carterton and Southern Wairarapa districts for Boffa Miskell in August–September 2009 as part of the Wairarapa Landscape Study for the Greater Wellington Regional Council.

Objectives

- Describe and map land types at 1:250 000 for the Masterton, Carterton and Southern Wairarapa districts according to the protocol of previous work.
- Delineate the spatial distribution of the land types at 1:250 000 on NZMS 262 and 1:50 000 on NZMS 260 base maps.

Methods

- The following data sources were used to select key defining criteria for the land types: scientific papers, geological maps (at various scales), topographic maps, Protected Natural Area surveys and the Register of Protected Natural Areas, and Earth Science Society inventories.
- The process involved the following steps:
    - Subdivision of the landscape into 'natural segments' or land types on the basis of topography and geology
    - Description of the landform components within land types
    - Search of the literature to determine the specific geology, vegetation, rainfall, altitude etc. of landform components
    - Description of the land-use potential and impacts of use within landform components from the authors' experience and local knowledge

Results

- Twelve land types have been established for the Masterton, Carterton and Southern Wairarapa districts. The land types distinguish major physiographic landform units and are broadly equivalent to a 'land region' as defined for hierarchical land resource mapping in New Zealand. The land types depict largely lithologically based macro relief units.

- The key features of the landform components within land types are summarised in table format under the following headings:
    - Geological formation
    - Elevation (m)
    - Remnant native vegetation
    - Present land use
    - Agronomic potential
    - Potential land use
    - Potential impacts (of land use on the landscape and environment)

Conclusions

- The 12 land types established at a scale of 1:250 000 for the Masterton, Carterton and Southern Wairarapa districts provide a geomorphologically based assessment and grouping of the district's landscape.
- Although the land types have been designed primarily to assist in landscape assessment they also provide an objective, physically based subdivision of the Masterton, Carterton and Southern Wairarapa districts' landscape suitable for resource monitoring, strategy planning, and land resource assessment and evaluation.

1. Introduction

Landcare Research, Lincoln, delineated and documented ‘land types’ of the Masterton, Carterton and Southern Wairarapa districts for Boffa Miskell in August–September 2009 as part of the Wairarapa Landscape Study for the Greater Wellington Regional Council.

2. Background

A hierarchical land systems approach was used for the Masterton, Carterton and Southern Wairarapa districts study following a similar methodology to that used in the studies of the Canterbury regional landscape (Boffa Miskell and Lucas Associates 1993), Queenstown Lakes District (Lucas et al. 1995), Marlborough Sounds (Lucas et al. 1997; McRae et al. 2004), Bay of Plenty Region (Lucas et al. 1998), and the Marlborough District (Lynn 2009).

‘Land type’ is the preferred term for geomorphologically based land units distinguished at a scale of 1:250 000, to overcome variation in the use of terminology between the landscape architects, planners and land-resource-based science professions.

The land types used in this study distinguish major physiographic landform units and are broadly equivalent to a ‘land region’ as defined for hierarchical land resource mapping in New Zealand by Lynn and Basher (1994). The land types depict largely lithologically based macro relief units and are frequently bounded by structural dislocations or contrasting rock terranes.

2.1 Regional setting of the current study area

The Wairarapa forms part of an eastern central New Zealand terrane and landscape characterised by intensive faulting, tilting and uplift of a similar suite of basement rocks extending from Marlborough to East Cape (Fig. 1). The pronounced north-east/south-west trend of axial ranges, inland valleys and coastal hills results from the ‘concertina like’ convergence, collision and subduction of the Pacific and Indian-Australian plates.

In this region the parent rocks are heterogeneous. The higher axial ranges consist of older indurated greywacke and argillite rocks. The plains have been built up from aggregation gravels deposited as fans, river terraces and floodplains through erosion of these ranges during the late Quaternary. Most of the coastal hill country, however, consists of a complex mixture of softer rocks of Tertiary and late Cretaceous age – marine sandstones and siltstones, and bands of harder, upstanding limestone. Scattered throughout are more erodible Tertiary rocks – mudstones, greensand and conglomerates. These geological factors in combination with the prevailing climate of pronounced summer dryness, desiccating NW winds and occasional heavy rainstorms have predisposed the hill country to widespread erosion. Consequently it is a landscape of shattered hills associated with deep-seated weaknesses in the material underlying the soils, the rapid rate of uplift, and the impact of severe storms.

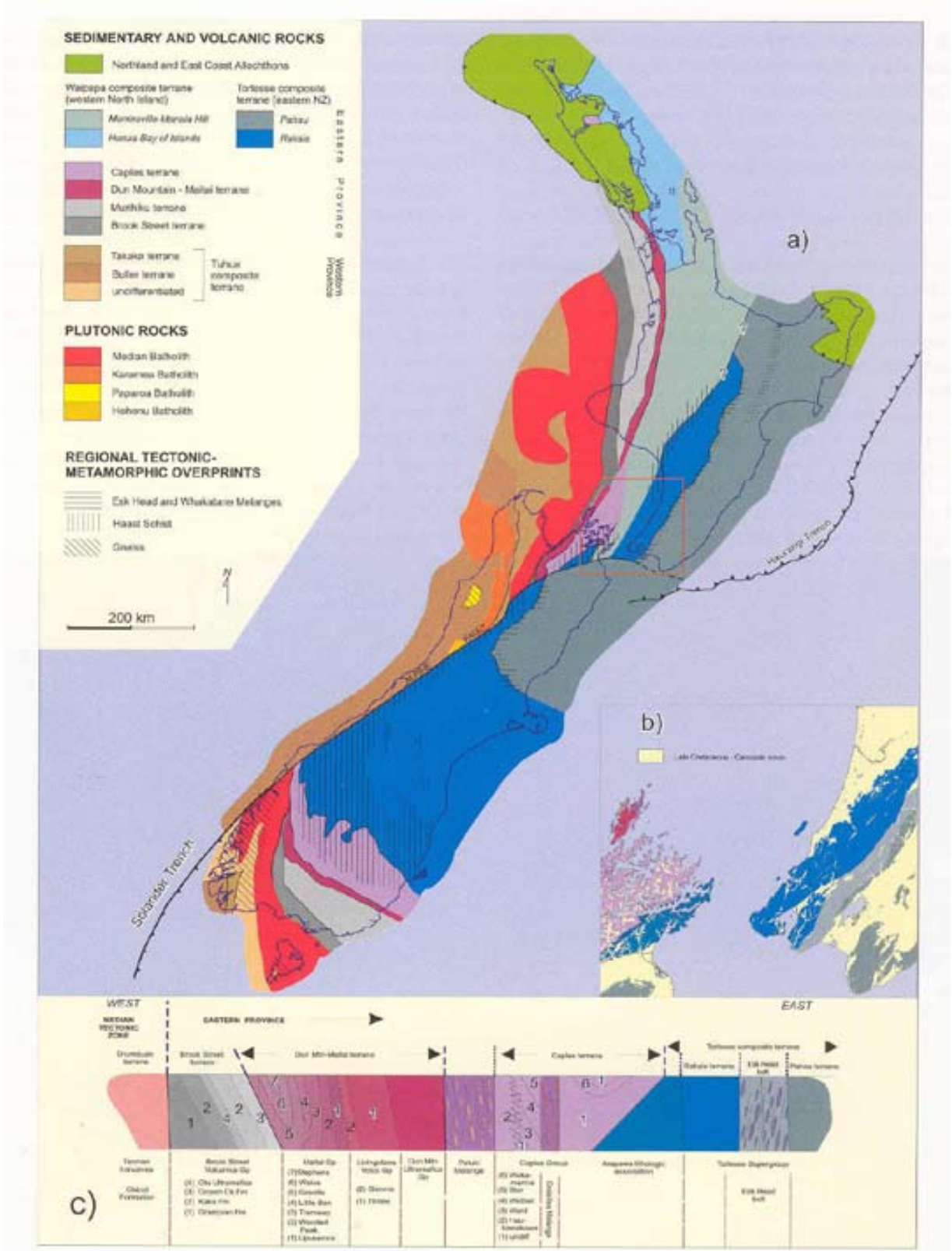

Figure 8a) Basement (pre-Late Cretaceous) geological map of New Zealand. Units are grouped according to major, rather than sole, rock type. Nomenclature and boundaries of North Island Torlesse and Waipapa terranes are controversial; parts of Morrinsville-Manaia Hill and Pahau units may be correlative. Northland and East Coast Allochthons were emplaced in the Early Miocene; all other units were in mutual juxtaposition by the Late Cretaceous. Adapted from Black (1994), Mortimer (1995), Mortimer *et al.* (1997, 1999) and references therein.
b) Basement rocks subdivided into tectonostratigraphic terranes for the Wellington area.
c) Cartoon cross section through basement rocks of Marlborough/Wellington area illustrating structural style and relationships.

Fig. 1 Illustration of the extent of similar basement rocks, deformation style and resulting gross landscape extending from Marlborough to East Cape (from Begg & Johnston 2000).

In the context of this report 'hard' and 'soft' rock are defined as:

'hard rock': includes indurated and moderately indurated rock – rocks that have acquired an element of hardness and strength through induration relating to depth of burial or through grain overgrowths and/or cementation to the extent that grain disintegration (grain fracturing) dominates over disaggregation (separation along existing grain boundaries). They have been deformed by brittle fracture and shearing, ring when struck with a hammer and require a strong blow to fracture.

'soft rock': includes weakly indurated rocks which are consolidated, with minor or insignificant cementation, and are of low strength. They disintegrate with a mild to strong hammer blow, or are crushable by hand. They deform by plastic flow and produce regoliths dominated by fine-grained materials with high clay contents that lack cohesion and strength. They are frequently dispersive and have poor drainage characteristics. They are susceptible to mass movement forms of erosion.

