Waiotahi Catchment Management Plan

Prepared by Ben Banks, Land Management Officer

Bay of Plenty Regional Council
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5 Quay Street
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NEW ZEALAND

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Bay of Plenty REGIONAL COUNCIL

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Cover Photo: Waiotahi Estuary

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Tables and Maps

Part 1: Introduction

As part of the region-wide focus for the Bay of Plenty Regional Council, the Land Resources Team (Eastern) has been tasked to implement action on the ground for soil and water conservation and protect and enhance biodiversity in the eastern Bay of Plenty.

The Waiotahi Catchment plan is an internal document that will be used to inform and guide the work programmes of Land Management Officers. This plan is a KPI of the Water and Land Plan that sets the Bay of Plenty targets for catchment plans – specifically "develop and implement a plan for reducing sediment and nutrients entering the Waiotahi estuary". The catchment plan briefly summarises the land management issues, provides an analysis of the physical resources in the Waiotahi catchment and recommends actions for land and resource use in the catchment.

The assessment and analysis of issues in this plan is at a catchment scale and prioritises the protection of biodiversity and waterways. When land management issues are identified at a catchment scale, the land management officer will provide advice in the first instance and then assess what further assistance is available to the landowner or community group. In accordance with the Regional Water and Land Plan (RWLP) some on-farm activities may require resource consent.

A large proportion of the analysis for this plan has been undertaken and represented geospatially using aerial photography and geospatial data. This is accurate at catchment scale (1:50,000); however, the data will need to be ground-proofed at farm scale by the visiting land management officer. This plan also recognises that the human inter-actions in the catchment have an effect on the Waiotahi Estuary. For this reason it is the health of the Estuary that is the long term indicator of Sustainable Land Use in the catchment.

1.1 The key issue

The primary environmental issue for the estuary is the increased level of sediments, nutrients and bacteria entering waterways, which eventually find their way into the Waiotahi Estuary.

Why are sediment, nutrients and bacteria an issue? Increased sediment loads, nutrients and faecal material reduce water quality. This reduction in water quality adversely affects shellfish beds, fish and bird habitat, aquaculture, swimming and recreational use.

Figure 1 Waiotahi Estuary.

Part 2: Introduction to the Waiotahi land management suites

The catchment can be divided up into five main management suites: dunes, alluvial plains, rolling to moderately steep hill country, steep hill country and very steep hill country. Their relation to soil and Land Use Classification (LUC) is discussed next.

2.1 Dunes

The windblown dune system makes up less than 0.1 % of the catchment. This area is characterised by the pingao and spinifix in the foredunes and scattered pohutukawa found throughout the dunes.

The 22 hectare dune system also makes up part of the Waiotahi River mouth and the Waiotahi Spit

Figure 2 Dunes on the Waiotahi Spit.

2.2 Alluvial Plains

The low lying alluvial plains make up 14% of this catchment and are located on the river terraces on the flood plains in the lower catchment. These areas are the dairy farms in the catchment. Due to the low lying nature of these areas they are subject to flooding and most of this unit is part of the Waiotahi Drainage Scheme.

Figure 3 Alluvial plains in the Waiotahi Catchment.

2.3 Rolling to moderately steep hill county

The rolling to moderately steep hill country occupies 29% of the catchment. The land cover for these areas are is pastoral with some of the moderately steep areas being used for forestry. There is evidence of soil slips across this land form, which is partially due to the high intensity of the rain fall events in this area.

Figure 4 *Rolling to moderately steep hill county.*

2.4 Steep hill country

The steep hill country accounts for 44 % of the catchment. The largest proportion of this is in forestry, with some indigenous forest. While this is the most appropriate land use, the intensity of the rain fall events is of concern especially when there is little canopy cover and tracking has occurred cross slope.

Figure 5 *Steep hill country.*

2.5 Very steep hill country

Very steep hill country makes up 19% of the catchment. The area is largely in native forest with a large part of this in the Conservation Estate forming part of the Waioeka Conservation Area.

Figure 6 *Very Steep hill country.*

Part 3: Soils with in the Waiotahi catchment

The soils in the catchment are predominantly derived from air fall rhyolitic volcanic ash. However, there are also other parent materials and processes which have formed soils in different parts of the catchment. Soils on the floodplains and lower flats are formed from a mixture alluvial rhyolitic ash, peat and greywacke. Soils on the dunes are formed from windblown sand. The soils of the hills and steep headwater areas are the associated steepland soils, formed from Tarawera ash, Kaharoa ash on Taupo pumice on greywacke.

3.1 Dune soils

The raw sand of the dunes is formed mainly from the littoral sands drifting along the coastline then inland to form the dunes systems.

The soils are identified as Ōhope sand soils, and are mainly formed from wind-blown littoral sands. The dunes are coarsely textured, excessively drained, and subject to wind erosion if vegetation is removed.

3.2 Soils of alluvial flood plains

These grey and organic soils are formed from alluvium which is derived from rhyolitic ash and greywacke eroded off the valley sides. In some areas there is also a layer of peat below this and this has formed by partly decomposed plant material being water-saturated.

The Hanaia soils (sand loam and silt loam) occur on the flat undulating land with the sandy loam being found closer to the coast. These soils have poor natural drainage and a fragile soil structure.

The Mateo soils (peaty sandy loam) occur on the slightly undulating land in the valley floor closest to Ōpōtiki. This soil is formed from a very thin alluvium, on a very thin Kaharoa and Taupō Tephra, on peat.

3.3 Soils of the rolling to moderately steep hill country

These pumice soils are formed from very thin Taupō Tephra on rhyolitic tephra and in some areas tephric loess. These soils have low nutrient levels, well drained and subject to slight summer droughts.

The Ōpōtiki sandy loam occurs on the rolling country and becomes coarser textured towards Ōpōtiki (sandy loam to loamy sand). These soils have a deep topsoil and a weakly developed subsoil structure.

The Ōpōtiki hill soils occur on the more rolling and moderately steep hill slopes. The tephra layer is thinner on theses hilly slopes and they also have a clay loam in the lower subsoil (50-130cm)

3.4 Soils of the Steep hill country

These recent soils are formed from thin rhyolitic tephra overlying greywacke, sandstone and or gravels. The Tutaetoko steepland soils are found on the steep and very steep slopes in the upper part of the catchment. Due to the soil and the slopes that these soils are found they required soil conservation measure to be undertaken when forestry operations are undertaken.

