

Land Use Capability Classification of the Wellington Region

M. J. Page



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**Land use capability classification
of the Wellington region:
A report to accompany the second edition
New Zealand Land Resource Inventory**

M. J. Page

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Cover:

View southwest down Horokiri Valley towards the Pauatahanui Arm of Porirua Harbour, with Mana Island at top right. The terraces in the foreground are classified as land use capability (LUC) units IIs3 with IIIw1 on the lower valley floodplain. The low hills in the left foreground are classified as VIIs1, and the steeper hills on the right of the valley as VIIe1 with VIc2 on the exposed ridgetops.

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Summary

This report describes the second edition Land Use Capability (LUC) classification of the Wellington region, an area of 426 902 ha in the south of the North Island, New Zealand. This region is one of 11 in the New Zealand Land Resource Inventory (NZLRI). The NZLRI provides a physical resource inventory for land resource and land use planning. The information in this inventory is the basis for evaluating the potential of land for sustained production, using the LUC system of land classification.

Fieldwork for second edition coverage at 1:50 000 scale commenced in 1987 and was completed in 1992. The methods of mapping and assessment, interpretation and application of the NZLRI follow the "Land Use Capability Survey Handbook" (Soil Conservation and Rivers Control Council 1971) and "Our Land Resources" (National Water and Soil Conservation Organisation 1979). Field checking followed published quality-control procedures, and was carried out by G. R. Harmsworth and G. O. Eyles.

In total, 3112 inventory map units were delineated in the Wellington region. These map units were grouped into 70 LUC units on the basis of their management requirements, soil conservation needs and land use potential. The LUC units have been arranged into eight LUC suites — groupings of LUC units which, although differing in capability, share a definitive physical characteristic which unites them in the landscape.

A description of Wellington region's physical land resources is provided, as well as a key to the recognition of LUC units in LUC suites, and descriptions of each LUC unit.

Introduction

Purpose

The purpose of this report is to explain the basis of the second edition New Zealand Land Resource Inventory (NZLRI) land use capability (LUC) classification of the Wellington region, and to describe the land use capability units delineated. The report accompanies a computerised database of the second edition of the NZLRI of the Wellington region, and supplements the extended legend for the region (Page 1990) which summarises much of the resource information for each land use capability unit.

New Zealand Land Resource Inventory (NZLRI)

The NZLRI is a national database of physical land resource information. It comprises two sets of data:

1. An inventory of the five physical factors (rock, soil, slope, erosion and vegetation) which are basic to the assessment of land resources. The physical factors are represented by symbols, in a standard layout:

Rock type — Soil unit — Slope group
 Erosion degree and type — Vegetation cover

A homogenous unit area approach is used to record the physical resource data (Eyles 1977), with the five factors being mapped simultaneously to an appropriate level of detail in relation to the scale of mapping being undertaken.

2. A land use capability rating of each map unit based on an assessment of the ability of the five physical factors, together with climate and the effects of past land use, to provide sustained agricultural production.

Detailed information on general aspects and interpretation of the NZLRI is available in the "Land Use Capability Survey Handbook" (Soil Conservation and Rivers Control Council 1971) and "Our Land Resources" (National Water and Soil Conservation Organisation 1979), and has been given by Howard and Eyles (1979).

The NZLRI was initially prepared for the National Water and Soil Conservation Organ-

isation (NWASCO), later the National Water and Soil Conservation Authority (NWASCA), by the Water and Soil Division, Ministry of Works and Development, and later by DSIR Land Resources, Palmerston North and Christchurch. Present-day upgrading is carried out by Landcare Research under contract to the Foundation for Research, Science and Technology.

All NZLRI data are stored on a computer geographic information system managed by Landcare Research. This provides the versatility to produce worksheets (maps) of various scales and tables in response to requests.

An NZLRI report such as this one is not intended to be an exhaustive land resource description of a region, rather it describes the region's physical resources in terms of land use capability. General texts on the physical resources of the region include "Rugged Landscape" (Stevens 1974) and "Pautahanui Inlet – an environmental study" (Healy 1980). Readers are referred to other literature cited in the text for more detailed resource information.

NZLRI information was first published as a series of first edition Land Resource Inventory worksheets at a scale of 1:63 360 (1 inch to 1 mile) (NWASCO 1975–79) together with supporting documents. Many first edition NZLRI worksheets have been updated or remapped as second edition worksheets at 1:50 000 scale, which correspond with New Zealand Mapping Series (NZMS) 260 series topographic maps. Where the 1:50 000 base was not available the second edition worksheets were prepared at 1:63 360 scale. At 1:63 360 scale an inventory map unit can be delineated to about 100 ha in size; at the 1:50 000 scale, an inventory map unit can be delineated to about 60 ha. When mapping at the scale of 1:50 000, the smallest practicable area size determined in the NZLRI for a hooked (i.e. joined by a vinculum) inventory map unit is approximately 15 hectares.

Application of the NZLRI

The NZLRI data have been widely used by local territorial authorities such as regional councils, government corporations, government departments, private companies, consultants and other

agencies involved in planning rural land use or management of natural resources. Examples of the types of information which can be generated for district and regional planning include the location of:

- hazardous areas that are highly erodible or liable to flooding (e.g. land physically unsuited to urban development);
- highly productive land;
- non-arable land;
- land with scenic value;
- areas that can physically sustain pastoral farming;
- areas that cannot physically sustain pastoral farming or have severe limitations for pastoral use;
- areas that can physically sustain production forestry;
- vegetation cover to indicate existing land uses;
- land physically suited to urban development.

NZLRI data should be used only at the published or smaller scales. Under no circumstances should the data be used for more detailed land use planning. It should be noted that the NZLRI information is a planning tool, not a plan. It is only one input into district or regional schemes, where it can be used as a physical base on which social and economic implications of land use can be considered.

Wellington region

The Wellington region is one of 10 North Island land resource survey regions (Figure 1) each with its own land use capability classification. The region has an area of 426 902 hectares and is located in the southwest of the North Island of New Zealand (Figure 2). In the north, the regional boundary follows the course of the Manawatu River from the coast to the east side of the Manawatu Gorge. The boundary then follows the eastern foot hills of the Tararua and Rimutaka Ranges (defined by the contact between greywacke and younger rocks) south to Palliser Bay. The region includes Wellington and Horowhenua, the southern part of Manawatu and the western-most part of Wairarapa.

Second edition NZLRI data for the Wellington region

Four small-scale land use capability surveys (Table 1) were carried out on an ad hoc basis in the Wellington region in the late 1960s. First edition mapping at a scale of 1:63 360 for the NZLRI was carried out between 1974 and 1976.

Fieldwork for the second edition coverage at 1:50 000 scale commenced in 1987 and was completed in 1992. In comparison to the first edition programme, the second edition placed greater emphasis on geomorphic delineation. Changes to the rock type and vegetation classification were also incorporated into the second edition inventory.

The Wellington region is covered by all or part of 11 NZMS 260 topographic maps (Figure 2). These maps are listed in Appendix 1, together with names of authors and dates of fieldwork for the NZLRI data. Survey numbers of aerial photographs used are given in Appendix 2. Field checking follows quality-control procedures fully discussed by Harmsworth (1988), and was carried out by G. R. Harmsworth and G. O. Eyles.

In total, 3112 inventory map units were delineated in the second edition NZLRI for Wellington region; the average area for a map unit is 137 ha. In the first edition NZLRI, 43 LUC units were defined for the region, whilst 70 LUC units have been defined for the second edition classification. A correlation between the first and second edition classifications is given in Appendix 3. For each region the land use capability units have been summarised in an extended legend. Extended legends for regions adjacent to the Wellington region have been prepared by Noble (1979) and Fletcher (1981). A correlation of land use capability units in all ten North Island regions has also been completed (Appendix 4).

This report emphasises the relationships between different LUC units by grouping related units into 'suites'.

The description of each suite emphasises the similarities between LUC units, while the descriptions of the LUC units themselves emphasise the differences. The suites are described in detail on pages 26 and 27.

Physical resources of the Wellington region

This section provides a brief description of the region's physiography and climate, and a summary of the physical resources of the region, as mapped in the NZLRI, including a brief description of the method of mapping each inventory factor. More details on the physical resource factors are given in the individual LUC unit descriptions.

Physiography

The tectonic and climatic histories of the Wellington region have had major effects on landform development. Numerous faults and crush zones occur (Grant-Taylor et al. 1974). Principle faults such as the Wellington, Owhariu, Pukerua and West Wairarapa Faults have major topographic expression, defining such features as mountain ranges and valley systems. The area has been, and still is, subject to tilting and uplift with subsequent downcutting by rivers and streams.

Many of the landforms of today, and their surficial deposits had their origins in the Pleistocene when climates were either colder or warmer than today (Stevens 1974; Grant-Taylor 1959, 1965). More detailed descriptions of landforms within the region and their development are given by Heerdegen and Shepherd (1992), Eyles and McConchie (1992) and Stevens (1974).

Eight major physiographic zones can be recognised (Figure 3).

Alluvial plains and low terraces

Extensive alluvial plains are confined to the northwest of the region in the Manawatu and Horowhenua districts. The largest is the southern

part of the Manawatu Plains, between the sand country and the dissected terraceland. The topography is flat and low lying (<15 m a.s.l.), consisting of recent, fine alluvial sediments and peats. Other areas occur around Levin and Otaki and between Ohau and Manakau.

Around Levin and Otaki the terraces are older, higher (up to 80 m a.s.l.) and stonier. They correlate with the extensive Ohakea terrace surface in the Manawatu district (Cowie 1978; Palmer et al. 1988).

Coastal greywacke hills

This zone consists of greywacke hills, cliffs and raised marine terraces which are affected by harsh coastal climatic conditions. It occurs along the coastline between Paekakariki and Wellington City and from Eastbourne to Palliser Bay, and extends inland between 0.5 and 4 km depending on the coastal influence. Annual rainfall is between 1000 and 1200 mm, and winds are strong and salt-laden. Erosion is generally more severe than in other greywacke hill-country zones.

The raised marine terraces indicate former sea levels, and are evidence of uplift that has occurred since the Pleistocene. These terraces form a sequence, with the highest (820 m) being formed approximately one million years ago, and successively lower terraces between 70 000 and 300 000 years ago. They have since been mantled by loess and colluvium. These terraces occur near Baring Head (Stevens 1974) and also between Cape Terawhiti and Tongue Point (Heine 1974). At Turakirae Head there is evidence of more recent uplift. Here five raised beaches range in age from 136 years to 5600 years (Stevens 1975), with the oldest beach being about 25 m above sea level.

Table 1. Land Use Capability (LUC) surveys in the Wellington region.

Title	Scale	Author	Date
Porirua Catchment	20 chains to 1 inch	Eyles	1966
Tuapaka Farm	10 chains to 1 inch	Gilchrist	1969
Tiritea Catchment and Water Reserve	20 chains to 1 inch	Gilchrist	1970
Western Tararua Catchments	1 mile to 1 inch	Gilchrist & Climie	1970

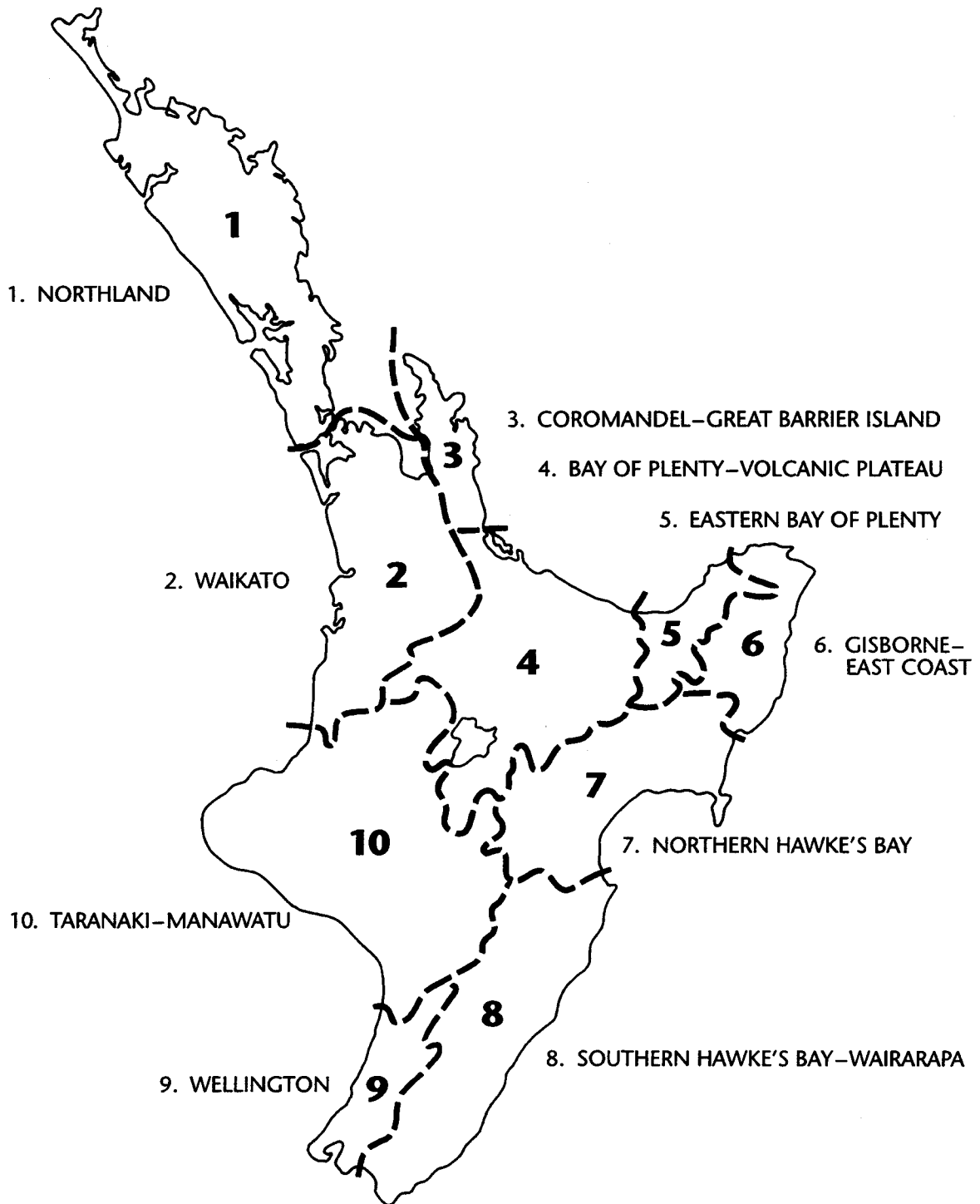


Figure 1.
North Island NZLRI Regions.

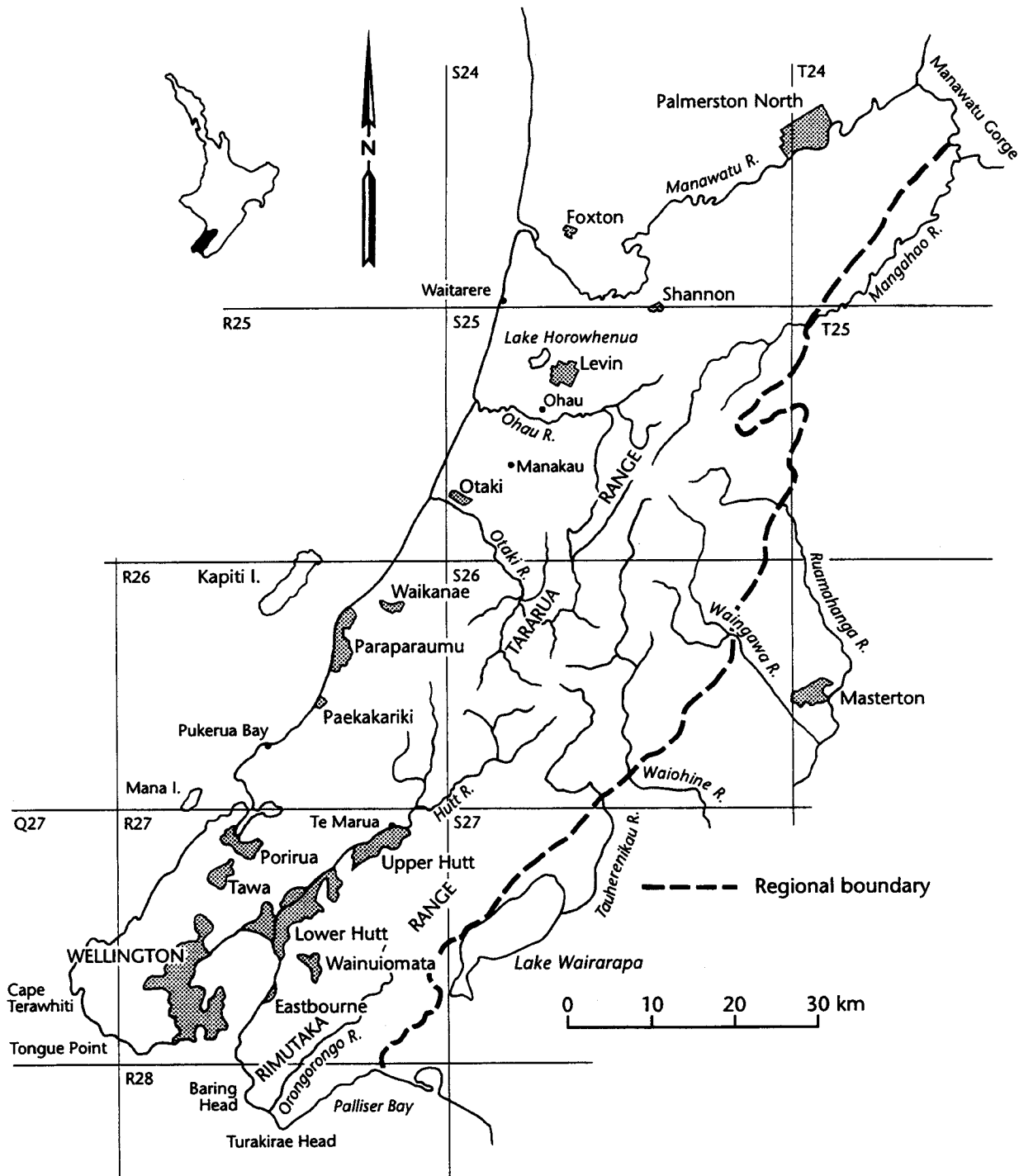


Figure 2. Location of the Wellington region, showing the main physical features and the position of NZMS 260 series topographical maps.

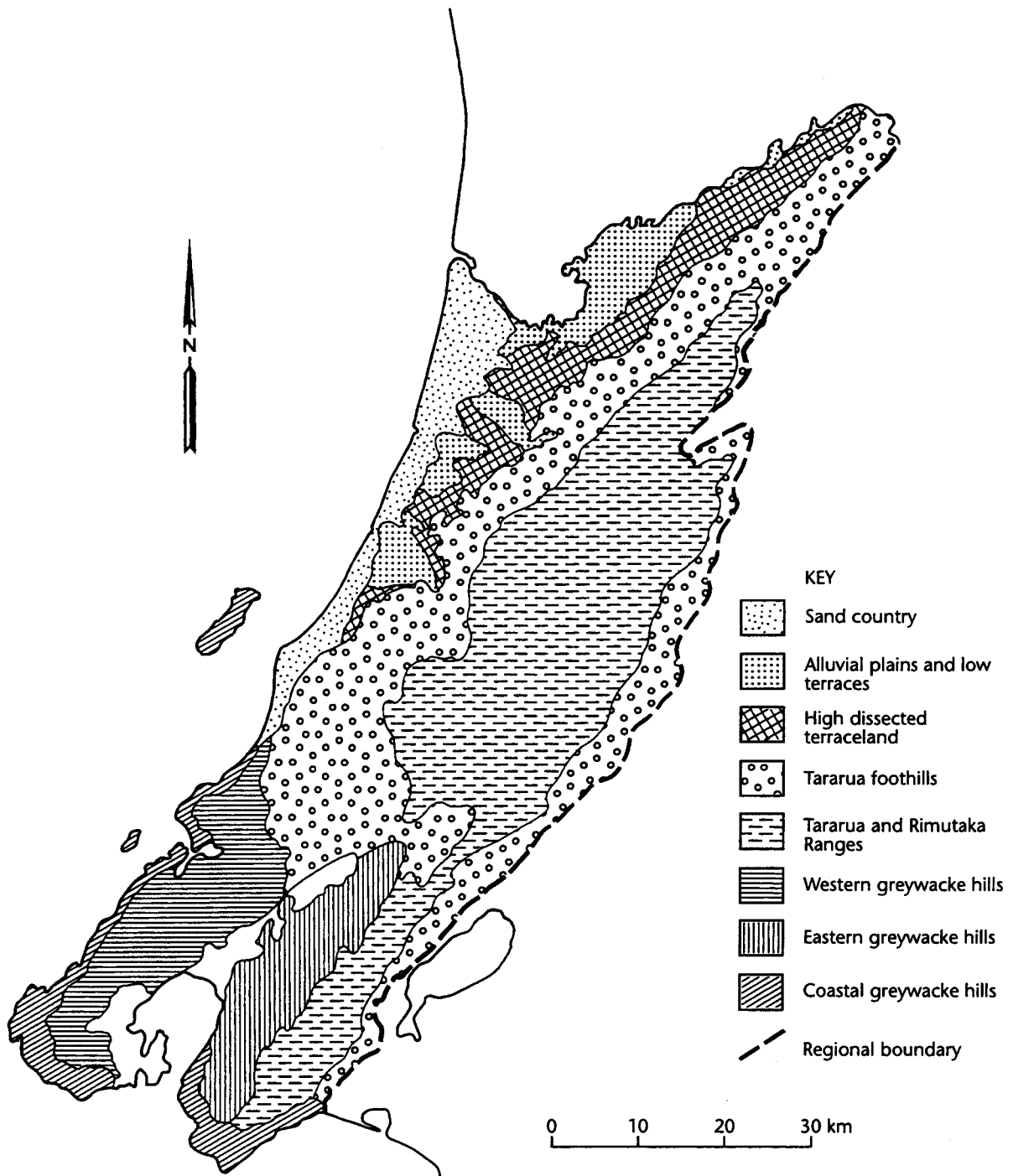


Figure 3.
Major physiographic zones in the Wellington region.

Eastern greywacke hills

These are the hills on the eastern side of the Hutt Valley, from Te Marua south and including the Mangaroa, Whitemans and Wainuiomata Valleys. These hills are moderately steep to steep and grade up into the Rimutaka Range. They are composed of greywacke which is more highly and deeply weathered than that of the western hills, while around Te Marua there are low hills composed of weathered Pleistocene gravels. Annual rainfall is also higher than on the Wellington Peninsula, being between 1400 and 2000 mm. The majority of these hills are in various stages of reversion to scrub.

High dissected terraceland

This zone extends eastward from the alluvial plains to the flanks of the Tararua Range. It is widest in the north near Palmerston North and stretches from the Manawatu Gorge as far south as Waikanae. This terraceland consists of a flat to undulating terrace surface at elevations between 20 and 150 m a.s.l., which has been dissected by rivers and streams draining from the Tararua Range. The result is a series of broad terrace surfaces bordered by terrace scarps and separated by narrow valleys which are extensions of the alluvial plains and low terrace zone. Where the terraces abut the greywacke foothills of the Tararua Range fans have developed which spread out onto the terrace surface.

This terrace surface is termed the Tokomaru Marine Terrace (Cowie 1978; Palmer et al. 1988), and is part of an uplifted coastal plain mantled by loess derived from aggrading river beds during past periods of cold climate (Cowie 1964).

Sand country

The sand country comprises a complex of sand dunes, sandplains, peaty swamps and small lakes which stretch from Paekakariki in the south to the Manawatu River mouth at the northern boundary of the region. The sand country varies in width from 0.5 to 10 km, being widest in the north.

Four distinct dune-building phases have been recognised (Cowie 1963). The most recent is the Waitarere phase nearest the coast. This is followed with increasing age inland by the Motuiti, Foxton

and Koputaroa phases. The Waitarere phase is the most unstable, and large areas of bare sand are common. Between the Manawatu and Ohau Rivers the dunes are (apart from the foredune) generally elongated and at right angles to the coastline. South of the Ohau River the orientation of the dunes changes and they are parallel to the coastline, becoming a series of sand hummocks near their southern extent.

Tararua and Rimutaka Ranges

The Tararua and Rimutaka Ranges are part of the greywacke main axial mountain ranges that extend throughout the South Island and much of the North Island. These ranges have a northeast-southwest alignment, and drainage of a number of the main rivers is fault controlled. The terrain is very steep, rugged and mountainous, with slopes generally greater than 35° and over 300 m in length. Elevations are higher than in the foothill zone, extending from approximately 600 to 1571 m a.s.l. The ranges experience harsh climatic conditions.

Tararua foothills

The Tararua Range is flanked in both the east and west by a series of strongly rolling to steep greywacke hills, which are extensive on the west side of the range. Although the boundary between this zone and the more mountainous range zone is indistinct, the foothills are generally below 600 m a.s.l. with slopes <35° and <300 m in length. These foothills have annual rainfalls of approximately 1400–2400 mm and are prone to scrub reversion.

Western greywacke hills

These are the greywacke hills of the Wellington Peninsula, which is defined as the area south of Pukerua Bay and west of the Hutt Valley and excluding the hills bordering the coastline.

The topography comprises moderately steep to steep hills which reach elevations of up to 450 m. In some areas (Quartz Hill, Belmont hills) ridgetops are broad and rolling and are remnants of the 'K surface' (Eyles and McConchie 1992). Numerous northeast-southwest-trending faults occur, the major of which are the Wellington, Owhariu and Pukerua faults. Much of the drainage

pattern is fault controlled with major valleys such as Makara and Owhariu being aligned along fault lines. Some of the larger valleys contain narrow alluvial flats. Annual rainfall is 1100–1400 mm.

Climate

There are 25 climatological stations in the Wellington region (New Zealand Meteorological Service 1983a), and these tend to be in the more densely populated lowland and coastal areas. There are few stations in the hill country or mountains, and consequently extrapolation of records in these areas is less reliable. Rainfall information is somewhat more reliable as raingauges are more numerous.

Major sources of climatic information used in the survey were: the 1:500 000 isohyet map of New Zealand (New Zealand Meteorological Service 1978), records of rainfall normals (New Zealand Meteorological Service 1984), climatological records from individual stations (New Zealand Meteorological Service 1983b), and the information given by Kerr et al. (1981).

Located on the southwest coast of the North Island, the Wellington region is exposed to the prevailing westerly weather systems which affect New Zealand and is generally windier and cloudier than other areas of the North Island. The southern coast bordering Cook Strait is particularly exposed and experiences frequent strong winds of up to gale-force intensity. Rainfall is fairly reliable and evenly distributed throughout the year, with severe droughts uncommon.

Within the region, climatic conditions vary considerably and are mildest along the west coast. With increasing altitude and distance inland conditions become more severe. Three climatic types as defined by New Zealand Meteorological Service (1983c) occur within the Wellington region. The majority of the region, comprising the plains and terracelands of Manawatu and Horowhenua, the western foothills of the Tararua Range, and the Wellington Peninsula, is type D1 with warm summers and mild winters. Annual rainfall is 900–1300 mm. In the Tararua and Rimutaka Ranges the climate is type M, with high rainfall, strong winds and colder temperatures. Along the eastern foothills of the ranges the climate type is C1, where

summers are very warm and dry and winter temperatures are moderate. Annual rainfall is 1000–1500 mm.

The annual rainfall for the region is from 900 to >6000 mm, with the majority of the region outside of the ranges receiving 1000–2000 mm. Raindays per year are as low as 100 in the northwest of the region near the Manawatu River mouth, and rising to 120–140 in the hill country, and 180 in the ranges. Although heavy falls may occur throughout the year there is generally a winter maximum and a summer minimum. The effect of these lower summer rainfalls on soil moisture reserves is accentuated by the drying effects of warm westerly winds.

Temperatures are highest near the coast and decrease with increasing altitude and distance inland. Lowland areas have a summer mean of 16–18°C and a winter mean of 7–9°C. Frosts occur throughout the region.

Rock type

Rock types were recorded for each map unit, using the NZLRI Rock Type Classification (Lynn and Crippen 1991), listed in Appendix 5. This classification is designed specifically for soil conservation purposes, and groups together rocks and lithological types with similar erosion susceptibilities. In the NZLRI the rock type factor is used to record basement rock and any cover deposit such as tephra or loess. Only those rock types that directly influence surface morphology and land use are recorded. For cover deposits a maximum of three rock types is recorded, in stratigraphic order; a rock type may therefore be present but not appear in the inventory. A maximum of two surface rock types is recorded per map unit.

A variety of geological information was used to assist in the mapping of rock types. The major source was the NZ Geological Survey 1:250 000 Geological Map of New Zealand series. The region is covered by Sheet 10 Wanganui (Lensen et al. 1959), Sheet 11 Dannevirke (Kingma 1962) and Sheet 12 Wellington (Kingma 1967). Appendix 6 lists the geological references used. However, these maps record rocks on a time-stratigraphic basis rather than a lithological basis, and do not show cover deposits. They are also at a smaller scale than the NZLRI mapping. For these reasons

these maps were of limited value, and extensive field work was normally necessary. Information on rock type, faulting and deformation in the Wellington area is given by Grant-Taylor et al. (1974). New Zealand Soil Bureau reports and bulletins provide information on the distribution of loess within the region (Cowie and Milne 1973).

The following is a brief description of the rock types in the Wellington region. Nine different rock types were recorded in the NZLRI.