3. Objectives

- Describe and map land types at 1:250 000 for the Masterton, Carterton and Southern Wairarapa districts according to the protocol of previous work.
- Delineate the spatial distribution of the land types at 1:250 000 on NZMS 262 and 1:50 000 on NZMS 260 base maps.
- Summarise the key features of the landform components within land types in a table format under the following headings:
    - Geological formation
    - Elevation (m)
    - Remnant native vegetation
    - Present land use
    - Agronomic potential
    - Potential land use
    - Potential impacts (of land use on the landscape and environment).

4. Methods

The following data sources were used to select key defining criteria for the land types: scientific papers (see Bibliography), geological maps (at various scales, e.g. Johnston 1980; Lee & Begg 2002; Begg & Johnston 2000), and topographic maps. The process involved the following steps:

- Subdivision of the landscape into 'natural segments' or land types on the basis of topography and geology

- Description of the landform components within each land type
- Search of the literature to determine the specific geology, vegetation, rainfall, altitude etc. of each landform component
- Description of the land-use potential and impacts from the authors' experience and local knowledge

The Protected Natural Area (PNA) programme (McEwen 1987; Beadel et al. 2004), the Register of Protected Natural Areas, and the inventory and maps of important geological sites and landforms (Kenny & Hayward 1996) were used as additional data sources.

In the summary tables 'agronomic potential', 'potential land use' and 'potential impacts' are based on an assessment of the factual information recorded in columns 1 to 5, and an evaluation of current trends. Agronomic potential is qualitatively ranked as high, medium, low or nil. Potential land use identifies current land uses that are considered to become dominant or that will become more widespread on that landform component in the foreseeable future. Potential impacts identify the major consequences on the landscape and environmental qualities of those projected land uses.

Due to the time constraints imposed on the study, information on the remnant native vegetation is indicative, and is intended to flag areas or communities that are potentially at risk. The remnant vegetation entries should be checked and modified by an ecologist. Detailed descriptions and locations of sites of rare and endangered communities or species are available from Landcare Research and PNA Programme reports (e.g. Beadel et al. 2004).

5. Results

Twelve land types have been established for the Masterton, Carterton and Southern Wairarapa districts and delineated at 1:250 000 on NZMS 262 and 1:50 000 on NZMS 260 topographic base maps. The constraints of map scale and time mean that the land type boundaries are indicative. For land types that occur in narrow valleys, individual land types are frequently nested within each other. Accurate delineation, more appropriate for individual site or 'local-level' assessment and planning, would require detailed precision mapping at scales greater than 1:50 000.

The following land types were established:
1. Southern Central Plains
2. Northern Central Plains
3. Southern Coastal Plains Fringe
4. South Western Greywacke Mountain Range
5. North Western Greywacke Mountain Range
6. Eastern Greywacke [Aorangi] Mountains
7. Cretaceous Hard Rock Hill and Steeplands
8. Basal Cover Beds Hill and Steeplands
9. Soft Rock Mudstone and Sandstone Hill and Steeplands
10. Tertiary Limestone Dominated Hill and Steeplands
11. Eastern Coastal Fringe and Uplifted Marine Terrace
12. Hard Rock Coastal Fringe

To convey the general characteristics and appearance, and to compare and contrast respective land types, some illustrations have been included. They have been sourced from either Begg & Johnston (2000), Lee & Begg (2002) or supplied by Boffa Miskell. Some of the illustrations are located adjacent to the current study region from areas into which the respective land types extend.

Detailed land type descriptions and tables of the respective land types follow.

1 Southern Central Plains Land Type

The Southern Central Plains Land Type incorporates the broad, flat to gently undulating (0–3°) and undulating (4–7°), predominantly fine-grained depositional floodplain landforms; floodplain terraces and associated backswamp basins, levees, channels, channel bars and cut-offs / oxbow lakes of the lower Ruamahanga River; extensive shallow lakebed deposits, lakeshore beaches and beach ridges; lakeshore and marginal swamp deposits; inland sand dune belts and associated swamps, ponds and sand flats; the marginal, rolling (8–15°) to strongly rolling (16–20°) coalescing alluvial gravel fans (frequently cut by faults, e.g. Wairarapa Fault); the eastern marginal, undulating (4–7°) to rolling (8–15°) coalescing gravel alluvial fans, marginal loess-mantled foothills and isolated soft- and hard-rock-cored downlands of the southern Wairarapa Valley. Elevation ranges from 2 to 200 m [GR:955760], and rainfall from 800 to 1200 mm per annum. The land type includes the lowland sections of the Ruamahanga, Tauherenikau, Waiohine and Waingawa rivers.

Landform component	Geological formation	Elevation (m)	Remnant native vegetation	Present land use	Agronomic potential	Potential land use	Potential impacts
Low terraces	Holocene and Recent alluvium	0–20	Short-tussock grassland, matagouri, kōwhai, kōnuka scrub/woodland	Intensive grazing, cash and feed cropping, viticulture, orchards	High	Cash and feed cropping, horticulture, viticulture, orchards, intensive grazing	Intensified land use, subdivision, windbreaks, irrigation, ‘lifestyle’ blocks
Floodbasins and backswamps	Holocene and Recent alluvium and organic deposits	0–20	Flax, raupō, sedge and rushland swamp vegetation, scrubland	Intensive grazing, cash and feed cropping	High	Cash and feed cropping, horticulture, intensive grazing	Intensified land use, windbreaks, drainage, irrigation, subdivision
Recently abandoned floodplains	Holocene and Recent fluvial deposits	0–20	Flax, raupō, sedge and rushland swamp vegetation, scrubland	Intensive grazing, feed cropping	High	Cash and feed cropping, horticulture, intensive grazing	Intensified land use, windbreaks, irrigation, drainage, subdivision
Channels and cut-off features, lakes and oxbows	Holocene and Recent fluvial deposits	0–20	Kahikatea forest, mānuka, flax, raupō, sedge and rushland	Intensive grazing, cash and feed cropping	High	Cash and feed cropping, horticulture, intensive grazing	Intensified land use, drainage, windbreaks, subdivision
Lakeshore margin flats	Holocene and Recent mud, silt and sands	0–10	Flax, raupō, sedge and rushland swamp vegetation, scrubland	Intensive grazing, cash and feed cropping	High	Cash and feed cropping, horticulture, intensive grazing	Intensified land use, windbreaks, drainage, subdivision
Lakeshore beaches and beach ridges	Holocene and Recent beach gravels and sands	0–10	Pīngao, scrub, bracken	Extensive grazing, wasteland	Low	Semi-intensive grazing, recreation, stabilisation	Loss of native vegetation, increase in exotics, recreational impacts
Inland sand dune complexes, (swamps and	Holocene and Recent dune sand and organic	0–40	Pīngao, spinifex, dune slack, danthonia grassland	Extensive grazing, exotic forestry, conservation,	Low	Exotic forestry, extensive grazing, dune stabilisation, recreation	Exotic trees, recreational impacts, loss of native vegetation

Landform component	Geological formation	Elevation (m)	Remnant native vegetation	Present land use	Agronomic potential	Potential land use	Potential impacts
sand flats)	deposits			recreation, stabilised wasteland			
Coalescing gravel alluvial fans	Holocene and Recent alluvium, poorly sorted fan gravel deposits	0–40	Short-tussock grassland, matagouri, kōwhai, kōnuka scrub/woodland	Intensive grazing, cash and feed cropping, viticulture, orchards, exotic forestry	High	Cash and feed cropping, horticulture, viticulture, orchards, intensive grazing	Intensified land use, windbreaks, irrigation, forestry, subdivision, ‘lifestyle’ blocks
Older dissected alluvial terrace remnants	Loess-mantled Quaternary gravel deposits	10–100	Short-tussock grassland, matagouri, kōwhai, kōnuka scrub/woodland	Intensive grazing, cash and feed cropping	High	Cash and feed cropping, horticulture, intensive grazing	Intensified land use, windbreaks, irrigation, forestry, subdivision, ‘lifestyle’ blocks
Loess-mantled marginal foothills and isolated soft-rock-cored downlands	Undifferentiated loess-mantled Early Quaternary deposits	10–200	Silver-tussock grassland matagouri and kōwhai scrub, broadleaved scrub	Intensive grazing, feed and cash cropping, exotic forestry	medium to high	Intensive grazing, cash and feed cropping, exotic forestry	Intensive land use, windbreaks, cultivation, exotic forestry, subdivision
Loess-mantled isolated hard-rock-cored hills and downlands	Torlesse Supergroup sandstones and mudstones with some loess cover	70–200	Silver-tussock grassland matagouri and kōwhai scrub, broadleaved scrub	Intensive grazing, feed and cash cropping, exotic forestry	medium to high	Intensive grazing, cash and feed cropping, exotic forestry	Intensive land use, windbreaks, cultivation, exotic forestry, subdivision

Fig. 2 View westwards from Whangaimoana across Lake Onoke to the Rimutaka Ranges, the dissected higher terraces of the Southern Central Plains (centre) and gravel beach ridges and soft rock cliffs of the Southern Coastal Plains Fringe Land Types (foreground). (Source: Boffa Miskell)

2 Northern Central Plains Land Type

The Northern Central Plains Land Type incorporates the extensive undulating (4–7°) to rolling (8–15°) stony and free-draining coalescing alluvial gravel fans, the heads of which are frequently offset by active faults in the west (e.g. Wairarapa and Mokonui faults), and associated terrace treads and risers, channels, channel bars and imperfectly drained inter-fan swales; flat to gently undulating (0–3°) predominantly depositional gravel floodplain landforms of low terraces, channels, channel bars and associated levees of the upper Ruamahanga and Waipoua rivers; the rolling (8–15°) to strongly rolling (16–20°) often loess-mantled soft- and hard-rock-cored downlands and marginal foothills of the northern Wairarapa Valley. Elevation ranges from 0 to 358 m [GR:S26/265353] and rainfall from 800 to 1400 mm per annum.