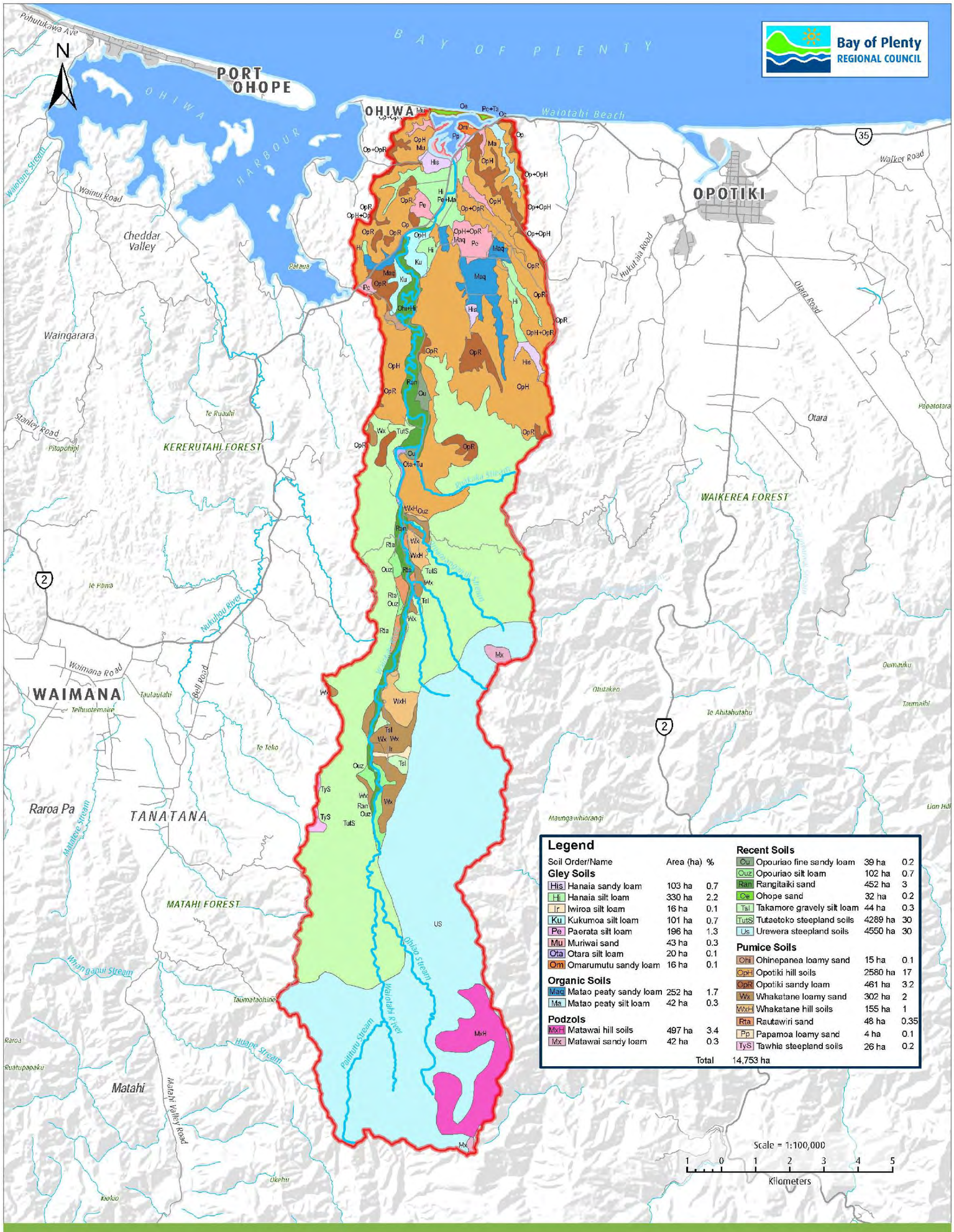
3.5 Soils of the Very Steep hill country

The Urewera stepland soils occur on the steep to very steep slopes (average slope around 35 degrees) in the headwaters of the catchment. They are formed from a thin Kaharoa Ash, on thin to moderately thick Taupō pumice, on weathered rhyolitic tephra overlying greywacke. These soils are well drained and are subject to moderate soil slips and severe slips along tracks.

The following table shows a brief summary of the soils in the catchment relating to the Land Management Suites and ultimately the LUC units and erosion types

Table 1 Soils and associated uses.

Land Management Suites	% of total	Description	Parent material	Name of dominant soil	LUC Unit	Current Land use	Major sediment generation source	Type of erosion	Other main sources of nutrients and bacteria	Area (ha)
Alluvial plains	14%	Gley and Organic soils	Alluvium, rhyolite ash and greywacke and peat	Hanaia silt loam Hanaia sandy loam Matao peaty sandy loam	2w1, 3w1	Dairying	Stream bank erosion, stock crossings stock access to waterways, cultivation	Sheet, rill and stream bank	Stock, dairy effluent.	2047
Rolling / moderately steep hill country	29%	Pumice soils	Thin Taupō tephra on rhyolitic tephra and loess.	Ōpōtiki sandy loam Ōpōtiki hill soils	4e2, 6e7 6e24	Kiwifruit, dairying, dry stock, lifestyle blocks, forestry.	Stream bank erosion, stock crossings stock access to waterways, earthworks, tracks	Sheet, rill and stream bank	Stock, dairy effluent, sewerage systems	4276
Steep hill country	44%	Recent soil	Thin rhyolitic tephra overlying greywacke	Tutaetoko steepland soils	7e11, 7e18	Dry stock, dairy support, forestry	Erosion on pasture and forestry, tracks. High rainfall events	Sheet, rill, stream bank, debris avalanche		6473
Dunes	0.1%	Coastal dunes	Windblown sand	Ōhope sand	7e19	Conservation, recreation	Wind blown sand	Wind	Tracks from people or vehicles	22
Very steep hill country	13%	Recent soil	Thin Kaharoa ash, Taupō pumice, rhyolitic tephra on greywacke	Urewera steep land soils	8e 4	Conservation, recreation	Goats, high rainfall events	Soil slips sheet and debris avalanche		1924



Legend

Soil Order/Name	Area (ha)	%
Gley Soils		
His Hanaia sandy loam	103 ha	0.7
Hi Hanaia silt loam	330 ha	2.2
Ir Iwiroa silt loam	16 ha	0.1
Ku Kukumoa silt loam	101 ha	0.7
Pe Paerata silt loam	196 ha	1.3
Mu Muriwai sand	43 ha	0.3
Ota Otara silt loam	20 ha	0.1
Om Omarumutu sandy loam	16 ha	0.1
Organic Soils		
Maq Matao peaty sandy loam	252 ha	1.7
Ma Matao peaty silt loam	42 ha	0.3
Podzols		
MxH Matawai hill soils	497 ha	3.4
Mx Matawai sandy loam	42 ha	0.3
Recent Soils		
Ou Opouriao fine sandy loam	39 ha	0.2
Ouz Opouriao silt loam	102 ha	0.7
Ran Rangitaiki sand	452 ha	3
Oe Ohope sand	32 ha	0.2
Tsl Takamore gravely silt loam	44 ha	0.3
TutS Tutaetoko steepland soils	4289 ha	30
Us Urewera steepland soils	4550 ha	30
Pumice Soils		
Ohi Ohinepanea loamy sand	15 ha	0.1
OpH Opotiki hill soils	2580 ha	17
OpR Opotiki sandy loam	461 ha	3.2
Wx Whakatane loamy sand	302 ha	2
WxH Whakatane hill soils	155 ha	1
Rta Rautawiri sand	48 ha	0.35
Pp Papamoa loamy sand	4 ha	0.1
TyS Tawhia steepland soils	26 ha	0.2
Total	14,753 ha	

Waiotahi Estuary Catchment

Soils of the Waiotahi Catchment

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Part 4: Catchment Assessment

4.1 Land Use Capability assessment

Land Use Capability (LUC) is a classification of land to show the potential for sustainable use. Initially a survey is carried out mapping geology, soils, slope, erosion and vegetation. The LUC is then derived by considering management constraints that would apply to any particular area of land. The LUC classification is divided into eight major classes of land, based on increasing management limitations from Class 1 through to Class 8. Class 1 land has very few limitations, and has the capability to sustain a wide range of potential land uses. Class 8 land has little or no inherent productive potential, and is normally used for catchment protection and/or recreational purposes. Classes 1 to 4 are arable. Classes 5 to 8 are non-arable.

The capability classes are further subdivided depending on their major physical limitation uses. These are erodibility (e), wetness (w), soil (s) and climate (c). The number following this denotes the level of limitation relative to other units in the same class.

Within the Bay of Plenty region, a further refinement of the LUC system has been developed. This refinement involves the grouping of LUC units which occur together into suites. These suites are synonymous with the land management suites used in this document. The primary factor to delineate these LUC suites is soil parent material.

The major suites within the Waiotahi Catchment are as below:

Suites

Dunes:	Windblown sand
Alluvial plains:	Pumiceaous alluvium with interbedded peat
Rolling hill country:	Rhyolitic tephra
Steep hill country:	Rhyolitic tephra over greywacke, sand stone
Very steep hill country:	Rhyolitic tephra over greywacke

Through the use of LUC suites, the management constraints of different classes of land have been linked back to the soils and ultimately to the geology of the catchment.