Coarse slope deposits

Coarse slope deposits (Cl) are mapped on fan slopes and fossil scree associated with steep greywacke hill country and mountain slopes. The mapping of such deposits has been restricted because of the limitations of scale. However, they are a component of many greywacke slopes.

Greywacke and argillite

Greywacke (Gw) is the major rock type in the region, and forms the Tararua and Rimutaka Ranges and most of the hill country of the Wellington Peninsula. It is the oldest rock type in the region, being of Triassic and Jurassic age and forming part of the Torlesse Supergroup (Suggate 1978). The term 'greywacke' describes indurated sandstones, siltstones and mudstones which are interbedded and deformed. The greywacke consists of three groups. The oldest and most deformed group, the Wellington Greywackes, occur furthest west, between Shannon and the southern coastline of the Wellington Peninsula. Induration, deformation and age decrease eastwards through the Ruahine Greywacke group of the main Tararua Range to the Wakarua Greywacke group which occurs along the eastern foothills of the Tararua Range and in the Rimutaka Range.

Folding and faulting is common. Where intense fracturing and shearing has occurred, often associated with fault zones, the resulting rock has a considerably reduced rock mass strength.

In the Rimutaka Range east of the Orongorongo River the rock is deformed greywacke and crushed argillite (Gw+Ac), which has led to extreme erosion (Robbins 1958).

Areas mapped as greywacke may include related slope deposits, such as coarse slope colluvium, scree and solifluction debris (Stevens 1957), which are too small to map separately.

Loess

During the Pleistocene, loess (Lo) was deposited over much of the landscape. This is a very uniform material, unstratified and consisting predominantly of silt sized particles. It is a slowly accumulating windblown deposit derived largely from the sediment from broad river beds during cold periods when reduced vegetation cover led to increased erosion rates. Today loess is found on older higher terraces (Lo/Gr, Lo/Us) and downlands and hills (Lo/Cw, Lo/Gw), although much has been eroded from the steeper slopes.

Lower Pleistocene gravels

Lower Pleistocene gravels are associated with some of the major basin and valley systems south of Waikanae. These gravels have been weathered to varying degrees and are set in a silty to sandy matrix. These deposits have been mapped as weakly consolidated conglomerate (Cw), and include the Kaitoke gravels, Normandale alluvial group and Emerald, Belmont and Whitemans gravels (Stevens 1974). They were deposited during glacial and interglacial periods and have subsequently been dissected to varying degrees and now form landforms ranging from high terraces to low hills.

Peat

Peat (Pt) is associated with both alluvial deposits of the plains and valleys and with the sand country where poorly drained interdune depressions are common.

Quaternary silts and clays

The high dissected terrace system which extends from Waikanae north to the Manawatu Gorge has developed on Castlecliffian and Hawera-age sediments which formed an extensive coastal plain that has since been uplifted. These sediments consist of unconsolidated sands with conglomerate beds and minor silts or clays (Us) and include Otaki Sandstone (Oliver 1948).

Table 2. Soil surveys used in the Wellington region.

Survey no.	Survey name	Author and date	Scale
1	General Survey of Soils of North Island, New Zealand	New Zealand Soil Bureau 1954	1:253 440
2	Provisional Soil Map of Horowhenua County, New Zealand	Gibbs 1957 (unpublished)	1:63 360
3	Soils and Agriculture of Kairanga County, North Island, New Zealand	Cowie 1978	1:63 360
4	Soils of the Manawatu–Rangitikei Sand Country	Cowie et al. 1967	1:63 360
5	Interim Report on Soils of Wairarapa Valley, New Zealand	Heine 1975a (unpublished)	1:63 360
6	Interim Report on Soils of Wellington region, New Zealand	Heine 1975b (unpublished)	1:63 360
7	Soil Definitions and Interpretations for Otaki District Soil Resources Study, North Island, New Zealand	Palmer & Wilde 1990 (unpublished)	1:15 000

Recent alluvial deposits

Recent alluvial deposits are mapped as fine alluvium (Af) where deposits consist of sand, silt or clay, or as alluvial gravels (Gr). They occur on floodplains and low terraces in the Manawatu and Horowhenua districts and on narrow river terraces in the hill country. Fine alluvium is also recorded on estuarine flats and gravels are recorded on raised marine terraces.

Tertiary sandstone

A small area of Tertiary sediments occurs in the Otaihangā Valley, east of Paraparaumu. These are green sands of Oligocene age (MacPherson 1948), and have been mapped as massive sandstone (Sm).

Windblown sands

Windblown sands (Wb) occur along the coastline from Paekakariki in the south to the Manawatu River mouth at the northern boundary of the

region. The sands form a mosaic of sand dunes and sandplains which extend inland toward the north. Four phases of dune building have been recognised (Cowie 1963). The oldest and furthest inland is the Koputaroa dune phase, followed by the Foxton and then Motuiti dune phases. The youngest and most unstable phase, the Waitarere dune phase, occurs nearest the coast (Heerdegen and Shepherd 1992). All except the Koputaroa phase have developed within the last 6000 years.

Soils

The soil information in the NZLRI database is based on published or publicly available soil surveys carried out by the New Zealand Soil Bureau (now part of Landcare Research). Several surveys have been carried out in the Wellington region, and these provided important information on the nature and distribution of soils. The soil surveys used in the database are listed in Table 2 and full bibliographic references are given in Appendix 7.

The second edition LUC classification of the Wellington region was completed before the New Zealand Soil Classification (NZSC) of Hewitt (1993) was published. Assignment of soil groups to their NZSC equivalents can be done through the New Zealand Soil Database which is maintained and developed by Landcare Research. [These details can be obtained by contacting Landcare Research in Palmerston North or in Lincoln, Canterbury.]

A general description of the soil pattern in the Wellington district is provided by Gibbs (1960), and in Kairanga County by Kear (1965). In areas which only have a soils coverage at scales smaller than the NZLRI mapping scale (1:50 000), especially those areas covered by the General Survey (NZ Soil Bureau 1954), more detailed soils information was required. In obtaining this extra detail the objective was not to prepare a 1:50 000 soil map but to accurately record, within NZLRI map units, soil sets or soil series which were already recognised by Soil Bureau. In the case of the General Survey the relevant soil map was consulted to see which soil sets had been mapped. Using these sets, as defined in the extended legend, together with detailed aerial photograph and field interpretation, boundary detail appropriate to the 1:50 000 scale was recorded. During fieldwork, soil profiles were checked to ensure that the correct soil set had been recorded (Hawley and Leamy 1980).

It should be noted that the soil information recorded in the NZLRI is not a new soil map. Because soils are only one of the five inventory factors recorded within a 'homogeneous' map unit, the boundaries do not necessarily correspond exactly to soil boundaries of soil maps covering the same area. For a more detailed soil description and interpretation, users should consult the appropriate soil maps and associated reports. Additional information may be obtained from pedologists at Landcare Research.

Typical soils recorded for each LUC unit are listed in the land use capability unit descriptions (page 39).

Loess or greywacke form the parent material of most of the soils in the region. Other significant parent materials include windblown sand, alluvium and gravel. There are eight major soil groups as used by the NZ genetic soil classification (NZ Soil Bureau 1968), which together cover over

90% of the region. The following are brief notes on the eight major groups:

Intergrades between yellow-grey earths and yellow-brown earths and related steepland soils

These soils occur in areas where rainfall is slightly lower than for yellow-brown earths (1020–1270 mm p.a.). The parent material is usually loess or greywacke. These soils occur in the hill country around the Cook Strait coastline and in the Manawatu district on high terraces bordering the Tararua foothills.

Intergrades between yellow-brown earths and yellow-brown loams

These soils are developed on loess with minor volcanic ash, and occur on high terraces in the Horowhenua district (rainfall 1000–1200 mm p.a.). They have well developed structure and are well drained, lacking the dense fragipan of the yellow-grey earths.

Organic soils

Organic soils have developed on peat, or peat and alluvium where peat has formed in low lying poorly drained sites from decaying plant remains. They are of limited extent and occur either in basins or depressions within the floodplain, or in interdune depressions in the sand country.

Podzolised yellow-brown earths and related steepland soils

Podzolised yellow-brown earths are developed on the same parent material as yellow-brown earths but occur where rainfall is higher (>1780 mm p.a.). Such areas are found in the mountain ranges where elevations are usually greater than 500 m. The high rainfall and cool temperatures have led to increased leaching of nutrients.

Recent and gleyed recent soils from alluvium

These soils are developed on silty or sandy alluvium or gravel, derived principally from greywacke. They occur on floodplains and along narrow valleys throughout the region where soil

profile development has been dominated by the effects of repeated flooding and the addition of fresh alluvium.

Yellow-brown earths and related steepland soils

These soils are developed on greywacke, loess or gravels in areas of moderate rainfall (1140–1780 mm p.a.) and are weakly to strongly leached. They are widespread and occur on moderately steep to steep hill country, rolling downland and medium-height terraces along the Tararua foothills and on the Wellington Peninsula.

Yellow-brown sands

Yellow-brown sands occur on both sand dunes and sandplains along a coastal strip which stretches between Paekakariki and the Manawatu River mouth. In the north this sand country extends up to 10 km inland. The parent material is windblown sand of greywacke origin with small amounts of sand of volcanic origin. Soils are weakly to strongly leached and have weakly developed structure.

Yellow-grey earths

Yellow-grey earths are limited to lower-rainfall areas (1000–1140 mm p.a.) with a pronounced dry summer season. They occur in the Manawatu district on high terraces and are developed on loess. A compact horizon or fragipan which impedes drainage is a feature of these soils.

Slope

Slopes are recorded using seven slope groupings which are standard for land resource mapping (Soil Conservation and Rivers Control Council 1971). Slopes are measured in degrees and are recorded as those areally dominant in each map unit. Details of the slope classification are given in Appendix 8.

Slopes are measured in the field with a handheld clinometer or estimated visually. For areas that have not been visited in the field, slope groups are estimated from aerial photographs.

Erosion

Erosion type and severity is recorded for each

map unit. This erosion information is based on the NZLRI erosion classification (Eyles 1985). A brief outline of the classification and severity rankings is given in Appendix 9. These assessments were mainly derived from interpretation of aerial photographs and from extensive fieldwork, aided by knowledge of the rock, soil, slope and climatic factors which have a direct influence on the erosion characteristics and the pattern of distribution.

It should be noted that the methods used to record mass movement and fluvial erosion in the NZLRI do not give actual areas of erosion. Because these types of erosion are assessed within a map unit whose boundaries reflect a combination of physical factors, only areas of map units in which erosion of specified severity occur can be obtained. However, approximate areas of surficial erosion types may be calculated from the inventory map unit area. With these erosion types (sheet, wind and scree creep) the assessment of severity (or alternatively, degree) of erosion relates to a percentage of bare ground on the following basis: 0 = <1%, 1 = 1–10%, 2 = 11–20%, 3 = 21–40%, 4 = 41–60%, 5 = >60%. The severity measurement of mass-movement and fluvial erosion is derived in a more complex, largely subjective way based on a combination of factors in addition to area, including rate and depth of movement, cost of repair, economic effect and rate of recovery. It is assessed according to the following scale: 0 = insignificant, 1 = slight, 2 = moderate, 3 = severe, 4 = very severe, 5 = extreme. No calculations of the actual areas of erosion can be made.

Soil slip, scree, debris avalanche and wind erosion are the most common erosion types in the Wellington region. Other erosion types include sheet, gully, tunnel gully, streambank and deposition. A number of these erosion types occur in 'combination' to form patterns or associations of erosion types that are characteristic of certain landforms. These erosion associations are mapped at 1:250 000 scale in the "Erosion Map of New Zealand series". This series also records present and potential erosion severity and types and is derived from the first edition NZLRI. Sheets 10, 11, and 12 (Fletcher 1976; Noble and Fletcher 1984; Page and Trustrum 1982) cover the Wellington region.

Erosion is a naturally occurring process,

evidence of which is indicated by many of the landforms in the region. For today's landscape to develop from such relatively recent sediments, erosion rates, at least during sometime in the past, must have been relatively high.

The causes of erosion are complex and include combinations of the following: geological structure, rock type, faults and crush zones, earthquakes, soil properties, slope characteristics (angle, shape, aspect), vegetation cover, climatic factors (e.g. rainfall intensity and duration, wind and frost), and land use practices. The removal of the natural vegetation and the development of the land for use by humans (both European and Maori) has led to increased erosion. Today, erosion is a significant limitation to land use on the sand country, the steeper hill country and the mountain ranges.

The history of landscape development in the Wellington region, and the erosion processes involved are described by Stevens (1974), Heerdegen and Shepherd (1992), Kamp (1992) and Eyles and McConchie (1992). A number of studies have been made of erosion in the region. Special attention has been given to the effects of storm-induced erosion (Bishop 1977; Eyles et al. 1974; Eyles et al. 1978; McConchie 1980; Lawrence et al. 1982).

Vegetation

Vegetation cover was assessed for each map unit, using a classification of 50 vegetation classes arranged into five major groups: grass, crops, scrub, forest and herbaceous (Appendix 10). Up to three vegetation classes were recorded in each map unit, in descending order of percentage cover, and with each vegetation class recorded to the nearest 10%. The method of recording vegetation distribution within map units is described in Appendix 10.

The vegetation classification used in the second edition NZLRI for the Wellington region (Page 1987) was adapted from an earlier classification (Hunter and Blaschke 1986) which was used in the first edition mapping of the region. A correlation of these two classifications is given in Appendix 10.

Information on vegetation cover was derived from fieldwork and interpretation of aerial photographs. This was supplemented by

published maps and associated reports and papers. Vegetation maps of the region are confined to areas of indigenous forest. These areas are covered at a scale of 1:250 000 by "Sheet 14 Tararua" of the Forest Service Mapping Series 6, and in the Otaki Forks area at 1:63 360 by "N157 Otaki" of the Forest Service Mapping Series 5. (For full bibliographic references refer to Appendix 11.) The vegetation of Kapiti Island has been mapped at a scale of 1:15 000 (Fuller 1987). Reference was also made to unpublished 1:50 000 scale Forest Type Maps of the Tararua Range (Bradey 1986).

A number of descriptions of the vegetation of the region are also available, including those of Esler (1978) for the Manawatu district, Zotov et al. (1938) and Holloway et al. (1963) for the Tararua Range, and Esler (1967) for Kapiti Island. Valuable information on vegetation type and condition in selected catchments of the Tararua and Rimutaka Ranges is also provided by Cunningham (1971). Many of these authors have also discussed the effects on the vegetation of climatic changes, droughts, storms, and the influence of humans and browsing animals.

A brief description of vegetation distribution in the region is based on the eight physiographic zones described on page 12 (Figure 3).

Alluvial plains and low terraces

On the alluvial plains in the Manawatu and Horowhenua districts, improved pasture (gI) has been developed to support intensive grazing (including dairying). This improved pasture comprises a high proportion of ryegrass and white clover but also includes such species as cocksfoot, timothy and red clover. Some cropping is also carried out, notably at Opiki and near Otaki. At Opiki, maize (cM), potatoes and onions (cV) are commonly grown, while around Otaki and Levin a wide range of vegetable crops are grown as well as berryfruit (cG), pipfruit (cP) and kiwifruit (cK).

Coastal greywacke hills

The hills, cliffs and marine terraces along the coastline from Paekakariki to Wellington City and from Eastbourne to Palliser Bay are exposed to strong salt-laden winds. This coastal influence

extends inland for varying distances (between 0.5 and 4 km), depending on topography and locality, but is greatest near Cook Strait.

Although the vegetation is mainly semi-improved pasture (gS), the extent of the coastal influence can be determined by the presence of coastal scrub (sO) and *Cassinia* (sC) throughout the pasture. They are typically low-growing and salt-tolerant species, and include divaricating *Coprosma* and *Muehlenbeckia* spp. and flax. Where conditions are harshest nearest the coast, silver tussock (gT) is found throughout the pasture. Small stands of coastal forest (fC) occur in sheltered locations.

Eastern greywacke hills

These are the hills on the eastern side of the Hutt Valley from Te Marua south and including the Mangaroa, Whitemans and Wainuiomata Valleys. By contrast with the western greywacke hills, very little of the vegetation is pasture. Instead they are almost entirely scrub-covered with mixes of manuka (sM), gorse (sG), mixed indigenous scrub (sX) and, to a lesser extent, fern (sF). Scattered stands of lowland beech forest (fW) are a common component. The stands are usually secondary forest rather than remnants of original forest. The present vegetation pattern is a result of the fires which frequently occur on these hills.

As with several other physiographic zones, there is a small but increasing area of exotic conifer forest (fF).

High dissected terraceland

Improved pasture (gI) is the main vegetation on the dissected terrace country between the Manawatu Gorge and Shannon. A small amount of cereal crops (cC) is also grown (wheat, barley). On the terrace scarps, semi-improved pasture is more common, with occasional scattered gorse (sG) or manuka (sM).

On the high dissected terrace system south of Shannon and particularly around Levin, market gardening and orcharding are very common. Crops include a wide range of vegetables (cV), berryfruit (cG), pipfruit (cP) and kiwifruit (cK). Areas not in horticultural use have an improved pasture cover.

Sand country

The nature and distribution of vegetation of the sand country are strongly influenced by the distance from the coastline (i.e. exposure to salt-laden winds), stability of the dunes and soil development. Three broad vegetation zones can be recognised. The zone nearest the coast is the most exposed, and here wind erosion is the most active. The recent nature of the dunes and their instability has resulted in little soil development. Consequently, significant areas are unvegetated (uV) or with only scattered sand-binding grasses (gD). In more stable areas a more complete cover of sand-binding grasses may be present with scattered lupins (sL). These grasses are principally *Spinifex* and marram and to a limited extent pingao. Other herbaceous plants which may also be present include catsear, haretail and sand pimelea. This zone normally extends up to 0.5 km inland in the Manawatu district.

Behind this zone is a zone dominated by scrub, usually lupins, but also including bracken (sF), manuka (sM) and scattered boxthorn. Herbaceous sand-dune vegetation (gD) may also be present. Pine plantations (fF) are significant, the largest being at Waitarere.

On the older, more stable dunes furthest inland, improved pasture (gI) or semi-improved pasture (gS) dominate with only scattered lupin, bracken or manuka within the pasture.

Tararua and Rimutaka ranges

The Tararua and Rimutaka Ranges have a largely indigenous forest cover, the distribution of which is, for the most part, altitudinally controlled. Below 700 m a.s.l. the forests are either lowland podocarp–broadleaved forest (fO), broadleaved forest (fB) or podocarp–broadleaved–beech forest (fD), with the latter usually occurring at higher elevations. Podocarp–broadleaved–beech forest is also more common on the eastern side of the Tararua Range.

Above 700 m beech forest occurs, either lowland beech forest (fW) dominated by red and silver beech, or above approximately 800–900 m, highland beech forest (fG) consisting mainly of stunted silver beech. Beech is absent in the northern Tararua Range and its place is taken by highland podocarp–broadleaved forest (fI).

The timberline in the central and southern Tararua Range varies from 1000 to 1200 m a.s.l. but may be as low as 600 m in the northern Tararua Range.

A belt of subalpine scrub (sS) occurs above the timberline. This in turn is replaced by snow tussock grassland (gW) and alpine and subalpine herbfield vegetation (hA) in the central Tararua Range at altitudes above 1200–1300 m.

The Rimutaka Range has a similar forest pattern, although with lower elevations subalpine scrub and tussock grassland are absent. Poor forest condition means that there is a greater scrub component.

Tararua foothills

The vegetation on the foothills, on both the eastern and western side of the Tararua Range, has been much modified from the original indigenous forest cover. Most areas have been burnt and/or logged at some time and converted to pasture.

Today, these foothills are a mosaic of vegetation reflecting various stages of development and reversion. Much is now in semi-improved pasture (gS) with a variety of scrub species scattered through the pasture. Such scrub includes manuka (sM), fern (sF) and to a lesser extent gorse (sG) and *Cassinia* (sC). Large areas have reverted to a complete scrub cover, often of

manuka (sM), mixed indigenous scrub (sX) or mixed indigenous scrub with tree ferns (sT). Small areas of indigenous forest remain, often broadleaved forest (fB) which has been logged to remove the podocarp species, or – particularly in the eastern foothills – lowland beech forest (fW).

Exotic forestry is becoming an increasingly significant land use on these foothills, replacing areas of reverted pasture. Most plantations are of softwood species (fF), principally *Pinus radiata*.

Western greywacke hills

These are the hills of the Wellington Peninsula, defined as the area south of Pukerua Bay and west of the Hutt Valley and excluding the hills bordering the coastline. The vegetation of this hill country is largely semi-improved pasture within which a variety of scrub classes is present. Many pastures may have three or four such classes, either scattered as small plants or as blocks of 'more mature' scrub. Common scrub includes gorse (sG), fern (sF), manuka (sM), *Cassinia* (sC) or mixed indigenous scrub (sX). These hills, like those of the Tararua foothills, are in various stages of development or reversion (Crocker 1953).

Improved pasture is only found on the limited areas of less steep land, including alluvial valley floors. There is also a small but increasing area of exotic conifer forest (fF).

Land use capability (LUC) classification

The land use capability (LUC) system of land classification assesses land in terms of its capacity for sustained productive use, taking into account physical limitations, management requirements and soil conservation needs. The assessment is based on an interpretation of the physical information in the land resource inventory, supplemented with information on climate, flood risk, land use practices (e.g. information on present and past land use) and erosion history.

The LUC classification has three components – class, subclass and unit – each of which is represented by a number or symbol.

Land use capability class

The LUC class is the broadest grouping in the capability classification. It is an assessment of the versatility of land and gives the general degree of limitation to use, taking into account the physical limitations to sustained production. There are eight classes, represented by roman numerals, with limitations to use increasing, and versatility of use decreasing, from class I to class VIII. Classes I–IV are suitable for arable, pastoral or forestry use, while classes V–VII are not suitable for arable use but are suitable for pastoral or forestry use. The limitations reach a maximum with class VIII land, which is unsuitable for grazing or production forestry,

and is best managed for catchment protection and nature conservation.

Of the eight LUC classes, only class V has not been mapped in the Wellington region. Class V covers the best non-cropping land. It is highly fertile, with few limitations to pasture growth, and usually occurs in low hill country.

The area of each class, both in hectares and as a percentage, is given in Table 3. The most versatile and potentially productive land, classes I and II, comprises only 5.9% of the region, while land classified as classes VI, VII and VIII comprises 78.5% of the region. The importance of the most productive land is therefore further increased by its scarcity.

Land use capability subclass

The LUC subclass is a subdivision of the LUC class according to the main kind of physical limitation or hazard to use. Four kinds of limitation are recognised: erodibility (e), soil limitations within the rooting zone (s), wetness (w) and climate (c). The initial letter of each limitation is used to identify the subclass (e.g. IIe, IIw, IIc). Only the dominant limitation is identified in the land use capability code. Other limitations may also exist, but are described in the LUC extended legend and in the LUC unit descriptions (page 39).

Table 3. Areas of LUC classes mapped in the Wellington region.

LUC class	Area (ha)	Percentage of region	
I	6291	1.5	} Arable 16.6%
II	18 658	4.4	
III	32 259	7.6	
IV	13 279	3.1	
V	–	–	} Non-arable 51.6%
VI	95 802	22.4	
VII	124 455	29.2	
VIII	115 026	26.9	Protection 26.9%
Unmapped (rivers, lakes, urban areas, etc.)	21 132	4.9	
TOTAL	426 902	100	

Table 4. Areas of LUC subclass limitations mapped in the Wellington region.

LUC subclass limitations	Area (ha)	Percentage of region
Climate (c)	31 329	7.4
Erodibility (e)	308 246	72.2
Soil limitation (s)	40 904	9.6
Wetness (w)	25 291	5.9
Unmapped (rivers, lakes, urban areas, etc.)	21 132	4.9
TOTAL	426 902	100.0

The area of each of the four subclass limitations in the Wellington region, both in hectares and as a percentage, is given in Table 4. More detailed data are given in Table 5. Because of the large proportion of hill country and mountainland in the region, erodibility is by far the major limitation.

Land use capability unit

The LUC unit is the most detailed component of the LUC classification. LUC subclasses are subdivided into a number of LUC units which are identified by arabic numerals at the end of the LUC code. Each LUC unit groups together land inventory units which require the same kind of management, the same kind and intensity of conservation treatment and are suitable for the same kind of crops, pasture or forestry species with similar potential yields. LUC units within subclasses are arranged in order of decreasing

versatility to use and increasing degree of limitation to use, e.g. VIIe5 has a higher use capability than VIIe8, but not as high as VIIe2.

An example of the LUC nomenclature is given for LUC unit VIe1: VI is the class, VIe is the subclass, VIe1 is the unit. The relationship between the three components of the classification is illustrated in Figure 4.

The areas of LUC units in the Wellington region are shown in Table 5.

Land use capability suite

The traditional numerical ranking of LUC units based on decreasing versatility and capability, as shown in the LUC extended legends, gives no direct indication of the relationships between LUC units in their actual landscape setting.

To enable these relationships to be better understood and to aid interpretation of maps and extended legends, related LUC units are

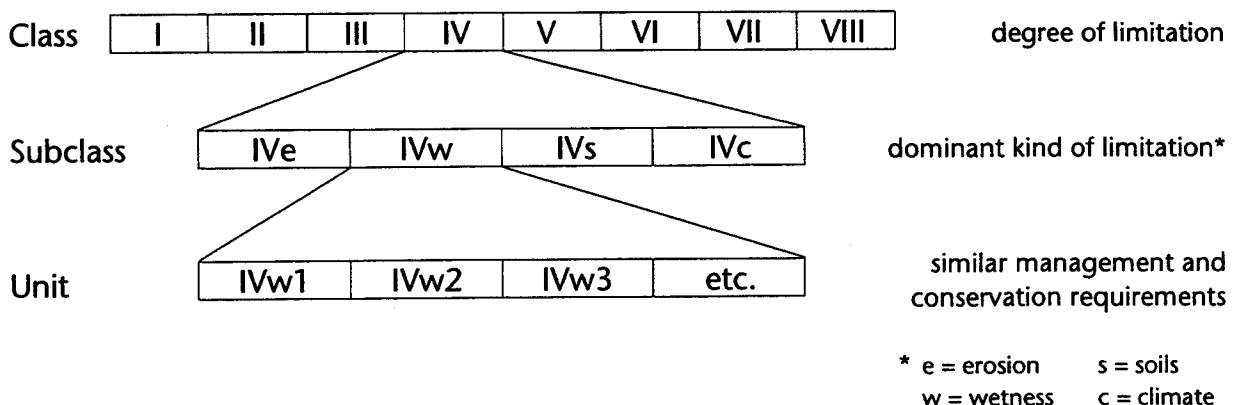


Figure 4. Components of LUC classification.

Table 5. Areas (ha) of LUC units mapped in the Wellington region.

LUC unit	Unit total	Subclass total	Class total	Class as % of region
Iw1	1151	1151		
Is1	1110	1110		
Ic1	4030	4030	6291	1.5
IIe1	997	997		
IIw1	7653			
IIw2	3744	11 397		
IIs1	1330			
IIs2	656			
IIs3	958	2944		
IIc1	3320	3320	18 658	4.4
IIIe1	1150			
IIIe2	571			
IIIe3	4474	6195		
IIIw1	2207			
IIIw2	3665			
IIIw3	4746	10 618		
IIIs1	892			
IIIs2	6911			
IIIs3	1357			
IIIs4		5928	15 088	
IIc1	358	358	32 259	7.6
IVe1	2485			
IVe2	2027			
IVe3	220			
IVe4	571			
IVe5	1198	6501		
IVw1	470			
IVw2	524			
IVw3	361	1355		
IVs1	2610			
IVs2	2525	5135		
IVc1	288	288	13 279	3.1
VIe1	4093			
VIe2	1305			
VIe3	2555			
VIe4	300			
VIe5	4716			

Table 5. (continued)

LUC unit	Unit total	Subclass total	Class total	Class as % of region
Vle6	14 933			
Vle7	8398			
Vle8	21 945			
Vle9	1376			
Vle10	2407	62 028		
Vlw1	317	317		
Vls1	3705			
Vls2	329			
Vls3	769			
Vls4	615			
Vls5	2263			
Vls6	2298			
Vls7	4816	14 795		
Vlc1	13 839			
Vlc2	4406			
Vlc3	417	18 662	95 802	22.4
Vlle1	15 527			
Vlle2	59 111			
Vlle3	4497			
Vlle4	6456			
Vlle5	32 571	118 162		
Vllw1	312			
Vllw2	142	454		
Vlls1	676			
Vlls2	391			
Vlls3	101	1168		
Vllc1	4671	4671	124 455	29.2
Vllle1	1040			
Vllle2	2439			
Vllle3	87 270			
Vllle4	9169			
Vllle5	14 442	114 360		
Vllls1	666	666	115 026	26.9
Unmapped (rivers, lakes, urban areas, etc.)	21 132			4.9
TOTAL	426 902			100.0

Table 6. LUC suites and component LUC units in the Wellington region.