Landform component	Geological formation	Elevation (m)	Remnant native vegetation	Present land use	Agronomic potential	Potential land use	Potential impacts
Well-drained coalescing stony fans and terraces	Late Pleistocene and Holocene alluvium, variable loess cover	40–300	Short-tussock grassland, matagouri, kānuka scrub/woodland	Intensive grazing, cash and feed cropping, orchards, exotic forestry	High	Cash and feed cropping, horticulture, orchards, intensive grazing	Intensified land use, windbreaks, irrigation, forestry, subdivision, ‘lifestyle’ blocks
Terrace treads (and risers)	Holocene and Recent alluvium	40–250	Danthonia grassland, kānuka, matagouri, scrub, cabbage trees, bracken	Intensive grazing, cash and feed cropping, orchards	High	Cash and feed cropping, horticulture, orchards, intensive grazing	Intensified land use, windbreaks, irrigation, subdivision
Inter-fan swales	Holocene and Recent alluvium	40–250	Danthonia grassland, kānuka, matagouri, kahikatea forest cabbage trees	Intensive grazing, feed cropping	High	Cash and feed cropping, intensive grazing	Intensified land use, windbreaks, irrigation, drainage, subdivision
Recent floodplains	Holocene and Recent fluvial deposits	40–200	Danthonia grassland, kānuka, matagouri, kahikatea forest cabbage trees	Intensive grazing, feed cropping	High	Cash and feed cropping, horticulture, intensive grazing	Intensified land use, windbreaks, irrigation, subdivision
Active braided floodplain	Holocene and Recent fluvial deposits	40–200	Ephemeral communities	Opportunist grazing, scrub wasteland	Low	Opportunist grazing	Largely ‘natural’ environment, exotic ‘river control’ trees, and scrub
Channels and cut-off features	Holocene and Recent fluvial deposits	40–200	Kahikatea forest, mānuka, flax, raupō, sedge and rushland	Intensive grazing, cash and feed cropping	High	Cash and feed cropping, horticulture, intensive grazing	Intensified land use, drainage, windbreaks, subdivision
Marginal hard rock foothills and isolated soft rock	Torlesse Supergroup rocks and undiff. loess-mantled Early	150–358	Silver-tussock grassland matagouri and kānuka scrub,	Intensive grazing, feed and cash cropping, exotic	Medium to high	Intensive grazing, cash and feed cropping, exotic forestry	Intensive land use, windbreaks, subdivision, cultivation,

Landform component	Geological formation	Elevation (m)	Remnant native vegetation	Present land use	Agronomic potential	Potential land use	Potential impacts
cored downlands	Quaternary deposits		broadleaved scrub	forestry			exotic forestry

Figure 7a The township of Masterton (middle distance) is sited largely upon Holocene and last glacial alluvial gravels. The braided Waingawa River (left) carries a bedload of cobbles of indurated sandstone and mudstone from the Tararua Range in the distance. The Masterton basin is traversed by a number of active faults, including the Wairarapa Fault at the base of the mountains in the distance, and the Masterton Fault, a splay that strikes northeastwards through Masterton township itself. The Masterton Fault crosses the Waingawa River close to the railway bridge, the further bridge visible in the middle distance. The lowlands of the Masterton basin are used principally for agriculture and horticulture.

Photo CN43682/4: D.L. Homer

Fig. 3 The well-drained coalescing stony fan component of the Northern Central Plains Land Type built by the Waingawa River, Masterton (from Lee & Begg 2002).

3 Southern Coastal Plains Fringe Land Type

The Southern Coastal Fringe Land Type incorporates the undulating (4–7°) to rolling (8–15°) marginal marine bench and beach ridge complexes, rolling (8–15°) coalescing foot-lope fans and debris aprons below the coastal escarpments, the active undulating (4–7°) to rolling (8–15°) gravel barrier bar that entraps Lake Onoke and the surrounding brackish lake and lagoon–estuary fringe wetlands, the basal gravel storm beach ridges and the steep (26–35°) to very steep (>35°) eroding sea cliffs formed in unconsolidated gravels and weakly consolidated mudstones, and minor indurated hard rock terrain bordering Palliser Bay. Elevation ranges from sea level to 100 m, the rainfall is in the vicinity of 1200 mm per annum and the land type is extremely exposed the southerly winds.

Landform component	Geological formation	Elevation (m)	Remnant native vegetation	Present land use	Agronomic potential	Potential land use	Potential impacts
Gravel barrier bar	Holocene and Recent beach gravel	0–20	Pīngao, scrub, bracken	Opportunistic grazing, wasteland	Low	Opportunistic grazing, recreation, stabilisation	Loss of native vegetation, increase in exotics, recreational impacts
Brackish lake and estuary fringe	Holocene and Recent fluviatile and lagoonal deposits	0–3	Swamp, carr, lacustrine, slacks, saltmarsh (estuarine, lacustrine)	Extensive grazing, feed cropping	Medium	Intensive grazing, cash and feed cropping	Intensified land use, drainage, windbreaks, subdivision
Basal cliff gravel beach ridges	Holocene and Recent beach gravel	0–20	Pīngao, dune slack, danthonia grassland	Opportunistic grazing, conservation, recreation, wasteland	Low	Conservation, extensive grazing, stabilisation, recreation	Exotic weeds and trees, recreational impacts, tracking, loss of native vegetation
Steep to very steep coastal escarpment	Holocene and Pleistocene gravel and weakly consolidated Tertiary mudstone	0–100	Mānuka scrub, danthonia grassland	Opportunistic grazing, conservation, recreation, stabilised wasteland	Low	Conservation	Exotic weed and tree invasion, tracking, recreational impacts, loss of native vegetation
Coalescing footslope fans and debris aprons	Alluvium & colluvium from Pleistocene gravel and weakly consolidated Tertiary mudstone	5–40	Scrub (mānuka?), danthonia grassland	Extensive and semi-intensive grazing	Medium	Intensive grazing, feed cropping	Subdivision, shelter belts, fencing, settlement development, recreational impacts
Marginal marine bench and beach ridge complexes	Holocene and Recent beach gravel and sands	0–40	Scrub, bracken fern, danthonia grassland	Extensive and semi-intensive grazing	Medium	Intensive grazing, feed cropping	Subdivision, shelter belts, fencing, settlement development, recreational impacts
Soft-rock sea cliffs	Holocene and	0–100	Specialist cliff	Conservation	Nil	Conservation	Exotic weed and tree

	Pleistocene gravel and weakly consolidated Tertiary mudstone		species				invasion, loss of native vegetation
Hard-rock sea cliffs & associated gravel beaches and reefs (minor component)	Torlesse Supergroup sandstones and mudstones	0–100	Specialist cliff species	Conservation	Nil	Conservation	Exotic weed invasion, loss of native vegetation

Fig. 4 Southern Coastal Plains Fringe Land Type, a view eastwards from above Whatarangi to Te Humenga Point (Source: Boffa Miskell).

4 South Western Greywacke Mountain Range Land Type (Rimutaka Ranges)

The South Western Greywacke Range Land Type encompasses the south-eastern slopes of the Rimutaka Ranges and includes those catchments draining into Lake Wairarapa south of Rimutaka Saddle. The faulted and heavily dissected uplifted landscape is predominantly underlain by deformed Esk Head Belt rocks, sandstone and/or mudstone dominated sequences with blocks of chert, basalt, and limestone of the Torlesse Supergroup, and associated minor valley-fill alluvium and colluvium. Landform components include steep (26–35°) to very steep (>35°), hill and mountain slopes to 941 m [Mt Matthews]; and minor narrow and sinuous, undulating terraces and floodplains [e.g. Owhanga Stream and Cross Creek]. Severe erosion, large-scale slumps and gravel-choked riverbeds are a feature. The climate is relatively moist, rainfall varies between 1200 and 2000+ mm per annum, increasing with elevation. Summer drought is uncommon or negligible above 150 m. Extensive stands of silver beech occur, with some hard beech, black beech and red beech being present; the lowland hardwood forests of the Rimutaka Range are a complex mosaic of hardwood species with isolated podocarps (Hall's totara and rimu); rātā–kāmahi and scrub at lower elevations.

Landform component	Geological formation	Elevation (m)	Remnant native vegetation	Present land use	Agronomic potential	Potential land use	Potential impacts
Steep to very steep upper mountain slopes	Torlesse Supergroup sandstones and mudstones	300–941	Silver, hard and red beech, rātā–kāmahi forest	Conservation land, protected native forest, recreation	Low–nil	Conservation land, recreation	Recreation, tracking, buildings, pylons etc.
Moderately steep to steep lower hill and mountain slopes	Torlesse Supergroup sandstones and mudstones	0–300	Silver hard and black beech, rātā–kāmahi forest	Conservation land, exotic forestry, reverted scrubland, extensive grazing, recreation	Low	Exotic forestry, conservation land, extensive grazing, recreation	Exotic forest, tracking, increase in exotic weeds, recreation
Narrow undulating terraces and footslope fans	Pleistocene and Recent alluvium from predominantly Torlesse Supergroup sandstones and mudstones rocks	5–120	Podocarp–broadleaved forest, rimu, matai, kahikatea	Intensive grazing, conservation land	Medium	Intensive grazing, feed cropping, exotic forestry, conservation land	Intensified land use, shelter belts, subdivision
Narrow sinuous floodplains	Recent alluvium from predominantly Torlesse Supergroup sandstones and mudstones rocks	5–20	Podocarp–broadleaved forest, kahikatea, rimu, matai	Semi-intensive grazing, conservation land	Medium	Intensive grazing, feed cropping	Intensified land use, shelter belts, subdivision

5 North Western Greywacke Mountain Range Land Type (Tararua Ranges)

The North Western Greywacke Range Land Type encompasses the south-eastern slopes of the Tararua Ranges and includes the major western tributaries of the Ruamahanga River system (the Waiohine, Waingawa, and Waipoua rivers). The intensively faulted and strongly dissected uplifted mountain landscape is predominantly underlain by deformed Torlesse Supergroup terrane rocks of well-indurated grey sandstone–mudstone dominated sequences with minor conglomerate, basalt, chert, and rare limestone, and associated minor valley-fill alluvium and colluvium. Landform components include steep (26–35°) to very steep (>35°), mountain and hill slopes to 1529 m [Mt Hector]; and minor narrow and sinuous, undulating terraces and floodplains [e.g. Kiriwhakapapa and Atiwhakatu streams]. Severe erosion, large-scale slumps and gravel-choked riverbeds are a feature. The climate is relatively moist, rainfall varies between 1600 and 8000^{+} mm per annum, increasing markedly with elevation. Summer drought is uncommon or negligible. Extensive stands of silver beech occur, with some hard beech, black beech and red beech being present; the lowland hardwood forests of the Tararua Range are a complex mosaic of hardwood species with isolated podocarps (Hall's totara and rimu); rātā–kāmahi and scrub at lower elevations.