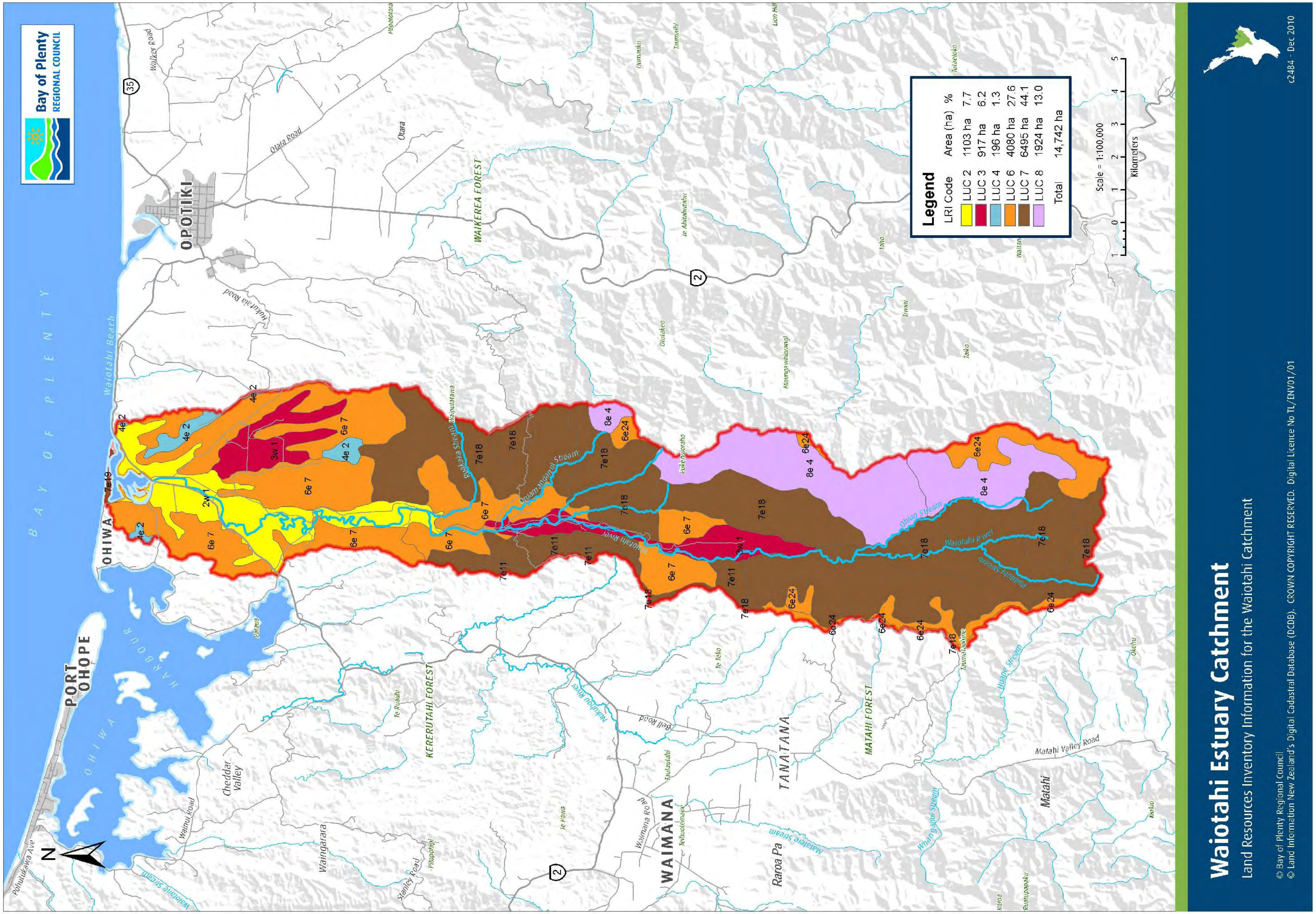
In general terms, the windblown sands form the Waiotahi Spit and alluvial is found on the fertile flood plains in the lower catchment. The Rolling hill country that is mostly coastal has the remains of marine deposits as well as the alluvial deposits brought down from the headwaters. The headwaters are the very steep and seep hill country formed from the greywacke rock

The following table gives a description of the LUC Class relating to the land management suites.

Table 2 Description of LUC Class relating to the land management suites.

Land Management Suites	LUC Class	LUC Unit	Area (ha)	% of total	Description	Strengths	Limitations	Recommended Land Use
Alluvial plains	2	2w 1	1130	7.7%	Flat to gently rolling river terraces found on the fertile floodplains	Natural fertility, high versatility and good stock carrying capacity	Occasional surface flooding with the high winter water table limiting versatility, this is overcome with good drainage systems	Cerals, root and green fodder crops, horticulture
	3	3w 1	917	6.2%	Flat narrow valley floor and poorly drained flats , with a moderately high water table	Natural fertility, high versatility and good stock carrying capacity	Occasional surface flooding with the high winter water table limiting versatility, this is overcome with good drainage systems	Cerals, root and green fodder crops, horticulture
Rolling / moderately steep hill country	4	4e 2	196	1.3%	Rolling hills on the valley floors	Good winter grazing	Has the potential for moderate to severe rill and sheet erosion under cultivation	
	6	6e 7	3294	22.3%	Moderately steep hills near sea level	Good production for sheep and beef	Not suitable for cropping or cultivation, slight sheet, earth slip and soil slip erosion.	Pastoral production with Soil conservation management in steep gully heads
	6	6e24	786	5.3%	Strongly rolling to moderately steep greywacke hills	Low producing pasture	Access to utilise these small areas is limited as they are found within Class VII and VIII land	Forestry and Indigenous forestry

Land Management Suites	LUC Class	LUC Unit	Area (ha)	% of total	Description	Strengths	Limitations	Recommended Land Use
Steep hill country	7	7e11	612	4.2%	Steep hills near sea level	Low producing pasture but excellent site index for *Pinus radiata*	Severe limitations under perennial vegetation Moderate soil, earth slip and sheet erosion.	Forestry and Indigenous forestry
	7	7e18	5861	39.8%	Steep Mountain slopes	Good site index for *P. radiata* for areas with good access	Severe limitations around forestry harvesting specifically the risk of soil slip and debris avalanche	Forestry and Indigenous forestry
Dunes	7	7e19	22	0.1%	Rolling unstable sand dunes	The dune vegetation is predominantly unmodified, good example of intact dune system.	Soil moisture levels are unsuitable for pastoral growth about 60% of the year, Extreme wind erosion when soil / sand is exposed	Coastal native vegetation, passive recreational
Very steep hill country	8	8e 4	1924	13.0%	Long very steep slopes	Part of the Waioeka Conservation Area	Feral goats have a high impact on soil stability on these very steep slopes	Native vegetation



Waiotahi Estuary Catchment
Land Resources Inventory Information for the Waiotahi Catchment
Legend
LRI Code Area (ha) %
LUC 2 1103 ha 7.7
LUC 3 917 ha 6.2
LUC 4 196 ha 1.3
LUC 6 4080 ha 27.6
LUC 7 6495 ha 44.1
LUC 8 1924 ha 13.0
Total 14,742 ha
Scale = 1:100,000
Kilometers
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BAY OF PLENTY
OPOTIKI
OHIWA
PORT OHOPE
OHIWA HARBOUR
WAIMANA
TANATANA
Waiotahi Beach
WAIKEREA FOREST
KERERUTAHI FOREST
MATAHI FOREST
Waiotahi River
Otara Road
Matahi Valley Road
Bell Road

Part 5: Land cover and land use in the Waiotahi catchment

The land use information for the Waiotahi catchment includes the land cover and the associated dominant land uses, and is therefore quite useful for catchment assessment. The combined land use/land cover data for the catchment is set out in the table below.

Table 3 Land cover with the associated land used in the Waiotahi catchment.