LUC suite number	LUC suite name	LUC subsuite name	Component LUC units
1	Low alluvial plains and terraces	1a. Soils with wetness limitations. 1b. Soils with limitations of stoniness and insufficient soil moisture.	Iw1, IIw1, IIIw1, IVw1, IVw2, VIIw2 Is1, IIs1, IIIs1, IVs1, VIs7, VIIs2
2	Peat bogs, swamps and basins		IIw2, IIIw2, IVw3, VIw1, VIIw1
3	Medium-height stony alluvial terraces		IIs3, IIIs2, IVs2, VIs3, VIs7
4	High, dissected, loess-covered terraceland	4a. Terraces and low hills formed from consolidated, weathered gravels. Soils are yellow-brown earths developed from loess. 4b. Dissected terraceland formed from unconsolidated sands and conglomerate. Soils are intergrades between yellow-brown earths and yellow-brown loams, developed from loess and minor tephra. 4c. Dissected terraceland and fans formed from unconsolidated to moderately consolidated sands and conglomerate. Soils are yellow-grey earths or intergrades between yellow-grey earths and yellow-brown earths developed from loess.	IIIs3, IVe1, VIs1, VIe2 Ic1, IIe1, IIc1, IIIe1, VIe1 IIIs4, IIIe3, IVe2, VIe1
5	Sand country	5a. Young, unstable sand dunes. 5b. Interdune sandplains. 5c. Older, slightly consolidated, inland sands, forming stable landforms.	VIs5, VIe5, VIIe3, VIIIe1 IIIw3, IVe4, VIs4 IIs2, IIIe2, IVe3, VIs2, VIe4
6	Raised marine		VIc3, VIIs3, VIIIs1

Table 6. (continued)

LUC suite number	LUC suite name	LUC subsuite name	Component LUC units
7	Greywacke hill country	7a. Coastal greywacke hill country exposed to strong salt-laden winds. Soils are intergrades between yellow-grey earths and yellow-brown earths.	Vlc2, Vle3, Vle9 VIIe4, VIIIe2
		7b. Inland greywacke hill country with annual rainfall <1270 mm. Soils are yellow-brown earths.	Vlc2, Vls6, Vle6, VIIe1, VIIIs1
		7c. Inland, weathered greywacke hill country with annual rainfall 1400–2000 mm. Soils are strongly leached yellow-brown earths.	Vle7, VIIe2
8	Greywacke mountainlands and associated foothills	8a. Greywacke foothills with annual rainfall 1270–1780 mm. Soils are strongly leached yellow-brown earths.	IIIc1, IVe5, VIc1, Vle8, VIIe2, VIIIe3
		8b. Greywacke mountainlands with annual rainfall >1780 mm. Soils are podzolised yellow-brown earths.	IVc1, Vle10, VIIe5, VIIc1, VIIIe3, VIIIe4, VIIIe5

arranged into groups, called LUC suites. A LUC suite is defined as, 'LUC units which, although differing in capability, share a definitive physical characteristic which unites them in the landscape'.

These 'definitive physical characteristics' may vary from suite to suite. The use of LUC suites as a tool in landscape assessment is discussed by Blaschke (1985a). The LUC classifications for the Southern Hawke's Bay–Wairarapa region (Noble 1985), Bay of Plenty–Volcanic Plateau region (Blaschke 1985b), Taranaki–Manawatu region (Fletcher 1987), Northern Hawke's Bay region (Page 1988) and Northland region (Harmsworth, in press) have also been described using the suite concept.

The 70 LUC units have been arranged into eight suites which were primarily delineated on

the basis of rock type and landform:

- LUC suites 1 and 2 on low river terraces and plains formed from alluvium, gravel or peat;
- LUC suite 3 on medium-height gravel terraces and low hills;
- LUC suite 4 on high dissected terraceland with a loess cover;
- LUC suite 5 on coastal sand country;
- LUC suite 6 on raised marine terraces;
- LUC suites 7 and 8 on greywacke hill and mountainland.

Six of the eight LUC suites were subdivided into a number of subsuites on the basis of other factors such as soil, climate, erosion type and vegetation (Table 6). Within each subsuite, variations in factors such as slope angle, slope profile, erosion potential, wetness and stoniness are used to delineate LUC units.

Productivity data

Part of the definition of a LUC unit is that it groups areas of land with a similar potential. Therefore, with the completion of the inventory and LUC mapping aspect of the NZLRI, a logical extension was to obtain production estimates for each LUC unit. These take the form of stock carrying capacity for pastoral production and site index for forestry production. This information was collected on a regional basis in co-operative exercises with MAFTech, the Ministry of Forestry and the Wellington Regional Council. These data are given in the description of LUC units in this publication and are stored as part of the computer database.

These production estimates provide a quantitative link between land use capability and agriculture and forestry. They take the NZLRI beyond the physical description, or composition, of land and provide a measure of land performance.

Stock carrying capacities

Data on stock carrying capacity were collected in 1991 from MAFTech staff at Palmerston North. Three levels of stock carrying capacity were assessed (expressed in terms of stock units per hectare, where a stock unit is equivalent to one breeding ewe): present average, top farmer, and attainable physical potential. These assessments were made by field inspection of a number of representative sites of each LUC unit. Assessments of individual LUC units were also obtained from more than one Farm Advisory Officer where possible. From these assessments a single figure was agreed upon. Rankings for stock-carrying capacity figures are given in Table 7. The stock-carrying capacity data for each LUC unit are given in Appendix 12.

Forestry site indices

Site index data were collected in 1992 from Ministry of Forestry staff at Palmerston North, from Wellington Regional Council staff and from NZ Forest Research Institute plot records. Site index was chosen as the most suitable measure of forest growth and was defined as 'the mean top height or predominant mean height in metres of *Pinus radiata* at age 20 years'.

Table 7. Stock-carrying capacity rankings.

Stock-carrying capacity ranking	Stock units per ha
very high	>25
high	21–25
moderately high	16–20
medium	11–15
low	6–10
very low	1–5
sparse	<1

Table 8. Site index rankings.

Site index ranking	Site index in metres
very high	>35
high	30–35
medium	25–29
low	20–24
very low	<20

Again a number of representative sites of each LUC unit were visited and assessments of site index made, based either on plot-record information where forests were present, or on field observations of shelterbelts, woodlots, etc.

Values were then checked for consistency throughout the region and adjustments made to ensure consistency with adjacent NZLRI regions. Because of the site variation within LUC units, site index information was recorded as a range rather than a single figure. In general most LUC units have site indices with a range of 2–5 metres. However, for a number of hill country and mountainland LUC units a wider range was recorded.

This reflected both the altitudinal range of these units and the exposed nature of some sites. Rankings for site index figures are given in Table 8. The site index data for each LUC unit are given in Appendix 13.

Key to recognising LUC units within LUC suites

In order to provide an aid to the recognition of LUC units, key physical attributes and unique associations of attributes are isolated within 'decision trees'.

This approach has the advantage of allowing both the mapper and the interpreter to examine clearly the internal discrimination logic of the classification. It does this by stripping away all factors from those which are identified as definitive for the LUC unit. Note, however, that the factors stripped away are still very important in understanding the classification – particularly

in the role as 'evidence corroborators'.

The decision pathway is a set of vertically tiered questions with answers yes (Y) or no (N). A 'yes' answer may either lead the enquirer to an appropriate solution (i.e. a LUC unit), or give an instruction to proceed to another identified question. A 'no' answer is followed by a number. This identifies the question that the enquirer should proceed to.

For each LUC suite a decision pathway is provided for keying out and identifying LUC units within that suite.

■ **Decision pathway for LUC Suite 3:
Medium-height stony alluvial terraces. Alluvial terraces above present river level**

1. Is the soil depth to gravels >60 cm?
Y → IIs3 N → go to 2
2. Is the soil depth to gravels 30–60 cm, with stones throughout the profile?
Y → IIIs2 N → go to 3
3. Is the soil depth to gravels 15–30 cm, with stones present at the surface?
Y → IVs2 N → go to 4
4. Is the soil depth to gravels 5–15 cm, with stones present at the surface?
Y → VIs7 N → go to 5
5. Does the land consist of strongly sloping fans with 10–30 cm of stony soil overlying very stony and bouldery colluvial deposits?
Y → VIs3

■ **Decision pathway for LUC Suite 4:
High dissected loess-covered terraceland**

1. Are the landforms developed on unconsolidated to moderately consolidated sands?
Y → go to 2 N → go to 13
2. Do the soils have a compact subsoil or fragipan which impedes drainage?
Y → go to 3 N → go to 7
3. Are the slopes A or A+B, forming flat, broad terrace tops?
Y → IIIs4 N → go to 4
4. Are the slopes dominantly C, forming rolling, gently dissected terraces?
Y → IIIe3 N → go to 5
5. Are the slopes dominantly D, forming strongly rolling dissected terraces and sloping fans?
Y → IVe2 N → go to 6

6. Are the slopes dominantly E, forming short terrace scarps?

Y → VIe1

7. Are the soils free draining with an absence of pans or compact subsoil layers which impede drainage?

Y → go to 8

8. Are the slopes A, forming flat to gently undulating broad terraces below approximately 60 m a.s.l. in areas where frosts are rare?

Y → Ic1

N → go to 9

9. Are the slopes A, forming flat to gently undulating broad terraces above approximately 40 m a.s.l. and adjacent to the Tararua foothills where there is an increased likelihood of frosts?

Y → IIc1

N → go to 10

10. Are the slopes B, forming undulating terraces?

Y → IIe1

N → go to 11

11. Are the slopes dominantly C, forming rolling, gently dissected terraces?

Y → IIIe1

N → go to 12

12. Are the slopes dominantly E, forming short terrace scarps?

Y → VIe1

13. Are the landforms developed on consolidated weathered gravels?

Y → go to 14

14. Are the slopes dominantly B, forming undulating, slightly dissected terraces and fans?

Y → IIIs3

N → go to 15

15. Are the slopes C and D, forming rolling to strongly rolling dissected downland?

Y → IVe1

N → go to 16

16. Are the slopes D and E, forming strongly rolling to moderately steep low hills with little evidence of erosion?

Y → VIIs1

N → go to 17

17. Are the slopes E, forming moderately steep hills with evidence of erosion?

Y → VIe2

14. Does the land consist of slightly consolidated sand forming downland and low hills among the coastal greywacke hill country?

Y → go to 15

15. Are the slopes dominantly C, forming dissected downland?

Y → IVe3

N → go to 16

16. Are the slopes D or D+E forming low hills?

Y → VIIs2

N → go to 17

17. Are the slopes dominantly E forming moderately steep hills?

Y → VIe4

Note: For interdune peat swamps, see the decision pathway for LUC Suite 2.

■ Decision pathway for LUC Suite 6:

Raised marine terraces. Coastal terraces bordering Cook Strait

1. Do the terraces occur at or near sea level?

Y → go to 2

N → go to 4

2. Do the terraces consist of flat to undulating rocky former sea bed and associated beach deposits?

Y → VIIIs1

N → go to 3

3. Does the land consist of gravelly to sandy terraces and fans?

Y → VIIIs3

4. Are the terraces 30–300 m a.s.l. with moderately deep loess and colluvial deposits over gravels?

Y → VIc3

■ Decision pathway for LUC Suite 7: Greywacke hill country

1. Is the land within 4 km of the coast and exposed to strong salt-laden winds? The presence of coastal scrub species determines the extent of the coastal influence.

Y → go to 2	N → go to 8
-------------	-------------
2. Does the land consist of broad rolling ridgetops?

Y → VIc2	N → go to 3
----------	-------------
3. Are the slopes dominantly E forming moderately steep hills?

Y → go to 4	N → go to 6
-------------	-------------
4. Does the land occur in the Pukerua Bay–Porirua area where the greywacke is moderately weathered?

Y → VIe3	N → go to 5
----------	-------------
5. Does the land occur adjacent to the Cook Strait coastline?

Y → VIe9	
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6. Are the slopes dominantly F forming steep hills with scree, sheet and wind erosion?

Y → VIIe4	N → go to 7
-----------	-------------
7. Are the slopes dominantly G with large areas of bare rock and forming coastal cliffs?

Y → VIIIe2	
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8. Is the annual rainfall less than 1270 mm?

Y → go to 9	N → go to 14
-------------	--------------
9. Does the land consist of broad rolling ridgetops?

Y → VIc2	N → go to 10
----------	--------------
10. Are the slopes D to E+D forming low hills with little evidence of erosion?

Y → VIIs6	N → go to 11
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11. Are the slopes E or E+F forming moderately steep hills?

Y → VIe6	N → go to 12
----------	--------------
12. Are the slopes F+G forming long steep hills with significant rock outcrops?

Y → VIIIs1	N → go to 13
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13. Are the slopes F or F+G forming steep hills without significant rock outcrops?

Y → VIIe1	
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9. Are the slopes A or A+B forming imperfectly drained upland basins at 500 m a.s.l?
Y → IVc1 N → go to 10
10. Are the slopes C or D forming exposed ridgetops, plateaux or basins at 500–900 m a.s.l?
Y → VIIc1 N → go to 11
11. Are the slopes E forming moderately steep montane hills below 700 m a.s.l?
Y → VIe10 N → go to 12
12. Are the slopes F or F+G forming steep to very steep montane hills, or are slopes E forming moderately steep montane hills 700–800 m a.s.l?
Y → VIIe5 N → go to 13
13. Are the slopes G forming long and very steep mountainland below the timberline?
Y → go to 14 N → go to 16
14. Is erosion only slight to moderate?
Y → VIIIe3 N → go to 15
15. Is erosion severe to extreme with large areas of bare rock and scree?
Y → VIIIe4
16. Are slopes above the timberline?
Y → VIIIe5

LUC unit descriptions

This section provides descriptions of each of the 70 LUC units in the second edition NZLRI of the Wellington region. Each description consists of a brief summary of the LUC unit, a list of the physical factors affecting land use, and a section on land use and land management.

Symbols in brackets (e.g. Gw, A+B, Sc) which are shown under the heading 'Physical

characteristics' denote the NZLRI classification symbols. These have also been entered into the NZLRI Geographic Information System (GIS) as attributes of each map unit.

For each LUC unit, names and symbols of common soils are listed. Soil surveys are referred to by number. A list of survey titles and authors is given in Table 2.

LUC unit: lw1 (1151 ha)**LUC suite:** 1. Low alluvial plains and terraces**LUC subsuite:** 1a. Soils with wetness limitations**Description:** Flat, low river terraces and levees of the floodplains with fine-textured alluvial soils. The soils are deep, fertile and well to moderately well drained, with only a very slight wetness limitation. Typically occurs near the Manawatu, Otaki and Waikanae Rivers.**Type location:** S25/923470 State Highway 1, Otaki**Altitudinal range:** 10–50 m**Slope:** Flat to gently undulating (A), 0–3°**Landform:** Floodplains, low terraces**Rock type:** Fine-grained alluvium (Af)

Soils:	Recent soils	Symbol	Survey
	<i>Name</i>		
	Manawatu fine sandy loam	3	3
		M4	7
		1	2
	Manawatu mottled fine sandy loam	3d	3
		M6	7
	Manawatu mottled silt loam	3a	3
		M5	7
	Waikanae silt loam	W	6
	<i>Texture:</i> Silt loam, fine sandy loam		
	<i>Depth:</i> >1 m		
	<i>Drainage:</i> Moderately well to well drained		

Erosion:*Present:* Negligible (0)*Potential:* Negligible (0)**Vegetation:** Improved pasture (gl), vegetables, nurseries (cV), maize (cM)**Annual rainfall range:** 950–1200 mm**Land use:**

<i>Present:</i>	Cropping –	Market gardening. Cereal cropping.
	Grazing –	Present average carrying capacity (s.u./ha) = 19 – Top farmer carrying capacity (s.u./ha) = 27
<i>Potential:</i>	Cropping –	Horticulture. Cereals
	Grazing –	Attainable physical potential carrying capacity (s.u./ha) = 32
	Forestry –	Production – site index (metres) for <i>Pinus radiata</i> = 32–34

Soil conservation management:

Stopbanks.

Comments:

Shelterbelts required for horticulture. Where not protected by stopbanks flooding may occur, but only for short, infrequent periods.

LUC unit:	Is1 (1110 ha)		
LUC suite:	1. Low alluvial plains and terraces		
LUC subsuite:	1b. Soils with limitations of stoniness and insufficient soil moisture		
Description:	Flat, low river terraces and levees of the floodplains with fine-textured alluvial soils. The soils are deep, fertile and well drained, although they dry out slightly in summer. Typically occurs near Manawatu, Ohau and Otaki Rivers.		
Type location:	R25/888482 Rangiuru Road, Otaki		
Altitudinal range:	10–50 m		
Slope:	Flat to gently undulating (A), 0–3°		
Landform:	Floodplains, low terraces		
Rock type:	Fine-grained alluvium (Af)		
Soils:	Recent soils		
	<i>Name</i>	<i>Symbol</i>	<i>Survey</i>
	Manawatu fine sandy loam	M3	7
		3b	3
	Karapoti silt loam	Kt1	7
	Karapoti fine sandy loam	Kt2	7
	<i>Texture:</i> Fine sandy loam, silt loam		
	<i>Depth:</i> >1 m		
	<i>Drainage:</i> Well drained		
Erosion:	<i>Present:</i>	Negligible (0)	
	<i>Potential:</i>	Negligible (0)	
Vegetation:	Improved pasture (gl), vegetables, nurseries (cV)		
Annual rainfall range:	950–1100 mm		
Land use:	<i>Present:</i>	Cropping – Market gardening	
		Grazing – Present average carrying capacity (s.u./ha) = 16	
		– Top farmer carrying capacity (s.u./ha) = 24	
	<i>Potential:</i>	Cropping – Horticulture. Cereals	
		Grazing – Attainable physical potential carrying capacity (s.u./ha) = 30	
		Forestry – Production – site index (metres) for <i>Pinus radiata</i> = 31–34	
Soil conservation management:	Stopbanks.		
Comments:	Shelterbelts required for horticulture. Is1 has slightly better drainage than Iw1.		

LUC unit: Ic1 (4030 ha)**LUC suite:** 4. High, dissected loess-covered terraceland**LUC subsuite:** 4b. Dissected terraceland formed from unconsolidated sands and conglomerate. Soils are intergrades between yellow-brown earths and yellow-brown loams developed from loess and minor tephra**Description:** Flat to gently undulating, high and medium-height terraces with a mantle of loess and minor tephra. The soils are deep, fertile and well drained. The terraces typically occur between 10–60 m a.s.l. where rainfall is 1000–1200 mm p.a. Occurs between Shannon and Otaki.**Type location:** S25/011597 State Highway 1, Levin**Altitudinal range:** 10–80 m**Slope:** Flat to gently undulating (A), 0–3°**Landform:** High terraces**Rock type:** Loess (and minor tephra) (Lo)**Soils:** Intergrades between yellow-brown earths and yellow-brown loams

	<i>Name</i>	<i>Symbol</i>	<i>Survey</i>
	Levin silt loam	Le	7
		76	2
	Kiwitea loam	76a	2
<i>Texture:</i>	Silt loam		
<i>Depth:</i>	>1 m		
<i>Drainage:</i>	Well drained		

Erosion:*Present:* Negligible (0)*Potential:* Negligible (0)**Vegetation:** Improved pasture (gl), vegetables, nurseries (cV), kiwifruit (cK), pip and stone fruit (cP), berryfruit (cG)**Annual rainfall range:** 1000–1200 mm**Land use:**

<i>Present:</i>	Cropping –	Market gardening. Orcharding
	Grazing –	Present average carrying capacity (s.u./ha) = 19
		– Top farmer carrying capacity (s.u./ha) = 27
<i>Potential:</i>	Cropping –	Horticulture. Cereals
	Grazing –	Attainable physical potential carrying capacity (s.u./ha) = 32
	Forestry –	Production – site index (metres) for <i>Pinus radiata</i> = 33–35

Soil conservation management:

–

Comments: Shelterbelts required for horticulture. Includes areas of Waitohu silt loam (Wu) which are only moderately well drained.

LUC unit:	Ile1 (997 ha)		
LUC suite:	4. High, dissected loess-covered terraceland		
LUC subsuite:	4b. Dissected terraceland formed from unconsolidated sands and conglomerate. Soils are intergrades between yellow-brown earths and yellow-brown loams developed from loess and minor tephra		
Description:	Undulating high and medium-height terraces with a mantle of loess and minor tephra. The soils are deep, fertile and well drained. There is a potential for slight sheet and rill erosion when cultivated. Occurs in the Levin district.		
Type location:	S25/053637 Roslyn Road, Levin		
Altitudinal range:	20–70 m		
Slope:	Undulating (B), 4–7°		
Landform:	High terraces		
Rock type:	Loess (and minor tephra) (Lo)		
Soils:	Intergrades between yellow-brown earths and yellow-brown loams		
	<i>Name</i>	<i>Symbol</i>	<i>Survey</i>
	Levin silt loam	Le	7
		76	2
	Kiwitea loam	76a	2
<i>Texture:</i>	Silt loam		
<i>Depth:</i>	>1 m		
<i>Drainage:</i>	Well drained		
Erosion:			
<i>Present:</i>	Negligible (0)		
<i>Potential:</i>	Slight (1) sheet (Sh) and rill (R) when cultivated		
Vegetation:	Improved pasture (gl), vegetables, nurseries (cV), kiwifruit (cK), pip and stone fruit (cP)		
Annual rainfall range:	1000–1100 mm		
Land use:			
<i>Present:</i>	Cropping –	Market gardening. Orcharding	
	Grazing –	Present average carrying capacity (s.u./ha) = 19	
		– Top farmer carrying capacity (s.u./ha) = 27	
<i>Potential:</i>	Cropping –	Horticulture. Cereals	
	Grazing –	Attainable physical potential carrying capacity (s.u./ha) = 32	
	Forestry –	Production – site index (metres) for <i>Pinus radiata</i> = 33–35	
Soil conservation management:	Contour cultivation.		
Comments:	Shelterbelts required for horticulture.		

LUC unit: **Ilw1 (7653 ha)****LUC suite:** 1. Low alluvial plains and terraces**LUC subsuite:** 1a. Soils with wetness limitations**Description:** Flat, low river terraces and floodplains with fine-textured alluvial soils. The soils are deep, fertile and imperfectly drained with a slight wetness limitation. Occurs on the Manawatu, Ohau, Otaki and Waikanae flood plains.**Type location:** S24/227828 Te Puna Road, Linton**Altitudinal range:** 5–30 m**Slope:** Flat to gently undulating (A), 0–3°**Landform:** Floodplains, low terraces**Rock type:** Fine-grained alluvium (Af)**Soils:** Gleyed recent soils

<i>Name</i>	<i>Symbol</i>	<i>Survey</i>
Kairanga silt loam	4	3
Kairanga fine sandy loam	4a	3
	K2	7
Kairanga silt loam and clay loam	2	2
Kairanga loam	2a	2

Texture: Silt loam or fine sandy loam*Depth:* >1 m*Drainage:* Imperfectly to poorly drained**Erosion:***Present:* Negligible (0)*Potential:* Slight (1) streambank (Sb)**Vegetation:** Improved pasture (gl), vegetables, nurseries (cV), maize (cM)**Annual rainfall range:** 950–1200 mm**Land use:***Present:* Cropping – Market gardening. Cereal cropping
Grazing – Present average carrying capacity (s.u./ha) = 17; top farmer carrying capacity (s.u./ha) = 25*Potential:* Cropping – Horticulture. Cereals
Grazing – Attainable physical potential carrying capacity (s.u./ha) = 30
Forestry – Production – site index (metres) for *Pinus radiata* = 31–33**Soil conservation management:**

Streambank protection. Stopbanks. Drainage.

Comments:

Shelterbelts required for horticulture. Occasional flooding may occur where not protected by stopbanks.

LUC unit: Ilw2 (3744 ha)

LUC suite: 2. Peat bogs, swamps and basins

LUC subsuite:

Description: Flat, low lying basins within the Manawatu floodplain, consisting of interbedded layers of peat and alluvium. The soils have peaty textures and are poorly drained.

Type location: S24/175787 Makerua – Rangitane Road, Opiki.

Altitudinal range: 5–20 m

Slope: Flat to gently undulating (A), 0–3°

Landform: Floodplains

Rock type: Peat and alluvium (Pt + Af), peat over alluvium (Pt/Af)

Soils: Gley recent soils. Organic soils.

<i>Name</i>	<i>Symbol</i>	<i>Survey</i>
Opiki peaty silt loam	5	3
	Op1	7
Opiki peaty loam	Op2	7
Opiki complex	2b	2
Makerua peaty silt loam	6	3
Makerua loamy peat	Mk	7
Makerua peaty loam	107	2
<i>Texture:</i> Peaty silt loam, peaty loam, loamy peat		
<i>Depth:</i> >1 m		
<i>Drainage:</i> Poorly drained		

Erosion:

Present: Negligible (0)
Potential: Negligible (0)

Vegetation: Improved pasture (gl), vegetables, nurseries (cV), maize (cM)

Annual rainfall range: 1000–1100 mm

Land use:

Present: Cropping – Market gardening. Cereal cropping.
Grazing – Present average carrying capacity (s.u./ha) = 18
– Top farmer carrying capacity (s.u./ha) = 22

Potential: Cropping – Horticulture. Cereals.
Grazing – Attainable physical potential carrying capacity (s.u./ha) = 30
Forestry – Production – site index (metres) for *Pinus radiata* = 30–32

Soil conservation management:

Drainage. Water table control.

Comments:

Shelterbelts required for horticulture. Logs appearing at the surface require removal for arable use.

LUC unit: IIs1 (1330 ha)**LUC suite:** 1. Low alluvial plains and terraces**LUC subsuite:** 1b. Soils with limitations of stoniness and insufficient soil moisture**Description:** Flat, low river terraces and levees of the floodplains with alluvial soils. The soils are sandy in texture and moderately deep, overlying gravels. They are fertile and well drained although they tend to dry out in summer. Occurs on Manawatu, Ohau and Waikanae floodplains.**Type location:** T24/326888 Massey University**Altitudinal range:** 20–40 m**Slope:** Flat to gently undulating (A), 0–3°**Landform:** Floodplains, low terraces**Rock type:** Fine-grained alluvium (Af)**Soils:** Recent soils

<i>Name</i>	<i>Symbol</i>	<i>Survey</i>
Manawatu sandy loam	3e	3
Karapoti brown sandy loam	7b	3
Waikanae sandy loam	Ws	6
Manawatu shallow fine sandy loam	M1	7
Manawatu shallow silt loam	M2	7
Karapoti shallow fine sandy loam	Kt3	7
<i>Texture:</i> Sandy loam, fine sandy loam		
<i>Depth:</i> 60–90 cm		
<i>Drainage:</i> Well drained		

Erosion:

Present: Negligible (0)
Potential: Slight (1) streambank (Sb)

Vegetation: Improved pasture (gl), vegetables, nurseries (cV)**Annual rainfall range:** 1000–1100 mm**Land use:**

Present: Cropping – Market gardening
 Grazing – Present average carrying capacity (s.u./ha) = 17
 – Top farmer carrying capacity (s.u./ha) = 23

Potential: Cropping – Horticulture. Cereals
 Grazing – Attainable physical potential carrying capacity (s.u./ha) = 28
 Forestry – Production – site index (metres) for *Pinus radiata* = 30–33

Soil conservation management:

Streambank protection. Stopbanks.

Comments:

Shelterbelts required for horticulture. Depth to gravels is 60–90 cm. Soils are sandier textured and shallower than Is1.

LUC unit: IIs2 (656 ha)

LUC suite: 5. Sand country

LUC subsuite: 5c. Older, slightly consolidated, inland sands, forming stable landforms

Description: Flat to undulating medium-height terraces overlain by slightly consolidated aeolian sands. Soils are sandy in texture and well drained, tending to dry out in summer. Occurs around Levin and Otaki.

Type location: S25/032667 Heatherlea, Levin

Altitudinal range: 10–40 m

Slope: Flat to undulating (A, A+B), 0–7°

Landform: Terraces overlain by aeolian sands

Rock type: Slightly consolidated sands (Us)

Soils: Yellow-brown sands

	<i>Name</i>	<i>Symbol</i>	<i>Survey</i>
	Koputaroa fine sandy loam	Kp1	7
	Waitawa fine sandy loam	Wt1	7
	Koputaroa sand	24	2
<i>Texture:</i>	Fine sandy loam		
<i>Depth:</i>	>1 m		
<i>Drainage:</i>	Well drained		

Erosion:

Present: Negligible (0)
Potential: Slight (1) wind (W) when cultivated

Vegetation: Improved pasture (gl), vegetables, nurseries (cV), kiwifruit (cK), berryfruit (cG)

Annual rainfall range: 1000–1100 mm

Land use:

Present: Cropping – Market gardening. Orcharding
Grazing – Present average carrying capacity (s.u./ha) = 17
– Top farmer carrying capacity (s.u./ha) = 20

Potential: Cropping – Horticulture. Cereals
Grazing – Attainable physical potential carrying capacity (s.u./ha) = 26
Forestry – Production – site index (metres) for *Pinus radiata* = 31–33

Soil conservation management:

Windbreaks. Contour cultivation.

Comments:

Shelterbelts required for horticulture. Includes areas of Waitawa fine sandy loam (Wt1) which are imperfectly to poorly drained.

LUC unit: IIs3 (958 ha)

LUC suite: 3. Medium-height stony alluvial terraces

LUC subsuite:

Description: Flat, medium-height alluvial terraces in the Otaki and Judgeford districts with well drained, moderately deep soils overlying gravel. Soils dry out in summer. Above present river level.

Type location: S25/902426 Te Horo

Altitudinal range: 20–80 m

Slope: Flat to gently undulating (A), 0–3°

Landform: Medium-height terraces

Rock type: Fine-grained alluvium over gravels (Af/Gr)

Soils: Yellow-brown earths. Yellow-brown shallow and stony soils associated with intergrades between yellow-grey earths and yellow-brown earths.