Landform component	Geological formation	Elevation (m)	Remnant native vegetation	Present land use	Agronomic potential	Potential land use	Potential impacts
Steep to very steep upper mountain slopes and summits	Torlesse Supergroup sandstones and mudstones	500–1530	Silver beech forest, snow tussock & alpine herbfield >1250 m	Conservation land, protected native forest, recreation	Nil	Conservation land, recreation	Recreation, tracking, buildings, pylons etc.
Moderately steep to steep lower mountain and hill slopes	Torlesse Supergroup sandstones and mudstones	150–500	Red beech–kāmahi forest, rātā–kāmahi forest	Conservation land, reverted scrubland, exotic forestry, recreation	Low	Conservation land, exotic forestry, recreation	Exotic forest, tracking, increase in exotic weeds, recreational impacts
Lower marginal hill slopes	Torlesse Supergroup sandstones and mudstones	150–500	Red beech–kāmahi forest, rātā–kāmahi forest	Exotic forestry, conservation land, reverted scrubland, extensive grazing, recreation	Low	Exotic forestry, conservation land, extensive grazing, recreation	Exotic forest, tracking, increase in exotic weeds, recreation
Narrow undulating terraces and footslope fans	Pleistocene and Recent alluvium from predominantly Torlesse Supergroup sandstone and mudstone rocks	100–250	Podocarp–broadleaved forest, rimu, matai, kahikatea	Intensive grazing, reverted scrubland, conservation land	Medium	Intensive grazing, feed cropping, exotic forestry, conservation land	Intensified land use, subdivision, shelter belts
Narrow sinuous floodplains	Recent alluvium from predominantly Torlesse Supergroup sandstone and mudstone rocks	100–250	Podocarp–broadleaved forest, kahikatea, rimu, matai	Semi-intensive grazing, conservation land	Medium	Intensive grazing, feed cropping	Intensified land use, subdivision, shelter belts

6 Eastern Greywacke [Aorangi] Mountains Land Type

The Eastern Greywacke Mountains Land Type encompasses the Aorangi Range and the associated marginal hills underlain by indurated Pahau terrane rocks of the Torlesse Supergroup and associated minor valley-fill alluvium and colluvium. The Pahau terrane consists of grey sandstones and sandstone–mudstone sequences with minor conglomerate, basalt and sparse limestone, and is less well indurated than the older greywackes to the west although they are commonly intensely fractured and deformed. Landform components include dissected steep (26–35°) to very steep (>35°) hill and mountain slopes up to 981 m [Mt Ross]; minor narrow and sinuous and frequently fault and crush zone controlled undulating terraces and floodplains [e.g. Otakaha, Pararaki and Mangatoetoe streams], and minor sea cliffs and associated coastal landforms in the south. Large-scale slumping is also a feature along the southern coast. The climate is characterised by exposure to strong desiccating north-westerly and cold salt-laden south-westerly winds. Rainfall varies between 1200 and 2400^{+} mm per annum increasing with elevation. In the southern area low altitude forest is dominated by mīhoe, hīnau and rewarewa with scattered rimu, matai and miro emergents, with areas of silver beech at higher elevations, and flax–mānuka–*Cassinia* scrub and grassland occurring on seaward faces. In the more northern region black, silver and red beech with occasional podocarps on the slopes and silver beech on the higher ridge tops is characteristic.

Landform component	Geological formation	Elevation (m)	Remnant native vegetation	Present land use	Agronomic potential	Potential land use	Potential impacts
Steep to very steep upper mountain slopes	Torlesse Supergroup sandstones and mudstones	500–981	Silver beech, subalpine scrub	Conservation land, protected native forest, extensive grazing, recreation	Low	Extensive grazing conservation land, recreation	Recreation, tracking, buildings, pylons etc.
Moderately steep to steep lower hill and mountain slopes	Torlesse Supergroup sandstones and mudstones	10–500	Silver, hard and black beech, scattered podocarps	Conservation land, exotic forestry, reverted scrubland, extensive grazing, recreation	Low	Exotic forestry, extensive grazing, conservation land, recreation	Exotic forest, tracking, increase in exotic weeds, recreation
Lower marginal hill slopes	Torlesse Supergroup sandstones and mudstones	150–500	Mīhoe, hīnau and rewarewa with scattered rimu, matai and miro	Extensive grazing, reverted scrubland, exotic forestry, conservation land, recreation	Medium	Exotic forestry, extensive grazing, conservation land, recreation	Exotic forest, fencing, tracking, increase in exotic weeds, recreation
Narrow undulating terraces and footslope fans	Pleistocene alluvium from predominantly Torlesse Supergroup sandstone and mudstone rocks	5–120	Podocarp–broadleaved forest, rimu, matai, kahikatea	Semi-intensive grazing, conservation land, exotic forestry	Medium	Intensive grazing, feed cropping, exotic forestry, conservation land	Intensified land use, subdivision, shelter belts
Narrow sinuous floodplains	Recent alluvium from predominantly Torlesse Supergroup sandstone and mudstone rocks	5–120	Podocarp–broadleaved forest, kahikatea, rimu, matai	Semi-intensive grazing, conservation land, flood/depositional hazard	Medium	Semi-intensive grazing, feed cropping	Intensified land use, subdivision, shelter belts

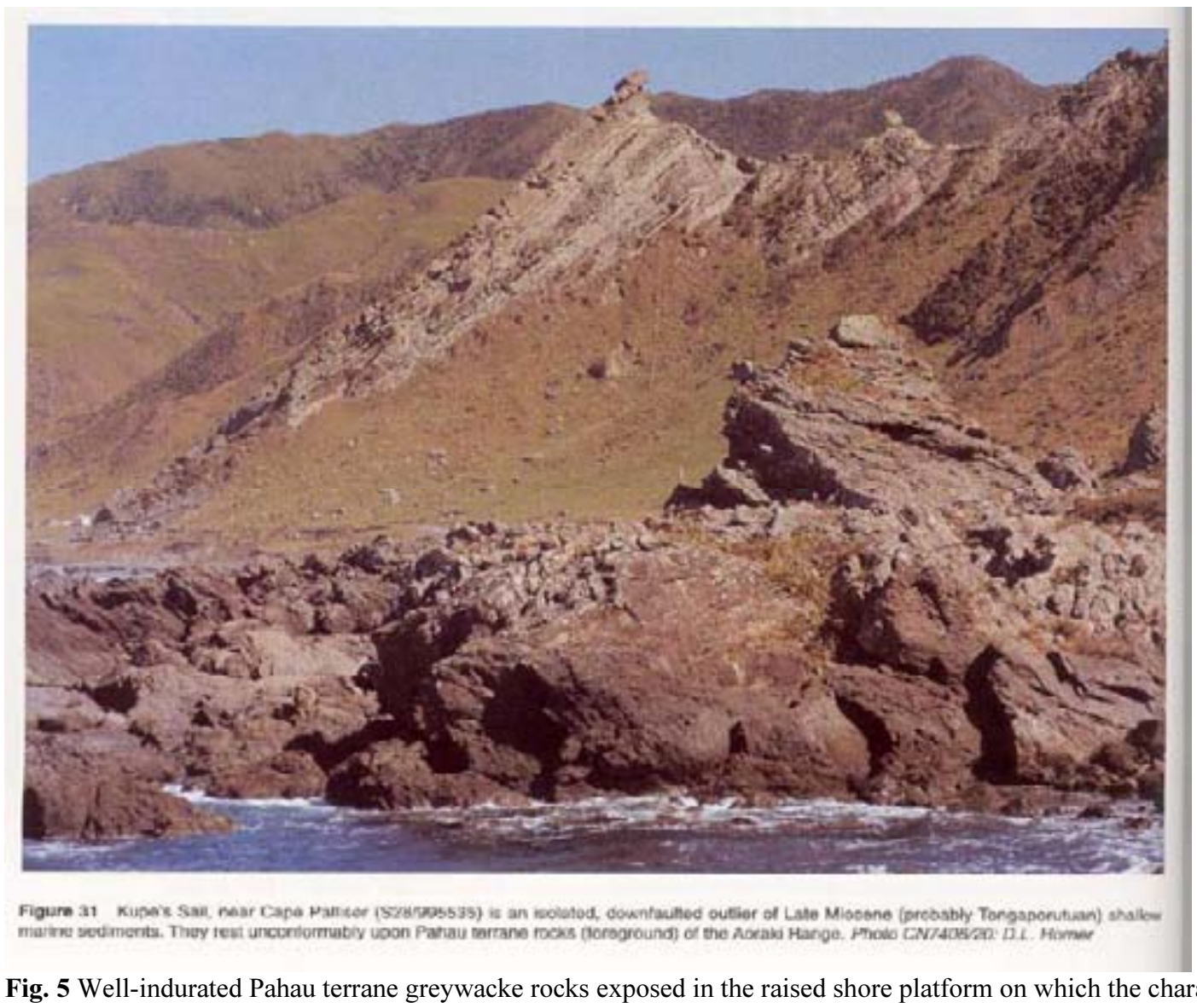

Figure 31 Kupe's Sail, near Cape Palliser (S28/995535) is an isolated, downfaulted outlier of Late Miocene (probably Tongaporutuan) shallow marine sediments. They rest unconformably upon Pahau terrane rocks (foreground) of the Aorakl Range. Photo CN7405/20: D.J. Homer

Fig. 5 Well-indurated Pahau terrane greywacke rocks exposed in the raised shore platform on which the characteristic Eastern Greywacke Mountain Land Type hill-slope landscape develops, middle and background (from Begg &Johnston 2000).