Combined land use/land cover data for Waiotahi Catchment			
Land cover	**Land Use**	**Area**	
		(ha)	**(%)**
Indigenous forest	Recreation, hunting, conservation	8634	58.0
Pasture	Dairy, sheep, beef	3650	24.5
Exotic plantation	Pinus radiata, eucalyptus	2323	15.5
Water	Estuarine, river	74	0.5
Horticulture	Kiwifruit,	58	0.3
Other		21	0.1
Urban		2	<0.1
Total		**14762**	**100%**

5.1 Indigenous forest

The area of indigenous vegetation in the Waiotahi Catchment comprises of 58% or 8634 ha of the land cover. A majority of this is found in a large contiguous area on the steeper parts of the catchment. This forms part of an altitudinal sequence from semi-coastal to montane. Common forest types found are Red / Silver beach (above 600m.a.s.l), rimu/tawa with rewarewa, kamahi, pukatea and tawari. There are scattered remnant totara and kahikatea stands on the valley floors, which are a notable feature of the area.

There are other areas scattered over the catchment with a mixture of vegetation types. These are all semi-coastal and either broadleaf/podocarp forests, sand dunes, estuarine and pohutukawa forests.

Figure 7 A stand of Totara in the valley floor.

5.2 Pasture

The pastoral areas in the catchment make up 24% or 3650 ha, with the largest proportion of this occurring across the valley floors (Class II and III). Most of these areas have been drained as part of the Waiotahi Drainage Scheme. This has helped increase the usability of the area and decreased the water table. The land use in the valley floors is predominantly dairy farming.

The valley sides are largely used to support the dairy farms. Some of the Class VI areas are being developed into lifestyle blocks (with in 5 km of the coast).

Figure 8 Pastoral areas.

5.3 Exotic forestry

There is 15% or 2523 ha of forestry in the catchment. Much of the forestry takes place on the class VII areas, draining into the Waiotahi River. Exotic forestry in the catchment is able to provide beneficial soil and water benefits over a long time period. However harvesting and re-establishment operations are capable of causing downstream sedimentation. There will need to be careful controls on roading and tracking, with earthmoving areas kept to a minimum. There are areas that will need to be harvested using aerial hauler systems, rather than ground based harvesting systems.

Figure 9 Exotic forest.

5.4 Water

The waterways in the catchment form an integral part of the landscape. There are six main tributaries of the River; they include the Paititutu Stream, Ohiao Stream, Oruamanganui River and the Ruakaka River. The river system meanders across the valley floor into the Waiotahi Estuary. The estuary is well known place to gather pipi and cockles, with locals reporting a dramatic decrease in cockles and a reduction in the size and abundance of pipi's.

Figure 10 Swimming hole in the Waiotahi River.

5.5 Horticulture

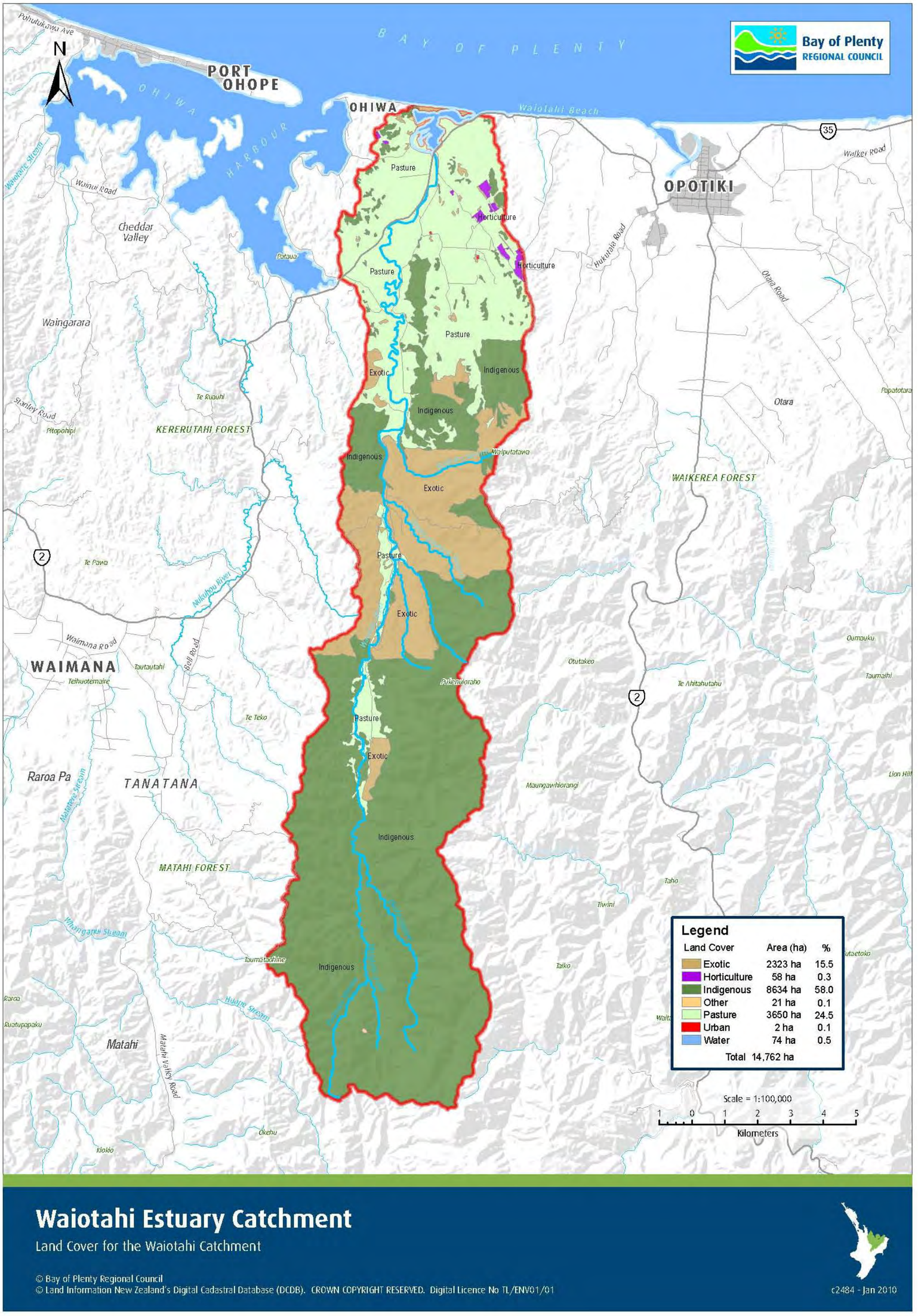
Horticulture is 0.3 % of the catchments land cover or 58 ha. This is located around the Paereta Ridge area, with the main crop being green and gold kiwifruit. The Ōpōtiki area has a sub-tropical climate and sunshine hours over 2,200 annually and is known to be one of the best growing climates in the country.

Where there are areas with good soil fertility this ensures that horticulture is likely to increase, especially in the flatter areas on the hill slopes that have a north facing aspect.

Figure 11 Areas utilised for horticulture.

5.6 Other and Urban

These two areas are mapped as other and urban, combined they make up less that 0.2 % or 23 ha of the catchment. The land cover includes large shelter belts, built up areas and alternative species of forestry (not Pinus spp).



Waiotahi Estuary Catchment

Land Cover for the Waiotahi Catchment

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Part 6: Erosion Risk for the Waiotahi Catchment

Erosion risk can be determined by the land use activities which coincide with Class 6 and 7 LUC classes - which have higher associated erosion risks.

The erosion risk map attached shows areas of high risk debris avalanche , slip and sheet erosion and medium risk slip and sheet erosion within the Waiotahi catchment. This is based on the pasture covered and production forest covered LUC Classes 6 and 7. The pastoral areas are extremely vulnerable to slip and sheet erosion during high intensity rainfall events. The plantation forested areas are prone to erosion events during harvesting, and continue to be vulnerable for up to five years following.

Table 4 Erosion risk and area in hectares for pasture and forestry land uses.

Land use	Erosion risk	LUC Class	Area (ha)	Erosion type	Recommended land use
Pasture	Medium	6	1678	Medium risk of soil slips, sheet and rill erosion under a pasture regime	Forestry, pasture if managed with lighter stock types, grazing to maintain suitable vegetation cover and spaced tree plantings
	High	7	78	Very high risk of soil slips, sheet and rill erosion under a pasture regime	Forestry, retirement, spaced tree planting if maintained in pasture
Forestry	Medium	6	465	Medium risk of soil slips, sheet and rill erosion during and immediately after harvest operation	Forestry
	High	7	1718	High risk of slip, sheet and rill erosion during and immediately after harvest operation. Medium to high risk of debris avalanches	Forestry

6.1 Sheet and rill erosion

Sheet erosion occurs when thin layers of soil are washed down a slope, in a dispersed pattern, generally over a widespread area of a hill slope. Bare ground or intensively grazed pasture on steep slopes is susceptible to sheet erosion.