<i>Name</i>	<i>Symbol</i>	<i>Survey</i>
Hautere silt loam	Hz	7
Te Horo silt loam	Te	7
Heretaunga sandy loam	H	6
Ashhurst silt loam	13	3
<i>Texture:</i>	Silt loam, fine sandy loam, sandy loam	
<i>Depth:</i>	60–100 cm	
<i>Drainage:</i>	Well drained to moderately well drained	

Erosion:

Present: Negligible (0)

Potential: Negligible (0)

Vegetation: Improved pasture (gl), kiwifruit (cK), vegetables, nurseries (cV), pip and stone fruit (cP)

Annual rainfall range: 1100–1200 mm

Land use:

<i>Present:</i>	Cropping	–	Market gardening. Orcharding
	Grazing	–	Present average carrying capacity (s.u./ha) = 16 Top farmer carrying capacity (s.u./ha) = 20
<i>Potential:</i>	Cropping	–	Horticulture. Cereals
	Grazing	–	Attainable physical potential carrying capacity (s.u./ha) = 26
	Forestry	–	Production – site index (metres) for <i>Pinus radiata</i> = 30–32

Soil conservation management:

–

Comments: Shelterbelts required for horticulture. Includes areas of Hautere stony silt loam (Hzs) and Te Horo stony silt loam (Tes) with more stones in profile. Depth to gravels is 60–100 cm+.

LUC unit:	Ilc1 (3320 ha)		
LUC suite:	4. High, dissected loess-covered terraceland		
LUC subsuite:	4b. Dissected terraceland formed from unconsolidated sands and conglomerate. Soils are intergrades between yellow-brown earths and yellow-brown loams developed from loess and minor tephra		
Description:	Flat to gently undulating high terraces between Shannon and Otaki with a mantle of loess and minor tephra. The soils are deep, fertile and well drained. The terraces typically occur between 40–100 m a.s.l. where rainfall is approx. 1200 mm p.a. Slight frosts and cool temperatures limit cropping versatility.		
Type location:	S25/022554 Kuku East Road, Ohau		
Altitudinal range:	40–100 m		
Slope:	Flat to gently undulating (A), 0–3°		
Landform:	High terraces		
Rock type:	Loess (and minor tephra) (Lo)		
Soils:	Intergrades between yellow-brown earths and yellow-brown loams		
	<i>Name</i>	<i>Symbol</i>	<i>Survey</i>
	Levin silt loam	76	2
		Le	7
	Kiwitea loam	76a	2
<i>Texture:</i>	Silt loam		
<i>Depth:</i>	>1 m		
<i>Drainage:</i>	Well drained		
Erosion:			
<i>Present:</i>	Negligible (0)		
<i>Potential:</i>	Negligible (0)		
Vegetation:	Improved pasture (gl), vegetables, nurseries (cV), kiwifruit (cK), berryfruit (cG)		
Annual rainfall range:	1200 mm		
Land use:			
<i>Present:</i>	Cropping –	Market gardening. Orcharding	
	Grazing –	Present average carrying capacity (s.u./ha) = 18	
		– Top farmer carrying capacity (s.u./ha) = 23	
<i>Potential:</i>	Cropping –	Horticulture. Cereals	
	Grazing –	Attainable physical potential carrying capacity (s.u./ha) = 30	
	Forestry –	Production – site index (metres) for <i>Pinus radiata</i> = 31–34	
Soil conservation management:	–		
Comments:	Shelterbelts required for horticulture. Ilc1 occurs further inland and at higher elevations than lc1, with a higher rainfall, lower temperatures and an increased likelihood of frosts.		

LUC unit: IIIe1 (1150 ha)**LUC suite:** 4. High, dissected loess-covered terraceland**LUC subsuite:** 4b. Dissected terraceland formed from unconsolidated sands and conglomerate. Soils are intergrades between yellow-brown earths and yellow-brown loams developed from loess and minor tephra**Description:** Rolling downland and dissected terraces with a mantle of loess and minor tephra. The soils are deep, fertile and well drained. There is a potential for moderate sheet and rill erosion when cultivated. Occurs in the Levin and Otaki districts.**Type location:** S25/004583 State Highway 1, Ohau**Altitudinal range:** 20–60 m**Slope:** Rolling and rolling to undulating (C, C+B), 4–15°**Landform:** High, dissected terraces**Rock type:** Loess (and minor tephra) (Lo)**Soils:** Intergrades between yellow-brown earths and yellow-brown loams

	<i>Name</i>	<i>Symbol</i>	<i>Survey</i>
	Levin silt loam	Le	7
	Kiwitea loam	76a	2
<i>Texture:</i>	Silt loam		
<i>Depth:</i>	>1 m		
<i>Drainage:</i>	Well drained		

Erosion:*Present:* Negligible (0)*Potential:* Moderate (2) sheet (Sh) and rill (R) when cultivated**Vegetation:** Improved pasture (gl), vegetables, nurseries (cV)**Annual rainfall range:** 1000–1200 mm**Land use:***Present:* Cropping – Market gardening

Grazing – Present average carrying capacity (s.u./ha) = 18

– Top farmer carrying capacity (s.u./ha) = 23

Potential: Cropping – Horticulture. Cereals

Grazing – Attainable physical potential carrying capacity (s.u./ha) = 30

Forestry – Production – site index (metres) for *Pinus radiata* = 32–34**Soil conservation management:**

Contour cultivation. Minimum tillage techniques.

Comments:

Shelterbelts required for horticulture. Includes areas of Waitohu silt loam (Wu) which are only moderately well drained.

LUC unit: IIIe2 (571 ha)**LUC suite:** 5. Sand country**LUC subsuite:** 5c. Older, slightly consolidated, inland sands, forming stable landforms**Description:** Rolling to undulating downlands of slightly consolidated aeolian sands. Soils are sandy textured and well drained. There is a potential for slight to moderate sheet, rill and wind erosion when cultivated. Occurs around Otaki and Paraparaumu.**Type location:** S25/943505 Forest Lakes Road, Otaki**Altitudinal range:** 20–40 m**Slope:** Rolling and rolling to undulating (C, C+B), 4–15°**Landform:** Terraces overlain by aeolian sands**Rock type:** Slightly consolidated sands (Us)**Soils:** Yellow-brown sands

<i>Name</i>	<i>Symbol</i>	<i>Survey</i>
Koputaroa fine sandy loam, rolling phase	Kp2	7
Koputaroa sand	24	2
<i>Texture:</i> Fine sandy loam		
<i>Depth:</i> >1 m		
<i>Drainage:</i> Well drained		

Erosion:*Present:* Negligible (0)*Potential:* Moderate (2) sheet (Sh), rill (R), and wind (W) when cultivated**Vegetation:** Improved pasture (gl)**Annual rainfall range:** 1000–1200 mm**Land use:***Present:* Cropping – –

Grazing – Present average carrying capacity (s.u./ha) = 14

– Top farmer carrying capacity (s.u./ha) = 17

Potential: Cropping – Horticulture. Cereals

Grazing – Attainable physical potential carrying capacity (s.u./ha) = 21

Forestry – Production – site index (metres) for *Pinus radiata* = 30–32**Soil conservation management:**

Contour cultivation. Windbreaks. Minimum tillage techniques.

Irrigation for horticulture

Comments:

Shelterbelts required for horticulture. Includes areas of Waitawa fine sandy loam, rolling phase (Wt2) which are imperfectly to poorly drained.

LUC unit: **Ille3 (4474 ha)**

- LUC suite:** 4. High, dissected loess-covered terraceland
LUC subsuite: 4c. Dissected terraceland and fans formed from unconsolidated to moderately consolidated sands and conglomerate. Soils are yellow-grey earths or intergrades between yellow-grey earths and yellow-brown earths developed from loess.

Description: Rolling, dissected terraceland with a mantle of loess over sands and conglomerate, and colluvium. Soils are imperfectly drained due to perching of water above dense subsoil layers. There is a potential for slight to moderate sheet and rill erosion when cultivated. Occurs between Palmerston North and Otaki.

Type location: S24/265815 Linton

Altitudinal range: 20–150 m

Slope: Rolling and rolling to undulating (C, C+B), 4–15°

Landform: High, dissected terraces

Rock type: Loess or loess and colluvium (Lo)

Soils: Intergrades between yellow-grey earths and yellow-brown earths. Yellow-grey earths

<i>Name</i>	<i>Symbol</i>	<i>Survey</i>
Shannon silt loam	14	3
	Sh	7
Waitohu silt loam	Wu	7
Tokomaru silt loam, rolling phase	10a	3
Kokotau silt loam	13d	2
<i>Texture:</i> Silt loam, clay loam		
<i>Depth:</i> 70–80 cm		
<i>Drainage:</i> Imperfectly drained		

Erosion:

Present: Negligible (0)

Potential: Slight (1) to moderate (2) sheet (Sh) and rill (R) when cultivated

Vegetation: Improved pasture (gl)

Annual rainfall range: 1000–1270 mm

Land use:

- Present:* Cropping – Root and green fodder cropping
 Grazing – Present average carrying capacity (s.u./ha) = 15
 – Top farmer carrying capacity (s.u./ha) = 21
- Potential:* Cropping – Cereals. Root and green fodder crops
 Grazing – Attainable physical potential carrying capacity (s.u./ha) = 26
 Forestry – Production – site index (metres) for *Pinus radiata* = 28–30

Soil conservation management:

Contour cultivation. Minimum tillage techniques.

Comments:

–

LUC unit: Illw1 (2207 ha)**LUC suite:** 1. Low alluvial plains and terraces**LUC subsuite:** 1a. Soils with wetness limitations**Description:** Flat, narrow, alluvial valley floors with imperfectly to poorly drained soils developed from fine-grained alluvium. Runoff from surrounding hills and a moderately high water table increase the wetness limitation. There is a potential for occasional flooding and slight to moderate streambank erosion. Occurs throughout the region.**Type location:** R26/705707 Plimmerton–Pauatahanui Road**Altitudinal range:** 0–200 m**Slope:** Flat to gently undulating (A), 0–3°**Landform:** Low terraces**Rock type:** Fine-grained alluvium (Af)**Soils:** Gleyed recent soils. Intergrades between yellow-grey earths and yellow-brown earths

<i>Name</i>	<i>Symbol</i>	<i>Survey</i>
Waiwhetu silt loam	Y	6
Waiwhetu heavy silt loam	Ym	6
Kairanga silt loam and clay loam	2	2
Kairanga silty clay loam	K1	7
Parewanui fine sandy loam	Pa	7
Paraha silt loam	Pz	7

Texture: Silt loam, heavy silt loam, silty clay loam*Depth:* 50→100 cm*Drainage:* Imperfectly to poorly drained**Erosion:***Present:* Negligible (0) to slight (1) streambank (Sb)*Potential:* Slight (1) to moderate (2) streambank (Sb)**Vegetation:** Improved pasture (gl), rushes (hR)**Annual rainfall range:** 1100–1500 mm**Land use:**

Present: Cropping – –
 Grazing – Present average carrying capacity (s.u./ha) = 15
 – Top farmer carrying capacity (s.u./ha) = 18

Potential: Cropping – Horticulture. Cereals. Root and green fodder crops.
 Grazing – Attainable physical potential carrying capacity (s.u./ha) = 26
 Forestry – Production – site index (metres) for *Pinus radiata* = 30–32

Soil conservation management:

Streambank protection. Stopbanks. Drainage.

Comments:

Shelterbelts required for horticulture. Parewanui fine sandy loam is included because of flooding potential. Paraha stony silt loam (Pzs) with more stones in profile, frequently occurs as an inclusion with Paraha silt loam. Heretaunga mottled silt loam sometimes included.

LUC unit: IIIw2 (3665 ha)**LUC suite:** 2. Peat bogs, swamps and basins**LUC subsuite:****Description:** Flat, poorly to very poorly drained peaty depressions and swamp margins associated with the sand country between Waitarere and Paekakariki. Soils are organic with >40 cm thickness of peat overlying sand.**Type location:** S25/995624 Arawhata Road, Levin**Altitudinal range:** 10–30 m**Slope:** Flat to gently undulating (A), 0–3°**Landform:** Interdune depressions (lowlying sandplains)**Rock type:** Peat (Pt)

Soils:	Organic soils		
	<i>Name</i>	<i>Symbol</i>	<i>Survey</i>
	Pukepuke–Omanuka association	P-O	4
	Omanuka peat	Om	7
	Paraparaumu peaty loam	Pp	6
<i>Texture:</i>	Peaty loam, loamy peat, peaty sandy loam		
<i>Depth:</i>	>1 m		
<i>Drainage:</i>	Poorly drained		

Erosion:*Present:* Negligible (0)*Potential:* Negligible (0)**Vegetation:** Improved pasture (gl), rushes (hR)**Annual rainfall range:** 950–1200 mm**Land use:**

<i>Present:</i>	Cropping	–	–
	Grazing	–	Present average carrying capacity (s.u./ha) = 10
		–	Top farmer carrying capacity (s.u./ha) = 16
<i>Potential:</i>	Cropping	–	Horticulture. Root and green fodder crops
	Grazing	–	Attainable physical potential carrying capacity (s.u./ha) = 22
	Forestry	–	Production – site index (metres) for <i>Pinus radiata</i> = 24–30

Soil conservation management:

Drainage. Water table control.

Comments:

Shelterbelts required for horticulture. Logs appearing at the surface require removal for arable use.

LUC unit:	Illw3 (4746 ha)		
LUC suite:	5. Sand country		
LUC subsuite:	5b. Interdune sandplains		
Description:	Low lying, imperfectly to poorly drained sandplains amongst the inland dunes between Waitarere and Waikanae. Water tables are at or near the surface in winter. Includes small areas of peaty soils.		
Type location:	S25/020692 State Highway 1, Poroutawhao		
Altitudinal range:	5–20 m		
Slope:	Flat to gently undulating (A), 0–3°		
Landform:	Interdune sandplains		
Rock type:	Windblown sands (Wb)		
Soils:	Sandy gley soils		
	<i>Name</i>	<i>Symbol</i>	<i>Survey</i>
	Carnarvon brown–Foxton association	Cb-F	4
	Carnarvon black–Foxton association	C-F	4
	Pukepuke–Omanuka association	P-O	4
	Pukepuke brown peaty fine sandy loam	Pu1	7
	Pukepuke brown peaty loam	Pu2	7
	Pukepuke black sandy loam	Pu3	7
	Pukepuke black sand	Pu4	7
	Carnarvon fine sandy loam	Cn	7
	<i>Texture:</i>	Sandy loam, fine sandy loam, peaty fine sandy loam	
	<i>Depth:</i>	>1 m	
	<i>Drainage:</i>	Imperfectly to poorly drained	
Erosion:			
	<i>Present:</i>	Negligible (0)	
	<i>Potential:</i>	Negligible (0)	
Vegetation:	Improved pasture (gl), rushes (hR)		
Annual rainfall range:	950–1100 mm		
Land use:			
	<i>Present:</i>	Cropping – –	
		Grazing – Present average carrying capacity (s.u./ha) = 14	
		– Top farmer carrying capacity (s.u./ha) = 18	
	<i>Potential:</i>	Cropping – Horticulture. Root and green fodder crops	
		Grazing – Attainable physical potential carrying capacity (s.u./ha) = 23	
		Forestry – Production – site index (metres) for <i>Pinus radiata</i> = 30–32	
Soil conservation management:	Drainage. Water table control. Irrigation for horticulture.		
Comments:	Shelterbelts required for horticulture. Often occurs in association with VIs5.		

LUC unit: IIIs1 (892 ha)**LUC suite:** 1. Low alluvial plains and terraces**LUC subsuite:** 1b Soils with limitations of stoniness and insufficient soil moisture**Description:** Flat, low river terraces, with sandy, well drained to somewhat excessively drained soils developed from fine-grained alluvium overlying gravels. Soils are moderately deep with weakly developed structure. In areas unprotected by stopbanks there is a potential for flooding and slight to moderate streambank erosion. Occurs throughout the region.**Type location:** R27/703827 Wainuiomata Coast Road**Altitudinal range:** 10–200 m**Slope:** Flat to gently undulating (A), 0–3°**Landform:** Low terraces**Rock type:** Fine-grained alluvium (Af) and fine-grained alluvium over gravels (Af/Gr)**Soils:** Recent soils

<i>Name</i>	<i>Symbol</i>	<i>Survey</i>
Waikanae sandy loam	Ws	6
Rangitikei fine sandy loam	R2	7
Rangitikei silt loam	R3	7
<i>Texture:</i> Sandy loam, fine sandy loam, silt loam		
<i>Depth:</i> 40–60 cm		
<i>Drainage:</i> Well to somewhat excessively drained		

Erosion:*Present:* Negligible (0) to slight (1) streambank (Sb)*Potential:* Slight (1) to moderate (2) streambank (Sb). Slight (1) wind (w) when cultivated**Vegetation:** Improved pasture (gl), semi-improved pasture (gS), rushes (hR)**Annual rainfall range:** 1200–1800 mm**Land use:**

<i>Present:</i>	Cropping	–	–
	Grazing	–	Present average carrying capacity (s.u./ha) = 13 Top farmer carrying capacity (s.u./ha) = 16
<i>Potential:</i>	Cropping	–	Horticulture. Cereals. Root and green fodder crops
	Grazing	–	Attainable physical potential carrying capacity (s.u./ha) = 24
	Forestry	–	Production – site index (metres) for <i>Pinus radiata</i> = 26–29

Soil conservation management:

Streambank protection. Stopbanks. Windbreaks.

Comments:

Shelterbelts required for horticulture. Depth to gravels is 40–60 cm.

LUC unit: IIIs2 (6911 ha)

LUC suite: 3. Medium-height stony alluvial terraces

LUC subsuite:

Description: Flat, medium-height alluvial terraces with somewhat excessively drained soils developed from stony alluvium. Subject to seasonal soil moisture deficiencies. Above present river level. Occurs throughout the region.

Type location: S25/924443 Otaki Gorge Road

Altitudinal range: 20–200 m

Slope: Flat to gently undulating (A), 0–3°

Landform: Medium-height terraces

Rock type: Fine-grained alluvium over gravels (Af/Gr)

Soils: Yellow-brown shallow and stony soils associated with intergrades between yellow-grey earths and yellow-brown earths. Yellow-brown shallow and stony soils associated with yellow-brown earths

	<i>Name</i>	<i>Symbol</i>	<i>Survey</i>
	Ashhurst silt loam, stony phase	13a	3
	Ashhurst stony silt loam	Az	7
	Kawhatau stony silt loam	Kz	7
	Heretaunga stony silt loam	Hs	6
<i>Texture:</i>	Stony silt loam		
<i>Depth:</i>	30–60 cm		
<i>Drainage:</i>	Somewhat excessively drained		

Erosion:

Present: Negligible (0)

Potential: Negligible (0)

Vegetation: Improved pasture (gl), semi-improved pasture (gS), kiwifruit (cK), pip and stonefruit (cP)

Annual rainfall range: 1100–1800 mm

Land use:

<i>Present:</i>	Cropping	–	Orcharding
	Grazing	–	Present average carrying capacity (s.u./ha) = 15 Top farmer carrying capacity (s.u./ha) = 18
<i>Potential:</i>	Cropping	–	Horticulture. Cereals. Root and green fodder crops.
	Grazing	–	Attainable physical potential carrying capacity (s.u./ha) = 24
	Forestry	–	Production – site index (metres) for <i>Pinus radiata</i> = 30–32

Soil conservation management: –

Comments: Shelterbelts required for horticulture. Stones occur throughout the profile. Depth to gravels is 30–60 cm.

LUC unit: IIIs3 (1357 ha)**LUC suite:** 4. High, dissected loess-covered terraceland**LUC subsuite:** 4a. Terraces and low hills formed from consolidated, weathered gravels. Soils are yellow-brown earths developed from loess**Description:** Undulating to rolling, slightly dissected, high terraces and fans, with a mantle of loess over consolidated gravels. Soils are moderately well drained. Typically occurs in the Paraparaumu, Kaitoke and Mangaroa areas.**Type location:** R27/867095 Emerald Hill, Upper Hutt**Altitudinal range:** 40–240 m**Slope:** Undulating to rolling (B, B+C), 4–15°**Landform:** Dissected high terraces**Rock type:** Loess (Lo) or loess over consolidated gravels (Lo/Cw)**Soils:** Yellow-brown earths

	<i>Name</i>	<i>Symbol</i>	<i>Survey</i>
	Judgeford silt loam	J	6
	Ngaio silt loam	N	6
<i>Texture:</i>	Silt loam, silty clay loam		
<i>Depth:</i>	65–100 cm		
<i>Drainage:</i>	Moderately well drained		

Erosion:*Present:* Negligible (0)*Potential:* Slight (1) sheet (Sh) and rill (R) when cultivated**Vegetation:** Improved pasture (gl)**Annual rainfall range:** 1200–1600 mm**Land use:**

<i>Present:</i>	Cropping	–
	Grazing	– Present average carrying capacity (s.u./ha) = 14 – Top farmer carrying capacity (s.u./ha) = 17
<i>Potential:</i>	Cropping	– Cereals. Horticulture. Root and green fodder crops.
	Grazing	– Attainable physical potential carrying capacity (s.u./ha) = 22
	Forestry	– Production – site index (metres) for <i>Pinus radiata</i> = 28–32

Soil conservation management:

Contour cultivation. Minimum tillage techniques.

Comments:

Shelterbelts required for horticulture.

LUC unit: IIIs4 (5928 ha)**LUC suite:** 4. High, dissected loess-covered terraceland**LUC subsuite:** 4c. Dissected terraceland and fans formed from unconsolidated to moderately consolidated sands and conglomerate. Soils are yellow-grey earths or intergrades between yellow-grey earths and yellow-brown earths developed from loess.**Description:** Flat to gently undulating high terraces with a mantle of loess. The presence of a subsoil pan causes perching of water. Soils are poorly drained in winter but subject to summer soil moisture deficiencies. The terraces occur between Palmerston North and Shannon.**Type location:** S24/294838 Linton**Altitudinal range:** 20–100 m**Slope:** Flat to undulating (A, A+B), 0–7°**Landform:** High terraces**Rock type:** Loess (Lo)**Soils:** Yellow-grey earths. Intergrades between yellow-grey earths and yellow-brown earths

<i>Name</i>	<i>Symbol</i>	<i>Survey</i>
Tokomaru silt loam	10	3
	13	2
Rahui silty clay loam	Ra	7
Ohakea silt loam	Oh	7
	9	3
Ohakea loam	12	2

Texture: Silt loam, heavy silt loam, silty clay loam*Depth:* 70–80 cm to fragipan*Drainage:* Poorly drained**Erosion:***Present:* Negligible (0)*Potential:* Negligible (0)**Vegetation:** Improved pasture (gl), cereal crops (cC)**Annual rainfall range:** 1000–1200 mm**Land use:***Present:* Cropping – Cereal cropping. Root and green fodder cropping

Grazing – Present average carrying capacity (s.u./ha) = 15

– Top farmer carrying capacity (s.u./ha) = 21

Potential: Cropping – Cereals. Root and green fodder crops

Grazing – Attainable physical potential carrying capacity (s.u./ha) = 26

Forestry – Production – site index (metres) for *Pinus radiata* = 28–31**Soil conservation management:**

Subsurface drainage

Comments: Wet winter, dry summer conditions are the result of soil structure limitations.

LUC unit: IIIc1 (358 ha)**LUC suite:** 8. Greywacke mountainlands and associated foothills**LUC subsuite:** 8a. Greywacke foothills with rainfall 1270–1780 mm p.a. Soils are strongly leached yellow-brown earths**Description:** Flat to undulating upland basins between 300–500 m a.s.l. with a mantle of loess, colluvium and solifluction material. Soils are strongly leached and have impeded drainage. Cool winter temperatures and frosts limit cropping. Occurs in the western foothills of the Tararua Range.**Type location:** S25/138645 Heights Road south of Shannon**Altitudinal range:** 300–500 m**Slope:** Flat to undulating (A, A+B), 0–7°**Landform:** Upland basins**Rock type:** Loess and solifluction deposits (Lo)**Soils:** Yellow-brown earths

	<i>Name</i>	<i>Symbol</i>	<i>Survey</i>
	Ramiha mottled silt loam	19a	3
	Matamau heavy silt loam	77b	2
<i>Texture:</i>	Silt loam		
<i>Depth:</i>	>1 m		
<i>Drainage:</i>	Imperfectly drained		

Erosion:*Present:* Negligible (0)*Potential:* Negligible (0)**Vegetation:** Improved pasture (gl), rushes (hR)**Annual rainfall range:** 1270–1780 mm**Land use:**

<i>Present:</i>	Cropping	–	–
	Grazing	–	Present average carrying capacity (s.u./ha) = 10 Top farmer carrying capacity (s.u./ha) = 12
<i>Potential:</i>	Cropping	–	Vegetable crops. Root and green fodder crops
	Grazing	–	Attainable physical potential carrying capacity (s.u./ha) = 18
	Forestry	–	Production – site index (metres) for <i>Pinus radiata</i> = 24–28

Soil conservation management:

Drainage.

Comments: No dry season. Includes fine tephra in parent material.

LUC unit: IVe1 (2485 ha)**LUC suite:** 4. High, dissected loess-covered terraceland**LUC subsuite:** 4a. Terraces and low hills formed from consolidated weathered gravels. Soils are yellow-brown earths developed from loess**Description:** Strongly rolling and rolling downland with a mantle of loess over consolidated gravels. There is a potential for moderate to severe sheet and rill erosion when cultivated. Occurs on the Wellington peninsula and along the eastern Rimutaka foothills.**Type location:** R27/600000 Ohariu Valley Road**Altitudinal range:** 20–200 m**Slope:** Rolling to strongly rolling (C+D, D+C), 8–20°**Landform:** Downland**Rock type:** Loess (Lo) or loess over consolidated gravels (Lo/Cw)**Soils:** Yellow-brown earths

<i>Name</i>	<i>Symbol</i>	<i>Survey</i>
Judgeford silt loam	J	6
Ngaio silt loam	N	6
Kaikouta silt loam	35b	5
<i>Texture:</i> Silt loam, silty clay loam		
<i>Depth:</i> 65–100 cm		
<i>Drainage:</i> Moderately well drained		

Erosion:*Present:* Negligible (0)*Potential:* Moderate (2) to severe (3) sheet (Sh) and rill (R) when cultivated**Vegetation:** Improved pasture (gl), gorse (sG)**Annual rainfall range:** 1140–1270 mm**Land use:***Present:* Cropping – –

Grazing – Present average carrying capacity (s.u./ha) = 14

– Top farmer carrying capacity (s.u./ha) = 17

Potential: Cropping – Root and green fodder crops

Grazing – Attainable physical potential carrying capacity (s.u./ha) = 21

Forestry – Production – site index (metres) for *Pinus radiata* = 26–30**Soil conservation management:**

Contour cultivation. Minimum tillage techniques. Strip cropping.

Comments: –

LUC unit:	IVe2 (2027 ha)		
LUC suite:	4. High, dissected loess-covered terraceland		
LUC subsuite:	4c. Dissected terraceland and fans formed from unconsolidated to moderately consolidated sands and conglomerate. Soils are yellow-grey earths or intergrades between yellow-grey earths and yellow-brown earths developed from loess.		
Description:	Strongly rolling, dissected terraceland and sloping fans with a mantle of loess over sands and conglomerate, and colluvium. Soils are imperfectly drained due to perching of water above dense subsoil layers. There is a potential for moderate to severe sheet and rill erosion when cultivated. Occurs between Palmerston North and Otaki.		
Type location:	S24/275785 Scotts Road south of Linton		
Altitudinal range:	20–200 m		
Slope:	Strongly rolling to rolling (D, D+C), 8–20°		
Landform:	High, dissected terraces and fans		
Rock type:	Loess (Lo) or loess and colluvium over unconsolidated to moderately consolidated sands and conglomerates (Lo/Us).		
Soils:	Intergrades between yellow-grey earths and yellow-brown earths. Yellow-grey earths		
	<i>Name</i>	<i>Symbol</i>	<i>Survey</i>
	Shannon silt loam, rolling phase	14a	3
	Shannon silt loam	Sh	7
	Kiwitea loam	76a	2
	Tokomaru silt loam, rolling phase	10a	3
	<i>Texture:</i>	Silt loam, clay loam	
	<i>Depth:</i>	60–80 cm	
	<i>Drainage:</i>	Imperfectly drained	
Erosion:	<i>Present:</i> Negligible (0)		
	<i>Potential:</i> Moderate (2) to severe (3) sheet (Sh) and rill (R) when cultivated		
Vegetation:	Improved pasture (gl)		
Annual rainfall range:	1100–1300 mm		
Land use:	<i>Present:</i>		
	Cropping	– Root and green fodder cropping	
	Grazing	– Present average carrying capacity (s.u./ha) = 14	
		– Top farmer carrying capacity (s.u./ha) = 18	
	<i>Potential:</i>	Cropping – Root and green fodder crops	
	Grazing	– Attainable physical potential carrying capacity (s.u./ha) = 22	
	Forestry	– Production – site index (metres) for <i>Pinus radiata</i> = 28–30	
Soil conservation management:	Contour cultivation. Minimum tillage techniques. Strip cropping.		
Comments:	Sands referred to as Otaki sandstone.		