7 Cretaceous Hard Rock Hill and Steeplands Land Type

The Cretaceous Hard Rock Hill and Steeplands Land Type is underlain by indurated, predominantly well-bedded alternating, sandstone and mudstone, with minor conglomerate and spilitic volcanics. This uppermost Torlesse terrane is less well indurated than the older greywackes to the west, and the Aorangi Range greywackes to the south, although they are similarly extensively fractured and deformed with extensive crush zones. Landform components include dissected steep (26–35°) to very steep (>35°) hill slopes, jagged sharp hill-slope summits; rolling (8–15°) to strongly rolling (16–20°) coalescing colluvial/alluvial footslope fans; and narrow and sinuous, undulating terraces and floodplains. Massive more erosion resistant sandstone blocks (taipos) occur within the various formations and form prominent strike ridges. Extensive shallow surficial soil slip erosion under pasture, intense gullying and large-scale slumps within crush zones, and gravel-choked riverbeds are a feature. Elevation varies from sea level to 628 m and rainfall from 1000 to 1600 mm per annum. Vegetation cover varies from extensive induced pasture, reverted scrubland and remnant beech–lowland podocarp–hardwood forest. Example areas include the hill country of the central Opouawe catchment, the coastal block north of Manurewe Point, and the lower Pahaoa River to Hikorangi.

Landform component	Geological formation	Elevation (m)	Remnant native vegetation	Present land use	Agronomic potential	Potential land use	Potential impacts
Steep to very steep hard rock erosional hill slopes	Cretaceous mudstones and sandstone, with minor conglomerate and limestone	0–630	Rimu, r̄ātā, tawa , hard and black beech forest, m̄anuka and broadleaved scrub	Semi-intensive grazing, exotic forestry, reverted scrubland	Medium	Intensive grazing, exotic forestry, conservation land	Fencing, tracking, exotic forest, decrease in scrub
Steep jagged summits, ridges and spur crests	Cretaceous sandstones and mudstone, with minor conglomerate and limestone	200–630	Hard and black beech, m̄anuka and broadleaved scrub	Semi-intensive grazing, exotic forestry, reverted scrubland	Medium	Intensive grazing, exotic forestry, conservation land	Fencing, tracking, exotic forest, decrease in scrub, man-made structures
Steep to very steep coastal escarpments	Cretaceous mudstones and sandstone, with minor conglomerate and limestone	0–200	Hard and black beech, m̄anuka and broadleaved scrub flax–m̄anuka–*Cassinia* scrub	Extensive grazing, exotic forest, conservation land	Low	Extensive grazing, exotic forest, conservation land	Tracking, fencing, increase in exotic vegetation
Terraces	Quaternary and Holocene alluvium	40–250	Podocarp forest	Intensive grazing, feed cropping	High	Intensive grazing, feed cropping	Intensified land used, cultivation, shelter trees, subdivision
Meander floodplains	Recent alluvium and swamp deposits	40–250	Wetlands, sedges and grasses	Intensive grazing and feed cropping	High	Intensive grazing, feed cropping	Subdivision, cultivation, drainage, shelter trees
Fans	Quaternary and Holocene fan deposits	40–250	Podocarp forest	Intensive grazing, feed cropping	High	Intensive grazing, feed cropping	Subdivision, cultivation, shelter trees

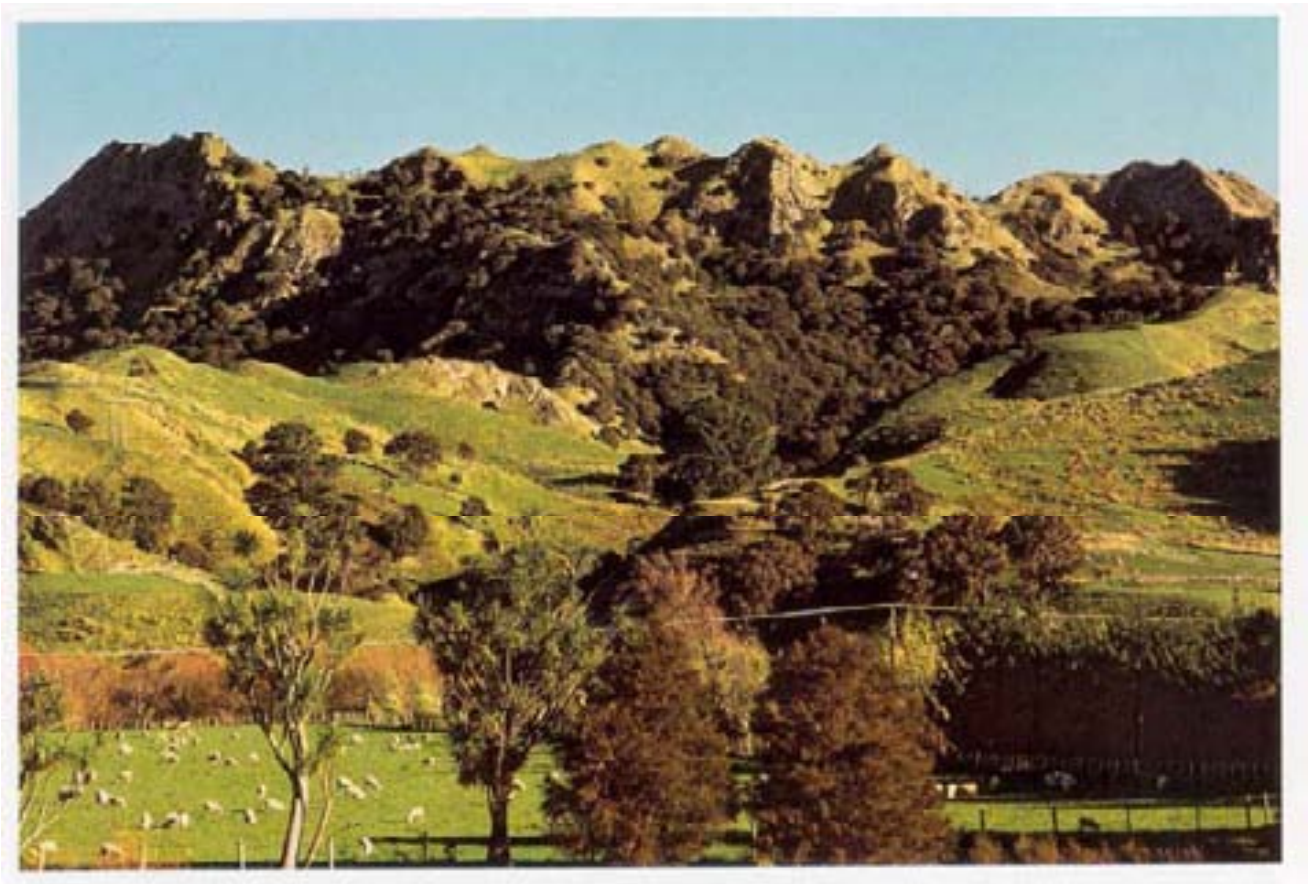

Figure 12 Massive bodies of erosion-resistant Taipo Formation sandstone are present within the more easily weathered Mangapokia Formation, resulting in steep-sided landforms known locally as "taipos". The Mangapakeha Taipos (T26/635275) cover an area 6 km by 4 km, elongate in a northerly direction, parallel to the regional strike of the enclosing rocks.

Photo CN11697/14: D.L. Horner

Fig. 6 Variation in erosion resistance of the underlying rocks is reflected in landform style and steepness within the Cretaceous Hard Rock Hill and Steepland Land Type (from Lee & Begg 2002).

8 Basal Cover Beds Hill and Steeplands Land Type

The Basal Cover Beds Hill and Steeplands Land Type is underlain by *moderately indurated* Early Cretaceous to Oligocene rocks overlying the greywacke basement. They consist of well-bedded fine- to coarse-grained sandstone, mudstone and conglomerate; and graded bedded to massive in parts carbonaceous, sandstone, siltstone, calcareous mudstone and greensand, with minor limestone. Although folded and faulted the degree of deformation is significantly less than in the older rocks. Landform components include dissected steep (26–35°) to moderately steep (21–25°) hill slopes with narrow rounded summits; rolling (8–15°) to strongly rolling (16–20°) coalescing colluvial/alluvial footslope fans; and narrow and sinuous, undulating terraces and floodplains. Shallow surficial soil slip erosion is extensive especially under pasture. Elevation varies from sea level to 663 m [Mt Adams] and rainfall from 1000 to 1600 mm per annum. Vegetation cover varies from extensive induced pasture, reverted scrubland and remnant beech – lowland podocarp– hardwood forest. Example areas include the hill country centred on Maungapurupuru.