Figure 12 Localised rill erosion.

Sheet erosion becomes more pronounced when rainfall intensity increases or where filtration is reduced (through soil compaction). Rill and sheet erosion often occur together, with sheet erosion advancing to rill erosion once in cuts a channel into the open soil. Rill erosion often damages cultivated paddocks with exposed soils, earthwork sites and farm tracks. Repeated erosion of the same rill can eventuate into gully erosion. On pastoral areas it is usually associated with over grazing, stock tracking, cultivated slopes and bare ground.

6.2 Soil slip

Soil slips are the mass movement of soil generally occurring in heavy rain events. When the soil becomes saturated and there is an impermeable material below the surface, the soil slips. When mixed with water this can become a chaotic mix of debris, and often fans out forming a debris tail.

Figure 13 Soil slips on pasture, 2004.

Soils slips are often induced by human activities especially slope modifications for roads and tracks, and compaction from heavy stock.

On steep sites soil slips often appear after heavy rain events, with the sediment being transported into the gully system and then entering the water ways.

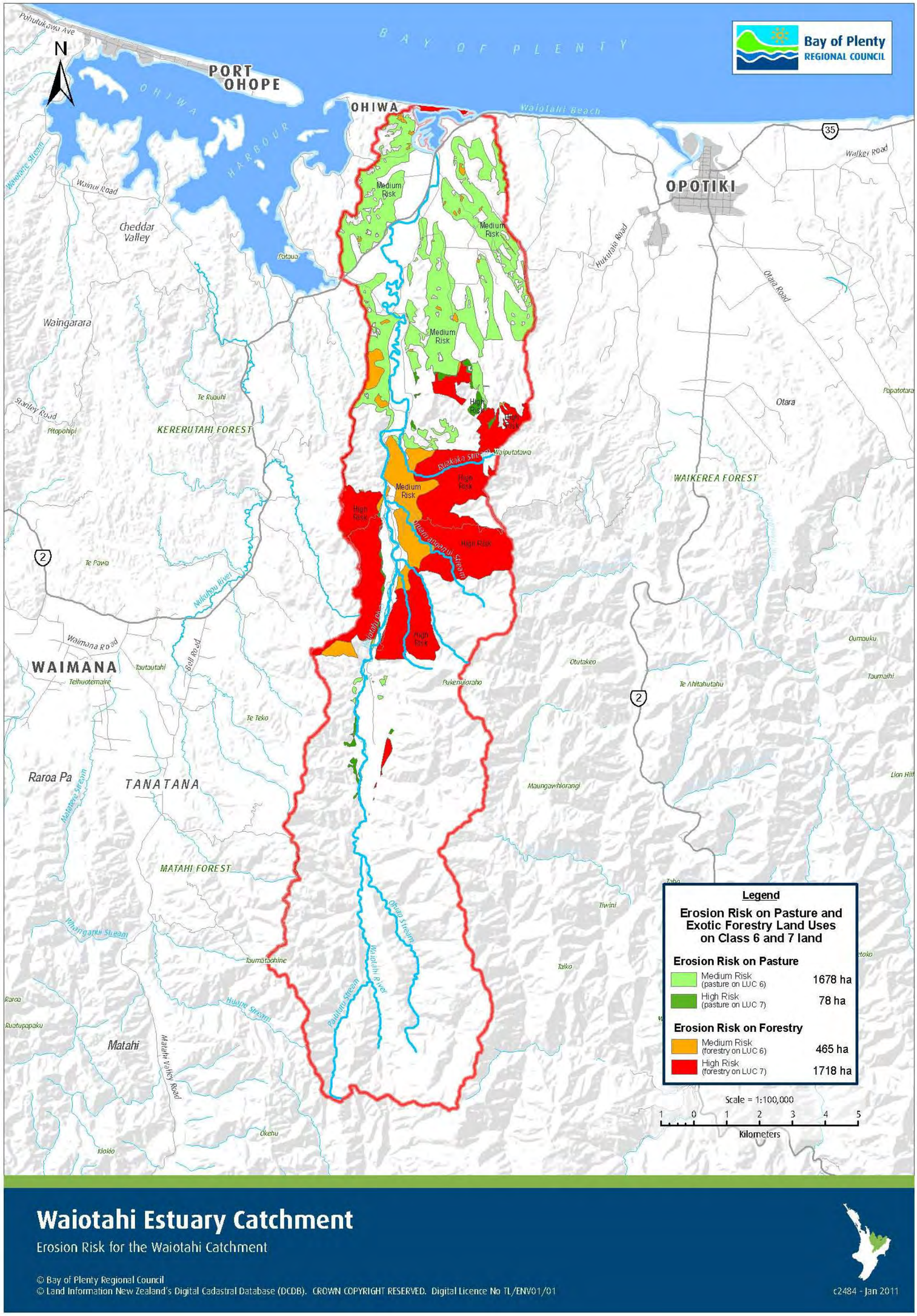
Figure 14 Soil slips on recently harvested forestry.

6.3 Debris Avalanche

Debris avalanche are trigged by the same mechanism as soil slips, but once trigged the slopes steepness ensures that instead of coming to a rest on the slope it keeps moving. Slope length enables the momentum to start scouring vegetation and soil in its path. The result is a long narrow scar stretching from upper slope to the foot of the slope.

The primary principle to manage the land is by maintaining or improving the vegetative cover and soil health. Success in erosion control can often only be made by changing the management over the whole unit, as opposed to site specific.

Figure 15 Moderate size debris avalanche.



Waiotahi Estuary Catchment

Erosion Risk for the Waiotahi Catchment

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Part 7: Riparian protection

7.1 Riparian areas

There is approximately 147 km of major waterways that were assessed in this catchment. Areas that are in indigenous forest or in forestry areas not subject to stock grazing have not been included. There is 97 km of riparian areas that requires work, this has been taken from recent aerial photos so fencing of water ways could have taken place since the aerial photography.

The protection of the waterways from stock is essential to reduce the direct entry of sediment and faecal material directly into the water. Where appropriate the planting along the riparian areas can help reduce stream bank erosion, plants need to be site specific and would include rank grass, shrub willows, native shrubs and flax.

The most basic form of riparian protection is a fence, this allows a vegetative buffer such as grass to establish and roots to hold the soil together. When the water level rises and velocity increase the soil is protected by the grass sward. The picture on the right shows the soil exposed on the bank edge allowing sediment and faecal matter to be transferred directly into the water ways. With a simple fence and stock excluded this stream bank would quickly stabilise.