LUC unit:	IVe3 (220 ha)									
LUC suite:	5. Sand country									
LUC subsuite:	5c. Older, slightly consolidated, inland sands, forming stable landforms									
Description:	Rolling dissected downlands of slightly consolidated aeolian sands occurring near the coast in the Plimmerton–Pukerua Bay area. There is a potential for severe sheet and rill and moderate wind erosion when cultivated.									
Type location:	R26/682165 Pukerua Bay									
Altitudinal range:	40–100 m									
Slope:	Rolling (C), 8–15°									
Landform:	Dissected downlands									
Rock type:	Slightly consolidated sands (Us)									
Soils:	Podzolised yellow-brown sands. Intergrades between yellow-grey earths and yellow-brown earths									
	<table border="0"> <thead> <tr> <th><i>Name</i></th> <th><i>Symbol</i></th> <th><i>Survey</i></th> </tr> </thead> <tbody> <tr> <td>Pukerua loamy sand</td> <td>Pa</td> <td>6</td> </tr> <tr> <td>Porirua fine sandy loam</td> <td>Pf</td> <td>6</td> </tr> </tbody> </table>	<i>Name</i>	<i>Symbol</i>	<i>Survey</i>	Pukerua loamy sand	Pa	6	Porirua fine sandy loam	Pf	6
<i>Name</i>	<i>Symbol</i>	<i>Survey</i>								
Pukerua loamy sand	Pa	6								
Porirua fine sandy loam	Pf	6								
<i>Texture:</i>	Fine sandy loam, loamy sand									
<i>Depth:</i>	50–100 cm									
<i>Drainage:</i>	Moderately well drained									
Erosion:										
<i>Present:</i>	Negligible (0)									
<i>Potential:</i>	Severe (3) sheet (Sh) and rill (R) and moderate (2) wind (W) when cultivated.									
Vegetation:	Improved pasture (gl)									
Annual rainfall range:	1100–1200 mm									
Land use:										
<i>Present:</i>	<table border="0"> <tr> <td>Cropping</td> <td>–</td> <td>–</td> </tr> <tr> <td>Grazing</td> <td>–</td> <td>Present average carrying capacity (s.u./ha) = 12</td> </tr> <tr> <td></td> <td>–</td> <td>Top farmer carrying capacity (s.u./ha) = 15</td> </tr> </table>	Cropping	–	–	Grazing	–	Present average carrying capacity (s.u./ha) = 12		–	Top farmer carrying capacity (s.u./ha) = 15
Cropping	–	–								
Grazing	–	Present average carrying capacity (s.u./ha) = 12								
	–	Top farmer carrying capacity (s.u./ha) = 15								
<i>Potential:</i>	<table border="0"> <tr> <td>Cropping</td> <td>–</td> <td>Root and green fodder crops</td> </tr> <tr> <td>Grazing</td> <td>–</td> <td>Attainable physical potential carrying capacity (s.u./ha) = 19</td> </tr> <tr> <td>Forestry</td> <td>–</td> <td>Production – site index (metres) for <i>Pinus radiata</i> = 27–29</td> </tr> </table>	Cropping	–	Root and green fodder crops	Grazing	–	Attainable physical potential carrying capacity (s.u./ha) = 19	Forestry	–	Production – site index (metres) for <i>Pinus radiata</i> = 27–29
Cropping	–	Root and green fodder crops								
Grazing	–	Attainable physical potential carrying capacity (s.u./ha) = 19								
Forestry	–	Production – site index (metres) for <i>Pinus radiata</i> = 27–29								
Soil conservation management:	Contour cultivation. Windbreaks. Minimum tillage techniques. Strip cropping.									
Comments:	–									

LUC unit: IVe4 (571 ha)

LUC suite: 5. Sand country

LUC subsuite: 5b. Interdune sandplains

Description: Flat, free draining, higher sandplains amongst the older, inland dunes between Waitare and Otaki. Soils have a moderately developed structure and are subject to seasonal soil moisture deficiencies. There is a potential for severe wind erosion when cultivated.

Type location: S24/029709 Koputaroa Road

Altitudinal range: 10–20 m

Slope: Flat to gently undulating (A), 0–3°

Landform: Sandplains

Rock type: Windblown sands (Wb)

Soils:	Yellow-brown sands		
	<i>Name</i>	<i>Symbol</i>	<i>Survey</i>
	Awahou–Foxton association	A-F	4
	Awahou sandy loam	Aw	7
	<i>Texture:</i> Sandy loam		
	<i>Depth:</i> 40–60 cm on sand		
	<i>Drainage:</i> Somewhat excessively to well drained		

Erosion:

Present: Negligible (0)
Potential: Severe (3) wind (W) when cultivated

Vegetation: Semi-improved pasture (gS)

Annual rainfall range: 900–1000 mm

Land use:

<i>Present:</i>	Cropping	–	–
	Grazing	–	Present average carrying capacity (s.u./ha) = 9
		–	Top farmer carrying capacity (s.u./ha) = 12
<i>Potential:</i>	Cropping	–	Root and green fodder crops. Horticulture
	Grazing	–	Attainable physical potential carrying capacity (s.u./ha) = 19
	Forestry	–	Production – site index (metres) for <i>Pinus radiata</i> = 28–31

Soil conservation management:

Windbreaks. Strip cropping. Minimum tillage techniques.

Comments:

–

LUC unit: IVe5 (1198 ha)**LUC suite:** 8. Greywacke mountainlands and associated foothills**LUC subsuite:** 8a. Greywacke foothills with rainfall 1270–1780 mm p.a. Soils are strongly leached yellow-brown earths**Description:** Rolling uplands at altitudes between 300–500 m a.s.l. in the foothills of the Tararua Range. The strongly leached soils are developed on a mantle of loess over greywacke. Cool winter temperatures and frosts limit cropping. There is a potential for moderate sheet, rill and wind erosion when cultivated.**Type location:** S25/145644 Heights Road south of Shannon**Altitudinal range:** 300–500 m**Slope:** Rolling (C), 8–15°**Landform:** Rolling uplands**Rock type:** Loess and solifluction deposits over greywacke (Lo/Gw)**Soils:** Yellow-brown earths

	<i>Name</i>	<i>Symbol</i>	<i>Survey</i>
	Matamau silt loam	77	2
	Ramiha silt loam	19	3
<i>Texture:</i>	Silt loam		
<i>Depth:</i>	>1 m		
<i>Drainage:</i>	Well drained		

Erosion:*Present:* Negligible (0)*Potential:* Moderate (2) sheet (Sh), rill (R) and wind (W) when cultivated**Vegetation:** Semi-improved pasture (gS), mixed indigenous scrub (sX)**Annual rainfall range:** 1270–1780 mm**Land use:**

<i>Present:</i>	Cropping	–	–
	Grazing	–	Present average carrying capacity (s.u./ha) = 9
		–	Top farmer carrying capacity (s.u./ha) = 11
	Reversion to scrub		
<i>Potential:</i>	Cropping	–	Root and green fodder crops. Vegetable crops
	Grazing	–	Attainable physical potential carrying capacity (s.u./ha) = 16
	Forestry	–	Production – site index (metres) for <i>Pinus radiata</i> = 22–28

Soil conservation management: Contour cultivation. Strip cropping. Minimum tillage techniques. Windbreaks.**Comments:** –

LUC unit: IVw1 (470 ha)**LUC suite:** 1. Low alluvial plains and terraces**LUC subsuite:** 1a. Soils with wetness limitations**Description:** Flat, very low alluvial terraces occurring in narrow valleys. The meandering nature of the streams and the low terrace level result in regular flooding and a potential for moderate to severe streambank erosion and deposition. Soils are well to poorly drained and texture varies from silty to stony.**Type location:** R27/536953 Makara Road south of Makara Beach**Altitudinal range:** 0–150 m**Slope:** Flat to gently undulating (A), 0–3°**Landform:** Low narrow terraces**Rock type:** Fine-grained alluvium over gravels (Af/Gr)**Soils:** Gleyed recent soils. Recent soils

	<i>Name</i>	<i>Symbol</i>	<i>Survey</i>
	Waiwhetu silt loam	Y	6
	Waikanae gravelly sand	Wg	6
<i>Texture:</i>	Silt loam, stony silt loam, gravelly sand		
<i>Depth:</i>	15–100 cm		
<i>Drainage:</i>	Well to poorly drained		

Erosion:*Present:* Slight (1) to moderate (2) streambank (Sb)*Potential:* Moderate (2) to severe (3) streambank (Sb). Moderate (2) deposition (D)**Vegetation:** Improved pasture (gl), rushes (hR)**Annual rainfall range:** 1200–1300 mm**Land use:**

<i>Present:</i>	Cropping	–	–
	Grazing	–	Present average carrying capacity (s.u./ha) = 13 Top farmer carrying capacity (s.u./ha) = 16
<i>Potential:</i>	Cropping	–	Root and green fodder crops
	Grazing	–	Attainable physical potential carrying capacity (s.u./ha) = 22
	Forestry	–	Production – site index (metres) for <i>Pinus radiata</i> = 27–29

Soil conservation management:

Streambank protection. Drainage.

Comments:

–

LUC unit: IVw2 (524 ha)**LUC suite:** 1. Low alluvial plains and terraces**LUC subsuite:** 1a. Soils with wetness limitations**Description:** Flat, narrow, alluvial valley floors with poorly drained gley soils. A high water table, periodic flooding and runoff from surrounding hills add to the drainage difficulty.**Type location:** R27/823030 Swamp Road, Mangaroo Valley**Altitudinal range:** 20–160 m**Slope:** Flat to gently undulating (A), 0–3°**Landform:** Low narrow terraces**Rock type:** Fine-grained alluvium (Af)

Soils:	Gley soils		
	<i>Name</i>	<i>Symbol</i>	<i>Survey</i>
	Gollans heavy silt loam	G	6
	<i>Texture:</i> Silt loam, heavy silt loam, clay loam, peaty silt loam		
	<i>Depth:</i> 50 cm+		
	<i>Drainage:</i> Poorly drained		

Erosion:*Present:* Negligible (0) to slight (1) streambank (Sb)*Potential:* Slight (1) streambank (Sb). Slight (1) deposition (D)**Vegetation:** Semi-improved pasture (gS), rushes (hR)**Annual rainfall range:** 1300–1400 mm**Land use:**

<i>Present:</i>	Cropping	–	–
	Grazing	–	Present average carrying capacity (s.u./ha) = 13
		–	Top farmer carrying capacity (s.u./ha) = 15
<i>Potential:</i>	Cropping	–	Root and green fodder crops
	Grazing	–	Attainable physical potential carrying capacity (s.u./ha) = 20
	Forestry	–	Production – site index (metres) for <i>Pinus radiata</i> = Unsuitable

Soil conservation management:

Drainage. Streambank protection.

Comments: –

LUC unit: IVw3 (361 ha)

LUC suite: 2. Peat bogs, swamps and basins

LUC subsuite:

Description: Interdune peat swamps and lake margins between Waitarere and Waikanae, with poorly to very poorly drained organic soils.

Type location: S25/014656 Lake Horowhenua

Altitudinal range: 5–10 m

Slope: Flat to gently undulating (A), 0–3°

Landform: Interdune depressions and lake margins

Rock type: Peat (Pt)

Soils: Organic soils

Name	Symbol	Survey
Omanuka peat	Om	7
Pukepuke–Omanuka association	P-O	4

Texture: Peat
Depth: >1 m
Drainage: Poorly to very poorly drained

Erosion:

Present: Negligible (0)

Potential: Negligible (0)

Vegetation: Semi-improved pasture (gS), wetland vegetation (hW), rushes (hR)

Annual rainfall range: 900–1100 mm

Land use:

Present: Cropping – –

Grazing – Present average carrying capacity (s.u./ha) = 7

– Top farmer carrying capacity (s.u./ha) = 10

Undeveloped

Potential: Cropping – Root and green fodder crops

Grazing – Attainable physical potential carrying capacity (s.u./ha) = 14

Forestry – Production – site index (metres) for *Pinus radiata* = Unsuitable

Soil conservation management:

Drainage. Water table control.

Comments:

Logs appearing at the surface require removal for arable use.

LUC unit: IVs1 (2610 ha)**LUC suite:** 1. Low alluvial plains and terraces**LUC subsuite:** 1b. Soils with limitations of stoniness and insufficient moisture**Description:** Flat, low river terraces with shallow, sandy to stony soils. Some stones present at the surface. Soils are somewhat excessively drained and subject to seasonal soil moisture deficiencies. In areas unprotected by stopbanks there is a potential for flooding and moderate streambank erosion and deposition.**Type location:** S25/919459 Otaki**Altitudinal range:** 0–200 m**Slope:** Flat to gently undulating (A), 0–3°**Landform:** Low river terraces**Rock type:** Fine-grained alluvium over gravels (Af/Gr)

Soils: Recent soils

Name	Symbol	Survey
Tukituki sandy loam, stony gravel etc.	1c	2
Waikanae gravelly sand	Wg	6
Rangitikei loamy sand	1	3
Rangitikei sandy loam	1b	3
	R4	7
Rangitikei shallow fine sandy loam	R1	7

Texture: Sandy loam, stony sandy loam, loamy sand, gravelly sand
Depth: 15–40 cm
Drainage: Somewhat excessively drained

Erosion:*Present:* Slight (1) streambank (Sb)*Potential:* Moderate (2) streambank (Sb). Moderate (2) deposition (D)**Vegetation:** Semi-improved pasture (gS), gorse (sG)**Annual rainfall range:** 1000–1400 mm**Land use:**

Present: Cropping – –
 Grazing – Present average carrying capacity (s.u./ha) = 14
 – Top farmer carrying capacity (s.u./ha) = 16

Potential: Cropping – Root and green fodder crops
 Grazing – Attainable physical potential carrying capacity (s.u./ha) = 20
 Forestry – Production – site index (metres) for *Pinus radiata* = 25–28

Soil conservation management:

Streambank protection. Stopbanks.

Comments:

–

LUC unit: IVs2 (2525 ha)

LUC suite: 3. Medium-height stony alluvial terraces

LUC subsuite:

Description: Flat, medium-height alluvial terraces, with shallow stony soils not subject to flooding. Some stones present at the surface. Occurs in areas of high rainfall but as soils are somewhat excessively drained, is subject to seasonal soil moisture deficiencies.

Type location: S26/977377 Otaki Gorge Road

Altitudinal range: 40–200 m

Slope: Flat to gently undulating (A), 0–3°

Landform: Medium-height terraces

Rock type: Alluvial gravels (Gr)

Soils: Stony soils associated with intergrades between yellow-brown loams and yellow-brown earths. Yellow-brown shallow and stony soils associated with yellow-brown earths.

	<i>Name</i>	<i>Symbol</i>	<i>Survey</i>
	Kopua stony loam	78a	2
	Kohinui stony loam	78a	5
	Heretaunga stony silt loam	Hs	6
<i>Texture:</i>	Stony silt loam		
<i>Depth:</i>	15–30 cm		
<i>Drainage:</i>	Somewhat excessively drained		

Erosion:

Present: Negligible (0)

Potential: Negligible (0)

Vegetation: Semi-improved pasture (gS), fern (sF), exotic conifer forest (fF)

Annual rainfall range: 1400–2000 mm

Land use:

<i>Present:</i>	Cropping	–	–
	Grazing	–	Present average carrying capacity (s.u./ha) = 8 Top farmer carrying capacity (s.u./ha) = 12
<i>Potential:</i>	Cropping	–	Root and green fodder crops. Orchards
	Grazing	–	Attainable physical potential carrying capacity (s.u./ha) = 17
	Forestry	–	Production – site index (metres) for <i>Pinus radiata</i> = 26–28

Soil conservation management: –

Comments: –

LUC unit:	IVc1 (288 ha)		
LUC suite:	8. Greywacke mountainlands and associated foothills		
LUC subsuite:	8b. Greywacke mountainlands with rainfall >1780 mm p.a. Soils are podzolised yellow-brown earths		
Description:	Flat to undulating upland basins at approx. 500 m a.s.l. with a mantle of loess, colluvium and solifluction material. Soils are podzolised and have impeded drainage. High rainfall, cold winter temperatures and frosts limit cropping. Occurs in the foothills of the Tararua Range.		
Type location:	S25/185637 Mangahao		
Altitudinal range:	450–500 m		
Slope:	Flat to undulating (A, A+B), 0–7°		
Landform:	Upland basins		
Rock type:	Loess and solifluction deposits (Lo)		
Soils:	Podzolised yellow-brown earths		
	<i>Name</i>	<i>Symbol</i>	<i>Survey</i>
	Renata silt loam	46	1
	Renata mottled silt loam	20a	3
	<i>Texture:</i> Silt loam, fine sandy loam		
	<i>Depth:</i> >1 m		
	<i>Drainage:</i> Imperfectly drained		
Erosion:			
	<i>Present:</i>	Negligible (0)	
	<i>Potential:</i>	Negligible (0)	
Vegetation:	Semi-improved pasture (gS), rushes (hR)		
Annual rainfall range:	2000–2500 mm		
Land use:			
	<i>Present:</i>	Cropping – –	
		Grazing – Present average carrying capacity (s.u./ha) = 8	
		– Top farmer carrying capacity (s.u./ha) = 10	
	<i>Potential:</i>	Cropping – Root and green fodder crops	
		Grazing – Attainable physical potential carrying capacity (s.u./ha) = 15	
		Forestry – Production – site index (metres) for <i>Pinus radiata</i> = 22–23	
Soil conservation management:	–		
Comments:	–		

LUC unit: Vle1 (4093 ha)**LUC suite:** 4. High, dissected loess-covered terraceland**LUC subsuite:** 4b. and 4c.**Description:** Strongly rolling to moderately steep, short terrace scarps of the high terracelands. The scarps have a shallow mantle of loess and tephra over unconsolidated sands and conglomerate. There is a potential for moderate soil slip and sheet erosion.**Type location:** S24/210740 Victoria Road, Tokomaru**Altitudinal range:** 20–200 m**Slope:** Strongly rolling to moderately steep (E, D), 16–25°**Landform:** Terrace scarps**Rock type:** Loess over unconsolidated to moderately consolidated sands and conglomerates (Lo/Us, Lo/Us * Cw)**Soils:** Intergrades between yellow-grey earths and yellow-brown earths. Yellow-grey earths

<i>Name</i>	<i>Symbol</i>	<i>Survey</i>
Halcombe hill soils	HaH	7
	15H	3
Raumai hill soils	17H	3
Tuapaka hill soils	16H	3
Kiwitea loam hill soil	76aH	2
Tokomaru hill soils	10H	3

Texture: Fine sandy loam, sandy loam*Depth:* 50–80 cm*Drainage:* Imperfectly to well drained**Erosion:***Present:* Slight (1) soil slip (Ss), slight (1) sheet (Sh), slight (1) tunnel gully (T)*Potential:* Moderate (2) soil slip (Ss), moderate (2) sheet (Sh), slight (1) tunnel gully (T)**Vegetation:** Semi-improved pasture (gS), improved pasture (gl), gorse (sG), manuka (sM)**Annual rainfall range:** 1000–1300 mm**Land use:***Present:* Grazing – Present average carrying capacity (s.u./ha) = 8

– Top farmer carrying capacity (s.u./ha) = 10

Potential: Cropping – Unsuitable

Grazing – Attainable physical potential carrying capacity (s.u./ha) = 14

Forestry – Production – site index (metres) for *Pinus radiata* = 27–29**Soil conservation management:** Maintain good quality pastures/apply adequate fertiliser levels. Avoid overgrazing. Open planting of soil conservation trees in areas susceptible to erosion. Control runoff from higher terraces.**Comments:** Stability of terrace scarps is related to the degree of consolidation of sands and presence of conglomerate beds. In some cases erosion potential is only slight and a Vls classification would be more appropriate.

LUC unit:	Vle2 (1305 ha)		
LUC suite:	4. High, dissected loess-covered terraceland		
LUC subsuite:	4a. Terraces and low hills formed from consolidated, weathered gravels. Soils are yellow-brown earths developed from loess		
Description:	Moderately steep hills in the Upper Hutt area with a shallow mantle of loess over consolidated weathered gravels. There is a potential for moderate soil slip erosion.		
Type location:	S26/912115 Kaitoke Hill		
Altitudinal range:	100–400 m		
Slope:	Moderately steep (E), 21–25°		
Landform:	Hills		
Rock type:	Shallow loess over consolidated gravels (Lo/Cw)		
Soils:	Yellow-brown earths		
	<i>Name</i>	<i>Symbol</i>	<i>Survey</i>
	Kaitoke hill soils	KH	6
	<i>Texture:</i> Stony silt loam, silt loam, fine sandy loam		
	<i>Depth:</i> 50–100 cm		
	<i>Drainage:</i> Well drained		
Erosion:			
	<i>Present:</i>	Slight (1) soil slip (Ss)	
	<i>Potential:</i>	Moderate (2) soil slip (Ss). Slight (1) sheet (Sh)	
Vegetation:	Exotic conifer forest (fF), mixed indigenous scrub (sX), lowland beech forest (fW), manuka (sM)		
Annual rainfall range:	1400–2400 mm		
Land use:			
	<i>Present:</i>	Exotic forestry	
		Reversion to scrub	
		Grazing	– Present average carrying capacity (s.u./ha) = 8
			– Top farmer carrying capacity (s.u./ha) = 10
	<i>Potential:</i>	Cropping	– Unsuitable
		Grazing	– Attainable physical potential carrying capacity (s.u./ha) = 13
		Forestry	– Production – site index (metres) for <i>Pinus radiata</i> = 20–24
Soil conservation management:	Open planting of soil conservation trees in areas susceptible to erosion. Avoid overgrazing.		
Comments:	Weathered Kaitoke gravels.		

LUC unit: Vle3 (2555 ha)**LUC suite:** 7. Greywacke hill country**LUC subsuite:** 7a. Coastal greywacke hill country exposed to strong salt-laden winds. Soils are intergrades between yellow-grey earths and yellow-brown earths**Description:** Moderately steep coastal greywacke hills in the Porirua–Paraparaumu area. The greywacke is moderately to highly weathered with a shallow mantle of loess. There is a potential for moderate soil slip erosion.**Type location:** R26/673134 Plimmerton**Altitudinal range:** 0–200 m**Slope:** Moderately steep to strongly rolling (E, E+D), 16–25°**Landform:** Coastal hills**Rock type:** Loess over greywacke (moderately to highly weathered) and related slope deposits (Lo/Gw)**Soils:** Intergrades between yellow-grey earths and yellow-brown earths.

Name	Symbol	Survey
Paremata hill soils	PmH	6
Porirua silt loam	P	6
<i>Texture:</i> Silt loam, sandy loam, clay loam		
<i>Depth:</i> >1 m		
<i>Drainage:</i> Moderately well to imperfectly drained		

Erosion:

Present: Slight (1) soil slip (Ss), slight (1) sheet (Sh), slight (1) tunnel gully (T)
Potential: Moderate (2) soil slip (Ss), slight (1) sheet (Sh), slight (1) tunnel gully (T)

Vegetation: Semi-improved pasture (gS), manuka (sM), coastal forest (fC), gorse (sG)**Annual rainfall range:** 1000–1200 mm**Land use:**

Present: Grazing – Present average carrying capacity (s.u./ha) = 9
 – Top farmer carrying capacity (s.u./ha) = 11
 Reversion to scrub

Potential: Cropping – Unsuitable
 Grazing – Attainable physical potential carrying capacity (s.u./ha) = 14
 Forestry – Production – site index (metres) for *Pinus radiata* = 22–26

Soil conservation management: Maintain good quality pastures/apply adequate fertiliser levels. Avoid overgrazing. Open planting of soil conservation trees in areas susceptible to erosion. Plant soil conservation trees in tunnel gullies.**Comments:** Moderately steep greywacke hills which border Cook Strait have a harsher coastal climate and are mapped as Vle9.

LUC unit: Vle4 (300 ha)**LUC suite:** 5. Sand country**LUC subsuite:** 5c. Older, slightly consolidated, inland sands, forming stable landforms**Description:** Moderately steep hills of slightly consolidated aeolian sands occurring near the coast between Plimmerton and Pukerua Bay. There is a potential for moderate soil slip and sheet erosion.**Type location:** R26/665145 Airlie Road, Plimmerton**Altitudinal range:** 0–100 m**Slope:** Moderately steep (E), 21–25°**Landform:** Coastal hills**Rock type:** Slightly consolidated sands (Us)**Soils:** Yellow-brown sands

	Name	Symbol	Survey
	Titahi hill soils	TiH	6
<i>Texture:</i>	Sandy loam, loamy sand		
<i>Depth:</i>	60–80 cm		
<i>Drainage:</i>	Moderately well to somewhat excessively drained		

Erosion:*Present:* Slight (1) soil slip (Ss), slight (1) sheet (Sh), slight (1) tunnel gully (T)*Potential:* Moderate (2) soil slip (Ss), moderate (2) sheet (Sh), slight (1) tunnel gully (T), slight (1) gully (G).**Vegetation:** Manuka (sM), semi-improved pasture (gS), exotic conifer forest (fF)**Annual rainfall range:** 1100 mm**Land use:***Present:* Grazing – Present average carrying capacity (s.u./ha) = 8
– Top farmer carrying capacity (s.u./ha) = 10

Reversion to scrub

Exotic forestry

Potential: Cropping – Unsuitable

Grazing – Attainable physical potential carrying capacity (s.u./ha) = 13

Forestry – Production – site index (metres) for *Pinus radiata* = 24–26**Soil conservation management:**

Maintain good quality pastures/apply adequate fertiliser levels. Avoid overgrazing. Open planting of soil conservation trees in areas susceptible to erosion. Control runoff from tracks and drainage channels to prevent gully formation. Plant soil conservation trees in tunnel gullies.

Comments:

–

LUC unit: Vle5 (4716 ha)**LUC suite:** 5. Sand country**LUC subsuite:** 5a. Young, unstable sand dunes**Description:** Strongly rolling to moderately steep consolidated sand dunes inland of the recent unconsolidated dunes. Soils are weakly developed and somewhat excessively drained. There is a potential for moderate wind erosion.**Type location:** S25/995662 Moutere Road, Lake Horowhenua**Altitudinal range:** 5–80 m**Slope:** Strongly rolling to moderately steep (D, E), 16–25°**Landform:** Sand dunes forming low hills**Rock type:** Windblown sands (Wb)**Soils:** Yellow-brown sands

Name	Symbol	Survey
Foxtton–Omanuka association	F-O	4
Foxtton black sand	Fx	7
Foxtton sand	F	6
Motuiti sand	Mt	7

Texture: Sand*Depth:* 20–60 cm*Drainage:* Somewhat excessively drained**Erosion:***Present:* Slight (1) to moderate (2) wind (W)*Potential:* Moderate (2) wind (W)**Vegetation:** Semi-improved pasture (gS), lupins (sL), exotic conifer forest (fF)**Annual rainfall range:** 900–1100 mm**Land use:***Present:* Grazing – Present average carrying capacity (s.u./ha) = 4
– Top farmer carrying capacity (s.u./ha) = 6

Exotic forestry

Potential: Cropping – Unsuitable
Grazing – Attainable physical potential carrying capacity (s.u./ha) = 10
Forestry – Production – site index (metres) for *Pinus radiata* = 26–29**Soil conservation management:** Maintenance of complete vegetation cover is essential to minimise wind erosion. This includes care in siting of fence lines, tracks, troughs, etc., and good pasture management to avoid overgrazing. Windbreaks.**Comments:** Dunes are of intermediate age. Blowouts are common.

LUC unit: Vle6 (14 933 ha)**LUC suite:** 7. Greywacke hill country**LUC subsuite:** 7b. Inland greywacke hill country with rainfall <1270 mm p.a. Soils are yellow-brown earths**Description:** Moderately steep to steep greywacke hill country in areas of moderate rainfall (1140–1270 mm p.a.) with seasonal soil moisture deficiencies. The hill country is at altitudes <400 m a.s.l. There is a potential for moderate soil slip erosion.**Type location:** R27/605003 Ohariu Valley**Altitudinal range:** 20–400 m**Slope:** Moderately steep to steep (E, E+F), 21–35°**Landform:** Hills**Rock type:** Shallow, patchy loess over greywacke (slightly weathered) and related slope deposits (pLO/Gw)**Soils:** Yellow-brown earths and related steepland soils

<i>Name</i>	<i>Symbol</i>	<i>Survey</i>
Korokoro hill soils	KoH	6
	35bH	2
	18H	3
Makara steepland soils	MkS	6
	122	2
	21	3

Texture: Silt loam, sandy loam, clay loam*Depth:* 40–80 cm*Drainage:* Well drained**Erosion:***Present:* Negligible (0) to slight (1) soil slip (Ss), slight (1) sheet (Sh)*Potential:* Moderate (2) soil slip (Ss), slight (1) sheet (Sh)**Vegetation:** Semi-improved pasture (gS), gorse (sG), mixed indigenous scrub (sX), exotic conifer forest (fF), manuka (sM), improved pasture (gl)**Annual rainfall range:** 1140–1270 mm**Land use:***Present:* Grazing – Present average carrying capacity (s.u./ha) = 8

– Top farmer carrying capacity (s.u./ha) = 10

Reversion to scrub

Exotic forestry

Potential: Cropping – Unsuitable

Grazing – Attainable physical potential carrying capacity (s.u./ha) = 12

Forestry – Production – site index (metres) for *Pinus radiata* = 26–28**Soil conservation management:** Maintenance of a complete vegetation cover is necessary. On pastoral land this includes applying adequate fertiliser and avoiding overgrazing to ensure good pasture cover.**Comments:** Pastures are prone to scrub reversion.