Landform component	Geological formation	Elevation (m)	Remnant native vegetation	Present land use	Agronomic potential	Potential land use	Potential impacts
Steep hard rock [moderately indurated] erosional hill slopes	Cretaceous to Oligocene mudstones and sandstone, with minor conglomerate and limestone	0–600	Rimu, rātā, tawa, hard and black beech forest, mānuka and broadleaved scrub	Semi-intensive grazing, exotic forestry, reverted scrubland	Medium	Intensive grazing, exotic forestry, conservation land	Fencing, tracking, exotic forest, decrease in scrub
Broad rounded summits, ridges and spur crests	Cretaceous to Oligocene mudstones and sandstone, with minor conglomerate and limestone	200–600	Hard and black beech, mānuka and broadleaved scrub	Semi-intensive grazing, exotic forestry, reverted scrubland	Medium	Intensive grazing, exotic forestry, conservation land	Fencing, tracking, exotic forest, decrease in scrub, man-made structures
Steep to very steep coastal escarpments	Cretaceous to Oligocene mudstones and sandstone, with minor conglomerate and limestone	0–200	Hard and black beech, mānuka and broadleaved scrub flax–manuka–*Cassinia* scrub	Extensive grazing, exotic forest, conservation land	Low	Extensive grazing, exotic forest, conservation land	Tracking, fencing, increase in exotic vegetation
Terraces	Quaternary and Holocene alluvium	40–250	Podocarp forest	Intensive grazing, feed cropping	High	Intensive grazing, feed cropping	Subdivision, cultivation, shelter trees
Meander floodplains	Recent alluvium and swamp deposits	40–250	Wetlands, sedges and grasses	Intensive grazing and feed cropping	High	Intensive grazing, feed cropping	Drainage, cultivation, subdivision, shelter trees
Fans	Quaternary and Holocene fan deposits	40–250	Podocarp forest	Intensive grazing, feed cropping	High	Intensive grazing, feed cropping	Cultivation, subdivision, shelter trees

9 Soft Rock Mudstone and Sandstone Hill and Steepland Land Type

The Soft Rock Mudstone and Sandstone Hill and Steepland Land Type consists of hill and valley landscapes underlain by predominantly Tertiary sedimentary strata. The landscape is developed on undifferentiated massive to well-bedded, often calcareous, blue-grey mudstone with discontinuous limestone lenses, and alternating bedded sandstone and mudstone sequences with minor conglomerate. Landform components include steep (26–35°), smooth rounded hills developed on the more weakly indurated lithologies, and minor structurally controlled hill slopes [strike ridges with distinctive dip and scarp slopes], and associated narrow and sinuous terraces and floodplains, and minor ‘hard rock’ hill slopes. Extensive mass movement erosion – large-scale slumps and both deep and shallow-seated earthflows, as well as shallow soil slips, are common. Elevation ranges from 0 to 598 m [Kupukore] and rainfall from 1200 to 1400 mm per annum. Vegetation cover varies from extensive induced pasture, reverted scrubland and remnant beech – lowland podocarp – hardwood forest. Example areas include the hill country around Alfredton, Wainuioru, and Hikawera.

Landform component	Geological formation	Elevation (m)	Remnant native vegetation	Present land use	Agronomic potential	Potential land use	Potential impacts
Soft rock erosional hill slopes	Tertiary mudstones and sandstone, with minor conglomerate and limestone	0–600	Podocarp forest, mānuka and broadleaved scrub	Semi-intensive grazing, exotic forestry, reverted scrubland	Medium	Intensive grazing, exotic forestry, conservation land	Fencing, tracking, exotic forest, decrease in scrub
Spur crests and summits	Tertiary sandstones, mudstones and conglomerate	200–600	Podocarp forest, mānuka and broadleaved scrub	Semi-intensive grazing, exotic forestry, reverted scrubland	Medium	Intensive grazing, exotic forestry, conservation land	Fencing, tracking, exotic forest, decrease in scrub, skyline structures
Soft rock structural landforms, e.g. cuestas	Tertiary limestones and calcareous sandstones	40–600	Podocarp forest, kāwhai, broadleaved scrub	Semi-intensive grazing, exotic forestry, reverted scrubland	Medium	Semi-intensive grazing, exotic forestry, conservation land	Fencing, tracking, exotic forest, decrease in scrub
Hard rock erosional hill slopes (minor)	Torlesse Supergroup sandstones and mudstones	40–295	Podocarp forest, kāwhai, broadleaved scrub	Semi-intensive grazing, exotic forestry, reverted scrubland	Medium	Semi-intensive grazing, exotic forestry, conservation land	Fencing, tracking, exotic forest, decrease in scrub
Terraces	Quaternary and Holocene alluvium	40–250	Podocarp forest	Intensive grazing, feed cropping	High	Intensive grazing, feed and cash cropping	Subdivision, cultivation, shelter trees,
Meander floodplains	Recent alluvium and swamp deposits	40–250	Wetlands, sedges and grasses	Intensive grazing and feed cropping	High	Intensive grazing, feed cropping	Drainage, cultivation, subdivision, shelter trees

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Fans	Quaternary and Holocene fan deposits	40–250	Podocarp forest	Intensive grazing, feed cropping	High	Intensive grazing, feed cropping	Cultivation, subdivision, shelter trees

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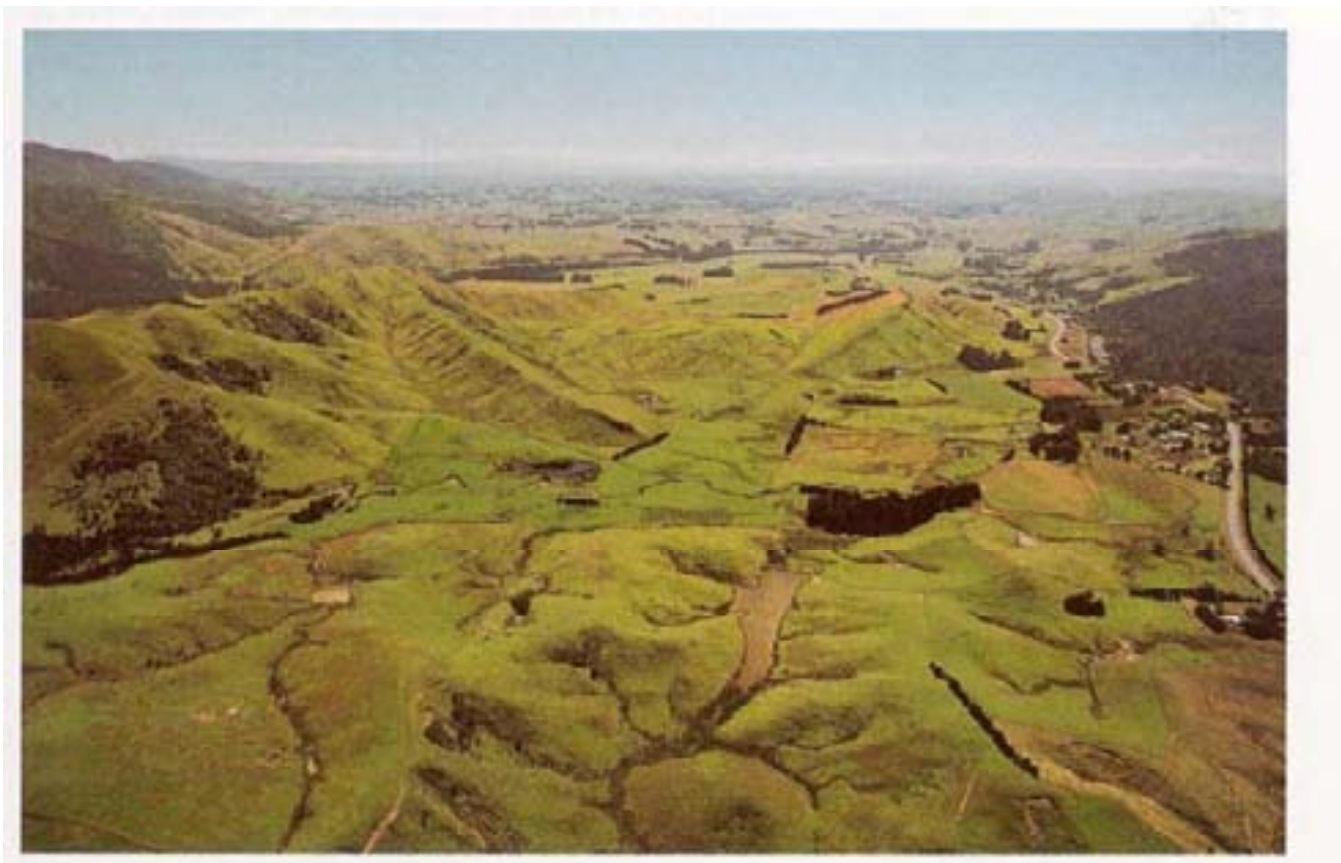

Figure 21 At Mount Bruce (T25/315500) Esk Head belt basement rocks on the west (left) and Waioeka terrane basement on the east (right) bound the Kaiparoro Syncline, comprising Late Miocene (Soren Subgroup) and Pliocene (Onoke Group) marine rocks. Rocks underlying the hills to the left of the prominent strike ridge are Late Miocene mudstones of the Soren Subgroup. The prominent strike ridge-forming horizon is the Kaiparoro Limestone of late Late Miocene (Kapitean) age, and the low hills in the core of the syncline are mudstones of Pliocene age.

Photo CN43665/11: D.L. Homer

Fig. 7 Variable soft rock lithologies and their characteristic landscapes in the Mt Bruce area (from Lee & Begg 2002).