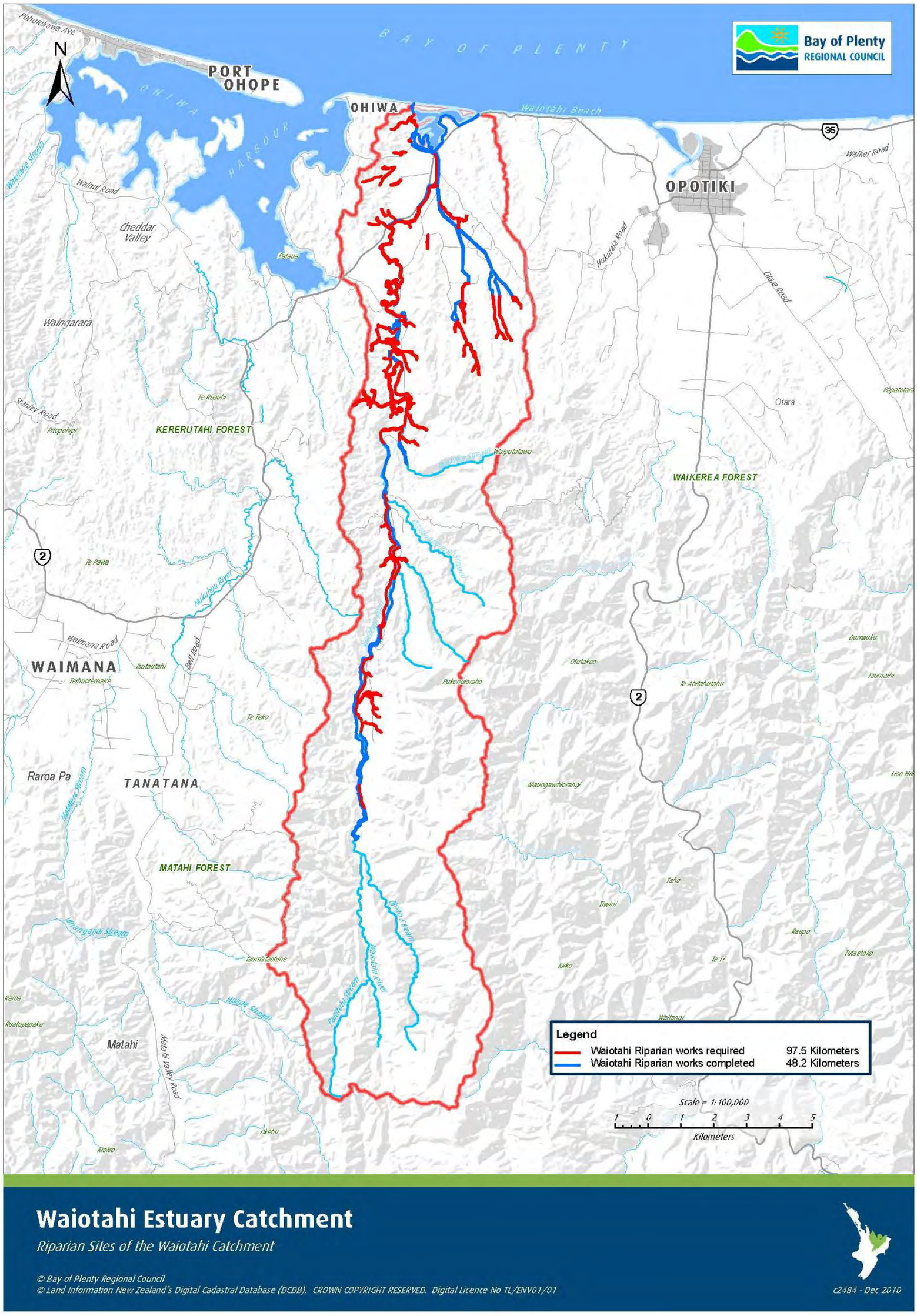
Figure 16 Slight stream bank erosion.

The stream bank erosion shown in this photo has stabilised in places. There are still areas actively eroding where the water is eroding the toe of the bank, this often occurs on the outside of corners. The placement of suitable shrub willows or native trees with good root structure should be used to increase the stability.

When the height of the bank increases beyond the rooting depth of your selected species, alternative methods will need to be used.

Figure 17 Stream bank with grass sward.

Culverts and bridges are essential for crossing streams or waterways with a high frequency of stock crossing. Any stock raceways leading up to crossing points should have bunding (humps in the raceway) so that runoff is diverted to pasture areas first, or sediment / bacteria traps before entering the stream. This is important for both filtering sediment and effluent runoff entering the waterways from raceways.



Waiotahi Estuary Catchment

Riparian Sites of the Waiotahi Catchment

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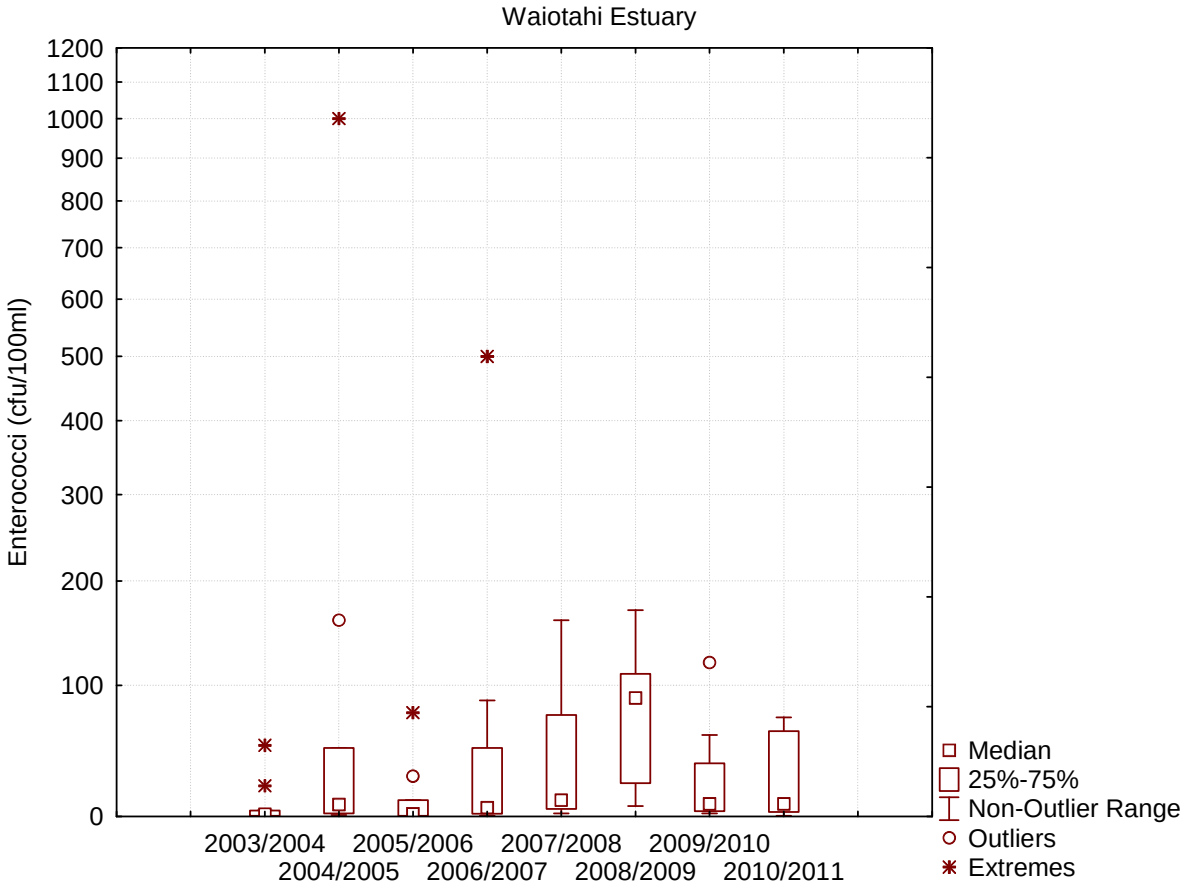
Part 8: Water quality for the Waiotahi

There is currently limited information for the Waiotahi River, to date the sampling regime has been aimed at providing water quality information for recreation use (bathing) and for shellfish. Information has been taken from Bathing and Shellfish Surveillance Report 2009-2010 and any new results available from this summer. A sampling regime would be required to look a suspend solids and what trend they would have on the water quality.

8.1 Recreational surveillance monitoring

Table 5 Levels of Enterococci in the Waiotahi Estuary since 2003.