LUC unit: **Vle7 (8398 ha)****LUC suite:** 7. Greywacke hill country**LUC subsuite:** 7c. Inland, weathered greywacke hill country with rainfall 1400–2000 mm p.a. Soils are strongly leached yellow-brown earths**Description:** Moderately steep to steep, highly weathered greywacke hills with low fertility soils. Occurs in the hill country east of the Hutt Valley. There is a potential for moderate soil slip erosion.**Type location:** R27/747008 Taita**Altitudinal range:** 20–400 m**Slope:** Moderately steep to steep (E, E+F), 21–35°**Landform:** Hills**Rock type:** Greywacke (deeply and highly weathered) and related slope deposits (Gw)**Soils:** Yellow-brown earths and related steepland soils

	<i>Name</i>	<i>Symbol</i>	<i>Survey</i>
	Taita hill soils	TH	6
	Tawai steepland soils	TaS	6
<i>Texture:</i>	Silt loam, clay loam		
<i>Depth:</i>	65→100 cm		
<i>Drainage:</i>	Moderately well to imperfectly drained		

Erosion:

Present: Negligible (0) to slight (1) soil slip (Ss)
Potential: Moderate (2) soil slip (Ss), slight (1) sheet (Sh)

Vegetation: Gorse (sG), manuka (sM), mixed indigenous scrub (sX), lowland beech forest (fW), semi-improved pasture (gS), exotic conifer forest (fF), fern (sF)**Annual rainfall range:** 1400–2000 mm**Land use:**

Present: Reversion to scrub
 Undeveloped
 Grazing – Present average carrying capacity (s.u./ha) = 7
 – Top farmer carrying capacity (s.u./ha) = 8
 Exotic forestry

Potential: Cropping – Unsuitable
 Grazing – Attainable physical potential carrying capacity (s.u./ha) = 11
 Forestry – Production – site index (metres) for *Pinus radiata* = 24–26

Soil conservation management: Maintenance of complete vegetation cover is necessary. On pastoral land this includes applying adequate fertiliser and avoiding overgrazing to ensure good pasture cover.**Comments:** Firebreaks are required near urban areas. Pastures are prone to scrub reversion.

LUC unit: Vle8 (21 945 ha)**LUC suite:** 8. Greywacke mountainlands and associated foothills**LUC subsuite:** 8a. Greywacke foothills with rainfall 1270–1780 mm p.a. Soils are strongly leached yellow-brown earths**Description:** Moderately steep to steep greywacke hill country, comprising the foothills of the mountain ranges. Typically occurs at altitudes between 200–500 m a.s.l. in areas of high rainfall (1270–1780 mm p.a.). Soils are strongly leached and of low fertility. There is a potential for moderate soil slip erosion.**Type location:** R26/889208 Cloustonville, Akatarawa Road**Altitudinal range:** 200–500 m**Slope:** Moderately steep to steep (E, E+F), 21–35°**Landform:** Foothills of the ranges**Rock type:** Greywacke (slightly weathered) and related slope deposits (Gw)**Soils:** Yellow-brown earths and related steepland soils

Name	Symbol	Survey
Akatarawa hill soils	AH	6
Matamau silt loam, hill soil	77H	1,2
Ramiha hill soils	19H	3
Tuhitarata hill soils	41aH	5
Ruahine steepland soils	RuS	6
	124	1,2
	22	3

Texture: Stony silt loam, silt loam, clay loam**Depth:** 25–85 cm**Drainage:** Well drained**Erosion:****Present:** Negligible (0) to slight (1) soil slip (Ss)**Potential:** Moderate (2) soil slip (Ss), slight (1) sheet (Sh), slight (1) scree (Sc)**Vegetation:** Semi-improved pasture (gS), mixed indigenous scrub (sX), manuka (sM), broadleaved forest (fB), exotic conifer forest (fF), lowland podocarp–broadleaved forest (fO), mixed indigenous scrub with tree ferns (sT)**Annual rainfall range:** 1270–1780 mm**Land use:****Present:** Grazing – Present average carrying capacity (s.u./ha) = 5
– Top farmer carrying capacity (s.u./ha) = 6

Reversion to scrub

Exotic forestry

Undeveloped

Potential: Cropping – Unsuitable

Grazing – Attainable physical potential carrying capacity (s.u./ha) = 10

Forestry – Production – site index (metres) for *Pinus radiata* = 24–28**Soil conservation management:** Maintenance of complete vegetation cover is necessary. On pastoral land this includes applying adequate fertiliser and avoiding overgrazing to ensure good pasture cover. Care in siting of tracks. Feral animal control.**Comments:** Pastures are prone to scrub reversion.

- LUC unit:** **Vle9 (1376 ha)**
- LUC suite:** 7. Greywacke hill country
- LUC subsuite:** 7a. Coastal greywacke hill country exposed to strong salt laden winds. Soils are intergrades between yellow-grey earths and yellow-brown earths
- Description:** Moderately steep, coastal greywacke hill country bordering Cook Strait. The hills are exposed to strong salt-laden winds and are subject to seasonal soil moisture deficiencies. There is a potential for moderate soil slip and sheet erosion.
- Type location:** R27/668805 Fitzroy Bay
- Altitudinal range:** 0–250 m
- Slope:** Moderately steep to strongly rolling (E, E+D), 16–25°
- Landform:** Coastal hills
- Rock type:** Shallow loess over greywacke (slightly weathered) and related slope deposits (Gw)
- Soils:** Intergrades between yellow-grey earths and yellow-brown earths and related stepland soils
- | | <i>Name</i> | <i>Symbol</i> | <i>Survey</i> |
|------------------|--|---------------|-------------------------|
| | Paremata hills soils | PmH | 6 |
| | Terawhiti hill soils | TwH | G. Mew
(pers. comm.) |
| | Terawhiti stepland soils | TwS | 6 |
| <i>Texture:</i> | Stony silt loam, stony sandy loam, clay loam | | |
| <i>Depth:</i> | 30–70 cm | | |
| <i>Drainage:</i> | Moderately well drained | | |
- Erosion:**
- Present:* Slight (1) soil slip (Ss), slight (1) sheet (Sh), slight (1) scree (Sc)
- Potential:* Moderate (2) soil slip (Ss), moderate (2) sheet (Sh), slight (1) wind (W), slight (1) scree (Sc)
- Vegetation:** Semi-improved pasture (gS), coastal scrub (sO), *Cassinia* (tauhinu) (sC), gorse (sG), manuka (sM)
- Annual rainfall range:** 1100–1200 mm
- Land use:**
- Present:* Grazing – Present average carrying capacity (s.u./ha) = 4
– Top farmer carrying capacity (s.u./ha) = 5
Reversion to scrub
- Potential:* Cropping – Unsuitable
Grazing – Attainable physical potential carrying capacity (s.u./ha) = 7
Forestry – Production – site index (metres) for *Pinus radiata* = 16–18
- Soil conservation management:** Maintenance of complete vegetation cover is necessary. On pastoral land this includes applying adequate fertiliser and avoiding overgrazing to ensure good pasture cover.
- Comments:** Pastures are prone to scrub reversion.

LUC unit:	Vle10 (2407 ha)		
LUC suite:	8. Greywacke mountainlands and associated foothills		
LUC subsuite:	8b. Greywacke mountainlands with rainfall >1780 mm p.a. Soils are podzolised yellow-brown earths		
Description:	Moderately steep hills in or adjacent to the greywacke mountain ranges. Typically occurs at altitudes between 400–700 m a.s.l. in areas of very high rainfall (>1780 mm p.a.). Soils are podzolised and of very low fertility. There is a potential for moderate soil slip erosion.		
Type location:	R26/844240 Akatarawa River Headwaters		
Altitudinal range:	400–700 m		
Slope:	Moderately steep (E), 21–25°		
Landform:	Hills within the mountain ranges		
Rock type:	Shallow loess and solifluction deposits over greywacke (moderately weathered) and related slope deposits (Gw, Lo/Gw)		
Soils:	Podzolised yellow-brown earths		
	<i>Name</i>	<i>Symbol</i>	<i>Survey</i>
	Renata hill soils	RH	6
		46H	1
	<i>Texture:</i>	Silt loam, fine sandy loam, clay loam	
	<i>Depth:</i>	70–100 cm	
	<i>Drainage:</i>	Moderately well drained	
Erosion:	<i>Present:</i> Negligible (0) to slight (1) debris avalanche (Da)		
	<i>Potential:</i> Moderate (2) soil slip (Ss), slight (1) sheet (Sh), slight (1) scree (Sc)		
Vegetation:	Podocarp–broadleaved–beech forest (fD), cutover lowland podocarp–broadleaved forest (cfO), highland podocarp–broadleaved forest (fl), mixed indigenous scrub (sX)		
Annual rainfall range:	1780–2800 mm		
Land use:	<i>Present:</i> Undeveloped		
	Selective logging of indigenous forest		
	Grazing	– Present average carrying capacity (s.u./ha) = 4	
		– Top farmer carrying capacity (s.u./ha) = 5	
	<i>Potential:</i> Cropping	– Unsuitable	
	Grazing	– Attainable physical potential carrying capacity (s.u./ha) = 8	
	Forestry	– Production – site index (metres) for <i>Pinus radiata</i> = 22–26	
Soil conservation management:	Maintenance of complete vegetation cover is necessary. Care in siting of tracks. Feral animal control.		
Comments:	Pastures are prone to scrub reversion		

LUC unit: Vlw1 (317 ha)**LUC suite:** 2. Peat bogs, swamps and basins**LUC subsuite:****Description:** Peat swamps and swamp margins with high water tables and capable of only limited drainage.**Type location:** R26/820368 Totara Lagoon, Waikanae**Altitudinal range:** 10–140 m**Slope:** Flat to gently undulating (A), 0–3°**Landform:** Peat swamps**Rock type:** Peat (Pt) or alluvium and peat (Af + Pt)

Soils:	Organic soils		
	<i>Name</i>	<i>Symbol</i>	<i>Survey</i>
	Mangaroa loamy peat	Mp	6
	Omanuka peat	Om	7
	Gollans silty muck	Gm	6
	<i>Texture:</i> Peat, loamy peat		
	<i>Depth:</i> 50–100 cm		
	<i>Drainage:</i> Poorly to very poorly drained		

Erosion:*Present:* Negligible (0)*Potential:* Negligible (0)**Vegetation:** Wetland vegetation (hW), rushes (hR), semi-improved pasture (gS)**Annual rainfall range:** 1100–1400 mm**Land use:***Present:* Undeveloped

Grazing – Present average carrying capacity (s.u./ha) = 5

– Top farmer carrying capacity (s.u./ha) = 7

Potential: Cropping – Unsuitable

Grazing – Attainable physical potential carrying capacity (s.u./ha) = 12

Forestry – Unsuitable

Soil conservation management:

Drainage. Water table control.

Comments: High water table (<35 cm).

LUC unit: VIs1 (3705 ha)**LUC suite:** 4. High, dissected loess-covered terraceland**LUC subsuite:** 4a. Terraces and low hills formed from consolidated, weathered gravels. Soils are yellow-brown earths developed from loess**Description:** Strongly rolling to moderately steep, low, stable hills with a mantle of loess over gravels and consolidated gravels. Rainfall typically 1140–1270 mm p.a. Occurs in the Wellington district.**Type location:** R27/730095 Flightys Road, Judgeford**Altitudinal range:** 20–240 m**Slope:** Strongly rolling to moderately steep (D+E, E+D), 16–25°**Landform:** Low hills**Rock type:** Loess over gravels (Lo/Gr) or loess over consolidated gravels (Lo/Cw)**Soils:** Yellow-brown earths

	<i>Name</i>	<i>Symbol</i>	<i>Survey</i>
	Judgeford hill soils	JH	6
	Kaitoke hill soils	KH	6
<i>Texture:</i>	Silt loam, loam, clay loam (stony)		
<i>Depth:</i>	65–80 cm		
<i>Drainage:</i>	Well drained		

Erosion:

Present: Negligible (0)
Potential: Slight (1) soil slip (Ss), slight (1), sheet (Sh)

Vegetation: Improved pasture (gl), exotic conifer forest (fF), manuka (sM), gorse (sG)**Annual rainfall range:** 1140–1270 mm**Land use:**

Present: Grazing – Present average carrying capacity (s.u./ha) = 12
 – Top farmer carrying capacity (s.u./ha) = 14
 Exotic forestry

Potential: Cropping – Unsuitable
 Grazing – Attainable physical potential carrying capacity (s.u./ha) = 18
 Forestry – Production – site index (metres) for *Pinus radiata* = 26–30

Soil conservation management: –**Comments:** Includes some terrace scarps.

LUC unit:	VIs2 (329 ha)		
LUC suite:	5. Sand country		
LUC subsuite:	5c. Older, slightly consolidated, inland sands, forming stable landforms		
Description:	Strongly rolling to moderately steep low stable hills of slightly consolidated aeolian sands occurring near the coast between Plimmerton and Paraparaumu.		
Type location:	R26/6851 65 Pukerua Bay		
Altitudinal range:	20–100 m		
Slope:	Strongly rolling to moderately steep (D, D+E), 16–25°		
Landform:	Low coastal hills		
Rock type:	Slightly consolidated sands (Us)		
Soils:	Yellow-brown sands		
	<i>Name</i>	<i>Symbol</i>	<i>Survey</i>
	Titahi hill soils	TiH	6
<i>Texture:</i>	Fine sandy loam, loamy sand		
<i>Depth:</i>	70–100 cm		
<i>Drainage:</i>	Moderately well to somewhat excessively drained		
Erosion:			
<i>Present:</i>	Negligible (0)		
<i>Potential:</i>	Slight (1) sheet (Sh), slight (1), gully (G)		
Vegetation:	Improved pasture (gl), coastal forest (fC)		
Annual rainfall range:	1100–1200 mm		
Land use:			
<i>Present:</i>	Grazing	–	Present average carrying capacity (s.u./ha) = 10
		–	Top farmer carrying capacity (s.u./ha) = 12
<i>Potential:</i>	Cropping	–	Unsuitable
	Grazing	–	Attainable physical potential carrying capacity (s.u./ha) = 16
	Forestry	–	Production – site index (metres) for <i>Pinus radiata</i> = 26–28
Soil conservation management:	Control runoff from tracks and drainage channels to prevent gully formation.		
Comments:	–		

- LUC unit:** VIs3 (769 ha)
- LUC suite:** 3. Medium-height stony alluvial terraces
- LUC subsuite:**
- Description:** Long, fossil scree and fan slopes associated with greywacke hill country or mountainland and formed of very stony and bouldery deposits.
- Type location:** R26/865383 Hadfield Road, Waikanae
- Altitudinal range:** 10–200 m
- Slope:** Strongly inclined (C), 8–15°
- Landform:** Fans and fossil screes
- Rock type:** Coarse slope colluvium (CI)
- Soils:** Yellow-brown shallow and stony soils associated with yellow-brown earths. Stony soils associated with intergrades between yellow-brown loams and yellow-brown earths
- | Name | Symbol | Survey |
|----------------------------|--------|--------|
| Kawhatau stony silt loam | 76b | 2 |
| Heretaunga stony silt loam | Hs | 6 |
| Kopua stony loam | 78a | 2 |
- Texture:* Stony silt loam
- Depth:* 10–30 cm
- Drainage:* Somewhat excessively drained
- Erosion:**
- Present:* Negligible (0) to slight (1) gully (G)
- Potential:* Slight (1) gully (G), slight (1) deposition (D)
- Vegetation:** Semi-improved pasture (gS), lowland podocarp–broadleaved forest (fO), coastal forest (fC)
- Annual rainfall range:** 1200–2400 mm
- Land use:**
- Present:* Grazing – Present average carrying capacity (s.u./ha) = 9
– Top farmer carrying capacity (s.u./ha) = 12
- Undeveloped
- Potential:* Cropping – Unsuitable
- Grazing – Attainable physical potential carrying capacity (s.u./ha) = 16
- Forestry – Production – site index (metres) for *Pinus radiata* = 24–28
- Soil conservation management:** Control runoff from tracks and drainage channels to prevent gully formation.
- Comments:** Occurs at the foot of steep greywacke hill slopes. In many places fans are too small to map separately and have been included in the associated hill country LUC unit.

LUC unit: VIs4 (615 ha)**LUC suite:** 5. Sand country**LUC subsuite:** 5b. Interdune sandplains**Description:** Flat to undulating, free draining, higher sandplains near the coast between Waitarere and Waikanae. Soils have little profile development and are subject to seasonal soil moisture deficiencies.**Type location:** S24/973714 Waitarere Forest**Altitudinal range:** 5–10 m**Slope:** Flat to undulating (A, A+B), 0–7°**Landform:** Sandplains**Rock type:** Windblown sands (Wb)**Soils:** Yellow-brown sands

<i>Name</i>	<i>Symbol</i>	<i>Survey</i>
Himatangi–Foxton association	Hm-F	4
Hokio–Waitarere association	H-W	4
Himatangi sand	Hm	7

Texture: Sand, loamy sand*Depth:* 30–60 cm on sand*Drainage:* Somewhat excessively to moderately well drained**Erosion:***Present:* Negligible (0)*Potential:* Slight (1) wind (W)**Vegetation:** Semi-improved pasture (gS), lupins (sL)**Annual rainfall range:** 900–1100 mm**Land use:***Present:* Grazing – Present average carrying capacity (s.u./ha) = 6

– Top farmer carrying capacity (s.u./ha) = 10

Potential: Cropping – Unsuitable

Grazing – Attainable physical potential carrying capacity (s.u./ha) = 17

Forestry – Production – site index (metres) for *Pinus radiata* = 26–30**Soil conservation management:**

Maintenance of complete vegetation cover is essential to minimise wind erosion. This includes care in siting of fence lines, tracks, troughs, etc., and good pasture management to avoid overgrazing. Windbreaks.

Comments:

–

LUC unit: VIs5 (2263 ha)**LUC suite:** 5. Sand country**LUC subsuite:** 5a. Young, unstable sand dunes**Description:** Rolling to strongly rolling low, stable sand dunes. The oldest and most consolidated dunes, forming the inland margin of the sand country. The soils exhibit maximum soil development, but are somewhat excessively drained.**Type location:** S25/996657 Moutere Road, Lake Horowhenua**Altitudinal range:** 10–30 m**Slope:** Rolling to strongly rolling (C, D), 8–20°**Landform:** Sand dunes forming low ridges**Rock type:** Windblown sands (Wb)**Soils:** Yellow-brown sands

<i>Name</i>	<i>Symbol</i>	<i>Survey</i>
Foxton–Omanuka association	F-O	4
Foxton black sand	Fx	7
Foxton sand	F	6

Texture: Sand*Depth:* 50–80 cm on sand*Drainage:* Somewhat excessively drained**Erosion:***Present:* Negligible (0)*Potential:* Slight (1) wind (W)**Vegetation:** Semi-improved pasture (gS), lupins (sL)**Annual rainfall range:** 950–1150 mm**Land use:***Present:* Grazing – Present average carrying capacity (s.u./ha) = 6
– Top farmer carrying capacity (s.u./ha) = 9*Potential:* Cropping – Unsuitable
Grazing – Attainable physical potential carrying capacity (s.u./ha) = 15
Forestry – Production – site index (metres) for *Pinus radiata* = 28–30**Soil conservation management:**

Maintenance of complete vegetation cover is essential to minimise wind erosion. This includes care in siting of fence lines, tracks, troughs, etc., and good pasture management to avoid overgrazing. Windbreaks.

Comments: Often occurs in association with Illw2 or Illw3.

LUC unit: VIs6 (2298 ha)**LUC suite:** 7. Greywacke hill country**LUC subsuite:** 7b. Inland greywacke hill country with rainfall <1270 mm p.a. Soils are yellow-brown earths**Description:** Strongly rolling to moderately steep low hills with a mantle of loess over greywacke. The hills are at elevations <300 m a.s.l. and have a moderate rainfall (1140–1270 mm p.a.). Slopes are stable but subject to seasonal soil moisture deficiencies.**Type location:** R27/593982 Ohariu Valley**Altitudinal range:** 20–300 m**Slope:** Strongly rolling to moderately steep (D, D+E, E+D), 16–25°**Landform:** Low hills**Rock type:** Loess over greywacke (slightly to moderately weathered) (Lo/Cw)**Soils:** Yellow-brown earths

	<i>Name</i>	<i>Symbol</i>	<i>Survey</i>
	Korokoro hill soils	KoH	6
	Matamau silt loam, hill soil	77H	2
<i>Texture:</i>	Sandy loam, silt loam		
<i>Depth:</i>	50–90 cm		
<i>Drainage:</i>	Well drained		

Erosion:

Present: Negligible (0) to slight (1) sheet (Sh)
Potential: Slight (1) sheet (Sh), slight (1) soil slip (Ss)

Vegetation: Improved pasture (gl), semi-improved pasture (gS), gorse (sG), exotic conifer forest (fF)**Annual rainfall range:** 1140–1270 mm**Land use:**

Present: Grazing – Present average carrying capacity (s.u./ha) = 8
 – Top farmer carrying capacity (s.u./ha) = 10
 Exotic forestry

Potential: Cropping – Unsuitable
 Grazing – Attainable physical potential carrying capacity (s.u./ha) = 13
 Forestry – Production – site index (metres) for *Pinus radiata* = 26–30

Soil conservation management: –**Comments:** –

LUC unit:	VIs7 (4816 ha)																					
LUC suite:	1. Low alluvial plains and terraces																					
LUC subsuite:	1b. Soils with limitations of stoniness and insufficient soil moisture																					
Description:	Flat to undulating, narrow river terraces bordering major rivers. Soils are shallow, bouldery, excessively drained and experience seasonal soil moisture deficiencies. There is a potential for moderate streambank erosion and deposition.																					
Type location:	S26/082120 Bucks Road, Tauherenikau Gorge																					
Altitudinal range:	20–500 m																					
Slope:	Flat to undulating (A, A+B), 0–7°																					
Landform:	River terraces																					
Rock type:	Alluvial gravels and sands (Gr)																					
Soils:	Recent soils. Stony soils associated with intergrades between yellow-brown loams and yellow-brown earths																					
	<table border="0"> <thead> <tr> <th><i>Name</i></th> <th><i>Symbol</i></th> <th><i>Survey</i></th> </tr> </thead> <tbody> <tr> <td>Tukituki sandy loam, stony gravel, etc.</td> <td>1c</td> <td>2,1</td> </tr> <tr> <td>Waikanae gravelly sand</td> <td>Wg</td> <td>6</td> </tr> <tr> <td>Otaki stony loamy sand</td> <td>Ot</td> <td>7</td> </tr> <tr> <td>Kopua stony loam</td> <td>78a</td> <td>2</td> </tr> <tr> <td>Kohinui stony loam</td> <td>78a</td> <td>5</td> </tr> <tr> <td>Heretaunga stony silt loam</td> <td>Hs</td> <td>6</td> </tr> </tbody> </table>	<i>Name</i>	<i>Symbol</i>	<i>Survey</i>	Tukituki sandy loam, stony gravel, etc.	1c	2,1	Waikanae gravelly sand	Wg	6	Otaki stony loamy sand	Ot	7	Kopua stony loam	78a	2	Kohinui stony loam	78a	5	Heretaunga stony silt loam	Hs	6
<i>Name</i>	<i>Symbol</i>	<i>Survey</i>																				
Tukituki sandy loam, stony gravel, etc.	1c	2,1																				
Waikanae gravelly sand	Wg	6																				
Otaki stony loamy sand	Ot	7																				
Kopua stony loam	78a	2																				
Kohinui stony loam	78a	5																				
Heretaunga stony silt loam	Hs	6																				
<i>Texture:</i>	Stony sandy loam, stony loamy sand																					
<i>Depth:</i>	5–15 cm																					
<i>Drainage:</i>	Somewhat excessively to excessively drained																					
Erosion:																						
<i>Present:</i>	Slight (1) to moderate (2) streambank (Sb), negligible (0) to slight (1) deposition (D)																					
<i>Potential:</i>	Moderate (2) streambank (Sb), moderate (2) deposition (D)																					
Vegetation:	Semi-improved pasture (gS), lowland podocarp–broadleaved forest (fO), mixed indigenous scrub (sX), manuka (sM), podocarp–broadleaved–beech forest (fD)																					
Annual rainfall range:	1400–3000 mm																					
Land use:																						
<i>Present:</i>	Grazing – Present average carrying capacity (s.u./ha) = 6 – Top farmer carrying capacity (s.u./ha) = 10 Reversion to scrub Undeveloped																					
<i>Potential:</i>	Cropping – Unsuitable Grazing – Attainable physical potential carrying capacity (s.u./ha) = 13 Forestry – Production – site index (metres) for <i>Pinus radiata</i> = 25–27																					
Soil conservation management:	Streambank protection.																					
Comments:	Includes both low and high terraces. (High terraces are included in LUC suite 3.)																					

LUC unit: Vlc1 (13 839 ha)**LUC suite:** 8. Greywacke mountainlands and associated foothills**LUC subsuite:** 8a. Greywacke foothills with rainfall 1270–1780 mm p.a. Soils are strongly leached yellow-brown earths**Description:** Rolling to strongly rolling, exposed, broad ridgetops with a mantle of loess over greywacke. The ridges occur at altitudes between 300–500 m a.s.l. and are subject to strong winds and cool temperatures.**Type location:** R27/704038 Belmont Hill Road**Altitudinal range:** 300–500 m**Slope:** Rolling to strongly rolling (C, D), 8–20°**Landform:** Broad ridgetops**Rock type:** Loess and solifluction deposits over greywacke (slightly to moderately weathered) (Lo/Gw)**Soils:** Yellow-brown earths

	<i>Name</i>	<i>Symbol</i>	<i>Survey</i>
	Belmont silt loam	B	6
	Belmont hill soils	BH	6
	Ramiha silt loam	19	3
	Ramiha hill soils	19H	3
	Matamau silt loam	77	2
	Matamau silt loam hill soil	77H	2
<i>Texture:</i>	Silt loam		
<i>Depth:</i>	>1 m		
<i>Drainage:</i>	Well drained		

Erosion:

Present: Negligible (0)
Potential: Slight (1) sheet (Sh)

Vegetation: Semi-improved pasture (gS), exotic conifer forest (fF), broadleaved forest (fB), lowland podocarp–broadleaved forest (fO), mixed indigenous scrub (sX)**Annual rainfall range:** 1270–1780 mm**Land use:**

Present: Grazing – Present average carrying capacity (s.u./ha) = 9
– Top farmer carrying capacity (s.u./ha) = 11
Exotic forestry
Selective logging of indigenous forest

Potential: Cropping – Unsuitable
Grazing – Attainable physical potential carrying capacity (s.u./ha) = 14
Forestry – Production – site index (metres) for *Pinus radiata* = 22–28

Soil conservation management: –**Comments:** Shelterbelts. Occurs further inland than Vlc2 and is not subject to seasonal soil moisture deficiencies.

LUC unit:	Vlc2 (4406 ha)		
LUC suite:	7. Greywacke hill country		
LUC subsuite:	7a. and 7b.		
Description:	Rolling to strongly rolling, exposed greywacke ridgetops near the coast. The ridges occur at <400 m a.s.l. and are exposed to strong salt laden winds. Soils are shallow and subject to seasonal soil moisture deficiencies. Rock outcrops are common.		
Type location:	R27/507917 White Rock Hill, Makara		
Altitudinal range:	50–400 m		
Slope:	Rolling to strongly rolling (C, D), 8–20°		
Landform:	Broad ridgetops		
Rock type:	Shallow patchy loess over greywacke (slightly to moderately weathered) and related slope deposits (pLo/Gw)		
Soils:	Yellow-brown earths		
	<i>Name</i>	<i>Symbol</i>	<i>Survey</i>
	Korokoro silt loam	Ko	6
	Korokoro hill soils	KoH	6
	<i>Texture:</i> Silt loam, clay loam		
	<i>Depth:</i> 20–60 cm		
	<i>Drainage:</i> Well to somewhat excessively drained		
Erosion:	<i>Present:</i> Negligible (0)		
	<i>Potential:</i> Slight (1) sheet (Sh) and wind (W)		
Vegetation:	Semi-improved pasture (gS), <i>Cassinia</i> (tauhinu) (sC), gorse (sG), coastal scrub (sO)		
Annual rainfall range:	1140–1270 mm		
Land use:	<i>Present:</i> Grazing – Present average carrying capacity (s.u./ha) = 9		
	– Top farmer carrying capacity (s.u./ha) = 11		
	<i>Potential:</i> Cropping – Unsuitable		
	Grazing – Attainable physical potential carrying capacity (s.u./ha) = 13		
	Forestry – Production – site index (metres) for <i>Pinus radiata</i> = 16–22		
Soil conservation management:	Windbreaks.		
Comments:	–		

LUC unit:	Vlc3 (417 ha)									
LUC suite:	6. Raised marine terraces									
LUC subsuite:										
Description:	Sloping, raised marine terraces and fans on the Cook Strait coastline exposed to strong salt-laden winds. Soils are subject to seasonal soil moisture deficiencies.									
Type location:	R28/664763 Baring Head									
Altitudinal range:	30–300 m									
Slope:	Inclined to strongly inclined (B, B+C), 4–15°									
Landform:	Elevated marine terraces and fans									
Rock type:	Colluvium and beach gravels (Cl + Gr). Loess over unconsolidated sands and gravels (Lo/Us)									
Soils:	Intergrades between yellow-grey earths and yellow-brown earths									
	<table border="0"> <thead> <tr> <th><i>Name</i></th> <th><i>Symbol</i></th> <th><i>Survey</i></th> </tr> </thead> <tbody> <tr> <td>Porirua silt loam</td> <td>P</td> <td>6</td> </tr> <tr> <td>Porirua fine sandy loam</td> <td>Pf</td> <td>6</td> </tr> </tbody> </table>	<i>Name</i>	<i>Symbol</i>	<i>Survey</i>	Porirua silt loam	P	6	Porirua fine sandy loam	Pf	6
<i>Name</i>	<i>Symbol</i>	<i>Survey</i>								
Porirua silt loam	P	6								
Porirua fine sandy loam	Pf	6								
<i>Texture:</i>	Silt loam, fine sandy loam									
<i>Depth:</i>	60→100 cm									
<i>Drainage:</i>	Imperfectly to moderately well drained									
Erosion:										
<i>Present:</i>	Negligible (0)									
<i>Potential:</i>	Slight (1) wind (W), slight (1) deposition (D)									
Vegetation:	Semi-improved pasture (gS), coastal scrub (sO)									
Annual rainfall range:	1100–1200 mm									
Land use:										
<i>Present:</i>	<table border="0"> <tr> <td>Grazing</td> <td>–</td> <td>Present average carrying capacity (s.u./ha) = 8</td> </tr> <tr> <td></td> <td>–</td> <td>Top farmer carrying capacity (s.u./ha) = 9</td> </tr> </table>	Grazing	–	Present average carrying capacity (s.u./ha) = 8		–	Top farmer carrying capacity (s.u./ha) = 9			
Grazing	–	Present average carrying capacity (s.u./ha) = 8								
	–	Top farmer carrying capacity (s.u./ha) = 9								
<i>Potential:</i>	<table border="0"> <tr> <td>Cropping</td> <td>–</td> <td>Unsuitable</td> </tr> <tr> <td>Grazing</td> <td>–</td> <td>Attainable physical potential carrying capacity (s.u./ha) = 11</td> </tr> <tr> <td>Forestry</td> <td>–</td> <td>Production – site index (metres) for <i>Pinus radiata</i> = 12–16</td> </tr> </table>	Cropping	–	Unsuitable	Grazing	–	Attainable physical potential carrying capacity (s.u./ha) = 11	Forestry	–	Production – site index (metres) for <i>Pinus radiata</i> = 12–16
Cropping	–	Unsuitable								
Grazing	–	Attainable physical potential carrying capacity (s.u./ha) = 11								
Forestry	–	Production – site index (metres) for <i>Pinus radiata</i> = 12–16								
Soil conservation management:	Windbreaks.									
Comments:	–									

LUC unit: Vll1 (15 527 ha)**LUC suite:** 7. Greywacke hill country**LUC subsuite:** 7b. Inland greywacke hill country with rainfall <1270 mm p.a. Soils are yellow-brown earths**Description:** Steep to very steep greywacke hill country in areas of moderate rainfall (1140–1270 mm p.a.) with seasonal soil moisture deficiencies. The hill country occurs between 50 and 400 m a.s.l. There is a potential for moderate scree, sheet and soil slip erosion.**Type location:** R27/534901 Makara Road**Altitudinal range:** 50–400 m**Slope:** Steep to very steep (F, F+G), 26→35°**Landform:** Steep hills**Rock type:** Greywacke and related slope deposits (Gw)**Soils:** Steepland soils related to yellow-brown earths

Name	Symbol	Survey
Makara steepland soils	MkS	6
	122	2
	21	3

Texture: Silt loam, stony silt loam, fine sandy loam*Depth:* 30–75 cm*Drainage:* Well drained**Erosion:***Present:* Slight (1) scree (Sc), slight (1) sheet (Sh), slight (1) soil slip (Ss)*Potential:* Moderate (2) scree (Sc), moderate (2) sheet (Sh), moderate (2), soil slip (Ss)**Vegetation:** Semi-improved pasture (gS), gorse (sG), manuka (sM), *Cassinia* (sC), mixed indigenous scrub (sX), fern (sF), exotic conifer forest (fF)**Annual rainfall range:** 1140–1270 mm**Land use:***Present:* Grazing – Present average carrying capacity (s.u./ha) = 6

– Top farmer carrying capacity (s.u./ha) = 8

Reversion to scrub

Exotic forestry

Potential: Cropping – Unsuitable

Grazing – Attainable physical potential carrying capacity (s.u./ha) = 10

Forestry – Production and erosion control – site index (metres) for *Pinus radiata* = 20–28**Soil conservation management:**

Maintenance of complete vegetation cover is necessary. On pastoral land this includes applying adequate fertiliser and avoiding overgrazing to ensure good pasture cover.