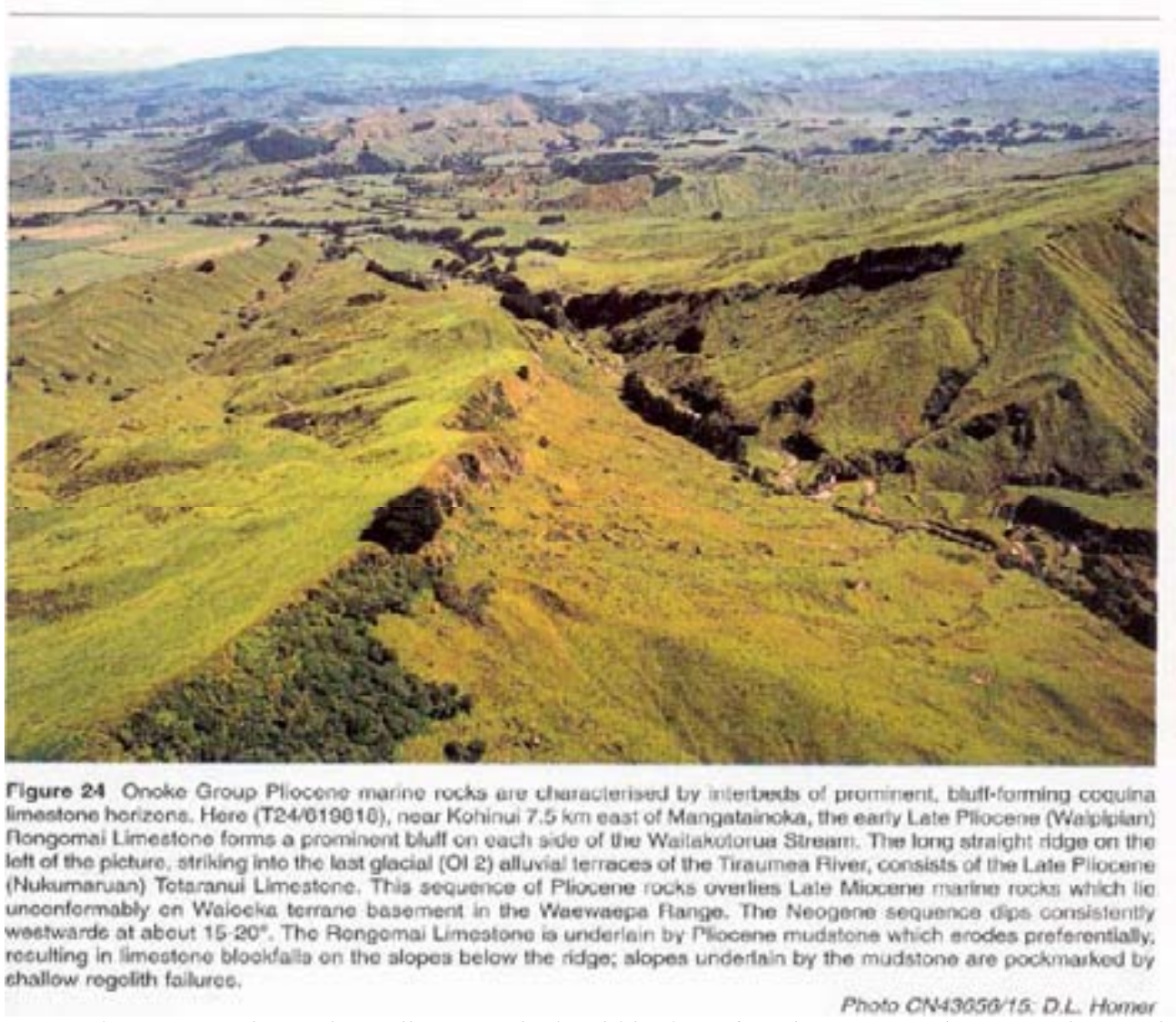

Figure 24 Onoke Group Pliocene marine rocks are characterised by interbeds of prominent, bluff-forming coquina limestone horizons. Here (T24/619616), near Kohinui 7.5 km east of Mangatainoka, the early Late Pliocene (Waiplpian) Rongomai Limestone forms a prominent bluff on each side of the Waitakotorua Stream. The long straight ridge on the left of the picture, striking into the last glacial (OI 2) alluvial terraces of the Tiraumea River, consists of the Late Pliocene (Nukumaruan) Totaranui Limestone. This sequence of Pliocene rocks overlies Late Miocene marine rocks which lie unconformably on Waiocka terrane basement in the Waewaepa Range. The Neogene sequence dips consistently westwards at about 15-20°. The Rongomai Limestone is underlain by Pliocene mudstone which erodes preferentially, resulting in limestone blockfalls on the slopes below the ridge; slopes underlain by the mudstone are pockmarked by shallow regolith failures.

Photo CN43656/15: D.L. Homer

Fig. 8 The more erosion resistant limestone beds within the soft rock sequence play a prominent role in determining ridgeline orientation (from Lee & Begg 2002).

10 Tertiary Limestone Dominated Hill and Steeplands Land Type

The Tertiary Limestone Dominated Hill and Steeplands Land Type consists of moderately steep (21–25°), to steep (26–35°), dissected hill country and steeplands with strong lithological control, underlain by mid- to late Tertiary coarse-grained coquina, commonly rubbly or pebbly and cross-bedded limestone [e.g. Totaranui Limestone] and associated undifferentiated massive to poorly bedded concretionary calcareous blue-grey mudstone with alternating sandstone and mudstones. Landform components include steep, structurally controlled, hill slopes [strike ridges and distinctive dip and scarp slopes], smooth rounded hills developed on the more weakly indurated strata; and associated narrow and sinuous terraces and floodplains. Mass movement erosion slumps and earthflows as well as shallow soil slips are common on the associated mudstone components. Elevation ranges from 100 to 604 m [Rangitumau], and rainfall from 1000 to 1400 mm per annum. Vegetation cover varies from extensive induced pasture, reverted scrubland and remnant beech – lowland podocarp – hardwood forest. Example areas include the Rangitumau hill country north of Masterton, the hill country east of Gladstone, and on the true right of the Huangaru and Ruakokoputuna rivers.

Landform component	Geological formation	Elevation (m)	Remnant native vegetation	Present land use	Agronomic potential	Potential land use	Potential impacts
Limestone-cored structurally controlled hill slopes – strike ridges and distinctive dip and scarp slopes	Tertiary limestones and calcareous sandstones	100–604	Hard and black beech, podocarp forest	Semi-extensive grazing, exotic forest, conservation	Medium	Semi-extensive grazing, exotic forestry, conservation	Increase in exotic pasture, fencing, tracking, exotic forest, recreation impacts
Soft rock erosional slopes	Tertiary sandstones, and mudstones	100–500	Hard and black beech, podocarp forest	Semi-extensive grazing, exotic forestry, reverted scrubland	Medium	Semi-extensive grazing, exotic forestry	Increase in exotic pasture, fencing, tracking, exotic forest, decrease in scrub cover
Minor valley terraces and drainage swales	Colluvium and alluvium from predominantly Tertiary sandstones, mudstones and limestones	100–250	Hard and black beech, podocarp forest	Semi-extensive grazing, feed cropping, exotic forestry	Medium	Semi-extensive grazing, feed cropping, exotic forestry	Increase in exotic pasture, fencing, tracking, exotic forest, decrease in scrub cover
Floodplains	Recent alluvium	100–200	Totara-rich podocarp forest, swampland vegetation	Semi-extensive grazing, feed cropping, exotic forestry	Medium	Semi-extensive grazing, feed and cash cropping	Increase in exotic pasture, fencing, tracking, drainage, exotic forest, decrease in scrub cover

Figure 8 The Puketoi Range is a spectacular topographic feature in the Wairarapa map area, with a high point (Summit, 803 m) that exceeds the elevation of the North Island axial ranges in this area (782 m, west of Mangamaire). The range is an elongate strike ridge of Late Pliocene coquina limestones (the lower, Rongomai Limestone of Waipipian age, the upper, Te Onepu Limestone of Mangapanian age). The green slope in the foreground is essentially a dip slope underlain by Te Onepu Limestone. Strong prevailing winds from the northwest account for the elongate form of the shrubs in the foreground.

Photo CN4366/24: D.L. Homer

Fig. 9 Prominent strike ridge with distinctive dip and scarp slopes underlain by erosion-resistant limestone formations (from Lee & Begg 2002).

11 Eastern Coastal Fringe and Uplifted Marine Terrace Land Type

The Eastern Coastal Fringe and Uplifted Marine Terrace Land Type encompasses the coastal margin from Ngapotiki to Te Kaukau Point, northwards to the Owahanga River and beyond. The land type is underlain by predominantly Tertiary or late Cretaceous centimetre to metre bedded, or massive to poorly bedded sandstone and mudstones, sometimes calcareous, with limited limestone. Landform components include flat to gently undulating (0–3°) dissected uplifted marine terraces; steep (26–35°) to very steep (>35°) coastal escarpments and cliffs formed in both soft and hard rock lithologies often with extensive earthflow and soil slip erosion; rolling (8–15°) to strongly rolling (16–20°) coalescing alluvial footslope fans; rolling (8–15°) to strongly rolling (16–20°) coastal sand dune complexes and inter-dune sand flats; narrow and sinuous undulating terraces and floodplains; lagoons and tidal creeks, and narrow sandy and gravel ocean beaches. Elevation ranges from sea level to 100 m, and rainfall varies from 1200 to 1600+ mm per annum. Remnant vegetation consists of totara-rich podocarp forest, pīngao and spinifex and specialised cliff and shore communities.