The graph above show the Mann-Kendall test for Enterococci (cfu/100mL). Monitoring is undertaken over the summer months, Enterococci (faecal matter) is used as the indicator. The period analysed is for the calendar years 2003 and 2010. Results indicate an increasing trend of increasing faecal contamination but has been a bit lower on average over the last couple of seasons. The recommended response is

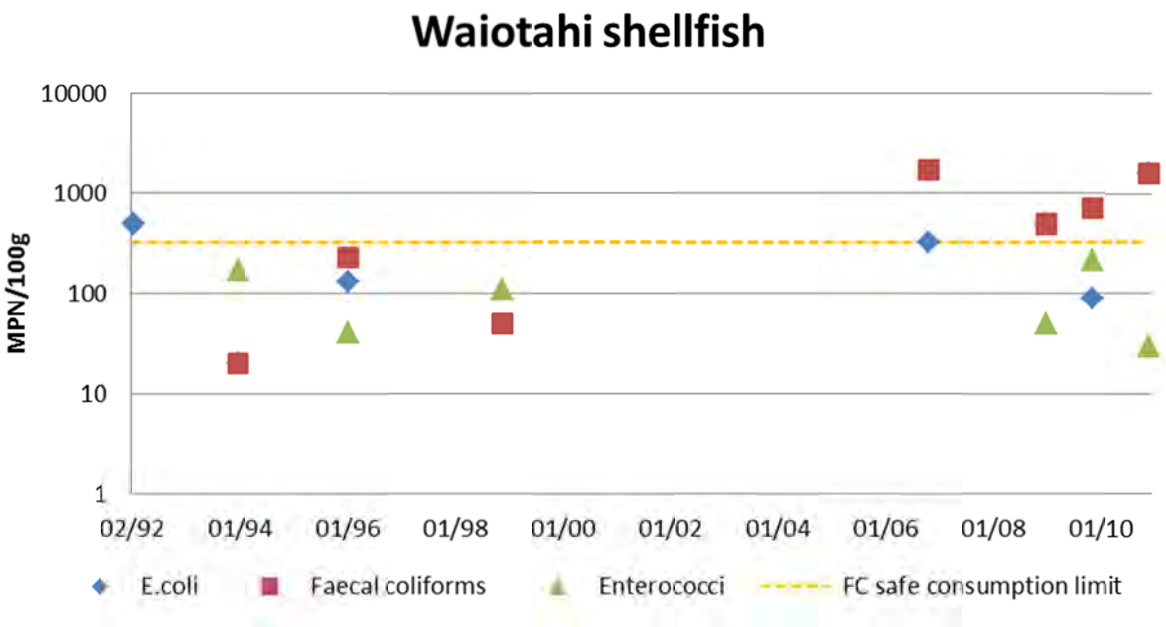
Routine monitoring for single sample up to 140 cfu/100 ml – Surveillance

Single sample monitoring for sample > 140 and 280cfu/100ml- increased monitoring, identify sources - Alert

Two consecutive single samples >280 - Public warnings, increased monitoring, source investigation - Action

8.2 Shellfish contaminants

Table 6 Levels of contaminants found in the shell fish flesh.



To comply with the standard faecal coliform levels in shell fish flesh should be less than 330 MPN/100g, and levels from 230 to 330 MPN/100g are marginally acceptable. Faecal coliform limits have been used historically for shellfish quality assessment but these have been abandoned in recent years in favour of *E.coli*. The *E.coli* median MPN of the shellfish samples must not exceed 230 *E.coli* per 100g and not more than 10% of the samples must exceed an MPN of 700 per 100g.

The above graph indicates which years shell fish have been above the FC safe consumption date. It must be noted that for the results for the 2010 year the Waiotahi Estuary pipi had elevated faecal coliform levels although *E.coli* levels were well under the NZFSA guideline. Levels were likely to be increased due to rainfall around the time of sampling.

It must be recognized that this annual sampling method is used to compare results across the Bay, which allows an snapshot of a catchment at that point in summer. To get an accurate picture of contaminates in a specific catchment over the shellfish harvesting period the frequency of monitoring would need to be increased (measured frequently over the summer months).

Part 9: High Value Ecological Sites in the Waiotahi Catchment

The areas below have been identified as part of the Biodiversity Programme undertaken by the Bay of Plenty Regional Council. The aim of the biodiversity policy is to support the protection of indigenous biodiversity by landowners and the community with a focus on those sites with highest significance and / or community value. These areas have been identified by using criteria established under the New Zealand Biodivoesity Strategy.

Landowner and community biodiversity "sites" are sites with biodiversity values present which landowners and the community wish to protect, but are not High Value Ecological sites. These will be identified by the landowners or the community and will be supported by implementing Biodiversity Management Plans.

9.1 Waiotahi Covenant

The areas comprises of fourteen small to relatively large remnants of indigenous forest along both sides of the Waiotahi Valley, The largest remnant protects much of the Atuarere and Oruamanganui Stream catchments. The vegetation is dominated by tawa, kamahi, rewerewa and beech with Kahikatea common in wet sites. These areas are surrounded by the Waioweka Conservation Area, an area with outstanding wildlife areas. Threatened species include the brown kiwi, kaka, Hochstetter's frog and kereru (not sure if the last is classified as threatened).

Threats to the area include the physical damage that will be associated with forestry operations, overspray, tracking and wilding pines. The damage from possum, rats stoats deer is unknown by the author, and there has been little surveys done to quantify threatened species or the threats.

9.2 Kahunui

The 315 area comprises of three distinct vegetation zones. With kahikatea forest on the river terrace, moving into the hills rewerewa, rimu and tawa are dominant in the canopy, but this eventually gives way to hard beech and tawa forest.

Figure 18 Pukenuiorahoho peak.

The kahikatea forest on the river flats are particularly notable, as most of this vegetation has been cleared in the Waioweka Ecological Area. These areas are surrounded by the Waioweka Conservation Area, an area with outstanding wildlife areas. The threats to this area include stock, with a moderate density of possums and goats found in this area

.

9.3 Waiotahi Valley

The 265 ha area is situated at the head of the valley. The dominant vegetation is dominated by tawa, emergent rimu, kahikatea and pukatea on the gentle slopes. There has been little botanical surveys carried out on this particular area.

Figure 19 Pukenuioraho peak.

9.4 Osborne's Bush

This vegetation of this site is mostly mature Tawa forest with rewarewa, puriri, mangeao, there are also emerging rimu and miro. Puriri forests were common in the Ōpōtiki Ecological Area. Most of this site is fenced and retired from stock access, the owners have stated that possum lines have been undertaken and numbers were relatively low.

Figure 20 Osborne's Bush.

9.5 Onekawa Forest Remnants

The 28 ha site has a mixture of vegetation types, tawa, puriri and pohutukawa and black beech, tawa and kohehohe forest. It is the pohutukawa and black beech that make this site distinctive. The threats currently are stock grazing and fragmentation due to subdivision. Black beech is a rare forest type in the Ōpōtiki Ecological District.

Figure 21 Onekawa forest remnants.

9.6 Waiotahi Estuary

There are distinct zones with in the estuary, the sandfields, reedlands and the mudflats. Within the mudflats there is also a small mangrove population (along with the Waiaua Estuary) which is at the south eastern range of mangroves in New Zealand.

The threats for this area are the siltation, eutrophication as well as adventive weed species.