In order to minimise soil erosion and maintain water quality, strict management guidelines should be followed in the case of the following activities: tree planting and logging, road construction, drain and culvert construction, scrub clearance.

Comments: Pastures are prone to scrub reversion. Includes areas of Vlls1 where soils are shallow and rock outcrops occur.

LUC unit: Vlle2 (59 111 ha)

LUC suite: 7. Greywacke hill country and
8. Greywacke mountainlands and associated foothills

LUC subsuite: 7c and 8a.

Description: Steep to very steep greywacke hill country in the foothills of the mountain ranges. Typically occurs at altitudes between 200–500 m a.s.l. in areas of high rainfall (1270–1780 mm p.a.). Soils are shallow and of low fertility. There is a potential for moderate to severe soil slip, scree and sheet erosion.

Type location: S26/980367 Otaki Gorge Road

Altitudinal range: 200–500 m

Slope: Steep to very steep (F, F+G), 26–>35°

Landform: Foothills of the ranges

Rock type: Greywacke and related slope deposits (Gw)

Soils: Steepland soils related to yellow-brown earths

Name	Symbol	Survey
Ruahine steepland soils	RuS	6
	124	2,1
	22	3
Tawai steepland soils	TaS	6

Texture: Silt loam, stony silt loam, silty clay loam

Depth: 40–80 cm

Drainage: Moderately well drained

Erosion:

Present: Slight (1) soil slip (Ss), slight (1) scree (Sc), slight (1) sheet (Sh), negligible (0) to slight (1) debris avalanche (Da)

Potential: Moderate (2) to severe (3) soil slip (Ss), moderate (2) to severe (3) scree (Sc). Moderate (2) sheet (Sh), slight (1) gully (G)

Vegetation: Lowland podocarp–broadleaved forest (fO), manuka (sM), mixed indigenous scrub (sX), semi-improved pasture (gS), lowland beech forest (fW), exotic conifer forest (fF)

Annual rainfall range: 1270–1780 mm

Land use:

Present: Undeveloped
Reversion to scrub
Grazing – Present average carrying capacity (s.u./ha) = 4
– Top farmer carrying capacity (s.u./ha) = 6
Exotic forestry

Selective logging of indigenous forest
Potential: Cropping – Unsuitable
Grazing – Attainable physical potential carrying capacity (s.u./ha) = 8
Forestry – Erosion control and production – site index (metres) for *Pinus radiata* = 20–27

Soil conservation management: Maintenance of complete vegetation cover is necessary. On pastoral land this includes applying adequate fertiliser and avoiding overgrazing to ensure good pasture cover. Erosion control forestry. Feral animal control. In order to minimise soil erosion and maintain water quality, strict management guidelines should be followed in the case of the following activities: tree planting and logging, road construction, drain and culvert construction, scrub clearance.

Comments: Pastures are prone to scrub reversion. Firebreaks are required near urban areas.

LUC unit:	VIIe3 (4497 ha)		
LUC suite:	5. Sand country		
LUC subsuite:	5a. Young, unstable sand dunes		
Description:	Rolling to moderately steep, recent, unconsolidated sand dunes near the coast. Soils are weakly developed and excessively drained. The dunes are exposed to strong salt-laden winds and there is a potential for very severe to extreme wind erosion.		
Type location:	S24/966718 Waitarere Forest		
Altitudinal range:	0–50 m		
Slope:	Rolling to moderately steep (C, D, E), 8–25°		
Landform:	Unstable sand dunes inland of the foredune		
Rock type:	Windblown sands (Wb)		
Soils:	Recent soils. Yellow-brown sands		
	<i>Name</i>	<i>Symbol</i>	<i>Survey</i>
	Waitarere–Hokio association	W-H	4
	Waitarere sand	Wa	7
	Foxton–Himatangi association	F-HM	4
	Bare rock	BR	
	<i>Texture:</i>	Sand	
	<i>Depth:</i>	0–20 cm on sand	
	<i>Drainage:</i>	Excessively drained	
Erosion:	<i>Present:</i> Slight (1) to very severe (4) wind (W)		
	<i>Potential:</i> Very severe (4) to extreme (5) wind (W)		
Vegetation:	Exotic conifer forest (fF), lupins (sL), fern (sF), semi-improved pasture (gS), manuka (sM), sand dune vegetation (gD)		
Annual rainfall range:	900–1100 mm		
Land use:	<i>Present:</i> Exotic forestry		
	Grazing	–	Present average carrying capacity (s.u./ha) = 1
		–	Top farmer carrying capacity (s.u./ha) = 2
	Undeveloped		
	<i>Potential:</i>	Cropping – Unsuitable	
		–	Attainable physical potential carrying capacity (s.u./ha) = 4
		–	Erosion control and production – site index (metres) for <i>Pinus radiata</i> = 24–28
Soil conservation management:	Maintenance of complete vegetation cover is essential to minimise wind erosion. Ensure recreational use does not damage vegetation cover. Erosion control forestry.		
Comments:	Pastures are prone to scrub reversion. Occurs inland of the foredune (>400 m inland).		

LUC unit: VIIe4 (6456 ha)**LUC suite:** 7. Greywacke hill country**LUC subsuite:** 7a. Coastal greywacke hill country exposed to strong salt laden winds. Soils are intergrades between yellow-grey earths and yellow-brown earths**Description:** Steep to very steep, coastal greywacke hill country. The hills are exposed to strong salt-laden winds and subject to seasonal soil moisture deficiencies. There is a potential for severe, sheet, wind and gully erosion.**Type location:** Q27/477881 Oteranga Bay Road**Altitudinal range:** 0–500 m**Slope:** Steep to very steep (F, F+G), 26–>35°**Landform:** Steep coastal hills**Rock type:** Greywacke and related slope deposits (Gw)**Soils:** Steepland soils related to intergrades between yellow-grey earths and yellow-brown earths

	<i>Name</i>	<i>Symbol</i>	<i>Survey</i>
	Terawhiti steepland soils	TwS	6
	Bare rock	BR	
<i>Texture:</i>	Stony sandy loam, stony silt loam		
<i>Depth:</i>	30–60 cm		
<i>Drainage:</i>	Moderately well to well drained		

Erosion:**Present:** Moderate (2) scree (Sc), moderate (2) sheet (Sh) and wind (W), moderate (2) gully (G), slight (1) soil slip (Ss)**Potential:** Severe (3) scree (Sc), severe (3) sheet (Sh), and wind (W), severe (3) gully (G), moderate (2) soil slip (Ss)**Vegetation:** Semi-improved pasture (gS), coastal scrub (sO), short tussock grassland (gT), *Cassinia* (sC), manuka (sM), gorse (sG)**Annual rainfall range:** 1100–1200 mm**Land use:****Present:** Grazing – Present average carrying capacity (s.u./ha) = 2
– Top farmer carrying capacity (s.u./ha) = 3

Reversion to scrub

Potential: Cropping – Unsuitable
Grazing – Attainable physical potential carrying capacity (s.u./ha) = 4
Forestry – Erosion control and production – site index (metres) for *Pinus radiata* = 14–20**Soil conservation management:** Maintenance of complete vegetation cover is necessary. On pastoral land this includes applying adequate fertiliser and avoiding overgrazing to ensure good pasture cover.

In order to minimise soil erosion and maintain water quality, strict management guidelines should be followed in the case of the following activities: tree planting and logging, road construction, drain and culvert construction, scrub clearance. Erosion control forestry.

Comments: Pastures are prone to scrub reversion.

LUC unit:	VIIe5 (32 571 ha)																					
LUC suite:	8. Greywacke mountainlands and associated foothills																					
LUC subsuite:	8b. Greywacke mountainlands with rainfall >1780 mm p.a. Soils are podzolised yellow-brown earths																					
Description:	Steep to very steep hills in or adjacent to the greywacke mountain ranges. Typically occurs at altitudes between 500–800 m a.s.l. in areas of very high rainfall (1780–4000 mm p.a.). Soils are podzolised, shallow and of very low fertility. There is a potential for severe soil slip and scree erosion.																					
Type location:	S27/008098 Rimutaka Hill Road																					
Altitudinal range:	500–800 m																					
Slope:	Moderately steep to very steep (F, F+G, E), 21–>35°																					
Landform:	Steep hills within the mountain ranges																					
Rock type:	Greywacke and related slope deposits (Gw)																					
Soils:	Steepland soils related to podzolised yellow-brown earths. Podzolised yellow-brown earths.																					
	<table border="0"> <thead> <tr> <th style="text-align: left;"><i>Name</i></th> <th style="text-align: left;"><i>Symbol</i></th> <th style="text-align: left;"><i>Survey</i></th> </tr> </thead> <tbody> <tr> <td>Rimutaka steepland soils</td> <td>RmS</td> <td>6</td> </tr> <tr> <td></td> <td>123</td> <td>2,1</td> </tr> <tr> <td></td> <td>23</td> <td>3</td> </tr> <tr> <td>Renata hill soils</td> <td>RH</td> <td>6</td> </tr> <tr> <td></td> <td>20H</td> <td>3</td> </tr> <tr> <td></td> <td>46H</td> <td>1</td> </tr> </tbody> </table>	<i>Name</i>	<i>Symbol</i>	<i>Survey</i>	Rimutaka steepland soils	RmS	6		123	2,1		23	3	Renata hill soils	RH	6		20H	3		46H	1
<i>Name</i>	<i>Symbol</i>	<i>Survey</i>																				
Rimutaka steepland soils	RmS	6																				
	123	2,1																				
	23	3																				
Renata hill soils	RH	6																				
	20H	3																				
	46H	1																				
<i>Texture:</i>	Silt loam, stony silt loam, stony sandy loam																					
<i>Depth:</i>	40–70 cm																					
<i>Drainage:</i>	Moderately well to well drained																					
Erosion:																						
<i>Present:</i>	Slight (1) to moderate (2) debris avalanche (Da), slight (1) scree (Sc)																					
<i>Potential:</i>	Severe (3) soil slip (Ss), severe (3) scree (Sc), moderate (2) gully (G), moderate (2) sheet (Sh)																					
Vegetation:	Podocarp–broadleaved–beech forest (fD), lowland beech forest (fW), manuka (sM), mixed indigenous scrub (sX), highland podocarp–broadleaved forest (fI)																					
Annual rainfall range:	1780–4000 mm																					
Land use:																						
<i>Present:</i>	Undeveloped Reversion to scrub Grazing – Present average carrying capacity (s.u./ha) = – – Top farmer carrying capacity (s.u./ha) = –																					
<i>Potential:</i>	Cropping – Unsuitable Grazing – Attainable physical potential carrying capacity (s.u./ha) = 2 Forestry – Erosion control and production – site index (metres) for <i>Pinus radiata</i> = 18–24																					
Soil conservation management:	Maintenance of indigenous forest. Care in siting of tracks. Feral animal control.																					
Comments:	Selective logging within indigenous forest. Prone to scrub reversion.																					

LUC unit: VIIw1 (312 ha)**LUC suite:** 2. Peat bogs, swamps and basins**LUC subsuite:****Description:** Peat swamps with water tables at or near the surface. Peat is strongly acid and very poorly drained.**Type location:** R27/842053 Waipango Swamp, Mangaroa.**Altitudinal range:** 10–150 m**Slope:** Flat to gently undulating (A), 0–3°**Landform:** Swamps**Rock type:** Peat (Pt)**Soils:** Organic soils

	Name	Symbol	Survey
	Mangaroa loamy peat	Mp	6
	Paraparaumu peaty loam	Pp	6
<i>Texture:</i>	Peat		
<i>Depth:</i>	30–50 cm		
<i>Drainage:</i>	Very poorly drained		

Erosion:*Present:* Negligible (0)*Potential:* Negligible (0)**Vegetation:** Wetland vegetation (hW), manuka (sM), semi-improved pasture (gS), rushes (hR)**Annual rainfall range:** 1100–1400 mm**Land use:***Present:* Undeveloped

Grazing – Present average carrying capacity (s.u./ha) = 2

– Top farmer carrying capacity (s.u./ha) = 3

Potential: Cropping – Unsuitable

Grazing – Attainable physical potential carrying capacity (s.u./ha) = 5

Forestry – Unsuitable

Soil conservation management:

Drainage. Water table control.

Comments:

Difficult to drain.

LUC unit:	VIIw2 (142 ha)		
LUC suite:	1. Low alluvial plains and terraces		
LUC subsuite:	1a. Soils with wetness limitations		
Description:	Tidal flats and salt marshes. Soils are highly saline and have a watertable at or near the surface.		
Type location:	R27/705097 Pauatahanui		
Altitudinal range:	0–2 m		
Slope:	Flat to gently undulating (A), 0–3°		
Landform:	Tidal flats		
Rock type:	Estuarine sands and muds (Af)		
Soils:	Saline gley recent soils		
	<i>Name</i>	<i>Symbol</i>	<i>Survey</i>
	Pauatahanui shelly sand	Ps	6
	Meanee–Farndon complex	MFc	4
	<i>Texture:</i> Loamy sand, shelly sandy loam		
	<i>Depth:</i> 35–45 cm		
	<i>Drainage:</i> Poorly to very poorly drained		
Erosion:	<i>Present:</i>	Negligible (0)	
	<i>Potential:</i>	Negligible (0)	
Vegetation:	Saline vegetation (hS)		
Annual rainfall range:	900–1100 mm		
Land use:	<i>Present:</i>	Undeveloped	
		Grazing	– Present average carrying capacity (s.u./ha) = –
			– Top farmer carrying capacity (s.u./ha) = –
	<i>Potential:</i>	Cropping	– Unsuitable
		Grazing	– Attainable physical potential carrying capacity (s.u./ha) = 3
		Forestry	– Unsuitable
Soil conservation management:	Stopbanks. Drainage.		
Comments:	–		

LUC unit: VIIIs1 (676 ha)**LUC suite:** 7. Greywacke hill country**LUC subsuite:** 7b. Inland greywacke hill country with rainfall <1270 mm p.a. Soils are yellow-brown earths**Description:** Steep to very steep greywacke hill country with numerous rock outcrops. The hills occur between 200–450 m a.s.l. in areas of moderate rainfall. Soils are shallow and subject to seasonal soil moisture deficiencies.**Type location:** R27/588958 Mt Kaukau, Johnsonville**Altitudinal range:** 200–450 m**Slope:** Steep to very steep (F+G), 26→35°**Landform:** Steep hills with numerous rock outcrops**Rock type:** Greywacke and related slope deposits (Gw)**Soils:** Steepland soils related to yellow-brown earths

	<i>Name</i>	<i>Symbol</i>	<i>Survey</i>
	Makara steepland soils	MkS	6
	Bare rock	BR	
<i>Texture:</i>	Stony silt loam, stony sandy loam		
<i>Depth:</i>	0–30 cm		
<i>Drainage:</i>	Somewhat excessively drained		

Erosion:*Present:* Slight (1) scree (Sc), slight (1) sheet (Sh)*Potential:* Slight (1) scree (Sc), slight (1) sheet (Sh), slight (1) soil slip (Ss)**Vegetation:** Semi-improved pasture (gS), *Cassinia* (sC), gorse (sG)**Annual rainfall range:** 1200–1400 mm**Land use:***Present:* Grazing – Present average carrying capacity (s.u./ha) = 2
– Top farmer carrying capacity (s.u./ha) = 3*Potential:* Cropping – Unsuitable
Grazing – Attainable physical potential carrying capacity (s.u./ha) = 5
Forestry – Unsuitable**Soil conservation management:** Maintenance of complete vegetation cover is necessary. On pastoral land this includes applying adequate fertiliser and avoiding overgrazing to ensure good pasture cover.**Comments:** Pastures are prone to scrub reversion.

LUC unit: VIIIs2 (391 ha)**LUC suite:** 1. Low alluvial plains and terraces**LUC subsuite:** 1b. Soils with limitations of stoniness and insufficient soil moisture**Description:** Flat, stony, low terraces and fans adjacent to river courses. Soils are very shallow and bouldery with boulders on the surface. Soils are excessively drained and subject to seasonal soil moisture deficiencies. There is a potential for severe streambank erosion and deposition.**Type location:** S26/116267 Totara Flats, Tararua Range**Altitudinal range:** 0–600 m**Slope:** Flat to undulating (A, A+B), 0–7°**Landform:** Low river terraces and fans**Rock type:** Alluvial gravels and sands (Gr)

Soils:	Recent soils		
	<i>Name</i>	<i>Symbol</i>	<i>Survey</i>
	Tukituki sandy loam, stony gravel, etc.	1c	1
	Waikanae gravelly sand	Wg	6
	<i>Texture:</i> Sandy loam, stony to gravelly sand		
	<i>Depth:</i> 0–10 cm		
	<i>Drainage:</i> Excessively drained		

Erosion:

Present: Moderate (2) streambank (Sb), moderate (2) deposition (D)
Potential: Severe (3) streambank (Sb), severe (3) deposition (D)

Vegetation: Podocarp–broadleaved–beech forest (fD), lowland podocarp–broadleaved forest (fO), semi-improved pasture (gS)**Annual rainfall range:** 1200–3000 mm**Land use:**

Present: Undeveloped
 Grazing – Present average carrying capacity (s.u./ha) = –
 – Top farmer carrying capacity (s.u./ha) = –

Potential: Cropping – Unsuitable
 Grazing – Attainable physical potential carrying capacity (s.u./ha) = 4
 Forestry – Production – site index (metres) for *Pinus radiata* = 22–26

Soil conservation management: Streambank protection.**Comments:** –

LUC unit: VIIIs3 (101 ha)**LUC suite:** 6. Raised marine terraces**LUC subsuite:****Description:** Flat to undulating, stony, low coastal terraces and fans exposed to strong salt-laden winds. The soils, developed on beach gravel and sand, are very shallow and excessively drained.**Type location:** R28/685752 Wainuiomata Coast Road**Altitudinal range:** 0–20 m**Slope:** Flat to undulating (A, A+B), 0–7°**Landform:** Low coastal terraces and fans**Rock type:** Beach sands, gravels and boulders (Gr)

Soils:	Recent soils		
	<i>Name</i>	<i>Symbol</i>	<i>Survey</i>
	Turakirae gravelly sand	Tg	6
	Bare rock	BR	
	Addington stony sand	Ag	7
	<i>Texture:</i> Gravelly sand		
	<i>Depth:</i> 0–15 cm		
	<i>Drainage:</i> Excessively drained		

Erosion:

Present: Slight (1) deposition (D)
Potential: Moderate (2) deposition (D), slight (1) wind (W)

Vegetation: Semi-improved pasture (gS), *Cassinia* (sC), lupins (sL)**Annual rainfall range:** 1200–1400 mm**Land use:**

Present: Grazing – Present average carrying capacity (s.u./ha) = 1
– Top farmer carrying capacity (s.u./ha) = 2
Potential: Cropping – Unsuitable
Grazing – Attainable physical potential carrying capacity (s.u./ha) = 3
Forestry – Production – site index (metres) for *Pinus radiata* = 12–14

Soil conservation management:

Maintenance of complete vegetation cover is necessary.

Comments:

–

LUC unit: VIIc1 (4671 ha)**LUC suite:** 8. Greywacke mountainlands and associated foothills**LUC subsuite:** 8b. Greywacke mountainlands with rainfall >1780 mm p.a. Soils are podzolised yellow-brown earths**Description:** Rolling to strongly rolling ridgetops, plateaux and basins in the mountain ranges, at altitudes between 500–900 m a.s.l. Locations are exposed and subject to severe climatic conditions. Rainfall range is 1780–3200 mm p.a. Soils are podzolised.**Type location:** S26/910182 Maymorn Ridge**Altitudinal range:** 500–900 m**Slope:** Rolling to strongly rolling (C,D), 8–20°**Landform:** Upland ridgetops, plateaux and basins**Rock type:** Greywacke and related slope deposits (Gw)**Soils:** Podzolised yellow-brown earths

<i>Name</i>	<i>Symbol</i>	<i>Survey</i>
Renata silt loam	R	6
	20	3
	46	1
Renata hill soils	RH	6
	20H	3
	46H	1

Texture: Silt loam, fine sandy loam*Depth:* 80–100 cm*Drainage:* Imperfectly to moderately well drained**Erosion:***Present:* Negligible (0)*Potential:* Slight (1) sheet (Sh) and wind (W), slight (1) soil slip (Ss)**Vegetation:** Highland beech forest (fC), podocarp–broadleaved–beech forest (fD), broadleaved forest (fB), highland podocarp–broadleaved forest (fI)**Annual rainfall range:** 1780–3200 mm**Land use:***Present:* Undeveloped

Selective logging of indigenous forest

Grazing – Present average carrying capacity (s.u./ha) = –

– Top farmer carrying capacity (s.u./ha) = –

Potential: Cropping – Unsuitable

Grazing – Attainable physical potential carrying capacity (s.u./ha) = 5

Forestry – Production – site index (metres) for *Pinus radiata* = 14–20**Soil conservation management:**

Maintenance of complete vegetation cover is necessary. Feral animal control.

Comments:

Selective logging within indigenous forest. Strong winds.

LUC unit:	Ville1 (1040 ha)		
LUC suite:	5. Sand country		
LUC subsuite:	5a. Young, unstable sand dunes		
Description:	Undulating to strongly rolling coastal foredunes, exposed to strong salt-laden winds. Typically extend up to 400 m inland and consist of unstable sand with little soil development. There is a potential for extreme wind erosion.		
Type location:	S25/946660 Hokio Beach		
Altitudinal range:	0–10 m		
Slope:	Undulating to strongly rolling (B, C, D), 4–20°		
Landform:	Coastal foredunes		
Rock type:	Windblown sands (Wb)		
Soils:	Recent soils		
	<i>Name</i>	<i>Symbol</i>	<i>Survey</i>
	Waitarere sand	Wa	7
	Waitarere–Hokio association	W-H	4
	Bare rock	BR	
	<i>Texture:</i>	Sand	
	<i>Depth:</i>	0–5 cm on sand	
	<i>Drainage:</i>	Excessively drained	
Erosion:	<i>Present:</i>	Severe (3) to extreme (5) wind (W)	
	<i>Potential:</i>	Extreme (5) wind (W)	
Vegetation:	Sand dune vegetation (gD), lupins (sL)		
Annual rainfall range:	900–1100 mm		
Land use:	<i>Present:</i>	Undeveloped Protection forestry	
	<i>Potential:</i>	Cropping – Unsuitable Grazing – Unsuitable Forestry – Protection forestry	
Soil conservation management:	Management is necessary, not only to protect the foredunes themselves but also to protect more productive areas inland. Stabilise eroding areas with marram grass, pingao, <i>Spinifex</i> , lupins, etc. Ensure recreational use does not damage vegetation cover. Protection forestry.		
Comments:	–		

- LUC unit:** **Ville2 (2439 ha)**
- LUC suite:** 7. Greywacke hill country
- LUC subsuite:** 7a. Coastal greywacke hill country exposed to strong salt-laden winds. Soils are intergrades between yellow-grey earths and yellow-brown earths
- Description:** Coastal cliffs exposed to strong salt laden winds. Slopes are very steep with large areas of bare rock and scree.
- Type location:** R27/534818 Sinclair Head
- Altitudinal range:** 0–250 m
- Slope:** Very steep (G), >35°
- Landform:** Coastal cliffs
- Rock type:** Greywacke and related slope deposits (Gw)
- Soils:** Steepland soils related to intergrades between yellow-grey earths and yellow-brown earths
- | | <i>Name</i> | <i>Symbol</i> | <i>Survey</i> |
|------------------|--------------------------------------|---------------|---------------|
| | Terawhiti steepland soils | TwS | 6 |
| | Bare rock | BR | |
| <i>Texture:</i> | Stony sandy loam | | |
| <i>Depth:</i> | 15–40 cm | | |
| <i>Drainage:</i> | Well to somewhat excessively drained | | |
- Erosion:**
- Present:* Moderate (2) to severe (3) scree (Sc), slight (1) to moderate (2) gully (G), slight (1) sheet (Sh) and wind (W)
- Potential:* Severe (3) scree (Sc), severe (3) gully (G), moderate (2) sheet (Sh) and wind (W)
- Vegetation:** Coastal scrub (sO), semi-improved pasture (gS), short tussock grassland (gT), coastal forest (fC)
- Annual rainfall range:** 1100–1200 mm
- Land use:**
- Present:* Undeveloped
- Potential:* Cropping – Unsuitable
Grazing – Unsuitable
Forestry – Unsuitable
- Soil conservation management:** Maintenance of vegetation cover is necessary. Retire from grazing.
- Comments:** –

LUC unit: Ville3 (87 270 ha)**LUC suite:** 8. Greywacke mountainlands and associated foothills**LUC subsuite:** 8a and 8b**Description:** Long, very steep slopes below the timberline in the greywacke mountain ranges. Vegetation consists of indigenous forest. Present erosion is of slight to moderate severity. Climatic conditions are severe.**Type location:** S26/915255 Waiotauru Road, Tararua Range**Altitudinal range:** 200–1100 m**Slope:** Very steep (G), >35°**Landform:** Mountainlands**Rock type:** Greywacke and related slope deposits (Gw)**Soils:** Steepland soils related to podzolised yellow-brown earths. Steepland soils related to yellow-brown earths.

<i>Name</i>	<i>Symbol</i>	<i>Survey</i>
Rimutaka steepland soils	RmS	6
	123	2,1
	23	3
Ruahine steepland soils	RuS	6
	124	2,1

Texture: Silt loam, stony silt loam*Depth:* 30–60 cm*Drainage:* Moderately well to well drained**Erosion:***Present:* Slight (1) to moderate (2) debris avalanche (Da), slight (1) to moderate (2) scree (Sc)*Potential:* Very severe (4) to extreme (5) soil slip (Ss)/debris avalanche (Da), severe (3) scree (Sc), severe (3) sheet (Sh) and wind (W), moderate (2) gully (G)**Vegetation:** Lowland beech forest (fW), highland beech forest (fG), podocarp–broadleaved–beech forest (fD), highland podocarp–broadleaved forest (fI), lowland podocarp–broadleaved forest (fO)**Annual rainfall range:** 2000–5000 mm**Land use:***Present:* Undeveloped*Potential:* Cropping – Unsuitable
Grazing – Unsuitable
Forestry – Protection forestry**Soil conservation management:**

Maintenance of indigenous forest. Feral animal control.