Landform component	Geological formation	Elevation (m)	Remnant native vegetation	Present land use	Agronomic potential	Potential land use	Potential impacts
Uplifted marine terraces (frequently dissected)	Late Pleistocene marginal marine sand and gravel	5–60 (80)	Totara-rich podocarp forest	Intensive grazing, exotic forestry	High	Intensive grazing, feed and cash cropping, exotic forestry	Shelterbelts, fencing, subdivision, settlement development
Steep to very steep coastal escarpments	Tertiary and late Cretaceous aged sandstone and mudstone with minor limestone	0–60 (80)	Podocarp forest, kīwhai, broadleaved scrub	Extensive grazing, exotic forestry, conservation land	Low	Exotic forestry, extensive grazing, conservation land	Invasion of exotic species, tracking
Coalescing alluvial footslope fans	Alluvium & colluvium from sandstone, mudstone and gravels	5–50	Totara-rich podocarp forest	Intensive grazing, exotic forestry	High	Intensive grazing, feed and cash cropping, exotic forestry	Shelterbelts, fencing, subdivision, settlement development
Coastal sand dune complexes – active fore dunes – semi-stable intermediate dunes – stable dunes – interdune sandflats	Holocene and Recent dune sand	0–20	Pīngao, spinifex, dune slack, danthonia grassland	Extensive grazing, conservation, recreation, stabilised wasteland	Low	Conservation, extensive grazing, recreation, stabilised wasteland	Exotic species invasion, tracking, loss of native vegetation, dwellings and structures
Lagoons and tidal creeks	Holocene and Recent mud, silts and sand	0–5	Wetland vegetation	Opportunistic grazing,	Low	Conservation	Exotic weed invasion, drainage

				conservation			
Narrow sinuous floodplains	Holocene and Recent alluvium	0–20	Totara-rich podocarp forest	Intensive grazing, feed cropping	High	Feed and cash cropping, intensive grazing	Intensified land use, subdivision, windbreaks, drainage
Coastal cliffs and reefs	Tertiary and late Cretaceous aged sandstone and mudstone with minor limestone	0–100	Specialist plant communities	Conservation, recreation	Nil	Conservation, recreation	Exotic weed invasion
Sandy and gravel beaches	Holocene and Recent beach sand & gravel	0–20	Specialist plant communities	Conservation, recreation	Nil	Conservation, recreation	Exotic weed invasion

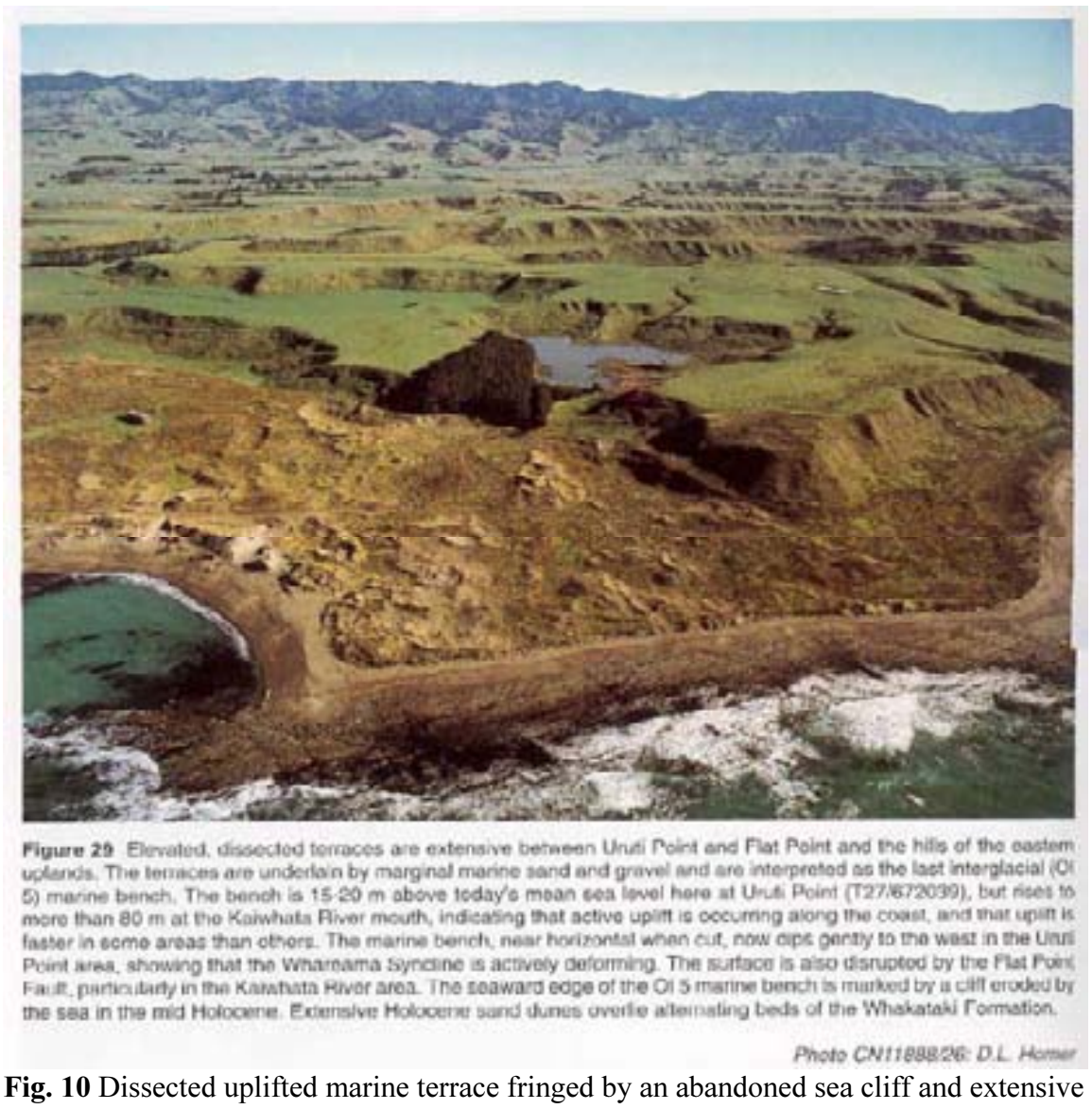

Figure 29 Elevated, dissected terraces are extensive between Uruti Point and Flat Point and the hills of the eastern uplands. The terraces are underlain by marginal marine sand and gravel and are interpreted as the last interglacial (Oi 5) marine bench. The bench is 15-20 m above today's mean sea level here at Uruti Point (T27/672039), but rises to more than 80 m at the Kaiwhata River mouth, indicating that active uplift is occurring along the coast, and that uplift is faster in some areas than others. The marine bench, near horizontal when cut, now dips gently to the west in the Uruti Point area, showing that the Whareama syncline is actively deforming. The surface is also disrupted by the Flat Point Fault, particularly in the Kaiwhata River area. The seaward edge of the Oi 5 marine bench is marked by a cliff eroded by the sea in the mid Holocene. Extensive Holocene sand dunes overlie alternating beds of the Whakataki Formation.

Photo CN11888:26: D.L. Homer

Fig. 10 Dissected uplifted marine terrace fringed by an abandoned sea cliff and extensive sand dune belt characteristic of the Eastern Coastal Fringe Land Type (from Lee & Begg 2002).

Figure 31 A wide, flat Holocene marginal marine bench in the Flat Point area is largely the result of continuing uplift. Sea level has remained static through the late Holocene (the last 6500 years). Streams carry cobbles derived from Glenburn Formation, and Tinui and Mangatu group lithologies across the bench to the sea, where they are distributed along the shoreline by longshore drift.

Photo CN43676/15. D.L. Homer

Fig. 11 Landforms characteristic of the Eastern Coastal Fringe Land Type low-angle coalescing alluvial fans building over a marine bench fringed by a stabilised sand dune belt at Flat Point (from Lee & Begg 2002).

12 Hard Rock Coastal Fringe Land Type

The Hard Rock Coastal Fringe Land Type encompasses the coastal margin from Turakirae Head to Corner Creek along the western Palliser Bay shoreline, and from Parakiti River to Ngapoiki along the south-eastern coast. It is underlain largely by well-indurated Torlesse Supergroup rocks consisting of grey sandstones and sandstone–mudstone sequences with minor conglomerate, basalt and sparse limestone, and is intensely faulted, fractured and deformed. Landform components include steep (26–35°) to very steep (>35°) coastal escarpments and cliffs, narrow active ocean gravel beaches, uplifted shore platforms with abandoned beach ridges, extensive offshore reefs, and minor rolling (8–15°) to strongly rolling (16–20°) coalescing alluvial footslope fans. Large-scale slumping and slope failure is a feature on the coastal escarpments and cliffs. Elevation ranges from sea level to 300+ m, and rainfall from 1000 to 1200+ mm per annum. The climate is characterised by exposure to strong cold salt-laden south-westerly winds. Remnant vegetation consists of coastal scrub and forest, pīngao and spinifex and specialised cliff and shore communities.

Landform component	Geological formation	Elevation (m)	Remnant native vegetation	Present land use	Agronomic potential	Potential land use	Potential impacts
Steep to very steep coastal escarpments	Torlesse Supergroup sandstones and mudstones	0–200	Coastal scrub, flax–mānuka–*Cassinia* scrub and grassland	Conservation land, opportunist grazing	Very low	Opportunistic grazing, conservation land	Tracking, recreational impacts, increase in exotic weeds, loss of native species
Steep to very steep sea cliffs and rock bluffs (some basal gravel beach ridges and associated reefs)	Torlesse Supergroup sandstones and mudstones	0–200	Specialist plant communities coastal scrub, flax–mānuka–*Cassinia* scrub and grassland	Conservation land	Nil	conservation land	Increase in exotic weeds, loss of native species
Gravel beaches	Holocene and Recent beach gravel	0–20	Pīngao, scrub, bracken, specialist plant communities	Conservation land, recreation	Nil	Conservation land, recreation	Increase in exotic weeds, loss of native species
Uplifted shore-cut platforms with beach ridges	Torlesse Supergroup sandstones and mudstones	0–60	Pīngao, scrub, bracken, specialist plant communities	Conservation land	Nil	Conservation land	Increase in exotic species
Coalescing alluvial footslope fans	Alluvium & colluvium from Torlesse Supergroup sandstones and mudstones	5–50	Coastal scrub, flax–mānuka–*Cassinia* scrub and grassland	Extensive grazing, conservation land	Low	Semi-intensive grazing, recreation	Tracking, recreational impacts settlement development

6. Conclusion

The 12 land types established at a scale of 1:250 000 for the Masterton, Carterton and Southern Wairarapa districts provide a geomorphologically based assessment and grouping of the district's landscape. Although the land types have been designed primarily to assist in landscape assessment and planning, they also provide an objective, physically based, subdivision of the Masterton, Carterton and Southern Wairarapa districts' landscape suitable for resource monitoring, strategy planning, and land resource assessment and evaluation.

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Fig. 12 Uplifted shore-cut platforms and associated beach ridges backed by an abandoned sea cliff characteristic of the Hard Rock Coastal Fringe Land Type (from Begg & Johnston 2000).

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