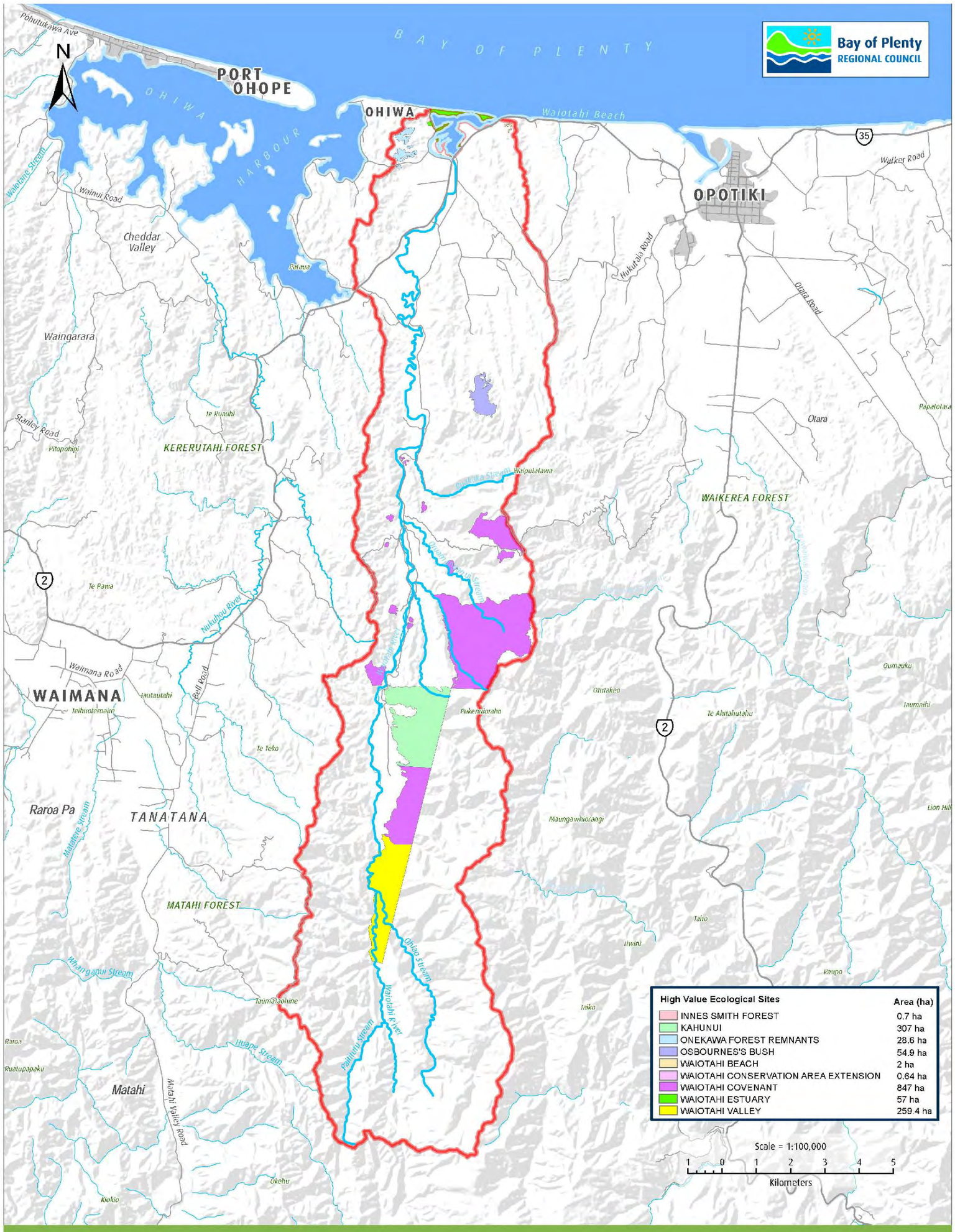
Figure 22 Waiotahi estuary.

9.7 Waiotahi Beach

The Waiotahi beach area extends outside this catchment, with approximately two hectares within the catchment. This area comprises of puriri/pohutukawa/ mahoe and kawakawa forest, with pohutukawa, kawakawa and taupata species present at the rear of the sand dunes.

The pressures are from invasion from adventive weeds, fires, vehicle and foot traffic along the dune system.

Figure 23 Waiotahi beach.



Waiotahi Estuary Catchment

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Part 10: Recommendations

The following key recommendation for the implementation over the next five years for reducing the sediment, nutrients and bacteria effects on the Waiotahi Estuary are;

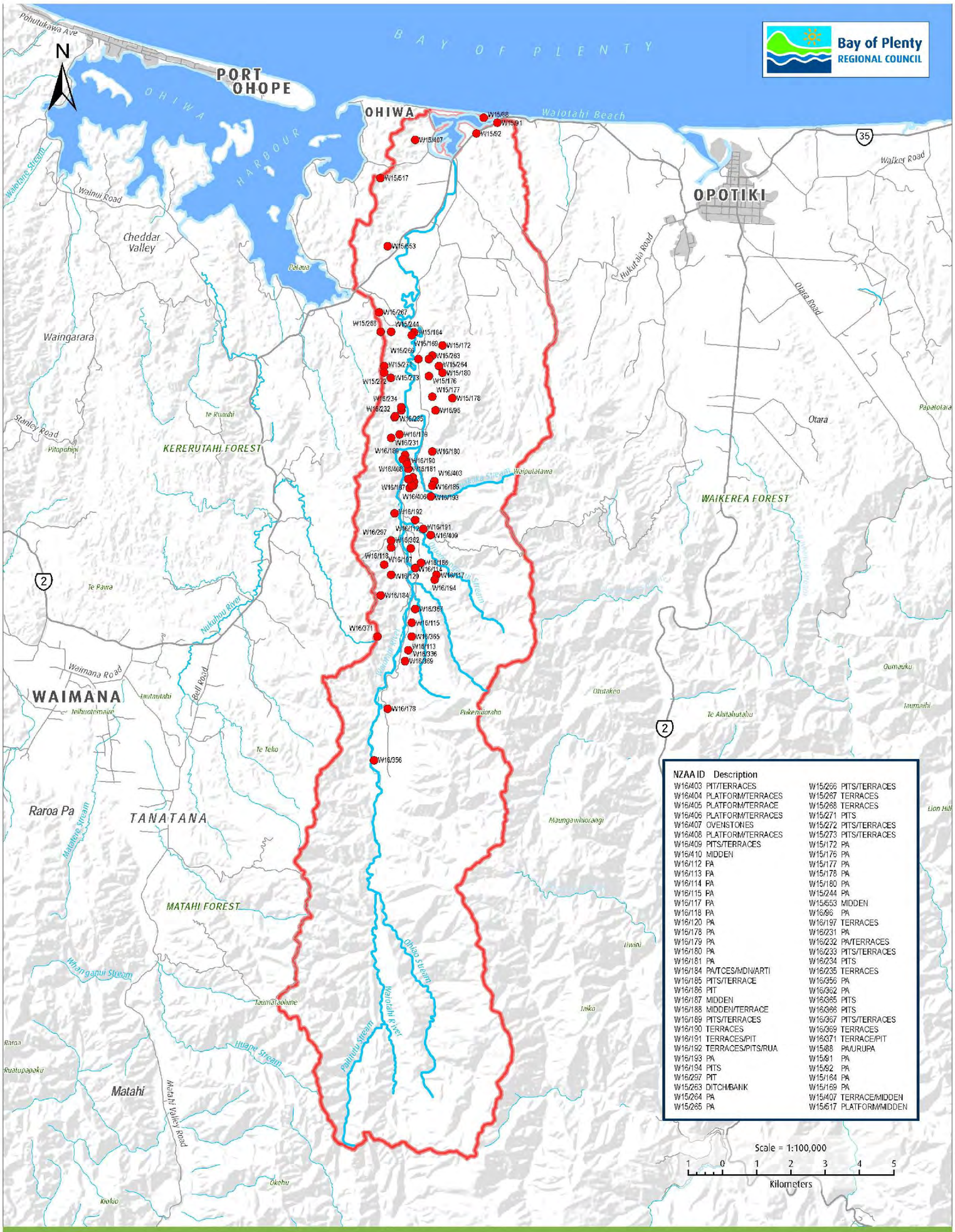
- Promote changes in land use and management where erosion risk is high
- Provide advice to pastoral landowners on how to reduce soil slip, sheet and rill erosion
- Provide advice on nutrient pathways and recommend solutions
- Support the adoption of Nutrient Management Plans and provide advice on nutrient pathways
- Support the adoption of the Clean Stream Accord
- Promote the use of Riparian Management Plans
- Support the Best Industry Standards for forestry harvesting

The following recommendations are specifically aimed at supporting the economic, social and cultural well-being of this community:

- Support biodiversity management on private land through.
- Investigate causes of salt water intrusion into the Alluvial flood plains.
- Investigate history of local pa sites with iwi, with the intent that iwi will decide on what information is to be made publicly available.
- Design a methodology for sampling shell fish in the Waiotahi Estuary over the summer period.
- Design a methodology for sampling suspended solids in the Waiotahi Estuary to show annual trends.

Appendices

Appendix 1 – Archaeological map



Waiotahi Estuary Catchment

Archaeological Sites of the Waiotahi Catchment

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