Comments:

–

LUC unit: VIIIe4 (9169 ha)**LUC suite:** 8. Greywacke mountainlands and associated foothills**LUC subsuite:** 8b. Greywacke mountainlands with rainfall >1780 mm p.a. Soils are podzolised yellow-brown earths**Description:** Long, steep to very steep, severely eroded slopes below the timberline in the greywacke mountain ranges. Vegetation consists of indigenous forest and scrub with large areas of bare rock and scree. Climatic conditions are severe.**Type location:** R27/780822 Mt Matthews, Rimutaka Range**Altitudinal range:** 20–1000 m**Slope:** Steep to very steep (G, F+G), 26–>35°**Landform:** Mountainlands**Rock type:** Greywacke and argillite (frequently weakened by intense crushing) and related slope deposits (Gw, Ac)**Soils:** Steepland soils related to podzolised yellow-brown earths. Steepland soils related to yellow-brown earths. Steepland soils related to intergrades between yellow-grey earths and yellow-brown earths.

<i>Name</i>	<i>Symbol</i>	<i>Survey</i>
Rimutaka steepland soils	RmS	6
	123	2,1
Ruahine steepland soils	RuS	6
	124	2,1
Terawhiti steepland soils	TwS	6
Bare rock	BR	

Texture: Stony silt loam, silt loam*Depth:* 10–50 cm*Drainage:* Moderately well to well drained**Erosion:***Present:* Severe (3) to very severe (4) scree (Sc), moderate (2) to severe (3) gully (G), moderate (2) debris avalanche (Da), slight (1) to moderate (2) sheet (Sh) and wind (W)*Potential:* Extreme (5) scree (Sc), very severe (4) gully (4), very severe (4) sheet (Sh) and wind (W), severe (3) soil slip (Ss)/debris avalanche (Da)**Vegetation:** Highland beech forest (fG), mixed indigenous scrub (sX), podocarp–broadleaved–beech forest (fD), coastal scrub (sO), highland podocarp–broadleaved forest (fl)**Annual rainfall range:** 1400–3000 mm**Land use:***Present:* Undeveloped*Potential:* Cropping – Unsuitable
Grazing – Unsuitable
Forestry – Protection forestry**Soil conservation management:** Maintenance of indigenous vegetation. Feral animal control.**Comments:** More severely eroded than VIIIe3.

LUC unit: VIIIe5 (14 442 ha)**LUC suite:** 8. Greywacke mountainlands and associated foothills**LUC subsuite:** 8b. Greywacke mountainlands with rainfall >1780 mm p.a. Soils are podzolised yellow-brown earths**Description:** Mountain tops above the timberline with tussock and subalpine scrub vegetation. Slopes are steep to very steep with numerous rock outcrops and areas of scree. There is a potential for extreme erosion. Climatic conditions are very severe.**Type location:** S25/023256 Mt Hector, Tararua Range**Altitudinal range:** 700–1570 m**Slope:** Moderately steep to very steep (G, F, E), 21–>35°**Landform:** Mountain tops**Rock type:** Greywacke and related slope deposits (Gw)

Soils:	Alpine soils		
	<i>Name</i>	<i>Symbol</i>	<i>Survey</i>
	Tararua complex	Tx	6
	Bare rock	BR	
	<i>Texture:</i> Stony or peaty silt loam, stony sandy loam		
	<i>Depth:</i> 20–50 cm		
	<i>Drainage:</i> Imperfectly to poorly drained		

Erosion:

Present: Moderate (2) scree (Sc), moderate (2) debris avalanche (Da), slight (1) to moderate (2) sheet (Sh) and wind (W), slight (1) gully (G)

Potential: Extreme (5) sheet (Sh) and (W), very severe (4) scree (Sc), very severe (4) soil slip (Ss)/debris avalanche (Da), severe (3) gully (G)

Vegetation: Snow tussock grassland (gW), alpine and subalpine herbfield/ fellfield vegetation (hA), subalpine scrub (sS), short tussock grassland (gT)**Annual rainfall range:** >5000 mm

Land use:

Present: Undeveloped

Potential: Cropping – Unsuitable
Grazing – Unsuitable
Forestry – Unsuitable

Soil conservation management: Maintenance of indigenous vegetation. Feral animal control.**Comments:** Alpine and subalpine zones.

LUC unit:	VIII1 (666 ha)		
LUC suite:	6. Raised marine terraces		
LUC subsuite:			
Description:	Very stony, raised beaches, consisting of a series of low sandy beach ridges separated by rocky former sea bed. Very shallow soils and a harsh coastal climate prevent productive use.		
Type location:	R28/703726 Turakirae Head		
Altitudinal range:	0–40 m		
Slope:	Flat to undulating (A, A+B), 0–7°		
Landform:	Raised stony beaches		
Rock type:	Beach sands, gravels and boulders (Gr)		
Soils:	Recent soils		
	<i>Name</i>	<i>Symbol</i>	<i>Survey</i>
	Turakirae gravelly sand	Tg	6
	Bare rock	BR	
	<i>Texture:</i>		
	Gravel, sand		
	<i>Depth:</i>		
	0–15 cm		
	<i>Drainage:</i>		
	Excessively drained		
Erosion:			
	<i>Present:</i>	Moderate (2) deposition (D), slight (1) wind (W)	
	<i>Potential:</i>	Severe (3) deposition (D), slight (1) wind (W)	
Vegetation:	Coastal scrub (sO), sand dune vegetation (gD), semi-improved pasture (gS)		
Annual rainfall range:	1200–1400 mm		
Land use:			
	<i>Present:</i>	Undeveloped	
	<i>Potential:</i>	Cropping	– Unsuitable
		Grazing	– Unsuitable
		Forestry	– Unsuitable
Soil conservation management:	–		
Comments:	Strong salt-laden winds. Includes areas of actively aggrading gravel fans derived from cliffs and hill slopes along the inland margin of the beaches.		

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- PALMER, A. S.; WILDE, R. H. 1990: Soil definitions and interpretations for Otaki District soil resources study, North Island, New Zealand (and accompanying provisional soil map). Unpublished report. DSIR Land Resources.
- ROBBINS, R. G. 1958: Direct effect of the 1855 earthquake on the vegetation of the Orongorongo Valley, Wellington. *Transactions of the Royal Society of New Zealand 85*: 205–212.
- SOIL CONSERVATION AND RIVERS CONTROL COUNCIL 1971: Land use capability survey handbook (2nd ed.). Water and Soil Division, Ministry of Works and Development, Wellington. 138 p.
- STEVENS, G. R. 1957: Solifluxion phenomena in the Lower Hutt area. *New Zealand journal of science and technology 38B*: 279–296.
- STEVENS, G. R. 1974: Rugged landscape: the geology of central New Zealand. Reed, Wellington.
- STEVENS, G. R. 1975: Wellington's restless coast: changes in land and sea at Turakirae Head. A guide book published by the Geological Society of New Zealand.
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- TRUSTRUM, N. A. 1975: New Zealand Land Resource Inventory Wellington region: land use capability extended legend. National Water and Soil Conservation Organisation, Wellington.
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Appendix 1. Authors and dates of fieldwork for NZLRI data in the Wellington region.

Map no.*	Map name	Author	Date of field work
pt S24	Foxton	M. J. Page	1987
pt T24	Palmerston North	J. R. Fletcher, P. F. Newsome	1992 1989
R25	Te Horo	M. J. Page	1987
pt S25	Levin	M. J. Page	1987
pt T25	Eketahuna	M. J. Page	Jan 1989
R26	Paraparaumu	M. J. Page	Jan 1988
pt S26	Carterton	M. J. Page	1987-1990
pt R27 and pt Q27	Wellington	M. J. Page	1987-1990
pt S27	Lake Wairarapa	M. J. Page	May 1990
pt R28	Turakirae	M. J. Page	Jan 1988

* Based on 1:50 000 scale NZMS 260 series topographic maps.

Appendix 2. Aerial photographs used in the compilation of the NZLRI in the Wellington region.

Map no.*	Map name	Date	Photographic scale	Survey no.
pt S24	Foxton	1979, 1980	1:25 000	5408
pt T24	Palmerston North	1979	1:25 000	5408
R25	Te Horo	1980	1:24 500	5497
pt S25	Levin	1983	1:24 999	8171
		1981	1:45 000	5309
pt T25	Eketahuna	1981	1:45 000	5309
R26	Paraparaumu	1980	1:24 500	5497
		1985	1:20 000	11205A**
		1972	1:15 272	3572
pt S26	Carterton	1979, 1981	1:45 000	5309
		1985	1:20 000	11205A**
		1983	1:24 999	8171
pt R27 and pt Q27	Wellington	1985	1:20 000	11205A**
		1980	1:24 500	5497
pt S27	Lake Wairarapa	1985	1:20 000	11205A**
		1980	1:24 500	5497
pt R28	Turakirae	1985	1:20 000	11205A**
		1980	1:24 500	5497

* Based on 1:50 000 scale NZMS 260 series topographic maps.

** Colour infrared photography, Aerial Surveys Nelson. All other surveys are black-and-white photography, New Zealand Aerial Mapping Ltd, Hastings.

Appendix 3. Correlation between first edition (1974) and second edition (1990) LUC classifications of the Wellington region of the NZLRI.

2nd edition	1st edition	2nd edition	1st edition
Iw1	Iw1	Vle4	included in Vle5
Is1	included in Iw1	Vle5	Vle6
Ic1	Ic1	Vle6	Vle7
Ile1	included in Icl	Vle7	Vle8
Ilw1	Ilw1	Vle8	Vle9, Vle2
Ilw2	Ilw2	Vle9	included in Vle5
Ils1	Ils1	Vle10	included in Vle9
Ils2	included in IIs1	Vlw1	included in VIIw1
Ils3	included in IIs1	Vls1	included in Vle1
Ilc1	Ilc1	Vls2	included in Vle5
IIIe1	IIIe1	Vls3	Vls1
IIIe2	included in IIIe1	Vls4	included in Vls3
IIIe3	included in IIIe1	Vls5	Vls3
IIIw1	IIIw1	Vls6	Vle3
IIIw2	IIIw2	Vls7	Vls4
IIIw3	included in IIIw2	Vlc1	Vlc1
IIIs1	included in IIIs2	Vlc2	Vls2
IIIs2	IIIs2	Vlc3	Vlc2
IIIs3	included in IIIe1	VIIe1	VIIe1
IIIs4	IIs2	VIIe2	VIIe2
IIlc1	included in IIIw1	VIIe3	VIIe4
IVe1	IVe1	VIIe4	VIIe3
IVe2	included in IVe1	VIIe5	VIIe5
IVe3	included in IVe1	VIIw1	VIIw1
IVe4	IIIs1	VIIw2	VIIw2
IVe5	IVe2	VIIIs1	included in VIIe1
IVw1	included in IIIw1	VIIIs2	included in Vls4
IVw2	included in IIIw1	VIIIs3	included in VIIIs1
IVw3	included in IIIw2	VIIc1	included in VIIe5 & Vle9
IVs1	IVs1	VIIle1	VIIle1
IVs2	included in IVs1	VIIle2	VIIle2
IVc1	included in IIIw1	VIIle3	VIIle3
Vle1	Vle1, Vle4	VIIle4	VIIle4
Vle2	included in Vle5	VIIle5	VIIle5
Vle3	Vle5	VIIIs1	VIIIs1

Appendix 4. Correlation of LUC units mapped in the Wellington region with LUC units in adjacent regions. (Page 1985)

Region 9 Wellington	Region 8 Southern Hawke's Bay – Wairarapa	Region 10 Taranaki – Manawatu
Iw1		Iw1
Is1		included in 1w1
Ic1		
Ile1		
Ilw1		Ilw2
Ilw2		Ilw4
Ils1		Ils1
Ils2		
Ils3		
Ilc1		
IIIe1		
IIIe2		
IIIe3		IIIe4
IIIw1	IIIw1 (south of Waipukurau)	IIIw2
IIIw2		
IIIw3		IIIw4
IIIs1	included in IIIs2	included in IIIs2
IIIs2	IIIs2	IIIs2
IIIs3		
IIIs4		IIs2
IIIc1		
IVe1		
IVe2		IVe4
IVe3		
IVe4		IVe10
IVe5		
IVw1		IVw1
IVw2		
IVw3		
IVs1	included in IVs1	included in IVs2
IVs2	IVs1	IVs2
IVc1		
VIe1		VIe2
VIe2		

Appendix 4. (continued)

Region 9 Wellington	Region 8 Southern Hawke's Bay – Wairarapa	Region 10 Taranaki – Manawatu
Vle3		
Vle4		
Vle5	Vle14	Vle24
Vle6		
Vle7		
Vle8	Vle11	Vle16
Vle9		
Vle10	included in Vle11	included in Vle16
Vlw1		
Vls1		
Vls2		
Vls3		
Vls4		Vls4
Vls5	Vls5	included in Vle24
Vls6		
Vls7	Vls4	Vls7
Vlc1		
Vlc2		
Vlc3		
Vlle1		
Vlle2	Vlle10	Vlle10
Vlle3	Vlle14	Vlle15
Vlle4		
Vlle5	included in Vlle10 or Vlle5	included in Vlle10 or Vlle4
Vllw1		
Vllw2		
Vlls1		
Vlls2	Vlls1	included in Vls7
Vlls3	included in Vlls1	
Vllc1		
Vllle1	Vllle4	Vllle1
Vllle2	Vllle2	Vllle3
Vllle3	Vllle5	Vllle4
Vllle4	Vllle6	Vllle7
Vllle5	Vllle9	Vllle9
Vllls1	included in Vlls1	

Appendix 5. NZLRI rock type classification.

A. Igneous rocks

(i) extremely weak to very weak igneous rocks

Ng	Ngauruhoe tephra
Rm	Rotomahana mud
Ta	Tarawera tephra
Sc	Scoria
Lp	Pumiceous lapilli
Kt	Kaharoa and Taupo ashes
Tp	Taupo and Kaharoa breccia and pumiceous alluvium
Mo	Ashes older than Taupo ash
Ft	Quaternary breccias older than Taupo breccia
La	Lahar deposits
Vu	Extremely weak altered volcanics

(ii) weak to extremely strong igneous rocks

Vo	Lavas and welded ignimbrites
Tb	Indurated fine-grained pyroclastics
Vb	Indurated volcanic breccias
In	Ancient volcanics
Gn	Plutonics
Um	Ultramafics

B. Sedimentary rocks

(i) very loose to compact (very soft to stiff) sedimentary rocks

Pt	Peat
Lo	Loess
Wb	Windblown sand
Af	Fine alluvium
Gr	Alluvial gravels
Cl	Coarse slope deposits
Gl	Glacial till
Uf	Unconsolidated clays and silts
Us	Unconsolidated sands and gravels

(ii) very compact (very stiff) to weak sedimentary rocks

Mm	Massive mudstone
Mb	Bedded mudstone
Mf	Frittered mudstone
Me	Bentonitic mudstone
Sm	Massive sandstone
Sb	Bedded sandstone
Cw	Weakly consolidated conglomerate
Mx	Sheared mixed lithologies
Ac	Crushed argillite association of rocks

(iii) moderately strong to extremely strong sedimentary rocks

Ar	Argillite
Si	Indurated sandstone
Cg	Conglomerate and breccia
Gw	Greywacke association of rocks
Li	Limestone

Appendix 5. (continued)

C. Metamorphic rocks

Sx	Semi-schist
Sy	Schist
Gs	Gneiss
Ma	Marble

D. Perennial ice and snow

I	Perennial ice and snow
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Prefixes

- p denotes that the rock type is present only in patches, or of localised significance, e.g. pAf/Mx, patchy fine alluvium overlying sheared mixed lithologies.
- w denotes a significant degree and depth of weathering such that the rock's physical characteristics are significantly different from its unweathered characteristics, e.g. wGw, weathered greywacke.

Combining symbols

- / denotes stratigraphic sequence with the surface rock type first, e.g. Mo/Vo ashes older than Taupo ash cover over volcanic lavas. A maximum of two '/'s may be used in any one code.
- + denotes that there are two or more rock types present and the first one is dominant, e.g. Af+Pt, Fine alluvium and Peat. A maximum of two '+'s may be used in any one code.
- * used in conjunction with /, indicates that both rock types joined together are both overlain by the preceding rock type, e.g. Uf/Mb * Sb, unconsolidated clays and silts overlying both bedded mudstone and bedded sandstone. (This contrasts with Uf/Mb + Sb where the unconsolidated clays and silts overlie Mb only.)

Appendix 6. Geological maps used in the Wellington region.

- KINGMA, J. T. 1962: Sheet 11 Dannevirke (1st edition) Geological map of New Zealand 1:250 000. Department of Scientific and Industrial Research, Wellington.
- KINGMA, J. T. 1967: Sheet 12 Wellington (1st edition) Geological map of New Zealand, 1:250 000. Department of Scientific and Industrial Research, Wellington.
- LENSSEN, G. J.; FLEMING, C. A.; KINGMA, J. T. 1959: Sheet 10 Wanganui (1st edition) Geological map of New Zealand 1:250 000. Department of Scientific and Industrial Research, Wellington.
- NEEF, G. 1974: Sheet N153 Eketahuna (1st edition) Geological map of New Zealand 1:63 360. Department of Scientific and Industrial Research, Wellington.
- OTA, Y.; WILLIAMS, D. N.; BERRYMAN, K. R. 1981: Part sheets Q27, R27 and R28 – Wellington 1st edition. Late Quaternary tectonic map of New Zealand 1:50 000. With notes. Department of Scientific and Industrial Research, Wellington.

Appendix 7. Soil surveys used in the Wellington region.

- ATKINSON, I. A. E. 1973: Soils of Taita experimental station. *New Zealand Soil Bureau bulletin 32*.
- COWIE, J. D. 1974: Soils of Palmerston North City and environs, New Zealand. *New Zealand Soil Survey report 24*.
- COWIE, J. D. 1978: Soils and agriculture of Kairanga County, North Island, New Zealand. *New Zealand Soil Bureau bulletin 33*.
- COWIE, J. D.; FITZGERALD, P.; OWERS, W. 1967: Soils of the Manawatu–Rangitikei sand country. *New Zealand Soil Bureau bulletin 29*.
- GIBBS, H. S. 1957: Provisional soil map of Horowhenua County, New Zealand. Unpublished New Zealand Soil Bureau map.
- GIBBS, H. S. 1957: Reconnaissance map of soils of Levin District, New Zealand. Unpublished New Zealand Soil Bureau map.
- GIBBS, H. S. 1960: Soil map of Hutt Valley, New Zealand. Unpublished New Zealand Soil Bureau map.
- HEINE, J. C. 1975: Interim report on soils of Wellington region, New Zealand. *New Zealand Soil Bureau record 39*.
- HEINE, J. C. 1975: Interim report on soils of Wairarapa Valley, New Zealand. *New Zealand Soil Bureau record 40*.
- HEINE, J. C. 1989: Mangaroa soil survey. Unpublished New Zealand Soil Bureau map (draft map).
- MILNE, J. D. G.; NORTHEY, R. D. 1975: Soils of the Wellington urban area. *New Zealand Soil Bureau report 34*.
- NEW ZEALAND SOIL BUREAU 1954: General survey of the soils of North Island, New Zealand. *New Zealand Soil Bureau bulletin (n.s. 5)*.
- NORTHEY, R. D. 1974: Soils of Pauatahanui area, Wellington, New Zealand. *New Zealand Soil Bureau scientific report 13*.
- PALMER, A. S.; WILDE, R. H. 1990: Soil definitions and interpretations for Otaki District soil resources study, North Island, New Zealand (and accompanying provisional soil map). Unpublished DSIR Land Resources report.

Appendix 8. NZLRI slope classification.

Slope groups	Slope angle (°)	Relief
A	0–3	Flat to gently undulating
B	4–7	Undulating
C	8–15	Rolling
D	16–20	Strongly rolling
E	21–25	Moderately steep
F	26–35	Steep
G	>35	Very steep

Additional symbols:

D/E	Average or compound slope between two slope groups
A+B	Complex slopes, first slope group is dominant
A'	Dissected slopes

Appendix 9. NZLRI erosion type and severity classification.

Erosion type	Basis for recording
Surface Erosion	} recorded on an areal basis
Sh – sheet	
W – wind	
Sc – scree	
Mass Movement Erosion	} recorded on a seriousness basis (a combination of rate and depth of movement, frequency of erosion events, feasibility and cost of control, economic effect).
Ss – soil slip	
Es – earth slip	
Su – slump	
Da – debris avalanche	
Ef – earthflow	
Fluvial Erosion	} recorded on a seriousness basis (a combination of rate and depth of movement, frequency of erosion events, feasibility and cost of control, economic effect).
R – rill	
G – gully	
T – tunnel gully	
Sb – streambank	
D – deposition	

Erosion severity	Percentage bare ground (surface erosion only)
0 – negligible	<1
1 – slight	1–10
2 – moderate	11–20
3 – severe	21–40
4 – very severe	41–60
5 – extreme	>60

Appendix 10 NZLRI vegetation classification.

The classification used in the Wellington Region was adapted from an earlier version (Hunter and Blaschke 1986). Symbols have been changed in this latest version, although many of the vegetation classes remain the same (except where some vegetation classes have been split or combined).

		Previous classification
Grass		
gl	Improved pasture	P ₁
gS	Semi improved pasture	P ₂
gU	Unimproved pasture	P ₂
gT	Short tussock grassland	P ₃
gW	Snow tussock grassland	P ₄
gR	Red tussock grassland	P ₅
gD	Sand dune vegetation	P ₆
Crops		
cC	Wheat, oats, barley, etc.	L ₁
cM	Maize	L ₁
cP	Pip and stone fruit	L ₂
cG	Grapes and berry fruit	L ₂
cK	Kiwifruit	L ₂
cS	Subtropical fruit	L ₂
cR	Root and green fodder crops	L ₃
cV	Vegetables, nurseries	L ₄
Scrub		
sM	Manuka, kanuka	M ₁
sC	<i>Cassinia</i>	M ₂
sD	<i>Dracophyllum</i>	M ₃
sF	Fern	M ₄
sS	Subalpine scrub	M ₅
sX	Mixed indigenous scrub	M _{6a}
sT	Mixed indigenous scrub with tree ferns	M _{6b}
sB	Broom	M ₇
sG	Gorse	M ₈
sK	Blackberry	M ₉
sW	Sweet brier	M ₁₀
sA	Matagouri	M ₁₁
sV	Mangrove	M ₁₂
sL	Lupin	M ₁₄
sH	Heath	M ₁₅
sO	Coastal scrub	M ₁₆
sE	Exotic scrub	M ₁₇
Forest		
fC	Coastal forest	N ₁
fK	Kauri forest	N ₂
fP	Podocarp forest	N ₇
fB	Broadleaved forest	N ₅

Appendix 10. (continued)

		Previous classification
fO	Lowland podocarp–broadleaved forest	N _{3a}
fI	Highland podocarp–broadleaved forest	N _{3b}
fD	Podocarp–broadleaved–beech forest	N _{3c}
fW	Lowland beech forest	N _{4a}
fG	Highland beech forest	N _{4b}
fU	Beech forest, undifferentiated	N ₄
fF	Exotic conifer forest	N _{6a}
fR	Exotic broadleaved forest	N _{6b}
Herbaceous		
hW	Wetland vegetation	H ₁
hR	Rushes, sedges	H ₂
hA	Alpine and subalpine herbfield/fellfield vegetation	H ₄
hS	Saline vegetation	H ₅
hP	Pakihi vegetation	H ₆
hM	Semi-arid herbaceous vegetation	H ₇
Unvegetated		
uV	Unvegetated land	–
Other Symbols		
<i>Placed before class:</i>		
c	cutover	C
s	stunted	S
e	erosion control trees	–
n	naturalised exotic trees	–
<i>Placed after class:</i>		
*	scattered (suffix)	

Vegetation is recorded to the nearest 10% and the distribution of vegetation *within inventory map units* is recorded as either 'clumped' or 'scattered'. Scattered vegetation classes are denoted by the use of an asterisk after the class symbol, e.g. sM*.

Vegetation classes without an asterisk are 'clumped', e.g. gIsM, and are recorded to the nearest 10%. Therefore gIsM may be recorded as gI₇sM₃, where gI is 70% and sM 30%. There is no percentage given for scattered vegetation.

A vegetation class is scattered throughout the clumped vegetation class immediately preceding it in the vegetation code.

For example, gIsM* – improved pasture with

scattered manuka and gIsM* would be recorded as 100%; or gIsM*sG* – improved pasture with scattered manuka and scattered gorse.

Stunted vegetation is represented by the symbol s before the class symbol, e.g. sF – stunted exotic conifer forest recorded in coastal buffer zones. Erosion control trees are represented by the symbol 'e' before the class symbol, e.g. eFR – exotic broadleaved trees planted for erosion control. Naturalised exotic conifer trees are represented by the symbol n before the class symbol, e.g. nFF – exotic conifers, usually selfseeded and growing wild, usually without any form of silvicultural management, and where trees represent a range of ages.

Appendix 11. Vegetation maps used in the Wellington region.

BRADLEY, P. J. 1986: Forest type maps of Tararua Range. Compiled from data collected by D. A. Franklin and J. L. Nicholls. Unpublished 1:50 000 Department of Conservation maps.

FRANKLIN, D. A. 1970: FSMS5 Sheet N157 and part N156 Otaki (1st ed.) Forest type map 1:63 360. Forest Research Institute, New Zealand Forest Service.

FULLER, S. A. 1987: Kapiti Island NZMS 290 Part sheets R25/R26 1:15 000. New Zealand Land Inventory, vegetation. Department of Survey and Land Information, Wellington.

NEW ZEALAND FOREST SERVICE 1974: FSMS6 Sheet No. 14 Tararua (1st ed.) Forest class map 1:250 000. Forest Research Institute, New Zealand Forest Service.

Appendix 12. Stock-carrying capacity data for LUC units in the Wellington region.

LUC unit	Present average (s.u./ha)	Top farmer (s.u./ha)	Attainable physical potential (s.u./ha)
Iw1	19	27	32
Is1	16	24	30
Ic1	19	27	32
Ile1	19	27	32
Iiw1	17	25	30
Iiw2	18	22	30
IIs1	17	23	28
IIs2	17	20	26
IIs3	16	20	26
Iic1	18	23	30
Ilie1	18	23	30
Ilie2	14	17	21
Ilie3	15	21	26
Iiiw1	15	18	26
Iiiw2	10	16	22
Iiiw3	14	18	23
IIs1	13	16	24
IIs2	15	18	24
IIs3	14	17	22
IIs4	15	21	26
Iic1	10	12	18
Ive1	14	17	21
Ive2	14	18	22
Ive3	12	15	19
Ive4	9	12	19

Appendix 12. (continued)

LUC unit	Present average (s.u./ha)	Top farmer (s.u./ha)	Attainable physical potential (s.u./ha)
IVe5	9	11	16
IVw1	13	16	22
IVw2	13	15	20
IVw3	7	10	14
IVs1	14	16	20
IVs2	8	12	17
IVc1	8	10	15
Vle1	8	10	14
Vle2	8	10	13
Vle3	9	11	14
Vle4	8	10	13
Vle5	4	6	10
Vle6	8	10	12
Vle7	7	8	11
Vle8	5	6	10
Vle9	4	5	7
Vle10	4	5	8
Vlw1	5	7	12
Vls1	12	14	18
Vls2	10	12	16
Vls3	9	12	16
Vls4	6	10	17
Vls5	6	9	15
Vls6	8	10	13
Vls7	6	10	13
Vlc1	9	11	14
Vlc2	9	11	13
Vlc3	8	9	11
Vlle1	6	8	10
Vlle2	4	6	8
Vlle3	1	2	4
Vlle4	2	3	4
Vlle5	–	–	2
Vllw1	2	3	5
Vllw2	–	–	3
Vlls1	2	3	5
Vlls2	–	–	4
Vlls3	1	2	3
Vllc1	–	–	5

Appendix 13. Site index data for LUC units in the Wellington region.

LUC unit	Site index (<i>Pinus radiata</i> in metres)	LUC unit	Site index (<i>Pinus radiata</i> in metres)
Iw1	32-34	VIe1	27-29
Is1	31-34	VIe2	20-24
Ic1	33-35	VIe3	22-26
IIe1	33-35	VIe4	24-26
IIw1	31-33	VIe5	26-29
IIw2	30-32	VIe6	26-28
IIs1	30-33	VIe7	24-26
IIs2	31-33	VIe8	24-28
IIs3	30-32	VIe9	16-18
IIc1	31-34	VIe10	22-26
IIIe1	32-34	VIw1	unsuitable
IIIe2	30-32	VIs1	26-30
IIIe3	28-30	VIs2	26-28
IIIw1	30-32	VIs3	24-28
IIIw2	24-30	VIs4	26-30
IIIw3	30-32	VIs5	28-30
IIIs1	26-29	VIs6	26-30
IIIs2	30-32	VIs7	25-27
IIIs3	28-32	VIc1	22-28
IIIs4	28-31	VIc2	16-22
IIc1	24-28	VIc3	12-16
IVe1	26-30	VIIe1	20-28
IVe2	28-30	VIIe2	20-27
IVe3	27-29	VIIe3	24-28
IVe4	28-31	VIIe4	14-20
IVe5	22-28	VIIe5	18-24
IVw1	27-29	VIIw1	unsuitable
IVw2	unsuitable	VIIw2	unsuitable
IVw3	unsuitable	VIIIs1	unsuitable
IVs1	25-28	VIIIs2	22-26
IVs2	26-28	VIIIs3	12-14
IVc1	22-23	VIIc1	14-20